

# SC901

---



## ***Service Manual***

### **Advance Model Numbers:**

**56115530      SC901 ST-28D**

**56115531      SC901 ST-34D**

**56115532      SC901 ST-32C**



English

Rev B, 2023 Form No. 56043178

# Contents

---

<b>03 - General Information.</b>	<b>5</b>
General Machine Description	5
Revision History	5
Service Manual Purpose and Application.	5
Other Reference Manuals and Information Sources	5
Parts And Service	5
Diagnostic and Service Tools	6
Conventions	6
Modifications	6
Nameplate	6
Safety	7
Symbols.	7
General Safety Instructions	7
Property Damage Messages.	8
Lifting or Transporting the Machine	9
Technical Specifications	10
Know Your Machine — Major components:	11
Maintenance Schedule	12
Lubricating the Machine	12
<b>14 - Wheel System, Non-Traction</b>	<b>13</b>
Functional Description.	13
Removal and Installation	13
<b>20 - Wheel System, Traction</b>	<b>14</b>
Functional Description.	14
Speed Limiting Potentiometer	14
Wigwag Throttle Potentiometer.	14
Drive Motor PWM Function.	15
Drive Controller	15
Circuit Description.	16
Drive Power	16
Throttle and Speed Limit	16
Troubleshooting	17
Error Codes	17
Removal and Installation	25
Drive Controller	25
Follow-up Testing	25
Wheels	26
Drive Motor	27
Motor Brushes	28
Transaxle.	29
Specifications	31
Shop Measurements	31
Special Tools	32
Curtis Programmer	32
<b>24 - Electrical System.</b>	<b>33</b>
Functional Description.	33
Maintenance and Adjustment	35
Setting Onboard Charger Battery Profile.	35
Troubleshooting	36
General Electrical Troubleshooting.	36

Understanding the Features of the Main Wiring Diagram . . . . .	37
Device Labeling . . . . .	38
Navigation . . . . .	38
Using the Wiring Harness Diagram . . . . .	39
Wire Numbers . . . . .	39
Splice Points . . . . .	39
Connector Numbers . . . . .	40
Back-Probing Connector Voltages. . . . .	40
Testing Cables . . . . .	41
Diagnostic Scenarios. . . . .	42
Battery Testing . . . . .	43
Removal and Installation . . . . .	44
Electrical Bay Cover . . . . .	44
Squeegee and Brush Switches. . . . .	44
Drive Handle . . . . .	45
Drive Handle Cover . . . . .	45
Hour Meter. . . . .	46
Batteries . . . . .	47
Wiring Diagrams. . . . .	48
Electrical Circuit Diagram . . . . .	48
Wiring Diagram . . . . .	49
Specifications . . . . .	50
Connector Pinouts . . . . .	50
TrackClean Connector. . . . .	50
EcoFlex Connector. . . . .	50
Operator's Handle Connector . . . . .	50
Drive Controller Connector . . . . .	51
<b>30 - Solution System . . . . .</b>	<b>52</b>
Functional Description. . . . .	52
Non-Detergent Models. . . . .	52
Detergent Models . . . . .	53
Detergent Pump . . . . .	53
Troubleshooting . . . . .	54
Scrub System, General . . . . .	54
No Solution Flow. . . . .	55
No EcoFlex Detergent Flow . . . . .	55
Removal and Installation . . . . .	56
Scrub Skirt . . . . .	56
Solution Solenoid . . . . .	56
Solution Filter . . . . .	57
Solution Control Panel and Cable. . . . .	58
EcoFlex Control Panel . . . . .	59
Specifications . . . . .	59
<b>34 - Scrub System, Disc. . . . .</b>	<b>60</b>
Functional Description. . . . .	60
Circuit Overview. . . . .	61
Troubleshooting . . . . .	62
Scrub System, General . . . . .	62
One Brush Not Working. . . . .	63
Both Brush Motors Not Working . . . . .	63
Removal and Installation . . . . .	64
Scrub Skirt . . . . .	64
Scrub Brush Motor. . . . .	64
Brush Motor Brushes . . . . .	65
Specifications . . . . .	67

<b>34 - Scrub System, Cylindrical</b>	<b>68</b>
Functional Description	68
Circuit Overview	69
Troubleshooting	70
Scrub System, General	70
One Brush Not Working	71
Both Brush Motors Not Working	71
Removal and Installation	72
Scrub Skirt	72
Scrub Brush Motor	72
Brush Motor Brushes	73
Specifications	76
<b>38 - Squeegee System</b>	<b>77</b>
Functional Description	77
Squeegee	77
Maintenance and Adjustment	78
Squeegee Blade Cleaning and Inspection	78
Squeegee Tilt Adjustment	78
Removal and Installation	79
Squeegee Blade Replacement	79
<b>40-Recovery System</b>	<b>80</b>
Functional Description	80
Vacuum Motor and Recovery Tank	80
Circuit Overview	81
Troubleshooting	81
No Vacuum Motor	81
Poor Suction	81
Vacuum Suction Test	82
Removal and Installation	83
Vacuum Motor	83
Vacuum Motor Brushes	84
Specifications	85
Special Tools	85
<b>90 - Options and Accessories</b>	<b>86</b>
Onboard Charger	86
TrackClean	86
EcoFlex	86
Battery Watering	86

## 03 - General Information

---

### General Machine Description

The SC901 machine is a battery-powered, walk-behind, self-propelled commercial floor scrubbing machine with either a disc or cylindrical scrub system, and suitable for use in hotels, schools, hospitals, factories, shops, offices, rental businesses and similar applications. The SC901-28D has a 28" disc deck. The SC901-34D has a 34" disc deck. The SC901-32C has a 32" cylindrical deck.

The machine is powered by six, 6-volt batteries connected in series, to provide 36 VDC to the motors and controls.

### Revision History

Revision	Summary of Changes
4/2019	First Release
Rev B, 2023	Updates for recovery float switch and electrical drawings

### Service Manual Purpose and Application

This Service Manual is a resource for professional service technicians. It provides information for understanding how the machine operates, where components are located, basic troubleshooting, maintenance, and mechanical service operations.

### Other Reference Manuals and Information Sources

Document Name	Document Number	Document Type
Instructions for Use	56091217	Operator's Manual
Parts List	56042675	Parts List

### Parts And Service

Repairs should be performed by an Authorized Advance Service Center that employs factory-trained service personnel and maintains an inventory of Advance original replacement parts and accessories.

Call the Advance Dealer named below for repair parts or service. Please specify the Model Number (same as the Part Number) and Serial Number when discussing your machine.

## Diagnostic and Service Tools

In addition to a full set of metric and standard tools, the following items are required in order to successfully and quickly perform troubleshooting and repair of Advance commercial floor cleaning equipment.

- Digital voltmeter (DVM) with DC current clamp
- Hydrometer
- Battery load tester for checking batteries
- Set of torque wrenches

These tools are also available from Nilfisk-Advance, Inc.:

- Curtis 1311 hand held programmer, p/n 56409441,
- Vacuum water lift gauge, p/n 56205281.

## Conventions

All references to right, left, front and rear in this manual are as seen from the Operator's position.

## Modifications

Modifications and additions to the cleaning machine which affect capacity and safe operation shall not be performed by the customer or user without prior written approval from Nilfisk, Inc. Unapproved modifications will void the machine warranty and make the customer liable for any resulting accidents.

## Nameplate

The nameplate contains important identification information which will be needed when ordering parts: The Model Number (Part No.) and Serial Number of the machine are shown on the Nameplate located on the inside of the battery compartment.

This information is needed when ordering repair parts for the machine.



## Safety

### Symbols

It is important for you to read and understand this manual. The information it contains relates to protecting your safety and preventing problems. The symbols below are used to help you recognize this information.



**DANGER:** Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



**WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



**Note:** Indicates an important informational message.

### General Safety Instructions

These safety instructions are included to warn you of potential bodily injury or property damage.



**CAUTION:** Read and understand all safety warnings and instructions. Failure to follow the warnings and instructions may result in electric shock, fire, and/or serious injury.

- To avoid personal injury, this machine should be used only by properly trained and authorized persons.
- Do not operate the machine near toxic, dangerous, flammable and/or explosive materials. This machine is not suitable for collecting dangerous or hazardous materials.
- In case of fire, use a powder fire extinguisher, not a water-based extinguisher.
- Do not use on surfaces having a gradient exceeding that marked on the machine. While on ramps or inclines, avoid sudden stops when loaded. Avoid abrupt sharp turns.
- Disconnect the power source and/or batteries before servicing electrical components
- Never work under a machine without safety blocks or stands to support the machine.
- Do not dispense flammable cleaning agents, operate the machine on or near these agents, or operate in areas where flammable liquids exist.
- When using floor cleaning detergents, follow all safety and handling instructions of the respective manufacturer.
- Battery charging may produce highly explosive hydrogen gas. Charge the batteries only in well-ventilated areas and away from ignition sources or open flames.
- When operating this machine, ensure that third parties, particularly children, are not endangered.
- Take precautions to prevent hair, jewelry, or loose clothing from becoming caught in moving parts.

### **Property Damage Messages**

- ***Storage and operation temperature must be above 32° F (0°C) and a humidity between 30% and 95%, non-condensing.***
- ***Before use, all doors and hoods should be properly latched.***
- ***This machine is not approved for use on public paths or roads.***
- ***This machine is only approved for hard surface use.***
- ***Use brushes and pads supplied with the machine or those specified in the User Manual. Using other brushes or pads could reduce safety.***
- ***Do not wash the machine with direct or pressurised water jets, or with corrosive substances.***
- ***Do not allow the brush/pad to operate while the machine is stationary to avoid damaging the floor.***
- ***Use only factory authorized parts and accessories.***
- ***This machine must be properly disposed of in accordance with local laws and regulations.***



## Lifting or Transporting the Machine

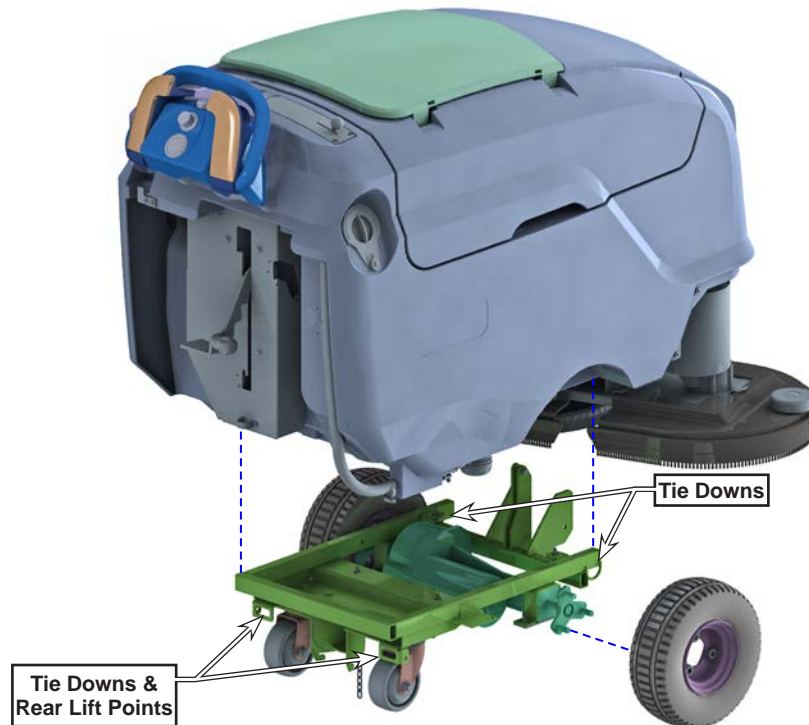


**CAUTION:** *Never work under a machine without safety stands or blocks to support the machine.*

- *Drain the recovery and solution tanks to prevent sloshing water from unbalancing the machine.*
- *Lift only from the subframe of the machine, as shown below.*
- *Secure the machine to the transport using the tie down points shown below.*

The actual procedure for transporting the machine will vary depending on the mode of transport. Follow these general guidelines as applicable to the situation.

- Remove the squeegee from the machine. This is required to access the rear hold down points and also protects the squeegee during loading, unloading, and transport.
- If transport will occur below freezing temperatures, place a small amount of environmentally friendly antifreeze in the recovery tank, solution tank, and solution lines.
- Make sure all doors, panels, and covers are secure.
- Secure the machine to the transport using both front and both rear tie down points.



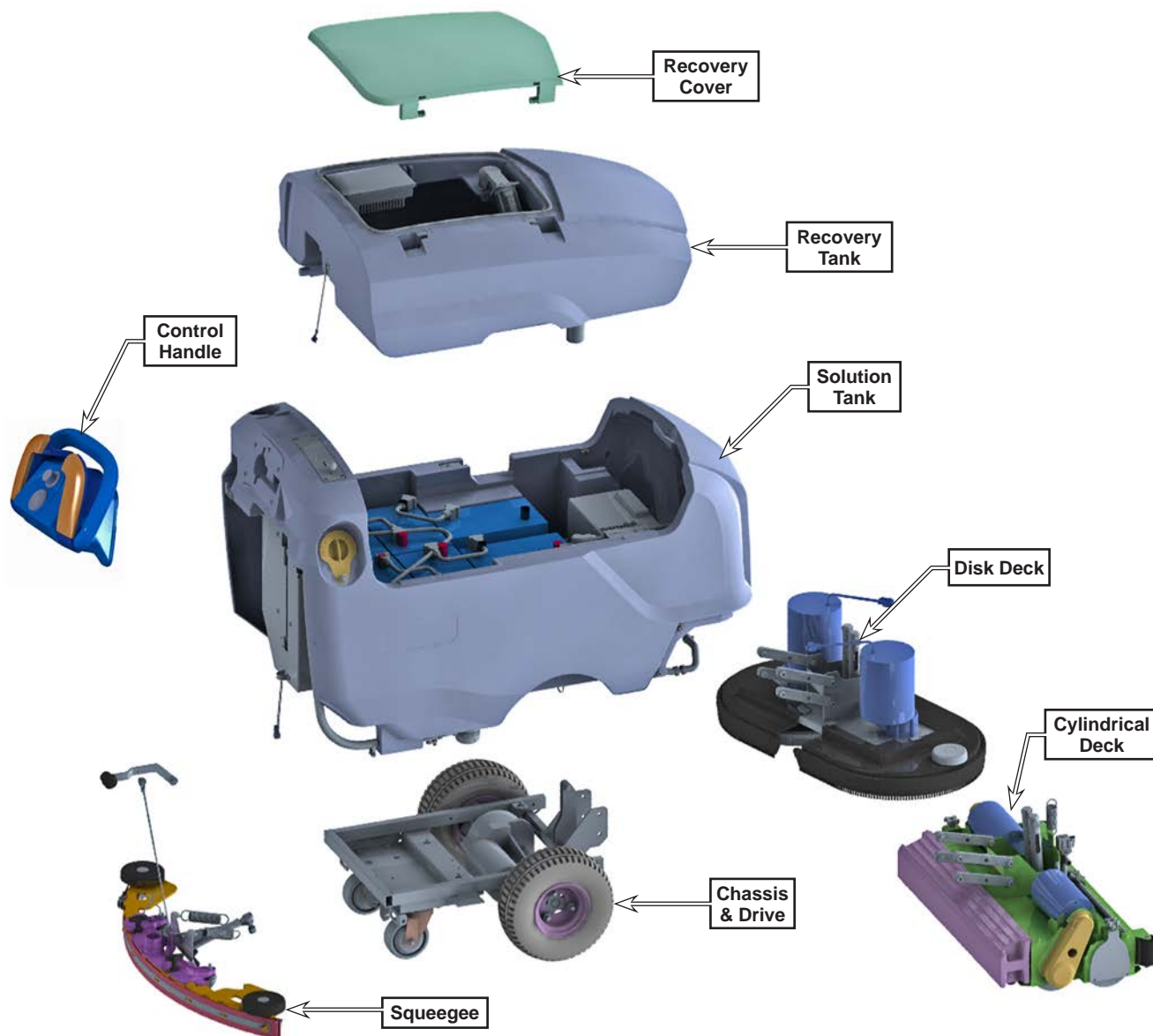
## Technical Specifications

Model	SC901 28D	SC901 34D	SC901 32C
Model No.	56115530	56115531	56115532
Voltage, Batteries	36V (6 x 6V)		
Battery Capacity	310 Ah		
Protection Grade	IPX4		
S P L IEC 60335-2-72: 2002 Amend. 1:2005, ISO 11201	68 dB(A)/20μPa	68 dB(A)/20μPa	69 dB(A)/20μPa
S P L – KpA (IEC 60335-2-72, ISO 11201) Uncertainty	±3.0 dB(A)		
Vibrations at the Hand Controls (ISO 5349-1)	< 2.5 m/s <sup>2</sup>		
Maximum Wheel Floor Loading (right front)	147 psi / 1.0 N/mm <sup>2</sup>	128 psi / 0.89 N/mm <sup>2</sup>	155 psi / 1.1 N/mm <sup>2</sup>
Maximum Wheel Floor Loading (left front)	107 psi / 0.74 N/mm <sup>2</sup>	132 psi / 1.0 N/mm <sup>2</sup>	128 psi / 0.88 N/mm <sup>2</sup>
Maximum Wheel Floor Loading (right rear)	205 psi / 1.4 N/mm <sup>2</sup>	432 psi / 3.0 N/mm <sup>2</sup>	245 psi / 1.7 N/mm <sup>2</sup>
Maximum Wheel Floor Loading (left rear)	521 psi / 5.6 N/mm <sup>2</sup>	640 psi / 4.4 N/mm <sup>2</sup>	416 psi / 2.9 N/mm <sup>2</sup>
Machine Width (chasis)	30.3" / 77.0 cm	30.3" / 77.0 cm	30.6" / 77.7 cm
Machine Width with Squeegee	41.8" / 106.2 cm	41.8" / 106.2 cm	41.8" / 106.2 cm
Machine Height	44.8" / 113.8 cm		
Machine Length	65.4" / 166 cm	67.4" / 171 cm	63.1" / 160.3 cm
Solution Tank Capacity	30 Gal / 113.6 L		
Recovery Tank Capacity	32 Gal / 121 L		
Battery Compartment Size (approximate)	Height (maximum) Width (maximum) Length (maximum)	15 in / 38 cm 26 in / 66 cm 27.5 in / 70 cm	
Scrub brush size (2 per machine)	Ø 14 inch / 35.5 cm	Ø 17 inch / 43.1 cm	5.5 x 31 Inch 13.9 x 78.7 cm
Scrub Brush Speed	250 RPM	250 RPM	900 RPM
Cleaning Path Width (scrubbing path)	28 inch / 71.1 cm	34 inch / 86.3 cm	31 inch / 78.7 cm
Brush Pressure	90 Lbs. 41kg 145 Lbs. 65kg 200 Lbs. 90kg	90 Lbs. 41kg 145 Lbs. 65kg 200 Lbs. 90kg	75 Lbs. 34kg 100 Lbs. 45kg 125 Lbs. 56kg
Gross Weight*	1189 Lbs. 539,3kg	1205 Lbs. 546,8kg	1235 Lbs. 560,2kg
Transport Weight**	942 lbs / 427 kg	979 lbs / 444 kg	1006 lbs / 456 kg
Vacuum Motor Size	710 watts max HP 0.95		
Drive Motor Size	.5 HP		
Brush Motor Size	0.75 HP		
Maximum Scrub Speed	3.2		
Maximum Transport Speed	3.2		
Gradeability Transport	2% (1.15°)		
Gradeability Cleaning	2% (1.15°)		

\*Gross Weight: Standard machine without options, full solution tank and empty recovery tank, with removable scrub brushes and 310 AH batteries installed.

\*\*Transport Weight: Standard machine without options, empty solution and recovery tanks, with batteries installed.

## Know Your Machine — Major components:



## Maintenance Schedule

Maintenance intervals given are for average operating conditions. Machines used in severe operational environments may require service more often.

Maintenance Item	Interval			
	Daily	Weekly	Monthly	Yearly
Charge Batteries	•			
Check/Clean Tanks & Hoses	•			
Check/Clean/Rotate the Brushes/Pads	•			
Check/Clean the Squeegee	•			
Check/Clean Vacuum Shut-Off Float	•			
Clean Hopper on Cylindrical System	•			
Empty/Clean Debris Catch Tray in Recovery Tank	•			
Check Battery Cell Water Level (does not apply to gel cell batteries)		•		
Inspect Scrub Housing Skirts		•		
Inspect and Clean Solution Filter		•		
Clean Solution Manifolds on Cylindrical System		•		
Purge Detergent System (AXP and EcoFlex)		•		
Lubricate the Machine			•	
Check Vacuum Motor Carbon Brushes				300 hours
Check Brush Motor Carbon Brushes				500 hours
Check Drive Motor Carbon Brushes				500 hours



**Note:** See the individual machine system sections for maintenance information.

### Carbon Brush Notes:

- The original (new) length of each carbon brush is 1" (25.4mm) on brush and wheel drive motors.
- All motors: Replace carbon brushes when shorter than 3/8" (9.5mm) to obtain the same motor efficiency as new brushes.

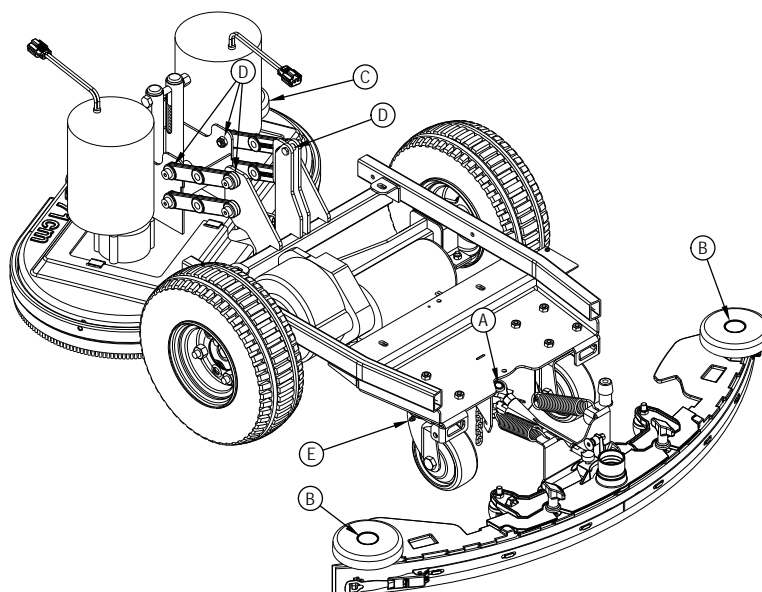
## Lubricating the Machine

Once a month, apply light machine oil to lubricate the:

- General Pivot Points for the Squeegee Linkage (A).
- Squeegee end wheels (B).
- Scrub deck bumper wheel (C).
- General Pivot Points for the Brush Linkage (D).

Once per quarter, Grease the following

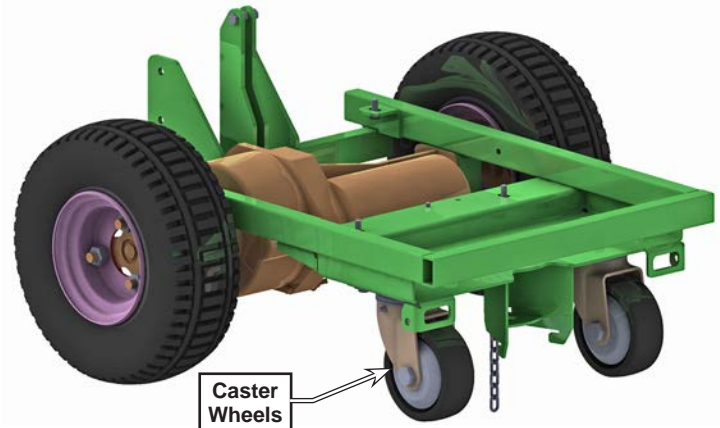
- Rear Caster Wheel Swivels (E).



## 14 - Wheel System, Non-Traction

### Functional Description

The SC901 machine is propelled by the drive wheels. The rear caster wheels add stability and ease of turning.

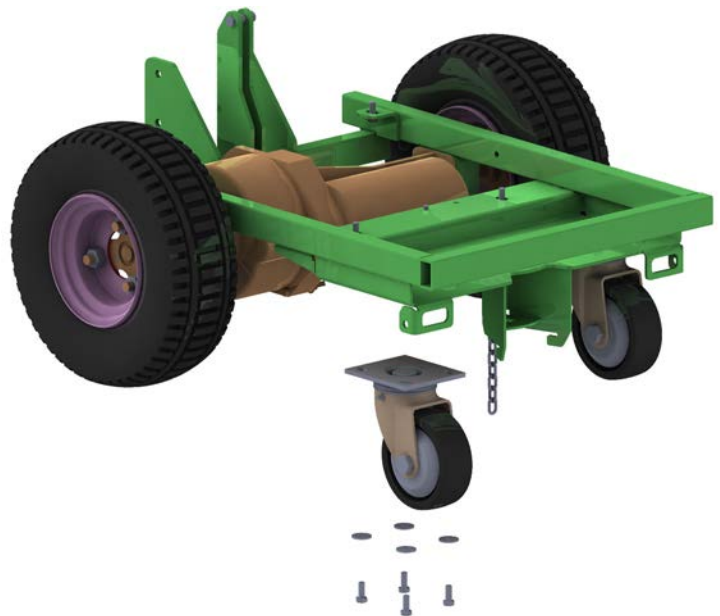


### Removal and Installation



**WARNING:** Never work under machine without safety stands or blocking to support the machine.

1. To reduce the weight of the machine, drain both the recovery and solution tanks.
2. Raise the rear of the machine and place blocking under the rear lifting points.
3. Remove the four screws and washers that secure the caster to the chassis, and remove the caster.





## 20 - Wheel System, Traction

### Functional Description

The SC901 machine is driven by an electrically powered transaxle. The transaxle is an open differential powered by a 1/2 hp, permanent magnet, 36V motor. A Curtis 1228 solid state speed controller regulates the speed and direction of the wheel drive motor. The motor speed controller is located in the electrical compartment of the battery bay. The drive controller uses what is called a “Wigwag” configuration for throttle and direction control, and a speed limiting potentiometer to set the maximum machine speed. These are discussed further below.

### Speed Limiting Potentiometer

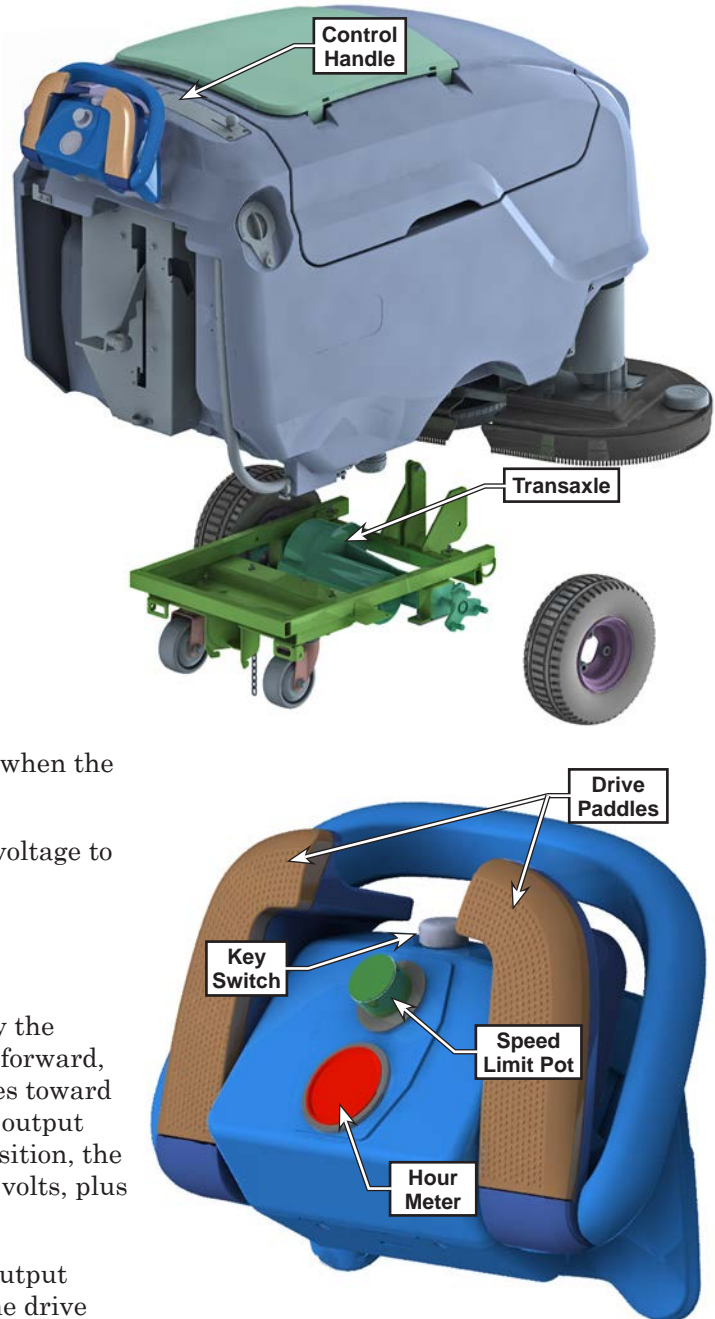
The speed limiting potentiometer (R1 pot) is a 3-wire variable resistor connected to the Speed Limit input of the drive controller. This pot sets the upper speed limit of the controller, which serves to “scale” the speed range for the throttle potentiometer. This scaling permits full throttle movement to control machine speed, even when the maximum speed is set very low.

The drive controller itself provides the 5-volt bias voltage to both the speed limit and throttle potentiometers.

### Wigwag Throttle Potentiometer

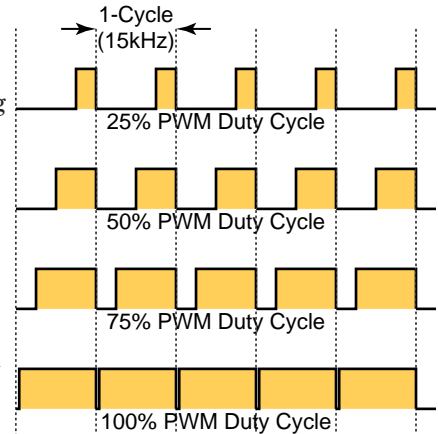
The throttle potentiometer (R2 pot) is controlled by the drive paddles. When the drive paddles are pushed forward, the output voltage from the potentiometer increases toward 5 volts, and when the paddles are pulled back, the output voltage decreases toward 0 volts. In the neutral position, the potentiometer output voltage is approximately 2.5 volts, plus or minus a margin of error called the deadband.

The Curtis 1228 drive controller interprets these output voltages as forward, reverse, and neutral. When the drive controller receives a throttle input voltage greater than 2.5V plus the deadband voltage (0.2V), it interprets the command for forward motion. That is, a voltage from 2.7 to about 5 volts (4.6V actually) is a forward voltage, and a voltage from 2.3 to about 0 volts (0.4V actually), is a reverse voltage. Note that even though the potentiometer is biased between 0 and 5 volts, the actual wiper voltage range is 0.4 to 4.6 volts.



## Drive Motor PWM Function

The drive motor is controlled from a Curtis 1228 controller, which is a pulse-width-modulation speed controller designed specifically for permanent magnet DC motors. Pulse-width-Modulation (PWM) is a form of motor speed control that alters the power to a motor by rapidly turning the power on and off. The ratio (also called “duty cycle”) between the On and Off states determines how much power the motor receives. The shorter the “off-time” the closer to full power the motor will receive. This switching occurs so fast (15kHz for this controller) that the motor simply sees it as a reduction in power (voltage) instead of the rapid on/off. PWM is a standard motor control technique because it is easier to turn power all the way on and all the way off, than it is to vary the magnitude of the power. Varying the magnitude would create a lot of heat that would need to be dissipated.



## Drive Controller

The primary purpose of the drive controller is, of course, to control the drive motor. However, it also provides some ancillary control of the other functions of the machine, which will be discussed in greater detail in the applicable chapters. As a motor controller, it delivers PWM-varying power to the drive motor in both positive and negative polarities for forward and reverse motor operation.

Even though the machine does not utilize an electromechanical brake system, the drive controller possesses the output control for one. Instead, this is used for ancillary machine control, specifically, the scrub functions.

As used by this machine, the Brake output from the drive controller is more aptly referred to as a “Scrub Enable” function. The brake outputs (or “Scrub Enable”) are active only when the drive is commanded for movement. In this manner, when the machine is stopped, the scrub motor, solution solenoid, and detergent pump circuits are all disabled. The Brake+ output is always 36 volts as long as the keyswitch is on, and the Brake- output is switched to ground when the machine is commanded to move.



The controller is powered directly from the batteries, but through a 30-amp circuit breaker. The drive controller remains inactive (inhibited) until the KSI input receives positive battery power through the main key switch. When KSI is active, the drive is ready to operate, and awaiting a throttle command to move.

## Circuit Description

### Drive Power

Main battery power is always present at the drive controller from the battery (fused at 30 amps), however, the drive controller contains an internal main relay to inhibit main power when the KSI circuit is inactive. When the KSI input receives battery-positive voltage, the controller pre-charges its internal DC Bus capacitor bank at 1.5 amps for 0.5 seconds, before it closes its own internal main relay. This is referred to as the precharge function, and is used to reduce arcing at the relay contacts. In short, it permits the capacitor voltage to slowly approach battery voltage before full battery power is connected to the internal capacitors.

The significance of this discussion is that if there is an unexpected drain (faulty load or short circuit) on the DC Bus of the controller before the KSI circuit is energized, it will prevent the precharge function from properly charging the capacitor bank, and the controller will issue a precharge error code.

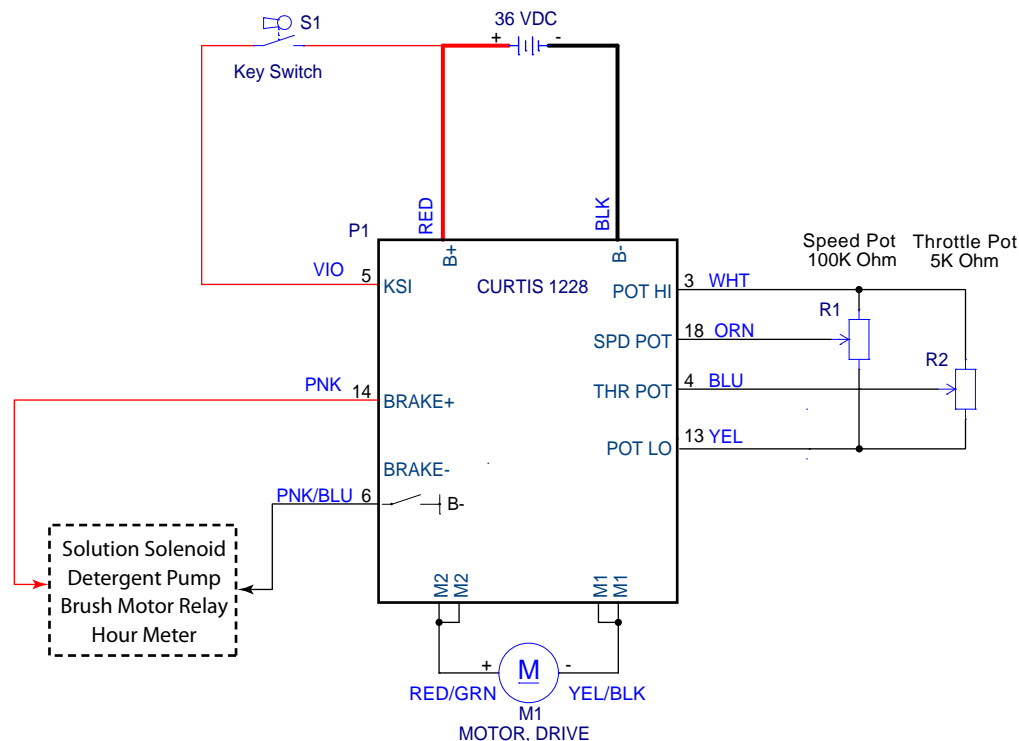
### Throttle and Speed Limit

Both the speed limit and throttle potentiometers receive a 5-volt bias voltage from the Curtis 1228 drive controller. This results in the wiper voltages from both potentiometers to have a 0 to 5 volt range. The Curtis drive controller interprets these voltages as the machine drive commands.

### Brake Output (Scrub Enable)

When the drive controller is commanded to move, it activates its “brake release” function by bringing the Brake(-) output to battery-negative voltage. This results in both positive and negative voltages being available to the various scrub circuits. Previously the scrub circuits were disabled, because both sides of the circuits were at the same battery-positive voltage, and no current could flow.

Refer to the [“24 - Electrical System”](#) on page 33 for a further description of the circuits affected by the Brake output.



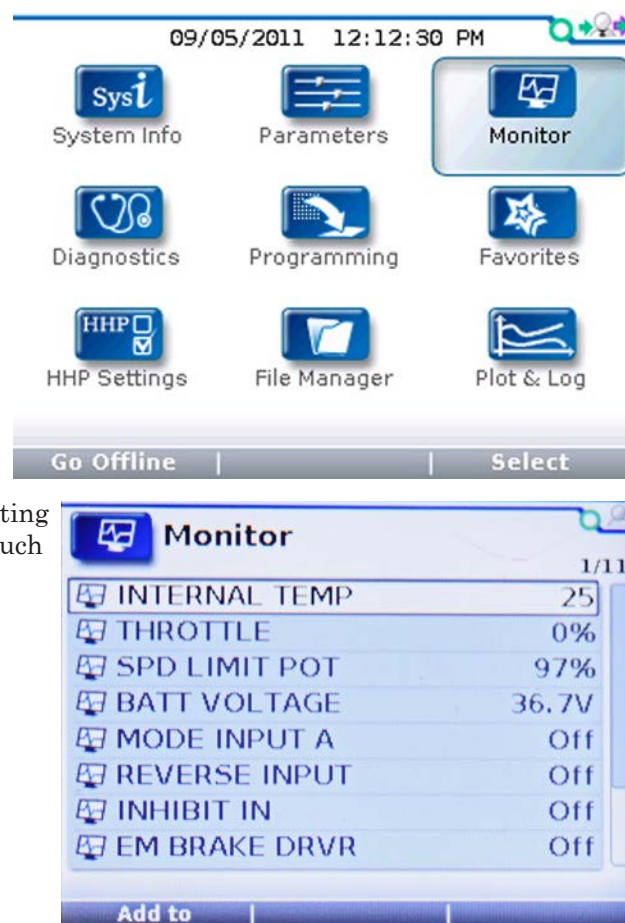


## Troubleshooting

The primary tool for troubleshooting the drive controller is the Curtis handheld programmer. This tool interfaces with the drive controller to report back error codes, control status, and other functions. The Curtis manual will describe this in greater detail, but the primary troubleshooting functions are under the Monitor and Diagnostics menus.

The diagnostics menu displays a list of either current or past error codes. These are used in conjunction with the table below to isolate possible causes of malfunction.

The monitor menu displays real-time values of inputs, outputs, and controls. This is very helpful for troubleshooting the drive system's prerequisite conditions for operation, such as throttle inputs. Additionally, if the brake output isn't active, it will cause the scrub system to not function.



## Error Codes

Because most drive system failures will be accompanied by a drive controller error code, troubleshooting is generally error code driven. Those few exceptions that would not be error code driven, are covered in the electrical chapter.

### 1-1 Thermal Cutback

Description	Drive Controller Over-Temperature or Under-Temperature cutback. Drive power output is reduced.	
Setting Conditions	Drive controller internal temperature below -25°C or above 92°C	<b>When Monitored</b> Always
Possible Causes	<ul style="list-style-type: none"><li>• Temperature above overtemp threshold.</li><li>• Excessive load on vehicle.</li></ul>	
Initial Action	Allow the machine to cool/warm to normal operating temperature (environment), and check if condition persists.	
Troubleshooting Steps		
<ol style="list-style-type: none"><li>1. Inspect the transaxle output shafts for obstructions, such as twine wound around the axles.</li><li>2. Inspect the drive motor brushes for excessive wear.</li><li>3. Inspect the drive motor wiring for corrosion or loose connections.</li></ol>		

**1-2 Throttle Fault 1**

<b>Description</b>	Throttle fault	
<b>Setting Conditions</b>	Throttle input voltage out of range for the condition	<b>When Monitored</b> Always
<b>Possible Causes</b>	<ul style="list-style-type: none"> <li>• Throttle input wire open or shorted</li> <li>• Throttle pot defective</li> <li>• Wrong throttle type selected</li> </ul>	
<b>Initial Action</b>	Make sure the drive paddle is in neutral position, and key-cycle the machine	

**Troubleshooting Steps**

1. If error code 3-1 or 3-5 is being reported, diagnose that error first.
2. Power the machine and with the drive paddle in the neutral position, check the voltage between contacts 3 and 4 of the drive controller connector.
  - If the voltage is at or near 2.5 volts (within throttle deadband) and the error persists, replace the drive controller.
  - If the voltage is at or near 0V or at or near 5V, see step 3 to inspect the potentiometer wiring.
3. Check the potentiometer.
  - a. Disconnect the X105 connector of the control handle (operator's controls).
  - b. Check the resistance between contacts 1 and 2, 1 and 3, and 2 and 3 (respectively) of the X105 connector of the control handle.
    - If any measurement is open circuit (greater than 5K ohms), repair or replace the throttle potentiometer and/or wiring.
    - If any measurement to contact 3 results in a reading of at or near 0 ohms, move the drive paddle position and confirm the measurement. If the result does not change, replace the potentiometer.
    - If all 3 measurements are not at or near 0 ohms, the potentiometer is not at fault. Continue to step 4.
4. Check the harness between the drive controller and the control handle.
  - a. Reconnect the X105 connector at the control handle.
  - b. Disconnect the X30 connector at the drive controller.
  - c. Check the resistance between contacts 3 and 4, 13 and 4, and 3 and 13 (respectively) of the X30 connector of the at the drive controller.
    - If any measurement is open circuit (greater than 5K ohms), repair or replace the harness between the drive controller and control handle.
    - If any measurement results in a reading of at or near 0 ohms, move the drive paddle position and confirm the measurement. If the result does not change, the harness is shorted. Repair or replace the harness.

**1-3      Speed Limit Pot Fault**

<b>Description</b>	Speed limit pot fault	
<b>Setting Conditions</b>	Speed limit input voltage out of range for the condition	<b>When Monitored</b> Always
<b>Possible Causes</b>	<ul style="list-style-type: none"> <li>• Speed limit input wire open or shorted</li> <li>• Speed limit pot defective</li> </ul>	
<b>Initial Action</b>	Key-cycle the machine	

**Troubleshooting Steps**

1. If any throttle errors are reported, diagnose those first.
2. Turn the speed limit potentiometer to its middle position.
3. Power the machine and check the voltage between contacts 3 and 18 of the X30 connector at the drive controller.
  - If the voltage is between 0.4 and 4.6 volts, and the error persists, replace the drive controller.
  - If the voltage is at or near 0V or at or near 5V, see step 4 to inspect the potentiometer.
4. Check the potentiometer.
  - a. Disconnect the X105 connector of the control handle (operator's controls).
  - b. Check the resistance between contacts 1 and 2, 1 and 4, and 2 and 4 (respectively) of the X105 connector of the control handle.
    - If any measurement is open circuit (greater than 100K ohms), repair or replace the speed limit potentiometer and/or wiring.
    - If any measurement to contact 4 results in a reading of at or near 0 ohms, replace the potentiometer.
    - If all 3 measurements are not at or near 0 ohms, the potentiometer is not at fault. Continue to step 5.
5. Check the harness between the drive controller and the control handle.
  - a. Reconnect the X105 connector at the control handle.
  - b. Disconnect the X30 connector at the drive controller.
  - c. Check the resistance between contacts 3 and 18, 13 and 18, and 3 and 13 (respectively) of the X30 connector of the at the drive controller.
    - If any measurement is open circuit (greater than 100K ohms), repair or replace the harness between the drive controller and control handle.
    - If any measurement results in a reading of at or near 0 ohms, the harness is shorted. Repair or replace the harness.

**1-4 Low Battery Voltage**

<b>Description</b>	.Battery voltage too low	
<b>Setting Conditions</b>	Battery voltage below 17 volts	<b>When Monitored</b> Always
<b>Possible Causes</b>	<ul style="list-style-type: none"> <li>• Faulty battery</li> <li>• Poor connection</li> </ul>	
<b>Initial Action</b>	Make sure the batteries are fully charged	

**Troubleshooting Steps**

If the actual battery voltage is not low, systematically check voltages from the drive controller, back to the batteries to identify the point of poor connection.

1. Turn the vacuum motor on to load the system.
2. Check the negative power circuit.
  - a. Place the positive voltage probe directly on the battery positive terminal.
  - b. Place to negative voltage probe on the B- contact at the drive controller.
    - If the voltage is 36 volts, skip to step 3.
    - If the voltage is low, continue.
  - c. Move the negative voltage probe to the Main Grounding Lug in the electrical bay.
    - If the voltage is 36 volts, repair or replace the connections/wire leading to the drive controller.
    - If the voltage is low, check the connections at the Main Ground lug and main battery terminal.
3. Check the positive power circuit.
  - a. Place the negative voltage probe at either the battery terminal or main ground lug, whichever is more convenient. (Both were tested above)
  - b. Place the positive voltage probe at the B+ contact of the drive controller.
    - If the voltage is 36 volts and the error persists, confirm the voltage directly at the drive controller, and if persistent, replace the drive controller.
    - If the voltage is low, continue.
  - c. Move the positive voltage probe to each of the circuit breaker CB1 terminals.
    - If both readings are 36 volts, repair or replace the wire between the circuit breaker and drive controller.
    - If one reading is 36 volts and the other is low, replace the circuit breaker.
    - If both readings are low, continue.
  - d. Move the positive voltage probe to the main terminal of the vacuum contactor (the side with multiple wires).
    - If the voltage is 36 volts, repair or replace the wire between the contactor and CB1.
    - If the voltage is low, continue.
  - e. Move the positive voltage probe to the main terminal of the brush contactor.
    - If the voltage is 36 volts, clean the copper busbar and check that the lugs of the two relays are securely tightened.
    - If the voltage is low, repair or replace the wire between the main battery and the K2 contactor.

**1-5      *Overvoltage***

<b>Description</b>	The battery voltage is too high	
<b>Setting Conditions</b>	Battery voltage above 48 volts	<b>When Monitored</b> Always
<b>Possible Causes</b>	<ul style="list-style-type: none"> <li>• Improper battery wiring</li> <li>• Faulty battery charger</li> </ul>	

**Initial Action****Troubleshooting Steps**

This scenario is very unlikely for a battery powered machine unless incorrect batteries were recently installed, or the battery charger is faulty AND plugged in to power.

- If the voltage at the drive controller is below 48 volts and the error persists, replace the drive controller.
- If the battery charger is delivering 48 volts to the batteries at any time, replace the charger.

**2-1      *Main Off Fault*****2-4      *Main On Fault***

<b>Description</b>	The main internal relay for the DC Bus failed in the open or closed condition.	
<b>Setting Conditions</b>		<b>When Monitored</b> Always
<b>Possible Causes</b>	Failed drive controller	

**Initial Action**      Replace the drive controller

**Troubleshooting Steps****2-3      *Main Contactor Fault***

<b>Description</b>	Internal error. Main DC Bus relay has failed in either the open or closed position.	
<b>Setting Conditions</b>		<b>When Monitored</b> Always
<b>Possible Causes</b>	Faulty drive controller	

**Initial Action**      Disconnect the battery to perform a full power-cycle of the machine. If the error persists, replace the drive controller.

**Troubleshooting Steps**

### 3-1 *Procedure/Wiring Fault*

### 3-5 *High Pedal Disable Fault*

Description	The throttle was commanded to be active at or before KSI activation.	
Setting Conditions	The 3-1 error is set if the 3-5 error persists for more than 10 seconds.	<div>When Monitored</div> Boot up
Possible Causes	Faulty potentiometer and/or built-in centering springs	
Initial Action	Make sure the drive paddle is in the neutral position, and key-cycle the machine.	
Troubleshooting Steps		

### 3-2 *Brake On Fault*

### 3-4 *Brake Off Fault*

Description	The internal driver (transistor) for the brake output has failed in the closed condition (shorted, Brake On Fault), or the open condition (open circuit, Brake Off Fault). Note that the “On” and “Off” refer to the driver, not the output of the brake circuit, which is inverted.	
Setting Conditions	The drive controller has detected an internal error with its driver output.	<b>When Monitored</b> Always
Possible Causes	Faulty drive controller	
Initial Action	Disconnect the battery to perform a full power-cycle of the machine. If the error persists, replace the drive controller.	
Troubleshooting Steps		

### 3-3 Precharge Fault

<b>Description</b>	The drive controller's DC bus failed to charge to the KSI voltage before timeout.	
<b>Setting Conditions</b>	The DC bus did not charge to within 5 volts of the KSI voltage within 1.5 seconds.	<b>When Monitored</b> Boot up
<b>Possible Causes</b>	<ul style="list-style-type: none"> <li>• Unintentional load on the DC Bus. (The Brake+ output is the only unswitched DC Bus connection.)</li> <li>• Poor connection in the KSI circuit.</li> </ul>	
<b>Initial Action</b>	Disconnect the battery to perform a full power-cycle of the machine.	

#### Troubleshooting Steps

1. Eliminate KSI as the cause.
  - a. With the keyswitch in the off position, use a jumper to provide battery positive power to the KSI input of the drive controller (J10-5).
    - If the error is not reported, trace the KSI circuit back toward the keyswitch to locate a loose connection.
    - If the error persists, continue.
2. Eliminate the Brake+ circuit as the cause.
  - a. Disconnect the J10 connector from the drive controller.
  - b. Use a jumper to provide battery positive power to the KSI input of the drive controller (J10-5).
    - If the error persists, replace the drive controller.
    - If the error is not reported, trace the Brake+ circuit to locate an unintended connection to ground.

### 4-1 Current Sense Fault

<b>Description</b>	Internal error. The drive controller determined an amperage reading was unexpected.	
<b>Setting Conditions</b>		<b>When Monitored</b> Always
<b>Possible Causes</b>	Faulty drive controller	
<b>Initial Action</b>	Diagnose all other errors first. If the error persists, replace the drive controller.	

#### Troubleshooting Steps

--

**4-2 Hardware Failsafe**

Description	Drive motor amperage exceeded the controller's capacity.	
Setting Conditions		When Monitored
		Always
Possible Causes	While a short circuit may be the root cause, the drive controller is likely damaged as a result of uncontrolled amperage.	
Initial Action	Clear any cause for a motor short circuit. If the error persists, replace the drive controller.	
Troubleshooting Steps		

**4-3 EEPROM Fault****4-4 Power Section Fault**

Description	Internal drive controller fault.	
Setting Conditions		When Monitored Always
Possible Causes		
Initial Action	Disconnect the battery to perform a full power-cycle of the machine. If the error persists, replace the drive controller.	
Troubleshooting Steps		



## Removal and Installation

### Drive Controller

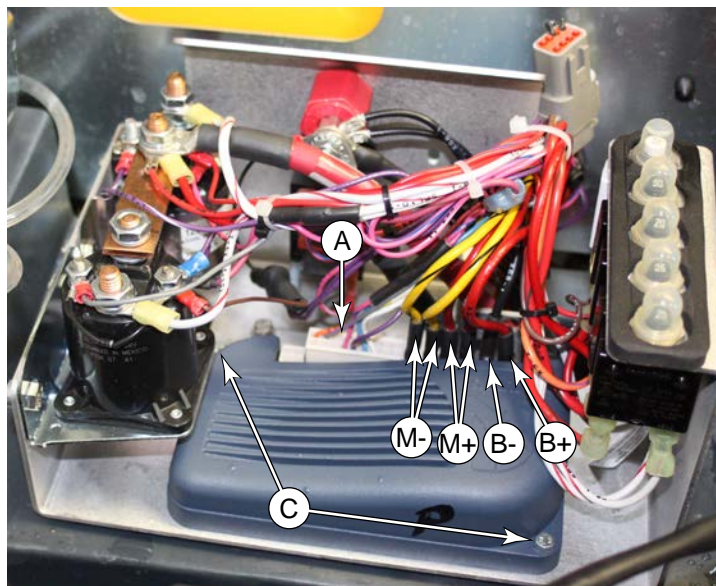


**WARNING:** Unswitched battery power is present at the drive controller. Disconnect the battery connector before servicing the machine.



**Note:** Drive controllers are factory pre-programmed for the specific machine. Use only factory authorized replacement controllers.

1. Drain the recovery tank and open the recovery tank to access the battery bay.
2. Turn off the key and disconnect the main battery connector.
3. Remove the [Electrical Bay Cover](#) described on page 44.
4. Disconnect the logic connector (A) from the drive controller.
5. Disconnect the high power wires as follows:
  - Two motor-negative (Yellow/Black)
  - Two motor-positive (Red/Green)
  - Battery-negative (Black)
  - Battery positive (Red)
6. Remove the two mounting screws (C), and remove the module.
7. Reverse the steps to install a new module.



### Follow-up Testing

1. Before reconnecting the battery, either block the wheels off the ground or move the machine to an open area without obstructions.
2. Turn the speed dial all the way to its lowest speed.
3. Reconnect the battery connector and turn on the key switch.
4. With the drive paddle in neutral, slowly increase the speed limit dial up and back down to verify that the drive paddle is within the throttle deadband. Make sure error codes 3-1 or 3-5 are not reported.
5. With the speed limit pot set to minimum, move the drive paddle forward or backward to confirm that the machine has no travel, or very slow travel.
6. With the drive paddle held forward or backward, slowly increase the speed limit potentiometer to confirm machine travel in the appropriate direction.
7. Continue testing the drive throughout its whole speed range, and for both forward and reverse directions.
8. Lower the scrub deck and verify the scrub function, which is controlled by the drive controller.

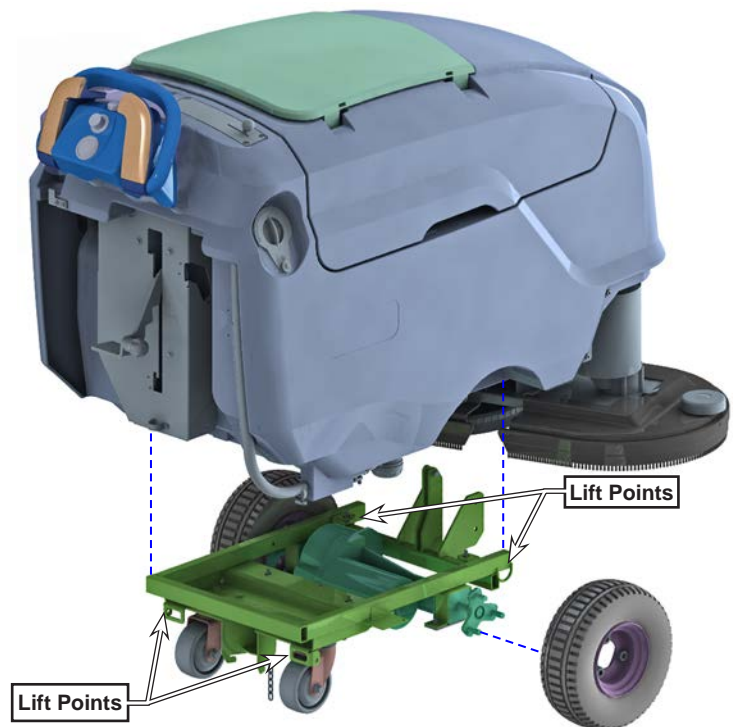
## Wheels



**WARNING:** To avoid unexpected movement, disconnect the battery connector before servicing the machine.

- **Never work under the machine without safety stands or blocking to support the machine.**
- **To avoid instability of the lifted machine, block the rear (caster) wheels so that the weight of the machine is not on the caster wheels, which can pivot unexpectedly.**

1. Drain both the recovery and solution tanks to reduce the weight of the machine.
2. Turn off the key and disconnect the batteries.
3. Slightly raise the rear of the machine, and place rigid blocking below the frame so the caster wheels are slightly off the ground.
4. Raise the front of the machine, and place rigid blocks under the lifting points.
5. Remove the three lug nuts that secure the wheel to the transaxle, and remove the wheel.



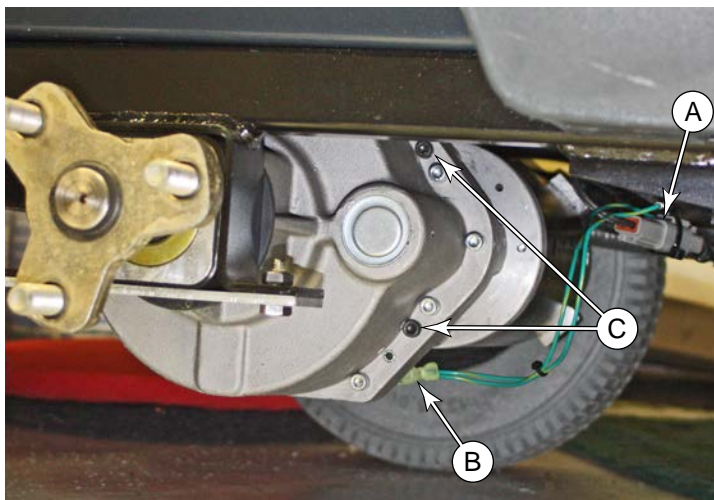
## Drive Motor



**WARNING:** To avoid unexpected movement, disconnect the battery connector before servicing the machine.

- Never work under the machine without safety stands or blocking to support the machine.
- To avoid instability of the lifted machine, block the rear (caster) wheels so that the weight of the machine is not on the caster wheels, which can pivot unexpectedly.

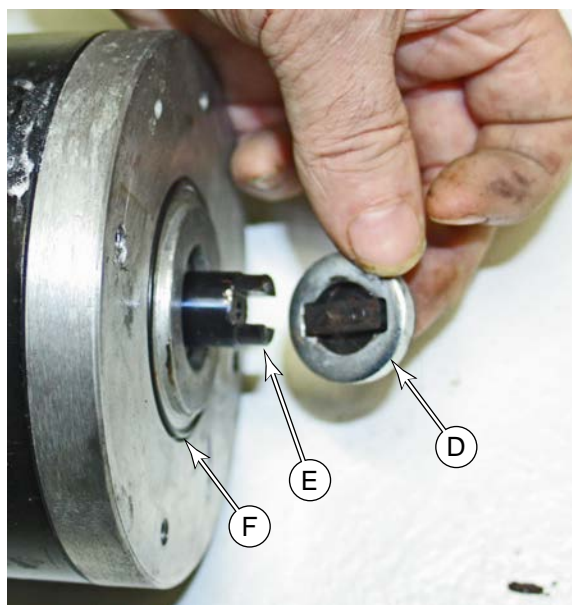
1. Drain the recovery and solution tanks to reduce the weight of the machine.
2. Disconnect the main battery connector.
3. You will find that access to the motor is much easier with the right wheel removed from the machine. Raise the right side of the machine, and remove the drive wheel.
4. Disconnect the motor connector (A) and the ground wire (B).
5. Using a 3/16" hex key, remove the two screws (C) that secure the motor to the transaxle.



- Due to the tight quarters, you may find it easier to remove the upper screw first.
- Support the motor before completely removing the last screw.

## Replacement Notes

- Apply a small amount of grease to the drive coupling (D).
- The drive coupling is 2 pieces. Install the washer-side of the coupling onto the motor shaft.
- Inspect the O-ring (F) to make sure it isn't damaged, and is in position in the O-ring groove.
- While inserting the motor back into the transaxle, rotate the right axle (without the wheel) to align the spline on the transaxle with the drive coupling.





## Motor Brushes

It is possible to replace the motor brushes without removing the motor from the transaxle, if you wish. This is a decision you should make before you start, however, because one method requires removing the right wheel and the other method removes the left wheel. Replacing the brushes is a relatively easy task, with the exception being the access to the upper-front brush.

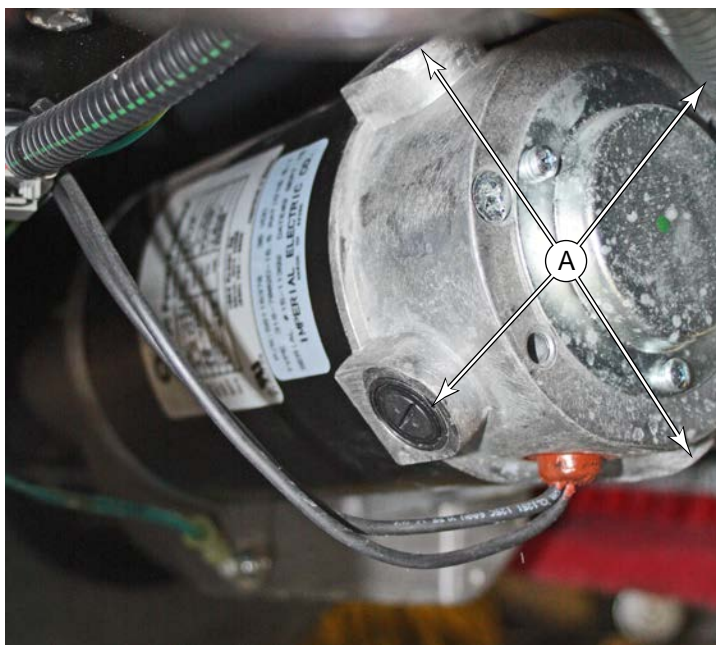
This procedure is written from the standpoint of leaving the motor in place.



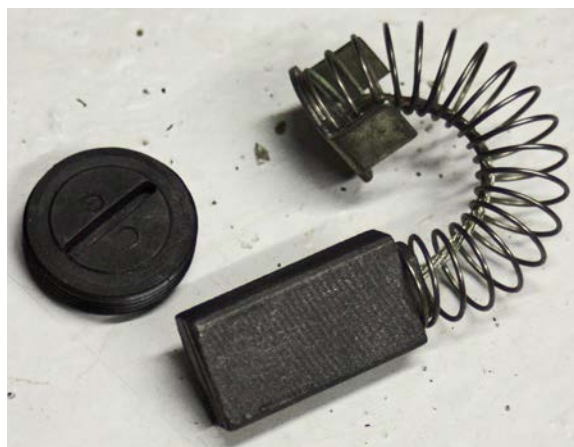
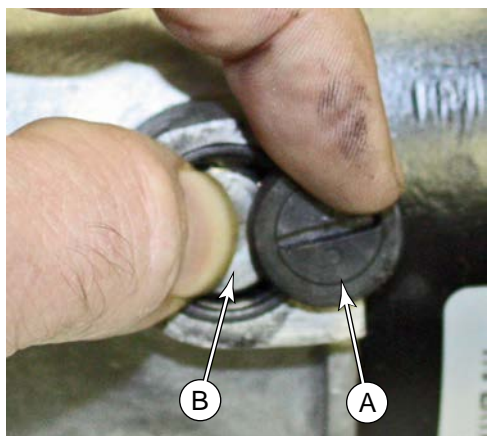
**WARNING:** To avoid unexpected movement, disconnect the battery connector before servicing the machine.

- **Never work under the machine without safety stands or blocking to support the machine.**
- **To avoid instability of the lifted machine, block the rear (caster) wheels so that the weight of the machine is not on the caster wheels, which can pivot unexpectedly.**

1. Drain the recovery tank and disconnect the main battery connector.
2. Optional, but recommended: Raise the left side of the machine and remove the left wheel for easier access to the brush motor.
3. Unscrew the brush cap (A), and remove the spring-loaded brush.
  - For the upper 2 brush caps, you will need to use a right-angle screw driver. If you don't have one compact enough for the task, you can try using a coin in the cap's slot.



4. During replacement, fit the brush all the way into the motor and hold the contact (B) with your finger. Then slide the cap (A) in from the side, replacing your finger with the cap to hold the brush. Carefully thread cap to prevent cross threading.
  - Hint: To reduce the likelihood of cross threading, unscrew the cap slightly first before screwing it in.
5. Repeat this for all 4 brushes.



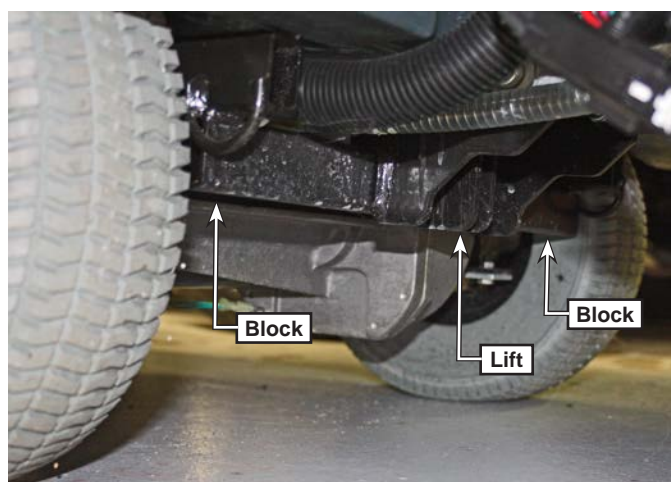
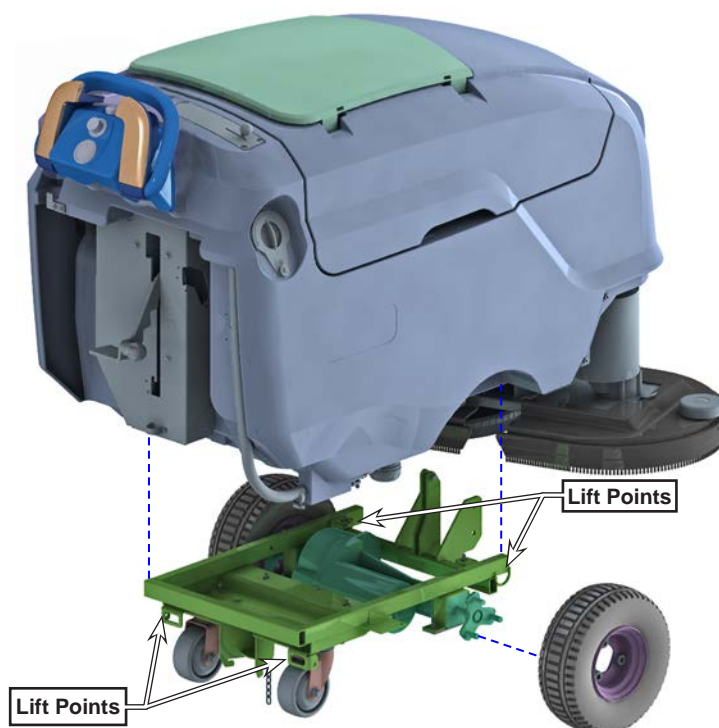
## Transaxle



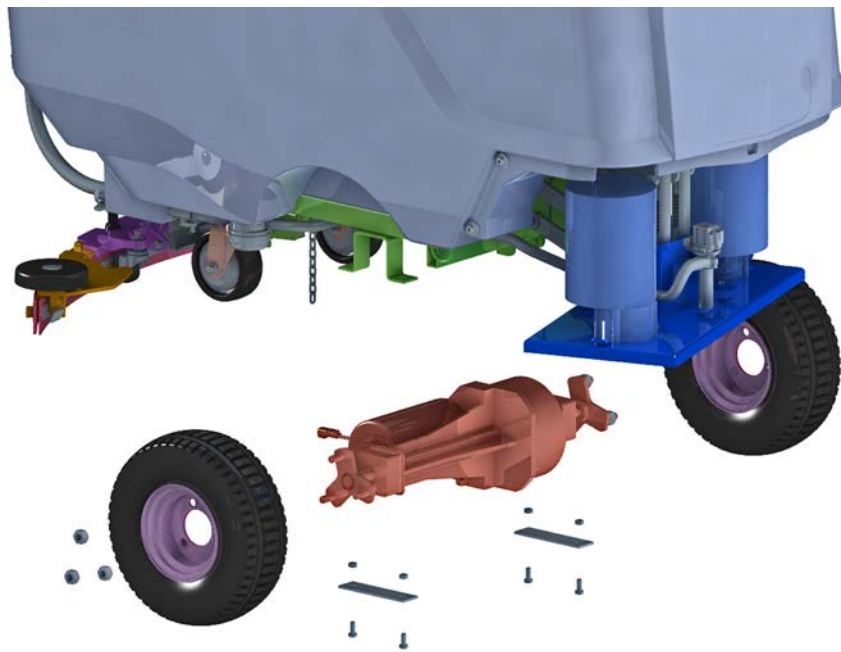
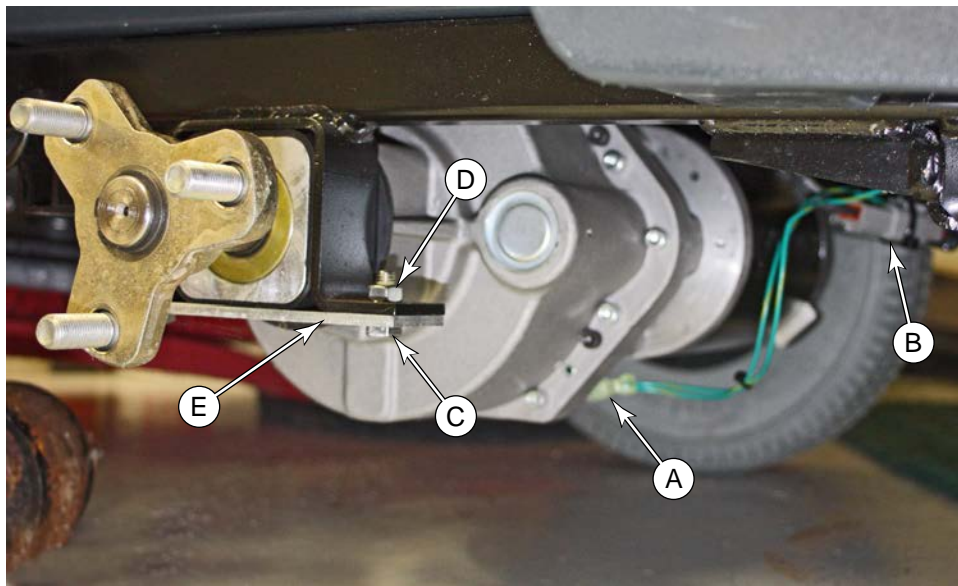
**WARNING:** To avoid unexpected movement, disconnect the battery connector before servicing the machine.

- Never work under the machine without safety stands or blocking to support the machine.
- To avoid instability of the lifted machine, block the rear (caster) wheels so that the weight of the machine is not on the caster wheels, which can pivot unexpectedly.

1. Drain both the recovery and solution tanks to reduce the weight of the machine.
2. Turn off the key and disconnect the batteries.
3. Slightly raise the rear of the machine, and place rigid blocking below the rear lifting points so the caster wheels are slightly off the ground. Make sure these blocks are stable and cannot tip over.
4. Remove the [Scrub Skirt](#) described on page 64.
5. Remove the brush skirt or hopper, depending on whether it is a disk or cylindrical deck.
6. Insert a small floor jack between the scrub deck and the drive wheel on the right-hand side of the machine, and carefully jack the front of the machine about 1 to 2 inches (25-50mm).
7. Place rigid blocks under the frame.



8. Remove the three lug nuts that secure each wheel to the transaxle, and remove both wheels.
9. Remove the ground wire **(A)** from the transaxle.
10. Disconnect the motor connector **(B)**.
11. To prevent the transaxle from falling to the floor, place supports or cushioning under the transaxle.
12. Remove the 4 bolts **(C)** and nuts **(D)** securing the right and left retaining plates **(E)** to the frame.
  - It's best to first loosen all 4 bolts, and then remove them when you are prepared for the transaxle to be lowered.
13. With the retaining plates removed, lower the transaxle to the floor. Note the orientation, with the motor toward the rear of the machine.



## Specifications

### Shop Measurements

Drive Controller Connector					
Pin	Terminal	Wire Color	Circuit		Voltage (DC Volts to GND)
1	N/A				
2	N/A				
3	Pot-Hi	White	5 Volt bias to the speed limit pot		4.56 V
4	Thrtl Pot	Blue	Throttle Pot	Neutral Position	2.48 V
				Full Forward	4.46 V
				Full Reverse	0.53 V
5	KSI	Violet	Key Switch Input		36.5 V @ On
6	Brake-	Pink/Blue	Scrub Enable	Deck Down, Drive Neutral	34.7 V
				Deck Down, Travelling	0.104 V
7	N/A				
8	N/A				
9	Status	None	Unused Status LED		Rapid Pulse
10	N/A				
11	N/A				
12	N/A				
13	Pot-Lo	Yellow	0 Volt bias to the potentiometers		0.43 V
14	Brake+	Pink	Positive power to the scrub functions		36.5 V
15	N/A				
16	N/A				
17	N/A				
18	Spd Pot	Orange	Speed limit pot input	Min Speed	0.43 V
				Max Speed	4.55 V



## Special Tools

### Curtis Programmer

The Curtis 1313, 1311, or 1307 generation Programmers may be used to display drive controller error codes and program the drive controller. The programmer presents complete diagnostic information in plain language without codes to decipher. Faults are displayed in the Diagnostic Menu, and the status of the controller inputs/outputs is displayed in the Test Menu.

The handheld programmer can also be used to access the drive controller's diagnostic history file. This file contains the history of cleared error codes, which may be helpful in determining the functional status of the machine between service intervals.

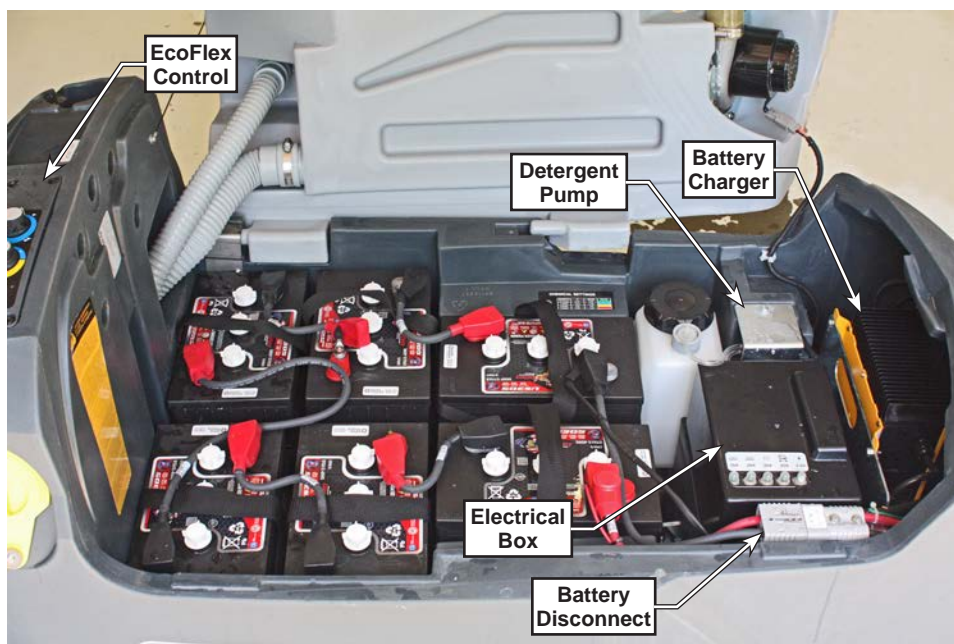
Refer to the Curtis Programmer manual for further information regarding the use and operation of the handheld programmer.



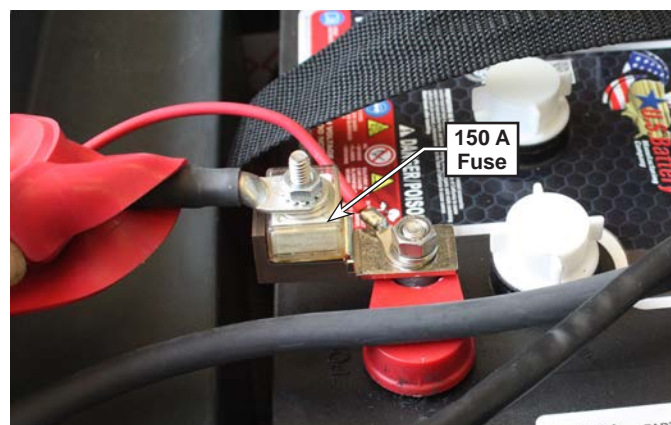


## 24 - Electrical System

### Functional Description



The SC901 machine is powered using six, 6-volt batteries connected in series, for a total system nominal voltage of 36 volts. To protect the batteries from over discharge, the system is protected with a 150 amp fuse located on the positive battery terminal.



There are 5 circuit breakers that protect the electronics. A 25A circuit breaker protects each of the two brush motors, a 20A circuit breaker protects the vacuum motor, a 30A circuit breaker protects the drive controller (and therefore the scrub system controls), and a 2.5A circuit breaker protects all logic circuits downstream from the key switch. If these circuit breakers trip, their respective button will pop up. Pressing the button back in after the overload has cleared will reset the breaker.



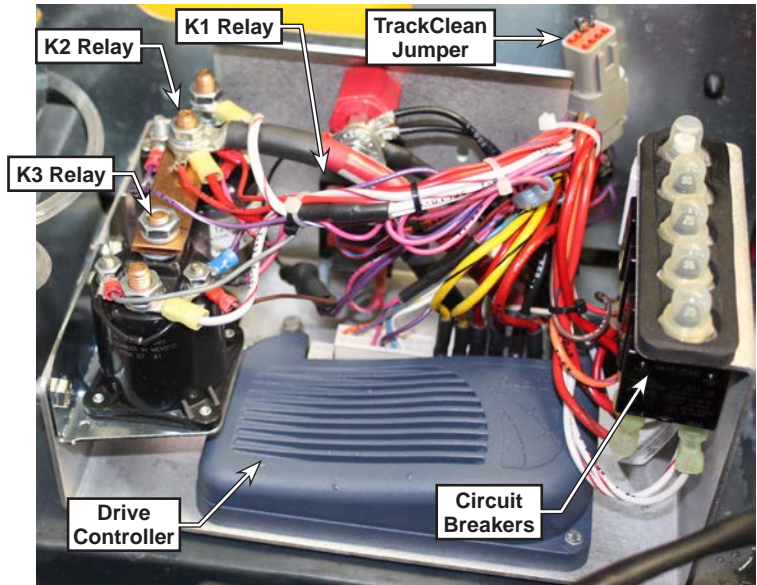
On the operator's handle is a combination battery indicator and hour meter. The hour meter increments whenever the scrub system is active. The LED bar graph on the battery indicator represents the battery charge.

The hour meter (battery indicator) also serves as a low-voltage cutout for the scrub system. When the battery voltage is above the cutout threshold, the hour meter grounds its FET (Field Effect Transistor) Drain output, which permits the K1 relay to be energized (when the key switch is on). When the battery voltage drops below this threshold, the FET opens, and the K1 relay is disabled.



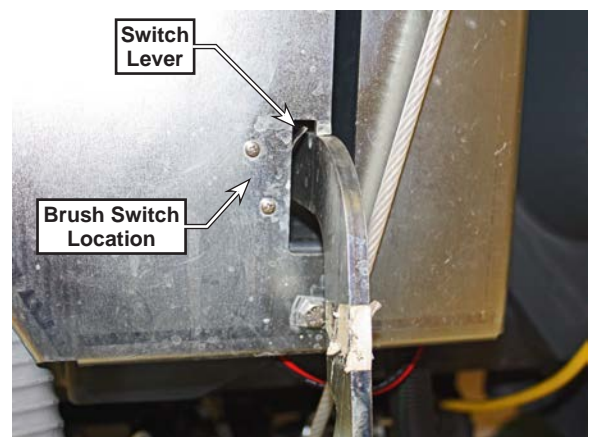
The electrical box contains the majority of the machine's electrical controls.

- The K1 relay, located on the front wall, serves as a "Scrub Enable" when the key switch is on and the battery voltage is above the cutout threshold (via the hour meter).
- The K2 relay controls the two brush motors, but first passes through the two 25 amp circuit breakers. The K2 relay is enabled only when the drive controller activates the "Brake Release" output, and is active only if the brush switch (deck lower lever) is closed.
- The K3 relay controls the vacuum motor, but first passes through the 20 amp circuit breaker. The relay is active whenever the keyswitch is on and the vacuum switch (squeegee lower handle) is closed.
- When the optional TrackClean module is not present, a jumper is installed at the TrackClean electrical connector. This jumper is required for machine operation, and is a series connection of the key switch. The purpose of the circuit is so that a TrackClean module with a SmartKey reader can disable the operation of the machine if no authorized SmartKey is present.



When the scrub deck is raised, all scrub related functions are disabled when the Brush Switch is opened. This switch is using the normally closed contacts, and the switch opens when the deck lift handle is moved to the raised and locked position.

When the optional on-board battery charger is present, the battery-side of the **key switch** is replaced with an interlock circuit from the charger. (Power to the 2.5A circuit breaker comes through the charger.) This interlock feature allows the charger to disable all control of the machine when the charger is plugged into a wall outlet and the battery is being charged. The charger doesn't disable all power to the machine; just the control power.



The charger contains a normally-closed relay. When the charger isn't plugged in to facility power, the relay is closed, and the key switch circuit is enabled. When the charger is plugged in, the relay opens, and the key switch circuit is disabled.

## Maintenance and Adjustment

### Setting Onboard Charger Battery Profile

The machine may be equipped with the optional onboard battery charger. If the charger is just being installed, or the batteries have been replaced with a different type, it will be necessary to program the charger to properly charge the batteries according to their type.

Batteries operate on chemical reactions that produce an electrical charge. Charging a battery reverses these chemical reactions so they can produce power again. Because these chemical reactions are complex, their reversal is also complex, at least from the standpoint of maintaining good health of the battery. This process is referred to as a charging algorithm. During the charging algorithm, various stages of the charging process are handled differently, depending on the chemical makeup of the battery.

Battery charging occurs in various phases, such as an initial charge, to a bulk charge, to an equalization or gassing phase. During each of these phases, the method and rate of charge is varied to optimize the reverse chemical reaction. Some may be constant-current, some constant-voltage, and some may be other methods. The Delta-Q charger is an intelligent charger that incorporates these various charging algorithms for multiple battery types.

### Charging Profiles

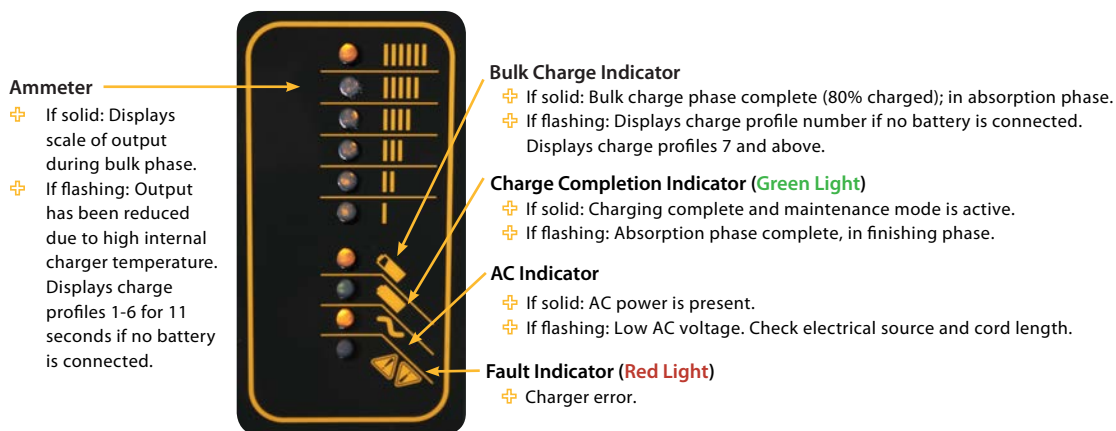
The Delta-Q charger contains many charging profiles, which are identified by number. The table to the right lists those profiles that are applicable to SC901 battery system options.

Nilfisk Part No.	Model	Charge Profile	Voltage
56206079	WET 6V 242AH	11	6
56391391	WET 6V 310AH	72	6
56112545	AGM 6V 255AH	43	6

The Delta-Q instruction manual explains how to set these profiles. There are two options for programming this information into the charger.

One option uses a laptop, QuiQ software, and a special USB interface connector kit. This method is the easiest, but it does require obtaining the QuiQ Program Kit (Pn 56315732). The QuiQ Program kit will contain instructions for use.

The second option, although more complex, doesn't require any special tools. It communicates to the charger by disconnecting the battery terminal and "tapping" the terminal back to the battery to signify which numerical algorithm code to use. These instructions are included with the charger.





## Troubleshooting

### General Electrical Troubleshooting

Diagnosing machine failures commonly involves testing electrical components and tracing electrical circuits as they pass throughout the machine. This section is intended to provide you with the general information necessary to identify an electrical circuit from a schematic, and physically trace it and test it within the machine itself, as well as common steps necessary to test the electrical components making up that circuit.

#### [“Electrical Circuit Diagram” on page 48:](#)

The main wiring diagram, generally referred to as the “Ladder Diagram” to distinguish it from other forms of wiring diagrams, provides the electrical functions of the circuits, modules, and components, but does not necessarily represent the physical locations of those components. This describes the raw interaction between components to achieve their functions.

The Ladder Diagram serves as the main launching point for all other electrical information, in that it also contains device labels, connector identifiers, and even wire colors. This information is described in [“Understanding the Features of the Main Wiring Diagram”](#) on page 37.

#### [“Wiring Diagram” on page 49:](#)

The main purpose of the wiring harness diagram is to trace the physical connections for each discrete wire in the system. Every wire in the machine’s harness is given a unique wire-number identifier. The significance of this is that even though the schematic shows a continuous circuit from one electrical connector to another, that circuit may be made up from one or more individual wire segments spliced together. Each of those segments has its own unique number, and those numbers are even printed directly on the physical wires.

#### [“Connector Pinouts” on page 50:](#)

The Harness Diagram identifies connector numbers throughout the system. J-connectors are those that are physically connected to a device or module, such as the Main Machine Controller. X-connectors are those that are in-line connectors between harnesses or other groups of wires, including extension wires that may be integral to a particular component. Some, but not all X-connectors are shown in the schematic, but all X-connectors are shown in the wiring harness diagram.

These tables are used to identify which wires pass through each connector, and at what location within that connector. Each table is accompanied by a graphic to identify the pin numbers. The table then correlates each of those pin numbers with the wire number, wire color, and functional description of the wire. 3D views of the connectors are shown, so that you can be certain which side of the connector you are looking at when identifying which pin is pin-#1.

This information is used for [Back-Probing Connector Voltages](#) described on page 40, and [Testing Cables](#) described on page 41

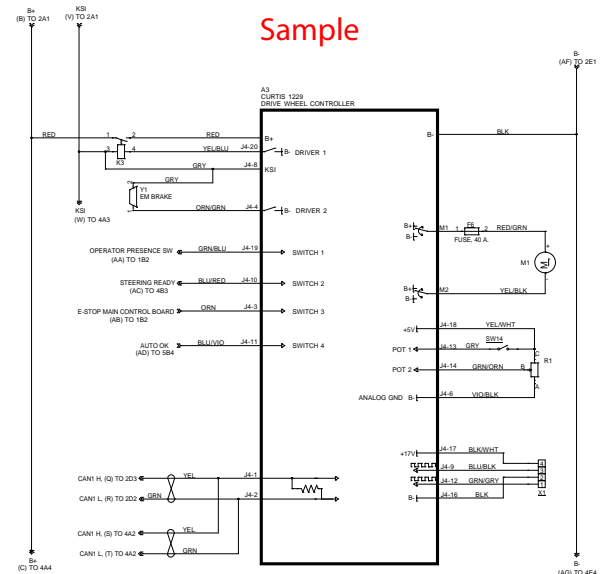
## Understanding the Features of the Main Wiring Diagram

The main wiring diagram is sometimes referred to as a ladder diagram because it is historically rooted in a type of schematic that resembled the rungs of a ladder. Over time it has evolved into a hybrid ladder diagram, specifically to accommodate the presence of intelligent control modules that drive the system components. (Such as a main controller and power module, for example.) Even as a hybrid diagram, it still maintains some of the features of a true ladder diagram.

Positive voltage source(s) are represented by vertical “Rails” on the left side of the diagram, and the negative voltages source (typically only 1, being battery negative) is represented by a vertical Rail on the right side of the diagram. Devices are drawn between the two rails, and current flows from the positive rail, through the load, and to the negative rail.

Unique to the hybrid ladder diagram are the intelligent controllers that control if and when devices are connected to either positive or negative power. Even though not technically accurate, circuit symbols have been drawn inside the controller outlines to represent the electrical function that takes place inside. These represent the function, but not an actual device. For example, even though a symbol may look like a switch, it cannot be tested as though it was a real switch.

Some of the common controller internal symbols are described below:



	<b>Output, Switch to positive or negative power.</b> The controller serves to complete the circuit to the respective power source, most commonly battery negative.
	<b>Output, Bi-directional switch to power</b> These outputs are always in pairs, and are for reversible loads. <ul style="list-style-type: none"> <li>• For forward direction, one output is positive and the other is negative.</li> <li>• For reverse direction, one output is negative and the other is positive.</li> <li>• For no movement, both outputs are the same, which may be positive, negative, or zero, depending on the controller.</li> </ul>
	<b>Pulse Width Modulation (PWM) Switch</b> This is an electronic (transistor) switch that completes the circuit to either battery positive or battery negative power. The duty cycle between on and off states determines how much power the load receives.
	<b>Digital Data Out</b> This symbol indicates that the output is a digital stream of data pulses.
	<b>Digital Data In, with Pullup</b> This symbol represents a digital data stream input signal that is active-low, and the pullup resistor represents the open-circuit (inactive) signal voltage.
	<b>Discrete Input with Pullup</b> This symbol represents a binary (On/Off) input with a 5-volt pullup resistor. When the switch or sensor is off (open circuit) the pullup resistor makes the input equal 5 volts. When the switch or sensor is closed, the input typically goes to 0 volts.

## Device Labeling

All of the components within the diagram carry various labels intended to assist in identifying those items in the actual machine, or to reference them to other drawings.

### Device Numbers (Names):

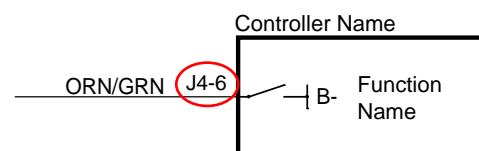
Each device is given its own unique identifier. The letter prefix identifies the type of device, such as “K” for a relay, “L” for a solenoid, “M” for motor, and “A” for a control module; just to name a few. Then each device within that class is given a unique number. For example, “K1” may be the main KSI relay. However, because this particular relay serves a common function, it is also identified by a simple name too: “KSI” (Legacy for Key Switch Input).

Device numbers and device names (when they exist) are synonymous, but device names are preferred because they are easier to remember, so long as they are unique and descriptive.

### Connector Contact Numbers:

All of the circuit lines going to any of the control modules will have indicators for their wire color and the connector pin-out location. When 2 colors are listed for a wire color, the first color is the main color and the second color is the color of a stripe on the wire.

For the connector identifier example shown (J4-6), the first part “J4” represents the connector number, and the last part “6” represents the pin number within that connector. This information, along with the [“Connector Pinouts”](#) on page 50 is used to locate the physical wires on the machine.

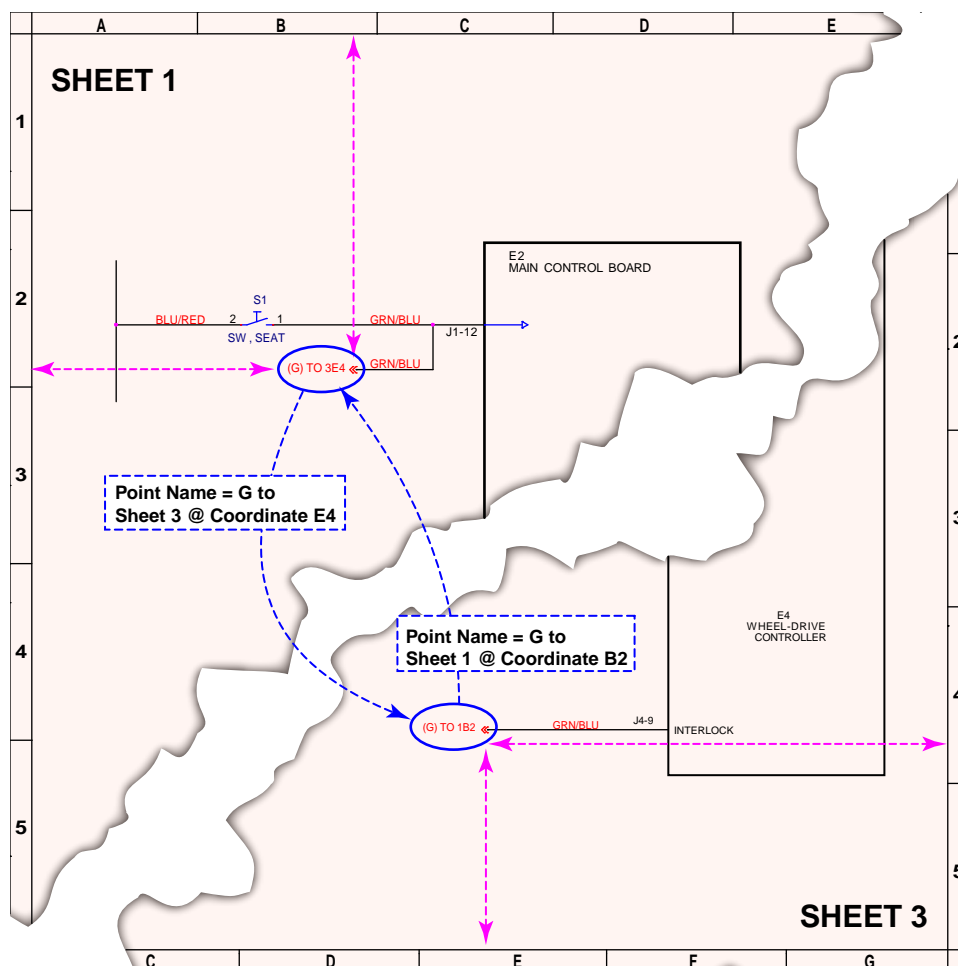


## Navigation

In some cases it is necessary to have references across different areas of a drawing. These references can point across the drawing sheet, or to different sheets in a multi-sheet schematic. The references are commonly referred to as “Tags”. At a minimum, tags typically have a name or designation, but they may also contain coordinate pointers to their counterpart.

In the sample diagram to the right, the output from the seat switch needs to connect to the main controller on sheet #1 and also to the drive controller on sheet #3. The identifying name could be an actual name, such as (Seat Switch), or in this case, just a letter designator (G). Both ends of a tag will have the same identifier.

In addition to the identifier, the tag also contains



coordinate information to help you locate the mating tag faster. So the first tag contains the coordinates of the second tag, and the second tag contains the coordinates of the first tag. The format of these coordinates are Sheet, Column, and Row.

These coordinates are part of the default title blocks on engineering drawings, and run around the perimeter of the drawing sheet. The columns are represented by the letters across the top/bottom of the drawing, and the rows are represented by the numbers down the sides of the drawing.

## Using the Wiring Harness Diagram

The wiring harness diagram contains detailed information about the physical wiring within the machine. Every wire segment is listed. Every connector is listed. Even the hidden splice points between wires are listed. This information is useful for tracing a specific circuit as it passes through the machine.

### Wire Numbers

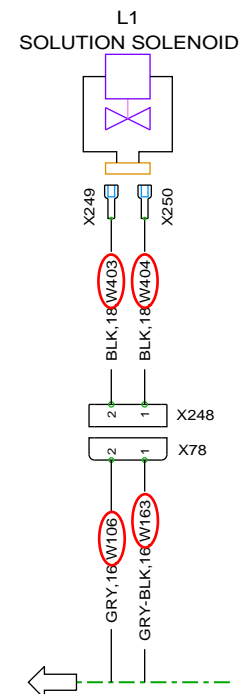
Every wire is labeled with 3 items: Wire color, Wire Gauge, and Wire Number. The wire number in the diagram is also printed on the actual wire used in the machine itself. The wire number can be used to locate both ends of any wire segment in the machine.

Even though an individual electrical circuit may pass from one electrical connector to another connector, that circuit may be made up from multiple wire segments. Each of those segments is identified in this diagram. The circuit may pass through a splice point or an intermediate connector (such as shown to the right), but each wire has only 2 connection points.

To trace a complete circuit, you would need to search for both ends of any wire number, and see where they connect to the next wire segment. And then repeat this for each wire segment in the circuit.



**Service Tip:** We use the Ladder Diagram to trace a circuit, but use the harness diagram to trace the wires that make up that circuit.

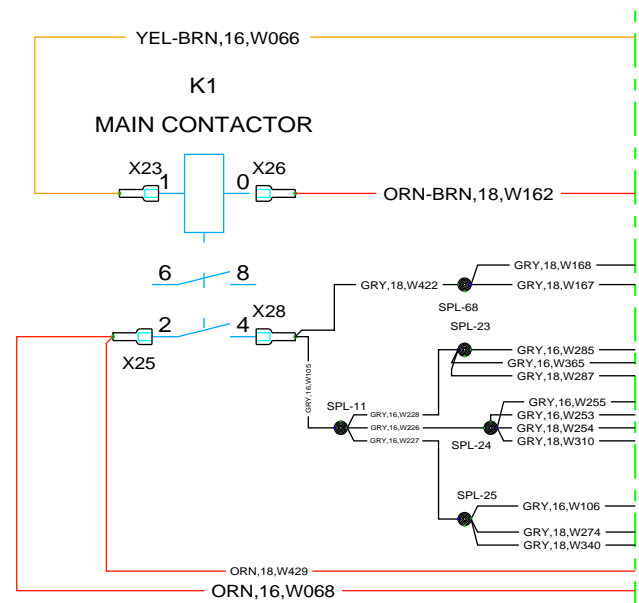


### Splice Points

Another valuable piece of information in the harness diagram is whether splice points exist in a circuit. Splice points are used when a circuit needs to divide and travel on to multiple destinations. Each splice point also has its own unique identifier (SPL) number. Power distribution leaving the K1 (KSI) contactor is prime example of using multiple splice points to distribute this common circuit to multiple locations.

This knowledge can be helpful in troubleshooting. If multiple components fail, and it is discovered that they all share a common splice point, it can be concluded that a wire failure occurred at or upstream from that splice point.

Conversely, if only one component has failed, then it can be concluded that a wire failure has not occurred in an upstream wire segment.



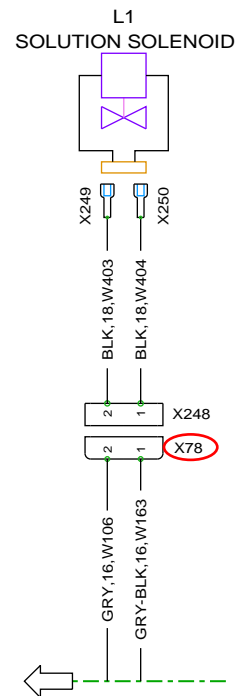
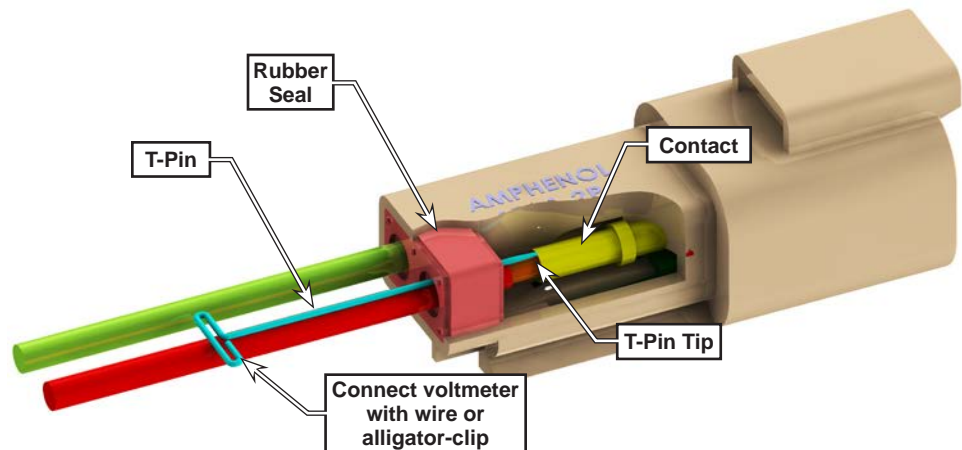
## Connector Numbers

Every harness connector throughout the system is given a unique connector ID number. The ID numbers can be used to locate the connector in the machine and to look up pin assignments in the [“Connector Pinouts”](#) on page 50. This information is used for tracing circuits and electrical signals throughout the machine. When there are mating connectors to a device, the harness-side connector is shown for pin-out assignment.

## Back-Probing Connector Voltages

An invaluable tool for diagnosing system performance is to be able to monitor system voltages while the system is active. This requires measuring voltages without disconnecting the devices to be measured. The best location for accessing a circuit is from the back side of an electrical connector. However, many of the connectors used in the machine are moisture resistant, and have seals where the insulated wire enters the connector body.

It is important that the seal not be damaged, as the connector may then corrode over time. Standard voltmeter probes are too large to slip past the seal without damaging it. The best alternative is to take a T-type push pin, blunt the sharp tip slightly so it doesn't cut the seal, and insert the pin along the wire until it reaches the metal contact inside the connector housing. A permanent probe could be fabricated by soldering a wire lead to the end of the pin, or you can connect your voltmeter probe with an alligator-clip.





## Testing Cables

Secondary to testing active voltages, inspecting cables for open-circuit or short-circuit is one of the most valuable troubleshooting techniques available to the technician. Testing for open circuit is pretty straight forward--if you don't have continuity from one end of a circuit to the other, the circuit is open.

Short-circuit detection can be more complex, because it requires testing all adjacent conductors for undesirable continuity. Compounding the problem is that the testing is conclusive only if a short-circuit is detected, but it cannot prove that a short-circuit does not exist. That's because not every wire in a harness bundle necessarily terminates at the same electrical connector being tested.

### Open Circuit Testing

Testing for an open circuit requires disconnecting the wiring harness at both connectors that the circuit in question passes through. Ohmmeter probes are placed on the two appropriate contacts, and continuity (at or near 0 ohms) is tested for.



**Service Tip:** *If the two connectors are too far apart for ohmmeter test leads to be connected, you can install a shorting jumper on the contacts at one connector. This creates a return path back to the first connector, where you can place both ohmmeter probes. The shorting jumper is typically placed between the ground circuit and the circuit in question, but any known "good" circuit can be used as the return path.*



### Short Circuit Testing

Testing for short circuits also requires disconnecting both connectors of the harness, but the reason is to ensure that the device (controller, sensor, motor, etc.) is not causing a false positive reading on the ohmmeter. Continuity is tested for between the connector contact in question, and all other contacts in the connector. If the circuit in question is passing between control modules, then the testing should be repeated at both connectors.

## Diagnostic Scenarios

The SC901 machine architecture is based on a hybrid of “Relay Logic” with limited control logic from the Curtis Drive Controller. This causes a lot of the system troubleshooting to be interrelated between the standard relay-logic components and the drive system controller. Most of the troubleshooting scenarios will be listed here, unless they are specific solely to the drive controller.

Problem	Cause	Notes & Correction
No system function. <ul style="list-style-type: none"> <li>• No Drive</li> <li>• No Brush</li> <li>• No Vac</li> <li>• No Hour Meter LED</li> </ul>	Main 150A fuse is blown	This is almost the equivalent of disconnecting the main battery connector, except that the optional onboard battery charger would also show as not being connected. <ul style="list-style-type: none"> <li>• If the optional charger indicates that the battery is present, then this is not the cause.</li> <li>• Replace the 150A fuse module on the positive battery terminal.</li> </ul>
	KSI circuit is disabled	The KSI circuit is the equivalent of not turning the key switch on, but can have a couple of different causes. The most notable symptom is that the hour meter indicators will not illuminate, nor will the vacuum run. <ul style="list-style-type: none"> <li>• <b>If the vacuum motor runs, then this is not the problem.</b></li> <li>• Reset the 2.5A circuit breaker</li> <li>• If the onboard charger is present, make sure the interlock wire is connected to the 2.5A breaker.</li> <li>• If the onboard charger is not present, make sure the red battery wire is connected to the 2.5A breaker.</li> <li>• If the optional TrackClean module is not installed, make sure the shunt connector is in place.</li> <li>• Check for 36 Volts at pin-5 of the Curtis controller. If not present, work back upstream to locate the break.</li> </ul>
Limited System Function <ul style="list-style-type: none"> <li>• No Drive</li> <li>• No Scrub</li> <li>• But Vacuum Runs</li> </ul>	Drive Controller Fault	Because the vacuum runs, this is most likely related to a drive controller fault. There can be many causes to a drive controller fault. Refer to the Drive Controller <a href="#">“Troubleshooting”</a> on page 17. Two exceptions that would not be error code drive: <ul style="list-style-type: none"> <li>• A break in the KSI input directly at the drive controller</li> <li>• Open circuit for the Go switches</li> </ul>
No Drive, but all other systems functional <ul style="list-style-type: none"> <li>• No Drive</li> <li>• Brush active</li> <li>• Vacuum active</li> </ul>	Drive motor or throttle fault.	This condition indicates that the drive controller has activated the brake release, but is not driving the transaxle without a drive controller fault. <ul style="list-style-type: none"> <li>• One likely cause is a broken speed limit pot wiper wire connection. The drive is active, but at zero speed.</li> <li>• Another possible cause is a break in the motor wiring, or worn motor brushes.</li> </ul>
No Scrub system, but drive and vacuum operational. <ul style="list-style-type: none"> <li>• No Brush</li> <li>• No Solution</li> <li>• No Detergent</li> <li>• Drive active</li> <li>• Vacuum active</li> </ul>	K1 circuit fault	The K1 circuit controls all of the scrub functions, and is related to the low-voltage cutout feature, which is controlled by the hour meter. <ul style="list-style-type: none"> <li>• Check the K1 relay:               <ul style="list-style-type: none"> <li>– If the relay is open, either the relay is faulty, or the hour meter is faulty.</li> <li>– If the relay is closed, then the brush switch is faulty.</li> </ul> </li> </ul>
	Hour Meter Failure	If the hour meter does not provide “ground” to the K1 relay, it will disable all scrub functions as though the battery voltage is too low for operation

Problem	Cause	Notes & Correction
No Solution, but brush motors run	Solution circuit or optional module	<p>The solution solenoid and optional detergent pump are enabled only when the brush is active.</p> <ul style="list-style-type: none"> <li>• For all models, make sure that the solution shutoff valve is not closed.</li> <li>• For non-EcoFlex models, make sure the shunt jumper below the solution lever is in place. If so, then check the solenoid.</li> <li>• For EcoFlex models, if both solution and detergent solenoids are non-functional, the module is likely faulty.</li> </ul>
No Brush function, but solution flows	Brush circuit failure	<p>Because solution is flowing, you can eliminate the K1 and S4 circuits as a cause.</p> <ul style="list-style-type: none"> <li>• If both brush motors are off, then the most likely cause is the K2 power relay.</li> <li>• If only one motor has failed, first check its circuit breaker, and then check the motor and wiring. Swap the two motor connectors to isolate whether the fault is before or after the connector.</li> </ul>
No vacuum, but all other systems function	Vacuum circuit	<p>If any other systems are running, then you know the KSI circuit is functional. This leaves solely the vacuum circuit itself as the cause.</p> <ul style="list-style-type: none"> <li>• Check the float switch (if present) in the recovery tank.</li> <li>• Check the vacuum switch at the squeegee lever</li> <li>• Check the vacuum relay (K3)</li> <li>• Check the vacuum breaker (CB4)</li> <li>• Check the motor</li> </ul>

## Battery Testing

A battery problem is usually recognized by the machine operator as a decrease in the machine's running time. This condition is usually caused by one or more "dead cells" in the battery system.

There are 2 ways to find a dead cell:

- Use a hydrometer to check the specific gravity (or "state of charge") of the fluid in each cell. A dead cell is one that reads 50 points (or more) lower than the other cells. A normal reading should be between 1275 to 1300, with a minimum of 1225.
- Use a volt meter to check the voltage of each battery. Look for a battery with a voltage that is 1 or 2 volts less than the other batteries. Check under the following conditions:
  - With the batteries fully charged,
  - With the scrub and drive motors running,
  - With the batteries discharged, but still above the voltage cutoff threshold.

If the batteries in the machine are more than 1 year old, it's usually best to replace the whole set, rather than replacing just one battery.

## Removal and Installation

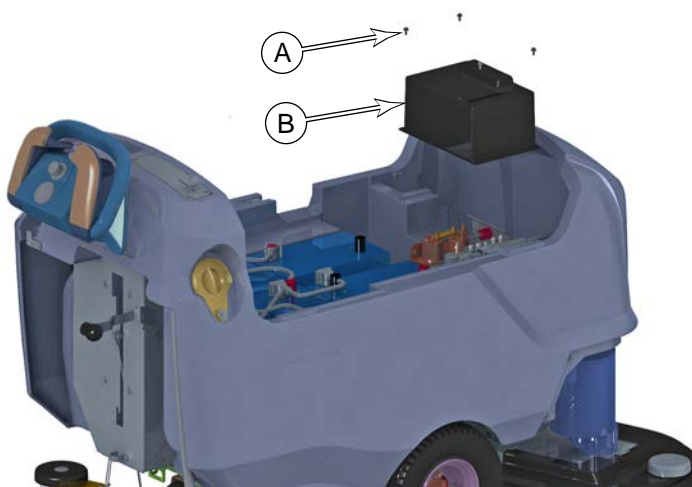
### Electrical Bay Cover



**CAUTION:** Risk of Arc flash. The electrical bay contains exposed high-amperage electrical components. Take care to not allow tools to come in contact with exposed components.

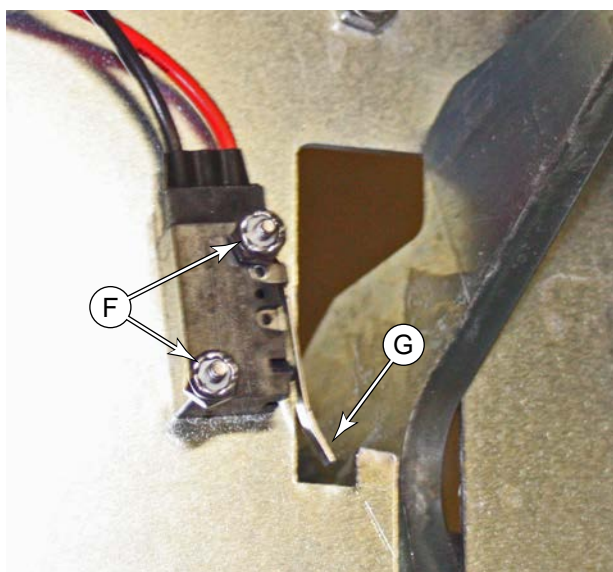
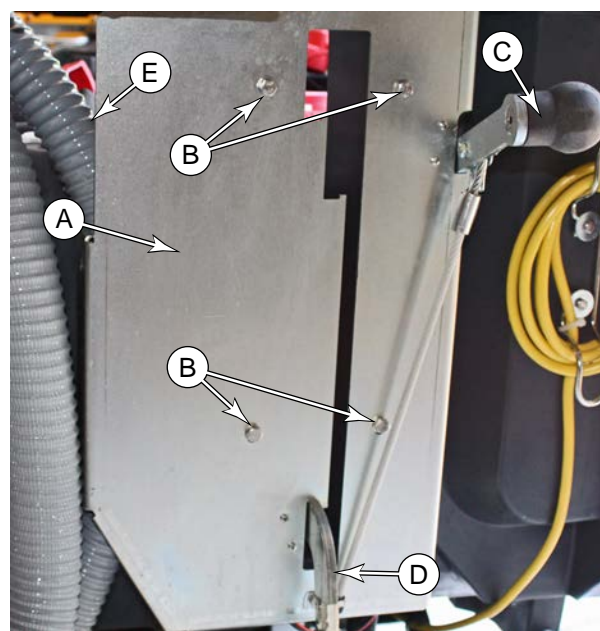
The electrical bay contains the majority of the machine's electrical components. The cover protects the components from debris and incidental contact.

To remove the cover, use an 8mm socket with a long extension remove the 4 screws that secure it to the body of the solution tank.



### Squeegee and Brush Switches

1. With the deck fully raised, place blocking under the scrub brushes to prevent the deck from lowering.
2. Move the deck lift lever (D) out of the raised position, and allow the blocking to support the deck.
3. Lower the squeegee (C).
4. Using a 10mm socket, remove the 4 screws (B) that secure the lift plate (A) to the solution tank. Tilt the lift plate downward to expose the switches.
5. Remove the two screws and nuts (F), and remove the switch.
6. When replacing the switch, make sure the switch lever (G) is properly positioned.





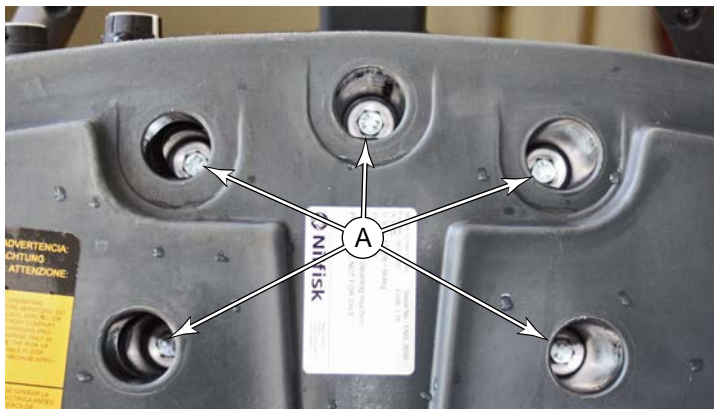
## Drive Handle

### Drive Handle Cover

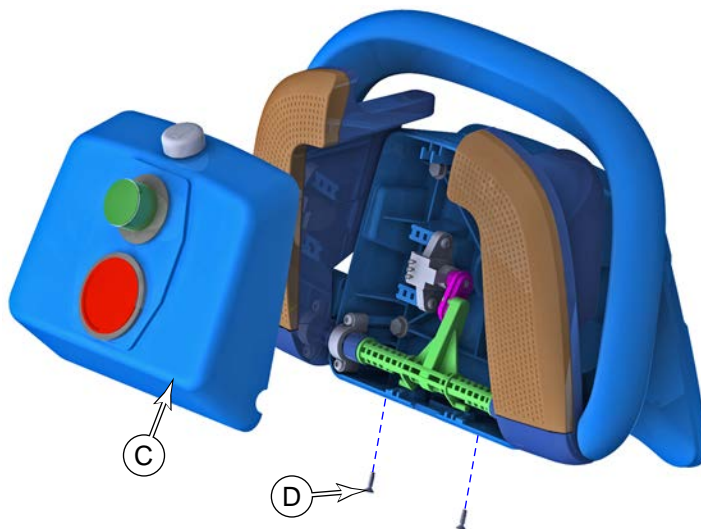
Removing the drive handle and/or the cover is a prerequisite to other procedures for servicing the hour meter, key switch, and drive potentiometers. Removing the drive handle is necessary to access the electrical connector **(B)** for the handle, but may not be necessary for servicing individual components within the handle.

If you do not need to disconnect the harness connector **(B)**, you may skip to step 3.

1. Using a 14mm socket and extension, unscrew the 5 screws **(A)** that secure the drive handle to the machine.
  - Make sure to support the handle as you loosen the last screw.
  - It is best to leave the screws and washers in place, versus removing them. This reduces the likelihood of dropping any of them in the cavity below the solution control.
2. Move the handle away, and disconnect the harness connector **(B)**.



3. Remove the 2 screws **(D)** that secure the bottom of the handle cover **(C)**.
4. Pull the bottom of the handle cover away from the handle, and then lift the top of the handle cover off the retaining tabs.
5. Disconnect any additional electrical connectors as applicable to the procedure you are completing.

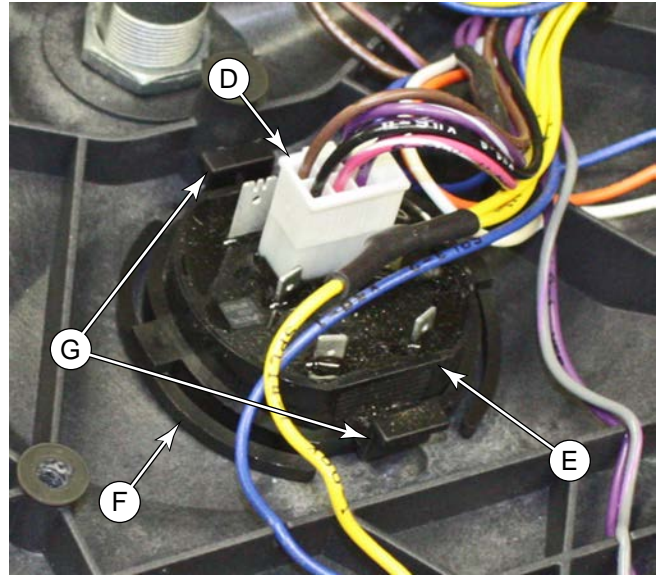


## Hour Meter

When replacing the hour meter, if possible, record the previous hours for maintenance tracking. The hour meter can neither be reset nor changed, but the previous hour meter value should be recorded in an equipment log.

1. Disconnect the wiring plug **(D)** from the hour meter.
2. Press outward on the latch tabs **(G)** while pressing downward on the main body of the hour meter **(E)**.

The hour meter is held in place with a ratcheting retaining ring. Make sure to firmly press the two together when reinstalling the meter.



After you have completed the reassembly (continued below), verify the function of the hour meter with the following observations:

- Key on → Battery LEDs on, hourglass steady.
- Scrub on → Battery LEDs on, hourglass blinking.
- Scrub off → Battery LEDs on, hourglass steady.
- Key off → Battery LEDs off, hourglass steady.

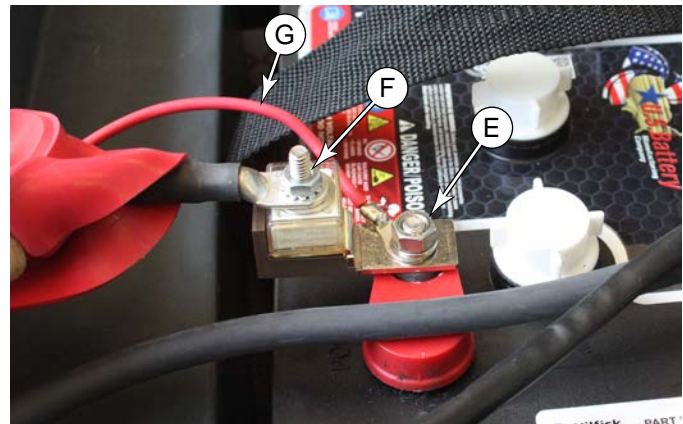
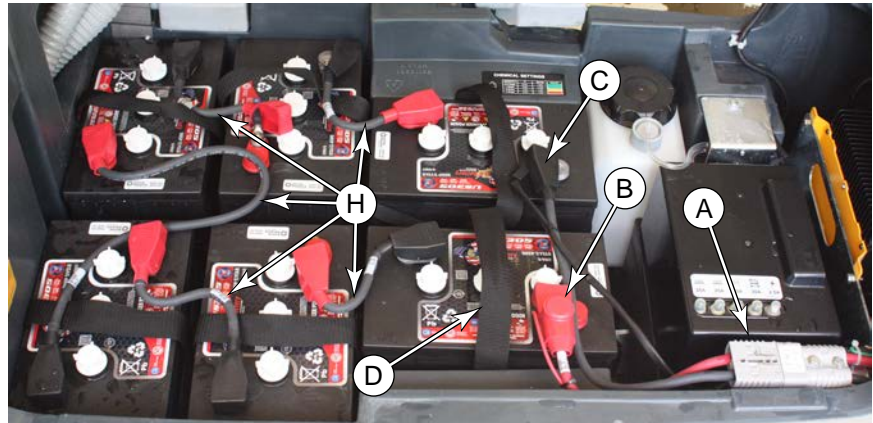
## Batteries



**CAUTION:** Use extreme caution when working with batteries. Sulfuric acid in batteries can cause severe injury if allowed to contact the skin or eyes.

- Explosive hydrogen gas is vented from the batteries through openings in the battery caps. Do not smoke while servicing the batteries.
- Remove all jewelry. Wear safety glasses, rubber gloves and a rubber apron
- Do not allow tools to touch more than one battery terminal at a time
- Electrical components in this machine can be severely damaged if the batteries are not installed and connected properly.
- The batteries are extremely heavy and may require a lifting device or assistance to remove and replace into the machine.

1. Turn the off the machine and disconnect the main battery connector (A).
2. Pull back the insulating boot (B) and disconnect the main battery connector's positive terminal at (E). Do not disconnect at lug (F) because that secures the 150 amp fuse.
3. In a similar manner, remove the main battery connector's negative terminal (C). However, there is no fuse at the negative terminal.
4. Taking care to not short across the battery terminals, remove each of the interconnecting cables (H) from the batteries.
5. Make sure the battery straps (D) are not damaged or cut, and then lift out each of the batteries from the battery bay.
6. Install the new batteries into the compartment. Note the orientation of the batteries shown above.
7. Reconnect the battery cables.
  - All cables are connected positive-to-negative for a series connection between all 6 batteries.
  - Position the cables so the battery caps can be easily removed for battery service.
  - Take care to not over torque the cable connector, as this may damage the battery post.
8. Coat the terminals with spray-on battery terminal coating (available at most auto parts stores).

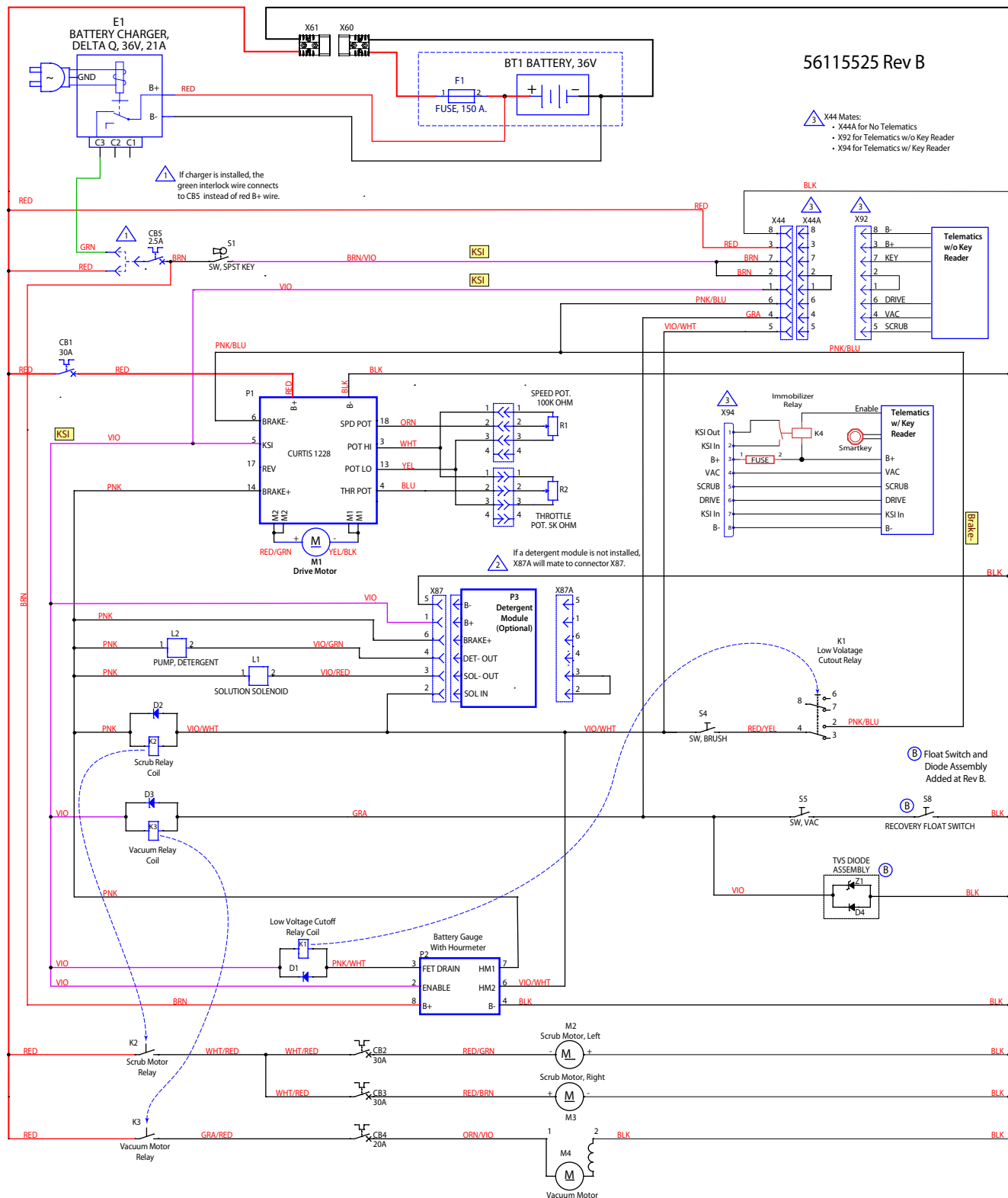




## Wiring Diagrams

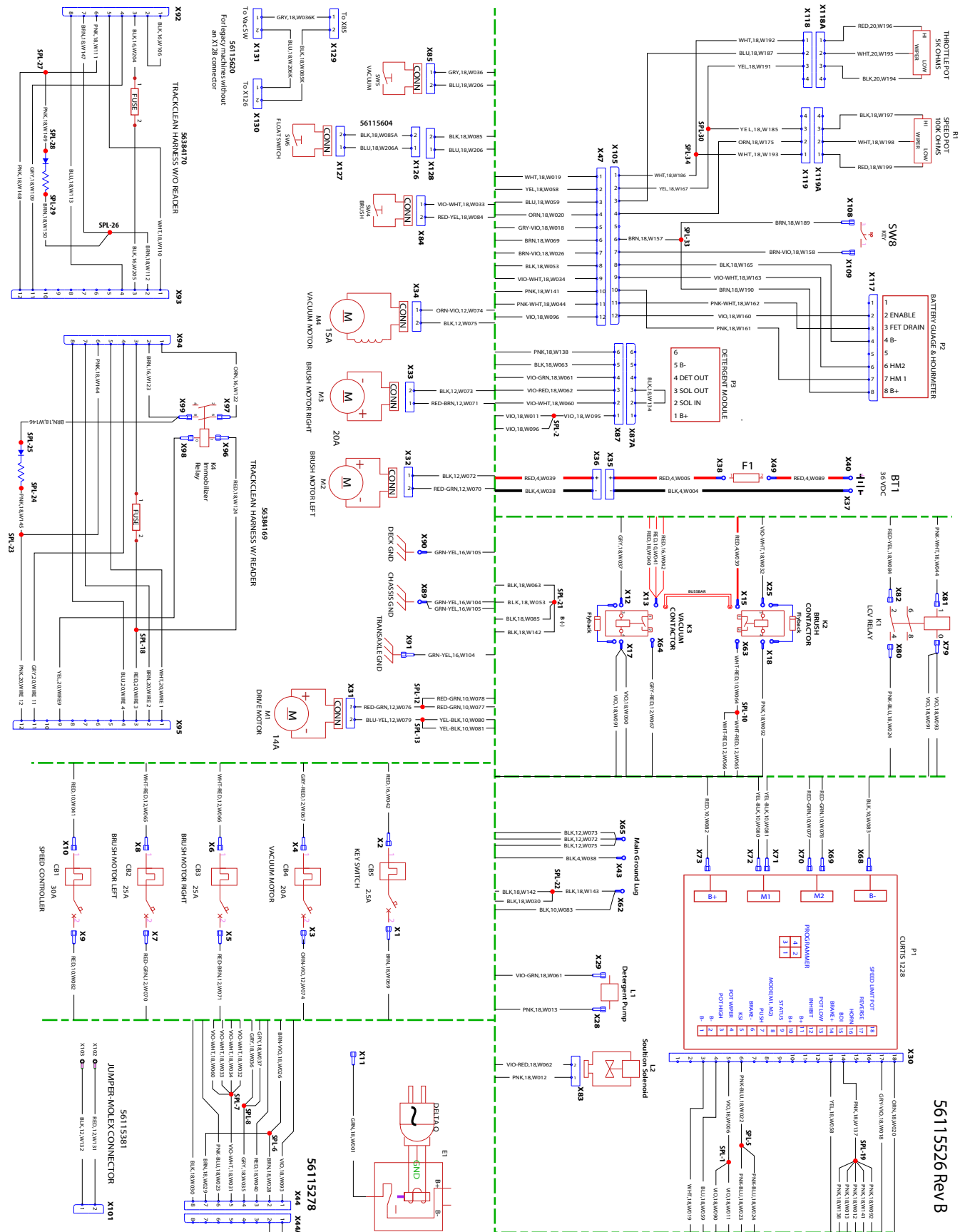
## Electrical Circuit Diagram

**56115525\_REV\_B**




## Wiring Diagram

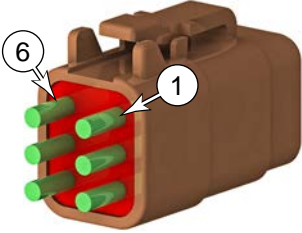
**56115526\_REV\_B**

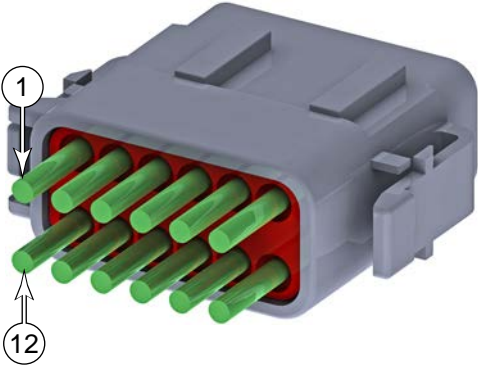


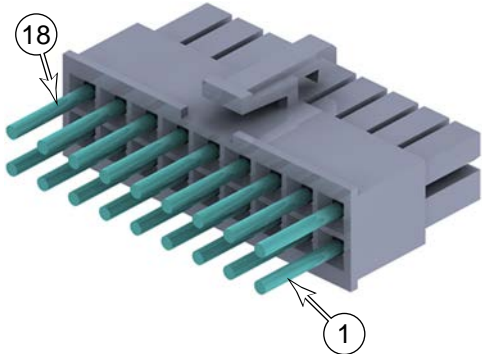
## Specifications

### Connector Pinouts

TrackClean Connector			
Pin #	Name	Wire Color, ID	
1	Interlock	VIO, W093	
2	Interlock	BRN/VIO, W026	
3	Batt+	RED, W040	
4	Vacuum	GRAY, W035	
5	Scrub	VIO/WHT, W031	
6	Drive	PINK/BLUE, W023	
7	Key Switch	BRN/VIO, W026	
8	Batt-	BLACK, W030	

EcoFlex Connector			
Pin #	Name	Wire Color, ID	
1	Batt+	VIO, W095	
2	Solution In	VIO/WHT, W060	
3	Solution Out	VIO/RED, W062	
4	Detergent Out	VIO/GRN, W061	
5	Batt-	BLK, W063	
6	Brake+	PINK, W138	

Operator's Handle Connector			
Pin #	Name	Wire Color, ID	
1	Pot High	WHT, W019	
2	Go In	YEL, W058	
3	Go Out/ Pot Low	BLU, W059	
4	Speed Limit	ORN, W020	
5	Reverse Out	GRY-VIO, W018	
6	Key Switch In	BRN, W069	
7	Key Switch Out	BRN-VIO, W026	
8	Batt-	BLK, W053	
9	Hour Meter Run-	VIO-WHT, W034	
10	Hour Meter Run+	PNK, W141	
11	Low Voltage Drain	PNK-WHT, W044	
12	Hour Meter Enable	VIO, W096	

Drive Controller Connector			
Pin #	Name	Wire Color, ID	
1			
2			
3	Pot High	WHT, W019	
4	Throttle Pot	BLU, W059	
5	KSI	VIO, W011	
6	Brake-	PNK-BLU, W023	
7			
8			
9			
10			
11			
12			
13	Pot Low	YEL, W058	
14	Brake+	PNK, W137	
15			
16			
17	Reverse	GRY-VIO, W018	
18	Speed Pot	ORN, W020	

## 30 - Solution System

### Functional Description

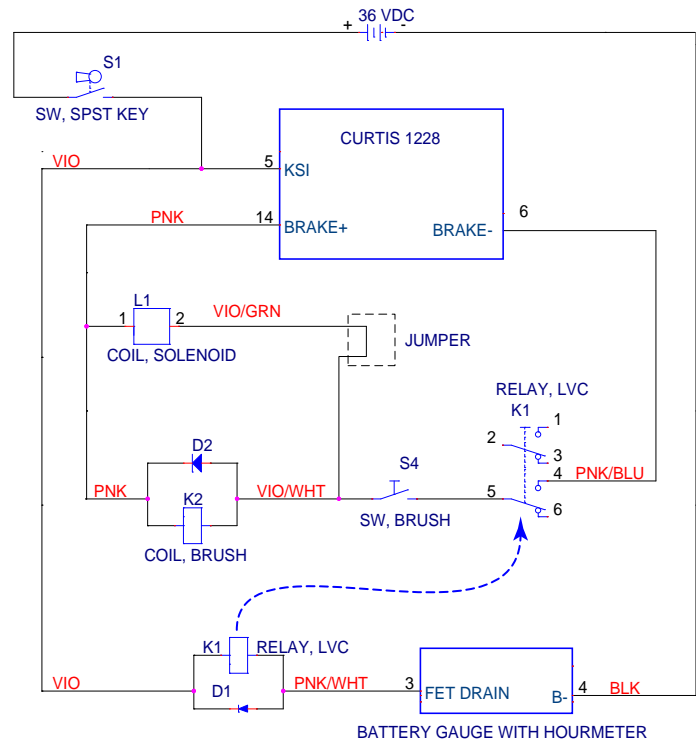
The SC901 machine has a 29.5-gallon (112 liter) solution tank incorporated into the main body of the machine. A clear tube on the right side of the machine below the fill cap serves as a water level indicator for the tank. At the outlet of the solution tank, under the machine, is a manual shutoff valve followed by a serviceable solution filter that prevents debris from entering the rest of the solution system.

### Non-Detergent Models

All machines use gravity feed and a solution solenoid to provide solution to the scrub deck. For non-detergent machines, the flow rate of solution is controlled mechanically with a cable connected between the solution lever, down to the solution shutoff valve. The solution solenoid is either all-on or all-off, and is controlled by the same circuit that activates the brush motors. A circuit jumper replaces the connector where the optional EcoFlex control board connects in the solution panel.

For the solution circuit to be active, the machine must be in motion, and the scrub brushes be active. When the machine is in motion, the Curtis drive controller makes the Brake- output equal to battery negative. This passes through the K1 relay, through the brush switch (foot lever), through the jumper (non-EcoFlex), and energizes the solution solenoid.

The solution solenoid receives 36-volt, non-PWM (Pulse Width Modulated) power, to be either all-on or all-off.



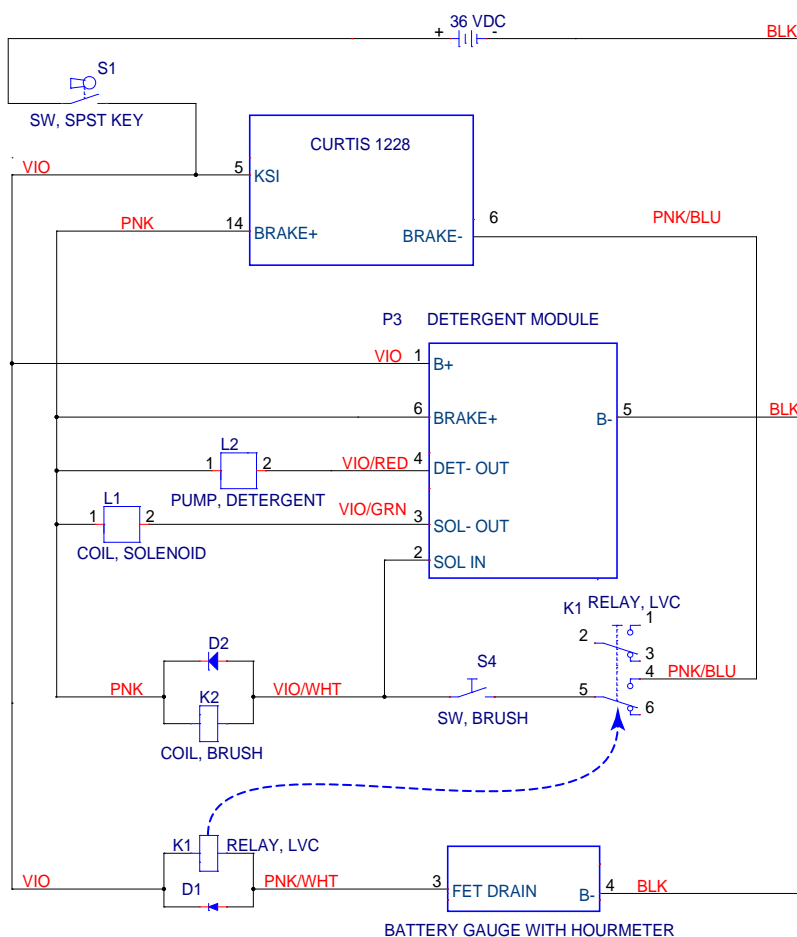
## Detergent Models

Machines that have on-board detergent mixing (EcoFlex Models) have a solution control circuit board, detergent pump, and detergent bottle. From an enabling standpoint, the detergent module (circuit board) has the same prerequisite control that a non-detergent solution solenoid has. The machine must be in motion, and the scrub brushes be active.

However, instead of battery negative passing straight to the solution solenoid, it passes into the detergent control board. This signal serves as an “Enable” function for the detergent and solution outputs.

Within the detergent module control board is a micro controller that generates PWM outputs for both the detergent pump and the solution solenoid. This is a battery-negative PWM, and applies negative voltage to the coils.

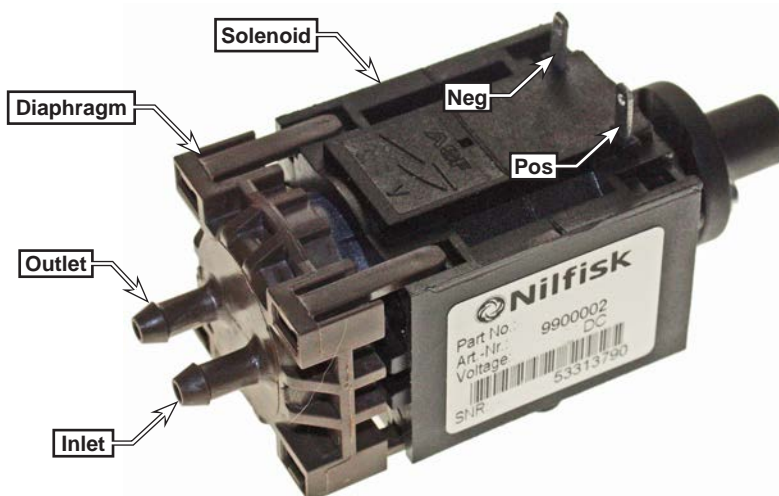
The two duty cycles of the PWM outputs are controlled by onboard potentiometers. The Burst of Power switch will temporarily increase both detergent and solution flow rates for 60 seconds.



## Detergent Pump

The detergent pump is a solenoid-driven diaphragm with one-way check valves. As the solenoid oscillates in and out, it drives a flexible diaphragm that draws fluid in during the retraction stroke, and drives fluid out during the compression stroke. The check valves allow fluid to enter only through the inlet port, and exit only through the outlet port.

Unlike an AC solenoid that moves its plunger the same direction regardless of the electrical polarity, a DC solenoid changes its direction of travel depending on the electrical polarity of the coil. This is an important distinction because if the pump is connected with the wrong polarity, it will not pump liquid.



The solenoid plunger is actively driven in only one direction (intake), but passively returned via the return spring (exhaust). If the wiring polarity is reversed, the solenoid plunger will be driven in the same direction that the return spring has already pushed the plunger. So the plunger will never move.

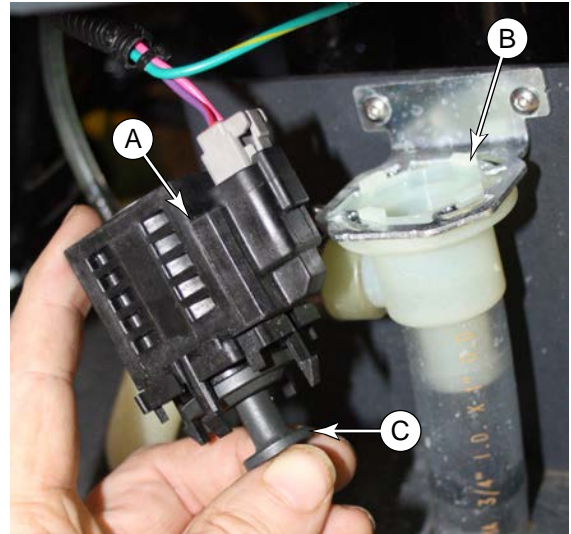


## Troubleshooting

### Scrub System, General

One of the first things about troubleshooting any part of the scrub system, is to make the scrub system active, so you can make observations. It is possible to active the scrub system without the machine moving, and without the brushes contacting the floor.

1. To avoid getting water on the floor, you may wish to close the solution shutoff valve. If the machine is equipped with EcoFlex, remove the suction hose from the detergent bottle.
2. If you need to inspect the solution solenoid, rotate the top of the solenoid counterclockwise about 1/8-turn, and lift the solenoid body (A) out of the valve body (B). Take care to not lose the plunger (C), spring, or sealing washer.
3. Set the speed limit dial to zero speed.

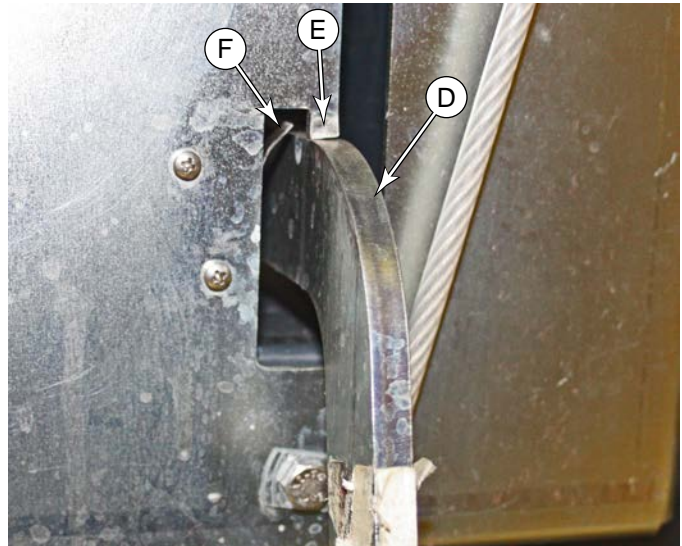


4. Carefully position the scrub deck lever (D) out of its retracted slot, but resting on the adjacent tab (E). This should permit the switch (F) to close without lowering the scrub deck.



**CAUTION:** Always be prepared for the scrub deck to unexpectedly drop. Keep hands and feet away from the scrub deck when it is raised in this manner.

5. If the machine is equipped with the EcoFlex system, set both detergent and solution flow rates to maximum.
6. Turn the key switch to the on position.
7. Press one of the Go switches to confirm that the machine won't move. If the machine doesn't move, you can tape the switch down or have an assistant hold it for you.



**CAUTION:** Make sure the Go switch can be released quickly in the event the machine starts to move.

8. To examine the function of the solution solenoid, hold the plunger (C) as shown above, but not all the way into the solenoid body (A). The plunger should be pulled into the solenoid when the solenoid is active. For an EcoFlex machine, this will happen every second or two, and then release.
9. To examine the detergent pump, you should be able to hear or feel the detergent pump cycling a couple of times a second (at max flow).

### **No Solution Flow**

- Make sure the solution shutoff valve is open.
- For a non-EcoFlex machine, make sure the solution cable is connected to the valve and moves through its full cycle as the solution lever is moved.
- Inspect and clean the solution Filter.
- Inspect the function of the solution solenoid as described in the [“Scrub System, General”](#) on page 54
- With the solution solenoid disassembled from the step above, inspect the valve body for foreign materials.
- If the brush motors are active, then you know the drive controller is not the cause.
- For non-EcoFlex machines, make sure the jumper is present on the electrical connector under the solution panel.
- Test the solenoid itself by applying battery voltage to the terminals.
- For EcoFlex machines, if the solenoid itself is functional, and the brush motor runs, then the detergent module is likely at fault.

### **No EcoFlex Detergent Flow**

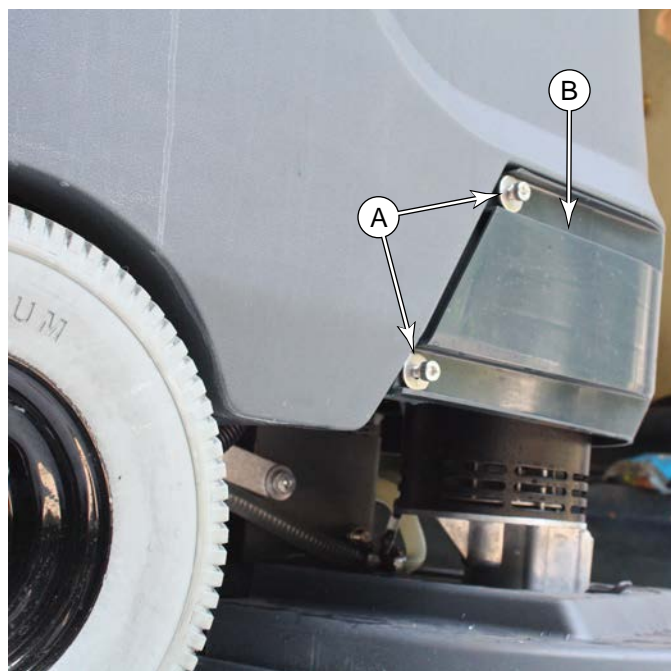
- Inspect the function of the detergent pump as described in the [“Scrub System, General”](#) on page 54. If the pump does not appear to be functioning, check the polarity of the wires.
- Verify the function of the pump by connecting it to the battery and listening for the plunger to move.
- If the pump itself is functional, and the brush motor runs, then the detergent module is likely at fault.

## Removal and Installation

### Scrub Skirt

Removing the scrub skirt **(B)** allows easy access to the scrub deck components. It is held in place with 4 screws **(A)** on the sides, and a tab in the center.

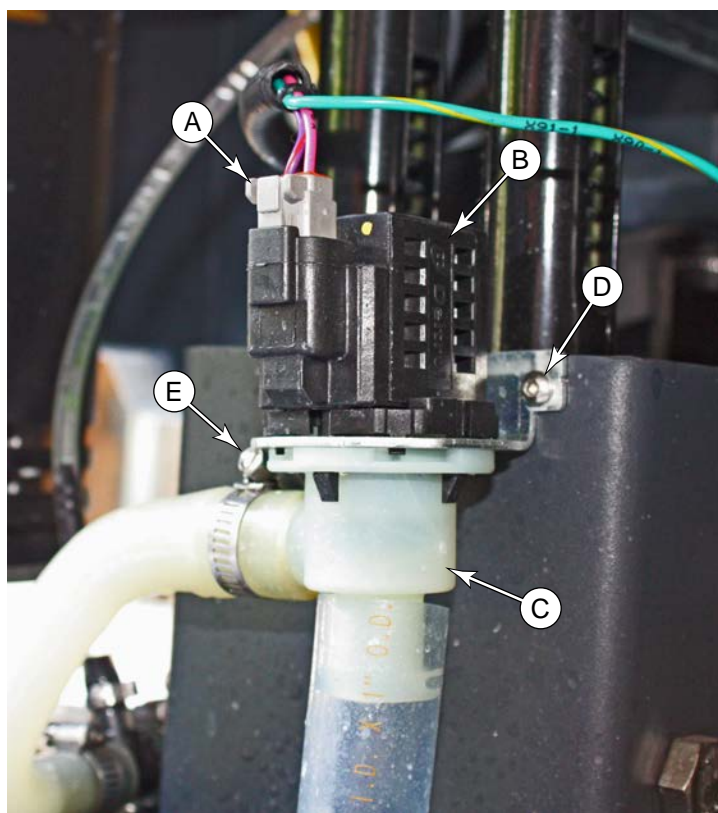
1. Using a 3mm hex key, remove the 4 screws and washers **(A)**.
2. Slide the skirt toward the front to free the center tab from the solution tank.



### Solution Solenoid

If the solution solenoid is being serviced for the purposes of inspection and cleaning, you can rotate the upper solenoid body **(B)** counterclockwise and remove it from the valve body **(C)**.

1. Disconnect the solenoid electrical connector **(A)**.
2. Loosen the hose clamp **(E)** and remove the supply hose from the solenoid.
3. Using a 2.5mm hex key, remove the two screws **(D)** that secure the solenoid bracket to the scrub deck.
4. Loosen the delivery tube hose clamp (not shown), and lift the solenoid body **(C)** out of the delivery tube and remove the solenoid.

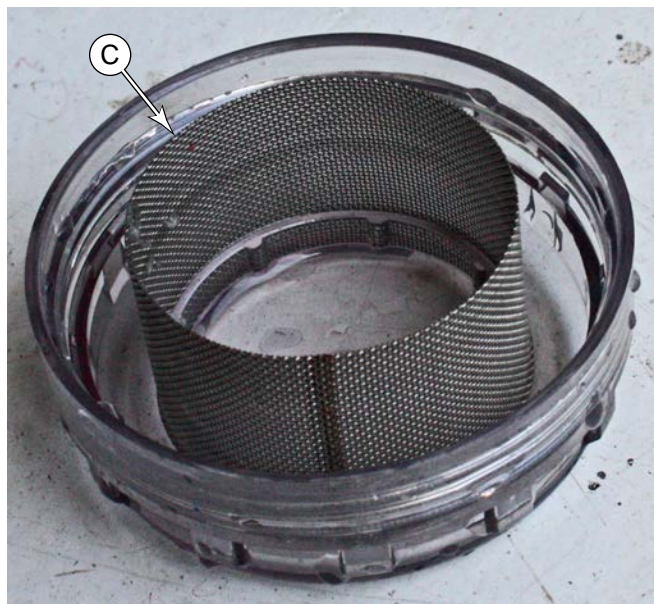


## Solution Filter

1. Shutoff the solution valve **(B)**.
2. Unscrew the solution filter **(A)**. There will likely still be some liquid in the line that will spill out.



3. Clean the filter bowl and screen **(C)**. Note that the screen is not removable from the bowl.

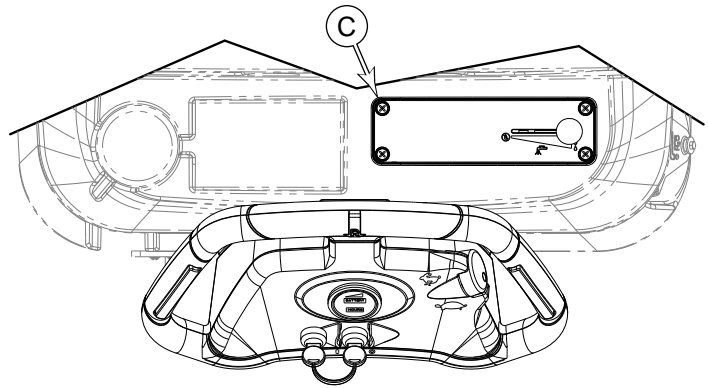
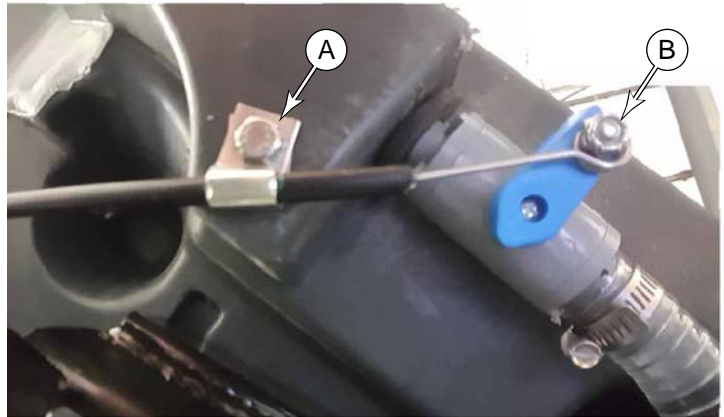




## Solution Control Panel and Cable

The solution control panel is located to the right of the operator's handle, and the cable passes down through the machine to the solution shutoff valve.

1. Remove the cable clamp **(A)**.
2. Remove the screw, nut, and washer **(B)** that secures the cable to the solution shutoff valve.
3. Remove the 4 screws **(C)** that secure the control panel to the solution tank, and lift the control panel upward, and free up the cable through the machine.



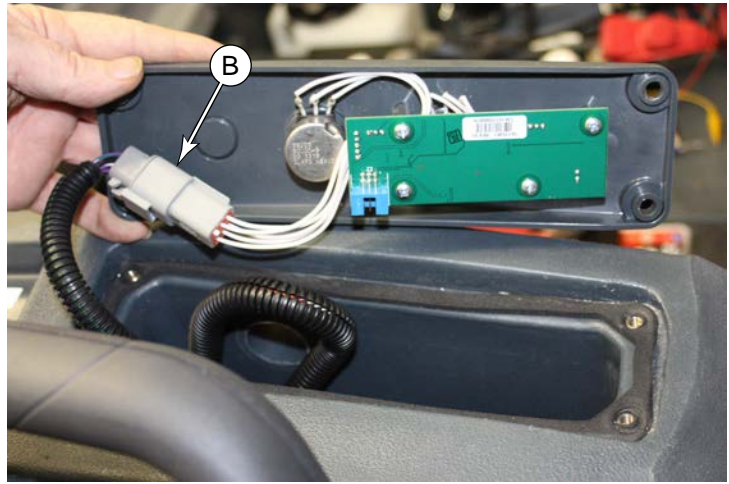
While you have the solution control panel off, it is a good idea to check that the solution jumper **(D)** is in place.



## EcoFlex Control Panel

For machines equipped with the option EcoFlex system, the standard solution control panel is replaced with the EcoFlex control panel.

1. Remove the 4 screws that secure the control panel to the solution tank, and lift the panel away from the tank.
2. Disconnect the electrical connector, and remove the control panel.



## Specifications

Parameter	Range
Solution Solenoid Coil Resistance	105 $\Omega$
Detergent Pump Coil Resistance	37 $\Omega$



## 34 - Scrub System, Disc

### Functional Description

The scrub system consists of a scrub deck that is raised and lowered with a foot pedal at the rear of the machine. The two counter rotating brushes are driven by independent motors with integral speed reduction gear boxes.

The scrub deck is supported by a parallelogram linkage to maintain level with the floor at any height. The deck lift lever can be set in a raised position, float, medium, or heavy scrub.

The brush motors are counter-rotating DC motors with integral gear reduction. They are relay controlled without variable speed or soft start.



## Circuit Overview

The brush circuit has several prerequisites to operate. All of the following must be true for the brushes to run:

- Key switch on
- Battery Voltage not low
- Machine in motion (even if zero speed)
- Brush deck lowered.

Starting at the motors and working back toward the batteries; the brush motors are connected directly to battery negative. On the positive side, each motor has its own circuit breaker, which is downstream from the K2 relay contact.

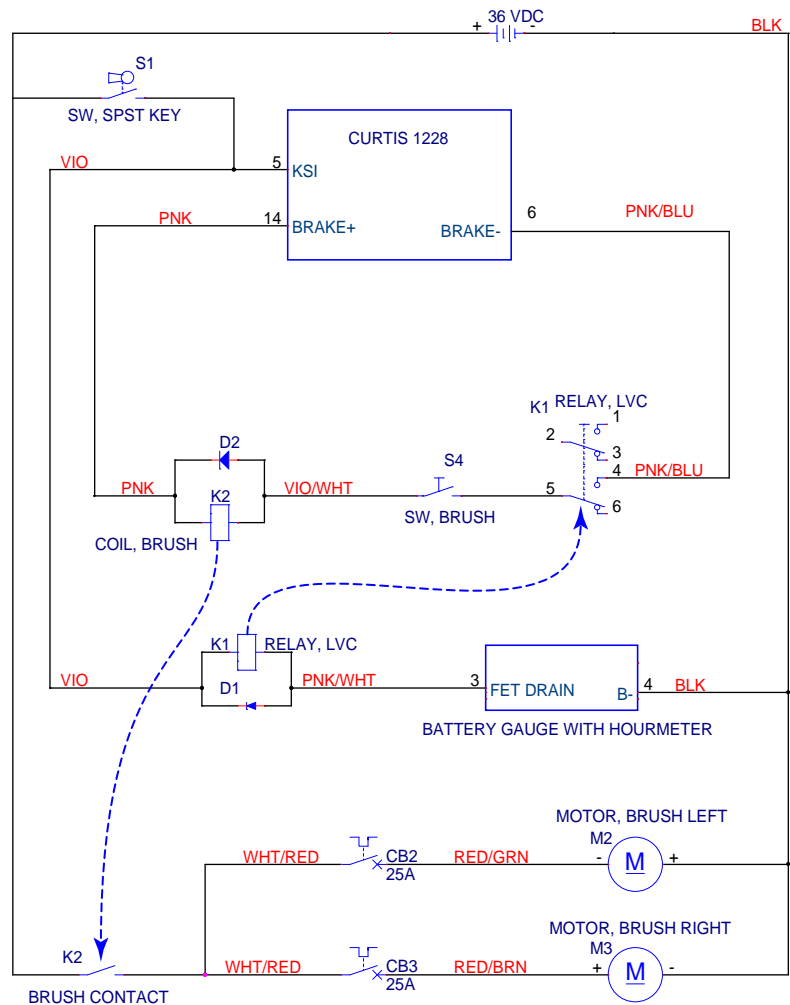
The control coil of the K2 relay is in series with the brush (deck lift) switch and the K1 relay. This circuit receives power from the Drive Controller's Brake output, which is active only when the drive controller is commanding motion. The positive side is always energized when the controller is enabled, and the negative side is switched to ground voltage when the machine is in motion.

This circuit of the K2 coil, Brush Switch, and K1 relay, along with the Drive Controller's Brake output, provides the fundamental control of the brush motor.

This circuit is active only when all 4 of the prerequisite conditions mentioned above have been met.

The control coil for the K1 relay is in series with the hour meter. This aspect of the circuit provides the low-voltage cutout feature to disable the scrub system when the batteries are running low. The hour meter contains a Field Effect Transistor (FET), which is active (conducting) when the battery voltage is sufficient for operation. The FET acts like a switch which connects the negative side of the relay coil to ground.

When the key switch is off, it disables the drive controller and also the K1 relay. This effectively disables all machine functions.

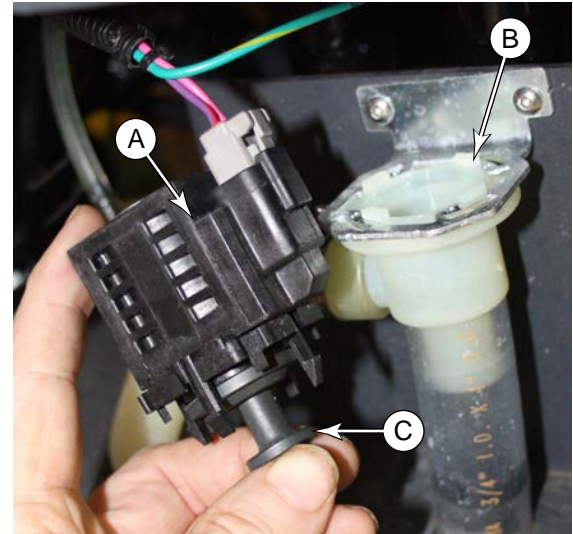


## Troubleshooting

### Scrub System, General

One of the first things about troubleshooting any part of the scrub system, is to make the scrub system active, so you can make observations. It is possible to active the scrub system without the machine moving, and without the brushes contacting the floor.

1. To avoid getting water on the floor, you may wish to close the solution shutoff valve. If the machine is equipped with EcoFlex, remove the suction hose from the detergent bottle.
2. If you need to inspect the solution solenoid, rotate the top of the solenoid counterclockwise about 1/8-turn, and lift the solenoid body (A) out of the valve body (B). Take care to not lose the plunger (C), spring, or sealing washer.
3. Set the speed limit dial to zero speed.



4. Carefully position the scrub deck lever (D) out of its retracted slot, but resting on the adjacent tab (E). This should permit the switch (F) to close without lowering the scrub deck.



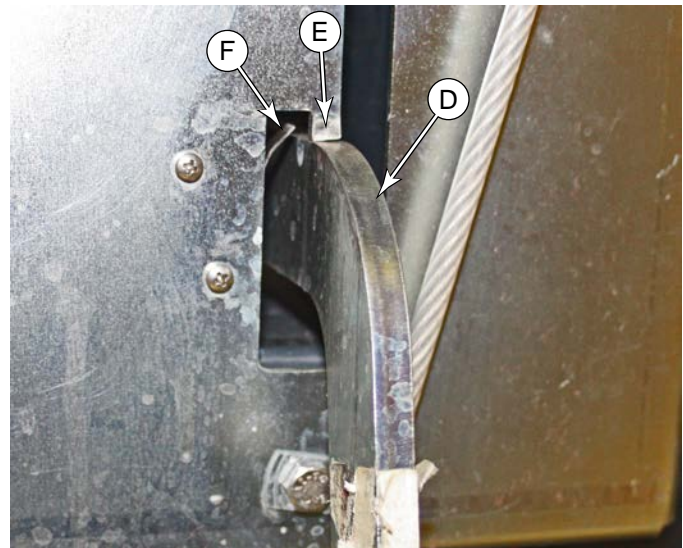
**CAUTION:** Always be prepared for the scrub deck to unexpectedly drop. Keep hands and feet away from the scrub deck when it is raised in this manner.

5. If the machine is equipped with the EcoFlex system, set both detergent and solution flow rates to maximum.
6. Turn the key switch to the on position.
7. Press one of the Go switches to confirm that the machine won't move. If the machine doesn't move, you can tape the switch down or have an assistant hold it for you.



**CAUTION:** Make sure the Go switch can be released quickly in the event the machine starts to move.

8. To examine the function of the solution solenoid, hold the plunger (C) as shown above, but not all the way into the solenoid body (A). The plunger should be pulled into the solenoid when the solenoid is active. For an EcoFlex machine, this will happen every second or two, and then release.
9. To examine the detergent pump, you should be able to hear or feel the detergent pump cycling a couple of times a second (at max flow).



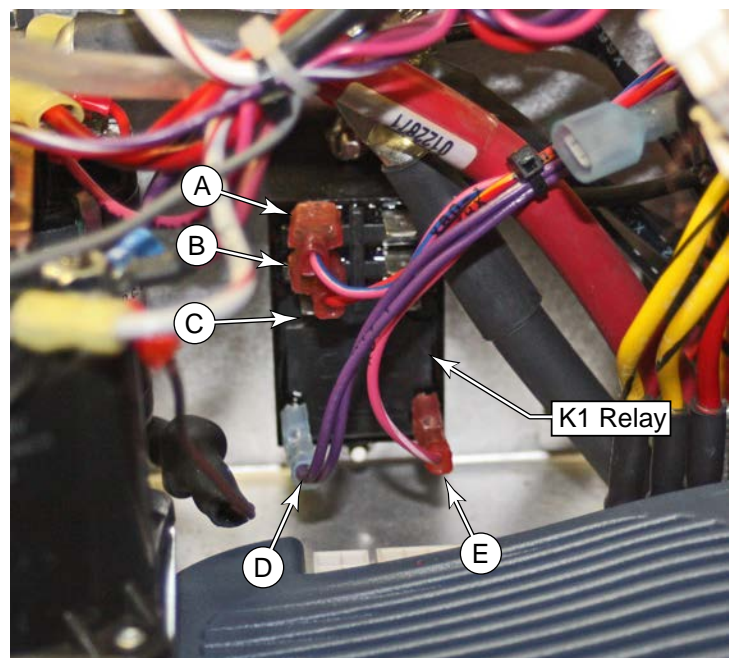
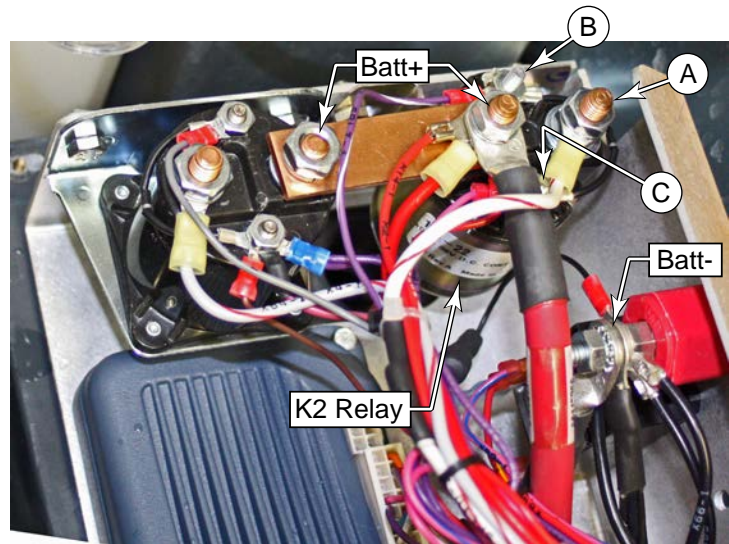
## One Brush Not Working

If only one brush is not working, you know it is not related to the drive controller, nor the power relay (K2). The problem is isolated between the 25 amp circuit breaker and the motor.

- Swap the two motor connectors at the scrub deck. If the same motor is inoperable, you know it's the motor. If the other motor becomes inoperable, you know it is in the wiring or the circuit breaker.
- If the problem is at the motor, inspect/replace the motor brushes. If the brushes are not worn, replace the motor.

## Both Brush Motors Not Working

- If solution flows, you can eliminate the drive controller and K1 relay as a possible cause. Troubleshoot the K2 relay.
  - Activate the scrub system as described on [page 62](#).
  - Check the voltage from (A) to (Batt-). If it's 36V, then the problem lies between the relay and the circuit breakers, or a broken ground at the (Batt-) lug.
  - Check the voltage across the coil from (B) to (C). If the voltage is 36V, then the relay is defective. If the voltage is zero, trace the Pink and Violet wires to locate a break.
- If neither solution nor optional detergent flows, check the following:
  - Check the continuity of the brush (deck lower) switch.
  - Check the function of the K1 relay.
    - Move the Pink/Blue wire from the top (A) terminal to the lower (C) terminal. If the brush motors run, you can eliminate the Drive Controller as a cause, but you know that the relay is not closing. (Make sure to move the wire back.)
    - If the brush motors did not run in the previous step, the drive controller is the most likely cause.
    - If the brush motors ran in the previous step, check the voltage between (D) and (E). If 36 volts is present, then the relay is faulty.
    - If 36 volts was not present in the previous step, then it is likely that the hour meter is faulty.



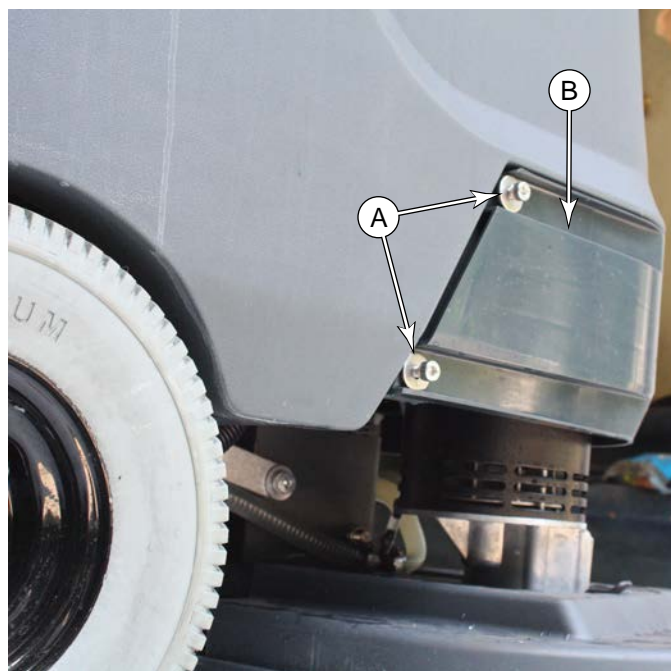


## Removal and Installation

### Scrub Skirt

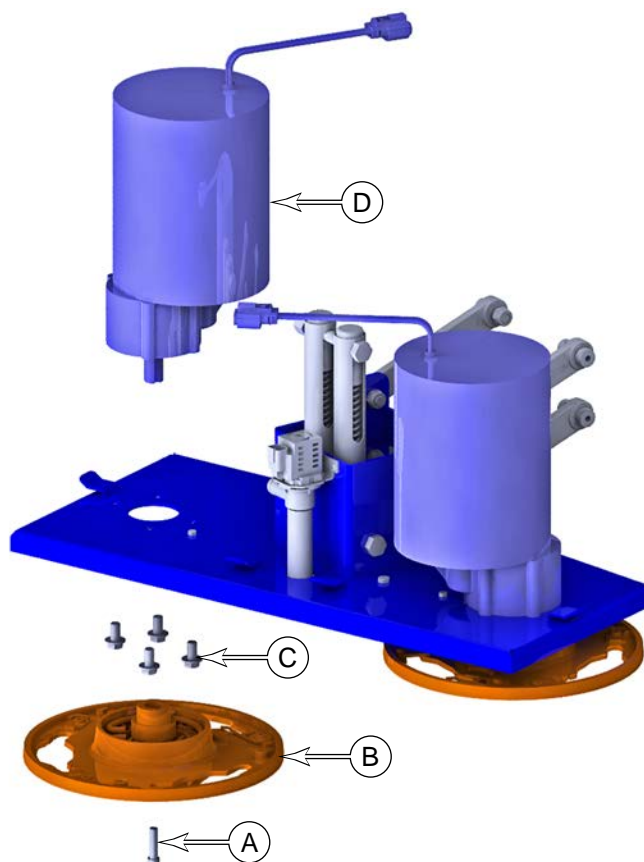
Removing the scrub skirt **(B)** allows easy access to the scrub deck components. It is held in place with 4 screws **(A)** on the sides, and a tab in the center.

1. Using a 3mm hex key, remove the 4 screws and washers **(A)**.
2. Slide the skirt toward the front to free the center tab from the solution tank.



### Scrub Brush Motor

1. Remove the Scrub skirt as described above.
2. Remove the two halves of the brush housings.
3. With the scrub deck fully raised, remove both scrub brushes (even if only one motor is being removed).
4. Using a 1/4" hex key, remove the socket head cap screw **(A)** that secures the brush plate **(B)** to the motor shaft.
5. Slide the brush plate off the motor shaft.
  - If you need to pry it off, try to pry evenly.
  - Lubricant may help if it is corroded.
  - Take care not to lose the motor shaft key.
6. Using a 9/16" socket, remove the 4 screws that secure the motor to the scrub deck.
7. Slowly lower the scrub deck so the motor doesn't tip over. (The deck can be lowered farther when both brushes are removed.)
8. Disconnect the motor connector, and remove the motor from the scrub deck.



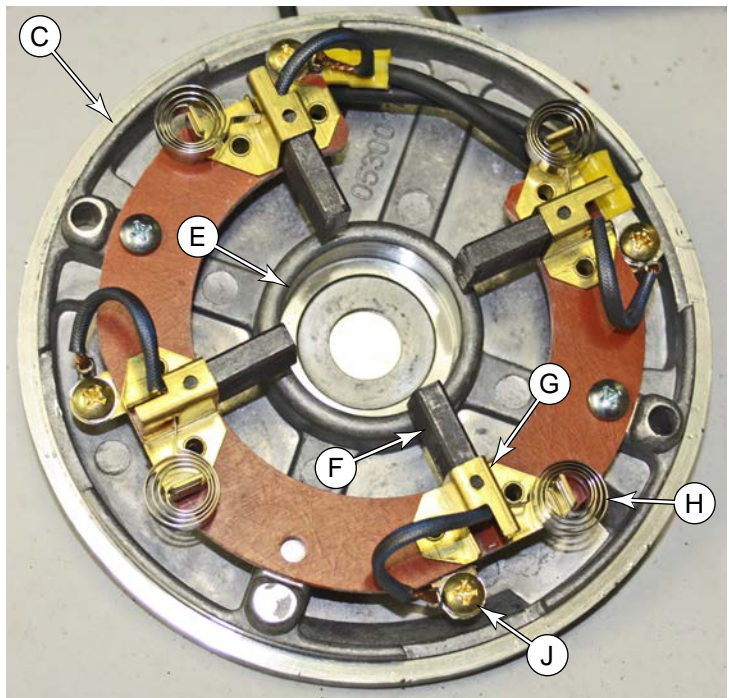
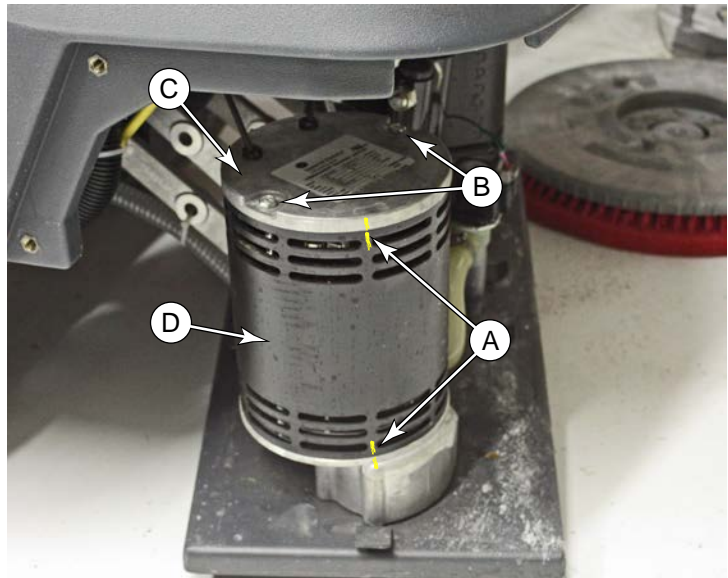
## Brush Motor Brushes

Unless you need to remove the motor(s), it is easier to complete this procedure with the motor(s) installed in the machine. As long as you disconnected the main battery connector, you don't even need to disconnect the motor connector. But if desired, remove the [Scrub Brush Motor](#) described on page 64.

1. Drain the recovery tank and disconnect the main battery connector.
2. Remove the [Scrub Skirt](#) described on page 64.
3. Remove both scrub brushes.
4. Lower the scrub deck as far as you can.
5. **Important:** Using a marker or paint pen, mark the alignment (A) of the top and bottom end caps with respect to the motor housing (D).
6. If necessary, disconnect the motor electrical connector.
7. Using an 11mm socket, remove the two screws (B) that secure the top cap (C), through the motor housing (D), and down to the bottom cap. The screws are very long.
8. Carefully pry up the top cap (C) away from the motor housing (D). Note the following:
  - The rotor's bearing is a light press into the top cap. It will come free fairly easily, but care must be taken to not skew the cap in the process.
  - A very light tap on the side of the cap with a plastic deadblow hammer should be enough to loosen the cap enough to begin prying with a small screw driver.
  - Taking care not to damage the aluminum cap, work the small screw driver around the cap enough to be able to get two medium sized screw drivers in 180° apart, and then pry up on both sides evenly.
9. Slowly and gently, lift the top cap up until the 4 brushes clear the commutator and rotor bearing.

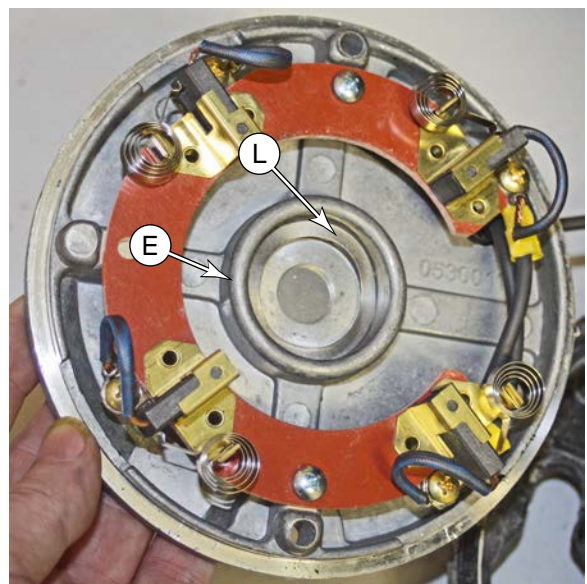
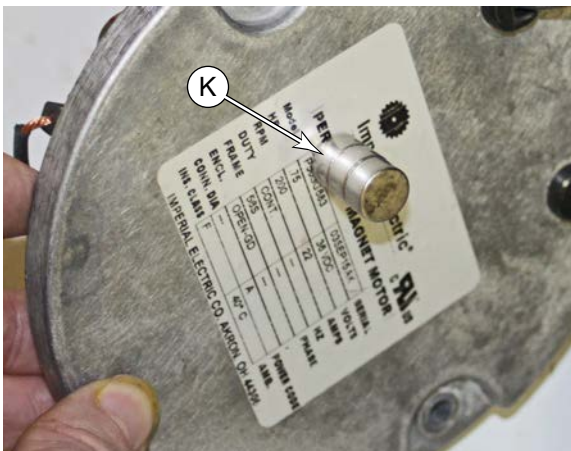
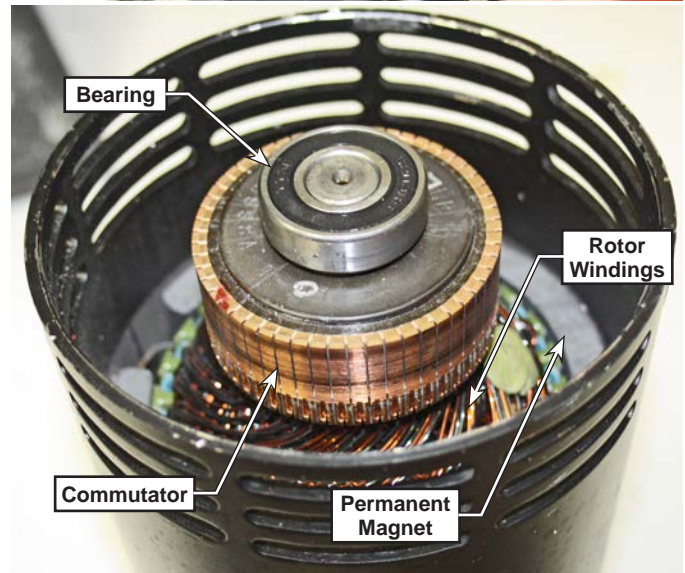
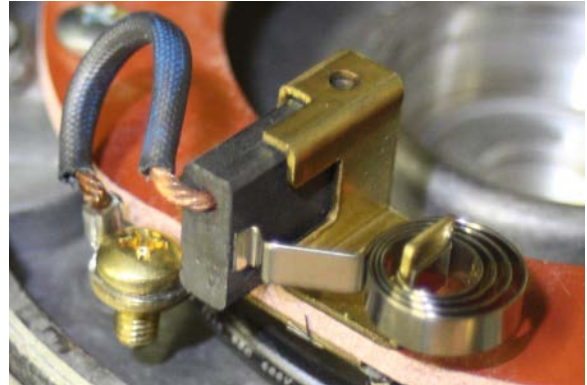
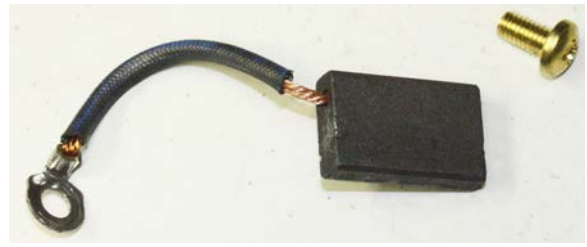
For reference, the picture to the right shows the components of the top cap.

- (C) Top Cap
- (E) Bearing Pocket
- (F) Carbon Brush
- (G) Brush Holder
- (H) Coil Spring (Brush Spring)
- (J) Terminal Screw





10. Remove the terminal screw (**J**) from the brush wire.
11. Pull the brush (**F**) outward and remove it from the brush holder (**G**).
12. While holding the coil spring out of the way, insert the new brush into the brush holder. Note that the brush wire is away from the phenolic base.
13. Re-secure the brush wire to the contact with the screw (**J**).
14. After replacing all 4 brushes, retract the brushes away from the center so the end cap can be placed back over the commutator without damaging them. In the picture to the right, note how the brush is retracted far enough for the coil spring to be pressing against the side of the brush. This will hold the brush retracted, but can easily be pushed forward later.
15. Before replacing the end cap, inspect the interior of the motor:
  - Inspect the commutator for missing or damaged bars. Replace the motor if any of the bars are missing.
  - Inspect the rotor bearing for wear. Replace the motor if worn.
  - Inspect the permanent magnets for metallic debris and clean off as needed.
16. Place the wave washer (**L**) in the bearing pocket (**E**). Use a Rare Earth magnet (**K**) on the opposite side of the cap to hold the washer in place. (A less powerful magnet can be used, but a Rare Earth magnet is powerful enough to hold itself in place.)
17. After reinstalling the end cap, reach in through the air vents in the motor housing and push inward on the brushes until you hear them “click” against the commutator.



## Specifications

Parameter	Range
K2 Brush Relay Coil Resistance	118 $\Omega$
Sample Left Brush Amps	2.44A, No Load
Sample Right Brush Amps	2.65A, No Load

## 34 - Scrub System, Cylindrical

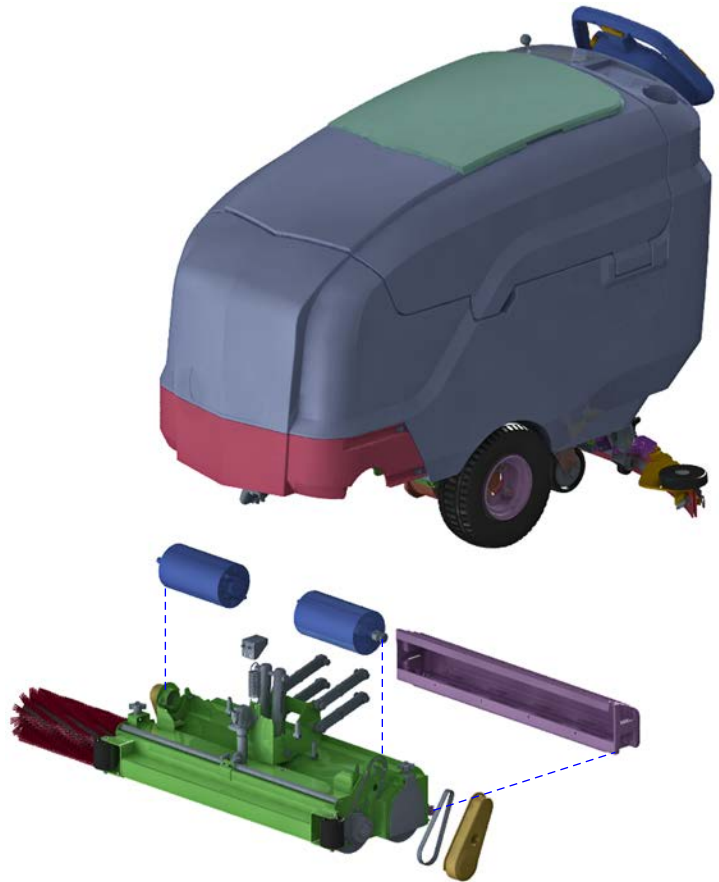
---

### Functional Description

The scrub system consists of a scrub deck that is raised and lowered with a foot pedal at the rear of the machine. The two counter rotating cylindrical brushes are driven by independent motors and belt drives.

The scrub deck is supported by a parallelogram linkage to maintain level with the floor at any height. The deck lift lever can be set in a raised position, float, medium, or heavy scrub.

The brush motors are counter-rotating DC motors. They are relay controlled without variable speed or soft start.



## Circuit Overview

The brush circuit has several prerequisites to operate. All of the following must be true for the brushes to run:

- Key switch on
- Battery Voltage not low
- Machine in motion (even if zero speed)
- Brush deck lowered.

Starting at the motors and working back toward the batteries; the brush motors are connected directly to battery negative. On the positive side, each motor has its own circuit breaker, which is downstream from the K2 relay contact.

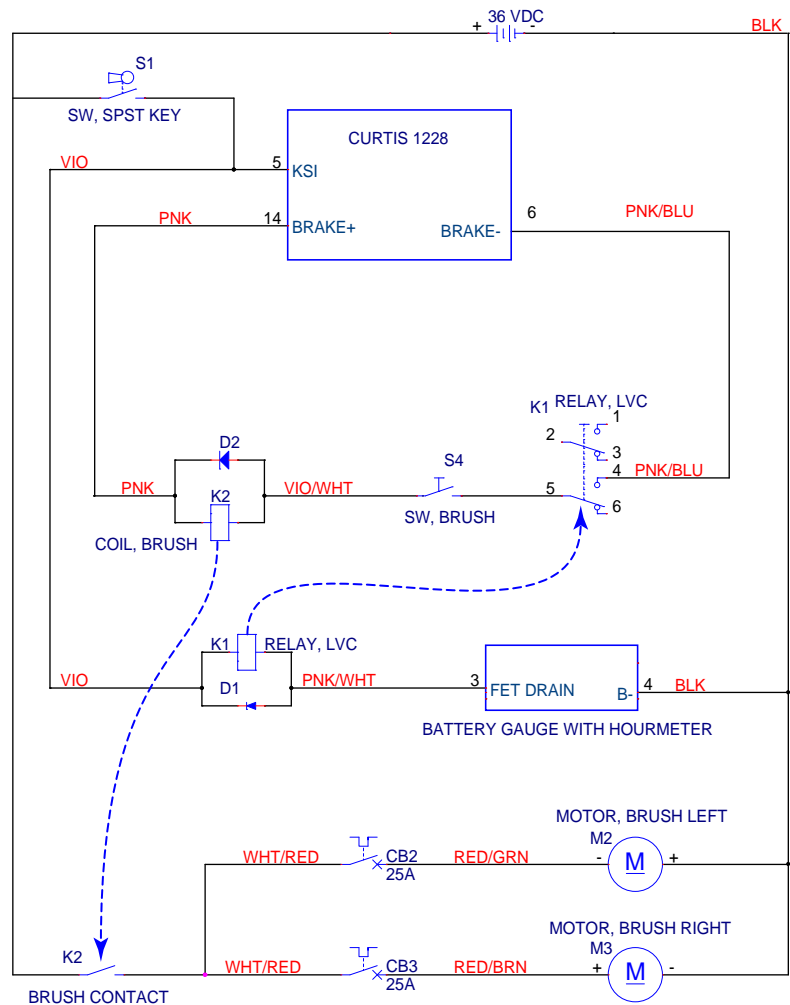
The control coil of the K2 relay is in series with the brush (deck lift) switch and the K1 relay. This circuit receives power from the Drive Controller's Brake output, which is active only when the drive controller is commanding motion. The positive side is always energized when the controller is enabled, and the negative side is switched to ground voltage when the machine is in motion.

This circuit of the K2 coil, Brush Switch, and K1 relay, along with the Drive Controller's Brake output, provides the fundamental control of the brush motor.

This circuit is active only when all 4 of the prerequisite conditions mentioned above have been met.

The control coil for the K1 relay is in series with the hour meter. This aspect of the circuit provides the low-voltage cutout feature to disable the scrub system when the batteries are running low. The hour meter contains a Field Effect Transistor (FET), which is active (conducting) when the battery voltage is sufficient for operation. The FET acts like a switch which connects the negative side of the relay coil to ground.

When the key switch is off, it disables the drive controller and also the K1 relay. This effectively disables all machine functions.



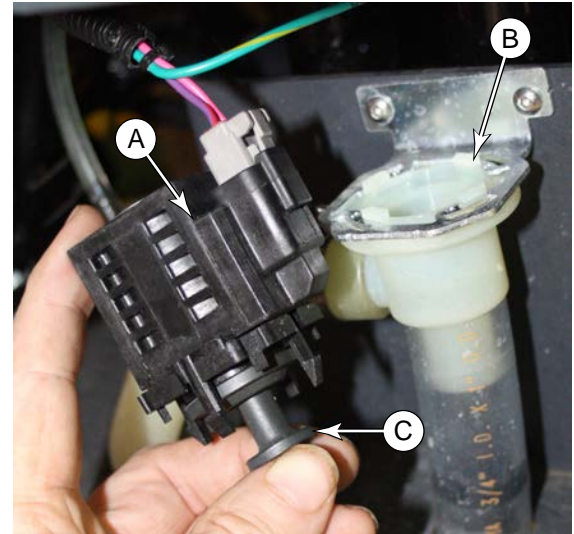


## Troubleshooting

### Scrub System, General

One of the first things about troubleshooting any part of the scrub system, is to make the scrub system active, so you can make observations. It is possible to active the scrub system without the machine moving, and without the brushes contacting the floor.

1. To avoid getting water on the floor, you may wish to close the solution shutoff valve. If the machine is equipped with EcoFlex, remove the suction hose from the detergent bottle.
2. If you need to inspect the solution solenoid, rotate the top of the solenoid counterclockwise about 1/8-turn, and lift the solenoid body (A) out of the valve body (B). Take care to not lose the plunger (C), spring, or sealing washer.
3. Set the speed limit dial to zero speed.



4. Carefully position the scrub deck lever (D) out of its retracted slot, but resting on the adjacent tab (E). This should permit the switch (F) to close without lowering the scrub deck.



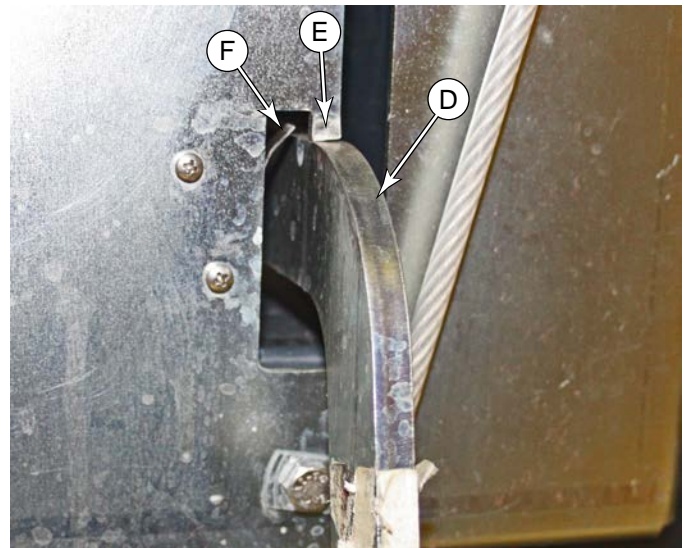
**CAUTION:** Always be prepared for the scrub deck to unexpectedly drop. Keep hands and feet away from the scrub deck when it is raised in this manner.

5. If the machine is equipped with the EcoFlex system, set both detergent and solution flow rates to maximum.
6. Turn the key switch to the on position.
7. Press one of the Go switches to confirm that the machine won't move. If the machine doesn't move, you can tape the switch down or have an assistant hold it for you.



**CAUTION:** Make sure the Go switch can be released quickly in the event the machine starts to move.

8. To examine the function of the solution solenoid, hold the plunger (C) as shown above, but not all the way into the solenoid body (A). The plunger should be pulled into the solenoid when the solenoid is active. For an EcoFlex machine, this will happen every second or two, and then release.
9. To examine the detergent pump, you should be able to hear or feel the detergent pump cycling a couple of times a second (at max flow).





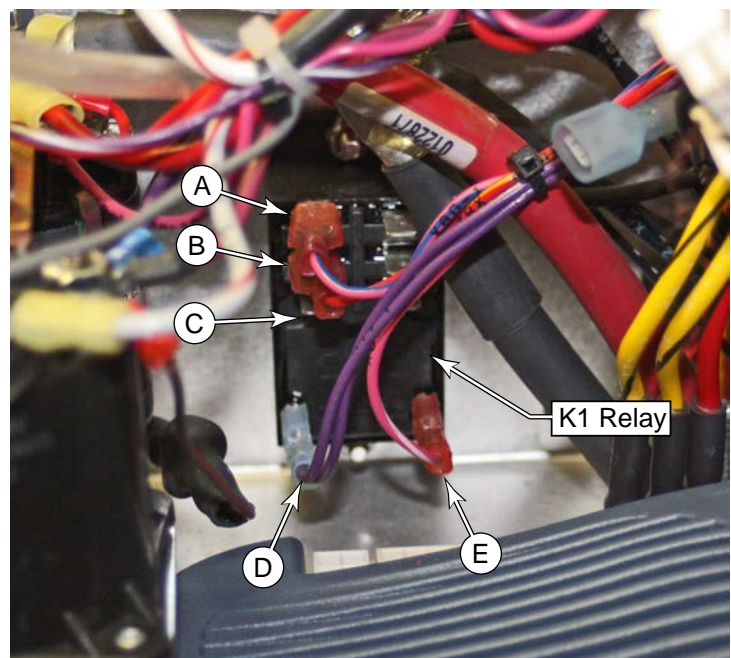
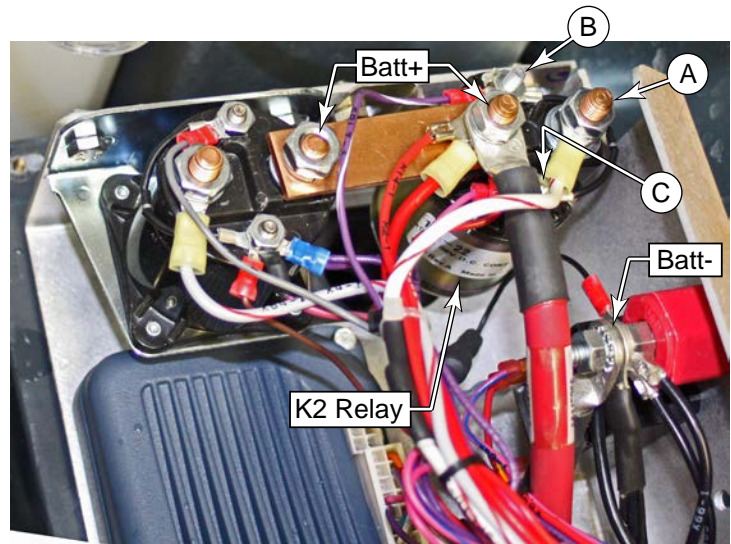
## One Brush Not Working

If only one brush is not working, you know it is not related to the drive controller, nor the power relay (K2). The problem is isolated between the 25 amp circuit breaker and the motor.

- Swap the two motor connectors at the scrub deck. If the same motor is inoperable, you know it's the motor. If the other motor becomes inoperable, you know it is in the wiring or the circuit breaker.
- If the problem is at the motor, inspect/replace the motor brushes. If the brushes are not worn, replace the motor.

## Both Brush Motors Not Working

- If solution flows, you can eliminate the drive controller and K1 relay as a possible cause. Troubleshoot the K2 relay.
  - Activate the scrub system as described on [page 70](#).
  - Check the voltage from (A) to (Batt-). If it's 36V, then the problem lies between the relay and the circuit breakers, or a broken ground at the (Batt-) lug.
  - Check the voltage across the coil from (B) to (C). If the voltage is 36V, then the relay is defective. If the voltage is zero, trace the Pink and Violet wires to locate a break.
- If neither solution nor optional detergent flows, check the following:
  - Check the continuity of the brush (deck lower) switch.
  - Check the function of the K1 relay.
    - Move the Pink/Blue wire from the top (A) terminal to the lower (C) terminal. If the brush motors run, you can eliminate the Drive Controller as a cause, but you know that the relay is not closing. (Make sure to move the wire back.)
    - If the brush motors did not run in the previous step, the drive controller is the most likely cause.
    - If the brush motors ran in the previous step, check the voltage between (D) and (E). If 36 volts is present, then the relay is faulty.
    - If 36 volts was not present in the previous step, then it is likely that the hour meter is faulty.

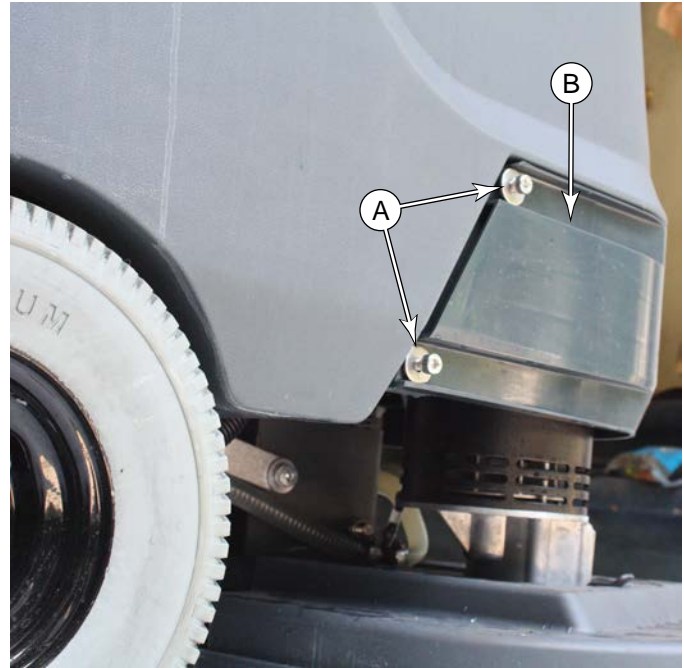


## Removal and Installation

### Scrub Skirt

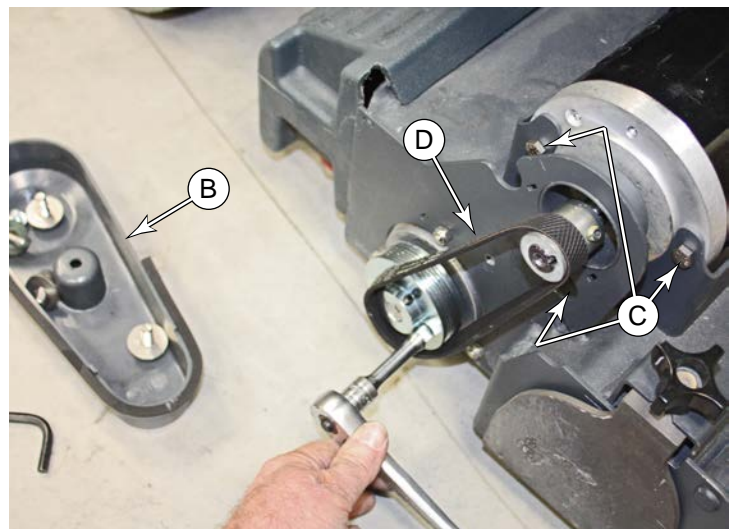
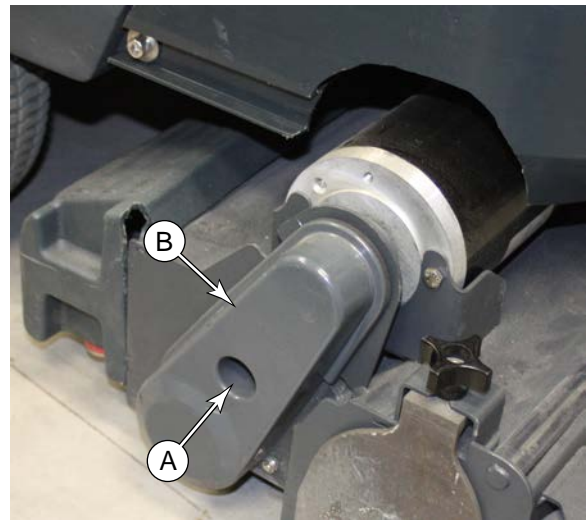
Removing the scrub skirt **(B)** allows easy access to the scrub deck components. It is held in place with 4 screws **(A)** on the sides, and a tab in the center.

1. Using a 3mm hex key, remove the 4 screws and washers **(A)**.
2. Slide the skirt toward the front to free the center tab from the solution tank.



### Scrub Brush Motor

1. Lower the scrub deck and remove the Scrub skirt as described above.
2. Using a 3/8" socket, remove the screw **(A)** that secures the belt cover **(B)** to the scrub deck, and remove the cover.
3. Walk the stretch belt **(D)** off the pulleys.
4. Remove the three screws **(C)** that secure the motor to the scrub deck.
5. Disconnect the motor connector, and remove the motor from the scrub deck.
6. During replacement, to aid in walking the stretch belt back on the pulleys, use a 3/8" socket extension to rotate the pulley.

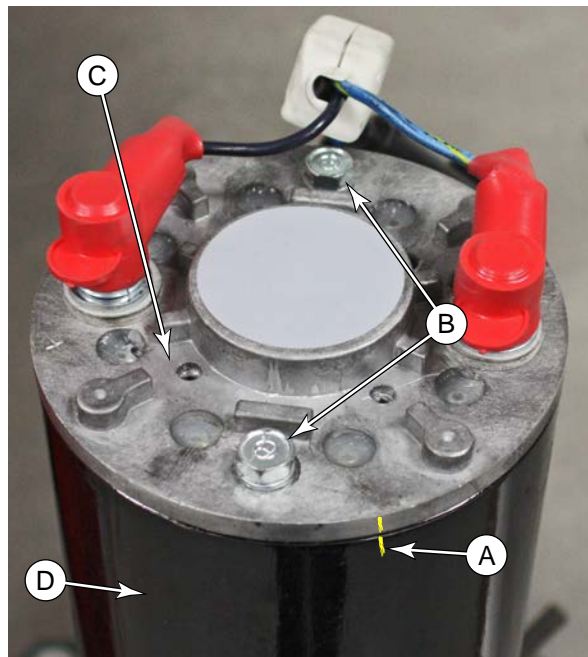




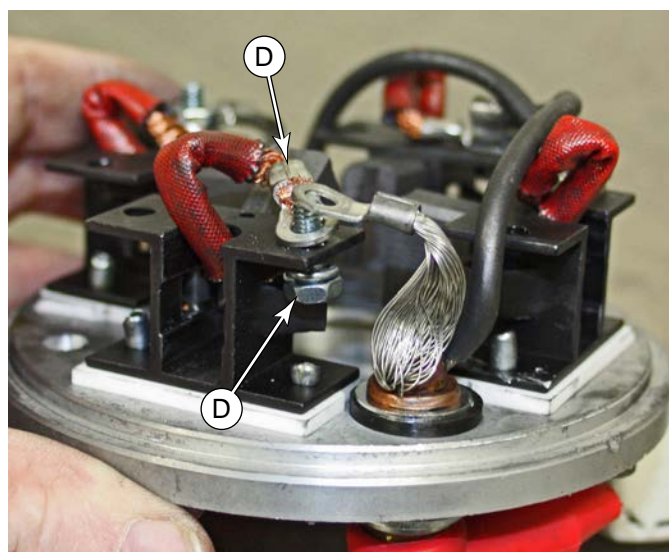
## Brush Motor Brushes

1. Drain the recovery tank and disconnect the main battery connector.
2. Remove the [Scrub Skirt](#) described on page 72.
3. Remove the [Scrub Brush Motor](#) described on page 72.

4. **Important:** Using a marker or paint pen, mark the alignment (A) of the top and bottom end caps with respect to the motor housing (D).
5. Remove the two screws (B) that secure the top cap (C), through the motor housing (D), and down to the bottom cap. The screws are very long.
6. Carefully pry up the top cap (C) away from the motor housing (D). Note the following:
  - The rotor's bearing is a light press into the top cap. It will come free fairly easily, but care must be taken to not skew the cap in the process.
  - A very light tap on the side of the cap with a plastic deadblow hammer should be enough to loosen the cap enough to begin prying with a small screw driver.
  - Taking care not to damage the aluminum cap, work the small screw driver around the cap enough to be able to get two medium sized screw drivers in 180° apart, and then pry up on both sides evenly.



7. Slowly and gently, lift the top cap up until the 4 brushes clear the commutator and rotor bearing.
8. Remove the nut from the terminal screw (E), and lift the brush wire off the screw.
9. Slide the brush toward the center to remove the brush and coil spring.





**Note:** When placing the coil spring and brush back into position, note the direction the coil spring faces so that it uncoils properly.



**Note:** You will need 4 temporary retaining pins, such as straightened out paperclips. Have them ready before completing the next steps.



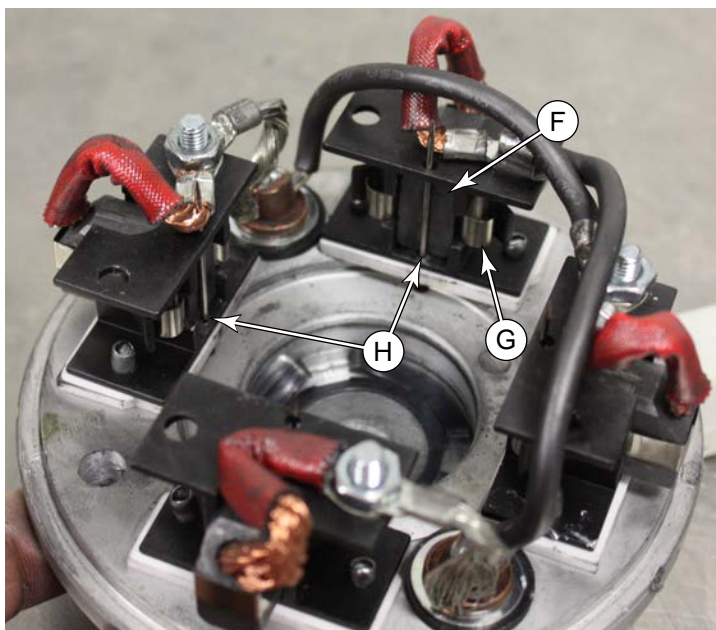
10. While holding the brush **(F)** and coil spring **(G)** together, feed the brush wire through the brush holder.



11. Insert the brush and coil spring into the brush holder. The brush wire should be toward the top, away from the brush cap.

12. Compress the brush all the way in to the brush holder, and insert the temporary retaining pin.

- Insert the pin from the opposite side of the end cap, through the bottom of the brush holder, in front of the brush, and up through the top of the brush holder.
- Make sure the pin is inserted in such a way that it can be removed after the motor is completely reassembled.
- The purpose of the pin is to hold the brush retracted while you install the end cap back onto the motor.

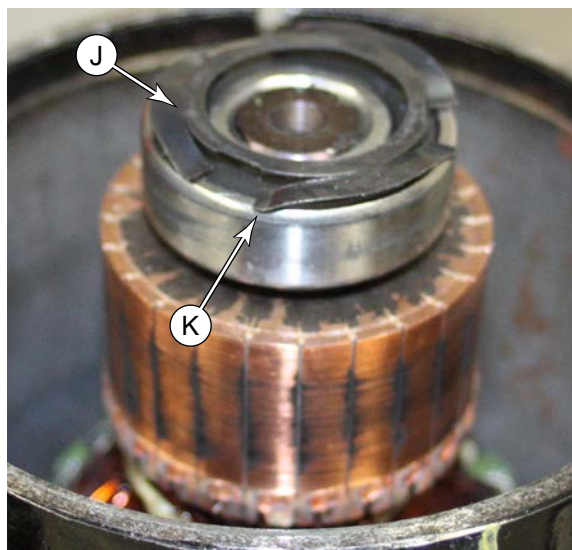






**Note:** The wave washer (**J**) fits between the rotor bearing and the end cap. When placing it in the end cap before assembly, note that the fingers (**K**) face toward the bearing.

The picture to the right is only for reference. It is easier to place the washer in the end cap than it is to leave it on the bearing.



13. Place the wave washer (**J**) in the bearing pocket of the end cap with the fingers (**K**) facing toward the bearing. Use a Rare Earth magnet (**L**) on the opposite side of the cap to hold the washer in place. (A less powerful magnet can be used, but a Rare Earth magnet is powerful enough to hold itself in place.)

14. Place the end cap over the top of the motor, and lower it until the coil springs prevent you from lowering it any farther.

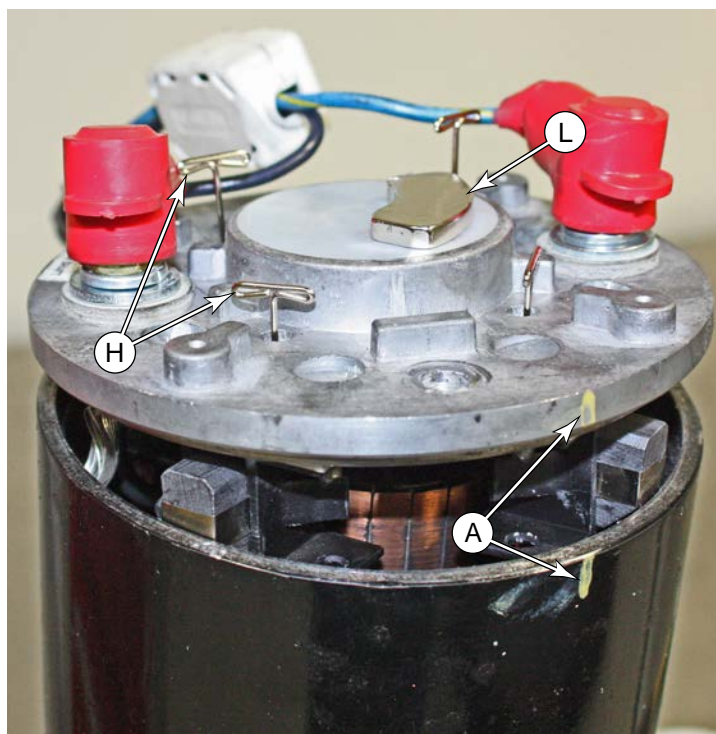
- Make sure to realign the marks (**A**) that you made on the motor before disassembly.
- When the brushes are compressed in this manner, they are too wide to fit the cap all the way into the motor. The coil springs will catch on the edge of the motor housing.

15. With the end cap on the motor as far as it will go, begin removing the pins (**H**) to allow the brushes to move toward the commutator.

16. Press the end cap down on to the bearing.

17. Install the two long screws (**B**) that secure the top cap to the bottom cap.

18. Remove the permanent magnet.





## Specifications

Parameter	Range
K2 Brush Relay Coil Resistance	118 $\Omega$
Sample Left Brush Motor Amps	2.84A, No Load
Sample Right Brush Motor Amps	2.48A, No Load

## 38 - Squeegee System

---

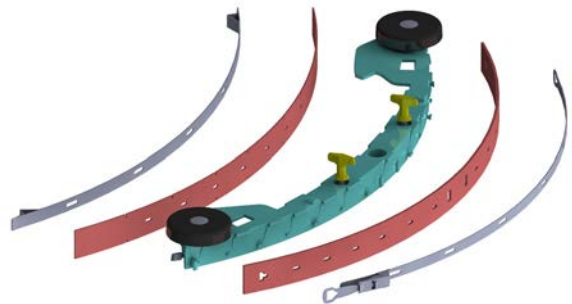
### Functional Description

The squeegee tool collects wastewater from the floor for the recovery system to lift the water into the recovery tank. The floor squeegee is wider than the swath of the scrub deck to ensure collection of all wastewater from the perimeter of the scrubbing area. The squeegee also pivots to the side to permit operation near walls and to keep the squeegee within the scrubbing path while turning the machine.



### Squeegee

The squeegee tool has a front and rear squeegee blade, creating a vacuum area in between where water can be drawn up from the fast moving airflow. The squeegee tool attaches to the lift/pivot assembly with two knobs.

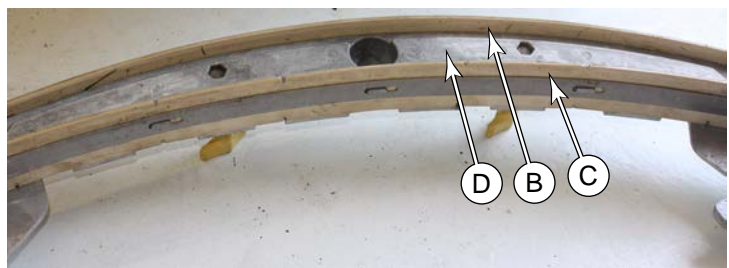


## Maintenance and Adjustment

### Squeegee Blade Cleaning and Inspection

Periodically clean and inspect the squeegee assembly and blades.

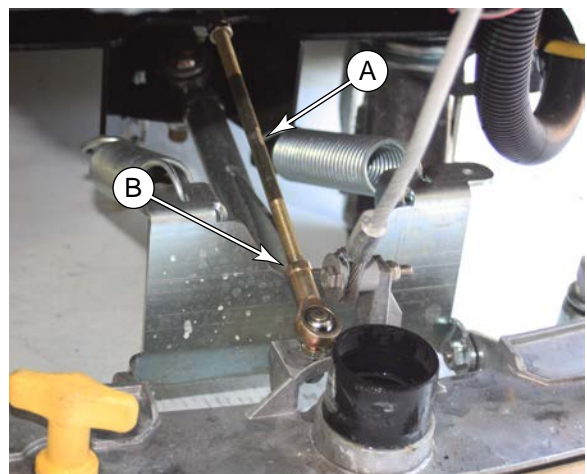
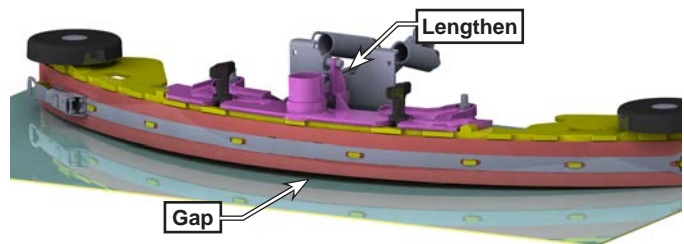
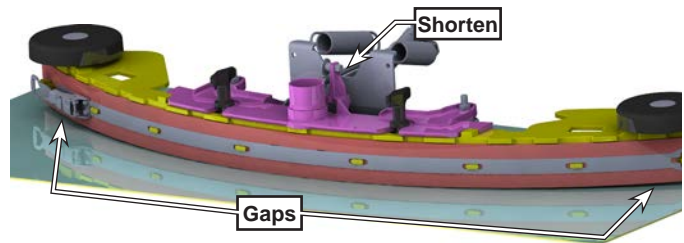
1. Loosen the two thumb nuts **(A)**, and slide the squeegee assembly off the lift mechanism.
2. Clean the squeegee blades **(B&C)** and suction area between the blades **(D)** with soap and water.
3. Inspect the squeegee blades for nicks, tears, and worn leading edges. If a squeegee blade is worn or damaged, it may be turned around with a fresh edge facing down/forward up to four times before complete blade replacement is required.



### Squeegee Tilt Adjustment

The squeegee tilt should be adjusted when the squeegee blades are replaced, or if the squeegee is not fully wiping the floor. Misadjustment symptoms include water streaks at the center or edges of the squeegee path.

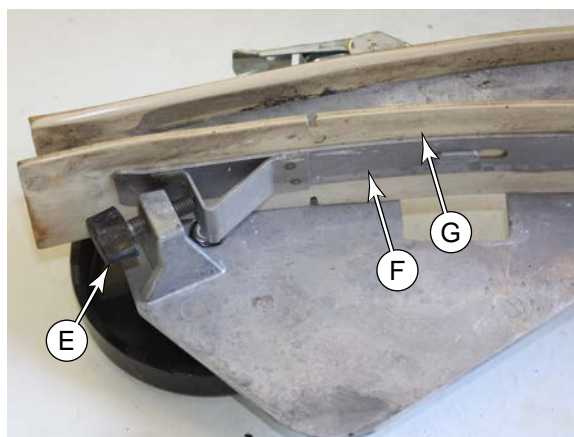
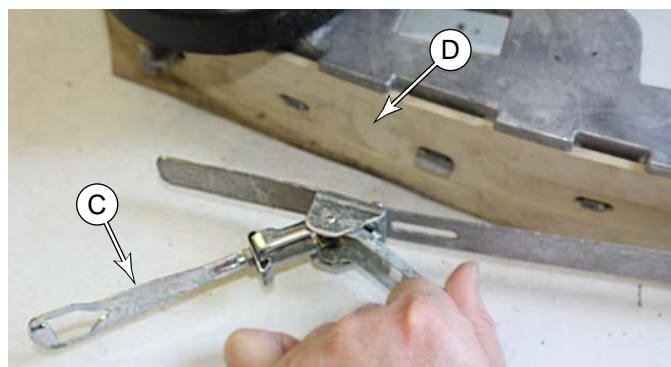
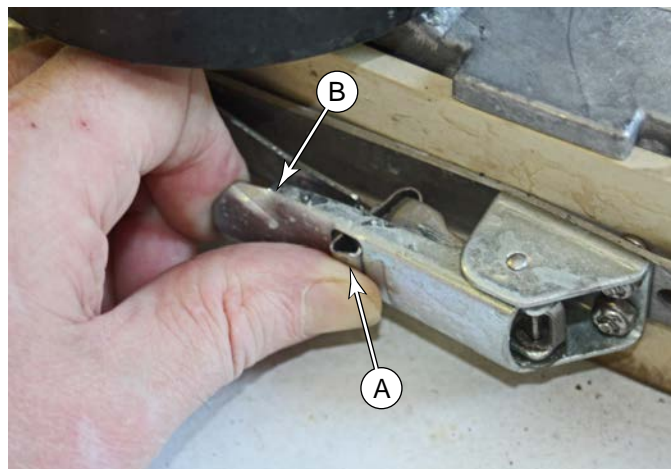
1. Park the machine on a flat, even surface and lower the squeegee.
2. Without moving the machine (which will cause the rear squeegee blade to bend backward), inspect the interface between the edge of the rear squeegee blade and the floor. Inspect for gaps at either the center or the edges.
3. If adjustments are necessary, loosen the turnbuckle jam nut **(B)**.
4. Lengthen (clockwise) or Shorten (counterclockwise) the squeegee tilt Turnbuckle **(A)** to level the squeegee across its length.
  - If there is a gap in the center, lengthen the turnbuckle.
  - If there are gaps at the outside, shorten the turnbuckle.
5. Retighten the jam nut.



## Removal and Installation

### Squeegee Blade Replacement

1. Remove the squeegee assembly from the machine.
2. Release the rear (main) squeegee latch (**B**) by pushing back on the latch release (**A**) and pulling the latch outward.
3. Remove the tension strap (**C**) from the end hooks, and remove the squeegee blade (**D**).
4. The squeegee blade has 4 working edges. Turn the blade so a clean, undamaged edge points toward the front of the machine. Replace the blade if all 4 edges are nicked, torn or worn to a large radius.
5. Reinstall the rear squeegee blade and tension strap, and tighten the latch.
6. To replace the front squeegee blade, loosen both thumbscrews (**E**) that hold the retaining strap (**F**), remove the strap and remove the squeegee blade (**G**).
7. After replacing both blades, rest the squeegee on a flat surface and look for any waves in the height of the blades.
8. After installing the squeegee assembly back on the machine, check the [Squeegee Tilt Adjustment](#) described on page 78.



## 40-Recovery System

### Functional Description

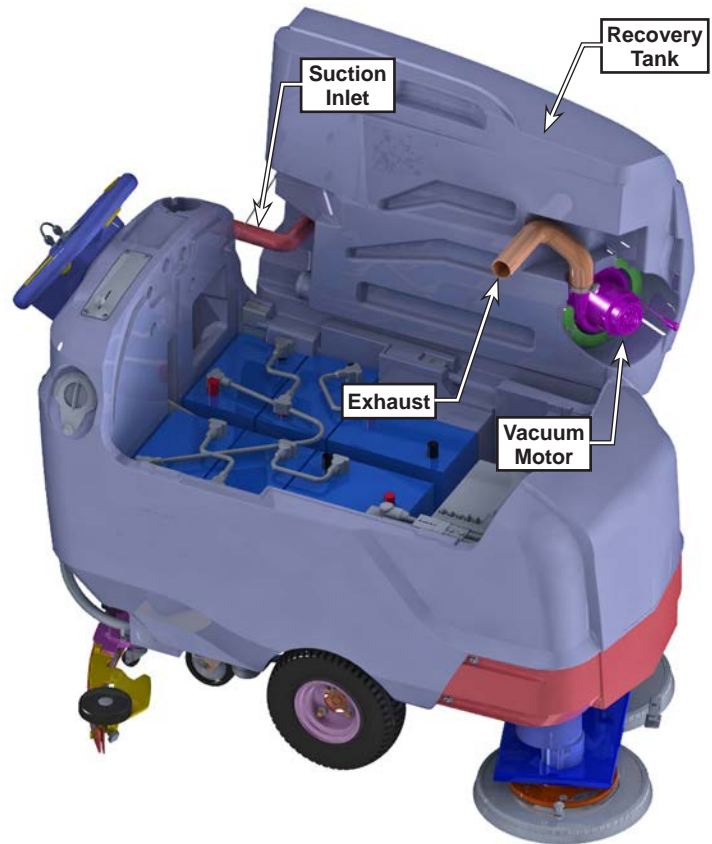
The recovery system extracts wastewater from the floor and deposits it into the on-board recovery tank.

### Vacuum Motor and Recovery Tank

The vacuum motor generates airflow through the recovery tank and suction hose to the squeegee. The high velocity air at the squeegee pulls the wastewater off the floor and up through the suction hose. As the mixture of air and water enters the recovery tank, the airflow slows down due to the larger space, and the water drops out of the airflow and into the tank.

The airflow passes through an inlet screen to prevent debris from entering the impeller of the vacuum motor. The exhaust air is expelled inside the machine so it can be dispersed without blowing directly on the operator or the work environment.

To prevent wastewater from entering the vacuum motor, a float valve blocks the vacuum when the recovery tank is full.

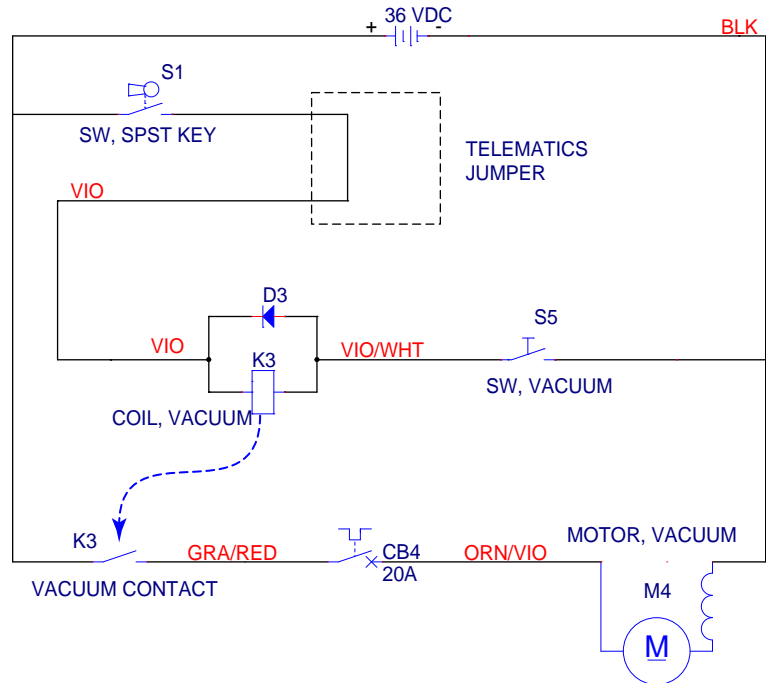




## Circuit Overview

Unlike other machine functions, the vacuum circuit is not dependant on the drive function nor the low voltage cutout of the hour meter. The only prerequisite for the vacuum circuit is the main key switch.

The vacuum motor is controlled by the K3 relay, which in turn, is controlled by the vacuum switch at the squeegee lift lever.

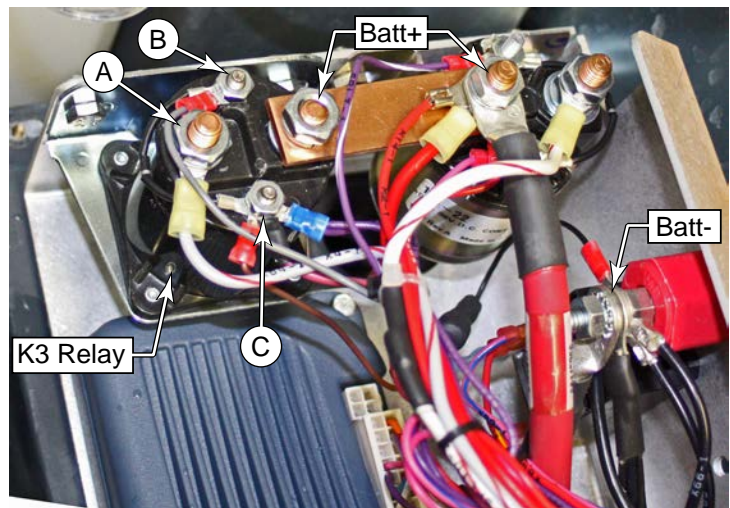


## Troubleshooting

### No Vacuum Motor

If the vacuum motor is not functioning, but all other machine functions are unaffected, The problem is limited to the vacuum switch, relay, circuit breaker, and the motor itself. Begin troubleshooting at the K3 relay.

- Check the voltage from relay out **(A)** and battery-negative **(Batt-)**. If 36 volts is present, then the problem is isolated to the circuit breaker or motor itself.
  - Check for 36 volts at both terminals of the circuit breaker.
  - Check for 36 volts at the vacuum motor connector.
  - If 36 volts is reaching the motor, then inspect/replace the motor brushes described on [page 84](#).
- If 36 volts was not present at **(A)**, then check the voltage between **(B)** and **(C)**. If 36 volts is present, then the relay is defective.
- If 36 volts is not present between **(B)** and **(C)**, then the vacuum switch is likely the cause.



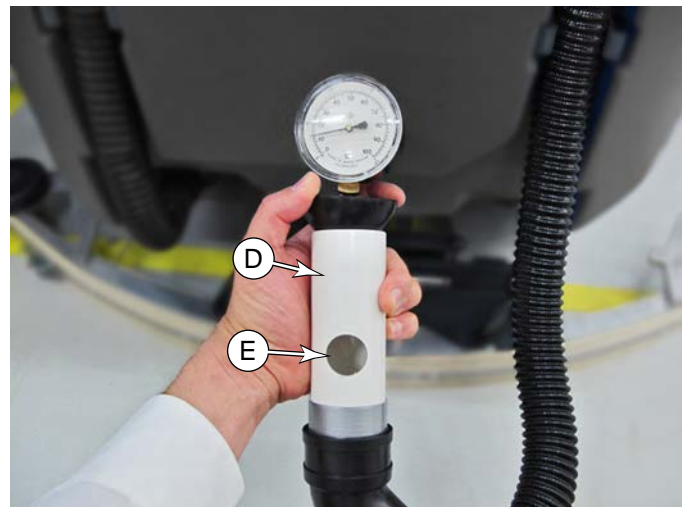
### Poor Suction

- Inspect the recovery tank cover seal. If the cover is not well sealed, the squeegee will have very low vacuum.
- Inspect the vacuum motor inlet screen and clean any built-up debris from the screen.
- Inspect the squeegee and suction hose for obstructions or leaks.
- Replace the squeegee blades if they are nicked or torn.
- Make sure that the recovery tank drain hose cap seals airtight.

## Vacuum Suction Test

Use this procedure to verify that the vacuum system is performing within factory specifications. This procedure can also be used to isolate the cause of a vacuum problem between a clog or leak. It is a two-part procedure that verifies both static pressure and flow rate. This procedure requires a vacuum gauge (PN 56205281), a piece of 2" PVC (or similar) tube, a 1" hole saw, and some duct tape (or similar, for a seal).

1. Remove the suction hose (A) from the squeegee and then turn on the vacuum.
2. Place the vacuum gauge (B) on the hose so the taper (C) seals against the end of the hose.
3. Record the vacuum pressure reading from the gauge. This is the static pressure.
4. Turn the vacuum off while constructing and fitting the PVC restrictor tube (D).
5. Cut a piece of 2" PVC approximately 6" long, and clean off the burs. The outer diameter of the tube should be close to, but not larger than 2½".
6. Drill a 1" hole (E) approximately in the middle of the PVC tube, and clean off the burs.
7. As necessary, wrap duct tape around the tube so it fits snugly in the end of the suction hose with no leaks.
8. Turn the vacuum on and place the vacuum gauge on the restrictor tube.
9. Record the vacuum pressure reading from the gauge. This is the restricted flow pressure.



## Results Summary

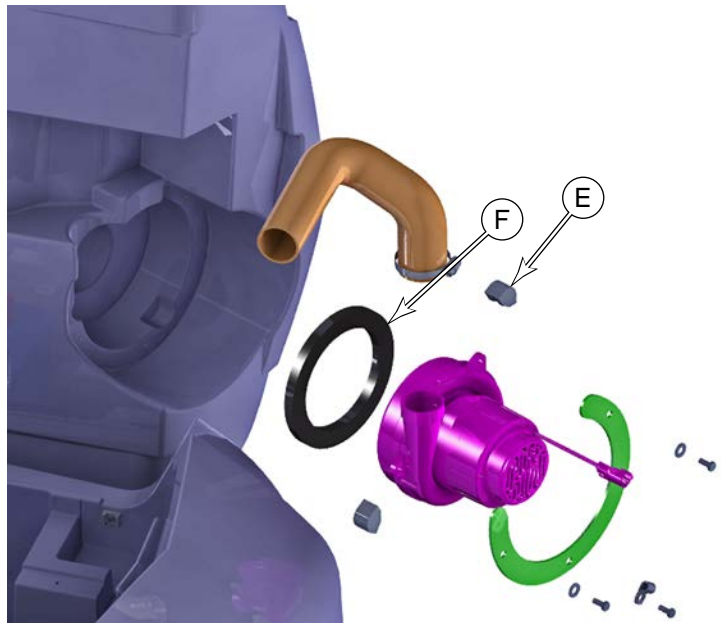
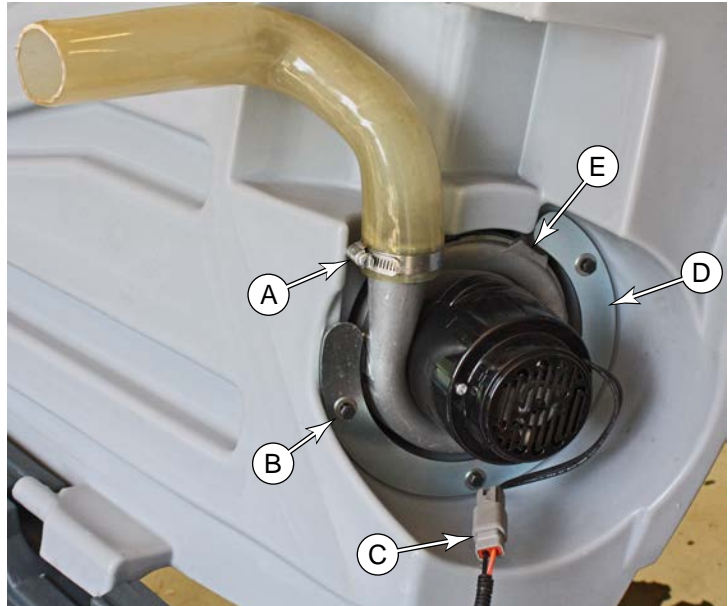
The first part of this procedure determined the static pressure of the vacuum system, and the second part determined the flow rate (by calculation). The flow rate through a restriction is determined by the pressure differential across the restriction. These two parameters may be used to determine if the vacuum system is functioning properly, and may also be used to isolate a possible cause for a problem.

- If the static pressure is at least 57 inches H<sub>2</sub>O, then the vacuum motor(s) are functioning properly and there are no significant leaks in the system.
- If the 1" restricted flow pressure is at least 20 inches H<sub>2</sub>O, then there are no significant clogs in the system.
- If both parameters are below specifications, then one or both vacuum motors may be failing, or there may be a significant leak in the system.

## Removal and Installation

### Vacuum Motor

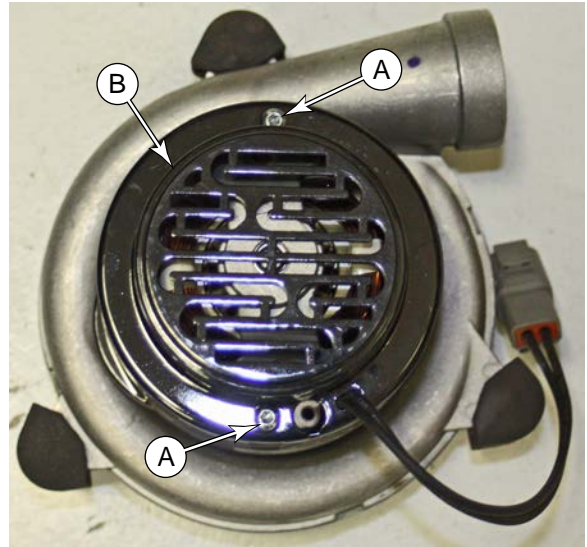
1. Drain the recovery tank and move it to the open position.
2. Disconnect the vacuum motor cable connector (C).
3. Loosen the hose clamp (A) on the exhaust hose, and remove the hose.
4. Remove the three screws and washers (B) that secure the vacuum retaining plate (D), and remove the plate and motor. Take care not to lose the three vibration mounts (E).
5. Inspect the main vacuum gasket (F) for damage and compressibility, and replace if necessary. Leaks in this gasket will reduce recovery system suction.
6. During replacement, make sure the three vibration mounts (E) are in place on the motor's tabs.



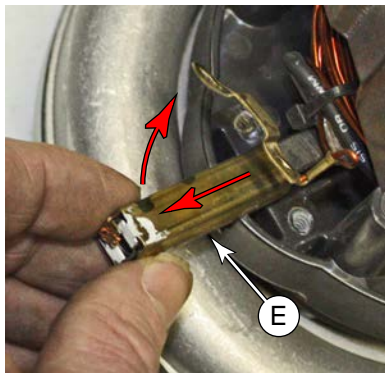
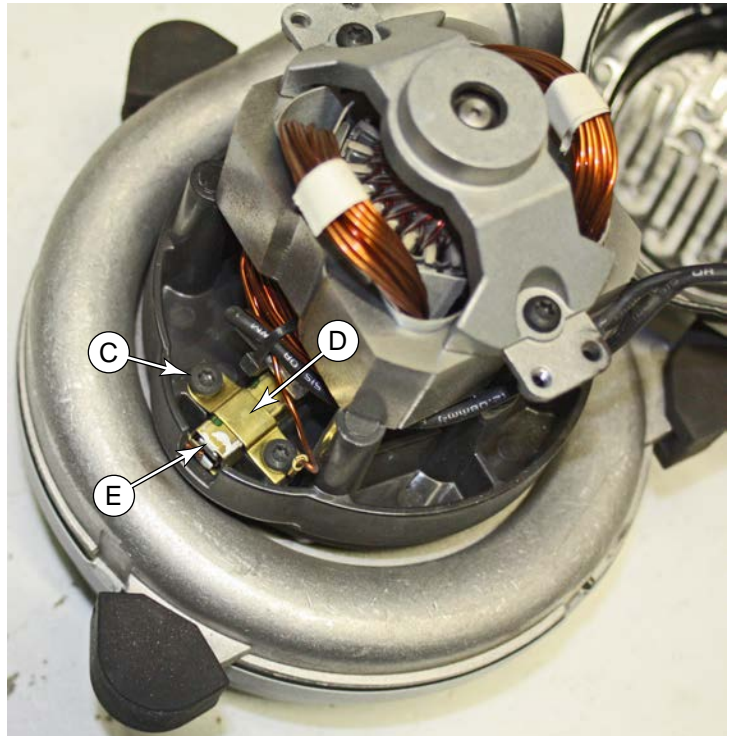


## Vacuum Motor Brushes

1. Remove the [Vacuum Motor](#) described on page 83.
2. Remove the two screws (A) that secure the motor cover to the motor, and remove the cover.



3. Remove the two screws (C) that secure the contact strap (D), and remove the strap. Take care to not bend the wire any more than necessary.
4. Lift the outer end of the brush (E) up, and slide the brush out of the motor housing.
5. Repeat for the second brush.



6. When installing a new brush, tilt the brush assembly downward at the front so the carbon bar contacts the commutator bars, and then compress the spring to fully insert the brush.



## Specifications

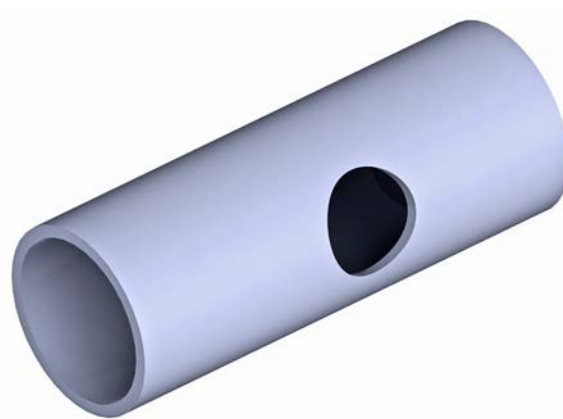
Parameter	Range
K3 Vac Relay Coil Resistance	105 $\Omega$
Sample Vacuum Motor Amps	17.5 to 18.3 Amps, Open hose, no squeegee.  Note that the less restricted the air flow, the higher the amps should be.

## Special Tools

Vacuum Pressure Gauge  
part number 56205281



1-inch open hole adapter  
Fabricated from PVC





## 90 - Options and Accessories

The SC901 machine may be equipped with optional accessories depending on the needs of the owner. Some of these accessories don't directly impact servicing the machine, but some may. So it is good to know what accessories you may encounter and how they impact the machine.

### Onboard Charger

The onboard battery charger is located in front of the battery bay. The charger connects directly to the batteries. It also adds (replaces) an interlock wire to the main key switch to prevent machine activation when the batteries are being charged.

When the charger is not present, a red battery-positive wire is connected to the input of the 2.5-amp circuit breaker. When the charger is present, this wire is replaced with the green interlock wire from the charger. When the charger is plugged in, this wire has no power, and therefore, the machine is inoperable.

Refer to the [“24 - Electrical System”](#) on page 33 for additional information on the charger.

### TrackClean

The TrackClean module adds a telemetry module at the front-left of the battery bay. This module receives discrete inputs from various circuits in the machine and reports them via cellular network to the machine's administrator. The module also receives GPS information for the machine's location and reports this as well.

The TrackClean module may also incorporate a Smartkey reader, located on the solution control panel. If this option is present, the machine will be inoperable without an authorized Smartkey.



### EcoFlex

The EcoFlex option adds a detergent control board behind the operator's handle, and also a detergent system with pump in the battery bay. Refer to the [“30 - Solution System”](#) on page 52 for additional details.

### Battery Watering

Adds a watering manifold and fill valves to the battery fill caps. It also includes a removable hand pump. It is not covered by the service manual.