

Naval Facilities Engineering Command Ergonomic Risk Assessment –Supply Operation

Introduction

This report summarizes the ergonomic risk assessment conducted in August of 2004. The Supply Area was observed in order to determine sources of ergonomic stress and recommend improvements. This assessment is based upon interviews with supervisor, safety personnel, and employees as well as an evaluation by the Naval Facilities Engineering Command (NAVFACENGCOM) Hazard Abatement Ergonomist.

The Supply operation was observed in order to determine sources of ergonomics stress and make recommendations to reduce the risk of work-related musculoskeletal disorders (WMSDs) and improve safety, health and productivity. 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.

The Job Requirements and Physical Demands Survey (JR/PD) was administered to the employees of the Supply Area. The JR/PD is an ergonomic assessment tool endorsed by the Department of Defense Ergonomic Working Group and used by the tri-services to collect occupational health data. The results of the JR/PD indicate the Supply Area is an Ergonomic Problem Area (EPPA). The Supply Area scored an Overall or Survey Priority Rank of **seven** (on a scale of 1 to 9), where nine has the highest priority for intervention. A score of five or greater indicates an Ergonomic Problem Area. The shoulder/neck, back/torso and leg/foot regions were associated with significant ergonomic risk. Ergonomic risk is based upon ergonomic stressors associated with the task and employee discomfort. Twenty-seven percent of the survey respondents have seen a health care provider within the last twelve months for pain or discomfort that he or she feels is related to the job. A significant number of employees also reported pre-existing MSDs and conditions known to be contributing factors, which places them at a higher risk of additional or more severe WMSDs. Refer to Appendix I for additional information regarding the survey results.

Recommendations for the command to further reduce the probability of injury include new equipmentⁱ and administrative controlsⁱⁱ. Recommendations are included with as much vendor informationⁱⁱⁱ as possible to assist in the evaluation of products and services. Input gathered from the workers, safety specialists, and other personnel to evaluate equipment before purchasing is recommended. This process will increase product acceptance, test product usability and durability, and take advantage of employee experience.

Hazard Abatement funding can be submitted for Fiscal Year 2006. Naval Facilities Engineering Command (NAVFACENGCOM) manages the 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. Information about the HA program can be found on the Naval Facilities Engineering Command web site www.navfac.navy.mil/safety and in OPNAVINST 5100.23F. Ch 12 Hazard Abatement.

Supply Operation

Purpose of the Operation: Responsible for storing, stocking, and distributing containers of medical and dental supplies. Employees also perform repair work on supplies.

Population: 38 active duty personnel (Navy and Marine Corps)

Injury Data: No recorded injuries. Six employees (27%) who completed the Job Requirements and Physical Demands Surveys have seen a health care provider for pain or discomfort that he/she feels is related to the job.

Description of the Operation:

Employees work with containers referred to as cans. A block is a single unit for shipping stored on a pallet and is comprised of a number of cans, figure 1. There are two types of blocks. An ADOL is an authorized dental allowance block which contains dental equipment. There are 22 ADOLs each containing 7 cans for a total of 154 cans. An AMOL is an authorized medical allowance block containing medical equipment. There are about 30 AMOLs each with 16 or 17 cans, approximately 500 cans. Each can has 10 latches which have to be released in order to open the container, figure 3. Each can weighs about 60 to 100 lbs. and requires two workers to pick up, figure 2. In order to work on an order, the block is lowered to the floor. The workers then remove each can from the pallet and place it on the floor in a line between the pallet racking. Two to three employees will work a single block in a line. The workers dump the contents of the can on the floor and compare every item to the packing list. If an item is missing, damaged, or expired it is removed and the employees walk to the supply area to replenish the article. Up to three blocks can be worked on at a time. Three or four times a year new items arrive. All of the cans containing that article must be opened and the new equipment inserted while the old item is removed.



Figure 1: A block of cans



Figure 2: Two workers lifting a can



Figure 3: Unlatching the cans

Ergonomic issue description:

The storage operation requires heavy and repetitive lifting, frequently combined with forceful exertions and awkward postures which place the workers at risk of developing WMSDs. Ergonomic risk factors occurring in combination increase the risk of development of injury.

Heavy and Repetitive Lifting: Each can weighs between 60 and 100 pounds and is lifted by a team, figure 4. According to MIL-STD 1472F a mixed population (male and female) performing a 2 person lift should not lift an item weighing more than 88 lbs. from the floor to a surface not greater than 3 feet. This weight limit is lowered to 74 lbs. if the object is being lifted up to 5 feet. Some of the heavier cans are therefore above the recommended weight allowance for this type of lift. Heavy lifting can place stress on the back and upper extremities. The stress to the back is magnified when lifting is being performed repetitively throughout the day. Awkward postures such as twisting of the back and lifting above shoulder height, shown in figure 5, also increases stress to the spine during lifting.



Figure 4: Two person lift of cans



Figure 5: Stocking operation

Forceful exertions: Employees in the Supply Area were also found to be exerting high levels of force while performing their duties. One of the supply areas is over the repair shop. This area is locked because it contains medical drugs. Employees climb the shelving units to reach the storage area, figure 6. Once in the storage area, employees load and unload new supplies via a forklift, figure 7. The major hazard associated with this task is from falls. Falling from a height or jumping and landing hard or awkwardly can cause an injury. Space in the storage facility is at a premium and there is no room to stock these materials elsewhere.



Figure 6: Jumping from shelves



Figure 7: Loading supplies in storage area

Employees also exert undo force while using a manual pallet jack to move pallets weighing over 1,000 lbs, figure 8. Forceful hand exertions are also required to unlatch the cans, figure 3, and to operate an old manual chain fall door mechanism which doesn't work well. Exerting high forces can contract muscles to their maximum capability which can lead to fatigue and possible damage to the muscles and other tissues.



Figure 8: Moving a block on a pallet



Figure 9: Lowering the bay door

Awkward Postures: Employees were found to be in awkward postures while lifting, figure 5. Lifting while twisting the torso places additional stress on the spine. Awkward postures were also seen while stocking supplies. Kneeling to access items stored at low levels places biomechanical stress on the knees, figure 10. Employees frequently bend over to sort supplies on the floor and twist or bend while sitting on stools, figure 11. Bending can place strain on the lower back. Risk of injury from awkward postures is increased when combined with repetition or duration. Sustained awkward postures can irritate tendons/muscles and restrict blood flow or nerve conduction leading to fatigue and possible damage to the musculoskeletal and nervous systems.



Figures 10 and 11: Stocking supplies

Employees also empty expired saline bags into a drain by puncturing the bags and then squeezing the contents out by hand or foot, figure 12. Employees exhibited poor posture while sitting on garbage cans, chairs, and even kneeling while performing this task.



Figure 12: Emptying saline bags

Recommendations

- ∞ A flexible conveyor system between the pallet racking with a possible computer operated inventory control system would increase productivity while reducing the lifting and awkward postures associated with stocking the cans. Instead of working on the floor, employees could work on the conveyor and maintain a neutral posture. A quote of \$21K to \$27K was obtained for this system with inventory control from Peaklogix 703-819-6061. The system without inventory control is \$8,000.
- ∞ Obtain material handling equipment to reduce manual lifting of items being repaired. Hydraulic height adjustable carts would allow workers to fill orders in the supply area and push the cart back to the cans. Carts would reduce heavy lifting and carrying and increase productivity by reducing trips. Refer to Table 1 for vendor information.
- ∞ Rolling tool stools would allow workers to access load shelves without kneeling; refer to Table 2 for vendor information.
- ∞ A scissor lift pallet jack would allow employees to raise and lower pallets while loading and unloading in order to maintain neutral work heights. The pallet jack could be raised to the height of the conveyor to reducing lifting while loading and unloading. A motorized pallet jack would reduce the force required when moving blocks around the warehouse. Refer to table 3 for vendor information.
- ∞ Bags of saline could be placed on an IV stand or other rack possibly fabricated in-house. Cutting a corner or the bottom of the IV bag and letting gravity empty it will reduce the time and effort associated with this task.
- ∞ Replacing the locked drug area with a locked automated retrieval system will free up floor space and allow the storage area above this to be moved to the floor.

Pricing depends on size and capacity. Vendors include:

Lektriever www.lektriever.com

Kardex www.kardex.com

Remstar www.remstar.com

Aislesavers www.aislesavers.com

- ∞ New chain fall door lift will eliminate hazards associated with raising and lowering the door. Contact a local vendor for an estimate.
- ∞ Conduct frequent lifting training for the employees in the storage area to remind them how to lift properly and avoid injury.


Table 1: Material Handling Equipment				
Description	Vendor	Product	Estimated Cost	Figure
Height Adjustable Carts *price depends on size	Lab Safety 1-800-356-0783	Bishamon Mobile Scissor Lift Tables 330 lb. Capacity #18771	\$560	
	Grainger 757-855-3153	Manual Hydraulic Elevating Scissor Cart 400 lb. Capacity #3KR46	\$378	
	Global Equipment 1-800-645-1232	Scissor Lift Table 660 lb. Capacity #GK954850	\$367	
	C&H 1-800-558-9966	Mobile Scissor Lift Truck 330 lb. Capacity 71-525A	\$568	




Table 2: Tool stools				
Description	Vendor	Product	Estimated Cost	Figure
Tool Stool	Grainger 757-855-3153	Tool Trolley Stool	\$166.50	
	Lab Safety 1-800-356-0783	Repair Maintenance Stool	\$149	
	Global Industrial 1-800-645-1232	Stool with Steel Tray	\$136	

Table 3: Pallet Jacks

Description	Vendor	Product	Estimated Cost	Figure
Scissor lift pallet Jack	Lab Safety 1-800-356-0783	High Lift Pallet Truck	\$706	
	Grainger	Electric Portable Scissor Lift	\$2640	
	Global Industrial 1-800-645-1232	Heavy duty- High Lift Skid Truck	\$539	
Pallet Mover	Global Industrial 1-800-645-1232	Self-propelled pallet truck (battery powered, 4,500 lb. capacity)	\$3900	 <p>Also available Self-propelled manual lift 3000 lb. Capacity truck</p>
	C&H 1-800-336-1331	Fully Powered Pallet Truck (Multiton or Big Joe)	\$2267- \$3750	
	Lab Safety and Supply 1-800-356-0783	Light/Medium Duty Multiton Powered Pallet Truck	\$2267	

Appendix I- Supply Area Job Requirements and Physical Demands Survey Results

Summary

The Job Requirements and Physical Demands Survey (JR/PD) was administered to the employees of the Supply Area. Information regarding the development, instruction, and validation of the JR/PD can be found at http://www.brooks.af.mil/afioh/Health%20Programs/ergonomics_jrpd.htm. The JR/PD is an ergonomic assessment tool endorsed by the Department of Defense Ergonomic Working Group and used by the tri-services to collect occupational health data.

The results of the JR/PD indicate the Supply Area is an Ergonomic Problem Area (EPRA). The Supply Area scored an Overall or Survey Priority Rank of seven (on a scale of 1 to 9), where nine has the highest priority for intervention. A score of five or greater indicates an Ergonomic Problem Area. The JR/PD assesses five distinct body regions: shoulder/neck, hand/wrist/arm, back/torso, leg/foot, and head/eye. The (body region) priority scores are a combination of identified ergonomic risk factors and employee reported discomfort. Ergonomic risk is based upon ergonomic stressors associated with the task and employee discomfort. The shoulder/neck, back/torso and leg/foot regions were associated with significant ergonomic risk. Twenty-seven percent of the survey respondents have seen a health care provider within the last twelve months for pain or discomfort that he or she feels is related to the job. A significant number of employees also reported pre-existing Musculoskeletal Disorders (MSDs) and conditions known to be contributing factors, which places them at a higher risk of additional or more severe Work-Related Musculoskeletal Disorders (WMSDs).

Overall Priority Score

The results of the JR/PD indicate the Supply Area is an ergonomic problem area with an overall score of **seven**. An Overall Job Priority score of five or greater establishes a task/job as an ergonomic problem area. The Overall Job Priority score is determined by selecting the highest Body Region Score for the job which in this case are the leg/foot, back/torso and shoulder/neck regions.

The Overall Priority Rating Score is used to determine which jobs or areas are associated with the most significant ergonomic risk. It is important to note that a high Overall Priority Score (i.e. ergonomic problem area) does not necessarily mean that the risk of illness associated with a job or area is high. Rather a high rating indicates that the tasks expose workers to a considerable level of risk factors associated with WMSDs in comparison to jobs/tasks or areas that receive lower scores.

Demographics

Twenty-two (workers/respondents) completed the JR/PD survey resulting in a **response rate of 58%**. The population is **82% male, 18% female, 27% active duty, and 73% military reserve**. **5%** of the workforce is **under the age of 20**. **28%** of the workforce is between the ages of **21 and 30**, **48%** of the workers are between **31 and 40**, **5%** of the workers are between **41 and 50**, **14%** are between **51 and 60**. Age is a contributing factor for WMSDs. Younger workers may be less likely to report pain and discomfort. A response rate of 80% is required for statistical significance.

Priority Score

The JR/PD prioritizes five distinct body regions based upon a combination of ergonomic risk factors and discomfort. Workers indicate their duration of exposure for different ergonomic risk factors. Ergonomic risk factors include posture, force, frequency, repetition, vibration, contact stress, and restrictive personal protective equipment. The frequency and severity factors are combined to evaluate discomfort in each of the five body regions. Table 1 demonstrates the relationship between body region, discomfort, and risk.

Table 1 Body Region, Discomfort and Risk

		BODY REGIONS				
		Shoulder/ Neck	Hand/Wrist /Arm	Back/ Torso	Leg/ Foot	Head/ Eye
Priority Score		7	2	7	7	2
Risk	Prevalence	68%	41%	73%	73%	32%
	Rating	High	Medium	High	High	Medium
Discomfort	Prevalence	32%	14%	32%	32%	14%
	Rating	Medium	Low	Medium	Medium	Low

Risk Prevalence and Rating

The percentage of respondents exposed to specific ergonomic risk factors for a given body region, for longer than two hours per day, assesses the prevalence of risk. A low rating represent less than 30% prevalence, medium 31% to 60% and high is greater than 61% of the respondents have exposure greater than 2 hours per day. The shoulder/neck, back/torso, and leg/foot have high prevalence levels.

Discomfort Prevalence and Rating

The terms fatigue, numbness, and pain categorize discomfort. The percentage of respondents and their discomfort ratings determine whether discomfort is prevalent among the workers. Combinations of frequency and severity that indicate significant discomfort prevalence are shown with asterisks in Table 2. Low ratings represent less than 30% prevalence, medium 31% to 60% and high is greater 61%. All of the body regions have medium or low levels of discomfort.

Table 2: Discomfort Matrix

FREQUENCY	SEVERITY		
	Mild	Moderate	Severe
Daily	*	*	*
Weekly		*	*
Monthly			*

The Priority matrix in Table 3 determines the overall prioritization of specific body regions. The relationship between discomfort and risk factors determines priority rating from 1 to 9 for each body region. A priority greater than four, indicated by an asterisk, is significant. The Overall Priority ranking for the Supply Area is equal to the highest body region priority value, which is a seven.

Table 3 Priority Matrix

RISK FACTOR	DISCOMFORT		
	High	Medium	Low
High	9*	7*	4
Medium	8*	5*	2
Low	6*	3	1

Organizational Information

Organizational factors contribute to ergonomic stressors. The organizational score for this area was **low**, which indicates 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, if they received comments on performance, etc. Suggestions to improve stress associated with organizational

factors include providing workers with more autonomy and improving discussion and feedback between workers and supervisors.

Physical Effort

The survey resulted in a perceived physical exertion score of **8.86**. Respondents were asked to describe the physical effort required of their job on a scale of 1 to 15 where one is no exertion at all and fifteen is maximal exertion. The higher the score, the greater the level of perceived physiological exertion. A value of 8 is somewhat hard, indicating a marginally physically demanding task.

Health Care Provider Score

According to the health care provider score, **six (27%)** of the respondents reported having been to a health care provider in the last 12 months for pain or discomfort that he or she thinks is related to his job.

Recovery Time Score

18% of the respondents reported experiencing work-related pain or discomfort that does not improve when away from work overnight or over the weekend. A score above 30% is of high importance. Lasting pain/discomfort is an indicator of inadequate recovery time for the muscles, tendons, and ligaments. Muscles, tendons, and ligaments that do not recover are more likely to be injured. The physically demanding nature of the job is apparent in the workers' inability to recover after the cessation of work.

Activity Interruption Score

32% of the respondents indicated that in the past 12 months, work-related pain or discomfort has caused difficulty in carrying out normal activities (e.g. job, hobby, leisure, etc.). A score above 50% is of high importance.

Previous Diagnosis Score

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
Trigger Finger,
Bursitis
Thoracic Outlet Syndrome
Overuse Syndrome"

Ganglion Cyst
Epicondylitis (Tennis Elbow)
Carpal Tunnel Syndrome
Back Strain, Knee or Ankle Strain

27% of respondents indicated affirmatively. Pre-existing WMSDs can contribute to an employee's pain and discomfort levels; thereby affecting the overall priority score. Working conditions may exacerbate a pre-existing disorder. Workers with pre-existing

WMSDs are likely to experience additional or more severe WMSDs if the environment is unchanged.

Contributing Factors

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

27% of the respondents indicated positively. These health conditions are contributing factors and may increase one's risk of developing a musculoskeletal disorder; thereby affecting overall priority.

Process Improvement Opportunities

This section of the survey allows employees to write in responses to questions. All statements are included exactly as written by the employees with the exception of spelling errors and expletives. Responses were also taken from a discomfort survey, which was distributed to the population.

1. Which tasks are the most awkward or require you to work in the most uncomfortable position?
 - ∞ Filling blocks
 - ∞ Filing cans on ground/deck
 - ∞ Reconstituting and filling cans on floor
 - ∞ Filling cans
 - ∞ Lifting cans
 - ∞ Filling cans with supplies while the cans are on the deck
 - ∞ Bending
 - ∞ Lifting cans and filling cans
 - ∞ Lifting boxes, crates, and pallets
 - ∞ Putting boxes on pallets
 - ∞ Lifting heavy containers
 - ∞ Working with cans and positioning cans on pallets
 - ∞ Having to climb without protective equipment on shelving units to get heavy boxes down, i.e. molly bags
 - ∞ Filling cans up
 - ∞ Bending and lifting canisters from pallets
 - ∞ When lifting equipment cans by hand
 - ∞ Moving, stocking, re-supplying amal cans

- ∞ Using the computer while the computer/mouse, etc., are in awkward positions (almost all are)
- ∞ Pulling on the chains on the shed garage door (pull up)

2. Which tasks take the most effort

- ∞ Lifting Amal/Aoal cans
- ∞ Lifting cans from ground, weigh 60-100 pounds
- ∞ Lifting and moving cans weighing from 60-100 pounds individually
- ∞ Moving cans
- ∞ Lifting and moving cans that weigh 60-100 lbs each
- ∞ Lifting heavy objects
- ∞ Moving cans
- ∞ Inventory, because of moving all the boxes around
- ∞ Lifting heavy containers
- ∞ Movement of heavy cans to get them into pallets and filling them up
- ∞ Lifting equipment cans by hand
- ∞ Remove cans from block, sorting, separating then to re-palletize
- ∞ Bending, shifting of torso
- ∞ Lifting cans
- ∞ Moving the can around, to get to the bottom one

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

- ∞ Amal cans with lid inserts
- ∞ Pallet jack
- ∞ Chain fall (pull door)
- ∞ Fork lift maneuvers
- ∞ Pallet jacks
- ∞ Manual saw
- ∞ The lift or stacker
- ∞ The pallet jacks don't work as they should
- ∞ Forklifts in confined areas
- ∞ Pallet Jacks
- ∞ Pallet jacks

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 space and bigger shelves
- ∞ Conveyor system or something to keep from bending over
- ∞ Conveyor belt system collapsible
- ∞ Need shelving system
- ∞ Belt system to bring work at waist level
- ∞ Training, and availability of equipment

- ∞ Utilizing a system or conveyer that would move the can from the floor and bring to waist high level
- ∞ Training, and availability of equipment
- ∞ Motorized shelving system
- ∞ Conveyor/roller ramps or belts, gloves, shelving units, ladder system to work on shelving units, electric roller gate
- ∞ More suitable forklifts for the confined spaces
- ∞ Collapsing conveyor belts for equipment cans
- ∞ Motorized doors, more lighting in warehouse
- ∞ Conveyer belts, collapsible
- ∞ New shelving (shifting)
- ∞ More automation – for everything

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

ⁱⁱ 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.

ⁱⁱⁱ 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.