

'VIRTUAL PATH' MAGNET MARKER INSTALLATION

Savant AGV/AGCs follow a CAD map stored in onboard memory. The vehicles follow a 'tape-free, target-free, maintenance-free' virtual path.

The navigation controls employ a solid state, inertial sensor that senses fractional drift left or right of the 'virtual path' map as the vehicle travels and provides steering direction to the AGV/AGC in order to maintain sub one-inch tracking tolerance. (Refer to separate document 'Savant 'Virtual Path' AGV/ AGC Navigation')

A very small reference marker is placed in the floor eliminating inflexible floor wire/slot cutting, damage-prone floor tape or blockage-vulnerable, large wall mounted reflective targets.



Marker Compared to
AAA Battery



Floor Flush Magnet
Can be Covered by Tile

The inertial navigation system incorporates a periodic positive position check in order to 'zero out' any minor accumulated course error (nominally less than 1/2"). This is accomplished by installing a small marker (steel magnet about the size of a AAA battery) in the floor. These single magnets are spaced 20 – 25 feet apart along the virtual path. As the AGV travels over these small floor embedded magnets, a compact electronic sensor under the AGV measures the position of the AGV relative to the magnet with tenths of an inch accuracy. Any existing small deviation measured is corrected 'on the fly' thereby maintaining the tight navigation accuracy.

NOTE The magnet markers are used only for navigation accuracy. With typical magnet spacing for straights and curves, about 60 magnets are required for every 1,000 feet of virtual path.

Path definition, path action locations (speed change, horn triggers, station destinations, door activation, path branches, etc.), path do not use magnets markers. They are all 'virtual' symbols on the tracked CAD map allowing them to be quickly changed (added/deleted/moved) as needed without requiring any associated physical floor work required. Once the revised CAD map file loaded, the changes are immediate.

Magnet Installation

Many customers elect to install the floor magnets themselves with documentation and/or supervision provided by Savant. This allows them to reduce their system purchase price and cost of future path changes.

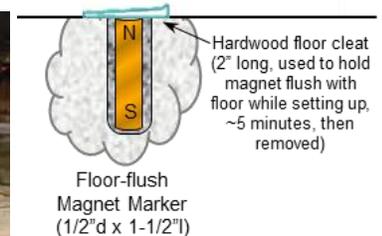
The installation of the inertial navigation magnets is simple and quick. The floor may be sealed or washed without interfering with proper operation. Floors can be covered if desired (check with Savant in advance).

Small steel magnets (approx. 1/2" dia. X 1.5" long, 12mm dia x 40mm long) spaced approximately 20 to 25 feet apart are installed. The typical installation time for each magnet location is approximately 5 minutes.

Installation of Magnets

Step 1 Layout/mark magnet locations on floor using Savant-provided drawing,

Step 2 Install a 1/4" dia x 1-3/4" pilot hole using hammer drill with vacuum attachment and then enlarge to a 9/16" diameter hole.



Step 3 Each magnet will be installed (north up - markings are provided), and sealed with a suitable anchoring adhesive/epoxy.

Step 4 Clean hole and verify depth of hole with a magnet. Magnet must fit completely in the hole with the top being flush with the floor surface.

NOTE Magnet must NOT be hammered into hole or ground off to fit; these activities will damage the magnet.

Step 5 Fill hole approximately 1/2 full with the anchoring material and insert magnet. Use typical hardwood floor cleat or 1" flat washer to ensure that the magnet is held flush with the floor will mix hardens. Excess cement should flow around the magnet and overflow a small amount.

NOTE Magnet MUST be installed with the **North** side up. The North end is indicated by a black mark on that end. For magnets without this identification, polarity is easily verified using a magnet of known polarity (the North end of one magnet will repel the North end of another magnet).

Step 6 When adhesive mixture has semi-hardened (approx. 5 minutes) remove retaining cleat/washer and shave excess cement from floor with putty knife. If cement has become fully cured, grind excess from floor, being careful not to damage the magnet.

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AGV System Guide Path Considerations

No in-floor wire or targets are used for path definition: Small steel magnets (1/2" dia. X 1.75" long.) spaced approximately 15 to 20 feet apart will be installed.

AGV Guide path Requirements: Reliable system operation is dependent upon proper floor conditions.. Any floor conditions deviating from these specifications may require additional cost and/or improvement by customer to meet the requirements.

Flooring Specifications for AGV Operation

Floor Conditions	Specifications
Surface	Dry brushed concrete or other approved equivalent; the <u>finished floor must be conductive</u> . NOTE Guide path areas shall be free of oil, grease, water, ice, snow or other substances or conditions which de-rate vehicle load capabilities and affect vehicle stopping distance.
Levelness	Floor to be level within 1/2 inch over 4 feet. NOTE Special floor levelness requirements may be necessary at turns, load transfer, charging, or other
Floor Debris	Loose debris such as wood or metal scrap, strapping, or other litter shall be kept clear of the guide path.
Ramp Specifications	Not required as the AGV path area will not have ramps.
Floor Painting	Savant recommends that the AGV System be marked and identified for safety purposes as required by the ANSI SAFETY STANDARD for GUIDED INDUSTRIAL VEHICLES B56.5-2012 standards. Per the standard, in non-restricted areas, the floor space boundary required for the vehicle and its intended load and/or train shall be clearly marked, including the clearance necessary for turns and maneuvering.
Clearance Recommendations	Recommended minimum clearance to fixed objects or passing AGVs is 19.7" (per ANSI/ITSDF B56.5-2012).

- **Static Conductivity** – any floor coatings that are or may be applied to the floor in the guide path area should be static dissipative to 100 Mega OHM per square inch maximum.
- **Metal and Magnetism** – all areas of the vehicle path are assumed to be non- metal and have no ferrous content, other than steel reinforcement bar a minimum of 3" from the surface of the concrete.



NOTE: SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE BASED ON PRODUCT IMPROVEMENTS OR TECHNICAL REQUIREMENTS. FORM: 0518MAGINST