
Pushing & Pulling Force Measurement for Carts

1.0 Objective & Intent

The objective of this SOP is to establish a standardized, repeatable method for measuring the manual pushing and pulling forces required to move carts, dollies, and other wheeled material handling equipment within the cabinet and millwork facility. Excessive push/pull forces are a leading cause of shoulder, back, and arm musculoskeletal injuries (MSIs) among production and warehouse personnel. This procedure ensures that all carts meet the WorkSafeBC ergonomic guideline of a maximum initial force of 25 kgf (55 lbs) and a sustained force of 10 kgf (22 lbs) for male workers, with lower thresholds for female workers and mixed-gender workforces. By identifying carts that exceed safe force limits, the company can proactively implement corrective actions such as wheel replacement, lubrication, or load reduction, thereby reducing injury risk and ensuring regulatory compliance.

2.0 Operational Scope

This procedure applies to all maintenance personnel, safety committee members, supervisors, and designated ergonomic assessors responsible for evaluating manual material handling equipment. It covers all wheeled carts, including flatbed carts, shelf carts, bin carts, and custom millwork transport dollies used in the production floor, warehouse, and shipping/receiving areas. This SOP does not apply to powered industrial trucks (forklifts, pallet jacks) or automated guided vehicles (AGVs). Measurements must be conducted on representative floor surfaces (concrete, asphalt, or sealed wood) under typical load conditions (empty, half-load, and full-load).

3.0 Hazard Identification & Mandatory PPE

- Musculoskeletal Injury (MSI): Overexertion from pushing or pulling carts that exceed safe force limits, leading to strains, sprains, or chronic pain in the shoulders, lower back, arms, and wrists.
- Slip/Trip/Fall: Uneven floor surfaces, debris, or wet conditions that may cause loss of footing during force measurement.
- Pinch Points: Fingers or hands caught between the cart handle and stationary objects or between cart wheels and floor obstructions.
- Struck-By: Carts rolling unexpectedly if brakes are not applied or if the cart is on an incline.
- CSA-Approved Steel Toed Boots (with slip-resistant soles)
- Class 2 High-Visibility Safety Vest (when working in active traffic areas)
- Cut-Resistant Gloves (ANSI A4 or higher) for handling carts with sharp edges or debris
- Safety Glasses (Z87.1 rated) to protect against dust or debris kicked up by wheels

4.0 Required Safety Equipment & Tools

- Digital Force Gauge (e.g., Mark-10 Series 5 or equivalent) with a minimum capacity of 50 kgf (110 lbf) and a resolution of 0.1 kgf, calibrated within the last 12 months
- Push/Pull Attachment (handle adapter or hook) compatible with the force gauge and cart handle design
- Measuring Tape (for recording cart dimensions and handle height)
- Floor Surface Thermometer (to record floor temperature, as some wheels have temperature-dependent rolling resistance)
- Camera or Smartphone (for documenting cart condition, wheel type, and floor surface)
- Clipboard, Paper Data Sheet, or Mobile Device with SafeDesk App for recording measurements

- Traffic Cones or Warning Tape (to cordon off the measurement area from forklift and pedestrian traffic)
- First Aid Kit (accessible nearby)

5.0 Step-by-Step Safety Procedure

1. Notify all affected personnel in the measurement area via the shift supervisor or by posting a warning sign. Cordon off the test zone with traffic cones and warning tape to prevent interference from forklifts, pedestrians, or other moving equipment.
2. Inspect the cart thoroughly before measurement. Check for damaged wheels, debris caught in axles, loose handlebars, or any sharp edges. If the cart is unsafe to handle, tag it out of service and do not proceed with force measurement until repairs are completed.
3. Select a representative test path that is at least 10 meters (33 feet) long, level, and free of obstructions. The floor surface must be dry and clean. Record the floor type (e.g., smooth concrete, broom-finished concrete, asphalt) and temperature.
4. Load the cart to the desired test condition (empty, half-load, or full-load). Ensure the load is evenly distributed and stable. Record the total weight of the cart and load using a floor scale if available, or estimate based on known material weights.
5. Attach the digital force gauge to the cart handle using the appropriate push/pull attachment. For push tests, position the gauge so that the force is applied horizontally at the handle height (typically between 36 and 42 inches from the floor). For pull tests, attach the gauge to the handle or a designated pull point.
6. Zero the force gauge on a flat, stationary surface before each test. Ensure the gauge is set to record peak force (initial force) and average force (sustained force) over the test duration.
7. Perform the push test: Stand with feet shoulder-width apart, keep your back straight, and use your legs to initiate the push. Apply force smoothly and steadily until the cart reaches a constant speed (approximately 1 m/s or walking pace). Maintain that speed for at least 5 meters. Record the peak force (initial breakaway force) and the average force over the steady-state portion. Repeat the test three times and record the average of the three trials.
8. Perform the pull test: Face the cart, grasp the handle or pull attachment, and walk backward while pulling the cart. Use the same smooth acceleration and steady-state speed as the push test. Record peak and average forces for three trials. If pulling backward creates a tripping hazard, consider using a forward-facing pull with a longer tether, but note the deviation in the report.
9. Compare the measured forces against the WorkSafeBC ergonomic guidelines: initial force should not exceed 25 kgf (55 lbs) for male workers and 15 kgf (33 lbs) for female workers; sustained force should not exceed 10 kgf (22 lbs) for male workers and 7 kgf (15 lbs) for female workers. If the cart is used by a mixed-gender workforce, apply the more restrictive female thresholds. Document any exceedances on the data sheet.
10. If the cart exceeds safe force limits, immediately tag it with a red 'Do Not Use' tag and submit a corrective action request to maintenance. Recommended corrective actions include: replacing worn or incorrect wheels (e.g., switching from hard plastic to polyurethane), lubricating wheel bearings, reducing load weight, or installing a powered assist device. Re-measure the cart after corrective actions are completed.

Regulatory Disclaimer: This document is a generic safety template provided for educational and informational purposes only. It does not constitute professional engineering, legal, or regulatory compliance advice. The end-user assumes all liability for validating all safety protocols against specific machinery manufacturer manuals and local occupational health and safety regulations (e.g., WorkSafeBC, CSA standards) before deployment.