

Naval Facilities Engineering Command

Ergonomics Risk Assessment for

Dinghy Retrieval and Storage

Introduction

This report summarizes the ergonomics risk assessment conducted on November 16th, 2006. The dinghy retrieval and storage task was observed in order to determine sources of ergonomics stress and recommend improvements. This assessment is based upon interviews with an assistant coach and safety personnel as well as an evaluation by a Certified Professional Ergonomist with the Naval Facilities Engineering Command (NAVFACENGCOM) Hazard Abatement and Mishap Prevention (HAMP) program.

The operation reviewed presents the opportunity to reduce the risk of work-related musculoskeletal disorders (WMSDs). Recommendations to the command to reduce the probability of injury include equipment purchase¹, process redesign, and implementation of administrative controls².

Musculoskeletal Disorders (MSDs) are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints, spinal discs, skin, subcutaneous tissues, blood vessels, and bones. Work-Related Musculoskeletal Disorders (WMSDs) are:

- ∞ Musculoskeletal disorders to which the work environment and the performance of work contribute significantly or
- ∞ Musculoskeletal disorders that are aggravated or prolonged by work conditions.

Representative vendor information is included in the recommendations to assist in the evaluation of products and services³. Recommendations to the command include gathering input from the coaches, students, safety specialists, and other personnel to evaluate equipment before purchasing. This process will increase product acceptance, test product usability, and durability, and takes advantage of employee experience.

Naval Facilities Engineering Command (NAVFACENGCOM) manages the Chief of Naval Operations (CNO) Hazard Abatement and Mishap Prevention Program, which is a centrally managed fund to correct safety and health deficiencies beyond the funding capabilities of the activity. This project has been submitted for FY08 funding under project 670AC.

Dinghy Storage

Purpose of the Operation: Store and retrieve dinghies at the US Naval Academy

Population: 33 Student team members as well as coaches, civilian and military personnel

Process Description: Student and civilian personnel manually store and retrieve dinghies from storage racks as shown in figures 1 through 4. The fleet includes Vanguard Collegiate 420's, collegiate Flying Juniors, Vanguard 15s, Snipes, Interclub and Tech dinghies. Dinghies are about 14' long, 5' wide, and 18" tall and weigh up to 230 lbs. depending on the model. There are 54 dinghies at the Naval Academy and the storage racks accommodate 32 at a time. Dinghies are retrieved for competitive events, summer training operations, as well as for repair. Every summer all of the dinghies are moved when the dinghies in active use are replaced with the dinghies in storage.

The storage racks have four levels and four to eight people are required to load a dinghy. When a hurricane is approaching all of the dinghies must be moved which can take two days. Personnel frequently complain of back pain after a mass movement of boats.

The top rack of the storage system is 98" tall which requires overhead reaching and crawling on the racks. The current storage system is about 15 years old and the wood has been severely damaged and degraded. There is a concern for the boats and personnel from the racks failing.



Figures 1: Carrying dinghy to storage rack



Figure 2: Placing dinghy in rack



Figures 3 and 4: Unloading dinghy

Ergonomics Issue Description: The ergonomics risk factors associated with dinghy storage and retrieval involve heavy lifting and awkward postures. When risk factors such as force and awkward posture occur in combination the risk of developing a WMSD is increased.

Excessive Lifting: Personnel risk injury from forceful exertions caused by handling dinghies in extremely awkward postures. Forceful exertions can place high loads on the muscles, tendons, ligaments, and joints being used. When lifting in an awkward posture the muscle force required to lift a load is amplified (i.e. greater muscle exertion is necessary to sustain the increased effort) which imposes greater compressive forces on the spine. As force increases, muscles fatigue more quickly. Prolonged or frequent exertions of this type can lead to WMSDs when there is not adequate time for rest or recovery.

The Department of Defense Design Criteria Standard for Human Engineering, Military Standard 1472F contains lifting guidelines and weight limits. For the dinghy storage operation, it was assumed that a male and female mixed population would be performing the task and they would be able to keep their hands close to the body (within 6"-12"). The recommended weight limit for lifting the dinghies and placing them on the bottom two racks is provided in table 1. The heavier the load the more people required to perform the lift in order to minimize risk as dictated by MIL-STD 1472F. If the people performing the lift are unable to keep their hands close to the body, then the recommended weight should be reduced. If the hands are kept between 12"-18" from the body the recommended weight should be reduced by 33%. If the distance from the body to the hand-holds is greater than 18", the recommended weights should be reduced by 50%.

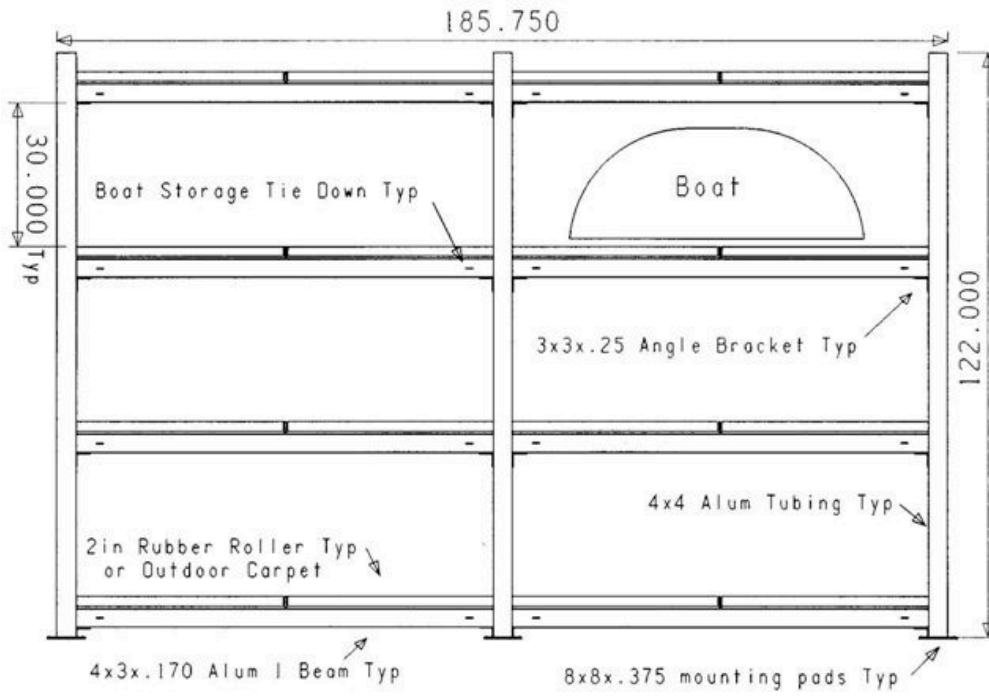
Table 1: Recommended weight for placing a dinghy on the two lower racks (below 5ft)	
Number of People Performing Lift	Recommended Weight
4	154 lbs.
5	187 lbs.
6	220 lbs.
7	253 lbs.

None of the validated lifting guidelines address lifting boats into the upper two storage racks, therefore no safe recommendation can be made. In addition, dinghies arrive at one end of the dock and have to be carried to the rack storage system. Military Standard 1472F does not allow for carrying loads greater than 33 feet which is exceeded when carrying the dinghies the length of the dock.

Awkward Posture: The storage operation is frequently performed in awkward postures because of the design of the rack system. Personnel usually reach overhead and crawl in the racks to pull the boats into place. Climbing on the racks is a safety hazard which puts personnel at risk of falls. Supporting a load overhead, as shown in figure 4 can be very stressful to the shoulders and back. Working in awkward postures increases the amount of force needed to accomplish an exertion, complete a task or sustain that posture. Over time muscles used in awkward postures tend to tire placing greater strain on tendons and ligaments and increasing the risk of injury. When risk factors such as force and awkward posture occur in combination the risk of developing a WMSD is increased.

Recommendations:

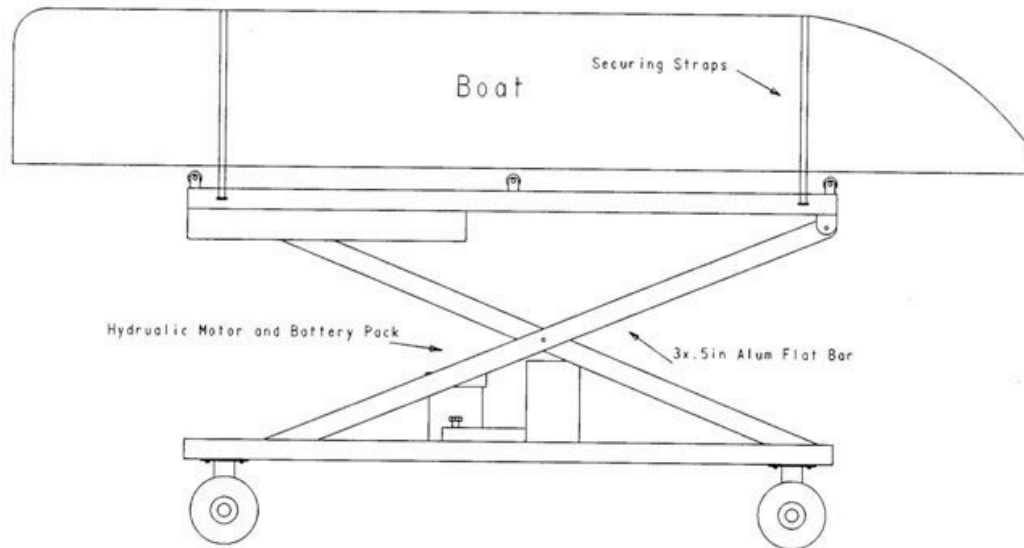
- ∞ A galvanized hot dipped steel storage system with carpet would be sturdier and better able to withstand the elements than the current system. Ernie Taylor at Peaklogix (703-819-6061) provided a quote for a 32 boat capacity system at \$19,085 with installation.
- ∞ A storage system with roller shelves will eliminate the need for personnel to climb into the racks to pull the boats into place. A scissor lift can be used to transport the dinghies to the shelving unit in order to eliminate carrying the boats the length of the dock. The lift can raise and lower the boat to the height of the rack so that the dinghy can then be slid into place without personnel having to support the weight of the boat. Cliff Thomas with Atlantic Coast Container Repair (757-647-5091) quoted \$70,791.98 for four aluminum modular boat racks and \$14,051.98 for the boat lift, as shown in figures 5 and 6.



Front View

Atlantic Coast Container Repair
 Naval Academy Boat Racks

Figure 5: Boat racks



Side View

Atlantic Coast Container Repair
 Boat Storage Lift Cart

Figure 6: Boat lift

- ∞ The more personnel performing the lift the lower the compression force for each person participating in the boat movement. The lower two rack positions are recommended over the top racks, particularly for the heaviest boats and the ones accessed most frequently. Proper communication and clear travel paths are imperative to team lifting. It is also important to match the heights and lifting capabilities of the individuals performing the lift as much as possible. Minimizing carrying distances for the boats is recommended to further reduce the risk of injury.
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End Notes:

¹ Equipment purchase without proper and repeated training will not mitigate risk and may in fact increase hazards.

² Administrative controls are management-controlled work practices and policies designed to reduce exposures to work-related musculoskeletal disorders (WMSDs) hazards by changing the way work is assigned or scheduled. Administrative controls reduce the exposure to ergonomic stressors and thus reduce the cumulative dose to any one worker. Examples of administrative controls that are used in the ergonomics context are employee rotation, employer-authorized changes in the pace of work and team lifting.

³ This report does not constitute an endorsement of any particular product. Rather, it is a recitation of how Navy personnel have addressed a particular work place safety issue. Neither the Navy nor its employees and agents, warrant any product described in this report for any use, either general or particular.