Design of Material

Handling Facilities

- **Handling facility:** The primer objective is to handling of products as per process requirement.

Handling facility

Storage facility

- **Storage facility:** Facility that used for storing of materials (inventory). Storage facility can be manual, semi-automated and automated.

- **Transfer facility:** Facility that used for movement of materials. To reduce manual efforts.

Transfer facility

Considerations for the design of material handling facilities are,

1. Type of product – Metal parts, Plastic parts, Fragile parts and painted parts.

2. Volume of product – Physical dimensions of the product
3. Shape of the product - Regular or irregular shapes
4. Sequence of process – Fabrication , Painting Assembly etc
5. Movement distance – Shorter / longer

Manual movement – Intra-plant factory

Mechanized movement – Inter-plant

Considerations for the design of material handling facilities are,

5. Power available – Manual, Battery operated, Fuel etc

6. Method of manufacturing – Types production process like job production, batch production and flow production.

7. Production rate - Product demand can able to decide the no. of handling facilities required to achieve the production rate smoothly. (Demand/day or shift).

8. Space available

9. Type of container

Product / Material Classification,

The ABC classification provides a mechanism for identifying items that will have a significant impact on overall inventory cost.

- 'A' Class – Bigger value, more sensitive, bigger size, more weight and less no. of parts/unit.

  E.g.: Chassis, stylish panels, etc..

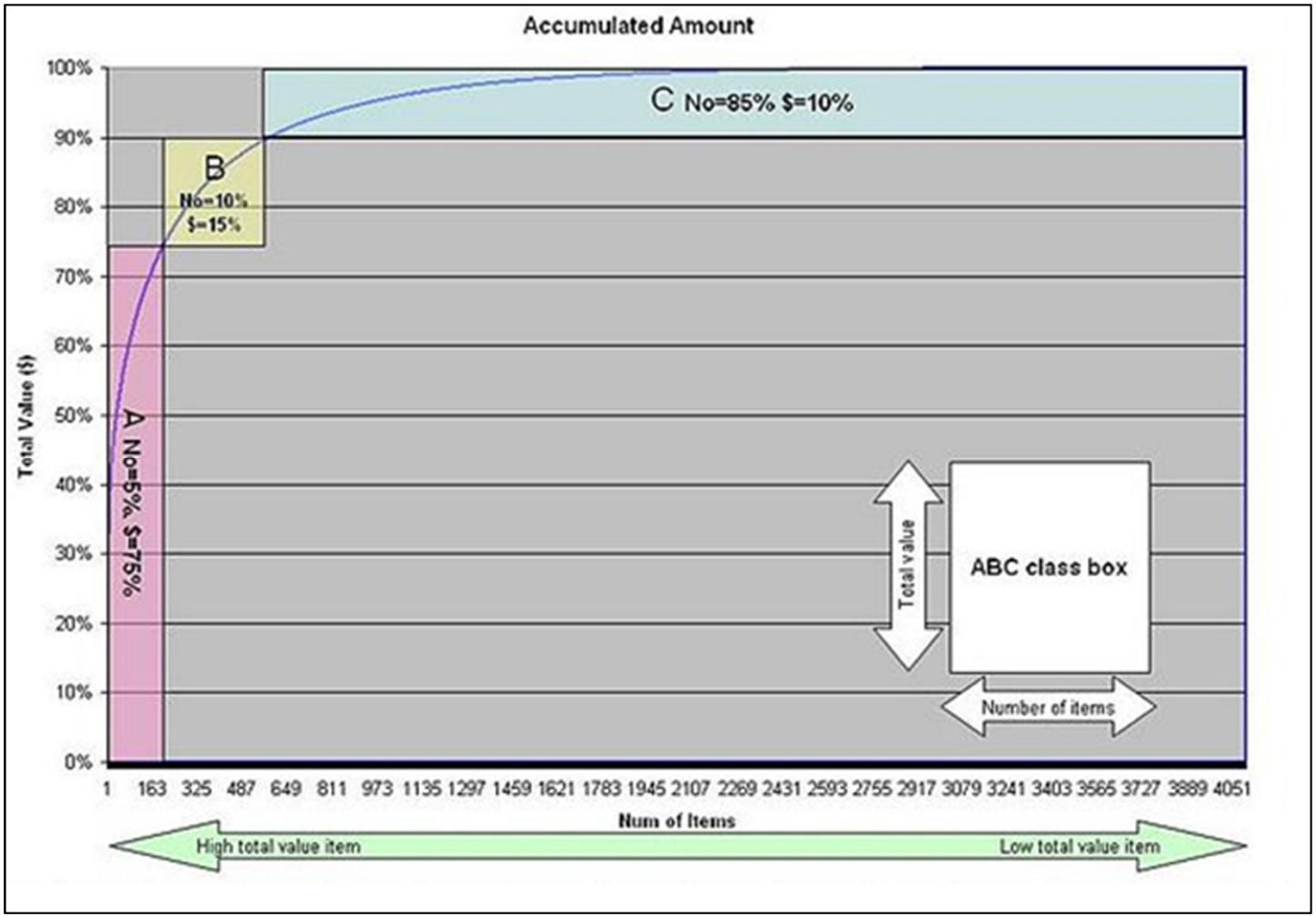
- 'B' Class – Smaller value, medium size.

  E.g.: Horn, Electrical parts, etc..

- 'C' – Less value, smaller size and more no. of parts/unit.

  E.g.: Fasteners.

ABC classification,



Design consideration for 'A' Class parts,

- 'A' class items are very important for an product. Because of the high value of these 'A' class items, frequent value analysis is required. In addition to that, an organization needs to choose an appropriate order pattern to avoid excess capacity.
- 'A' class items – 20% of the items accounts for 70% of the annual consumption value of the items.
- Trolley are mostly preferred for 'A' class parts

Design considerations are,

- Parts should not touch each other
- Facility should have self-locking mechanism to hold the part for avoid rattling
- Easy of loading and unloading of parts
- Unitization in capacity

Design consideration for 'B' Class parts,

- 'B' class items are important, but of course less important, than 'A' class items.
- 'B' class items - 30% of the items accounts for 25% of the annual consumption value of the items.
- **Crates are mostly preferred for 'B' class parts**

Design considerations are,

- Parts should not touch each other
- Facility should have self-locking mechanism to hold the part for avoid rattling
- Facility gross weight should not exceeds, the manual handling limit
- Easy of loading and unloading of parts
- Unitization
- Multi level storage

Design consideration for 'C' Class parts,

- 'C' class items are marginally important.
- 'C' class items - 50% of the items accounts for 5% of the annual consumption value of the items.
- **Bins/Totes are mostly preferred for 'C' class parts**

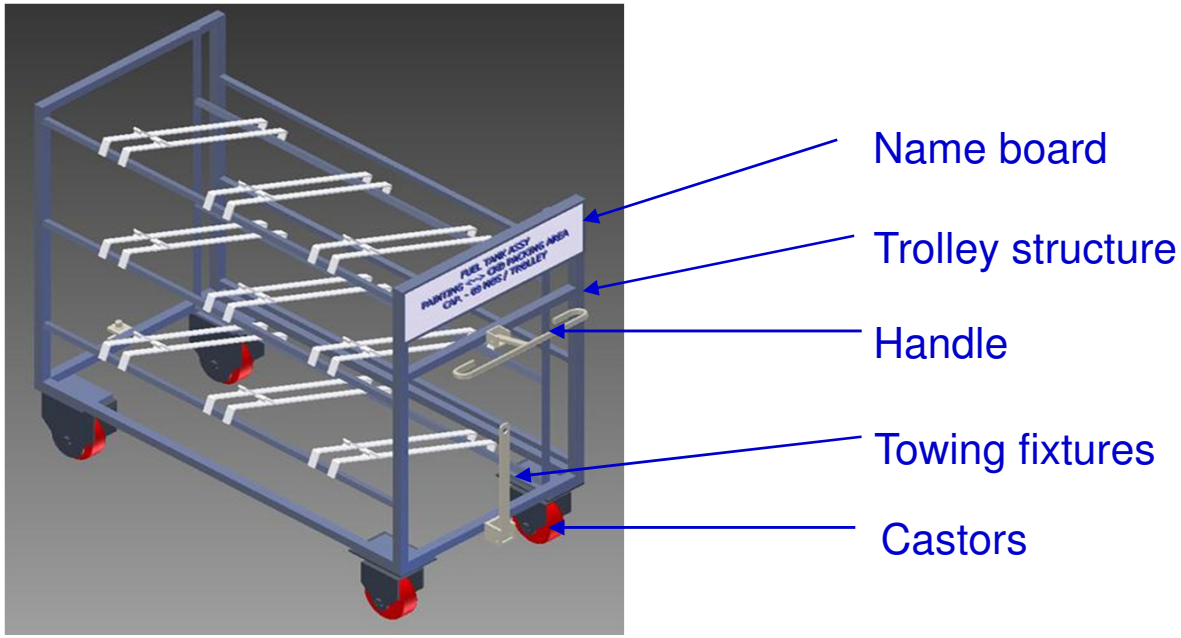
Design considerations are,

- Facility gross weight should not exceeds, the manual handling weight limit
- Easy of loading and unloading of parts
- Since less value and size, can store more inventory.

Design of Material Handling Facility for “A” Class Parts - Trolley

Elements of Trolley:

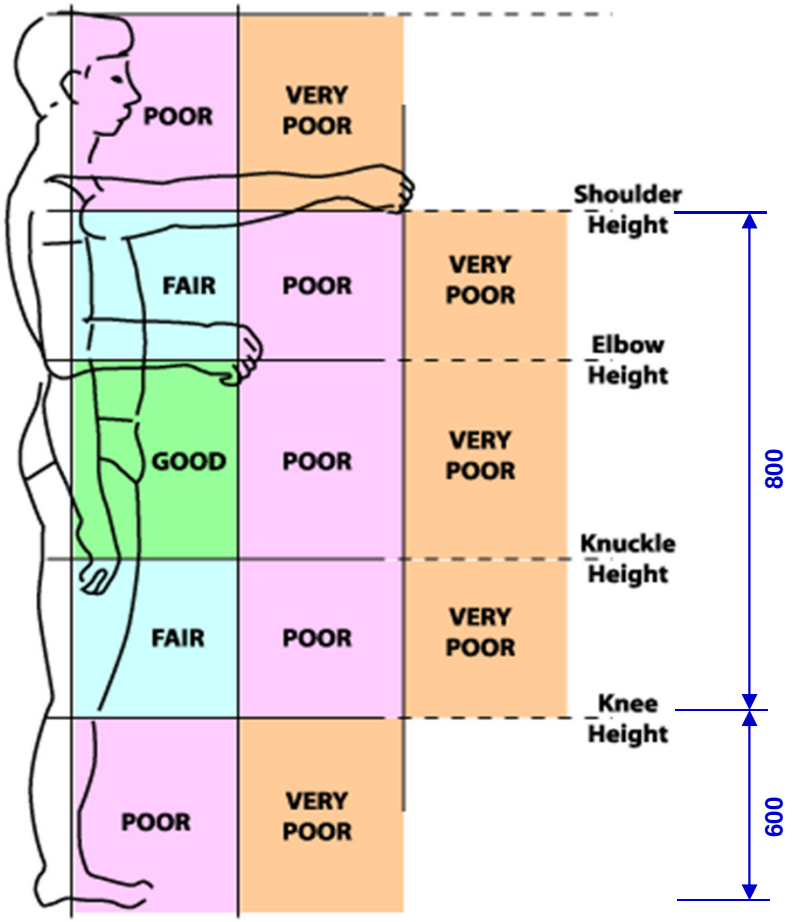
1. Trolley Structure
2. Castor design / selection
3. Handle
4. Towing fixtures
5. Name board

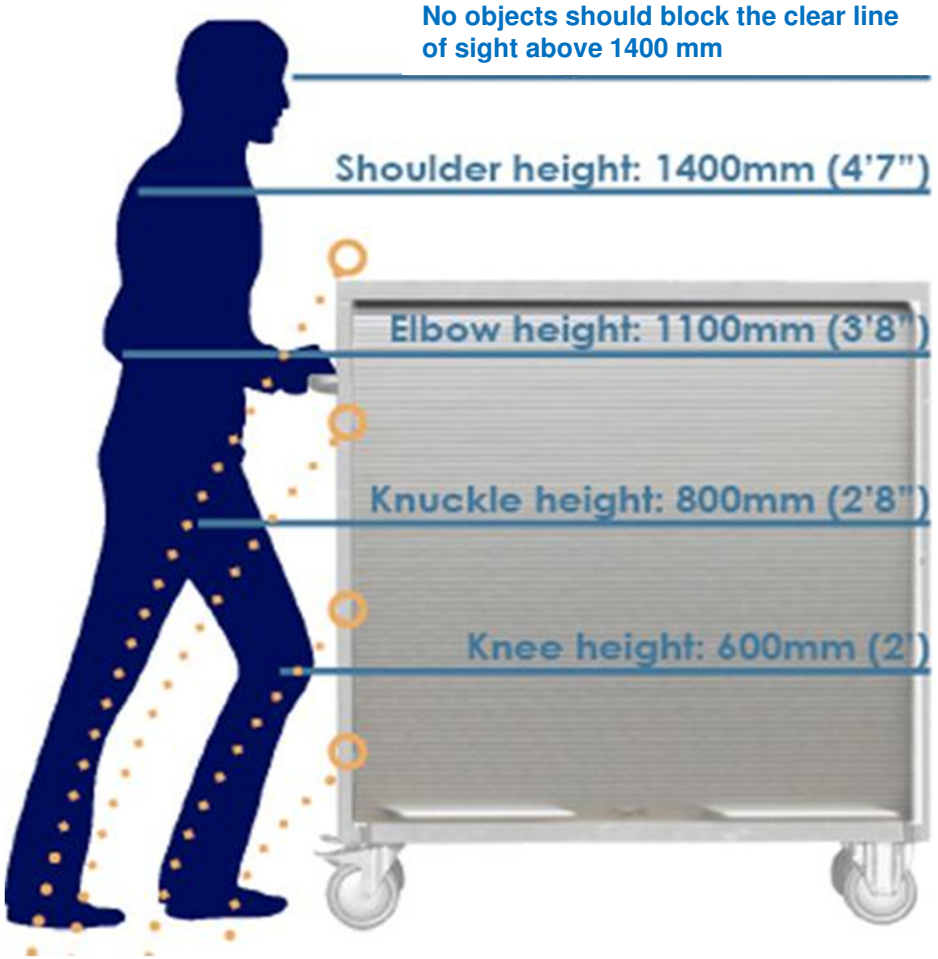


Dimensions of the trolley:

	Recommendations	Reason	Effects
Length	Trolley length should be between 1.5 and 2 times its width.	If too long, the trolley is difficult to steer, or fit into lifts or other small spaces.	If longer than 2.5 times width, a second person should help steer the trolley.
		If too short, operators tend to steer the trolley by twisting their spine.	If shorter, only lightly load the trolley.
Width	The trolley width (including buffer, etc.) should be at least, • 80mm less than the narrowest doorway for hand pushing/pulling trolley	Width affects trolley stability, loading volume, shelf depth, manoeuvrability, and access through doorways.	If slightly too wide, will need to add additional buffering to trolley to protect door jambs, and maybe redesign trolley handles so hands are protected from scrapes. If too wide and access is restricted, there will be more lifting and carrying of loads.
	• 500mm less than the narrowest doorway for towing single trolley, and • 700mm less than the narrowest doorway for multiple trolleys	Trolleys must conveniently fit through doorways to provide safety to hands of operators, and to reduce damage to door jambs.	If wheel base must be narrow, then height of trolley must be lowered.
		Trolleys must not be so wide users have difficulty placing loads on the shelves.	Tube mounting wheels mount further apart than plate mounting wheels, and thus increases stability.

Human factor for Deciding the Trolley Height :





Dimensions of the trolley:

	Recommendations	Reason	Effects
Height	Maximum trolley height 1400mm.	Trolley heights affect trolley stability, available loading volume (and thus load), the height to which objects are lifted to fully load the trolley and visibility.	Allow some visibility through the frame, mesh or bars at eye level of user.
Shelf height	A shelf height of: 1100 to 1400mm (elbow to shoulder) for infrequently use and light items (less than 10kg).	1100 to 1400mm - with lifting above elbow height there is more strain on muscles and joints.	If heavier loads are to be put low it may be necessary to allow knees to face inwards while lifting by recessing knee height shelves.
	800 to 1100mm (knuckle to elbow) for frequent use and heavy items (above 10kg).	800 to 1100mm - this is the strongest working area, and is best for both heaviest and most frequently used units.	
	600 to 800mm (knee to knuckle) for less frequent use.	600 to 800mm - taller people will need to slightly bend to use this shelf.	
	Under 600mm (below knee) for infrequent use and light items (less than 10kg).	Under 600mm too much bending.	

Trolley Structure:

Structure is the body of trolley. Generally it will be built by steel, may be in fabricated or modular type. Chassis will be designed to carry/hold the parts.

	Recommendation	Reason	If not following recommendations
Trolley Materials & Structure	Carefully consider trolley materials and the construction of the trolley.	Frame material and structure affect trolley weight, rigidity, durability resistance to corrosion, visibility through frame, noise, vibration, type and strength of castor mounting, and potential for cuts, scratches and other injuries. Consults the trolley and	If your conditions of use are severe it is best to trial a sample under actual use conditions.
	Special conditions of use, e.g. very hot or cold, or exposure to chemicals or the weather will require special materials or finishes.		

Wheels:

Considering factors are,

a. Diameter of the wheel
   - 125mm (5”) for non-patient trolleys
   - 175mm (7”) for patient trolleys used indoors
   - 200mm (8”) for trolleys used outdoors or for load over 200 kg

b. Tyre material – PU, Nylon, Ceramic, Metal

c. Tyre width and profile

d. Bearing type

e. Use of thread guards

f. Type and number of castor brakes

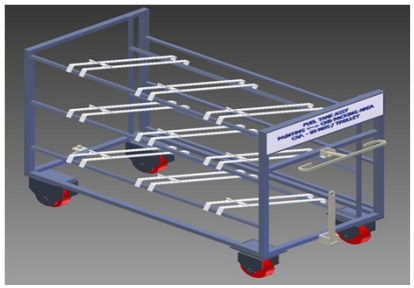
g. Shock Absorber

Normal / Spring Loaded

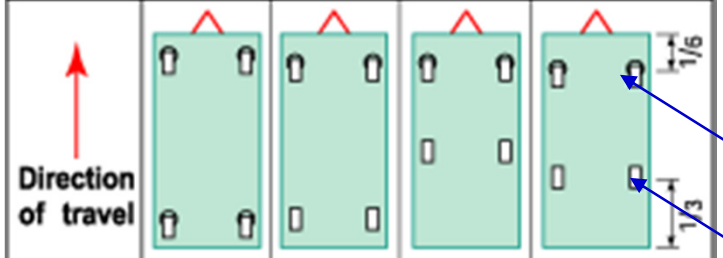
Fixed wheels

Rotating wheel

Rotating wheel with brake



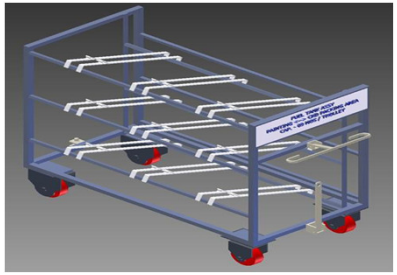
CASTOR ARRANGEMENT FOR TOWING



Trailing	Poor	Poor	Perfect	Good
Whip	Bad	Least	Bad	Little
Stablility	V.Good	V.Good	Bad	Good

Handle:

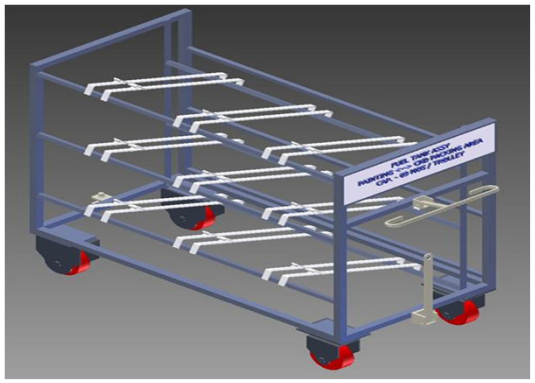
	Recommendations	Reason	Effects
Handles	Fit at least one handle to a trolley	Using the trolley corner posts or side edges risks crushing fingers.	Open top bins with rolled edges may not need handles if top edge is at good height and provides adequate grip.
Handle height	Handle should be between 910 and 1000mm	A middle height of 950mm is a good compromise.	Handles at up to 1090mm may be appropriate if loads are moved by taller males only.
Handle diameter	From 25 to 40mm.	Smaller diameters cramp the grip, larger are uncomfortable.	
Handle clearance	Allow a clearance of 115mm length (to clear palm breadth) by 50mm (to clear knuckles).	To allow hand to grip the handle.	
	Allow a clearance of 200mm out from back edge of trolleys used at low speed, and 400mm out for higher speeds.	Minimum at normal walking speed to ensure ankles do not hit lower shelves when taking good stride length.	
Handle shape	Handles must be cylindrical, smooth and have no sharp edges, seams or 'hot spots'.	Best for safe power grip.	

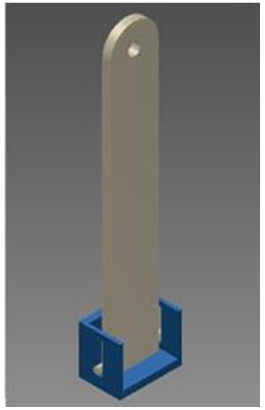


Towing fixtures:

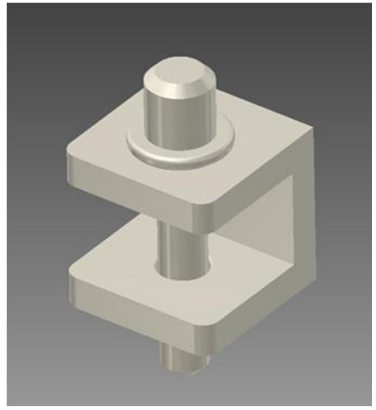
It will be used to move the trolley with prime mover and also connect more additional trolleys.

	Recommendation	Reason	If not following recommendations
Towing fixtures	Towing fixtures (tow bars, tow hitches, and tow brackets and other couplings) must be designed, constructed and fitted appropriately and adequately. Couplings must be robust and secure.	The location of the couplings, and their location to the trolleys and design of the trolley all affect the safe use of trolleys during towing. Consult the manufacturer's recommendations. Towing causes high impact loads and trolleys and castors must be specially strong.	There can be no exception to careful and adequate design of towed trolleys. Trolleys that break loose at towing speeds are an immediate danger to health and safety.
	For towing, heavy duty castors or wheels must be used.		
	200mm minimum diameter.		





Towing FR link

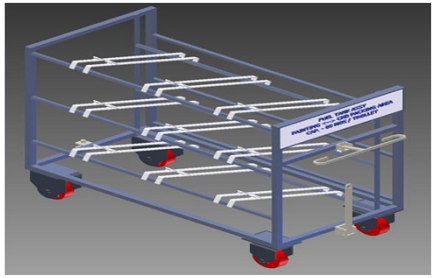


Towing RR link

Buffers:

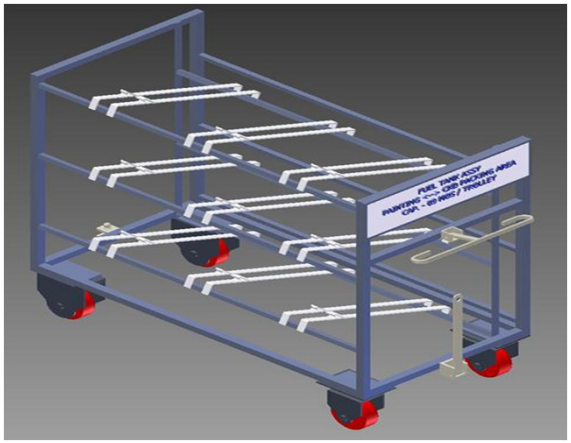
Buffers reduce the amount of damage to trolleys, walls , door jambs and other equipment and thus reduce the amount of splinters, metal slivers and roughness that can damage people.

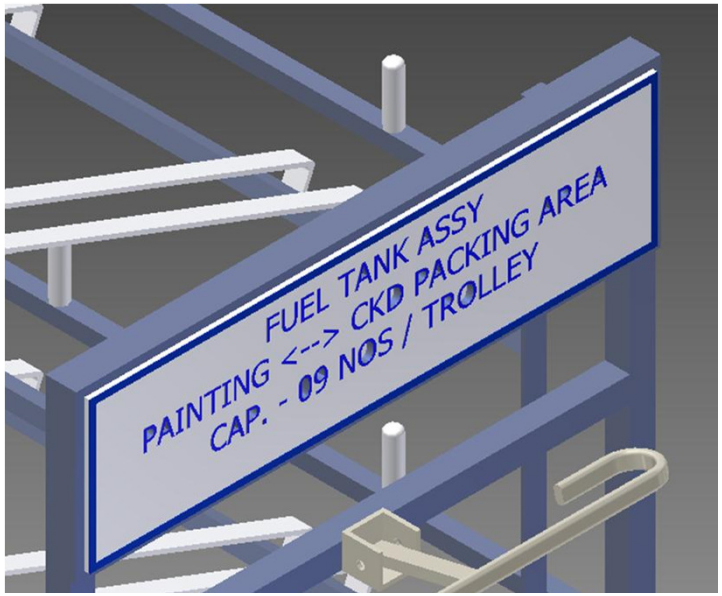
	Recommendation	Reason	If not following recommendations
Buffers	Appropriate buffers should be fitted and must be made from impact absorbing materials such as rubbers or polyurethane.	Think through how the trolley will be used because each different type of buffer is better at reducing different types of damage.	If buffers are not fitted extra maintenance will be required following regular examinations of trolleys and walls for damage.
	- Side or edge buffers protect trolley sides, door jambs and walls from damage.	More than one type of buffer may be needed for maximum effect e.g. a perimeter buffer.	
	- Round leg buffers mounted just above the castor on tubular trolleys, rotate along walls and prevent scraping.		
	- Corner buffers cushion trolleys parked against walls.		



Name board:

It is a kind of product display board. It consists the trolley details like part name, model, POS, POC, capacity of the trolley and serial number of trolley.

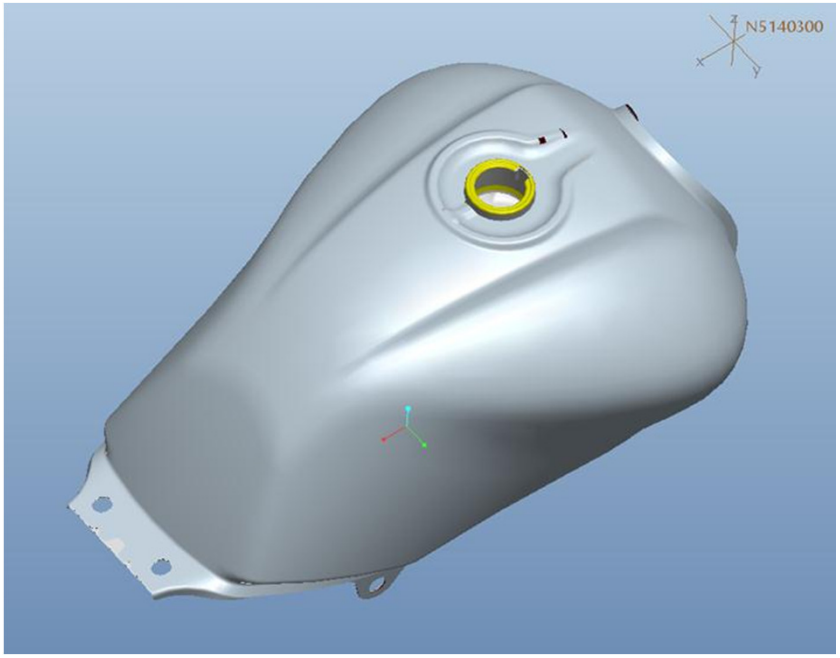




Steps Involved in Trolley design:

1. Requirement study – Part and Application
2. Inputs and assumptions
3. Selection of material
4. Concept design
5. DFMEA
6. Improved design and design analysis
7. Release manufacturing drawing
8. Cost estimation, quotation and sample procurement
9. Physical sample approval
10. Drawing standardization
11. Mass Production

Sample design the trolley for Fuel tank assembly,



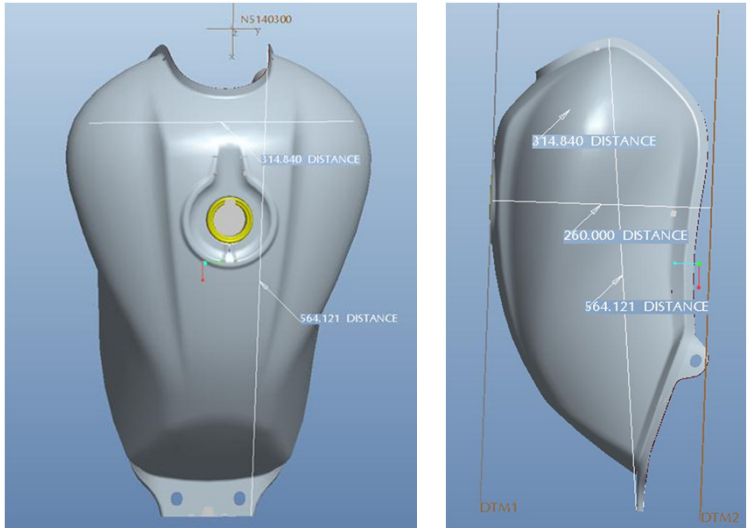
After Welding

After Painting

Fuel tank assembly

1. Study the part

Part name	: Fuel tank assembly
Part number	: N5140300
Part type	: Metal part
Material	: Steel
Part profile	: Odd
Classification	: ‘A’ Class
Part weight	: 4.0 kg
Category	: MIW
Part dimension	: 565 x 315 x 260 mm
Nature	: Painted part (More sensitive)



1. Study the part

Part flow	: Fabrication ➔ Paint shop ➔ Vehicle assembly
POM	: Fabrication (VA – Pressing and welding)
POS	: Overhead conveyor
POM	: Paint shop (VA – Painting and stickering)
POS	: Overhead conveyor
POC	: Vehicle assembly

2. Inputs and assumptions

Fuel Tank Complete Fabrication Process

Transfer

Part storage after fabrication

Part storage after painting

Fuel Tank Assembly at V/A Conveyor