

# Naval Facilities Engineering Command

## Ergonomics Risk Assessment for

### Electroplating Shop

#### Introduction

This report summarizes the ergonomics risk assessment conducted on November 15<sup>th</sup>, 2006. The Electroplating Shop was observed in order to determine sources of ergonomic stress and recommend improvements. This assessment is based upon interviews with representatives from the shop, safety, industrial hygiene, ergonomics contract support, and human resources as well as an evaluation by a Certified Professional Ergonomist with the Naval Facilities Engineering Command (NAVFACENGCOM) Hazard Abatement and Mishap Prevention (HAMP) Program. The facility does not permit photography; therefore, photos from similar operations were substituted.

The operations reviewed present the opportunity to reduce the risk of Work-related Musculoskeletal Disorders (WMSD). Recommendations to the command to reduce the probability of injury include equipment purchase<sup>1</sup>, process redesign, and implementation of administrative controls<sup>2</sup>.

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.

Representative vendor information is included in the recommendations to assist in the evaluation of products and services<sup>3</sup>. Recommendations to 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 takes advantage of employee experience.

## **Electroplating Shop**

Purpose of the operation: Employees clean and plate parts through a series of dipping processes. The electroplater is also responsible for some specialized painting processes.

Population: One electroplater with temporary assistance.

Injury Data: The electroplater is experiencing pain in his neck and lower back. He suffered an injury while painting in an awkward posture and has been placed on restricted work duty.

Description of the Operation: The employee first rigs new parts with a hook or holder in order to establish an electrical contact for the dipping process. The electroplating process requires the worker to lift and lower parts into and out of multiple cleaning and chemical dip tanks. Figures 1 and 2 show dipping processes from Whidbey Island and NUWC Keyport. Tank height is about 36" and the estimated horizontal reach is 27". The worker is lifting the parts at or above shoulder height depending on the size of the part. The employee can spend 6 to 8 hours a day electroplating.

The electroplater completes approximately 10 iridized parts and one anodized part each week. The shop receives parts weighing up to 50 lbs, but the employee requests assistance for anything over 25 lbs. Iridizing a part requires approximately 11 baths while anodizing takes 19. The employee has to move quickly between baths. He usually supports the part by the holder at arm's length with one arm and turns his body away from the tank to avoid splatter. He can usually process a part in 15 minutes but it has taken up to three hours for a part with holes. A part with multiple holes takes longer and is more difficult because the employee has to hold the part with one hand and quickly spray the holes with water between baths. The employee also holds the part with one hand to dry it with an air hose. The parts received in the shop vary greatly in terms of size, shop and processing requirements. The shop recently received 200 lead bricks each weighing 25 lbs. which had to be placed in a metal basket in order to dip.



Figures 1 and 2: Dip tank at other Naval Activities

The electroplater also works in a paint booth on items that require a specialized painting license. He is the only person certified in the country to apply Aeroglaze finishes for planes and spacecraft. While painting missile pods he sits on a five gallon can and works overhead, moving the part to maintain adequate lighting.

In order to paint a part he first preps it by cleaning it and taping off, mixes the epoxy and catalyst for the paint, cleans the part with a steam cleaner or alcohol wipe, and then paints for up to an hour with a spray gun starting with a primer coat. It is not possible to take a break while painting because that will leave a line which may mar the finish. The employee paints about once a month. Large parts like a missile pod can take up to a week.

Ergonomics Issue Description: The electroplating operation requires sustained awkward postures and repetitive heavy lifting. The chances of developing WMSDs are increased when risk factors (e.g. awkward posture and lifting) occur in combination, especially for significant frequency and duration.

*Sustained Awkward Postures:* The worker assumes a number of sustained awkward postures during the painting and electroplating operations. The employee usually dips parts with the arm extended away from the body and the torso twisted. Static awkward postures 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. Awkward postures increase the muscular effort required to do the task. The longer or more frequently static loading occurs, the greater the risk of injury due to overuse of muscles, joints, and other tissues.

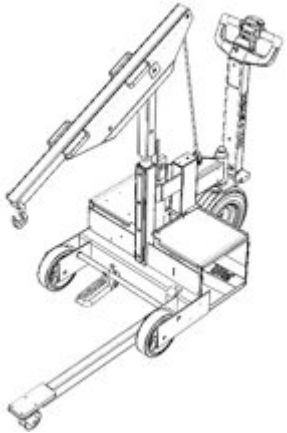


Painting requires the employee to assume awkward postures in order to see the part with enough light to ensure quality. Inadequate lighting can lead to eye strain and fatigue as well as discomfort from maintaining awkward postures. Working overhead causes the worker to contort his body in order to access areas of the product he is painting. Holding the arms overhead can place strain on the shoulders and back. The muscles must apply considerably more contraction force to maintain awkward postures. As the duration of the contraction increases, stress on the muscles also rise. The continuous stress on these muscles can lead to fatigue and discomfort which can be precursors to injury.

*Excessive Lifting:* The employee performs frequent and sustained lifts during the dipping process. Holding a part at arm's length creates significantly more stress on the spine than if the part was held close to the body. Holding the part with one hand also increases the stress on the back and shoulder. 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.

The dipping process was modeled using the Three Dimensional Static Strength Prediction Program (3DSSPP), a biomechanical modeling program from the University of Michigan. It was assumed that the worker is in the posture shown in figure 2, while handling a 25lb weight in one hand, and the worker is in the 50<sup>th</sup> percentile for males (69.7"; 165.6 lbs). The abductor shoulder muscles bear the greatest strain resulting in 72 Nm moment about the joint. 55% of the population has sufficient strength to repeatedly perform the task. Forces about the lumbar spinal discs are considered in the safe zone at this load, according to the model.

#### Recommendations:

- ∞ A lifting device would support the weight of the part and reduce heavy lifting and sustained awkward postures. Vendor table 1 contains mobile lifting devices. The shop is very small and it may be difficult to maneuver a lifting device.
- ∞ A track and trolley system above the dip tanks would be an ideal solution to move parts through the shop. Public Works and Naval Facilities Engineering Command should be contacted for this project.
- ∞ A creeper would support the worker during the painting process to reduce static muscle loading. Refer to vendor table 1.
- ∞ Additional explosion proof lighting in the paint booth should increase productivity, quality and comfort. Adequate lighting would reduce the need for the worker to contort his body to see the parts he is painting.

Vendor Table 1- Product recommendations			
Product	Vendor	Estimated Cost	Figure
Lifting crane- the arm extends up to 30" and can be parallel to the lift.	Powerpusher <b>800.800.9274</b>	\$8,490	
Shop Crane Engine Hoist with foldable legs	Vestil 800-348-0868  EH-60T 2,000 lb. capacity. 76" boom length, 34" legs	\$529	 model EHN-20-C FOLDABLE LEGS
Angle adjustable creepers	Eidos Corp 1-800-210-9666	Price depends on features	
	Northern Tool & Equipment Co 800-221-0516	\$60	
	Whiteside 470 363 1179	\$147	

Vendor Table 1- Product recommendations			
Product	Vendor	Estimated Cost	Figure
	Lab Safety 1-800-356-0783	\$114	

End Notes:

<sup>1</sup> Equipment purchase without proper and repeated training will not mitigate risk and may in fact increase hazards.

<sup>2</sup> 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.

<sup>3</sup> 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.

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