

Ergonomic Guidelines for Carts and Dollies

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1.0 SCOPE

This document describes the assessment methods and physical requirements associated with the manual handling of carts and dollies, specific to material handling systems.

All possible designs and applications could not be anticipated in creating these guidelines. Where there are questions of adherence to this document, such as use of an "off-the shelf" design, always consult the responsible Ergonomics Department.

Force guidelines were primarily developed referencing the push/pull psychophysical Snook data contained in *A Guide to Manual Materials Handling* (second edition) by Mital, Nicholson and Ayoub (NY: Taylor & Francis, 1997). The force guidelines accommodate 75% of female capabilities and 99% of male capabilities.

Factors that were included in the established guideline include: push / pull distances, vertical hand height, horizontal hand height, frequency and wheel / castor alignment and load rating. These factors were used to develop a conservative force guideline. The guidelines assume frequent handling of carts / dollies (handling frequency greater than once per minute) throughout a work shift. For carts that exceed the force guidelines and do not align with the assumptions utilized to determine the guidelines within the document, please contact the appropriate Ergonomic Subject Matter Expert for a deep dive ergonomic analysis. The deep dive analysis will account for the differences in the assumptions (i.e. frequency, push/pull distance, hand height, etc.).

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2.0 GENERAL

The approach taken in this guideline focused on the manual push / pull motions associated with the manual manipulation of carts and or dollies. Proper dolly design and selection, job assessment and planning will avoid negative dolly handling, operator health and safety effects, and ergonomic stressors. Ergonomics stressors and injury risks may include risks of acute strain/sprain injury or acute injury due to excessive forces, trip hazards, sharp edges, etc. Cumulative trauma injuries and excessive fatigue may result from sustained high workloads. The guidelines provided are intended to provide protection to the workers involved in cart and or dolly movement.

The following general areas will be addressed in this guideline:

- Required Measurement Tools
 - Force Gauge and Attachments
- Cart / Dolly Measurement Technique
 - Initial push / pull force
 - Sustained push / pull force
- Strength Requirements / Analysis Results
 - 75% female population, 99% male population
- Potential Solutions to Reduce Forces
- Cart / Dolly Design Recommendations

3.0 Terminology and Concepts

- ⇒ Initial Push Force – defined as the force required to start the cart into motion (i.e. force required to accelerate the cart). Assumes force is applied by two hands and is a whole body force exertion (i.e. while standing and walking) and the force is applied in front of the Operator
- ⇒ Sustained Push Force – is defined as the force to maintain the movement of the cart. Once the cart is in motion, the sustained push force is relatively constant and is required to keep the cart moving. Assumes force is applied by two hands and is a whole body force exertion (i.e. while standing and walking) and the force is applied in front of the Operator
- ⇒ Initial Pull Force – is defined as the human physical effort where the force is in front of the body and directed towards the body as the body stands or moves backwards. Assumes force is applied by two hands and is a whole body force exertion (i.e. while standing and walking) and the force is applied in front of the Operator.
- ⇒ Sustained Pull Force is defined as the force to maintain the movement of the cart. Once the cart is in motion, the sustained pull force is relatively constant and is required to keep the cart moving. Assumes force is applied by two hands and is a whole body force exertion (i.e. while standing and walking) and the force is applied in front of the Operator
- ⇒ A *cart* or *dolly* is a four (or more) wheeled vehicle or cart that can be propelled by human effort. Powered vehicles may tug dollies as part of the delivery cycle although line side dolly positioning may be manual or mechanically assisted.

4.0 Required Tools

- Force gauge (ensure that force gauge calibration is up to date)
- Force gauge attachments (push / pull)
- Cart / Dolly (maximum load capacity, weight evenly distributed)
- Tape Measure
- Stop Watch
- Cart Design Ergo Checklist
- 2 people (one person to push cart, other person to time, 'push', align cart during test, record results)

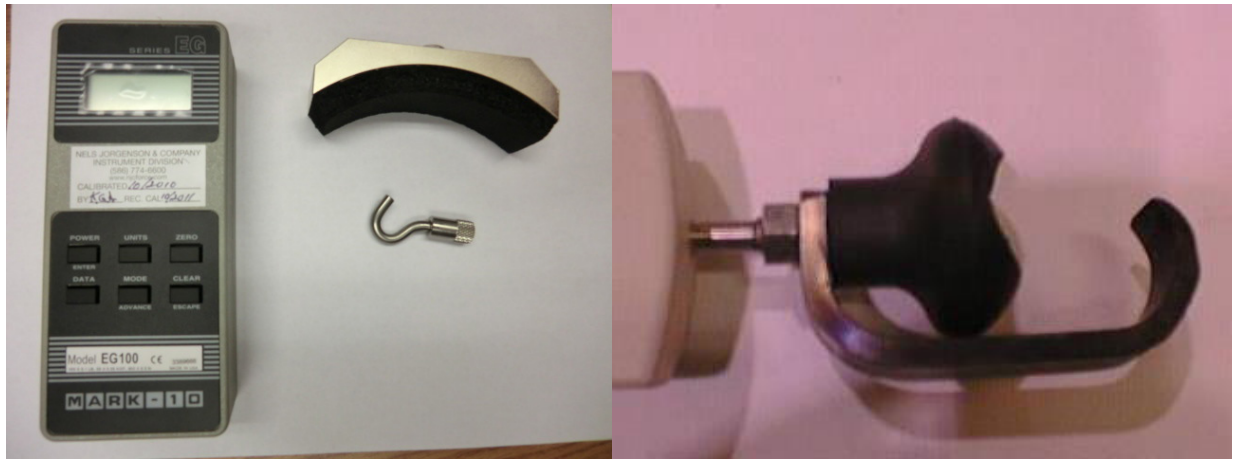


Figure 1. Force Gauge and Push / Pull Attachments

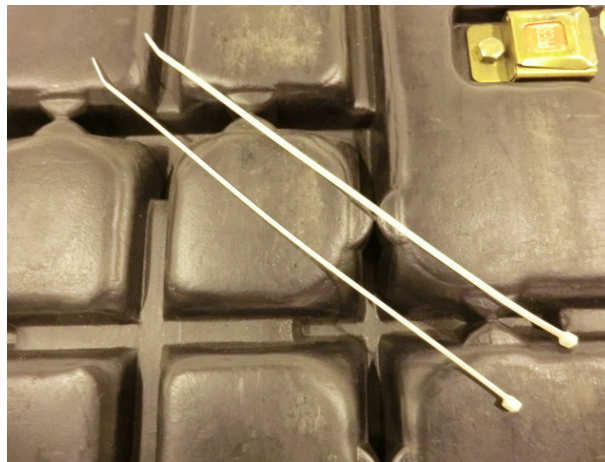


Figure 2. Tie Straps – used during ‘pull’ test. The strap is wrapped around the cart / dolly handle. The hook is used as the attachment for the test

5.0 Cart / Dolly Measurement Technique

- This approach applies only to carts or dollies that are pulled or pushed by human operators.
- The testing is to be performed on the same floor surface(s) as cart will be used on, as flooring surface heavily influences push / pull force values. It is important that one does not assume all surfaces in the plant will have the same push / pull values.
- Both the push and pull forces need to be measured and recorded. The reason behind this requirement is to assist in validating that the measurement results are accurate as well as to identify possible issues with the cart. The results of the push and pull should be very similar (within 2-4 lbs.).
- Note: In determining the maximum acceptable cart push / pull force, the higher of the two values (push vs. pull) needs to be used.