



## Recommended Forklift Free System Features for Proper Safety and Ergonomic Operation

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*When re-designing material handling flow to address restricted use of forklifts (Forklift Free), equipment ergonomics and safety play a key role. Following is a list of equipment and corresponding features to evaluate during your selection process of material handling equipment for use in Forklift Free Systems.*

### **CARTS**

FEATURES	BENEFITS
<b>FRAME DESIGN</b>	
All welded steel lower perimeter frame with upper deck inside perimeter.	Designed to absorb greater forces without failure or repair when impacted, prohibit or reduce load damage from impacts and allow frame to frame loading in tractor trailers for transport.
Low floor to deck height.	Provide proper ergo-height at <u>top layer</u> unload (see Liberty Mutual tables <sup>1</sup> )
All external corners or edges where operator's hand or legs may come in contact should be beveled, rounded or provided with rounded contact bumpers. Possible pinch points between towbar and handle, etc. should be eliminated.	Eliminate or reduce the chance of an operator injury.

### **ROTATIONAL UPPER DECK DESIGN**

Rotational auto-deck lock w/ <u>mechanical</u> all steel linkage; floor lock activated.	Eliminates top rotation and load loss during towing with minimal operator attention. No cables that may loosen or pedals required to activate.
Soft detent w/locations every 90 degrees of rotation.	Controls "drifting" of loads during operator use w/o wasted motion (no foot pedal release).
If used for manual movement, cart <u>labeled</u> capacity may or may not reflect maximum <u>deck load</u> that can be handled ergonomically within acceptable push/pull limits (see Liberty Mutual tables <sup>1</sup> ).  Push / pull forces at actual user loads should be verifiable by actual ergo-test data.  Frame integrity (under static and dynamic conditions) verifiable by FEA <sup>2</sup> results or other acceptable means.	Reduce or eliminate the chance for operator injury when manually pushing or pulling a loaded cart.  Positive confirmation that carts meet or exceed safe operation requirements (rather than assumptions that designs meet requirements).
Movable or stationary load stop corners and edges should be rounded or smoothed.	Eliminate or reduce the chance of an operator injury.

<sup>1</sup> *Manual Material Handling Guidelines*, Liberty Mutual Group,  
[www.libertymmhtables.libertymutual.com/CM\\_LMTablesWeb/pdf/LibertyMutualTables.pdf](http://www.libertymmhtables.libertymutual.com/CM_LMTablesWeb/pdf/LibertyMutualTables.pdf)

<sup>2</sup> FEA, computer based finite element analysis.



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### **CART HANDLES**

<p>Four bend minimum 1 ¼” diameter steel, one piece ergo-handle.</p>	<p>Diameter correct for hand comfort and strength, set at proper ergo-height (~ 36”-42”) and designed to angle away from cart to allow foot clearance with cart frame when pushing / pulling.</p>
<p>Handles should be rigidly and securely mounted to frame in two places with at least a minimum width of 25”. “T” handle design not recommended.</p>	<p>Prevents possible injury due to excessively unbalanced forces on operator during movement.</p>

### **WHEEL SYSTEMS (caster steering)**

<p><u>4-wheel</u> chassis design w/two swivel 8” kingpinless casters, two rigid 8” casters all wheels w/sealed precision bearings. Preferred wheel systems incorporate selected swivel lead angles, mixed durometers (hardness ratings) on front and back wheels and biased wheel mounting (with respect to load).</p>	<p>Produces the lowest initial push / pull forces and reduced “skidding” of empty carts on turns which could cause severe contact injury and damage to inventory, equipment, etc.</p>
<p>Optional <u>6-wheel</u> chassis design featuring two swivel 8” kingpinless casters, two rigid 8” center casters and two stabilizer casters.</p>	<p>6-wheel system significantly improves manual maneuvering on frames larger than 40” x 40” and corner turning in long trains (better for tight aisles). Uses MPP™ (modified pivot point) steering system.</p>
<p>Phenolic or steel wheel sets are not recommended for towing. For non-towing applications, OK. High hardness rating of phenolic wheels produces good push / pull values on clean, smooth floors.</p>	<p>Phenolic wheels are very hard and sensitive to impacts (cracking and chipping). They are slippery on smooth concrete floor surfaces and can cause skidding in turns when towing. Steel wheels while rugged, can skid, will damage concrete floors and are noisy when towed.</p>

### **FLOOR LOCK, TOWBARS and HITCHES**

<p>Heavy duty telescoping tubular structural steel floor lock w/large foot activating pedals, replaceable anti-skid elastomer floor pad, industrial quality return springs, foot and <u>tow bar activated</u> unlocking mechanism are preferred.</p>	<p>HD design resists wear and tear damage, provides ample pedal surface for large shoes. HD spring mechanism and anti-skid pad holds cart securely in position. Tow bar activated auto release prevents “dragging” damage to lock and floor if operator forgets to release when towing.</p>
<p>Floor lock should have a minimum of 2” ground clearance when retracted.</p>	<p>Reduces the possibility of severe cart impact with floor protrusions and other uneven surfaces when tugging which could cause damage to carts and possible load loss.</p>
<p>Compact 5,000lb rated auto-hitch. Hitch features oversized release pedals and structural grade steel tongue (to match towbar eyelet). Rating verifiable by FEA<sup>2</sup> results or other acceptable means.</p>	<p>Compact size allows rotational frame heights to be lower resulting in lower top layer heights. Large pedal design eliminates the need for the operator to bend down to latch or unlatch hitch.</p>



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Self-stowing HD trapezoidal shaped steel tow bar featuring reinforced construction and structural grade steel eyelet. Tow bar pivots at base and is spring loaded for self-level when positioned for hookup. Tow bar also features auto floor lock release, all mechanical.	Self-stowing feature eliminates the need for the operator to bend down. <u>Reinforced design “bends” without breaking when excessively overloaded so carts remain connected.</u> Matching of the eyelet and hitch tongue prevents excessive wear.
<b>LIFT POCKETS</b>	
Under frame lift pocket built into cart chassis w/ lead-ins at frame back. Lift pocket size should allow the use of a lift with protective 4-sided bellows skirting and not allow the skirt to rub on the cart frame or be touched by the operator’s shoes when working from the cart.	Allows cart w/load to be centered (using limit switch in lift) safely over lift top to avoid tipping issues with unbalanced loads and use of maximum lift rating. Lift pocket also prevents lift top from damaging cart wheels / rigs from impact when pushing cart over lifts and cart wheels from damaging the skirt.
<b>FINISH</b>	
Safety yellow powder coat or other electrostatic finish.	Durable low chipping surface provides protection from rust and contamination of parts.

### PNEUMATIC / HYDRAULIC LIFTS

#### **PERFORMANCE RATINGS**

Both hydraulic and pneumatic lift capacity rating should be capable of lifting (to maximum vertical travel) the maximum load rating of the cart plus the cart tare weight.	Proper attention to rating will allow the cart and load to reach proper heights for ergonomic operator use.
Maximum vertical travel plus closed lift height (equals total platform height) for most cart lift applications should total at least 21”.	Provides minimum operator ergo-lift height when working from pallets or other containers loaded on a cart deck of ~ 31”.
Closed height of lift should allow the cart frame to be as low as possible. With 8” wheel systems, closed lift height should be 7” or lower.	Allows top layers on full containers to fit into acceptable ergo-lift range for the operator.

#### **TOP PLATFORM**

Top platforms shall fit the lift pocket opening with acceptable side and top clearance to eliminate jamming and be designed with straight sides (non-rolled edges).	Requires little or no additional force to load cart over lift. Square edges on top platform provide maximum safety from tipping when deck loads are unbalanced.
Cart should be equipped with a limit switch mounted in the perimeter of the top platform frame that impacts the front of the lift pocket frame.	Use of contact limit switch allows lift to raise only when cart is fully in the lift pocket to assure safe lifts.



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<b>LIFT BASE</b>	
Lift base should be secured (lagged) to the floor with legs mounted externally to the <u>short side</u> of the base frame or internal to the base.	Eliminates the possibility of wheel contact when loading carts and damage to wheels.
<b>CONTROLS</b>	
Hydraulic controls: either covered foot or pedestal mounted push button controls, 100% contact. Velocity fuses should be used in line with each cylinder, adjustable flow valve to control speed of table drop.	Operator must hold down foot pedal or button during entire cycle to prevent accidental activation with no operator present. Flow valve and 100% contact control prohibits fast drop and trapping of feet or other appendages under the cart. Velocity fuses on each cylinder control table drop in case of line rupture.
Pneumatic controls: pedestal mounted up/down valve control with air filtration. Circuit should incorporate excess pressure dump valve and master lockout valve. Additional mechanical travel stops bars should be provided for maintenance.	Operator must hold down hand valve during entire cycle to prevent accidental activation with no operator present. Master lockout valve shuts down air to valve when not in use and mechanical stops limit closure of unit to protect maintenance personal from table drop due to bag rupture.

## TUGS

### **TOWING CAPACITY**

<p><b>Rated towing capacity should be sized to be equal to or greater than the total load to be towed<sup>3</sup>.</b></p> <p><b>Normal drawbar pull (DBP<sub>n</sub>) should be equal to or greater than the initial rolling force required to move the entire train.</b></p> <p>Rule of thumb A: Class III tug normal DBP is ~ 2% of rated capacity, e.g.: 10,000lb. rated tug will have about 200lb. normal DBP.</p> <p>Rule of thumb B: On slopes ranging from 1% to 5% grade, the required normal DBP to handle the grade can be 2-3 times greater than flat grade requirements.</p> <p><b>PLEASE CONSULT TUGGER MANUFACTURER FOR MORE DETAILED PERFORMANCE AND SAFETY INFORMATION.</b></p>	<p>Safe moving of loads without leading to loss of control and possible severe damage to tug operator, equipment and workers.</p> <p>Tugs sized for proper flat ground performance <u>will not have the capacity to pull the same load up slopes.</u></p>
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<sup>3</sup> Total Towed Load - sum of the cart deck load, cart tare weight and maximum number of carts in a train.



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FEATURES	BENEFITS
<p><b>STOPPING CAPACITY</b></p> <p>Stopping capacity of a Class III tugger is designed to be appropriate for the load rating of the tug within <u>normal</u> operating parameters (charge, tow speed, tread condition, etc.)</p> <p>Stopping of the tug on a grade will require that the capabilities are de-rated per the <i>Towing Capacity</i> discussion above.</p> <p><b>PLEASE CONSULT TUGGER MANUFACTURER FOR MORE DETAILED PERFORMANCE AND SAFETY INFORMATION.</b></p>	<p>Safe stopping of loads without leading to loss of control and possible severe damage to tug operator, equipment and workers.</p>