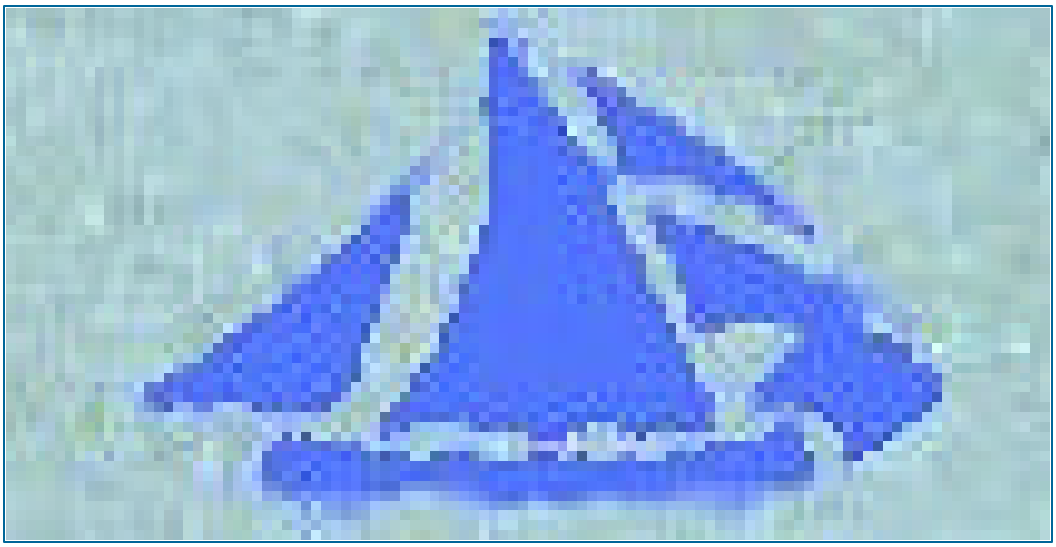
OSHA Occupational Safety and Health Administration



SHIPS

SAFETY and HEALTH INJURY PREVENTION SHEETS

Working with the Shipyard Industry

Introduction: Working with the Shipyard Industry

Shipyards operating in the United States often do not have the benefit of full-time, on-board safety and health specialists. Although help is available from workers' compensation loss control consultants, or state consultation services, their consultants are not always familiar with the unique aspects and hazards of shipyard operations. To meet this need and help prevent injuries, the shipyard community and OSHA have jointly developed **S**afety and **H**ealth **I**njury **P**revention **S**heets (SHIPS).

Representatives of large and small shipyards around the country assisted OSHA in identifying the most frequent hazards and injuries in shipbuilding and ship repair work. Designed for both employers and workers, SHIPS presents information on hazard awareness and controls in a user-friendly format. Pictures from actual shipyards depict hazards and recommended solutions. The time-tested solutions presented are those the shipyard community has found to be most effective in reducing or eliminating shipyard injuries.

The goal of SHIPS is to reduce or eliminate unsafe work practices by increasing employer and worker awareness of safety and health hazards. The first SHIPS presented is Hot Work-Welding, Cutting and Brazing. Some of the material may need to be adapted to different size shipyards and different local conditions. We hope that you will find the information helpful in setting up a plan to make your shipyard a safer and more healthful place to work.

This document is not a standard or regulation and it creates no legal obligations. It is advisory in nature, informational in content, and intended to assist employers in providing a safe and healthful workplace. Mention or depiction of companies or trade name products in no way constitutes an endorsement by the Department of Labor.

For additional information on this Safety and Health Injury Prevention Sheet, contact the Directorate of Science, Technology and Medicine at 202-693-2300.









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Shipyard Industry: Most Prevalent Injury Types by Process

= Not a prevalent cause of injury in this process

= Most common cause of injury In this process

A3 = Page Number

Process \ Hazard	Improper Body Position	Repeated Trauma	Over Exertion	Eye Injuries	Lifting	Falls	Burns/ Shocks	Over Exposure	Traumatic Injury / Acute
Hot Work - Welding, Cutting and Brazing (A1)	A3	A8		A12			A17	A25	
Surface Preparation: Abrasive Blasting, Painting, etc.									
Rigging									
Machinery/Machinist (grinding, lathes, sheers, presses, tools)									
Tank Cleaning									
Materials Handling: Ship									
Materials Handling: Shop									
Housekeeping									
Insulation / Lagging Installation									
Electrical									
Ship Fitting									
Sheet Metal									
Pipe Fitting									
Support Services									

Hazard Definitions

Body Position-Injuries from awkward or prolonged static postures or hand gripping.

Repeated Trauma-Injuries which develop over time due to repeated motion, vibration, or pressure.

Over Exertion-Injuries brought about by extreme fatigue.

Eye Injuries-Injuries to the eye caused by some external agent or force.

Lifting-Injuries that occur from manually raising or lowering objects to a different level.

Falls-Injuries resulting from falling on the same or to a different level.

Burns-Injuries (usually to the skin) resulting from either thermal or radiant energy.

Shocks-Injuries resulting from an electrical current passing through the body.

Over exposure-Exposure which exceeds specified limits.

Traumatic Injury-Injury or wound brought about by an outside force that manifests itself immediately.

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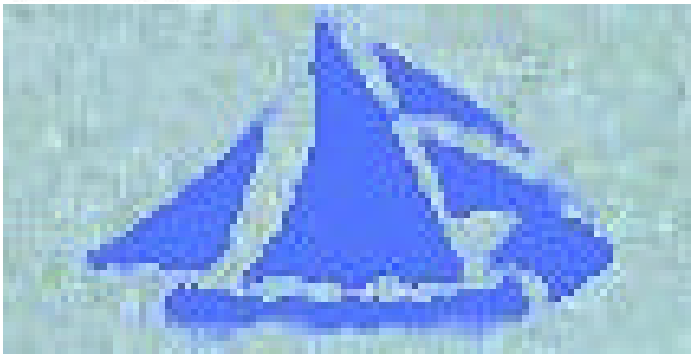
SHIPS

SAFETY and HEALTH INJURY PREVENTION SHEETS



Working with the Shipyard Industry

Process

Hot Work - Welding, Cutting and Brazing

Process: Hot Work - Welding, Cutting and Brazing

Program Applicability: [X] Shipbuilding [X] Ship Repairing [X] Ship Breaking

Potential Hazards

- [X] Body position
- [ ] Over exertion
- [X] Repeated trauma
- [X] Over exposure
- [X] Eye injuries
- [ ] Lifting
- [ ] Falls
- [X] Burns/shocks
- [ ] Traumatic/acute

Most Common Cause Of Injury In Hot Work:

The shipyard community has identified the above five potential hazards associated with hot work. Of these hazards, improper body position was identified as the most prevalent.

***Improper body position**:*

Prolonged static postures associated with neck flexion, working for extended periods on knees or in positions that create awkward postures of the spine, and hand gripping are the leading causes of injury to workers performing hot work in the shipbuilding and repair industry. Additional risk factors are the frequent bending, stooping, squatting and crouching inherent to performing hot work in shipyards.

For more information on improper body position see Hot Work Guide Sheet page A3.

Standards Applicable to Hot Work:

29 CFR 1915 Subpart D: Welding, Cutting and Heating

29 CFR 1915 Subpart B: Confined and enclosed spaces and Other Dangerous Atmospheres in Shipyard Employment.

29 CFR 1915 Subpart I: Personal Protective Equipment

29 CFR 1910 Subpart G: Occupational Health and Environmental Control

Fire Protection in Shipyard Employment Standard (29 CFR 1915 Subpart P) was issued on September 15, 2004 and becomes effective on December 14, 2004. This rule will provide increased protection from fire hazards in shipbuilding, ship repair and shipbreaking industries.

Resource Materials:

www.cdc.gov/niosh/ergship/reports.html-Ergonomic solutions in shipyards

www.osha.gov -Outreach materials for the maritime industry

Process: Hot Work

Hazard: Improper Body Positioning

Improper body positioning is considered the most frequent cause of injuries to workers routinely performing hot work.

Hot work is required in nearly every phase of new ship construction, repair, or overhaul. With the exception of shop work, and work done on outdoor platens, the shape of the hull most often defines the work environment. This circumstance frequently requires that workers place themselves in unusual body positions, often for extended periods of time. Welders, for example, may find themselves in spaces or inner bottoms where they must lie on their backs with extended arms and use a mirror to view the working area. Additionally, many tight and confined spaces are very difficult to access and exit, requiring workers to bend, stoop, crawl, and navigate obstacles such as piping, temporary wiring, ventilation equipment, and machinery.

Several of the shipyards that participated in the development of this material indicated that the average age of the workers in their yards is around forty-five years old. The fact that the work force is getting older must be considered a contributing factor in the frequency and severity of back and other injuries associated with improper body positioning. As we get older we are all subject to a cumulative degeneration process and loss of flexibility that increases our vulnerability to these types of injuries. In recognition of this problem, one large shipyard has experimented with a pre-shift exercise and stretching program to improve workers flexibility. The exercise program named, “Fit For Work”, was designed by health care professionals and could be completed in about eight minutes at the start of the work shift. There was an encouraging reduction in injuries within the group of employees participating in the program.

Traditional prevention techniques, such as work station layout or using adjustable work tables to position work, can be used in shop or landside work areas. However, these prevention methods are usually not feasible on board a vessel. So what can be done?

One Shipyard, alarmed by an increase in the number of back injuries, instituted “back schools” for at risk workers and saw an almost immediate twenty-five percent reduction in back injuries. The “back schools” were designed by shipyard medical and safety personnel working with a physical therapy provider. The training is customized for each trade and the curriculum includes basic instruction in anatomy, and occupational and non-occupational risk factors associated with improper body positioning. Hands-on demonstrations and worker participation enhances interest in the program. Training aids which included video presentations were also developed at the shipyard. The training material depicts the types of work practices that are actually performed by the workers receiving the training.

Planning jobs to eliminate or minimize the need for work to be performed in awkward positions is the best prevention for these types of injuries. When awkward positioning cannot be avoided, allowing periodic mini-breaks for stretching, and or rotating workers, will allow for the periodic recovery needed to reduce the possibility of injury. Additionally, workers should periodically reposition themselves when working in tight areas that require awkward positioning.

Hazard: Improper Body Positioning

While personal protective equipment options for helping to prevent these types of injuries are limited, such things as gloves designed to reduce tight static gripping, knee pads to relieve contact stress, and light weight welding hoods and hard hats that reduce neck strain are available.

As with other types of soft tissue injuries, early reporting of symptoms such as neck or back pain is encouraged. Early reporting and intervention can often make the difference between a relatively short treatment and recovery period and a long term or permanent disability. Worker awareness and training are essential tools for the prevention of injuries resulting from improper body positioning and body mechanics. The examples on the following pages illustrate some of the more frequent causes of these types of injuries and suggest methods to prevent them.

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Process: Hot Work

Hazard: Improper Body Positioning

Problems

Working in tight spaces often requires awkward body positions: bending, stooping, crouching, or working on knees for extended periods of time. Strains, or severe injuries of the back, neck, and knees may develop from sustaining those awkward postures for extended periods without adequate recovery time.

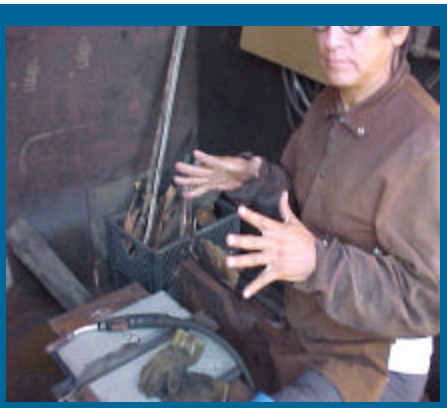
Neck injuries are often caused from flexing and maintaining the neck in unusual positions for extended periods. The muscles of the neck are supporting the worker's head plus the added weight of the welding hood and hard hat.

Hand gripping for extended periods is a frequent cause of hand and wrist injuries for employees performing hot work.

Solutions

When hot work must be performed in these conditions, rotation of workers is a good idea. Some stretching exercises prior to entering tight spaces is helpful in maintaining flexibility and preventing injuries. Workers should take periodic breaks to stretch and relieve the strain on muscles and tendons. Workers who will be on their knees for extended periods of time should wear knee pads in addition to all other required PPE.

Whenever possible, work should be positioned to avoid unusual or prolonged neck flexion. When this cannot be done, periodic mini breaks to relieve the static posture and allow the neck muscles to recover should be taken. Warm up exercises for neck flexion are a good idea. Light weight hard hats and welding hoods may also help in reducing neck strain.



Tools must he held tight enough to maintain control, but not excessively tight. Periodic resting of the hands and flexion of the wrist and fingers is the best way to avoid static gripping injuries. Gloves to reduce static gripping may also be helpful.

OSHA Occupational Safety and Health Administration

Process: Hot Work

Hazard: Improper Body Positioning

Most Prevalent Causes of Injuries Resulting from Improper Body Position

Awkward positions of the spine, bending over, working on one's knees, and working overhead are the most frequent causes of injuries resulting from poor body positioning to workers performing hot work operations. These injuries seldom result from a single traumatic incident. Instead they develop over time as a result of frequently placing the body or it's extremities in unusual positions for extended periods of time.

Awkward Spine Position

Awkward positions of the spine can often be avoided by placement of staging or work platforms to eliminate or reduce the amount of reaching, twisting, or bending required to access the work. Positioning of mobile work platforms, such as scissors lifts, is also important in reducing or eliminating the need for workers to assume awkward postures. In the photograph above, repositioning the scissors lift a little to the left would have eliminated the back strain experienced by this worker from bending sideways at the waist and maintaining that position while performing the hot work.

Bending Over/Working On Knees

Working while bending over sometimes cannot be avoided. This posture compresses the spinal column and places strain on the lower back, which can lead to chronic back pain or a more significant back injury over time. In the photograph above, even though the welder is working in a fairly tight space there is sufficient room for him to reposition himself occasionally. Repositioning oneself may allow the lower back muscles to recover and reduce the risk of injury. The contact stress that results from working on the knees is also a frequent cause of injury. This problem is even more severe when kneeling on cold surfaces for extended periods. Wearing knee pads and occasional stretching will help provide relief.

Working Overhead

Performing hot work overhead places strain on the muscles of the neck and shoulders and compresses the vertebrae in the neck. Muscles of the shoulders and arms as well as those of the neck which support the weight of the head, tend to tire very quickly when performing overhead work. Taking frequent, short breaks to allow for muscle recovery may prevent injury.

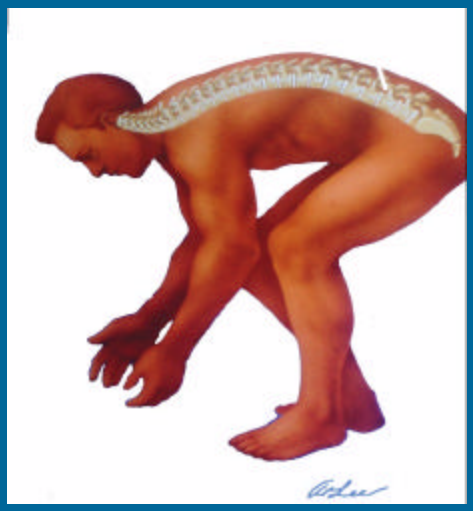
OSHA Occupational Safety and Health Administration

Process: Hot Work

Hazard: Improper Body Positioning

CASE HISTORY

A worker went to the medical department and reported that he had been having low back pain for some time. He enjoyed his work and had previously dismissed the pain as the normal aches and pains associated with the job and had been treating himself with aspirin. As a burner and welder he would frequently perform his work while bent over at the waist for a considerable time. Lately, he had been experiencing severe pain when bending at the waist and had developed a weakness in his left leg that seemed to be getting worse. Concerned, he sought treatment.



Analysis and Preventive Measures

Bending forward at the waist and maintaining a bent-over posture places a significant strain on the lower back, compresses the spine and over time can cause damage to the shock absorbing pads or disks which are located between the vertebrae. In this case, a herniated or ruptured disk developed creating pressure on the spinal cord and the nerves to the workers leg. Treatment for this condition included permanent work restrictions.

Maintaining strength and flexibility in the muscles of the abdomen, back, buttocks and thighs will reduce the risk of back injury. Whenever possible work should be positioned to avoid or limit the amount of bending required. When work must be performed in a bent over position, stopping and stretching periodically will help strained muscles to recover. Had this worker reported his back pain earlier, permanent damage may have been avoided simply by providing a sufficient period of time for full recovery to take place. Instruction from medical personnel on early intervention techniques such as exercise may also help to minimize the risk of injury.

Process: Hot Work

Hazards: Repeated Trauma

Repeated Trauma-Injury:

Repeated trauma injuries in hot work, are often the result of hand and arm vibration, excessive force, and inadequate recovery time when workers use pneumatic tools in association with hot work tasks. These tools (primarily hand held pneumatic grinders) are often used for removing paint or corrosion in preparation for hot work, or in dressing welds. Workers performing welding, burning, or brazing may be required to perform this type of work periodically for short or extended periods depending on the size of the job. Over time, repeated trauma disorders such as carpal tunnel syndrome, tendonitis, vibratory white finger disease, or other neurovascular disorders may develop unless employees are aware of their causes and early symptoms. These injuries are gradual in their onset and frequently workers do not report early symptoms, dismissing them as normal aches and pains. This can lead to a more severe condition requiring extensive and lengthy treatment of the injury when it is finally diagnosed, and may result in long term or permanent restrictions or disability.

A few newer models of pneumatic grinders are equipped with adjustable vibration damping handles and incorporate other design characteristics intended to reduce the effects of vibration. Anti-vibratory gloves are available which may help to reduce the problems associated with tight, static gripping as well as vibration. Defective tools that vibrate excessively should be removed from service. Workers should be encouraged to replace consumable-grinding discs frequently, as excessively worn or damaged discs contribute to vibration. One Shipyard has chosen to make the discs easily available to workers by placing “consumables cabinets” throughout the shipyard.

Alternating tasks that require the use of pneumatic tools with other work will allow for periodic recovery. For example, rather than completing all of the grinding on a large job before starting to weld, grinding and welding can be alternated to reduce the duration of the exposure to vibration. Periodically removing gloves and flexing the fingers will help to relax tense muscles that result from prolonged or forceful gripping of the tool. These simple techniques will greatly reduce the risk of repeated trauma disorders which can develop from the use of these pneumatic tools.

Welders who repeatedly use the neck muscles to flip the welding hood up or snap it down are at risk of developing a painful and potentially permanent neck injury. The force required to flip the hood can strain the neck muscles and compress the vertebrae in the upper spine. Over a period of time a musculoskeletal injury may develop. This type of injury may be avoided simply by using the hand to raise and lower the hood.

Repeated Trauma-Noise:

Shipyard medical personnel consider industrial hearing loss to be a repeated trauma. Noise-induced hearing loss is caused by repeated exposure to loud noise over time. The deterioration in hearing is gradual and may go unnoticed by workers until they start having difficulty communicating with others or find it hard to hear warning devices. At that point, significant permanent hearing loss has developed. Noise induced hearing loss is preventable. But once it is acquired, it is permanent and irreversible.

Hazards: Repeated Trauma

In shipyards the nature of the work and characteristics of the materials used often result in an extremely noisy environment. For example, use of pneumatic or impact tools on large, often hollow metal sub assemblies, hull sections, or in small enclosed areas, produce high levels of noise.

Employees performing hot work often do not think of themselves as vulnerable to noise because they are frequently moving to different work locations to perform different tasks. Also, the dynamic nature of shipyard work can result in frequent changes in noise levels.

Because of the unique nature of shipyard operations, what works best to prevent hearing loss is the consistent use of hearing protectors. In fact, most shipyards require hearing protection when working in high-noise areas and/or when using certain noisy equipment. A variety of hearing protectors should be made available to workers and they should be individually fitted with a hearing protector that is most comfortable to wear consistently. It has been shown that when workers are given an option about the type of protector to wear, they are more likely to use them. Some workers prefer the disposable foam plugs which expand in the ear to provide a snug custom fit. Others prefer the premolded flexible plug that comes in different sizes and has to be individually sized for each ear. Some of these have a cord attached to them so it doesn't get lost. Some workers may prefer ear muffs. For very loud noises, workers may be required to wear muffs and plugs together for additional hearing protection. Of most importance, the hearing protector has to be the right type of protector for each worker and the noise environment they are working in. Workers may be initially concerned that they may not be able to hear conversation, and even more so, machinery and warning sounds. That is why training on hearing protectors is so important. At training, many myths about hearing protectors will be dispelled. Workers will learn how to fit hearing protectors properly and may find that they hear better with the protectors on if they have normal hearing. Workers who have some hearing loss may find it more difficult to hear with conventional protectors, but there are specific protectors made for these situations that should be made available to them. Many shipyards place containers of earplugs at numerous locations throughout the yard, such as at the entrance to shops, break areas, or near gangways, and make earmuffs available in all tool cribs so they are easily obtainable.

Hearing tests are the only way to know for sure about one's hearing ability. There are two types of audiograms. A baseline audiogram is the first hearing test which allows for a comparison to future audiograms. The annual audiogram indicates if there are changes in hearing. Baseline and annual audiograms are enormously important and will identify early signs of hearing loss beyond those that are the result of the normal aging process. These annual checks also offer an excellent opportunity to reinforce hearing protector usage, to ensure that the worker understands the importance of hearing protection and how to use it properly. Discussing the results of the audiogram with the worker can have a tremendous impact on hearing protector usage and protecting oneself from loud noise.

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Process: Hot Work

Hazards: Repeated Trauma

Problems

Repeatedly using the neck to flip back the welding hood or to snap it down stresses the neck muscles and vertebra. Over time painful musculoskeletal injury with long lasting or permanent effects may develop.

Welders and burners must frequently use vibratory pneumatic tools in tasks associated with their work such as smoothing welds, or removing paint or corrosion from areas where hot work is to be performed. Hand and arm vibration, excessive force, or inadequate recovery time after using such tools can lead to tendon, nerve, or neurovascular disorders, which like many repeated trauma injuries may go unnoticed until the injury is severe.

Even when tools are properly maintained, using damaged or excessively worn consumable grinding discs can significantly contribute to the vibration being produced and increase the risk of injury.

Solutions

This injury can easily be prevented by using the hand to raise or lower the welding hood. Repeated trauma injuries such as this are gradual in their onset and employees often don't recognize the problem until the damage has been done.

Alternating hot work and tasks utilizing vibratory tools to reduce the number of hours per day the tool is used is one method of preventing this type of injury. Wearing anti-vibration gloves, wrapping tool handles with anti-vibration tape, focusing on relaxing tense muscles and taking frequent mini breaks are all methods that will help prevent repeated trauma disorders.

"Consumables cabinets" such as the one in this photo can be placed in work areas and provide workers convenient access to grinding discs and other consumable items.

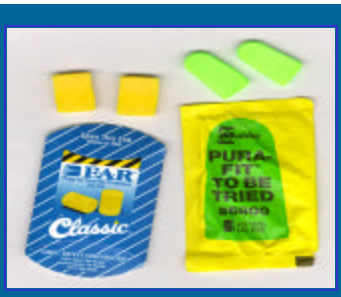
Process: Hot Work

Hazards: Repeated Trauma

CASE HISTORY

A worker who had been welding for 15 years and whose assignments routinely required him to work in different locations, sometimes on board vessels and at other times in support shops, was found to have significant hearing loss. Although the worker knew that he sometimes worked in noisy areas he had always assumed that because he was not assigned to the area permanently, he would not need to comply with the hearing protection signs, or be concerned about the noise being produced by the chipping hammers or grinders being operated nearby. Nor would he need to be concerned about the noise being produced by the arc welding process itself. Believing that he did not have a problem, he continually ignored the post cards from the medical department each year scheduling him for a hearing exam. Not until he began routinely having trouble understanding spoken words did he have his hearing checked. This could have been prevented.

Minimum Effort - Great Results



Analysis and Preventive Measures

Although modern tools and fabrication techniques have contributed to overall workplace noise reduction, the noise generated in shipyard operations is often significant. While the worker was not routinely exposed to a single noise source for an extended period, the various work going on around him from day to day often produced significantly high noise levels. For example, a chipping hammer or grinder will routinely produce noise levels in excess of 100 decibels.

Participation in the company's hearing conservation program could have detected any change in hearing ability early on so that permanent impairment may have been avoided. Follow-up procedures by the company's medical department would ensure that workers who are in the hearing conservation program have annual audiograms, are fitted or refitted with hearing protectors, and understand the importance of the various components of the program to prevent further hearing loss.

Process: Hot Work

Hazards: Eye Injuries

For shipyard workers engaged in hot work, eye injuries are among the most common type of injury experienced. Although most are not serious, the devastating potential for losing sight in one or both eyes exists. Eye injury prevention is therefore one of the most important elements in any shipyard safety program.

The processes in shipbuilding and repair generate a great deal of dust, dirt, and metal particulates. These materials are frequently airborne as a result of the processes producing them, air movement, and activity. Airborne debris, including the hot sparks and slag generated by hot work is the most frequent source of eye injuries in shipyards. When these materials get into an eye it is uncomfortable and often very painful. The natural tendency to rub the eye aggravates the problem and may cause a corneal abrasion or imbed the foreign body in the eye. Imbedded foreign bodies always require medical removal. While these foreign body injuries account for the majority of eye injuries in shipyards, most are easily preventable. Most shipyard eye injuries can be prevented by properly using personal protective equipment.

Many of the foreign body injuries to the eye reported by shipyard workers are caused by workers blowing into goggles, welding helmets, face shields, or respirators to remove dust or debris.. Providing wipes and eyeglass-cleaning stations at convenient locations throughout the shipyard has proven to be effective in significantly reducing the number of these occurrences. Eye-wash stations located throughout the shipyard provide workers the opportunity to flush foreign bodies from the eyes quickly, often preventing more severe injury. On board ship, portable eye-wash stations can be strategically placed in work areas.

In hot work, exposure to the ultraviolet rays and radiant energy in the visible light bands produced by electric arcs and gas flames can cause eye injuries. The most frequent injury, UV Keratitis, commonly called welders flash, occurs when the unprotected eye is exposed to the intense light generated from a welding arc. The intense ultraviolet light literally sunburns the surface of the eye. Although this is painful and disabling, it is temporary in most instances. Chronic exposure, however, greatly increases the risk of cataracts. Nearby workers and workers passing through an area where welding is going on sometimes experience this injury if they happen to be watching when the welder strikes their arc. Radiation in the visible light band, if too intense, can also cause eyestrain, headache and retinal damage.

Shaded filter lenses are required to protect workers from injurious light radiation. Such equipment includes goggles, face shields, welding helmets or a combination of equipment depending on the type of work being done, worker preference, and shipyard rules. Minimum filter lens requirements for protection against radiant energy in all types of hot work can be found in 29 CFR section 1915.153 of the OSHA regulations. Street sunglasses do not offer the level of protection needed and should not be used for hot work

Process: Hot Work

Hazards: Eye Injuries

The labor intensive nature of shipyard work frequently requires that a number of specialized workers perform a variety of tasks within close proximity to one another. The same small space may be occupied by welders, shipfitters, carpenters etc. This circumstance has led many shipyards to require that safety glasses with side shields be worn under welding hoods and face shields. If the worker were to raise his hood or shield, his eyes wouldl be protected from eye injury hazards that may be created by these other work activities. In many shipyards, safety glasses with side shields are a minimum requirement for every worker. The dynamic nature of shipyard work leads to constantly changing conditions that necessitate having safety glasses with side shields available for all workers at all times.

Another concern for workers doing hot work is sweating. Hot work is indeed, "*hot work*", using sweat bands can help in preventing eye irritation, aid in visibility, and reduce work interruptions for face mopping.

As with all personal protective equipment, fit and comfort are important considerations in selecting eye protection. Workers should be trained in fitting, adjusting, and properly caring for the equipment they use.

Making workers aware of the hazards and proper work procedures through safety briefings, posters, and other forms of communication, goes a long way in motivating workers to use personal protective equipment and work safely.

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Process: Hot Work

Hazards: Eye Injuries

Problems

The clear face shield worn by this worker does not provide the appropriate level of protection from the harmful UV radiation generated by the brazing he is doing. For brazing, a shade 3 shield or lens is needed.

Foreign bodies in the eye (sometimes imbedded) can result from workers blowing into their safety glasses, goggles, welding hoods or respirators to remove debris. Using a compressed air cleaning nozzle for this purpose can have the same result.

Incidents of welders flash (UV Keratitis) are common in shipyard work.This injury is sometimes experienced by workers who although not actually performing the welding themselves, are working nearby, or assisting the welder. This picture is an example of a welder's helper trying to shield his eyes with his hand. Symptoms may not appear for 30 minutes to 24 hours following exposure.

Solutions

In this case the problem was resolved by the worker wearing properly shaded safety glasses under the clear face shield. Appropriate filter lens requirements for protection against radiant energy produced by all types of hot work as well as requirements for their use can be found in OSHA standard, 29 CFR section 1915.153.

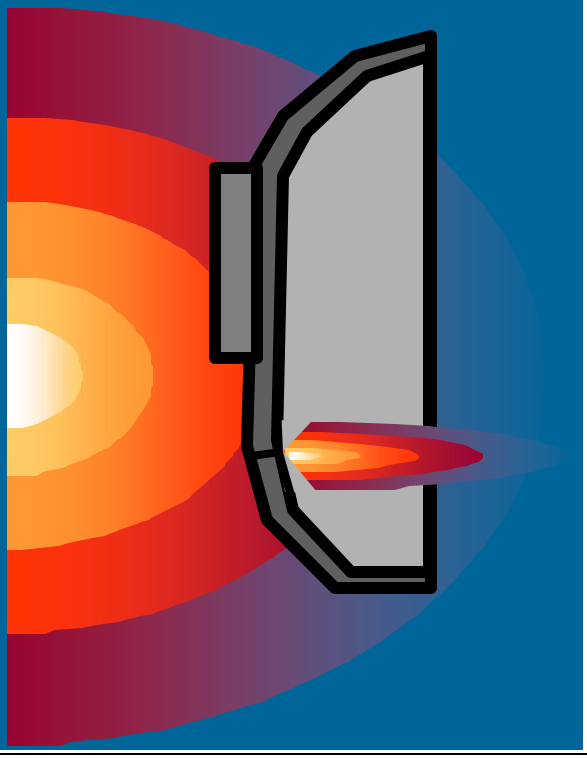
Using proper cleaning methods for PPE will prevent many of these foreign body eye injuries. Cleaning stations with lens cleaning solution and wiping tissues,along with disposable respirator wipes can be conveniently located throughout work areas. Storing PPE in a clean area will also help. One shipyard issues zip lock bags to workers to keep PPE free of debris when not in use.

Welding screens can be placed to protect workers who are working in, or passing through,areas where hot work is underway. Workers assisting welders, or working in close proximity to welding operations where screens are not practical, should be provided with properly shaded eye protection.

Hazards: Eye Injuries (continued)

CASE HISTORY

A worker was given an assignment to arc-weld some fixtures to the deck plates on board a vessel under construction. He had not welded for some time and had stored his welding gear in his gang box along with other tools and equipment. He found the hood at the bottom of the gang box. Although it looked a little "beat up," the filter lens was intact so he cleaned it up a bit and went to work. That night he awoke with the feeling of sand being rubbed in his eyes. By morning he was experiencing severe eye pain. Unable to work he sought medical treatment for welders flash. He told the physicians assistant that he couldn't understand how he got a flash. After all, he was wearing his PPE and the lens in his hood was in good shape.



Analysis and Preventive Measures

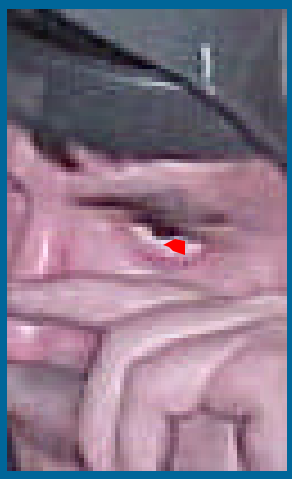
The worker had stored his hood (already not in the best of condition) in a gang box where over time it had been subjected to considerable abuse from being tossed around and having tools and equipment dropped on it. Although the lens had not been damaged, a small crack, hardly noticeable, had developed in the hood. Small, yes. But large enough to admit ultraviolet radiation and allow the exposure to occur. Small cracks or holes in welding hoods can occur from improper care, or by being struck by molten slag.

Inspection prior to each use will assure that it will provide protection from harmful ultraviolet radiation. Small cracks or holes in a welding hood can be spotted by holding the hood up to the light. If any light shines through, **replace the hood, do not try to repair it!**

Hazards: Eye Injuries (continued)

CASE HISTORY

A welder working on a warm day in a southern shipyard was perspiring heavily and would frequently stop working,raise his hood and wipe his brow. During one such break, a high speed steel particle thrown by a hand held grinder being operated by another welder working nearby, struck the welder in the left eye, and imbedded itself deeply in the cornea. In immediate pain, the injured welder rubbed the eye, and caused further damage. In this case, the steel sliver was successfully removed and the worker did not permanently lose sight in his left eye. However, his recovery was slow and painful.



Analysis and Preventive Measures

The injured worker had assumed that his welding hood provided all the eye protection he needed. Even though he had safety glasses with him to wear when he had completed his welding task, he did not consider himself at risk when raising his hood to mop his brow. The shipyard did not require that safety glasses be worn under welding hoods or face shields.

Safety glasses, with side shields worn under the hood will provide protection to workers whenever the hood is raised. Sweat bands can be used to prevent perspiration from trickling into the eyes, minimizing the workers need to raise the hood to wipe them. The shipyard is a very dynamic work environment and even if no hazard from other flying objects or debris exists when the welder begins his work, conditions can change quickly. For this reason, many shipyards require that safety glasses with side shields be worn in all places at all times, including under welding hoods and face shields.

Hazards: Burns and Shocks

Burns

In shipbuilding and repair, burns are among the most prevalent injuries to workers performing hot work. These burn injuries most often occur when hot sparks or molten slag become trapped in footwear or clothing. Another common cause of burns, especially in inexperienced workers, is contact with heated surfaces that remain hot long after hot work has been completed. Burn injuries to workers passing under staging, platforms or deck grating where hot work is being performed above also occur.

Most shipyards restrict welding or burning jobs to workers who have completed a comprehensive training or apprenticeship program and are deemed to be proficient and safe to perform this work. In this interest, some shipyards operate their own welding schools to assure quality work, and safe operations. This training will typically follow the standards for the training and qualification of welders as established by the American Welding Society. The safety component of the training includes instruction in the types of welding hazards, personal protective equipment, fire safety, electrical hazards, fumes and ventilation. Training also covers welding and other types of hot work. Shipyard policy and procedures governing hot work permits and performing hot work in confined spaces, as well as other special requirements are also covered. Shipyards that do not operate welding schools may avail themselves of safety and health training which may be offered by insurance carriers, state and federal agencies, or one of the many commercial training resources that can be located on the Internet. Contractors who are working in the shipyard should also be made aware of, and be required to adhere to the same rules and follow the same procedures as shipyard workers performing hot work.

It is important that all employees who work near, or pass through or under areas where hot work is being performed, be aware of the potential hazards associated with this work. Employee orientation programs and periodic safety talks or bulletins are used in shipyards to provide workers with this information. Shipyard operations often require that workers perform many different jobs in close proximity to one another,and care must be taken to prevent workers from coming into contact with surfaces that have recently had, or are having hot work performed on them. Flame resistant blankets or pads are often used for this purpose. Some yards require workers that have completed hot work to mark surfaces as “hot” and indicate the time before leaving the area.

Personal protective equipment (PPE) consisting of hood, face shield, or goggles with appropriate filter lenses (as discussed in the eye protection section), leathers, protective sleeves, and flame resistant gauntlet type gloves are essential. Hard hats with fasteners for attaching welding hoods or face shields should be available for use in areas where protective helmets are required. Skullcaps of leather or flame resistant fabric will provide protection against head burns and may be worn under the hard hat. Also needed are long sleeve coveralls or a long sleeve cotton shirt with a close fitting collar to keep out sparks and slag. When long trousers are worn instead of coveralls they should not have cuffs, that might catch and hold hot materials. Shirts and trousers should be made of cotton or a flame resistant material; synthetic fibers such as nylon or polyester will burn and melt to form a hot plastic mass that adheres to the skin and may cause a more serious burn injury.

Hazards: Burns and Shocks

For personnel performing hot work, protective footwear should be of the high top or work boot variety as this will help prevent burn injuries from sparks or molten slag entering the shoe. Hard rubber soles will provide insulation for workers performing arc welding or cutting. For overhead work, capes and sleeves should be worn. Some workers like to wear a cotton bandana around the neck to prevent sparks and slag from going down the shirt collar.

Proper job set up and preparation will also help to prevent burn injuries. Removing combustible materials from the work area prior to the start of hot work will prevent hot sparks or slag from starting fires. A suitable fire extinguisher should be available at or near the work location. Further, ensuring that the work area is free of flammable dust or gas is also important as part of job set up. When flammable gas welding, gas cutting or brazing is to be performed in an enclosed or confined space the worker must understand and adhere to all rules and procedures for preventing flammable atmospheres from developing in the workspace. When hot work is to be performed on structural voids such as stanchions, rudders, railings or bilge keels, inspection and testing to ensure that no flammable or explosive atmosphere exists within the void must be performed. Whenever possible, overhead welding or burning should be avoided and workers should position themselves away from falling slag. Additionally, workers should avoid performing hot work directly over other employees or in heavy traffic areas. When this is unavoidable, signs can be posted to warn of the hazard from falling sparks and slag, traffic patterns can be temporarily altered, or a worker can be stationed to warn others.

Shocks

The nature of shipbuilding and repair work requires that many arc-welding operations be performed out doors in all kinds of weather. Arc welding is also performed in tight and awkward locations in confined and enclosed spaces aboard a vessel. This work is often performed using portable welding equipment that is frequently moved from place to place and subject to rough handling and use. These circumstances necessitate extreme caution to avoid electrical shocks. Though the shock itself may cause injury, a worker's reflexive reaction to even a small electrical shock may cause the worker to suffer a more serious accident such as a fall.

In arc-or-stick welding, the open circuit voltage that exists between the electrode holder and the ground during the "off arc" or "no load" period presents a potential hazard to the worker. The worker can become exposed to this voltage when setting up work, changing working position, or changing welding electrodes.

The insulation on welding electrode holders is sometimes damaged from rough use and from moving welding equipment through tight spaces aboard vessels. Contact with skin or damp clothing by the bare metal exposed when this occurs can result in a shock. Similarly, welding leads and cables can become cut or nicked from rough handling and use, exposing the bare metal of the conductor. Leads, cables and electrode holders should be inspected prior to work and more frequently in rough use situations. When working in tight and confined spaces, care should be taken to prevent hot sparks and slag from falling onto and damaging welding leads.

Process: Hot Work

Hazards: Burns and Shocks

When working a substantial distance from the welding unit, cables should be suspended on S-hooks or overhead supports whenever possible. Damaged leads or cables should be immediately removed from service. Many shipyards require that damaged equipment be " tagged" and taken out of service to ensure that it is not used until properly repaired or disposed of.

Shipyard safety and health professionals tend to agree that changing electrodes with bare hands, wet gloves or while standing on a wet, or grounded surface is probably the leading cause of electrical shock to shipyard welders. In hot weather or when working in a hot location, electrode contact with perspiration soaked clothing has also been the cause of electrical shock.

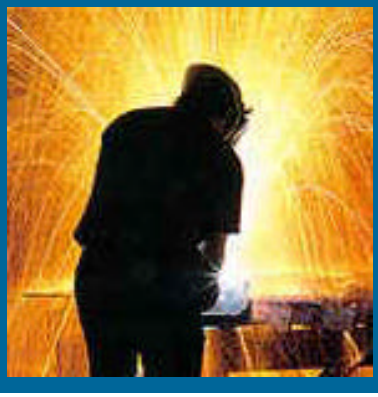
Proper grounding to assure that electrical current flows from the arc and back to welding machine is extremely important. When the work is not properly grounded the worker may become part of the ground path and receive an electrical shock. One hundred percent grounding and/or ground fault circuit interrupters are the surest means of preventing electrical shock. Often in shipyards, welding is performed on a number of components, plates, or sub assemblies that may be set up in a staging area, or on an outdoor platen. When a single welding machine is used to do this work, the work pieces should be bonded together with a cable of sufficient current carrying capacity to assure an adequate ground return is maintained as the worker moves from one work piece to another.

OSHA Occupational Safety and Health Administration

Process: Hot Work

Hazards: Burns and Shocks

Problems



By its very nature hot work produces the potential for burn injuries. Burns resulting from hot sparks or molten welding slag falling into shoes and clothing are the most frequent burn injuries in shipyards. Burns resulting from worker contact with surfaces that have not yet cooled following hot work also occur.

There are many potential hazards associated with welding. Shocks and burns account for most of the injuries to Inexperienced or inadequately trained workers.

In arc welding and cutting operations, shocks or electrocution may result when work pieces or sub assemblies are not properly grounded. The sub-assemblies or work pieces may become energized placing all workers who come in contact with them at risk. In this photograph, the grounding clamp is not connected exposing this worker to the potential for electrical shock.

Solutions

Personal protective equipment in the form of eye, face, and head protection, leathers, gauntlet type gloves, and protective sleeves are the best protection from burn injuries. Cotton coveralls or long sleeve shirts and trousers should be worn, along with high top work boots. Taping trouser legs to boot tops offers additional protection from sparks and slag. Workers should position themselves or the work to minimize hot spark, or slag from falling on themselves or others. Posting signs or restricting access when falling sparks or hot material may present a hazard to employees passing underneath a work area is standard practice in many shipyards.

Training is critical. Assigning a new worker to work with an experienced individual for a time is a frequently used technique. Because shipyard work is unique, many shipyards operate their own welding schools and provide initial training and periodic refresher classes for welders and burners with an emphasis on safety requirements. Training all shipyard workers in these hazards will help prevent injuries to other workers who may be working near or passing through areas where hot work is underway.

Ground cables must be connected to a structure that has been determined appropriate for this use, both in providing a continuous grounding path and necessary current carrying capacity. Additionally, when a single welding machine is used on multiple work pieces, the pieces should be bonded together. Standing in water or working in wet clothing or gloves significantly increases the risk of electrical shock. Establishing good work habits is the most effective means of preventing accidents resulting from improper grounding. Refer to OSHA standard 29 CFR 1915.56 for grounding requirements.

OSHA Occupational Safety and Health Administration

Process: Hot Work

Hazards: Burns and Shocks

Problems

Welding equipment used in shipbuilding and repair is often exposed to hard use and frequent moving. As a result, damaged welding electrode holders such as this one occur frequently. When the insulation on the electrode holder is damaged and the exposed bare metal comes into contact with a worker's skin or damp clothing an electrical shock may result.

Installing or changing welding electrodes with bare hands or while standing on a wet surface is a common cause of electrical shock in shipyards. The potential for the worker to become part of the ground return path for the open circuit voltage exists whenever a low resistance path to ground is created by contact with the skin or wet clothing or gloves.

Leaving an electrode holder unattended with the electrode installed even for a short time presents a number of potential hazards. In this case, a worker may come into contact with the electrode and receive an electrical shock. Additionally, as welding leads are often very long, the possibility of the electrode being pulled off and falling to the ground or contacting a conductive surface exists. In addition to the shock hazard that would be created, the sparking that might occur would constitute a potential fire hazard.

Solutions

This electrode holder offers good insulating capability and will protect the worker from shock. Electrode holders, welding leads, and cables should be inspected prior to every use and more frequently in rough handling and use situations. Damaged or faulty equipment should be removed from service. Workers should not attempt to make temporary repairs to electrode holders using electrician's tape or other materials.

Wearing dry gloves as shown here will insulate the worker from the welding electrode and prevent electrical shock. The long sleeve shirt worn by this worker offers additional protection from accidental electrode contact with the skin. Development of good work habits by welders to prevent electrical shock can be fostered by periodic safety talks and publications containing safety reminders and messages.

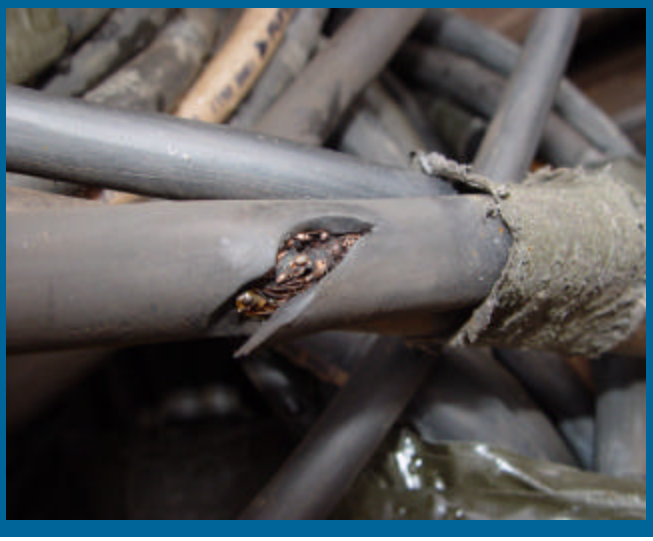
The welder has removed the electrode from the holder prior to leaving the area. This eliminates a possible hazard.

OSHA Occupational Safety and Health Administration

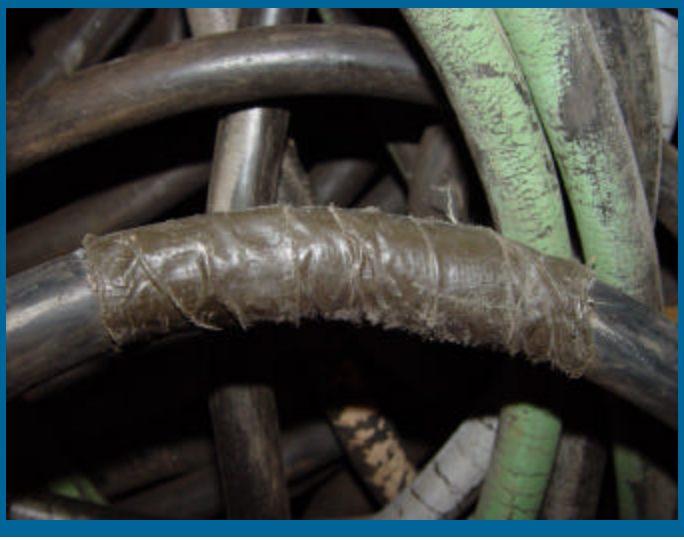
Process: Hot Work

Hazards: Burns and Shocks

Problems



Welding leads and cables can become cut or crushed from the rough handling and usage they sometimes receive in shipbuilding and repair work. When the copper conductor is exposed as shown here, there is a real danger of electrical shock, especially in wet or damp locations.



This green tape repair to a damaged welding cable though well intentioned does not provide necessary insulation. This repair will not hold up very long to rough handling and usage or exposure to wet weather or wet locations.

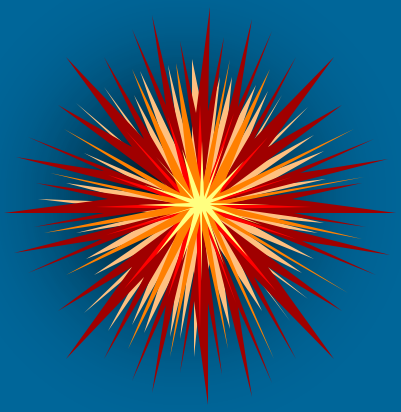
Solutions

Welding leads and cables should be inspected at the beginning of each work shift and more frequently when they are subjected to rough handling and usage, or are extremely lengthy. **When a damaged lead or cable is discovered it should be immediately removed from service. Workers should never attempt to make on-the-spot or temporary repairs.**

Hazards: Burns and Shocks

CASE HISTORY

A burner working in a confined space noticed that it was five minutes past the start of lunch break. In hurrying to get to the lunch area, he did not completely close the gas valve on his torch. Neither did he take the time to disconnect or shut off the gas supply to the torch at the manifold on deck as he was taught to do in training. The escaping gas mixed with the air in the space until its explosive potential was reached and an electrical spark from equipment in the space ignited the mixture causing an explosion and fire. Fortunately,all the workers had left the area for lunch and no injuries occurred.



Analysis and Preventive Measures

Although the worker's haste in leaving the area without ensuring that the valves on the torch were tightly shut off contributed to this accident, the fact that the gas supply was not shut off at the manifold as procedure required was the root cause of this accident. It is good practice to shut off the gas at a point outside the confined space when the torch is to be left unattended for a substantial period of time, such as during lunch hour. It is even better practice to remove the torch entirely from the confined space any time the space is unattended to eliminate the hazard. However, 29 CFR section 1915.52(a)(4) only requires the torch and hoses be removed from the space entirely when it is left unattended for longer periods, such as overnight. The accident investigation revealed that even though workers were trained to shut the gas supply off at the gas manifold, some supervisors were lax in enforcing this rule. These circumstances clearly had the potential for catastrophic consequences.

Process: Hot Work

Hazards: Burns and Shocks

CASE HISTORY

A worker was assigned to weld an attachment to a stanchion. As it was “only a stanchion” and not a tank or large void he assumed there should be no problem. After all the supervisor didn’t mention any special precautions. And so he began the job. Shortly into the work, an explosion ripped the stanchion apart causing second and third degree burns to the workers neck and chest. Shrapnel from the explosion also struck the welder causing additional injuries.

Competent person testing similar stanchion

Analysis and Preventive Measures

The welder knew that before hot work was done on structural voids that a competent person is required to test for flammable liquids or vapors. His assumption that this was only a stanchion that did not and had never contained any flammable material was flawed. Corrosion on the inside of the stanchion was the culprit in this case. Corrosion of metal can produce hydrogen gas. When this occurs inside a hollow non-vented void over time, a potentially explosive condition can occur. OSHA standard 29 CFR Section 1915.54 specifically addresses welding cutting and heating on hollow metal containers and structures. The standard requires that, in all cases, a competent person inspect and, if necessary, test structural voids (including stanchions and railings), before hot work is performed. This requirement must be strictly adhered to. Supervisors assigning hot work on structural voids should be certain that the worker is aware of the requirement and ensure that it is complied with no matter how small or seemingly safe the job. A contributing cause in this accident was that the employer’s training program for welders did not satisfactorily explain all of the hazards associated with performing hot work on hollow structures. While hot work on tanks and voids that may have contained flammables was discussed in detail, the natural formation of hydrogen from metal corrosion in pipes and other hollow containers was not addressed.

Process: Hot Work

Hazards: Over Exposure to Harmful Substances

Hot work in shipbuilding and repair is performed on a variety of surfaces and under circumstances that sometimes require precautions to prevent employee over exposures to harmful substances. Because of the wide variety of materials and coatings used or encountered in shipyard work, material safety data sheets (MSDS) are the best source of information for determining which materials present a potential hazard when heated. If an MSDS is not available (as is often the case in repair work or ship breaking) the surface on which the hot work is to be performed should be tested to determine its composition and that of any coatings that may have been applied.

In an enclosed space, general mechanical or local exhaust ventilation is required for hot work (welding, cutting, or heating) on any of the following toxic metals:
- Zinc-bearing base or filler metals or metals coated with zinc bearing materials (i.e. galvanized pipe)
- Lead base metals
- Cadmium-bearing filler materials
- Chromium-bearing metals or metals coated with chromium-bearing materials (i.e. stainless steel)

The air exhausted from the working space must be discharged into the open air, away from the intake air.

When performing hot work in an enclosed space on metals containing lead as other than an impurity, cadmium-bearing, or cadmium coated base metals, or metals coated with mercury bearing materials, only local exhaust ventilation **or** airline respirators are acceptable as a means of protecting workers.

Both local exhaust ventilation and airline respirators are required for work on beryllium-containing base or filler metals in an enclosed space.

General mechanical ventilation onboard a vessel is usually accomplished by fans or air movers which add or remove air in a space in order to maintain the concentration of the contaminant below hazardous levels. The sucker tube is one of the most frequently used methods of local exhaust ventilation in shipyards, and when used properly is one of the most effective. A well positioned sucker tube will remove nearly all of the plume being generated by the hot work at it's source. The tubes can be easily repositioned as the work progresses or as the worker changes position. The most common mistake in using this device is that the welder or burner will place the sucker tube either too far from the plume or place it in a location that draws the plume through the breathing zone.

In landside shops, the natural air flow through open doors, windows, or roof ventilators may be adequate for maintaining safe air concentration levels. It is important to note that air sampling is the only way to be certain that acceptable levels of air quality are being maintained when this type of general ventilation is utilized. It is a safe bet however, that if a blue cloud surrounds the workers head, or fumes seem to be hovering in the breathing zone, **ventilation is not adequate.**

Hot work performed in the open air on these toxic metals requires the use of respiratory protection. Filter type respirators are most commonly used for this purpose but workers must be trained in their use, and fit tested before being permitted to use them. A comprehensive respiratory protection program must be implemented to ensure that filters are changed when needed and respirators are kept clean. Some shipyards require that respirators be turned in everyday. Other shipyards make respirator filters and wipes for cleaning available to employees at area tool cribs, while another shipyard issues zip lock bags along with respirators so that workers have a clean place to store them. Some shipyards have found it effective to post a respirator-use matrix in the areas where the respirators and filters are issued as a way to ensure that the right type of respirator and filter for the job are issued for use.

Process: Hot Work

Hazards: Over Exposure to Harmful Substances

Workers performing hot work on bulkheads, decks, or overheads are sometimes unaware of what is on the other side. This is problematic if a painted or insulated surface is being worked on. While the worker may have removed paint or insulation from the area where the hot work is to be done, the other side can present a problem if the material is not removed and begins to smolder or burn. In the case of lead paint, epoxy compounds and some insulating materials this may result in a potential overexposure, not to the worker performing the hot work, but to those workers on the other side of the bulkhead adjacent space. Shipyards employ a variety of methods to try and prevent this occurrence. "No paint mark up," for example, involves identifying and marking areas where hot work will later need to be performed so that no paint is applied until after it has been completed. Masking prior to painting those areas where hot work will be required later is another method employed in some shipyards. Experience has shown that the surest way to prevent this problem is to check both sides of the bulkhead before applying heat.

It should be noted that certain confined and enclosed spaces and spaces adjacent to them will require testing by a shipyard competent person or Marine Chemist prior to entry, and must be certified as "safe for hot work." Additionally, anyone entering spaces that meet this criteria must have a confined and enclosed space training certificate. The specific requirements for entering and performing hot work in confined and enclosed spaces can be found in OSHA standards 29 CFR Part 1915, Subpart B.

OSHA Occupational Safety and Health Administration

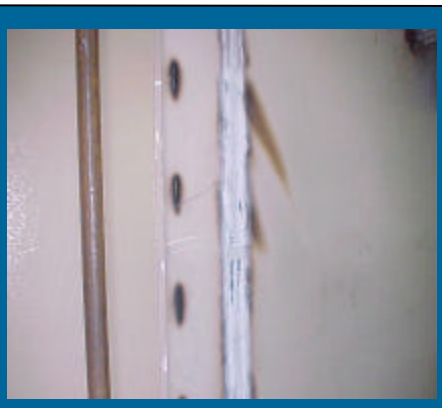
Process: Hot Work

Hazards: Over Exposure to Harmful Substances

Problems

The welding, cutting, and heating of some materials onboard a vessel in enclosed and confined spaces will produce fumes and gasses at levels which may be harmful. Such exposures may not cause immediate symptoms and workers may be unaware of these over exposures until they are discovered through either medical surveillance or the onset of illness.

Hot work performed on potentially toxic materials in open air may result in over exposures if adequate precautions to protect workers are not taken. This employee assumed incorrectly, that because he is working outside that he need not wear his respirator.



Hot work performed on surfaces coated with toxic preservative coatings may also result in employee illness. As noxious fumes, gasses, and particularly odors are frequently emitted by these coatings when heated, workers are prone to report such exposures immediately. Even when the coating is not hazardous the fume produced can be very irritating.

Solutions

Local exhaust ventilation is the best method for removing toxic fumes. Care should be taken when placing exhaust ("sucker") tubes to ensure that fumes are pulled away from the breathing zone as shown here. Hot work performed on beryllium-containing materials requires the use of airline respirators in addition to mechanical or local exhaust ventilation. For specific requirements regarding ventilation see OSHA regulation 29CFR section 1915.51

Filter type respirators such as the one being worn by this worker may be used in most cases for open air hot work on potentially toxic materials. Employees must be properly trained in respirator usage and fit-tested. Additionally, tool room or other personnel who dispense respirators and cartridges should receive training in order to ensure that the correct equipment is being issued. Hot work on beryllium-containing materials will require the use of airline respirators even when performed outdoors.

In this photograph, the paint has been ground off in preparation for welding of bulkhead attachments. Toxic coatings such as epoxies and lead based paints must be stripped back a minimum of 4" before hot work can be performed or airline respirators must be used to protect workers.

Process: Hot Work

Hazards: Over Exposure to Harmful Substances

CASE HISTORY

A worker performing hot work on a bulkhead stripped back the paint four inches where the welding was to be done and began working. As the heat passed through the bulkhead the epoxy paint on the other side of the bulkhead in the adjacent space began to smolder. Several employees working in the adjacent space were quickly affected by the noxious fumes and exited the space. Their eyes were burning and their throats were already becoming sore.They were advised to go to the medical department for treatment. One of the employees was suffering considerably more than the others. Her medical record revealed a preexisting sensitivity to epoxies, due to past exposures.

Analysis and Preventative Measures

This accident could have easily been prevented. Whenever possible, hot work should be completed before painting is done. Some shipyards employ a technique called “no paint mark up,” that identifies areas where hot work will be required later and no paint is applied until after the hot work has been completed. Others mask areas where hot work will be required before painting. These techniques are often not possible in repair work. However in new ship construction some rework after painting is inevitable. Prior to starting work the supervisor and the worker should ensure that the work set up includes checking the bulkhead, deck, or overhead in the space opposite where hot work is to be performed. If paint or some other coating is present it should be removed from the area to be heated. Alternatively, workers can be removed from the adjacent area or protected by some other means. Attention should also be given to any insulating materials that may be behind or between bulkheads that could potentially produce smoke, fumes, or gasses when heated.

It is always a good practice to check the backside of any bulkhead and take necessary precautions before commencing hot work.

Process: Hot Work

Hazards: Over Exposure to Harmful Substances

CASE HISTORY

A new welder was assigned to an area where he had never worked before. After welding pipe for several hours he began to feel ill. As the day progressed, his flu like symptoms worsened and he became lethargic. When he woke up the next morning he felt even worse, but as a new worker he felt that he must report for work. His supervisor noticed he was ill and sent him to the medical department who found that his symptoms were consistent with Metal Fume Fever. Metal Fume Fever is an illness that results from exposure to the fumes produced by the oxidation of zinc. This is seen in shipyards most often as the result of welding or burning on galvanized steel or pipe. A quick call to the supervisor, who checked the area where the welder had been working the day before confirmed that the worker had been welding on galvanized pipe components for most of the preceding day.

Analysis and Preventive Measures

While this worker was trained in the hazards associated with welding on galvanized and other potentially toxic materials as part of his initial training program, he had not worked on galvanized metal before and did not recognize that the pipe he was working on was galvanized. New and inexperienced workers must be familiar with the potential hazards of materials they are working with before starting work. Even experienced workers when assigned to a new work location, or different job must familiarize themselves with all of the potential hazards associated with the area, processes, and the materials being used. Had this worker been aware that the pipe he was to weld on was galvanized, and had he taken necessary precautions in the form of ventilation and respiratory protection, this illness would have been prevented. Fortunately, if no further exposure occurs, Metal Fume Fever usually runs its course in 24 to 48 hours.

In this case, the employer conducted “deck plate” safety talks to re-instruct employees on the hazards associated with performing hot work on potentially toxic materials. The subject of supervisory responsibilities in assuring that workers understand the hazards and precautions that need to be taken was discussed and reinforced at the the weekly foreman's meeting.

CREDITS

Thanks to the following for contributing time talent and resources to the development of *SHIPS*

Industry

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- Northrop Grumman Ship Systems, Pascagoula, Mississippi
- Northrop Grumman Ship Systems, New Orleans Louisiana
- Rupy Innovations, Ledyard, Connecticut
- Shipyard Members of the Shipbuilders Council of America

OSHA

- Directorate of Science, Technology and Medicine, Office of Science and Technology Assessment;
- Directorate of Enforcement Programs, Office of Maritime Enforcement;
- Directorate of Safety Standards and Guidance