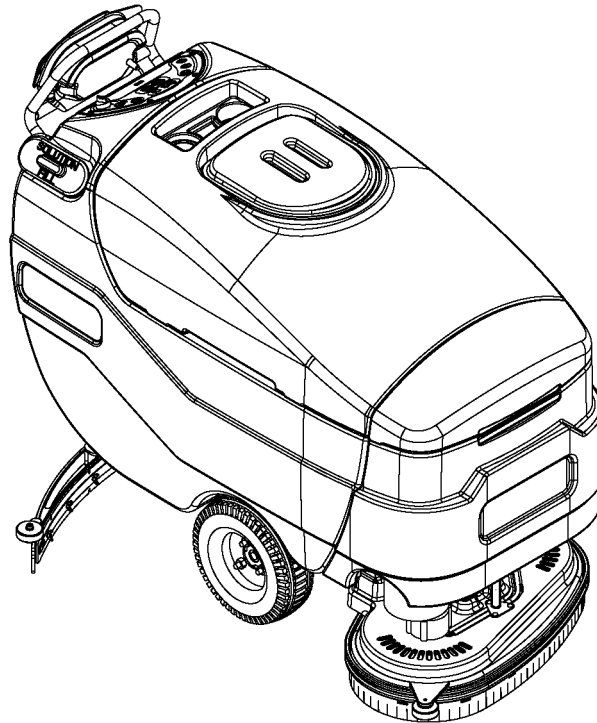


# Warrior™ ST, Warrior™ AXP

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## BA 755 series

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### Service Manual

Advance Models: 56315036(28D), 56315037(32D), 56315038(28C)  
56315039(32C-C), 56315040(X28D-C), 56315041(X32D-C)  
56315538(28D-C), 56315539(32D-C), 56315540(28C-C)  
56315541(X28C-C), 56315542(X32C-C)

Nilfisk Models: 56315042(755), 56315043(755C), 56315044(855)  
56315045(755X), 56315046(755CX), 56315047(855X)



**Advance**  
by Nilfisk-Advance

9/05 revised 8/06 FORM NO. 56043103



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**Note:** All references to right, left, front, or rear in this manual are as seen from the operator's stand-point.

## INTRODUCTION

This manual will help you get the most from your **Nilfisk-Advance automatic scrubber**. Read it thoroughly before servicing the machine.

**Note: Bold numbers and letters in parentheses indicate an item illustrated on pages 8-10.**

## PARTS AND SERVICE

Repairs, when required, should be performed by your Authorized Nilfisk-Advance Service Center, who employs factory trained service personnel, and maintains an inventory of Nilfisk-Advance original replacement parts and accessories.

Call the NILFISK-ADVANCE DEALER named below for repair parts or service. Please specify the Model and Serial Number when discussing your machine.

(Dealer, affix service sticker here.)

## NAME PLATE

The Model Number and Serial Number of your machine are shown on the Nameplate on the machine. This information is needed when ordering repair parts for the machine. Use the space below to note the Model Number and Serial Number of your machine for future reference.

MODEL NUMBER \_\_\_\_\_

SERIAL NUMBER \_\_\_\_\_

## TRANSPORTING THE MACHINE

### CAUTION!

Before transporting the machine on an open truck or trailer, make sure that . . .

- The machine is tied down securely.
- All access doors and covers are secured (tape and strap as needed).

## TOWING

### CAUTION!

If the machine must be towed or pushed, make sure the Master On/Off Key Switch **(A)** is in the OFF position and do not move the machine faster than a normal walking pace (2-3 mph, 3-5kph) and for short distances only. Note: Disconnecting the wheel drive motor wiring connector will make a disabled machine easier to push.

## OTHER MANUALS AVAILABLE FOR YOUR MACHINE

The manuals listed below can be found via Nilfisk-Advance's two electronic supported databases. They are:

- Nilfisk-Advance Dealer Customer Zone
  - Ezparts service / parts CD-Rom
  - Parts List - Form Number 56042463
  - Instructions for Use - Form Number
- 56041614 (Danish, Norwegian, Swedish, Finnish)  
56041615 (German, French, Dutch, Russian)  
56041616 (Spanish, Portuguese, Italian, Greek)  
56041617 (Estonian, Latvian, Lithuanian, Slovenian)  
56041618 (Slovakian, Czech, Polish, Hungarian)  
56041619 (English, Spanish)

# CAUTIONS AND WARNINGS

## SYMBOLS

Nilfisk-Advance uses the symbols below to signal potentially dangerous conditions. Read this information carefully and take the necessary steps to protect personnel and property.

### **DANGER!**

Is used to warn of immediate hazards that will cause severe personal injury or death.

### **WARNING!**

Is used to call attention to a situation that could cause severe personal injury.

### **CAUTION!**

Is used to call attention to a situation that could cause minor personal injury or damage to the machine or other property.



Read all instructions before using.

## GENERAL SAFETY INSTRUCTIONS

Specific Cautions and Warnings are included to warn you of potential danger of machine damage or bodily harm.

### **WARNING!**

- \* This machine should only be used by properly trained and authorized persons.
- \* While on ramps or inclines, avoid sudden stops when loaded. Avoid abrupt sharp turns. Use low speed down hills. Clean only while ascending (driving up) the ramp.
- \* Keep sparks, flame and smoking materials away from batteries. Explosive gases are vented during normal operation.
- \* Charging the batteries produces highly explosive hydrogen gas. Charge batteries only in well-ventilated areas away from open flame. Do not smoke while charging the batteries.
- \* Remove all jewelry when working near electrical components.
- \* Turn the key switch off (O) and disconnect the 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.
- \* Do not clean this machine with a pressure washer.
- \* Do not operate this machine on ramps or inclines of more than a 2 percent gradient.
- \* Only use the brushes provided with the appliance or those specified in the instruction manual. The use of other brushes may impair safety.

### **CAUTION!**

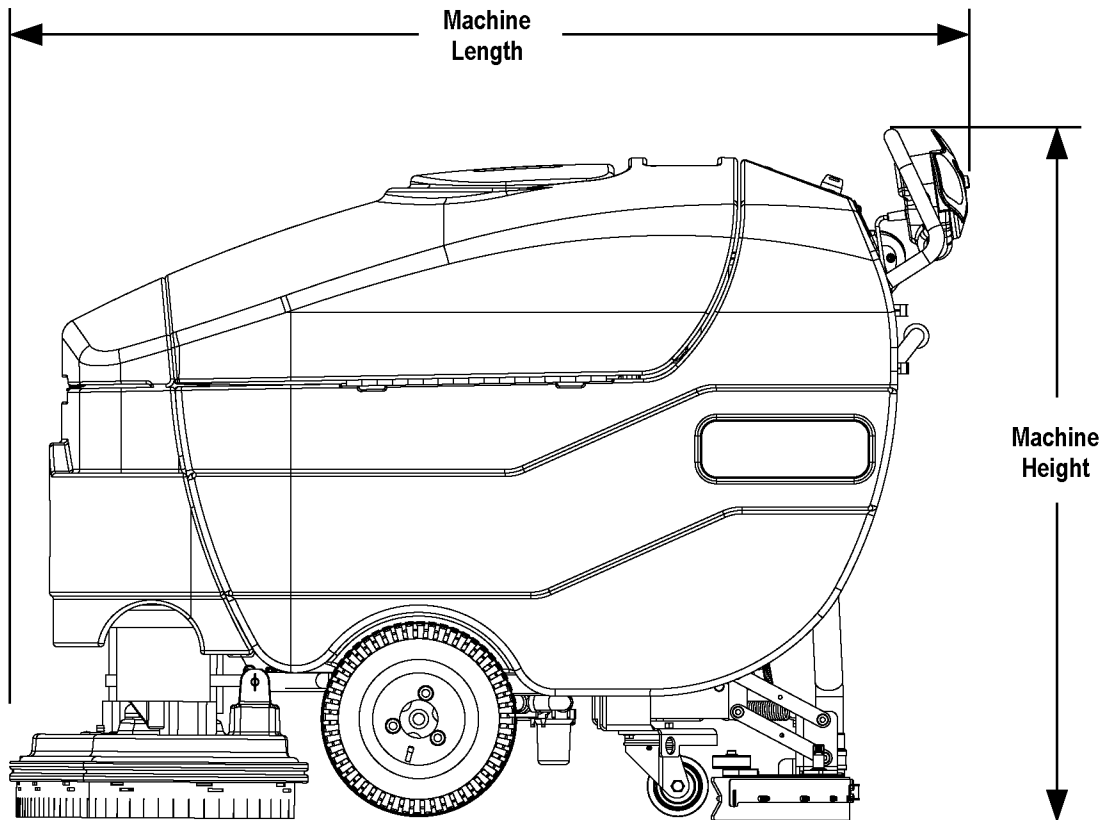
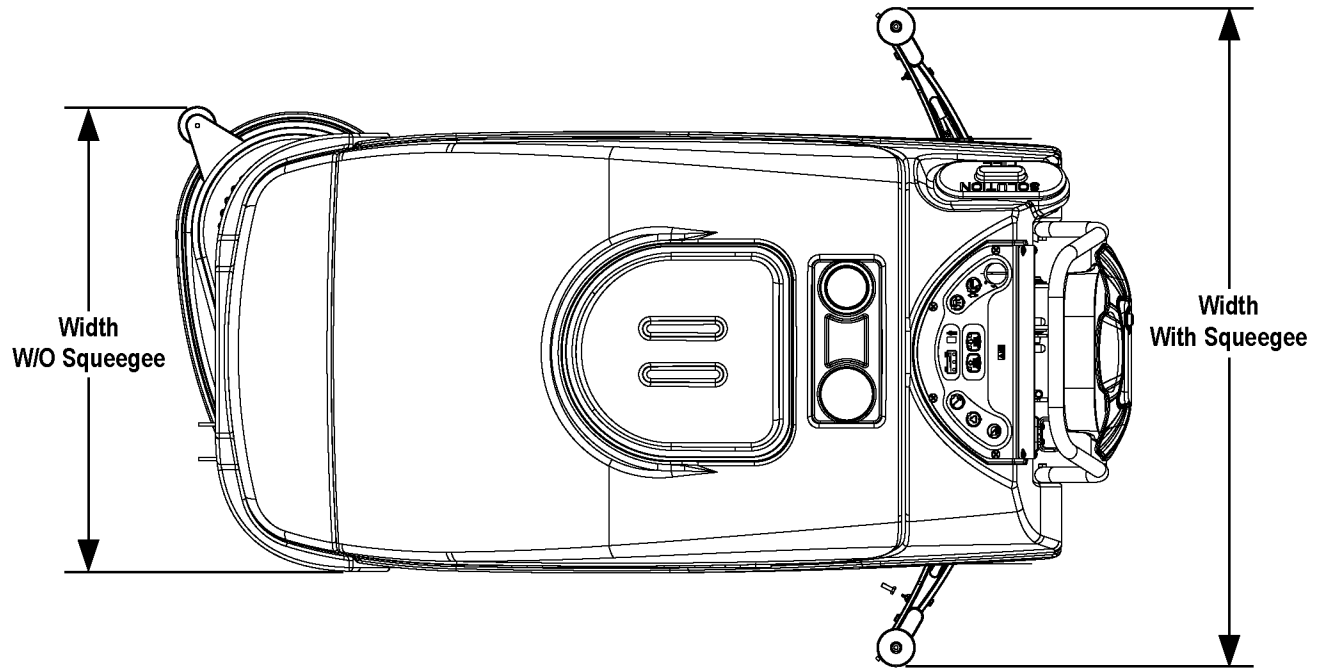
- \* This machine is not approved for use on public paths or roads.
- \* This machine is not suitable for picking up hazardous dust.
- \* Use care when using scarifier discs and grinding stones. Nilfisk-Advance will not be held responsible for any damage to floor surfaces caused by scarifiers or grinding stones.
- \* When operating this machine, ensure that third parties, particularly children, are not endangered.
- \* Before performing any service function, carefully read all instructions pertaining to that function.
- \* Do not leave the machine unattended without first turning the key switch off (O), removing the key and securing the machine.
- \* Turn the key switch off (O) and remove the key, before changing the brushes, and before opening any access panels.
- \* Take precautions to prevent hair, jewelry, or loose clothing from becoming caught in moving parts.
- \* Use caution when moving this machine in below freezing temperature conditions. Any water in the solution, recovery or detergent tanks or in the hose lines could freeze, causing damage to valves and fittings. Flush with windshield washer fluid.
- \* The batteries must be removed from the machine before the machine is scrapped. The disposal of the batteries should be safely done in accordance with your local environmental regulations.
- \* Do not use on surfaces having a gradient exceeding that marked on the machine.
- \* All doors and covers are to be positioned as indicated in the instruction manual before using the machine.
- \* Refer to the battery charger OEM product manual for additional specific battery charger warnings.

## SAVE THESE INSTRUCTIONS

# TECHNICAL SPECIFICATIONS

Voltage	36 Volt		
Power Source	(6) 6 volt batteries (wet acid and gel cell available)		
Onboard Battery Charger	36 volt, 25 amp Wet/Gel Compatible		
Solution Control	Precision-flow electric pump (Pulse-control gravity feed -Warrior ST)		
Solution Tank	30 gal. (114 L)		
Recovery Tank	30 gal. (114 L)		
Scrub Motors	(2) .75 hp (560 watt)		
Vacuum Motor	0.75 hp (560 watt) 3-stage		
Sound Level	69 dB(A) with sound suppression kit or 71dB(A) standard		
Drive System	0.5 hp (375 watt) variable forward and reverse, max speed =3 mph (4.83 km/hr), 10% gradeability		
Drive Wheels	(2) 13 in. (33 cm) dia. foam-filled, gray non-marking		
Scrub Head Type	Warrior 28D	Warrior 32D	Warrior 28C
Scrub Path	Disc		Cylindrical
Max Productivity @ 3.0 mph	28 in (71cm) 36,960 ft <sup>2</sup> /hr (3,434 m <sup>2</sup> /hr)	32 in (81cm) 42,240 ft <sup>2</sup> /hr (3,924 m <sup>2</sup> /hr)	28 in (71cm) 36,960 ft <sup>2</sup> /hr (3,434 m <sup>2</sup> /hr)
Max Productivity @ 1.5mph	18,480 ft <sup>2</sup> /hr (1,717 m <sup>2</sup> /hr)	21,120 ft <sup>2</sup> /hr (1,962 m <sup>2</sup> /hr)	18,480 ft <sup>2</sup> /hr (1,717 m <sup>2</sup> /hr)
Scrub Head Size & Type	(2) 14 in (36 cm) brushes or pad holders	(2) 16 in (41 cm) brushes or pad holders	(2) 27 in (69 cm) brushes
Scrub Pressure	(1) Regular Scrub (2) Heavy Scrub (3) Extreme Scrub	max 90 lbs max 175 lbs max 250 lbs	max 80 lbs max 100 lbs max 120 lbs
Scrub Head Speed		220 rpm	900 rpm
Solution Flow Rate	(1) Regular Scrub (2) Heavy Scrub (3) Extreme Scrub	.30 gal/min (1.1 L/min) or 100 minutes per solution tank .60 gal/min (2.3 L/min) or 50 minutes per solution tank .90 gal/min (3.4 L/min) or 33 minutes per solution tank	
Squeegee Width	41.9 in (106 cm)	41.9 in (106 cm)	41.9 in (106 cm)
Dimensions (w/o squeegee)	W=30.5 in (77cm) L=61.5 in (156 cm) H=45 in (114 cm)	W=31 in (79 cm) L=62.5 in (159 cm) H=45 in (114 cm)	W=35 in (89cm) L=61.75 in (157 cm) H=45 in (114 cm)
Weight w/ Std Batteries	914 lb (415 kg)	914 lb (415 kg)	946 lb (430 kg)
<b>AXP Specifications</b>			
Refillable Cartridge Capacity	1.25 gal (4.75 L)		
Available Dilution Rates	32:1, 50:1, 64:1, 100:1, 128:1, 150:1, 200:1, 256:1, & 300:1		
Low Detergent Warning	Standard		

# TECHNICAL SPECIFICATIONS



## MAINTENANCE SCHEDULE

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

MAINTENANCE ITEM	Daily	Weekly	Monthly	Yearly
Charge Batteries	X			
Check/Clean Tanks & Hoses (clean recovery tank switches & vacuum inlet screen)	X			
Check/Clean/Rotate the Brushes/Pads	X			
Check/Clean the Squeegee	X			
Clean Hopper on Cylindrical System	X			
Purge Extended Scrub System (if installed)	X			
Check Each Battery Cell(s) Water Level (does not apply to gel cell batteries)		X		
Inspect Scrub Housing Skirts		X		
Inspect and clean Solution Filter		X		
Clean Solution Manifolds on Cylindrical System		X		
Purge Detergent System (AXP/ECO+Solution only)		X		
Lubricate the Machine			X	
* Check Carbon Brushes				X

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

\* Have Nilfisk-Advance check the vacuum motor carbon motor brushes once a year or after 300 operating hours. The brush and drive motor carbon brushes check every 500 hours or once a year.

### **⚠ WARNING!**

Turn the key switch off and disconnect the batteries before servicing the machine.

- \* Check vacuum motor carbon brushes (Qty 2) once a year or after 300 operating hours.
- \* Check brush and wheel drive motor(s) carbon brushes (Qty 4 per motor) once a year or after 500 operating hours.
- \* The original (new) length of each carbon brush is 1" (25.4mm) on all 36 volt machine models 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.

### **⚠ IMPORTANT!**

Motor damage resulting from failure to service the carbon brushes is not covered under warranty. See the Limited Warranty Statement.

## BATTERIES AND CHARGERS

**Attention:** See the ELECTRICAL SYSTEM section for battery installation, battery maintenance and charger system requirements.

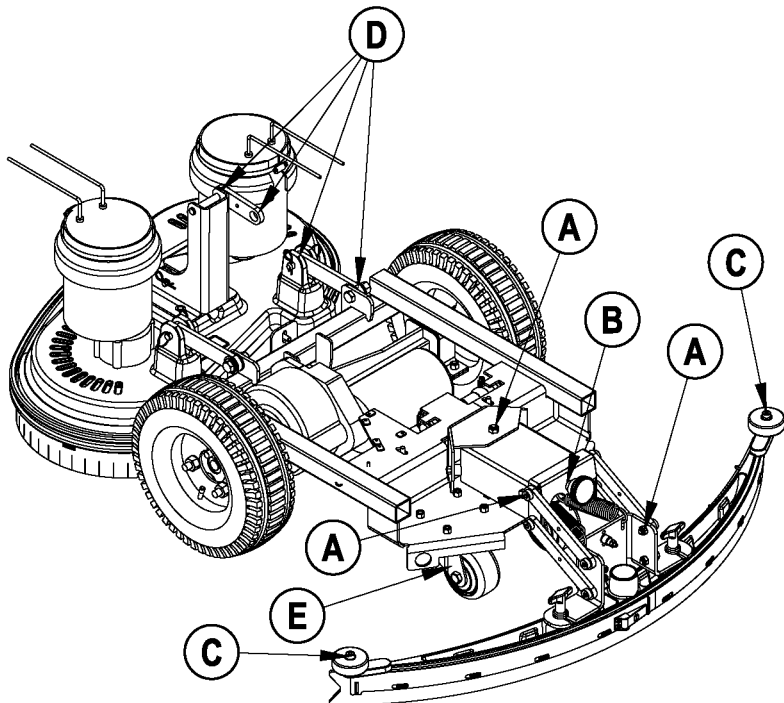
## LUBRICATING THE MACHINE

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

- General Pivot Points For the Squeegee Linkage (A).
- Squeegee mount angle adjustment knob threads (B).
- Squeegee Tool end wheels (C).
- General Pivot Points For the Brush Linkage (D).
- Scrub Deck Bumper Wheels.

Once per quarter, Grease the following

- Rear Caster Wheel Swivels (E).





# Nilfisk-Advance Warrior™ ST, Warrior™ AXP / BA 755 series Models

## Cylindrical and Disc PM Checklist

Customer \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ St \_\_\_\_\_ Zip \_\_\_\_\_  
 Model \_\_\_\_\_ Serial \_\_\_\_\_ Hours \_\_\_\_\_

**Defect Codes**  
**A** needs adjustment  
**B** binding  
**C** dirty or contaminated  
**D** damaged, bent or torn  
**L** leaks  
**M** missing  
**W** worn out

Ref	OPERATIONAL INSPECTION ITEMS	OK	Defect Codes (circle)	Does Not Work
1	Drive Paddle Operation (check for Fwd/Rev Drive & any neutral creep)		A B D	
2	Drive System Performance (Speed Changes Min/Max)		noisy sluggish	
3	Scrub System (Raise/Lower, Brush Motor On/Off & Optional Brush Remove Feature)		A B D	
4	Scrub Brush Pressure settings (1-3)		A B	
5	Squeegee System (Raise/Lower & Squeegee Tool pickup Performance)		A B D	
6	Vac Performance (Sealed water lift & 1" open hole adapter, 36v-56/9)		C L W	
7	Solution Control (On/Off Manual /Auto and Flow Volume settings 1,2 &3)		A B L	
8	Battery Charger (Auto turn ON & OFF)		D	
9	Main Controller Special Program Options (see SVR manual 56043103). Check all applicable machine settings. Examples: Scrub mode pressure settings, SVR test mode, low voltage cutout etc.		A	

Ref	VISUAL INSPECTION ITEMS	Comments	OK	Defect Codes (circle)	Does Not Work
10	Scrub Brushes, check for wear and rotate			D M W	
11	Scrub Brush Motor(s), check for carbon brush wear	500 Hours		B C W	
12	Scrub Brush Motor(s), check gearboxes	(disc)		B D L	
13	Brush Drive Plate Retainer Clips & flex couplers	(disc)		C D M	
14	Scrub Deck Lift Motor, Skirt & Side Wheel			D M W	
15	Solution Solenoid Valve			C L W	
16	Solution Pump & Hoses			C L W	
17	Solution Tank, Delivery Hoses & Filter	clean filter screen		C L	
18	Vacuum Motor Carbon Brushes (wear limit 3/8")	300 Hours		B C W	
19	Vacuum motor inlet filter (located in recovery tank)	clean screen		C D M	
20	Recovery Tank Cover Gasket			L M W	
21	Recovery Tank Drain Hose & Cap			C D L	
22	Squeegee Pick-Up Hose	back flush		C D L	
23	Squeegee Tool & Blades (clean, rotate & adjust)			A D W	
24	Squeegee Tool lift cable & mount Wheels (lubricate)	two side & one floor		A D W	
25	Battery Condition (load test, clean & water)			C W	
26	Drive Wheel Trans Axle Motor Check Carbon Brushes	500 Hours		B C D W	
27	Trans Axle Drive Tires	tread wear		W	
28	Rear chassis Caster Wheel (Lubricate)	tread wear		W	

**NOTE: For additional service information see service manual form number 56043103 and operator manual form number 56041619.**

WORK COMPLETED BY: \_\_\_\_\_

ACKNOWLEDGED BY: \_\_\_\_\_

Service Technician Signature \_\_\_\_\_

Date \_\_\_\_\_

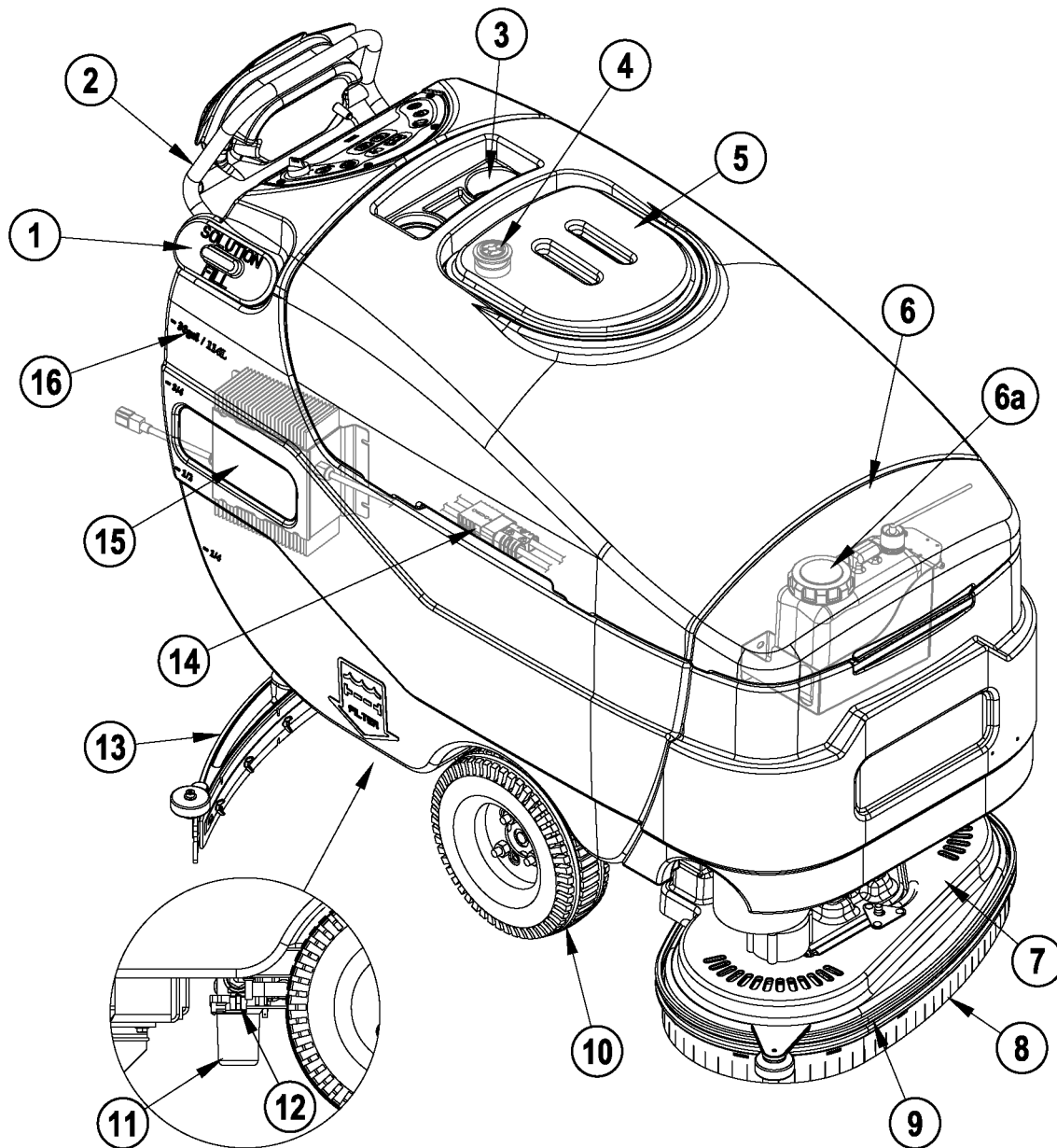
Customer Signature \_\_\_\_\_

Date \_\_\_\_\_

## KNOW YOUR MACHINE

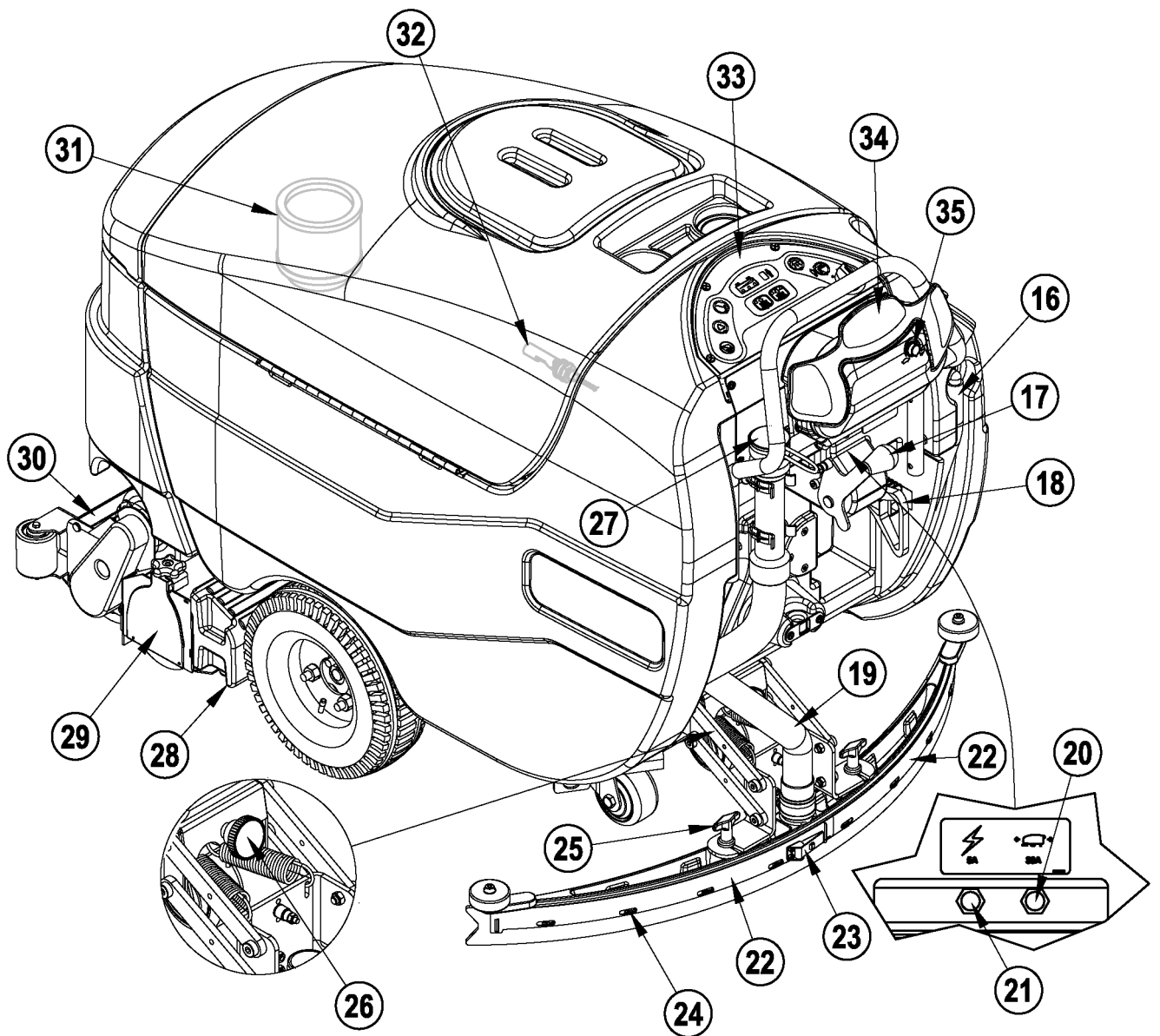
As you read this manual, you will occasionally run across a bold number or letter in parentheses - example: **(2)**. These numbers refer to an item shown on these pages unless otherwise noted. Refer back to these pages whenever necessary to pinpoint the location of an item mentioned in the text. **NOTE:** Refer to the service manual for detailed explanations of each item illustrated on the next 4 pages.

- |    |  |    |  |
|----|--|----|--|
| 1  | Solution Tank Fill   | 8  | Scrub Deck Skirt                                     |
| 2  | Operator Control Handle  | 9  | Scrub Deck Bumper                                    |
| 3  | Bottle Holders   | 10 | Drive Wheel  |
| 4  | Vacuum Motor Inlet Screen  | 11 | Solution Filter                                      |
| 5  | Recovery Tank Cover  | 12 | Solution Shut-Off Valve                              |
| 6  | Detergent(AXP/ECO+Solution) Cartridge Access Cover                   | 13 | Squeegee Assembly                                    |
| 6a | Detergent(AXP/ECO+Solution) Cartridge (AXP/ECO+Solution models only) | 14 | Battery Pack Connector (onboard charger models only) |
| 7  | Scrub Deck   | 15 | Onboard Battery Charger (Not found on all models)    |



# KNOW YOUR MACHINE

- |    |  |    |   |
|----|--|----|---|
| 16 | Solution Drain Hose / Level Indicator                    | 27 | Recovery Tank Drain Hose                    |
| 17 | Squeegee Raise / Lower Lever                             | 28 | Debris Hopper (Cylindrical Models Only)     |
| 18 | Battery Pack Connector (non onboard charger models only) | 29 | Idler Assembly (Cylindrical Models Only)    |
| 19 | Recovery Hose  | 30 | Solution Manifold (Cylindrical Models Only) |
| 20 | Wheel Drive Circuit Breaker                              | 31 | Extended Scrub Filter (Optional)            |
| 21 | Control Circuit Circuit Breaker                          | 32 | Vacuum Shut Off Switch                      |
| 22 | Squeegee Blade Tension Strap                             | 33 | Control Panel                               |
| 23 | Squeegee Blade Latch                                     | 34 | Drive Paddle                                |
| 24 | Squeegee Blade Alignment Pins                            | 35 | Speed Limit Control Knob                    |
| 25 | Squeegee Mount Thumb Nut                                 |    |   |
| 26 | Squeegee Adjustment Knob                                 |    |   |



# CONTROL PANEL – AXP/ECO+Solution

A Key Switch (Main Power)

B Solution Switch

C Vacuum Switch

D Display Panel

D1 Solution Flow Indicator

D2 Fault Indicator

D3 Hour Meter

D4 AXP/ECO+Solution Indicator

D5 Battery Indicator

D6 Scrub Pressure Indicator

D7 Recovery Tank FULL Indicator

D8 Battery Low Indicator

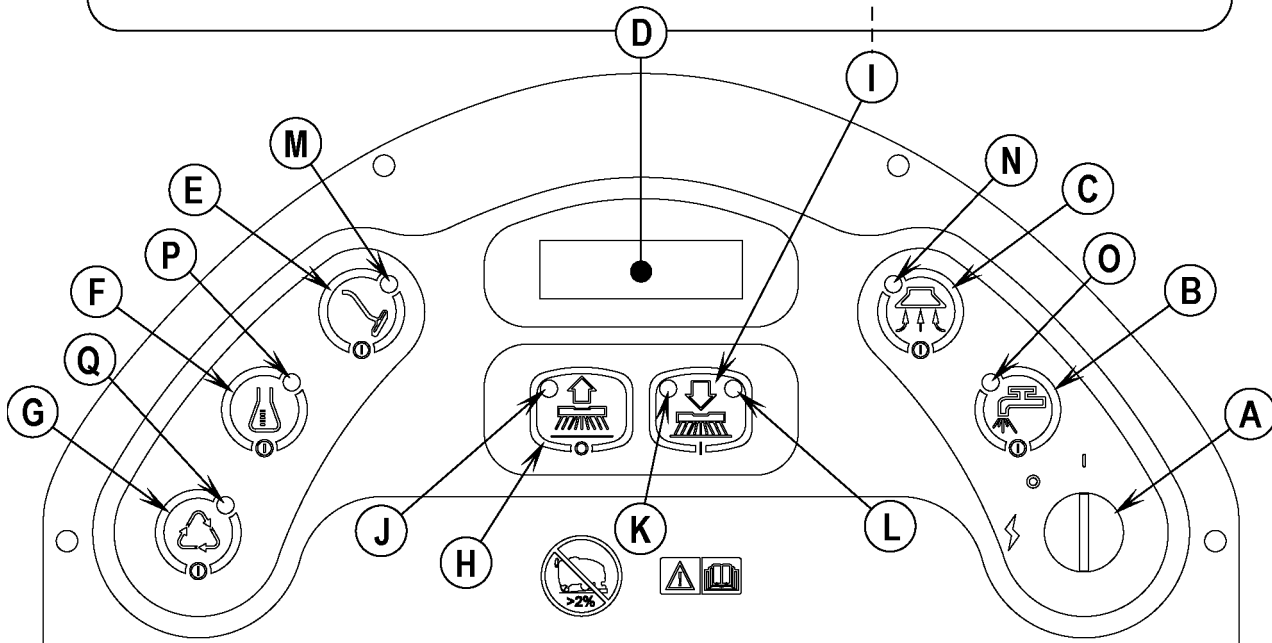
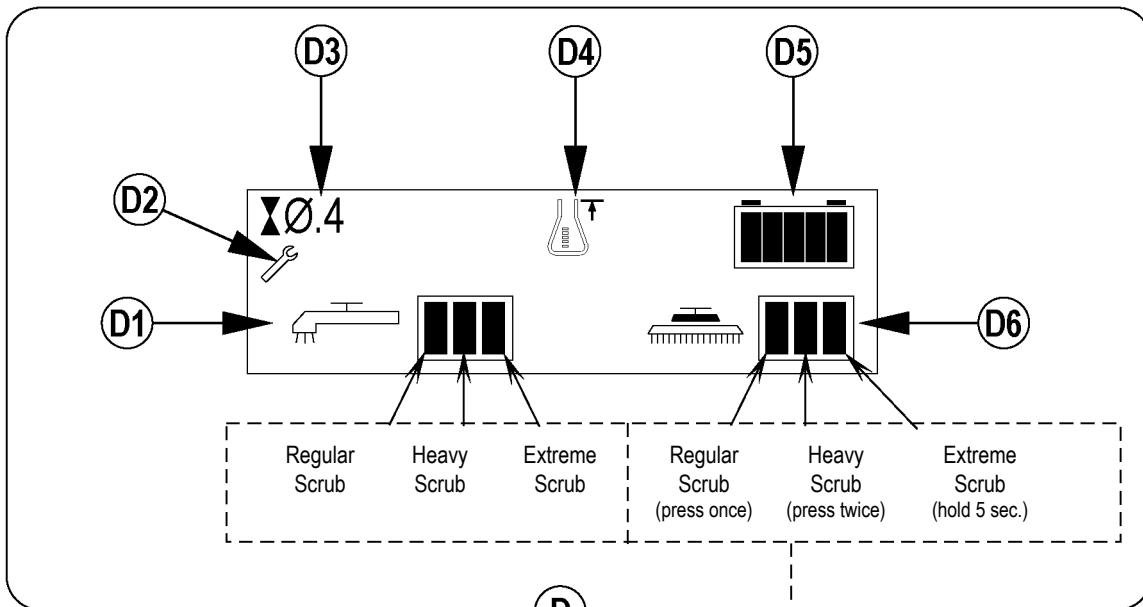
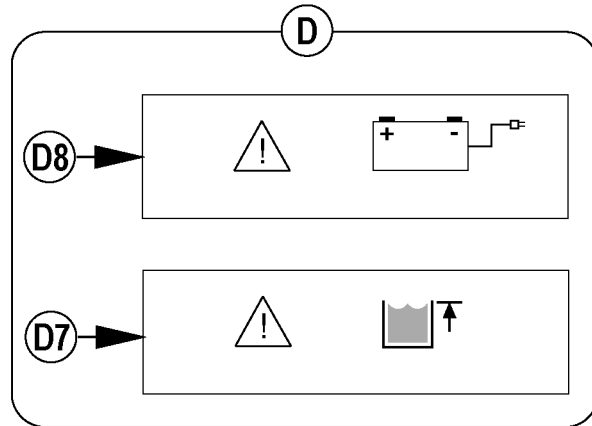
E Wand Switch (Dealer Installed Option)

F Detergent System (AXP/ECO+Solution models only)

G Extended Scrub System (Dealer Installed Option)

H Scrub OFF

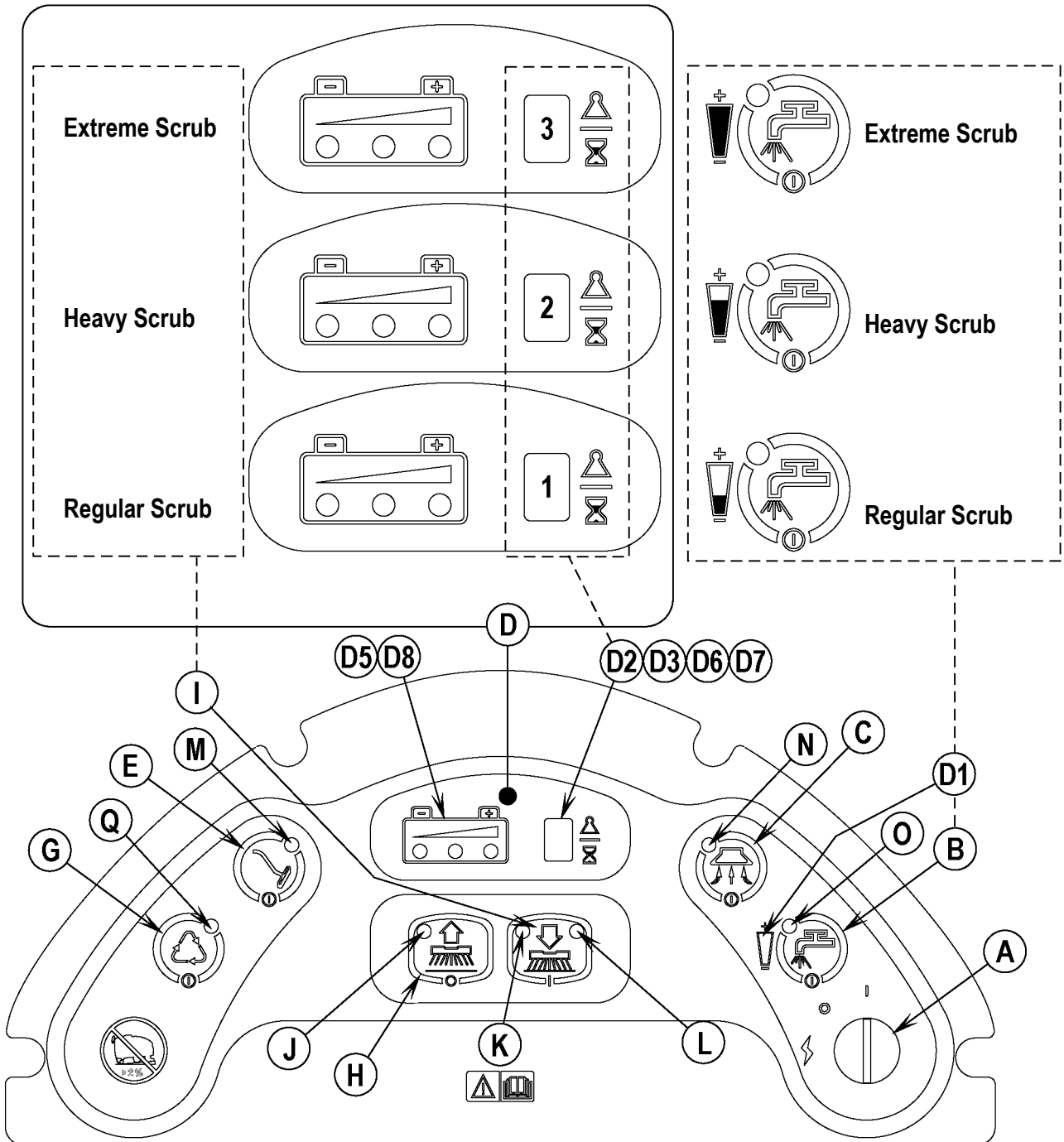
I Scrub ON



# CONTROL PANEL – STANDARD

- A Key Switch (Main Power)
- B Solution Switch
- C Vacuum Switch
- D1 Solution Flow Indicator
- E Wand Switch (Dealer Installed Option)
- G Extended Scrub System (Dealer Installed Option)
- H Scrub OFF
- I Scrub ON

- D Display Panel
- D1 Solution Flow Indicator
- D2 Fault Indicator
- D3 Hour Meter
- D5 Battery Indicator
- D6 Scrub Pressure Indicator
- D7 Recovery Tank FULL Indicator
- D8 Battery Low Indicator



## KNOW YOUR MACHINE

### FUNCTIONAL DESCRIPTION OF CONTROL PANEL:

The controls on the Convertamatic were designed with *one touch operation* in mind. For single pass scrubbing the user can simply depress one switch and all systems on the machine will be ready to go. For most single-pass scrubbing operations, the operator should only need to use the middle switches on the control panel. These are the Scrub System OFF and Scrub system ON switches.

**Scrub OFF Switch (H)** - Pressing this switch when the unit is in a scrub mode will cause the following to occur:

- The scrub brushes will turn off and the scrub deck will be raised to the up position
- The solution flow will be stopped
- The first time that this switch is pressed, the vacuum system will NOT be turned off. This is so that any remaining water may be picked up without having to turn the vacuum back on. If this switch is pressed a second time (pressed after the scrub system has been turned off) the vacuum will shut off after a 10 second delay.

**Scrub ON Switch (I)** – If the scrub system is off, pressing this switch once will cause the following to occur:

- The scrub system will be enabled with the scrub pressure set to the regular setting and the scrub deck will be lowered. Note press twice for the heavy scrub pressure mode and hold this switch for 5 seconds to enter the extreme scrub mode.
- The vacuum system will be enabled.
- The solution system will be enabled.
- As soon as the throttle (operator drive paddle) is moved from the neutral position the scrub brushes will start turning and the vacuum will turn on. If the direction is forward the solution flow will start. If the direction is reverse, the solution flow will be stopped. If the scrub system is already enabled when this switch is pressed, the scrub pressure will increase to the heavy scrub mode. If the switch is held for 5 seconds the pressure will change to the extreme scrub mode. At the same time the panel display will show the correct changed scrub pressure setting.

**Wand Switch (E)** – This switch is used when an external vacuum/scrub wand is used. Pressing this switch will turn the vacuum on continuously without regard to the throttle position. If the scrub system was on it will be turned off. This includes turning off the scrub brushes and turning the solution flow off (to the scrub deck). **NOTE:** *automatic shutoff of the vacuum motor when the recovery tank is full is disabled when the wand is enabled.*

**Key Switch (A)** – Main power switch

**Vacuum Switch (C)** – This switch is used to turn the vacuum system on or off. Pressing this switch will alternate between on and off. The vacuum will only turn on when the throttle is moved from the neutral position. It will remain on for 10 seconds after the throttle returns to neutral. The vacuum also has an automatic shutoff feature that will turn the vacuum and scrub systems off if the recovery tank becomes full.

**Solution Switch (B)** - This switch is used to turn the solution system on or off. Pressing this switch when the scrub system has been activated will alternate between on and off. The solution flow will only turn on when the throttle is moved from the neutral position in the forward direction. The solution flow will turn off if the throttle returns to neutral or is moved to reverse. Pressing this switch when the scrub system is off will momentarily turn the solution flow on to allow pre-wetting of the scrub brushes.

**Chemical Switch (AXP™ / ECO+Solution™ only) (F)** – Pressing this switch will turn on or off the chemical option. See the main programming options in this manual to select (activate) the onboard chemical distribution system.

**Extended Scrub (Recycle) Switch (G)** - Pressing this switch will turn on or off the recycle option. See the main programming options in this manual to select (activate) the recycle option. Push and hold this switch for 3 seconds (the indicator **(Q)** will turn green) to initiate the purge function. The purge will run for 20 seconds. **NOTE:** This is to flush any debris from the system. If you do not do this, the extended pump and(or) solenoid valve could become plugged up with debris.

## KNOW YOUR MACHINE

### DESCRIPTION OF INDICATORS ON THE CONTROL PANEL:

In general, the following guidelines apply to the control panel indicators:

A **flashing green or yellow** indicator means that a fault has occurred in the particular system. An example of this would be an over-current fault.

A **yellow** indicator means that the particular function has been enabled but is not currently on. For example, if a scrub mode is selected and the throttle is in neutral, the scrub system, vacuum, and solution indicators will all be yellow indicating that the systems are enabled and ready to turn on when the throttle is moved to forward or reverse.

A **green** indicator means that the particular system is on.

A **flashing green** indicator means that the particular system is in a delayed-off condition. An example of this is when a scrub mode is selected and the throttle goes from forward or reverse to neutral. When this happens the vacuum indicator will flash green indicating that the vacuum is still on but that it will be turning off after the delay period.

#### **Scrub OFF Indicator (J):**

- This indicator will be green if the scrub system is off and ready to be activated.
- This indicator will be red if the scrub system has been turned off and the scrub deck is not up yet.
- This indicator will flash red if there is a fault in the scrub system.
- This indicator will be off if the scrub system has been activated.

#### **Regular Scrub ON Indicator (K):**

- This indicator will be yellow if the scrub system is enabled in "Regular" scrub mode but the drive paddle is in neutral.
- This indicator will be green if the scrub system has been turned on in "Regular" scrub mode and the machine is moving in either direction.
- This indicator will be off if the scrub system has been turned OFF.

#### **Heavy Scrub ON Indicator (L):**

- This indicator will be yellow if the scrub system is enabled in "Heavy" scrub mode but the drive paddle is in neutral.
- This indicator will be green if the scrub system has been turned on in "Heavy" scrub mode and the machine is moving in either direction.
- This indicator will be off if the scrub system has been turned OFF.

#### **Extreme Scrub ON Indicators (K & L):**

- Both of these indicators will be yellow if the scrub system is enabled in "Extreme" scrub mode but the drive paddle is in neutral.
- Both of these indicators will be green if the scrub system has been turned on in "Extreme" scrub mode and the machine is moving in either direction.

#### **Control panel Display (D):**

See the detailed drawing shown in the Know Your Machine manual section for the specific description of the individual icon symbols. **NOTE:** If a speed control fault occurs (error code 3) the wand indicator will flash the fault code produced by the Curtis speed control. Refer to the service manual troubleshooting section for details.

#### **Wand Switch Indicator (M):**

- This indicator will be green if the Wand Switch has been turned ON.
- This indicator will be off if the Wand Switch has been turned OFF.

#### **Vacuum System Indicator (N):**

- This indicator will be green if the vacuum is on.
- This indicator will flash green if the vacuum is in the 10 second delayed-off condition.
- This indicator will be yellow if the vacuum is enabled but the drive pedal is in neutral.
- This indicator will flash yellow if there is a vacuum system fault.
- This indicator will be off if the vacuum is disabled and turned off.

#### **Solution System Indicator (O):**

- This indicator will be green if the solution is on.
- This indicator will be yellow if the solution is enabled but the drive paddle is in neutral.
- This indicator will flash yellow if there is a solution system fault.
- This indicator will be off if the solution is disabled and turned off.

#### **Chemical "AXP" System Indicator (P):**

- This indicator will be green if the AXP system is on.
- This indicator will be yellow if the AXP system is enabled but the drive paddle is in neutral.
- This indicator will be off if the AXP system is disabled and turned off.

#### **Extended Scrub System Indicator (Q):**

- This indicator will be green if the Extended Scrub system is on or if the "Purge" function has been initiated.
- This indicator will be yellow if the Extended Scrub system is enabled but the recovery tank switches haven't been activated.
- This indicator will be off if the Extended Scrub system is disabled and turned off.

# SOLUTION SYSTEM

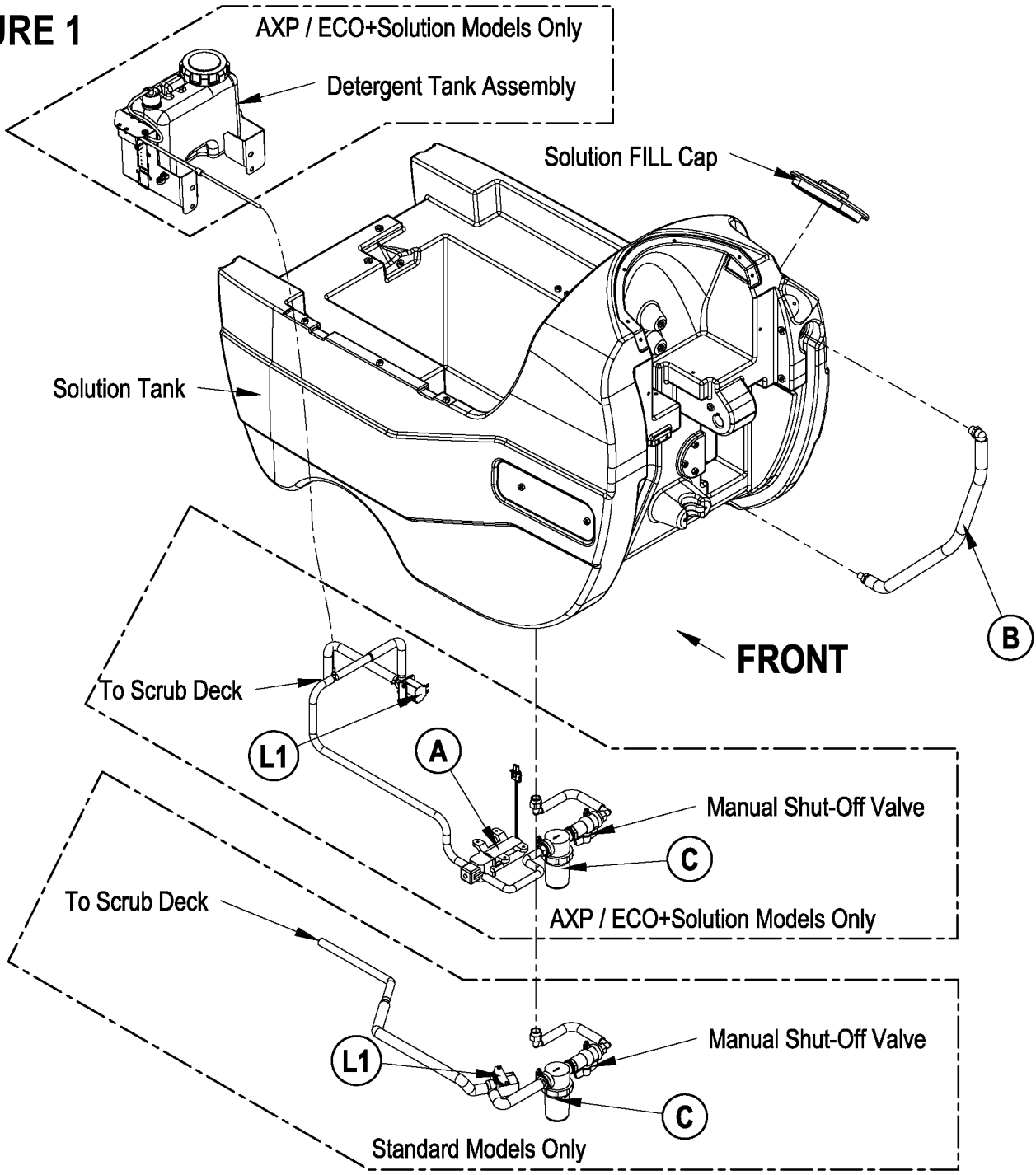
## FUNCTIONAL OVERVIEW

See Figure 1. The Warrior™ / BA 755 series models have a solution tank fill capacity of 30 gallons (113.5 Liters). All models use one right rear tank fill opening, which offers ease of filling. Plumbed into the manual solution shut off valve outlet is a serviceable Solution Filter (C), to keep debris from entering the solenoid valve (all models) and solution pump (AXP™ / ECO+Solution™ only). Also fitted to the tank is a flexible Clear Hose (B) used to indicate the solution level and to drain the tank for system maintenance.

The solution system uses an electrical Solenoid Valve (L1) which stops and starts the solution flow to the scrub brushes. The M7 water pump (A) located on the machine chassis controls the needed flow volume demand to the scrub brushes (AXP™ / ECO+Solution™ only). See Electrical Diagram Figure 2. The electrical circuit that turns on (energizes) the solenoid coil and water pump is activated through the (A1) control panel's solution switch button input and the FWD / REV (A2) Speed Controller voltage output signals. Note: See the Know Your Machine section in this manual for a complete explanation of the solution operation modes.

During normal machine scrubbing the solution system's Auto Mode is selected and works in conjunction with the wheel drive speed controller and the (A1) main controller's scrub system outputs to turn On & Off the Solenoid Valve (L1) and Pump (A). The solution will flow to the scrub brushes when the scrub deck is lowered and the handle drive paddle (box) is pushed Fwd. Note: When the solution On/Off button is turned Off, no flow can occur while the machine scrub deck is down and the drive paddle activated.

**FIGURE 1**





## SOLUTION SYSTEM

### CIRCUIT OVERVIEW SOLUTION AUTO MODE (SOLENOID VALVE CIRCUIT)

APPLIES TO AXP™ / ECO+SOLUTION™ MODELS

See Figure 2.

**+ (Positive) circuit input starts with:**

- A closed S3 key switch will direct the needed positive voltage (BRN wires) to the L1 solenoid coil and A1 control board terminal #J1-13.

**- (Negative) circuit input starts with:**

- A battery negative ground input at the A1 control board terminal #B2 (J1-9)
- The A1 control board solution button enabled.
- A negative voltage output from the A2 speed controller's (pin #6) Red/Blk wire to the A1 control board Red/Blk wire (terminal J1-5). Note: The A2 speed controls brake output (pin #6) occurs whenever the R1 direction throttle pot is moved off its neutral setting.
- A negative voltage output from the A1 board's terminal J1-11 Red/Grn wire is direct to the L1 solenoid coil turning it on to allow flow through the valve body.

### CIRCUIT OVERVIEW SOLUTION AUTO MODE (SOLUTION PUMP CIRCUIT)

APPLIES TO AXP™ / ECO+SOLUTION™ MODELS

See Figure 2.

**+ (Positive) circuit input starts with:**

- With the batteries connected the needed positive voltage (Red wires) to the M7 Solution Pump.

**- (Negative) circuit input starts with:**

- A battery negative ground input at the A1 control board terminal #B4 (J2-6)
- The A1 control board solution button enabled.
- A negative voltage output from the A2 speed controller's (pin #6) Red/Blk wire to the A1 control board Red/Blk wire (terminal J1-5). Note: The A2 speed controls brake output (pin #6) occurs whenever the R1 direction throttle pot is moved off its neutral setting.
- A negative voltage output from the A1 board's terminal J1-8 Grn/Blk wire is direct to the M7 Solution Pump turning it on to allow flow to the L1 Water Valve Solenoid. **NOTE:** The solution pump's output volume is controlled by the A1 board's programmable capability and changes the pulsing of the negative battery connection to the pump. This circuit turns the pump on and off by supplying different reduced voltage values which manages the (3) different working flow volumes.

### CIRCUIT OVERVIEW SOLUTION AUTO MODE (SOLENOID VALVE CIRCUIT)

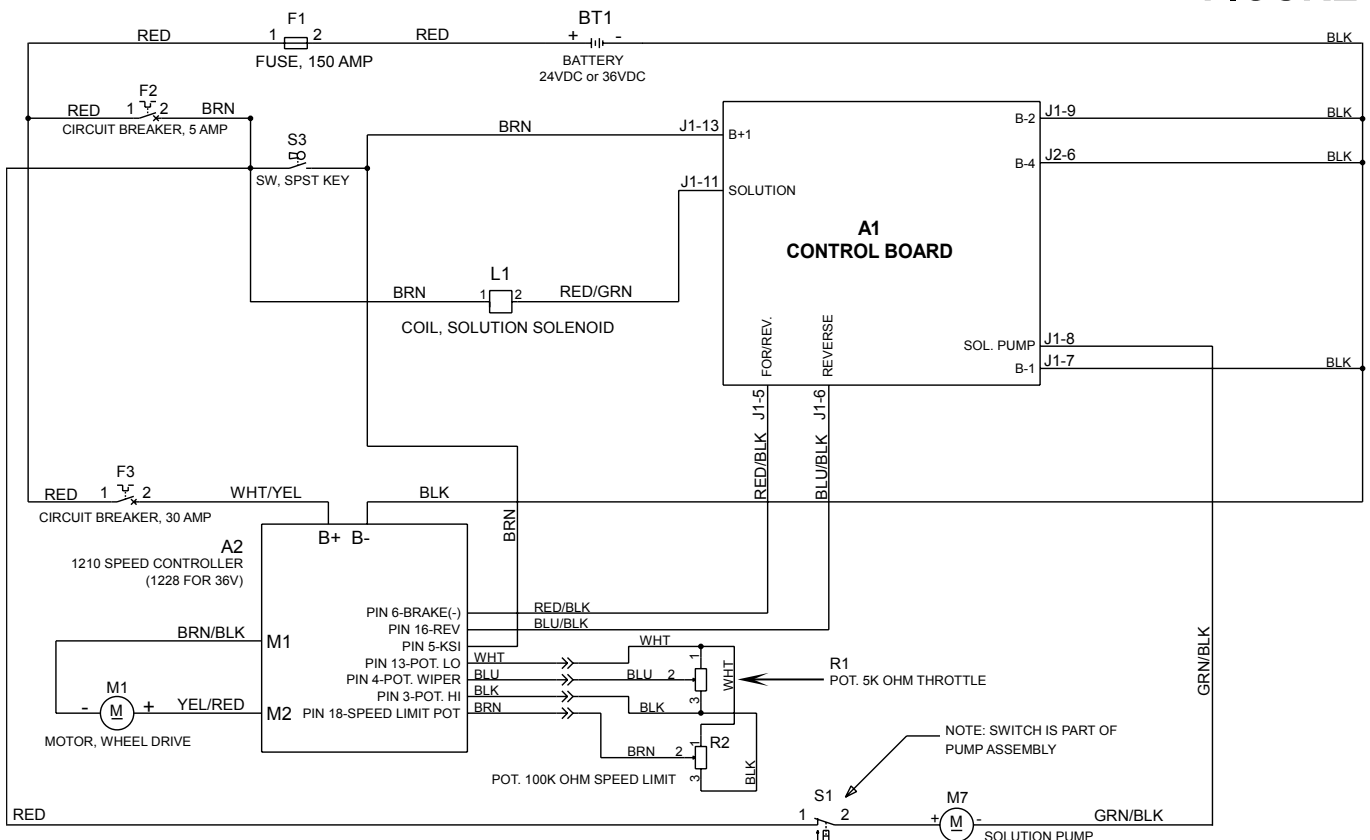
APPLIES TO STANDARD (NON AXP™ / ECO+SOLUTION™) MODELS

- **NOTE:** The standard machines do not use a solution pump. The (3) standard solution flow volumes are managed by the A1 control board's negative voltage output from the terminal J1-11 Red/Grn wire. This circuit turns on and off thus opening and closing the L1 solenoid which manages the (3) distinctive solution flow rates by gravity feed only.

## Electrical Diagram

\*For complete description of all callouts see Electrical System *Wiring Diagram*.

**FIGURE 2**



## SOLUTION SYSTEM

### SOLUTION SYSTEM MAINTENANCE

- **Solution Tank:** See Figure 1. Empty the solution tank weekly; remove the solution Drain Hose (B) from its storage area (located on the right rear control handle compartment). Direct the hose to a designated "Disposal Site" and flush the tank with clean water.
- **Solution Filter:** Remove and clean the inline Solution Filter (C). To access the filter housing for removal, work underneath the middle right rear side of the machine's chassis. No tools are needed to remove the filter (hand tighten only). **Service Tip:** The solution filter ball valve must be placed in the OFF (Closed) position. This prevents loss of solution when servicing the filter strainer with a partial or full tank.
- **Solution Delivery Trough:** On the cylindrical scrub deck clean the holes in the delivery trough and manifolds to assure even distribution of solution.

### TROUBLESHOOTING GUIDE

Problem	Possible Cause
Inadequate or no solution flow	No solution in the tank
	Solution tank filter ball valve in the off position
	Clogged solution filter, valves and(or) hoses

\*Reference the Solution System Troubleshooting Guide flowchart in this manual section for further component diagnostics.

# SOLUTION SYSTEM

## TROUBLESHOOTING GUIDE ELECTRICAL

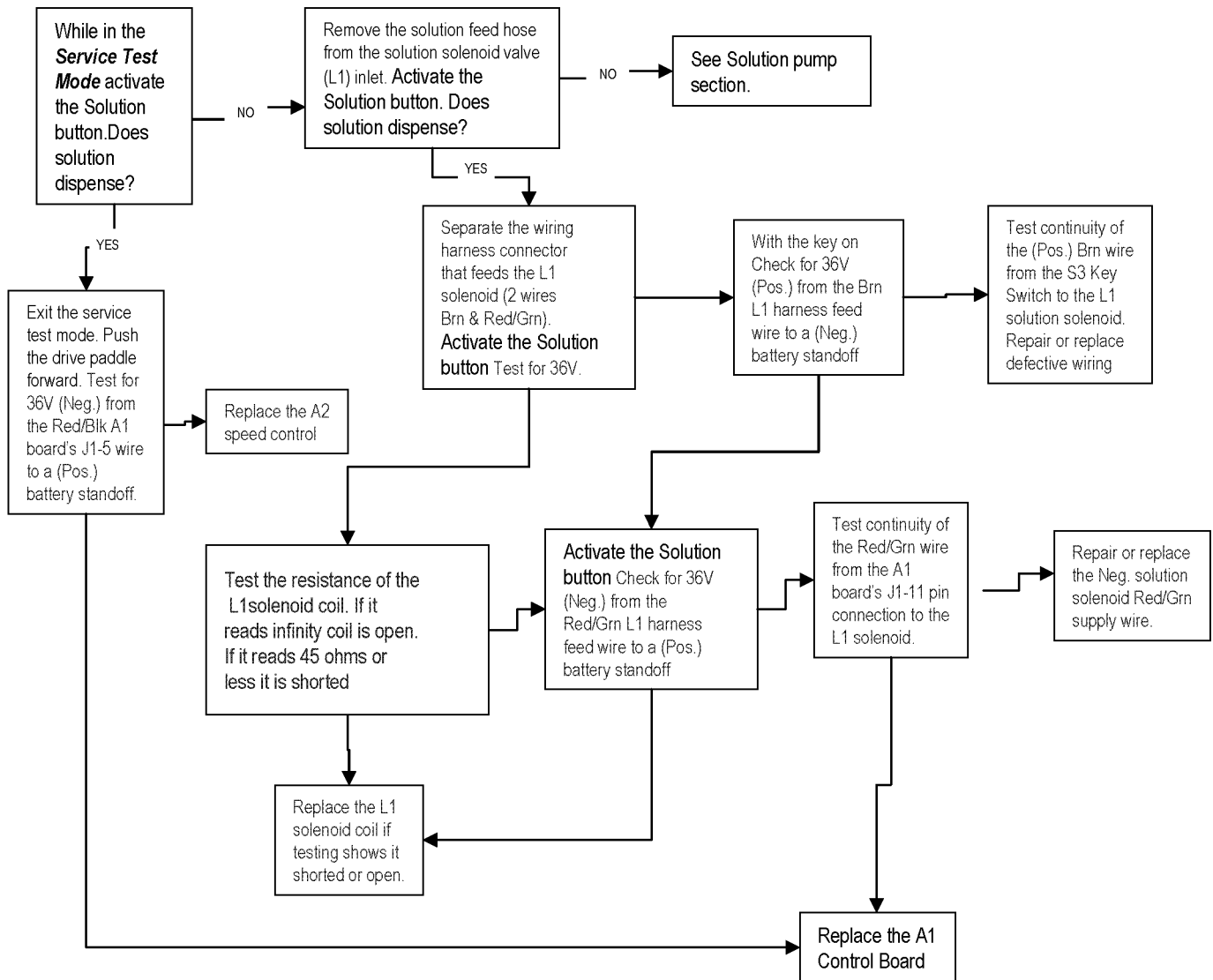
### Possible Symptoms

- 1-No solution flow while in the scrub auto solution mode.
- 2-Solution Pump will not operate:

### SYMPTOM ONE

**Note: Activate the Service Test Mode Program. See optional program section for instructions.**

All testing will be performed in the **Service Test Mode Program**.

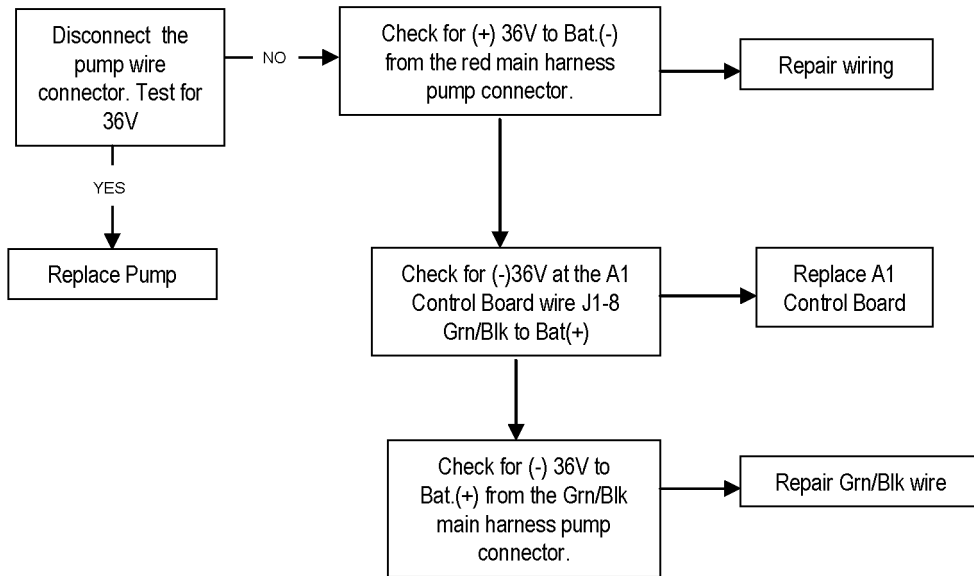


# SOLUTION SYSTEM

## TROUBLESHOOTING GUIDE ELECTRICAL (CONTINUED)

### SYMPTOM TWO

**Note:** Activate the Service Test Mode Program. See optional program section for instructions.  
All testing will be performed in the *Service Test Mode Program*.



## SOLUTION SYSTEM

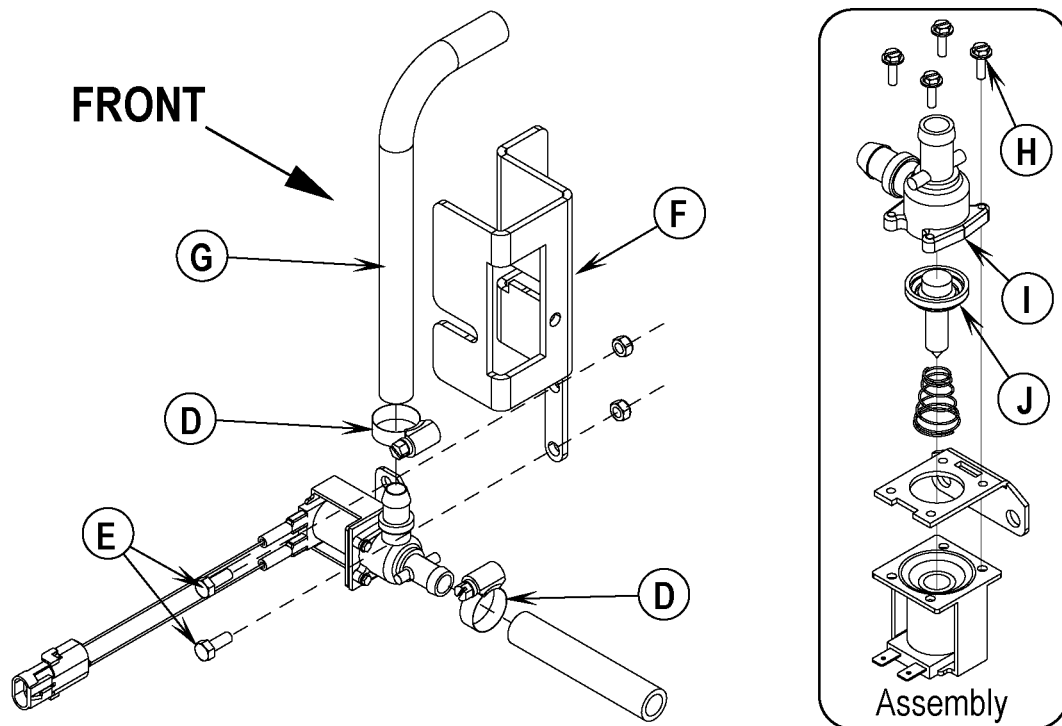
### SOLENOID VALVE REMOVAL (AXP™ / ECO+Solution™)

- 1 Drain the solution tank or turn the solution filter ball valve to the off position to prevent solution loss.
- 2 Lower the deck and disconnect the battery supply to the machine.
- 3 Remove the front Nose Cone from the machine by firmly grasping the lower part and lifting straight up.
- 4 **See Figure 3.** Unplug the L1 solenoid valve wire assembly connection from the machine harness.
- 5 Unscrew the inlet Hose Clamps (D) that secure the hoses to the valve body.
- 6 Separate (pry) the solution outlet hose off from its valve body barbed fitting.
- 7 Remove the (2) Hex Screws (E) that secure the valve to the Mount Bracket (F), then pull the valve body to the front separating it from the solution inlet Hose (G), completing the part removal.

### SOLENOID VALVE DISASSEMBLY AND CLEANING (AXP™ / ECO+Solution™)

- 1 Remove the solenoid valve. See the *Solenoid Valve Removal* section for instructions.
- 2 **See Figure 3.** Remove the (4) (H) Screws and disassemble the valve (be careful not to lose any internal parts).
- 3 Thoroughly wash dirt from block (I) and diaphragm (J).
- 4 After reassembling, test the solenoid valve for proper operation.

**FIGURE 3**



## SOLUTION SYSTEM

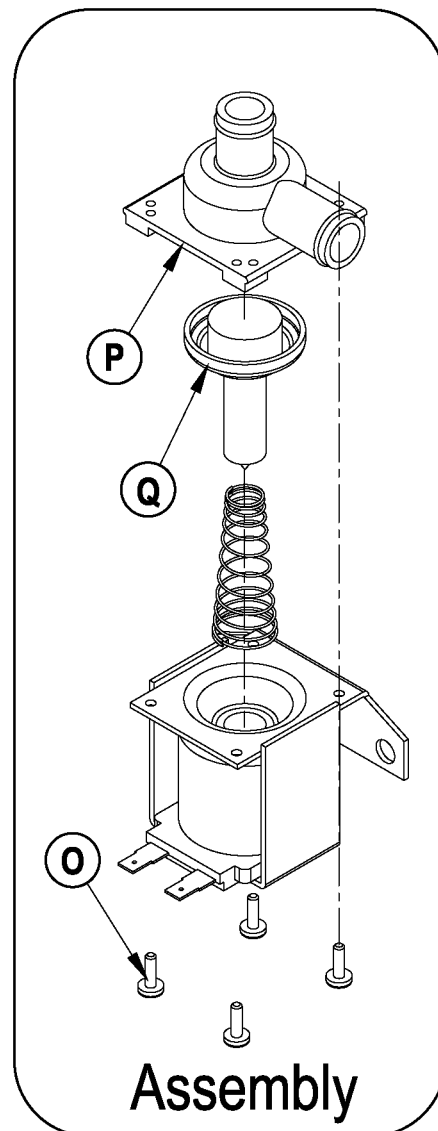
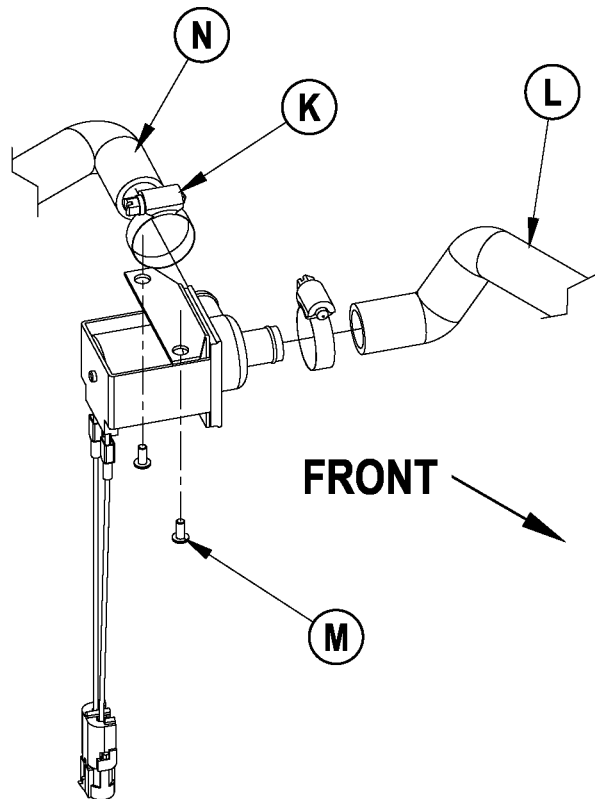
### SOLENOID VALVE REMOVAL (STANDARD)

- 1 Drain the solution tank or turn the solution filter ball valve to the off position to prevent solution loss.
- 2 Disconnect the battery supply to the machine.
- 3 **See Figure 4.** Unplug the L1 solenoid valve wire assembly connection from the machine harness.
- 4 Unscrew the inlet Hose Clamps (K) that secure the hoses to the valve body.
- 5 Separate (pry) the solution outlet hose (L) off from its valve body barbed fitting.
- 6 Remove the (2) Hex Screws (M) that secure the valve to the underside of the chassis, then pull the valve body to the front separating it from the solution inlet Hose (N), completing the part removal.

### SOLENOID VALVE DISASSEMBLY AND CLEANING (STANDARD)

- 1 Remove the solenoid valve. See the *Solenoid Valve Removal* section for instructions.
- 2 **See Figure 4.** Remove the (4) (O) Screws and disassemble the valve (be careful not to lose any internal parts).
- 3 Thoroughly wash dirt from block (P) and diaphragm (Q).
- 4 After reassembling, test the solenoid valve for proper operation.

**FIGURE 4**

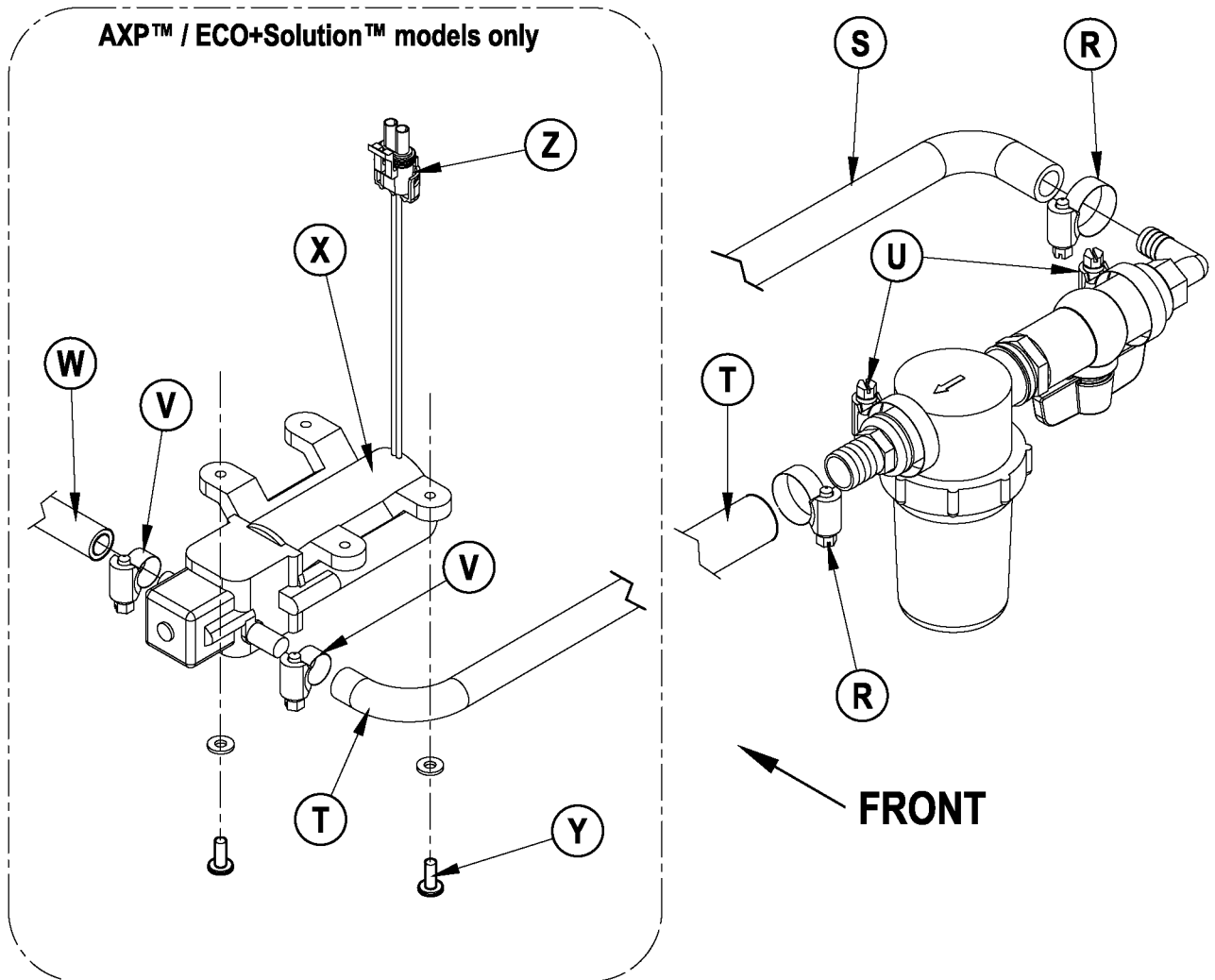


## SOLUTION SYSTEM

### SOLUTION FILTER AND BALL VALVE REMOVAL

- 1 Drain the solution tank using the solution drain hose (B).
- 2 See Figure 5. Loosen the (2) Hose Clamps (R) and pry off the inlet Solution Hose (S) and Solution Hose (T).
- 3 Remove the (2) Hose Clamps (U) that secure the Filter / Valve Assembly to the chassis and remove the assembly from the machine.

## FIGURE 5



### SOLUTION PUMP REMOVAL (AXP™ / ECO+Solution™)

- 1 Drain the solution tank or turn the solution filter ball valve to the off position to prevent solution loss.
- 2 See Figure 5. Loosen the (2) Hose Clamps (V) and pry off inlet Hose (T) and outlet Hose (W) from Solution Pump (X).
- 3 Remove the (2) Screws (Y) that secure the Solution Pump to the Chassis.
- 4 Disconnect the Solution Pump Electrical Connector (Z); (A tie strap may need to be cut) completing the part removal.

**NOTE:** Refer to the *APPENDIX* at the back of this manual for solution system flow schematics and detergent system information.

# SCRUB SYSTEM

## FUNCTIONAL OVERVIEW

### • Disk Brush System Overview

See Figure 2. The disk models use a disk type scrub system powered by (2) 3/4 hp motor gearbox assemblies.

### • Cylindrical Brush System Overview

See Figure 4. The cylindrical models use two cylindrical brushes that counter rotate to sweep up light debris and scrub at the same time. Each scrub brush is powered on opposing ends by 3/4 HP permanent magnet motors attached to separate poly-V belt/pulley drives.

### • General Brush Overview

**Note: Recovery Tank Full switch must be closed (Tank empty).** On all models the scrub deck platform is raised & lowered automatically by a vertically mounted electric lift actuator motor. The operation of the machine's scrub functions are activated when the operator selects (presses) the scrub on (mode) panel button. The scrub pad or brush pressure ranges (1-3) are selectable allowing the operator the choice to vary the scrubbing effort (pressure) while operating the machine. Note: See the *Main Control Board Special Program Options* section in this manual for more detailed operation and instructions to change scrub pressure settings.

See Figure 1. The machine's main scrub system input and output operating functions are regulated (managed) by the display panel and combined main control board A1. The major scrub system functions are...

### • M2 / M3 - Scrub Brush Motor Run Function

Circuit Overview Scrub Brush Motor

#### + (Positive) Circuit input starts with:

- A closed S3 key switch supplies the needed positive voltage to the K1 brush solenoid coil and the A1 control board #J1-13 (Brn wire). Note: The A1 control board scrub-on button must also be depressed (enabled). This operator command lowers the brush deck. Once the K1 load is closed the needed Positive voltage is supplied to the motors M2 and M3 from battery Pos.

#### - (Negative) Circuit input starts with:

- A battery negative ground input at the A1 control board terminals B2 (J1-9) Blk and B1 (J1-7) Blk.
- Note: The A1 control board scrub-on button must also be depressed (enabled).
- A negative voltage output from the A2 speed controller's Neg. (pin #6) Red/Blk wire to the A1 control board Red/Blk wire (terminal J1-5). Note: The A2 speed control brake output (neg.) (pin #6) occurs whenever the R1 direction throttle pot is moved off its neutral setting.
- A negative voltage output from the A1 board's terminal (J1-14) Vio/Blk wire completes the K1 solenoid coil circuit (Pos. & Neg.) and pulls in the load contact making the brush motors run.  
The Neg. M2 and M3 load voltage is supplied from the battery Neg.

### • M5 - Scrub Brush Actuator Lift Motor Function

The A1 control board outputs a controlled motor voltage polarity change (wires J2-1 and J2-8) that raises and lowers the scrub-deck for installing, removing and controlling the scrub brushes' selected current load. The large BLK negative (-) scrub brush motor wire is specially designed so that it has a known (specified) resistance value. As brush motor current passes through the negative wire that is, in effect, a low value resistor, a small voltage drop is developed across it which is proportional to the motor current. This voltage change is inputted to the A1 control board at J2-5 and J1-7 (sense wires WHT/GRA & BLK). Any surrounding temperature change in this large Neg. motor wire affects its resistance so the temperature is sensed by a thermistor (\*) built into the control board A1. This allows the controller to provide error correction for the temperature resistance changes. When the controller senses a current draw out of the desired range it automatically turns on the M5 actuator motor to raise or lower the scrub deck. This process is on going in maintaining the operator's selected scrub motor current load setting to sustain the desired brush working pressure.

### • Scrub System Low Voltage Cut-Out Function

The purpose of the special low battery voltage cutout function is to help prolong battery life. The scrub deck will be raised and the brush motors and solution solenoid valve will turn OFF automatically and cease to function when the batteries discharge to the selected cutout level. The cutout level is adjustable between two settings. The standard setting (wet cell/lead acid) is 1.72 volts per cell and alternate setting (gel/maintenance free) is 1.81 volts per cell. Note: See the battery system section for instructions for selecting (setting) the two different thresholds.

## SPECIAL SCRUB SYSTEM FUNCTIONS

### • Scrub Brush Removal Function (Disc only)

For removal of the scrub brushes automatically, the scrub deck must be in the up position and the drive system in neutral. To remove the scrub brushes simply depress the control panel scrub-off button (H) for 2-3 seconds. The A1 control board will momentarily run the brush motors and then stop them quickly, where the brushes inertia causes the brushes to easily spin off of the scrub brush motors drive caps.



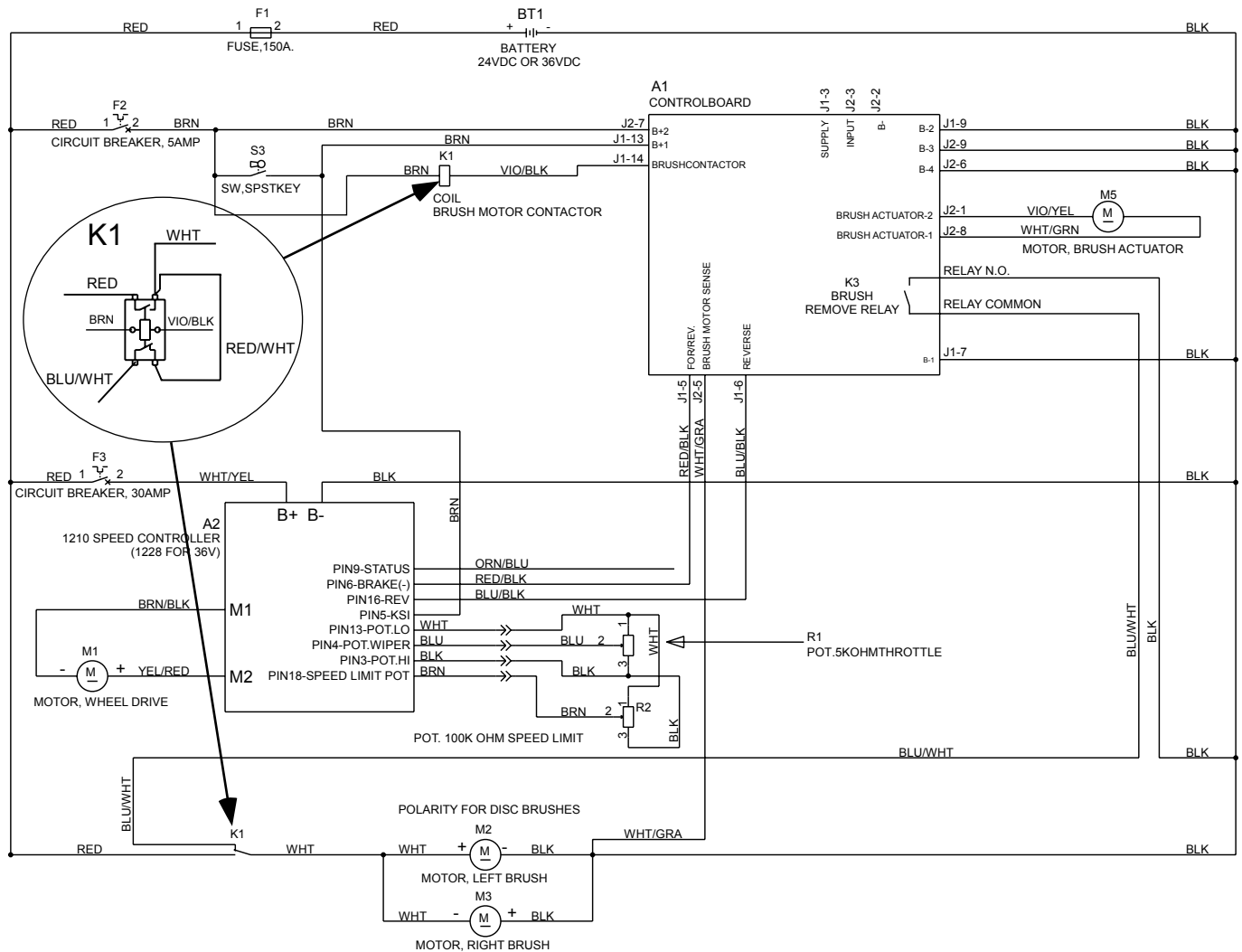
# SCRUB SYSTEM

- Scrub Brush Removal Function (Continued / Disc only)
- Control and Load circuit detail.

A closed S3 key switch supplies the needed positive voltage to the K1 brush solenoid coil, A1 control board (J1-13) Brn wire and K3 brush remove coil relay (Part of A1 Control Board).

- The brush remove circuit sequence starts when the operator depresses the control panel scrub off button (H) for 2-3 seconds activating the A1 board's brush remove function. This triggers (starts) an internal timer relay closing the K1 coil ground circuit, pin (J1-14) Vio/Blk wire turning on momentarily the brush solenoid to run the brush motors.
- Simultaneously with the K1 coil being turned on the same input command closes the K3 coil (Part of A1 Control Board) turning it ON.
- This pulls in the K3 load contacts (Part of A1 Control Board) connecting it to the battery ground through the A1 Brush Remove circuit N.O. Blk wire and Common Blu/Wht wire to K1 Load Contactor N.C
- The next step is the board timer turning off the K1 brush solenoid and connecting the normally Pos. motor load circuit to a battery ground, sending a neg. voltage from the K3 Relay (Part of A1 Control Board) though the Blu/Wht N.O. wire. When K1 is de-energized the neg. voltage from the K3 relay is connected to the Brush Motors Positive Wht. wires through a Red/Wht jumper wire connected to the K1 N.C.
- With two battery ground inputs at the brush motors this circuit causes a short to ground and the motors stop abruptly. The built up brushes inertia easily spins the brushes off the motors drive disc lugs.

## FIGURE 1



## SCRUB SYSTEM

### SCRUB BRUSH DECK REMOVAL (DISC)

- 1 Lower the scrub deck with brushes (pads) installed. Turn the key switch off and disconnect the battery pack.
- 2 Lift up and remove cover and nose cone, from front of machine.
- 3 **See Figure 2.** Separate the solution system water line located on top of the scrub deck. Loosen the Hose Clamp (A) and separate the hoses.
- 4 Unplug both of the brush motor wiring harnesses (B). **NOTE:** Cable ties may need to be cut.
- 5 Remove the lower Hitch Pin (C) that secures the brush deck lift actuator to the scrub deck. **NOTE:** Lift up on the actuator spring housing to take pressure off the Pin (C).
- 6 Remove the Cotter Pin (D) and washers that attaches the Upper Hitch Pin (E) to the machine chassis Linkage Arm (F).
- 7 Remove the two (G) Hitch Pins that attach the scrub deck to the machine's chassis Linkage Arms (H). Then rotate the Arms (H) out of the way.
- 8 From the front of the machine swing the lower actuator housing forward to clear the deck mount bracket (remove the actuator on AXP™ / ECO+Solution™ models). Then slide the deck towards the left side of the machine until Pin (E) is clear of Arm (F). Pull the deck forward away from the machine to complete the removal. **SERVICE NOTE: It is important that the actuator motor is not run while it is disconnected from the deck or chassis mounts. This precaution will prevent the actuator drive nut from being misadjusted (moved out of its set specification).**
- 9 To reinstall a scrub deck, follow the above steps in reverse order.

### SCRUB BRUSH LIFT ACTUATOR REMOVAL (DISC.)

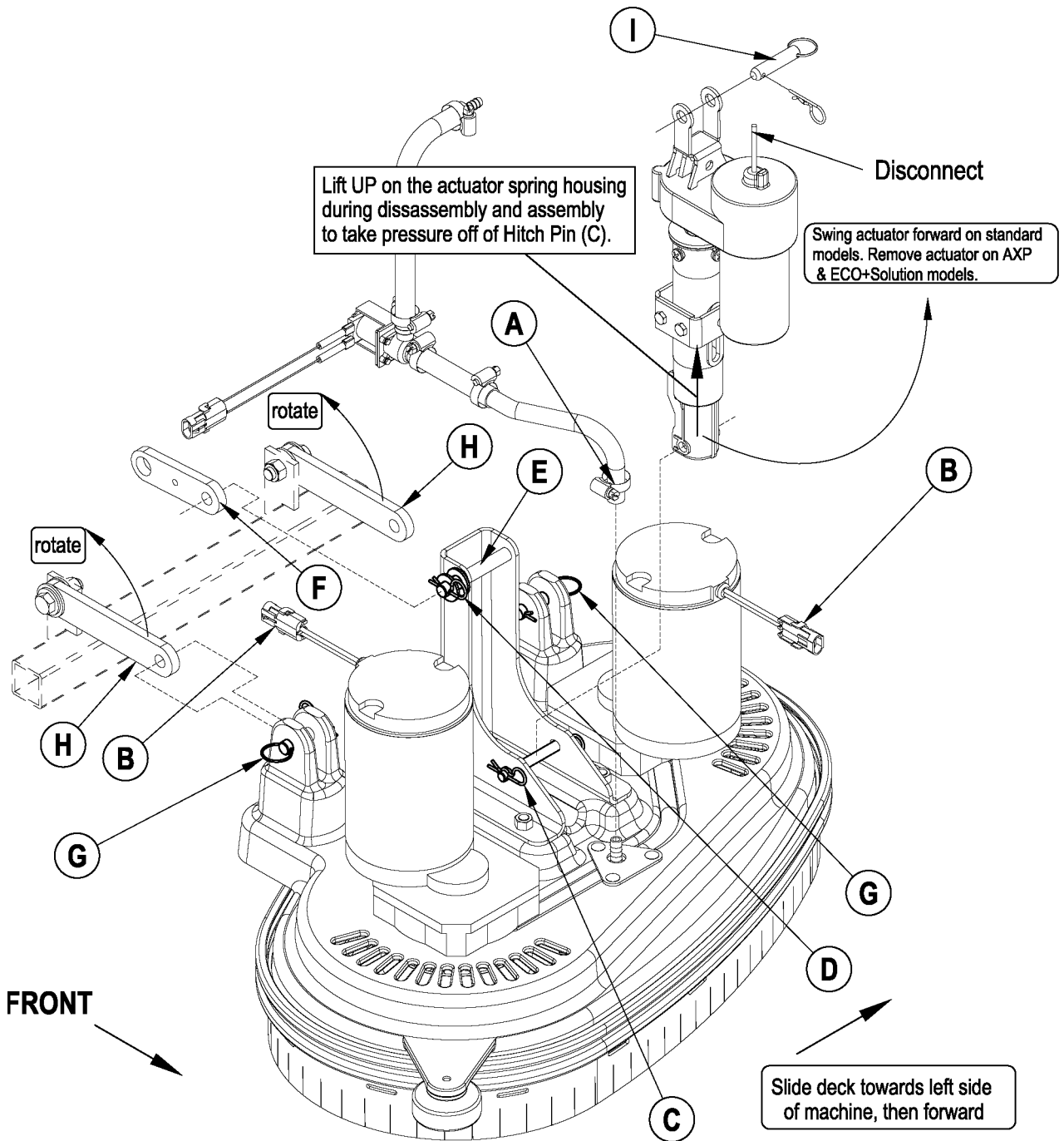
- 1 Lower the scrub deck with brushes (pads) installed. Turn the key switch off and disconnect the battery pack. **Note:** If the lift actuator motor will not run go to step 2 and perform the following, shim up the brush deck to remove the weight on the lower deck Actuator Pin (C).
- 2 Lift up and remove cover and nose cone, from front of machine.
- 3 Disconnect the actuator motor wiring harness pig tail connector.
- 4 Remove the lower actuator mount Pin (C). **Note:** Lift up on the actuator spring housing to take pressure off the Pin (C).
- 5 Remove the Pin (I) from the upper actuator mount weldment and remove the motor.
- 6 See \*Important Service Note below.
- 7 Reinstall in reverse order.

**\*Important Service Note:** After removing any actuator motor and before installing a new motor or drive nut the IN and OUT limit switches must be set (or checked) to their correct specifications. Reference the Electrical System in this manual for the *Actuator Drive Nut Adjustment* and follow these instructions before replacing the actuator motor.

After setting the correct actuator nut adjustments for the scrub brush lift motor, follow removal steps in reverse order to reassemble.

# SCRUB SYSTEM

## FIGURE 2

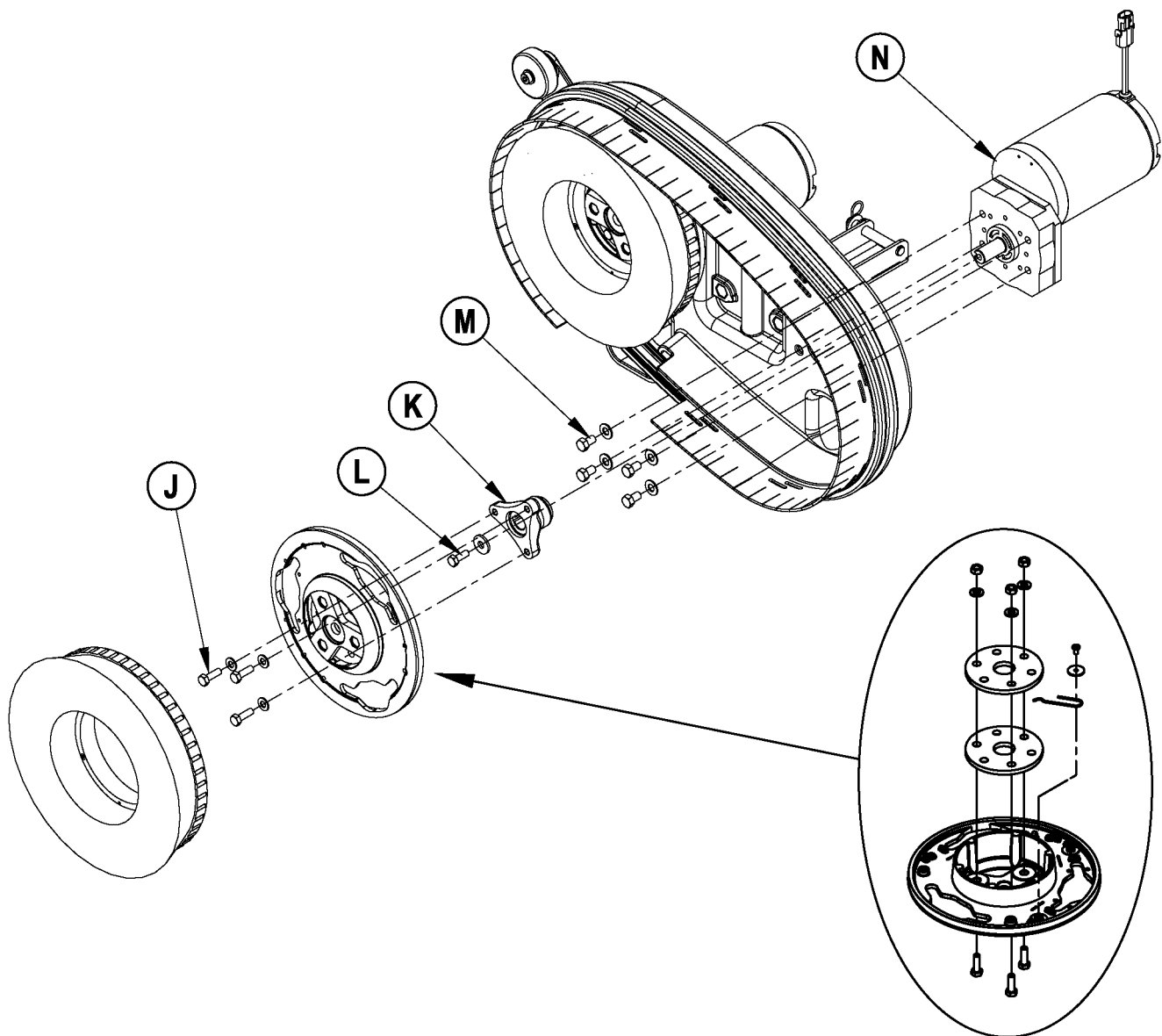


## SCRUB SYSTEM

### SCRUB BRUSH MOTOR/GEARBOX REMOVAL (DISC)

- 1 Follow the steps in the *Scrub Brush Deck Removal (Disc)* section.
- 2 Turn the brush deck on its back.
- 3 Remove the scrub brushes from the brush holders. If removing both motor/gearboxes mark the location of the holders and motors to the brush deck for proper re-assembly.
- 4 **See Figure 3.** Remove the (3) (J) Hex Screws from the flexible coupler that attaches the brush holder to the drive Hub (K) of the Motor/Gearbox Assembly you want to remove.
- 5 Remove the (1) Hex Screw (L) that secures the Hub (K) to the output shaft on the defective motor/gearbox. Then pull the hub from the shaft and save the key.
- 6 Remove the (4) (M) Screws and separate the defective Motor/Gearbox Assembly (N) from the scrub deck.
- 7 Re-assemble in reverse order and test for proper operation. Note: Apply a small amount of grease or a product called "Never Seize" to the gearbox output shaft when reinstalling the Drive Hubs (K).

**FIGURE 3**



**NOTES**

## SCRUB SYSTEM

### SCRUB BRUSH DECK REMOVAL (CYLINDRICAL)

- 1 Lower the scrub deck with brushes installed. Turn the key switch off and disconnect the battery pack.
- 2 Lift up and remove cover and nose cone, from front of machine.
- 3 **See Figure 4.** Disconnect the Solution Hose (O) from the scrub deck.
- 4 Unplug both brush motors wire assemblies. **Note:** cable ties may need to be cut.
- 5 Remove the lower Actuator Mount Pin (P). **NOTE:** Lift up on the actuator spring housing to take pressure off the Pin (P). **Service Note:** It is important that the actuator motor is not run while it is disconnected from the deck or chassis mounts. This precaution will prevent the actuator drive nut from being misadjusted (moved out of its set specification).
- 6 Remove the Cotter Pin (Q) and washers that attaches the Upper Hitch Pin (R) to the machine chassis Linkage Arm (S).
- 7 Remove the two (T) Hitch Pins that attach the scrub deck to the machine's chassis Linkage Arms (U). Then rotate the Arms (U) out of the way.
- 8 From the front of the machine swing the lower actuator housing forward to clear the deck mount bracket (remove the actuator on AXP™ / ECO+Solution™ models). Then slide the deck towards the left side of the machine until Pin (R) is clear of Arm (S). Pull the deck forward away from the machine to complete the removal. **SERVICE NOTE: It is important that the actuator motor is not run while it is disconnected from the deck or chassis mounts. This precaution will prevent the actuator drive nut from being misadjusted (moved out of its set specification).**
- 9 To reinstall a scrub deck, follow the above steps in reverse order.

### SCRUB BRUSH MOTOR(S) REMOVAL (CYLINDRICAL)

- 1 Follow the steps in the Scrub Brush Deck Removal (Cyl.) section.
- 2 Remove the Belt Guard(s) (V) held in place by (1) screw.
- 3 Disconnect the defective motor wiring plugs.
- 4 Remove the 3 (W) Screws and slide the motor out. **Note:** The belt can be removed at this time.
- 5 Reassemble in reverse order. **Note:** The belts are self tensioning no adjustment is needed.

### SCRUB BRUSH BELT REPLACEMENT (CYLINDRICAL)

- 1 Remove the Belt Guard(s) (V) held in place by (1) screw.
- 2 Carefully roll the belt off the top Motor Pulley (X).
- 3 Reinstall the belt by placing it on the top Motor Pulley (X) and carefully roll it onto the Lower Brush Pulley (Y). **NOTE:** Be sure the belt grooves and pulley grooves match up (Aligned).

### SCRUB BRUSH SYSTEM MAINTENANCE (CYLINDRICAL)

The scrubbing system must be serviced at regular intervals to maintain good scrubbing performance. Follow the maintenance steps listed below.

- 1 Rinse clean, built up debris from the debris hopper drain holes (daily).
- 2 Clean drain holes in the solution delivery trough on top of the scrub deck (weekly).
- 3 Clean built up dirt from the inside of the scrub brush housing (weekly).
- 4 Remove any string wrapped around the scrub brush, drive hub and idler hub (weekly).
- 5 Remove both the scrub brushes and rotate, turn end for end (weekly). See *Scrub Brush Removal and Installation (Cyl)* section.
- 6 Inspect the scrub brush bristles for wear, the brushes should be replaced when the bristle length is 1 inch (26mm) or less (monthly).

### SCRUB BRUSH REMOVAL AND INSTALLATION (CYLINDRICAL)

- 1 Make sure the key switch is off and disconnect the battery pack before servicing.
- 2 Loosen the black knobs (one on each side) that secure the removable bearing idler support Plate (Z) to the brush housing, then pull the plates down and out to remove. Grip the scrub brush and slide it from the housing end.
- 3 To install the brush slide it into the housing, lift slightly, push and turn until it seats into the drive end assembly.
- 4 Re-install the idler end plate assemblies.

### SCRUB BRUSH LIFT ACTUATOR REMOVAL (CYLINDRICAL)

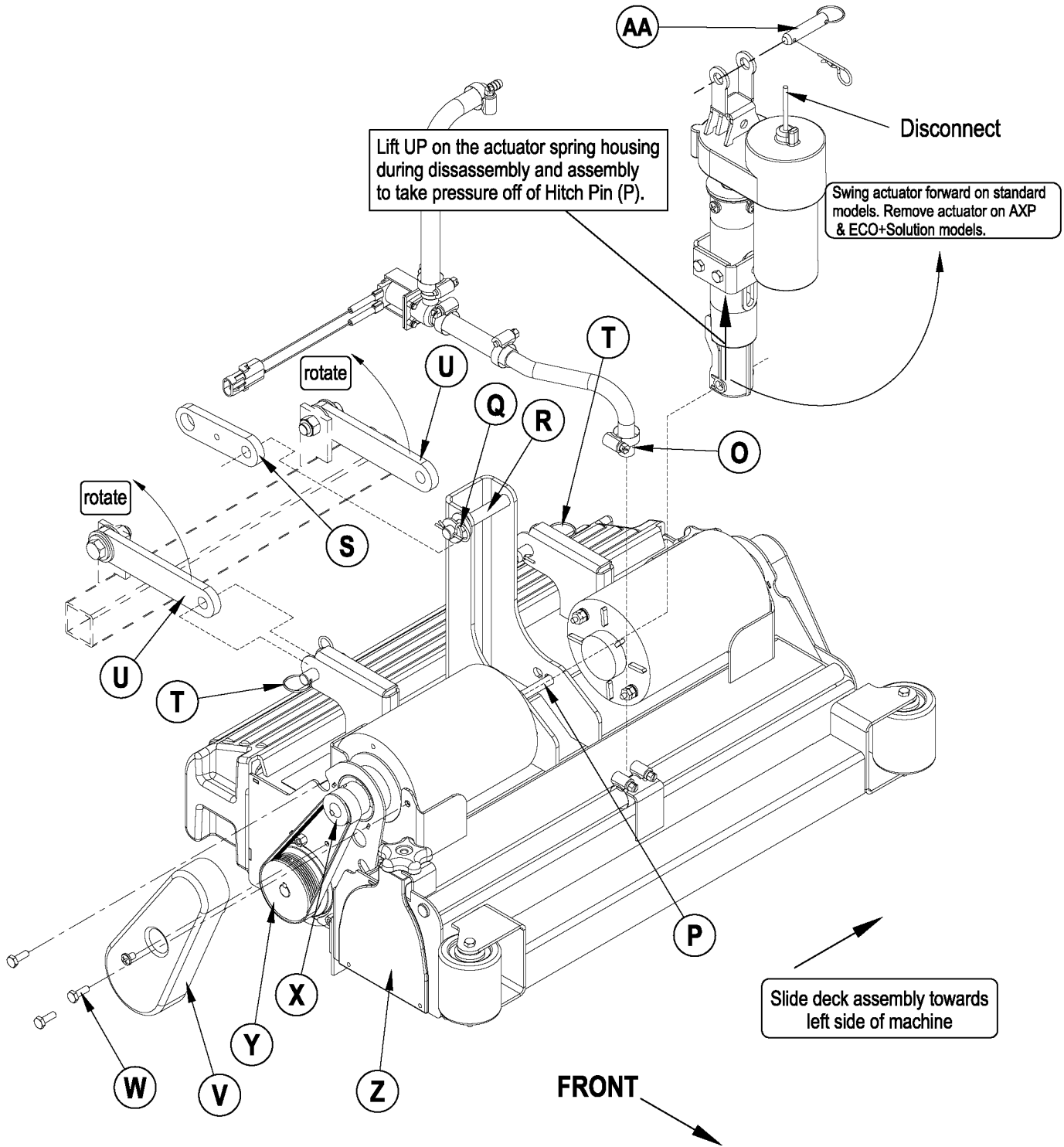
- 1 With scrub brushes installed lower the scrub deck, turn the key off and disconnect the battery pack. **Note:** If the lift actuator motor will not run go to step 2 and perform the following, shim up the brush deck to remove the weight on the lower deck Actuator Pin (P) to remove.
- 2 Remove the front nose cone by firmly grasping the lower part and lifting straight up.
- 3 Disconnect the actuator motor wiring harness pig tail connector.
- 4 Remove the lower actuator mount pin (P). Lift up on the actuator spring housing to take pressure off the Pin (P).
- 5 Remove the Pin (AA) from the upper actuator mount weldment and remove the motor.
- 6 See \*Important Service Note below.
- 7 Reinstall in reverse order.

**\*Important Service Note:** After removing any actuator motor and before installing a new motor or drive nut the IN and OUT limit switches must be set (or checked) to their correct specifications. Reference the Electrical System in this manual for the *Actuator Drive Nut Adjustment* and follow these instructions before replacing the actuator motor.

After setting the correct actuator nut adjustments for the scrub brush lift motor, follow removal steps in reverse order to reassemble.

SCRUB SYSTEM

FIGURE 4



# RECOVERY SYSTEM

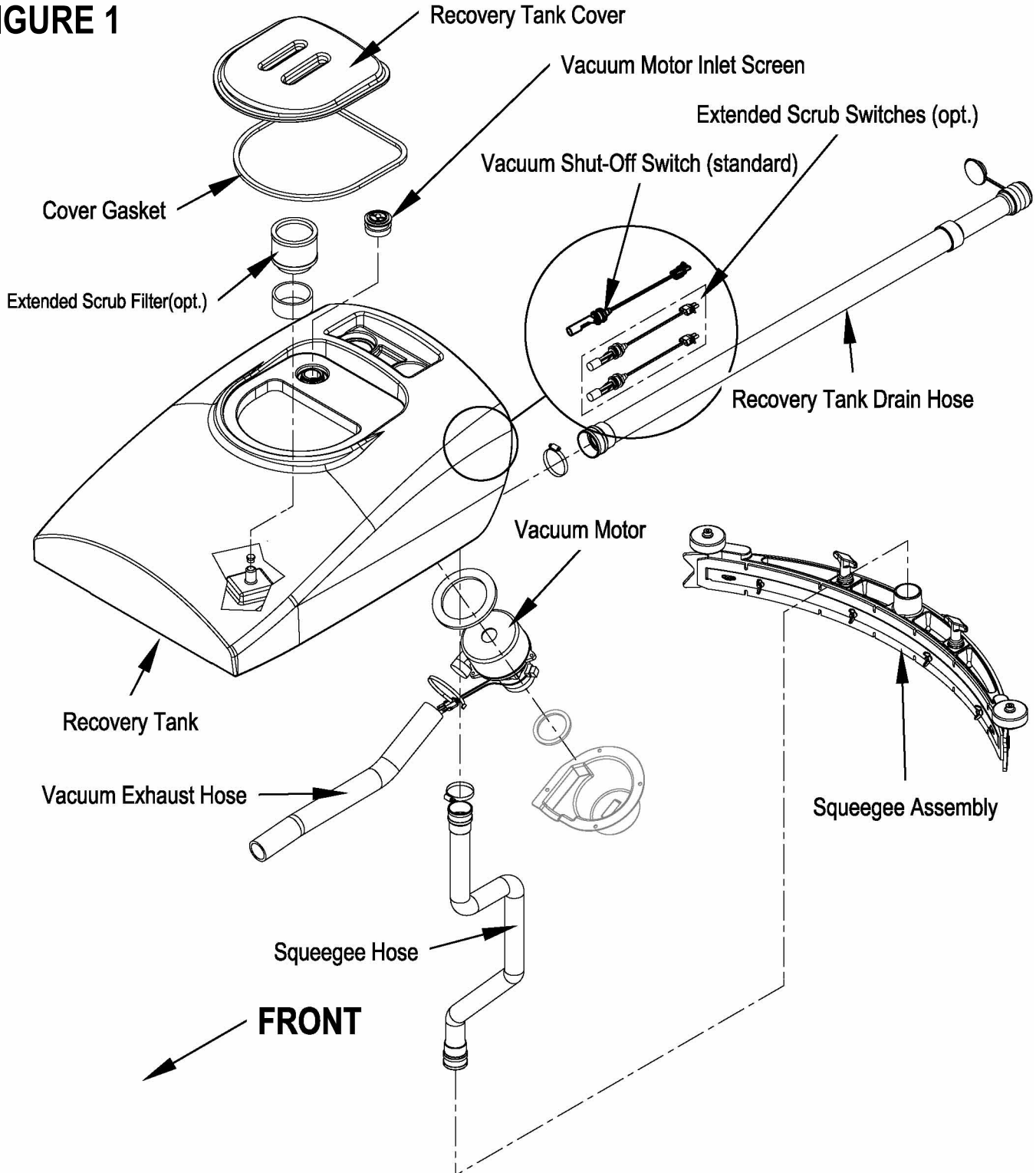
## FUNCTIONAL OVERVIEW

### Vacuum / Recovery System General

Dirt and water are lifted off the floor into the 30 Gallon (114 liter) recovery tank by airflow, created by a 3-Stage 36V vacuum motor. The wastewater and air enter the vacuum system at the squeegee tool, through small openings (notches) located in the front squeegee blade. The small openings are the entrance points for the water and air, and help speed up the airflow producing the suction to lift the wastewater off of the floor. The air and wastewater move through the squeegee hose at high speed until it reaches the recovery tank. There the air slows down because of the increased volume (large size) of tank. With the decreased air speed the heavier water falls to the bottom of the recovery tank. Then at the same time the airflow continues through the tank, vacuum fan inlet screen, vacuum motor and is exhausted out of the vacuum exhaust hose. No wastewater ever actually moves through the vacuum motor, just the working air.

The vacuum system uses a float switch to prevent the tank from being overfilled and stops any water from being sucked into the vacuum motor.

### FIGURE 1





# RECOVERY SYSTEM

## VACUUM MOTOR CONTROL CIRCUIT OVERVIEW (AUTO MODE)

See Figure 2.

**+ (Positive) Circuit input starts with:**

- A closed S3 key switch supplies the needed positive voltage to the K2 vacuum solenoid coil and the A1 control board J1-13 (Brn wire). Note: The A1 control board scrub-on button must also be depressed (enabled). This operator command lowers the brush deck.

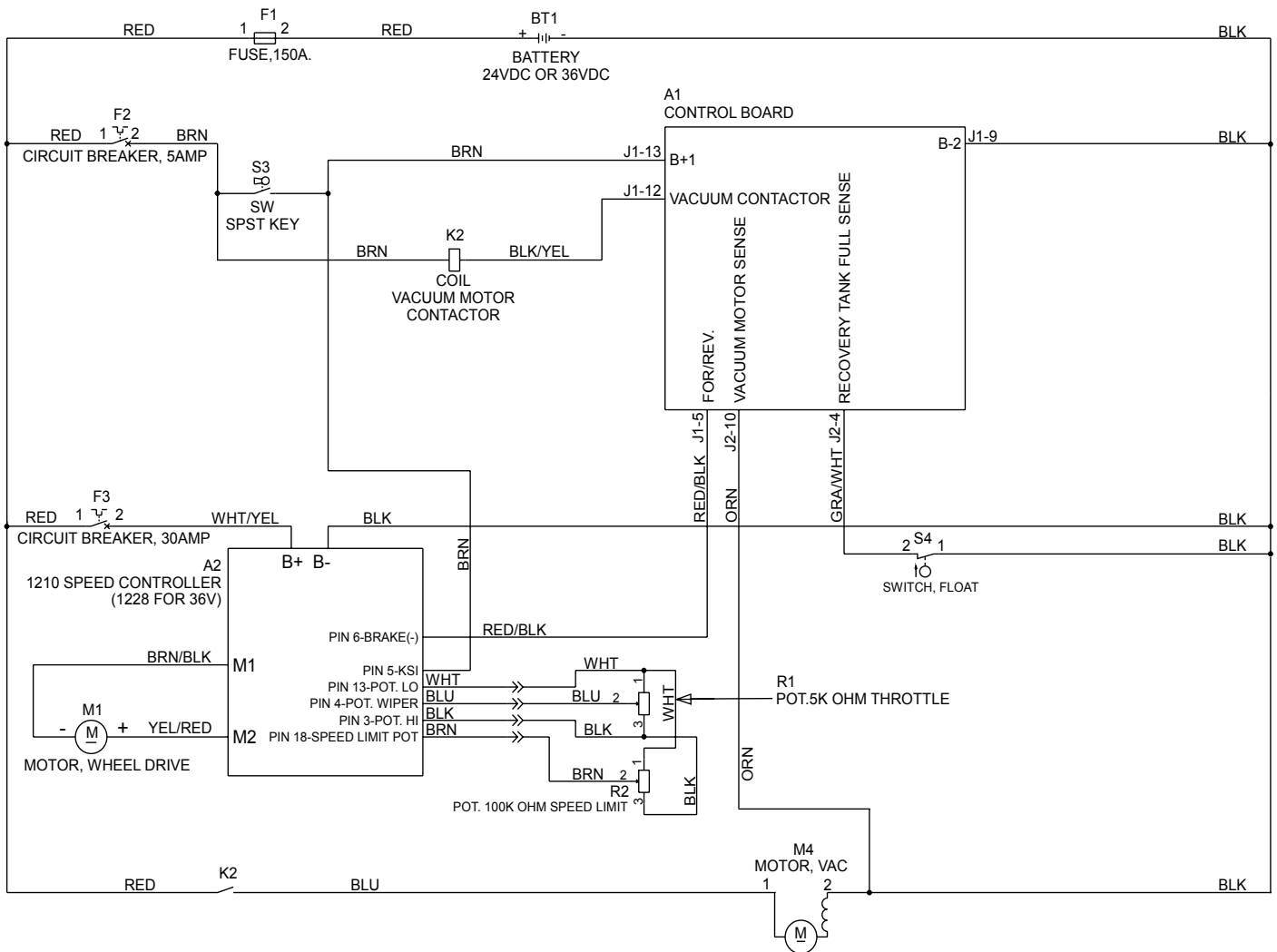
**- (Negative) circuit input starts with:**

- A battery negative ground input at the A1 control board terminal B-2 (J1-9) and at the A2 speed controller terminal B-.
  - A negative voltage output from the A2 speed controller's (pin #6) Brake Neg. to the A1 control boards Red/Blk wire (J1-5) For/Rev. Note: The A2 speed control brake output (pin #6) occurs whenever the R1 directional/throttle pot is moved off its neutral setting. This operator command happens when the drive paddle is pushed or pulled to run the wheel drive motor in Fwd or Rev.
- The recovery tank float switch (S4) must be closed in order for a negative voltage output from the A1 board's terminal J1-12 Blk/Yel wire to complete the K2 solenoid coil circuit (Pos. & Neg.) and pulls in the solenoid load contact making the vacuum motor run.

### Electrical Diagram

\*For complete description of all callouts see Electrical System *Wiring Diagram*.

## FIGURE 2



## RECOVERY SYSTEM

### VACUUM / RECOVERY SYSTEM SERVICE MAINTENANCE CHECKLIST

Whenever there is a vacuum problem, it's best to check over the entire system. Use the checklist below as a guide, to thoroughly check the vacuum system.

- Inspect and clean the vacuum motor float switch. (If the switch is open [tipped up] the vacuum motor will not operate)
- Clean built-up dirt from the inside of the squeegee tool.
- Replace the squeegee blades if they are nicked or torn.
- Inspect the hose between the squeegee tool and the recovery tank and rinse any built-up dirt from the hose. Replace the hose if it is kinked or damaged.
- Inspect and make sure the gasket on the recovery tank cover is sealing and not damaged.
- Make sure that the recovery tank drain hose cap seals airtight.

#### TROUBLESHOOTING GUIDE

If water flows around the ends of the squeegee tool, instead of being pulled into the tool, the vacuum system is not working properly. When a vacuum system performs poorly, it is usually because of one of the following problems:

**Vacuum Leak(s)** – Air flowing into the vacuum system past a bad gasket or leaky hose, damaged tank, or a leaky drain valve. A vacuum leak below the water line will create turbulence in the recovery tank, causing water to enter the vacuum motor.

**Restriction(s)** – Anything that blocks the flow of air through the system. Restrictions may also be caused by built-up debris in the squeegee tool, vacuum hoses, and vacuum motor inlet screen or wherever the airflow is forced to make a sharp turn.

Both leaks and restrictions decrease the quantity of air flowing through the squeegee tool. The air that does go through the squeegee tool moves slower, so it has less suction (water lift performance).

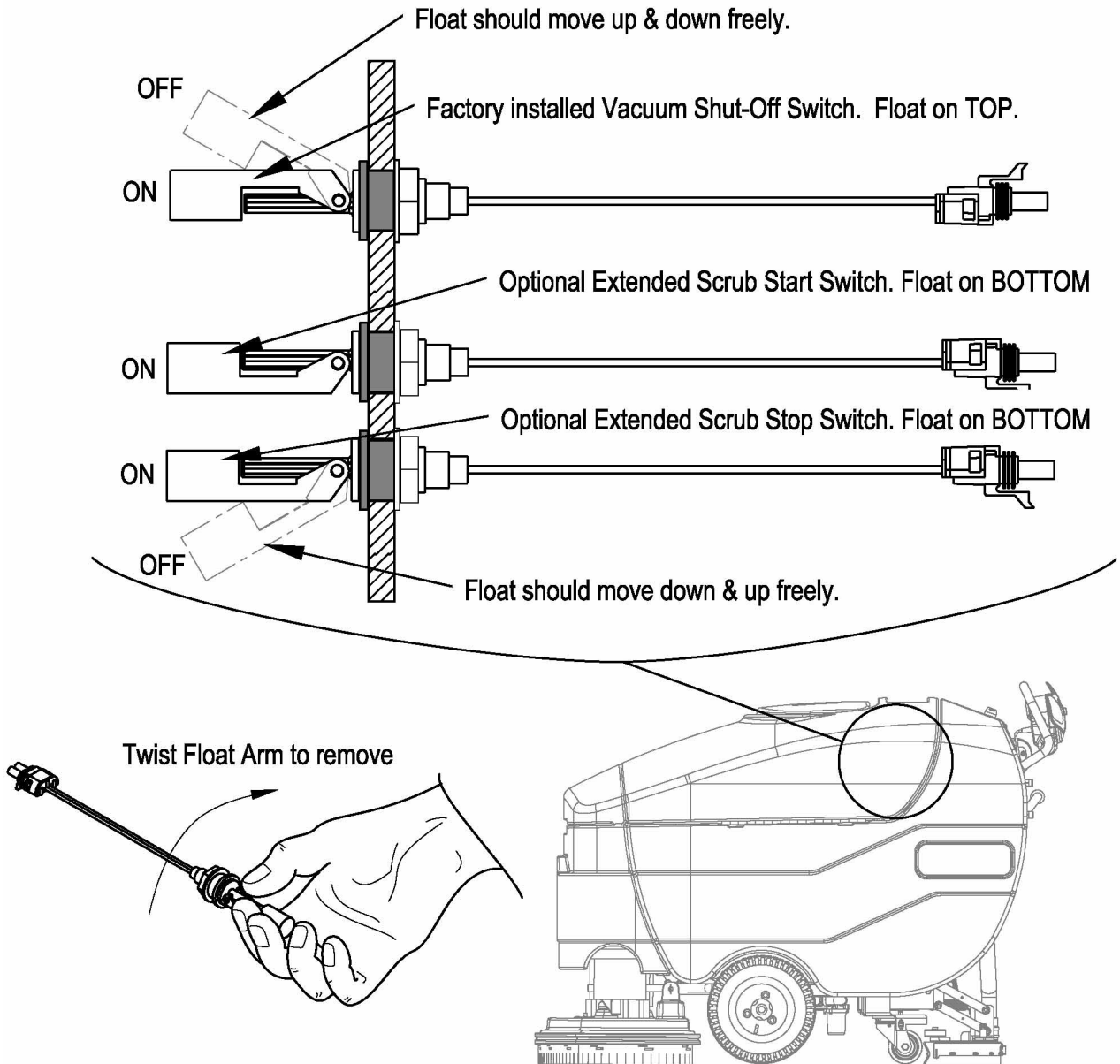
# RECOVERY SYSTEM

## MAINTENANCE OF RECOVERY TANK FLOAT SWITCHES

If the recovery tank float switch(es) become dirty it can impair their proper operation. A dirty vacuum shut off switch can cause the vacuum motor to not function at all or to not shut off when the tank is full. Dirty extended scrub system switches can prevent the optional extended scrub system from functioning properly.

If daily rinsing of the recovery tank does not suffice to keep the switches clean you may need to remove the float arms for cleaning. The float arms can be removed easily by grasping them as shown below and twisting to remove. It is very important that they be reassembled correctly in order to function. See **Figure 3** for the correct orientation of the switch float arms.

### FIGURE 3

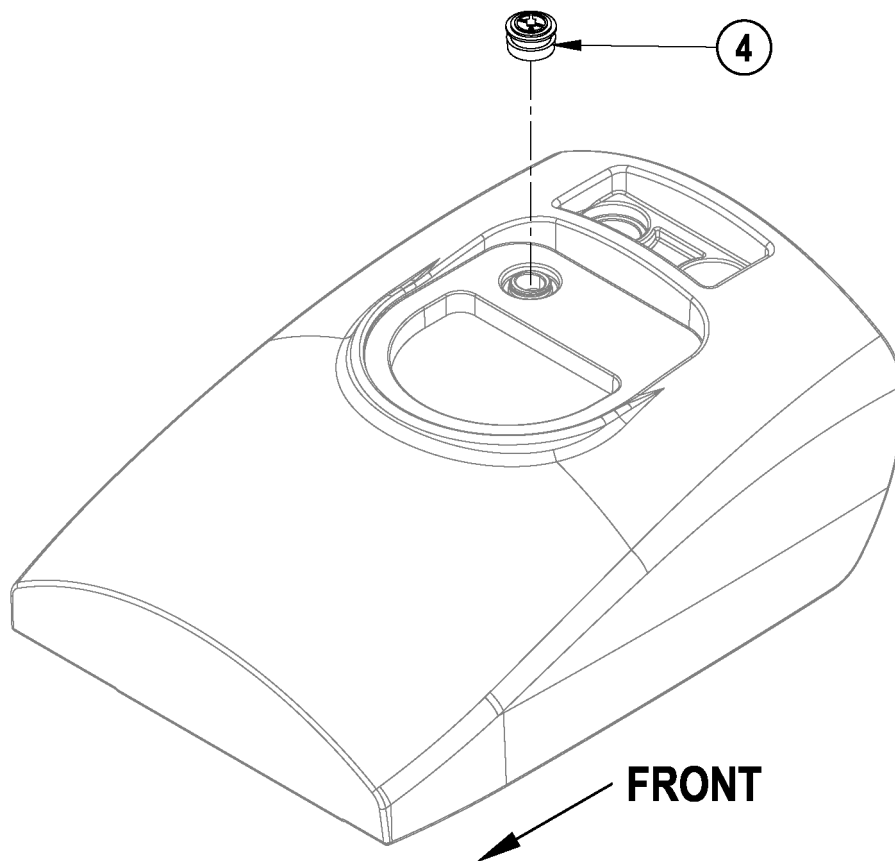


## RECOVERY SYSTEM

### MAINTENANCE OF VACUUM MOTOR INLET SCREEN

The Vacuum Motor Inlet Screen (4) should be cleaned on a daily basis. DO NOT run water down the screen in an attempt to clean it. If you do this you will be running water directly into the vacuum motor. Remove the Screen (4) from the machine to clean and then reinstall.

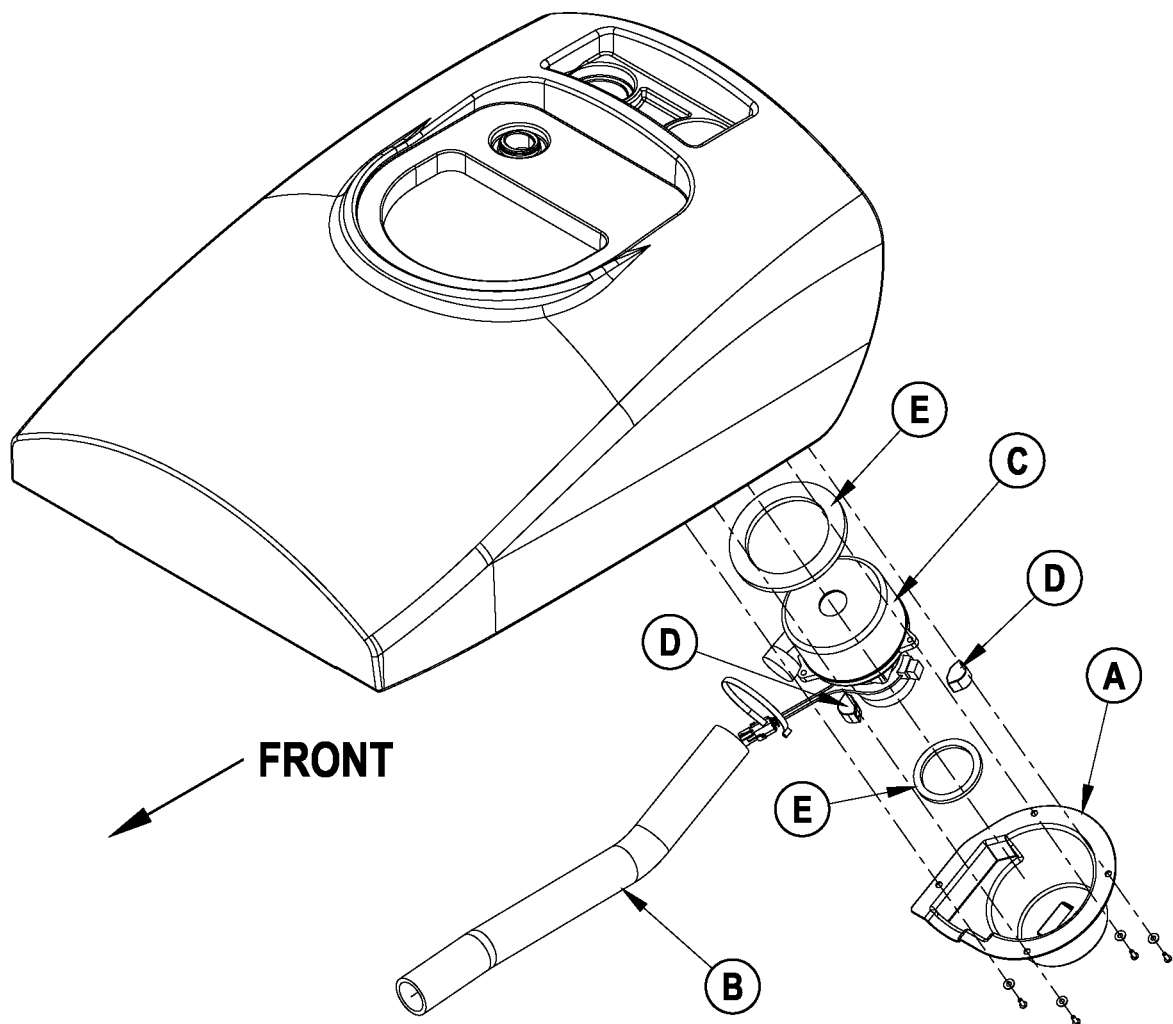
## FIGURE 4



## RECOVERY SYSTEM VACUUM MOTOR REMOVAL

- 1 Drain the recovery tank using the drain hose.
- 2 Turn the key off and disconnect the battery pack
- 3 Swing open the recovery tank and disconnect the vacuum motor harness connector.
- 4 **See Figure 5.** Remove the vacuum motor Shroud Cover (A) secured to the bottom of the recovery tank (qty 4 screws).
- 5 Loosen the exhaust hose clamp and remove Hose (B) from the vacuum motor discharge tube and completely remove the Vacuum Motor (C) from its mount cavity. **NOTE:** Take care not to loose the 3 (D) Vibration Mounts.
- 6 Inspect the condition of the Vacuum Motor Gaskets (E).
- 7 Make service repairs to the Vacuum Motor and re-install by following steps in reverse order.

**FIGURE 5**

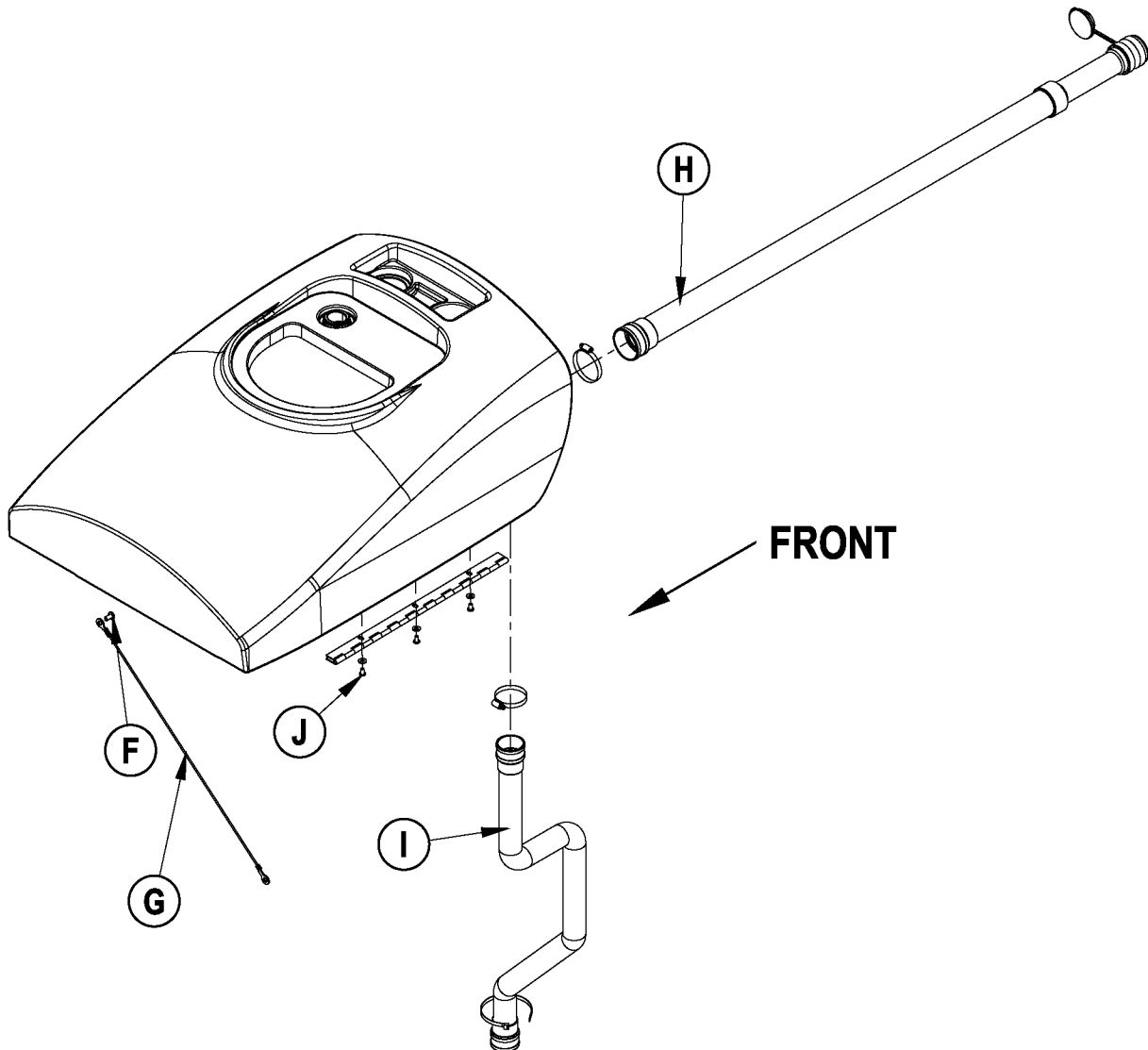


## RECOVERY SYSTEM

### RECOVERY TANK REMOVAL

- 1 Follow steps 1-5 in the *Vacuum Motor Removal* section.
- 2 Disconnect Recovery Tank float switch(es). **NOTE:** Disconnect any other options installed on the tank.
- 2 **See Figure 6.** Remove the Screw (F) and Tank Cable (G) and allow the tank to swing down to the side of the battery compartment box.
- 3 Remove the Recovery Tank Drain Hose (H).
- 4 Disconnect the Squeegee Hose (I) from the tank.
- 5 Support the tank and remove the (3) (J) Screws that attach the tank to the hinge and pull the tank free from the machine.

**FIGURE 6**



## SQUEEGEE SYSTEM

### SQUEEGEE LIFT LINKAGE ADJUSTMENT

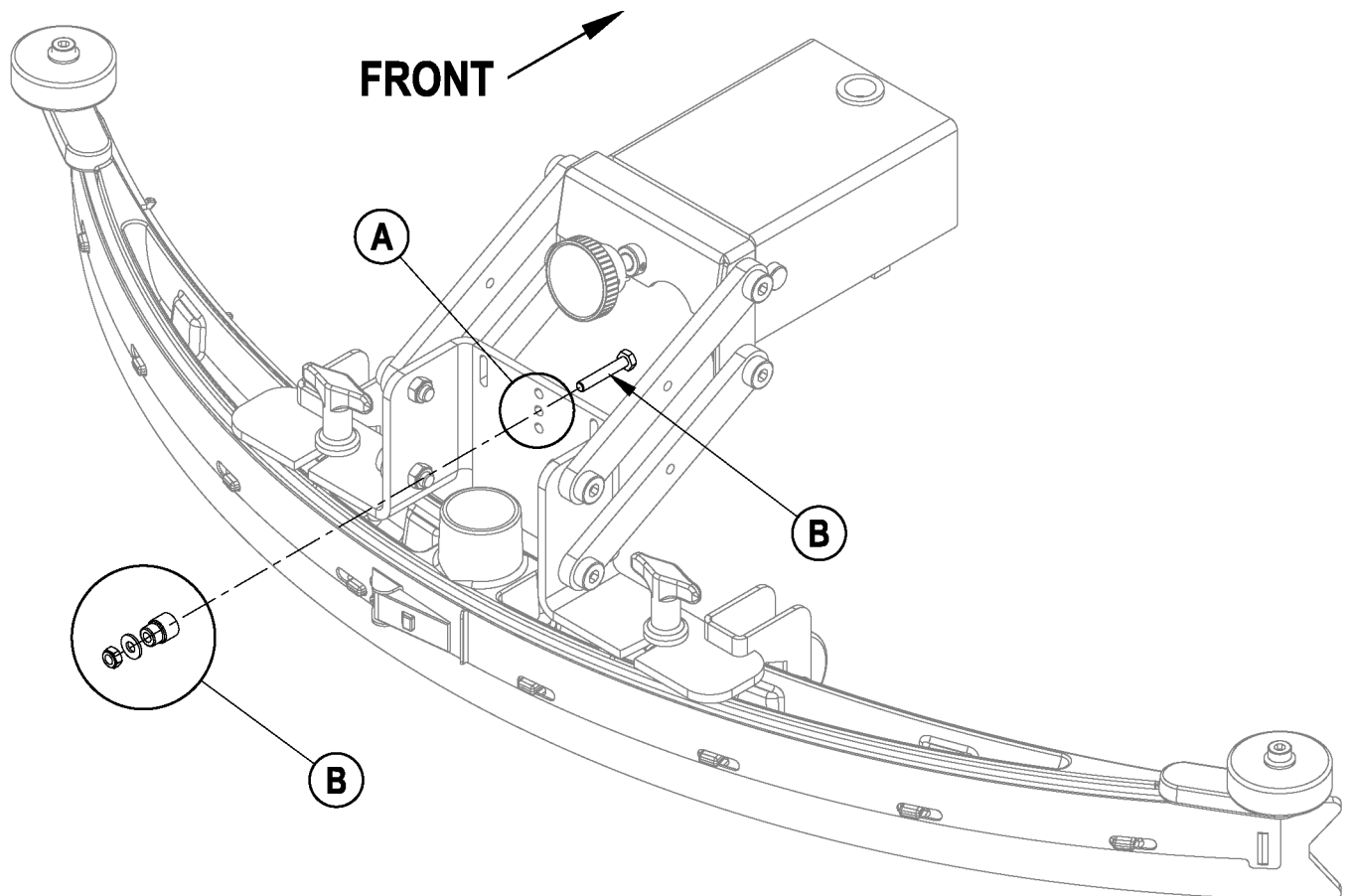
See "Know Your Machine". The squeegee pick-up tool is raised and lowered manually by a rear control panel mounted Lever (17).

#### Squeegee Lift Lever Adjustment

The squeegee tool's storage and operating positions are adjustable. To adjust:

- 1 Lower the squeegee assembly to the floor.
- 2 See Figure 1. The Squeegee Mount Bracket has (3) Mount Holes (A) for changing the lift cable length.
- 3 Remove the Hardware Items (B) from the Squeegee Mount Bracket and place in the one of the other holes.
- 4 Observe when the lever is lowered that the squeegee lift cable has ample free play. **Note:** This allows the tool the proper movement to raise and lower (float) so the rear blade remains on the floor surface through normal adjustments and wear.

FIGURE 1



## SQUEEGEE SYSTEM

### SERVICING THE SQUEEGEE

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

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

- 1 See Figure 2. Raise the squeegee tool off the floor, and then unsnap the Center Latch (23) on the squeegee tool.
- 2 Remove the Tension Straps (22).
- 3 Slip the rear blade off the Alignment Pins (24).
- 4 The squeegee blade has 4 working edges. Turn the blade so a clean, undamaged edge points toward the front of the machine. Replace the blade if all 4 edges are nicked, torn or worn to a large radius.
- 5 Install the blade, following the steps in reverse order and adjust the squeegee tilt.

#### To Reverse or Replace the Front Squeegee Blade...

- 1 Raise the squeegee tool off the floor, loosen the (2) Thumb Nuts (25), disconnect the Recovery Hose (19) and remove the Squeegee Assembly (15) from the mount.
- 2 Remove both rear Tension Straps (22) first.
- 3 Remove all the wing nuts that hold the front blade in place, and then remove the tension strap and blade.
- 4 The squeegee blade has 4 working edges. Turn the blade so a clean, undamaged edge points toward the front of the machine. Replace the blade if all 4 edges are nicked, torn or worn to a large radius.
- 5 Install the blade, following the steps in reverse order and adjust the squeegee tilt.

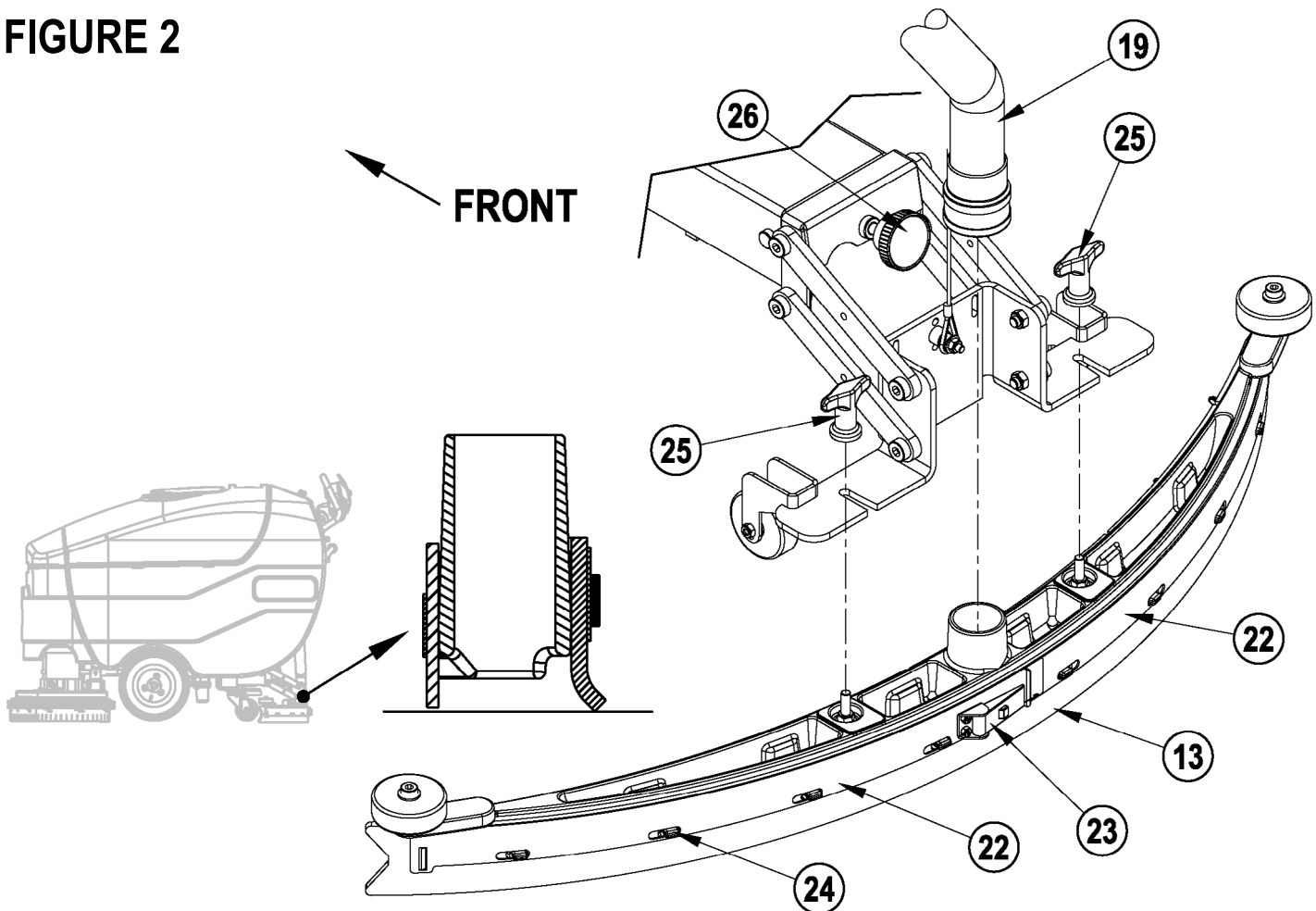
## ADJUSTING THE SQUEEGEE

Adjust the squeegee angle whenever a blade is reversed or replaced, or if the squeegee is not wiping the floor dry.

#### To Adjust the Squeegee Angle...

- 1 Park the machine on a flat, even surface and lower the squeegee.
- 2 While moving the machine forward slowly, turn the Squeegee Adjustment Knob (26) until the rear squeegee blade folds over evenly across the entire width of the squeegee as shown below.

## FIGURE 2



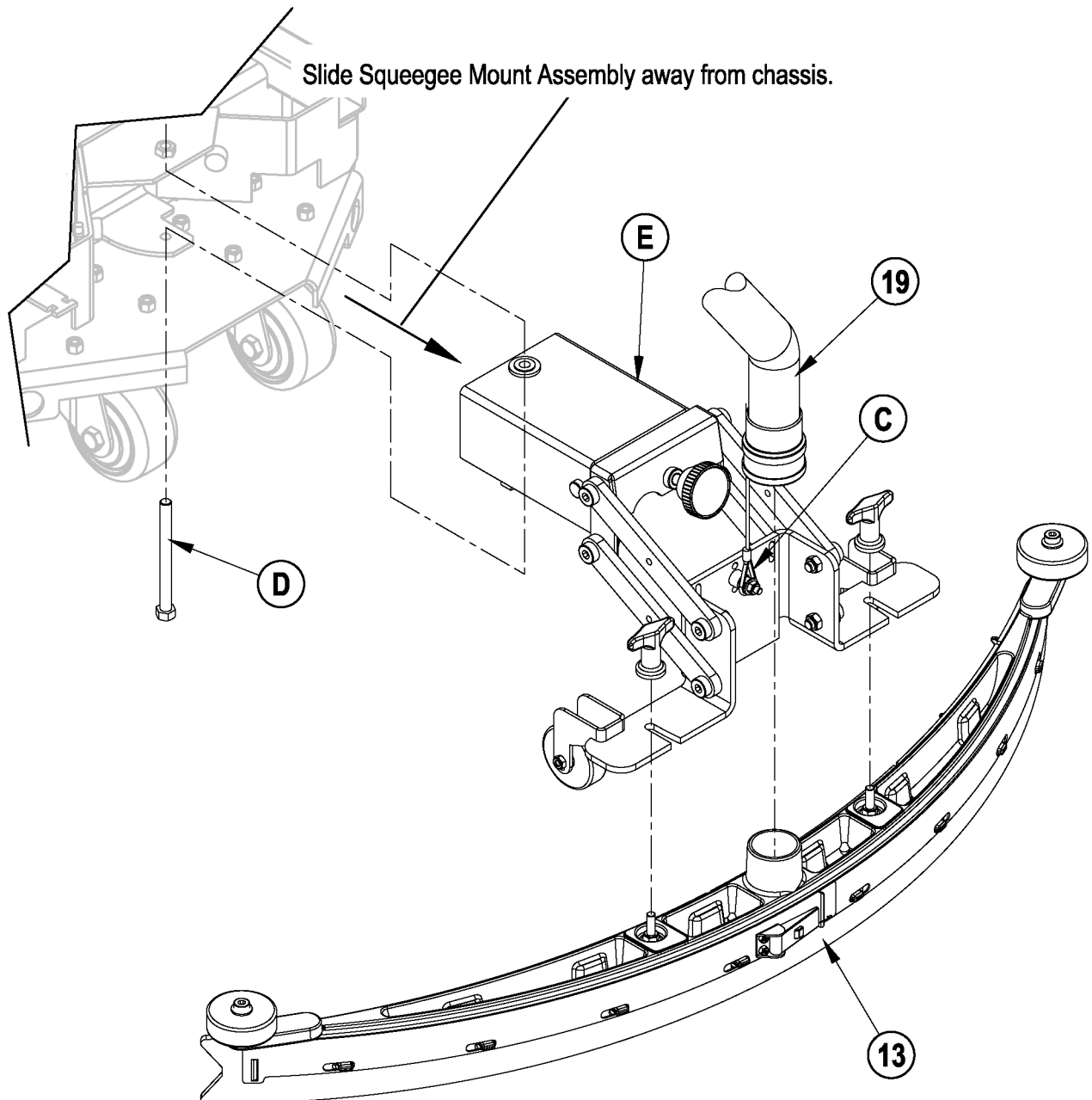


## SQUEEGEE SYSTEM

### SQUEEGEE MOUNT ASSEMBLY REMOVAL

- 1 See Figure 3. Disconnect Squeegee Hose (19) and remove the Squeegee Assembly (13) from the machine.
- 2 Lower the Squeegee Lever (17) and disconnect the Squeegee Lift Cable (C) from the squeegee mount bracket.
- 3 Remove Screw (D) and slide the Squeegee Mount Assembly (E) away from the chassis.

FIGURE 3



## SQUEEGEE SYSTEM CASTER WHEEL REMOVAL

### ⚠ WARNING!

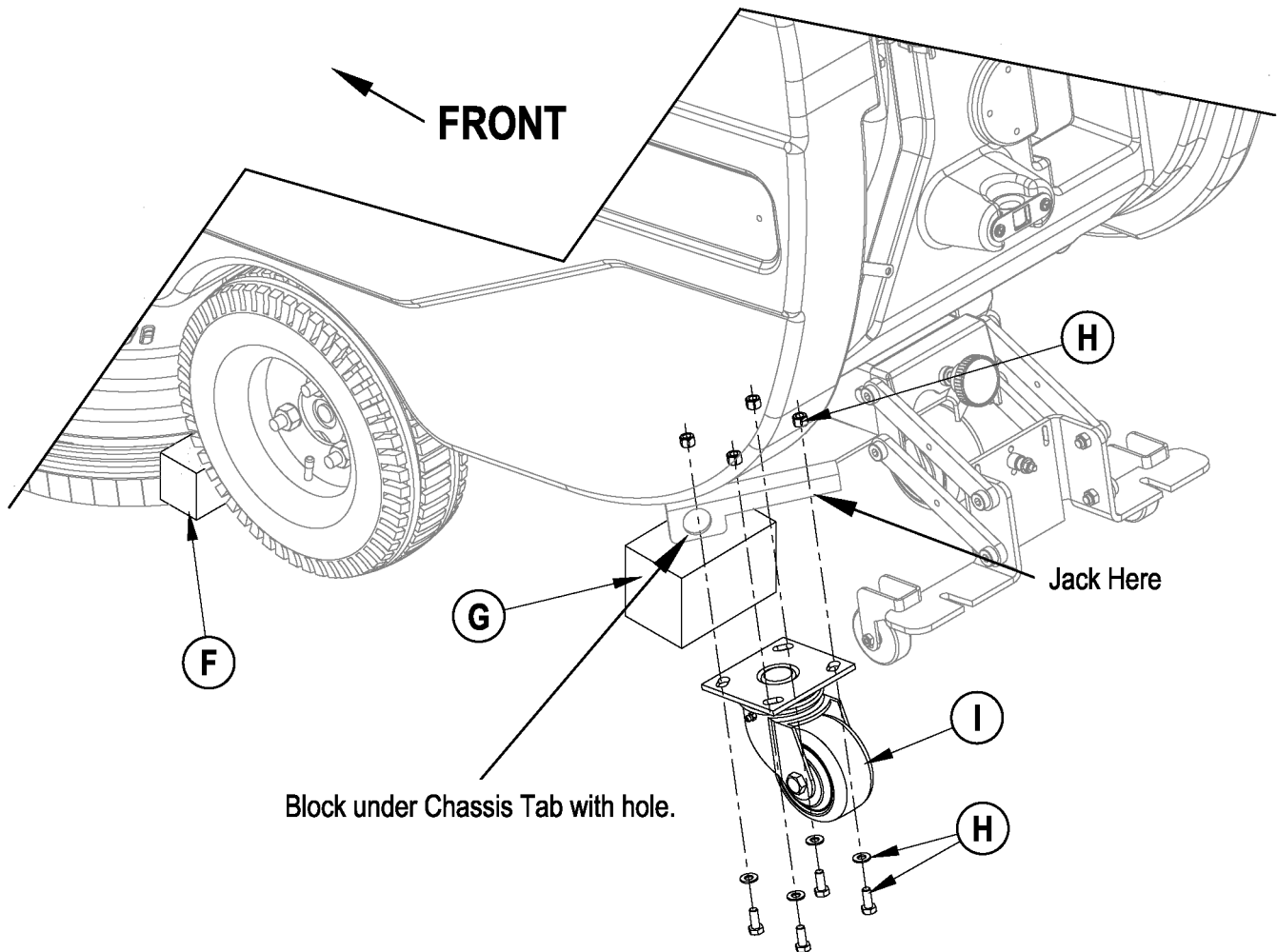
Disconnect the battery pack connector before servicing machine.

### ⚠ WARNING!

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

- 1 Drain both the solution and recovery tanks. Remove the squeegee assembly and have the scrub deck in the up (stored) position with the scrub brushes installed.
- 2 **See Figure 4.** Place Wood Blocking (F) in front of the drive wheels to prevent the machine from rolling.
- 3 Jack the machine in the location shown until the caster wheels are approximately 1" off the ground.
- 4 Place Blocking (G) under the chassis tab as shown.
- 5 Remove the (4) Screws, Nuts & Washers (H) then remove the Caster Assembly (I). **NOTE:** Same procedure for either side.
- 6 Reinstall in reverse order.

## FIGURE 4



# WHEEL DRIVE SYSTEM

## GENERAL FUNCTIONAL OVERVIEW

See Figures 1 and 2. A 375 watt (.5 HP) permanent magnet (36V) motor transaxle (M1) is used for the wheel drive on all machines. A Curtis PMC solid state speed controller (A2) regulates the variable speed and Fwd/Rev wheel drive motor functions. Location of the controller is in the rear handle housing electrical compartment (accessible by removing the 4 screws securing the rear electrical panel). The potentiometer R1 mounted inside the drive paddle inputs to the A2 controller the machine operator's throttle (variable speed) and direction demands. A second pot R2 (knob adjusted) is located on the outside of the paddle cover and controls the machine's maximum transport and scrub speeds.

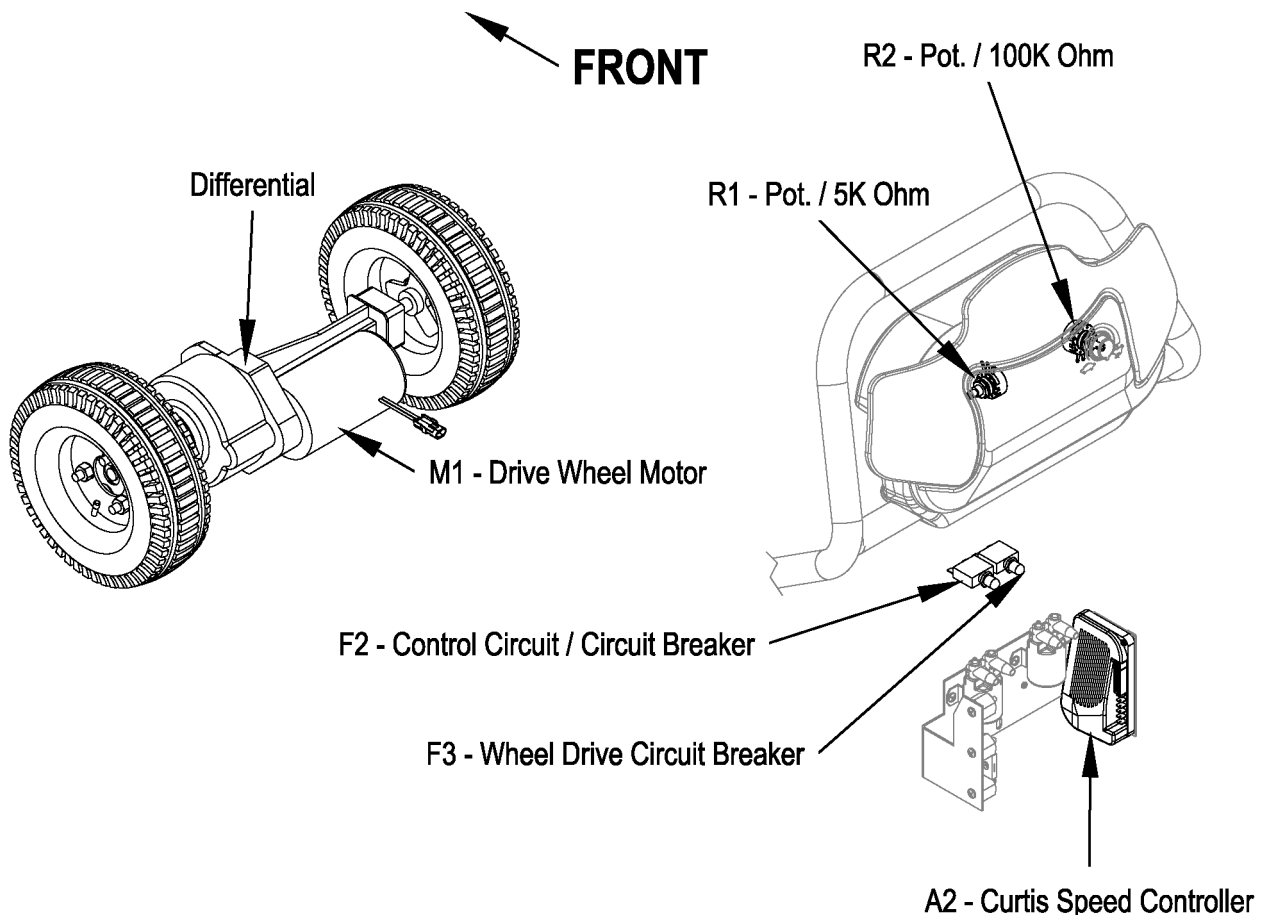
### Drive Motor System Function

See Figures 2 and 3. With the key switch S3 closed the Brn wire inputs 36V to the A2 speed controller (Pin 5-KSI) to make its internal control circuits operational (powering it up). The F3 circuit breaker (30 Amp) supplies the positive load circuit voltage input to the B+ controller terminal (Wht/Yel wire). The black wire from the battery negative standoff supplies the (NEG.) input to the B- controller terminal.

Moving the 5K Ohm R1 pot off its centered balanced neutral setting of approximately 2500 Ohms, activates the operator input to the speed control. Forward or Reverse movement of the drive paddle rotates the pot shaft and the pot's variable resistance values are changed, which generates the internal voltage signals (0-5Volts) needed for the controller's output operation. These control board voltage input signals are what energizes the Fwd and Rev directional relays, which then selects the motor polarity and final voltage level outputs at the M1 & M2 terminals.

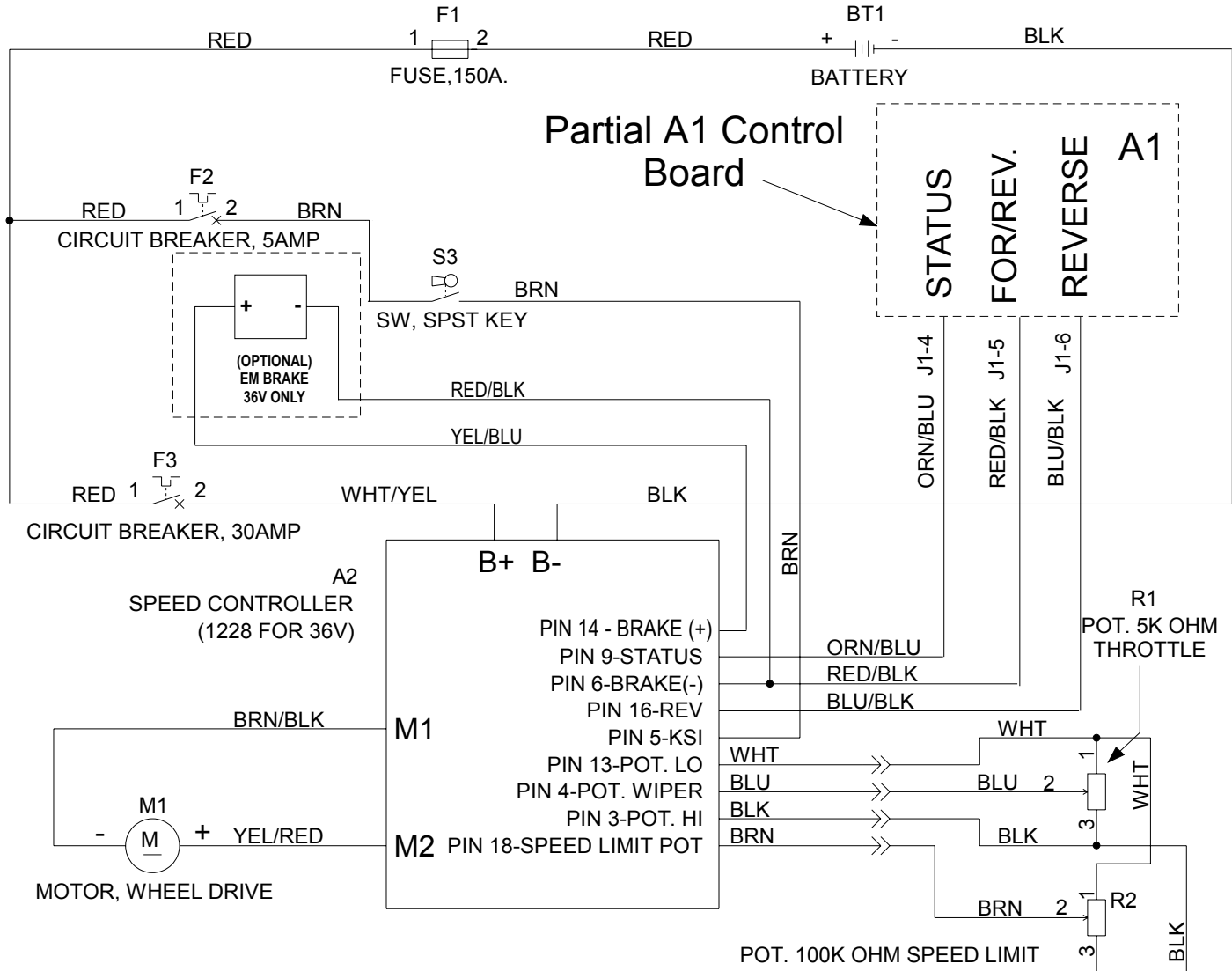
When the operator turns the R2 speed limit Pot from min. to max. (CW) this causes an input resistance relationship change between the pot high (+) and wiper terminals (high to low Ohms) thus increasing the maximum wheel motor operating speed range. Turning the knob (CCW) increases the resistance and the motor speed range is reduced.

FIGURE 1



# WHEEL DRIVE SYSTEM

## FIGURE 2



### Electrical Diagram

\*For complete description of all callouts see Electrical System *Wiring Diagram*.

# WHEEL DRIVE SYSTEM

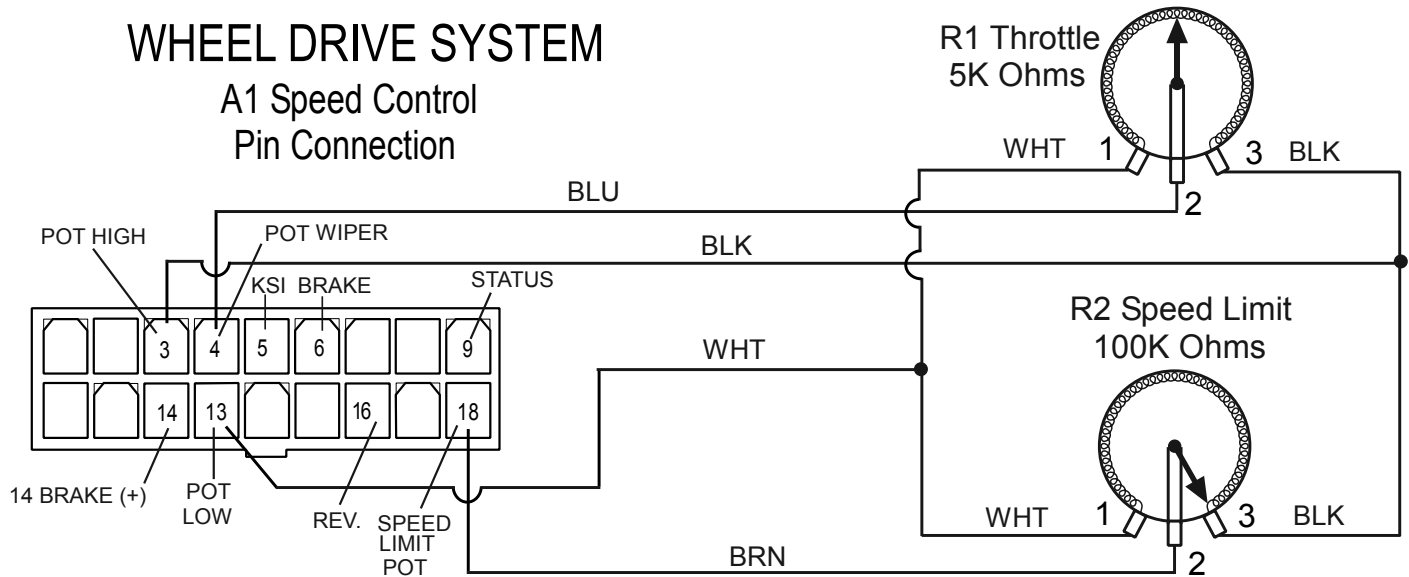
## FIGURE 3

R2 Voltage Values  
 0V = Minimum Speed  
 5V = Maximum Speed

R1 Voltage Values  
 0 – 2.5V Forward  
 2.5V – 5V Reverse

### WHEEL DRIVE SYSTEM

#### A1 Speed Control Pin Connection



This drawing shows additional controller input circuit detail. The R2 pot is shown at the Max speed setting and the R1 pot in neutral.

### LOW CURRENT A1 SPEED CONTROL PIN KEY DETAIL

PIN#	WIRE COLOR	CONTROLLER DESCRIPTION & FUNCTION
1	-	Open not used
2	-	Open not used
3	Black	Throttle Pot R1 pot high input
4	Blue	Throttle Pot R1 pot wiper input
5	Brown	KSI (key switch input): Battery (+) powers up controller logic circuits.
6	Red/Blk	Auxiliary Driver: Battery (-) output to main controller (E1) to turn on (activate) all auto scrub functions.
7	-	Open not used
8	-	Open not used
9	Orn/Blu	Status Fault: Speed controller fault output to main control panel fault indicator light (accessory wand).
10	-	Open not used
11	-	Open not used
12	-	Open not used
13	White	Throttle Pot R1 pot low input
14	Yel/Blu	Drive wheel brake release: Battery (+) output to the parking brake (optional)
15	-	Open not used
16	Blu/Blk	Rev/Alarm Driver output Battery (-) command turns off solution Valve.
17	-	Open not used
18	Brown	Speed limit pot input connection.

## WHEEL DRIVE SYSTEM

### WHEEL DRIVE TROUBLESHOOTING GUIDE

Problem	Possible Cause
<ul style="list-style-type: none"> <li>• Wheel drive motor will not run in forward and reverse.</li> </ul>	<ul style="list-style-type: none"> <li>• Wheel Drive Motor Circuit Breaker (F3) tripped (reset 30A circuit breaker)</li> <li>• Control Circuit Circuit Breaker (F2) tripped (reset circuit breaker)</li> <li>• Defective Wheel Drive Motor (replace motor) *</li> <li>• Defective Throttle Potentiometer (R1) (replace) *</li> </ul>
<ul style="list-style-type: none"> <li>• Wheel drive in one direction only, loss of either forward or reverse.</li> </ul>	<ul style="list-style-type: none"> <li>• Test the Fwd &amp; Rev (<b>R1</b>) wiring outputs (pins 3, 4 &amp; 13) at the speed control for an open. Repair wiring or replace the R1 pot.</li> <li>• Controller can't change electrical polarity to wheel motor. Replace the (<b>A1</b>) speed control.</li> </ul>
<ul style="list-style-type: none"> <li>• Display LED panel shows an error 03 fault code.</li> </ul>	<ul style="list-style-type: none"> <li>• Speed controller has sensed an operation error code fault. (see the <i>Status LED Fault Codes (Table 1)</i> in the Electrical System)</li> </ul>

\* = See *Curtis Speed Control Troubleshooting* Section.

## WHEEL DRIVE SYSTEM DRIVE MOTOR TRANSAXLE REMOVAL

### **WARNING!**

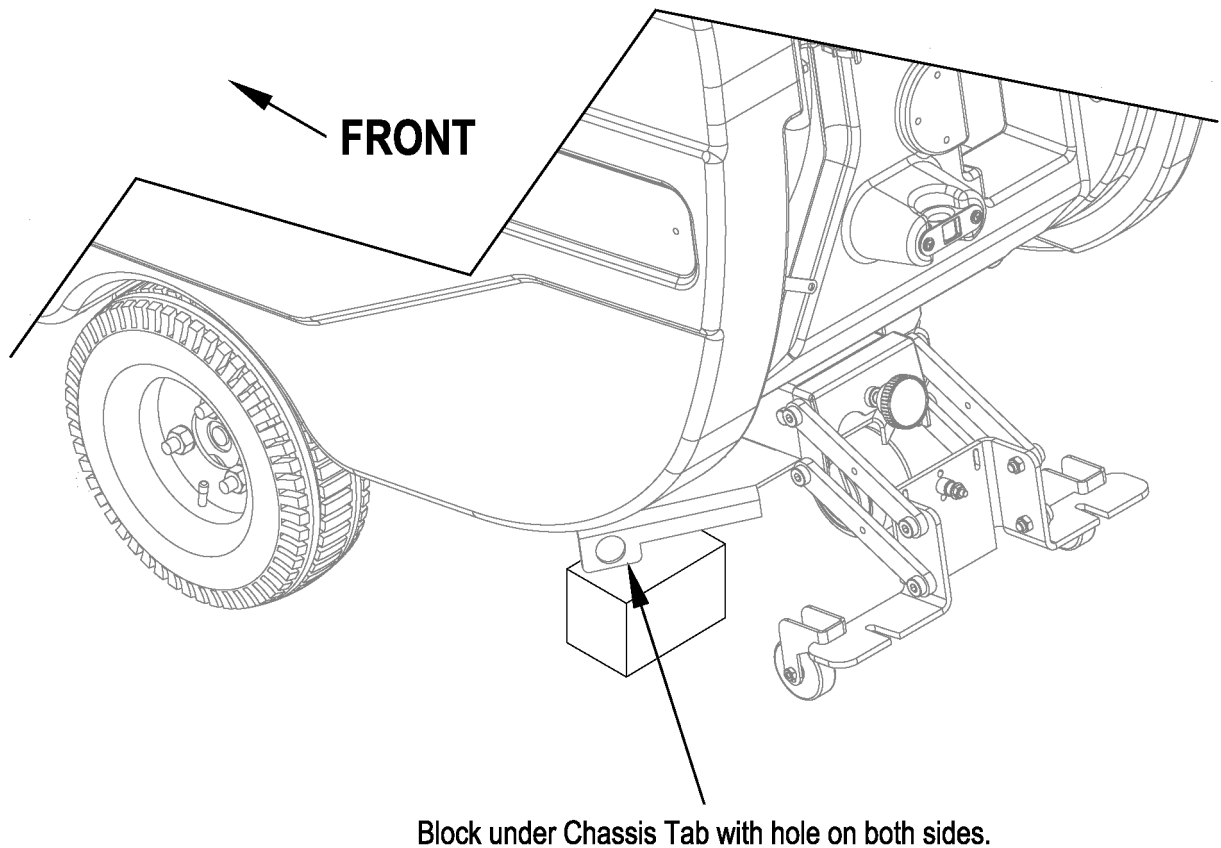
Disconnect the battery pack before servicing machine.

### **WARNING!**

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

- 1 Drain both the solution and recovery tanks and remove the squeegee.
- 2 Remove the Scrub deck by following the Scrub Deck Removal instructions in this manual.
- 3 Jack and block the rear of the machine so the rear casters are off the ground. See **Figure 4** for proper placement of the wood blocking.

## FIGURE 4

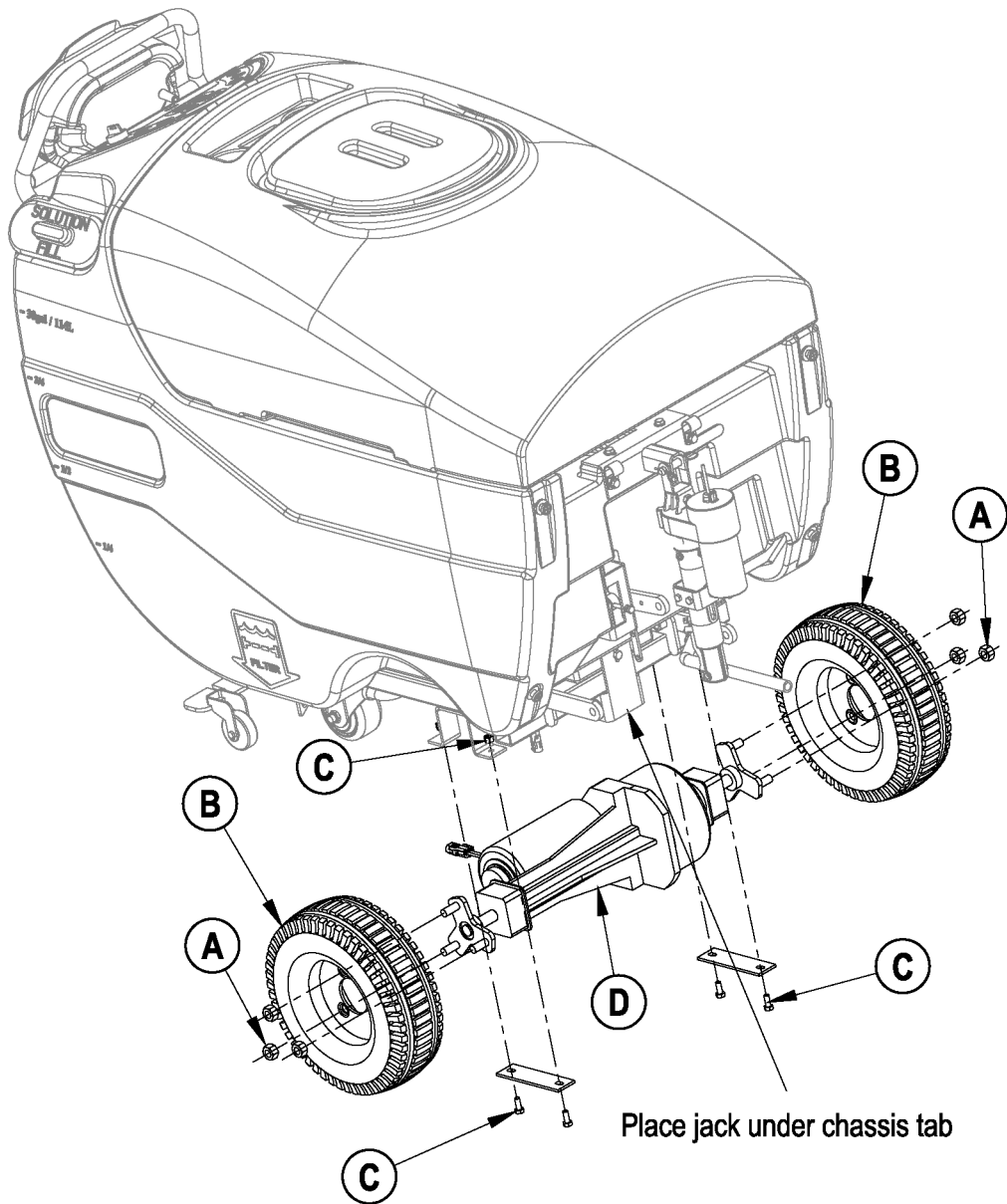


## WHEEL DRIVE SYSTEM

### DRIVE MOTOR TRANSAXLE REMOVAL CONTINUED

- 4 See Figure 5. Jack the front of the machine from this location until the drive wheels are approximately 1" off the ground.
- 5 Remove the (6) Locknuts (A) and then remove the (2) Drive Wheels (B) from the transaxle.
- 6 Disconnect the drive motor wiring connector.
- 7 Remove the (4) Motor Mount Bolts and Nuts (C) and carefully slide the Motor Transaxle (D) away from the machine.
- 8 Reinstall in reverse order.

**FIGURE 5**





## WHEEL DRIVE SYSTEM DRIVE WHEEL REMOVAL

### **WARNING!**

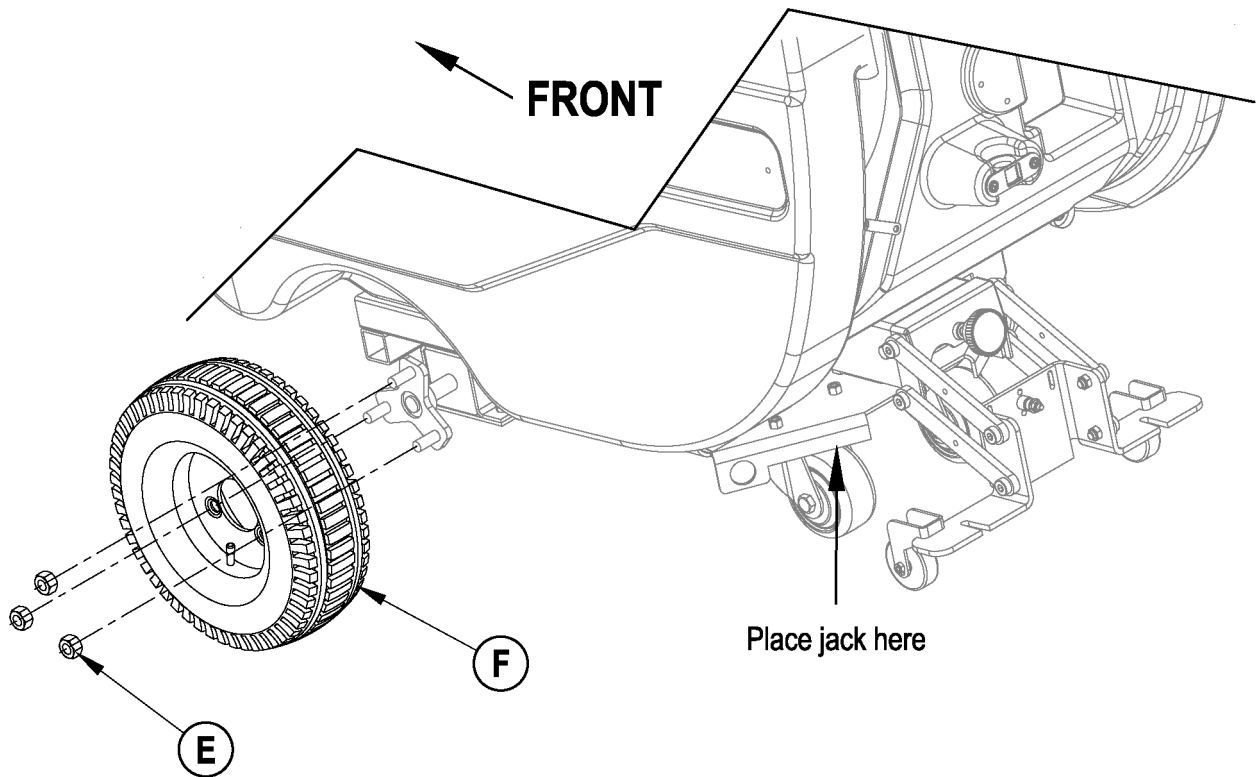
Disconnect the battery pack connector before servicing machine.

### **WARNING!**

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

- 1 Remove the squeegee and place wood blocking in front and rear of the opposite drive wheel that you are removing to prevent the machine from rolling.
- 2 Using a scissors jack, raise the machine until the wheel is off the ground. **See Figure 6** for jack placement.
- 3 Remove the (3) Locknuts (**E**) and Drive Wheel (**F**).
- 4 Reinstall in reverse order.

## FIGURE 6



## WHEEL DRIVE SYSTEM

### (5K) POTENTIOMETER (R1) TESTING AND REMOVAL

#### ⚠ WARNING!

Disconnect batteries at the battery pack disconnect before servicing.

#### Testing the 5K Directional/Throttle Potentiometer R1

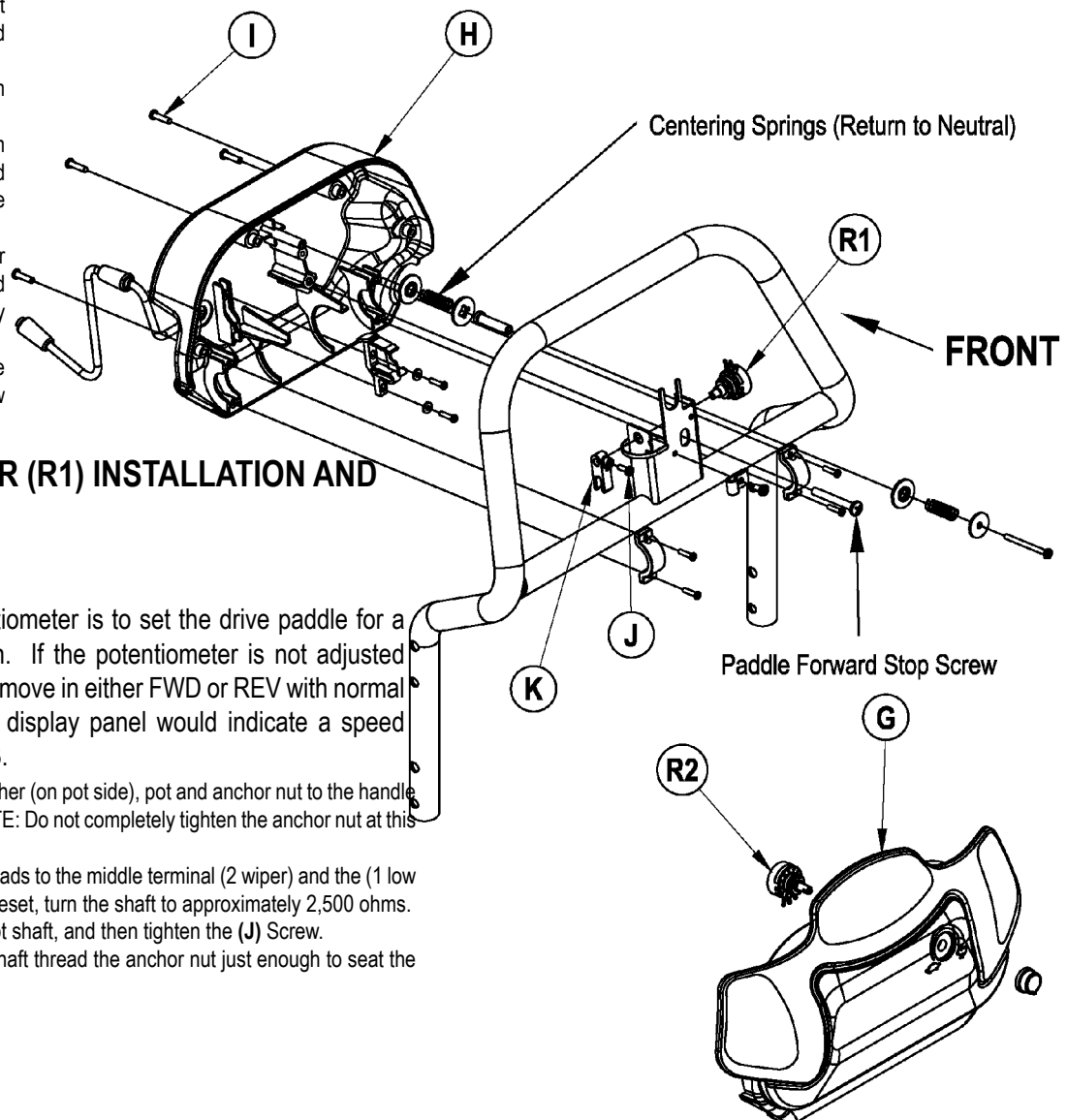
Note: The potentiometer (pot) doesn't have to be removed from its housing mount to test.

- 1 See Figure 7. Remove the front Drive Paddle Cover (G) from the Rear Housing (H) held together with (4) (I) Screws. Note the cover will have the speed limiting Pot (R2) mounted to it, observe the (3) wires and separate them to complete the removal of the cover.
- 2 See Figure 8. Observe the 3 wires connected to the R1 pot and disconnect. Note the proper wire numbers and/or colors and their terminal connections for re-assembly.
- 3 Test the Pot (R1) using an ohmmeter, the potentiometer specification is 5K Ohms. Connect the meter leads to each of the outside connections (3 high & 1 low, shown in Figure 8) on the pot, it should read approximately 5,000 ohms (range 4,500-5,500 ohms).
- 4 Next, take the 3 high pot connection test lead and connect to the middle connection (2 wiper), then push and pull the rear cover to turn the shaft in both directions. The readings should be approximately half the total resistance (2,500 ohms) towards 5,000 ohms and 2,500 ohms towards 0 ohms. Example "A": total resistance of pot 4,840 ohms (3 high/1 low) test connections. Example "B": test middle connection (2 wiper) and outside rear (1 low) Fwd reading 2,420 ohms to 4,700 ohms, Rev 2,420 ohms to 230 ohms.
- 5 Testing Summary: The above tests are to show the increase and decrease of the pot through its working range. If you do not get similar readings replace the Potentiometer (R1).

#### R1 Potentiometer Removal


- 6 See Figure 9. Loosen the pot shaft anchor nut and unthread it to the end of the shaft.
- 7 Back out the Screw (J) from the pot Fork (K).
- 8 Maneuver the pot (R1) out from its mounting bracket hole and separate the Fork (K) from the shaft end.
- 9 Finish unthreading the anchor nut from the end of the pot and then remove the pot completely from the handle mount.
- 10 To reinstall a potentiometer see the adjustment section below in this manual section.

## FIGURE 7



### (5K) POTENTIOMETER (R1) INSTALLATION AND ADJUSTMENT

#### ⚠ WARNING!

The adjustment of the potentiometer is to set the drive paddle for a neutral drive motor operation. If the potentiometer is not adjusted properly, the machine will not move in either FWD or REV with normal operator input. Also the Led display panel would indicate a speed control system fault  03.

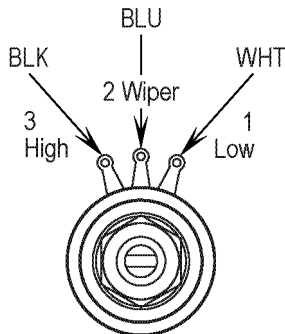
- 1 See Figure 9. Install lock washer (on pot side), pot and anchor nut to the handle mount bracket as shown. NOTE: Do not completely tighten the anchor nut at this time.
- 2 Using an ohmmeter connect leads to the middle terminal (2 wiper) and the (1 low pot) outside terminal. Then preset, turn the shaft to approximately 2,500 ohms.
- 3 Install the Fork (K) onto the pot shaft, and then tighten the (J) Screw.
- 4 Then without turning the pot shaft thread the anchor nut just enough to seat the pot to its mounting bracket.

## WHEEL DRIVE SYSTEM

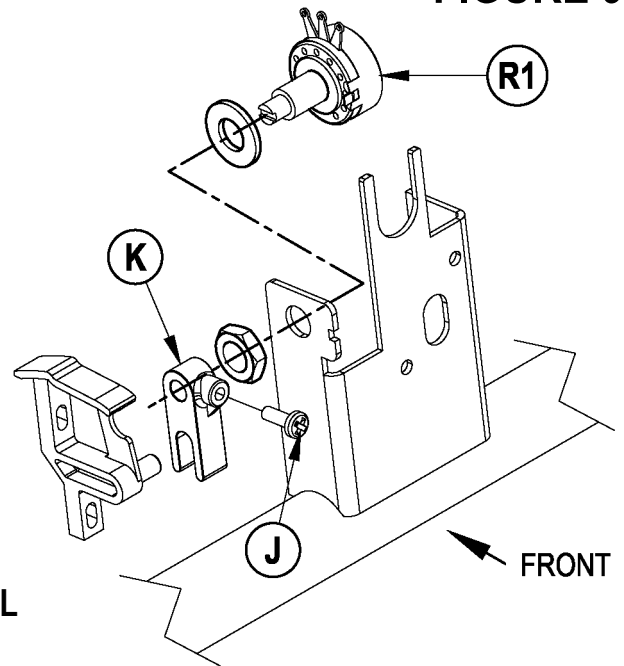
### (5K) POTENTIOMETER (R1) INSTALLATION AND ADJUSTMENT (CONTINUED)

- 5 Reconnect the ohmmeter test leads to the pot wiper and low terminal connections and adjust (turn the pot) to obtain half of pot's total resistance. This will accurately set the true neutral drive paddle operator position.
- 6 Tighten the anchor nut secure. Note: Do not turn the potentiometer shaft when tightening. Next re-attach all the wiring to both the pots and re-install the cover.
7. Reconnect the battery connector and turn the key switch on and test the drive system for proper FWD and REV operations. Note: The covers outside mounted speed limit knob should be turned to the full speed position for testing. If the display panel shows the 03 fault code the Potentiometer's are either not wired correctly or the R1 pot is not set to its neutral setting.

### FIGURE 8



### FIGURE 9



### (100K) POTENTIOMETER (R2) TESTING AND REMOVAL

#### ⚠ WARNING!

Disconnect the battery connector before servicing.

Note: The potentiometer (pot) doesn't have to be removed from the drive paddle cover to test.

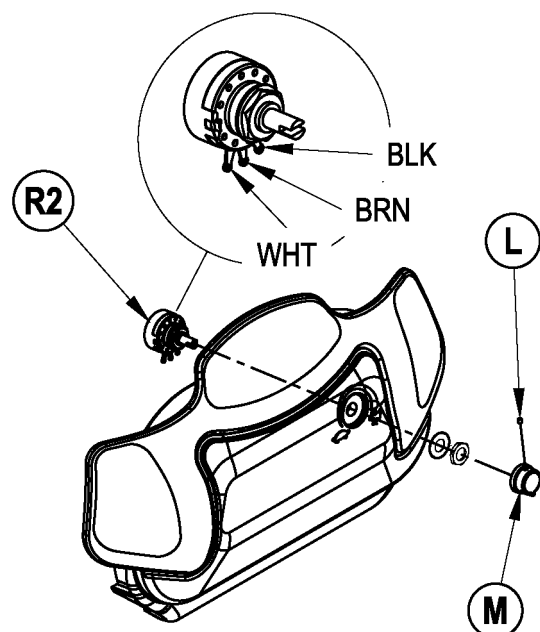
#### Test Procedure

- 1 See Figure 7. Remove the front drive paddle Cover (G) from the rear housing (H) held together with (4) item (I) Screws. Note the cover will have the speed limiting pot (R2) mounted to it; observe the (3) wires to reassemble and then separate them to complete the removal of the cover.
- 2 Test the (R2) potentiometer's resistance values using an ohmmeter, its specification is 100,000 ohms (plus or minus 10%). Connect the meter leads to each of the outside connections on the potentiometer, should read approximately 100,000 ohms. Next, take one of the test leads and connect to the middle terminal, then turn the stem both directions. The resistance value will change (vary) increasing and decreasing through its full range of 0-100,000 ohms and 100,000-0 ohms approximately. If you do not get similar readings replace the potentiometer.

#### R2 Potentiometer Removal

- 3 See Figure 10. Remove the Set Screw (L) (1/16" wrench) and pull off the Adjustment Knob (M) from the stem of the pot.
- 4 Remove the pot's anchor nut (1/2 inch wrench) then remove the (R2) Pot from the drive paddle cover.

### FIGURE 10



## ELECTRICAL SYSTEM

### BATTERIES

If your machine shipped with batteries installed do the following:

- Check that the batteries are connected to the machine (14 or 18).
- Turn ON the Key Switch (A) and check the Battery Indicator (D5 or J1). If the gauge is completely filled or the green light is ON, the batteries are ready for use. If the gauge is less than full or the green light is OFF, the batteries should be charged before use. See the "Charging The Batteries" section.
- **IMPORTANT!: IF YOUR MACHINE HAS AN ONBOARD BATTERY CHARGER REFER TO THE OEM PRODUCT MANUAL AND CONFIRM THAT THE CHARGER IS SET CORRECTLY FOR YOUR BATTERY TYPE (SEE CHART).**

If your machine shipped without batteries installed do the following:

- Consult your Authorized Nilfisk-Advance dealer for recommended batteries.
- Install the batteries by following the instructions below.
- **DO NOT install three 12 volt batteries in your machine. This affects the stability of the machine.**
- **IMPORTANT!: IF YOUR MACHINE HAS AN ONBOARD BATTERY CHARGER REFER TO THE OEM PRODUCT MANUAL FOR INSTRUCTIONS REGARDING SETTING THE CHARGER FOR BATTERY TYPE (SEE CHART).**

### WARNING!

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. This gas can be ignited by any electrical arc, spark or flame. Do not install any lead-acid battery in a sealed container or enclosure. Hydrogen gas from overcharging must be allowed to escape.

**When Servicing Batteries...**

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

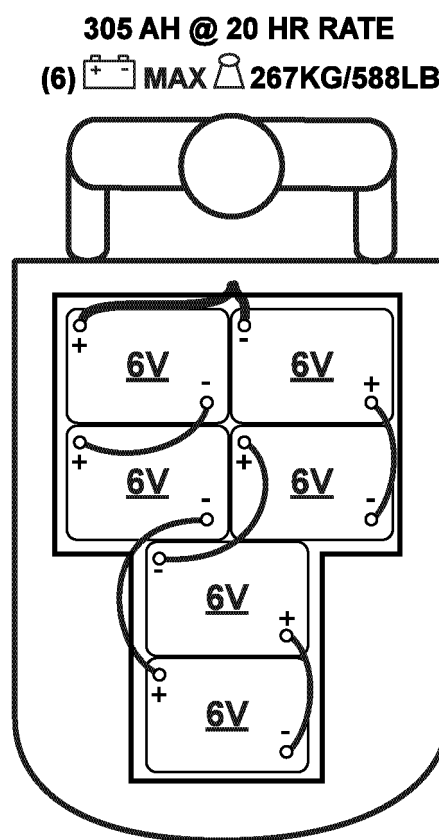
### CAUTION!

Electrical components in this machine can be severely damaged if the batteries are not installed and connected properly. Nilfisk-Advance, a qualified electrician, or the battery manufacturer should install batteries.

- 1 Remove the batteries from their shipping crate and carefully inspect them for cracks or other damage. If damage is evident, contact the carrier that delivered them or the battery manufacturer to file a damage claim.
- 2 Turn the Master Key Switch (A) OFF and remove the key.
- 3 Tip the recovery tank to the side, locked position. Remove the battery cables from inside the battery compartment.
- 4 Your machine comes from the factory with enough battery cables to install six 6 volt batteries. Carefully lift the batteries into the battery compartment and arrange them exactly as shown in **FIGURE 1**. Secure the batteries as close to the back of the machine as possible.
- 5 Install the battery cables as shown. Position the cables so the battery caps can be easily removed for battery service.
- 6 Carefully tighten the nut in each battery terminal until the terminal will not turn. Do not over-tighten the terminals, or they will be very difficult to remove for future service.
- 7 Coat the terminals with spray-on battery terminal coating (available at most auto parts stores).
- 8 Put one of the black rubber boots over each of the terminals and connect the Battery Pack Connector (14 or 18).

AH/Rate	MFG	Algorithm
180	DEKA(gel)	6
195	US	4
238	US / Trojan	4 / 1
305	Trojan	7

**FIGURE 1**



# ELECTRICAL SYSTEM

## SPECIFIC WET CELL BATTERY INFORMATION

### Wet Cell Battery specifications

- Use a combination of multiple 2-volt cell units to construct a 36 Volt DC battery pack system.
- Nilfisk-Advance recommended battery pack capacity is a 305 AH @ 20 Hour Rate deep cycle battery system. Note: The battery pack must fit the battery compartment size listed in *Specifications*.

### Wet Cell Battery Charger Specifications

- Use a 36 Volt DC output charger matching the DC battery pack voltage and the input AC line voltage supply being used.
- When selecting a battery charger always follow the recommendation of the battery supplier to match the proper charger DC output amperage to the amp/hour rating batteries being installed. This will prevent the battery pack from being over or under charged.
- The recommended 305 AH battery should be matched to a 36V, 20-25 Amp output charger on machines using (6) 6V batteries.

## DESCRIPTION OF THE LOW VOLTAGE CUTOUT FEATURE

All models discussed in this manual are equipped with a low voltage cutout feature to prevent over-discharging of the batteries. When a machine's battery pack voltage falls below specifically defined thresholds (voltage settings) the scrub system is automatically shut down. The cutout level is adjustable. The standard lead acid battery (wet cell) setting is 1.72V per cell and alternate maintenance free battery (gel cell) setting is 1.81V per cell. The standard setting is factory selected and should be used unless the battery manufacturer specifies the higher cutout voltage.

**Special Service Note:** On all the 36V machines a minimum recharge voltage of 2.13 volts per cell must be reached to allow the scrub brush and solution system to (reset) function again. A 36V-battery pack must increase to a 38.6-volt minimum.

## DESCRIPTION OF THE BATTERY CONDITION INDICATORS

The Battery Condition Indicator will give an indication of the state of charge of the batteries, 5 vertical bars (or a green light) indicates a fully charged battery after a complete charging cycle. The battery condition indicator will retain the state-of-charge even if the key has been turned off. The state-of-charge indication is reset to full charge when the batteries have been recharged. It is also possible to choose between two different low voltage thresholds depending on whether maintenance free or standard batteries are being used (**have qualified service engineer perform this selection\***). NOTE: The following percentages are based on *useable* battery capacity not total battery capacity. Therefore, 100% discharge = 80% of total battery capacity for standard wet cell batteries or 70% of total battery capacity for maintenance free batteries.

### Explanation of Battery Indicator Bars and Voltage Ranges (AXP™ / ECO+Solution™ models)

Battery Indicator	36 volt machines	
	Standard	Alternate
5 vertical indicator bars	36.1+	36.1+
4 vertical indicator bars	35.5-36.1	35.5-36.1
3 vertical indicator bars	34.4-35.5	34.4-35.5
2 vertical indicator bars	33.9-34.4	33.9-34.4
1 vertical indicator bars	32.2-33.9	33.3-33.9
0 vertical indicator bars	30.9-32.2	32.8-33.3
Low Voltage Cut Out	<30.9	<32.8

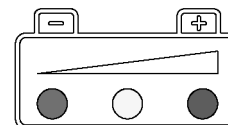
AXP™ / ECO+Solution™



### Explanation of Battery Indicator Lights and Voltage Ranges (Non AXP™ / ECO+Solution™ models)

Battery Indicator	36 volt machines		
	% of Discharge	Standard	Alternate
Green	Full to 50%	34.0+	34.5+
Green & Yellow	50% to 75%	33.0-34.0	34.0-34.5
Yellow	75% to 90%	32.0-33.0	33.5-34.0
Yellow & Red	90% to 95%	31.5-32.0	33.0-33.5
Red	95% to 99%	31.0-31.5	32.5-33.0
Flashing Red/Cutoff	100%	<31.0	<32.5

Standard (NonAXP™ / ECO+Solution™)



**\*Important Note:** See the *Main Control Board Special Program Options* manual section (located in the Electrical System) and follow the instructions for changing the low voltage cutout threshold.

## ELECTRICAL SYSTEM

### CHARGING WET BATTERIES

AXP/ECO+Solution - Charge the batteries each time the machine is used or when the Battery Indicator (D5) is reading less than full.

Standard - Charge the batteries each time the machine is used or when the Battery Indicator (J1) is flashing RED.



### WARNING!

Do not fill the batteries before charging.

Charge batteries in a well-ventilated area.

Do not smoke while servicing the batteries.

#### When Servicing Batteries...

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

#### If your machine shipped with an onboard battery charger do the following:

Turn the Key Switch (A) OFF. Unwind the electrical cord from the side of the onboard charger and plug it into a properly grounded outlet. Refer to the OEM product manual for more detailed operating instructions.

#### If your machine shipped without an onboard battery charger do the following:

Disconnect the batteries from the machine and push the connector from the charger into the Battery Pack Connector (18). Follow the instructions on the battery charger. **SERVICE**

**NOTE:** Make sure you plug the battery charger into the connector with the handle attached to it.



### CAUTION!

To avoid damage to floor surfaces, wipe water and acid from the top of the batteries after charging.

### CHECKING THE BATTERY WATER LEVEL

Check the water level of the batteries at least once a week.

After charging the batteries, remove the vent caps and check the water level in each battery cell. Use distilled or demineralized water in a battery filling dispenser (available at most auto parts stores) to fill each cell to the level indicator (or to 10 mm over the top of the separators). **DO NOT** over-fill the batteries!



### CAUTION!

Acid can spill onto the floor if the batteries are overfilled.

Tighten the vent caps. Wash the tops of the batteries with a solution of baking soda and water (2 tablespoons of baking soda to 1 liter of water).

### CHARGING GEL (VRLA) BATTERIES

AXP/ECO+Solution - Charge the batteries each time the machine is used or when the Battery Indicator (D5) is reading less than full.

Standard - Charge the batteries each time the machine is used or when the Battery Indicator (J1) is flashing RED.



### WARNING!

Charge batteries in a well-ventilated area.

Do not smoke while servicing the batteries.

#### When Servicing Batteries...

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



### CAUTION!

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

#### If your machine shipped with an onboard battery charger do the following:

Turn the Key Switch (A) OFF. Unwind the electrical cord from the side of the onboard charger and plug it into a properly grounded outlet. Refer to the OEM product manual for more detailed operating instructions.

#### If your machine shipped without an onboard battery charger do the following:

Disconnect the batteries from the machine and push the connector from the charger into the Battery Pack Connector (18). Follow the instructions on the battery charger. **SERVICE**

**NOTE:** Make sure you plug the battery charger into the connector with the handle attached to it.

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

## ELECTRICAL SYSTEM

### BATTERY MAINTENANCE WET CELL BATTERIES

Proper maintenance of electric vehicle batteries can greatly extend their life. Well-maintained batteries may last up to 3 years, but failure after 1 year is common if maintenance has been poor.

There are 3 simple rules for good battery maintenance:

- **Maintain Proper Electrolyte Level (Weekly)** - Use distilled water in batteries whenever possible. If batteries are discharged, add just enough water to cover the plates in each cell. If batteries are fully charged, fill each cell to the bottom of the filler tube. Do not over-fill the batteries! Do not add acid to batteries!
- **Keep the Batteries Charged (Weekly)** - Batteries should be charged each time that a machine is used for more than 1 hour. Machine operators should open the battery compartment cover for charging, to avoid a concentrated build-up of hydrogen gas. Operators should follow the instructions provided with their specific battery charger, to determine how long the batteries should be charged. Even when a machine is stored, the batteries should be charged once a month to prevent the batteries from "sulfating". Almost all battery caps are vented, so there's no need to loosen or remove them for charging.
- **Keep the Batteries Clean (Monthly)** - Use a damp cloth to wipe dirt from the top of the batteries. Battery terminals must be clean and tight. If the tops of the batteries are wet after charging, the batteries have probably been over-filled or over-charged. Note: If there is acid on the batteries, wash the tops of the batteries with a solution of baking soda and water (2) tablespoons of baking soda to 1 quart of water.

### 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- that is, one or more cells that are putting out less voltage than the other cells.

**Note:** Always charge batteries before testing.

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.
- Use a volt meter to check the voltage of each battery with the scrub and drive motors running. The battery with the dead cell will read 1 or 2 volts lower than the other batteries in the system.

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.

# ELECTRICAL SYSTEM

## ACTUATOR DRIVE NUT ADJUSTMENT

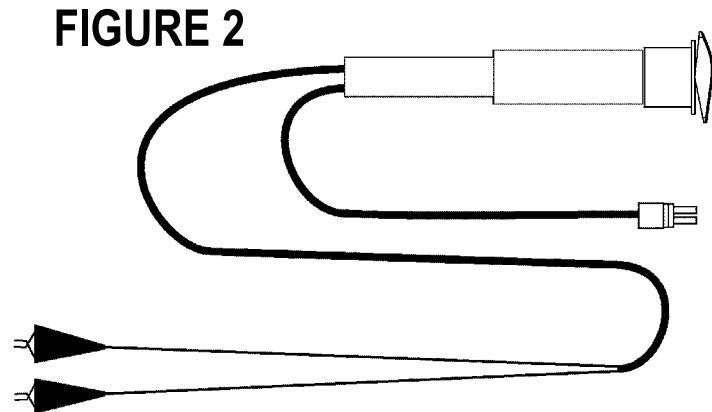
This manual section explains the steps for adjusting the drive nut (spring housing) setting for all the models' scrub brush lift actuator motor. Reference the chart below to find the IN & OUT dimensional specification for an actuator motor needing adjustment.

Part #	Actuator Motor	Spring Housing IN Position	Spring Housing OUT Position	Models
56393303	Scrub Brush Lift (ALL)	1/16"(1.6mm) - 3/16"(4.76mm)	4-1/8"(10.47cm) - 4-1/4"(10.8cm)	ALL

\*The "Spring Housing IN/OUT Position" dimensions are measured when completely assembled. Reference points are the gear box step to the edge of the plastic Spring Housing Guide (A) as shown in Figures 3 and 4.

### General Instructions for All Actuator Motors

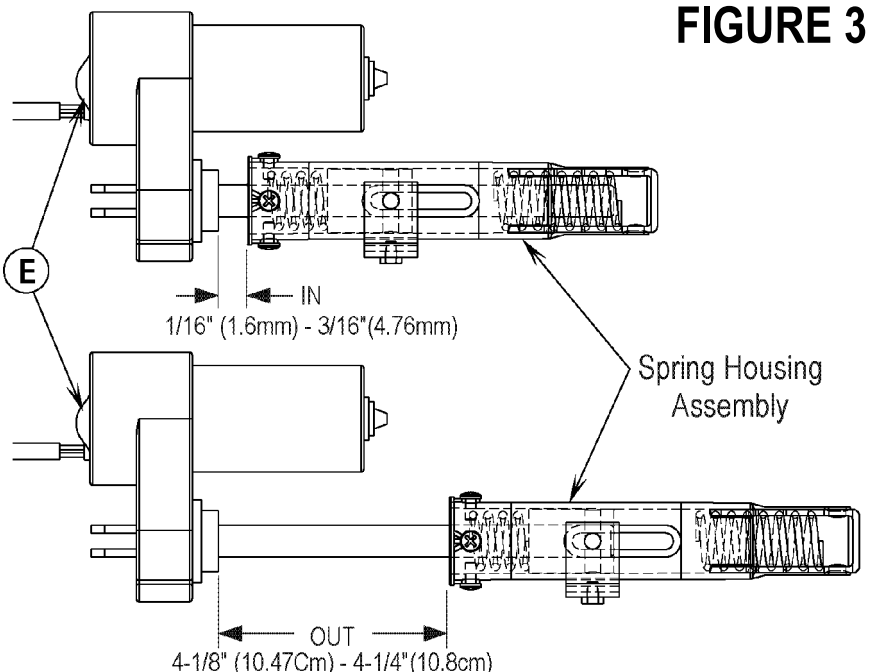
- 1 See **Figure 2**. This shows the special actuator power cord adapter (PN 56407502) that is needed to connect the machine's battery pack and actuator motor for setting the drive nut limit settings.
- 2 Open the machine battery compartment and disconnect the battery connector. The battery pack is needed to power the lift actuator motor to properly set the IN & OUT limit switches.
- 3 Connect the actuator motor to be tested to the power cord adapter end. Then connect the alligator clips from the cord adapter (red clip to the positive and black to negative) to battery connector or battery posts. The rocker switch is used to change the motor rotation in setting the correct drive nut dimension.



### Instructions for Scrub Brush Lift Actuator Drive Nut Adjustment

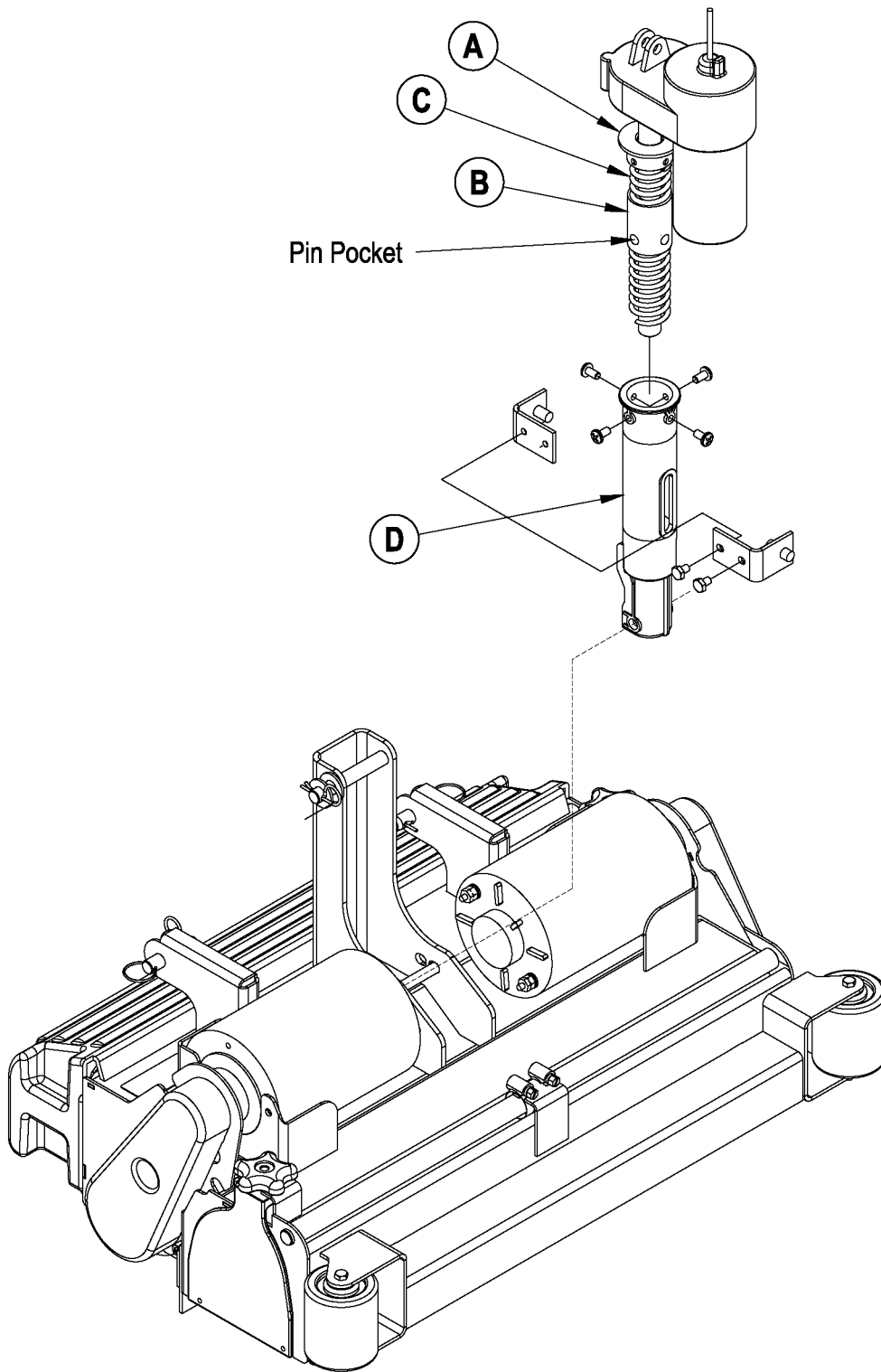
- 1 See Figure 3 and 4. On a new scrub lift actuator motor remove (spin-off) the Drive Nut (B) and first slide on the Spring Housing Guide (A), then install the short compression Spring (C) onto the actuator (lead screw) shaft. Next reinstall the plastic Drive Nut (B) as shown (with the nut pin pocket away from the motor). Then finish assembly of remaining parts (long compression spring, Spring Housing (D) and mounting hardware).
- 2 Hold onto the spring housing assembly and press the rocker switch to run the drive motor and retract the spring housing towards the motor housing (its IN limit).
- 3 Measure the position of the spring housing assembly on the actuator shaft. Manually turn the spring housing assembly to the appropriate IN position shown in the chart above.
- 4 Hold the spring housing assembly, then press the adapter cord rocker switch to run the drive motor to the OUT position (wait until the motor stops).
- 5 Measure the position of the spring housing assembly on the shaft and compare the measurement with the OUT position shown in the chart.
- 6 When the measurement doesn't match the dimension shown in the chart it is necessary to remove the Adjuster Cover (E) and adjust the OUT position.
- 7 To increase the travel of the spring housing assembly, turn the adjuster clockwise. To decrease the travel of the assembly, turn the adjuster counter clockwise.  
NOTE: Use a 1/2" (13mm) socket to turn the adjuster. Each click of the adjuster will change the spring housing assembly travel 1/16 inch (1.6mm).
- 8 After each adjustment, hold the spring housing assembly, run the actuator IN & OUT and check both dimensions. After checking that the spring housing limits are set correctly replace the adjuster cover. Service Tip Note: Use the above power cord adapter to help position the spring housing assembly (in or out) for ease in actuator motor installations.
- 9 After adjusting the actuator spring housing dimensions, follow the *Scrub Brush Lift Actuator Removal (Disc or Cylindrical)* manual section to reassemble.

**Service Tip:** See **Figure 4**. Note the correct orientation of the Spring Housing (D) when installing the complete motor assembly and also run the spring housing assembly to the IN (retracted) position for machine installation.





**FIGURE 4**




## ELECTRICAL SYSTEM

### CURTIS CONTROLLER DIAGNOSTICS:

**Diagnostics Method A:** Uses the machine's control display LED panel and wand switch indicator.

### FUNCTION OF THE SPEED CONTROLLER STATUS LIGHT AND DISPLAY

The Curtis 1228- (36V) speed control will output a fault code if there is a problem associated with the speed control and wheel drive system. See **Figure 5**. If a speed control fault occurs, the display LED panel (**D**) on AXP™ / ECO+Solution™ models will indicate  03. The (**J2**) Indicator on standard models will flash the following 3 characters one at a time E 0 3. When the 03 or E 0 3 error code is displayed and detects a fault the Green Indicator (**M**) normally the accessory wand indicator light will flash a special error code sequence until the fault is corrected. See "Table 1" for a description of the fault indications. Service Note: Instructions on how to read the error code status light. Example, OO O = two light flashes, a short pause. One flash, long pause and the code will be repeated. This indicates a fault code 2,1.

**Diagnostics Method B:** Uses the optional hand held Curtis programmer model 1307 or the new model 1311 MP1101.

### PROGRAMMER DIAGNOSTICS:

With a programmer, diagnostics and troubleshooting is more direct than with the LED alone. The programmer presents complete diagnostic information in plain language, no 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 following 4-step process is generally used for diagnosing and troubleshooting an inoperative vehicle: (1) visually inspect the vehicle for obvious problems; (2) diagnose the problem, using the programmer; (3) test the circuitry with the programmer; and (4) correct the problem. Repeat the last three steps as necessary until the vehicle is operational.

Example: A vehicle that does not operate in "forward" is brought in for repair.

- 1 Examine the vehicle and its wiring for any obvious problems, such as broken wires or loose connections.
- 2 Connect the programmer, put it in diagnostic mode, and read the displayed fault information. In this example, the display shows "No Faults Present", indicating that the controller has not detected anything out of the norm.
- 3 Put the programmer in test mode, and observe the status of inputs and outputs in the forward direction. In this example, the display shows that the forward input did not activate when "forward" was selected, which means the problem is either in the electronic throttle or the throttle wiring.
- 4 Check or replace the electronic throttle and wiring and repeat the test. If the programmer shows the forward switch closing and the vehicle now drives normally, the problem has been corrected.

Refer to the Status Fault Codes (**Table 1**) for suggestions covering a wide range of possible faults.

### DIAGNOSTIC HISTORY

The handheld programmer can be used to access the controller's diagnostic history file. Connect the programmer, press the MORE INFO key, and then while continuing to hold the MORE INFO key, press the DIAGNOSTICS key. The programmer will read out all the faults that the controller has experienced since the last time the diagnostic history file was cleared. The faults may be intermittent faults, faults caused by loose wires, or faults caused by operator errors. Faults such as HPD or over temperature may be caused by operator habits or by overloading.

After a problem has been diagnosed and corrected, clearing the diagnostic history file is advisable. This allows the controller to accumulate a new file of faults. By checking the new diagnostic history file at a later date, you can readily determine whether the problem was indeed completely fixed.

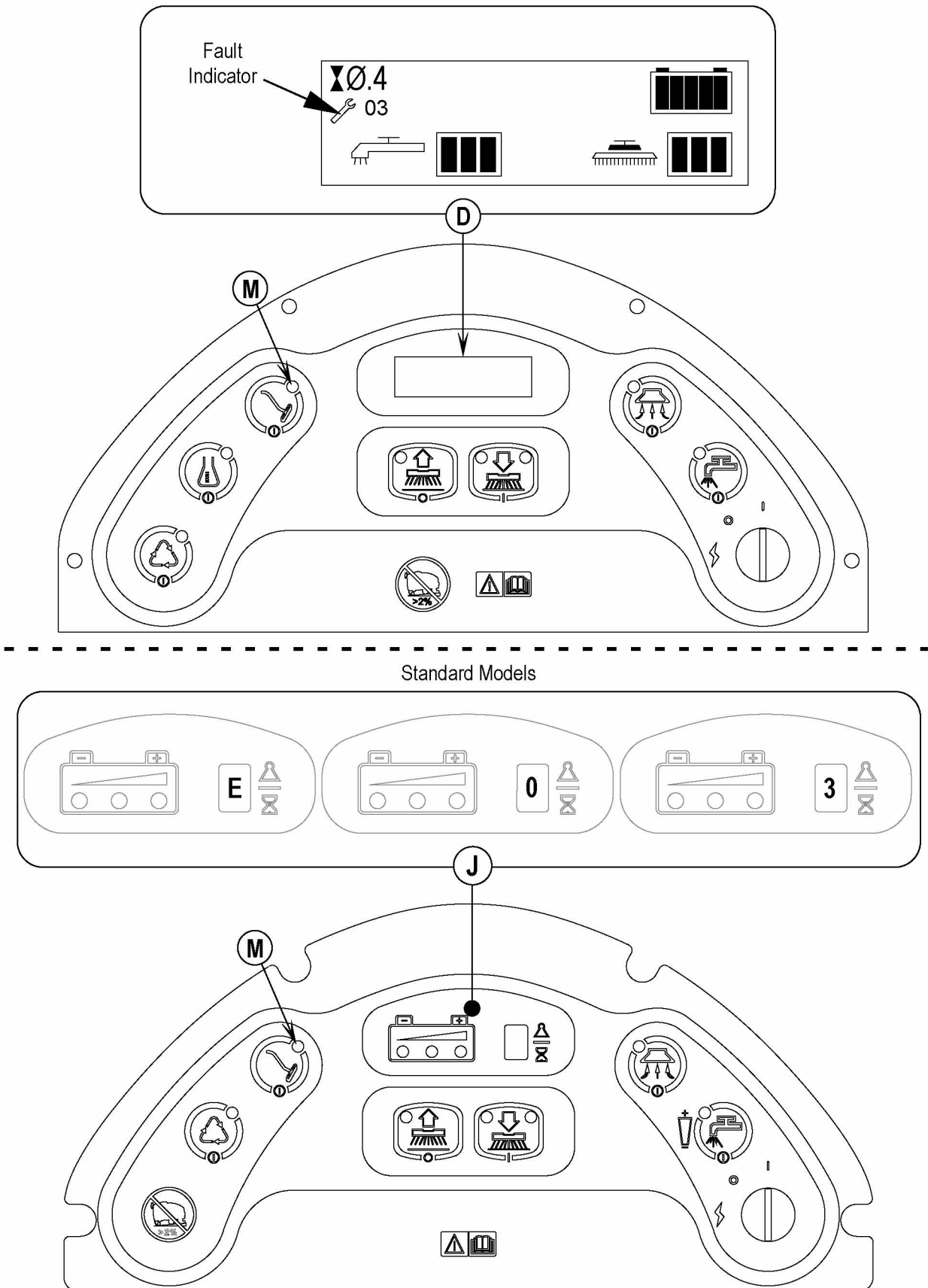
To clear the diagnostic history file, go to the Special Program Menu (by pressing and holding the MORE INFO key, and then pressing the PROGRAM key), scroll through the menu until "Clear Diagnostic History" is the top line in the display, and then press MORE INFO again. The programmer will prompt you to acknowledge or cancel.

See the Curtis programmer manual 56043101 for more detail on programmer operation.

# ELECTRICAL SYSTEM

## FIGURE 5

AXP™ / ECO+Solution™ Models



# ELECTRICAL SYSTEM

**STATUS LED FAULT CODES (TABLE 1)**

LED CODE	STATUS LIGHT DISPLAY	EXPLANATION	POSSIBLE CAUSE
1,1	0 0	over-/under-temperature cutback	1. Temperature >92°C or < -25°C. 2. Excessive load on vehicle 3. Operation in extreme environments. 4. Electromagnetic brake not releasing.
1,2	0 00	throttle fault	1. Throttle input wire open or shorted 2. Throttle pot defective. 3. Wrong throttle type selected.
1,3	0 000	speed limit pot fault	1. Speed limit pot wire(s) broken or shorted. 2. Broken speed limit pot.
1,4	0 0000	battery voltage too low	1. Battery voltage <17 volts. 2. Bad connection at battery or controller.
1,5	0 00000	battery voltage too high	1. Battery voltage >36 volts. 2. Vehicle operating with charger attached. 3. Intermittent battery connection.
2,1	00 0	main contactor driver Off fault	1. Main contactor driver failed open.
2,3	00 000	main contactor fault	1. Main contactor welded or stuck open. 2. Main contactor driver fault. 3. Brake coil resistance too high.
2,4	00 0000	main contactor driver On fault	1. Main contactor driver failed closed.
3,1	000 0	fault present for >10 sec.	1. Misadjusted throttle. 2. Broken throttle pot or throttle mechanism.
3,2	000 00	brake On fault	1. Electromagnetic brake driver shorted. 2. Electromagnetic brake coil open.
3,3	000 000	precharge fault	1. Low battery voltage. 2. KSI and throttle turned on at same time.
3,4	000 0000	brake Off fault	1. Electromagnetic brake driver open. 2. Electromagnetic brake coil shorted.
3,5	000 00000	HPD (High Pedal Disable) fault	1. Improper sequence of throttle and KSI,** push, or inhibit inputs. 2. Misadjusted throttle pot.
4,1	0000 0	current sense fault	1. Short in motor or in motor wiring. 2. Controller failure. *
4,2	0000 00	motor voltage fault (hardware failsafe)	1. Motor voltage does not correspond to throttle request. 2. Short in motor or in motor wiring. 3. Controller failure. *
4,3	0000 000	EEPROM fault	1. EEPROM failure or fault.
4,4	0000 0000	power section fault	1. EEPROM failure or fault. 2. Short in motor or in motor wiring. 3. Controller failure. *

\* Jack up vehicle and retest to confirm diagnosis. Clean connections, inspect system wiring, and retest.

\*\*NOTE: A KSI (key switch input) system problem is a specific HPD (high pedal disable) type operational fault, caused by the operator activating the Fwd/Rev drive paddle before turning on the main key switch. This can be cleared by returning the operator's drive paddle to neutral and cycling the key switch OFF and ON.

## SPEED CONTROL PROGRAMMING OPTIONS

The following is a list of the speed control parameters that can be adjusted using a Curtis hand held programmers:

M1 MAX SPEED – Transport/Scrub speed maximum limit (% of full throttle)

M2 MAX SPEED – Not applicable

M1 MIN SPEED – Transport/Scrub speed maximum limit with the speed limit pot in minimum position (% of full throttle limited by speed limit pot)

M2 MIN SPEED – Not applicable

M1 REVERSE MAX SPEED – Reverse Transport/Scrub speed maximum limit (% of full throttle)

M2 REVERSE MAX SPEED – Not applicable

REVERSE MIN SPEED – Transport/Scrub speed maximum limit with the speed limit pot in minimum position (% of full throttle limited by speed limit pot)

THROTTLE AUTOCAL – Used for calibration of the throttle assembly

## ELECTRICAL SYSTEM

### INSTALLATION CHECKOUT FOR THE CURTIS SPEED CONTROLLER

#### SAFETY!

The 1228 controller is inherently a high power device. When working around any battery powered vehicle, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, avoiding loose clothing and jewelry, and using insulated wrenches.

After installing a controller and before operating the vehicle, carefully complete the following checkout procedure. If you find a problem during the checkout, refer to the DIAGNOSTICS section of this chapter for further information.

The installation checkout can be conducted with or without the handheld programmer. The checkout procedure is easier with a programmer otherwise observe the Status LED for codes (located on operator panel wand indicator light). The part number of the handheld programmer is 56409441.

#### WARNING!

Put the vehicle up on blocks to get the drive wheel off the ground before beginning these tests.

Turn the key switch off and make sure that the throttle is in neutral.

Do not stand, or allow anyone else to stand, directly in front of or behind the vehicle during the tests.

- 1 Remove electrical panel to access controller then observe LED status light on touch pad operator panel wand indicator light. If a programmer is available, connect it to the programmer plug-in port.
- 2 Turn the key switch on. The programmer should “power up” with an initial display. If neither happens, check for continuity in the key switch circuit and controller ground.
- 3 If you are using a programmer, put it into the diagnostic mode by pressing the DIAGNOSTICS key. The display should indicate “No Faults Found”. Note: Before pressing the diagnostics key, wait until model # screen appears, if the throttle is activated prior to this screen appearing the controller will shut down.
  - If there is a problem, the LED will flash a diagnostic code and the programmer will display a diagnostic message. If you are conducting the checkout without a programmer, look up the LED diagnostic code in the DIAGNOSTICS section of this chapter (**Table 1**).
  - When the problem has been corrected, it may be necessary to cycle the key switch to clear the fault code.
- 4 Move the drive paddle to operate the throttle. The motor should begin to turn in the selected direction. If it does not, verify the wiring to the controller, and the motor. The motor should run proportionally faster with increasing throttle. If not, refer to the DIAGNOSTICS section of this chapter (**Table 1**).
- 5 If you are using a programmer, put it into the test mode by pressing the TEST key. Scroll down to observe the status of the forward, reverse and brake switch. Cycle each switch in turn, observing the programmer. Each input should show the correct state on the programmer.
- 6 Take the vehicle off the blocks and drive it in an open area. It should have smooth acceleration and good top speed.

### PROGRAMMING VEHICLE SPEED CHANGES

The maximum high-speed M1 (transport) and maximum low speed M2 (scrub) can be changed electronically, using the handheld programmer. To change a parameter using the programmer, press the PROGRAM key, and scroll down the Program Menu until the desired parameter is the top line of the display. Press the appropriate CHANGE VALUE key (“up” or “down”) until the desired number is reached. The parameter is now set at the desired value. All programming occurs in real time. In other words, the parameters can be changed while the vehicle is in operation.

The upper and lower limits of parameters are set at the factory. Some parameters have dependencies on other parameters. When the programmer is being used to adjust a parameter and a limit is reached, the display will stop changing. To see why the display has stopped changing, press the MORE INFO key. If the limit is related to another parameter, that information will be displayed; changing the value of the related parameter may allow the original parameter to be adjusted further. Otherwise, the display simply says “Max Limit” or “Min Limit.”

Use of the programmer models (1307 / old style and 1311 / new style) is described more fully in the Curtis Programmer manual 56043101.

### MAINTENANCE

There are no user-serviceable parts inside the Curtis PMC 1228 controller. No attempt should be made to open the controller. Opening the controller may damage it and will void the warranty.

However, it is recommended that the controller exterior be cleaned periodically, and if a handheld programmer is available, this periodic cleaning provides a good opportunity to check the controller’s diagnostic history file.



## ELECTRICAL SYSTEM

### FUNCTIONAL OVERVIEW OF MAIN CONTROL BOARD

The primary function of the main control board A1 is to position the scrubbing brush(s) with respect to the floor surface using a lift actuator motor to maintain the correct brush pressure and current draw of the brush motor(s). When the scrub ON switch is depressed this will lower the scrub deck to the operating position and by activating the drive paddle start the brush motors. The controller is continuously monitoring the current to the brush motors and when it senses a current draw out of the desired range it automatically raises or lowers the brush deck by turning on the brush actuator motor. This process is repeated until the brush motor is shut off. The controller also manages the other supportive systems such as the solution on/off, and vacuum motor. Note: See the Know Your Machine system in this manual for a complete explanation of the machine's operation.















The secondary function of the main control is to detect any system failures and display an error code on the display panel or store it in the main control board's recall memory mode. The error code(s) are used to help the serviceperson determine the fault and to quickly guide in repairing a specific system malfunction. Note: See the *Troubleshooting Guide* for further information. An additional special feature of the main control board is to change program settings for a set of specific machine functions. See the *Main Control Board Special Program Options* section in this manual for further information.

### TROUBLESHOOTING GUIDE

Any error codes detected by main control board will be displayed on the display panel as they occur. If more than one-error exists the display will sequence through the error codes at one-second intervals. On AXP™ / ECO+Solution™ models the error will display as a mechanical wrench symbol  followed by a two-digit code. EX:  03 would be a drive system fault. On standard models the hour meter / error display will flash 3 characters one at a time. EX. E 0 3 would be a drive system fault. When troubleshooting any "Fault Description" noted with a double asterisk (\*\*) follow the instructions for entering the SERVICE TEST MODE in the control boards special programs. See the *Main Control Board Special Program Options* section in this manual.

# ELECTRICAL SYSTEM

## MAIN CONTROLLER ERROR CODES

Display Code	Fault Description	Troubleshooting Action
 03(E-0-3)	Drive system fault.	1. Check for a tripped drive motor circuit breaker (30 amp). Investigate reason for possible mechanical over load. Examples: Debris wrapped around the drive wheels, defective differential and prolonged ramp climbing. 2. Observe the green flashing wand indicator light (location operator panel) then see Curtis drive motor controller section to further troubleshoot the drive system (Table 1).
 04(E-0-4)	Scrub deck lift actuator overload. Normal current load 1-2.5 Amps, max. Current load 6 Amps, Max. Current no load 1.4 Amps.	1. Check for binding or frozen brush lift linkage and excessive weight on brush deck. 2. Check for short circuits in actuator in the motor and wiring. Repair or replace.* To test, disconnect the motor plug and attach the actuator test cord (56407502) and perform an Amp draw test. Compare readings to the fault description table on the left.
 05(E-0-5)	Solution pump overload. Normal current load .8-1.8 Amps max. Current load 3.2 Amp over will cause 05 pump motor overload.	1. Check for short circuits in wiring and pump motor. 2. Disconnect pump motor and run the machine to see if the wiring is shorted. 3. Check the pump motor to see if it is bad.
 06(E-0-6)	Scrub motor overload Note: See Table #2 Scrub Pressure for detail load current values for the different PA#s.	1. Check for binding in rotation of brushes or improper brush Scrub Pressure lift actuator operation. 2. Check the negative supply cable at the brush motor for a wiring problem or improper modifications. 3. Check for an open in the small WHT/ GRA current sense wire. 4. Check to see that the proper brush programming type is selected*** (disc or cyl). 5. Check for short circuit* in brush motor or wiring. 6. Inspect gearbox for failure (disc). Repair or replace. 7. Inspect scrub brush drive bearings & drive belts for excessive wear (cyl).
 07(E-0-7)	Vacuum motor overload Normal current load 36V 23-25 Amps.	1. Check for debris in the vacuum motor. 2. Worn carbon brushes. 3. Defective motor bearings. 4. Check for short circuit* in vacuum motor or wiring. Repair or replace 5. Check for an open in the small ORG current sense wire.
 08(E-0-8)	Solenoid Coil Bank Overload Brush Solenoid Coil (K1) Overload Vacuum Solenoid Coil (K2) Overload Solution Solenoid Coil (L1) Overload	1. Check for wiring problems (short) on all three coil circuits and repair wiring. 2. Check resistance on all three coils. The brush, vacuum and solution coil's nominal spec. is 120 Ohms. If resistance is below 95 Ohms on any one coil, replace the solenoid.
 17(E-0-17)	Scrub deck lift actuator circuit open (**)	1. Check for disconnected actuator wiring, open in wiring or defective actuator motor. Repair or replace. 2. Check controller output voltage, should be 24 if 0V controller failure (replace).
 18(E-0-18)	Scrub deck lift actuator short	1. Check for binding or frozen brush lift linkage and excessive weight on brush deck. 2. Check for short circuit* in brush lift motor and wiring. Repair or replace.
 21(E-0-21)	Scrub motor circuit open (**)	1. Check for disconnected brush motors, open in wiring, defective brush motor solenoid load contact failure. 2. Check the negative supply cable at the brush motor for a wiring problem or improper modifications.
 22(E-0-22)	Scrub motor short	Same as  06(E-0-6)
 23(E-0-23)	Vacuum motor circuit open (**)	1. Check for disconnected vacuum motor wiring, open in wiring, defective vacuum motor and vacuum contactor failure.
 24(E-0-24)	Vacuum motor short	Same as  07(E-0-7)

\*\* See Service Test Mode in this Manual for further trouble shooting information.

\*\*\* See the *Main Control Board Special Program Options* section to activate the Brush Type Selection function

\*Short Circuit definition:

- A short circuit is a parallel path of very low resistance, often caused accidentally.
- With low resistance there is an excessive amount of current.
- The excessive current will either melt the wires or open a fusible link.

## ELECTRICAL SYSTEM

### SERVICE TEST MODE:

To assist in the troubleshooting and servicing of the electrical system and related components on the Warrior™ / BA 755 series scrubbers, a special test mode that allows independent control of the various outputs and monitoring of the various inputs has been incorporated.

**To enter the service test mode perform the following step:**

- 1 Turn the main power Key Switch **(A)** to the off position.
- 2 Press and hold the Wand Switch **(E)**.
- 3 While holding the wand switch turn the main power key switch to the on position.
- 4 Continue to hold the wand switch until the Wand Indicator **(M)** turns green.
- 5 Release the wand switch.
- 6 The Display **(D or J)** will now display “SVCTEST” or “ $\epsilon$ ” and current battery voltage and speed control status (SCS).
- 7 The function of each switch and indicator is described below.
- 8 To exit this mode, turn the main key switch to the off position.

### INPUT INDICATORS (SEE FIGURE 6 FOR PANEL DISPLAY & BUTTON LOCATIONS):

#### SCS / GREEN LIGHT:

Speed control status signal. This is an output from the speed control to the main control unit that indicates the status of the speed control. Normally this indicator will be displayed whenever the key is on. If there is a speed control fault this indicator will flash the fault code produced by the speed control. Refer to the speed control section for details on these codes.

If **(SCS / Green Light)** does not display follow the troubleshooting procedure below.

- Disconnect the Org/Blu wire from the speed controller and main controller and check the continuity of the wire. If the wire tests open repair or replace the wire or plug. If wire tests ok replace the speed controller.

#### F/R / YELLOW LIGHT:

Speed control forward/reverse signal. This is an output from the speed control to the main control unit that indicates when the throttle has been moved from the neutral position either forward or reverse. **(F/R / Yellow Light)** will be displayed if this signal is active.

If **(F/R / Yellow Light)** does not display follow the troubleshooting procedure below.

- Disconnect the Red/Blk wire from the speed controller and main controller and check the continuity of the wire. If the wire tests open repair or replace the wire or plug. If wire tests ok replace the speed controller.

#### REV / RED LIGHT:

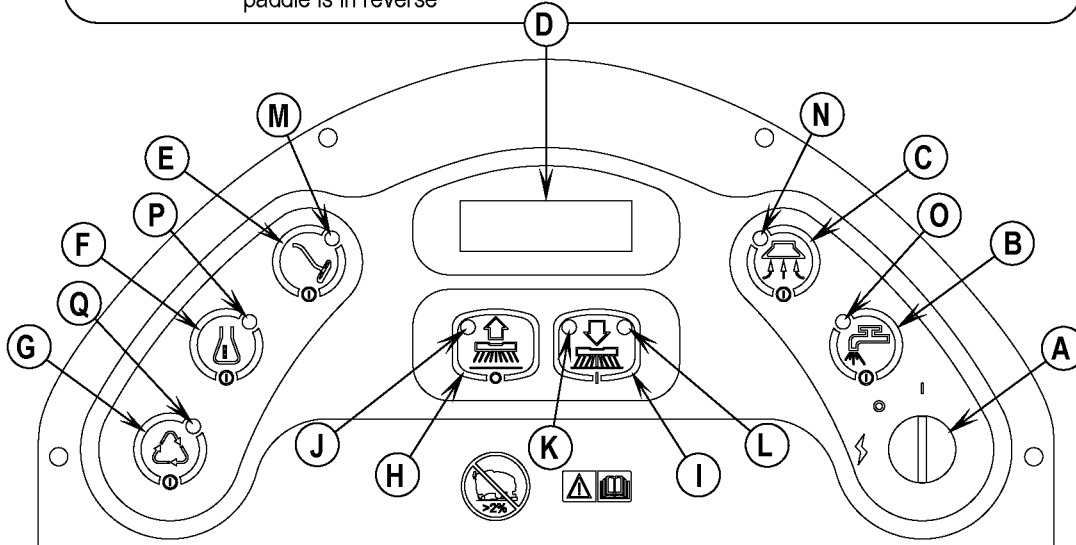
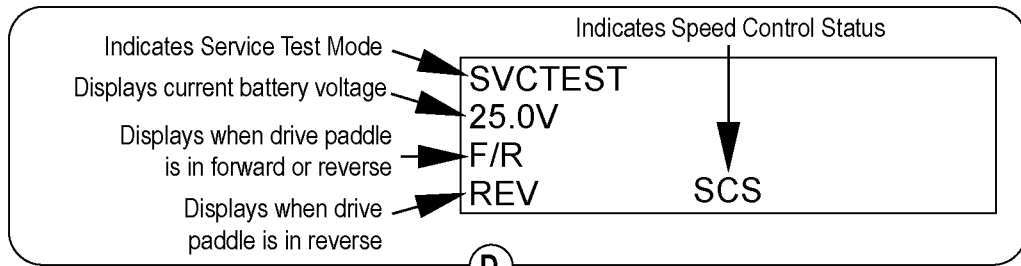
Speed control reverse signal. This is an output from the speed control to the main control unit that indicates when the throttle has been moved to the reverse position. **(REV / Red Light)** will be displayed if this signal is active.

If **(REV / Red Light)** does not display follow the troubleshooting procedure below.

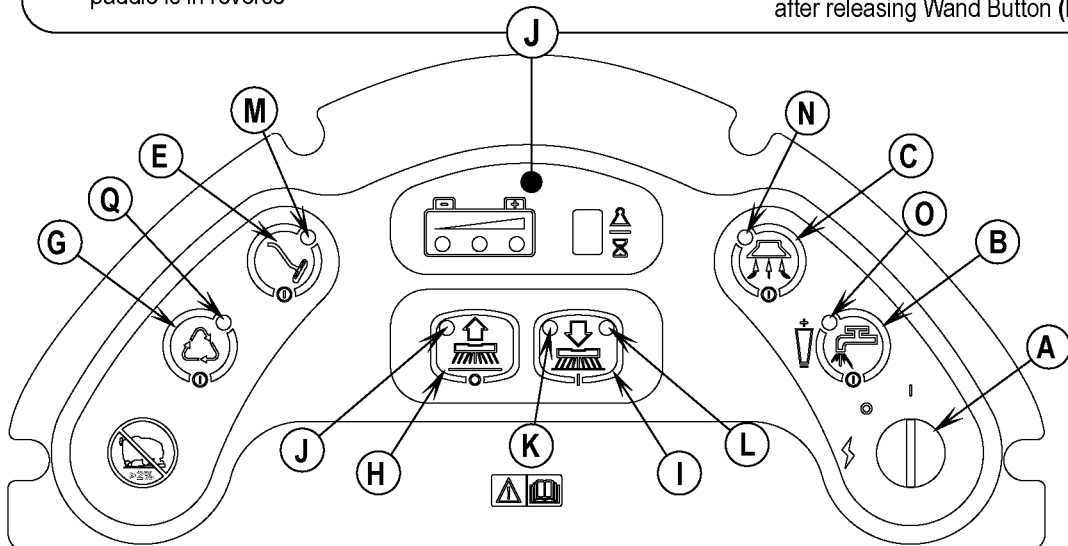
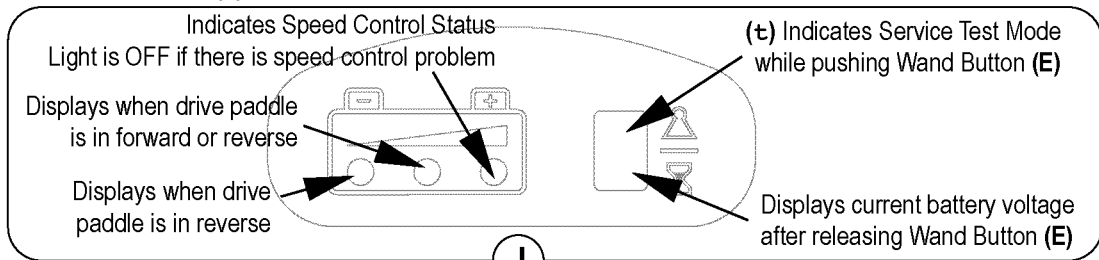
- Disconnect the Blu/Blk wire from the speed controller and main controller and check the continuity of the wire. If the wire tests open repair or replace the wire or plug. If wire tests ok replace the speed controller.



Panel (D) with Service Test Mode activated on AXP™ / ECO+Solution Models.



Panel (J) with Service Test Mode activated on Standard Models.



## ELECTRICAL SYSTEM

### BATTERY STATUS DISPLAY:

The display will show the battery voltage. This display is accurate to within +/- 0.15 volts. Therefore, the voltage displayed may not correlate precisely to a high-accuracy, calibrated voltmeter.

### OUTPUT CONTROLS:

The control panel switches are used to control various output functions of the main control unit. Below is a list of each switch and the function it controls. Following the list is a detailed description of each function.

**Scrub off Switch (H):** Controls brush motor.

**Scrub on Switch (I):** Controls scrub deck lift actuator.

**Vacuum Switch (C):** Controls vacuum motor.

**Wand Switch (E):** Used to jog actuator.

**Solution Switch (B):** Turn on solution pump and solenoid valve.

**Extended Scrub Switch (G):** Turn on recycle pump (If available).

**Detergent System Switch (F):** turn on chemical pump (If available).

#### **Scrub System Off Switch (H):**

This switch is used to toggle the state of the brush motor. Pressing and releasing this switch will alternately turn the brush motor on and off. The indicator provides the following status information:

Off – Brush motor output is off and there is no brush motor current sensed.

Steady Green – Brush motor output is on and there is normal brush motor current sensed.

Brief On Green Flash – Brush motor output is off and brush motor current is being sensed (abnormal condition).

- Check for voltage at the Wht wire on K1 contactor to battery ground.
- If any voltage is present, replace K1 contactor.
- NO voltage, replace the Main control board.

Brief Off Green Flash – Brush motor output is on and brush motor current is not being sensed (abnormal condition).

- Check brush motor wiring plugs.
- Check one of the Blk wires of the main harness connector at the brush motor to battery Positive. If no voltage repair or replace wire.
- Check one of the Wht wires of the main harness connector at the brush motor to battery Neg. If no voltage repair or replace wire.
- Check for voltage at the Red wire on K1 contactor to battery ground. If no voltage is present repair the Red wire.
- Check for voltage at the Wht wire on K1 contactor to battery ground. If no voltage is present replace the K1 contactor.

Flashing Red – Brush motor overload has occurred.

- Check to see that the proper brush programming type is selected (disc or cyl).
- Check for binding in rotation of brushes or improper scrub brush type installed. (Amp. Test) See Pressure Chart in this Manual.
- Check the negative supply cable at the brush motor for a wiring problem or improper modifications.
- Check for open in the small WHT/GRA current sense wire.
- Check for short circuit\* in brush motor or wiring.
- Inspect gearbox for failure (disc). Repair or replace.
- Inspect scrub brush drive bearings for excessive wear (cyl.).

## ELECTRICAL SYSTEM

### OUTPUT CONTROLS (CONTINUED):

#### Scrub On Switch (I):

This switch is used to control the output to the scrub deck lift actuator. Pressing and releasing this switch will cycle the actuator output through 4 states. These are:

- 1 – Output off, direction = up
- 2 – Output on, direction = down (Display will show down arrow)
- 3 – Output off, direction = down
- 4 – Output on, direction = up (Display will show up arrow)

When the output is in state 1, the actuator output is turned off. The scrub pressure decrease indicator should be off. If the indicator is flashing green, this indicates that the control is sensing current flow through the actuator (shorted output driver, control error). If the scrub pressure decrease switch was the last switch pressed, it is possible to momentarily activate the actuator output using the wand switch. This can be used to jog the actuator to allow precise positioning of the actuator. NOTE: the actuator can only move in this situation if it is not at its up limit.

When the output is in state 2, the actuator output is turned on. The scrub pressure decrease indicator should be green or flashing green. The indicator will be a steady green if the control senses current flow through the actuator. It will flash green if no actuator current flow is sensed (actuator at limit, open circuit, open output driver). The wand switch has no effect in this state.

When the output is in state 3, the actuator output is turned off. The scrub pressure decrease indicator should be off. If the indicator is flashing green, this indicates that the control is sensing current flow through the actuator (shorted output driver, control error). If the scrub pressure decrease switch was the last switch pressed, it is possible to momentarily activate the actuator output using the wand switch. This can be used to jog the actuator to allow precise positioning of the actuator. NOTE: the actuator can only move in this situation if it is not at its down limit.

When the output is in state 4, the actuator output is turned on. The scrub pressure decrease indicator should be green or flashing green. The indicator will be a steady green if the control senses current flow through the actuator. It will flash green if no actuator current flow is sensed (actuator at limit, open circuit, open output driver). The wand switch has no effect in this state.

#### Vacuum Switch (C):

This switch is used to toggle the state of the vacuum motor. Pressing and releasing this switch will alternately turn the vacuum motor on and off. The indicator provides the following status information:

Off - Vacuum motor output is off and there is no vacuum motor current sensed.

Steady Green - Vacuum motor output is on and there is normal vacuum motor current sensed.

Brief On Green Flash – Vacuum motor output is off and vacuum motor current is being sensed (abnormal condition).

- Check for voltage at the Blu wire on K2 contactor to battery ground.
- If any voltage is present, replace K2 contactor.
- NO voltage, replace the Main control board.

Brief Off Green Flash – Vacuum motor output is on and vacuum motor current is not being sensed (abnormal condition).

- Check Vacuum Motor wiring plug, disconnection.
- Check for voltage at the Red wire on K2 contactor to battery ground. If no voltage is present repair the Red wire.
- Check for voltage at the Blu wire on K2 contactor to battery ground. If no voltage is present replace the K2 contactor.
- Check the Blu wire of the main harness connector at the vacuum motor to battery Negative. If no voltage repair or replace wire.
- Check the Blk wire of the main harness connector at the vacuum motor to battery Positive. If no voltage repair or replace wire.

Flashing Yellow – Vacuum motor overload has occurred.

- Check for an open in the small ORG current sense wire.
- To confirm an overload, disconnect the motor plug from the main harness, run a 30 amp fused test leads from the batteries to the motor and perform an Amp draw test. Normal current load 36V 23-25 Amps.
- Check for debris in the vacuum motor.
- Worn carbon brushes.
- Defective motor bearings.
- Check for short circuit\* in vacuum motor or wiring. Repair or replace

## **ELECTRICAL SYSTEM OUTPUT CONTROLS (CONTINUED):**

### **Solution Switch (B):**

This switch is used to toggle the state of the solution solenoid. Pressing and releasing this switch will alternately turn the solution solenoid on and off. The indicator provides the following status information:

Off - Solution output is off.

Steady Green - Solution output is on. (solution pump is on and valve is open)

Flashing Yellow – Solution solenoid / contactor coil overload has occurred.

### **Extended Scrub Switch (G):**

This switch is used to toggle the state of the recycle pump and recycle valve (If available). Pressing and releasing this switch will alternately turn the recycle pump and recycle valve on and off. The indicator provides the following status information:

Off – Recycle pump and valve off.

Steady Green – Recycle output is on and valve is open.

### **Detergent Switch (F):**

This switch is used to toggle the state of the chemical pump (If available). Pressing and releasing this switch will alternately turn the chemical pump on and off. The indicator provides the following status information:

Off – Chemical pump and valve off.

Steady Green – Chemical output is on.

## ELECTRICAL SYSTEM

### MAIN CONTROL PROGRAMMING OPTIONS

#### Selection of Low Voltage Cutout Threshold:

FACTORY DEFAULT: 20.6V (STANDARD)

The Warrior™ / BA 755 series is equipped with a low voltage cutout feature to prevent over-discharging the batteries. This feature will automatically shut down the scrub system when the battery voltage falls to the selected threshold. The cutout level is adjustable. The Standard setting is 30.96 volts (1.72 volts per cell) and the alternate (Gel Cell) setting is 32.58 volts (1.81 volts per cell). Select the proper cutout level based on the battery manufacturer's specifications. *It is important to note that some maintenance free batteries (including some gelled electrolyte cells) are capable of being safely discharged down to 1.72 volts per cell.* To select between the two cutout levels:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub system off switch.
- 3 While holding the scrub system off switch turn the main power key switch to the on position.
- 4 Continue to hold the scrub system off switch until the scrub off indicator turns red.
- 5 Release the scrub off switch.
- 6 The status display will now show "30.96V" or "32.58V" and battery icon (AXP™ / ECO+Solution™ models) on the right top corner indicating that you are in battery voltage cutout selection mode. Depending on current setting, scrub on yellow indicator will turn on green.
- 7 Pressing and releasing the scrub on switch will now select between the two options. Green indicator will toggle between two options and display will be updated same time. For the standard cutout level (factory default), select "30.96V". For the alternate cutout level, select "32.58V".
- 8 To save the new setting, press scrub off switch. Scrub off indicator will turn to Green and display will show key switch icon to reset the machine. Turn the main key switch to the off position.
- 9 The new setting will be saved and will remain in effect until it is changed again.

#### Recall of Stored Error Codes:

Whenever the main control unit detects an electrical system fault, one or more error codes are displayed and stored by the control unit. If it is desired, the error code (if any) from the previous operation of the machine can be recalled for troubleshooting purposes, To recall the last stored error codes perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the solution switch.
- 3 While holding the solution switch, turn the main power key switch to the on position.
- 4 Continue to hold the solution switch until the solution indicator turns green.
- 5 Release the solution switch.
- 6 Wrench icon will be displayed on right top corner of the display indicating you are in fault recall mode (AXP™ / ECO+Solution™ models).
- 7 If there were previously no error codes stored, the display will show key switch icon asking you to reset the machine. (No fault). Go to step 11.
- 8 If error codes were stored, the display will show wrench icon and error number right next to the wrench. The scrub system off indicator will now be red. If there are more than one error codes stored. It will toggle through all the error codes stored.
- 9 To clear the stored codes press scrub off switch. The display will now show key switch icon asking you to reset the machine.
- 10 If it is desired to save the codes, go to step 11.
- 11 To exit the error code recall mode, turn the main power key switch to the off position.

## ELECTRICAL SYSTEM

### MAIN CONTROL PROGRAMMING OPTIONS (CONTINUED)

#### Restoring the scrub pressures to factory default settings:

If it is desired to restore the scrub pressures to factory default setting, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on switch.
- 3 While holding the scrub on switch, turn the main power key switch to the on position.
- 4 Continue to hold the scrub on switch until the scrub off indicator turns green.
- 5 The display will show pressure icon on the right top corner indicating you are in pressure restoring mode. Now display will show key switch icon asking you to reset the machine.
- 6 The factory default pressures have now been restored.
- 7 Turn the main power key switch to the off position.

#### Scrub deck type, chemical and recycle option selection (Warrior™ AXP / BA 755X series):

The Warrior™ AXP and BA 755X series can be equipped with numerous scrub deck options. This function configures the control unit current settings for each of the scrub deck types. Improper setting of the deck may result in motor damage due to overloading. Chemical option and recycle option can be selected in this mode.

To select the proper scrub deck, chemical option and recycle option:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub system off and scrub on switches.
- 3 While holding both switches, turn the main key switch to the on position.
- 4 Continue to hold both switches until light scrub indicator turns yellow.
- 5 Release both switches. Scrub off indicator will turn red and the display will show the current scrub brush type icon and scrub deck size. Display will display current deck size and type. (disc or cylindrical, 28" or 32"). Chemical option and recycle option can be selected here while selecting scrub deck.
- 6 To select chemical option, press chemical switch. Chemical indicator will turn green. To deselect chemical option, press chemical switch again. Chemical indicator will turn off.
- 7 To select recycle option, press recycle switch. Recycle indicator will turn green. To deselect recycle option, press recycle switch again. Recycle indicator will turn off.
- 8 The display will display current scrub deck. There are four selections that can be made. Pressing the scrub on switch will select between the four settings. Scrub on indicator will change every time switch gets pressed.
- 9 Select disc icon with 28" if the machine is equipped with a 28" disc deck.  
Select cylindrical icon with 28" if the machine is equipped with a 28" cylindrical deck.  
Select disc icon with 32" if the machine is equipped with a 32" disc deck.  
Select cylindrical icon with 32" if the machine is equipped with a 32" cylindrical deck.
- 10 Once the proper scrub deck size, chemical option and recycle option are selected, press the scrub off switch to save this setting.
- 11 The display will display key switch icon asking user to reset the machine.
- 12 Turn the main power key switch to the off position.

Note: It is very important to set chemical and recycle options properly. This could result unusual operation of the machine.

#### Scrub deck type and recycle option selection (Warrior™ ST / BA 755 series):

FACTORY DEFAULT: Dependent on machine model

The Warrior™ ST and BA 755 series models can be equipped with numerous scrub deck options. This function configures the control unit current settings for each of the scrub deck types. Improper setting of the deck may result in motor damage due to overloading. Chemical option and recycle option can be selected in this mode. To select the proper scrub deck, chemical option and recycle option:

- 1 Turn the main power key switch to the OFF position.
- 2 Press and hold the scrub system OFF and scrub ON switches.
- 3 While holding both switches, turn the main key switch to the ON position.
- 4 Continue to hold both switches until light scrub indicator turns yellow.
- 5 Release both switches. The scrub OFF indicator will turn red and the display will show current deck size and type (disc or cylindrical, 28" or 32"). The recycle option can be selected here while selecting scrub deck.
- 6 To select recycle option, press recycle switch. Recycle indicator will turn green. To deselect recycle option, press recycle switch again. Recycle indicator will turn off.
- 7 The display will display current scrub deck. There are four selections that can be made. Pressing the scrub ON switch will select between the four settings. The scrub ON indicator will change every time switch gets pressed.
- 8 Select "D28" if the machine is equipped with a 28" disc deck.  
Select "C28" if the machine is equipped with a 28" cylindrical deck.  
Select "D32" if the machine is equipped with a 32" disc deck.  
Select "C32" if the machine is equipped with a 32" cylindrical deck.
- 9 Once the proper scrub deck size and recycle option are selected, press the scrub OFF switch to save this setting.
- 10 The scrub OFF indicator will turn green.
- 11 Turn the main power key switch to the OFF position.

Note: It is very important to set recycle options properly. This could result in unusual operation of the machine.

## ELECTRICAL SYSTEM

### MAIN CONTROL PROGRAMMING OPTIONS (CONTINUED)

#### Turning Fault Detection On or Off:

FACTORY DEFAULT: ON

Normally, the main control unit will perform checks of the electrical system during operation. If a fault occurs in a particular system, that system (and possibly others) will be shut down. This can make troubleshooting the system difficult. This option will allow service personnel to disable some of the fault detection checks to facilitate troubleshooting. This will not disable the over-current protection on any of the systems. To turn the fault checking on or off:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub system off switch and the solution switch.
- 3 While holding both switches turn the main power key switch to the on position.
- 4 Continue to hold both switches until the solution indicator turns yellow.
- 5 Release both switches. The display will now display wrench icon on right top corner indicating fault detection mode. Another wrench (wrench with cross) will be displayed on left top corner. Scrub off indicator will turn red.
- 6 Pressing and releasing the solution switch will now select between normal wrench icon for enabled or wrench with cross for disabled. Enabled means that the fault checking is turned on, disabled means that the fault checking is turned off.
- 7 To save the new setting, press scrub off switch. The display will display key switch key asking user to reset the machine.
- 8 The new setting will be saved and will remain in effect until it is changed again.

#### Displaying the Control Unit Revision Level:

If it is desired to view the revision level of the control unit software perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub off switch and chemical switch.
- 3 While holding both switches until scrub off and chemical indicators turn green.
- 4 Release both switches.
- 5 The display will display the revision level of the control unit. Chemical indicator will blink in revision display mode.
- 6 To exit this mode, turn the main power key switch to the off position.

#### Scrub Deck Down Time Period Adjustment:

FACTORY DEFAULT: 4 SECONDS (CLOCK SETTING #5)

When scrub on switch is pressed, the control unit will automatically lower the deck for 4 seconds. The time that the deck is lowered is adjustable from 3.5 seconds to 4.4 seconds in .1 second increment. To adjust the scrub deck down time, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on and the solution switch.
- 3 While holding both switches turn the main power key switch to the on position.
- 4 Continue to hold both switches until the scrub on green indicators and solution green indicator turn green.
- 5 Release both switches. The display will display scrub deck icon on right top corner and clock icon with number. Scrub on indicator will turn yellow and scrub off indicator will turn red.
- 6 Pressing and releasing the scrub on will now select the time period. Each number represents .1 sec. 0 = 3.5 seconds, 1 = 3.6 seconds.
- 7 To save the new setting, press scrub off switch. Key switch icon will appear on display.
- 8 Turn the main power key switch to the off positions.
- 9 The new setting will be saved and will remain in effect until it is changed again.

# ELECTRICAL SYSTEM

## MAIN CONTROL PROGRAMMING OPTIONS (CONTINUED)

### Light Scrub Setting Adjustment:

FACTORY DEFAULT: SCRUB PRESSURE =1, SOLUTION = ONE BAR(#1), CHEMICAL = 0 (IF AVAILABLE).

The light scrub pressure, solution rate and chemical rate can be programmed depending on its application where high solution rate is need with light scrub pressure or low solution rate with heavy scrub pressure. To change scrub pressure setting, solution rate setting and chemical setting, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on and the wand switch.
- 3 While holding both switches, turn the main power key switch to the on position.
- 4 Continue to hold the both switches until the wand indicator and light scrub indicator turn green.
- 5 Release both switches. The display will now show disc icon with current scrub pressure setting. Scrub off indicator will turn red and light scrub indicator will turn yellow.
- 6 Pressing scrub on switch will now select new scrub pressure. Pressing scrub off switch will save the new setting and move to solution rate setting.
- 7 The display will now show solution icon with gauge. Light scrub indicator will now turn green and solution indicator will turn yellow. Pressing solution switch will now select new solution rate. Pressing scrub off switch will save the new setting and move to chemical setting (If available).
- 8 The display will now show chemical bottle with current chemical setting. Solution indicator will turn green and chemical indicator will turn green. Pressing chemical switch will now select new chemical setting. Pressing scrub off switch will save the new setting and display key switch icon on display.
- 9 Turn the main power key switch to the off position.
- 10 The new settings will be saved and will remain in effect until it is changed again.

### SCRUB PRESSURE & CURRENT LOAD (AMPS) SPECIFICATIONS CHART

Scrub Mode	Scrub Pressure Indicator	DECK TYPE			
		Disc 28"	Cyl. 28"	Disc 32"	Cyl. 32"
Light Scrub	1 bar(#1)	14 AMPS	22 AMPS	16 AMPS	24 AMPS
Heavy Scrub	2 bars(#2)	22 AMPS	31 AMPS	24 AMPS	33 AMPS
Extreme Scrub	3 bars(#3)	36 AMPS	40 AMPS	38 AMPS	42 AMPS

### SOLUTION FLOW RATE CHART

Solution Flow Indicator	Flow Rate
One bar gauge(#1)	.3 g/m
Two bar gauge(#2)	.6 g/m
Three bar gauge(#3)	.9 g/m

### CHEMICAL CHART

0	Normal chemical setting
-	10% less than normal chemical setting
+	10% more than normal chemical setting



## ELECTRICAL SYSTEM

### MAIN CONTROL PROGRAMMING OPTIONS (CONTINUED)

#### Heavy Scrub Setting Adjustment:

FACTORY DEFAULT: SCRUB PRESSURE =2, SOLUTION = TWO BARS(#2), CHEMICAL = 0 (IF AVAILABLE).

The heavy scrub pressure, solution rate and chemical rate can be programmed depending on its application where high solution rate is need with light scrub pressure or low solution rate with heavy scrub pressure. To change scrub pressure setting, solution rate setting and chemical setting, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on and the chemical switch.
- 3 While holding both switches, turn the main power key switch to the on position.
- 4 Continue to hold the both switches until the wand indicator and heavy scrub indicator turn green.
- 5 Release both switches. The display will now show disc icon with current scrub pressure setting. Scrub off indicator will turn red and heavy scrub indicator will turn yellow.
- 6 Pressing scrub on switch will now select new scrub pressure. Pressing scrub off switch will save the new setting and move to solution rate setting.
- 7 The display will now show solution icon with gauge. Heavy scrub indicator will now turn green and solution indicator will turn yellow. Pressing solution switch will now select new solution rate. Pressing scrub off switch will save the new setting and move to chemical setting (If available).
- 8 The display will now show chemical bottle with current chemical setting. Solution indicator will turn green and chemical indicator will turn green. Pressing chemical switch will now select new chemical setting. Pressing scrub off switch will save the new setting and display key switch icon on display.
- 9 Turn the main power key switch to the off position.
- 10 The new settings will be saved and will remain in effect until it is changed again.

#### Extreme Scrub Setting Adjustment:

FACTORY DEFAULT: SCRUB PRESSURE =3, SOLUTION = THREE BARS(#3), CHEMICAL = 0 (IF AVAILABLE).

The extreme scrub pressure, solution rate and chemical rate can be programmed depending on its application where high solution rate is need with extreme scrub pressure or low solution rate with heavy scrub pressure. To change scrub pressure setting, solution rate setting and chemical setting, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on and the recycle switch.
- 3 While holding both switches, turn the main power key switch to the on position.
- 4 Continue to hold the both switches until the recycle indicator and light and heavy scrub indicators turn green.
- 5 Release both switches. The display will now show disc icon with current scrub pressure setting. Scrub off indicator will turn red and light and heavy scrub indicator will turn yellow.
- 6 Pressing scrub on switch will now select new scrub pressure. Pressing scrub off switch will save the new setting and move to solution rate setting.
- 7 The display will now show solution icon with gauge. Light and heavy scrub indicators will now turn green and solution indicator will turn yellow. Pressing solution switch will now select new solution rate. Pressing scrub off switch will save the new setting and move to chemical setting (If available).
- 8 The display will now show chemical bottle with current chemical setting. Solution indicator will turn green and chemical indicator will turn green. Pressing chemical switch will now select new chemical setting. Pressing scrub off switch will save the new setting and display key switch icon on display.
- 9 Turn the main power key switch to the off position.
- 10 The new settings will be saved and will remain in effect until it is changed again.

# ELECTRICAL SYSTEM

## MAIN CONTROL PROGRAMMING OPTIONS (CONTINUED)

### LCD Style Selection ((Warrior™ AXP / BA 755X series):

FACTORY DEFAULT: RECTANGULAR SHAPE WITH THREE BARS

LCD graphic style can be programmed to different style. There are two different styles and to change LCD graphic style, perform the following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the scrub on and vacuum switch.
- 3 While holding both switches, turn the main power key switch to the on position.
- 4 Continue to hold the both switches until the vacuum indicator and scrub on indicator turn yellow.
- 5 Release both switches. The display will now show current graphic style. The scrub off switch will turn red.
- 6 Pressing scrub on switch will now select between two different graphic styles and the display will be updated with new graphic style.
- 7 Press scrub off switch to save the setting. Turn the main power key switch to the off position.
- 8 The new setting will be saved and will remain in effect until it is changed again.

### Monitor Mode:

The Warrior™ / BA 755 series is equipped with a monitor mode where the 3 machine settings shown below can be quickly checked for the machine's specific set up. In order to monitor current settings, perform following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the recycle switch.
- 3 While holding the recycle switch turn the main key switch to the on position.
- 4 Continue to hold the recycle switch until the recycle indicator turns yellow.
- 5 Release the recycle switch.
- 6 The display will display current **deck setting, low voltage cutout setting and error checking setting.**
- 7 To exit this mode, turn the main power key switch to the off position.

### Chemical User Ratio Selection:

FACTORY DEFAULT: 8

There are 9 different settings for chemical ratio. Without magnet, user chemical ratio can be achieved. To change user chemical ratio, perform following steps:

- 1 Turn the main power key switch to the off position.
- 2 Press and hold the chemical switch.
- 3 While holding the chemical switch turn the main key switch to the on position.
- 4 Continue to hold the chemical switch until the chemical indicator turns yellow.
- 5 Release the chemical switch.
- 6 The display will display chemical bottle with current user ratio. Chemical indicator will turn green.
- 7 Pressing chemical switch will now select chemical setting (32, 50, 64, 100, 128, 150, 200, 256, 300).
- 8 Press scrub off switch to save new setting. The display will show key switch icon.
- 9 Turn the main power key switch to the off position.
- 10 The new setting will be saved and will remain in effect until it is changed again.

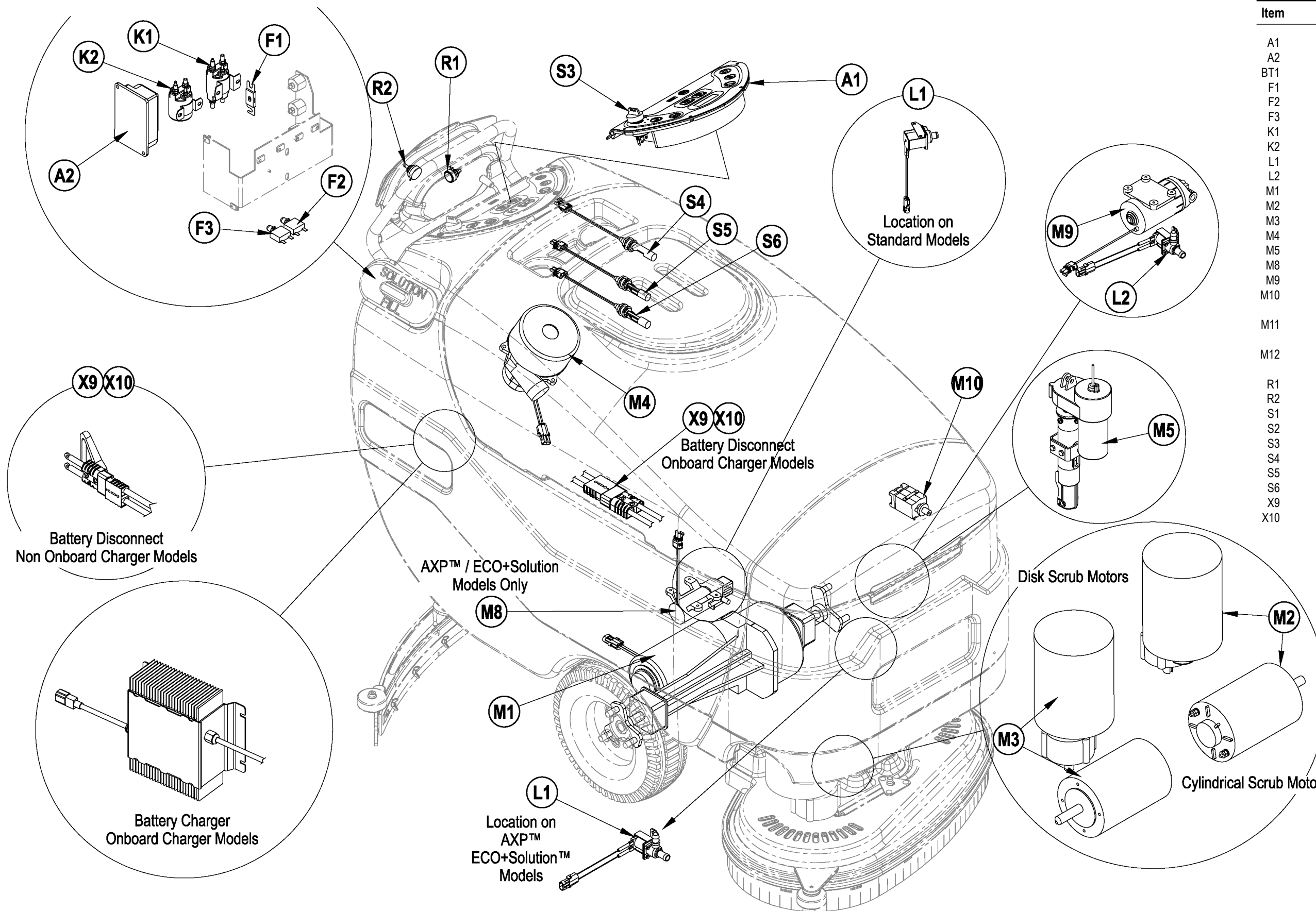
**NOTE:** Program to the desired ratio needed when not using a chemical container (cartridge) that uses the magnetic slider.

%	oz./gal	RATIO	
.3	-	1:300	← 9
.4	½	1:256	← 8
.5	-	1:200	← 7
.66	-	1:150	← 6
.8	1	1:128	← 5
1	-	1:100	← 4
1.5	2	1:64	← 3
2	2½	1:50	← 2
3	4	1:32	← 1

# ELECTRICAL SYSTEM

## COMPONENT LOCATION

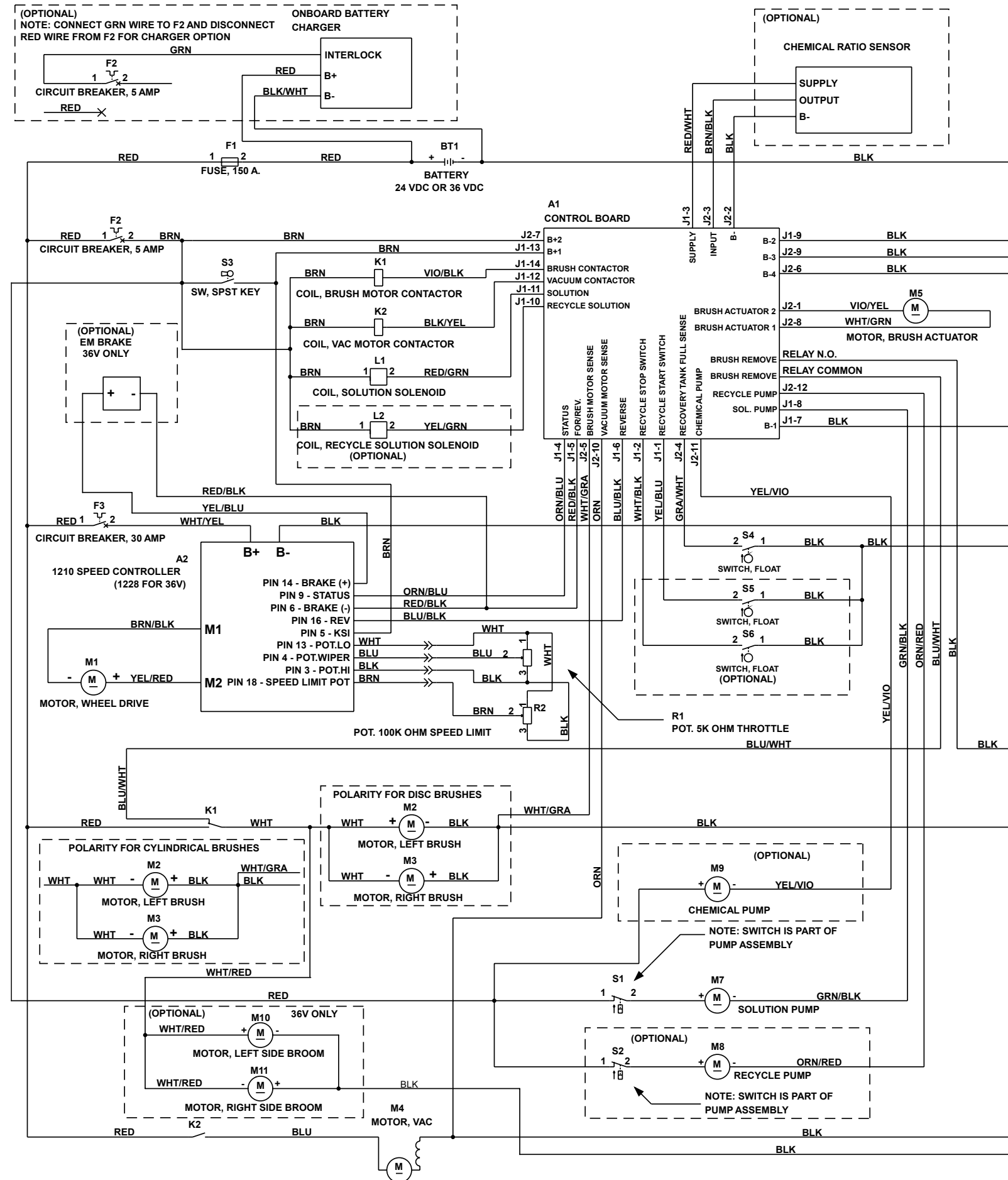
Item	Description
A1	Control Board
A2	Speed Control
BT1	Battery (Not Shown)
F1	Fuse, 150 Amp
F2	Circuit Breaker, 5 Amp
F3	Circuit Breaker, 30 Amp
K1	Contactors, Brush Motor
K2	Contactors, Vac Motor
L1	Solenoid, Solution
L2	Solenoid, Recycle Solution (Optional)
M1	Motor, Wheel Drive
M2	Motor, Left Brush
M3	Motor, Right Brush
M4	Motor, Vac
M5	Motor, Brush Actuator
M8	Pump, Solution (AXP™ / ECO+Solution™)
M9	Pump, Recycle (Optional)
M10	Detergent Pump (Optional / AXP™ / ECO+Solution™)
M11	Side Broom Motor, Left (Not Shown) (Optional / Cylindrical models only)
M12	Side Broom Motor, Right (Not Shown) (Optional / Cylindrical models only)
R1	Potentiometer, 5K Ohm, Throttle
R2	Potentiometer, 100K Ohm, Speed Limit
S1	Part of M8
S2	Part of M9
S3	Switch, Key
S4	Switch, Float (Recovery Tank Full)
S5	Switch, Float (Optional / Recycle Start)
S6	Switch, Float (Optional / Recycle Stop)
X9	Battery Disconnect
X10	Battery Disconnect



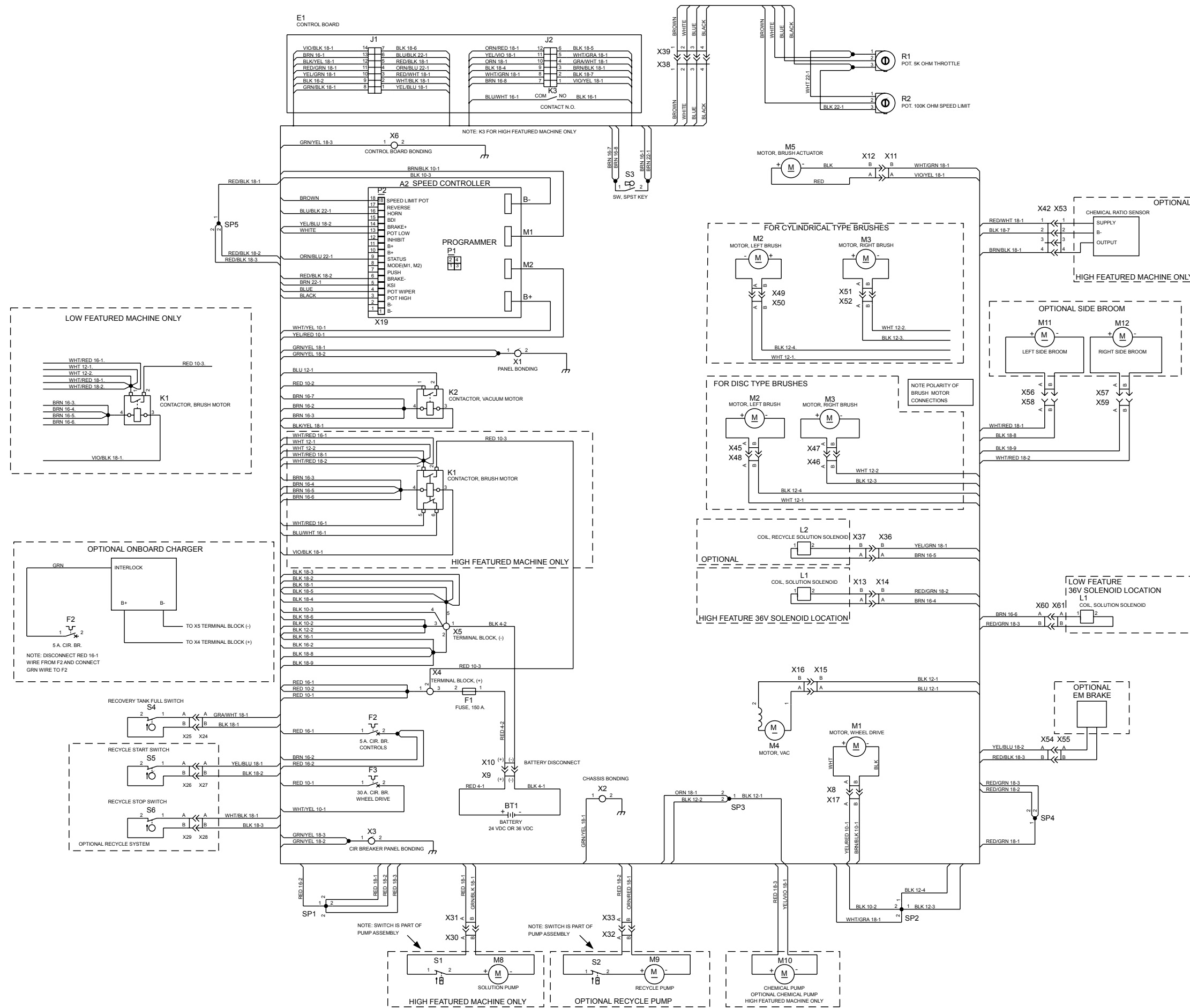
# ELECTRICAL SYSTEM

## WIRING DIAGRAM / SCHEMATIC

Item	Description
A1	Control Board
A2	Speed Control
BT1	Battery (Not Shown)
F1	Fuse, 150 Amp
F2	Circuit Breaker, 5 Amp
F3	Circuit Breaker, 30 Amp
K1	Contact, Brush Motor
K2	Contact, Vac Motor
L1	Solenoid, Solution
L2	Solenoid, Recycle Solution (Optional)
M1	Motor, Wheel Drive
M2	Motor, Left Brush
M3	Motor, Right Brush
M4	Motor, Vac
M5	Motor, Brush Actuator
M8	Pump, Solution (AXP™ / ECO+Solution™)
M9	Pump, Recycle (Optional)
M10	Detergent Pump
M11	Side Broom Motor, Left (Not Shown)
M12	Side Broom Motor, Right (Not Shown)
R1	Potentiometer, 5K Ohm, Throttle
R2	Potentiometer, 100K Ohm, Speed Limit
S1	Part of M8
S2	Part of M9
S3	Switch, Key
S4	Switch, Float (Recovery Tank Full)
S5	Switch, Float (Optional / Recycle Start)
S6	Switch, Float (Optional / Recycle Stop)
X9	Battery Disconnect
X10	Battery Disconnect



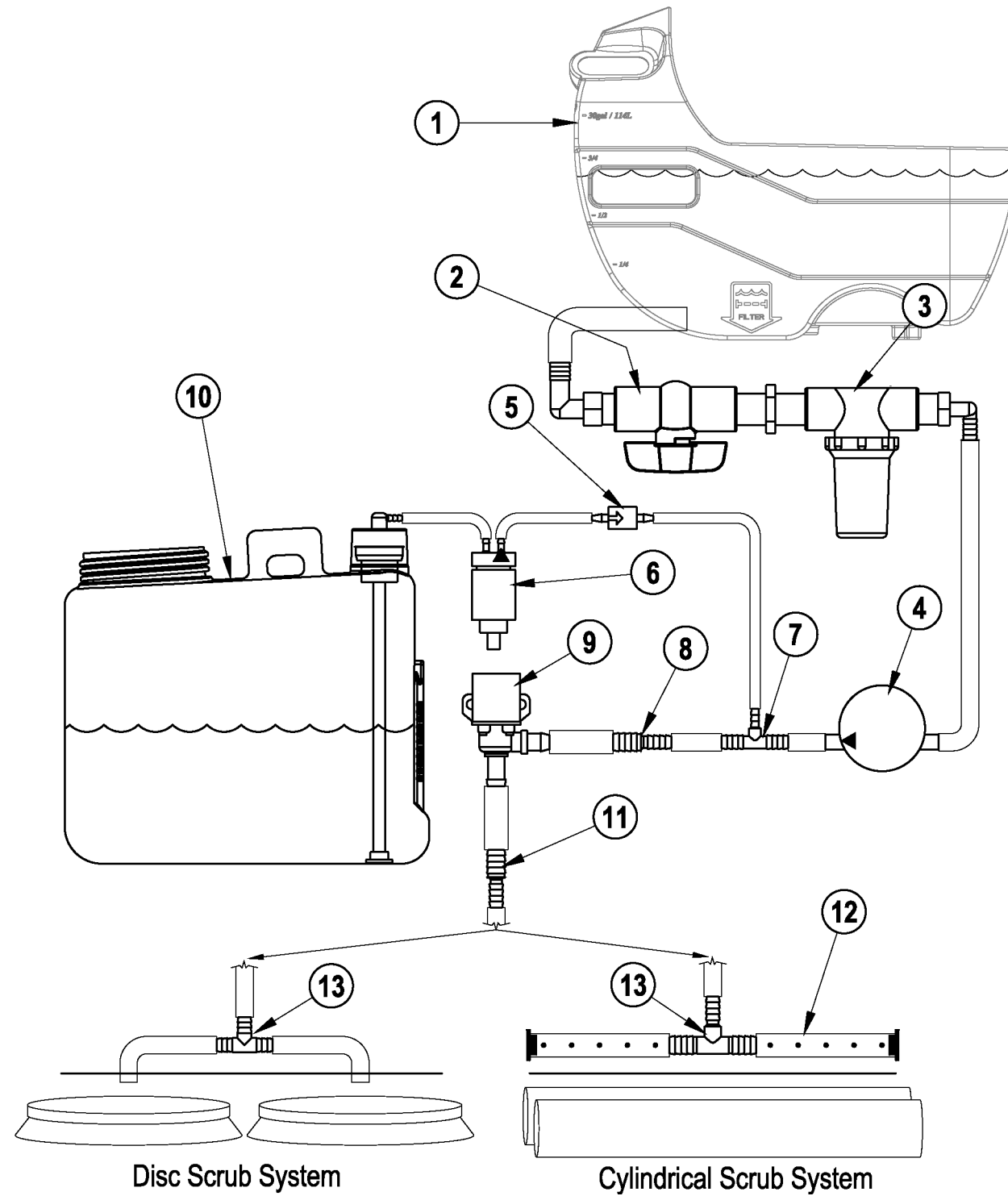
# ELECTRICAL SYSTEM



# APPENDIX

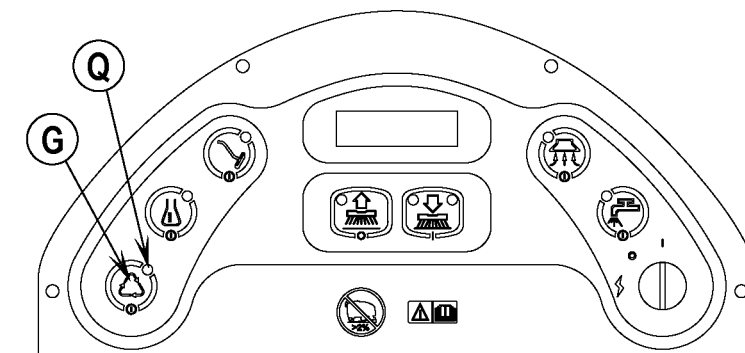
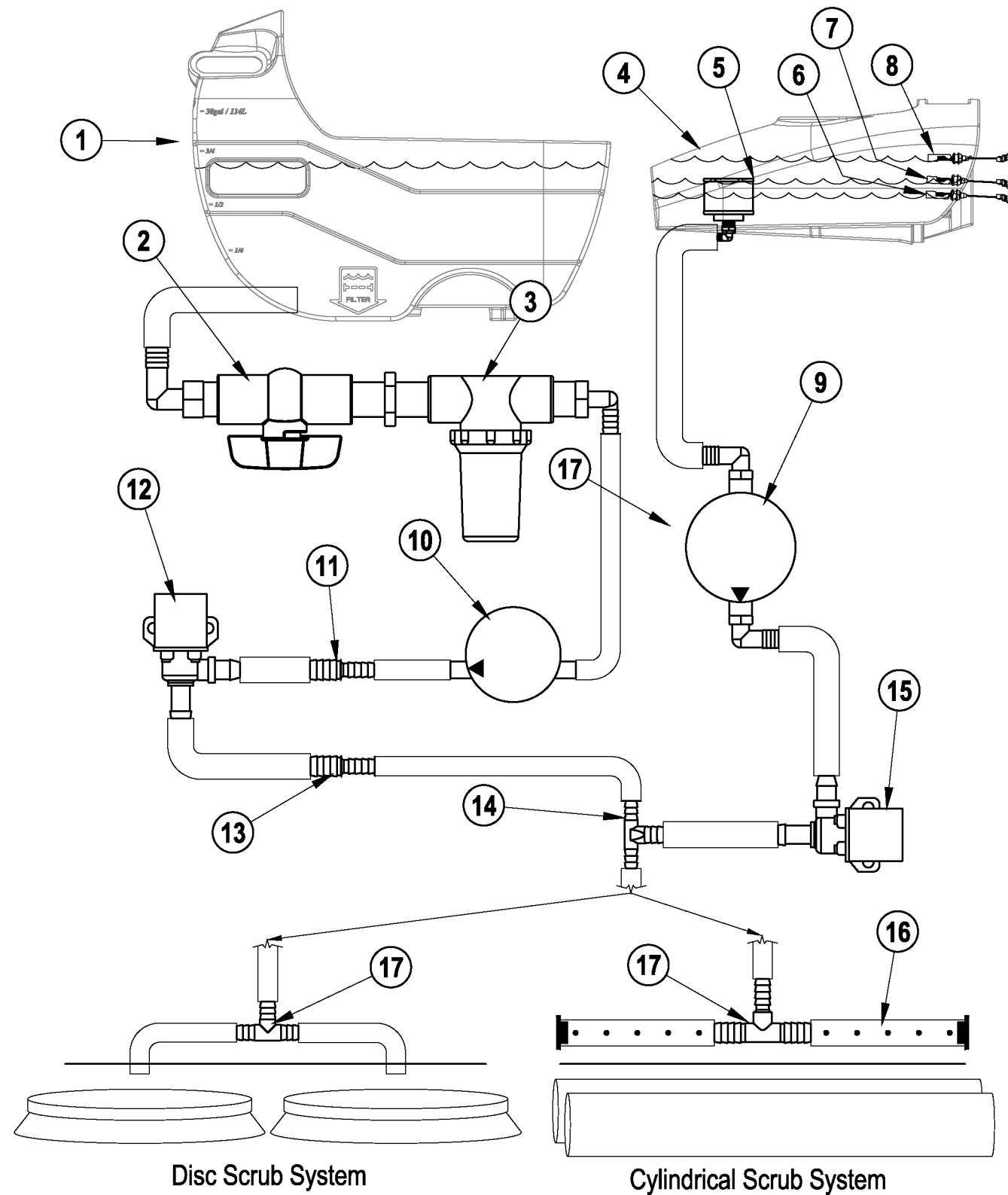
## DETERGENT (AXP) SYSTEM PLUMBING SCHEMATIC

Item	Description
1	Solution Tank
2	Shut Off Valve
3	Inline Solution Filter
4	Solution Pump
5	Check Valve
6	Detergent Pump
7	Reducer Tee
8	Reducer Coupler
9	Solution Solenoid Valve
10	Detergent Tank
11	Reducer Coupler
12	Solution Manifold (Cylindrical Models)
13	Tee



EXTENDED SCRUB SYSTEM PLUMBING SCHEMATIC

Item	Description
1	Solution Tank
2	Shut Off Valve
3	Inline Solution Filter
4	Recovery Tank
5	Extended Scrub Filter
6	Extended Scrub Stop Switch
7	Extended Scrub Start Switch
8	Vacuum Shut Off Switch
9	Extended Scrub Pump
10	Solution Pump
11	Reducer Coupler
12	Solution Solenoid Valve
13	Reducer Coupler
14	Tee
15	Extended Scrub Solenoid Valve
16	Solution Manifold (Cylindrical Models)
17	Tee



**Service Note:**

- 1 After each use, drain and rinse the recovery tank thoroughly and then fill the recovery tank with about 2 gallons (7.57 liters) of clean water.
- 2 Push and hold the Extended Scrub Button (G) for 3 seconds ( the indicator (Q) will turn green) to initiate the purge function. The purge will run for 20 seconds. NOTE: This is to flush any debris from the system. If you do not do this, the extended pump and(or) solenoid valve could become plugged up with debris.

# APPENDIX

## DETERGENT (AXP™ / ECO+Solution™) SYSTEM PREPARATION AND USE

Fill the detergent cartridge with a maximum of 1.25 gallons (4.73 Liters) of detergent. **SERVICE NOTE:** Remove the detergent cartridge from the detergent box prior to filling to avoid spilling detergent on the machine.

It is recommended that a separate cartridge be used for each detergent you plan to use. The detergent cartridges have a white decal on them so you can write the detergent name on each cartridge to avoid mixing them up. The detergent cartridge has a Magnetic Slider (AA) on one end that needs to be set to the proper dilution ratio according to the dilution instructions on the manufacturer's bottle. Slide the Magnet Slider (AA) to the appropriate location on Detergent Dilution Ratio Decal (BB). The system should be purged of previous detergent when switching to a different detergent. **SERVICE NOTE:** Move machine over floor drain before purging because a small amount of detergent will be dispensed in the process.

### To Purge When Changing Detergents:

- 1 Disconnect and remove the detergent cartridge.
- 2 Turn the Key Switch (A) ON and press the Detergent Switch (F) and the Solution Switch (B) down for at least 3 seconds. **NOTE:** Once activated the purge process takes 10 seconds. See illustration on next page for Detergent System indicators. Normally one purge cycle is adequate to purge the system.

### To Purge Weekly:

- 1 Disconnect and remove the detergent cartridge. Install and connect a Cartridge filled with clean water
- 2 Turn the Key Switch (A) ON and press the Detergent Switch (F) and the Solution Switch (B) down for at least 3 seconds. **NOTE:** Once activated the purge process takes 10 seconds. See illustration on next page for Detergent System indicators. Normally one purge cycle is adequate to purge the system.

When the Detergent Cartridge is almost empty a Display Panel (D) indicator will come on. This "Low Detergent" indicator will remain on until you reset the system. Once this indicator comes on you should be able to simply pour an entire gallon bottle of detergent into the Cartridge to refill without worrying about measuring. **NOTE:** Only reset the system when the cartridge is full. When switching cartridges, the "Low Detergent" indicator is only accurate if the replacement cartridge is at the same level as the cartridge being replaced.

### To Reset:

- 1 Turn the Key Switch (A) ON and hold the Detergent Switch (F) down for 3 seconds. See the illustration to the right for Detergent System indicators.

