

Ergonomic Risk Assessment Ship Intermediate Maintenance Activity Mayport NAVFAC East Division

An ergonomic risk assessment was conducted at the Ship Intermediate Maintenance Activity (SIMA) Mayport on March 29 and 30, 2000. The life raft packing operation was observed in order to determine sources of ergonomic stress. This assessment is based upon interviews with employees, supervisors, and safety personnel as well as evaluation by the Hazard Abatement East Coast occupational ergonomist. The Job Requirements and Physical Demands Survey (JRPD), an ergonomic survey, was also administered to the employees. The results of the JRPD indicate that the life raft packing operation is an Ergonomic Problem Area. Appendix I contains a summary of the JRPD results as well as a description of the methodology. Recommendations are included with as much vendor information as possible to assist in the evaluation of products and services.

Life Raft Packing Operation

The life raft packing operation employs 8 active duty personnel 40 hours a week. All Navy life rafts require testing and repacking every three years. SIMA Mayport contains one of only four Navy life raft packing stations. There are no recorded injuries for this site. The young age of the packers and transitory nature of this position may be a factor in the lack of reported injuries. The same operation at Naval Station San Diego has experienced an injury rate of 33% (refer to the attached Ergonomic Evaluation performed by Hazard Abatement SW Division). The employees executing this task were observed performing maximal force exertions in extremely awkward posture and are at a high risk of ergonomic injuries.

Three days are spent preparing a single batch of life rafts. Life rafts arrive in canisters by forklift. Canisters are deployed by pulling a ripcord, which causes the raft to inflate. The canister opens into two pieces. Figure 1 show a 25 man life raft deployed and figure 2 depicts a canister in two pieces. The life rafts are left inflated for 24 hours and repeatedly tested at different pressures and with soapy water to inspect for leaks. Life rafts are deflated by industrial vacuum. Any leaks, fiberglass damage, or marred markings are repaired. During the repair process, the survival bags and air tanks are filled. The survival bags weighs between 70 and 100 lbs. The survival bags and air tanks are placed into the rafts before they can be packed.

Two days are then spent packing life rafts. A fully packed life raft weighs over 500 lbs. The packing operation requires awkward postures, poor tooling, and extreme force, placing operators at risk of ergonomic injury. Two to three people fold each life raft, as shown in figure 3. Figure 4 shows two employees using body weight to try and compress the raft during folding. The raft is further compressed with a cinch belt as shown in figure 5. The cinch belt works with a ratchet mechanism and requires extreme force and repetitive motion. After the raft is folded, it is then rolled onto one side and

one half of the canister is slipped underneath. The cinch belts are removed and placed around the canister to allow for further cinching. When the raft fits in one half of the canister, the cinch belts are again removed. The top half of the canister is positioned and the cinch belts are applied around the entire canister. The employees then alternate cinching the canister halves together and forcing pieces of the raft inside. Figure 6 shows one employee cinching the canister while the other tries to align the two halves with a crowbar. Figure 7 shows an employee with a crowbar trying to align canister halves from a supine position with raised arms and elbows. Employees also use the end of hammers to push pieces of the life raft into the canister, as shown in figure 8. When the canister is finally closed an elastic band is applied, as shown in figure 9. Applying the band requires awkward postures and extreme force. Adding gold banding and stenciling is conducted on the padded floors, as shown in figure 10. A forklift removes the finished canisters.

Reference Photos



Figure 1: 25 Man life raft open



Figure 2: Life raft canister



Figure 3: Folding a life raft



Figure 4: Compressing the raft



Figure 5: Cinching the raft



Figure 6: Cinching and prodding



Figure 7: Employee using crowbar to align canister halves



Figure 8: Using hammer handles to push raft into canister



Figure 9: Applying band to finished canister



Figure 9: Banding and stenciling

Recommendations:

Training

Zodiac manufacturing company offers training in packing life rafts. Mr. Alan Brocious (410-643-4839) co-ordinates this training and is familiar with the Navy life raft packing operation. With permission from SIMA Mayport, the video taken during the ergonomic evaluation could be sent to Mr. Brocious. If SIMA Mayport is interested in this option, the Hazard Abatement Ergonomics Program would like to review Zodiac's training before the Navy purchases it. The Ergonomics Program would ensure the course contains proper training methods and ergonomic techniques for packing life rafts. Training costs would be \$750 per person plus a fee for modifying Zodiac material to meet the Navy's needs. The training facility is in Vancouver, bringing a trainer to Mayport would cost \$3,000 plus expenses.

Cinchers

Some of the current cinch bands are worn and should be replaced to avoid unnecessary exertion and injury due to bands breaking under stress.

Vendor	Product	Price
Lab Safety 1-800-356-0783	Huggers	\$14-\$31
Global Industrial 1-800-645-1232	Cargo Load Binder	\$19-\$29
Grainger	Ratchet Style Load Hugger	\$32-39
C&H 1-800-558-9966	Ratchet Tie-Downs	\$15-\$33

Engineering Services

Currently, no tools have been identified in the commercial life raft industry or industrial manufacturing that would aide in the life raft packing process. It is recommended that an engineering consulting service be contacted about designing a tool to aid in life raft compression. An ideal tool would apply force in a concentrated area to compress the raft without harming the survival kit or air canister. This tool could be used during the folding process and while the raft is in the first half of the canister.

A possible short-term solution would be a cinching belt with a winch instead of a hand ratchet mechanism. Engineering services could also design this tool.

Appendix I- Life Raft Packing Operation Job Requirements and Physical Demands Survey

Summary

The Job Requirements and Physical Demands Survey (JRPD) was administered to employees responsible for packing and testing life rafts at SIMA Mayport. The results of the JRPD indicate that this is an Ergonomic Problem Area (EPRA) with an overall priority score of 5 (on a scale of 1-9, where 9 has the greatest priority). The JRPD looks at five distinct body areas: shoulder/neck, hand/wrist/arm, back/torso, legs/feet, and head/eyes. The overall priority value is based upon the highest priority ranking for a single body area. The back/torso region has a significant priority rating with a value of 5. A low level of reported discomfort (in the discomfort survey section) reduced the priority ratings, which is a common effect among enlisted populations. This effect can be seen in the number of personnel responding (to the general questions) that work-related pain or discomfort does not improve away from work and causes difficulty in carrying out normal activities. Packing life rafts is a physically demanding task with many design constraints. While the risk factors associated with this task cannot easily be eliminated, they can be reduced through proper training and possibly additional tools. The JRPD indicates the presence pre-existing work-related musculoskeletal disorders among the employee population, which may have contributed to the overall priority score. The specific results of the JRPD as well as a brief discussion of methodology are as follows:

Population Data

Surveys were completed and returned by all of the 8 sailors responsible for packing life rafts, resulting in a **response rate of 100%**. An 80% response rate is desired for statistical significance. For those responding to the background questions, the population surveyed was **100% male and in the military**. **38%** of the respondents were between the ages of **21 and 30**, **63%** were between **31 and 40**. **88%** of the employees have been with SIMA Mayport and working in the life raft packing operation for over a year. None of the respondents have been in this position for over 5 years.

Body Regions

The JRPD prioritizes five distinct body regions based upon a combination of ergonomic risk factors and discomfort. Employees are asked to indicate the duration for which they are exposed to different ergonomic risk factors. Ergonomic risk factors include posture, force, frequency, repetition, vibration, contact stress, and restrictive personal protective equipment. Discomfort is assessed through frequency and severity for each of the five body regions. Table 1 demonstrates the relationship between body region and discomfort and risk. The priority score, from 1 to 9, is also shown for each body region. The leg/torso region has the greatest priority score with a value of 5, which indicates significant risk.

		Shoulder/ Neck	Hand/ Wrist/ Arm	Back/ Torso	Leg/ Torso	Head/ Eye
Risk	Prevalence	50%	25%	63%	38%	13%
	Rating	Medium	Low	High	Medium	Low
Discomfort	Prevalence	13%	25%	25%	38%	13%
	Rating	Low	Low	Low	Medium	Low
Priority Score		2	1	4	5	1

Risk prevalence is determined by the percentage of respondents indicating a specific number of ergonomic risk factors for a duration greater than 2 hours a day. Ratings are determined by prevalence. Low ratings represent less than 30% prevalence; medium is 31% to 60% and high is greater than 61%.

Discomfort is categorized by the terms discomfort, fatigue, numbness, and pain. The following combinations of frequency and severity indicate discomfort prevalence. Discomfort rankings are determined by the percentage of respondents with prevalent discomfort. Table 2 contains the discomfort criteria based upon frequency and severity.

	Mild	Moderate	Severe
Daily	*	*	*
Weekly		*	*
Monthly			*

The body regions are prioritized based on the following ranking matrix. Table 3 demonstrates the relationship between discomfort and risk, which determines priority.

Risk Factor	Discomfort			
		High	Medium	Low
High		9*	7*	4
Medium		8*	5*	2
Low		6*	3	1

The ranking of a body part determines its priority. A ranking greater than 4, indicated by an *, is significant. The overall priority ranking is equal to the highest value, in this case 5.

Organizational Information- Low

Organizational factors can also be ergonomic stressors. The organizational score for this area was low, which indicates that job stress factors are of minimal concern. Survey respondents were asked if they understood their job responsibilities, if their

workload was too heavy, if they are able to get pertinent information, etc. This score can be improved by providing workers with more autonomy and improving discussion and feedback between employees and supervisors.

Physical Effort- 9.88

Survey results indicate an average physical effort score of 9.88. Respondents were asked to describe the physical effort required of their job on a scale of 1 to 15 where 1 is no exertion at all and 15 is maximal exertion. A value of 10 is hard, indicating a difficult operation.

Health Care Provider Score- 1

According to the health care provider score, one employee reported having been to a health care provider in the last 12 months for pain or discomfort that he thinks relates to his job.

Recovery Time Score- 25

25% of the survey respondents reported having experienced work-related pain or discomfort that does not improve when he is away from work overnight or over the weekend.

Activity Interruption Score- 37.5

37.5% of the respondents indicated that in the past 12 months, work-related pain or discomfort has caused him difficulty in carrying out normal activities (e.g. job, hobby, leisure, etc.).

Previous Diagnosis Score- 25

The survey asks if “a health care provider ever told you that you have any of the following conditions which you think might be related to your work?”

Tendonitis/Tenosynovitis	Ganglion Cyst	Trigger Finger
Epicondylitis (Tennis Elbow)	Bursitis	Carpal Tunnel Syndrome
Thoracic Outlet Syndrome	Back Strain	Knee or Ankle Strain
Overuse Syndrome”		

25% of respondents indicated affirmatively. Pre-existing work-related musculoskeletal disorders can contribute to an employee’s pain and discomfort levels; thereby affecting the overall priority score. Working conditions may exacerbate a pre-existing disorder.

Contributing Factors- 12.5

Respondents were asked if they had ever had one or more of the following conditions:

Wrist Fracture

Hypertension

Kidney Disorders

Thyroid Disorders

Diabetes

Gout

Rheumatoid Arthritis

12.5% of the respondents indicated affirmatively. These health conditions are contributing factors and may increase one's risk of developing a musculoskeletal disorder; thereby affecting overall priority.

Routine Task Distribution

The following tasks were noted by the more than 50% of the employees as being routine (performed on three or more days per week):

Bolting/Screwing

Lifting

Process Improvement Opportunities

This section allows employees to write in responses to questions. All statements are included exactly as written by the employee.

1. Which tasks are the most awkward or require you to work in the most uncomfortable position?

Packing Liferafts (two responses)

2. Which tasks take the most effort

Packing Liferafts (four responses)

3. Are there any tools or pieces of equipment that are notoriously hard to work with?

No answers given

4. If you could make any suggestions that would help you do your job more easily or faster or better, what would you suggest.

More time to complete job

Have someone else do it