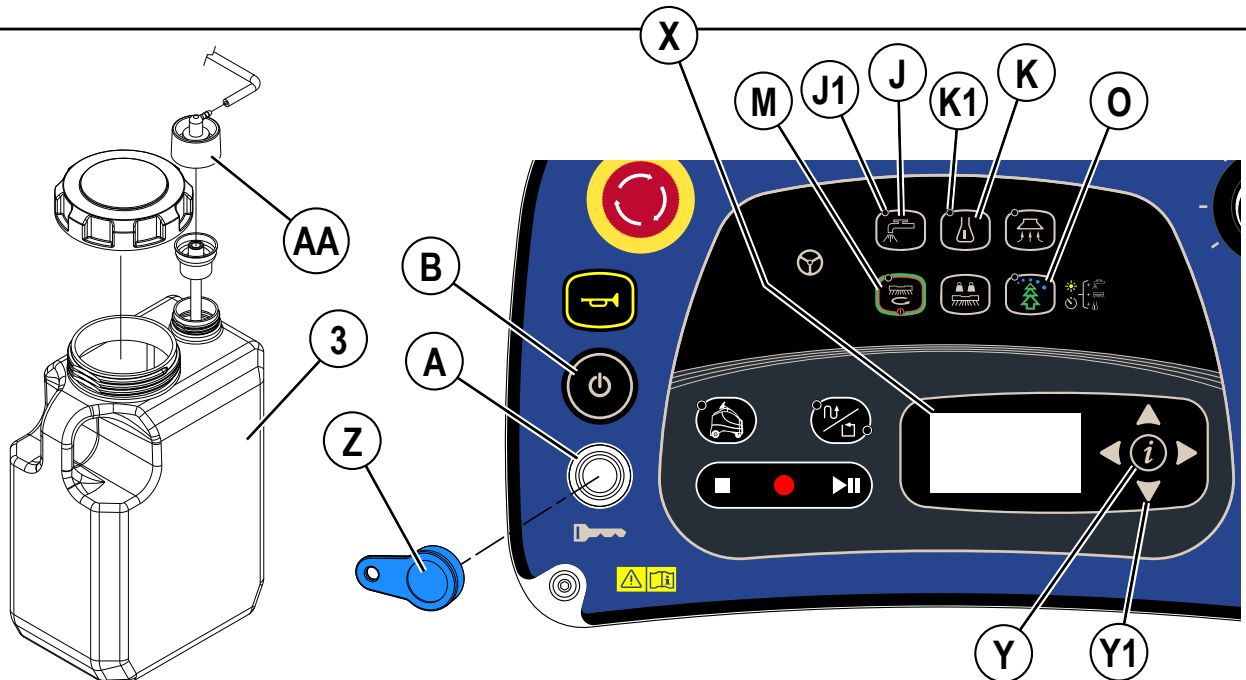
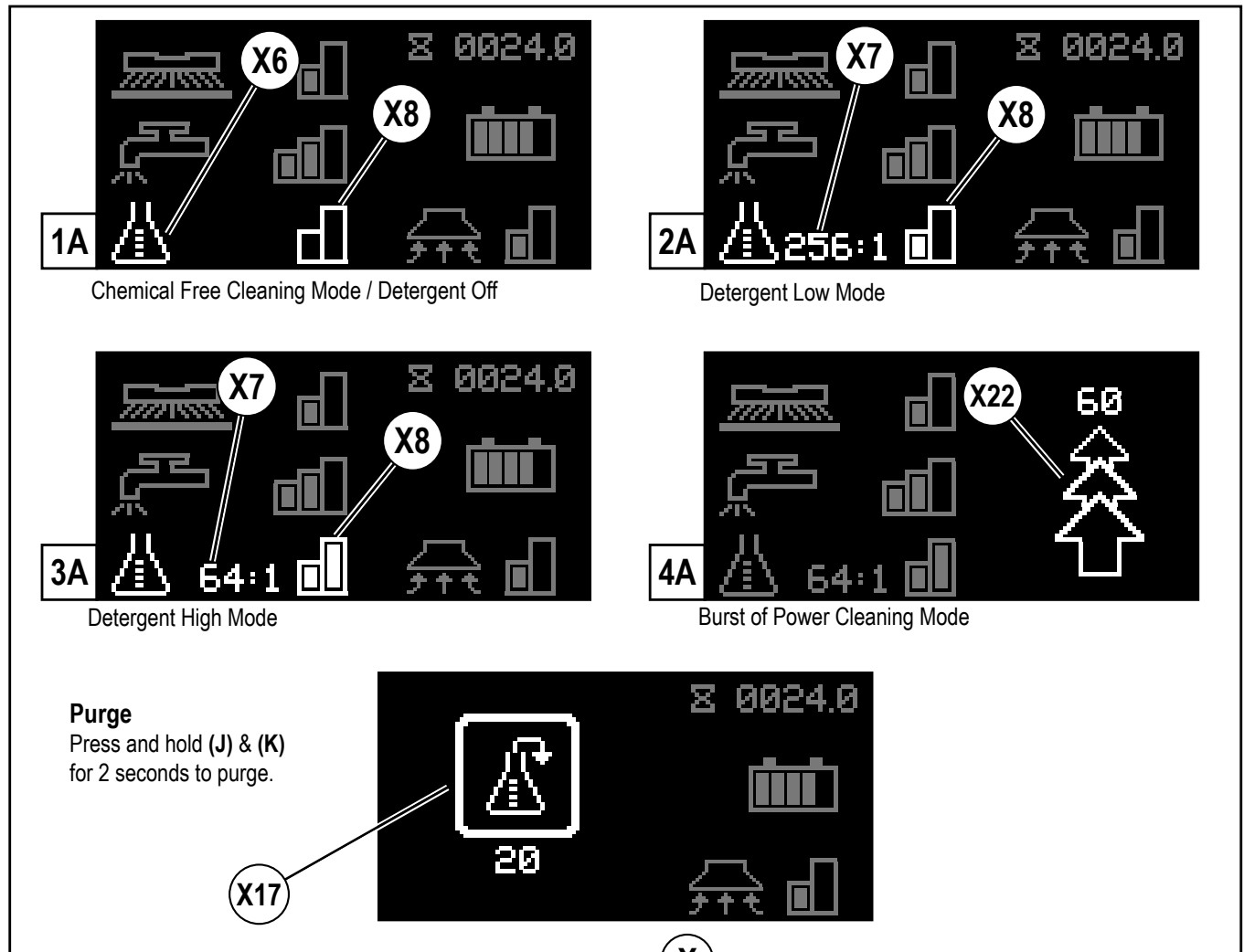


DETERGENT SYSTEM PREPARATION AND USE (ECOFLEX)

FIGURE 2-10



OPERATING THE MACHINE

WARNING!

Be sure you understand the operator controls and their functions.

While on ramps or inclines, avoid sudden stops. Avoid abrupt sharp turns. Use low speed down ramps.

Do not operate autonomously when ambient RF signal falls at or near the frequency range of 340 MHz to 460 MHz.

Operating Modes

The Nilfisk Liberty SC50 has three operating modes:

- **Manual Operating Mode:** Provides normal functioning of the machine, without autonomy. In this mode the machine is driven and controlled by an operator, and operates in a conventional manner. The machine must be driven in the manual mode while creating plans the machine will follow during Autonomous Operation. This includes driving to and from the autonomous scrubbing plans (locations). Full details of the Manual Operating Mode are contained in the *OPERATING THE MACHINE MANUAL MODE* section of this manual.
- **Autonomous Mode:** The Autonomous Operating Mode is used to perform scrubbing operations automatically, without active Operator involvement. This is done by training the machine to follow a specific plan or perimeter of an area.
 - Plans may also include specific actions the machine will make while performing the scrubbing activity. Such actions might include knowing when to raise or lower the scrub deck, how much solution to dispense. When played back, the plan tells the machine exactly what to do; what path it should follow, and what scrubbing actions it should take along the way.
 - To operate autonomously, the machine needs to always know exactly where it is in relation to the recorded plan, and the operating environment. This mapping process operates constantly, in every operating mode, whenever the machine is turned on.
- **Training Mode:** Used to create plans (either CopyCat™ or Fill-In) the machine will follow when scrubbing autonomously. Before the machine can operate autonomously, it must be trained to follow a specific plan(s) while scrubbing. During training, both the plan and required actions are recorded and saved.

STARTING THE MACHINE

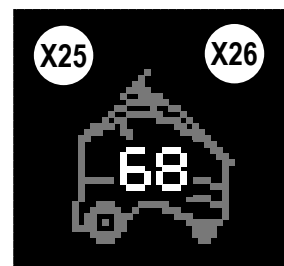
- 1 Follow the instructions in "Preparing the Machine for Use" section of this manual and verify the following;
 - Exterior of machine is free of damage. Report any damage to your supervisor.
 - Proper brush/pad is correctly installed.
 - Squeegee is installed.
 - Camera and laser lenses are clean, see *CLEAN SENSOR LENSES* section.
 - Batteries are fully charged.
 - Solution tank is full.
 - Recovery tank is empty.
 - Location tag is properly installed to a wall
 - Home Position is set (required for autonomous operation).
 - Ensure that area to be scrubbed is clear of obstacles that are not fixed, such as hoses, buckets or pails, boxes, electrical cords, carts, pallets, etc.
- 2 **See Figure 3-1.** Step onto the Platform (26) compressing Operator's Presence Pedal (25). **NOTE:** Do not press the Go Pedal (24) until you are ready to move the machine.
- 3 Place the Magnetic SmartKey (Z) onto the SmartKey Reader (A). Press the Power Switch (B). This will activate the Display (X). Wait for the start-up sequence to finish.

NOTE: At startup, the machine conducts a system self-test for the Autonomous Operating Mode. This test takes about 70 seconds to complete in order to get values from the lasers. Display will indicate the system is booting by showing Autonomous Indicator along with a Countdown Timer (X25 & X26) during the startup sequence. If the system fails to boot the countdown timer will be replaced by a question mark "?" for a few seconds then machine will display a fault code and go into manual mode.

Before startup, make sure there are no obstacles within 2' (0.6m) of the machine. Operators must stand directly behind the machine during startup to be clear of all sensors.
- 4 Reference the Battery Condition Indicator (X3) and check for any Fault Codes (X2) before proceeding.
- 5 The Manual Operation Indicator (H) will be lit.
- 6 To transport the machine to the work area, first push the Forward Drive Switch (Q) or Reverse Drive Switch (R) to select the direction of travel and then apply pressure with your foot on the Go Pedal (24). An audible alert from the speaker will sound in reverse.

NOTE: Stepping off of the Operator's Presence Pedal (25) for more than 2 seconds will cause the Forward or Reverse Drive Switch Indicator to turn off. The operator will need to select forward or reverse again before the machine can be driven.
- 7 Adjust machine speed by rotating the Speed Adjustment Knob (P) clockwise to go faster or counterclockwise to go slower.

NOTE: While the machine is operating in autonomous mode the machine's speed is set by the computer and not adjustable by using the speed adjustment knob.



STOPPING THE MACHINE

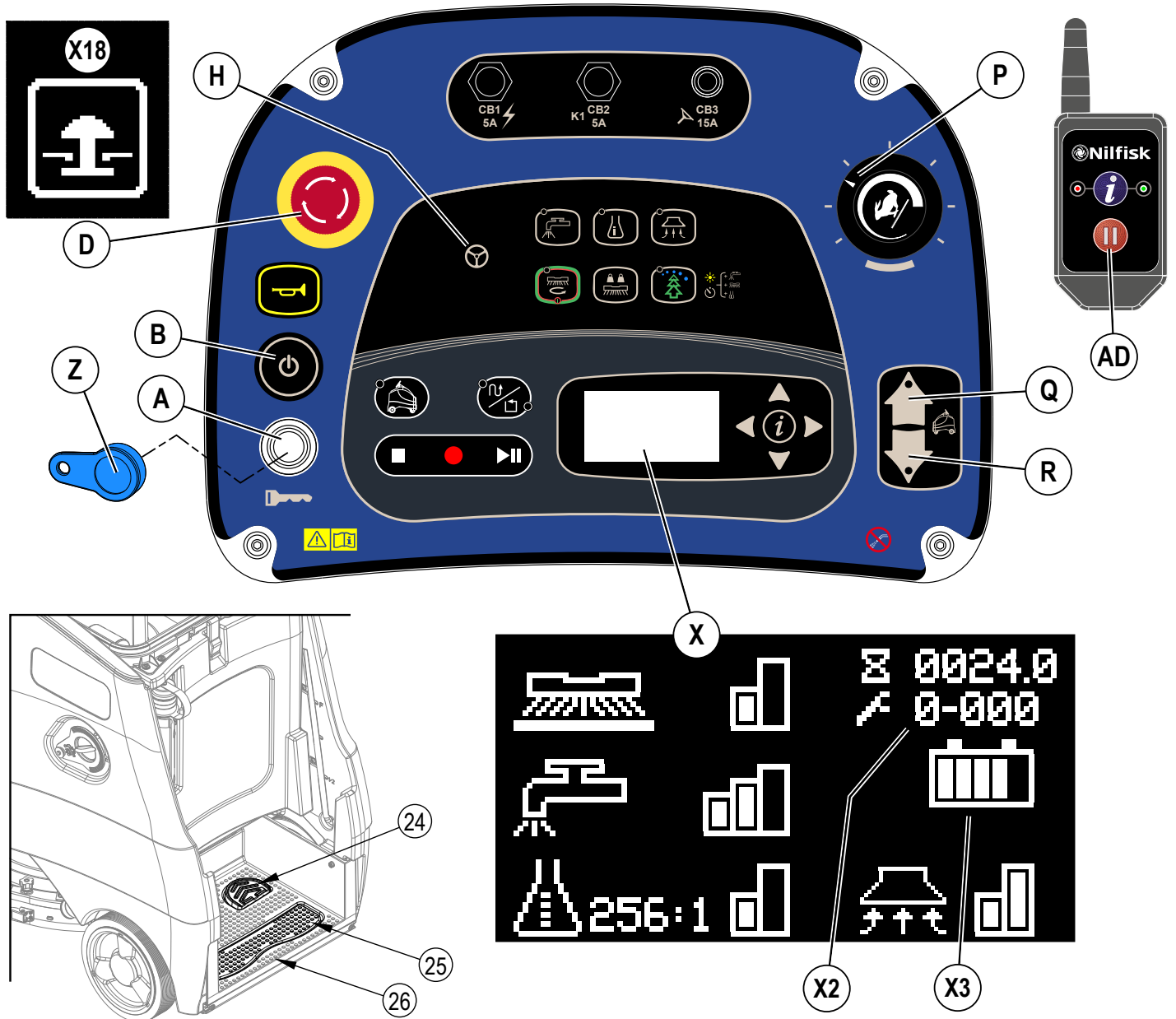
- 1 Stop the machine by releasing the Go Pedal (24) while operating in Manual Mode.
- 2 In Autonomous Mode machine can be stopped by one of the following methods;
 - Pressing the Remote Pause Button (AD)
 - Stepping onto the Operator Presence Pedal (25), (this will temporarily stop machine, if operator stays on machine for 30 seconds it will exit autonomous mode)
 - Pressing the Stop Switch (T) or the Play/Pause Switch (V)

NOTE: The electromagnetic brake built into the drive wheel is engaged automatically when the Go Pedal is not pressed (or in autonomous mode when machine stops playback).

CAUTION!

In the event of an emergency, to stop all machine functions immediately, press the Emergency Stop Knob (D). The display will show the Emergency Stop Activated Indicator (X18). To reset the machine functions, rotate the emergency stop knob clockwise.

FIGURE 3-1

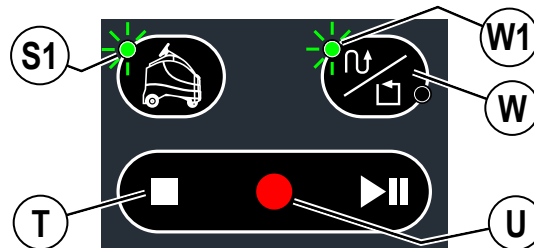


TRAINING THE MACHINE FOR AUTONOMOUS MODE

- 1 There are two types of autonomous plans. To change between the two types press the CopyCat™/Fill-In Switch (W).
 - a. **CopyCat™** – Machine will follow the same plan driven by the operator (default setting). The CopyCat Mode is used to stage scrubbing in hallways, aisles, and irregular-shaped areas.
 - b. **Fill-In** – Operator must drive the machine in a counter-clockwise plan around the perimeter of an area and the machine will clean the area contained within this closed plan (start and stop at the same point). The Fill-In Mode is used when scrubbing inside rooms or other confined areas. The Fill-In Mode is also well suited for scrubbing straight hallways that are at least 4 machine widths wide.
- 2 Follow the instructions in “Starting the Machine” section and manually drive the machine to the starting point for training.

TRAINING/RECORD CopyCat™...

- 1 Press CopyCat/Fill-in Switch (W) so that CopyCat LED (W1) is lit. This indicates machine has entered the CopyCat mode and is ready to begin training.
- 2 Press Record Switch (U).
 - a. Autonomous Mode Indicator (S1) will be lit.
 - b. Screen displays Autonomous Indicator along with Advancing Lines (X25 & X28) to indicate machine is in training mode.
 - c. LED Status Bar (4) will emit a slow flashing green light.
- 3 Clean the area as desired using the vacuum, solution, scrub and detergent settings you want.



- While training CopyCat;

- a. Operate all of the scrub functions. Clean the floor as you would on a manual machine. See section “OPERATING THE MACHINE MANUAL MODE” for more information on adjusting any of the scrub settings. The machine will record every action of the operator including adjustments to scrub settings, use of the horn and remember the route traveled **See Figure 3-2**.
- b. The reverse switch is not selectable while training.



- 4 When finished CopyCat training, press the Stop Switch (T) or Record Switch (U), to stop training. Pressing either button brings up a menu with the options to save or cancel the plan.
 - a. Use the up and down navigation arrows (Y1) to choose between;
 - “ ✓ ” (X39) to Save the plan
 - “ X ” (X40) to cancel the plan
 - b. Press the right arrow to select the option
 - c. Or press left arrow to exit and continue training



- 5 Display will show Computer Processing Indicator (X30) while computer is compiling/saving the plan. Do not move machine while plan is being saved. This may take several minutes.
- 6 Machine indicates if recording was successful or failed.
 - d. If plan saves successfully the screen will briefly display CopyCat Plan Saved Indicator (X33).
 - e. If plan fails to save the screen will display a fault
- 7 Machine LED Status Bar will change from green to OFF or ON white (optional setting).

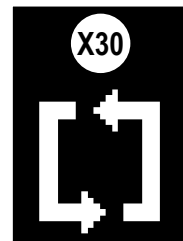
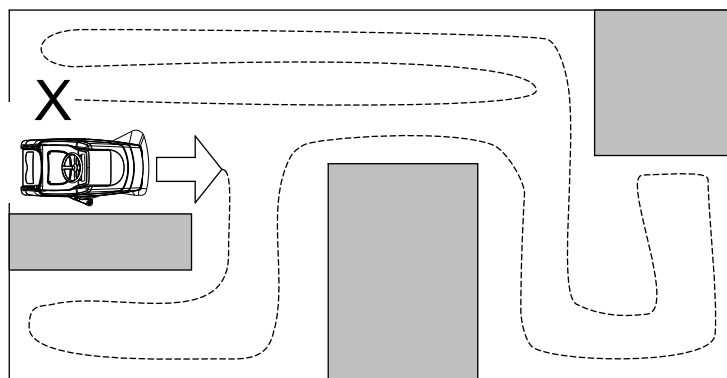


FIGURE 3-2



TRAINING THE MACHINE FOR AUTONOMOUS MODE - CONTINUED

TRAINING/RECORD Fill-In...

1. Press and release CopyCat/Fill-In Switch (W) until Fill-In LED (W2) is lit. This indicates machine has entered the Fill-In mode and is ready to begin training.
2. Select the scrub settings to be used for the whole Fill-In plan. See section "OPERATING THE MACHINE MANUAL MODE" for more information on adjusting any of the scrub settings. Once the record switch is pressed these settings will be remembered and applied to the whole Fill-In upon playback.
3. Press Record Switch (U).
 - a. Autonomous Mode Indicator (S1) will be lit.
 - b. Screen displays Autonomous Indicator along with Advancing Lines (X25 & X28) to indicate machine is in training mode.
 - c. LED Status Bar (4) will emit a slow flashing green light.
4. Drive the machine in a counter-clockwise plan around the perimeter of the area to be cleaned. When creating a plan (training) in the Fill-in Mode, the right side of the machine must be towards the wall and the 2-D Laser Scanner pointed towards the center of the room. From the starting point, movement must be in a counterclockwise direction.
 - While training Fill-In;
 - a. The reverse switch is not selectable while training.
5. Drive the machine around the perimeter of the area to be cleaned and drive back through the starting point and continue along the plan another 25 feet a second time until the machine stops on its own. See Figure 3-3. NOTE: When the Fill-In plan is being played back the machine will use an algorithm to create a plan that covers the entire area and ends back at the starting point. See Figure 3-4.
 6. Machine will indicate it is close to the starting point by emitting two beeps.
 7. When finished Fill-In training, press the Stop Switch (T) or Record Switch (U), to stop training. Pressing either button brings up a menu with the options to save or cancel the path.
 - a. Use the up and down navigation arrows (Y1) to choose between;
 - "✓" (X39) to Save the plan
 - "X" (X40) to cancel the plan
 - b. Press the right arrow to select the option
8. Display will show Computer Processing Indicator (X30) while computer is compiling/saving the plan. Do not move machine while plan is being saved. This may take several minutes.
9. Machine indicates if recording was successful or Failed.
 - a. If plan saves successfully the screen will briefly display Fill-In Plan Saved Indicator (X37).
 - b. If plan fails to save the screen will alternate between icons Fill-In Plan Indicator & Fill-In Plan Failed Indicator (X35 & X36).
10. Machine LED Status Bar will change from green to OFF or ON white (optional setting).

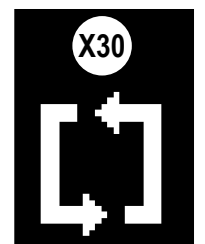
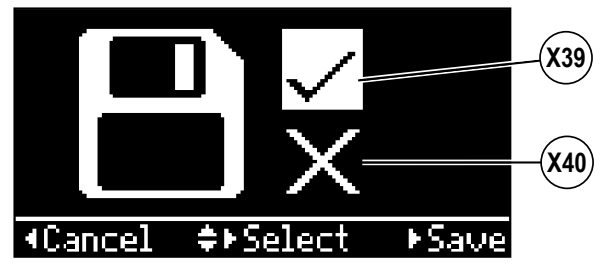
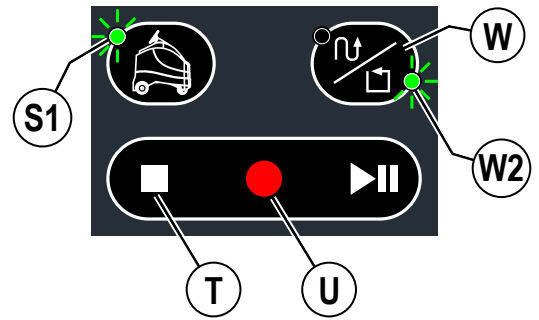


FIGURE 3-3

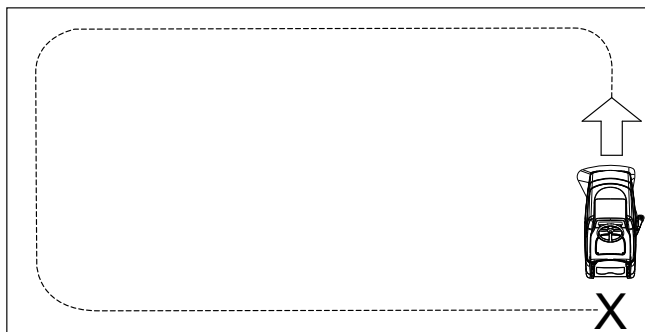
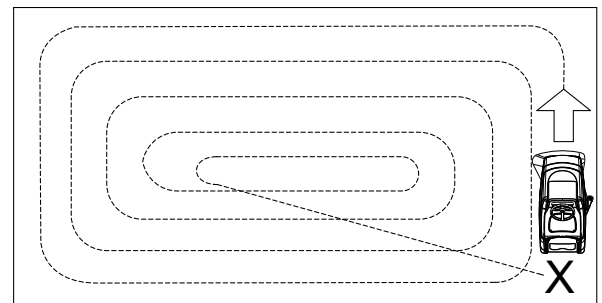


FIGURE 3-4



TRAINING THE MACHINE FOR AUTONOMOUS MODE - CONTINUED

WHILE TRAINING/RECORDING IN COPYCAT OR FILL-IN MODES...

Operator is interrupted

- 1 If operator is interrupted during the recording process, release foot from Go Pedal to stop machine and step off the machine to stop all functions. If operator steps off the machine at any time during the record process the machine will stop.
- 2 Remove the magnetic SmartKey and attend to other issues.
- 3 After returning step back onto the machine, replace the SmartKey and press the Record Switch (**U**) to resume training.

Training needs to be stopped

- 1 If training needs to be stopped during the recording process (to re-fill solution tank, empty recovery tank etc.) release foot from Go Pedal to stop machine movement and press the Play/Pause Switch (**T**) to stop recording.
- 2 The machine will not remember where it left off training and plan must be re-recorded. After emptying recovery tank, refilling solution etc., return to starting point and re-train the plan.

Important to Know About Training a Plan

- Be mindful of where you start a plan so it's not in a busy or congested area, but also in a logical place to start cleaning. Start point should be in a location that's easy to remember and get to in the future since machine will need to start there each time to playback.
- Be mindful of where you will end the plan (only for CopyCat) so that machine is not blocking a doorway or otherwise in the way when it comes to a stop at the end of the plan.
- Train plan with the left side of the machine facing into the room.
- Two plans cannot have the same starting point. If two starting points are close to each other the machine will playback the plan which has the starting point nearest to the machine. Any two starting points should be a minimum of 8 ft. (2.4m) apart.
- For CopyCat plans the start and end points do not need to be the same location.

Results of Training a Plan Include

- Saved plan guides machine movements during autonomous operation.
- Machine will follow exact plan(s) recorded, avoiding known obstacles identified on plan.
- Machine will drive around new obstacles detected but not recorded.
- Machine will signal the remote to notify Operator if there are problems or machine cannot move around newly detected obstacles.
- Machine will signal the remote when the machine has finished cleaning and reached the end of the plan.

DELETE A PLAN

- 1 **Cancel Current Recording:**
 - a. During training press Stop Switch (**T**) at any time to bring up a menu which allows the operator to cancel/delete the current plan being trained.
- 2 **Delete Existing Plan:**
 - a. Drive machine to the start area of the plan.
 - b. Machine will recognize the plan by an audible alert (2 beeps), lighting the appropriate LED either CopyCat or Fill-In that corresponds to the plan.
 - c. Press Autonomous Switch (**S**) to enter Autonomous menu choose "Delete this plan".

PLAYBACK OF RECORDED PLAN, AUTONOMOUS MODE

Once the operator has recorded a plan (training complete) in an area playback is possible.

- 1 Follow the steps under "Starting the Machine". Drive machine to the start area of a trained plan.
- 2 Machine will indicate it has a viable cleaning plan for the area in which the machine is currently located. Signal is audible and visual.
 - a. When within 6 ft. (2 m) of a start point for a trained plan machine will emit two beeps. When driving through a start area machine will emit one beep as it drives out of the start area.
 - b. The Autonomous Indicator (**S1**) will flash.
 - c. The LEDs on CopyCat/Fill-In Switch (**W**) will light to indicate which cleaning plan mode is available from this location.
 - d. Display will show (**X29**) if playback is available. If (**X13**) is displayed, playback is not available due to batteries not having enough charge to allow playback.
- 3 Scrub settings;
 - a. Machine will scrub with the scrub settings used while training the plan.
- 4 Press the Play Switch (**V**). Machine will display Autonomous Mode Indicator (**X25**) to indicate playback is ready.
- 5 Step off of the machine.
- 6 Remove the magnetic SmartKey from the machine. Machine will display (**X38**) (flashing arrow) and blink the LED (**A1**) below the SmartKey Reader (**A**) to indicate operator must remove the magnetic key from the machine before playback can begin.
- 7 At the start of playback the horn will sound for two seconds, LED bar will turn blue and then machine will begin scrubbing.
- 8 While the machine is cleaning in autonomous mode the following will be observed;
 - a. Autonomous Indicator along with Advancing Lines (**X25 & X28**) will be on the display.
 - b. An audible 'heartbeat' sound will be emitted.
 - c. LED Status Bar (**4**) will be slow flashing blue. While executing a turn the LED Status Bar will flash yellow on either side to indicate the direction of the turn. LED Status Bar will change to chasing red if someone walks in front of the machine or encounters an unmapped obstruction.
- 9 When machine gets to the end of the recorded plan;
 - a. Scrub brushes and solution flow will stop and the scrub deck will raise up. Machine will continue to travel a short distance to pick up remaining water.
 - b. The squeegee will raise up after a brief delay with the scrub deck and the vacuum will stop after an additional delay (this is to allow any remaining water to be picked up without turning the vacuum back on).
 - c. Machine will signal the remote. Flash red LED and beep every 2 minutes to notify operator should return to machine.
 - d. After a set time the machine will enter a sleep mode to save battery power.

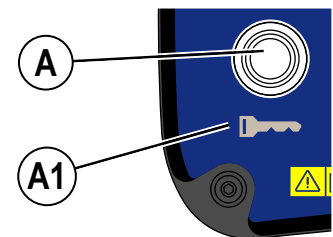
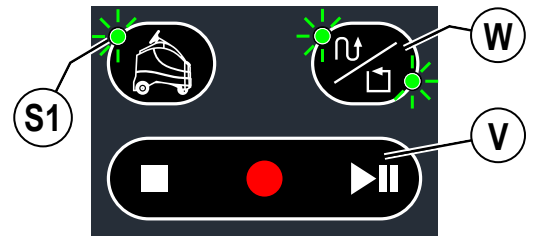
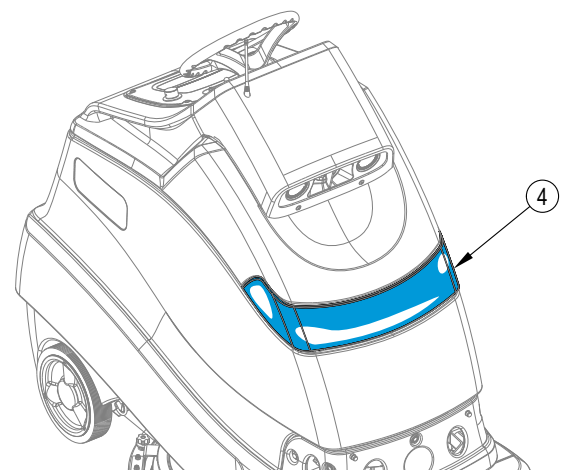


FIGURE 3-5



PLAYBACK OF RECORDED PLAN, AUTONOMOUS MODE - CONTINUED

IMPORTANT TO KNOW WHILE IN PLAYBACK MODE

- If the Stop Switch (T) is pressed the machine will stop and go into manual mode.
- If the Pause Switch (V) is pressed the machine will pause playback. Place the SmartKey back on the reader and press Pause Switch (V) again, then remove SmartKey to resume playback.
- If the Emergency Stop (D) is pressed the machine will stop immediately and go into manual mode.
- All other switches (and speed control knob) are "locked out" pressing them will have no effect.

While in Playback Mode...

Operator needs to interrupt autonomy to Take-Over Cleaning

- 1 While machine is cleaning in autonomous mode. Operator can approach the machine with the remote.
- 2 Press the Remote Pause Button (AD). The Remote Status Indicator (AC1) will turn red.
- 3 Machine stops/pauses project – lifts scrub deck, stops solution/detergent flow, travels a bit further to vacuum water, lifts squeegee/stops vac.
- 4 Operator steps onto machine and inserts SmartKey.
- 5 Machine signals that operator now has control of machine by lighting Manual Operation Indicator (H).
- 6 Operator can now drive/operate machine as needed in manual mode.

Playback needs to be paused/resumed

- 1 If autonomous scrubbing needs to be interrupted during the playback of a plan (to re-fill solution tank, empty recovery tank etc.) press the Remote Pause Button (AD) to stop machine movement and stop all functions. The machine will remember where it left off playback and create a temporary "resume area". Make note of this location to return here.
- 2 Go empty recovery tank, refill solution etc.
- 3 After returning to where the recording was paused, the machine will beep twice and display Resume Plan Available Indicator (X33) as it enters the "resume area". Press the Play Switch (V) to resume and finish cleaning the plan.

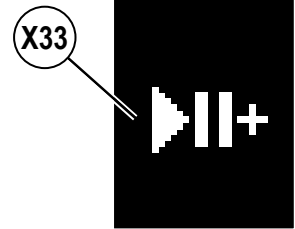


FIGURE 3-6



PLAYBACK OF RECORDED PLAN, AUTONOMOUS MODE - CONTINUED

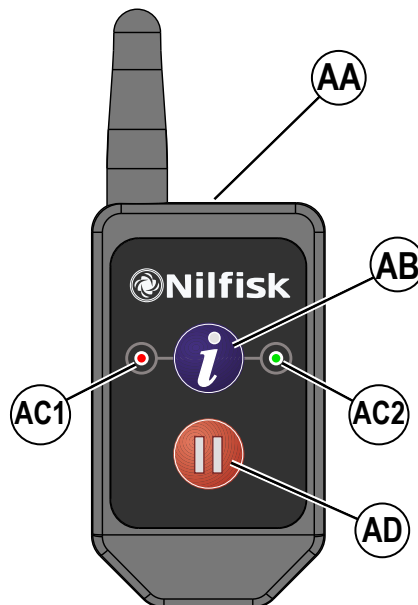
Machine Encounters an Issue While Cleaning in Autonomous Mode

- 1 While machine is successfully cleaning in autonomous mode. Machine may encounter any one of the scenarios listed below;
 - a. Obstacle – Does NOT Move
 - b. Machine is Blocked – CANNOT Plan Around
 - c. Machine needs to locate Home Position
 - d. Machine System Crash
 - e. Machine Battery Level Low
 - f. Solution Tank Empty
 - g. Recovery Tank Full
 - h. Repeated Obstacles Continuously Disturb machine
 - i. Person steps onto machine for longer than 30 seconds
 - j. Sensors Blocked
 - k. Machine is Impacted/Hit by Other Vehicle/Person/Obstacle, etc.
 - l. E-Stop Button Pressed
 - m. Serious Scrubber Fault Code
- 2 In all cases the machine stops moving, the scrub deck stops and raises to the vac only height and the vacuum will run briefly until it times out. Then all functions turn off and the remote will be signaled of an error. The remote will beep and show Red LED (**AC1**) if error occurs.
- 3 Operator must return to the machine to clear/eliminate error. SmartKey must be placed on reader to access menu or restart.

Operator Monitors Machine Progress via Remote...

- 1 While machine is successfully cleaning in autonomous mode the operator can get feedback on its status through the remote.
 - a. Remote includes one RED LED (**AC1**) and one GREEN LED (**AC2**).
 - b. Operator can press the Remote Information Button (**AB**) at any time to receive status update.
 - c. Green LED (**AC2**) is lit when status is GOOD.
 - d. Red LED (**AC1**) is lit and remote will beep to indicate there is an error present.
 - e. Machine stops if an error occurs and sends a signal to remote.
 - f. Both Red and Green LED's (**AC1 & AC2**) will flash along with a beep when plan is completed successfully.

FIGURE 3-7



OPERATING THE MACHINE MANUAL MODE

WARNING!

Be sure you understand the operator controls and their functions.

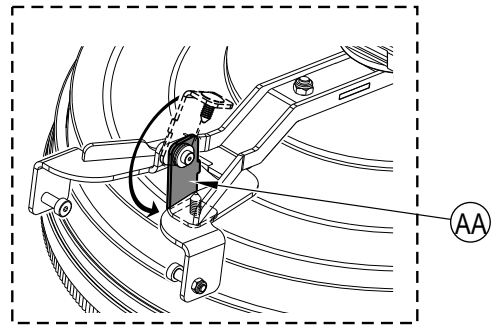
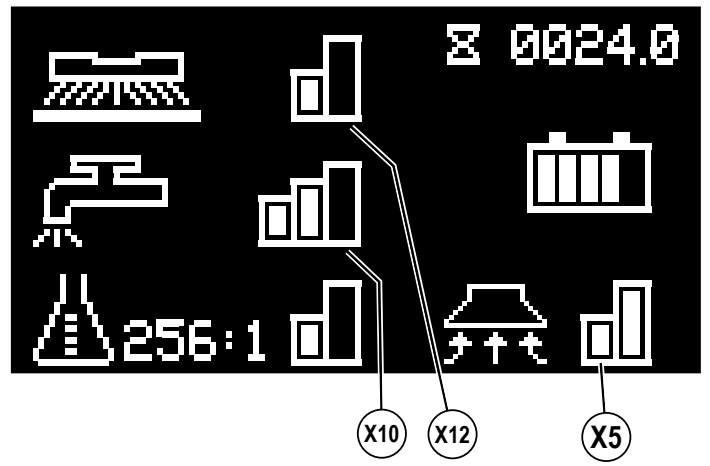
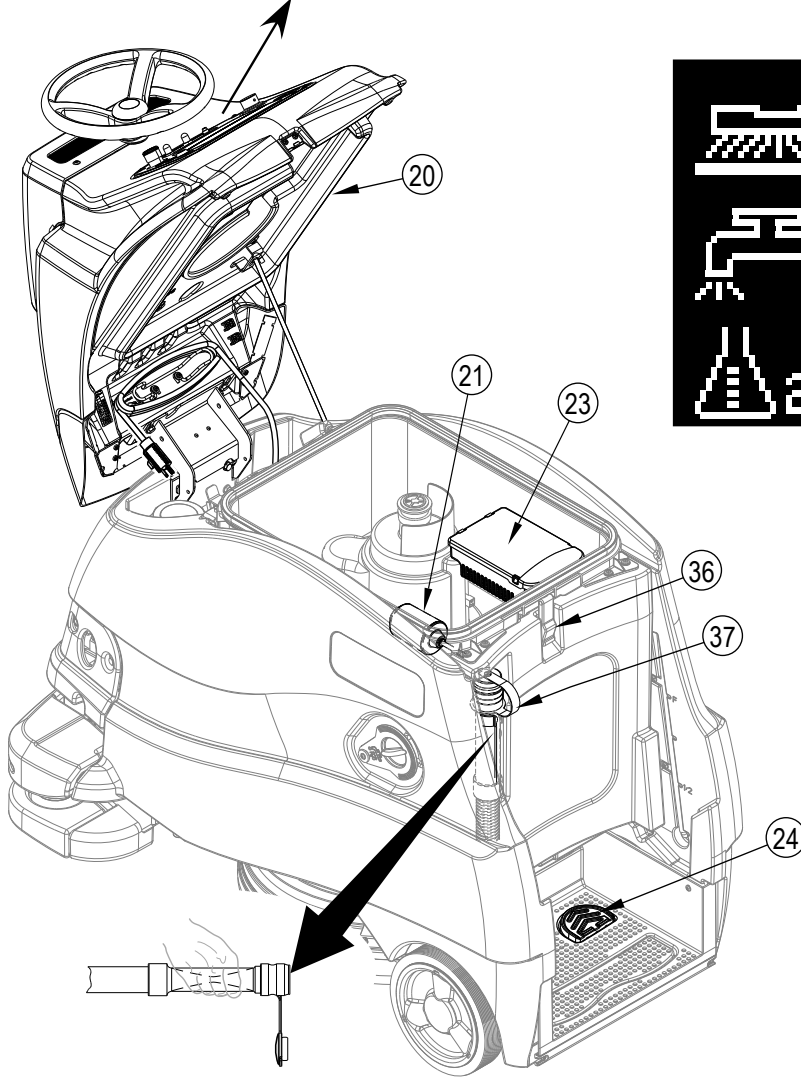
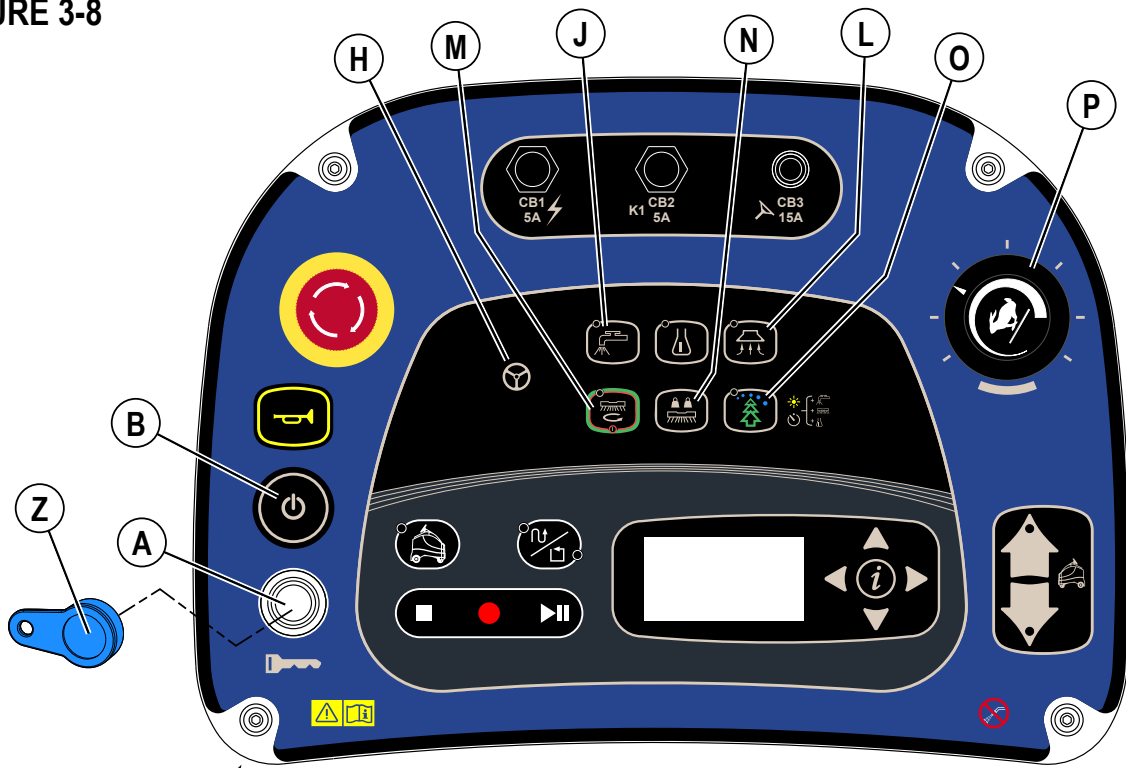
While on ramps or inclines, avoid sudden stops. Avoid abrupt sharp turns. Use low speed down ramps.

- 1 Follow the instructions in "Starting the Machine" section and drive the machine to the starting point for cleaning.
- 2 Press and hold the Solution Switch (**J**) to pre-wet the brush or pad, solution will be dispensed at the HIGH rate while the switch is held. **NOTE:** This will help prevent scarring of the floor surface when starting to scrub with dry brushes. This can only be done prior to pressing the One-Touch Scrub Switch (**M**). Additionally when the machine starts scrubbing the solution will flow at the High rate for 2 seconds to flood the floor.
- 3 Press the One-Touch Scrub ON Switch (**M**) once for Regular Scrub. Press the Extra Pressure Switch (**N**) once for Heavy Scrub. The solution flow has settings that coincide with the scrub pressure, it will increase and decrease along with the scrub pressure.
NOTE: The solution flow rate can also be increased or decreased independently of the scrub pressure by pressing the Solution Flow Adjustment Switch (**J**), observe the Solution Flow Rate Bar Graph (**X10**) (see Control Panel). Any subsequent scrub pressure adjustments will reset the solution flow rate to default.
- 4 When the One-Touch Scrub ON Switch (**M**) is selected, the brushes and squeegee are automatically lowered to the floor. The scrub, solution, vacuum and detergent systems are all automatically enabled and will start when the Go Pedal (**24**) is activated. Any individual system can be adjusted or turned OFF or ON by simply pressing its switch at any time during scrubbing.
Scrub Pressure: Each press of the Extra Brush Pressure Switch (**N**) will change between REGULAR pressure and HEAVY pressure (shown on the display (**X12**)). The scrub system can only be turned OFF by pressing the One-Touch Scrub Switch (**M**).
Solution: The solution flow rate can be changed independently of the scrub pressure by pressing the Solution Switch (**J**). Each press of the switch will cycle between LOW, MEDIUM, HIGH, OFF and back to LOW. The setting is shown on the display (**X10**).
Vacuum: The vacuum level can be changed independently. The default setting is REGULAR mode. Each press of the Vacuum Switch (**L**) will cycle between QUIET, OFF and REGULAR. The setting is shown on the display (**X5**).
NOTE: To pick up solution without scrubbing, press the Vacuum Switch (**L**) while in transport mode. This will cause the squeegee to lower and the vac motor to turn ON at the REGULAR level.
Detergent: See "Detergent System Preparation and Use (EcoFlex)" for more detailed information regarding the adjustment and use of the detergent system.
- 5a **Daily Scrub:** Begin scrubbing by driving the machine forward in a straight line at a normal walking speed and overlap each plan by 2-3 inches (50-75 mm). Adjust the machine speed and scrub parameters when necessary according to the condition of the floor.
- 5b **Floor Finish Removal (REV model only):** Ensure there is a red pad attached directly to the fixed pad driver and that the maroon SPP pad is not attached to the fixed pad driver. Adjust the scrub parameters as follows: Adjust the machine speed potentiometer to a slow scrub speed approximated by that shown in Figure 6 (**P**). Adjust the solution flow rate to low, the scrub pressure to high and turn detergent off. The vacuum power setting can be set to either quiet or regular mode.
- 6 Press the Burst of Power Switch (**O**) to temporarily (1 minute) engage the high detergent strength, extra scrub pressure, full vacuum power and increase the solution flow rate to the next available level. The Burst of Power Indicator (**X22**) will display along with a 60 second countdown timer, after which all scrub parameters will return to their previous state.
- 7 When scrubbing, check behind the machine occasionally to see that all of the used solution is being picked up. If there is water trailing the machine, you may be dispensing too much solution, the recovery tank may be full, or the squeegee tool may require adjustment.
- 8 For extremely dirty floors, a one-pass scrubbing operation may not be satisfactory and a "double-scrub" operation may be required. This operation is the same as a one-pass scrubbing except on the first pass the squeegee is in the raised position. Lift up the squeegee assembly and rotate the double scrub bracket (**AA**) down, to hold the squeegee off the floor. This allows the cleaning solution to remain on the floor to work longer. The final pass is made over the same area, with the squeegee lowered to pick up the accumulated solution.
- 9 The recovery tank has a Tank Full Switch (**21**) that causes ALL systems to turn OFF except the drive system when the recovery tank is full. When this switch is activated, the recovery tank must be emptied. The machine will not pick up water or scrub with the switch activated.
NOTE: Scrub, solution and detergent indicators vanish and the Recovery Tank Full Indicator (**X16**) appears on the Display Panel when the switch is activated.
- 10 When the operator wants to stop scrubbing:
Press the One-Touch Scrub Switch (**M**) once. This will automatically stop the scrub brushes and solution flow and the scrub deck will raise up. The squeegee will raise up after a brief delay with the scrub deck and the vacuum will stop after an additional delay (this is to allow any remaining water to be picked up without turning the vacuum back on) if the vacuum switch is pressed during this time delay the vacuum will turn off.
- 11 Drive the machine to a designated waste water "DISPOSAL SITE" and empty the recovery tank. To empty, pull the Recovery Tank Drain Hose (**37**) from its rear storage area, then unscrew the cap (hold the end of the hose above the water level in the tank to avoid sudden, uncontrolled flow of waste water). The drain hose can be squeezed to regulate the flow. Unlatch (**36**) and lift open the Recovery Tank Cover (**20**) to inspect and empty the Debris Catch Tray (**23**) in the recovery tank. Refill the solution tank and continue scrubbing.

NOTE: Make sure the Recovery Tank Cover (**20**) and the Recovery Tank Drain Hose (**37**) cap are properly seated or the machine will not pick-up water correctly.

When the batteries require recharging the Battery Low Voltage Indicator (**X13**) will come on, the scrub brushes and solution flow will stop and the scrub deck will raise up. The squeegee will raise up after a brief delay and the vacuum will stop after an additional delay. Transport the machine to a service area and recharge the batteries according to the instructions in the Battery section of this manual.

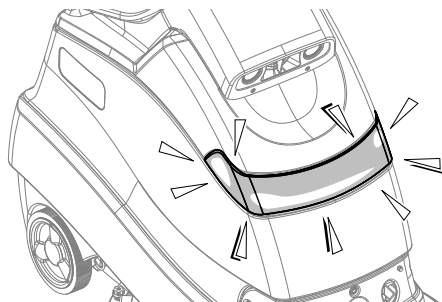
FIGURE 3-8



LED STATUS BAR OPERATION

Machine Action	LED Response
• Manual Mode	- Light Bar off (lights up white with blue on the sides only while scanning for a location tag). - Options include (see "Information Menu Display" to change) "Always On" (white light) "Always Off"
• Training	Slow Flashing Green
• Autonomous Mode	Slow Flashing Blue
• Machine Error	Flashing Red
• Obstacle Detected	Chasing Red or Orange (starting in center and moving to sides) - Options include (see "Information Menu Display" to change) Red Orange
• Turning	Side LEDs flash yellow
• Charging Batteries	Light Bar will "fill" and advancing colors as follows (red, orange, yellow, green and solid green) from discharged to fully charged see "Charging Batteries".

FIGURE 3-9



SPEAKER OPERATION

Speaker Audible Alerts Sound	Description	Mode	Sound Description
Horn	Operator activates by pressing Horn Switch (C).	Manual	Standard Horn
Reverse	Slow beep when moving in reverse	Manual	Standard back-up alarm sound
Scan Successful	Scan of location tag was successful	Manual	Two note ascending tone
Object Detection	Alerts person to move out of way	Autonomous	Four beeps changing tone repeating
Machine Error	Machine stops, playback cannot continue	Autonomous	Longer low tone 3 seconds repeating
Autonomous Operation	Alerts person in area of scrubber (heartbeat) Volume is adjustable between OFF, 1, 2, & 3.	Autonomous	Standard back-up alarm sound
Enter Recorded Plan Start Area	Machine recognizes it is driving into the start area of a plan	Autonomous	Two beeps higher tone
Leave Recorded Plan Start Area	Machine recognizes it is driving out of the start area of a plan	Autonomous	One beep lower tone
Plan Saved Successfully	After training a plan, machine indicates plan has been saved successfully	Autonomous	Three note ascending tone
Playback to Begin	Alerts anyone in the area that machine is about to start moving	Autonomous	Two second beep

AFTER USE

- 1 When finished scrubbing, press the One-Touch Scrub Switch **(M)**, this will automatically raise, retract and stop all the machine systems (brush, squeegee, vacuum, solution and detergent). Drive the machine to a service area for daily maintenance and review of other needed service upkeep.
- 2 To empty the solution tank;
 - Solution tank only needs to be emptied if detergent was mixed in the tank and machine will not be used for a while.
 - Drive the machine over a designated "DISPOSAL SITE" and open the Solution Drain Valve **(8)**.
 - The tank can also be drained by closing the Solution Shutoff Valve **(34)** and removing the cap from the Solution Filter **(33)**, then open the Solution Shutoff Valve to drain the solution out through the filter.
 - Rinse the tank with clean water if detergent was used in the tank.
- 3 To empty the recovery tank;
 - Pull the Recovery Tank Drain Hose **(37)** from its storage area.
 - Direct the hose to a designated "DISPOSAL SITE" and unscrew the cap (hold the end of the hose above the water level in the tank to avoid sudden, uncontrolled flow of waste water). The Recovery Tank Drain Hose can be squeezed to regulate the flow.
 - Unlatch **(36)** and lift open the Recovery Tank Cover **(20)** set the prop rod **(39)**.
 - Empty and rinse the Debris Catch Tray **(23)** in the recovery tank.
 - Thoroughly rinse the recovery tank with clean water.
 - Inspect the squeegee and drain hoses; replace if kinked or damaged.
- 4 Remove the brush or pad holder. Rinse it in warm water and hang up to dry.
- 5 Remove the squeegee, rinse it with warm water and hang it up to dry. Inspect the squeegee blades for wear or tears.
- 6 Check the maintenance schedule below and perform any required maintenance before storage.
- 7 Store the machine indoors in a clean dry place. Keep from freezing. Leave the tanks open to help prevent odors.
- 8 Turn the machine off by pressing the Power Switch **(B)** and then remove the magnetic SmartKey.
- 9 Batteries are one of the most expensive replacement items on this machine. To protect your investment and to get as many cycles from the batteries as possible, remember the following:
 - When installing batteries make certain the machine and charger are programed for the correct battery type.
 - Batteries will last longer if they are kept fully charged.
 - Batteries will prematurely fail if stored in a discharged state.
 - Battery chargers will not over or undercharge the batteries.
 - Every day after use, the battery charger must be plugged in and the charger must be allowed to run through a full charging sequence to fully charge the batteries. This may take 8-12 hours depending on the battery status.
 - Always have the charger plugged into an AC outlet if the machine will not be used for a longer period of time to keep the battery(s) charged.

MAINTENANCE

MAINTENANCE SCHEDULE

MAINTENANCE ITEM	Daily	Weekly	Monthly	Yearly
Charge Batteries	X			
Check/Clean Tanks & Hoses	X			
Check/Clean the Brushes/Pads	X			
Check/Clean the Squeegee	X			
Check/Clean Vacuum Motor Fan Inlet Screen (28)	X			
Empty/Clean Debris Catch Tray in Recovery Tank	X			
Clean 2D Safety Sensors (two) see "CLEAN SENSOR LENSES"	X			
Clean 3-D camera lenses see "CLEAN SENSOR LENSES"	X			
Clean Drop-Off sensors lenses see "CLEAN SENSOR LENSES"	X			
Clean 2-D Laser Scanner see "CLEAN SENSOR LENSES"	X			
Inspect Scrub Housing Skirt		X		
Inspect and clean Solution Filter		X		
Purge Detergent System		X		
Lubrication of Machine			X	
* Check Carbon Brushes				X

* Have an Authorized Nilfisk Service Center check the vacuum motor carbon motor brushes after 1200 operating hours (replace motor after 2000 recovery hours).

NOTE: Refer to the Service Manual for more detail on maintenance and service repairs.

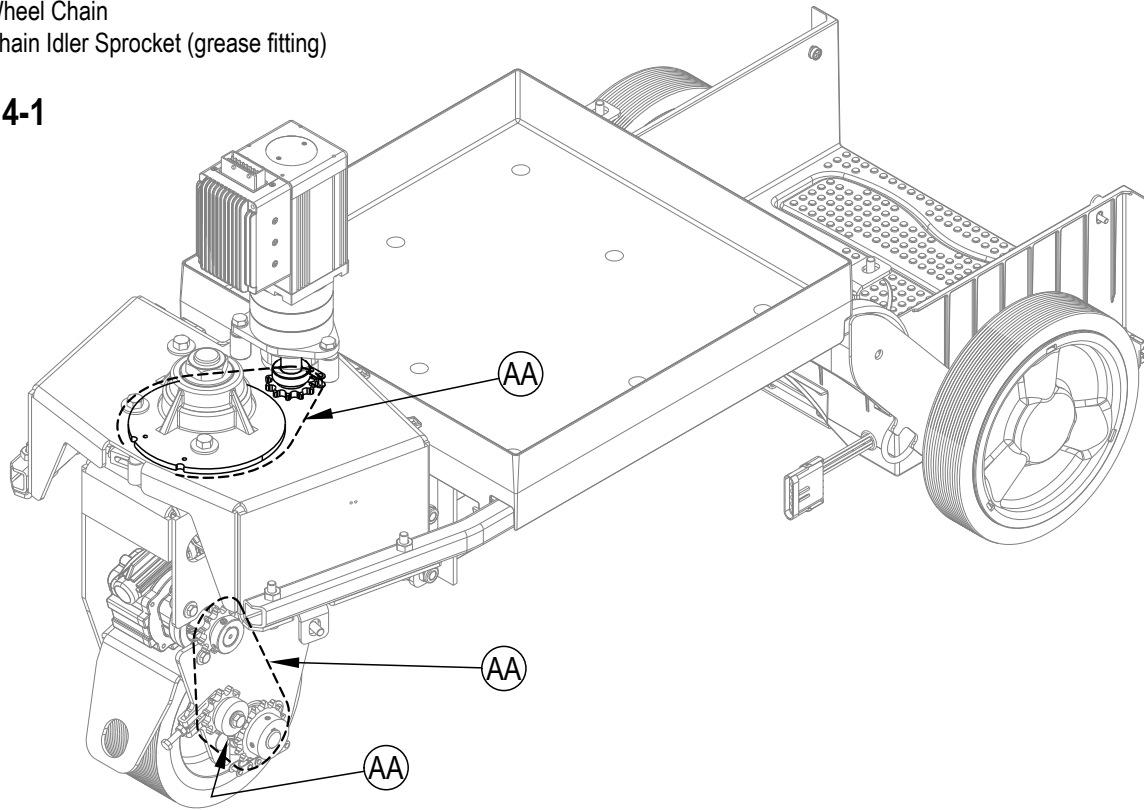
LUBRICATING THE MACHINE

Apply grease to (or grease fitting locations) (AA):

Use grease type Lubriplate® 730-2 or equivalent

- Steering Chain
- Drive Wheel Chain
- Drive Chain Idler Sprocket (grease fitting)

FIGURE 4-1



ELECTROMAGNETIC BRAKE

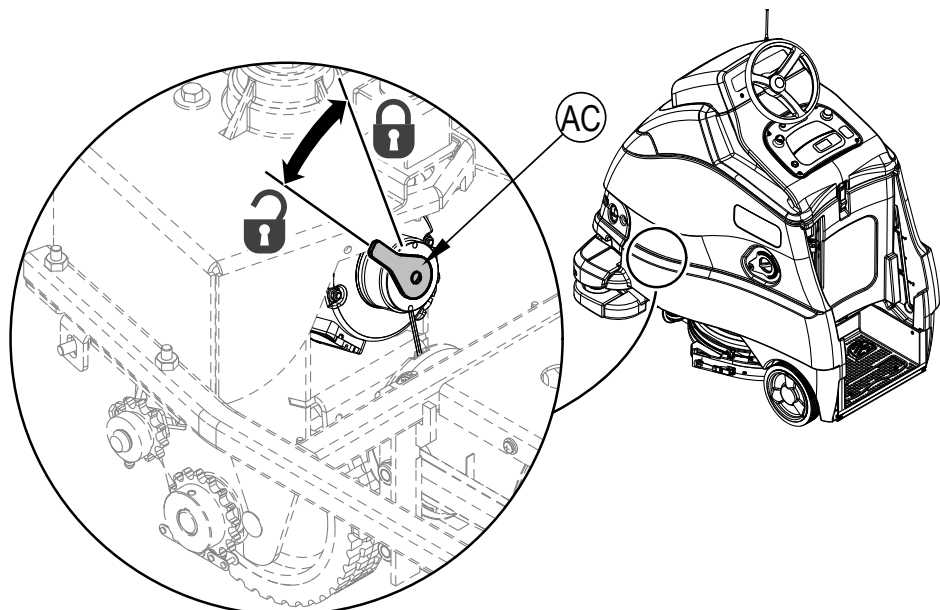
See Figure 4-2. The drive wheel motor has a built in electromagnetic brake that is engaged whenever the machine Power Switch (B) is OFF or the Go Pedal (24) is not being pressed, machine in neutral. This brake can be manually overridden if necessary by reaching up around the back of the front drive wheel and rotating the Brake Arm (AC) as shown. This should only be done in the event the machine needs to be pushed or pulled. Remember to re-engage the brake arm after the machine is moved.

⚠ CAUTION!

Disconnect the batteries before reaching into this area and rotating the brake arm. Severe injury could occur if steering components suddenly move.

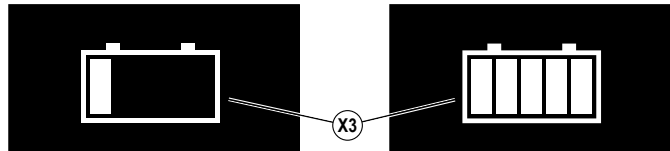
IMPORTANT: The steering is controlled electronically rather than by mechanical linkage. This means that whenever the power is off the machine cannot be steered using the steering wheel.

FIGURE 4-2



CHARGING GEL/AGM (VRLA) BATTERIES

Charge the batteries each time the machine is used or when the Battery Indicator **(X3)** is reading less than full.



⚠ WARNING!

Charge batteries in a well-ventilated area. If battery acid makes contact with your skin, flush the affected area with water for 5 minutes and seek medical attention.

Do not smoke while servicing the batteries.

When Servicing Batteries...

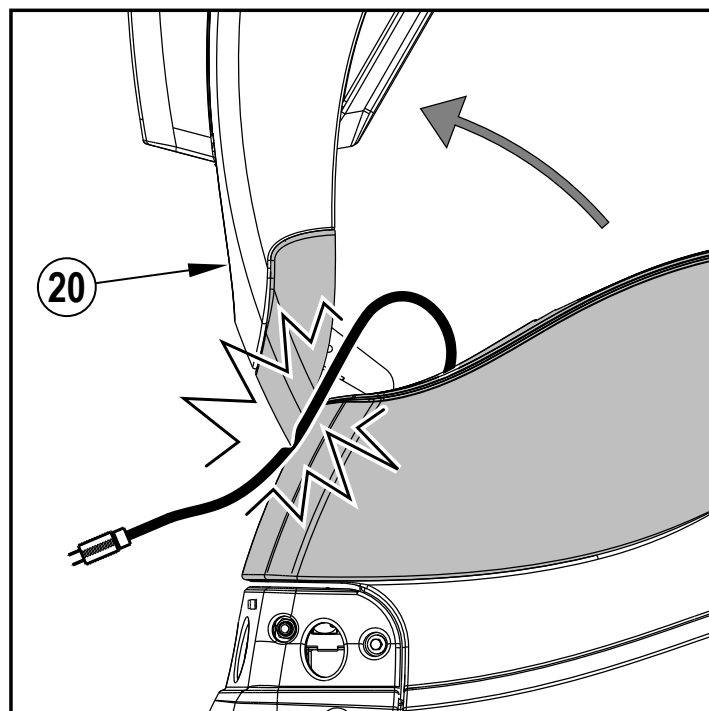
- * Remove all jewelry
- * Do not smoke
- * Wear safety glasses, rubber gloves and a rubber apron
- * Work in a well-ventilated area
- * Do not allow tools to touch more than one battery terminal at a time
- * ALWAYS disconnect the negative (ground) cable first when replacing batteries to prevent sparks.
- * ALWAYS connect the negative cable last when installing batteries.

⚠ CAUTION!

Your valve regulated lead acid (VRLA) battery will deliver superior performance and life ONLY IF IT IS RECHARGED PROPERLY! Under or overcharging will shorten battery life and limit performance. Be sure to FOLLOW PROPER CHARGING INSTRUCTIONS! DO NOT ATTEMPT TO OPEN THIS BATTERY! If a VRLA battery is opened, it loses its pressure and the plates become oxygen contaminated. THE WARRANTY WILL BE VOIDED IF THE BATTERY IS OPENED.

⚠ CAUTION!

When the Control Panel Housing **(20)** is opened it creates a pinch point between the LED lens and the solution tank. Do not route the power cord through this area or the cord will be pinched and may be damaged.



CHARGING GEL/AGM (VRLA) BATTERIES - CONTINUED

The machine shipped with an onboard battery charger. To begin charging do the following:

- 1 Turn the machine off at the Power Switch (B).
- 2 See Figures 4-3 & 4-4. Open the Control Panel Housing (20) set the Prop Rod (39).
- 3 Empty the Recovery Tank (22) using the Recovery Tank Drain Hose (37). Tip the Recovery Tank (22) back for proper ventilation using the Recovery Tank Lift Handles (27).
- 4 Unwind the electrical cord for the onboard charger near the front of the machine and plug it into a properly grounded outlet. Refer to the OEM product manual for more detailed operating instructions.

NOTE: While AC power is applied to the onboard charger all machine functions are disabled.

- 5 The Battery Charge Status Indicator (X3) will begin showing the batteries' state of charge. This indicates that the charging cycle has begun. As the charging cycle continues, the battery charge level will fill in. Each of the five bars within the icon will flash and then become solid until all of the five bars are lit solid. The Display (X) will also show battery voltage and percent of charge (X47).
- 6 The LED status bar (4) will also display the state of charge, using advancing colors from red to green see Figure 4-5.
- 7 When the Battery Charge Status Indicator (X3) is completely filled and status bar is solid green, the machine senses fully charged batteries, however the charging process may not be complete. Rely on the status lights on the Charger (31) (and its OEM manual) to verify when the batteries are completely charged. This may take several hours depending upon the condition of the batteries before charging.
- 8 After charging is complete unplug the charger and wind up the Cord (40). Wait at least 10 seconds before turning on the machine after unplugging the charger.

FIGURE 4-4

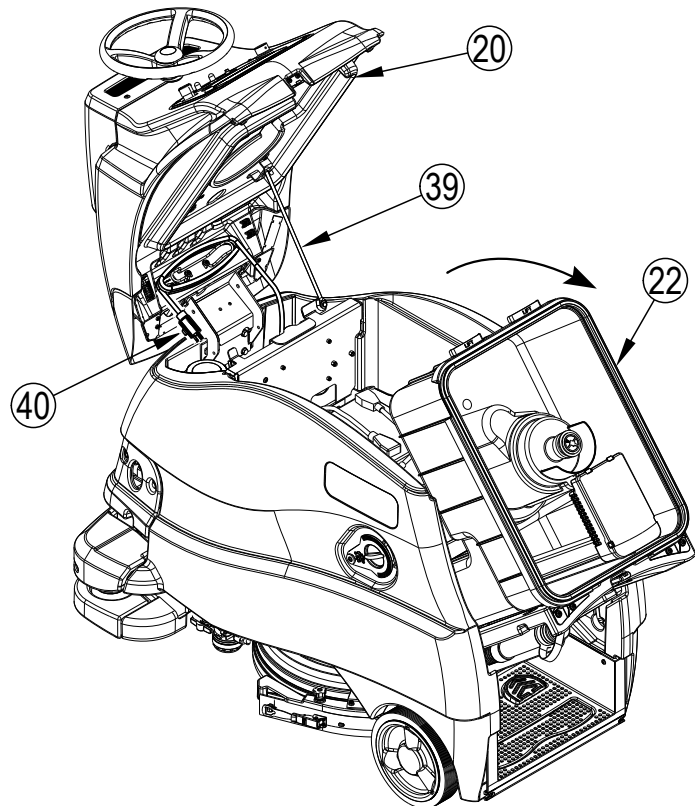
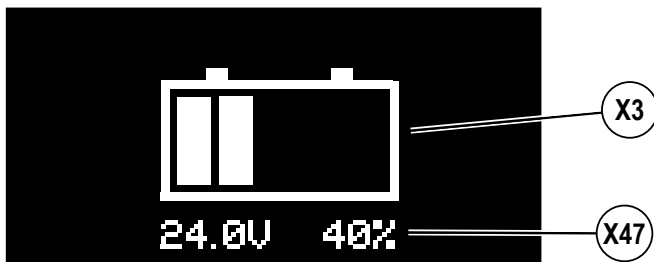
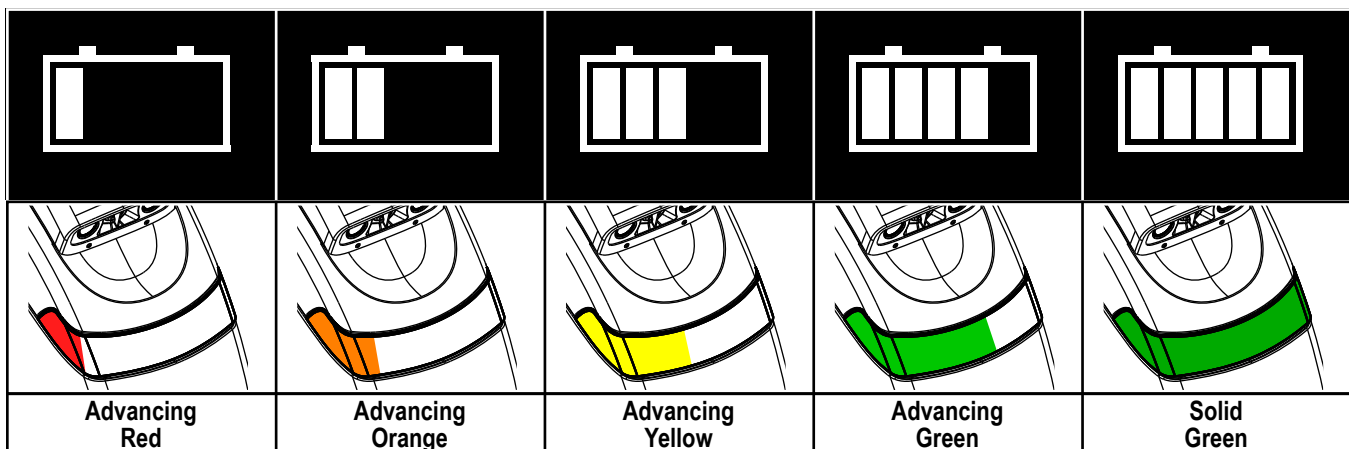


FIGURE 4-3



IMPORTANT: Make sure you have an appropriate charger for use on Gel cell batteries. Use only "voltage-regulated" or "voltage-limited" chargers. Standard constant current or taper current chargers MUST NOT be used. A temperature-sensing charger is recommended, as manual adjustments are never accurate and will damage any VRLA battery.

FIGURE 4-5



SQUEEGEE MAINTENANCE

If the squeegee leaves narrow streaks or water, the blades may be dirty or damaged. Remove the squeegee, rinse it under warm water and inspect the blades. Reverse/flip or replace the blades if they are cut, torn, wavy or worn.

To Reverse or Replace the Rear Squeegee Wiping Blade...

- 1 See Figure 4-5. Raise the deck and squeegee assembly off the floor, then unsnap the Rear Squeegee Blade Removal Latch (23).
- 2 Remove the Tension Strap (AA).
- 3 Slip the rear blade (AB) off the alignment pins.
- 4 The squeegee blade has 4 working edges. Turn the blade so a clean, undamaged edge points toward the front of the machine. Replace the blade if all 4 edges are nicked, torn or worn to a large radius.
- 5 Install the blade, following the steps in reverse order and adjust the squeegee tilt if necessary.

To Reverse or Replace the Front Squeegee Blade...

- 1 Raise the squeegee off the floor, then rotate the squeegee towards the outside of the machine to access. Disconnect the squeegee hose (AD) from the squeegee. Squeeze the back of the Squeegee Mount Bracket (AE) to open the bracket and pull the squeegee assembly off the machine.
- 2 Loosen the four Squeegee Cover Knobs (11). Then lift the Squeegee Cover (AF) off of the Squeegee Casting (AG).
- 3 Slip the front blade (AH) off the alignment pins.
- 4 The squeegee blade has 4 working edges. Turn the blade so a clean, undamaged edge points toward the front of the machine. Replace the blade if all 4 edges are nicked, torn or worn to a large radius.
- 5 Install the blade, following the steps in reverse order and adjust the squeegee tilt if necessary.

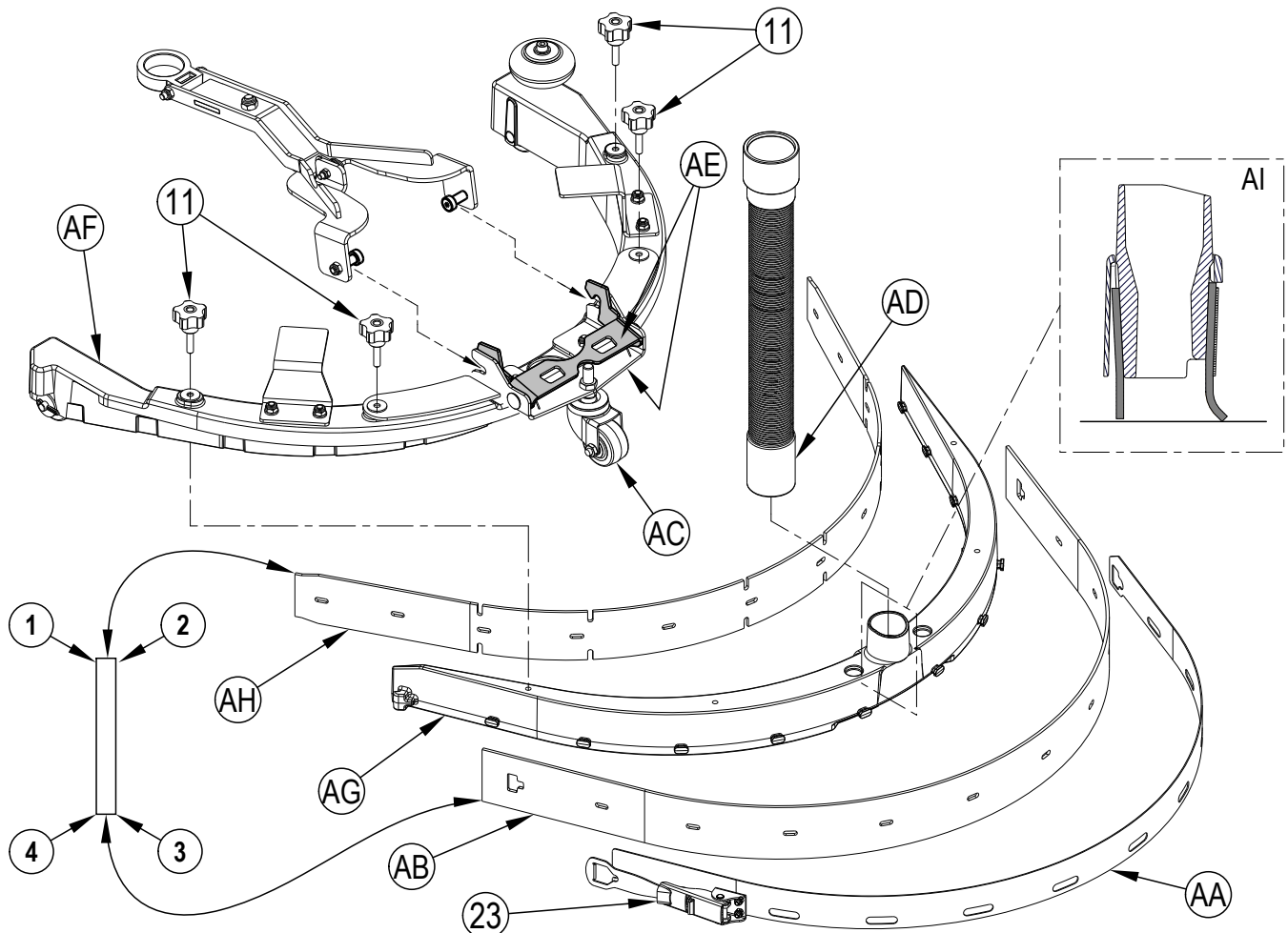
SQUEEGEE ADJUSTMENT

There is only one squeegee assembly adjustment possible, tilt.

Adjust the squeegee tilt if the squeegee is not wiping the floor dry.

- 1 Park the machine on a flat, even surface and lower the squeegee. Then drive the machine forward enough to have the squeegee blades fold over to the rear.
- 2 Adjust the squeegee tilt using the Rear Caster Wheel (AC) so that the rear squeegee blade touches the floor evenly across its entire width and is bent over slightly as shown in the squeegee cross section (AI).

FIGURE 4-5



REMOTE BATTERY REPLACEMENT

The remote's battery has an expected life of 6 to 8 months, assuming normal usage. More frequent operation will shorten battery life. Replacement battery is type CR2430.

- 1 See Figures 4-6 & 4-7. Slide the Protective Cover (AA3) off of Remote (AA1) to expose Battery Cover (AA2).
- 2 See Figures 4-8 & 4-9. Insert the tip of a tweezers or small screwdriver (AA4) between battery cover (AA2) and Remote body (AA1), and begin to pry open battery cover.
- 3 See Figure 4-10. Fully raise the battery cover (AA2) from the body of the remote then remove the battery cover.
- 4 See Figure 4-11. Using the tip of a tweezers or blade screwdriver (AA4) carefully start to slide the Battery (AA5) out of the remote. Grasp the battery and pull it out of the remote. Discard the battery according to local requirements.
- 5 Install the new battery by following the previous steps in reverse order. Check the battery polarity for correct orientation before insertion.

FIGURE 4-6



FIGURE 4-7

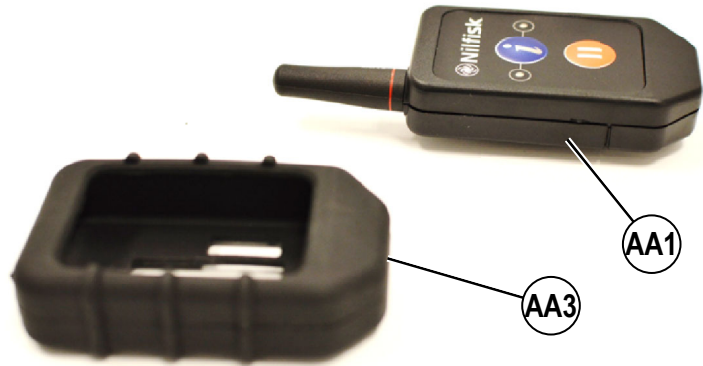


FIGURE 4-8

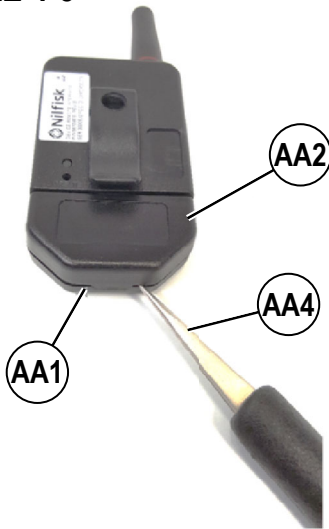


FIGURE 4-9



FIGURE 4-10

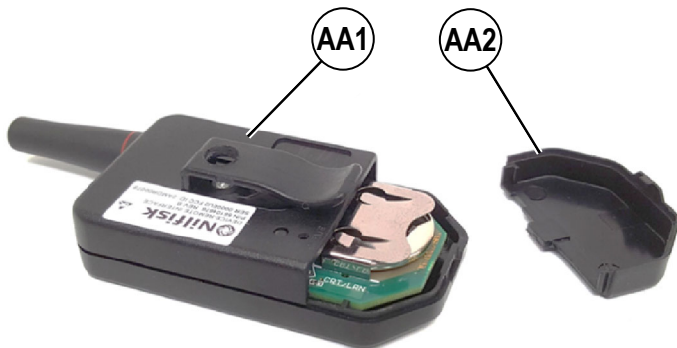
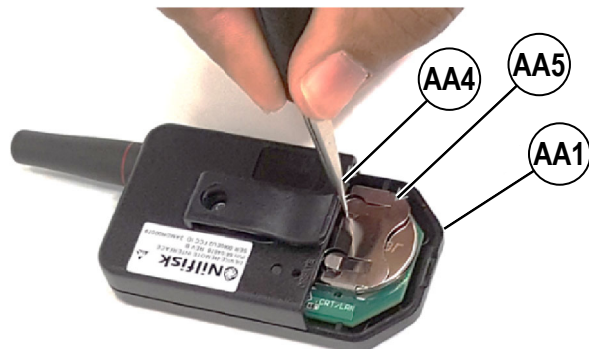


FIGURE 4-11



TROUBLESHOOTING

GENERAL MACHINE TROUBLESHOOTING

Problem	Possible Cause	Remedy
Poor water pick-up	Vacuum hose not connected to the squeegee assembly	Connect vacuum hose to squeegee assembly
	Worn or torn squeegee blades	Reverse or replace
	Squeegee out of adjustment	Adjust so blades touch floor evenly across entire width
	Recovery tank full	Empty recovery tank
	Recovery Tank Drain Hose (37) leak	Secure drain hose cap or replace
	Recovery Tank Cover (20) gasket leak	Replace gasket / Seat cover properly
	Debris caught in Squeegee (11)	Clean squeegee assembly
	Recovery Hose between squeegee and recovery tank clogged	Remove debris
	Using too much solution	Reduce flow via control panel solution switch
	Vacuum set to quiet mode	Set vacuum to high
Poor scrubbing performance	Worn brush or pad	Replace brush or pad
	Wrong brush or pad type	Consult Nilfisk
	Wrong cleaning detergent	Consult Nilfisk
	Moving machine too fast	Slow down
	Not using enough solution	Increase solution flow
Inadequate or no solution flow	Solution tank empty	Fill solution tank
	Solution lines, valves or filter (33) clogged	Flush lines and clean solution filter
	Solution Shutoff Valve (34) closed	Open solution shutoff valve
	Solution Solenoid Valve (32) plugged or defective	Clean or replace valve
	Solution pump air locked	(contact Nilfisk Authorized Service Center)
Solution tank empty Indicator (X23) appears when there is solution in the tank	Solution sensor failed	(contact Nilfisk Authorized Service Center)
Machine does not power ON	Machine Battery Connector (43) disconnected	Reconnect battery connectors
	Tripped 5 Amp circuit breaker (E)	Check for electrical short circuit & reset
	Blown Main Fuse 100 Amp (42)	Replace Main Fuse 100 Amp
	Charger Interlock engaged	Unplug Charger
No FWD/REV wheel drive	A direction has not been selected	Press (Q) to select Forward direction or press (R) to select Reverse direction.
	Emergency Stop Switch (D) activated, display will show Emergency Stop Activated Indicator (X18)	Reset the Emergency Stop Switch
	Drive system speed controller	Check error fault codes (contact Nilfisk Authorized Service Center)
	Tripped 50 Amp circuit breaker (D)	Check for drive motor overload
No Detergent Flow	Empty Detergent Cartridge (3)	Fill detergent cartridge
	Plugged or kinked detergent flow line	Purge system, straighten lines to remove any kinks
	Detergent pump	Check pump, wiring and lines
Magnetic SmartKey Errors	No Key Indicator (X19). -No Magnetic SmartKey is present on the SmartKey Reader (A).	Place an appropriate SmartKey onto the SmartKey Reader.
	Key Read Error Indicator (X20). - Magnetic SmartKey present on the SmartKey Reader (A) cannot be read.	Clean both the SmartKey and the SmartKey Reader using a clean cloth. Depress the SmartKey between your thumb and forefinger to insure free movement of the magnet.
	Restricted User Key Indicator (X21). -Magnetic SmartKey present on the SmartKey Reader (A) is not programmed to be used with this machine.	Place a SmartKey that has been programmed to be used with this machine onto the SmartKey Reader.


AUTONOMOUS MODE TROUBLESHOOTING

Problem	Possible Cause	Remedy
Machine driving erratic (stopping frequently when there is no obstacle) or not driving	Dirty lenses	Clean all of the sensor lenses (see “Clean Sensor Lenses”)
	Scratched lens	Severe scratch may require component (sensor) replacement (contact Nilfisk Authorized Service Center)
Machine will not train a plan	Home position has not been set	Move machine to a Location Tag and Set Home Position
Machine will not playback a plan	Machine not within a start area	Drive machine to the start area of a plan (audible cue of two beeps upon entering start area)
	Battery charge too low to complete plan	Fully charge the batteries
	Environment has changed too much so that machine cannot locate itself on its map	Delete the tag, rescan the tag, retrain the plan
Plan playback not as expected	Machine	

REMOTE TROUBLESHOOTING

Problem	Possible Cause	Remedy
Remote does not flash LEDs and beep upon machine startup	Remote not paired to the machine	Contact Nilfisk to pair the remote to the machine
	Batteries are worn-out/discharged	Replace/recharge remote batteries
Remote does not light any LEDs after pressing the status request button (AB)	Remote is out-of-range of the machine	Move the remote closer to the machine


FAULT CODE DISPLAY

Any fault codes detected by the controllers will be displayed on the control panel display as they occur. If more than one fault exists, the display will sequence through the fault codes at one-second intervals. The fault will display as a mechanical wrench symbol  followed by a four-digit code.

Fault codes are displayed as X-YYY, where

X = system number (1: main board, 2: power module, 3: drive controller, 5: autonomous platform)

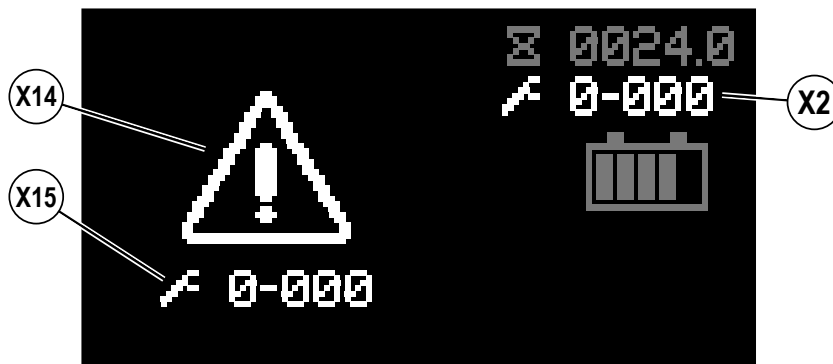
YYY = fault code number

For example,  1-101 would be M10 solution pump – short.

X2 Active Fault Code

X14 Critical Fault Indicator

X15 Fault Code (Critical)



Fault Code	Description
A1 Main Controller Faults	
1-001	K1 Key Switch Input (KSI) Relay Coil Open
1-002	K1 Key Switch Input (KSI) Relay Coil Shorted
1-003	K1 Key Switch Input (KSI) Relay Contact Welded
1-010	CAN Bus 0
1-011	CAN Bus 1
1-101	M11 Solution Pump Shorted
1-102	L2 Solution Solenoid Shorted
1-106	M6 Detergent Pump Shorted
1-201	M2 Scrub Motor Overload
1-202	M5 Vacuum Motor Overload
1-301	M1 Drive Wheel Motor Overload
1-560	EEPROM Configuration Fault
1-561	EEPROM Options Fault
1-562	EEPROM Sys Values Fault
1-563	EEPROM Fault Log Fault
1-564	EEPROM User Key List Fault
1-565	EEPROM Impact Log Fault
1-901	Steering Controller packet loss:
1-902	Drive controller packet loss:
1-903	Steering queue congestion
1-904	Drive queue congestion
1-905	Autonomy spamming: Command Over-run

Fault Code	Description
A2 Power Module Faults	
2-011	Power Supply Fault
2-012	K2 Power Module Contactor Coil Overload
2-013	K2 Power Module Contactor Contacts Welded
2-014	K2 Power Module Contactor Coil Open
2-017	Overvoltage Cutoff
2-018	Undervoltage Cutoff
2-021	M1 Output Open
2-022	M2 Output Open
2-025	M5 Output Open
2-026	Actuator 1 Output Open
2-027	M7 Actuator Output Open
2-028	Actuator 3 Output Open

Fault Code	Description
A2 Power Module Faults - continued	
2-031	M1 Output Overload Warning
2-032	M2 Output Overload Warning
2-033	M3 Output Overload Warning
2-034	M4 Output Overload Warning
2-035	M5 Output Overload Warning
2-036	Actuator 1 Output Overload
2-037	M7 Deck Actuator Output Overload
2-038	Actuator 3 Output Overload
2-041	M1 Output Overcurrent
2-042	M2 Output Overcurrent
2-045	M5 Output Overcurrent
2-046	Actuator 1 Output Overcurrent
2-047	M7 Deck Actuator Output Overcurrent
2-048	Actuator 3 Output Overcurrent
2-051	M1 Output Short
2-052	M2 Output Short
2-053	M3 Output Short
2-054	M4 Output Short
2-055	M5 Output Shorted
2-056	Actuator 1 Output Short
2-057	M7 Deck Actuator Output Shorted
2-058	Actuator 3 Output Short
2-061	M1 Output Current Sensor Fault
2-062	M2 Output Current Sensor Fault
2-063	M3 Output Current Sensor Fault
2-064	M4 Output Current Sensor Fault
2-065	M5 Output Current Sensor Fault
2-066	Over Temperature Cutoff
2-067	Under Temperature Cutoff
2-071	M1 Output Overload Timeout
2-072	M2 Output Overload Timeout
2-073	M3 Output Overload Trip
2-074	M4 Output Overload Trip
2-075	M5 Output Overload Timeout
2-076	Actuator 1 Output Stall Fault
2-077	M7 Deck Actuator Output Stall
2-078	Actuator 3 Output Stall Fault
2-081	EEPROM Fault

FAULT CODE DISPLAY - CONTINUED

Fault Code	Description
A2 Power Module Faults - continued	
2-082	PDO Timeout Fault
2-083	CAN Bus Fault
2-084	Internal Communication Timeout
2-086	Over Temperature Cutback
2-087	Under Temperature Cutback
2-088	K2 Power Module Contactor Coil Open
2-091	M1 Output Hardware Fault
2-092	M2 Output Hardware Fault
2-093	M3 Output Hardware Fault
2-094	M4 Output Hardware Fault
2-095	M5 Output Hardware Fault
2-096	Parameter Change Fault
2-097	Actuator 1 Output Current Sensor Fault
2-098	M7 Actuator Output Current Sensor
2-101	Actuator 3 Output Current Sensor Fault
2-102	Temperature Sensor Fault
2-103	K2 Power Module Contactor Coil Short

Fault Code	Description
A3 Drive Controller Faults	
3-001	Excessive M1 Drive Wheel Motor Current
3-002	Internal Clock Failure
3-009	Internal A3 Drive Wheel Controller Fault
3-010	Driver 1 or Driver 2 Overcurrent
3-011	K3 Drive Wheel Contactor Coil Open
3-012	Emergency Reverse Redundancy
3-013	A3 Drive Wheel Controller EEPROM Fault
3-015	K3 Drive Wheel Contactor Contact Not Closing
3-016	M1 or M2 Drive Wheel Motor Outputs Shorted
3-017	K3 Drive Wheel Contactor Contact Stuck Closed
3-019	Lost Communication with A1 Main Machine Controller (MMC)
3-020	Internal A3 Drive Wheel Controller Fault
3-021	Internal A3 Drive Wheel Controller Fault
3-022	Go Pedal (POT 1) Supervisor Fault
3-023	R1 Speed Limit Potentiometer Supervisor Fault
3-024	Supervisor Pot3 Fault
3-025	5V Output Supervisor Fault
3-026	S1 Operator Presence Switch (OPS) Input Supervisor Fault
3-027	Steering System Ready Input (Switch 2) Supervisor Fault
3-028	S2 Emergency Stop Switch Input (Switch 3) Supervisor Fault
3-029	Autonomous System Okay Input (Switch 4) Supervisor Fault
3-030	Supervisor Sw5 Fault
3-031	Key Switch Input (KSI) Supervisor Fault
3-032	Supervisor Motor Speed Fault
3-033	Controller Check Fault

Fault Code	Description
A3 Drive Controller Faults- continued	
3-034	External Supply Fault
3-036	Y1 Emergency Brake Coil Open
3-037	Y1 Emergency Brake Coil Driver On
3-041	Go Pedal Switch Input
3-042	Speed Limit Input
3-043	Pot 3 Fault
3-050	Very Low Voltage
3-052	Very Low Controller Temperature
3-053	Very High Controller Temperature
3-054	Low Battery Positive (B+) Power Input
3-070	K3 Drive Wheel Contactor Shorted or Y1 Emergency Brake Coil Shorted
3-071	Driver 3 Fault
3-072	Driver3 Overcurrent
3-073	Driver4 Fault
3-074	Driver4 Overcurrent
3-075	Driver5 Fault
3-076	Driver5 Overcurrent
3-077	Driver6 Fault
3-078	Driver6 Overcurrent
3-079	Correlation Fault
3-080	Go Pedal Switch Closed At Power On
3-081	Parameter Change
3-082	Internal A3 Drive Wheel Controller Fault
3-090	A3 Drive Wheel Motor Temperature Hot Cutback
3-092	M1 Drive Wheel Motor Circuit Open
3-093	M1 Drive Wheel Motor Short
3-094	High Voltage
3-095	A3 Wheel Drive Controller Temperature Is Low
3-096	Stall Detected
3-097	A3 Wheel Drive Controller Temperature Is High
3-098	High Voltage
3-099	Low Voltage
3-101	User Fault Estop
3-102	User Fault Severe

FAULT CODE DISPLAY - CONTINUED

Fault Code	Description
A4 Steering Controller Faults	
4-000	A4 Timeout
4-001	Low Voltage
4-002	Intermediate stage under voltage
4-004	Controller, High Temperature
4-006	Controller Failure, Power Stage
4-007	Excessive Voltage
4-009	5V Output Fault
4-010	12V Output Fault
4-014	CAN Message Error
4-015	Controller Error, Checksum
4-016	Controller Error, Initialization
4-021	Very High Motor Current
4-022	Voltage at J5-12
4-023	Encoder Error
4-024	Open Stator Winding
4-025	High Controller Temperature
4-026	High Motor Current
4-027	Input Sum Failure
4-028	Insufficient Input Difference
4-029	Steering Angle Input Matches J5-5
4-030	J5-5 Input Voltage Abnormal
4-031	Steering Angle Input Abnormal

Fault Code	Description
A5 Autonomous Platform Controller Faults	
5-4060	E5 Low Temp
5-4061	E5 High Temp
5-F040	E5 Power Idle
5-F041	E5 Power Key
5-F042	E5 Power K Board
5-F043	E5 Power C Board
5-F344	E5 Power Temp
5-F345	E5 Power Voltage
5-F246	E5 No Laser Acknowledge
5-F640	E5 Unknown Free Space on SD Card
5-F641	E5 No Space on SD Card
5-F642	A5 Failed to Delete Log File
5-F270	A5 Platform has lost Communication with Compute Board
5-F271	A5 Platform has lost Communication with CAN server
5-F652	A5 No Forward Plan without Collisions
5-F650	A5 No Valid 3D Data from Camera
5-F653	A5 Brush Height Not Responding
5-F651	A5 No Valid Laser Scan Data
5-F660	A5 Could Not Load Plan from Database
5-F470	A5 User Cancelled Training
5-F671	A5 Save Plan Failed
5-F672	A5 Save State Timed Out
5-F661	A5 Failed to Generate or Load Plan
5-F673	A5 Failed when Ending Training
5-F454	A5 Lost
5-F455	A5 Outside Safe Zone
5-F456	A5 Internal Plan Problem
5-F474	A5 Can't Train, No Home Position
5-F475	A5 Can't Train, Lost
5-F476	A5 Can't Train, Busy
5-F643	A5 Save Log Error
5-F444	A5 Log Upload Busy
5-F445	A5 Log Upload Fail
5-F677	A5 Train Cancel Fail
5-F657	A5 Bad Traction
5-F658	A5 Autonomy Exit
5-F45D	A5 Person On Board
5-F559	A5 Bad Exit
5-F45A	A5 Camera Block
5-F45B	A5 Laser Block
5-F45C	A5 C&L Block
5-F45E	A5 Out Of Memory
5-F646	A5 Log Clear Fail
5-F478	A5 Near Dropoff

FAULT CODE DISPLAY - CONTINUED

Fault Code	Description
A6 Platform Controller Faults	
6-0000	A6 Timeout (no can bus heartbeat)
6-3000	A6 Low Battery Voltage
6-3001	A6 High Battery Voltage
6-3010	A6 Low 1.8 Voltage
6-3011	A6 High 1.8 Voltage
6-3020	A6 Low 3.3 Voltage
6-3021	A6 High 3.3 Voltage
6-3030	A6 Low 5.0 Voltage
6-3031	A6 High 5.0 Voltage
6-FB00	A6 ILOK Boot
6-FB01	A6 ILOK Off
6-FB10	A6 Health
6-F400	A6 Wrong Port
6-F401	A6 Hwack
6-F402	A6 Swack
6-F510	A6 Boot Error
6-F511	A6 Boot Image
6-F612	A6 Boot Timeout
6-F513	A6 Laser Calibration
6-F514	A6 Camera Calibration
6-F515	A6 Dropoff Calibration
6-F421	A6 Set Home Position Successful
6-F422	A6 No Home Position
6-F623	A6 Permanently Lost
6-FC00	A6 Main Board Fault
6-FC01	A6 Unknown Main Fault
6-F530	A6 Update Not Ready
6-F431	A6 Update: No Connection
6-F632	A6 Update Timeout
6-F433	A6 Bad Update Download
6-F634	A6 Bad Update Install
6-F424	A6 Unknown Location Tag
6-F616	A6 Bad Mapping State
6-F617	A6 Persistence Database is Corrupt
6-F618	A6 File Access Problem with Database
6-F510	A6 Compute Box Boot Failure
6-F619	A6 Inconsistent Boot Image
6-F480	A6 Failed to Set QR Code to File
6-F790	A6 Exception
6-F591	A6 Error Deleting File

Fault Code	Description
A6 Platform Controller Faults-continued	
6-F692	A6 Bad Command
6-F693	A6 Bad Object
6-F694	A6 No Data for SDO
6-F695	A6 Received another SDO before Finishing
6-F696	A6 Wrong Toggle Bit
6-F4A0	A6 No Laser Pulse
6-F427	A6 Unsaved loc. Tag
6-F4A0	A6 Bad Laser Calib.
6-F4A1	A6 Bad Camera Calib
6-F4A2	A6 Bad Dropoff Calib.
6-F4A3	A6 Calib. Cancelled
6-F4A4	A6 Calib. Error
6-F625	A6 Orphaned Plan
6-F426	A6 Tag Already Saved
6-F61A	A6 Old Platform Box
6-F61B	A6 No Platform Ver.
6-F4B1	A6 Out of Memory
6-F41C	A6 No Platform S/W
6-FE10	A6 Mode Out Of Range
6-FE11	A6 Manual Fail
6-FE12	A6 Copycat Fail
6-FE13	A6 Fill-in Fail
6-FE14	A6 Autoscrub Fail
6-F61D	A6 Boot Timeout
6-F6C0	A6 Moving Backward
6-F6C1	A6 Bad Battery
6-F6C2	A6 Bad Config
6-F6CC	A6 Platform Comm.
6-F6CD	A6 Overspeed
6-F6CE	A6 Bad Wheel Enc.
6-F6CF	A6 High Speed Turn
6-F5C3	A6 Dropoff Error
6-F4C4	A6 L Front Dropoff
6-F4C5	A6 R Front Dropoff
6-F4C6	A6 L Side Dropoff
6-F4C7	A6 R Side Dropoff
6-F4C8	A6 Prox. Error
6-F4C9	A6 Front Prox. Err.
6-F4CA	A6 Left Prox. Err.
6-F4CB	A6 Right Prox. Err.
6-F6D0	A6 Plan Failed
6-F5B2	A6 SD Card Fail
6-F4B3	A6 Degraded

FAULT CODE DISPLAY – CONTINUED

Fault Code	Description
G1 Battery Charger Faults	
8-0000	G1 Timeout
8-F001	F-0-0-1 DC-DC failure: LLC excessive leakage fault
8-F002	F-0-0-2 PFC failure: PFC excessive leakage fault
8-F003	F-0-0-3 PFC has taken too long to boost
8-F004	F-0-0-4 The charger has been unable to calibrate the current offset
8-F005	F-0-0-5 The voltage drop across the DC relay is too high while the relay is closed.
8-E001	E-0-0-1 Battery voltage over limit in software. Typically 2.5V/cell.
8-E002	E-0-0-2 Battery voltage too low to start a charge cycle. Algorithm dependent – typically 0.1V/cell.
8-E003	E-0-0-3 Charge time limit reached. Algorithm dependent.
8-E004	E-0-0-4 Battery could not be trickle charged up to the minimum voltage. May also be used for other battery-related errors depending on the algorithm.
8-E007	E-0-0-7 Charge amp-hour Limit reached. Algorithm dependent.
8-E008	E-0-0-8 Battery temperature out of range. Algorithm dependent.
8-E012	E-0-1-2 Reverse polarity
8-E013	E-0-1-3 Battery does not take current
8-E020	E-0-2-0 No active algorithm selected
8-E021	E-0-2-1 High battery voltage while charging. Algorithm dependent – typically 2.8V/cell
8-E022	E-0-2-2 Low battery voltage while charging. Algorithm dependent – typically 0.1V/cell
8-E023	E-0-2-3 High AC voltage error (>270VAC)
8-E024	E-0-2-4 Charger failed to turn on properly
8-E025	E-0-2-5 AC voltage has dipped below 80VAC 3 times in 30 seconds
8-E028	E-0-2-8 Attempt to select algorithm incompatible with this software
8-E029	E-0-2-9 Cannot transmit on CAN bus
8-E030	E-0-3-0 CAN-1 heartbeat timeout on Battery module
8-E031	E-0-3-1 The Vref for the ADC measurements has triggered an alarm

Fault Code	Description
G1 Battery Charger Faults-continued	
8-E032	E-0-3-0 CAN-2 heartbeat timeout on Battery module
8-E036	E-0-3-6 Battery temperature sensor is missing or shorted
8-E037	E-0-3-7 CAN Open reprogramming failed
8-E038	E-0-3-8 Fan will not turn
8-E040	E-0-4-0 Fan voltage pulled low
8-0098	General USB Fault
8-0099	Unknown Fault

FAULT CODE HISTORY

Every fault code that occurs is recorded by the machine and kept in a history log. See Figures 5-1 – 5-4. To view the fault history press the Information Switch (Y) to bring up the information menu. Use the four Navigation Arrows (Y1) (up, down, left & right) to move through the menu and the information switch to exit the menu.

Scroll down to Faults, right arrow to select.

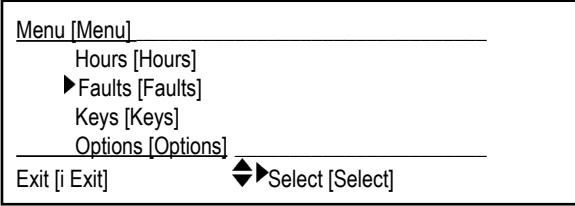
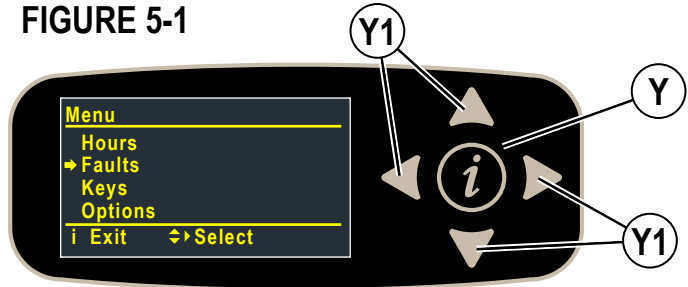


FIGURE 5-1



Scroll down to Fault History, right arrow to select.

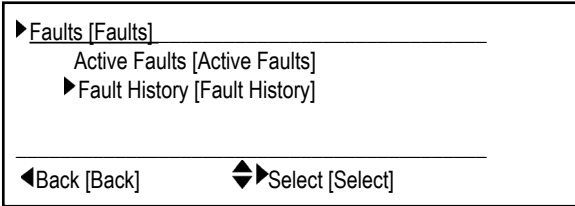


FIGURE 5-2



A list of all faults and corresponding timestamp will be displayed, scroll up or down to an individual fault, right arrow for more information.

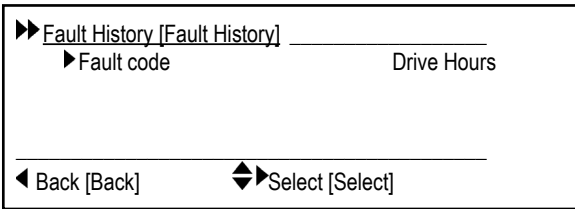


FIGURE 5-3



The fault is displayed along with the timestamp and description. Use the up and down arrows to scroll through the list of faults.

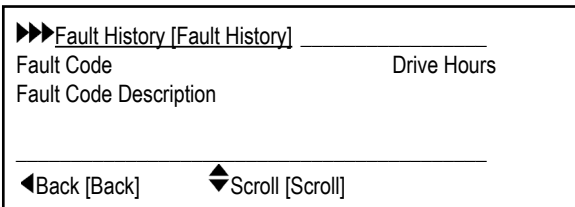
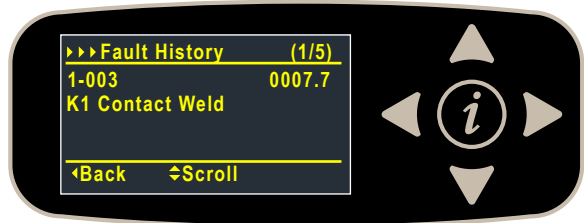


FIGURE 5-4



SPECIFICATIONS

ACCESSORIES / OPTIONS

In addition to the standard components, the machine can be equipped with the following accessories/options, according to the machine specific use:

Disc Machines

- Brushes with harder or softer bristles
- Pads with more or less abrasiveness

REV Machines

- Pads with more or less abrasiveness
- SPP pads for finish removal

For further information about the above-mentioned accessories, contact an authorized Retailer.

MATERIAL COMPOSITION AND RECYCLABILITY

Material Composition and Recyclability		
Type	% of machine weight	% recyclable
Aluminum	1%	100%
Electrical / motors / engines - misc.	24%	80%
Ferrous metals	35%	100%
Harnesses / cables	2%	90%
Liquids	0%	0%
Plastic - non-recyclable	1%	0%
Plastic - recyclable	8%	100%
Polyethylene	26%	100%
Rubber	3%	100%

SOLUTION FLOW RATES

Manual Mode	Flow Rates At Full Manual Speed*		
	1 bar	2 bars	3 bars
20" Disc	0.16 GPM / 0.6 liters/minute	0.35 GPM / 1.3 liters/minute	0.50 GPM / 1.9 liters/minute
20" REV	0.13 GPM / 0.5 liters/minute	0.18 GPM / 0.7 liters/minute	0.23 GPM / 0.9 liters/minute

Autonomous Mode	Flow Rates At Full Autonomous Speed*		
	1 bar	2 bars	3 bars
20" Disc	0.11 GPM / 0.4 liters/minute	0.23 GPM / 0.9 liters/minute	0.33 GPM / 1.3 liters/minute
20" REV	0.09 GPM / 0.3 liters/minute	0.12 GPM / 0.5 liters/minute	0.15 GPM / 0.6 liters/minute

* Flow rates are proportional to speed

TECHNICAL SPECIFICATIONS

(AS INSTALLED AND TESTED ON THE UNIT)

Model		Nilfisk Liberty SC50 (X20D) Disc	Nilfisk Liberty SC50 (X20R) REV
Model No.		56104500	56104501
Voltage, Batteries	V	24V	24V
Battery Capacity (max)	Ah	420	420
Protection Grade		IPX4	IPX4
Sound Pressure Level IEC 60335-2-72: 2002 Amend. 1:2005, ISO 11203, ISO 3744	dB(A)/20 μ Pa	63	63
Sound Pressure level - KpA (IEC 60335-2-72, ISO 11203) Uncertainty	dB(A)	3.0	3.0
Gross Vehicle Weight*	lbs / kg	1050 / 476.4	1056.5 / 479.23
Transportation Weight**	lbs / kg	759.9 / 344.4	766.4 / 347.23
Maximum Wheel Floor Loading (center front)	psi / kg/cm ²	161.03 / 11.32	161.03 / 11.32
Maximum Wheel Floor Loading (right rear)	psi / kg/cm ²	105.60 / 7.42	105.60 / 7.42
Maximum Wheel Floor Loading (left rear)	psi / kg/cm ²	109.33 / 7.68	109.33 / 7.68
Vibrations at the Hand Controls (ISO 5349-1)	m/s ²	0.17	0.17
Vibrations for the Whole Body (ISO 2631-1)	m/s ²	0.01	0.01
Gradeability – Manual Transport		15% (8.53°)	
Gradeability – Manual Cleaning		9% (5.14°)	
Gradeability - Autonomous		2% (1.15°)	
Machine Length	inch / cm	53.1 / 134.9	
Machine Height	inch / cm	53.7 / 136.3	
Machine Width	inch / cm	28.4 / 72.1	
Machine Width with Squeegee	inch / cm	31.5 / 79.9	
Minimum Aisle Turn Width - Manual	inch / cm	61.5 / 156.2	
Solution Tank Capacity	Gallon / L	15 / 57	
Recovery Tank Capacity	Gallon / L	14 / 53	
Transport Speed (Fwd. Maximum) Manual	mph / kph	3.1 / 5.0	
Transport Speed (Rev. Maximum) Manual	mph / kph	1.62 / 2.6	
Transport Speed – Autonomous	mph / kph	x	
Battery Compartment Size (approximate)			
Height (maximum)	inch / cm	12.25 / 31.115	
Width (maximum)	inch / cm	18.5 / 46.99	
Length (maximum)	inch / cm	18 / 45.72	
Scrub brush size			
Brush / Pad Diameter – (Quantity of 1)	inch / cm	20 / 50.8	
Scrub Brush Speed	RPM	157	2250 RPM – ¼ orbits & macro of 10-30 RPM
Cleaning Path Width (scrubbing path)	inch / cm	20 / 50.8	20 / 50.8

*Gross Vehicle Weight: Standard machine without options, full solution tank and empty recovery tank, with removable scrub brushes, batteries installed and 165 lb / 75 kg operator.

**Transportation Weight: Standard machine without options, empty solution and recovery tanks, with batteries installed and no operator.

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