

**OPERATORS MANUAL**  
**FOR KUSTODIAN ION LANE MACHINES**  
**EDITION 4:12**

KEGEL LLC.  
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863-734-0200 / 800-280-2695



# WARRANTY

KEGEL warrants that lane machines and replacement parts will be manufactured free from defects in material and workmanship under normal use and service. Except as stated below, KEGEL shall repair or replace, at its factory or authorized service station, any lane machine or replacement part (“Warranty Item”) which, within **ONE YEAR** after the date of installation by an authorized KEGEL Distributor, has been determined to be defective upon examination by KEGEL. In no event shall the Warranty coverage be more than twenty-four (24) months from the date of shipment from KEGEL’s factory.

In the contiguous United States, the bowling center or end-user will be responsible for requesting Warranty Items from KEGEL and must return Warranty Items directly to KEGEL, following the required procedures. KEGEL will pay reasonable freight charges to deliver and receive Warranty Items from the bowling center. KEGEL will not be responsible for any “expedited” shipping charges. Customer will be invoiced for Warranty Items that are not promptly returned per the required procedures.

Outside the contiguous United States, the bowling center or end-user will be responsible for requesting Warranty Items from the DISTRIBUTOR and must return Warranty Items directly to the DISTRIBUTOR, following the required procedures. KEGEL will compensate the DISTRIBUTOR for reasonable freight charges to deliver and receive the Warranty Items from bowling center and to return them to KEGEL. Under no circumstances will KEGEL be responsible for any “expedited” shipping charges or taxes and duties.

This Warranty shall not apply to any lane machine repaired or altered outside of KEGEL’s factory, or authorized service station, in any way, or where replacement parts have been installed in the lane machine other than KEGEL approved replacement parts, or where the lane machine has been subjected to misuse, negligence, accident, or abuse.

KEGEL reserves the right to inspect and make the final decision on any claim under Warranty which it deems questionable. KEGEL’s liability under the Warranty expressed above is limited to repair or replacement; KEGEL shall have no liability for incidental or consequential damages or for costs of installing Warranty Items.

KEGEL provides a limited, pro-rated Warranty on batteries that are used in the lane machine based on the schedule shown on this page.

| <b><u>Battery Type</u></b> | <b><u>Part #</u></b> | <b><u>Description</u></b>                 | <b><u>TimeLimit</u></b> | <b><u>Warranty</u></b> |
|----------------------------|----------------------|---|-------------------------|------------------------|
| Odyssey 925                | 158-8651             | PAIR OF BALANCED ODYSSEY BATTERY (PC925)  | 90 Days                 | 100%                   |
| Odyssey 925                | 158-8651             | PAIR OF BALANCED ODYSSEY BATTERY (PC925)  | up to 12 Months         | Pro-rated by Day+S&H   |
| Odyssey 1200               | 158-8652             | PAIR OF BALANCED ODYSSEY BATTERY (PC1200) | 90 Days                 | 100%                   |
| Odyssey 1200               | 158-8652             | PAIR OF BALANCED ODYSSEY BATTERY (PC1200) | up to 12 Months         | Pro-rated by Day + S&H |
| Odyssey Battery Pack       | 158-8650             | PAIR OF BALANCED ODYSSEY BATTERY (PC680)  | 90 Days                 | 100%                   |
| Odyssey Battery Pack       | 158-8650             | PAIR OF BALANCED ODYSSEY BATTERY (PC680)  | up to 12 Months         | Pro-rated by Day + S&H |

This Warranty applies to batteries installed as original equipment and replacement batteries that are purchased at regular retail price from KEGEL or their authorized DISTRIBUTOR. Using any other batteries in the lane machine voids the Warranty.

**KEGEL DISCLAIMS ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

## KEGEL KOMFORT BONUS WARRANTY PROGRAM

The KEGEL Komfort Bonus Warranty program provides Sanction Technology™ customers additional protection on costly components after the initial standard Warranty expires. By accepting the KEGEL Komfort Program, the owner will receive an additional two (2) year Warranty by committing to use KEGEL Chemical Products exclusively in their lane machine. This includes Conditioner, Cleaner and Kloth for the first three (3) years of operating the machine. To accept the program, simply check the box on the front of the Warranty card.

In the event that a selected part should fail, a verification process will be initiated with the cooperation of the assigned Distributor to confirm that the requirements of the program have been met. If sufficient documentation cannot be provided, the customer shall be responsible for the cost of the replaced components.

This Warranty program will follow the same guideline as our standard Warranty that accompanies the purchase of a KEGEL lane machine and is exclusive for Sanction Technology™ lane machines.

KEGEL has developed two parts list that are customized to Sanction Technology™ machines according to their operating voltage.

| <i><b>PART<br/>DESCRIPTION</b></i>         | <i><b>DC POWER</b></i>    | <i><b>AC POWER</b></i>               |
|--|---------------------------|--------------------------------------|
|  | <i><b>PART NUMBER</b></i> | <i><b>PART NUMBR 115V / 230V</b></i> |
| OIL CONTROL VALVE ASSEMBLY                 | 154-8298                  | 154-8298                             |
| OIL PUMP (FMI)                             | 154-1214                  | 154-1214                             |
| PROXIMITY SENSOR                           | 154-1220                  | 154-1220                             |
| PLC CPM2A                                  | 158-1423                  | 154-1801                             |
| PLC CPU1H (SPORT MODEL ONLY)               | 158-1610P                 | N/A                                  |
| TOUCHSCREEN KEYPAD (SPORT MODEL ONLY)      | 158-8671                  | N/A                                  |
| KEYPAD ASSEMBLY                            | 154-1802                  | 154-1802                             |
| BRUSH / SQUEEGEE LIFT MOTOR ASSEMBLY       | 158-8402                  | 153-8207 / 153-8907H                 |
| DUSTER MOTOR ASSEMBLY                      | 158-8403                  | 153-8403 / 153-8803H                 |
| CLEANER MOTOR ASSEMBLY                     | 158-8404                  | 158-8404                             |
| BUFFER MOTOR ASSEMBLY                      | 158-8414                  | 154-8616A / 154-8616E                |
| OIL PUMP MOTOR ASSEMBLY                    | 158-8401                  | 154-8604 / 154-8604E                 |
| HEAD DRIVE MOTOR ASSEMBLY                  | 158-8405                  | 154-8232 / 154-8632                  |
| DRIVE MOTOR ASSEMBLY (KPLUS)               | N/A                       | 154-8865                             |
| DRIVE MOTOR ASSEMBLY (ION MODEL B)         | 158-8406                  | N/A                                  |
| DRIVE MOTOR ASSEMBLY (WALKER/ION SPORT ED) | 158-8602                  | N/A                                  |
| STEPPER MOTOR (OIL / HEAD DRIVE)           | 158-8632                  | N/A                                  |
| SPEED CONTROL BOARD ONLY (DRIVE)           | N/A                       | 153-1012 / 153-1812                  |
| SPEED CONTROL BOARD ASSEMBLY (CLEANER)     | 158-8415                  | 158-8848                             |
| SPEED CONTROL BOARD ASSEMBLY (DRIVE)       | 158-8412                  | N/A                                  |
| SPEED CONTROL DRIVE (OIL / HEAD DRIVE)     | 158-1605                  | N/A                                  |



# **MODEL B**

## **Lane Machine Manual**

**REV 4:12**

### **Machine Specifications**

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

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

### **Dimensions**

Width - 55-1/4" (140.34 cm)  
Height - 14-1/2" (36.83 cm)  
Length - 40-3/4" (103.51 cm)  
Regular Weight - 359 pounds (162.8 kg)

**Manual Part Number: 158-5400**

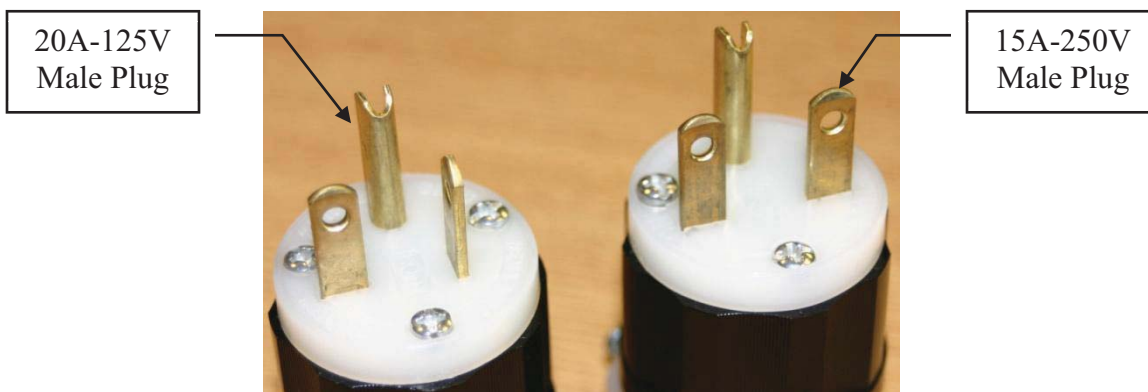
*Fifth Edition*

# Safety First

This Class I Single Phase lane cleaning/conditioning machine shall be grounded while in use with the cord to protect the operator from electric shock. The machine is provided with a three-conductor cord and a three-contact grounding type attachment plug to fit the proper grounding type receptacle.

The GREEN/YELLOW conductor in the cord is the grounding wire. Never connect this wire to any other terminal than the grounding pin of the attachment plug. If the supply cord is damaged, it must be replaced by a special cord or assembly available from the manufacturer or its service agent.

Machines rated at 115 Volts A.C. are for use on a nominal 120-volt circuit and have a 20A grounding plug (shown on left). Make sure that the machine is connected to an outlet having the same configuration as the plug.



Machines rated at 220-230 Volts A.C. are for use on a nominal 240-volt circuit. The 15A grounding plug is shown on the right. A “Schuko” type adapter for Europe may be provided for this plug.

**Warning of Potential Injury:  
Moving Parts – To Reduce The Risk Of Injury, Unplug Before Servicing!**

This  
prod  
uct

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

# Safety First

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.

**It is a HEAVY piece of equipment, and care should be taken when lifting it into the transport position. Use the proper technique to lift 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.**

**DO NOT** operate the machine while standing up in the transport position. There is a **POTENTIAL FOR INJURY** due to moving parts. Be sure to **DISCONNECT** the electrical power source before servicing the machine. Refer all servicing to qualified personnel.

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.

***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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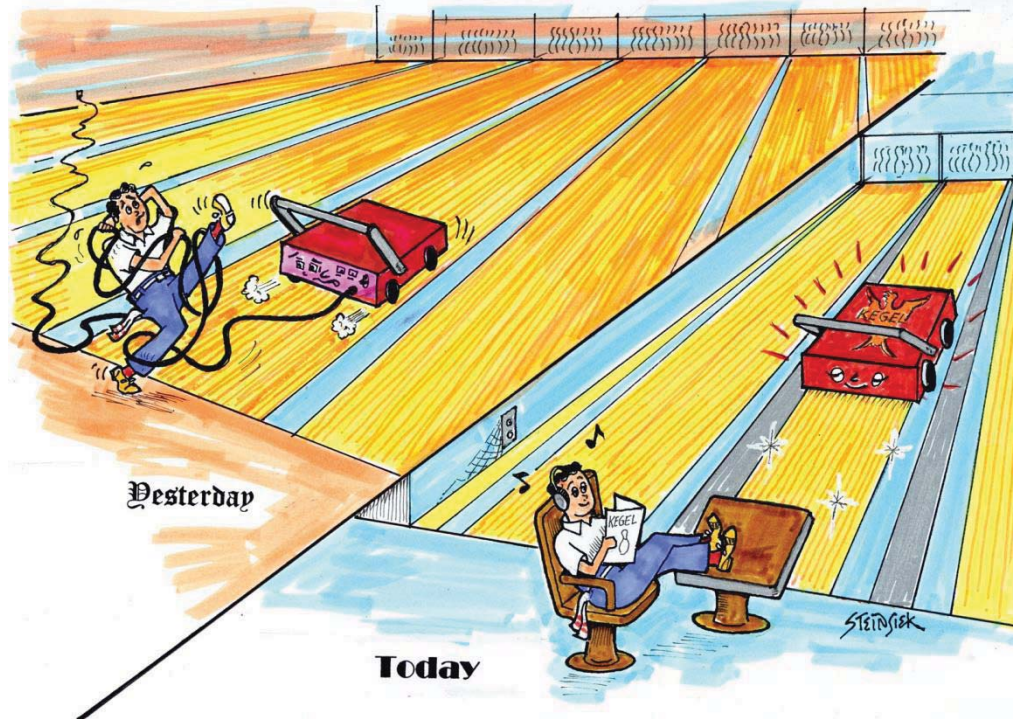
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# PREFACE



**T**he KEGEL Kustodian ION Lane Cleaning and Conditioning Machine represents advanced technology in automated lane care. Clean and consistent bowling conditions are quickly accessed from an on-board keypad linked to an industrial Programmable Logic Controller (PLC).

- The Kustodian ION is a battery operated lane maintenance machine like no other. Cordless operation 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 & UNDERSTAND THIS OPERATING MANUAL BEFORE USING THE MACHINE.  
WHEN ALL ELSE FAILS...READ THE MANUAL AGAIN  
OR WATCH TRAINING VIDEOS FOUND IN KOSI.

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## **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 ION. 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](mailto:lmc@kegel.net).

## **Disclaimer**

The identification of individuals, companies and products in this manual is provided for technical informational purposes only and does not constitute endorsement by KEGEL of any business entity, service or products. Product brand names mentioned in this manual are trademarks or registered trademarks of their respective holders. KEGEL disclaims any and all rights in those marks.

## **Trademark(s)**

KEGEL, KEGEL Kustodian ION, Sanction Technology, Offense-HV and Defense-S are registered trademarks of KEGEL.

## **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:**

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1951 Longleaf Blvd.  
Lake Wales, FL 33859  
USA

[www.kegel.net](http://www.kegel.net)  
(800) 280-2695 (Toll Free in the U.S.)  
(863) 734-0200

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## 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, and the Kustodian Ion.

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 Kustodian ION Lane Machine and inspect the machine 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 ION Lane Machine** - 17-5400 (115VAC) | 17-5450 (230VAC)
- (2) Funnels - 158-8252 & 153-0052A (Small funnel is in Accessory Kit)
- Accessory Kit
- Operators Manual - 158-5400
- KOSI Software - 154-8771
- Extra Roll of EZ Core Cloth - 153-0047EZ
- Long Power Cord (Kustodian ION)** - 154-8829 (115VAC) | 154-8830 (230VAC)
- Short Power Cord (Battery Charger)** - 158-8425 (115VAC) | 158-8425E (230VAC)
- Chemical Starter Kit (on top of crate) - 154-8866

**Date Unpacked:** \_\_\_\_\_

**Unpacked by:** \_\_\_\_\_

**Machine Serial Number:** ION-\_\_\_\_\_

### Register your Lane Machine

It is important to register your Machine with KEGEL in order to receive valuable updates, service bulletins and your Lane Machine's Limited Warranty.

**IMPORTANT: Please take a minute and register at: [www.kegel.net](http://www.kegel.net)**

## Daily Setup and Operation

### Moving / Transporting your Lane Machine

You would think that transporting and moving your machine in and out of the lanes 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 easy insertion and removal of 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 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.***

## Machine Sequence of Events - “How it Works”

The machine should be on the approach in down or operating position with the main start screen displayed on the keypad. The machine 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 machine, how the errors work, and what happens as the machine travels down your lanes.

1. 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 (**D5**) 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 did not lower error (**SA**) displayed. The oil pump will turn on.
2. 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.
3. Press the **Start Button** a second time and the moving heads will start and move from one side to the other (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.
4. 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. After the machine has traveled about 2 feet the vacuum will turn on.
5. Additionally, the second press of the start button will start a clock to record the total amount of run time in the upper right hand corner of the display. The left-hand corner of the display will show the total time the oil valve is on.
6. 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 an **H7** error will be displayed.
7. 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 **T1** error will be displayed. The speed of the machine is also being monitored by the tachometer sensor and is displayed on the bottom left side of the screen.
8. 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.

9. 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 **B4** error displayed. If the brush up switch sticks closed when it should be open, it will give a brush down error (**B3**).
10. 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 head will park. At the same time the machine will down shift to low speed to reduce its momentum into the pin deck.
11. When the machine enters the pin deck the duster windup motor will turn on and start to windup the cloth to raise the duster. The duster up switch's normally open contacts will close to turn off the duster windup motor. If the contacts do not close there will be a duster did not wind up (**D6**) error displayed.
12. The machine will then continue the rest of its travel and come to a stop. The squeegee will then lift up and stop when the squeegee up switch's normally open contacts close. If the contacts do not close an **S9** error will be displayed.
13. The machine will then 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.
14. 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.
15. As the machine travels in reverse at high speed the LDS is counting inches traveled and is also monitoring the movement of the machine. If travel is interrupted a **T2** error will be displayed.
16. 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 **B3** error will be displayed. If the brush down switch sticks closed when it should be open it will give a brush up error (**B4**).
17. The brush will then begin buffing at the end of the pattern as the machine travels in reverse. The oil head will start back up when it reaches the first reverse load distance.
18. 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.
19. If the oil float contacts open, the machine will pause and an **FO** error will be displayed after the machine has stopped at the foul line. The oil will then need to be filled and the **F6** key will need to be pressed to reset the error.

20. If the cleaner float contacts open, the machine will pause and an **FC** error will be displayed after the machine has stopped at the foul line. The cleaner will then need to be filled and the **F6** key will need to be pressed to reset the error. Empty the recovery tank if you fill cleaner tank.
21. The machine can be resumed after all errors except the **SA** squeegee down error. The machine program will need to be zeroed by pressing **F6** and then re-starting the machine.

***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), the E-Stop is pressed, or there is a loose power connection.*

### **Basic Steps to Operate Your Kustodian ION**

1. 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.
2. Locate the **E-Stop** and rotate the red button to reset and turn the machine on. When the machine is powered ON the menu screen on the keypad will illuminate. The machine is now ready to run.

**To operate this machine you need to understand the Machine Sequence of Events. Read previous 2 pages again if you do not fully understand “How it Works”!**

3. Position the machine square to the foul line and then press the **Start Button** as you push machine into the lane. The duster and squeegee will lower while you are moving the machine into the lane. Once the machine is seated properly on the lane you can now press the **Start Button** for a second time to finish starting the machine. The machine will now begin operating.
4. **Burning the first pair** - It is necessary to run 2 complete lanes each time you put out a pattern. This is especially true if someone just finished cleaning the oiling system. This step of running warm-up lanes helps to refresh the buffer brush and stabilize the conditioning system. After you have “burned” a pair, then you can start again and condition all of your lanes.

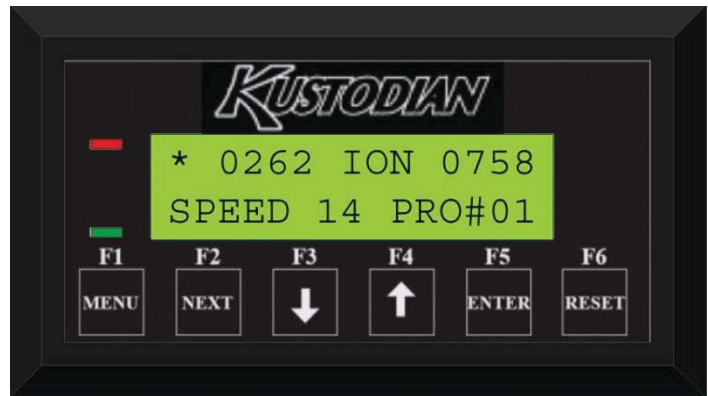
***NOTE:** These two warm-up lanes will allow the Transfer Brush and Buffing Brush to be replenished with oil and return to a constant refreshed state. This will help prevent the first lane pair from being different (drier) than the rest. This is critical for league and tournament play conditions. KEGEL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

**Is it OK not to burn or run any warm-up lanes? Don't we all know the end pairs of any center always get a bad rap, so what's the difference? Everyone has heard the phrase “I don't like to bowl next to the wall” (even if the wall is 8 feet away). The end pairs of any bowling center do tend to be dirtier since there is usually a walkway next to them.**

## Keypad and Menu

### Keypad Button Descriptions

Located under the lid to the right of the conditioning compartment is the computer (PLC) keypad. This keypad is used to enter all programming information. The keypad consists of 6 input keys, two indicator lights, and a two-line Liquid Crystal Display (LCD) where the menu items and prompts appear.



**INDICATOR LIGHTS:** The red indicator light comes on any time you press any of the 6 keys. The green indicator light comes on when the **NEXT** key is enabled in the Change Program area. The green light will also come on after the Managers Password has been entered correctly (to access the Change Program menu).

**MENU / F1:** Pressing this key will display and advance the available main menus for the operator. It will also act as a zero button when the machine is operating. When the key is pressed the machine will stop, the program will zero, and the menu will advance to **MANUAL REVERSE**.

**NEXT / F2:** Use this key to advance within a main menu from one menu prompt to the next. It is also used to advance the output number in the Test Output menu.

**DOWN ARROW / F3:** This button decreases number values in certain menu prompts. Holding the key down will make the numbers decrease faster. This key is also used to change programs when the program override function is enabled.

***NOTE:** The Down Arrow will not work in screens that display a menu prompt requesting you to choose a program number.*

**UP ARROW / F4:** This button increases number values in certain menu prompts. Holding the key down will make the numbers increase faster. The **Up Arrow** will loop around to 01 when the upper limit is reached. The **Up Arrow** is also a backup start button.

**ENTER / F5:** This key is used in the Change Program menu for entering data in the oil load screens. The key is also used to enable Program Override and turn outputs **ON** and **OFF** in the Test Output menu.

**RESET / F6:** This key has four functions.

- Zeros the program like the Menu key, but it does not advance to the next menu
- Used to start the Oil Volume Test
- Resets the Duster Cloth counters
- Used to return back to the Start Screen from any menu prompt (except for the three situations mentioned above).

***NOTE:** The contrast on the display can be controlled with the knob located on the side of the keypad.*

## Operator Menu Selections

This is how the menus would look if you laid them out in a complete view. Each of these menus will be explained in detail in another Chapter. The copyright screen is where the program version is located.

| * 0000 ION 0000<br>SPEED 00 PRO# 01 | * MANUAL REVERSE<br>PRESS BUTTON | CHANGE PROGRAM<br>CHOOSE -> 01       | SYSTEM CONTROL<br>CLEANING         | SYSTEM CONTROL<br>DUSTER        |
|-------------------------------------|----------------------------------|--------------------------------------|------------------------------------|---------------------------------|
|                                     |                                  | START BRUSH<br>IN INCHES -> 00       | LAST SQUIRT DIST<br>IN FEET -> 57  | * UNWIND TIME<br>F6 TO RESET 06 |
|                                     |                                  | OIL PATTERN DIST<br>IN FEET -> 40    | LIFT DUSTER<br>IN INCHES -> 20     |                                 |
|                                     |                                  | DROP BUFFER IN<br>REV IN FEET ->40   | FORWARD DISTANCE<br>SUBTRACT -> 32 |                                 |
|                                     |                                  | 01F 2L- 2R X 02<br>00->02 FT IPS=18  | REVERSE DISTANCE<br>SUBTRACT -> 32 |                                 |
|                                     |                                  | 02F 8L- 8R X 01<br>02->05 FT IPS=18  |                                    |                                 |
|                                     |                                  | 03F 10L-10R X 03<br>05->12 FT IPS=18 |                                    |                                 |
|                                     |                                  | 04F 13L-13R X 02<br>12->17 FT IPS=18 |                                    |                                 |
|                                     |                                  | 05F 2L- 2R X 00<br>17->24 FT IPS=18  |                                    |                                 |
|                                     |                                  | 06F 2L- 2R X 00<br>24->33 FT IPS=22  |                                    |                                 |
|                                     |                                  | 07F 2L- 2R X 00<br>33->40 FT IPS=30  |                                    |                                 |
|                                     |                                  | 01R 2L- 2R X 00<br>40->35 FT IPS=30  |                                    |                                 |
|                                     |                                  | 02R 15L-15R X 01<br>35->31 FT IPS=22 |                                    |                                 |
|                                     |                                  | 03R 14L-14R X 02<br>31->26 FT IPS=18 |                                    |                                 |
|                                     |                                  | 04R 13L-13R X 04<br>26->16 FT IPS=18 |                                    |                                 |
|                                     |                                  | 05R 11L-11R X 04<br>16->06 FT IPS=18 |                                    |                                 |
|                                     |                                  | 06R 10L-10R X 02<br>06->03 FT IPS=10 |                                    |                                 |
|                                     |                                  | 07R 2L- 2R X 00<br>03->00 FT IPS=10  |                                    |                                 |
|                                     |                                  | NEXT TO REVIEW<br>* MENU TO EXIT *   |                                    |                                 |

**Operator Menu Selections (Continued)**

| 7 DAY PROGRAM<br>PLANNER      | TEST OUTPUT #01<br>PRESS F2-F5 OFF | OIL AND CLEANER<br>VOLUME TEST  | * (C) COPYRIGHT<br>KEGEL 2006 1.9 |
|-------------------------------|------------------------------------|---------------------------------|-----------------------------------|
| * MONDAY<br>***** AM--> 01    | TEST OUTPUT #02<br>PRESS F2-F5 000 | * OIL VOLUME<br>PRO#01 PRESS F6 |                                   |
| * MONDAY<br>***** PM--> 01    | TEST OUTPUT #03<br>PRESS F2-F5 000 |                                 |                                   |
| * TUESDAY<br>***** AM--> 01   | TEST OUTPUT #04<br>PRESS F2-F5 000 |                                 |                                   |
| * TUESDAY<br>***** PM--> 01   | TEST OUTPUT #05<br>PRESS F2-F5 000 |                                 |                                   |
| * WEDNESDAY<br>***** AM--> 01 | TEST OUTPUT #06<br>PRESS F2-F5 000 |                                 |                                   |
| * WEDNESDAY<br>***** PM--> 01 | TEST OUTPUT #07<br>PRESS F2-F5 000 |                                 |                                   |
| * THURSDAY<br>***** AM--> 01  | TEST OUTPUT #08<br>PRESS F2-F5 OFF |                                 |                                   |
| * THURSDAY<br>***** PM--> 01  | TEST OUTPUT #09<br>PRESS F2-F5 OFF |                                 |                                   |
| * FRIDAY<br>***** AM--> 01    | TEST OUTPUT #10<br>PRESS F2-F5 OFF |                                 |                                   |
| * FRIDAY<br>***** PM--> 01    | TEST OUTPUT #11<br>PRESS F2-F5 OFF |                                 |                                   |
| * SATURDAY<br>***** AM--> 01  | TEST OUTPUT #12<br>PRESS F2-F5 OFF |                                 |                                   |
| * SATURDAY<br>***** PM--> 01  | TEST OUTPUT #13<br>PRESS F2-F5 OFF |                                 |                                   |
| * SUNDAY<br>***** AM--> 01    | TEST OUTPUT #14<br>PRESS F2-F5 OFF |                                 |                                   |
| * SUNDAY<br>***** PM--> 01    | TEST OUTPUT #15<br>PRESS F2-F5 OFF |                                 |                                   |
|                               | TEST OUTPUT #16<br>PRESS F2-F5 OFF |                                 |                                   |
|                               | TEST OUTPUT #17<br>PRESS F2-F5 OFF |                                 |                                   |

**NOTE:** The values shown in these tables are sample screens and may not reflect the actual default menu settings for the machine.

**For Manual Reverse:** Press and hold the **Start Button** to return machine to the foul line.

## Machine Error Messages

The machine is equipped with Error Message Codes that are displayed in case the machine malfunctions. These message codes indicate the type of operational error that has occurred. A detailed description of how the errors occur can be located in the troubleshooting area of the appropriate section.

| <u>ERROR CODE</u> | <u>DESCRIPTION</u>    |
|-------------------|-----------------------|
| T1                | FORWARD TRAVEL ERROR  |
| T2                | REVERSE TRAVEL ERROR  |
| B3                | BRUSH DOWN ERROR      |
| B4                | BRUSH UP ERROR        |
| D5                | DUSTER UNWIND ERROR   |
| D6                | DUSTER WIND-UP ERROR  |
| H7                | OIL HEAD TRAVEL ERROR |
| S9                | SQUEEGEE UP ERROR     |
| SA                | SQUEEGEE DOWN ERROR   |
| FO                | OIL EMPTY ERROR       |
| FC                | CLEANER EMPTY ERROR   |

This is how an error messages will appear:

**ERROR MESSAGE**  
**\*\*CODE T1\*\***

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 power comes back on.

**LOW BATTERY**  
**OR E-STOP PRESSED**

*NOTE: THIS MAY ALSO APPEAR IF THE FUSEABLE LINK HAS BLOWN.*



## **Maintenance, Recharging & Storage**

Included inside the crate with the lane machine you will find a tube containing a Lane Maintenance Schedule that informs you of all the tasks needed to keep your lane machine operating in top condition. Follow these maintenance intervals and your lane machine shall give you the consistency needed to make your bowlers happy!

### **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**

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

## **Weekly or Monthly Cleaning**

1. Use compressed air to remove dust from those hard to reach areas.
2. Inspect recovery tank filter.
3. Clean lint from Transfer Brush and wipe between both brushes.
4. Whenever the duster cloth is changed clean entire cleaning compartment.
5. Wipe off casters; they should not grow hair.
6. Remove large black covers and clean around the motors.
7. 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.
8. 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.

## Storage

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).

***NOTE:** This is also where the machine will be charging its batteries so there should be a reliable power receptacle in this location. It would be best if the receptacle is a dedicated circuit with a power indicating light.*

## Recharging

To recharge your ION plug it into a standard wall receptacle (power source). Always put the machine on charge when not in use. The charging voltage should be monitored each day when put away 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. So here are a few 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.

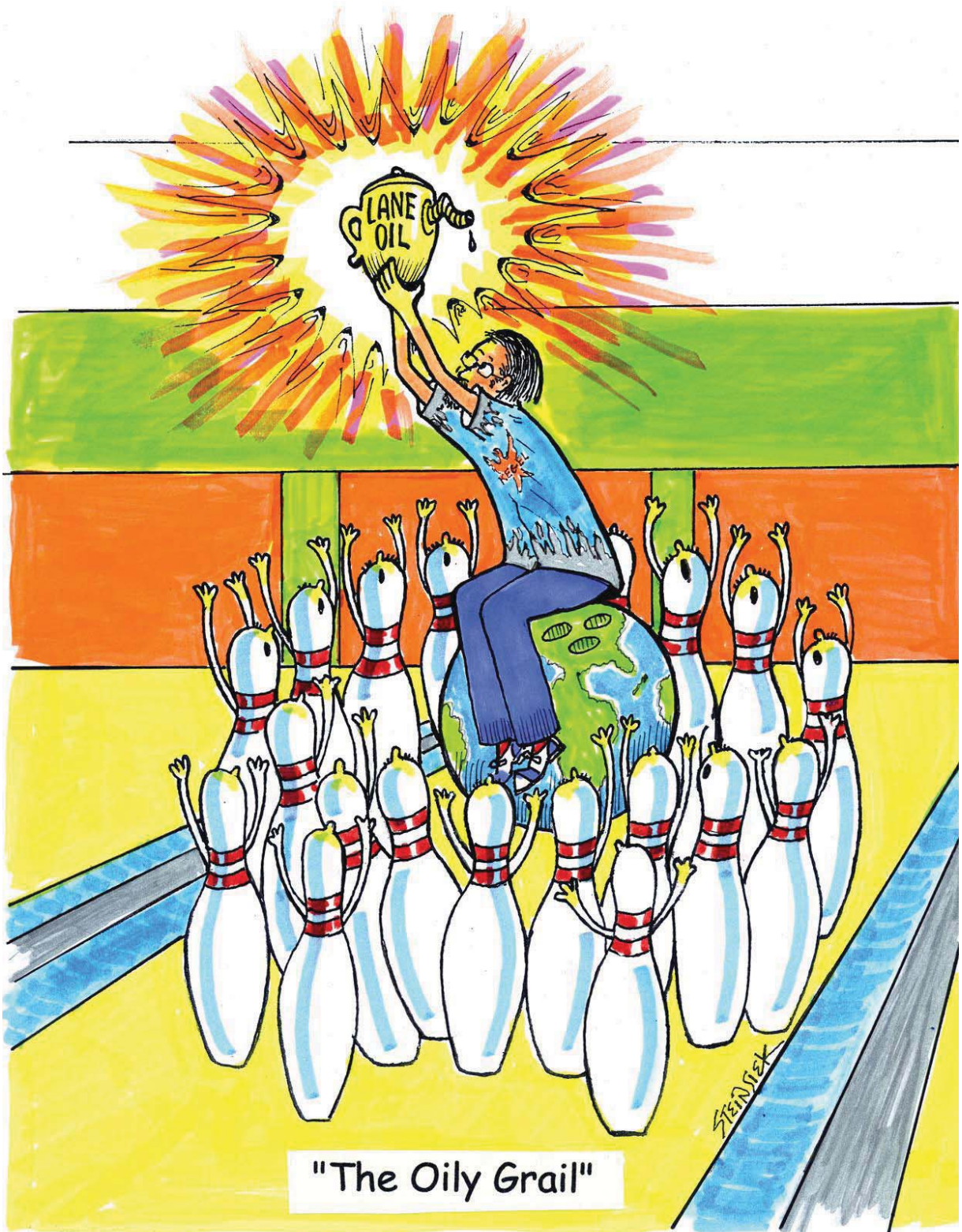
**What you do with this extra time is up to you, but one thing is certain...  
we think you will enjoy the freedom of a Kustodian ION.**

# 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.



"The Oily Grail"

# CHAPTER 2



## Conditioning Overview

### How Conditioner is measured

This machine uses proven "SANCTION TECHNOLOGY" patented by Kegel. This patented 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.

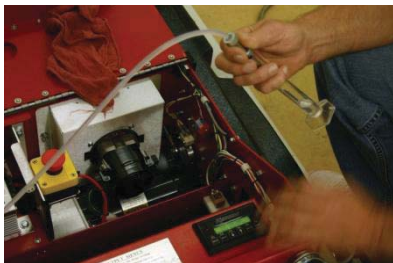
With the pump rotating at a constant RPM, the conditioner is pumped at an exact flow rate to a three-way valve known as the Oil Pattern Control Valve. The valve in its OFF state routes the conditioner back to the conditioner tank. When turned ON, the valve routes the conditioner to a line connected to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

**Anyone who pays attention to the machine's operation will fully be able to understand lane conditions.**

**We use Sanction Technology because all adjustments to the oil pattern are exact and repeatable.**

### Calibrating the Oil Pump



The following exercise teaches you to calibrate the machine which confirms the factory pump setting. The pump should be set at 50 microliters per board, unless otherwise specified by the oil pattern.

***NOTE: This test will not work if the machine is set to CLEAN ONLY.***

1. **TURN ON** the machine and go to the menu:

**OIL AND CLEANER  
VOLUME TEST**

2. Press **NEXT** to access the:

**OIL VOLUME  
PRO#1 PRESS F6**

3. Use the **UP ARROW** and advance to **Program #04**.
4. Place the conditioner tip into a clean 25 or 50 milliliter graduated cylinder and press **F6**. Make sure the toggle switch is not set to **Clean Only**.
5. The oil head will travel back and forth 8 times to simulate forward loads and again 8 times for reverse loads. The loads of conditioner (oil) 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**.
6. 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 1,000 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.*

7. After running the test, the amount in the cylinder should be **20 µl**.
8. If the amount of oil is higher or lower than 20, a pump 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.*
9. Behind the splash guard on the rear wall of the machine is the conditioner pump assembly (shown below). If an adjustment is necessary, turn the dial approximately **5** small marks.

Each small mark on the dial is 1/10 *microliter*; each large mark is a 1 *microliter* change in the output of the pump (per 1 revolution). The pump is revolving at approximately 2600 RPM. At the speed the oil head is traveling across the transfer brush, the pump actually revolves about 1.89 revolutions as it crosses one board.



*NOTE: Direction of arrow in picture decreases the pump output.*

10. 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.*

11. Repeat steps 4 through 10 to check any adjustments that were made. (If a change makes the output too low, then unscrew the pump about 1/2 of the amount it was previously adjusted.)
12. Keep repeating the test until the amount in the graduated cylinder reads **EXACTLY 20  $\mu$ l**.

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.

#### Proving the Oil Pattern

We will use some pre-programmed sample settings from **Program #01** as an example. The chart below shows the position of the loads and how many times each different load is applied.

#### PROGRAM 01

2 - 2 x 2 (Forward Loads)

8 - 8 x 1

10 - 10 x 3

13 - 13 x 2

*Zero Loads are ignored going forward and reverse.*



15 - 15 x 1 (Reverse Loads)  
14 - 14 x 2  
13 - 13 x 4  
11 - 11 x 4  
10 - 10 x 2

Each load can quickly be condensed to a total number of boards by referring to the Board Chart 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 for Program 01, the numbers become very simple.

#### PROGRAM 01

37 x 2  
25 x 1  
21 x 3  
15 x 2

11 x 1  
13 x 2  
15 x 4  
19 x 4  
21 x 2

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.

#### PROGRAM 01

37 x 2 = 74  
25 x 1 = 25  
21 x 3 = 63  
15 x 2 = 30

11 x 1 = 11  
13 x 2 = 26  
15 x 4 = 60  
19 x 4 = 76  
21 x 2 = 42

## 407 Total Boards

In our example there are 192 boards covered during Forward travel and 215 boards covered during the Reverse travel. This total number (**407**) can be multiplied by the pump setting (**50**  $\mu$ l) to determine the exact amount of oil used when conditioning with this pattern.

$$\begin{array}{r} 407 \text{ Boards} \\ \times \quad 50 \text{ microliters} \\ \hline 20,350 \text{ microliters} \end{array}$$

The total amount is 20,350 microliters. To convert this to milliliters the number has to be divided by 1000.

$$20,350/1000 = \mathbf{20.35 \text{ milliliters}}$$

This total program amount can be confirmed by running an **OIL 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.

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. To make it even easier, KOSI provides this information on **More Info** tab on the Overhead Graph and in the pattern summary reports.

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, this information 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**

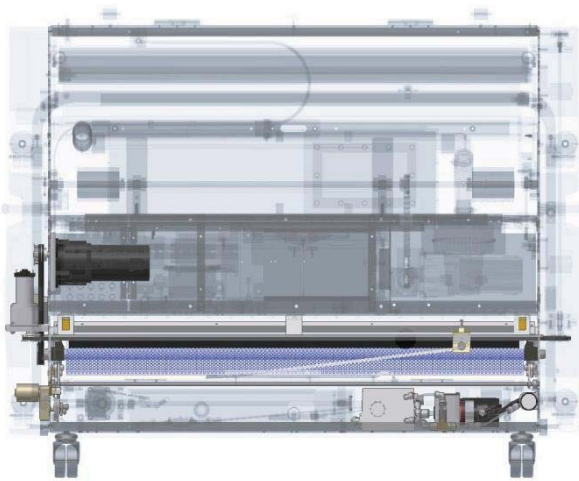
This chart shows the total number of boards the head travels across when distributing conditioner. This will make it much easier to determine the amount of oil that is used for your pattern, on paper, before it is measured by the machine through the Program Calibration Test.

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

\* Each load of oil must cross at least three boards, unless program is downloaded using KOSI.

# Conditioning System

## Theory of Operation



This machine uses proven SANCTION TECHNOLOGY<sup>®</sup> 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.**

## Conditioning Menu Adjustments

### Stock Programs

The Lane machine has 4 pre-programmed patterns that are downloaded into the PLC. The first three patterns are actual patterns to be used for conditioning and the fourth pattern is used for calibration only. It is recommended NOT to overwrite program 4 as this will be used to calibrate the machine on a daily basis. Below is the pattern name of each program and details of each can be found in the list of Navigation patterns in the following chapter.

- Program 1 - Main Street - Recreation Series pattern
- Program 2 - Middle of the Road – Challenge Series pattern
- Program 3 - Highway to Hell – Sport Series pattern
- Program 4 - Calibration Program – DO NOT OVERWRITE

### Change Program

Four (4) factory-preset cleaning and/or conditioning patterns are stored in the computer's memory. These preset programs may be altered in the **CHANGE PROGRAM SETTINGS** menu. This menu cannot be accessed without entering the Manager's **PASSWORD**. A combination of the **F3**, **F4**, and/or **F5** keys must be used to enter the password.

To see a sample graph and default settings for each of the patterns applied by the programs, please see “Oil Patterns” later in this Chapter.

To continue within the menu, enter the password using the appropriate sequence of keystrokes. A green light will indicate that the password has been entered. The following prompt will appear:

**CHANGE PROGRAM  
CHOOSE > 1**

To change the program number use the **UP ARROW**. The **DOWN ARROW** does not function in this menu screen. The program number will loop back around to **01** if the **UP ARROW** is pressed with **PROGRAM 04** showing.

To continue within this menu, press the **NEXT** key and the following prompt will appear:

**START BRUSH  
IN INCHES > 00**

This prompt will display the current distance where the machine should start and stop the buffer motor from the foul line. This delay in starting the buffer will apply less oil near the foul line. To change this distance, use the **UP** or **DOWN ARROW** to adjust.

***NOTE:** Changing the value sets the data automatically.*

When using this feature it is recommended to make adjustments in the oil pattern. An example would be moving the 2-2 loads to the second forward screen and putting smaller loads such as 19-19 in the first forward screen.

***NOTE:** There should be at least a trace of oil on the lane near the foul line to help protect the lane surface.*

To continue within this menu, press the **NEXT** key and the following prompt will appear:

**OIL PATTERN DIST  
IN FEET > 40**

This prompt will display the current travel distance (buff out in feet) for the program selected. In this case, the machine will travel 40 feet before returning to the foul line (in oil only). To change this distance, use the **UP** or **DOWN ARROW** and the value in the lower right corner will reflect the changes.

***NOTE:** Any changes made to this value will be accepted by the PLC without the need to press **ENTER**. Make sure you complete all the programming steps that follow when the pattern distance is changed.*

**IMPORTANT NOTE:** If the **UP** or **DOWN** arrows are pressed in this screen, then **ALL** conditioning menus for the forward loads must have the **ENTER** key pressed **4 times** before the **NEXT** key will advance you to the next load screen. A green LED light above the **MENU** key will indicate when the **NEXT** key is enabled. The program will not exit the load screens until you have advanced to the **REVIEW** or **EXIT** screen.

**DROP BUFFER IN  
REV IN FEET > 40**

This feature is used along with the *Buffer Advance Drop* feature and is where on the lane you want the brush to drop in reverse. The upper limit is the oil distance while the lower limit can be changed to zero. **DO NOT** set this number below the beginning oil reverse distance as this will cause the machine to apply oil on the transfer brush without the buffer brush being activated.

The speed of the machine in reverse will have an effect on where the buffer drops in relationship with the oil line. If the machine is moving faster it will drop further behind the line and when moving slower, in front of the line. Do not make this adjustment by changing the speed of the machine.

**NOTE:** Any changes made to this value will be accepted by the PLC without the need to press **ENTER**. Make sure you complete all the programming steps that follow when the pattern distance is changed.

If this is correct, press the **NEXT** key. The following prompt will appear:

**01F 2L – 2R X 02**  
**00>02 FT IPS=18**

**01F** is the menu number for the first load screen for forward oil. There are 15 possible load screens for forward oil. If the oil pattern distance is reached in less than 15 screens, then the remaining screens will not be shown.

The next item, **2L- 2R**, designates the load (the length of the stream of oil applied to the transfer roller) will run from the 2 board on the left to the 2 board on the right. The next item, **X 02** determines how many 2 to 2's will be applied; in this case it is 2.

On the bottom line the **00->02 FT IPS=18** says that the machine will travel from 0 feet (the foul line) to 2 feet at 18 inches per second (IPS).

When the screen is first displayed, the left load size designator **2L** will be blinking. This means it is the only one that can be changed.

By pressing the **UP ARROW** once, the 2L will increment to 3L. When the desired left side load designator is reached, press **ENTER** and the right side designator 2R will begin blinking (much like a digital watch).

**NOTE:** All loads entered into the program must begin on the left side and end on the right side, so the smallest load would cover 3 boards (19L to 19R). However, this limitation can be overcome by downloading the program from KOSI.

The blinking designator indicates the right load limit is ready to be changed. Use the **UP** or **DOWN ARROW** until you reach your desired number, then press **ENTER**.

Now **02** will begin blinking, **UP** or **DOWN ARROW** this to the number of loads you want and press **ENTER**.

Two things will now happen: 1) The **IPS** number will begin blinking, and 2) the distance it takes for that load screen will re-calculate.

For example, if you increase the load number from 2 to 3 the 00->02 FT will change to 00->05 FT. Since the 18 in IPS=18 is now blinking you now may **UP** or **DOWN ARROW** the speed. You have six different speeds to choose from. When the desired speed is reached press **ENTER**. This will be entered into memory.

***NOTE:** Speed changes should be an even flow from slower to faster, from one screen to the next. Speed changes will control the lengthwise taper of the pattern. They also allow the operator to add-in more loads and still have the last load be within the oil pattern distance.*

The **ENTER** key will loop you back around to the left side load designator and it will begin blinking again. Also if the speed is changed, the program will re-calculate the area of the lane for that load sequence.

For example, if you have 4 loads at 14 inches per second, the area of the lane for that load sequence is 00->05 feet and you change the speed to 18 inches per second, the area for that load sequence will change to 00->07 feet.

During a Cleaning Only Program, the travel speeds and shift points can be controlled by entering "phantom loads" into these screens. To make the machine shift speeds at a specified point, **set the speed** and then enter loads until the prompt shows the desired footage for the shift point.

***NOTE:** The machine will automatically travel at High Speed (or 30 IPS) after it has reached the Oil Pattern Distance. The pattern distance can be increased up to 55 feet.*

**ENTER** may be pressed as many times as you want. Pressing **ENTER** simply steps the blinking variable from one to the next. Remember, only the variable that is blinking will be changed with either the **UP** or **DOWN ARROW** at any given time.

If the **UP** or **DOWN ARROW** is pressed while in this menu, the **ENTER** key must be pressed **4 times** before the **NEXT** key will let you into the next forward load screen.

Now press the **NEXT** key. The following menu prompt will appear:

**02F 8L – 8R X 01**  
**02>05 FT IPS=18**

The **8L** will be blinking. In the previous screen we left with the load area at 00 to 02 feet, so the beginning screen for the second load forward begins with the ending distance of the previous screen. The area for this screen is calculated from the number of loads and the speed.



The keypad display rounds the distance to the nearest foot, but the PLC accurately calculates the travel distance as the machine operates on the lane. The footage shown is only an estimate on the keypad. KOSI shows the actual travel distance in its reports.

Any changes to this screen are performed the same way the first changes were entered. Remember, you must press the **ENTER** key 4 times before you may use the **NEXT** key to go into the third screen.

Press **NEXT** and the following menu will appear:

**03F 10L – 10R X 03**  
**05>12 FT IPS=18**

You may now change this screen to anything you want. Remember you must press **ENTER** 4 times after any changes of load number or speed before you may use **NEXT** to advance to the next load screen.

Press **NEXT** and the following menu will appear:

**04F 13L – 13R X 02**  
**12>17 FT IPS=18**

You may now change this fourth load screen to anything you want. Remember you must press **ENTER** 4 times after any changes of load number or speed before you may use **NEXT** to advance to the next load screen.

Press **NEXT** and the following menu will appear:

**05F 02L – 02R X 00**  
**17>24 FT IPS=18**

You may now change this screen to anything you want. Here we are using the last three screens for buffing. Sometimes it is necessary to utilize 3 buffing screens to achieve better front to back taper (notice the speed changes in the following screens). Remember you must press **ENTER** 4 times after any changes of load number or speed before you may use **NEXT** to advance to the next load screen.

Press **NEXT** and the following menu will appear:

```
06F 02L - 02R X 00
24>33 FT IPS=22
```

You may now change this screen to anything you want. Remember you must press **ENTER 4 times** after any changes of load number or speed before you may use **NEXT** to advance to the next load screen.



Since the area for this load screen is getting close to the overall oil distance set previously ... there is one more rule.

**Keep in mind that the area for each load is calculated with the ending distance of the previous load screen. This is the starting distance for each successive screen.**

The ending distance is calculated with the number of loads versus the speed that the machine is programmed to travel. This is added to the starting distance for each screen.

When changing the number of loads, the program will not allow you to increment the number so that it takes the ending distance beyond the oil travel distance. It won't let you increase the speed so that it takes you beyond the oil pattern distance either.

The **last load screen forward must have 00** for the number of loads. This screen is the buffer distance control. This gives time for the last load to get from the brush to the lane.

When **00** for the number of loads is showing and **ENTER** is pressed on the speed variable, the next blinking variable will now be the ending distance for that screen.

It is possible to increment it up to the travel distance. When the oil travel distance is reached as the ending distance for the screen you are in, it concludes the oil forward screens. Even though 15 screens are possible, the program will show only those needed to reach the travel distance.

Press **NEXT** and the following menu will appear:

```
07F 02L - 02R X 00
33>40 FT IPS=30
```

Since the ending distance for this load is the pattern distance (40 FT), this is the last forward load screen. If you enter around and decrease the ending distance for this screen, it will open up another forward screen when you press the **NEXT** key. The number of loads will be 00 automatically and the ending distance could be anything above the oil travel distance (or even below the starting distance of that screen). **Be Very Careful** in this instance.

Always enter around the load screen and change the distance up or down to match the ending pattern distance that was set. If each screen going forward does not flow from the foul line to the travel distance, the machine will not function properly. Overlapping load areas are only possible when opening up new screens previously not used.

It is also possible to make the machine have loads right up to the travel distance. This is **NOT** recommended. The last screen forward **must** be 0 loads.

***NOTE:** If you were to go into the screen with the last oil distance to increment the number of loads from 0 to 1, the program will not allow you to increase the number of loads until you "enter around" to the travel distance and decrement it. Use the **Down Arrow** to change it to something less than the oil pattern distance. You may then enter around to the number of loads and change it.*

### **Return Oil Screens**

When the last screen forward has been entered you may now proceed to the next screen. If no changes are needed to the reverse screens, you will be able to advance through them without pressing **ENTER** four times for each screen.

Press **NEXT** and the following menu will appear:

**01R 02L – 02R X 00  
40>35 FT IPS=30**

Notice the screen number is now **01** again and the **F** has changed to an **R** (meaning reverse). The area for the load screens now starts with the oil travel distance and goes down.

The first screen in reverse must be a buff only (00 loads) for at least the first 1 foot of return travel. The last screen in reverse should be 00 loads for at least 4 feet before the foul line (just like the last screen forward).

***NOTE:** If the machine does not oil in reverse at all, check the **01R** screen for loads within the first foot of return oil travel. Remove any loads to change the screen to a buff only for at least 1 foot.*

**IMPORTANT NOTE:** If the **UP** or **DOWN ARROWS** are pressed in this screen, then ALL conditioning menus for the reverse loads must have the **ENTER** key pressed **4 times** before the **NEXT** key will advance you to the next load screen. A green LED light above the **MENU** key will indicate when the **NEXT** key is enabled. The program will not exit the load screens until you have advanced to the **REVIEW** or **EXIT** screen.

To move to the next load screen press **ENTER** 4 times (if necessary) and press **NEXT** and the following menu will appear:

**02R 15L-15R X 01**  
**35->31 FT IPS=22**

You may now change this screen to anything you want using the procedures described previously. Press **NEXT** after pressing **ENTER** four times (if changes were made) and the following screen will appear:

**03R 14L-14R X 02**  
**31->26 FT IPS=18**

You may now change this screen to anything you want using the procedures described previously. Press **NEXT** after pressing **ENTER** four times and the following screen will appear:

**04R 13L-13R X 04**  
**26->16 FT IPS=18**

You may now change this screen to anything you want using the same process. Press **NEXT** after pressing **ENTER** four times and the following screen will appear:

**05R 11L-11R X 04**  
**16->06 FT IPS=18**

You may now change this screen to anything you want using the same process. Press **NEXT** after pressing **ENTER** four times and the following screen will appear:

**06R 10L-10R X 02**  
**06->03 FT IPS=10**

You may now change this screen to anything you want using the same process.

Keep in mind that the last loads going in reverse should always end a minimum of **3 to 4 feet** before the foul line. If more than 2 or 3 loads are selected, then end the loads even sooner.

If you don't want the loads to affect the oil pattern on the next lane, then you must pay close attention to where the loads end, and how far the machine can travel as it buffs to the foul line.

Press **NEXT** after pressing **ENTER** four times and the following screen will appear:

**07R 2L- 2R X 00**  
**03->00 FT IPS=10**

There are no loads in this screen which will allow the machine to properly buff out the conditioner. This is also the last screen in reverse that is available to the operator since the ending distance is zero.

There are a total of 15 screens possible in reverse. The reverse oil is typically used to "beef up" the lay down and or skid area in the first 10 to 20 feet of the lane. You can do this with several loads at a slower speed.

***NOTE:** When the 15th screen is reached, going forward or reverse, the number of loads is forced to 00. The load area ending distance is forced to the oil distance going forward and forced to 00 when going in reverse.*

Press **NEXT** and the following menu will appear:

**NEXT TO REVIEW**  
**\* MENU TO EXIT \***

In this screen you may press **NEXT** to review the current program settings from the top of the menu, or press **MENU** to exit the Change Program Settings and go into the another Managers Menu.

**From this menu prompt it is possible to change Data Memories and adjust the Clock (after entering the password).**

**It is recommended that you use KOSI to adjust these settings and always call KEGEL Tech Support at (863) 734-0200 if this area needs to be accessed.**

## Special Functions

The machine can be programmed to perform some special functions.

### ***Start Brush***

**START BRUSH  
IN INCHES -> 00**

This prompt will display the current distance from the foul line where the machine should start and stop the buffer motor. This delay in starting the buffer will apply less oil near the foul line. With more open play these days it is important to cut down on the oil near the foul line.

To change this distance, use the **UP** or **DOWN ARROW** to adjust, changing the value sets the data automatically.

When using this feature it is recommended to make adjustments in the oil pattern. An example would be moving the 2-2 loads to the second forward screen and putting a small load such as 19-19 in the first forward screen.

***NOTE:** There should be at least a trace of oil on the lane near the foul line to help protect the lane surface.*

### ***Buffer Up Stop Delay***

This function has no prompt to be displayed. It can only be adjusted through KOSI or Data Memory (DM529). When set at **0000** the machine will not stop at the end of the pattern. Change the value to **0005** and the machine will pause to raise the buffer brush then continue on. This will create the straight buffer line as it does in the Oil Only Mode. Buffer Advance Drop should be fine-tuned when using this function, it is very easy to see if the buffer starts on the oil line in reverse.

### ***Buffer Advance Drop***

This function has no prompt to be displayed. It can only be adjusted through KOSI or Data Memory (DM24). The factory default is **0039**. When adjusting the value lower than 0020 the buffer will drop behind the oil line and when higher than **0039** it will drop in front of the line. High speed will also have an effect on where the buffer drops in relationship with the oil line. If the machine is moving faster it will drop further behind the line and when moving slower, in front of the line.

***NOTE:** Call Tech Support at 863-734-0200 if you have questions on the buffer functions above.*

### *Drop Brush in Reverse*

**DROP BUFFER IN  
REV IN FEET -> 40**

This feature is used along with the *Buffer Advance Drop* feature and is where on the lane you want the brush to drop in reverse. The upper limit is the oil distance while the lower limit can be changed to zero. DO NOT set this number below the beginning oil reverse distance as this will cause the machine to apply oil on the transfer brush without the buffer brush being activated.

High speed will have an effect on where the buffer drops in relationship with the oil line. If the machine is moving faster it will drop further behind the line and when moving slower, in front of the line.

### *Lift Duster*

**LIFT DUSTER  
IN INCHES -> 20**

The number displayed will refer to the distance from the tail plank where the duster will begin to lift up 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 **UP** or **DOWN ARROW** to adjust.

***NOTE:** Every time a value is changed, the program saves the data automatically.*

### *Program Override*

In the **Run Screen** it is also possible to override the pre-selected program. By pressing the **F5** key you will enable the override feature. Press the **DOWN ARROW** to choose the program that is desired, once chosen the machine is ready.

***NOTE:** When power is removed from the machine the override feature will be disabled and the machine will return to its original auto programming.*

## ***Oil Valve Time and Machine Run Time***

The Oil Valve Time and Machine Run Time is not something you adjust, but something you can monitor.

The valve time displayed is the total time the oil valve is turned on for each lane. If your valve time is 260 and you notice it change to 280 this may indicate the oil head is slowing down and the head bar may need to be lubricated. It can also mean someone has changed the oil pattern program. The recorded valve time will fluctuate just a few counts, but not more than 2 or 3.

The machine run time is the time it takes to run one lane in tenths of seconds. This time should also be monitored and will indicate if the drive speeds are changing or if someone has changed the oil pattern program. 0817 is 81.7 seconds.

The valve time is on the top left hand side of the screen and run time is on the top right.



## **Auto Programming (7 Day Planner Program)**

Press the **MENU** key until the following screen appears:



This feature allows the machine to store specific conditioning programs to be used for each day of the week, within each time period of the day.

The "real time" clock in the machine's PLC keeps track of the time of day and will run the program selected for that specific time period. The time periods are not broken down by the hour, but rather are separated into two time categories, AM and PM.

For example, a conditioning program selected for Monday AM means that operation of the machine any time between 12:01 AM and 12 Noon will apply that selected conditioner program.



To continue within this menu, press **NEXT** and the following prompt will appear:

```
*      MONDAY
***** AM--> 01
```

Use the **UP ARROW** to change the program number and the value will be set. The **DOWN ARROW** does not function in these menu screens, the program number will loop back around to **01** if the **UP ARROW** is pressed with program **04** showing.

Press **NEXT** and the **PM** time period for Monday will appear:

```
*      MONDAY
***** PM--> 01
```

Once again, use the **UP ARROW** to change the program number and the value will be set.

Advance to the rest of the days of the week with **NEXT** and enter the program numbers that you wish to run for each time period of each day.

A program can be entered for each of the following time periods:

|                     |                     |
|---------------------|---------------------|
| <b>MONDAY AM</b>    | <b>MONDAY PM</b>    |
| <b>TUESDAY AM</b>   | <b>TUESDAY PM</b>   |
| <b>WEDNESDAY AM</b> | <b>WEDNESDAY PM</b> |
| <b>THURSDAY AM</b>  | <b>THURSDAY PM</b>  |
| <b>FRIDAY AM</b>    | <b>FRIDAY PM</b>    |
| <b>SATURDAY AM</b>  | <b>SATURDAY PM</b>  |
| <b>SUNDAY AM</b>    | <b>SUNDAY PM</b>    |

***NOTE:** The machine will only run the program set for that day and time. If you wish to override a program press the **F5** key in the start screen and press the **DOWN ARROW** to choose the desired program. When power is removed, the machine will change back to its original program that was set into the 7 Day Program Planner.*

## Adjustments



### Buffer Brush

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 **TEST OUTPUT** menu. If the brush is not already down in the "zero" position, press **NEXT** until **OUTPUT #09** is displayed.

Press **ENTER** 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. 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 an 1/8 inch Allen wrench, turn the set 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"** (3.2 mm to 4.8 mm) of an inch of crush evenly on the top side. Once this adjustment is made, tighten the set 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 topside and make the adjustment the same way you adjusted the crush on the topside, 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.

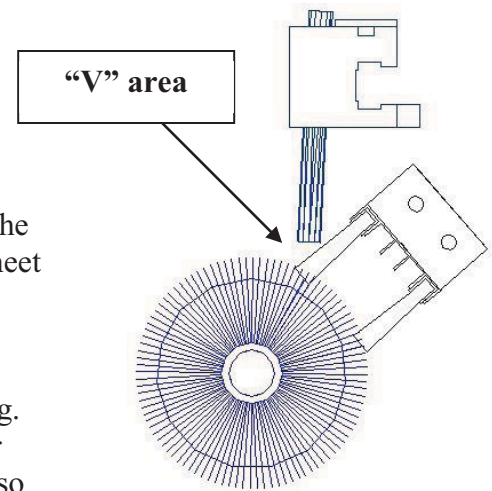
## Oil Tip

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

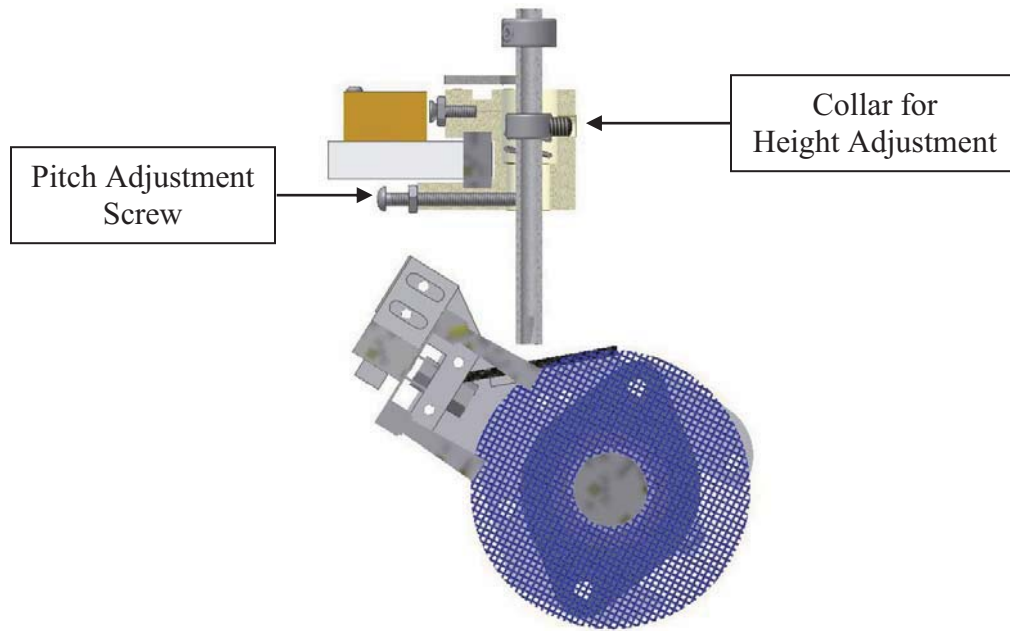
There are two adjustments that can be made to the oil tip. One adjustment is the **height** of the tip. The other is the position of the tip. The point where the Transfer Brush and the Buffer Brush meet will form a "V". The Oil Tip should be as close to this "V" as possible, without actually dispensing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

This adjustment should be checked with the buffer brush running. To operate the brush, press the button on top of the buffer motor relay (CR3). 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 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.



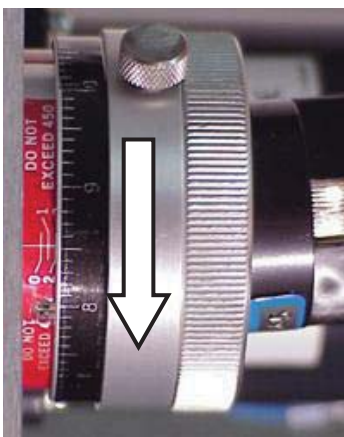
The oil tip **pitch** can be adjusted using the screw and jam nut. Pitch should be set to dispense conditioner on the black transfer brush (very close to the V) not on the blue buffer brush.



**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).

## Oil Pump

Beneath the splash guard on the rear wall of the machine is the fluid metering pump assembly (oil pump). The picture shows the calibration ring of the pump. If an adjustment is necessary you should turn the dial only 1/2 microliter.

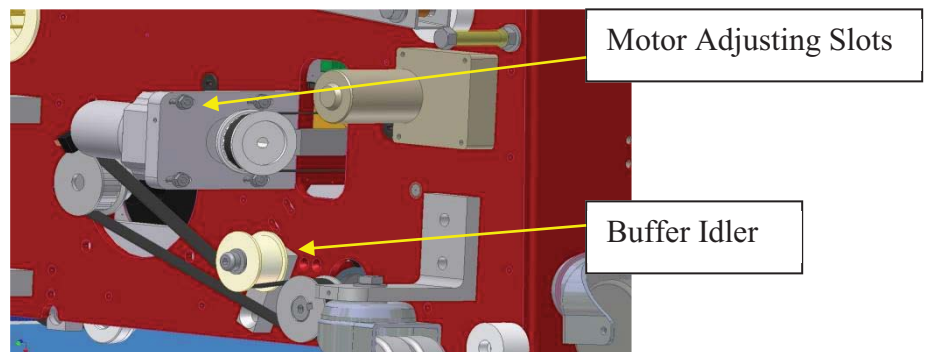


Each small mark on the dial is 1/10 microliter; each large mark is a one microliter change in the output of the pump (per 1 revolution). The pump is revolving at about 2600 RPM. At the speed the oil head is traveling across the transfer brush, the pump actually revolves about 1.89 revolutions as it crosses one board.

**NOTE:** Direction of arrow in picture **increases** the pump output.

## Timing Belts

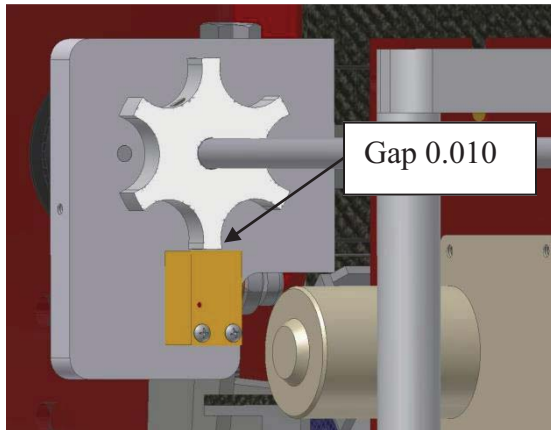
There are 3 timing belts that operate in the conditioning system. Watch KOSI to see the proper amount of belt tension.



1. **Buffer Belt.** The machine has a belt tension idler roller that can be positioned to maintain the 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 very desirable.
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. This may also cause oil volume fluctuations. Loosen up the oil pump fasteners to change belt tension.
3. **Oil Head Belt.** This belt should run on the tight side. **Unplug the motor before attempting to work on this belt to disable the braking circuit.**

To adjust 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.

## Board Counting Target and Proximity Switch



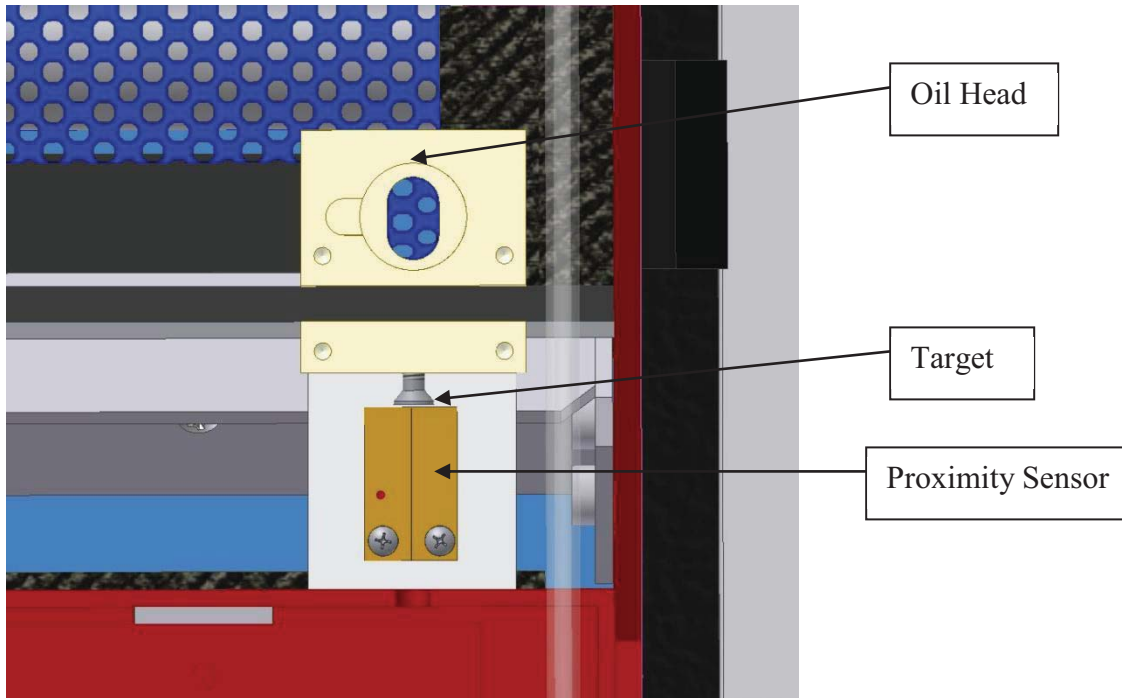
The timing for the oil head is a precise adjustment. Remove the plastic cover on the 10-pin side to access the sensor assembly. **Remove the plastic guard from the 7-pin side to access the Head Motor and unplug the motor to disable the braking circuit.**

Once the covers are off you will be able to see the belt tension and head timing assembly. 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" ( $\pm 0.005$ " ), which is 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 a clockwise rotation.*
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.

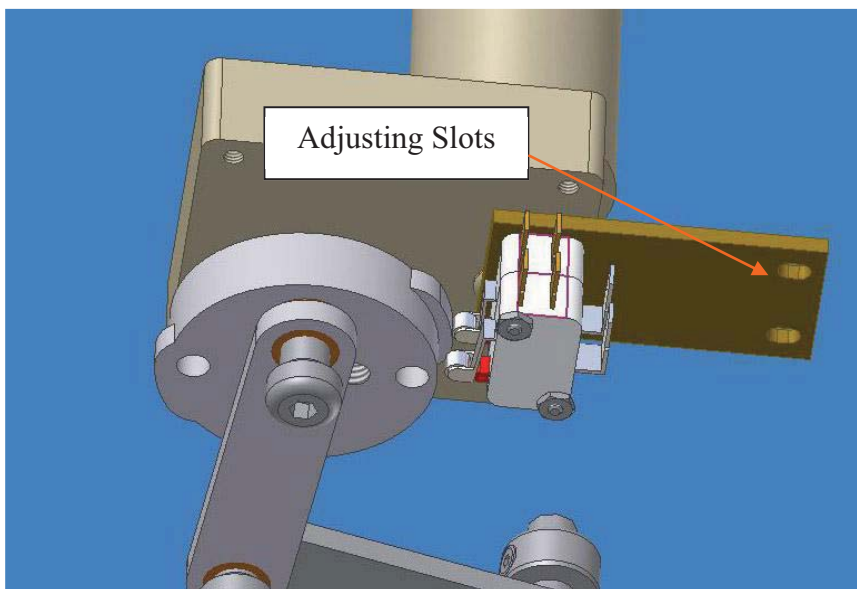
*NOTE: The machine's computer has to park the oil head on the right side to ensure the proper starting point for loads of conditioner. When the head goes to the home or zero position it will bump into the side wall and kick back. The clicking sound that is heard is **normal** and no damage is occurring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

## Oil Head Target



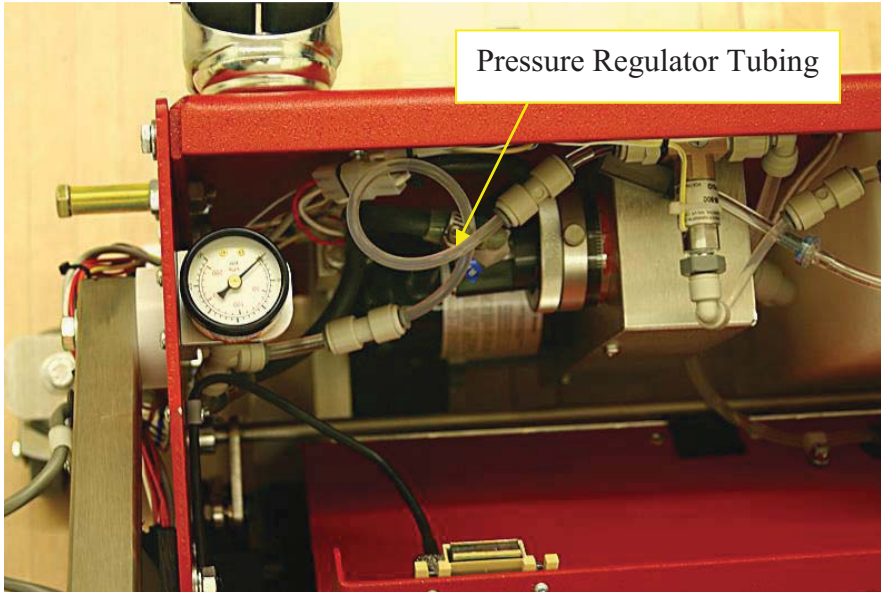
The moving Oil Head uses a flat head screw as a target for the Board Edge Sensors to “see”. The screw should be adjusted to 0.025” (0.635 mm) from the face of the proximity sensors. Check both sensors to be certain that the gap is the same. The proximity sensors have a small amount of adjustment so they 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 (0.13 mm ~ 0.254 mm).

## Pressure Regulator Tubing Chart (for changing conditioner types)



The following ranges of conditioner viscosity have 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 50µl. 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.

| <i>Conditioner (Viscosity)</i> | <i>Size (OD)</i> | <i>Length</i> | <i>Pressure</i> |
|--------------------------------|------------------|---------------|-----------------|
| Offense HV (39.1 cps)          | 3/16"            | 5"            | 15psi           |
| Offense HV                     | 3/16"            | 8"            | 20psi           |
| Prodigy (29.7 cps)             | 3/16"            | 10"           | 15psi           |
| Prodigy                        | 3/16"            | 15"           | 20psi           |
| Defense-S (39.6 cps)           | 3/16"            | 5"            | 15psi           |
| Defense-S                      | 3/16"            | 8"            | 20psi           |
| Infinity (35.4 cps)            | 3/16"            | 11"           | 15psi           |
| Infinity                       | 3/16"            | 15"           | 20psi           |

**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 Kustodian ION ships from the factory with about a 7-1/2" piece (19 cm) of 3/16" pressure regulator tubing for Offense-HV.

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.

### 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. 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.



**Buffer Brush did not lower error**

**Menu Out** of the program and access the **MANUAL Reverse Menu** and depress the **Start Button** and return machine to the approach.

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 **B3 ERROR**.

1. The brush lift motor runs but the down switch failed to operate and send a signal to PLC **Input #5 0CH 05**.
  - a. Check and inspect 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 #09**. 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. CR7 Relay came loose in socket or has failed.
  - d. Motor failed.
  - e. Bad connection to motor, check all power wiring to motor.
  - f. PLC output 11CH 02 failed.

**ERROR MESSAGE**

**\*\* CODE B4 \*\***

**Buffer Brush did not raise error**

**Menu Out** of the program and return machine to approach.

This error will occur at the end of the programmed oil distance.

Normally this error occurs when **Input 0CH 04** fails to receive a signal within 3.5 seconds of the motor starting. Here are the possible causes that can produce a **B4 ERROR**.

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 #09**. 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. CR7 Relay came loose in socket or has failed.
  - d. Motor failed.
  - e. Bad connection to motor, check all power wiring to motor.
  - f. PLC output 11CH 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.*

**ERROR MESSAGE**

**\*\* CODE H7 \*\***

An **H7** error occurs 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.

Possible **H7** error causes include:

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 to cause this.
  
2. Oil Head Motor does not run in one or both directions.
  - a. Fuse is blown.
  - b. CR5 or CR6 relay is loose in socket base or has failed.
  - c. Motor has failed.
  - d. Motor unplugged or has a damaged wire between motor and control relays.
  - e. PLC output **11CH 00** or **11CH 01** has failed.

**ERROR MESSAGE**

**\*\* CODE FO \*\***

Machine is low on conditioner (oil), fill and start machine to clear error from the screen. If this does not clear the error the float may have a problem. Unplug float and install jumper plug to bypass the float (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 everyday will eliminate many problems from turning into disasters.**

1. Oil Pump fails to run.
  - a. Blown fuse
  - b. Motor is unplugged or has a damaged or open connection.
  - c. CR4 relay is loose in socket base or has failed.
  - d. PLC output 10CH 07 failed.

2. Buffer fails to run.
  - a. Blown fuse.
  - b. Motor is unplugged or has a damaged or open connection.
  - c. The buffer motor relay CR3 operates when **Input 0CH 05** is on and the brush is down. Also when the pump relay is on and either forward or reverse relays are on. If any one of these areas fails, the buffer will not operate. Refer to wiring diagram for connections in Chapter 7.
  - d. Motor has failed.
  - e. Belt is broken.
  
3. Machine oils 2-2 more than programmed, or looks like solid 2-2's.
  - 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 (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 output 10CH 00 failed.
  - f. Filter is clogged.
  - g. No oil in tank, 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 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.

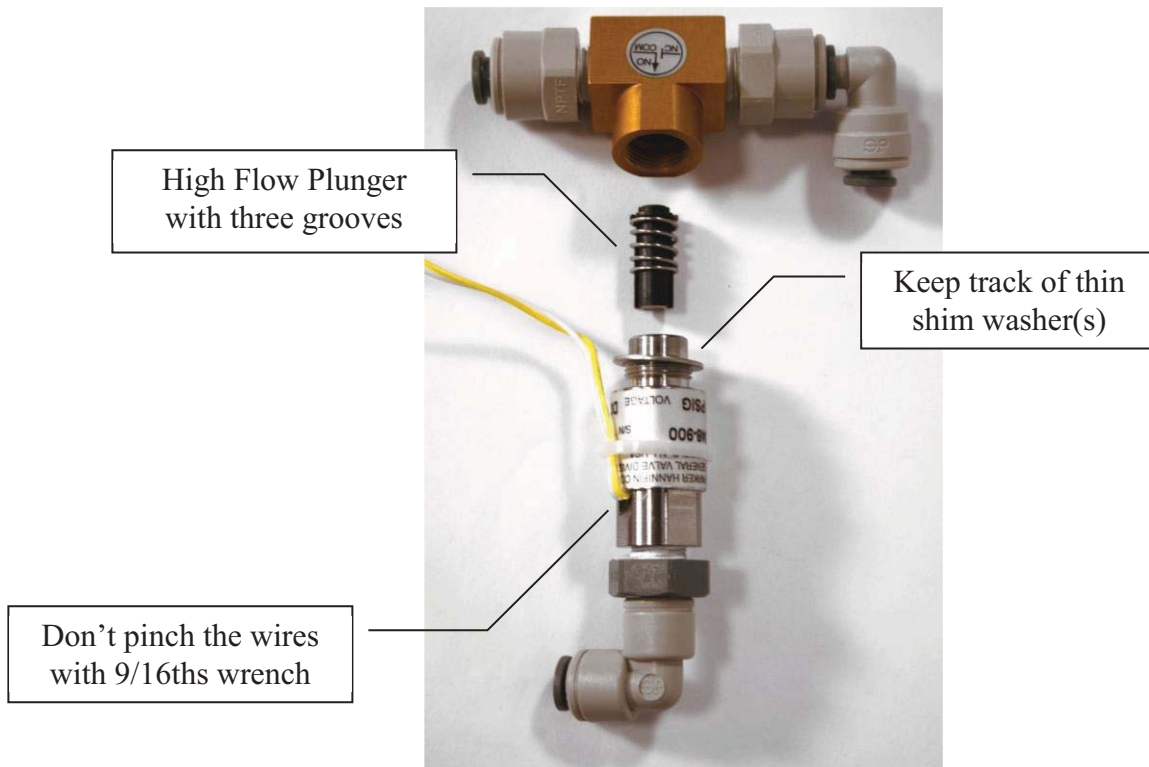
### *Procedure for Cleaning Oil Control Valve*

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.

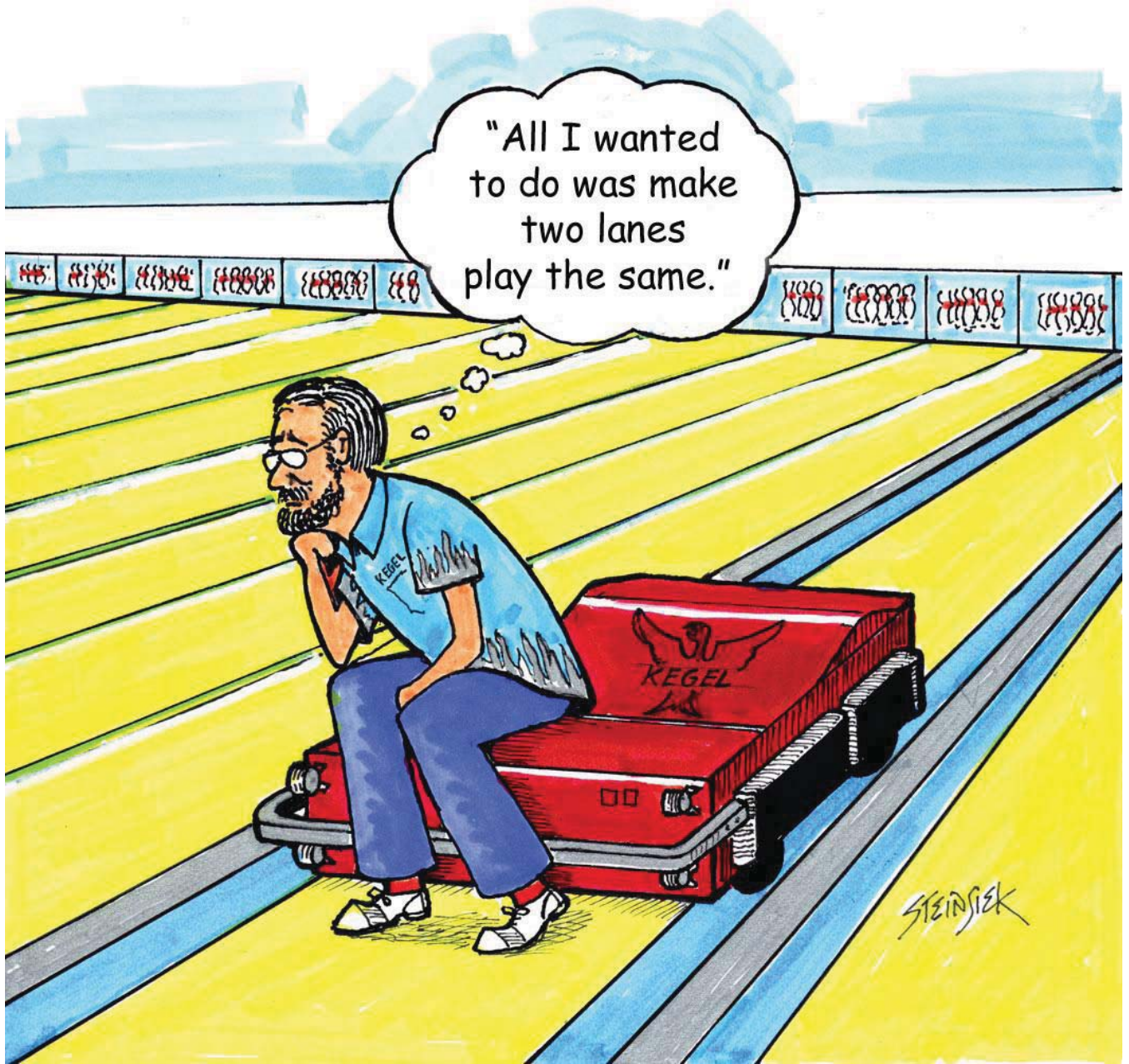
1. Disconnect power and place the machine in the operating or down position.
2. Remove the oil assembly from the rear wall.
3. Clean the area around the oil assembly.
4. Use a Phillips screwdriver to remove the two screws holding the valve to the back plate.
5. Remove the two stem elbows or the lines on the top of the valve. **PUSH IN** on the outer collet to release each elbow or oil line. Plug the open ends of the elbows to prevent dirt from entering the lines and to stop the oil from leaking (do 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 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 each elbow or line back into the proper fitting and clean around all the connections.
12. Return the oil assembly to the machine and plug in the connections.
13. Run the \* **PUMP OUTPUT VOLUME TEST**. Run this 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: **Recreation**; **Challenge**; and **Sport**. 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](http://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.

**NAVIGATION PATTERN WORKSHEETS AND DESCRIPTIONS CAN BE FOUND  
IN THE APPENDIX OF THIS MANUAL**

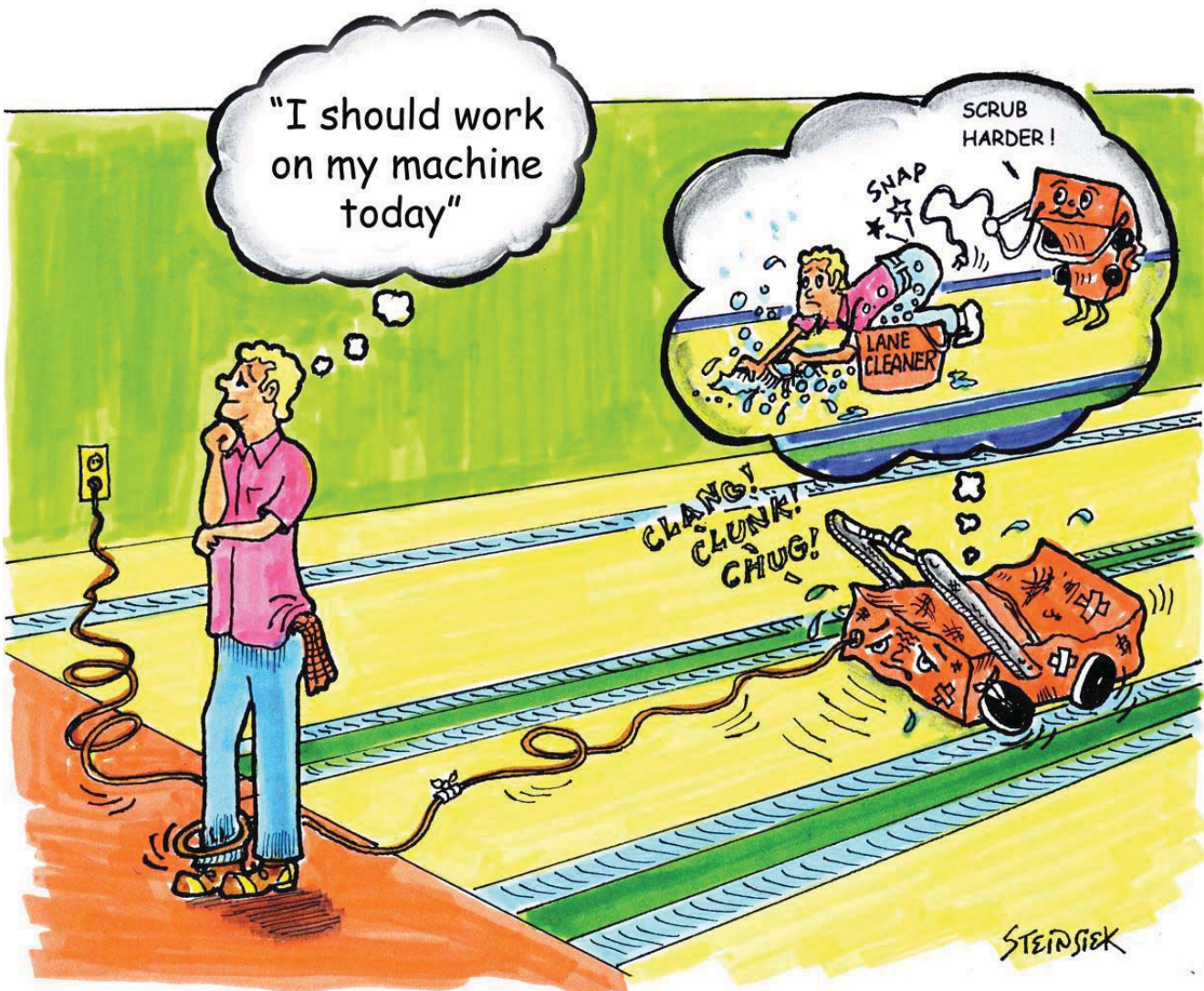
Go to <http://www.kegel.net/patternlibrary/default.asp> for additional patterns.



## 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. I suggest reading the following scenarios to see if it is similar to your problem (and to maintain your sanity).

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 had mixed cleaner mistaken for 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 along side 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.
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 set recommendations about 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, the following page shows some suggestions to answer common questions about lane conditioning. These tips should help you make the proper adjustments to the patterns supplied in this manual.

***Note: Failure to check machine operation before pattern adjustments can result in the loss of your sanity. If loss of sanity does occur, please call KEGEL at 863-734-0200 and we will be happy to 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 in the Change Program menu in the forward screens only. Increasing the drive speed on your forward run will allow the lane condition to taper properly.

# CHAPTER 3

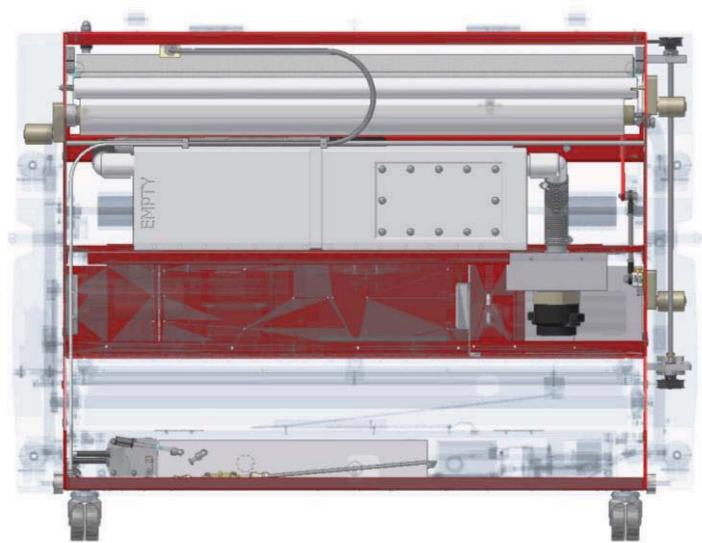


## Cleaning System

### Theory of Operation

The Kustodian ION 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.

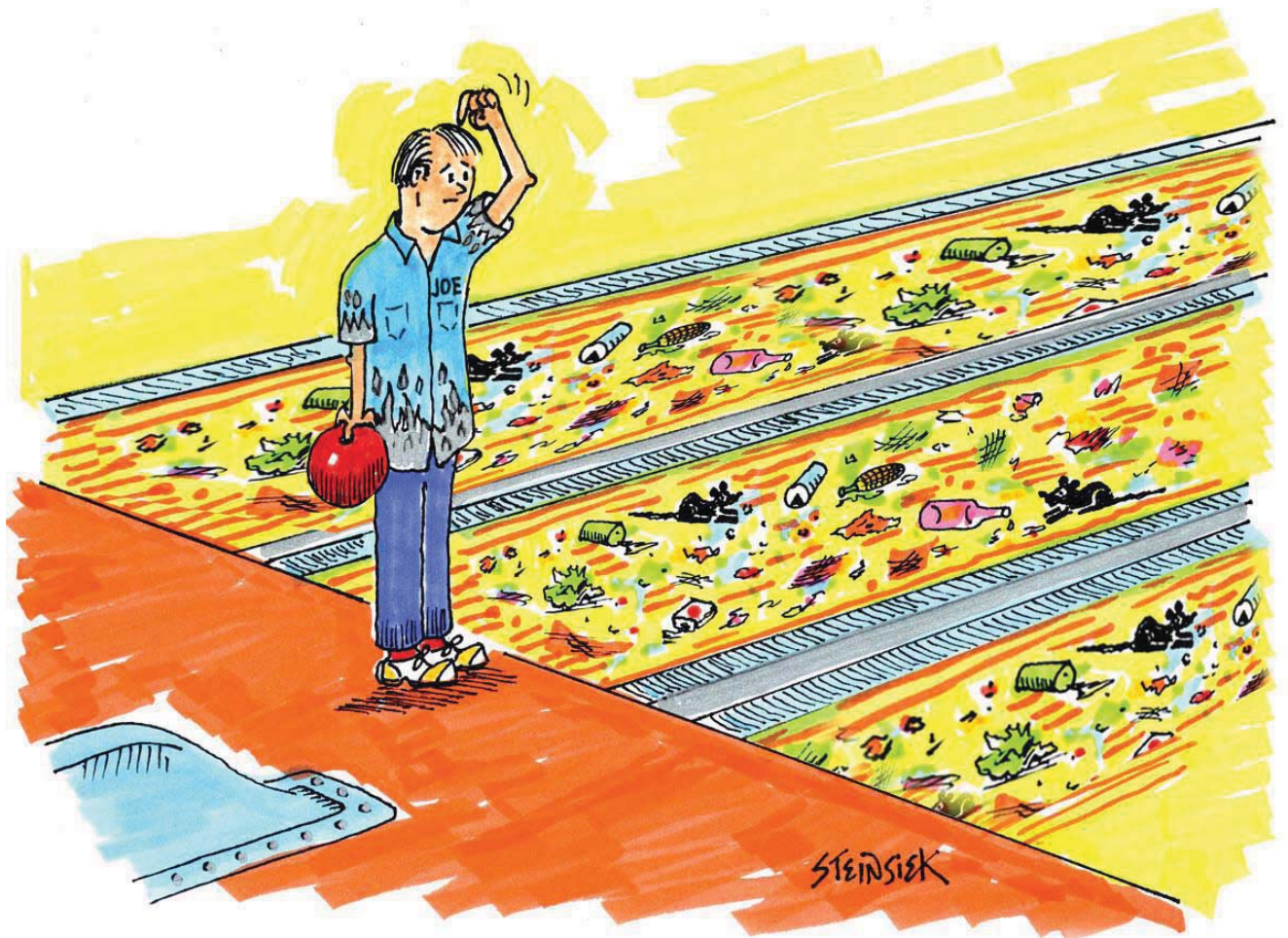
The proper cleaning of your lanes is very important to the consistency of your playing conditions. Various things can cause the machine to not adequately remove the dirt and conditioner from your lanes. In this section we will describe how the machine cleans your lanes and reasons why it may not.



The below sequence is an overview of how the ION 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 its 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 desired, call Lane Maintenance Central for help.

### 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 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.

## System Control Duster Menus

### Unwind Time

These screens will be used to operate and reset the duster functions.

Press the **MENU** key until the following screen appears:



From this menu prompt the operator may run the duster motors to help when installing a new roll of duster cloth. Pressing the **handle button** will operate the unwind motor. Pressing the **cleaner presoak** button will operate the windup motor. This motor will run until contact is made with the duster up switch then it automatically stops.

Press the **NEXT** key and the following screen will appear:

**\* UNWIND TIME**  
**F6 TO RESET 06**

This screen will display the current unwind time setting for each "ratchet" of cloth. This number will automatically increase as the size of the cloth roll decreases. This value will return to the default setting of **06** when **F6** is pressed.

This prompt is referring to the amount of time in tenths of seconds. The "**06**" is actually 0.6 seconds. To change the amount of unwind time, use the **UP** or **DOWN ARROWS**. Changing the value sets the data automatically.

***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. In this menu, it is possible to correct the present unwind time if one of your pin chasers has presented you with this problem.***

The unwind time varies from **06** for a fresh roll to **20** 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 **13**.

The machine will default back to a setting of **06** when a new roll of cloth is installed and the unwind time is reset using the **F6** or **RESET** key.

## System Control Cleaning Menus

This series of screens will be used to adjust various cleaning features in the machine's program.

Press the **MENU** key until the following screen appears:

**SYSTEM CONTROL  
CLEANING**

Press the **NEXT** key and the following will appear:

**LAST SQUIRT DIST  
IN FEET -> 57**

The number displayed will refer to the distance in feet down the lane at which no more streams of cleaner will be applied. To change this distance, use the **UP** or **DOWN ARROW** to adjust. Once the value has been changed, the program accepts the data automatically.

Press the **NEXT** key and the following will appear:

**LIFT DUSTER  
IN INCHES -> 20**

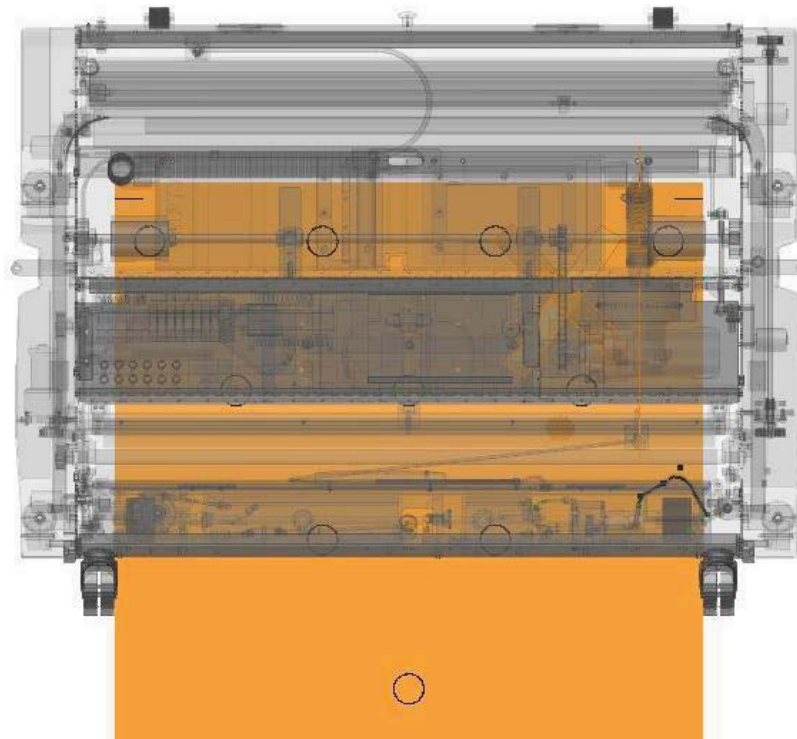
The number displayed will refer to the distance from the tail plank the duster will begin to lift off of the lane. To change this distance, use the **UP** or **DOWN ARROW** to adjust. Once the value has been changed, the program accepts the data automatically.

Press the **NEXT** key and the following will appear:

**FORWARD DISTANCE  
SUBTRACT -> 32**

This prompt allows the operator to adjust the travel distance to the end of the lane. Increasing the number subtracts more from the distance, so the machine travels shorter. Use the **UP** or **DOWN ARROW** to adjust. Any changes to the value set the data automatically.





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

Press the **NEXT** key and the following will appear:

**REVERSE DISTANCE  
SUBTRACT -> 32**

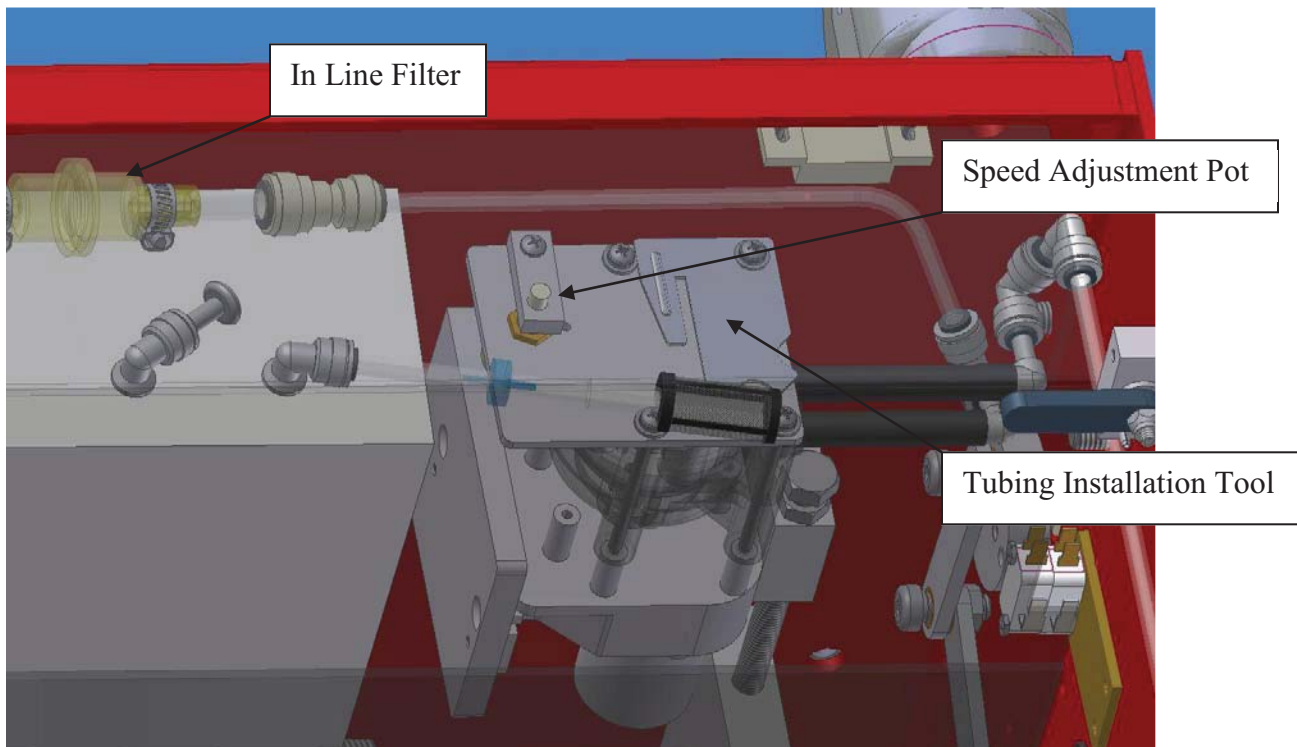
This prompt allows the operator to adjust the travel back to the foul line. Increasing the number subtracts more from the distance, so the machine will stop further away from the foul line. Use the **UP** or **DOWN ARROW** to adjust. The PLC accepts any changes to the data automatically.

This concludes the selections in the  
**SYSTEM CONTROL CLEANING MENU.**

Press **NEXT** to loop around to the start of the menu again.

## Mechanical Adjustments

### Cleaner Pump Volume Adjustment (Cleaner Calibration)



The cleaner pump volume can also be checked in the same menu prompt as the oil. Press **MENU** to access the correct screen which displays:

**OIL AND CLEANER  
VOLUME TEST**

Press the **NEXT** key and remove cleaner tip from the holder (*make sure the spring in the tip holder block doesn't fall out*). Place the tip in a 50ml graduated cylinder and press the **PRESOAK** button on the handle; this will make the oil and cleaner heads start operating.

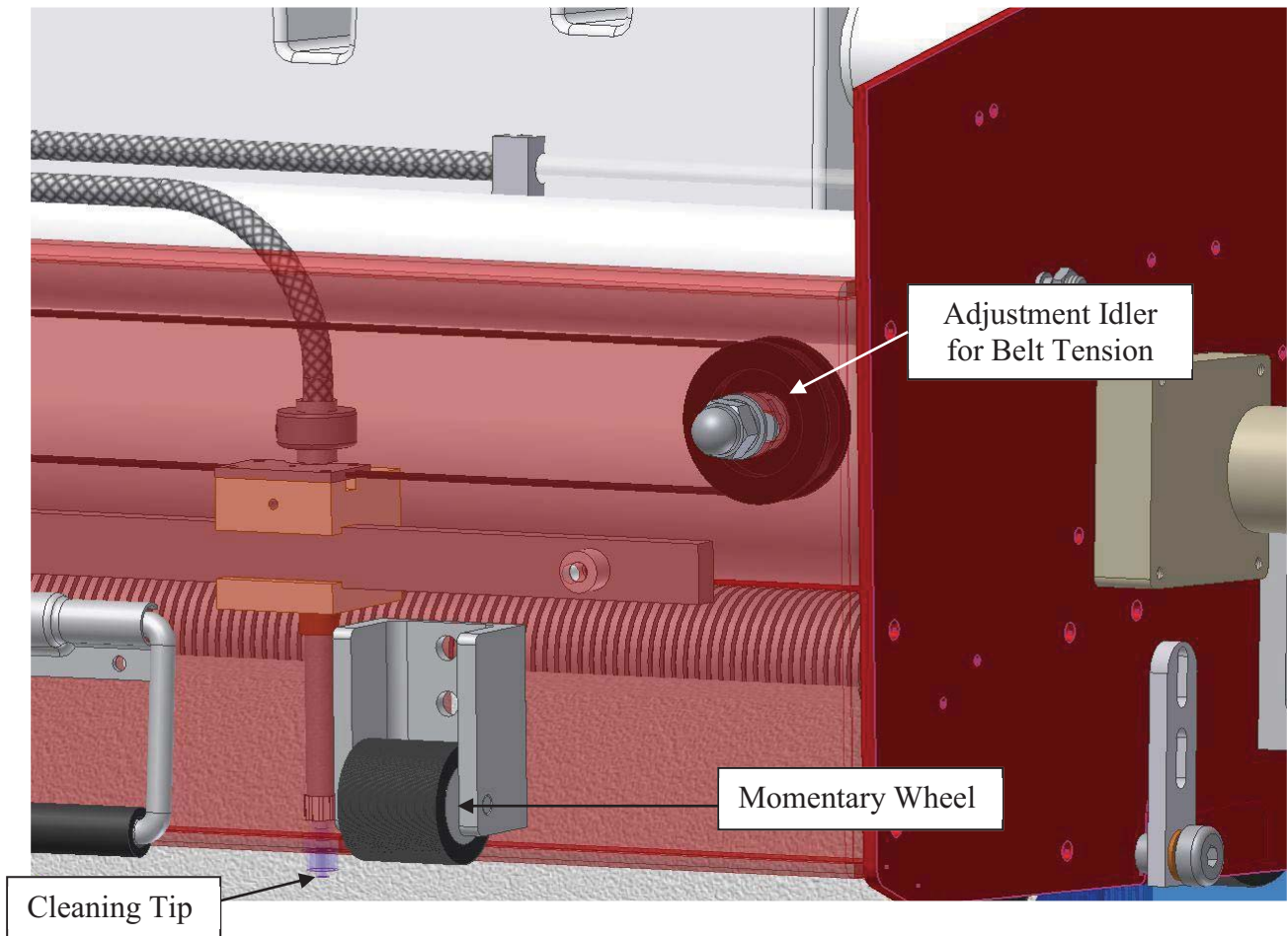
The cleaner head will apply one stream of cleaner then stop. **Repeat this test three more times and write down the volume dispensed. The factory setting for 4 streams of cleaner is 30µl.**

To adjust the cleaner volume, simply loosen the 8-32 set screw on the locking bar. Turn the adjusting pot on the cleaner pump **clockwise to increase volume** and counter-clockwise to decrease the volume. The factory setting will clean between 50 and 55 lanes.

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. When the adjusting pot has been turned to the maximum setting, the tubing should be replaced.

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

### Adjustment of Cleaner Dispensing Tip



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 the 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, but who knows?*)

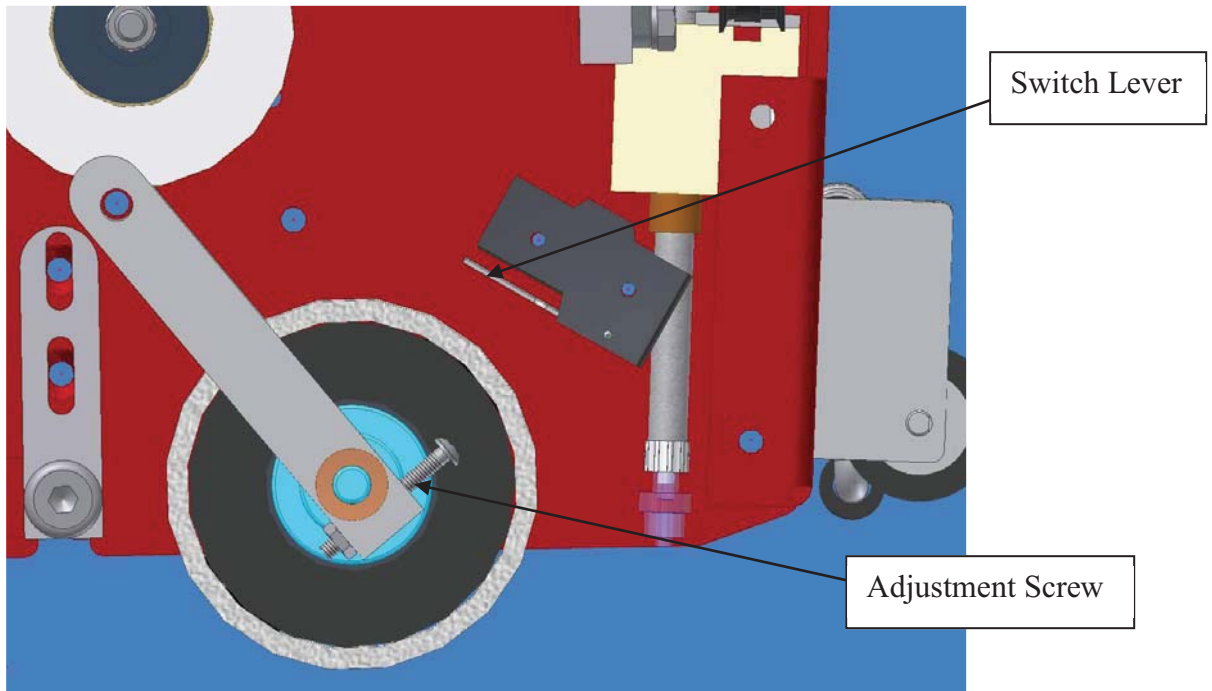
## Momentary Wheel Adjustment

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 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 ~ 3.2 mm).

The wheels need to be as close to the lane as possible without touching, provided the lanes are 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.*

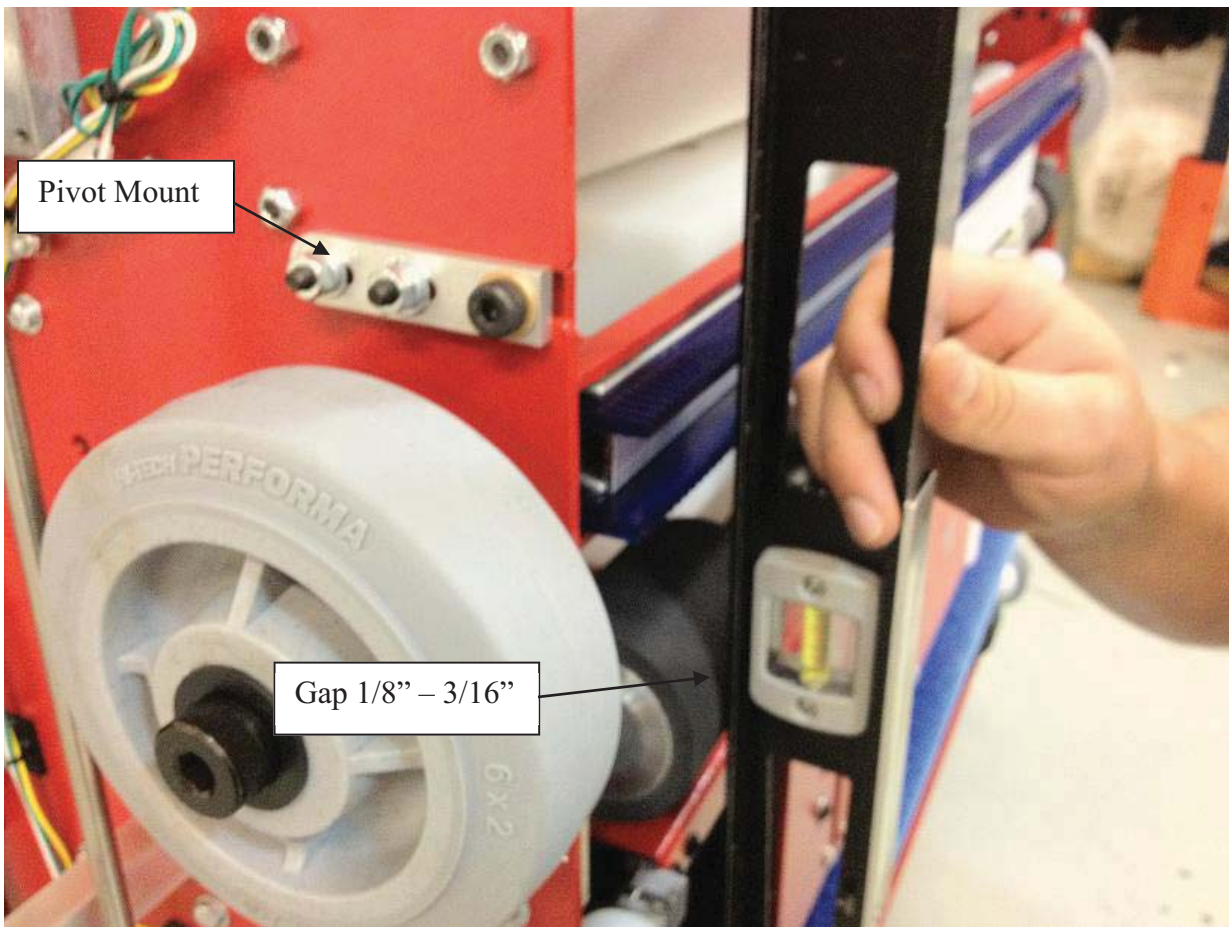
## Duster Switches



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. Lift the cushion roller up to actuate the switch and hold it against the stop. The switch should clearly actuate before the cushion lever hits the stop and there should be a small amount of over-travel of the switch lever.
3. Check the other side and be certain that both switches are adjusted with the same amount of over-travel.
4. If there is no over-travel, loosen adjusting screw with an 11/32 nut driver and back the screw out until there is some over-travel of the switch lever.
5. Tighten nut and check adjustment.

## Squeegee Blades



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 **TEST OUTPUT** screen.

When you reach the **TEST OUTPUT** section, press the **NEXT** key and advance to **OUTPUT #11**.

Press the **ENTER** key 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.

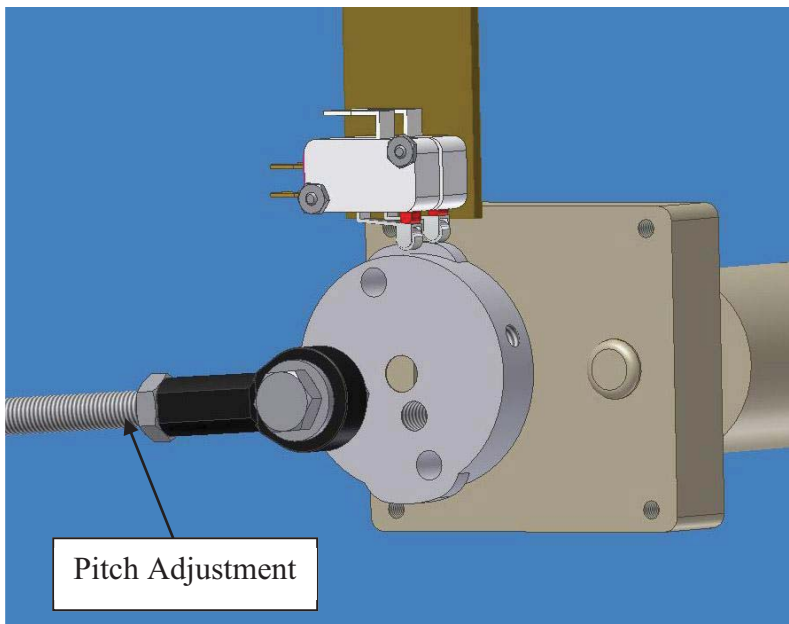
If the distance is more or less, loosen the bolts (two on each side) that hold the squeegee pivot in place. Move the pivot until the squeegee height is correct. This should be done for both the left and the right side. Tighten the bolts after the adjustment is acceptable.

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 strip properly and will cause stress on the assembly.*

### Squeegee Switches



The squeegee switches should have a little over-travel in the lever of about 0.015. 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.)

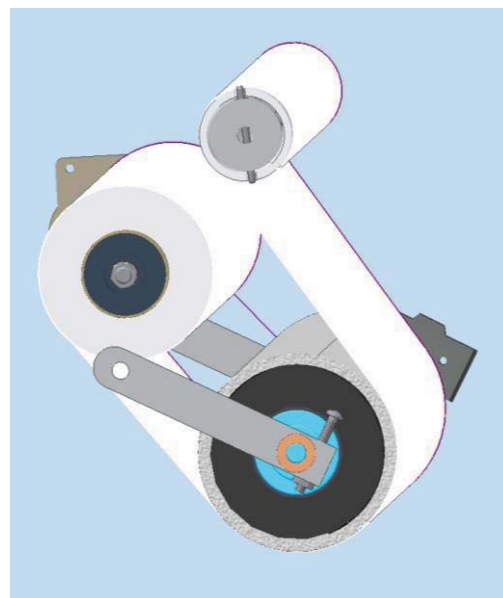
The Kustodian ION uses a patented Dual Motor Ratcheting (DMR) Cloth system. The duster assembly operates by means of two brake motors. The first unwinds cloth and sets the cushion roller down on the lane surface. The second winds up used cloth onto the used core.

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 Lane 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.
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 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. Apply power to the machine and bring up the **SYSTEM CONTROL DUSTER** menu.
8. When the keypad shows the **SYSTEM CONTROL DUSTER** on the display the handle buttons become active. Press the **start button** to unwind and press the cleaner **presoak button** to 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.

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.*

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.

5. It is recommended that the inside of the tank be cleaned and the filter material in the tank be replaced periodically. **A good rule of thumb would be: If you have a 40 lane house and clean twice a day we would recommend changing the filter every 30 days.** Maintenance will vary depending on center size so it is best to inspect the tank filter by looking through the end that connects to the vacuum 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 Filter:**

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

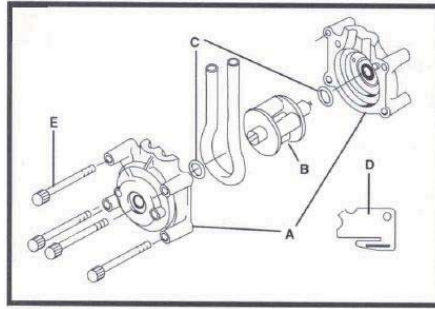
### **Pump Tubing Replacement**

If the cleaner pump maximum volume output is a problem, follow these instructions to disassemble the pump and replace the tubing. This probably needs to be done once a year. 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 mount 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**

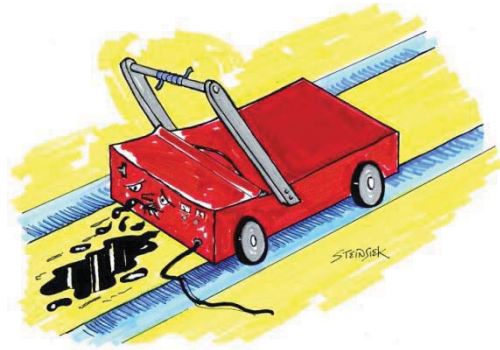
The squeegee blades should be flipped every 6 months and changed once a year. Poor cleaning results could occur if the trailing edge is allowed to get dull.

### **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 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 normally are easily corrected and happen for definite reasons. 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.

#### **ERROR MESSAGE**

**\*\* CODE D5 \*\***

**Menu Out** of the Program and Return machine to approach.

This error normally happens when Duster **Input 0CH 10** fails to open, meaning the input light does not turn off. Here are a few things that can cause a **D5** error. If the Duster Motor does not run, menu to the **Test Output** and check **Output #12** 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. Motor failed.
4. Blown fuse.
5. Duster CR9 relay failed or is loose in socket.
6. Duster motor wire is damaged or there is a loose wire between motor and CR9 relay.
7. Cleaner was dumped onto switch causing it to short, but only a dim light is on **Input 0CH 10**.

**ERROR MESSAGE**

**\*\* CODE D6 \*\***

**Menu Out** of the Program and Return machine to approach.

This error normally happens when the duster fails to windup the cloth and actuate the duster up switch, failing to turn on **Input 0CH 10**. Here are a few things that can cause a **D6** error. If the Duster Motor does not run, access the **Test Output** menu and check **Output #13** to check relay operation and voltages.

1. Blown fuse.
2. Motor has failed.
3. Duster Up Switches are both broken or out of adjustment.
4. Duster CR10 relay has 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 motor Green / Red wire is damaged or there is a loose wire between the motor and CR10 relay.

**ERROR MESSAGE**

**\*\* CODE SA \*\***

**Squeegee did not lower error**

**Menu Out** of the Program and Return machine to approach.

Normally this error occurs when **Input 1CH 00** fails to receive a signal within 3.5 seconds of the motor starting. Here are the possible causes that can produce an **SA ERROR**.

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. 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 #11**. You will need to determine if power is getting to the motor.

- a. Fuse is blown.
- b. Squeegee linkage is in a bind.
- c. CR8 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 11CH 03** failed.

**ERROR MESSAGE**

**\*\* CODE S9 \*\***

**Squeegee did not raise error**

**Menu Out** of the Program and Return machine to approach.

Normally this error occurs when **Input 1CH 01** fails to receive a signal within 3.5 seconds of motor starting. Here are the possible causes that can produce an **S9 ERROR**.

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 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 #11**. You will need to determine if power is getting to the motor.

- a. Fuse is blown.
- b. Squeegee linkage is in a bind.
- c. CR8 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 11CH 03** failed.

## ERROR MESSAGE

**\*\* CODE FC \*\***

Machine is low on cleaner.

Fill and start 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. CR2 relay failed or is loose in socket base.
  - c. Bad connection between motor and relay.
  - d. Loose connection at speed control.
  - e. Speed control has failed.
2. Cleaner pump volume low.
  - a. Tubing is starting to wear. (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<sup>th</sup> 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 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 bad connection.
  - c. Machine is not running 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 overfilled machine and made a mess.
11. Duster cloth hangs down on one side and sometimes touches the lane when pulling the machine out 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 Tech Support at 863-734-0200.



# CHAPTER 4



## Drive System

### Manual Reverse

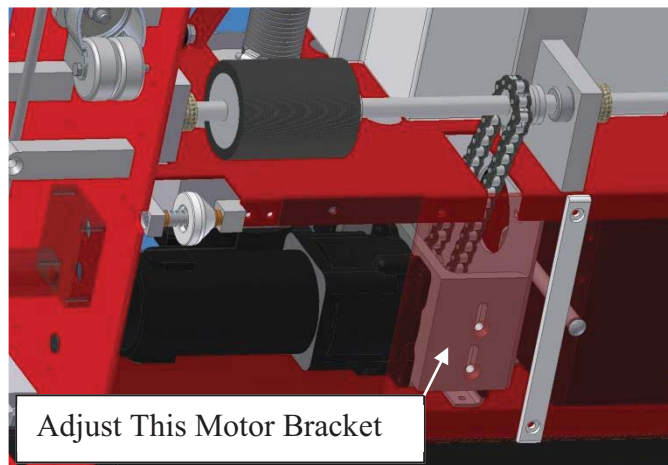
From this menu prompt the machine can be operated in reverse after clearing an error. The menu will be displayed as seen below.

**\* MANUAL REVERSE  
PRESS BUTTON**

To return the machine to the foul line, press the **START BUTTON** on the handle and hold it. The machine will return to the foul line at about 22 inches per second as long as the button is held down. Use caution when operating the machine in manual mode.

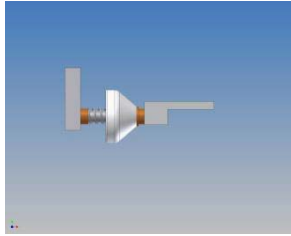
### Adjustments

#### Drive Chain

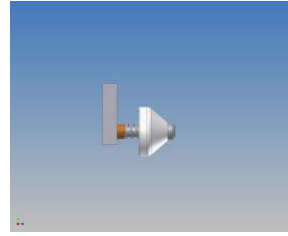


**It is important for the drive chain to stay tight.** To adjust the chain, loosen the drive motor mounting bolts. Slide the motor by hand until it will move no more and tighten motor bolts. A loose chain can cause damage to the motor, but too much tension will have the same effect.

## Guide Roller



Front Guide Wheel Assembly



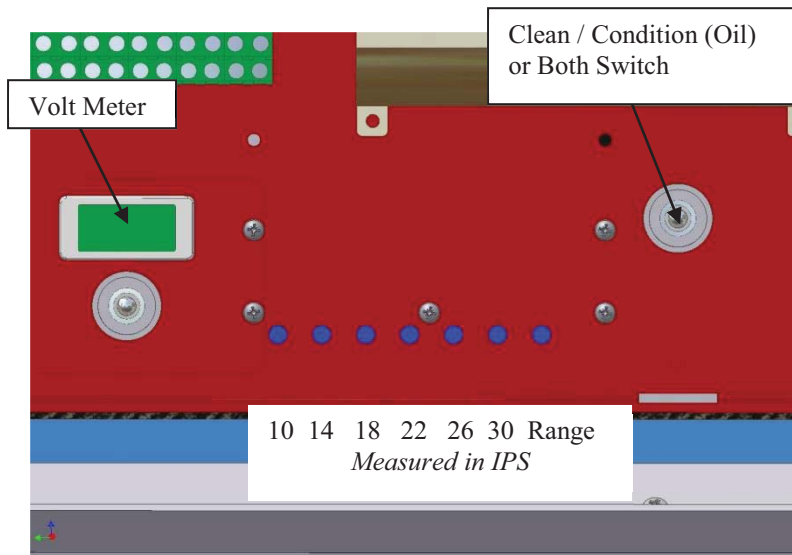
Rear Guide Wheel Assembly

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 guide roller 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.

## Drive Speeds



To set the drive speeds you will need to Menu to the **Test Output** area. **Outputs #02** through **#07** will run the drive motor in a forward and reverse direction and the speed will be displayed on the screen in place of the **OFF** text.

The machine can be put onto the lane to check the **load speeds** and it will travel 30 feet stop and return to the foul line for each speed.

*NOTE: While the machine is operating, it is possible to advance to each speed because it may not be necessary to monitor each speed for the entire forward and reverse cycle.*

**TEST OUTPUT #02**  
**PRESS F2-F5 000**

The adjusting trimpots are located on the control plate in front of the PLC Relays. The trimpots and their speed ranges go in order from left to right as follows:

**9-10 IPS**  
**13-14 IPS**  
**17-18 IPS**  
**21-22 IPS**  
**25-26 IPS**  
**29-30 IPS**

**RANGE Pot** (Adjusts speed for all trimpots).

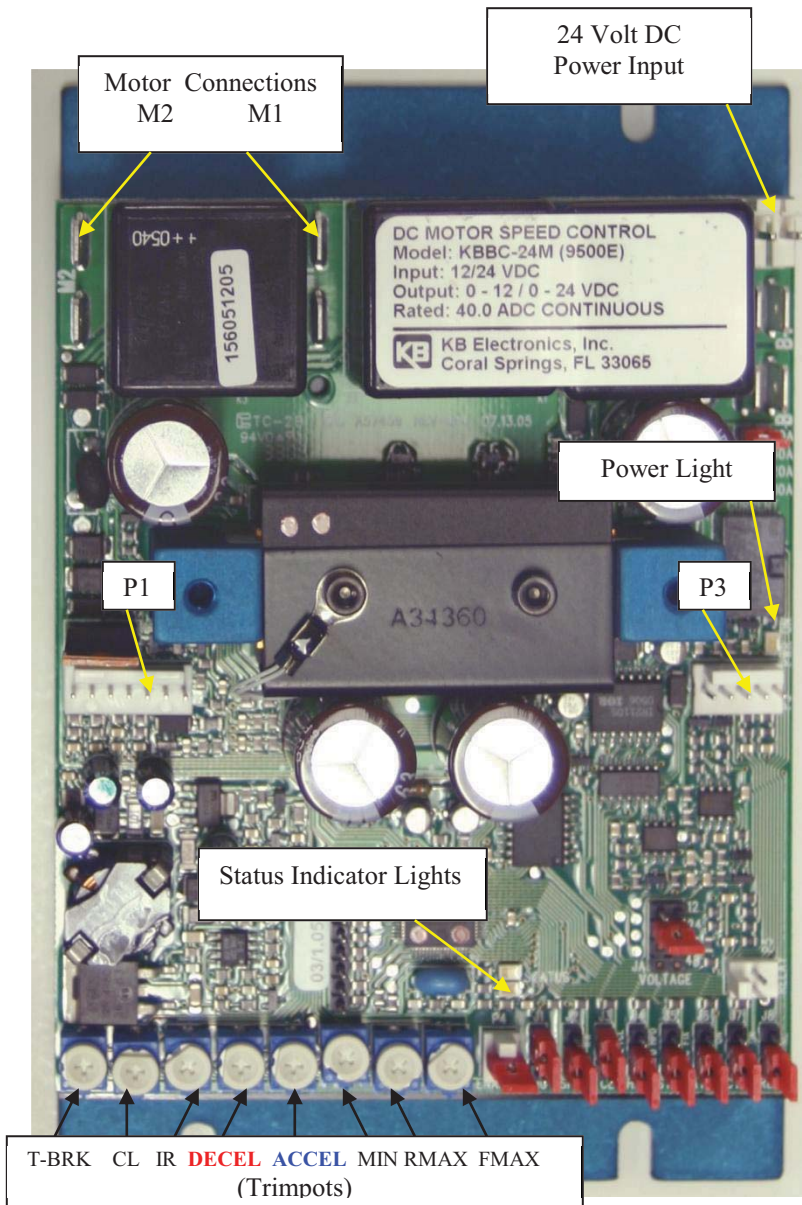
When adjusting the speeds always start with the 10 inches per second speed. It affects **ALL** of the other speeds.

1. After you have reached the **Test Output** screen press **NEXT (F2)** to advance to **Output #02**, then press **ENTER (F5)**. The speed will be displayed on the lower right side of the keypad. Using a small screwdriver, turn the trimpot clockwise to increase the speed if needed. The screen should flash between 9-10 for the low speed.
2. Press **NEXT** to advance to the next speed. Adjust your second speed to 13-14 then advance to the other speeds by pressing **NEXT** and adjust accordingly if needed.

3. If one of the speeds can't be reached, adjust the RANGE trimpot. Turn it clockwise to slow down and counter-clockwise to speed up the drive motor. **Always go back to Speed 1 and check all the speeds again after adjusting the RANGE trimpot.**
4. Once the 6 speeds are set, run the machine on the lane and check each speed to see if it matches the no load adjustments that were just made.
5. It is possible that the load and no load speeds will never match 100% on each speed. This is due to the fact that the machine is only operating off 24 VDC. If the speeds don't match take note of the difference for each speed.
6. For example, if the 2<sup>nd</sup> speed shows a load speed range of 12-13 and the no load speed shows the correct setting of 13-14, increase the no load speed to 14-15.
7. Run machine on the lane and check all 6 drive speeds. Repeat the step above if needed for each speed.

***NOTE:*** *The most important thing is that the load speeds are correct it is **not** necessary to have the load and no load speeds match. See the video in KOSI or call Kegel Tech Support anytime at 863-734-0200.*

## Drive Motor Controller



*The drive control board has all kinds of adjustments. **Please don't touch anything unless you know what you are doing.***

There are only two adjustments that may need to be fine-tuned and they are the Deceleration (**DECEL**) and Acceleration (**ACCEL**) trim pots.

The **Acceleration** trimpot needs to be adjusted for a smooth transition from one speed to the next without sudden jerks of the machine. Turning the trimpot clockwise will increase the ACCEL time.

*Increasing the ACCEL trimpot too quickly could result in the drive board shutting down and displaying an error light on the board itself.*

The **Deceleration** trimpot is adjusted for smooth decelerations from one speed to the next. Decelerating too quickly will result in the drive board shutting down from an over-voltage fault.

*If you adjust the DECEL too much in the clockwise direction the machine may not slow down properly when entering the pin deck. **Be certain that the machine is absolutely slowing down before coming to a stop.***

The Drive Motor Controller 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.

| Function                     | Flash Code | LED Color             |
|------------------------------|------------|-----------------------|
| Normal Operation Mode        | Slow       | Green                 |
| Stop Mode                    | 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                   |
| TCL (Current limit time out) | Quick      | Red                   |
| Normal Control Operation     | Steady     | Green                 |
| Bus & Power Supply Fault     | Off        |                       |

## Maintenance

There are only a few things that the operator should do to maintain the Drive System. Here are a few suggestions that should be done to maintain a perfect machine.

1. Keep all of the bushings oiled on the drive shaft (one or two drops is plenty). There are felt washers to help hold the oil longer next to the bushings. **DO NOT OVER-OIL!**
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).

### Drive System Problems Indicated by Error Messages

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

Errors **T1** and **T2** 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. Here are a few things that can cause a **T1** or **T2** error.

If the Drive Motor does not run, menu to the **Test Output** and check **Output #02** to check relay operation and voltages. **T1** is for forward errors and **T2** is for reverse.

**ERROR MESSAGE**

**\*\*CODE T1\*\***

**ERROR MESSAGE**

**\*\*CODE T2\*\***

1. The drive motor runs but gives **T1** or **T2** errors.
  - 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 in the pit when the machine does the squeegee wipe. 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. CR11 Forward Relay is loose in socket or failed.
  - b. CR12 Reverse Relay is loose in socket or failed.
  - c. One of the motor control plugs are loose or unplugged. Check speed control, relay board and drive motor plugs.
  - d. Blown fuse.
  - e. Drive Motor or Speed Control failure.
  - f. Go to the Test Output Menu and Check **Output #01** Forward Drive Relay and **#03** Reverse Drive Relay.
  
3. Machine drives off into pit giving a **T1** 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 not turning freely.
  - d. Lane Distance target loose.
  - e. Lane Distance Proximity Sensor too far from target.
  - f. Lane Distance Proximity Sensor damaged.
  - g. Operator needs more training and is starting the machine too far past the foul line.
  - h. Tail plank missing from pin deck. (Look for missing tail planks.)

**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. The return distance will have to be adjusted while the machine is configured to operate this way. Go to the SYSTEM CONTROL CLEANING menu to adjust the return distance.*



## Drive System Problems that Do Not Display Errors

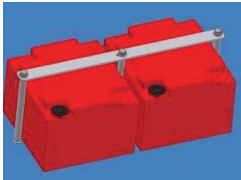
There are a number of things that can go wrong with the Drive System and the machine will appear to operate poorly. Most of these problems can be corrected before the machine fails, but only if the operator is paying attention. **Checking the drive speeds as the machine runs is a good thing! It is kind of fun to have a machine with no cord to watch!**

1. Machine has a jerky motion to it.
  - a. Drive chain is loose.
  - b. Sprocket is loose and is destroying the motor shaft and keyway.
2. Machine jerks when shifting to next speed.
  - a. Acceleration trimpot needs adjusted clockwise on speed control.
3. Machine takes too long to ramp up to next speed.
  - a. Acceleration trimpot needs to be adjusted counter-clockwise on speed control.
4. Machine comes to sudden stop, not smooth controlled stops.
  - a. Deceleration trimpot needs to be adjusted clockwise on speed control.
5. Machine takes too long to ramp down to next speed.
  - a. Deceleration trimpot needs to be adjusted counter-clockwise on speed control.

# CHAPTER 5

## Battery Power and Charging Systems

### Battery



The Kustodian ION Model B uses two (2) Odyssey batteries: Absorbed Glass Mat (AGM) or Regular batteries

**Regular Battery:** Two Odyssey™ AGM dry cell batteries are connected in series to produce 25.6 Volts fully charged. These are nonspillable batteries and can be mounted on their side. The batteries should be recharging any time the machine is not in use, but make sure the charger has adequate ventilation.

In large centers, opportunity charging may need to be done to the AGM batteries. Any time you stop to fill the supply tank or dump the recovery tank is time that can be used to charge the batteries. If storing the batteries for an extended period of time, make sure they are fully charged and disconnect the negative battery cable to eliminate discharge during storage.

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

**WARNING!** Do not use a battery that is not authorized by Kegel in this machine.  
**DO NOT USE FLOODED ACID BATTERIES** in this machine.

**Battery Disposal:** Always properly recycle your lead acid battery by returning it to an authorized recycling center or automotive dealer.



**NEVER PLACE USED BATTERIES IN YOUR REGULAR TRASH!**

## Fuse Link



The regular capacity batteries (Odyssey) are fused with a 40 Amp fuse between the two batteries. Model A machines used a GLASS AGU fuse, which has been discontinued from production. Picture shows a machine without the battery door.



The Model B machine was originally equipped with a mini ANL type fuse, which was replaced with a MAXI fuse (automotive-style Blade Fuse). This fuse link provides an additional safeguard that will prevent serious injury to the operator and protect the machine's vital electrical components in the event that there is a short between the batteries. Picture to the left shows the Model B machine with the battery door.



The automotive-style fuse replaces the other two types. It is located in the in-line fuse link housing that is attached to the inside terminals of both batteries. If necessary, replacement fuses and fuse links are available from your Distributor. Always check for the correct type before ordering. Kegel recommends upgrading to the newer automotive-style link (Part Number 154-8421) if a replacement is necessary.



**NOTE:** *Disconnect the battery charger from the batteries before replacing the fuse.*

The lithium-ion XL (Extended Life) Batteries do not have this fuse link. Additional hardware, such as the U-BDI, is connected to the batteries as a protective device.

## Battery Cycle Life

The Odyssey Batteries (AGM) are capable of 400 charge/discharge cycles to 80% depth of discharge (DOD). That is equal to doing 32 lanes once-a-day or 16 lanes twice-a-day for about a year (365 days). When the batteries are brand new they can complete a maximum of about 50 lanes on a full charge, depending on machine pattern settings. As the batteries age the maximum number of lanes per charge will tend to decrease.

Battery life depends tremendously on the correct charging voltage so we can't say enough about monitoring your charging voltage.

## Battery Charger

### Pro Tech Charger

When the charger is plugged in, it will go through 3 stages of charging (**CHARGING, CONDITIONING & READY**). The green light on the charger is an indicating light notifying the user as to what stage the charging cycle is in. The first stage, the **CHARGING** stage, produces an output voltage of around 29.0 volts and will stay in this state for approximately 1 hour or so, depending on beginning voltage.

After the initial Charging stage, the charger will go into the second stage of the cycle, called the **CONDITIONING** charge. During this stage the output voltage will drop to around 28.0 volts during this time. This process will take approximately around 4 or so hours to complete.

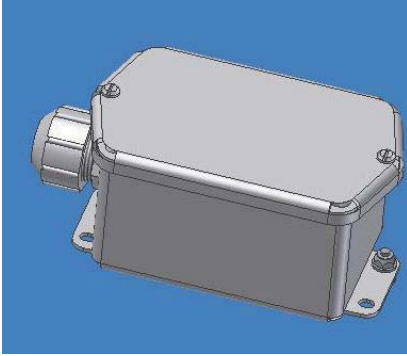
The last stage of the charging cycle is the **READY** stage. Once the charger has reached the Ready stage, the charging process is complete and the charger output voltage will maintain 27.0 volts.

Once the machine has been on charge for 6 plus hours you can safely remove the plug from the lane machine. Once the machine has been off the charger for approximately 15 minutes, the voltage on the machine should be around 25.6 volts.

*Note:* How far you discharge the batteries will have an impact on how long it will take to fully charge the batteries!



## Constant Voltage Regulator (CVR)



The CVR is located under the PLC and relay plate. 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.

There is a voltage check point attached to the CR3 relay in case the voltmeter was to fail. Here is where you can plug your meter in to check the CVR voltage. The CVR is protected by an internal user replaceable fuse.

**DO NOT attempt to adjust the CVR voltage unless authorized to do so by KEGEL!**

## Voltmeter

This machine is equipped with an LCD Volt screen and toggle switch. The toggle is a momentary on / momentary off spring-loaded switch. This means you have to hold the switch to the left to check the voltage from the CVR (constant voltage regulator) and hold it to the right to check the voltage from the batteries (or charger).



***CAUTION: DO NOT check voltage when machine is operating on the lane, this could cause damage to the meter. It is best to do this test with a hand held volt meter at the available voltage check points.***

It is recommended that you only use this screen as a troubleshooting tool. The far right digit will only read in even numbers.

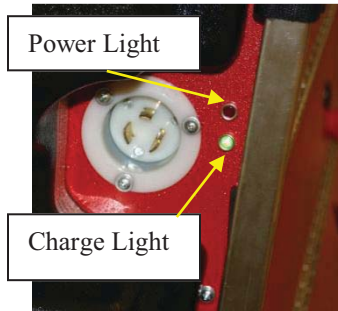
To use the voltmeter, press the toggle switch to the **right** and you will read the charger voltage when charging, unplug the charger and you can read the battery voltage.

Press the toggle switch to the **left** and you will read the CVR output voltage. The CVR voltage will always be at 26.2 - 26.6 volts unless the charger is plugged in.

If the batteries are charging, refer to the Pro Tech charger section as to what voltage should be present.

It is recommended that you check the charging voltage daily. **The E-Stop will need to be turned on to check voltages. This is the only way to know if there is a possible charging problem before you get to the lanes. Do NOT check the voltage while the machine is running on the lane, damage will occur to the LCD Volt Screen.**

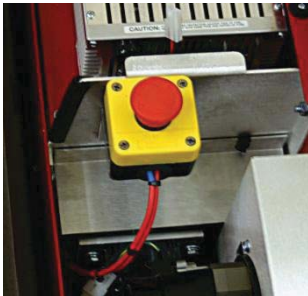
## Indicating Lights



There are two indicating lights on the side of the machine next to the power cord inlet. The RED one will indicate the machine has AC power applied and the charger should be working.

The GREEN light will indicate the E-Stop is turned on and the machine is ready to run.

## **E-Stop**



The E-Stop is located to the right of the charger and is used to remove battery power from the machine. 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 restarted.**

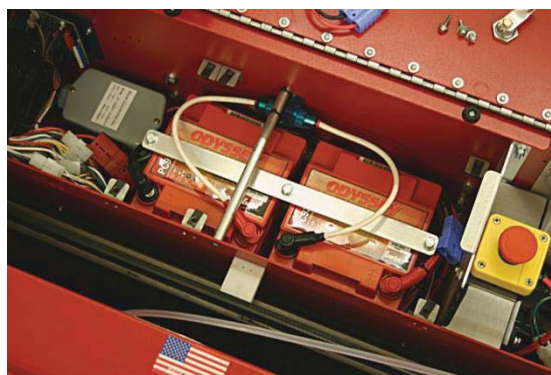
## **Running with the Power Cord**

The machine can be run off the cord when there is a battery or charging problem, provided it is not the charger at fault. Simply plug the machine in with the supplied power cord assembly and run the machine like normal.

## Replacing Batteries

### Replacing batteries in machines WITH the Battery Door

1. First, turn the E-Stop OFF. **Power to the machine must be turned OFF.**
2. Remove the fasteners on bottom of the machine and open the battery compartment.
3. Because the batteries are heavy, use caution when sliding them out of the machine. Do not apply downward pressure! Secure the machine so it can't fall over from improper weight balance.
4. Remove the fuse link first using a 10 mm socket. The fuse link is used as protection on the Odyssey batteries only. Once removed, this will disable both batteries.
5. Remove the negative wire on the left battery and then remove the positive wire on the right battery.
6. Remove the mounting hardware.
7. Remove batteries. BE CAREFUL! Each regular battery weighs about 26 lbs.
8. 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 connections at the batteries will cause operating problems and may simulate dead batteries.
9. Close compartment door and replace the fasteners, making sure all bolts are tight.
10. Set the machine down and turn power on to check the charger and battery voltage.



*Odyssey Batteries with original Fuse Link*

## Troubleshooting Battery & Charging Problems

Battery problems are not 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..... it may be something we can live with.

Battery connections can be very deceiving. You can read voltage on a fully charged battery, but just as soon as a load is introduced, it's gone. So when it comes to 24 Volt battery connections you must have nothing less than perfect connections! 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 is a list of all of the locations between the batteries and the machine control plate.

*Always turn OFF E-Stop when inspecting connections.*

1. Battery terminals (4 locations).
2. Fuse link between AGM batteries.
3. Colored 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 on batteries or cord.**

Voltmeter shows charger is output is 27.2 volts but batteries are dead. It is possible for the voltmeter to show proper charging float voltage but the connection is not good enough to operate machine or charge batteries.

1. Loose connection between the two batteries or fuse link is the most common cause.
2. Bad Fuse.
3. Loose connection between charger and batteries.
4. Loose battery terminal. Check ALL connections.
5. Faulty charger and/or dead batteries.

**Machine runs but the number of lanes have been reduced or are 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 or is set too low. Check voltage and refer back to adjustments in this section.
2. Charger operates intermittently. Battery charger has internal bad connection.
3. Vacuum is drawing more amps.
4. Machine run time is longer.



5. Possible bad connection between charger and batteries.
6. Possible battery problem.

**Batteries are not charging.**

Charger shows no output voltage.

1. Charger has failed.
2. Blown internal fuse.
3. Open or very bad connection between charger and batteries.

**CVR is not working.**

1. Fuse blown inside CVR.
2. CVR is unplugged.
3. Bad connection to CVR
4. CVR has failed.

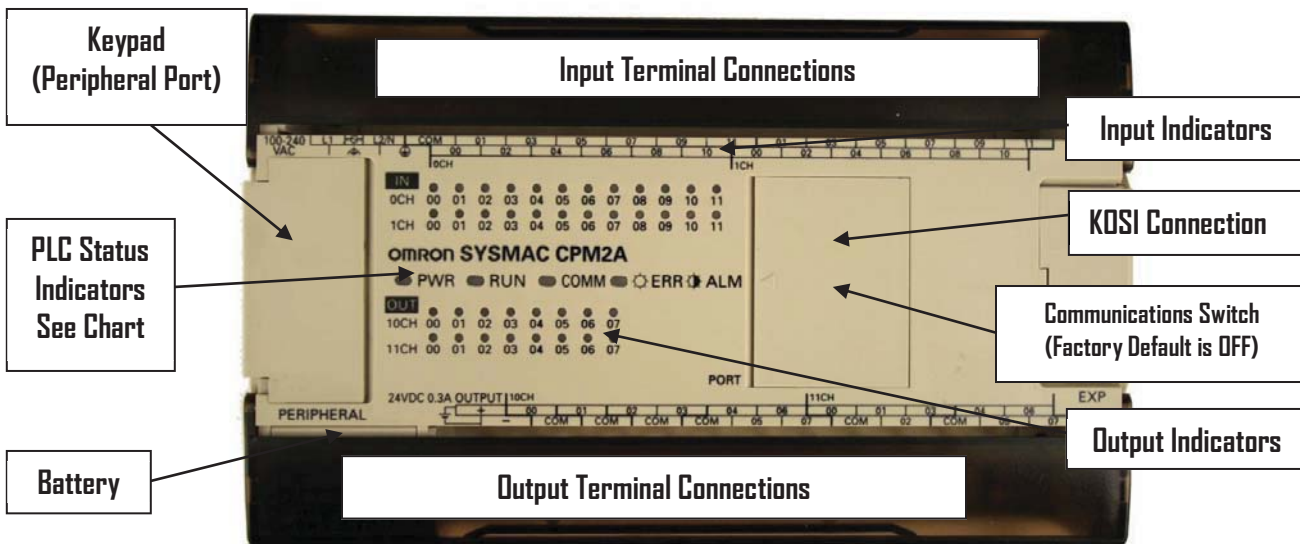
**CVR not maintaining set voltage.**

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<br>(green)     | ON       | Power is being supplied to the PC.                                    |
|                    | OFF      | Power isn't being supplied to the PC.                                 |
| RUN<br>(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<br>(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<br>(red) | ON       | A fatal error has occurred. (PC operation stops.)                     |
|                    | Flashing | A non-fatal error has occurred. (PC operation continues.)             |
|                    | OFF      | Indicates normal operation.   |

## **Inputs and Testing**

The PLC assembly of the machine has 24 inputs and 16 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:

| <b><u>INPUT</u></b> | <b><u>DESCRIPTION</u></b>            | <b><u>WIRE COLOR</u></b> |
|---------------------|--------------------------------------|--------------------------|
| 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             | VIOLT / YELLOW           |
| 0CH 06              | DRIVE SHAFT TACHOMETER PROX SENSOR   | BLACK / BLUE             |
| 0CH 07              | LANE DISTANCE PROXIMITY SENSOR (LDS) | WHITE / PINK             |
| 0CH 08              | START BUTTON (HANDLE)                | VIOLET                   |
| 0CH 09              | OIL ONLY SWITCH                      | GRAY / GREEN             |
| 0CH 10              | DUSTER UP SWITCHES (2)               | GREEN / BLACK            |
| 0CH 11              | CLEAN ONLY SWITCH                    | GRAY / PINK              |
| 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              | CLEANER PRESOAK BUTTON               | WHITE / ORANGE           |

The following three Inputs are programmed to be a redundant back-up to the Input shown above. In an emergency, these Inputs can be used by activating them with a jumper wire. Call Tech Support at 863-734-0200 for assistance.

### **These Inputs are designated on the PLC as:**

| <b><u>INPUT</u></b> | <b><u>DESCRIPTION:</u></b>        |
|---------------------|-----------------------------------|
| 1CH 06              | BACK-UP PROGRAM RESET             |
| 1CH 10              | BACK-UP RESET FOR DUSTER          |
| 1CH 11              | BACK-UP DUSTER INCREMENT FUNCTION |

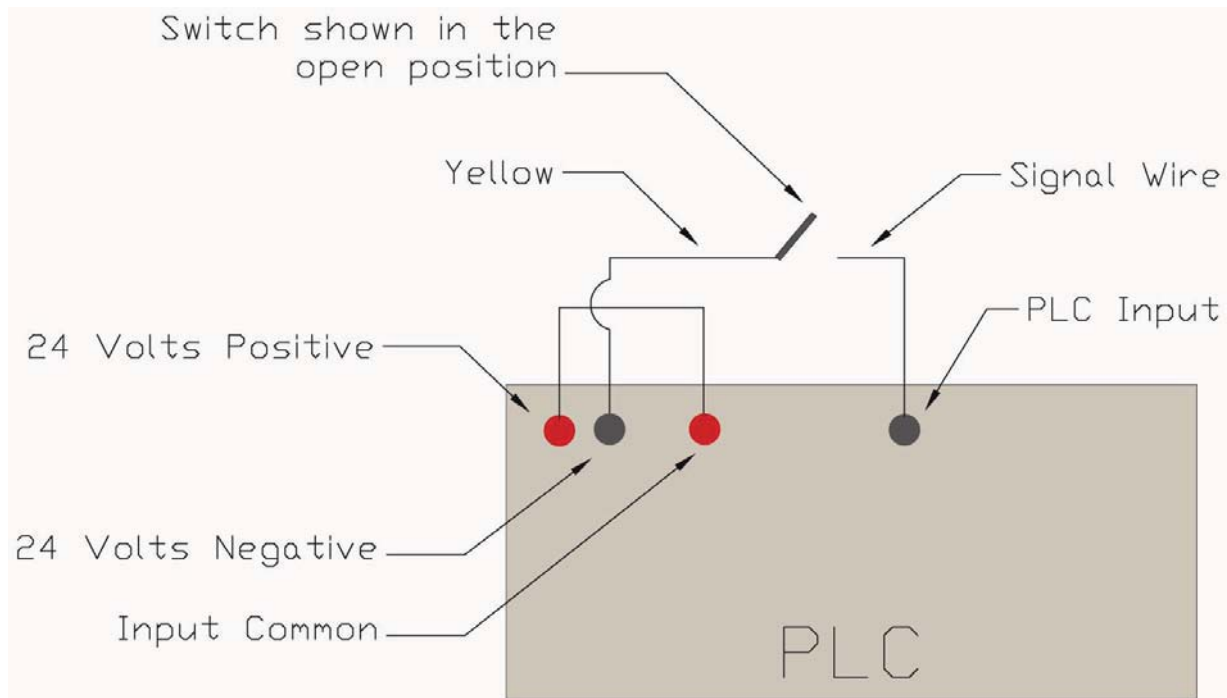
### *Inputs and Testing Continued...*

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 next two wiring drawings will show the simplest way a switch and proximity sensor connect to the PLC.

The first one shown below is an example of a typical input circuit using a microswitch. One side of the microswitch goes to the PLC Input and the other side of the microswitch 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.

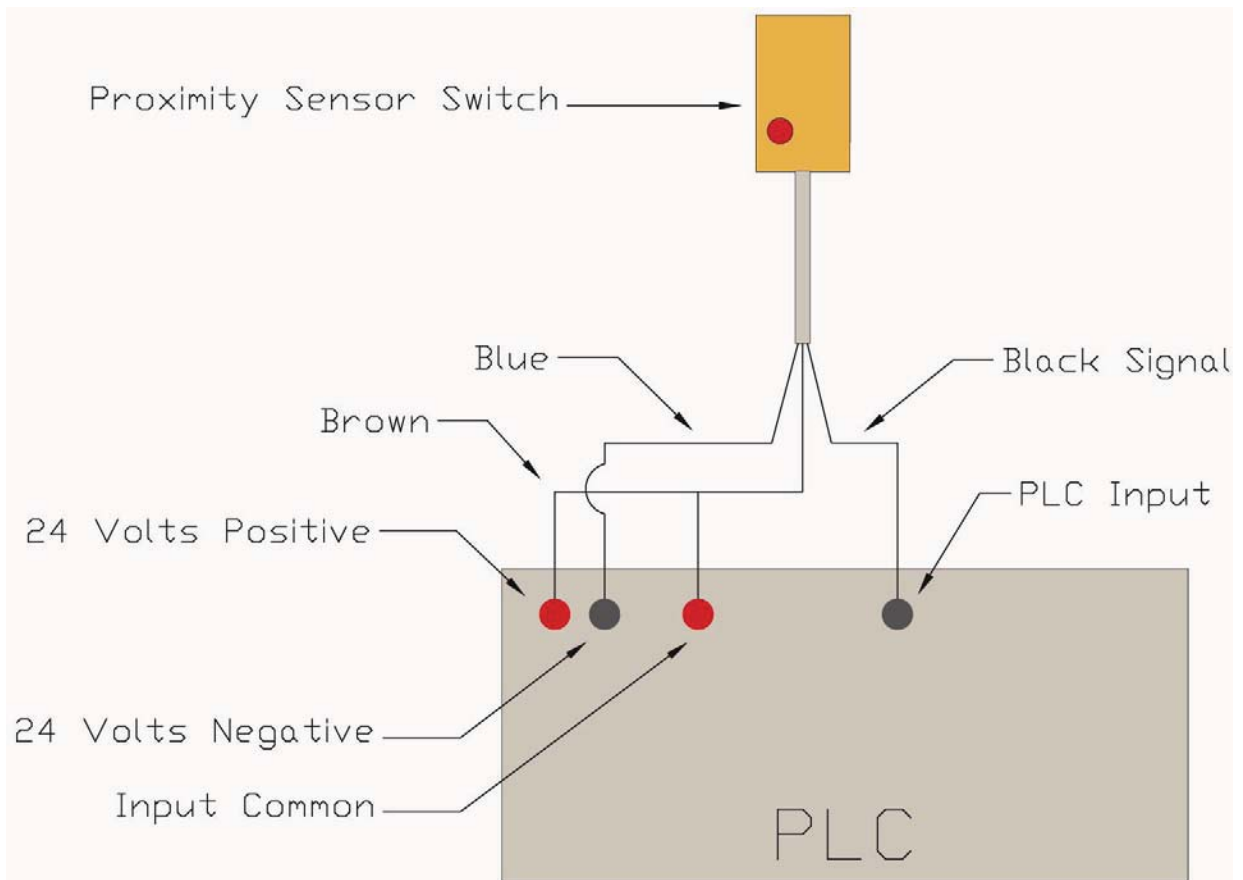
**All of the machine switches are wired like this. The only difference is that the wires will pass through plugs and junction blocks.**



### *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 machines' Proximity Sensor Switches are wired like this; the only difference is that the wires will pass through plugs and junction blocks.



## Outputs and Testing

Here is a list of the **OUTPUT** numbers for the PLC along with their Test Output number, wire color and designations:

| <u>OUTPUT</u> | <u>TEST #</u> | <u>DESCRIPTION</u>           | <u>WIRE COLOR</u> |
|---------------|---------------|------------------------------|-------------------|
| 10CH 00       | #08           | OIL PROGRAM CONTROL VALVE    | ORANGE            |
| 10CH 01       | #02           | SR1 SPEED RELAY              | WHITE / RED       |
| 10CH 02       | #01           | FORWARD DRIVE                | GREEN / ORANGE    |
| 10CH 03       | #03           | REVERSE DRIVE                | YELLOW / VIOLET   |
| 10CH 04       | #04           | SR2 SPE ED RELAY             | WHITE / GREEN     |
| 10CH 05       | #05           | SR3 SPEED RELAY              | BLACK / PINK      |
| 10CH 06       | #06           | SR4 SPEED RELAY              | YELLOW / ORANGE   |
| 10CH 07       | #10           | OIL PUMP                     | RED / BROWN       |
| 11CH 00       | #17           | LEFT TO RIGHT OIL HEAD DRIVE | GRAY              |
| 11CH 01       | #16           | RIGHT TO LEFT OIL HEAD DRIVE | YELLOW / RED      |
| 11CH 02       | #09           | BRUSH LIFT MOTOR             | WHITE / BLACK     |
| 11CH 03       | #11           | SQUEEGEE MOTOR               | BLUE / WHITE      |
| 11CH 04       | #12           | DUSTER UNWIND                | GREEN / BLUE      |
| 11CH 05       | #13           | DUSTER WINDUP                | GREEN / RED       |
| 11CH 06       | #15           | CLEANER PUMP MOTOR           | BLUE / YELLOW     |
| 11CH 07       | #14           | VACUUM MOTOR                 | BLUE / BLACK      |

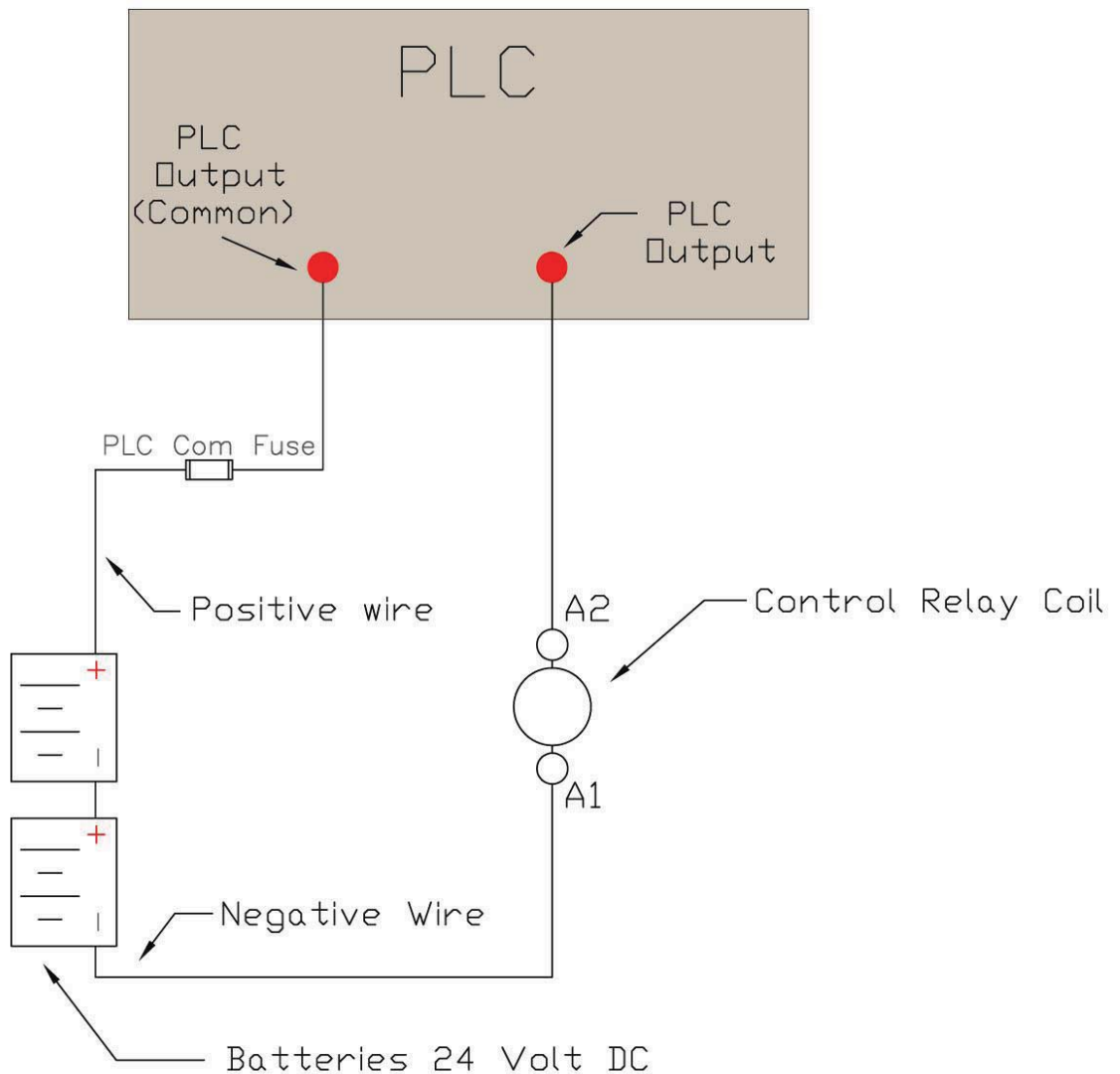
**NOTE:** The **Buffer Motor** does not have a direct output that operates its relay. The buffer motor relay operates when the brush down switch (Normally Open) contacts close, when the Oil Pump Relay turns on, and when either of the Forward or Reverse Relays turn on.

**NOTE:** Test Output #07 not listed above is a combination of output **10CH 05** and **10CH 06** turning on to operate the drive motor in high speed.

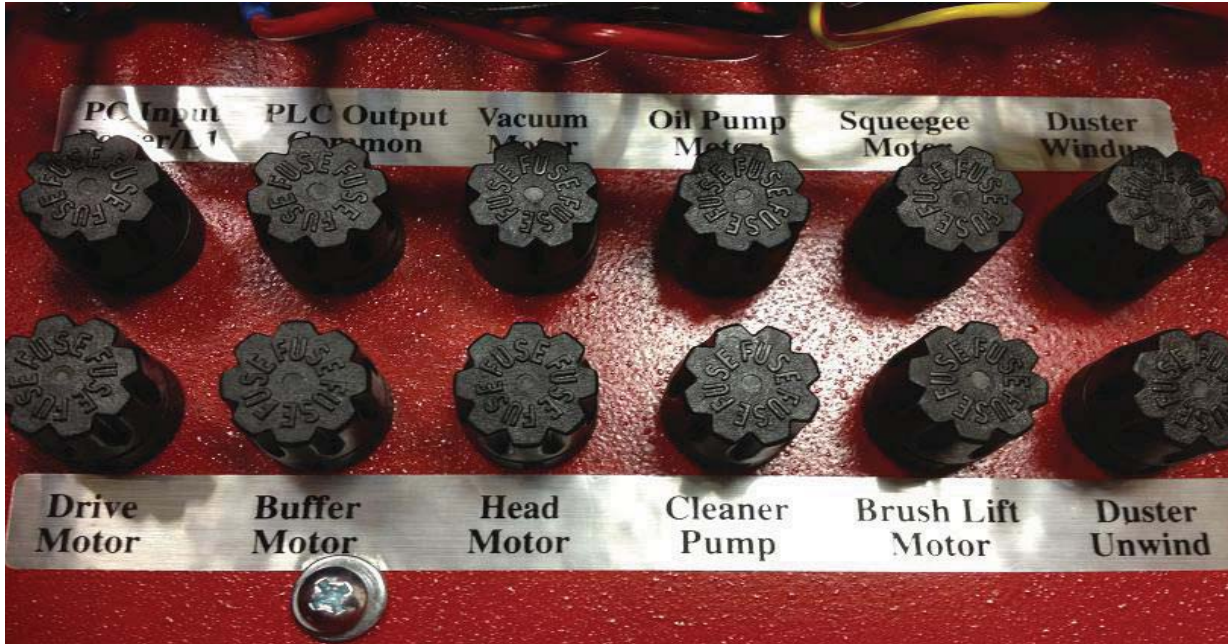
## Testing

Here is an example how the PLC output is wired to the isolation Control Relay. When the PLC output turns on the control relay coil 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.



## Fuses



Mounted on the control plate are several slow-blow fuses and a circuit breaker to protect your ION.

- PLC Power Fuse - 0.5A (PLC Input Power / L1)
- PLC Common Fuse - 0.5A (PLC Output Common)
- Vacuum Motor Circuit Fuse - 20A
- Conditioner Pump Fuse - 4A (Oil Pump Motor)
- Squeegee Lift Fuse - 3.2A
- Duster Windup Fuse - 3.2A
- Drive Motor Fuse - 7.5A
- Buffer Fuse - 10A
- Oil and Cleaner Head Fuse - 0.75A (Head Motor)
- Cleaner Pump Fuse - 3.2A
- Brush Lift Fuse - 3.2A
- Duster Unwind Fuse - 3.2A

Mounted on the Odyssey batteries is another fuse to protect your ION.

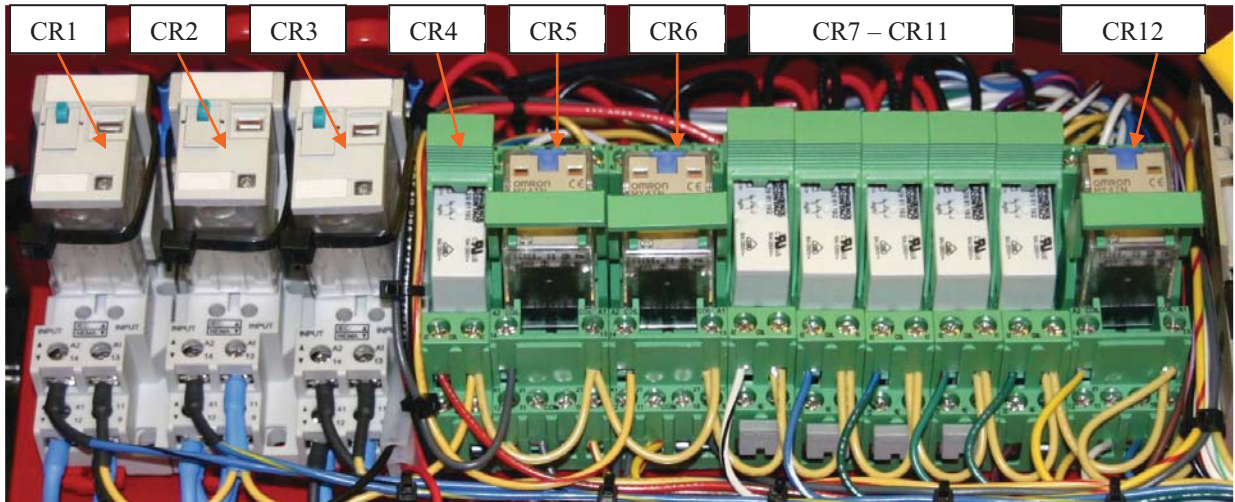
- In-line Fuse between AGM Batteries - 40A (Not used on XL Batteries)



Do not over-amp fuses. If you can't find the direct replacement you will cause damage to the smaller motors.



## Control Relays



All of the components on the Kustodian ION are isolated from the PLC (except for the Oil Control Valve since the PLC operates it directly). When we say isolated, we mean 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 internal PLC relays.

The machine has 12 replaceable control relays that operate ALL the motors of the machine and 4 speed control relays that are not replaceable. (Speed relays can be replaced, but not easily.)

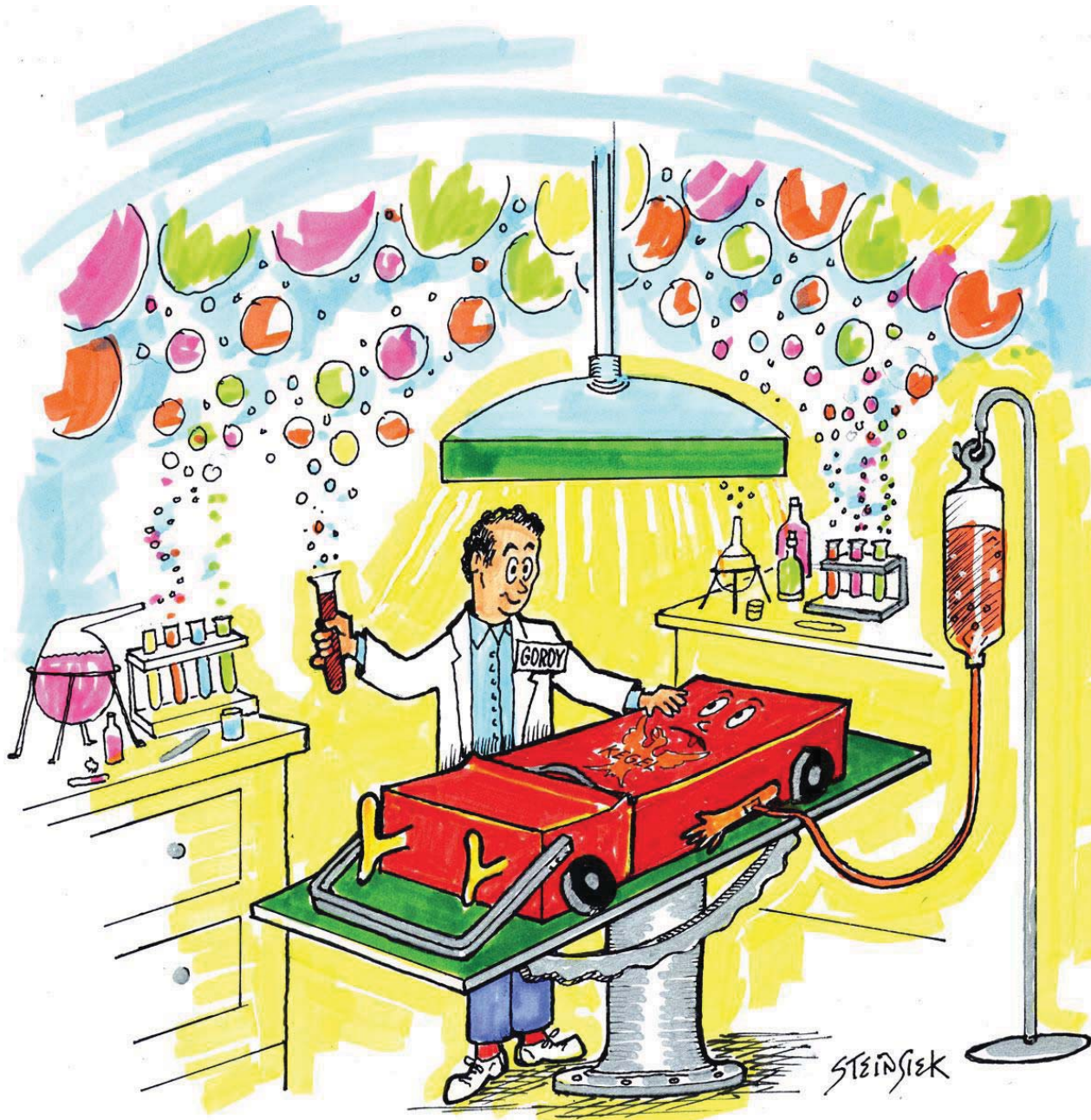
**Control Relays 1 - 4 & 7 - 11** are two-pole | **Control Relays 5, 6, & 12** are four-pole relays.

- **CONTROL RELAY 1:** Vacuum Motor
- **CONTROL RELAY 2:** Cleaner Pump Motor
- **CONTROL RELAY 3:** Buffer Motor
- **CONTROL RELAY 4:** Oil Pump Motor and Buffer Motor
- **CONTROL RELAY 5:** Oil/Cleaner Head Motor (Left to Right Direction)
- **CONTROL RELAY 6:** Oil/Cleaner Head Motor (Right to Left Direction)
- **CONTROL RELAY 7:** Brush Lift Motor
- **CONTROL RELAY 8:** Squeegee Lift Motor
- **CONTROL RELAY 9:** Duster Unwind Motor.
- **CONTROL RELAY 10:** Duster Windup Motor.
- **CONTROL RELAY 11:** Forward Operation of the Drive Motor & Buffer Motor.
- **CONTROL RELAY 12:** Reverse Operation of the Drive Motor, Buffer Motor, and reverses the voltage to the Cleaner Pump (to prevent drips).
- **OPERATION TOGGLE SWITCH:** This switch controls whether the program will CLEAN only, CONDITION only, or CLEAN and CONDITION at the same time. The machine will NOT calibrate the Pump Output if switch is set to CLEAN ONLY.



## Troubleshooting

Visit [www.kegel.net](http://www.kegel.net) or call KEGEL Tech Support at 863-734-0200.



# CHAPTER 7

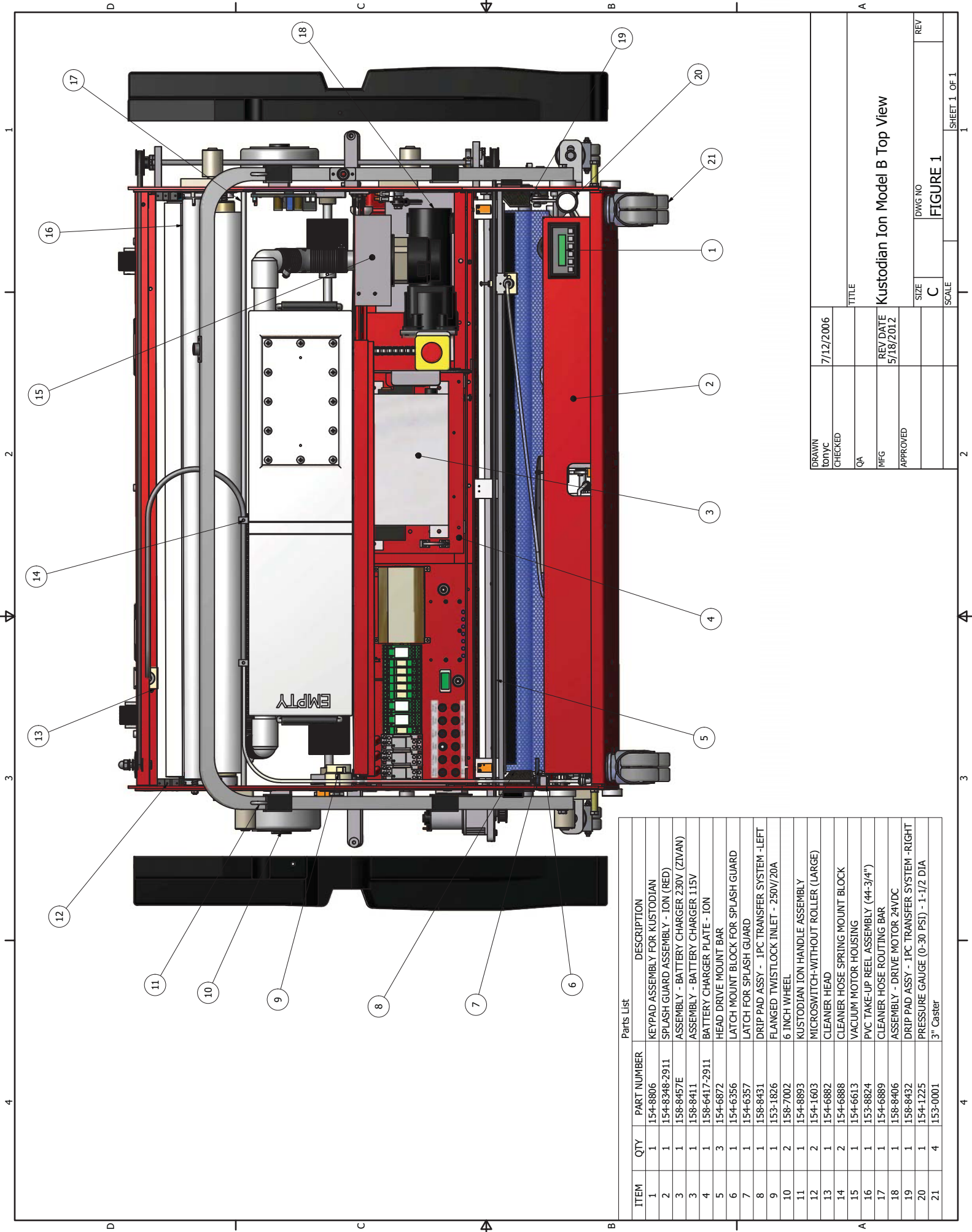


## Mechanical Drawings

### Machine Descriptions and Part Numbers

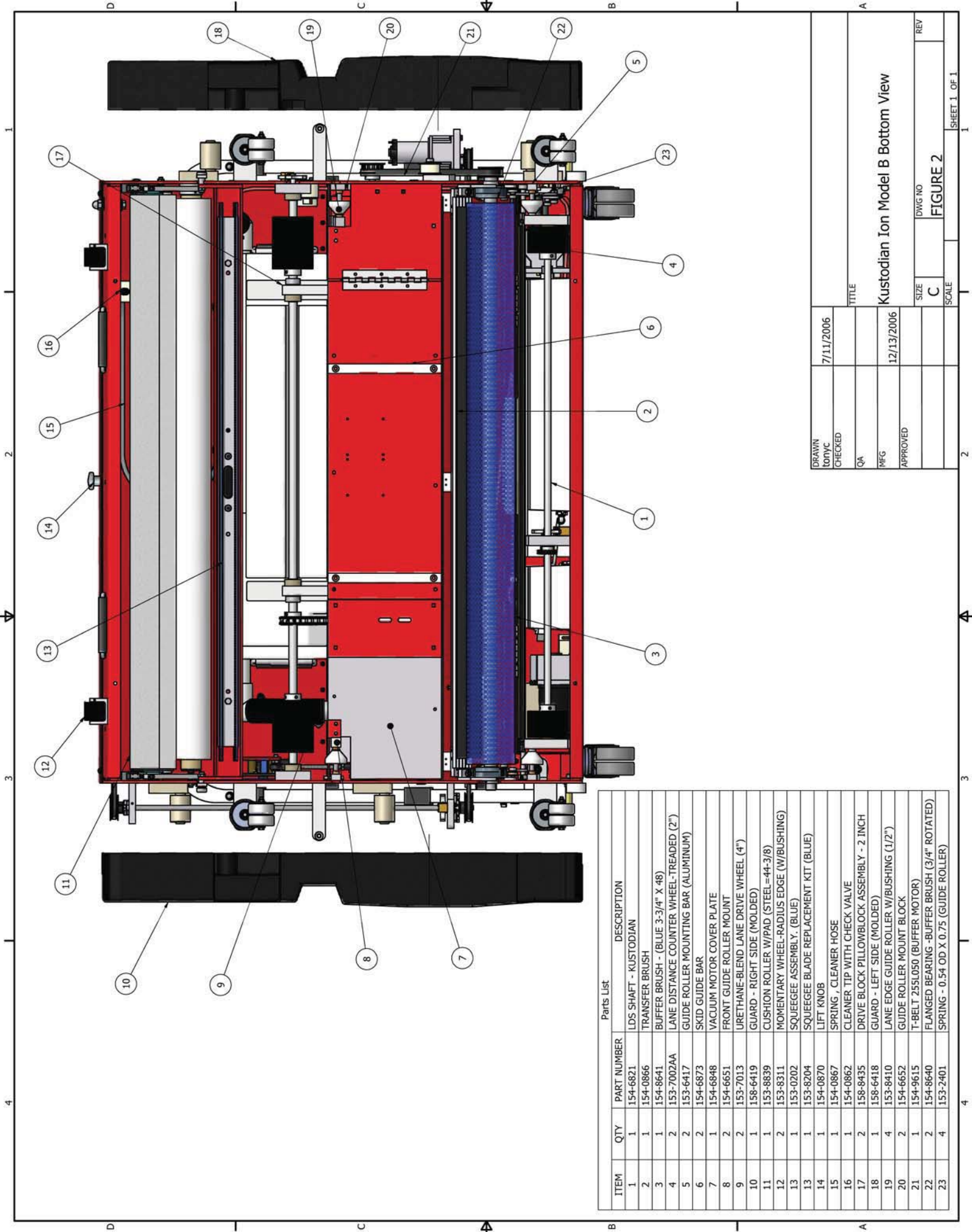
The following figures show major systems for the Walker and the Ion and the associated parts:

|  |     |
|--|-----|
| Figure 1 – Kustodian ION (Top View) .....              | 115 |
| Figure 2 – Kustodian ION (Bottom View).....            | 116 |
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| Figure 5 – PLC Plate Assembly .....                    | 119 |
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| Figure 14 – Duster Assembly .....                      | 128 |
| Figure 15 – Oil Transfer Assembly .....                | 129 |
| Figure 16 – Drive Shaft Assembly .....                 | 130 |
| Figure 17 – 6” Caster Wheel Assembly .....             | 131 |



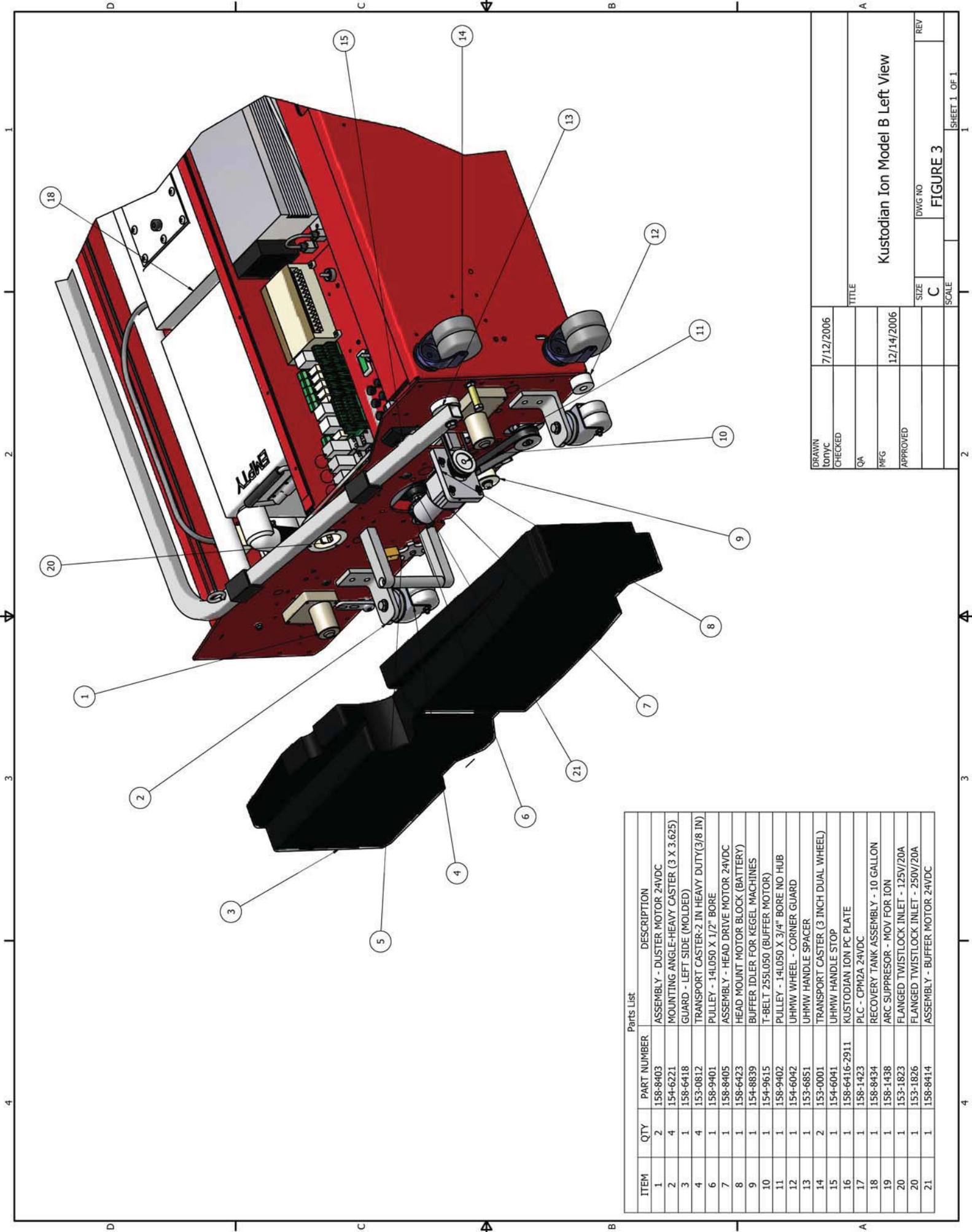
| ITEM | QTY | PART NUMBER   | DESCRIPTION                                 |
|------|-----|---------------|---|
| 1    | 1   | 154-8806      | KEYPAD ASSEMBLY FOR KUSTODIAN               |
| 2    | 1   | 154-8348-2911 | SPLASH GUARD ASSEMBLY - ION (RED)           |
| 3    | 1   | 158-8457E     | ASSEMBLY - BATTERY CHARGER 230V (ZIVAN)     |
| 3    | 1   | 158-8411      | ASSEMBLY - BATTERY CHARGER 115V             |
| 4    | 1   | 158-6417-2911 | BATTERY CHARGER PLATE - ION                 |
| 5    | 3   | 154-6872      | HEAD DRIVE MOUNT BAR                        |
| 6    | 1   | 154-6356      | LATCH MOUNT BLOCK FOR SPLASH GUARD          |
| 7    | 1   | 154-6357      | LATCH FOR SPLASH GUARD                      |
| 8    | 1   | 158-8431      | DRIP PAD ASSY - .1PC TRANSFER SYSTEM -LEFT  |
| 9    | 1   | 153-1826      | FLANGED TWISTLOCK INLET - 250V/20A          |
| 10   | 2   | 158-7002      | 6 INCH WHEEL                                |
| 11   | 1   | 154-8893      | KUSTODIAN ION HANDLE ASSEMBLY               |
| 12   | 2   | 154-1603      | MICROSWITCH-WITHOUT ROLLER (LARGE)          |
| 13   | 1   | 154-6882      | CLEANER HEAD                                |
| 14   | 2   | 154-6888      | CLEANER HOSE SPRING MOUNT BLOCK             |
| 15   | 1   | 154-6613      | VACUUM MOTOR HOUSING                        |
| 16   | 1   | 153-8824      | PVC TAKE-UP REEL ASSEMBLY (44-3/4")         |
| 17   | 1   | 154-6889      | CLEANER HOSE ROUTING BAR                    |
| 18   | 1   | 158-8406      | ASSEMBLY - DRIVE MOTOR 24VDC                |
| 19   | 1   | 158-8432      | DRIP PAD ASSY - .1PC TRANSFER SYSTEM -RIGHT |
| 20   | 1   | 154-1225      | PRESSURE GAUGE (0-30 PSI) - 1-1/2 DIA       |
| 21   | 4   | 153-0001      | 3" Caster                                   |

|                |           |          |                                |
|----------------|-----------|----------|--------------------------------|
| DRAWN<br>IonyC | 7/12/2006 | TITLE    | Kustodian Ion Model B Top View |
| CHECKED        |           | REV/DATE | 5/18/2012                      |
| QA             |           | APPROVED |                                |
| MFG            |           | SIZE     | C                              |
| DWG NO         |           | SCALE    |                                |
| REV            |           |          | FIGURE 1                       |



| ITEM | QTY | PART NUMBER | DESCRIPTION                                   |
|------|-----|-------------|---|
| 1    | 1   | 154-6821    | LDS SHAFT - KUSTODIAN                         |
| 2    | 1   | 154-0866    | TRANSFER BRUSH                                |
| 3    | 1   | 154-8641    | BUFFER BRUSH - (BLUE 3-3/4" X 48)             |
| 4    | 2   | 153-7002AA  | LANE DISTANCE COUNTER WHEEL-TREADED (2")      |
| 5    | 2   | 153-6417    | GUIDE ROLLER MOUNTING BAR (ALUMINUM)          |
| 6    | 2   | 154-6873    | SKID GUIDE BAR                                |
| 7    | 1   | 154-6848    | VACUUM MOTOR COVER PLATE                      |
| 8    | 2   | 154-6651    | FRONT GUIDE ROLLER MOUNT                      |
| 9    | 2   | 153-7013    | URETHANE-BLEND LANE DRIVE WHEEL (4")          |
| 10   | 1   | 158-6419    | GUARD - RIGHT SIDE (MOLDED)                   |
| 11   | 1   | 153-8839    | CUSHION ROLLER W/PAD (STEEL=44-3/8)           |
| 12   | 2   | 153-8311    | MOMENTARY WHEEL-RADIUS EDGE (W/BUSHING)       |
| 13   | 1   | 153-8204    | SQUEEGEE ASSEMBLY. (BLUE)                     |
| 14   | 1   | 154-0870    | LIFT KNOB                                     |
| 15   | 1   | 154-0867    | SPRING , CLEANER HOSE                         |
| 16   | 1   | 154-0862    | CLEANER TIP WITH CHECK VALVE                  |
| 17   | 2   | 158-8435    | DRIVE BLOCK PILLOWBLOCK ASSEMBLY - 2 INCH     |
| 18   | 1   | 158-6418    | GUARD - LEFT SIDE (MOLDED)                    |
| 19   | 4   | 153-8410    | LANE EDGE GUIDE ROLLER W/BUSHING (1/2")       |
| 20   | 2   | 154-6652    | GUIDE ROLLER MOUNT BLOCK                      |
| 21   | 1   | 154-9615    | T-BELT 255L050 (BUFFER MOTOR)                 |
| 22   | 2   | 154-8640    | FLANGED BEARING - BUFFER BRUSH (3/4" ROTATED) |
| 23   | 4   | 153-2401    | SPRING - 0.54 OD X 0.75 (GUIDE ROLLER)        |

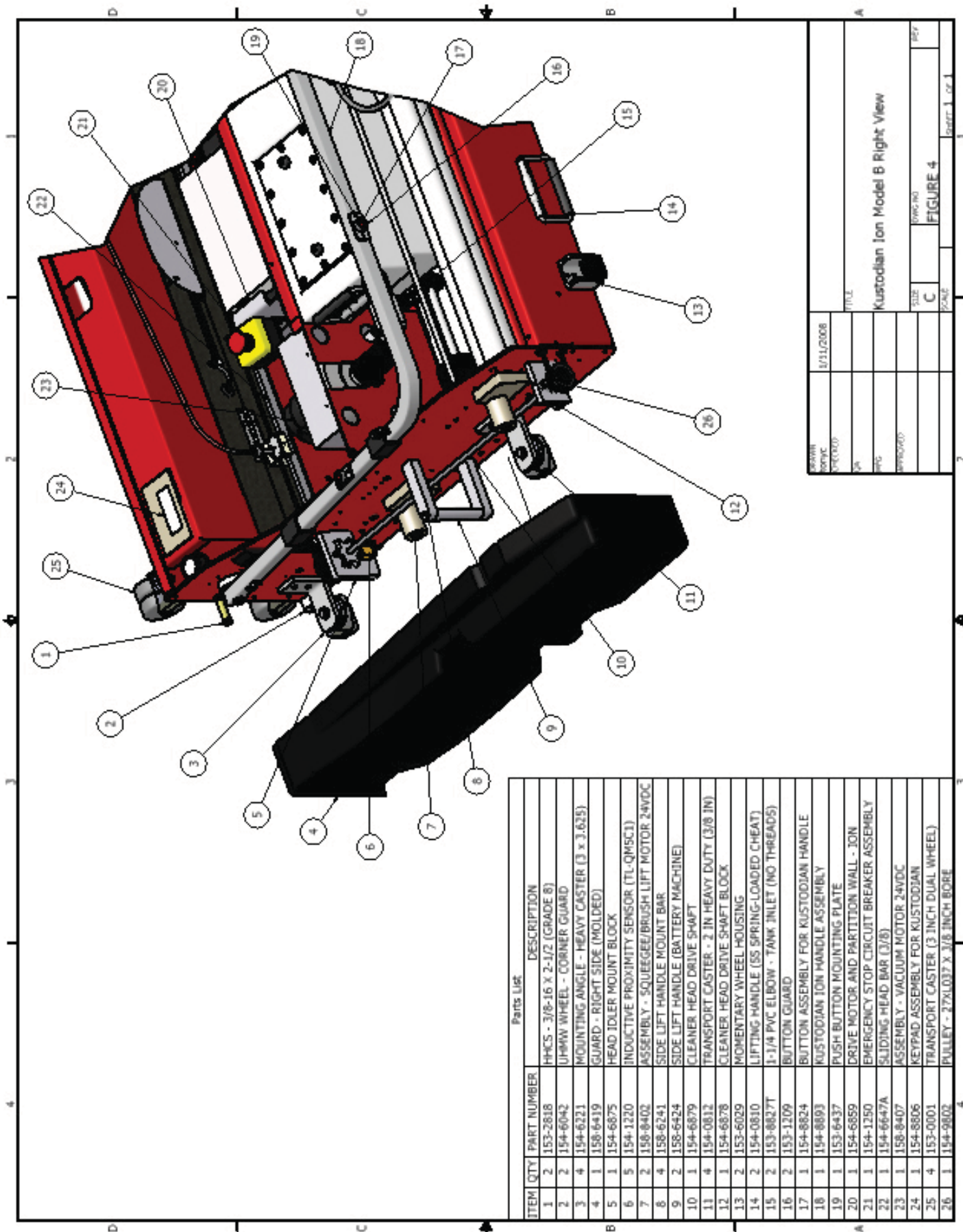
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| CHECKED  |            |        |              |
| QA       |            |        |              |
| MFG      | 12/13/2006 |        |              |
| APPROVED |            |        |              |
|          |            | SIZE   | C            |
|          |            | DWG NO | FIGURE 2     |
|          |            | SCALE  |              |
|          |            |        | SHEET 1 OF 1 |



Parts List

| ITEM | QTY | PART NUMBER   | DESCRIPTION                              |
|------|-----|---------------|--|
| 1    | 2   | 158-8403      | ASSEMBLY - DIUSTER MOTOR 24VDC           |
| 2    | 4   | 154-6221      | MOUNTING ANGLE-HEAVY CASTER (3 X 3.625)  |
| 3    | 1   | 158-6418      | GUARD - LEFT SIDE (MOLDED)               |
| 4    | 4   | 153-0812      | TRANSPORT CASTER-2 IN HEAVY DUTY(3/8 IN) |
| 6    | 1   | 158-9401      | PULLEY - 14L050 X 1/2" BORE              |
| 7    | 1   | 158-8405      | ASSEMBLY - HEAD DRIVE MOTOR 24VDC        |
| 8    | 1   | 158-6423      | HEAD MOUNT MOTOR BLOCK (BATTERY)         |
| 9    | 1   | 154-8839      | BUFFER IDLER FOR KEGEL MACHINES          |
| 10   | 1   | 154-9615      | T-BELT 255L050 (BUFFER MOTOR)            |
| 11   | 1   | 158-9402      | PULLEY - 14L050 X 3/4" BORE NO HUB       |
| 12   | 1   | 154-6042      | UHMW WHEEL - CORNER GUARD                |
| 13   | 1   | 153-6851      | UHMW HANDLE SPACER                       |
| 14   | 2   | 153-0001      | TRANSPORT CASTER (3 INCH DUAL WHEEL)     |
| 15   | 1   | 154-6041      | UHMW HANDLE STOP                         |
| 16   | 1   | 158-6416-2911 | KUSTODIAN ION PC PLATE                   |
| 17   | 1   | 158-1423      | PLC - CPM2A 24VDC                        |
| 18   | 1   | 158-8434      | RECOVERY TANK ASSEMBLY - 10 GALLON       |
| 19   | 1   | 158-1438      | ARC SUPPRESSOR - MOV FOR ION             |
| 20   | 1   | 153-1823      | FLANGED TWISTLOCK INLET - 125V/20A       |
| 20   | 1   | 153-1826      | FLANGED TWISTLOCK INLET - 250V/20A       |
| 21   | 1   | 158-8414      | ASSEMBLY - BUFFER MOTOR 24VDC            |

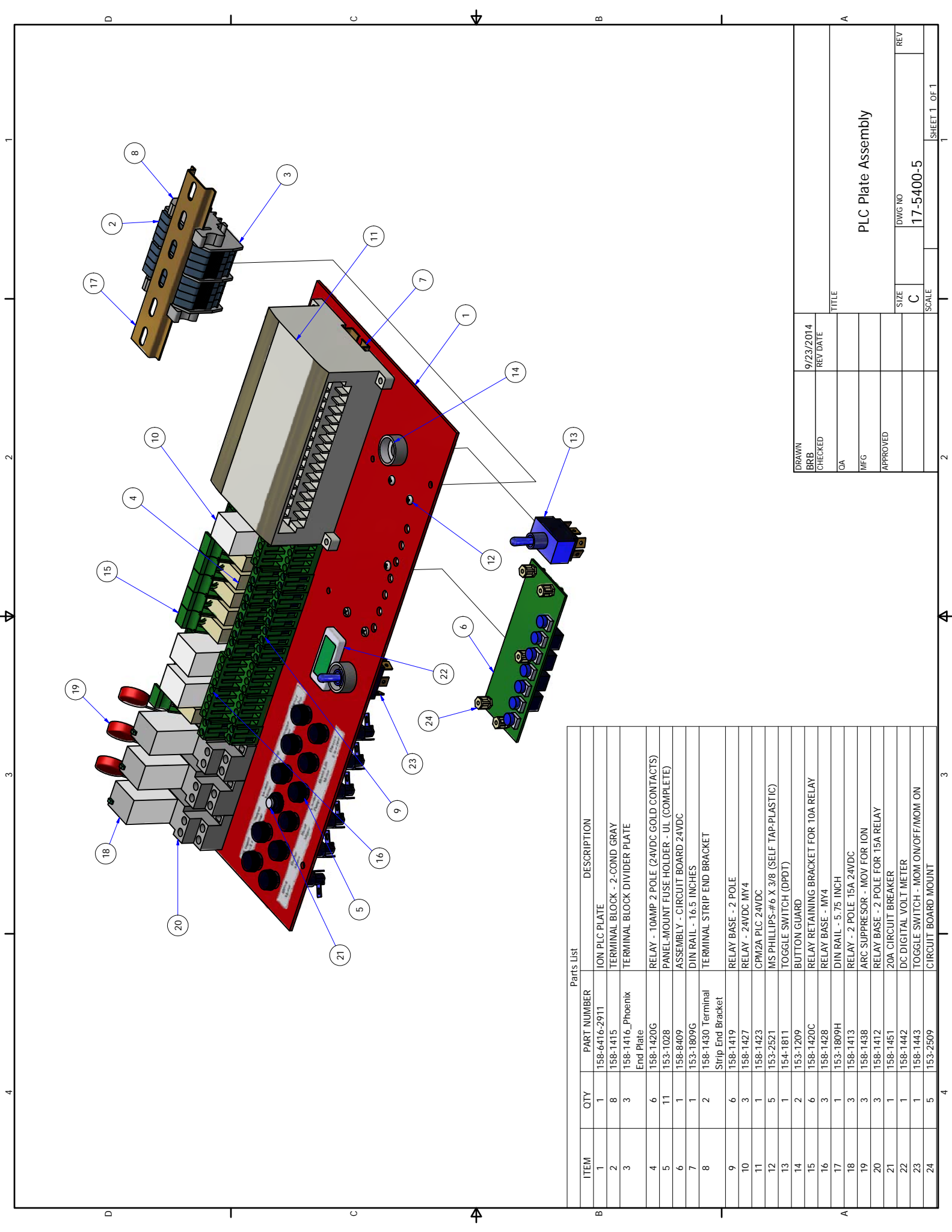
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|----------------|------------|----------|---------------------------------|
| DRAWN<br>TONYC | 7/12/2006  | TITLE    | Kustodian Ion Model B Left View |
| CHECKED        |            | DATE     |                                 |
| QA             |            | APPROVED |                                 |
| MFG            | 12/14/2006 | SIZE     | C                               |
| REV            |            | DWG NO   | FIGURE 3                        |
|                |            | SCALE    |                                 |



Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION                                 |
|------|-----|-------------|---|
| 1    | 2   | 153-2818    | HFCS - 3/8-16 X 2-1/2 (GRADE 8)             |
| 2    | 2   | 154-6042    | UPMWN WHEEL - CORNER GUARD                  |
| 3    | 4   | 154-6321    | MOUNTING ANGLE - HEAVY CASTER (3 X 3.625)   |
| 4    | 1   | 158-6419    | GUARD - RIGHT SIDE (MOLDED)                 |
| 5    | 1   | 154-6875    | HEAD IDLER MOUNT BLOCK                      |
| 6    | 5   | 154-1220    | INDUCTIVE PROXIMITY SENSOR (TL-QM5C1)       |
| 7    | 2   | 158-8402    | ASSEMBLY - SQUEEGEE/BRUSH LIFT MOTOR 24VDC  |
| 8    | 4   | 158-6241    | SIDE LIFT HANDLE MOUNT BAR                  |
| 9    | 2   | 158-6424    | SIDE LIFT HANDLE (BATTERY MACHINE)          |
| 10   | 1   | 154-6879    | CLEANER HEAD DRIVE SHAFT                    |
| 11   | 4   | 154-0812    | TRANSPORT CASTER - 2 IN HEAVY DUTY (3/8 IN) |
| 12   | 1   | 154-6878    | CLEANER HEAD DRIVE SHAFT BLOCK              |
| 13   | 2   | 153-6029    | MOMENTARY WHEEL HOUSING                     |
| 14   | 2   | 154-0810    | LIFTING HANDLE (SS SPRING-LOADED CHEAT)     |
| 15   | 2   | 153-8827T   | 1-1/4 PVC ELBOW - TANK INLET (NO THREADS)   |
| 16   | 2   | 153-1209    | BUTTON GUARD                                |
| 17   | 1   | 154-8824    | BUTTON ASSEMBLY FOR KUSTODIAN HANDLE        |
| 18   | 1   | 154-8893    | KUSTODIAN ION HANDLE ASSEMBLY               |
| 19   | 1   | 153-6437    | PUSH BUTTON MOUNTING PLATE                  |
| 20   | 1   | 154-6859    | DRIVE MOTOR AND PARTITION WALL - ION        |
| 21   | 1   | 154-1250    | EMERGENCY STOP CIRCUIT BREAKER ASSEMBLY     |
| 22   | 1   | 154-6647A   | SLIDING HEAD BAR (3/8)                      |
| 23   | 1   | 158-8407    | ASSEMBLY - VACUUM MOTOR 24VDC               |
| 24   | 1   | 154-8806    | KEYPAD ASSEMBLY FOR KUSTODIAN               |
| 25   | 4   | 153-0001    | TRANSPORT CASTER (3 INCH DUAL WHEEL)        |
| 26   | 1   | 154-9402    | PULLEY - 27X1.037 X 3/8 INCH BORE           |

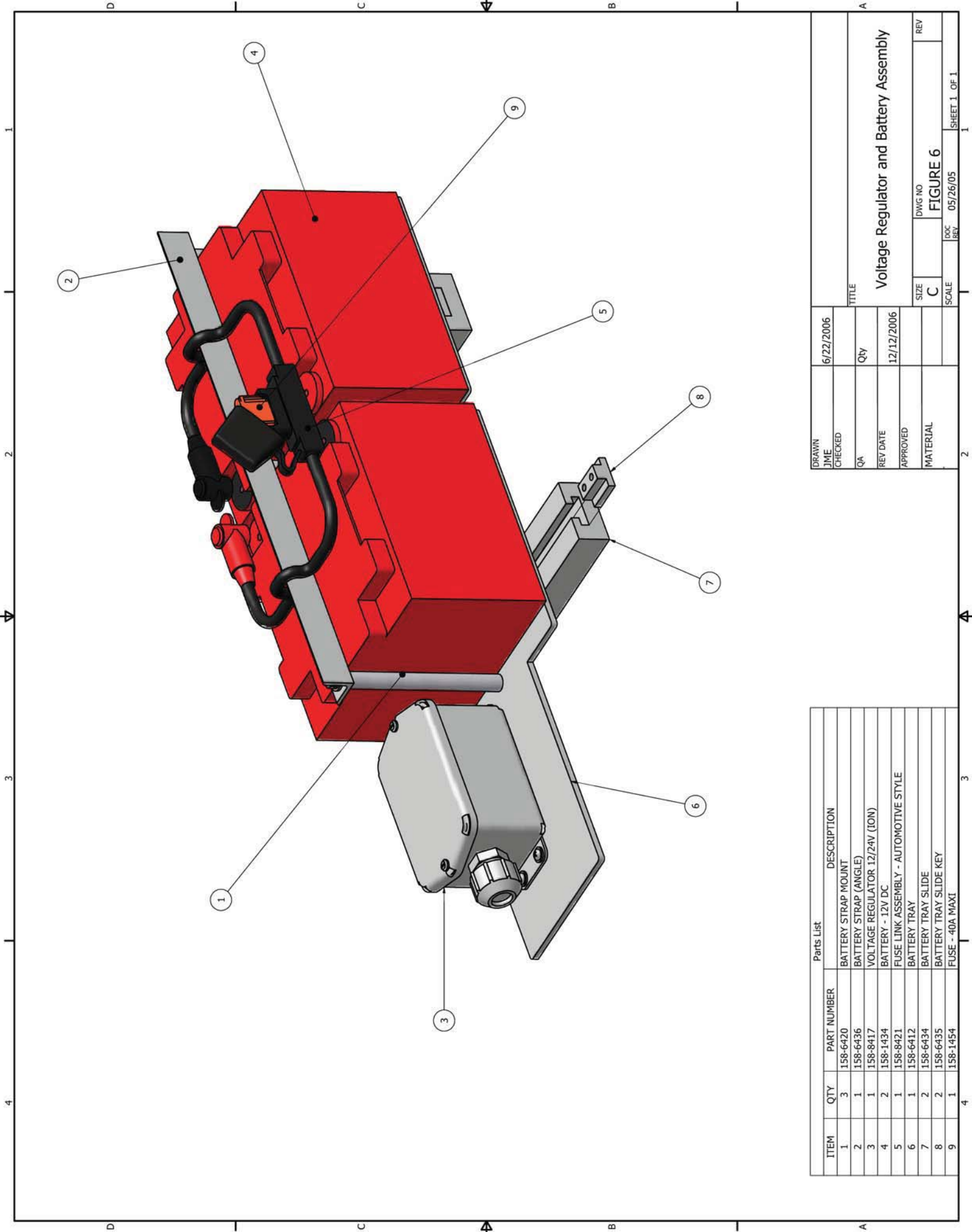
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| DATE                             | 1/11/2008 |
| BY                               |           |
| CHKD                             |           |
| APPROVED                         |           |
| TITLE                            |           |
| Kustodian Ion Model B Right View |           |
| SIZE                             | C         |
| DWG NO                           |           |
| CAGE                             |           |
| FIGURE 4                         |           |
| REV                              |           |



| ITEM | QTY | PART NUMBER      | DESCRIPTION                                |
|------|-----|------------------|--|
| 1    | 1   | 158-6416-2911    | ION PLC PLATE                              |
| 2    | 8   | 158-1415         | TERMINAL BLOCK - 2-COND GRAY               |
| 3    | 3   | 158-1416_Phoenix | TERMINAL BLOCK DIVIDER PLATE               |
| 4    | 6   | 158-1420G        | RELAY - 10AMP 2 POLE (24VDC GOLD CONTACTS) |
| 5    | 11  | 153-1028         | PANEL-MOUNT FUSE HOLDER - UL (COMPLETE)    |
| 6    | 1   | 158-8409         | ASSEMBLY - CIRCUIT BOARD 24VDC             |
| 7    | 1   | 153-1809G        | DIN RAIL - 16.5 INCHES                     |
| 8    | 2   | 158-1430         | TERMINAL STRIP END BRACKET                 |
| 9    | 6   | 158-1419         | Strip-End Bracket                          |
| 10   | 3   | 158-1427         | RELAY BASE - 2 POLE                        |
| 11   | 1   | 158-1423         | RELAY - 24VDC MY4                          |
| 12   | 5   | 153-2521         | CPM2A PLC 24VDC                            |
| 13   | 1   | 154-1811         | MS PHILLIPS-#6 X 3/8 (SELF TAP-PLASTIC)    |
| 14   | 2   | 153-1209         | TOGGLE SWITCH (DPDT)                       |
| 15   | 6   | 158-1420C        | BUTTON GUARD                               |
| 16   | 3   | 158-1428         | RELAY RETAINING BRACKET FOR 10A RELAY      |
| 17   | 1   | 153-1809H        | RELAY BASE - MY4                           |
| 18   | 3   | 158-1413         | DIN RAIL - 5.75 INCH                       |
| 19   | 3   | 158-1438         | RELAY - 2 POLE 15A 24VDC                   |
| 20   | 3   | 158-1412         | ARC SUPPRESSOR - MOV FOR ION               |
| 21   | 1   | 158-1451         | RELAY BASE - 2 POLE FOR 15A RELAY          |
| 22   | 1   | 158-1442         | 20A CIRCUIT BREAKER                        |
| 23   | 1   | 158-1443         | DC DIGITAL VOLT METER                      |
| 24   | 5   | 153-2509         | TOGGLE SWITCH - MOM ON/OFF/MOM ON          |
|      |     |                  | CIRCUIT BOARD MOUNT                        |

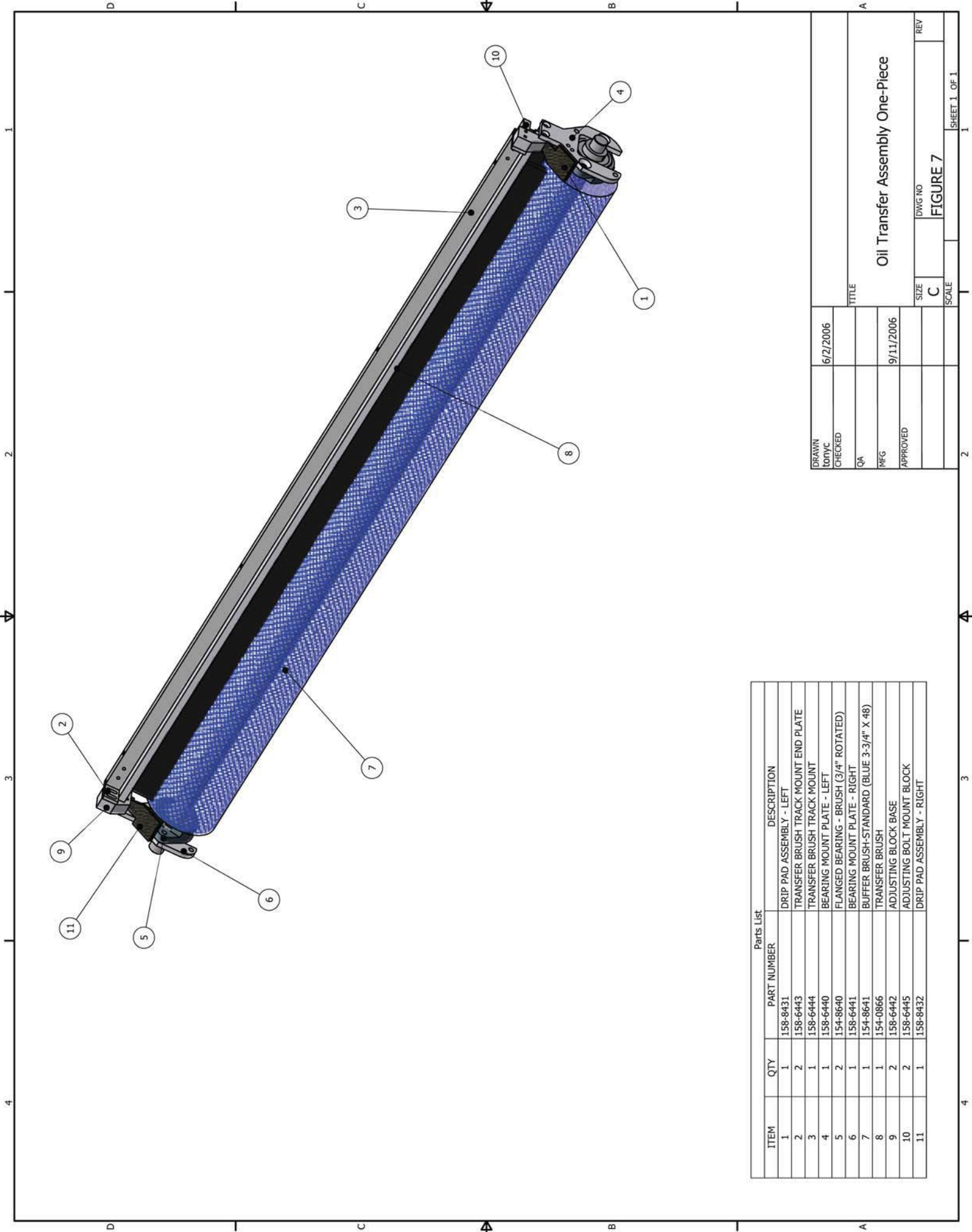
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|----------|-----------|--------|--------------------|
| DRAWN    | 9/23/2014 | TITLE  | PLC Plate Assembly |
| CHECKED  |           | REV    |                    |
| QA       |           | SIZE   | C                  |
| MFG      |           | DWG NO | 17-5400-5          |
| APPROVED |           | SCALE  |                    |
|          |           | REV    |                    |





| ITEM | QTY | PART NUMBER | DESCRIPTION                           |
|------|-----|-------------|---------------------------------------|
| 1    | 3   | 158-6420    | BATTERY STRAP MOUNT                   |
| 2    | 1   | 158-6436    | BATTERY STRAP (ANGLE)                 |
| 3    | 1   | 158-8417    | VOLTAGE REGULATOR 12/24V (ION)        |
| 4    | 2   | 158-1434    | BATTERY - 12V DC                      |
| 5    | 1   | 158-8421    | FUSE LINK ASSEMBLY - AUTOMOTIVE STYLE |
| 6    | 1   | 158-6412    | BATTERY TRAY                          |
| 7    | 2   | 158-6434    | BATTERY TRAY SLIDE                    |
| 8    | 2   | 158-6435    | BATTERY TRAY SLIDE KEY                |
| 9    | 1   | 158-1454    | FUSE - 40A MAXI                       |

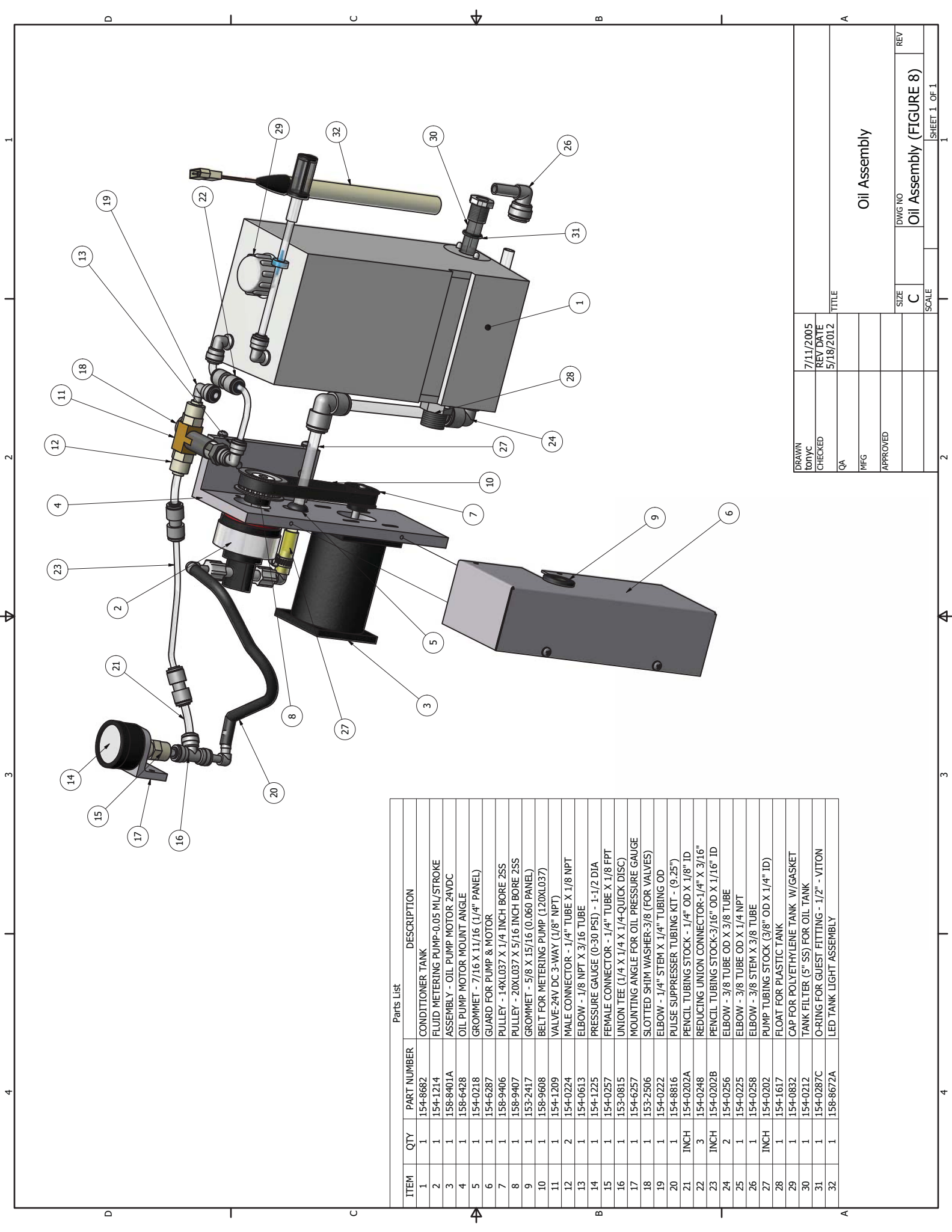
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|----------|-----------|----------|--|
| DRAWN    | 6/22/2006 | TITLE    | Voltage Regulator and Battery Assembly |
| CHECKED  |           | QTY      |  |
| QA       |           | REV DATE | 12/12/2006                             |
| APPROVED |           | SIZE     | C                                      |
| MATERIAL |           | DWG NO   | FIGURE 6                               |
|          |           | SCALE    | 05/26/05                               |
|          |           |          | SHEET 1 OF 1                           |



Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION                              |
|------|-----|-------------|--|
| 1    | 1   | 158-8431    | DRIP PAD ASSEMBLY - LEFT                 |
| 2    | 2   | 158-6443    | TRANSFER BRUSH TRACK MOUNT END PLATE     |
| 3    | 1   | 158-6444    | TRANSFER BRUSH TRACK MOUNT               |
| 4    | 1   | 158-6440    | BEARING MOUNT PLATE - LEFT               |
| 5    | 2   | 154-8640    | FLANGED BEARING - BRUSH (3/4" ROTATED)   |
| 6    | 1   | 158-6441    | BEARING MOUNT PLATE - RIGHT              |
| 7    | 1   | 154-8641    | BUFFER BRUSH-STANDARD (BLUE 3-3/4" X 48) |
| 8    | 1   | 154-0866    | TRANSFER BRUSH                           |
| 9    | 2   | 158-6442    | ADJUSTING BOLT MOUNT BLOCK               |
| 10   | 2   | 158-6445    | DRIP PAD ASSEMBLY - RIGHT                |
| 11   | 1   | 158-8432    | DRIP PAD ASSEMBLY - RIGHT                |

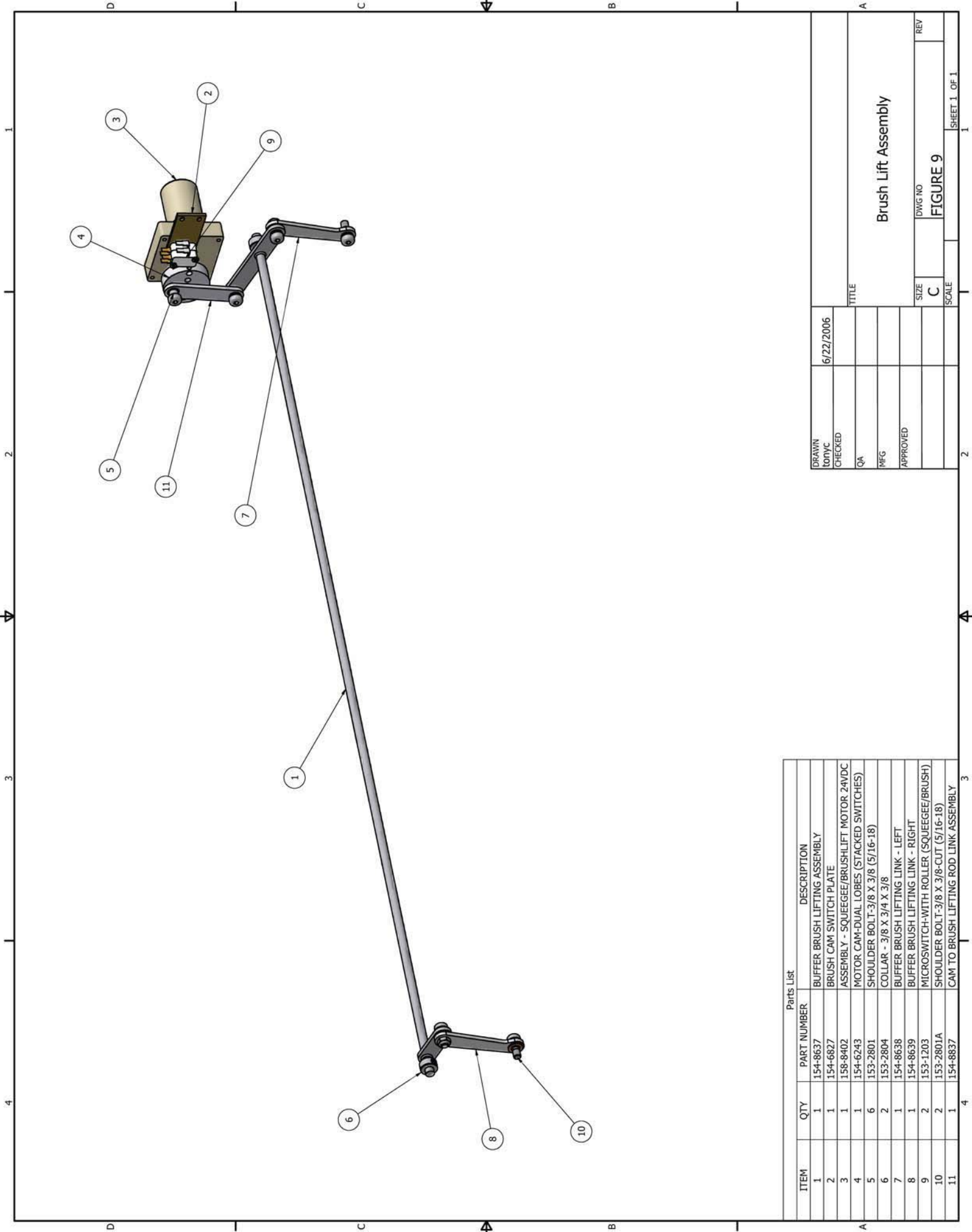
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|-----------------|----------|----------|---------------------------------|
| DRAWN<br>T/ONYC | 6/2/2006 | TITLE    | Oil Transfer Assembly One-Piece |
| CHECKED         |          | QA       |                                 |
|                 |          | MFG      | 9/11/2006                       |
|                 |          | APPROVED |                                 |
|                 |          | SIZE     | C                               |
|                 |          | DWG NO   | FIGURE 7                        |
|                 |          | SCALE    |                                 |
|                 |          |          | SHEET 1 OF 1                    |



Parts List

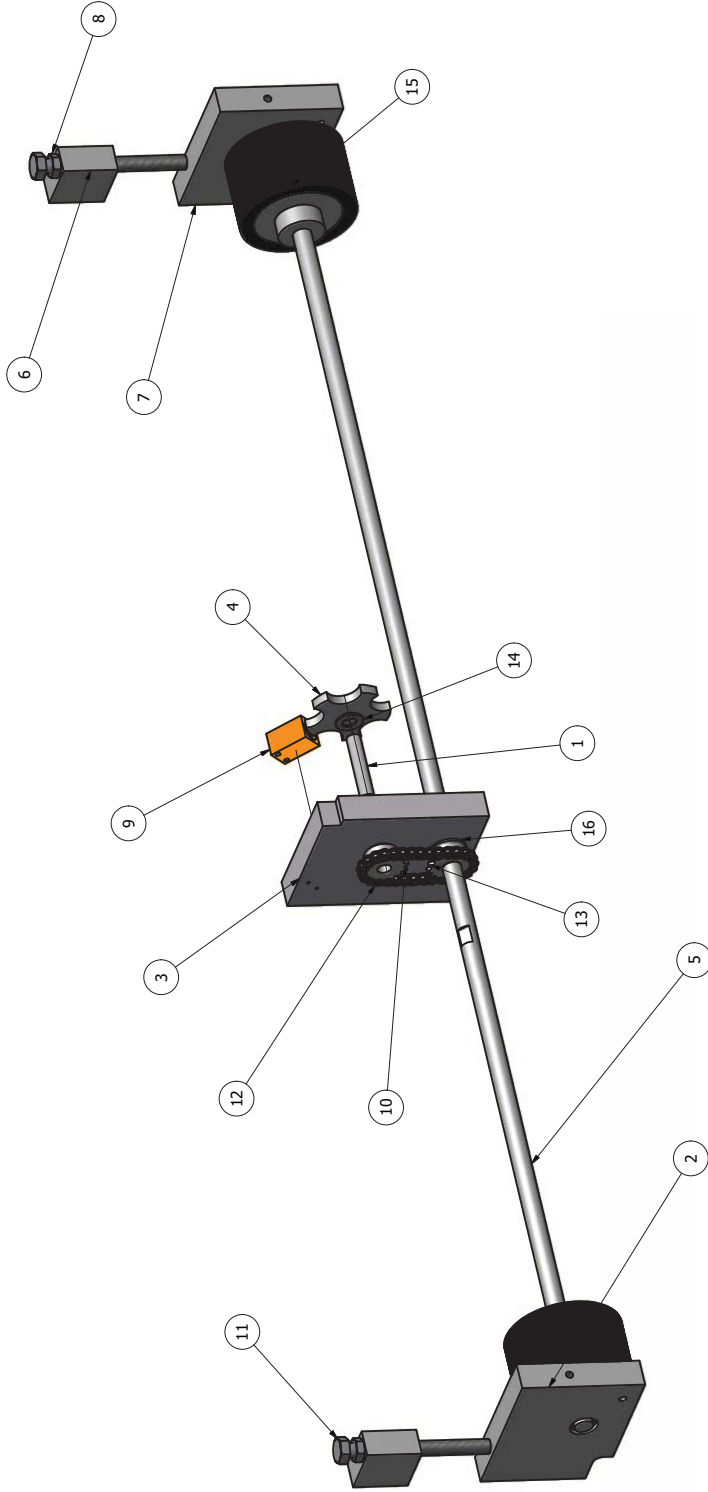
| ITEM | QTY  | PART NUMBER | DESCRIPTION                             |
|------|------|-------------|---|
| 1    | 1    | 154-8682    | CONDITIONER TANK                        |
| 2    | 1    | 154-1214    | FLUID METERING PUMP-0.05 MI/STROKE      |
| 3    | 1    | 158-8401A   | ASSEMBLY - OIL PUMP MOTOR 24VDC         |
| 4    | 1    | 158-6428    | OIL PUMP MOTOR MOUNT ANGLE              |
| 5    | 1    | 154-0218    | GROMMET - 7/16 X 11/16 (1/4" PANEL)     |
| 6    | 1    | 154-6287    | GUARD FOR PUMP & MOTOR                  |
| 7    | 1    | 158-9406    | PULLEY - 14XL037 X 1/4 INCH BORE 2SS    |
| 8    | 1    | 158-9407    | PULLEY - 20XL037 X 5/16 INCH BORE 2SS   |
| 9    | 1    | 153-2417    | GROMMET - 5/8 X 15/16 (0.060 PANEL)     |
| 10   | 1    | 158-9608    | BELT FOR METERING PUMP (120XL037)       |
| 11   | 1    | 154-1209    | VALVE-24V DC 3-WAY (1/8" NPT)           |
| 12   | 2    | 154-0224    | MALE CONNECTOR - 1/4" TUBE X 1/8 NPT    |
| 13   | 1    | 154-0613    | ELBOW - 1/8 NPT X 3/16 TUBE             |
| 14   | 1    | 154-1225    | PRESSURE GAUGE (0-30 PSI) - 1-1/2 DIA   |
| 15   | 1    | 154-0257    | FEMALE CONNECTOR - 1/4" TUBE X 1/8 FPT  |
| 16   | 1    | 153-0815    | UNION TEE (1/4 X 1/4 X 1/4-QUICK DISC)  |
| 17   | 1    | 154-6257    | MOUNTING ANGLE FOR OIL PRESSURE GAUGE   |
| 18   | 1    | 153-2506    | SLOTTED SHIM WASHER-3/8 (FOR VALVES)    |
| 19   | 1    | 154-0222    | ELBOW - 1/4" STEM X 1/4" TUBING OD      |
| 20   | 1    | 154-8816    | PULSE SUPPRESSOR TUBING KIT - (9.25")   |
| 21   | INCH | 154-0202A   | PENCIL TUBING STOCK - 1/4" OD X 1/8" ID |
| 22   | 3    | 154-0248    | REDUCING UNION CONNECTOR-1/4" X 3/16"   |
| 23   | INCH | 154-0202B   | PENCIL TUBING STOCK-3/16" OD X 1/16" ID |
| 24   | 2    | 154-0256    | ELBOW - 3/8 TUBE OD X 3/8 TUBE          |
| 25   | 1    | 154-0225    | ELBOW - 3/8 TUBE OD X 1/4 NPT           |
| 26   | 1    | 154-0258    | ELBOW - 3/8 STEM X 3/8 TUBE             |
| 27   | INCH | 154-0202    | PUMP TUBING STOCK (3/8" OD X 1/4" ID)   |
| 28   | 1    | 154-1617    | FLOAT FOR PLASTIC TANK                  |
| 29   | 1    | 154-0832    | CAP FOR POLYETHYLENE TANK W/GASKET      |
| 30   | 1    | 154-0212    | TANK FILTER (5" SS) FOR OIL TANK        |
| 31   | 1    | 154-0287C   | O-RING FOR GUEST FITTING - 1/2" - VITON |
| 32   | 1    | 158-8672A   | LED TANK LIGHT ASSEMBLY                 |

|          |           |          |                         |   |
|----------|-----------|----------|-------------------------|---|
| DRAWN    | 7/11/2005 | TITLE    | Oil Assembly            |   |
| CHECKED  | 5/18/2012 | REV DATE | SIZE                    | C |
| QA       |           | REV      | SCALE                   |   |
| MFG      |           | DWG NO   | Oil Assembly (FIGURE 8) |   |
| APPROVED |           | REV      | SHEET 1 OF 1            |   |



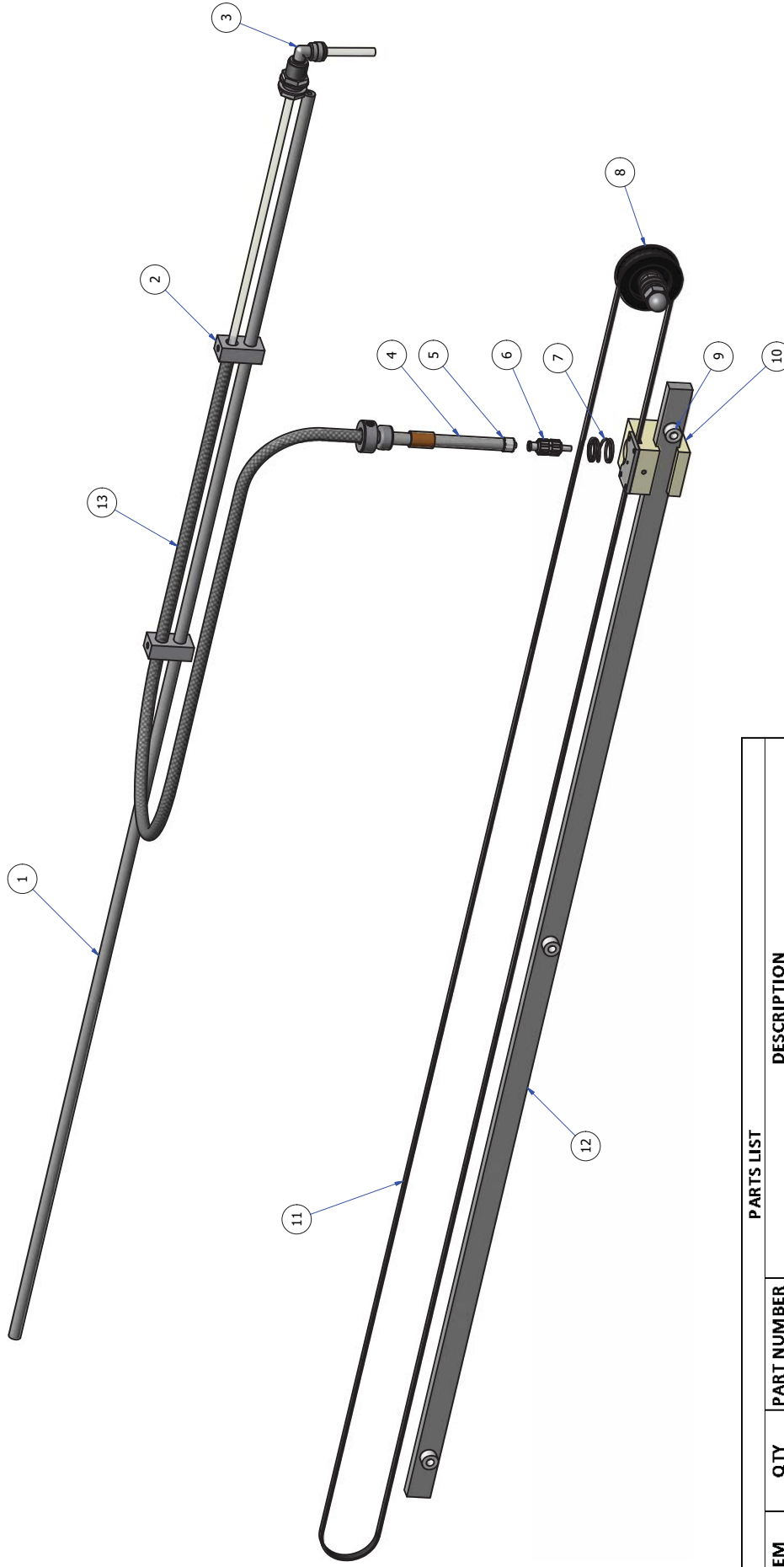
|                |           |        |                     |
|----------------|-----------|--------|---------------------|
| DRAWN<br>TONYC | 6/22/2006 | TITLE  | Brush Lift Assembly |
| CHECKED        |           | SIZE   | C                   |
| QA             |           | SCALE  |                     |
| MFG            |           | DWG NO | FIGURE 9            |
| APPROVED       |           | REV    |                     |

| Parts List |     |             | DESCRIPTION                               |
|------------|-----|-------------|---|
| ITEM       | QTY | PART NUMBER |   |
| 1          | 1   | 154-8637    | BUFFER BRUSH LIFTING ASSEMBLY             |
| 2          | 1   | 154-6827    | BRUSH CAM SWITCH PLATE                    |
| 3          | 1   | 158-8402    | ASSEMBLY - SQUEEGEE/BRUSHLIFT MOTOR 24VDC |
| 4          | 1   | 154-6243    | MOTOR CAM-DUAL LOBES (STACKED SWITCHES)   |
| 5          | 6   | 153-2801    | SHOULDER BOLT-3/8 X 3/8 (5/16-18)         |
| 6          | 2   | 153-2804    | COLLAR - 3/8 X 3/4 X 3/8                  |
| 7          | 1   | 154-8638    | BUFFER BRUSH LIFTING LINK - LEFT          |
| 8          | 1   | 154-8639    | BUFFER BRUSH LIFTING LINK - RIGHT         |
| 9          | 2   | 153-1203    | MICROSWITCH-WITH ROLLER (SQUEEGEE/BRUSH)  |
| 10         | 2   | 153-2801A   | SHOULDER BOLT-3/8 X 3/8-CUT (5/16-18)     |
| 11         | 1   | 154-8837    | CAM TO BRUSH LIFTING ROD LINK ASSEMBLY    |



| ITEM | QTY | PART NUMBER | DESCRIPTION                                |
|------|-----|-------------|--|
| 1    | 1   | 154-6264    | SHAFT FOR TIMING DISK (REMOTE SENSOR)      |
| 2    | 1   | 154-8621    | PILLOWBLOCK-LANE DISTANCE (RIGHT-FLANGE)   |
| 3    | 1   | 154-8320    | PILLOWBLOCK - LANE DISTANCE (CENTER-PLAIN) |
| 4    | 1   | 154-6717    | 5-TOOTH SENSOR DISK (3/8 BORE)             |
| 5    | 1   | 154-6821    | LDS SHAFT - KUSTODIAN                      |
| 6    | 2   | 153-6027    | LANE DISTANCE ADJUSTMENT BLOCK             |
| 7    | 1   | 154-8619    | PILLOWBLOCK-LANE DISTANCE (LEFT-FLANGED)   |
| 8    | 1   | 153-2027    | JAM NUT - 3/8-16                           |
| 9    | 1   | 154-1220    | INDUCTIVE PROXIMITY SENSOR                 |
| 10   | 1   | 154-9211    | LDS AND TACH SENSOR DRIVE CHAIN (25P29)    |
| 11   | 2   | 153-2234    | HHCS - 3/8-16 X 4 (FULL THREAD)            |
| 12   | 1   | 153-9010    | SPROCKET-25B15 (3/8") 1/4-20 SET           |
| 13   | 1   | 154-9213    | SPROCKET-25B15 (1/2") 1/4-20 SET SCREW     |
| 14   | 4   | 153-2009    | NYLON FLAT WASHER (3/8 - 0.060)            |
| 15   | 2   | 153-7002AA  | LANE DISTANCE COUNTER WHEEL - TREADED (2") |
| 16   | 1   | 153-2992    | WAVE WASHER                                |

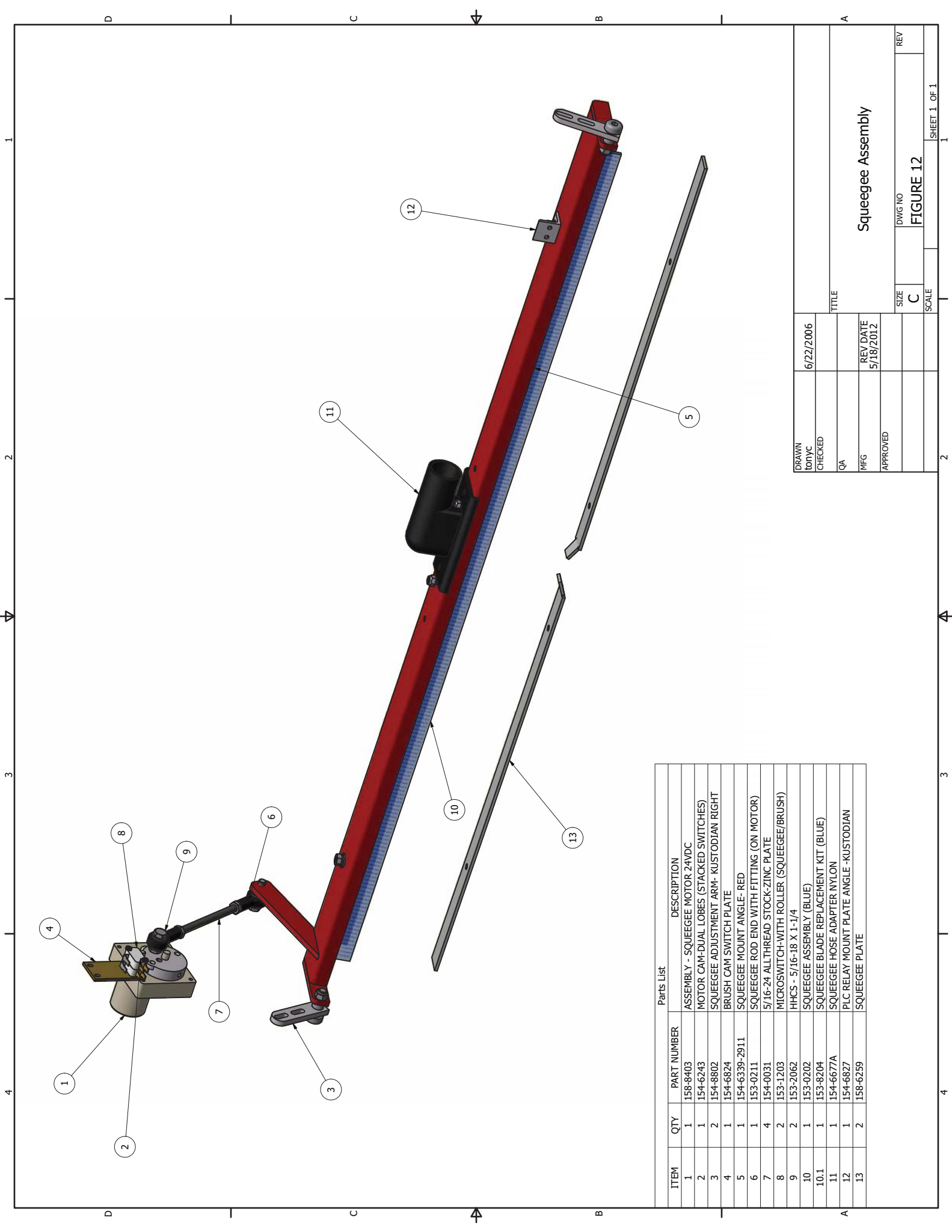
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|----------------|-----------|--------------|--------------|
| DRAWN<br>tonyc | 7/11/2005 | TITLE        | LDS Assembly |
| CHECKED        |           | REV          |              |
| QA             |           | SIZE         | C            |
| MFG            |           | REV DATE     | 5/18/2012    |
| APPROVED       |           | SCALE        |              |
|                |           | DWG NO       | FIGURE 10    |
|                |           | SHEET 1 OF 1 |              |



| ITEM | QTY | PART NUMBER | DESCRIPTION                                   |
|------|-----|-------------|---|
| 1    | 1   | 154-6889    | CLEANER HOSE ROUTING BAR                      |
| 2    | 2   | 154-6888    | CLEANER HOSE SPRING MOUNT BLOCK               |
| 3    | 1   | 154-0222    | ELBOW 1/4" STEM X 1/4" TUBING OD              |
| 4    | 1   | 154-8852    | CLEANER HOSE TUBE (4.5 INCH) AND TIP ASSEMBLY |
| 5    | 1   | 154-0863    | MALE LUER TO HOSE BARB                        |
| 6    | 1   | 164-0012M   | CLEANER TIP WITH CHECK VALVE                  |
| 7    | 1   | 153-2713    | SPRING - OIL TIP RETAINER                     |
| 8    | 1   | 154-9802    | PULLEY 27XLO37 DF 2SETS 3/8" BORE             |
| 9    | 3   | 154-6874    | CLEANING HEAD BAR SPACER                      |
| 10   | 1   | 154-6882    | CLEANER HEAD                                  |
| 11   | 1   | 154-9201    | CLEANER HEAD DRIVE BELT                       |
| 12   | 1   | 154-6877    | CLEANER HEAD GUIDE BAR                        |
| 13   | 1   | 154-0867    | CLEANER HOSE SPRING (3.6")                    |

PARTS LIST

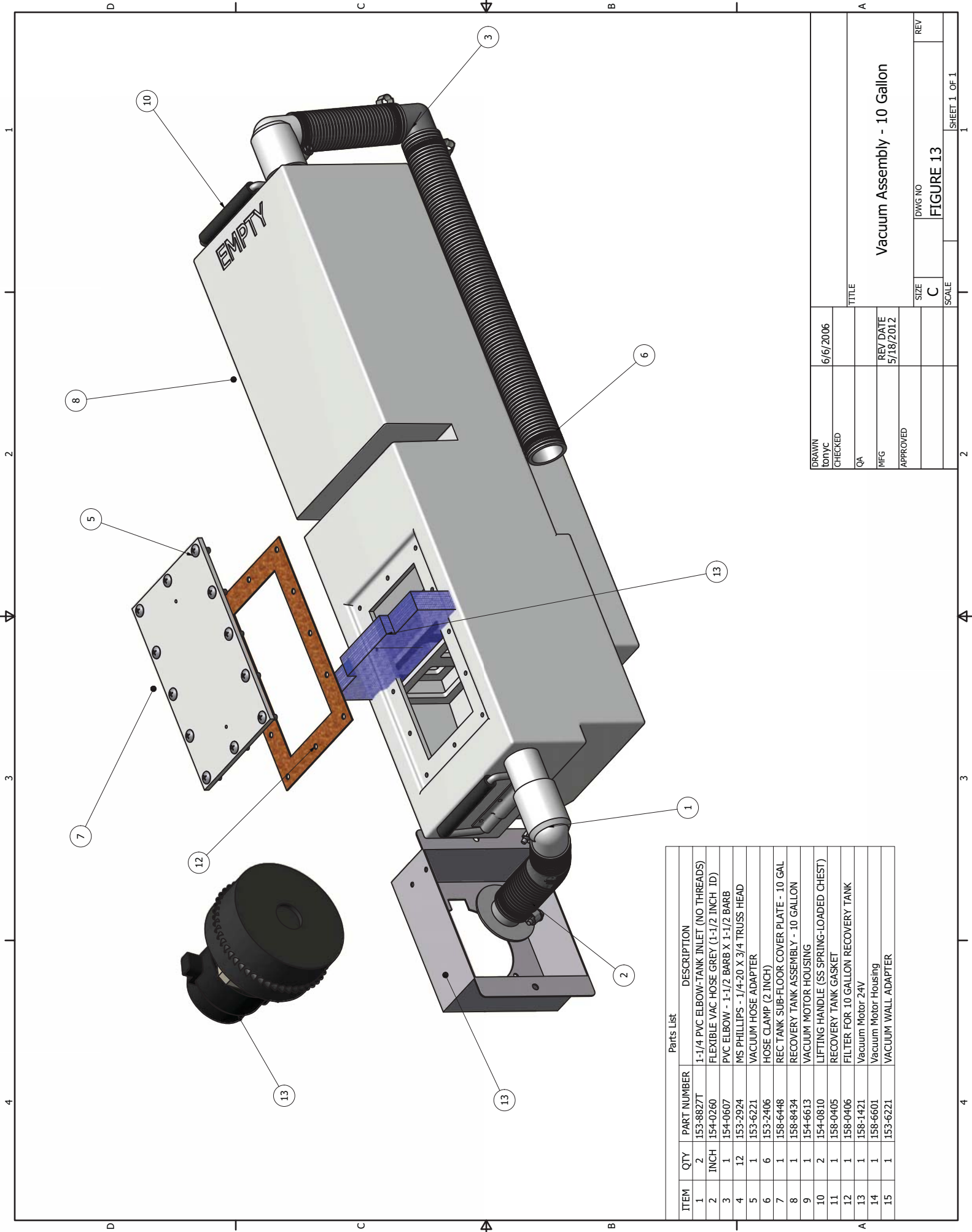
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| DRAWN           | 4/10/2014 | TITLE        | Cleaner Head Assembly |
| CHECKED         |           | SIZE         | C                     |
| QA              |           | DWG NO       | 17-5400-12            |
| MFG             |           | REV          |                       |
| APPROVED        |           | SCALE        |                       |
| REV. 11/19/2012 |           | SHEET 1 OF 1 |                       |



Parts List

| ITEM | QTY | PART NUMBER   | DESCRIPTION                              |
|------|-----|---------------|--|
| 1    | 1   | 158-8403      | ASSEMBLY - SQUEEGEE MOTOR 24VDC          |
| 2    | 1   | 154-6243      | MOTOR CAM-DUAL LOBBES (STACKED SWITCHES) |
| 3    | 2   | 154-8802      | SQUEEGEE ADJUSTMENT ARM- KUSTODIAN RIGHT |
| 4    | 1   | 154-6824      | BRUSH CAM SWITCH PLATE                   |
| 5    | 1   | 154-6339-2911 | SQUEEGEE MOUNT ANGLE- RED                |
| 6    | 1   | 153-0211      | SQUEEGEE ROD END WITH FITTING (ON MOTOR) |
| 7    | 4   | 154-0031      | 5/16-24 ALL THREAD STOCK-ZINC PLATE      |
| 8    | 2   | 153-1203      | MICROSWITCH-WITH ROLLER (SQUEEGEE/BRUSH) |
| 9    | 2   | 153-2062      | HHCS - 5/16-18 X 1-1/4                   |
| 10   | 1   | 153-0202      | SQUEEGEE ASSEMBLY (BLUE)                 |
| 10.1 | 1   | 153-8204      | SQUEEGEE BLADE REPLACEMENT KIT (BLUE)    |
| 11   | 1   | 154-6677A     | SQUEEGEE HOSE ADAPTER NYLON              |
| 12   | 1   | 154-6827      | PLC RELAY MOUNT PLATE ANGLE -KUSTODIAN   |
| 13   | 2   | 158-6259      | SQUEEGEE PLATE                           |

|          |           |          |                   |  |
|----------|-----------|----------|-------------------|--|
| DRAWN    | 6/22/2006 | TITLE    | Squeegee Assembly |  |
| CHECKED  |           | REV      |                   |  |
| QA       |           | REV DATE | 5/18/2012         |  |
| MFG      |           | SIZE     | C                 |  |
| APPROVED |           | SCALE    |                   |  |
|          |           | DWG NO   | FIGURE 12         |  |
|          |           | REV      | 1                 |  |

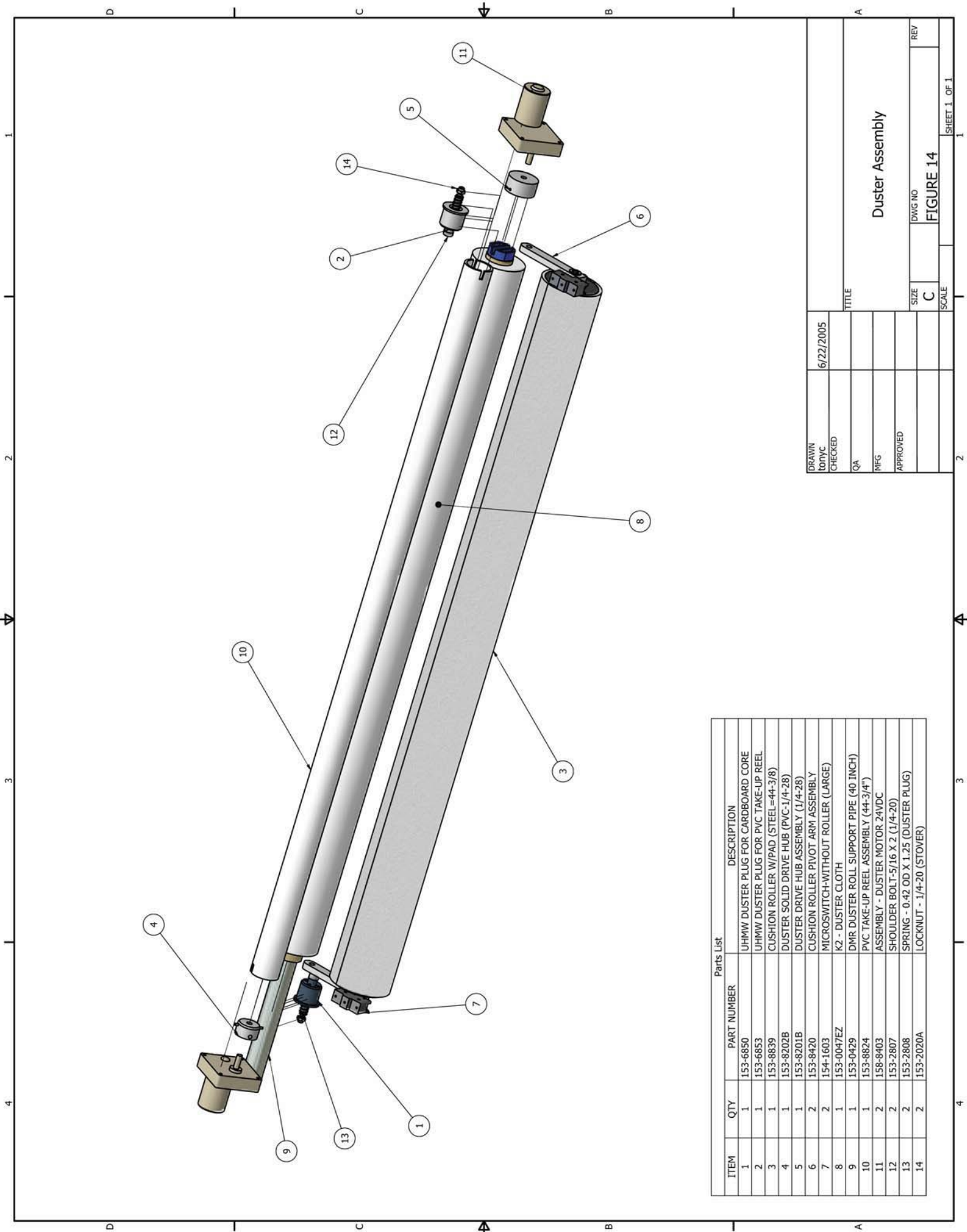


Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION                             |
|------|-----|-------------|---|
| 1    | 2   | 153-8827T   | 1-1/4 PVC ELBOW-TANK INLET (NO THREADS) |
| 2    | 1   | 154-0260    | FLEXIBLE VAC HOSE GREY (1-1/2 INCH ID)  |
| 3    | 1   | 154-0607    | PVC ELBOW - 1-1/2 BARB X 1-1/2 BARB     |
| 4    | 12  | 153-2924    | MS PHILLIPS - 1/4-20 X 3/4 TRUSS HEAD   |
| 5    | 1   | 153-6221    | VACUUM HOSE ADAPTER                     |
| 6    | 6   | 153-2406    | HOSE CLAMP (2 INCH)                     |
| 7    | 1   | 158-6448    | REC TANK SUB-FLOOR COVER PLATE - 10 GAL |
| 8    | 1   | 158-8434    | RECOVERY TANK ASSEMBLY - 10 GALLON      |
| 9    | 1   | 154-6613    | VACUUM MOTOR HOUSING                    |
| 10   | 2   | 154-0810    | LIFTING HANDLE (SS SPRING-LOADED CHEST) |
| 11   | 1   | 158-0405    | RECOVERY TANK GASKET                    |
| 12   | 1   | 158-0406    | FILTER FOR 10 GALLON RECOVERY TANK      |
| 13   | 1   | 158-1421    | Vacuum Motor 24V                        |
| 14   | 1   | 158-5601    | Vacuum Motor Housing                    |
| 15   | 1   | 153-6221    | VACUUM WALL ADAPTER                     |

|          |          |          |                             |
|----------|----------|----------|-----------------------------|
| DRAWN    | 6/6/2006 | TITLE    | Vacuum Assembly - 10 Gallon |
| CHECKED  |          | REV DATE | 5/18/2012                   |
| QA       |          | SIZE     | C                           |
| MFG      |          | SCALE    |                             |
| APPROVED |          | DWG NO   | FIGURE 13                   |
|          |          | REV      |                             |

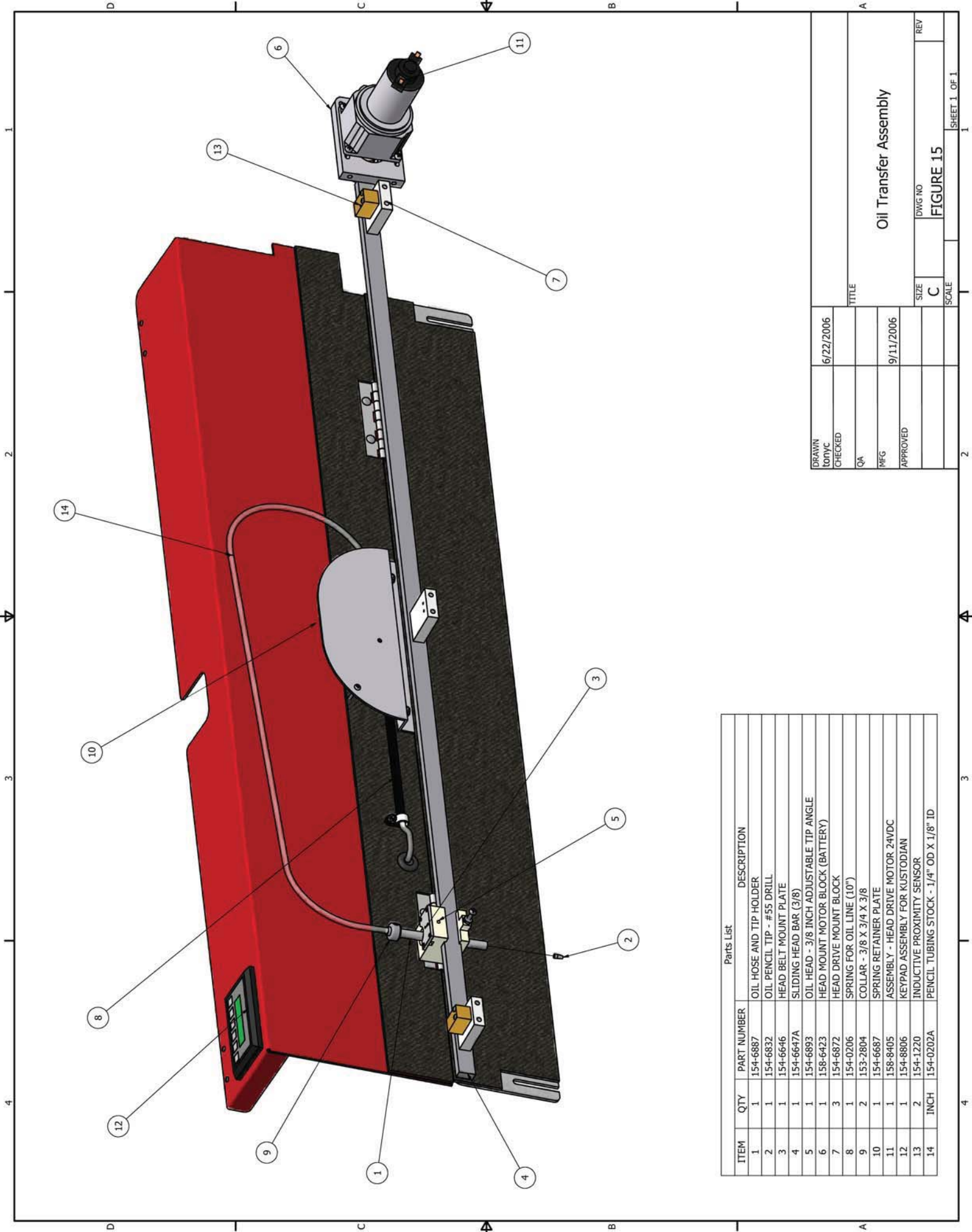




Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION                            |
|------|-----|-------------|--|
| 1    | 1   | 153-6850    | UHMW DUSTER PLUG FOR CARDBOARD CORE    |
| 2    | 1   | 153-6853    | UHMW DUSTER PLUG FOR PVC TAKE-UP REEL  |
| 3    | 1   | 153-8839    | CUSHION ROLLER W/PAD (STEEL=44-3/8)    |
| 4    | 1   | 153-8202B   | DUSTER SOLID DRIVE HUB (PVC-1/4-28)    |
| 5    | 1   | 153-8201B   | DUSTER DRIVE HUB ASSEMBLY (1/4-28)     |
| 6    | 2   | 153-8420    | CUSHION ROLLER PIVOT ARM ASSEMBLY      |
| 7    | 2   | 154-1603    | MICROSWITCH-WITHOUT ROLLER (LARGE)     |
| 8    | 1   | 153-0047EZ  | K2 - DUSTER CLOTH                      |
| 9    | 1   | 153-0429    | DMR DUSTER ROLL SUPPORT PIPE (40 INCH) |
| 10   | 1   | 153-8824    | PVC TAKE-UP REEL ASSEMBLY (44-3/4")    |
| 11   | 2   | 158-8403    | ASSEMBLY - DUSTER MOTOR 24VDC          |
| 12   | 2   | 153-2807    | SHOULDER BOLT-5/16 X 2 (1/4-20)        |
| 13   | 2   | 153-2808    | SPRING - 0.42 OD X 1.25 (DUSTER PLUG)  |
| 14   | 2   | 153-2020A   | LOCKNUT - 1/4-20 (STOVER)              |

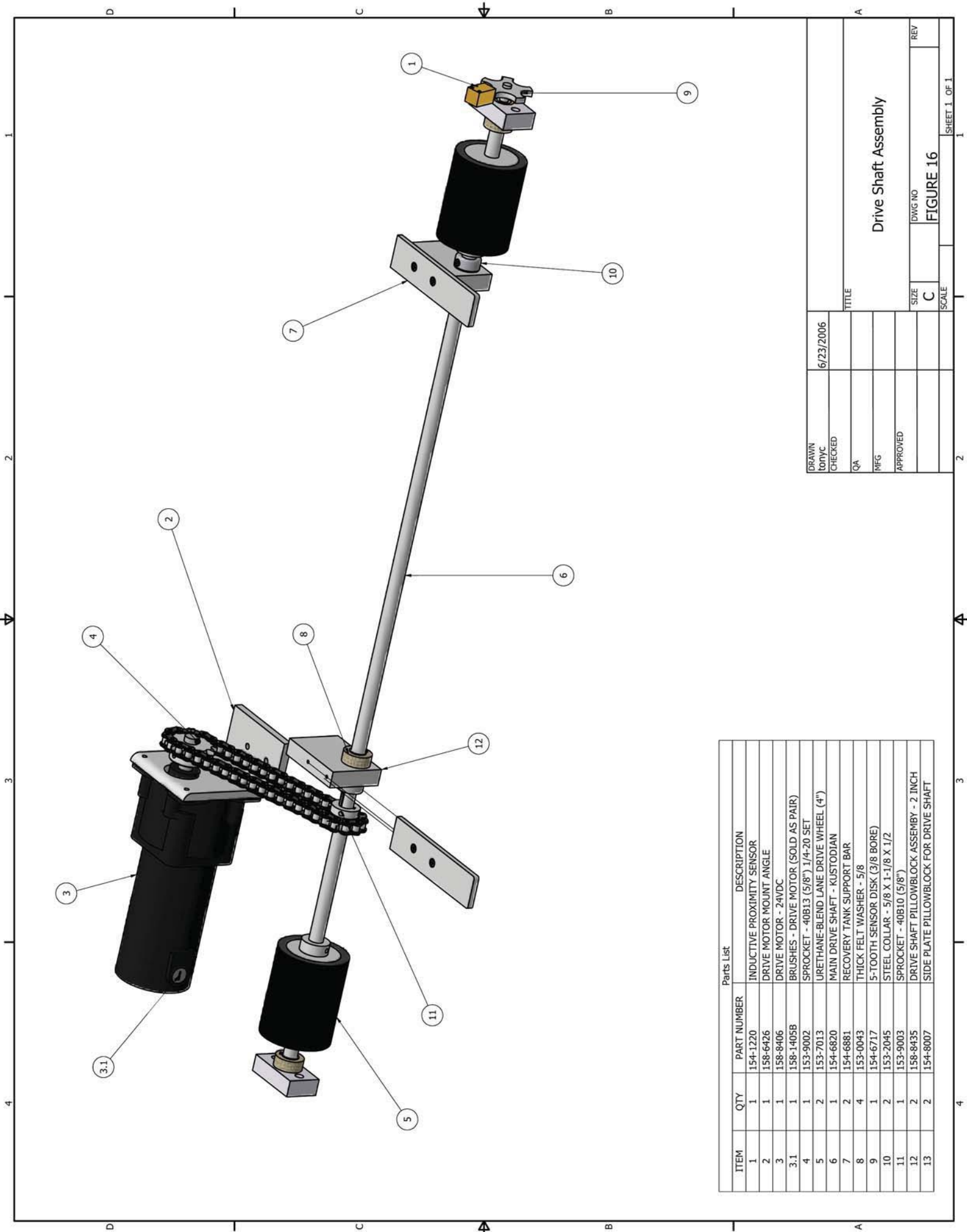
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|---------|-----------|----------|-----------------|
| DRAWN   | 6/22/2005 | TITLE    | Duster Assembly |
| CHECKED |           | QA       |                 |
|         |           | MFG      |                 |
|         |           | APPROVED |                 |
|         |           | SIZE     | C               |
|         |           | DWG NO   | FIGURE 14       |
|         |           | SCALE    |                 |
|         |           | REV      |                 |



Parts List

| ITEM | QTY  | PART NUMBER | DESCRIPTION                              |
|------|------|-------------|--|
| 1    | 1    | 154-6887    | OIL HOSE AND TIP HOLDER                  |
| 2    | 1    | 154-6832    | OIL PENCIL TIP - #55 DRILL               |
| 3    | 1    | 154-6646    | HEAD BELT MOUNT PLATE                    |
| 4    | 1    | 154-6647A   | SLIDING HEAD BAR (3/8)                   |
| 5    | 1    | 154-6893    | OIL HEAD - 3/8 INCH ADJUSTABLE TIP ANGLE |
| 6    | 1    | 158-6423    | HEAD MOUNT MOTOR BLOCK (BATTERY)         |
| 7    | 3    | 154-6872    | HEAD DRIVE MOUNT BLOCK                   |
| 8    | 1    | 154-0206    | SPRING FOR OIL LINE (10")                |
| 9    | 2    | 153-2804    | COLLAR - 3/8 X 3/4 X 3/8                 |
| 10   | 1    | 154-6687    | SPRING RETAINER PLATE                    |
| 11   | 1    | 158-8405    | ASSEMBLY - HEAD DRIVE MOTOR 24VDC        |
| 12   | 1    | 154-8806    | KEYPAD ASSEMBLY FOR KUSTODIAN            |
| 13   | 2    | 154-1220    | INDUCTIVE PROXIMITY SENSOR               |
| 14   | INCH | 154-0202A   | PENCIL TUBING STOCK - 1/4" OD X 1/8" ID  |

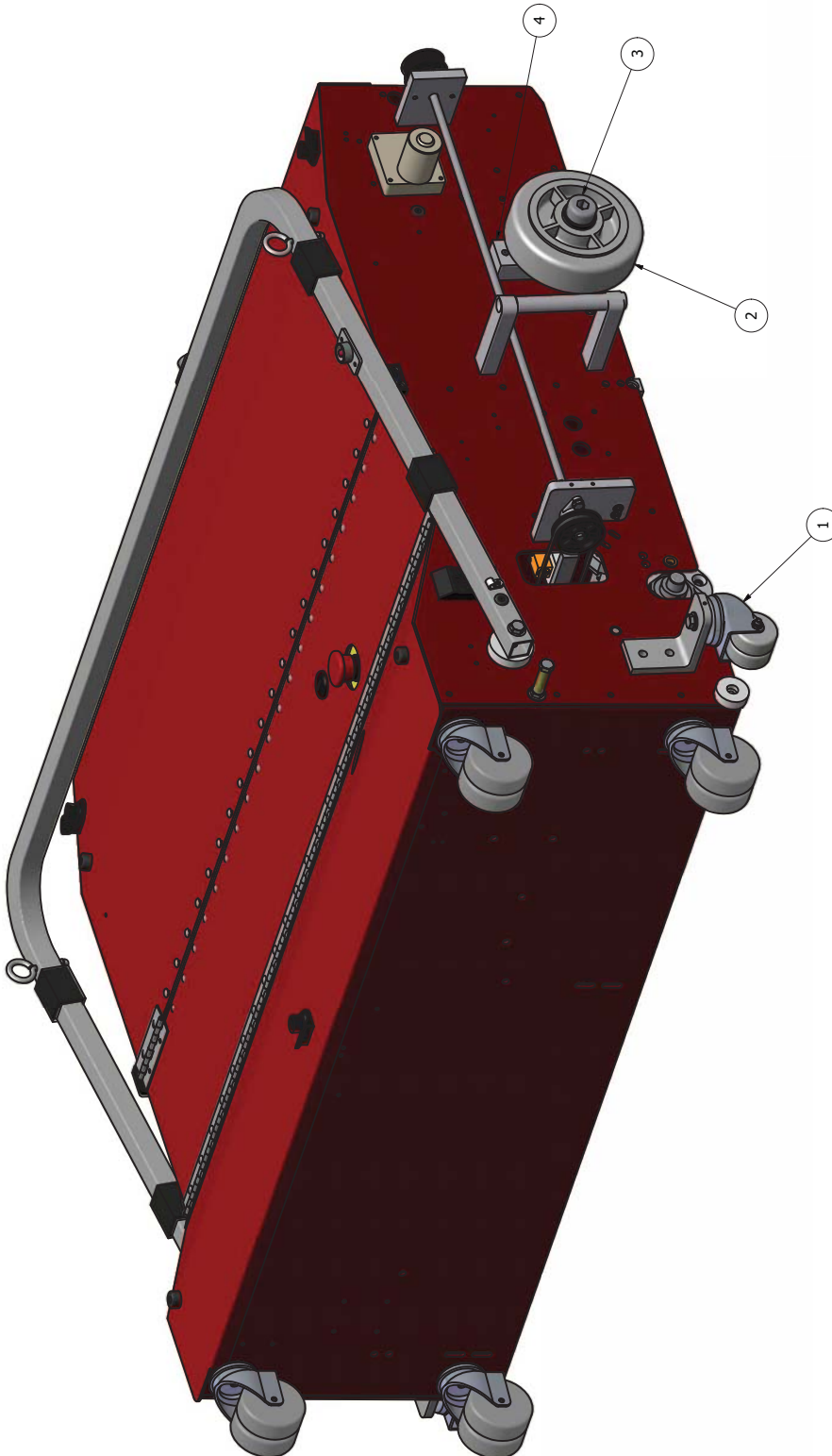
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|----------------|-----------|--------------|-----------------------|
| DRAWN<br>TONYC | 6/22/2006 | TITLE        | Oil Transfer Assembly |
| CHECKED        |           | DATE         |                       |
| QA             |           | APPROVED     |                       |
| MFG            | 9/11/2006 | SCALE        | C                     |
| REV            |           | DWG NO       | FIGURE 15             |
|                |           | SCALE        |                       |
|                |           | SHEET 1 OF 1 |                       |



Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION                               |
|------|-----|-------------|---|
| 1    | 1   | 154-1220    | INDUCTIVE PROXIMITY SENSOR                |
| 2    | 1   | 158-6426    | DRIVE MOTOR MOUNT ANGLE                   |
| 3    | 1   | 158-8406    | DRIVE MOTOR - 24VDC                       |
| 3.1  | 1   | 158-1405B   | BRUSHES - DRIVE MOTOR (SOLD AS PAIR)      |
| 4    | 1   | 153-9002    | SPROCKET - 40B13 (5/8") 1/4-20 SET        |
| 5    | 2   | 153-7013    | URETHANE-BLEND LANE DRIVE WHEEL (4")      |
| 6    | 1   | 154-6820    | MAIN DRIVE SHAFT - KUSTODIAN              |
| 7    | 2   | 154-6881    | RECOVERY TANK SUPPORT BAR                 |
| 8    | 4   | 153-0043    | THICK FELT WASHER - 5/8                   |
| 9    | 1   | 154-6717    | 5-TOOTH SENSOR DISK (3/8 BORE)            |
| 10   | 2   | 153-2045    | STEEL COLLAR - 5/8 X 1-1/8 X 1/2          |
| 11   | 1   | 153-9003    | SPROCKET - 40B10 (5/8")                   |
| 12   | 2   | 158-8435    | DRIVE SHAFT PILLOWBLOCK ASSEMBLY - 2 INCH |
| 13   | 2   | 154-8007    | SIDE PLATE PILLOWBLOCK FOR DRIVE SHAFT    |

|         |           |          |                      |
|---------|-----------|----------|----------------------|
| DRAWN   | 6/23/2006 | TITLE    | Drive Shaft Assembly |
| CHECKED |           | QA       |                      |
|         |           | MFG      |                      |
|         |           | APPROVED |                      |
|         |           | SIZE     | C                    |
|         |           | DWG NO   | FIGURE 16            |
|         |           | SCALE    |                      |
|         |           | REV      |                      |



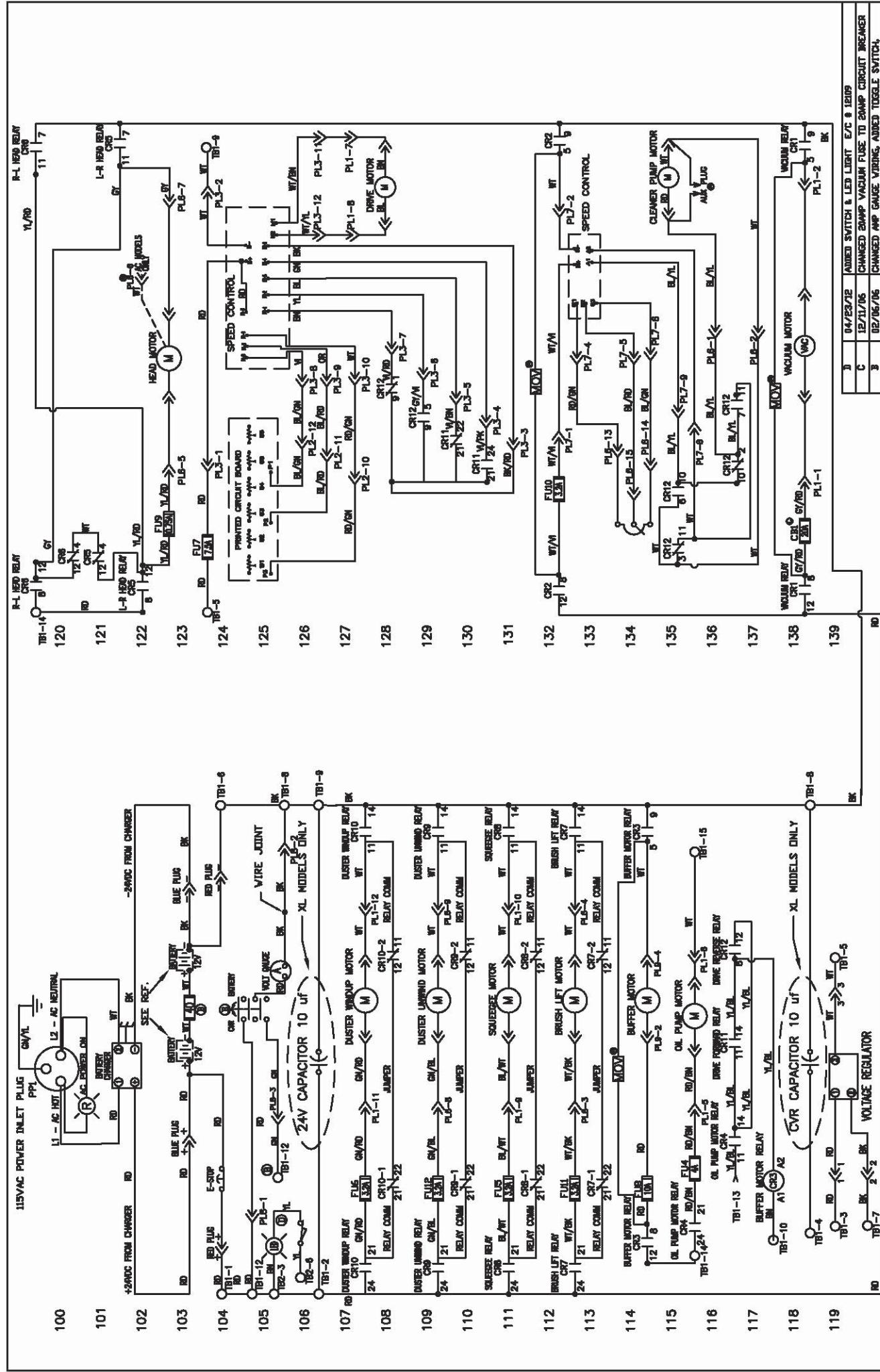
| ITEM | QTY | P/N      | DESCRIPTION                          |
|------|-----|----------|--------------------------------------|
| 1    | 2   | 153-0001 | TRANSPORT CASTER (3 INCH DUAL WHEEL) |
| 2    | 2   | 158-7002 | 6" WHEEL                             |
| 3    | 2   | 153-2833 | WHEEL AXLE - SHOULDER BOLT           |
| 4    | 2   | 158-6453 | 6" WHEEL MOUNT                       |

|  |         |                       |  |  |              |
|--|---------|-----------------------|--|--|--------------|
| DRAWN<br>JME   | CHECKED | APPROVED<br>5/21/2012 | QTY<br>0                                     | KEGEL LLC<br>1951 LONGLEAF BLVD<br>LAKE WALES, FL. 33859 |              |
| MATERIAL   |         |                       | TITLE<br>Kustodian Ion Model B Wheel Upgrade |  |              |
| FINISH<br>NONE   |         |                       | SIZE<br>C                                    | DWG NO<br>Figure 24                                      | REV          |
| TOLERANCES:<br>3 DECIMALS +/- 0.005<br>2 DECIMALS +/- 0.010<br>1 DECIMAL +/- 0.030 |         |                       | SCALE  | DOC<br>REV   | REV          |
|  |         |                       |  | 09/05/06   | SHEET 1 OF 1 |

## Kustodian ION Wiring Diagrams

The following diagrams show wiring schematics for this lane machine. If you have any questions please call 863-734-0200 or email [tech@kegel.net](mailto:tech@kegel.net).

|   |     |
|---|-----|
| Main Wiring .....   | 133 |
| Output Wiring.....  | 134 |
| Input Wiring .....  | 135 |
| Terminal Block Layout.....  | 136 |
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| Voltage Regulator Wiring .....                                      | 138 |
| Vacuum Motor Wiring .....   | 139 |
| Squeegee Motor and Switch Wiring.....                               | 140 |
| Speed Tachometer and Lane Distance Sensor Wiring .....              | 141 |
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**LEGEND**

- PL1 - MAIN PLUG - RIGHT SIDE (1S)
- PL2 - CIRCUIT BOARD PLUG (1S)
- PL3 - DC SPEED BOARD PLUG (1S)
- PL4 - PLC INPUT PLUG (RIGHT-9)
- PL5 - PLC INPUT PLUG (LEFT-6)
- PL6 - MAIN PLUG - LEFT SIDE (1S)
- PL7 - WATER PUMP SPEED BOARD (9)
- PL8 - AMP GAUGE (5)
- PL9 - BUFFER MOTOR (9)
- TBI - TERMINAL BLOCK 1 (MAIN)
- TBI2 - TERMINAL BLOCK 2 (OIL ASSY)
- TBI3 - TERMINAL BLOCK 3 (LEFT SIDE)
- TBI4 - TERMINAL BLOCK 4 (HANDLE)
- PL1 - CHARGING PLUG (9)
- PL2 - VACUUM RELAY
- CR1 - CLEANER MOTOR RELAY
- CR2 - BUFFER MOTOR RELAY
- CR3 - OIL PUMP MOTOR RELAY
- CR4 - L-R HEAD RELAY
- CR5 - L-R HEAD RELAY
- CR6 - BRUSH LIFT RELAY
- CR7 - SQUEEZE MOTOR RELAY
- CR8 - UNWIND RELAY
- CR9 - WINDUP RELAY
- CR10 - FORWARD RELAY
- CR11 - REVERSE RELAY
- CR12 - VACUUM MOTOR 20A (9)
- FUL - PLC INPUT POWER 0.5A
- FUS - PLC OUTPUT COMMONS 0.5A
- FU4 - OIL PUMP MOTOR 4A
- FU5 - SQUEEZE MOTOR 3.2A
- FU6 - WINDUP MOTOR 3.2A
- FU7 - BUFFER MOTOR 7.5A
- FU8 - BRUSH LIFT MOTOR 10A
- FU9 - HEAD MOTOR 0.75A
- FU10 - CLEANER MOTOR 3.2A
- FU11 - BRUSH LIFT MOTOR 3.2A
- FU12 - UNWIND MOTOR 3.2A

**VIEW OF CONTROL BOARD**

**REVISIONS**

| REV | DATE     | DESCRIPTION   |
|-----|----------|---|
| 3   | 04/23/78 | ADDED SWITCH & LED LIGHT ETC & LEADS  |
| C   | 12/11/76 | CHANGED RAMP VACUUM FUSE TO RAMP CIRCUIT BREAKER                                    |
| 3   | 02/06/76 | CHANGED AMP GAUGE WIRING, ADDED TOGGLE SWITCH, ADDED FUSE TO RAMP                   |
| A   | 09/06/65 | ADDED MCV, CHANGED PLUG NUMBER, CHANGED NAME, ADDED MAIN PLUG & ADDED AC MODEL PLUG |

**MATERIAL**

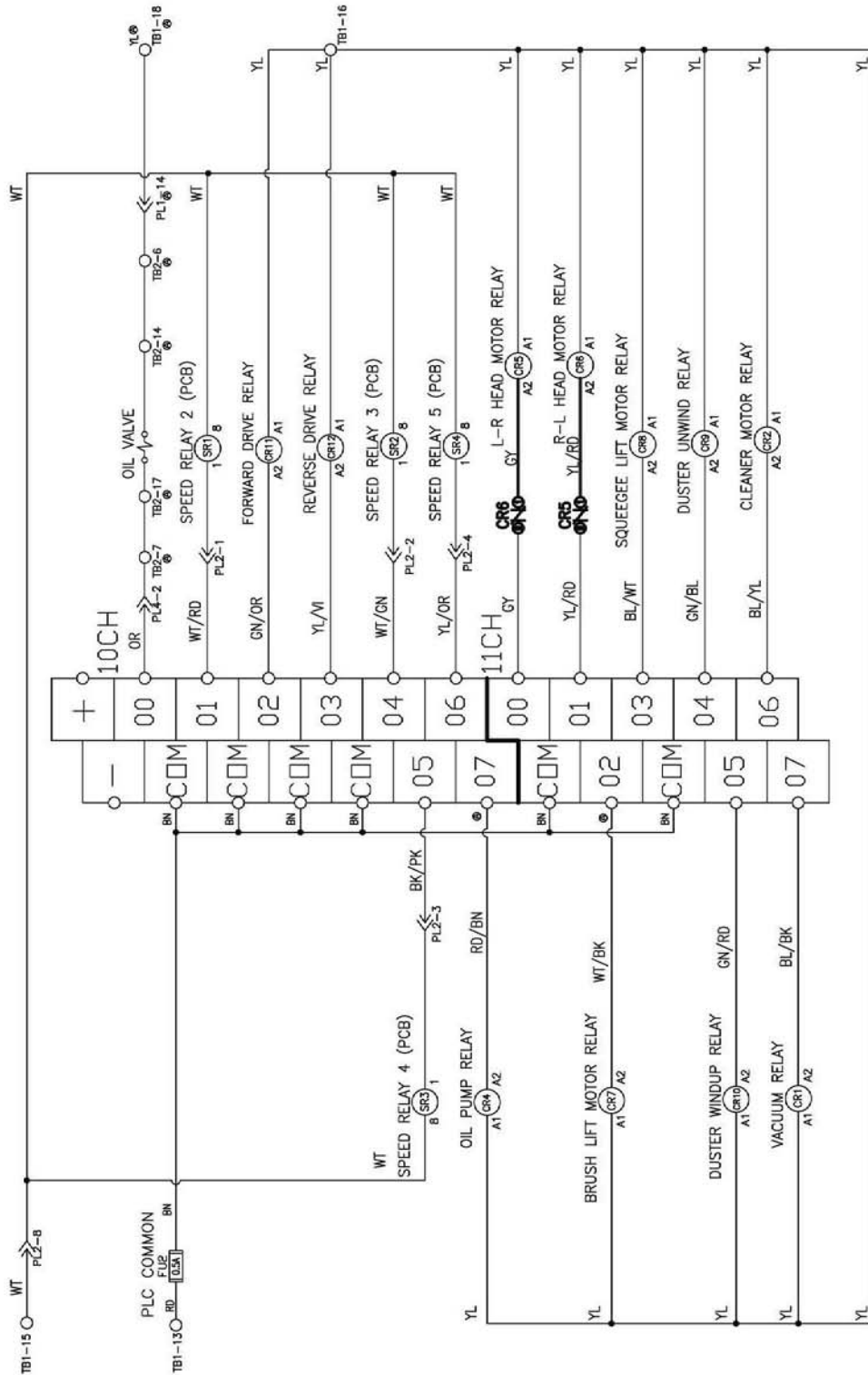
| REV | DATE     | DESCRIPTION |
|-----|----------|-------------|
| NA  | 08/5/05  | NA          |
| HFG | 09/12/06 | NA          |
| HFG | 09/12/06 | NA          |

**DESCRIPTION**

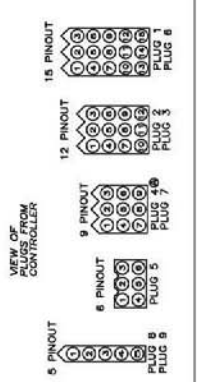
KEGEL  
KUSTODIAN ION (MODEL B)  
MAIN WIRING SCHEMATIC  
REV 09/12/06  
DRAWN BY: JAMES WALKER, JR.  
CHECKED BY: JAMES WALKER, JR.  
(080) 700-0800

REV: 1 OF 4

OMRON  
SYM2AC  
CPM2A  
OUTPUTS



- LEGEND**
- PL1 - MAIN PLUG - RIGHT SIDE (15)
  - PL2 - CIRCUIT BOARD PLUG (12)
  - PL3 - DC SPEED BOARD PLUG (12)
  - PL4 - PLC INPUT PLUG (RIGHT-9)
  - PL5 - PLC INPUT PLUG (LEFT-6)
  - PL6 - MAIN PLUG - LEFT SIDE (15)
  - PL7 - WATER PUMP SPEED BOARD (9)
  - PL8 - AMP GAUGE (5)
  - PL9 - BUFFER MOTOR (5)
  - TB1 - TERMINAL BLOCK 1 (MAIN)
  - TB2 - TERMINAL BLOCK 2 (COIL ASSY)
  - TB3 - TERMINAL BLOCK 3 (LEFT SIDE)
  - TB4 - TERMINAL BLOCK 4 (HANDLE)
  - PP1 - CHARGING PLUG 6
  - CR1 - VACUUM RELAY
  - CR2 - CLEANER MOTOR RELAY
  - CR3 - BUFFER MOTOR RELAY
  - CR4 - OIL PUMP MOTOR RELAY
  - CR5 - L-R HEAD RELAY
  - CR6 - BRUSH LIFT RELAY
  - CR7 - SQUEEGEE MOTOR RELAY
  - CR8 - UNWIND RELAY
  - CR9 - WINDUP RELAY
  - CR10 - FORWARD RELAY
  - CR11 - REVERSE RELAY
  - CR12 - VACUUM MOTOR 20A
  - FU1 - PLC INPUT POWER 0.5A
  - FU2 - PLC OUTPUT COMMONS 0.5A
  - FU3 - OIL PUMP MOTOR 4A
  - FU4 - SQUEEGEE MOTOR 3.2A
  - FU5 - WINDUP MOTOR 7.5A
  - FU6 - DRIVE MOTOR 10A
  - FU7 - BUFFER MOTOR 0.75A
  - FU8 - HEAD MOTOR 3.2A
  - FU9 - CLEANER MOTOR 3.2A
  - FU10 - BRUSH LIFT MOTOR 3.2A
  - FU11 - UNWIND MOTOR 3.2A
  - FU12 - VACUUM MOTOR 20A



| REV. LTR. | DATE     | DESCRIPTION  |
|-----------|----------|--|
| C         | 12/11/06 | CHANGED 20AMP VACUUM FUSE TO 20AMP CIRCUIT BREAKER   |
| B         | 02/06/06 | CHANGED AMP GAUGE WIRING, ADDED TGGLE SWITCH, AND FUSIBLE LINK                               |
| A         | 09/06/05 | CHANGED PLUG NUMBER, CHANGED NAME, BELLETED IN, CHANGED TERM LOCATIONS, PLUGS AND WIRE COLOR |

| REV. LTR. | DATE     | DESCRIPTION |
|-----------|----------|-------------|
| NA        | 08/5/05  | DESCRIPTION |
| NA        | 12/11/06 | DESCRIPTION |

| REV. LTR. | DATE     | DESCRIPTION |
|-----------|----------|-------------|
| NA        | 08/5/05  | DESCRIPTION |
| NA        | 12/11/06 | DESCRIPTION |

| REV. LTR. | DATE     | DESCRIPTION |
|-----------|----------|-------------|
| NA        | 08/5/05  | DESCRIPTION |
| NA        | 12/11/06 | DESCRIPTION |

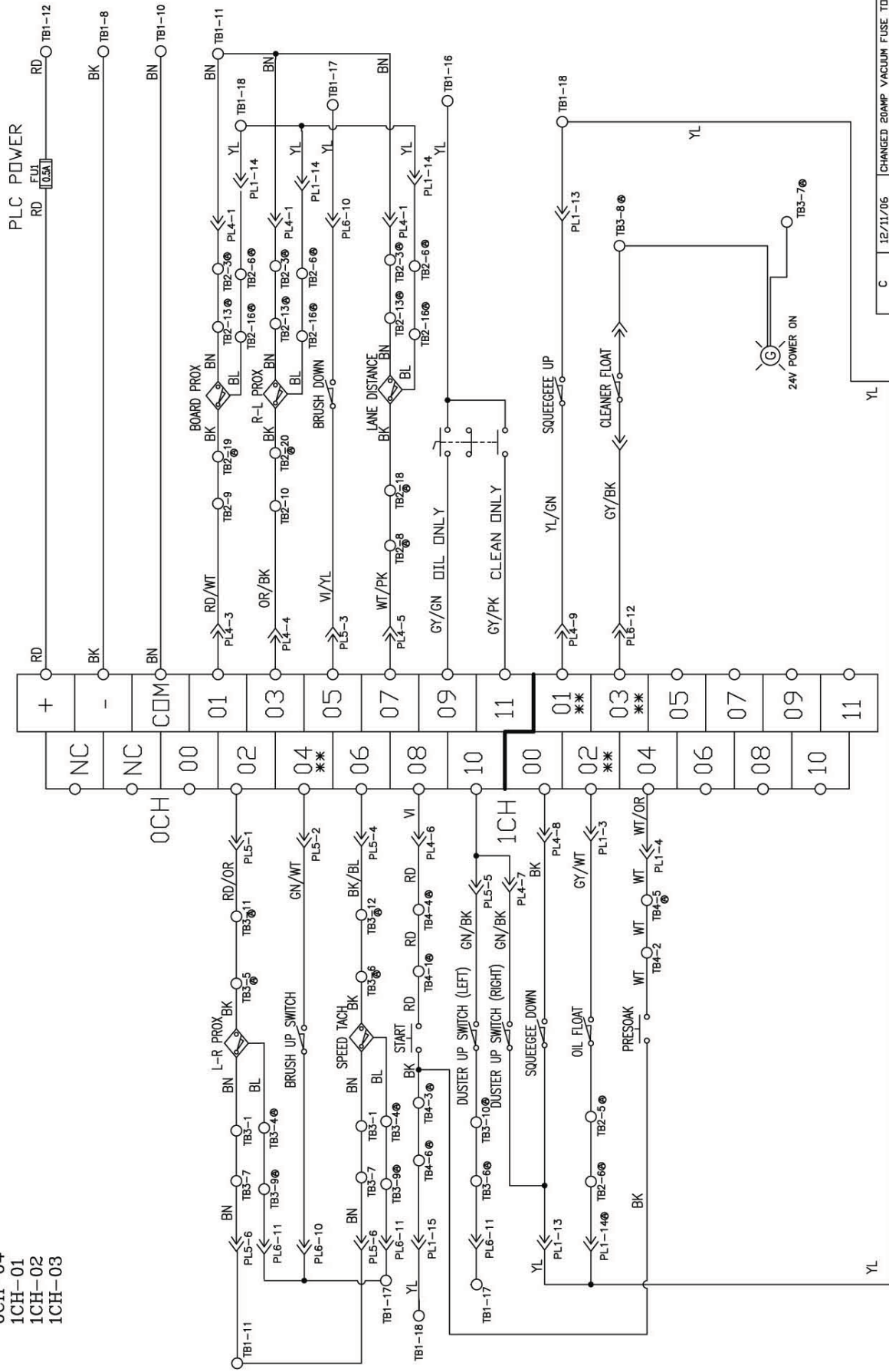
  

| REV. LTR. | DATE     | DESCRIPTION |
|-----------|----------|-------------|
| NA        | 08/5/05  | DESCRIPTION |
| NA        | 12/11/06 | DESCRIPTION |

OMRON  
SYSMAC  
CPM2A  
INPUTS

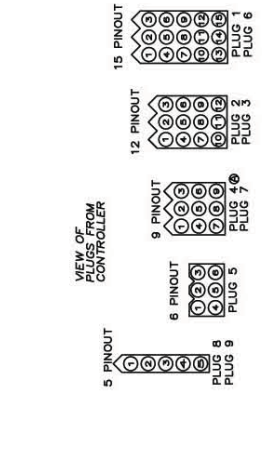
NOTE: WHEN POWER IS APPLIED TO THE MACHINE,  
THE INPUTS DESIGNATED WITH \*\* MUST BE ON TO  
START.  
REF:

OCH-04  
1CH-01  
1CH-02  
1CH-03



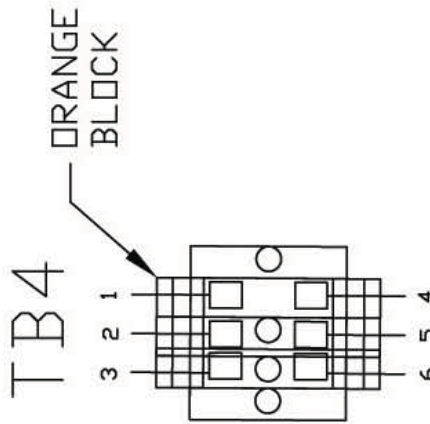
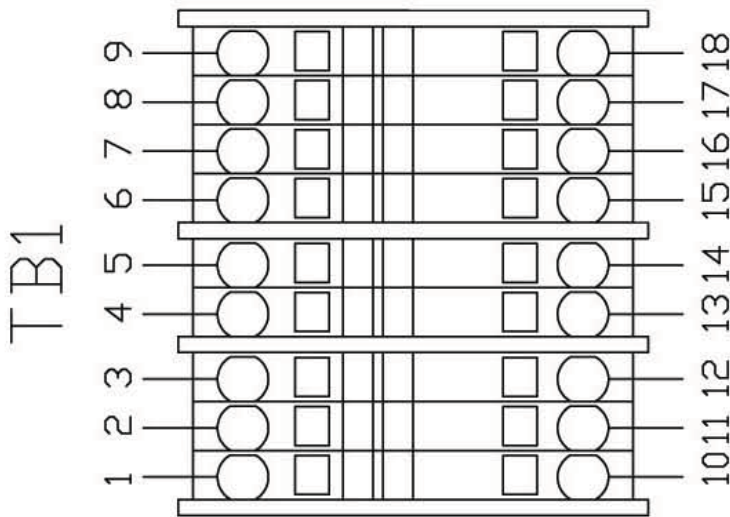
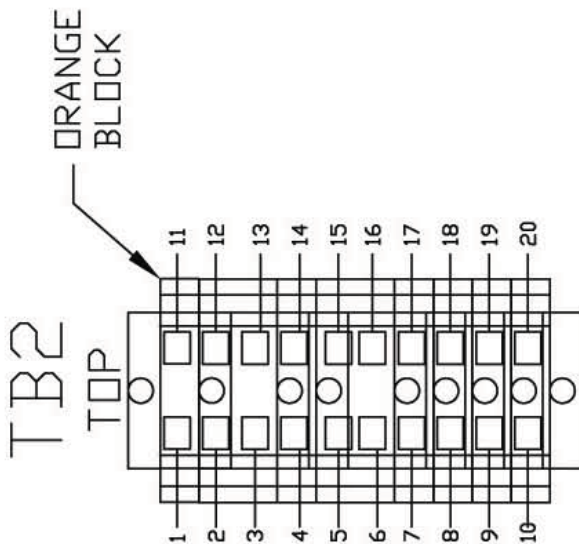
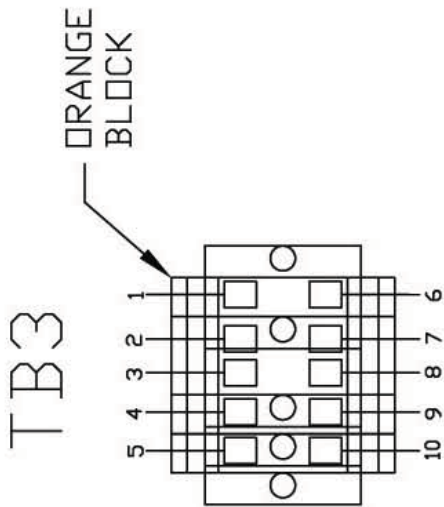
- LEGEND**
- CR1 - VACUUM RELAY
  - CR2 - CLEANER MOTOR RELAY
  - CR3 - BUFFER MOTOR RELAY
  - CR4 - DIL PUMP MOTOR RELAY
  - CR5 - L-R HEAD RELAY
  - CR6 - R-L HEAD RELAY
  - CR7 - BRUSH LIFT RELAY
  - CR8 - SQUEEGEE MOTOR RELAY
  - CR9 - UNWIND RELAY
  - CR10 - WINDUP RELAY
  - CR11 - FORWARD RELAY
  - CR12 - REVERSE RELAY
  - PL1 - MAIN PLUG - RIGHT SIDE (15)
  - PL2 - CIRCUIT BOARD PLUG (12)
  - PL3 - DC SPEED BOARD PLUG (12)
  - PL4 - PLC INPUT PLUG (RIGHT-9)
  - PL5 - PLC INPUT PLUG (LEFT-6)
  - PL6 - MAIN PLUG - LEFT SIDE (15)
  - PL7 - WATER PUMP SPEED BOARD (9)
  - PL8 - AMP GAUGE (5)
  - PL9 - BUFFER MOTOR (5)
  - TB1 - TERMINAL BLOCK 1 (MAIN)
  - TB2 - TERMINAL BLOCK 2 (OIL ASSY)
  - TB3 - TERMINAL BLOCK 3 (LEFT SIDE)
  - TB4 - TERMINAL BLOCK 4 (HANDLE)
  - PP1 - CHARGING PLUG

- CB1 - VACUUM MOTOR 20A
- FU1 - PLC INPUT POWER 0.5A
- FU2 - PLC OUTPUT COMMONS 0.5A
- FU3 - VACUUM MOTOR 4A
- FU4 - SQUEEGEE MOTOR 3.2A
- FU5 - WINDUP MOTOR 3.2A
- FU6 - DRIVE MOTOR 7.5A
- FU7 - BUFFER MOTOR 10A
- FU8 - HEAD MOTOR 0.75A
- FU9 - CLEANER MOTOR 3.2A
- FU10 - BRUSH LIFT MOTOR 3.2A
- FU11 - UNWIND MOTOR 3.2A
- FU12 - UNWIND MOTOR 3.2A



|                        |             |   |             |
|------------------------|-------------|---|-------------|
| C                      | 12/11/06    | CHANGED 20AMP VACUUM FUSE TO 20AMP CIRCUIT BREAKER                              |             |
| B                      | 02/06/06    | CHANGED AMP GAUGE WIRING, ADDED TOGGLE SWITCH, AND FUSIBLE LINK                 |             |
| A                      | 09/06/05    | CHANGED PLUG NUMBER, CHANGED NAME, CHANGED TERM LOCATIONS, PLUGS AND WIRE COLOR |             |
| REV                    | LTR         | DATE  | DESCRIPTION |
| <b>MATERIAL</b>        |             |   |             |
| NA                     |             |   |             |
| <b>KEGEL</b>           |             |   |             |
| DESCRIPTION            |             |   |             |
| KUSTDIAN ION (MODEL B) |             |   |             |
| INPUT WIRING SCHEMATIC |             |   |             |
| DO                     | QTY/MACHINE | PART NUMBER   | SCALE       |
| 17                     | 5400        |   | 17-5400     |
| DOC                    | REV         | SHEET   | OF          |
| B                      |             | 3   | 4           |

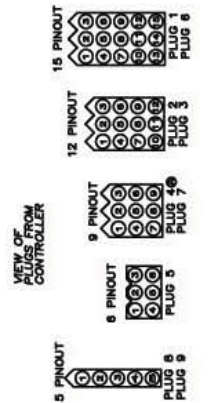




- LEGEND**
- PL1 - MAIN PLUG - RIGHT SIDE (15)
  - PL2 - CIRCUIT BOARD PLUG (12)
  - PL3 - DC SPEED BOARD PLUG (12)
  - PL4 - PLC INPUT PLUG (RIGHT-9)
  - PL5 - PLC INPUT PLUG (LEFT-6)
  - PL6 - MAIN PLUG - LEFT SIDE (15)
  - PL7 - WATER PUMP SPEED BOARD (9)
  - PL8 - AMP GAUGE (5)
  - PL9 - BUFFER MOTOR (5)
  - TB1 - TERMINAL BLOCK 1 (MAIN)
  - TB2 - TERMINAL BLOCK 2 (COTIL ASSY)
  - TB3 - TERMINAL BLOCK 3 (LEFT SIDE)
  - TB4 - TERMINAL BLOCK 4 (HANDLE)
  - PP1 - CHARGING PLUG 6

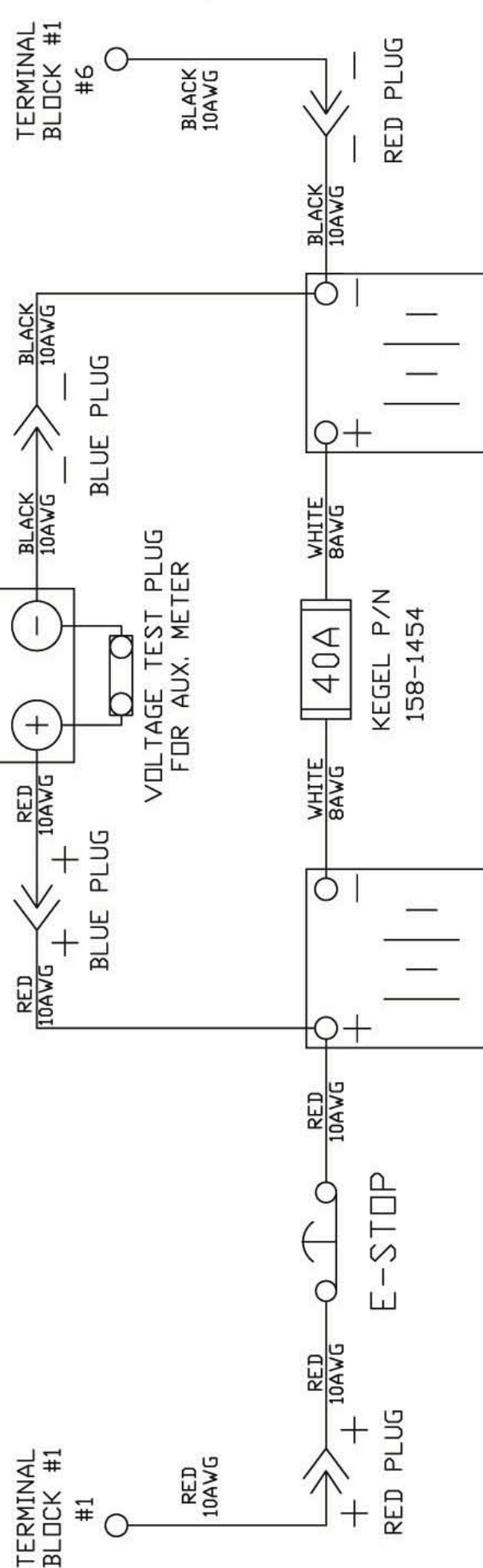
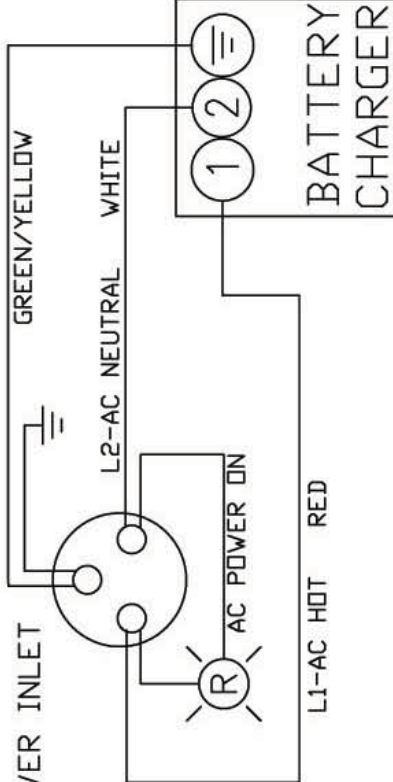
- CR1 - VACUUM RELAY
- CR2 - CLEANER MOTOR RELAY
- CR3 - BUFFER MOTOR RELAY
- CR4 - OIL PUMP MOTOR RELAY
- CR5 - L-R HEAD RELAY
- CR6 - R-L HEAD RELAY
- CR7 - BRUSH LIFT RELAY
- CR8 - SQUEEGEE MOTOR RELAY
- CR9 - UNWIND RELAY
- CR10 - UNWIND RELAY
- CR11 - FORWARD RELAY
- CR12 - REVERSE RELAY

- CBI - VACUUM MOTOR 20A0
- FU1 - PLC INPUT POWER 0.5A
- FU2 - PLC OUTPUT COMMONS 0.5A
- FU3 - OIL PUMP MOTOR 4A
- FU4 - SQUEEGEE MOTOR 3.2A
- FU5 - WINDUP MOTOR 3.2A
- FU6 - DRIVE MOTOR 7.5A
- FU7 - BUFFER MOTOR 10A
- FU8 - HEAD MOTOR 0.75A
- FU9 - CLEANER MOTOR 3.2A
- FU10 - BRUSH LIFT MOTOR 3.2A
- FU11 - UNWIND MOTOR 3.2A



|   |          |   |
|---|----------|---|
| C   | 12/11/06 | CHANGED 20AMP VACUUM FUSE TO 20AMP CIRCUIT BREAKER                                |
| B   | 02/06/06 | CHANGED AMP GAUGE WIRING, ADDED TOGGLE SWITCH, AND FUSIBLE LINK                   |
| A   | 09/06/05 | CHANGED PLUG NUMBER, CHANGED NAME<br>CHANGED TERM LOCATIONS, PLUGS AND WIRE COLOR |
| REV LTR   | DATE     | DESCRIPTION   |
| <b>MATERIAL</b>   |          |   |
| NA  | NA       | DESCRIPTION   |
| KEGEL   | KEGEL    | DESCRIPTION   |
| 1981 LONGLEAF BLDG.<br>LAKE WALES, FL 32800<br>(888) 794-0800 |          |   |
| DRAWN BY  | DATE     | DESCRIPTION   |
| SLS   | 08/5/05  | KUSTODIAN IDN   |
| APPROVED  | REV DATE | TERMINAL BLOCK LAYOUT   |
| HFG   | 12/11/06 | DO NOT SCALE DRAWING  |
| C   | C        | SIZE / QTY / MACHINE / PART NUMBER  |
| C   | C        | 17-5400   |
| SCALE   | 4        | DIFF 4  |

4 3 2 1



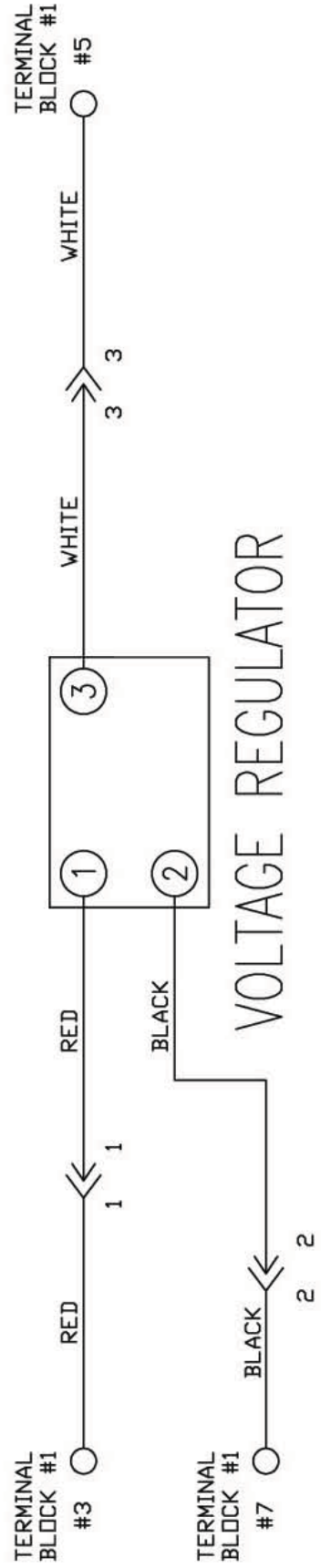
# ODYSSEY BATTERIES

|           |          |                                    |             |  |        |
|-----------|----------|------------------------------------|-------------|--|--------|
| MATERIAL  |          | THE KEGEL CO.                      |             | 1961 LONGLEAF BLVD.<br>LAKE WALKER, FL 33669 |        |
| N/A       |          | DESCRIPTION                        |             | KUSTODIAN ION                                |        |
| DRAWN BY  | DATE     | BATTERIES, CHARGER & E-STOP WIRING |             |  |        |
| SLS       | 07/28/06 | DO NOT SCALE DRAWING               |             |  |        |
| APPROVED: | REV DATE | SIZE                               | QTY/MACHINE | PART NUMBER                                  |        |
| HFG       |          | A                                  | N/A         |  |        |
| DOC       |          | SCALE                              | N/A         | SHEET  | 1 OF 1 |
| REV       |          |                                    |             |  |        |

|                     |                 |
|---------------------|-----------------|
| TOLERANCES - U.D.S. |                 |
| 3                   | DECIMAL = ±.003 |
| 2                   | DECIMAL = ±.010 |
| 1                   | DECIMAL = ±.030 |

1 2 3 4

4 3 2 1



VOLTAGE REGULATOR

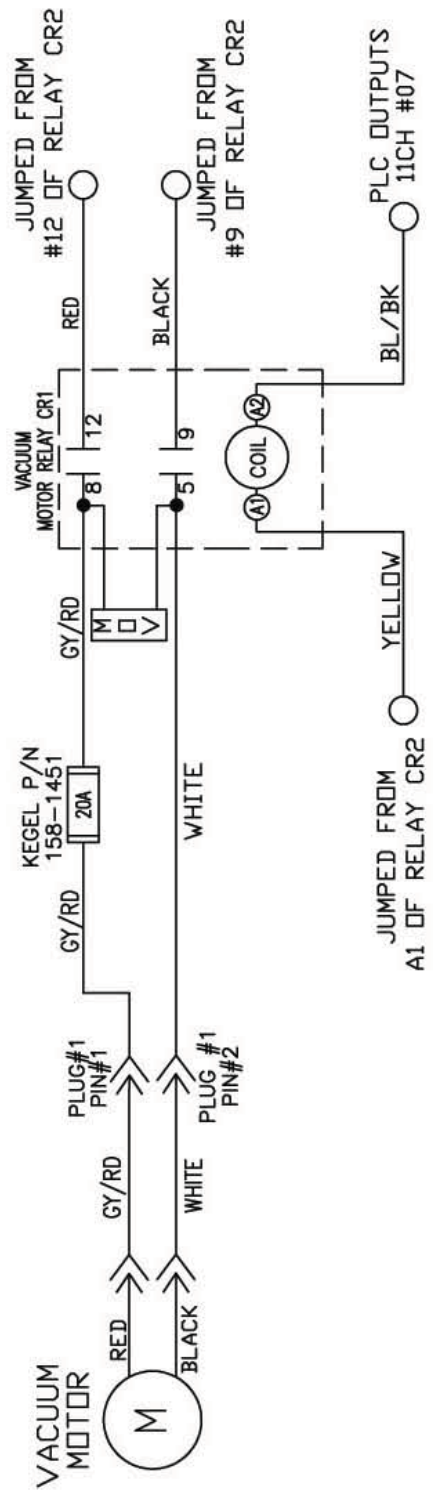
TOLERANCES - U.I.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

|           |          |  |                         |
|-----------|----------|--|-------------------------|
| MATERIAL  |          | THE KEGEL CO. 1961 LONGLEAF BLVD. LAKE WALES, FL 33859 |                         |
| N/A       |          | DESCRIPTION  |                         |
| DATE      | 07/28/06 | KUSTODIAN ION  |                         |
| REVISION  | HFG      | VOLTAGE REGULATOR WIRING                               |                         |
| APPROVED: |          | DO NOT SCALE DRAWING                                   |                         |
| DOC       |          | SIZE   | QTY/MACHINE PART NUMBER |
| REV       |          | A  | N/A                     |
|           |          | SCALE  | N/A                     |
|           |          |  | SHEET 1 OF 1            |

4 3 2 1

4 3 2 1

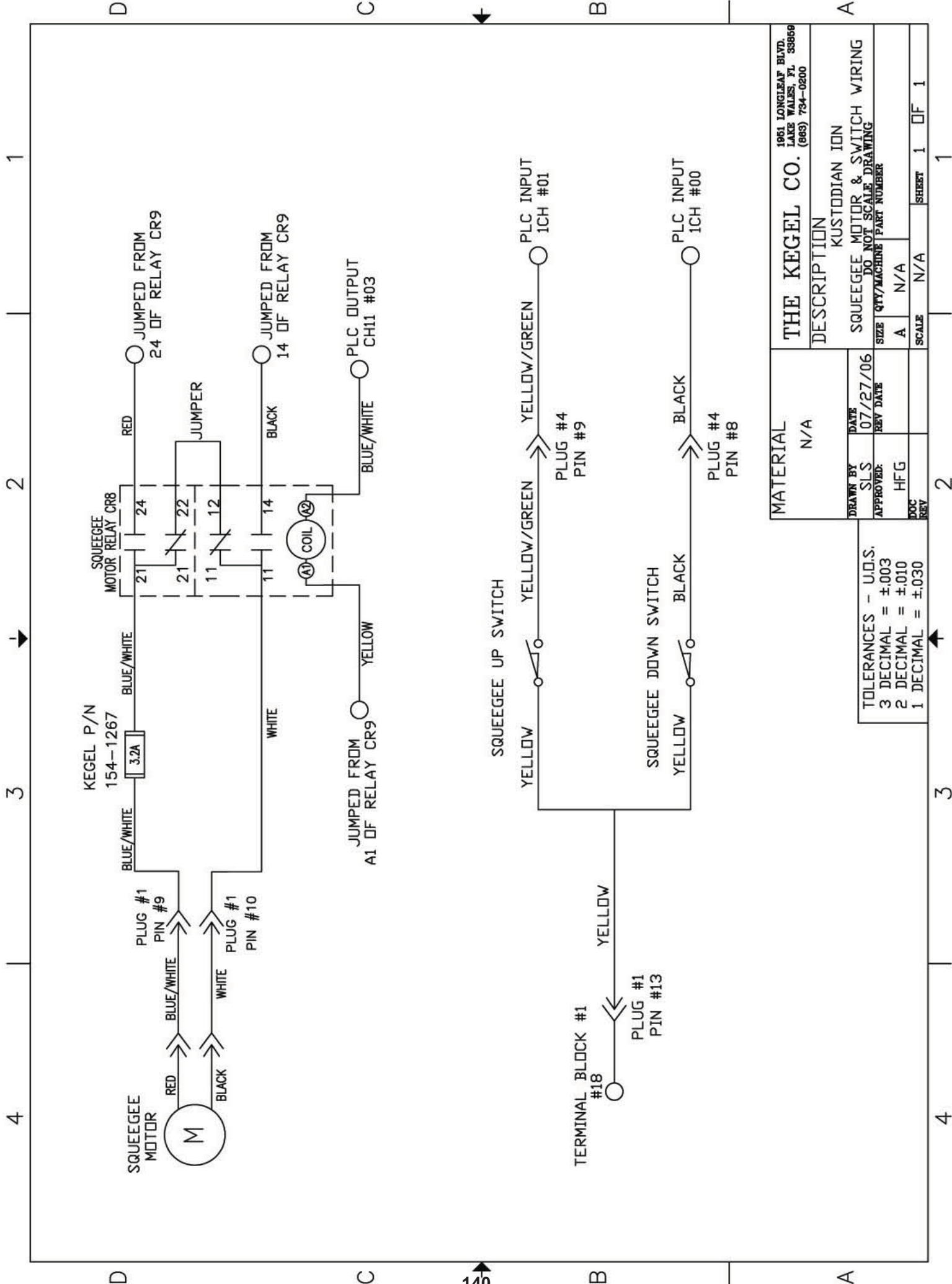
D C B A



|           |          |  |                         |
|-----------|----------|--|-------------------------|
| MATERIAL  |          | THE KEGEL CO. (868) 734-0200                 |                         |
| N/A       |          | 1961 LONGLEAF BLVD.<br>LAKE WALKER, FL 33869 |                         |
| DATE      | 07/27/06 | DESCRIPTION                                  |                         |
| DRAWN BY  | SLS      | KUSTODIAN ION                                |                         |
| REV DATE  |          | VACUUM MOTOR WIRING                          |                         |
| APPROVED: | HFG      | DO NOT SCALE DRAWING                         |                         |
| DOC       |          | SIZE   | QTY/MACHINE PART NUMBER |
| REV       |          | A  | N/A                     |
|           |          | SCALE  | N/A                     |
|           |          |  | SHEET 1 OF 1            |

TOLERANCES - U.O.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

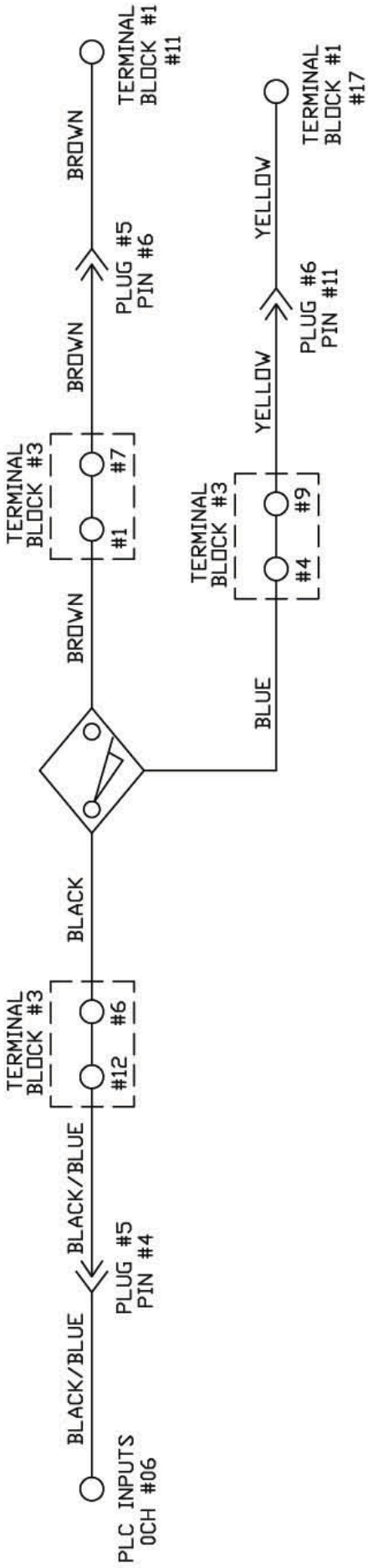
4 3 2 1



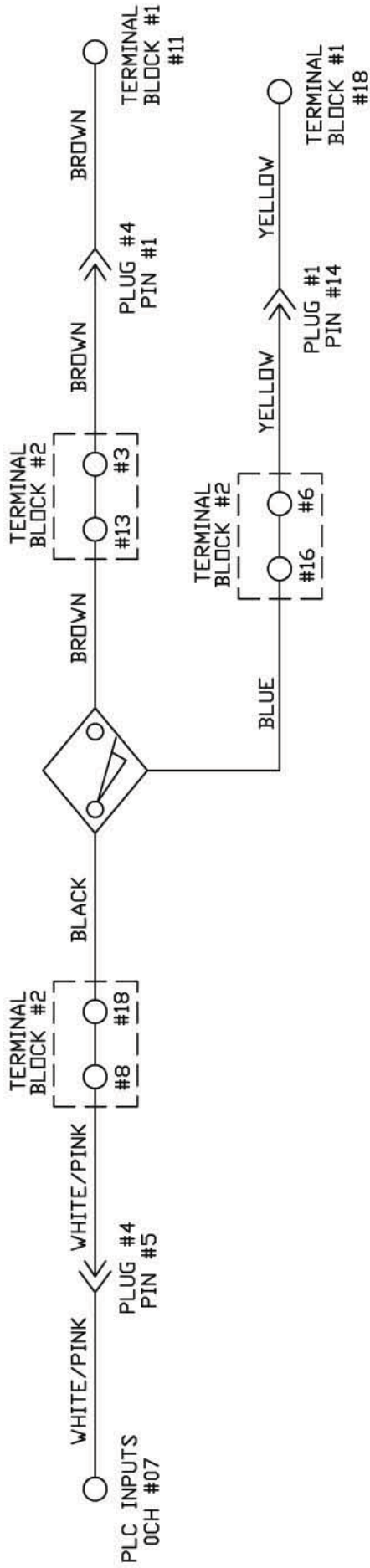
|                                |          |                      |                         |
|--------------------------------|----------|----------------------|-------------------------|
| MATERIAL                       |          | N/A                  |                         |
| DESCRIPTION                    |          | KUSTODIAN ION        |                         |
| SQUEEGEE MOTOR & SWITCH WIRING |          | DO NOT SCALE DRAWING |                         |
| DRAWN BY                       | DATE     | SIZE                 | QTY/MACHINE PART NUMBER |
| SLS                            | 07/27/06 | A                    | N/A                     |
| APPROVED:                      | REV DATE | SCALE                | N/A                     |
| HFG                            |          | SHEET                | 1 OF 1                  |
| DOC REV                        |          |                      |                         |

|                     |         |   |       |
|---------------------|---------|---|-------|
| THE KEGEL CO.       |         | 1961 LONGLEAF BLVD.<br>LAKE WALES, FL 33859<br>(888) 794-0200 |       |
| TOLERANCES - U.D.S. |         |   |       |
| 3                   | DECIMAL | =   | ±.003 |
| 2                   | DECIMAL | =   | ±.010 |
| 1                   | DECIMAL | =   | ±.030 |

# SPEED TACH PROX



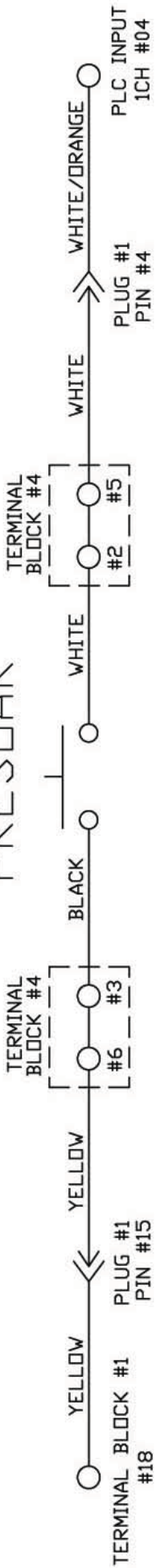
# LANE DISTANCE PROX



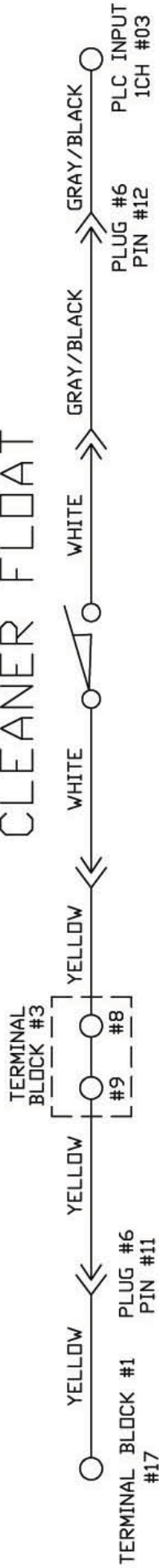
|  |          |       |                         |
|--|----------|-------|-------------------------|
| MATERIAL   |          | N/A   |                         |
| THE KEGEL CO. 1961 LONGLEAF BLVD. LAKE WALES, FL 33859 |          |       |                         |
| DESCRIPTION<br>KUSTODIAN ION                           |          |       |                         |
| SPEED TACH / LANE DISTANCE WIRING                      |          |       |                         |
| DRAWN BY   | DATE     | SIZE  | QTY/MACHINE PART NUMBER |
| SLS  | 07/28/06 | A     | N/A                     |
| APPROVED:  | REV DATE | SCALE | N/A                     |
| HFG  |          |       |                         |
| DOC REV  |          |       |                         |
|  |          |       | SHEET 1 OF 1            |

|                     |                 |
|---------------------|-----------------|
| TOLERANCES - U.I.S. |                 |
| 3                   | DECIMAL = ±.003 |
| 2                   | DECIMAL = ±.010 |
| 1                   | DECIMAL = ±.030 |

# PRESOAK



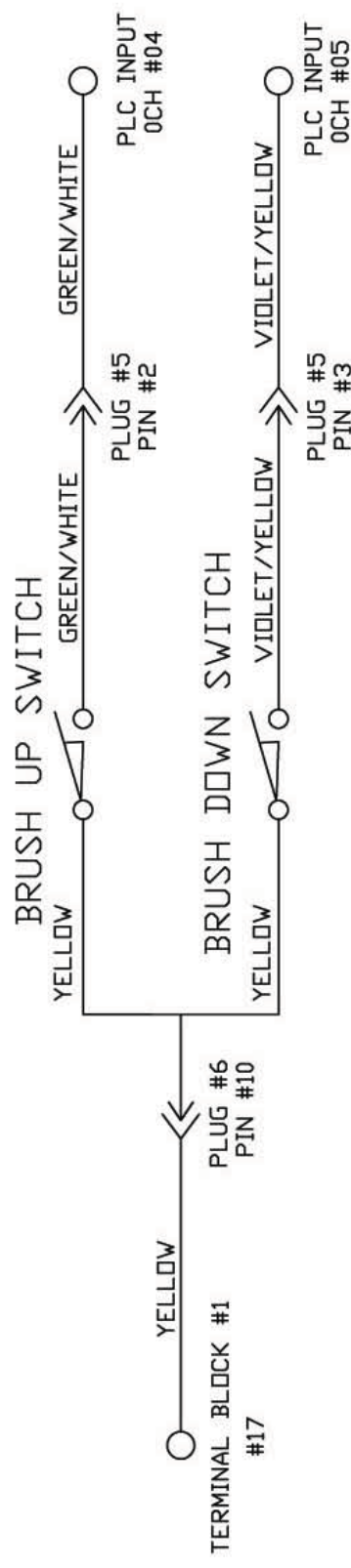
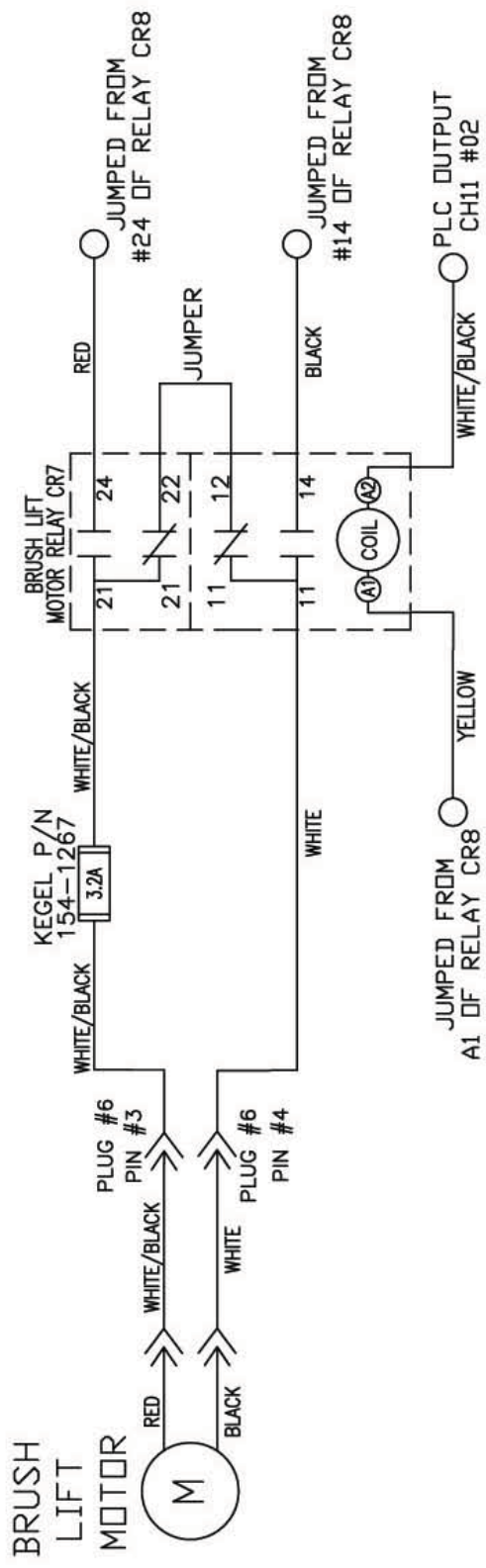
# CLEANER FLOAT



|           |          |   |                           |
|-----------|----------|---|---------------------------|
| MATERIAL  |          | N/A   |                           |
| DRAWN BY  | DATE     | 1961 LONGLEAF BLVD.<br>LAKE WALES, FL 33856<br>(866) 734-0200 |                           |
| SLS       | 07/27/06 | THE KEGEL CO.   |                           |
| APPROVED: | REV DATE | DESCRIPTION   |                           |
| HFG       |          | PRESOAK BUTTION & CLEANER FLOAT                               |                           |
| DOC       |          | SIZE  | QTY/MACHINE / PART NUMBER |
| REV       |          | A   | N/A                       |
|           |          | SCALE   | N/A                       |
|           |          | SHEET   | 1 OF 1                    |

TOLERANCES - U.O.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

4 3 2 1



|           |          |                                  |                         |  |        |
|-----------|----------|----------------------------------|-------------------------|--|--------|
| MATERIAL  |          | THE KEGEL CO.                    |                         | 1961 LONGLEAF BLVD.<br>LAKE WALKER, FL 33869 |        |
| N/A       |          | DESCRIPTION                      |                         | KUSTODIAN ION                                |        |
| DRAWN BY  | DATE     | BRUSH LIFT MOTOR / SWITCH WIRING |                         | DO NOT SCALE DRAWING                         |        |
| SLS       | 07/27/06 | SIZE                             | QTY/MACHINE PART NUMBER | A  | N/A    |
| APPROVED: | REV DATE | SCALE                            | N/A                     | SHEET  | 1 OF 1 |
| HFG       |          |                                  |                         |  |        |
| DOC       |          |                                  |                         |  |        |
| REV       |          |                                  |                         |  |        |

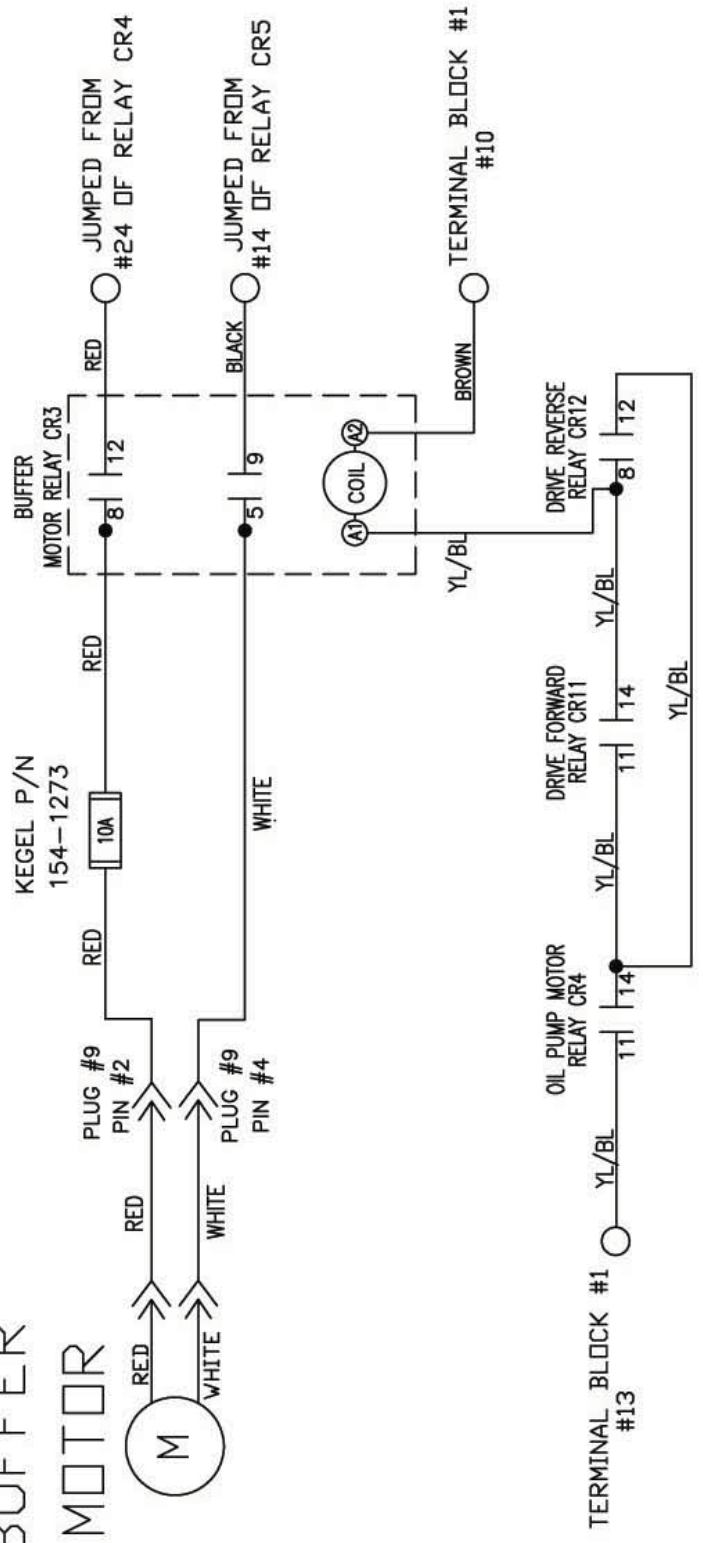
TOLERANCES - U.D.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

2 3 4



4 3 2 1

# BUFFER MOTOR



|           |          |                              |                         |
|-----------|----------|------------------------------|-------------------------|
| MATERIAL  |          | N/A                          |                         |
| DRAWN BY  | DATE     | DESCRIPTION                  |                         |
| SLS       | 07/27/06 | THE KEGEL CO. (666) 734-0200 |                         |
| APPROVED: | REV DATE | KUSTODIAN IDN                |                         |
| HFG       |          | BUFFER MOTOR WIRING          |                         |
| DOC       |          | SIZE                         | QTY/MACHINE PART NUMBER |
| REV       |          | A                            | N/A                     |
|           |          | SCALE                        | N/A                     |
|           |          | SHEET                        | 1 OF 1                  |

|                     |                 |
|---------------------|-----------------|
| TOLERANCES - U.D.S. |                 |
| 3                   | DECIMAL = ±.003 |
| 2                   | DECIMAL = ±.010 |
| 1                   | DECIMAL = ±.030 |

4 3 2 1

D D

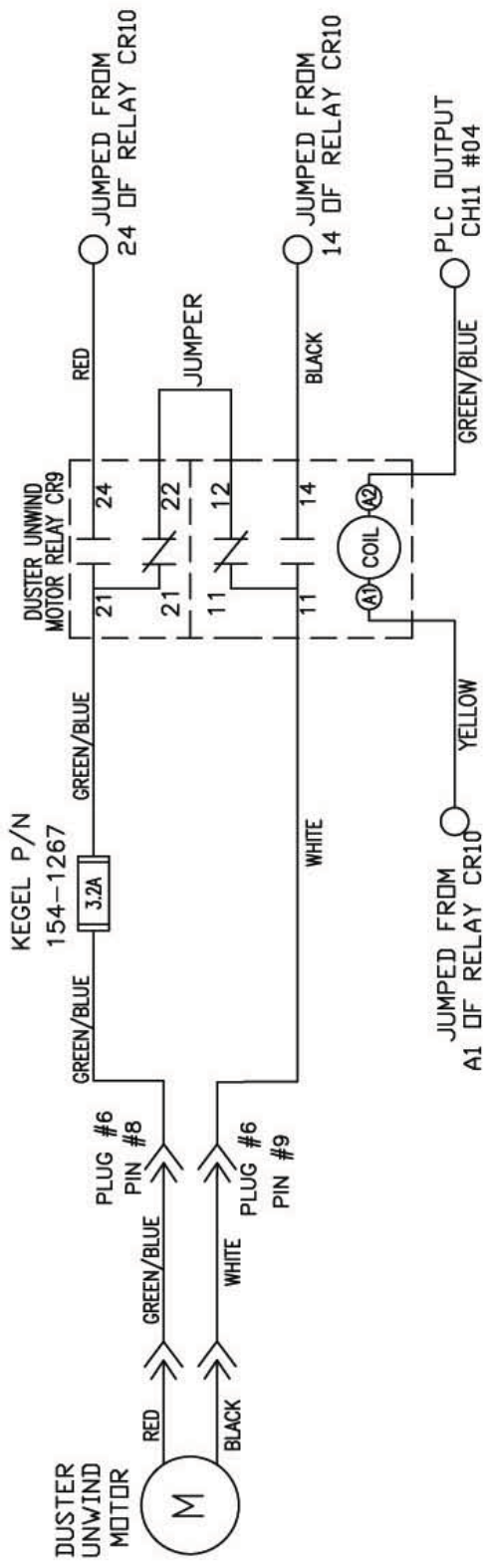
C C

B B

A A

4 3 2 1

D C B A

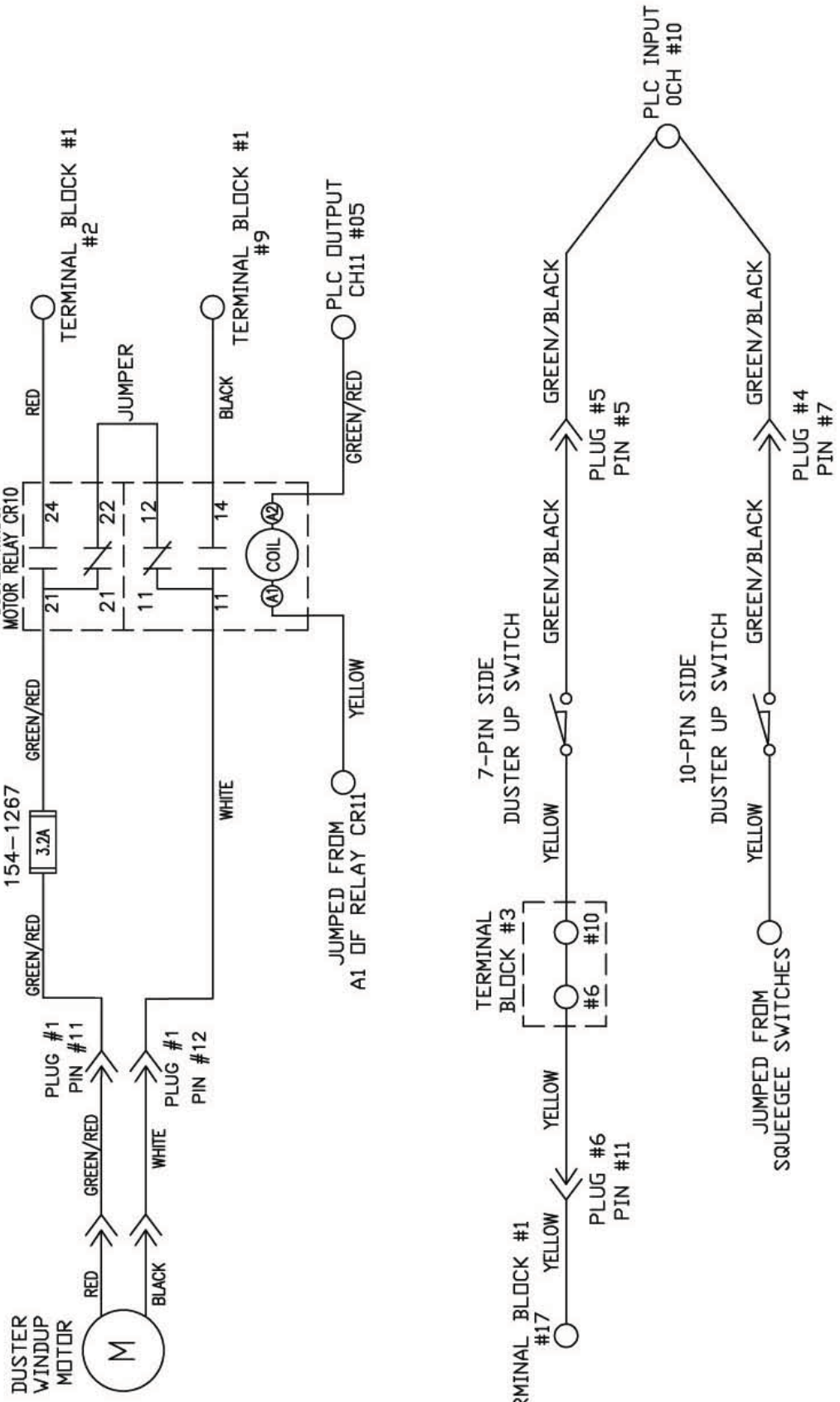


|           |          |                     |     |   |        |
|-----------|----------|---------------------|-----|---|--------|
| MATERIAL  |          | THE KEGEL CO.       |     | 1961 LONGLEAF BLVD.<br>LAKE WALES, FL 33869<br>(888) 734-0200 |        |
| N/A       |          | DESCRIPTION         |     | KUSTODIAN IDN   |        |
| DRAWN BY  | DATE     | DUSTER UNWIND MOTOR |     | DO NOT SCALE DRAWING  |        |
| SLS       | 07/27/06 | SIZE                |     | QTY/MACHINE PART NUMBER                                       |        |
| APPROVED: | REV DATE | A                   | N/A | N/A   |        |
| HFG       |          | SCALE               | N/A | SHEET   | 1 OF 1 |
| DOC       |          |                     |     |   |        |
| REV       |          |                     |     |   |        |

TOLERANCES - U.D.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

4 3 2 1

4 3 2 1



|           |          |                                 |               |
|-----------|----------|---------------------------------|---------------|
| MATERIAL  |          | N/A                             |               |
| DATE      | 07/27/06 | DESCRIPTION                     | KUSTODIAN ION |
| DRAWN BY  | SLS      | DUSTER UP MOTOR / SWITCH WIRING |               |
| APPROVED: | HFG      | DO NOT SCALE DRAWING            |               |
| DOC REV   |          | SIZE                            | A             |
|           |          | QTY/MACHINE PART NUMBER         | N/A           |
|           |          | SCALE                           | N/A           |
|           |          | SHEET                           | 1 OF 1        |

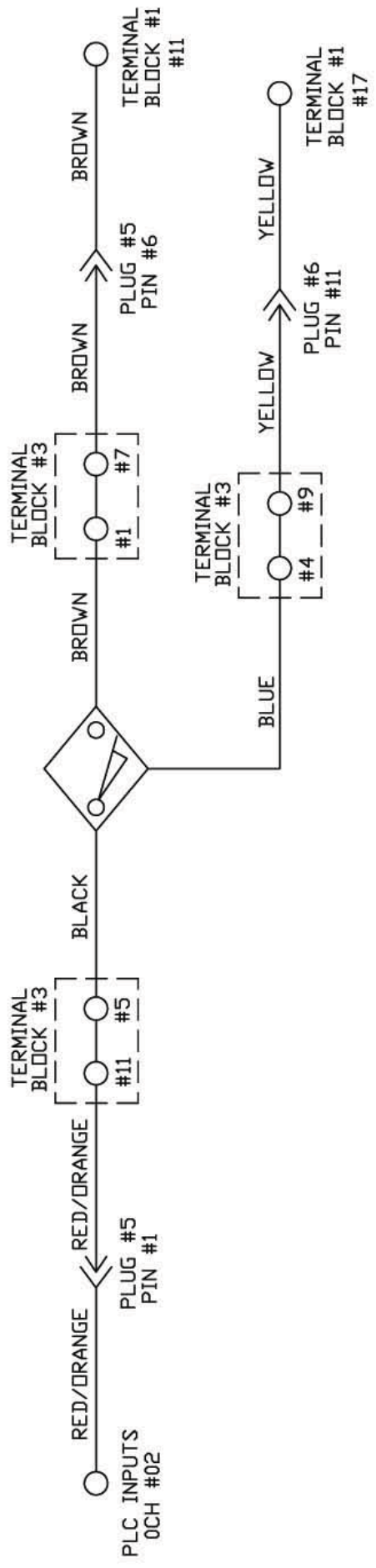
THE KEGEL CO.  
1961 LONGLEAF BLVD.  
LAKE WALES, FL 33859  
(888) 794-0200

TOLERANCES - U.O.S.  
3 DECIMAL = ±.003  
2 DECIMAL = ±.010  
1 DECIMAL = ±.030

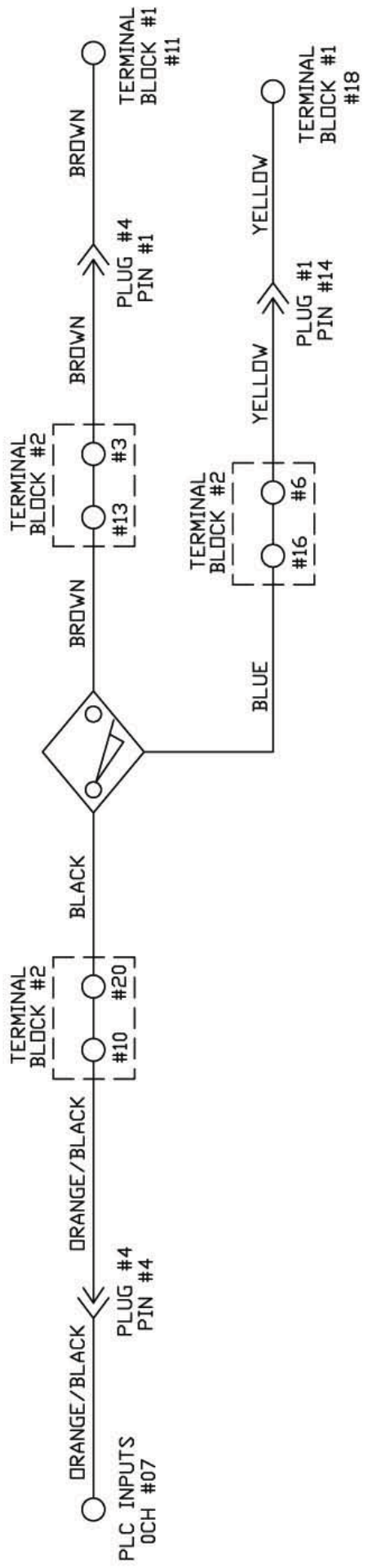
4 3 2 1

4 3 2 1

### L-R HEAD PROX



### R-L HEAD PROX



|                        |                         |   |     |
|------------------------|-------------------------|---|-----|
| <b>MATERIAL</b><br>N/A |                         | <b>THE KEGEL CO.</b><br>1961 LONGLEAF BLVD.<br>LAKE WALES, FL 33866<br>(888) 784-0200 |     |
| <b>DESCRIPTION</b>     | KUSTODIAN ION           |   |     |
| <b>DATE</b>            | 07/27/06                |   |     |
| <b>REV DATE</b>        | DO NOT SCALE DRAWING    |   |     |
| <b>SIZE</b>            | QTY/MACHINE PART NUMBER |   |     |
| <b>SCALE</b>           | A                       | N/A   | N/A |
| <b>SHEET</b>           | 1                       | OF  | 1   |

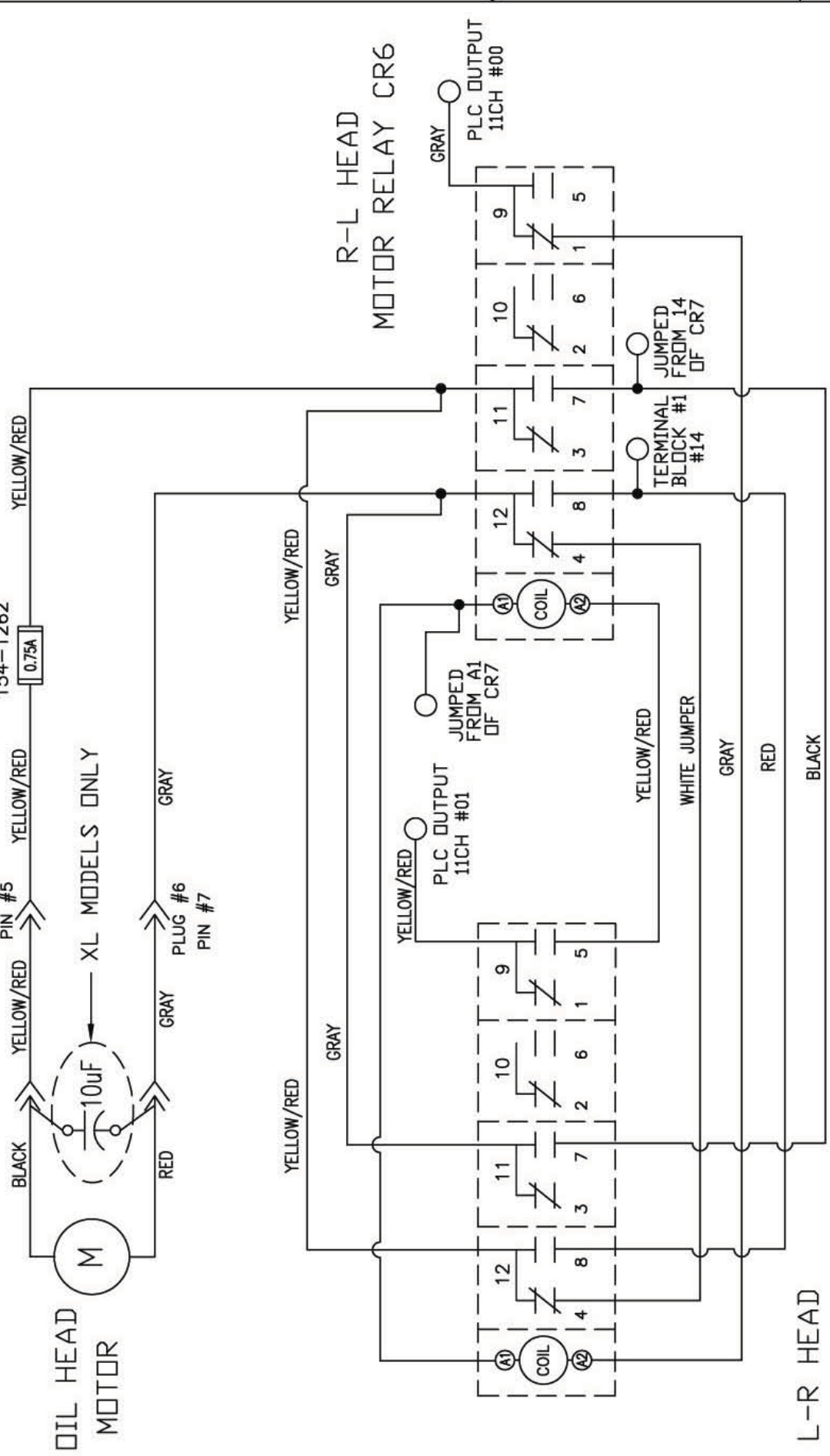
TOLERANCES - U.D.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

3 2 1

D C B A

D C B A

4 3 2 1



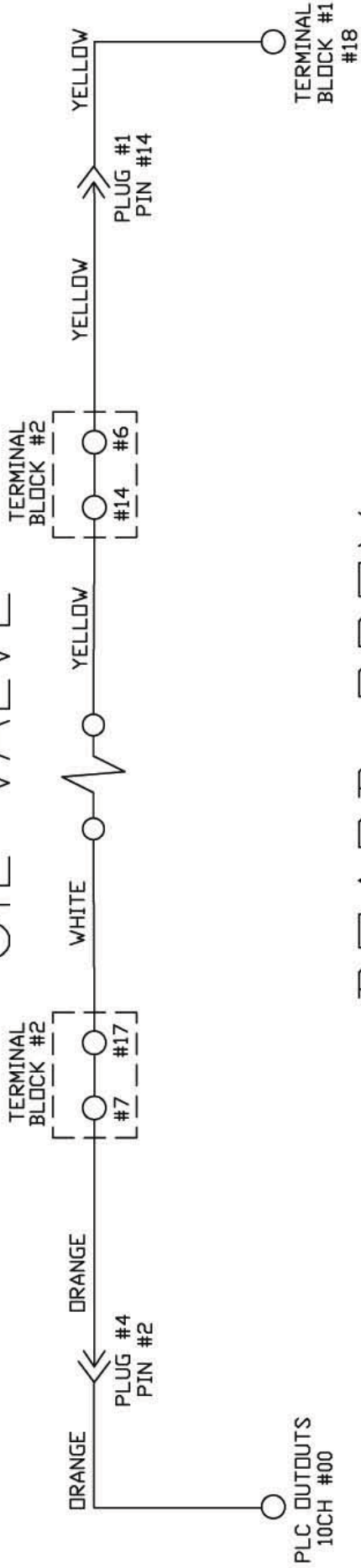
|           |          |                       |                         |
|-----------|----------|-----------------------|-------------------------|
| MATERIAL  |          | N/A                   |                         |
| DRAWN BY  | DATE     | DESCRIPTION           |                         |
| SLS       | 12/11/06 | OIL HEAD MOTOR WIRING |                         |
| APPROVED: | REV DATE | DO NOT SCALE DRAWING  |                         |
| HFG       |          | SIZE                  | QTY/MACHINE PART NUMBER |
| DOC       |          | A                     | N/A                     |
| REV       |          | SCALE                 | N/A                     |
|           |          | SHEET                 | 1 OF 1                  |

THE KEGEL CO. 1961 LONGLEAF BLVD.  
LAKE WALKER, FL 33969  
(866) 734-0200

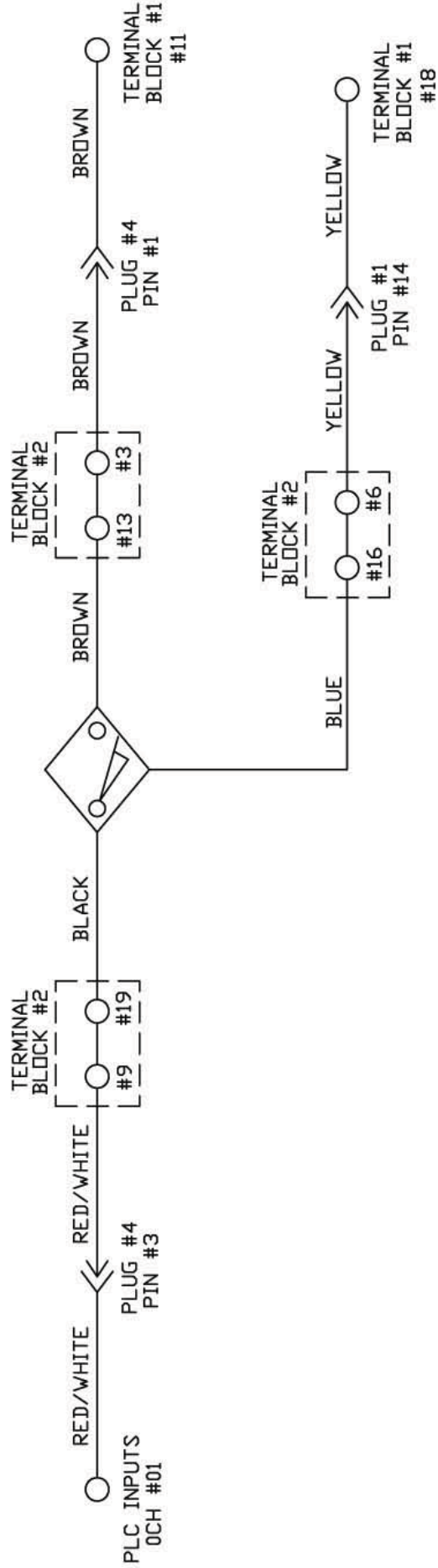
TOLERANCES - U.D.S.  
3 DECIMAL = ±.003  
2 DECIMAL = ±.010  
1 DECIMAL = ±.030

4 3 2 1

# OIL VALVE



# BOARD PROX



|             |   |  |                         |
|-------------|---|--|-------------------------|
| MATERIAL    |   | THE KEGEL CO.<br>1961 LONGLEAF BLVD.<br>LAKE WALES, FL 33856<br>(863) 794-0200 |                         |
| DESCRIPTION | OIL VALVE & BOARD PROX WIRING<br>DO NOT SCALE DRAWING |  |                         |
| DRAWN BY    | DATE  | SIZE   | QTY/MACHINE PART NUMBER |
| SLS         | 07/27/06  | A  | N/A                     |
| APPROVED:   | REV DATE  | SCALE  | N/A                     |
| HFG         |   | SHEET  | 1 OF 1                  |
| DOC         |   |  |                         |
| REV         |   |  |                         |

TOLERANCES - U.D.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

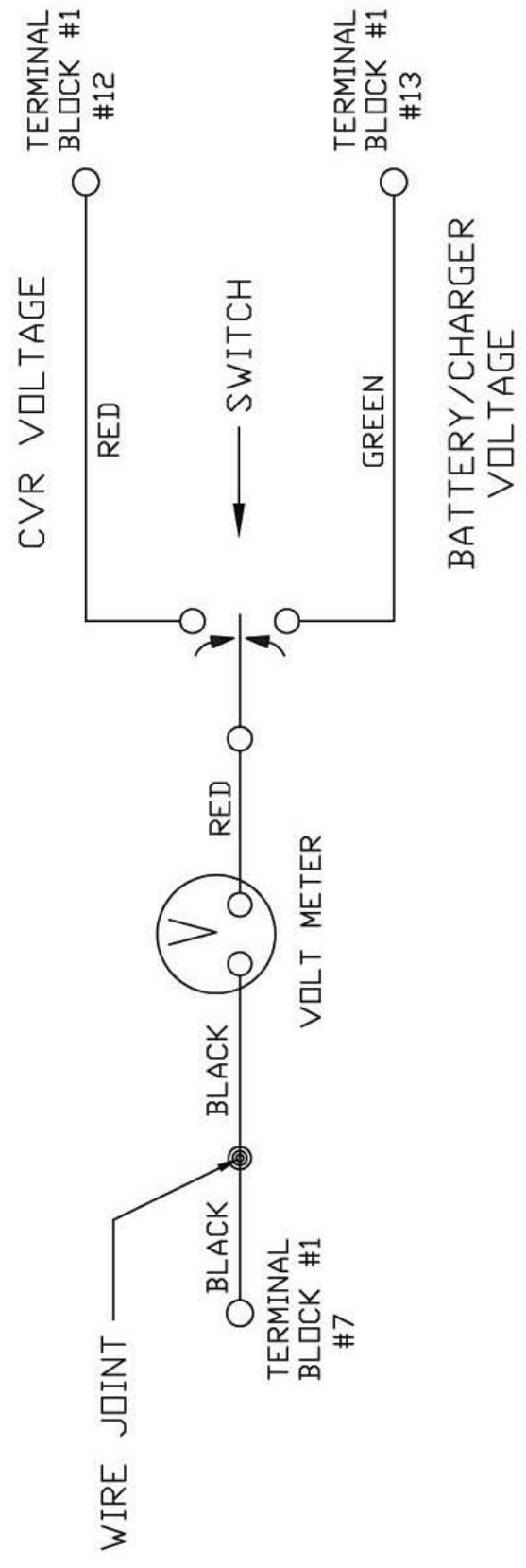
4 3 2 1

4 3 2 1

D C B A

4 3 2 1

D C B A



TOLERANCES - U.O.S.  
 3 DECIMAL = ±.003  
 2 DECIMAL = ±.010  
 1 DECIMAL = ±.030

|             |             |                           |        |
|-------------|-------------|---------------------------|--------|
| MATERIAL    |             | N/A                       |        |
| DRAWN BY    | DATE        | 07/28/06                  |        |
| SLS         | REV DATE    |                           |        |
| APPROVED:   | HFG         |                           |        |
| DOC REV     |             |                           |        |
| DESCRIPTION |             | KUSTODIAN ION             |        |
|             |             | VOLT METER/ SWITCH WIRING |        |
| SIZE        | QTY/MACHINE | PART NUMBER               |        |
| A           | N/A         |                           |        |
| SCALE       | N/A         |                           |        |
|             |             | SHEET                     | 1 OF 1 |

4 3 2 1





# NAVIAGTE PATTERNS



### **BOURBON STREET 6240**

Kegel's reverse drop function is used for this pattern which provides more shots up front while also making the shot more open downlane.

So just like the famous street in New Orleans, once the shot's start flowing, you can really let loose and have a good time when playing on Kegel's Bourbon Street.

#### **Latitude Ratio Coordinates**

22' 6.2 to 1

38' 6.7 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 5.0 to 1

Inside Taper 4.0 to 1

#### **Pattern Distance**

40 Feet

#### **Pattern Volume**

Forward 15.60 mL

Reverse 7.85 mL

Total 23.45 mL



# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### BOURBON STREET 6240

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 40 feet

Reverse Drop Brush: 32 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 3                                    | 14.00                 | 0.00                              | 1.90                           | 37                        | 111                  | 5550                           |  |
| 02F  | 9                  | 9                   | 1                                    | 18.00                 | 3.90                              | 6.40                           | 23                        | 23                   | 1150                           |  |
| 03F  | 10                 | 10                  | 3                                    | 18.00                 | 6.40                              | 14.00                          | 21                        | 63                   | 3150                           |  |
| 04F  | 11                 | 11                  | 3                                    | 18.00                 | 14.00                             | 21.60                          | 19                        | 57                   | 2850                           |  |
| 05F  | 13                 | 13                  | 3                                    | 18.00                 | 21.60                             | 29.20                          | 15                        | 45                   | 2250                           |  |
| 06F  | 14                 | 14                  | 1                                    | 22.00                 | 29.20                             | 32.30                          | 13                        | 13                   | 650                            |  |
| 07F  | 2                  | 2                   | 0                                    | 22.00                 | 32.30                             | 34.00                          | 0                         | 0                    | 0                              |  |
| 08F  | 2                  | 2                   | 0                                    | 26.00                 | 34.00                             | 40.00                          | 0                         | 0                    | 0                              |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 312                  | 15.60                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 30.00                          |                           |                      |                                |  |
| 02R  | 14                 | 14                  | 1                                    | 22.00                 | 30.00                             | 26.90                          | 13                        | 13                   | 650                            |  |
| 03R  | 13                 | 13                  | 3                                    | 18.00                 | 26.90                             | 19.30                          | 15                        | 45                   | 2250                           |  |
| 04R  | 11                 | 11                  | 3                                    | 18.00                 | 19.30                             | 11.70                          | 19                        | 57                   | 2850                           |  |
| 05R  | 10                 | 10                  | 2                                    | 14.00                 | 11.70                             | 7.80                           | 21                        | 42                   | 2100                           |  |
| 06R  | 2                  | 2                   | 0                                    | 10.00                 | 7.80                              | 0.00                           | 0                         | 0                    | 0                              |  |
| 07R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 157                  | 7.85                           |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>469</b>           | <b>23.45</b>                   |  |





### **EASY STREET 7938**

Because of the medium distance of this pattern, it is favorable to many different styles and ball choices. Bowlers with higher rev rates can easily swing the ball and bowlers with lower rev rates can play more direct. This pattern is just like walking down EASY STREET with no worries on a nice summer day.

#### **Latitude Ratio Coordinates**

22' 7.9 to 1

36' 5.2 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 2.4 to 1

Inside Taper 3.9 to 1

#### **Pattern Distance**

38 Feet

#### **Pattern Volume**

Forward 7.25 mL

Reverse 11.45 mL

Total 18.70 mL



# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### EASY STREET 7938

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 38 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 1                                    | 14.00                 | 0.00                              | 0.00                           | 37                        | 37                   | 1850                           |  |
| 02F  | 10                 | 10                  | 3                                    | 18.00                 | 0.00                              | 7.60                           | 21                        | 63                   | 3150                           |  |
| 03F  | 13                 | 13                  | 3                                    | 18.00                 | 7.60                              | 15.20                          | 15                        | 45                   | 2250                           |  |
| 04F  | 2                  | 2                   | 0                                    | 18.00                 | 15.20                             | 24.00                          |                           |                      |                                |  |
| 05F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 33.00                          |                           |                      |                                |  |
| 06F  | 2                  | 2                   | 0                                    | 30.00                 | 33.00                             | 38.00                          |                           |                      |                                |  |
| 07F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 145                  | 7.25                           |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 33.00                          |                           |                      |                                |  |
| 02R  | 14                 | 14                  | 2                                    | 18.00                 | 33.00                             | 27.90                          | 13                        | 26                   | 1300                           |  |
| 03R  | 13                 | 13                  | 4                                    | 18.00                 | 27.90                             | 17.70                          | 15                        | 60                   | 3000                           |  |
| 04R  | 12                 | 12                  | 4                                    | 14.00                 | 17.70                             | 9.80                           | 17                        | 68                   | 3400                           |  |
| 05R  | 11                 | 11                  | 2                                    | 10.00                 | 9.80                              | 7.00                           | 19                        | 38                   | 1900                           |  |
| 06R  | 2                  | 2                   | 1                                    | 10.00                 | 7.00                              | 5.60                           | 37                        | 37                   | 1850                           |  |
| 07R  | 2                  | 2                   | 0                                    | 10.00                 | 5.60                              | 0.00                           |                           |                      |                                |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 229                  | 11.45                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>374</b>           | <b>18.70</b>                   |  |





### **HIGH STREET 8144**

At 44 feet in length, the oil line is very high and extends far down lane giving hold area like no other pattern in the series. Players will have to target along the highest point of oil much longer to prosper on the HIGH STREET.

#### **Latitude Ratio Coordinates**

22' 8.1 to 1

42' 5.5 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 2.9 to 1

Inside Taper 1.8 to 1

#### **Pattern Distance**

44 Feet

#### **Pattern Volume**

Forward 10.85 mL

Reverse 10.25 mL

Total 21.10 mL



# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### HIGH STREET 8144

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 44 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 2                                    | 18.00                 | 0.00                              | 2.50                           | 37                        | 74                   | 3700                     |  |
| 02F  | 9                  | 9                   | 2                                    | 18.00                 | 2.50                              | 7.60                           | 23                        | 46                   | 2300                     |  |
| 03F  | 10                 | 10                  | 3                                    | 18.00                 | 7.60                              | 15.20                          | 21                        | 63                   | 3150                     |  |
| 04F  | 12                 | 12                  | 2                                    | 18.00                 | 15.20                             | 20.30                          | 17                        | 34                   | 1700                     |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 20.30                             | 24.00                          |                           |                      |                          |  |
| 06F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 33.00                          |                           |                      |                          |  |
| 07F  | 2                  | 2                   | 0                                    | 30.00                 | 33.00                             | 44.00                          |                           |                      |                          |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 217                  | 10.85                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 35.00                          |                           |                      |                          |  |
| 02R  | 14                 | 14                  | 3                                    | 18.00                 | 35.00                             | 27.40                          | 13                        | 39                   | 1950                     |  |
| 03R  | 13                 | 13                  | 4                                    | 18.00                 | 27.40                             | 17.20                          | 15                        | 60                   | 3000                     |  |
| 04R  | 12                 | 12                  | 4                                    | 14.00                 | 17.20                             | 9.30                           | 17                        | 68                   | 3400                     |  |
| 05R  | 11                 | 11                  | 2                                    | 10.00                 | 9.30                              | 6.50                           | 19                        | 38                   | 1900                     |  |
| 06R  | 2                  | 2                   | 0                                    | 10.00                 | 6.50                              | 0.00                           |                           |                      |                          |  |
| 07R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                | 205                       | 10.25                |                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                | <b>422</b>                | <b>21.10</b>         |                          |  |





### MAIN STREET 7241

This 41 foot pattern is typical of the many house shots used across the USA. Using a slight blend, the MAIN STREET is a pattern that enables many different styles to score while socializing and hanging out with friends.

#### Latitude Ratio Coordinates

22' 7.2 to 1

39' 4.7 to 1

#### Longitude Ratio Coordinates

Outside Taper 2.7 to 1

Inside Taper 1.9 to 1

#### Pattern Distance

41 Feet

#### Pattern Volume

Forward 8.55 mL

Reverse 10.75 mL

Total 19.30 mL





# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### MAIN STREET 7241

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 41 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 2                                    | 18.00                 | 0.00                              | 2.50                           | 37                        | 74                   | 3700                           |  |
| 02F  | 8                  | 8                   | 1                                    | 18.00                 | 2.50                              | 5.00                           | 25                        | 25                   | 1250                           |  |
| 03F  | 10                 | 10                  | 2                                    | 18.00                 | 5.00                              | 10.10                          | 21                        | 42                   | 2100                           |  |
| 04F  | 13                 | 13                  | 2                                    | 18.00                 | 10.10                             | 15.20                          | 15                        | 30                   | 1500                           |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 15.20                             | 24.00                          |                           |                      |                                |  |
| 06F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 33.00                          |                           |                      |                                |  |
| 07F  | 2                  | 2                   | 0                                    | 30.00                 | 33.00                             | 41.00                          |                           |                      |                                |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 171                  | 8.55                           |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 35.00                          |                           |                      |                                |  |
| 02R  | 15                 | 15                  | 1                                    | 22.00                 | 35.00                             | 31.90                          | 11                        | 11                   | 550                            |  |
| 03R  | 14                 | 14                  | 2                                    | 18.00                 | 31.90                             | 26.80                          | 13                        | 26                   | 1300                           |  |
| 04R  | 13                 | 13                  | 4                                    | 18.00                 | 26.80                             | 16.60                          | 15                        | 60                   | 3000                           |  |
| 05R  | 11                 | 11                  | 4                                    | 14.00                 | 16.60                             | 8.70                           | 19                        | 76                   | 3800                           |  |
| 06R  | 10                 | 10                  | 2                                    | 10.00                 | 8.70                              | 5.90                           | 21                        | 42                   | 2100                           |  |
| 07R  | 2                  | 2                   | 0                                    | 10.00                 | 5.90                              | 0.00                           |                           |                      |                                |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 215                  | 10.75                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>386</b>           | <b>19.30</b>                   |  |





### STONE STREET 9642

Like Wall Street, the area to play this pattern is very defined but its prime location is just outside a couple boards from its travel companion.

Some might refer to this pattern as a "Stone Wall" since it fits into USBC's Red pattern category.

#### Latitude Ratio Coordinates

22' 9.6 to 1

40' 4.1 to 1

#### Longitude Ratio Coordinates

Outside Taper 1.7 to 1

Inside Taper 3.7 to 1

#### Pattern Distance

42 Feet

#### Pattern Volume

Forward 11.50 mL

Reverse 11.65 mL

Total 23.15 mL



# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### STONE STREET 9642

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 42 feet

Reverse Drop Brush: 42 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 2                                    | 14.00                 | 0.00                              | 1.90                           | 37                        | 74                   | 3700                     |  |
| 02F  | 9                  | 9                   | 1                                    | 14.00                 | 1.90                              | 3.80                           | 23                        | 23                   | 1150                     |  |
| 03F  | 10                 | 10                  | 2                                    | 18.00                 | 3.80                              | 8.90                           | 21                        | 42                   | 2100                     |  |
| 04F  | 11                 | 11                  | 3                                    | 18.00                 | 8.90                              | 16.50                          | 19                        | 57                   | 2850                     |  |
| 05F  | 12                 | 12                  | 2                                    | 18.00                 | 16.50                             | 21.60                          | 17                        | 34                   | 1700                     |  |
| 06F  | 2                  | 2                   | 0                                    | 18.00                 | 21.60                             | 34.00                          | 0                         | 0                    | 0                        |  |
| 07F  | 2                  | 2                   | 0                                    | 26.00                 | 34.00                             | 38.00                          | 0                         | 0                    | 0                        |  |
| 08F  | 2                  | 2                   | 0                                    | 30.00                 | 38.00                             | 42.00                          | 0                         |                      | 0                        |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 230                  | 11.50                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 35.00                          |                           |                      |                          |  |
| 02R  | 12                 | 12                  | 1                                    | 18.00                 | 35.00                             | 32.50                          | 17                        | 17                   | 850                      |  |
| 03R  | 11                 | 11                  | 2                                    | 18.00                 | 32.50                             | 27.40                          | 19                        | 38                   | 1900                     |  |
| 04R  | 10                 | 10                  | 4                                    | 18.00                 | 27.40                             | 17.20                          | 21                        | 84                   | 4200                     |  |
| 05R  | 9                  | 9                   | 3                                    | 18.00                 | 17.20                             | 9.60                           | 23                        | 69                   | 3450                     |  |
| 06R  | 8                  | 8                   | 1                                    | 14.00                 | 9.60                              | 7.70                           | 25                        | 25                   | 1250                     |  |
| 07R  | 2                  | 2                   | 0                                    | 10.00                 | 7.70                              | 0.00                           | 0                         | 0                    | 0                        |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 233                  | 11.65                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>463</b>           | <b>23.15</b>             |  |





### **WALL STREET 7240**

Unlike WALL STREET of today, this 40 foot pattern yields no surprises and is defined heavily at the 10th board. To be successful on the WALL STREET, we advise you to place your position near the big dot and bowl over the second arrow so your scores will flourish!

#### **Latitude Ratio Coordinates**

22' 7.2 to 1  
38' 5.2 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 2.8 to 1  
Inside Taper 2.1 to 1

#### **Pattern Distance**

40 Feet

#### **Pattern Volume**

Forward 8.80 mL  
Reverse 10.90 mL  
Total 19.70 mL



# KEGEL NAVIGATION PATTERNS

## RECREATION SERIES



### WALL STREET 7240

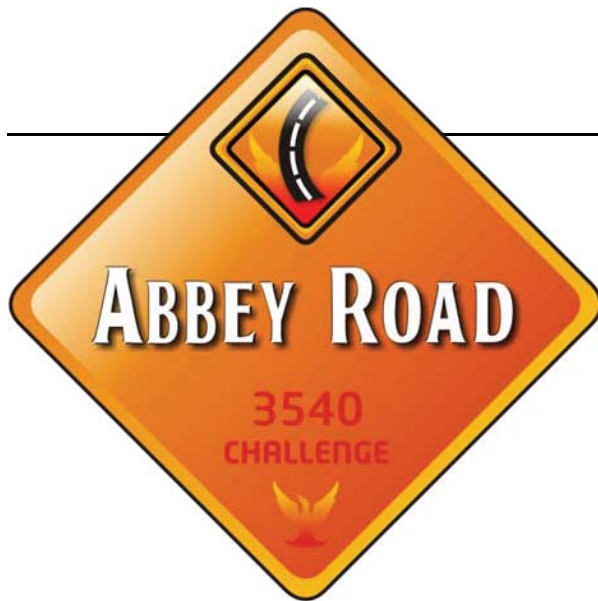
#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 40 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 1                                    | 18.00                 | 0.00                              | 0.00                           | 37                        | 37                   | 1850                           |  |
| 02F  | 10                 | 10                  | 3                                    | 18.00                 | 0.00                              | 7.60                           | 21                        | 63                   | 3150                           |  |
| 03F  | 10                 | 10                  | 2                                    | 18.00                 | 7.60                              | 12.70                          | 21                        | 42                   | 2100                           |  |
| 04F  | 12                 | 12                  | 2                                    | 18.00                 | 12.70                             | 17.80                          | 17                        | 34                   | 1700                           |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 17.80                             | 24.00                          |                           |                      |                                |  |
| 06F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 32.00                          |                           |                      |                                |  |
| 07F  | 2                  | 2                   | 0                                    | 30.00                 | 32.00                             | 40.00                          |                           |                      |                                |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 176                  | 8.80                           |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 34.00                          |                           |                      |                                |  |
| 02R  | 11                 | 11                  | 4                                    | 22.00                 | 34.00                             | 21.60                          | 19                        | 76                   | 3800                           |  |
| 03R  | 10                 | 10                  | 5                                    | 18.00                 | 21.60                             | 8.90                           | 21                        | 105                  | 5250                           |  |
| 04R  | 2                  | 2                   | 1                                    | 14.00                 | 8.90                              | 7.00                           | 37                        | 37                   | 1850                           |  |
| 05R  | 2                  | 2                   | 0                                    | 14.00                 | 7.00                              | 0.00                           |                           |                      |                                |  |
| 06R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 07R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 218                  | 10.90                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>394</b>           | <b>19.70</b>                   |  |





### ABBEY ROAD 3540

Like the goal of the famous album, this pattern is designed more like the way things used to be; back to the basics. Players should try different lines across the Abbey Road and watch out for traffic to find their best way to the scoring side.

For some it may be on the corner while for others towards the middle, but like the last line the Beatles ever sang... *"in the end the score you take is equal to the score you make."*

#### **Latitude Ratio Coordinates**

22' 3.5 to 1

38' 3.1 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 5.1 to 1

Inside Taper 4.0 to 1

#### **Pattern Distance**

40 Feet

#### **Pattern Volume**

Forward 16.60 mL

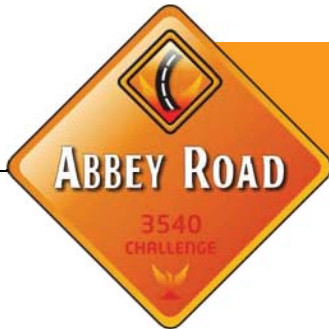
Reverse 7.60 mL

Total 24.20 mL



# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### ABBEY ROAD 3540

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 40 feet

Reverse Drop Brush: 34 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |
| 01F  | 2                  | 2                   | 2                                    | 14.00                 | 0.00                              | 1.90                           | 37                        | 74                   | 3700                           |
| 02F  | 4                  | 4                   | 1                                    | 14.00                 | 1.90                              | 3.80                           | 33                        | 33                   | 1650                           |
| 03F  | 5                  | 5                   | 1                                    | 14.00                 | 3.80                              | 5.70                           | 31                        | 31                   | 1550                           |
| 04F  | 6                  | 6                   | 1                                    | 14.00                 | 5.70                              | 7.60                           | 29                        | 29                   | 1450                           |
| 05F  | 7                  | 7                   | 1                                    | 14.00                 | 7.60                              | 9.50                           | 27                        | 27                   | 1350                           |
| 06F  | 9                  | 9                   | 2                                    | 14.00                 | 9.50                              | 13.40                          | 23                        | 46                   | 2300                           |
| 07F  | 11                 | 11                  | 2                                    | 18.00                 | 13.40                             | 18.50                          | 19                        | 38                   | 1900                           |
| 08F  | 13                 | 13                  | 2                                    | 18.00                 | 18.50                             | 23.60                          | 15                        | 30                   | 1500                           |
| 09F  | 14                 | 14                  | 1                                    | 18.00                 | 23.60                             | 26.10                          | 13                        | 13                   | 650                            |
| 10F  | 15                 | 15                  | 1                                    | 18.00                 | 26.10                             | 28.60                          | 11                        | 11                   | 550                            |
| 11F  | 2                  | 2                   | 0                                    | 18.00                 | 28.60                             | 31.00                          | 0                         | 0                    | 0                              |
| 12F  | 2                  | 2                   | 0                                    | 26.00                 | 31.00                             | 40.00                          | 0                         | 0                    | 0                              |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 332                  | 16.60                          |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 22.00                          | 0                         | 0                    | 0                              |
| 02R  | 12                 | 12                  | 1                                    | 18.00                 | 22.00                             | 19.50                          | 17                        | 17                   | 850                            |
| 03R  | 10                 | 10                  | 1                                    | 18.00                 | 19.50                             | 17.00                          | 21                        | 21                   | 1050                           |
| 04R  | 8                  | 8                   | 1                                    | 18.00                 | 17.00                             | 14.50                          | 25                        | 25                   | 1250                           |
| 05R  | 7                  | 7                   | 1                                    | 18.00                 | 14.50                             | 12.00                          | 27                        | 27                   | 1350                           |
| 06R  | 6                  | 6                   | 1                                    | 14.00                 | 12.00                             | 10.10                          | 29                        | 29                   | 1450                           |
| 07R  | 4                  | 4                   | 1                                    | 14.00                 | 10.10                             | 8.20                           | 33                        | 33                   | 1650                           |
| 08R  | 2                  | 2                   | 0                                    | 14.00                 | 8.20                              | 0.00                           | 0                         | 0                    | 0                              |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                | 152                       | 7.60                 |                                |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                | <b>484</b>                | <b>24.20</b>         |                                |





### **BEATEN PATH 4531**

This 41 foot pattern is much like the MIDDLE ROAD but two feet longer. Because of this added length, the options of attack will be a little more limited and the pattern will usually play where the most worn or highest friction part of the lane surface is. The players who excel in reading the lanes will easily find the BEATEN PATH and make this pattern look relatively easy. If you veer too far off the BEATEN PATH, it will play more difficult.

#### **Latitude Ratio Coordinates**

22' 4.5 to 1

39' 3.1 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 3.6 to 1

Inside Taper 3.3 to 1

#### **Pattern Distance**

41 Feet

#### **Pattern Volume**

Forward 12.05 mL

Reverse 12.20 mL

Total 24.25 mL





# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### BEATEN PATH 4541

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 41 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 2                                    | 10.00                 | 0.00                              | 1.40                           | 37                        | 74                   | 3700                           |  |
| 02F  | 8                  | 8                   | 1                                    | 14.00                 | 1.40                              | 3.30                           | 25                        | 25                   | 1250                           |  |
| 03F  | 10                 | 9                   | 2                                    | 14.00                 | 3.30                              | 7.20                           | 22                        | 44                   | 2200                           |  |
| 04F  | 12                 | 10                  | 3                                    | 14.00                 | 7.20                              | 13.10                          | 19                        | 57                   | 2850                           |  |
| 05F  | 14                 | 12                  | 2                                    | 14.00                 | 13.10                             | 17.00                          | 15                        | 30                   | 1500                           |  |
| 06F  | 16                 | 14                  | 1                                    | 18.00                 | 17.00                             | 19.50                          | 11                        | 11                   | 550                            |  |
| 07F  | 2                  | 2                   | 0                                    | 18.00                 | 19.50                             | 27.00                          |                           |                      |                                |  |
| 08F  | 2                  | 2                   | 0                                    | 22.00                 | 27.00                             | 34.00                          |                           |                      |                                |  |
| 09F  | 2                  | 2                   | 0                                    | 26.00                 | 34.00                             | 41.00                          |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 241                  | 12.05                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 32.00                          |                           |                      |                                |  |
| 02R  | 15                 | 13                  | 1                                    | 22.00                 | 32.00                             | 28.90                          | 13                        | 13                   | 650                            |  |
| 03R  | 13                 | 12                  | 2                                    | 18.00                 | 28.90                             | 23.80                          | 16                        | 32                   | 1600                           |  |
| 04R  | 11                 | 11                  | 2                                    | 18.00                 | 23.80                             | 18.70                          | 19                        | 38                   | 1900                           |  |
| 05R  | 9                  | 9                   | 1                                    | 18.00                 | 18.70                             | 16.20                          | 23                        | 23                   | 1150                           |  |
| 06R  | 7                  | 7                   | 1                                    | 14.00                 | 16.20                             | 14.30                          | 27                        | 27                   | 1350                           |  |
| 07R  | 2                  | 2                   | 3                                    | 14.00                 | 14.30                             | 8.40                           | 37                        | 111                  | 5550                           |  |
| 08R  | 2                  | 2                   | 0                                    | 14.00                 | 8.40                              | 0.00                           |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 244                  | 12.20                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>485</b>           | <b>24.25</b>                   |  |





### **BROADWAY 4537**

This 37 foot pattern is named after the wide open street in Manhattan called BROADWAY, which ironically originates at a park called Bowling Green. BROADWAY was originally translated from the Dutch name of 'Breede weg' because of its location in New Amsterdam. Because of the medium short length of this pattern and light volume of conditioner towards the outside portion of the lane, players can arrive to the pocket on the BROADWAY from multiple directions.

#### **Latitude Ratio Coordinates**

22' 4.5 to 1

35' 3.5 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 3.1 to 1

Inside Taper 2.5 to 1

#### **Pattern Distance**

37 Feet

#### **Pattern Volume**

Forward 11.00 mL

Reverse 12.25 mL

Total 23.25 mL



# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### BROADWAY 4537

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 37 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 4                  | 4                   | 1                                    | 14.00                 | 0.00                              | 0.00                           | 33                        | 33                   | 1650                           |  |
| 02F  | 5                  | 5                   | 1                                    | 14.00                 | 0.00                              | 1.90                           | 31                        | 31                   | 1550                           |  |
| 03F  | 7                  | 7                   | 2                                    | 14.00                 | 1.90                              | 5.80                           | 27                        | 54                   | 2700                           |  |
| 04F  | 9                  | 9                   | 2                                    | 14.00                 | 5.80                              | 9.70                           | 23                        | 46                   | 2300                           |  |
| 05F  | 11                 | 10                  | 2                                    | 18.00                 | 9.70                              | 14.80                          | 20                        | 40                   | 2000                           |  |
| 06F  | 13                 | 12                  | 1                                    | 18.00                 | 14.80                             | 17.30                          | 16                        | 16                   | 800                            |  |
| 07F  | 2                  | 2                   | 0                                    | 18.00                 | 17.30                             | 24.00                          |                           |                      |                                |  |
| 08F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 31.00                          |                           |                      |                                |  |
| 09F  | 2                  | 2                   | 0                                    | 26.00                 | 31.00                             | 37.00                          |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 220                  | 11.00                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 31.00                          |                           |                      |                                |  |
| 02R  | 12                 | 11                  | 1                                    | 22.00                 | 31.00                             | 27.90                          | 18                        | 18                   | 900                            |  |
| 03R  | 10                 | 9                   | 1                                    | 18.00                 | 27.90                             | 25.40                          | 22                        | 22                   | 1100                           |  |
| 04R  | 8                  | 8                   | 3                                    | 18.00                 | 25.40                             | 17.80                          | 25                        | 75                   | 3750                           |  |
| 05R  | 7                  | 7                   | 1                                    | 14.00                 | 17.80                             | 15.90                          | 27                        | 27                   | 1350                           |  |
| 06R  | 6                  | 6                   | 1                                    | 14.00                 | 15.90                             | 14.00                          | 29                        | 29                   | 1450                           |  |
| 07R  | 2                  | 2                   | 2                                    | 14.00                 | 14.00                             | 10.10                          | 37                        | 74                   | 3700                           |  |
| 08R  | 2                  | 2                   | 0                                    | 14.00                 | 10.10                             | 0.00                           |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 245                  | 12.25                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>465</b>           | <b>23.25</b>                   |  |





### **MIDDLE ROAD 4239**

In political terms, this pattern is centrism in nature because the characteristics lie between the extremes of having to play too far to the right or too far to the left. The MIDDLE ROAD is a 39 foot pattern that is moderately challenging; it's not too easy and it's not too tough. The best mindset and line for this pattern is usually somewhere near the middle of the road.

#### **Latitude Ratio Coordinates**

22' 4.2 to 1

37' 3.2 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 4.0 to 1

Inside Taper 2.9 to 1

#### **Pattern Distance**

39 Feet

#### **Pattern Volume**

Forward 11.90 mL

Reverse 10.95 mL

Total 22.85 mL



# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### MIDDLE ROAD 4239

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 39 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 2                                    | 14.00                 | 0.00                              | 1.90                           | 37                        | 74                   | 3700                     |  |
| 02F  | 6                  | 6                   | 1                                    | 14.00                 | 1.90                              | 3.80                           | 29                        | 29                   | 1450                     |  |
| 03F  | 8                  | 8                   | 1                                    | 14.00                 | 3.80                              | 5.70                           | 25                        | 25                   | 1250                     |  |
| 04F  | 10                 | 10                  | 3                                    | 14.00                 | 5.70                              | 11.60                          | 21                        | 63                   | 3150                     |  |
| 05F  | 12                 | 12                  | 2                                    | 18.00                 | 11.60                             | 16.70                          | 17                        | 34                   | 1700                     |  |
| 06F  | 14                 | 14                  | 1                                    | 18.00                 | 16.70                             | 19.20                          | 13                        | 13                   | 650                      |  |
| 07F  | 2                  | 2                   | 0                                    | 18.00                 | 19.20                             | 26.00                          |                           |                      |                          |  |
| 08F  | 2                  | 2                   | 0                                    | 22.00                 | 26.00                             | 32.00                          |                           |                      |                          |  |
| 09F  | 2                  | 2                   | 0                                    | 30.00                 | 32.00                             | 39.00                          |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 238                  | 11.90                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 32.00                          |                           |                      |                          |  |
| 02R  | 13                 | 13                  | 2                                    | 22.00                 | 32.00                             | 25.80                          | 15                        | 30                   | 1500                     |  |
| 03R  | 11                 | 11                  | 2                                    | 18.00                 | 25.80                             | 20.70                          | 19                        | 38                   | 1900                     |  |
| 04R  | 9                  | 9                   | 1                                    | 18.00                 | 20.70                             | 18.20                          | 23                        | 23                   | 1150                     |  |
| 05R  | 7                  | 7                   | 2                                    | 18.00                 | 18.20                             | 13.10                          | 27                        | 54                   | 2700                     |  |
| 06R  | 2                  | 2                   | 2                                    | 18.00                 | 13.10                             | 8.00                           | 37                        | 74                   | 3700                     |  |
| 07R  | 2                  | 2                   | 0                                    | 14.00                 | 8.00                              | 0.00                           |                           |                      |                          |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 219                  | 10.95                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>457</b>           | <b>22.85</b>             |  |





### ROUTE 66 4345

As one of the longest roads in America, so is this pattern in the series. At 45 feet in length, and as with most long oil patterns, the optimum line is usually one that is closer to the pocket or more towards the inside portion of the lane. The greatest slope of conditioner on the ROUTE 66 is from the 11th board to the 16th board so players should target along this route. Outside of that slope, the pattern is flat so there will be very little room for error. 🎵 If you get hip to this tip, take that bowling center trip to get your kicks on ROUTE 66! 🎵

#### **Latitude Ratio Coordinates**

22' 4.3 to 1

43' 2.6 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 3.4 to 1

Inside Taper 3.2 to 1

#### **Pattern Distance**

45 Feet

#### **Pattern Volume**

Forward 10.30 mL

Reverse 13.00 mL

Total 23.30 mL



# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### ROUTE 66 4345

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 45 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 3                                    | 14.00                 | 0.00                              | 3.90                           | 37                        | 111                  | 5550                           |  |
| 02F  | 12                 | 12                  | 1                                    | 14.00                 | 3.90                              | 5.80                           | 17                        | 17                   | 850                            |  |
| 03F  | 13                 | 13                  | 2                                    | 18.00                 | 5.80                              | 10.90                          | 15                        | 30                   | 1500                           |  |
| 04F  | 14                 | 14                  | 2                                    | 18.00                 | 10.90                             | 16.00                          | 13                        | 26                   | 1300                           |  |
| 05F  | 15                 | 15                  | 2                                    | 18.00                 | 16.00                             | 21.10                          | 11                        | 22                   | 1100                           |  |
| 06F  | 2                  | 2                   | 0                                    | 18.00                 | 21.10                             | 26.00                          |                           |                      |                                |  |
| 07F  | 2                  | 2                   | 0                                    | 26.00                 | 26.00                             | 36.00                          |                           |                      |                                |  |
| 08F  | 2                  | 2                   | 0                                    | 30.00                 | 36.00                             | 45.00                          |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 206                  | 10.30                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 36.00                          |                           |                      |                                |  |
| 02R  | 14                 | 14                  | 2                                    | 22.00                 | 36.00                             | 29.80                          | 13                        | 26                   | 1300                           |  |
| 03R  | 13                 | 13                  | 2                                    | 18.00                 | 29.80                             | 24.70                          | 15                        | 30                   | 1500                           |  |
| 04R  | 12                 | 12                  | 2                                    | 18.00                 | 24.70                             | 19.60                          | 17                        | 34                   | 1700                           |  |
| 05R  | 11                 | 11                  | 2                                    | 14.00                 | 19.60                             | 15.70                          | 19                        | 38                   | 1900                           |  |
| 06R  | 10                 | 10                  | 1                                    | 14.00                 | 15.70                             | 13.80                          | 21                        | 21                   | 1050                           |  |
| 07R  | 2                  | 2                   | 3                                    | 14.00                 | 13.80                             | 7.90                           | 37                        | 111                  | 5550                           |  |
| 08R  | 2                  | 2                   | 0                                    | 14.00                 | 7.90                              | 0.00                           |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 260                  | 13.00                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>466</b>           | <b>23.30</b>                   |  |





### SUNSET STRIP 3240

Using Kegel's reverse drop brush function, this pattern places oil on the lane in four board strips.

Some lanes may allow certain styles to play the outside strip while others may find the middle or inside strip the best.

With a great performance and a little luck, you too can be a star on the Sunset Strip!

#### **Latitude Ratio Coordinates**

22' 3.2 to 1

38' 2.6 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 4.6 to 1

Inside Taper 4.3 to 1

#### **Pattern Distance**

40 Feet

#### **Pattern Volume**

Forward 15.95 mL

Reverse 8.75mL

Total 24.70 mL





# KEGEL NAVIGATION PATTERNS

## CHALLENGE SERIES



### SUNSET STRIP 3240

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 40 feet

Reverse Drop Brush: 32 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 2                                    | 14.00                 | 0.00                              | 1.90                           | 37                        | 74                   | 3700                           |  |
| 02F  | 5                  | 5                   | 3                                    | 18.00                 | 1.90                              | 9.50                           | 31                        | 93                   | 4650                           |  |
| 03F  | 9                  | 9                   | 4                                    | 18.00                 | 9.50                              | 19.70                          | 23                        | 92                   | 4600                           |  |
| 04F  | 13                 | 13                  | 4                                    | 18.00                 | 19.70                             | 29.90                          | 15                        | 60                   | 3000                           |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 29.90                             | 33.00                          | 0                         | 0                    | 0                              |  |
| 06F  | 2                  | 2                   | 0                                    | 22.00                 | 33.00                             | 40.00                          | 0                         | 0                    | 0                              |  |
| 07F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 319                  | 15.95                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 21.00                          | 0                         | 0                    | 0                              |  |
| 02R  | 13                 | 13                  | 2                                    | 14.00                 | 21.00                             | 17.10                          | 15                        | 30                   | 1500                           |  |
| 03R  | 9                  | 9                   | 2                                    | 14.00                 | 17.10                             | 13.20                          | 23                        | 46                   | 2300                           |  |
| 04R  | 5                  | 5                   | 2                                    | 14.00                 | 13.20                             | 9.30                           | 31                        | 62                   | 3100                           |  |
| 05R  | 2                  | 2                   | 1                                    | 10.00                 | 9.30                              | 7.90                           | 37                        | 37                   | 1850                           |  |
| 06R  | 2                  | 2                   | 0                                    | 10.00                 | 7.90                              | 0.00                           | 0                         | 0                    | 0                              |  |
| 07R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 175                  | 8.75                           |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>494</b>           | <b>24.70</b>                   |  |





### AUTOBAHN 2542

Using Kegel's reverse drop brush function, the amount of applied conditioner is increased in the midlane but less is at the end of the pattern.

This makes the Autobahn more about speed control and keeping your path straighter through the front part of the 'drive'; a term used for bowling lanes in the early 1900's.

On some 'drives', faster speeds may be best while other 'drives' may require a little less speed to navigate the corner without crashing through the breakpoint.

#### **Latitude Ratio Coordinates**

22' 2.5 to 1

40' 2.0 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 4.6 to 1

Inside Taper 4.0 to 1

#### **Pattern Distance**

42 Feet

#### **Pattern Volume**

Forward 18.70 mL

Reverse 7.15 mL

Total 25.85 mL



# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### AUTOBAHN 2542

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 42 feet

Reverse Drop Brush: 33'

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 5                                    | 14.00                 | 0.00                              | 7.90                           | 37                        | 185                  | 9250                     |  |
| 02F  | 6                  | 6                   | 1                                    | 14.00                 | 7.90                              | 9.80                           | 29                        | 29                   | 1450                     |  |
| 03F  | 9                  | 9                   | 2                                    | 14.00                 | 9.80                              | 13.70                          | 23                        | 46                   | 2300                     |  |
| 04F  | 9                  | 9                   | 2                                    | 18.00                 | 13.70                             | 18.80                          | 23                        | 46                   | 2300                     |  |
| 05F  | 12                 | 12                  | 4                                    | 18.00                 | 18.80                             | 29.00                          | 17                        | 68                   | 3400                     |  |
| 06F  | 2                  | 2                   | 0                                    | 18.00                 | 29.00                             | 34.00                          | 0                         | 0                    | 0                        |  |
| 07F  | 2                  | 2                   | 0                                    | 22.00                 | 34.00                             | 42.00                          | 0                         | 0                    | 0                        |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 374                  | 18.70                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 32.00                          | 0                         | 0                    | 0                        |  |
| 02R  | 12                 | 12                  | 1                                    | 18.00                 | 21.00                             | 18.50                          | 17                        | 17                   | 850                      |  |
| 03R  | 9                  | 9                   | 1                                    | 18.00                 | 18.50                             | 16.00                          | 23                        | 23                   | 1150                     |  |
| 04R  | 6                  | 6                   | 1                                    | 18.00                 | 16.00                             | 13.50                          | 29                        | 29                   | 1450                     |  |
| 05R  | 2                  | 2                   | 2                                    | 18.00                 | 13.50                             | 8.40                           | 37                        | 74                   | 3700                     |  |
| 06R  | 2                  | 2                   | 0                                    | 14.00                 | 8.40                              | 0.00                           | 0                         | 0                    | 0                        |  |
| 07R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 143                  | 7.15                     |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>517</b>           | <b>25.85</b>             |  |





### **BOARDWALK 2435**

Based upon the 2000 PBA Indianapolis Open pattern which was created by Kegel, this pattern is designed to play towards the edge board. Because of the relatively short 35 foot length of the BOARDWALK, players will need to control the excessive change of direction of the bowling ball as it enters the 25 feet of dry backend. Since lanes do have many topographical differences, on some lanes the BOARDWALK will require a more direct route to the pocket while other lane characteristics may allow players to swing the ball to the edge board. Like all wooden walkways, this pattern can provide great excitement but stray too far off the BOARDWALK and you'll find yourself in the moat!

#### **Latitude Ratio Coordinates**

22' 2.4 to 1  
33' 2.1 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 2.5 to 1  
Inside Taper 2.3 to 1

#### **Pattern Distance**

35 Feet

#### **Pattern Volume**

Forward 10.55 mL  
Reverse 13.35 mL  
Total 23.90 mL



# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### BOARDWALK 2435

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50  $\mu$ L

Pattern Distance: 35 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01F  | 2                  | 2                   | 1                                    | 14.00                 | 0.00                              | 0.00                           | 37                        | 37                   | 1850                           |  |
| 02F  | 5                  | 5                   | 2                                    | 14.00                 | 0.00                              | 3.90                           | 31                        | 62                   | 3100                           |  |
| 03F  | 6                  | 6                   | 2                                    | 18.00                 | 3.90                              | 9.00                           | 29                        | 58                   | 2900                           |  |
| 04F  | 7                  | 7                   | 2                                    | 18.00                 | 9.00                              | 14.10                          | 27                        | 54                   | 2700                           |  |
| 05F  | 2                  | 2                   | 0                                    | 22.00                 | 14.10                             | 26.00                          |                           |                      |                                |  |
| 06F  | 2                  | 2                   | 0                                    | 26.00                 | 26.00                             | 35.00                          |                           |                      |                                |  |
| 07F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 211                  | 10.55                          |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil ( $\mu$ L) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 28.00                          |                           |                      |                                |  |
| 02R  | 8                  | 8                   | 1                                    | 18.00                 | 28.00                             | 25.50                          | 25                        | 25                   | 1250                           |  |
| 03R  | 7                  | 7                   | 2                                    | 18.00                 | 25.50                             | 20.40                          | 27                        | 54                   | 2700                           |  |
| 04R  | 6                  | 6                   | 2                                    | 14.00                 | 20.40                             | 16.50                          | 29                        | 58                   | 2900                           |  |
| 05R  | 5                  | 5                   | 2                                    | 14.00                 | 16.50                             | 12.60                          | 31                        | 62                   | 3100                           |  |
| 06R  | 4                  | 4                   | 1                                    | 14.00                 | 12.60                             | 10.70                          | 33                        | 33                   | 1650                           |  |
| 07R  | 3                  | 3                   | 1                                    | 14.00                 | 10.70                             | 8.80                           | 35                        | 35                   | 1750                           |  |
| 08R  | 2                  | 2                   | 0                                    | 14.00                 | 8.80                              | 0.00                           |                           |                      |                                |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                                |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 267                  | 13.35                          |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>478</b>           | <b>23.90</b>                   |  |





### DEAD MAN'S CURVE 3043

This 43 foot pattern has more out of bounds than most patterns because of the increased application of conditioner on the forward pass. With a slight increase slope of oil from the tenth board to the fourteenth board on the return pass, the goal of the player is to target along those boards of extra conditioner without swinging the ball too much towards the outside part of the lane. Players who try to excessively curve the ball with too much speed will find DEAD MAN'S CURVE hazardous to their score.

#### Latitude Ratio Coordinates

22' 3.0 to 1

41' 2.4 to 1

#### Longitude Ratio Coordinates

Outside Taper 4.2 to 1

Inside Taper 3.5 to 1

#### Pattern Distance

43 Feet

#### Pattern Volume

Forward 13.85 mL

Reverse 10.40 mL

Total 24.25 mL



# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### DEAD MAN'S CURVE 3043

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 43 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 5                                    | 14.00                 | 0.00                              | 7.90                           | 37                        | 185                  | 9250                     |  |
| 02F  | 11                 | 11                  | 1                                    | 14.00                 | 7.90                              | 9.80                           | 19                        | 19                   | 950                      |  |
| 03F  | 12                 | 12                  | 2                                    | 14.00                 | 9.80                              | 13.70                          | 17                        | 34                   | 1700                     |  |
| 04F  | 14                 | 14                  | 3                                    | 18.00                 | 13.70                             | 21.30                          | 13                        | 39                   | 1950                     |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 21.30                             | 26.00                          |                           |                      |                          |  |
| 06F  | 2                  | 2                   | 0                                    | 22.00                 | 26.00                             | 33.00                          |                           |                      |                          |  |
| 07F  | 2                  | 2                   | 0                                    | 26.00                 | 33.00                             | 43.00                          |                           |                      |                          |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 277                  | 13.85                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 32.00                          |                           |                      |                          |  |
| 02R  | 15                 | 15                  | 1                                    | 26.00                 | 32.00                             | 28.40                          | 11                        | 11                   | 550                      |  |
| 03R  | 13                 | 13                  | 2                                    | 22.00                 | 28.40                             | 22.20                          | 15                        | 30                   | 1500                     |  |
| 04R  | 12                 | 12                  | 2                                    | 18.00                 | 22.20                             | 17.10                          | 17                        | 34                   | 1700                     |  |
| 05R  | 11                 | 11                  | 2                                    | 18.00                 | 17.10                             | 12.00                          | 19                        | 38                   | 1900                     |  |
| 06R  | 10                 | 10                  | 1                                    | 14.00                 | 12.00                             | 10.10                          | 21                        | 21                   | 1050                     |  |
| 07R  | 2                  | 2                   | 2                                    | 14.00                 | 10.10                             | 6.20                           | 37                        | 74                   | 3700                     |  |
| 08R  | 2                  | 2                   | 0                                    | 10.00                 | 6.20                              | 0.00                           |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 208                  | 10.40                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>485</b>           | <b>24.25</b>             |  |





### HIGHWAY TO HELL 2340

This 40 foot pattern is the flattest of the group and therefore can be the most difficult. With an increased amount of conditioner outside, the HIGHWAY TO HELL is a low latitude ratio pattern with very little left to right shape to help guide the bowling ball towards the pocket. Each player will have to decide and make sense of their ball reaction to decide what is best for them to find their way down the HIGHWAY TO HELL!

#### **Latitude Ratio Coordinates**

22' 2.3 to 1  
38' 1.9 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 4.0 to 1  
Inside Taper 3.5 to 1

#### **Pattern Distance**

40 Feet

#### **Pattern Volume**

Forward 10.75 mL  
Reverse 14.55 mL  
Total 25.30 mL





# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### HIGHWAY TO HELL 2340

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 40 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 4                                    | 14.00                 | 0.00                              | 5.90                           | 37                        | 148                  | 7400                     |  |
| 02F  | 7                  | 7                   | 1                                    | 14.00                 | 5.90                              | 7.80                           | 27                        | 27                   | 1350                     |  |
| 03F  | 9                  | 9                   | 1                                    | 14.00                 | 7.80                              | 9.70                           | 23                        | 23                   | 1150                     |  |
| 04F  | 12                 | 12                  | 1                                    | 18.00                 | 9.70                              | 12.20                          | 17                        | 17                   | 850                      |  |
| 05F  | 2                  | 2                   | 0                                    | 18.00                 | 12.20                             | 26.00                          |                           |                      |                          |  |
| 06F  | 2                  | 2                   | 0                                    | 26.00                 | 26.00                             | 40.00                          |                           |                      |                          |  |
| 07F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 2                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 215                  | 10.75                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 30.00                          |                           |                      |                          |  |
| 02R  | 14                 | 14                  | 1                                    | 18.00                 | 30.00                             | 27.50                          | 13                        | 13                   | 650                      |  |
| 03R  | 12                 | 12                  | 2                                    | 18.00                 | 27.50                             | 22.40                          | 17                        | 34                   | 1700                     |  |
| 04R  | 10                 | 10                  | 2                                    | 14.00                 | 22.40                             | 18.50                          | 21                        | 42                   | 2100                     |  |
| 05R  | 8                  | 8                   | 1                                    | 14.00                 | 18.50                             | 16.60                          | 25                        | 25                   | 1250                     |  |
| 06R  | 6                  | 6                   | 1                                    | 14.00                 | 16.60                             | 14.70                          | 29                        | 29                   | 1450                     |  |
| 07R  | 2                  | 2                   | 2                                    | 14.00                 | 14.70                             | 10.80                          | 37                        | 74                   | 3700                     |  |
| 08R  | 2                  | 2                   | 2                                    | 10.00                 | 10.80                             | 8.00                           | 37                        | 74                   | 3700                     |  |
| 09R  | 2                  | 2                   | 0                                    | 10.00                 | 8.00                              | 0.00                           |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 291                  | 14.55                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>506</b>           | <b>25.30</b>             |  |





### TURNPIKE 2441

With the conditioner being applied in a flat manner on the forward travel, and with a little shape created on the journey back towards the foul line, this makes the last third of this pattern very flat.

So when bowling on the Turnpike, you better pay strict attention to your direction or you will pay a hefty toll!

#### **Latitude Ratio Coordinates**

22' 2.4 to 1

39' 1.1 to 1

#### **Longitude Ratio Coordinates**

Outside Taper 3.0 to 1

Inside Taper 5.3 to 1

#### **Pattern Distance**

41 Feet

#### **Pattern Volume**

Forward 11.10 mL

Reverse 14.20 mL

Total 25.30 mL



# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### TURNPIKE 2441

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 41 feet

Reverse Drop Brush: 41 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 6                                    | 18.00                 | 0.00                              | 12.70                          | 37                        | 222                  | 11100                    |  |
| 02F  | 2                  | 2                   | 0                                    | 18.00                 | 12.70                             | 31.00                          | 0                         | 0                    | 0                        |  |
| 03F  | 2                  | 2                   | 0                                    | 26.00                 | 31.00                             | 36.00                          | 0                         | 0                    | 0                        |  |
| 04F  | 2                  | 2                   | 0                                    | 30.00                 | 36.00                             | 41.00                          | 0                         | 0                    | 0                        |  |
| 05F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 06F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 07F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 08F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09F  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 222                  | 11.10                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 32.00                          |                           |                      |                          |  |
| 02R  | 12                 | 12                  | 2                                    | 18.00                 | 32.00                             | 26.90                          | 17                        | 34                   | 1700                     |  |
| 03R  | 11                 | 11                  | 2                                    | 18.00                 | 26.90                             | 21.80                          | 19                        | 38                   | 1900                     |  |
| 04R  | 10                 | 10                  | 2                                    | 14.00                 | 21.80                             | 17.90                          | 21                        | 42                   | 2100                     |  |
| 05R  | 9                  | 9                   | 2                                    | 14.00                 | 17.90                             | 14.00                          | 23                        | 46                   | 2300                     |  |
| 06R  | 8                  | 8                   | 2                                    | 14.00                 | 14.00                             | 10.10                          | 25                        | 50                   | 2500                     |  |
| 07R  | 2                  | 2                   | 2                                    | 14.00                 | 10.10                             | 6.20                           | 37                        | 74                   | 3700                     |  |
| 08R  | 2                  | 2                   | 0                                    | 10.00                 | 6.20                              | 0.00                           |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 284                  | 14.20                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>506</b>           | <b>25.30</b>             |  |





### WINDING ROAD 2839

This oil pattern uses a distance of 39 feet with very little downlane help to guide the ball into the pocket. Because of the lower ratios towards the end of pattern, the greatest factor on how the WINDING ROAD will play is the lane surface and how the bowlers breakdown the pattern. The WINDING ROAD could play more inside or it could play more outside but the player who figures it out will straighten out the WINDING ROAD!

#### Latitude Ratio Coordinates

22' 2.8 to 1  
37' 2.4 to 1

#### Longitude Ratio Coordinates

Outside Taper 4.2 to 1  
Inside Taper 3.5 to 1

#### Pattern Distance

39 Feet

#### Pattern Volume

Forward 12.10 mL  
Reverse 10.35 mL  
Total 22.45 mL



# KEGEL NAVIGATION PATTERNS

## SPORT SERIES



### WINDING ROAD 2839

#### Kegel Sanction Technology™ Lane Machine Settings

Oil per Board (Pump Setting): 50 µL

Pattern Distance: 39 feet

| Forward Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
|--|--------------------|---------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------------|---------------------------|----------------------|--------------------------|--|
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01F  | 2                  | 2                   | 3                                    | 14.00                 | 0.00                              | 3.90                           | 37                        | 111                  | 5550                     |  |
| 02F  | 6                  | 6                   | 1                                    | 14.00                 | 3.90                              | 5.80                           | 29                        | 29                   | 1450                     |  |
| 03F  | 9                  | 8                   | 1                                    | 14.00                 | 5.80                              | 7.70                           | 24                        | 24                   | 1200                     |  |
| 04F  | 10                 | 9                   | 2                                    | 14.00                 | 7.70                              | 11.60                          | 22                        | 44                   | 2200                     |  |
| 05F  | 12                 | 11                  | 1                                    | 18.00                 | 11.60                             | 14.10                          | 18                        | 18                   | 900                      |  |
| 06F  | 13                 | 12                  | 1                                    | 18.00                 | 14.10                             | 16.60                          | 16                        | 16                   | 800                      |  |
| 07F  | 2                  | 2                   | 0                                    | 18.00                 | 16.60                             | 24.00                          |                           |                      |                          |  |
| 08F  | 2                  | 2                   | 0                                    | 22.00                 | 24.00                             | 35.00                          |                           |                      |                          |  |
| 09F  | 2                  | 2                   | 0                                    | 30.00                 | 35.00                             | 39.00                          |                           |                      |                          |  |
| Forward Buff Screens: 3                                |                    |                     | Forward # Boards Crossed   Volume mL |                       |                                   |                                |                           | 242                  | 12.10                    |  |
| Reverse Settings                                       |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Screen #   | Left End of Stream | Right End of Stream | # Loads or Streams                   | Travel Speed (in/sec) | Beginning Distance of Load (feet) | Ending Distance of Load (feet) | # Boards Crossed per Load | Total Boards Crossed | Total Volume of Oil (µL) |  |
| 01R  | 2                  | 2                   | 0                                    | 30.00                 |                                   | 29.00                          |                           |                      |                          |  |
| 02R  | 14                 | 13                  | 1                                    | 22.00                 | 29.00                             | 25.90                          | 14                        | 14                   | 700                      |  |
| 03R  | 11                 | 10                  | 2                                    | 18.00                 | 25.90                             | 20.80                          | 20                        | 40                   | 2000                     |  |
| 04R  | 8                  | 8                   | 2                                    | 18.00                 | 20.80                             | 15.70                          | 25                        | 50                   | 2500                     |  |
| 05R  | 6                  | 6                   | 1                                    | 18.00                 | 15.70                             | 13.20                          | 29                        | 29                   | 1450                     |  |
| 06R  | 2                  | 2                   | 2                                    | 14.00                 | 13.20                             | 9.30                           | 37                        | 74                   | 3700                     |  |
| 07R  | 2                  | 2                   | 0                                    | 14.00                 | 9.30                              | 0.00                           |                           |                      |                          |  |
| 08R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| 09R  |                    |                     |                                      |                       |                                   |                                |                           |                      |                          |  |
| Reverse # Boards Crossed   Volume mL                   |                    |                     |                                      |                       |                                   |                                |                           | 207                  | 10.35                    |  |
| <b>Forward plus Reverse Boards Crossed   Volume mL</b> |                    |                     |                                      |                       |                                   |                                |                           | <b>449</b>           | <b>22.45</b>             |  |

