

Pneumatic Landing Gear automation for the Transportation Industry
Ergonomic and Technical Design Considerations

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INTRODUCTION

For decades, truck drivers have been suffering from the physically demanding and repetitive nature of their work relative to the raising/lowering of truck trailer landing gear when the trailer needs to be parked. In fact, truck drivers are a high risk group for non-traumatic MSDs (musculoskeletal disorders) of the neck, upper and lower back, shoulders, elbows and arms. This paper seeks to explore the ergonomic reasons driving the recent surge of interest in pneumatic lift systems and to provide technical guidance and considerations for specifying and recommending the purchase of such equipment.

TYPICAL DRIVER ACTIVITIES THAT CAUSE LOWER BACK MSDS

Since the majority of work-related injuries in the trucking industry are in the lower back, a review of the NIOSH literature related to such injuries indicates the following risk factors:

1. Heavy physical work
2. Lifting and forceful movements
3. Bending and twisting (awkward postures)

Although any one of these factors can cause injury on its own, the risk increases when multiple factors exist simultaneously in the same occupation.

Based on an OSHA grant study as reported by Rob Strickland provides an ergonomic evaluation of truck driver activities at Hamann Angus Ranch in Oregon, November 2001, it is quite obvious that all 3 of the above risk factors apply to truck driver activities.

Heavy Physical Work

NIOSH Definition: heavy tiring tasks, manual materials handling tasks, and heavy, dynamic, or intense work. This definition applies to truck drivers since it involves the repetitive raising and lowering of truck trailer landing gear, where the truck trailer can weigh anywhere up to 100,000 lbs. The coupling and uncoupling and raising/lowering of truck trailers in the Hamann Angus Ranch Study occurred up to 24 times per shift, thus

requiring considerable physical strength and energy. The torque required to raise or lower a fully loaded trailer of this weight is 100 ft / lbs for a manual operation. The automated operation requires a force of less than ½ lb. The amount of repetitive cranks to fully raise or lower a trailer is approximately 50 cranks for a manual landing gear operation. The time to perform the manual raising or lowering of landing gear is typical 10 minutes under continuous repetitive motion and high torque. The automated operation takes approximate 10 seconds with very little effort.

Lifting and Forceful Movements

NIOSH Definition: Lifting is defined as moving or bringing something from a lower level to a higher one. Forceful movements include movement of objects in other ways, such as pulling, pushing, or other efforts. Repetitive hand cranking to raise or lower truck trailer landing gear is a key activity truck drivers are engaged in and is described under the Heavy Physical Work risk factor above. This repetition is approximately 50 full circle cranks to raise or lower landing gear to full height.

Bending and Twisting (awkward postures)

NIOSH Definition: Bending is defined as flexion of the trunk, usually in a forward or lateral direction. Twisting refers to trunk rotation or torsion. Awkward postures include non-neutral trunk postures (related to bending and twisting) in extreme positions or at extreme angles. Strickland, in his ergonomic evaluation at Hamann Angus Ranch, noted considerable trunk bending and twisting, extension and rotation of the neck, reaching forward with the dominant shoulder, elbow flexion/extension and wrist flexion/extension relating to turning the crank handle.

The following chart shows the pre-project results of the Employee Discomfort Survey conducted by the Hamann Angus Ranch study:

Discomfort Area	Number of employees with discomfort	Percentage of total	Average Rating (0-10 scale)
Neck	6	67%	4.8
Shoulder	9	100%	7.0
Chest	3	33%	5.3
Elbow/forearm	8	89%	6.0
Hand/wrist	9	100%	5.1
Upper back	7	78%	5.1
Lower back	9	100%	6.6
Hip/thigh	7	78%	3.4
Knee	5	56%	3.6
Lower leg	4	44%	3.3
Ankle/foot	4	44%	2.3

The following chart shows the post-project results of the Employee Discomfort Survey conducted by the Hamann Angus Ranch study, indicating significant improvement in all areas:

Discomfort Area	Number of employees with discomfort	Percentage of total	Average Rating (0-10 scale)
Neck	2 *	29%	3.5
Shoulder	2 *	29%	3.5
Chest	0	0%	NA
Elbow/forearm	3*	43%	5.7
Hand/wrist	3*	43%	6.0
Upper back	1*	14%	2.0
Lower back	0	0%	NA
Hip/thigh	0	0%	NA
Knee	0	0%	NA
Lower leg	0	0%	NA
Ankle/foot	0	0%	NA

*** Utilizing pneumatic landing gear automation these discomforts are totally eliminated**

LANDING GEAR LIFTING OPTIONS

Since the act of manually cranking landing gear has a direct impact on the on the amount of bending and twisting at awkward posture, as well as repetitive excessive force, consideration should be made for optional methods of raising and lowering the landing gear.

A powered landing gear lift system completely eliminates bending, twisting, rotation and extension of back, neck, elbows, shoulders and wrists, as well as continuous and repetitive excessive forceful movements that can cause ergonomic conditions and injuries. Automation of landing gear improves the working environment associated with loading and unloading trailers.

Pneumatic landing gear systems are the recommended solution for landing gear automation because of their simplicity, cost, low maintenance, reliability and low environmental impact.

Simplicity

A pneumatic landing gear lift system operates by channeling the available truck/tractor air system to automate the raising and lowering of the landing gear. This is accomplished with the use of a pneumatic reversible motor directly applied to the landing gear to raise and lower the landing gear. The motor is controlled by a pneumatic valve which requires approximately less than ½ foot-pound of force to operate. The control to the system is located on the trailer at the appropriate height so that the operator only needs to turn on the system and manually operate the valve lever.

Cost

Compared to hydraulic systems the cost of a pneumatic landing gear system is significantly less. When compared to the life cycle of an electric motor the cost is also less. The electric system does not deliver the torque required for lifting a trailer.

Low maintenance

A pneumatic automated lift system requires very little maintenance. Replacement of the lubricant and occasional cleaning to prevent road grime build up are the only maintenance required.

Reliability

Pneumatic systems are very reliable since they operate on the trailer's air system. There are no possible electrical issues due to broken wires or corroded wires or motor burnout. There are also no issues due to hydraulic fluid leaks or fluid thickening in cold weather. The pneumatic motors have had extensive testing of over 30,000 cycles without significant wear.

Low environmental impact

Since they operate on pure air, there are no possible environmental issues due to hydraulic fluid leaks or disposal. Also, no battery recycling or disposal required

CONCLUSION

With increasing employee and industry pressures to implement ergonomic solutions for labor intensive tasks that are prone to generating lost time injuries, pneumatic automation solutions for truck driver activities have been gaining popularity. The review of the ergonomic study conducted by Strickland supports the use of pneumatic automation, specifically for keeping truck drivers at an ergonomic working height during their activities when raising/lowering truck trailer landing gear.

Automation of the landing gear raising and lowering operation enables drivers of all ages regardless of gender or physical handicaps can easily perform the operation in a safe and efficient manner.