

Naval Facilities Engineering Command Ergonomic Risk Assessment Security

Introduction

An ergonomics risk assessment was conducted on November 7th and 8th, 2007. The security operation was observed in order to determine sources of ergonomics stress and recommend improvements. This assessment is based upon interviews with employees and safety and health personnel as well as an evaluation by a Certified Professional Ergonomist with the Naval Facilities Engineering Command (NAVFACENGCOM) Mishap Prevention and Hazard Abatement (MPHA) program.

The risk assessment was conducted in conjunction with the Job Requirements and Physical Demands Survey (JR/PD). The JR/PD is an ergonomics survey designed to assess ergonomics risk in the workplace. The results of the JR/PD indicate the security operation is an ergonomics problem area with a score of **seven** on a scale of 1 to 9 where 9 is a maximum value. The JR/PD assesses five distinct body regions: shoulder/neck, hand/wrist/arm, back/torso, legs/feet, and head/eyes. The leg/feet region was found to have significant ergonomics risk. Ergonomics risk is based upon ergonomics stressors associated with the task and employee discomfort. Sixteen 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 illnesses recognized as contributing factors which places them at a higher risk of additional or more severe Work-Related Musculoskeletal Disorders (WMSDs). Appendix I contains a summary of the JR/PD results as well as a description of the methodology.

The operation reviewed presents opportunities to reduce the risk of work-related musculoskeletal disorders (WMSDs). 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 working conditions.

Recommendations for the command to reduce the probability of injury include equipment purchaseⁱ, process redesign, and implementation of administrative controlsⁱⁱ. Representative vendor information is included in the recommendations to assist in the evaluation of products and servicesⁱⁱⁱ. Recommendations for the

command include gathering input from the workers, safety specialists, and other personnel to evaluate equipment before purchasing. This process will increase product acceptance, test product usability and durability, and take advantage of employee experience.

Naval Facilities Engineering Command (NAVFACENGCOM) manages the Chief of Naval Operations (CNO) Mishap Prevention and Hazard Abatement Program, which is a centrally managed fund to correct safety and health deficiencies beyond the funding capabilities of the activity. The submission deadline for FY09 is March 31st, 2008.

Security

Purpose of the Operation: Responsible for providing security.

Population: 63 civilian police officers and 12 open billets covering three shifts

Injury Data: None provided. Three employees (16%) 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 rotate daily between working at the gate, patrolling the base, and performing building and magazine checks. The base currently has five gates with varying schedules. Working at the gate requires security personnel to verify identification for all incoming traffic, figure 1. Police officers also process and inspect incoming trucks.

Officers perform checks to ensure buildings and ammunition magazines are secure. Many locations have to be checked daily and sometimes twice a day to ensure security. Up to 150 separate checks are conducted in a single shift. Security personnel are also responsible for patrolling the base and answering calls (traffic accidents, fire alarms, etc). Employees estimate that they spend up to 90% of their time driving a vehicle.



Figure 1: Police officer standing at the gate

Police officers also undergo quarterly shooting tests at a gun range. Frequency of the gun tests will soon be reduced to once a year with additional tests performed through a simulation program. Officers shoot from standing and kneeling positions with pistols and rifles. There are six separate shooting corrals on a concrete floor, figure 2. The range safety officer stands in a separate room where he can view the shooters and provide instruction, figure 3. The range safety officer is also responsible for loading all of the magazines, cleaning the range, and removing the bullet casings. The bullet casings are placed in a

metal barrel which the range safety officer transports to the dock, figure 4. When the barrel is full it can weigh over 100 lbs. although he tries to empty it frequently to keep the weight down. He moves the barrel by carrying it or rolling it on one side. Rolling barrels is a safety hazard which can lead to crushing injuries. The barrels are moved to the edge of the dock, figure 5, where the range safety officer drives up a pick-up truck. He then stands in the bed of the truck and pulls the barrels down.



Figure 2: Shooting demonstration



Figure 3: Range Safety Officer



Figure 4: Barrel of bullet casings



Figure 5: Dock

Ergonomics issue description: Driving while on patrol and monitoring the gate can require prolonged static postures which have been reported to cause fatigue. Temperature can contribute to the risk of developing a WMSD.

Static Postures: Officers stand at the gate and gun range or sit in his/her car for extended periods. Standing or sitting for extended durations can contribute to lower back pain which is exacerbated by a heavy gun belt. Standing can be a strenuous activity that promotes blood pooling in the legs and feet and can result in discomfort and fatigue. Static postures of either type (standing or sitting)

impede the flow of blood needed by the muscles to supply nutrients and remove the waste products of muscle metabolism. Reduced blood flow also slows delivery of oxygen to the muscles resulting in a longer recovery time. Waste products, such as lactic acid, can build up in the muscle and cause fatigue. The longer or more frequently static loading occurs, the greater the risk of injury due to overuse of muscles, joints, and other tissues. Leg/Foot discomfort indicated in the JR/PPD may be a result of prolonged standing. During the assessment, employees also noted back discomfort from riding in the car for extended durations.

Awkward Postures: Employees also noted discomfort while filling out paperwork in their vehicles. The police vehicles lack a center console so the officers have to twist their torso and lean over to fill out paperwork on the passenger-side seat or try to balance their work on the steering wheel. The muscles must apply considerably more contraction force to maintain awkward postures. As the duration of the contraction increases, stress on the muscles also rises. The continuous stress on these muscles can lead to fatigue and discomfort which can be precursors to injury.

Temperature: Employees are supposed to stand outside of the guard shack while checking identification. According to weather.com, the average temperatures range from 21°F to 88 °F. Extreme temperature does not cause WMSDs but it can be a contributing risk factor which increases the likelihood of developing an injury. Working in a hot climate can increase the physical demands on a worker. Cold climates can reduce blood circulation as the body tries to keep the core warm. Decreased blood circulation to the extremities can inhibit dexterity and increase the difficulty of performing tasks such as handling identification cards. Cold working environments can also affect muscle strength and mental acuity. As we age it is harder to regulate our internal temperature, so older workers are at a greater risk of developing temperature related injuries.

Heavy lifting: The range safety officer performs forceful exertions while emptying barrels of bullet casings. Forceful exertions can place high loads on the muscles, tendons, ligaments, and joints being used. Increasing the force required to lift a load also means increasing body demands (i.e. greater muscle exertion is necessary to sustain the increased effort) and imposing 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. According to the American Conference of Governmental Industrial Hygienists, the Threshold Limit Value for low frequency lifting from between knuckle and mid-shin height is 40 lbs.



Recommendations

- ∞ A sit/stand stool for the gate house would allow the officers to maintain a standing eye height while seated, which allows for monitoring but also permits the worker to easily get up from the chair to assist fellow workers

and customers seeking base access. The officer checking identification can also use a sit/stand chair if traffic is intermittent. A sit/stand stool would benefit the range safety officer by allowing him to view the gun range from a semi-seated position. A sit/stand stool supports 2/3 of the user's body weight to reduce stress associated with prolonged standing. Refer to Table 1 for vendor information.



Table 1: Security Equipment			
Vendor	Product	Estimated Cost	Figure
Lab Safety 1-800-356-0783	Bevco Sit/Stand	\$152	
Grainger	Sit-Stand Stool	\$231	
Grainger	Bevco Sit/Stand	\$150	
Alimed 1-800-225-2610	Portable Sit/stand	\$299	

- ∞ Light-weight anti-fatigue matting for the gates may help reduce fatigue. Matting provides a soft, uneven surface that promotes an imperceptible sway which can relieve pressure on the bottom of the foot and aid circulation. The gun range would also benefit from anti-fatigue matting in the shooting corrals and the observation room. Refer to Table 2 for vendor information.
- ∞ A portable heater at the gates would improve comfort levels and increase circulation. Heated mats are another alternative; refer to vendor table 2 for more information. Refer to the Navy's energy, utility and design policies to validate the acceptability of using heating units for this task.


Table 2: Matting			
Anti-fatigue Matting	Cessi Ergonomics 1-800-Buy-Ergo	Matting prices depend on size. Most vendors will send you a sample. Matting is very subjective and it is a good idea to let your employees try it. Look for a vendor with a warranty.	
	Alimed 1-800-225-2610		
	Ergomat 1-800-357-2111		
Heated matting	Martinson-Nicholls, Inc 440-951-1312	36"x39" with a 2'x3' heated section. 3/8" thick.	\$199
	Allmats 1-866-411-MATS	Pricing depends on size	\$187- \$2265
			






- ∞ Promote stretch breaks and continue to educate workers on the importance of drinking fluids during the summer and wearing gloves and hats during the winter.
- ∞ Provide all workers with gun belts with suspenders to transfer the load across the torso and reduce exposure to the low back. Employees should try to avoid placing hard objects on the back-side of the belt where they may press against the lower back. Refer to table 3.


Table 3: Duty Belt Suspenders			
Vendor	Product	Estimated Cost	Figure

Galls 1-800-477-7766	Transfers weight of duty rig from hips to shoulders. Fits all duty belt styles.	\$30	
Uncle Mike's (800) 330-6422	These nylon web duty police suspenders transfer weight of duty rig from hips to shoulders. Fully adjustable front and rear, with special cross piece in the back that adjusts as you move. These police suspenders have a breakaway snap designed to help defeat grabbing. Ideal for uniformed police officers; also can be used as load bearing harness for tactical team members.	\$25	
A&F Deals Afdeals.com	Duty belt suspenders	\$32	

- ∞ A vehicle organizer would provide an arm rest as well as a place to write reports on to reduce fatigue and awkward postures. Refer to vendor table 4.
- ∞ A backrest with adjustable lumbar support may help reduce fatigue during long patrols. Table 4 contains vendor information.




Table 4: Vehicle Accessories			
Vendor	Product	Estimated Cost	Figure
Galls 1-800-477-7766	Galls Exclusive StreetThunder™ Console II has a large compartment for storage of personal items and a hinged armrest that's padded for extra comfort. Lets you custom-fit your electronic equipment on the hump or between your bucket seats.	\$169 Price varies by product	

	Jotto Desk	\$339	
CarGoDesk 866-573-7065	Car desk- Roadrunner model with pull-out writing surface	\$220	
Organize It 1-800-210-7712	Auto Exec- This auto workstation straps to the seat with the existing seat belt and provides a non-slip writing surface, a hanging file section, and space for a laptop and accessories.	\$185	
Comfort Channel 1-800-303-7574	Car seat cushion- The Jobri BetterBack Variable Support with adjustable Lumbar Pad is portable and foldable.	\$139	
Amazon.com	Car Seat Lumbar Support - Bucket Seat Lumbar Roll - Regular Support - Navy - 15"	\$15	

<p>Alimed 1-800-225-2610</p>	<p>Sacro-Ease absorbs road shock and engine vibration. Adjustable cushion and internal rubber supports driver in a natural upright position. Stays put as user gets in and out of vehicle. Fatigue is reduced and alertness increased with shock absorption and posture correction. Comofortable 1" Polyfoam cushioning. Choose 19" Bench or 15" Bucket seat model. Five-year warranty.</p>	<p>\$189</p>	
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- ∞ An appliance dolly or drum dolly could be used to transport the drums of bullet casings at the gun range. Refer to vendor table 5 for product information. The barrels should be emptied frequently to minimize the load weight. The range officer should also ask for assistance in transporting and loading the barrel into the truck.

Table 5: Dollies			
Vendor	Product	Estimated Cost	Figure
<p>Grainger</p>	<p>Drum Caddy Low Profile Drum Caddy, Dolly Capacity 1200 Pounds, Caster Size 3 x 1 1/4 Inches, Caster Material Polyurethane on Steel, For Drum Size 5, 30, 55 Gallons</p>	<p>\$93</p>	
	<p>Steel Hand Truck, Load Capacity 650 Pounds, Handle Dual, Noseplate Depth 8 Inches, Noseplate Width 14 Inches, Stack Height 51 Inches, Tubular Stair Climber, Wheel Pneumatic, Wheel Size 10 x 4 Inches, Overall Height 50 2/5 Inches, Overall Width 22 Inches, With Continuous Frame and High Stack Capability</p>	<p>\$100</p>	

	Battery Powered Stair Climbing Appliance Truck, Lightweight Alloy, Load Capacity 850 Lbs, Half Horsepower 50 Amp 12 Volt DC Motor, Industrial Grade Gearbox, 6 Inch Diameter by 2 Inch Wide Mold On Rubber Wheel, 24 Inch by 4 Inch Noseplate, Overall Width 24 Inches, Depth 12 Inches, Height 72 Inches, Gray Silcon Alkyd Paint Finish, Includes; Battery Charger, Ratchet Belt Tightener w/ Auto Rewind, Non Marking Vinyl Contact Surfaces	\$1888	
Powermate 1-800-697-6283	PowerMate® Motorized Stairclimbing Handtruck is a two wheel dolly with a built-in, battery powered, lift mechanism. The motorized lift gives the operator push button control to power loads up & down stairs, on & off delivery vehicles, and in & out of buildings.	Call for a quote	
Escalera 1-530-673-6318	Escalera Stair Climbing handtrucks	Contact for pricing	
Ultra-lift 1-800-346-3057	Ultra-lift powered handtrucks		

Naval Facilities Engineering Command
Job Requirements and Physical Demands Survey Results
Naval Support Activity
Security

Summary

The Job Requirements and Physical Demands Survey (JR/PD) was administered to the employees of the security operation. 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 ergonomics assessment tool endorsed by the Department of Defense Ergonomics Working Group and used by the tri-services to collection occupational health data. The JR/PD is a survey used to assess ergonomics related risk in the workplace.

The results of the JR/PD indicate that the security operation is an Ergonomics Problem Area (EPRA). The operation 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 Ergonomics Problem Area. The JR/PD assesses five distinct body regions: shoulder/neck, hand/wrist/arm, back/torso, leg/foot, and head/eye. Each body region has a priority scores which is based upon a combination of identified ergonomics risk factors and employee reported discomfort. The leg/foot region had a significant priority score (5 or higher) which can be related to long periods of standing at the gates. Sixteen 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 illnesses recognized as 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 that the security operation is an ergonomics problem area with an overall priority score of **seven**. An overall priority score of five or greater establishes a task/job as an ergonomic problem area. The overall priority score is determined by selecting the highest body region score for the job which in this case is the leg/foot region with a score of seven.

The overall priority 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

Eighteen (workers/respondents) completed the JR/PD survey, resulting in a 24% response rate. A response rate of 80% is desired for statistical significance. The population demographics are contained in Table 1. Age is a contributing factor for the development of WMSDs.

Table 1: Population Demographics

Gender:	Male: 83%	Female: 11%
Group:	Civilian: 94%	Military: 0%
	6% between the ages of 21 and 30	
	28% between the ages of 31 and 40	
	28% between the ages of 41 and 50	
	17% between the ages of 51 and 60	
	17% over the age of 60	

Note: Totals may not sum to 100% due to under-reporting.

Priority Score

The JR/PD prioritizes five distinct body regions based upon a combination of ergonomics risk factors and discomfort. Workers indicate their duration of exposure for different ergonomics risk factors. Ergonomics 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 2 demonstrates the relationship between body region, discomfort, and risk for this job. The shaded body regions have significant priority scores.

Table 2 Body Region, Discomfort and Risk

		Body Regions				
		Shoulder/ Neck	Hand/Wrist /Arm	Back/ Torso	Leg/ Foot	Head/ Eye
Priority Score		2	2	1	7	1
Risk	Prevalence	39%	39%	28%	83%	22%
	Rating	Medium	Medium	Low	High	Low
Discomfort	Prevalence	17%	22%	17%	33%	11%
	Rating	Low	Low	Low	Medium	Low

Risk Prevalence and Rating

The percentage of respondents exposed to specific ergonomics risk factors for a given body region, for longer than two hours per day, assesses the prevalence of risk. A low rating represents less than 30% prevalence, medium 31% to 60% and high is greater than 61% of the respondents have exposure of more than 2 hours per day. The leg/foot region is associated with high levels of risk while the shoulder/neck and hand/wrist/arm regions have medium 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 3. Low ratings represent less than 30% prevalence, medium 31% to 60% and high is greater 61%. The leg/foot region is associated with medium levels of discomfort while the other regions are low.

Table 3: Discomfort Matrix

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

The Priority Matrix in Table 4 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 score greater than four, indicated by an asterisk, is significant. The Overall Priority ranking for the security operation is equal to the highest body region priority value, which is a 7. The other body region scores were not significant.

Table 4 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 **6.56**. 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 6 is light which does not indicate a physically demanding task.

Health Care Provider Score

According to the health care provider score, **3 (16%)** 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

17% 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. Significant discomfort is apparent in the workers' inability to recover after the cessation of work.

Activity Interruption Score

22% 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

17% 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

39% 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.

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

- ∞ Working in the guard shacks at Gate 1 and Gate 4.
- ∞ Standing on the island and waving inbound cars into our facility.
- ∞ Practical training exercises. The required bending, kneeling, sitting, lifting, physical restraints.
- ∞ Typing on computer.
- ∞ PowerPoint presentations.
- ∞ Practical exercises bending, squatting, reaching, running.
- ∞ Shooting
- ∞ Shooting, hand guns, shot gun, rifle.

2. Which tasks take the most effort?

- ∞ Checking locks.
- ∞ Vehicle inspections.
- ∞ Practical training exercises.
- ∞ Running
- ∞ Running, waling on gravel.

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

- ∞ Beretta M-9

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

- ∞ Driver side mounted spotlights on vehicles.
- ∞ Spotlights on vehicles.
- ∞ More recliners and soft chairs.
- ∞ Spotlights on vehicles.
- ∞ Up to date state of the art equipment.
- ∞ We had a lean event but that didn't work
- ∞ Better and more well designed office equipment.
- ∞ Better equipment to include office supplies, chairs, desk, etc.

End Notes:

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.