

Ergonomic Risk Assessment of Naval Surface Warfare Center Carderock Division NAVFAC East Division

An ergonomic survey of Shipping and Receiving and Computer Redistribution at the Naval Surface Warfare Center Carderock Division was conducted on February 2, 2000. This assessment is based upon interviews with employees, supervisors, and safety personnel as well as evaluation by the ergonomist. Recommendations are included with as much vendor information as possible.

I. Shipping and Receiving

Two employees in shipping and receiving are responsible for cataloging and inspecting incoming packages as well as preparing outgoing parcels for shipment. Both employees work nine hour days and alternate four and five day weeks.

Issues:

All packages coming to Shipping and Receiving arrive on a cart like the one shown in figure 1. The base height of the cart is 11.5" from the ground. Lifting boxes from this height as well as pushing or pulling a fully loaded cart places strain on the upper extremities and back.



Figure 1: Cart used in shipping/receiving

Outgoing packages are weighed for postage in Shipping and Receiving. Containers like those shown in Figure 2 have to be manually carried to the scale shown in Figure 3 or lifted onto a cart to be taken to the scale. All packages are then lowered onto the scale for weighing. Large weight and poor or non-existent

handles increases stress on the back during the handling of packages for weighing.



Figure 2: Containers to be shipped



Figure 3: Scale used to determine postage

Employees in the Shipping and Receiving area use an Exacto knife to open pallets of packages like those shown in figure 4. This cutting tool promotes non-neutral hand and wrist postures while applying mechanical stress to the operator's hand. The cutting motion also requires repetitive force.



Figure 4: Pallet shrink-wrapped and tied

Recommendations:

Mobile Lift Table

1. Incoming packages should be loaded on mobile lift tables to maintain a proper work height when inspecting packages. The recommended tables can be used as work surfaces as well as for transporting packages. A neutral working height will minimize the strain caused by repeatedly handling heavy packages at various heights. The dimensions of the recommended tables are smaller than the current carts; therefore, additional tables may be necessary. Vendor information is supplied in Table 1.

| Table 1: Mobile Lift Table Recommendations | | | | | | |
|---|---------------|--------------------|-----------|----------------|---------|-------------------------------------|
| Product | GSA | Capacity | Dimension | Height Range | Price | Vendor |
| Hydraulic Lift Table with Casters Product A | GSA # 260 063 | 2,000 lb. Capacity | 32"x48" | 30.5" to 47.5" | \$738 | Alzar Lift |
| Scissor Lift Table Product A | | 1,000 lb. | 32"x63" | 11.25" to 36" | \$689 | Vestil Manufacturing 1-800-348-0868 |
| Hydraulic Lift Table with Casters Product B | | 2,000 lb. | 30"x36" | 36" to 54" | \$950 | Grainger 301-869-0011 |
| Autohite Self-Elevating Cart Product C | | 1,000 lb. | 42"x42" | 14" to 34". | \$1,090 | Vestil Manufacturing |



A - Hydraulic Table



B - Scissor Lift Table



C - Autohite

Flexible Conveyors

2. Currently, many packages are delivered directly to NRL employees. If more packages for NRL are routed through Shipping and Receiving, flexible conveyors will allow this area to increase capacity. Flexible conveyors can be used in conjunction with the mobile lift tables to maintain neutral working heights. Flexible conveyors are easy to use and can conform to any layout. Telescoping legs allow the conveyor to be placed at a variety of work heights and can turn it into a gravity fed incline. When not in use, the conveyor can be compressed and stored. The delivery person should load incoming packages directly onto the conveyor. Refer to table 2 for product information.

| Table 2: Flexible Conveyor Recommendations | | | | | |
|---|--------------|---------|----------------|-------|-----------------------------------|
| Product | Length (ft)* | Width * | Height Range | Price | Vendor |
| Flexible Portable Conveyor 9H-32161 with plastic wheels | 39" to 154" | 24" | 28" to 44" | \$732 | Lab Safety Supply 800-543-9910 |
| Expandable Portable Conveyor 76-080DX with plastic wheels | 39" to 146" | 24" | 28" to 44" | \$685 | C & H 800-336-1331 |
| Flexible/Expandable Conveyor 4W587 | 36" to 144" | 24" | 28.5" to 41.5" | \$850 | Grainger 301-695-5063 |

Pallet Lifter

3. Pallet scissor lifts should be used when unloading pallets to maintain a neutral working height. A pallet lifter will eliminate bending to pallet height to lift packages. Table 3 contains vendor information.

| Table 3: Pallet Lifter Recommendations | | | | | | |
|---|--------------|------------|------------------|---------------|-------------|-----------------------------------|
| Product | GSA | Capacity | Fork Dimension | Height Range | Price | Vendor |
| Pallet Lifter* | GSA # 272153 | 1,100 lbs. | 27"x44" | 3.2" to 35" | \$433 | Alzar Lift |
| Pallet Lifter | GSA # 272755 | 2,200 lbs. | 21"x44.5" | 3.6" to 31.5" | \$543 | Alzar Lift |
| Pallet Lifter | | 2,200 lbs | 21" or 27" x 44" | | \$625 | Autoquip 513-245-2902 |
| Pallet Lifter | | 2,200 lbs | 21" or 27" x 44" | | \$732-\$792 | Systems Design, Inc. 252-995-6117 |

*Not for use with closed pallets



2,200lb Capacity Pallet Lifter

Scale

4. A pallet truck with a scale will allow employees to weigh heavy packages without having to manually transfer them from the pallets to the scale. A less expensive alternative is a scale with a ramp. This option would still require the transfer of large items from a pallet to a hand truck, which would then roll the package up the ramp to the scale. Some containers may be too large for the hand trucks, so the pallet truck with scale is preferred. Please refer to table 4 for details.

| Table 4: Scale Recommendations | | | | | |
|---------------------------------------|--------------|---------------------------|--------------------------------|---------------|--------------------------------------|
| Product | GSA | Capacity | Dimension | Price | Vendor |
| Pallet Truck with Scale* | GSA # 123000 | 5,000 lb. | | \$2447 | Intercomp. |
| Pallet Truck with Scale | | 4,000 lb. | Fork Dimensions 22" by 45" | \$2,450 | Vestil Manufacturing. 1-800-348-0868 |
| Pallet Truck with Scale | | 5,000 lb. | Adjustable Fork Dimensions | \$2350 | Systems Design Inc. 252-995-6117 |
| Industrial Scales** | | 1,000 lbs. to 10,000 lbs. | 30"x30", 36"x36", and 48"x48". | \$1436-\$1596 | The Scale People |

*Measures in one pound increments.

**Purchase with optional ramp.



Pallet Truck with Scale

Knives

5. A knife with an ergonomic handle and a box opener would encourage neutral wrist posture and decrease the force required in opening boxes.

Vendor: Box Cutter Price \$22.95 Alimed 1-800-225-2610
Box Cutter Price \$15.30 C&H 1-800-558-9966

Vendor: SK-4 Safety Knife \$34.95 Alimed 1-800-225-2610



Box Cutter



Ergonomic Knife

II. Computer Redistribution Area

The computer redistribution area receives retired computer equipment, which is then processed and designated for disposal, internal reutilization, or donation.

Issues:

Pallets are often used to hold equipment being processed or awaiting storage, as shown in figure 1. Employees bending over to work on equipment on pallets are at risk of back and neck strain. Figure 2 shows an employee picking a monitor up from a pallet. Computer equipment can weigh up to 40 pounds apiece. The low height of the pallets and poor handles on equipment like monitors adds to the weight of the load to increase the biomechanical stress on the spine while lifting.



Figure 1: Employee working on printer on pallet



Figure 2: Lifting monitor from pallet

The current storage units in the computer redistribution area are 3 and 4 shelf systems, as shown in Figure 3. Shelf heights vary from 9.25" to 96". The lower shelves require the employee to bend over to retrieve and return equipment. The stairs shown in figure 4 are used to place equipment on the top shelves. These stairs present a fall hazard, particularly when carrying heavy equipment.



Figure 3: Storage Systems



Figure 4: Ladder for accessing shelves

Recommendations:

Mobile Lift Tables

1. Individual equipment arriving in the computer redistribution area should be placed directly onto height adjustable carts and remain there until transferred to the storage racks. These carts will reduce the need for manually lifting parts and allow the operator to work on equipment at a neutral working height. Vendor information is supplied in Table 1.

| Table 1: Mobile Lift Table Recommendations | | | | | | |
|---|---------------|--------------------|-----------|----------------|---------|-------------------------------------|
| Product | GSA | Capacity | Dimension | Height Range | Price | Vendor |
| Hydraulic Lift Table with Casters Product A | GSA # 260 063 | 2,000 lb. Capacity | 32"x48" | 30.5" to 47.5" | \$738 | Alzar Lift |
| Scissor Lift Table Product A | | 1,000 lb. | 32"x63" | 11.25" to 36" | \$689 | Vestil Manufacturing 1-800-348-0868 |
| Hydraulic Lift Table with Casters Product B | | 2,000 lb. | 30"x36" | 36" to 54" | \$950 | Grainger 301-869-0011 |
| Autohite Self-Elevating Cart Product C | | 1,000 lb. | 42"x42" | 14" to 34". | \$1,090 | Vestil Manufacturing |



A - Hydraulic Table



B - Scissor Lift Table



C - Autohite

Pallet Lifter

2. Equipment arriving on pallets should be moved using a scissor lift pallet lifter. The pallet can then be raised to an appropriate working height or to a point where the parts can be transferred to shelving or carts. The pallet lifter will eliminate lifting heavy parts from a low level and allow the operators to work at a neutral height. Table two contains product information for pallet lifters.

| Table 2: Pallet Lifter Recommendations | | | | | | |
|---|--------------|------------|------------------|---------------|-----------------|--------------------------------------|
| Product | GSA | Capacity | Fork Dimension | Height Range | Price | Vendor |
| Pallet Lifter* | GSA # 272153 | 1,100 lbs. | 27"x44" | 3.2" to 35" | \$433 | Alzar Lift |
| Pallet Lifter | GSA # 272755 | 2,200 lbs. | 21"x44.5" | 3.6" to 31.5" | \$543 | Alzar Lift |
| Pallet Lifter | | 2,200 lbs | 21" or 27" x 44" | | \$625 | Autoquip 513-245-2902 |
| Pallet Lifter | | 2,200 lbs | 21" or 27" x 44" | | \$732- \$792 | Systems Design, Inc. 252-995-6117 |

*Not for use with closed pallets



2,200lb Capacity Pallet Lifter

Stockpicker

3. The top storage shelves should be used as little as possible to reduce the risk of equipment falling from heights during handling. A forklift should be used to place pallets of items on the top shelf. If there is not enough room in the aisle for a fork lift, an automated stock picker should be obtained. The scissor lift tables and pallet lifters can be adjusted to the same height as the lower shelves to ease the loading of equipment onto the shelves. The bottom shelves could be raised to reduce back bending while placing or retrieving equipment. The distance between the bottom shelf and the next shelf should allow for the tallest piece of equipment and clearance for a pallet or hands. A stockpicker truck can be used for loading shelves of 54" and 72" heights instead of the current ladder. Refer to table 3 for product information.

| Product | GSA | Capacity | Dimension | Total Height | Price | Vendor |
|-------------------|----------------|-----------|--------------------------|--------------|-------|----------------------------|
| Stockpicker Truck | GSA#3502 54 | 500 lb. | Three shelves 22"x40" | 50" | \$343 | Alzar Lifts |
| Stockpicker Truck | | 500 lb. | Two Shelves 19.5"x34" | 50" | \$475 | Rol-Away 1-800-547-4548 |
| Stockpicker Truck | | 1,000 lb. | Three Shelves 28"x48" | | \$470 | Grainger |



Stockpicker Ladder

Job Requirements and Physical Demands Survey Results

Summary

The Job Requirements and Physical Demands Survey (JRPD) was administered to employees in Carderock's Shipping/Receiving and Computer Redistribution areas. The results of the JRPD indicate that this is an Ergonomic Problem Area (EPRA) with an overall priority score of 9 (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 results indicate that all five body areas have significant priority ratings, but the leg/torso region (9) and the back/torso (7) have the greatest scores. Most of the risk factors associated with these body areas were addressed by reducing the need for lifting heavy loads through conveyors, height adjustable carts, and pallet lifters. The other body areas may be associated with working at non-neutral working heights. The JRPD results indicate the presence of health disorders among the employee population, which may have contributed to the overall priority score. Health disorders include pre-existing work-related musculoskeletal disorders (MSD's) and health problems, such as diabetes, which may be a contributing factor for MSD's. The specific results of the JRPD are as follows:

Population Data

Surveys were completed and returned by 8 of the 10 employees in the areas reviewed, resulting in a **response rate of 80%**. The population surveyed was **100% male, civilian, and over the age of 40**. All of the employees have been with at Carderock and in their current job greater than one year.

The current work force is entirely male and over the age of 40. Age is a risk factor for MSD's and an older work force is at increased risk of developing work-related MSD's. While a male employee is capable of greater strength and endurance, this job must accommodate future or temporary female workers.

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.

| | Shoulder/ Neck | Hand/Wrist/ Arm | Back/Torso | Leg/Torso | Head/Eye |
|-----------------------|-------------------|--------------------|------------|-----------|----------|
| Risk Prevalence | 38% | 38% | 63% | 63% | 25% |
| Risk Rating | Medium | Medium | High | High | Low |
| Discomfort Prevalence | 38% | 50% | 50% | 63% | 63% |
| Discomfort Rating | Medium | Medium | Medium | High | High |
| Priority Score | 5 | 5 | 7 | 9 | 6 |

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 equal 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 9.

Organizational Information- Medium

Organizational factors can also be ergonomic stressors. The organizational score for this area was medium, which indicates that job stress factors may be present. 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- 9.50

Survey results indicate an average physical effort score of 9.50. 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. Reducing the amount of required lifting can reduce the physical effort score for this job.

Health Care Provider Score- 3

According to the health care provider score, three employees 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- 0

None 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- 25

25% 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- 62.50

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” | | |

62.5% 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- 37.50

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 | | |

37.5% 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 | Calling (Telephone Use) |
| Cleaning by hand | Copying |
| Driving (vehicles) | Filing (general administrative) |
| Hammering | Lifting |
| Loading | Monitoring (visual displays) |
| Mousing (computer) | Opening/closing heavy doors |
| Packing/packageing | Stapling |
| Transporting loads on non-powered carts | |
| Tying/twisting/wrapping | Typing/keying |
| Wheeling Loads | Writing/Illustrating |

One respondent wrote in that his routine tasks include sign language and fingerspelling.

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?
 - Stress or pressurized time by officers. Split personalized mind into a few positions by supervisor ordering.
 - When removing items from tri-wall boxes
 - Standing for length of times
 - Bad high stool with “fallout” back
 - Offloading computers, copiers, etc. from skids or conversely loading onto skids
2. Which tasks take the most effort
 - Need new system for disposal
 - Placing or removing heavy items to or from the storage shelves
 - Lifting from lowbed cart or low shelf
3. Are there any tools or pieces of equipment that are notoriously hard to work with?
 - Need computer relating disposal
 - Allen wrench (too many screws)
4. If you could make any suggestions that would help you do your job more easily or faster or better, what would you suggest.
 - For many years, I always think of getting better way but they can't accept due to poor reasonable doubt for budget. Prefer easily access and fast service and well done organization.
 - Management should make sure the workforce is working together at all times in a coordinated effort and not allow some to wander on their own.
 - More help
 - Better air circulation
 - Clean up the air quality in building 145 (bldg to dusty)
 - Need help

Based on operator comments, it is suggested that an Industrial Hygienist investigate the building air quality.

Anti-fatigue matting, sole inserts, and sit/stand stools are all available from Alimed (1-800- 437-2966) and should be looked into.