Tall Ships America

Guidelines for Safety Aloft

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Overview and Scope

Tall Ships America member vessels represent a broad spectrum of vessels types, programs, and missions. The guidelines provided here attempt to cover a wide range of application and are necessarily general in nature. This document is aimed at providing a variety of options and some discussion and context for implementation of a vessel-specific aloft safety regimen. This document aims to provide resources for both training and equipment suitable for use in aloft work in sailing vessels, with emphasis placed on both training and safety. Effective training and practice are the primary means of ensuring safety aloft. Harnesses, tethers, and related safety equipment provide protection in advent of the unexpected, auxiliary gear to best practices.

Introduction

Sailing vessels, by nature of their design, require that crew go aloft as a part of regular care and operation of the ship. Whether for routine rig inspections and maintenance or for the operation of the sailing rig, this aloft work carries with it a measure of risk. Although falls from aloft are rare, the implications of such a fall are dire and all sail training vessels must provide effective safety aloft training, gear, and operational protocols to their trainees and crew. All successful sail training operators place safety at the heart of their program. Tall Ships America encourages a culture of safety and seeks to assist where it can in enhancing safety practices.

Operational Risk Assessment

Tall Ships America recommends a codified method to assess and mitigate operational risk. A risk assessment should be completed prior to every sailing evolution or other event that involves personnel aloft. Items that might be covered in a risk assessment include proper supervision, evolution planning, crew and trainee selection and job assignment, crew and trainee fatigue/fitness, environmental considerations, equipment needs, and the complexity of the evolution. A debrief of the assessment provides for explanation, questions, and discussion. A common-sense approach is to be encouraged, partnered with a structured process for assessing risk.

Physical and Medical Considerations

Fitness assessment and medical screening of all personnel going aloft is critical to minimizing risk. Physical fitness for climbing must be assessed, either subjectively or by a structured evaluation, to ensure trainees and crew can meet the rigors of the task. Specific medical conditions may call for additional safety measures and/or limitations. Physical and medical

assessment is an ongoing process that extends past the medical practitioner's evaluation. Potential effects of fatigue, seasickness, illness, medications, etc. must be continuously monitored.

Drugs and Alcohol

No personnel known to be under the influence of recreational drugs or alcohol should be allowed aloft. Additionally, some drugs taken for appropriate medical reasons (including some seasickness remedies), prescribed or otherwise, can have debilitating side-effects and operators should assess whether to allow personnel to go aloft who are undergoing such treatment.

Equipment

No topic generates a more spirited discussion than the use of harnesses and other fall arrest equipment for safety aloft. First and foremost, it is imperative to recognize that any safety equipment must be considered secondary to proper training, sound judgment and alert climbing practices. The use of safety equipment has the potential to create complacency; a false sense of security. Secondly, when considering what safety equipment to use, it is important to understand the potential forces generated as that equipment arrests the fall of a sailor.

For example: A 170 lb. sailor climbing with a 6' lanyard falls 8'. As the fall is arrested the individual and equipment will be subject to over 4,000 lb. or 18 kN of force.

Even if the equipment stood up to this strain, the individual will be injured. A lineman's belt or sailor's chest harness are not designed for arresting a fall and should not be used as safety aloft equipment. Minimizing the potential distance of a fall and using equipment specifically designed to arrest a fall is essential in the selection of equipment. Professionals who work at height and rock and ice climbers use harnesses designed specifically for their activity. Tall Ships America recommends full body harnesses, certified to national standards and fitted with double lanyards. A lanyard one meter in length provides for a full arm's reach and will limit falling distances. A shorter lanyard in the pair further reduces falling distances and should be used when stationary in the rig. It is important to recognize that clipping the lanyard to the rig and then climbing to the full extent of the lanyard above that connection could result in a fall twice the length of the lanyard. Climbing above the attachment point should be discouraged. The lanyard(s) should be attached to the front of the harness for ease of use and facilitating self-rescue. The size of the clip or carabiner should be considered for ease of attachment to the standing rig. The ship's rig can be a harsh environment; UV exposure, salt, and solvents can take a toll on equipment. All equipment must be subject to regular inspection, testing and maintenance. Many climber's sit harnesses have a useable life span, represented by an expiration date on the harness itself. This and all other manufacturer's recommendations should be carefully monitored and adhered to.

Harnesses:

- Full body

Extensively used as fall protection in industrial settings; construction, antennae maintenance, linemen's work, building maintenance, etc., the full body harness is the gold standard for fall

arrest protection. It reduces two key risks: inversion with the possibility of falling out of the harness, and back injury during fall arrest. Available with attachment points on back or front. The front or sternal attachment point should be used when aloft in a sailing rig. The sternal attachment point is easy to use and promotes self-rescue and simplifies assisted rescue. The back tether attachment is often used in industrial at-height environments where a sternal attachment would put safety tethers in the work area and rescue is possible in the event of a fall. Operators should consider the risks associated with a back-tether harness and the difficulty of retrieving a swinging sailor from below a yardarm at sea.

- Rock/Ice climber's "sit" harness

Designed for alpine, rock, and ice climbing environments where repeated falls are the expected. They are available in a broad range of styles and are good candidates for aloft work, but do not protect as well against inversion or back injury. Many options are available with a range of features, including attachment points for tools and padded waste belts and leg loops for greater comfort.

- Arborist harness

Available as full body or "sit" harness, these are more stoutly built, with numerous additional attachment points for rigging. Additional padding provides a more comfortable seat. These are best suited for rigging work aloft in which the rigger must sit in the harness for extended periods or carry tools and gear along.

- Chest (sailboat cockpit/deck) harness

Chest harnesses are designed for use on deck only, where they are designed to keep sailors on board the vessel during heavy weather. Rigged to jack lines or other attachment points, their purpose is lateral restraint, never fall arrest. These types of harnesses are wholly unsuitable for work aloft or fall arrest and should not be used under any circumstances.

- Lineman's belt

Lineman's belts are designed for climbing poles along with boot spikes. These or any other type of belt are wholly unsuitable for fall-arrest and should not be used under any circumstances.

Lanyards/Tethers and Clips/Shackles/Carabiners:

Lanyards and tethers are the essential linkage between the harness and the rig. Minimizing any fall distance and avoiding loading the gear unnecessarily (see Fall Factors below) are critical to minimizing the risk of serious injury in a fall. Tethers should be only as long as can be extended with an arm, (1 meter is a common length) and should ideally be clipped at or above the climber's harness attachment point. The attachment point below the climber increases fall length and fall factor, dramatically increasing the forces experienced by the climber.

All harnesses should have two tethers, each with a carabiner suitable for the rig of the ship in which they are to be used. Two tethers are preferred. One shorter than the other. The short one

should be used once in position. The use of different lengths also eliminates the risk of having the climber's neck captured between two secured tethers.

A ship with large gear and large attachments might require an oversized pear-shaped carabiner with large gate opening. Vessels with smaller gear might allow for the use of conventional climbing gear. Choice of materials is important. Aluminum 'biners, used for their low cost and extremely low weight, are readily available because they're the choice of the recreational climbing community. But aluminum is harder to inspect, more prone to invisible cracking, and more susceptible to corrosion. A more practical, reliable, and long-lasting choice may be a steel carabiner found in industrial applications.

Shock absorption devices

Many at-height industrial safety rigs use a shock absorption device. One example of this is a length of webbing stitched back and forth, accordion style, so the stitching tears out during a fall, slowly decelerating the climber. While these are excellent at reducing the effects of a fall, they may have other negative repercussions at sea. For example, they might result in a faller sailor swinging below a yard arm and unable to reach anything to self-rescue. These devices may be appropriate for some training vessel applications and should be considered in the context of these benefits and drawbacks.

Rig

The condition of both standing and running rigging play a critical role in working safely aloft. A rigorous formal inspection and preventative maintenance program for all components of the rig is strongly advised. [For additional resources on this topic, see Tall Ships America's Rig Inspection Checklist and Self-Inspection Protocol.]

Running rigging should always be properly secured. Prior to any sail evolutions, all personnel aloft must be alerted and readied for the executed change, and when complete, running rigging should again be made fast.

Differing types of rigs can create different areas where the potential for a fall is greater. A square-rigged vessel presents different challenges than those found on a fore and aft rigged schooner. The futtock shrouds, transition over crosstrees, and yards are locations in the rig that have been the site of multiple incidents. Vessels have modified their rigging to create alternative means for climbing in these locations and/or added rigging specifically designed as anchor points for harness lanyards. Truss cranelines from shrouds to yards assist when laying out on the yards. The addition of safety jackstays provides an attachment point for harness lanyards, but must be fitted with forethought. A vertical jackstay at the futtock shrouds may potentially add a significant distance that a sailor could fall before being arrested by their equipment. The forces generated by a long fall may exceed the breaking strain of equipment and/or cause critical or fatal injury to the climber. The horizontal (Jarvis) jackstay or back wire on the yard have been used to provide an attachment point for harness lanyards allowing the sailor to traverse out to the end of the yard while remaining attached to the wire. However, when a downward load is placed on a horizontal wire the strain is increased, up to six times the force created by the fall alone.

With multiple sailors on a yard, if one falls while attached to a wire jackstay, there is potential to create a chain reaction of fall. Attachment points along the yard jackstay require clipping and unclipping as one moves out on the yard, but with a two lanyard system can still provide continuous safety while making the traverse while eliminating the dangers of the horizontal wire.

The use of a back wire on the yards provides an additional measure of safety, and should not be overlooked when used as a passive safety wire (not used as an attachment for lanyards).

All equipment designed to prevent or arrest falls should take into account the specific rig of the vessel and the anticipated maximum strain the gear may experience.

Safety aloft regimes should explicitly include the bowsprit and areas near headsail standing and running rigging.

Working Aloft while being Belayed

An individual who is hoisted aloft on halyards or belayed from deck using a gantline necessitates additional training, skills, and supervision. The climber's safety is dependent on a crewmember on deck. The line must be attended at all times by a crewmember experienced in these skills. The gantline often uses the friction of a belaying pin to adjust the line and secure the worker aloft. The crew member on deck and at the belay pin controls the safety of the climber and must be an expert at this skill. Clear communications between deck and aloft are essential. Whenever practical, a redundant safety system should be employed. Possible backup safety systems could include a camming-self arrest device riding on a suitable line or a prusik hitch on a safety line or stay. As with all safety gear, these devices and techniques require professional training, supervision, and practice to be effective. An improperly employed technique or piece of gear can create a feeling of safety where none exists and may be worth less than no gear at all. A sailor lowered down a stay must ensure that a shackle pin is moused and is not riding on the stay to prevent an unexpected failure (backing out) of the pin.

Training and Best Practices

Tall Ships America recommends all personnel (professional crew, participants, trainees, and/or students) receive formal training on proper procedures and techniques before climbing aloft. Participation in this training should be required prior to going aloft and should be documented in writing. Permanent crew should participate in refresher training, preferably no less frequently than annually, including a refresher on the sailing organization's aloft policy or Safety Management System. Training with external companies or organizations may be appropriate where little or no experience exists, as in the case of a new vessel or organization.

A suggested list of training topics include but are not limited to:

- Proper dress for laying aloft and for weather conditions. Full fingered gloves should be discouraged.
- Explanation of vessel-specific harness, proper donning, care and storage, and proper use of carabiners and lanyards.

- Use only a properly fitted at-height safety harness in good condition. Inspect prior to donning. Personnel "buddy-check" each other's harness.
- Receive permission and final inspection of harness/attire from the appropriate designated authority (master, mate, bosun or designated observer on deck) prior to laying aloft and report in when back on deck.
- Remove and leave all unnecessary gear on deck. Knives, marlinespikes, pliers, cameras, etc. must be secured to the person by a lanyard.
- Know the status of all radio transmitters before going aloft and avoid restricted areas.
- Whenever possible, lay aloft on the windward side only.
- Move only one hand or foot at a time: one hand for the ship and one hand for yourself.
- Description and identification of standing and running rigging.
- Clip directly to standing rigging, or loop around or through standing rigging and clip back to harness attachment point. Avoid looping around and clipping to lanyard, this may place improper strain on the clip/carabiner.
- Location and use of vessel-specific clip-in points.
- Grasp, stand on or clip in to standing rigging or fixed gear only, never use running rigging or ratlines to hold onto or clip in to. Do not clip in to backstays.
- No unnecessary risks.
- No skylarking, acrobatics, grandstanding, haste, or competitions in the rig. Cloud walking on sails, descents or ascents other than by approved paths through the rig should be forbidden. An example is a descent via a backstay.
- No unnecessary noise.
- As soon as a person aloft stops moving or needs to work, clip in immediately unless already attached to a fall arrest device, safety stay, or other such equipment. A secondary point of clip-in is recommended with the shortest possible lanyard length.
- When aloft, work sails from the windward side. While on the bowsprit, stay on the windward side of the headsails.
- Stay well clear of all headsail and staysail sheets.
- Do not lay out onto a yard until it is secured (all braces are taut and, if the sail is not set, it is in its fixed lifts). Where fall arrest systems or designated clip-in points allow, clip in before transferring to or from the yard.
- Announce the fact that you are laying out on the yard before doing so.
- Avoid straddling shrouds and running rigging; do not sit or stand on yards.
- While working on deck, never cast off or move running rigging while personnel are moving or unclipped in the rig.
- Take extra care bracing yards when personnel are aloft. Do not brace yards when personnel are on the yards. Ensure that no personnel (in the shrouds) will become trapped as the yards are braced sharp up to the (lee) rigging.
- Take extra care to ensure that sails are kept under control whenever personnel are in the vicinity, aloft or on the bowsprit.
- The officer supervising the helm should ensure that the sails are not luffed up when personnel are on the head rig or in the vicinity of sheet blocks/sheets.

- When on the fo'c'sle or foredeck of the vessel, be aware of flying sheet blocks.
- Professional crew engaged in work aloft should understand the additional risk of conducting maintenance aloft. Additional training should be given to crewmembers working aloft for the first time and should be overseen by authorized personnel.
- Work to be done aloft with a crewmember on belay (attached to running rigging in bosun's chair or sit-harness); explain and demonstrate belaying a person on a pin. Verify the skill level of the crewmember tending the line on the pin and limit distractions. Confirm that the crewmember on belay and the crewmember on deck have a set of commands that they both understand. Use a locking hitch or other method to communicate to all crew that the line must not be cast off.
- On vessels where it may be necessary for watch standers to lay aloft quickly, harnesses should be worn throughout the watch.
- Rescuing a fallen climber: Training should include the rescue of a fallen climber who is injured, unresponsive or cannot self-rescue. A special rescue kit will facilitate a quicker response. This gear should be purpose specific; light weight, compact and preferably different then ship's running rigging. (Note: Rescue practice is a high-risk activity. Experienced personnel should lead this training.)
- Review of previous incidents, accidents, and "near-misses" aloft, their cause, and the organization's response to prevent the accident in the future.

Summary

Climbing aloft on a sail-training vessel is required for rig inspection, maintenance, and sail handling. It also provides trainees with a unique challenge and experience found only aboard these sailing ships. A fall from aloft would be a catastrophic event, but the risk associated with this beneficial and often necessary activity can be effectively managed. It is critical that best practices be employed to minimize risk. Sail-training organizations are encouraged to use the principles in this document, the resources listed below, and to consult experts in evaluating their own operation's risks and in preparing and implementing a safety aloft program.

RESOURCES

Definitions:

1. Fall Factor -The fall factor is the ratio of the height a climber falls before the rope begins to arrest the fall and the rope length. Ex. Climbing aloft with a 3 ft. tether, the climber is 2 ft. above the attachment point of the tether. A fall will result in 5 ft. of free fall. The fall factor ratio

is 5:3, or a fall factor of 1 2/3. Minimizing fall factor reduces the forces generated by a fall and the forces that people and equipment must tolerate.

2. Prusik – The term prusik is used both to describe a loop of cord and the knot or hitch created with that loop around another rope. The prusik hitch is similar to a rolling hitch or icicle hitch in its ability to grab onto a rope while tensioned or weighted. The prusik hitch may be moved when the load is removed from the cord.

3. Ascender – An ascender is a mechanical climbing tool that can grab a rope, similar to the friction knots described above. It employs a cam that allows the device to slide along a rope in one direction, but grabs the rope when weighted in the opposite direction.

4. Carabiner – A carabiner is a "spring hook". A metal loop with a spring-loaded gate used to quickly and reversibly connect components. Carabiners are available in different shapes, sizes, and materials. The gates, when closed, are a critical part of the strength of the equipment. There are non-locking gates or locking gates. The screw gate must be manually turned to screw the lock into place. A twist lock automatically locks when the gate closes.

Note: Many aluminum caribiners are made for recreational climbing. Industrial caribiners are commonly made of steel.

Publications:

1. Mountaineering: Freedom of the Hills, 8th edition. The Mountaineers and Ronal C. Eng. (2010). ASIN: 159485138.

This reference is referred to as the mountaineer's and rock climber's bible. It is the American Practical Navigator (Bowditch) of the climbing world. Freedom of the Hills has detailed information about equipment, ropes, and their use. The reference is has been updated 8 times reflecting the latest in equipment and techniques. The relevant sections of this book would be very helpful to those exploring options for equipment as well as the use of this equipment. Rope techniques and the use of specialized knots are discussed and illustrated.

2. The Complete Caving Manual. Andy Sparrow. (2010). Cornwood Press. ISBN: 1847971466.

The equipment and techniques used in caving have relevancy to some practices used while climbing aloft. Chapters on equipment, horizontal and vertical techniques, and single rope technique may provide useful information for safe practices aloft.

Web Links:

Petzl USA

Petzl is a leading manufacturer of climbing gear/equipment. Their web site is split between Sport and Professional sections. The Professional site provides a multitude of information on equipment and its use. The link below is for Verticality:

http://www.petzl.com/en/Professional/Verticality?l=US#.VMvu6mjF-So

There are numerous topics relevant to safe working practices aloft. Navigate through this section for a variety of applications.

This link accesses Petzl's Rope Access section.

http://www.petzl.com/en/Professional/Rope-access-and-confined-space?l=US#.VMvtymjF-So

Wespur

Wespur is an arborist's site for equipment and training. The gear used by arborists is similar to climbing equipment but more industrial in design and materials. The gear is also specific to the needs of tree work. This may be helpful when selecting the best equipment for a vessels rig. Wespur contracts Ascension Group Northwest for training (see training).

http://www.wesspur.com/

NFPA (National Fire Protection Association)

NFPA 1983: STANDARD ON LIFE SAFETY ROPE AND EQUIPMENT FOR EMERGENCY SERVICES

http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=1983

OSHA

OSHA regulates and provides information for safe work practices in the US. The link below offers numerous articles regarding fall protection and work in the marine environment.

https://www.osha.gov/SLTC/fallprotection/standards.html

Training:

Ascension Group Northwest

This organization offers a variety of high angle training courses and will also customize a training course to fit the needs of their client.

http://www.ascensiongroupnw.com/html/custom-training-courses.html

Ropes that Rescue: Training in the Vertical Realm

The Rope Access Skills Workshop 1 is an intensive 6 day long open enrollment workshop intended specifically for those who work on rope at elevation. Rope access is used around the world to support or place workers in various environments for the purpose of performing their jobs. This may include, but is not limited to:

- Bridge, dam or structural inspectors
- High scalers
- Construction personnel
- Sea platform inspection and construction
- Tower workers

http://www.ropesthatrescue.com/rope-access

American Alpine Institute

Technical Self-Rescue for Climbers

The Technical Self-Rescue for Climbers program is an intensive one to two-day seminar on improvised multi-pitch rock rescue techniques. Participants study a series of haul, lower, rappel and rope-climbing systems and then apply them to a variety of practical scenarios. Individuals who complete this rock-rescue program should be able to apply these skills to a wide array of complex high-angle problems.

http://www.alpineinstitute.com/catalog/technical-self-rescue-for-climbers/