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Post Project Ergonomic Evaluation PECO Manufacturing Co., Inc. Semi-automated Thermal Calibration (103) December 18, 2002 By Rob Strickland, OTR

An on-site ergonomic evaluation of the new semi-automated thermal calibration workstation was conducted at PECO MFG on December 18, 2002. This was done at the request of Dave Looper, Manufacturing Consultant from OMEP. Videotaping and digital photos of the work tasks were conducted and are available for review.

Purpose/Background:

The purpose of this evaluation is to provide an assessment and documentation of the Musculoskeletal Disorder (MSD) risk factors associated with the use of this device as compared to the old (manual) method. This is being done as part of the Oregon OSHA Worksite Redesign Program Grant which has been awarded to PECO. The intended goal of this project is to make engineering improvements to reduce the MSD risk factors in order to prevent work injury.

General Description:

The new thermostat calibration machine has been built according to the criteria set forth in section C of the Worksite Redesign Grant application (semi-automating the calibration aspects of the process) and in compliance with the recommendations contained in the initial ergonomic evaluation. This eliminates many of the repetitive movements and un-supported, non-neutral positions of the arms previously associated with the manual calibration procedures. The resulting manual tasks performed by employees primarily relate to loading/unloading and documentation functions.

The calibration machine is divided into two sections. The left side is stationary (not on wheels) and contains the temperature controlled water bath. The right side is mobile (on wheels) and holds the automatic calibration equipment and dual activation switches (both switches must be simultaneously activated to prevent pinch point safety hazards). This unit is mobile so it can be moved to another area to calibrate thermostats in air. The right and left sides can be joined with quick connection devices. Each side of the machine is height adjustable using hydraulic cylinders with manual retractable crank handles. There is ample open space under the workstation to provide room for a moveable foot rest to allow an alternating, foot-up position while standing.

Relevant dimensions

Workstation table width- 60" (when two sides are connected)

Workstation table depth- 30"

Calibration fixture effective work height- 3" above table surface (adjustable from 36.5" to 45.4" up from floor)

Calibration fixture effective horizontal reach distance- 6" from front edge of table

Calibration tank effective horizontal reach distance- 6" from front edge of table

Work flow process: New thermal calibration sequence

- A) Adjust height of workstation suitable to employee (crank handles)
- B) Turn machine on
- C) Enter thermostat number on “Quick Panel” control screen (touch screen)
- D) Place actuator bulb in a water bath for 3 minutes.
- E) Apply Glyptal (thread lock) to secure the calibration screw inside thermostat (squeeze bottle).
- F) Secure the stat assembly in new fixture (align part and apply light pressure) while keeping the thermostat bulb in the tank
- G) Attach the stat assembly lead wires to the calibration fixture.
- H) Touch both switches on workstation table to activate calibration sequence
- I) When sequence is complete, remove stat assembly
- J) Repeat procedures E-I

Each sequence (E through I) requires approximately one minute with the automated calibration portion taking approximately 30 seconds (50% of the task time). This provides the employee ample time for ongoing quality control, time for gathering thermostats and applying Glyptal, as well as brief periods of rest (micro breaks).

The reduction in risks of musculo-skeletal injury due to the implementation of this new tool include are described below:

The ergonomic risk factors related to the tasks of manually calibrating thermostats (identified in the initial ergonomic evaluation report) have been largely eliminated since the new semi-automated calibration workstation performs these steps. The new semi-automated thermal calibration machine and workstation allows the employee to choose sitting or standing while making adjustments to the work height. This allows for an optimal human/machine interface to be achieved, allowing the employee to perform the tasks with an upright trunk posture, elbows close to their side and wrists/hands in near-neutral range of postures, working around elbow height. The adjustment range accommodates a wide range of the adult working population (5th percentile female to 95th percentile male).

1. Repetition of hand/arm movement has been greatly reduced by automating the calibration process so that the primary manual tasks now are applying Glyptal to the calibration screw, loading the part into the fixture and unloading the part. These tasks involve light manipulation of the part with fingers & hands with minimal forward reaching at elbow level.
2. Awkward postures have been nearly eliminated with most tasks now occurring in near neutral ranges of joint motion.
3. Static postures related to unsupported reaching with both arms have been eliminated by automating the calibration procedures. Since the workstation is height adjustable, demands of prolonged sitting or standing have been reduced as these postures can easily be alternated.
4. Forces and loads related to static holding of the arms in a forward reaching position have been eliminated.

Remaining physical demands and musculo-skeletal disorder (MSD) risk factors:

Static postures related to looking down at the thermostats (neck flexion) while applying Glyptal and while loading and unloading parts remain present for approximately 50% of the cycle time. This however is a significant improvement compared to the nearly constant neck flexion observed in the manual method of calibration.

Employee Discomfort Survey Results:

Job Title- 103 Calibration Number of surveys completed= 0

Employee Discomfort Survey Summary

At the time of this post-project ergonomic evaluation, due to a slow down in production, the new thermal calibration machine has not yet been utilized by company employees.

Job Hazard Analysis Tools Utilized

Rapid Upper Limb Assessment (RULA)* results: Action Level 1 (rating score 2).

A RULA rating score of 2 (on a scale of 1-7) results in a RULA action level of 1. This results in a recommendation of “**Posture is acceptable**” if it is not maintained or repeated for long periods”.

**See Applied Ergonomics 1993, 24(2), 91-99, “RULA: a survey method for the investigation of work-related upper limb disorders” RULA is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported. This tool requires no special equipment in providing a quick assessment of the postures of the neck, trunk and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list which indicated the level of intervention required to reduce the risks of injury due to the physical loading on the operator.*

The Requirements for action into which the grand scores are divided is summarized into action levels as follows: (The action level leads in most cases, to proposals for a more detailed investigation)

Action level 1- A score of 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods.

Action level 2- A score of 3 or 4 indicated that further investigation is needed and changes may be required.

Action level 3- A score of 5 or 6 indicated that investigation and changes are required soon.

Action level 4- A score of 7 indicates that investigation and changes are required immediately.

Strain Index Analysis results* Strain Index (SI score)= **1.7**

An SI Score less than 3 is the lowest classification and is rated “**probably safe**” in terms of risk for distal upper extremity disorders.

**See American Industrial Hygiene Association Journal 56:443-458 (1995) “The Strain Index: A Proposed Method to Analyze Jobs for Risk of Distal Upper Extremity Disorders”. The Strain Index is a semi-quantitative job analysis methodology that results in a numerical score (SI score) that is believed to correlate with the risk of developing distal upper extremity disorders. The index is based on multiplicative interactions among its task variables, consistent with physiological, biomechanical, and epidemiological principles. The SI score represents the product of (1) intensity of exertion, (2) duration of exertion, (3) exertions per minute, (4) hand/wrist posture, (5) speed of work, and (6) duration of task per day. Preliminary testing has revealed that jobs associated with distal upper extremity disorders had SI Scores greater than 5. SI Scores less than or equal to 3 are probably safe. SI Scores greater than or equal to 7 are probably hazardous.*

Worksite Redesign Project Completion Summary:

The new semi-automated thermostat calibration workstation has fulfilled the objectives of this worksite redesign project with the elimination or reduction of each of the MSD risk factors previously observed in the manual calibration procedures (evidenced by RULA and Strain Index post-project evaluation results). The device is simple to operate and does not create additional MSD risk factors.

PECO has estimated based on early testing of the equipment that production could be up to 30% greater than production figures with the manual methods.

All of these factors point to a very successful outcome for this worksite redesign project.

Photos



Figure 1

Semi-automated Thermal Calibration Workstation



Figure 2

Placing thermostat assembly into fixture requires only light pressure in optimal reach zone

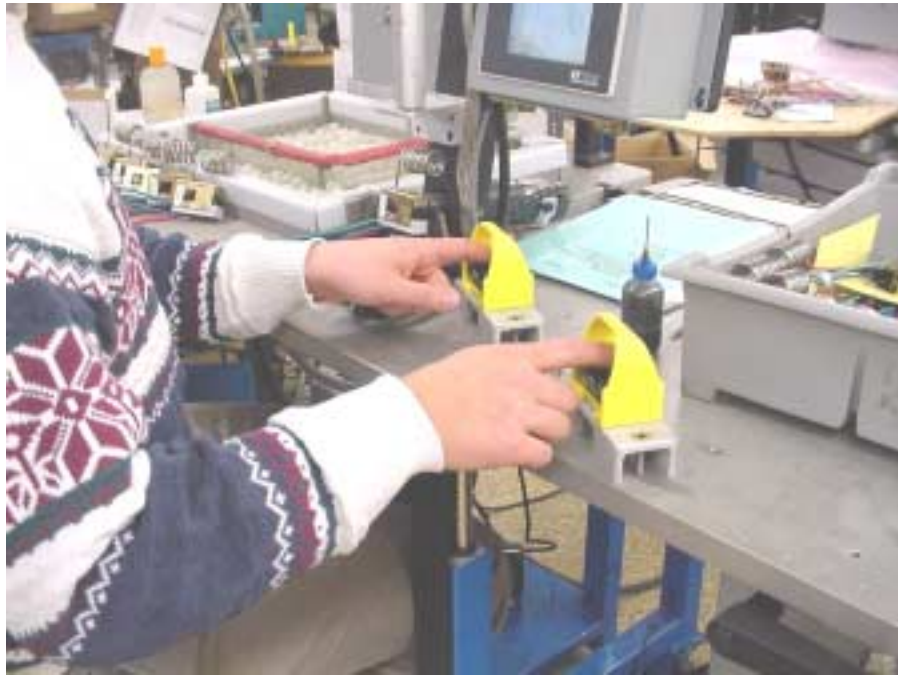


Figure 3

Dual activation switches

For further assistance or questions regarding this report please contact Rob Strickland, Ergonomics Specialist. Phone (503) 667-3564.

Respectfully,

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