

Naval Facilities Engineering Command (East Division) Ergonomic Risk Assessment

An ergonomic risk assessment was conducted on June 5, 2000 and a follow-up evaluation was conducted on April 12, 2001. The Food Services, Laundry Services, and Sail Shop were observed in order to determine sources of ergonomic stress and make recommendations to reduce the risk of work-related musculoskeletal disorders (WMSDs). This assessment is based upon interviews with employees, supervisors, and safety personnel as well as evaluation by a Hazard Abatement occupational ergonomist. The Job Requirements Physical Demands Survey (JR/PD), an ergonomic survey, was also administered to the employees. The results of the JR/PD indicate that the Food and Laundry Services areas are Ergonomic Problem Areas. Appendix I and II contain a summary of the JR/PD results as well as a description of the methodology.

Recommendations to reduce the risk of WMSDs include considering equipment purchase, process redesign, and implementation of administrative controls. Recommendations are included with as much vendor information 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.

I. Laundry Facilities

The Laundry Facility washes and dry-cleans laundry for all 3,000 people. The injury and illness records from 1996 to the time of the evaluation indicate 17 incidents. Nine of the recorded injuries were related to ergonomics, with 5 incidents in the Check-in area. Ergonomic injuries in the Check-in area include repetitive trauma in the hands, wrist, and back. The Check-in operation at the Laundry Facility is recognized as an ergonomic hazard area by the Safety Department and Laundry supervisor, and is the focus of the evaluation.

The results of the JR/PD indicate that the Check-In area is an Ergonomic Problem Area with an overall priority value of 9, based on a scale of 1 to 9 where 9 is the highest. The shoulder/neck, hand/wrist/arm, and leg/torso regions were found to have significant priority scores. Significant priority ratings indicate high levels of ergonomic risk combined with employee discomfort. The JR/PD indicates the presence of pre-existing work-related musculoskeletal disorders and contributing factors among the employee population, which may have contributed to the overall priority score. A significant number of respondents replied that work-related pain or discomfort doesn't improve away from work and has interfered with carrying out normal activities. A number of employees have seen health care professionals within the past year regarding work-related pain and discomfort. Appendix I contains a summary of the JR/PD results as well as a description of the methodology.

Check-In Process

There are 11 employees working in the check-in area who are responsible for receiving and sorting laundry for processing. Laundry arrives by truck in carts to a loading dock, as shown in figure 1. The workers push fully loaded carts to the laundry area, as shown in Figure 2. A loaded cart can weigh between 900 and 1200 pounds. Pulling the carts off the truck and pushing them through the facility is a very physically demanding task. The carts are pushed through the Check-in area where the employee grabs each laundry bag and throws it on top of the Check-in workstation, as shown in figure 3. Raising a laundry bag above shoulder height to place it in the check-in area creates an ergonomic stressor, which is compounded by the weight of the bag and the repetitive exposure. The carts are not equipped with brakes, which would reduce the force required to slow or stop the cart.



Figure 1: Unloading carts



Figure 2: Pushing fully loaded cart



Figure 3: Loading laundry bags at Check-in Workstation

Check-in employees sit at workstations along a laundry-sorting conveyor. Each employee checks in about 14 bags of laundry and hour. Bags of laundry arrive on top of the conveyor at each employee's workstation. Standard operating procedure is to reach up into the laundry bag and pull out smaller mesh bags, as shown in figure 4, rather than pull the entire bag onto the workstation. Reaching into the large laundry bags requires twisting of the torso as well as extended arms raised above shoulder height. Twisting the torso while reaching and lifting increases the biomechanical stress to the spine. After some of the smaller mesh bags have been removed, the employee pulls the large laundry bag onto the workstation and empties the contents, as shown in figure 5. Grabbing a large laundry bag by the ends and dumping the contents out requires a pinch grip and arms extended above shoulder height. Emptying laundry bags is a difficult operation, but the standard operating procedure for this task is less stressful than dumping the large laundry bags as they arrive at the workstation.



Figure 4: Retrieving laundry



Figure 5: Emptying laundry bag

Once the laundry bag has been emptied onto the work surface, the order is checked for accuracy and the contents are sorted and directed onto the appropriate conveyor for washing. The large laundry bags contain smaller mesh bags, which are color coded for specific types of laundry (e.g. black socks, white socks, white clothes, colored clothes, etc.). The employee ensures that each mesh bag contains the appropriate clothing type and is properly closed. The mesh bags are closed with large safety pins and then tied for a double safety mechanism. The safety pins are large (almost 5" long) and require a forceful pinch grip to open and close. Securing a bag requires the operator to wrap the mesh bag around the safety pin repeatedly, gathering small sections of the bag at a time, as shown in figure 6. Closing the bags is a very stressful task combining awkward postures, repetitive hand and wrist motions, and forceful exertions. The customers have been instructed on how to properly seal the individual mesh bags, yet the Laundry staff estimates that less than 50% of the incoming laundry is adequately closed. After the safety pin is securely attached,

a white plastic tie is also added to the bag to seal it. The plastic ties are manually attached, requiring another pinch grip.

Special laundry items also require repetitive, stressful hand and wrist motions. White uniforms are marked with paper tags attached to tiny metal clips, which requires an extreme pinch grip, as shown in figure 7. Blue uniforms are stapled with small tags.



Figure 6: Pinning a mesh bag closed

Figure 7: Attaching metal clip

The Check-in employees verify each laundry bag order for accuracy. The customers's identification number should be clearly printed on all laundry bags. The employees check for consistency of numbers and correct any illegible numbers with a marker. The employee tends to assume a bent over posture while completing paperwork and inking identification numbers, as shown in figure 8. Awkward posture places strain on the back and can increase fatigue in the back muscles. Reaching for paperwork from across the workstation requires an extended reach of 47", which also places strain on the shoulder and back. Figure 9 shows the front edge of the work surface. The padding on the work surface has deteriorated and is not providing proper support to the forearms. A hard surface can cause contact stress to the forearms.

When the order is complete, the employee places the laundry bag on the appropriate conveyor next to their workstation, as shown in figure 10. There is an 11" space through which the laundry bag is pushed to get it onto the far conveyor. Placing bags on the farthest conveyor requires a reach of 47". Full bags require excessive force in order to get them through the small window, which places strain on the back, arms, and shoulders.



Figure 8: Employee writing ID number



Figure 9: Work surface edge



Figure 10: Putting order on conveyor

Recommendations

Carts

Currently bags of laundry are staged at each workstation above the conveyor system. The staging shelf is at a height of 43" which requires the employees loading and unloading the bags to reach above shoulder height, often while twisting at the torso. Replacing the staging shelf with small carts that can be wheeled to each workstation should eliminate this hazard. The employees unloading the carts that come off the trucks can place the laundry bags onto the smaller carts and take them to each check-in station. Reducing the load weight will reduce the force required to push the carts. The smaller carts should not be overloaded. The employees at the check-in stations can pull laundry bags directly onto their workstation without lifting or reaching. It is not recommended that the bottom shelf be used.

Vendor	Product	Dimensions (l x w x h)	Price
C&H 1-800-558-9966	Eurokraft Table Trolley Truck 70-412AX	52.5x24x32.75	\$319-\$396
Global Equipment 1-800-645-1232	Heavy Duty Service Cart Xf502353	36"x24"x31"	\$175-\$243
Lab Safety 1-800-543-9910	Edsal Welded Steel Truck OM-36825	36"x24"x30.25"	\$175-\$192



Employees are currently pushing and pulling incoming carts loaded full of laundry bags at a level above shoulder height. A handle could be welded on to the next lower crossbar of the cart to reduce ergonomic stress on the shoulder and back. The carts can also be retrofitted with brakes. If the current carts remain, preventative maintenance should be performed regularly on the carts and flooring and casters should be replaced as needed to reduce pushing forces.

Workstation Improvements

A tie gun is recommended to eliminate the ergonomic stressors associated with manually applying a plastic tie to each mesh laundry bag.

Vendor	Model	Price
Mark-rite 1-800-848-7279	Tagging Gun	\$19.98
Mark-rite 1-800-848-7279	Dennison Tagging Gun	\$25.95
Tiewraps.com 1-800-942-2292	TW-Gun	\$47.95



Replacing the current mesh bags with mesh bags containing a locking mechanism would eliminate the ergonomic hazards associated with applying the large safety pins to the bags.

Vendor	Model	Dimension	Price
Grainger 410-391-9000	5N451	24"x36"	\$142.31 (12-pack)
Industrial Bag 1-800-334-9695		15"x20", 18"x24", 18"x30", 24"x36", 30"x40"	\$27-\$85 (12-pack)
Rubbermaid 1-800-347-9800	U210	24"x36"	\$15.02

In order to reduce contact stress on the forearms, edge protectors are recommended.

Vendor	Model	Dimension	Price
Alimed 1-800-225-2610	70459	30"	\$17.99
Alimed 1-800-225-2610	70452	6'	\$32.99



In order to reduce reaching for paperwork and tools (ties, clips, pens, etc.) items should be moved closer to the operator. Employees could try an apron or tool belt with pockets. Storing items, that are currently stored in flat trays on the side of the workstation, in vertical pockets near the front of the workstation will also reduce reaching. In order to eliminate the 48" reach to tickets, an angled vertical pocket system could be attached to the front edge of the work surface. A hinged fold out writing surface could also be manufactured in-house to reduce reaching.

In order to reduce fatigue employees should be encouraged to alternate between sitting and standing during the day. Anti-fatigue matting should be used where employees stand. Job rotation in and out of the check-in line along with a stretch and exercise program may also help reduce fatigue and discomfort.

Update

Since the original site visit, the conveyor system was redesigned. The shelves on top of the original outgoing conveyors were replaced with a single incoming conveyor. An employee now loads the incoming conveyor from the end of the conveyor system as shown in figure 11. The employee still has to reach into the carts to retrieve the laundry bag and reach above shoulder height to throw the bags onto the conveyor. The bags arrive at each employee's workstation. The employees can no longer empty bags a little at a time because the bags are continually moving. The employees have to reach up and pull the entire filled laundry bag onto their workstation as shown in figure 13.



Figure 11: Loading conveyors



Figure 12: Automated conveyors



Figure 13: Employee Workstations

Recommendations

In order to reduce the ergonomic stressors associated with pulling a full bag of laundry from above shoulder height onto the work surface, a reaching aide is recommended. A reaching aide should be used while standing and the operator should support the weight of the bag as it comes down. A flat guide rail could be installed from the conveyor to the workstation to support the weight of the laundry.

Vendor	Model	Dimension	Price
North Coast Medical 1-800-235-7054	NC23621 North Coast Reacher	26"	\$18.95
North Coast Medical 1-800-235-7054	NC23622 North Coast Reacher	30"	\$19.95
North Coast Medical 1-800-235-7054	NC28628 Collapsible Dressing Stick	27.5"	\$4.95
Hold Your Own 919-834-3563	Deluxe EZ Reacher with Lock	32"	\$29.99



It is also recommended that the conveyor manufacturer be contacted about retrofitting the current conveyor system with a ramping conveyor at the end of the system to reduce the load height. This would eliminate employees throwing bags from the carts onto the conveyor. The top of the conveyor still appears too tall, the manufacturer may be able to lower it without lowering the bottom conveyor. The top conveyor could also be operated only at certain times, maybe every 30. If laundry bags were loaded in batches to that they arrived in groups (7 bags for 30 minutes) at each workstation, employees could continue to unload the bags a little at a time thereby reducing the ergonomic stressors associated with pulling down full laundry bags. The conveyor operator could warn the check-in employees a few minutes before the conveyor is set to move so that they can finish the bag they are working on.

II. Food Services

Food Services can provide a sit down meal for up to 4,200 people. The injury and illness records from 1996 to the time of the evaluation indicate 30 incidents. Eleven of the recorded injuries were related to ergonomics, with eight incidents in the Galley (food preparation area). Most of the ergonomic injuries involved pulled muscles resulting from heavy lifting or pushing carts. The pot washing area in Food Services is recognized as an ergonomic hazard area, and was the focus of this evaluation.

The results of the JR/PD indicate that the Pot Scrubbing area is an Ergonomic Problem Area with an overall priority value of 5, based on a scale of 1 to 9 where 9 is the greatest. The back/torso region was the only area with a significant priority score. Priority scores are based upon assessed ergonomic risk as well as employee discomfort. The employees evaluated the pot washing operation as a “somewhat hard”. The JR/PD indicated the presence of pre-existing work-related musculoskeletal disorders (WMSDs) as well as medical conditions recognized as risk factors for WMSDs among the employee population, which may have contributed to the overall priority score. A significant number of employees have seen medical care providers for pain and discomfort believed to be job-related. Appendix II contains a summary of the JR/PD results as well as a description of the methodology.

Pot Washing Process

The pot washing area is responsible for cleaning all of the kitchenware. Employees rotate between two shifts in the pot washing area. The first shift works two meals, while the second shift works just during dinner.

There is a pot washing machine, but many items require pre-soaking and scrubbing before they are placed into the machine. Employees work at a long sink that is 38" high, as shown in figure 10. Washing pots in the sink requires extended reaches and bent back postures. Larger items are sometimes washed on the floor. The employee in figure 11 is scrubbing a large pot with a small piece of steel wool. The employee is shown in a very stressful posture with his back in extreme flexion.



Figure 10: Washing pots in the sink

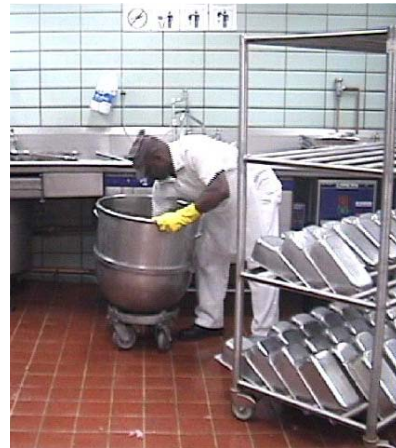


Figure 11: Washing pot

The pot washer is a large machine that washes pots on a conveyor. Loading and unloading the pot washer requires awkward postures and extended reaches. The staging area is a corner work surface leading into the opening of the conveyor. Loading the conveyor requires the operator to reach up to 36" to place pots inside the machine, as shown in figure 12. The staging area is very deep and pots tend to get stuck in the corner. Figure 13 shows an employee using a long spoon to get to the pots in the corner.



Figure 12: Loading the pot washer



Figure 13: Getting pots with a ladle

As the clean pots exit the pot washer, an employee loads them onto a cart. Figure 14 shows an employee unloading the pot washer with his right hand, while holding the pots on the cart in place with his left hand. This action requires coordination combined with repeated twisting of the torso and reaching. This area tends to get wet and creates a slip hazard.

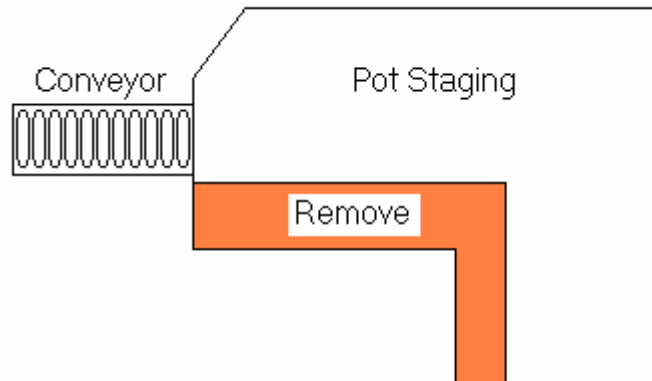


Figure 14: Unloading the pot washer

Recommendations

Pot Washer

The extended reaching required to load the pot washer and grab pots from the corner of the staging area could be reduced by making a cut-out in the corner of the work surface to bring the employee closer to the machine.



Extending the conveyor on the end of the machine further and placing the cart perpendicular to the work surface could reduce the ergonomic hazards associated with unloading the pot washer.

Carts

The carts that hold the pots could be redesigned to reduce reaching and bending. The small pots are the most commonly used item. There is a lot of empty space between the pots and the shelves that could be eliminated by moving the shelves closer together.

Scrub Brush

The use of scrub brushes with handles could replace the steel wool and eliminate some of the bending into pots on the floor. The kitchen and scrub brushes are available from OXO (1-800-545-4411) for \$4.50 and \$6.50 each. A small bucket to rinse the brushes would help reduce trips to the sinks.



Kitchen Brush



Scrub Brush

Anti-fatigue Matting

Providing the employees with anti-fatigue matting could reduce fatigue in the pot washing area. Anti-fatigue matting can be washed every day with anti-bacterial agents and may possibly be placed in the pot washer. Anti-fatigue matting may also help reduce slips, trips, and falls.

Maintenance

There are a few maintenance items that would improve the health and safety in the food services area. Currently one of the disposals is out of service. There is an area of floor near the pot washer where the tiles have been removed and replaced with a piece of wood, which poses a health risk. One of the sinks near the pot washer is missing a drainpipe.

III Sail Shop

The Sail Shop is responsible for manufacturing and repairing all boat sails for the activity. The sail shop has 4 employees and 1-2 ensigns. People are often in the shop working on design projects. Up to 15 bolts of sailcloth arrive each day and have to be hand carried up a flight of stairs containing 28 steps, as shown in figure 1. Bolts of sail cloth can weigh up to 130 lbs and are up to 61” in length as shown in figure 2. Lifting heavy bolts of sailcloth and carrying them up a flight of stairs puts the employees at risk of back injury as well as tripping and falling from the awkward load.



Figure 1: Stairs for sail shop



Figure 2: Bolt of sail cloth

Recommendations

An automated lift mechanism is recommended for the sail shop in order to reduce the ergonomic stressors caused by carrying sailcloth up stairs. The lift is designed to hold sailcloth only and not employees. The lift will be located outside of the building near the outside stairs. A custom quote will have to be developed. An estimated cost for installation and equipment is \$50,000.

Vendors: Ernie Taylor from New Dominion 800-850-8559 ext. 132
Advance Lifts 800-843-3625



*Some information has been removed from this report that is specific to the activity.