Health and Safety Plan
Remedial Investigation/Feasibility Study
Falcon Refinery Superfund Site
Ingleside, San Patricio County, Texas
EPA Identification No. TXD086278058

Remedial Action Contract 2 Full Service
Contract No.: EP-W-06-004
Task Order: 0088-RICO-06MC

Prepared for:

U.S. Environmental Protection Agency
Region 6
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24 October 2012

Tim Startz, Program Manager — Date
EA Engineering, Science, and Technology, Inc.

24 October 2012

Robert Owens, Project Manager — Date
EA Engineering, Science, and Technology, Inc.

24 October 2012

Peter Garger, CIH, Corporate Health and Safety Director — Date
EA Engineering, Science, and Technology, Inc.

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1. INTRODUCTION

EA Engineering, Science, and Technology, Inc. (EA) has been authorized by the U.S. Environmental Protection Agency (EPA), under Remedial Action Contract No. EP-W-06-004, Task Order 0088-RICO-06MC, to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Falcon Refinery Site (site).

1.1 PURPOSE

The purpose of this Health and Safety Plan (HSP) is to provide personnel with protection standards and mandatory safety practices, procedures, and contingencies to be followed while performing field activities at the site. This HSP defines actions to be taken in respect to personnel safety during work activities associated with the RI/FS field activities.

EA considers the safety and health of its employees, clients, and visitors and the prevention of work-related accidents and illness and property loss to be of the highest priority. Proactively implemented, a comprehensive and systematic health and safety program will result in more efficient and profitable operations by improving employee health and morale, and by reducing worker's compensation costs, lost time, fire and liability insurance premiums, and property damage. The objectives of EA's Safety and Health Program are to ensure:

1. Sound safety and health practices and conditions necessary for the protection of the health and welfare of employees, clients, and visitors

2. Compliance with federal and state safety and health regulations and standards

3. Effective safety and fire prevention practices necessary for protection of company-owned or -operated property.

This HSP addresses the following regulations and guidance documents:

- Occupational Safety and Health Administration (OSHA) Standards for General Industry, 29 Code of Federal Regulations (CFR) 1910

- OSHA Standards for Construction Industry, 29 CFR 1926

- National Institute of Occupational Safety and Health, OSHA, EPA, and U.S. Coast Guard *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October 1985.

One copy of this HSP will be maintained for use during the entire duration of field activities and made available for site use/employee review at all times.

The Health and Safety Plan Review Record in Appendix A must be signed by all personnel

before they enter the site. Protocols established in this HSP are based on site conditions and health and safety hazards known or anticipated to be present, and on available site data. This plan is intended solely for use during proposed activities described in the corresponding site-specific Sampling and Analysis Plan (SAP). Specifications herein are subject to review and revision based on actual conditions encountered in the field during site activities. Significant revisions to this HSP must be approved by the Project Manager and the EA Health and Safety Coordinator.

1.2 BACKGROUND

A description of the site history and the field activities covered by this HSP are included below.

1.2.1 Site History

The site is located 1.7 miles southeast of State Highway (SH) 361 on Farm-to-Market (FM) 2725 at the north and south corners of the intersection of FM 2725 and Bishop Road near the City of Ingleside in San Patricio County, Texas. The site occupies approximately 104 acres and consists of a refinery that operates intermittently and is currently inactive, except for a crude oil storage operation being conducted by Superior Crude Gathering, Inc. When in operation the refinery had a capacity of 40,000 barrels per day and the primary products consisted of naphtha, jet fuel, kerosene, diesel, and fuel oil. The refinery also historically transferred and stored vinyl acetate, a substance not excluded under the CERCLA petroleum exclusion.

Surface water drainage from the site enters the wetlands along the southeastern section of the abandoned refinery. The wetlands connect to the Intracoastal Waterway and Redfish Bay, which connects Corpus Christi Bay to the Gulf of Mexico. The site is bordered by wetlands to the northeast and southeast, residential areas to the north and northwest, Plains Marketing L.P. (a crude oil storage facility) to the north, and several construction companies to the west and south. Other portions of the site include above-ground and buried piping leading from the site to dock facilities, owned by National Oil Recovery Corporation (NORCO), at Redfish Bay.

1.2.2 Scope of Work

The field activities covered by this HSP include, but are not limited to, health and safety hazards anticipated for field activities including:

1. Site reconnaissance (e.g., site surveys)
2. Drilling and installation of ground water monitoring wells
3. Collection of soil samples using a Geoprobe®
4. Collection of soil samples from agricultural and/or other areas

5. Collection of sediment and surface water samples from intracoastal waterways using a boat

6. Collection of ground water samples from monitoring wells and residential tap wells

7. Survey using ground penetrating radar (GPR) and/or electromagnetic survey

8. Collection of biota and/or fish tissue samples using a boat.

1.3 SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN ORGANIZATION

This HSP presents the approach to safety during execution of the Task Order activities conducted at the site. This section presents an introduction and outlines the report organization. Section 2 summarizes the project management team. Section 3 outlines the hazard communications and environmental monitoring during field operations. Section 4 presents the required employee training. Section 5 details personal protective equipment (PPE). Section 6 summarizes emergency response reactions to site contingencies. Section 7 outlines site controls and work zones.

Prior to entering the site, employees must review this HSP, and agree to comply with the requirements. The plan must be signed by all personnel, including contractors, subcontractors, and visitors (Appendix A). Contractors and subcontractors are ultimately responsible for ensuring that their own personnel are adequately protected. In signing this agreement, the contractors and subcontractors acknowledge their responsibility for the implementation of the HSP requirements. All personnel onsite will be informed of the site emergency response procedures and any potential health and safety hazards associated with site operations.

A list of personnel entering the site will be recorded in a Daily Site Log (Appendix B). In addition, personnel will participate in the daily safety meetings and sign the Daily Safety Meeting Form (Appendix C).

2. PROJECT MANAGEMENT

This section identifies key personnel that will be involved in RI/FS activities at the site.

2.1 KEY PERSONNEL

Table 1 presents information on key project personnel.

Table 1 Project Personnel

Name	Position	Work Phone	Cell Phone
Rafael Casanova	EPA Task Order Monitor	214-665-7437	817-832-8209

---	EPA Alternate Task Order Monitor	---	---
Tim Startz	EA Program Manager	972-315-3922	214-616-7027
Pete Garger	EA Corporate Health and Safety Director	410-527-2425	410-790-6338
Robert Owens	EA Project Manager	972-315-3922	972-989-7956
Brian Yost	EA Dallas Office Health and Safety Coordinator	972-459-5012	214-906-0253
To be determined	EA Site Manager	972-315-3922	--
	EA Site Health and Safety Officer		

2.2 RESPONSIBILITIES

Clear lines of authority will be established for enforcing compliance with the safety, health, and contingency procedures consistent with industry policies and procedures. Designated EA personnel are responsible for implementation of the HSP during field activities, including:

- Field supervision
- Enforcing safe work practices and decontamination procedures (if needed)
- Ensuring proper use of PPE
- Communicating site-safety program modifications and requirements to site personnel
- Proper reporting of injuries, illnesses, and incidents to the appropriate internal and external organizations
- Containing and controlling the loss of potentially hazardous materials to soil, air, surface water, and ground water during all phases of the investigation
- Directing emergency operations and coordinating with onsite and offsite emergency responders (if any).

In the event of an onsite injury, occupational illness, near miss, or environmental contamination incident, the following organizations/individuals will be notified, as appropriate:

- Project Manager
- Health and Safety Coordinator
- Site Manager/Site Health and Safety Officer
- Corporate Health and Safety Director
- Program Manager.

2.2.1 Project Manager

The Project Manager has overall responsibility for site activities and will be the primary contact

during field activities.

2.2.2 Health and Safety Coordinator

The Health and Safety Coordinator (HSC) is responsible for administering the company health and safety program. The HSC will act in an advisory capacity to the Project Manager and onsite personnel for Task Order-specific health and safety issues. The Project Manager will establish a liaison between officers and representatives of EPA and the HSC on matters relating to health and safety.

2.2.3 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) is responsible for coordination of onsite contingency operations, as well as the implementation of the Site Health and Safety Program. The SHSO will be onsite throughout the Task Order and will be responsible for daily compliance with site safety and health requirements. For this Task Order, the Site Manger (SM) and SHSO will be the same person. In the event of an emergency situation, the SHSO will be responsible for initiating and coordinating emergency responses/contingency operations.

The PM, HSC, and SM/SHSO will have the authority to make on-the-spot corrections concerning safety, health, and environmental pollution.

2.2.4 Site Manager

The SM reports to the Project Manager and HSC. His/her responsibilities include, but are not limited to: providing technical support, evaluating onsite environmental monitoring results, coordinating site activities with subcontractors, initiating evacuation of the work site when needed, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders.

2.2.5 EA Corporate Health and Safety Director

The EA Corporate Health and Safety Director reports to senior management and is responsible for establishing and administering the company-wide health and safety program designed to ensure compliance with federal and state health and safety regulations and standards, and safe work practices.

2.2.6 Program Manager

The Program Manager reports directly to the senior management. He oversees management and coordination between client, staff, and subcontractors.

2.2.7 Employee Responsibilities

Employees are responsible for reading, understanding, and meeting the health and safety requirements contained in this HSP. A HSP Review Record sign-off sheet is provided in Appendix A. Employees are required to implement these procedures when conducting daily operations. This will also include receiving appropriate training and medical monitoring (if required) and utilization of EA-provided health and safety equipment (to include all forms of PPE) to safely conduct site operations. Employees will review each task prior to commencement to consider the potential health and safety hazards, and the measures to be taken in the event of an emergency. Employees should know where material safety data sheets (MSDSs), first aid supplies, and emergency equipment are maintained. The SHSO should be notified of potential health and safety hazards, near-miss conditions, or incidents present on the job site or unusual effects believed to be related to hazardous chemical exposures. Failure to follow established health and safety procedures could result in immediate dismissal from the site, and, if repeated, a potential loss of employment.

2.2.8 Subcontractors

Responsibilities of subcontractor personnel include following the HSP and applicable health and safety rules, regulations, and procedures. This may include:

- Using required controls, procedures, and safety devices, including PPE
- Notifying his/her supervisor of identified or suspected emergencies as well as safety or health hazards
- Complying with training and medical requirements (if required).

Subcontractor personnel are responsible for reading, understanding, and meeting the health and safety requirements contained in this HSP in addition to their own HSP. The Health and Safety Plan Review Record in Appendix A must be signed by all subcontractors. The subcontractors may elect to prepare a HSP Addendum, or they may adopt this HSP.

3. HAZARD EVALUATION AND CONTROL

Field activities to be performed by EA and subcontractors during the RI/FS include the following tasks:

1. Site reconnaissance (e.g., site surveys)

2. Drilling and installation of ground water monitoring wells

3. Collection of soil samples using a Geoprobe®

4. Collection of soil samples from agricultural and/or other areas

5. Collection of sediment and surface water samples from intracoastal waterways using a boat

6. Collection of ground water samples from monitoring wells and residential tap wells

7. Survey using GPR and/or electromagnetic survey

8. Collection of biota and/or fish tissue samples using a boat.

EA staff and subcontractors will be responsible for completing all tasks. Hazards associated with these tasks and necessary work practices are discussed below.

3.1 PHYSICAL AND BIOLOGICAL HAZARDS

Potential physical hazards and appropriate control measures or each of the above-listed tasks are summarized in Table 2.

Table 2 Physical and Biological Hazard Evaluation and Control

Hazard	Tasks	Control Measures
Biological	1, 2, 3, 4, 5, 6, 7, 8	• Potential hazards include poison ivy, poison oak, poison sumac, snakes, insect bites, stings • Be aware of insects in areas of inland water, low lands, and swamps • Establish site-specific procedures for working around identified hazards • Snakes and Insects – areas of heavy vegetation, rocks, and other site features • Clear vegetation, when necessary, within the work zone and wear long-sleeve shirts, pants, and gloves
Cold Stress	1, 2, 3, 4, 5, 6, 7, 8	• Provide warm break area and take adequate breaks • Provide non-caffeinated beverages • Promote cold stress awareness
Drilling	2, 3	• Keep safe distance from the drill rig • Locate 'kill-switch' of the drill rig to stop the drill rig, in case of emergency • Cease activities during thunderstorm periods • Maintain line of sight with driller during drilling activities • Wear proper PPE – hard hat, safety glasses, and steel-toed boots
Excavation and Trenching	Not applicable	• No personnel will enter the excavation area • Keep safe distance from all the equipment • Shut down operations if there is a sign of cave in, change in weather, or unacceptable site conditions • Maintain safe distance during excavation activities
Fire and Explosion	2, 3, 5, 7, 8	• Inform personnel of the locations of potential fire/explosion hazards both onshore and aboard the sampling boat • Identify subsurface utility lines, if possible • Establish site-specific procedures for working around flammables • Ensure that appropriate fire suppression equipment and systems are available and in good condition

Hazard	Tasks	Control Measures
Heat Stress	1, 2, 3, 4, 5, 6, 7, 8	• Promote heat stress awareness • Provide cool break areas and take adequate breaks • Provide non-caffeinated beverages • Remain aware of signs of heat stress and monitor yourself and co-workers
Heavy Equipment Operations	2, 3, 5, 7, 8	• Ensure that the operators are properly trained and equipment has been properly inspected and maintained • Establish equipment routes, traffic pattern, and site-specific safety measures • Assign spotters and inform of proper hand signals and protocols • Wear reflective vests while working around heavy equipment • Keep safe distance from all equipment. • Lifting capabilities and load limits of equipment will not be exceeded.
Impaling	1, 2, 3, 4, 5, 6, 7, 8	• Sharp protruding objects (steel rebar, debris) – walk carefully • Wear proper PPE – hard hat, safety glasses, steel-toed boots
Noise	2, 3, 5, 7, 8	• Keep safe distance from all the equipment • Implement hearing protection measures • Establish noise level standards for all onsite equipment
Power Tools	2, 3, 5, 7, 8	• Comply with the requirements of 29 CFR 1926 Subpart P • Only allow trained personnel to use power tools • Wear proper PPE
Site Debris	1, 2, 3, 4, 5, 6, 7, 8	• Trip/Fall hazard – walk carefully • Boating concerns may include subsurface structures or sunken debris • Wear proper PPE – hard hat, safety glasses, steel-toed boots • Wear hard hat, safety glasses against flying debris • Follow illumination requirements of 29 CFR 1926 Subpart P if sufficient illumination is absent • Contact local utility company, if required
Utility Lines	2, 3	• Identify and locate existing utilities prior to work • Contact local utility company, if required • Keep safe distances from utility lines
Working on or Near Water	1, 2, 3, 4, 5, 6, 7, 8	• EA Corporate Vessel Operations Manual and standard operating procedures (SOPs) must be followed at all times • Subcontractors/Captains must follow EA corporate Boating Operations Plans and SOPs at all times • An emergency plan must be reviewed and followed in the event that the boat is disabled or damaged • Slips may occur due to wet surfaces • Reflective personal flotation devices must be worn at all times • All sampling equipment and other onboard materials must be appropriately stowed to avoid shifting equipment due to sea state • Guard against drowning • Avoid electrocution due to weather/lighting strikes • Carefully operate electric winches and power tools, in accordance with SOPs. • If possible, onshore contact will be maintained
Material Handling and Moving	1, 2, 3, 4, 5, 6, 7, 8	• Heavy loads should be lifted by 2 or more people • The boat will be safely loaded, and not carry more than the manufactured capability of the boat
Vehicular Traffic	1, 2, 3, 4, 5, 6, 7, 8	• Keep a safe distance from all boat traffic • Maintain and monitor all boat traffic using marine band radios

Hazard	Tasks	Control Measures
		• Wear warning vests or other suitable garments marked with or made of reflectorized or high visibility material

The following section provides a brief description of physical hazards that may potentially be present during field activities. These physical hazards may include, but are not be limited to: working over or near water, fire/explosion, heat/cold stress, heavy equipment, noise, electrical, utilities, weather, biological, vehicular and pedestrian traffic, and material handling, moving, or lifting.

The site will be visually inspected for the presence of general safety hazards (e.g., trip/slip hazards, unstable surfaces or steep grades, vehicle/pedestrian/boat traffic, and sharp objects) prior to beginning work. If hazards are identified, these hazards will be recorded and precautionary measures taken to prevent injury.

3.1.1 Working Over or Near Water

A portion of the field effort will occur over or near water. Safe operations and procedures for safe small boat operations are laid out in EA's Corporate Vessels Operation Manual (Appendix D). Hazards associated with working on the water include: slips caused by wet surfaces, shifting of equipment because of instability of the boat, drowning, and electrocution caused by electrical storms. Onsite personnel will be required to wear a U.S. Coast Guard approved Personal Flotation Device (PFD). The PFD must be inspected for wear and sized appropriately prior to beginning activities. A ring buoy will be kept on board the boat and will be readily available for emergency situations. Personnel will be requested to identify and prevent unsafe work conditions such as accumulations of water or sediment on the work surface, obstructions on the work deck which could cause a trip or fall, or overhead obstructions that could cause a fall. Weather conditions will be monitored via broadcast from marine radio channel to identify the approach of severe weather situations. Work on the boat will be suspended during thunderstorms and other severe weather situations.

A written float plan containing a summary of the details of the trip, including route, type of boat, persons aboard, and other salient information which may be useful in the event of an emergency, must be produced prior to departure. Subcontractors/captains must be familiar with and follow EA's Corporate Vessels Operation Manual (Appendix D) concerning boat operations at all times. All sampling personnel must be familiar with and follow the U. S. Coast Guard's Rules of the Water. All sampling equipment and other onboard materials must be appropriately stowed to avoid shifting due to sea state. Emergency plans and procedures must be reviewed prior to departing shore and followed in case the boat is disabled or damaged. When possible, every attempt will be made to notify the Project Manager when the boat is both on and off the water.

3.1.2 Fire/Explosion

When working around machinery and boats fueled by gasoline or diesel products, the potential for

fire and/or explosion emergencies is present. Employees shall always be on the alert for unexpected events, such as ignition of chemicals or sudden release of materials under pressure, and prepared to act in case of fire and/or explosion.

Flammable liquids, such as gasoline, will be stored in well-ventilated areas. Smoking will not be permitted on the boat at any time.

Heavy equipment and boats will be equipped with fire extinguishers. Employees will be trained in the proper use of fire suppression equipment. However, large fires that cannot be controlled with a fire extinguisher shall be handled by professionals. The proper authorities shall be notified in these instances.

The potential for fire and/or explosive conditions will exist. Workers must continuously monitor the work area for combustible or explosive gases when operations have the potential to generate sparks. Employees should always be alert for unexpected events, such as ignition of chemicals or sudden release of materials under pressure, and be prepared to act in these emergencies.

Smoking is not allowed at any time within the work area.

3.1.3 Heat Stress and Heat-Related Illness

Effects of heat stress and illness are possible during the performance of field activities at the site. Injury from heat exposure may occur to persons working outdoors during a period of high temperature conditions. This is a major concern when personnel are working in PPE clothing. The body's principal means of cooling is through the evaporation of sweat. When personnel are working in PPE, sweat is trapped inside the clothing and cannot evaporate, thus allowing a rise in the body's core temperature and possibly resulting in a heat-related illness. Monitoring will commence at temperatures of 70 degrees Fahrenheit (°F) and above when employees are wearing impervious full-body clothing.

Personnel should be familiar with the signs and symptoms of heat stress. These include:

- **Heat Cramps**—Painful contraction of voluntary muscles
- **Heat Exhaustion**—Dizziness, lightheadedness, slurred speech, rapid pulse, confusion, fainting, fatigue, copious perspiration, cool skin that is sometimes pale and clammy, and nausea
- **Heat Stroke**—Hot, dry, flushed skin; delirium; and coma (in some cases).

Resting frequently in a shaded area and consuming large quantities of fresh, potable water and electrolyte replenishing fluids (i.e., Gatorade) can prevent heat stress. If heat exhaustion symptoms are observed, the person will be required to rest in a shaded area and consume liquids. If symptoms are widespread or observed frequently, an appropriate work/rest regimen will be

instituted. This may involve limiting the work period so that after 1 minute of rest, a person's heart rate does not exceed 110 beats per minute.

If the heart rate is higher than 110 beats per minute, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the heart rate is 110 beats per minute at the beginning of the next rest period, then the next cycle should be shortened by another 33 percent. Resting heart rate should be determined prior to starting onsite activities.

A healthy individual's resting heart rate is usually 60–72 beats per minute. If symptoms of heat stroke are observed, the victim will be cooled immediately and transported to the nearest hospital. Workers should not hesitate to seek medical attention if heat stroke is suspected.

3.1.4 Effects of Cold Exposure

Cold stress can be caused by exposure to temperatures at or below freezing or to excessive wind at higher temperatures. When an individual's body temperature falls below 98.6°F, cold stress injuries may occur. The body's cells are composed primarily of water that can freeze when exposed to low temperatures, resulting in cell damage or death. Primary effects of cold exposure include frostnip, frostbite, and hypothermia:

- **Frostnip** commonly occurs as a result of surface tissue freezing at the tips of the ears, nose, cheeks, chin, fingertips, and toes. Symptoms of frostnip include the appearance of white shiny skin. If frostnip occurs, gradually warm the affected areas with a warm hand or warm breath. Do not rub.

- **Frostbite** occurs as the result of surface and subsurface tissues freezing. Symptoms include erythema (abnormal redness of skin from capillary dilation), blistering, throbbing pain, numbness, and swelling. If frostbite is suspected, move to a warm location and provide slow and steady re-warming.

- **Hypothermia** is the result of prolonged exposure to cold temperatures and body heat loss. Symptoms of hypothermia include body shivers, slow reaction time, mental confusion, glassy eyes, low body temperature, low pulse rate, and difficult respiration. Death can occur within 2 hours if not treated. If hypothermia is suspected, move to a warm location, remove wet and/or cold clothing, and provide re-warming as rapidly as possible. Provide both external heat (fire, electric blanket, body heat) and internal heat (hot liquids for conscious victims). Seek medical attention immediately.

In order to avoid potential cold stress, field personnel should take precautions against the cold and maintain body temperatures. This is most easily done by wearing the proper protective clothing, including insulated head and ear covering, gloves, insulated socks and/or boots, and insulated clothing in layers. If the potential exists for clothing to become wet, then the outer layer of clothing should be water repellent. Clothing that becomes wet with either water or

sweat should be replaced immediately. In addition, the work area can be protected by the placement of vehicles or tarps to reduce wind chill.

3.1.5 Heavy Equipment

The use of heavy equipment (e.g., front-end loader, excavator, dozer, drill rigs, dump trucks, vacuum trucks, concrete hauling trucks, generators, compressors) may pose safety hazards to site workers. Only trained, experienced personnel will conduct heavy equipment work. If possible, personnel must remain outside the turning radius of large, moving equipment. At a minimum, personnel must maintain visual contact with the equipment operator. No guards, safety appliances, or other devices may be removed or made ineffective unless repairs or maintenance are required, and then only after power has been shut off and locked out. Safety devices must be replaced once repair or maintenance is complete. Exhaust from equipment must be directed so that it does not endanger workers or obstruct the view of the operator. When not operational, equipment must be set and locked so that it cannot be activated, released, or dropped.
No employee is permitted under loads being handled by lifting equipment. Personnel are required to stand away from any vehicle being loaded or unloaded to avoid being struck by falling material. All personnel will wear high-visibility, reflective vests while onsite to aid in being seen by equipment operators. Hard hats are to also be worn any time drilling activities are occurring.

3.1.6 Noise

Work around large equipment often creates excessive noise. Noise can: startle, annoy, or distract workers; physically damage the ear, which may lead to pain and/or temporary/permanent hearing loss; and interfere with communication. If workers are subjected to noise exceeding an 8-hour, time-weighted average sound level of 85 dBA (decibels on the A-weighted scale), hearing protection will be selected with an appropriate noise reduction rating to comply with 29 CFR 1910.95 and to reduce noise levels to or below the permissible values. The SHSO may use the simple “rule-of-thumb” test to determine if noise levels are in excess of 85 dBA. The test requires the SHSO to determine how loud he or she must speak to be heard at an arm’s length from another person. If the SHSO must raise his or her voice to be heard, the average noise level likely exceeds 85 dBA.

3.1.7 Electrical

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. Workers will take appropriate protective measures when working near live electrical parts, including inspection of the work area to identify potential spark sources, maintenance of a safe distance, proper illumination of the work areas, provision of barriers to prevent inadvertent contact, and use of nonconductive equipment. If overhead lines cannot be de-energized prior to the start of work, a 10-foot distance must be maintained between overhead energized power lines with a voltage of 50 kilovolt (kV) and elevated

equipment parts. This distance will be increased 4 inches for every 10 kV greater than 50 kV. For example, workers must maintain a distance of 11.7 feet from energized power lines with a voltage of 100 kV.

3.1.8 Utilities

Underground utilities pose hazards to workers involved in drilling and other invasive operations such as excavation. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, and water lines. Prior to commencement of invasive operations, utility companies will be contacted to inspect and flag the area of investigation, if required.

Personnel should be aware that although an area may be cleared, it does not mean that unanticipated hazards will not appear. Workers should always be alert for unanticipated events such as snapping cables, drilling into unmarked underground utilities, and drilling into a heavily contaminated zone. Such occurrences should prompt involved individuals to halt work immediately and take appropriate corrective measures to gain control of the situation.

3.1.9 Weather

Weather conditions should always be taken into consideration. Weather can change quickly during a boating excursion. Weather can make sampling activities dangerous with very little notice. In the event of hostile weather, the return distance and trip time to safety must be taken into account. Weather must be monitored constantly. Heavy rains, electrical storms, high winds, and extreme temperatures, for example, may create extremely dangerous situations for employees. Equipment performance may also be impaired because of inclement weather. Whenever unfavorable conditions arise, the SHSO will evaluate both the safety hazards and ability of the employees to effectively perform given tasks under such conditions. Activities will be halted at their discretion. Wind direction should be accounted for when positioning equipment at sampling locations. If exposure to organic vapors is anticipated, workers should locate upwind of sampling points. Wind direction often changes abruptly and without warning, so personnel should always be prepared to reposition if necessary. Workers should seek safe shelter at the first sound of thunder, when dark threatening clouds develop, or when lightning strikes. Personnel should count the seconds between the time between the sight of lightning and sound of thunder. A safe location is one that has this time duration of approximately 30 seconds or more. Personnel should stay inside until 30 minutes after the thunder or lightning subsides.

3.1.10 Biological

The known animal species that may potentially be encountered include feral pigs, mice, snakes, skunks, rats, dogs, etc. These animals are typically afraid of human beings and will stay away from workers. However, any animal that acts aggressively should be considered dangerous due to the possibility of rabies or potential infections from bites or punctures.

Poisonous plants (e.g., poison ivy, poison oak, poison sumac, etc.) may potentially be encountered at the site. Precautions should be taken to minimize exposure to plants by clearing vegetation within the work zone and wearing snake boots, as appropriate. Long-sleeve shirts, pants, safety glasses, and gloves may be worn to reduce the potential exposure.

During the site operations, EA employees may be exposed to blood and body secretions in support of emergency response operations where site personnel have been injured, and require first aid and/or cardiopulmonary resuscitation (CPR) – see Section 6.5. Due to the potential that blood and body secretions may contain disease-causing organisms such as the Hepatitis B Virus, and Human Immunodeficiency Virus, employees electing to provide first aid and CPR support (until the arrival of a competent onsite medical responder) should take appropriate measures to reduce or eliminate their potential for contact and exposure. The concept of "Universal Precautions" will be followed, assuming a potential hazard is present. Employees providing first aid support should wear the appropriate PPE to prevent or reduce their potential for contact and exposure. This will typically be accomplished through the use of nitrile gloves, splash-proof eye protection, and the use of mouth-to-mouth guards and proper cleanup (good sanitation and hygiene) following the incident. The hands and face should be thoroughly washed with water and antiseptic soap or cleanser following an incident, or antiseptic-containing disposable towelettes used in the absence of appropriate field washing facilities. The HSC should be notified of potential employee exposure to blood and body fluids while conducting work in support of this Task Order. In this case, the HSC will coordinate with the EA Corporate Health and Safety Director to obtain medical guidance from EA's Occupational Health physician at All-One Health Resources.

3.1.11 Vehicle and Pedestrian Traffic

Traffic at certain sites, particularly active sites in busy areas, presents a hazard to site personnel. Equipment must be located in an area that does not present hazards to bystanders. Barriers must be used to separate the work areas from both vehicle and pedestrian traffic areas and to prevent inadvertent entry of either type of traffic into the work area. Standard traffic cones are not considered adequate for these situations due to their low vertical profile. Taller, 28-inch cones can be effectively modified with warning flags and barricade tape. Barriers demarcating the work area are required even if the site is inactive during work operations.

Employees exposed to public vehicular traffic are required to wear warning vests or other suitable garments marked with or made of reflective or high-visibility material. In excavation areas, excavated soil materials may be placed between the hole and traffic areas to act as a barrier to both vehicle and pedestrian traffic. Such material must be placed in a manner that will not pose engulfment hazards to either site workers or bystanders.

Adequate precautions and construction zone marking should be made to prevent accidents during the period between work shifts.

Boating traffic, particularly in busy areas, may be susceptible to site hazards or may present a

hazard to site workers. All interactions with other boats, whether at launch or during the course of sampling, must comply with EA's rules and regulations for boat operations.

3.1.12 Material Handling, Moving, Lifting

Improper handling of materials, equipment, or supplies results in a large number of occupational injuries. This will be compounded when working on or over water. For this project, employees will lift and move equipment and supplies during mobilization and demobilization activities. In addition, workers will be required to lift coolers containing water and sediment samples from the boat to the dock area for sample pick-up. Before lifting loads, personnel will consider the overall weight, distribution of weight, awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Bulky, heavy loads will be handled by at least two people, and carriers should know the destination and path of the load. Loads will be inspected for slivers, sharp edges, and slippery surfaces prior to lifting. Personnel will be instructed on proper lifting procedures to minimize injuries. Personnel must assess the appropriate conditions (sea state, weather, etc.) before attempting to move materials. The employees or samplers must ensure that the boat is appropriately loaded and not exceed the capacity for the boat including personnel.

3.2 CHEMICAL HAZARDS

This section identifies known chemical hazards at the site.

3.2.1 Hazard Communication

The SHSO will maintain a MSDS for each chemical brought onsite during field activities. Subcontractors must inform the SHSO of hazardous substances brought onsite and provide appropriate MSDSs to the SHSO. Chemicals brought onsite must be labeled in accordance with OSHA Hazard Communication Requirements, 29 CFR 1926.59.

3.2.2 Chemical Hazards

The samples collected will be analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and herbicides. Specific VOCs of primary concern are benzene, toluene, ethylbenzne, and xylene (BTEX). It is not anticipated that chemical concentrations will exceed action levels for worker exposure. The most likely route of exposure to BTEX is dermal contact. Therefore dermal protection (nitrile gloves) will be worn when handling or contacting decontamination chemicals and environmental media (water and sediments). In addition, eye protection will be worn to minimize potential dangers associated with splashing.

Assumptions regarding potential chemical constituents were made by reviewing information from past investigation activities conducted at the site. The primary contaminants of concern detected in sediment, soil, surface water, and ground water at the site were benzene, naphthalene,

thallium, arsenic, and lead. Any newly identified constituents detected from the sampling activities will be evaluated and, if required, this HSP will be amended to address any new chemical hazards. In the absence of sufficient data, the concept of "Universal Precautions" will be followed, assuming that all potential constituents of concern are present while sampling. Concentrations detected are relatively low, and the likelihood of adverse health effects should be considered equally low.

Potential chemical hazards for Tasks 1 through 8 and their evaluation are provided in Table 3.

Table 3 Chemical Hazard Evaluation

Compound	Exposure Limits (Time-weighted Average)		Routes of Exposure	Symptoms (Acute)	Dermal Hazard
	Permissible Exposure Limit	Threshold Limit Value			
Benzene	1 ppm	0.5 ppm	Inhalation, ingestion, and skin absorption	Eye, nose, respiratory system irritation, impairment of hearing, central nervous system disturbances, giddiness, headache, nausea, staggered gait, fatigue	Yes
Arsenic	0.010 mg/m^3	0.010 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Headaches, confusion, sleepiness, convulsions, gastrointestinal disturbances, vomiting, diarrhea, respiratory irritation	Yes
Thallium	0.10 mg/m^3	0.10 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Yes
Lead	0.050 mg/m^3	0.050 mg/m^3	inhalation, ingestion, skin and/or eye contact	lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension	Yes
Naphthalene	50 mg/m^3	50 mg/m3	inhalation, ingestion, skin and/or eye contact	irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria	Yes

Compound	Exposure Limits (Time-weighted Average)		Routes of Exposure	Symptoms (Acute)	Dermal Hazard
	Permissible Exposure Limit	Threshold Limit Value			
				(blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	

NOTE:
OSHA Permissible Exposure Limit (PEL) – Time-weighted average concentration for up to an 8-hour workday during a 40-hour work week.
NIOSH Recommended Exposure Limit (REL) – Time-weighted average concentration for up to a 10-hour workday during a 40-hour work week.
C – A ceiling REL value that should not be exceeded unless otherwise demonstrated protection.
OSHA PELs were adjusted to provide site-specific exposure levels for a TWA 10-hour workday.
Exposure Limits will also include the evaluation of site-specific background contributions, which will be determined onsite.

mg/m^3	milligram(s) per cubic meter
ppm	part(s) per million
$\mu g/m^3$	microgram (s) per cubic meter
NA	not available

3.2.3 Chemicals for Equipment Calibrations and Operations

The following chemicals are typically supplied by the primary field program team:

- Alconox® and/or Liquinox®
- Isopropyl alcohol
- Hydrochloric acid (sample preservative)
- Hydrogen gas
- Nitric acid (sample preservative)
- pH calibration standard solution
- Conductivity calibration standard solution
- Isobutylene calibration gas
- Methane calibration gas.

These chemicals will be used for equipment calibrations/operations, decontamination, and cleaning. The decontamination wastewater will be containerized as part of the investigation-derived waste and disposed offsite or treated onsite, as required.

The following chemicals are typically supplied by the driller:

- Portland cement
- No. 2 silica sand
- Sodium bentonite.

Portland cement, No. 2 silica sand, and sodium bentonite are typically used for well installation

and/or plugging and abandoning activities. Chemicals used during the field activities will be properly contained and labeled.

Occupational exposures will be negligible. Chemicals for preservation of samples will be handled in such a way that there is no exposure to these chemicals. Laboratory-supplied sample jars with preservatives will be used to prevent handling of preservatives in the field. In addition, if necessary, gasoline and diesel will be stored temporarily onsite in small quantities for the heavy equipment.

3.3 SAFE WORK PRACTICES

Safe work practices that must be followed by site workers include:

- EA provisions followed at all times.
- The cleaning of hands immediately, or as soon as feasible, after removal of gloves by the use of antiseptic cleanser in conjunction with clean paper towels.
- The washing of hands and any other exposed skin with antiseptic cleanser and water immediately or as soon as feasible following contact with blood or other potentially infectious material. Staff will also wash hands:
    - After removing PPE
    - After handling potentially infectious materials
    - After cleaning or decontaminating equipment
    - After using the bathroom
    - Before eating
    - Before and after handling or preparing food.
- Eating, drinking, smoking, or using any tobacco product only in those areas designated by the SHSO. These activities will not take place within work zones.
- In the event a potential for chemical contamination exists onsite, employees will wash and conduct appropriate decontamination activities.
- Wearing appropriate PPE all the time.
- Defective PPE must be repaired or replaced immediately.
- Each employee required to take prescription drugs will notify the SM/SHSO prior to the start of work. Controlled or unauthorized drugs will **not** be permitted onsite at any time.
- All procedures for sampling and/or analysis will be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets. The slow and careful transfer of all potentially infectious liquids will accomplish this.

- All potentially infectious materials will be placed in a clearly marked container, which prevents leakage during collection, handling, and transporting.

- If outside contamination of the primary container occurs, the primary container will be placed within a second container, which prevents leakage during handling and transporting.

- Equipment that may become contaminated will be decontaminated as necessary.

3.4 ENVIRONMENTAL MONITORING

Environmental monitoring will not be required since primary contaminants typically are not found to be volatile or airborne. Should odors be detected during the course of sampling, attempts will be made to monitor the vapors. Only employees who have been trained in the proper operation, use limitations, and calibration of the monitoring equipment will operate instruments. Direct-reading instruments will be calibrated prior to use on a daily basis with a known concentration of calibration gas following the instrument manufacturer's guidance. Calibration will be properly recorded in the field logbook to show the date, calibration material type and concentration, and the actual reading obtained. Equipment failing to meet the manufacturer's standards for accuracy and repeatability will be considered suspect and replaced with an alternate, properly functioning piece of equipment. Instructions in the manufacturer's operations manual regarding storage, cleaning, and maintenance of the instruments will be followed.

3.5 FIELD TASK MONITORING

Safety procedures will be followed and enforced to protect onsite personnel and the public during field activities for each task performed on site. Long-sleeve shirts may be worn as appropriate to mitigate dermal exposure to site contaminants.

3.5.1 Site Reconnaissance

Field activities for this task include site survey/inspections. Exposure to contaminants during this task is anticipated to be low. However, weather conditions and task-related activities will be monitored. At a minimum, PPE for this task will include safety glasses and steel-toed boots. Chemical-resistant gloves and hard-hats will be worn as appropriate.

3.5.2 Survey with Ground Penetrating Radar (GPR)

GPR will be used to identify possible sources in investigation areas. Vehicles and/or personnel may be used to move equipment depending on terrain. Exposure to contaminants during this task is anticipated to be low. However, weather conditions and task-related activities will be

monitored. At a minimum, PPE for this task will include safety glasses and steel-toed boots. Chemical-resistant gloves and hard-hats will be worn as appropriate.

3.5.3 Drilling

Subsurface soil samples will be collected and monitoring wells will be installed using hollow stem auger or air rotary drilling and /or similar technology. If the selected drilling method is air rotary then water will be used to mitigate dust particles. If dust is observed during drilling activities, dust masks will be worn by field crews to minimize inhalation of the dust particles. At a minimum, PPE for activities associated with this task will include hard hats, steel-toed boots, safety glasses, work gloves, hearing protection, and reflective vests. Chemical-resistant gloves will be worn any time there is the chance for workers to come into contact with contaminated soil and/or water.

3.5.4 Onsite Soil Sampling – Geoprobe®

Onsite subsurface soil samples will be collected using a Geoprobe®. At a minimum, PPE for activities associated with this task will include hard hats, steel-toed boots, safety glasses, work gloves, hearing protection, and reflective vests. Chemical-resistant gloves will also be worn any time there is the chance for workers to come into contact with contaminated soil and/or water.

Wind direction should be determined prior to and during Geoprobe® operations; support equipment and non-critical personnel should be upwind from each Geoprobe® location.

3.5.5 Sample Processing

Field activities for this task include processing and preparing media samples to be shipped to the laboratory. At a minimum, PPE for activities associated with this task will include steel-toed boots, safety glasses, and chemical-resistant gloves.

3.5.6 Sediment and Surface Water Sampling

During the collection of sediment samples, exposure to contaminants is expected to be low to moderate depending on the location and moisture content of the sediment. Exposure to contaminants during surface water sampling is anticipated to be low, as long as proper PPE is worn to prevent dermal contact with surface water. At a minimum, PPE for activities associated with this task will include steel-toed boots, safety glasses, PFDs (if applicable), and chemical-resistant gloves.

3.5.7 Ground Water and Residential Tap Water Sampling

Ground water samples will be collected from monitoring wells located on- and offsite. Tap water samples will be collected from offsite properties. Ground water and tap water samples are expected to contain low concentrations of contaminants. Sampling personnel will be cautious of

traffic, pedestrians, and animals during sampling activities. At a minimum, PPE for activities associated with collection of ground water samples will include steel-toed boots, safety glasses, and chemical-resistant gloves.

3.6 BUDDY SYSTEM

Where practical, work at the site will be scheduled so that no employee works alone at any time. Each worker will either maintain a visual contact or audile contact (via two-way radios) with another specified worker at all times. The buddy system will ensure against an employee becoming distressed without a coworker being aware of his or her condition. Workers must watch out for each other while working close to potential chemical and physical hazards. Where practical, this fellow worker/observer must keep his/her partner in his/her line of sight at all times and be prepared to immediately assist in case of emergencies.

If a telephone is not immediately available for emergency use, an alarm or horn should be sounded to summon further help from others on the job site.

4. EMPLOYEE TRAINING

This section describes employee training procedures.

4.1 SITE PERSONNEL

Personnel who will be performing construction-related, non-hazardous onsite tasks are not required to have been trained according to U.S. Department of Labor OSHA Standard, 29 CFR 1926.65, *Hazardous Waste Operations and Emergency Response*. These workers will have equivalent health and safety training based upon their specific job tasks and activities.

The SHSO and personnel conducting the field activities will be trained as required to meet the U.S. Department of Labor OSHA Standard, 29 CFR 1926.65, *Hazardous Waste Operations and Emergency Response*, to qualify as hazardous waste site workers and supervisors. Training will include:

- A minimum of 40 hours of initial offsite instruction
- An annual 8-hour refresher training period
- A minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor
- Additional training for unique or special hazards/operational requirements
- At least one person onsite at any time must be currently trained in first aid and

cardiopulmonary resuscitation (first aid/CPR).

Onsite management and supervisors who are directly responsible for or who supervise employees will receive at least 8 additional hours of specialized management training.

In addition, personnel operating heavy equipment (e.g., drill rig) and/or boat will be specifically trained in their operation. Personnel will be trained in the operation of hand-held tools and in general operations. EA will ensure that personnel are properly trained, and will provide training where necessary.

Copies of training certificates and dates of attendance will be available through the SHSO, upon request.

4.1.1 Subcontractor Training

Prior to start of work operations, the PM will obtain a written list of subcontractor personnel to be onsite and written certification from subcontractor management that these workers meet the training requirements for their assigned tasks.

4.1.2 Pre-Entry Orientation Session

Prior to entering the site, personnel will attend a pre-entry orientation session presented by the SHSO. Personnel will verify attendance of this meeting by signing the review record provided in Appendix A. Visitors entering designated work areas will be subject to applicable health and safety regulations during field operations at the site. The SHSO is responsible for briefing the onsite personnel of potential hazards that may be encountered on the site, the presence and location of the HSP, and emergency response procedures. Visitors will be under the direct supervision of the SM or his/her representative.

At a minimum, the pre-entry orientation session will discuss the contents of this HSP and will discuss the following items:

- Nature and degree of potential health and safety hazards associated with each task
- PPE to be worn for each task
- Decontamination procedures
- Training and medical surveillance requirements
- Safe work practices
- Emergency procedures.

A question and answer period will also be conducted.

4.2 MEDICAL SURVEILLANCE

Hazardous waste site workers must have satisfactorily completed a comprehensive medical examination by a licensed physician within 12 months (or 24 months pending physician's approval) prior to the start of site operations. Subcontractors will provide this information in writing to the Project Manager for their workers prior to mobilization onsite. This information will be available onsite during field events.

A licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine will review medical surveillance protocol and examination results. Medical surveillance protocols will comply with 29 CFR 1926.65. The content of medical examinations will be determined by the attending physician and will be based upon the guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.* Medical examinations and consultations will be provided for employees covered by this program on the following schedule:

- Prior to field work assignment
- At least annually for employees covered by the program (or biennial with the approval of the occupational physician)
- At termination of employment or reassignment to an area where the employee would not be covered if the employee has not been examined within the past 6 months
- As soon as possible upon the development of signs or symptoms that may indicate an overexposure to hazardous substances or other health hazards, or that an unprotected person has been exposed in an emergency situation
- More frequently if the physician deems such examination necessary to maintain employee health.

An accurate record of the medical surveillance will be maintained for each employee for a period of no less than 30 years after the termination of employment. Records will be managed and maintained per recordkeeping provisions of EA's Safety and Health Program Manual (SHP-001). Records must include at least the following information about the employee:

- Name and social security or driver license number
- Physician's written opinions, recommendations, limitations, and test results
- Employee medical complaints related to hazardous waste operations
- Information provided to the physician by the employee concerning possible exposures, accidents, etc.

4.3 HAZARD COMMUNICATION PROGRAM

EA's hazard communication program consists of hazard communication, hazard communication labeling, MSDSs, and hazard communication training. Each of these elements is further explained below.

4.3.1 Hazard Communication

The SHSO will conduct regularly-scheduled safety meetings with site workers to discuss the planned activities, since these activities and workers may change over the duration of this Task Order. The objective of instituting a Hazard Communication Program is to ensure that hazards associated with the site and with chemicals brought onsite by EA or subcontractors are evaluated, and that information concerning these hazards is transmitted to site employees. Site personnel include EA and subcontractor employees, manufacturer's representatives, or local agency employees, and other workers who observe or perform services onsite. Employee awareness of chemical identities, health and physical hazards, properties, and characteristics is essential to safely handle chemicals and to minimize potential hazards. The Hazard Communication Program must follow OSHA requirements listed in 29 CFR 1926.59.

4.3.2 Hazard Communication Labeling

The SHSO will ensure that containers are properly labeled and that workers know the contents of containers. Container labels will contain, at a minimum, information on name of product in container, chemical(s) in product, manufacturer's name and address, protective equipment required for the safe handling of the product, and first aid procedures in case of overexposure to product contents.

4.3.3 Material Safety Data Sheets

MSDSs for each hazardous substance brought to, stored on, or used at the work site is located in Appendix E of this HSP. The file will be easily accessible to all employees. Subcontractors and visitors to the work place will be informed of the existence and location of the MSDS. Workers and visitors will be instructed on how to read and understand the information shown on the MSDS. Subcontractors must inform the SHSO about hazardous substances that they bring onsite and provide MSDS.

4.3.4 Hazard Communication Training

Site workers and visitors will be informed of the Hazard Communication Program, their legal rights under the program, the location of the chemical inventory, and the location of the MSDS file. Prior to site work or potential exposure to hazardous substances, the SHSO will describe hazardous substances routinely used and provide information about:

- Nature of potential chemical hazards
- Appropriate work practices
- Appropriate control programs
- Appropriate protective measures
- Methods to detect presence or release of hazardous substances
- Emergency procedures.

5. PERSONAL PROTECTIVE EQUIPMENT

This section describes the requirements, maintenance, and inspection of PPE.

5.1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

Based upon currently-available information and the nature of the anticipated tasks, the level of protection selected for all the work tasks is currently anticipated to be Level D.

In the event that potential chemical hazards are identified, the level of protection may be upgraded appropriately to the potential hazard conditions by the SHSO. Only those personnel identified and qualified for hazardous waste work as defined in 29 CFR 1926.65 will be allowed to upgrade beyond Level D or provide support of hazardous material/substance contingency operations. Only the SHSO, in conjunction with the HSC and Project Manager, will be allowed to approve PPE upgrade beyond Level D and site re-entry for the purpose of hazardous conditions assessment.

The following is a list of the Level D PPE components for the minimum level of protection authorized for use during this Task Order as necessary:

- Coveralls or appropriate work clothes
- Steel-toed and steel-shank safety boots
- Hard hats (if overhead hazards are present)
- Chemical-resistant gloves
- Leather work gloves
- Safety glasses with side shields and face shield
- Hearing protection
- Light-weight long sleeve shirts

- Highly visible reflective vests and/or PFDs based on the location of the working area. Requirements for PFD's are listed in EA's Corporate Vessels Operation Manual (Appendix D).

5.2 MAINTENANCE AND IN-USE INSPECTION OF PERSONAL PROTECTIVE EQUIPMENT

Effective use of PPE requires that the equipment be properly used, maintained, and inspected periodically during the day. Site-specific issues and standard procedures will be reiterated during pre-entry training. Gloves and body coverings will be regularly inspected and replaced promptly if torn. Disposable coveralls will be replaced daily at a minimum. Reusable gloves will be decontaminated whenever exiting the area.

In addition to the above, PDFs will be inspected daily for tears and ensure all clasps and straps are in working condition as prescribed by the manufacturer.

6. EMERGENCY RESPONSE AND REACTION TO SITE CONTINGENCIES

This section describes emergency procedures for the site.

6.1 EMERGENCY RECOGNITION

Prior to work startup, personnel must be familiar with emergency condition identification, notification, and response procedures.

The emergency telephone numbers for local emergency response and reporting organizations are provided in Table 4. Figures 1 and 2 provide directions to the nearest hospital.

Table 4 Emergency Telephone Numbers

Organization	Phone Number
Emergency – Ambulance	911
Ingleside Fire Department	911 361-776-7422
Ingleside Police Department	911 361-776-2531
San Patricio County Sherriff's Office	911 361-364-2251
San Patricio County Emergency Management	911 361-364-9650 361-364-9653
Texas Commission on Environmental Quality	800-782-7860
Hospital – Care Regional Medical Center	General- 361-758-8585 Emergency-911 1711 W. Wheeler Avenue Aransas Pass, Texas 78336
Directions to Hospital from the site (Former Falcon Refinery): Drive Northeast on FM 2725 toward Co Rd 146/Sunray Rd Turn right onto TX-361 S/S Commercial St Turn left onto Harrison Blvd	

Continue onto Cleveland Blvd / West Wheeler Ave
Hospital will be on the right
Total Distance: 4.9 mi, Time Estimate: 11 min. (see Figure 1)

Directions to Hospital from the (Current Barge Docking Facility):
Drive Northwest on Co Rd 146/Sunray Rd toward FM 2725
Turn right onto FM 2725
Turn right onto TX-361 S/S Commercial St
Turn left onto Harrison Blvd
Continue onto Cleveland Blvd / West Wheeler Ave
Hospital will be on the right
Total Distance: 5.2 mi, Time Estimate: 13 min. (see Figure 2)

Name	Position	Work Phone	Cell Phone
EA Project Personnel			
To be determined	Site Manager (SM)	972-315-3922	---
To be determined	Site Health and Safety Officer (SHSO)	972-315-3922	---
Tim Startz	Program Manager	972-315-3922	214-616-7027
Pete Garger	EA Corporate Health and Safety Director	410-527-2425	410-790-6338
Robert Owens	Project Manager	972-315-3922	972-989-7956
Brian Yost	EA Dallas Office Health and Safety Coordinator	972-459-5012	214-906-0253
EPA Project Personnel			
Rafael Casanova	EPA Task Order Monitor	214-665-7437	817-832-8209

The SM/SHSO will rehearse/review emergency procedures and/or applicable site contingencies initially during site orientation and as part of the ongoing site safety program with EA and subcontractor personnel. Offsite emergency personnel will ultimately handle onsite emergencies. However, initial response and first aid treatment will be provided onsite.

Person(s) identifying an accident, injury, emergency condition, or a scenario requiring implementation of a response in support of this HSP will immediately take actions to report the situation to the SHSO. Notification may take place by runner, hand-held radio, or cell phone. The SHSO will initiate the required response based upon the type of incident, following the procedures contained in this HSP. Chain-of-command and sign-in sheets for personnel on the site will be established at the beginning of each work day to ensure personnel are accounted for. Each day, the SM/SHSO will establish who will take control should the SM/SHSO become injured.

The following items constitute those site conditions requiring an emergency response or contingency action in accordance with this HSP:

- Fire/explosion
- Heavy equipment accident
- Natural disaster
- Medical emergency

- Discovery of unanticipated hazards (e.g., unmarked utility lines).

Follow-on operations to evaluate and control the source of fire, explosion, and hazardous material incidents will occur only after discussion with the Project Manager, HSC, and SM/SHSO along with EPA personnel.

The SHSO will act as the Emergency Coordinator at the site to coordinate onsite activities and contingencies with outside response organizations. If the SHSO is unable to act as the Emergency Coordinator, then the authority to take action will be transferred to the other designee, as indicated in the daily updated chain-of-command.

6.2 PRE-EMERGENCY PLANNING

The SHSO will contact the applicable local emergency response organizations listed in Table 4 prior to beginning of the project to identify the emergency response requirements and commitments required to support this Task Order. The Project Manager, or designee, will contact those local authorities potentially required to respond in the event of an onsite emergency incident or contingency. This notification will inform each applicable agency of the starting date, anticipated scope of work, and existence of the HSP. A copy of the HSP will be made available to each emergency response agency upon request to the Project Manager. Emergency activities will be coordinated (as applicable) with the local emergency planning committee, as required in accordance with Superfund Amendments and Reauthorization Act (SARA) Title III requirements.

6.3 OPERATIONS SHUTDOWN

The SHSO may mandate operations shutdown. Conditions warranting work stoppage will include (but are not limited to):

- Fire
- Explosion
- Uncovering potentially dangerous buried hazardous materials
- Conditions immediately dangerous to life and health or the environment
- Potential for electrical storms
- Treacherous weather-related conditions
- Limited visibility
- Upgrading of site security threat conditions.

6.4 PROCEDURES FOR HANDLING EMERGENCY INCIDENTS

In the event of an emergency, the information available at that time must be properly evaluated and the appropriate steps taken to implement the emergency response plan. The SHSO will assume command of the situation. He/she will alert the emergency management system per

Table 1, and evacuate personnel to the pre-designated evacuation location. The SHSO will make required notifications to include, but not be limited to, the EA Project Manager and HSC, EPA point-of-contact, as defined in this HSP and Table 4 and the appropriate Federal and State agencies, as applicable. Site personnel will have the capability of notifying emergency responders directly from the site using the onsite cell phone.

The PM will complete and submit to EA's Corporate Human Resources Department and an EPA-appointed representative an accident/loss and incident report (Appendix F), within 24 hours. The following information will be provided when reporting an emergency:

- Name and location of person reporting
- Location of accident/incident
- Name and affiliation of injured party
- Description of injuries, fire, spill, or explosion
- Status of medical aid and/or other emergency control efforts
- Details of chemicals involved
- Summary of accident, including suspected cause and time it occurred
- Temporary control measures taken to minimize further risk.

This information is not to be released under any circumstances to parties other than those listed in this section and emergency response team members. Once emergency response agencies have been notified, the PM and EPA point-of-contact will be immediately notified.

6.5 MEDICAL EMERGENCIES

Personnel should always be alert for signs and symptoms of illnesses related to chemical, physical, and onsite health hazards. Severe injuries resulting from accidents must be recognized as emergencies and treated as such.

In a medical emergency, the SHSO must sound the emergency alarm, upon which work must stop and personnel must move to the pre-designated evacuation location. **If the emergency situation cannot be conveyed by word of mouth, a whistle or other horn will be sounded. Three short blasts, separated by a 2-second silence, will be used as the emergency signal.** Personnel currently trained in first aid will evaluate the nature of the injury, decontaminate the victim (if necessary), and initiate first aid assistance immediately and transport, if appropriate. First aid will be administered only to limit further injury and stabilize the victim. The local Emergency Medical Services (EMS) must be notified immediately if needed.

Although not anticipated, victims who are heavily contaminated with toxic or dangerous materials must be decontaminated before being transported from the site. Since no acutely hazardous materials are anticipated, a formal decontamination station will not be available; however, there is an emergency eyewash station in each of the EA vehicles. Decontamination will consist of removal of contaminated coveralls/clothing, and wrapping the victim in a sheet or

other cloth like material. No persons will re-enter the site of injury/illness until the cause of the injury or symptoms has been determined and controlled. At no time will personnel transport victims to emergency medical facilities unless the injury does not pose an immediate threat to life and transport to the emergency medical facility can be accomplished without the risk of further injury. EMS will be used to transport serious injuries offsite unless deemed otherwise by the SHSO.

The SHSO must complete a detailed report and submit it to the PM within 24 hours of the following types of incidents:

- Job-related injuries and illnesses
- Accidents resulting in loss or damage to property
- Accidents involving vehicles and/or vessels, whether or not they result in damage to property or personnel
- Accidents with no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property
- Near-miss incidents that could have resulted in any of the conditions defined above.

An accident that results in a fatality or the hospitalization of three or more employees must be reported within 8 hours to the U.S. Department of Labor through the Project Manager and EA Corporate Health and Safety Director. Subcontractors are responsible for their reporting to the U.S. Department of Labor.

In order to support onsite medical emergencies, first aid/emergency medical equipment will be available in the onsite company vehicle:

- Portable emergency eye wash
- A 20-pound multipurpose (ABC-rated) fire extinguisher
- An adequately stocked first aid kit
- Potable water supply for decontamination, personnel hygiene, and emergency use
- An emergency siren or horn
- Cell phone
- Copy of HSP.

6.6 FIRE/EXPLOSION EMERGENCIES

Fire and explosion must be immediately recognized as an emergency. The SHSO must sound an emergency signal, and personnel must be decontaminated (if necessary) and evacuated to the pre-designated evacuation location. Only persons properly trained in fire suppression and other

emergency response procedures will support control activities. Control activities will consist of the use of onsite portable fire extinguishers for limited fire suppression and employee evacuation. Upon sounding the emergency alarm, personnel will evacuate the hazard location and assemble at the designated site meeting area. Only the SHSO, or those site personnel trained in the use of portable fire extinguishers, will attempt to suppress a site fire. Small, multi-purpose dry chemical extinguishers will be maintained in each EA vehicle onsite. Fires not able to be extinguished using onsite extinguishers will require the support of the local Fire Department. The SHSO should take measures to reduce injury and illness by evacuating personnel from the hazard location as quickly as possible. The SHSO must then notify the local Fire Department. The SHSO will determine proper follow-up actions. Site personnel will not resume work during or after a fire/explosion incident until the SHSO has directed that the incident is over and work may resume. During the incident, site personnel will remain outside the incident area and obey the instructions of the SHSO.

6.7 EMERGENCY TELEPHONE NUMBERS

Communications will be by cell phones. Each field team will be equipped with a cell phone to directly contact offsite emergency response organizations. Refer to Table 4 for a listing of emergency telephone numbers in Section 6.1.

6.8 CONTROL OF SITE PRODUCED AMBIENT NOISE LEVELS

Equipment used onsite containing internal combustion engines will be required to have mufflers attenuating sound output 80 dBA at a distance of 50 feet from the operating equipment. Efforts will be made to minimize impacts to landowners and residents.

6.9 MAN OVERBOARD PROCEDURE

In the event a worker falls out of the boat and into the water, every attempt should be made by one other boat passenger to loudly yell “man overboard” three times and ensure the boat operator/captain is aware of the man in the water. If the man in the water is visible, a boat occupant will point his hand and arm at the man in the water and will not take his eye off him. The spotter must not stop pointing at the man overboard until a rescue is imminent. A person on the boat other than the spotter must ready the life ring and be ready to deliver the ring to the man in the water. It is essential that communication be maintained with the captain as he maneuvers the boat into a rescue position. Under no circumstances should a rescuer enter the water to swim to the man overboard. The procedures for handling an emergency incident in Section 6.4 must be concurrently followed. If a rescue is successful the Field Team Leader or senior onsite supervisor will assume command of the situation and will call 911 from the nearest telephone or cell phone, notify authorities of his/her location (the docking point at which he/she will meet them), evacuate personnel as needed, and take other steps needed to gain control of the emergency.

The information requested in Section 6.4 should only be disclosed to the Field Team Leader, Site Manager/Site Health and Safety Officer, and to 911 by telephone.

7. SITE CONTROL AND WORK ZONES

The following work zones will be established (if needed) during implementation of the field activities as a means of site control.

- **Exclusion Zone (EZ) –** The EZ has either known or potential contamination and has the highest potential for exposure to chemicals onsite. The outer boundary of the EZ is called the hotline. The hotline separates the area of known or potential contamination from the rest of the site. The hotline should initially be established by visually surveying the site for signs of contamination, providing sufficient space to protect personnel outside the zone, allowing an adequate area in which to conduct site operations, and for reducing the potential for contaminant migration. The hotline will be physically secured or clearly marked. During subsequent site operations, the boundary may be adjusted as more information becomes available. Persons who enter the EZ must wear the appropriate level of PPE for the degree and types of hazards present at the site.

- **Investigation Area (IA) –** The IA is comprised of six areas of concern: three are identified onsite and four are identified offsite. The IA includes the following: a former drum disposal area, non-operational areas of the former refinery property, wetlands area, barge docking facility located on intracoastal waterways, the intracoastal waterway, and residential areas.

- **Contamination Reduction Zone (CRZ) –** The purpose of the CRZ is to reduce the possibility that the Support Zone (SZ) will become contaminated or affected by the site hazards. Because of both distance and decontamination procedures, the degree of contamination in the CRZ generally will decrease as one moves from the hotline to the SZ.

  The CRZ will be established outside the areas of known or potential contamination. Contamination Reduction Corridors, which are access control points between the IA and CRZ, should be established for both personnel and heavy equipment. These corridors should consist of an appropriate number of decontamination stations necessary to address the contaminants of the particular site.

- **Support Zone –** The SZ is the uncontaminated area where workers are unlikely to be exposed to hazardous substances or dangerous conditions. The SZ is the appropriate location for the equipment and supply center and other administrative or support functions that are necessary to keep site operations running efficiently.

  Potentially contaminated clothing, equipment, and samples must remain outside the SZ until decontaminated. However, personnel located in the SZ must receive instruction in

proper evacuation procedures in case of a hazardous substance emergency. The SZ should be upwind and as far from the IA as practicable.

The SZ for the site is still to be determined, but will be situated in a location that is relatively close to the IA.

The level of PPE will depend upon the type of work performed and site monitoring data. Level D will be the minimum protection in the IA. The CRZ will require a minimum Level D. No specific PPE requirements are needed in the SZ, as contaminated materials are prohibited from being stored in this area. Only authorized personnel will be permitted in the IA and CRZ. Entering these zones will require donning the required PPE prior to entry. These zones will be established prior to beginning the field activities. Exiting the IA will require going through decontamination in the CRZ.

Safe work practices to be followed by site workers include:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in all the four zones at any given time.
- Hands and face must be thoroughly washed upon leaving the work area.
- Personnel must not take prescription drugs unless specifically approved by a licensed physician who is familiar with the issues of worker exposure to hazardous materials.
- When respirators are required, facial hair that interferes with the face-to-facepiece fit of the respirator will not be permitted.
- Possessing, using, purchasing, distributing, selling, or having controlled substances in your system during the workday, including meal or break periods onsite, is strictly prohibited.
- The use or possession of alcoholic beverages onsite is prohibited. Similarly, reporting to work or performing one's job assignments with excessive levels of alcohol in one's system will not be permitted.

Figures

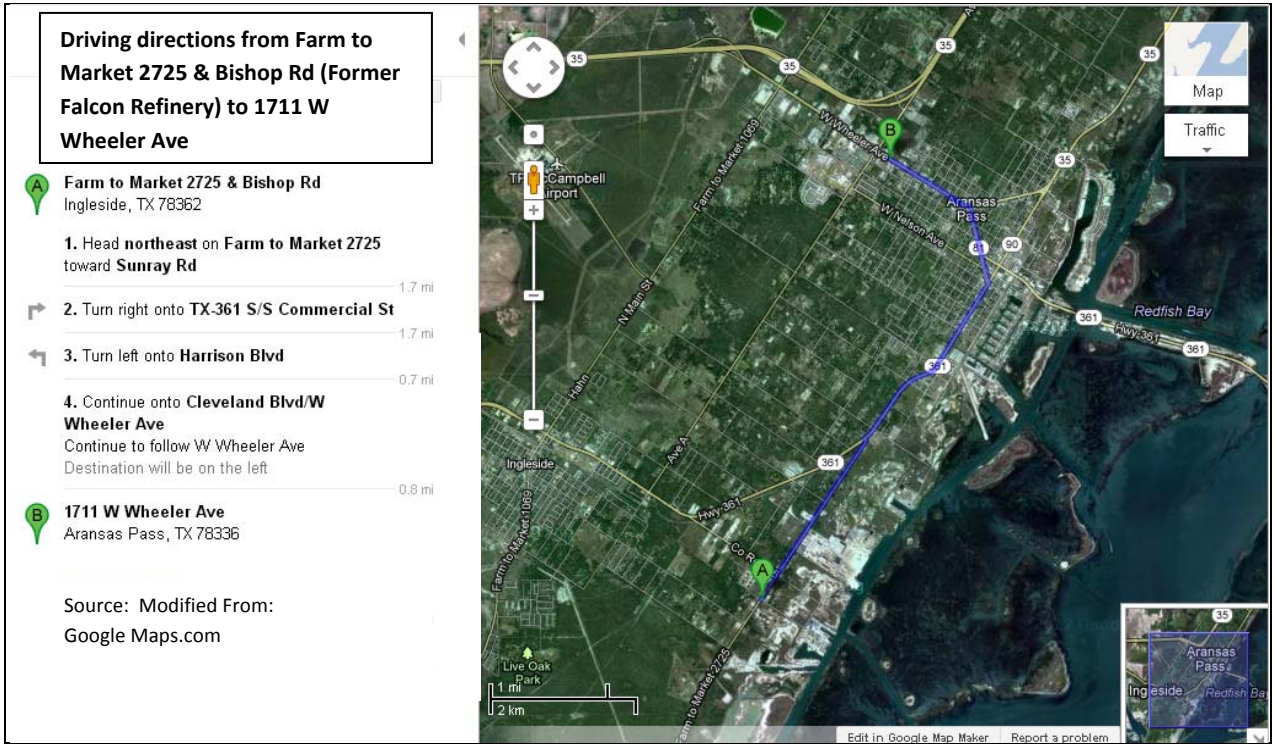

Figure 1: Directions to Hospital from Farm to Market 2725 & Bishop Rd (Former Falcon Refinery)

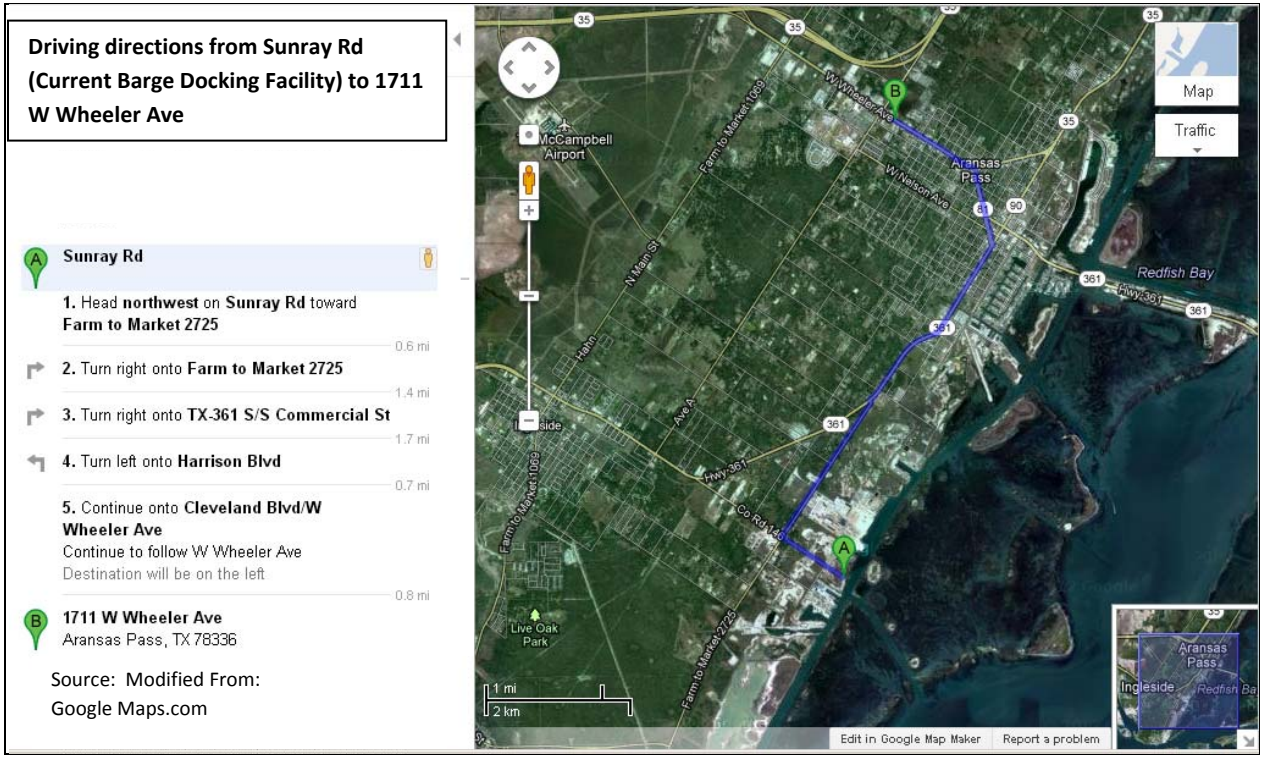

Figure 2: Directions to Hospital from Sunray Rd (Current Barge Docking Facility)

Appendix A

Health and Safety Plan Review Record

HEALTH AND SAFETY PLAN REVIEW RECORD

Site Name/Location: _____

I have read the Health and Safety Plan for this Site and have been briefed on the nature, level, and degree of exposure likely as a result of participation in this project. I agree to conform to all the requirements of this Plan.

NAME	SIGNATURE	COMPANY	DATE

HEALTH AND SAFETY PLAN REVIEW RECORD

Site Name/Location: _____

I have read the Health and Safety Plan for this Site and have been briefed on the nature, level, and degree of exposure likely as a result of participation in this project. I agree to conform to all the requirements of this Plan.

NAME	SIGNATURE	COMPANY	DATE

Appendix B

Daily Site Log

DAILY SITE LOG

Site Name: _____ **Date:** _____

Name (Print and Sign)	Company (City and State)	Time	
		In	Out

Comments:

_____

_____

_____

Appendix C

Daily Safety Meeting Form

DAILY SAFETY MEETING FORM

Date:_____ Time: _____Project No.: _____

Site Name/Location: _____

Site Activities Planned for Today: _____

_____

Safety Topics Discussed
Protective clothing and equipment:
Chemical hazards:
Physical hazards:
Environmental and biohazards:
Equipment hazards:
Decontamination procedures:
Other:
Review of emergency procedures and comments:

DAILY SAFETY MEETING FORM (CONTINUED)

Attendees	
Printed Name	**Signature**

Meeting Conducted by:

_____ _____

Name Title

_____

Signature

Appendix D

EA Corporate Vessels Operation Manual

EA Engineering, Science, and Technology, Inc.

Corporate Vessel Operations Manual

December 2004

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NOTE: Prior to beginning any EA vessel-related activities, copies of the checklists (Chapter 11) should be made available for easy access.

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1. INTRODUCTION

Personnel involved in activities associated with boating and watercraft are potentially exposed to a variety of hazards from activities including operations, maintenance, and transportation.

No person will be required or instructed to work in surroundings or under conditions that are unsafe or dangerous to his or her health.

Each individual employee is responsible for complying with applicable safety requirements, wearing prescribed safety equipment, and preventing avoidable accidents.

Safety and health programs, documents, signs, and tags will be communicated to employees in a language that they understand.

Adequate planning is needed before performing work at these sites to reduce the risk of employee injury or illness.

A partial listing of terms and phrases used during the operation of a vessel is provided in Appendix A. All members of the crew should be familiar with these terms.

1.1 PURPOSE

The purpose of this Manual is to communicate EA's basic policies and procedures regarding safety and health during the performance of work involving boating and watercraft activities. This Manual introduces the reader to EA's Boating and Watercraft Operations Program and critical references and definitions of terms used in this program.

1.2 APPLICABILITY

The procedures and requirements in this section apply to EA and subcontractor personnel involved in the boating and watercraft activities and operations. Visitors are required to follow these requirements.

1.3 DISCLAIMER

This Manual is not a comprehensive overview of all situations an operator may encounter, is not a substitute for common sense or experience, nor is it a substitute for a project- and/or site-specific Safety and Health Plan, as applicable.

1.4 REFERENCES

Maloney, E.S. 1981. Chapman Piloting, Seamanship and Small Boat Handling, 55th Edition. The Hearst Corporation, New York.

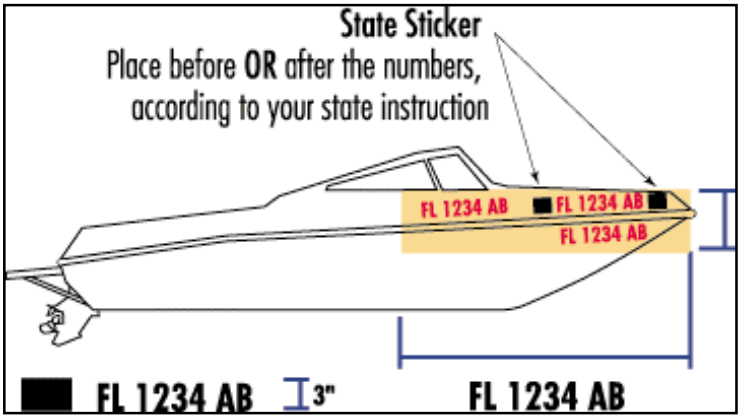
U.S. Coast Guard safe boating website: www.uscgboating.org.

2. BOATING LAWS AND REGULATIONS

The purpose of this section is to acquaint the reader with different types of vessel registrations and numbering, according to the Federal Boat Safety Act of 1971, and adopted by Congress 15 July 1997.

2.1 REGISTRATION, NUMBERING, AND DOCUMENTATION

All undocumented vessels equipped with propulsion machinery must be registered in the state of principal use. A Certificate of Number will be issued upon registering the vessel. These numbers must be displayed on your vessel. The owner/operator of a vessel must carry a valid Certificate of Number whenever the vessel is in use. When moved to a new state of principal use, the certificate is valid for 60 days. Check with your state boating authority for numbering requirements. Some states require all vessels to be numbered.



Some larger recreational vessels may be documented. The certificate of documentation MUST be on board a documented vessel at all times. A document serves as a certificate of nationality and an authorization for a specific trade. A documented vessel is not exempt from applicable state or federal taxes, nor is its operator exempt from compliance with federal or state equipment carriage requirements.

2.1.1 Display of Numbers

Numbers must be painted or permanently attached to each side of the forward half of the vessel. The validation stickers must be affixed within 6 in. of the registration number. With the exception of the vessel fee decal, no other letters or numbers may be displayed nearby.

2.1.2 Notification of Changes to a Numbered Vessel

The owner of a vessel must notify the agency that issued the Certificate of Number within 15 days if:

- The vessel is transferred, destroyed, abandoned, lost, stolen, or recovered
- The Certificate of Number is lost or destroyed, or the owner's address changes.

If the Certificate of Number becomes invalid for any reason, it must be surrendered in the manner prescribed to the issuing authority within 15 days.

A documented vessel must have the name of the vessel and hailing port plainly marked on the exterior part of the hull in clearly legible letters not less than 4 in. in height. In addition, the documented vessel must have the "Official Number" permanently affixed in block type, Arabic numerals, not less than 3 in. in height on some clearly visible interior structural part of the boat.

Table 2-1 provides a quick reference of vessel length and equipment requirements. The "Rules of the Water" are provided in Appendix B.

TABLE 2-1 QUICK REFERENCE

Vessel Length (in ft)				Equipment	Requirement
<16	16<26	26<40	40<65		
X	X	X	X	Certificate of Number (State Registration)	All undocumented vessels equipped with propulsion machinery must be State registered. Certificate of Number must be on board when vessel is in use. NOTE: Some states require all vessels to be numbered.
X	X	X	X	State Numbering	(a) Plain block letters/numbers not less than 3 in. in height must be affixed on each side of the forward half of the vessel (Contrasting color to boat exterior). (b) State validation sticker must be affixed within 6 in. of the registration number.
	X	X	X	Certificate of Documentation	Applies only to "Documented" vessels: (a) Original and current certificate must be on board. (b) Vessel name/hailing port marked on exterior part of hull - letters not less than 4 in. in height. (c) Official Number permanently affixed to interior structure - numbers not less than 3 in. in height.
X	X	X	X	Life Jackets (personal flotation devices)	(a) One Type I, II, III, or V wearable personal flotation device for each person on board (must be U.S. Coast Guard approved).
	X	X	X		(b) In addition to Paragraph (a), must carry One Type IV (throwable) personal flotation device.
X				Visual Distress Signal	(a) One electric distress light or Three combination (day/night) red flares. NOTE: Only required to be carried on board when operating between sunset and sunrise.
	X	X	X		(b) One orange distress flag or one electric distress light; or three hand-held or floating orange smoke signals and one electric distress light; or three combination (day/night) red flares: hand-held, meteor, or parachute type.
X	X			Fire Extinguishers	(a) One B-I (when enclosed compartment).
		X			(b) One B-II or two B-I. NOTE: Fixed system equals one B-I.
			X		(c) One B-II and one B-I or three B-I. NOTE: Fixed system equals one B-I.
X	X	X	X	Ventilation	(a) All vessels built after 25 April 1940 that use gasoline as their fuel with enclosed engine and/or fuel tank compartments must have natural ventilation (at least two ducts fitted with cowls). (b) In addition to paragraph (a), a vessel built after 31 July 1980 must have rated power exhaust blower.
X	X	X	X	Backfire Flame Arrester	Required on gasoline engines installed after 25 April 1940, except outboard motors.
X	X	X	X	Sound Producing Devices	(a) Some means of making an "efficient" sound signal—audible for 1/2 mi/4-6 seconds (i.e., horn)
		X	X		(b) In addition to Paragraph (a), a vessel 39.4 ft (12 m) or greater, must carry on board a bell with clapper (bell size not less than 7.9 in.—based on the diameter of the mouth).
X	X	X	X	Navigational Lights	Required to be displayed from sunset to sunrise and in or near areas of reduced visibility.
NA	NA	NA	NA	FCC Radio License	Operator of a recreational vessel less than 65.6 ft (20 m) in length is not required to be licensed to operate VHF marine radios, emergency position indicating radio beacons, or any type of radar.
		X	X	Oil Pollution Placard	(a) Placard must be at least 5 × 8 in., made of durable material. (b) Placard must be posted in the machinery space or at the bilge station.
		X	X	Garbage Placard	(a) Placard must be at least 4 × 9 in., made of durable material. (b) Displayed in a conspicuous place notifying all on board the discharge restrictions.
X	X	X	X	Marine Sanitation Device	If installed toilet, vessel must have an operable Marine Sanitation Device Type I, II, or III.
		X	X	Navigational Rules (inland only)	The operator of a vessel 39.4 ft (12 m) or greater must have on board a copy of these rules.

NOTE: NA = Not applicable.

3. FEDERAL MANDATED SAFETY EQUIPMENT

Federal mandated safety equipment is governed by the U.S. Coast Guard (USCG) Motor Boat Act of 1940 and retained by the Federal Boat Safety Act of 1971, which covers four classes of boats. Table 3-1 provides the minimum required equipment.

3.1 EQUIPMENT REQUIREMENTS – PERSONAL FLOTATION DEVICE

The USCG sets minimum safety standards for recreational boats and associated safety equipment. To meet these standards some of the equipment must be USCG approved. "USCG Approved Equipment" meets USCG specifications and regulations relating to performance, construction, or materials.

3.1.1 Personal Flotation Devices

All recreational boats must carry one wearable personal flotation device (PFD) (Type I, II, III, or V) for each person aboard. A Type V PFD provides performance of either a Type I, II, or III PFD (as marked on its label) and must be used according to the label requirements. Any boat 16 ft and longer (except canoes and kayaks) must also carry one throwable PFD (Type IV PFD).

PFDs must be USCG approved, in good and serviceable condition, and the appropriate size for the intended user.

Accessibility

- Wearable PFDs must be readily accessible
- You must be able to put them on in a reasonable amount of time in an emergency (vessel sinking, on fire, etc.)
- They should not be stowed in plastic bags, in locked or closed compartments, or have other gear stowed on top of them
- The best PFD is the one you will wear
- Though not required, a PFD should be worn at all times when the vessel is underway; a wearable PFD may save your life, but only if you wear it
- Throwable devices must be immediately available for use.

Inflatable Personal Flotation Devices

- Inflatable PFDs may be more comfortable to wear
- The best PFD is the one you will wear
- Inflatable PFDs require the user to pay careful attention to the condition of the device.
- Inflatable PFDs must have a full cylinder and all status indicators on the inflator must be green, or the device is NOT serviceable, and does NOT satisfy the requirement to carry PFDs.

USCG-approved inflatable PFDs are authorized only on recreational boats by a person at least 16 years of age.

Personal Flotation Device Requirements for Certain Boating Activities under State Laws

The USCG recommends, and many states require, wearing PFDs for the following activities:

- Water skiing and other towed activities (use a PFD marked for water skiing)
- While operating personal watercraft (use a PFD marked for water skiing or personal watercraft use)
- During white water boating activities
- While sailboarding (under federal law, sailboards are not "boats").

Check with your state boating safety officials.

Federal law does not require PFDs on racing shells, rowing sculls, and racing kayaks. State laws vary. Check with your state boating safety officials.

If you are boating in an area under the jurisdiction of the U.S. Army Corps of Engineers, or a federal, state, or local park authority, other rules may apply.

Remember, PFDs will keep you from sinking, but not necessarily from drowning.

- Select a properly-sized PFD to ensure a safe and proper fit
- Test your PFD by wearing it in shallow water or guarded swimming pool to see how it will float you.

U.S. Coast Guard Auxiliary U.S. Power Squadrons Vessel Safety Check Requirements for Personal Flotation Devices

- All boats must be equipped with a wearable PFD for each person on board
- Boats 16 ft and over are required to have a minimum of two PFDs on board, one wearable PFD (Type I, II, III, or V) and one throwable (Type IV); in addition, a wearable PFD is required for each person on board.

Personal Flotation Device Flotation

There are three basic kinds of PFD flotation in the five types of PFDs with the following characteristics:

- **Inherently Buoyant (primarily Foam)**
  - The *most* reliable
  - Adult, youth, child, and infant sizes
  - For swimmers and non-swimmers

— Wearable and throwable styles
— Some designed for water sports

Minimum Buoyancy		
Wearable Size	Type	Inherent Buoyancy (Foam)
Adult	I II and III V	22 lb 15.5 lb 15.5 to 22 lb
Youth	II and III V	11 lb 11 to 15.5 lb
Child and Infant	II	7 lb
Throwable: Cushion Ring Buoy	 IV	 20 lb 16.5 and 32 lb

- **Inflatable**

— The most compact
— Sizes only for adults
— Only recommended for swimmers
— Wearable styles only
— Some with the best in-water performance

Minimum Buoyancy		
Wearable Size	Type	Inherent Buoyancy
Adult	I and II III V	34 lb 22.5 lb 22.5-34 lb

- **Hybrid (Foam and Inflation)**

— Reliable
— Adult, youth, and child sizes
— For swimmers and non-swimmers
— Wearable styles only
— Some designed for water sports

Hybrid (Foam and Inflation)			
Wearable Size	Type	Inherent Buoyancy	Inflated Total Buoyancy
Adult	II and III V	10 lb 7.5 lb	22 lb 22 lb
Youth	II and III V	9 lb 7.5 lb	15 lb 15 lb
Child	II	7 lb	12 lb

Types of Personal Flotation Devices

A Type I PFD, or offshore life jacket, provides the most buoyancy. It is effective for all waters, especially open, rough, or remote waters where rescue may be delayed. It is designed to turn most unconscious wearers in the water to a face-up position.

A Type II PFD, or near-shore buoyancy vest, is intended for calm, inland water or where there is a good chance of quick rescue. Inherent buoyant PFDs of this type will turn *some* unconscious wearers to a face-up position in the water, but the turning is not as pronounced as a Type I. This type of inflatable turns as well as a Type I foam PFD.

[redacted]

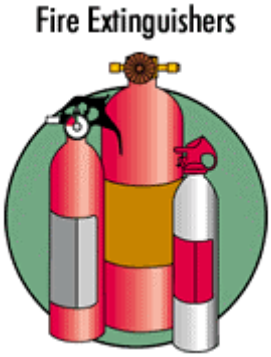
A Type III PFD, or flotation aid, is good for conscious users in calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water. The wearer may have to tilt their head back to avoid turning face down in the water. The Type III foam vest has the same minimum buoyancy as a Type II PFD. It comes in many styles, colors, and sizes and is generally the most comfortable type for continuous wear. Float coats, fishing vests, and vests designed with features suitable for various sports activities are examples of this type PFD. This type inflatable turns as well as a Type II foam PFD.

A Type IV PFD, or throwable device, is intended for calm, inland water with heavy boat traffic, where help is always present. It is designed to be thrown to a person in the water and grasped and held by the user until rescued—it is *not* designed to be worn. Type IV devices include buoyant cushions, ring buoys, and horseshoe buoys. There are no inflatable Type IV devices.

A Type V PFD, or special use device is intended for specific activities and may be carried instead of another PFD only if used according to the approval condition(s) on its label. A Type V PFD provides performance of either a Type I, II, or III PFD (as marked on its label). If the label says the PFD is "approved only when worn" the PFD must be worn, except for persons in enclosed spaces and used in accordance with the approval label, to meet carriage requirements. Some Type V devices provide significant hypothermia protection. Varieties include deck suits, work vests, and board sailing vests.

3.2 EQUIPMENT REQUIREMENTS – FIRE EXTINGUISHERS

USCG-approved fire extinguishers are required on boats where a fire hazard could be expected from the motors or the fuel system. Extinguishers are classified by a letter and number symbol. The letter indicates the type of fire the unit is designed to extinguish (Type B, for example, are designed to extinguish flammable liquids such as gasoline, oil, and grease fires). The number indicates the relative size of the extinguisher. The higher the number, the larger the extinguisher.



USCG-approved extinguishers required for boats are hand portable, either B-I or B-II classification, and have a specific marine type mounting bracket. The special bracket is required to securely hold the extinguisher in a moving boat. It is recommended the extinguishers be mounted in a readily accessible position, away from the areas where a fire could likely start such as the galley or the engine compartment.

Extinguisher markings can be confusing because extinguishers can be approved for several different types of hazards. For instance, an extinguisher marked "Type A, Size II, Type B:C, Size I" is a B-I extinguisher.

Look for the part of the label that reads "Marine Type USCG."

- Make sure Type B is indicated
- Portable extinguishers will be either size I or II. Size III and larger are too big for use on most recreational boats.

Classes	Foam (gal)	CO_2 (lb)	Dry Chemical (lb)	Halon (lb)
B-I (Type B, Size I)	1.25	4	2	2.5
B-II (Type B, Size II)	2.5	15	10	10

Fire extinguishers are required on boats if any of the following conditions exist:

- Inboard engines are installed.
- There are closed compartments and compartments under seats where portable fuel tanks may be stored.
- There are double bottoms not sealed to the hull or which are not completely filled with flotation materials.
- There are closed living spaces.
- There are closed stowage compartments in which combustible or flammable materials are stored.
- There are permanently installed fuel tanks (fuel tanks secured so they cannot be moved in case of fire or other emergency are considered permanently installed. There are no gallon capacity limits to determine if a fuel tank is portable. If the weight of a fuel tank is such that persons on board cannot move it, the USCG considers it permanently installed).

3.2.1 Fire Extinguisher Maintenance

Inspect extinguishers monthly to make sure that:

- Seals and tamper indicators are not broken or missing
- Pressure gauges or indicators read in the operable range (NOTE: CO_2 extinguishers do not have gauges)

- There is no obvious physical damage, corrosion, leakage, or clogged nozzles
- Weigh extinguishers annually to assure that the minimum weight is as stated on the extinguisher label.

Fire extinguishers that do not satisfy the above requirements or that have been partially emptied must be replaced or taken to a qualified fire extinguisher servicing company for recharge.

3.2.2 Required Number of Fire Extinguishers

The number of fire extinguishers required on a recreational boat is based on the overall length of the boat. The following chart lists the number of extinguishers that are required. In the case where a USCG-approved pre-engineered fire extinguishing system is installed for the protection of the engine compartment, the required number of units may be reduced in accordance with the chart.

Minimum number of hand portable fire extinguishers required:

Vessel Length	No Fixed System	With Approved Fixed Systems
Less than 26 ft	1 B-1	0
26 ft to less than 40 ft	2 B-1 or 1 B-II	1 B-I
40-65 ft	3 B-I or 1 B-II and 1 B-I	2 B-1 or 1 B-II

The pressure gauge alone is not an accurate indicator that Halon extinguishers are full. The weight of the units should be checked regularly. It is recommended that portable extinguishers be mounted in a readily accessible position.

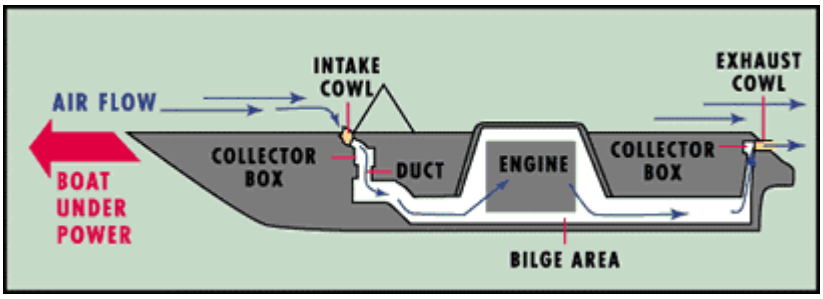
3.3 EQUIPMENT REQUIREMENTS – VENTILATION

All boats that use gasoline for electrical generation, mechanical power, or propulsion are required to be equipped with a ventilation system. A natural ventilation system is required for each compartment in a boat that:

- Contains a permanently installed gasoline engine
- Has openings between it and a compartment that requires ventilation
- Contains a permanently installed fuel tank and an electrical component that is not ignition-protected
- Contains a fuel tank that vents into that compartment (including a portable tank)
- Contains a non-metallic fuel tank.

A natural ventilation system consists of:

- A supply opening (duct/cowl) from the atmosphere (located on the exterior surface of the boat) or from a ventilated compartment or from a compartment that is open to the atmosphere
- An exhaust opening into another ventilated compartment or an exhaust duct to the atmosphere



All blower motors installed in exhaust ducts must be in working condition of date of manufacture.

Each exhaust opening or exhaust duct must originate in the lower one-third of the compartment. Each supply opening or supply duct and each exhaust opening or duct in a compartment must be above the normal accumulation of bilge water.

A powered ventilation system is required for each compartment in a boat that has a permanently installed gasoline engine with a cranking motor for remote starting.

A powered ventilation system consists of one or more exhaust blowers. Each intake duct for an exhaust blower must be in the lower one-third of the compartment and above the normal accumulation of bilge water.
For boats built prior to 1980, there was no requirement for a powered ventilation system; however, some boats were equipped with a blower.

The USCG Ventilation Standard, a manufacturer requirement, applies to all boats built on or after 1 August 1980. Some builders began manufacturing boats in compliance with the Ventilation Standard as early as August 1978. If your boat was built on or after 1 August 1978, it might have been equipped with either: (1) a natural ventilation system, or (2) both a natural ventilation system and a powered ventilation system. If your boat bears a label containing the words "This boat complies with USCG safety standards," etc., you can assume that the design of your boat's ventilation system meets applicable regulations.

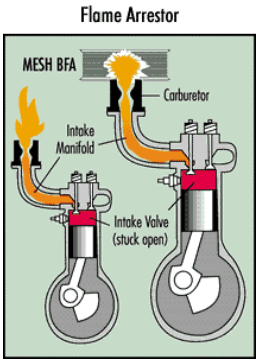
Manufacturers of boats built after 1980 with remote starters are required to display a label that contains the following information:

> ***WARNING***
> *Gasoline vapors can explode. Before starting engine, operate blower at least 4 minutes and check engine compartment bilge for gasoline vapors.*

All owners of boats equipped with exhaust blowers are strongly encouraged to take the same precautions before starting a gasoline engine.

All owners are responsible for keeping their boat's ventilation systems in operating condition. This means making sure openings are free of obstructions, ducts are not blocked or torn, blowers operate properly, and worn components are replaced with equivalent marine type equipment.

3.4 EQUIPMENT REQUIREMENTS – BACKFIRE FLAME ARRESTOR



Gasoline engines installed in a vessel after 25 April 1940, except outboard motors, must be equipped with an acceptable means of backfire flame control. The device must be suitably attached to the air intake with a flame tight connection and is required to be USCG approved or comply with SAE J-1928 or UL 1111 standards and marked accordingly.

3.5 EQUIPMENT REQUIREMENTS – SOUND-PRODUCING DEVICES

The navigation rules require sound signals to be made under certain circumstances. Meeting, crossing, and overtaking situations described in the Navigation Rules section are examples of when sound signals are required. Recreational vessels are also required to sound signals during periods of reduced visibility.

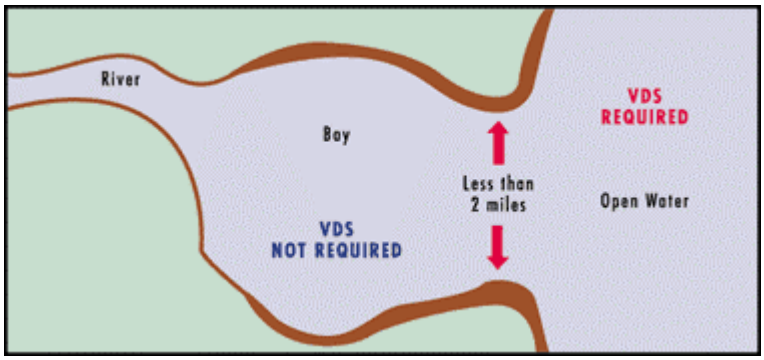
Vessels 39.4 ft/12 m or more in length are required to carry on board a whistle or horn, and a bell.

Any vessel less than 39.4 ft/12 m in length may carry a whistle or horn, or some other means to make an efficient sound signal to signal your intentions and to signal your position in periods of reduced visibility.

Therefore, any vessel less than 39.4 ft/12 m in length is required to make an efficient sound signal to signal intentions and to signal your position in periods of reduced visibility.

Vessel operators are required to carry some type of horn or whistle capable of a 4-second blast audible for 0.5 mi for all boats (athletic whistles are not acceptable on boats over 39.4 ft/12 m).

3.5.1 Visual Distress Signals



All vessels used on coastal waters, the Great Lakes, territorial seas, and those waters connected directly to them, up to a point where a body of water is less than 2 mi wide, must be equipped with USCG-approved visual distress signals. Vessels owned in the United States operating on the high seas must be equipped with USCG-approved visual distress signals.

The following vessels are not required to carry day signals but must carry night signals when operating from sunset to sunrise:

- Recreational boats less than 16 ft in length
- Boats participating in organized events such as races, regattas, or marine parades
- Open sailboats less than 26 ft in length not equipped with propulsion machinery
- Manually propelled boats.

3.5.2 Pyrotechnic Devices

Pyrotechnic visual distress signals must be USCG-approved, in serviceable condition, and readily accessible.

- They are marked with an expiration date. Expired signals may be carried as extra equipment, but cannot be counted toward meeting the visual distress signal requirement, since they may be unreliable.

- Launchers manufactured before 1 January 1981, intended for use with approved signals, are not required to be USCG-approved.

- If pyrotechnic devices are selected, a minimum of three is required; that is, three signals for day use and three signals for night. Some pyrotechnic signals meet both day and night use requirements.
- Pyrotechnic devices should be stored in a cool, dry location, if possible.

- A watertight container painted red or orange and prominently marked "DISTRESS SIGNALS" or "FLARES" is recommended.

USCG-approved pyrotechnic visual distress signals and associated devices include:

- Pyrotechnic red flares (hand-held or aerial)
- Pyrotechnic orange smoke (hand-held or floating)
- Launchers for aerial red meteors or parachute flares.

Each of these devices has a different operating (burning) time x seconds to y seconds. Check the label to see how long each pyrotechnic device will actually be illuminated. This will allow you to select a warning device better suited to the conditions where your boat will operate.

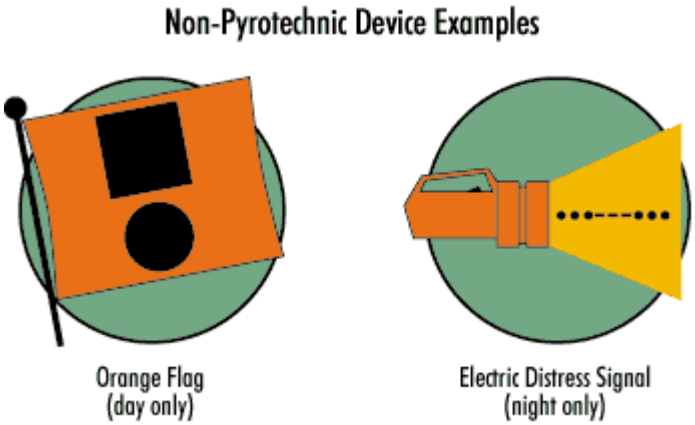
3.5.3 Non-Pyrotechnic Devices

Non-pyrotechnic visual distress signals must be in serviceable condition, readily accessible, and certified by the manufacturer as complying with USCG requirements. They include:

Orange Distress Flag

- Day signal only
- Must be at least 3 × 3 ft with a black square and ball on an orange background

- Must be marked with an indication that it meets USCG requirements in 46 CFR 160.072
- Most distinctive when attached and waved on a paddle, boathook, or flown from a mast
- May also be incorporated as part of devices designed to attract attention in an emergency, such as balloons, kites, or floating streamers.



Electric Distress Light

- Accepted for night use only
- Automatically flashes the international SOS distress signal (... --- ...)
- Must be marked with an indication that it meets USCG requirements in 46 CFR 161.013.

Under Inland Navigation Rules, a high intensity white light flashing at regular intervals from 50-70 times per minute is considered a distress signal. However, such devices do NOT count toward meeting the visual distress signal requirement.

Regulations prohibit display of visual distress signals on the water under any circumstances except when assistance is required to prevent immediate or potential danger to persons on board a vessel.

All distress signals have distinct advantages and disadvantages. No single device is ideal under all conditions or suitable for all purposes. Pyrotechnics are universally recognized as excellent distress signals. However, there is potential for injury and property damage if not properly handled. These devices produce a very hot flame and the residue can cause burns and ignite flammable materials.

Pistol launched and hand-held parachute flares and meteors have many characteristics of a firearm and must be handled with caution. In some states, they are considered a firearm and prohibited from use.

The following are just a few of the variety and combination of devices which can be carried in order to meet the requirements:

- Three hand-held red flares (day and night)
- One hand-held red flare and two parachute flares (day and night)
- One hand-held orange smoke signal, two floating orange smoke signals (day), and one electric distress light (night only).

All boaters should be able to signal for help. Boaters must have current dated USCG-approved day and night signals for all boats operating on coastal and open bodies of water.

3.6 EQUIPMENT REQUIREMENTS – POLLUTION REGULATIONS

The Refuse Act of 1899 prohibits throwing, discharging, or depositing any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States.

The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances which may be harmful into United States navigable waters. Vessels 26 ft in length and over must display a placard at least 5 × 8 in., made of durable material, fixed in a conspicuous place in the machinery spaces, or at the bilge pump control station, stating the following:

Discharge of Oil Prohibited
The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste upon or into any navigable waters of the United States. The prohibition includes any discharge that causes a film or discoloration of the surface of the water or causes a sludge or emulsion beneath the surface of the water. Violators are subject to substantial civil and/or criminal sanctions including fines and imprisonment.

Regulations issued under the Federal Water Pollution Control Act require all vessels with propulsion machinery to have a capacity to retain oil mixtures on board. A fixed or portable means to discharge oily waste to a reception facility is required. A bucket or bailer is suitable as a portable means of discharging oily waste on recreational vessels. No person may intentionally drain oil or oily waste from any source into the bilge of any vessel. You must immediately notify the USCG if your vessel discharges oil or hazardous substances in the water. Call toll-free 800-424-8802 (in Washington, D.C. [202] 267-3675).

Report the following information:

- Location
- Color
- Source
- Substances
- Size
- Time observed.

The Act to Prevent Pollution from Ships (MARPOL ANNEX V) places limitations on the discharge of garbage from vessels. It is illegal to dump plastic trash anywhere in the ocean or navigable waters of the United States. It is also illegal to discharge garbage in the navigable waters of the United States, including the Great Lakes. The discharge of other types of garbage is permitted outside of specific distances offshore as determined by the nature of that garbage.

Garbage Type	Discharge
Plastics- including synthetic ropes, fishing nets, and plastic bags	Prohibited in all areas
Floating dunnage, lining, and packing materials	Prohibited less than 25 mi from nearest land
Food waste, paper, rags, glass, metal, bottles, crockery, and similar refuse	Prohibited less than 12 mi from nearest land
Comminuted or ground food waste, paper, rags, glass, etc.	Prohibited less than 3 mi from nearest land

United States vessels of 26 ft or longer must display, in a prominent location, a durable placard at least 4 × 9 in. notifying the crew and passengers of the discharge restrictions.

United States oceangoing vessels of 40 ft or longer which are engaged in commerce or are equipped with a galley and berthing must have a written Waste Management Plan describing the procedures for collecting, processing, storing, and discharging garbage, and designate the person who is in charge of carrying out the plan.

3.7 EQUIPMENT REQUIREMENTS – MARINE SANITATION DEVICES

All recreational boats with installed toilet facilities must have an operable marine sanitation device (MSD) on board. Vessels 65 ft and under may use a Type I, II, or III MSD. Vessels over 65 ft must install a Type II or III MSD. All installed MSDs must be USCG certified. USCG-certified devices are so labeled, except for some holding tanks, which are certified by definition under the regulations.

When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited, the operator must secure the device in a manner which prevents any discharge. Some acceptable methods are: padlocking overboard discharge valves in the closed position, using non-releasable wire tie to hold overboard discharge valves in the closed position, closing overboard discharge values and removing the handle, and locking the door with padlock or keylock to the space enclosing the toilets (for Type I and Type II only.)

3.8 ADDITIONAL RECOMMENDED EQUIPMENT

Besides meeting the legal requirements, prudent boaters should carry additional safety equipment. The following additional items of equipment are suggested depending on the size, location, and use of your boat:

- Very high frequency (VHF) radio
- Boat hook
- Spare anchor
- Heaving line
- Fenders
- First aid kit
- Flashlight
- Mirror
- Searchlight
- Sunburn lotion
- Tool kit
- Ring buoy
- Whistle or horn
- Fuel tanks
- Anchor
- AM/FM radio
- Chart and compass
- Visual distress signals
- Spare propeller
- Mooring line
- Food and water
- Binoculars
- Spare batteries
- Sunglasses
- Marine hardware
- Extra clothing
- Spare parts
- Alternate propulsion (paddles)
- Dewatering device (pump or bailer)
- Spare fuel
- Pumps must work or have manual bailer

TABLE 3-1 MINIMUM REQUIRED EQUIPMENT

Equipment	Class A (Less than 16 ft)	Class 1 (16 ft to less than 26 ft)	Class 2 (26 ft to less than 40 ft)	Class 3 (40 ft to not more than 65 ft)
Personal Flotation Devices	One Type I, II, III, or IV for each person.	One Type I, II, or III for each person on board or being towed on water skis, etc., plus one Type IV available to be thrown.		
Fire Extinguisher-Portable When NO fixed fire extinguishing system is installed in machinery space(s)	At least one B-1 type approved hand portable fire extinguisher (Not required on outboard motorboat less than 26 ft in length and not carrying passengers for hire if the construction of such motorboats will not permit the entrapment of explosive or flammable gases or vapors.)		At least two B-I type approved hand portable fire extinguishers; OR at least one B-II type approved hand portable fire extinguisher.	At least three B-I type approved hand portable fire extinguishers; OR at least one B-I type *Plus* one B-II type approved hand portable fire extinguisher.
Backfire Flame Arrestor	One approved device on each carburetor of all gasoline engines installed after 25 April 1940, except outboard motors.			
Ventilation	At least two ventilator ducts fitted with cowls or their equivalent for the purpose of properly and efficiently ventilating the bilges of every engine and fuel-tank compartment of boats constructed or decked over after 25 April 1940, using gasoline or other fuel having a flashpoint less than 110°F. Boats built after 31 July 1981 must have operable power blowers.			
Whistle	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats 12 to 20 m (39.4 – 65.7 ft) – device meeting technical specifications of Inland Rules Annex III audible 0.5 mi.
Bell	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats 12-20 m (39.4 – 65.7 ft) – bell meeting technical specifications of Inland Rules Annex III; mouth diameter of at least 200 m (7.9 in.).
When fixed fire extinguishing system is installed in machinery space(s).	None	None	At least one B-I type approved hand portable fire extinguisher.	At least two B-I type approved hand portable fire extinguishers; OR at least one B-II type approved hand portable fire extinguisher.
	NOTE: Dry chemical and carbon dioxide are the most widely used types, in that order. The others, while acceptable, are seldom seen on boats.			

(a) Not required by the Motorboat Act of 1940; however, the "Rules of the Water" require these vessels to sound proper signals.

NOTE: Fire extinguishers manufactured after 1 January 1965 will be marked, "Marine Type, Size, Approval No. 162.028/EX." Toxic vaporizing-liquid type fire extinguishers, such as those containing carbon tetrachloride or chlorobromomethane, are not accepted as required approved extinguishers on uninspected vessels (private pleasure craft).

4. NAVIGATION RULES

Navigation rules require vessels to display lights and shapes under certain conditions.

4.1 NAVIGATION LIGHTS

Recreational vessels are required to display navigation lights between sunset and sunrise and other periods of reduced visibility (fog, rain, hazy, etc.). The USCG Navigation Rules, International-Inland, specifies lighting requirements for every description of water craft. The information provided here is intended for power-driven and sailing vessels less than 65.5 ft/20 m in length.

4.2 POWER-DRIVEN VESSELS

If your vessel is less than 65.5 ft/20 m in length, then it must display navigation lights per Figure 4-1.

If your vessel is less than 39.4 ft/12 m in length, then it may display navigation lights per Figure 4-2.

Figure 4-1.

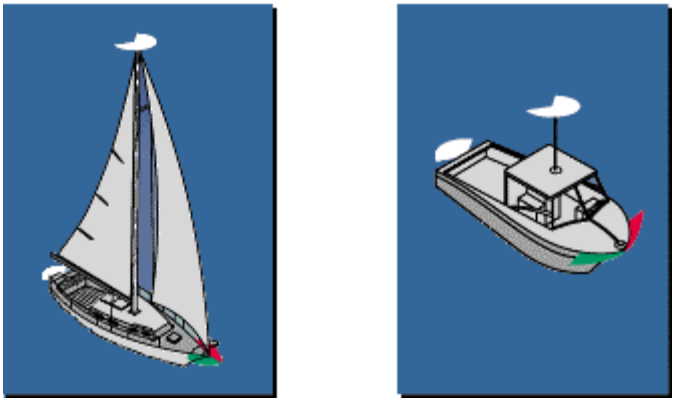
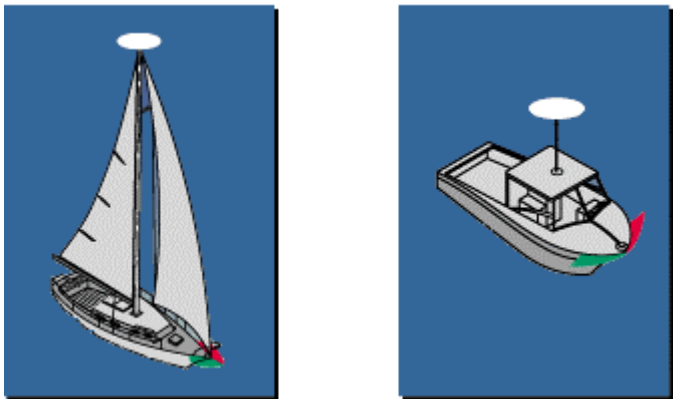


Figure 4-2.



If your vessel is less than 23 ft/7 m in length and its maximum speed cannot exceed 7 knots, then it may display an all-around white light, and if practicable, sidelights instead of the lights prescribed previously (for international rules only).

For vessels less than 39.4 ft/12 m in length, the masthead or all-around white light must be at least 1 m above the sidelights.

Sidelights may be a combination light instead of two separate lights.

4.3 SAILING VESSELS

If your vessel is less than 65.6 ft/20 m in length, then it must display navigation lights shown on Figures 4-3, 4-4, or 4-5.

Figure 4-3.

Figure 4-4.

Figure 4-5.

If your vessel is less than 23 ft/7 m in length, then it should display lights for a sailboat (Figure 4-3), if practicable. As an option, your vessel may carry a flashlight or lighted lantern that can show a white light in sufficient time to prevent collision (Figure 4-6).

4.3.1 Vessel under Oars

If your vessels is under oars, then it should display lights for a sailboat (Figures 4-3, 4-4, or 4-5), if practicable. As an option, your vessel may carry an electric torch (flashlight) or lighted lantern that can show a white light in sufficient time to prevent collision (Figure 4-7).

Figure 4-6.

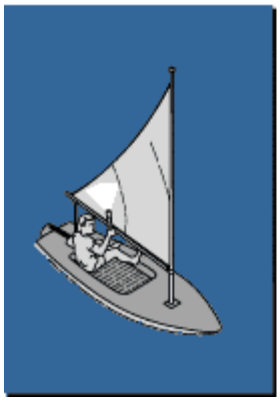


Figure 4-7.

4.3.2 Lights and Shapes

To alert other vessels of conditions that may be hazardous, there are requirements to display lights at night and shapes during the day.

4.3.3 Anchored Vessels

AT NIGHT: All vessels at anchor must display anchor lights. If your vessel is less than 164 ft/50 m in length, then its anchor light is an all-around white light visible where it can best be seen from all directions (Figure 4-8).

DURING THE DAY: All vessels at anchor must display, forward where it can be best seen, a black ball shape conditions (Figure 4-9).

Figure 4-8.

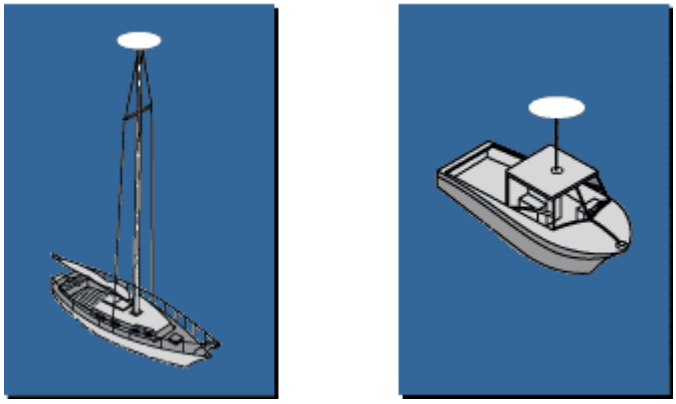
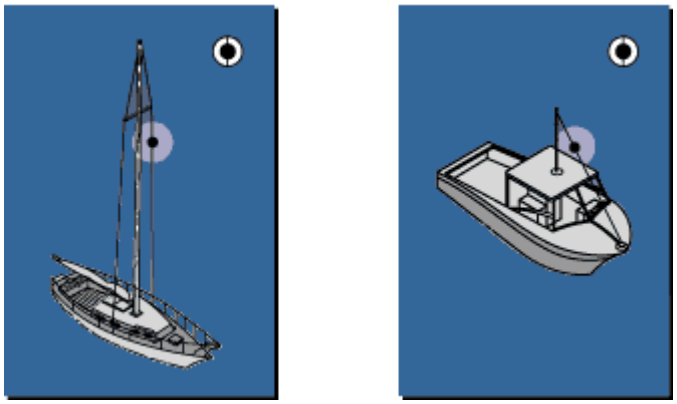


Figure 4-9.



EXCEPTIONS: If your vessel is less than 23 ft/7 m in length, then it is not required to display an anchor light or shape unless it is anchored in or near a narrow channel, fairway or anchorage, or where other vessels normally navigate. If your vessel is less than 65.6 ft/20 m in length, then is not required to display an anchor light if it is anchored in Inland Waters in a special anchorage designated by the Secretary of Transportation.

4.3.4 Sailing Vessels under Power (Machinery)

During the day, vessels under sail also being propelled by machinery must exhibit forward, where best seen, a black conical shape with the apex pointing down (Figure 4-10).

EXCEPTION: If your vessel is less than 39.4 ft/12 m in length, then it is not required to display the shape in Inland Waters.

REMINDER: If you are operating your sail vessel at night using machinery or sail and machinery, then your vessel must display lights required for a power-driven vessel (Figures 4-1 or 4-2).

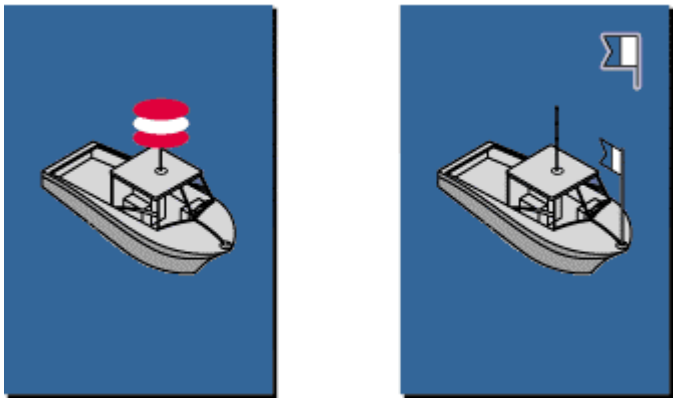
Figure 4-10.

4.3.5 Restricted Maneuverability

The Navigation Rules require vessels restricted in their ability to maneuver to display appropriate day shapes or lights. To meet this requirement, if your vessel is engaged in diving activities during the day, then it must exhibit a rigid replica of the international code flag "Alpha" not less than 3.3 ft/1 m above deck. If diving activities are at night, then your vessel must display the navigation lights shown on

Figure 4-11. This requirement does not affect the use of a red and white divers flag which may be required by state or local law to mark a diver's location. The "A" flag is a navigation signal indicating the vessel's restricted maneuverability and does not pertain to the diver.

Figure 4-11.



All vessels 16 ft or greater must have operable navigation lights and an all around anchor light. Sailboats capable of both power and sail must be able to display navigation lights for both systems.

Tables 4-1 and 4-2 provide the required lights for various types of vessels for inland and international rules, respectively.

TABLE 4-1 LIGHTS FOR VARIOUS TYPES OF VESSELS – 1980 INLAND RULES

No.	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
1	Power-driven vessel 12 m but less than 20 m in length	White, 225°, visibility 3 mi; at least 2.5 m above gunwale[(a)]	Separate red and green 112 ½° or combination, visibility 2 mi; above hull at least 1 m below masthead light[(b)]	White 135°, visibility 2 mi	---
2	Power-driven vessel less than 12 m in length	White, 225°, visibility 2 mi; can be less than 2.5 m above gunwale, but at least 1 m above side lights[(a),(c)]	Separate red and green 112 ½° or combination, visibility 1 mi; above hull at least 1 m below masthead light[(b),(c)]	White 135°, visibility 2 mi	---
3	Sailing vessel under 20 m in length	None	Separate red and green, 112 ½°, or combination, visibility 2 mi[(b),(d)]	White 135°, visibility 2 mi	Optional—two all-round lights at or near top of mast, red over green, separated at least 1 m, visibility 2 mi
4	Sailing vessel under 12 m in length	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[(b),(d),(e)]	White 135°, visibility 2 mi[(d),(e)]	---
5	Vessel propelled by oars	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[(f)]	May show white, 135°, visibility 2 mi[(f)]	---
6	Power-driven vessel 20 but less than 50 m in length	White, 225°, visibility 5 mi; not more than ½ of length aft from stem; 6 m or beam (up to 10 m) above hull	Red and green, 112 ½°, visibility 2 mi; at or near sides of vessel; above hull at least 1 m below masthead light	White, 135°, visibility 2 mi	After masthead light may be shown; at least 4.5 m higher than forward masthead light
7	Power-driven vessel 50 m or more in length	White, 225°, visibility 6 mi; not more than ½ of length aft from stem; 6 m or beam (up to 10 m) above hull	Red and green, 112 ½°, visibility 3 mi; at or near sides of vessel; above hull at least 1 m below masthead light	White, 135°, visibility 3 mi	After masthead light required; at least 4.5 m higher and ¼ of vessel length (up to 50 m) aft of forward masthead light
8	Vessel towing: tow less than 200 m overall from stern of towing vessel; (also towing alongside or pushing ahead)	Two white, arranged vertically, 225°, visibility determined by length of vessel (not required pushing ahead or towing alongside on western rivers)	Normal for size of vessel	Normal for size of vessel	Towing astern: towing light[(g)] over stern light; pushing ahead or towing alongside: two towing lights[(g)] vertically
9	Vessel towing: tow 200 m or more overall length	Three white, arranged vertically, 225°, visibility determined by length of vessel	Normal for size of vessel	Normal for size of vessel	Towing light: yellow, 135°, above sternlight[(g)]
10	Vessel being towed astern, if manned	None	Normal for size of vessel	Normal for size of vessel	
11	Vessel being towed alongside or pushed ahead	None	Normal for size of vessel; at forward end	Normal for size of vessel (not used for pushed ahead)	Also "special flashing light" at center or forward end; a group of vessels is lighted as a single vessel

(a) After masthead light may be shown but not required (exception allowed on Great Lakes).
(b) Fitted with inboard screens if necessary to prevent being seen across bow.
(c) Less than 12 m in length, need only have all-round white light, visibility 2 mi but should have side lights.
(d) May be combined into triple combination light at masthead.
(e) Less than 7 m, need only have flashlight or lantern to show.
(f) Need only have flashlight or lantern to show white light.
(g) Visibility 3 mi for vessels 50 m or more in length; 2 mi for shorter vessels.

No.	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
12	Vessel engaged in trolling or drift fishing	(h)	(h)	(h)	---
13	Vessel engaged in trawling	None(a)(b)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all-round lights, green over white(g),(i),(j),(k)
14	Vessel engaged in fishing, other than trawling (or trolling)	None(l)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all-round lights, red over white(g),(i),(j),(k)(l); when not actually fishing, show normal masthead lights for vessel its size
15	Vessel at anchor, less than 50 m in length	None	None	None	White, all-round light where can best be seen; visibility 2 mi (not required if less than 7 m in length and not anchored in a narrow channel or where vessels normally navigate)
16	Vessel at anchor; 50 m or more in length	None	None	None	White, all-round light in fore part of vessel not less than 6 m above hull; a second white, all-round light in after part, not less than 4.5 m lower than forward anchor light; visibility 3 mi
17	Vessel aground	None	None		Anchor light(s) as line 15 or 16 plus two red all-round lights of same visibility range(g),(i),(j) (not required if less than 12 m in length)
18	Pilot vessel	None if on pilot duty; normal if underway and not on pilot duty	When underway, normal for size of vessel	When underway, normal for size of vessel	Two all-round lights, white over red, at masthead(g),(i),(j); if at anchor, normal anchor light(s); line 15 or 16
19	Vessel not under command	None	If making way through the water, normal for size of vessel	If making way through the water, normal for size of vessel	Two red all-round lights vertically where best can be seen(g),(i),(j)
20	Vessel restricted in ability to maneuver	None	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Three all-round lights vertically, red-white-red.(g),(i); if at anchor, normal anchor light(s) (not required if less than 12 m in length)

(h) Show only normal lights of power-driven or sailing vessel.
(i) Vertical spacing 1 m.
(j) Lower light not less than 4 m (2 m if under 20 m in length) above hull.
(k) Lower light above sidelights at least twice vertical spacing.
(l) When not actually fishing, show normal masthead lights for vessel its size.

TABLE 4-2 LIGHTS FOR VARIOUS TYPES OF VESSELS –1972 INTERNATIONAL RULES

	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
A	Power-driven vessel 12 m but less than 20 m in length	White, 225°, visibility 3 mi. At least 2.5 m above gunwale[a].	Separate red and green, 112 ½°, or combination, visibility 2 m; above hull at least 1 m below masthead light[b]	White, 135°, visibility 2 mi	---
B	Power-driven vessel less than 12 m in length	White, 225°, visibility 2 mi. Can be less than 2.5 m above gunwale, but at least 1 m above side lights[c]	Separate red and green, 112 ½°, or combination, visibility 1 mi; above hull at least 1 m below masthead light[b]	White, 135°, visibility 2 mi	---
C	Sailing vessel under 20 m in length	None	Separate red and green, 112 ½°, or combination, visibility 2 mi	White, 135°, visibility 2 mi	Optional – two all-round lights at or near top of mast, red over green, separated at least 1 m, visibility 2 mi.
D	Sailing vessel under 12 m in length	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[b][d]	White, 135°, visibility 2 mi[d][e]	---
E	Vessel propelled by oars	None	May show separate red and green, 112 ½°, or combination, visibility 1 mi[f]	May show white, 135°, visibility 2 mi[f]	---
F	Power-driven vessel 20m but less than 50 m in length	White, 225°, visibility 5 mi. Not more than ¼ of length aft from stem; 6 m or beam (up to 12 m) above hull.	Red and green, 112 ½°, visibility 2 mi. At or near sides of vessel; not more than ¾ height of masthead light	White, 135°, visibility 2 mi	After masthead light may be shown; at least 4.5 m higher than forward masthead light
G	Power-driven vessel 50 m or more in length	White, 225°, visibility 6 mi. Not more than ¼ of length aft from stem; 6 m or beam (up to 12 m) above hull.	Red and green, 112 ½°, visibility 3 mi. At or near sides of vessel; not more than ¾ height of forward masthead light	White, 135°, visibility 3 mi	After masthead light required; at least 4.5 m higher and half of vessel length (up to 100 m) aft of forward masthead light
H	Vessel towing; tow from stern of towing less than 200 m overall vessel. (Also towing alongside or pushing ahead)	Two white, arranged vertically, 225°, visibility determined by length of vessel.	Normal for size of vessel	Normal for size of vessel	Towing light[g] over sternlight (not shown when towing alongside or pushing ahead)
I	Vessel towing; tow 200 m or more overall length	Three white, arranged vertically, 225°, visibility determined by length of vessel	Normal for size of vessel	Normal for size of vessel	Towing light[g] over stern light

(a) After masthead light may be shown but not required.
(b) Fitted with inboard screens if necessary to prevent being seen across bow.
(c) Less than 7 m and less than 7 kt max speed need only have all-round white light, visibility 2 mi but should have sidelights.
(d) May be combined into triple combination light at masthead.
(e) Less than 7 m need only have flashlight or lantern to show.
(f) Need only have flashlight or lantern to show white light.
(g) Visibility 3 mi for vessels 50 m or more in length; 2 mi for shorter vessels.

	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
J	Vessel being towed astern, if manned	None	Normal for size of vessel	Normal for size of vessel	
K	Vessel being towed alongside or pushed ahead	None	Normal for size of vessel; at forward end	Normal for size of vessel (not used for pushed ahead)	A group of vessels is lighted as a single vessel
L	Vessel engaged in trolling or drift fishing	(h)	(h)	(h)	---
M	Vessel engaged in trawling	None(i)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all- round lights, green over white(g)(j)(k)(l)
N	Vessel engaged in fishing, other than trawling (or trolling)	None(i)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all- round lights, red over white(g)(j)(k)(l)
O	Vessel at anchor, less than 50 m in length	None	None	None	White, all-round light where can best be seen; visibility 2 mi (not required if less than 7 m in length and not anchored in a narrow channel or where vessels normally navigate)
P	Vessel at anchor; 50 m or more in length	None	None	None	White, all-round light in fore part of vessel not less than 6 m above hull; a second white all-round light in after part, not less than 4.5 m lower than forward anchor light; visibility 3 mi.
Q	Vessel aground	None	None		Normal anchor light(s) plus two red all-round lights of same visibility range
R	Pilot vessel	None if on pilot duty; normal if underway and not on pilot duty	When underway, normal for size of vessel	When underway, normal for size of vessel	Two all-round lights, white over red, at masthead(g)(j)(k); if at anchor, normal anchor light(s)
S	Vessel not under command	None	If making way through the water, normal for size of vessel	If making way through the water, normal for size of vessel	Two red all-round lights vertically where best can be seen(g)(j)(k)
T	Vessel constrained by her draft	Normal for size of vessel	Normal for size of vessel	Normal for size of vessel	Three red all-round lights, arranged vertically and equally spaced.(g)(j)(k)

(h) Show only normal lights of power-driven or sailing vessel.
(i) When not actually fishing, show normal masthead lights for vessel its size.
(j) Vertical spacing 2 m for vessels 20 m or more in length, 1 m for shorter vessels.
(k) Lower light not less than 4 m (2 m if under 20 m in length) above hull.
(l) Lower light above sidelights at least twice vertical spacing.

5. INLAND "RULES OF THE WATER"

5.1 MEETING SITUATIONS

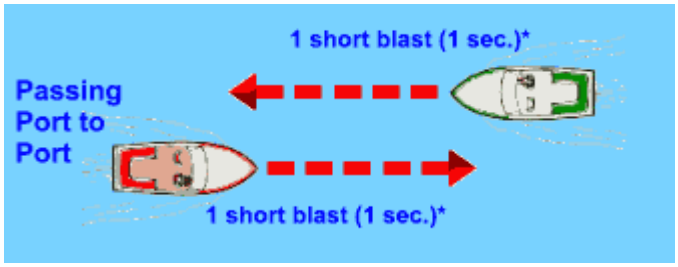
In the following situations, the give-way vessel must take action to keep well clear. The stand-on vessel should maintain its course and speed. If it becomes apparent that the actions taken (or not taken) by the give-way vessel are dangerous or insufficient, you should take action to avoid collision.

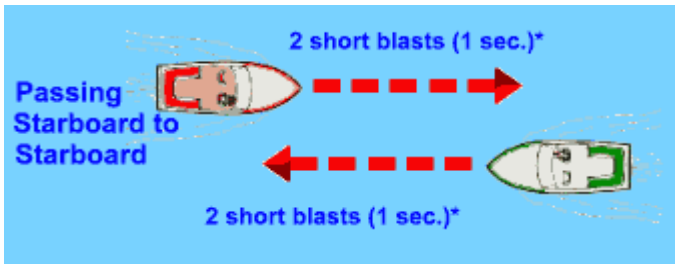
5.1.1 Meeting Head-On

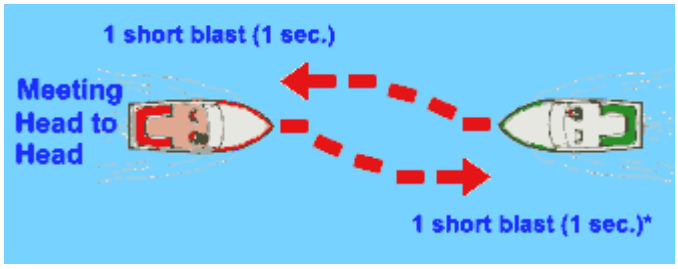
When two power driven vessels are approaching head-on or nearly so, either vessel will indicate its intent which the other vessel will answer promptly. In a meeting situation, neither vessel is the stand-on vessel.

It is generally accepted that you should alter course to starboard and pass port-to-port. The accompanying sound signal is one short blast. If you cannot pass port-to-port due to an obstruction or other vessels, you should sound two short blasts to indicate your intention to pass starboard-to-starboard. Make sure the other vessel understands your intent before proceeding. The other vessel should return your two-short-blast signal.

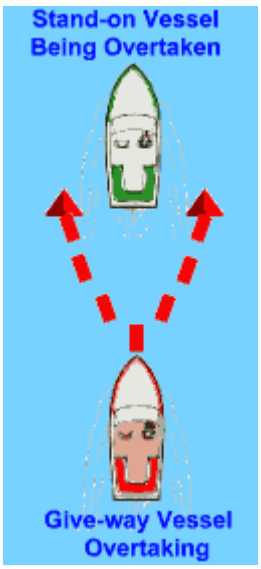
- Not sounded on International Waters







5.1.2 Overtaking

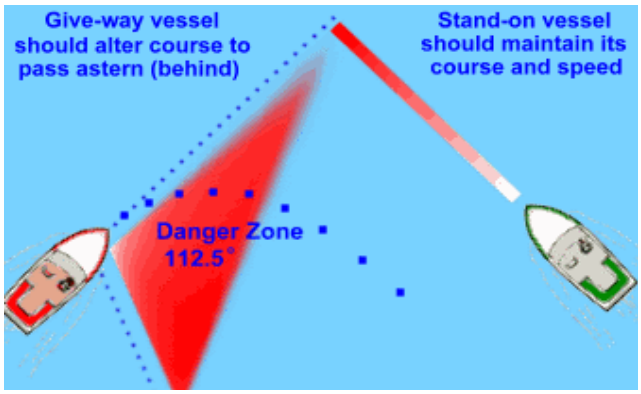


When two vessels are moving in the same direction, and the astern vessel wishes to pass, it must initiate the signal to pass as shown in the diagram. The vessel passing is the give-way vessel and should keep out of the way of the vessel being passed. The vessel being passed is the stand-on vessel and must maintain its course and speed. If the stand-on vessel realizes that the course intended by the give-way vessel is not safe, it should sound the danger or doubt signal.

If you are the overtaking vessel, remember that you are the give-way vessel until well past, and safely clear of, the passed vessel. Do not cut in front, impede, or endanger another vessel.

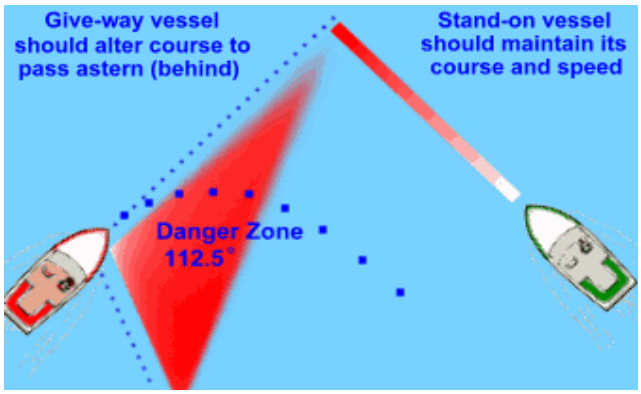
Inland Rules: "I intend to pass you on your port side" *2 short blasts (1 second)* "Agreement" *2 short blasts (1 second)*	**Inland Rules:** "I intend to pass you on your starboard side" *1 short blast (1 second)* "Agreement" *1 short blast (1 second)*
International Rules: "I intend to pass you on your port side" *2 prolonged blasts/2 short* "Agreement" *1 prolonged/1 short/1 prolonged/1 short*	**International Rules:** "I intend to pass you on your starboard side" *2 prolonged blasts/1 short* "Agreement" *1 prolonged/1 short/1 prolonged/1 short*

5.1.3 Crossing



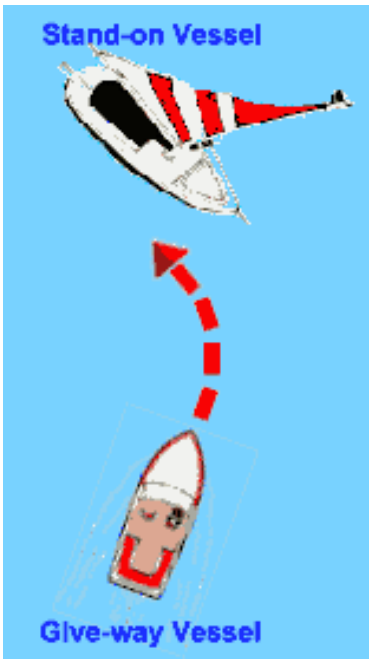
When two power driven vessels are approaching at right angles or nearly so, and risk of collision exists, the vessel on the right is the stand-on vessel and must hold its course and speed. The other vessel, the give-way vessel, will maneuver to keep clear of the stand-on vessel and will pass it by its stern. If necessary, slow or stop or reverse until the stand-on vessel is clear.

In the example above, the red vessel is the give-way vessel and should alter course and speed to pass behind the green vessel. If the skipper of the green vessel does not observe the red vessel taking action to avoid collision, then he/she must take the required action to avoid a collision.



5.1.4 Sailing Craft and Vessels Propelled by Oars or Paddles

Sailing craft and boats propelled by oars or paddles have the right-of-way over power driven vessels. An exception to this is if the sailing craft or self-propelled vessel is passing a power driven vessel. In an overtaking situation, the overtaking vessel is the give-way vessel, even if it is not propelled by an engine.



Sailing craft and boats propelled by oars or paddles have the right-of-way over power driven vessels. An exception to this is if the sailing craft or self-propelled vessel is passing a power driven vessel. In an overtaking situation, the overtaking vessel is the give-way vessel, even if it is not propelled by an engine.

Sailing craft and boats propelled by oars or paddles have the right-of-way over power driven vessels. An exception to this is if the sailing craft or self-propelled vessel is passing a power driven vessel. In an overtaking situation, the overtaking vessel is the give-way vessel even if it is not propelled by an engine.

5.1.5 Navigating Narrow Channels

The rules tell you to stay to the starboard side of narrow channels. Make sure that you do not impede a vessel that is constrained by draft, i.e., a large vessel that must operate within the channel in order to make way safely. When crossing a channel, do so at a right angle and in such a way as to avoid causing the traffic in the channel to make course or speed changes. Do not anchor in a channel unless you cannot make way (broken down, etc.).

When operating on the Great Lakes, Western rivers and other designated rivers, the down bound vessel (going with the current) has the right of way over a vessel going upstream. This is because a vessel going upstream can maneuver better than a vessel going downstream.
If you approach a bend in a river around which you cannot see, sound one prolonged blast to alert vessels approaching from the other side of the bend that you are there. If another vessel is around the bend, it should answer with one prolonged blast. Conversely, if you hear a prolonged blast as you approach the bend, answer with a prolonged blast.

5.1.6 Commercial Vessel Situations

If at all possible stay out of areas where there is commercial vessel traffic such as shipping lanes or traffic separation zones. Large ships and barges have special problems in maneuvering and **cannot and will not** get out of your way.

If you must operate around commercial vessels take heed of the following:

- Avoid ship channels; if you must cross, do so at right angles and as quickly as possible
- Be alert; watch for traffic
- Be seen, especially at night
- Know the sound signals, especially the danger or doubt signal
- Keep your VHF radio tuned to Channel 16 and listen carefully
- Order all aboard to wear PFDs
- Be familiar with the area and have current navigation charts
- Do not be a non-survivor of a collision with a large ship.

6. SEAMANSHIP

Seamanship is defined as " the knowledge of and skill in all things pertaining to the operation, navigation, and maintenance of a ship." This knowledge may include; handling and working with rope, wire, and various boat hardware. Basic engine and boat electrical layout maintenance and troubleshooting. Piloting including boat handling, engine operation, proper use of charts, and use of navigation equipment (i.e., depth finders, compass, Global Positioning System (GPS) or loran units, speedometer). A fundamental knowledge of weather (wind, fronts, and cloud types) and the water environment (wave action, tides, and currents). Proper emergency preparation training, basic first aid knowledge, and survival techniques are an integral part of seamanship.

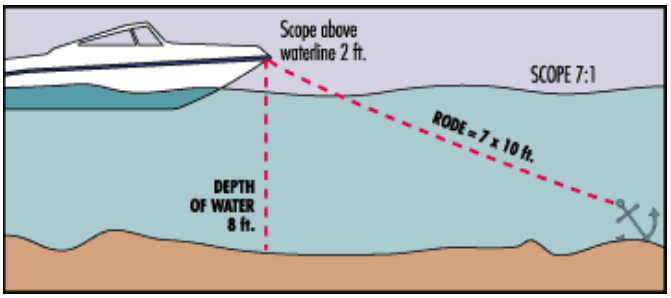
Seamanship skills are developed through training courses, such as the USCG Auxiliary Training course, through training manuals, regulatory handbooks, instructional guides and videos, and most importantly through actual hands on experience and working with people who have developed the skills.

6.1 ANCHORING

Anchoring is done for two principal reasons: first, to stop for fishing, lunch, or an overnight stay and second, to keep you from running aground in bad weather or as a result of engine failure. Anchoring can be a simple task if you follow these guidelines:

- Make sure you have the proper type of anchor (danforth/plow/mushroom).
- A 3- to 6-ft length of galvanized chain should be attached to the anchor. The chain will stand up to the abrasion of sand, rock, or mud on the bottom much better than a fiber line.
- A suitable length of nylon anchor line should be attached to the end of the chain (this combination is called the "Rode"). The nylon will stretch under heavy strain cushioning the impact of the waves or wind on the boat and the anchor.
- Select an area that offers maximum shelter from wind, current, and boat traffic.
- Determine depth of water and type of bottom (preferably sand or mud).
- Calculate the amount of anchor line you will need. General rule: 5-7 times as much anchor line as the depth of water plus the distance from the water to where the anchor will attach to the bow. For example, if the water depth is 8 ft and it is 2 ft from the top of water to your bow cleat, you would multiply 10 ft by 5-7 to get the amount of anchor line to put out (Figure 6-1).

Figure 6-1.



- Secure the anchor line to the bow cleat at the point you want it to stop.
- Bring the bow of the vessel into the wind or current.

- When you get to the spot you want to anchor, place the engine in neutral.
- When the boat comes to a stop, slowly lower the anchor. Do not throw the anchor over, as it will tend to entangle the anchor.
- When all anchor line has been let out, back down on the anchor with engine in idle reverse to help set the anchor.
- When anchor is firmly set, use reference points (landmarks) in relation to the boat to make sure you are not drifting. Check these points frequently.
- Maximum anchoring is achieved at an angle of less than 8 degrees.

The following table provides anchor weights:

Boat Length (Maximum)	Lunch Hook	Working Anchor	Storm Anchor
20 ft	**4** (10)	**5** (20)	**12** (40)
30 ft	**5** (15)	**12** (30)	**18** (60)
40 ft	**12** (20)	**18** (40)	**28** (80)
NOTE: Bold indicates figures based on modern lightweight burial-type anchors of efficient design. Figures in parentheses show how weights would be increased, using a formula of 0.5 lb, 1 lb, and 2 lb per foot for certain kedges.			

Table 6-1 provides suggested rode and anchor sizes.

6.2 WEATHER

You should never leave the dock without first checking the local weather forecast. You can get the weather information from the TV, radio, local, newspaper, on-line, or from one of the weather channels on your VHF radio.

At certain times of the year weather can change rapidly and you should continually keep a “weather eye” out. While you are out in a boat, here are a few signs you can look for that indicate an approaching weather change:

- Weather changes generally come from the west. Scan the sky with your weather eye, especially to the west.
- Watch for cloud to build up, especially rapid vertically rising clouds.
- Sudden drop in temperature.
- Sudden change in wind direction and/or speed.
- If you have a barometer on your boat, check it every 2-3 hours. A rising barometer indicates fair weather and rise in wind velocity; a falling barometer indicates stormy or rainy weather.

TABLE 6-1 SUGGESTED RODE AND ANCHOR SIZES[(a)]

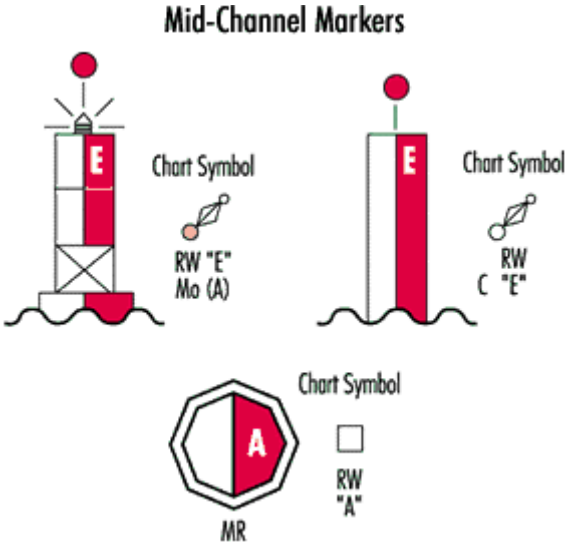
L.O.A.	Beam		Rode		Anchor		
	Sail	Power	Nylon	Chain	Northill	Standard	Hi-Tensile
FOR STORM ANCHOR (WINDS UP TO 60 KNOTS)							
10 ft	5 ft	5 ft	100 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
15 ft	7 ft	7 ft	125 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
20 ft	8 ft	9 ft	150 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H
25 ft	9 ft	10 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	22-S	12-H
30 ft	10 ft	11ft	250 ft-7/16 in.	5 ft-5/16 in.	46 lb (20-R)	22-S	20-H
35 ft	12 ft	13 ft	300 ft-1/2 in.	6 ft-3/8 in.	46 lb (20-R)	40-S	35-H
40 ft	13 ft	14 ft	400 ft-5/8 in.	8 ft-7/16 in.	80 lb (30-R)	65-S	60-H
50 ft	14 ft	16 ft	500 ft-5/8 in.	8 ft-7/16 in.	105 lb (50-R)	130-S	60-H
60 ft	16 ft	19 ft	500 ft-3/4 in.	8 ft-1/2 in.	105 lb (50-R)	180-S	90-H
FOR WORKING ANCHOR (WINDS UP TO 30 KNOTS)							
10 ft	5 ft	5 ft	80 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
15 ft	7 ft	7 ft	100 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	8-S	5-H
20 ft	8 ft	9 ft	120 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
25 ft	9 ft	10 ft	150 ft-3/8 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
30 ft	10 ft	11ft	180 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H
35 ft	12 ft	13 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	22-S	12-H
40 ft	13 ft	14 ft	250 ft-7/16 in.	5 ft-5/16 in.	46 lb (20-R)	22-S	20-H
50 ft	14 ft	16 ft	300 ft-1/2 in.	6 ft-3/8 in.	46 lb (20-R)	40-S	35-H
60 ft	16 ft	19 ft	300 ft-1/2 in.	6 ft-3/8 in.	80 lb (30-R)	65-S	35-H
FOR LUNCH HOOK							
10 ft	5 ft	5 ft	70 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
15 ft	7 ft	7 ft	80 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
20 ft	8 ft	9 ft	90 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
25 ft	9 ft	10 ft	100 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
30 ft	10 ft	11ft	125 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
35 ft	12 ft	13 ft	150 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	4-S	5-H
40 ft	13 ft	14 ft	175 ft-3/8 in.	4 ft-1/4 in.	12 lb (6-R)	8-S	5-H
50 ft	14 ft	16 ft	200 ft-3/8 in.	4 ft-1/4 in.	12 lb (6-R)	8-S	12-H
60 ft	16 ft	19 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H

(a) Suggested sizes assume fair holding ground, scope of at least 7-to-1 and moderate shelter from heavy seas.

Plow Anchors—Woolsey, manufacturer of the Plowright anchor, makes the following recommendations for winds up to 30 knots: for *working anchors*, 10-21 ft, 6 lb; 22-32 ft, 12 lb; 32-36 ft, 18 lb; 36-39 ft, 22 lb; and 39-44 ft, 35 lb. For *lunch hooks*, they advise stepping down one size. For *storm anchors*, up one size.
Kedges—Holding powers vary widely with the type. Best to consult manufacturer for individual recommendations.

7. AIDS TO NAVIGATION

Aids to navigation are placed along coasts and navigable waters as guides to mark safe water and to assist mariners in determining their position in relation to land and hidden dangers. Each aid to navigation is used to provide specific information.



Several aids to navigation are usually used together to form a local aid to navigation system that helps the mariner follow natural and improved channels. Such aids to navigation also provide a continuous system of charted marks for coastal piloting. Individual aids to navigation are used to mark landfall from seaward, and to mark isolated dangers.

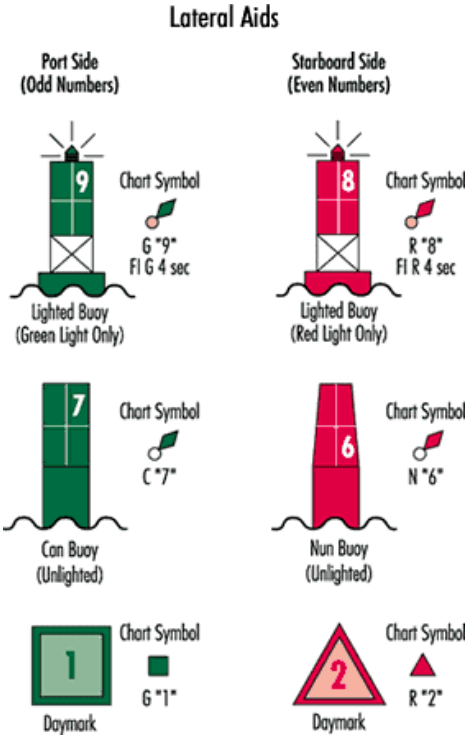
Lateral markers are buoys or beacons that indicate the port and starboard sides of a route to be followed. Virtually all U.S. lateral marks follow the traditional 3R rule of "red, right, returning." This means, when returning from sea, keep red marks on the right-hand (starboard) side of the vessel.

Mariners must NOT rely on buoys alone for determining their position. Storms and wave action can cause buoys to move.

7.1 LATERAL AIDS

Lateral aids marking the sides of channels as seen when entering from seaward.

Do not tie up to Aids to Navigation; it is dangerous and illegal.



7.2 NAUTICAL CHARTS

One of the most important tools used for safely navigating waterways are Nautical Charts. Nautical Charts show the nature and shape of the coast, depths of water, general configuration and character of the bottom, prominent landmarks, port facilities, aids to navigation, marine hazards, and other pertinent information. Changes brought about by people and nature require that nautical charts be constantly maintained and updated to aid safe navigation.

To meet the needs of the boaters, the National Ocean Service (NOS) produces a variety of nautical charts and chart products. The date of a nautical chart is critical to the boater. Only up-to-date charts should be used for navigation. Nautical charts vary in scale and format. For coastal navigation, for instance, boaters should use the largest chart scale available. Chart updating information can be obtained from "Local Notice to Mariners" published by the USCG.

NOS nautical charts may be purchased either directly by mail from the NOS Distribution Branch or through an authorized agent. There are more than 1,700 nautical chart agents that sell NOS charts.

Other charts available consist of tide and current charts for various localities and a local notice to mariners. These local charts should be used with NOS Charts.

8. ELECTRONICS

8.1 EQUIPMENT REQUIREMENTS – RADIO REGULATIONS

8.1.1 Carrying a Radio

Most recreational vessels under 65.6 ft/20m in length do not have to carry a marine radio. Any vessel that carries a marine radio must follow the rules of the Federal Communications Commission (FCC).

8.1.2 Radio Licenses

The FCC does not require operators of recreational vessels to carry a radio or to have an individual license to operate VHF marine radios (with or without digital selective calling capability), Emergency Position Indicating Radio Beacons (EPIRBs), or any type of radar. Operators must, however, follow the procedures and courtesies that are required of licensed operators specified in FCC Rules. You may use the name or registration number of your vessel to identify your ship station.

Users of VHF marine radio equipped with digital selective calling will need to obtain a maritime mobile service identity number from the FCC. It is unlawful to use digital selective calling without obtaining this identity.

The following vessels are still required to be licensed:

- Vessels that use medium frequency/high frequency single side-band radio, satellite communications, or telegraphy
- Power driven vessels over 65.6 ft/20 m in length
- Vessels used for commercial purposes including:
  - Vessels documented for commercial use, including commercial fishing vessels
  - CG inspected vessels carrying more than 6 passengers
  - Towboats more than 7.8 m in length
  - Vessels of more than 100 tons certified to carry at least 1 passenger
  - Cargo ships over 300 tons
- Any vessel, including a recreational vessel, on an international voyage.

8.1.3 Radio Listening Watch

Vessels not required to carry a marine radio (e.g., recreational vessels less than 20-m length), but which voluntarily carry a radio, must maintain a watch on Channel 16 (156.800 MHz) whenever the radio is operating and not being used to communicate. Such vessels may alternatively maintain a watch on VHF Channel 9 (156.450 MHz), the boater calling channel.

U.S. vessels required to carry a VHF marine radio, such as commercial fishing vessels, must maintain a watch on Channel 16 (156.800 MHz) while underway whenever the radio is not being used for exchanging communications.

False Distress Alerts

It is unlawful to intentionally transmit a false distress alert, or to unintentionally transmit a false distress alert without taking steps to cancel that alert.

Very High Frequency Marine Radio Channels

The chart below contains a partial listing of channels recreational boaters should be familiar with:

Channel	Type of Message and Use
06	Intership Safety: Used for ship-to-ship safety messages and search messages and ships and aircraft of the USCG.
09	Boater Calling: FCC has established this channel as a supplementary calling channel for non-commercial vessels (recreational boaters). The purpose is to relieve congestion on VHF Channel 16. The USCG announces urgent marine information broadcasts and storm warnings on Channel 9 in the First USCG District (waters off the coast of northern New Jersey, New York, and New England) and USCG Group Grand Haven, Milwaukee and Sault Ste. Maria (Lake Michigan). For that reason, we strongly urge boaters to use Channel 9 in these waters. Use of Channel 9 in other waters is optional, and we recommend boaters keep turned to and use Channel 16 in those waters unless otherwise notified by the USCG.
13,67	Navigation Safety (also known as Bridge-to-Bridge channel): Ships greater than 20 m in length maintain a listening watch on this channel in US waters. This channel is available to all ships. Messages must be about ship navigation (i.e., passing or meeting other ships). You must keep your messages short. Your power output must not be more than 1 watt. This is also the main working channel at most locks and drawbridges. Channel 67 is for lower Mississippi River only.
16	International Distress, Safety and Calling: Use this channel to get the attention of another station (calling) or in emergencies. Ships required to carry a radio maintain a listening watch on this channel. USCG and most coast stations also maintain a listening watch on this channel.
21A, 23A, 83A	USCG only.
22A	USCG Liaison and Maritime Safety Information Broadcasts: Announcements of urgent marine information broadcasts and storm warnings (Broadcasts announced on Channel 16).
24,25,26, 27,28,84, 85,86,87	Public Correspondence (Marine Operator): Use these channels to call the marine operator at a public station. By contacting a public coast station, you can make and receive calls from telephones on shore. Except for distress calls, public coast stations usually charge for this service.
70	Digital Selective Calling: Use this channel for distress and safety calling and for general purpose calling using only digital selective calling techniques. Voice communications not allowed. NOTE: The USCG will not be equipped to respond to digital selective calling distress calls on Channel 70 until 2006 – use Channel 16.

Distress Calls

The radiotelephone distress call consists of:

- Distress signal MAYDAY spoken three times
- Words THIS IS
- Call sign (or vessel registration number or name if no call sign is assigned) of the mobile station in distress, spoken three times.

Other electronic gear available is GPS, fathometer, and radar. The user should refer to individual operator manuals for proper orientation in the use of the gear.

9. TOWING AND LAUNCHING

9.1 TRAILERING YOUR BOAT

Choose the proper trailer for your boat. More damage can be done to a boat by the stress of road travel than by normal water operation. A boat hull is designed to be supported evenly by water. When transported on a trailer, your boat should be supported structurally as evenly across the hull as possible. This will allow for even distribution of the weight of the hull, engine and equipment. It should be long enough to support the whole length of the hull but short enough to allow the lower unit of the boat's engine to extend freely.

- Rollers and bolsters must be kept in good condition to prevent scratching and gouging of the hull.

- Tie-downs and lower unit supports must be adjusted properly to prevent the boat from bouncing on the trailer. The bow eye on the boat should be secured with either rope, chain or turnbuckle in addition to the winch cable. Additional straps may be required across the beam of the boat.

- The capacity of the trailer should be greater than the combined weight of the boat, motor, and equipment.

- The tow vehicle must be capable to handling the weight of the trailer, boat, equipment, as well as weight of the passengers and equipment which will be carried inside. This may require that the tow vehicle may need to be specially equipped with an:

  — Engine of adequate power
  — Transmission designed for towing
  — Larger cooling systems for the engine and transmission
  — Heavy duty brakes
  — Load bearing hitch attached to the frame, not the bumper.

Check your vehicle owners manual for specific information.

9.1.1 Check Before You Go Out on the Highway

- The tow ball and coupler are the same size and bolts with washers are tightly secured. (The vibration of road travel can loosen them.)

- The coupler is completely over the ball and the latching mechanism is locked down.

- The trailer is loaded evenly from front to rear as well as side to side. Too much weight on the hitch will cause the rear wheels of the tow vehicle to drag and may make steering more difficult. Too much weight on the rear of the trailer will cause the trailer to "fishtail" and may reduce traction or even lift the rear wheels of the tow vehicle off the ground. The safety chains are attached crisscrossing under the coupler to the frame of the tow vehicle. If the ball were to break, the trailer would follow in a straight line and prevent the coupler from dragging on the road.

- The lights on the trailer function properly.

- Check the brakes. On a level parking area roll forward and apply the brakes several times at increasing speeds to determine a safe stopping distance.

- The side view mirrors are large enough to provide an unobstructed rear view on both sides of the vehicle.

- Check tires (including spare) and wheel bearings. Improper inflation may cause difficulty in steering. When trailer wheels are immersed in water, (especially salt water) the bearings should be inspected and greased after each use.

- Make certain that water from rain or cleaning has been removed from the boat. Water weighs approximately eight pounds per gallon and can add weight that will shift with the movement of the trailer.

9.1.2 Towing Precautions

- Allow more time to brake, accelerate, pass, and stop.

- Remember the turning radius is also much greater, curbs and roadside barriers must be given a wide berth when negotiating corners.

- Prior to operating on the road, practice turning, backing up, etc. on a level, uncongested parking area.

9.1.3 Pre-Launching Preparations

- For the courtesy of others and to prevent rushing, prepare your boat for launching away from the ramp.

- Check the boat to ensure that no damage was caused by the trip.

- Raise the lower unit (remove supports) to proper height for launching so that it will not hit bottom.

- Remove tie-downs and make sure that the winch is properly attached to the bow eye and locked in position.

- Put the drain plug in securely.

- Disconnect the trailer lights to prevent shorting of electrical system or burning out a bulb.

- Attach a line to the bow and the stern of the boat so that the boat cannot drift away after launching and it can be easily maneuvered to a docking area.
- Visually inspect the launch ramp for hazards such as a steep drop off, slippery area, and sharp objects.

- When everything has been double checked, proceed slowly to the ramp remembering that your boat is just resting on the trailer and attached only at the bow. The ideal situation is to have one person in the boat and one observer at the water's edge to help guide the driver of the tow vehicle.

- Keep the rear wheels of the tow vehicle out of the water. This will generally keep the exhaust pipes out of the water. If the exhaust pipes become immersed in the water, the engine may stall.

- Set the parking brake and place tire chocks behind the rear wheels.

- Make sure someone else on shore is holding the lines attached to the boat.

- Lower the motor and prepare to start the engine (after running blowers and checking for fuel leaks).

- Start the boat motor and make sure that water is passing through the engine cooling system.

- Release the winch and disconnect the winch line from the bow when the boat operator is ready.

- At this point, the boat should be able to be launched with a light shove or by backing off the trailer under power. Finish loading your boat at a sufficient distance from the ramp so that others may use it.

9.1.4 Retrieval

The steps for removing your boat from the water are basically the reverse of those taken to launch it. However, keep in mind that certain conditions may exist during retrieval that did not exist during launching. As you approach the takeout ramp, take special care to note such factors as:

- Change in wind direction and/or velocity
- Change in current and/or tide
- Increase in boating traffic
- Visibility, etc.

First, unload the boat at a dock or mooring if possible. Next, maneuver the boat carefully to the submerged trailer, and raise the lower unit of the engine. Then, winch the boat onto the trailer and secure it. Finally, drive the trailer with the boat aboard carefully out of the ramp to a designated parking area for cleanup, reloading, and an equipment safety check. Practice will make launch and retrieval a simple procedure. The best advise is just, “do it cautiously with safety as your main concern.”

9.1.5 Storage

Since your boat may be sitting on its trailer for quite some time before it is used again, it is important that it be stored properly. To avoid damage from sun and weather, cover the boat with a tarp. To remove weight from the wheels, put cinderblocks or wood beams under the tongue and all four corners of the trailer frame.

The safety chains are attached crisscrossing under the coupler to the frame of the tow vehicle. If the ball were to break, the trailer would follow in a straight line and prevent the coupler from dragging on the road.

- The lights on the trailer function properly.

- Check the brakes. On a level parking area, roll forward and apply the brakes several times at increasing speeds to determine a safe stopping distance.

- The side view mirrors are large enough to provide an unobstructed rear view on both sides of the vehicle.

- Check tires (including spare) and wheel bearings. Improper inflation may cause difficulty in steering. When trailer wheels are immersed in water (especially salt water), the bearings should be inspected and greased after each use.

- Make certain that water from rain or cleaning has been removed from the boat. Water weighs approximately 8 lb per gal and can add weight that will shift with the movement of the trailer.

10. OFFSHORE OPERATION SAFETY EQUIPMENT

10.1 EQUIPMENT REQUIREMENTS – VESSEL OPERATING OFFSHORE

If you operate offshore, you should seriously consider carrying additional equipment beyond the minimum federal requirements. This equipment should include appropriate communications gear, an EPIRB, a means of accurately determining your location, and an inflatable life raft. In cold waters, an immersion suit should be carried for everyone on board.

10.1.1 Communications

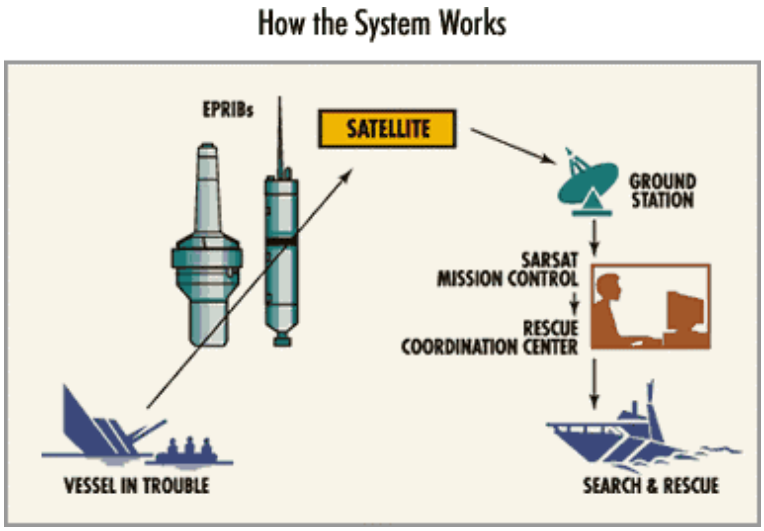
Carry communications gear, marine VHF-FM, and/or HF transceiver(s), appropriate to your operating area. Cellular phone coverage is available in many coastal areas. However, cellular phones should not be considered a substitute for VHF-FM marine band radios for emergency purposes.

10.1.2 Satellite Emergency Position Indicating Radio Beacons

Satellite EPIRBs (406 MHz) are designed to quickly and reliably alert rescue forces, indicate an accurate distress position, and guide rescue units to the distress scene, even when all other communications fail.

Satellite EPIRBs, operate as part of a worldwide distress system. An international satellite constellation maintains a vigilant, global "listening" watch for satellite EPIRB distress signals. The National Oceanic and Atmospheric Administration operates satellites, ground stations, and an alert distribution system serving the United States and a wide segment of the international community.

When activated, the satellite EPIRB transmits a distress signal with a beacon-unique identifying code. The system detects the signal, calculates an accurate distress position, checks the unique identifying code against the EPIRB registration database (vessel and point-of-contact information supplied by the owner), and routes the distress alert with registration information to the responsible USCG (or international) Rescue Coordination Center, 406 MHz EPIRBs with GPS (internal or attached) also provide an immediate GPS position in the information passed to the Rescue Coordination Center.

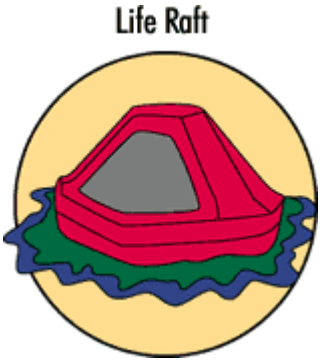


Geostationary satellites make detection almost immediate. If the EPIRB does not have the ability to provide a GPS position, the process to determine a position takes about an hour on average and almost always less than 2 hours. Satellite EPIRBs also include a homing beacon and strobe to help rescue forces quickly locate the distress scene.

Satellite beacons have significant coverage, alerting timeliness, position accuracy, and signaling advantages over other types of EPIRBs (121.5 MHz). Before purchasing or using an other-than-406 MHz EPIRB, be sure you understand its capabilities and limitations.

Mount the EPIRB to float free according to the manufacturer's instructions, if possible. Otherwise, make sure it is **readily accessible. Register** the EPIRB with National Oceanic and Atmospheric Administration, according to the instructions provided with the beacon. Registration is mandatory, improves response, and reduces false alarms.

10.1.3 Inflatable Life Rafts



An inflatable life raft can provide a survival platform for an extended period of time. Make sure the life raft is large enough for everyone on board when the boat operates offshore. It should have the appropriate emergency equipment pack, and should be professionally serviced periodically, according to the manufacturer's instructions. USCG approved life rafts must meet a number of stringent material and performance standards.

10.1.4 Immersion Suits

Immersion suits will delay the effects of hypothermia in cold water. They should be stored and maintained according to the manufacturer's instructions. Table 10-1 provides the required or recommended equipment for the vessel safety check decal.

10.2 ELECTROFISHING FIELD MANUAL

The electrofishing field manual and checklist for a safety and health audit are provided in Appendix C.

TABLE 10-1 REQUIRED OR RECOMMENDED EQUIPMENT FOR THE VESSEL SAFETY CHECK DECAL

Numbering	Proper spacing, contrasting color, minimum 3-in. block letters.
Registration/Documentation	Must be on board.
Navigation Lights	Must operate and show proper configuration.
Sound Producing Device	Horn, whistle, or other; bell on boats over 12 m (39.4 ft) or longer.
Personal Flotation Device	One wearable for each passenger, Type IV on boats 16 ft or longer.
Fire Extinguishers	Minimum for size of boat, HALON, FE241/CO_2-current tag.
Visual Distress Signals	INLAND – Visual Distress Signals, Flag, Signal Light, etc.; INT'L - Minimum flares, aerial rockets, or approved signals, not expired.
Backfire Flame Arrestor	Approved, tight, and clean.
Ventilation	For closed compartments with potential for explosive vapors and an ignition source. Blower must work. Warning Posted. Fuel System tanks secure, over 7 gal considered permanent and must be grounded/vented. Hoses in good condition, no leaks.
Anchor and Tackle	Suitable to boat and the area.
Alternate Propulsion	Under 16 ft, paddle or oar; if mechanical, separate fuel tank and starting source.
Dewatering Device	Pumps must work, extra manual bailer.
Overall Vessel Condition	Bilge and equipment area clean, well maintained. Not overloaded, overpowered, or no automotive parts.
Electrical System	Batteries secure, terminals covered, well organized wiring, proper fuses/circuit breakers.
Galley/Heating Systems	Secure system, proper tank installation. No flammable material nearby.
State Requirements	Compiles with state safety requirements. Contact state boating regulators for current state boating regulations.
Marine Sanitation Device	Approved device, overboard discharge sealed.
MARPOL Trash Placard	Boats 26 ft and longer, written plan over 40 ft.
Pollution Placard	Boats 26 ft and longer with machinery compartment.
Navigation Rules	Boats 12 m (39.4 ft) and longer.

11. CHECKLISTS

11.1 EQUIPMENT REQUIREMENTS – SAFETY AND SURVIVAL TIPS

Boater's Checklist	Yes	No
State Numbering Displayed		
Certificate of Number (State Registration)		
Certificate of Documentation/Display		
Official Number Displayed		
Personal Flotation Devices		
Throwable Personal Flotation Device		
Visual Distress Signals		
Fire Extinguishers		
Ventilation		
Backfire Flame Arrester		
Sound Producing Device		
Bell		
Navigation/Anchor Lights		
Oil Pollution Placard		
Garbage Placard		
Marine Sanitation Device		
Ring Buoy[(a)]		
VHF Radio[(a)]		
Heaving Line[(a)]		
Fenders[(a)]		
First Aid Kit[(a)]		
Flashlight[(a)]		
Mirror[(a)]		
Search Light[(a)]		
Tool Kit[(a)]		
Chart and Compass[(a)]		
Boat Hook[(a)]		
Spare Propeller[(a)]		
Mooring Line[(a)]		
Food and Water[(a)]		
Binoculars[(a)]		
Spare Batteries[(a)]		
Marine Hardware[(a)]		
Sunscreen (SPF 30+)[(a)]		
Extra Clothing[(a)]		
Spare Parts[(a)]		
Spare Fuel[(a)]		
AM-FM Radio[(a)]		
Anchor and Tackle[(a)]		
Dewatering Device[(a)]		
Alternate Propulsion[(a)]		
Overall Boat Condition[(a)]		
Electrical Systems[(a)]		
Fuel Systems[(a)]		
Galley/Heating Systems[(a)]		
State Safety Requirements[(a)]		
File Float Plan[(a)]		
Weather Forecast[(a)]		
(a) Recommended.		

11.2 SMALL CRAFT INSPECTION LIST

	Yes	No
Maintenance Records		
Hull Soundness		
Metal Visual Cracks/Date of Last Ultrasound		
Wood Rot and Loose Planking		
Fiberglass Stress Cracks and Delamination		
Soundness of Deck and Superstructure		
Standing Rigging and Frames		
Stays		
Cleats		
Bits		
Shackles		
Thimbles		
Lines		
Running Rigging		
Lines		
Shackles		
Blocks		
Thimbles		
Engine Compartment		
Belts		
Hoses		
Fuel Lines		
Seacocks		
Bilge Blowers		
Deck Machinery		
Hydraulics		
Wire		
Winches		
OSHA and EA Requirements		

11.3 TRAILER CHECKLIST

Trailer Checklist – Prior to On-Road/Boat Retrieval	Yes	No
Vehicle is appropriate for trailering weight of trailer and boat (e.g., pickup, suburban, or similar)		
Trailer is appropriate for boat		
Tow ball and light system are in good working order		
Safety chains are in good working order		
Vessel tie-downs (if needed) are attached to trailer		
Trailer lights operate (brake and turn signals)		
If outboard engine, engine is in secured up position		
Trailer tires are inflated and suspension in good working order		
Trailer Checklist – Pre-Launch		
Ensure drain plugs are in position		
Trailer lights are disconnected		
Tie-downs removed		
Line attached to bow and is tended		
Inspect ramp for hazards, steep drops, etc.		
Ensure engine starts and cooling system are properly working		

Appendix A

Nautical Terms

APPENDIX A

NAUTICAL TERMS

A	
ABAFT	Toward the rear (stern) of the boat; behind.
ABEAM	At right angles to the keel of the boat, but not on the boat.
ABOARD	On or within the boat.
ABOVE DECK	On the deck (not over it – see ALOFT).
AFT	Toward the stern of the boat.
AGROUND	Touching or fast to the bottom.
AHEAD	In a forward direction.
AIDS TO NAVIGATION	Artificial objects to supplement natural landmarks to indicate safe and unsafe waters.
ALOFT	Above the deck of the boat.
AMIDSHIPS	In or toward the center of the boat.
ANCHOR	A heavy metal device, fastened to a chain or line, to hold a vessel in position, partly because of its weight, but chiefly because the designed shape digs into the bottom.
ANCHORAGE	A place suitable for anchoring in relation to the wind, seas, and bottom.
ASTERN	In back of the boat, opposite of ahead.
ATHWARTSHIPS	At right angles to the centerline of the boat; rowboat seats are generally athwartships.
B	
BATTEN DOWN	Secure hatches and loose objects both within the hull and on deck.
BEACON	A lighted or unlighted fixed aid to navigation attached directly to the earth's surface (lights and day beacons both constitute "beacons").
BEAM	The greatest width of the boat.
BEARING	The direction of an object expressed either as a true bearing as shown on the chart, or as a bearing relative to the heading of the boat.
BELOW	Beneath the deck.
BIGHT	The part of the rope or line between the end and the standing part on which a knot is formed. A shallow bay.
BILGE	The interior of the hull below the floor boards.
BITTER END	The last part of a rope or chain. The inboard end of the anchor rode.
BLOCK	A wooden or metal case enclosing one or more pulleys and having a hook, eye, or strap by which it may be attached.
BOAT	A fairly indefinite term. A waterborne vehicle smaller than a ship. One definition is a small craft carried aboard a ship.
BOAT HOOK	A short shaft with a fitting at one end shaped to facilitate use in putting a line over a piling, recovering an object dropped overboard, or in pushing or fending off.
BOW	The forward part of a boat.
BOW LINE	A docking line leading from the bow.
BOW SPRING LINE	A bow pivot line used in docking and undocking, or to prevent the boat from moving forward or astern while made fast to a pier.
BOWLINE KNOT	A knot used to form a temporary loop in the end of a line.
BOWSPRIT	A spar extending forward from the bow.
BRIDGE	The location from which a vessel is steered and its speed controlled. "Control Station" is really a more appropriate term for small craft.
BULKHEAD	A vertical partition separating compartments.

BUOY	An anchored float used for marking a position on the water or a hazard or a shoal and for mooring.
C	
CABIN	A compartment for passengers or crew.
CAPSIZE	To turn over.
CAST OFF	To let go.
CATAMARAN	A twin-hulled boat, with hulls side-by-side.
CHAFING GEAR	Tubing or cloth wrapping used to protect a line from chafing on a rough surface.
CHANNEL	1. That part of a body of water deep enough for navigation through an area otherwise not suitable. It is usually marked by a single or double line of buoys and sometimes by range markers. 2. The deepest part of a stream, bay, or strait through which the main current flows. 3. A name given to a large strait, for example, the English Channel.
CHART	A map for use by navigators.
CHINE	The intersection of the bottom and sides of a flat or v-bottomed boat.
CHOCK	A fitting through which anchor or mooring lines are led. Usually U-shaped to reduce chafe.
CLEAT	A fitting to which lines are made fast. The classic cleat to which lines are belayed is approximately anvil-shaped.
CLOVE HITCH	A knot for temporarily fastening a line to a spar or piling.
COAMING	A vertical piece around the edge of a cockpit, hatch, etc. to prevent water on deck from running below.
COCKPIT	An opening in the deck from which the boat is handled.
COIL	To lay a line down in circular turns.
COMPASS	Navigation instrument, either magnetic (showing magnetic north) or gyro (showing true north).
COMPASS CARD	Part of a compass, the card is graduated in degrees, to conform with the magnetic meridian-referenced direction system inscribed with direction which remains constant; the vessel turns, not the card.
COMPASS ROSE	The resulting figure when the complete 360° directional system is developed as a circle with each degree graduated upon it, and with the 000° indicated as True North. True North is also known as true rose. This is printed on nautical charts for determining direction.
CURRENT	The horizontal movement of water.
D	
DAYBEACON	A fixed navigation aid structure used in shallow waters upon which is placed one or more daymarks.
DAYMARK	A signboard attached to a daybeacon to convey navigational information presenting one of several standard shapes (square, triangle, rectangle) and colors (red, green, orange, yellow, or black). Daymarks usually have reflective material indicating the shape, but may also be lighted.
DEAD AHEAD	Directly ahead.
DEAD ASTERN	Directly aft or behind.
DEAD RECKONING	A plot of courses steered and distances traveled through the water.
DECK	A permanent covering over a compartment, hull, or any part of a ship serving as a floor.
DISPLACEMENT	The weight of water displaced by a floating vessel.
DISPLACEMENT HULL	A type of hull that plows through the water, displacing a weight of water equal to its own weight, even when more power is added.

DOCK	A protected water area in which vessels are moored. The term is often used to denote a pier or a wharf.
DRAFT	The depth of water a boat draws.
E	
EASE	To slacken or relieve tension on a line.
EBB TIDE	A receding tide.
EVEN KEEL	When a boat is floating on its designed waterline, it is said to be floating on an even keel.
EYE OF THE WIND	The direction from which the wind is blowing.
EYE SPLICE	A permanent loop spliced in the end of a line.
F	
FAST	Said of an object that is secured to another.
FATHOM	6 ft.
FENDER	A cushion, placed between boats, or between a boat and a pier, to prevent damage.
FIGURE EIGHT KNOT	A knot in the form of a figure eight, placed in the end of a line to prevent the line from passing through a grommet or a block.
FLAME ARRESTER	A safety device, such as a metal mesh protector, to prevent an exhaust backfire from causing an explosion; operates by absorbing heat.
FLARE	The outward curve of a vessel's sides near the bow. A distress signal.
FLYING BRIDGE	An added set of controls above the level of the normal control station for better visibility. Usually open, but may have a collapsible top for shade.
FOLLOWING SEA	An overtaking sea that comes from astern.
FORE AND AFT	In a line parallel to the keel.
FORWARD	Toward the bow of the boat.
FOULED	Any piece of equipment that is jammed or entangled, or dirtied.
FOUNDER	When a vessel fills with water and sinks.
FREEBOARD	The minimum vertical distance from the surface of the water to the gunwale.
G	
GAFF	A spar to support the head of a gaff sail.
GALLEY	The kitchen area of a boat.
GANGWAY	The area of a ship's side where people board and disembark.
GEAR	A general term for ropes, blocks, tackle, and other equipment.
GIVE-WAY VESSEL	A term, from the Navigational Rules, used to describe the vessel which must yield in meeting, crossing, or overtaking situations.
GRAB RAILS	Hand-hold fittings mounted on cabin tops and sides for personal safety when moving around the boat.
GROUND TACKLE	Anchor, anchor rode (line or chain), and all the shackles and other gear used for attachment.
GUNWALE	The upper edge of a boat's sides.
H	
HARBOR	A safe anchorage, protected from most storms; may be natural or man-made, with breakwaters and jetties; a place for docking and loading.
HATCH	An opening in a boat's deck fitted with a watertight cover.
HEAD	A marine toilet. Also the upper corner of a triangular sail.
HEADING	The direction in which a vessel's bow points at any given time.
HEADWAY	The forward motion of a boat. Opposite of sternway.
HEAVE TO	To bring a vessel up in a position where it will maintain little or no headway, usually with the bow into the wind or nearly so.

HEEL	To tip to one side.
HELM	The wheel or tiller controlling the rudder.
HITCH	A knot used to secure a rope to another object or to another rope, or to form a loop or a noose in a rope.
HOLD	A compartment below deck in a large vessel, used solely for carrying cargo.
HULL	The main body of a vessel.
HYPOTHERMIA	A life-threatening condition in which the body's warming mechanisms fail to maintain normal body temperature and the entire body cools.
I	
INBOARD	More toward the center of a vessel; inside; a motor fitted inside the boat.
J	
There are no boating terms under this heading.	
K	
KEDGE	To use an anchor to move a boat by hauling on the anchor rode; a basic anchor type.
KEEL	The centerline of a boat running fore and aft; the backbone of a vessel.
KETCH	A two-masted sailboat with the smaller after mast stepped ahead of the rudder post.
KNOT	A measure of speed equal to one nautical mile (6,076 ft) per hour. A fastening made by interweaving rope to form a stopper, to enclose or bind an object, to form a loop or a noose, to tie a small rope to an object, or to tie the ends of two small ropes together.
L	
LEEWARD	The direction away from the wind. Opposite of windward.
LEEWAY	The sideways movement of the boat caused by either wind or current.
LINE	Rope and cordage used aboard a vessel.
LOG	A record of courses or operation. Also, a device to measure speed.
LUBBER'S LINE	A mark or permanent line on a compass indicating the direction forward; parallel to the keel when properly installed.
M	
MAST	A spar set upright to support rigging and sails.
MONOHULL	A boat with one hull.
MOORING	An arrangement for securing a boat to a mooring buoy or a pier.
MOORING BUOY	A buoy secured to a permanent anchor sunk deeply into the bottom.
N	
NAUTICAL MILE	One minute of latitude; approximately 6,076 ft – about 1/8 longer than the statute mile of 5,280 ft.
NAVIGATION	The art and science of conducting a boat safely from one point to another.
O	
OUTBOARD	Toward or beyond the boat's sides. A detachable engine mounted on a boat's stern.
OUTDRIVE	A propulsion system for boats with an inboard engine operating an exterior drive, with drive shaft, gears, and propeller; also called stern-drive and inboard/outboard.
OVERBOARD	Over the side or out of the boat.
P	
PAINTER	A line attached to the bow of a boat for use in towing or making fast.
PAY OUT	To ease out a line, or let it run in a controlled manner.

PENNANT (sometimes PENDANT)	The line by which a boat is made fast to a mooring buoy.
PERSONAL FLOTATION DEVICE	Personal flotation device (PFD) is official terminology for life jacket. When properly used, the PFD will support a person in the water. Available in several sizes and types.
PIER	A loading/landing platform extending at an angle from the shore.
PILOTING	Navigation by use of visible references, the depth of the water, etc.
PITCH	1. The alternate rise and fall of the bow of a vessel proceeding through waves. 2. The theoretical distance advanced by a propeller in one revolution. 3. Tar and resin used for caulking between the planks of a wooden vessel.
PITCHPOLING	A small boat being thrown end-over-end in very rough seas.
PLANING HULL	A type of hull shaped to glide easily across the water at high speed.
PORT	The left side of a boat looking forward. A harbor.
PROPELLER	A rotating device, with two or more blades, that acts as a screw in propelling a vessel.
Q	
QUARTER	The sides of a boat aft of amidships.
QUARTERING SEA	Sea coming on a boat's quarter.
R	
REEF	To reduce the sail area.
RIGGING	The general term for all the lines of a vessel.
RODE	The anchor line and/or chain.
ROLL	The alternating motion of a boat, leaning alternately to port and starboard; the motion of a boat about its fore-and-aft axis.
ROPE	In general, cordage as it is purchased at the store. When it comes aboard a vessel and is put to use, it becomes a line.
RUDDER	A vertical plate or board for steering a boat.
RUNNING LIGHTS	Lights required to be shown on boats underway between sundown and sunup.
S	
SCOPE	The ratio of the length of an anchor line, from a vessel's bow to the anchor, to the depth of the water.
SCREW	A boat's propeller.
SEA ANCHOR	Any device used to reduce a boat's drift before the wind.
SECURE	To make fast.
SHACKLE	A U-shaped connector with a pin or bolt across the open end.
SHEAR PIN	A safety device used to fasten a propeller to its shaft; it breaks when the propeller hits a solid object, thus preventing further damage.
SHEET BEND	A knot used to join two ropes. Functionally different from a square knot in that it can be used between lines of different diameters.
SHIP	A larger vessel usually used for ocean travel. A vessel able to carry a "boat" on board.
SHOAL	An offshore hazard to navigation at a depth of 16 fathoms (30 meters or 96 ft) or less, composed of unconsolidated material.
SLACK	Not fastened; loose. Also, to loosen.
SLOOP	A single masted vessel with working sails (main and jib) set fore and aft.
SPLICE	To permanently join two ropes by tucking their strands alternately over and under each other.
SPRING LINE	A pivot line used in docking, undocking, or to prevent the boat from moving forward or astern while made fast to a dock.

SQUALL	A sudden, violent wind often accompanied by rain.
SQUARE KNOT	A knot used to join two lines of similar size. Also called a reef knot.
STANDING PART	That part of a line which is made fast. The main part of a line as distinguished from the bight and the end.
STAND-ON VESSEL	That vessel which continues its course in the same direction at the same speed during a crossing or overtaking situation, unless a collision appears imminent (was formerly called "the privileged vessel").
STARBOARD	The right side of a boat when looking forward.
STERN	The after part (back) of the boat.
STERN LINE	A docking line leading away from the stern.
STOW	To pack or store away; especially, to pack in an orderly, compact manner.
SWAMP	To fill with water, but not settle to the bottom.
T	
TACKLE	A combination of blocks and line to increase mechanical advantage.
THWART	A seat or brace running laterally across a boat.
TIDE	The periodic rise and fall of water level in the oceans.
TILLER	A bar or handle for turning a boat's rudder or an outboard motor.
TOPSIDES	The sides of a vessel between the waterline and the deck; sometimes referring to onto or above the deck.
TRANSOM	The stern cross-section of a square-sterned boat.
TRIM	Fore and aft balance of a boat.
TRIMARAN	A boat with three hulls.
TRIPLINE	A line fast to the crown of an anchor by means of which it can be hauled out when dug too deeply or fouled; a similar line used on a sea anchor to bring it aboard.
TRUE NORTH POLE	The north end of the earth's axis. Also called North Geographic Pole. The direction indicated by 000° (or 360°) on the true compass rose.
TRUE WIND	The actual direction from which the wind is blowing.
TURNBUCKLE	A threaded, adjustable rigging fitting, used for stays, lifelines, and sometimes other rigging.
U	
UNDERWAY	Vessel in motion, i.e., when not moored, at anchor, or aground.
V	
V BOTTOM	A hull with the bottom section in the shape of a "V."
VARIATION	The angular difference between the magnetic meridian and the geographic meridian at a particular location.
VHF RADIO	A very high frequency electronic communications and direction finding system.
W	
WAKE	Moving waves, track, or path that a boat leaves behind when moving across the waters.
WATERLINE	A line painted on a hull which shows the point to which a boat sinks when it is properly trimmed.
WAY	Movement of a vessel through the water, such as headway, sternway, or leeway.
WHARF	A man-made structure bonding the edge of a dock and built along or at an angle to the shoreline, used for loading, unloading, or tying up vessels.
WINCH	A device used to increase hauling power when raising or trimming sails.
WINDWARD	Toward the direction from which the wind is coming. Opposite of leeward.

X	
There are no boating terms under this heading.	
Y	
YAW	To swing off course, as when due to the impact of a following or quartering sea.
YAWL	A two-masted sailboat with the small mizzen mast stepped abaft the rudder post.
Z	
There are no boating terms under this heading.	

Appendix B

“Rules of the Water”

APPENDIX B

"RULES OF THE WATER"

PART A – GENERAL

Rule 1—Application

(a) These Rules shall apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels.

(b) Nothing in these Rules shall interfere in the operation of special rules made by an appropriate authority for roadsteads, harbors, rivers, lakes, or inland waterways connected with the high seas and navigable by seagoing vessels. Such special rules shall conform as closely as possible to these Rules.

(c) Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any State with respect to additional station or signal lights or shapes or whistle signals for ships of war and vessels proceeding under convoy, or with respect to additional station or signal lights for fishing vessels fishing as a fleet. These additional station or signal lights or whistle signals shall, so far as possible, be such that they cannot be mistaken for any light, shape, or signal authorized elsewhere under these Rules.

(d) Traffic separation schemes may be adopted by the Organization for the purpose of these Rules.

(e) Whenever the Government concerned shall have determined that a vessel of special construction or purpose cannot comply fully with the provisions of any of these Rules with respect to number, position, range, or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signaling appliances, such vessel shall comply with such other provisions in regard to number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signaling appliances, as her Government shall have determined to be the closest possible compliance with these Rules in respect to that vessel.

Rule 2—Responsibility

(a) Nothing in these Rules shall exonerate any vessel, or the owner, master, or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(b) In construing and complying with these Rules, due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

Rule 3—General Definitions

For the purpose of these Rules, except where the context otherwise requires:

(a) The word "vessel" includes every description of watercraft, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.

(b) The term "power driven vessel" means any vessel propelled by machinery.

(c) The term "sailing vessel" means any vessel under sail provided that propelling machinery, if fitted, is not being used.

(d) The term "vessel engaged in fishing" means any vessel fishing with nets, lines, trawls, or other fishing apparatus which restrict maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manageability.

(e) The term "seaplane" includes any aircraft designed to maneuver on the water.

(f) The term "vessel not under command" means a vessel which through some exceptional circumstance is unable to maneuver as required by these Rules and is, therefore, unable to keep out of the way of another vessel.

(g) The term "vessel restricted in her ability to maneuver" means a vessel which from the nature of her work is restricted in her ability to maneuver as required by these Rules and is, therefore, unable to keep out of the way of another vessel. The term "vessel restricted in her ability to maneuver" shall include but not be limited to:

(i) A vessel engaged in laying, servicing, or picking up a navigational mark, submarine cable, or pipeline
(ii) A vessel engaged in dredging, surveying, or underwater operations
(iii) A vessel engaged in replenishment or transferring persons, provisions, or cargo while underway
(iv) A vessel engaged in the launching or recovery of aircraft
(v) A vessel engaged in mine clearance operations
(vi) A vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.

(h) The term "vessel constrained by her draft" means a power-driven vessel which because of her draft in relation to the available depth and width of navigable water is severely restricted in her ability to deviate from the course she is following.

(i) The word "underway" means a vessel is not at anchor, or made fast to the shore, or aground.

(j) The words "length" and "breadth" of a vessel mean her length overall and greatest breadth.

(k) Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other.

(l) The term "restricted visibility" means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms, and any other similar causes.

PART B – STEERING AND SAILING RULES

Section I – Conduct of Vessels in any Condition of Visibility

Rule 4—Application

Rules in this section apply to any condition of visibility.

Rule 5—Look-Out

Every vessel shall at all times maintain a proper look-out by sight as well as by hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

Rule 6—Safe Speed

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed, the following factors shall be among those taken into account:

(a) By all vessels:

(i) The state of visibility
(ii) The traffic density including concentrations of fishing vessels or any other vessels
(iii) The manageability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions
(iv) At night the presence of background light such as from shore lights or from back scatter from her own lights
(v) The state of wind, sea, and current, and the proximity of navigational hazards
(vi) The draft in relation to the available depth of water.

(b) Additionally, by vessels with operational radar:

(i) The characteristics, efficiency, and limitations of the radar equipment
(ii) Any constrains imposed by the radar range scale in use
(iii) The effect on radar detection of the sea state, weather, and other sources of interference
(iv) The possibility that small vessels, ice, and other floating objects may not be detected by radar at an adequate range
(v) The number location and movement of vessels detected by radar
(vi) The more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

Rule 7—Risk of Collision

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt, such risk shall be deemed to exist.

(b) Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

(c) Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

(d) In determining if risk of collision exists, the following considerations shall be among those taken into account:

(i) Such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change.
(ii) Such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

Rule 8—Action to Avoid Collision

(a) Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed shall be avoided.

(c) If there is sufficient sea room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.

(d) Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.

(e) If necessary to avoid collision or allow more time to assess the situation, a vessel may slacken her speed or take all the way off by stopping or reversing her means of propulsion.

(f) (i) A vessel which, by any of these rules, is required not to impede the passage or safe passage of another vessel shall, when required by the circumstances of the case, take early action to allow sufficient sea room for the safe passage of the other vessel.
(ii) A vessel required not to impede the passage or safe passage of another vessel is not relieved of this obligation if approaching the other vessel so as to involve risk of collision and shall, when taking action, have full regard to the action which may be required by the rules of this part.
(iii) A vessel, the passage of which is not to be impeded, remains fully obliged to comply with the rules of this part when the two vessels are approaching one another so as to involve risk of collision.

Rule 9—Narrow Channels

(a) A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.

(b) A vessel of less than 20 m in length or a sailing vessel shall not impede the passage of a vessel which can safely navigate only within a narrow channel or fairway.

(c) A vessel engaged in fishing shall not impede the passage of any other vessel navigating within a narrow passage or fairway.

(d) A vessel shall not cross a narrow passage or fairway if such crossing impedes the passage of a vessel which can safely navigate only within such channel or fairway. The latter vessel may use the sound signal prescribed in Rule 34(d) if in doubt as to the intention of the crossing vessel.

(e) (i) In a narrow channel or fairway when overtaking can take place only when the vessel to be overtaken has to take action to permit safe passing, the vessel intending to overtake shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c)(i). The vessel to be overtaken shall, if in agreement, sound the appropriate signal prescribed in Rule 34(c)(ii) and take steps to permit safe passing. If in doubt, she may sound the signals prescribed in Rule 34(d).
(ii) This rule does not relieve the overtaking vessel of her obligation under Rule 13.

(f) A vessel nearing a bend or an area of a narrow channel or fairway where other vessels may be obscured by an intervening obstruction shall navigate with particular alertness and caution and shall sound the appropriate signal prescribed in Rule 34(e).

(g) Any vessel shall, if the circumstances of the case admit, avoid anchoring in a narrow channel.

Rule 10—Traffic Separation Schemes

(a) This rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other rule.

(b) A vessel using a traffic separation scheme shall:

(i) Proceed in the appropriate traffic lane in the general direction of traffic flow for that lane.
(ii) So far as is practicable keep clear of a traffic separation line or separation zone.
(iii) Normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.

(c) A vessel shall so far as practicable avoid crossing traffic lanes, but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.

(d) (i) A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 m in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.
(ii) Notwithstanding subparagraph (d)(i), a vessel may use an inshore traffic Zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.

(e) A vessel, other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:

(i) in cases of emergency to avoid immediate danger
(ii) to engage in fishing within a separation zone.

(f) A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.

(g) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near its terminations.

(h) A vessel not using a traffic separating scheme shall avoid it by as wide a margin as is practicable.

(i) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

(j) A vessel of less than 20 m in length or a sailing vessel shall not impede the safe passage of a power driven vessel following a traffic lane.

(k) A vessel restricted in her ability to maneuver when engaged in an operation for the maintenance of safety of navigation in a traffic separating scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.

(l) A vessel restricted in her ability to maneuver when engaged in an operation for the laying, servicing or picking up a submarine cable, within a traffic separating scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Section II – Conduct of Vessels in Sight of One Another

Rule 11—Application

Rules in this section apply to vessels in sight of one another.

Rule 12—Sailing Vessels

(a) When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

  (i) When each of them has the wind on a different side, the vessel which has the wind on the port side shall keep out of the way of the other
  (ii) When both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward
  (iii) If the vessel with the wind on the port side sees a vessel to windward and cannot determine with certainty whether the other vessel has the wind on the port or the starboard side, she shall keep out of the way of the other.

(b) For the purposes of this Rule the windward side shall be deemed to be the side opposite that on which the mainsail is carried or, in the case of a square rigged vessel, the side opposite to that on which the largest fore-and-aft sail is carried.

Rule 13—Overtaking

(a) Notwithstanding anything contained in the Rules of Part B, Sections I and II, any vessel overtaking any other shall keep out of the way of the vessel being overtaken.

(b) A vessel shall be deemed to be overtaking when coming up with a another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights.

(c) When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.

(d) Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel within the meaning of these Rules or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

Rule 14—Head-On Situation

(a) When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision, each shall alter her course to starboard so that each shall pass on the port side of the other.

(b) Such a situation shall be deemed to exist when a vessel sees the other ahead or nearly ahead and by night she could see the masthead lights in line or nearly in line and/or both sidelights and by day she observes the corresponding aspect of the other vessel.

(c) When a vessel is in any doubt as to whether such a situation exists, she shall assume that it does exist and act accordingly.

Rule 15—Crossing Situation

When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Rule 16—Action by Give-way Vessel

Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

Rule 17—Action by Stand-on Vessel

(a) (i) Where one of two vessels is to keep out of the way of the other shall keep her course and speed.
(ii) The latter vessel may, however, take action to avoid collision by her maneuver alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in accordance with these Rules.

(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

(c) A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.

(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

Rule 18—Responsibilities between Vessels

Except where Rules 9, 10, and 13 otherwise require:

(a) A power driven vessel underway shall keep out of the way of:

(i) a vessel not under command
(ii) a vessel restricted in her ability to maneuver
(iii) a vessel engaged in fishing
(iv) a sailing vessel

(b) A sailing vessel under way shall keep out of the way of:

(i) a vessel not under command
(ii) a vessel restricted in her ability to maneuver
(iii) a vessel engaged in fishing

(c) A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of:

(i) a vessel not under command
(ii) a vessel restricted in her ability to maneuver.

(d) (i) Any vessel other than a vessel not under command or a vessel restricted in her ability to maneuver shall, if the circumstances of the case admit, avoid impeding the safe passage of a vessel constrained by her draft, exhibiting the signals in Rule 28.
(ii) A vessel constrained by her draft shall navigate with particular caution having full regard to her special condition.

(e) A seaplane on the water shall, in general, keep well clear of all vessels and avoid impeding their navigation. In circumstances, however, where risk of collision exists, she shall comply with the Rules of this Part.

Section III – Conduct of Vessels in Restricted Visibility

Rule 19—Conduct of Vessels in Restricted Visibility

(a) This rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and condition of restricted visibility. A power-driven vessel shall have her engines ready for immediate maneuver.

(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of Section I of this Part.

(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration in course, so far as possible the following shall be avoided:

(i) An alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken
(ii) An alteration of course toward a vessel abeam or abaft the beam.

(e) Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to be the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

PART C – LIGHTS AND SHAPES

Rule 20—Application

(a) Rules in this part shall be complied with in all weathers.

(b) The Rules concerning lights shall be complied with from sunset to sunrise, and during such times no other lights shall be exhibited, except such lights which cannot be mistaken for the lights specified in these Rules or do not impair their visibility or distinctive character, or interfere with the keeping of a proper look-out.

(c) The lights prescribed by these rules shall, if carried, also be exhibited from sunrise to sunset in restricted visibility and may be exhibited in all other circumstances when it is deemed necessary.

(d) The Rules concerning shapes shall be complied with by day.

(e) The lights and shapes specified in these Rules shall comply with the provisions of Annex I to these Regulations.

Rule 21—Definitions

(a) "Masthead light" means a white light placed over the fore and aft centerline of the vessel showing an unbroken light over an arc of horizon of 225 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the vessel.

(b) "Sidelights" means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of horizon of 112.5 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on the respective side. In a vessel of less than 20 m in length the sidelights may be combined in one lantern carried on the fore and aft centerline of the vessel.

(c) "Stern light," means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of horizon of 135 degrees and so fixed as to show the light 67.5 degrees from right aft on each side of the vessel.

(d) "Towing light" means a yellow light having the same characteristics as the "stern light" defined in paragraph (c) of this Rule.

(e) "All round light" means a light showing an unbroken light over an arc of horizon of 360 degrees.

(f) "Flashing light" means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.

Rule 22—Visibility of Lights

The lights prescribed in these Rules shall have an intensity as specified in Section 8 of Annex I to these Regulations so as to be visible at the following minimum ranges:

(a) In vessels of 50 m or more in length:
- A masthead light, 6 mi
- A sidelight, 3 mi
- A towing light, 3 mi
- A white, red, green, or yellow all-around light, 3 mi.

(b) In vessels of 12 m or more in length but less than 50 m in length
- A masthead light, 5 mi; except that where the length of the vessel is less than 20 m, 3 mi
- A sidelight, 2 mi
- A stern light, 2 mi, A towing light, 2 mi
- A white, red, green or yellow all-round light, 2 mi.

(c) In vessels of less than 12 m in length:
- A masthead light, 2 mi
- A sidelight, 1 mi
- A towing light, 2 mi
- A white, red, green, or yellow all-around light, 2 mi.

(d) In inconspicuous, partly submerged vessels or objects being towed
- A white all-round light; 3 mi.

Rule 23—Power-Driven Vessels Underway

(a) A power-driven vessel underway shall exhibit:

(i) A masthead light forward
(ii) A second masthead light abaft of and higher than the forward one; except that a vessel of less than 50 m in length shall not be obliged to exhibit such a light but may do so;
(iii) Sidelights
(iv) A stern light.

(b) An air-cushion vessel when operating in non-displacement mode shall, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit an all-round flashing yellow light.

(c) (i) A power-driven vessel of less than 12 m in length may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and sidelights.
(ii) A power-driven vessel of less than 7 m in length whose maximum speed does not exceed 7 knots may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and shall, if practicable, also exhibit sidelights.

(iii) The masthead light or all-round white light on a power-driven vessel of less than 12 m in length may be displaced from the fore and aft centerline of the vessel if centerline fitting is not practicable, provided the sidelights are combined in one lantern which shall be carried on the fore and aft centerline of the vessel or located as nearly as practicable in the same fore and aft line as the masthead light or all-round white light.

Rule 24—Towing and Pushing

(a) A power driven vessel when towing shall exhibit:

(i) Instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line. When the length of the tow measuring from the stern of the towing vessel to the after end of the tow exceeds 200 m, three such lights in a vertical line
(ii) Sidelights
(iii) A stern light
(iv) A towing light in a vertical line above the stern light
(v) When the length of the tow exceeds 200 m, a diamond shape where it can best be seen.

(b) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and exhibit the lights prescribed in Rule 23.

(c) A power-driven vessel when pushing ahead or towing alongside, except in the case of a composite unit, shall exhibit:

(i) Instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line. When the length of the tow measuring from the stern of the towing vessel to the after end of the tow exceeds 200 m, three such lights in a vertical line
(ii) Sidelights
(iii) A stern light.

(d) A power-driven vessel to which paragraph (a) or (c) of this Rule apply shall also comply with rule 23(a)(ii).

(e) A vessel or object being towed, other than those mentioned in paragraph (g) of this Rule, shall exhibit:

(i) Sidelights
(ii) A stern light
(iii) When the length of the tow exceeds 200 m, a diamond shape where it can best be seen.

(f) Provided that any number of vessels being towed alongside or pushed in a group shall be lighted as one vessel,

(i) A vessel being pushed ahead, not being part of a composite unit, shall exhibit at the forward end, sidelights
(ii) A vessel being towed alongside shall exhibit a stern light and at the forward end, sidelights.

(g) An inconspicuous, partly submerged vessel or object, or combination of such vessels or objects being towed, shall exhibit:

(i) If it is less than 25 m in breadth, one all-round white light at or near the front end and one at or near the after end except that dracones need not exhibit a light at or near the forward end
(ii) If it is 25 m or more in breadth, two or more additional all-round white lights at or near the extremities of its breadth
(iii) If it exceeds 100 m in length, additional all-round white lights between the lights prescribed in subparagraphs (i) and (ii) so that the distance between the lights shall not exceed 100 m.
(iv) A diamond shape at or near the aftermost extremity of the last vessel or object being towed and if the length of the tow exceeds 200 m an additional diamond shape where it can best be seen and located as far forward as is practicable.

(h) When from any sufficient cause it is impracticable for a vessel or object being towed to exhibit the lights or shapes prescribed in paragraph (e) or (g) of this Rule, all possible measures shall be taken to light the vessel or object being towed or at least indicate the presence of such vessel or object.

(i) Where from any sufficient cause it is impracticable for a vessel not normally engaged in towing operations to display the lights prescribed in paragraph (a) or (c) of this Rule, such vessel shall not be required to exhibit those lights when engaged in towing another vessel in distress or otherwise in need of assistance. All possible measures shall be taken to indicate the nature of the relationship between the towing vessel and the vessel being towed as authorized by Rule 36, in particular by illuminating the towline.

Rule 25—Sailing Vessels Underway and Vessels Under Oars

(a) A sailing vessel underway shall exhibit:

(i) Sidelights
(ii) A stern light.

(b) In a sailing vessel of less than 20 m in length the lights prescribed in paragraph (a) of this Rule may be combined in one lantern carried at or near the top of the mast where it can best be seen.

(c) A sailing vessel underway may, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit at or near the top of the mast, where they can best be seen, two all-round lights in a vertical line, the upper being red and the lower Green, but these lights shall not be exhibited in conjunction with the combined lantern permitted by paragraph (b) of this Rule.

(d) (i) A sailing vessel of less than 7 m in length shall, if practicable, exhibit the lights prescribed in paragraph (a) or (b) of this Rule, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.
(ii) A vessel under oars may exhibit the lights prescribed in this rule for sailing vessels, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.

(e) A vessel proceeding under sail when also being propelled by machinery shall exhibit forward where it can best be seen a conical shape, apex downwards.

Rule 26—Fishing Vessels

(a) A vessel engaged in fishing, whether underway or at anchor, shall exhibit only the lights and shapes prescribed by this rule.

(b) A vessel when engaged in trawling, by which is meant the dragging through the water of a dredge net or other apparatus used as a fishing appliance, shall exhibit

(i) Two all-round lights in a vertical line, the upper being green and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel of less than 20 m in length may instead of this shape exhibit a basket
(ii) A masthead light abaft of and higher than the all-round green light; a vessel of less than 50 m in length shall not be obliged to exhibit such a light but may do so
(iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(c) A vessel engaged in fishing, other than trawling, shall exhibit:

(i) Two all-round lights in a vertical line, the upper being red and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel of less than 20 m in length may instead of this shape exhibit a basket
(ii) When there is outlying gear extending more than 150 m horizontally from the vessel, an all-round white light or a cone apex upwards in the direction of the gear
(iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(d) A vessel engaged in fishing in close proximity to other vessels engaged in fishing may exhibit the additional signals described in Annex II to these Regulations.

(e) A vessel when not engaged in fishing shall not exhibit the lights or shapes prescribed in this Rule, but only those prescribed for a vessel of her length.

Rule 27—Vessels Not Under Command or Restricted in Their Ability to Maneuver

(a) A vessel not under command shall exhibit:

(i) Two all-round red lights in a vertical line where they can best be seen
(ii) Two balls or similar shapes in a vertical line where they can best be seen
(iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(b) A vessel restricted in her ability to maneuver, except a vessel engaged in mine clearance operations, shall exhibit:

(i) Three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white
(ii) Three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes shall be balls and the middle one a diamond.
(iii) When making way through the water, a masthead light, sidelights and a stern light in addition to the lights prescribed in subparagraph (i)

(iv) When at anchor, in addition to the lights or shapes prescribed in subparagraphs(i) and (ii), the light, lights, or shape prescribed in Rule 30.

(c) A power-driven vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course shall, in addition to the lights or shapes prescribed in Rule 24(a), exhibit the lights or shapes prescribed in subparagraph (b)(i) and (ii) of this Rule.

(d) A vessel engaged in dredging or underwater operations, when restricted in her ability to maneuver, shall exhibit the lights and shapes prescribed in subparagraphs (b)(i),(ii) and (iii) of this Rule and shall in addition when an obstruction exists, exhibit:

(i) Two all-round red lights or two balls in a vertical line to indicate the side on which the obstruction exists
(ii) Two all-round green lights or two diamonds in a vertical line to indicate the side on which another vessel may pass
(iii) When at anchor, the lights or shapes prescribed in this paragraph instead of the lights or shapes prescribed in Rule 30.

(e) Whenever the size of a vessel engaged in diving operations makes it impracticable to exhibit all lights and shapes prescribed in paragraph (d) of this Rule, the following shall be exhibited:

(i) Three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white
(ii) a rigid replica of the code flag "A" not less than 1 m in height. Measures shall be taken to ensure its all-round visibility.

(f) A vessel engaged in mine clearance operations shall in addition to the lights prescribed for a power-driven vessel in Rule 23 or to the light or shape prescribed for a vessel at anchor in Rule 30 as appropriate, exhibit three all-round green lights or three balls. One of these lights or shapes shall be exhibited near the foremast head and one at each end of the fore yard. These lights or shapes indicate that it is dangerous for another vessel to approach within 1,000 m of the mine clearance vessel.

(g) Vessels of less than 12 m in length, except those engaged in diving operations, shall not be required to exhibit the lights prescribed in this Rule.

(h) The signals prescribed in this Rule are not signals of vessels in distress and requiring assistance. Such signals are contained in Annex IV to these Regulations.

Rule 28—Vessels Constrained by their Draft

A vessel constrained by her draft may, in addition to the lights prescribed for power-driven vessels in Rule 23, exhibit where they can best be seen three all-round red lights in a vertical line, or a cylinder.

Rule 29—Pilot Vessels

(a) A vessel engaged on pilotage duty shall exhibit:

(i) At or near the masthead, two all-round lights in a vertical line, the upper being white and the lower red
(ii) When underway, in addition, sidelights and a stern light

(iii) When at anchor, in addition to the lights prescribed in subparagraph (i), the light, lights, or shape prescribed in Rule 30 for vessels at anchor.

(b) A pilot vessel when not engaged on pilotage duty shall exhibit the lights or shapes prescribed for a similar vessel of her length.

Rule 30—Anchored Vessels and Vessels Aground

(a) A vessel at anchor shall exhibit where it can best be seen:

(i) In the fore part, an all-round white light or one ball
(ii) At or near the stern and at a lower level than the light prescribed in subparagraph (i), an all-round white light.

(b) A vessel of less than 50 m in length may exhibit an all-round white light where it can best be seen instead of the lights prescribed in paragraph (a) of this Rule.

(c) A vessel at anchor may, and a vessel of 100 m and more in length shall, also use the available working or equivalent lights to illuminate her decks.

(d) A vessel aground shall exhibit the lights prescribed in paragraph (a) or (b) of this Rule and in addition, where they can best be seen

(i) Two all-round red lights in a vertical line
(ii) Three balls in a vertical line.

(e) A vessel of less than 7 m in length, when at anchor not in or near a narrow channel, fairway or where other vessels normally navigate, shall not be required to exhibit the shape prescribed in paragraphs (a) and (b) of this Rule.

(f) A vessel of less than 12 m in length, when aground, shall not be required to exhibit the lights or shapes prescribed in subparagraphs (d)(i) and (ii) of this Rule.

Rule 31—Seaplanes

Where it is impracticable for a seaplane to exhibit lights or shapes of the characteristics or in the positions prescribed in the Rules of this Part she shall exhibit lights and shapes as closely similar in characteristics and position as is possible.

PART D – SOUND AND LIGHT SIGNALS

Rule 32—Definitions

(a) The word "whistle" means any sound signaling appliance capable of producing the prescribed blasts and which complies with the specifications in Annex III to these Regulations.

(b) The term "short blast" means a blast of about one second's duration.

(c) The term "prolonged blast" means a blast from four to six seconds' duration.

Rule 33—Equipment for Sound Signals

(a) A vessel of 12 m or more in length shall be provided with a whistle and a bell and a vessel of 100 m or more in length shall, in addition be provided with a gong, the tone and sound of which cannot be confused with that of the bell. The whistle, bell and gong shall comply with the specifications in Annex III to these Regulations. The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the prescribed signals shall always be possible.

(b) A vessel of less than 12 m in length shall not be obliged to carry the sound signaling appliances prescribed in paragraph (a) of this Rule but if she does not, she shall be provided with some other means of making an efficient signal.

Rule 34—Maneuvering and Warning Signals

(a) When vessels are in sight of one another, a power-driven vessel under way, when maneuvering as authorized or required by these Rules, shall indicate that maneuver by the following signals on her whistle:

- One short blast to mean "I am altering my course to starboard"
- Two short blasts to mean "I am altering my course to port"
- Three short blasts to mean "I am operating astern propulsion."

(b) Any vessel may supplement the whistle signals prescribed in paragraph (a) of this Rule by light signals, repeated as appropriate, whilst the maneuver is being carried out:

(i) These signals shall have the following significance:
- One flash to mean "I am altering my course to starboard"
- Two flashes to mean "I am altering my course to port"
- Three flashes to mean "I am operating astern propulsion."

(ii) The duration of each flash shall be about one second, the interval between flashes shall be about 1 second, and the interval between successive signals shall not be less than 10 seconds.

(iii) The light used for this signal shall, if fitted, be an all-round white light, visible at a minimum range of 5 mi, and shall comply with the provisions of Annex I to these Regulations.

(c) When in sight of one another in a narrow channel or fairway:

(i) A vessel intending to overtake another shall in compliance with Rule 9 (e)(i) indicate her intention by the following signals on her whistle.
- Two prolonged blasts followed by one short blast to mean "I intend to overtake you on your starboard side"
- Two prolonged blasts followed by two short blasts to mean "I intend to overtake you on your port side"

(ii) The vessel about to be overtaken when acting in accordance with 9(e)(i) shall indicate her agreement by the following signal on her whistle:
- One prolonged, one short, one prolonged and one short blast, in that order.

(d) When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle. Such signal may be supplemented by at least five short and rapid flashes.

(e) A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel that may be within hearing around the bend or behind the intervening obstruction.

(f) If whistles are fitted on a vessel at a distance apart of more than 100 m, one whistle only shall be used for giving maneuvering and warning signals.

Rule 35—Sound Signals in Restricted Visibility

In or near an area of restricted visibility, whether by day or night the signals prescribed in this Rule shall be used as follows:

(a) A power-driven vessel making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast.

(b) A power-driven vessel underway but stopped and making no way through the water shall sound at intervals of no more than 2 minutes two prolonged blasts in succession with an interval of about 2 seconds between them.

(c) A vessel not under command, a vessel restricted in her ability to maneuver, a vessel constrained by her draft, a sailing vessel, a vessel engaged in fishing and a vessel engaged in towing or pushing another vessel shall, instead of the signals prescribed in paragraph (a) or (b) of this Rule, sound at intervals of not more than 2 minutes three blasts in succession, namely one prolonged followed by two short blasts.

(d) A vessel engaged in fishing, when at anchor, and a vessel restricted in her ability to maneuver when carrying out her work at anchor, shall instead of the signals prescribed in paragraph (g) of this Rule sound the signal prescribed in paragraph (c) of this Rule.

(e) A vessel towed or if more than one vessel is being towed the last vessel of the tow, if manned, shall at intervals of not more than 2 minutes sound four blasts in succession, namely one prolonged followed by three short blasts. When practicable, this signal shall be made immediately after the signal made by the towing vessel.

(f) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and shall give the signals prescribed in paragraphs (a) or (b) of this Rule.

(g) A vessel at anchor shall at intervals of not more than 1 minute ring the bell rapidly for ten seconds. In a vessel 100 m or more in length the bell shall be sounded in the forepart of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about 5 seconds in the after part of the vessel. A vessel at anchor may in addition sound three blasts in succession, namely

one short, one long and one short blast, to give warning of her position and of the possibility of collision to an approaching vessel.

(h) A vessel aground shall give the bell signal and if required the gong signal prescribed in paragraph (g) of this Rule and shall, in addition, give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell. A vessel aground may in addition sound an appropriate whistle signal.

(i) A vessel of less than 12 m in length shall not be obliged to give the above mentioned signals but, if she does not, shall make some other efficient sound signal at intervals of not more than 2 minutes.

(j) A pilotage vessel when engaged on pilotage duty may in addition to the signals prescribed in paragraph (a), (b) or (g) of this Rule sound an identity signal consisting of four short blasts.

Rule 36—Signals to Attract Attention

If necessary to attract the attention of another vessel, any vessel may make light or sound signals that cannot be mistaken for any signal authorized elsewhere in these Rules, or may direct the beam of her searchlight in the direction of the danger, in such a way as not to embarrass any vessel Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation. For the purpose of this Rule the use of high intensity intermittent or revolving lights, such as strobe lights, shall be avoided.

Rule 37—Distress Signals

When a vessel is in distress and requires assistance she shall use or exhibit the signals described in Annex IV to these Regulations.

PART E – EXEMPTIONS

Rule 38—Exemptions

Any vessel (or class of vessel) provided that she complies with the requirements of the International Regulations for the Preventing of Collisions at Sea, 1960, the keel of which is laid or is at a corresponding stage of construction before the entry into force of these Regulations may be exempted from compliance therewith as follows:

(a) The installation of lights with ranges prescribed in Rule 22, until 4 years after the date of entry into force of these regulations.

(b) The installation of lights with color specifications as prescribed in Section 7 of Annex I to these Regulations, until 4 years after the entry into force of these Regulations.

(c) The repositioning of lights as a result of conversion from Imperial to metric units and rounding off measurement figures, permanent exemption.

(d) (i) The repositioning of masthead lights on vessels of less than 150 m in length, resulting from the prescriptions of Section 3 (a) of Annex I to these regulations, permanent exemption.

(ii) The repositioning of masthead lights on vessels of 150 m or more in length, resulting from the prescriptions of Section 3 (a) of Annex I to these regulations, until 9 years after the date of entry into force of these Regulations.

(e) The repositioning of masthead lights resulting from the prescriptions of Section 2(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(f) The repositioning of sidelights resulting from the prescriptions of Section 2(g) and 3(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(g) The requirements for sound signal appliances prescribed in Annex II to these Regulations, until 9 years after the date of entry into force of these Regulations.

(h) The repositioning of all-round lights resulting from the prescription of Section 9(b) of Annex I to these Regulations, permanent exemption.

Appendix C

Electrofishing Field Manual

C.1 Checklist for Electrofishing Safety and Health Audit

ELECTROFISHING

FIELD MANUAL

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May 1994

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EA Engineering, Science and Technology
Environmental Assessment and Management
Electrofishing Health and Safety Audit Checklist

Date:
Site name:
Crew:
Boat used:
Generator used:
Motor used:

	Yes	No
Safety Equipment		
Life preservers on-board for each individual?		
Leak-free electrical insulating gloves and boots available for each individual?		
Note: gloves and boots should extend above the knees and elbows.		
Radio available for emergency contacts?		
Radio properly charged?		
First aid kit in boat?		
Burn Jel bandages available in first aid kit?		
Personnel trainned in first aid/CPR		
Fire extinguisher in boat? (type ABC 5lbs)		
Emergency air horn on-board?		
Funnel available for adding gasoline to generator or pump?		
Note: gasoline should not be added to a hot motor.		
Polarized sun glasses		
Boat Safety		
Lights available and working for nightime fishing?		
Boat equipped with an anchor?		
Boat in good repair free from sharp edges and weak or broken areas?		
Fuel tanks positioned a safe distance from the generator and battery?		
Note: gasoline vapors cannot be allowed to contact hot surfaces or sparks.		
Fuel tanks properly capped and lines leak-free?		
Generator/Pump shut-off switch available to eliminate grounding the spark plug?		
Generator/Pump muffler facing outside the boat and shielded to prevent		
contact in rough seas?		
Foot pedal "dead man" switch controlling the flow of electricity in place in bow of boat?		
Note: device must be operationable for netter(s) to control.		
If no netter foot pedal exists, is there another means of emergency generator shut off?		
Probes used to extend the electrodes to the water made of non-conducting material?		
All electrical connections weather-proof and water tight?		
All electrical conducting surfaces connected to create one circuit on board?		
Note: Separate circuits create "floating metal" which can cause electrocution.		
All surfaces checked with an Ohm meter prior to launching the boat?		
Trailer		
Trailer frame free of significant rust and structurally sound?		
Hitch on trailer solid and working properly with locking hasp?		
Two safety chains present that can be properly connected to the towing vehicle hitch?		
Trailer stand secured properly and can be locked in the vertical and horizontal position?		
Trailer stand and winch handles present and working properly?		
Safety chains present to secure boat to trailer during transportation? (Other than the winch)		
Winch secure and in good working order?		
Winch cable or rope free of broken strands?		

Winch hook a locking type?		
Trailer tires in good shape with adequate tread?		
Trailer wheel bearings been greased (if not sealed)?		
Lights on trailer working properly (brake and turning indicator)?		
Trailer brakes working properly?		
Motor		
Motor bolted to boat with four bolts?		
Motor equipped with proper handles?		
Can the motor be properly locked in the "up" or travel position?		
Emergency motor shut-off connected to operator in case operator falls from boat?		
Post Fishing Checklist		
Generator shut off during rain?		
Boat operated free of sudden turns or changes in direction?		
Comments and items needed for next trip:		
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1. INTRODUCTION

This field manual was compiled with available documents which describes basic concepts, proper setup, use, safety, and trouble shooting. The information in this document should reduce the field problems resulting from improper use of our electrofishing equipment. Also, by using proper troubleshooting techniques, it will be possible to make many needed repairs in the field thus salvaging field efforts. The information should also increase understanding of how the systems work and how to properly operate them to increase their effectiveness and reduce unnecessary harm to fish.

Several pages summarize information of EA's available electrofishing equipment based on personal experience and available manufacturers guides. After reviewing these documents, personnel with basic mechanical and electrical skills should be able to properly hook-up, operate and trouble shoot the equipment. If, however for any reason an employee feels uncomfortable with the tasks required, they should not proceed. Safety is always EA's main concern. Electrofishing equipment is **DEADLY** if not handled properly. Do not place yourself in any situation you feel Hazardous. Employees should ask for assistance with any tasks they are hesitant about performing on their own.

2. BASIC CONCEPTS

Electrofishing is in many cases the most effective means of collecting fish for scientific purposes. Electrical current is placed in the water to immobilize fish allowing them to be collected with dip-nets. It involves the use of either AC (alternating current) or DC (direct current) to immobilize fish for capture. These two types of current have very different effects on fish. The choice of which current to use depends on the type of study being performed and the importance of returning healthy fish to the water.

AC And DC Current

AC current typically has the most violent effect on fish. Once in the electrical field a fish will immediately "take a posture transverse to the current in such a way as to receive a minimum of voltage" (Coffelt Electronics). This action is called **oscillotaxis.** Fish will be immobilized quickly and the effect will last longer than that of DC current. Great care must be taken in the collection of fish in this manner. If AC current is applied for too long of a period, the fish may not recover. Another drawback to this type of collection is that since fish usually become immobilized almost immediately when hit by the current, some may be missed because they are shocked while several feet below the surface and out of sight.

DC current will in most cases be the preferred method of collection. Fish react in three ways to DC current. First they line up with the direction of the electrical current, then swim toward the anode (positive electrode). This reaction is called **galvanotaxis.** Finally when fish near the anode they are stunned, roll belly up, and collection becomes possible. The effects of DC current do not last as long as of AC current. When the power is turned off the fish recover quickly. Mortality is far more limited than with the use of AC. This along with the fact that fish actually swim to the anode makes DC current the more effective means of electrofishing.

Control Box

AC or DC current can be selected with electrofishing **control boxes.** In addition to controlling the type of current, a control box allows adjustments to how the current acts. Most equipment will allow you select for standard or pulsed output and to vary the pulse width and frequency of pulses which allows for more efficient collections and limits the risk and stress to fish.

Pulsed output means that the electrical current going from the system into the water comes in pulses or waves. When the pulse rate is low and the width of the field is narrow, less current is required to collect fish. This results in less stress to fish. Since conductivity of water (the ease with which an electrical charge to passes through it) varies it is necessary to have the ability to adjust the pulse rate and width for optimum collection with minimum

harm to the fish being collected. EA uses a simple rule of thumb to determine what setting is adequate. Adjustments should be made until the unit output reads **5-6 amps**. Less than 5 is probably below the optimum collection output. More than six is probably inflicting too much damage to fish.

The control box also allows selection of voltage output. This selector should be positioned at the lowest possible setting that allows 5-6 amps to be obtained by adjusting the pulse width and rate.

Types of Equipment

There are several types of electrofishing equipment available. EA typically uses boat, backpack, or pram type units. These units differ in the type of power source used and in their application.

Boat electrofishing is utilized where water depths and characteristics make maneuvering the boat possible. EA primarily uses this type of electroshocking in reservoirs and in navigable rivers. Boat electrofishing usually involves the use of a generator as an electrical power source. The generator sends electricity through a control box which allows the operator to adjust the type of electrical current being placed in the water.

Both pram and back-pack electrofishing are designed for use in areas where boat electrofishing may not be possible or practical. Backpack units consist of a power source (a small generator or battery) and a control box mounted on a backpack frame. Two hand held electrodes (anode and cathode) are utilized by the operator to place electrical current in the water. The user is protected from the current by rubber waders and electrical gloves.

Pram shocking involves the use of a power source and electroshocking unit either placed on the bank or in a barge or small boat. Like backpack electrofishing the operator utilizes two hand held electrodes to place current in the water. The methods differ in that the operator is not required to carry the power source. Cables with up to 50 ft of wire allow mobility over a large section of water.

In all types of electrofishing, current is passed through the water between a positive electrode **(anode)** and a negative electrode **(cathode).** EA typically uses a boom mounted anode and the boat hull as a cathode when boat electrofishing. You may however, see different arrangements. In back-pack electrofishing both the anode and cathode are the hand-held probes. In pram shocking, the cathode may be the hull of either the barge or boat carrying the equipment or a cable from a bank-mounted power source. Pram shocking may also be performed with the anode and cathode hand-held as in back-pack electrofishing.

Conductivity

Electrofishing works by passing electrical current through a fishes body causing the effects described above. Several factors effect the amount of current passing through the fishes body and thus the effectiveness of electrofishing. If the conductivity of the fishes body is equal to or slightly above the conductivity of the surrounding water, the electricity will choose the path of least resistance and pass through the fish. The greater the conductivity of the fishes body in relation to the surrounding water, the greater the effect of the electricity on the fish. The conductivity of fish flesh differs among species. When shocking you may observe catfish floating up as far as 50 ft from the boat. At the same time scaled fish may not succumb to the current until they actually pass within a few feet of the anode. Also larger fish tend to receive a larger charge electricity than do smaller fish.

Another factor that influences the effectiveness of electroshocking is the conductivity of the water. Pure distilled water will actually act as an insulator in an electrical current. This is because there are few electrolytes or dissolved solids to conduct the electricity. It would take a great deal of current to pass through this type of water. Conversely the water of a typical lake or river in the South may be very high in dissolved solids. This water will readily conduct very low amounts of current. In all cases the conductivity of the water must be equal to or below the conductivity of the fishes body for electrofishing to be effective. It is not effective to shock in salt water because it is an electrolyte solution. The conductivity of the water is so much higher than that of the fish in it that an electrical current will find that the path of least resistance is actually around the fish rather than through it.

Conductivity of the water being surveyed should always be checked before attempting electrofishing. If it is very low or extremely high, a different type of collection should be considered. When backpack or pram shocking small streams it may actually be possible to increase the conductivity of the water by placing a block of salt upstream of the study area several hours before beginning your survey. This however should only be considered in very controlled conditions.

Equipment Operation

A typical boat shocking survey would be made up of two or three team members. The team leader or an experienced technician will operate the boat and shocking system while the other crew member(s) will stand at a bow mounted railing and collect fish with properly insulated dip nets. Either the operator or the netter will operate a foot switch which will immediately cut the power output if released. This is a very important safety feature and no electroshocking boat should be operated without safety switch.

Backpack and pram shocking are slightly more hazardous than boat shocking because of the users position in the water with the electrical charge. Field training sessions should be completed with an experienced backpack or pram operator before attempting this technique. Basically the system is a miniaturized version of the boat system. At least two operators are required. One person monitors equipment while the other handles the electrodes. One of the

electrodes has a dip-net attached to the end. The operator wades through the water holding the electrodes 2-3 feet apart. Thumb switches on the handles of the probes serve the same function as the foot switch on the boat. When a fish is shocked the operator dips it up with the net, releases (turns off) the switches on the handle and places it in a bucket carried by the second crew member. When pram shocking special attention should be paid by all crew members to the size of the electrical field. If the cathode is mounted on a barge, boat, or bank the electrical field will reach from that point to the anode held by the operator. When backpack shocking this field is concentrated only around the two probes.

3. SAFETY RULES

Safety is a matter that should be foremost on all crew members minds when conducting electrofishing operations. The amount of current in the water may at times be in excess of 600 volts. The amount of amperage generated during typical shocking operations averages 6 amps. This is enough to **Kill** you if you come in direct skin contact with an electrical source such as a cathode, anode, or improperly grounded boat or generator. This hazard is compounded by the fact that the boat and other equipment may be wet.

Always follow the manufacturers instructions when installing or operating electrical equipment. Applicable manuals have been included in this binder. It is each crew members responsibility to familiarize themselves with this information. Furthermore it is the responsibility of each crew member to assure that others are following proper procedure. If you are asked to do something that you feel is improper or unsafe, you have the authority to refuse. Don't depend on someone else to look out for you. Look out for yourself. Read through these manuals so that you have a understanding of what is safe and what is not.

Despite all of this, electroshocking surveys can be conducted in a safe manner. All that is required is proper attention to detail and the use of the safety equipment provided to you.

Here are some common sense rules that **Must** be followed by all crew members at all times:

1. Read the available literature; know what you are doing.
2. Take first aid and CPR. Know how to use it and when.
3. Stay alert! Watch out for the other guy.
4. Always wear PFD.
5. Correctly hook up equipment, check for hazards.
6. If wading is involved, be sure waders are in good shape. **No Leaks!**
7. Wear electrical gloves when operating electroshocking equipment.
8. Never touch a loose wire or make an adjustment while unit is in operation.
9. Always use safety switchs.
10. Never over extend yourself when netting fish.
11. Warn observers of danger.
12. Know proper boating safety
13. Communicate hazards to boat operator. The operator has a limited view in front of the boat because of the position of the netters. Don't assume he/she sees what you see. If noise level restricts normal conversation, establish hand signals.
14. Never place your hand in the water.
15. If gloves become wet inside, turn off equipment and dry them.
16. Keep boat deck as dry and clear of obstacles as possible.
17. Look up from the water from time to time to assure that overhanging branches or other items don't pose a risk.

18. Take breaks, fatigue leads to accidents.
19. No Horseplay.
20. If you have a question, Ask...

See the following pages for safety information extracted primarily from Coffelt's manuals.

Some shocking facts about...

Coffelt Electronics

LEADERS IN ELECTROFISHING EQUIPMENT

FACTS AND SAFETY TIPS ON ELECTROFISHING

EMERGENCY MEASURES

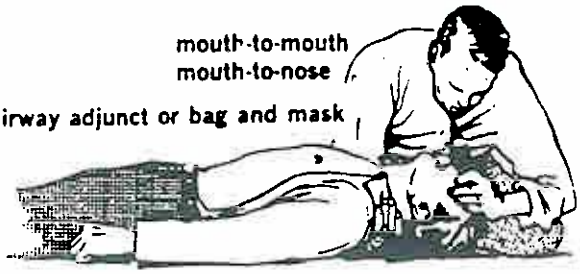
Heart-Lung Resuscitation

IF UNCONSCIOUS

Airway - Open by tilting head back

IF NOT BREATHING

Breathe - Inflate lungs rapidly 3-5 times



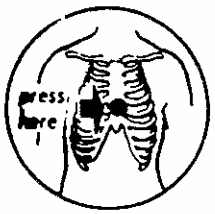
IF CAROTID PULSE IS PRESENT

continue 12 lung inflations per minute

IF PULSE IS ABSENT

Pupils dilated and deathlike appearance

Circulate



Depress Sternum 1½" to 2" once per second

CONTINUE RESUSCITATION until spontaneous pulse returns

ONE OPERATOR – alternate 2 quick inflations with 15 compressions

TWO OPERATORS – interpose one inflation after every fifth compression

YOUR HEART ASSOCIATION

produced by the American Heart Association • 44 East 23rd Street, New York, N. Y. 10010

Mouth-to-Mouth (Mouth-to-Nose) Method of ARTIFICIAL RESPIRATION

If there is foreign matter visible in the mouth, wipe it out quickly with your fingers or a cloth wrapped around your fingers.

a. Tilt the head back so the chin is pointing upward (Fig. 1). Pull or push the jaw into a jutting-out position (Fig. 2 and 3).
These maneuvers should relive obstruction of the airway by moving the base of the tongue away from the back of the throat.

Fig. 1

Fig. 2

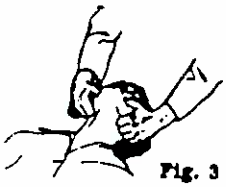


Fig. 3

b. Open your mouth wide and place it tightly over the victim's mouth. At the same time pinch the victim's nostrils shut (Fig. 4) or close the nostrils with your cheek (Fig. 5). Or close the victim's and place your mouth over the nose (Fig. 6). Blow into the victim's mouth or nose. (Air may be blown through the victim's teeth, even though they may be clenched.)
The first blowing efforts should determine whether or not obstruction exists.

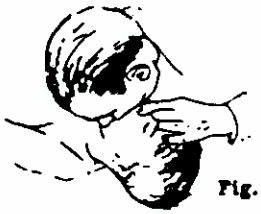


Fig. 4

Fig. 5

c. Remove your mouth, turn your head to the side, and listen for the return rush of air that indicates air exchange. Repeat the blowing effort.
For an adult, blow vigorously at the rate of about 12 breaths per minute. For a child, take relatively shallow breaths appropriate for the child's size, at the rate of about 20 per minute.

d. If you are not getting air exchange, recheck the head and jaw position (Fig. 1 or Fig. 2 and Fig. 3). If you still do not get air exchange, quickly turn the victim on his side and administer several sharp blows between the shoulder blades in the hope of dislodging foreign matter (Fig. 7).
Again sweep your fingers through the victim's mouth to remove foreign matter.

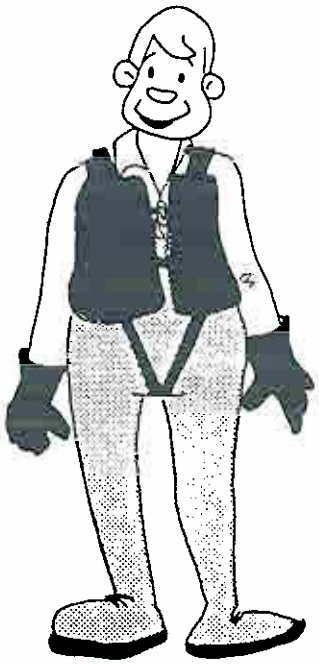
Fig. 6

Fig. 7

Those who do not wish to come in contact with the person may hold a cloth over the victim's mouth or nose and breathe through it. The cloth does not greatly affect the exchange of air.

Don't be shocked - Son

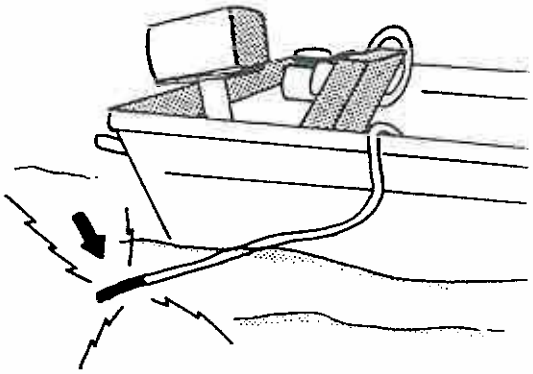
1. WEAR THE PROPER SAFETY ITEMS:



Three basic safety items must be worn by those involved in electrofishing. 1. LIFE JACKET - Even if you are an excellent swimmer or working in shallow water your life may at some time depend on a life jacket. Don't be without it! 2. WADERS - High waders are preferrable. Make sure there are no leaks. (If you have leaks, you'll probably find them when the juice is turned on). 3. RUBBER GLOVES - The easily slipped on gauntlet type are best. Always watch what you touch when working with electricity.

2. NEVER TOUCH THE ANODE OR CATHODE:

Since the business end of an electrofishing unit is its probes, it should be clear they are not to be touched under any circumstances. Make sure you are aware of their location at all times. Also make sure you do not operate any conductive equipment near the probes.

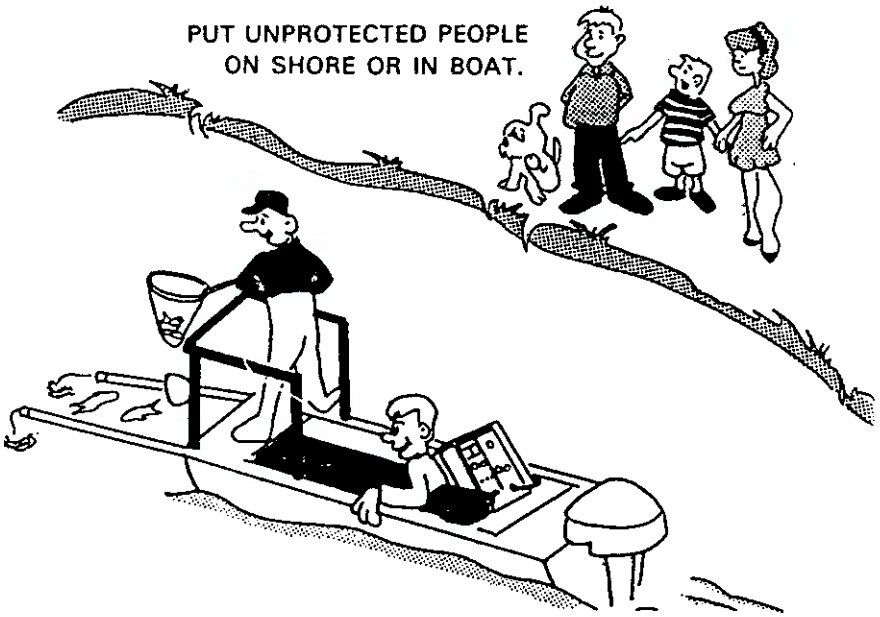


3. KEEP BOOTS AND GLOVES DRY:

If you have leaks in your boots or gloves you run the same risk as the fish. Maintain all protective clothing in a waterproof, shockproof condition. Make sure you are thoroughly dry during an electrofishing operation.

4. KEEP OTHER PEOPLE CLEAR OF AREA:

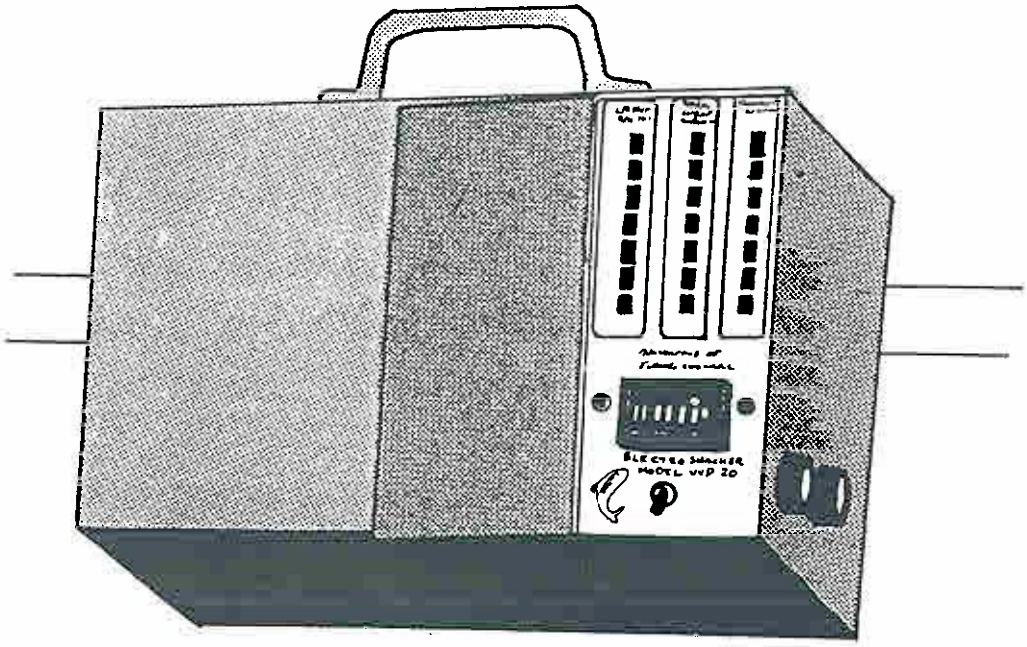
Before starting an electrofishing operation make sure that everybody, including pets, is in a safe place. Everyone on shore should be kept at a safe distance and only authorized people should participate in the operation. Remember you are using a very powerful force which can be lethal to unprotected persons or animals.



important safety tips:

5. USE PROPER EQUIPMENT:

As suggested before - make sure you use the appropriate equipment. Commercially designed units have every possible safety feature built into them in the testing stages. Don't take chances with poorly designed, home-made equipment. It just isn't worth the risk!



6. FOLLOW MFRS. OPERATION INSTRUCTIONS:

Reliable professionally designed equipment comes with complete operating, safety and hookup instructions. Even if you think equipment operation is perfectly obvious, read and understand every step; then read it again. It is very important to you.

7. KNOW PROPER FIRST AID PROCEDURES:

If trouble should occur, your life or someone elses may depend on adequate knowledge of first aid. Keep on hand a well equipped kit and check it often. Be especially familiar with the proper techniques for mouth-to-mouth resuscitation.

When all safety and proper operating procedures are followed, electrofishing is a safe operation. Don't allow yourself to be narcotized with the fish by foolishly ignoring basic safety rules and procedures.

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STATIC ELECTRICITY

Here's how to understand and prevent gasoline explosions that occur due to improper grounding of the fuel system

By Geoffrey Smith

THE BLAST came out of nowhere as far as anyone could see. I came to in ice-cold water fighting to get rid of my rubber hip boots and mackinaw, then swimming up wind to get away from the flames. The score was this: One sailor killed, the total loss of a coastwise schooner and half the pier burnt away. The cause: static electricity.

All this happened 34 years ago on the West Coast of Canada. We knew very little about handling gasoline except that it was considered somewhat dangerous to smoke. There were no dockside pumps at this out-of-the-way harbor and accepted re-fueling practice was to roll drums of gasoline down the pier, hoist them aboard and suspend them from a boom over an out-size funnel fitted into the fill pipe. One man handled the operation on deck, unscrewed the bung, steadied the drum over the funnel and controlled the flow of gasoline by opening and closing the vent. This was the man who was killed—he had spelled me so that I could warm up in the lee of the deck house and catch a smoke.

Our ship and dozens of others had used this method of refueling hundreds of times and nothing had ever gone wrong. It may have been because of the crisp dry weather, it may have been that the drum was hoisted a little higher than usual and the gasoline flowed farther and faster into the funnel. Neither of these explanations was of any great comfort to the captain of the schooner, the owner of the pier or the dead sailor's widow.

In the next couple of years I was involved directly or indirectly with three more gasoline explosions, all of them due to human error. One was when cargo was stowed in an air shaft, reducing ventilation, and a sea-going schooner went up a hundred miles off-shore from the fumes of a leaky beat-up engine. The second time was when we went to the help of an out-of-fuel fishing boat, and gasoline fumes from a now-illegal under-deck vent seeped 30 feet to an open galley fire. The third time was when a deck hand filling a five-gallon can for a light plant moved an oil lantern closer so he could see better. Since then I have learned a lot about gasoline.

Static electricity is generally considered to be frictional electricity generated by two dissimilar materials passing over each other, such as gasoline flowing through a pipe into the air, a car rolling along a highway, or you yourself brushing your hair or walking across a carpet. These and many other actions cause electrical rearrangement. How many times have you reached for a door knob and received an electrical shock, or fondly petted the family dog or cat and had the little animal take off with every hair standing on end? Nylon and other synthetic cloth is particularly conducive to the creation of static electricity and in the dark you can see it. These examples of static occur generally in very dry weather, but when filling your boat's tank it can happen at any time.

Along the coast we generally feel static sparks in the cold weather which a Northwest wind brings in and naturally assume that it is most prevalent in the winter. One reason behind this is that warm weather in coastal waters usually goes with high humidity and the dampness of the air tends to dissipate the electrical discharge.

Your main protection against static electricity while refueling is grounding, also known as bonding, which is direct metal-to-metal contact from the fuel hose nozzle to the water in which your boat is floating.

The first step is to be sure that the hose nozzle is in direct contact with the fill pipe deck fitting. Most fill pipes are metal and consequently you have metal contact to the fuel tank, but in some cases the pipe may be rubber or plastic which, although dangerous, is sometimes used for economy where there are complex curves. If you have such a fill pipe your best bet is to replace it with metal or make a connection with copper wire (8 to 10 gauge or bigger) from the deck fitting to the tank. Should you use solder be very sure that the tank is empty and free from fumes.

Your next concern is the fuel line from tank to engine. If it is metal you have nothing to worry about, but if it is plastic or other non-metallic material you must follow the procedure given above for the fill pipe. Once you are grounded to the engine there is direct metal contact through the engine casing and propeller shaft to the water. In the very rare case where there is a non-metallic gasket on the shaft to allow for play you must set up a metal contact either through it or over it.

Recently fiberglass gasoline tanks have come into being. These pose problems of their own. One method of grounding would be to run a copper wire around the tank from fill pipe to fuel line, but this would not ground the fuel in the tank. An expert on the subject suggests the manufacturers imbed the wire in the fiberglass connected to intake and outlet fittings. This would avoid corrosion which could occur if a wire went through the fuel.

It is not necessary to have a big static spark to set off an explosion—anything you can feel is enough. Even the spark caused by brushing your hair will do it under the right combination of fumes and air.

A disquieting thought is that, under certain atmospheric conditions, you can cause a static explosion yourself, particularly if you are wearing synthetic clothing and the almost certainty if you are insulated by rubber soled shoes. So, for safety's sake and the remote chance, ground yourself before you open the fill pipe deck fitting and release fumes to the air. You can do this by dipping your hand into the water overside, touching the engine block or a metal fitting on the dock connecting to the water.

Diesel fuel is too lean for static electrical explosion under normal conditions, but should it vaporize through contact with hot metal or if a leak in hose or nozzle forms a fine mist, it is potentially dangerous.

Another danger point is water. If there is water mixed with the fuel you are taking aboard the possibility of static spark increases ten to 20 fold.

Gasoline is dangerous unless it is handled properly. Pound for pound, in the right air to vapor mixture, it has more explosive power than T.N.T. But it is a fine efficient fuel and all you need do is treat it as you would the sea itself: with infinite respect. — ⚓

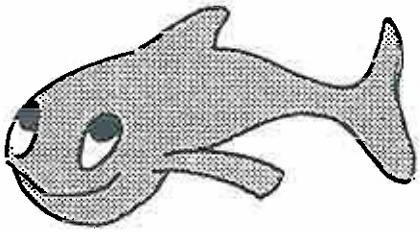
Let's start with the basic elements:

WATER

COMES HARD OR SOFT, CAN RUN FAST (STREAMS) OR BE DEEP (LAKES).

The first thing you need is some water. It comes in all types from fast running mountain streams to deep rivers and lakes. It seems almost every location has some different water problem for the electrofisher. The hardness [number of dissolved particles] determines the conductivity of the water, or how well it will carry an electrical current. The conductivity of water is measured by ohms per centimeter. The higher the ohms number the softer the water. Water temperature is another variable affecting the electrofisher.

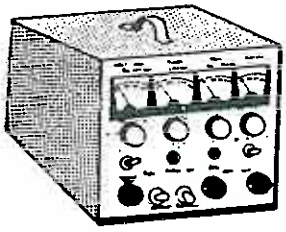
FISH



COMES LARGE AND SMALL AND IN DIFFERENT KINDS.

Fish come large-small-fat-skinny-handsome-ugly, etc. Various species of fish react differently to electro-shocks. For instance large fish are influenced more quickly and by relatively smaller voltages. Fish also have different densities of flesh which means that conductivity can vary from species to species.

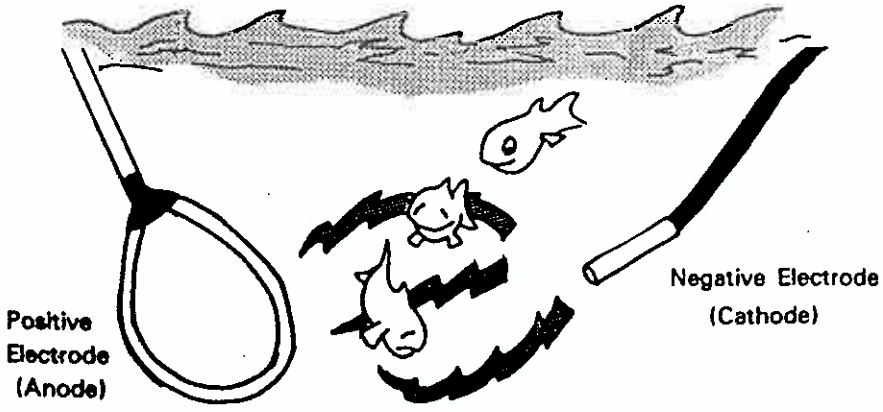
ELECTROSHOCKER



COMES IN A VARIETY OF SHAPES AND SIZES TO DO DIFFERENT JOBS.

Our first suggestion is to use an electronic unit which is designed and tested for electrofishing. Home-made units can be very dangerous. Electroshockers basically are designed to put electricity into water. The more control you have over the types of electric current, the more successful you're going to be in dealing with the variables involved. The two basic types of electricity used are AC or DC. [More about that later.] Choose the unit that best suits the physical surroundings, type of water and fish you are going after.

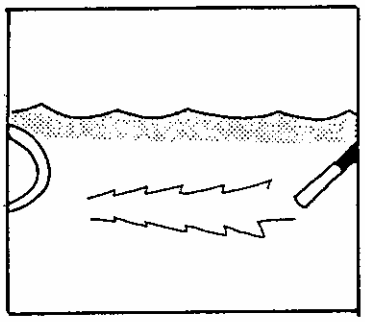
Put them all together and they spell ZAP!



Electricity needs positive and negative electrodes to complete a circuit. In boat electrofishing the negative electrode [cathode] usually hangs over the boat's side. The positive electrode [anode] can dangle from a boom or be hand maneuvered. You put them into the water, aim at the fish, turn on the juice [after following all safety and proper operating procedures] and the result is a bunch of surprised fish.

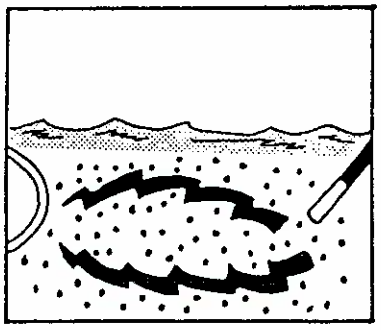
It's the variables that make electrofishing interesting:

Water Conductivity:



LOW CONDUCTIVITY - HARD TO GET ELECTRICITY FROM POS. TO NEG.

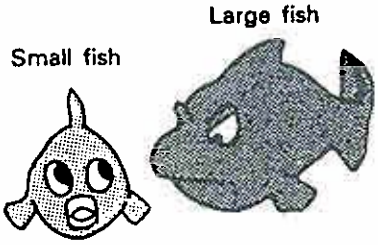
The amount of dissolved solids in the water determines its conductivity. The fewer the dissolved solids the harder it is to pass electrical current from positive to negative electrodes. For instance, distilled water is actually an insulator. Hard water, with lots of dissolved solids is a good conductor and current passes readily between anode and cathode.



HIGH CONDUCTIVITY - EASY TO PASS CURRENT FROM POS. TO NEG.

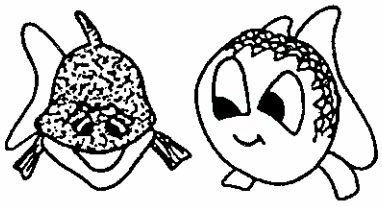
You might think that high water conductivity automatically means really good electrofishing. Not necessarily so. This is where the size of fish and the density of their flesh is important. As an example salt water has very high conductivity, but fish have relatively less conductivity in their bodies and the electrical current sort of slides around them requiring more voltage for a reaction.

When the conductivity of the water is lower than the conductivity of the fish, electrofishing conditions are more favorable. Electrical force lines are drawn to the fish with a resultant satisfactory reaction. Again control of current, pulse, etc. is essential for best results.



LARGE FISH REACT TO CURRENT MORE THAN SMALL FISH.

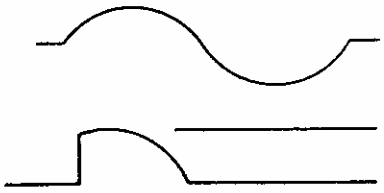
Larger fish receive a greater voltage in the water than smaller fish and are influenced more quickly and by relatively smaller voltages. Furthermore, the conductivity of fish flesh varies from species to species and environment to environment.



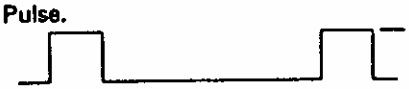
FISH FLESH OF DIFFERENT SPECIES CAN HAVE DIFFERENT CONDUCTIVITIES.

Variable shocking waves & currents help match the right shocking to the water conditions

AC-60 hz. Sine wave form.



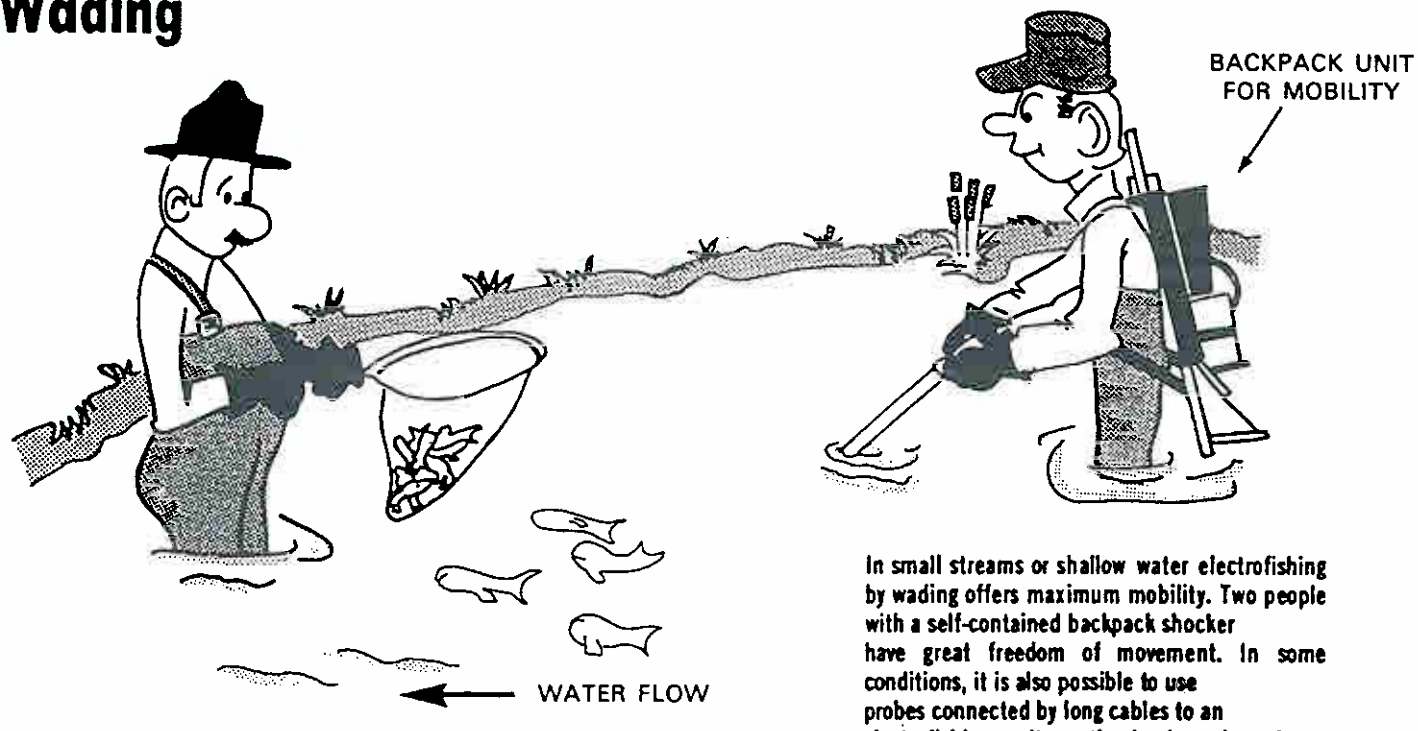
Square wave form. DC Pulse.



As we've suggested, the more control over the type of current and pulse rate, etc. the better the chances for successful electrofishing. It's not our intention to get too technical, but to give you some idea of the basic principles of electrofishing. In summation, you can introduce continuous Alternating or Direct currents into the water, or you can break the current by pulsing a certain number of times per second. This is extreme simplification and for more detailed consideration there is an abundance of technical data available.

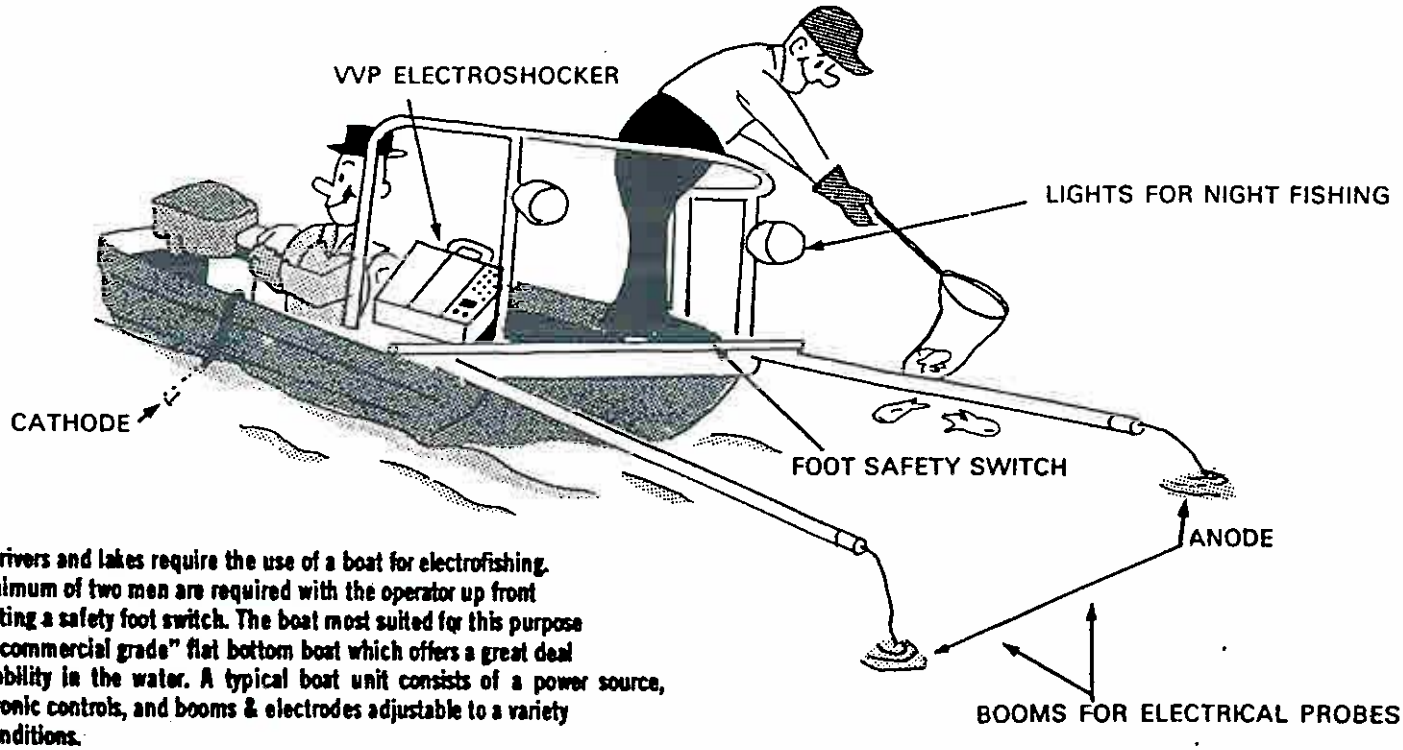
A couple of popular electrofishing set ups:

Wading



In small streams or shallow water electrofishing by wading offers maximum mobility. Two people with a self-contained backpack shocker have great freedom of movement. In some conditions, it is also possible to use probes connected by long cables to an electrofishing unit on the bank or in a boat.

From a boat:



Most rivers and lakes require the use of a boat for electrofishing. A minimum of two men are required with the operator up front operating a safety foot switch. The boat most suited for this purpose is a "commercial grade" flat bottom boat which offers a great deal of stability in the water. A typical boat unit consists of a power source, electronic controls, and booms & electrodes adjustable to a variety of conditions.

A suitable holding tank should be available to contain fish. Several sizes of boat are available with the component equipment outfitted to individual needs.

WARNING

HIGH VOLTAGE

IS USED IN THE OPERATION
OF THIS EQUIPMENT

DEATH ON CONTACT

MAY RESULT IF OPERATING PERSONNEL
FAIL TO OBSERVE SAFETY PRECAUTIONS

BE CAREFUL TO AVOID CONTACT WITH HIGH-VOLTAGE CIRCUITS
OR 115VAC INPUT CONNECTIONS WHILE CHECKING OR
SERVICING THIS EQUIPMENT

DIRECT CURRENT is a flow of current in one direction only. This flow is from the negative cathode to the positive anode.

The reaction of fish to direct current is quite different from their reaction to alternating current. The first reaction of the fish is to turn their heads toward the positive anode and start to swim toward it. This reaction, known as galvanotaxis, will continue until the fish either reaches the anode or encounters a current sufficiently strong enough to cause it to turn on its side and become incapable of any further forward movement. This reaction is known as galvanonarcosis. The severe and often harmful muscle contractions encountered with alternating current do not occur and the fish recover much more quickly from a direct current shock. Thus the mortality rate is much less with direct current than with alternating current. Also, galvanotaxis does not occur with alternating current.

Even greater anode attraction is possible by the use of pulsed direct current. Pulsed direct current is obtained by interrupting a direct current flow with an electronically controlled switch which will give a number of on and off pulses of direct current. Different species of fish differ in the number of pulses per second which will best attract them. Adjustment of pulse frequency and duration are of great importance in electrofishing to produce the desired galvanotaxis reaction.

Experimentation has shown that a fast rising pulse of 325 volts to 425 volts and with a frequency of 40 to 80 pulses per second is the most desireable for optimum results in streams in the range of 35 μmhos to 1000 μmhos per cm^3 conductivity.

The Type VI, Type VII, and the Type VIII electrofishers were designed for use in waters whose conductivity ranges from 20-1350 micromhos, 20-1000 micromhos, and 35-500 micromhos, respectively.* The Type VI is for use in large lakes and rivers and the Type VII is for medium size streams and lakes, and the Type VIII is for use in small fresh water streams. All Smith-Root electrofishers were designed to incorporate the desireable characteristics listed above.

* These figures correspond to the following resistivity ranges: Type VI - 750 - 50,000 ohms/cm^3; Type VII - 1000-50,000 ohms/cm^3; Type VIII - 2000-30,000 ohms/cm^3.

To convert ohms/cm^3 to conductance: Micromhos = $\frac{1 \times 10^6}{\text{ohm/cm}^3}$

CONSIDERATIONS FOR ELECTROFISHING

The effectiveness of the shocker's output is sometimes effected drastically by environmental and/or biological factors.

Generally speaking, the shocker's output is not greatly modified by the waters resistance or temperature, however, the power that reaches the fish is greatly effected by the water's parameters and the animals physiological make-up.

If these environmental and biological parameters are too far out of line, poor electrofishing will result. Adjustments in the shocker's output can help to reduce erratic actions and the escape of fish.

The following discussion may help to clarify the wide variation of reactions among fish.

INFLUENCE OF RESISTIVITY

The resistivity of the water and of the fish flesh are the main factors that effect electrofishing.

The resistivity of natural water depends on the quantity of dissolved salts and minerals in the water available to carry electric current.

Distilled water is a very good insulator of electric current. If a voltage is applied between two electrodes in distilled water, little or no current would flow through the water and the water would be considered to have extemely high or infinite resistivity.

In the past it was customary to talk in terms of volts per inch required to envoke a given response in a fish. From a theoretical standpoint, it is possible to have many volts per inch and not shock the fish at all.

For example, if a fish were placed in distilled water with high voltage applied, no current would pass through the water and hence, no current would pass through the fish's body even though many volts per inch may be present. What a fish reacts to is the current flowing through its body.

On the other side of the coin if we were able to put a fish in water that had near zero resistance and applied a voltage, a corresponding large current would flow through the water but negligible current would flow through the fish's body because the electric current would find it much easier to pass through the low resistance water than through the fish's flesh of medium to high resistance.

It can be seen from the afore mentioned considerations that a fish will receive the maximum shock (current flow) when a voltage is impressed across water having a resistance per cube equal to the resistance per cube of fish flesh. Typically fish flesh ranges from about 1.5 Kohm per cube to as high as 5 Kohm per cube. Successful electrofishing can be carried out in water with a mismatch ratio or resistance of about 3:1.

Practices which reduce the effects of high resistance water by delivering more useful electrical energy to fish include the use of high frequencies and duration with the use of square waves with peak voltages of 300 to 400 volts; it also helps to maintain a large cathode while keeping the anode medium size (not over 100 sq. in.). The smaller anode has a more intense current field near the anode while a large anode distributes the current over a larger area.

In some areas water resistivity is so high that electrofishing is impractical. The upper limit of resistivity for electrofishing is about 30,000 ohm per cube. In some cases this problem has been helped by adding salt to the water to lower the resistivity to a level more suitable for electrofishing.

In waters of very low resistivity the only solution is to run very heavy current through the water. However, a limit is soon reached where the shocker cannot deliver sufficient current to electrofish successfully. The lower limit on resistivity suitable for electrofishing is about 300 ohms per cube.

Individual variation is notable among fish even though they are of the same species and have similar lengths. However, the longer the individual of a species, generally, the more sensitive it is to electrical shock as fish absorb power as a function of body surface area.

EFFECTS OF TEMPERATURE

Fish flesh has a certain resistivity that decreases with increasing temperature. The success of electrofishing may be enhanced or hindered by this effect depending upon whether the water's resistance is higher or lower than the fish flesh resistance. If it is in a direction to cause a closer resistivity match, the fish will receive a greater shock.

Output energies commonly used in electrofishing are capable of killing fish. Death can occur with or without gross physical damage or by irreversible physiological damage. Mortalities caused by A. C. electrofishing are usually higher than those caused by D. C. or pulsed D. C.. Harmful effects from pulsed D. C. are usually a result of excessive exposure or very intense electrical fields.

ELECTROFISHING TECHNIQUES

One engaged in electrofishing must wade or float, depending upon the depth or swiftness of the water. In suitable waters, the operators wade and can probe the anode into likely fish habitat. Wading upstream eliminates the effects of turbidity caused by bottom sediment. Furthermore, if collections are for food-habit study, stunned prey are not swept downstream and consumed by predators. If turbidity and predication are unimportant, however, collections can be made more efficiently and less strenuously when moving downstream. The fish are normally oriented upstream, or toward the descending electrical field, and the shocked fish initially induced into flight bolt upstream into higher voltage densities, where they are held. Fish that manage to escape are often captured a short distance downstream. The size of the fish captured by wading operations in large streams is usually less than 150 mm., whereas larger fish are taken in deep waters by the floating method.

The floating method of electrofishing is used when the stream is too deep or swift to wade. The anode is clamped rigidly ahead of the boat, extending into the water. One man guides the boat with the oars while one or two operators dip fish as the boat drifts with the river.

Collecting can be improved further by introducing the element of surprise through intermittent fishing. The intensity of the anode's peripheral electric energies only frightens fish, causing them to bolt or penetrate deeper into cover. In either situation, chances of capture are reduced. It is better not to move through a body of water with the power continuously on, but rather to fish only in likely habitat. Fish can be extracted from areas of heavy cover or from under shore ice by inserting the anode, turning the power on, and withdrawing the anode slowly and smoothly. Fish follow the anode under the influence of galvanotaxis into the open, where they can be netted. If the stream velocity is appreciable, the electrical power can be left on during floating without loss of efficiency.

Night fishing with lights has proven to be exceedingly productive in lakes but it is not so in streams. The reflection and refraction of the spotlight beam caused by the ruffled stream surface greatly impairs sighting of the fish. Headlamps are useful for electrofishing by wading at night. For daytime fishing the use of Polaroid sunglasses greatly improves in locating stunned fish.

SAFETY PRECAUTIONS FOR ELECTROFISHING

The operator of an Electrofisher must always keep in mind that his chance of receiving an electrical shock is multiplied when dealing with electric currents in or near water more than any other place. Using an Electrofisher is like using a firearm, if used properly and with good judgement it is perfectly safe. Have respect for electricity and it is easily controlled, lose respect and you could lose your life.

The Smith-Root Electrofishers have a HIGH VOLTAGE OUTPUT and certain safety precautions must be observed to provide safe operation and prevent possible dangerous electric shock.

When operating the Electrofisher NEVER let yourself come in contact with the anode. If this were to happen your body would complete a path for the electric current and a possible lethal shock would result.

The following articles must be worn when using the Electrofisher. They are not just to keep you dry, they are to keep you insulated from the electric currents that may be present.

1. Nonleaking wading boots chest high. If they become wet inside, STOP electrofishing and let them dry out thoroughly. Wet boots can conduct electricity as well as water around them.

2. Nonleaking rubber electricians gloves that reach the elbow or higher. If they become wet inside, STOP electrofishing and let them dry out. Wet gloves conduct electricity.

THE FOLLOWING ARE SOME DO'S AND DON'TS FOR ELECTROFISHING

DO – Always make sure that all personel are clear of the area surrounding the anode before turning on the power. DOUBLE CHECK.

DON'T – Continue to electrofish if your boots or gloves become damp or wet.

DO – Make sure that the anode and cathode electrodes make good connection with the output cable and that both electrodes are in contact with the water.

DON'T – Operate an electrofisher if you have any prior heart ailment history or if you have been under abnormal strain, which may weaken your heart.

DO – Study and know how to administer first aid treatment for electrical shock.

DO – BE CAREFUL!

FRONT PANEL CONTROLS AND PLUGS:

BEFORE ATTEMPTING OPERATION OF THIS EQUIPMENT BE SURE TO READ AND FOLLOW THE INSTRUCTIONS AND SAFETY PRECAUTIONS'

INPUT PLUG – Located lower left. This supplies all power for the Type VI Electrofisher. Do not plug a Type VI that is set up for 220 VAC input into a 110 VAC outlet or a Type VI set up for a 110 VAC into a 220 VAC outlet or serious damage to the unit may result.

POWER SWITCHES – Located lower left. These are circuit breaker switches used to turn on and off the input power and the auxiliary power outlets.

POWER INDICATOR – Located lower left. Will be lighted when input plug has power applied and power switches are in the on position.

OUTPUT MODE SELECTOR SWITCH – Located lower right. Selects actual output waveshape and frequency, 60 HZ A.C. Sine wave, 60 PPS or 120 PPS pulsating D.C.

VOLTAGE SELECTOR SWITCH – Located top left. This switch selects output voltage providing steps of 100 volts per step over the range of 0 to 600 VAC and 0 to 850 volts peak D.C.

HIGH VOLTAGE INDICATOR – Located center right. Indicates when power is being supplied to the anode-cathode electrodes.

PULSE WIDTH CONTROL – Located lower right. Adjusts pulsating D.C. output pulse width within the range of 1 to 7 milliseconds.

AMMETER – Located top center. Indicates the current flowing through the water via the anode-cathode electrodes.

MECHANICAL REGISTER – Located upper left on front panel. Records actual shocking time in seconds. Actuated at one count per second only when high voltage is applied to the anode, and the timer switch, (located just to the right of the mechanical register) is in the on position.

KEY SWITCH – Located lower left. The provided key must be inserted and this switch turned on before the remote switches can be actuated to supply high voltage to the anode. This way high voltage can only be obtained deliberately for obvious safety reasons.

REMOTE INPUT PLUG – Located lower right. Remote switches provided with your Type VI Electrofisher are plugged in here and are used to actuate the circuits supplying high voltage to the anode. With the key switch (lower left panel) in the on position, BOTH remote buttons must be depressed to obtain high voltage at the anode. This is an added safety precaution so there will never be high voltage unless two operators press their respective buttons simultaneously.

OUTPUT PLUG – Located lower right. Both the anode and cathode wires are connected to this plug. Pin "A" goes to the anode and Pin "B" to the cathode. The output cable supplied is wired so that the white wire must be connected to the anode and the black to the cathode.

FUSE, 6 AMP – Located upper right. Limits output to 6 amperes and protects high voltage circuit if anode and cathode should become shorted together.

SECTION 10

GLOSSARY OF ELECTRICAL TERMS

Appendix. Glossary of Electrical Terms.

Conductivity (c) The ratio of the density of the unvarying current in a conductor to the voltage gradient that produces it; common units of measurement are mhos per centimeter or siemens per centimeter.

Conductance (G) The measurement of the ability of a component to conduct electricity; the reciprocal of resistance; unit of measurement is the mho.

Current (I) The rate of electrical charge flow in a circuit. The practical unit is the ampere, which is one coulomb per second.

Current density (J) The ratio of a current to the cross-sectional area of its path in a plane perpendicular to the direction of the current.

Effective fish conductivity (c_f) The apparent electrical conductivity of live fish as determined by statistically fitting electroshock response data to the theoretical curve developed for the concept of constant power.

Electrical charge (Q) A fundamental property of matter that can be classified as a fundamental physical quantity. The practical unit is the coulomb. The electron, the smallest charge identified in nature, has a magnitude of 1.6×10^{-19} coulomb.

Mismatch ratio (q) The ratio of either the two resistance values or two conductivity values determined for adjoining media. For electrofishing, this is the ratio of conductivity of the water to the effective conductivity of the fish.

Power (P) The rate of doing work or the energy per unit of time. The practical unit is the watt, which is one joule per second.

Applied power (P_a) Power incident at an electrical interface separating two media.

Constant transferred power (P_m) The constant value of transferred power desired under all conditions of mismatch.

Maximum output power (P_M) The maximum available power delivered to an external load from a power source having an internal resistance equal to that of the external load.

Reflected power (P_r) The portion of applied power that is not transferred to the second medium.

Transferred power (P_t) The portion of applied power transferred from the first medium to the second medium.

Power density (D) The power or energy per unit of time dissipated in a given volume of material; the unit of measurement is watts per cubic centimeter.

Applied power density (D_a) Power density available for transfer to a fish at a particular location in the water.

Power density in fish (D_m) The desired constant value of power density to be transferred to a fish; also, the threshold of in vivo power density required to produce a specific electroshock response.

Resistance (k) The ability to react to the flow of AC or DC with an opposition to the flow of current. Also, the ratio of the applied voltage to the induced current that it produces. The unit of measurement is the ohm.

Resistivity (r) The reciprocal of conductivity. The common unit of measurement is the ohm-cm.

Volts or Voltage (V) The energy per unit of electrical charge. The volt is the unit of measure where one volt is one joule per coulomb.

Voltage gradient (E) The rate of change of voltage with distance. Also, the force per unit of electrical charge. The common unit of measurement is volt per centimeter.

Appendix C.1

Checklist for Electrofishing Safety and Health Audit

APPENDIX C.1

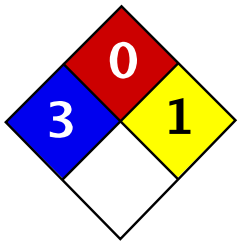
CHECKLIST FOR ELECTROFISHING SAFETY AND HEALTH AUDIT

Item	Remarks	Yes	No
Safety Equipment	• Life preservers on board for each individual		
	• Leak-free electrical insulating gloves and boots available for each individual (NOTE: Gloves and boots should extend above the knees and elbows)		
	• Radio available for emergency contacts		
	• Radio property charged		
	• First aid kit in boat		
	• Burn Jel bandages available in first aid kit		
	• Personnel trained in first aid/CPR		
	• Fire extinguisher in boat (Type ABC 5 lb)		
	• Emergency air horn on board		
	• Funnel available for adding gasoline to generate or pump (NOTE: Gasoline should not be added to a hot motor)		
	• Polarized sun glasses		
Boat Safety	Lights available and working for night-time fishing		
	Boat equipped with an anchor		
	Boat in good repair free from sharp edges and weak or broken areas		
	Fuel tanks positioned a safe distance from the generator and battery (NOTE: Gasoline vapor cannot be allowed to contact hot surfaces or sparks)		
	Fuel tanks property capped and lines leak-free		
	Generator/pump shut-off switch available to eliminate grounding the spark plug		
	Generator/pump muffler facing outside the boat and shielded to prevent contact in rough seas		
	Foot pedal “dead man” switch controlling the flow of electricity in place in bow of boat (NOTE: Device must be operating for netter[s] to control)		
	If no netter foot pedal exists, is there another means of emergency generator shut off?		
	Probes used to extend the electrodes to the water made of non-conducting material		
	Electrical connections weather-proof and water tight		
	Electrical conducting surfaces connected to create one circuit on board (NOTE: Separate circuits create “floating metal” which can cause electrocution)		
	Surfaces checked with an OHM meter prior to launching the boat		

Item	Remarks	Yes	No
Trailer	• Trailer frame free of significant rust and structurally sound		
	• Hitch on trailer solid and working properly with locking hasp		
	• Two safety chains present that can be properly connected to the towing vehicle hitch		
	• Training stand secured properly and can be locked in the vertical and horizontal position		
	• Trailer stand and winch handles present and working property		
	• Safety chains present to secure boat to trailer during transportation (other than winch)		
	• Winch secure and in good working order		
	• Winch cable or rope free of broken strands		
	• Winch hook a locking type		
	• Trailer tires in good shape with adequate tread		
	• Trailer wheel bearings were greased (if not sealed)		
	• Lights on trailer working properly (brake and turning indicator)		
	• Trailer brakes working properly		
Motor	• Motor bolted to boat with four bolts		
	• Motor equipped with proper handles		
	• Motor can be properly locked in the “up” or travel position		
	• Emergency motor shut-off connected to operator in case operator falls from boat		
Post-Fishing Checklist	• Generator shut off during rain		
	• Boat operated free of sudden turns or changes in direction		
	• Comments and items needed for next trip		

Appendix E

Material Safety Data Sheets



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].
MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible.
Calcium carbide reacts with hydrogen chloride gas with incandescence.
Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine.
Rubidium acetylene carbides burns with slightly warm hydrochloric acid.
Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved.
Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas.
Cesium acetylene carbide burns hydrogen chloride gas.
Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute.
Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:
Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate.
Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture.
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States]
CEIL: 7 (mg/m3) from OSHA (PEL) [United States]
CEIL: 5 from NIOSH
CEIL: 7 (mg/m3) from NIOSH
TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)]
TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water)
83 C @ 760 mm Hg (for 31% HCl in water)
50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water)
-46.2 C (31.24% HCl in water)
-25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1)
1.10 (20%and 22% HCl solutions)
1.12 (24% HCl solution)
1.15 (29.57% HCl solution)
1.16 (32% HCl solution)
1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals.
Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316).
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product.
Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C.
Sodium reacts very violently with gaseous hydrogen chloride.
Calcium phosphide and hydrochloric acid undergo very energetic reaction.
It reacts with oxidizers releasing chlorine gas.
Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates.
Reacts with most metals to produce flammable Hydrogen gas.
Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure)
Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid.
Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction.
Hydrogen chloride causes aldehydes and epoxides to violently polymerize.
Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:
Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions).
It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys.
No corrosivity data on zinc, steel.
Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse].
Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].
May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin,

eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, .
Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL)
LDL [Man] -Route: Oral; 2857 ug/kg
LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M
LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity).
May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Corrosive. Causes severe skin irritation and burns.
Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis.
Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure,
occur, particularly if exposure is prolonged. May affect the liver.
Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis).
Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel.
Chronic Potential Health Effects:
dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid
Illinois toxic substances disclosure to employee act: Hydrochloric acid
Illinois chemical safety act: Hydrochloric acid
New York release reporting list: Hydrochloric acid
Rhode Island RTK hazardous substances: Hydrochloric acid
Pennsylvania RTK: Hydrochloric acid
Minnesota: Hydrochloric acid
Massachusetts RTK: Hydrochloric acid
Massachusetts spill list: Hydrochloric acid
New Jersey: Hydrochloric acid
New Jersey spill list: Hydrochloric acid
Louisiana RTK reporting list: Hydrochloric acid
Louisiana spill reporting: Hydrochloric acid
California Director's List of Hazardous Substances: Hydrochloric acid
TSCA 8(b) inventory: Hydrochloric acid
TSCA 4(a) proposed test rules: Hydrochloric acid
SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid
SARA 313 toxic chemical notification and release reporting: Hydrochloric acid
CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns.
R37- Irritating to respiratory system.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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Last Updated: 10/09/2005 05:45 PM

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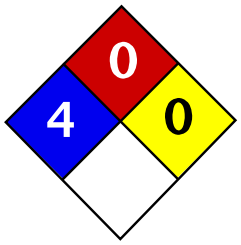

Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Nitric acid, 70% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric acid, 70%

Catalog Codes: SLN1963, SLN1549

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid, 70%

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	30
Nitric acid, fuming	7697-37-2	70

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.

MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials

Explosion Hazards in Presence of Various Substances:
Explosive in presence of reducing materials, of metals, of alkalis.
Slightly explosive in presence of combustible materials.
Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Flammable in presence of cellulose or other combustible materials.
Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas.
Phosphine ignites in concentrated nitric acid.
Nickel tetraphosphide ignites with fuming nitric acid.
Contact with metals may evolve flammable hydrogen gas.
A jet of ammonia will ignite nitric acid vapor.
Cellulose may be converted to the highly flammable nitrate ester on contact with the vapor of nitric acid as well as the liquid itself.

Special Remarks on Explosion Hazards:
Reacts exlposively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine.
Can react explosively with many reducing agents.
Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid.
Cesium and rubidium acetylides explode in contact with nitric acid.
Explosive reaction with Nitric Acid + Nitrobenzene + water.
Detonation with Nitric Acid + 4-Methylcyclohexane.
The addition of warm fuming nitric acid to phosphine causes explosion.
Addition of water to nitration mixture diluted with an equal volume of water can cause a low order explosion.
Cyclopentadiene reacts explosively with fuming nitric acid.
Mixtures of fuming nitric acid and acetonitrile are high explosives.
(Nitric acid, fuming)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Oxidizing material. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their

respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States]
TWA: 2 STEL: 4 from OSHA (PEL) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acrid. Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point: 121°C (249.8°F)

Melting Point: -41.6°C (-42.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.408 (Water = 1)

Vapor Pressure: 6 kPa (@ 20°C)

Vapor Density: 2.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.29 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water.
Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:
Highly reactive with alkalis.
Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of brass.
Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316)

Special Remarks on Reactivity:
A strong oxidizer.
Reacts violently with alcohol, organic material, turpene, charcoal.
Violent reaction with Nitric acid + Acetone and Sulfuric acid.
Incompatible with combustible materials, metallic powders, hydrogen sulfide, carbides, aldehydes, cyanides, chromic acid, hydrogen sulfide, metals, metal powders, organic solvents, acetic acid, alcohols.
Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors.
(Nitric acid, fuming)

Special Remarks on Corrosivity:
In presence of traces of oxides, it attacks all base metals except aluminum and special chromium steels.
It will attack some forms of plastics, rubber, and coatings.
Nitric Acid corrodes almost all metals except gold, and white gold, forming nitrates.
No corrosive effect on bronze.
No corrosivity data for zinc, and steel

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive).
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects based on animal data (effects on newfborn, fetotoxicity)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Severely irritates skin. Causes skin burns and may cause deep and penetrating ulcers of the skin with a characteristic yellow to brownish discoloration. May be fatal if absorbed through skin.
Eyes: Severely irritates eyes. Causes eye burns. May cause irreversible eye injury.
Ingestion: May be fatal if swallowed. Causes serious gastrointestinal tract irritation or burns with nausea, vomiting, severe abdominal pain, and possible "coffee grounds" appearance of the vomitus . May cause perforation of the digestive tract.

Inhalation: May be fatal if inhaled. Vapor is extremely hazardous. Vapor may cause nitrous gas poisoning. Effects may be delayed. May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting.
Chronic Potential Health Effects:
Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contaction or spasticity, weakness, loss of coordinaton, mental confusion), and urinary system (kidney faillure, decreased urinary output after several hours of uncorrected circulatory collapse).
Repeated exposure may cause discoloration and/or errosion of teeth (dental enamel).
Eye irritation and respiratory tract signs and symptoms resembling those of frequent upper respiratory viral infections have been associated with chronic nitric acid exposure.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Nitric acid (Nitric acid, fuming) UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Nitric acid, fuming
Rhode Island RTK hazardous substances: Nitric acid, fuming
Pennsylvania RTK: Nitric acid, fuming
Florida: Nitric acid, fuming
Minnesota: Nitric acid, fuming
Massachusetts RTK: Nitric acid, fuming
New Jersey: Nitric acid, fuming
TSCA 8(b) inventory: Water; Nitric acid, fuming
SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming
SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming 70%
CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R8- Contact with combustible material may cause fire.
R35- Causes severe burns.
S23- Do not breathe gas/fumes/vapour/spray [***]
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36- Wear suitable protective clothing.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 4

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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LIQUINOX MSDS

Section 1 : PRODUCT AND COMPANY IDENTIFICATION

Chemical family: Detergent.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Supplier: Same as manufacturer.

Product name: Liquinox

Section 2 : INGREDIENT INFORMATION

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE

Section 3 : HAZARD IDENTIFICATION

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of acute exposure

Eye contact: May cause irritation.

Skin contact: Prolonged and repeated contact may cause irritation.

Inhalation: May cause headache and nausea.

Ingestion: May cause vomiting and diarrhea.
May cause gastric distress.

Effects of chronic exposure: See effects of acute exposure.

Section 4 : FIRST AID MEASURES

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
If irritation persists, seek medical attention.

Ingestion: Do not induce vomiting, seek medical attention.
Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.

Section 5 : FIRE FIGHTING MEASURES

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.
Use water spray to cool fire exposed containers.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Explosion Data

Sensitivity to static discharge: Not available.

Sensitivity to mechanical impact: Not available.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: Containers may rupture if exposed to heat or fire.

Section 6 : ACCIDENTAL RELEASE MEASURES

Leak/Spill: Contain the spill.
Prevent entry into drains, sewers, and other waterways.
Wear appropriate protective equipment.
Small amounts may be flushed to sewer with water.
Soak up with an absorbent material.
Place in appropriate container for disposal.
Notify the appropriate authorities as required.

Section 7 : HANDLING AND STORAGE

Handling procedures and equipment: Protect against physical damage.
Avoid breathing vapors/mists.
Wear personal protective equipment appropriate to task.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Avoid extreme temperatures.
Launder contaminated clothing prior to reuse.

Storage requirements: Store away from incompatible materials.
Keep containers closed when not in use.

Section 8 : EXPOSURE CONTROLS / PERSONAL PROTECTION

Precautionary Measures

Gloves/Type:

Wear appropriate gloves.

Respiratory/Type: None required under normal use.

Eye/Type:

Safety glasses recommended.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash facility should be in close proximity.
Emergency shower should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

Exposure limit of material: Not available.

Section 9 : PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid.

Appearance & odor: Odourless.
Pale yellow.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): @ 20°C (68°F).
17

Vapour density (air=1): >1

Volatiles (%)

By volume: Not available.

Evaporation rate (butyl acetate = 1): < 1.

Boiling point (°C): 100 (212F)

Freezing point (°C): Not available.

pH: 8.5

Specific gravity @ 20 °C: (water = 1).
1.083

Solubility in water (%): Complete.

Coefficient of water\oil dist.: Not available.

VOC: None

Chemical family: Detergent.

Section 10 : STABILITY AND REACTIVITY

Chemical stability: Product is stable under normal handling and storage conditions.

Conditions of instability: Extreme temperatures.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizing agents.

Hazardous decomposition products: See hazardous combustion products.

Section 11 : TOXICOLOGICAL INFORMATION

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Section 12 : ECOLOGICAL INFORMATION

Environmental toxicity: No data at this time.

Environmental fate: No data at this time.

Section 13 : DISPOSAL CONSIDERATIONS

Waste disposal: In accordance with local and federal regulations.

Section 14 : TRANSPORT INFORMATION

D.O.T. CLASSIFICATION: Not regulated.

Special shipping information: Not regulated.

Section 15 : REGULATORY INFORMATION

Canadian Regulatory Information

WHMIS classification: Not controlled.

DSL status: Not available.

USA Regulatory Information

SARA hazard catagories sections 311/312: Immediate (Acute) Health Hazard: No.
Delayed (Chronic) Health Hazard: No.
Fire Hazard: No.
Sudden Release of Pressure: No.
Reactive: No.

SARA Section 313: None

TSCA inventory: All components of this product are listed on the TSCA inventory.

NFPA

Health Hazard: 1

Flammability: 0

Reactivity: 0

HMIS

Health Hazard: 1

Flammability: 0

Physical hazard: 0

PPE: A

Section 16 : OTHER INFORMATION

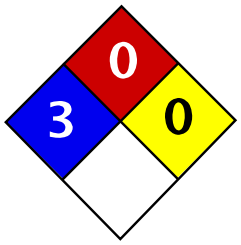
Supplier MSDS date: 2006/07/14

Data prepared by: Global Safety Management
3340 Peachtree Road, #1800
Atlanta, GA 30326

Phone: 877-683-7460
Fax: (877) 683-7462

Web: www.globalsafetynet.com
Email: info@globalsafetynet.com.

General note: This material safety data sheet was prepared from information obtained from various sources, including product suppliers and the Canadian Center for Occupational Health and Safety.



Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Mercury MSDS

Section 1: Chemical Product and Company Identification

Product Name: Mercury

Catalog Codes: SLM3505, SLM1363

CAS#: 7439-97-6

RTECS: OV4550000

TSCA: TSCA 8(b) inventory: Mercury

CI#: Not applicable.

Synonym: Quick Silver; Colloidal Mercury; Metallic Mercury; Liquid Silver; Hydragyrum

Chemical Name: Mercury

Chemical Formula: Hg

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Mercury	7439-97-6	100

Toxicological Data on Ingredients: Mercury LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (permeator).
CARCINOGENIC EFFECTS: Classified A5 (Not suspected for human.) by ACGIH. 3 (Not classifiable for human.) by IARC.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
When thrown into mercury vapor, boron phosphodiiodide ignites at once.
Flame forms with chlorine jet over mercury surface at 200 deg to 300 deg C.
Mercury undergoes hazardous reactions in the presence of heat and sparks or ignition.

Special Remarks on Explosion Hazards:
A violent exothermic reaction or possible explosion occurs when mercury comes in contact with lithium and rubidium.
CHLORINE DIOXIDE & LIQUID HG, WHEN MIXED, EXPLODE VIOLENTLY.
Mercury and Ammonia can produce an explosive compound.
A mixture of the dry carbonyl and oxygen will explode on vigorous shaking with mercury.
Methyl azide in the presence of mercury was shown to be potentially explosive.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Corrosive liquid. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.025 from ACGIH (TLV) [United States] SKIN
TWA: 0.05 CEIL: 0.1 (mg/m3) from OSHA (PEL) [United States] Inhalation
TWA: 0.025 (mg/m3) [United Kingdom (UK)]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Heavy liquid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 200.59 g/mole

Color: Silver-white

pH (1% soln/water): Not available.

Boiling Point: 356.73°C (674.1°F)

Melting Point: -38.87°C (-38°F)

Critical Temperature: 1462°C (2663.6°F)

Specific Gravity: 13.55 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 6.93 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Ground mixtures of sodium carbide and mercury, aluminum, lead, or iron can react vigorously.
A violent exothermic reaction or possible explosion occurs when mercury comes in contact with lithium and rubidium.
Incompatible with boron diiodophosphide; ethylene oxide; metal oxides, metals(aluminum, potassium, lithium, sodium, rubidium); methyl azide; methylsilane, oxygen; oxidants(bromine, peroxyformic acid, chlorine dioxide, nitric acid, tetracarbonynickel, nitromethane, silver perchlorate, chlorates, sulfuric acid, nitrates,); tetracarbonylnickel, oxygen, acetylinic compounds, ammonia, ethylene oxide, methylsiliane, calcium,

Special Remarks on Corrosivity:
The high mobility and tendency to dispersion exhibited by mercury, and the ease with which it forms alloys

(amalga) with many laboratory and electrical contact metals, can cause severe corrosion problems in laboratories.
Special precautions: Mercury can attack copper and copper alloy materials.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A5 (Not suspected for human.) by ACGIH. 3 (Not classifiable for human.) by IARC.
May cause damage to the following organs: blood, kidneys, liver, brain, peripheral nervous system, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Hazardous in case of skin contact (corrosive, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May affect genetic material.
May cause cancer based on animal data.
Passes through the placental barrier in animal.
May cause adverse reproductive effects(paternal effects- spermatogenesis; effects on fertility - fetotoxicity, post-implantation mortality), and birth defects.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Mercury UNNA: 2809 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Mercury
California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Mercury
Connecticut hazardous material survey.: Mercury
Illinois toxic substances disclosure to employee act: Mercury
Illinois chemical safety act: Mercury
New York acutely hazardous substances: Mercury
Rhode Island RTK hazardous substances: Mercury
Pennsylvania RTK: Mercury
Minnesota: Mercury
Massachusetts RTK: Mercury
New Jersey: Mercury
New Jersey spill list: Mercury
Louisiana spill reporting: Mercury
California Director's List of Hazardous Substances.: Mercury
TSCA 8(b) inventory: Mercury
SARA 313 toxic chemical notification and release reporting: Mercury
CERCLA: Hazardous substances.: Mercury: 1 lbs. (0.4536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R23- Toxic by inhalation.
R33- Danger of cumulative effects.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R50/53- Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S2- Keep out of the reach of children.
S7- Keep container tightly closed.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S39- Wear eye/face protection.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S46- If swallowed, seek medical advice immediately and show this container or label.
S60- This material and its container must be disposed of as hazardous waste.

S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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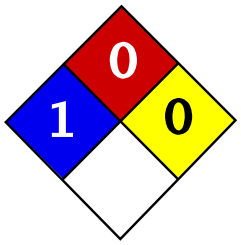

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Zinc oxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc oxide

Catalog Codes: SLZ1009, SLZ1114, SLZ1222, SLZ1057

CAS#: 1314-13-2

RTECS: ZH4810000

TSCA: TSCA 8(b) inventory: Zinc oxide

CI#: Not available.

Synonym: Calamine; Zinc white

Chemical Name: Zinc Oxide

Chemical Formula: ZnO

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc oxide	1314-13-2	100

Toxicological Data on Ingredients: Zinc oxide: ORAL (LD50): Acute: 7950 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Slow addition of zinc oxide to cover linseed oil varnish causes generation of heat and ignition.

Special Remarks on Explosion Hazards:
May explode when mixed with chlorinated rubber.
Zinc Oxide and Magnesium can react explosively when heated.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 5 STEL: 10 (mg/m3) from ACGIH (TLV) [United States] Inhalation
TWA: 15 (mg/m3) from OSHA (PEL) [United States] Inhalation Total.
TWA: 5 STEL: 10 CEIL: 25 (mg/m3) from NIOSH Inhalation
TWA: 5 STEL: 10 (mg/m3) from OSHA (PEL) [United States] Inhalation Respirable.Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Odorless.

Taste: Bitter.

Molecular Weight: 81.38 g/mole

Color: White to yellowish-white

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: 1975°C (3587°F)

Critical Temperature: Not available.

Specific Gravity: 5.607 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Is not dispersed in cold water, hot water.

Solubility:
Insoluble in cold water, hot water
Soluble in dilute acetic acid, or mineral acids, ammonia, ammonium carbonate, fixed alkali hydroxide solution..

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts violently with magnesium, linseed oil.
Reacts with hydrochloric acid to produce zinc chloride.
Reacts with sulfuric acid to produce zinc sulfate.
Reacts with hydrogen fluoride to produce zinc fluoride tetrahydrate.
Gradually absorbs CO2 on exposure to air.
Sublimes at normal pressure.
Zinc Oxide reacts with Carbon Monoxide or hydrogen to produce elemental zinc.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 7950 mg/kg [Mouse].

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.

Other Toxic Effects on Humans:
Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects based on animal data. No human data found at this time.
May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
May cause mild skin irritation.
Eyes: May cause mechanical eye irritation and conjunctivitis.
Inhalation: May cause mechanical irritation of the respiratory tract. A few sources claim that finely divided zinc

oxide dust can cause "metal fume fever." Zinc oxide dust is generally considered a nuisance dust; adverse effects are unlikely when exposures are kept under reasonable control. Inhalation of high concentrations of Zinc Oxide fume or dust may cause "Metal Fume Fever." Symptoms of metal fume fever may include a flu-like condition involving headache, chills, fever, sweats, nausea, vomiting, cough, muscle aches and pains, and difficulty breathing, ;ulmonary edema. May also affect the liver.
Ingestion: May cause digestive tract irritation although Zinc oxide has a low toxicity by oral exposure route.
Chronic Potential Health Effects:
Ingestion: Prolonged or repeated ingestion of zinc oxide may affect blood, metabolism, and the thyroid.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Zinc oxide
Rhode Island RTK hazardous substances: Zinc oxide
Pennsylvania RTK: Zinc oxide
Minnesota: Zinc oxide
Massachusetts RTK: Zinc oxide
New Jersey: Zinc oxide
California Director's List of Hazardous Substances: Zinc oxide
TSCA 8(b) inventory: Zinc oxide

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R40- Possible risks of irreversible

effects.
S2- Keep out of the reach of children.
S36/37- Wear suitable protective clothing and gloves.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Appendix F

Accident/Loss and Incident Report

ACCIDENT/LOSS REPORT

THIS REPORT MUST BE COMPLETED BY THE INJURED EMPLOYEE OR SUPERVISOR AND FAXED TO EA CORPORATE HUMAN RESOURCES WITHIN 24 HOURS OF ANY ACCIDENT. THE FAX NUMBER IS **(410) 771-1780**.

NOTE WHENEVER AN EMPLOYEE IS SENT FOR MEDICAL TREATMENT FOR A WORK RELATED INJURY OR ILLNESS, PAGE 4 OF THIS REPORT MUST ACCOMPANY THAT INDIVIDUAL TO ENSURE THAT ALL INVOICES/BILLS/CORRESPONDENCE ARE SENT TO HUMAN RESOURCES FOR TIMELY RESPONSE.

a. DEMOGRAPHIC INFORMATION:

NAME OF INJURED EMPLOYEE:_____
HOME ADDRESS:_____
HOME PHONE:_____ DATE OF BIRTH:_____
AGE:_____ SEX: M F
MARITAL STATUS:_____ NAME OF SPOUSE (if applicable)_____
SOCIAL SECURITY NUMBER:_____ DATE OF HIRE:_____
NUMBER OF DEPENDENTS:_____
EMPLOYEES JOB TITLE:_____
DEPT. REGULARLY EMPLOYED:_____
WAS THE EMPLOYEE INJURED ON THE JOB: Y N
PRIMARY LANGUAGE OF THE EMPLOYEE: _____

b. ACCIDENT/INCIDENT INFORMATION:

DATE OF ACCIDENT:_____ TIME OF ACCIDENT:_____
REPORTED TO WHOM: _____ NAME OF SUPERVISOR_____
EXACT LOCATION WHERE ACCIDENT OCCURRED (**including street, city, state and County**):
EXPLAIN WHAT HAPPENED (include what the employee was doing at the time of the accident and how the accident occurred): _____
_____
_____
_____

DESCRIBE THE INJURY AND THE SPECIFIC PART OF THE BODY AFFECTED (i.e., laceration, right hand, third finger):
_____
_____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE:_____

NUMBER OF DAYS AND HOURS EMPLOYEE USUALLY WORKS PER WEEK:_____
IS THE EMPLOYEE EXPECTED TO LOSE AT LEAST ONE FULL DAY OF WORK?_____
DOES THE EMPLOYEE HAVE A PREVIOUS CLAIM? Y N if yes, STATUS Open Closed
WAS THE EMPLOYEE ASSIGNED TO RESTRICTED DUTY? _____

c. ACCIDENT INVESTIGATION INFORMATION

WAS SAFETY EQUIPMENT PROVIDED? Y N If yes, was it used? Y N
WAS AN UNSAFE ACT BEING FORMED ? Y N If yes, describe_____
WAS A MACHINE PART INVOLVED? Y N If yes, describe _____
WAS THE MACHINE PART DEFECTIVE? Y N If yes, in what way _____
WAS A 3RD PARTY RESPONSIBLE FOR THE ACCIDENT/INCIDENT? Y N
If yes, list Name, address and phone number_____
_____

WAS THE ACCIDENT/INCIDENT WITNESSED? Y N
If yes, list Name, address and phone number: _____
_____

d. PROVIDER INFORMATION

WAS FIRST AID GIVEN ON SITE? Y N
If yes, what type of medical treatment was given _____
PHYSICIAN INFORMATION (if medical attention was administered)
NAME:_____
ADDRESS (incl. City, state and zip):_____
PHONE:_____

HOSPITAL ADDRESS (incl. Name, address, city, state, zip code & phone)
_____
_____

WAS THE EMPLOYEE HOSPITALIZED? Y N If yes, on what date_____
WAS THE EMPLOYEE TREATED AS AN OUTPATIENT, RECEIVE EMERGENCY TREATMENT OR AMBULANCE SERVICE? _____

PLEASE ATTACH THE PHYSICIANS WRITTEN RETURN TO WORK SLIP

***NOTE* A PHYSICIANS RETURN TO WORK SLIP IS REQUIRED PRIOR TO ALLOWING THE WORKER TO RETURN TO WORK**

e. AUTOMOBILE ACCIDENT INFORMATION (complete if applicable)

AUTHORITY CONTACTED AND REPORT #_____
EA EMPLOYEE VEHICLE YEAR, MAKE AND MODEL_____

V.I.N._____ PLATE/TAG #_____
OWNER'S NAME AND ADDRESS:_____
DRIVER'S NAME AND ADDRESS: _____
RELATION TO INSURED:_____DRIVER'S LICENSE #_____
DESCRIBE DAMAGE TO YOUR PROPERTY:_____
DESCRIBE DAMAGE TO OTHER VEHICLE OR PROPERTY:_____
OTHER DRIVER'S NAME AND ADDRESS: _____
OTHER DRIVER'S PHONE:_____
OTHER DRIVER'S INSURANCE COMPANY AND PHONE:_____
LOCATION OF OTHER VEHICLE:_____
NAME, ADDRESS AND PHONE OF OTHER INJURED PARTIES:_____
WITNESSES

NAME:_____ PHONE:_____
ADDRESS:_____
STATEMENT:_____
SIGNATURE: _____

NAME:_____ PHONE:_____
ADDRESS:_____
STATEMENT:_____
SIGNATURE: _____

f. ACKNOWLEDGEMENT

NAME OF SUPERVISOR:_____
DATE OF THIS REPORT: _____ REPORT PREPARED BY:_____

I have read this report and the contents as to how the accident/loss occurred is accurate to the best of my knowledge.

Signature: _____ Date: _____
Injured Employee

7.1.1.1

I am seeking medical treatment for a work related injury/illness.

Please forward all bills/invoices/correspondence to:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

11019 McCORMICK ROAD

HUNT VALLEY, MD 21031

ATTENTION: Michele Bailey
HUMAN RESOURCES

(410) 584-7000

NEAR MISS INCIDENT REPORT

THIS REPORT IS TO BE COMPLETED WHEN A NEAR MISS OCCURS THAT COULD HAVE POTENTIALLY RESULTED IN SERIOUS PHYSICAL HARM. PLEASE FAX THIS FORM TO EA HUMAN RESOURCES DEPARTMENT AT **(410) 771-1780**.

EXPLAIN WHAT HAPPENED (include what the employee was doing at the time the near miss and how it occurred): _____

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REPORT PREPARED BY: _____ DATE:_____