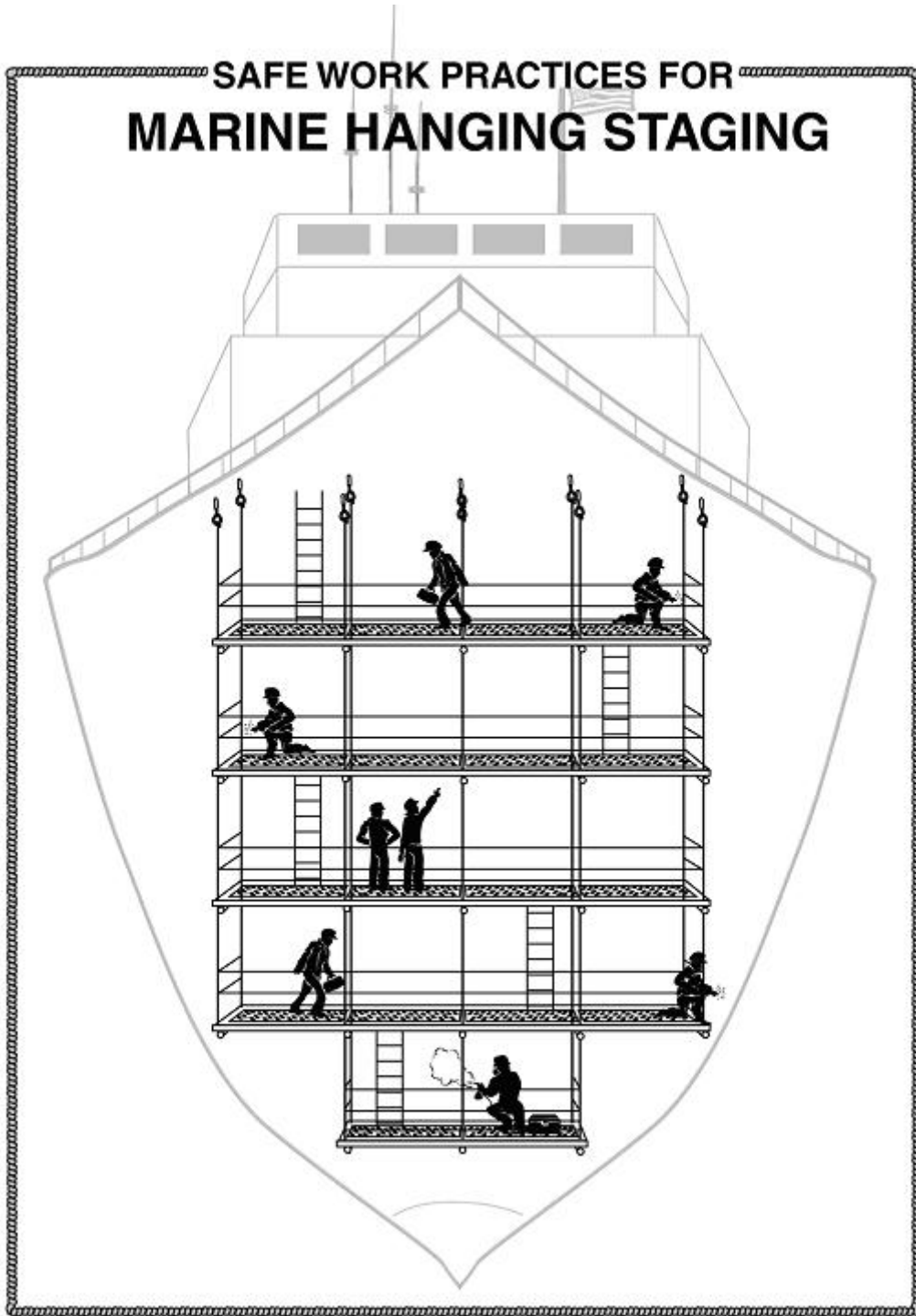


# SAFE WORK PRACTICES FOR MARINE HANGING STAGING



**An OSHA Guidance Document**

**SAFE WORK PRACTICES FOR  
MARINE HANGING STAGING:  
AN OSHA GUIDANCE DOCUMENT**

**Occupational Safety and Health Administration  
Directorate of Standards and Guidance  
Office of Maritime**

**U.S. Department of Labor  
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# CONTENTS

<b>Introduction.....</b>	<b>1</b>
<b>Intended Use .....</b>	<b>2</b>
<b>Planning .....</b>	<b>3</b>
<b>Roles and Responsibilities .....</b>	<b>3</b>
<b>Fall Protection .....</b>	<b>4</b>
<b>Protection during erection and dismantlement.....</b>	<b>4</b>
<b>Protection During Work Operations .....</b>	<b>6</b>
<b>Anchorage and Attachments .....</b>	<b>7</b>
<b>Suspension Cables .....</b>	<b>8</b>
<b>Scaffold Stability and Strut Connections.....</b>	<b>8</b>
<b>Planking .....</b>	<b>10</b>
<b>Access .....</b>	<b>11</b>
<b>Material Handling Operations .....</b>	<b>11</b>
<b>Definitions and Specifications.....</b>	<b>12</b>

## Appendix A: Diagrams

<b>Diagram 1—Pork Chop (Cable Attachment Hanger) .....</b>	<b>15</b>
<b>Diagram 2—S-Hook Cable Hanger.....</b>	<b>16</b>
<b>Diagram 3—S-Hook Attachment Detail .....</b>	<b>17</b>
<b>Diagram 4—Safety Hook .....</b>	<b>18</b>
<b>Diagram 5—Safety Hook .....</b>	<b>19</b>
<b>Diagram 6—Backing Rod, Suspension Rope, and Strut Pin Connection.</b>	<b>20</b>
<b>Diagram 7—Strut Pin Connection .....</b>	<b>21</b>
<b>Diagram 8—Side elevation, marine hanging staging, rigid guardrail system (top); wire rope guardrail system (bottom) .....</b>	<b>22</b>
<b>Diagram 9—Back elevation, marine hanging staging, rigid guardrail system (top); wire rope guardrail system (bottom) .....</b>	<b>23</b>

## Appendix B

**Job Hazard Analysis (JHA).....24**

## Appendix C

**Tagging System.....26**

## **Introduction**

The purpose of this document is to help employers design, assemble, use, and dismantle marine hanging staging (MHS) in a manner that is safe for employees. The use of MHS is becoming more common in shipyard operations because it can be configured to a variety of hull configurations. However, the safe use of MHS requires careful planning and proper work practices. MHS is not specifically covered by an Occupational Safety and Health Administration (OSHA) standard or other national consensus standard, so OSHA is publishing this guidance document to assist employers with their duty to ensure the safety of employees who install, use, and dismantle this type of staging.

MHS is a suspended scaffolding system that is especially useful when workers are performing abrasive blasting and painting work in or on a vessel or vessel section. The staging is typically rigged as paired assemblies of wire rope hung from overhead anchorages. Struts are then attached to the wire rope pairs at various heights to support manufactured planks. Oftentimes, several assemblies are joined together to form continuous levels of staging inside a vessel compartment.

The guidance in this document is based on design criteria and work practices developed and used by shipyards in Virginia and its regional association, the Virginia Ship Repair Association, Inc. (VSRA). OSHA has reviewed the testing of component parts of this system (based on 5/8-inch wire rope cables for suspension) and specifications for various components. In addition, the Agency had the specifications reviewed by a registered professional engineer to ensure that the components had sufficient strength for their intended use. The Agency has concluded that, as specified and designed it is sufficiently strong when used within its rated capacity.

This document has several important limitations. It does not cover all forms and sizes of MHS, and MHS safety is highly dependent on proper design, material selection, installation, and use. Each MHS installation will be unique, and the recommendations in this guidance document should be adapted to the particular circumstances of the installation. Therefore, OSHA cannot guarantee the safety of any individual MHS installation.

OSHA recommends that employers use only trained workers under the supervision of a qualified person (discussed below) to erect and dismantle MHS. OSHA further recommends that employers train employees and others who use the staging to recognize unsafe acts and conditions related to the equipment.

This guidance is not a standard or regulation, and it creates no new legal obligations. It is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace. The OSH Act requires employers to comply with hazard-specific safety and health standards. Under the OSH Act, the extent of an employer's obligation to address hazards related to scaffolding and fall protection is governed by 29 CFR Part 1915 Subpart E Scaffolds, Ladders and Other Working Surfaces, and 29 CFR Part 1915 Subpart I Personal Protective Equipment. Many of these requirements are referenced in this guidance and employers must comply with them. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the OSH Act, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement the recommendations in this guidance is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

## Intended Use

Knowing a scaffold's intended use is critical to its design and construction. By design, MHS is a temporary elevated platform that supports workers and their tools. **Marine Hanging Staging is not intended to support heavy materials such as plate or pipe.** A marine hanging scaffold might be installed by one contractor, such as a painting contractor performing blasting and coating at a later date, and then be used by another employer, such as a contractor repairing a hull prior to blasting and coating. Erecting this type of scaffolding to safely accomplish more than one kind of work requires careful planning and clearly defined roles and responsibilities.

Fundamental to determining the loading characteristics of any scaffold is its material makeup and the manner in which it is constructed. MHS must be capable of supporting its own weight (the dead load) and at least four times the maximum intended load - the sum of weight of persons occupying the scaffold and equipment to be placed on the scaffold. In other words, the staging must have a safety factor of 4:1 [29 CFR Part 1915.71(b)(1)]. Wire rope used for suspending scaffolds must have a safety factor of 6:1 [29 CFR Part 1915.112(b)(1)]

Using accepted engineering principles and field tests, Virginia shipyard employers<sup>1</sup> have determined that this type of MHS is a suitable support for two workers and their tools, or 500 pounds per platform level, provided the staging does not exceed seven (7) tiers (platform levels) in height. Any staging that exceeds seven tiers requires a complete engineering analysis for the entire installation. [29 CFR Part 1915.71(h)(1)].

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<sup>1</sup> Members of the Virginia Ship Repair Association, Inc. (VSRA).

## **Planning**

Given the unique configuration of each vessel, employers will need to carefully plan the manner in which the MHS will be erected and used. After a physical inspection of the areas to be staged, the qualified person responsible for the staging installation should prepare a job hazard analysis (JHA). A qualified person possesses a degree, professional certification, or extensive knowledge and experience relating to MHS so he or she can identify hazards and problems and ensure safe MHS use. An effective JHA will consider and address safety factors and conditions such as the reliability of overhead structural supports; the sizing and spacing of platform assemblies; the sequence of work to be performed; and fall protection strategies during erection, use, and disassembly. The JHA will provide a consistent set of safe work practices for all workers and contractors who will use the MHS.

The JHA will also inform and guide the crews who will erect and dismantle the staging and those who use it. The qualified person will usually present and discuss the JHA with the different work crews. A sample JHA format for MHS can be found in Appendix B.

## **Roles and Responsibilities of the Qualified Person**

The qualified person, designated by the employer, is critical to both planning for and ensuring the safety of the staging. The qualified person's responsibilities include:

- Preliminary inspection of the areas where MHS will be erected, including the condition of the overhead anchorages;
- Inspection of the materials to be used for the staging, including the suspension rope assemblies and fall protection equipment;
- Continuous supervision of the assembly, disassembly, alteration, or modification of the staging and fall protection system;
- Periodic inspection of all MHS components (the frequency of inspections depends on the type of components used and the duration of use).

It is critical that any hazards associated with the staging are eliminated before workers are permitted to use it. Because more than one employer may be involved in erecting, inspecting, and using MHS, procedures are necessary to ensure ongoing accountability for its safety. For example, after one employer erects and uses a scaffold, another employer might alter it and make it unsafe or simply use it in a manner different from its intended purpose. An employer that erects and uses the MHS may leave the staging in place for a variety of reasons and rely on a shipyard owner or other entity to assume responsibilities for its inspection, maintenance, and use.

The shipyard owner or other entity with an ongoing presence at the worksite and in control of the ship or vessel being repaired needs to coordinate the use of the MHS and be responsible for informing other employers (whose workers might use the scaffold) about its safe use and limitations. OSHA recommends that each shipyard establish a uniform system throughout the shipyard that serves to notify workers of a scaffold's status at any given time, such as a tagging program meeting the requirements of American National Standards Institute (ANSI) A10.8–2001, *Safety Requirements for Scaffolding*, Section 4.46.<sup>2</sup> Tags or signs are most effective when located at the scaffold access points. A sample scaffold tagging system is presented in Appendix C.

## **Fall Protection**

### ***Protection During Erection and Dismantlement***

Erection and dismantlement of MHS poses potential fall hazards to workers. This section describes methods for controlling fall hazards and ensuring that the work can be performed safely.

OSHA recommends that the employer reduce the potential for falls during erection and dismantlement by keeping work performed at heights to a minimum. One way to minimize this work is to assemble as many staging components as possible at ground level. For example, attaching wire rope clips and backing rods for the support of struts at predetermined lengths on suspension rope assemblies and tightening them can be performed at ground level.

One operation that cannot be carried out on the ground is the attachment of suspension rope assemblies to overhead structural supports. In certain vessels, the use of ladders, mechanized lifts, and other ground-based equipment to reach certain attachment points on the overhead is impractical or poses a greater hazard. To accomplish this task, the shipyard industry uses a method of working aloft known as “rope walking.”

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<sup>2</sup> “On scaffolds that will remain in place for long durations in either a fully or partially erected state, or on scaffolds that may be potentially used by trades other than those responsible for its erection, dismantlement, alteration or modification, a notification system shall be used to inform workers of the status and condition of the scaffold that includes at least the following information:

- Completed, inspected by a competent person (or “qualified person” in the terminology of shipyard employment), and ready for use, (date, inspector/competent person);
- Partially completed, not ready for use (why, date, inspector/competent person); or
- This scaffold is unsafe, not ready for use. Do not use without prior authorization from \_\_\_\_\_.”

(ANSI A10.8-2001, Section 4.46)

Rope walking is physically demanding work. Protected with a full-body harness and a self-retracting lanyard/lifeline (SRL) secured to an anchorage near the point of access, a cable hanger or rope walker moves from point to point across an overhead area. As the rope walker travels, hanging and standing on “footholds” or stirrups attached to weep holes or other openings on the overhead, the rope walker connects a succession of stand-off pulleys that maintain downward tension on the lifeline and prevent a swing fall. The stirrups are attached to the same kinds of openings in the overhead supports that ultimately hold the attachments for the scaffold’s suspension rope assemblies. In moving from location to location, the rope walker hoists the suspension rope assemblies from the base of the tank and attaches them to overhead supports with S-hooks, pork chops, or beam clamps. Important considerations for rope walkers include:

- Rope walkers must have 100% fall protection at all times.
- Employers should assign the task of rope walking only to workers with the physical endurance and upper body strength necessary for this kind of activity.
- Before assigning workers to the task of rope walking, employers should evaluate their capacity for such work by testing them at ground level to determine their familiarity with the procedures for rigging, fall protection, and retrieval.
- Rope walkers must be trained to understand the specialized rigging and fall protection procedures established by their employers, and to identify and use only those supporting structures that are strong enough for the intended loads.
- Equipment used by rope walkers (such as full body harness, carabiners, and stirrups must comply with the strength and safe working loads (SWL) requirements of 29 CFR Part 1915.159.
- Rope walkers must examine their equipment, tools, and personal fall arrest system before each use. They should visually inspect all safety hooks for damage and ensure their proper attachment to the overhead supports.
- A co-worker who is trained in appropriate emergency response procedures should always attend a rope walker. Where voice communication between the rope walker and co-worker is impaired by location or surrounding noise levels, other effective forms of communication should be used.
- SRLs used in this application must be of a type that will effectively deploy when arresting forces are applied from both horizontal and vertical directions. For purposes of retrieval, SRLs used for rope walking should incorporate a manual lowering feature.

While rope walkers installing suspension rope assemblies may face the most obvious fall hazard, workers performing other phases of MHS erection and

dismantlement must be protected as well. Attaching vertical lifelines and other fall protection equipment to protect those workers is also a job for the rope walker. While erecting and dismantling MHS is, in most cases, performed from the lowest level upward, certain scaffold configurations or sequences of erection and dismantlement may not enable workers to always be protected by guardrails. Securing fall protection equipment to the scaffold itself, regardless of its size or readiness for use, may compromise the scaffold's designed safety factor. Personal fall arrest systems must be independent of the staging. Rope walkers install vertical lifelines for operations such as jumping planks, attaching/detaching struts to rope assemblies, and installing/removing guardrails. Personnel can also be protected by this personal fall protection equipment when they work in areas that cannot be protected by guardrails. A qualified person should plan for the installation of such equipment before the work proceeds.

### ***Protection During Work Operations***

During use of MHS for work operations, the types of fall protection to be used might vary, depending on the hull configuration, the distance(s) between scaffold platforms and solid structures, and the types of guardrail systems best suited for the intended operation(s).

Standard guardrails are always preferable to personal fall arrest systems. A guardrail system prevents falls from occurring, thereby reducing the potential for a worker to be injured if he/she is only protected by a personal fall arrest system itself. Whenever practical, use standard guardrails with rigid top and middle rails for all open sides of the staging when the fall distance to a lower level exceeds five feet [29 CFR Part 1915.71(j)(1)].

When wire rope is used for top rails and/or middle rails, additional protective features must be introduced. The suspension rope assemblies to which the wire rope guardrails are attached are flexible. When guardrails of wire rope are attached to suspension cable assemblies using wire rope clamps (not tied), the outward and downward deflection of the top and middle cables cannot be minimized. Positioning the top cable at 48 inches and the middle cable at 24 inches above platform level and using safety screen to fill the gap will provide an added degree of protection by "containing" worker(s) on the platform. From field tests, the Virginia Ship Repair Association, Inc. (VSRA) engineering study has determined that for the screen to be an effective barrier, it must be attached to the top rail cable, platform, and scaffold suspension ropes with plastic ties at 18-inch intervals. Use flame-resistant, polyethylene fencing material with maximum openings of 1½ by 3½ inches, and plastic wire ties, each with a breaking strength of not less than 740 pounds.

Workers can fall through gaps between the platform and the adjacent solid structure (hull, bulkhead, or flats) if such gaps are greater than six (6) inches. In operations such as blasting and coating, however, it is often impractical to use guardrails on the working sides of MHS. A guardrail may be eliminated on a working side when

this gap can be limited to 6 inches and the platform is secured (from movement). Operations performed on the staging that could move the platform away from the structure and widen the gap must be prohibited. If the required distance cannot be maintained and guardrails are either infeasible due to clearances or impractical because of the type of work to be performed, workers must be protected with personal fall arrest systems [29 CFR Part 1915.71(j)(3)].

A personal fall arrest system is the least desirable type of fall protection. Stopping a fall with this equipment can result in serious internal injuries to a worker. A worker can be prevented from falling altogether from an unguarded edge of a working platform if his/her harness is secured to a reliable anchorage [29 CFR Part 1915.159(a)(9)] with a pre-determined length of lanyard.

A qualified person must carefully evaluate the design and use of personal fall arrest systems. In addition, regardless of the type of system used, workers must receive comprehensive training in the safe use and limitations of such equipment. 29 CFR Part 1915.159(d) contains the training requirements for personal fall arrest systems.

### **Anchorage and Attachments**

A staging system's capacity is greatly affected by the condition of the overhead supports, as well as the type of connection(s) to be made between the supports and suspension wire rope assemblies. Based on information from the shipyard owner, the qualified person must determine the condition of a vessel's structural components, including those to which the staging will be attached. This information shall then be used to calculate both the weight of the MHS itself and the loads to be placed on it [29 CFR Part 1915.71 (h)(1)].

The types of overhead supports available in a vessel dictate the type of attachment to be made between the staging suspension ropes and the structure. A beam clamp, which positively engages an overhead structural member, is preferable to an S-hook or a pork chop. The latter two systems depend heavily on downward and inward forces of the scaffold itself to prevent detachment. Diagrams 1 and 2, in Appendix A, illustrate two of these tested systems of attachment that are used by shipyard employment, the pork chop and the S-hook.

When S-hooks or pork chops are used, the wire ropes used in suspending this type of scaffold will necessarily be out-of-plumb to prevent uplift and/or displacement of the attachments. To maintain this non-vertical condition, installation crews should construct the bottom-most platform level of the staging first. They should then hang the suspension cables in a manner that exerts an inward tension to the overhead attachments. Both the structural supports and the wire rope must be able to sustain additional loads imposed by these eccentric forces.

## **Suspension Cables**

Suspension cable failure is a major concern with any type of suspended scaffold, and MHS is no exception. A number of conditions can cause the cables to part, including overloading, stray welding current, and internal (hence undetectable) damage from various kinds of chemical and environmental attack. Important considerations for cables are listed below:

- Consider suspension cables to be tools. Care for them and store them in a dry location away from potential damage and corrosive agents.
- The Qualified Person must thoroughly examine the suspension cables for all conventional signs of wear. Flattening, distortion, individual broken wires, and corrosion are the typical indications that a wire rope cable should be removed from service [29 CFR Part 1915.111(a)].
- Build-ups of coatings from spray operations make visual inspection even more difficult. Whenever practical, cover all suspension cable assemblies to prevent accumulations of material that will make inspection difficult and ultimately degrade the assemblies' strength.
- Observe special precautions when welding or burning from MHS. For example, use insulation between the structure and suspension cable attachment points to prevent cable embrittlement and stray current. Protect suspension cables from contact with exposed energized welding cables [29 CFR Part 1915.56(b)(4) and (c)(6)].

## **Scaffold Stability and Strut Connections**

Stability in an MHS platform is achieved in part by the number of adjacent platform systems. The tendency of any cable-suspended staging to sway, whether during erection, use, or disassembly, must be considered by the qualified person when a particular installation is being designed. In general, the more tiers and sections of MHS that are tied together, the more stable the staging. Conversely, a failure of one component or section of staging may damage other portions of the staging. Operations such as hoisting and lowering of materials near the MHS could cause it to move and widen the gap between an unguarded, working side of the stage and the adjacent solid structure. Tie-ins should be installed to stabilize the staging whenever lateral movement could compromise fall protection systems or the integrity of the scaffold or its component parts.

Properly securing platforms to struts and connecting struts to suspension cable assemblies are critical aspects of safe MHS. Struts form the bearing for the staging planks. The sequence of their installation and the manner in which they are connected to the suspension ropes is critical to the safe erection and use of the staging. Important

stability considerations include the following items, which are based on sound engineering principles:

- Cable clamps and backing rods to support the struts must be installed at predetermined intervals along the length of the suspension cables before being hoisted by the rope walker to overhead attachment points.
- The struts that support the lowest level of platforms should be attached to the suspension cable assemblies first, and an entire tier of platforms should be put in place and secured to the struts before erecting the next level. This ensures the degree of angulated cable necessary when overhead attachments such as S-hooks and pork chops are used to hang suspension cable assemblies. It also minimizes horizontal sway in the staging generally.
- Rough edges on the struts should be smoothed by grinding, machining, or other methods so that the struts do not abrade the suspension cables.
- Cable clamps and backing rods that support the struts should be installed in pairs, close together, and tightened to not less than 90 foot-pounds ( Diagram 6 in Appendix A).
- Wire cable used for backing rod assemblies must be the same size as the suspension cable, and wire cable clamps must be sized appropriately to the suspension cable.
- U-bolt cable clamps are used to support the struts at intervals along the suspension cables. In MHS, the clamps must be the same size as the suspension cables and spaced close to each other and applied with the saddle on the live end of the cable (in this case, the suspension cable itself), not the backing rod [29 CFR Part 1915.112(b)(3)].
- The strut pins, though not designed or intended as primary, load-carrying elements of the scaffold, must be capable of withstanding the forces during erection, use, or disassembly (e.g., the minor angle of suspension rope when attached to an overhead with S-hooks or pork chops, and the potential for side-loading from material handling operations where a suspended load may hang up on a portion of the staging system).
- The strut pins must provide a positive closure, such as a bolt with a locking nut, that will not disengage the struts from the suspension cables.

## Planking

The standing surfaces typically used in MHS are of a specialized design and constructed for hard use. Referred to in the industry as “bedsprings” by virtue of their appearance and material makeup, they vary in length between two and ten feet, depending on desired platform length. Bedsprings consist of two rails constructed of 1-inch solid steel stock (ASTM 105), 2-inch (OD) 40-gauge steel tubing (ASTM 105) or equivalent, joined by cross members of equivalent strength, and spaced between 12 and 27 inches apart, depending on length. Expanded metal mesh, the standing surface of the bedspring, is welded to the rails and cross members at intervals that prevent no more than 1-inch of downward deflection. The ends of the bedspring rails are equipped with hangers that secure the rails to the staging struts. Bedsprings are wire-tied to the struts at both ends to prevent displacement.

Through design criteria established by engineering analyses and failure mode analysis of MHS components, a duty rating of 500 pounds has been assigned to this type of planking. Thus, no more than two persons and their tools can occupy a single platform at any given time [29 CFR Part 1915.71(b)(1)].<sup>3</sup> Important considerations for planking include.

- Except during erection, disassembly, alteration, or modification of the MHS system, struts must be fully planked with bedsprings or standing surfaces of equivalent strength and safety characteristics.
- Platforms must be secured to the struts at each end with tie wire to prevent uplift and horizontal movement across the struts [29 CFR Part 1915.71(i)(3)].
- When installing, modifying, or removing platforms, workers who are erecting staging must be protected by personal fall protection equipment when they are exposed to falls of more than 5 feet [29 CFR Part 1915.71(j)(3)].
- Platforms, when ready for scaffold users, should be level to within an inch for every foot of length. For example, a completed platform supported by two struts spaced 7 feet apart should have one end no more than 7 inches higher than the other. The qualified person shall ensure that tripping hazards are not created for workers moving from one platform to another [29 CFR Part 1915.91(a)].

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<sup>3</sup> Relevant engineering analyses were performed or commissioned by the Virginia Ship Repair Association, Inc. (VSRA) and provided to OSHA in association with the preparation of this document.

## **Access**

Safe access to MHS platforms shall be provided at all times by stairways or ladders [29 CFR Part 1915.71(k)(1)]. The qualified person should consider access when performing the JHA.

Stair and ladderway openings in staging platforms must be protected with standard guardrails on all open sides, except at points of entry. Locate entry points to ladder or stairway openings away from work locations to the extent feasible, or install removable rails or gates. Ladders used for access to staging must comply with 29 CFR Part 1915 Subpart E.

## **Material Handling Operations**

Because MHS is designed as only a temporary elevated support for workers and their tools, using the staging for storage of materials or as an attachment point for lifting and tensioning devices such as chain falls, come-alongs, and spreaders is considered an unsafe work practice.

Similarly, operations in close proximity to the staging, such as those involving lifting equipment and suspended loads, can cause uplift, horizontal movement of the stage, or displacement of critical scaffold components. Important considerations for materials handling include.

- Always attach equipment to anchorages that are separate from those supporting the scaffold [29 CFR Part 1915.114(d)].
- Loads in suspension or being brought under tension (other than scaffold components during assembly or disassembly) should never be in contact with the staging.
- As in any lifting operation, the qualified person is expected to meet with all persons involved or who may be potentially exposed to hazards posed by the lift. He or she will determine who has overall responsibility for the lift, who will give signals, and where persons will be positioned.

## Definitions and Specifications

*Angulated roping:* In MHS, a method of rigging suspension ropes to prevent uplift or displacement of their attachments to overhead anchorage points. With this rigging method, suspension ropes are hung slightly off vertical and farther apart at their anchorage points than at their connections to the lowest platform level(s).

*Backing rod:* A short length of wire rope that serves as a spacer between the suspension cable and the “dead” sides of U-bolt-type wire rope clips. Backing rods should be 5/8-inch improved plow steel, independent wire rope core (IWRC) 6 by 7 wire rope (see Diagram 6, Appendix A).

*Bedspring:* A shipyard term for a manufactured metal scaffold plank. Synonyms: dimes, planks, staging boards.

*Cable installer or hanger:* See definition for “rope walker.”

*Fall protection system:* A system to keep workers from falling to lower levels. Three kinds of protection are suitable for MHS: (1) a guardrail system consisting of a rigid top rail at 42 to 45 inches above the platform, a middle rail located halfway between the upper rail and the platform, a toeboard, and related attachments; (2) a guardrail system consisting of two horizontal wire rope rails at intervals of 48 and 24 inches, and a safety screen between the top rail and the platform and related attachments; or (3) a personal fall arrest system meeting the requirements of 29 CFR 1915.159

*Marine hanging staging (MHS):* A type of hanging scaffolding used for ship repair, incorporating tiers/levels of manufactured scaffold planks (“bedsprings”) supported by bearers (“struts”) attached to pairs of wire ropes suspended near-vertically from overhead anchorages.

*Platform (alternative title: “Section”):* A section (or “module”) of MHS. A platform consists of four anchor attachments (S-hooks, pork chops, or beam clamps); four suspension cable assemblies; eight 5/8-inch wire rope clips; four backing rods; two struts; bedsprings wire-tied to the struts; and a fall protection system.

*Pork chop:* A shipyard term for a type of bracket used to attach a suspension cable assembly to an overhead L-shaped structural steel anchorage. This type of attachment engages portions of the top and bottom of the L’s lower flange. Pork chops vary in size, based on flange width. As such, they must be designed and fabricated in accordance with accepted engineering principles. (See Diagram 1, Appendix A.)

*Qualified person:* A person who by possession of a recognized degree or certification of professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems related to the subject matter, the work, or the project. The qualified person is designated by an employer as

responsible for erection, alteration, modification, dismantlement, and any ongoing inspection of the staging.

*Rat hole:* A shipyard term for the existing holes found on overhead structural steel supports in cargo holds, tanks, and other areas aboard a vessel. Synonym: weep hole.

*Rope walker:* A person who installs anchorage attachments and suspension cable assemblies on the overheads of holds and at other heights where the use of conventional access equipment such as ladders, scaffolding, or lifts is either infeasible or potentially creates a greater hazard. Synonym: suspension cable installer or hanger.

*S-hook:* A type of attachment between a support cable assembly and an overhead anchorage. Typically formed of steel bar stock, one leg of an S-hook is placed through a rat hole on an overhead structural steel support of a vessel or tank; the opposite leg is closed, forming an eye for attachment of a suspension cable assembly with a shackle. (See Diagrams 2 and 3, Appendix A.)

*Safety hook:* A means of attaching stirrups and personal fall protection equipment to overhead structural steel supports by cable installers/“rope walkers.” (See Diagrams 4 and 5, Appendix A.)

*Safety screen:* Flame-resistant plastic screening that supplements the fall protection characteristics of a guardrail.

*Struts:* The bearers that serve as supports for a stage’s planks (“bedsprings”). Struts are typically 1½-inch diameter ASTM Schedule 40 pipe of varying lengths, with machined (not burned) notches at each end to receive the suspension cable assemblies. The struts bear on wire rope clips and backing rods attached at intervals along the lengths of the suspension ropes. (See Diagram 6, Appendix A.)

*Strut pin:* A ¼-inch bolt or equivalent, at least 3 inches in length, with a locking nut that positively secures a strut to a suspension rope. (See Diagram 7, Appendix A.)

*Suspension cable:* A 5/8-inch improved plow steel, IWRC 6 by 7 (or greater, based in the intended load) wire rope having a nominal strength of not less than 17.1 tons that, when installed with others, forms the vertical supports for the scaffold’s bearers (“struts”).

*Suspension rope assembly:* A suspension rope with a closure formed by three wire rope clips at its top; a thimble to attenuate wear on the closure; a screw pin shackle having a working load of not less than 4,000 pounds for attachment to an S-hook, pork chop, or beam clamp; and wire rope clips and backing rods positioned at intervals along the length of the rope. (See Diagrams 8 and 9, Appendix A.)

*Weep hole:* See definition for “rat hole.”

# **Appendix A**

## **Diagrams**

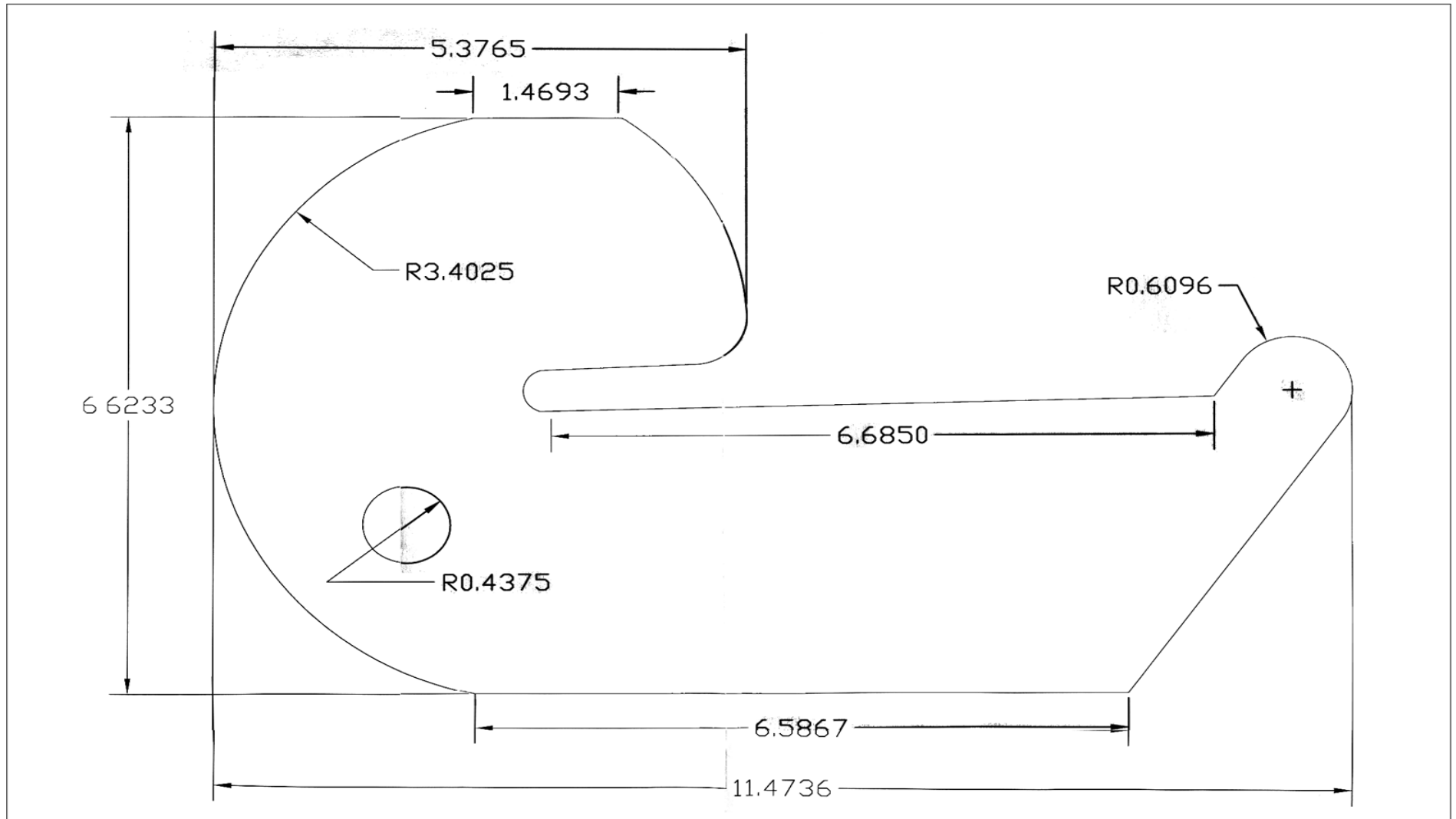


DIAGRAM 1 - "PORK CHOP" (CABLE ATTACHMENT HANGER)

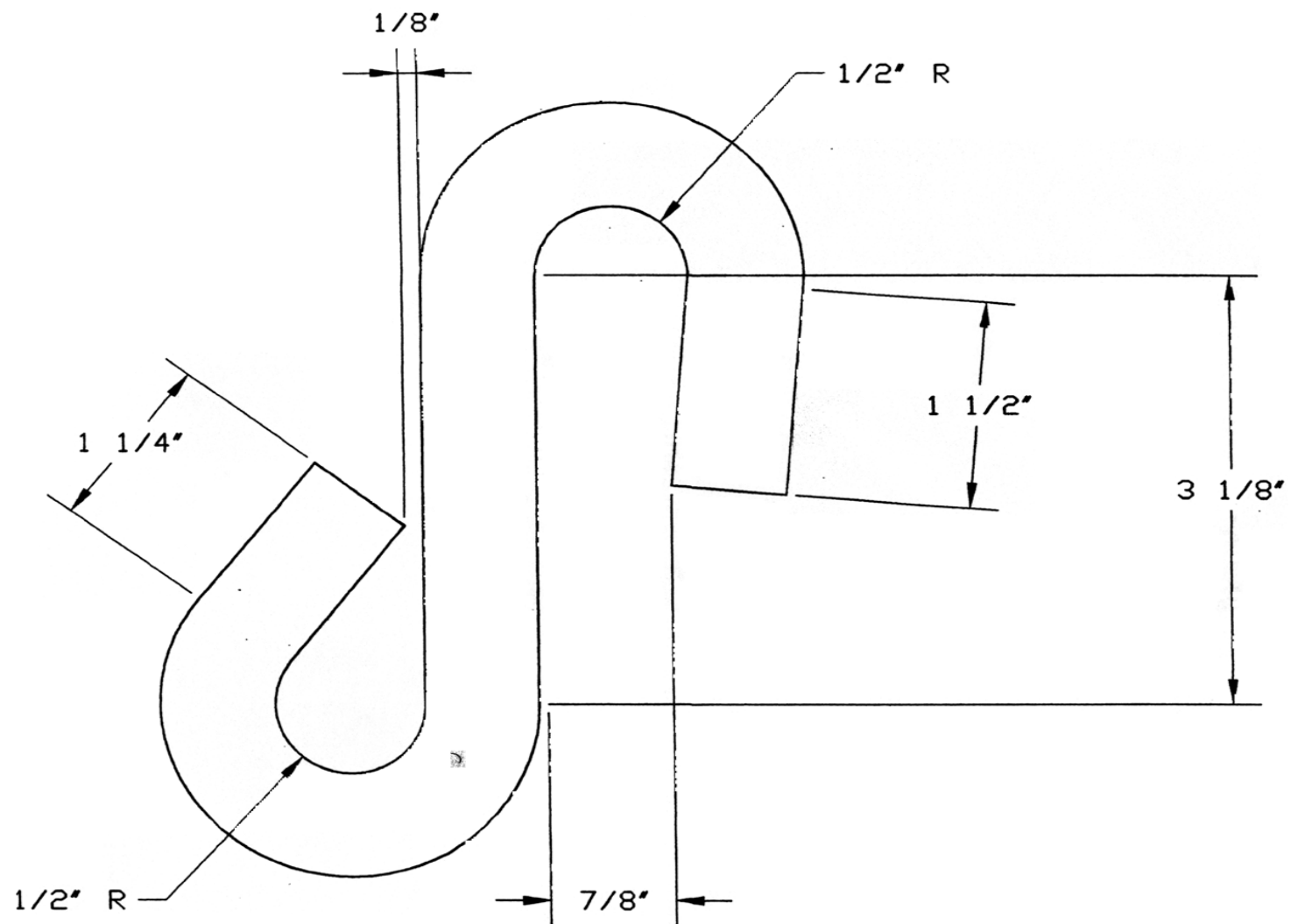


DIAGRAM 2 - S-HOOK CABLE HANGER

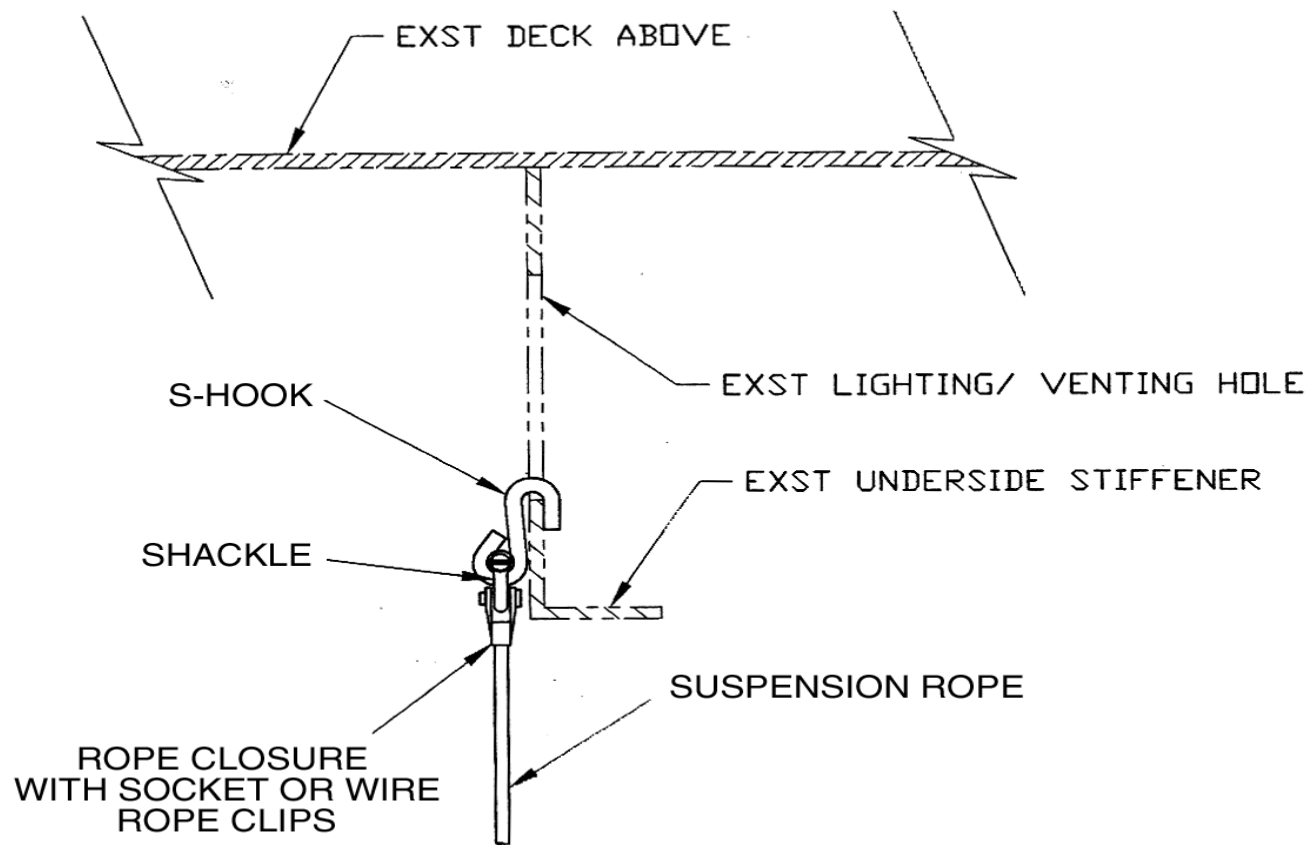


DIAGRAM 3 - S-HOOK ATTACHMENT DETAIL

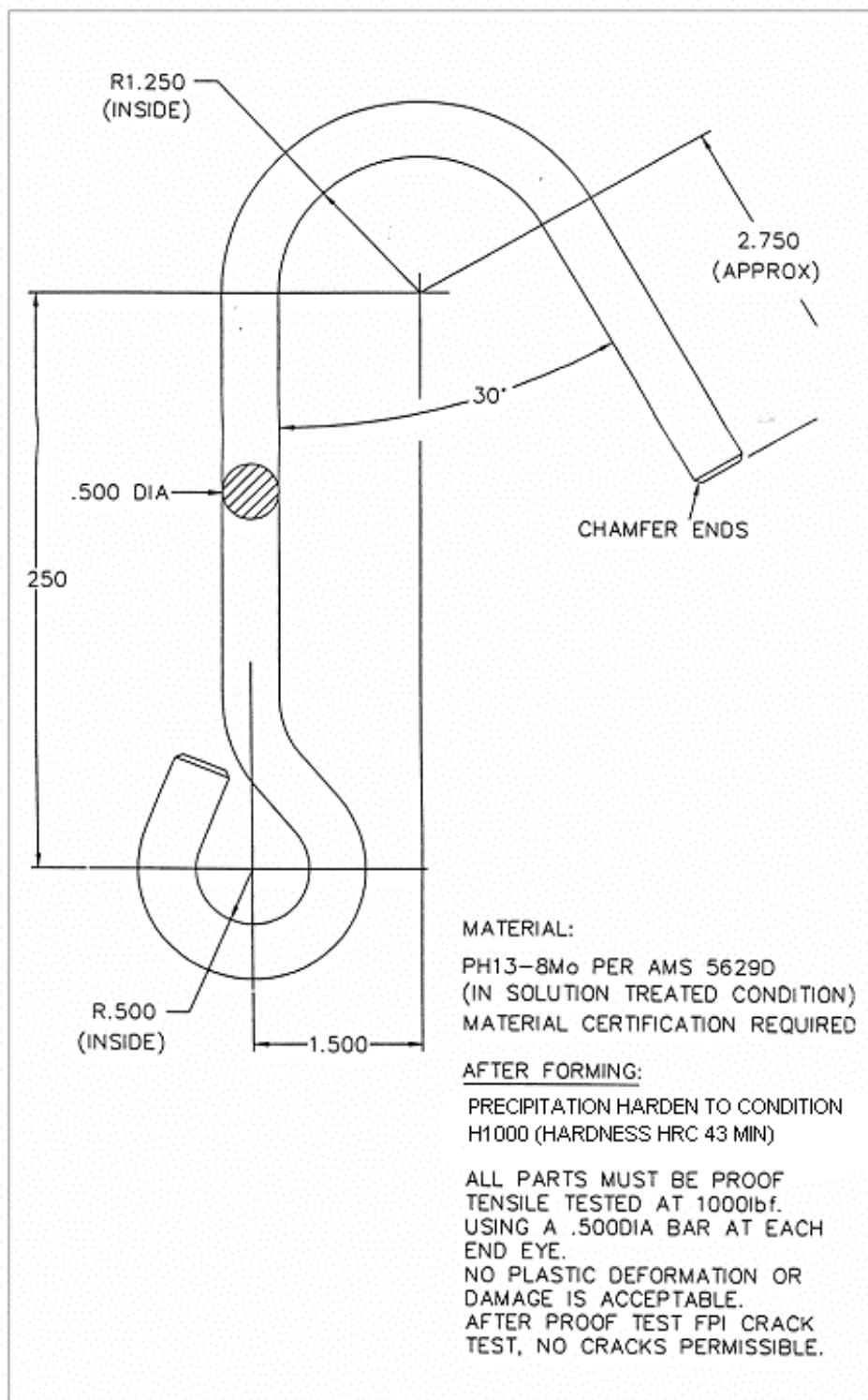


DIAGRAM 4 - SAFETY HOOK

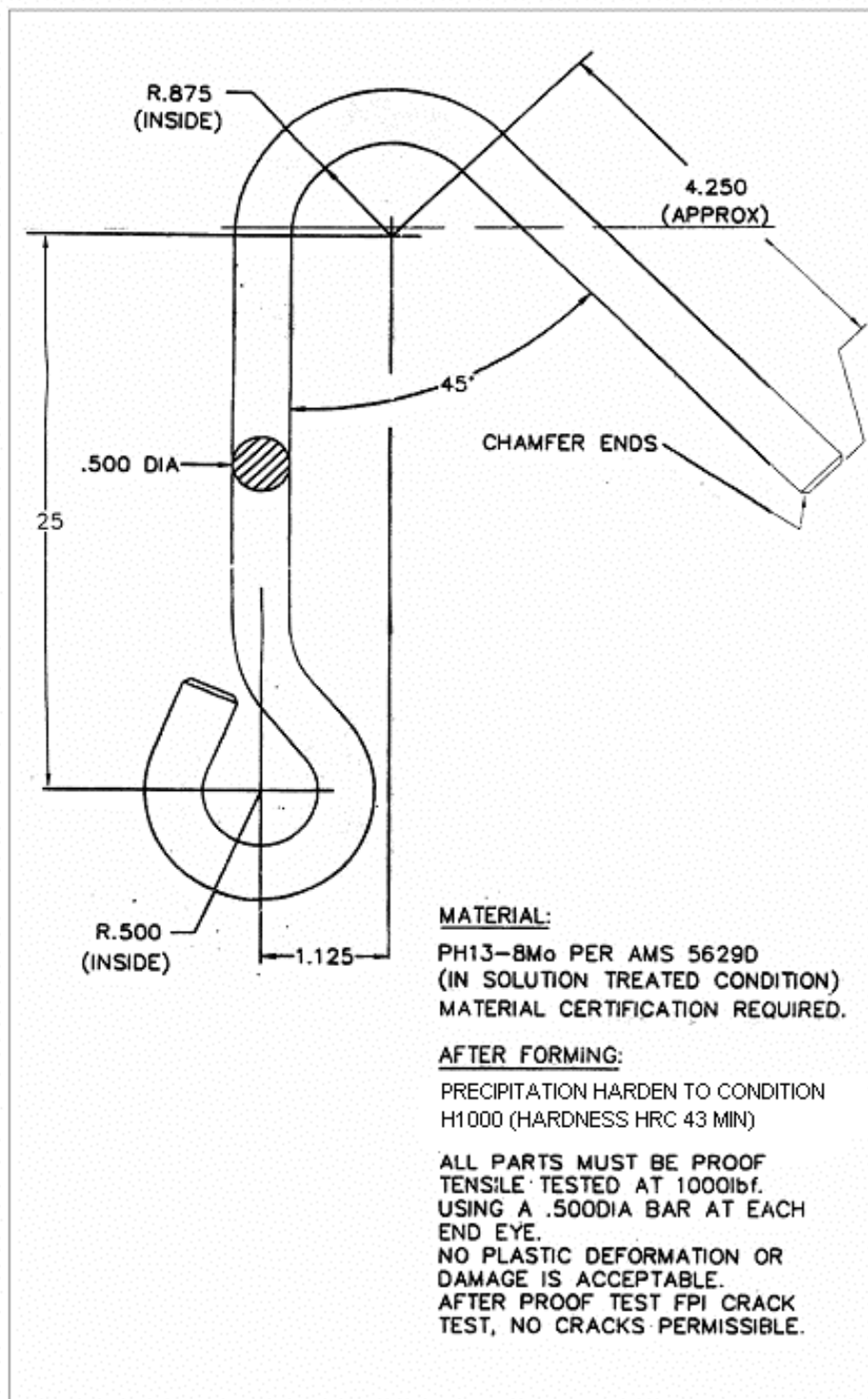


DIAGRAM 5 - SAFETY HOOK

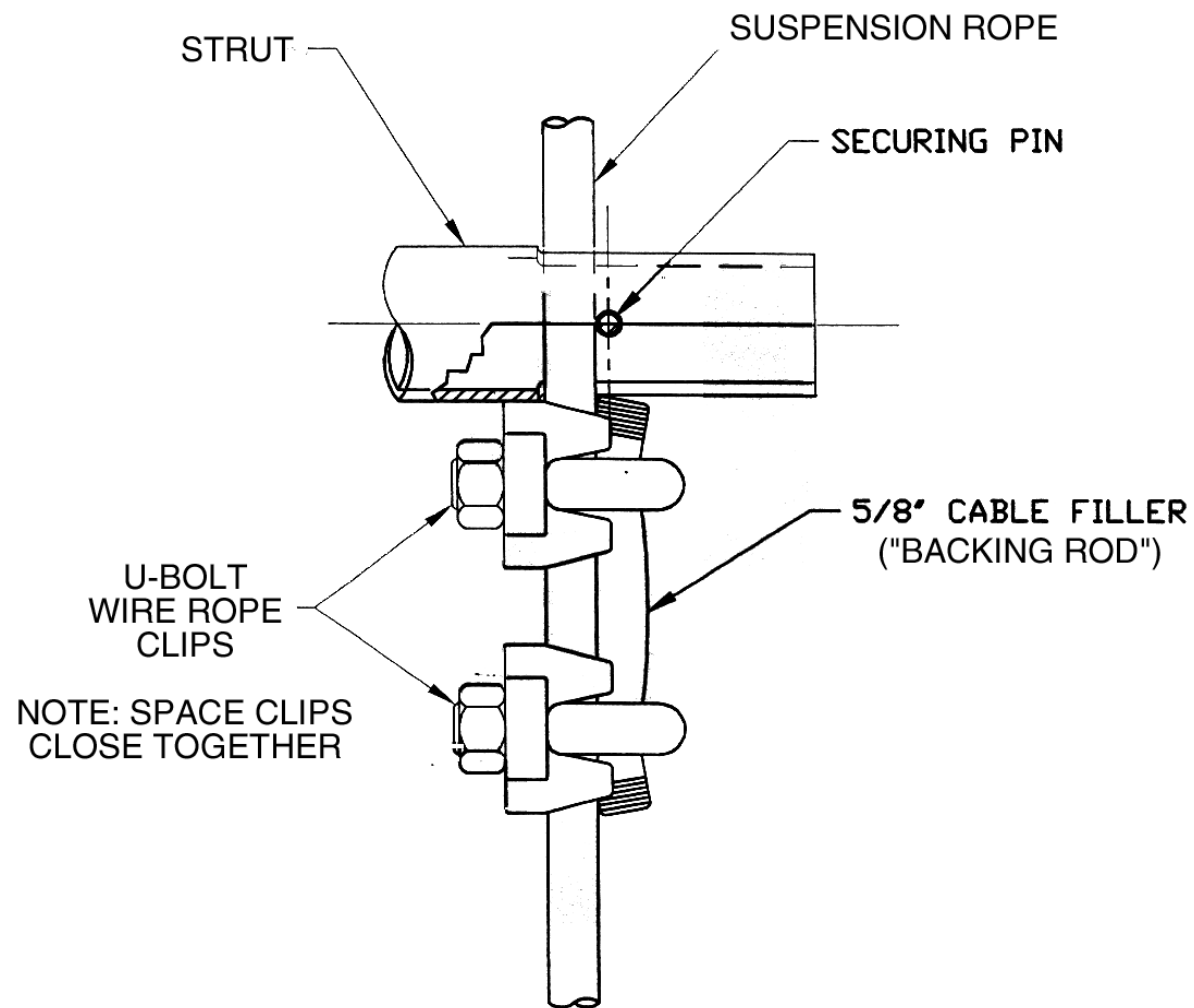


DIAGRAM 6 - BACKING ROD, SUSPENSION ROPE, AND STRUT PIN CONNECTION

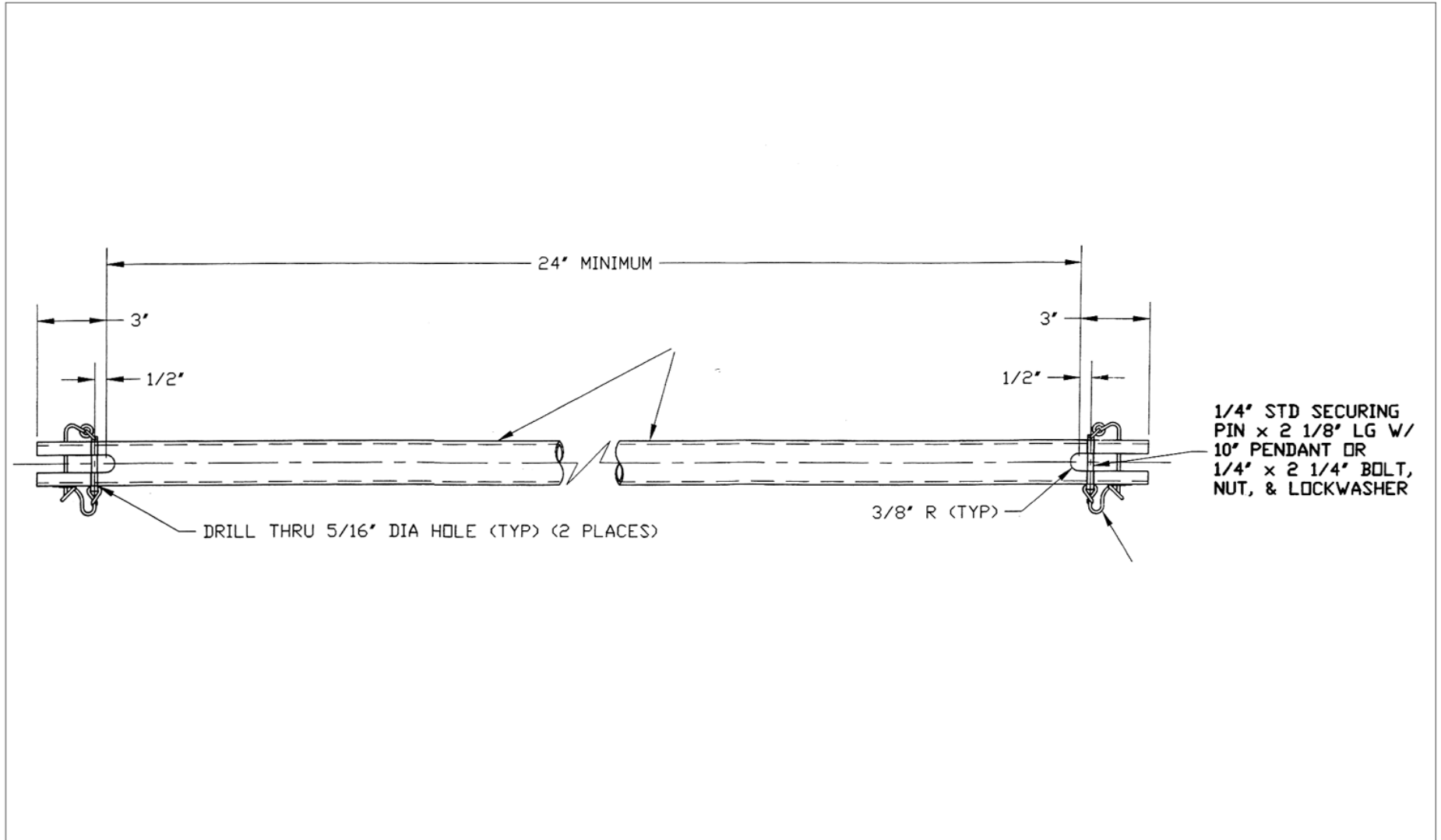
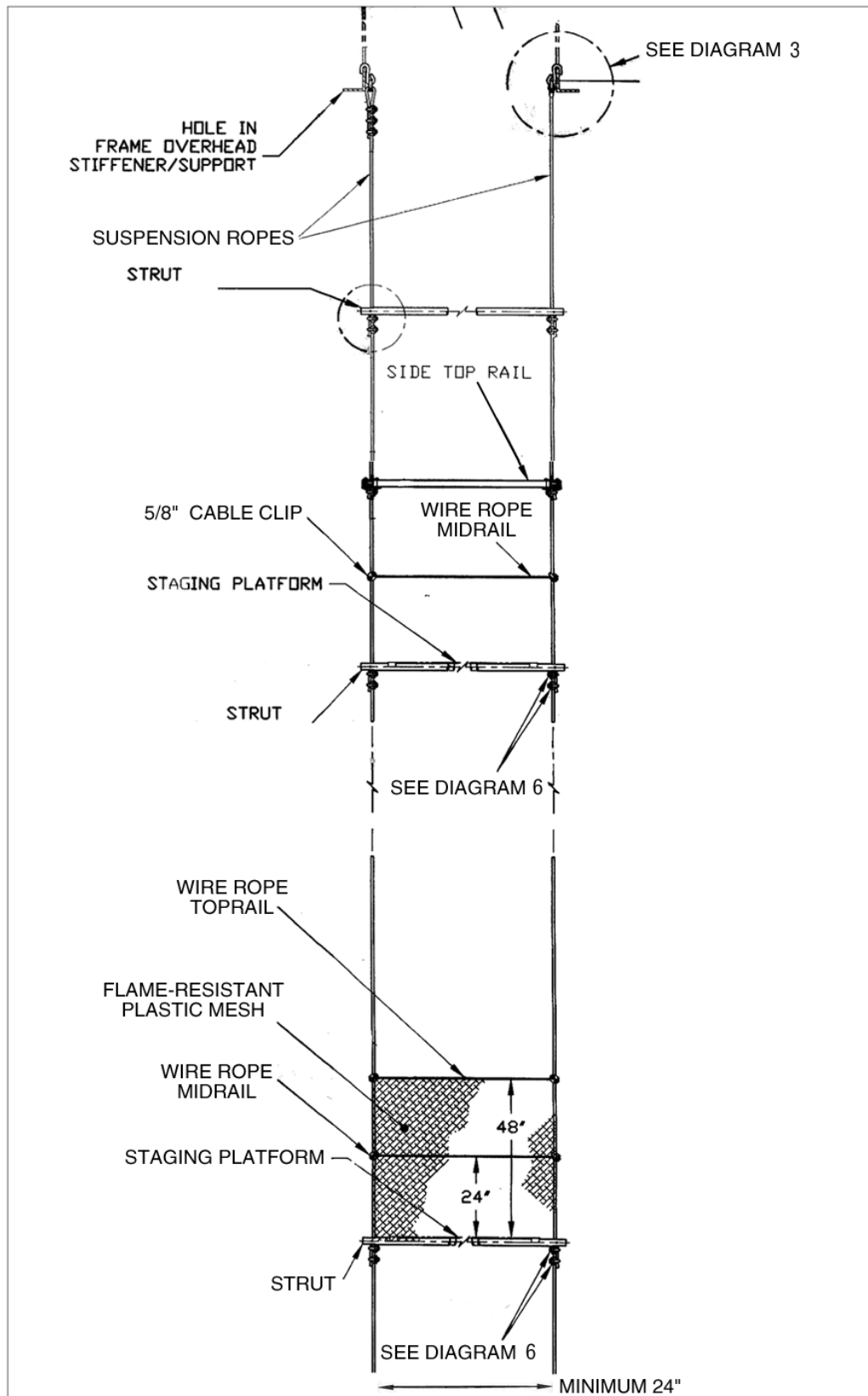


DIAGRAM 7 - STRUT PIN CONNECTION



**DIAGRAM 8 - SIDE ELEVATION  
MARINE HANGING STAGING  
RIGID GUARDRAIL SYSTEM (TOP); WIRE ROPE GUARDRAIL SYSTEM (BOTTOM)**

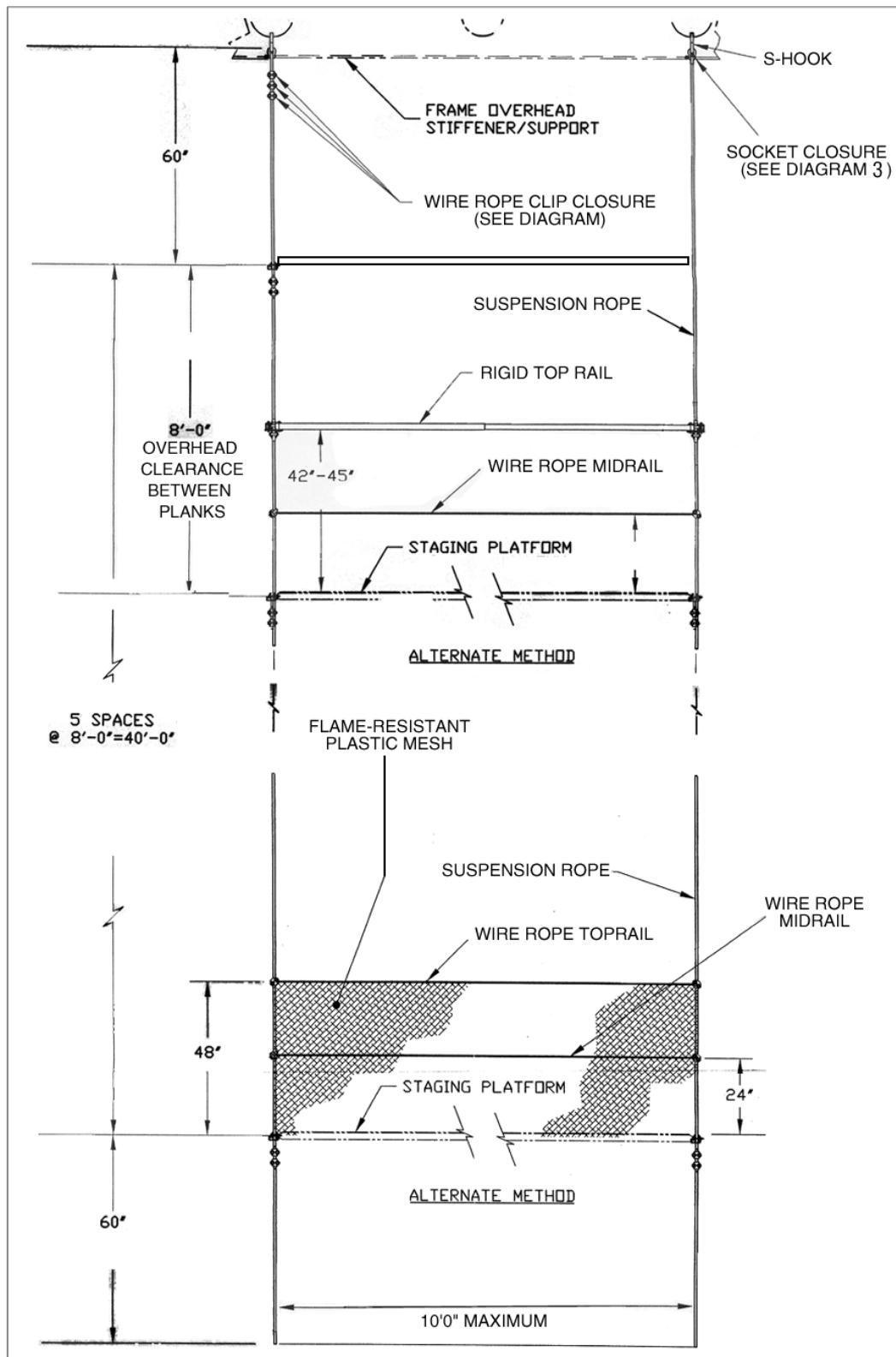


DIAGRAM 9 - BACK ELEVATION  
MARINE HANGING STAGING  
RIGID GUARDRAIL SYSTEM (TOP); WIRE ROPE GUARDRAIL SYSTEM (BOTTOM)

## **Appendix B**

### **Sample Job Hazard Analysis (JHA) Format**

<b>Fall Protection Work Plan for Marine Hanging Staging (MHS)</b> <b>Job Hazard Analysis (JHA)</b>																				
All employees involved in the installation or removal of MHS must review this JHA prior to the initial start-up of work. This plan must be posted in the work site office for the duration of the job. All employees subject to wear fall protection must be trained in accordance with the written plan. <b>Hazards must be corrected or safely controlled before starting work.</b>																				
<b>Location:</b>	<b>Vessel:</b>																			
<b>1. Identify potential hazard(s):</b> <input type="checkbox"/> Space certified "Safe for Workers" <input type="checkbox"/> Adequate housekeeping <input type="checkbox"/> Adequate supply of drinking water <input type="checkbox"/> Adequate ventilation <input type="checkbox"/> Adequate lighting	<b>2. Identify potential fall hazard(s):</b> <input type="checkbox"/> Deck openings protected <input type="checkbox"/> Interior ladder safe to climb <input type="checkbox"/> Slip and trip hazards removed <input type="checkbox"/> Adequate sole tread on workers' boots <input type="checkbox"/> Warning signs posted																			
<b>3. Describe the hazard(s):</b>   <div style="text-align: right; font-size: small;">All corrections made: Inspector's initials</div>																				
<b>4. Attendant's field check of fall protection systems:</b> <input type="checkbox"/> Tripod/retrieval system locking capacities <input type="checkbox"/> Defects in cable, tripod, hooks, mildew, wear <input type="checkbox"/> Chaffing gear on site <input type="checkbox"/> Retrieval system inspection data <input type="checkbox"/> Body harnesses for supporting workers <input type="checkbox"/> Other _____	<b>5. Installer's field check of work platform:</b> <input type="checkbox"/> Harness <input type="checkbox"/> Lanyards <input type="checkbox"/> Carabiners <input type="checkbox"/> Anchor straps <input type="checkbox"/> Stirrups <input type="checkbox"/> Other support equipment																			
<b>6. Qualified person's inspection of interior tank structure for safe and secure anchor points:</b> <b>If structure anchor points are unsafe – Stop Work</b>																				
<b>7. Describe the method for prompt, safe removal of injured workers.</b>  <input type="checkbox"/> Call _____ Call 911 Call offsite rescue number _____  <input type="checkbox"/> Describe the location of the phone:																				
<b>8. Trained cable installer(s) and attendant(s) on site under this plan:</b>  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black; width: 33%;">Signature</th> <th style="text-align: left; border-bottom: 1px solid black; width: 33%;">Print Name</th> <th style="text-align: left; border-bottom: 1px solid black; width: 33%;">Installer or Attendant</th> </tr> </thead> <tbody> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table>			Signature	Print Name	Installer or Attendant	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Signature	Print Name	Installer or Attendant																		
_____	_____	_____																		
_____	_____	_____																		
_____	_____	_____																		
_____	_____	_____																		
_____	_____	_____																		
<div style="text-align: center; font-weight: bold;">Signatures</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <b>Approvals:</b>            Responsible supervisor _____         </div> <div style="width: 35%;">           Date of inspection: _____         </div> </div> <div style="margin-top: 10px;">           Qualified person _____         </div>																				

## **Appendix C**

### **Tagging System**

**WARNING**  
**This Scaffold**  
**Is Not Complete.**

**Do Not Use.**

---

Signed by \_\_\_\_\_

---

Date \_\_\_\_\_

Red Color

**CAUTION**  
**This Scaffold**  
**Does Not Meet**  
**Safety Regulations.**

**Safety Harness**  
**Must be used.**

---

Signed by \_\_\_\_\_

---

Date \_\_\_\_\_

Yellow Color

**ATTENTION**  
**This Scaffold**  
**Was Built to**  
**Meet Safety**  
**Regulations.**

**It Is Safe To Use.**

---

Signed by \_\_\_\_\_

---

Date \_\_\_\_\_

Green Color

**SCAFFOLD**  
**USE TAG**

**Pre-shift Inspection Required**  
**Before Use as Indicated Below.**

Name	Date
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Side 1

**SCAFFOLD**  
**USE TAG**

**Removal by Authorized**  
**Personnel Only.**

**Special Precautions**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Side 2