LANE MACHINE MANUAL

KUSTODIAN WALKER MODEL D

KUSTODIAN ION MODEL D

Lane Machine Manual

REV 1:10

Kustodian Walker Specifications

17-5500D Kustodian Walker (24VDC)
Class I - Single Phase
115 Volts, 50/60 Hz, 13 Amps

17-5550D Kustodian Walker (24VDC)
Class I - Single Phase
230 Volts, 50 Hz, 6.8 Amps

Kustodian Ion Specifications

17-5400D Kustodian Ion (24VDC)
Class I - Single Phase
115 Volts, 50/60 Hz, 15 Amps

17-5450D Kustodian Ion (24VDC)
Class I - Single Phase
230 Volts, 50 Hz, 6 Amps

Machine Dimensions

Width - 55" (139.7 cm)
Height - 16" (40.64 cm)
Length - 42.5" (107.95 cm)
Weight: Kustodian Walker - 425 pounds (192.8 kg)
Weight: Kustodian Ion- 382 pounds (173.3 kg)

Manual Part Number: 158-5500D
First Edition

Safety First

This Class I Single Phase lane cleaning/conditioning machine shall be grounded while charging to protect the operator from electric shock. The machine is provided with a three-conductor charger cord for use in a properly grounded receptacle. Machines rated at 115 Volts A.C. are for use on a nominal 120-volt circuit and machines rated at 230 Volts A.C. are for use on a nominal 240-volt circuit.

Warning of Potential Injury: Moving Parts – To Reduce the Risk of Injury Always Disconnect Power Before Servicing!

This product is intended for COMMERCIAL USE. To reduce the risk of fire, use only commercially available bowling lane cleaners & conditioners intended for machine application.

This is a HEAVY piece of equipment, and care should be taken when lifting it into the transport position. Use the proper technique to lift and lower the machine, and get a partner to help lift it up and set it down whenever possible. Make sure to bend at the knees and use a back support or mechanical lift if needed. Kegel does sell an optional piece of equipment that can assist the operator when lifting and lowering the machine. It can be mounted next to the end pairs of lanes to significantly reduce the transitional weight of the machine. Large centers might consider getting one for each end of the center for more convenience.

DO NOT operate the machine while standing up in the transport position. There is a POTENTIAL FOR INJURY due to moving parts. Refer all servicing to qualified personnel. This machine is designed and manufactured for many years of dependable service. To ensure the durability of this equipment please handle it carefully. Do NOT drop or bang the machine around.

Disconnect power BEFORE filling the Supply Tank or the Conditioner Tank. Be careful not to overfill the tanks. Do not allow excess fluid to enter the electrical compartment or come into contact with any electrical components. WIPE UP spills immediately, and make sure all components are dry before applying power to the machine.

Replace fuses with the same type (Slow Blow) and Amp rating as indicated on the original fuse (or refer to the wiring diagram). Failure to do so may result in DAMAGE to the machine.

NEVER use any batteries, other than the type supplied with the machine. Mixing battery types or using batteries that are different from what is supplied with the machine may damage the machine and cause serious injury or death to the operator. Use of alternate battery or charger types will void the machine's warranty.

Please make sure the WARRANTY CARD is filled out and returned immediately. This will allow the manufacturer or distributor to notify you of potential problems and/or offer upgrades to machine as they become available. Register your machine on line at www.kegel.net .

If you need assistance or more information about this equipment please contact Kegel in Lake Wales, Florida USA at (863) 734-0200.

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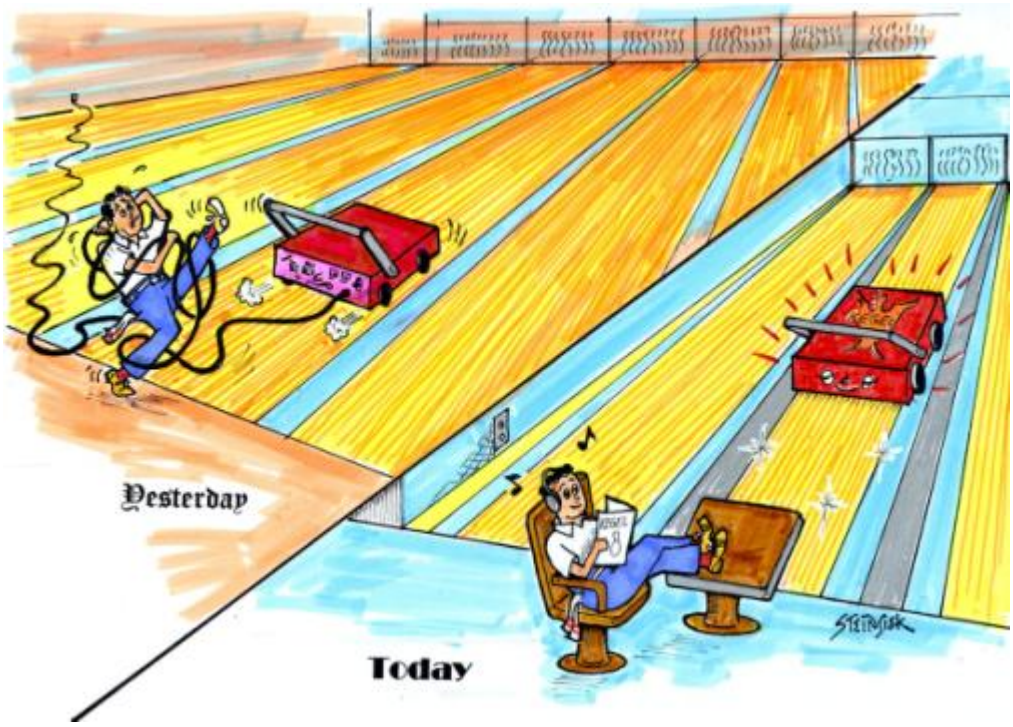
PREFACE



The Kegel Kustodian Lane Cleaning and Conditioning Machine represent advanced technology in automated lane care. Clean and consistent bowling conditions are accessed from an on-board touchscreen linked to an industrial Programmable Logic Controller (PLC).

- Battery-operated Kustodians operate like no other lane maintenance machines. Cordless operation of the Ion and automatic lane to lane advancement of the Walker allows for fewer operating problems and increased customer satisfaction.

- A patented fluid metering transfer system, along with the vacuum/squeegee cleaning system and duster system, allow the machine to maintain clean and consistent bowling conditions.

- In addition to this manual, Kegel has developed an On-line Support Interface called KOSI. This software is provided free with the machine. KOSI allows the operator to access additional functions that are otherwise not available to the operator through the keypad. KOSI includes programs and instructional videos which should be used as a supplement to this manual.

IT IS VERY IMPORTANT THAT THE OPERATOR THOROUGHLY READ AND UNDERSTAND THIS OPERATING MANUAL BEFORE USING THE MACHINE. WHEN ALL ELSE FAILS...READ THE MANUAL AGAIN OR WATCH TRAINING VIDEOS FOUND IN KOSI.

Copyright Notice

 The information contained herein is designated only for use with the Kegel Kustodian Walker and the Kegel Kustodian Ion Lane Machines. Kegel is not responsible for any use of this information as applied to other lane machines. For items exclusive to the Walker, the font color will be blue.

About This Manual

This manual was prepared by the engineering, graphics & documentation departments of Kegel to provide detailed information and technical support about this lane machine and its operation. This manual was specially designed to educate the operator and ensure your investment is maintained properly.

The Intended User / Operator

Although every attempt has been made to make this manual easy to understand and use, the operator should have basic electrical, mechanical and technical understanding to operate and maintain the Kustodian. Should you have any questions after reading this manual about proper operation or procedures, please contact Kegel at (863) 734-0200 or via email at lmc@kegel.net for technical support.

Disclaimer

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Trademark(s)

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Conformity

Kegel is an ISO 9001 Certified Manufacturer. This lane machine has been independently tested to comply with applicable standards for the equipment.

For additional copies of this or any other Kegel product manuals contact:

KEGEL
1951 Longleaf Blvd.
Lake Wales, FL 33859
USA

www.kegel.net
1 (800) 280-2695 (Toll Free in the U.S.)
+1 (863) 734-0200

Kegel Company Background

Kegel was founded in 1981 by John Davis, Linda Davis, and David Jennings. At that time, Kegel had designed a small hand operated cleaning tool named "The Key", which they manufactured in David's garage.

In 1983, Kegel purchased Ridge Lanes in Sebring, Florida and the crew moved south to run the bowling center and start Research & Development of lane maintenance and machines. The Sanction Machine® was soon developed and marketed as Kegel's first fluid metering lane machine.

In the following years many more machines were designed, such as the DBA LaneWalker, followed by the innovative LCM, Excel, Arrow, Phoenix, Phoenix-S, Standard, Kustodian, Sanction Walker, Kustodian Plus, Kustodian Ion, and the Kustodian Walker.

Manufacturing – Our core division designs and manufactures the world's best lane conditioning and cleaning machines, replacement parts, and other specialized machinery products.

Kegel Bowling Technologies – This division develops and blends conditioners and cleaners that are used in our lane conditioning machines, as well as other areas in bowling and beyond.

Lane Maintenance Central (LMC) – Regarded by many as the best in the industry, LMC provides 24 hour telephone support, educational seminars, workshops, and on-site support to bowling centers and distributors throughout the world.

Kegel Training Center – Located on-site, we custom built this 12-lane bowling center for serious bowlers to train to be the best. Kegel is proud to host educational clinics in various forms for bowlers, coaches and pro shop operators. The first of its kind, the Kegel Training Center boasts several original concepts including C.A.T.S. on every lane, adjustable topography lanes, and advanced coaching tools.

Kegel has grown into a worldwide organization with several product divisions, over 100 employees, and a specially designed 72,000 sq. ft. state-of-the-art facility located in Lake Wales, Florida.

Kegel has done this with a simple philosophy of **researching the problems that exist in the bowling industry, developing a product or service to solve that problem, and making sure to support the customer with the highest of standards**.

"Wah-lah…I did them the same!"

CHAPTER 1

Installation & Setup

Machine Inspection

It is important to identify all of the parts included with your lane machine and inspect its condition before you begin. Use the following list to make sure all parts are accounted for:

Fill in the following Check Boxes and Information:

☐ **Kustodian Walker Lane Machine -** 17-5500C (115V) | 17-5550C (230V)

or

☐ **Kustodian Ion Lane Machine -** 17-5400C (115V) | 17-5450C (230V)

☐ (2) Funnels - 153-0252 & 153-0052 (in Accessory Kit)

☐ Accessory Kit

☐ Operators Manual - 158-5500C

☐ KOSI Software & PLC Cable - 154-8777

☐ Extra Roll of EZ Core Cloth - 153-0047EZ

☐ Battery Charger – 158-8411C (115V) | 158-8616E (230V)

☐ Maintenance Supplies Starter Kit - 154-8866

☐ Battery Back-up Pack - 158-8631 (Included with the Walker; Optional with the Ion)

Date Unpacked: _____

Unpacked by: _____

Machine Serial Number: _____

Register your Lane Machine

It is important to register your new Kustodian with Kegel in order to receive valuable updates, service bulletins and your Limited Warranty. Fill out the card or go on-line.

IMPORTANT: Please take a minute and register at: www.kegel.net

Machine Installation Procedures for the Distributor

1. Decide on the storage area for machine, which is where the charger will be mounted. It is strongly suggested to use only a dedicated circuit with a receptacle that has a power indicating light. The light may prevent the machine from not being charged due to a tripped breaker (a simple night light works fine).

2. Unpack and inspect machine for shipping damage; make sure all the extra items are included in the shipping crate. Put batteries on charge as soon as possible after inspecting. See Chapter 5 for instructions.

3. Menu to the ABOUT screen and enter the install date.

4. Remove the lid and the side guards to reveal all of the components.

5. Inspect all of the switches and sensors and describe the function of each one:
   a. 7-pin & 10-pin Whiskers Switches - adjusting screw is hard to see (KW only);
   b. Bumper Switches (KW only);
   c. On Lane Switch (OLS) – it is very important to show this switch since it is hard to see. The machine will not start if the Lane Distance Shaft rotates and actuates this switch (KW only);
   d. Stop by Duster Switches (KW Only) and the Duster Up Switches (Ion & KW);
   e. Cleaning Compartment Button - both functions should be explained (KW only);
   f. 7-pin & 10-pin Approach Sensors (KW only);
   g. Lane Distance Sensor (LDS);
   h. Tachometer Sensor (Tach);
   i. Right & Left Board Edge Sensors;
   j. Board Counting Sensor;
   k. Brush and Squeegee Lift Switches;
   l. Resume Button (KW) Handle Button (Ion) - explain the functions of this button;
   m. Back-up Start Button - explain how to use this function;
   n. Recovery Tank Switch – explain that this switch only gives a warning; the machine will still run without the tank.
   o. Oil & Cleaner Floats Switches.

6. On the Walker, examine the Zero Turn Radius (ZTR) Wheels and explain how these wheels, plus the approach casters, are the only wheels on the approach when the machine is turning and moving to next lane. The rear blue wheels help the machine out of the lane and also help steer the machine just before they leave the approach as the machine is going into lane. Also mention that the 7-pin drive wheels turn off after the machine enters the lane.

   Discuss how important it is to have a good transition to the approach. The adapters from gutter to approach must be the same for the machine to come out as straight as possible, it is up to the center to make this happen. Extra dusty approaches are not good.

7. On the Walker, describe how the red rear Bumper Wheels function and make certain that adjustment is not too wide for center (always run the machine first before making any adjustments). The factory adjustment will typically work just fine.

8. On the Walker, show the Whisker adjustment and make sure they are not adjusted too wide for center (run the machine before adjusting). Factory adjustment usually works well. Describe how the Whiskers self-adjust when machine is moving onto the lane.

9. Show the Motor Controls for the Drive Motor, Cleaner Pump Motor and the two Stepper Motor controls. On the Walker, also show the resistance wire box and explain how to balance the motors. Make sure they call Kegel for advice on balancing the motors.

10. Inspect all the relays and describe their function. Make sure all are seated properly in the socket bases.

11. On the Walker, show the two steering relays (CR3 & CR4) and notice that both input lights come on when just one whisker switch is operated (when machine is not in motion). When both drive motors are on while traveling forward, the Whiskers will only turn on their input. When both input lights come on it is due to the Negative DC power feeding back through the coil of the relays. Positive DC power for the coils of CR3 & CR4 is routed through the Whisker Control Relay (CR11).

12. Show the PLC and how the Inputs light up when a sensor or switch is actuated. Explain the channel designations and which Inputs are 0CH and which are 1CH; Outputs are 100CH and 101CH. This can be confusing for both the Inputs and Outputs since it is not clearly printed this way on the PLC (i.e. 2 connections are labeled 00, but one is 0CH 00 and the other is 1CH 00).

13. Show how the LCD Voltage Switch provides information about the batteries and the Constant Voltage Regulator (CVR).

14. Describe the CVR and what components have controlled voltage: Oil Pump; Drive Motors; Buffer Motor; Moving Head Motor; Oil Valve; and all of the Relays.

15. Loosen the fasteners for the Main Control Plate to lift it out of the way and show the batteries and the motor chain adjustments.

16. Open the Splash Guard and describe all of the components behind it.

17. Discuss how the cleaner tank can do up to 60 lanes depending on cleaner volume settings and show how this adjustment is made. The recovery tank holds what the cleaner supply tank dispenses (and it is heavy when full).

18. Explain that the Conditioner Tank can hold up to 100 lanes, depending on pattern volume. Tank also has a quick disconnect to reduce the mess when replacing the oil or cleaning the tank.

19. Stop and take a break…let some of the information sink in and consider getting something to drink. Reassure them that Kegel provides many resources with this information.

20. Point out the KOSI software CD that was provided for their PC. Some may want to install it right away. (The CP1H PLC requires a different cable than the other Omron PLCs.)

21. View all of the menus on the touchscreen.

Now that a thorough overview of the machine has been completed, we are ready to run it. Keep in mind that some steps only apply to the Walker.

1. When the machine is powered ON the touchscreen will illuminate. With power applied, press the **MOVE MACHINE** icon on the touchscreen and demonstrate how easy it is to position the machine. Line the machine up with lane as if you are ready to operate. When starting the machine on the first lane it is important to position it the correct distance from the foul line. The front bumper should be about 20" to 22" (51 to 56 cm) away from the foul line. This is required so the machine functions will happen at the proper location relative to the foul line of the first lane.

2. Have the operator(s) practice moving the machine and provide tips of what to look for.

3. Using the touchscreen, perform the starting sequence to run the machine. On the Walker, if you are just checking lane to lane settings choose program 30, it is set to run for 10 feet at oil only.

4. Watch the machine as it enters the lane. Describe the function of the Whiskers as they operate to steer the machine. Watch how the machine will continue to move on one side and slow down on the other to steer if one of the Whiskers hits the foul light cover.

5. As the machine enters and sets itself onto the lane describe how the On Lane Switch changes the machine from approach functions to on-lane functions. For example, on the Walker, the 7-pin drive motor turns off as a result of this action.

6. Watch the machine operate on the lane and monitor the speeds. Make certain they are in the proper range for each speed.

7. As the machine travels to the back end, explain how the brush rotates occasionally past the end of the oil pattern to prevent conditioner build-up on the buffer brush which can leave a "choppy" look at the end of the pattern.

8. When machine enters pin deck check to see if the squeegee completely clears the pin deck. Listen for the Buzzer to make certain that the Lane Distance Sensor stops the machine.

9. Explain the squeegee wipe function when the machine enters the pin deck and how this is meant to remove any excess drips of cleaner that could fall off on the lane or approach.

10. Monitor the machine back to the foul line. On the Walker, watch for the 7-pin drive motor to turn on and make sure that it does so well before the machine reaches the foul line. ***Note:*** *The touchscreen buzzer will indicate the machine is going into approach drive functions and will sound the entire time while on the approach.*

11. Watch closely as the machine exits the lane. This is where you can see if the adapters from gutter to approach will cause any problems with the operation of the machine.

12. Watch the machine travel from lane to lane. It is possible to customize the travel to each lane and all settings in your center.

13. Be very alert when machine exits the lane, turns 90 degrees, moves to the next lane, turns back 90 degrees and goes forward toward lane. This is where you watch to see how closely the two drive motors are balanced.

14. Observe the machine as it enters the second lane and note how far off it is from center. Estimate how many counts you think it will take to achieve perfection and make a mental note. As the machine enters the third lane, note how far off-center it is as it enters and estimate how many counts it will take to be correct. Stop the machine before it goes into the third lane and change the lane to lane settings for the entire center set-up using these revised values, if necessary.

15. Check the lane to lane distances the same way for the opposite direction of travel (if the machine is going to be run from both directions).

16. After adjusting these settings, re-start the machine on Lane #1 (or the high end) and operate it across the center. Point out things the operator can do while the machine is running to impress their boss by multi-tasking.

17. After operation, review proper steps to transport, clean, and charge the machine for its next use. Tell them to read this Operators Manual and show them how the manual is organized to help them find what they are looking for.

Daily Setup and Operation

Moving / Transporting your Lane Machine

You would think that transporting and moving your machine to and from the approach is an easy task, but some places can be difficult. Be careful when moving the machine.

Ramps that are used for moving the machine to and from the approach should also be "machine friendly". These ramps should be no less than 12 feet long with no bump on either end of the transition. Improving these transitions will not only extend the life of your machine, but can make it easier to transport the machine to and from the approach.

The transition from the gutter to the approach should be as smooth as possible for an easy entrance and exit for the lane machine. This will prolong the life of the casters as well as other parts. Better transitions also help in preventing drips of cleaner from falling off the squeegee.

It may seem like a lot of work to improve these areas (and it is in some cases) but it is well worth the time and effort. You should have no problem fitting this project in between pinsetter repair, scoring problems, glow bowl light repair, lane repair, plumbing, electrical work, carpentry and who knows what else…

Filling the Conditioner and Cleaner Tanks

Filling the Conditioner Tank

1. To fill the conditioner tank, the machine should be in the operating position on the lane. Open the splash guard and remove the cap located on the top of the tank.
2. Insert the funnel assembly provided with the machine. Wrap a rag around the bottom of the funnel to prevent spills from getting in the machine.
3. Fill the tank until the conditioner level in the tank is about 1-1/2" (3.8 cm) from the top edge. Failure to watch the tank level could cause the tank to overflow. This overflow can drain down onto the lane distance sensor or the buffer brush, which will cause an excessive amount of conditioner to be applied to the lane in that area for several lanes. You should place rags beneath the tank to prevent this from happening.

When finished, be sure to remember to replace the cap.

Failure to do so could cause a major spill when the machine

is lifted up to the transport position.

Filling the Cleaner Supply Tank

Make sure your splash guards are in place prior to filling the tank. This will help protect your electrical components.

1. To fill the Cleaner Supply Tank, the machine should be in the down or operating position on the lane. Prepare an appropriate mixture of cleaner and water. Open the splash guard and place a rag beneath the tank. Open the tank cap and place a rag around the base of the funnel to prevent foam from over-flowing into the machine.
2. Slowly pour the mixture into the Cleaner Supply Tank using the supplied funnel until the level in the tank is about 1/2" (1.3 cm) below the top of the tank. This will prevent an air pocket from forming and blocking the fluid flowing from the funnel. Replace cap tightly when finished.

NOTE: *Always use the funnel supplied with the machine. This funnel has a plastic filter screen. This screen filters out large debris and trash to prevent this from contaminating the supply tank and cleaning system.*

Not using a funnel with a filter may cause the tank's internal filter to become clogged frequently and reduce the cleaner output, resulting in inadequate cleaning. This may lead to customer complaints, ball calls and an excess of out-of-range pins. When necessary, the supply tank can be removed for cleaning.

Do not spill cleaner on the electrical components. Spills may cause a "short", which may send a false signal to the PLC causing improper operation. A wet switch may also produce a dim LED light on the PLC.

Any spills or drops of cleaner onto the approach should be wiped up immediately!

Any spills on the machine can stain the paint and make the machine ugly.

Ugly machines do not run as well as clean, sharp, and highly maintained machines.

NOTE: *If the lanes are going to be cleaned, make sure the Cleaner Supply Tank is filled, the Recovery Tank is empty, and an adequate supply of Lane Cleaning Cloth is installed before beginning operation. Always empty the recovery tank when filling the supply tank or standing the machine to transport position.*

Kustodian Walker Sequence of Events - "How it Works"

The following steps detail how the Walker operates. Skip to Page 15 for the Ion. The Walker should be on the approach in the down or operating position behind the first lane with the HOME SCREEN showing. The machine needs to be in CLEAN & OIL MODE for the following sequence of events to occur. The following sequence will explain how to start the machine, how the errors work, and what happens as the machine travels down your lanes. If errors are present, the recovery tank is missing, or the duster cloth low there will be a message indicating this on the Home Screen.

1. Press the **GO TO STARTING LANE** button to advance to the starting lane screen. Choose the starting lane then press **GO TO ENDING LANE** and choose the ending lane. After choosing the ending lane, press **START MACHINE** the machine will change to a screen that will ask you to double check your info. If it's correct press **YES** and the machine will be ready to operate.

2. The Walker starts moving toward the lane using two drive motors, each monitored by a proximity sensor. If the 7-pin motor sensor fails to receive a signal while on the approach, there will be an **APPROACH 7 PIN** error. If the 10-pin sensor fails, there will be an **APPROACH 10 PIN** error.

3. The **OLS** error is also active when the Walker is moving toward the lane. If the On Lane Switch (OLS) does not close the contacts in 8 seconds, then the PLC assumes that the machine has failed to seat on the lane or it is going too slowly and displays an **OLS LATE** error. If the OLS switch is actuated before the machine goes into the lane an **OLS STUCK ON** error will be displayed. *All error messages are explained on the touchscreen and in their appropriate section.*

4. As the Walker moves toward the lane, the squeegee, duster, cleaner pump, and oil head will start up at their individual preset distance. The duster cloth is monitored by the duster up switch. If the switch's normally open contacts do not open up, there will be a **DUSTER EMPTY** error displayed. The squeegee will move down and stop when the down switch's normally open contacts close. If the switch contacts do not close there will be a **SQUEEGEE DOWN** error displayed. Finally, the oil pump will turn on.

5. As the Walker enters the lane the 10-pin whisker sensor just brushes the foul light which will turn on the steering relay. This will cause the machine to go into its steering function. The 7-pin motor will slow down due to the steering relay opening up the power to the motor.
   At the same time the 10-pin motor will continue to run to turn left. When the 10-pin whisker sensor comes off the foul light the machine will either be lined up with the lane or the 7-pin whisker sensor will come in contact with the left division rail. If the 7-pin whisker touches, the machine will turn back to the right and will most likely be lined-up with the lane.

6. The moving heads will start and move in opposite directions. The cleaner head will start to apply cleaner when signaled and not stop until the last squirt distance has been reached. When the oil head reaches the right board edge proximity sensor, the moving heads will reverse and begin to apply the first stream of oil.

7. When the oil head reaches the left board edge proximity sensor, the head motor will reverse. At the very moment the moving oil head reaches the 7-pin side, the machine should be entirely on the lane. When the Walker is on the lane, the lane distance wheels will make a half revolution to engage the OLS switch.

8. When the On Lane Switch's normally open contacts close the 7-pin drive will turn off, the whisker sensors will be disabled, the buffer will turn on, and the main drive will remain on to continue moving the Walker forward. After the Walker has traveled about 2 feet, the vacuum will turn on.

9. Additionally, the OLS switch will start a clock to record the total amount of run time and display it on the screen.

10. As the Walker travels forward down the lane the moving heads will continue to operate applying oil and cleaner. The board counting proximity sensor monitors the motion of the moving heads. If the motion is interrupted, a **MOVING HEAD TRAVEL** error will be displayed.

11. As the Walker travels down the lane, the lane distance sensor (LDS) is counting inches traveled and is also monitoring the movement of the machine. If travel is interrupted a **FORWARD TRAVEL** error will be displayed. The speed of the machine is also being displayed on the screen.

12. As the Walker continues to move forward, speeds will change and oil and cleaner will continue to be dispensed to the lane as programmed. As the Walker approaches the applied oil distance the oil will turn off and the buffer will continue to buff oil onto the lane.

13. When the oil distance is reached the buffer brush will stop and rise up, then the brush up switch's normally open contacts close. If the contacts do not close there will be a **BRUSH UP** error displayed. If the brush up switch sticks closed when it should be open it will give a **BRUSH DOWN** error.

14. When the oil distance has been reached the machine will shift into high speed and continue to travel toward the pin deck. As the Walker approaches the pin deck the last squirt distance will turn off the cleaner pump and the moving heads will park. At the same time the Walker will down shift to low speed to reduce its momentum into the pin deck. The shift to low speed will also enable the bottom duster switch, which can be set to reverse the Walker.

15. There are two ways to reverse the Walker. One option is setting the Lift Duster function to a value other than ZERO, so when the Walker enters the pin deck the duster wind-up motor will turn on at that distance and start to wind up the cloth (to raise the duster). The duster up switch's normally open contacts will close to turn off the duster wind-up motor. If the contacts do not close there will be a **DUSTER WINDUP** error displayed. In this scenario, the LDS sensor stops the Walker and the alarm buzzer will sound to alert the operator.

16. The other option is the Stop and Reverse by Duster function (Lift Duster is set to ZERO). The Walker will be signaled to stop when the cushion drops off the tail plank and closes the bottom duster switches' normally open contacts. The duster will wind up after one of the bottom switches makes contact. The Walker will travel forward until the Stop and Reverse by Duster value is reached. Using both functions to stop forward travel creates a back-up method for the stopping the Walker.

17. When the Walker reaches its travel distance and comes to a stop, the squeegee will proceed to lift up and stop when the squeegee up switch's normally open contacts close. If the contacts do not close, a **SQUEEGEE UP** error will be displayed.

18. The Walker will then start traveling in reverse and stop after moving 4 inches. The squeegee will lower and the machine will go forward again and stop, then lift the squeegee. This function helps to remove drips off the squeegee blades.

19. The Walker will now travel in reverse, turn the vacuum off, and run the cleaner pump in reverse for 1 second to help reduce pressure on the cleaner tip.

20. As the Walker travels in reverse at high speed the lane distance sensor is counting inches traveled and is also monitoring the movement of the machine. If travel is interrupted, a **REVERSE TRAVEL** error will be displayed.

21. As the Walker reaches the oil distance the brush will begin to lower and stop in its down position when the brush down switch's normally open contacts close. If the contacts do not close a **BRUSH DOWN** error will be displayed. If the brush down switch sticks closed when it should be open, it will give a **BRUSH UP** error.

22. The brush will begin buffing at the end of the pattern as the Walker travels in reverse. The oil head will start back up again when it reaches the first reverse load distance.

23. As the Walker continues to travel in reverse it will be down-shifting to lower speeds. After the Walker applies the last reverse load the moving heads will park.

24. As the Walker approaches the foul line the 7-pin side motor will turn on and the buzzer will begin to sound. When both motors turn on they are once again monitored by their respective sensors to confirm they are in motion. The Walker will drive up on the approach and stop at the preset distance past the foul line.

25. After a short delay the Walker will turn 90 degrees; the direction of turn will be determined from the starting lane and ending lane. The machine will stop, have a short delay, move to the next lane, stop, have a short delay, turn 90 degrees, and face the next lane.

26. When the Walker stops after the second 90 degree turn all functions will reset and the machine will begin to operate on the next lane. When the Walker is done it will back out of the lane and stop.

27. If the oil float contacts open, an **OIL EMPTY** error will be displayed after the Walker has completed its second 90 degree turn. The oil will then need to be filled and the Walker will have to be re-started.

28. If the cleaner float contacts open, a **CLEANER EMPTY** error will be displayed after the Walker has completed its second 90 degree turn. The cleaner will then need to be filled and then re-started. Always empty the recovery tank when filling the cleaner tank.

29. The Walker cannot be resumed if the following errors occur: **APPROACH 7 & 10; OLS LATE OR STUCK; OIL & CLEANER FLOAT; DUSTER UNWIND;** and **SQUEEGEE DOWN**. In the event one of these errors occurs, the machine will need to be re-started.

NOTE: *If the Walker stops and displays the LOW BATTERY OR E-STOP PRESSED it will need to be returned to the foul line and plugged in. This message comes up only if the voltage drops below 17 volts (meaning it has a dead battery), if the E-Stop is pressed, or if there is a loose power connection.*

Kustodian Ion Sequence of Events - "How it Works"

The following steps detail how the Ion operates, which is much like the Walker. The Ion should be on the approach in down or operating position with the HOME SCREEN displayed on the touchscreen. The Ion needs to be in "clean and oil mode" for the following sequence of events to occur. The following sequence will explain how to start the Ion, how the errors work, and what happens as the Ion travels down your lanes.

1. Press the **GO TO STARTING LANE** button to advance to the starting lane screen. Choose the starting lane then press **GO TO ENDING LANE** and choose the ending lane. After choosing the ending lane, press **START MACHINE** the machine will change to a screen that will ask you to double check your info. If it's correct press **YES** and the screen will change to the run screen and it will be ready to run.

2. Press the **start** button on the handle one time and the machine will lower the duster cloth which is monitored by the duster up switch. If the switch's normally open contacts do not open up there will be a **DUSTER EMPTY** error displayed. The squeegee will move down and stop when the down switch's normally open contacts close. If the switch contacts do not close there will be a **SQUEEGEE DOWN** error displayed. The oil pump will turn on.

3. Push the machine onto the lane and make sure it is properly seated. If you want to add extra cleaner (pre-soak) to the front of the lane, press the red button on the bottom right side of the handle. If more cleaner is needed, wait for the moving heads to stop and press the button again.

4. Press the **start** button a second time and the moving heads will start and move from left to right or from right to left (the heads move in opposite directions). The cleaner head will start to apply cleaner instantly to the lane and not stop until the last squirt distance has been reached. When the oil head reaches the right board edge proximity sensor, the moving heads will reverse and begin to apply the first stream of oil.

5. The moving heads are now moving in opposite directions, so when the oil head reaches the left board edge proximity sensor, the head motor will reverse and the drive motor will start up. The buffer will then turn on and the machine will begin its forward travel down the lane. When using the factory settings, the buffer motor does not turn on until the rear of the machine is about 3 feet (0.914 meters) past the foul line. Also, the vacuum motor does not turn on until the rear of the machine is about 3 to 4 feet (0.914 to 1.2 meters) past the foul line.

6. Additionally, the second press of the **start** button will start a clock to record the total amount of run time to be displayed on the screen, the total valve time will also be recorded and displayed.

7. As the machine travels forward down the lane the moving heads will continue to operate applying oil and cleaner. The board counting proximity sensor monitors the motion of the moving heads. If the motion is interrupted, a **MOVING HEAD TRAVEL** error will be displayed.

8. As the machine travels down the lane, the lane distance sensor (LDS) is counting inches traveled and is also monitoring the movement of the machine. If travel is interrupted a **FORWARD TRAVEL** error will be displayed. The speed of the machine is also being displayed on the screen.

9. As the machine continues to move forward, speeds will change and oil and cleaner will continue to be dispensed to the lane as programmed. As the machine approaches the applied oil distance the oil will turn off and the buffer will continue to buff oil onto the lane.

10. When the oil distance is reached the buffer brush will stop and rise up, then the brush up switch's normally open contacts close. If the contacts do not close there will be a **BRUSH UP** error displayed. If the brush up switch sticks closed when it should be open it will give a **BRUSH DOWN** error.

11. When the oil distance has been reached the machine will shift into high speed and continue to travel toward the pin deck. As the machine approaches the pin deck the last squirt distance will turn off the cleaner pump and the moving heads will park. At the same time the machine will down shift to low speed to reduce its momentum into the pin deck.

12. When the machine enters the pin deck the duster wind-up motor will turn on at its pre-determined distance and start to wind up the cloth (to raise the duster). The duster up switch's normally open contacts will close to turn off the duster wind-up motor. If the contacts do not close there will be a **DUSTER WINDUP** error displayed.

13. When the machine reaches its travel distance and comes to a stop, the squeegee will proceed to lift up and stop when the squeegee up switch's normally open contacts close. If the contacts do not close, a **SQUEEGEE UP** error will be displayed.

14. The machine will then start traveling in reverse and stop after moving 4 inches. The squeegee will lower and the machine will go forward again and stop, then lift the squeegee. This function helps to remove drips off the squeegee blades.

15. The machine will now travel in reverse, turn the vacuum off, and run the cleaner pump in reverse for 1 second to help reduce pressure on the cleaner tip.

16. As the machine travels in reverse at high speed the lane distance sensor is counting inches traveled and is also monitoring the movement of the machine. If travel is interrupted, a **REVERSE TRAVEL** error will be displayed.

17. As the machine reaches the oil distance the brush will begin to lower and stop in its down position when the brush down switch's normally open contacts close. If the contacts do not close a **BRUSH DOWN** error will be displayed. If the brush down switch sticks closed when it should be open, it will give a **BRUSH UP** error.

18. The brush will begin buffing at the end of the pattern as the machine travels in reverse. The oil head will start back up again when it reaches the first reverse load distance.

19. As the machine continues to travel in reverse it will be down-shifting to lower speeds. After the machine applies the last reverse load the moving head will park. The machine will continue to the foul line then stop.

20. If the oil float contacts open, an **OIL EMPTY** error will be displayed after the machine has completed its run. The oil will then need to be filled and the machine re-started.

21. If the cleaner float contacts open, a **CLEANER EMPTY** error will be displayed after the machine has completed its run. The cleaner will then need to be filled and the machine re-started. Always empty the recovery tank when filling the cleaner tank.

22. The machine cannot be resumed if the following errors occur: **OIL & CLEANER FLOAT; DUSTER UNWIND;** and **SQUEEGEE DOWN**. In the event one of these errors occurs, the machine will need to be re-started.

NOTE: If the machine stops and displays the **LOW BATTERY OR E-STOP PRESSED** it will need to be returned to the foul line and plugged in. This message comes up only if the **voltage drops below 17 volts** (meaning it has a dead battery), if the **E-Stop is pressed**, or if there is a **loose power connection**.

Basic Steps to Operate Your Kustodian Walker or Ion

Carefully set the machine in the operating (down) position on the approach. It should be completely on the approach, with the cleaning end behind the foul line.

Locate the **E-Stop** and rotate the red button to reset and turn the machine on. When the machine is powered ON the touchscreen will boot up to the Password Screen shown below on the left (or if this has been disabled it will go directly to the Home Screen on the right).

Since the machine allows different users to have different permissions, select the correct user or master icon assigned to you to access the Home Screen.

The blue Question Mark on the bottom right of the screen provides access to HELP.

After selecting the User Type, enter your assigned password to gain access to machine menus.

The green arrow pointing to the left at the bottom of the screen is the “back” button to take you to the previous screen. In some menus you’ll see a “forward” button pointing to the right that will advance you to the next screen.

If you enter the wrong password, the touchscreen will display a notification. Press CONTINUE and then try again.

Machine Setup I

From the Home Screen, press the icon for the MAIN MENU. A series of sub-menus appear on the screen. *The screens shown here are examples from the Walker program so the Ion may not look identical.*

To access the machine setup menus, press MORE MENUS and then select the MACHINE SETUP icon.

The screen will change to the password screen where you will need to enter the correct password to access these settings.

Once the correct password is entered, press CONTINUE.

MACHINE SETUP I is the area for special functions.

The ENABLE BUTTON at the bottom will need to be pressed *AT THE SAME TIME* as one of the listed functions to enable or disable the selected function.

The PLC Operating System is able to operate either a KUSTODIAN WALKER or KUSTODIAN ION. When the machine type icon is pressed the name will change (along with the available functions for that model).

The NUMBER OF LANES button allows you to set the size of the center. Press on the number and a keypad will appear to update the program with the correct number of lanes. To lock in the setting press ENTER. To exit the keypad press CANCEL.

PASSWORD START is used to prevent unauthorized operation of the machine. For convenience, you can disable the password and the machine start functions will be unlocked and the operator will not need a password just to run the machine.

SQUEEGEE WIPE is a function to help remove excess cleaner off the blades. Disabling this function will stop the machine from doing the reverse/forward/reverse jog in the pit.

When the default setting has been changed in a menu screen, the background color of the button will change to yellow.

Press CHANGE PASSWORDS to advance to the password control screen shown to the right. To change passwords press on the value and a keypad will appear, type in the new password and press ENTER.

Up to three unique USERS can be setup in this screen. Additionally, MASTER #1 & MASTER 2 can be set with the ability to gain access in all areas <u>and if zeros are left in for them master passwords then all will still have access.</u>

SYSTEM MENU should never be enabled unless you need access to the SPECIAL FUNCTIONS of the touchscreen.

SET TIME & DATE is used to set the correct time and date. To update this data, press SET TIME & DATE and the screen to the right will appear. In the buttons under Military Time is where the adjustments can be made by pressing the appropriate area. When setting time and date be certain to put the period in its proper place, there is an example at the top of the keypad to follow as a guide. Please note that the time at the bottom of the screen will show 00 for the hour when it is 12 am or 12 pm, so it looks like it is only displaying the minutes.

Press on the day of the week to choose the proper DAY and the button will change color to show the selected day.

SELECT LANGUAGE is used to choose which language is displayed on the touchscreen. English, Spanish, French, Italian, German, and Japanese are all available.

Pressing the green Forward Arrow (in the lower right corner of the screen) will advance the menu to the MACHINE SETUP II options for the Walker.

The MACHINE SETUP II provides additional Walker options as described below.

MOON WALK SETUP will advance to next screen when pressed. This is where the data can be customized for your center.

Press on MOON WALK TO LAST LANE to enable or disable this function. This feature allows the machine to back-up to the end pairs that are built next to walls or other obstacles.

The MOON WALK TO POLES OR WALLS is useful when there is a pole or wall to walk around. The flexibility of the machine allows it to back-up to obstacles before it walks around it.

For example, if the machine needs to back-up going to Lane 8, then **7** will be the Lane Value for going Left to Right. If the machine is going Right to Left and needs to back up to Lane 10, then **9** will be the Lane Value.

AUTO BURN is for when the 7 DAY PLANNER is set to use ZONES. When the pattern changes to the next ZONE, the machine will run the first two lanes twice before continuing on with the rest of the lanes. Press on the AUTO BURN button and the ENABLE BUTTON at the same time to enable or disable this function.

VACUUM DISABLED ON THE APPROACH can be activated by pressing that button and the ENABLE BUTTON at the same time. These two buttons pressed at the same time will toggle the function ON and OFF. Setting this ON will cause the vacuum to turn on as it exits the lane.

The **APPROACH BUZZER** can be disabled if the noise is just too much. Press ENABLE BUTTON and APPROACH BUZZER buttons at the same time to toggle the alarm between ON and OFF.

To operate this machine you need to understand the Machine Sequence of Events as described on Page 12. Read pages 12 - 17 again if you do not fully understand "How it Works"!

Positioning Your Kustodian Walker

When starting the Kustodian Walker it is best to line it up with the lane as accurately as possible. To do this, press **MOVE MACHINE** from the Home Screen.

To move your Walker like a pro you should practice and pay close attention to where your main approach drive wheels are. These wheels represent the center of the turning radius. Using the **STOP** button to stop the machine and the **Directional Arrow** buttons to position the machine, you will be smoothly operating your machine in no time.

Use the **Down Arrow 5** to move the machine in reverse and the **Up Arrow 5** for forward. Press either button one time and the machine will move 5 feet in that direction and then stop.

The buttons will disappear after they are pressed and a STOP MACHINE screen will take their place. The buttons will re-appear when the machine stops or after the stop button is pressed.

Press the **Up Arrow** in the upper right side of the screen and the machine will move continuously forward, touch a whisker to increase the travel speed. To stop the machine, press STOP on the touchscreen, E-Stop or hit the bumper. This function is normally used to get the machine from one end of the center to the other.

To turn the machine, use the two turning buttons. The one on the left is the **Counter Clockwise** direction and the button to the right is **Clockwise**. Like the other buttons, they will disappear while the machine is moving. If the side of the machine is parallel to the foul line and the main drive wheels are on the center board, the machine will be lined up with the lane when turned 90 degrees.

It is not unusual to start then stop the machine quickly to obtain the exact position desired.

NOTE: Caution should be used when positioning your machine. Turning the machine too close to the foul lights will result in the machine crashing into them and causing possible damage to the lane sensing whiskers. The whiskers are springs and are meant to bend but not get smashed.

Starting Your Machine

After you have positioned the machine, press GO TO STARTING LANE. From this screen you can select the PROGRAM OVERRIDE function to choose a different pattern, condition the first two lanes twice (BURN PAIR) on a Walker, and choose the STARTING LANE.

The screen will also display the name of the pattern that is currently set to run for that time period. To choose the starting lane you can use the SKIP buttons to go to the FIRST LANE or the LAST LANE in your center. Or you can simply change the value in one lane increments by using the buttons on either side of the Lane Number to DECREASE or INCREASE the value.

On a Walker, to set the machine to **run the first two lanes twice**, press the **BURN PAIR OFF** button. When it is pressed, the button will change to **ON** and the function will be enabled. Pressing it again will turn it back off. The function can also be set to happen if the machine changes patterns (ZONES) from the settings in the **7 DAY PLANNER**. This setting can be done in the **MACHINE SETUP II** screen.

For the Ion, it may be necessary to add more lanes in SYSTEM SETUP to have burn lanes available when burning lanes while using Zones in the 7 Day Planner. This way you can set up the Zones to have two extra lanes which allows you run the first two lanes of the new Zone twice.

> ***NOTE:*** *Running two warm-up lanes will allow the Transfer Brush and Buffing Brush to be replenished with conditioner and return to a constant refreshed state. This will help prevent the first lane pair from being different (drier) than the rest. This is critical for league and tournament play conditions. Kegel has recommended this procedure to be done with every machine we have produced.*

To override the preset pattern showing in the STARTING LANE screen, press the **PROGRAM OVERRIDE** button (in the bottom center of the screen) and the display will change. A password will need to be entered into the screen to continue.

After you enter a valid password, the screen will allow you to choose your desired pattern number. The name of the pattern will also appear above the pattern number. After choosing the desired pattern press **GO TO STARTING LANE**.

When entering the pattern number each digit must be adjusted. The left digit will go no lower than 0 and no higher than 3, the right digit will go from 0 to 9 (as long as there is not a 3 for the left digit).

The upper limit is **30**, which is the number of total patterns stored in the program. To advance from pattern 29 to 30 you will need to change the right digit to 0 before you can change the left digit to 3. Program 31 is a READ ONLY calibration program that cannot be accessed from the Program Override menu.

After you have chosen the starting lane, press **GO TO ENDING LANE** to advance to the screen on the left. Choose the ending lane the same way as the starting lane.

You can still choose to do a Pattern Override and set the Burn Pair function from the ending lane screen.

After you have chosen the last lane for this operation, press **START MACHINE** in lower right corner of the display.

The screen will change to a confirmation screen so you can double-check to make sure all the information is correct.

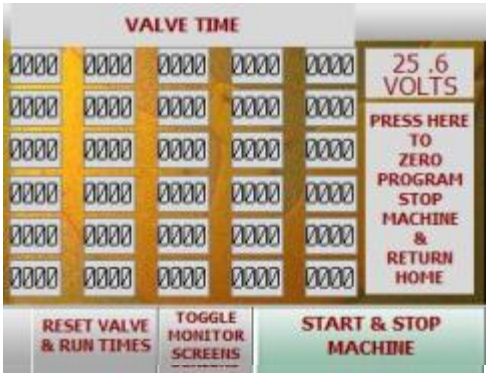
The screen will show the pattern name and number, what lanes the machine is going to run, and the mode of operation. If all the data entries are correct then press **YES** or use the Back Arrow to return to the previous Starting Lane screen. Once you press **YES** the Ion will be ready to operate and the Walker will begin to operate.

Monitor Screens

The machine has five screens that can be viewed by pressing the TOGGLE MONITOR SCREENS while the machine is running. These screens are used for trouble shooting or just general information. The RUN and VALVE times are reset by the button on the MACHINE RUNNING screen.

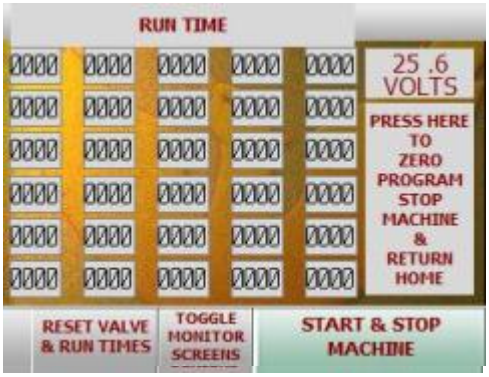
The **Main Monitor Screen** will display the pattern NAME and NUMBER, the RUN TIME for one lane, the travel SPEED in inches per second, the OIL VALVE TIME, and the estimated amount of LANES LEFT ON DUSTER CLOTH. The display also shows the current VOLTAGE the machine is operating at. If the Burn Pair function has been enabled, this will be displayed in place of the RUNNING LANE and ENDING LANE.

The monitoring area is also a big pause and resume button when needed. Just press on the START & STOP MACHINE button to STOP the machine, press it again to RESUME operation. Additionally, the program can be reset if necessary by pressing in the ZERO PROGRAM area.



The **Valve Time** screen (shown to the left) will display 30 consecutive valve times to the screen, each count is 1/50th of a second. To ensure consistency in conditioner application, frequently check the valve times. A button on the menu screen allows the times to be reset, when desired.

The **Run Time** screen (to the right) will display 30 consecutive run times to the screen, each count is 1/10th of a second and these should be checked periodically to ensure the travel speed of the machine is consistent.



The **Distance to End** screen will display the counts to the end of travel (716), the Stop By Duster option setting (YES or NO), and how many counts are required to Stop By Duster (12). This screen should be used on the Walker when adjusting the values for the distance to the end of the lane so the machine reverses properly.

The screen to the left is used for the **Ion** which shows the distance to the end as well as the distance back to the foul line. The Ion does not have a Stop by Duster switch.

The data screen for the **Lane to Lane** settings displays the Data Memory and the Counter (cnt) for the eight possible steps to travel from one lane to the next. This screen is used primarily for trouble-shooting Kustodian Walker approach functions.

Starting Walker without the Touchscreen

The Walker has a back-up start function in case the touchscreen fails for some reason. Press the **L-R Button** and hold it for more than 5 seconds. This will enter the Starting Lane as lane #1 and the Ending Lane will be the last lane programmed for your center. Press the **L-R Button** a second time and the machine will start.

Keypad and Menus

Machine Error Messages

The machine is equipped with Error Messages that are displayed on the touchscreen in case the machine malfunctions. These messages will indicate the type of operational error that has occurred. A description of some common causes of how the errors might occur can be viewed from the error message screen.

This manual may hold more detailed information on some errors that require more explanation.

If errors are present when the machine is turned on, the screen will display the ERRORS DETECTED message as shown above. Pressing on the message will take you to the Error List (there are two screens). The error that was detected will have the border of the button flashing.

Press on the flashing error to view possible causes. If no errors are detected, you can still press in the area where the message appears even when it is not present to view the error list. Additionally, you can even select HISTORY MONITOR to view errors.

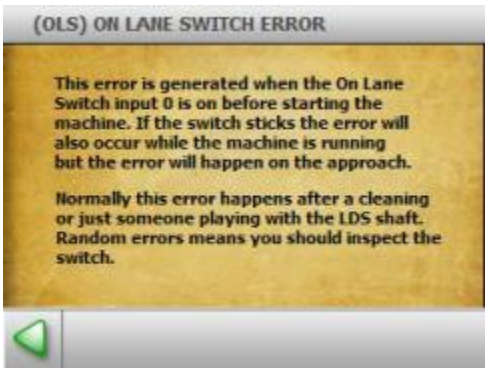
LIST OF MACHINE ERRORS

FORWARD TRAVEL ERROR	REVERSE TRAVEL ERROR
BRUSH DOWN ERROR	BRUSH UP ERROR
OIL HEAD TRAVEL ERROR	STEPPER DRIVE ERROR
SQUEEGEE UP ERROR	SQUEEGEE DOWN ERROR
OIL EMPTY ERROR	CLEANER EMPTY ERROR
DUSTER UNWIND ERROR	DUSTER WIND-UP ERROR
CLOTH RESET ERROR	

ADDITIONAL ERROR LIST FOR WALKER

APPROACH 7-PIN SIDE ERROR	APPROACH 10-PIN SIDE ERROR
OLS SWITCH STUCK ON	OLS SWITCH TOO LATE ERROR
7 PIN WHISKER ERROR	10 PIN WHISKER ERROR
BUMPER SWITCH ERROR	

Below is an example of how an error messages will appear along with its help screen.



When the machine loses battery power, or if the **E-STOP** is pressed while operating on the lane, the machine will display this error message when the power resumes.

Press anywhere on the screen to return to the Home Screen.

Operator Menu Selections

The machine has a series of menus that are accessed from the Main Menu screen.

Each of these menus will be explained in detail in the appropriate section of this manual.

The ABOUT menu is where the program version and other pertinent machine information is located. This data will be required for technical support on the machine.

Pressing the ABOUT button brings up a screen telling you the PLC PROGRAM VERSION, the machine SERIAL NUMBER, the INSTALL DATE, and the QC DATE.

The dates are used to determine if the machine is still under warranty and should not be adjusted to prevent voiding your warranty.

Technical support on the machine is available at any time, day or night. To reach a technician, press the CONTACT KEGEL button and several ways to access Kegel is displayed.

Operating History

From the MAIN MENU screen by pressing the MORE MENUS and then HISTORY MONITOR you will be able to view the OPERATING HISTORY of the Lane Machine.

The machine will record the Day, Month, Hour, User #, Pattern #, Start Lane, End Lane and Number of Lanes Run each time the machine completes one lane or more.

The main function of this feature is to keep track of the centers conditioning program. It will also monitor any operational error codes as well as restarts. If many restarts are recorded, this may indicate a potential operating problem. It will hold and display the last 55 operations

By pressing the Blue question mark, you will be able access the HELP screens that will assist you in understanding the OPERATING HISTORY screens.

Maintenance, Recharging & Storage

Cleaning Guidelines

Cleaning is the single most important thing the operator can do for this lane machine and it is not hard. Not taking the time to do simple cleaning will result in the downward spiral of your conditioning program. The end result will be a machine that is not reliable, and customers may begin to think they are bowling the Petersen Classic™.

For those who do not know, the Petersen Classic™ is a tournament where the conditions are sometimes worse than bowling in a parking lot. It is the only place on the planet where the lane man gets no grief from the players since no one cares if two lanes play the same.

Keeping your machine clean also helps you find potential problems. Loose fasteners or wires can be found and fixed before they interfere with normal lane maintenance. A good cleaning program is worth a few extra minutes per day.

Daily Cleaning

- First things first, you should **never transport the machine with waste in the recovery tank**!
- The oil compartment should be wiped down completely. Do not clean the Transfer Brush or Buffing Brush excessively unless needed.
- Clean drip pads on each side of the machine in the oil compartment.
- Clean the Drive, Lane Distance, Momentary wheels, and Blue ZTR wheels on Walkers. Dust and lint should not be allowed to build up.
- Wipe squeegee clean and inspect frequently for wear. Keep an extra set of blades on hand (store them in a dark cool place).
- Wipe down the bottom of the machine (this area collects a lot of dust).
- Wipe off the outside of the machine.

Weekly or Monthly Cleaning

- Use compressed air to remove dust from those hard to reach areas.
- Inspect recovery tank filter.
- Clean lint from Transfer Brush and wipe between both brushes.
- Whenever the duster cloth is changed clean entire cleaning compartment and lube the cleaner head bar.

- Wipe off casters; they should not grow hair.
- Remove large black covers and clean around the motors.
- Inspect the motor end of the vacuum and make sure dust does not build up on the cover for the vacuum motor. Not keeping this clean will shorten the life of the motor.
- Inspect the vacuum housing and investigate if wet.

Yearly Cleaning

Yearly cleaning is when you take the opportunity to do a little extra. Spend the entire day on the machine giving it extra care. Remove key components so you can get to some of those hard to reach areas. Scheduling a day or two would be a good thing.

Charger Location & Storing of the Machine

The machine should be stored in a safe and warm environment and as close to the lanes as possible. Some centers build dog houses for their machine next to the approach or behind the pinsetters. If possible, the machine should be stored where all of its related Kegel products are kept (i.e. cloth, conditioner, cleaner, and whatever else you use to keep it clean and maintained).

The storage location is where you will have the charger mounted for charging the batteries. **There should be a reliable dedicated receptacle for the charger, along with a power indicating light to show there is power to the charger.**

Recharging

To recharge your Walker or Ion simply plug the cord from the charger into the receptacle on the 7-pin side of the machine. Open the small spring-loaded door and fully insert the plug. Always put the machine on charge when not in use. The charging voltage should be monitored each day when the machine is ready for charging. **Refer to Chapter 5 for more detailed information on charging.**

Things You Can Do with No Cord Attached!

Now that there is no cord to manage you have the freedom to do many things you couldn't do with previous lane machines.

In the past, you had to hold the cord whenever operating the lane machine.

If it takes you 45 to 60 minutes to condition your lanes, you virtually gain that time to do other things.

Here are a few time-saving recommendations:

1. More attention can be given to the approaches and the area just past the foul line.
2. Dusting the approaches is much easier without a cord lying around.
3. Adjust foul lights. This is always an on-going task.
4. Inspect power lifts. Not much fun when these things go down.
5. Socialize with the customers. Now you can do it and not worry about the machine running over the cord when you turn your head.
6. Watch the machine do its job. Make sure it is conditioning (oiling) and cleaning properly because it's not much fun when the bowlers know before you do.
7. Get your ball out and bowl while you condition and check the lanes out. It is always nice to know the strike-ability of the lanes.
8. It is much easier to have that morning cup of coffee when conditioning now.
9. Inspect the entire lane area as you condition. You are now able to stroll all over the place.
10. Think of how to make the transition better at the foul line (only if it's bad). This is very important because you do not want to damage your new cordless machine due to poor transitions.

What you do with this extra time is up to you, but one thing is certain…

we think you will enjoy the freedom of a dependable battery-operated lane machine.

Lane Maintenance 101

Overview

Bowling lane maintenance is more than just pushing a button on a lane machine and applying oil to the surface. It also requires giving attention to the approaches, gutters and capping which all get dusty. Maintaining all of this area on a daily schedule is important to provide the best service to your customers. Your lane machine also benefits from keeping these areas clean. Here are a few suggestions that should be followed to maintain your bowling center.

1. One of the first things that should be done each morning is a walk across the approaches. This is when you find out if the lanes, gutters and approaches were dusted the night before. This is also great time to inspect the approaches for any kind of possible problems that just jump out at you.

2. Walking the lanes each morning also gives you a chance to see what the left over oil looks like in the applied area and what it looks like on the back-ends as well. It is possible to see many things, from unusual amounts of dirt to possible cleaning problems with the lane machine. Who knows what can be found?

3. Dust the gutters, caps and division rails each and every day. This greatly reduces the amount of dirt the lane machine pulls into the conditioning compartment. It sounds like a lot of work, but so what, it makes your life easier the more you run the machine. If you want to provide the best conditions it will take time. Also, it's easier to keep up on a day-to-day basis.

4. Dust your approaches no less than three times a day… if not four. Some areas of the country or world will require this just to keep them from looking like they were just plowed and ready for planting.

5. Dusting your lanes between conditioning is another big bonus that seems to be a lost art. High lineage and dusty lanes are a bad combination, especially if your lanes are synthetic. Dust will increase the wear on the surface and reduce the life of your lanes, not including the changes that will result in the way the lanes react and play.

6. The approaches are very important to good customer satisfaction and you should pay close attention to them. Besides frequent dusting, using a rotary buffer will improve the slide consistency and cleanliness of your approaches when done regularly.

7. Keeping your lane machine spotless will help you find problems before they become nightmares.

8. Other areas that affect the cleanliness of your lanes is your pinsetters and ball returns (anything that the bowling ball comes in contact with). Dirt comes from these things, along with grease and oil that is very difficult for the lane machine to clean off the surface.


LANE OIL
"The Oily Grail"

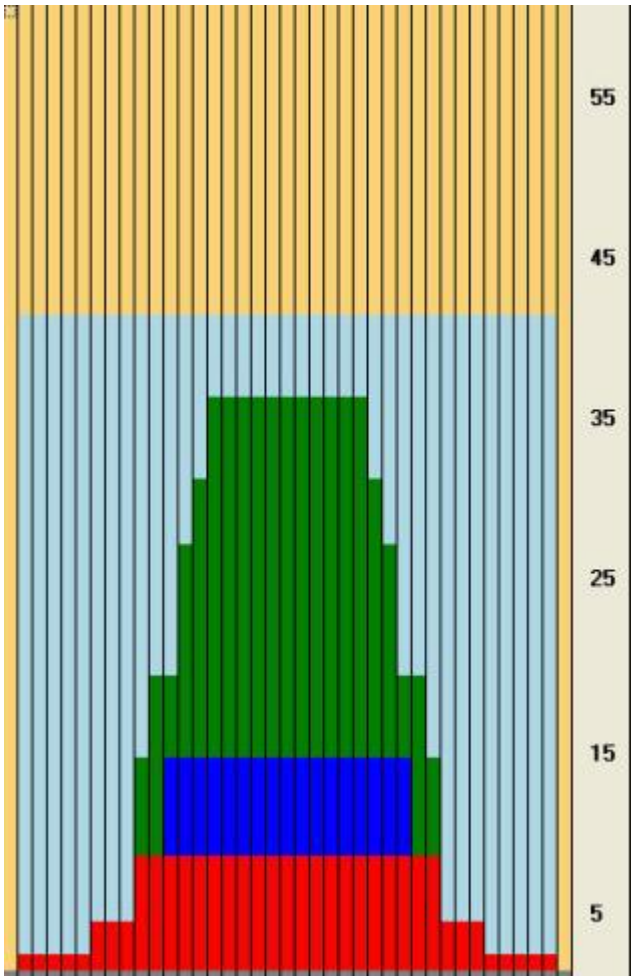
CHAPTER 2

Conditioning Overview

How the Conditioner (Oil) is Metered and Controlled

Sanction Technology™ is patented and the only measurable method capable of applying precise amounts of lane conditioner. An explanation of how this is accomplished will help you understand the art form of oil pattern application.

When conditioning a lane, the oil head travels back and forth across the transfer brush applying streams of conditioner. This gives the machine the ability to create patterns like the one below.



The size of the stream can be set to an exact amount or volume. We achieve this exact stream and volume by using a highly accurate fluid metering pump. This pump, running at a constant speed, gives absolute positive displacement of the conditioner. The accuracy of the pump is ± **1%** with a continued precision of ± 0.5% after millions of cycles. This is the same pump used in hospital medication dispensers.

The oil head traveling at a constant speed puts down the same amount of oil as it travels across each board. The pump allows us to set the exact amount of conditioner that goes on each and every board within the stream. We measure this amount as the **Volume per Board**.

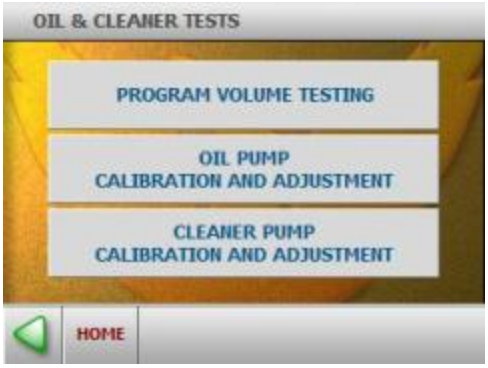
The pump output is measured in *microliters*. This is a metric measurement for fluid volume. The factory setting for the pump is 50 microliters per board.

To give you a visual perspective of how much conditioner is being applied in 50 microliters, consider that about 20 microliters make up one drop of oil. So each time a stream of oil crosses one board it applies almost 2-1/2 drops of conditioner.

Since this amount of conditioner is too small to measure with the naked eye, we must use a larger number of boards to get an amount we can visibly measure. Factory-set **PATTERN #31** is designed to condition 400 boards. This will give us enough conditioner to determine the amount that is being applied per board. Using a large round number makes the math a little easier to figure.

Calibrating the Oil Pump

Turn the machine on and go to the main menu and press **TEST OIL CLEANER PUMP VOLUME** and the screen will change to the display on the right.



Press OIL PUMP CALIBRATION AND ADJUSTMENT and the screen will change to the password screen, enter password and press CONTINUE.

Conditioner pump adjustments are done through the touchscreen. Press on a microliter (µl) selection to highlight the button and check the pump volume for that setting. In this example, we will use the 50 µl PUMP SETTING.

The OIL VALVE TIME is displayed on the screen along with the number of TIMES the test has been done.

1. Place the conditioner tip into a perfectly clean 25 milliliter graduated cylinder and press **RUN TEST**.

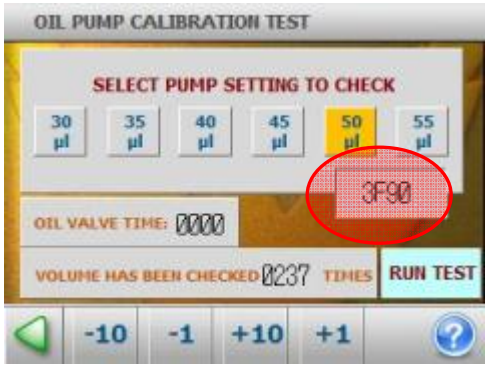
2. The head will travel back and forth eight times to simulate forward loads. It will pause and then run again for eight loads in reverse. The loads of conditioner are deposited from **2-to-2** four times and **14-to-14** four times for each direction in the graduated cylinder. This is equivalent to a total oil stream of **400 boards**.

3. Remove the tip from the graduated cylinder and read the amount. If the pump is set at 50 microliters, then the output in the cylinder should be 20,000 microliters or **20 milliliters**.

   ***NOTE**: There are 1000 microliters (unit of measurement for pump) in 1 milliliter (unit of measurement for graduated cylinder); we divided 20,000 by 1,000 to get 20.*

4. After running the test, the amount in the cylinder should be **20 µl**.

5. If the amount of oil is higher or lower than 20, a pump speed adjustment is necessary.
   ***NOTE:** Check to make sure the head is moving freely. If it binds up during travel the oil output may be affected.*



6. The pump is adjusted by changing the speed of the motor. Use the buttons on the bottom of the screen to add or subtract from the motor speed value located to the right under the microliter selection. The adjustment will only affect the setting that is highlighted.

7. Clean out the graduated cylinder using the long felt wick that is provided with the machine. A thorough cleaning is important because any oil left clinging to the sides of the cylinder will give inaccurate readings.
   ***NOTE**: When felt gets soaked with oil it can be cleaned by squeezing it in a rag or just use strips of rags to clean the graduated cylinder*.

8. Keep repeating the test until the amount in the graduated cylinder reads **EXACTLY 20 µl**.

This calibration sets the machine to a standard stream size of **50 microliters per board**. This allows us to "prove" or measure the oil pattern that is programmed into the machine. This value should be entered in the KOSI Advanced Designer screen as the **Oil/Board** value. This will be used for all the pattern volume calculations.

Proving the Oil Pattern

We will use some generic pattern settings as an example to explain how the math adds up. The numbers below show forward and reverse loads in a hypothetical pattern. From this you can see the boards covered by each load and how many times each different load is being applied.

PATTERN STRUCTURE

2 - 2 x 1 (Forward Loads)
10 - 10 x 3
13 - 13 x 3

*Zero Loads are ignored going forward and reverse***.**

14 - 14 x 2 (Reverse Loads)
13 - 13 x 4
12 - 12 x 4
11 - 11 x 2
2 - 2 x 1

Each load can quickly be condensed to a total number of boards by referring to the Board Chart found at the end of this section. Using the Board Chart we can determine that a load or stream of oil from **2 - 2 covers 37 boards.**

After converting all the loads the numbers become very simple.

CONVERTED BOARD QUANTITIES

37 x 1
21 x 3
15 x 3

13 x 2
15 x 4
17 x 4
19 x 2
37 x 1

When all these loads are multiplied and added together, the result is the total number of boards that are covered by a stream of oil.

TOTAL PATTERN BOARDS

37 x 1 = 37
21 x 3 = 63
15 x 3 = 45

13 x 2 = 26
15 x 4 = 60
17 x 4 = 68
19 x 2 = 38
37 x 1 = 37

374 Total Boards

In our example, there are 145 boards covered during Forward travel and 229 boards covered during the Reverse travel. This total number (**374**) can be multiplied by the pump setting (**50** µl) to determine the exact amount of oil used when conditioning with this pattern.

374 Boards
x 50 *microliters*
18,700 *microliters*

The total amount is 18,700 microliters. To convert this to milliliters the number has to be divided by 1,000.

18,700/1,000 = **18.7** *milliliters*

The special thing about Sanction Technology is that this total pattern amount can be confirmed by running the pattern and performing a **PATTERN VOLUME TEST**. This step is the most important element in the Process Verification Procedure and you should perform it whenever conditioning lanes for competition. Running the test 3 or 4 times should be enough to convince anyone of the machine's accuracy and repeatability.

NOTE: *Any time you run a different program you should calculate the total boards and volume.*

By calculating your program's total oil volume and double-checking the math, you can use the reading you get to check your volume per board adjustment. When the math is correct, it will tell you if the pump needs adjusting. The KOSI software provides a **Total** tab in the Advanced Designer screen that allow you to see the forward, reverse, and total oil volumes and boards crossed so you do not have to do the math.

Having the total output for the program will ensure that the program values are entered correctly. It will also help you understand each change you make. Although it is not information that will be used daily, it is a way of explaining a lane condition in exact terms. These measurements can be written down and duplicated in the future. In other words, it defines a lane condition so that it can be recognized and explained to anyone, much like any other specification of the bowling lane such as its length and width.

All adjustments to the oil pattern are exact and repeatable with Sanction Technology.

Board Chart for Calibrating Oil Pattern (Program) Loads

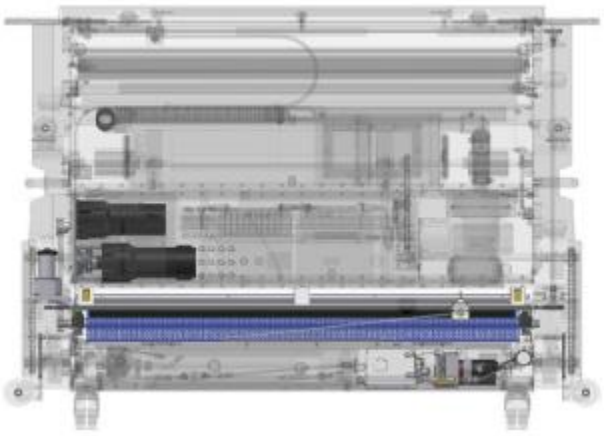
This chart shows the total number of boards the head travels across when distributing conditioner. This will make it much easier to determine the amount of oil that is used for your pattern, on paper, before it is measured by the machine during a Calibration Test.

		R I G H T																		
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	2	**37**	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
	3	36	**35**	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18
	4	35	34	**33**	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
	5	34	33	32	**31**	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	6	33	32	31	30	**29**	28	27	26	25	24	23	22	21	20	19	18	17	16	15
	7	32	31	30	29	28	**27**	26	25	24	23	22	21	20	19	18	17	16	15	14
L	**8**	31	30	29	28	27	26	**25**	24	23	22	21	20	19	18	17	16	15	14	13
E	**9**	30	29	28	27	26	25	24	**23**	22	21	20	19	18	17	16	15	14	13	12
F	**10**	29	28	27	26	25	24	23	22	**21**	20	19	18	17	16	15	14	13	12	11
T	**11**	28	27	26	25	24	23	22	21	20	**19**	18	17	16	15	14	13	12	11	10
	12	27	26	25	24	23	22	21	20	19	18	**17**	16	15	14	13	12	11	10	9
	13	26	25	24	23	22	21	20	19	18	17	16	**15**	14	13	12	11	10	9	8
	14	25	24	23	22	21	20	19	18	17	16	15	14	**13**	12	11	10	9	8	7
	15	24	23	22	21	20	19	18	17	16	15	14	13	12	**11**	10	9	8	7	6
	16	23	22	21	20	19	18	17	16	15	14	13	12	11	10	**9**	8	7	6	5
	17	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	**7**	6	5	4
	18	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	**5**	4	3
	19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	**3**	*
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	*	*

***** Each load of oil should cross at least three boards.

Conditioning System

Theory of Operation



This machine uses proven SANCTION TECHNOLOGY® patented by Kegel. This exclusive technology, perfected over the past 2 decades, is the only way to measure the volume of conditioner (oil) that is applied to a bowling lane.

The precision starts with the Fluid Metering Pump. Inside, a ceramic piston and cylinder are precisely milled to perfect clearances. This pump has no valves to impair its operation. The piston revolves and reciprocates during operation for flawless performance.

With the pump rotating at a constant RPM, the conditioner is pumped at an exact flow rate to a three-way valve known as the Oil Pattern Control Valve. The valve in its OFF state routes the conditioner back to the conditioner tank. When turned ON, the valve routes the conditioner to a line connected to the Oil Head.

The OIL HEAD travels back and forth across the transfer system at a constant speed, much like the printer head on a computer printer. The Oil Pattern Control Valve is then turned ON and OFF according to the chosen program. The result is a series of board to board streams of conditioner applied to the transfer system as the machine travels down the lane.

Anyone who pays attention to the machine's operation

will really be able to understand lane conditions.

We use Sanction Technology because all adjustments

to the oil pattern are exact and repeatable.

Change Pattern

Press CHANGE PATTERN in the main menu screen and the screen will change to the password screen.

Enter the password and press CONTINUE; the factory default is zero zero zero.

To the left is the main CHANGE PATTERN screen. From this screen you choose the pattern to view and then you can check the settings in SYSTEM SETTINGS or LANE PATTERN DESIGN.

System Settings is the area where all of the special adjustments that can be made for each pattern can be selected. Lane Pattern Design is where the pattern is created.

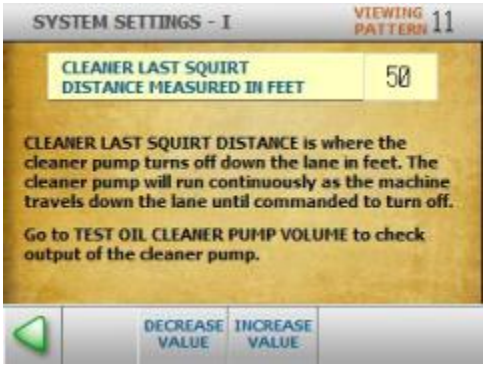
You can change the name of patterns 13 to 30 by pressing the Name Button (the first 12 patterns are locked as the Navigation Series standard patterns). A keyboard will appear to type in a new name, press CLR then type a new name, and press ENTER to lock in the changes.

SYSTEM SETTING

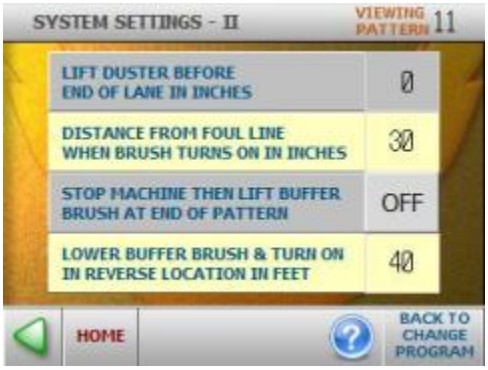
The first screen is the operating mode. Press on the mode to set the machine to perform the desired operation. When pressed the button will turn yellow and the text will change indicating what mode the pattern is set to perform.

SYSTEM SETTINGS I are all cleaning related adjustments that can be set different in each pattern. Press on the adjustment button and the screen will change to the adjustment area that includes the description of the adjustment. All cleaning related adjustments will be discussed in detail in the Cleaning Section.

This is an example of the adjustment screen for the System Settings. Once in this screen simply increase or decrease the value as needed then use the back arrow to exit to the previous screen.



SYSTEM SETTING II has one duster related adjustment and three oil related adjustments which will all be explained in there sections.



SYSTEM SETTINGS III are Walker functions that are timed to happen as the machine moves onto the lane. It is very important to understand what affect the numbers will have in this screen before changing them. Be careful when changing the values; and for each change you need to make sure you test your machine for the desired results.

The default settings do not allow the machine to oil the first 30 inches of the lane. This area will need to be maintained by hand to keep the oil in the area to a smudge and the area looking good.

By keeping the head area of the lane clean with just a small amount of oil, it will help prevent the area of the lane just past the foul line from being too slick for customers that just go over the foul line a little bit. Giving your bowlers a margin for error that is a foot or so beyond the foul line might help prevent injury if someone steps into this area.

This area of the lane is the most abused because it is close to the foul line and it collects all of the dirt from the approach. No lane machine is able to maintain this area to the level of perfection it needs. We cannot stress enough that the area next to the foul line needs tender loving care.

A tool similar to an approach finish applicator with a pad does a nice job and it takes only a few seconds to maintain this area. Our experience at Kegel's Center in Sebring, Florida has shown that this will not affect your scores and after we started doing it no one even noticed (and we do have a few bowlers that can strike here).

LANE PATTERN DESIGN

In this screen we are adjusting the Oil Distance and the Volume Per Board setting of the pump. Press on the function to enable the adjustment, the function will turn yellow to indicate it is active. The pump setting has 6 selections to choose from: 30, 35, 40, 45, 50, and 55.

When the Oil Distance is changed you will need to advance through all of the Design Screens for the distance data to calculate. If the oil distance is increased, then the last BUFF LINE # will default to LINE #15.

To Design a Pattern, start with the first LINE and choose the Board Numbers that you want the oil stream to go from and to, for example most patterns start with 2 to 2 (which is from the 2-board on the left to the 2-board on the right).

Press on the desired button to activate it and allow an adjustment to be made; the function will be highlighted in bright yellow when it is enabled.

Next, choose how many times you want to repeat that oil stream. We refer to an oil stream as a LOAD, so enter how many "loads" this LINE will have.

Once the LOADS are set, choose how fast the machine will travel while applying them. Normally, the machine will start out a little slower and increase gradually through the 6 available conditioning speeds. The ability to change speeds while applying these loads is a patented feature of Kegel lane machines.

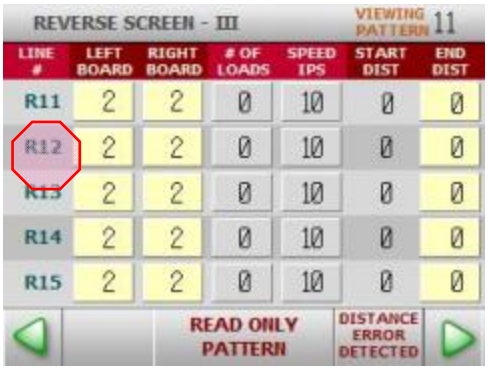
After you complete each pattern LINE the footage will automatically calculate as long as the Line # has LOADS in it.

The first LINE that does not have any LOADS will be the first BUFF LINE. This is also the first LINE that will allow you to change the END DISTANCE.

You can have more than one BUFF LINE in the pattern, which normally will be at different speeds. Just choose the distance & speed for each BUFF LINE, with the OIL DISTANCE being your upper limit.

Once you have created a LINE with no LOADS and started your BUFF LINES you cannot create the next LINE with LOADS, the present program does not allow skipping between buff out and oil loads.

Whenever the OIL DISTANCE is increased the last BUFF LINE will need to be adjusted to the OIL DISTANCE. When this change is made, the program defaults the new OIL DISTANCE to the 15th Forward BUFF LINE (F15). You will need to fix this.



After the forward screens are complete the display advances to enter reverse loads. On the first Reverse LINE you can only change the BUFF DISTANCE and SPEED, you can't change the boards crossed or put any LOADS in.

The rest of the LINES work just like the Forward
Screens. Row **R2** will be the first LINE to have LOADS.

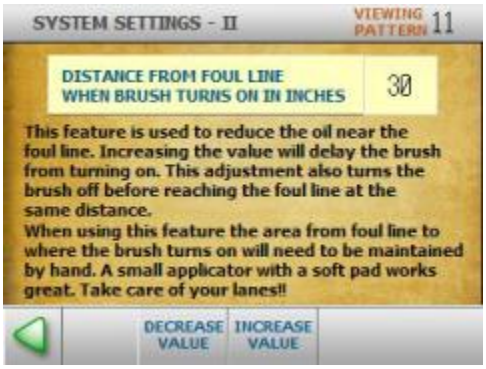
The DISTANCE is calculated when LOADS & SPEEDS are entered. You can have more than one BUFF LINE during the return trip to the foul line, by entering lines until you hit zero footage as the lower limit.

Like the Forward screens, once you have created BUFF LINES you cannot create the next LINE with LOADS, the present program does not allow skipping.

System Settings Conditioning Menus

These are the Change Pattern System Settings that relate to the conditioning of the lane. All System Settings adjustments are individual to the pattern selected.

DISTANCE FROM FOUL LINE WHEN BRUSH TURNS ON IN INCHES



This feature is used to reduce the oil near the foul line. Increasing the value will delay the brush from turning on. This adjustment also turns the brush off before reaching the foul line at the same distance.

The default setting is **30 inches** from the foul line. Changes made for the Walker will also require changes to be made in System Settings III to time the start of duster, cleaner and squeegee. The lower limit to this adjustment is 9 inches from the foul line.

This feature is great for open play bowling when it is near impossible to keep customers behind the foul line. Another tip that does help is to never turn off foul lights during open play. This will detour some from going past the line and tripping the buzzer.

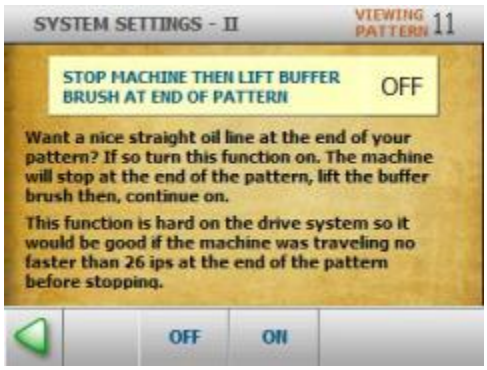
When using this delayed oil application feature the area from foul line to where the brush turns on will need to be maintained by hand. A small applicator with a soft pad works great. Take care of your lanes!!

STOP MACHINE THEN LIFT BUFFER BRUSH AT END OF PATTERN

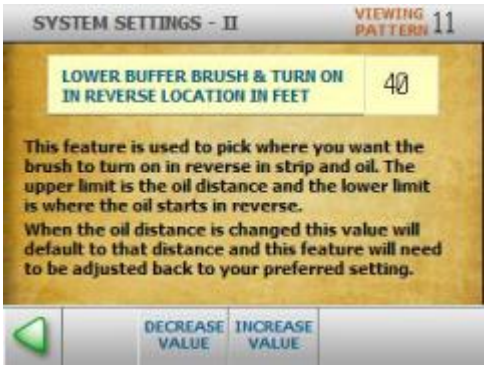
Want a nice straight oil line at the end of your pattern? If so, turn this function ON. The machine will stop at the end of the pattern, lift the buffer brush and then continue on.

The function has a preset delay so all that is needed is to turn it off or on.

This function can cause more wear on the drive system so it is best to use this when the machine is traveling less than 26 IPS at the end of the pattern before abruptly stopping.



LOWER BUFFER BRUSH & TURN ON IN REVERSE LOCATION IN FEET



This feature is used to choose where you want the brush to turn on in reverse. The upper limit is the oil distance and the lower limit is where the oil starts in reverse.

When the oil distance is changed, this value will default to that same distance and this feature will need adjusted back to your desired setting.

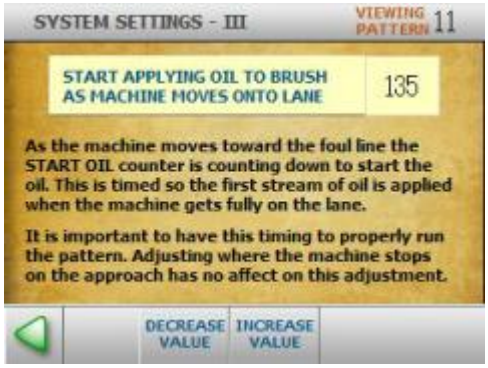
It is possible to drop the brush after the reverse oil distance has been reached, but this will require a call to Kegel's Lane Maintenance Central for tech support.

START APPLYING OIL TO BRUSH AS MACHINE MOVES ONTO LANE

As the Walker moves toward the foul line the START OIL counter is monitoring travel and counting down to start the oil. This feature is timed so the first stream of oil is applied when the machine gets fully seated on the lane.

This should be a value that does not need much adjustment, but is available when necessary. Any change here will affect the distance where the oil loads happen at.

It is important to have this timing set properly when running a pattern. Adjusting where the machine stops on the approach has no affect on this adjustment.



Auto Programming (7 Day Planner Program)

Go to the main menu and press 7 DAY AUTO PLANNER and the password screen will appear, enter password and press CONTINUE.

The day selection will appear press MONDAY and the screen will change to MONDAY AM. The button in the lower right will change you to PM settings for Monday (screens shown at bottom of page).

Press on the Pattern number to enable it and then use the Decrease and Increase buttons to make the change.

It is possible to have 3 Conditioning Zones across the center. When there are no Lane Numbers in Zones 2 & 3 the Zones are disabled.

To create a second Zone, press on the Ending Lane number in Zone #1. Decrease the Lane Number and Zone #2 will fill in Starting & Ending Lanes.

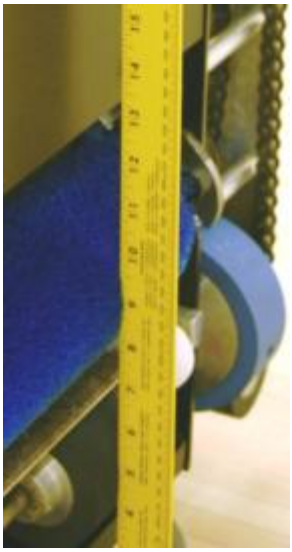
To create the third Zone, press on the Ending Lane number in Zone #2. Decrease the Lane Number and Zone #3 will fill in Starting & Ending Lanes.

To disable the Zones just Increase the Ending Lane in Zone #1 or #2 to the last lane.

The Walker can be set to automatically do a Burn Pair function in MACHINE SETUP when using Zones. For the Ion, it may be necessary to add more lanes in system setup to have burn lanes available when using Zones in the 7 Day Planner. This way you can set up the Zones to have two extra lanes so you can run the first two lanes in that Zone twice.

Adjustments

Buffer Brush (An adjustment video is available in KOSI.)



The buffer brush is made of a long-lasting synthetic bristle, which under normal circumstances can be expected to last approximately 18 months. However, changing this annually before each league season is recommended to ensure consistency throughout the year.

To check the buffer brush adjustment, the brush must first be in the down position. This is done at the **INPUT/OUTPUT TEST** menu. If the brush is not already down in the "zero" position, press **BRUSH LIFT**.

Press **TEST BUTTON** to activate this output. This will lower the buffer brush into the operating position. If the brush does not stop in the down position, check the condition of the Brush Down Switch.

With the brush down, stand the machine in an upright position and hold a level or straight edge across the drive wheels and rear lane distance wheels (shown above). The buffer brush material should extend approximately **3/32"** to **3/16"** (2.38 mm to 4.76 mm) beyond the straight edge for proper adjustment. The buffer brush is factory adjusted prior to being shipped at approximately **1/8"** (3.2 mm).

If an adjustment is needed, determine how much and then place the machine on the approach in the operating position. Open the splash guard and locate the adjusting screws above the lane distance sensor shaft. Loosen the jam nuts on the two adjusting screws, along with the three lane distance shaft pillow blocks.

Turn the adjusting screws until proper adjustment is reached. Each full turn of an adjusting screw is equal to a little less than 1/16" adjustment (1.41 mm). Tighten the jam nuts on the adjusting screws.

Make sure that the Lane Distance Sensor (LDS) pillow blocks are firm against the adjusting screws and then tighten the pillow blocks. Always tighten the center block last.

Once the blocks are secure, check that the LDS shaft turns as freely as possible, and there is a small amount of end play in the shaft. If the shaft does not spin freely, check and make sure the shaft is square throughout the LDS blocks.

***NOTE:** When cleaning the buffing brush, **NEVER** use any type of cleaner on the brush. Use of cleaners will decrease the brush's ability to hold conditioner and greatly affect the lengthwise taper of the conditioner pattern. All that you need to clean the buffer brush is a clean, soft, dry rag.*

Transfer Brush

The following steps adjust the transfer brush to the buffer brush.

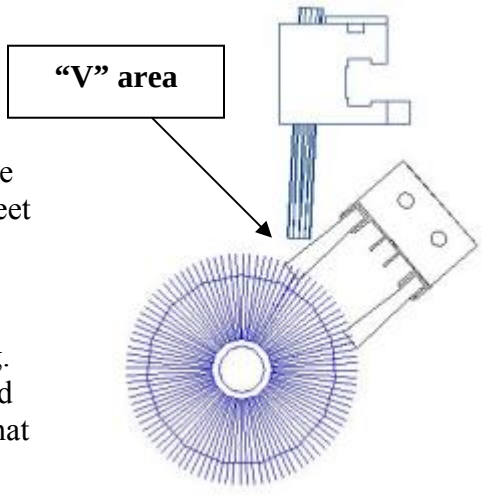
Step 1: Loosen the four #8-32 screws on the right and left side that are used to secure the adjustment (but keep them snug).

Step 2: Using a 1/8 inch Allen wrench turn the screw clockwise to raise the transfer brush or counter-clockwise to lower the transfer brush. You want to position the transfer brush so it is just touching the buffer brush, then turn it counter-clockwise to lower the transfer brush into the buffer brush so that when you turn on the buffer motor you have about an **1/8 - 3/16** of an inch (3.2 mm – 4.8 mm) of crush evenly on the top side. Once you get this adjustment, tighten your screws completely.

Step 3: Stand the machine up onto the transport casters and check the transfer brush crush to the buffer brush. To check this you will need to manually turn the buffer brush towards you, the bristles on the buffer brush should pull back about **1/8 - 3/16** of an inch. If this is not correct, you will have to return to the top side and make the adjustment the same way you adjusted the crush on the top side, but only loosening up the bottom screw on each side. Moving this may affect the adjustment you made on the top side so you might have to go back and forth from top side to bottom side until you get the **1/8 - 3/16** of an inch of crush on the top and bottom side of the transfer brush.

Oil Tip

Correct adjustment of the Oil Tip is very important and is a determining factor in applying a consistent pattern.

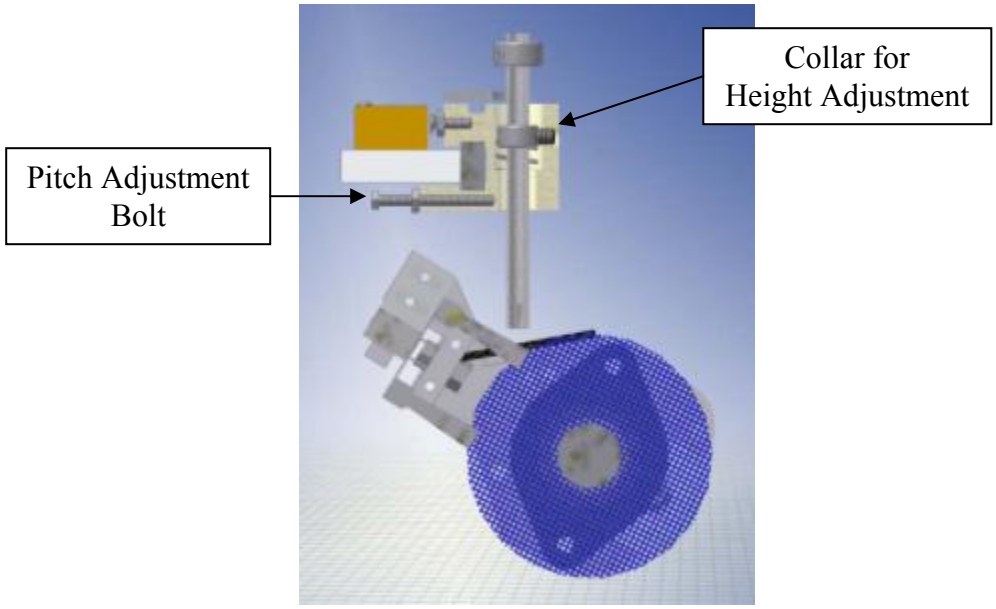


There are two adjustments that can be made to the oil tip. One adjustment is the height of the tip. The other is the position of the tip. The point where the Transfer Brush and the Buffer Brush meet will form a "V". The Oil Tip should be as close to this "V" as possible, without actually dispensing oil into the "V" area.

This adjustment should be checked with the buffer brush running. To operate the brush, go to your test INPUT/OUTPUT screen and press the BUFFER MOTOR then press the button in the center that says BUFFER TEST to turn on the motor. After making each position adjustment you will also need to make sure the tip is as close to the drip pads as possible, without touching them.

The oil tip height can be adjusted by loosening the set screw in the tip holder collar and sliding the tip holder up or down. Re-tighten the set screw when desired height is achieved.

The oil tip pitch can be adjusted using the screw and jam nut. Pitch should be set to dispense conditioner on the black transfer brush (very close to the V) not on the blue buffer brush.

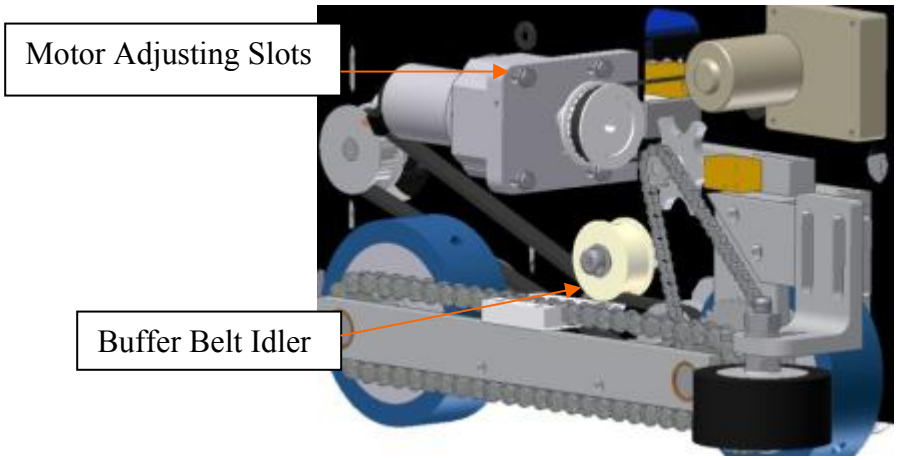


NOTE: *If you notice a zigzag pattern in the oil on the lane, you will need to adjust the Oil Tip position. Adjust the oil tip further up the transfer brush to eliminate this problem (make adjustments in small increments until zigzags disappear).*

Timing Belts

There are 3 timing belts that operate in the conditioning system. Refer to the KOSI videos to see the proper amount of tension required for each belt.

1. **Buffer Belt**: The machine has a belt tension roller that can be positioned to maintain the proper tension. The belt should have a fair amount of tension and should just flex a small amount when pressed on, but not be overly tight. If the belt is too loose it is possible for it to jump cogs and this is not good.



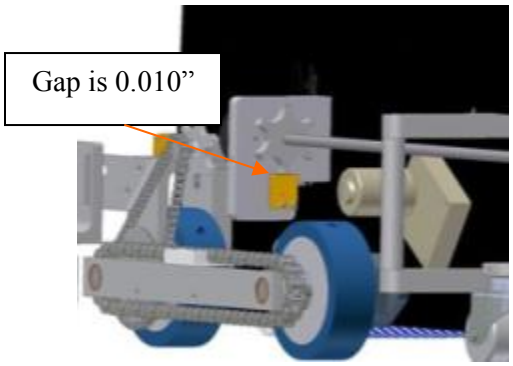
2. **Oil Pump Belt**: It is important to run the oil pump belt on the loose side. Over-tightening of this belt will reduce bearing life in the pump and cause premature failure of the oil pump motor. This may also cause oil volume fluctuations. Loosen up the oil pump motor fasteners to change belt tension.

3. **Oil Head Belt**: This belt should run on the tight side. **Unplug the head motor fuse before attempting to work on this belt to disable the braking circuit.**

   To adjust head belt tension, loosen the motor up from its mount, adjust to the desired tension and tighten all screws when done. This belt drives the board counting disk and the cleaner assembly making it important that the belt not run loose. A loose belt can cause the machine to lose its oil head timing and the timing that controls the movement of the cleaner head.

   Replace fuse when belt tension is correct and fasteners are tight.

Board Counting Target and Proximity Switch (An adjustment video is available in KOSI.)



The timing for the oil head is a precise adjustment. **Before making an adjustment, the Head Motor Fuse will need to be removed to disable the braking circuit.**

Remove the plastic cover on the 10-pin side to access the sensor assembly. Once the covers are off you will be able to see the belt tension and head timing assembly. If a timing adjustment is necessary, follow these steps closely to avoid confusion.

1. Move the oil head against the 10-pin side wall and check the belt tension.

2. When pushing down on the belt, half-way across the head track, you should feel the belt get tight just before it touches the track. Adjust tension if necessary.

3. The illustration above shows the board counting target and the board counting proximity sensor. The gap between the target and the proximity sensor should be **0.010**” (±0.005) or about 0.254 mm. The proximity sensor should be mounted square to the plate.

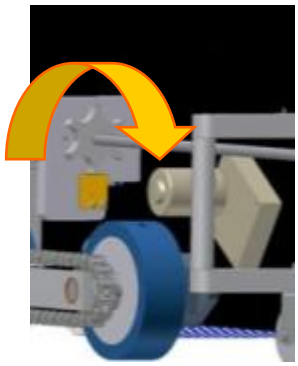
4. The next procedure is to adjust the board counting target by using the indicator lights on the proximity sensors. These lights come on when metal passes by the face of the sensors. The goal is to have the indicator light for the board counting proximity sensor come on when the oil head target is in the middle of both the left and right lane edge sensors (or close to it).

5. Move the oil head all the way to the 10-pin side wall (outside of the proximity sensor). Slowly move the head toward the middle of the lane edge proximity sensor. When the board counting sensor light comes on, stop and note the position of the oil head target to the lane edge sensor. Use this same procedure for the 7-pin side.

6. After doing step #5, if the board counting sensor indicator light is coming on in the same position for both lane edge sensors then the adjustment is good. If not, go to next step.

7. If on the 10-pin side the board counting sensor comes on too soon and the 7-pin side comes on late, the board counting target will need to be turned in a counter-clockwise direction and vice-versa if they are off in the other direction.

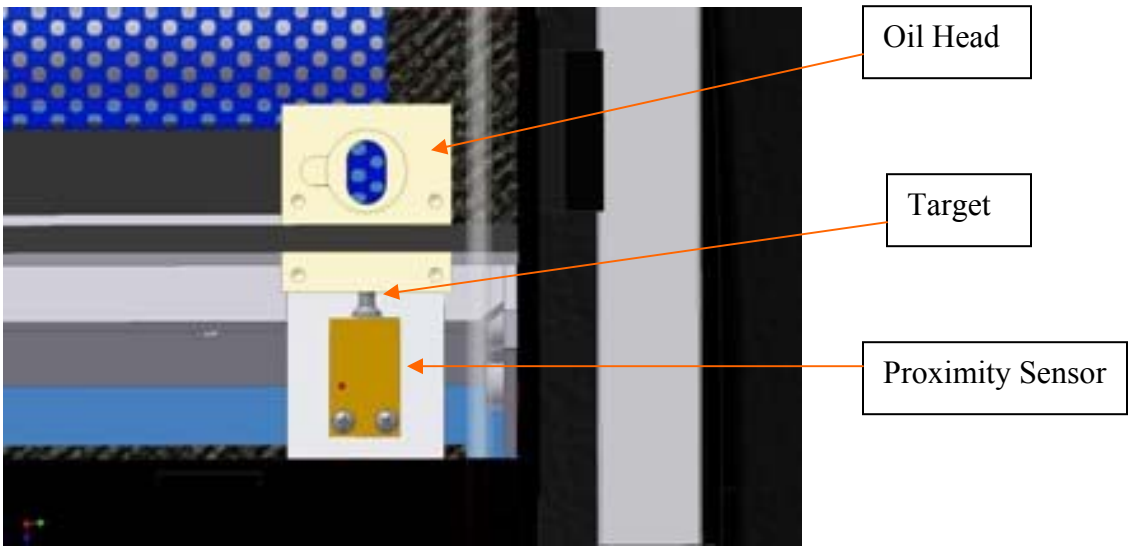
   ***NOTE**: When determining the direction to turn the target, look at the face of the target for the clockwise rotation. The illustration shows a clockwise adjustment (when the 7-pin sensor light is coming on too soon).*



8. Now it is time to make sure that the board counting target is secured and the head assembly is tight. Place the cover back on the head assembly and re-insert the two mounting screws. Replace the fuse for the motor.

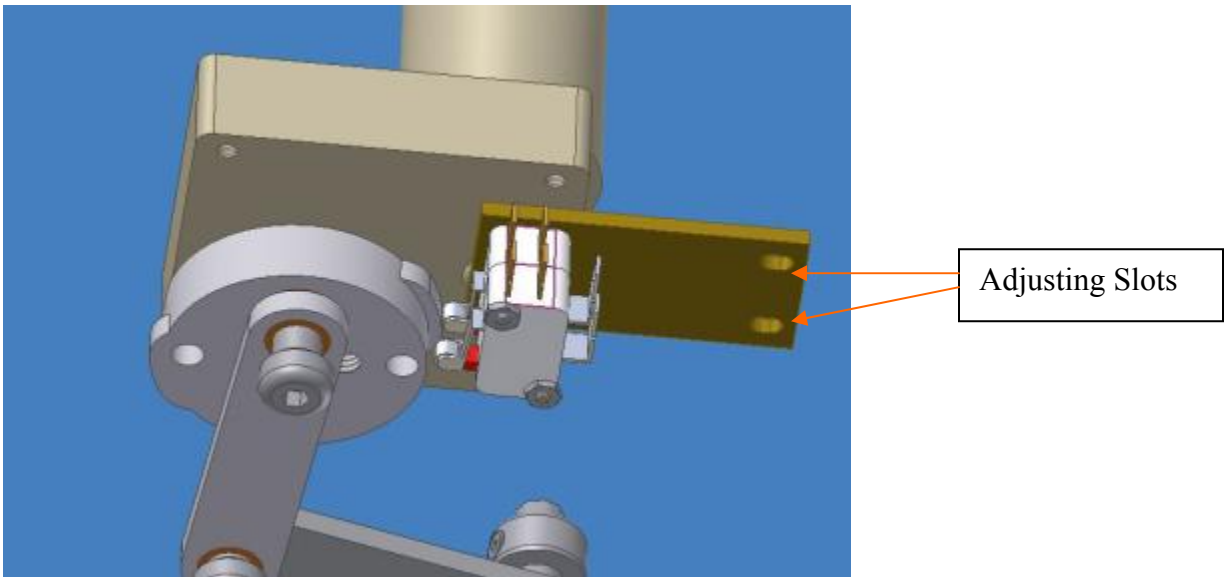
***NOTE:** The machine's computer has to park the oil head on the right side to ensure the proper starting point for loads of conditioner. When the head goes to the home or zero position it will bump into the side wall and kick back. The clicking sound that is heard is **normal** and no damage is occurring to the machine.*

Oil Head Target



The moving Oil Head uses a flat head screw as a target for the Board Edge Sensors to "see". The screw should be adjusted to **0.010**" (0.254 mm) from the face of the proximity sensors. Check both sensors to be certain that the gap is the same. The proximity sensors have a small amount of adjustment so they can also move if necessary.

Brush Lift Switches



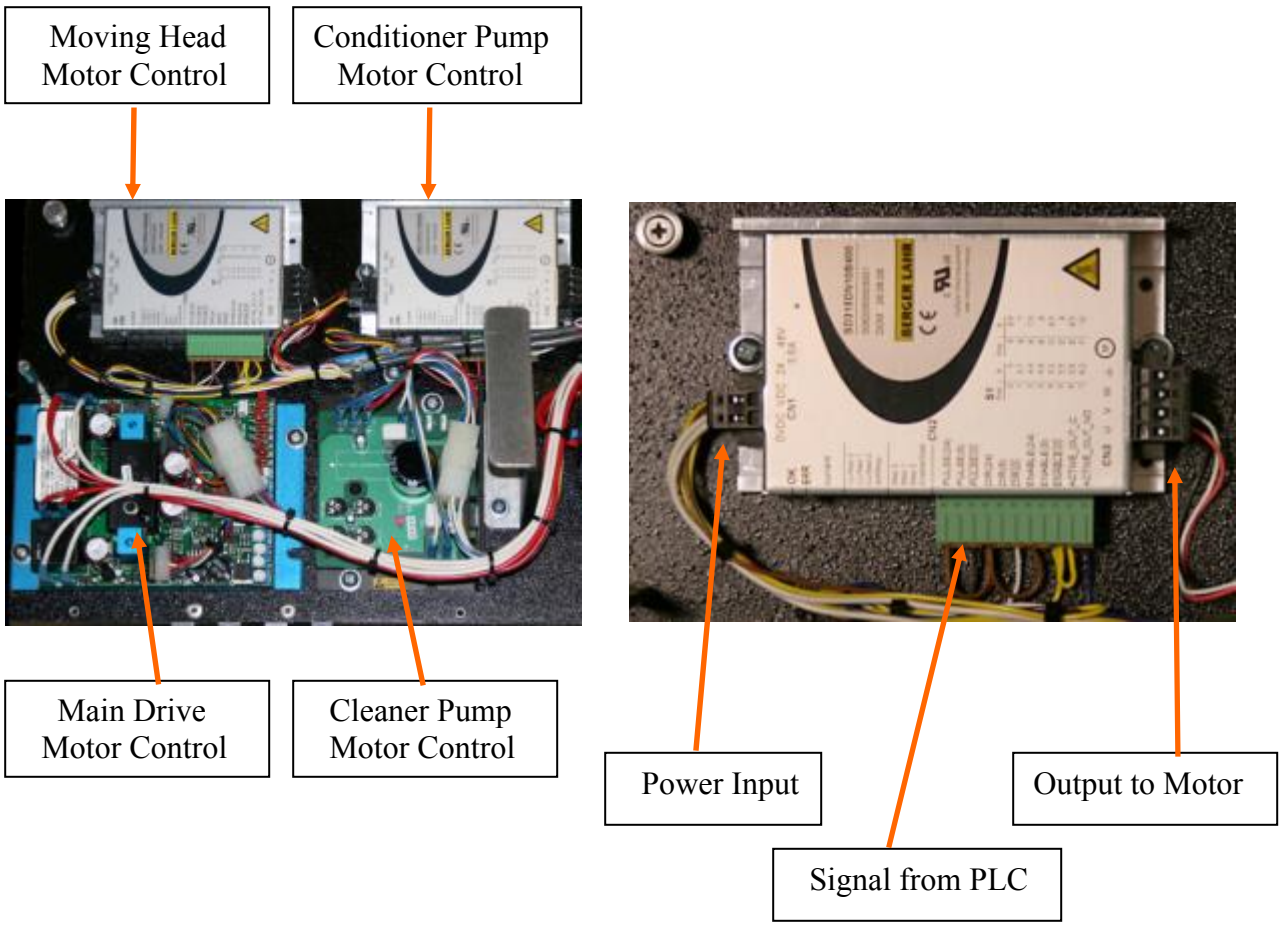
The Brush Lift Switches are mounted to a plate that has adjusting slots. The switch plate adjustment should be checked when each switch is on the cam lobe. The switch rollers should not "bottom out" and have only between 0.005" and 0.010" over-travel of the roller (about 0.127 mm to 0.254 mm).

Stepper Motor Controls

The two stepper controls do not have any user adjustments, all adjustments are done through the touchscreen. Changing any dip switch settings will only cause operational errors; each of the controls uses the same dip switch settings.

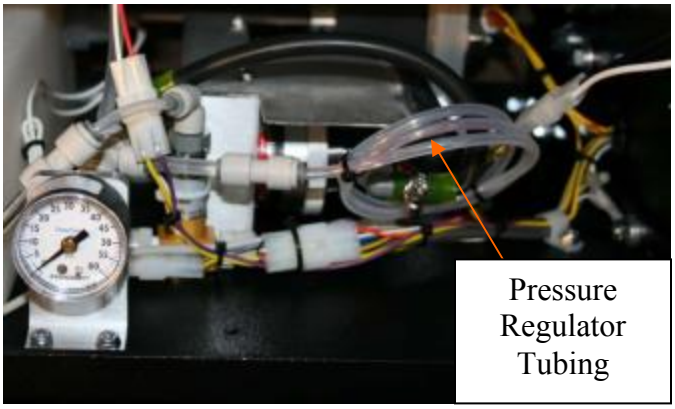
The **Moving Head Control** uses two PLC outputs; one for movement and the other for direction. When output **100.04 is on** and output **100.05 is off** the motor will run the oil head left to right, when both outputs are on the oil head runs right to left.

The **Oil Pump Motor Control** is set to run the pump motor in a counter-clockwise rotation and is controlled by **output 100.00**. The controller is wired to run the motor in this direction and uses only one PLC output to operate the motor.



Pressure Regulator Tubing

A wide range of conditioner viscosity has been tested in the machine to determine the size and length of the pressure regulator tubing that is needed. Keep in mind that these are only **guidelines**; temperature greatly affects viscosity and may change these results. The conditioners (oils) listed below have a viscosity range from about 30-40 cps.



Testing was performed at 72° Fahrenheit with a variety of conditioners with the pump calibration set at 55 µl. Equipment is available to measure the viscosity of any conditioner. A viscosity cup, thermometer, and a stopwatch are valuable tools if you are mixing your own blend of conditioner. Call Kegel for more information on how to obtain this equipment.

The oil pressure for this model machine is a little higher than previous designs due to the 6 different pump speeds available in the machine. The mechanical adjustment of the pump is done at the 55 µl setting at the maximum speed value of 45B0 (this is a hexadecimal value).

Conditioner (Viscosity)	*Size (OD)*	*Length*	*Pressure*
Offense HV (39.1 cps)	3/16”	18”	42psi
Prodigy (29.7 cps)	3/16”	28”	36psi
Defense-S (39.6 cps)	3/16”	18”	42psi
Infinity (35.4 cps)	3/16”	28”	32psi
Navigate (29 cps)	3/16”	28”	36psi

Note: *When using a conditioner with a higher viscosity than 60, use a 1/4" OD (6.35 mm) piece of tubing that is approximately 3" long (7.62 cm) and connect it between the Tee Fitting and the Oil Control Valve Input Fitting. Store all the elbows, fittings, and lines in a safe place in case you want to switch back to a lighter conditioner. The machine has been tested up to 100 centistokes. The machine ships from the factory with roughly a 28" piece of 3/16" pressure regulator tubing for Prodigy (71 cm long).*

To purchase stock tubing for adjusting the regulator lengths order the following part numbers:

154-0202A - 1/4" OD Tubing Stock (Inch)
154-0202B - 3/16" OD Tubing Stock (Inch)

Troubleshooting the Conditioning System

Please go over this section if there is any kind of problem with your conditioning system. Reviewing this before calling for Technical Support will help in correcting any problems you may have and allow you to communicate more clearly with a technician on the phone.

Conditioning Problems Indicated by Error Messages

Problems that display errors are normally corrected easily and happen for definite reasons. Usually, a stuck or out of adjustment switch (and possibly loose or damaged wires) will cause most problems when the machine is old.

If an input fails to go off completely and still displays a dim light, the PLC will still consider that as a good input, so look very closely.

Normally, this error occurs when Input 0CH 05 fails to receive a signal within 3.5 seconds of the motor starting.

Here are the possible causes that can produce a BRUSH DOWN ERROR. If the Brush Lift Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **BRUSH LIFT** to check relay operation and voltages.

1. The brush lift motor runs but the down switch failed to operate and send a signal to PLC Input 0CH 05.
    a. Check and inspect the microswitch, manually operate switch to see if Input 0CH 05 will illuminate.
    b. Possible broken wire or loose connection in either the yellow 24 VDC wire or the Violet/Yellow Wire that connects to Input 0CH 05.
    c. This error can also happen if the Brush Up Input 0CH 04 is stuck on.

2. Brush Lift motor does not run when tested in the Output Test. You will need to determine if power is getting to the motor.
    a. Fuse is blown or fuse holder is bad.
    b. Brush bearings are causing a bind not allowing free movement up and down.
    c. Relay came loose in socket or has failed.
    d. Motor has failed.
    e. Bad connection to motor, check all power wiring to motor.
    f. PLC output 101CH 02 failed.

Normally, the Brush Up Error occurs when Input 0CH 04 fails to receive a signal within 3.5 seconds of the motor starting. Below is a list of the possible causes that can produce a BRUSH UP ERROR**.**

If the Brush Lift Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **BRUSH LIFT** to check relay operation and voltages.

1. The Brush Lift motor runs but the up switch failed to operate and send the signal to PLC Input 0CH 04.
   a. Check and inspect microswitch, manually operate switch to see if Input 0CH 04 will illuminate.
   b. Possible broken wire or loose connection either the yellow 24VDC or the Green/White Wire that connects to Input 0CH 04.
   c. This error can also happen if the brush down Input 0CH 05 is stuck on.

2. Brush Lift motor does not run when tested in the Output Test. You will need to determine if power is getting to the motor.
   a. Fuse is blown or fuse holder is bad.
   b. Brush bearings are causing a bind not allowing free movement up and down.
   c. Relay came loose in socket or has failed.
   d. Motor has failed.
   e. Bad connection to motor, check all power wiring to motor.
   f. PLC output 101CH 02 failed.

NOTE: *The brush lift motor (and the squeegee motor) will both time-out in 9 seconds if the position switch the PLC is looking for is not actuated. Before the motor "times-out", the machine should have stopped and displayed an error.*

Normally, this error screen appears when Input 0CH 01 fails to receive a signal within 0.5 seconds of the head motor starting or if there is not a continuous pulsing signal as the motor runs. This makes the machine think that the motor is not running causing the machine to stop.

Here are the possible causes that can produce a MOVING HEAD TRAVEL ERROR**.** If the Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **HEAD MOTOR** to check for motor operation and voltages.

1. Oil Head Motor runs, but Input 0CH 01 does not operate when oil head is moving or it was interrupted.
    a. Board counting target has fallen off the shaft.
    b. Board counting sensor has failed.
    c. Wire between sensor and PLC is damaged or loose causing an open connection.
    d. Motor is starting too slow due to lack of lubrication on the oil and cleaner sliding head bars.
    e. Cleaner belt jumped timing causing the cleaner head to jam against the wall of the machine. A set screw can come loose resulting in this problem.

2. Oil Head Motor does not run in one or both directions.
    a. Stepper Drive Fuse is blown.
    b. Motor has failed.
    c. Motor unplugged (CN3) or has a damaged wire between motor and Stepper Drive.
    d. Bad connection on Stepper Drive
    e. PLC output 100CH 04 has failed causing no operation.
    f. PLC output 100CH 05 has failed causing no operation right to left.

Normally, this error screen occurs when Input 0CH 09 is not turned on. Either Drive Board can cause this error.

Each Driver Board has a switch at terminals 10 and 11. Terminal 10 is the Common and terminal 11 is Normally Open. The switches are wired in series back to Input 0CH 09.

Here are the possible causes that can produce a STEPPER DRIVE ERROR.

a. Turning power off, then back on quickly, will send the driver into fault.
b. Bad power connections at the CN1 plug.
c. Bad E-Stop Button
d. Loose or open connection at the CN2 plug (shown above).
e. Removing the fuse and re-installing it while power is on.
f. Blown fuse.

A Flashing Red Light will indicate there is a FAULT with the Drive. To clear it, turn the power off then wait a few seconds before turning the power back on. This will usually reset the error.

A flashing green light will indicate the drive has been de-activated, which is a wiring problem at the CN2 plug. Check terminals 7 & 9 on that plug.

The following chart helps determine what type of fault is present.

STEPPER ERROR CODE

FUNCTION	FLASH CODE	LED COLOR
Amplifier Activated	STEADY	Green
Amplifier Deactivated	EVEN	----------Green_____
Reserved	STEADY	Red
Temperature Fault	EVEN	----------Red_____
Overvoltage	QUICK	Red_____
Under Voltage Warning	QUICK	Red Red_____
Signal Frequency High	QUICK	Red Red Red_____
Short Circuit	QUICK	Red Red Red Red____

If the Temperature fault was flashing you would see an even on off flash of the red light.
If the Overvoltage fault was flashing you would see a quick flash with a pause before the next flash.

Press anywhere on screen to return.

This error lets you know that the machine is low on conditioner (oil). Simply fill the tank to clear error from the screen, then restart machine.

If this does not clear the error, the float may have a problem. Unplug float and install the jumper plug to by-pass the float (if the jumper is lost a paper clip works well). The jumper plug should be secured properly in the conditioner compartment and the proper repairs should be done as soon as practical.

Conditioning System Problems that DO NOT Display Errors

There are a number of things that can go wrong even if the machine appears to operate correctly. Most of these problems can be caught before the bowlers notice them but only if the operator is paying attention. **Doing a calibration test every day will eliminate many problems from turning into disasters.**

1. Oil Pump fails to run.
    a. Motor is unplugged or has a damaged or open connection.
    b. Motor has failed.
    c. PLC output 100CH 00 failed.

2. Buffer fails to run, which will cause serious conditioning problems if the motor works on some of the lanes and fails on others.
    a. Blown fuse.
    b. Motor is unplugged or has a damaged or open connection.
    c. The buffer motor relay failed or is loose in the base.
    d. Motor has failed.
    e. Belt is broken.

3. Machine oils 2-2 more than programmed or looks as if it is just oiling 2-2 badly (a.k.a. Sport Shot Error).
    a. Board counting target is loose but not giving errors.
    b. Gap is too large between the board counting sensor and the target.
    c. Oil tip insert has come out of the line (Replace with part # 154-6832).

4. Machine fails to dispense oil from tip.
    a. Oil pump motor has failed.
    b. Pump has failed.
    c. Pump belt is broken.
    d. Oil control valve has failed.
    e. PLC oil control valve output 100CH 07 failed.
    f. Filter is clogged.
    g. No oil in tank and the float failed to error machine.

5. Conditioner (oil) loads not ending at correct footage.
    a. Oil Head not running at correct speed; Check Oil and Cleaner Heads for lubrication.
    b. Machine speeds are not set correctly.

6. Oil Valve time has increased.
    a. Oil Head is not running at correct speed, check oil and cleaner heads for lubrication.
    b. Board counting target loose.
    c. Wrong program was run or someone has changed the program (#1 culprit ☺).
    d. Belts are too tight on one or both of the moving heads.
    e. Shaft bushings need lubricated.

Maintenance

It is very important to maintain a clean environment in the conditioning compartment. Not doing this will result in oil migrating through the entire machine causing damage to wiring and making a mess of things. The following procedures should be followed in order to keep your machine healthy.

Daily Maintenance

1. The felt in the compartment must be wiped down and the drip pads on each side of the machine must be wiped off.
2. Wipe around the moving head and check each end of the rail.
3. All surfaces around the oil compartment should be wiped down.
4. Make certain that the moving head bar does not get dry in either the oil or cleaning compartments, but **DO NOT over-oil**, just a film of oil is all that is needed.
5. Remove lint from transfer brush.
6. **DO NOT** wipe down the buffer brush unless some sort of build up is occurring on the ends of the buffer. Build up could be the result of dirty gutters.

Clean the conditioning compartment every day!!!
We do not recommend using alcohol to clean the plastic tanks.

Monthly Maintenance

1. Remove guards from both sides of machine to clean and inspect motor and sensor shaft.
2. Lightly oil sensor extension shaft and bushings in the cleaning compartment.
3. Inspect buffer belt and its tension.
4. Oil buffer belt idler.
5. Check and inspect sliding head belts.
6. Clean and inspect the compartment that contains the conditioner (oil) tank and pump.
7. Clean between transfer brushes.

Yearly Maintenance

If you are a real neat freak you could do things like this:

1. Remove any component that prevents you from cleaning the machine entirely. If you are doing good daily cleaning you may do this every two years because your machine still looks like new!
2. Replace buffer and sliding head belts with new ones. (*If running 60 lanes or more a day this may not be a bad idea. This all depends on how the machine was treated over the last year.)*
3. Inspect oil pump compartment.
4. Replace buffer brush if needed. If your buffer bristles begin to feel very soft then it is time to replace your brush. The ends of the brush normally go bad first due to dust from the gutters and lane contact.
5. Inspect and clean transfer brush assembly completely.

Procedure for Cleaning Oil Control Valve

The following steps outline the procedure for disassembling the conditioner metering valve. Be careful when removing the oil lines from the fittings since they will leak.

Block off the stem elbows to prevent them from leaking all over the machine (do not split the stem). Open 1/4" lines can be blocked off with a #8 screw.

Keep the oil lines and the valve free from dirt and debris while they are disassembled. Clean up any conditioner spills immediately, the sensors and electronic components do not like oil baths.

1. Disconnect power and place the machine in the operating or down position.

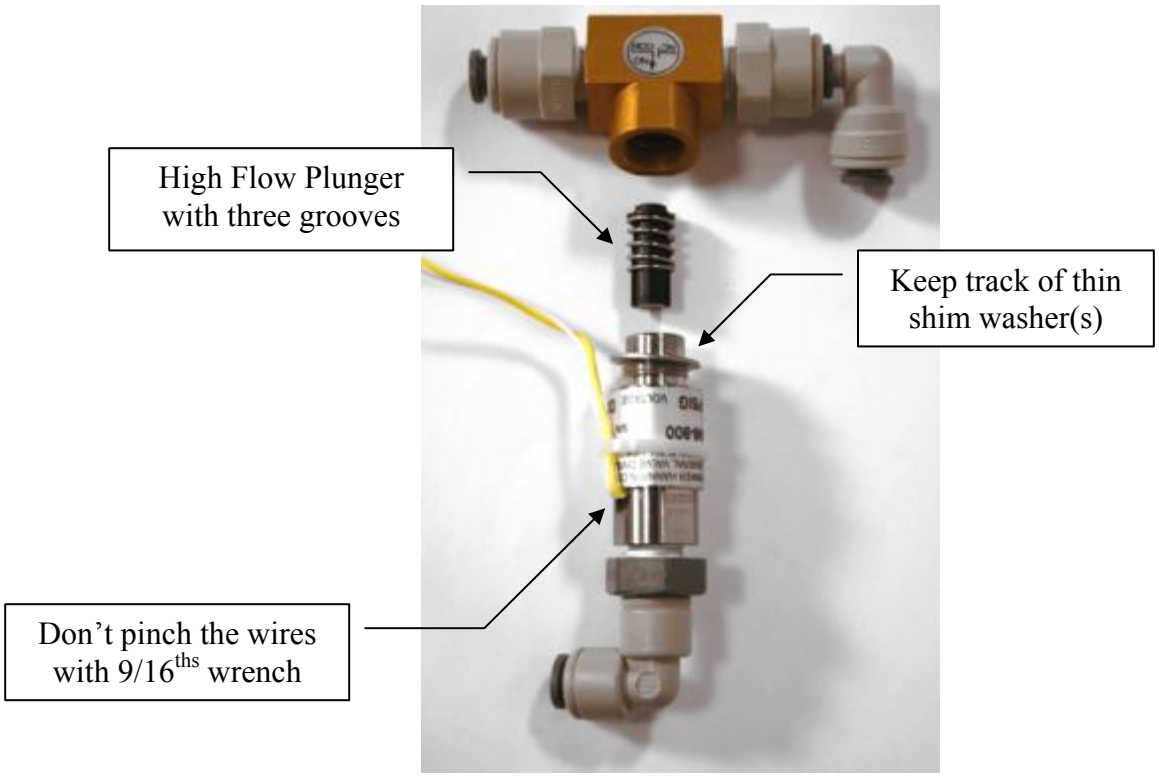
2. Remove the oil assembly from the rear wall.

3. Clean the area around the oil assembly.

4. Use a Phillips screwdriver to remove the two screws holding the valve to the back plate.

5. Remove the two pieces of tubing from the top of the valve. **PUSH IN** on the outer collet to release the tubing or the elbow. Plug the open ends to prevent dirt from entering the lines and to stop the oil from leaking (be careful to not split the elbow).

6. Use a 9/16" open-end wrench to remove the bottom half of the valve. Do not pinch the small wires on the base of the valve. Keep track of the thin shim washer(s) on the valve. Make sure to use the same washer(s) during re-assembly.



7. The top section of the valve should be blown out with a canister of compressed air. Air should flow freely from the bottom through both sides at the top. A few short bursts of canned air in both holes should displace any debris. Alcohol can also be used to remove any build-up of sediment. (Do not use an air compressor to blow out the valve; water in the air lines may be forced into the manifold.)

8. The bottom section contains a plunger and spring. Make sure the three grooves on the sides of the plunger are clean. This part should be cleaned with a cotton swab and alcohol to remove the debris.

   IMPORTANT: If a valve is found to have only one groove please call KEGEL for an immediate replacement. All machines should have the "high flow" valves which are machined with three grooves. Please call **(863) 734-0200** if a replacement is needed.

9. Replace the valve body on the head of the valve using the same shim washer(s).

10. Replace the valve on the back plate.

11. Plug the line or elbow back into its proper fitting and clean around all the connections.

12. Return the oil assembly to the machine and plug in the connections.

13. Run the **OIL VOLUME** test once to clear the lines out. Then check the volume of conditioner output for a typical program and adjust the pump if necessary.

KEGEL's Original Mission
By: John Davis

Oil Patterns

Why do we Apply Oil to Bowling Lanes?

The primary reason is to protect your investment. The lane surface would get destroyed without at least a light film of lubrication. Another reason is to create better playing conditions for your bowlers. The scoring level is up to you, but the main reason to apply oil is to ensure your lane conditions are the same week to week.

You can get by with small changes in conditions, but when one week the ball hooks off the lane and the next it's a frozen rope off your hand, most bowlers will not see this as a fun challenge; it's really more like an annoyance. It is important to monitor your playing conditions to keep them consistent and provide the best customer service.

Navigation Pattern Settings

We realize everyone is searching for some kind of direction when it comes to lane patterns so the Kegel "Navigation Patterns" were created to help proprietors give bowlers the stepping stones needed to improve, compete, and reach their full potential.

Until now, there have not been many pattern choices or a level of difficulty between 'House' and 'USBC Sport Bowling' patterns. USBC's Sport Bowling is a good description of difficulty, but the definition of a 'House' shot only means what bowling has given to it. To beginners who are just starting to bowl that description means nothing. With that in mind, Kegel has created a series of patterns called the Kegel "Navigation Patterns".

All of the Navigation Patterns are grouped and separated by three levels of difficulty: **Sport**; **Challenge**; and **Recreation**. The Recreation Series of patterns will be at a ratio of 5:1 or greater; the Challenge Series patterns will be between 3:1 to 4.9:1; and all Sport Series patterns will be USBC Sport Bowling compliant, which adhere to a ratio of 3:1 or less.

The Navigation Patterns will be available in Kegel's Pattern Library on www.kegel.net and they are available to view and download for free. Kegel's award winning technical support department, Lane Maintenance Central, will also be available for questions and to assist in setting up these patterns in your bowling center for your customers.

Go to **http://www.kegel.net/patternlibrary/default.asp** for additional patterns.

Troubleshooting Lane Conditions

Troubleshooting lane conditions can be very tricky. You must first think about what you want to accomplish, who the adjustment will affect, and if the machine is calibrated correctly. We suggest reading the following scenarios to see if it is similar to your problem (and to maintain your sanity before making adjustments).

1. First, why do you think there is something wrong with your conditions? Are all of your bowlers complaining, or is it just a few? Are the bowlers right to complain? Don't let bowlers manage your lane maintenance program, you can please some of your bowlers all of the time but you can't please all of them all of the time. Sometimes good personal relations make your customers just as happy as good conditions.

2. Looking for the Holy Grail of lane conditions is something you can't get caught up in either. Bowlers can and will adjust to all kinds of conditions but only if they can bowl on the same thing more than once. Don't make a change for the sake of change. Think before changing the pattern. It is best to prove a change before unleashing it on your bowlers.

3. Never make pattern adjustments before checking the stripping; run your machine in clean only. If your lanes are not coming clean like they should, this could be your only problem. Check your squeegee, cleaner volume, and duster adjustments. Refer to Chapter 3 for the cleaning troubleshooting for solutions to possible problems.

4. Who mixed the cleaner last? Concentration of the cleaner is very important and must stay consistent. At Kegel, we have seen mixed diluted cleaner mistaken as the concentrate. Then it was diluted again making a very, very weak solution. However, mixing cleaner stronger than a 4 to 1 ratio is not good either.

5. When was the last time you checked your oil calibration? Maybe someone adjusted the pump and didn't tell anyone. This should be one of the first things checked along with cleaning. Calibration should be checked regularly and if there is an oil output problem check the troubleshooting section for the conditioning system.

6. Now that you have no cord to watch out for, walk alongside the machine while it runs, look at the display for speeds and on the way back check the back end for cleanliness. Check to see if the pattern looks uniform across the house. Do this each day and you may be able to stop and correct problems before they happen.

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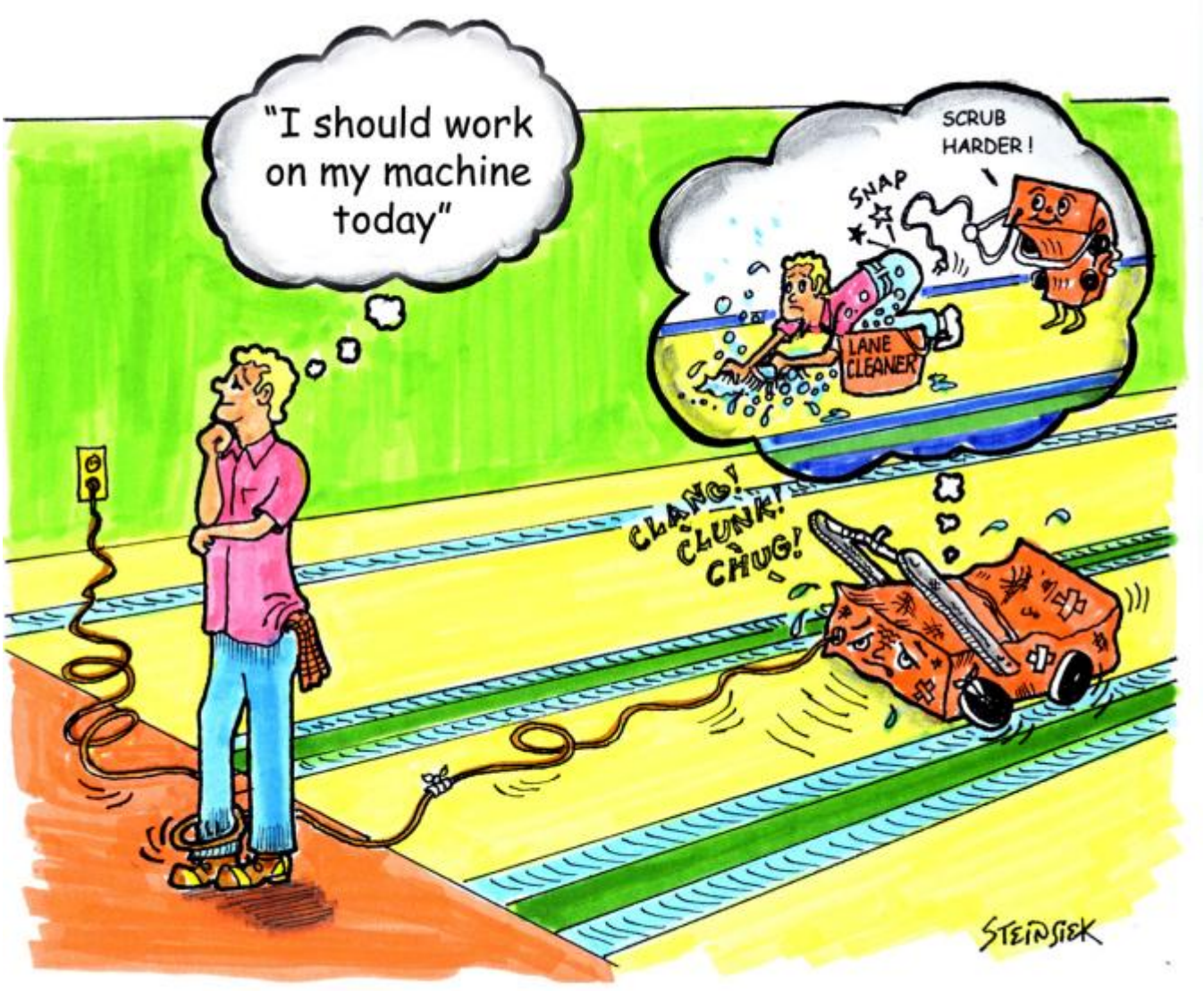
7. A general inspection of the machine should be done whenever there is a concern that something may be wrong. **Just because there were no 300's and 800's shot last night does not mean you should make a change. Bowlers don't always bowl great.**

8. There is always the chance for operator error when it comes to conditioning machines. Always do spot checks on employees that operate the machine to make sure they do the job properly.

9. We hope this does not happen to you…but make sure that the cleaner was not put in the oil or oil in the cleaner tank. Sounds funny, but this happens more than you think and it is no fun to fix.

10. Did someone put the wrong conditioner in the oil tank or use the wrong cleaner? Always make sure that your KEGEL lane machine uses KEGEL products. We have thoroughly tested and established recommendations for all of our lane maintenance chemicals and supplies. It just makes sense to use KEGEL Genuine products.



Pattern Troubleshooting

Now that you have determined the machine is in perfect working order, here are some tips to common questions about lane conditioning, which should help you make proper adjustments.

Note: Failure to check machine operation before making adjustments can result in the loss of sanity. If it occurs, please call KEGEL at 863-734-0200 and we'll help you get it back.

Q: What should I do if I have too much **carrydown**?
A: Shorten the applied oil distance. Too much oil in the middle and at the end of the pattern can cause excessive carrydown. Change only the buff-out distance. Do not shorten the pattern as this only creates more transition and possibly more moves. Make sure the machine is cleaning properly before making any pattern adjustments.

Q: What should I do if the **back ends** are too strong?
A: Lengthen the pattern to tone down the back end reaction. Tamer back ends provide predictable ball reaction and makes spare shooting much easier. Be aware of potential carrydown problems when the pattern length is increased.

Q: What should I do if I do not have enough **hold**?
A: The distance of the applied oil on the return pass creates hold. This area is known as the mid-lane (from about 18-32 feet). The mid-lane provides direction to the breakpoint and dictates the score-ability of a pattern. Starting the reverse oil loads farther down the lane will help increase hold.

Q: What should I do if the **heads hook**?
A: The amount of oil in the lay down area or a lane surface in poor condition can cause the heads to hook. In both instances the lane machine should run slower in the heads. This is better controlled on the return oil due to the direction of travel and the rotation of the buffer brush. Apply oil loads during the return travel that finish closer to the foul line (but not less than 4 feet).

Q: What should I do if I have no **swing**?
A: The amount of oil on the outside boards or adverse lane topography can affect swing. Reducing the length (or volume) of the applied oil will increase the amount of swing. If this is a topography issue the pattern should be adjusted by reducing the amount of oil on the outside boards to allow the bowlers to play a more direct line to the pocket. This should create more area where ball reaction is concerned.

Q: What should I do if the **track** dries up too quickly?
A: Many bowling centers do not apply enough oil to the track on both forward and return passes. The volume (in units) at the end of the pattern should be slightly more than the outside boards. Applying oil to the track on the return pass provides longevity and stability. This application of oil can be started further down the lane on the return without drastically affecting the forward oil readings and ball reaction.

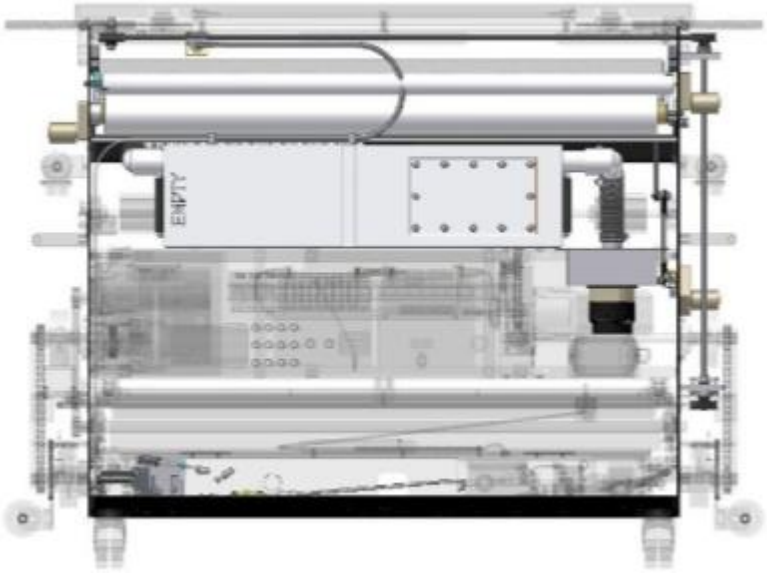
Q: What should I do if there is no **taper** to my pattern?
A: The easiest way to create taper in the pattern is to make adjustments to your drive speeds during the forward loads only. Increasing the drive speed on your forward run should allow the lane condition to taper properly.

CHAPTER 3

Cleaning Systems

Theory of Operation

The cleaning system is the result of years of experience with automated lane care. The changes that the game has gone through over the years have created the need for improved ways to remove the dirt and conditioners.



The proper cleaning of your lanes is very important to the consistency of your playing conditions. Various things can cause the machine to not adequately remove the dirt and conditioner from your lanes. In this section we will describe how the machine cleans your lanes and reasons why it may not.

The below sequence is an overview of how the Cleaning System operates.

1. When the machine sequence is started the cleaner pump will turn on and stay on until the last squirt distance has been reached. The moving head will apply an equal amount of cleaner across the width of the lane as it travels forward.

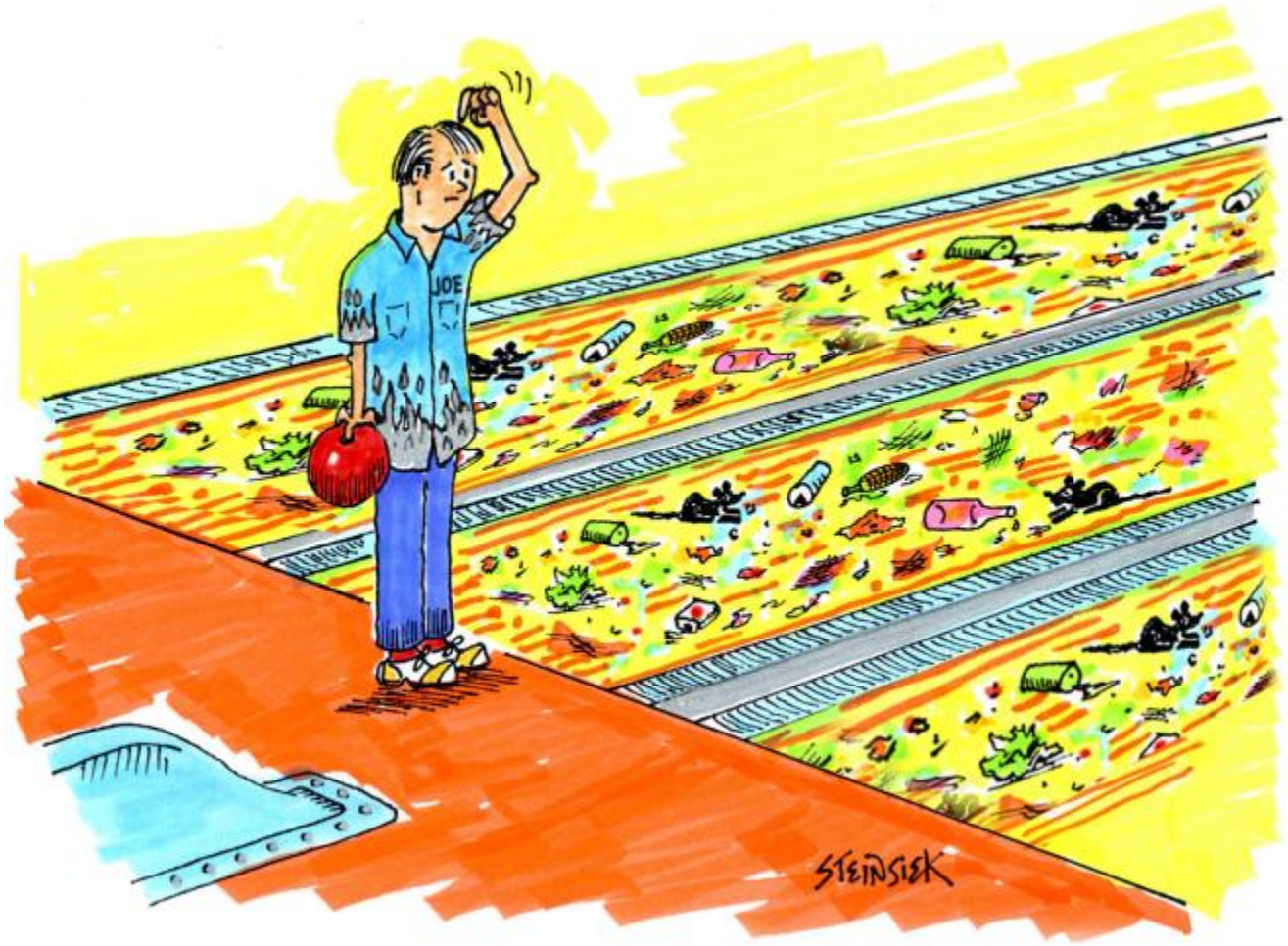
2. As the machine travels forward the cleaner will pass underneath the cushion roller and will be wiped onto the surface of the lane. The special texture of the cushion roller wrap prevents the cloth from creating a seal against the surface of the lane and also allows it to follow the crowns and depression of a normal lane.

3. The heavy dirt, along with oil and conditioner, will get trapped in the cloth as it wipes the lane.

4. The front blade of the squeegee then passes over the cleaner and the rear blade seals to the surface of the lane.

5. The vacuum pulls the cleaner, dirt and oil from the squeegee and deposits it into the recovery tank.

Why do we Clean Lanes?



The reason for cleaning lanes is to protect your investment. Not having a good lane maintenance program will not allow you to achieve the best results. The other reason is it's just good customer service. Another reason would be to have your center create high scoring conditions (but that can also be achieved with poor maintenance).

If you have synthetic lanes there is no room for error. Every scratch will be part of that surface forever and the more you do to prevent it, the longer they will last.

When it comes to wood lanes, I guess you can say there is some room for error. You can always sand and re-coat the surface. Good maintenance for your wood lanes is important in protecting the finish and preventing it from glazing in the ball track. It is impossible to prevent this completely, but it can be slowed down.

Special Cleaning Functions

Squeegee Wipe

This function is used to prevent drips from falling off the squeegee. The machine stops in the pit area and then moves 4 inches in reverse and then stops again. It lowers the squeegee, travels forward 4 inches, and then raises the squeegee and returns to the foul line.
It is very important that the rear squeegee blade clears the tail plank.

This function can be turned off if necessary in MACHINE SETUP.

Cleaner Pump Reversing

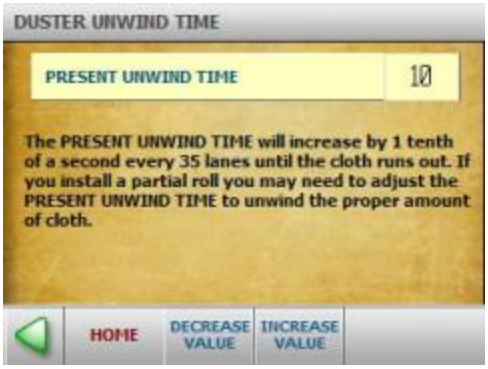
The cleaner pump has no valve that turns off the flow of cleaner, nor does it re-route cleaner back to the supply tank. The cleaner is held back by the pinch of the rollers inside the peristaltic pump. For this reason, the cleaner pump reverses for a second at the pin deck to suck back the cleaner in the line to prevent it from dripping.

Duster Settings

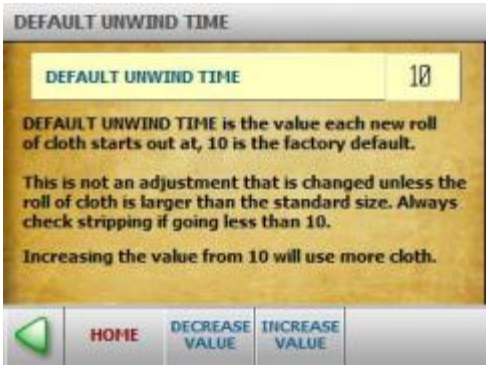
Go to the Main Menu and press on DUSTER SETTINGS and the screen will change.

Press on a function and the screen will go to an adjustment screen.

If resetting the duster cloth counter, press RESET CLOTH.



The PRESENT UNWIND TIME will increase by 1/10 (one-tenth) of a second every **35** lanes until the cloth runs out. If you install a partial roll you may need to adjust the PRESENT UNWIND TIME to unwind the proper amount of cloth. Use the buttons at the bottom to change the unwind time value.



DEFAULT UNWIND TIME is the value each new roll of cloth starts out at; **10** is the factory default. This is not an adjustment that is changed unless the roll of cloth is larger than the standard size. Always check your cleaning when changing this to less than 10.

Increasing the value from 10 will use more cloth.

DEFAULT # OF LANES ON ROLL is used to trigger the “Almost Out of Cloth Warning” that pops up in the HOME screen.

When replacing a roll of cloth try not to wrap any more on the take-up reel than needed, it is easy to waste 10 lanes worth of cloth by making extra wraps.

The Duster Warning (to the right) comes up when there is only enough cloth left to run your center. The Warning is not a fatal error just a reminder to check the roll.

While in the duster screen press CHANGING CLOTH? PRESS HERE and the button will change and the cloth counter will be reset.

If you press this button and reset the counter when it is not time yet, simply adjust the Present Unwind Time to unwind the proper amount of cloth.

The duster error is generated when the present unwind time reaches **25**, which it should never reach. The only way to see this error is to forget to reset the cloth after changing out the roll or if you put half a roll of cloth back in the machine and guess too high for the present unwind time.

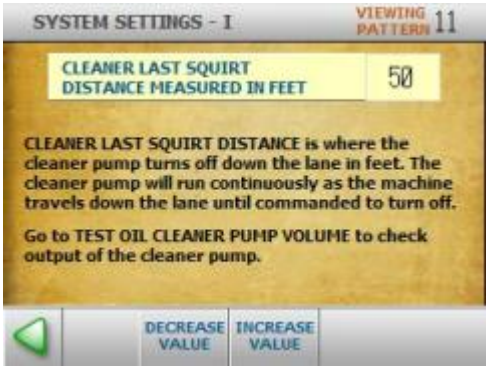
NOTE: Resetting the DUSTER counter prior to the roll of cloth being empty could reduce the cleaning efficiency of the machine. The cushion roller must be allowed to drop far enough to contact the lane and hit the Stop By Duster Switch.

The unwind time varies from **10** for a fresh roll to **22** for an almost empty roll. If accidentally reset, use an educated guess on how much of the roll is already used and set your time accordingly. **EXAMPLE:** If the roll is about half used, set the time to **16**.

System Settings Cleaning Menus

These are the Change Pattern System Settings that relate to the cleaning of the lane. All System Settings adjustments are individual to the pattern selected.

The number displayed will refer to the distance in feet down the lane at which no more streams of cleaner will be applied. It is possible for the machine to look like it is applying cleaner farther down the lane, but this may be the moving head continuing to travel in order to park in the proper position.



To change the values, use the increase and decrease to adjust. Once the value has been changed, the program accepts the data automatically.

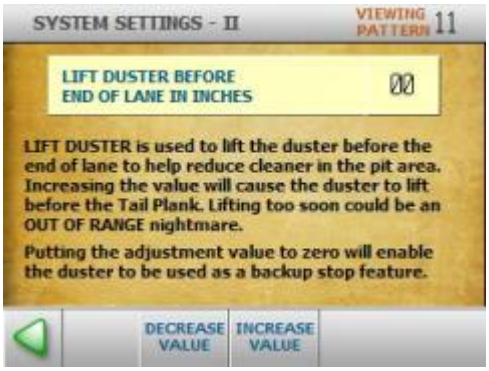
The BACKEND STRIP SPEED adjustment is used to run the machine slower in the area past the oil pattern to help cleaning, if needed.

The adjustment can only go as fast as the 6th speed (30 IPS) but can go as slow as you want it. The default adjustment is set the same as the 30 IPS speed setting.

This adjustment should be monitored and checked.

The number displayed in the screen to the right will refer to the distance from the tail plank the duster will begin to lift off of the lane. This feature prevents the cushion roller from dropping off the tail plank when reaching the end of the lane.

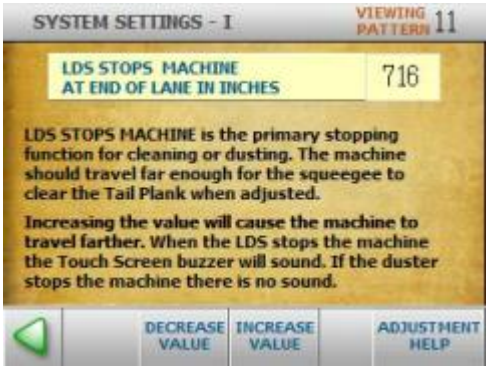
To change this distance, use the increase decrease buttons to adjust. Once the value has been changed, the program accepts the data automatically.

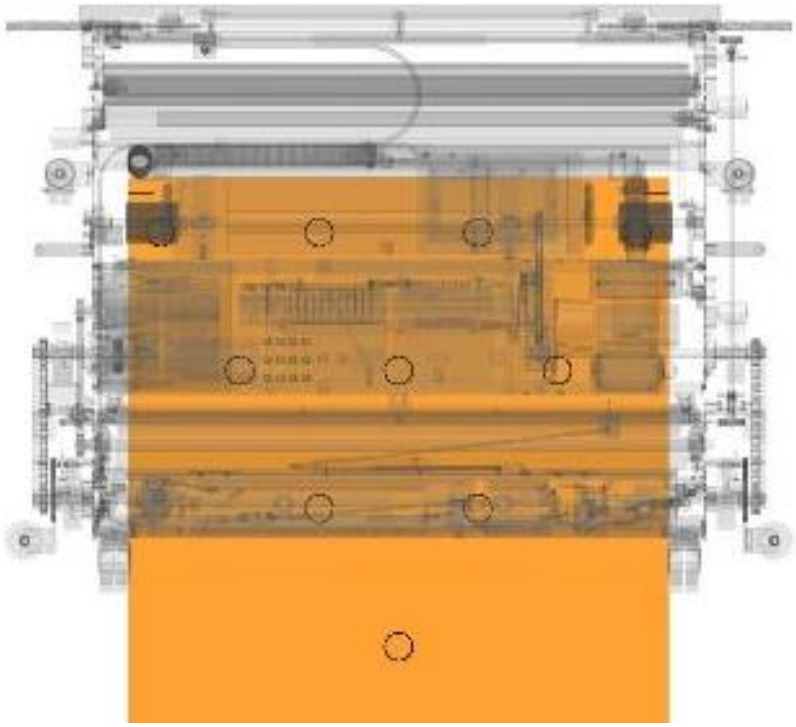


When there is a value of zero displayed, the duster will wind up and lift when the machine is signaled to stop by the LDS or the Duster Switch.

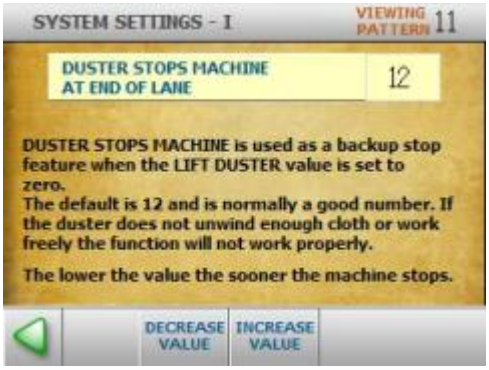
LDS STOPS MACHINE is the primary stopping function for cleaning or dusting. The machine should travel far enough for the squeegee to clear the tail plank when adjusted. Increasing the value will cause the machine to travel farther.

When the LDS stops the machine the touchscreen buzzer will sound. If the duster stops the machine there is no sound. Use the increase and decrease value buttons to make adjustments. Any change to the value sets the data automatically.



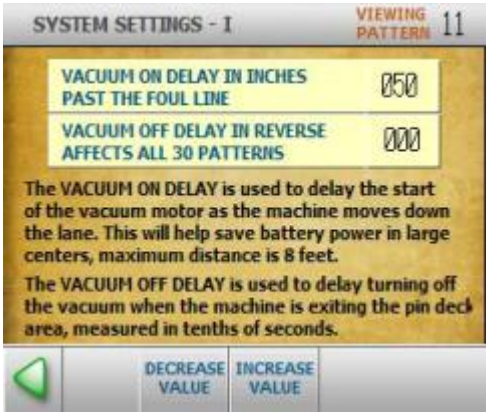


Machine overview showing maximum distance for Forward Travel.
The drive wheels cover 7-pin & 10-pin spots when squeegee is off the pin deck.



The duster can be used on the Walker to stop the machine when the Lift Duster screen is set to ZERO. It works when the duster drops and actuates the duster switch located on the bottom side of the duster pivot arms.

When the machine is stopped by the duster there is no buzzer sound from the touchscreen. The adjustment is in increments of 0.30 of an inch (7.62 mm) for fine adjustments (available on the Walker only).



This Walker menu gives the operator the ability to adjust where the vacuum motor will turn on when the machine travels from lane to lane. The VACUUM ON DELAY is used to delay the start of the vacuum motor as the machine moves down the lane. This will help save battery power in large centers.

However, if you see cleaner running into the gutters you may have delayed the vacuum a bit too far. The larger the value is, the greater the delay. To run the vacuum on the approach go to Machine Setup and enable the function.

Fine-Tuning the Walker for Stopping the Machine at the End of Lane

It really does not matter which function stops the Walker as long as it stops and the squeegee completely clears the tail plank. Setting the **LDS Stops Machine** first and then enabling the **Duster Stops Machine** and adjusting it properly is the preferred method for this adjustment.

Put a value of 1 in LIFT DUSTER to turn off STOP BY DUSTER. Then adjust LDS STOPS MACHINE so the squeegee clears tail plank.

Put LIFT DUSTER back to zero and run machine, see if STOP BY DUSTER affects where the machine stops at then adjust the function, if needed.

Check the Pin Deck to make sure the squeegee completely cleared it. The duster must unwind enough cloth (and work freely) for the Stop by Duster function to work properly.

Using the two functions together will ensure that the Walker has a back-up system for stopping in the pit. If the duster is not unwinding enough cloth to actuate the duster switch, the LDS reverses the Walker. If the LDS wheels started rolling farther past the foul line, then the duster will drop off and reverse the Walker before it travels too far forward.

NOTE: *When the Lift Duster is used to raise the cushion roller before reaching the end of the lane, the Stop By LDS is the only function that will stop the machine.*

Mechanical Adjustments

<u>Cleaner Pump Volume Adjustment</u> (Cleaner Calibration)

The cleaner pump volume can also be checked in the same menu as the oil. Go to the Main Menu and press TEST OIL CLEANER PUMP VOLUME, then press:

CLEANER PUMP
CALIBRATION AND ADJUSTMENT

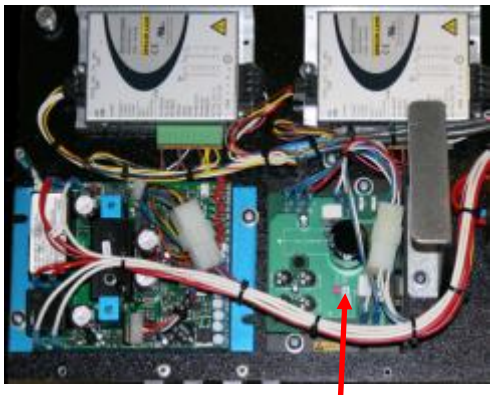
In this screen follow these steps:

1. Press ENABLE TEST.
2. Open up the cleaner compartment.
3. Remove the cleaner tip.
4. On the Walker, locate the button on the 10-pin side. For the Ion, the button is on the bottom side of the handle.
5. Hold cleaner tip over cloth then press button for one cycle to clear out air bubbles.
6. Now dispense 4 cycles into a graduated cylinder.

Factory setting is 30 µl. Anywhere from 25 to 30 µl should adequately clean the lane. As the cleaner pump tubing ages the volume will tend to decrease. The motor will need to increase in speed to dispense the same volume. To increase speed use the **-10** and **+10** buttons. The value shown under Enable Test button is the present value set in the machine.

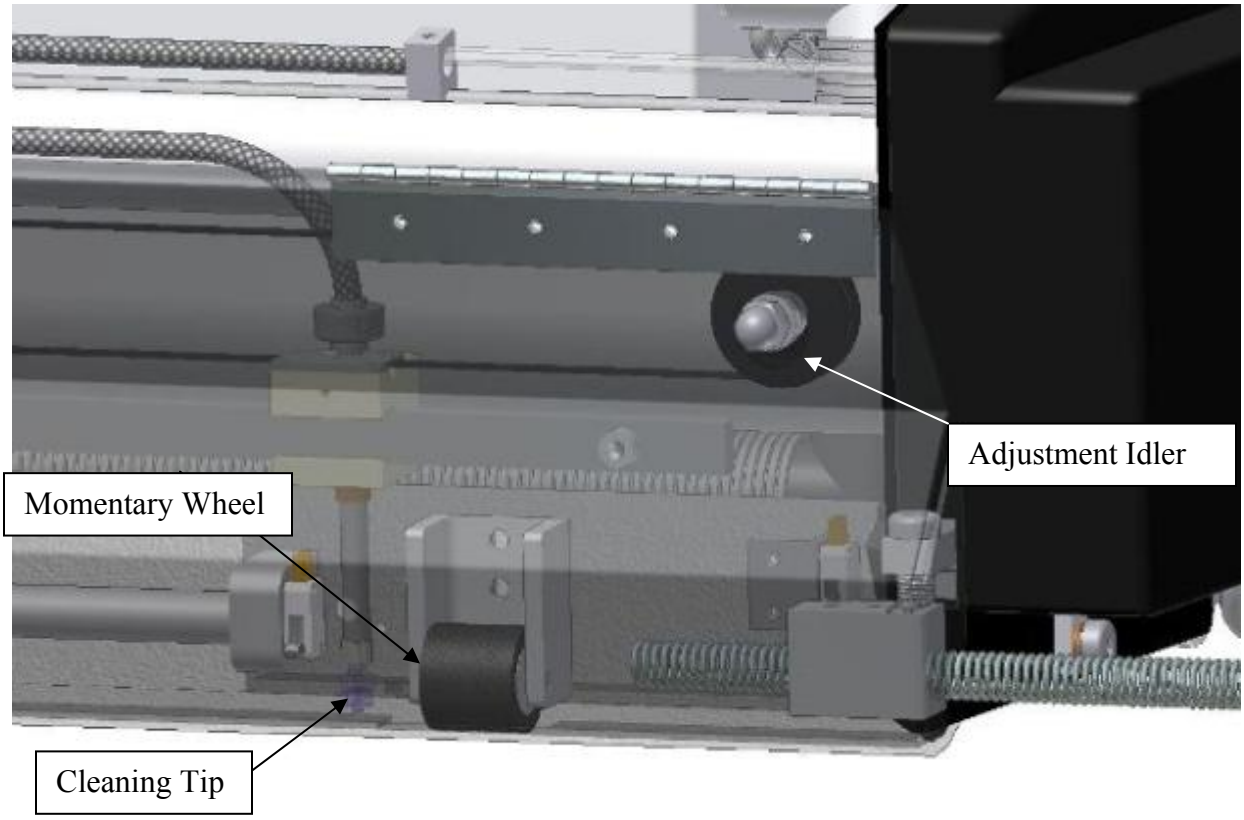
NOTE: *When making changes to the cleaner volume output, always perform this test more than once and note the volume with each adjustment.*

The Max Speed trimpot is set at the factory and there should be no reason to adjust the control board to increase cleaner output. If your cleaner pump tubing is at least a year old, then the tubing should be replaced before making any adjustments. Typically, new tubing in the pump will fix a low output problem.



Cleaner Pump Control

Adjustment of Cleaner Dispensing Tip (An adjustment video can be viewed in KOSI.)



The machine uses a single cleaner dispensing tip that moves back and forth to apply cleaner to the lane surface in front of the duster cloth. Factory adjustment of the tip is flush with the machine panel (diagram shows it lower than normal for illustrative purposes). Loosen the set screw on the collar that is used to lock it in place to move the tip up and down. If tip is adjusted closer to lane, make sure it does not come in contact with the lane surface when machine enters or exits the lane.

NOTE: *The tip height will affect how close to the edge of the lane the cleaner will be applied.*

Cleaner Head Timing Belt

The machine also uses a timing belt to drive the cleaner head back and forth. To check this adjustment, move the oil head to the middle of the machine. When the oil head is in the center the cleaner head should also be in the center.

Before loosening the idler, place a reference mark on the belt and drive pulley. Loosen the idler and shift the belt one cog on the drive pulley in the proper direction. **Do not adjust from the idler end.** Once the belt is moved adjust the belt tension and tighten the idler. Verify that both heads are in the center of the machine after an adjustment is made.

This belt can also be adjusted to shift the cleaner dispensing head to the left or right if the machine tends to favor one side of the lane. (*It is unlikely that you will want to do this and close attention should be given to the guide rollers if you have this problem.*)

Momentary Wheel Adjustment

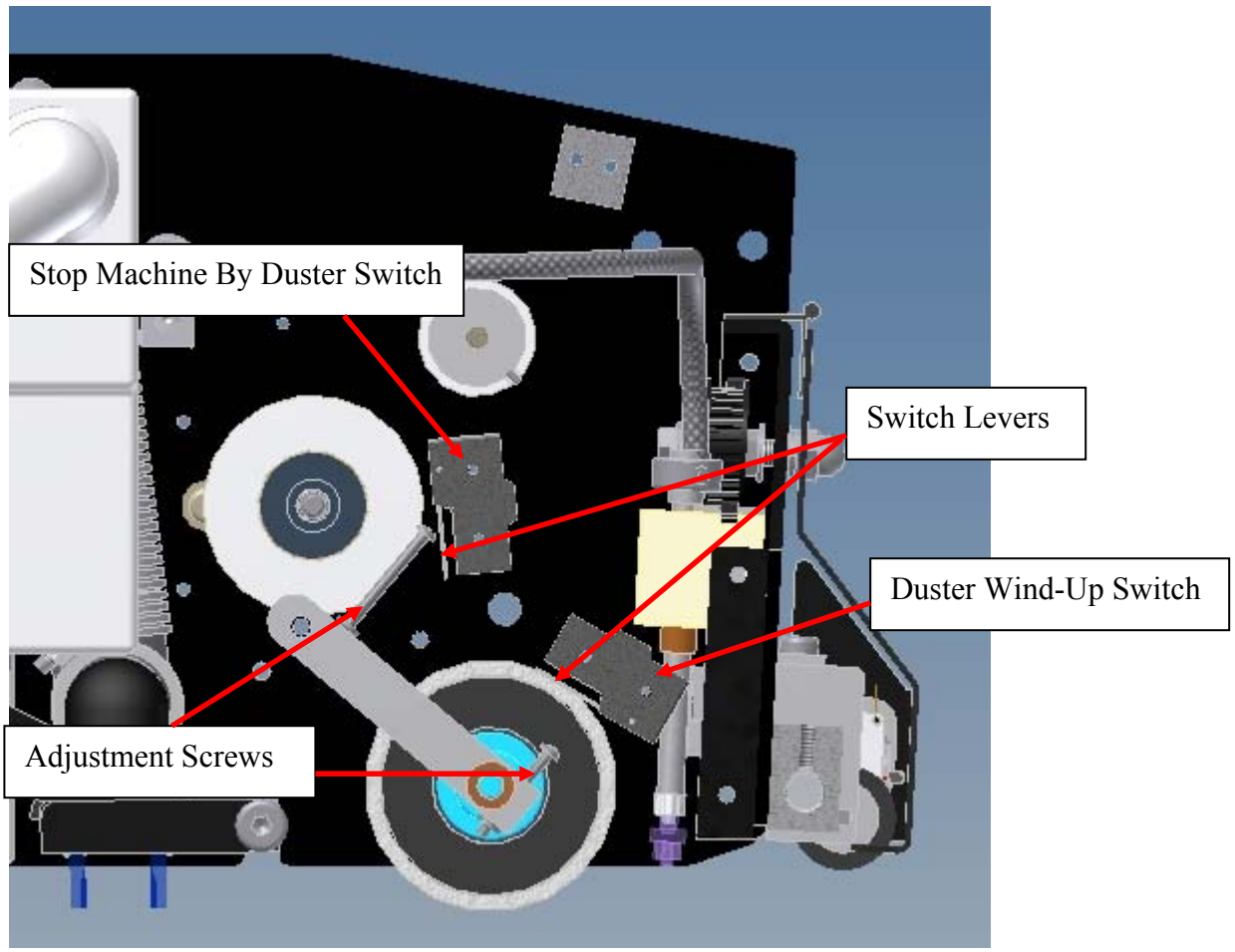
We like to call this the forgotten adjustment because no one does much with these wheels. To adjust the momentary wheels the machine will have to be stopped on the lane. Once the machine is on the lane, loosen (do not remove) the bolts that hold the momentary wheels to the machine. Slide the momentary wheel housings up or down until the gap between the wheels and the lane is approximately **1/16”** to **1/8”** (1.6 mm to 3.2 mm).

The wheels need to be as close to the lane as possible without touching. For proper adjustment the lanes need to be relatively flat lengthwise. Tighten the bolts in the housing once the desired gap is achieved. Both momentary wheel housings should have the same height adjustment on both sides.

NOTE: *When the machine is pushed into the lane if you notice that an area close to the foul line is missed by the squeegee due to a depression (mainly on wood lanes or overlays), you will have to adjust the momentary wheels further up. This will allow the squeegee to touch the lane a little sooner.*

Duster Switches (An adjustment video can be viewed in KOSI.)

This illustration points out the adjustments for the duster switches.



Adjust the duster switches only when the machine is standing up in the transport position.

1. Unwind some cloth so there is free movement of the cushion roller.

2. Check the **Wind-Up Switches** first by lifting the cushion roller up and holding it against the stop bolts. The switches on both sides should clearly actuate before the cushion lever screws hit the stops and there should be a small amount of over-travel of the switch levers.

3. Be certain that the switches on both sides are adjusted with the same amount of over-travel. If there is no over-travel, loosen adjusting screw with an 11/32" wrench and back the screw out until there is some over-travel of the switch lever. Tighten the nut(s) and make sure the cushion roller moves up and down freely.

4. On the Walker, check the **Stop Machine By Duster Switches**. The switches above the duster arm pivots will stop the machine when the cushion roller falls off the tail plank.

5. The Stop Machine By Duster Switches are fixed in their locations and no adjustments should be necessary, however the holes are over-sized to allow a small adjustment.

Squeegee Blades (An adjustment video can be viewed in KOSI.)

The Squeegee Assembly is adjusted at the factory to ensure proper cleaning. This adjustment should be checked when the machine is installed. The factory "zero" point is measured on the pivot mounts that secure the squeegee to the sides plates. We suggest the gap between the bottom of the side plate and the bottom of the pivot arm should be about **3/16"** (4.76 mm) on both sides of the machine. *Adjustments may vary depending on your lane characteristics.*

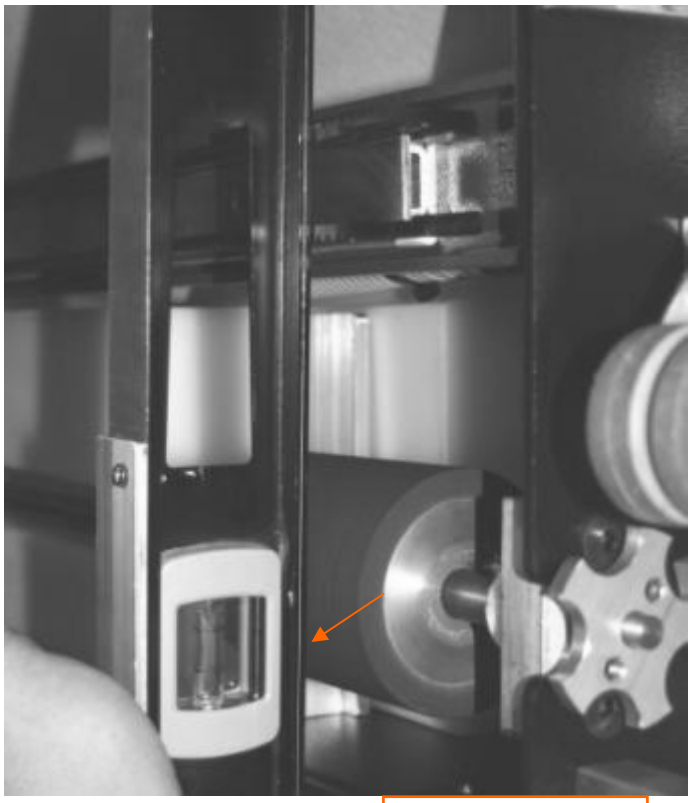
To check this **height adjustment** and make changes, the machine should be in the upright or transport position. The squeegee will need to be lowered to the down position. To lower the squeegee, apply power to the machine and menu to the **INPUT/OUTPUT TEST**.

When you reach the **INPUT/OUTPUT TEST** section, press SQUEEGEE LIFT to access the screen shown to the left.

Press the **SQUEEGEE LIFT TEST BUTTON** once. The squeegee motor will activate and rotate 180°, this will lower the squeegee. If the squeegee does not stop in the down position, check the condition of the Squeegee Down Switch.

With the squeegee down, take a straight edge and place it from the squeegee blade across the drive wheels to the lane distance wheels. The gap between the straight edge and the drive wheels should be about **1/8"** to **3/16"** (3.18 mm to 4.76 mm) on each side.

If the distance is more or less, loosen the bolts (two on each side) that hold the squeegee pivot in place. Move the pivot mount until the squeegee height is correct. This should be done for both the left and the right side. Tighten the bolts after the adjustment is acceptable.



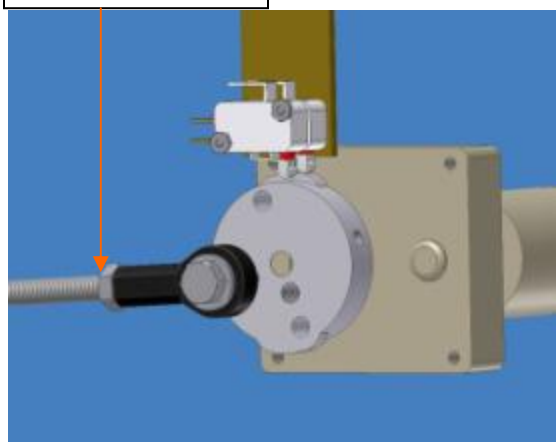
Gap should be 1/8” ~ 3/16”

The **tilt** or **pitch** of the squeegee may also need adjustment to ensure that both blades are contacting the lane squarely. If a pitch adjustment is necessary, follow the steps below to make the adjustment. Make sure the squeegee motor does not bind up when making an adjustment. If the link is too short the motor cannot rotate 360°.

1. Locate the squeegee motor on the right side plate of the machine. Mounted to the motor shaft (inside the machine) is a cam. Mounted to the cam is a rod end and rod. This rod lifts and lowers the squeegee (see diagram below).
2. Loosen the jam nut between the rod end and the rod.
3. Remove the bolt that connects the rod end to the cam.
4. Rotate the rod end as needed to increase or decrease the pitch. **DO NOT** make the linkage too short.
5. Re-install and tighten the bolt to connect the rod end to the cam.
6. Re-check the gap between the straight edge and the drive wheels.
7. Tighten the rod end to the rod with the jam nut.
8. Check cleaning to ensure adjustment is adequate.

NOTE: *Excessive crush on the squeegee will not allow the machine to clean properly and will cause stress on the assembly.*

Pitch Adjustment



Squeegee Switches

The squeegee switches should have a little over-travel in the lever of about 0.015 (0.381 mm). To adjust, loosen the mounting screws a little (but not too much) so the assembly can be tapped to a fine adjustment using feeler gauges. When the proper adjustment is made you can tighten the screws. If you have no over-travel in the switch while on the cam lobe you will damage the switch (*this is very bad*).

Maintenance

Changing Duster Cloth (An adjustment video can be viewed in KOSI.)

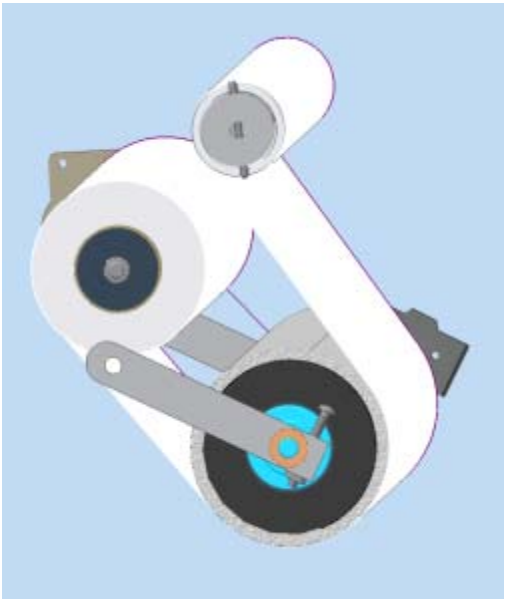
The machine uses a patented Dual Motor Ratcheting (DMR) Cloth system. The duster assembly operates by means of two brake motors. The first unwinds cloth and sets the cushion roller down on the lane surface. The second winds up used cloth onto the used core.

The wind-up motor also lifts the cushion roller off the lane at the end of the run. This dual action simulates that of a ratcheting duster, helping to eliminate dirt lines during a conditioning run. This system also controls cloth usage better and has no clutch mechanism to adjust.

IMPORTANT! The machine can NOT be operated without Cleaning Cloth installed.

Lane Cleaning Cloth should be loaded into the machine using the following procedure:

1. Remove the cleaner dispensing tip from the holder and then remove the old cloth ***(make sure the spring in the tip holder block doesn't fall out)***.
2. **Now take this opportunity to clean and maintain this compartment**. The cloth is now gone so there no reason not to clean the compartment. The cleaner belt should be inspected and the sliding head bar lubricated at this time.
3. Remove the pipe from the old duster core and insert into the new one. Unroll about 3 feet of cloth and then install the new roll into its location.
4. Route the cloth down between the squeegee and the cushion roller. Pull the cloth under the cushion roller and distribute it evenly.
5. Once the cloth is routed under the cushion, pull the excess cloth far enough through to get at least 3 or 4 wraps around the PVC take-up reel or EZ Core. Make sure the cloth is wrapped evenly from side to side around the pipe.
6. Insert the take-up reel into its location and **replace the cleaner dispensing tip**.
7. The button that is located on the side of the handle will advance the duster cloth. Press this button 3 or 4 times to ensure the cloth is set properly in the machine. Locate the motor button in the cleaner compartment; this button is always enabled to operate the duster (unless the cleaner volume is being checked). Press the button once and the duster will unwind, press again and it will wind-up cloth. The cloth should be rolled up tight and evenly across the assembly.



Cleaner Tank (An adjustment video can be viewed in KOSI.)

To fill the Cleaner Supply Tank, the machine should be in the down or operating position on a surface that will not be harmed if cleaner is spilled on it.

1. Prepare an appropriate mixture of concentrated cleaner and water.

2. **Press E-Stop** to turn power off, open the splash guard and place a rag under the tank.

3. Open the tank cap, insert the funnel with a rag around the base, and pour the mixture into the Supply Tank using the supplied funnel (with screen filter).

4. Fill the tank until the fluid is about 1/2" (1.3 cm) from the top of the tank. **DO NOT** overfill this tank.

5. Replace the cap.

NOTE: *The supply tank on the machine is removable for cleaning when necessary.*

CAUTION: Do not spill cleaner inside the machine. Spills may "short" the electronic components and cause the machine to malfunction. A switch contaminated with moisture may also produce a dim INPUT LED on the PLC and drive you crazy.
Any spills or drops of cleaner should be wiped up immediately!

Recovery Tank

To empty the recovery tank the machine must be in the down or operating position.

1. Disconnect the inlet from the side of the recovery tank and the outlet hose from vacuum motor by removing the PVC elbows. It is best to have a rag in each hand to hold over the fittings to help prevent drips.

2. Remove the tank from machine and dispose of the used cleaner **properly**. Do NOT dump recovery tank in a septic tank or sanitary sewer system. Follow your local environmental regulations for the best method of disposal.

3. When dumping liquid from Recovery Tank, it is important to dump from the end marked EMPTY, or the end that was connected to the squeegee assembly. If liquid accumulates between baffles on the opposite side of tank dirty cleaner may be discharged from the vacuum exhaust and onto the lane until the line is cleared.

NOTE: *If you notice foam build-up in the tank due to soft water conditions at your facility it will be necessary to purchase a de-foaming agent to add to the dilution mixture.*

4. Transporting the machine with waste in the recovery tank is one of the worst things that an operator can do. It should be strictly forbidden to allow any of your employees to do this. The vacuum will get trashed out and begin to have problems and it will also affect the battery life. Expensive PLC replacement is also possible if you are not lucky enough to clean it and have it still work (after is takes a nasty bath).

5. It is recommended that the inside of the tank be cleaned and the filter material in the tank be replaced periodically. Maintenance will vary depending on center size so it is best to inspect the tank filter by looking though the outlet end (where the vacuum is connected) to determine how often it needs to be maintained.

NOTE: *We suggest swapping recovery tank filters after each cleaning. Order a spare recovery tank filter (Part Number 158-0406).*

To replace the Filter:

1. Remove the Phillips screws from the cover to access the filter.
2. Remove the filter and replace or clean it.
3. Inspect the gasket and re-fasten the cover to the recovery tank.

Pump Tubing Replacement

It is recommended that the pump tubing be replaced every year. When the cleaner pump's maximum volume output is a problem, follow these instructions to disassemble the pump and replace the tubing. To perform the following steps you will need to use the tubing loading key. This key (see D in diagram) is attached to the top of the cleaner pump assembly with a screw. Replace the key when finished.

STEPS:

1. Release both tube fittings from quick disconnects (depress collet and pull tube from quick disconnect fitting).

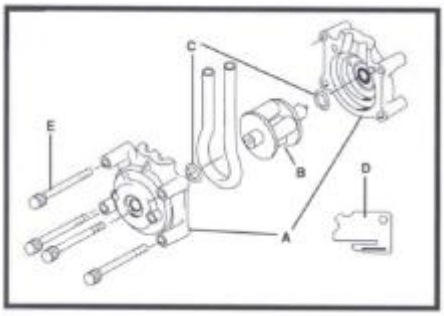
2. Remove the four screws that attach pump to the mounting plate.

3. Remove both stem elbows from tubing (note the direction of elbows). Save for re-installation on new tubing if a complete assembly is not being installed.

4. Separate the end bells (the pump head valves shown as A in diagram). Hold the end bell containing the rotor (as shown) with tubing retainer grooves pointing down. Remove old tubing.

5. Place new tubing (which is broken in at the factory before shipping) in the right groove and against the first two rollers. Hold tubing with your thumb. Near the groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.

6. Push down and turn the key counter-clockwise completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of tubing. Remove the key.



A. End Bells
B. Rotor Assembly
C. Thrust Washer (2)
D. Tubing Loading Key
E. Mounting Screws (4)

7. Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together you need to reload the tubing. If necessary, turn the key in the slot on rotor shaft to adjust tubing.

8. With key in slot on rotor shaft, turn the key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly until it snaps on the alignment pins (if present).

9. Replace stem elbows in new tubing if necessary. Make sure elbows are facing correct direction.

10. Re-attach the cleaner pump to mount plate.

11. Press the stems back into quick disconnect fittings.

Squeegee Blade Replacement

The squeegee blades should be flipped every 6 months and changed once a year. Poor cleaning results could occur if the trailing edge is allowed to get dull.

General Maintenance

1. Squeegee should be wiped down after each use.
2. Place a drop of oil on the adjusting link end fittings and the squeegee pivots once every 6 months.
3. Flip squeegee blades every 6 months and replace blades once a year.
4. Change filter in recovery tank once a month or when needed.
5. Check vacuum housing once a week and clean if wet with oil.
6. Check vacuum hose from squeegee head to tank for clogs at least once a year in high lineage centers. We have seen clogs you would not believe, some look like bath tub drains with dirty, hairy clogs the size of dead rats.
7. Check the electrical end of the vacuum once a week for dirt collecting on the cover.

Troubleshooting the Cleaning System

Please go over this section if there is any kind of problem with your cleaning system. Reviewing this **before** calling for Technical Support may help in correcting any problems you have.

Cleaning System Problems Indicated by Error Messages

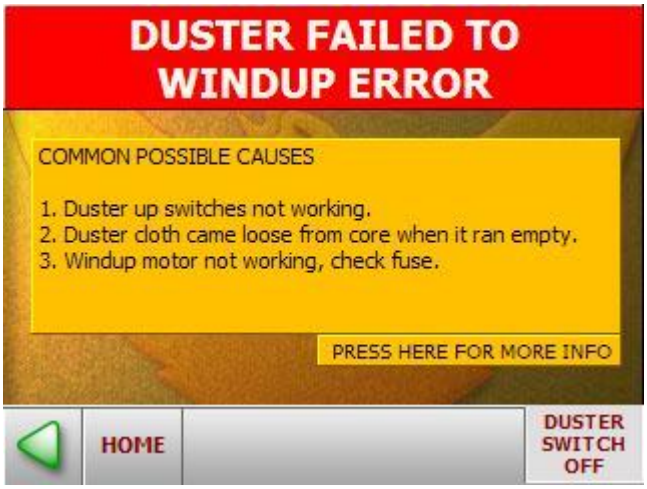
Problems that display errors are usually easily corrected and happen for a definite reason. Usually a stuck or out-of-adjustment switch or possible loose or damaged wires will cause most problems.

If an input fails to go off completely and still displays a dim light, the PLC will still consider that as a good input so look closely.

This error normally happens when Duster **Input 0CH 10** fails to open, meaning the input light does not turn off.

Below are a few things that can cause an **UNWIND** error. If the Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **DUSTER** to check relay operation and voltages.

1. Duster cloth is empty. Replace cloth.
2. One or both of the Duster Up Switches are stuck. Check if **Input 0CH 10** has an LED light showing on the PLC with the cushion roller adjusting screws off the switches.
3. Duster Unwind Motor has failed.
4. Blown fuse.
5. Duster Unwind relay failed or is loose in socket.
6. Duster motor wire is damaged or a there is a loose wire between motor and CR9 relay.
7. Cleaner dumped onto switch causing it to short, but only a dim light is showing on **Input 0CH 10**.

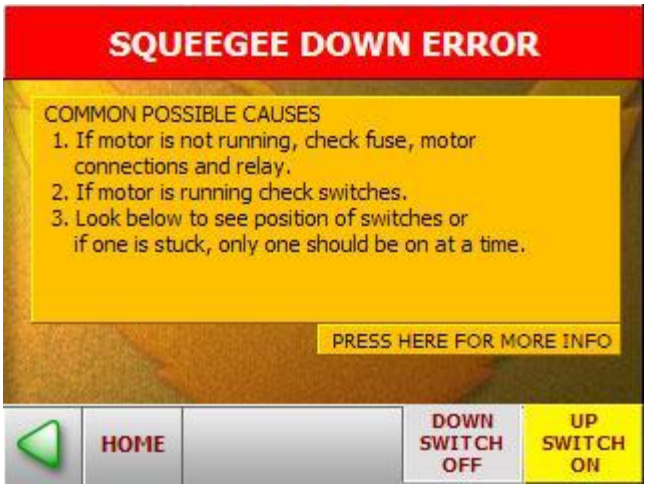


This error screen normally happens when the duster fails to wind-up the cloth and actuate the duster up switch, failing to turn on **Input 0CH 10** on the PLC.

Below are a few things that can cause a **WINDUP** error. If the Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **DUSTER** to check relay operation and voltages.

1. Blown fuse.
2. Duster Wind-up Motor has failed.
3. Duster Up Switches are both broken or out of adjustment.
4. Duster Windup relay failed or is loose in socket base.
5. Duster cloth cardboard core is loose from the plastic hub.
6. Duster hub is slipping on the motor shaft.
7. Duster Wind-up Motor wire (Green/Red) is damaged or there is a loose wire between motor and relay.

This error is generated when the present unwind time reaches 25, which it should never reach. The only way to see this error is to forget to reset the cloth after changing it or putting half a roll in machine and guessing too high for the present unwind time.



Normally, this error screen occurs when **Input 1CH 00** fails to receive a signal within 3.5 seconds of the motor starting. A few things that can cause this **SQUEEGEE DOWN ERROR** are shown on the next page.

If the Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **SQUEEGEE LIFT** to check relay operation and voltages.

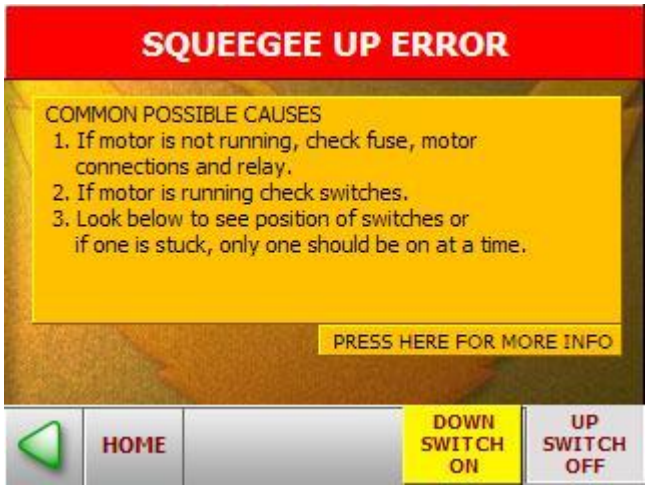
1. The Squeegee **motor runs** but the down switch failed to operate and a send signal to PLC **Input 1CH 00**.

a. Check and inspect microswitch. Manually operate switch to see if **Input 1CH 00** will illuminate.
b. Possible broken wire or loose connection. It will be either the **Yellow** (24 VDC) or the **Black Wire** that connects to **Input 1CH 00**.
c. This error can also happen if the squeegee up **Input 1CH 01** is stuck on.

2. Squeegee motor does not run when tested in the **Output Test**. You will need to determine if power is getting to the motor.

a. Fuse is blown.
b. Squeegee linkage is in a bind.
c. Relay came loose in socket base or has failed.
d. Motor has failed.
e. Bad connection to the motor. Check all power wiring to motor.
f. PLC **Output 101CH 03** failed.

Normally this error occurs when **Input 1CH 01** fails to receive a signal within 3.5 seconds of motor starting. The following list will cover a few things that can cause a **SQUEEGEE UP ERROR**.



If the Motor does not run, menu to the **INPUT/OUTPUT TEST** and press **SQUEEGEE LIFT** to check relay operation and voltages.

1. The Squeegee motor runs but the up switch failed to operate and send signal to PLC **Input 1CH 01**.

a. Check and inspect microswitch, manually operate switch to see if **Input 1CH 01** will illuminate.
b. Possible broken wire or loose connection with either the **Yellow** (24 VDC) or the **Yellow** / **Green Wire** that connects to **Input 1CH 01**.
c. This error can also happen if the squeegee down **Input 1CH 00** is stuck on.

2. Squeegee motor does not run when tested in the **Output Test**. You will need to determine if power is getting to the motor.

a. Fuse is blown.
b. Squeegee linkage is in a bind.
c. Relay came loose in socket base or has failed.
d. Motor has failed.
e. Bad connection to the motor. Check all power wiring to motor.
f. PLC Output 101CH 03 failed.

Machine is low on cleaner. Fill and restart machine to clear error from the screen.

If this does not clear the error the float may have a problem. Unplug the float and install jumper plug to bypass the float.

The jumper plug should be properly secured in the oil compartment.

Hint: In a bind you can use a paper clip as a jumper, but please make proper repairs to maintain your machine in proper working order.

Cleaning System Problems that Do Not Display Errors

There are a number of things that can go wrong when cleaning, but the machine will appear to operate correctly. Most of these problems can be caught before the bowlers notice them but only if the operator is paying attention. **Doing a cleaner test and checking the cleaning system every day will eliminate many problems from turning into disasters.**

1. Cleaner pump fails to run.
    a. Blown fuse.
    b. Bad connection at PLC analog connection.
    c. Loose connection at speed control.
    d. Speed control has failed.

2. Cleaner pump volume low.
    a. Tubing is starting to wear – probably more than a year old. (See Cleaner Pump Adjustment in this section.)
    b. Filter is clogged.
    c. Someone has tampered with the adjustment.

3. Machine leaves water on the lane after a test clean in various spots but cleans everywhere else.
    a. Squeegee not low enough to the lane (#1 cause).
    b. The lane has bad depressions, possibly more than $1/100^{th}$ of an inch (mostly around screw holes).
    c. Squeegee has a damaged area.
    d. Squeegee is worn out and should have been replaced a long time ago.
    e. Recovery tank is not in machine.

4. Machine leaves oil streaks in various spots, but cleans everywhere else.
    a. Duster is not touching the lane and may not be unwinding enough cloth.
    b. Lane has bad depressions.

5. Machine leaves streaks that look like squeegee marks.
    a. Cleaner dilution is weak.
    b. Someone made a mistake and diluted the diluted cleaner instead of the concentrate, making one very weak solution.
    c. Duster is not touching the lane and may not be unwinding enough cloth.
    d. You must not be using Defense-C!
    e. Lane has not been cleaned in months, just oiled.

6. Machine cleans only where it applies cleaner.
    a. The duster is definitely not touching the lane.

7. Machine drips dirty cleaner and oil off the squeegee.
    a. Rear squeegee blade is not clearing the tail plank. It is very important that the rear squeegee blade clears the pin deck completely.
    b. The squeegee double wipe function has been turned off.
    c. Filter in recovery tank is plugged up.
    d. Vacuum hose is plugged up with hair and all kinds of nasty stuff.
    e. Vacuum motor is failing.

8. Machine pushes cleaner into gutters and excessive amounts into the pinsetter.
    a. Forgot to put recovery tank in the machine (been there…done that).
    b. Vacuum hose has come off.
    c. Real nasty clog in vacuum hose after the squeegee head.
    d. Applying too much volume while the machine is traveling too fast.

9. Machine drips cleaner from tip.
    a. Check valve has failed or is broken.
    b. Cleaner line may have a bad connection.
    c. Machine is not running the pump in reverse at the pin deck.

10. Machine is leaking cleaner.
    a. Tubing in pump failed and needs to be replaced.
    b. Tubing connector failed or came loose.
    c. Tank is leaking around fittings.
    d. Operator over-filled machine and made a mess.

11. Duster cloth hangs down on one side and sometimes touches the lane when the machine exits from of the lane.
    a. Duster switches are out of adjustment; hitting the switch too soon.
    b. Duster plug bolt is loose from the side of the machine.
    c. Duster switch is broken on one side.
    d. Cushion Roller may be on the large side.
    e. Duster cloth stretched and needs to be balanced and tightened up.
    f. Duster motor brake is not holding (or working at all).
    g. New roll of duster cloth was not checked after installation.
    h. This machine may need a special adjustment to the program. Please call for Technical Support at 863-734-0200.

CHAPTER 4

Drive Systems

Manual Walker Operation

From this screen on the Walker you can position your machine, test the motors, and return the machine back to the foul line in the event of an error. While in the Home Screen press MOVE MACHINE and the following screen appears:

To move your Kustodian Walker like a pro you should practice and pay close attention to your main approach drive wheels. These wheels represent the center of the turning radius. Using the **STOP** button to stop the machine and the **Arrow** buttons to position the machine, you will be smoothly operating your machine in no time.

Use the **Down Arrow 5** to move the machine in reverse and the **Up Arrow 5** for forward. Press either button one time and the machine will move **5 feet** (about 1.5 meters) then stop. The arrow buttons will disappear and the screen to the right will pop up when a button is pressed. This is a STOP button that will take their place. The buttons come back when the machine stops or after the stop button is pressed. The Down Arrow is also used for return to foul line, when pressed on the lane the Walker will travel back to the approach and park.

Press the **Up Arrow** in the upper right side of the screen and the machine will move continuously forward, touch a whisker to increase speed. To stop the machine press STOP on the touchscreen, exit the menu, or hit the bumper. This function is normally used to get the machine from one end of the center to the other.

To turn the machine use the two turning buttons, the one on the left is **Counter-Clockwise** direction the button to the right is **Clockwise**. Like the other buttons, they will disappear while the machine is moving. If the machine is parallel to the foul line and the main drive wheels are on the center board, the machine will be lined up with the lane when turned 90 degrees.

It is not unusual to start then stop the machine quickly to obtain the exact position desired.

Approach Adjustments

Go to the Main Menu on the Walker and select APPROACH ADJUSTMENTS and the screen will change to LANE TO LANE ADJUSTMENTS. From this screen you choose Standard or Super Advance.

Press STANDARD LANE TO LANE and the screen will change to the adjustment screen.

First choose a direction and press one of the buttons to the right of the STEPS. The NEXT and LAST buttons will appear and the STEPS can be enabled.

Press on a STEP and it will change color to show it is enabled to be adjusted.

Use the buttons at the bottom to increase or decrease the value. In most cases, the STOP ON APPROACH value will never need to be changed but the others will. Use your NEXT and LAST buttons to advance lanes or back up lanes.

There are 4 steps used for each lane to guide the machine across the center: 1, 2, 7, and 8. Steps 3 through 6 are used for SUPER ADVANCE programming.

STEP #1 is used to stop the machine on the approach after it has exited the lane.
STEP #2 is used to turn 90 degrees away from the lane.
STEP #7 is used to travel to the next lane. STEP #7 is also the STEP that is adjusted by the Whiskers.
STEP #8 is used to turn 90 degrees to face the lane.

Steps 2, 7 and 8 will be the ones that need the most attention. As the machine gets older its turning adjustments may need to be modified to make up for mechanical wear.

STEP #2 should always be adjusted so the machine does not drift closer to the foul line.

STEP #7 and #8 should be adjusted to enter the lane as perfectly as possible.

Having all 4 steps adjustable for every lane that the machine travels to will make the Walker easier to fine-tune and you can customize the adjustments for all of the lanes, if needed.

One example might be if the machine has a drive motor that runs a little slow each day until it warms up. If it gets faster as the Walker moves across the center, then steps 2 and 8 can be adjusted at certain lane intervals to compensate for the change in the motor's speed.

Programming Around Large Divisions Between Pairs

It is very easy to adjust the Walker to move around walkways or larger divisions (i.e. columns). First, measure to find out what the distance is from center dot to center dot on the lanes that have the large division. If you find out that the measurement is 93 inches then divide **0.31** into 93 to get 300. Enter this value into the proper lane to lane location and run the machine to see how close the setting comes to lining up with the lane.

Programming Around Poles or Walls

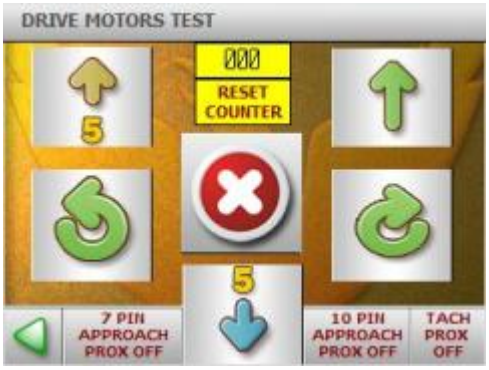
To view Super Advance settings, menu back to the LANE TO LANE ADJUSTMENT screen and press on SUPER ADVANCE. A password screen will appear, enter your password and press CONTINUE.

In SUPER ADVANCE LANE TO LANE there are four more adjustments, two turning and two straight, that can be used to maneuver around objects. There is a 6 STEP version and an 8 STEP version.

The 6 STEP version uses steps 1, 2, 3, 4, 7, and 8. To enable the 6 STEP version, increase the values of STEPS 3 and 4 to a number greater than 40. If a value greater than 40 is put in steps 5 and 6, then all 8 STEPS will be used.

Put 40 back in steps 3 through 6 and the function turns off. The machine will not enable Super Advance function if steps 1, 2, 5, 6, 7, and 8 are used, only the above 6 Step method will work. Call Kegel for help when using the Super Advance function.

To assist you in finding out what the starting values should be, menu to INPUT/OUTPUT TEST and then press DRIVE MOTORS. The yellow counter above the STOP button is our guide. The counter will make it very easy to see what each turn and straight value should be (or it gets us very close).



You must first have an idea what path the machine is going to take. First, make sure the machine is parked on the lane behind the foul line where it will normally stop after running a lane and reset the counter. If the machine needs to back-up farther than where it normally stops, then press the reverse button and stop the machine at the new location and write down the number in the counter.

This will be added to STEP #1. Reset the counter and press the turning button and stop the machine at the proper angle, record the counter value for STEP #2. Do the same procedure for the rest of the steps and then enter that data in its proper places.

It is very important that when the machine TURNS TO FACE THE LANE that the machine is the same spot as it came out of the lane for STEP #1. This ensures that the Cleaner, Duster, Oil and Squeegee all happen in their proper places on the lane.

It may be necessary for the machine to back up to the lane that is next to an obstacle that the machine needs to maneuver around. If the machine has to back up to a lane, other than the end lanes, you will need to menu to MACHINE SETUP and press the Forward Green Arrow and advance to MACHINE SETUP II.

From here you press MOON WALK SETUP.

The MOON WALK TO POLES OR WALLS is available for situations where there is a pole or wall to walk around that requires the machine to first back up to it before it can walk around it.

If the machine needs to back up going to lane 8, then 7 will be the lane value for going left to right. If the machine is going right to left and needs to back up to lane 10, then 9 will be the lane value to enter in this menu.

Steering Whiskers

The Kustodian Walker uses "whiskers" to sense when it is too far to the right or left when entering the lane. When the machine enters the lane and the 7-pin whisker contacts the foul light, the 7-pin drive motor will continue to run and the 10-pin drive will slow down.

When the machine over-steers it will contact the opposite whisker to straighten the machine onto the lane. A light brush of the whisker will result in a small steering movement and the other whisker should not hit.

If the Walker makes more than three whisker strikes the machine may be way out of alignment with the lane or is slow entering the lane.

Note: *Keeping the machine traveling straight in and out of the lane will result in a machine that makes small adjustments when steering into the lane. It should be common to watch the machine miss both foul lights and only make light brushes of the whiskers when they do hit.*

Automatic Lane to Lane Adjustments

The Kustodian Walker is equipped with automatic lane to lane adjusting. The two whiskers mounted in the front of the machine not only steer the machine into the lane but they also detect if the machine is traveling too far or too short.

When the machine is programmed to travel left to right if the 7-pin whisker hits first, it will indicate the machine has traveled short and will add one count to the value for that lane. After the first whisker contact, the feature is disabled. As the PLC "learns" the center, the lane to lane distances will become very accurate.

Motor Speeds

Go to the Main Menu and select MOTOR SPEEDS and the screen will advance to the Motor Speeds.

Press on any of the drive speeds to enable adjustment. When enabled, the button will turn bright yellow and then the value can be increased or decreased by 10.

Press AUTO SPEED ADJUST to advance to the next screen. From this screen you can have the machine adjust the speeds by running up and down a single lane. As the machine travels it is monitoring the speed and making adjustments when it goes above or below the limits.

The Walker will come out of the lane, stop, and go back into the lane for the next speed so you can do other things while it sets the speeds. The Ion will need to be operated as if you were running 6 lanes; you must pull it in and out of the lane to complete the settings. This process will take about 20 minutes.

The machine will clean and condition 6 lanes while adjusting its speeds using pattern 31 (calibration pattern). Press **Start Speed Adjust** and the machine will start operating. The machine sets 10 IPS first for the Forward and Reverse settings.

The number to the left of Analog Speed Value is the Step Number; 1 is 10 IPS Forward and 2 is 10 IPS Reverse, 3 is 14 IPS Forward and 4 is 14 IPS Reverse. This number sequence continues through all the speeds.

The number to the right of Analog Speed Value is the adjustment value. Below these numbers we show the TARGET SPEED and the RUNNING SPEED. The higher speeds may need to be run a couple of times to properly set the adjustment.

To skip to the higher speeds, press where it says Analog Speed Value. The TARGET SPEED button will change to INC SPEED, then press where it says INC SPEED to change the step number.

Warning: ODD numbers are for FORWARD travel and EVEN numbers are REVERSE. Do not run the wrong step number in forward or reverse travel.

The following list shows the Inches Per Second settings for the machine speeds:

1. 9-10 IPS
2. 13-14 IPS
3. 17-18 IPS
4. 21-22 IPS
5. 25-26 IPS
6. 29-30 IPS

Note: These six speeds will need to be adjusted through the touchscreen. High speed and speeds for approach travel are all self-adjusting and do not need any adjustment.

Bumper Wheels

Located in the rear of the Walker are two Bumper Wheels. These wheels will help seat the machine on the lane by kicking the rear end around if the machine does not enter the lane squarely. The overall width of the machine from outside of bumper wheel to bumper wheel should be between 59-½ to 60 inches (152.4 cm), depending on foul lights and lane installation. Adjust the height between the bottom of the wheel and the surface of the approach to about 1-½" (3.81 cm).

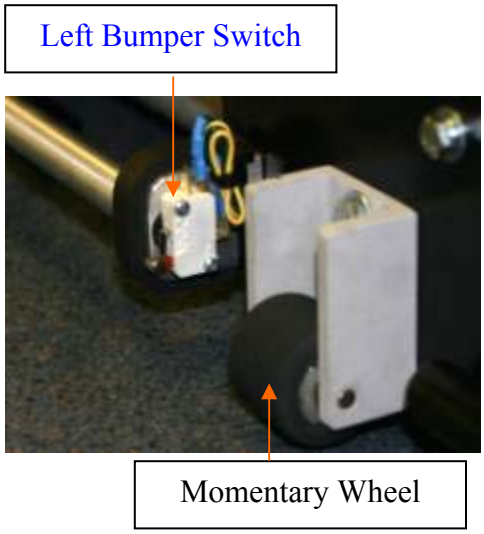
Basically, the bumper wheels need to be set to prevent the guide roller on the opposite side from sitting on top of the lane. If the adjustment is too wide the machine may get wedged between the foul lights.

Safety Stop Bumper

The machine is equipped with a front bumper in case the machine comes in contacts with something, most likely a foul light cover.

On the Walker, this typically occurs if the machine is started on the wrong lane. If this happens, the Walker will stop and give the **BS** error.

To move the Walker away from the foul light or other obstacle, menu to **MOVE MACHINE** on the touchscreen then press and hold the **DOWN ARROW**. This will drive the machine backwards and away from the foul light or whatever it ran into.

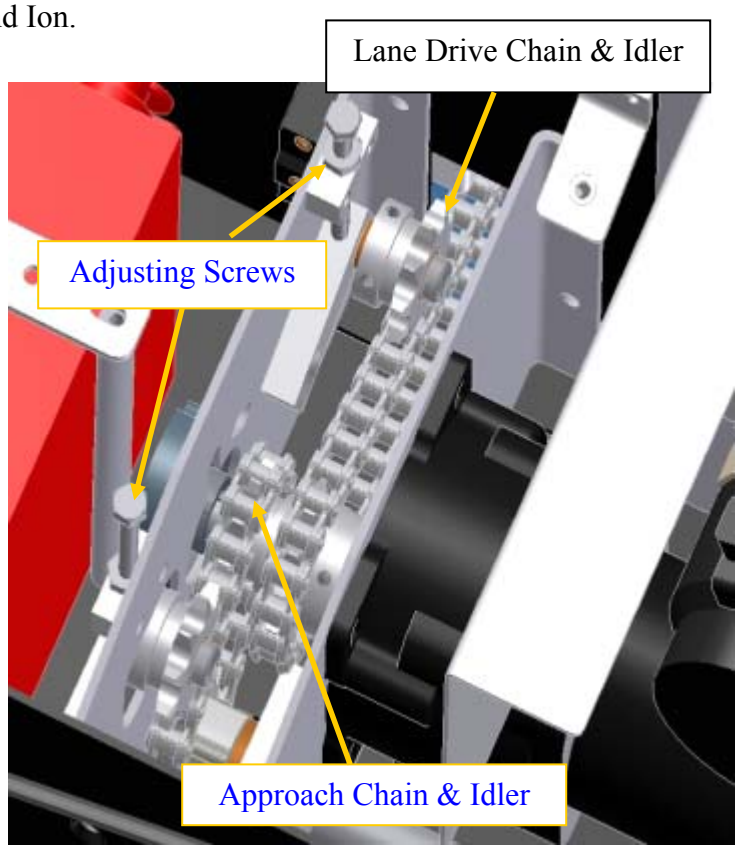


***NOTE**: The button must be held down or the Walker will not move in reverse.*

Adjustments

Main Drive Motor Chains (An adjustment video can be viewed in KOSI.)

It is important for the drive chains to stay tight but not too tight. First, determine what adjustment needs to be made. A chain that is too tight means that there is no movement of the chain when you press between the sprockets with your finger. A chain that is too loose is when you can move the drive wheels back and forth without engaging the motor. The lane drive chain adjustment is the same in the Walker and Ion.



To adjust **Lane Drive Chain**:

1. Loosen the three screws that secure the center compartment and hinge it back.
2. Locate the lane drive chain idler adjustment and loosen main pivot and adjusting jam nut.
3. Turn adjusting screw until lane drive chain tightens up (but not too much) then tighten fasteners and check play in wheels.

To adjust **10-pin Approach Drive Chain**:

1. Loosen the three screws that secure the center compartment and hinge it back.
2. Locate the chain idler adjustment and loosen main pivot and adjusting jam nut.
3. Adjust the idler until there is no play in the approach wheel. Make sure the sprockets do not come in contact with each other after the adjustment is made.
4. Tighten jam nut and pivot and check play in the wheel.

To adjust **7-pin Approach Drive Chain**:

1. Loosen the three screws that secure the center compartment and hinge it back.
2. Loosen the motor mount from the outside of the panel.
3. Loosen the adjusting screw jam nut if one is used on the machine.
4. Turn the adjusting screw in or out so the chain has between 1/4 inch and 3/8 inch (6.35 mm to 9.53 mm) of movement, but no play in the approach wheel.
5. Re-tighten the motor mount and adjusting screw jam nut then check buffer belt tension and re-adjust if needed.
6. Hinge the PLC control plate into place and tighten the three screws.

Note: It is a good idea to inspect and clean everything in the center compartment when it is open.

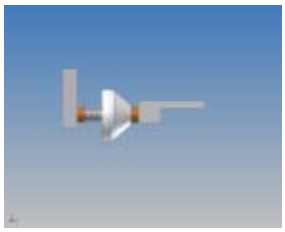
Rear Approach Wheel Chains

These chains should never be tight and the adjustment should last a long time due to the light duty of these wheels. The plastic idler used to give chain tension is only removing the excess slack in the chain. A little movement in the rear approach wheels is fine.

Approach Sensor Chains

The Approach Sensors located on each side of the machine use a #25 chain to drive the target. This chain is small and should never be tight; it should always run a little loose. A good adjustment would be to have 1/2 inch (1.27 cm) of total play in the chain. To make an adjustment, loosen the two bolts on the bracket and move the assembly to achieve the proper amount of play.

Guide Rollers



Front Guide Wheel Assembly

Rear Guide Wheel Assembly

Adjustment of the guide rollers may be needed if the bowling center has lanes that have been injected or if the gutters are even with the lane surface. In most cases, adjustment to the guide rollers on one side will be all that is required. The guide rollers in the front half of the machine are different than those in the rear half, but the adjustments are the same.

To remove the front guide rollers:

1. Remove the bottom bolt that holds the mounting block to the frame. This provides clearance to remove the shoulder bolt from the mounting block. *(To remove the rear guide roller, you will need to remove the rear approach wheel mounting block completely to remove the shoulder bolt).* One bronze bushing is normally between the roller and the side plate of the machine and one is between the head of the shoulder bolt and the wheel (in the front section of the machine).

2. Place the bronze bushing located toward the side plate between the head of the mounting bolt and the guide roller on one side of the machine (both front and rear rollers). This will give approximately 1/4" additional clearance between the guide rollers as the machine travels on the lane surface.

3. Operate the machine after changing one side. If needed, make adjustments to the wheels on the other side of the machine.

Adjusting the Lane Sensing Whiskers on the Walker

Adjusting a whisker is done by simply loosening the two set screws that hold it to its pivot mount and sliding the spring in or out. The whiskers will be around 6 inches (15.24 cm) from the side plate of the Walker, depending on foul light castings and the lane installation.

To determine if the whisker adjustment is correct, line the Walker up to just miss the 10-pin whisker when it enters the lane. The machine should go straight into the lane without either of the front guide rollers sitting on top of the lane.

If the 7-pin side front guide roller were to hang up on top of the lane this would mean the 10-pin whisker needs to be extended out from the machine at least half an inch. If you hear the guide roller snap off the lane when the machine enters the lane, the adjustment may only be a 1/4-inch (6.35 mm). The 7-pin whisker can be checked the same way.

The gap between each whisker and the foul light cover should be between 1/2-inch and 3/4-inch (1.27 cm to 1.91 cm).

The goal is when the machine enters the lane and the whiskers just miss, the guide rollers never have a chance to high-center the machine and cause a travel error. The whisker should just miss the foul lights and seat the machine on the lane correctly without hearing a guide roller snap over the edge of the lane.

The whiskers also detect when the machine has traveled too far or too short so they are always adjusting the Lane to Lane settings to keep your Walker entering the lane as close to perfectly as possible.

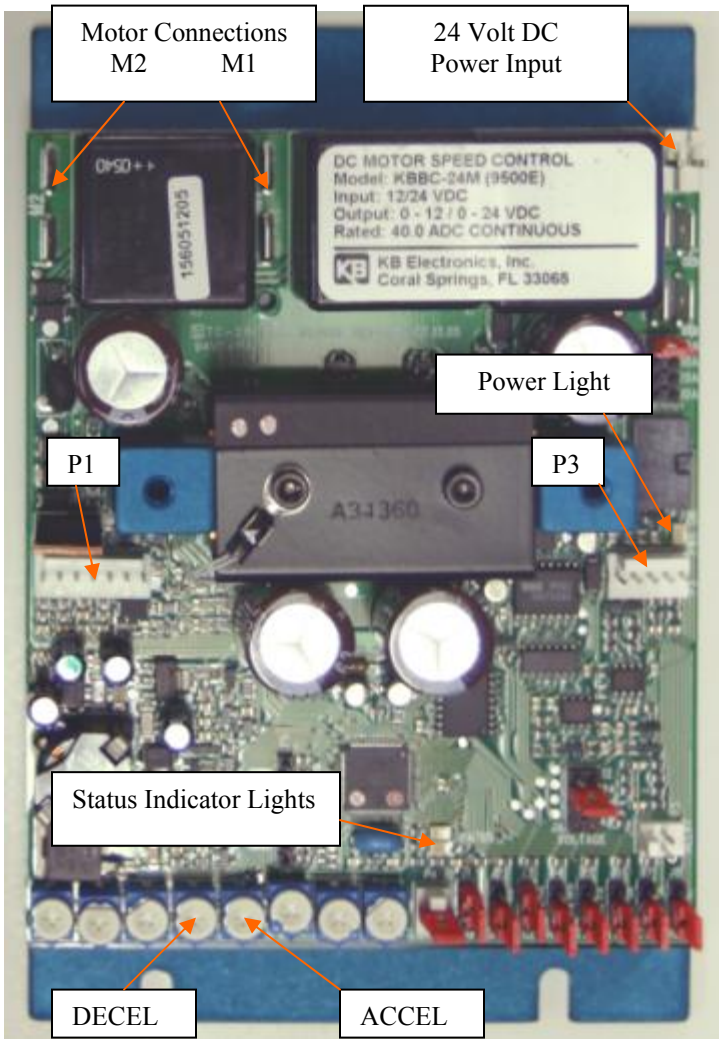
Drive Board Adjustments

There are only two adjustments on the motor controller board that may need to be fine-tuned. They are the Deceleration (DECEL) and Acceleration (ACCEL) trimpots.

The **Acceleration** trimpot needs to be adjusted for a smooth acceleration from one speed to the next without sudden jerks of the machine when shifting speeds. Turning the trimpot clockwise will increase the ACCEL time and turning the trimpot counter-clockwise will decrease the ACCEL time (which could cause the machine to make sudden speed changes). **This function can cause travel errors in the pit if the acceleration time is too slow.**

The **Deceleration** trimpot is adjusted for smooth decelerations from one speed to the next. Decelerating too quickly will possibly cause the drive board to shut down from an over-voltage fault when going from a higher speed to a lower speed. Turning the trimpot clockwise will increase the Decel time and turning the trimpot counter-clockwise will decrease the Decel time (which could cause the machine to make sudden speed changes).

If you adjust the DECEL too much in the clockwise direction the machine may take too long to slow down properly when entering the pin deck. ***Be certain that the machine is definitely slowing down before coming to a stop.***



The Drive Motor Controller, shown above, also has indicator lights used to display error codes. The codes can help in troubleshooting a problem with the drive that may be nothing more than a trimpot adjustment. These codes are located with the Forward and Reverse travel errors in the touchscreen.

BOARD ERROR CODE CHART

FUNCTION	FLASH CODE	LED COLOR
Motor Running	SLOW	Green
Motor Stopped	QUICK	Green
Speed Pot Fault	QUICK	Red/Green (Alternate)
Temperature Fault	SLOW	Red/Green (Alternate)
Over/Under Voltage	QUICK	Red + Green
Under Voltage Warning	SLOW	Red + Green
Motor Brake Fault	QUICK	Red Red / Green Green
Internal Fault	SLOW	Red Red / Green Green
Current Fault	STEADY	RED
Current Limit Time Out	QUICK	RED
Power On	STEADY	GREEN
Power Off	OFF	OFF

Press anywhere on screen to return.

Balancing the Two Walker Drive Motors

The two drive motors are "balanced" with a long 22 AWG yellow wire. This wire is used on either the 7-pin or the 10-pin drive motor, depending on which motor needs more resistance.

The wire only receives current while the machine is traveling on the approach and it is only creating a small amount of resistance in the circuit to balance the two motors so they will run at the same speed. A longer length of wire will make the motor run slower.

To balance the motors on the Walker, first determine which motor is using or needs the resistance wire. The instructions below are written as if there is no resistance wire.

1. Go to the **MOVE MACHINE** screen and position the machine as if it was going to the next lane.
2. Line the rear panel up with the approach boards so they are parallel with each other.
3. Press the **UP ARROW 5** and let the machine run until it stops.
4. Check to see if the rear panel is still parallel with the approach boards. If one side only advances ½ an inch this may not be a concern (unless you want it absolutely perfect).
5. Press the **DOWN ARROW 5** and observe if the machine advances back to where it started.
6. Do this exercise several times to see if the machine repeats its movements forward and back.
7. If the machine repeats its error and is off by as much two boards, then replace the proper jumper with a wire between 6 and 8 feet (1.8 to 2.4 m) to start with. If the machine does not travel the same in both directions then you will need to split the difference when adjusting the resistance wire.
   - If the yellow resistance wire is used to control the **7-pin motor** it will be connected to the two terminals on the left hand side of the black box (red wires).
   - If the yellow resistance wire is used to control the **10-pin motor** it will be connected to the two terminals on the right hand side of the black box (white wires).
   - When stripping the wire, remove ½ inch of the insulation so you can fold the wire in half when inserting into the terminal block.

.

Be certain to turn the power off when adjusting the wire length.

8. After you have installed the length of wire (which we hope is a little long to start), repeat steps 1 through 5 and observe the movement of the Walker.
9. Shorten the yellow wire if needed in 6 to 12 inch increments (~15 to 30 cm) and then test the results. Continue until the motors are balanced and the machine travels straight. Put the excess wire inside the black box along with the jumper when finished.

The length of wire used will vary from machine to machine and it may be necessary to move the resistance wire to the other motor after motors break in.

Note: The machine has approach adjustments for each lane in both directions so it is possible to adjust them in case the motors change (or warm up) as the machine travels across the center.

Maintenance

There are a few things that the operator should do to maintain the Drive System. Here are some suggestions that should be done to maintain your machine in proper working order.

1. Keep all of the bushings oiled on the drive shaft (one or two drops is plenty). Do not allow chains to get dry but do not over-oil. There are felt washers to help hold the oil longer next to the bushings. **DO NOT OVER-OIL, THEY WILL DRIP FOREVER!**

2. Keep the LDS shaft bushings oiled, one drop of oil every 4 to 6 months is sufficient.

3. Inspect the drive wheels for tightness and free rotation each time you clean the machine.

4. Inspect the drive chain adjustment whenever the wheels are checked or cleaned.

5. Inspect the LDS when cleaning the machine to make sure all parts are tight (it takes just a second).

6. Inspect the main ZTR wheels for loose chains or set screws on the Walker.

7. Inspect the rear ZTR wheels on the Walker for loose set screws or excessively loose chains (but keep in mind that these chains can run loose with no problem).

8. Inspect the two approach sensor chains on the Walker. They should run loose, but not too loose.

Drive System Problems Indicated by Error Messages

Problems that display errors are easily corrected and happen for definite reasons.

Forward and Reverse Travel Errors normally happen when LDS **Input 0CH 07** fails to go off and on as the lane distance wheels turn. When the motor is turned on an error counter is also activated at the same time. If the LDS does not constantly reset the counter every 2.4 seconds, a travel error will be displayed. We've made a list of a few things that can cause a **Forward or Reverse Travel Error**.

If the Drive Motor does not run, menu to the **MOVE MACHINE** screen for the Walker and check the operation of the relays and voltages. For the Ion, menu to **INPUT/OUTPUT TEST** to run the motor.

1. The drive motor runs but gives a **Forward or Reverse Travel Error**.
   a. Machine is not seated on the lane, there are high gutters, or the drive wheels are slipping.
   b. LDS signal has failed or the LDS shaft is binding.
   c. Wire is loose or broken for the **0CH 07** Input circuit.
   d. Turn the LDS shaft and see if **Input 0CH 07** is flashing on the PLC as the wheels rotate.
   e. Machine Acceleration trimpot needs to be adjusted. This problem will show up the most often in the pit when the machine does the squeegee wipe function. There will also be an error code flashing on the speed control board when the ACCEL needs to be adjusted. A clockwise turn of the trimpot will be needed.
   f. Machine Deceleration trimpot needs to be adjusted. This problem will show up when the machine enters the pit or returns to the foul line in clean only. This is when the machine shifts from high speed to 14 or 10 IPS. There will also be an error code flashing on the speed control board when the DECEL needs to be adjusted. A clockwise turn of the trimpot will be needed.

2. Drive Motor does not run.

   a. Forward Relay is loose in socket or failed.

   b. Reverse Relay is loose in socket or failed.

   c. One of the motor control plugs is loose or unplugged. Check speed control and drive motor plugs.

   d. Blown fuse.

   e. Drive Motor or Speed Control has failed.

   f. Go to the proper menu and check the operation of the relays.

3. Machine drives off into pit giving a **Forward Travel Error**.

   a. DECEL set too slow on drive board.

   b. Forward Subtract needs to be increased by one or two counts.

   c. Lane Distance shaft is not turning freely.

   d. Lane Distance target is loose.

   e. Lane Distance Proximity Sensor is too far from target.

   f. Lane Distance Proximity Sensor is damaged.

   g. Operator needs more training and is starting the machine too far past the foul line.

   h. Tail plank is missing from pin deck. Check for missing tail planks.

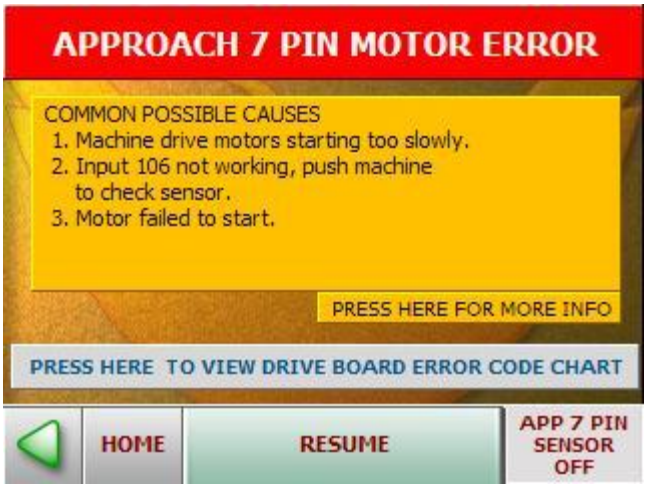
Q: If there is a definite failure of the Lane Distance Sensor is it possible to use the TACH sensor for the LDS functions?

The answer is YES. The operator will have to remove the wire off of Input 0CH 06, which is a Black / Blue wire and put it in place of the White / Pink wire that is on Input 0CH 07.

Connect the wire from 0CH 07 to 0CH 06 and remember to reverse the wires when the sensor is repaired or replaced. Exchanging the wires will turn the TACH sensor into a Lane Distance Sensor.

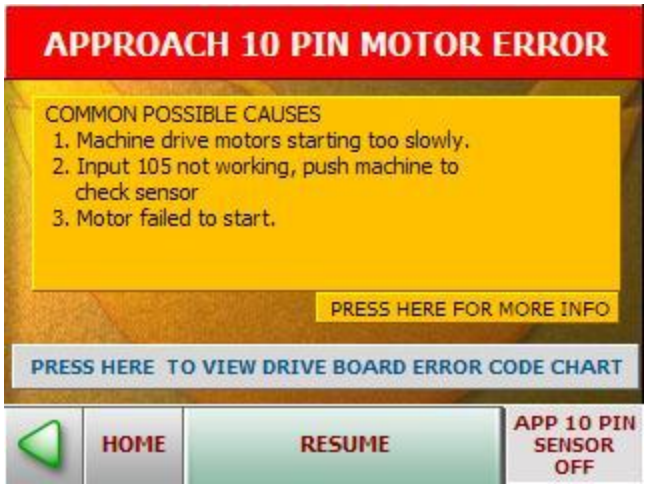
NOTE: *If the TACH sensor is used as a distance counting sensor it is possible the machine will run short up to as much as a foot of travel so the travel distance will need adjusting.*

Normally this Walker error screen appears when **Input 1CH 06** fails to receive a signal within 1.5 seconds of the 7-pin Approach Motor starting. Here are the possible causes that can produce an **APPROACH 7 PIN** error.



1. 7-pin Approach Motor runs but gives an error.
    a. Sensing target is loose or has fallen off.
    b. Sensor has failed.
    c. Bad connection between sensor and PLC.
    d. Chain broke that drives sensor target.
    e. Main drive chain to rear wheel is off.

2. 7-pin Approach Motor does not run. Menu to **MOVE MACHINE** screen to test motors.
    a. Drive motor has failed.
    b. CR2 (ZTR Enabling Relay) is loose in socket base or failed.
    c. CR1 (Directional Relay) is loose in the socket.
    d. Fuse is blown.
    e. The Motor Drive Board has a fault; check error code for drive board. Turn the machine off for a few seconds and then back on to see if the fault resets.
    f. The motor is unplugged.
    g. Make sure CR3 is seated properly in its base.
    h. Check 10-pin Whisker Switch.



Normally this approach error occurs when **Input 1CH 05** fails to receive a signal within 1.5 seconds of the motor starting.

Here is a list of the possible causes that can produce an **APPROACH 10 PIN ERROR**.

1. 10-pin Main Drive Motor runs but gives an error.
    a. Sensing target is loose or has fallen off.
    b. Sensor has failed.
    c. Bad connection between sensor and PLC.
    d. Chain has broken that drives sensor target.
    e. Main drive chain to rear wheel is off.

2. 10-pin Main Drive Motor does not run. Menu to **MOVE MACHINE** screen to test motors.
   a. Drive motor has failed.
   b. CR12 (Forward Relay) is loose in socket base or failed.
   c. CR13 (Reverse Relay) is loose in socket base or failed.
   d. Fuse is blown.
   e. 10-pin Motor Drive Board has a fault; check error code for the drive board. Turn machine off for a few seconds and then back on to see if the fault resets.
   f. Motor is unplugged.
   g. 7-pin Whisker Switch is stuck.
   h. Make sure CR4 is seated in base.

There are two On Lane Switch (OLS) errors for the Walker. The OLS is used to detect when the Walker is on the lane or if it is taking too long to get there. In order for the OLS switch to work, the Walker must be fully seated and start rolling the LDS shaft.

The OLS LATE error is enabled when the machine begins its movement toward the lane. If the machine takes more than 8 seconds to close the normally open contacts, it will display the error. The machine could either be high-centered on the lane by a guide roller or the speed is set too slow.

The OLS STUCK error is displayed when the OLS contacts are already closed due to a bad switch or the wheel was rotated, causing it to close the switch. Someone could wire the switch wrong as well.

The BUMPER error is displayed on the Walker when the bumper switch contacts close due to a bad switch or running into something while the machine is moving.

Drive System Problems that Do Not Display Errors on Lane or Approach

There are a number of things that can go wrong with the Drive System and the Walker will appear to operate poorly. Most of these problems can be corrected before the machine fails, but only if the operator is paying close attention.
Checking the drive speeds as the machine runs is a good thing! One of the first things to check when experiencing drive problems is to make sure the drive chains are all operating at the proper tension.

NOTE: When making changes to how the machine moves and turns, the Lane to Lane adjustments will also change.

1. When the machine comes out of the lane and onto the approach it drifts to the left or right.
   a. Check gutter adapter blocks to see if they are causing the machine to come out crooked.
   b. The machine could be favoring the left or right side and coming out a little crooked.
   c. The 10-pin motor could be running too fast. Adjust the length of the yellow resistance wire.

2. The machine turns more than (or less than) 90 degrees when turning clockwise or counter-clockwise.
   a. Check the STEP #2 TURN AWAY FROM LANE and STEP #8 TURN TO FACE LANE adjustment to see if they are set properly for each lane.
   b. The 10-pin Approach Sensor is mis-counting allowing it go beyond 90 degrees.

3. The machine drifts to right or left when traveling to the next lane.
   a. The yellow resistance wire needs to be adjusted to balance the motors.

4. The machine will not make a 90 degree turn.
   a. The CR1 Directional Relay is not operating.

5. The machine makes more than three whisker strikes when entering the lane.
   a. The whiskers are set too wide and are not giving the machine enough room to maneuver.
   b. Lane to Lane adjustments have not been fine-tuned.

6. The machine slows down suddenly when down-shifting or stopping
   a. The Decel Potentiometer on the drive board needs to be adjusted clockwise.

7. The machine appears not to ramp down to a slower speed just before stopping when on the approach.
   a. The Decel Potentiometer on the drive board needs adjusted counter-clockwise.

8. The machine starts very quickly and makes sudden speed changes.
   a. The Accel Potentiometer needs adjusted clockwise.

9. The machine starts slowly and may display travel errors.
   a. The Accel Potentiometer needs adjusted counter-clockwise.

CHAPTER 5

Battery Power and Charging Systems

Batteries

The Walker and Ion use two Odyssey Dry Cell batteries hooked in series to produce 25.6 volts at a full charge. These are non-spillable batteries and can be mounted on their sides. The batteries should be on charge any time the machine is not in use.

In large centers, opportunity charging may need to be done. Any time you stop to fill the supply tank or dump the recovery is time that can be spent charging the batteries.

It is not a bad idea to get a set of spare batteries just to keep on hand.

Note: Do not use any battery not authorized by Kegel in this machine. Do **not** use flooded acid batteries in this machine.

Fuse Link

The batteries are fused with a 40 amp buss fuse link between the batteries. In the case of a dead short the fuse will blow to protect the batteries and machine.

Battery Cycle Life

The Odyssey Battery is capable of about 400 charge/discharge cycles to 80% depth of discharge (DOD). This is equal to doing somewhere around 32 lanes a day for over a year or a 16 lane center doing lanes twice a day and charging after each operation. The exact number of lanes that the machine can condition, will depend on the machine run time. The longer the run time, the fewer amount of lanes can be conditioned on a single charge. Battery life depends tremendously on the correct charging voltage so we can't say enough about monitoring your charging voltage.

Battery Charger

Proper Location and Mounting of Charger

It is recommended that the Charger be mounted securely to a wall that is located in a cool dry place. During the Installation of the machine, you will find a 20A receptacle located in the accessory kit to be used for the charging of the machine. Use this receptacle along with a dedicated line to charge the machine.

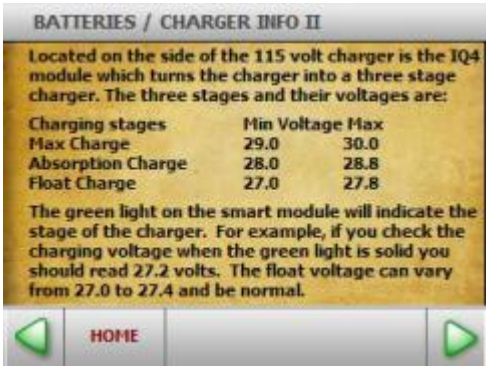
Proper Charging Procedure

IMPORTANT NOTE: *Always plug the cord into the machine charger BEFORE plugging the cord into the wall outlet. The charger may not sense the correct voltage and start in the correct charging stage if the plug end has power when connected to the charger. Improper charging of the batteries may occur if this sequence is not done correctly each time you charge the batteries.*

Three Stage Charging

Located on the side of the charger, the IQ4 module turns the charger into a three stage smart charger. The three stages and their voltages are located in the Battery Charger information screens like the one shown here:

In order to better understand the batteries and the charging system, there are information screens that will help you in checking voltages as well as troubleshooting if necessary.



Charging Voltages

Charging Stage	Min Voltage	Max
Max Charge	29.0	30.0
Absorption Charge	28.0	28.8
Float Charge	27.0	27.8

Green LED Indicator

The LED Indicator on the IQ4 informs the user as to the status of the battery and the charging stage. When first activated, the IQ4 will read the number of cells in the battery and indicate the voltage of the battery through a number of flashes.

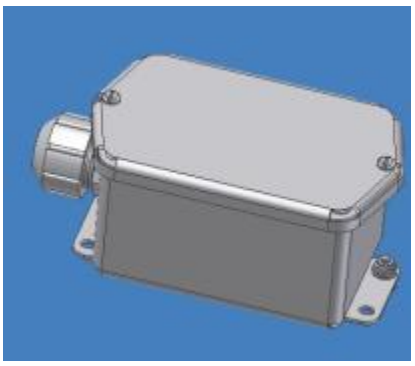
6 flashes = 12 volt battery
12 flashes = 24 volt battery
18 flashes = 36 volt battery
24 flashes = 48 volt battery

After reading the battery, the IQ4 will initiate either a Bulk Charge or Float Charge depending on the batteries' charge status. When the IQ4 is in the Bulk Charge mode, the green LED indicator will flash rapidly.

When the Bulk Charge is complete, the IQ4 begins the Absorption Charge and the LED indicator will flash at a slower even rate. When the battery charging is complete and the IQ4 begins the Float Charge, the LED will remain lit and will no longer flash.

If, when first activated, the batteries are not in need of charging, the IQ4 will immediately begin the Float Charge and the LED will remain lit after it has counted the battery cells.

Constant Voltage Regulator (CVR)



The CVR is located under the control plate to the left of the batteries. It maintains a constant 26.2 - 26.6 volts to the key components of the machine. It controls the drive motor, oil pump, sliding head motor, and buffer motor.

The CVR is protected by a 25A internal fuse (Part Number 158-1439) which can be replaced by the operator.

Indicating Light

There is one indicating light on the side of the machine above the charging power inlet.

The Green Light will indicate the E-Stop is turned on and the machine is ready to operate.

E-Stop

The E-Stop is used to remove battery power from the machine by pressing on the big red button. The button must be rotated to resume power. The machine should always be turned off by the E-Stop during charging or maintenance.

When the E-Stop is pressed while operating on the lane the machine program will be zeroed and the machine will need to be returned to the foul line and re-started.

Battery Pack

The Battery Pack is two smaller batteries that will provide a boost of power to get you through those times when the main batteries are close to the end of their cycle life, or someone didn't charge them fully. Using the pack will enable you to continue to get the most out of your main batteries before replacing them.

The machine has two holes in the rear panel to hook the pack onto the machine. A plug is located on the 7-pin side of the rear panel. When using the pack be certain that the wire is secure and cannot be damaged by the pin spotter. In addition, to avoid possible damage, DO NOT fill the chemicals while the Battery Pack is attached to the Lane Machine.

*Always keep the pack fully charged in a cool, dry storage area, and ready to go when needed. A full charge on the pack will be the same as the machine (25.6 volts) and it uses the same charger.

When Should You Replace the Batteries?

Replacing the batteries when the machine will not clean and condition all lanes with one charge could be one sign. Opportunity charging should be done when the batteries get to where they fail to finish the center, but still have life. Do not discard the batteries until you get the most possible life out of them.

With a battery pack it is possible to use the batteries even longer, allowing you to get even more use before replacing them. The pack should do another 20 lanes on the Walker, depending on the pattern run times.

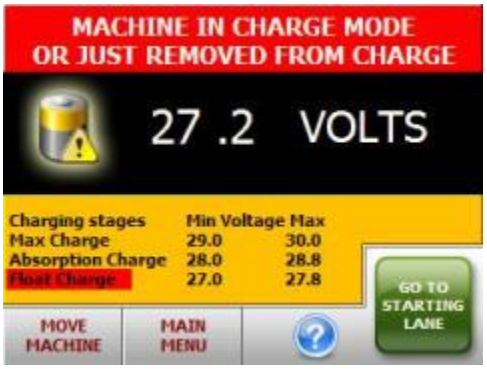
Replacing Batteries

Replacing the batteries is simple, but with the center compartment hinged open, great care should be used whenever this job is done.

1. First turn the E-Stop OFF. Power to the machine must be turned off.
2. Loosen the three fasteners across the top of the center compartment plate.
3. Remove the fuse link between the batteries first to disable both batteries. The battery terminals will require a 10 mm socket.
4. Remove the Negative wire on the left battery and then remove the Positive wire on the right battery.
5. Remove the mounting hardware.
6. Carefully remove the batteries. Care should be taken since each battery weighs about 38 pounds (17.2 kg).
7. After replacing batteries and mounting hardware, hook batteries up in the reverse order putting the fuse link in last. Be certain not to over-tighten battery terminals (but make sure they are tight). Bad connection at the batteries will cause operating problems and may simulate dead batteries.
8. Close the center compartment and tighten fasteners.
9. Turn machine ON to check charger and battery voltage.

Troubleshooting Battery & Charging Problems

Battery problems are no fun no matter what piece of equipment you are using. It is a fact of life you will experience battery problems but to have a lane machine that has no cord … well it may just be something you are willing to deal with.

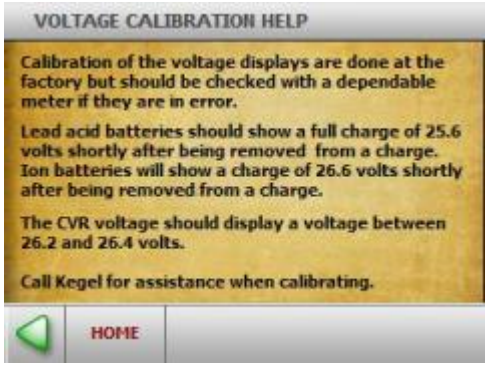


This screen is displayed when the charger is plugged into the machine. It will show the charge voltage and highlight the present charging stage of the machine. If this screen does not appear when charging it can indicate the charger is not functioning or the signal voltage has been lost.

This advisory screen will pop up when the battery voltage is equal to or lower than 24 Volts. This may indicate the machine was not charged or the machine meter is not calibrated, check voltage with a reliable meter.

This advisory screen will pop up when the CVR voltage is not detected or is equal to or lower than 25 Volts. This may indicate the CVR has failed or the meter is not calibrated. If the CVR has failed, check the fuse inside and if it is good, then check the calibration of the machine meter with an external meter that is reliable.

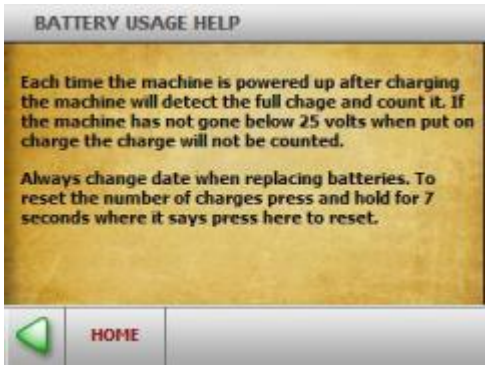
To adjust the voltage meters accurately you must have a dependable voltmeter. First, locate the three-pin plug next to the relays. The wire at the point goes to the CVR and the wire at the flat will be the Battery Voltage (the center pin is the Ground wire). Using the screen to the left, press on the Voltage you want to adjust; the buttons will become enabled and an adjustment reference number will appear. Put the voltmeter probes in the appropriate pins then add or subtract using the buttons at the bottom of the screen until the Voltage on the screen matches the correct Voltage from the external voltmeter.



The screen to the left provides information about calibrating the Voltage display.

Has ION!!

Each time the machine is powered-up after charging, the machine will detect the full charge and count it. If the machine has not gone below 25 Volts when put on charge the charge will not be counted. **Always change date when replacing batteries**. To reset the number of charges press and hold for 7 seconds on the button labeled PRESS HERE TO RESET.



The screen to the left provides instructions to reset the battery cycle counter when a new set of batteries is installed in the machine.

Battery connections can be very deceiving when there is a bad connection. You can read fully charged battery voltage but just as soon as a load is introduced it is gone. When it comes to 24-Volt battery connections, you must have nothing less than perfect connections or you may be dead in the water. Here are a few things that can cause battery or charging problems.

The last thing you want your machine to have is …
loose connections!

Loose connections are the number one cause of charging and operating problems. Here are all of the locations between the batteries and the machine control plate.

Always turn off E-Stop when inspecting connections.

1. Battery terminals have 4 locations.
2. Fuse link between batteries.
3. Blue connector between charger and batteries.
4. Screw terminals in back of charger, positive and negative.
5. Fuse mounts in back of charger.
6. Red plug between batteries and PLC plate.
7. Terminal junction block on back of PLC plate.
8. Terminal junction block jumpers.
9. E-Stop.

Machine will not run. Check for the following:

1. Loose connection between the two batteries or fuse link is the most common cause of this issue.
2. Bad fuse.
3. Loose battery terminal. Check all connections.
4. Dead batteries.

Machine runs but the number of lanes has been reduced or is reducing.

Any time this occurs the charging voltage should be monitored daily to determine if the charger is working 100% of the time.

1. The charger voltage is incorrect. The IQ4 is not working properly.
2. Charger operates intermittently. Battery charger has internal bad connection.
3. Vacuum is drawing more amps.
4. Machine run times are longer.
5. Possible bad connection between charger and batteries.
6. Possible battery problem.

Batteries are not charging. Check for the following when the charger shows no output voltage.

1. Charger has failed.
2. Blown fuse in back of charger.
3. Open or very bad connection between charger and batteries.

CVR not working. Check for the following:

1. Fuse blown inside CVR.
2. CVR has come unplugged.
3. Bad connection to CVR
4. CVR has failed.

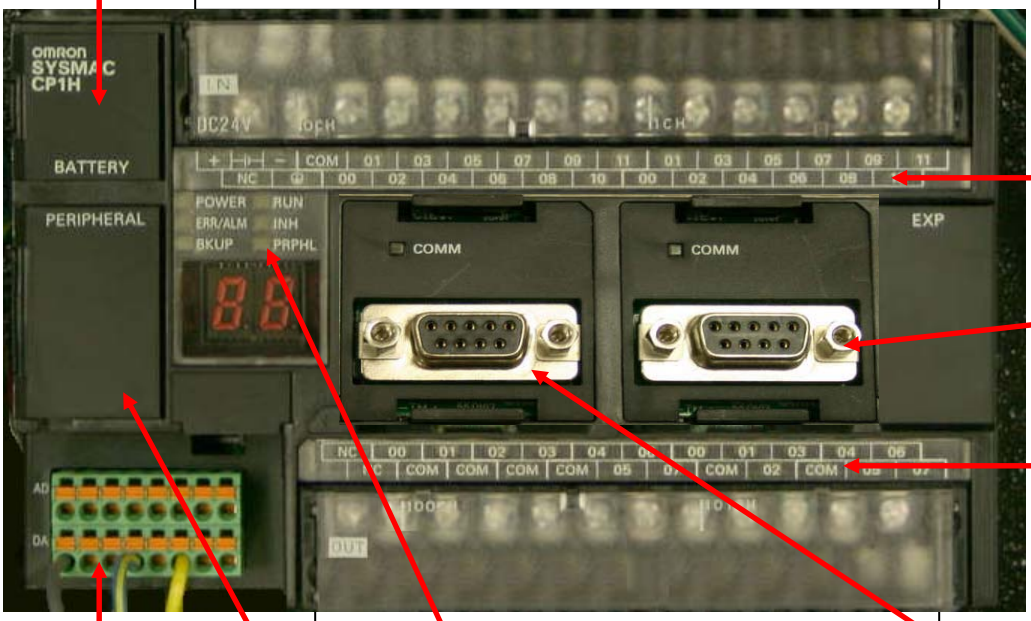
CVR not maintaining set voltage.

1. CVR has failed. It may operate the machine but not as designed.

CHAPTER 6

Computer and Control Relays

Programmable Logic Controller (PLC)



Indicator	Status	Meaning
PWR (green)	ON	Power is being supplied to the PC.
	OFF	Power isn't being supplied to the PC.
RUN (green)	ON	The PC is operating in RUN or MONITOR mode.
	OFF	The PC is in PROGRAM mode or a fatal error has occurred.
COMM (yellow)	Flashing	Data is being transferred via the Peripheral port or RS-232C port.
	OFF	Data isn't being transferred via the Peripheral port or RS-232C port.
ERR/ALARM (red)	ON	A fatal error has occurred. (PC operation stops.)
	Flashing	A non-fatal error has occurred. (PC operation continues.)
	OFF	Indicates normal operation.

PLC Inputs and Testing

The PLC assembly of the machine has 24 inputs, 16 relay outputs, and two analog outputs. Inputs accept data from various sensors or switches in the machine and then use that information to control functions of the machine through its outputs. Here is a list of the **INPUT** numbers for the PLC along with their wire color and designations:

INPUT	DESCRIPTION	WIRE COLOR
0CH 00 *	ON LANE SWITCH (OLS)	YELLOW / ORANGE
0CH 01	BOARD COUNTING PROX SENSOR	RED / WHITE
0CH 02	LEFT OIL HEAD REVERSING PROX SENSOR	RED / ORANGE
0CH 03	RIGHT OIL HEAD REVERSING PROX SENSOR	ORANGE / BLACK
0CH 04	BUFFER BRUSH UP SWITCH	GREEN / WHITE
0CH 05	BUFFER BRUSH DOWN SWITCH	VIOLET / YELLOW
0CH 06	DRIVE SHAFT TACHOMETER PROX SENSOR	BLACK / BLUE
0CH 07	LANE DISTANCE PROXIMITY SENSOR (LDS)	WHITE / PINK
0CH 08	RESUME BUTTON / HANDLE BUTTON	VIOLET
0CH 09	STEPPER DRIVE ERROR	BROWN / YELLOW
0CH 10	DUSTER UP SWITCHES (2)	GREEN / BLACK
0CH 11	L>R MANUAL START	BROWN / BLUE
1CH 00	SQUEEGEE DOWN SWITCH	BLACK
1CH 01	SQUEEGEE UP SWITCH	YELLOW / GREEN
1CH 02	OIL FLOAT SWITCH	GRAY / WHITE
1CH 03	CLEANER FLOAT SWITCH	GRAY / BLACK
1CH 04	RECOVERY TANK SWITCH	VIOLET / GREEN
1CH 05 *	10-PIN APPROACH SENSOR	GRAY / ORANGE
1CH 06 *	7-PIN APPROACH SENSOR	GRAY / BROWN
1CH 07 *	BOTTOM DUSTER SWITCHES (2)	WHITE / ORANGE
1CH 08	MANUAL DUSTER / CLEANER CALIBRATION	BROWN / VIOLET
1CH 09 *	7-PIN WHISKER	VIOLET / ORANGE
1CH 10 *	10-PIN WHISKER	RED / VIOLET
1CH 11 *	BUMPER SWITCHES (2)	GREEN

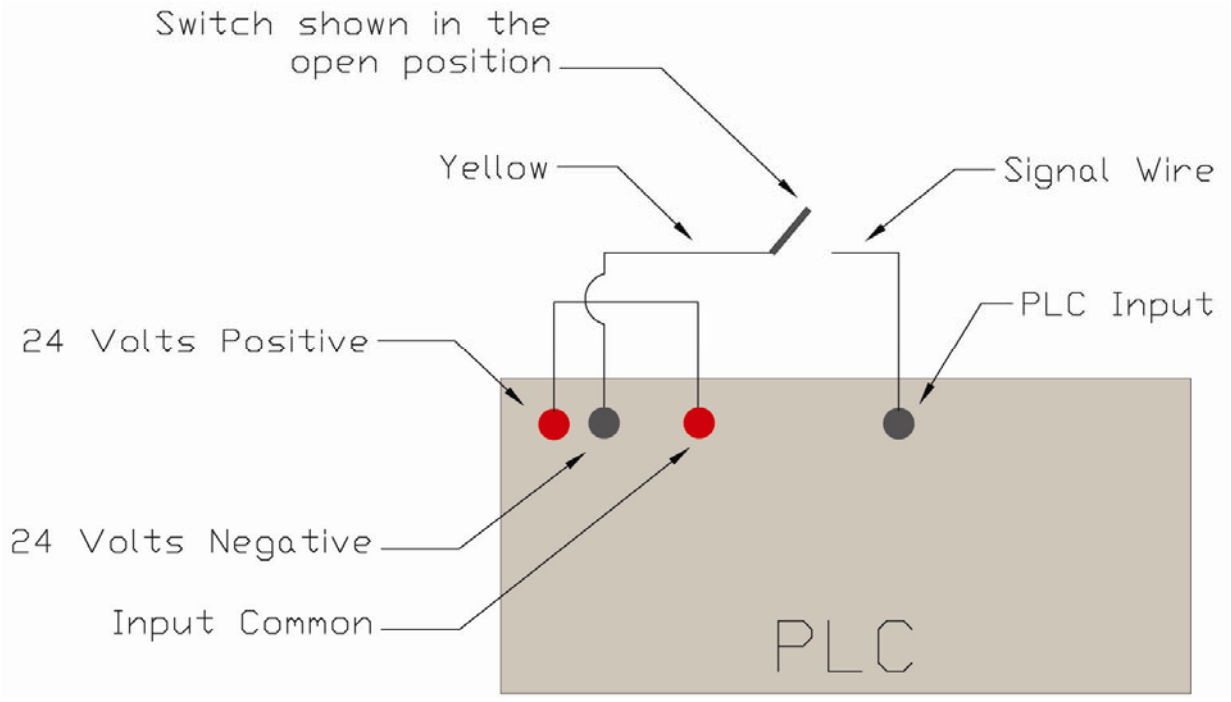
Note: Inputs with an * next to them are only used in the Walker.

Inputs and Testing Continued…

Testing inputs is very simple, like the flick of a light switch. To test proximity sensors pass a metal object across the face of any sensor. Lights on both the proximity sensor and PLC Input should light up. To test inputs operated by switches, depress the lever on the switch and the appropriate input should light up.

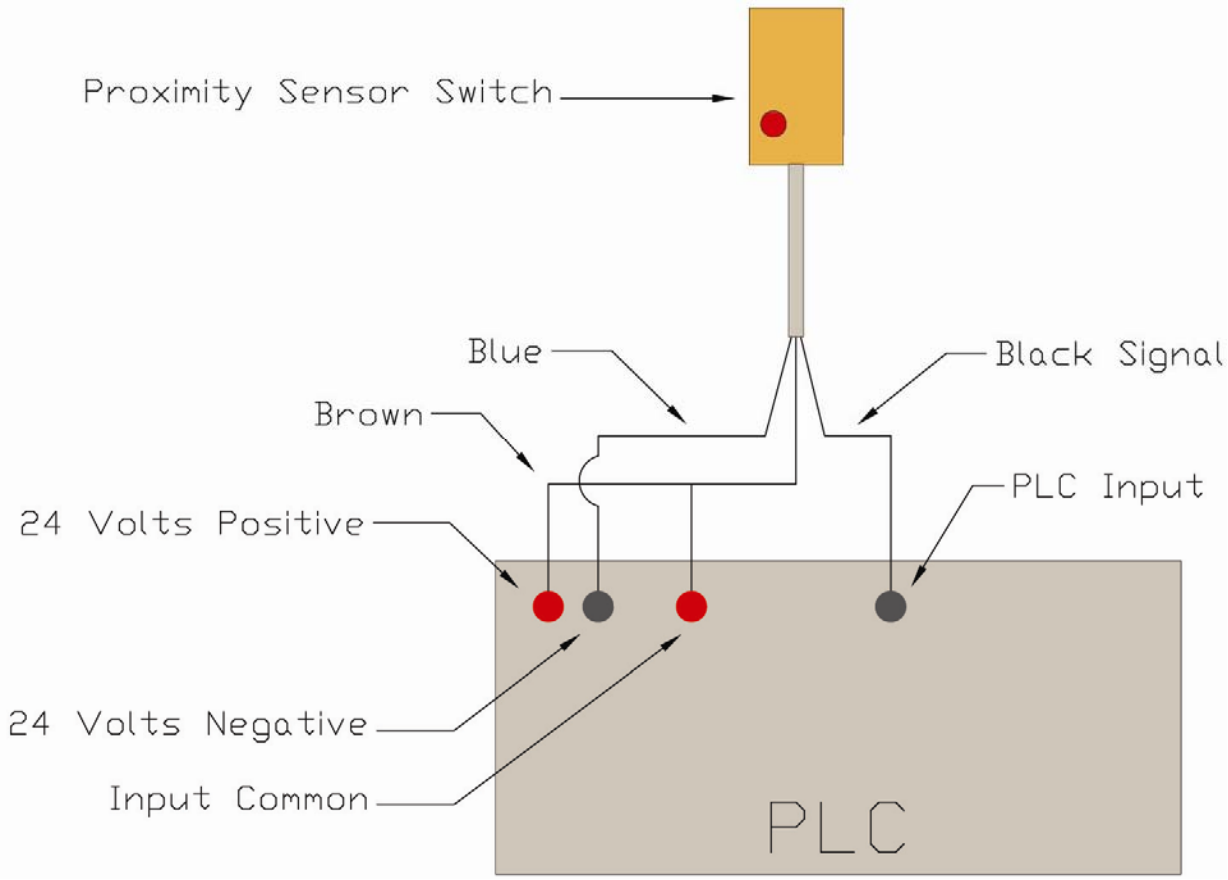
The following wiring drawings will show the simplest way a switch and proximity sensor connect to the PLC.

Below is an example of a typical input circuit using a switch. One side of the switch goes to the PLC Input and the other side of the switch goes to Negative Voltage. The PLC Input Common is supplied with Positive Voltage. The circuit is shown in the open position so there will be no input light on the PLC. The batteries will supply the 24 Volts. **All of the machine switches are wired like this. The only difference is that the wires will pass though plugs and junction blocks.**



Inputs and Testing Continued…

Below is a wiring example of a typical input circuit using a Proximity Sensor Switch. The Proximity Switch has three wires. Blue will connect to negative, Brown to positive, and Black is the signal which connects to the appropriate PLC Input. The sensor operates when metal passes by the face. An LED light located on the sensor will indicate operation. The batteries will supply the 24 Volts. All of the machine's Proximity Sensor Switches are wired like this; the only difference is that the wires will pass though plugs and junction blocks.



PLC Outputs

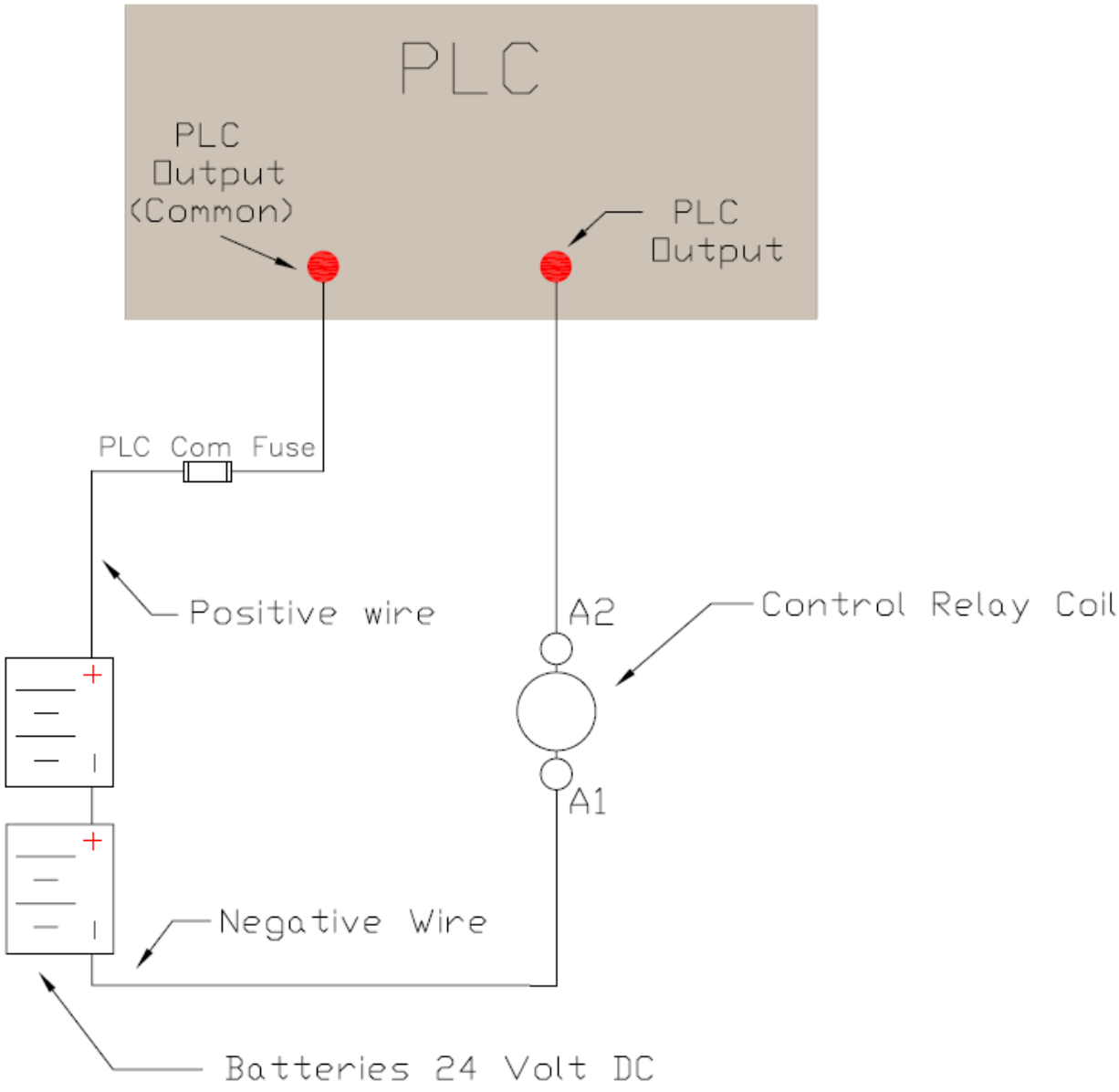
Here is a list of the **OUTPUT** numbers for the PLC along with their, wire color, and designations.

OUTPUT	DESCRIPTION	WIRE COLOR
100CH 00	OIL PUMP MOTOR	RED
100CH 01	OPEN	
100CH 02	FORWARD MAIN DRIVE	GREEN / ORANGE
100CH 03	REVERSE MAIN DRIVE	YELLOW / VIOLET
100CH 04	MOVING HEAD MOTOR RUN	BLACK
100CH 05	MOVING HEAD MOTOR DIRECTION	WHITE
100CH 06	BUFFER MOTOR	YELLOW / BLUE
100CH 07	OIL PROGRAM CONTROL VALVE	ORANGE
101CH 00 *	ZTR ENABLE RELAY	WHITE / GREEN
101CH 01 *	ZTR DIRECTIONAL RELAY	BLACK / PINK
101CH 02	BRUSH LIFT MOTOR	WHITE / BLACK
101CH 03	SQUEEGEE MOTOR	BLUE / WHITE
101CH 04	DUSTER UNWIND	GREEN / BLUE
101CH 05	DUSTER WIND-UP	GREEN / RED
101CH 06	OPEN	
101CH 07	VACUUM MOTOR	BLUE / BLACK

Note: Inputs with an * next to them are only used in the Walker.

Testing an Output

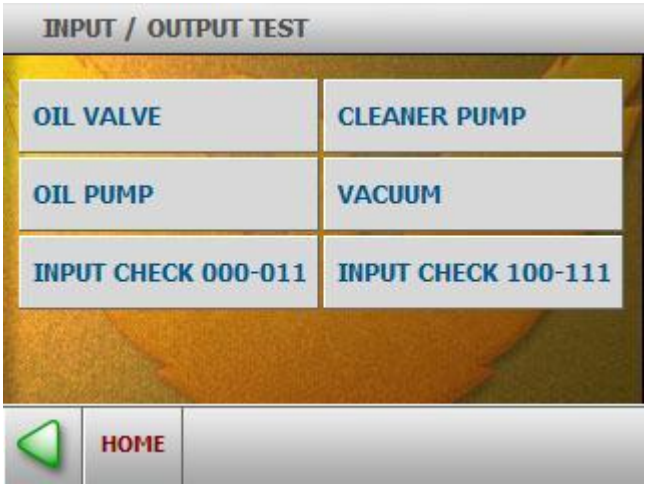
Here is an example how the PLC output is wired to the isolation Control Relay. When the PLC output turns on the control relay turns on. The control relay supplies power to the motor or device to protect the PLC from heavy amp load or short circuit conditions. **Only one fuse is used to protect ALL of the PLC outputs commons, so when it fails ALL outputs fail.** The PLC has 6 Output Commons which, for our purposes, are all connected together by jumpers to act as one.

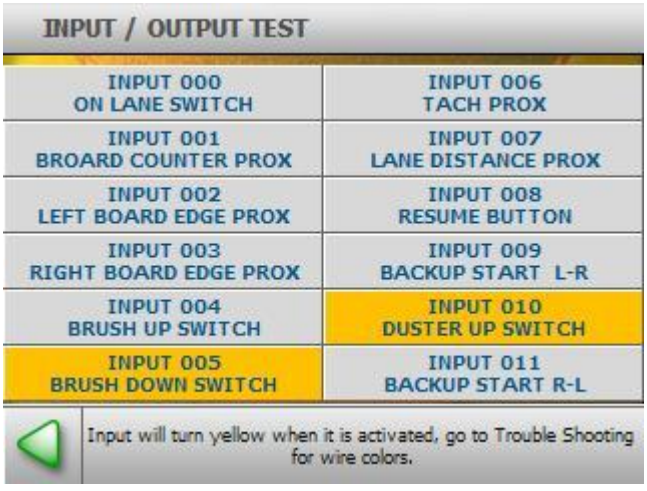


INPUT / OUTPUT TEST

Go to the main menu and select INPUT/OUTPUT TEST and the screen will change to the first test screen. Press on an output selection to test, below is an example of the BRUSH LIFT test. The Brush Lift test also shows the inputs that control the motor to stop in the proper position. When testing the motor you are also testing and watching for correct switch operation at the same time.

To check inputs, press on one of the two input screens to view. The inputs that are on will change color to yellow. To test an input you will need to physically operate the switch by pressing on it or pass metal by a proximity sensor.





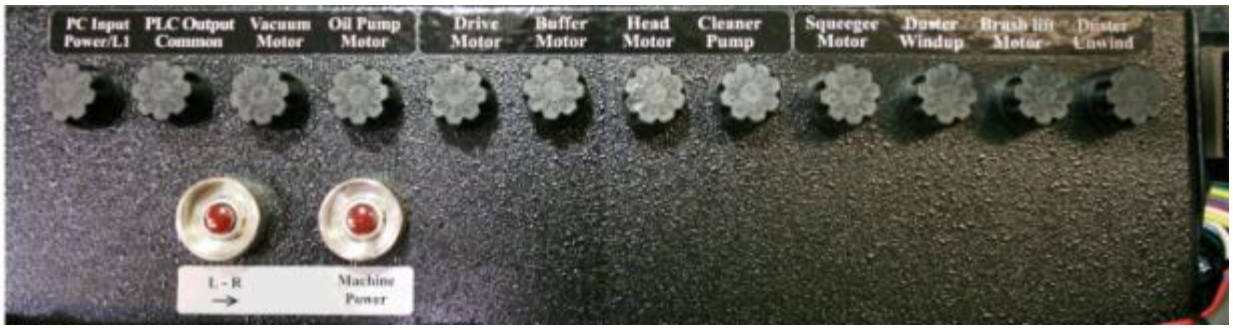
Fuses

Mounted on the control plate are several protective devices for your Kustodian.

- PLC Power Fuse - 0.5A (Input Power / L1)
- PLC Common Fuse - 0.5A (Output Common)
- Vacuum Motor Fuse - 20A
- Conditioner Pump Fuse - 2.25A (Oil Pump Motor)

- Squeegee Motor Fuse - 3.2A
- Duster Wind-up Motor Fuse - 3.2A
- Brush Lift Motor Fuse - 3.2A
- Duster Unwind Motor Fuse - 3.2A

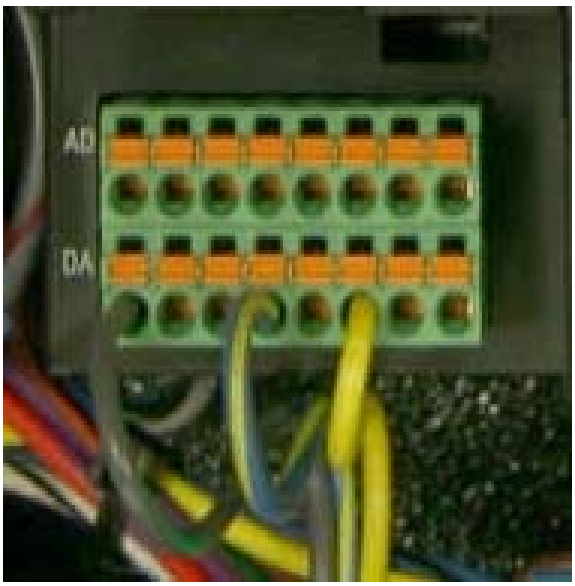
- Drive Motor - 7.5A
- Buffer Motor Fuse - 10A
- Head Motor Fuse - 2.25A
- Cleaner Pump Fuse - 3.2A
- Touchscreen Fuse - 0.5A
- Battery Fuse - 40A
- Battery Pack - 40A



Do not over-amp fuses. If you can't find the direct replacement you will cause damage to the smaller motors. In addition to fuses and breakers, the PLC program also protects the machine by "timing out" after operating motors for a pre-determined amount of time.

Analog Variable Speed Control

The variable speeds for the Drive Motor(s) and Cleaner Pump in the machine are controlled by an analog output. The signal comes from the green junction on the PLC then goes to the Motor Speed Control Boards located on the left side of the electrical compartment.

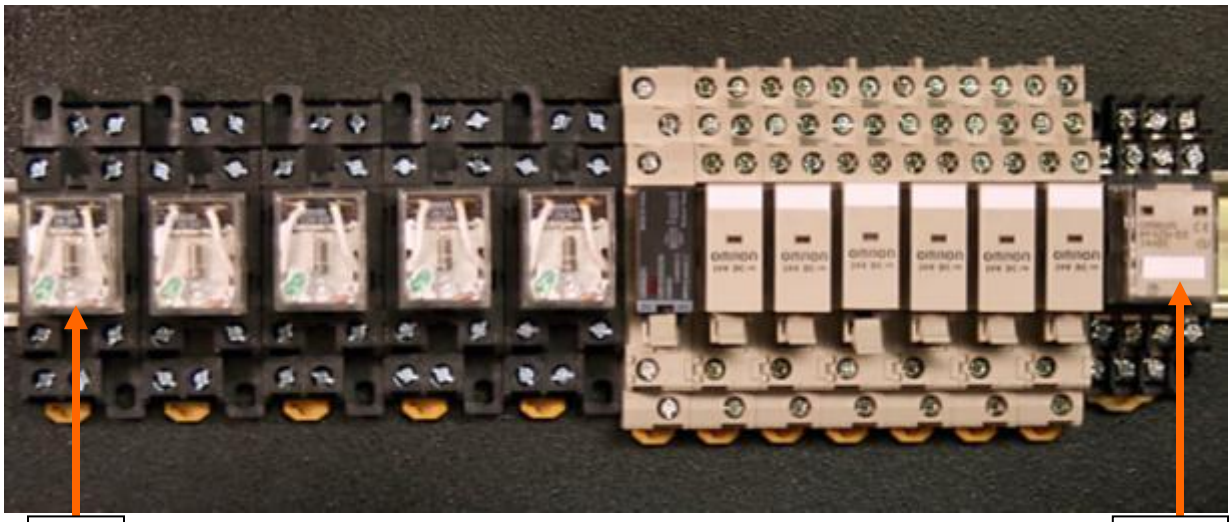


The analog module works by taking values from the PLC and converting them to voltage. The higher the voltage, the higher the speed. The analog outputs generate voltage from 0 to a maximum of 5 VDC.

The Gray / Green wire on the bottom left is the drive motor output and the Blue / Yellow wire (fourth from the left) is the cleaner pump motor. As with all DC circuits, the Yellow is common.

Control Relays on the Walker

All of the components on the Kustodian Walker are isolated from the PLC. When we say isolated, it means there is a control relay between the PLC and the motor or device. This is to protect the PLC against power spikes from motor amp loads that can cause damage to the smaller internal PLC relays.



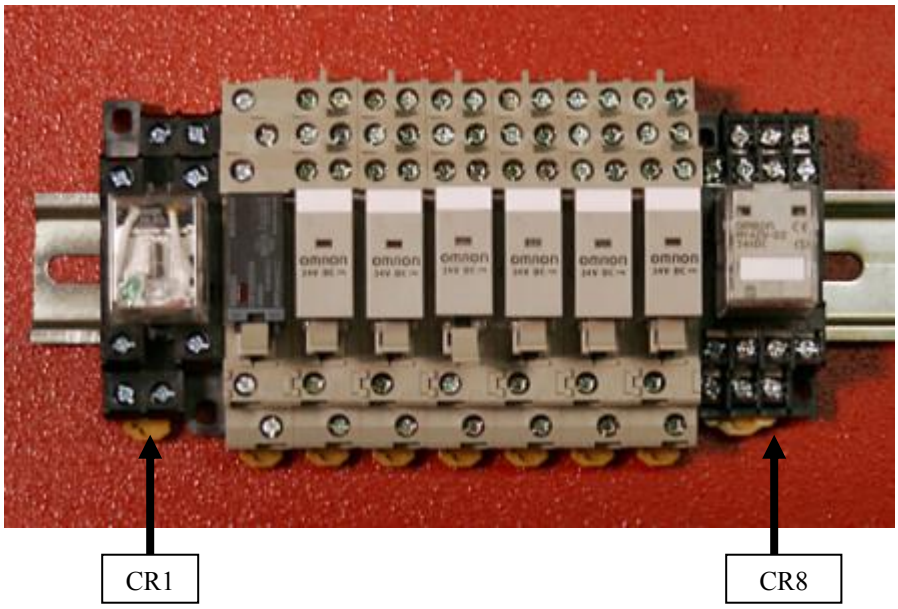
The machine is equipped with 14 replaceable control relays that operate ALL the motors of the machine. The Vacuum Relay (CR14) is located above the PLC.

Control Relays 1 through **5** (Part # 158-1462) are two-pole relays.
Control Relay 6 (Part # 158-1460) is a solid state relay.
Control Relays 7 through **12** (Part # 158-1458) are small two-pole relays.
Control Relay 13 (Part # 158-1463) is a 4 pole relay.
Control Relay 14 (Part # 158-1465) is a 25 amp relay.

- **CONTROL RELAY 1:** Directional Relay
- **CONTROL RELAY 2:** ZTR Enabling Relay
- **CONTROL RELAY 3:** 10-Pin Steering Relay (Whisker)
- **CONTROL RELAY 4:** 7-Pin Steering Relay (Whisker)
- **CONTROL RELAY 5:** Buffer Motor
- **CONTROL RELAY 6:** Oil Valve Relay
- **CONTROL RELAY 7:** Brush Lift Motor
- **CONTROL RELAY 8:** Squeegee Lift Motor
- **CONTROL RELAY 9:** Duster Unwind Motor
- **CONTROL RELAY 10:** Duster Wind-up Motor
- **CONTROL RELAY 11:** Whisker Control Relay
- **CONTROL RELAY 12:** Forward Operation Drive Motor
- **CONTROL RELAY 13:** Reverse Operation of the Drive Motor
- **CONTROL RELAY 14:** Vacuum Relay

Control Relays on the Ion

All of the components on the Kustodian Ion are isolated from the PLC. When we say isolated, it means there is a control relay between the PLC and the motor or device. This is to protect the PLC against power spikes from motor amp loads that cause damage to the smaller internal PLC relays.



The machine is equipped with 9 replaceable control relays that operate ALL the motors of the machine. The Vacuum Relay (CR-9) is located above the PLC.

Control Relay 1 (Part # 158-1462) is a two-pole relay.
Control Relay 2 (Part # 158-1460) is a solid state relay.
Control Relays 3 through **7** (Part # 158-1458) are small two-pole relays.
Control Relay 8 (Part # 158-1463) is a 4 pole relay.
Control Relay 9 (Part # 158-1465) is a 25 amp relay.

- **CONTROL RELAY 1:** Buffer Motor
- **CONTROL RELAY 2:** Oil Valve Relay
- **CONTROL RELAY 3:** Brush Lift Motor
- **CONTROL RELAY 4:** Squeegee Lift Motor
- **CONTROL RELAY 5:** Duster Unwind Motor
- **CONTROL RELAY 6:** Duster Wind-up Motor
- **CONTROL RELAY 7:** Forward Operation Drive Motor
- **CONTROL RELAY 8:** Reverse Operation of the Drive Motor
- **CONTROL RELAY 9:** Vacuum Relay

Troubleshooting

For All Wiring Diagrams or 24/7 Tech Support, please call Kegel Tech Support at +1 (863)734 0200 or Toll Free in the US at (800) 280 2695.

“Take care of your lane machine and it will take care of you”