

**Ergonomic Evaluation**  
**Vanguard Technologies, Inc**  
**Heat Exchanger Coil Transfer and Insertion Tool**  
**May 1, 2000**  
**By Rob Strickland, OTR**

An on-site ergonomic evaluation of the task of lifting and moving a heat exchanger coil was completed on May 1, 2000. Joseph Junker, PE., Mfg. Consultant, OMEP, and Steve Kujawa, President of Vanguard were present. A video tape and still photos were taken during the evaluation and are available for review. Copies of a symptom survey were left for employees to fill out. (The task involved in this study is related to a new product not yet in production. Once production begins, involved employees will fill out the symptom survey and forward it to Mr. Junker for inclusion in the report).

**Purpose/Background:**

The purpose of this review is to provide an initial ergonomic assessment of the musculo-skeletal disorder (MSD) risk factors associated with this activity. Following implementation of engineering controls a follow-up assessment will be made for comparison.

**Observations:**

This task is one of several activities involving the heat exchanger coils. The copper tubing with fins is coiled onto an electric powered coil roller drum. The completed coil is then slid off and lifted manually onto a transport cart. The cart is pushed close to the heat exchanger shell which is resting on a wood pallet atop another cart. The worker reaches with one arm into the coil (which weighs 110 lb.), then lifts and turns to insert it into the heater shell. It is inserted with one arm into the shell while reaching forward setting it down several times until it is in place, 17" back from the front edge. The ultimate horizontal reach distance is 42" (from feet/base of support to hand position). This task will be performed 1 to 5 times per day when full production is under way. Future increases in expected production may boost the frequency up to 10 times per day.

The primary physical demands likely to contribute to risk of musculo-skeletal injury include:

1. Forces and Loads- 110 lb. is excessive for any one individual to safely lift and handle. This load places significant mechanical strain on the supporting structures of the spine (discs, muscles, ligaments and tendons) and presents an unacceptable degree of injury risk to the majority of the working population.
2. Awkward trunk postures- forward bending (30 to 40 degrees) and slight side bending (lateral flexion) while handling the load.
3. Contact Stress- Hard/sharp edges of coil fins resting on soft tissues of lower arm.

These MSD risk factors were quantified using the revised NIOSH Guide Program for Manual Lifting. (See attached reports giving background information and details of calculations). The result of this analysis indicates that when the worker is lifting the coil as pictured in the photographs, the lifting index is 7.53 (7.53 times greater than what would be recommended by this NIOSH model). The estimated percent capable for males doing this task safely over time is 1%.

It is important to note that even after changing the horizontal locations to a much more favorable number (bringing the coil closer to the worker's upright body by reducing the reach distance as much as possible), the lifting index can only be improved to 3.51. This is still considered an unacceptable risk to all but 8% of the male working population.

These results indicate a strong need for engineering controls to eliminate or greatly reduce worker exposure to this task.

**Recommendations:**  
**Engineering controls**

Design and build an adjustable height lifting/handling device that will hold the heater coil while inserting it into the heater shell. The design features of this device should consider other tasks which may be performed that currently involve holding, manipulating or moving the heater coil. The goal is to eliminate or materially reduce the need of a worker to physically hold, support, lift or move the coil manually. Furthermore, the device should be efficient, simple to operate and not create additional MSD risk factors.

I will gladly review proposed equipment designs and prototypes for the presence or absence of Musculoskeletal disorder risk factors. (See attached background information on Ergonomics and MSD risk factors).

For further assistance or questions regarding this report please contact Rob Strickland, 667-3564.

Respectfully,

Rob Strickland, OTR  
Ergonomic Specialist