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Route Strategy Guide

This route strategy guide is designed to help readers achieve a thorough understanding of best practices for using the robotic scrubber. Incorporating these best practices into your unique environment will help ensure sustained success with your BrainOS®-powered robotic floor scrubber. Detailed machine information can be found in the Operation Manual which arrived with the robotic floor scrubber.

While the *Operation Manual* contains specifics about standard floor scrubber functions, this *Route Strategy Guide* focuses on suggestions and methods to set up the robot to run on its own, employing the user-friendly “Teach and Repeat” method.

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Overview

The goal of this guide is to help you get your robotic scrubber up and running in your site with minimal disruptions to your workflow. It will walk you through the process of how to divide your space into cleaning zones, where to place Home Markers, how to teach routes, and how to run routes. Once you are familiar with these core concepts, you will be able to adapt these best practices to a workflow that fits the needs of your unique environment.

Pro Tips:

Make a Plan. Think about how you want to divide up your space, when you want different sections cleaned, and how other site activities could prevent the machine from cleaning effectively.

Start Simple. Once you have placed your first Home Marker, teach the robotic scrubber a small demo route, then run the route in self-driving mode. This will get you familiar with the machine and how it navigates.

Iterate. Update your plan as you learn more about the machine and how it works in your space. There's often more than one correct way to do this. Unless your supervisor directs otherwise, find the way that works best for you and your space.

Note
A 'route' i s simply the path the robotic scrubber will take to clean a section of your site. Think of each route as a loop, with the same start and end point. First the installer teaches a route by manually cleaning the desired section. While they are driving, the machine learns the route and stores it. Once stored, the robot can clean the route on its own later. That's how 'Teach and Repeat" works.

Considerations Before Getting Started

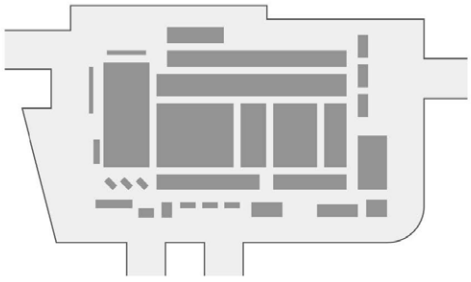
The primary goal of any effective route strategy should be to maximize the coverage of the machine's cleaning routes across your floor plan – cleaning as much of your facility as possible with the robotic scrubber. The goal of a specific route should be the smooth operation of the robotic scrubber throughout the route, without requiring any assistance. Keep this in mind as you read the next few sections.

Segmenting Your Facility for Routing Success

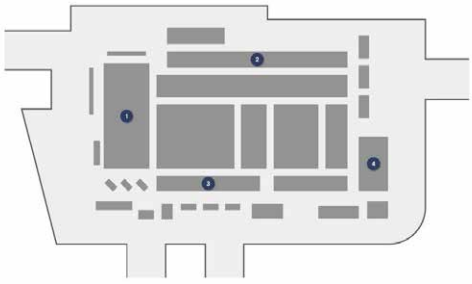
Before actually teaching your robotic scrubber its cleaning routes, it's helpful to think of your facility as a series of zones or segments. Each zone may have unique cleaning and operational requirements that need to be considered when developing the routes for your robotic scrubber. Consider the following:

- If your facility has environment barriers, such as multiple levels connected by elevators or ramps, then each level should be considered its own segment.
- If your facility is already divided into departments (e.g. a grocery store) these departments can serve as natural segments for creating routes.
- Robotic scrubbers are designed to work around people and obstacles, but they work best in areas that are clear of temporary obstacles like freight and heavy human traffic. Think about which segments in the facility will be most free of obstacles at different times of the day/night.
- Walk the floor of your facility and make note of places that will be too tight or over-crowded before training a route.

Ultimately, the flow of work within your facility will play a major factor in the cleaning routes you teach the robotic scrubber, and the sequencing of those cleaning routes throughout the facility. The best routes are designed by considering the unique environmental aspects of the segments within a facility along with the facility's daily/nightly flow of activities and traffic.



Think of your facility as a series of zones or segments.



Each zone may have unique cleaning requirements that should be considered when developing routes for your robotic scrubber.

Home Markers

Home Markers represent the starting position and finish point for self-driving (autonomous) routes that the machine will use to clean your facility. By scanning a Home Marker code from the camera on the right side of the machine (like a phone does with a QR code), your robotic scrubber is able to determine its location and which routes are associated with that Home Marker.

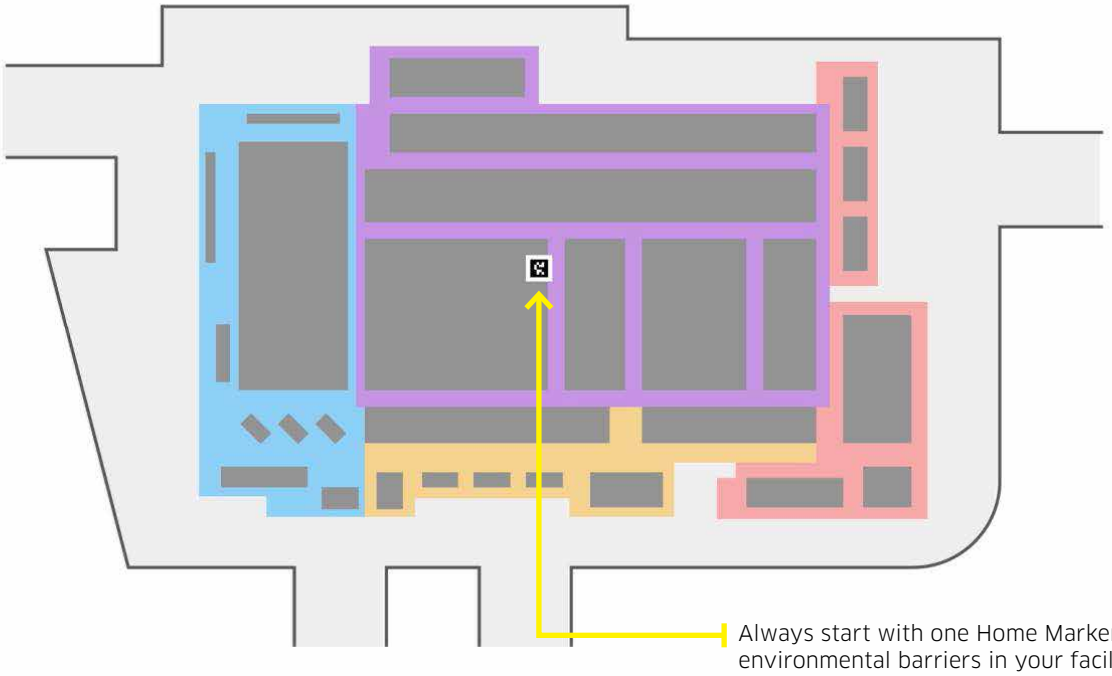
Always start with one Home Marker. If there are environmental barriers or you need to teach more routes, add more Home Markers. Consider these requirements as you determine the best placement for your Home Marker:

- Home Markers must remain in the exact same locations they are placed each time your robotic scrubber runs a cleaning route associated with that Home Marker
- Home Markers must be fixed to a wall or flat surface at about the height of the steering wheel, or approximately 40" from the floor.
- Much like an airplane on a runway, the robotic scrubber needs to have space to "take off" and "land" back at the Home Marker.
- Do not place a Home Marker near an emergency exit or fire door.
- Home Markers should never be photocopied, laminated, or placed in a sleeve or cover as this may prevent the robotic scrubber from reading the code.

Note

Think of a Home Marker as the robotic scrubber's home, or safe point. All cleaning routes will be taught by starting and finish ing at a Home Marker. Six (6) cleaning routes can be associated with each Home Marker and a total of ten (10) Home Markers are provided.

Home Markers must be fixed to a wall or flat surface at about the height of the steering wheel.



Always start with one Home Marker, if there are environmental barriers in your facility, such as ramps or elevators, or if you need to teach more routes, add more Home Markers.

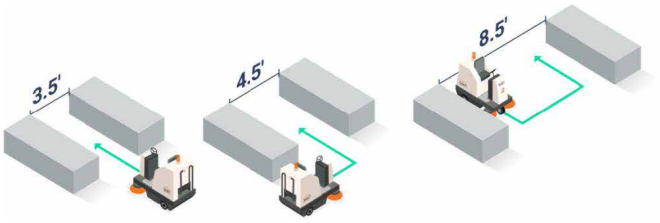
Robotic Scrubber Space Requirements and Navigation Considerations

Because your robotic scrubber is first and foremost developed to operate safely, its sensors will not allow it to get as close to obstacles as you might when driving the machine manually. In other words, just because you can manually maneuver through or around tight areas does not mean that your robotic scrubber will do so on its own. Your robotic scrubber can move around people and other obstacles in its path as long as there is enough space for it to do so safely.

For safe and efficient route navigation, consider these space requirements:

FOR SCRUBBERS WITH 20" – 22" SCRUBBER DECKS

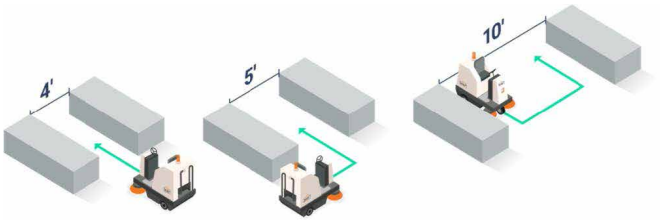
- 3.5' is needed to move straight between two obstacles
- 4.5' is needed to turn into an aisle or corridor
- 8.5' is needed to perform a U-turn



U-turns slow the robotic scrubber down. Circle around or alternate aisles and corridors whenever possible.

FOR SCRUBBERS WITH 26" – 28" SCRUBBER DECKS

- 4' is needed to move straight between two obstacles
- 5' is needed to turn into an aisle or corridor
- 10' is needed to perform a U-turn

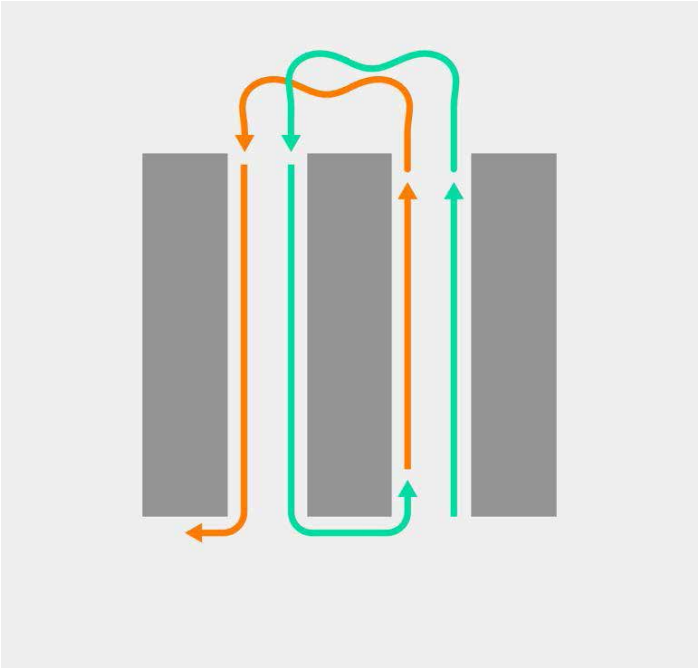


For robotic scrubbers with scrubber decks greater than 28" consult the machine's operation manual for specific space requirements.

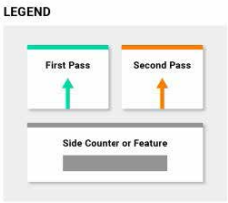
General Navigation Considerations

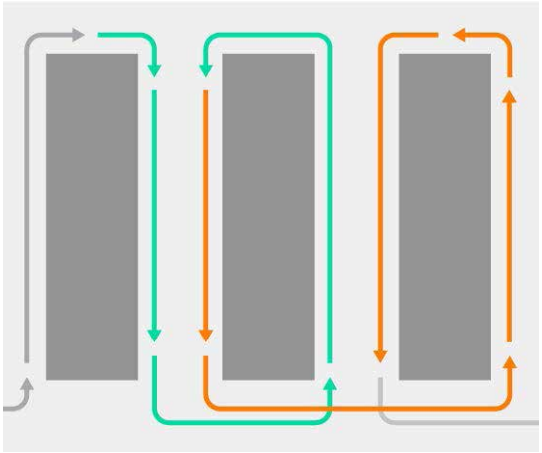
- Avoid all inclines or declines
- Do not drive in reverse
- Always make smooth wide turns, remember the space requirements that align with the size of your robotic scrubber.
- When making a route, pay close attention to how many passes an aisle requires for optimal cleaning coverage.
- Teach routes when the area is most clear of obstacles and people. This may require teaching routes outside of normal cleaning times.
- If you drive around an obstacle or area while teaching a route, the robot will follow that route and never clean that spot.
- Avoid areas with edges and cliffs when training routes, (e.g. escalators, stairs, loading docks, etc.)

For best practices regarding specific environment types, such as shopping malls, airports and train stations, see the Environmental Considerations Across Facility Types section in this guide.

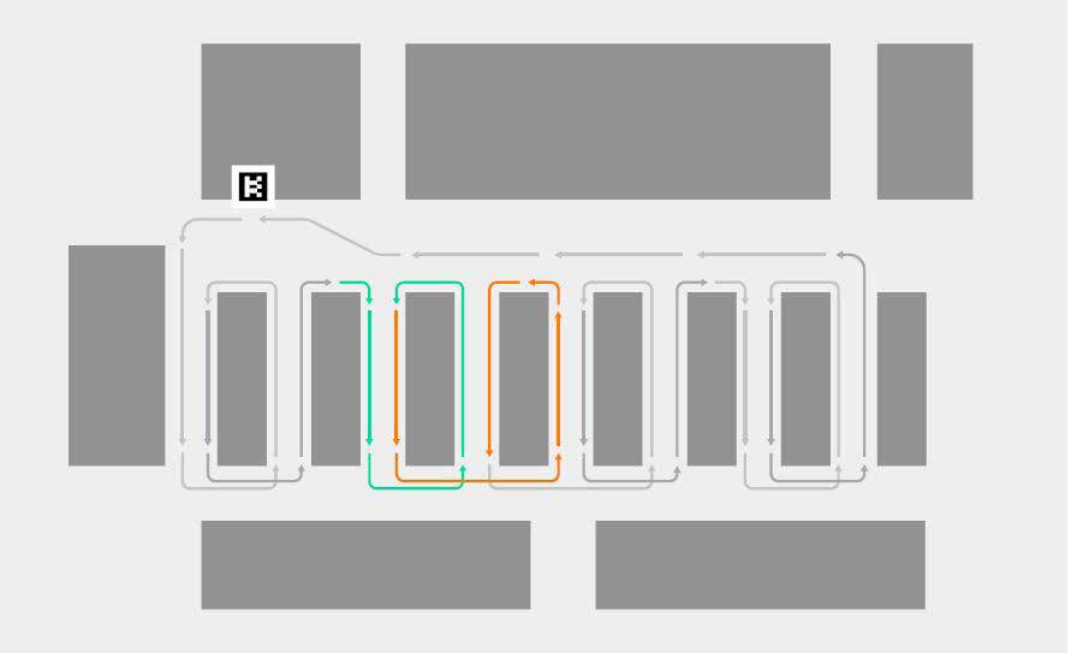


Depending on the allowable room in the facility, often making an apple shaped or molar shaped turn delivers the best autonomous navigational results.





When teaching cleaning routes between aisles or in a facility that contains rows or repetitive stacks of merchandise or materials, remember to make smooth, wide turns and alternate sides of the aisle as shown in the illustration here.



Route Sizing Considerations

Route sizing plays an important role in the overall route strategy of a facility. Due to the unique cleaning or operational requirements of a given zone within a facility, a series of smaller routes may work better than one larger route.

Consider some benefits and concerns related to route sizing as you build the overall route strategy for your facility.

	Large Routes: 25 Minutes To Train, 45+ Minutes To Run	**Small Routes: 5 Minutes To Train, 10 Minutes To Run**
BENEFITS	• Provides operator with a larger window of time to work on other tasks • Greater percentage of time focused on floor cleaning vs time spent in-between routes	• Provides flexibility to change and rearrange routes based on facility traffic and conditions • Allows for better focus on high traffic areas that need more attention / more frequent cleaning
CONCERNS	• Greater possibility of experiencing low water / low battery during route • Entire route unable to run if one area is obstructed • Requires prepping entire area for scrubber	• Operator more involved with robot scrubber throughout routes which could keep them away from other tasks

If you're not sure what size routes are best for your site, start small. The consecutive routes feature (described later in this guide) will allow you to combine multiple small routes into a single, larger route during the run routes process.

What Your Robotic Scrubber Records

Your robotic scrubber learns by recording how you clean and then repeats it. If you steer around obstacles while training a route, the robotic scrubber will steer in the same way when driving by itself. Consider the two lists below when training cleaning routes:

ROBOTIC SCRUBBER RECORDS

- The route it's driven
- Where scrub deck is dropped
- Where scrub deck is raised
- What Home Marker the route started and ended with
- What route name was chosen to identify the route

ROBOTIC SCRUBBER DOES NOT RECORD

- Speed route is driven
- Water level selected
- Scrub deck pressure selected
- Any pauses or stops during the route (i.e. to let a customer pass by)

Robotic Scrubber Speeds

Due to operating safety considerations, your robotic scrubber will 'drive' the route slower than most manual operators would. The speed will automatically adjust based on a number of factors:

- When it moves around obstacles and people
- When it approaches an aisle or blind intersection within the facility
- Sometimes the robot's sensor might pick up reflections in a facility that will cause the robot to slow down
- Anything moving in the area the machine is operating

Teaching Routes

Once you've segmented your facility into cleaning zones, strategically placed your Home Markers, considered space and navigation requirements, and determined what route sizes will work best within your facility, you are ready to teach the robotic scrubber its cleaning routes. Follow these simple steps:

Step 1: Ensure your robotic scrubber has sufficient battery charge to accommodate the number of routes you plan on training.

Step 2: Drive the robotic scrubber to the Home Marker associated with the zone you intend to clean. Enter the access PIN (1337) into the UI on the left side of the robotic scrubber's dashboard, select "Teach Route". The screen displays "Drive to scan my home location".

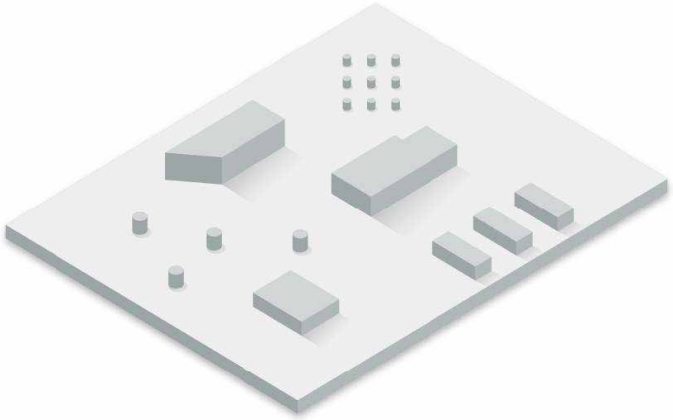
Step 3: Position the robotic scrubber approximately 2 - 3 feet away from the Home Marker to properly scan it from the right side of the machine. Once the scrubber confirms the Home Marker scan, select any undefined route available.

Step 4: Turn on scrubber settings and scrub the specific route as you would with a manual scrubber. Keep in mind all the previously mentioned space and navigation requirements of your robotic scrubber.

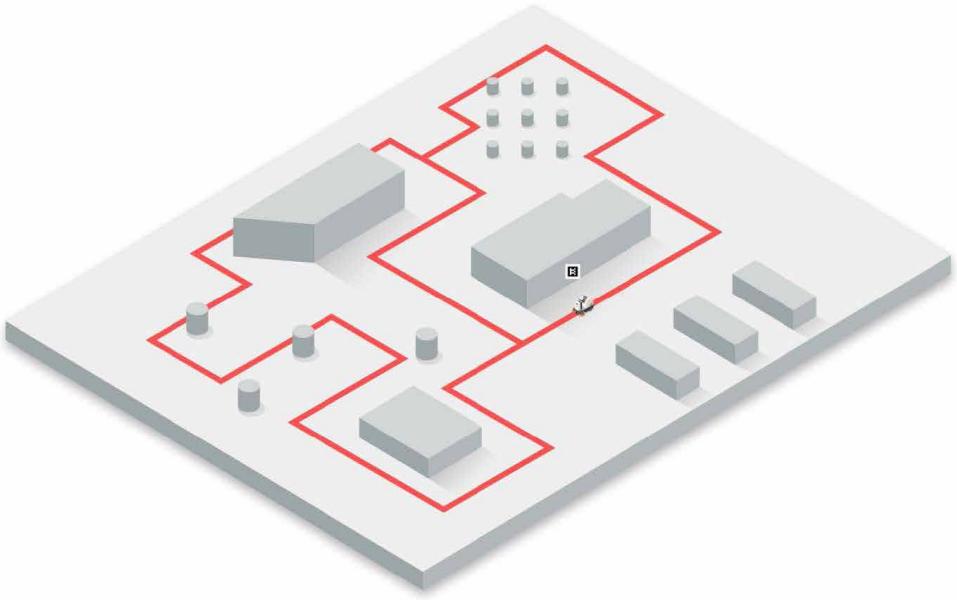
Step 5: Once you have completed cleaning the selected area, drive the machine back to the same Home Marker you started the route from

Step 6: Once positioned back at the Home Marker, scan the Home Marker as you did at the beginning of the route, then save the route and select an available label/name for the route.

Step 7: Repeat steps 1 – 6 to teach and store additional routes.



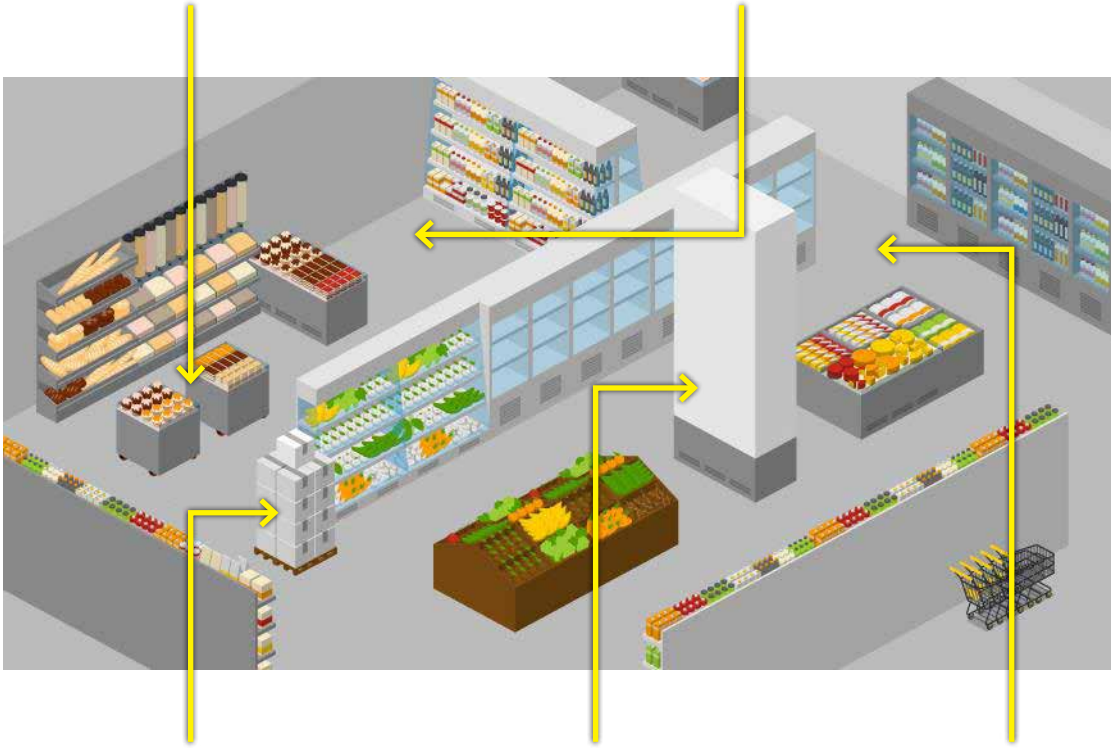
Once segmented into zones considering environmental and navigation requirements you're ready to teach the robotic scrubber cleaning routes.



Things To Consider Before Training Routes

Some areas with mobile display may be too narrow to clean, either move for cleaning or a void training routes in these areas.

Consider possible U-turn issues some a reas that may be accessible with a manual scrubber may be too tight for a robotic scrubber.



Environment should be free of temporary pallets or merchandise when training new routes

Note the robot's space requirements if pillars and other struc tural elements are present.

Pre-sweep / dust mop areas to be scrubbed to pick up any debris. Remove floor mats, if applicable.

Common Space Challenges

Robotic scrubbers need more room to maneuver than do manual scrubbers. Always consider space requirements.

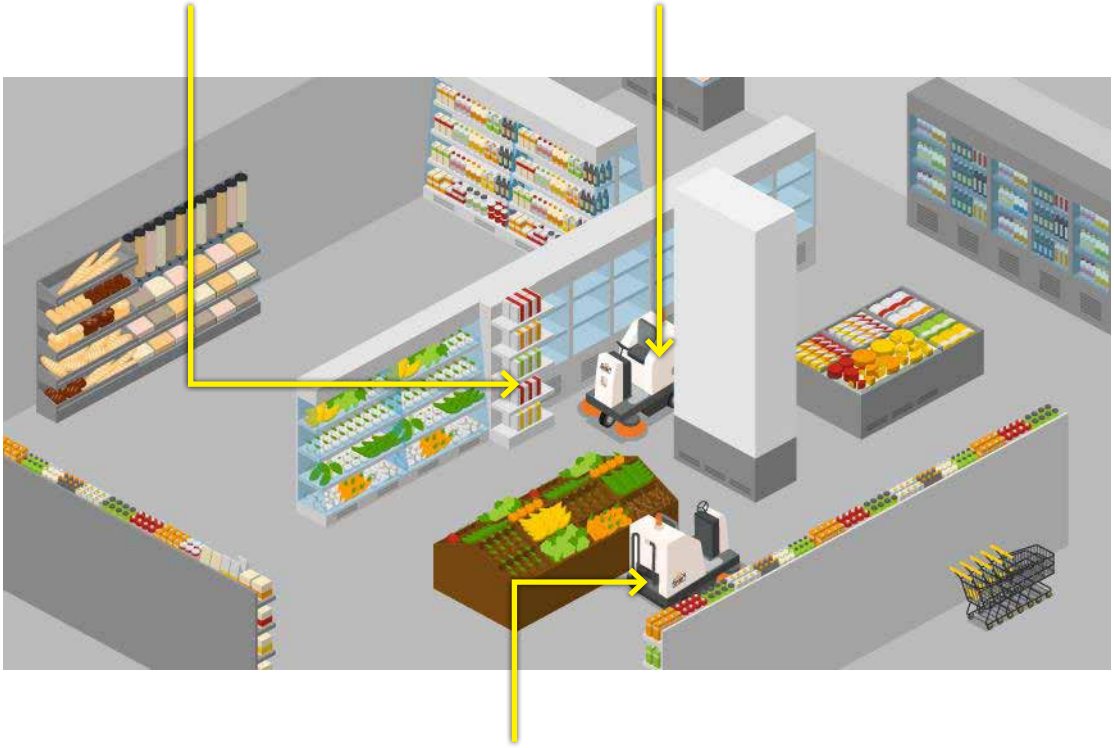
If displays are too close to pillars, consider cleaning area manually

Pallets or merchandise left on the floor can create navigation and cleaning challenges. Move prior to autonomous cleaning whenever possible.

Things To Consider When An Environment Changes

Adding in aisle displays can create space and navigation issues after a route is stored.

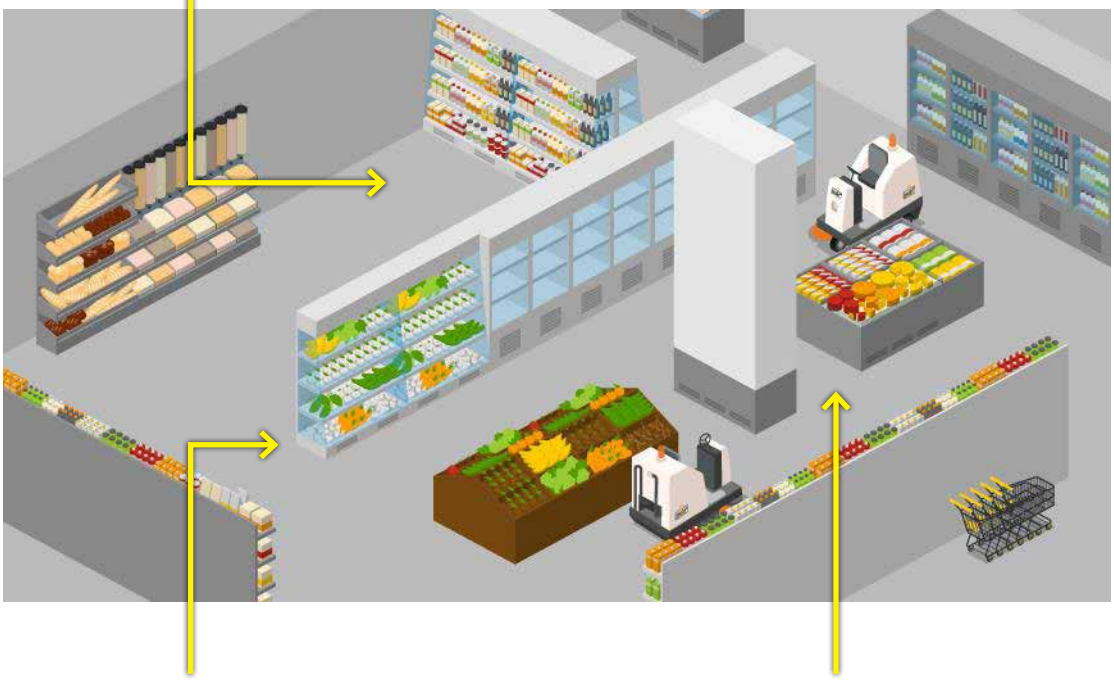
Previously clear aisles can become un passable when new displays are added.



A new in aisle display could cause the robotic scrubber to be unable to perform a turn around an existing display.

Ideal Robotic Scrubber Environment

Expansive open areas that allow sufficient room for navigation and maneuverability.



Endcaps free of displays and inventory allow for smooth, wide turns between aisles.

Wide open aisles, free of in aisle displays and stock items on the floor.

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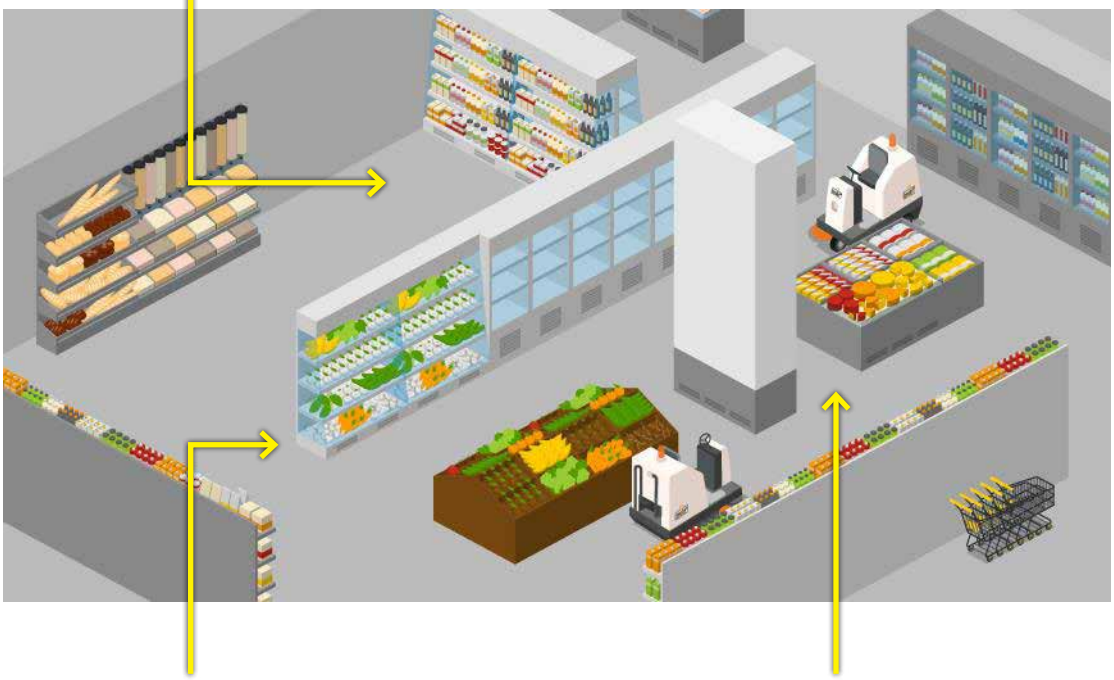


Endcaps free of displays and inventory allow for smooth, wide turns between aisles.

Wide open aisles, free of in aisle displays and stock items on the floor.

Testing Routes
After teaching the robotic scrubber its cleaning routes, always test each route to ensure the scrubber can run them successfully. If the robot needs assistance along the way, take a look at what might be causing the issue and remove any obstructions. If the robot still needs assistance, the route may include maneuvers that the machine cannot replicate on its own. The best solution is to retrain the route.

Note
The robotic scrubber is equipped with sensors in the seat and steering wheel designed to detect and mitigate any unauthorized operation while the machine is running a route in self drive mode. Therefore, it is important that operators do not attempt to ride on the machine, use the steering wheel, or put hand or arms through the steering wheel when the machine is running a route on its own. The steering wheel can move rapidly and unexpectedly, which could cause physical injuries and disrupt machine operations.

Running Routes Autonomously

After teaching the robotic scrubber cleaning routes and testing those routes, the scrubber can be used to clean your facility autonomously. Prior to selecting a route for the robotic scrubber to run, consider these recommendations:

- When possible, run routes when the area is most free of people and freight. This is particularly applicable in Retail environments.
- Preparing the environment during dust mopping is key to successful autonomous operation. Remove all rugs present in routes.
- It is essential to remove obstructions like boxes, new moveable features, and to push back any protruding merchandise. This is particularly applicable in Retail environments.
- Visually inspect all sensors and wipe them down before starting the scrubber for the day. Dirty sensors can affect the machine's performance.
- To receive performance and informational alerts from the scrubber during operation, pair a mobile device via the user interface (UI) – see Pairing a Mobile Device below.
- Never crowd the front of the robot, but especially at the start of a route. This may cause the machine to be unable to recognize the environment.
- During the start of an autonomous route, monitor the machine until it drops the scrub deck and back squeegees. Observe the side and rear squeegees to make sure they are properly adjusted for water pickup. Use the blue run/pause button to pause the route and adjust the squeegees if necessary.
- For retail spaces: If the robotic scrubber is being run during stocking hours, make a goal to run cleaning routes ahead of stocking activities to minimize work interruption.

Individual and Consecutive Routes
Once cleaning routes have been recorded and stored in the robotic scrubber, you have the option of running the machine on an individual route (i.e. one at a time) or you can choose multiple routes in sequence – a function called Consecutive Routes. The primary benefit of consecutive routes is that it allows the flexibility of smaller routes while providing the time savings afforded by larger routes. Your decision to select individual or consecutive routes will likely vary from day to day, depending on what is happening in your facility.

The Importance of Pairing a Mobile Device
Before running an autonomous route, it is highly recommended operators pair their mobile device with the robotic scrubber. This allows you to focus on other tasks while the machine is running a route and then be alerted if/when the machine may require assistance and your robotic scrubber will send you a notification when the cleaning route(s) are complete.

Pairing the robotic scrubber to a mobile device is an easy process. Simply select “Settings” from the main menu of the UI, select “Notifications” and then follow the instructions on the screen. The pairing is successful when your mobile device receives a confirmation text message.

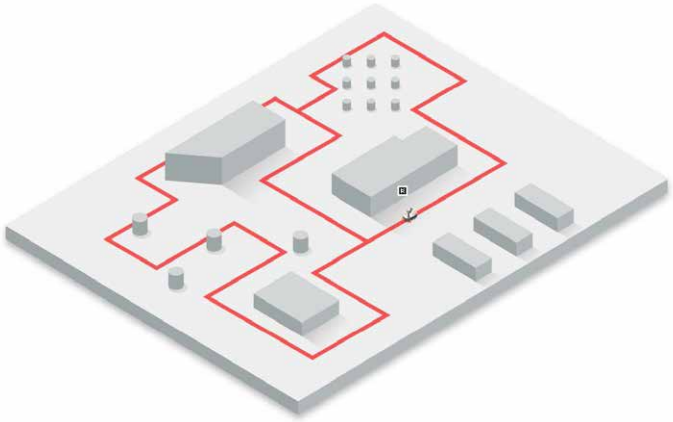
Selecting a Route to Run Autonomously
Follow these simple steps to select any cleaning route(s) stored on the robotic scrubber>

Step 1: Manually drive the scrubber to the desired Home Marker. Make sure to stop with the right side of the machine facing the marker. Select “Run Route” and wait for the robot to scan the Home Marker.

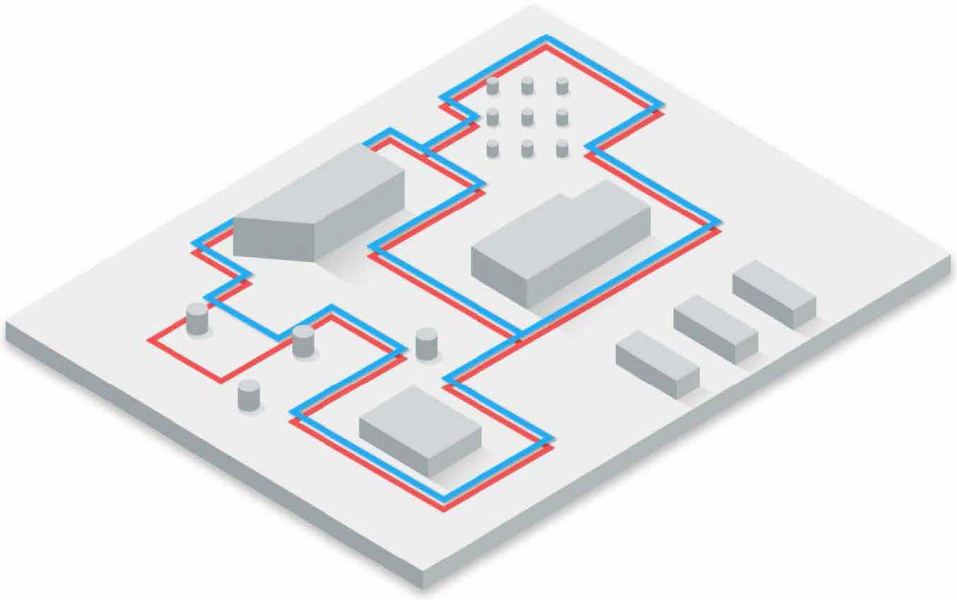
Step 2: After the robot successfully scans the Home Marker, select the route or routes you wish to have cleaned in your desired order.

Step 3: Confirm the water and pad pressure (if applicable to your scrubber) settings are correct and do a final visual inspection of the scrub deck, squeegees, and hoses before pressing the blue button to start the route.

Step 4: Press the blue button on the rear of the robotic scrubber to start the route.



The blue path in the below illustration shows how a robotic scrubber may automatically alter its route if it encounters an obstacle along its cleaning route.



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Troubleshooting Routes

During autonomous operation, your robotic scrubber may require assistance (an assist). Because the robot is developed with a safety-first approach, it avoids getting too close to anything and may stop when it is uncertain that it's safe to proceed. With this in mind, the robotic scrubber may need an assist if it detects an obstacle blocking the route or picks up something it doesn't understand with one of its sensors. When this occurs, the machine will pause, notify the operator via an alert on the paired mobile device, and wait in position until an operator can respond to the request for assistance. To troubleshoot the issue, perform the following:

Step 1: If you've paired a mobile device, the robot will send a photo of its location from the front camera along with an alert that it needs assistance.

Step 2: Once at the robotic scrubber, read the detail of the assist required on the UI screen and follow the steps to resolve the issue:

- If an obstruction is blocking the route, move it or manually drive around it
- If something has caused the machine to stray too far away from the programmed route that it is lost, manually drive the machine back the route and try resuming the route
- If applicable, address the machine-specific issue noted on the alert

Note
Occasionally, there may be so many obstacles in one area of the route that the robotic scrubb er gets off route trying to maneuver around the obstacles. If this occurs, simply follow the instructions on the UI to get the robotic scrubber back on the correct path.

Step 3: After either moving or driving around all obstacles, and/or positioning the robotic scrubber back to the correct route (as seen on the screen route display) press the "Start/Pause" button to resume autonomous operation.

If the robotic scrubber calls for many assists on a particular route or repeatedly calls for assistance in a specific area of a route, take a look at the environment and move or adjust any obstructions that might be causing the issues. In particular, consider the following:

- Is there anything very close to the machine that could be causing issues with one of the sensors?
- Has this route been run successfully before without issue? If so, what has changed that might be causing an issue? Is there anything new in the environment?

If the machine still requires assistance after obstructions are removed, the route may include maneuvers that the machine cannot replicate autonomously or there may be something on the route that is causing an issue for the machine. In these cases, often the best solution is to simply retrain the route.

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Ensuring Success with Your Robotic Scrubber Should be a Team Effort

To get the most out of your robotic scrubber, remember to:

1. Make a plan

2. Start simple

3. Iterate

In most environments, one individual will be responsible for developing and training the robotic scrubber on its cleaning routes – typically referred to as the Installer. However, maximizing the effectiveness of the robotic scrubber in your facility will be a team effort. Many times, other staff members can help identify opportunities for routing and operational improvements as the machine becomes ingrained in the overall cleaning strategy of the facility.

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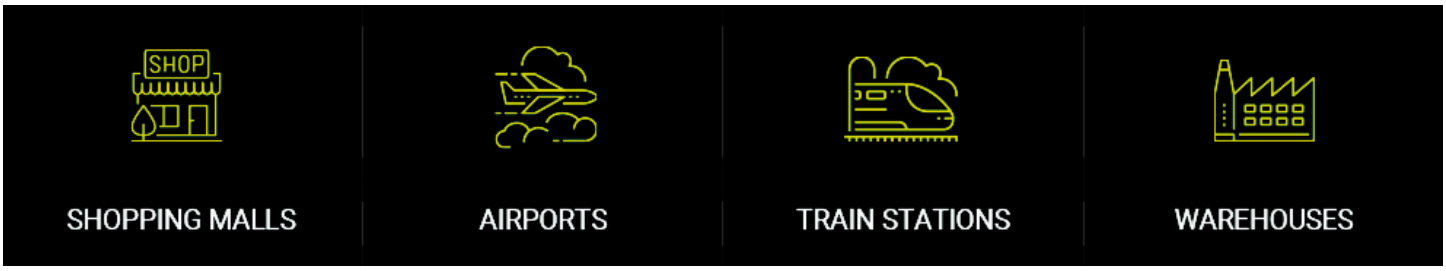
Environmental Considerations Across Facility Types

Some environments/facilities have unique routing challenges that can be easily addressed with proper planning:



These sites tend to be large open spaces with few dynamic objects. It is preferable to make long routes, making sure to avoid common problematic obstacles and consider battery and clean water tank capacity when designing routes.

Seasonal Décor

- Seasonal displays for the holidays are often in areas that obstruct the robotic scrubber's normal route path. This presents challenges with the robot's original mapped route which could lead to the robot having trouble localizing or navigating around potentially undetectable objects such as fake snow, signs or temporary carpet.
- If this is not an option, it is recommended that new routes be created to accommodate the seasonal displays
- Do not delete original routes so they can be used again when the seasonal displays are removed

Retail Or Food & Beverage Kiosks

- Similar to the challenge with seasonal decor are when retail kiosks are added or removed from the environment. The robotic scrubber may not be able to navigate around a new kiosk placed in its path, and it will not automatically adjust its routes to scrub areas previously occupied by kiosks that have been removed.
- When autonomous routes are created, areas subject to frequently added or removed kiosks should be excluded and instead be cleaned manually.

Food Court Seating Areas

- Dynamic environments such as the food court below may not be best suited for autonomous cleaning. The tables and chairs move around and often there is not enough space for the machine to clean in between. It is possible where there is enough space, but it would require thorough preparation each night to ensure all the areas are clear and chairs pushed in.

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Flat Objects On The Floor
Signs or umbrellas with flat bases, all-weather entrance mats, and raised flooring for displays can create issues

- The robotic scrubber cannot detect these types of objects and will run them over in autonomous mode. If they appear in the robot's route, move them out of the way or retrain routes to avoid such objects.

Ramps And Sloped Floors
- The robotic scrubber cannot navigate up and down slopes. When making autonomous routes do not attempt to go up or down ramps and other sloped areas.
- Sloped areas can serve as a natural barrier when segmenting a space between several different autonomous routes.

Uneven Flooring
- Uneven flooring or areas with raised flooring less than 4 inches are undetectable by the robot's vision system.
- The robotic scrubber may be able to drive over the uneven flooring manually but running autonomously can present issues with the robot's ability to see the depression or raised portion of the floor. If this happens while the machine is running autonomously, it may recognize the depressed area as a cliff and the raised area as a wall.
- Avoid uneven flooring while training routes keeping in mind that the robot sees the environment differently.
- Place objects like cones or wet floor signs over the affected area you'd like the robot to avoid.

Leafy Plants / Floral Sections And Displays
- Plants can become problematic obstacles because they grow over time and their dimensions increase.
- When creating routes you may need to leave a 2-foot buffer between the robot's autonomous path and leafy plants.

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Retail Environments

During autonomous operation, the robotic scrubber's environment is often shared with employees restocking shelves or performing other activities. Therefore, route preparation is vital to minimize disruptions and maximize cleaning efficiency. Keep these possible environmental factors in mind to ensure successful operation of your robotic scrubber:

New Displays In Aisle Entrances And Racetrack Aisles

- New displays can reduce the width of an aisle entrance to less than the dimensions required for the robotic scrubber, making it hard or impossible for the machine to turn into when operating autonomously
- When possible, move such displays out of the way or make new routes

Display Swap Outs

- Merchandise displays will often be swapped out, particularly in produce areas of grocery stores or in areas with seasonal merchandise.
- If the dimensions of the displays are greatly different, the machine may be unable to navigate the space without calling for assistance. If navigation or cleaning coverages is compromised, teach a new route for that affected area.

Wheeled Displays

- If the environment is already tight, slight movements to wheeled displays can create spaces that are too tight for navigation.
- Exclude these areas from routes, and instead clean manually

Leafy Plants / Floral Sections And Displays

- Plants can become problematic obstacles because they grow over time and their dimensions increase.
- When creating routes you may need to leave a 2-foot buffer between the robot's autonomous path and leafy plants.

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