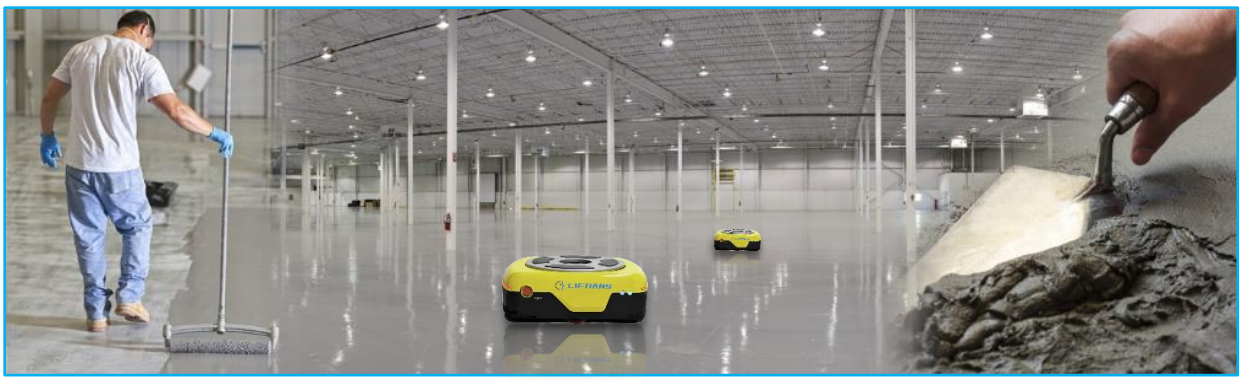
Liftians Warehouse Floor Requirements Guide



Scope

This document details the requirements for the warehouse floor area that will be used for Liftians AGVs. Warehouse floors require specialized coatings that can withstand the heavy traffic from forklifts, wheeled carts, dirt, foot traffic and infrequent cleaning. Surface defects can only get worse over time with heavy use. AVGs like to take the same path every time. This can prematurely wear out concrete floors. It is possible that some warehouses will need to fix some issues with their floor before a Liftians implementation. Issues such as cracks, gaps, bumps/depressions, defects etc. might need to be addressed before implementation if they surpass the threshold allowed by Liftians. Most warehouse floors are built to last and will generally be in good shape for an implementation after thorough cleaning.

Liftians' AGVs are designed to function on a level, clean, and smooth warehouse floor. Gaps between concrete slabs can introduce a bump to a Liftians AGV while it is carrying a rack. This can cause the rack and its contents to bounce and shake. While Liftians AGVs can recover from an event such as this, guiding itself back on track, it will decrease efficiency at which it can move around the grid due to corrections in guidance. This bouncing of the rack also introduces vibrations and possible momentary maximum forces to the AGV, possibly decreasing its operational lifespan. This bouncing is most noticeable on an empty rack. There is no latching between the AGV and rack. With no weight in the rack to hold it down, the rack is free to tilt to an extreme degree if encountering an imperfection. It is possible that the tilting rack can encounter another rack outside of the AGVs current grid and lead to bigger problems. There are many other possible issues that can be introduced with a poor-quality warehouse floor when using Liftians AGVs. That is why we recommend warehouse floors to be used with the Liftians AGVs should be of the highest quality the client can provide before implementing our solution.

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1. Cracks/Chipping

Inspect your warehouse floor for cracks and chipped areas. If found, they should be filled and smoothed out. Traffic from Liftians AGVs will only cause the cracks/chips to propagate further and start to crumble.

2. Gaps/Joints

Inspect the gaps between concrete slabs in your warehouse. Gaps between slabs should be smaller than 1/4in with no change in height. You should be able to slide a quarter on the surface of one slab, cross the gap, and not get stuck on the edge of the next slab due to a height difference (1.75mm). We suggest gaps be filled and smoothed.

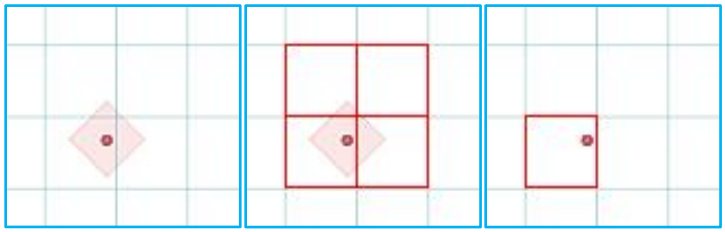
3. Bumps/Holes/Depressions

While uncommon in most warehouses, any changes in elevation must be addressed. Depressions/holes need to be filled and bumps need to be ground down to create a level, even surface.



4. Remove Column Protectors

Column protectors increase the radius of a column which can interfere with the grid designated for AGVs. If the edges of a column protector enter another grid, that specific grid will be unusable and off limits for the AGVs. The image below shows a column with protector around it taking up extra grid space:



The column in the above floorplan image is taking up 3 grids more than if it had no protector (columns should only take the space of one grid). Columns will be defined in the grid as off limits to the AGVs. To maximize your grid space, it is recommended to remove column protectors.

5. Check Area Around Columns

Occasionally, columns might have a specific concrete slab configuration for various reasons. This can interfere with the grid like a column protector if it introduces a variation in the floor continuity. This image below shows the base of a column where it interfaces with the floor. As you can see there is a square depression around the base of the column. This height variation will need to be filled and leveled to maximize Liftians grid space.

6. Remove Bolted Shelves

If there are Bolted Shelves in the planned Liftians area, they will need to be removed. This will leave holes in the floor from the bolts, and they will need to be filled like any other holes. Sometimes there might be a patch of concrete laid specifically for a post on a bolted shelf. This might need to be ground down to be level if it is raised like in the image below

7. Ideal Floor Environment

7.1. Two Coat Epoxy with Urethane Topcoat

This solution is provided by local Warehouse Floor Coating companies. Typically, most areas of the USA will have multiple vendors available to provide this service. It is best to shop around for the best quote. In essence this is an investment in creating an entirely new long-lasting surface for your warehouse floor. Epoxy is generally the most popular option for commercial flooring. It's one of the least expensive per sq ft options you can pick, while still providing superior long-term value. Epoxy is hard, but brittle – it can be damaged by falling objects, especially those with sharp points. While damage remains localized, repairs require laying down another layer of epoxy. Urethane is less strong against crushing damage than epoxy, but it is more resilient. It resists scratching better than epoxy and is much less likely to be damaged by falling objects. This can lead to lowered repair and maintenance costs over time.

	Epoxy	Urethane
1- 1,500 sqft	$5.25 – $8 sqft	$13-$19 sqft
1,500 – 5,000 sqft	$3.05 – $7 sqft	$9 – $12.85 sqft
> 5000 sqft	$2.50 – $6 sqft	$6 – 10 sqft

Cost Estimates

Epoxy flooring is a popular option for industrial-grade floors. They are tough, aesthetically pleasing, come in many options such as anti-slip coatings, and more. An epoxy primer coat seals the concrete and provides maximum adhesion. An optional epoxy mid coat builds further thickness. Finally, a polyurethane topcoat is applied. This provides for an easily cleanable surface. It features excellent gloss retention, light reflection, and has excellent wear resistance.