UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

RESEARCH VESSEL SAFETY STANDARDS

10th Edition

July 2015

UNOLS RVSS – Tenth Edition –July 2015

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This edition of the Research Vessel Safety Standards is dedicated to Captain Robertson P. Dinsmore, U.S. Coast Guard, (Ret.) Captain Dinsmore was instrumental in the establishment of UNOLS and has dedicated his life to the safety of those who go to sea. A long time advocate for the improvement of sound maritime practices, the tenth edition is dedicated in his honor.

The UNOLS Office and the UNOLS Research Vessel Safety Committee would like to acknowledge the support of the National Science Foundation, Office of Naval Research, National Oceanic and Atmospheric Administration, US Geological Survey, and Bureau of Ocean Energy Management for support of this project.

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PREFACE

UNOLS Member Institutions first adopted the Research Vessel Safety Standards (RVSS) in May 1976. Later editions were adopted by members at UNOLS meetings in May 1981, May 1985, October 1989, September 1992, October 1995, July 1999, March 2003, March 2009, and this revision July 2015. In lieu of published institutional policy, these safety standards are considered the guidelines for UNOLS Research Vessels. For that reason, all UNOLS Members, both Operators and others, should be thoroughly familiar with the contents of this manual and comply with its recommendations as appropriate.

Changes made since last revision: March 2009

- Appendix A: Revised: UNOLS Rope and Cable Safe Working Load Standards
  Appendix B: Added UNOLS Overboard Load Handling Systems Design
- Chapter 19: Added on Ship-based Aircraft Operations
- Extensive review and update of references and content throughout the RVSS
- All Chapters have been reviewed for accuracy and information has been updated where needed.

RESEARCH VESSEL SAFETY STANDARDS

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1. INTRODUCTION

The UNOLS Research Vessel Safety Standards (RVSS) are the standards for the operation of oceanographic research vessels owned, operated or chartered by members of the University-National Oceanographic Laboratory System (UNOLS), to assure that research at sea is conducted to the highest practicable standards of safety. Full compliance is a requirement to maintain status as a UNOLS designated research vessel.   UNOLS member institutions who operated other vessels or small boats which are not designated as UNOLS vessels are encouraged to comply and should adhere to the requirements of Chapter 18, “Chartering of Non-Institution Vessels. These standards are based in major part on applicable laws and regulations. In addition and where appropriate, they supplement, extend, and assist in the interpretation of the legal requirements. Nothing herein is intended to conflict with the legal standards, but rather to encourage and assist the operator to not only meet, but also exceed the legal minimums, as practical. It is recognized that the wide variety of vessel types and sizes, and their diverse operational usage will necessarily lead to many discretionary interpretations. In such cases, a common-sense application of the principles of good seamanship and sound marine engineering practice will be more effective than attempting to cover all conceivable cases.

The UNOLS Research Vessel Operators’ Committee (RVOC) and the UNOLS Research Vessel Technical Enhancement Committee (RVTEC) are available to assist operating institutions by providing reference materials, and interpreting the laws, regulations and standards.

Operators are reminded that in addition to the legal responsibilities and liabilities associated with Federal laws and regulations, and maritime law, safe operation is one of the factors used by Federal science sponsors in evaluating the merit of a ship as a research platform.

These standards do not apply to research submersibles, which are covered by a different, and detailed, set of regulations, however a chapter on handling research submersibles from UNOLS vessels is covered in these standards.

Recognizing that research vessels and ocean research in general should be at the forefront of maritime safety, research vessel operators should take every opportunity to participate in innovative research, procedures, and equipment operation to enhance the practice of safety at sea.

Institutions are strongly encouraged to make available “Cruise Handbooks” or “User Manuals“ incorporating important parts of these standards, plus additional information on their particular ships and any pertinent institutional regulations or procedures. This document deals solely with safety standards for craft engaged in oceanographic or limnological research, or related instruction. For the purposes of this document the adjective “Research Vessel” applies to the terms ship, vessel, boat, or motorboat.

2. PROCEDURES

2.0 SCOPE

These safety standards are not intended to cover all possible cases, but only those where there is a clear-cut, widespread need for guidance, or to fill a gap not covered by laws and regulations. Federal laws, U.S. Coast Guard regulations, American Bureau of Shipping rules or other federal, state, or local regulations supersede these UNOLS standards. To the extent possible, these standards are organized as follows:

Required by Regulations for All Vessels

Required by Regulations for Certain Vessels

Inspected Vessels

Classed Vessels

SOLAS Vessels

Uninspected Vessels

Other Regulations

Required Standards Under RVSS

Required By RVSS Under Certain Circumstances

Recommendations And Best Practices

2.1 PROPOSED STANDARDS

Draft standards, or a statement of the need may be proposed by any UNOLS member, or any other person or group having an interest in the safe operation of academic research vessels. Proposed standards will be referred to the UNOLS Research Vessel Safety Committee for review, recommendations, and possible action.

2.2 ADOPTION

Standards approved by the Research Vessel Operators' Committee (RVOC) will be transmitted to the UNOLS Council for consideration and adoption under the terms of the UNOLS charter.

2.3 APPLICABILITY

Use of these standards by UNOLS members shall be as provided for under the terms of the UNOLS charter.

Waivers

- In the event that despite best efforts, compliance with a standard is not possible, a waiver may be granted. For example in attempting to comply with the size of winch rollers and sheaves as prescribed in Appendix A, physical structural limitations prevented the modifications of the sheaves/roller in order to meet Appendix. A waiver was applied for and granted.

- Procedures for Waivers: The UNOLS ship operator shall send a written request to the UNOLS Safety Committee Chair explaining the situation and the request for a ruling on a proposed operation. The Chair would then seek subject matter expert advice and conduct a review by a board of (3) Safety Committee members. The Chair will then provide a written response back to the operator with a copy to the agencies funding that program.

2.4 REFERENCE MATERIAL

The UNOLS Office will maintain and provide to members pertinent reference materials, circulars, and other information. The RVOC will provide assistance in interpretation of laws, regulations, and standards, and suggest assistance in areas not covered by these standards.

2.5 CHANGES TO RESEARCH VESSEL SAFETY STANDARDS MANUAL

Changes to laws, rules, or regulations, which affect or supplement these standards shall be brought to the attention of the member institutions by the RVOC. Periodically, not later than every three years, the Research Vessel Safety Committee shall review the safety standards to ensure that they are current and complete. Necessary changes shall be submitted by the Chair of the RVOC to the UNOLS Council for approval.

2.6 Record of Revisions to this Edition and Applicable Versions

Chapter	***Title***	***Revision #***	***Effective Date***
One	Introduction	10	July/2015
Two	Procedures	10	July/2015
Three	Definitions, Regulations and Documentation	10	July /2015
Four	Operations	10	July/2015
Five	Manning	10	July/2015
Six	Personal Behavior and Individual Safety	10	July/2015
Seven	Communications	10	July/2015
Eight	Scientific Support Equipment	10	July/2015
Nine	Scientific and Shipboard Hazardous Materials	10	July/2015
Ten	Radioactive Materials	10	July/2015
Eleven	Diving Operations	10	July/2015
Twelve	Human Occupied Vehicles	10	July/2015
Thirteen	Stability	10	July/2015
Fourteen	Load Lines and Watertight Integrity	10	July/2015
Fifteen	Electrical and Marine Engineering	10	July/2015
Sixteen	Firefighting Equipment and Fire	10	July 2015

	Protection		
Seventeen	Lifesaving Equipment	10	July/2015
Eighteen	Chartering of Non-Institutional Vessels	10	July/2015
Nineteen	Ship-based Aircraft Operations	1.0	July/2015
App A	UNOLS Rope and Cable Safe Working Load Standards	Ed. 10 Rev. 2.0	July/2015
App B	UNOLS Load Handling System Design Standards	Ed. 10.0 Rev. 4.	July 2015
App C	Safety Inspection Check List for Shipboard Vans	10	July/2015
App D	Inspection Checklist for Chartering Non-UNOLS vessels	10.	July/2015
App E	Sexual Harassment Brochure	10	July/2015
App F	List of Acronyms	10	July/2015

3. DEFINITIONS, REGULATIONS AND DOCUMENTATION

3.0 INTRODUCTION

All seagoing vessels are subject to various requirements for documenting their ownership, occupation, and safety. These requirements, as indicated below, vary greatly, depending on the size and type of vessel, its employment, the area of operations, etc. The language used herein is chosen to convey the sense of the regulations; for the actual legal wording, reference is made to the pertinent parts of the Code of Federal Regulations (CFR), the United States Code (USC), or other sources. References to the CFR and USC generally are cited as the Title Number (e.g. 46) Source (e.g. CFR or USC) and Part Number (e.g. 189) such that 46 CFR 188 would be the reference for the beginning of the regulations regarding Oceanographic Research Vessels.

3.1 REFERENCES

33 CFR - Navigation and Navigable Waters

33 CFR 101 and 104 - International Ship and Port Facility Security Code (ISPS)

33 CFR 138, 33 USC 2702 to 2761 - Oil Pollution Act of 1990 (OPA 90)

33 CFR 151 and 155.70 - International Convention for the Prevention of Pollution from Ships 1973 (MARPOL)

46 CFR - Shipping

46 CFR 188 – 196 Subchapter U - Oceanographic Research Vessels

46 CFR 10, 12, and 15 - International Convention on Standards of Training, Certification and Watch standing for Seafarers (STCW-95)

46 CFR 15.701 - The Seaman's Competency Act and Officer's Competency Certificates Convention 1936

46 CFR 15.705 and **46 CFR 15.1111** - respectively - Watches and Rest Periods

46 CFR 188.05-10 - International Convention for Safety of Life at Sea (SOLAS)

46 USC 41 - Motorboat Act

46 USC Sections 30104 - Jones Act

46 USC 32, 33 CFR 96.100 et seq. - International Management Code for the Safe Operations of Ships and Pollution Prevention (ISM)

46 USC 43, 46 CFR 24 - 27 - Federal Boat Safety Act of 1971

46 USC 51 and 46 CFR 42 et seq. - International Load Line Act

Navigation and Vessel Inspection Circulars (NVIC) - Informational material published by the USCG.

NVIC 8-83 - MARPOL 73/78 Annex I, Regulation 9 and 26

NVIC 11-93 Ch. 3 - Applicability Of Tonnage Measurement Systems To U.S. Flag Vessels

POLAR CODE- International Maritime Organization- Polar Code: www.IMO.org

3.2 ORGANIZATIONS-

AMERICAN BUREAU OF SHIPPING (ABS): A non-profit organization authorized by the Coast Guard to ensure compliance with load line regulations and other related safety factors. The organization provides inspection services to operators for a fee. ABS documents and publications (including Rules for Shipbuilding) are available online at: www.eagle.org .

AMERICAN BOAT AND YACHT COUNCIL (ABYC): This organization is primarily concerned with private pleasure craft and sets standards for small vessel construction. Some of their standards are referenced in portions of these safety standards and some are incorporated by reference in Coast Guard regulations concerning small craft and commercial fishing vessels. ABYC standards and technical reports are available at www.abycinc.org

U.S. COAST GUARD (USCG): The Federal agency charged with enforcement of many laws and regulations concerning ships and seagoing operations. Information and inspection services are provided either from headquarters in Washington or from several district offices around the country. Operators should always check with their local Coast Guard Sector Office or Officer in Charge of Marine Inspection (OCMI) for interpretation of laws and regulations. For information use the website located at: http://homeport.uscg.mil/mycg/portal/ep/home.do.

FEDERAL COMMUNICATIONS COMMISSION (FCC): Federal agency charged with the regulation of radio communications, including those to, from and between ships. (47 CFR) Contact FCC at: www.fcc.gov.

INTERNATIONAL MARITIME ORGANIZATION (IMO): Established during a 1948 United Nations conference, IMO is an international body devoted exclusively to maritime matters. Headquartered in London, IMO consists of various committees and subcommittees. The Maritime Safety Committee (MSC) is the senior committee that carries out the organization’s technical work. At a 1960 conference, IMO adopted the International Convention on Safety of Life at Sea (SOLAS). SOLAS is the basic international instrument dealing with matters of marine safety. SOLAS has been amended several times. These amendments cover a variety of issues such as vessel construction and fire safety, Roll On – Roll Off (RO-RO) passenger ship safety, passenger ship safety, GMDSS, tonnage admeasurements, traffic separation schemes, INMARSAT, fishing boat safety, STCW, etc. IMO conventions have also led to adoption of oil pollution policies. These include the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) and the 1990 International Convention on Oil Pollution Preparedness Response and Cooperation (OPRC). IMO can be contacted at : www.imo.org.

INTERNATIONAL ORGANIZATION OF STANDARDIZATION (ISO): ISO is a non-government organization that develops various international standards for business, government and society. ISO standards distill an international consensus for standards from a broad base of stakeholders. It is recognized worldwide. Two management systems exist, ISO 9000, which deals with quality management, and ISO 14000, which deals with environmental management. ISO 9000 is the standard that certified auditors for ISM code are trained to meet. To implement ISO 9000, ISO 9001 was developed. It is a series of documents that define the requirements for a Quality Management Safety Standard. Certification under ISO 9001 meets the certification requirements for ISM provided that an alcohol & drug abuse/misuse policy and the handling of contingencies are added to the ISO 9001 standards. ISO does not perform certifications nor are their standards compulsory. However, following ISO 9001 standards as closely as possible will ease the certification process under ISM. Information regarding the standards can be found at: www.iso.org.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE): A professional group, which develops standards in electrical and electronic practices. Many of these standards are incorporated as legal or prudent requirements for ships. Their standards are located at: www.ieee.org.

UNDERWRITERS LABORATORIES (UL): A testing and certification laboratory that provides standards and tests equipment for safety. Some of their standards are used in Coast Guard regulations by reference such as those for smoke detectors and commercial cooking exhaust hoods. UL can be contacted at: www.ul.com.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA): A professional organization that sets standards for firefighting equipment and standards for fire prevention. Some of their standards are included in Coast Guard regulations by reference such as those for a National Electrical Code and for pleasure and commercial motor craft. NFPA is available online at www.nfpa.org.

SEAFARERS HEALTH IMPROVEMENT PROGRAM (SHIP):

The Seafarers Health Improvement Program (SHIP) was initiated in 1978 by the United States Public Health Service to improve the health status of seafarers, their health environment, medical care and safety aboard ship, and communication between parties responsible for the health and safety of American seafarers. The program is a collaborative effort of representatives of the maritime industry, physicians, and concerned governmental agencies. Principal achievements of SHIP include establishment of Entry Level Standards and Retention Guidelines for seafarers, development of the Seafarer Emergency Medical Training Program, and initiation of a program making medical records available on board.

3.3 DEFINITIONS

3.3.1 TONNAGE

Other than weight as in displacement, discussed below, other forms of tons and tonnages are arcane descriptors of ship size that may readily be traced back to the *Magna Carta* and beyond. The numbers so derived are used to determine fees and applicability of national and international regulations. For officially determining which version and formula applies and calculating tonnage the services of a professional naval architect are required.

GROSS AND NET REGISTERED TONS: A “registered ton” is a measure of volume, in which one registered ton = 100 ft ^{3}. There are two types of registered tonnages: “Gross” and “Net”. Gross Registered Tonnage (GRT) is the total enclosed volume of the vessel, minus certain exempted spaces. Net Registered Tonnage (NRT) is the GRT minus certain deducted spaces. Exempted and deducted spaces are determined according to measurement regulations for U.S., Panama, and Suez tonnage. Tonnage certificates, to the extent required by the vessel’s operations, are carried on board with GRT and NRT being permanently affixed to the vessel. (46 CFR 69.107*)*

CONVENTION TONNAGE: This is tonnage as determined under the International Convention on Tonnage Measurement of Ships, 1969. New documented vessels and new vessels engaged on a foreign voyage that are 79 feet or over are required to be measured under the Convention Measurement system. Existing vessels that undergo a change that substantially affects the gross tonnage and are otherwise required, would have to be measured under the Convention Tonnage system. After July 1994 all existing vessels over 79 feet that engage in a foreign voyage have to be measured under the Convention Tonnage System as well as the existing system. (46 CFR 69.11)

NVIC 11-93 Change 3 provides guidelines on applying tonnage measurements to U.S. Vessels and helps to determine how this affects the application of U.S. and International regulations. Convention Tonnage when used to determine application of regulations and treaties will be referred to as Gross Tonnage (GT). Domestic tonnage measurements used for the application of regulations will be referred to as Gross Registered Tonnage (GRT) or Net Registered Tonnage (NRT) as defined above.

DISPLACEMENT: Displacement is the weight of water displaced by a vessel and is equal to the vessel’s actual weight. Displacement is used in stability calculations. A “displacement ton” is a measure of weight stated in long tons of 2,240 pounds/ton.

DEADWEIGHT: The “deadweight” of a vessel is its total weight when floating at the load waterline, minus its “lightship weight”. Lightship weight includes the vessel’s structure, machinery, permanent outfit and so forth. Deadweight may be subdivided into “operating deadweight” and “payload.” Operating deadweight includes all items required to operate the vessel, including crew and effects, fuel, lube oil, fresh water and stores. Payload includes all items of deadweight not directly concerned with operations, including non-crew personnel and effects, equipment other than that considered part of the ship, instrumentation not concerned with ship operations, and cargo.

Note that the variations of displacement provide an accurate “weight” of the ship, and are to be used in calculations involving stability, loading, and the like. Registered tonnages are to a large extent artificialities, but they are those, which are involved in many licensing and documenting procedures, rather than the actual displacements.

3.3.2 TYPES OF VESSELS

VESSEL: Any watercraft, other than a seaplane, used as a means of transportation.

SHIP: Often used interchangeably with “vessel,” the preferred legal term.

MOTOR VESSEL: A vessel more than 65 feet in length, which is equipped with propulsion machinery, other than steam. (46 CFR 24.10-1)

MOTOR BOAT: Motorboat includes every vessel propelled by machinery and not more than 65 ft. Excluded are tugboats and towboats propelled by steam, tank vessels, cargo and miscellaneous vessels, and research vessels. Motorboats are classed as; Class A -- less than 16 ft; Class 1 -- 16 ft - 26 ft; Class 2 -- 26 ft - 40 ft; Class 3 -- 40 ft - 65 ft. (46 USC 526 and 46 CFR 24.10-1)

DOCUMENTED VESSEL: A vessel of greater than 5 net tons, which is registered, enrolled or licensed as a "vessel of the United States." This is a requirement for engaging in "trade or commerce." UNOLS research vessels are not ordinarily engaged in "trade or commerce;" commercial vessels ordinarily are.

UNDOCUMENTED VESSEL: Any vessel, which is not required to, and does not, have a marine document issued by the USCG. (46 CFR 188.10-75)

INSPECTED VESSEL: Is one that is inspected and certificated by the USCG. Motor vessels, tank vessels, and the majority of other non-public vessels over 300 GRT are required to be inspected. 46 CFR Table 188.05-1(a) identifies vessels to which the inspection laws apply.

UNINSPECTED VESSEL: A vessel not certificated under the inspection laws or subjected to regular inspections by the USCG. Fishing vessels, recreational motorboats, and oceanographic research vessels less than 300 GRT are examples. Uninspected vessels, however, are still subject to rules about safety and, in some cases, licensed personnel. (46 CFR Subchapter C, 24 et seq.)

VESSEL IN CLASS: A vessel is said to be "in class" when it holds a current certificate of classification issued by a recognized classification society, such as American Bureau of Shipping, Lloyds, Bureau Veritas, and other members of the International Association of Classification Societies (IACS). The certificate of classification signifies conformity with prescribed standards of structural strength, machinery, and equipment, providing for seaworthiness and safety in connection with marine insurance.

OCEANOGRAPHIC RESEARCH VESSEL: A vessel, which the USCG determines is being employed only in instruction in oceanography or limnology, or both, or only in oceanographic or limnological research, including those studies about the sea such as seismic, gravity meter, and magnetic exploration and other marine geophysical or geological surveys, atmospheric research, and biological research. This is a formal designation in writing by the cognizant Coast Guard Marine Safety Office (MSO). (46 CFR 188.10-53, 46 USC 2101(18) and 2113)

NUMBERED VESSEL: A vessel that is numbered under the provisions of the Federal Boat Safety Act of 1971. Oceanographic research vessels not engaged in commerce are not required to be documented, and may therefore become numbered vessels (except for certain federal and state owned vessels). (46 CFR 188.10-49)

PUBLIC VESSEL: Under federal shipping laws (46 USC 2101(24)), a public vessel means a vessel that is owned, or chartered, and operated by the U.S. Government and is not engaged in commercial service. Examples would be USCG and NOAA research vessels.

3.3.3 OPERATIONS

NAUTICAL MILE (nm): The internationally agreed standard sea mile, of 6,076 feet, this is commonly used in laws, regulations and treaties for specifying distance at sea or offshore.

RESEARCH CRUISE: Cruise by vessel primarily for the purpose of conducting marine research at sea. This is commonly defined as commencing on the day of departure, and terminating on the day of return to a port.

TRANSIT: Voyage of a vessel during which little or no research is being carried out; primarily for the purpose of going from one port to another, or to/from a port and an area of research.

LAY DAYS: Days in homeport for purposes of fitting out, cruise preparation, crew rest, and upkeep. May, in rare cases, include similar periods in other ports.

MAINTENANCE DAYS: Days undergoing overhauls, dry-docking, or other scheduled or unscheduled repairs during which the ship is not available for service.

OPERATING DAYS: All days away from homeport in an operating status incident to the scientific mission.

DAYS AT SEA: All days actually at sea incident to the scientific mission.

DAYS OUT OF SERVICE: Periods in which a ship is laid up out of service for an extended period for reasons of economy, unemployment, or unfitness for service.

OCEAN: Used to describe an operating area or route in any ocean or the Gulf of Mexico, more than 20 nm offshore. (46 CFR 188.10-51)

NEAR COASTAL: "The term near coastal means ocean waters not more than 200 nautical miles off a US shore." (46 CFR 10.103)

NEAR COASTAL AS PER STCW REG I/1: "STCW defines near coastal as a voyage in the vicinity of a signatory party. Each signatory party defines its own boundary for near coastal waters. It may not be consistent with 46 CFR 10.103.

COASTWISE: Used to describe a route or operating area, which is not more than 20 nm offshore, on any ocean, Gulf of Mexico, Caribbean Sea, Gulf of Alaska, and such other waters as may be designated. (46 CFR 188.10-15)

DOMESTIC SERVICE: "Domestic Service means a vessel used in trade from one U.S port to another U.S. port, or a voyage to nowhere that returns to the originating port." (NVIC 7-00

BOUNDARY LINES: "Boundary lines are lines drawn following the general trend of the seaward, high-water shorelines and lines continuing the general trend of the seaward, high-water shorelines across entrances to small bays, inlets, and rivers." (NVIC 7-00 and 46 CFR 7)

INTERNATIONAL VOYAGE: A sea voyage, by a mechanically propelled vessel of 500 gross tons or more, from a country to which SOLAS applies, to a port outside that country, or conversely. Within Subchapter U of 46 CFR, the USCG treats voyages between the continental United States, Hawaii and Alaska as international voyages. NOTE: State numbered vessels in accordance with the Federal Boating Safety Act of 1971, or vessels holding a special exemption issued by the Coast Guard need not comply with regulations applicable to vessels on an international voyage. Such voyages are therefore termed “foreign voyages.” (46 CFR 188.05-10, 46 CFR 188.10-35)

FOREIGN VOYAGE: A voyage between two countries or between two territories or possessions of the U.S, by a vessel which is not subject to the SOLAS provisions because of its size, propulsion, or documentation. Vessels engaged in such voyages, if 150 gross tons or over that were built before July 21, 1968 or if 79 feet or greater in length and built on or after July 21, 1968, must comply with load line requirements. After July 1984 existing vessels over 79 feet in length, and engaged in a foreign voyage, must be admeasured under the convention measurement system. (46 CFR 42.03-5, 46 CFR 69.9 & 69.11)

COLREGS: The Rules of the Road - International Regulations for Avoiding Collisions at Sea as well as the Inland Rules for U.S. waters. (USCG COMDTINST M16672.2D)

3.3.4 PERSONNEL

CREW: Personnel involved exclusively or primarily in the navigation and operation of a vessel.

PASSENGER: Every person other than the crew or other persons engaged on board a vessel in the business of the vessel. However, on oceanographic research vessels scientific personnel are not considered to be passengers. Research vessels may not carry passengers for hire, since this would constitute engaging in “trade or commerce.” (46 CFR 24.10)

SCIENTIFIC PERSONNEL: “Scientific personnel on oceanographic research vessels are not considered to be seamen or passengers, but are considered as persons when requirements are based on total persons on board.” and “Scientific Personnel - This term means those persons who are aboard an oceanographic research vessel solely for the purpose of engaging in scientific research, or in instructing, or receiving instruction, in oceanography or limnology, and shall not be considered seamen under the provisions of Title 46, United States Code.” (46 CFR 188.10-71 and 46 CFR 188.05-33)

MASTER: The designated member of the crew of a vessel who is in legal overall charge of the entire operation of the vessel. See section on “Manning“ for further discussion. The term “captain” is used almost interchangeably.

CHIEF SCIENTIST: The designated member of the scientific personnel who is in overall charge of the research operations on board ship. See section on “Manning“ for further discussion.

PRINCIPAL INVESTIGATOR (PI): The individual in charge of a research grant that is being supported on a research cruise. Research cruises often support more than one PI making it necessary to coordinate cruise planning, safety procedures and science operations for several groups with different goals and from different institutions. This is usually coordinated through the Chief Scientist who may or may not be one of the PIs.

MARINE TECHNICIAN: An employee or representative of the ship operator responsible for at sea operation of oceanographic instrumentation and onboard laboratory facilities. These individuals are legally part of the science party, but are in fact an integral part of the research vessel operator’s shipboard personnel supporting the science mission. They are responsible for helping to ensure safety in the laboratories and on deck during science operations and often have key responsibilities during emergency procedures. They serve as a primary point of contact between the scientific party and the ship's crew. Marine Technicians can also be referred to as Resident Technicians, Marine Science Technician or other similar titles.

EXPEDITION LEADER: This is a term that is often applied to the leader of a submersible crew deployed on a research vessel. This individual is responsible for the safe operation of Human Occupied Vehicles (HOV), Remotely Operated Vehicles (ROV) or other submersibles. They are legally part of the science party on a research vessel, but have a key role in helping to ensure the safe operations of submersibles. Other similar titles may be used for this position.

CREDENTIALS FOR MARINERS: Under Title 46 USC, the US Coast Guard is the domestic authority for promulgating requirements and issuing credentials for mariners. Each marine credential has specific requirements as to age, citizenship, physical condition, character, qualifying sea service, assessment and specialized training. The Coast Guard issues credentials in the form of licenses for deck, engineering and radio officers; Certificate of Registry (CORs) for staff officers; and Merchant Mariner Documents (MMDs) for unlicensed ratings of shipboard deck, engineering and steward departments. Any credential may contain limitations as to vessel type, tonnage, propulsion, horsepower, or water upon which service is authorized. MMDs are issued to unlicensed personnel who support ship operations. Unqualified rating documents are issued to entry-level persons who have little or no sea service. These are ordinary seaman (deck department), wipers (engineering department), or food handler (steward department). Additionally, qualified rating documents are issued based on previous sea service or specialized service, Deck department qualified ratings are able seaman and bosun; for engineering the qualified rating is Qualified Member of the Engineering Department (QMED). Various endorsements or rating are also issued on MMDs to qualified individuals. These include oiler, junior engineer, pumpman, lifeboat man, tankerman, GMDSS at sea maintainer, etc. To serve aboard inspected vessels, an individual must possess a credential but must also hold an STCW certificate. This is a separate document from the credential.

INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHSTANDING FOR SEAFARERS (STCW-95): The convention initially held in 1978 was amended in 1995. It requires comprehensive training and assessment of a mariner's practical skills. These standards were adopted by the USA under 46 CFR Parts 10 and 15 and the STCW code. To obtain an STCW certification, a seafarer must meet the requirements set forth in the regulations. A license or MMD will not be issued if the STCW certification is not presented when applying.

OFFICER COMPETENCY CERTIFICATES AND CONVENTION OF 1936 (46 CFR 15.701): Provisions of the Officer Certificates Convention of 1936 are incorporated into US regulations in this part of the CFRs. It applies to documented vessels 200 GRT and over navigating outside of the boundary line. Public vessels and undocumented vessels less then 300 GRT are exempted. The convention requires masters, mates and engineers to hold licenses.

3.3.5 TYPES OF CERTIFICATION AND DOCUMENTATION

Certification and documentation in the various forms is not in itself a safety standard. Rather, it defines categories of vessels to which certain safety rules and standards apply. In most instances certification and documentation are dictated by the pertinent laws and regulations, with which the operator must comply. In a few cases, there is a choice, owing to the unique nature of research vessel operation. In general the standards set by each category of certification will be adequate for ordinary operations, but prudent operators will often go beyond the legal minimums. Examples of this would be in the case of additional fire extinguishers, or lifesaving equipment. UNOLS operators are urged to recognize the legal requirements as minimums, and take additional steps as the situation may justify in each case.

DOCUMENTATION: Certificates of registry, enrollment, or license are Federal maritime documents required by vessels engaged in trade or commerce. Oceanographic research vessels under 46 USC 2101(18) are not required to be documented, but may be at the option of the operator. If documented, however, the certification should clearly define the vessel's service as "Oceanographic Research." No special advantages accrue, nor are restrictions avoided, by documentation, insofar as research vessel safety is concerned. (46 USC 121 and 46 CFR 67)

NUMBERING: Undocumented research vessels are usually numbered in accordance with the Federal Boat Safety Act (excepting certain federal- or state-owned vessels). Thus, the state-issued "Award of Number" becomes the official certificate identifying the vessel. Most state certificates do not have a routine box to check for "research," and it is important for the operator to see that this special use is clearly indicated.

OWNER'S CERTIFICATE: The unique and sometimes confusing role of marine research in the context of the U.S. shipping laws and regulations makes it advisable that all research vessels carry a letter, certificate, or plaque stating that the vessel is operated in oceanographic research under the laws of the U.S. This should include an affirmative statement that the vessel is complying with the provisions of 46 USC 2101(18). Such certification will help to avoid difficulties both in the U.S. and abroad.

USCG LETTER OF DESIGNATION AS OCEANOGRAPHIC RESEARCH VESSEL: 46 CFR 3 establishes US Coast Guard procedures for a designation as oceanographic research vessels. The designation is voluntary and is for the purpose of providing relief from otherwise applicable vessel inspection and the "Employment of Seamen" requirements. Such designation is necessary for the vessel to benefit from the exemptions of Subchapter U (46 CFR 188). Without this letter of designation, scientific personnel on board must be considered either crew or passengers. To be designated, a written request should be made to the local USCG officer in charge of marine inspection. The request must contain the information specified by 46 CFR 3.10-1. If the vessel is found to be employed exclusively in oceanographic or limnological research and/or instruction, a designation will usually be granted. For inspected research vessels, designation will be indicated on the certificate of inspection and is valid for the duration of the certificate. For uninspected research vessels a letter of designation will be issued. This letter of designation, which is valid for two years, must be requested by mail 60 days in advance of expiration.

INSPECTION CERTIFICATE: Oceanographic Research Vessels 300 GRT or greater are usually required to be inspected and certificated by the USCG. (46 CFR Subchapter U; 46 CFR 188.05-1)

ABS CLASSIFICATION: ABS classification of both hull and machinery is a detailed survey of the material condition of the vessel. This is not directly safety-related, but obviously bears heavily on the basic safety and operability of the vessel. In most matters of insurance and equity, ABS classification is attractive, and unless there is some strong reason to the contrary, it is recommended.

COURTESY INSPECTION OR UNINSPECTED VESSEL EXAMINATION: The USCG Auxiliary offers courtesy motorboat inspections for vessels that are moored as well as underway. The USCG may board and inspect any U.S. vessel at any time while underway. The annual sticker that is issued by the auxiliary as a result of a satisfactory inspection will be recognized by the USCG as showing the vessel as in compliance with the Boating Safety Act of 1971. Uninspected vessels may request an "Uninspected Vessel Examination" from a local USCG Marine Inspection Office. This service, which is advisory rather than regulatory, depends on the availability of USCG personnel and is not available from all offices. Neither of these "inspections" are mandatory but it is recommended that vessels under 65 ft undergo an auxiliary inspection and large vessels undergo the uninspected vessel examination, if available.

INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS 1973 (33 CFR 151.59 and 33 CFR 155.700) (MARPOL): The provisions of MARPOL and its 1978 modified protocol are incorporated into the US regulations under these CFRs. Designed to minimize pollution of the high seas including the dumping of oil and exhaust pollutions. It contains six annexes. Each addresses a separate area of pollution. Annex 1 - Oil, Annex II - Noxious Liquid Substances carried in bulk, Annex III - Harmful Substances carried in bulk, Annex IV - Sewage, Annex V - Garbage, and Annex VI - Air. Annex I and II are obligatory to parties to the agreement. Annex III to VI are voluntary.

3.4 LAWS AND REGULATIONS

APPLICABLE TO ALL VESSELS *CODE OF FEDERAL REGULATIONS (CFR):* A compilation of the rules and regulations made by Federal executive departments and agencies, pursuant to the authority of a Federal law. Most material concerning shipping is contained in Title 46 of the CFR. This is divided into chapters and subchapters, of which Subchapter U contains rules for oceanographic vessels. For example, "46 CFR 192" means Part 192 of Title 46 of the CFR. Not all CFRs apply to all vessels but those that do apply must be followed.

UNITED STATES CODE (USC): A compilation of the laws of the U.S., generally arranged by subject matter under "Titles." Shipping laws are primarily contained in Title 46 of the code, which contains the Oceanographic Vessels Acts of 1964. Note that the USC contains actual laws from Congress; the CFR contains agency generated regulations. Like the CFRs not all code applies to all vessels but those that do apply must be followed.

INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA (SOLAS): An international treaty, periodically modified, concerning safety at sea. The U.S. follows the provisions of the treaty and incorporates them in U.S. laws and regulations. Undocumented vessels, fishing vessels, vessels under 500 GT and certain others are not subject to the general SOLAS rules. (46 CFR 188.05-10)

JONES ACT (46 USC App 688a): The Jones Act was written to protect seamen injured while working. Under the Jones Act, a seaman is entitled to recover damages if he is injured during employment and they can elect a jury trial to recover damages. If a seaman is killed, a personal representative may bring a Jones Act suit to recover damages. The statute of limitations for a maritime injury suit under the Jones Act is three years. However, the courts have applied either the “time of event” rule or also the “discovery” rule in establishing the start of the statute of limitation. Historically, a Jones Act case has provided a very high cash settlement, compared to Workers Compensation, when either the slightest appearance of negligence or un-seaworthiness of the vessel could be demonstrated. Scientists are not considered seaman for the purposes of the Jones Act. The term seaman as defined by the Jones Act historically has been interpreted broadly. UNOLS vessels must be aware of this when embarking persons who are not part of a science party. (See Workers Compensation below.)

WORKERS COMPENSATION: Workers compensation is a State program that varies widely from state to state. It is traditionally designed to provide medical care, disability payments, and income benefits to employees hurt on the job. Workers Compensation settlements usually provide for lost wages and medical bills. Death benefits generally provide payment for life to a surviving spouse. While some court decisions have ruled that workers compensation may apply in lieu of a Jones Act settlement, this does not prohibit a seaman covered under workers comp from also bringing a Jones Act suit to collect damages nor does it mean he will not receive compensation under the Jones Act. (See Jones Act above.)

IEEE 45:

A Standard issued by IEEE titled “Recommended Practices for Electrical Installations on Shipboard.” As revised, it is a widely accepted standard for shipboard electrical systems.

APPLICABLE TO INSPECTED VESSELS 46 CFR Subchapter U46 CFR Subchapter U - Oceanographic Research Vessels.

This subchapter defines the regulations for research vessels of 300 GRT or more. They are not all inclusive and further applicable regulations may be found in other parts of the CFRs. While applicable to vessels of 300 GRT or larger, it is prudent for uninspected vessels to comply with these regulations to the maximum extent possible.

APPLICABLE TO VESSELS BASED ON TONNAGE

3.4.1.1 Vessels 200 GT or greater

INTERNATIONAL SHIP AND PORT FACILITY SECURITY CODE (ISPS):

In the wake of the 9/11 attacks on the USA, the ISPS code was developed as part of SOLAS. ISPS is a comprehensive set of measures to cope with perceived threats to enhance the security of ships and port facilities. The purpose of the code is to provide a standardized, consistent framework for evaluating risk, enabling Governments to offset changes in threats with changes in vulnerability for ships and port facilities by determining appropriate security levels and corresponding security measures. It has three different security levels based on threats that contracting countries may implement. It requires facilities and ports to assess the threat and evaluate the risk of potential unlawful acts. Measures to minimize and combat these threats must be developed in a security plan and the plan approved by the contracting state’s ISPS certification authority. If a ship's security plan is approved, the ship will be issued an International Ship Security Certificate. Ships not holding a valid security certificate may be detained in port until a certificate is received, may be expelled from a port, or may be refused entry. All ships that visit other ports particularly foreign ports should develop a security plan and obtain a ship security certificate   In addition, Automated Information System (AIS), a broadcasting device similar to an aircraft's Identification Friend or Foe (IFF) is required. A Ship Security Alert System (SSAS), an alert system designed to raise the alarm ashore in reaction to security treats or incidents, is being investigated and may become a future requirement.

In the USA, the US Coast Guard reviews and approves ISPS security assessments and plans. It issues security certificates and ensures compliance. It does so under 33 CFR 101 and 104. ISPS code applies to vessels subject to 46 CFR Chapter I Subchapter L. In addition, the Coast Guard enforces the provisions of the Maritime Transport Safety Act of 2003 (MTSA). For this reason, the ISPS code is frequently referred to as ISPS/MTSA. NVIC 04-03 provides guidance in implementing the ISPS/MTSA provisions. Under 33 CFR 401.20 an AIS is required for all commercial vessels over 200 GT and with a length over all of 20 meters or more.

INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHSTANDING FOR SEAFARERS (STCW-95):

With few exceptions, STCW applies to mariners employed on vessels 200 GRT or 500 GT that operate seaward of the boundary line specified in 46 CFR 7. Vessels specifically exempted from having STCW qualified mariners aboard are uninspected passenger vessels defined in 46 USC 2101(42), fishing vessels (46 USC 2101(11) 9(a) and (b), and vessels operating exclusively on the Great Lakes.

Environmental Protection Agency- (EPA) General Vessel Permit

EPA regulates discharges incidental to the normal operation of commercial vessels greater than 79 feet in length and operating as a means of transportation primarily through the Vessel General Permit (VGP). The first VGP was issued in 2008 and effective until December 19, 2013. On March 28, 2013, EPA re-issued the VGP for another five years. That reissued permit, the 2013 VGP, took effect December 19, 2013 and superseded the 2008 VGP at that time.

3.4.1.2 Vessels 300 GRT or greater

46 CFR SUBCHAPTER U - OCEANOGRAPHIC RESEARCH VESSELS: This subchapter defines the regulations for research vessels of 300 GRT or more. They are not all inclusive and further regulations that apply may be found in other parts of the CFRs.

3.4.1.3 Vessels 400GT or greater

MARPOL 73/78 ANNEX I, REGULATION 9 AND 26:

Contains requirements for maintaining an oil record log for all vessels over 400 GT, specifies the requirements for maintaining a shipboard oil pollution plan and oil transfer procedures (see NVIC 2-93 change 1 for more information).

OIL POLLUTION ACT OF 1990 (OPA 90) (33 CFR 138, 33 CFR 155.1010, NVIC 03-06/ US MARINE TRANSPORTATION ACT OF 2004 (NVIC 01-05)):

"The act established the Oil Spill Liability Trust Fund. It also requires vessels over 400 gross tons to have an Oil Spill Response Plan that is approved by the US Coast Guard in order to sail and vessels over 300 GT to establish and maintain evidence of financial responsibility in the form of a Certificate of Financial Responsibility (COFR) issued by the US Coast Guard."

OIL SPILL REMOVAL ORGANIZATION (OSRO):

A major feature of the National Response System and Marine Transportation Act of 1970 is that vessels over 400 GT are required to ensure the US Coast Guard the availability of response resources to meet their maximum, most probable and worse case discharge of oil into US waters. These resource requirements can be met by private contracts. This requires US Coast Guard approval of the vessel response plan and organization. This requirement is still evolving, however, certain States require these plans when transiting their waters. NVIC 01-05 provides guidance for submission and US Coast Guard approval of these plans.

3.4.1.4 Vessels 500 GT or Greater

INTERNATIONAL MANAGEMENT CODE FOR THE SAFE OPERATIONS OF SHIPS AND POLLUTION PREVENTION (International Safety Management (ISM) Code) (46 USC 32, 33 CFR 96.100 et seq.):

"Adopted by IMO in 1978 and amended in 1995, this convention outlines training requirements for personnel serving as crewmembers aboard vessels in order for them to qualify for the required STCW certification. The ISM code establishes safety management objectives and requires a formal, written Safety Management System (SMS) to be implemented onboard certain vessels and at the management company which assumes responsibility for operating these ships. ISM code also requires every vessel over 500 GT to be issued a safety management certificate (SMC) that verifies the company and its shipboard management operate in accordance with the approved safety management system. To obtain and maintain the SMC, the ISM code requires that a US Coast Guard approved external auditing agent approve the initial SMS and that an annual external audit be conducted. It also requires internal audits be conducted. The ISM code also established a new position, the Designated Person Ashore (DPA), and the distinct responsibilities of this person are delineated. The DPA is designated in writing by the company and must have direct access to the company's highest level of management. The DPA will ensure the safe operation of the vessel and provide a link between the company and those on board. The DPA must have the responsibility and authority to monitor all safety and pollution prevention aspects of vessel operations and ensure that adequate resources and shore-based support are supplied. It is the responsibility of the company to identify the best candidate to fill the role of the DPA. Within the UNOLS fleet, the Institution operating the vessel is the company and in most instances the Institute will designate its Marine Superintendent as the DPA. This is a new concept in the marine industry where responsibility for safety is now shared between the DPA and vessel's Master. This concept of shared responsibility has yet to be fully tested by the courts."

3.4.2 APPLICABLE TO UNINSPECTED VESSELS

MOTORBOAT ACT:

A federal law enacted originally in 1940 and subsequently amended, which covers many aspects of safety for small craft. (46 USC 41)

FEDERAL BOAT SAFETY ACT OF 1971:

Act setting forth certain requirements concerning documentation and safety, principally applicable to small craft (46 USC 43, 46 CFR 24-27). Safety for recreational vessels is contained in 33 CFR Subchapter S, 173 et seq.

3.4.3 APPLICABLE TO VESSELS ON INTERNATIONAL OR FOREIGN VOYAGES

INTERNATIONAL LOAD LINE ACT (46 USC 71 and 46 CFR 42 et seq.): This act concerns stability standards and inspections. It is applicable to certain vessels sailing beyond the Boundary Line. This certificate is issued by ABS for U.S. vessels and is required for most vessels on foreign or international voyages.

INTERNATIONAL POLAR CODE

For vessels operating in the Arctic or Antarctic polar regions, compliance with the International Polar Code will be required. This standard specifies life saving equipment which must be on board.

The expected date of entry into force of the SOLAS amendments is 1 January 2017, under the tacit acceptance procedure. It will apply to new ships constructed after that date. Ships constructed before 1 January 2017 will be required to meet the relevant requirements of the Polar Code by the first intermediate or renewal survey, whichever occurs first, after 1 January 2018.

3.5 RECOMMENDATIONS

SAFETY STANDARDS FOR SMALL CRAFT:

Standards issued by the ABYC concerning safety of small craft (e.g. ABYC E-1-1972).

LOAD LINE CERTIFICATE:

Uninspected research vessels, which do not engage in international voyages, are not required to have a load line certificate, but unless there is some strong reason to the contrary, it is recommended.

46 CFR SUBCHAPTER U - OCEANOGRAPHIC RESEARCH VESSELS: While applicable to vessels of 300 GRT or larger, it is prudent for uninspected vessels to comply with these regulations to the maximum extent possible.

4. OPERATIONS

4.0 INTRODUCTION

The safe operation of conducting marine research aboard oceanographic research vessels is based on sound seamanship and accepted nautical science practices. This chapter will cover operational practices from both a marine operations and scientific research perspective. It is important for crew, technicians and science party members to always consider the unique nature of conducting science at sea. This adds a level of complexity not found in other maritime fields.

4.1 REFERENCES

Certain operations for inspected vessels are regulated by 46 CFR 185-196 of Subchapter U and for uninspected vessels by 46 CFR, Part 26 of Subchapter C. Other operations affecting the navigation of vessels, and “rules of the road” are contained in 33 CFR, Chapter I. Recent developments to combat terrorism have added Subchapter H, Maritime Security, to Chapter 1 of 33 CFR; all operators are encouraged to familiarize themselves with parts 101, and 103 thru 106 of this section. To achieve sound operational guidelines, uninspected vessels, insofar as practicable, should use the provisions of 46 CFR 196. In addition to the points mentioned herein, the internal policies set by the operating institution are an essential part of overall operational safety.

4.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

4.2.1 SAFETY ORIENTATION

Before getting underway or as soon as possible afterwards, there should be a formal safety orientation for all embarked science party members. Participation is mandatory. Areas to be covered should include as a minimum: stowage and proper donning of lifejackets, type and location of lifesaving devices, the viewing of the RVOC safety and harassment prevention video, and any other instructions relating to safety for the particular vessel. (46 CFR 185-506 and 46 CFR 26.03-1)

4.2.2 EMERGENCY PROCEDURES

Posted instructions for crew and science party to follow in case of emergency are required. (46 CFR 199.80)

4.2.3 CHARTS AND NAUTICAL PUBLICATIONS

Appropriate charts and publications for the voyage shall be carried. They shall be maintained up to date, and of the appropriate scale to facilitate safe navigation at all times. Electronic charting systems supplement but do not replace the requirement to maintain an up to date chart library for the region of vessel operations. (46 CFR 130.330)

4.2.4 VOYAGE PLANS

The Master must prepare a voyage plan that includes a Crew and Science Party list before departure. The usual Passenger List is often presented as “Scientific Crew List” or something similar to clearly distinguish that the Science party members are not "Passengers." (46 CFR 185.503)

4.3 <u>REQUIRED REGULATIONS FOR CERTAIN VESSELS</u>

4.3.1 REQUIRED BASED ON TONNAGE OR SIZE

4.3.1.1 OIL TRANSFER PROCEDURES

All vessels, whether inspected or uninspected, with a fuel capacity of more than 250 barrels (10,500 gallons) of oil are required to have written oil transfer procedures. These procedures must be available during a USCG inspection and must be permanently mounted where the procedures can be easily seen and used by crewmembers engaged in oil transfers. These procedures must apply to both bulk fuel oil transfers to or from another facility and internal transfers between the vessel's tanks. The requirements for these procedures are contained in 33 CFR 155.720 and 33 CFR 155.730.

If there is an ISM system in place, there should be a specific procedure for the guidance of loading and transfer of fuel oil and lube oil.

4.3.1.2 OIL RECORD BOOK

An oil record book (Form CG-4602A) is required to be maintained by all vessels 400 Gross Tons (GT) and above under International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, Annex I, Chapter II, Regulation 9. Log entries are to be made whenever a vessel discharges ballast or cleaning water from fuel tanks, disposes oily residue (sludge), bunkers, discharges engine room bilge water or has an accidental discharge into the water. Detailed instructions for maintaining the log are contained in the record book.

4.3.1.3 REFUSE RECORD BOOK

33 CFR 151.55 requires that vessels over 40 meters (131 feet) in length maintain a Refuse Record Book in which log entries are made by the Master whenever garbage is transferred to another ship or shore facility, or whenever garbage is incinerated or dumped over-the-side. The log entry is to include the date, position, or port where disposal occurred and the amount in cubic meters. The log must be available to the USCG during a boarding or inspection. The log must also be kept for two years after a logbook is full. A waste management plan and mounted warning placard that prohibits the discharge of prohibited refuse over-the-side is also required.

4.3.2 INSPECTED VESSELS

4.3.2.1 STABILITY LETTER

If a stability letter is issued in accordance with 46 CFR 170, it shall be posted in the pilothouse. (46 CFR 170.120 and 46 CFR 196.12)

4.3.2.2 STATION BILLS

All research vessels should have posted in conspicuous places station bills setting forth the duties of the crew and scientific personnel under emergency situations. New personnel should be indoctrinated in their duties. (46 CFR 199.80)

4.3.2.3 DRILLS

Drills must, as far as practicable, be conducted as if there were an actual emergency. Every crewmember on board must participate in at least one abandon-ship drill and one fire drill every month. The drills for the crew must take place within 24 hours of the vessel leaving a port if more than 25 percent of the crew have not participated in abandon-ship and fire drills on board that particular vessel in the previous month (46 CFR 199.180). A ship specific training manual should be developed. Conduct of drills should be noted in the deck log.

4.3.2.4 MEDICAL

All research ships and boats, of whatever size, must carry first aid kits, jump bags, and other medical supplies as appropriate for the size of vessel, number of persons aboard, and operational pattern. In particular, ships on extended voyages, or in areas remote from shore medical assistance should carry fully adequate medical supplies and instructions. Specific guidance as to medical supplies should be obtained from a competent medical support activity. Selected personnel should be trained in basic First Aid and Cardiopulmonary Resuscitation (CPR). Additionally, the Standards of Training, Certification & Watchkeeping (STCW) requires crewmembers to demonstrate competence to undertake listed tasks, duties, and responsibilities. Competency can be demonstrated by successful completion of an STCW approved medical training courses. Vessels on ocean, international, or extended voyages should have firmly established procedures for obtaining medical assistance by satellite phone or radio from a medical support activity, and administering it on board. Support involving radio advisory services, pharmaceuticals, medical supplies, training, evaluation and repatriation are available from commercial sources on a subscription and/or contractual basis. All operators should be familiar with and avail themselves of the current UNOLS medical contractor who provides emergency medical advice at sea and routine medical support activity ashore. (46 CFR 72.20-35 - Hospital Spaces)

The following reference books are valuable sources of information:

- "The Ship's Medicine Chest and Medical Aid at Sea", 2003 Edition. This book has been updated and is available online at: http:www.uscg.mil/hq/g-w/g-wk/wkh/smc/index.htm
- International Medical Guide for Ships", Second Edition, World Health Organization, Geneva, 1988.

4.3.2.5 LOG BOOKS

A properly kept ship's log is a recognized part of a well-operated vessel. All research vessels, except small boats on day trips, should maintain a formal logbook in which is entered all appropriate records and data. If in doubt, it is much better to log too much than too little. In addition to the purely operational considerations, it is often found that the ship's log is a useful adjunct source of information for the scientific program, and it thus should include sufficient notations of the research operation to permit relating the scientific logbooks to the ship's operational activities. (46 CFR 196.35 and 46 CFR 78.37)

4.3.2.6 CRUISE (VOYAGE) PLANS

Recognizing that planned cruise tracks are often changed between the time a proposal is submitted and the time of the voyage, either the Master or Marine Superintendent of all research vessels shall ensure that a cruise plan is on file with their home office, prior to sailing, which includes the following information:

- The names of all ship's crew (unless recorded elsewhere).
- The names of scientific personnel (including technicians).
- Designation of Master and Chief Scientist.
- Date/time and place of departure.
- Estimated date/time and place of arrival.
- Cruise track and operating areas.
- Capsule summary of science planned.
- Communications instructions to comply with standards as set out in Chapter 6 of these safety standards, and institutional requirements.
- Early and complete information concerning the use of hazardous materials, explosives, and radioactive material. See Chapters 8 and 9 of these standards.
- Other information as appropriate to safe and effective vessel operations.

A copy of the Cruise Plan should be kept at the institutional facility or other designated base, and a copy should be maintained on board. The termination of the cruise or a port arrival should be reported, and it is the responsibility of the Master to see that this is done. The base facility should establish procedures for prompt follow-up action in case of receipt (or non-receipt) of reports.

4.3.2.7 NOTIFICATION OF HAZARDS

The National-Geospatial Agency (NGA) is the point of contact for ship operations that use sonic emitters, towed devices, explosive charges, or deploy moored instrumentation. These items could pose a hazard to the safe navigation and operation of submarines and in some cases to surface vessels, particularly those engaged in fishing, towing or other research work. NGA will disseminate this information through the Notice to Mariners and broadcast warnings as well as directly to appropriate Naval commands. Sending the same information directly to the Aids to Navigation office of the appropriate Coast Guard District and in some cases to local Naval Commanders may improve the level of notification and improve local co-ordination of operations.

To contact NGA to update a chart, or submit a notification:

http://www.nga.mil

Click on "Products and Services" then on the Nautical section on the web site, and then click on the "Maritime Safety Information" http://www.nga.mil/portal/site/maritime/

4.3.2.8 COLLISIONS, CASUALTIES, AND ACCIDENTS

The actions required at the scene of a collision, accident, or casualty, and the follow-up paperwork, vary with the legal requirements. In most cases, submission of United States Coast Guard (USCG) forms to the USCG Officer in Charge, Marine Inspection (OCMI) is required. As a general rule, if another vessel is involved, the ship is required to render all practicable assistance in addition to identifying itself. Operators and captains should be thoroughly familiar with the particular requirements, which apply, to their vessel since legal and administrative liability will likely be at stake.

In the case of accidents involving injury to personnel, most institutions have very specific requirements for reporting in addition to the USCG requirement noted above. Ship's personnel should be thoroughly familiar with these since they are often crucial to liability or insurance proceedings at the federal, state, or institutional level. Notice of collisions, casualties, and accidents are usually required by the owner of the vessel as part of the Charter Party Agreement.

If the incident qualifies as a "serious marine incident" as defined in 46 CFR 4.03-2, then drug and alcohol testing of the individuals involved, including scientists, is required within twenty four hours and must be reported to the Coast Guard. 46 CFR 4.40

4.3.2.9 SECURITY

Research vessels shall follow the new Maritime Security Policies outlined in 33 CFR Subchapter H; parts 101, 104, and 105. Vessels and facilities required by these new regulations shall submit and follow the provisions of a vessel or facility security plan. It is strongly urged that security obligations and requirements be factored into any science expedition.

Marine superintendents and vessel Masters should also consult the NGA web site to download information on piracy and hostile action towards ships. The Office of Naval Intelligence (ONI) "Worldwide threats to shipping report" and the Anti-shipping Activity Messages (ASAM) are useful tools to avoid trouble spots throughout the world. The threat of piracy and terrorist groups attacking ships cannot be underestimated or dismissed as passé.

4.3.3 CLASSED VESSELS

None.

4.3.4 SOLAS VESSELS

None.

4.3.5 UNINSPECTED VESSELS

None.

4.3.6 OTHER REGULATIONS

None.

4.4 REQUIRED STANDARDS UNDER RVSS

4.4.1 BALLAST WATER MANAGEMENT

33 CFR 151.1510 Due to the serious problem of invasive species in US waters, all UNOLS vessels should follow the guidelines established in the USCG Voluntary Ballast Water Management Program. Information can be obtained at: http://www.uscg.mil/hq/gm/mso/mso4/old/estandards.htm.

Vessels over 300 GRT and not owned by the Department of Defense may also have to comply with the EPA regulations regarding Vessel Discharges under the National

Pollutant Discharge Elimination System (NPDES). See the EPA web site at: http://cfpub.epa.gov/npdes/home.cfm?program_id=350

4.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

4.6 RECOMMENDATIONS AND BEST PRACTICES

4.6.1 INSTITUTIONAL POLICIES

Policies of a laboratory or institution operating research vessels regarding their safe operation should be clearly stated in written directives and posted or disseminated as appropriate. As operators implement safety management systems in compliance with International Safety Management (ISM) requirements, these policies will become part of the organization's structure of accountability and will be subjected to regular audits and reviews – both at home and by foreign port state authorities. As a minimum, the following should be covered:

- Preparation, use, and handling of cruise plans.
- Communications instructions.
- Authority and responsibility of the Captain and the Chief Scientist.
- Safe loading standards for equipment and personnel.
- Instructions concerning hazardous materials.
- Responsibilities of base personnel for vessel operations, and procedures for follow-ups in case of overdue vessels or vessels not reporting on schedule.
- A security plan.
- Preventative Maintenance Policy- Each operator is required to have both in writing and in practice a preventative maintenance policy. The policy should include, at a minimum, a designated responsible person, (s), qualifications of persons conducting maintenance, inventory of equipment requiring maintenance and inspection, specific maintenance procedures and procedures for reporting and correcting deficiencies.
- Navigation Light Panels- All vessels should have navigation light panels supplied by two sources of power, the panel should visually and audibly signal the failure of side, masthead, and stern lights at a minimum. There should also be duplicate light sources for the side, masthead, and stern lights.
- Bridge Navigation Watch Alarm- All ships should have a bridge watch alarm system in place.
- 12/24 VDC Navigation and Communication Line Diagram- All vessels should maintain an accurate 12/24 VDC navigation and communication one line diagram to conduct a load analysis, optimize the bridge electrical distribution, and eliminate the electronic interference problems. Emergency power to critical

communications and navigation equipment should be provided via an emergency generator and/or a DC power supply.

- Crew Endurance Management Policy- With the small crew size and 24 hour operations typical on a research vessel, operators should adopt crew endurance management procedures to mitigate risk factors associated with fatigue.
- Magnetic Compass Deviation Tables- All vessels should have magnetic compass deviation tables posted in clear view of the helm station. They should be updated periodically or when structural or electronic modifications are made in the vicinity of the magnetic compass.
- Warning Placards- All vessels should post a warning placard alerting personnel to remain clear of the antenna deck when electronics are in operation.
- Deck Machinery Controls- All deck machinery controls should be clearly labeled describing the control function and the result of the control movement in words and/or symbols. All deck equipment controls should be labeled consistently and be clearly visible by the operator with adequate lighting and a conspicuous format.
- Hydraulic Hose Preventative Maintenance Program- All hydraulic hoses should be part of a preventative maintenance program which includes an inventory, inspection record, and maintenance and replacement schedule. The information should be entered into a hydraulic hose log containing replacement dates, serial numbers, equipment, hose specifications and supplier information.
- Winch Safety- Personnel protective screens should be installed at each winch control station that is in line with snapback or other tension member dangers. For hydraulically powered winches, a hydraulic pump emergency stop should be installed at each winch control station.
- Deck Safety- A procedure to inform and keep personnel out of harm’s way during deck operations shall be in place. Placards indicating when tension members are in use must be posted.

4.6.2 VESSEL HANDBOOKS

Research vessel operators should provide cruise handbooks or user manuals with complete information on the ship’s capabilities and procedures for use in planning and conducting cruises. These manuals should be kept current and dated so that users can be sure they have the most current version. These manuals can be posted online as well. Principal Investigators and Chief Scientists should make sure that they thoroughly review and use the appropriate manual when they schedule, prepare for, and carry out their cruise.

5. MANNING

5.0 INTRODUCTION

By their very nature, oceanographic research vessels have unique manning and crewing requirements which must satisfy both governmental regulations, and the science mission requirements of each expedition. In addition, the class of the vessel, (inspected, uninspected, class, SOLAS, domestic, international, inshore, coastal, ocean) will govern manning requirements.

A partial list of the regulatory entities and references include:

- The regulations put forth by the United States Coast Guard (USCG), and the USCG Marine Safety Manual, Chapters 22-26.
- Code of Federal Regulations (CFR),
- United States Code (USC)
- Standards of Training, Certification, and Watchkeeping, (STCW),
- International Convention for the Safety of Life at Sea, 2004 ed.(SOLAS),
- International Maritime Organization (IMO),
- International Convention on Tonnage Measurement of Ships (ITC)
- Global Maritime Distress and Safety System (GMDSS),.

In addition to the manning requirements set forth by regulations, the number and type of crew on a particular vessel may also be influenced by the science mission requirements of the ship or a particular cruise. The operating area, over-all experience of the science party, length of the voyage, operating tempo and complexity of the science plan all impact the number and mix of scientists and technicians needed to successfully carry out the cruise. Crew fatigue and personnel endurance must also be considered.

The UNOLS fleet represents a diverse and broad spectrum of vessel types, and manning requirements will vary for each type of vessel. The Chief Scientist and/or Principal Investigator determine the makeup of the science party for each science mission based on the nature of the work. Although ultimately, the Master of the research vessel is responsible for safety, the Chief Scientist has the responsibility to ensure that each task during the cruise is adequately planned and manned with appropriately trained and experienced scientific personnel. The ship operator should be consulted during the cruise planning phase and factors such as the cruise plan, round-the-clock operations and rest, complexity of over-the-side operations and length of cruise must all be considered. There are several terms found in the various regulations, which must be clearly understood in the interpretation of these laws. The following terms affect manning levels and are defined in Chapter 3.

- Oceanographic Vessel (46 CFR 188.10-53)
- Scientific Personnel (46 CFR 188.05-33 and 46 CFR 188.10-71)
- Near Coastal (46 CFR 10.103)

- Near Coastal as per STCW REG I/1
- International Voyage (NVIC 7-00)
- Domestic Service (NVIC 7-00)
- Boundary Lines (NVIC 7-00 and 46 CFR 7)

5.1 REFERENCES

- Code of Federal Regulations (CFR) – 46CFR15 covers manning
- United States Code (USC)
- Navigation and Vessel Inspection Circular (NVIC) in particular 4-97 & 7-00 for guidance on STCW
- United States Coast Guard Marine Safety Manual, Chapters 22-26 http://www.uscg.mil/hq/g-m/nmc/pubs/msm/vol3.htm
- Standards of Training and Certification of Watchkeepers (STCW)
- International Convention for the Safety of Life at Sea (SOLAS), 2004 Ed.
- American Boat and Yacht Council (ABYC)

5.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Manning regulations are contained in 46 CFR 15. The purpose of the regulations in this part is to set forth uniform minimum requirements for the manning of vessels. In general, they implement, interpret, or apply the specific statutory manning requirements in title 46, USC., parts E & F, implement various international conventions which affect merchant marine personnel, and provide the means for establishing the complement necessary for safe operation of vessels.

The regulations in this part apply to all vessels, which are subject to the manning requirements contained in the navigation, and shipping laws of the United States, including uninspected vessels (46 USC. 7101-9308).

The navigation and shipping laws state that a vessel may not be operated unless certain manning requirements are met. In addition to establishing a minimum of licensed individuals and members of the crew to be carried on board certain vessels, they establish minimum qualifications concerning licenses, citizenship, and conditions of employment. It is the responsibility of the owner, charterer, managing operator, master, or person in charge or command of the vessel to ensure that appropriate personnel are carried to meet the requirements of the applicable navigation and shipping laws and regulations.

46 CFR 15.801 states in part that the Masters or individuals in command of all vessels, whether required to be inspected under 46 USC. 3301 or not, are responsible for properly manning vessels in accordance with the applicable laws, regulations, and international conventions.

5.3 <u>REQUIRED REGULATIONS FOR CERTAIN VESSELS</u>

5.3.1 INSPECTED VESSELS

The Inspected Vessel manning requirements, (composition, billets, and total number of personnel onboard) are established as part of the Certificate of Inspection issued by the USCG (46 CFR 15.103 & 15.501). For specific details on how the Officer in Charge Marine Inspection (OCMI) determines these numbers see 46 CFR 15.801.

5.3.2 CLASSED VESSELS

None.

5.3.3 SOLAS VESSELS

Applies STCW requirements and documentation to Intermediates and larger (over 500GT) and any vessel going foreign. (See NVIC 4-97 and 7-07) Also SOLAS Chapter V, regulation 14 requires: "vessels engaged in international voyages to be sufficiently and efficiently manned." See section 5.3.5 – STCW regulations below.

5.3.4 UNINSPECTED VESSELS

The rules, which govern manning requirements on uninspected research vessels, are not well defined. As stated in the USCG Marine Safety Manual, Chapter 26: "there are very few statutory requirements that allow the Coast Guard to regulate uninspected vessels." The regulations governing the uninspected vessel industry focus on towing vessels, motor-propelled yachts, fishing vessels, and uninspected passenger vessels. Most of the regulations that apply to uninspected vessels are applied to documented vessels.

There is a manning chart in Chapter 26, Figure 26-1, which lists requirements and references for citizenship, manning, and watch requirements that apply to uninspected, documented vessels.

46 CFR 15.701: Implements the Officers Competency Certificate Convention 1936, which applies to each vessel documented under the laws of the US navigating seaward of boundary lines except a vessel of less than 200 GT.

46 CFR 15.805: "There must be an individual holding an appropriate license as Master in command of each of the following vessels:

- Every self-propelled seagoing documented vessel of 200 gross tons and over.
- Every self-propelled inspected vessel of 200 gross tons and over.
- Every vessel documented under the laws of the U.S. other than a vessel with only a recreational endorsement, must be in command of a U.S. citizen"

46 CFR 15.810(c): "An individual in charge of the navigation or maneuvering of a self-propelled, uninspected, documented seagoing vessel of 200 gross tons or over must hold an appropriate license authorizing service as mate.

46 CFR 15.810(f): "The USCG Commandant will consider increases or decreases in the number of mates when special circumstances allowing a vessel to be safely operated can be demonstrated."

46 CFR 15.820: "There must be an individual holding an appropriate license as Chief Engineer or a license authorizing service as a Chief Engineer on board inspected mechanically propelled seagoing vessels of 200 GT and over." An individual engaged or employed to perform the duties of Chief Engineer on a mechanically propelled uninspected seagoing documented vessel of 200 GT or over must hold an appropriate license authorizing service as a Chief Engineer."

46 CFR 15.825: "An individual in charge of an engineer's watch on a mechanically propelled seagoing documented vessel of 200 GT or over must hold an appropriate license authorizing service as an assistant engineer.

The regulations are mostly silent for un-documented (state numbered) vessels, which include many of the UNOLS research vessels. Because of this it is recommended that operators of these vessels consult directly with the responsible Marine Safety Office for any questions.

On uninspected, undocumented research vessels the total number of crew and scientists is usually governed by the number berths on the vessel. Requirements for life saving equipment should be similar to those of inspected vessels of similar size and operating characteristics. For day trips, availability of lifesaving equipment and the ability of the crew to supervise safe operations will influence the allowable number of people on board.

5.3.5 OTHER REGULATIONS

5.3.5.1 STCW Regulations

46CFR15.1101 is the beginning of Subpart J of 46 CFR 15 and defines STCW and certain terms relative to STCW. It also describes the applicability of the STCW regulations to U.S. Vessels. Subpart J includes 46CFR15.1101 through 46CFR15.1111. Further STCW guidance is contained in two USCG NVICs. NVIC 4-97 establishes guidelines for applying STCW for companies owning or operating U.S. documented, self-propelled vessels that operate beyond the boundary line (seagoing). The intent is to ensure that U.S. documented seagoing vessels are appropriately manned with personnel fully competent and fit to perform all routine and emergency duties on board. NVIC 7-00 provides clarification regarding the application of STCW to vessels less than 200 GRT.

Subpart J defines STCW to mean the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995 and STCW Code means the Seafarer's Training, Certification and Watchkeeping Code. Also for STCW, Seagoing vessel means a self-propelled vessel in commercial service that operates beyond the Boundary Line established by 46 CFR part 7. It does not include a vessel that navigates exclusively on inland waters.

Rest means a period of time during which the person concerned is off duty, is not performing work (which includes administrative tasks such as chart corrections or preparation of port-entry documents), and is allowed to sleep without being interrupted. Overriding operational conditions means circumstances in which essential shipboard work cannot be delayed for safety or environmental reasons, or could not reasonably have been anticipated at the commencement of the voyage.

Subpart J applies to seagoing vessels subject to STCW. Further clarification in NVIC 7-00 makes it clear that vessels less than 200 GRT on domestic near coastal voyages do not have to comply with STCW requirements. Near Coastal is considered to be within 200 nm of the U.S. shore and within the jurisdiction of the U.S. (see *Domestic Voyages* below). NVIC 7-00 applies STCW to vessels over 200 GRT on "international voyages", which they define more broadly than elsewhere in the CFRs (see *International voyages* below).

A vessel that has on board a valid Safety Management Certificate and a copy of a Document of Compliance issued for that vessel in accordance with 46 U.S.C. 3205 is presumed in compliance with the regulations in subpart J.

STCW Regulation II/4 lists minimum requirements for ratings forming part of a navigational watch for unlicensed mariners working on a seagoing vessel of 500 GT or more.

STCW-95 certificates or endorsements are required as follows on board seagoing vessels operating beyond the boundary line as established by 46 CFR 7:

No person may serve as Master, chief mate, chief engineer, first assistant engineer, officer in charge of the navigating watch or engineering watch unless the person holds an appropriate, valid STCW certificate or endorsement.

On board a seagoing vessel of 500 GT (200 GRT) or more, no person may serve in a rating, which forms a part of a navigational watch unless the person holds an appropriate, valid STCW certificate or endorsement.

On board a seagoing vessel driven by main propulsion machinery of 750 kw (1000 hp) propulsion power or more, no person may serve in a rating forming part of a watch in a manned or perform duties in a periodically unmanned engine room except for training or duties of an unskilled nature unless the person holds an appropriate, valid STCW certificate or endorsement. (Note: STCW does not apply to engineering officers serving on a seagoing vessel less than 750 kW (1000hp).

For purposes of these rules 200 Gross Registered Tons (domestic tonnage) is equal to 500 Gross Tons (international tonnage). Specific rules regarding the applicability of STCW for vessels under 200 GRT are summarized below:

5.3.5.2 Domestic Voyages

The Coast Guard, as per NVIC 7-00, has determined that, for certain small vessels on domestic near coastal voyages that safety provided through the current licensing, inspection and oversight programs for small vessels delivers a level of safety comparable to STCW. As such the Coast Guard has imposed no new requirements either on mariners serving on passenger vessels of less than 100 GRT inspected under subchapter T or K or on other vessels less than 200 GRT on domestic voyages or on the owners or operators of such vessels.

The Coast Guard considers near coastal voyages to be those within 200 miles of the U.S. shore and within the jurisdiction of the U. S.

As a result, when a Master or other mariner is serving on a vessel of less than 200 GRT on a domestic near coastal voyage, no new training requirements have been imposed beyond the regulations. Holding a suitably endorsed license for service complies with the STCW under domestic law.

An officer operating a vessel on domestic voyages will have an appropriate STCW endorsement automatically placed directly on his or her license. This endorsement is available to any officer on an inspected passenger vessel less than 100 GRT and on any other U. S. vessel less than 200 GRT (500 GT) that is operating exclusively on a domestic voyage, if this mariner does not already hold a STCW certificate. This endorsement should read as follows:

When the holder of this license is serving on an U. S. Vessel of less than 200 gross registered tons (500 gross tonnage) in domestic service, no added STCW endorsement is necessary to meet the U. S. regulations implementing the STCW Convention.

5.3.5.3 International Voyage

This section uses the terminology found in NVIC 7-00 addressing International voyages. As described in Chapter 3 of the RVSS, International Voyages are made by vessels subject to SOLAS. However NVIC 7-00 seems to cast a broader net regarding "International Voyages", defined in the NVIC as a voyage from a port in the U.S. to a port in a foreign country. The NVIC also states that these endorsements apply to mariners not engaged on vessels on near coastal voyages and that a license endorsed for near coastal voyages is not valid for international voyages or operations in waters of a foreign country.

Mariners licensed for service on vessels of less than 100 GRT inspected under subchapter T or K and on other vessels less than 200 GRT (500GT), when operating on an international voyages (except for the specific exemptions identified in NVIC 7-00), must meet the training and assessments required by the applicable U. S. and STCW regulations in accordance with 46 CFR 10.202. A mariner seeking a license or certificate valid for international voyages must meet the requirements for training and assessment required by STCW as may be applicable to the license or rating.

Any unlicensed mariner assigned a watch in an engine room or designated to perform duties in a periodically unmanned engine room on a vessel on an international voyage must have an STCW endorsement documenting that he or she meets the competencies of the STCW. This requirement applies only to those vessels driven by machinery of 750kw (1000 hp) or more.

NVIC 7-00 also sets forth a method to issue a STCW certificate to a mariner required to make an occasional international voyage, whose routine operations are domestic voyage.

5.4 REQUIRED STANDARDS UNDER RVSS

All uninspected UNOLS research vessels under 300GRT in addition to inspected vessels over 300GRT shall maintain crews that are trained and organized and whenever possible certified per the regulations established by STCW 95 and NVIC 4-97 & 7-00.

Operators should be guided by 46 CFR 15.1111 which addresses work hours and required rest periods when identifying final crew complement. In general, watch standers must receive a minimum of 10 hours of rest in any 24-hour period. The hours of rest may be divided into not more than two periods, one of which must be at least 6 hours in length.

5.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

5.6 RECOMMENDATIONS AND BEST PRACTICES

PHYSICAL EVALUATION STANDARDS: Institutions employing personnel as crewmembers not possessing a Coast Guard issued license or merchant marine document should insure these crewmembers meet the physical standards of NVIC 2-98 or an equivalent set of physical standards established by their institution.

MANNING- SCIENTIFIC PERSONNEL: As noted above, the maximum number of scientific personnel is regulated for inspected vessels.

For uninspected vessels, the operator shall determine the maximum number allowable. This must be consistent with the safety and lifesaving equipment available on board the vessel and consistent with crew and science accommodations provided on the vessel. For smaller vessels, which have a labeled boat or raft capacity provided by the manufacturer these ratings shall not be exceeded. This limit should be made known to prospective chief scientists well in advance, so their staffing can be adequately planned. Recommended guidelines in this regard are to be found in manufacturers' specifications, ABYC publications, the Federal Safe Boating Act, and similar sources. (46 CFR 188.05-33; ABYC H-5)

Chief Scientists should ensure that they have adequate numbers of trained personnel to safely carry out their planned science operations. The requirements for crew rest outlined in 46 CFR 15.1111 (described in section 4.4 above) should be used as a guide for marine technicians and scientific personnel engaged in science operations, especially those on deck or in the laboratories when the use of equipment or chemicals might present hazards to personnel. If safety is compromised due to a lack of rest, the Master retains the authority and obligation to suspend operations.

MASTER OF THE VESSEL: The interrelationship of the Master of a vessel and the Chief Scientist is unique. The ship's Master is, in both law and tradition, solely and ultimately responsible for the safety and good conduct of the ship and all persons embarked, including the scientific party. Some specific regulatory requirements concerning the responsibilities of the Master of inspected vessels are found in 46 CFR Subchapter U, and these can be extrapolated to the Master of any vessel. To avoid disputes and misunderstandings, the substance of these regulations and customs should be clearly set forth in the ship's Cruise Handbook or similar publication, since many scientists are not aware of the legal and customary constraints.

Because of these legal responsibilities, the Master is also given full legal authority over all operations and personnel, both on board ship and in foreign ports. However, the primary objective of the Master and the crew is to facilitate carrying out the research in a safe and effective manner. In practice, the Chief Scientist informs the Master what is desired, and unless it is unsafe or illegal, it will be carried out. In case of serious disagreement, the question can be referred to the institution's marine manager, but it must be emphasized that if a decision has to be made quickly, the authority of the Master is absolute. (46 CFR Subchapter U)

CHIEF SCIENTIST: One member of the scientific party shall be designated Chief Scientist. This is to avoid placing conflicting demands from scientists on the Master, and asking the Master to referee disputes on scientific matters. The Chief Scientist is responsible for the coordination and execution of the entire scientific mission, not just his/her own portion of it. By custom, the personal and professional conduct of the scientific party on board ship and ashore is the responsibility of the Chief Scientist, under the overall control of the ship's Master.

In matters of safety, the Chief Scientist must always defer to the Master in case of dispute. In many cases, safety matters are common knowledge, and not unique to research vessels. In other cases there may be safety hazards unique to the research, which the ship's crew may not be aware of. In such instances, the Chief Scientist has a special responsibility to assure safety, and consult with the Master as necessary. (46 CFR 19415-3; 195.09)

6. PERSONAL BEHAVIOR AND INDIVIDUAL SAFETY

6.0 INTRODUCTION

Personal safety and well being starts with each individual and then extends to your fellow shipmates. There are inherent risks with being at sea which can be managed with training, personal awareness, knowledge of the equipment and a team effort to work safely together. This chapter was established to address aspects of behavior and the physical ability of individuals, which may have an impact on the overall safety of the vessel and other embarked personnel. All persons upon joining a UNOLS vessel must become familiar with the vessel. This must include the location of safety equipment, damage control lockers, emergency lighting, emergency escape hatches and means of egress. Escape routes from your stateroom and all lab spaces must be familiar. "Kickout" panels in doors are there to provide a means of escape in the event of an emergency.

REFERENCES

- American's with Disability Act (ADA) - 42 USC 12101
- ADA Regulatory Guidance - 29 CFR 1630 (primary reference), 1602 (EEOC)
- ADA Title II (State and Local Regulatory Guidance) - 28 CFR 35 (DOJ)
- American Disabilities Act (ADA) Guidelines for UNOLS Vessels, 2008, UNOLS
- Sexual Harassment Regulatory Guidance - 29 CFR 1604.11
- Sexual Harassment Prevention- Training Video, Maritime Training Services, 2013
- UNOLS Ship Safety Orientation Training Video- 2013 Ed.
- Drug and Alcohol Testing Regulatory Guidance - 46 CFR 16 and 49 CRF 40
- Resolution by UNOLS Council dated October 5, 2006 regarding the ban of alcohol use on board UNOLS vessels at sea.

6.1 REQUIRED BY REGULATIONS FOR ALL VESSELS

All UNOLS Vessels will comply with U.S. Coast Guard regulations related to drug and alcohol testing specified in 46 CFR 16 and 49 CFR 40 in order to minimize the use of intoxicants and to promote a drug free and safe work environment.

6.2 REQUIRED REGULATIONS FOR CERTAIN VESSELS

6.2.1 INSPECTED VESSELS

None.

6.2.2 CLASSED VESSELS

None.

6.2.3 SOLAS VESSELS

None.

6.2.4 UNINSPECTED VESSELS

None.

6.2.5 OTHER REGULATIONS

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6.3 REQUIRED STANDARDS UNDER RVSS

6.3.1 ALCOHOL & MEDICAL MARIJUANA USE ON UNOLS VESSELS

It is the policy of UNOLS, as approved by the UNOLS Council, that all UNOLS vessel operators shall ban the consumption of alcoholic beverages on board UNOLS vessels by crewmembers or embarked members of the scientific party, except as provided below.

Certain exceptions can be approved in writing by institutional management for the purpose of allowing the possession and consumption of alcohol on board UNOLS vessels while in port for receptions, special occasions and entertainment of visiting dignitaries. Participation by ship's crew in these events shall take into consideration scheduled time of sailing and the need for full sobriety at the time of departure.

Possession of alcohol on board UNOLS vessels by crewmembers or embarked members of the scientific party is prohibited, with the exception of transport in bond under the control of the Master as allowed by institutional policies and at the discretion of the Master.

It is the UNOLS policy to follow the US Coast Guard directive, "Marine Safety Information Bulletin, MSIB # 01-14 which addresses the use of marijuana. The Coast Guard has continued to prohibit the use of marijuana, (which includes medical marijuana) by those serving in safety-sensitive positions in the maritime transportation industry. Marijuana remains a drug listed in Schedule I of the Controlled Substances Act and is subject to drug testing under the Department of Transportation regulations.

6.3.2 PERSONAL BEHAVIOR AND SEXUAL HARASSMENT

Each vessel operator is required to maintain a positive working and learning environment, and an environment free of illegal discrimination and harassment in accordance with their own institution's policies and the RVSS. Vessel operators shall consult with the appropriate persons at their institution to ensure they are in compliance regarding crew training, posting of information, and the proper procedures to follow in the event a harassment situation arises on board.

This subject shall be covered in the vessel's Safety Briefing; in particular, the fact the operation is committed to maintaining a harassment free environment, and what resources are available to individuals when at sea. Appendix E of this manual may be printed and made available to the science party, as the operator deems appropriate. Release forms should include information on harassment policies and an indication that the person signing the form has been informed of these policies. Each operator shall make the Sexual Harassment Prevention video available for viewing. See Appendix E for additional information.

6.4 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

6.5 RECOMMENDATIONS AND BEST PRACTICES

6.5.1 AMERICANS WITH DISABILITIES ACT (ADA)

By virtue of the "Oceanographic Research Vessel Act" (ORVA), 46 USC 2101, research vessels are considered under U.S. law to be a special class of sea-going platform. The RVSS contends that research vessels are not "public accommodations" as defined in the Americans with Disabilities Act (ADA) and are therefore exempt from these regulations. However, UNOLS operators should strive to set the example for our industry by making every reasonable accommodation with regard to sailing with disabled crew and scientists as long as safety is not compromised.

UNOLS has developed and approved "*American Disabilities Act (ADA) Guidelines for UNOLS Vessels",* which are available on the UNOLS website. It should be noted that many of the design and outfitting features for the hearing and vision impaired might also improve safety for everyone on board the vessel.

The key to making reasonable accommodations is prior planning. The ship's Master and shore-side personnel need the opportunity to consider all of the ramifications and to ensure that adequate procedures can be put in place. It is highly recommended that Pre-Cruise Planning Questionnaires specifically ask about scientists with disabilities.

The following is a list of the items that should be considered by the operator when working with a disabled scientist who accepts the personal risk and chooses to go to sea:

- The particular disability: Some, such as the hearing impaired, may be easier to accommodate than a severe mobility disability.
- The particular individual: Overall physical ability, their determination to overcome obstacles, and their own understanding of the inherent risks involved.
- The particular cruise: Operating area, such as exposed offshore waters (vs. inshore) and remote location and/or access to medical assistance. The type of operations – mooring deployment vs. CTD casts. Number in the science party – and the number of scientists available to assist crew with disabled individual's needs.

- The Ship and Facility: Of particular concern are gangways when the vessel is alongside, emergency debarkation facilities when the vessel is underway, wheelchair accessible compartments/decks, and alternate facilities for dining, sleeping, bathing, and toilets.

It is the ultimate responsibility of the vessel's Master to determine if it is safe to embark ANY individual on a scientific mission regardless of whether or not they are disabled.

The following is a list of recommended procedures for accommodating disabled scientists:

- Establish a "buddy system" for the individual. Develop procedures for moving a disabled individual during an actual emergency.
- Assess the overall layout of the vessel to accommodate a particular disability. i.e. lighting, audible and visual alarms, exits. Conduct a thorough orientation with the disabled individual. The following is a list of simple accommodations, which the operator might find helpful:
- Electric wheel chairs
- Wheel Chair clamps
- "Hearing Impaired Kit"
- Wireless Wigglers
- Minimize obstacles in passageways and decks
- Adequate lighting
- High contrast markings on trip hazards and ladders

7. COMMUNICATIONS

7.0 INTRODUCTION

Radio communications are essential to the safety of a vessel and must be functional at all times when the vessel is underway. Most communication regulations are based on vessel size and the type of service they are engaged in. Section 7.1 below provides some of the specific references to regulations for certain classes of vessels. All research vessels, including small boats, zodiacs and dive boats must have radio equipment appropriate for the operation. .

In recent years, technological advances have led to substantial changes and increases in communication methods, devices, procedures, rules, and regulations. Operators are strongly encouraged to refer to regulations listed below to ensure a comprehensive understanding of associated requirements.

Communications equipment is usually a mix of required and elective systems on board UNOLS platforms and could include:

- Very High Frequency (VHF) Radio
- Medium Frequency (MF) Radio
- High Frequency (HF) Radio
- Digital Selective Calling (DSC)
- Narrow Band Direct Printing (NBDP) or Simplex Teletype Over Radio (SITOR)
- Cellular Telephone including Iridium
- Satellite Telephone (INMARSAT)
- NAVTEX
- Search And Rescue Transponder (SART)
- Automated Identification System (AIS)
- Long Range Identification and Tracking System (LRIT)

All items listed above except AIS may be components of a Global Maritime Distress & Safety System (GMDSS). GMDSS regulations require that every GMDSS equipped ship shall be capable of the following:

Transmitting ship-to-shore Distress Alerts by at least two separate and independent means, each using a different radio communication service;

Receiving shore-to-ship Distress Alerts; transmitting and receiving ship-to-ship Distress Alerts;

- Transmitting and receiving search and rescue coordinating communications;
- Transmitting and receiving on-scene communications;
- Transmitting and receiving locating signals;
- Receiving maritime safety information;

- Transmitting and receiving general radio communications relating to the management and operation of the vessel;
- Transmitting and receiving bridge-to-bridge communications

AIS is a shipboard broadcast transponder system operating in the VHF maritime band that is capable of sending and receiving ship information such as identification, position, heading, speed, ship length, beam, type, draft and hazardous cargo information, to other ships and to shore.

The LRIT system consists of the already installed (generally) ship borne satellite communications equipment, communications service providers (CSPs), application service providers (ASPs), LRIT data centers, the LRIT data distribution plan and the International LRIT data exchange. Ships must report their position to their flag administration at least four times a day. Most vessels set their existing satellite communications systems to automatically make these reports.

7.1 REFERENCES

Communication references for rules and regulations include:

- 33 CFR 26 - Vessel Bridge-to-Bridge Radiotelephone Regulations
- 33 CFR 164.46 - Vessel Bridge-to-Bridge Radiotelephone Act 33 U.S.C.
- 46 CFR CHAPTER 1 SUBPART J, PART 25, SUBPART 25.26 - Emergency Position Indicating Radio Beacons (EPIRB)
- 47 CFR CHAPTER 1, SUBCHAPTER D, PART 80 - Stations in the Maritime Services
- 33 CFR Part 169 – Ship Reporting Systems, Subpart C – Transmission of Long Range Identification and Tracking Information
- SOLAS Chapter IV "Radio communications"
- SOLAS Chapter XI-2 "Special Measures to Enhance Maritime Security"
- The majority of relevant regulations for required communication systems and equipment can be found in 47 CFR 80.

7.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Most communications regulations are based on vessel size and service; see section 7.3 below.

7.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

Primary communication regulation requirements can be found in 47 CFR, Part 80. A breakdown according to vessel types follows:

- Subpart C General provisions for ship stations (47CFR80.141)
- Subpart F Equipment Authorization for Compulsory Ships (47CFR80.251)

- Subpart R Radiotelephone Installations for Vessels over 300 Gross Tons (47CFR80.851)
- Subpart T Radiotelephone Installation Required for Vessels on the Great Lakes (47CFR80.951)
- Subpart U Radiotelephone Installations Required by the Bridge-to-Bridge Act applicable for vessels over 20 meters (47CFR80.1001)
- Subpart W Global Maritime Distress and Safety System (GMDSS) (Required for vessels over 300 gross tons) (47CFR80.1065)

Compulsory ship. Any ship which is required to be equipped with radio telecommunication equipment in order to comply with the radio or radio-navigation provisions of a treaty or statute to which the vessel is subject.

AIS Carriage Requirements can be found in 33 CFR 164.46. Self-propelled vessels of 65 feet or more are required to have fully compliant AIS on board.

All ships over 500 gross tons are required to be equipped with a Ship Security Alert System (SSAS), which is capable of discreetly raising the alarm to the relevant authorities and tracking the vessel if the security of the vessel is compromised.

Classed vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. In addition, classed vessels should comply with 47 CFR 80.1069, Subpart W, GMDSS, Maritime Sea Areas, for required GMDSS radio equipment, which is dependent on radio frequency and operating areas.

SOLAS Chapter IV, Part A, B, & C of the International SOLAS Convention.

Uninspected vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. There are specific EPIRB requirements for uninspected vessels in 46 CFR CHAPTER 1 SUBPART J, PART 25, SUBPART 25.26: EMERGENCY POSITION INDICATING RADIO BEACONS (EPIRB)

7.3.1 INSPECTED VESSELS

Inspected vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3.

7.3.2 CLASSED VESSELS

Classed vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. In addition, classed vessels should comply with 47 CFR 80.1069, Subpart W, GMDSS, Maritime Sea Areas, for required GMDSS radio equipment, which is dependent on radio frequency and operating areas.

7.3.3 SOLAS VESSELS

SOLAS Chapter IV, Part A, B, & C of the International SOLAS Convention.

7.3.4 UNINSPECTED VESSELS

Uninspected vessels should adhere to communication regulations per vessel size breakdowns listed in section 7.3. There are specific EPIRB requirements for uninspected vessels in 46 CFR CHAPTER 1 SUBPART J, PART 25, SUBPART 25.26: EMERGENCY POSITION INDICATING RADIO BEACONS (EPIRB)

7.3.5 OTHER REGULATIONS

All vessels should adhere to communication requirements listed in 33 CFR 161, VESSEL TRAFFIC MANAGEMENT, when working in areas regulated by Vessel Traffic Service systems.

7.4 REQUIRED STANDARDS UNDER RVSS

7.4.1 REPORTING

All research vessels, while operating, should make the following reports to their home base or other base designated to receive such reports:

- At least once daily when underway on cruises overnight or longer than one day.
- When any change in the cruise plan affects the planned position or Estimated Time of Arrival (ETA) at any previously designated point.
- When any equipment failure adversely affects the capability of the vessel.
- When adverse weather or other factors affect the planned operations of the vessel.
- On arrival and departure from an overnight or other designated stop.
- When an injury occurs to personnel that prohibits them from performing their regularly scheduled duties for 24 hours or more.

7.4.2 LOSS OF RADIO CONTACT

As required by the Maritime Safety Act of 1984 (46 CFR 4.04-3), an operating institution's representative having reason to believe (because of the lack of daily communications for two successive days, 48 hours, or non-appearance of a vessel, or other unusual instance) that the status of a vessel is uncertain or imperiled shall notify the cognizant USCG Rescue Coordination Center (RCC). The operating institution shall continue to use all available means to establish communications with the vessel and determine its status. The person notifying the Coast Guard shall provide complete information concerning the vessel's itinerary, identification, and communication capabilities. The purpose of notification is to make the Coast Guard aware that some uncertainty exists concerning the status of the vessel and to save time if and when it becomes necessary to declare an emergency. A vessel unable to communicate with any station for a period of 60 hours will terminate all operations and proceed to the nearest point where communications can be re-established. Normally, the vessel will proceed to the nearest port having communications capability.

7.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

7.6 RECOMMENDATIONS AND BEST PRACTICES

None.

8. SCIENTIFIC SUPPORT EQUIPMENT

8.0 INTRODUCTION

Scientific Support Equipment is defined as:

- Ship-Owned equipment, such as winches, handling systems, portable vans, sampling instruments, and laboratory equipment that is specifically designed to support scientific operations
- Portable equipment that is owned or obtained by the science party or the ship operator that is brought aboard for a specific mission.

Scientific support equipment carried on board research vessels ranges from the familiar equipment standard on most cruises (Conductivity-Temperature-Depth (CTD) profilers with rosettes or box cores) to one-of-a-kind developmental hardware which is largely unknown to all hands, perhaps even to the scientists who brought it. This raises two safety concerns: first, extreme familiarity may lead to carelessness with gear, which could be inherently dangerous, and second, novel equipment with unknown potential hazards can lead to unpleasant surprises. In either case, both crew and science party should exercise prudence and caution when deploying, recovering, or staging scientific equipment.

Although the actual operation of scientific equipment may be delegated to the Chief Scientist or others in the science party, ultimate responsibility for safety lies with the Master of the vessel, and it is assumed that the Master has full knowledge of and has given consent to every operation on board.

8.1 REFERENCES

With very few exceptions, federal laws and regulations do not cover scientific equipment, other than the general requirements embodied in International Safety Management (ISM) code, which requires pro-active safety management of all operations undertaken on board the vessel. The following code of federal regulations listed below do provide the applicable regulations to adhere to.

- 46 CFR 189.35 - “Weight Handling Gear”
- 46 CFR 194.15 - “Chemical Laboratories”
- 46 CFR 195.11 - “Portable Vans and Tanks”
- Institute of Electrical and Electronics Engineers (IEEE) publish the IEEE-45, which is a non-regulatory document that provides Underwriters Laboratory (UL) recommendations for the standards of construction and maintenance that should be observed for equipment and materials that are placed in marine service.
- UNOLS Portable Scientific Van Manual: https://www.unols.org/document/unols-portable-scientific-vans-manual-2005

In the majority of cases, the CFRs and other rules delegate the responsibility for safety procedures to the operator, thus placing a heavy burden on those involved. Therefore, it is important that all hands approach research operations with particular care and use the principles of good seamanship, sound marine engineering practices, and common sense.

8.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

None.

8.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

8.3.1 INSPECTED VESSELS

Though autonomous vehicles and instruments are rapidly becoming more commonplace, most research equipment is still handled over the side on wires and cables. All the handling gear must be installed to meet the manufacturer's specifications and be in compliance with Subchapter U requirements for weight handling gear (46 CFR 189.35). The science party is responsible to ensure that their equipment also meets these requirements.

Weight Handling Gear: Inspected research vessels shall comply with 46 CFR 189.35. Where applicable, stress and general design calculations should be performed. 46 CFR 189.35-9 requires that, "The safety factor for all metal structural parts shall be a minimum of 1.5; i.e. the yield strength of the material shall be at least 1.5 times the calculated stresses resulting from application of a load equal to the nominal breaking strength of the strongest section or wire rope to be used. Suitable assumptions for the actual loading conditions shall be used in the design of wet gear. The lead of the wire rope from the head sheave or winch drum shall be considered to vary from the vertical and in azimuth in a manner to represent the most adverse loading condition." These concerns also apply to the means by which equipment is secured to the vessel's deck.

Installation and periodic tests (see 46 CFR 189.35-5): Tests should normally consist of exercising the equipment as a unit with a proof load 25 percent in excess of the equipment's normal working load (125%); however, manufacturer's design limitations should not be exceeded. Examination and testing procedures for weight handling equipment used to deploy scientific equipment over-the-side must be followed, documented and recorded. The RVSS defines "periodic" as every two years or twice in five years, not to exceed three years.

The owner or operator shall conduct a safety assessment of weight handling gear. Section 189.35-13 details the Master's responsibilities (listed below) and these may be used as a guide for the operator's safety assessment. In the event of any modifications to the overboard handling system are made, then the weight handling gear will require retesting.

- The gear is properly installed and secure.
- Suitable safety guards are installed in way of rotating machinery, hazardous cable runs and at other appropriate locations.
- Operating limitations are posted in an appropriate manner.
- Only qualified operators are permitted to operate the weight handling gear. The master shall designate the operators.

- A minimum number of persons, as required to perform the task at hand, are allowed in the immediate area.
- The installation does not violate the approved trim and stability information.
- A suitable permanent record is maintained on the equipment as appropriate showing such items as inspections, tests, important repairs and casualties experienced. This record shall be made available to the Officer in Charge of Marine Inspection (OCMI), upon request.
- Prior to a vessel's departure, an entry shall also be made in the official logbook that the ship's weight handling gear is in compliance with the applicable requirements in this subchapter.

<u>Vans:</u> 46 CFR 188.10-67 provides the definition of a van as science equipment. 46 CFR 195.11 contains the Coast Guard regulations concerning the use of certain vans aboard inspected vessels. These regulations consider only three categories; accommodation vans, power/machinery vans, and chemical storage vans, which are subject to both Coast Guard regulatory plan approval and inspections at a two-year interval. Laboratory vans are NOT considered accommodation vans and are not subject to Coast Guard inspection regulations. More detailed information concerning containers and securing of vans may be found in International Organization for Standardization (ISO) Standard 1496 and the American Bureau of Shipping (ABS) Guide for Certification of Container Securing Systems and Certification of Cargo Containers. These regulations are helpful for dimensional details and shipping as containerized cargo. For conversion to portable scientific vans, or for new construction of vans, the UNOLS Portable Scientific Van Manual, which is available in the Publications section of the UNOLS website, should be consulted. Table One of the Van Manual contains a summary of van types and requirements.

Accommodation vans, power/machinery vans, and chemical storage vans designed for use aboard uninspected vessels before the implementation of the UNOLS Scientific Van Standards are not subject to Coast Guard inspection. Therefore, such a van cannot be transferred to an inspected vessel unless the Coast Guard inspects it first.

Operators of uninspected vessels must be aware that a van placed aboard a vessel does count as measurable volume for admeasurement purposes. It is possible for a van to increase tonnage to 300 or more tons, potentially placing the vessel into an inspected status.

8.3.2 CLASSED VESSELS

None.

8.3.3 SOLAS VESSELS

None.

8.3.4 UNINSPECTED VESSELS

Operators of uninspected vessels must be aware that a van placed aboard a vessel does count as measurable volume for admeasurement purposes. It is possible for a van to increase tonnage to 300 or more tons, potentially placing the vessel into an inspected status.

8.3.5 OTHER REGULATIONS

None.

8.4 REQUIRED STANDARDS UNDER THE RVSS

All vessels shall comply with Appendix A - UNOLS Rope and Cable Safe Working Load Standards and Appendix B UNOLS Overboard Handling System Design Standards.

All ship-owned vans built after January 1, 2002 must meet the requirements given in the UNOLS Portable Scientific Van Manual.

All science-owned vans delivered after January 1, 2010 must meet the requirements given in the UNOLS Portable Scientific Van Manual.

All Vans, including vans delivered prior to January 1, 2010, shall be examined and approved for use based on Appendix C – *Safety Inspection Checklist for Shipboard Vans*.

All science support equipment installations shall be consistent with the approved stability data for the vessel for the entire range of weights and heights through which these are deployed.

8.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

NONE.

8.6 RECOMMENDATIONS AND BEST PRACTICES

Operators of uninspected vessels, as a matter of best-accepted practices, should follow the requirements of section 8.3.1. Inspected Vessels.

For handling systems, operating limitations should be clearly posted, and operators of winches, cranes, and the like must be qualified in their use or properly certified depending on the system. Labels providing test information should be posted with recent SWL/WLL/MPT appropriate values and test dates. Test loads should not be posted as these values could be misinterpreted to be the SWL/WLL/MPT value. Since overstresses may degrade the long-term safety factor, records must be maintained of tests, excessive loading, maintenance, alterations, and other factors. It should be noted that potential consequential losses arising from equipment failures may extend to delays of the scientific program, immediate hazards to operating personnel, and potential financial liability.

Ship Operators should provide appropriate safety equipment such as tag lines, lifelines, hard hats and communications systems to be used as deemed necessary by the Master for safe deck operations.

EPA Vessel General Permit and Environmentally Acceptable lubricants (EAL)

EPA regulates discharges incidental to the normal operation of commercial vessels greater than 79 feet in length and operating as a means of transportation primarily through the Vessel General Permit (VGP). The first VGP was issued in 2008 and effective until December 19, 2013. On March 28, 2013, EPA re-issued the VGP for another five years. That reissued permit, the 2013 VGP, took effect December 19, 2013 and superseded the 2008 VGP at that time.

The impact of lubricant discharges (not accidental spills) to the aquatic ecosystem is substantial. The majority of ocean going ships operate with oil-lubricated stern tubes and use lubricating oils in a large number of applications in on-deck and underwater (submerged) machinery. Oil leakage from stern tubes, traditionally considered a part of normal “operational consumption” of oil, results in millions of liters of oil being released to the aquatic environment every year. Where the discharge can’t be eliminated, this permit condition seeks to reduce the potential environmental impact of those discharges. Use of EALs results in discharges that biodegrade more quickly and that are less toxic than discharges from their traditional mineral oil counterparts. For all applications where lubricants are likely to enter the water, EAL formulations instead of mineral oils can offer significantly reduced environmental impacts across all applications.

SCIENCE SUPPORT AND OPERATIONS INCLUDING LABORATORY SAFETY

The Chief Scientist is responsible for the general operation and safety of the scientific laboratories and storage areas. Periodic inspections of the vessel’s laboratory spaces should be made by a scientist and one of the ship’s officers to verify safe stowage, securing of equipment, and cleanliness. Particular attention must be paid to the stowage and use of chemicals, flammables, and other hazardous materials; safety labeling; posted standard safety precautions, and common-sense safe operating procedures. Fire extinguishers, ventilation, eyewash facilities, spill kits, and other laboratory safety equipment should be available and marked. Ship’s motion is by far the most common cause of damage and personal injury aboard ship, and experienced ship’s crew should help the science party to secure laboratory and scientific equipment. It should be remembered that while in practice the Chief Scientist is primarily responsible for safety of the science operations, the ultimate legal responsibility (and authority) lies with the Master of the vessel. (46 CFR 194.15-3)

The carrying of portable science equipment including vans, tanks, special winches, crates of equipment, large sampling gear, and other instrumentation must be carefully checked for conformity with approved stability and load line conditions. It is particularly important that accurate weights be provided for equipment being brought on board. Since such installations are temporary, their design, selection of materials, attachments and hold-downs, should be carefully factored in. The use of standard-sized hold-down holes at 2-foot spacing on the deck is commonplace throughout the UNOLS fleet and all scientific equipment to be embarked should be designed to fit the bolt pattern. While each installation will, of course, be somewhat different, as a basic guide, the van itself and accessory components should be designed and constructed to good marine commercial standards. Electrical and other connections to the permanent ship systems should be to marine standards. Adequate ventilation for the intended use must be provided. Particular attention should be given to van electrical systems since building electrical systems have “grounded neutrals” while ship systems are generally ungrounded. Proper design of van electrical systems, including the provisions to isolate van electrical circuits, is particularly important since it can avoid problems both as shock source and electrolysis. Machinery brought on board should be in good repair and operating condition, because hydraulic leaks and electrical problems pose a safety risk to scientists and crew alike. Acceptable “marine standards” are those standards published by UL for marine service, found in IEEE-45 or Coast Guard regulations.

46 CFR 195.09 Scientific Equipment: All scientific equipment shall be designed to good commercial standards and it is the responsibility of the owner to assure their equipment is free of personnel hazards.

Autonomous equipment: Autonomous science support equipment such as Autonomous Underwater Vehicles (AUVs), gliders, drifters, and Unmanned Aerial Vehicles (UAVs) are becoming more and more common place. Generally speaking, deployment and recovery may not be any more complicated than any other piece of science instrumentation.   These systems do, however, present a different legal framework once they are deployed and free from the vessel. The question of who is responsible for incidents caused by an AUV has been raised, but probably won’t be settled until some event occurs.   Until then, it should be considered like any other piece of science equipment deployed from the vessel. The Master and the Chief Scientist should consult on the details of the particular operation to minimize risk to the instrument itself and outside parties.

9. SCIENTIFIC AND SHIPBOARD HAZARDOUS MATERIALS

9.0 INTRODUCTION

A hazardous material is any substance or combination of substances that, because of quantity, concentration, physical, chemical, radiological, explosive, or infectious characteristics, poses a substantial present or potential danger to humans or the environment. Generally, such materials are classified as:

- Flammable liquids and solids
- Oxidizing materials
- Corrosive materials
- Flammable and non-flammable compressed gases
- Poisons or toxic substances
- Disease-causing agents
- Combustible liquids
- Explosives and blasting agents
- Radioactive materials
- Other Regulated Materials (ORM) (Department of Transportation (DOT) Hazard Class "ORM"), including hazardous wastes

Radioactive materials are covered separately in Chapter 10.

Hazardous materials will be found among both ship and scientific stores and include such items as organic solvents, corrosives, compressed gases, flammable liquids, and toxic or reactive chemicals. Material Safety Data Sheets (MSDS) contain a list of product ingredients, indicating information about the type of hazard; recommended personnel protection and precautions, spill or leak procedures, and fire, explosion, health (including first aid), and reactivity data. Most importantly, an emergency telephone number for assistance in the event of an accident. Employers are required to inform employees of what hazardous materials are present in the work place and train them, with the aid of the MSDS, in their proper use and handling. (29 CFR 1910)

9.1 REFERENCES

- 46 CFR 194 – Subchapter U section on Hazardous Materials
- 29 CFR 1910 – MSDS
- 49 CFR 172 and 105 – Hazardous Materials

9.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Rules for stowage, labeling, and handling of hazardous materials for all vessels are given in 46 CFR 194.

A Hazardous Material Table can be found in 49 CFR 172.101. This table lists and classifies those materials, that have been designated as hazardous materials, and prescribes the requirements for shipping, labeling, and transporting. Additional regulatory information and guidelines for hazardous waste are in 49 CFR 172.205 and 49 CFR 105.

9.2.1 EXPLOSIVES, PERMITS, AND AUTHORIZATION

Since USCG rules dealing with explosives are stringent and strictly enforced, the Port Captain, USCG Office should be contacted at least 8 weeks prior to the cruise departure date. In addition, Fish and Game Departments, local and state law enforcement agencies, the fire department etc., should be contacted for information on possible restrictions, truck routing, spot assistance and inspections, etc.

The use of explosives, sonic emitters, or towed devices (as well as instrumented moorings) present special hazards to submarine operations and navigation. The National-Geospatial Agency (NGA) (Formerly the National Imagery and Mapping Agency) has agreed to disseminate information concerning underwater hazards as part of the Notice to Mariner system. See chapter 4 (Operations) for details on reporting these hazards.

Rules for carrying, stowage, and labeling of explosives on board inspected ships are given in Subchapter U, CFR. All UNOLS research vessels should follow these rules. In addition, 49 CFR 176 prescribes requirements for all vessels carrying hazardous materials in the domestic waters of the United States, with some exceptions. Magazines and storage areas should be properly labeled and inspected daily, and safety precautions should be posted. (46 CFR 194.05, 194.10, 196.80, 196.85)

9.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

9.3.1 INSPECTED VESSELS

None.

9.3.2 CLASSED VESSELS

None.

9.3.3 SOLAS VESSELS

The SOLAS- Consolidated Edition 2004, Chapter VI, Carriage of Cargoes governs the carriage of cargoes. Some of these cargoes may present hazards to ships or persons on board and may require special precautions. The following regulations will guide you in the safe handling of these cargoes:

Part A- Regulation 1- Application states: “this chapter may require special precautions in all ships to which the present regulations apply and in cargo ships of less than 500 gross tonnage. However for cargo ships of less than 500 gross tonnage, the Administration (i.e. U.S. Government) if it considers that the sheltered nature and conditions of the voyage are such as to render the application of this chapter unreasonable or unnecessary, may take other effective measures to ensure the required safety for these ships.”

Note: For this ruling UNOLS research vessels are considered cargo ships.

Part A- Regulation 2- Cargo Information.

In this regulation the shipper (i.e. scientist) shall provide the Master or his/her representative with appropriate information on the cargo sufficiently in advance of loading to enable the precautions, which may be necessary for proper stowage and safe carriage.

Scientific supplies, which may include hazardous goods are normally brought aboard research vessels in small quantities in packaged form and not as bulk cargoes. In SOLAS Chapter VII- Carriage of Dangerous Goods guidelines are provided for these instances.

In Part A- Regulation 1, Dangerous goods means the substances, materials, and articles covered by the International Maritime Dangerous Goods (IMDG) Code. Therefore if a chemical is on the IMDG list, the handling of it is governed by these SOLAS regulations.

Note: Regulation 2 states that this part does not apply to ship's stores and equipment. In this case RVSS does not consider scientific cargo as part of the ship's stores.

Regulation 3 states the carriage of dangerous goods shall be in compliance with the IMDG Code.

Regulation 4- Documents- All documents must use the proper shipping name of the goods and a correct description. The transport documents prepared by the shipper must provide certification that the item is properly packaged, marked, labeled or placarded, and in proper condition for carriage.

Regulation 5 governs that the cargo units shall be loaded, stowed, and secured throughout the voyage.

Regulation 6 provides instructions that require the reporting of incidents involving dangerous goods. The master or other person in charge must report without delay when an incident takes place involving the loss or likely loss of dangerous goods into the sea.

9.3.4 UNINSPECTED VESSELS

None.

9.3.5 OTHER REGULATIONS

None.

9.4 REQUIRED STANDARD UNDER RVSS

CRUISE PLANNING: The Chief Scientist will be responsible for providing the following to the ship operator at least 30-days prior to the cruise departure date unless a shorter time is specifically allowed by the ship:

- A list of all hazardous materials by chemical name, common name, UN identification number, type and classification of hazard, quantity (size of containers and number of each size container), user name and contact information
- MSDS sheets for all materials listed above

- A list of the spill response materials and the amount to be brought aboard to address spills or accidents
- The plans for offloading all materials brought aboard at the end of the scheduled cruise.

The ship operator will review the provided material and contact the Chief Scientist if there are any questions or concerns. The ship operator will then forward copies of the required information to the vessel or request that the Chief Scientist carry a copy to the vessel for delivery to the Master.

TRANSPORTATION AND DISPOSAL: The Chief Scientist will be responsible for the proper transportation, shipping and disposal of hazardous materials and waste, including the empty containers, associated with their project. Transportation and disposal must be carried out in accordance with Federal, State and Local regulations. In no case will this responsibility be passed to the ship's crew or operating institution. Each Institution's Shipping Department can provide up-to-date information about regulatory requirements.

CHEMICAL STORAGE LOCKER SYSTEM: A chemical storage locker system should be installed on the weather deck. Lockers should be provided with a fire suppression system and the ability to separate incompatible chemicals, (i.e. bases from acids). Alternatively, a designated chemical storeroom in accordance with Subchapter U 46 CFR 194.20 should be provided.

HAZARD COMMUNICATION PROCEDURES: A procedure should be in place which can be followed in the event of a hazardous spill to be able to provide information to the crew and scientists. The type, location, hazard, and spill response plan must be communicated to the ship's complement in an effective manner. The location of MSDS information must be clearly labeled. A list of chemicals in use and in storage must be posted outside the entry to the space so as to inform emergency response teams as to the danger present.

SHIPBOARD HAZARDOUS MATERIALS AND POLLUTION: Many of the materials associated with normal operation and maintenance of research vessels are classified as hazardous materials. In addition, waste products and sewage are the subject of pollution control regulations issued by the Coast Guard and other agencies. Research vessel operators have an obligation to ensure that their crews and science parties are informed of the hazards associated with these materials and that they are aware of the pollution control regulations so that wastes are not disposed of in violation of the law. Several regulatory documents apply to this area. These are: International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78), 46 CFR 131.935 Prevention of Oil Pollution and the Federal Water Pollution Control Act 33 USC-1321.

LITHIUM BATTERIES: Lithium batteries require special fire extinguishing capabilities depending on the type of material used in the manufacturing process. The Chief Scientist is required to notify the ship operator of the use and/or recovery of instruments using lithium batteries and to supply appropriate fire extinguishing equipment and a stowage locker if one is not available from the ship operator.

INCOMPATIBLE MATERIALS: These are materials that should not be stored together. See 49 CFR 176.83 and Table 176.83(b), General Segregation Requirements for Hazardous Materials for information on incompatible materials. The table found in 49 CFR 172.101 is also helpful in this area.

STORAGE CONTAINERS: Material should remain in their original shipping containers (as received from the vendor) with labeling intact. Working quantities in the amount of a one-day supply can be stored inside the ship. Working containers must be marked as follows: Common or trade name, UN identification number (49 CFR 172.101, Hazardous Material Table), the nature of hazard (flammable, acid, poison, etc.), and the contact information (name and work phone number) of the person using the material aboard the vessel.

COMPRESSED GASES: Must be securely held to the ship structure with metal brackets or positive cargo straps to hold them in place. Ropes or other similar lashings must be avoided. All gas cylinders must have their safety cap in place unless they are in use with a regulator. No cylinder should be moved without the cap in place. See 46 CFR 194.05-15, 46 CFR 194.15-17 and 49 CFR 172, 173, 176.

SPILL RESPONSE: The Chief Scientist shall be responsible for providing spill response procedures and remote monitoring equipment as applicable for each hazardous material brought aboard. Kits or materials to address spills or accidents are supplied by the user, not the ship. The amount of material brought aboard must be sufficient to address a spill of the entire amount of the specific materials being brought aboard. (For example, if you bring 1 liter of Hydrochloric acid, you need to supply spill response material to clean up a spill of 1 liter of Hydrochloric acid.)

SHARPS DISPOSAL: Syringes, sharps, hypodermic needles brought on board should be treated as a safety hazard and proper provisions should be made for safe use and disposal. Safe disposal of other sharp objects such as broken glass, pipettes, etc. should be included in the laboratory safety plan. The science party is responsible for providing the appropriate “Sharps” container(s).

LAB SINKS: Signs should be conspicuously posted at each lab sink indicating if they drain directly overboard or to a holding tank.

LAB WASTE: Laboratory waste and disposal plans must be arranged as part of the pre-cruise planning process. It is the responsibility of the owner of the lab chemicals or other hazardous material to safely handle, package, document and dispose of these materials at the conclusion of each cruise.

EMERGENCY SHOWER AND EYE WASH STATIONS: An emergency shower and eye wash station should be installed in every lab where chemicals are used. Flow rates should be at least 20 gpm. Emergency showers should be tepid water where a person could remain in the shower for 15 minutes.

LITHIUM BATTERY- HANDLING AND STORAGE:

Lithium batteries are used extensively in consumer electronics and within the oceanographic research community because of their energy density/size characteristics and recharge capability. They also have the potential to be extremely hazardous if used improperly resulting in fires, poisonous gases, and explosions. Recent information coming from the U.S. Navy, FAA, and manufacturers has indicated that the use of Class D fire extinguishers is not effective when combating a lithium battery fire. Depending on the type of lithium battery; lithium non-rechargeable or lithium-ion rechargeable batteries, water is also not effective. For lithium non-rechargeable batteries, water reacts explosively and can produce poisonous gases.
Because of the potential hazards combined with the extensive use of lithium batteries, every ship in the UNOLS fleet should develop procedures on how to handle lithium batteries. The procedures should cover usage, storage, disposal, and how to respond to emergencies. The website includes information from the U.S. Navy on firefighting procedures, WHOI's "Lithium Battery Safety and Handling Guideline", and the British Natural Environment Research Council (NERC) guidance on the use of lithium batteries.

An additional reference on lithium batteries can be found at:

http://ehs.whoi.edu/ehs/occsafety/lithiumbattery.pdf

FUME HOODS: A fume hood is ventilation equipment that vents separately from the ship's heating, ventilation and air conditioning (HVAC) system. The primary means of controlling airborne chemical exposure is a fume hood. Fume hoods should be used when working with toxic compounds or compounds with a boiling point below 120°C. Air flow surveys of fume hoods should be certified at least annually by the owner of the hood with the proper sash height indicated on the fume hood. Fume hoods must have stainless steel trays to catch any spillage. The trays should have a restraining system to prevent chemical containers from sliding due to the ship's motion. Fume hood exhausts must have a closure external to the compartment to be able to shut off in case of a fire or chemical release. The exhaust must be clearly labeled and designed so that exhaust fumes are directed away from personnel. OSHA CFR 1910.1450, is the federal laboratory standard. It simply states that you must have a chemical hygiene plan for the lab that includes "A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment"

A couple of other industry group standards are the Scientific Equipment & Furniture Association (SEFA 1-2006) which recommends annual testing of fume hoods. For additional testing criteria, refer to AIHA (Laboratory Ventilation Z9.5-2003), ASHRAE (110-1995), and ANSI. Check with the appropriate department at your operating institution for their rules and regulations regarding fume hood use, safety, and testing.

RESPONSIBILITY: Proper storage, labeling, and spill response (clean-up) is the responsibility of the user. Anyone using hazardous material should be trained in proper laboratory safety procedures. The Chief Scientist shall be responsible for ensuring that safe laboratory procedures are followed including use of personal protective equipment, prohibiting the consumption of food and drinks in labs, and other safety precautions as outlined on MSDS and considered standard laboratory procedures.

9.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

9.6 RECOMMENDATIONS AND BEST PRACTICES

CHECK VESSEL REQUIREMENTS: Individual ship operators may have additional (and more stringent) policies regarding the handling, storage and use of hazardous materials. Users should contact the ship operator as early as possible in the cruise planning process to ensure they comply with the vessel requirements.

10. RADIOACTIVE MATERIALS

10.0 INTRODUCTION

Radioactive materials on board ship pose unique problems not found in shore-based laboratories. Normally all radioisotope work is conducted in a laboratory van set-aside exclusively for this purpose. Even when all radioisotope work is conducted in a dedicated van, the potential to inadvertently transport small amounts of isotopes to other areas of the vessel is greater due to the confined nature of research ships and the inherent instability of the laboratory space. Because of this, research ship operators and scientists have a particular obligation to assure adherence to prudent laboratory procedures; including monitoring, preventing spills, cleanup, and record keeping. These precautions are necessary for the protection of personnel and to ensure the integrity of measurements made by different investigators of environmental levels of natural or artificial radionuclides. In most cases, it is necessary for these programs to measure extremely low levels of ambient radioactive activity. As a result, this work is sensitive to contamination by very small amounts of isotope material, far below levels having any public health significance. The SWAB program mentioned at the end of this chapter can provide assistance in monitoring and cleaning lab spaces. UNOLS has developed a Rad Awareness Program which can be found at:

https://www.unols.org/unols-radioisotope-awareness-program

10.1 REFERENCES

Activity and quantity of the materials shall not exceed that authorized by the operating institution's Nuclear Regulatory Commission (NRC) Byproduct Material License, or equivalent, which is monitored by that institution's Radiation Safety Committee, or equivalent. This committee should consist of a Radiation Safety Officer (RSO) and representatives from the user community, and ship operations if desired. Provisions of such a license usually apply to a research vessel at sea or away from homeport. The use, storage, transportation, labeling and disposal of such materials shall conform to applicable regulations of the NRC, any state agencies that have jurisdiction, and the operating institution's procedures.

10.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

See below

10.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

See below

10.3.1 INSPECTED VESSELS

None.

10.3.2 CLASSED VESSELS

None.

10.3.3 SOLAS VESSELS

None.

10.3.4 UNINSPECTED VESSELS

None.

10.3.5 OTHER REGULATIONS

None.

10.4 REQUIRED STANDARD UNDER RVSS

As part of the procedure for obtaining authorization to use radioisotopes at sea, the PI must submit an application which includes information on the amount and type of isotope to be used, the qualifications of all users listed in the request, protocols for the experiments in which these isotopes will be used, and how radioactive waste will be stored or disposed of. The operating institution's Radiation Safety Committee, RSO, or equivalent, will review and authorize the proposed use of the isotope or isotopes.

Laboratory vans and other work areas designated for isotope use shall conform to minimum standards for such facilities. A properly rated (120 Linear Feet per Minute (LFM) or greater) and vented fume hood must be available for all activities for which there is a potential of airborne radioactivity. It is important to know where this fume hood exhaust exits the ship to make sure that personnel are not exposed directly or indirectly. All working surfaces must be constructed of materials that are nonporous and resistant to corrosion by seawater and chemical solutions. A refrigerator/freezer capable of being locked must also be available for storage of isotope stocks. No food items may be stored in this appliance with appropriate signage indicating this restriction.

Regulations prohibit the disposal of liquid or solid radioactive waste into the ocean. The scientific user must provide facilities for the safe and secure storage of liquid and solid radioactive waste. The operating institution's RSO and the science user's RSO will approve these containers with proper certification. In order to reduce the possibility of spills, the waste containers must be located in the radiation laboratory van when one is available or in another certified safe storage van/location. The Principal Investigator (PI) assumes all responsibility for the necessary activities and costs to properly dispose of all radioactive materials at the end of the cruise.

It is essential that ship operators be informed of the intent to use radioisotopes as early in the scheduling process as possible. To this end, the following is required:

- The amounts and types of isotopes to be used aboard ship and the name, email address, and telephone number of the RSO from the PI's home institution must be provided on the UNOLS Ship Time Request (STR) form or the ship operators Cruise Planning Documents.
- Upon notification of funding, the PI will be required to initiate the procedure required to obtain authorization to use radioisotopes on UNOLS vessels; i.e. to immediately contact ship operators for instructions and to notify their own RSO.

10.4.1 SCIENCE GROUP

The Chief Scientist must ensure that any PI or other user of radioactive materials has been granted written authority by their home institution's Radiation Safety Committee, RSO, or equivalent, to possess and use radioisotopes. Upon notification of funding, the PI must contact the operating institution and initiate the procedures required to obtain authorization to use radioisotopes on the assigned vessel. The RSO of the PI's home institution must verify to the operating institution that the PI is an authorized user.

Once the PI has been authorized to use isotopes by the operating institution, the PI should notify the Chief Scientist and confirm the laboratory space or radioisotope van that will be used and restricted for isotope work. The PI will be responsible for posting the area, monitoring, cleanup of spills, and ensuring that the work area is clean upon completion of the isotope work. All users must have personal dosimeters (except when using low energy beta emitters C^{14}, H^{3}, and S^{35}) and work areas must be surveyed as required by the operating institution. All spills must be reported to the Chief Scientist who will immediately report them to the Master and Marine Technician. Upon completion of the cruise, the PI will report the results of all surveys and the disposition of waste, unused isotopes, and labeled samples to the Chief Scientist. The Chief Scientist must provide this information in a post cruise report to the operating institution and the funding agencies if they require it. In any event, the PI will supply a survey report of the work area to the ship's technician.

The responsibilities for cleanup, disposal and transport of all waste and the associated costs will be borne by the PI. If subsequent wipe or SWAB testing finds isotope contamination above the defined limits, the associated cost of decontamination is the responsibility of the Chief Scientist.

10.4.2 OPERATING INSTITUTION

Operators must require that the members of the science party using isotopes, including the PI and Chief Scientist, are familiar with NRC procedures as well as specific shipboard rules and regulations. These shipboard regulations must be specific as to the science party's responsibility during the cruise, especially with regard to an isotope spill and the appropriate method for cleanup. These procedures can be found in the ship's cruise planning manual or handbook and should be discussed with the Marine Technician during the cruise planning process.

Of central importance is the establishment of procedures by which a PI may be granted the authority to use radioisotopes at sea. This responsibility rests with the operating institution and its RSO. The information upon which authority is granted should include at least the following:

1. The names of all personnel that will be engaged in the use of isotopes aboard ship, and the quantities and forms of all isotopes to be used.
2. Written verification by the RSO of the PI's home institution that the PI and/or the personnel listed above is currently authorized to possess and use the quantity and type(s) of isotope(s) proposed by the PI.
3. A description of experimental protocol. This should include the proposed location of the work and procedures for storage and manipulation, isolation and control of samples, containment and cleanup of spills, and the disposition of liquid and solid waste.

To ensure the safe and orderly use of radioisotopes at sea, the operating institution should also assume the following responsibilities:

- Provide suitable facilities for use and storage. Such facilities include appropriately designed laboratory space, preferably a laboratory van designated exclusively for radioisotope use, and monitoring equipment (scintillation counter). Personal dosimeters, if required, should be supplied by the user's home institution.
- Prior to departure, ship's personnel and the scientific party should be briefed on the types of isotopes to be used, location of van and storage, and potential hazards.
- A member of the ship's complement (i.e. an officer or marine technician) should be trained in basic radiation safety and emergency procedures. This individual, designated as the ship's radiation safety officer, will work with the scientist to ensure that the isotope work is conducted in designated areas that are properly posted and monitored, and that spills are properly cleaned up and reported.

10.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

10.6 RECOMMENDATIONS AND BEST PRACTICES

10.6.1 Facilities, Instrumentation and Training

The use of laboratory vans restricted for radioisotope use is strongly encouraged; i.e., all operating institutions should have access to at least one laboratory van for this purpose. Appendix C is a checklist for inspecting shipboard vans and contains a reference to the standards to be used in fabricating a van for this purpose. Using this van for other purposes; e.g., storing gear and paints, transporting spares, etc., is prohibited.

In order to ensure proper monitoring of work areas, all UNOLS vessels should be equipped with monitoring equipment such as a liquid scintillation counter, single source counter or Geiger counter with pancake probe. Personal dosimeters shall be provided by the scientific user's home institution, as appropriate, for the isotopes being used.

Likewise, UNOLS institutions are encouraged to require a member of the ship's complement (could be marine technicians) to be trained in basic radiation safety procedures. At the beginning of each cruise, this person would be responsible for briefing the crew and scientific party on the isotopes to be used, where they are to be used and stored, the disposition of wastes, and potential hazards.

10.6.2 SWAB program

Operators and PI's should be aware of the SWAB team operated by the Tritium Lab at the University of Miami. This group will conduct tests for extremely low levels of ^{14}C and ^{3}H before and/or after a cruise. This serves as a mechanism for determining when an unreported spill has occurred. SWAB tests can be requested directly from the University of Miami. A SWAB test is recommended both immediately before a cruise measuring natural abundance ^{14}C and ^{3}H and immediately after a cruise where elevated levels of

^{14}C and ^{3}H were used. If logistics prevent personnel from the University of Miami performing the test, a sample collection kit and instructions can be sent to the ship for samples to be collected and returned to the University of Miami for testing. The contact information for the Tritium Lab is:

Tritium Laboratory
University of Miami, Rosenstiel School of Marine and Atmospheric Sciences
4600 Rickenbacker Causeway, Miami, Fl 33149
Attn: Jim Happell or Charlene Grall
E-mail: Tritium@rsmas.miami.edu Phone: 305-421-4100

11. DIVING OPERATIONS

11.0 INTRODUCTION

Scientific diving is a normal part of oceanographic research vessel operations. Such diving conducted from a University National Oceanographic Laboratory System (UNOLS) vessel must be under the auspices of a diving program that meets the minimum American Academy of Underwater Sciences' (AAUS) Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. Operators without a program may accommodate scientific diving cruises, which are under the auspices of an institution with such a diving program.

11.1 REFERENCES

The American Academy of Underwater Sciences Standards for Scientific Diving www.aaus.org/downloads/aausstandards.pdf.

11.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

As required by AAUS Standards, a single lead institution's campus diving administration will be designated for all cruises requiring diving. This is usually accomplished by the agreement of all campus diving administrations involved. Items in the AAUS Standards, which refer to the campus diving administration, may be the concern of the Diving Safety Officer according to the practices of the institutions involved. The procedures, rules and regulations that govern the diving operation are those of the designated lead institution, subject to the approval of the operator's Marine Office. All UNOLS vessels must comply with the AAUS standards.

11.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

11.3.1 INSPECTED VESSELS

See required by RVSS below.

11.3.2 CLASSED VESSELS

None.

11.3.3 SOLAS VESSELS

None.

11.3.4 UNINSPECTED VESSELS

None.

11.3.5 OTHER REGULATIONS

None.

11.4 REQUIRED STANDARD UNDER RVSS

All UNOLS vessels will comply with the AAUS “standard”.

11.4.1 CRUISE PLANNING

The Principal Investigator will prepare and supply a cruise dive plan to his or her campus diving administration who will forward the cruise plan, once approved, to the lead institution’s campus diving administration and the Chief Scientist. The dive plan, prepared in a standard format, includes: diving credentials for all diving members of the scientific party, detailed operational plans, emergency plans including accident management and emergency evacuation protocols, a list of needed medical supplies, a specified quantity of medical grade oxygen with a positive pressure demand delivery system and required diving support equipment (i.e. small boats and tank racks).

The lead institution’s diving administration will, after approving this plan, forward it to the operator’s Marine Office one month prior to the cruise.

11.4.2 CRUISE PERSONNEL

The Master has responsibility for the safety of all activities aboard including diving. The Master should ensure that appropriate safety procedures are in place for conducting research diving from the vessel or it’s small boats including but not limited to ensuring that high powered acoustics sources are turned off, potentially hazardous over-board discharges are secured, propellers and bow-thrusters are not turning with divers in the vicinity and that proper notifications and signals are made.

The Chief Scientist is responsible for the coordination and execution of the entire scientific mission including the research diving plans and certifications.

The Principal Investigator of the diving project (who may or may not be the Chief Scientist) is responsible for the planning and co-ordination of the research diving operations.

The On-Board Diving Supervisor will be proposed by the Principal Investigator and approved by the lead institution’s diving administration. The On-Board Diving Supervisor is responsible for the execution of the research diving operations in accord with the cruise dive plan. He or she has the authority to restrict or suspend diving operations and alter the cruise dive plan in consultation with the Master, Principal Investigator/Chief Scientist and lead Dive Safety Officer when possible. The On-Board Diving Supervisor’s responsibilities include:

- Meeting with the Master and Chief Scientist to review the cruise dive plan and emergency procedures prior to diving.
- Remaining in regular communication with the Master on the progress of the research diving operation.
- Assuring that both the lead and operating institution’s diving manual are available to the scientists and crew aboard the vessel. The lead institutions manual will take precedence in the event of a conflict unless otherwise agreed to in advance.
- Inspecting high-pressure cylinders and breathing air compressors to assure that they meet the lead institutions’ standards.

- Ensure that air used to refill tanks is of proper quality and that all air tanks used by divers have a current hydrostatic test.

11.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

11.6 RECOMMENDATIONS AND BEST PRACTICES

It is important to ensure that the placement of the air intake for any compressor used for breathable air on board a vessel is made with regards to the location of the vessel's exhaust systems and how it may change with the wind.

Other "in-the-water" research activities such as small boat operations, swimming or snorkeling should be treated similarly to diving operations. At the very least a statement of the qualifications and physical ability to undertake the planned operations and a plan of operations detailing safety precautions should be provided and approved by the ship operator.

Research divers must also recognize their individual responsibility for their safety.

12. HUMAN OCCUPIED VEHICLES

12.0 INTRODUCTION

Marine science researchers have employed submersibles such as the *Alvin*, the two *Johnson Sea-Link* submersibles, the *Clelia*, the *Pisces IV* and *Pisces V* as effective platforms for oceanographic observations, collections and experiments for several decades. In the future, the inventory of Human Occupied Vehicles (HOVs) may change but the concerns for safety will remain. The terms “Human Occupied Vehicles” and “Human Occupied Submersibles” are used interchangeably throughout this chapter.

Safety, both for the personnel embarked aboard the HOV and for those aboard the support ship, is paramount in establishing the operating procedures under which Human Occupied Submersibles support science research missions. Over the years, operating institutions have each developed checklists, personnel training syllabi, testing procedures, maintenance intervals, and safety reviews. Conscientious operators have kept pace with advances in material sciences, metallurgy, composites, hydraulic systems, handling systems, electronics, and science tools and have continually improved their systems in relevance and utility for the science users, training of operational personnel, and in overall safety.

An HOV system consists of three major components: the undersea vehicle, the submersible support surface platform, and the handling system that moves the submersible across the air/water interface. Regulatory agencies and experienced operators worldwide focus on the essential synergy of these three elements to provide an effective and safe tool for undersea research and exploration and the personnel supporting this endeavor. Common Certifying agencies in the U.S. are ABS and NAVSEA. Consideration will be given to foreign certification on a case-by-case basis with ultimate authority to accept such certification lying with the home institution.

12.1 REFERENCES

- UNOLS Safety Standards for Human Occupied Vehicles- March 2009

12.2 REQUIRED BY REGULATION FOR ALL VESSELS

Regulations based on type and certification of HOV and regulatory status of vessel.

12.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

12.3.1 INSPECTED VESSELS

None.

12.3.2 CLASSED VESSELS

None.

12.3.3 SOLAS VESSELS

None.

12.3.4 UNINSPECTED VESSELS

None.

12.3.5 OTHER REGULATIONS

None.

12.4 REQUIRED STANDARDS UNDER RVSS

12.4.1 UNOLS HOV SAFETY STANDARDS

Any UNOLS vessel or vessel chartered by a UNOLS institution in accordance with Chapter 18 of these standards will adhere to the UNOLS HOV Safety Standards when conducting any operations involving submersibles designed to carry human occupants.

All HOVs must meet all applicable inspection standards and be currently certified by ABS or the U.S. Navy or other such bodies recognized for that purpose within established regulatory compliance regimes.

12.4.2 SUBMERSIBLE SUPPORT SHIP

The surface support vessel must have the ability to conduct two-way communications with the HOV both on the surface and beneath the surface throughout the design-operating envelope of the vehicle in whatever sea state operations are to be conducted. Typically, this will include VHF radiotelephone communications when the HOV is on the surface, and an acoustic underwater telephone system when the vehicle is submerged. A Loss of Communication Procedure must be provided.

The support ship must have a means for tracking of the position of the HOV either visually or by electronic means.

Transducers for acoustic tracking and communications systems, both on the surface ship and on the submersible, must be mounted so that there are no blocked azimuth angles, and so that the propagation covers maximum horizontal distances and depths expected to be encountered under both normal and emergency operational scenarios

Personnel assigned to operation of the tracking/communications equipment on the ship must be provided with proper training, spare parts, and technical support. The importance of training cannot be over-emphasized.

The surface support ship must have an adequate suite of depth sounding equipment to determine, with precision and certainty, the depth of the water in which the HOV will be operating. Sufficient spares, backup systems and technical support of these essential components must be provided.

Rescue assets and outside assistance for an entrapped or entangled submersible may, depending upon operating area and environmental conditions, be days away. The surface support ship and/or submersible must be equipped with a self-rescue capability. This may consist of a second HOV, a ROV system, , or a passive buoy tag-line captive engagement system. The self-rescue system must be operational throughout the depth range at which the submersible is capable of operating. Realistic drills and exercises, simulating a submersible rescue scenario shall be held at regular intervals, no less than once a year, and the results must be documented, to assure the integrity of the rescue equipment and to familiarize the personnel on the surface ship and the HOV with its use. These may include tabletop exercises or comprehensive reviews of safety or rescue plans.

In the event of entrapment, entanglement, or component failure, life support for at least 72 hours should be available in the submersible (i.e. air, water and food).

12.4.3 CHAIN-OF-COMMAND DURING HOV OPERATIONS

As per maritime law and tradition, the Master retains responsibility for and authority over all operations conducted aboard the ship, including the deployment of any off-board vehicles employed by the vessel and its embarked personnel. The Expedition Leader (or other appropriate official title) is responsible for and has authority over the HOV and its embarked personnel. The designated HOV pilot commands his or her vehicle and has responsibility for and authority over its operation. The Chief Scientist, as described elsewhere in this document, is in charge of the mission. Unless accomplishment of the expedition plan is unsafe or illegal, the Master and other key individuals responsible for HOV operations should make every attempt to facilitate science needs.

Four persons have launch veto authority. The Master, the Expedition Leader, the HOV pilot, or the Chief Scientist can make a “no-go” decision. (On occasion, the HOV pilot may also fill the role of Expedition Leader.) The others may not outvote or over-ride such a call. A decision to proceed with a HOV dive should be a consensus decision of these key leadership personnel, but it must be understood that a majority cannot over-rule a “hold” or “no go” determination by any one of these key personnel.

Similarly, a decision to terminate a dive early and to recover the HOV may become necessary due to a change in the weather, mechanical issues on the HOV or the support ship, conflicting traffic, or personnel needs. Again, any one of the key leadership personnel identified in the preceding paragraph can order an early termination of the dive. The final say on the actual timing of the surfacing (unless there is a situation requiring the submersible to make an emergency ascent) is routinely deferred to the Master who will take into account actual surface conditions and the position of the ship with respect to the HOV, maneuvering the ship as required for the recovery procedure.

12.4.4 SUBMERSIBLE SUPPORT SHIP PROCEDURES

Prior to the commencement of HOV launch procedures, the following steps must be taken: (Operators will define step-by-step checklists.)

- Assessment of weather, sea-state, and visibility, forecast out to the anticipated end time of the dive and recovery plus long-range forecasts for the life support capabilities of the HOV in emergency conditions.
- Assessment of the operating area including currents, bottom depth, and the possible presence of seafloor hazards that create an undue risk of damage to or ensnarement of the HOV.
- Assessment of surface traffic, especially in areas of heavy recreational boating and / or fishing activity.
- Establishment of radio and underwater telephone protocol, selection of frequencies and intervals for communications with the HOV, and announcements on the radio guard channels to warn off other shipping.

- Conducting planning meetings, as needed, including the Expedition Leader, the HOV Pilot, the Chief Scientist, and the Scientist(s)/Observer(s) who will be embarking in the HOV, and ship personnel if required.
- Establishment and review of standard operating procedures for launching and recovering of the HOV tailored to the specific support vessel and launch/recovery system.
- Assignment of launch/recovery personnel and the handling system operator. Ensure that all deck personnel are equipped with Personal Floatation Devices (PFDs), hard-hats, and proper footwear and that common signals are understood by all. Verifying clear two-way communications between the deck, the handling system control location, and the bridge watch-keepers.
- Establish an unambiguous decision process for an abort of HOV operations and submersible recovery in the event of an emergency, inclement weather, or other unanticipated event.
- Establishment of an area of the deck adjacent to the HOV and handling system that is off limits to non-essential personnel.

The institution's Procedures Manual must address unique operations such as multiple simultaneous HOV operations, simultaneous HOV and ROV or AUV operations, other over-the-side operations such as launching/recovering elevators or instruments, submersible rescue drills, and coordination with other research vessels present in the immediate area.

Operators of vessels chartered for HOV operations for the first time, or with an HOV system that is being used for the first time from their ship, must participate in a combined ship operator/HOV operator pre-cruise meeting where operational scenarios, methods and procedures will be discussed and agreed upon prior to commencement of operations. As a minimum, all of the above topic areas in this section must be discussed and agreed upon.

During the HOV dive, there must be continuous evaluation of conditions and hazards by the ship and HOV operators.

12.4.5 ISM AND SUBMERSIBLE SUPPORT SHIP OPERATIONS

All UNOLS Ocean Class and Global Class ships operate under ongoing safety management systems as per the International Safety Management (ISM) treaty and national implementing laws and regulations. Smaller vessels in the UNOLS fleet are encouraged to comply with ISM to the fullest extent possible.

ISM Procedures for UNOLS vessels already mandate specific written plans for over-the-side science operations, however these may be fairly generic. Ships conducting launch and recovery of HOVs shall also define specific procedures and include them in their reviewed and approved ISM handbooks and other documentation, as required.

- ISM Procedures for HOV operations will include, at a minimum:
- Trained personnel on the support ship required for launch and recovery operations.
- Chain-of-Command and designation of lead personnel during operations.

- Communications between the deck, the handling system control position, the bridge and the HOV.
- Weather and operational safety constraints.

12.4.6 HOV SHIP-MOUNTED HANDLING SYSTEMS

Additional information regarding HOV handling systems is covered in the HOV Safety Standards, Chapter 6.

In general terms, a submersible handling system for the launch and recovery of a HOV is a robust, specially designed piece of precision heavy-lift equipment, built, operated and maintained to exacting standards so that the delicate and human-occupied submersible can be safely and securely hoisted off the deck, placed into the water and recovered after the dive operation--while under full control during the widest possible window of sea-state conditions. The handling system:

- Must meet and be certified under ABS, Naval Sea Systems Command (NAVSEA) system certification, or another appropriate classification society.
- Ship and submersible system operators must make themselves aware of any regulations, promulgated by the USCG or Occupational Safety and Health Administration (OSHA) or classification societies that may require lifting equipment to be “man rated” or “human rated,” and the applicability of such regulations to the anticipated operation and deployment of an HOV.
- Must have operator qualifications and training established by the HOV operating institution.
- The use of a handling system for purposes other than its intended purpose of launching and recovering HOVs requires approval of the certifying authority.

12.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

12.6 RECOMMENDATIONS AND BEST PRACTICES

12.6.1 ADDITIONAL DESIRABLE CAPABILITIES OF SUPPORT SHIP

A vessel supporting a human occupied submersible should offer adequate space for routine servicing and maintenance of the embarked HOV. This may include such elements as a machine shop, an electronics shop, or a dedicated space on board for these functions. Separate storage space for the submersible’s spare parts should be provided in a secure location where they will not be depleted to meet other routine ship maintenance needs. Since maintenance and battery charging often take place at night, adequate lighting of the HOV work area should be provided. The lighting should be aimed so as to illuminate the submersible while not blinding the bridge watch-keeping personnel.

The ship should be equipped with a multi-beam seafloor sonar mapping system, which can be used to map the operational area before the HOV is deployed. These systems provide data of considerable utility to the science investigators and also enhance safety and security by verifying the depth and topography of the seafloor, the presence of wrecks or other entanglement hazards, and assist in localization of the submersible and positioning of a rescue vehicle during an emergency.

Equipping the vessel with an acoustic Doppler current measuring system is recommended. This sonar can help the operators determine the presence, direction and velocity of undersea currents, before the HOV is launched, and assist the surface vessel in determining environmental factors critical to dynamic-positioning (see next item.)

Dynamic positioning systems will enhance the ability of the support ship to carryout the HOV mission. These systems serve to efficiently keep the vessel within a defined circle of position over the vehicle's dive site. Some systems permit automatic tracking of the submerged vehicle's acoustic transponder, moving the surface ship in concert with the submersible. The bridge personnel can thus better dedicate their attention to monitoring systems and watching out for conflicting surface traffic during lengthy dive operations.

12.6.2 TRAINING OF SUBMERSIBLE SUPPORT SHIP PERSONNEL

Submersible support from a surface ship is sufficiently unique as to require specialized training for personnel involved in these operations. This training should include the Master, the bridge watch-keeping officers, the sonar/underwater communications and tracking operators, swimmers (if used), deck personnel, and handling system operators. As required for seagoing personnel under ISM, a syllabus for training shall be established and sign-off documents of training milestones and qualifications shall be maintained.

Emergency exercises and drills shall be held to verify the readiness of the rescue and emergency equipment and the personnel tasked with its employment. Pre-dive briefs and post-dive debriefs along with post exercise critiques are useful practices for advising personnel about performance needs and opportunities for improvements. Institutions operating HOVs are encouraged to share experiences through professional organizations, technical journals, publications, and submersible operations sessions at professional meetings.

13. STABILITY

13.0 INTRODUCTION

An understanding of the principals of ship stability is essential to the safe operation of any vessel, but particularly so for the operation of a research vessel which can be subject to greatly varying deck loads, towing loads and crane loads from overboard handling systems. These and other factors such as ice loads, must all be considered in the trim and stability calculations. The vessel operators must understand the concepts of stability and in the event that any questions do arise, the services of a qualified naval architect must be contracted. A vessel's stability characteristics are based on its hull form, sail area (windage profile), weight (displacement), center of gravity, and free surface of liquids on board. Changes in any of these characteristics will impact the vessel's stability.

Hull form is rarely changed during the life of a vessel. If a hull form change is needed for a particular operation, e.g., addition of a transducer pod, additional sea chests, etc., a naval architect can evaluate potential impacts to stability.

Sail area can change from voyage to voyage, most commonly by the addition of science or equipment vans. Some vessel's stability booklets account for the addition of a van by including an alternate required GM curve based on the additional windage area. If a vessel's existing stability documentation does not account for planned increases in sail area, a naval architect should be consulted to verify that stability criteria can be met.

Weight and center of gravity are typically determined by calculations that add loads to an approved lightship value (determined via stability test). Changes to the lightship weight must be documented in accordance with the guidance given in section 13.3.1 below for inspected research vessels.

Liquids in tanks can reduce a vessel's stability. Stability letters and booklets typically document tank-loading requirements for a specific vessel including the number of tanks that are allowed to be slack at any one time.

In applying the required and recommended stability standards, the operator must also take into account any unique vessel mission requirements which require additional stability measures.

STABILITY STANDARDS: for the design, construction, and operation of oceanographic research vessels may be placed into one of two categories:

- Standards required for inspected and certain uninspected vessels, and
- Those recommended for the remaining uninspected vessels.

Required standards have been set forth by the USCG and by International Conventions (see next section). Generally these take the form of minimum righting energy requirements, minimum GM, and in the case of larger (inspected) vessels, damage stability requirements.

Additionally, vessels engaged in towing and lifting operations must meet additional criteria. Vessels that operate in areas where ice accretion is possible should meet stability criteria with icing loads.

Uninspected vessels with an assigned load line, although not subject to the requirements of Subchapter S, must still demonstrate adequate stability. The requirements of Subchapter S may be used for guidance. Alternatively, the guidelines for fishing vessels may be used, although these criteria may be more demanding than those outlined for oceanographic research vessels in Subchapter S.

STABILITY TESTS: include formal inclining experiments and, in some cases, rolling period tests. Inclining experiments are conducted to obtain "as inclined" data from which "light ship" displacement and centers of gravity can be derived to define the "light ship condition." This experiment is normally conducted under the auspices of a qualified Naval Architect, and witnessed by the US Coast Guard or its designee, commonly ABS. Various loadings can then be added to this basic condition to obtain prescribed "service conditions" and associated stability information. This becomes the basis for a "Stability Letter" or "Stability Book".

STABILITY INFORMATION: includes 1) specific information pertinent to the safe operation of a specific vessel and 2) general information, the understanding of which promotes the safe operation of vessels in a more general sense. Specific information is contained in "Stability Booklets" and "Stability Letters," or their equivalents, which are carried on board. General information should also be carried on board and made readily available to all personnel on board having duties or functions, which may affect the vessel's stability.

13.1 <u>REFERENCES</u>

Principal references include Title 46 CFR 170 - Subchapter S, the International Maritime Organization (IMO) Code of Safety For Special Purpose Ships Resolution A.534 (13), and the Commercial Fishing Vessel regulations (46 CFR 28). The last reference concerns commercial fishing vessels but contains much information of value for uninspected oceanographic research vessels.

13.2 <u>REQUIRED BY REGULATIONS FOR ALL VESSELS</u>

Requirements are based on sizes and service.

13.3 <u>REQUIRED REGULATIONS FOR CERTAIN VESSELS</u>

13.3.1 INSPECTED VESSELS

Inspected oceanographic vessels, including motor-driven vessels of 300 and over gross registered tons and steam ships over 65 ft long, must comply with stability criteria set forth in Title 46 CFR, Subchapter S, Parts 170 and 173.

New inspected oceanographic vessels are required to be inclined in accordance with inclining experiment details set forth in 46 CFR, Subchapter S, Part 170, Subpart F.

Any research vessel should be re-inclined any time a significant change in magnitude and/or location of a "light ship" weight occurs or there is a major change in hull shape. For inspected vessels the Coast Guard, in MTN 04-95, requires the following actions based on the amount of <u>aggregate</u> (magnitude of weight removed and weight added) weight change:

- Weight-moment Calculation only when the aggregate weight change does not exceed 2% of the lightship weight and the Longitudinal Center of Gravity (LCG) does not shift by more than 1% of the Length Between Perpendiculars (LBP).
- Deadweight Survey Only when the aggregate weight change is between 2-10% or LCG shifts by more than 1% of LBP
- Full Stability Test when the total aggregate weight change exceeds 10%.

Inspected oceanographic vessels are required to carry the following stability information on board as set forth in Title 46 CFR, Subchapter S, Part 170, Subpart D:

- Stability Booklet (Section 170.110)
- Stability Letter (Section 170.120)
- Lifting information for vessels engaged in lifting operations (Section 170.125)

The above reference does not specify that vessels engaged in towing are required to carry towing information pertinent to stability. Nevertheless, it is recommended that these vessels carry this information.

13.3.2 CLASSED VESSELS

Uninspected oceanographic vessels engaged in international or foreign voyages and subject to load line assignment, as described in Chapter 14, are treated as inspected vessels with regard to stability tests and stability information.

13.3.3 SOLAS VESSELS

An uninspected vessel subject to SOLAS requirements, i.e., over 500 GT Convention Tonnage yet under 300 GRT domestic tonnage will be subject to load line requirements and SOLAS stability requirements. The SOLAS requirements for vessels under 100m (328 ft) in length are not well defined, but compliance with the IMO Code of Safety For Special Purpose Ships would be a reasonable minimum requirement. For a load line, ABS would seek compliance with a “recognized” stability standard such as those outlined in Subchapter S for oceanographic vessels or, alternatively, the requirements contained in IMO’s Code of Safety For Special Purpose Craft.

An inspected vessel subject to SOLAS must meet the stability criteria of Subchapter S.

13.3.4 UNINSPECTED VESSELS

Other uninspected vessels that are not in “class” have no required stability standards unless they have an assigned load line, in which case ABS will require compliance with IMO A167/A206 with A562 or “recognized” criteria suitable to vessel type, such as Subchapter S criteria for oceanographic research vessels. Standards for these vessels under the RVSS are described below.

13.3.5 OTHER REGULATIONS

None.

13.4 REQUIRED UNDER THE RVSS

It shall be the Master‘s responsibility to maintain the vessel in a satisfactory stability condition at all times through control and management of liquid, solid and science loads.

It is the Operating Institution‘s responsibility to insure that (1) current stability data are correct and available to the Master, (2) changes to the vessel are controlled and managed to insure compliance with all regulatory requirements and the recommendations of this section.

As a minimum, a deadweight survey shall be performed every five years. If the deadweight survey shows a shift in LCG over 1% and/or a change in weight over 10%, the vessel must undergo a complete stability test (inclining).

Un-classed and uninspected oceanographic vessels, while not required by regulation to undergo inclining experiments, will be inclined and have sufficient data and documentation to determine safe loading. These vessels will carry operators' directives containing specific stability information equivalent to that required for inspected vessels.

13.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

NONE.

13.6 RECOMMENDATIONS AND BEST PRACTICES

Uninspected vessels may be divided into two groups: 1) vessels from 79 feet to 328 feet in length, and 2) vessels shorter than 79 feet.

Recommended intact stability standards for group (1) vessels are contained in IMO's Code of Safety For Special Purpose Craft, which invokes IMO A167/A206 with A562

No firm criteria exist for recommended stability standards applicable to group (2) vessels. Again, criteria set forth in the fishing vessel regulations provide useful guidelines but one must be cautious in their direct use to establish stability standards for these small vessels and it may be necessary to increase IMO Resolution A.168 (ES.IV) criteria. While the basis for this increase has not been established, the practice of some European countries is to increase all criteria by twenty percent.

It is recommended that all uninspected oceanographic vessels carry general stability information on board. Consideration should be given to following the regulations for commercial fishing vessels in 46 CFR 28.

Instructions and data contained in Stability Booklets and Stability Letters, or their equivalents, should be set forth in a clear and concise manner to facilitate stability analysis either by hand or by use of a personal computer. In this regard, it is recommended that vessels be provided with user-friendly stability software for intact and damaged conditions (if feasible) and on board personal computers.

The RVOC Safety Training Manual contains chapters on Stability and on Load Lines and Watertight Integrity that could be used to help in understanding the principals covered by regulations and guidelines. The information provided includes diagrams and example calculations as well as useful safety practices that will minimize or eliminate adverse effects on stability. The North Pacific Fishing Vessel Operators Association (NPFVOA) also publishes a safety manual and a series of videotapes that are excellent training resources with regard to stability on smaller vessels.

13.6.1 RECOMMENDED READING

For those interested in learning more about the basics of vessel stability, the following publications are recommended:

- NPFVOA "Vessel Safety Manual". Available at: www.npfvoa.org
- "Stability and Trim of Fishing Vessels for Skippers & Second Hands" by J. Anthony Hind, Published by Fishing News (Books) Ltd.
- USCG- A Best Practices Guide to Vessel Stability- http://www.uscg.mil/hq/cgcvc/cvc3/references/Stability_Reference_Guide.pdf

14. LOAD LINES AND WATERTIGHT INTEGRITY

14.0 INTRODUCTION

This chapter provides guidance regarding the requirements for the assignment of load lines as well as the closely related topic of maintenance of watertight integrity. Both items are extremely important to vessel safety in that they are designed to prevent conditions of overloading and/or down flooding that could lead to vessel loss.

Since the assignment of a load line to a vessel is almost universally done as part of the original construction or major conversion of a vessel, the material contained in this chapter serves mainly as background information to the operator. However, it is important that vessel operation conforms to load line restrictions and maintains vessel watertight integrity as identified and discussed herein.

The regulations regarding load lines and watertight integrity vary depending on the type and service of the vessel; however, under USCG requirements, the substantial majority of vessels in the UNOLS system will require a load line.

This chapter also provides information on stability and watertight integrity for vessels not required to have load lines because of their service or size. Such information may be of particular use to institutions chartering smaller, uninspected craft to support oceanographic research operations. A list of references is presented in section 2 of this chapter.

The basics of the load lines requirements are effectively addressed and summarized by a publication of the U.S. Coast Guard's Naval Architecture Division entitled "Load Line Regulations."

www.uscg.mil/hq/cg5/cg5212/loadlines.asp

LOAD LINES: Load line marks are affixed to vessel side shell plating amidships and indicate the maximum drafts to which the vessel can be lawfully loaded in several different maritime venues. These load line marks are also related to freeboard. The distance at the side of a vessel measured vertically from the edge of its "freeboard deck" to the upper edge of a particular load line mark represents "statutory freeboard".

LOAD LINE CERTIFICATE: Domestic load line certificates are issued by the American Bureau of Shipping (ABS) on behalf of the Coast Guard.

International load line certificates for U.S. vessels, in accordance with the International Maritime Organization (IMO) International Convention on Load Lines (ICLL), are issued by the American Bureau of Shipping (ABS), or the vessel's classification society (if approved by the Coast Guard).

The Coast Guard itself does not issue load line certificates other than a "single voyage load line exemption certificate." This allows a non-load line vessel to make a "positioning voyage" (transit from one port to another) to relocate to a new place of work or go into a shipyard for an overhaul. The local Coast Guard Marine Safety Office (MSO) at the port of departure issues such exemption certificates. "Round trip" exemptions are not issued; the return voyage requires a new exemption certificate issued by the local MSO.

Load line information is given in the vessel's "Load Lines Certificate." This document certifies to the correctness of the load line marks and that the vessel is in compliance with all applicable requirements. It also provides a diagram of the assigned load line marks and the freeboard deck line, locating the marks with reference to this line in terms of assigned freeboard, as well as stating any conditions, restrictions and exemptions that the vessel shall observe. The validity of these certificates is reviewed annually in load line inspections and every five years in more thorough load line surveys. During these inspections and surveys, ABS is particularly concerned with the following items:

- Freeing ports - Drainage must be adequate from all weather deck areas and not blocked. Particular attention is given to potential water-trapping areas such as wells formed by structure or pockets formed by cargo or equipment.
- Sill heights - Access openings in superstructure and deck houses may have sills that are less than 15 inches, 15 inches, or 23 ½ inches depending on location.
- Vent and hatch coaming heights and fittings above the assigned freeboard deck are carefully checked.
- Watertight doors and fittings - Any penetration of watertight boundaries must be as high and as far inboard as possible. As a minimum, three dogs are required on a circular fitting and four on an oblong fitting.
- Subdivision in general - Subdivision requirements must be met as applicable for vessels being inspected/surveyed. These requirements are the same as for those passenger vessels carrying 400 or fewer passengers and include provisions for a collision bulkhead.

A load line map showing zones and seasonal areas of the world's oceans provides the Master with information regarding the maximum draft amidships to which his vessel can be loaded during various segments of a cruise. The vessel must be loaded at the beginning of a cruise so that at no time during the cruise will the applicable seasonal/zone mark be submerged.

Freeboard is vitally important on smaller vessels not subject to load line requirements. Consequently, these vessels should carry information on board regarding maximum drafts amidships to which they can be loaded safely.

ORIGIN OF LOAD LINES: Historically, the concept of a load line evolved during the 1870s in Great Britain to guard against merchant ships being overloaded. Lloyd's Register established a minimum freeboard requirement for its classed ships, to ensure that a ship had good reserve buoyancy in heavy boarding seas. After considerable persuasive efforts by Samuel Plimsoll, Parliament extended the requirement to all British merchant ships; thus was born the "Plimsoll mark."

Similar load line requirements were adopted by other maritime nations, until they were internationally standardized in the Load Line Convention of 1930. The present International Convention on Load Lines (ICLL) was drawn up in 1966 (in force since 21 July 1968), and modified by the Load Line Protocol of 1988 (in force since 3 February 2000). The Convention is administered by the IMO, a specialized agency of the United Nations. Vessels of countries signatory to the Convention are required to have an ICLL certificate for international voyages. As of April 2005, 155 countries (representing 98.49% of world tonnage) are signatory to the 1966 ICLL, and 74 countries (representing 66.70% of world tonnage) are signatory to the 1988 Load Line Protocol.

The United States is a signatory nation to both the original 1966 ICLL and the 1988 LL Protocol, and therefore load line requirements for U.S. vessels engaged on international voyages are stipulated in the Convention.

Modern load line requirements also ensure the watertight integrity of a vessel below its waterline (i.e. hull penetrations) and the weathertight integrity above its waterline (i.e. critical openings in the superstructure, deckhouses, cargo hatches, etc). The requirements also provide for crew safety on deck by specifying dimensions and locations of guardrails and walkways.

Load line regulations for U.S. vessels operating solely on domestic routes are developed by the Coast Guard, and reflect the less-severe operating environments of coastwise service. Special load line standards apply to vessels operating on the Great Lakes.

MINIMUM STATUTORY FREEBOARD: The minimum “statutory freeboard” is measured to the uppermost load line mark applicable for a specific maritime venue (for example, there are different marks for normal ocean waters vs. fresh waters) taking into account conditions (as discussed below) of 1) reserve buoyancy (buoyancy which can be supplied by the hull and watertight superstructure above the water line) and height of weather deck above this water line, 2) subdivision, and 3) hull strength. In the United States, ABS is the load line assigning authority on behalf of the U.S. Coast Guard.

Condition 1) - reserve buoyancy -- provides for a minimum statutory freeboard by specifying the maximum draft amidships based on the degree of reserve buoyancy and height of weather deck above the waterline which have been found adequate from past experience in providing for vessel and personnel safety. The basic load line mark thus determined, which passes through the center of the load line disk, fixes the “minimum summer freeboard” in salt water. A series of adjacent load line marks above/below this basic mark provide for decreased/increased minimum statutory freeboard when the vessel is operating during seasons and in ocean areas where less/more severe weather-sea conditions are likely to be encountered than assumed in loading the basic mark. Freshwater marks above the basic mark may be authorized for a vessel in ocean service. If such is the case, care must be taken in loading to these marks as these allowances require the vessel to be in virtually fresh water with a specific gravity of 1.000. If the vessel is in brackish water, proportional use of the fresh water allowances must be based on the actual water specific gravity and standard salt-water specific gravity of 1.025.

Condition 2) - subdivision -- concerns vessels whose hulls are subdivided by transverse watertight bulkheads to limit the extent of damage by flooding due to hull penetration -- such damage causing sinkage, trim and reduction of stability. Subdivision of a vessel is either required or made on a voluntary basis -- it being required for inspected oceanographic vessels per reference 3. In design, the location of these bulkheads along the length of the vessel is based on the vessel floating at a specific water line called the “subdivision load line.” The vessel is said to meet a “one compartment standard of subdivision” if subdivision is such that the flooding of any one main compartment can be sustained without submerging the so-called “margin line” just below the freeboard deck while retaining adequate after-damage, or residual, stability, The validity of this or higher standard of subdivision is dependent on the subdivision load line mark being at or above the waterline of the undamaged vessel. A vessel subject to these requirements cannot be loaded deeper than this mark. Note, however, that the subdivision mark has no meaning and is not affixed to the vessel if it lies above other load line marks. Conversely, any marks above the subdivision mark become meaningless and are not affixed to the vessel. In this case, the minimum statutory freeboard is based on the subdivision load line mark.

Condition 3) - hull strength -- refers to the maximum draft amidships to which a vessel can be loaded from a hull strength point of view -- this draft being called the “scantling draft” (scantling being the cross-section dimensions of plates and shapes comprising the hull girders). The authorizing authority must be satisfied that the hull strength is adequate for the minimum freeboard assigned from consideration (1) or (2). If for any reason the scantling draft mark lies below other marks, these marks are meaningless and not affixed to the vessel. In this instance, the minimum statutory freeboard would be the scantling draft freeboard.

In addition to the above considerations, a vessel’s freeboard has an important affect on its intact stability curve. As freeboard increases, the freeboard deck edge is immersed at greater angles of inclination, which increases the maximum righting arm and angle of occurrence. The result is increased righting energy and resistance to heeling by wind/wave action. This consideration is extremely important for smaller vessels. In general, vessels with higher freeboards have better performance in stormy weather and are less affected by water on deck.

WATERTIGHT INTEGRITY: The basic concept of watertight integrity is to ensure that the entire vessel does not flood with water and sink. The watertight integrity of a vessel is essential to calculations of required freeboard, stability and subdivision characteristics, so it plays an important role in causing the vessel to remain upright in operation through waves and weather.

During the construction of a vessel, appropriate mechanisms must be incorporated to allow for secure and efficient closure of openings in watertight areas of the vessel such as the hull, watertight bulkheads and sections of the superstructure considered watertight. Examples of such openings include hatches, side openings, and internal watertight doorways.

In order to maintain the watertight integrity of vessels, these watertight closures must be utilized as required, properly operated, and be objects of proper maintenance. It should also be remembered that some watertight doors are set to close automatically under certain conditions and that such doors can close with potentially harmful force.

Watertight integrity is vital to vessel safety -- in December 1978, the charter vessel *M/V Holoholo*, under charter for oceanographic work, was lost with all hands. According to National Transportation Safety Board (NTSB) Report Number: MAR-80-15, the primary reason for this loss was loss of watertight integrity.

14.1 REFERENCES

The following is a list of the documents that were referenced by this chapter, including the regulations and guidance regarding load lines and watertight integrity for various types of vessels. As these documents may be updated or amended periodically care should be taken that the latest edition is used.

Regulations, Standards and Related Information:

- USCG Article, “Load Line Regulations“, accessed August 2006. http://www.uscg.mil/hq/cg5/cg5212/loadlines.asp
- 46 USC Chapter 51.
- IMO International Convention on Load Lines (ICLL), 1966.
- Load Line Protocol of 1988.
- 46 CFR Subchapter E, “Load Lines” (Parts 41 thru 47).
- Navigation & Vessel Inspection Circulars (NVICs) pertaining to Load Lines:
- NVIC 7-94 Guidance on the Passenger Vessel Safety Act of 1993.
- NVIC 8-91 Initial & Subsequent Inspection of Un-certificated Offshore Supply Vessels, Including Liftboats.
- NVIC 1-88 (CH-1) International Load Line Certificates for Small Passenger Vessels Operating Within 20 Miles of the Mouth of a Harbor of Safe Refuge (Change 1).
- NVIC 1-88 International Load Line Certificates for Small Passenger Vessels Operating Within 20 Miles of the Mouth of a Harbor of Safe Refuge.
- NVIC 10-86 Equivalence to Minimum Bow Height Requirements for Load Line Assignment.
- NVIC 8-86 Coast Guard Relationships with Classification Societies for U.S. Flag Vessels.
- USCG Marine Safety Manual, Volume 4, Chapter 6, Section F, “Load Lines”.
- Load Line Technical Manual, USCG-M-1-90, prepared by ABS, 1990 (See also annotated online version with more recent but incomplete updates).
- USCG, Load Line Policy Notes.
- 46 CFR 188.05-35 (from Subchapter U - Oceanographic Vessels).
- 46 CFR 170-174, Subchapter S (Subdivision and Stability).
- American Bureau of Shipping (ABS). “Rules for Building and Classing Steel Vessels”.
- International Convention for the Safety of Life at Sea (SOLAS), 1974 (and see amendments).
- 46 CFR 28 Subpart E (from Subchapter C - Uninspected Vessels).
- 46 CFR 179.210, et seq. (from Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)).
- American Boat and Yacht Council, Inc. (ABYC), “Safety Standards for Small Craft“.

- 33 CFR 183 Subpart C (from Subchapter S - Boating Safety).
- 46 CFR 69.117, (from Subchapter G - Documentation and Measurement of Vessels).
- 46 CFR 72.05 (from Subchapter H - Passenger Vessels).
- 46 CFR 78.15 and 78.17 (from Subchapter H - Passenger Vessels).
- 46 CFR 97.15 (Subchapter I - Cargo and Miscellaneous Vessels).
- 46 CFR 170.248 and 171 (Subchapter S - Subdivision and Stability).
- NTSB Report Number: MAR-80-15. Sinking of the *M/V Holoholo* in the Pacific Ocean, near the Hawaiian Island, December 1978.
- USCG. Marine Safety Manual - Volume 5 - Chapter 7 - "Load Line Investigations".
- "Load Line Assignment" by Cleary and Ritola; Society of Naval Architects and Marine Engineers (SNAME); 1980.
- "Load Line Assignment" by Robert T. Ryan; Principles of Naval Architecture; SNAME; 1967.
- Some additional sources of information on details of watertight integrity include:
- 46 CFR 42.15 (Subchapter E), entitled "Conditions of Assignment of Freeboard," contains details on doors, hatches, machinery space openings, miscellaneous openings, ventilators, air pipes, cargo ports, scuppers, inlets and discharges, side scuttles, and freeing ports.
- 46 CFR 69.117 (Subchapter G) contains information on tonnage openings.
- 46 CFR 72.05 (Subchapter H) contains information on windows and air ports for passenger vessels.
- 46 CFR 78.15 and 78.17 (Subchapter H) contain information on doors to be closed at sea and closing appliances for passenger vessels.
- 46 CFR 97.15 (Subchapter I) contains information on hatches and other openings for cargo and miscellaneous vessels.
- 46 CFR 170.248 and 171 (Subchapter S) contain information on watertight bulkhead doors and vessel subdivision.
- 46 CFR Subchapter C Part 28 Subpart E contains regulations for commercial fishing vessels on stability and watertight integrity.

14.2 <u>REQUIRED BY REGULATIONS FOR ALL VESSELS</u>

There are no regulations regarding load lines or watertight integrity that apply to all vessels.

The U.S. load line regulations are found in 46 CFR Subchapter E, "Load Lines" (parts 41 thru 47). These regulations were originally derived from the Coastwise Load Line Act and the International Voyage Load Line Act, and also incorporate the requirements of the ICLL. The statutory basis for the regulations comes from chapter 51 of Title 46 of the U.S. Code (46 USC chapter 51).

However, some of the regulations have been superseded by the recodification of 46 USC in 1988, which revamped certain load line requirements (particularly vessel applicability and penalties for overloading). Therefore, until the CFR regulations are revised, 46 USC Chapter 51 must also be consulted.

Similarly, the ICLL is subject to periodic amendment via the LL Protocol (the most recent revisions went into force on 1 January 2005). Therefore, the most current revision of the ICLL is applicable for new vessels.

Also, special load line policies have evolved to meet new vessel designs and configurations that did not exist when the original regulations were developed (for example, liftboats). These special situations are addressed in several Navigation & Vessel Inspection Circulars (NVICs) and Chapter 6 of the USCG Marine Safety Manual. (Note: the Marine Safety Manual has not been recently updated; refer to the discussion below concerning the “Load Line Policy Notes”).

In general, most commercial U.S. vessels more than 79 feet (24 m) in length must have a valid load line certificate when venturing outside the U.S. Boundary Line, whether on a domestic or international voyage (even on “voyages to nowhere” that return to the same domestic port of departure). There are a few limited categories of vessels excluded from needing a load line; refer to 46 USC 5102 for specifics.

The design process for new vessel construction or major modification of a vessel should address all applicable load line and watertight integrity requirements.

Masters of oceanographic vessels subject to load line requirements have the responsibility to maintain load line certificates and current survey reports on board their vessels and to comply with all terms and conditions stated in these documents. Further, they should keep logbook records as prescribed in 46 CFR Subchapter E Section 42.07-20.

Masters of other oceanographic vessels not subject to these requirements should comply with load line, or maximum draft amidships, information supplied to the vessels in lieu of load line certificates.

Masters of all oceanographic vessels have the responsibility for maintaining the watertight integrity of these vessels. This responsibility involves the careful maintenance of all watertight closures and associated systems and the assurance that their functions, operation and status in various normal and emergency conditions are clearly understood by members of the crew and science party.

14.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

14.3.1 INSPECTED RESEARCH VESSELS

Inspected vessels that do not represent special exceptions are subject to the load line requirements as set forth in 46 CFR Subchapter E. Also note that in 46 CFR 188.05-35 (from Subchapter U referring to Oceanographic Research Vessels) it indicates that

“Certificated vessels shall be subject to the applicable provisions of the Load Line Acts, and regulations in Subchapter E (Load Lines)”.

Some exceptions are:

- Vessels that do not make foreign or international voyages by sea.
- Vessels that make voyages exclusively on the Great Lakes.
- New vessels of less than 79 feet in length.
- Existing vessels under 150 gross tons, which did not require a load line at the time of construction.

NOTE: *A question often arises as to whether a vessel engaged in oceanographic research upon international waters is on an international voyage if the port of departure, port of return and any intermediate ports are all domestic. Typically, voyages beginning from and terminating at domestic ports are considered domestic voyages, even if international waters are traversed. In certain cases however, the Coast Guard has previously construed voyages to certain ocean dumpsites, offshore weather monitoring stations, etc. to represent arrivals at international destinations, making the voyage an international one. Whether or not some new offshore research area would be considered an international destination should be checked on a case-by-case basis with the Coast Guard office nearest to the departure port.*

Inspected vessels are also subject to watertight subdivision requirements, such as those set forth in reference 46 CFR Subchapter S and some watertight requirements which are included in 46 CFR, Subchapter E, Subpart 42.15, “Conditions of Assignment of Freeboard.”

14.3.2 CLASSED VESSELS

U.S. flag vessels will be classed by ABS and, in addition to all other applicable Regulatory Body requirements, must comply with the applicable set of ABS “Rules for Building and Classing Steel Vessels”. These Rules contain requirements pertaining to load lines, as well as stability, subdivision and watertight integrity.

14.3.3 SOLAS VESSELS

Regulations from the SOLAS convention (including all current amendments) apply to vessels over 500 GT (international). Vessels less than 500 GT, which do not carry more than 12 passengers, are generally exempt. These Regulations contain requirements pertaining to stability, subdivision and watertight integrity.

14.3.4 UNINSPECTED VESSELS

There are few specific U.S. regulations applicable to watertight integrity for uninspected oceanographic research vessels that are below 500 GT (international). See requirements under RVSS below.

14.3.5 OTHER REGULATIONS

For vessels less than 65 feet in length, all standards relating to capacity or watertight/weathertight integrity in the “Safety Standards for Small Craft“ published by ABYC should be met. For watertight/weathertight integrity issues see Sections H-3, H-4, and H-27. Also, applicable safety requirements from the Motorboat Act of 1940, including all current amendments, must be followed.

For boats under 26 feet in length the boat load capacity standards outlined by Section H-5 of the “Safety Standards for Small Craft“ published by ABYC should be observed. (See also 33 CFR 183 Subpart C - Safe Loading).

14.4 REQUIRED STANDARDS UNDER RVSS

UNOLS vessels will be designed to and maintained in accordance with the applicable load line and watertight integrity requirements as set forth in US regulations, international conventions and accepted marine standards for the size and operating area of the vessel.

While not legally required for uninspected oceanographic research vessels that are below 500 GT (international), 46 CFR, Part 28, Subpart E (Stability) and 46 CFR 179 (Subdivision, Damage Stability and Watertight Integrity) may provide useful guidance. Vessels chartered to do oceanographic research work should meet, as a minimum, the requirements of 46 CFR Subchapter C, Part 28, Subpart E.

14.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

NONE.

14.6 RECOMMENDATIONS AND BEST PRACTICES

Operations managers or Marine Superintendents shall oversee and assist the Master in fulfilling the above listed responsibilities.

Uninspected vessels exempted from load line regulations, including those having state boat registration numbers and not sailing in foreign or international waters, should strive to adhere to load line and related requirements given in 46 CFR Subchapter E to the extent feasible for vessels of their size. These vessels should be surveyed in a manner paralleling the annual and five-year periodic surveys made in reviewing the “Conditions of Assignment of Freeboard” for vessels requiring load line assignments.

Further information is provided in:

“LOAD LINE TECHNICAL MANUAL”: The U.S. Coast Guard commissioned the American Bureau of Shipping (ABS) to prepare a report that integrated U.S. load line regulations & policies, ABS and International Association of Classification Societies (IACS)interpretations, IMO circulars, and the International Convention on Load Lines (ICLL) into a single reference document.

The “Load Line Technical Manual” is the result of that effort. It sets forth the technical procedures for evaluating, calculating and assigning ICLL load lines, using USCG and ABS policies where the Convention leaves certain requirements “to the satisfaction of the Administration” or is open to interpretation.

The Technical Manual applies to U.S. vessels seeking an international ICLL assignment or a domestic U.S. load line assignment for unrestricted voyages by sea; it does not cover U.S. load line regulations for other types of domestic voyages (such as coastwise or Great Lakes).

“LOAD LINE POLICY NOTES”: The “Load Line Policy Notes” supplement Chapter 6.F, “Load Lines,” of the Marine Safety Manual (Vol. IV).

The LL Policy Notes encompass all the current USCG load line policies that have evolved since the previous (1990) revision of Marine Safety Manual (MSM) Chapter 6.F. The LL Policy Notes also include expanded discussions and clarifications for both domestic U.S. and international ICLL load line regimes.

15. ELECTRICAL AND MARINE ENGINEERING

15.0 INTRODUCTION

This chapter covers Marine and Electrical Engineering practices on vessels in the UNOLS fleet and certain aspects of these practices as they pertain to setting up and utilizing scientific or science-related equipment. Scientific or science-related equipment installations on vessels may be unique, non-standard (from a marine environment perspective) and/or temporary. Particular attention should be given to such specialized installations, since the equipment is frequently experimental in nature and the researchers providing and using it may not be familiar with accepted marine and electrical engineering practices. Such equipment may have been designed for operation in a shore-based environment; whereas, in a shipboard application additional environmental factors may be present, such as: moisture, motion, vibration, temperature variations, and power supply fluctuations. For example, one area of confusion and occasional problems entails equipment designed for use with grounded neutral electrical systems (the norm for office and laboratory equipment) on ships with ungrounded distribution systems.

BASICS OF MARINE ENGINEERING: Marine engineering encompasses the design, operation and maintenance of a vessel's propulsion and auxiliary machinery as well as the mechanical, electrical, fluid (fuel, steam, hydraulic, water, etc.), and control systems aboard a vessel. Additionally, systems engineered for research vessels must support equipment used for research purposes such as electrical and hydraulic distribution systems needed for specialized winches and cranes, and sometimes, special refrigeration equipment used for science purposes.

BASICS OF ELECTRICAL ENGINEERING: The textbook "Marine Engineering" published by the Society of Naval Architects and Marine Engineers (SNAME) includes the following with regard to shipboard electrical systems:

"All ships have an electric power plant similar to a land-based electric utility . . . Electric power is required for propulsion, propulsion system auxiliaries, deck machinery, illumination, heating, ventilation, air conditioning, stores and cargo refrigeration, galley, fresh water and sanitary systems, and safety and casualty control such as fire and bilge systems, fire detection and alarm systems, and remotely operated watertight and firescreen doors. Power must also be supplied for interior communication systems, controls, radio communications, radar, and other electronic aids to navigation and shipboard operation."

On research vessels, power must also be supplied for scientific work, in addition to all of the above functions. Such "scientific" power must often be especially "clean" and/or delivered from uninterruptible sources. Scientific power may also entail different voltages that must be transformed from those available on the ship's service electrical bus.

15.1 REFERENCES

The following is a list of the documents that are referenced by this chapter, including regulations and guidance regarding Marine and Electrical Engineering practices. These documents are updated or amended periodically, so a check should be made to ensure that the latest edition is used.

- 46 CFR Subchapter F - Marine Engineering
- 46 CFR Subchapter J - Electrical Engineering
- 46 CFR Subchapter H - Passenger Vessels
- 46 CFR Subchapter I - Cargo and Miscellaneous Vessels
- 46 CFR Subchapter U - Oceanographic Research Vessels
- 46 CFR Subchapter D - Tank Vessels
- 46 CFR Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)
- 46 CFR Subchapter C - Uninspected Vessels
- American Bureau of Shipping (ABS). "Rules for Building and Classing Steel Vessels"
- International Convention for the Safety of Life at Sea (SOLAS), 1974 (and all amendments)
- American Boat and Yacht Council, Inc. (ABYC), "Safety Standards for Small Craft"
- Federal Motorboat Act of 1940 (and all amendments)
- 46 CFR 197, Subpart B - Commercial Diving Operations
- Marine Engineering, edited by Harrington, Society of Naval Architects and Marine Engineers, 1992
- UNOLS "RVOC Safety Training Manual" Chapter One, accessed January 2008
- Other Relevant Standards (not expressly referenced herein):
- IEEE 45, "Recommended Practice for Electrical Installations on Shipboard"
- National Fire Protection Association, "The National Electrical Code"

15.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

Nearly all UNOLS vessels are subject to marine and/or electrical engineering regulations promulgated by the Coast Guard and other regulatory bodies, as well as possibly classification rules. Due to differences in size, mission and areas of operation, not all the same regulations and rules necessarily apply to all UNOLS vessels. Thus, it is important that a careful analysis be made to ascertain which ones apply to your particular vessel.

All applicable marine and electrical engineering regulations, as well as recommended standards (even if they are not legally binding requirements), must be addressed by the design process for new vessel construction or major modification of a vessel.

For existing vessels, as a general rule, any significant changes to the vessel's machinery or electrical systems must be designed or reviewed for compliance with applicable regulatory and classification requirements by a qualified naval architect and/or marine engineer, preferably one who has relevant experience with research vessels. Operational staff who are not similarly qualified cannot assume they understand all the implications and effects of what they may perceive as a simple modification; remember the "rule of unintended consequences."

15.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

15.3.1 INSPECTED VESSELS

Inspected vessels are generally subject to the marine engineering regulations of 46 CFR Subchapter F – Marine Engineering and electrical engineering regulations of 46 CFR Subchapter J – Electrical Engineering. This is specifically required for vessels regulated by any of the following subchapters:

- 46 CFR Subchapter H - Passenger Vessels,
- 46 CFR Subchapter I - Cargo and Miscellaneous Vessels,
- 46 CFR Subchapter U - Oceanographic Research Vessels, and
- 46 CFR Subchapter D - Tank Vessels (except as specifically modified by that subchapter).

Oceanographic research vessels, which are subject to 46 CFR Subchapter U, are subject to certain additional regulations. For example, Subchapter U includes some discussion of marine and electrical engineering concerns related to scientific equipment such as the following:

- Subpart 194.15 - Chemistry Laboratory and Scientific Laboratory, and
- Subpart 195.09 - Scientific Equipment, and Subpart 195.11 - Portable Vans and Tanks.

15.3.2 CLASSED VESSELS

U.S. flag vessels in the UNOLS fleet are typically classed by the American Bureau of Shipping ("ABS") and maintained in accordance with associated ABS requirements for their class. In addition to all other applicable Regulatory Body requirements, such classed vessels must comply with the set of ABS "Rules for Building and Classing Steel Vessels" that is appropriate to their size and service. These rules contain numerous requirements pertaining to marine and electrical engineering. Even if a vessel is not "classed," those Rules can provide guidance on good practices.

15.3.3 SOLAS VESSELS

UNOLS vessels which fall under SOLAS rules should refer to Chapter II-1 "Structure, subdivision and stability, machinery and electrical installations".

15.3.4 UNINSPECTED VESSELS

The marine and electrical engineering requirements for uninspected vessels are contained in 46 CFR Subchapter C - Uninspected Vessels. Beyond that which is expressly required by Subchapter C, additional guidance for marine engineering and electrical systems aboard UNOLS vessels can be found by consideration of Subchapter C Part 28 (for fishing vessels) and 46 CFR Subchapter T (for small passenger vessels), as well as 46 CFR Subchapters F and J. There is no prohibition against using the inspected vessel requirements for uninspected vessels; those requirements cited above for inspected vessels should be considered for guidance as well.

15.3.5 OTHER REGULATIONS

For vessels under 65 feet in length, "Safety Standards for Small Craft" published by American Boat and Yacht Council (ABYC) shall be met. Some examples relating to the mechanical and electrical systems include these ABYC standards:

- A-27 Alternating Current (AC) Generator Sets
- E-11 AC & Direct Current (DC) Electrical Systems on Boats
- H-30 Hydraulic Systems
- H-33 Diesel Fuel Systems

ABYC standards related to the control or documentation of electrical and mechanical systems such as: “T-5, Safety Signs and Labels” shall be adhered to. Also, any and all applicable safety requirements from the Motorboat Act of 1940, including all amendments, must be complied with.

15.4 REQUIRED STANDARDS UNDER THE RVSS

VESSELS: UNOLS vessels will be designed to and maintained in accordance with all applicable marine and electrical engineering requirements as set forth in US regulations, international conventions and accepted marine standards for the size and operating area of the vessel.

PORTABLE SCIENTIFIC EQUIPMENT: Major portable scientific equipment such as winches, seismic air compressors, and laboratory vans or powered sampling equipment may present hazards of injury to personnel or damage to the vessel or vessel systems. Such equipment shall be designed to meet the requirements of 46 CFR Subchapter F and J when applicable. The use of these standards will help in ensuring that the equipment is safe and suitable for use on all vessels.

The following examples demonstrate how the requirements may apply to portable equipment. They do not form a complete list of applicable requirements.

FUEL TANKS: Fuel tanks for portable, engine-driven equipment, see 46 CFR 58.50 - Independent Fuel Tanks.

MACHINERY GUARDS: 46 CFR 58.01-20 requires that “Gears, couplings, flywheels and all machinery capable of injuring personnel shall be provided with adequate covers or guards.” By extension, this includes exposed shafts, which can snag a person’s clothing.

HYDRAULIC AND PNEUMATIC SYSTEMS: For hydraulic and pneumatic systems on winches, portable A-frames and cranes, etc., see 46 CFR 58.30-50 - Requirements for miscellaneous fluid power and control systems.

PRESSURE VESSELS: For pressure vessels, (including hydraulic accumulators which may be part of a winch or over-the-side recovery system), see 46 CFR 54 - Pressure Vessels.

DIVING SUPPORT EQUIPMENT: For diving support equipment including compressors, chambers, etc., see 46 CFR 197, Subpart B – Commercial Diving Operations. Additional information can be found in Chapter 11 (Diving Operations) of this manual.

SYSTEMS IN VANS: Electrical and mechanical systems contained in laboratory vans, machinery vans and chemical storage vans shall meet all applicable requirements of 46 CFR Subchapters F, J, and U. Note especially 46 CFR 195.11 - Portable Vans and Tanks. Additional information can be found in Appendix C of this manual.

GROUNDING OF PORTABLE EQUIPMENT: All portable electric powered equipment must be safely grounded - see 46 CFR 111.05. Specific attention is directed to vans, winches and other equipment connected to the ship's electrical supply by portable cords.

Most shipboard electrical distribution systems are not grounded, and in that respect are different from household or shore systems. Neither of the two conductors in a shipboard system is grounded, while the potential between them is about 120 volts. If an individual, while grounded, were to touch either of these two conductors, that person would receive a severe shock. All live electrical circuits are always treated as potential hazards.

Scientific equipment (including power supplies and clean power sources) and the metal racks usually erected for stowage of scientific equipment must be properly grounded. Any discrepancies found must be reported to the Chief Engineer and remedied before such equipment is energized. Temporary electrical cables rigged for scientific equipment shall be arranged to the satisfaction of the Chief Engineer. This includes marking the cable for identification and ensuring the cable is properly supported, free from possibility of chaffing, is properly protected by an overcurrent device, and is of proper size and construction for the application. Further, such cables must be removed after they have served their purpose.

PIPING:

The use of PVC piping should be kept to a minimum. The USCG MTN 01-10 provides relevant detail about this issue.

NON DESTRUCTIVE TESTING:

Principal plating and structure should be monitored by a systematic non destructive testing program. Areas exhibiting wastage should be plotted on the shell expansion drawing. In addition, new plating replacement and repairs should be noted on the shell expansion plan.

SURGE PROTECTORS:

Surge protectors and power strips are often brought on board by the science party. Typical commercially available surge protectors are designed for ashore and will interrupt only the hot conductor when a surge occurs and may be a fire risk aboard vessels. The ship operator crews should check and approve all surge protectors in use or brought on board for compatibility with the vessel's electrical distribution system prior to use.

ANNUAL MEGGER READINGS:

Annual megger readings should be part of a maintenance/inspection program.

EMERGENCY STEERING

Instructions for changing to emergency and secondary steering gear should be posted in the steering gear room and at each secondary steering station in 1.3 centimeters (1/2 inch) letters and numerals of contrasting color to the background.

HYDRAULIC FLUIDS

Hydraulic Fluids should meet EPA Vessel General Permit requirements for environmentally acceptable lubricants.

DIESEL ENGINE OVERSPEED TESTING

All the engines on board a ship needs to be run in a particular speed range. Any deviation from this speed range might damage the engine completely. In order to ensure that the engine speed doesn't overshoot the pre-set speed limit, over speed trips are used. The over speed trip should be tested regularly.

CONFINED SPACE ENTRY-

Many workplaces contain areas that are considered "confined spaces" because while they are not necessarily designed for people, they are large enough for workers to enter and perform certain jobs. A confined space also has limited or restricted means for entry or exit and is not designed for continuous occupancy.

OSHA uses the term "permit-required confined space" (permit space) to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress.

Each ship operator should have a formal policy for identifying confined spaces and procedures for safely entering these spaces. The type of work to be performed, including hot work, must be part of the procedures and policies for confined space entry.

LOCK-OUT/TAG OUT

Each operator is required to have a policy when working in/around electrical circuits. A formal policy which addresses training, personnel qualifications and procedures must be established.

15.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

15.6 RECOMMENDATIONS AND BEST PRACTICES

The following relevant information has been reproduced from the UNOLS, RVOC Safety Training Manual.

Consider the results of each act. There is absolutely no reason for individuals to take chances that will endanger their lives or the lives of others.

Assume circuits are live. Don't take the word of others. Stored capacitance can be fatal. Take time to test/discharge circuits before starting work.

Test your tester. When testing circuits to see if they are live, test a known voltage source first to see if your tester works.

Heed warning signs. If a sign warns that there may be two sources of power to a cabinet, take time to identify and secure both sources before reaching into the cabinet.

Use your senses. Be alert to smoke, overheating, and an "electrical smell" which are signs that trouble may not be far off.

Authorized personnel only. Only personnel authorized by the Chief Engineer should work on installed shipboard electrical equipment. Researchers should coordinate their requirements with the Chief Engineer before proceeding with work, which may impact a ship's distribution system.

Keep covers closed. Close covers to fuse panels, junction boxes, etc., when not in use. Covers are there to keep moisture and debris out.

Count tools. When working in cabinets or other equipment, count the tools you take in with you and be certain that you remove the same number when you leave.

Beware of dual voltages. Some switchboard panels have both 440/220-volt and 120-volt circuits. If servicing a 120-volt circuit, beware that a higher voltage circuit is close by.

Remove jewelry. Don't wear jewelry when working with electrical equipment or moving machinery. Remove rings, necklaces, and bracelets when you need to work near live components. The jewelry may serve as a path to ground or cause a short circuit, which could be fatal or cause injury. Make sure to avoid contact with metal zippers on clothing.

Tagged-out equipment. The ship's electricians and engineers place equipment out-of-service if it could jeopardize safety of personnel or cause equipment damage if started. Know how to secure all sources of possible power to such equipment. Never violate a tag by energizing that equipment.

- Leave equipment in working order, or tag it out-of-service before you leave.
- Do not service high-voltage equipment alone.

Do not ground yourself. Make sure you are not grounded when adjusting equipment or using measuring equipment. Use only one hand when servicing energized equipment. Keep the other hand behind you or in your pocket.

- Don't energize wet equipment.
- Use only properly grounded power tools.
- Use fuse puller when pulling fuses.

- Examine extension cords and portable cords and remove from service if unsafe.

16. FIRE FIGHTING EQUIPMENT & FIRE PROTECTION

16.0 INTRODUCTION

The risks associated with fire at sea cannot be over emphasized. This chapter, will identify practices and standards, which when applied on UNOLS vessels, will help to ensure that a vessel is adequately outfitted, that equipment is properly maintained, that proper training is carried out and that adequate plans and procedures for fire safety emergencies exist.

These practices and standards identified herein will not relieve a vessel from complying with existing class standards, Code of Federal Regulations (CFR) requirements, SOLAS requirements or other rules and guidelines, and may in some instances establish or recommend a more stringent standard for the operator of an oceanographic research vessel than contained in the CFR.

This section does not address structural fire protection requirements for any group of vessels.

16.1 REFERENCES

The following documents contain information, rules, and requirements pertaining to fire safety on vessels, which may be applicable. They include:

- 46 CFR Subchapter C-Parts 24-28 Uninspected Vessels
- 46 CFR Subchapter U-Parts188-196 Oceanographic Research Vessels
- American Boat and Yacht Council (ABYC), Project A-4 Standard and Technical Information Reports for Small Craft
- SOLAS-Chapter II-2, Consolidated Edition 2004, International Maritime Organization Note: For classification purposes, the fire and safety measures in the International Convention for the Safety of Life at Sea (1974 SOLAS), as amended are applicable to vessels of type, size and service coming under that convention.
- American Bureau of Shipping, Chapter 4, Part 3, Rules for Building and Classing Vessels Under 90 meters (295 ft) in length (2006)

16.2 REQUIRED BY REGULATION FOR ALL VESSELS

Required fire protection equipment for inspected vessels is prescribed by 46 CFR 193 Subchapter U, and for uninspected vessels by 46 CFR 25.30 Subchapter C. In addition, further practices and standards for them are contained in ABYC's "Safety Standards For Small Craft."

On all vessels, including non-self-propelled vessels of less than 300 gross tons, where fire detecting or extinguishing systems or other equipment are not required but are installed, the system or equipment and its installation shall meet the requirements of 46 CFR 193.

16.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

16.3.1 INSPECTED VESSELS

16.3.1.1 PORTABLE FIRE EXTINGUISHERS

Inspected vessels over 300 gross tons must follow the requirements of subpart 46 CFR 193.50 for classification, number, size, type, location and spares required.

16.3.1.2 FIXED FIRE EXTINGUISHING SYSTEMS

All inspected research vessels shall have an approved fixed fire extinguisher system installed to protect paint lockers, chemical storerooms, and similar spaces. Machinery spaces containing gasoline engines and machinery spaces containing any internal combustion engines on vessels over 1,000 GRT and total power over 1,000 HP must have fixed CO2 systems installed. (46 CFR 193.05)

Installations must adhere to the details contained in subpart 193.15 and in particular, protected spaces which are normally accessible to personnel while the vessel is underway should be fitted with an approved audible alarm which will sound automatically during a 20 second delay prior to fire suppression materials being discharged into the space. (46 CFR 193.15-30)

16.3.1.3 FIRE PUMPS

Inspected vessels must be equipped with at least one (two if over 1,000 gross tons) independently driven fire pump and the appropriate number of hydrants and hose. If the fire pump is located in an unmanned machinery space, inspected vessels must have the controls for its operation remotely located at a fire control station, on the bridge, or other readily accessible space. (46 CFR 193.10-5)

16.3.1.4 FIRE AXES

All inspected vessels shall carry on board at least the minimum number of fire axes using guidelines set forth in Table 46 CFR 193.60-5(a). The axes should be distributed so as to be most readily available in the event of an emergency. Fire axes shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose, and the enclosure so marked. (46 CFR 193.60)

16.3.1.5 TESTS AND INSPECTIONS

Tests and inspections of portable and fixed fire extinguishing equipment must be conducted at least once every twelve months. Records of these tests shall be maintained and the equipment tagged to indicate that it has been inspected. It is encouraged, where practicable, that such tests and inspections be conducted by a company recommended by the manufacturer and for classed vessels by a company approved by the classification society. Fire hoses shall be tested every 12 months at a pressure equivalent to the maximum pressure they will be subjected to in service, but not less than 100 psi. (46 CFR 189.25-20 and 46 CFR 196.15-60)

16.3.1.6 FIREMAN'S OUTFIT

All inspected vessels must have aboard, in an accessible area, at least two Fireman's Outfits, each to include: one pressure-demand or positive-pressure self contained breathing apparatus (SCBA), one lifeline with belt, one flashlight, one flame safety lamp or combination oxygen/combustible gas indicator (must be intrinsically safe and UL or Factory Mutual (FM) approved), one spanner wrench, an approved firefighters outfit (to include approved rigid helmet, boots, gloves, coat, trousers and coveralls), and one fire axe. These outfits shall be stored in widely separated, accessible locations. A spare charge is required for each SCBA (46 CFR 195.35, NVIC 12-86 and NVIC 6-01).

16.3.1.7 SELF CONTAINED BREATHING APPARATUS

Two of these appliances are mandatory for inspected vessels as part of a fireman's outfit (46 CFR 195.35).

Consideration should be given to ease of operation and response time in selecting from the list of approved equipment. Lockers and spaces containing the apparatus shall be marked "Self-Contained Breathing Apparatus." (46 CFR 196.37-20) Selected members of the crew should be instructed in its use. Apparatus shall be Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) approved for 30 minutes. A spare bottle shall be available for each apparatus and one additional bottle for training. This equipment is not approved for medical use.

16.3.1.8 FIRE AND SMOKE DETECTORS

Fire detecting, manual alarm, and supervised patrol systems are not required on inspected vessels by Subchapter U, but if installed, the systems shall meet the applicable requirements of 46 CFR-part 76 of Subchapter H (Passenger Vessels) (46 CFR 193.05-1).

See 16.3.3 for SOLAS vessel requirements.

16.3.1.9 MARKINGS FOR FIRE EQUIPMENT

Fire equipment for all inspected vessels shall be marked in accordance with the guidelines as set forth in 46 CFR 196.37 if the specified equipment is on board a vessel.

16.3.1.10 FIRE CONTROL PLANS

Fire control plans for inspected vessels must be submitted to the Coast Guard for new construction under 46 CFR 189.55-5.

It is required that all manned vessels have available a set of plans which include a general arrangement showing fire retardant bulkheads with particulars of fire-detection, manual alarm and fire extinguishing systems, fire doors, ingress to various compartments, ventilation, location of remote means of stopping fans and identification of sections of ship served by. These requirements are applicable to inspected vessels. When in port, vessels shall have fire control plans immediately available for emergency personnel called to the vessel for fire emergencies. (46 CFR 196.36)

16.3.2 CLASSED VESSELS

None

16.3.3 SOLAS VESSELS

16.3.3.1 GALLEY

SOLAS compliant oceanographic vessels are required to have fixed suppression system in galleys outfitted with a broiler or deep fat fryer (SOLAS Chapter II-2 Part C Regulation 10).

16.3.3.2 FIRE AND SMOKE DETECTORS

For vessels subject to SOLAS, Chapter II-2 Part C Regulation 7 requires that a fixed fire detection and fire alarm system shall be installed in periodically unattended machinery spaces, in machinery spaces where the installation of automatic and remote control systems and equipment has been approved in lieu of continuous manning of the space and in spaces where the main propulsion and associated machinery including sources of the main sources of electrical power, are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room. Additional requirements call for smoke detection systems in accommodation and service spaces.

16.3.3.3 EMERGENCY ESCAPE BREATHING DEVICE (EEBD)

EEBDs are required on SOLAS ships as of 1 July 2002. The intent of an EEBD is to allow personnel to escape from smoke filled areas as well as areas where a total flooding fire suppression system has been discharged. They are not intended for confined space entry or firefighting purposes. The Coast Guard will accept NIOSH approved EEBDs that have a minimum service time of 10 minutes, are supplied air or oxygen type device, and have a full-face piece or hood. Minimum Coast Guard requirements call for at least two units and one spare unit for the overall crew or passenger living area, and one EEBD for each crewmember normally assigned to continuous or periodic duty in machinery spaces, and at least one spare EEBD such that any person visiting machinery spaces will have access to a unit. Note that compressed air or oxygen cylinders over two inches in diameter will require periodic hydrostatic testing per 46 CFR 173.34.

Training in the use of EEBDs should be part of shipboard familiarization training. (NVIC 6-02)

16.3.4 UNINSPECTED VESSELS

Uninspected vessels requirements for fire-fighting equipment are contained in 46 CFR 25.30 in Subchapter C.

In general, the minimum requirements of Subchapter C are substandard for a research vessel. All uninspected research vessels over 65 ft and less than 300 gross tons shall meet the standards set out in Subchapter U (46 CFR 193) for vessels of their size or to the extent possible when the requirements are stated for large vessels only. Those vessels under 65 ft at a minimum must comply with Subchapter C and with elements of Subchapter U appropriate for vessels of their size. See Section 16.4 below.

16.3.5 OTHER REGULATIONS

Under STCW, mariners with safety-related duties must complete a Basic Safety Training course. Incorporated in this requirement is 16 hours of Basic Fire Fighting. STCW also requires that “Seafarers designated to control fire-fighting operations shall have successfully completed advanced training in techniques for fighting fires, with organizational tactics and command.” This competence must have been demonstrated within the previous five years. Participation and compliance with these training requirements is encouraged; however, the U.S. exempts mariners from STCW requirements who serve on small passenger vessels under subchapters T and K and other vessels of less than 200 Gross tons sailing on near coastal, domestic voyage, that being a voyage that begins and ends in a U.S. port, does not touch at a foreign port or enter foreign waters, and is not more than 200 miles from shore.

16.4 REQUIRED STANDARDS UNDER RVSS

The requirements for firefighting equipment contained in subchapter U (46 CFR 193) provide specifications in many sections for vessels smaller than 300 GT. The use of wood and other flammable materials should be kept to a minimum. Any wood or flammable material that is used should be properly insulted from heat sources.

PORTABLE FIRE EXTINGUISHERS

Uninspected vessels less than 300 gross tons and over 65 ft shall comply with the requirements of 46 CFR 193.50 regarding classification, number and location of fire extinguishers. In lieu of carrying spare charges if the vessel when meeting the requirements of 46 CFR 193.50 meets or exceeds the requirements of 46 CFR 25.30-20(c) then no spare charges will be required.

Uninspected vessels under 65 ft are required to follow the requirements in Subchapter C concerning the carriage of portable fire extinguishers. (46 CFR 25.30)

A portable dry chemical and CO2 fire extinguisher should be provided in each science space.

16.4.1.1 FIXED FIRE EXTINGUISHING SYSTEMS

Any uninspected vessel operating beyond the boundary line and with overnight accommodations for science party and crew shall have a fixed fire extinguishing system for spaces containing an internal combustion engine over 50 hp, an oil fired boiler, an incinerator or a gasoline storage tank. Equipment for a fixed system installed on an uninspected vessel must be type-accepted by the Commandant (G-MSE) or the Commanding Officer U. S. Coast Guard Marine Safety Center and installed properly. (46 CFR 25.30-15)

Protected spaces which are normally accessible to personnel while the vessel is underway should be fitted with an approved audible alarm which will sound automatically during a 20 second delay prior to fire suppression materials being discharged into the space. (46 CFR 25.30-15, 46 CFR 193.05-10 and 46 CFR 193.15-30)

16.4.1.2 FIRE PUMPS

Uninspected vessels over 65 ft in length and under 300 gross tons whenever practicable shall be equipped with at least one independently driven fire pump and provided with an appropriate number of 1 1/2 inch-hydrants and hoses complying with table (46 CFR 193.10-5). If the fire pump is located in an unmanned machinery space vessels should, so far as practicable, have the ability to start a fire pump remotely from an accessible space.

For vessels less than 65 ft in length, operated beyond the boundary line with overnight accommodations for crew and science party, a ¾ inch hose (46 CFR 193.10-5) of good commercial grade together with a commercial nozzle may be used. The pump may be hand operated, and the length of hose shall be sufficient to assure coverage of all parts of the vessel.

16.4.1.3 FIRE AXES

All uninspected vessels shall carry on board at least the minimum number of fire axes using guidelines set forth in Table 46 CFR 193.60-5(a). The axes should be distributed so as to be most readily available in the event of an emergency. Fire axes shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose, and the enclosure so marked. (46 CFR 193.60)

16.4.1.4 TESTS AND INSPECTIONS

This section is applicable to all UNOLS research vessels. Tests and inspections of portable and fixed fire extinguishing equipment must be conducted at least once every twelve months. Records of these tests shall be maintained and the equipment tagged to indicate that it has been inspected. It is encouraged, where practicable, that such tests and inspections be conducted by a company recommended by the manufacturer and for classed vessels by a company approved by the classification society. Fire hoses shall be tested every 12 months at a pressure equivalent to the maximum pressure they will be subjected to in service, but not less than 100 psi. (46 CFR 189.25-20 and 46 CFR 196.15-60)

16.4.1.5 GALLEY

Galley areas in general, and deep fat fryers in particular, are high fire risk areas and merit specialized protection by a smothering system, which can be remotely or automatically activated.

While Coast Guard Regulations do not call for a suppression system on inspected or uninspected vessels, the standards used for other inspected vessels as well as uninspected fishing vessels call for the following: each grease extraction hood must be equipped with a pre-engineered dry or wet chemical fire extinguishing system meeting the applicable sections of NFPA 17 or 17A or other standard set by the Coast Guard and must be listed by an independent lab (46 CFR 28.330 and 46 CFR 181.425) All UNOLS vessels should install remotely or automatically activated systems that at least meet these requirements.

16.4.1.6 FIREMAN'S OUTFIT

Vessels over 65 ft in length and less than 300 gross tons operating beyond the boundary line and providing overnight accommodations for crew and science party shall carry firemen's outfits as required for inspected oceanographic vessels (46 CFR 195.35, NVIC 12-86 and NVIC 06-01).

(a) Each fireman's outfit must consist of one self-contained breathing apparatus, one lifeline with a belt or a suitable harness, one flashlight, one flame safety lamp, one rigid helmet, boots and gloves, protective clothing, and one fire axe.

(b) Every vessel shall carry at least two fireman's outfits. The fireman's outfits must be stored in widely separated, accessible locations.

Vessels less than 65 ft in length are not required to carry a fireman's outfit.

16.4.1.7 SELF CONTAINED BREATHING APPARATUS

Two of these appliances are required as part of the fireman's outfit (46 CFR 195.35).

Vessels less than 65 ft in length shall consider whether a self-contained breathing apparatus is appropriate.

Consideration should be given to ease of operation and response time in selecting from the list of approved equipment. Lockers and spaces containing the apparatus shall be marked "Self-Contained Breathing Apparatus." (46 CFR 196.37-20) Selected members of the crew should be instructed in its use. Apparatus shall be Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) approved for 30 minutes. Each SCBA should have a spare bottle. Spare SCBA bottles should be stowed in the same location as the equipment they are intended to replenish. A spare bottle shall be available for each apparatus and one additional bottle for training. This equipment is not approved for medical use.

16.4.1.8 FIRE AND SMOKE DETECTORS

All vessels with accommodations for overnight berthing of crew and science party must be provided with smoke detection devices. Each accommodation space shall be equipped with an independent modular smoke detector or a smoke actuated fire detecting unit installed in accordance with 46 CFR 76, Subpart 76.33. If an independent modular smoke detector is installed, it must meet UL 217 and be listed as a "Single Station Smoke Detector - Also suitable for use in Recreational Vehicles." (46 CFR 28.325) Further consideration should be given to installation of detection and alarm devices in unattended machinery spaces.

16.4.1.9 MARKINGS FOR FIRE EQUIPMENT

Fire equipment for uninspected vessels shall be marked in accordance with the guidelines as set forth in 46 CFR 196.37 if the specified equipment is on board a vessel.

16.4.1.10 FIRE CONTROL PLANS

Uninspected vessels 65 ft or over in length and less than 300 gross tons should have a fire plan as provided for in 46 CFR 196.36. In the event such a plan is not available, a general arrangement drawing, at a minimum, shall be readily available for this purpose. When in port, vessels shall have fire control plans immediately available for emergency personnel called to the vessel for fire emergencies.

No requirement exists for vessels less than 65 ft in length; however, it is strongly recommended that a general arrangement drawing of the vessel be readily maintained for emergencies.

16.4.1.11 TRAINING

Vessel crews must receive adequate training to properly operate the fire-fighting equipment available aboard their vessel. It is further recommended that all crewmembers, no matter the size of vessel, meet the STCW training requirements for Basic Safety Training and remain current in this training. If possible, the crew should attend as a group.

16.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

16.6 RECOMMENDATIONS AND BEST PRACTICES

All vessels should consider carrying portable pumps of appropriate size for fire fighting and dewatering.

Vessels less than 65 ft in length shall give due consideration to the benefit of having a fire axe available onboard. In the event a fire axe is carried they shall be located where they maybe readily seen or they should be placed in enclosures together with fire hose and the enclosure so marked

Operators should be aware of hazards posed by specialized spaces or contents of spaces, e.g., labs, spaces with hydraulic oil storage, etc., and ensure these specialized hazards are identified and addressed with additional fire fighting systems to accommodate the added potential danger.

Consideration should be given to providing EEBDs as specified for SOLAS vessels in 16.3.3 above on uninspected vessels with the number available taking into account the location and arrangement of berthing spaces as well the science and crew.

For all uninspected vessels there are any number of operational issues, which must be given consideration by the operator when outfitting a vessel. These considerations include the size of the vessel and its capability, area of operation, distance offshore, the number of crewmembers, the training and experience of the crew, and the number of persons in the science party. The standards identified herein are minimum standards.

17. LIFESAVING APPLIANCES

17.0 INTRODUCTION

In general, the minimum standards set out in 46 CFR for inspected vessels are adequate for research vessels. Within SOLAS, oceanographic research vessels fall into a group defined as "Special Purpose Vessels" and are subsequently grouped as "Cargo Vessels." For vessels operating in the Arctic or Antarctic polar regions, compliance with the International Polar Code will be required. This standard specifies life saving equipment which must be on board.

The expected date of entry into force of the SOLAS amendments is 1 January 2017, under the tacit acceptance procedure. It will apply to new ships constructed after that date. Ships constructed before 1 January 2017 will be required to meet the relevant requirements of the Polar Code by the first intermediate or renewal survey, whichever occurs first, after 1 January 2018.

However, the minimum standards set forth by 46 CFR 25-28 of Subchapter C for uninspected vessels are substandard for any vessel which operates on coastal or ocean routes unless a vessel is operating well inshore. The RVSS takes the position that research vessels, while operating on ocean routes (20 or more miles offshore), shall meet the general principles and standards set forth by 46 CFR 199 Subchapter W for vessels not subject to SOLAS.

The following definitions apply to this chapter:

- "Survival craft" is a craft capable of sustaining the lives of persons in distress from the time of abandoning the vessel on which the persons were originally carried. This term includes lifeboats, life rafts, buoyant apparatus, and life floats, but does not include rescue boats.
- "Rescue boat" as defined in the CFR's means a boat designed to rescue persons in distress and to marshal survival craft. (46 CFR 160.056)
- "Buoyant apparatus" is floatation equipment, (other than lifeboats, life rafts, and personal floatation devices), designed to support a specified number of persons in the water and of such construction that it retains its shape and properties and requires no adjustment or preparation for use. The types generally in use are of a box float type or peripheral buoyant apparatus. (46 CFR 160.010-2)
- "Inflatable buoyant apparatus" is floatation equipment that depends on inflated compartments for buoyancy and is designed to support a specific number of persons completely out of the water. (46 CFR 160.010-2)
- "Life float" is a buoyant apparatus with a peripheral body designed so that persons are supported only partially submerged with approximately 40 lbs of buoyancy required per person. Each float must have a platform that drops through the center of the float. (46 CFR 160.027)
- "Lifeboats" refer to 46 CFR 199- Subchapter W

NVIC 2-92 addresses survival equipment for life rafts. A transition has been in progress, which has resulted in oceangoing vessels replacing "ocean" and "limited" service life rafts. The new life rafts will be "SOLAS A" (equivalent to ocean service), "SOLAS B" (equivalent to limited service) and "coastal" service life rafts. The changes to the SOLAS requirements for A and B Pack rafts include "an efficient radar reflector", "thermal protective aids ...sufficient for 10% of the number of persons the life raft is permitted", and being "fitted with retro reflective material".

17.1 REFERENCES

- Title 46 CFR 199, Subchapter W - Inspected Vessels 199
- Title 46 CFR 25-28, Subchapter C - Uninspected Vessels
- NVIC 2-92 - Survival Equipment for Lifeboats and Liferafts
- SOLAS - Consolidated Edition 2004 or more recent.
- International Code for Ships Operating in Polar Waters IMO Polar Code- http://www.imo.org/MediaCentre/HotTopics/polar/Pages/default.aspx

17.2 REQUIRED BY REGULATION FOR ALL VESSELS

17.2.1 PERSONAL FLOATATION DEVICES (PFD)

All vessels shall be provided with a USCG approved PFD for each person on board. Vessels over 65 ft and all vessels operating in the open ocean should carry Type 1 PFDs. Vessels under 65 ft operating in protected waters should carry life jackets for their size as prescribed by 46 CFR 25.25-5. Each life preserver must be fitted with a USCG approved light (USCG and SOLAS approved for SOLAS vessels), and retro reflective material of approved type. Lifejackets should be marked with the name of the vessel or operating institution. Details on lifejackets may be found in 46 CFR 199.70 and 46 CFR 25.25.

17.2.2 IMMERSION SUITS

Immersion suits are required for vessels operating north of 32 degrees north and south of 32 degrees south and should be type approved under series 46 CFR 160.171. See 46 CFR 199.70c for details of requirements, markings, stowage, and required attachments and fittings. The immersion suits should be marked and equipped the same as life preservers and stowed in close proximity to working or living areas.

Because immersion suits take longer to don than life preservers, periodic donning drills must be scheduled per CFR for both crew and scientists. 46 CFR 199.180(d)(12) requires all persons other than crew to receive instruction on donning immersion suits monthly. 46 CFR 199.180(d)(11) requires all crewmembers to don an immersion suit every 3 months.

17.2.3 RING LIFE BUOYS

All inspected and uninspected vessels under 328 ft (100m) in length in ocean service shall carry a minimum of eight ring life buoys that shall be stowed, marked, and have attachments per 46 CFR 199.70(a). Life buoys must be stowed so they can be rapidly cast loose, may not be permanently attached to the vessel, and each position must be marked with either the words "LIFEBUOY" or "LIFE BUOY" or the appropriate IMO designated symbol. They must be distributed so they are readily available on either side of the vessel, with at least one near the stern. At least two life buoys fitted with self-activating smoke signals shall be stowed near the bridge where they can be easily released. Life buoys fitted with self-activating smoke shall also be fitted with self-illuminating lights. Each life buoy must be marked in block capital letters with the vessels name and homeport. At least one life buoy on each side shall be fitted with a buoyant lifeline at least 100 ft long. Half the total number of life buoys shall be fitted with approved self-illuminating lights.

For vessels 65 ft or over in length and in services other than ocean (not more than 20 miles offshore), lifebuoys should be stored, marked, and fitted with attachments and fittings as per 46 CFR 199.70(a). For vessels over 65 ft and under 98 ft the minimum number of life buoys to be carried shall be three and for vessels over 98 ft and under 196 ft a minimum of four life rings shall be carried. (46 CFR 199.630) One ring buoy on either side of the vessel shall have 100 ft (30m) of buoyant line attached. All ring buoys shall be marked in capital letters with the name and homeport of the vessel. At least two of the ring buoys with water lights attached shall also be provided with a self-activated smoke signal and capable of quick release from the bridge. While these are not legally required on other voyages, they are strongly recommended minimums.

All uninspected vessels over 26 ft and under 65 ft in services other than ocean (not more than 20 miles off shore) shall be equipped with a minimum of at least one ring life buoys which shall be equipped with a line at least 60 ft in length and shall be placed so as to be readily accessible to the persons on board. The position of the life buoy shall be plainly indicated. (46 CFR 25.25-5)

17.2.4 PYROTECHNIC DISTRESS SIGNALS

All vessels in coastwise or ocean service must carry, in the pilothouse or other suitable location, the following minimum pyrotechnic distress signals: 12 approved rocket, parachute, red flare distress signals contained in an approved portable water-tight container. Each approved signal must have an expiration date marked on it and that date must not be more than 42 months from the date of manufacture. (46 CFR 199.60(c))

17.3 OTHER REQUIRED REGULATIONS FOR CERTAIN VESSELS

17.3.1 INSPECTED VESSELS

Rescue Boat: All inspected vessels must have a rescue boat approved under approval series 46 CFR 160.156 and be equipped as specified in table 46 CRF 199.175 and shall comply with requirements for stowage, launch and embarkation. (46 CFR 199.262)

17.3.2 CLASSED VESSELS

None.

17.3.3 SOLAS VESSELS

Survival Craft: SOLAS vessels constructed after July 1, 1986 must be in conformance with the new requirements. Existing SOLAS ships were subject to these requirements July 1, 1991. Older vessels may continue to use life rafts approved for “ocean service” with an “ocean service” equipment pack so long as they remain in good condition. Inspected vessels not required to comply with SOLAS may use the SOLAS A Pack, Ocean Service, or Limited Service (with SOLAS B equipment pack) life rafts as appropriate. “Coastal” service life rafts with a “coastal” equipment pack shall only be used for uninspected vessels operating within 20 miles of the coast.

17.3.4 UNINSPECTED VESSELS

Requirements for Life Preservers and Lifesaving equipment on uninspected vessels in Subchapter C are contained in 46 CFR 25.5. UNOLS Vessels should adhere to the higher standards in this chapter under section 17.4 in addition to the basic requirements in section 17.2.

17.3.5 OTHER REGULATIONS

None.

17.4 REQUIRED STANDARDS UNDER RVSS

17.4.1 PERSONAL FLOATATION DEVICES

UNOLS research vessels shall carry an additional number of life preservers readily accessible for the personnel on watch in the engine room, pilothouse, laboratories, and lookout. Lifejackets should be distributed throughout the crew and scientific quarters and other places accessible to each person on board.

17.4.2 IMMERSION SUITS

In addition to the legal requirements, each UNOLS operator shall carry this equipment, based on local or operational circumstances. Operators should consider water temperature in all areas of operations, local or otherwise. 46 CFR 199.70 applies to vessels operating north of 32 degrees north and south of 32 degrees south. The guidelines of the IMO Polar Code should also be followed.

17.4.3 WORK VESTS AND WORK SUITS

The work vest, Type V PFD, is an item of safety apparel and an adequate number of approved work vests must be carried for use by personnel working near or over water. They are not an acceptable substitute for life jackets and shall not be stowed in the same location. Operators shall outfit their work vests with retro reflective material as a minimum, with a PFD light and Global Positioning System (GPS) locators being additional recommendations. Because of the nature of their use, these vests will require replacement more frequently than other lifesaving equipment and frequent inspections are therefore necessary. There are a number of floatation suits and coats available that are recommended when operations take place in a low temperature environment. However, unless these are Coast Guard approved, they may not be substituted for work vests. (46 CFR 26.30 and 46 CFR 196.34)

17.4.4 LIFE BUOYS

All UNOLS research vessels between 65 ft and 98 ft shall comply with the inspected vessel standards.

17.4.5 RESCUE BOAT

All vessels need to maintain a capability to quickly recover a person in the water. On inspected vessels, rescue boats provide this means. All uninspected vessels have a responsibility and should maintain a capability to recover a person in the water. There is no requirement for uninspected vessels to carry rescue boats. However, consideration should be given to types of operations the vessel will be conducting, vessel maneuverability, and vessel freeboard. It is recommended that uninspected vessels have a designated rescue boat when operating in ocean service, coastwise service, or in the Great Lakes. The vessel's workboat may be designated as the rescue boat. In so doing due consideration must be given to the workboats suitability for such purposes and the need to be readily launched, embarked, easily recovered, and suitable for existing conditions (46 CFR 199.640(g)). Since the vessel's workboat may be used for other science support purposes, the vessel operator should decide whether or not the boat should comply with state motorboat registration rules or be marked as a ship's boat.

17.4.6 SURVIVAL CRAFT

Survival Craft needs for uninspected vessels are unclear and inadequate. Therefore, the following minimum standards shall apply for UNOLS Research Vessels:

Inflatable life rafts are the only type of buoyant apparatus acceptable for uninspected vessels operating in the open ocean more than 20 miles from shore. Each vessel shall carry life rafts or a SOLAS A life raft (or equivalent ocean service if they remain in good condition) with an aggregate capacity sufficient to accommodate the total number of persons on board and that are stowed in a position providing for easy side to side transfer at a single open deck level, or with an aggregate capacity on each side of the ship to accommodate the total number of persons on board (46 CFR 199.261 and 46 CFR 199.640). Life raft capacity shall be prominently displayed near each raft. They shall be of a capacity of six persons or more. They shall be stowed and equipped with hydrostatic release or float free link (46 CFR 199.130). Life rafts and releases shall be inspected and serviced at approximately 12-month intervals at a facility approved by the manufacturer and US Coast Guard to service the specific type of life raft

Vessels over 65 ft in length and not operating more than 20 miles beyond shore shall give due consideration to vessels service, operating area, and environmental conditions including water temperature when selecting an appropriate survival craft. Any US Coast Guard approved type buoyant apparatus may be used. The institutional decision to carry equipment must be based on the vessel's service and operating area. When carried, the apparatus should be of a capacity sufficient for all persons on board, or the number of persons on board limited to the capacity of the apparatus. The apparatus shall be mounted so it can be readily launched and, when unlashed, will float free should the vessel sink. Each will be attached to the vessel by a painter and float free link (NVIC 1-83). Each apparatus will be marked as per 46 CFR 199.640(j)(3). Also, each shall be equipped for the service of the vessel and periodically examined for integrity and condition.

Vessels operating in "cold water" where the monthly mean low water temperature is below 59 degrees F (15 degrees C) shall carry an inflatable life raft with a coastal service pack. Cold-water areas are defined in NVIC 7-91. Each vessel shall carry life rafts with an aggregate capacity sufficient to accommodate the total number of persons on board and are stowed in position providing easy side-to-side transfer at a single open deck level, or with an aggregate capacity on each side of the ship to accommodate the total number of persons on board. Each raft shall prominently display life raft capacity. Rafts shall be stowed and equipped with a hydrostatic release or float free link. Life rafts and releases shall be inspected at approximately 12-month intervals at a facility approved by the manufacturer and the U. S. Coast Guard to service the specific type of life raft. If a life raft canister is damaged or the seal broken, the life raft shall be serviced again promptly by an approved facility. Hydrostatic releases shall be provided with stainless steel tags on which is stamped their annual test dates (46 CFR 160.062-4).

Embarkation aids in the form of ladders or other suitable devices and continuous illumination shall be provided at life raft stowage and launching areas. (46 CFR 199.110)

Vessels operating in “warm water” where the monthly mean low water temperature is normally more the 59 degrees F (15 degrees C) may give consideration to carrying inflatable buoyant apparatus. Vessels opting to carry inflatable buoyant apparatus, or life floats shall ensure they are stowed, equipped and marked in accordance with guidelines set forth in 46 CFR 199.640(j).

17.4.7 TRAINING AND DRILLS

Inspected vessels shall comply with those requirements for Muster List and Emergency Instructions contained in 46 CFR 199.180. These same requirements shall apply to all vessels in ocean service.

For uninspected vessels, clear instructions must be provided to each person on board a vessel in the event of an emergency. Copies of muster lists shall be posted in conspicuous locations and shall be current for the particular voyage. Each muster list shall include at a minimum, instructions for operating the general emergency alarm system, emergency signals, actions to be taken when an emergency signal is sounded, and duties assigned to members of the ship’s crew.

Emergency instructions and illustrations shall be posted in each cabin occupied by personnel on board. The instructions and illustrations shall include fire and emergency signals, muster station, location of lifejackets, and methods of donning lifejackets. As an alternative smaller uninspected research vessels may consider complying with 46 CFR 28.265 for uninspected fishing vessels.

Training and drills for inspected vessels are addressed in 46 CFR 199.180. These same requirements shall apply to all vessels in ocean service. As an alternative uninspected vessels may comply with those requirements for drills and orientation on fishing vessels contained in 46 CFR 28.270.

17.4.8 TETHERS

Vessel operators shall also make available tethers for use as appropriate by persons involved in deck operations. These should be comprised of an easy-release belt or shoulder harness and buoyant line. There is no Coast Guard approval requirement.

17.4.9 RETRO REFLECTIVE MATERIAL

Lifeboats, life rafts, ring life buoys, rescue boats, work boats, life floats, and personal floatation devices shall have retro reflective material which is Coast Guard approved for that application and is approved under 46 CFR 164.018. (46 CFR 25.25-15)

17.4.10 LINE THROWING APPLIANCES

The handling of oceanographic equipment poses a high risk of a person on deck falling overboard, and a vessel with equipment over the side is usually not able to maneuver freely to make a recovery. All UNOLS vessels must maintain a capability to recover a person in the water. Depending on the vessel's operating characteristics and responses to weather and sea conditions this capability may include a line-throwing appliance. Reliability and speed are the main criteria for developing a recovery capability. On the approved equipment list there are two approved line-throwing devices:

- Rocket propelled, canister type, line-throwing appliances are relatively inexpensive to procure and maintain, but the rocket that is used to propel the line must be replaced at its expiration. At least two should be carried to provide back up capability.
- The shoulder gun type has a higher initial cost, and greater maintenance requirements. However, it has the advantage of allowing more than one shot with out having multiple units. One gun can be provided with several projectiles and canisters of line. At least one reload shall be available if this type of appliance is carried.

Training in the use of the line throwing gun or device shall be held quarterly and logged. All vessels should actually fire these devices at a frequency appropriate to maintain proficiency. (46 CFR 199.170 and 46 CFR 199.180(e))

17.4.11 ADDITIONAL LIFESAVING DEVICES

17.4.11.1 LIGHTWEIGHT PERSONAL FLOATATION DEVICES

Vessels equipped with Stearns Ultra 4000 inflatable PFDs (or equivalent) with manual and automatic features and outfitted with the ACR ResQFix™ 406 PERSONAL LOCATION BEACON (PLB) will provide them to scientists and crew while working on the open deck. Should an overboard situation arise, the vest will inflate automatically and the PLB can be activated giving a GPS location while simultaneously transmitting a signal on 121.5 MHz (Search and Rescue (SAR) homing frequency) to assist rescuers once in the general area. NOTE: Some vessels are equipped with Radio Direction Finders that can track on 121.5 MHz

17.4.11.2 RETRIEVAL DEVICES

Vessels equipped with the MUSTANG SURVIVAL RESCUE STICK or other new water-rescue devices will place them in locations in close proximity to existing throwable life rings. The RESCUE STICK ™ is a throwable personal floatation device that inflates into a horseshoe shape upon contact with the water. The RESCUE STICK can be thrown over 100 feet with good accuracy making it more effective than a standard life ring.

17.5 <u>REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES</u>

None

17.6 RECOMMENDATIONS AND BEST PRACTICES

Lifesaving equipment carried in excess of CFR requirements should still be of a type approved by those regulations and should be maintained in accordance with those regulations.

The Master should determine when activities on deck or circumstances require the wearing of work vests, work suits or inflatable work vests and ensure these requirements are known and followed by all personnel on board.

Care must be used in designating and marking life rafts. Life rafts are approved for service separately from the equipment pack provided.

Immersion suits must be available in the sizes and numbers for each member of the ship's compliment. Vessels should have available small adult and oversize adult sizes if there will be persons on board under 110 lbs or over 330 lbs. If persons with disabilities are on board, special suits may be required.

Immersion suits are expensive and must be ready for use when needed. To save wear on emergency equipment, operators may want to have some suits marked "not serviceable-drill only" and separately stowed for this purpose. These suits often tend to crack along fold lines when packed and stored for long periods, and at least quarterly suits should be hung unfolded for a day. Immersion suits shall be tagged or marked on the outside of the bag with the date of the last inspection.

When re-stowing life preservers after drills, each shall be checked for condition. At least semi-annually a thorough inspection of each lifejacket shall be made by a qualified crewmember, including a squeeze to ensure floatation pads are still sealed.

Chemiluminescent type lights should be avoided on vessels operating in near-freezing waters.

Litters and Stretchers: Litters or stretchers that are used to evacuate an ill or injured person from a vessel should be equipped with floatation.

Dated Materials: Many items of lifesaving equipment, such as flares, EPIRB batteries and life raft supplies, have a specified, limited service life. Care shall be taken to ensure these items are marked with an expiration date upon being placed into service, and records shall be kept to ensure timely replacement.

Training and Drills: The key to emergency response is training and drills. Therefore uninspected vessels should at minimum:

- Have training materials relating to emergency equipment and procedures readily available on board
- Ensure every crewmember on board is familiar with emergency duties before a voyage.
- Provide a safety briefing for special personnel/science party before sailing or immediately after sailing.

Drills shall include:

- One fire and abandon ship drill every month and within 24 hours of leaving port.

- As far as practical, rescue boats should be launched with assigned crew aboard and maneuvered in the water at a minimum of every three months.
- Emergency lighting for muster and abandon ship should be tested at every abandon ship drill.
- Line throwing appliance drills shall be conducted every quarter with actual firing at the Master's discretion.

Every new crewmember shall be provided:

- Onboard training in use of vessels lifesaving appliances, survival craft and fire extinguishing appliances within two weeks of arrival.
- Onboard training in heat, stress, hypothermia and other appropriate first aid.
- Instruction in the use of fire and lifesaving equipment at the same interval as drills.

A record of all training, drills and personnel attending should be maintained on board the vessel. The date, time and type of drill should be documented in the vessel's log.

18. CHARTERING OF NON-UNOLS OR NON-INSTITUTION VESSELS

18.0 INTRODUCTION-

There are occasions that research and/or educational projects require the use a small boat or vessel other than those operated as part of the UNOLS fleet. These research platforms may or may not be under the control of their own institutions. At these times it is necessary to seek suitable vessels with a suitable crew for charter. UNOLS member institutions which operate other vessels or small boats which are not designated as UNOLS vessels are encouraged to comply with the RVSS. In the case of chartering vessel non UNOLS vessels, the requirements of Chapter 18, “Chartering of Non-Institution Vessels” must be complied with.

There have been incidents in the past where PIs, scientists and students, have chartered a vessel which resulted in an accident and/or loss of life. With an inspection and the assistance of their institution’s Marine Operations staff a serious mishap may have been avoided

The purpose of this chapter and the forms in Appendix D are to provide a procedure that will assist in mitigating the risks involved with the chartering of a non-UNOLS and/or non-institution vessel(s). These procedures will assist in ensuring that a qualified vessel(s), appropriate to the task, is employed. This will be accomplished by ensuring the regulations and provisions of the Research Vessel Safety Standards (RVSS) are adhered to through inspections and a systematic confirmation of a chartered vessel’s capabilities, crew competency, proper outfitting, material condition and compliance with applicable safety standards and regulations.

18.1 REFERENCES

- UNOLS RVSS & Appendix D of the UNOLS RVSS
- NSF/OCE policy regarding charter of non-UNOLS vessels provided through correspondence and included in section 18.4 below
- Federal Boat Safety Act of 1971 (Public Law 92-75)
- Commercial Fishing Industry Vessel Safety Act of 1988 (Public Law 100-424)
- Safety of Life at Sea (SOLAS) Passenger Ship Safety Certificate (PSSC)
- U.S. Navy’s Board of Inspection and Survey (INSURV) Inspection (INSURVINST 4730)
- Oceanographic Research Vessel (Title 46 USC 2101 (18))
- Code of Federal Regulations for Uninspected Vessels (Title 46 – Shipping; Subchapter C; Parts 24 – 28)

18.2 REQUIRED BY REGULATIONS FOR ALL VESSELS

The chartering institution or their qualified representative must verify that the chartered vessels are in compliance with all applicable regulations.

18.2.1 INSPECTED VESSELS

Use the vessel's letter of inspection to help determine suitability for charter.

18.2.2 CLASSED, SOLAS, & UNINSPECTED VESSELS

See Below.

18.2.3 OTHER REGULATIONS

See Below.

18.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

Chartered vessels must be able to prove adherence to applicable local, federal and international regulations.

18.4 REQUIRED STANDARDS UNDER THE RVSS

When a UNOLS institution charters a vessel for research or education that is not operated by UNOLS or their home institution, the procedures of this chapter must be followed. The Principal Investigator, their respective institution's Business, Risk Management, and/or General Counsel's office and the institution's Marine Operations office all have a responsibility to ensure that only vessels that are safe and suitable for a project are chartered. It is recommended that institutions have in place procedures, utilizing the expertise of their Marine Operations staff, or the Marine Operations staff of a UNOLS institution, to ensure that all applicable documentation, inspections and licenses to which the vessel is subject to are complete and current. Particular attention should be paid to the safety, material condition, and crew competency of vessel(s) chartered.

When funding support from the National Science Foundation, Division of Ocean Sciences (NSF/OCE) is used for the charter of a non-UNOLS or non-institution vessel, the requirement is that *the standards of this RVSS* are met for the vessel being chartered. Projects funded from other NSF Divisions, the Office of Naval Research (ONR), the National Oceanic and Atmospheric Administration (NOAA) or other federal agency should follow the requirements of this chapter as a minimum.

The review of pertinent maritime documentation and inspection of the vessel to be chartered should take place as early as possible so any deficiencies encountered can be corrected before the execution of the charter. It is recommended that the correction of deficiencies be completed before entering into the charter agreement or at a minimum before the vessel departs port for operations. The goal is to ensure the chartered vessel meets the safety standards expected of a comparable size UNOLS or institution vessel.

If the resident Marine Operations staff is in charge of chartering, such reviews and inspections occur routinely. The situation becomes more difficult when principal investigators, unfamiliar with marine operations, enter into the chartering of vessels on their own. It is emphasized that all institutions should set up procedures which will ensure safe, effective operations regardless of who undertakes the charter.

Chartered vessels that possess a current U.S. Coast Guard, SOLAS Passenger Ship Safety Certificate or U.S. Navy INSURV inspection certificate have been physically inspected by competent marine personnel. Those inspections may be used to satisfy the requirements of this chapter. A current inspection is one that has been performed within 12 months of the vessel's charter date. Certain large projects, or those involving international cooperation, may require a contract inspection by an NSF approved inspection group. If that is not possible then the principal investigator must provide evidence that the charter vessel follows the RVSS safety standards. The chartering institution's Marine Operations office can assist in verifying these requirements.

Small vessels that carry six or less personnel, and possess a current U.S. Coast Guard safety inspection performed under the Federal Boat Safety Act of 1971 or the Commercial Fishing Industry Vessel Safety Act of 1988, may also satisfy this inspection requirement if the safety requirements are considered sufficient for the expected area of operation and mission. The chartering institution's Marine Operations office can assist in verifying these requirements.

A chartered vessel that does not meet the inspection criteria above must be inspected by the chartering institution's Marine Superintendent (or equivalent) or other competent marine personnel (such as another member of the Marine Operations staff), a marine surveyor, marine architect, etc. that the Marine Superintendent designates. The purpose of this inspection is to ensure the proposed charter vessel meets the safety standards of the RVSS and is otherwise suited for the intended purpose. The *Inspection Checklist for Chartering of Non-UNOLS Vessels*, located in Appendix D, provides the guidelines to be used in conducting the inspections. Once inspected the chartering institution's Marine Operations office will review the inspection provided on the checklist and verify that the RVSS safety standards have been met.

18.4.1 PRE-CHARTER

At the time a Principal Investigator (PI) anticipates the need for a charter, the PI shall notify the institution's Marine Operations office of their intended plans and the identity of the proposed vessel for charter. Working in tandem, it is the PI's and his/her respective Marine Operations office that will determine the suitability of the intended research on a chartered vessel.

A *Vessel Charter Data* form, located in Appendix D, must be completed for each vessel to be chartered. It is the PI's responsibility to collect particulars on the vessel and to have an understanding of the vessel's safety and capability. Vessel data needed includes items like, but not limited to, vessel description, radio call sign, owner and operator's name and addresses, licenses, inspections, surveys, and safety equipment. Once the Vessel Charter Data form is completed it can be presented to the institution's Marine Operations for review and comment.

It is important that the PI and institution's Marine Operations conduct whatever inquiry may be necessary to establish the competency of captain, crew, and operator to provide for a safe voyage. The PI and Marine Operations should ensure the owner has an appropriate Certificate of Inspection, a letter of designation as an Oceanographic Research Vessel or can legally operate as a six passenger charter vessel. Vessels less than 100 gross tons and less than 65 feet in length can carry up to six passengers with a properly licensed master. Vessels over 65 feet should be inspected to carry even one passenger or have a letter of designation that exempts the vessel from Coast Guard Inspection. If the vessel is not otherwise inspected or certificated the institution reserves the right to have the vessel examined by the appropriate Marine Operation's staff or professional marine surveyor if any questions exist as to vessel's condition, stability or general sea worthiness.

If none of the foregoing inspections, certificates, etc. can be obtained in a timely manner, the institution's Marine Operations office should ensure the vessel is inspected by a qualified person or, at their discretion, inspect the vessel themselves prior to charter. To aid in that inspection the inspector should complete the RVSS *Inspection Check List for Chartering of Non-UNOLS Vessels* in Appendix D. Upon completion of this inspection the inspector must provide a copy of the inspection checklist to the PI and institution's Marine Operations office. Consultation with the inspector, PI and Marine Operations staff will result in the approval or denial of the vessel's charter.

Costs associated with complying with these requirements are the responsibility of the research project. If required the institution's Marine Operations can make local trips to inspect vessels at no cost or will endeavor to have inspections made on a cooperative basis by sister UNOLS organizations' Marine Operations. Institution's Marine Operation can attempt to obtain some key equipment (EPIRB, Life Raft, Exposure Suits, etc.) if available for loan when these are not provided by the chartered vessel. However the financial responsibility of insuring that a chartered vessel has the safety equipment required by this policy remains that of the chartering investigator and institution.

Charter vessel operators should carry insurance that is customary and reasonable for the duration and area of operation of the charter to indemnify and save harmless the institution in case of any damage or loss occurring either directly or indirectly as a result of the charter. Charter vessel operators should carry insurance that covers the vessel crew and scientific complement. Institution standards will dictate the type of vessel insurance (such as Hull, Protection & Indemnity and Collision Liability insurance or Protection & Indemnity) and limits of liability of such policies. It is recommended that Charter vessel owners will provide an Insurance Certificate that shows they meet the institution's standards at the time of execution of the charter.

Each institution should develop some type of vessel or time charter agreement or contract for all vessel charters. Many institutions already have a charter agreement/contract in place. If your institution does not have one it is recommended you contact another UNOLS institution to obtain a copy of their charter agreement/contract. The charter agreement/contract should be formulated, agreed to and approved by, at a minimum, the institution's Marine Operations Office, Business Office, General Counsel, Risk Management and/or a similar institution office.

Agreement and execution of a vessel charter agreement/contract should be signed by the institution (head of the institution's Marine Operations, the PI, an institution's designee like the Business Office, General Counsel, Risk Management, etc.) and the vessel's captain or owner. Each institution's procedures and policies are different therefore each institution should establish their own formal procedure for documenting approvals of vessel charters.

All operations that will occur during the charter must meet the applicable federal, state and local regulations. It is the PI's responsibility to ensure all the necessary permits, regulations, and/or institutional responsibilities are in place.

All embarked scientist should meet basic medical standards, especially if the vessel chartered is not a vessel under U.S. flag. Medical standards on an uninspected vessel can be minimal. It is prudent for the PI and the institution to have each scientist complete a basic medical form, which is kept in a secure place with the PI or Chief Scientist on the chartered vessel, and can be used in case of an emergency. PI's can check with their institution's Marine Operations office for example of medical forms used in the marine industry.

Wide distribution of the institution's procedures and the RVSS requirements will ensure PI's are aware of the requirements, especially the safety-related terms of the charter.

18.4.2 DURING CHARTER

The Principal Investigator (PI), in cooperation with their respective Marine Operation's office, must designate a contact office or person (called Designated Official Contact or DOC) with whom all communications will go through during the vessel charter. The DOC must be available at all times during the charter. The DOC must be land based and is recommended be part of the PI's institution. It is the PI's responsibility to disseminate the DOC's contact information to all scientists aboard the charter as well as the chartered vessel's captain, vessel's owner and their respective office. The vessel captain should have their own shore based contact (called the vessel's contact). The PI should provide the DOC the vessel's contact information thus streamlining all communications during the charter.

The PI must compile a list of names for all scientific personnel participating in a charter voyage which includes emergency contact information (next of kin, addresses and telephone numbers). This personnel list must be filed with the DOC before the vessel's departure from port.

While aboard the chartered vessel all embarked scientists must abide by the standards of personal behavior and individual safety as is delineated in Chapter 6 (Personal Behavior and Individual Safety) of the RVSS.

The PI, Chief Scientist or vessel Captain must prepare a Chartered Vessel Cruise Plan (example found in Appendix D) for each voyage. The Cruise Plan shall include, as a minimum, the elements listed in the Cruise Plan in Appendix D and in the paragraph regarding cruise/voyage plans in Chapter 4.3.2.6 of these RVSS. The Cruise Plan shall be submitted to the vessel's contact and the DOC. A copy of the Cruise Plan must remain aboard the charter vessel with the Captain and PI or Chief Scientist. The PI, Chief Scientist or vessel Captain must report all significant cruise plan changes to the vessel's contact and the DOC.

The vessel captain must report to the vessel's contact all vessel departures and arrivals from port, a return to port notice within two hours of the scheduled arrival time, and notice of a change in cruise plan if the vessel is to be more than two hours late. If a vessel's contact does not exist then the DOC will receive these change notices. The DOC will initiate procedures for query, notification and action if reports are not received in the time frames noted.

For voyages planned to last over 24 hours the DOC should also receive daily reports of the vessel's present location, and planned movements for the next 24 hours. This report should also include reports of adverse weather, equipment failures or other factors affecting the vessel and its planned operations. These reports can be sent via radio, email, text message or voice.

18.4.3 POST CHARTER

Upon completion of the charter it is recommended the PI provide Marine Operations with some kind of evaluation of the vessel charter. This evaluation can then be disseminated to not only the home institution but to all UNOLS institutions. This information can then be used to not only find safe, reliable vessels to charter, but also provide information on vessels that should not be chartered.

18.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

18.6 RECOMMENDATIONS AND BEST PRACTICES

None.

19. SHIP-BASED AIRCRAFT OPERATIONS

19.0 INTRODUCTION

Marine science researchers have employed aircraft as productive platforms for supporting ocean observations and research since the middle of the 20th Century. More recently, the emergence of unmanned aircraft, both remotely piloted and autonomous, holds significant promise as a means to significantly expand the visual and electromagnetic horizon of research ships, providing cost-effective employment of off-board sensors for conducting marine science research missions. In the near future, the inventory of oceanographic aircraft used by the UNOLS community will likely change, but the concerns for safely embarking and utilizing such assets on board or in conjunction with oceanographic research ships will remain. The terms “Unmanned-Air Vehicles (UAVs)” and “Unmanned Aerial Systems (UAS)” are used interchangeably throughout this chapter. The more general terms “aircraft” and “platform” and “vehicle” may refer to manned and/or unmanned aircraft, within the context whereby these terms are utilized.

Safety, both for the personnel embarked aboard a manned research aircraft, and for those aboard the supporting ship (both for manned and unmanned aircraft), is paramount in establishing the operating procedures under which oceanographic aviation platforms are employed in science research missions. Over the years, aircraft operating institutions and Federal agencies such as NOAA, the Navy and the USCG have each developed checklists, personnel training syllabi, testing procedures, maintenance intervals, and safety reviews. Conscientious operators likewise will keep pace with advances in material sciences, air platform design, operational envelopes, metallurgy, composites, sensor systems, aircraft handling, launch and recovery systems, embarked electronics, and science data processing and they will continually seek to improve these systems in their relevance and utility for the science users, in training of operational personnel, and in overall safety.

An embarked aerial support system consists of three major components: the aviation vehicle, the surface ship platform, and the on-board system that encompasses launch and recovery and handling the aircraft on deck. A focus on the essential synergy of these three elements can provide an effective and safe tool for marine science research and exploration, and for the personnel supporting this endeavor. Common Certifying agencies in the U.S. are the Federal Aviation Administration, the U.S. Navy NAVSEA, and the U. S. Coast Guard.

19.1 REFERENCES

- USN NATOPS

- USCG (ref. Document here)
- NOAA (ref. Document here)

19.2 19.2 REQUIRED BY REGULATION FOR ALL VESSELS

Regulations based on type and certification of aircraft and regulatory status of vessel.

19.3 19.3 REQUIRED REGULATIONS FOR CERTAIN VESSELS

19.3.1 INSPECTED VESSELS
None.

19.3.2 CLASSED VESSELS
None.

19.3.3 SOLAS VESSELS
None.
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19.3.4 UNINSPECTED VESSELS
None.

19.3.5 OTHER REGULATIONS
None.

19.4 REQUIRED STANDARDS UNDER RVSS

19.4.1 UNOLS AIRCRAFT OPERATIONS SAFETY STANDARDS

Any UNOLS vessel or vessel chartered by a UNOLS institution in accordance with Chapter 18 of these standards will adhere to the UNOLS Aircraft Operations Safety Standards when conducting any operations involving aircraft designed to carry human occupants, or, if unmanned, to be launched from and recovered aboard UNOLS vessels.

Aircraft platforms must meet all applicable inspection or certification standards applicable, and be currently certified as required by such bodies recognized for that purpose within established regulatory compliance regimes.

19.4.2 AIRCRAFT-CAPABLE OCEANOGRAPHIC SHIP

The vessel must have the ability to conduct two-way communications with the aircraft at the ranges and altitudes throughout the designed operating envelope of the air vehicle in whatever sea state or atmospheric weather conditions within which operations are to be conducted.

Typically, this will include line-of-sight VHF/UHF radio telemetry communications, but relay between aircraft and satellite communications systems may be utilized for over-the-horizon connectivity. A Loss-of-Communication Procedure must be provided. The aircraft-operating ship must have a means for electronic tracking of the position and altitude of the aircraft. This may be accomplished by means of ship's air-search radar, ADS-B or a similar self-reporting system, or such future technologies as may become available. Antennas for tracking and communications systems, both on the surface ship and on the aircraft, must be mounted so that there are no blocked azimuth angles, and so that the propagation covers maximum horizontal distances and altitudes expected to be encountered under both normal and emergency operational scenarios. Personnel assigned to operation of the tracking/communications equipment on the ship must be provided with proper training, spare parts, and technical support. The importance of training cannot be over-emphasized. Please see HOV Safety Standards Chapter 7 and 12 for cross-reference.

The surface support ship must be able to determine, with precision and certainty, the type of airspace in which the aircraft will be operating, and all applicable regulations pertinent to that airspace. Sufficient spares, backup systems and technical support of essential components must be provided.

Rescue assets and outside assistance for a ditched manned-aircraft may, depending upon operating area and environmental conditions, be days away. The surface support ship must be equipped with, and prepared for, a self-rescue capability. This may consist of a second aircraft, along with a ROV system, and a rescue boat. The self-rescue system must be operational over the distances and in the conditions in which the aircraft is capable of operating. Realistic drills and exercises, simulating an aircraft rescue scenario shall be held at regular intervals, no less than once a year, and the results must be documented to assure the integrity of the rescue equipment and to familiarize the personnel on the surface ship and the aircraft operators with its use. These may include tabletop exercises or comprehensive reviews of safety or rescue plans.

In the event of ditching a manned aircraft, life support for at least 72 hours must be available in the aircraft (i.e. life rafts, immersion suits, emergency signaling equipment, water and food).

19.4.3 CHAIN-OF-COMMAND DURING AIRCRAFT OPERATIONS

As per maritime law and tradition, the Master retains responsibility for and authority over all operations conducted aboard the ship, including the deployment of any off-board vehicles employed by the vessel and its embarked personnel. The Aviation Component Leader (or other appropriate official title) is responsible for and has authority over the air vehicle and personnel embarked aboard the ship for its operation and maintenance. The designated aircraft (whether manned or remotely-operated) pilot commands his or her vehicle and has responsibility for and authority over its safe operation. The Chief Scientist, as described elsewhere in this document, is in charge of the mission. Unless accomplishment of the expedition plan is unsafe or illegal, the Master and other key individuals responsible for oceanographic aircraft operations should make every attempt to facilitate science needs. Four persons have launch veto authority. The Master, the Aviation Component Leader, the aircraft pilot, or the Chief Scientist can make a “no-go” decision. (On occasion, the aircraft pilot may also fill the role of Aviation Component Leader.) The others may not outvote or over-ride such a call. A decision to proceed with an aircraft launch should be a consensus decision of these key leadership personnel, but it must be understood that a majority cannot overrule a “hold” or “no go” determination by any one of these key personnel. Similarly, a decision to terminate a flight early and to recover the aircraft may become necessary due to a change in the weather, mechanical issues on the aircraft or the research ship, conflicting traffic (airborne or on the surface), or personnel needs. Again, any one of the key leadership personnel identified above can order an early termination of the flight. The final say on the actual timing of the aircraft recovery (unless there is a situation requiring the aircraft to make an emergency descent) is routinely deferred to the ship’s Master who will take into account actual surface conditions and the position of the ship with respect to the aircraft, maneuvering the ship as required for the recovery procedure.

19.4.4 SHIP PROCEDURES WHILE OPERATING AIRCRAFT

Prior to the commencement of aircraft launch procedures, the following steps must be taken: (Operators will define specific step-by-step checklists.)
• Assessment of weather, sea-state, and visibility, forecast out to the anticipated end time of the flight and recovery plus long-range forecasts for the life support capabilities of a manned aircraft in emergency conditions.
• Assessment of the operating area including winds, sea-conditions, ceiling and restrictions to visibility, and the possible presence of other hazards that creates an undue risk of damage to or loss of the aircraft.
• Assessment of air and surface traffic, especially in areas of heavy maritime or airborne activity.
• Establishment of radio and vehicle tracking protocol, selection of frequencies and intervals for communications with the aircraft, and announcements on the radio guard channels to provide warnings for other aircraft and/or shipping.
• Conducting planning meetings, as needed, including the Aviation Component Leader, the aircraft Pilot, the Chief Scientist, and the Scientist(s)/Observer(s) who may be embarking in a manned aircraft, and ship personnel as required.
• Assignment of launch/recovery personnel and the handling system operator. Ensuring that all deck personnel are equipped with Personal Floatation Devices (PFDs), hard-hats, and proper footwear, and that common signals are understood by all. Verifying clear two-way communications between the deck, the launch and recovery system control location, and the bridge watch-keepers.
• Continuous evaluation of conditions and hazards during the flight operations.
• Establishing an unambiguous decision process for an abort of flight operations and aircraft recovery in the event of an emergency, inclement weather, or other unanticipated event.
• Establishment of an area of the deck that is off limits to non-essential personnel during launch and recovery of the aircraft.

The institution’s Procedures Manual must address unique operations such as multiple simultaneous aircraft operations, or aircraft operations conducted simultaneously with other deck or over-the-side operations or with embarked submersible assets such as HOVs, AUVs, and ROVs, drills, and coordination with other research vessels present in the immediate area.

19.4.5 ISM AND SHIP-BASED AIRCRAFT OPERATIONS

All UNOLS Ocean Class and Global Class ships operate under ongoing safety management systems as per the International Safety Management (ISM) treaty and national implementing laws and regulations. Smaller vessels in the UNOLS fleet are encouraged to comply with ISM to the fullest extent possible. ISM Procedures for UNOLS vessels already mandate specific written plans for over-the-side science operations; however these may be fairly generic. Ships conducting launch and recovery of aircraft shall also define specific procedures and include them in their reviewed and approved ISM handbooks and other documentation, as required. These will likely include, at a minimum:

• Trained personnel on the ship required for launch and recovery operations.
• Chain-of-Command and designation of lead personnel during operations.
• Communications between the deck, the handling system control position, the bridge and the aircraft.
• Weather and operational safety constraints.

19.4.6 SHIP-MOUNTED AIRCRAFT LAUNCH/RECOVERY SYSTEMS

Additional information regarding handling systems for embarked manned submersibles is covered in the UNOLS publication: Safety Standards for Human Occupied Vehicles, Chapter 6. In a general sense, these provide a useful template for the safe installation and utilization of aircraft handling systems.

In broad terms, an aircraft handling system for the launch and recovery of a UAS is typically a robust, specially designed piece (or pieces) of precision equipment, built, operated and maintained to exacting standards so that the delicate aircraft platform can be safely and securely transferred from the deck, and launched into the air, and then recovered after the flight--while under full control during the widest possible window of sea-state conditions. The handling system:

• Must meet operational standards and be certified by the manufacturer and possibly under ABS, NAVSEA or other appropriate system certification, or another classification society.
• Ship and aircraft system operators must make themselves aware of any regulations, promulgated by the USCG or the FAA, or internationally by ICAO, or classification societies that may require equipment to be type-approved and periodically tested or re-certified in compliance with regulations related to the anticipated operation and deployment of an aircraft, manned or un-manned.
• Must have operator qualifications and training established by the aircraft operating institution.

• The use of an aircraft launch and recovery system for purposes other than its intended purpose of launching and recovering aircraft requires approval of the manufacturer and/or certifying authority.

19.5 REQUIRED BY RVSS UNDER CERTAIN CIRCUMSTANCES

None.

19.6 RECOMMENDATIONS AND BEST PRACTICES

(These will be contained in a separate document to be provided by the UNOLS Scientific Committee for Oceanographic Aircraft Operations.)

19.6.1 ADDITIONAL DESIRABLE CAPABILITIES OF AN AIR-CAPABLE SHIP

A vessel operating an aircraft should offer adequate space for routine servicing and maintenance of the embarked aircraft, its sensor systems and support equipment. This may include such elements as a machine shop, an electronics shop, or a dedicated space on board for these functions. Separate storage space for the aircraft's spare parts should be provided in a secure location where they will not be depleted to meet other routine ship maintenance needs. Since maintenance and battery charging or re-fueling often take place at night, adequate lighting of the aircraft work area should be provided. The lighting should be aimed so as to illuminate the aircraft and the working environment around it, while not blinding the bridge watch-keeping personnel.

The ship should be equipped with a tracking system, which can continuously and without interruption update the position of the aircraft while it is operating. Every effort should be employed to provide timely data of considerable utility to the science investigators and also enhance safety and security by providing enhanced situational awareness, both during normal operations and during an emergency.

Dynamic positioning systems may enhance the ability of the support ship to carryout the aircraft's mission. These systems serve to efficiently keep the vessel within a defined circle of position which capability may be useful during recovery operations. Some systems permit automatic tracking of an off-board vehicle's transponder, moving the surface ship in concert with the other platform.

19.6.2 TRAINING SHIP-BASSED AVIATION SUPPORT PERSONNEL

Aircraft support from a surface ship is sufficiently unique as to require specialized training for personnel involved in these operations. This training should include the Master, the bridge watch-keeping officers, the radar observer and communications and tracking operators, off-board recovery personnel (if an aircraft that lands in the water is used), deck personnel, and launch/recovery system operators. As required for seagoing personnel under ISM, a syllabus for training shall be established and sign-off documents of training milestones and qualifications shall be maintained.

Emergency exercises and drills shall be held to verify the readiness of the rescue and emergency equipment and the personnel tasked with its employment. Pre-flight briefs and post-flight debriefs along with post exercise critiques are useful practices for advising personnel about performance needs and opportunities for improvements.

Institutions operating oceanographic aircraft are encouraged to share experiences through professional organizations, technical journals and publications, aircraft operations sessions at national meetings and informal communications.

<u>APPENDICES</u>

A. UNOLS Rope and Cable Safe Working Load Standards
B. UNOLS Load Handling System Design Standards
C. Safety Inspection Check List for Shipboard Vans
D. Inspection Check List for Chartering Non-UNOLS Vessels
E. Sexual Harassment Brochure
F. List of Acronyms

APPENDIX A
UNOLS Rope and Cable Safe Working Standards

Revision 2 09/03/2014

A.0. Introduction

46 CFR 189.35 – “Weight Handling Gear” describes design standards for handling systems aboard inspected oceanographic research vessels. However, this standard does not address Factor of Safety (FS) on the tension members. The purpose of this appendix to the RVSS is to establish safe and effective operating limits for vessels in the UNOLS fleet for tension members loaded beyond traditional shore-side limits.
This standard seeks to define the requirements, which must be adhered to during over-the-side deployments in order to maintain a safe working environment for all personnel aboard. The secondary goal of this standard is to minimize damage to tension members and handling equipment, and the loss of scientific equipment, while still permitting the science objective to be met.
Normal operation beyond the parameters defined in this standard is forbidden. Exceptions to this are an emergency situation declared by the Master or other officer in charge of the vessel as noted in Section A.8.4.

A.1. References

A.1.1. <u>HANDBOOK OF OCEANOGRAPHIC WINCH, WIRE AND CABLE TECHNOLOGY, Third Edition.</u>

A.1.2. <u>Mechanics of Materials, Second Edition, Gere and Timoshenko, 1984</u>

A.1.3. <u>Wires and Cables Deployed Overside of RVS Vessel – Generic Operating Limits, Document Number SE301050, Issue No.: 001, 12/01/00.</u>

A.1.4. <u>Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities, ABS, 2014, Section 17 Handling Systems</u>

A.1.5. <u>UNOLS Wire Pool Wire Maintenance Policy, 2014</u>

A.2. Definitions

A.2.1. <u>Assigned Breaking Load, (ABL)</u>	Will be the lowest of the Nominal Breaking Load and Tested Breaking Load. In practice ABL will be equal to NBL used unless testing shows TBL to be less than NBL. An ABL that is greater than the NBL may never be used. Depending on the intended use of the tension member there may be two ABLs for fixed end and free to rotate conditions.
A.2.2. <u>Auto-Render</u>	The capability of the winch to automatically pay out at a pre-set maximum tension in order to prevent the tension member from exceeding the pre-set tension.
A.2.3. <u>Cable</u>	A woven, flexible tension member with internal conductors or other means of transmitting data such as glass fiber.
A.2.4. <u>“D”</u>	The root diameter of the sheave.
A.2.5. <u>“d”</u>	The outside diameter of the cable or rope.
A.2.6. <u>“d1”</u>	For cable the largest diameter wire in the armor wires. For wire rope the largest of the outer wires.
A.2.7. <u>Dynamic Loads</u>	Loads induced due to vessel motion (heave, roll, pitch, etc.)
A.2.8. <u>Elastic Limit</u>	The elastic limit or yield point of a material is the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed some fraction of the deformation will be permanent and non-reversible. For rope or cable this is the load that causes permanent set, or

	deformation, of the wires. (See Background Information)

A.2.9. <u>Estimated Maximum Tension (EMT)</u>	An estimate of the greatest line tension that will occur during a given deployment. It's calculated using specific properties of the OHS, the science package, and other factors.
A.2.10. <u>Factor of Safety (FS)</u>	Factor of Safety is defined as the ratio of the maximum stress that a structural part of other piece of material can withstand to the maximum stress estimated for it in the use for which it is designed. For the purposes of this standard, FS shall be considered the value selected by the operator. Section A.8 defines the minimum standards that must be met to select specific FS values.
A.2.11. <u>Fixed Ends (FE)</u>	Both ends of the tension member being fixed without the ability to swivel. Most wire rope and cable NBL values are based on FE. An example of a fixed end application is towing a MOCNESS.
A.2.12. <u>Free to Rotate</u>	The end of the tension member is free to rotate either because a swivel is at the end of the tension member or the package at the end of the tension member can rotate freely. Tension members used in free to rotate applications typically have a NBL below the fixed end NBL. An example of a free to rotate application is a lowered CTD package.
A.2.13. <u>"g"- question on def.</u>	The vertical acceleration due to gravity. For normal static loading (no dynamic effect), "g" is equal to 1.0. To take into account dynamic effect due to ship's motion and package drag, the simple static load is multiplied by a factor higher than 1.0. Under ABS standards, normally 1.75 or 2.0 for vertical accelerations is used depending on the application. "g" is applied to the mass of the package and tension member, not the weight. For permanently installed systems, consideration may be given to lesser loads where it can be shown that the maximum expected loads are less than those given above. (Ref A.1.4)
A.2.14. <u>Induced Rotation</u>	Induced rotation occurs when external forces cause torque to be applied to the tension member. An example of an induced rotation situation would be a tow vehicle that spins while being towed but a swivel is not in place to decouple the vehicle from the tension member. This situation could develop if the tail fin of a corer was bent. Induced rotation should never be allowed to occur on a tension member that has not been specifically designed for this purpose.
A.2.15. <u>Nominal Breaking Load (NBL)</u>	Manufacturer's minimum published breaking load for a rope or cable.
A.2.16. <u>Render-and-Recover</u>	A winch's combined ability to auto render, then haul the tension member back when the tension drops to an amount below the pre-set tension. Generally recovery haul back is limited to the point of the initial rendering.

A.2.17. <u>Rope</u>	A woven, flexible tension member with no internal conductors. It may be made from natural fibers, synthetic fibers, or metal.
A.2.18. <u>Safe Working Tension (SWT)</u>	The maximum tension that is allowed to be applied to the tension member during normal operation. SWT = ABL / FS Because there may be two different ABLs (fixed end & free to rotate) there may be two SWTs.
A.2.19. <u>Tension Member</u>	Generic name used to describe a rope or cable in service for over the side work.
A.2.20. <u>Tested Breaking Load (TBL)</u>	The actual load required to pull a tension member to destruction as determined by testing. Depending on the intended use of the tension member testing may need to be done under fixed end and free to rotate conditions.
A.2.21. <u>Transient Loads</u>	Loads induced which are temporary by nature, including the weight of entrained mud, weight of entrained water, pull out loads, drag due to package characteristics and/or winch speed, etc.
A.2.22. <u>"w"</u>	The width of the sheave groove supporting the sides of the tension member.
A.2.23. <u>Winch Owner</u>	The party or their representative who is normally responsible for the operation, inspection, maintenance, and testing of the winch. This could be the vessel operator or the scientific party.

A.3. Limitations

Loading limitations are expressed in terms of Factor of Safety (FS) on Assigned Breaking Load (ABL) in this document.

The limits in this document may not be used where other regulations are applicable, for example, on cargo cranes. In such cases, the shore-side regulations, which apply, must be adhered to. For example, the Occupational Safety and Health Administration (OSHA) generally require a 5.0 FS on cable breaking strength.

This standard assumes that the tension member is properly used for its intended purpose.

A.4. Compliance Dates

This standard went into effect 01 June 2011 with the exception of rollers. The addition of rollers to the requirements in

Table A.8.1 to Table A.8.4 was incorporated into the RVSS as part of Revision 1 to Appendix A. Roller diameter shall meet this requirement as soon as the appropriate equipment modifications can be funded and purchased and no later than 01 June 2015. Additionally as part of Revision 1 to Appendix A, Table 6.1 for operating with a FS of 5.0 or greater has been modified to require sheave and roller diameters "as large as practicable" versus equal or greater than the manufacturer's recommendations.

A.5. Testing and Preventative Requirements

A.5.1. Testing Program

Cable paths and fairlead arrangements vary widely from ship to ship and change over both the short term (from cruise to cruise) and the life of the vessel. It is impossible to develop a set of standards, which tries to quantify the precise effects on breaking strength, or tension member life, as a result of system design. Instead, each vessel must have a testing program in place, which suits how their tension members are used, and routinely evaluates the status of each. The assumption is that the results of testing will indicate the effect of both the loading and system design on the breaking strength of the tension member.

The testing program followed shall be based on the FS selected by the Owner, which is in turn based on use and the particulars of the handling system employed. The Owner shall have documentation in place specifying the FS for each tension member in use.

Tension member test samples shall be a clean, "representative" length from the end that will be put into future use, not simply the end immediately adjacent to the existing termination. Although this may not be the location of maximum loading during operations, this represents a practical means of determining ABL from an operational standpoint.

The initial ABL shall be assigned through testing by the UNOLS Wire Pool before distribution to the fleet. If the initial test results in an ABL less than the NBL, the Wire Pool shall reject the tension member.

If subsequent testing results in a TBL that is greater than or equal to the initial ABL, the initial ABL shall be used by the Vessel Operation for the purposes of this standard.

If subsequent testing results in a TBL that is less than the initial ABL, then the new TBL shall be used in lieu of the initial ABL by the Vessel Operation for the purposes of this standard.

A.5.2. Method of determining (TBL) – Steel Wires and Cables

ASTM A931-96, "Standard Test Method for Tension Testing of Wire Rope and Strand" (Re-approved 2002) shall be used. Tests shall be done with one end of the tension member free to rotate.

The Vessel Operator shall send samples to a UNOLS-accepted test facility (UNOLS Wire Pool at WHOI) for consistency of testing purposes and maintaining statistics. For steel cables and wire rope, the Operation shall send a five-meter (16 ft.) test sample (as described in Section 4.3) terminated on both ends with the fittings normally used in the field. If the field terminations are found to not develop full breaking strength, a test may be conducted using standard poured epoxy resin terminations.

The Vessel Operator shall also provide a copy of the wire history or wire log information with the sample and, as a minimum, this should include the following:

- UNOLS wire identifier, as described in Chapter 7 UNOLS Winch and Wire Handbook, Third Edition
- Winch and system manufacturer.
- Number and/or duration of deployments since last test.
- Maximum tension of each deployment.
- Maximum payout of each deployment.
- Description of wire train: the number of sheaves between winch and water. Sheave material and values of “D” and “w” for each sheave.

Lubrication Log- A log of the lubrication and maintenance on the wire shall be maintained.

A hard copy and/or electronic copy of the TBL test results and ABL will be provided to the Vessel Operator for each sample tested.

A.5.3. Method of determining (TBL) – Synthetic Tension Members

Reserved

A.5.4. Electromagnetic Testing

Reserved

A.5.5. DC Resistance Testing

Reserved

A.5.6. Retirement of Steel Tension Members

Beside obvious physical damage (kinks, bird caging, abrasion, broken strands, excessive corrosion, etc.), a length of tension member shall be removed from service, or cut back so that the unacceptable length is removed, if any of the three following criteria are met:

- If the ABL, with the appropriate FS applied as described above, does not meet future scientific requirements.
- If the ABL deteriorates below 50% of NBL.
- Peak tension over turning sheaves at any time during operations exceeds the Elastic Limit (FS of 1.8 for cable, FS of 1.33 for wire rope).

A.5.7. Retirement – Synthetic Tension Members

Reserved

A.5.8. Lubrication

Appendix A does not directly deal with requirements for tension member lubrication. Lubrication of tension members is detailed in the UNOLS Wire Pool Wire Maintenance Policy (Ref A.1.5). This policy prescribes the application of a lube/corrosion inhibitor at a frequency of no less than once every twelve months while in service and when the tension member is taken out of service.

A.5.9. Fresh Water Wash Down

While understanding that fresh water is limited at sea, an automatic system that washes the tension member on retrieval is highly encouraged since it greatly extends service life. This is expanded upon in the UNOLS Wire Pool Wire Maintenance Policy. The policy dictates for a tension member in use that a wash down occur at the end of every cruise, but at an interval no greater than one month.

A.6. Background Information

A.6.1. Performance Over a Rolling Sheave

When a steel wire rope or cable passes over a rolling sheave, up to a 30% reduction in breaking strength occurs (Ref A.1.1 Section 6.4, Pg. 8-22). For a tension member with a nominal breaking load of 10,000 lbs., this would be a reduction in strength of 3,000 lbs. to an anticipated breaking load of 7,000 lbs. Using a FS of 1.5 in this example, the Safe Working Tension equals 6,667 lbs., just below the reduced strength anticipated. Since all oceanographic tension members pass over at least one sheave, this is the primary argument for not exceeding a FS of 1.5.

A.6.2. Yield Point and Elastic Limit

“Yield Point” is where continued deformation will occur without adding significantly more load. The “Elastic Limit” is considered to be the load, which induces permanent set or deformation. For steel, the “Yield Point” and “Elastic Limit” are essentially the same for all practical purposes. However, these two points may be quite different for other materials such as synthetics and glass fiber. Since wire rope and cables are made of strands and are not solid bars of steel, the precise Yield Point can be hard to determine by testing. A point on the stress-strain curve known as “0.2% Offset Yield” is used instead. The 0.2% Offset Yield for three-strand wire rope can be found in Section 2.2 (pg. 1-5) of Reference A.1.1.

For cables with copper conductors, the yield point generally occurs anywhere from 50-55% of the breaking strength (FS = 1.8) at which point the performance of conductors deteriorates. This is the principle argument for not exceeding a FS of 2.0 for steel cables with copper conductors, the goal being to maintain conductor performance over the life of the cable.

For wire rope, the yield point generally occurs around 75% of the breaking strength (FS = 1.33). This is the other reason for not exceeding a FS of 1.5 on steel wire rope, the goal being to maintain the useful life of the wire rope. This limit matches well with the performance over rolling sheaves above.

A.6.3. Tension Monitoring Justification

When using low FS in oceanographic research, the capabilities of the tension member monitoring system become critical with respect to capturing and displaying dynamic loads. This standard is divided into four primary sections (

Table A.8.1– Table A.8.4), with each section having increasingly stringent requirements for the monitoring system. If the monitoring system is not capable of reliably capturing peak (or low) dynamic loads, then the chosen FS must keep the tension member below its yield point.

For example, on a tension member with a breaking strength of 20,000 lbs., the approximate yield point would be 20,000 x 0.75 = 15,000 lbs. Using a FS of 2.5, the allowable loading would be 20,000/2.5 = 8,000. If the system is not capable of reliably capturing dynamic effect, then a worst case scenario of 1.75 times static load would have to be assumed (i.e. "g" = 1.75), or 8,000 x 1.75 = 14,000. 14,000 is below the approximate yield strength of 15,000 so the integrity of the tension member would be preserved despite the monitoring system. Figure 1 illustrates this, and is why a FS of 2.5 is used as the lower limit in Table A.8.2.

Figure 1: Tension Member Integrity

When a tension measuring system is not available which forces using a minimal FS of 5.0, EMT calculations must be done based on mass not weight. In general, the weight of the package, entrained water and the cable or rope in air is roughly equal to the mass. Do not use weight in water for the dynamic loading estimates.

A.7. WINCHES AND HANDLING SYSTEM DESIGN

All handling systems and winches, whether portable or permanently installed, must be properly designed to an appropriate standard as described in Appendix B of the RVSS.

A.7.1. Load Limiting Devices

For operations where the weak link itself might be entangled or buried, then Auto-Render shall be the preferred method of strain relief.

A.7.2. Heave Compensation

Heave compensation may not be used as a load limiting device but may be used to minimize the dynamic accelerations during deployments. When using heave compensation it must be realized that most methods work a small section of a tension member over a sheave or sheave train. For this situation it is important to make adjustments so that a different section of the tension member is worked on each deployment or over extended deployments.

A.8. Requirements

A.8.1. Estimated Maximum Tension(EMT)

This is an assessment of the maximum tension that a payload can exert on a tension member during a deployment. The EMT is the sum of static loads (package weight, sample weight, tension member weight), quasi-static loads (drag force), transient loads (pull out forces), and dynamic loads (the effects due to accelerations from heave). Not every deployment will involve every type of load.

The effect the EMT has on a given deployment depends on the monitoring system employed. For cases where there is no monitoring system or a low resolution monitoring system (as described in

Table A.8.1 and Table A.8.2), the EMT for a deployment needs to be equal or less than the SWT of a tension member and the SWT of the OHS (see Appendix B) for a deployment to be allowed. In cases where there is a high resolution monitoring system (as described in Table A.8.3 and Table A.8.4), the EMT without dynamic loads should be less than the tension member SWT and the SWT of the OHS with the provision that should the monitored tension exceed the SWT the deployment will be halted. Section A.9 provides examples of calculating EMT.

A.8.2. Steel Tension Members

Operating tension members with a Factor of Safety (FS) less than 5.0 results in increasingly higher levels of risk to personnel and equipment. To manage the higher risks so that operations stay within a manageable level,

Table A.8.1 to Table A.8.4 were developed. These tables outline the procedures and equipment requirements that must be in place to operate at different ranges of Factor of Safety. It is the operator's discretion at which FS they choose to operate under as long as they meet the requirements for that FS.

The impact that the diameter of sheaves in the wire path have on tension member service life and safety is significant. For higher loads such as those seen when operating with a FS less than 5.0, having adequately sized sheaves is critical. Further study has shown that the diameter of load carrying rollers has an equally critical impact on tension member service life. For this reason Revision 1 to the RVSS Appendix A included load carrying rollers along with sheaves in the requirements of

Table A.8.1 to Table A.8.4. Only load carrying rollers were impacted by Revision 1 to Appendix A. A load carrying roller would be any roller in the wire and cable +path that serves to change the direction of the loaded tension member.
Examples of rollers where the requirements of Appendix A apply:

- Rollers on a level wind whose function is to ensure a small fleet angle to the level wind sheave is maintained. There is the potential for the tension member to come up hard against one of these rollers and change the direction of the tension member when under load.
- Any level wind that only uses rollers without a sheave has the potential for the tension member to come up hard against one of the rollers and change the direction of the tension member when under load.

Examples of rollers where the requirement of Appendix A do not apply:

- Sense rollers such as what are used on an electro-active level wind that senses when a level wind needs to change direction.
- Capture rollers that are there to help keep the tension member in a sheave groove during no load pre and post deployment periods, but that once the tension member is loaded it is not in contact with the capture rollers.

Table A.8.1 Steel Tension Member – Factor of Safety 5.0 or Greater – Minimum Requirements

General	Wire Rope or Cable of steel construction may be operated to a nominal FS = 5.0 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	When the minimum Factor of Safety of 5.0 is reached, the deployment must be halted, or the next level of standards described in Table A.8.2 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the tension member.. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
Tension Monitoring	Tension monitoring is not required. If tension monitoring is not available tension should be determined by calculation of EMT, as long as the Owner is confident that a FS of 5.0 will not be compromised. If no other precise information is available on package drag and/or vessel accelerations, the Vessel Operator should use the ABS "g" factor of 0.75 as a minimum.
Alarms	None
Sheaves & Load Carrying Rollers	The sheave and roller diameter should be as large as practicable.
Deck Safety	Personnel on deck should follow good safety practices when working in the vicinity of tension members during use
Testing	No routine break testing is required. Tension members shall only be tested every two years to the desired SWT, along with the handling system.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description, maximum payout and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the tension member if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Owner and the Master of the vessel must deem competent, in writing, all winch operators. "Deemed Competent" means that both the Owner and the Captain are confident, given the particulars of the winch and the overall operational scenario (weather conditions, equipment being deployed, etc.), that the Winch Operator has the necessary experience to operate the winch safely. If there are configuration changes to controls or to the hardware then the operator qualifications must be refreshed and documented.

Table A.8.2 Steel Tension Member – Factor of Safety From Less Than 5.0 to 2.5 – Minimum Requirements

General	Wire rope or cable of steel construction may be operated to a nominal FS =2.5 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	When the minimum Factor of Safety of 2.5 is reached, the deployment must be halted, or the next level of standards described in Table A.8.3 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the tension member.. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a "zero load" condition.
Tension Monitoring	Tension must be monitored at the winch operator's station with a display refresh rate of at least 3 Hz (every 330 mS). The system must also be capable of logging tension data at a minimum frequency of 3 Hz (every 330 mS). The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed at the selected FS. The tension measuring system must be maintained with an accuracy of 4% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate prior to a FS=2.8 of a wire's Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving of the sheaves should be as close to "d" as practical, and generally no larger than 1.5d.
Deck Safety	The Operator should identify "Danger Zones" around ropes, wires and cables under tension. To the extent possible, given the nature of operations involved, all personnel should be excluded from these zones such that a sudden failure cannot result in injury.
Testing	Wire Samples from the end closest to the termination shall be sent for testing every two (2) years and generally in conjunction with handling system SWT tests. If a 10% decrease in ABL is detected, then the testing shall be increased to annually. Alternately, the Owner may cut back to and re-test a new representative length
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, break tests, lubrication, wire train description,maximum payout and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By "Certified Competent" it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify certifications and designate the approved winch operators. If there are configuration changes to controls or to the hardware then the operator qualifications must be refreshed and documented.

Table A.8.3 Steel Tension Member – Factor of Safety From Less Than 2.5 to 2.0 – Minimum Requirements

General	Wire rope or cable of steel construction may be operated to a nominal FS =2.0 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	FOR CABLES -When the minimum Factor of Safety of 2.0 is reached, the deployment must be halted. FOR WIRE ROPE -When the minimum Factor of Safety of 2.0 is reached, the deployment must be halted, or the next level of standards described in Table A.8.4 must be used.
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a “zero load” condition.
Tension Monitoring	Tension must be monitored at the winch operator’s station with a display refresh rate of at least 10 Hz (every 100mS). The system must also be capable of logging tension data at a minimum frequency of 20 Hz (every 50 mS). Tension must be continuously monitored using a “tension trending” graph at the winch operator’s station. The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed load at the selected FS. The tension measuring system must be maintained with an accuracy of 3% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate prior to a FS=2.2 of a wire’s Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving shall be per Ref A.1.1, Chapter 1, and Section 11.0 to provide adequate support.
Deck Safety	The Operator should identify “Danger Zones” around ropes and wires under tension. To the extent possible, given the nature of operations involved, all personnel shall be excluded from these zones such that a sudden failure cannot result in injury. Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible
Testing	Wire Samples from the end closest to the termination shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months. Alternately, the Owner may cut back to and re-test a new representative length.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description, maximum payout and maximum loading (as determined by monitoring system for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By “Certified Competent” it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify qualifications and designate the approved winch operators. If there are configuration changes to controls or to the hardware then the operator qualifications must be refreshed and documented.

Table A.8.4 Wire Rope – Safety Factor From Less Than 2.0 to 1.5 – Minimum Requirements

General	Wire rope of steel construction may be operated to a nominal FS =1.5 on the ABL, including transient and dynamic loads, as long as the following precautions in this section are adhered to.
	Once a FS = 2.0 is reached a regular check on wire loading shall be performed. This will require halting a deployment at regular intervals (~ 500 m) and conducting a slow haul until the nominal and peak tensions are established and verified. A decision on whether to proceed must then be based upon the limiting value of SF = 1.5. The deployment must be halted, when the minimum Factor of Safety of 1.5 is reached.
	Sea conditions and the resulting ship motion will affect the transient loads created on the wire. Thus, the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.
	Motion-compensation may be used to reduce the dynamic loads below the permissible limit and/or to reduce the chances of a “zero load” condition.
Tension Monitoring	Tension must be monitored at the winch operator’s station with a display refresh rate of at least 10 Hz (every 100mS). The system must also be capable of logging tension data at a minimum frequency of 20 Hz (every 50 mS). Tension must be continuously monitored using a “tension trending” graph at the winch operator’s station. The tension measuring system must be calibrated at a minimum of every 6 months at load equal to the imposed load at the selected FS. The tension measuring system must be maintained with an accuracy of 3% of the applied load.
Alarms	The handling system shall be fitted with both audible and visual tension alarms that sound and illuminate at prior to a FS=1.7 of a wire’s Assigned Breaking Load (ABL). Alarm conditions must automatically be included in the logged data.
Sheaves & Load Carrying Rollers	The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving shall be per Ref A.1.1, Chapter 1, and Section 11.0 to provide adequate support.
Deck Safety	The Operator should identify “Danger Zones” around ropes and wires under tension. To the extent possible, given the nature of operations involved, all personnel shall be excluded from these zones such that a sudden failure cannot result in injury. Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible
Testing	Wire Samples from the end closest to the termination shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months. Alternately, the Owner may cut back to and re-test a new representative length.
Logbooks	At a minimum, the Owner shall maintain logs showing cutbacks, spooling operations, lubrication, wire train description,maximum payout and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or wire. The wire log shall transfer with the wire if it is removed and placed in storage, or transferred to another winch or Owner.
Winch Operator	The Winch Owner must certify that all Winch Operators are competent. By “Certified Competent” it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify qualifications and designate the approved winch operators. If there are configuration changes to controls or to the hardware then the operator qualifications must be refreshed and documented.

A.8.3. Synthetic Tension Members

Reserved

A.8.4. Extenuating Circumstances

Ship operators and their seagoing staff must understand that if, by force of circumstance or by the desire to maintain scientific operations while on a cruise, when they do not meet the operating requirements as described in tables 8.1 through 8.4, they are embarking on a potentially dangerous activity. The consequences of this activity could be loss of valuable equipment, damage to the vessel and its fixed equipment, and, in the worst case, injury to personnel. Operators shall develop a procedure on how, and under what circumstances, the vessel will safely continue operations in the event the operating requirements are not met.

A.9. Examples

A.9.1. Safety Factor of 5.0

Examples of where a SF of 5 has to be used because a tension measuring system is not available or the sheave/roller diameters are smaller than required.

Figure 12

A grab is planned on 500m of 0.25" 3x19 wire rope using a FS of 5.0.		
Assigned Breaking Load (Free to Rotate)	6,750	
Factor of Safety	5	
Safe Working Tension = ABL/FS	1,350	
Weight of Grab (in seawater)	175	
Weight of Sample (in seawater)	25	
Weight of wire rope (in seawater) = 0.284 lbs/m x 500m	142	
Static Total		**342**
Quasi-Static Load (drag)		**35**
Pound-mass of Grab (in air)	200	
Pound-mass of Entrained Mud (in air)	50	
Pound-mass of 500m of wire rope (in air) = 0.327 lbs/m x 500m	164	
Total Mass of System	414	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**310**
Transient Load Pull Out Load	100	**100**
Estimated Maximum Tension Pounds-force		**787**
Because the estimated maximum tension of 787 pounds is less than the SWL of 1,350 pounds it is acceptable to proceed with this grab.		

Figure 2

A CTD cast is planned on 500m of 0.322 cable using FS of 5.0.	
Assigned Breaking Load (Free to Rotate)	10,000

Factor of Safety	5	
Safe Working Tension = ABL/FS	2,000	
Weight of CTD (in seawater)	600	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) = 0.474 lbs/m x 500m	237	
Static Total		**837**
Quasi-Static Load (drag)		**300**
Pound-mass of CTD (in air)	1,000	
Pound-mass of Samples (24btls*10liters sea water =240 liters*2.2lb/l)	528	
Pound-mass of 500m of tension member (in air) = 0.573 lbs/m x 500m	287	
Total Mass of System	1,815	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**1,361**
Transient Load		**-**
Estimated Maximum Tension Pounds-force		**2,498**
Because the estimated maximum tension of 2,498 pounds is more than the SWL of 2,000 pounds it is NOT acceptable to proceed with this CTD cast.		
Vessel Operator must either: know the actual dynamic loading on the package (based on location on vessel, drag, weather conditions, etc.) and/or meet the requirements allowing a lower FS described in Section 6 in order to proceed.		

Figure 3

A tow is planned on 1000m of 0.322" cable using a FS of 5.0.		
Assigned Breaking Load (Fixed Ends)	11,600	
Factor of Safety	5	
Safe Working Tension = ABL/FS	2,320	
Weight of Grab (in seawater)	350	
Weight of Sample (in seawater)	-	
Weight of wire rope (in seawater) = 0.474 lbs/m x 1000m	474	
Static Total		**824**
Quasi-Static Load (drag)		**180**
Pound-mass of Grab (in air)	500	
Pound-mass of Entrained Mud (in air)	-	
Pound-mass of 500m of wire rope (in air) = 0.573 lbs/m x 1000m	573	
Total Mass of System	1,073	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**805**
Transient Load Pull Out Load	-	**-**
Estimated Maximum Tension Pounds-force		**1,809**
Because the estimated maximum tension of 1,809 pounds is less than the SWL of 2,320 pounds it is acceptable to proceed with this grab.		

A.9.2. Finding a Factor of Safety for an Operation

An example of estimating the FS requirements that will need to be met for a particular operation.

Figure 4

A piston core is planned on 4000 m of 9/16" wire rope with an ABL of 32,000 lbs. The winch and frame are both rated for 50,000 lbs.		
Weight of corer (in seawater)	2,000	
Weight of Sample (in seawater)	100	
Weight of 4000 m of wire rope (in seawater) = 1.404 lbs/m x 4000m	5,616	
Static Total		**7,716**
Quasi-Static Load (drag)		**300**
Pound-mass of corer (in air)	2,600	
Pound-mass of mud sample (in air)	350	

Pound-mass of 4000m of cable (in air) = 1.614 lbs/m x 4000 m	6,456	
Total Mass of System	9,406	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**7,055**
Transient Load Pull Out Load		**2,000**
Estimated Maximum Tension Pounds-force		**17,071**
FS = Assigned Breaking Load (32,000)/Estimated Maximum Load (17,071)		**1.87**
In order to proceed with this core the requirements in Section 6 for operating at a safety factor (FS) of 1.5 will need to be met.		
Since there is a "substantial risk" of entanglement with this kind of operation, a weak link should be selected by the Vessel Operator to protect the wire rope and personnel.		

Figure53

A 36-bottle CLIVAR CTD cast deploying 6000 meters of .322-diameter cable is planned. The steel cable has a Free to Rotate ABL of 10,000 lbs. The SWT of the handling system is 10,000 lbs. The minimum FS permitted for E.M. cables is 2.0 per Section 8; therefore the maximum tension allowed on the cable is 5,000 lbs.		
Weight of CTD (in seawater)	1,000	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) 0.474 lbs/m x 6000m	2,844	
Static Total		**3,844**
Quasi-Static Load (drag)		**500**
Pound-mass of CTD (in air)	1,500	
Pound-mass of Samples (36btls*10liters sea water =360 liters*2.2lb/l)	572	
Pound-mass of 6000m of cable (in air) = 0.573 lbs/m x 6000 m	3,438	
Total Mass of System	5,510	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**4,133**
Transient Load		**-**
Estimated Maximum Tension Pounds-force		**8,477**
FS = Assigned Breaking Load (10,000)/Estimated Maximum Tension (8,477)		**1.18**
6,000-meter deployments with a 36-bottle rosette on 0.322 cable easily falls below a FS of 2.0 and can only be accomplished in very calm weather or with motion compensation. Without good cable monitoring this should be a no-go situation.		
Note: It is clear that deep CTD operations using 0.322 cable in heavy weather or with a large/heavy CTD will easily exceed an FS of 2.0 and easily could go lower than 1.5. This is below the advisable limit for conductor cable because of the increased potential failure of the internal conductors. If FS is reduced to this level, parting of the cable or decreased cable life due to failure of internal conductors should be anticipated. Operators should do everything possible to reduce ship or deployment system movement. Operators can use a motion compensation package,auto render, or slow down the rate of winch operation in order to reduce the dynamic loads. As an alternative, a stronger cable could be considered, however most stronger UNOLS Cables also weigh more – see next example		

Figure 6

A CLIVAR CTD cast deploying 6000 meters of 0.680-diameter coax cable is planned. The steel cable has a Free to Rotate ABL of 37,000 lbs. The SWT of the handling system is 45,000 lbs. The minimum FS permitted for E.M. cables is 2.0 per Section 6; therefore the maximum tension allowed on the cable is 18,500 lbs.

The Vessel Operator has chosen to use a FS of 2.0 on the cable under Section 6 above. The Vessel Operator must either know the actual dynamic loading on the package (based on location on vessel, drag, etc.) and/or monitor cable tensions closely as required in Section 5.0, or use motion compensation to reduce dynamic effect.

Weight of CTD (in seawater)	1,000	
Weight of Sample (in seawater)	-	
Weight of tension member (in seawater) 1.814 lbs/m x 6000m	10,884	
Static Total		**11,884**
Quasi-Static Load (drag)		**500**
Pound-mass of CTD (in air)	1,500	
Pound-mass of Samples (36btls*10liters sea water =360 liters*2.2lb/l)	572	
Pound-mass of 6000m of cable (in air) = 2.271 lbs/m x 6000 m	13,626	
Total Mass of System	15,698	
Dynamic Load (multiply Mass Total by 0.75 for g=1.75)		**11,774**
Transient Load		**-**
Estimated Maximum Tension Pounds-force		**24,158**
FS = Assigned Breaking Load (37,000)/Estimated Maximum Tension (24,158)		**1.53**

6,000 meter deployments with a 36-bottle rosette on 0.680 cable gives a slightly better FS than 0.322 cable for deep casts. An even greater FS can be achieved with 0.681 F.O. cable that has a breaking strength of around 46,000 and is only slightly heavier than 0.680. A 36 place CTD with all bottles full can be handled at a FS of 2.0 in conditions that yield a "g" factor as high as 1.4.

Note: In all circumstances, a full ocean depth CTD cast will require using the procedures contained in Table 6.3 for FS between 2.0 and 2.5 as long as a steel cable is being used due to the weight and mass of the deployed cable. The level of tension monitoring will allow the operator to use actual dynamic loading to make decisions about whether or not to continue a cast.

Appendix B

UNOLS Overboard Handling Systems Design Standards and Criteria for the Design and Operation of Overboard Handling Systems

B.0. Introduction

B.0.1. Objective

Appendix B provides a unified code of practice for the design and operation of overboard handling systems used onboard vessels in the UNOLS Fleet. It is not intended to supersede existing regulations. It is intended only to better define acceptable design limits, procedures, documentation, and capabilities for overboard handling systems used specifically for modern oceanographic research.

B.0.2. Acronyms

- ABL Assigned Breaking Load
- CFR Code of Federal Regulations
- CTD Conductivity, Temperature and Depth
- DLT Design Line Tension
- DP Dynamic Positioning
- EMT Estimated Maximum Tension
- FS Factor of Safety
- MCD Maximum Capability Document
- NAME Naval Architecture and Marine Engineering
- NBL Nominal Breaking Load
- NSF National Science Foundation
- OHDD Overboard Handling Data Document
- OHS Overboard Handling System
- RVSS Research Vessel Safety Standards
- SWT Safe Working Tension
- UDT Ultimate Design Tension
- UNOLS University-National Oceanographic Laboratory System
- USCG United States Coast Guard

B.0.3. Definitions

B.0.3.1. Assigned Breaking Load (ABL)	Defined in Appendix A: The lesser of the nominal breaking load (NBL) and the tested breaking load (TBL).
B.0.3.2. Added Mass	The anticipated mass of sampled or entrained material that will be added to the science package or tension member during the course of a deployment.
B.0.3.3. Added Weight	The anticipated weight of sampled or entrained material that will be added to the science package during the course of a deployment.
B.0.3.4. Auto Render	A winch's ability to automatically pay out at a pre-set maximum tension in order to prevent this tension from being exceeded.
B.0.3.5. Coaming	A vertical surface designed to prevent water from entering a vessel; it most commonly refers to the raised plating surrounding a hatch or other opening.
B.0.3.6. Component	Any part of an OHS (e.g. winch, tension member, hydraulic pump, deck bolt).
B.0.3.7. Design Line Tension (DLT)	The greatest line tension an OHS/component is designed to withstand. DLT is further defined in §§ B.4.5 - B.4.7
B.0.3.8. Downflooding	The flooding of a compartment due to water on deck.
B.0.3.9. Drag	A force that arises when fluid flows around a component. It opposes efforts to move the component through the fluid.
B.0.3.10. Estimated Maximum Tension (EMT)	Defined in Appendix A: An estimate of the greatest line tension that will occur during a given deployment. It's calculated using specific properties of the OHS, the science package, and other factors.
B.0.3.11. Factor of Safety (FS)	For components: $FS = S_{fail} / S_{calc}$, where S_{fail} is the stress at which a component yields or otherwise begins to fail, and S_{calc} is the greatest calculated stress in a component when submitted to a line tension (e.g., UDT, DLT or SWT). FS differs for tension members: See Appendix A.
B.0.3.12. Fixed System	A complete or partial OHS permanently installed on a vessel.
B.0.3.13. Inspected Vessel	A vessel that is inspected and certificated by USCG as required by 46 CFR subchapter U.

B.0.3.14. Load Geometry	The range of directions that a tension member might enter into or depart from a component.
B.0.3.15. Maximum Capability Document (MCD)	A document that defines a component/system's safe working tension (SWT). More detailed information about the MCD is given in § B.5
B.0.3.16. Maximum Drag	The greatest anticipated amount of drag that will be imparted upon the package and tension member during the course of a deployment.
B.0.3.17. Maximum Package Mass	The greatest anticipated mass of a science package.
B.0.3.18. Maximum Package Weight	The greatest anticipated weight of a science package in water.
B.0.3.19. Maximum Pull Out Load	The greatest anticipated amount of force that will be required to dislodge an item from the sea floor.
B.0.3.20. Maximum Tension Member Mass	The greatest anticipated mass of a tension member.
B.0.3.21. Maximum Tension Member Weight	The greatest anticipated weight of a tension member in water.
B.0.3.22. Nominal Breaking Load (NBL)	Defined in Appendix A: Manufacturer's minimum published breaking load for a tension member.
B.0.3.23. Overboard Handling Apparatus	The component of the OHS that launches/retrieves a package directly from the water, or maintains the tension member leading to the water (e.g. a-frame, hydro-boom).
B.0.3.24. Overboard Handling Data Document (OHDD)	A data sheet developed by the science party to communicate deployment requirements to the operator. The OHDD is described in detail in § B.3
B.0.3.25. Overboard Handling System (OHS)	A system used to tow objects, to lower them beneath the surface of the water, or to retrieve them from beneath the surface of the water. A system is only considered an OHS if it features a tension member coupling the object and vessel, and payed beneath

	the surface of the water.

B.0.3.26. Owner	An individual or group that possesses the exclusive right to hold, use, benefit from, transfer, or dispose of property, as well as maintain in good working order.
B.0.3.27. Package	Any object launched into or retrieved from the water by an OHS.
B.0.3.28. Portable System	A complete or partial OHS intended for temporary use onboard vessels.
B.0.3.29. Reactions	Forces that arise between connected components when one of them becomes loaded.
B.0.3.30. Render-and-Recover	A winch's combined ability to auto render, then haul the tension member back when the tension drops to an amount below the pre-set tension. Generally recovery haul back is limited to the point of the initial rendering.
B.0.3.31. Rig	To arrange, set up, or prepare for use.
B.0.3.32. Subject Matter Expert	A person with recognized expertise in the subject under consideration. This may include manufacturers, engineers, naval architects, and others with demonstrable expertise. In general, engineering analysis must be accomplished by an engineer or naval architect whose area of competence includes the thermal and mechanical aspects of marine machinery design; they must possess a bachelor's degree in mechanical engineering, NAME, or an equivalent field of study, and be licensed or exempt from licensure in their locale. Analysis of a vessel's structure may only be undertaken by subject matter experts licensed to perform NAME services in their locale.
B.0.3.33. Safe Working Tension (SWT)	The greatest line tension that may be placed on an OHS/component under normal operating conditions. See § B.4.4. SWT differs for tension members: See Appendix A.
B.0.3.34. Tension Member	A generic name used to describe a rope or cable in service for over the side work.
B.0.3.35. Tension Mitigation Device	Hardware and/or technology employed in the OHS that limits the tension member's load to a pre-set value.
B.0.3.36. Ultimate Design Tension	The line tension at which a component begins to yield or otherwise fail. See § B.4.3

(UDT)	
B.0.3.37. User	A group or individual which uses, but does not own an OHS/component.

B.0.4. <u>Scope of Application</u>

Appendix B applies to all overboard handling systems (OHS) used onboard UNOLS vessels including:

- Both fixed systems and portable systems
- Both general purpose systems and dedicated OHS
- Every component of an OHS
- Cranes that are used as OHS components
- Shipboard structures that serve as attachment points for an OHS

OHS and components used onboard *inspected* UNOLS vessels must also comply with the requirements in *46 CFR Subchapter U*.
Appendix B does not apply to the design of components or systems used with human occupied vehicles. Guidance for this activity is set forth in the RVSS chapters <u>*Human Occupied Vehicles*</u> and <u>*UNOLS Safety Standards for Human Occupied Vehicles*</u>.

B.0.5. <u>Date of Application for a New OHS / Component</u>

OHS and components commencing development on or after 07/15/2014 must comply with the requirements of this document.

B.0.6. <u>Date of Application for an Existing OHS / Component</u>

OHS and components already in existence, or those completed before the applicable date above, are to be brought into compliance with these standards by 07/15/2016.

B.0.7. <u>Responsibility for Application</u>

All personnel involved in the design, analysis, manufacture, or operation of an OHS have responsibilities outlined here and elaborated on in following sections. The deployment compliance process is illustrated in a flow chart, which is included as Attachment B.1.

B.0.7.1. The Prospective Owner

When purchasing a new OHS/component, the prospective owner must:

- Work with the manufacturer, or subject matter expert to ensure that all potential uses, deployment types, and configurations are identified
- Ensure the requirements in § B.0.7.7 are contained in the OHS/component specification or purchase agreement
- If applicable, witness, or delegate a party to witness the tests and trials carried out during the first mobilization and sea trial of the OHS/component per § B.7.1
- If they are required by § B.7.1, review the manufacturer's procedures for rigging and un-rigging the OHS/component, and/or for using it to launch and retrieve packages; approve or reject them

- Review the manufacturer's operator training program; and approve or reject it per § B.8 (when applicable)

B.0.7.2. The Owner

The owner of an OHS/component is responsible for ensuring that it complies with Appendix B. To accomplish compliance the owner must:

- Produce the following documents for each OHS/component:
  - An MCD per § B.5
  - Test procedures and test records per § B.6
  - Procedural and general safety requirements per § B.7
  - An operator training program per § B.8 (when applicable)
- Use these documents to assemble:
  - An MCD component booklet for each component per § B.11 (as required)
  - An OHS operators manual for each OHS per § B.12
- Label the OHS or component per § B.9
- Maintain and abide by the documents and label outlined above
- Ensure each OHS/component maintains compliance with the general safety procedures outlined in § B.7.2
- Carry out periodic testing as prescribed in § B.6

An owner who contracts with a subject matter expert to produce an MCD, test procedure, or training program must:

- Work with the subject matter expert to ensure that all potential uses, deployment types, and configurations are identified.
- Ensure the contract, statement of work, or purchase agreement requires the deliverable to conform with §§ B.5, B.6.6.1, or B.8 (whichever applies).
- Review and approve the test procedure or training program per §§ B.6.6.1 or B.8, respectively (when applicable)
- Prior to a deployment, an owner of a portable OHS/component must:
- Furnish the operator with an MCD for the OHS/component
- Provide the operator with the calculations used to evaluate the OHS/component, upon request

B.0.7.3. The Operator

The operator of a vessel is the owner of its fixed systems. Operators are also responsible for ensuring that all portable systems used on their vessels comply with Appendix B. To this end, operators must:

- Verify that the capabilities of each portable OHS/component are explained in an MCD per § B.5
- Verify that each portable OHS/component will be used within the limits defined in its MCD

- Prohibit the use of a portable OHS/component that is without an MCD
- Prohibit the use of a portable OHS/component outside the limits defined in its MCD

If an OHS is formed by combining portable and fixed systems, the operator must:

- Produce an MCD for the OHS per § B.5
- Verify that the OHS will be used within the limits defined in the MCD
- Prohibit the use of the OHS outside the limits defined in its MCD
- Produce OHS testing procedures per § B.6 as required
- Make arrangements for all required tests; request user assistance only when required
- Conduct OHS testing in assistance from the user

The vessel operator must confirm that a fixed system is suitable for a given deployment. The operator must determine suitability by verifying:

- The deployment may be carried out within the limits defined in its MCD

If the science package or the configuration of an OHS is changed during the course of a cruise, and the EMT or the load geometry of the new configuration is not within the limits defined in the OHS MCD, the operator must not allow the deployment. If the scientific operation is to occur, the operator must take one or more of the following actions:

- Change components, component locations, or load geometry to increase SWT
- Change component locations to bring them within the geometric limits defined in the OHS MCD
- Modify the scientific package to reduce the EMT (e.g. reduce package weight, reduce entrained mass, reduce hydrodynamic drag)
- Employ a tension mitigation device/system to reduce the EMT (e.g. a weak link, a winch with motion compensation)
- Make structural modifications to the OHS to increase its SWT

In many of the above cases the operator will be required to produce a new MCD for the OHS.

B.0.7.4. The User

If an OHS is formed by combining portable and fixed systems, the user must:

- At the request of the operator, assist in making arrangements for testing
- Assist the operator in carrying out testing

B.0.7.5. The Science Party

Prior to a deployment, the science party must:

- Submit a completed OHDD per § B.3, to the operator in advance of each deployment.
- Select the OHDD submission date in consultation with the operator.

B.0.7.6. The Subject Matter Expert

Producing an MCD for an OHS/component may require the assistance of a subject matter expert. The subject matter expert shall:

- Work with the owner/prospective owner to ensure that all potential uses, deployment types, and configurations are identified
- Consider all uses, deployment types, and configurations when determining the maximum capability of an OHS/component
- Construct the MCD per § B.5
- Share all structural calculations with the owner, UNOLS, and other agencies that provide the owner with support or oversight; when acting as subject matter experts, manufacturers are exempt from sharing calculations revealing proprietary information.

If called upon to produce a test procedure for a component, the subject matter expert must:

- Derive test load application procedures in consultation with the owner
- Prepare the test procedure per § B.6.6.1
- If called upon to produce a training program, the subject matter expert must:
- Prepare the training program per § B.8

B.0.7.7. The Manufacturer

The manufacturer of a new OHS/component shall:

- Work with the prospective owner to ensure all potential uses, deployment types, and configurations are identified and reasonable
- Provide design and construction that conforms with §§ B.4, B.7.2, B.9, and B.10 (as they apply)
- Develop procedural safety requirements per § B.7.1
- Provide the owner with an MCD component booklet per § B.11, or an OHS operators manual per § B.12 (as they apply), containing at least:
    - An MCD per § B.5
    - Procedural safety requirements per § B.7.1
    - An operator training program per § B.8 (when applicable)

B.0.8. <u>References</u>

B.0.8.1. UNOLS RVSS Appendix A, UNOLS Rope and Cable Safe Working Load Standards.

B.0.8.2. 46 CFR Chapter 1, Subchapter U

B.0.8.3. ABS Rules for Building and Classing Underwater Vehicles, Systems, and Hyperbaric Facilities, 2010

B.1. Companion Standard – RVSS Appendix A

B.1.1. <u>Compatibility</u>

Appendix B is fully compatible with, and must be used in conjunction with UNOLS RVSS Appendix A, <u>UNOLS Rope and Cable Safe Working Load Standards</u>.

B.1.2. <u>Application of Appendix A</u>

Every OHS is presumed to require a tension member to function in each of its configurations. Therefore, the *safe working tension* (SWT) of an OHS must take into account the (SWT) of its tension member.

Appendix A requires the estimated maximum tension (EMT) be calculated for each deployment scenario. For cases where there is no tension monitoring equipment or low resolution tension monitoring, a deployment shall only be conducted if its EMT is no greater than the SWT_{OHS}. For cases where there is a high resolution tension monitoring system, the deployment must be halted

B.2. Deployment Types

B.2.1. <u>Description</u>

The depth and nature of an oceanographic deployment are concisely defined by its deployment type. Names, characteristics, and examples of each deployment type are summarized on the following page in Table B.2.1. It should be noted that this table uses deployed tension member length in lieu of deployed package depth to insure against settling that might occur due to an inadvertent loss of vessel speed.

Table B.2.1 Deployment Type

Deployment Type	Example
B.2.1.1. Towing – Surface (floating or shallow tow)	towed arrays (e.g., streamers, smart floats) air gun arrays towed sonar fish (e.g., PES, 3.5kHz, EK60)
B.2.1.2. Towing - Mid Water (Where the deployed length of the tension member does not exceed 75% of the water depth)	fisheries nets (twin and single wire) magnetometers, sonar, towfish (e.g., SeaSoar, TriAxis, MVP) MOCNESS Anchor-last mooring deployments
B.2.1.3. Towing - Deep Water (where the deployed length of the tension member is greater than 75% of the water depth with either intentional or high likelihood of bottom contact)	deep water fisheries nets (single wire) sonar, multidiscipline deep-towed platforms dredges, bottom trawls, sledges, grapnel/batfish camera sled, SeaSoar, TriAxis
B.2.1.4. Station Keeping – Surface (shallow dips with or without dynamic positioning (DP)	plankton nets precision echo sounders (PES) hydrophones free-floating buoys autonomous underwater vehicles (AUVs) (e.g. gliders)
B.2.1.5. Station Keeping – Mid Water (where the deployed length of the tension member does not	acoustic arrays conductivity, temperature, depth (CTD) other water sampling operations

exceed 75% of the water depth, with or without DP)	
B.2.1.6. Station Keeping – Deep Water (where the deployed length of the tension member is greater than 75% of the water depth with either intentional or high likelihood of bottom contact, with or without DP)	• remotely operated vehicles (ROVs) • CTD/water sampler operations • elevators • standard wire coring • deep coring (Synthetic Rope) • multicorer • rock drilling • seabed laboratory placement/retrieval • steered bottom samplers (e.g., HyBIS, ARGO) • anchor-first mooring deployments

B.2.2. Application

Deployment type is a mandatory entry into the OHDD. This helps ensure the deployment requirements of the science party are clearly communicated to the operator. MCDs must also outline allowable deployment types; their inclusion helps ensure OHS/components are used in a manner consistent with their capabilities. Knowledge of the deployment type is required to select design loads and to identify regulations relevant to the design of an OHS/component. For this reason, specifications for a prospective OHS/component must elaborate on the deployment types it must accommodate.

B.3. The Overboard Handling Data Document (OHDD)

B.3.1. Description

The OHDD is a data sheet developed by the science party to communicate deployment requirements to the operator. One OHDD must be completed by the science party and submitted to the operator in advance of each cruise. The submission date should be selected in consultation with the operator.

Table B.3.1 is a sample OHDD including some examples and explanations that may be of use. A blank sample OHDD is also available in Attachment B.2. Some parameters will not apply to every deployment.

Table B.3.1 Overboard Handling Data Document

Primary Deployment Information:	Science Party Response
Deployment Type	
Provide a brief narrative of scientific purpose and the equipment to be deployed. Attach drawings or other documents as required to describe the nature of deployment and the OHS or other equipment used/needed to carry it out.	*e.g., "Obtain water samples and CTD data for CLIVAR." Anticipate the need to deploy a 36-bottle rosette to a depth of 6000m."* *The science party must provide MCDs for the OHSs/components they furnish.*
Package Type	*e.g., "36-bottle CTD rosette"*
Maximum Package Weight (in water)(lbf)	*Include specifics about the package if it will be furnished by the science party.*
Maximum Package Mass (weight in air) (lbm)	*e.g., "2,200 lbm"*
Added Weight (in water) (lbf)	*e.g., the weight of captured or entrained material other than water, such as mud.*
Added Mass (weight in air) (lbm)	*e.g., the mass of captured or entrained material, including water.*
Maximum Drag (lbf)	*e.g., "1,300 lbf"*
Maximum Extraction Force (lbf)	*Include if applicable and known.*
Maximum Anticipated Tension Member Deployment Length (m)	*e.g., "6000 m"*
Deployment Depth (m) / Water Depth (m) / Percent of tension member deployed length to water depth	*Required to confirm deployment type. If multiple deployments are to occur, enter the % for the deployment with the greatest ratio of deployed depth and water depth.*
OHS/Components Furnished by Science Party	*Elaborate on any OHSs/components, including tension members, the science party will furnish.*
Vessel Services Required	*Outline any vessel services required for the OHS/components the science party will furnish. e.g., electrical power, hydraulic power, or cooling water.*
Tension Member Type	*Elaborate on the required tension member construction, if known. e.g., "wire rope," "9/16 3X19 wire rope" or "0.322 EM cable."*
Maximum Tension Member Weight (in water) (lbf)	*Include specifics about the tension member if it will be furnished by the science party.*
Maximum Tension Member Mass (weight	*Include specifics about the tension member*

in air) (lbm)	*if it will be furnished by the science party.*
Tension Member ABL/SWT@FS (lbf)	*Include specifics about the tension member if it will be furnished by the science party.*
Load Mitigating Devices	*e.g., render-and-recover and/or weak link along with proposed set values. This must be included if the science party will furnish an OHS, component, or package that features such a device.*

B.4. Structural Design Criteria

B.4.1. General

OHS and their components should be designed and analyzed in accordance with a USCG-recognized classification society or professional standard; if a criterion in §§ B.4.2 thru B.4.7 is more conservative, it shall supersede that criterion in the chosen standard unless a special case is granted per 46 CFR § 198.35-11 by the USCG MSC (see § B.4.6).

B.4.2. Principal, Secondary, and Worst Case Loading Scenarios

The deployment type(s) and the most adverse loading scenario(s) must be considered when analyzing or designing an OHS/component.
Because it's rare for a single component to comprise an overboard handling system, these loading scenarios should be used to evaluate components, including the science package and that portion of the ship attached to the OHS, as a completely integrated system. Each loading scenario is defined by a line tension and line of action (direction) at the overboarding sheave (if an OHS) or exit sheave (if a component with one), or at another appropriate location.

B.4.2.1. Principal Loads

Principal loads are those that occur under ideal conditions, and during the principal phase of a deployment.

B.4.2.2. Secondary Loads

Secondary loads are those that might occur when conditions are other than ideal. These might occur due to a deviation from ideal vessel attitude, vessel heading, vessel position, scientific package position, or any other parameter.

B.4.2.3. Worst-Case Loads

Worst-case loads are loads unlikely to occur, but quite likely to cause equipment or personnel casualties. Surprise entanglement with a submerged object might, for example, lead to overloading and damage to an OHS. Because of their serious nature, worst-case loads should be defined in consultation with the operator. Load mitigating devices should be identified and used to prevent their occurrence whenever possible.

B.4.3. Ultimate Design Tension (UDT)

The UDT is the line tension at which a component begins to yield, or otherwise fail. When determining the UDT for a fixed component, calculations must encompass, at a

minimum, its foundation and all structural members adjacent to it. When determining the UDT for a portable component, or any component fastened to an adjacent structure via a bolted joint, calculations must include an evaluation of that joint.
A component's UDT must be calculated by a subject matter expert.

B.4.4. Safe Working Tension (SWT)

SWT is the working tension of an OHS/component—the greatest tension that may be placed on an OHS/component under normal operating conditions.
The SWT of a new component must be arrived at via calculation. Calculations must be carried out by a subject matter expert. If the SWT of an existing component is unknown, and it’s infeasible to establish its value via calculation, it may be arrived at via load testing in some cases. §§ B.6.11 provides conditions and procedures for establishing a SWT by way of load testing.
The SWT of an OHS must take into consideration the SWT of each of its components, including its tension member. It may be no greater than the least of its component SWTs. Ideally, establishing the SWT of an OHS will only require one to examine the MCD for each of its components. However, if the component MCD's are insufficient, or if the OHS has a complexity that precludes straightforward evaluation, then its SWT should be established via calculation by a subject matter expert.
.
The SWT of an OHS/component may never exceed its DLT.

B.4.5. Design Line Tension (DLT)

The design line tension (DLT) is the greatest line tension an OHS/component is designed to withstand. When subjected to the DLT, an OHS/component must remain operable and have a safety factor of at least 1.5 against yielding or any other form of failure. Generally, the DLT of an OHS must be no less than the nominal breaking load (NBL) of its tension member. However, the DLT of an OHS may be less than NBL if:

B.4.5.1.

The OHS is intended to be used with a deployed tension member length less than 75% of the nominal water depth for any deployment envisioned for that system. In this case DLT may be as low as the greater of:

DLT = [max. package weight (in water) + max. tension member weight (in water) + added weight (in water)] +[(max. package mass + max. tension member mass + added mass) x 0.75] +max. hydrodynamic drag

or

DLT = the maximum line tension imparted by the vessel

B.4.5.2.

The OHS features a winch designed and operated with auto render or render-and-recover as described in § B.10.2. In this case DLT may be as low as:

DLT = the pre-set maximum line tension at which the winch *will automatically pay out*

B.4.5.3.

The OHS features a calibrated and tested weak link as described in § B.10.3. In this case DLT may be as low as:

DLT = the line tension at the overboarding sheave when the calibrated weak link fails

B.4.5.4.

The vessel carrying the OHS cannot develop thrusts and accelerations sufficient to develop a line tension as great as NBL. Calculations must show that the vessel cannot create this tension:

i. **while under power**
ii. **while in a dead ship or inadvertently anchored situation, given a sea state of 5 and a wave height of 4 meters**
iii. **if decelerated from the greatest anticipated speed to a full stop by a science package or tension member that becomes hung up**

Calculations must also demonstrate that the vessel's stability is adequate to sustain the loads and geometries these scenarios present. If this criterion is used, operating conditions shall be limited to a sea state of 5, and a wave height of 4 meters; DLT may be as low as:

DLT = the greatest line tension calculated for cases B.4.5.4.i thru B.4.5.4.iii.

B.4.5.5.

A special case is granted per 46 CFR § 198.35-11 by the USCG MSC (see § B.4.6). If the OHS does not meet criteria B.4.5.1 thru B.4.5.4, DLT may be as low as the greater of:

DLT = [max. package weight (in water) + max. tension member weight (in water) + added weight (in water)] +[(max. package mass + max. tension member mass + added mass) x 0.75] +max. hydrodynamic drag + max. pull out load

or

DLT = the maximum line tension defined in the USCG recognized standard the OHS is demonstrated to comply with (When applicable. See § B.4.6, paragraph (4).)

or

DLT = a greater line tension calculated by a subject matter expert

The DLT of a component should be arrived at via calculation. When determining the DLT for a fixed component, calculations must encompass, at a minimum, its foundation and all structural members adjacent to it. When determining the DLT for a portable

component, or any component fastened to an adjacent structure via a bolted joint, calculations must include an evaluation of that joint.
The DLT of an OHS must take into consideration the DLT of each of its components. It may be no greater than the least of its component DLTs.

B.4.6. Additional Requirements for Inspected Vessels

An OHS used onboard inspected vessels must comply with 46 CFR ch. 1, subch. U wherever its requirements exceed those in the RVSS. §189.35-9 (c)(1) of this regulation, *Wet Weight Handling Gear*, states than an OHS must:

"...withstand and operate in excess of the breaking strength of the strongest section or wire to be used in any condition of loading. The safety factor of all metal structural parts shall be a minimum of 1.5..."

This requires the DLT of an OHS to be no less than the nominal breaking load (NBL) of the tension member without exception.
§189.35-11 of this regulation, *Special Cases*, allows these requirements to be relaxed when they defeat the purpose of an OHS. Relaxation is at the discretion of the USCG Commandant; in practice, the matter is addressed by the USCG Marine Safety Center (MSC). Relaxation is generally allowed provided the owner demonstrates that the OHS meets the standards of a USCG recognized classification society. As of the date of this publication, these societies include: the American Bureau of Shipping (ABS), Det Norske Veritas (DNV), Lloyd's Register (LR), Germanischer Lloyd (GL), Bureau Veritas (BV), RINA S.p.A. (RINA) and ClassNK (NKK).
To report a special case under §189.35-11, and request §189.35-9 (c)(1) be relaxed, contact the Commanding Officer (CO) at the USCG Marine Safety Center (MSC).

B.4.7. Acceptable Methods of Constructing and Operating an OHS

Different OHS constructions require the DLT and SWT of the OHS to be determined in different ways. OHS construction also affects the type of deployment the OHS may be used to carry out, and the type of vessel it may be used on without permission from the USCG MSC.
The sections that follow illustrate allowable OHS constructions. The method of determining the OHS DLT and SWT, and applicable operating parameters are elaborated upon for each construction. Each illustration presumes the OHS consists of an arbitrary number of components, numbered component 1 (weakest), component 2,…,component n (strongest). SWT1, SWT2,…,SWTn refer to the SWT of components 1, 2,…, n, respectively; DLT1, DLT2,…,DLTn refer to the DLT of OHS components 1, 2,…,n, respectively.
The DLT for an existing component may be unknown. In this case, the DLT of the OHS cannot be determined. Nonetheless each illustration assumes a component’s DLT is known, and both its DLT and SWT take into account the various tension member orientations it might experience as part of the OHS. The DLT and SWT of an OHS are assumed to encompass all tension member orientations required for a given deployment.

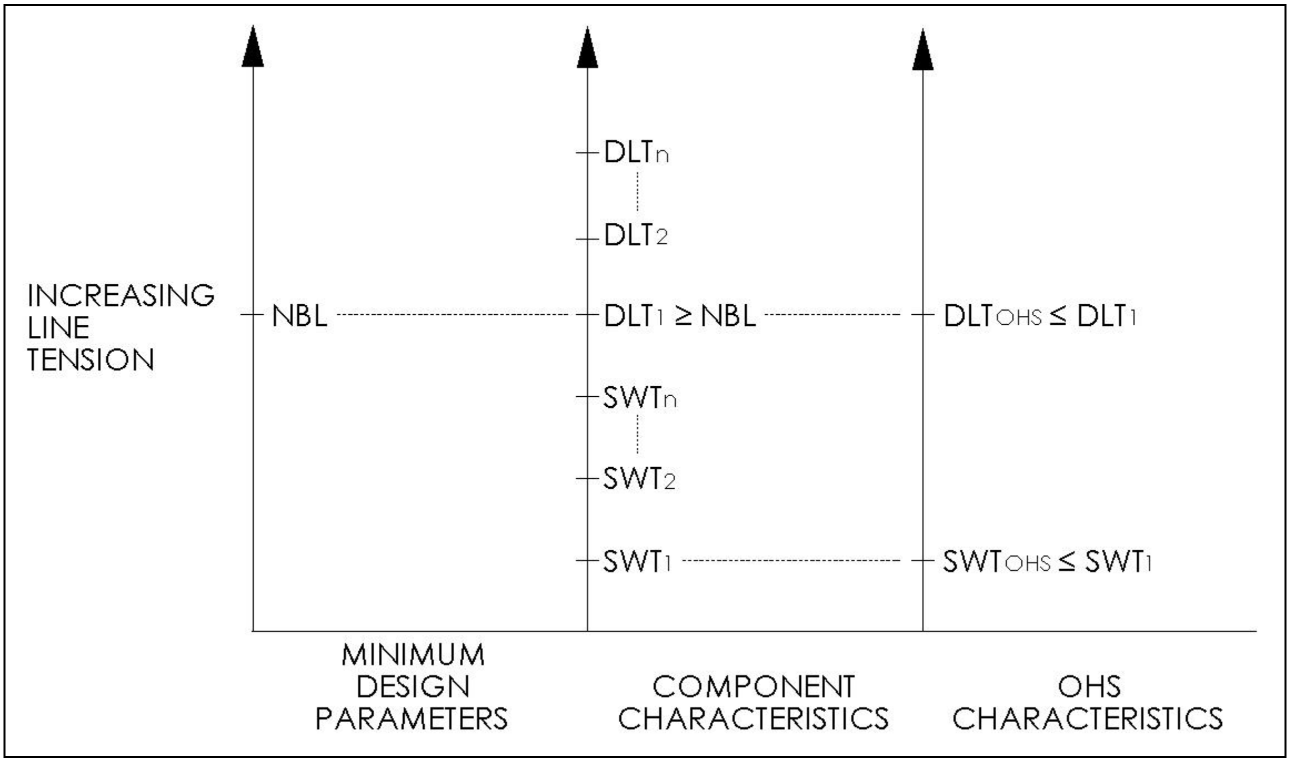


Figure B.4.7.1: Example of an OHS complying with 46 CFR § 189.35-9.

B.4.7.1. Allowable OHS Construction 1

Key Features

- The DLT of every component is at least as great as the NBL of the tension member.

DLT and SWT

- The DLT of the OHS (DLT_{OHS}) may be no greater than the DLT of the weakest component, DLT_1.
- The SWT of the OHS (SWT_{OHS}) may be no greater than the lowest component SWT, SWT_1.

Operational Limitations

- The OHS complies with § B.4.6 and 46 CFR ch. 1, subch. U, § 189.35-9 (c)(1). Therefore, it’s acceptable for use on any UNOLS vessel.
- This OHS is acceptable for any deployment provided the EMT for the deployment is no greater than SWT of the OHS.
- Line tension cannot exceed SWT_{OHS} during normal operations.

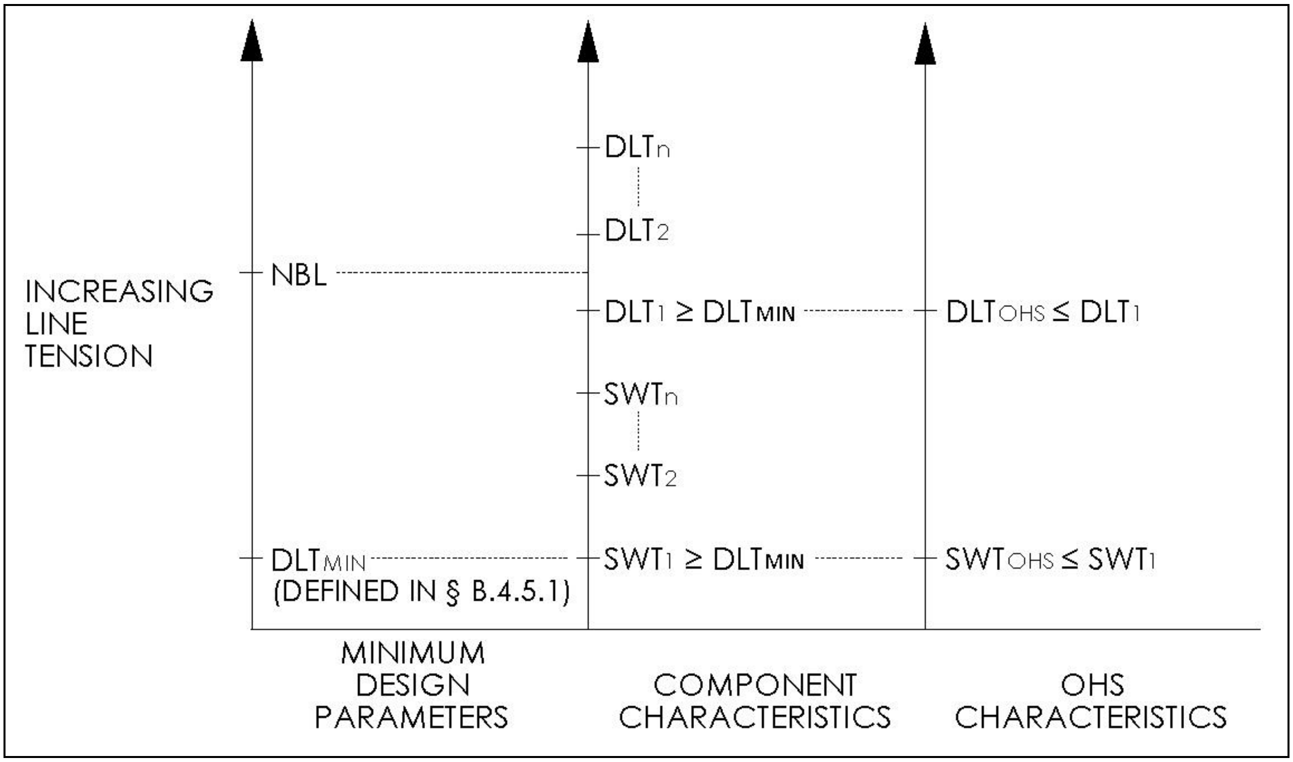


Figure B.4.7.2: Example of an OHS complying with § B.4.5.1

B.4.7.2. Allowable OHS Construction 2

Key Features

- The DLT of one or more components is less than the NBL of the tension member.
- The OHS does not feature a load-limiting device.
- The lowest component DLT (DLT1) is no less than the minimum DLT (DLTMIN) defined in §B.4.5.1.

DLT and SWT

- The DLT of the OHS (DLTOHS) may be no greater than the DLT of the weakest component, DLT1.
- The SWT of the OHS (SWTOHS) may be no greater than the lowest component SWT, SWT1.

Operational Limitations

- This OHS is acceptable for use on uninspected UNOLS vessels. It may only be used on an inspected UNOLS vessel if a special case is granted by the USCG MSC (see §B.4.6).
- The deployed tension member length must never exceed 75% of the nominal water depth. Therefore, this OHS is restricted to the following deployment types: Towing—Surface (§B.2.1.1), Towing—Mid Water (§B.2.1.2), Station Keeping—Surface (§B.2.1.4), Station Keeping—Mid Water (§B.2.1.5).

- The EMT for each deployment may be no greater than SWT_{OHS}.
- Line tension cannot exceed SWT_{OHS} during normal operations.

B.4.7.3. Allowable OHS Construction 3

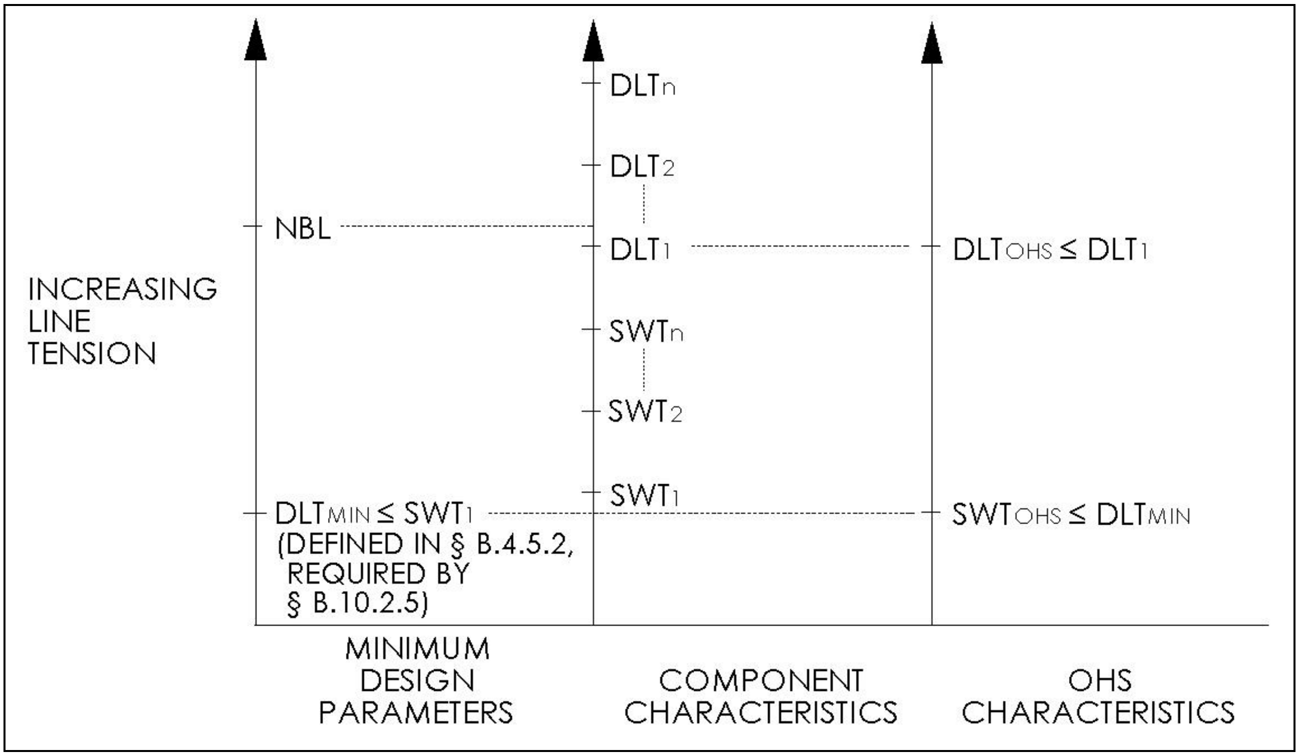


Figure B.4.7.3: Example of an OHS complying with § B.4.5.2

Key Features

- The DLT of one or more components is less than the NBL of the tension member.
- The OHS features a winch with auto render or render-and-recover meeting the criterion in §B.10.2.
- The lowest component DLT (DLT1) is no less than the minimum DLT (DLTMIN) defined in §B.4.5.2. This will always be true regardless of the value of DLT1 because DLTMIN is the winch's rendering tension, §B.10.2.5 requires the rendering tension to be no greater than the lowest component SWT (SWT_1), and DLT_1 is, by definition, at least SWT_1.

DLT and SWT

- The DLT of the OHS (DLTOHS) may be no greater than the DLT of the weakest component, DLT1.
- The SWT of the OHS (SWT_{OHS}) is no greater than the rendering tension, DLT_{MIN}.

Operational Limitations

- This OHS is acceptable for use on uninspected UNOLS vessels. It may only be used on an inspected UNOLS vessel if a special case is granted by the USCG MSC (see §B.4.6).

- This OHS is acceptable for any deployment provided the EMT for the deployment is no greater than SWT_{OHS}.
- The winch should limit line tension automatically. Nonetheless, the OHS operator must ensure SWTOHS is not exceeded during normal operations.

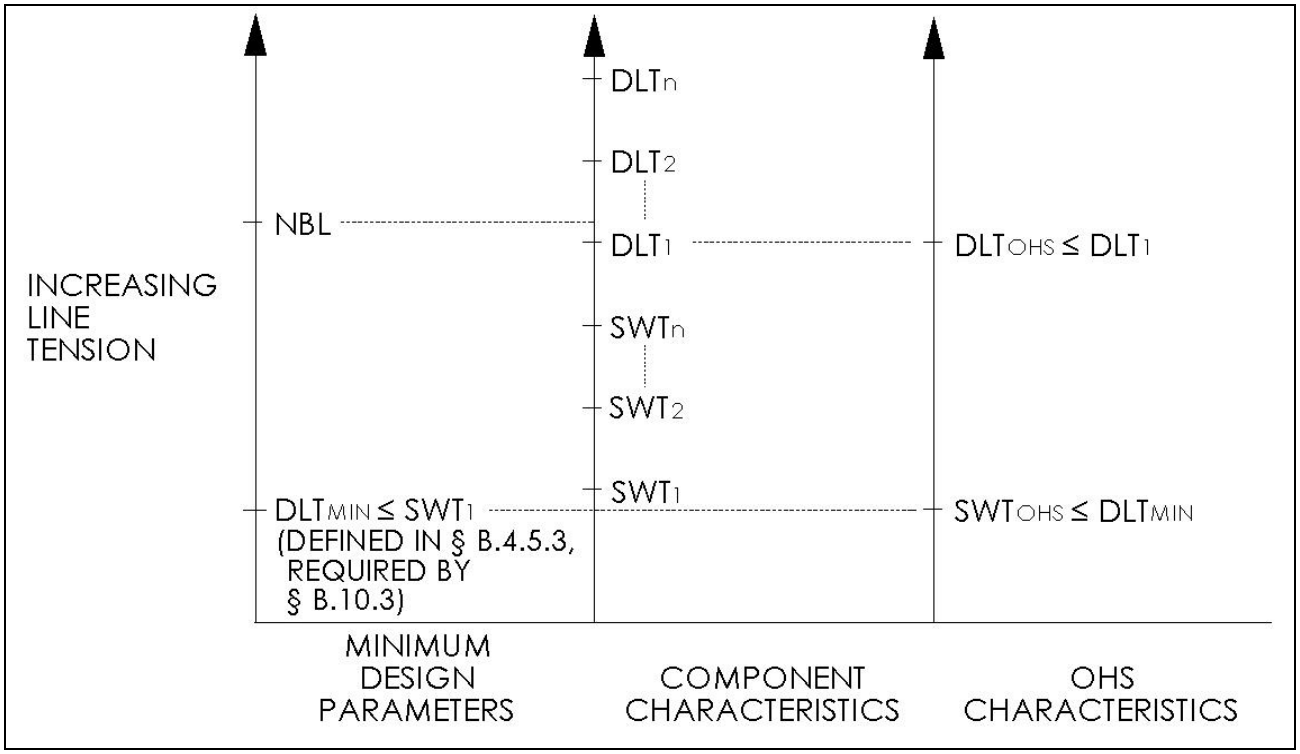


Figure 4.7.4: Example of an OHS complying with § B.4.5.3

B.4.7.4. Allowable OHS Construction 4

Key Features

- The DLT of one or more components is less than the NBL of the tension member.
- The OHS features a weak link installed between the tension member and science package.
- The lowest component DLT (DLT1) is no less than the minimum DLT (DLTMIN) defined in §B.4.5.3. This will always be true regardless of the value of DLT1 because DLTMIN is the tension at the overboarding sheave when the weak link fails, §B.10.3 requires the weak link to fail before the lowest component SWT (SWT_1) is exceeded, and DLT_1 is, by definition, at least SWT_1.

DLT and SWT

- The DLT of the OHS (DLTOHS) may be no greater than the DLT of the weakest component, DLT1.
- The SWT of the OHS (SWT_{OHS}) may be no greater than the line tension at the overboarding sheave when the weak link fails, DLT_{MIN}.

Operational Limitations

- This OHS is acceptable for use on uninspected UNOLS vessels. It may only be used on an inspected UNOLS vessel if a special case is granted by the USCG MSC (see §B.4.6).
- This OHS is acceptable for any deployment provided the EMT for the deployment is no greater than SWT_{OHS}.
- The weak link should limit line tension automatically. Nonetheless, the OHS operator must ensure the SWT_{OHS} is not exceeded during normal operations.

B.4.7.5. Allowable OHS Construction 5

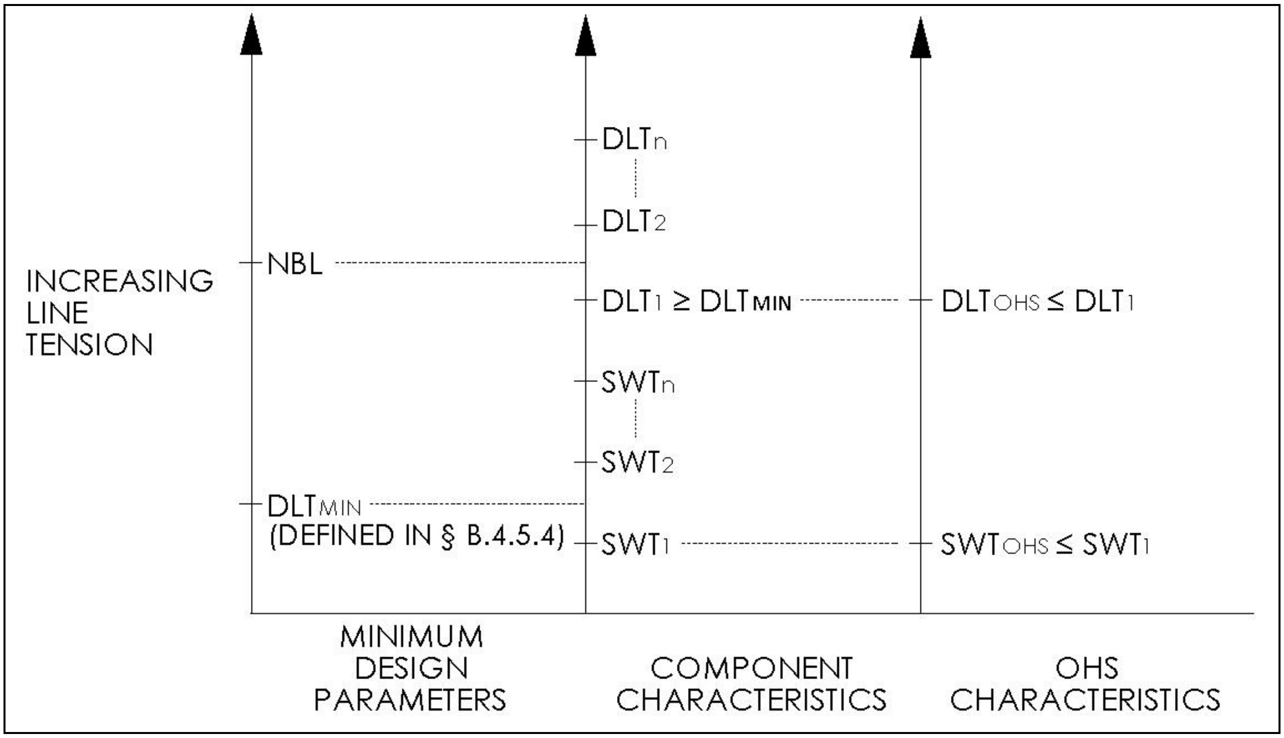


Figure 4.7.5: Example of an OHS complying with § B.4.5.4

Key Features

- The DLT of one or more components is less than the NBL of the tension member.
- The OHS does not feature a load-limiting device.
- The lowest component DLT (DLT1) is no less than the minimum DLT defined in §B.4.5.4, DLT_{MIN}. That is, the DLT of every component is at least as great as any tension the vessel might impart on the OHS.

DLT and SWT

- The DLT of the OHS (DLTOHS) may be no greater than the DLT of the weakest component, DLT1.
- The SWT of the OHS (SWT_{OHS}) may be no greater than the lowest component SWT, SWT_1.

Operational Limitations

- This OHS is acceptable for use on uninspected UNOLS vessels. It may only be used on an inspected UNOLS vessel if a special case is granted by the USCG MSC (see § B.4.6).
- The EMT for each deployment may be no greater than the SWT_{OHS}.
- Line tension cannot exceed the SWT_{OHS} during normal operations.

B.4.7.6. Allowable OHS Construction 6

Key Features

- The DLT of one or more components is less than the NBL of the tension member.
- The OHS does not feature a load-limiting device.
- The lowest component DLT is no less than the minimum DLT defined in §B.4.5.5, DLTMIN.

DLT and SWT

- The DLT of the OHS (DLTOHS) may be no greater than the DLT of the weakest component, DLT1.
- The SWT of the OHS (SWTOHS) may be no greater than the lowest component SWT, SWT1.

Operational Limitations

- This OHS may not be used on any UNOLS vessel unless a special case is granted by the USCG MSC (see § B.4.6).
- The EMT for each deployment may be no greater than the SWT_{OHS}.
- Line tension cannot exceed the SWT_{OHS} during normal operations.

B.5. The Maximum Capability Document (MCD)

B.5.1. Description

The maximum capability document (MCD) generally specifies the design line tension (DLT) and safe working tension (SWT) of an OHS/component, and generally includes a description of the reaction forces the OHS/component will produce. Excepting deck bolts, every OHS and component, including tension members, must have an MCD. The MCD development process is illustrated in a flow chart, which is included as Attachment B.3.

B.5.2. Content

The MCD for an existing OHS/component must specify its SWT. The MCD for an existing component must also include the reaction forces it places on adjacent structures in terms of SWT.

The MCD for a new OHS/component must specify both its DLT and SWT. The MCD for a new component must also include the reaction forces it places on adjacent structures in terms of DLT.

Components fastening to adjacent structures via a bolted joint must include the reaction forces on the bolts, a diagram of its bolt pattern, and the required bolt strength/grade.

An MCD should identify the standard (s) by which the OHS/component was evaluated. When feasible, the calculations used to evaluate an OHS/component should be attached to its MCD as well.

B.5.2.1. Standard Deck Hardware

For standard deck hardware, such as a shackle or swivel, a manufacturer's data sheet(s) may serve as an MCD providing the hardware is made to a standard requiring a FS $\geq$ 1.5, the data sheet(s) identify the standard, and they include the component's SWT.

B.5.2.2. Tension Members

A manufacturer's data sheet(s) may serve as the basis of a tension member MCD. The MCD must also include a current ABL and a SWT calculated for each applicable FS defined in Appendix A.

B.5.2.3. Custom Components

A custom component requires a custom MCD.. It must elaborate on the allowable deployment types for the component, include a DLT and/or a SWT for each allowable deployment type, and illustrate the applicable range of tension member geometries.

B.5.2.4. Deck Sockets

The DLT and SWT of a deck socket will differ depending on its location, the component attached to it, and how the component is rigged. For this reason, a vessel's deck socket MCD must include a DLT and/or a SWT for each unique combination of: component, component rigging, deck socket location, and deck socket pattern. Each

DLT and SWT must be accompanied by a description sufficient to determine its applicability to a given deployment; it should include key component parameters, illustrations of the deck socket pattern, its location on the vessel, the applicable range of tension member geometries, and the allowable deployment type(s).
A deck socket MCD need only encompass those sockets used as OHS components.

B.5.2.5. Winches

A winch MCD should include information regarding its maximum line pull. It should be sufficient to determine if a package deployed to a given depth may also be retrieved.

B.5.2.6. Tension Mitigation Devices and Systems

If an OHS/component features a tension mitigation device or system, it's MCD must elaborate on its nature and use. See §§ B.10.2and B.10.3

B.5.2.7. OHS

Ideally, examining an MCD for each of its components will be sufficient to produce an OHS MCD. However, if the complexity of the OHS is such that it cannot be evaluated in this way, its MCD must be prepared by a subject matter expert. An OHS MCD must elaborate on allowable deployment types, include a DLT and/or a SWT for each OHS configuration and/or deployment type, and illustrate the applicable range of load geometries.
An OHS MCD must list the component MCDs used in its production, and their version.

B.5.3. Application and Responsibilities

In all but the following two cases, production of the MCD is the sole responsibility of the OHS/component owner. If an MCD does not include the calculations used to evaluate the OHS/component, the owner must furnish them to the vessel operator upon request. When an OHS is formed by combining portable and fixed components, the vessel operator is responsible for producing its MCD. If a portable component is without an MCD, or if the inadequacy of its MCD prevents the OHS from being evaluated, the operator may require the owner to produce a new MCD.
A new OHS/component should be delivered with an MCD component booklet or OHS operators manual (whichever applies) that includes an MCD. The prospective owner should ensure this requirement is clearly stated in the purchase agreement. The MCD component booklet and OHS operators manual are described in §§ B.11 and B.12, respectively.

B.5.4. Presentation

The best method of presenting DLT and SWT will depend on the OHS/component and its use. If it provides sufficient capability in all foreseen configurations, its MCD should present single values for DLT and/or SWT, and illustrate the applicable load geometries. This is the preferred method and the most straightforward. Additional complexity should only be added to the presentation as required to:

- Provide additional capabilities required to carry out all foreseen operations
- Account for load geometries, operations, or configurations that can't be included otherwise

Sample MCDs are included as Attachment B.4 through Attachment B.10. These sample MCDs can be viewed as component MCDs or as the MCDs that make up an OHS System MCD.

B.6. Testing and Test Documentation

B.6.1. General Requirements

Test loads should be measured with a calibrated instrument, as they are applied to an OHS/component. Alternately, the loads may be applied using a certified test weight. Test loads may not exceed the SWT of the test rig, which may include a stand-in tension member.

B.6.2. Requirements for Components

B.6.2.1. Exemptions

If the test loads for a general purpose component are effectively applied during the course of an OHS test, then the OHS test satisfies that component's testing requirements as well.

If a component is only used as part of a single OHS, and that OHS is tested to 125% of its SWT, as a system, in the configuration that most adversely loads the component, then the component need not be tested individually.

Auxiliary padeyes, such as those found on a-frames and other overboard handling apparatus, need only be tested if they are used as part of an OHS.

Deck sockets that are not used as part of an OHS need not be load tested.

Deck bolts need not be load tested provided they're made to a specification including a minimum strength, and they're marked to indicate their specification or grade. All deck bolts that are not load tested must be inspected periodically.

B.6.2.2. Deck Sockets and Foundations

Equipment foundations and deck sockets need only be load tested if they are used as part of an OHS.

Deck socket test records must be sufficient to determine the test date for each socket. However, it is not required that each socket have its own test log.

B.6.2.3. Tension Members

Tension members are to be tested in accordance with UNOLS RVSS Appendix A, UNOLS Rope and Cable Safe Working Load Standards.

B.6.2.4. Other Components

Unless otherwise stated in the sections that follow, all non-exempt components shall be tested to 125% of their SWT.

B.6.2.5. Frequency

All components are to be tested at least twice every five years, not to exceed three years between tests, with the following exceptions: auxiliary padeyes, and deck sockets.

An auxiliary padeye or deck socket may be used as part of an OHS if it has received a load test in the previous three years.
All deck bolts that are not load tested must receive biennial inspections.

B.6.3. Requirements for Fixed OHS

An OHS shall be tested once, in each test configuration, at least twice every five years, not to exceed three years between tests. In each test, the OHS must be loaded to 125% of the applicable OHS SWT.

B.6.4. Requirements for Portable Systems

An OHS that is entirely portable, or is formed by combining both fixed and portable components, shall only be used on a vessel if it has been tested on that vessel, in the same configuration(s) it will be used, in the previous three years. In each test, the OHS must be loaded to 125% of the applicable OHS SWT.

B.6.5. The Preferred Testing Method

An OHS/component should be tested in a manner that most closely mimics its use at sea. It should be tested once in each of its configurations and/or modes of operation; the most adverse load geometry should be used for each test. Component tests should address both main and auxiliary features; a-frame side-arms, for example, should be tested. OHS tests should include configurations to incorporate each of its components including, but not limited to its winch, tension member, sheaves, overboard handling apparatus, and a simulated science package.

B.6.6. Alternative Testing Methods

The preferred test method will be impractical or impossible to realize in many instances. These alternative testing methods may be used in lieu of the preferred test method whenever warranted.

B.6.6.1. Resolution by a Subject Matter Expert

As an alternative to the preferred test method, a test method verifying the gross capability of a component may be prepared by a subject matter expert. They may define a minimum number of test loads which will, as a whole, verify a component's integrity is sufficient to provide 125% of SWT in each of its configurations and/or modes of operation. A test load(s) must be included to validate each of a component's auxiliary features; a-frame side-arms, for example, must be tested. In no case shall a test load be defined which is in excess of a component's DLT.
Test loads should be defined with a method of application in mind. The component owner should concur with its feasibility. Whenever possible, they should be defined to enable use of the owner's existing components/equipment, in their usual location and in a typical fashion. If this is not workable, the subject matter expert should clearly stipulate the components/equipment required to develop the test loads.

B.6.6.2. Laboratory Testing

For some components, such as portable winches, blocks, and sheaves, laboratory or "bench" testing may be more practical than field testing. Such methods may be employed provided the component is loaded to 125% of its SWT in the range of geometries it’s subjected to in service.

B.6.6.3. Piecewise Testing

When OHS testing is not viable: if each component of the OHS has a valid test record, if it can be demonstrated that the test procedures for each component require test loads at least as great as those produced by a valid OHS test, and if these procedures include the load geometries each component sees as part of the OHS, then the sum of the component tests shall satisfy the periodic load testing requirement for the OHS.

B.6.7. Test Procedures

Every load test must be conducted using a written procedure. These procedures must clearly state the amount and geometry of each test load. If the procedure is complicated, or involves components that are adjustable or portable, it must include dimensioned diagrams that clearly illustrate the reeving, location, and configuration of each component. They must specify the tension member to be used and describe both how the test load is to be developed, and how it is to be measured (when applicable). Applicable safety precautions must be included as well. Finally, pertinent MCDs and calculations must be incorporated into the test procedure; include them by reference or as an appendix to the procedure.

Procedures for deck bolts must be sufficient to ensure good physical condition; they must also state a minimum strength, and require their marking be evaluated to ensure their strength is sufficient.

B.6.8. Test Records

Test logs must, as a whole, encompass every OHS and component. If it is tested singly, a component must generally have its own test log. Conversely, if a component is only subjected to OHS testing, the test log for the OHS shall satisfy the component's requirement as well. In this case, all mandatory entries pertaining to the component must be made in the OHS test log.

Test logs must be sufficient to determine the test date for each piece of standard deck hardware (e.g., deck bolts, shackles, swivels, and cleats). However, it is not required that each piece have its own test log.

Any entry into a test log must be accompanied by a date. If it pertains to a test, the entry must identify the test method or revision thereof, and the names of those who accomplished it. Entries must also be made into a test log whenever an OHS/component is inspected, repaired, or if it experiences a casualty. When made, the purpose of these entries must be clear, descriptive, and include the names of those involved.

Test logs for fixed equipment must be available both aboard the parent vessel, and in the office of the operator. Test logs for portable equipment must be kept by the owner. All test logs must be made available to representatives of regulatory agencies, such as the USCG, and those who provide oversight, such as the NSF, upon their request.

B.6.9. Testing Responsibilities

If an OHS is formed by combining portable and fixed systems, the operator must produce its test procedures, assist the user by making arrangements for all required tests, and conduct them. In this case, the user must support the operator in conducting tests. At the request of the operator, the user must also assist in arranging tests, and share financial responsibility for them.

In all other cases it is the sole responsibility of the OHS/component owner to produce its test procedures and logs, to maintain its test logs, and to carry out testing at the required intervals.

B.6.10. Testing of Load Limiting Devices

Testing of load limiting devices is discussed in § B.10.

B.6.11. Testing in Lieu of Calculation

If the SWT of an existing OHS/component is not known, it may be determined with a load test if, following a thorough inspection, the OHS/component is found to be in safe working condition.

The load test must be performed using a procedure developed per §§ B.6.1 thru B.6.6, as they apply. The test must be followed by a careful inspection of the OHS/component. Provided the OHS/component remains in safe working condition; it does not exhibit a permanent change in shape or size, or any other indication of failure; its SWT may be as great as:

SWT = test load ÷ 1.5

If the SWT is established via a load test, only the tested range of load geometries may be presented and labelled as such in its MCD.

B.6.12. Additional Requirements for Inspected Vessels

Inspected vessels must also comply with 46 CFR §§ 189.35-5 and 189.35-13.

B.7. Procedural and General Safety Requirements

B.7.1. Procedural Safety Requirements

B.7.1.1. Requirements for a New OHS/Component

If a new OHS/component will not be permanently configured and affixed to a vessel, the manufacturer must develop procedures for rigging and un-rigging it. They must include reeving and package attachment procedures whenever they are not straightforward. If its function requires input by a user, or the control of an operator, the manufacturer must develop procedures for using it to launch and retrieve packages. These procedures must emphasize the protection of the OHS/component, the vessel, the package and, most importantly, personnel.

These procedures must be continually reviewed during the design, manufacturing, and/or integration stages to ensure they remain sound and safe. They must be validated during factory acceptance trials and harbor acceptance trials as far as practicable.

Prior to the first mobilization and sea trial (if applicable), the manufacturer must prepare a detailed plan of the tests necessary to prove the OHS/component ‘fit for service’. The plan must include a demonstration of requisite procedures; all participants must be rehearsed in the procedures prior to performing them.

During the first mobilization and sea trial (if applicable), the procedures must be fully demonstrated to the prospective owner or another delegated party. Wherever they are found to be invalid, unsafe, or otherwise in need of improvement, they must be amended.

Final procedures are to be reviewed and approved by the prospective owner prior to delivery of the OHS/component. They must be incorporated into an OHS operators manual per § B.12 or an MCD component booklet per § B.11 (whichever applies) and provided to the owner upon delivery.

B.7.1.2. Requirements for Existing Equipment

If an existing OHS/component will not be permanently configured and affixed to a vessel, the owner must produce procedures for rigging and un-rigging it. They must include reeving and package attachment procedures whenever they are not straightforward.

If its function requires input by a user, or the control of an operator, the owner must produce procedures for using the OHS/component to launch and retrieve packages. These procedures must emphasize the protection of the OHS/component, the vessel, the package and, most importantly, personnel.

Final procedures are to be reviewed continuously. Wherever they are found to be invalid, unsafe, or otherwise in need of improvement, they must be amended. They must be incorporated into an OHS operators manual per § B.12 or an MCD component booklet per § B.11 (whichever applies).

B.7.2. General Safety Requirements

All moving elements shall be protected by guards or guard rail enclosures to prevent inadvertent contact by personnel in a seaway environment.

Emergency stops should be accessible at the equipment and all operator's stations.

Machinery should provide operating beacon lights to indicate when operating in order provide warning especially when equipment is remotely operated.

To the greatest extent possible, wire mesh guards, casings, and restraining posts must be used to physically exclude personnel from tension member paths and snap-back zones. In the absence of these barriers, deck safety procedures must bar personnel access to tensioned lines and snap-back zones whenever possible; they must conform to those outlined in UNOLS RVSS Appendix A, UNOLS Rope and Cable Safe Working Load Standards, at a minimum.

Where tension members are led from below deck through trunks, due regard must be taken of the potential for downflooding through the open trunks and the requisite coaming heights provided.

Any other penetrations required by the design must also take into account the need for watertight integrity of the equipment and the hull and superstructure, and be configured accordingly.

B.8. Training

All OHS and/or component operators/users must receive training and be able to prove operational and safety competency. Winch operator training must be in agreement the requirements set forth in UNOLS RVSS Appendix A, UNOLS Rope and Cable Safe Working Load Standards, at a minimum.

A formal training program must be developed for each operating station; its scope should be appropriate for the complexity of the OHS/component. The program must include general operating guidelines. Monitoring guidelines, application specific instruction, and Appendix A guidelines specific to the operation of the OHS/component shall also be included whenever applicable. Training should be conducted in a hands-on fashion whenever possible.

Training programs shall require an annual demonstration of competence and provide auditable records of initial training and competency checks. The vessel master shall be the arbiter of competence and the designator of OHS/component operators.

The owner is responsible for producing training programs for existing equipment. The program may be developed by the owner or a subject matter expert. Training programs for new equipment must be produced by the manufacturer. They are to be reviewed and approved by the prospective owner prior to delivery of the OHS/component. They must be incorporated into an OHS operators manual per § B.12 or an MCD component booklet per § B.11 (whichever applies) and provided to the owner upon delivery.

B.9. Labeling

B.9.1. General

An OHS/component must be labeled. The labels must include its SWT, its most recent test date and, whenever possible, an SWT diagram--a clear illustration of the tension member's allowable range of angles when loaded to its SWT. If the complexity of the OHS/component precludes such a diagram, the label must include a drawing number or make reference to an MCD or other document containing this information.

B.9.2. Standard Deck Hardware

In order to be used as part of an OHS, standard deck hardware, such as deck bolts, shackles, swivels, and cleats, must be color coded or conspicuously marked in some other way to indicate they were deemed acceptable during a given test cycle. The color code or mark must change each test cycle; personnel must know which code(s)/marking(s) are indicative of acceptable hardware.

B.9.3. Deck Sockets

Damaged sockets must be prominently marked. Personnel must be made aware of this mark and its meaning to prevent them from being used inadvertently.

B.9.4. Use Outside of Labeled Bounds

Ship operators and their seagoing staff must understand that using an OHS/component outside of its labeled bounds could lead to the loss of valuable equipment, damage to the vessel and its fixed equipment and, in the worst case, injury to personnel. If circumstances or the desire to maintain scientific operations require a line tension or configuration outside of its labeled bounds, its safety must be confirmed by the OHS/component MCD or potentially dangerous operation may ensue.

B.10. Tension Mitigation Devices and Systems

B.10.1. General

As their name implies, tension mitigation devices and systems generally act to reduce line tension. Those limiting tension in an automated fashion are referred to as load limiting devices. If used on an uninspected vessel, they may allow the DLT of an OHS/component to be less than the NBL of its tension member if certain criteria are met. Others reduce, but do not limit line tension, or require user intervention; these do not allow for a reduction in the DLT in any case.

B.10.2. Requirements for Auto Render and Render-and-Recover

§ B.4.5.2 allows the DLT to be less than NBL if an OHS/component features a winch designed and operated with auto render or render-and-recover. If this allowance is used, it must be clearly stated in the OHS/component MCD, which must also include the capabilities of the auto render or render-and-recover system. In order to qualify for this allowance, an auto render or render-and-recover systems must:

B.10.2.1. Continuously monitor the loading condition of the winch.

B.10.2.2. Be inactive when launching or recovering a science package.

B.10.2.3. Operate continuously in all deployed modes of winch operation without requiring operator intervention.

B.10.2.4. Provide rapid response to an overload condition, never allowing the tension member to exceed the SWT of the OHS/component.

B.10.2.5. Be adjustable by the winch operator to enable rendering at any tension, with a maximum of 110% of the OHS/component SWT or 75% of the OHS/component DLT. Once installed as part of an OHS, the rendering tension must be no greater than the lowest component SWT.

B.10.2.6. Retain the pre-set tension while activated, and in an overload condition. (Free spooling is not an acceptable method of rendering a tension member.)

B.10.2.7. Signal the system is actively monitoring the loading condition of the winch with a continuous visual indicator at each operating station.

B.10.2.8. Signal an overload condition with a continuous visual indicator at each operating station. After an overload condition, these indicators must remain activated until manually reset by the operator, or until the winch system is powered down.

B.10.2.9. Signal an overload condition with a continuous a continuous alarm audible at the winch, the working deck areas, and each control station. The alarm must stop when the overload condition has passed.

B.10.2.10. Automatically return the winch to full operating capability after the overload condition has passed: no operator intervention must be required.

B.10.3. Weak Links

§ B.4.5.3 allows the DLT of an OHS/component to be less than NBL if it features a calibrated and tested weak link. If this allowance is used, it must be clearly stated in the OHS/component MCD, which must also include design details for the weak link, and the value of the failure load.

A weak link must be installed between the end of the tension member and the science package. It must be tested to fail at a tension no greater than the lowest component SWT, less the following: the weight of the tension member's deployed length, the maximum drag of the tension member, mass added to the tension member, and any other forces that might be imparted on the tension member, such as those due to strumming.

Those intending to use weak links must recognize their limitations. If the science package becomes entangled it may be lost. If the tension member becomes entangled, or the required failure load is improperly estimated, a tension as great as the breaking load of the tension member may be placed on the OHS.

B.10.4. Acoustic Releases

Acoustic releases may be used to facilitate the retrieval of an otherwise lost package or section of tension member. They are not, however, considered load limiting devices.

B.10.5. Remotely Operated Cutters

A remotely-operated cutting device may be used to release an irretrievable package or to ensure the safety of a vessel in the event of an entanglement. Wherever they are installed, they must be directly controlled by the vessel master, who is the sole arbiter of the necessity and timing of their use.

Cutting devices should operate using stored mechanical energy; they must operate independently of the shipboard power system.

Cutting devices are not considered load limiting devices.

B.10.6. Motion Compensation

Motion compensation may be used to control the vertical position of a deployed science package, and/or to reduce the dynamic loads on an OHS/component. However, as they do not generally limit line tension, motion compensation systems are not considered load limiting devices; the DLT of an OHS/component may never be reduced solely because it features motion compensation.

Motion compensation is generally accomplished by winch pay-in/pay-out, causing an otherwise stationary tension member to be continuously worked back-and-forth over sheaves. The result is increased tension member wear, grossly accelerated by sheaves with small diameters or improper grooves.

Minimum sheave diameter and groove requirements are set forth in UNOLS RVSS Appendix A, UNOLS Rope and Cable Safe Working Load Standards. If possible, these requirements should be exceeded whenever motion compensation is employed in order to minimize its deleterious effect on the tension member.

B.11. The MCD Component Booklet

Generally, an MCD component booklet must be assembled for each component. It must contain:

- The component MCD per § B.5
- The component's overall dimensions in each of its configurations
- Component test procedures and records per § B.6
- Procedural safety requirements per § B.7
- Operator training procedures and records per § B.8
- Preventative maintenance procedures and their frequency

If the component is portable, the booklet must also contain:

- The component's weight
- Ship service and ship interface requirements, such as electrical power, hydraulic power, and automated data collection
- An inventory of spares

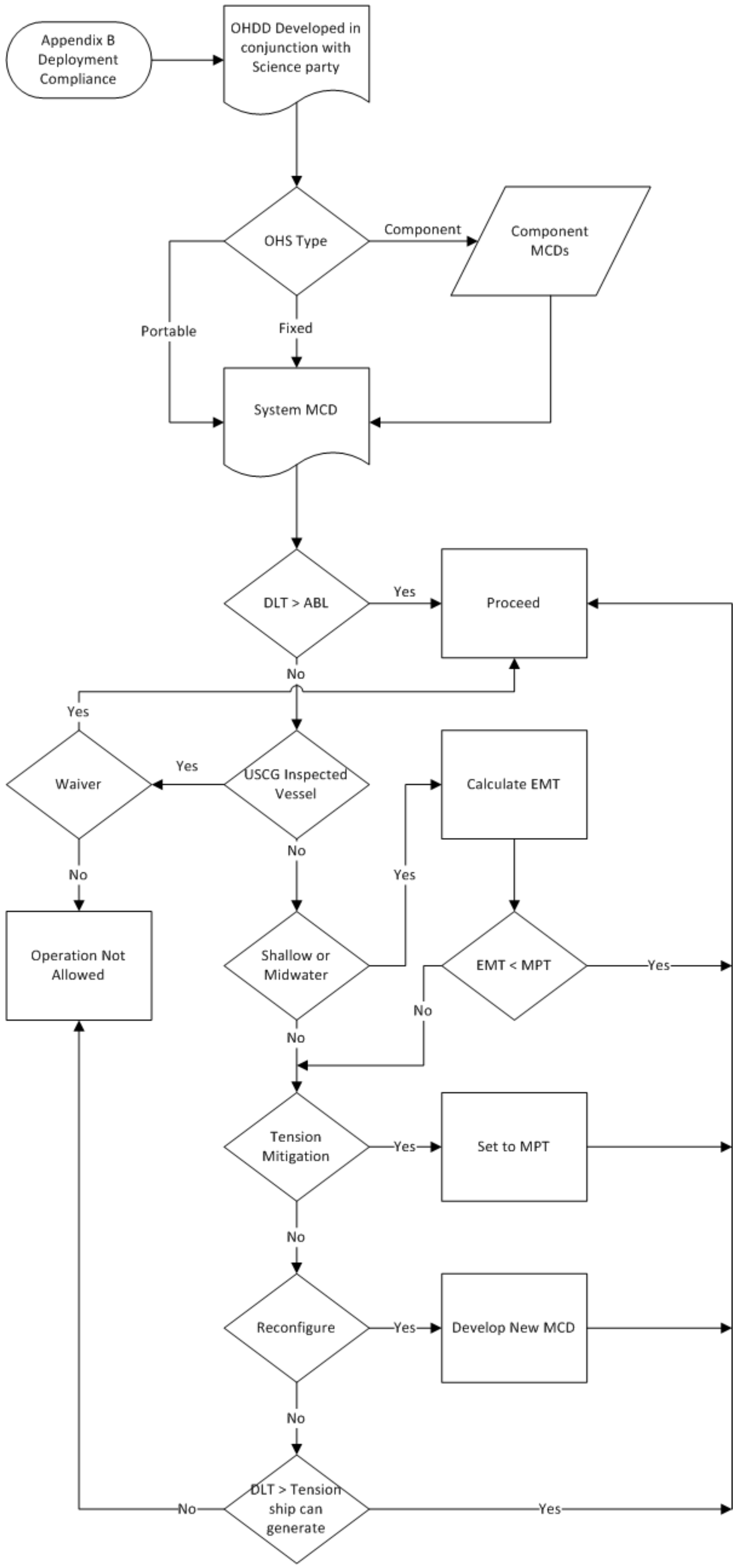
MCD component booklets are not required for tension members or standard deck hardware. If a component's nature precludes the contents outlined above, or if these contents are included in its MCD, it does not require an MCD component booklet.

B.12. The OHS Operator's Manual

An OHS operator's manual must be assembled for each OHS, excepting those formed by combining portable and fixed equipment. The OHS operator's manual must contain:

- An OHS MCD per § B.5
- An MCD for each component per § B.5
- A reference to each applicable MCD component booklet
- A description of the OHS layout including:
    - The location of each major component
    - The orientation of each major component in each OHS configuration
    - The geometry of the tension member in each OHS configuration
    - The overall dimensions of each major component
    - The weight of major portable components
- OHS test procedures and records per § B.6
- Procedural safety requirements per § B.7
- Operator training procedures and records per § B.8

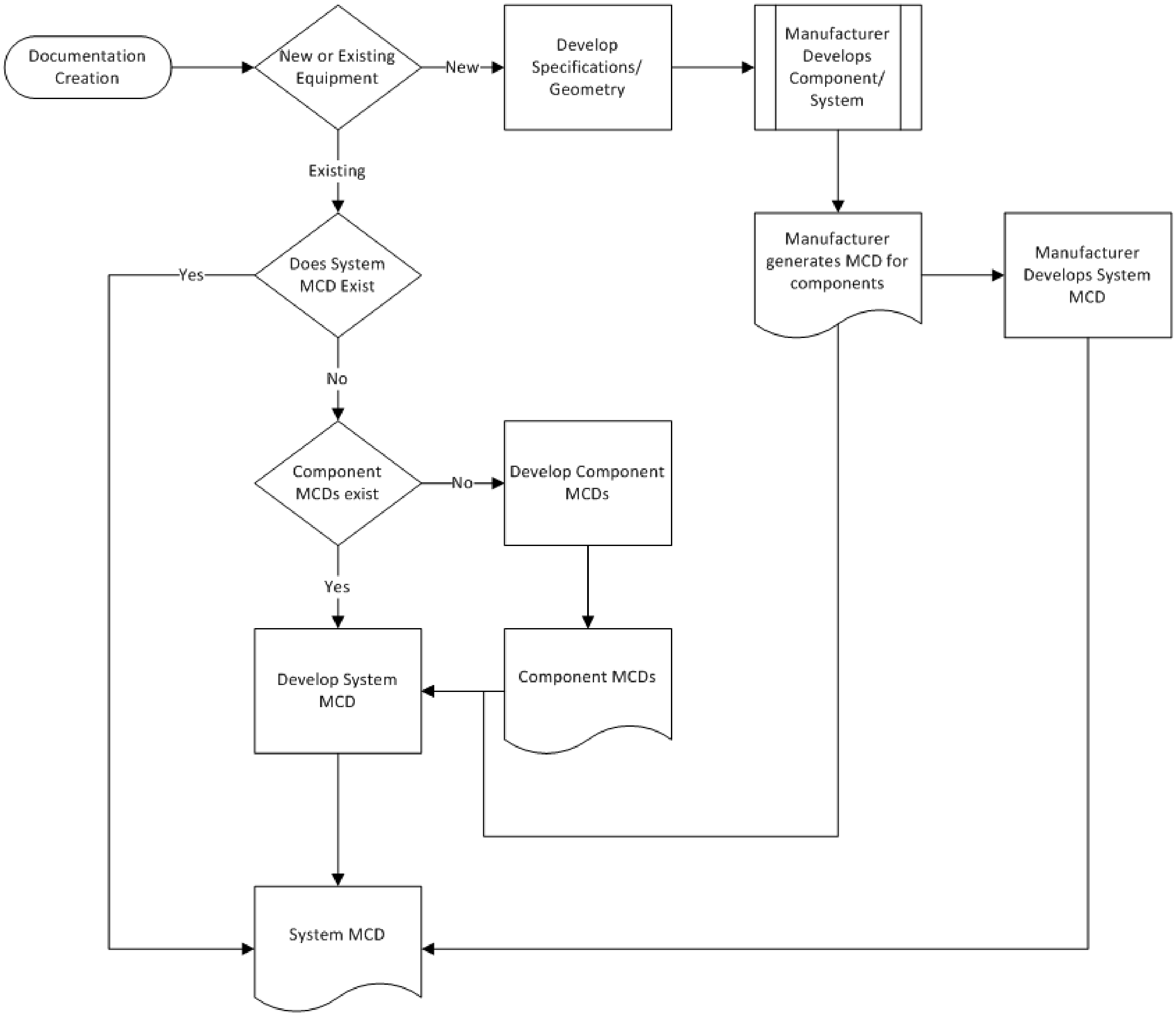
Attachment B.1: Appendix B Deployment Compliance Flow Chart



Attachment B.2: Overboard Handling Data Document

Primary Deployment Information:	Science Party Response
Deployment Type	
Provide a brief narrative of scientific purpose and the equipment to be deployed. Attach drawings or other documents as required to describe the nature of deployment and the OHS or other equipment used/needed to carry it out.	
Package Type	
Maximum Package Weight (in water) (lbf)	
Maximum Package Mass (weight in air) (lbm)	
Added Weight (in water) (lbf)	
Added Mass (weight in air) (lbm)	
Maximum Drag (lbf)	
Maximum Extraction Force (lbf)	
Maximum Anticipated Tension Member Deployment Length (m)	
Deployment Depth (m) / Water Depth (m) / Percent of tension member deployed length to water depth	
OHS/Components Furnished by Science Party	
Vessel Services Required	
Tension Member Type	
Maximum Tension Member Weight (in water) (lbf)	
Maximum Tension Member Mass (weight in air) (lbm)	
Tension Member ABL/SWT@FS (lbf)	
Load Mitigating Devices	

Attachment B.3: The MCD Development Process



Attachment B.4: Sample System MCD (2 pages)

UNOLS Institution

Engineer, *UNOLS Ship Operations*
UNOLS Institution

System MCD

Mixed System of Portable and Fixed Equipment

This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This system is rated for all deployment types referred to by Appendix B section B.3.5. Due to the lack of tension monitoring system, the tension member is limited to a safety factor of 5.

Section	Operation	Allowed
B.3.5.1	Towing – Surface	Y
B.3.5.2	Towing - Mid Water	Y
B.3.5.3	Towing - Deep Water	Y
B.3.5.4	Station Keeping – Surface	Y
B.3.5.5	Station Keeping – Mid Water	Y
B.3.5.6	Station Keeping – Deep Water	Y

Component MCDs

Component	MCD	Supplied By:
Deck Sockets	Ship Deck Socket MCD	Ship
Deck Bolts	Manufacturers Data Sheet	Ship
Winch	UWP Portable Winch MCD	UNOLS Winch Pool
Tension Member	Manufacturers Data Sheet	User
Sheave	UWP Sheave MCD	UNOLS Winch Pool
Shackle	Ship Shackle MCD	Ship
A-Frame	Ship A-Frame MCD	Ship
EMT	OHDD	User

Component Characterizations

Deck Socket Characteristics	Value from MCD
SWT / DLT Tension	5,000 lbf
SWT / DLT Shear	8,000 lbf

Deck Bolt Characteristics	Value from Data Sheet
SWT	20,500 lbf
DLT	102,000 lbf

Winch Characteristics	Value from MCD
SWT	4,500 lbf
SWT Reaction at Deck	775 lbf
DLT	12,000 lbf
DLT Reaction at Deck	4,090 lbf

Wire Characteristics	Value from Data Sheet & MCD
SWT	2,320 lbf
NBL	11,600 lbf

Sheave Characteristics	Value from MCD
SWT	10,000 lbf
SWT Reaction	20,000 lbf
DLT	20,000 lbf
DLT Reaction	40,000 lbf

Shackle Characteristics	Value from MCD
DLT	22,680 lbf
SWT	13,500 lbf

A-Frame Characteristics	Value from MCD
SWT Towing	10,000 lbf
DLT Towing	20,000 lbf
SWT Station Keeping	14,140 lbf
DLT Station Keeping	30,000 lbf

Science Package Characteristics	Value From OHDD Work Sheet
Package	Sub-Bottom Profilier
Water Depth	500 m
Cable Length	1,000 m
EMT	1,809 lbf

System Characterization

System Characteristicss	Value from Components
EMT	1,809 lbf
SWT	2,320 lbf
DLT	11,600 lbf
Deployment Types	Deep Water Towing and Station Keeping

Attachment B.5: Deck Socket MCD Example (2 pages)

UNOLS Institution

Engineer, *UNOLS Ship Operations*
UNOLS Institution

Maximum Capability Document

Ship Deck Socket

This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This deck socket is rated for all deployment types referred to by Appendix B section B.2.1 depending on geometry and the tension member selected. If the load could exceed the ratings a load limiting device or system must be employed.

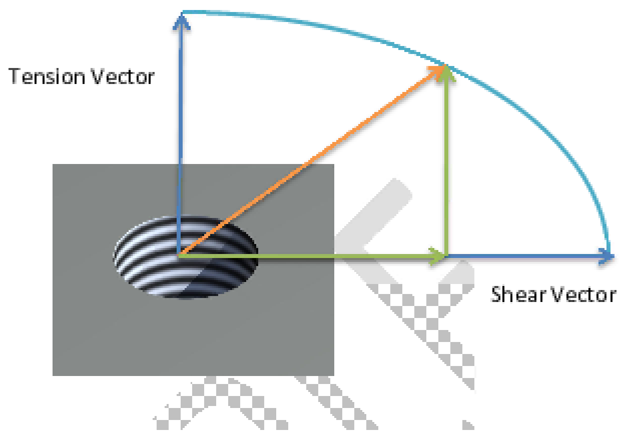
Section	Operation	Allowed
B.2.1.1	Towing – Surface	Y
B.2.1.2	Towing - Mid Water	Y
B.2.1.3	Towing - Deep Water	Y
B.2.1.4	Station Keeping – Surface	Y
B.2.1.5	Station Keeping – Mid Water	Y
B.2.1.6	Station Keeping – Deep Water	Y

System Characterizations

In the case of Deck sockets the DLT and SWT refer to forces directly acted upon them.

Tension DLT[1]	5,000 lbf
Tension SWT[1]	5,000 lbf
Shear DLT[2]	8,000 lbf
Shear SWT[2]	8,000 lbf

[1] Tension DLT/SWT is the pull perpendicular to the ship's deck
[2] Shear DLT/SWT is the pull parallel to the ship's deck



Angle	Tension Vector	Shear Vector	Combined Vector
0	0 lbf	8000 lbf	8000 lbf
10	850 lbf	7875 lbf	7900 lbf
20	1700 lbf	7500 lbf	7700 lbf
30	2500 lbf	6900 lbf	7350 lbf
40	3200 lbf	6100 lbf	6900 lbf
50	3800 lbf	5100 lbf	6400 lbf
60	4300 lbf	4000 lbf	5875 lbf
70	4650 lbf	2700 lbf	5400 lbf
80	4900 lbf	1375 lbf	5100 lbf
90	5000 lbf	0 lbf	5000 lbf

Attachment B.6: Winch MCD (2 pages)

UNOLS Winch Pool

Engineer, *UNOLS Winch Pool*

UNOLS Facility

Maximum Capability Document

UWP Portable Winch

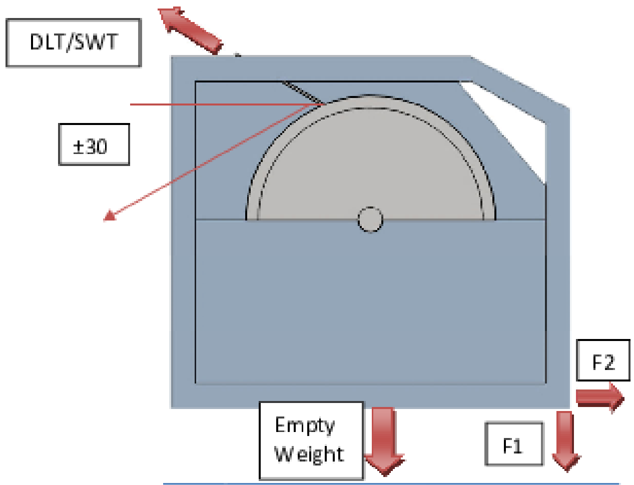
This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This machine is primarily used for 0.322 tension members, with an 11,600 lbf breaking strength. Per Appendix A, the machine in its' current configuration is limited to a Factor of Safety (FS) of 5.0 on the tension member due to the lack of cable monitoring system. The FS on the tension member could be lowered if a monitored over-boarding block is employed in accordance with Appendix A. Per Appendix B this machine is rated for "Lifting & Towing - Deep Water" (Section B.3.5.2 & 5) with .322 or weaker tension members. Stronger tension members are limited to "Lifting & Towing - Mid Water" as currently configured due to the lack of load limiting equipment; this strictly limits tension member deployed length to 75% of water depth. This machine could be rated for "Lifting and Towing - Deep Water" with stronger tension members if proper load limiting equipment were employed per Appendix B.

Section	Operation	Allowed
B.3.5.1	Towing – Surface	Y
B.3.5.2	Towing - Mid Water	Y
B.3.5.3	Towing - Deep Water	Y
B.3.5.4	Station Keeping – Surface	Y
B.3.5.5	Station Keeping – Mid Water	Y
B.3.5.6	Station Keeping – Deep Water	Y

System Characterizations

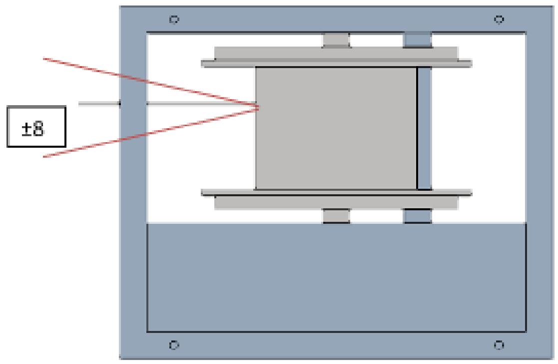
Empty Weight	5,000	lbf
Maximum Weight	6,500	lbf
Safe Working Tension (SWT)	4,500	lbf
Design Line Tension (DLT)	12,000	lbf
Maximum Speed at Bottom Layer	40	m/min
Maximum Oil Operating Temperature	180	F
Power Requirements	3 Phase 480VAC 60 Hz	
	60 Amp Circuit	

Free Body Diagram



	Reaction At SWT	Reaction At DLT
F1	775 lbf	4,090 lbf
F2	975 lbf	2,600 lbf

Forces are maximum forces per bolt, at SWT & DLT, for a 4 bolt hold down pattern (Rows spaced at 48").
Analysis is good for a vertical fleet angle of ±30° and a horizontal fleet angle of ±8°.



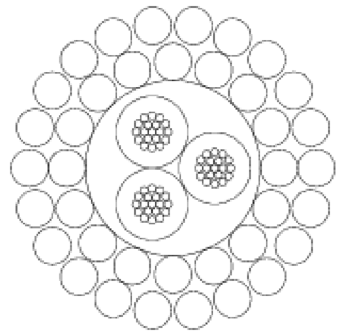
Attachment B.7: Tension Member Data Sheet as an MCD (2 pages)

751 Old Brandy Road
Culpeper, Virginia 22701

Tele: 540 825-2111
Fax: 540 825-2238

DATALINE®

Description	Inch	mm
INSULATED CONDUCTOR (3)		
Cdr: #19 AWG (19/0.008")Bare Cu	0.039	0.99
Ins: .016" wall Polypropylene	0.071	1.80
ASSEMBLY		
3 ins. cdrs. cabled	0.153	3.89
BELT		
0.015" wall HD Polyethylene	0.183	4.65
ARMOR - 2 layers		
16/0.0375" GEIPS	0.247	6.27
22/0.0375" GEIPS	0.322	8.18



Tyco Electronics *The Rochester Corporation*

Instrumentation & Control Cable
Code: I10030152PO00

Date	Page	Revision	Part No.
11/20/2008	1	U	A301592

PERFORMANCE CHARACTERISTICS

Nominal Values @ 20°C	Metric	English
PHYSICAL		
Weight in Air	257 kg/km	173 lb/kft
Weight in Seawater	212 kg/km	143 lb/kft
Specific Gravity (SG = 1.028)	5.7	5.7
MECHANICAL		
Breaking Strength, Fixed End	52 kN	11,600 lbf
Breaking Strength, Free End	45 kN	10,000 lbf
Working Load @.4% Strain	11 kN	2,500 lbf
Maximum Working Load[1]	22.2	5,000 lbf
Recommended Bend Radius	15 cm	6"
Rotation @ 2,500 lbf	49°/m	15°/ft
ELECTRICAL		
Voltage Rating	1,000 V	1,000 V
Insulation Resistance	3,000 MΩ•km	10,000 MΩ•kft
dc Resistance		
Cdr.	30.8 Ω/km	9.4 Ω/kft
Armor	7.9 Ω/km	2.4 Ω/kft
Capacitance (cdr.-armor)	115 pF/m	35 pF/ft

[1] "The cable working load as stated on the DATALINE (2,500 lbf) represents the maximum quasi-static load of the operational system that will be supported by the cable. Transient dynamic loads may be applied to the cable providing that the maximum dynamic load applied remains below 5,000 lbf and its period is smooth and gradual, greater than several seconds. Caution must be taken with rapid fluctuations in the loading condition that will result in conductor buckling (compression, otherwise known as "z" kinking). These rapid load variations include, but are not limited to, shock loading, the rapid and erratic removal and increasing of load. This load transient has a period less then a few seconds and can result in cable buckling and/or hockling. Extended excursions above the working load value may affect service life and increases the risk of component buckling."

Tyco Electronics *The Rochester Corporation*

Instrumentation & Control Cable
Code: I10030152PO00

Date	Page	Revision	Part No.
11/20/2008	2	U	A301592

Attachment B.8: Sheave MCD Example

UNOLS
Winch Pool

Engineer, *UNOLS Winch Pool*
UNOLS Facility

Maximum Capability Document

UWP Sheave

This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This Hanging sheave has been designed for use with 0.322 & 0.393 cable and 5/16 wire rope. The sheave grooving is in accordance with Appendix A for a safety factor of 5-2.5. This sheave is rated for all deployment types referred to by Appendix B section B.2.1.

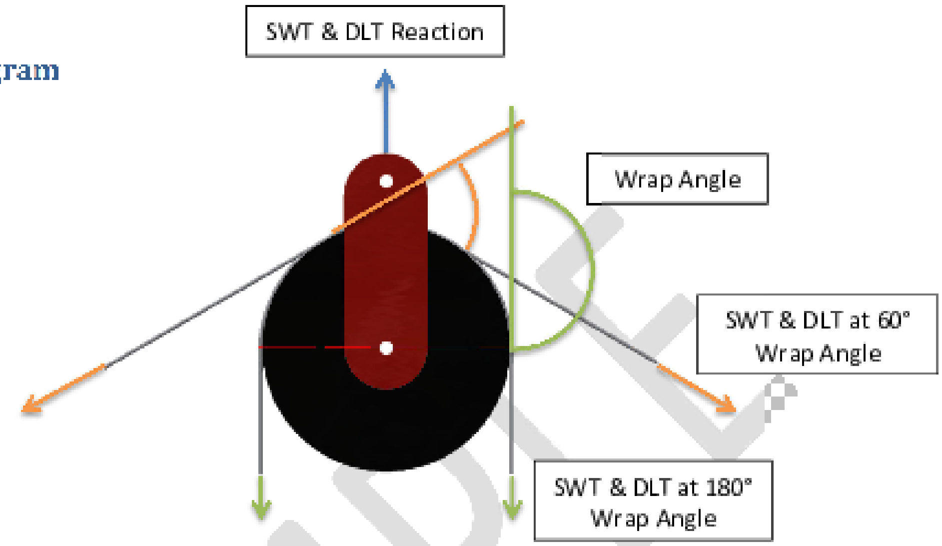
Section	Operation	Allowed
B.2.1.1	Towing – Surface	Y
B.2.1.2	Towing - Mid Water	Y
B.2.1.3	Towing - Deep Water	Y
B.2.1.4	Station Keeping – Surface	Y
B.2.1.5	Station Keeping – Mid Water	Y
B.2.1.6	Station Keeping – Deep Water	Y

System Characterizations

Manufacturer's FS	5.0
Appendix A FS	2.5
Manufacturer's SWL	20,000 lbf
Minimum SWT[1]	10,000 lbf
Minimum DLT[1]	20,000 lbf
Wrap Angle[1]	180°
Maximum SWT[1]	< 20,000 lbf
Maximum DLT[1]	< 40,000 lbf
Wrap Angle[1]	> 60°
Weight	115 lbf
DLT Reaction Load[2]	40,000 lbf
SWT Reaction Load[2]	20,000 lbf
Groove Diameter	0.45 in
Tread Diameter	18 in

[1] SWT/DLT changes as the wrap angle changes. In some cases some tension members may be limited to certain angles.
[2] The Reaction Load is based on DLT/SWT at any angle

Free Body Diagram



The reaction force is constant over the SWT/DLT range. Using the table below it is possible to estimate the SWT/DLT based on a given geometry and use.

Wrap Angle	SWT	SWT Reaction	DLT	DLT Reaction
180°	10,000 lbf	20,000 lbf	20,000 lbf	40,000 lbf
165°	10,090 lbf	20,000 lbf	20,170 lbf	40,000 lbf
150°	10,350 lbf	20,000 lbf	20,170 lbf	40,000 lbf
135°	10,820 lbf	20,000 lbf	21,640 lbf	40,000 lbf
120°	11,550 lbf	20,000 lbf	23,090 lbf	40,000 lbf
105°	12,600 lbf	20,000 lbf	25,200 lbf	40,000 lbf
90°	14,140 lbf	20,000 lbf	28,280 lbf	40,000 lbf
75°	16,430 lbf	20,000 lbf	32,850 lbf	40,000 lbf
60°	20,000 lbf	20,000 lbf	40,000 lbf	40,000 lbf
45°	26,130 lbf	20,000 lbf	52,260 lbf	40,000 lbf

Attachment B.9: Shackle MCD Example

UNOLS Institution

Engineer, *UNOLS Ship Operations*

UNOLS Institution

Maximum Capability Document

Ship Shackle

This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This a-frame is rated for all deployment types referred to by Appendix B section B.2.1 depending on geometry and the tension member selected. If the load could exceed the ratings a load limiting device or system must be employed.

Section	Operation	Allowed
B.2.1.1	Towing – Surface	Y
B.2.1.2	Towing - Mid Water	Y
B.2.1.3	Towing - Deep Water	Y
B.2.1.4	Station Keeping – Surface	Y
B.2.1.5	Station Keeping – Mid Water	Y
B.2.1.6	Station Keeping – Deep Water	Y

System Characterizations

Shackle Type	Crosby G-2130
Shackle Size	1-3/8
Ultimate Strength[1]	113,400 lbf
Working Load Limit	27,000 lbf
DLT[2]	22,680 lbf
SWT[3]	13,500 lbf

[1] Calculated as 70% of Ultimate Load for cases of side loading up to 45°
[2] DLT incorporates a factor of safety of 1.5 to Yield and assumes a 180° wrap angle
[3] SWT incorporates a factor of safety of 1.7 to DLT and assumes a 180° wrap angle

Attachment B.10: A-Frame Example MCD (2 pages)

UNOLS Institution

Engineer, *UNOLS Ship Operations*

UNOLS Institution

Maximum Capability Document

Ship A-Frame

This document has been prepared in accordance with Appendices A & B from the UNOLS RVSS. This a-frame is rated for all deployment types referred to by Appendix B section B.3.5 depending on geometry and the tension member selected. If the load could exceed the ratings a load limiting device or system must be employed.

Section	Operation	Allowed
B.3.5.1	Towing – Surface	Y
B.3.5.2	Towing - Mid Water	Y
B.3.5.3	Towing - Deep Water	Y
B.3.5.4	Station Keeping – Surface	Y
B.3.5.5	Station Keeping – Mid Water	Y
B.3.5.6	Station Keeping – Deep Water	Y

System Characterizations

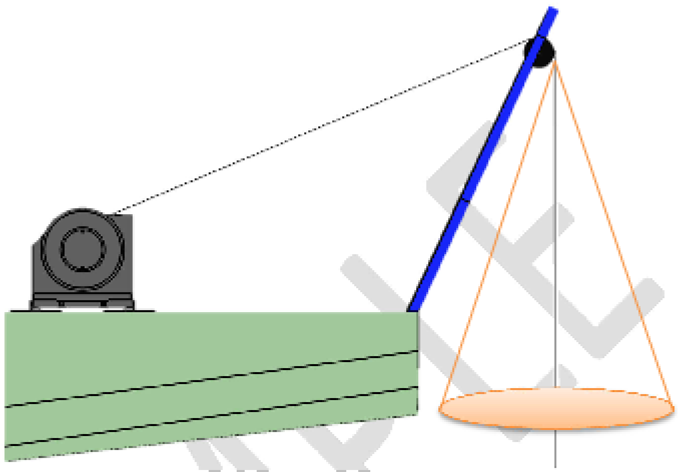
Station Keeping Parameters	Maximum Capability Value
Station Keeping SWT[1]	10,000 lbf
Station Keeping DLT[2]	20,000 lbf
Maximum Side Angle	30° (Cone)
Maximum Vertical Angle	30° (Cone)
Nominal Wrap Angle	125° (Cone tolerance 95°-155°)

Towing Parameters	Maximum Capability Value
Towing SWT[1]	14,140 lbf
Towing DLT[2]	30,000 lbf
Maximum Side Angle	30°
Maximum Vertical Angle	35°
Maximum Wrap Angle	90°

[1] Working Tension
[2] Tension where there is a 1.5 SF to yield on metal components

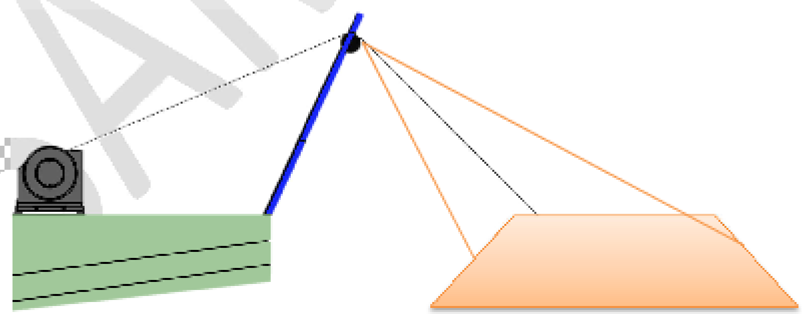
Free Body Diagrams

Station Keeping



The station keeping SWT and DLT are based on the worst case analysis of a 30° cone around an idealized vertical tension member.

Towing



The towing SWT and DLT are based on the worst case analysis of a 30° side angle outboard of the A-Frame and a 15° swath inboard of an idealized 45° tension member.

Attachment B.11: OHDD Example

Primary Deployment Information:	Science Party Response
Deployment Type	*Deep Water Towing*
Provide a brief narrative of scientific purpose and the equipment to be deployed. Attach drawings or other documents as required to describe the nature of deployment and the OHS or other equipment used/needed to carry it out.	*Towing a sub bottom profiler to exam water column properties.*
Package Type	*Edge Tech Sub Bottom Profiler, Tow Fish*
Maximum Package Weight (in water) (lbf)	*350*
Maximum Package Mass (weight in air) (lbm)	*500*
Added Weight (in water) (lbf)	*0*
Added Mass (weight in air) (lbm)	*0*
Maximum Drag (lbf)	*180*
Maximum Extraction Force (lbf)	*0*
Maximum Anticipated Tension Member Deployment Length (m)	*1000*
Deployment Depth (m)/ Water Depth (m) /Max %	*475 / 500 / 95%*
OHS/Components Furnished by Science Party	*Tension Member*
Vessel Services Required	*A-Frame*
Tension Member Type	*0.322 EM*
Maximum Tension Member Weight (in water) (lbf)	*474*
Maximum Tension Member Mass (weight in air) (lbm)	*573*
Tension Member ABL/SWT@FS (lbf)	*11,600/2,320@5.0*
Load Mitigating Devices	*None*

APPENDIX C
Safety Inspection Check List for Shipboard Vans

The attached checklist is intended for use by UNOLS Marine Superintendents and the Masters of vessels in the UNOLS fleet who need to determine if portable laboratory vans brought for use on their ships by Principle Investigators or other scientific personnel are reasonably safe. The placement and use of vans on research vessels is a complex issue involving many regulatory issues as well as common sense and an understanding of the shipboard environment. It is to be particularly noted that the United States Coast Guard and the American Bureau of Shipping regulate portable vans in various ways depending on the vans intended use and the registered tonnage of the vessel (i.e., a van acceptable for use on an “uninspected” vessel, such as the UNOLS “Intermediate” class vessels, may not be suited for a larger inspected vessel such as the UNOLS “Global” class.

Those responsible for inspecting vans as well as scientists planning to use vans should familiarize themselves with the “UNOLS Portable Scientific Vans Manual”

Table 1 in the referenced manual provides an outline of requirements for vans. As an example, a chemical storage, machinery or accommodation van, going on an inspected vessel must have a current USCG Inspection Certificate to be used on the vessel.   In many cases, decisions about scientist-supplied vans will be less clear and more subject to judgment.

The attached checklist is intended as a guide. It is not intended to cover accommodation, chemical storage, power/machinery or explosives storage vans which all have specific requirements (see Table 1 in the referenced manual). It need not be used for vans brought on for storage use only. It is intended for laboratory vans of various types that will have scientific personnel working in them during the time the ship is at sea. The goal of the checklist is to reasonably determine if the van is safe for the personnel that will be using the van and that it will not pose an unreasonable hazard to the vessel and embarked personnel.

Safety Inspection Check List for Shipboard Laboratory Vans

Ship:______________ Date: _____________ Inspected by:________________

Van Description: __________________ Van Purpose: ____________________

PI or Owner: ____________________ Cruise(s): _________________________

A. EXTERIOR

Yes	No	
		Does the van appear structurally adequate for the intended use and location (wind, spray, vessel motion, “green water on deck”)? See Table 1 in the referenced document for the UNOLS bulkhead stiffening requirements?
		Does the van appear to provide some level of fire boundary between the working space inside the van and the exterior? Will it be located a safe distance from the ship’s structure? See Table 1 in the referenced document for the UNOLS Fire Boundary Requirements.
		Is the van constructed of steel, aluminum or other substantial material suitable for marine use?
		Are there suitable attachment points for securing to vessel?
		Is the exterior condition acceptable: holes, obvious structural damage, etc.?
		Are doors equipped with latches to prevent self-releasing from vessel motion?
		Are doors that will be left open during van use equipped with holdbacks?
		Do doors open outward (escape direction)?
		Are external doors and hatches “weather tight?” Are overhead escape hatches “watertight?”
		Is there a label stating the lightweight and gross (tare) weight?
		When applicable, is there a label stating power requirements?
		Are the hook up receptacles (power, water, etc) in good condition?

B. INTERIOR

Yes	No	
		Are there two means of egress that can be opened from both the interior and exterior of the van? (Container doors do not qualify.) (Does not apply to storage vans.)
		If overhead escape hatch, does it open? Test it.
		If fitted with an overhead escape hatch, does it have a unobstructed ladder, footholds, steps or other method for accessing the hatch? Is there a safe method to get down from the top of the van?
		Does the electrical system meet good commercial standards (conduit, GFCI protection, commercial lighting enclosures, grounding)?
		Is the electrical system equipped with adequate and accessible circuit breaker protection?
		Are any internal doors free of locking devices and unblocked (Exterior doors may be fitted with locking devices for security and shipping as long as they remain unlocked while in use)?
		Is there adequate ventilation for the intended purpose?
		Are there suitable fire extinguishers?
		Are there a first aid kit, eyewash, and emergency shower if applicable?
		Is there emergency lighting for egress in the event of a power failure?
		Is there provision for internal communication (intercom, general announcing system, general alarm)?

APPENDIX D
Vessel Charter Data

Charterer – PI/Office/Institution (include contact information)	
Dates of Planned Charter	
Project Area of Operations	
Operations Planned	
Vessel Name / Radio Call Sign	
Vessel Type / Year Built General Description	
Charter Vessel Owner/Operator And Contact Information	
Length Overall / Draft / Displacement / Tonnage [GT/GRT/NT]	
Vessel Material /Type of Construction	
Certificate/Letter of Designation (type/expiration date, ID #s, etc.)	
Master/Crew Maritime Licenses (additional space on next page)	
Charter Vessel's Home Port	
Port Vessel Will Work Out Of During Charter	

Vessel Charter Data

Life Jackets (Quantity/Condition)	
Life Rafts (Quantity / Capacity)	
EPIRBs Aboard	Yes / No How Many?
Number of Exposure Suits (Quantity / Condition)	
Max Number of Passengers & Scientists Vessel Carries	
Number of Scientists Going	
Number of Days Chartered	
Overnight Trip(s)?	
Radio(s) / Type(s)?	
Electronic Positioning Equipment (Name / Type)	
Charter Rate/Fee	
Insurance	Yes / No Type Liability Coverage Amounts
Master/Crew Maritime Licenses	

Inspection Check List for Chartering of Non-UNOLS Vessels

Vessel Name:	
Owner:	
Address and Contact Information:	
Operator:	
Address and Contact Information:	
Licenses held:	
Vessel Type and General Description:	
Length Overall:	
Displacement:	
Tonnage [GT/GRT/NT] :	
Draft:	
Radio Call Sign	
Number of Passengers/Scientists that can be carried:	
Charterer – PI and Institution	
Dates of planned charter:	
Area of operations:	
Type of operations or activities planned:	
Number in planned science party:	

Inspection Check List for Chartering of Non-UNOLS Vessels

Check each category listed below as appropriate for the charter mission and operating area. Ensure necessary equipment is aboard and operates properly.

Bridge and Navigation Equipment:

_____Compass

_____Two GPS Systems

_____Depth Sounder

_____Radar

_____Navigation Lights

_____Ships Bell

_____Whistle or Sound Device

_____Emergency Alarm

_____Pyrotechnics

_____ Expiration Date Not Exceeded?

_____Navigational Charts & Pubs

_____ECDIS or Electronic Charting/Navigation Programs

Communications Equipment:

_____Radios, VHF and/or SSB

_____EPIRB(s), Registered?

_____Cellular Phone

_____SART

_____INMARSAT, Iridium or Other Satellite phone system

_____Emergency Radio with backup battery or power

Documentation:

_____

_____ Ensure the appropriate documentation, ownership, inspections and certificates are current for planned mission.

_____ Ensure Master's license is current and appropriate for vessel being chartered.

_____ Ensure crew size and credentials are appropriate for charter's mission.

_____ Ensure insurance coverage meets chartering Institutes minimum requirements for charter duration.

Exterior Decks and Equipment:

____ Anchors and Associated Equipment

____ Watertight Doors and Hatch Comings

____ Deck Surfaces Non-Skid

_____ Freeing Ports

_____ Deck Vents

_____ Life Lines and Safety Chains

_____Cargo and Weight Handling Equipment (Safe Work Load posted & tested, 46CFR189.35 requirements, Appendix A requirements if appropriate).

Life Saving Equipment:

_____PFDs

_____Immersion Suits

_____Inflatable Life Rafts

_____Life Ring Buoys

_____Rescue Boats

_____Water Lights/Strobes

Fire Fighting Equipment:

_____ Fixed and Portable Fire Extinguishers

_____ Inspection Dates Current?

_____ Smoke and Fire Detectors

_____ Fire Stations and Hoses

_____ Self Contained Breathing Apparatus

_____ Fire and Damage Control Locker

_____ Emergency Stations Bill

Engineering:

_____ Gas Engines; Check flame arrestor, vents, hoses, no sparking devices in bilges.

_____ Diesel Engines. Check oil and exhaust leaks, starting system, maintenance, hours since last overhaul.

_____Inspect overall cleanliness and condition of power sources.

_____Check bilge and ballast systems and pumps.

_____Check engine room fire suppression capability.

_____Check all manifolds for saltwater, fuel, etc.

_____Check condition of switchboards, wiring and auxiliary generators.

_____Check emergency lights.

_____Check refrigeration systems.

_____Check fueling system and pumps.

_____Check fire pump.

Miscellaneous:

_____Assess vessel's overall ability to perform charter mission (i.e. laboratory and deck space, berthing and feeding capability, scientific equipment and winches, etc.)

_____Oil Pollution Placard and other required notices are posted.

_____First Aid Kits and Medical Supplies

_____Emergency Steering

_____General Appearance and Cleanliness

_____Damage Control Equipment

_____Sanitary System Operations

_____Assess vessel's overall stability

_____Tank Inspections/Record of Inspections

Chartered Vessel Cruise Plan

1. Names of all ship's crew (unless provided to Marine Operations previously)

2. Names of all scientific personnel (including technicians)

3. Designated Master and Chief Scientist during this voyage

Master: Chief Scientist:

4. Date/time and port of departure

5. Date/time and port of arrival

6. Cruise track (way points), ETA at those points, and operating area(s)

7. Summary of science planned

8. Communications plan (include means of communication, primary means, secondary means, phone numbers, call signs, etc.)

9. Information concerning the use of hazardous materials, explosives, and radioactive material during cruise

10. Other information as appropriate to safe and effective vessel operations

APPENDIX E
Harassment Prevention

UNOLS institutions and vessel operators are committed to maintaining a positive working and learning environment, free of illegal discrimination and any forms of harassment. While recognizing operator institutions have their own internal policies, this appendix builds on these and reemphasizes the unique nature of being at sea.

What is harassment?

Harassment includes verbal or physical conduct, whether on or off the premises, which has the intent or effect of unreasonably interfering with any individual's or group's academic or work performance, which significantly affects an individual's ability to participate in the activities of the vessel or field expedition (whether on or off duty), or which creates an intimidating, hostile or offensive educational or work environment, when such conduct is based upon age, race, color, national origin, gender, sexual orientation, religion, creed, disability or status as a veteran.

What types of behavior constitute harassment?

Harassment can take many forms. It can be blatant or subtle, verbal or physical, printed on paper or communicated electronically. Examples of conduct that can constitute harassment are:

- Outright propositions and improper suggestions or requests for sexual favors
- Threats or promises regarding compliance with sexual behavior
- Sexist, racial or ethnic jokes, slurs or cartoons; lewd or obscene remarks; disparaging remarks relating to gender, race, ethnicity, etc.
- Abuse, insults or jokes concerning sexual orientation, including insinuations or offensive comments about private life or lifestyle
- Sexual or racial innuendoes or offensive sexual or racial statements disguised or presented as humorous
- Unwanted physical contact, including touching, pats, hugs, or squeezes.
- Unwelcome advances such as repeatedly asking someone out on a date in spite of past refusals
- Actions or sounds – whistling, cat-calls, suggestive sounds, obscene gestures, display of offensive pictures or graffiti that would be found offensive by a reasonable colleague
- Stalking or following someone in an unacceptable unprofessional fashion
- Imbalance of attention, whether it be positive or negative, towards one employee or student based upon gender or race that has the intent or effect of providing an inequitable work or educational environment
- Any form of assault – sexual or otherwise

Special conditions at sea.

Social conditions in remote locations such as at sea or at an ice camp are very different from those typically faced at work. The close quarters demand utmost consideration of others at all times. Privacy is greatly reduced, and as a result, interactions can become more intense, intentionally or not. When in these situations, anyone may be subject to more excessive personal attention, welcomed or un-welcomed, than might be experienced in a more typical work situation. Sexual awareness and tensions may be heightened, especially if people feel lonely, overtired or homesick and the resulting behavior may be so disruptive as to constitute harassment.

What should you do if you witness or experience an inappropriate or uncomfortable incident or situation?

Speak up: If you believe you may have experienced or witnessed harassment, do not hesitate to speak with the offender. Many situations can be resolved very simply by directly and promptly telling the offending party that his/her behavior is making you feel uncomfortable and asking the person to stop. If you feel uncomfortable speaking with the person privately, approach the individual with a trusted friend or colleague.

Tell someone: It is your right and and responsibility to inform your supervisor or other designated individual in the event that you witness or are a victim of any form of harassment. You are strongly encouraged to report the matter to the ship's Captain and/or the Chief Scientist. They are responsible for maintaining a safe working and learning environment, free of harassment and discrimination.

Keep records: Keep notes describing the incidents noting the date, place, time and any witnesses to the behavior.

Seek advice: While speaking directly to the offender or reporting your concerns to the Captain or Chief Scientist are the first options to consider, there may be instances when neither of those is appropriate. In that case, you should seek advice from someone else that is in a position to help, such as the Marine Superintendent who can often be reached by e-mail from the ship at sea.

Resources:

It cannot be emphasized enough that if you are the recipient of unwanted or unwelcome attention or harassment and have not resolved or cannot resolve the situation yourself, you need to speak with someone. For overall or general support, you may want to speak with a friend, colleague, peer or member of the clergy. To address your specific concern it is important that you speak with someone in a position to help. The following personnel are a resource available to you..

At Sea:

- Chief Scientist or immediate supervisor
- Captain
- Chief Mate
- Marine Superintendent

APPENDIX F
List of Acronyms

AAUS	American Academy of Underwater Sciences'
ABL	Assigned Breaking Load
ABS	American Bureau of Shipping
ABYC	American Boat and Yacht Council
AC	Alternating Current
ADA	Americans with Disabilities Act
AIS	Automated Identification System
ASAM	Anti-shipping Activity Messages
AUV	Autonomous Underwater Vehicle
CFR	Code of Federal Regulations
COR	Certificate of Registry
CPR	Cardiopulmonary Resuscitation
CTD	Conductivity-Temperature-Depth
DC	Direct Current
DPA	Designated Person Ashore
DSC	Digital Selective Calling
EEBD	Emergency Escape Breathing Device
EPIRB	Emergency Position Indicating Radio Beacons
ETA	Estimated Time of Arrival
FCC	Federal Communications Commission
FM	Factory Mutual
FS	Factor of Safety
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRT	Gross Registered tonnage
GT	Gross tonnage
HF	High Frequency
HOV	Human Occupied Vehicle
IACS	International Association of Classification Societies LTD.
ICLL	International Convention on Load Lines
IEEE	Institute of Electrical and Electronics Engineers

IFF	Identification Friend or Foe
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
INSURV	Inspection and Survey
ISM	International Safety Management
ISO	International Organization for Standardization
ISPS	International Ship and Port Facility Security
ITC	International Convention on Tonnage Measurement of Ships
LBP	Length between perpendiculars
LCG	Location of the Center of Gravity
LFM	Linear Feet per Minute
LL	Load Line
MARPOL	International Convention for the Prevention of Pollution from Ships
MEOL	Maximum Expected Operating Load
MF	Medium Frequency
MMD	Merchant Mariner Document
MSC	Maritime Safety Committee
MSO	Marine Safety Office
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MSM	Marine Safety Manual
MTSA	Maritime Transport Safety Act
NBDP	Narrow Band Direct Printing
NBL	Nominal Breaking Load
NFPA	National Fire Protection Association
NGA	National-Geospatial Agency
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPFVOA	North Pacific Fishing Vessel Operators Association
NRC	Nuclear Regulatory Commission
NRT	Net Registered Tonnage
NSF	National Science Foundation
NTSB	National Transportation Safety Board
NVIC	Navigation and Vessel Inspection Circular

OCMI	Officer in Charge, Marine Inspection
ONI	Office of Naval Intelligence
ONR	Office of Naval Research
OPA	Oil Pollution Act
OPRC	International Convention on Oil Pollution Preparedness Response and Cooperation
ORM	Other Regulated Materials
ORVA	Oceanographic Research Vessel Act
OSHA	Occupational Safety and Health Administration
OSRO	Oil Spill Removal Organization
PFD	Personal Floatation Device
PI	Principal Investigator
PLB	Personal Location Beacon
QMED	Qualified Member of the Engineering Department
RCC	Rescue Coordination Center
RO-RO	Roll On – Roll Off
RSO	Radiation Safety Officer
RVOC	Research Vessel Operators' Committee
RVSS	Research Vessel Safety Standards
SAR	Search And Rescue
SART	Search And Rescue Transponder
SHIP	Seafarers Health Improvement Program
SITOR	Simplex Teletype Over Radio
SMC	Safety Management Certificate
SMS	Safety Management System
SNAME	Society of Naval Architects and Marine Engineers
SOLAS	International Convention for the Safety of Life at Sea
SSAS	Ship Security Alert System
STCW	Standards of Training, Certification & Watchkeeping
STR	Ship Time Request
SWAB	Service offered by the Tritium Lab at the University of Miami to detect very low levels radio activity in shipboard labs and vans..
SWL	Safe Working Load
TBL	Tested Breaking Load
UL	Underwriters Laboratories

UNOLS	University-National Oceanographic Laboratory System
USC	United States Code
USCG	United States Coast Guard
VHF	Very High Frequency

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NOTES