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Final Report Oregon OSHA Grant # 99/01-29

Company: **PECO Manufacturing**
Semi-Automated Thermal Calibration (103)

To: Mark Hurliman, OR-OSHA Worksite Redesign Program
Wayne Beck, Manufacturing Engineer, PECO Manufacturing

From: David Looper, Consultant, Oregon Manufacturing Extension Partnership (OMEP)

CC: Barb Forni, Financial Manager, Oregon Manufacturing Extension Partnership (OMEP)

Enclosures: Exhibit C, OR-OSHA Quarterly Report Expenditure Worksheet
Budget Summary & Projections, rev. Final Report
Fund Disbursement Report, Barb Forni, OMEP Financial Manager
Project Management Hours Log, David Looper, OMEP Consultant
EPS CD, CADD files, Bills of Materials, PLC Program and Data Tables
Ergonomist Pre & Post Assessment Reports with Photos
Ergonomist Video of Pre & Post Assessment Operations
Executive Overview of Project
Key Vendor List
Technical Article of Devices Effectiveness
Digital Photo Album

PROJECT ACCOMPLISHMENTS AND EFFECTIVENESS

The original objectives of this project, as outlined by the grant application were to reduce or eliminate the employee exposure to musculoskeletal disorders (MSDs) while accurately adjusting calibration screws that activate the switches and mechanical assemblies of the thermal control units.

Based on the ergonomic pre-assessment of the calibration process and equipment, a semi-automated calibration station was specified, designed and built to eliminate the targeted motions that provided the employee exposure to MSD risks. As with most automation projects the process time is faster than the previous manual operation, therefore special attention was paid to the design of the new equipment to assure that new injury risks were not created. Again we relied on the ergonomist guidance and expertise. As a result required operator insertion forces/pinch pressures are near-zero, the station height is adjustable to the operator in both the standing and sitting position, and adequate tank/leg clearance in the sitting position was created.

The final ergonomic report indicates that all of the previous objectives from the pre-assessment have been met. The following is the ergonomist's post-assessment summary:

“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.”

Other benefits from the project:

- The equipment was designed so it could be easily modified and replicated for other thermostat families within Peco manufacturing,
- The process capacity was increased through the automation, and
- The quality/repeatability of the calibration process was improved beyond the ability of the most experienced operator.

PLANS TO CONTINUE PROJECT EVALUATION

Wayne Beck, manufacturing engineer for Peco Manufacturing, will ensure that the device receives continued use, evaluation and application within the production environment. Peco manufactures 90 plus models of the 103 Product Series Thermostat, and while we considered all of them in the design specifications for the calibration station, we qualified the machine on only 5 models. These five models were both the higher volume units and were spread across the spectrum of design variations seen in the product family. Every model will have to be statistically qualified before it will be approved on the new calibration station.

DISSEMINATION ARTICLE

A dissemination article has been included for your review. Based on your review, acceptance and suggestions for publication, Peco is forward the article to appropriate agencies.

DELIVERABLES FOR OR-OSHA WEB SITE POSTING

Engineering & Prototype Services (EPS CD)

Solid Model CAD Files

- **Original CAD File Format from creation.**
- DXF Format (wire frame).
- Pneumatic, electrical and hydraulic schematics & wire diagram files.
- Single 8-1/2" x 11" Isometric view drawing of equipment as working.

PLC Programming

- Theory of Operation (Format: MS Word)
- Programming code in original programmed format. (Format: paper copy & MS Excel)

Bill of Materials

- List all purchased parts with associated cost, quantities, and supplier/source information. Hardware item detail maybe eliminated. (Format: MS Excel)

Oregon Manufacturing Extension Partnership (OMEP CD)

OMEP Documentation

- Key Vendor Listing of all major vendors, key support staff and subcontractors. (Format: MS Excel)
- Executive Overview with digital photos of device. (Format: MS Word)

Ergonomist Documentation

- Ergo Pre Assessment Report, by Rob Strickland (Format: MS Word)
- Ergo Post Assessment/Final Findings Report, by Rob Strickland (Format: MS Word)
- Video of Pre & Post Assessment Operations. (Format: VHS Tape)

Dissemination Article

- Technical Article on effectiveness of the device, by Wayne Beck, PECO Manufacturing. (Format MS Word)

GRANT FINANCIAL REPORT

The completed Exhibit C Quarterly Report Expenditure Worksheet has been included with this report, outlining the use of the budget. The total OR-OSHA dollars spent on this project were \$146,295.00, which is \$405.00 less than the \$146,700.00 budgeted. There are no open billings remaining for this project.

OMEP has billed the grant for \$1,770.00 in the final period for various services provided as outlines in the grant.

OMEP is requesting \$14,264.00 as the final grant dispersement payment. This will reimburse OMEP for expenses OMEP has paid in excess of OR-OSHA's previous dispersements.

Project expense summary by expense category.

	<u>Final Period Expenses</u>	<u>Total Project Expenses</u>
Category 1	\$3,170.00	\$60,295.00
Category 2 (Peco In-Kind)		\$16,700.00
Category 3	\$25,000.00	\$86,000.00
Category 4		\$0.00
Total Expenses	\$28,170.00	\$162,995.00

Peco's In-Kind Match Requirement – PECO Manufacturing's In-Kind contribution exceeded their project match requirements at the end of the 3rd quarterly period, so they stopped recording their in-kind time against the grand project due to the drain on their time and their changing business climate (decline in business and key personnel). Their total In-Kind Match requirement for the project was \$16,300.00 and they had contributed \$16,700.00 through the 3rd quarter, exceeding their match requirement by \$400.00. We estimate that their additional time put into completing the project is 100 to 150 hours.

Enclosed is a Fund Disbursement Report from Barb Forni, OMEP's Financial Manager, which shows where all fees were expended; and the Budget Summary Projection shows the Final Quarterly spending.

FINAL SUMMARY

While this project was over a year late in completion, it has successfully met the objectives of the Worksite Redesign Program and Peco Manufacturing. The issues that we encountered in completing this project were mostly focused on vendor related performance issues with defective components, the vendor not standing behind their product and their lack of customer support. Once these issues were unmasked and corrected the design related issues were easily rectified. I give Engineering & Prototype Services (EPS) a lot of credit for sticking with the project and not walking away from it. In the end, the calibration process is now significantly safer for the employees and the past injury history of 19 compensatable claims over a 5 year period should disappear in the future.

If you or anyone at Oregon OSHA or PECO Manufacturing has any questions regarding any content of this report, please do not hesitate to contact me.

Best regards,

David G. Looper
Manufacturing Consultant
Oregon Manufacturing Extension Partnership