

# Deck Barge Safety



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# OSHAcademy Course 895 Study Guide

## Deck Barge Safety

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Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 895.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

OSHAcademy

15220 NW Greenbrier Parkway, Suite 230

Beaverton, Oregon 97006

[www.oshatrain.org](http://www.oshatrain.org)

[instructor@oshatrain.org](mailto:instructor@oshatrain.org)

+1 (888) 668-9079

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## Contents

Course Introduction .....	1
Module 1: Deck Barge Requirements .....	2
Regulation of Workplace Safety on Deck Barges.....	2
What the U.S. Coast Guard Regulates .....	2
What OSHA Regulates.....	2
Where OSHA Has Jurisdiction .....	2
Where are the Outer Continental Shelf (OCS) Lands? .....	3
OSHA Regulations That Apply to Barge Safety .....	3
OSHA Enforcement Depends on the Work Activity .....	4
Mine Safety and Health Administration (MSHA) Enforcement .....	4
Training .....	4
Training Topics .....	5
Specific Training .....	6
Accident Summary .....	6
Module 1 Quiz.....	7
Module 2: Slips, Trips and Falls.....	9
Minimizing Hazards on Deck.....	9
Precautions in Walking .....	10
Preventing Elevated Falls .....	11
Accident Summary .....	13
Module 2 Quiz.....	14
Module 3: Falling Overboard .....	16
Personal Flotation Devices.....	16

U.S. Coast Guard Regulations for Uninspected Vessels .....	16
Regular Maintenance and Inspection .....	17
Safety Precautions .....	17
Job Hazard Analysis to Prevent Overboard Incidents.....	17
Man Overboard Rescue Procedures .....	17
Accident Summary .....	18
Module 3 Quiz.....	19
Module 4: Equipment Operator Safety .....	21
Hoists, Cranes and Derricks .....	21
Spuds.....	22
Preventing Accidental Deployment of Spuds .....	22
Winches and Cable Systems .....	23
Accident Summary .....	24
More Information about Machinery and Equipment Safety .....	24
Module 4 Quiz.....	25
Module 5: Confined/Enclosed Space Hazards .....	27
Oxygen-Deficient Atmospheres .....	27
Explosive or Flammable Atmospheres.....	27
Identifying Toxic Atmospheres .....	28
Accident Summary .....	29
More Information About Atmospheric Hazards and Confined Spaces .....	29
Module 5 Quiz.....	30
Module 6: Fire and Electrical Hazards .....	32
Fuel Storage .....	32

Ignition Sources.....	32
Electrical Hazards .....	33
U.S. Coast Guard Regulations for Uninspected Vessels .....	34
Fire Extinguishing Equipment [46 CFR 25.30].....	34
Backfire Flame Control.....	35
Ventilation.....	35
Accident Summary .....	35
Module 6 Quiz.....	36
Endnotes .....	38

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## Course Introduction

A barge is a flat-bottomed boat, built mainly for river and canal transport of heavy goods. Some barges are not self-propelled and need to be towed or pushed by **towboats**.

A deck barge is a manned or unmanned barge that has a continuous, flat main deck. It is used to carry deck cargo and is also used in the marine construction industry for such work as pier or bulkhead construction, dredging, bridge construction and maintenance, and marine oil service. These types of vessels are not self-propelled.

Employees on barges and other vessels can face serious hazards. Between 1997 and 2006, 305 employees were killed on barge/tow combinations, and 379 explosions or fires occurred on barges or towboats, killing 14 employees. Some examples of these incidents include the following:

- ) An employee was setting a steel pile upright in the water. The steel pile was being held upright by a chain connecting it to the barge. A large boat passed by the barge, creating a wake. The barge moved and the steel pile fell, pivoting on the chain. The steel pile struck the employee on the back of the head, killing him.
- ) An employee carrying a right angle grinder attempted to step from one barge to another by using a barge rope. He lost his balance and fell into the river between the two barges. He was not wearing a life vest. Rescue efforts were unsuccessful and the employee drowned.
- ) An employee was standing on a barge with a coworker, waiting for a personnel basket to land on the barge. He was holding a small sheet of plywood. He stepped back, stumbled on a board, and fell over the side of the barge into 12 feet of water. He was not wearing a life vest. Rescue attempts by his coworkers with a life ring failed and he drowned.

Approximately 4,000 deck barges operate in the United States, using different types of winches and other equipment in a variety of operations. Many injuries and deaths could be prevented with proper controls, procedures, training, and awareness of hazards and possible solutions.

This course presents guidance on preventing injuries and illnesses from workplace hazards on deck barges. In the following modules, the major physical hazards of concern are highlighted and steps to address them are outlined, along with resources for additional information.

## Module 1: Deck Barge Requirements

### Regulation of Workplace Safety on Deck Barges

For construction barges underway and other “uninspected vessels,” the U.S. Coast Guard oversees fire and lifesaving equipment and overall navigational matters.

An uninspected vessel is a vessel not subject to inspection under 46 U.S.C. 3301 and not a recreational vessel under 46 U.S.C. 2101(43).



USCG Tugboat pushing a barge

### What the U.S. Coast Guard Regulates

A vessel classified as an uninspected vessel by the U.S. Coast Guard is subject to limited U.S. Coast Guard inspection of the following areas:

- ) basic firefighting equipment
- ) approved life jackets and lifesaving equipment
- ) ventilation of engine bilges and fuel tank compartments
- ) backfire traps/flame arresters on inboard engine carburetors using gasoline as a fuel

### What OSHA Regulates

The U.S. Occupational Safety and Health Administration (OSHA) exercises its authority to regulate employers for all working conditions not covered by U.S. Coast Guard regulations on these vessels, provided that the vessel is in the geographic jurisdiction of OSHA.

OSHA regulations that apply are in 29 CFR Part 1910, with the following exceptions:

- ) For ship repair, shipbuilding, and shipbreaking, 29 CFR Part 1915 standards apply.
- ) For longshoring and cargo handling operations, 29 CFR Parts 1918 and 1919 standards apply.
- ) For marine construction activities, 29 CFR Part 1926 standards apply.

### Where OSHA Has Jurisdiction

OSHA has safety and health coverage over working conditions of employees on vessels and facilities on or adjacent to U.S. navigable waters and the Outer Continental Shelf.

Navigable Waters of the United States (U.S. navigable waters) includes State territorial seas and U.S. inland waters (i.e., all rivers, tributaries, lakes, bays, and sounds shoreward of the territorial sea baseline) that:

1. are subject to tidal influence, or
2. are or have been used for interstate or foreign commerce [33 CFR Part 2].

The U.S. Coast Guard is the agency responsible for making any determination of whether a body of water is considered to be U.S. navigable waters.

### **Where are the Outer Continental Shelf (OCS) Lands?**

The Outer Continental Shelf (OCS) Lands are considered to be:

- ) the submerged subsoil and seabed lying seaward and outside of the lands beneath navigable waters of the United States (U.S. inland waters, and State territorial seas) subject to the jurisdiction of the United States
- ) all artificial islands, and all installations and other devices permanently or temporarily attached to the seabed, which may be erected thereon to explore for, develop, or produce resources therefrom, or any installation or other device (other than a ship or vessel) to transport such resources

### **OSHA Regulations That Apply to Barge Safety**

An employer who is an owner, charterer, managing operator, or agent in charge of an uninspected vessel (including deck barges) may be cited for hazards to which any of their employees are exposed if the hazard is not regulated by the U.S. Coast Guard.

OSHA standards and requirements apply as follows:

- ) Section 5(a)(1) contains the general duty clause of the Occupational Safety and Health Act (OSH Act) for recognized hazardous situations that are causing or are likely to cause death or serious physical harm to the employees of the employer to be cited, for which there are no specific OSHA standards or U.S. Coast Guard regulations.
- ) 29 CFR Part 1910 details the general working conditions not otherwise regulated, such as the working conditions on uninspected vessels that are not addressed by U.S. Coast Guard regulations
- ) 29 CFR Part 1915 is for information regarding ship repair, shipbuilding and shipbreaking (including 29 CFR Part 1910 requirements applicable to shipyards).
- ) 29 CFR Part 1917 is for marine terminal operations.
- ) 29 CFR Part 1918 is for longshoring operations.

- ) 29 CFR Part 1919 is for cargo handling gear.
- ) 29 CFR Part 1926 is for marine construction activities.

### **OSHA Enforcement Depends on the Work Activity**

Generally, when considering enforcement of safety on deck barges, the applicable OSHA standard depends on the work activity taking place. For example, a vessel may be loading and unloading cargo at a marine terminal while at the same time the vessel is undergoing ship repairs. OSHA would enforce safety as follows:

- ) The cargo handling work activity shore-side is regulated by the Marine Terminals Standards (29 CFR Part 1917) and on the vessel (ship) by the Longshoring Standards (29 CFR Part 1918).
- ) However, the work activity for the vessel repairs are regulated by the Shipyard Employment Standards (29 CFR Part 1915), even though the repairs are being conducted at a marine terminal instead of a shipyard facility.

### **Mine Safety and Health Administration (MSHA) Enforcement**

The Mine Safety and Health Administration (MSHA) has authority over the loading/unloading of coal or other minerals into/out-of barges or vessels in the extraction, preparation, or milling process.

MSHA does not have authority once the vessel is loaded/unloaded and is underway. Likewise, MSHA authority extends to barges and vessels used in mineral dredging operations, such as mining sand and gravel from underwater deposits, and includes the loading/unloading of such barges/vessels.

### **Training**

Training is an essential part of every employer's safety and health program for protecting employees from injuries and illnesses. Many OSHA standards require employers to train employees in the safety and health aspects of their jobs. Other OSHA standards make it the employer's responsibility to limit certain job assignments to employees who are certified, competent, or qualified—that is, to employees who have received training either on-site or off-site.

Designated personnel are selected or assigned by the employer as having the necessary knowledge, skills and abilities (KSAs), and therefore qualified to perform specific duties.

## Training Topics

To control or eliminate any hazards or other exposure to illness or injury, employees must be properly trained in the recognition and avoidance of unsafe conditions. Employees should also be familiar with the company's policies, rules, and regulations set forth by OSHA and the U.S. Coast Guard that are applicable to their work environment.

Some of the general safety topics to be addressed in training for employees on deck barges are:

- ) Employee Emergency Plans
- ) Medical Services and First Aid
- ) Explosive and Other Dangerous Atmospheres
- ) Fire Protection and Prevention
- ) Handling and Storage of Materials
- ) Machinery and Machine Guarding
- ) Toxic and Hazardous Substances
- ) Storage of Gases and Fuels
- ) Gear and Equipment for Rigging and Material Handling
- ) Tools and Related Equipment
- ) Stairways, ladders and fall protection
- ) Work on or in the Vicinity of Radar and Radio
- ) Electrical Safety-Related Work Practices
- ) The Control of Hazardous Energy (Lockout/Tagout)
- ) Personal Protective Equipment
- ) Procedures for Securing Barges to Tugs

) Noise and Hearing Conservation

### Specific Training

The training should address the specific hazards faced by employees on barges such as:

- ) ways to prevent overboard incidents
- ) the use of personal flotation devices
- ) awareness of the risks of carelessness/distractions while working on deck or overextending oneself
- ) employee emergency plans must include man overboard rescue procedures and drills
- ) for spud winch operators, the use of spud securing pins before a barge is moved to a different worksite

### Accident Summary

A deck engineer died when she was struck by the counterweight of a barge mounted crane/derrick. The deck engineer (victim) and a crane operator, both employees of a marine construction company, were working from a crane/derrick barge in support of a crew working at a job site on a project to replace pilings underneath a pier. She was welding repairs to a guard railing on the barge's upper deck when the crane operator rotated the crane to make a pick of pilings from the water. The crane's counterweight struck her in the head and neck, pinning her against the railing.



A deck engineer on barge died when struck by crane counterweight in Washington State.

## Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following is true about deck barges?**
  - a. They are for use primarily on the high seas
  - b. They are not self-propelled
  - c. They are diesel-powered
  - d. They are not used to carry cargo
  
- 2. For construction barges underway and other uninspected vessels, the U.S. Coast Guard oversees \_\_\_\_\_.**
  - a. fire and lifesaving equipment and overall navigational matters
  - b. only fire and lifesaving equipment
  - c. only overall non-navigational matters
  - d. fire and lifesaving equipment and non-navigational matters
  
- 3. The U.S. Coast Guard would inspect which of the following on uninspected vessels?**
  - a. Safety signage
  - b. Employee safety training
  - c. Approved life jackets and lifesaving equipment
  - d. Working conditions on board the vessel
  
- 4. Which of the following training topics should be given to spud winch operators?**
  - a. How to peel spuds most efficiently
  - b. Effective spud recognition methods
  - c. Spud accident analysis techniques
  - d. The use of spud securing pins

- 5. Employee emergency plan training for barge workers must include \_\_\_\_.**
- a. flooding control and mitigation controls
  - b. man overboard rescue procedures and drills
  - c. loss of power procedures
  - d. prevention of overboard incidents



## Module 2: Slips, Trips and Falls

Slips, trips and falls are major causes of workplace injuries in the maritime industry and can lead to overboard incidents. The following are some definitions that can help you distinguish between slips, trips and falls:

- ) A slip occurs when the foot skids, usually on a wet or slippery surface (e.g., ice) and the person falls backward or forward.
- ) A trip occurs when an obstacle stops the foot and the person falls forward.
- ) Same-level falls can be the result of an unrecoverable slip or trip. Another type of same-level fall is a step and fall, when the front foot lands on a surface that is lower than expected. In this type of fall, the person usually falls forward.
- ) Elevated falls include falls from stairs, equipment, ladders, and falls through holes in decks, and uncovered or unguarded hatches.

Many factors can contribute to slips, trips, and falls on a barge. Some of these include:

- ) gear and equipment on the deck
- ) changing walking speed or direction
- ) slippery surfaces (oil, ice and snow)
- ) fatigue
- ) carrying heavy objects
- ) visibility
- ) unsuitable footwear

### Minimizing Hazards on Deck

Be sure to follow these safe practices to minimize the hazards to employees while working on barge decks:

- ) Keep all walking and working surfaces clean, dry, and unobstructed.

- )] Keep all areas free of debris.
- )] Clean up and/or report any spill immediately.
- )] Stack materials in a stable manner.
- )] Secure gear and equipment that is not in use.
- )] Keep stairs, doorways, walkways, and gangways free of equipment and stowed materials.
- )] Secure ramps during loading and offloading operations.
- )] Repair leaks from hoses, pipelines, and valves immediately.
- )] Use non-skid protective deck compound and do not paint over the non-skid compound with standard paint.
- )] Have de-icing procedures in place when necessary.
- )] Paint the perimeter and tripping hazards in a contrasting color.

### **Precautions in Walking**

Deck barge workers should use the following OSHA checklist to understand how to safely walk on a barge deck to prevent slips and trips:

- )] Walk at a normal rate, keeping your hands out of your pockets.
- )] Slow down when moving between different surfaces.
- )] Do not run.
- )] Minimize short stops.
- )] Avoid sharp turns.
- )] Modify your way of walking to match the surface, such as an icy deck.
- )] Do not jump from one barge to another.

- ) Do not climb on cargo, supplies, or equipment instead of using a ladder.
- ) Do not step on hatch covers.
- ) Avoid walking along the unguarded edge of a barge.
- ) Watch out for reduced visibility due to poor lighting and weather conditions.
- ) If working at night, be sure there is adequate illumination (e.g., flashlight, headlight, light tower).
- ) Wear safety shoes or boots with slip-resistant soles as appropriate.
- ) Keep shoes clean of mud, snow, ice, spilled liquids, and debris.

### Preventing Elevated Falls

Deck barge workers should use the following safe practices to prevent falls:

- ) Always maintain three-points of contact on a ladder—two hands and a foot, or two feet and a hand—so that only one limb is in motion at any one time.
- ) Avoid overextending the body when performing tasks such as checking sounders, checking lights, and wiring rigging, which can lead to falls from ladders.
- ) Falls from portable ladders are one of the leading causes of occupational fatalities and injuries. Use the following safe work practices when using ladders:
  - Use ladders only for their designed purpose (i.e., step ladders should not be used as portable rung ladders).
  - Position the ladder so that for every four feet in height, the ladder extends out from the vertical surface at the base approximately one foot.
  - Make sure that the ladder is long enough for the job. If used for access to an upper landing surface, the side rails must extend at least three feet above that surface.
  - Make sure that there is proper footing to keep the ladder from slipping or sliding.

- Tie the ladder to a secure object. Remember, the vessel(s) the ladder is secured to can move. Use the buddy system, if possible, so one person can hold the ladder to stop it from moving.
  - Never use portable metal ladders near energized electrical equipment (such as conductors or electric arc welding machines).
  - Keep your body near the middle of the step and always face the ladder while climbing.
  - Do not move, shift, or extend ladders while in use. Move the ladder instead of stretching or leaning to the side to reach your work.
  - Use hand lines or a tool bag/belt to keep hands free when using a ladder.
- ) Fully enclosed slip-resistant footwear should always be worn when using ladders.
- ) An adequate guard rail should be installed or employees should wear Personal Fall Arrest Systems when work is being performed above a solid surface (e.g., to prevent falls from the barge to the dock). Note: body belts are not acceptable as part of a personal fall arrest system. See 29 CFR 1926.502(d) and 29 CFR 1915.159.
- ) Use gangplanks with guardrails to prevent falls on the dock or pilings.
- ) All deck holes, openings, and hatches should be covered or guarded.
- ) Pigeon holes should not be used to access barge walking or working surfaces.

## Accident Summary

A cement handler was fatally injured when he fell through an open hatch on a barge while attempting to cover a dust collection hatch with a tarp. He landed on the barge floor 20 feet below.

The accident occurred because management policies and procedures did not require that persons working on barges wear fall protection while working near open hatches. A risk assessment to identify hazards and establish safe procedures had not been conducted to protect persons loading material on barges.

Full report can be viewed at:

[www.msha.gov/FATALS/2008/ftl08m19.pdf](http://www.msha.gov/FATALS/2008/ftl08m19.pdf)



Worker suffers a fatality from falling through hatch in barge.

Check out this Mine Safety and Health Administration video: [Safety On or Near the water.](#)

## Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following would NOT contribute to slips, trips, and falls on a barge?**
  - a. Slippery surfaces
  - b. Fodder on the flight line
  - c. Gear and equipment on the deck
  - d. Carrying heavy objects
  
- 2. Which of the following includes falls from stairs, equipment, ladders, and falls through holes in decks, and uncovered or unguarded hatches?**
  - a. Same-level falls
  - b. Trips
  - c. Slips
  - d. Elevated falls
  
- 3. Which of the following should be done to minimize the hazards to employees while working on barges?**
  - a. Do not step on hatch covers
  - b. Wear safety shoes or boots with slip-resistant soles as appropriate
  - c. Keep all walking and working surfaces clean, dry, and unobstructed
  - d. Keep shoes clean of mud, snow, ice, spilled liquids, and debris
  
- 4. Which of the following should be done to safely walk on a barge deck to prevent slips and trips?**
  - a. Keep shoes clean of mud, snow, ice, spilled liquids, and debris
  - b. Have de-icing procedures in place when necessary
  - c. Repair leaks from hoses, pipelines, and valves immediately
  - d. Secure gear and equipment that is not in use

**5. Which of the following safe practices should be done to prevent common elevated falls on a barge?**

- a. Repair leaks from hoses, pipelines, and valves immediately
- b. Secure gear and equipment that is not in use
- c. Stack materials in a stable manner
- d. Fully enclosed slip-resistant footwear should always be worn when using ladders

## Module 3: Falling Overboard

### Personal Flotation Devices

If the deck of a barge or work platform is not equipped with an OSHA-compliant railing system, employees walking or working on deck must wear a U.S. Coast Guard-approved life jacket or buoyant work vest, also called a life preserver or personal flotation device (PFD). These PFDs should be fully buckled, snapped, or zipped whenever there is a hazard of falling into the water, regardless of the size of the barge.

While a PFD is not required to be worn while an employee is inside an enclosed cab or equipment compartment on a barge, each employee should have a PFD accessible to them at all times. This safety precaution will allow employees the opportunity to don a PFD in a reasonable amount of time during an emergency (i.e., vessel sinking, fire, etc.).

### U.S. Coast Guard Regulations for Uninspected Vessels

Life preservers and other lifesaving equipment requirements include:

- ) An approved and readily available PFD is required to be on board the vessel for each individual on board. An immersion/exposure suit is considered to be an acceptable substitute for a PFD. All lifesaving equipment designed to be worn is required to be readily available and in serviceable condition.
- ) Each vessel 26 feet or longer must have at least one approved ring life buoy which is immediately available. All lifesaving equipment designed to be thrown into the water is required to be immediately available and in serviceable condition.
- ) An approved commercial hybrid PFD is acceptable if it is:
  - o worn when the vessel is underway and the intended wearer is not within an enclosed space
  - o labeled for use on uninspected commercial vessels
  - o used as marked and in accordance with the owner's manual
- ) An approved light is required for all PFDs and immersion/exposure suits. Also, all PFDs must have approved retro-reflective material installed.



## Regular Maintenance and Inspection

Barges should be inspected by employers on a regular basis and as necessary. This will prevent problems related to missing equipment, hazardous working surface conditions, and mechanical failures that could contribute to falls overboard. For example, inspections should check for missing or damaged PFDs, missing lifelines, and burned-out lights.

## Safety Precautions

There are several controls that may help prevent employees from falling overboard. Examples include marking the edge of the deck with contrasting paint or, if practical, installing guardrails or handrails.

## Job Hazard Analysis to Prevent Overboard Incidents

To reduce the risks of overboard incidents and drowning, employers and employees can conduct a joint job hazard analysis to identify conditions that may contribute to overboard incidents. Appropriate control measures and training can be implemented to reduce the hazards associated with falling overboard.

For example, if the separation between a barge and the dock or another vessel is more than 12 inches, a gangway or ladder must be used. Additionally, it is important to look for warning signs such as employee fatigue, complacency, and lack of concentration. Be sure to resolve these issues before an overboard incident occurs. Employers also may consider hiring a professional safety engineer to evaluate hazards and possible controls.

## Man Overboard Rescue Procedures

It is critical to have clear procedures in place in case someone falls overboard. Man-overboard procedures should incorporate the use of stand-by boats, life rings with appropriate length of rope (90 feet minimum), and ladders that extend three feet below and above the water surface. In a case where an employee falls overboard, they will need assistance to get back on board. This must be accomplished quickly, particularly if the water is frigid, the person is not wearing a life jacket, is tangled in a line or caught in a current.

Crews should practice man overboard drills regularly. Additionally, in regions such as Alaska, where employees are at a greater risk of hypothermia, additional precautions (e.g., use of immersion suits) should be considered when there is a chance of falling overboard.

For More Information About Preventing Overboard Incidents The American Waterways Operators. Fall Overboard Prevention Best Practices. March 2001.

[www.americanwaterways.com/commitment\\_safety/BESTPRAC.doc](http://www.americanwaterways.com/commitment_safety/BESTPRAC.doc).

## Accident Summary

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An employee was standing on a barge with a coworker, waiting for a personnel basket to land on the barge. He was holding a small sheet of plywood. He stepped back, stumbled on a board, and fell over the side of the barge into 12 feet of water. He was not wearing a life vest. Rescue attempts by his coworkers with a life ring failed and he drowned.



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Check out this short video by AEP River Operations: [Working on the River.](#)

### Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. What is the requirement on a barge if the deck or work platform is not equipped with an OSHA-compliant railing system?**
  - a. Employees on the deck must wear fall-arrest protective systems
  - b. Employees on the deck must wear a U.S. Coast Guard-approved life jacket or buoyant work vest
  - c. Employees on the deck must wear fall-restraint protective systems
  - d. Employees on the deck must wear an OSHA-approved personal floatation device
  
- 2. How many personal flotation devices (PFD) are required to be readily available on a vessel if there are 6 employees working on board?**
  - a. 3
  - b. 4
  - c. 5
  - d. 6
  
- 3. Each vessel \_\_\_\_\_ must have at least one approved ring life buoy which is immediately available.**
  - a. 26 feet or longer
  - b. 20 feet or longer
  - c. 16 feet or longer
  - d. 10 feet or longer
  
- 4. To help prevent falls overboard, a gangway or ladder must be used if the separation between a barge and the dock or another vessel is more than \_\_\_\_\_.**
  - a. 2 feet
  - b. 3 feet
  - c. 12 inches
  - d. 18 inches

**5. Which of the following should be incorporated into man-overboard rescue procedures?**

- a. Life rings attached to an appropriate length of rope
- b. Inflatable boats with quick-inflate devices
- c. 911 communications system
- d. At least 30 feet of synthetic rope

## Module 4: Equipment Operator Safety

Hazards to equipment operators while using equipment and machinery on barges can result in injuries to hands, feet, or limbs that become caught in moving machinery; head and other injuries from being struck by falling objects or moving equipment; and burns. Other potential hazards include getting pinned under a load, falling off equipment, and electric shock.

To reduce hazards from machinery and equipment:

- ) Inspect all equipment before use.
- ) Maintain equipment properly.
- ) Shut down and lockout the power source before repairing mechanical systems.
- ) Make repairs according to the manufacturer's guidelines.
- ) Ensure that the person using the equipment is trained in its proper use and maintenance.
- ) Install appropriate rails, temporary or permanent, to avoid equipment being driven off the barge or dock.
- ) Ensure retaining pins are properly installed and positively secured with a keeper or locking device.
- ) Emergency shut-offs must be easily accessible, and sufficient guarding should be used for equipment controls.

### Hoists, Cranes and Derricks

Hazards of hoists include being struck by a heavy object, such as the boom or the load being moved. To reduce these hazards:

- ) Stay clear when a hoist is being used unless you are part of the procedure and, in which case, never stand under a load or boom with a suspended load.
- ) Wear personal protective equipment, such as head, foot, eye, and hand protection at all times.
- ) Assess the hoisting systems for structural soundness by inspecting regularly for problems with welds, rivets, chains, pulleys, lines, blocks, hooks, etc.
- ) Secure power blocks with a safety chain.

- ) Ensure that cranes in use are secured to the barge.
- ) Do not try to help lift a load being hoisted.

Areas that workers are able to access within the swing radius of a crane's superstructure present a hazard of being struck by, crushed, or pinched between the rotating superstructure and a stationary object. Employers should restrict those areas within the crane's swing radius from entry so as to prevent injury to workers.

Methods of marking the boundaries of the swing radius hazard area include control lines, warning lines, railings, and other similar barriers. Follow these safe practices to help prevent injuries due to crane operations:

- ) Ensure a method of communication is established between the crane operator and other workers.
- ) Do not move the crane and its superstructure until the "all clear" signal is given.
- ) If a worker will be working within the swing radius of the crane, the operator should physically lockout/tagout the crane.
- ) Make sure all workers are properly trained on the hazards associated with working around cranes.

## Spuds

During marine construction work deck barges are held in place by vertical steel shafts known as spuds. The spud equipment typically consists of forward and aft spuds and a diesel engine—powered spud winch.

Three methods are available to prevent the spud from accidentally dropping or slipping:

1. latching the winch foot brake;
2. engaging a steel pawl that fits into a notched ring on the outside of the winch drum; and
3. inserting a steel securing pin directly through the fully raised spud, preventing it from free-falling if the winch or cable fails.

## Preventing Accidental Deployment of Spuds

To ensure the safety of employees on construction barges and towing vessels, employers and employees need to take the following safety precautions:

- )] Before a barge is moved, the spuds need to be raised so that the pinhole is above the resting area of the securing pin. Each spud should be pinned in the raised position.
- )] The licensed master of a towing vessel, who is responsible for ensuring that the vessels under his or her control are safe to move, needs to ensure that spud securing pins are in place and have a means to prevent inadvertent disengagement before the tow is underway.
- )] If the spuds must be lowered to stop the barge in an emergency situation (for example, in case of a power failure of the tug or an imminent collision), a supervisor needs to direct the barge employees on how and when to lower the spuds.
- )] Before attempting to lower mooring spuds, ensure that spud securing pins are completely removed and that employees are clear of the immediate area. Such practices will help to avoid employees being struck by dislodged or falling pins, which can weigh up to 85 pounds and measure approximately 4-foot-long and 3 inches in diameter.
- )] Employers who own and operate barges need to develop standard operating procedures. Employers should provide initial and periodic training to employees on barges, including how to use securing pins to hold spuds safely in place before a barge is moved from one site to another.

### Winches and Cable Systems

Operating or working near winches may potentially expose employees to hazards such as body parts caught in a winch drum, being struck by a broken line or cable, and tripping over a line or cable.

Be sure to follow these safe practices when working with winches:

- )] Use a device or tool—never your hand—to keep the winch line spooling properly.
- )] Enclose the winch drum in a cage if practical.
- )] Stay off the deck unless you are part of the operation.
- )] Never stand in, on, over, or in line with lines or cables connected to winches when they are under tension. The danger zone lies within 15 degrees of either side of a line under tension.

- ) Never step on or walk over the winch drum.
- ) Inspect the winch system regularly for problems associated with general or localized deterioration, cracked welds, and other structural, mechanical, or electrical deficiencies.
- ) Inspect lines and cable systems regularly, including blocks, hooks, and associated components, for signs of damage or deterioration.
- ) A guard should be installed between the winch operator and the connected cables to protect the operator from potential whiplash.
- ) Never stand in the bight of a line.

### Accident Summary

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A deckhand was working on a spud barge helping a coworker raise the spud legs using a winch system. A 42-inch pin was to be inserted into the spud leg to prevent it from falling if the winch brake released. The spud leg was raised just high enough for the employee to insert about 4 inches of the pin into the hole, when the winch brake failed. The pin came up and the employee was pinned between the pin and spud leg, sustaining fatal crushing injuries to his chest.

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### More Information about Machinery and Equipment Safety

OSHA Shipyard Employment eTool: Gear and Equipment for Rigging and Materials Handling. [www.osha.gov/SLTC/etools/shipyard/standard/material\\_handling/index\\_mh.html](http://www.osha.gov/SLTC/etools/shipyard/standard/material_handling/index_mh.html).

OSHA Publication, Mobile Crane Inspection Guidelines for OSHA Compliance Officers, June 1994. [www.osha.gov/SLTC/cranehoistsafety](http://www.osha.gov/SLTC/cranehoistsafety)



## Module 4 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following should be accomplished to reduce the hazards from working with equipment and machinery on a barge?**
  - a. Cover all deck holes, openings, and hatches
  - b. Shut down and lockout the power source before repairing mechanical systems
  - c. Always use gangplanks with guardrails on docks or pilings
  - d. Use pigeon holes to access the barge walking or working surfaces
  
- 2. What should the barge crane operator do if a worker will be working within the swing radius of the crane?**
  - a. Cover all deck holes, openings, and hatches within the swing radius of the crane
  - b. Do not move the crane until a clear signal is given
  - c. Use specific signals when moving the crane
  - d. Physically lockout/tagout the crane
  
- 3. Which of the following is one of the three methods available to prevent the spud from accidentally dropping or slipping?**
  - a. Inserting a steel securing pin
  - b. Roping the winch foot brake
  - c. Engaging a steel ring into the pawl on the inside of the winch
  - d. Latching the spud securely to the winch
  
- 4. Before a barge is moved, the spuds need to be raised so that the \_\_\_\_.**
  - a. pinhole is above the resting area of the securing pin
  - b. spud is lowered below the securing pin
  - c. pinhole is positioned at least 1 foot above the securing pin
  - d. the spud securely latched to the winch

- 5. When working around winches when they are under tension, the danger zone lies within \_\_\_\_.**
- a. 90 degrees of the side of a line under tension
  - b. 45 degrees of the side of a line not under tension
  - c. 15 degrees of either side of a line under tension
  - d. 30 degrees of the line under tension

## Module 5: Confined/Enclosed Space Hazards

The confined or enclosed spaces on barges may have an atmosphere that is unsafe, causing injury or death. The three main atmospheric hazards while working in a confined or enclosed barge space are:

1. oxygen deficiency
2. explosive or flammable atmospheres
3. atmospheres containing toxic compounds

These hazards might be found in any watertight compartment or other area on a barge with little or no ventilation.

### Oxygen-Deficient Atmospheres

The most hazardous confined or enclosed space conditions in barge operations occur while exposing workers to oxygen-deficient atmospheres and toxic atmospheres. Toxic vapors may be produced by the previous cargo or cleaning agents and could present significant health hazards. When encountered in confined or enclosed spaces, these agents produce vapors that are often heavier than air. This can cause displacement of air, reducing oxygen levels, which may be fatal. An oxygen-deficient atmosphere inside a tank can be caused by many factors such as:

- ) Rusting that may occur in a steel tank where water or water vapor is present. If the tank is airtight, as they are designed to be, then the rusting process would remove oxygen from the tank atmosphere until there is not enough oxygen in the space to support human life.
- ) Displacement of oxygen by another gas or vapor, which may occur when a tank is sealed after it is freshly painted. The paint coating may not have time to cure, resulting in the paint vapor displacing oxygen.

Check out this short [OSHA video](#) describing how a worker was overcome by carbon monoxide in a confined space.

### Explosive or Flammable Atmospheres

An explosive or flammable atmosphere can develop from many sources. Some examples of these sources may include:

- ) If you are leasing a barge, a previous user may have dumped waste into the space or used it as a slop tank.
- ) A spill of diesel fuel or gasoline on deck may have entered the tank, resulting in an explosive atmosphere.
- ) The paint or coating system applied to the tank could ignite if not locally removed prior to hotwork.

Watch this short OSHA video: [Improper Ventilation Causes Fire in Confined Space.](#)

Before beginning work in, near or around a confined space or compartment, be sure to do the following:

1. A visual inspection must first be performed in order to identify potential physical, atmospheric and fire hazards.
2. The atmosphere must be tested, using a combustible gas meter, not only prior to entry into the space but also if you plan on doing hotwork on a tank exterior. Conducting hotwork on the exterior of a tank can be just as dangerous as when done internally if an explosive atmosphere or a flammable coating is present, which could result in a fire or explosion.

### Identifying Toxic Atmospheres

Toxic atmospheres are generally the most difficult to identify and can only be determined through testing, which should only be conducted by a qualified person (i.e., marine chemist, competent person, etc.). The potential for a toxic atmosphere is always present and can come from several sources including:

- ) A space that is painted and sealed up before the paint has time to cure, causing the off-gassing of the fresh paint to release toxic levels of paint and solvent vapors into the secured space.
- ) A tank cover is inadvertently left open that allows nearby engine exhaust to raise the amount of carbon monoxide in the tank to dangerous levels.
- ) Contents from a chemical spill (deck above) enters the space.
- ) Multiple waste or slop is dumped into a space that creates a toxic compound.

Based on the hazards discussed above, entry into any confined/enclosed space or any space with limited ventilation space on a deck barge should be done with caution.

### **Accident Summary**

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Two riggers were capping a sulfur well in a shallow bay, working from the deck of a barge equipped with a crane with a clamshell bucket. The employees dug around the well casing and then set a caisson around the wellhead. Standard procedures required them to cut off the casing and then weld a circular plate over the end. The first employee went into the caisson to wrap a sling around the pipe end, and was asphyxiated due to hydrogen sulfide gas. The second employee entered the caisson to rescue him, and was also overcome by the gas. Neither was wearing respiratory protection (i.e., airline or Self-Contained Breathing Apparatus). Both employees died.

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### **More Information About Atmospheric Hazards and Confined Spaces**

OSHA Safety and Health Topics: Confined Spaces [www.osha.gov/SLTC/confinedspaces](http://www.osha.gov/SLTC/confinedspaces).

Shipyards Employment e-Tool: Ship Repair

[http://www.osha.gov/SLTC/etools/shipyards/shiprepair/sr\\_index.html](http://www.osha.gov/SLTC/etools/shipyards/shiprepair/sr_index.html)

Take OSHA Academy [Course 713, Confined Space Safety](#)

## Module 5 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. The most hazardous confined space conditions in barge operations occur while exposing workers to \_\_\_\_.**
  - a. oxygen-enriched and biohazardous atmospheres
  - b. atmospheres containing toxic compounds
  - c. oxygen-deficient atmospheres and toxic atmospheres
  - d. atmospheres containing dihydrogen oxide
  
- 2. Rusting that may occur within a steel tank where water or water vapor is present may result in which of the following conditions?**
  - a. Oxygen-enriched atmosphere
  - b. Toxic compounds
  - c. Dihydrogen oxides
  - d. Oxygen-deficient atmosphere
  
- 3. Which of the following conditions may occur if the paint or coating system applied to a tank was not locally removed prior to hotwork?**
  - a. Explosive or flammable atmosphere
  - b. Oxygen-deficient atmosphere
  - c. Toxic compounds
  - d. Dihydrogen oxides
  
- 4. Which of the following must be completed prior to beginning work in, near or around a confined space?**
  - a. OSHA inspection
  - b. BSEE inspection
  - c. Visual inspection
  - d. Safety staff inspection

- 5. Which of the following are generally the most difficult types of hazardous atmospheres to identify within a barges confined space?**
- a. oxygen-deficient atmospheres
  - b. toxic atmospheres
  - c. flammable atmospheres
  - d. explosive atmospheres

## Module 6: Fire and Electrical Hazards

Fire and explosions on barges may be caused by:

- ) flammable and combustible cleaning solvents, such as Methyl Ethyl Ketone (MEK), mineral spirits, and diesel fuel/oil
- ) liquids with high flash points (greater than 100° F) applied as a fine mist
- ) airborne particulate or dust
- ) hydrogen gas generated during cleaning processes
- ) reactive cargoes such as iron-ore, fertilizer, or incompatible chemicals

### Fuel Storage

Store engine fuel tanks and compressed gas tanks properly, away from sources of ignition. Only keep onboard quantities of flammable and combustible materials that are necessary for operations and maintenance. Post appropriate danger signs.

Read about why [Google's barges were shut down over fire fears](#).

### Ignition Sources

When dealing with work that is capable of providing a source of ignition through a flame or spark (hotwork), such as welding, cutting, burning, drilling, grinding, etc., follow these precautions:

- ) Ensure the space is properly tested by a qualified or shipyard-competent person and deemed safe before work is begun.
- ) Make sure that proper fire extinguishing equipment is near the work area and that it is maintained in a state of readiness for emergency use.
- ) Do not leave oxygen or acetylene hoses unattended.
- ) Consider where sparks will fall when doing hotwork and employ a fire watch.
- ) Shield fuel sources to protect them from ignition sources.
- ) Cover openings to prevent sparks from entering.
- ) Stop any hotwork if you smell fuel or gas until the source has been identified and the problem fixed.



- ) When welding or burning on the deck of a barge, the space below should be inspected to ensure that no flammable atmosphere or combustible materials are present.
- ) Use good housekeeping practices to limit the amount of clutter, debris and combustible/flammable material.

### Electrical Hazards

On barges and other vessels, employees who work with or around electrical equipment in wet or damp locations have an increased risk of getting shocked or electrocuted due to:

- ) exposed energized electrical parts
- ) open lighting parts (such as broken bulbs, exposed conductors, etc.)
- ) damaged insulation on power cords

Electrical equipment (unless this equipment is explosion proof or intrinsically safe) must not be used on hot barges until they are gas free (such as barges that have contained flammable/combustible material including gasoline, methanol, styrene, toluene, etc.).

Non-explosion proof or non-intrinsically safe electrical equipment may be used on a barge after it has been determined the barge is gas-free.

Static electricity can be generated in barge cleaning operations by:

- ) friction of different metals
- ) movement of grain
- ) transfer of liquids
- ) mechanical ventilation (such as pneumatic, non-sparking, air movers)
- ) vessel docking
- ) atmospheric conditions
- ) movement of water around the vessel
- ) clothing (such as nylon or polyester fabrics, conductive shoes)
- ) conductive tools (such as shovels, scrapers, wrenches, and wire brushes)

- ) high-pressure washing

Follow these safety measures to help prevent electrical injuries and fires:

- ) Make sure that electrical systems are installed by a qualified marine electrician and that electrical systems are inspected regularly.
- ) Regularly conduct visual inspections of connections, switches and wiring, which may be subject to corrosion from saltwater and damage from use.
- ) All electrical tools or equipment should undergo a visual inspection before use.
- ) All portable electric hand and power tools and temporary lighting systems should use Ground-Fault Circuit Interrupters (GFCI).
- ) Electrical tools and equipment should correspond with the requirements of the job.
- ) Electrical equipment and tools should be used with proper grounding and circuit protection for the voltage and amperage used.
- ) Only qualified electricians should attempt repair of electrical tools and equipment in use.
- ) A Ground Assurance Program should be in place for all electrical tools and equipment used including:
  - o records of tools inspected and repaired
  - o records of electrical boxes inspected and repaired
  - o records of electrical extension cords inspected and repaired
  - o recall of records of the above

The requirements of the Ground Assurance Program should be performed on a regular basis.

### **U.S. Coast Guard Regulations for Uninspected Vessels**

#### **Fire Extinguishing Equipment [46 CFR 25.30]**

Hand-portable fire extinguishers and semi-portable fire extinguishing systems must be of the "B" type (i.e., suitable for extinguishing fires involving flammable liquids, greases, etc.).

- a. Hand-portable fire extinguishers and semi-portable fire extinguishing systems must have a metal name plate listing the name of the item, rated capacity (gallons, quarts or pounds), name and address of person/firm for whom approved, and the manufacturer's identifying mark.
- b. Portable fire extinguishers must be inspected and weighed every six months.
- c. Minimum number of B-II hand-portable fire extinguishers required to be on board motor vessels: one if less than 50 tons, two if 50-100 tons, three if 100-500 tons, six if 500-1,000 tons, and eight if over 1,000 tons.
- d. Fixed fire extinguishing systems must be an approved carbon dioxide type and must meet U.S. Coast Guard requirements. (See OSHA Directive CPL 02-01-020, November 1996.)

### Backfire Flame Control

Every gasoline engine, except outboard motors, must be equipped with an acceptable means of backfire flame control.

### Ventilation

Fuel tanks and engine spaces, using fuel with a flashpoint of 110 degrees Fahrenheit or less, must be provided with adequate ventilation to remove explosive or flammable gases from the fuel tank compartment and bilges.

### Accident Summary

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A towing vessel was pushing two deck barges to a pile-driving location off the Louisiana coast. While the vessels were underway, a spud on one of the barges suddenly dropped into the water from its raised position.

The spud struck and ruptured a buried high-pressure natural gas pipeline. The gas ignited and created a fireball that engulfed the towing vessel and both barges.

The master of the towing vessel and four barge employees were killed, and one barge employee was listed as missing.

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## Module 6 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Fire and explosions on barges may be caused by liquids \_\_\_\_.**
  - a. when under high pressure
  - b. with high flash points applied as a fine mist
  - c. when stored outside on the deck level
  - d. in oxygen-deficient spaces
  
- 2. Which of the following precautions should be taken when dealing with work that is capable of providing a source of ignition through a flame or spark (hotwork)?**
  - a. Make sure oxygen and acetylene hoses remain unattended
  - b. Shield and protect ignition sources from sources of fuel
  - c. Ensure the space is deemed safe by a competent person
  - d. Inspect the deck above to make sure others are not present
  
- 3. Movement of grain, transfer of liquids, docking, and mechanical ventilation may all be sources of \_\_\_\_ on a barge.**
  - a. high voltage
  - b. electrical shock
  - c. explosion
  - d. static electricity
  
- 4. All portable electric hand and power tools, and temporary lighting systems on barges should \_\_\_\_.**
  - a. use Ground-Fault Circuit Interrupters (GFCI)
  - b. be 12-volt battery systems
  - c. be approved by BSEE prior to use
  - d. be inspected at least annually

**5. How often must portable fire extinguishers be inspected and weighed on barges?**

- a. Daily
- b. Every six months
- c. Annually
- d. Every three months

## Endnotes

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