Howard Industries

Ergonomic Evaluation

June 24, 2015

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Introduction:

Howard Industries requested an ergonomic evaluation be performed on a redesigned lifting latch on a Pad-mounted transformer. The evaluation started at 1:00 pm on June 24, 2015 and completed at 2:15 pm. The evaluation was requested to determine if the changes made to the transformer improved ergonomically the lifting of the door and appropriately keeps the door handle from ground level.

The below pictures reflect two volunteer employees who were used to evaluate postural changes to the lumbar spine. One employee was noted to be six (6) feet four (4) inches and the second employee was noted to be five (5) feet ten (10) inches. The two (2) men reflect different postural heights and will allow a greater understanding of postural changes with the transformer handle.

Testing Procedure:

Two current employees were asked to lift according to a stoop or squat lift during the test. The mechanics of the lift were only defined and not taught to lift according to the evaluator's recommendation. The two employees represent the median anthropometry measurements of current men in the workforce. It was appropriate to allow the employees to determine the correct lifting mechanics which would represent appropriate changes with postural changes, rather than, coached mechanical postural lifting.

Transformer #1- Smaller

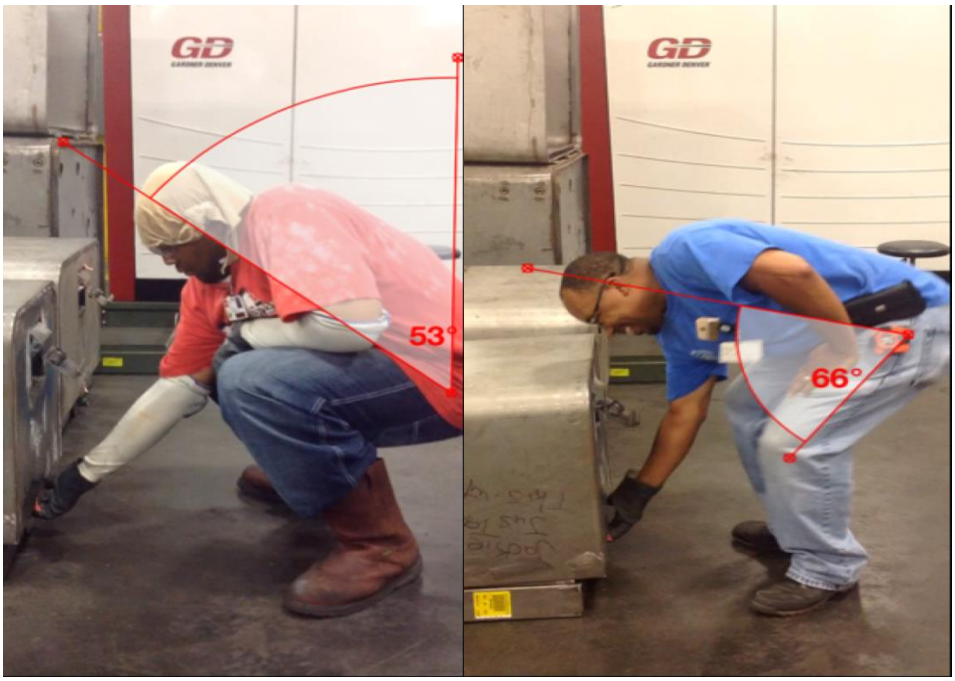
The old handle was located 3 $_{3/8}$ inches from the ground and required thirteen (13) pounds of average force to initiate the pull of the handle. The measurement requires twenty-five (25) pounds of average force to sustain the lift. The old handle would introduce increased incidence of debris that could or could not collect around the handle and restrict the ability to utilize and activate the handle.

New Handle

The new handle was noted at 16 $_{7/8}$ inches from the ground and required eleven (11) pounds of average force to initiate the handle and thirty (30) pounds of force to sustain lift the transformer door. The new handle provides a decreased postural utilization. The new handle does increase a five (5) pound utilization to perform the essential task of lifting the transformer door. The increase in weight does not present with increased risk in performing the essential task. The increase in weight is minimal, in comparison, with the increased postural change to the lumbar spine.

Transformer # 1

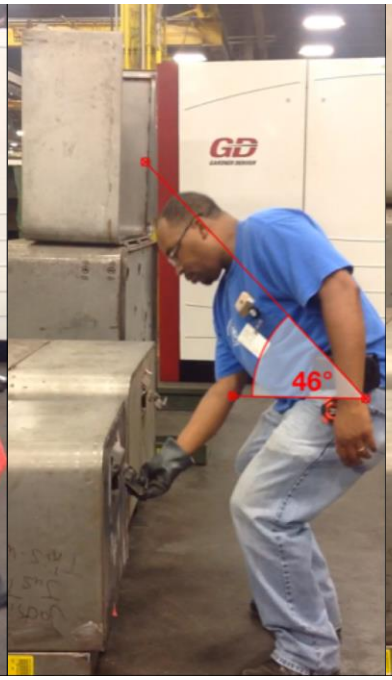
The below pictures reflect two volunteer employees who were used to evaluate postural changes to the lumbar spine. One employee was noted to be six (6) feet four (4) inches tall and the second employee was noted to be five (5) feet ten (10) inches tall.

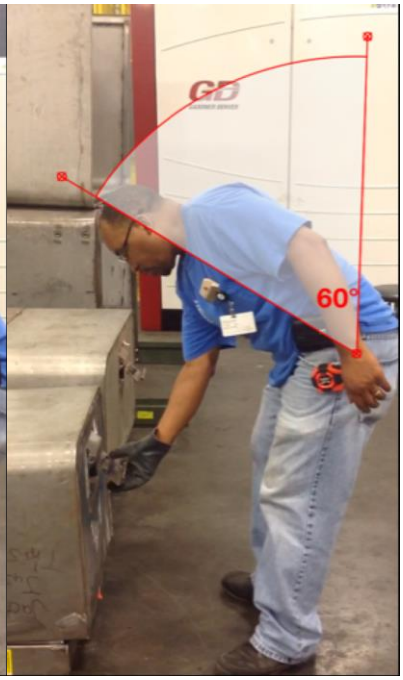


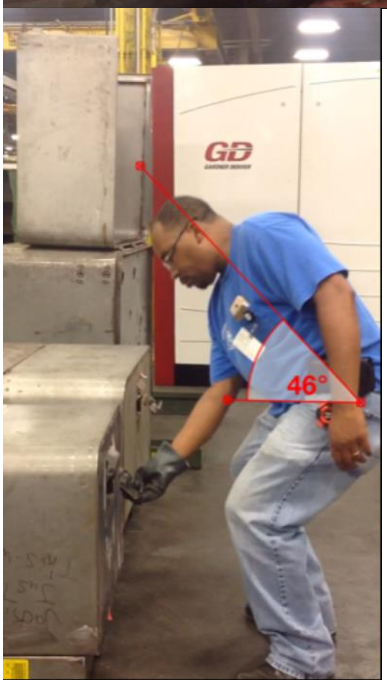
Each employee was asked to lift the old handle using a stoop lift. The taller employee demonstrates an increased flexion of the lumbar spine to perform the task. The shorter employee requires less flexion of the lumbar spine and decreased need to perform knee flexion.

The New Handle position pictures are located below.

Each employee required lumbar flexion comparative to one another, but the shorter employee demonstrates a decrease of knee flexion and lumbar flexion. The new handle does not diminish appropriate lifting mechanics nor increase postural deviations that would substantiate risk. The evaluation demonstrates that the stooping lift still increases lumbar flexion and reduces force production to perform the essential task.







The employees present with improved biomechanical lifting mechanics with the improved handles. The conclusions will be presented at the end of the report. Unit #1 does demonstrate a reduction in knee and lumbar postural risks that may produce increased risk to the operator. The improved handle replacement would demonstrate a decrease in possibility of debris collection along the lower handle.

Transformer # 2- Medium

The old handle was located 3 3/8 inches from the ground with the new handle located 17 1/8 inches from the ground. The old handle required twenty-eight (28) pounds of initial force to lift the handle and thirty-two (32) pounds of sustained force to complete the essential tasks. The new handle demonstrates nine (9) pounds of initial force and twenty (20) pounds of sustained force to complete the essential task. The new handle demonstrates an improvement in posture and decreased requirement of force to perform the essential task. The ability to perform the essential tasks was improved by the changing of the handle height.

Old Handle

The old handle requires an increase of lumbar flexion and knee flexion to complete the essential task. The employee was evaluated performing a squat and stoop lift. The employee presents with the ability to decrease the time it required to perform the essential task.

New Handle

The new handle requires diminished lumbar flexion and knee flexion. The ability to perform the essential task demonstrates with occurrences of lumbar flexion, but the increase in lumbar flexion would not constitute risk or inappropriate change to the lumbar spine.

Ergonomic Summary:

NIOSH 1981

- Many loads cannot be handled close to the body within 18 cm (7 in) in front of the ankles.
- Handlers often control their workload by stooping over to lift instead of squatting, which increases the pressure on the lumbar spinal column. Altering the height to require less bending will increase productivity by reducing the amount of recovery time needed and will leave tan energy reserve for more sustained periods of lifting.

One Handed Lifting

Guidelines assume that the object can be grasped easily and that the lifting height is between 63 and 127 cm (25-50 in) above the floor.

- Object should have good handholds.
- The metabolic demands of raising and lowering the body become as important in one-handed lifts below 63 cm (25 in) as they are in two-handed lifts.
- Muscle strength and endurance are not major limiting factor when the items weight less than 14 kg (31 pounds) and less than 5 lifts per minute are made.
- The requirement is less than 1 lift per minute and 75 % drop of productivity.
- Lifting was noted to be smooth, but does not indicate a reduction of potential.

Andersson et al. 1977

States lifting should exclude greater than 50 degrees of flexion for safe lifting activities.

Norman et al. 1998 and Punnette et al. 1991

Reports increased risk of lower back pain with increased average and peak forward inclination, but not with sideward inclination or twisting angles.

Hoogendoorn et al. 2000

861 coworkers followed over three year period video based. Low but significant increase in risk of sciatica was found with exposure to non-neutral postures. When flexed postures over 60 were adopted for more than 5% of the work time, the risk increased by 50%. When twisted postures were adopted from more than 10% of the work time, the risk increased by 30%. There was also some indication of an exposure- response relationship with the risk increasing with longer exposure.

Nachemson and Elfstrom 1970 and Anderson and Ortengren 1974

Studied the pressure upon the intervertebral disc. Bending the back, while keeping the knees straight, puts increased and greater stress on the discs in the lumbar region than keeping the back as straight as possible and bending the knees.

Mital et al. 1993

Avoid a rotating or twisting movement of the trunk when lifting or lowering a load, make sure that your hold on the load is not lower than knee height, a lift starting at knee height can be continued easily to hip or elbow height. Lifts starting at elbow height may be continued to shoulder height; higher levels require much more strength; seize the load and lift it with a straight back and with bent knees.

Ergonomic Conclusion:

The change in the handle height does provide a clear ergonomic and postural change deviation that allows the employee to effectively choose the method of lifting. The new handle height gives each employee the opportunity to perform a stoop lift or squat lift with minimal postural deviations and diminishes the risk of substantial harm to the lumbar spine. The evaluation presents with diminished REBA and RULA score due to improved postural deviations to the lumbar spine and lower extremity. The changes would present with minimal difficulties where debris could restrict the ability to ambulate the handle during lifting. The handle height at 17 inches renders appropriate ergonomic requirement to 18 inches from the ground. The mild increase in weight to essentially lift the transformer door does not present with risk and should not be qualified as inappropriate requirement. The new handle tasks avoid rotating, twisting, or increasing postural deviations during the course of performing the essential tasks. The patient presents with the ability to perform lifting with a straight back and with appropriate lifting mechanics.

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