



TENNANT AMR

PROCESS GUIDE

TO BECOMING AN EXPERT IN
ROBOTIC FLOOR CARE



This process guide serves as a training and reference manual to help you achieve a good understanding of your **robotic scrubber** and the deployment process. This document details the process and best practices for getting the most out of your robotic scrubber. This guide also provides tips and tricks to keep in mind when working with your Tennant robotic floor scrubber.

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INTRODUCING YOUR **TENNANT ROBOTIC FLOOR SCRUBBER** POWERED BY **BrainOS®**

A SMART, SAFE, AUTONOMOUS FLOOR CARE SOLUTION

Brain Corporation's artificial intelligence (AI) technology, BrainOS®, represents the next generation of robotic floor care. BrainOS® is an advanced vision-based AI system capable of navigating complex, real-world environments. Brain Corporation has partnered with leading commercial equipment brands to create best-in-class, self-driving floor care machines.

WHY A ROBOTIC FLOOR SCRUBBER

- Allows janitorial staff to focus on higher-value cleaning tasks
- Maximizes efficiency and lowers operational costs
- Ensures greater reliability and more consistent floor-cleaning performance
- Elevates janitorial skills by offering a robot-operator certification program

HOW YOUR ROBOTIC FLOOR SCRUBBER WORKS

NAVIGATING COMPLEX ENVIRONMENTS



PERCEIVE THE ENVIRONMENT

CONTROL VEHICLE MOTION

NAVIGATE VIA ENVIRONMENTAL
CUES AND LANDMARKS

AVOID PEOPLE AND OBSTACLES

This Tennant robotic floor scrubber navigates complex environments without requiring infrastructure modifications or relying on GPS. BrainOS technology uses a multi-layered sensor array which is used to both scan and perceive the environment while in operation.

While the machine scans the environment to create a map, it simultaneously records the route the operator teaches. Routes saved then appear on the user interface screen.

The robotic floor scrubber then uses that map and route to navigate and clean the facility while avoiding unexpected obstacles and people.

ROBOTIC FEATURES



Dual Mode: Manual and Autonomous.



Multiple cleaning routes can be programmed by the user. Robot operators can do this by selecting **Teach Route** on the touchscreen.



Automatic status messages are sent to the operator via SMS message.



Multi-layer sensor system perceives environments, while detecting & avoiding people and obstacles.



Sensors detect & avoid stairs and other abrupt changes in floor height.



Cloud Connected robot operations center that provides remote monitoring and machine analytics.



ROBOTIC FLOOR SCRUBBER

ON-SITE INSTALLATION

SITE DEPLOYMENT AND SETUP

Please carefully review the outline below, as this document prepares you for a successful deployment.

YOUR DEPLOYMENT TEAM

Your deployment team will provide routine communication and updates as the deployment progresses. Once the deployment is complete and your robotic scrubber is fully operational, you will start to receive usage reports and continue to have access to support and service throughout the Tennant ecosystem to help ensure optimal machine performance.



PROCESS OVERVIEW

Your deployment team will contact you prior to delivery to coordinate logistics and answer any questions.



- Deployment and training ranges from a 1 to 4 day process, depending on the size of your facility.
- The instruction process is designed as a “Train the Trainer” program. That is, we will train your staff to train other machine operators. Please be sure to identify your in-house trainer(s) prior to the start of deployment.



- Your robotic scrubber comes with 10 Home Markers. Each Home Marker must be affixed to a wall or other vertically flat surface. Each cleaning route begins and ends at a single Home Marker.



- » Up to 6 cleaning routes can be associated with each Home Marker. 10 Home Markers are included with each robotic scrubber, giving you a total of 60 possible cleaning routes.



- Your deployment team will train you on how to optimize routes.
- Best practices for your environment will be reviewed. Refer to pages 13-18 for best practices and environmental considerations.

TIMELINE AND AGENDA

Below are the steps that make for a successful deployment at your facility.



1. Identify the area where you plan to house and charge your robotic scrubber.
2. Uncrate, set up and test your robotic scrubber to ensure proper operation.
3. Trainee introductions and overview.
4. Walk the areas targeted for cleaning and discuss scope of work (cleaning routes and optimal times).
5. Product overview.
6. How to pair a phone for assists.
7. Begin mapping and teaching cleaning routes.
8. Test routes to ensure Trouble Free Operation (TFO).
9. Observe and recap best practices.
10. Discuss workflow considerations with staff, including working in parallel.
11. Review service and preventative maintenance.

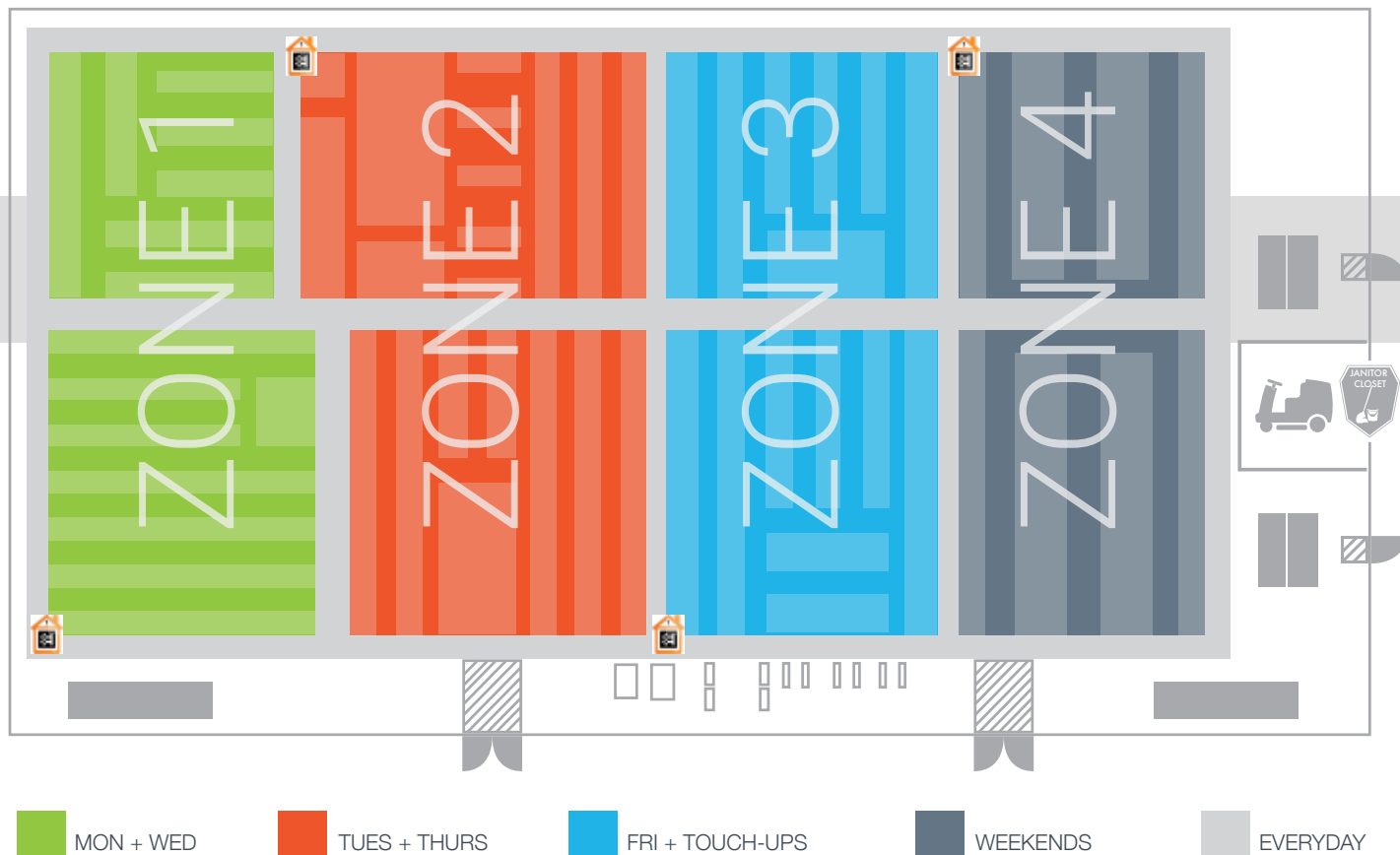
CLEANING STRATEGIES FOR YOUR ROBOTIC FLOOR SCRUBBER

SPACE SEGMENTATION FOR OPTIMAL PERFORMANCE

There are many considerations when planning cleaning routes in order to maximize and optimize your robotic scrubber performance. When teaching routes, it's important to create a logical cleaning strategy that works for your specific space and its unique configuration, size and features.

For best performance, follow the turn parameters for your robotic scrubber. Turn parameters are the space requirements needed for your machine to successfully maneuver within a given environment. These parameters are detailed in the machine's Operational Manual.

Figure A

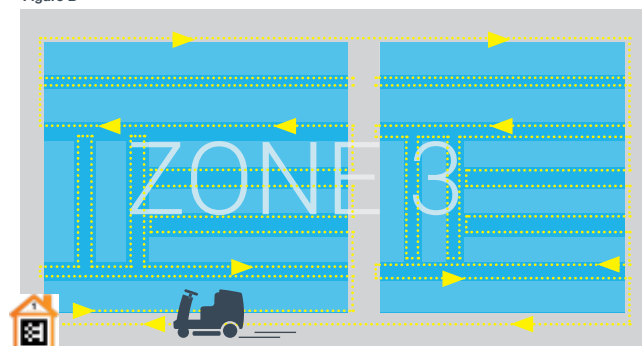


PATH CREATION EXAMPLE

Figure A - Shows one large space that has been segmented into four zones.

Figure B - Illustrates the importance of logical path planning. Pay particular attention to how many passes an aisle requires for optimal coverage.

Figure B



TEACH CLEANING ZONES

If your robotic scrubber will be cleaning a particularly large space, such as a warehouse, large retail store or distribution center, it's best to create multiple, smaller cleaning zones within the space, rather than one long route encompassing the entire space.

This approach creates more manageable cleaning routes. It also allows for effective planning and space usage and prevents unnecessary low-water assists. By creating multiple cleaning zones, you can ensure that the zone your robotic scrubber will be cleaning on a given day or time is free of obstacles and clutter, while leaving other areas fully functional.



PLAN FOR SPACE AND FREQUENCY

It's important to consider space type when planning cleaning routes. For instance, it's a good idea to identify spaces that might need to be cleaned more frequently or on an ad-hoc basis, and create individual routes for such spaces. Examples include an entrance way, lobby, or heavily traveled artery that might need to be cleaned more frequently. This warrants its own separate cleaning route, versus being part of a big route that is not used as often.

CONSIDER DIFFERENT TYPES OF SPACES

Some spaces, such as offices or schools, will not necessarily divide into cleaning zones in the same manner as a store or warehouse. In such cases, review the entire space before starting to teach cleaning routes and develop an efficient and logical plan that is easy to complete and predictable for the operator.

For example, when there are multiple buildings to be cleaned or multiple wings in a building, use separate Home Markers for each floor building or wing. This allows your robotic scrubber to start and stop closer to the area it is cleaning, minimizing long traverses across a space.

In addition, when cleaning large or unusually shaped spaces, it's best to divide the space into smaller, more manageable routes for optimal robotic scrubbing.



WHY PLAN AHEAD?

- Teach manageable cleaning routes
- Effective planning and space usage
- Prevents unnecessary low water alerts
- Frees up any obstacles and clutter giving maximum floor coverage

OPTIMIZING WORKFLOW WITH YOUR ROBOTIC FLOOR SCRUBBER

Your robotic scrubber is reliable and consistent, autonomously cleaning floors and freeing up valuable staff time. By using a Brain OS-powered robotic scrubber, your staff is able to focus on higher value work or special projects. This section is designed to help you think about how to optimize workflow and create efficiency within your cleaning routine.

CONDUCT WORK IN PARALLEL

Think of your robotic scrubber as a teammate. One of the best ways to maximize the efficiency of your new machine is to conduct work in parallel. After users start the robotic scrubber on its designated cleaning route, they can edge clean at the same time or even move onto other tasks such as dusting, cleaning windows, etc., while the robotic scrubber works nearby.

- ✓ OPTIMIZE WORKFLOW
- ✓ EFFICIENT ROUTING
- ✓ MULTI-TASKING



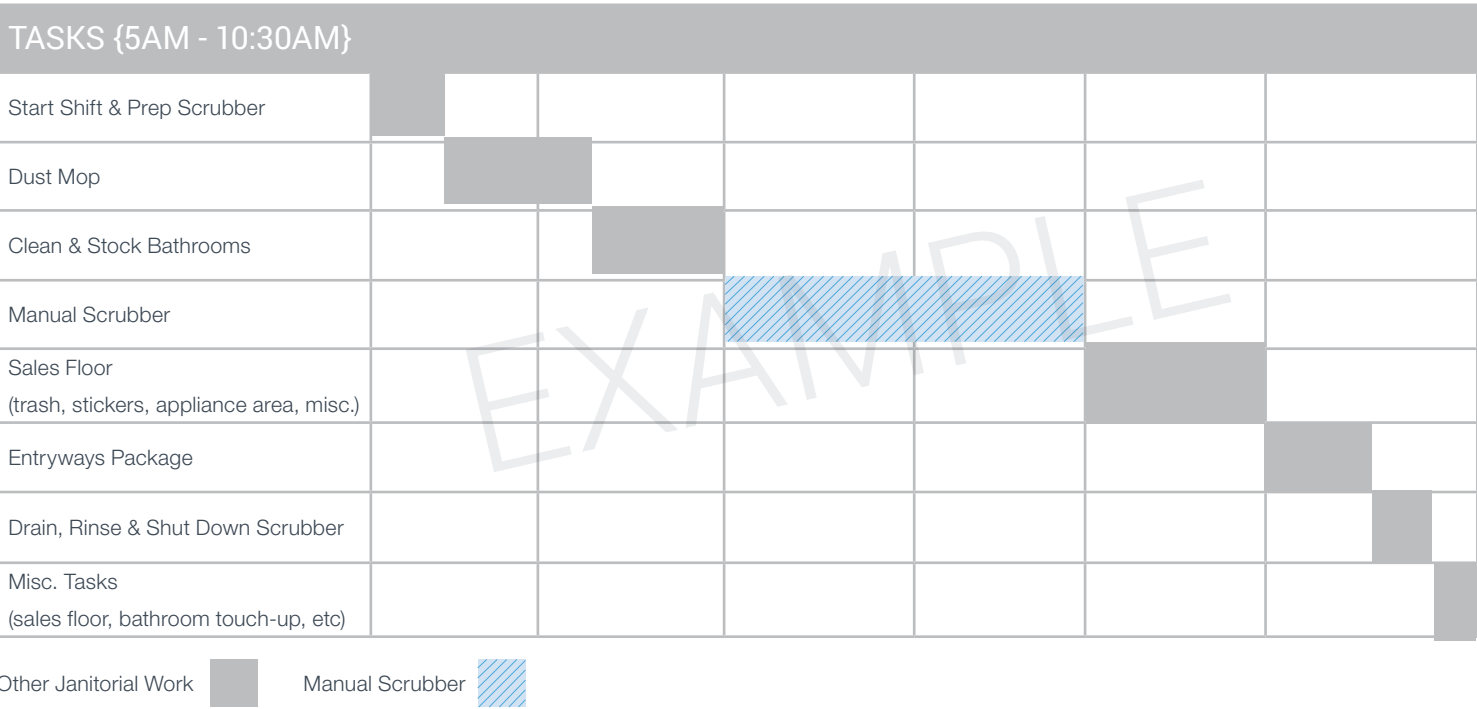
REORGANIZE CLEANING TASKS

For best results, you may need to consider reorganizing the order of cleaning tasks while your robotic scrubber cleans the floor.

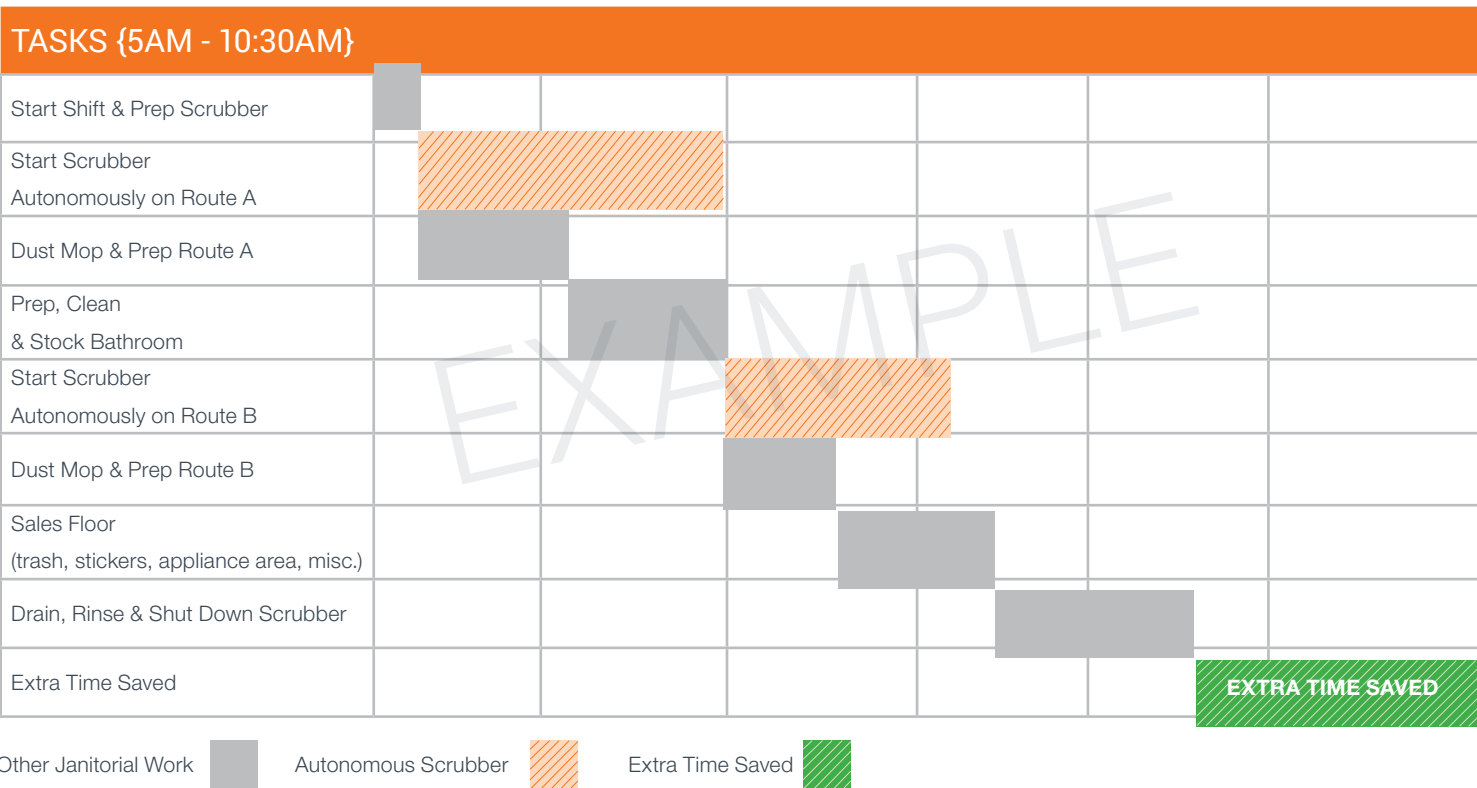
For instance, you may want to prep or dust mop the floor just ahead of the robotic scrubber, allowing two steps of the cleaning process to be completed at once.

For safety reasons, the robotic scrubber will slow down when people are around. If floor cleaning is typically performed when the facility is busy, consider shifting this task to another time of day. Doing so may improve area coverage and performance.

EXISTING WORKFLOW WITHOUT A ROBOTIC SCRUBBER



OPTIMIZED WORKFLOW WITH A ROBOTIC SCRUBBER



ROBOTIC FLOOR SCRUBBER

USAGE REPORTS

OVERVIEW

Your robotic floor scrubber is cloud connected, and uploads usage information to the Robot Operations Center (ROC). One of the most powerful benefits of your new robotic floor scrubber machine is provided by the web-based ROC Portal, which generates usage reports that are sent right to your inbox. The information in these reports provides key insights regarding your robotic scrubber's operations and usage.

USAGE DATA

Know exactly how your robotic floor scrubber was used based on data, not anecdote. Usage data allows your team to quantify how your floors are being cleaned. This data can help drive budgetary and operational decisions.

Reports include usage information for robotic, manual, and training usage. In addition, reports detail the time of day the robotic scrubber is being used and for how long. A percentage complete for each route is also included.

Reports provide operational insights, allowing you to identify trouble spots, confirm work being done, and determine if your staff may need additional training on proper use and maintenance.

EXAMPLE USAGE SUMMARY

Usage by Mode

Date	Auto	Manual	Training
11/5	3:16 hrs	0:33 hrs	0 hrs
11/6	3:13 hrs	0:59 hrs	0 hrs
11/7	3:16 hrs	0:36 hrs	0 hrs
11/8	3:56 hrs	0:39 hrs	0:27 hrs
11/9	3:47 hrs	0:26 hrs	0 hrs
11/10	3:14 hrs	0:36 hrs	0 hrs
11/11	3:34 hrs	0:19 hrs	0 hrs
Total	24:17 hrs	4:10 hrs	0:27 hrs

ROBOTIC FLOOR SCRUBBER

HEAT MAPS

OVERVIEW

Each time your robotic floor scrubber autonomously cleans a route, the machine's sensors record the path and map the space that's being cleaned. These maps provide valuable insights into how much of your space was cleaned. For example, the maps can highlight areas where the robotic floor scrubber consistently encounters obstacles, allowing you to make changes in your environment or workflow to improve performance.

HOW TO READ THE HEAT MAPS

The heat maps show the layout of your facility along the cleaning route from the perspective of the robotic scrubber. The map's appearance is similar to what a construction floorplan looks like.

There are three colors used to illustrate cleaning paths on the maps.

- Blue shaded areas represent the actual route cleaned by the robotic scrubber.
- Orange shaded areas represent the original path where the robotic scrubber was trained to clean, but did not clean during this current operation.
- Dark-blue shaded areas represent multiple passes by the robotic scrubber. Multiple passes are often used for heavily soiled areas, or can occur when the machine has areas that it must pass through to get from one section to the next.

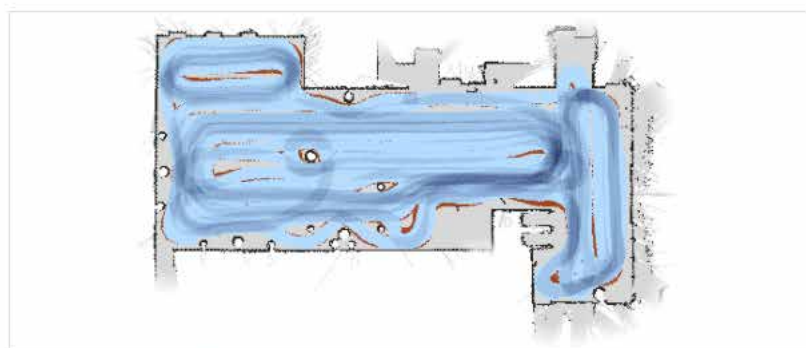


HOW TO UTILIZE MAP INFORMATION

Heat maps illustrate the overall consistency of your cleaning routes. These maps also identify spaces that your machine may have missed or avoided due to obstacles. Should your map show more orange areas (original route), this is an indication of areas missed. Workflow changes (such as changing the time of operation to off-peak hours), better preparation of the environment, machine service, retraining operators, or retraining routes may be possible solutions to consider.

Route 1A

Start Time	11/10/2020, 9:36:01 PM CST
End Time	11/10/2020, 10:01:58 PM CST
Run Time	00:25 hrs
Coverage	10781 ft ²
Assists	0



● Autonomous Route ● Trained Route ● Training Route

ROBOTIC FLOOR SCRUBBER SAFETY INFORMATION

SMART & SAFE PERFORMANCE

When used properly, your robotic floor scrubber can provide many benefits. Outlined below are some of the important performance features that help provide safe, consistent and predictable operation.

SENSORS

Your robotic floor scrubber was designed with advanced sensors to prevent collisions and help stay clear of obstacles, people, or abrupt changes in floor height such as stairs. To deter unauthorized use, while in self-driving mode the robotic floor scrubber will stop if anyone attempts to ride or operate the robotic floor scrubber.



SIGNALS AND ALERTS

The robotic floor scrubber is equipped with a variety of visual and audible alerts that help ensure safe operation. Turn signals, beeps, and warning lights help convey information while the robotic floor scrubber is in use.

Operators can pair a phone to wirelessly receive notifications during its operation. These same notifications can be viewed on the touchscreen.



WHAT TO DO IF YOUR ROBOTIC SCRUBBER NEEDS HELP

Sometimes your robotic floor scrubber can get stuck. If your robotic floor scrubber is stopped with blinkers flashing, this means your assistance is needed. You can help by moving the obstacle out of the way. Simply press the blue button once the obstacle is removed and the robot will continue on its path!

BRAKING DISTANCE

The stopping distance for the robot is approximately half that of a human operator, ensuring maximum safety at all times.

Average Human
Stopping Distance



Robotic Scrubber
Stopping Distance



Thinking Distance

Braking Distance

PAUSING OR STOPPING THE ROBOTIC FLOOR SCRUBBER

If you need to stop or pause your robotic floor scrubber, approach from behind and press the Pause/Start button at the back of the robotic floor scrubber. You can resume operation by pressing the button again. If necessary, the robotic floor scrubber can be driven around an obstacle should it be too large or heavy to move. The touchscreen helps guide you on the machine's path. Once around the obstacle, press the Start/Pause button to resume.



EMERGENCY SHUTDOWN

If there is an emergency and you need to stop your robotic scrubber immediately, this may be done by pressing the Emergency Stop button. Keep in mind that stopping the machine with the Emergency Stop button may result in water leakage. Note, the button must be twisted clockwise (to the right) to release it. Check the floor and vacuum any residual water near or under the machine.

NAVIGATION

Your robotic floor scrubber's navigation system includes a variety of features to ensure safe operation.

- Your robotic floor scrubber is never in a rush, minimizing mistakes or safety issues tied to hasty performance.
- When your robotic floor scrubber encounters moving objects, the robotic floor scrubber stops and waits, proceeding once the path is clear.
- Your machine also adjusts and slows its speed based on the complexity of the environment. The machine slows around blind corners and when going around obstacles.
- Your machine approaches people and static objects differently. When near people, the robot pauses and waits for them to pass.
- Your robot has a frontal view of about 25 meters (82 feet).
- The machine operates at a max speed of 2.2 mph (1 m/s) while operating autonomously. Average speed is based on the complexity of the environment, and varies based on how many obstacles and people are present.

ROBOTIC FLOOR SCRUBBER BEST PRACTICES

ESTABLISHING PERMANENT HOME MARKER(S)

Home Markers must be in the exact same location each time your robotic floor scrubber is used.

- Home Markers must be fixed to a wall or flat surface, at the height of the side 2D camera. See your Operational Manual for the specification.
- Home Markers should be placed in an area with enough light for the camera to see the code. A flashlight may be used in a lights-out building.
- Home Markers should never be photocopied, laminated, or placed in a sleeve or cover. Doing so may prevent the robot scrubber's camera from reading the code.
- Home markers should be placed in an area where there is good 4G LTE service.

TEACHING ROUTES

- Teach routes when the area is most clear of obstacles and people that may block the scrubber's path. This may require teaching routes outside of your normal cleaning times.
- If a route is taught in an area with obstructions that are later removed, the scrubber will not clean any areas previously occupied by those obstructions. Therefore, it is recommended to train routes when there are the fewest number of obstacles and activity in the corresponding environment.
- When teaching a route make smooth wide turns, avoid narrow aisles, and do not drive in reverse.
For best performance, follow the turn parameters for your robotic scrubber, as outlined in the Operational Manual.
- Knowing the turn parameters will help prevent the robot from getting stuck in tight spaces.
- U-turns slow the robot down and should be used as minimally as possible. Try to circle around or alternate aisles wherever possible.
- Avoid routes over 1.5 hours in length – break up your space into cleaning zones based on the capacity of your water tank.
- To traverse a non-scrubbable area, lift the scrub deck about ten feet prior to reaching it.

TESTING ROUTES

- Test all routes to ensure the unit can run them successfully. Monitor the scrubber during testing and note any areas of difficulty. In general, the robotic floor scrubber requires more space than a standard manual floor scrubber. Your autonomous machine has a safety bubble around it, making the footprint slightly larger and ensuring safe operation.
- If you notice the unit calling for many assists when testing your route, assess the environment and remove any obstructions. If the assists persist after obstructions are removed, the route you trained may include maneuvers that the robotic floor scrubber cannot replicate autonomously. The best solution is to retrain the route.
- Understanding your machine's turn parameters is critical for optimized performance in your facility.

RUNNING ROUTES

- Preparing the environment during dust mopping is key to successful autonomous operation. It is essential to remove obstructions like boxes, new “movable” features (e.g. end-caps), and to push back any protruding merchandise or items.
- Run routes when the area is most free of people and freight. Identify the best times to run different routes based on how the environment changes throughout your shift.

- Stay clear of the front of the robotic floor scrubber and sensors. Do not crowd or stand in front of the robotic floor scrubber, especially while choosing routes at the Home Marker. Keep people behind the robotic floor scrubber.

RUNNING ROUTES (CONTINUED)

- During the first 30 seconds of an autonomous route, monitor the robotic floor scrubber's side and rear squeegees to make sure they are properly adjusted. Pause the robot by pressing the Start/Pause button and adjust the squeegees if necessary.
- Remember to pair your phone to receive notifications from your robotic floor scrubber.
- Optimize power usage
 - » For daily floor maintenance, use lower water and pressure settings for longer battery life when possible (ex: daily cleaning routes that have minimal dirt).

WHEN TO TEACH NEW ROUTES

- If the environment changes significantly (e.g. remodeling, significant new features, obstructions, etc.), it may be necessary to teach a new route.
- A new route will be needed when the dimensions of the space have changed so much that the scrubber is having trouble navigating and is calling for frequent assists.
- Some common examples of changes that can necessitate new routes include:
 - » New wing stacks added to the ends of aisles in retail spaces can narrow the width of the aisle entrances to less than the required turn parameter for your robotic floor scrubber. Extremely narrow aisles should be excluded from autonomous routes.
 - » New merchandise displays in the racetrack areas of retail stores, blocking the machine's intended path.
 - » Merchandise displays switched out, with new displays having different dimensions that the scrubber has trouble navigating.
- Also, if dimensions change revealing new floor space that was previously covered, new routes may be desired to include that area in a robotic route.

INSPECT & MAINTAIN THE ROBOTIC SCRUBBER

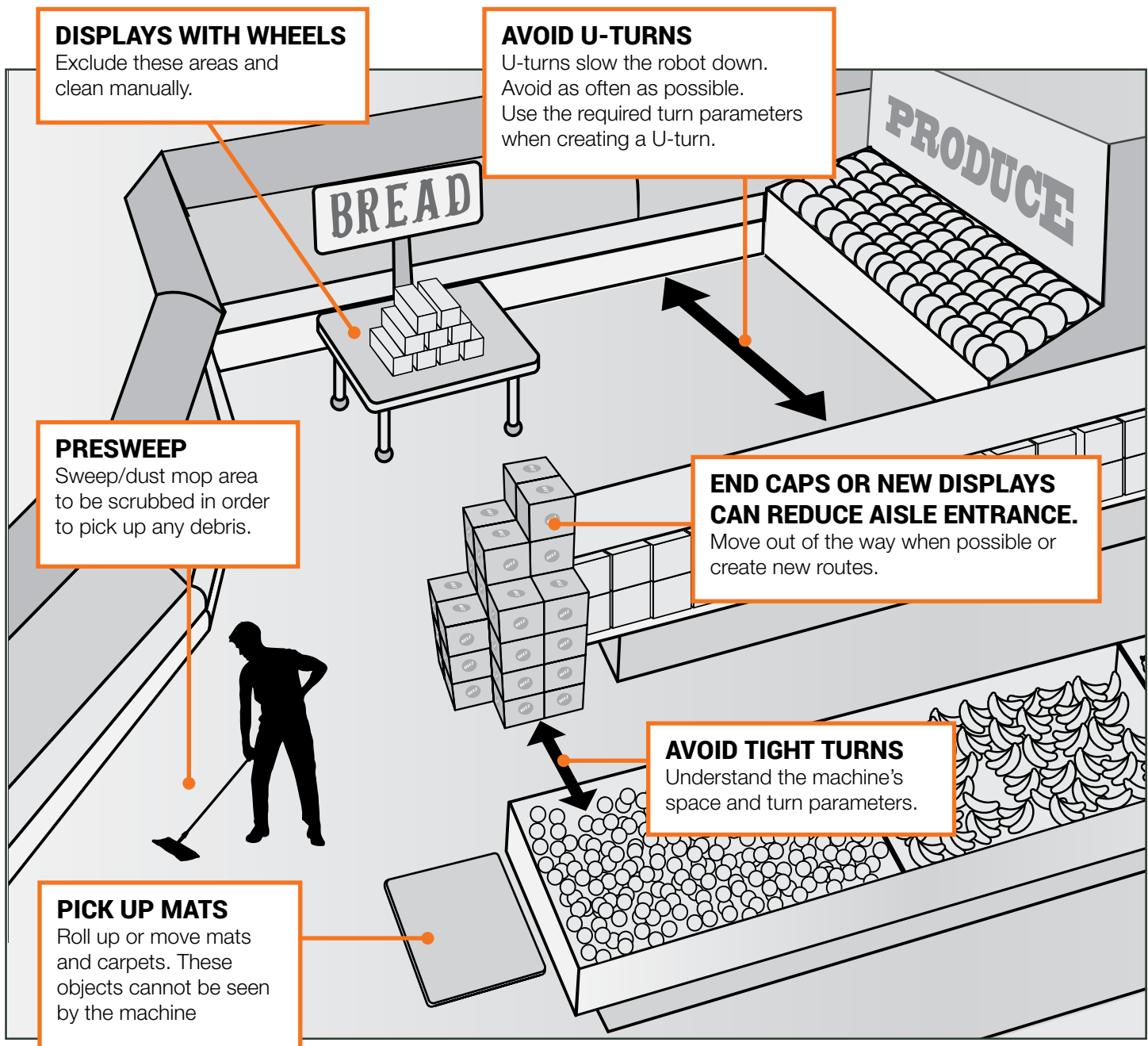
Ensure optimal performance by performing the following maintenance steps.

- Visually inspect the sensors and wipe down each day.
- Dirty sensors can affect the performance of your robot. Inspect the LIDARs and 3D sensors to ensure they are free of dust, dirt and smudges. Use the microfiber cloth provided. Do not apply water to the sensor.
- Inspect pads, brushes & squeegees.
 - » As brushes wear down, the scrub deck gets lower. Ensure the side squeegees are adjusted properly and raise them as needed.
 - » Replace worn brushes and pads.
 - » Inspect rear squeegee for wear and flip or replace if necessary.
- Park your robotic scrubber with the sensors and front of the robotic scrubber facing the wall. Having the sensors face out can potentially expose them to being struck and damaged by other equipment.

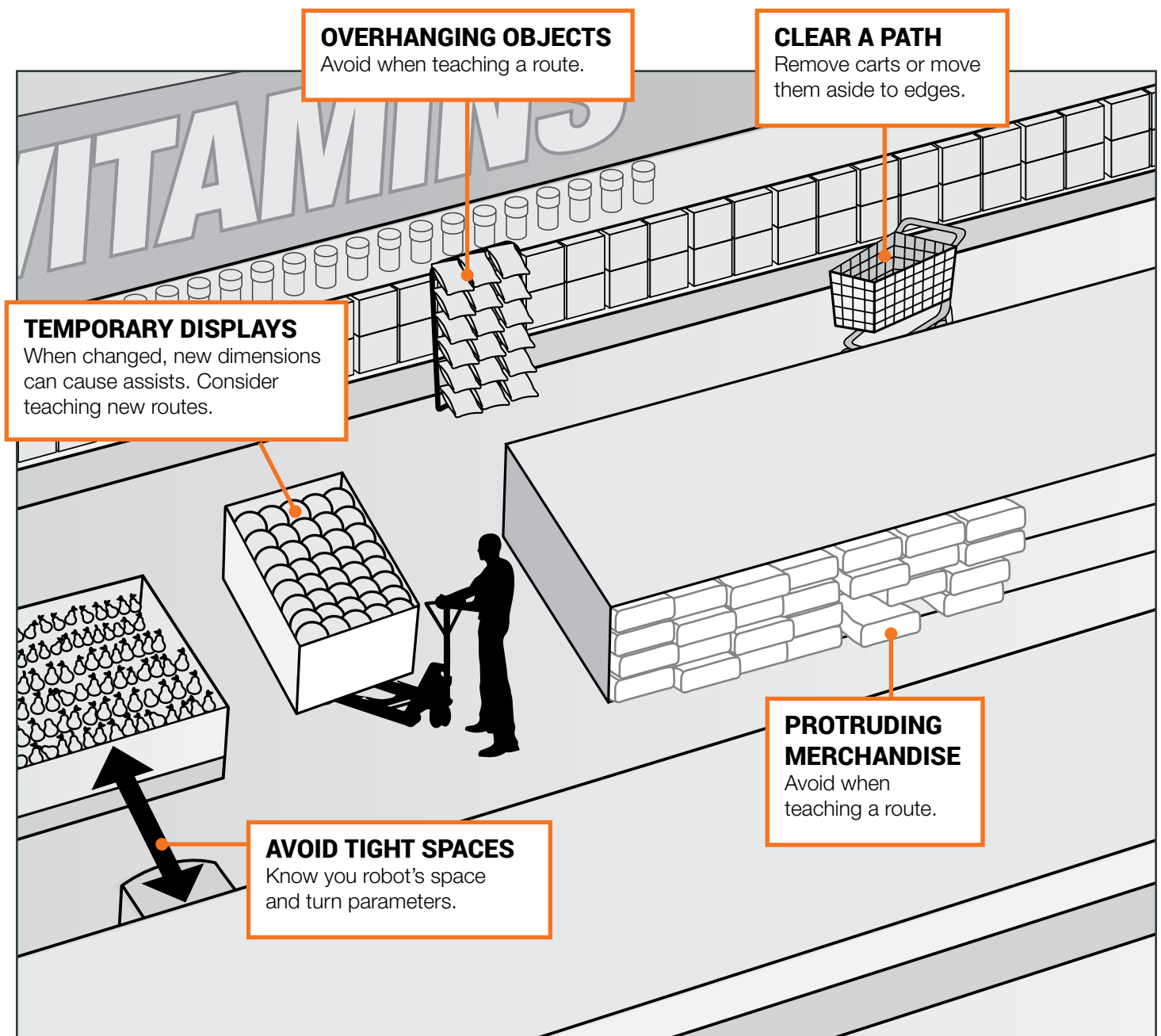
ENVIRONMENTAL CONSIDERATIONS **RETAIL**

During robotic floor scrubbing, this type of environment is often shared with employees restocking shelves. Route prep is vital. Before teaching or running a route, move boxes, pallets, shopping carts, and other movable objects out of the machine's path.

- Segment the space.
- Create multiple routes to account for other workflows at the site.
- When possible, adjust other tasks and workflows to accommodate robotic scrubbing.



ENVIRONMENTAL CONSIDERATIONS RETAIL

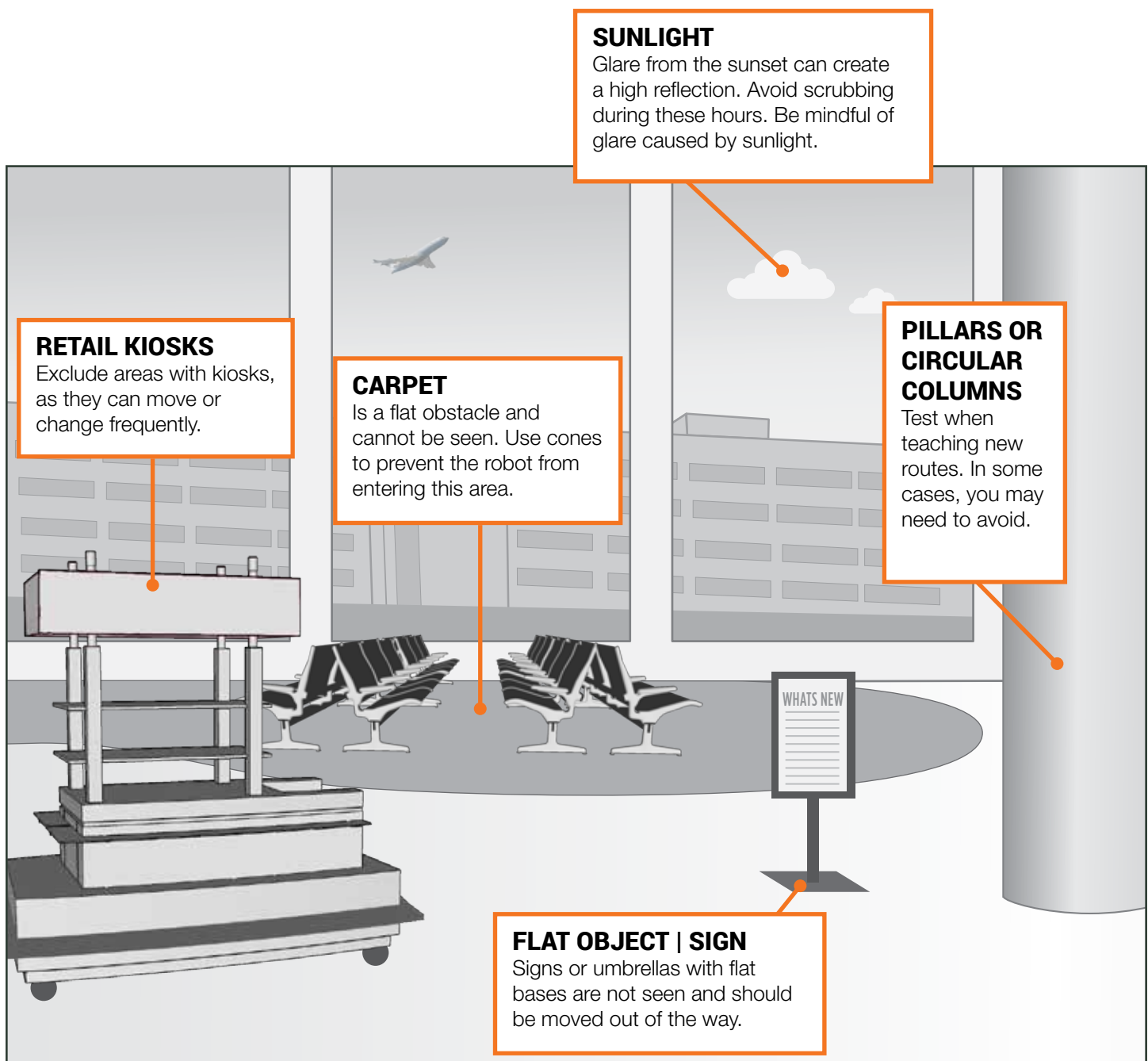


ENVIRONMENTAL CONSIDERATIONS

AIRPORT | MALL | TRAIN STATION

Large open spaces are usually less complex and have fewer objects to maneuver around. This allows you to teach longer routes.

- Base routes on water tank capacity to avoid low-water alerts.
- Avoid uneven flooring.
- Raised thresholds less than 4 inches tall are not seen by the robotic scrubber.
- Vinyl floor stickers cannot be seen and should be avoided to prevent damage during scrubbing.



ENVIRONMENTAL CONSIDERATIONS

AIRPORT | MALL | TRAIN STATION



SEASONAL DECOR AND DISPLAYS

- Holiday decorations significant in size change the environment infrastructure. Seasonal routes are therefore highly recommended.
- Small objects such as fake snow or temporary carpet are not seen. Use cones to avoid these items.

LEAFY PLANTS

As plants grow they can extend into the machine's path. Leave a 2-foot buffer between cleaning path and plant.

FOOD COURT AND CAFE AREAS.

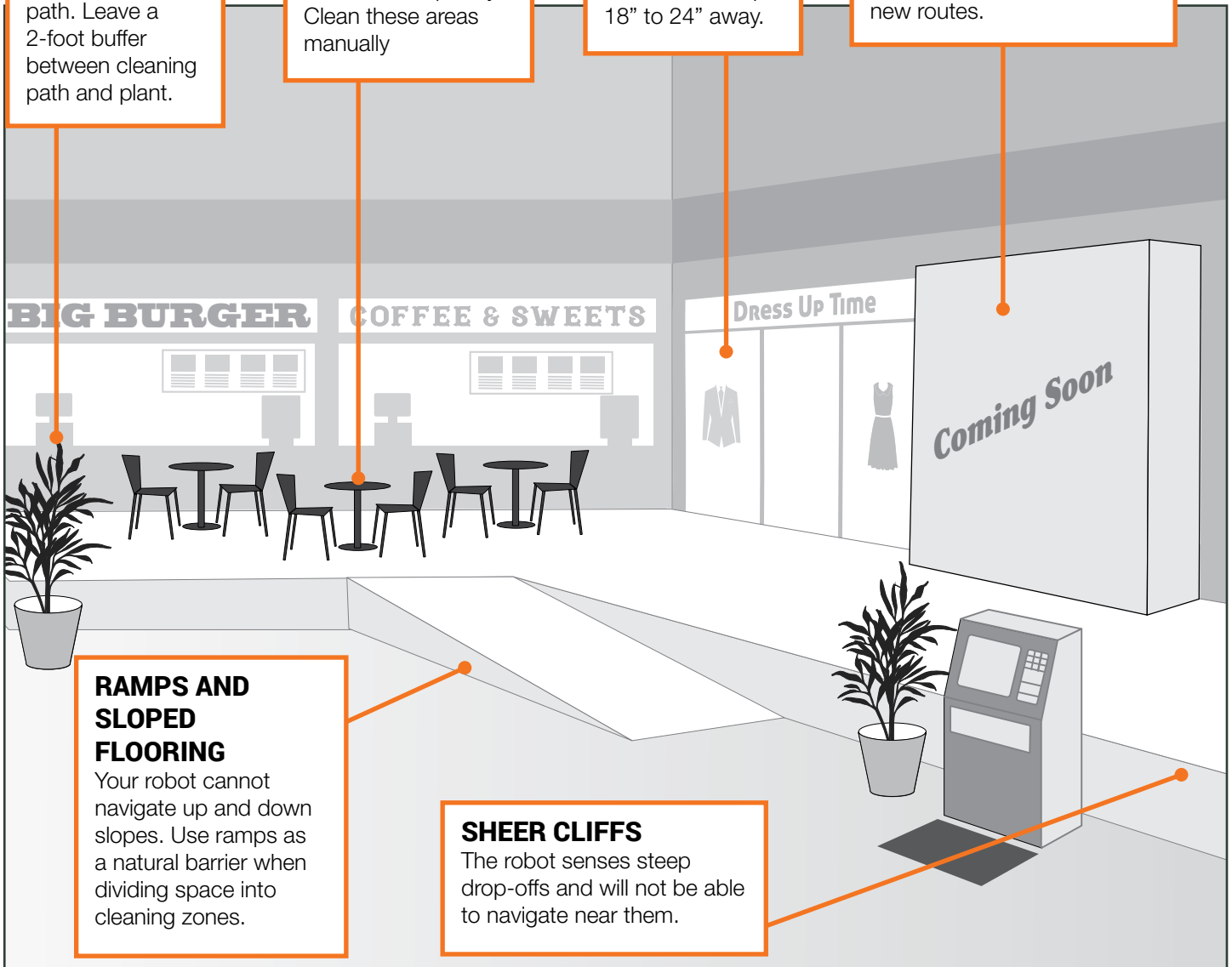
Chairs and tables move too frequently. Clean these areas manually

FLOOR-TO-CEILING GLASS

When teaching new routes keep 18" to 24" away.

CONSTRUCTION FACADES

Frequent assists may occur when facades are added or removed. Consider teaching new routes.



RAMPS AND SLOPED FLOORING

Your robot cannot navigate up and down slopes. Use ramps as a natural barrier when dividing space into cleaning zones.

SHEER CLIFFS

The robot senses steep drop-offs and will not be able to navigate near them.

ROBOTIC FLOOR SCRUBBER FAQs

FREQUENTLY ASKED QUESTIONS AND ANSWERS

Some of the most frequently asked questions can be found below with answers.

Q: How long of a route can I teach?

A: Routes should be based on the capacity of the water tank and speed of the machine. You must limit training of autonomous routes to 30 minutes or less. A route that takes 30 minutes to teach takes a machine approximately one hour to run. It is also easier to monitor and control the environment if your space is divided into smaller areas.

Q: How do I pair my phone?

A: On the robotic scrubber's touchscreen, navigate to **Settings > Notifications**. Follow the on-screen instructions to pair your phone by texting the code to the phone number displayed on the screen. Note that data charges may apply to these messages.

Q: I paired my phone yesterday but today I am not receiving any notifications.

A: You have to pair your phone every time you turn on the robotic floor scrubber, and whenever the scrubber is restarted. This is to ensure only an on-site operator will receive the notifications.

Q: My robotic scrubber gets stuck in the same place every day. There is nothing obstructing the robot, but it always stops and asks for help.

A: There could be an environmental factor such as a strong reflection causing the robotic scrubber to think there is an obstruction. For safety reasons, the robot errs on the side of caution. To help resolve the issue, contact your service provider. Make note of the route letter, the Home Marker number, the area of concern, and the date. Photos of what the robot sees are also helpful. In some cases, we may be able to remotely adjust the route to improve performance.

Q: How many routes can I train?

A: You can teach up to 6 routes per Home Marker, and there are 10 Home Markers provided. This gives you a total of 60 routes per facility.

Q: My robotic scrubber is supposed to turn (or turn around) but often stops and asks for help. Is there minimum space needed to operate or turn around?

A: Please follow the **TURN PARAMETERS** as outlined in your Operational Manual. There are three numbers to know when creating a route that is specific to your machine's size.

1. When the robot is on a straight path (passing between two objects or the width of an aisle)
2. When turning into an aisle
3. When making a U-turn

Please note the turn parameters and create routes accordingly.

ROBOTIC FLOOR SCRUBBER

CUSTOMER SERVICE

KEEPING YOUR ROBOTIC FLOOR SCRUBBER HEALTHY

From preventative maintenance to warranty service and support, the goal of customer service is to keep your **robotic scrubber** running smoothly.

SERVICE AND SUPPORT

If you have questions about your robotic scrubber or are having technical issues, start by contacting your Tennant service provider. BrainOS software is supported by the ROC (Robot Operations Center), where each machine's performance is monitored. New software updates are downloaded periodically, making sure your robotic floor scrubber has the most up-to-date version available.

FOR IMMEDIATE ASSISTANCE

If you require service or maintenance, are having technical issues, or otherwise need immediate assistance, a customer service representative can help. They may be contacted either by email or telephone.

- Toll-free customer support hotline:
1-800-553-8033
- Email support:
service@tennantco.com



