

resinDEK®

Manufactured by:  **CORNERSTONE**
SPECIALTY WOOD PRODUCTS, LLC®



◆ **Performance Engineered Flooring for Robotic Traffic**
Ground Level and Mezzanines

Cornerstone Specialty Wood Products has been at the forefront of testing and innovating flooring panels for the Material Handling Industry since 1994. In 2007, we began providing ResinDek® panels for robotic applications. Much of our initial research and development occurred with AGVs. In the last decade, we have provided a variety of ResinDek flooring products to numerous AGV and AMR manufacturers for their testing labs. As a result, millions of square feet of ResinDek panels are in service worldwide with robotic traffic in distribution centers, warehouses, and retail environments.

We understand that the AMR and AGV flooring solutions can be complex, and there may be a variety of demands within a single project. Therefore, we offer a multitude of ResinDek flooring options that can be customized for load capacities, required finish type, and volume of robotic traffic. The optimization of all these criteria provides an extremely cost-effective solution that is tailored for each project.



ResinDek panels are custom manufactured with engineered processes which enhance the functionality, durability, and life of the floor. ResinDek finishes are developed by our internal coating innovation lab where innovation never stops. Premium materials and unsurpassed manufacturing methods ensure that every ResinDek floor panel will withstand the rigorous requirements of autonomous mobile robots and automated guided vehicles.



ResinDek® Floor Finishes Engineered for Long-Lasting Durability and Performance

The durability and condition of the floor are important considerations for the optimal performance of AGVs and AMRs. Worn, uneven surfaces can disrupt the functioning of the vehicle's laser-based navigation sensors, slowing down its rate of travel. Coefficient of friction can impact the robot's acceleration, stopping accuracy, and turning. Gloss and light reflectivity can affect the fluidity and accuracy of the robot. To meet these demands of various robots, ResinDek panels are available in three unique finishes for automated warehouse robots: TriGard® ESD, TriGard® ESD Ultra and MetaGard® SST.

Description	Reference Standard	Test Procedure	Gray Diamond Seal® ESD	RECOMMENDED FOR ROBOTICS		
				TriGard® ESD	TriGard® ESD Ultra	MetaGard® SST
Coefficient of Friction: BOT 3000E	ASTM A326.3	Neolite sensor has material that is 95+/-3 Shore A	Avg Dry: 0.50 Avg Wet: 0.33	Avg Dry: 0.62 Avg Wet: 0.28	Avg Dry: 0.56 Avg Wet: 0.30	Avg Dry: 0.77 Avg Wet: 0.68
Taber Abrasion	ASTM D4060	180 grit aluminum oxide sand paper replaced every 500 cycles with 1 kg of weight	Wear Rating: 2,000 cycles	Wear Rating: 6,000 cycles	Wear Rating: 13,000 cycles	Wear Rating: >50,000 cycles
Gloss, 85 deg	ASTM D523	Tested with glossmeter geometries of 85°	20 GRUs	7 GRUs	7 GRUs	8 GRUs
Robot Navigation Sytem/Travel Path:			N/A	Lidar/Variable Path	Fiducials/Fixed Path	Fiducials/Fixed Path
Suggested Robot Type:			N/A	AMR	AMR, AGV	AGV

TriGard ESD and TriGard ESD Ultra utilize our unique coating technology that is engineered and designed specifically for robotic traffic. Both come standard electrostatic dissipative properties (ESD) to limit the flow of electrical current and discharge to less than 50 volts.

TriGard® ESD Finish

TriGard ESD Coating is the perfect flooring finish for autonomous mobile robots that use lidar navigation system or a variable path.

The Trigard® ESD finish offers several benefits, including:

- Engineered to withstand high-frequency robotic traffic
- Optimal coefficient of friction, allowing robot to run at it's peak performance
- Ideal degree of light reflectivity that does not impair a vehicle's laser-based navigation sensors



TriGard® ESD Ultra Finish

TriGard ESD Ultra is ideal for high-traffic robotic applications characterized by highly repetitive movement patterns, defined travel paths or some type of fiducial.

The TriGard ESD Ultra finish offers several benefits, including:

- An innovative finish that provides more than 2X greater wear than the TriGard ESD coating
- Optimal coefficient of friction, allowing robot wheels to travel fluidly and with precision
- Coating can be modified for surface roughness and light reflectivity



MetaGard® SST

ResinDek with MetaGard SST is engineered for the extreme wear of AGVs and has been proven to withstand more than 2 million annual pivoting passes generated when AGVs change direction. In testing, ResinDek® with MetaGard SST has been shown to be 5x more abrasion resistant than concrete in heavily trafficked areas where dirt and debris

are not routinely removed. ResinDek with MetaGard SST flooring panels combine the structural integrity of a ResinDek panel along with the strength and durability of a steel wearing surface.

The MetaGard® SST finish offers several benefits, including:

- Fused to the ResinDek panel with a proprietary bonding agent and features an edge that encapsulates the perimeter of the panel, creating a floor that will not delaminate
- Has superior physical properties
- Level for rolling loads
- Has no sharp edges that could cut or snag objects passing over it.



A Hybrid Flooring Solution

TriGard® ESD Ultra and MetaGard® SST

We recommend using a combination of ResinDek with MetaGard in the higher traffic, debris-laden areas and ResinDek with TriGard ESD Ultra in the cleaner, lower traffic regions, maximizing the performance of the platform while decreasing the overall cost of the robotics flooring system. This creates a cost-efficient flooring solution.

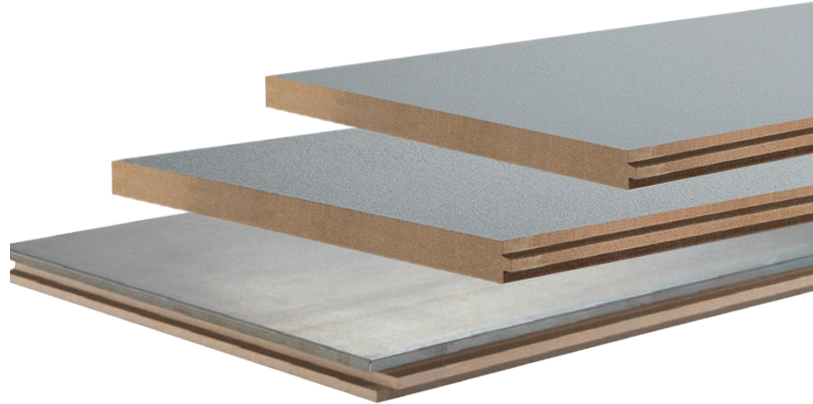
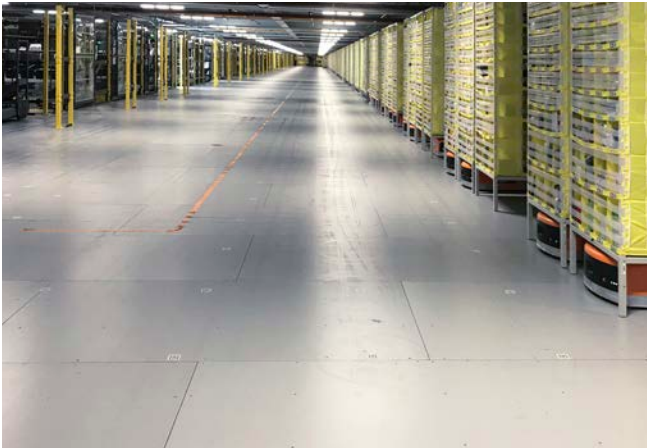


ResinDek® Flooring Panels for AMR and AGV Traffic

ResinDek is the perfect flooring for industrial robots, the panels create a level floor with surface characteristics that are critical for the successful deployment of robots. They are manufactured with mostly recycled and recovered wood fibers, environmentally friendly resins with no added urea formaldehyde, and a wax emulsifier. The ingredients are combined and compressed under extremely high pressure and temperature, resulting in a panel with superior physical properties. In addition, ResinDek panels meet MR50 classification, the most stringent composite panel requirement for moisture resistance.

ResinDek panels are formulated in different thicknesses and densities to meet the requirements of varying load capacities. The panels can be used on mezzanines or on the ground for robotic traffic. Depending upon the application the ResinDek panel can be used as a single panel solution or with a corrugated metal deck. Each panel features a tongue-and-groove configuration promoting effective panel to panel wheel load transfer. They are available in sizes up to 4' x 10' (1206mm x 3048mm). ResinDek with MetaGard maximum size is 4' x 8' (1206mm x 2438mm).

ResinDek® Xspan® and ResinDek® Xspan® FR panels have been extensively tested and approved by IBC Code Officials for use as a structural flooring system in certain applications where a metal corrugated substructure is not required. Structural supports must be reviewed and approved by Cornerstone Specialty Wood Products, LLC® and must be capable of supporting floor loads at specific intervals. For further details, call us and/or your local building code official. ResinDek Xspan FR is a fire resistant panel and meets ASTM E-84 Class "A" flame spread less than 25, meets UK Class "0", and meets European standards B-Class (B_{FL}-s1 | B-s1,d0) for both top and bottom.



SCS Global Certifications, LEED® and FSC®

As part of Cornerstone Specialty Wood Products, LLC's commitment to environmental sustainability, all ResinDek® panels are certified by SCS Global Services for use of recycled materials and to have no added formaldehyde. They also contribute towards earning points for LEED® qualified buildings. ResinDek® panels may also be specified for construction with FSC® certified materials (FSC® License Code FSC-C124474).

Flame Spread Index and UL Classification

When tested in accordance with ASTM E84, the ResinDek panels plus the corrugated metal deck assembly meet Class A criteria for an interior finish. ResinDek Xspan FR is a fire resistant panel and meets ASTM E-84 Class "A" flame spread less than 25, meets UK Class "0", and meets European standards B-Class (B_{FL}-s1 | B-s1,d0) for both top and bottom.

UL Classification ResinDek® flooring system can be UL Classified for up to a 2-hour fire rated assembly under UL Design No. L701 and UL File No. R39265.

Uniform Evaluation Service Report

ResinDek floor panels have been independently evaluated and approved for use in Types I-V construction and as part of a fire resistance rated assembly by the IAPMO Uniform Evaluation Services. United States ER Number 467. Canada ER Number UEL 5027.

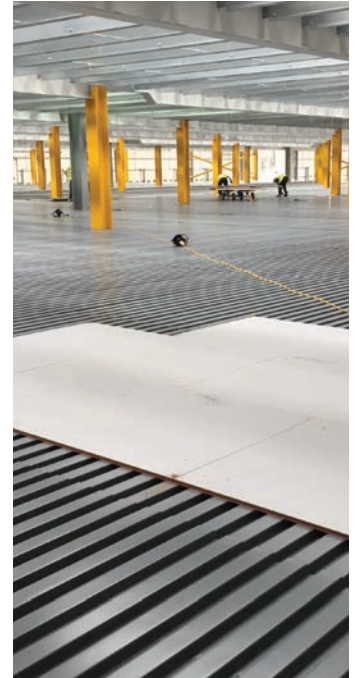
ResinDek® 10-Year Product Warranty

ResinDek panels are backed by our comprehensive design engineering services and a 10-year product warranty. The panels are warranted to be free from defect, structurally sound, and able to safely carry the specified design loads. The warranty will flow through and transfer to the end user for the entire period of the warranty.

ResinDek® Flooring Panels for AGVs & AMRs

For use with Corrugated B-Deck

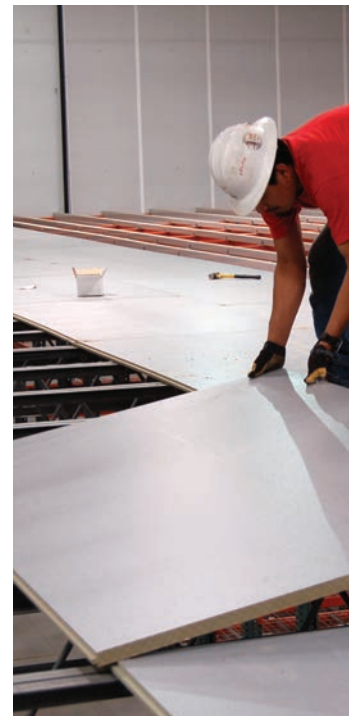
Product Name	Robot & Product Load Limits	Maximum Contact Pressure	Robot Load Type	B-Deck Thickness
ResinDek® LD Panel Thickness: 19 mm	up to 230 kgs	3.4 MPa	AMR	0.9 mm
ResinDek® MD Panel Thickness: 19 mm	up to 910 kgs	5.2 MPa	AMR, AGV	0.9 mm
	up to 1,365 kgs	6.9 MPa	AMR, AGV	1.2 mm
ResinDek® HD Panel Thickness: 19 mm	up to 1,815 kgs	8.3 MPa	AMR, AGV	1.2 mm
ResinDek® MAX Panel Thickness: 38 mm	up to 2,725 kgs	10.3 MPa	AMR, AGV	1.2 mm



ResinDek® Flooring Panels for AGVs & AMRs

Single Panel Solution - No Corrugated B-Deck Required

Product Name	Beam Spacing	400 mm	600 mm	800 mm
ResinDek® HD Panel Thickness: 19 mm <i>For AMRs only</i>	Uniform Loads	10.9 kN/m ²	6.1 kN/m ²	
	Total Robot & Product Load	345 kgs	230 kgs	
	Contact Pressure	5.2 MPa	3.4 MPa	
ResinDek® Xspan Panel Thickness: 28 mm	Uniform Loads	18.1 kN/m ²	10.9 kN/m ²	6.1 kN/m ²
	Total Robot & Product Load	1,135 kgs	910 kgs	685 kgs
	Contact Pressure	6.2 MPa	5.2 MPa	4.1 MPa
ResinDek® Xspan FR Panel Thickness: 28 mm	Uniform Loads	18.1 kN/m ²	10.9 kN/m ²	6.1 kN/m ²
	Total Robot & Product Load	1,135 kgs	910 kgs	685 kgs
	Contact Pressure	6.2 MPa	5.2 MPa	4.1 MPa



NOTES FOR TABLES (above):

- Testing was completed with polyurethane caster wheels and any deviation or alternative wheels such as crowned, steel or plastic could void the warranty. Contact CSWP for more information.
- Contact pressure values are to be used as a guide. Please consult factory for specific robot usage.
- For flooring used with corrugated b-deck: Please note load values above are calculated on 914 mm beam spacing, increased spacing will reduce capacity. Floor deflection is L/240.
- For flooring solutions with no b-deck: All allowable loads are based on a two span condition. Uniform load values are based on L/240 deflections, any deviation can positively or negatively impact these values. Please contact Cornerstone for other span conditions.
- The calculations and load tables above been compiled based on specified calculation methods and assumptions. The loads provided are for the purpose of information for preliminary studies and cannot be used as a reference in structural studies. Contact an accredited engineering office or architect to perform a complete stability analysis.

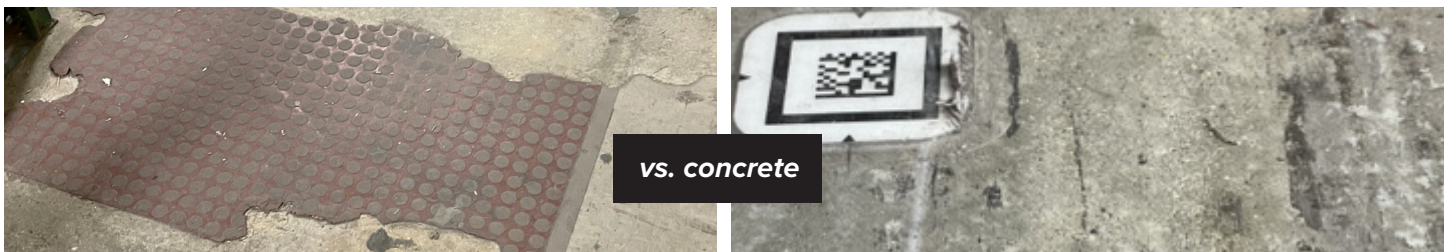
Advantages of Using ResinDek® Flooring Instead of Concrete

A Low Maintenance, Flat, Level Surface

- ResinDek floors provide a consistent finish in floor flatness, levelness and surface roughness. Worn or uneven surfaces can disrupt the functioning of the vehicle's laser-based navigation sensors, slowing down its rate of travel. ResinDek panels ensure a level flooring surface with just the right amount of surface roughness to avoid the impairment of a robot's navigation or slow its movement.
- ResinDek panels do not produce dust, require sealing or crack like concrete. Unlike concrete, ResinDek does not require large expansion joints. In addition, individual panels can be removed without having to refinish an entire floor.

Cost Savings and Speed of Construction

- ResinDek panels are 85-90% lighter than concrete which allows for less steel in the support structure and reduced footings
- Platforms using ResinDek can be designed with an allowable deflection limit of L/240, whereas concrete's allowable deflection is limited to L/360; this reduces the amount of steel required in the support structure
- An independent study found that ResinDek flooring is significantly more cost effective than concrete
- Since ResinDek is supplied with a factory finish, and concrete needs time to cure, ResinDek can be installed faster



ResinDek® for Ground Floor Robotic Applications

While more operations are deploying Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) in their facilities, not every existing ground floor surface can support them. Although it may be possible to grind down uneven areas, patch cracks, add a new layer of concrete on top, or apply an epoxy coating over the surface, ultimately these repairs have multiple drawbacks. First, it takes a considerable amount of time and manual labor to grind down concrete — which also creates a lot of dust. Patching often does not match the properties of the original concrete flooring, creating more problems for robot navigation. And pouring fresh concrete or an epoxy coating both take extensive amounts of time to dry and set properly, while still not offering the wear resistance robots often require.

Additionally, some facilities may have other floor coverings laid over the concrete, such as tiles with asbestos content. Safely removing this material is both dangerous and costly. Further, the surface beneath it will likely be marred by adhesive, as well as scratched and damaged — requiring additional remediation.

The solution is to install ResinDek® panels directly on top of an existing ground floor. The panels create a level floor with surface characteristics that are critical for the successful deployment of robots. Installing ResinDek floor panels directly over an existing ground floor is faster, cleaner, easier, and more cost-effective. It also creates the optimal flooring surface to support a successful AGV or AMR deployment.



Cornerstone Specialty Wood Products' team never stops evaluating and testing new approaches for mezzanine floors. We believe in helping our customers solve problems through innovative designs and long-lasting durability.

ResinDek flooring panels outperform other flooring solutions time and time again. We go to great lengths to extensively test internally and send our products to be evaluated by independent laboratories as well as robotic manufacturers. At our advanced research and engineering facility we have designed and built a series of floor testing equipment that accurately replicates field conditions. Here is an example of just some of the testing that we do:

- Taber Abrasion
- Gouge Resistance
- Gloss, 85 Deg.
- Reflectivity
- Surface Roughness
- Uniform Load Capacity
- Dynamic Coefficient of Friction
- Stain Resistance
- Electrostatic Dissipative Surface
- Impact Resistance
- Dynamic and Static Rolling Load Capacity
- Fire Resistance & Ratings
- Modulus of Rupture
- Modulus of Elasticity
- Surface Hardness
- Pallet Jack Capacity
- Point Load Capacity
- Screw Pull Test

With constant testing and new product development we have been able to solve both existing problems and address the challenges of new technologies and applications for our customers. If you have a custom loading condition that we can recreate, we will work with you to develop a custom test. If a custom test application can be successfully completed to meet the rigors of our requirements, we will stand behind your unique application with our unmatched 10-year ResinDek product warranty.

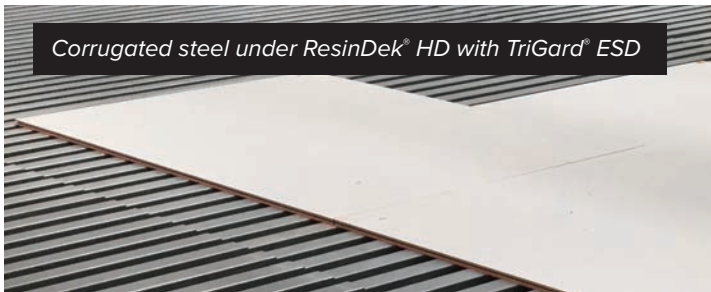


ResinDek® Flooring Saves Time, Money, and Provides a Level Platform

A project located in Manchester, U.K. had a three level mezzanine with 20,000 m² per level. The flooring system that was selected was 19 mm ResinDek® HD with the TriGard® ESD finish and corrugated steel decking. During the final walk through, the main Contractor made the following comments:

“The ResinDek flooring system offered a substantial savings over elevated concrete platforms, which was the only real alternative for this project. The levelness of this floor (+/- 3 mm across a 20,000 m² continuous surface) is just not something that we can normally produce with concrete.”

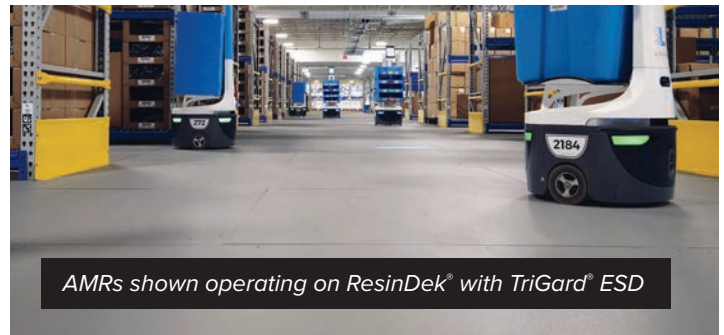
“The speed of installation was impressive. ResinDek goes down quickly, and the floor, once installed allows for instant structural access for subsequent trades. Concrete, on the other hand, requires 10 days of curing time per bay, along with additional screeding and leveling work. My guess is that we saved a solid 5 weeks of construction time by using ResinDek instead of concrete. We are sold on the superiority of the ResinDek Flooring System compared to a traditional concrete floor!”



Rack & AMR Manufacturer Trusts ResinDek® with TriGard® ESD

When called upon to design and install two separate rack supported work platforms that would deploy a fleet of AMRs for a third-party logistics (3PL) company's two warehouses, Ridg-U-Rak, one of the world's largest pallet rack and storage rack manufacturers, turned to Cornerstone Specialty Wood Products. *“We've partnered with Cornerstone to use their ResinDek flooring in our designs for more than a decade,”* notes Jim Staszewski, a Ridg-U-Rak Senior Designer. *“They're on the leading edge of developing high-density, elevated flooring products that handle high traffic and highly concentrated dynamic loads, like those on pallet jacks and robotic wheels. When you buy their products you know you're getting high-quality flooring. They are the clear leader with an unparalleled combination of design, engineering, and product testing.”*

Jeffrey Cody, Director at Locus Robotics, states: *“From my perspective, the whole design was built out dimensionally to optimize the movement of our robots. Although we didn't make any specific recommendations about the flooring, when we learned it would be ResinDek from Cornerstone Specialty Wood Products, we knew our AMRs wouldn't have any problems. As a robotics company, we test a variety of performance parameters — including antistatic, coefficient of friction, stopping with and without full loads, and so on — on different flooring surfaces. Cornerstone Specialty Wood Products has been key in helping us with research and development.”*



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