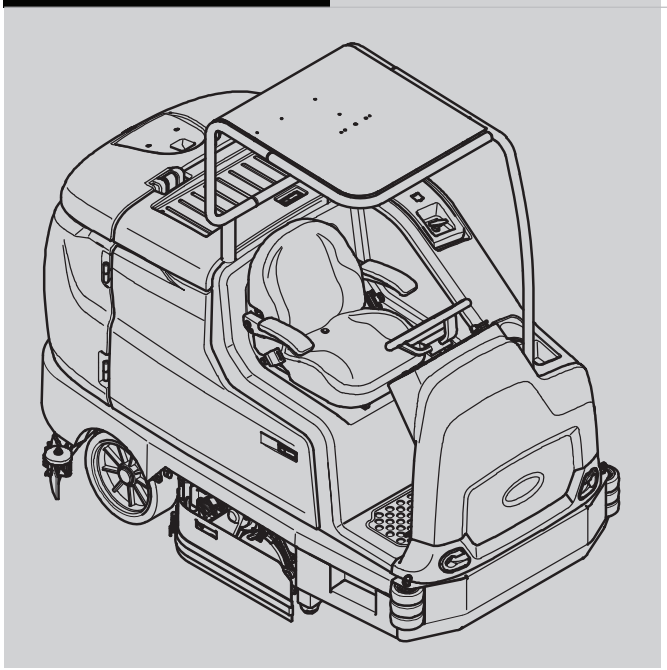
T17
(Battery)



Rider Scrubber
Service Information Manual

The Safe Scrubbing Alternative®
Tennant*True®* Parts
IRIS™ a Tennant Technology

ec H2O™
An ORBIO™ Technology

North America / International

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www.tennantco.com/manuals

9020167
Rev. 00 (6-2014)

INTRODUCTION

This manual provides necessary service and maintenance instructions.

Read this manual completely and understand the machine before servicing it.

This machine will provide excellent service. However, the best results will be obtained at minimum costs if:

- The machine is operated with reasonable care.
- The machine is maintained regularly - per the machine maintenance instructions provided.
- The machine is maintained with manufacturer supplied or equivalent parts.

PROTECT THE ENVIRONMENT

Please dispose of packaging materials, old machine components and fluids in an environmentally safe way according to local waste disposal regulations.

Always remember to recycle.

MACHINE DATA

Please fill out at time of installation for future reference.

Model No. – _____

Serial No. – _____

Installation Date – _____

INTENDED USE

The T17 is an industrial/commercial rider machine designed to wet scrub both rough and smooth hard surfaces (concrete, tile, stone, synthetic, etc). Typical applications include schools, hospitals / health care facilities, office buildings, and retail centers. Do not use this machine on soil, grass, artificial turf, or carpeted surfaces. This machine is intended for indoor use only. This machine is not intended for use on public roadways.

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IMPORTANT SAFETY INSTRUCTIONS – SAVE THESE INSTRUCTIONS

The following precautions are used throughout this manual as indicated in their description:

WARNING: To warn of hazards or unsafe practices that could result in severe personal injury or death.

FOR SAFETY: To identify actions that must be followed for safe operation of equipment.

The following information signals potentially dangerous conditions to the operator. Know when these conditions can exist. Locate all safety devices on the machine. Report machine damage or faulty operation immediately.

WARNING: Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away. Keep covers open when charging.

WARNING: Flammable materials can cause an explosion or fire. Do not use flammable materials in tank(s).

WARNING: Flammable materials or reactive metals can cause an explosion or fire. Do not pick up.

WARNING: Electrical Hazard

- **Disconnect Battery Cables and Charger Plug Before Servicing Machine.**
- **Do Not Charge Batteries with Damaged Power Supply Cord. Do Not Modify Plug.**

If the charger supply cord is damaged or broken, it must be replaced by the manufacturer or its service agent or a similarly qualified person in order to avoid a hazard.

This machine may be equipped with technology that automatically communicates over the cellular network. If this machine will be operated where cell phone use is restricted because of concerns related to equipment interference, please contact a Tennant representative for information on how to disable the cellular communication functionality.

FOR SAFETY:

1. **Do not operate machine:**
   - **Unless trained and authorized.**
   - **Unless operator manual is read and understood.**
   - **Under the influence of alcohol or drugs.**
   - **While using a cell phone or other types of electronic devices.**
   - **Unless mentally and physically capable of following machine instructions.**
   - **With brake disabled.**
   - **If it is not in proper operating condition.**
   - **With pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.**
   - **In outdoor areas. This machine is for indoor use only.**
   - **In areas where flammable vapors/liquids or combustible dusts are present.**
   - **In areas that are too dark to safely see the controls or operate the machine unless operating / headlights are turned on.**
   - **In areas with possible falling objects unless equipped with overhead guard.**
   - **With the rear bumper door / step in the lowered position.**
2. **Before starting machine:**
   - **Check machine for fluid leaks.**
   - **Make sure all safety devices are in place and operate properly.**
   - **Check brakes and steering for proper operation.**
   - **Adjust seat and fasten seat belt (if equipped).**

3. When using machine:
   - Use only as described in this manual.
   - Use brakes to stop machine.
   - Go slowly on inclines and slippery surfaces.
   - Do not scrub on ramp inclines that exceed 8.7% grade or transport (GVWR) on ramp inclines that exceed 12% grade.
   - Reduce speed when turning.
   - Keep all parts of body inside operator station while machine is moving.
   - Always be aware of surroundings while operating machine.
   - Use care when reversing machine.
   - Keep children and unauthorized persons away from machine.
   - Do not carry passengers on any part of the machine.
   - Always follow safety and traffic rules.
   - Report machine damage or faulty operation immediately.
   - Follow mixing, handling and disposal instructions on chemical containers.
   - Follow site safety guidelines concerning wet floors.

4. Before leaving or servicing machine:
   - Stop on level surface.
   - Set parking brake.
   - Turn off machine and remove key.

5. When servicing machine:
   - All work must be done with sufficient lighting and visibility.
   - Keep work area well ventilated.
   - Avoid moving parts. Do not wear loose clothing, jewelry and secure long hair.
   - Block machine tires before jacking machine up.
   - Jack machine up at designated locations only. Support machine with jack stands.
   - Use hoist or jack that will support the weight of the machine.
   - Do not push or tow the machine without an operator in the seat controlling the machine.
   - Do not power spray or hose off machine near electrical components.
   - Disconnect battery connections and charger cord before working on machine.
   - Do not use incompatible battery chargers as this may damage battery packs and potentially cause a fire.
   - Inspect charger cord regularly for damage.
   - Do not disconnect the off–board charger's DC cord from the machine receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging, disconnect the AC power supply cord first.
   - Avoid contact with battery acid.
   - Keep all metal objects off batteries.
   - Use a non–conductive battery removal device.
   - Use a hoist and adequate assistance when lifting batteries.
   - Battery installation must be done by trained personnel.
   - Follow site safety guidelines concerning battery removal.
   - All repairs must be performed by a trained service mechanic.
   - Do not modify the machine from its original design.
   - Use Tennant supplied or approved replacement parts.
   - Wear personal protective equipment as needed and where recommended in this manual.


For Safety: wear hearing protection.


For Safety: wear protective gloves.


For Safety: wear eye protection.


For Safety: wear protective dust mask.

6. When loading/unloading machine onto/off truck or trailer.
   - Drain tanks before loading machine.
   - Lower scrub head and squeegee before tying down machine.
   - Turn off machine and remove key.
   - Use ramp, truck or trailer that will support the weight of the machine and operator.
   - Do not load/unload on ramp inclines that exceed 21% grade.
   - Use winch. Do not push the machine onto/off the truck or trailer unless the load height is 380 mm (15 in) or less from the ground.
   - Block machine tires.
   - Tie machine down to truck or trailer.

The safety labels appear on the machine in the locations indicated. Replace damaged labels.

WARNING LABEL – Flammable materials or reactive metals can cause explosion or fire. Do not pick up.

Located on bottom of recovery tank cover.

WARNING LABEL – Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away. Keep covers open when charging.

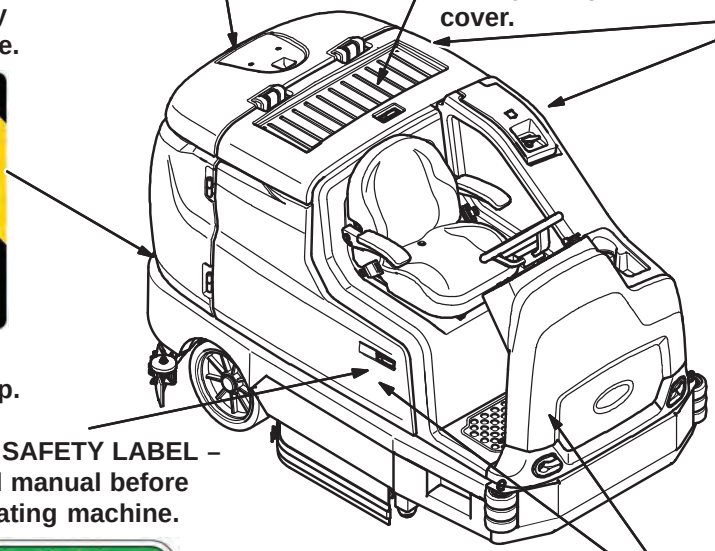
Located on bottom of battery compartment cover.

WARNING LABEL – Flammable materials can cause explosion or fire. Do not use flammable materials in tank.

Located on solution tank cover and on detergent tank (option).

FOR SAFETY LABEL – Do not operate machine with rear bumper door / step in the lowered position. Do not carry passengers on any part of the machine.

Located on rear bumper door / step.



FOR SAFETY LABEL – Read manual before operating machine.

Located on electrical panel.

FOR SAFETY LABEL – Authorized Service Mechanic Only.

Located on circuit board cover and electrical panel.

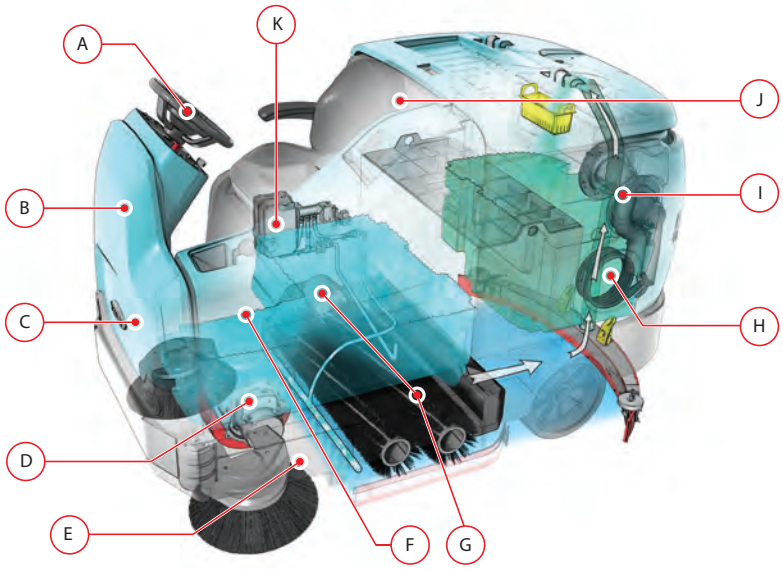
SECTION 2

Contents **Page**

COMPONENT LOCATOR

Components	
A	Interface Module and Touch Panel
B	Curtis® AC Propel Controller
C	Power Steering Assembly*
D	AC Drive Assembly
E	IRIS™ Module*
F	ec-H2O Pump*
G	BLDC (Brushless DC) Brush Motors
H	Spray Wand*
I	Dual Vacuum Fans
J	IRIS™ Shunt Assembly*
K	ec-H2O Module*
L	Backup Alarm/Flashing Light*, Circuit Breaker #16, M2 Relay
M	Recovery Tank Full Switch, ES Half-Full Switches*
N	Rear Squeegee Lift Actuator
O	Brake Adjustment Rods
P	Scrub Head Lift Actuator
Q	Brake Pedal Interlock Switch
R	Control Modules, M1 Contactor Circuit Breakers (1-9)
S	Seat Switch
T	Battery Rollout Switch

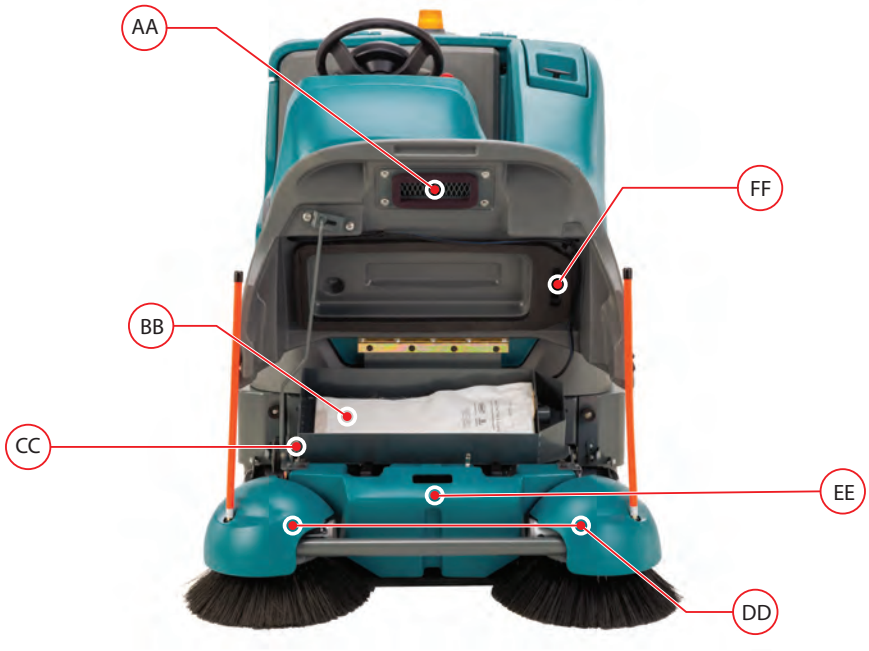
*** Optional Equipment**



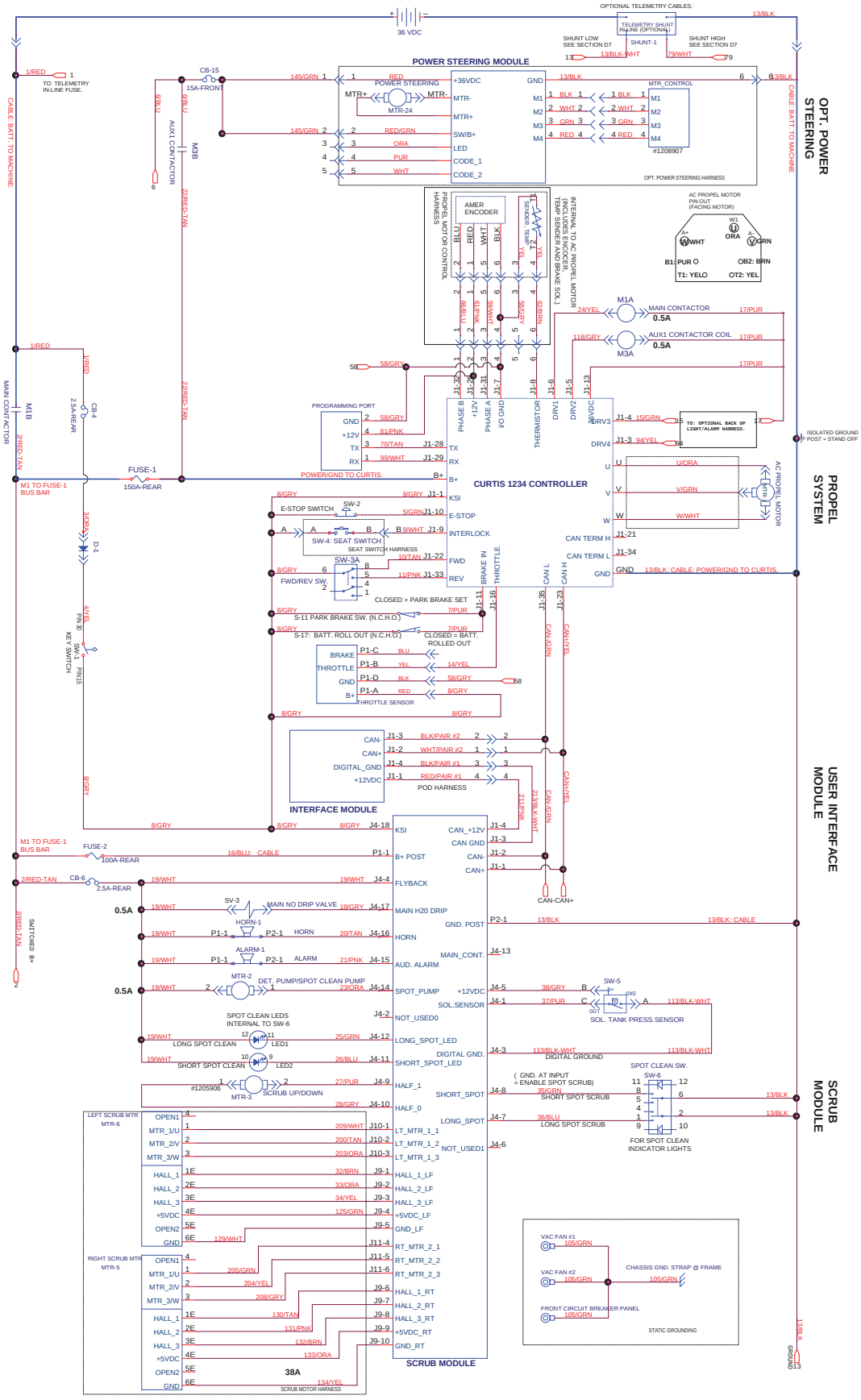
COMPONENT LOCATOR (cont'd)

Components	
U	Battery
V	Detergent Metering Pump*
W	BLDC (Brushless DC) Side Scrub Brush Motor
X	Side Scrub Brush Lift Actuator
Y	M3 Contactor, Power Steering Motor Control*
Z	Throttle Sensor
AA	Pre-Sweep, Hopper Vacuum Duct*
BB	Pre-Sweep, Dust Filter Bag
CC	Pre-Sweep, Main Sweep Brush Motor
DD	Pre-Sweep, Side Sweep Brush Motors
EE	Pre-Sweep, Hopper
FF	Pre-Sweep, Bag Housing Vacuum Duct

*** Optional Equipment**



ELECTRICAL SCHEMATIC (1 of 3)



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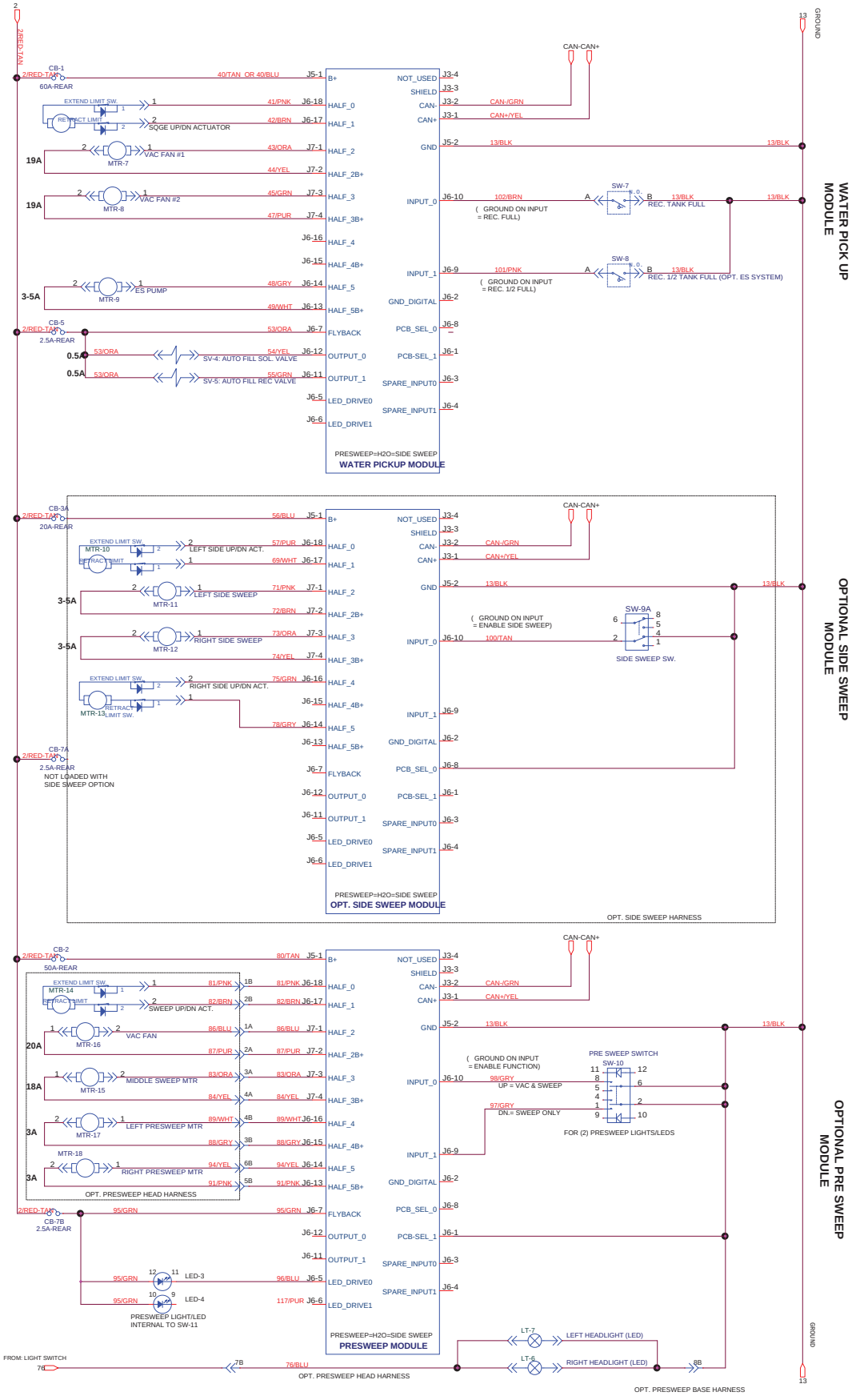

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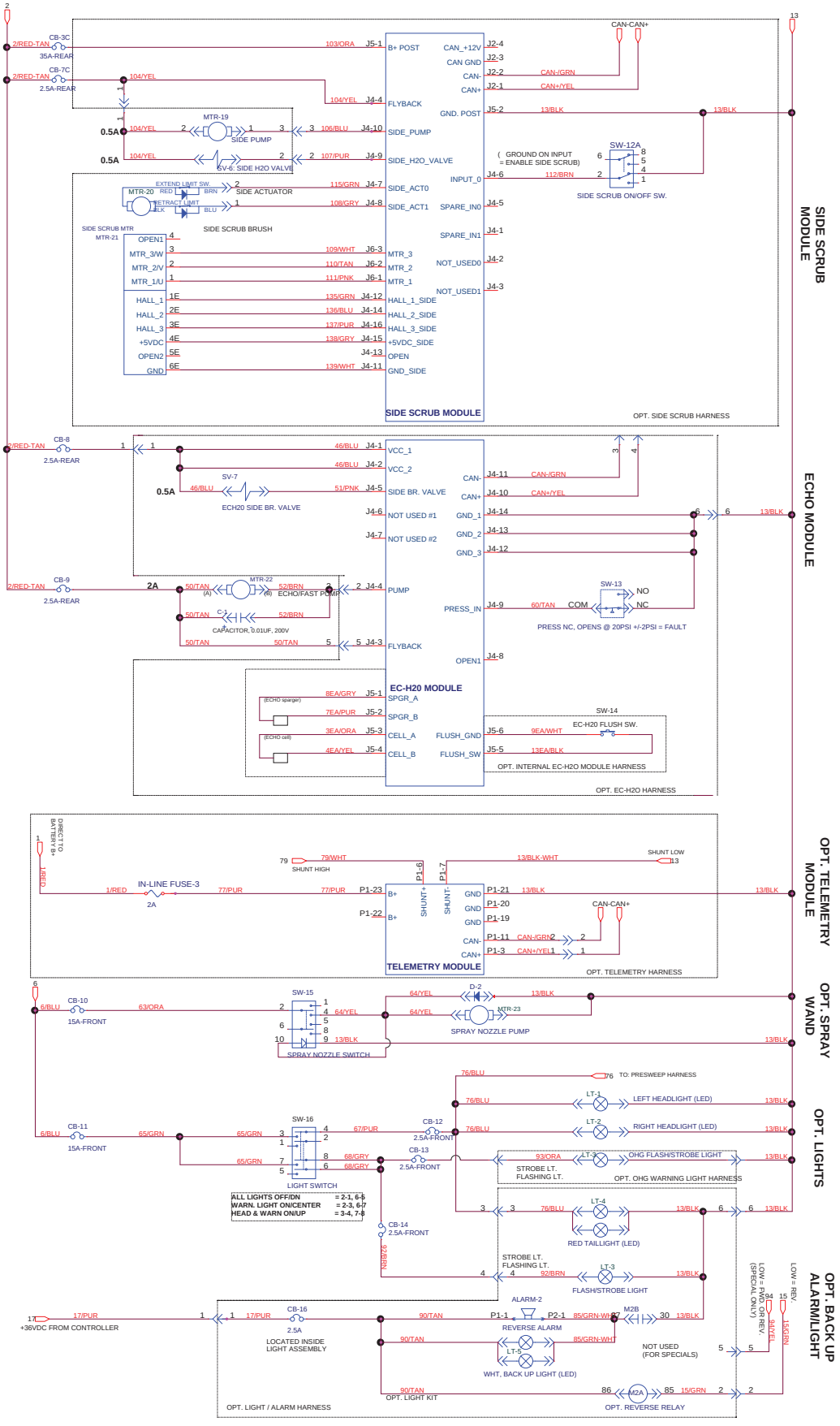
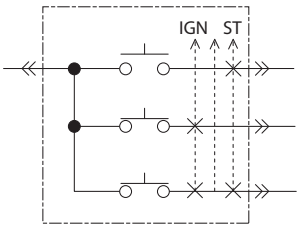
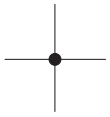
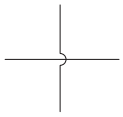


ELECTRICAL SCHEMATIC SYMBOLS



Key Switch


Connected


Not Connected

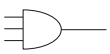
Connector

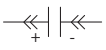

Energized


Adaptor Harness


Notes


Assembly


AC Plug



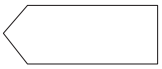
Capacitor

Battery

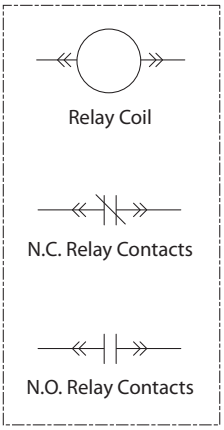

Circuit Breaker

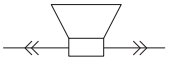

Fuse

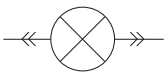

Diode

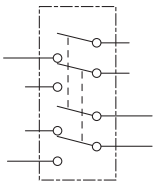

Single Continuation Tab

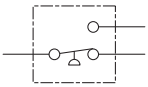

Double Continuation Tab

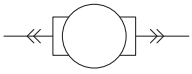


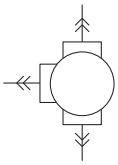

Horn or Alarm

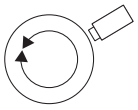

Light


DPDT Switch


Pressure Switch


Motor


3 Phase AC
Induction Motor


Motor Encoder


Sensor
(Variable Resistor)


Momenary Switch N.O.

Contact Switch N.C.


Solenoid Valve

OPERATIONAL MATRIX

Output	Pin(s)	Enable	Input	Disable	Input
Vacuum Fan, Scrubbing	Water PU Module: Fan #1 *J7-1, J7-2* Fan #2 *J7-3, J7-4*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Squeegee/Vacuum On	Interface Module	Squeegee/Vacuum Off	Interface Module
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Rear Squeegee Down	Water PU Module: *J6-17, J6-18*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Squeegee/Vacuum On	Interface Module	Squeegee/Vacuum Off	Interface Module
				Reverse Propel	Curtis PMC, *J1-33 High*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Main Scrub Brushes	Scrub Module: Right Motor *J10-1, J10-2, J10-3, J9-1, J9-2, J9-3, J9-4, J9-5* Left Motor *J11-4, J11-5, J11-6, J9-6, J9-7, J9-8, J9-9, J9-10*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
Scrub Head Down	Scrub Module: *J4-9, J4-10*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Side Brush Extend/ Down (Option)	Side Scrub Module: *J4-7, J4-8*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Side Brush Switch On	Side Scrub Module, *J4-6 Ground*	Side Brush Switch Off	Side Scrub Module, *J4-6 Not Grounded*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
Side Scrub Brush Motor (Option - Non Pre-Sweep)	Side Scrub Module: Motor *J6-1, J6-2, J6-3, J4-11, J4-12, J4-13, J4-14, J4-15*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Side Brush Switch On	Side Scrub Module, *J4-6 Ground*	Side Brush Switch Off	Side Scrub Module, *J4-6 Not Grounded*
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Solution Control (Conventional)	Scrub Module: Main Valve *J4-17* Side Scrub Module (Option): Side Pump *J4-10* Side Valve *J4-9*	1-STEP Scrub On	Interface Module	1-STEP Scrub Off	Interface Module
		Solution Control On	Interface Module	Solution Control Off	Interface Module
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
		Side Scrub Switch On (Option)	Side Scrub Module, *J4-6 ≈ Grounded*	Side Scrub Switch Off (Option)	Side Scrub Module, *J6-10 ≈ Not Grounded*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
Solution Control ec-H2O (Option)	ec-H2O Module: Side Br. Valve *J4-5* Pump *J4-4* Sparger *J5-1, J5-2* e-Cell *J5-3, J5-4*	1-STEP Scrub On	Interface Module, CAN-Bus	1-STEP Scrub Off	Interface Module, CAN-Bus
		Solution Control On	Interface Module, CAN-Bus	Solution Control Off	Interface Module, CAN-Bus
		ec-H2O Button On	Interface Module, CAN-Bus	ec-H2O Button Off	Interface Module, CAN-Bus
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Recovery Tank Full	Water PU Module, *J6-10 Low*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				ec-H2O System Fault (see ec-H2O system troubleshooting)	ec-H2O Module to CAN-Bus
				Circuit Fault	CAN-Bus to Interface Module
				Flush Mode	ec-H2O Module, *J5-5 and J5-6 = Closed*
				System Over Pressure (≈ > 20 psi)	ec-H2O Module, *J4-9 = Not Grounded*
				Severe Environment Mode	Scrub Module, *J4-8 Low or J4-7 Low*

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
ES (Extended Scrub) Pump (Option) *NOTE: 45 seconds/10 seconds Off until recovery tank is less than 1/2 full and solution tank is not full.*	Water PU Module: Water Pump *J6-13, J6-14*	1-STEP Scrub On	Interface Module, CAN-Bus	1-STEP Scrub Off	Interface Module, CAN-Bus
		Solution Control On	Interface Module, CAN-Bus	Solution Control Off	Interface Module, CAN-Bus
		ES Button On	Interface Module, CAN-Bus	ES Button Off	Interface Module, CAN-Bus
		Recovery Tank 1/2 Full	Water PU Module, *J6-9 = Ground*	Recovery Tank Full	Water PU Module, *J6-10 = Ground*
		Solution Tank Not Full	Scrub Module, *J4-1 ≈ < 1.34 Vdc*	Solution Tank Full	Scrub Module, *J4-1 ≈ > 1.34 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
ES Detergent Pump: (Option) *NOTE: Does not operate on 1 solution level LED.*	Scrub Module: Detergent Pump *J4-14*	1-STEP Scrub On	Interface Module, CAN-Bus	1-STEP Scrub Off	Interface Module, CAN-Bus
		Solution Control On (2 or 3 Solution LEDs On)	Interface Module, CAN-Bus	Solution Control Off (including 0 or 1 solution LEDs On)	Interface Module, CAN-Bus
		ES Button On	Interface Module, CAN-Bus	ES Button Off	Interface Module, CAN-Bus
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Recovery Tank Full	Water PU Module, *J6-10 = Ground*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
Severe Environment Pump: (Option) *NOTE: Short and Long cycle duration times can be adjusted in configuration mode.*	Scrub Module: Detergent Pump *J4-14*	1-STEP Scrub On	Interface Module, CAN-Bus	1-STEP Scrub Off	Interface Module, CAN-Bus
		Solution Control On	Interface Module, CAN-Bus	Solution Control Off	Interface Module, CAN-Bus
		Severe Environment Switch On	Scrub Module, *J4-8 Low or J4-7 Low*	Severe Environment Switch Off	Scrub Module, *J4-8 Not Low and J4-7 Not Low*
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
		Configured for 1%, 2%, or 3% Mix Ratio	Interface Module, CAN-Bus	Configured for 0% Mix Ratio	Interface Module, CAN-Bus
				Recovery Tank Full	Water PU Module, *J6-10 = Ground*
				Solution Tank Empty	Scrub Module, *J4-1 ≈ < 0.73 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Pre-Sweep Brushes	Pre-Sweep Module: Main *J7-3, J7-4* Right *J6-13, J6-14* Left *J6-15, J6-16*	Pre-Sweep Switch On	Pre-Sweep Module: *J6-9 or J6-10 = Grounded*	Pre-Sweep Switch Off	Pre-Sweep Module: *J6-9 and J6-10 = Not Grounded*
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Pre-Sweep Brushes Down	Pre-Sweep Module: Actuator *J6-17, J6-18*	Pre-Sweep Switch On	Pre-Sweep Module: *J6-9 or J6-10 = Grounded*	Pre-Sweep Switch Off	Pre-Sweep Module: *J6-9 and J6-10 = Not Grounded*

OPERATIONAL MATRIX (cont'd)

Output	Pin(s)	Enable	Input	Disable	Input
Pre-Sweep Vacuum Fan	Pre-Sweep Module: Vacuum Fan *J7-1, J7-2*	Pre-Sweep Vacuum Fan Switch On	Pre-Sweep Module: *J6-10 = Grounded*	Pre-Sweep Vacuum Fan Switch Off	Pre-Sweep Module: *J6-10 = Not Grounded*
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Low Battery Voltage	Curtis PMC Module, *J1-1 ≈ < 32 Vdc*
				Circuit Fault	CAN-Bus to Interface Module
Propel		Seat Switch Closed	Curtis PMC, *J1-9 ≈ Battery Voltage*	Seat Switch Open	Curtis PMC, *J1-9 ≈ No Battery Voltage*
		Fwd/Rev Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
		Fwd/Rev Switch Input	Curtis PMC, J1-22 or J1-33 ≈ Battery Voltage	Brake Switch Input	Curtis PMC, *J1-11 ≈ Battery Voltage*
				Rollout Battery Switch Input	Curtis PMC, *J1-11 ≈ Battery Voltage*
				Curtis® Propel Control Fault	See Curtis PMC Diagnostics.
Back-Up Alarm/ Lights (Option)		Reverse Switch Input	Curtis PMC, J1-33 ≈ Battery Voltage	Forward Switch Input	Curtis PMC, J1-22 ≈ Battery Voltage
		Reverse Throttle Command	Curtis PMC, *J1-6 ≈ 0.2-5 vDC*	Neutral - Ready State	Curtis PMC, *J1-6 ≈ 0 Vdc*
				Curtis® Propel Control Fault	See Curtis PMC Diagnostics.

FASTENER TORQUE

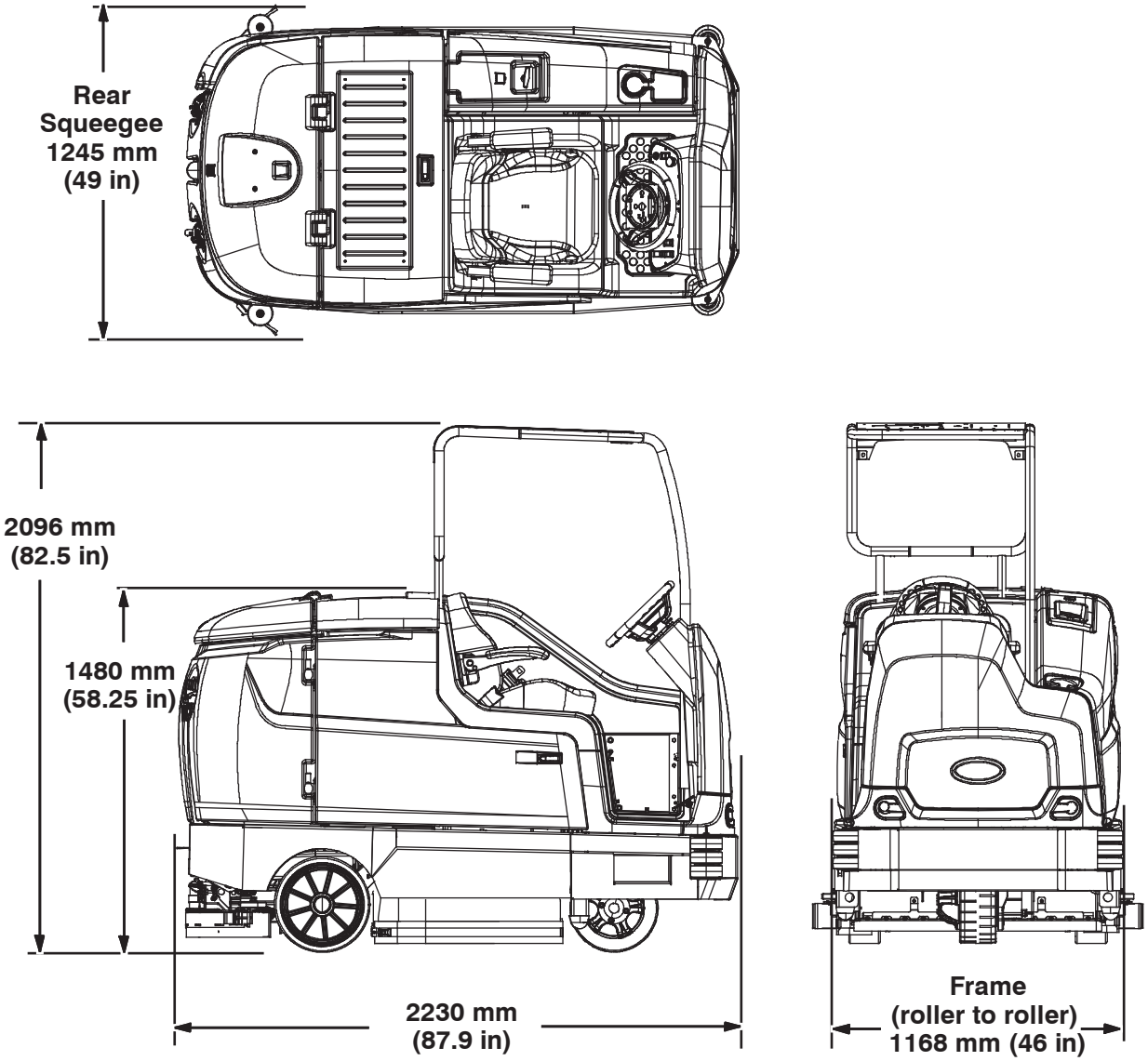
SAE (STANDARD)

Thread Size	SAE Grade 1	SAE Grade 2 Carriage Bolts	Thread Cutting Thread Rolling	SAE Grade 5 Socket & Stainless Steel	SAE Grade 8	Headless Socket Set Screws	Square Head Set Screws	
4 (.112)	(5) - (6.5)					(4) - (6)		Inch Pounds
5 (.125)	(6) - (8)					(9) - (11)		
6 (.138)	(7) - (9)		(20) - (24)			(9) - (11)		
8 (.164)	(12) - (16)		(40) - (47)			(17) - (23)		
10 (.190)	(20) - (26)		(50) - (60)			(31) - (41)		
1/4 (.250)	4 - 5	5 - 6	7 - 10	7 - 10	10 - 13	6 - 8	17 - 19	Foot Pounds
5/16 (.312)	7 - 9	9 - 12	15 - 20	15 - 20	20 - 26	13 - 15	32 - 38	
3/8 (.375)	13 - 17	16 - 21		27 - 35	36 - 47	22 - 26	65 - 75	
7/16 (.438)	20 - 26	26 - 34		43 - 56	53 - 76	33 - 39	106 - 124	
1/2 (.500)	27 - 35	39 - 51		65 - 85	89 - 116	48 - 56	162 - 188	
5/8 (.625)		80 - 104		130 - 170	171 - 265		228 - 383	
3/4 (.750)		129 - 168		215 - 280	313 - 407		592 - 688	
1 (1.000)		258 - 335		500 - 650	757 - 984		1281 - 1489	

METRIC

Thread Size	4.8/5.6	8.8 Stainless Steel	10.9	12.9	Set Screws
M3	43 - 56 Ncm	99 - 128 Ncm	139 - 180 Ncm	166 - 215 Ncm	61 - 79 Ncm
M4	99 - 128 Ncm	223 - 290 Ncm	316 - 410 Ncm	381 - 495 Ncm	219 - 285 Ncm
M5	193 - 250 Ncm	443 - 575 Ncm	624 - 810 Ncm	747 - 970 Ncm	427 - 554 Ncm
M6	3.3 - 4.3 Nm	7.6 - 9.9 Nm	10.8 - 14 Nm	12.7 - 16.5 Nm	7.5 - 9.8 Nm
M8	8.1 - 10.5 Nm	18.5 - 24 Nm	26.2 - 34 Nm	31 - 40 Nm	18.3 - 23.7 Nm
M10	16 - 21 Nm	37 - 48 Nm	52 - 67 Nm	63 - 81 Nm	
M12	28 - 36 Nm	64 - 83 Nm	90 - 117 Nm	108 - 140 Nm	
M14	45 - 58 Nm	102 - 132 Nm	142 - 185 Nm	169 - 220 Nm	
M16	68 - 88 Nm	154 - 200 Nm	219 - 285 Nm	262 - 340 Nm	
M20	132 - 171 Nm	300 - 390 Nm	424 - 550 Nm	508 - 660 Nm	
M22	177 - 230 Nm	409 - 530 Nm	574 - 745 Nm	686 - 890 Nm	
M24	227 - 295 Nm	520 - 675 Nm	732 - 950 Nm	879 - 1140 Nm	

MACHINE DIMENSIONS



SPECIFICATIONS

GENERAL MACHINE DIMENSIONS/CAPACITIES

Item	Dimension/Capacity
Length	2230 mm (87.9 in)
Length (with Pre-Sweep)	2870 mm (113 in)
Width (less squeegee)	1168 mm (46 in)
Width (with squeegee)	1245 mm (49 in)
Width (with side brush)	1346 mm (53 in)
Wheel base	1163 mm (45.8 in)
Track	1041 mm (41 in)
Height	1480 mm (58.25 in)
Height with overhead guard	2096 mm (82.5 in)
Disk brush diameter for scrubbing side brush (option)	411 mm (16.18 in)
Disk brush diameter for sweeping side brush (option)	482.60 mm (19 in)
Disk brush diameter for Pre-Sweep (option)	482.60 mm (19 in)
Disk brush diameter	510 mm (20 in)
Cylindrical brush diameter	230 mm (9 in)
Cylindrical brush length	1015 mm (40 in)
Cylindrical sweep brush diameter for Pre-Sweep (option)	203.20 mm (8 in)
Cylindrical sweep brush length for Pre-Sweep (option)	709.68 mm (27.94 in)
Scrubbing path width	1015 mm (40 in)
Scrubbing path width (with scrubbing side brush)	1320 mm (52 in)
Scrubbing path width (with right sweeping side brush)	1165 mm (46 in)
Scrubbing path width (with dual sweeping side brushes)	1320 mm (52 in)
Solution tank capacity	285 L (75 gallons)
Recovery tank capacity	346 L (91.1 gallons)
Demisting Chamber	61 L (16.1 gallons)
Weight (Empty)	875 Kg (1925 lbs)
Weight (with standard 510 AH batteries)	1525 Kg (3365 lbs)
GVWR	2750 Kg (6062 lbs)
Protection Grade	IPX3

Values determined as per EN 60335-2-72	Measure - Cylindrical scrub head	Measure- Disk scrub head
Sound pressure level L_{pA}	67.8 dB(A)	65.3 dB(A)
Sound uncertainty K_{pA}	2.8 dB(A)	3.0 dB(A)
Sound power level L_{WA} + Uncertainty K_{WA}	88.2 dB(A)	85.8 dB(A)
Vibration - Hand-arm	2.04 m/s^2	2.04 m/s^2
Vibration - Whole body	0.27 m/s^2	0.27 m/s^2
Vibration uncertainty K	0.18 m/s^2	0.18 m/s^2

SPECIFICATIONS

GENERAL MACHINE PERFORMANCE

Item	Measure
Aisle turnaround width	1854 mm (73 in)
Aisle turnaround width (with Pre-Sweep)	2362 mm (93 in)
Travel Speed (Forward)	9 Km/h (5.5 mph)
Travel Speed while scrubbing (Forward)	6.5 Km/h (4 mph)
Travel Speed (Reverse)	5 Km/h (3 mph)
Maximum ramp incline for loading - Empty	21%
Maximum ramp incline for scrubbing	8.7%
Maximum ramp incline for scrubbing (With optional ramp kit)	10.5%
Maximum ramp incline for transporting (GVWR)	12%
Maximum ramp incline for transporting (GVWR)(With optional ramp kit)	14.8%
Maximum ambient temperature for machine operation	43° C (110° F)
Minimum temperature for operating machine scrubbing functions	0° C (32° F)
Runtime (estimated continuous: economy mode)	510 AH, Up to 3.5 hours 750 AH, Up to 5.75 hours 930 AH, Up to 7.5 hours
Ground clearance (transport)	64 mm (2.5 in)
Vacuum fan speed	14500 RPM
Vacuum fan water lift	1650 mm (65 in)
Disk main brush speed	315 RPM
Disk main brush down pressure	Up to 250 kg (550 lb)
Cylindrical main brush speed	500 RPM
Cylindrical main brush down pressure	Up to 250 kg (550 lb)

POWER TYPE

Type	Quantity	Volts	Ah Rating	Weight
Batteries (Max. battery dimensions: 406 mm (7 in) W x 963 mm (11.8 in) L x 775 mm (15 in) H	1	36	510 @ 6 hr rate	661 kg (1458 lb)
	1	36	750 @ 6 hr rate	963 kg (2124 lb)
	1	36	930 @ 6 hr rate	988 kg (2178 lb)

Type	Use	Voltage	kW (hp)
Electric Motors	Scrub brush (disk)	36 VDC	1.125 (1.50)
	Scrub brush (cylindrical)	36 VDC	1.125 (1.50)
	Vacuum Fan	36 VDC	0.6 (0.8)
	Propelling	36 VAC	2.25 (3.0)

Type	VDC	Amperage	Hz	Phase	VAC
Chargers (Smart)	36	21	45-65	1	85-265

SPECIFICATIONS

TIRES

Location	Type	Size
Front (1)	Solid	150 mm wide x 350 mm OD (5.8 in wide x 13.8 in OD)
Rear (2)	Solid	125 mm wide x 380 mm OD (5 in wide x 15 in OD)

SCRUBBING SIDE BRUSH SOLUTION FLOW RATE (OPTION)

Item	Measure
Solution pump	36 Volt DC, up to 1.51 LPM (0.40 GPM)

ec-H2O SYSTEM (OPTION)

Item	Measure
Solution pump	36 Volt DC, 5A, 6.8 LPM (1.8 GPM) open flow,
Solution flow rate (machines without optional scrubbing side brush)	3.79 LPM (1.0 GPM)
Solution flow rate (machines with optional scrubbing side brush)	Up to 2.65 LPM (0.70 GPM) - To main scrub head
	Up to 1.14 LPM (0.30 GPM) - To scrubbing side brush

SPECIFICATIONS

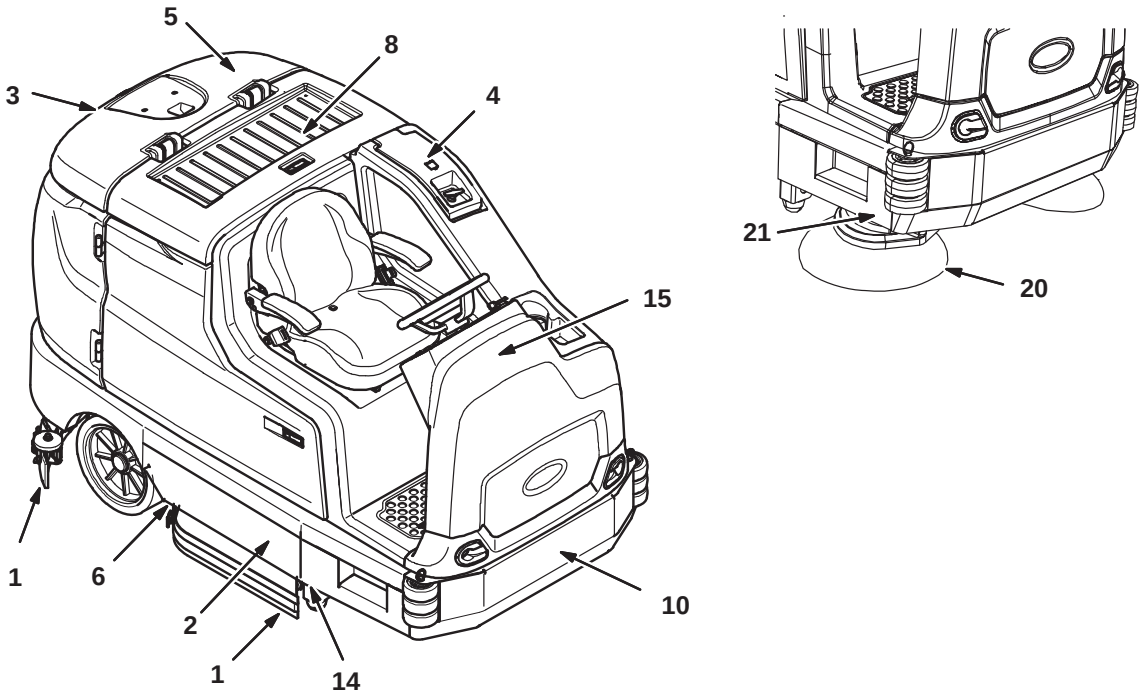
ELECTRICAL COMPONENTS *(For Reference Only)*

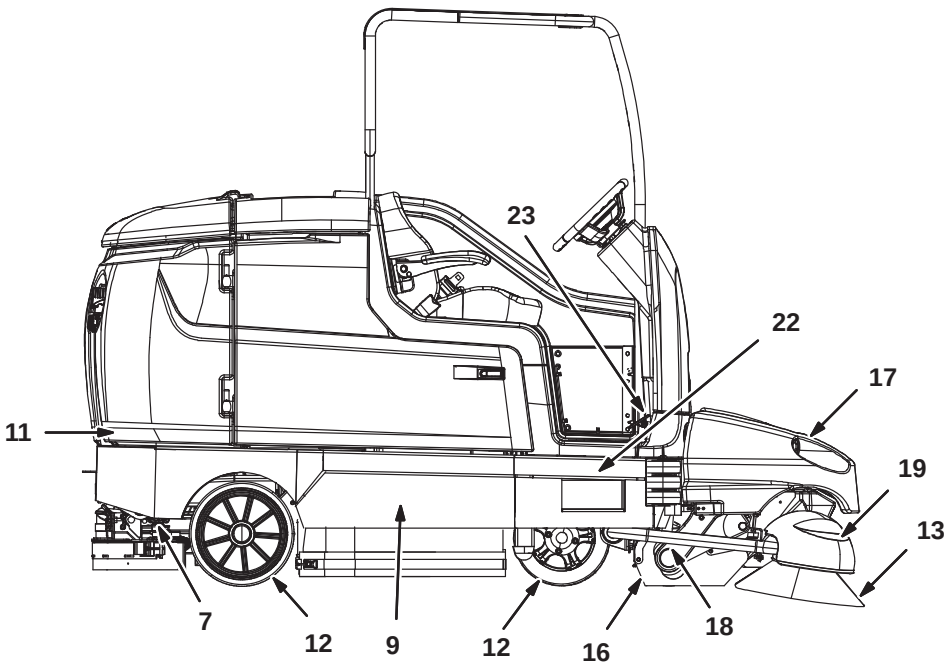
Component	Measure
Contactor Coil, M1	102 Ω +/- 10%
Relay Coil, M2	0.822 kΩ +/- 5%
Contactor Coil, M3	160 Ω +/- 10%
Actuator, Scrub head lift	1 - 3 Amps continuous
Actuator, Side brush lift	1 - 3 Amps continuous, Internal limit switches
Actuator, Rear squeegee lift	2 - 4 Amps continuous, Internal limit switches
Motor, Vacuum Fan(s)	14 - 20 Amps continuous (15 - 16 Amps average)
Motor, Propelling (5.4 mph transport speed)	38 - 64 Amps continuous
Motors, Main cylindrical brush	
Down pressure #1	12 - 18 Amps/Motor (default 13 Amps)
Down pressure #2	18 - 28 Amps/Motor (default 26 Amps)
Down pressure #3	28 - 35 Amps/Motor (default 35 Amps)
Motors, Main disk brush	
Down pressure #1	12 - 18 Amps/Motor (default 14 Amps)
Down pressure #2	18 - 28 Amps/Motor (default 25 Amps)
Down pressure #3	28 - 35 Amps/Motor (default 35 Amps)
Motor, Side Sweep Brush	5 - 8 Amps
Motor, Side Scrub Brush	12-40 Amps
Pump, *ec-H2O*	4 - 6 Amps
Pump, Spray Nozzle	2 - 3 Amps
Pump, Side Brush	0.5 - 2 Amps
Pump, Detergent Metering/ Severe Environment	0.5 - 1.5 Amps
Valve, ec-H2O Side Brush	129 Ω +/- 5%
Valve, Conventional Side Brush	108 Ω +/- 10%
Valve, Conventional Main Brush	108 Ω +/- 10%
Valve, Autofill	218 Ω +/- 10%

SECTION 3

Contents **Page**

MAINTENANCE





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MAINTENANCE CHART

The table below indicates the *Person Responsible* for each procedure.

O = Operator.
T = Trained Personnel.

Interval	Person Resp.	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
Daily	O	1	Side and rear squeegees	Check for damage and wear. Check deflection.	–	4
	O	2	Main brushes	Check for damage, wear, and debris	–	2
	O	3	Recovery tank	Clean tank, top sensor, and check cover seal	–	1
	O	4	Solution tank	Check cover seal	–	1
	O	3	ES machines only: Recovery tank	Clean filter at bottom of tank and second lower sensor.	–	2
	O	4	ES machines only: Solution tank	Clean tank and level sensor	–	1
	O	5	Vacuum fan inlet filter, screen, and debris tray	Clean	–	1
	O	6	Cylindrical brushes only: Debris tray	Clean	–	1
	O	20	Sweeping or scrubbing side brush (Option)	Check for damage, wear, debris	–	1 (2)
	O	20	Scrubbing side brush squeegee (Option)	Check for damage and wear	–	1
	O	13	Pre–Sweep side brushes (Option)	Check for damage, wear, debris	–	2
	O	16	Pre–Sweep main bush (Option)	Check for damage, wear, debris	–	1
	O	17	Pre–Sweep debris hopper (Option)	Clean	–	1
Weekly	T	8	Battery cells	Check electrolyte level	DW	Multiple
50 Hours	T	1	Side and rear squeegees	Check leveling	–	4
	O	16, 17	Pre–Sweep skirts and seals (Option)	Check for damage and wear	–	4
	O	2	Main brushes (cylindrical)	Rotate brushes from front to rear	–	2
	O	14	Scrub head skirts (disk)	Check skirts for damage and wear	–	2

LUBRICANT/FLUID

DW . . . . Distilled water.
SPL . . . Special lubricant, Lubriplate EMB grease (Tennant part number 01433–1)
GL . . . . SAE 90 weight gear lubricant

NOTE: More frequent maintenance intervals may be required in extremely dusty conditions.

The table below indicates the *Person Responsible* for each procedure.

O = Operator.
T = Trained Personnel.

Interval	Person Resp.	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
100 Hours	T	8	Battery watering system (option)	Check hoses and connections for damage and wear	–	Multiple
200 Hours	T	23	Brakes	Check adjustments	–	1
	T	8	Battery terminals and cables	Check and clean	–	2
	T	9	Cylindrical brush drive belts	Check for damage and wear	–	2
	T	18	Pre–Sweep brush drive belt	Check for damage and wear	–	1
	T	22	Drive wheel pivot	Lubricate	SPL	1
	T	15	Steering chain	Lubricate, check tension, and check for damage and wear.	GL	1
	T	10	Steering gear chain	Lubricate, check tension, and check for damage and wear.	GL	1
500 Hours	T	11	Vacuum fan motors	Check motor brushes	–	2
	O	12	Tires	Check for damage and wear	–	3
1000 Hours	T	21	Sweeping side brush motors	Check motor brushes **(Check every 100 hours after initial 1000 hour check)**	–	1 (2)
	T	18	Pre–Sweep main brush motor (Option)	Check motor brushes **(Check every 100 hours after initial 1000 hour check)**	–	1
	T	19	Pre–Sweep side brush motors (Option)	Check motor brushes **(Check every 100 hours after initial 1000 hour check)**	–	2

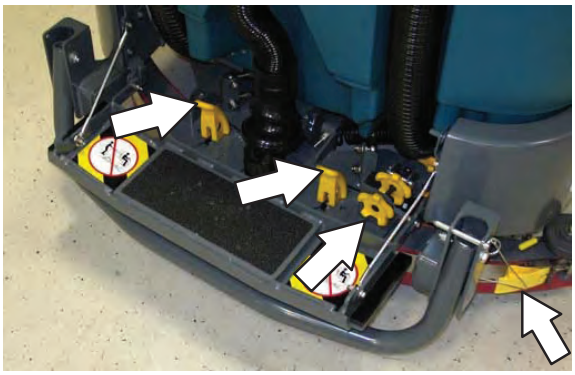
LUBRICANT/FLUID

DW . . . . Distilled water.
SPL . . . Special lubricant, Lubriplate EMB grease (Tennant part number 01433–1)
GL . . . . SAE 90 weight gear lubricant

NOTE: More frequent maintenance intervals may be required in extremely dusty conditions.

YELLOW TOUCH POINTS

This machine features easy to find yellow touch points for simple service items. No tools are required to perform these maintenance operations.

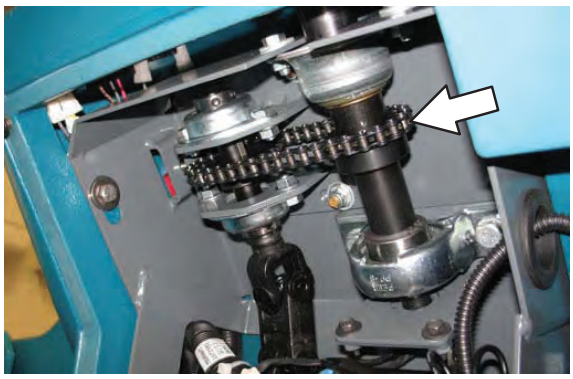


LUBRICATION

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

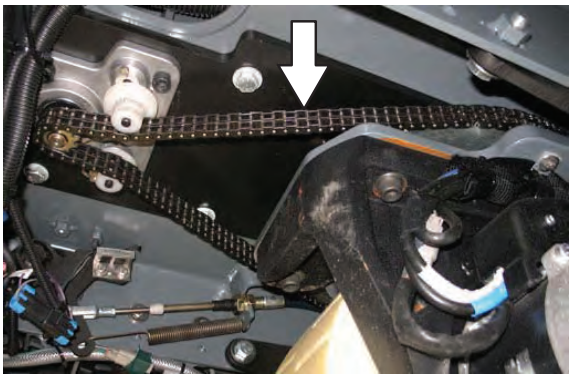
STEERING CHAIN

The steering chain is located on the steering column directly under the control panel. Check for damage or wear and lubricate the steering chain after every 200 hours.



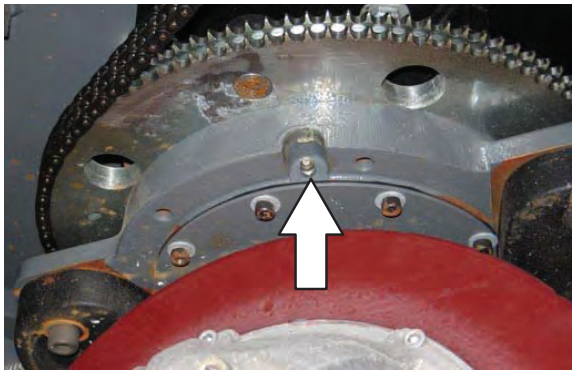
STEERING GEAR CHAIN

The steering gear chain is located directly above the front tire. Check for damage or wear and lubricate the steering gear chain after every 200 hours.



DRIVE WHEEL PIVOT

The drive wheel pivot is located directly above the drive wheel. Lubricate the drive wheel pivot after every 200 hours.



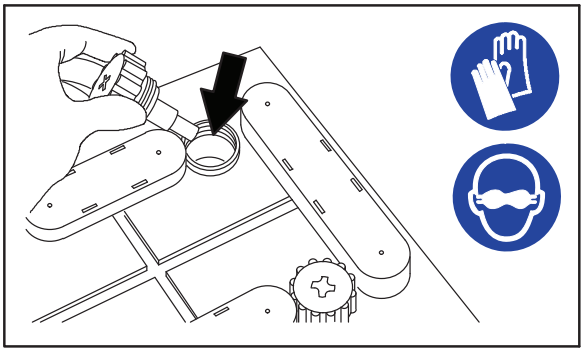
BATTERIES

The lifetime of the batteries is limited to the number of charges the batteries receive. To get the most life from the batteries, only recharge the batteries when the battery discharge indicator is down to the last bar. It is also important to maintain the proper electrolyte levels during the life of the battery.

CHECKING THE ELECTROLYTE LEVEL

*NOTE: **Do** **Not** check the electrolyte level if the machine is equipped with the battery watering system. Proceed to the BATTERY WATERING SYSTEM (OPTION).*

Check the battery electrolyte level weekly for machines equipped with wet/lead acid batteries.



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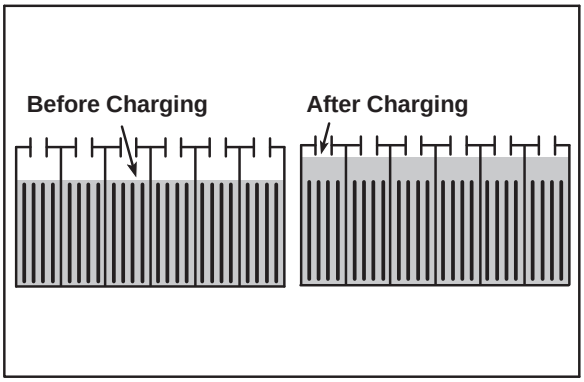
FOR SAFETY: When servicing machine, avoid contact with battery acid.

The level should be slightly above the battery plates as shown before charging. Add distilled water if low. DO NOT OVERFILL. The electrolyte will expand and may overflow when charging.



NOTE: Make sure the battery caps are in place while charging.

CHECKING CONNECTIONS / CLEANING

After every 200 hours of use check for loose battery connections and clean the surface of the batteries, including terminals and cable clamps, with a strong solution of baking soda and water. Replace any worn or damaged wires. Do not remove battery caps when cleaning batteries.

Objects made of metal can potentially short circuit the batteries. Keep all metallic objects off the batteries.

CHARGING THE BATTERIES

IMPORTANT: Before charging, make sure that the charger setting is properly set for the battery type.

NOTE: Use a charger with the proper rating for the batteries to prevent damage to the batteries or reduce the battery life.

1. Drive the machine to a flat, dry surface in a well–ventilated area.

2. Stop the machine and turn off the machine power.

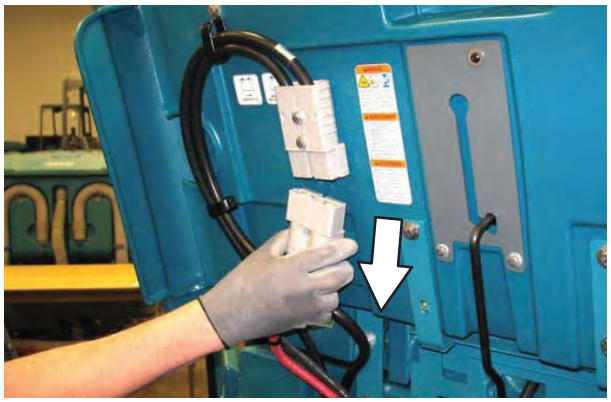
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

3. Lift the battery compartment top cover open and engage the support.

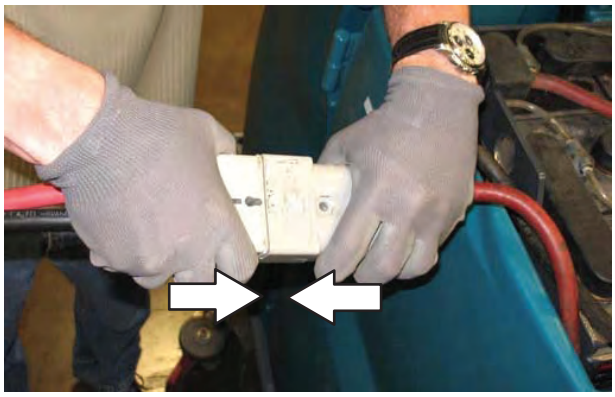
NOTE: Make sure the batteries have the proper electrolyte level before charging. See CHECKING THE ELECTROLYTE LEVEL.

4. Plug the charger AC power supply cord into a properly grounded outlet.

5. Disconnect the battery cable from the machine connector.

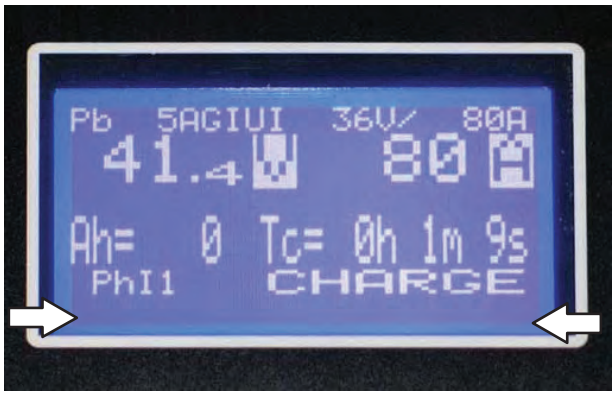


6. Connect the charger connector to the battery cable. The Tennant charger will start automatically.

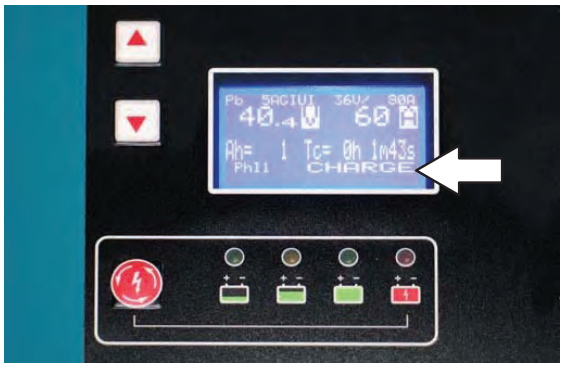


WARNING: Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away. Keep covers open when charging.

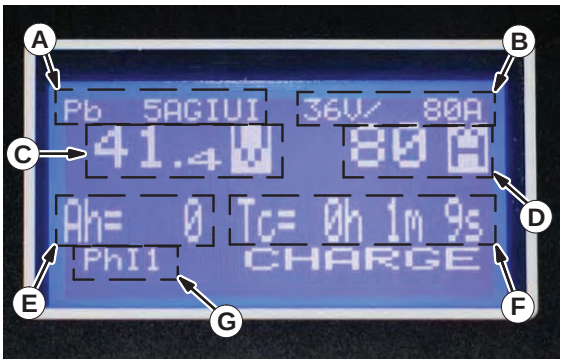
NOTE: If there are charger fault codes when the battery is plugged into the battery charger, the fault codes will appear at the bottom of the charger display. Refer to the battery charger manual for fault code definitions.



7. Observe the charger display. CHARGE appears on the display when the battery is charging. This is the charger default screen.

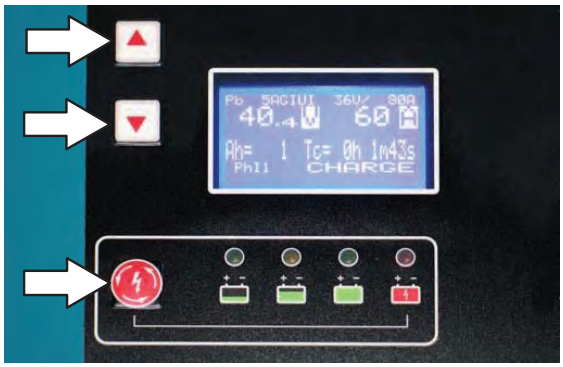


Charger Display:

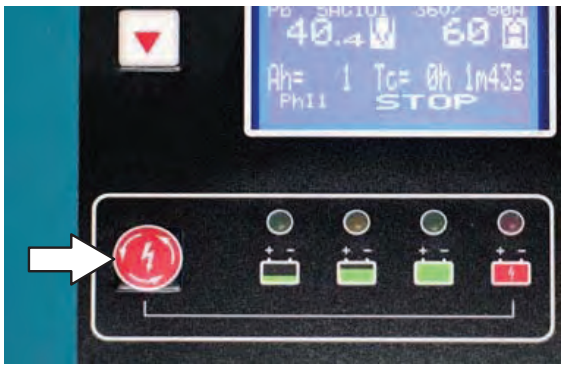


A. Charge profile number
B. Charger rating
C. Battery voltage (Volts)
D. Battery current (Amperes)
E. Ampere hours charged
F. Time charged (hours / minutes / seconds)
G. Charging phase (Phase 1 / Phase 2 / Phase 3)

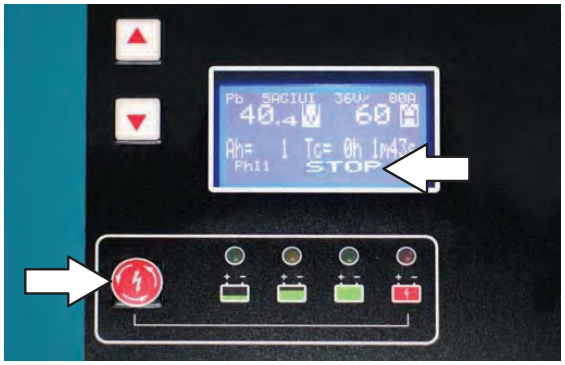
8. If necessary, press the navigation buttons to access additional screens. Press the charger *stop / start / enter button* to enter selection. The charger will return to the default screen in 30 seconds. Refer to manufacturers operator manual for additional information.



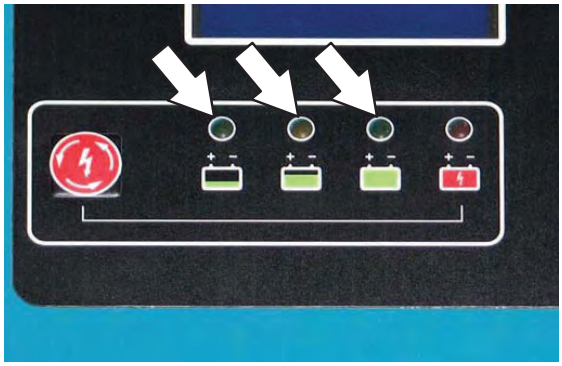
9. Press the charger *stop / start / enter button* to return to the charger default screen.



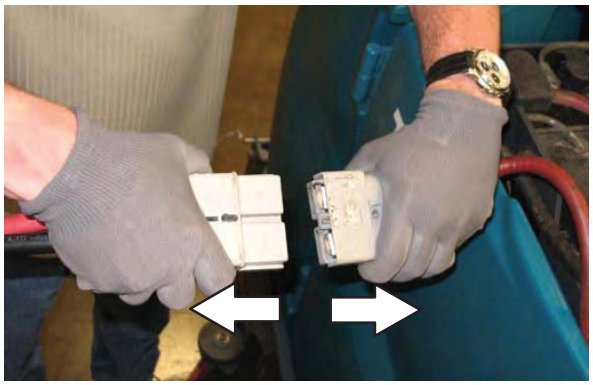
NOTE: If the charger cable must be disconnected from the battery before they are fully charged, press the charger stop / start / enter button *to stop charging. Be sure STOP appears on the display and the red stop charge light is illuminated before disconnecting the battery charger cable.*



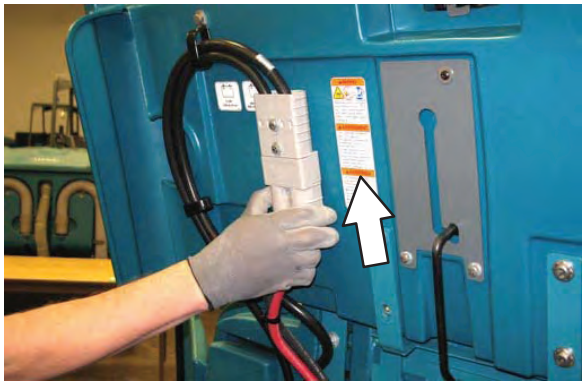
10. The green charger status indicators will illuminate from left to the right as the battery is charging. COMPLETE will appear in the display, all the green charger status indicators will be illuminated, and the Tennant charger will stop charging when the battery is completely charged.



11. After the charger has turned off, disconnect the charger connector from the battery cable connector.



12. Reconnect the battery connector to the machine connector.

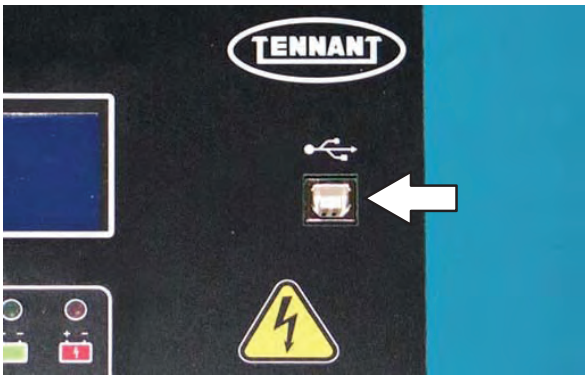


FOR SAFETY: When servicing machine do not disconnect the off–board charger's DC cord from the machine receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging, disconnect the AC power supply cord first.

13. Close the battery compartment top cover.

BATTERY CHARGER USB PORT

The battery charger USB port is for maintenance computer access to the charger by authorized service personnel only. **Do Not** plug cell phones or other unauthorized electronic devices into the battery charger USB port. **Do Not** plug anything into the USB port while the battery is charging.



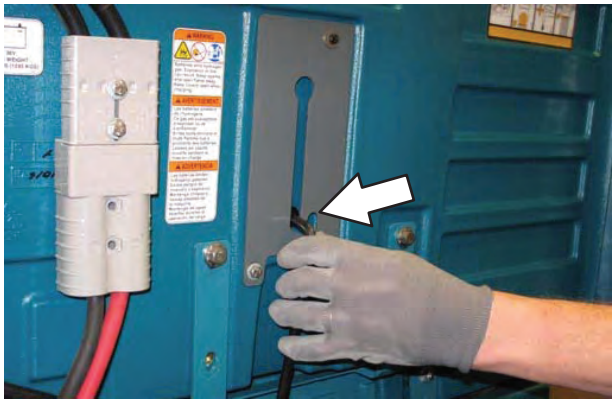
BATTERY WATERING SYSTEM (OPTION)

The optional battery watering system provides a safe and easy way to maintain the proper electrolyte levels in the batteries.

Check the battery watering system hoses and connections for damage or wear after every 100 hours.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

1. Lift the battery compartment cover open and engage the support.



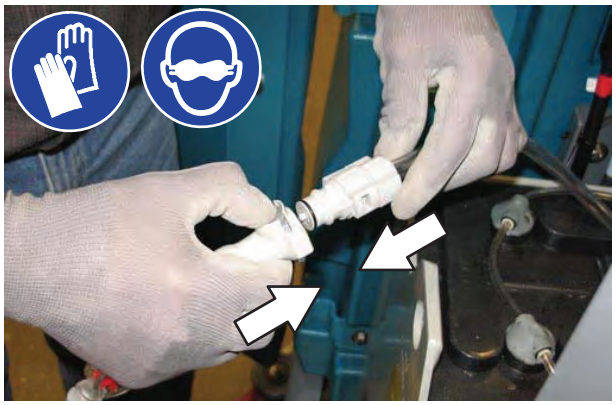
2. Fully charge batteries prior to using the battery watering system. Do not add water to batteries before charging, the electrolyte level will expand and may overflow when charging. See *CHARGING THE BATTERIES.*

3. Connect the battery watering system hose to the water supply source.

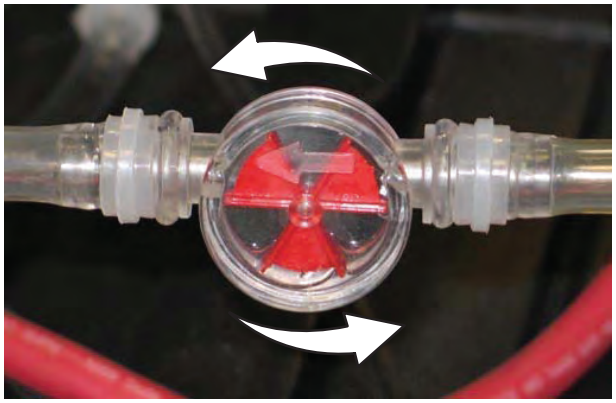
NOTE: Water quality is important to maintain the life of the battery. Always use water that meets battery manufacturer requirements.

NOTE: The water supply to the battery water system must always be 7.57 LPM (2 GPM) or more. Use the purger to confirm the water supply pressure. Refer to manufacturer Operator Manual for additional information.

4. Connect the battery watering system hose to the battery fill hose.



5. Turn on the water supply. The indicator inside the flow indicator will spin. The indicator stops spinning when the batteries are full.



6. Disconnect the battery watering system hose from the water supply hose.

7. Turn off the water supply.

8. After adding water, return the battery watering system hose to the storage location for future use.

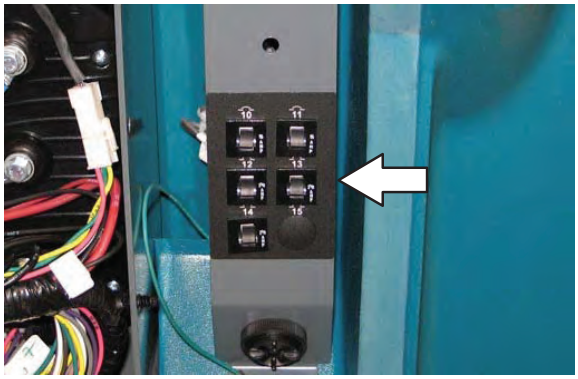
CIRCUIT BREAKERS, FUSES, AND RELAYS

CIRCUIT BREAKERS

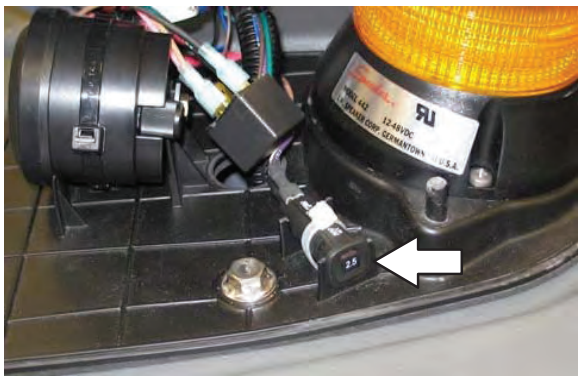
Circuit breakers are resettable electrical circuit protection devices designed to stop the flow of current in the event of a circuit overload. Once a circuit breaker is tripped, reset it manually by pressing the reset button after the breaker has cooled down.

Circuit breakers 1 through 9 are located under the operator seat behind the battery compartment side cover.

Circuit breakers 10 through 15 are located behind the steering shroud access panel.



Circuit breaker 16 is located inside the optional light assembly mounted on top of the recovery tank.



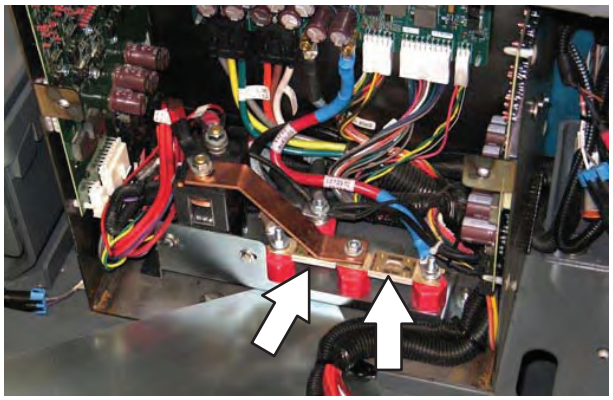
If the overload that caused the circuit breaker to trip is still present, the circuit breaker will continue to stop current flow until the problem is corrected.

The chart below shows the circuit breakers and the electrical components they protect.

Circuit Breaker	Rating	Circuit Protected
CB1	60 A	Water pickup module
CB2	50 A	Pre–Sweep module (Option)
CB3A	20 A	Side brush sweep module (Option)
CB3B	35 A	Side brush scrub module (Option)
CB4	2.5 A	Key switch
CB5	2.5 A	Water pick up module
CB6	2.5 A	Scrub module
CB7A	–	Not Used
CB7B	2.5 A	Pre–Sweep module (Option)
CB7C	2.5 A	Side brush scrub module (Option)
CB8	2.5 A	*ec–H2O* module
CB9	2.5 A	*ec–H2O* pump
CB10	15 A	Spray nozzle (Option)
CB11	15 A	Lights (Option)
CB12	2.5 A	Headlights (Option)
CB13	2.5 A	Strobe light / Flashing light on over head guard (Option)
CB14	2.5 A	Strobe light / Flashing light on recovery tank cover (Option)
CB15	15 A	Power steering (Option)
CB16	2.5 A	Backup alarm / light (Option)

FUSES

Fuses are one-time protection devices designed to stop the flow of current in the event of a circuit overload. Never substitute higher value fuses than specified.



The fuses are located in the control box behind the circuit breaker panel.

Fuse	Rating	Circuit Protected
FU-1	150 A	Propelling
FU-2	100 A	Scrub module power
FU-3	2.0 A	Telemetry module harness

RELAYS

Relays are electrical switches that open and close under the control of another electrical circuit. Relays are able to control an output circuit of higher power than the input circuit. The relays are located in the control box behind the circuit breaker panel.

Refer to the table below for the *relays* and circuits controlled.

Relay	Rating	Circuit Controlled
M1	36 VDC, 200 A	Main contactor
M2	36 VDC, 5 A	Backup alarm / light (Option)
M3	36 VDC, 100 A	Auxiliary line contactor

ELECTRIC MOTORS

Inspect the carbon brushes on the vacuum fan motor after every 500 hours of operation. Inspect the carbon brushes on the sweeping side brush motors and all Pre−Sweep motors after the first 1000 hours of operation and every 100 hours after the initial check. Refer to the table below for carbon brush inspection intervals.

Carbon Brush Inspection	Hours
Side brush motors − Sweeping (Option)	1000*
Pre−Sweep motors (Option)	1000*
Vacuum motor	500

**Inspect carbon brushes every 100 hours after the initial 1000 hour change.*

SCRUB BRUSHES

The machine can be equipped with either *disk* or *cylindrical* scrub brushes. Check scrub brushes daily for wire or string tangled around the brush or brush drive hub. Also check brushes or pads for damage and wear.

DISK BRUSHES AND PADS

Replace the brushes or pads when they no longer clean effectively.

Cleaning pads must be placed on pad drivers before they are ready to use. The cleaning pad is held in place with a center disk. Both sides of the pad can be used for scrubbing. Turn the pad over to use the other side.

Cleaning pads need to be cleaned immediately after use with soap and water. Do not wash the pads with a pressure washer. Hang pads, or lay pads flat to dry.

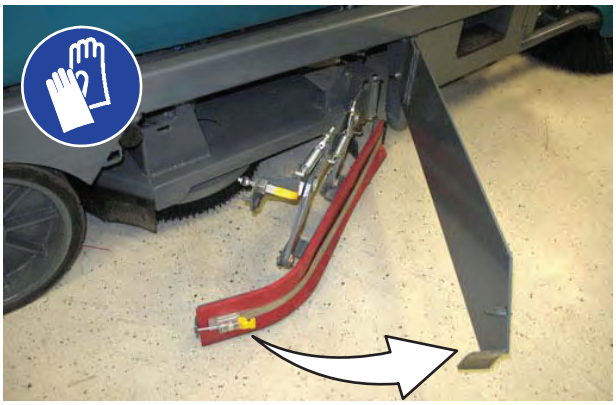
NOTE: Always replace brushes and pads in sets. Otherwise one brush or pad will be more aggressive than the other.

REPLACING DISK BRUSHES OR PAD DRIVERS

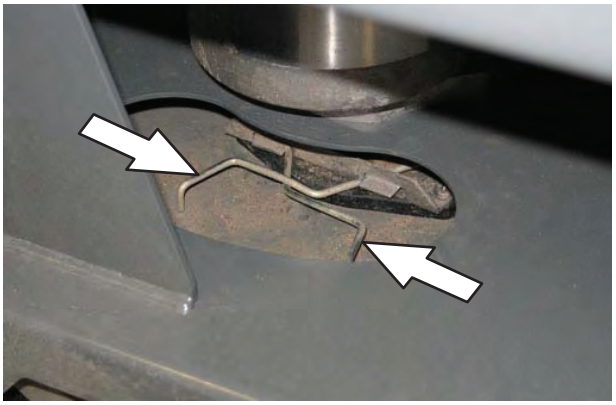
1. Raise the scrub head.
2. Turn off the machine.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

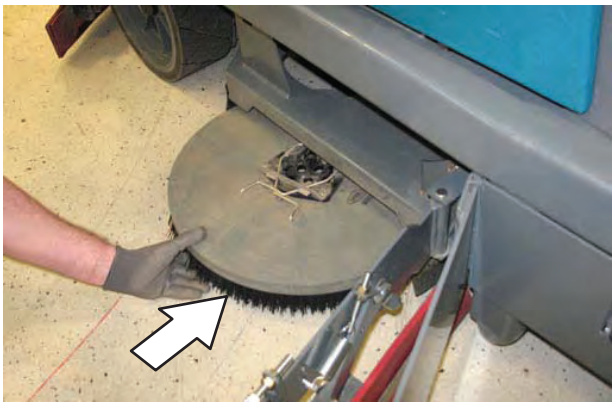
3. Open the main brush access door and side squeegee support door.



4. Turn the brush until the spring handles are visible.



5. Squeeze the spring handles and let the brush drop to the floor. Remove the brush from under the scrub head.
6. Push the new brush under the scrub head, align the brush drive socket with the brush drive hub, and lift the brush up onto the brush drive hub.

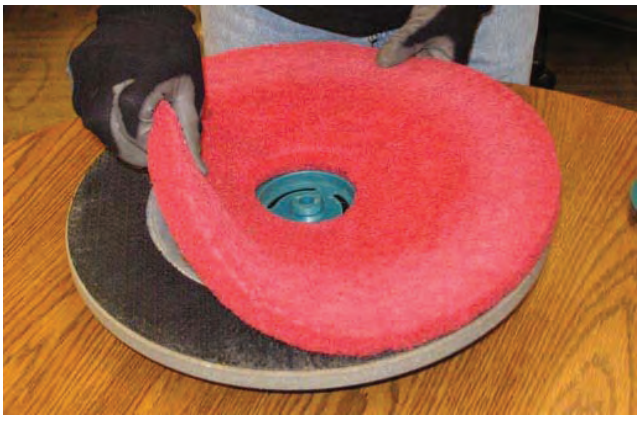


7. Ensure the brush is securely mounted on the brush drive hub.
8. Close and secure the squeegee support door and close the main brush access door.
9. Repeat procedure for the other brushes.

REPLACING DISK SCRUB PADS

1. Remove the pad driver from the machine.
2. Squeeze the spring clip together and remove the center disk from the pad driver.

3. Remove the scrub pad from the pad driver.



4. Flip or replace the scrub pad. Center the scrub pad on the pad driver and reinstall the center disk to secure the pad in place on the pad driver.
5. Reinstall the pad driver onto the machine.

CYLINDRICAL BRUSHES

Rotate the brushes from front-to-rear after every 50 hours of operation.

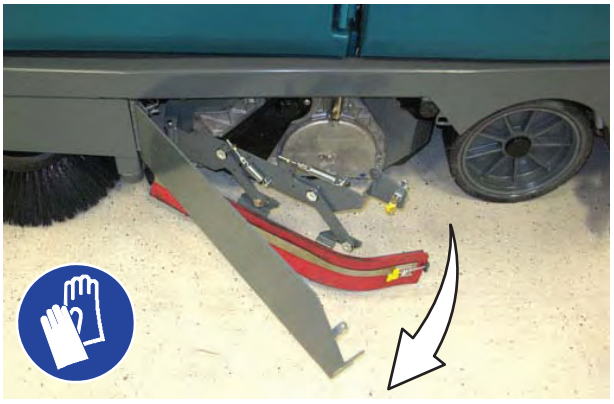
Replace the brushes when they no longer clean effectively.

NOTE: Replace worn brushes in pairs. Scrubbing with brushes of unequal bristle length will result in diminished scrubbing performance.

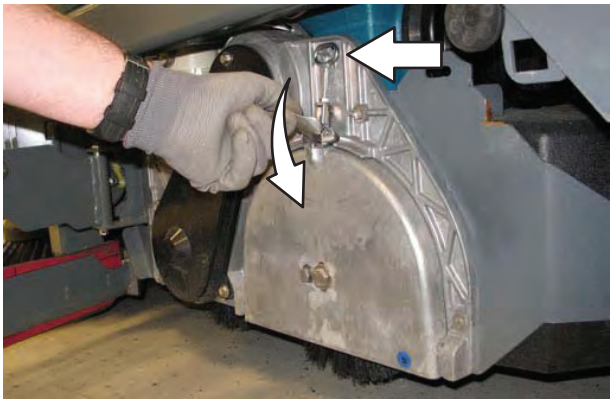
REPLACING CYLINDRICAL SCRUB BRUSHES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

1. Open the main brush access door and side squeegee support door.

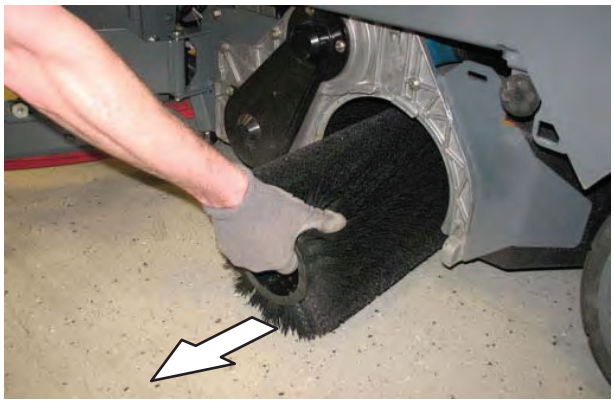


2. Lift the idler plate retainer handle and unhook the retainer ring from the idler plate hook.



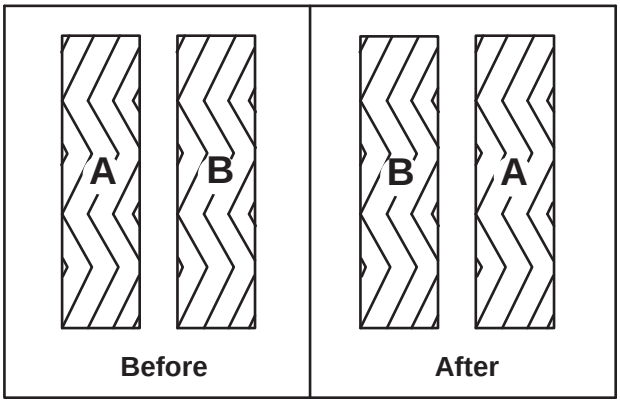
3. Remove the idler plate from the scrub head.

4. Remove the brush from the scrub head



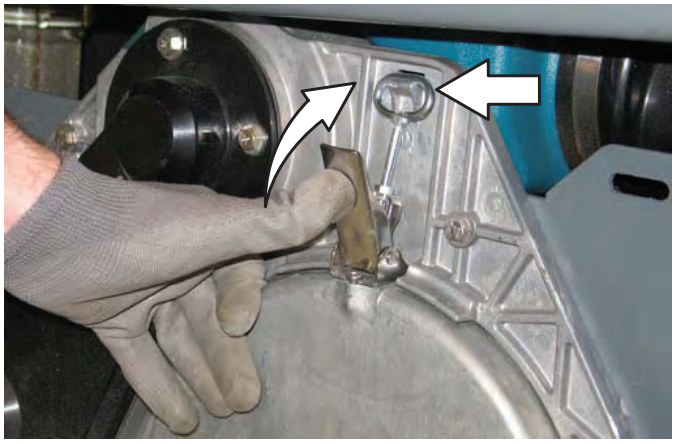
5. Position the brush with the *double row end towards the scrub head opening.* Guide the new brush onto the drive hub.

6. If rotating the brushes, always rotate the front with the back so that they wear evenly. They may be rotated end for end as well.



7. Slide the idler plate up into the scrub head.

8. Secure the idler plate into place with the idler plate retainer.



NOTE: Do not switch the left or right idler plates or the brushes will need to be readjusted by trained personnel.

9. Close and secure the squeegee support door and close the main brush access door.

10. Repeat for the brush on the other side of the scrub head.

SIDE BRUSH(ES) (OPTION)

Check the side brushes daily for wear or damage. Remove any tangled string or wire from the side brushes or side brush drive hubs.

REPLACING THE SCRUBBING SIDE BRUSH

Replace the brush when it no longer cleans effectively.

1. Raise the side brush assembly and turn off the machine.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

2. Squeeze the spring handles and let the side brush drop to the floor.

3. Remove the side brush from under the side brush assembly.

4. Place the new side brush underneath the side brush assembly and lift the side brush up onto the side brush hub until the brush locks onto the hub.

REPLACING THE SWEEPING SIDE BRUSH(ES)

Replace the brushes when they no longer clean effectively.

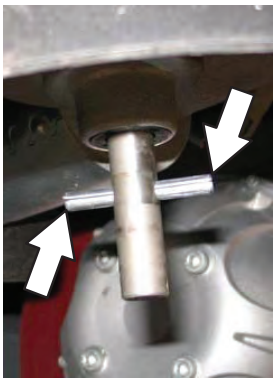
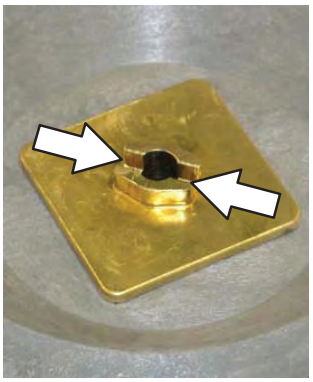
1. Raise the side brush assembly and turn off the machine.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

2. Reach into the center of the brush and remove the cotter pin holding the brush and the retaining washer to the hub.

3. Remove the side brush and retaining washer from under the side brush assembly.

4. Place the new side brush underneath the side brush and align the channel in the side brush receptacle with the two brush locks on the side brush hub.

5. Lift the side brush up onto the side brush hub, hold the side brush onto the hub, install the retaining washer onto the hub, and reinstall the cotter pin into the hub.

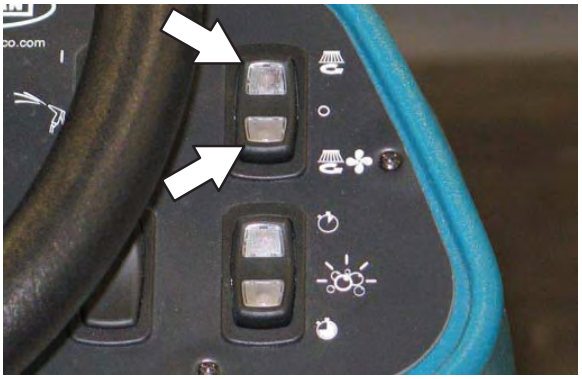
PRE–SWEEP BRUSHES (OPTIONAL)

The Pre–Sweep assembly is equipped with *disk* side brushes and a *cylindrical* main brush. Check the brushes daily for wire or string tangled around the brush or brush drive hub. Check the brushes daily for damage and wear.

REPLACING THE PRE–SWEEP SIDE BRUSHES

Replace the brushes when they no longer clean effectively.

1. Turn on the machine.
2. Press the Pre–Sweep switch to raise the Pre–Sweep assembly and stop sweeping.



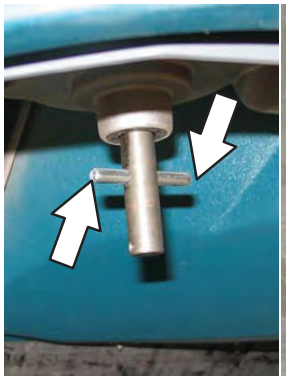
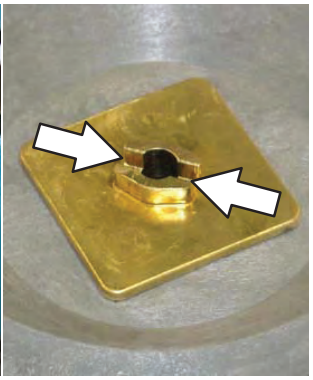
3. Turn off the machine.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

4. Reach into the center of the brush and remove the cotter pin holding the brush and the retaining washer to the hub.

5. Remove the side brush and retaining washer from under the Pre–Sweep assembly.

6. Place the new side brush underneath the side brush and align the channel in the side brush receptacle with the two brush locks on the side brush hub.

7. Lift the side brush up onto the side brush hub, hold the side brush onto the hub, install the retaining washer onto the hub, and reinstall the cotter pin into the hub.

REPLACING THE PRE–SWEEP CYLINDRICAL BRUSH

Replace the brush when it no longer cleans effectively.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

1. Turn off the machine.
2. Loosen both Pre–Sweep cover latches.

3. Lift the Pre–Sweep cover, lock the cover open, and engage the Pre–Sweep cover support.

4. Loosen and remove the left brush arm knob.

5. Remove the left brush arm.

6. Remove the three knobs holding the Pre–Sweep side skirt and side skirt plate to the Pre–Sweep assembly.

7. Remove the side skirt plate and side skirt from the Pre−Sweep assembly.

8. Remove the cylindrical brush and replace with a new brush.

9. Guide the slotted end of the new brush onto the drive hub.

10. Reinstall the side skirt, side skirt plate, and left brush arm.

SQUEEGEE BLADES

Check the squeegee blades for damage and wear daily. When the blades become worn, rotate the blades end–for–end or top–to–bottom to a new wiping edge. Replace blades when all edges are worn.

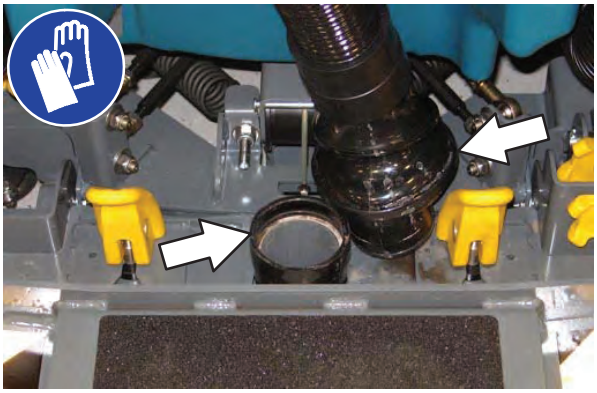
Check the deflection of the squeegee blades daily or when scrubbing a different type of surface. Check the leveling of the rear squeegee every 50 hours of operation.

REPLACING (OR ROTATING) THE REAR SQUEEGEE BLADES

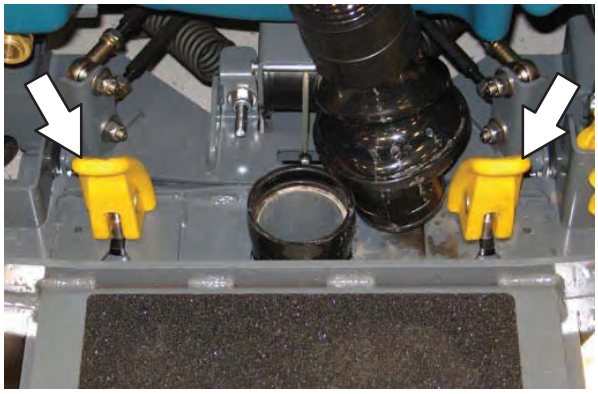
1. If necessary, lower the *Rear bumper door / step*.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

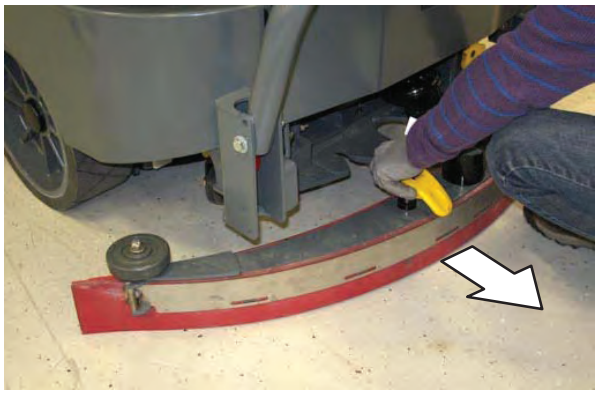
2. Disconnect the vacuum hose from the rear squeegee assembly.



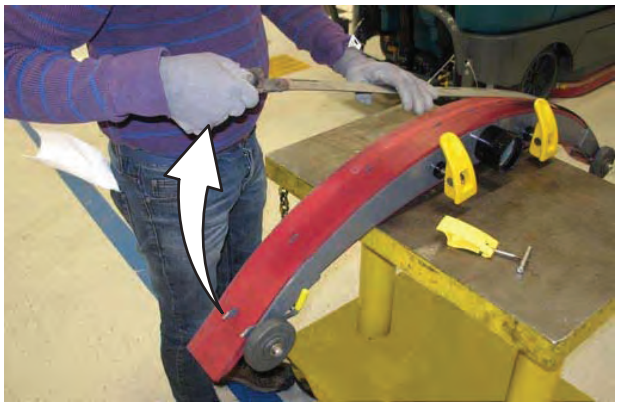
3. Loosen both squeegee mounting handles.



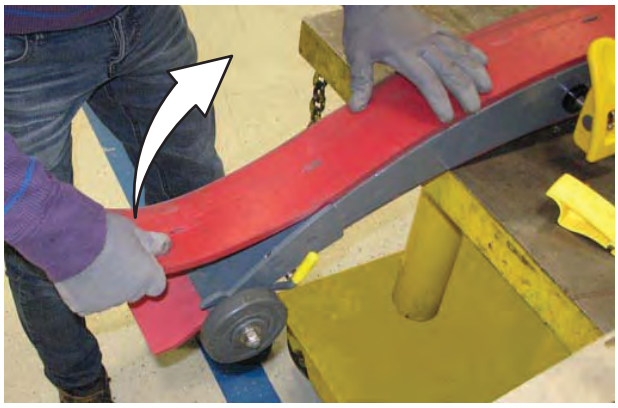
4. Pull the rear squeegee assembly from the machine.



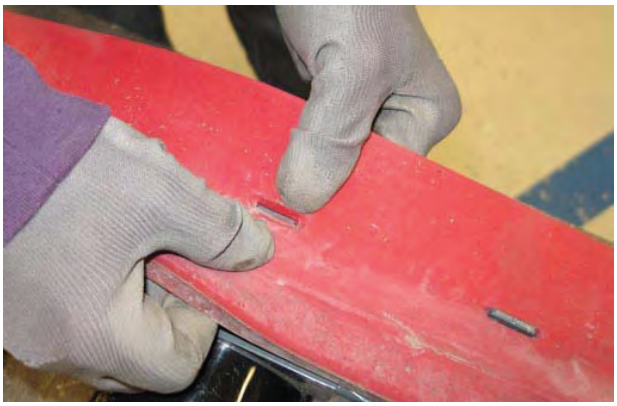
5. Loosen the rear retainer latch and remove the latch and the retainer from the squeegee assembly.



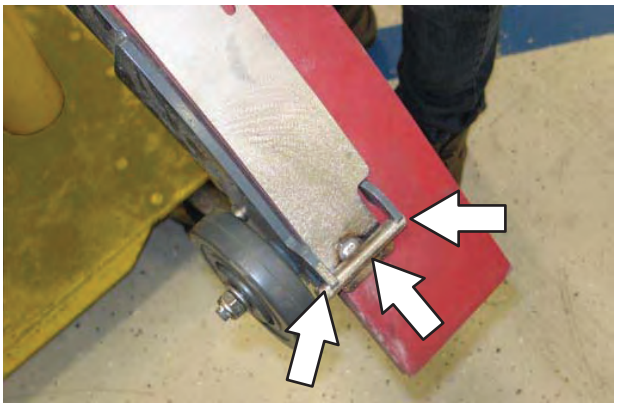
6. Remove the rear squeegee from the squeegee assembly.



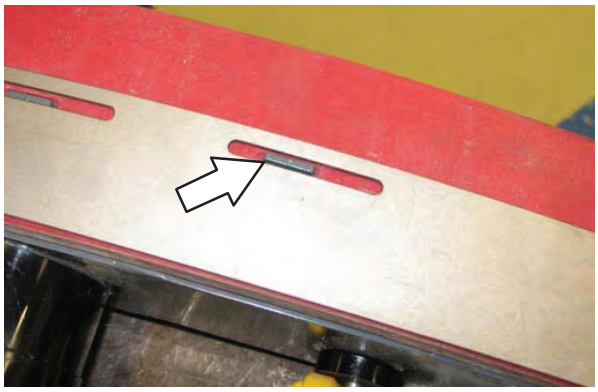
7. Place the rotated or new squeegee blade onto the rear squeegee assembly. Be sure the squeegee is securely attached on each tab on the rear squeegee assembly.

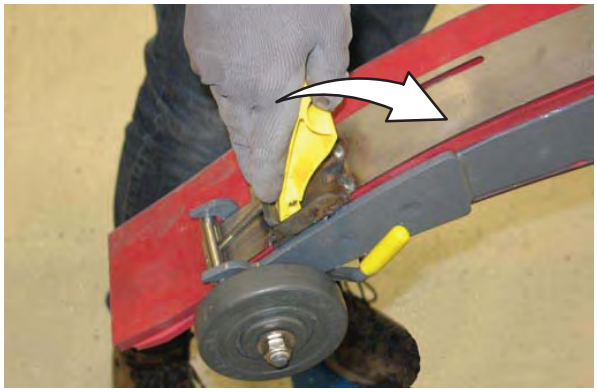


8. Insert the hinge end of the retainer into the hooks in the rear squeegee assembly.



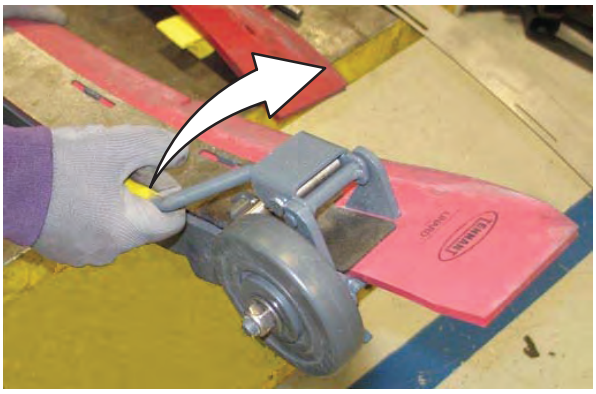
9. Install the retainer along the rest of the squeegee assembly, align the tabs on the squeegee assembly into the slots in the retainer, and tighten the latch onto the other end of the squeegee assembly.





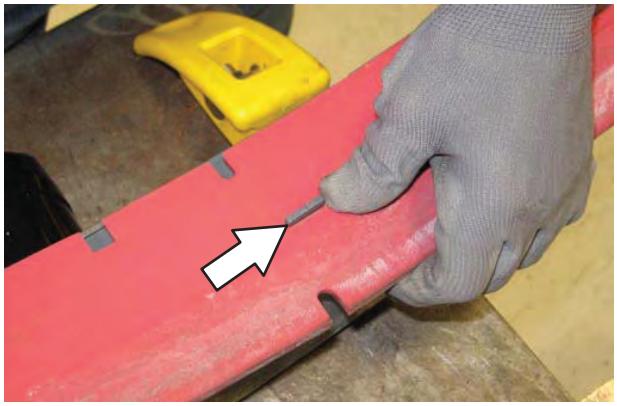
10. Turn the rear squeegee assembly over to access the front of the squeegee assembly.

11. Loosen the front retainer latch and remove the latch and the retainer from the squeegee assembly.

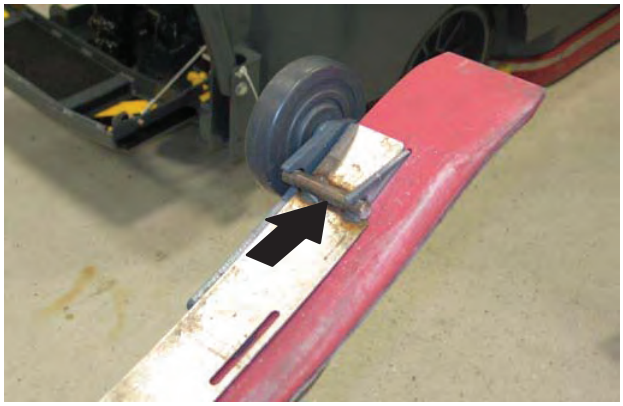


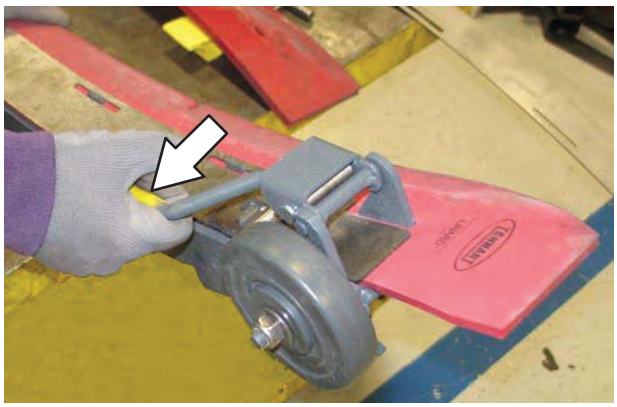
12. Remove the front squeegee from the squeegee assembly

13. Install the rotated or new squeegee blade onto the squeegee assembly. Be sure the holes in the squeegee blade are hooked onto the tabs.



14. Install the front squeegee retainer onto the rear squeegee assembly.





15. Reinstall the rear squeegee assembly onto the machine

16. Raise the *Rear bumper door / step* if it was lowered to access the rear squeegee assembly.

LEVELING THE REAR SQUEEGEE

Leveling the squeegee ensures the entire length of the squeegee blade is in even contact with the surface being scrubbed. Perform this adjustment on an even and level floor.

1. Lower the squeegee and drive the machine several meters (feet) forward and slowly bring the machine to a stop.

2. Check the squeegee deflection over the full length of the squeegee blade.

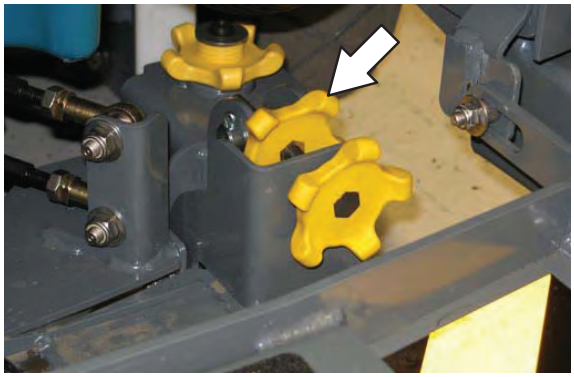
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

3. Lower the *Rear bumper door / step*.

4. If the deflection is not the same over the full length of the blade, use the tilt adjust knob to make adjustments.

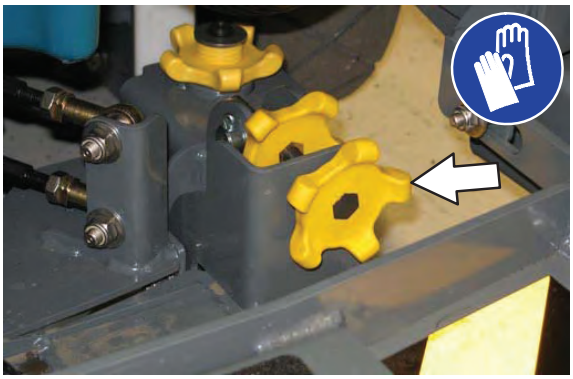
   DO NOT *disconnect the vacuum hose from the squeegee frame when leveling squeegee.*

5. To adjust the squeegee leveling, loosen the tilt lock knob.



6. Turn the squeegee tilt adjust knob counter-clockwise to decrease the deflection at the ends of the squeegee blade.

   Turn the squeegee tilt adjust knob clockwise to increase the deflection at the ends of the squeegee blade.



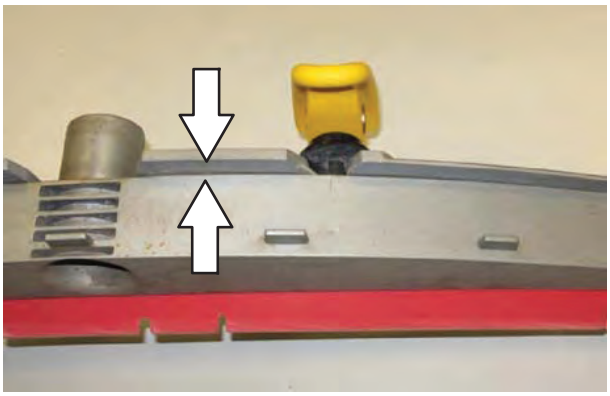
7. Tighten the tilt lock knob.

8. Drive the machine forward with the squeegee down to recheck the squeegee blade deflection if adjustments were made.

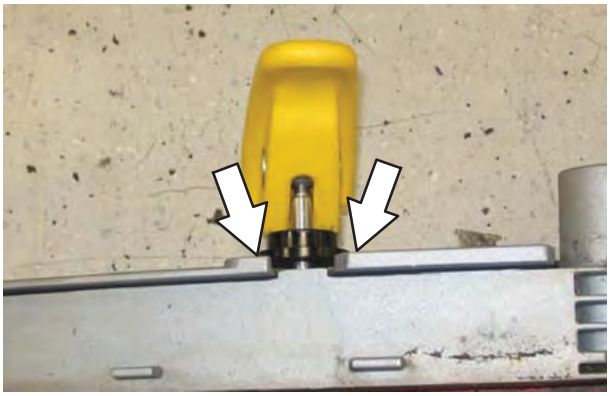
9. Readjust the squeegee blade deflection if necessary.

10. Raise the *Rear bumper door / step* when finished leveling the rear squeegee.

11. Install the inner frame over the squeegee and onto the outer frame. Be sure the inner frame is tight against the top of the outer frame.

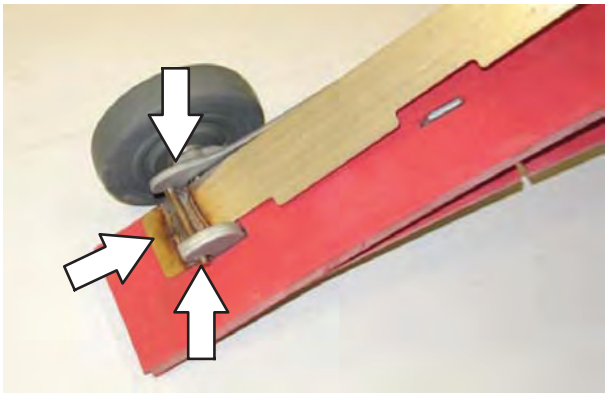


12. Slide both retainers into the squeegee assembly.

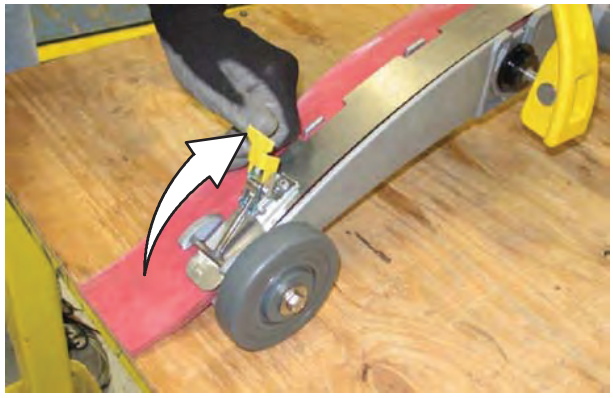


13. Place the rotated or new squeegee blade onto the inner frame. Be sure the squeegee is securely attached on each tab on the inner frame.

14. Insert the hinge end of the retainer into the hooks in the inner frame.



15. Install the retainer along the rest of the squeegee assembly and fasten the latch onto the other end of the squeegee assembly.



LEVELING THE REAR SQUEEGEE

Leveling the squeegee ensures the entire length of the squeegee blade is in even contact with the surface being scrubbed. Perform this adjustment on an even and level floor.

1. Lower the squeegee and drive the machine several meters (feet) forward and slowly bring the machine to a stop.

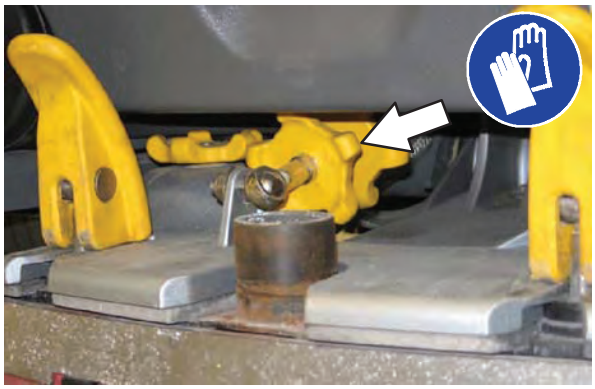
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and remove key.

2. Check the squeegee deflection over the full length of the squeegee blade.

3. If the deflection is not the same over the full length of the blade, use the tilt adjust knob to make adjustments.

   DO NOT *disconnect the vacuum hose from the squeegee frame when leveling squeegee.*

4. To adjust the squeegee leveling, loosen the tilt lock knob.



5. Turn the squeegee tilt adjust knob counter-clockwise to decrease the deflection at the ends of the squeegee blade.

   Turn the squeegee tilt adjust knob clockwise to increase the deflection at the ends of the squeegee blade.

6. Tighten the tilt lock knob.

7. Drive the machine forward with the squeegee down to recheck the squeegee blade deflection if adjustments were made.

8. Readjust the squeegee blade deflection if necessary.

ADJUSTING THE REAR SQUEEGEE BLADE DEFLECTION

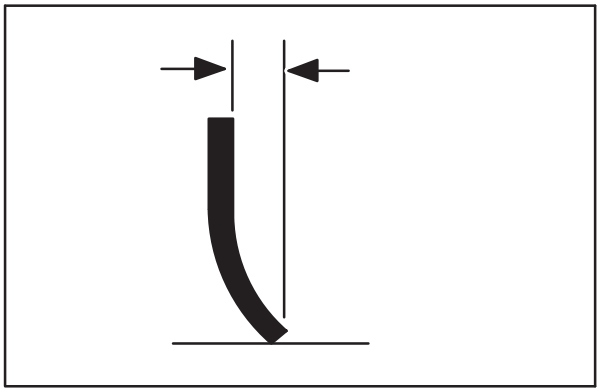
Deflection is the amount of curl the overall squeegee blade has when the machine moves forward. The best deflection is when the squeegee wipes the floor dry with a minimal amount of deflection.

NOTE: Make sure the squeegee is level before adjusting the deflection. See LEVELING THE REAR SQUEEGEE.

1. Lower the squeegee and drive the machine several meters (feet) forward and slowly bring the machine to a stop.

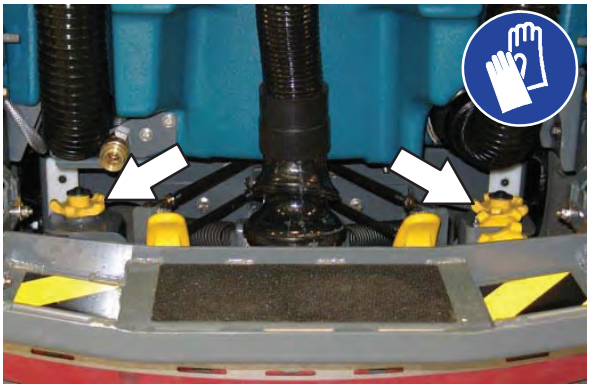
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

2. Look at the amount of deflection or “curl” of the squeegee blade. The correct amount of deflection is 12 mm (0.50 in) for scrubbing smooth floors and 15 mm (0.62 in) for rough floors.

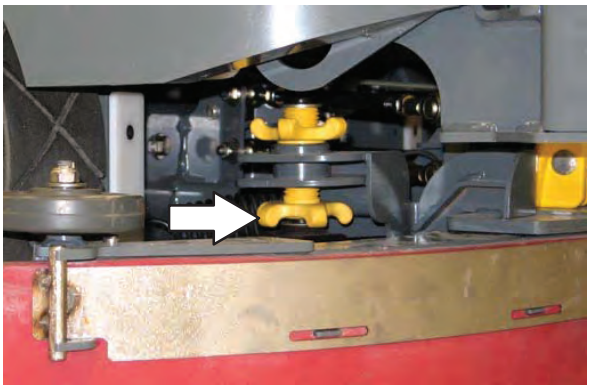


3. Lower the *Rear bumper door / step*.

4. To adjust the overall squeegee blade deflection, loosen the lock knobs on both sides of the machine.



5. Turn the adjustment knobs clockwise to increase deflection or counterclockwise to decrease deflection.



6. Retighten the lock knobs.

7. Drive the machine forward again to recheck the squeegee blade deflection.

8. Readjust the squeegee blade deflection if necessary.

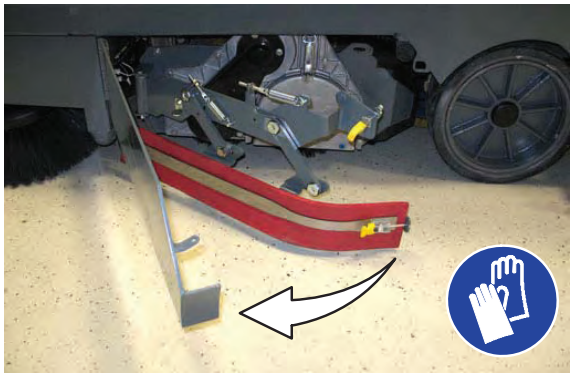
9. Raise the *Rear bumper door / step* when finished adjusting the rear squeegee blade deflection.

REPLACING OR ROTATING THE SIDE SQUEEGEE BLADES

1. If necessary, raise the scrub head.

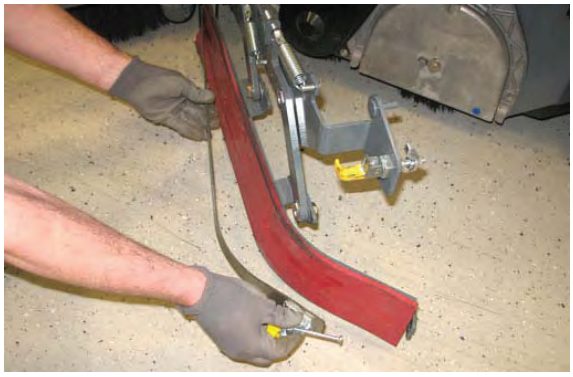
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

2. Open the main brush access door and side squeegee support door.



3. Unhook the retaining band latch from the side squeegee assembly.

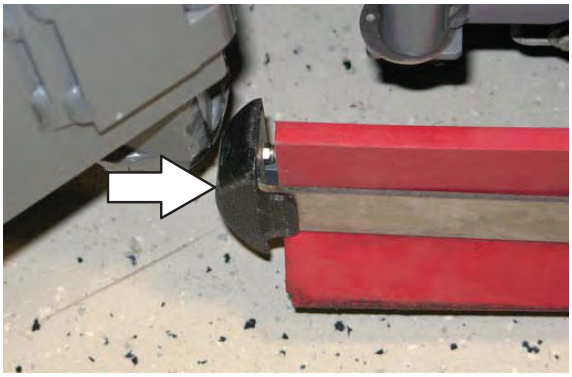
4. Remove the retaining band from the side squeegee assembly.



5. Remove the squeegee blade from the side squeegee assembly.

6. Install the rotated or new rear squeegee blade onto the side squeegee assembly.

7. Hook the retaining band onto the retaining band retainer tab on the side squeegee assembly.



8. Fasten the retaining band latch onto the side squeegee assembly.

9. Close and secure the squeegee support door and close the main brush access door.

10. Repeat for the side squeegee on the other side of the scrub head.

REPLACING OR ROTATING THE SIDE BRUSH SQUEEGEE BLADES (OPTION)

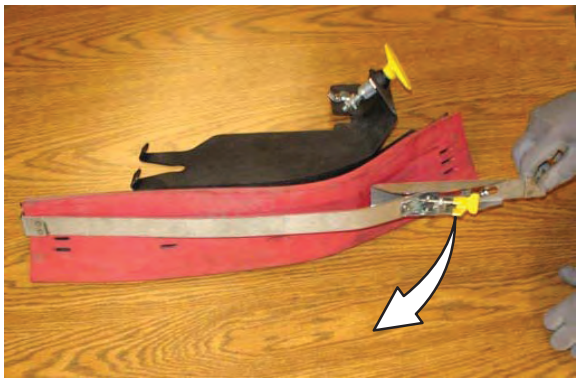
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

Check the side brush squeegee blades for damage and wear daily. Replace or rotate a blade if the leading edge is torn or worn half-way through the thickness of the blade.

1. Loosen the side brush squeegee assembly handle and remove the squeegee assembly from the machine.

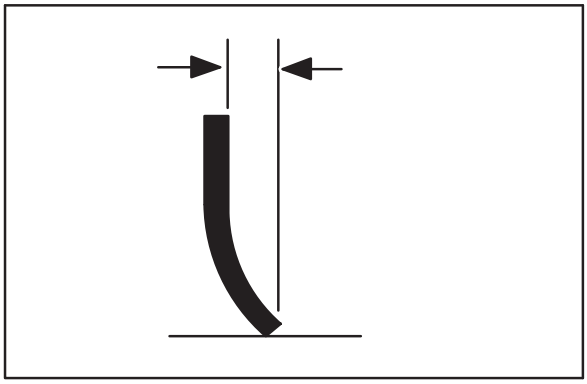
2. Loosen the retaining band latch.

3. Remove the retaining band, squeegee blades, and spacer from the squeegee frame.



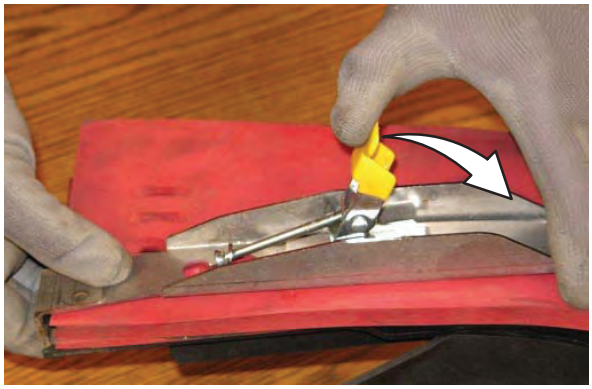
NOTE: Observe which squeegee slots were installed on the squeegee frame before removing the squeegee.

NOTE: The squeegee blade(s) have slots for adjusting the squeegee blade deflection. Install / reinstall squeegees so the deflection is approximately 12 mm (0.50 in) *for smooth floors and 15 mm* (0.62 in) *for rough floors.*



4. Install the rotated / new squeegee blades, spacer, and retaining band onto the side brush assembly. Be sure the holes in the squeegee blade are hooked onto the tabs.

5. Fasten the side brush retaining band latch.



6. Reinstall the side brush squeegee assembly onto the side brush assembly.

SKIRTS AND SEALS

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

RECOVERY TANK SEAL

Check the recovery tank cover seal for damage and wear daily.

SOLUTION TANK SEAL

Check the solution tank cover seal for damage and wear daily.

SCRUB HEAD SKIRTS (DISK SCRUB HEADS ONLY)

Check the scrub head skirts for damage and wear after every 50 hours of operation.

PRE–SWEEP SKIRTS (OPTION)

The Pre–Sweep skirts are located around the Pre–Sweep main brush.

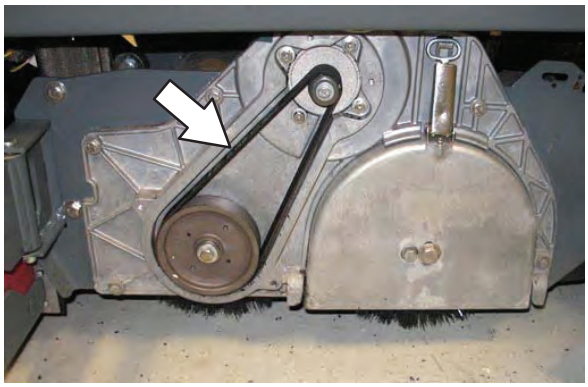
Check the skirts for damage and wear after every 50 hours of operation.

BELTS

CYLINDRICAL BRUSH DRIVE BELTS

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

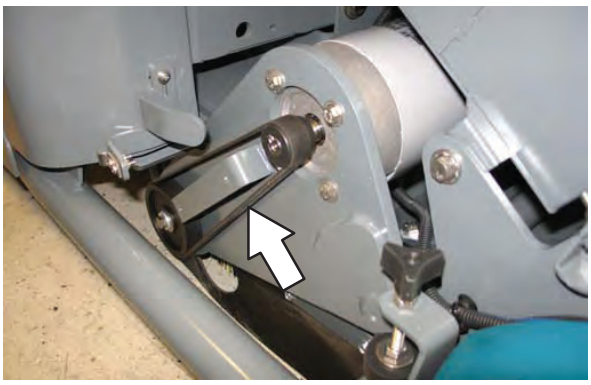
The brush drive belts are located on the cylindrical brush scrub head. Check the belts for damage and wear after every 200 hours of operation.



PRE–SWEEP BRUSH DRIVE BELT (OPTION)

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

The Pre–Sweep brush drive belt is located inside the Pre–Sweep assembly on the right side of the cylindrical brush. Check the belt for damage and wear after every 200 hours of operation.

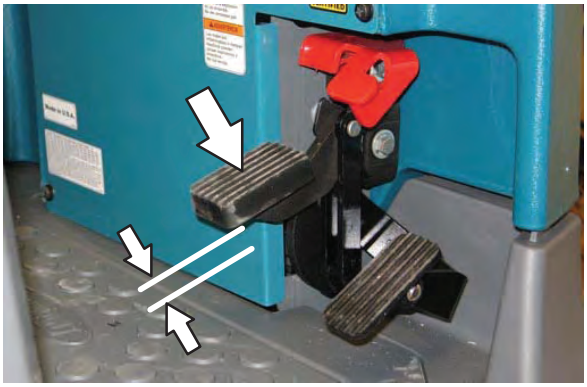


BRAKES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

The foot brake and the parking brake operate the linkage that controls the brakes on the rear wheels.

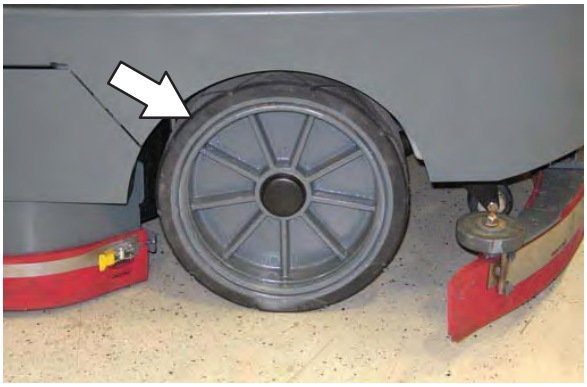
The foot pedal should not travel more than 25 mm (1in) to engage the brake. Check the brake adjustment after every 200 hours of operation.



TIRES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

The machine has three solid rubber tires: one in front, and two in the rear of the machine. Check tires for damage and wear after every 500 hours of operation.



PUSHING, TOWING, AND TRANSPORTING THE MACHINE

PUSHING OR TOWING THE MACHINE

FOR SAFETY: When servicing the machine, do not push or tow the machine without an operator in the seat controlling the machine.

If the machine becomes disabled, it can be pushed from the front or rear, but it can only be towed from the front.

Only push or tow the machine for a *very short distance* and do not exceed 3.2 kp/h (2 mph). It is NOT intended to be pushed or towed for a long distance or at a high speed.

ATTENTION! Do not push or tow machine for a long distance or damage may occur to the propelling system.

TRANSPORTING THE MACHINE

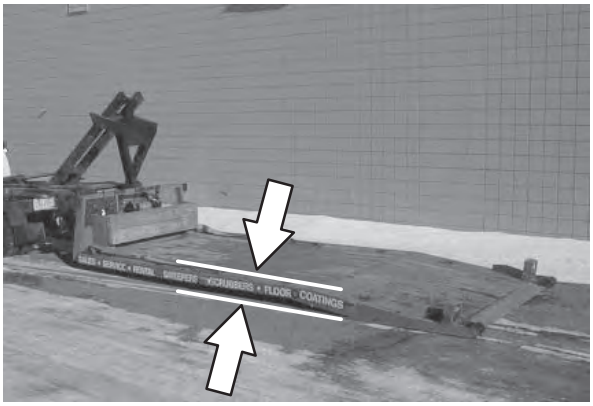
1. Raise the squeegee, scrub head, and brushes.

FOR SAFETY: When loading/unloading machine onto/off truck or trailer, drain tanks before loading machine.

2. Position the machine at the loading edge of the truck or trailer.

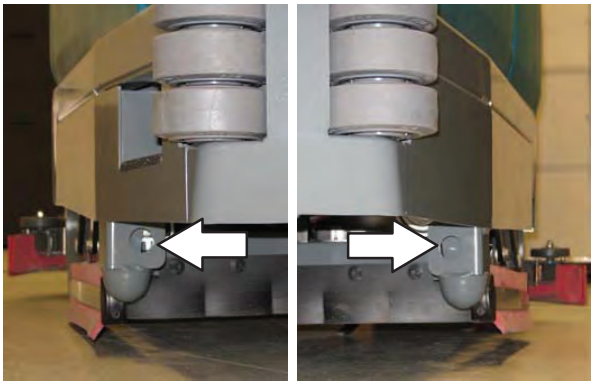
3. If the loading surface is not horizontal or is higher than 380 mm (15 in) from the ground, use a winch to load machine.

   If the loading surface is horizontal AND is 380 mm (15 in) or less from the ground, the machine may be driven onto the truck or trailer.

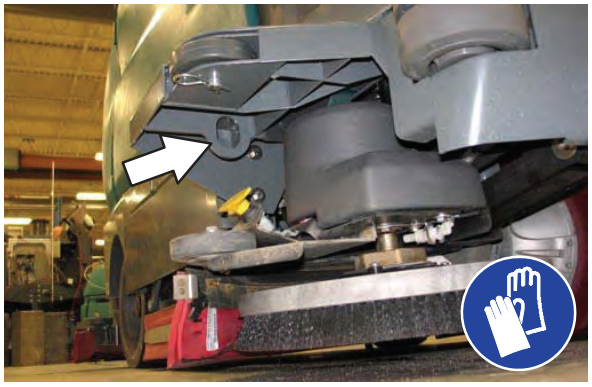


FOR SAFETY: When loading machine onto truck or trailer, use winch. Do not drive the machine onto the truck or trailer unless the loading surface is horizontal AND is 380 mm (15 in) or less from the ground.

4. To winch the machine onto the truck or trailer, attach the winching chains to the stabilizer legs.



Machines with optional scrubbing side brush only: Connect one winching chain to the step located on top the scrubbing side brush assembly and the other to the stabilizer located on the other side of the machine.



5. Position the machine as close to the front of the trailer or truck as possible. If the machine starts to veer off the center line of the truck or trailer, stop and turn the steering wheel to center the machine.

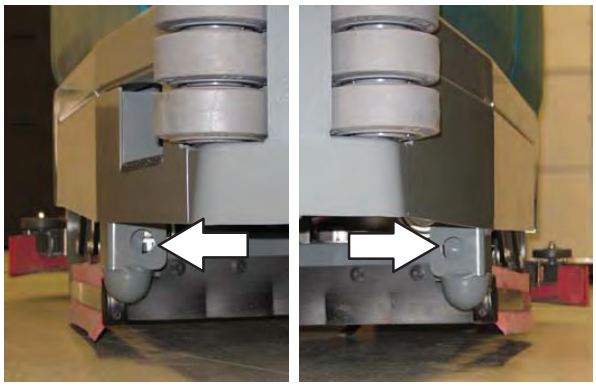
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

6. Place a block behind each wheel to prevent the machine from rolling.

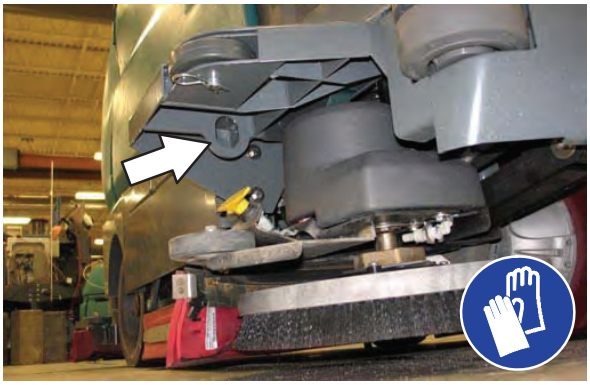
7. Lower the scrub head and turn off machine.

FOR SAFETY: When loading/unloading machine onto/off truck or trailer, lower scrub head and squeegee before tying down machine.

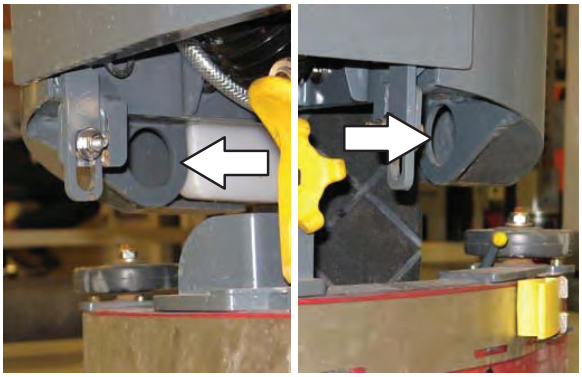
8. Connect the tie–down straps to the right and left stabilizers in front of the machine.



Machines with optional scrubbing side brush only: Connect one tie down strap to the step located on top the scrubbing side brush assembly and the other to the stabilizer located on the other side of the machine.



9. Connect the tie–down straps to the holes in the rear jacking brackets at the rear of the machine.



10. If the loading surface is not horizontal or is higher than 380 mm (15 in) from the ground, use a winch to unload machine.

    If the loading surface is horizontal AND is 380 mm (15 in) or less from the ground, the machine may be driven off the truck or trailer.

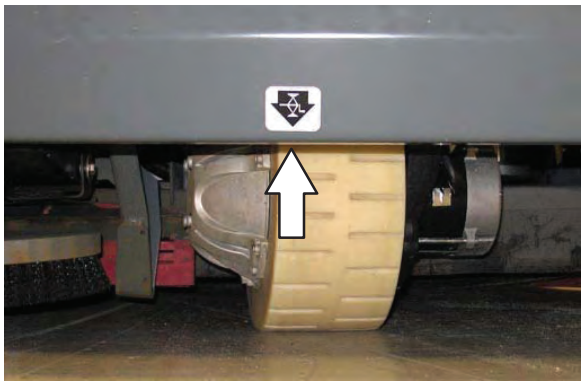
FOR SAFETY: When unloading machine off truck or trailer, use winch. Do not drive the machine off the truck or trailer unless the loading surface is horizontal AND 380 mm (15 in) or less from the ground.

MACHINE JACKING

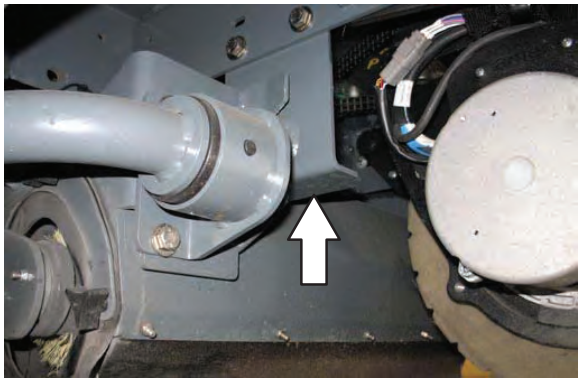
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

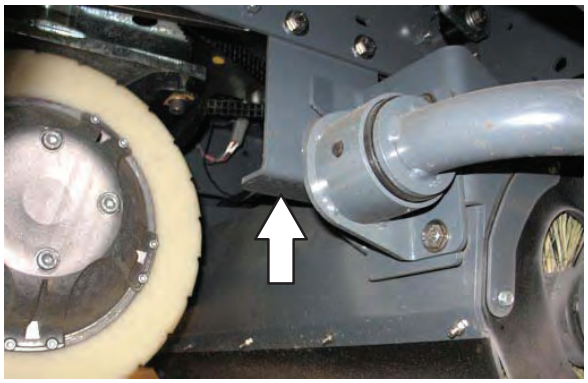
Empty the recovery and solution tanks before jacking the machine.

Jacking point location at the front of all machines.

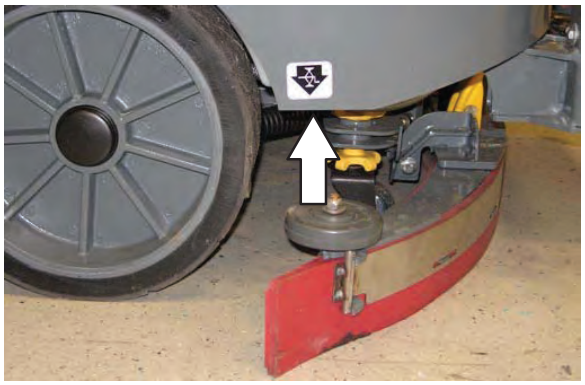


Jacking point locations at the front of machines equipped with the Pre–Sweep option.





Jacking point location at the rear of all machines.



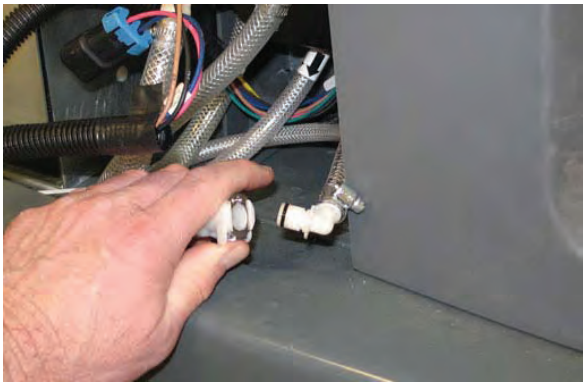
FOR SAFETY: When servicing machine, block machine tires before jacking machine up. Use a hoist or jack that will support the weight of the machine. Jack machine up at designated locations only. Support machine with jack stands.

ec–H2O MODULE FLUSH PROCEDURE

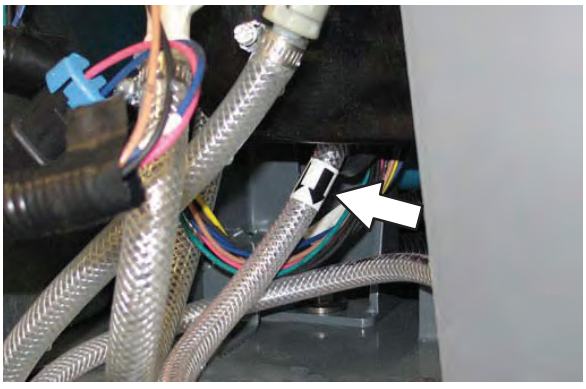
This procedure is only required when the red indicator light begins to flash and there is an audible alarm.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and set parking brake.

1. Open the right shroud to access the *ec–H2O* assembly.
2. Press the connector button to disconnect the outlet hose from the *ec–H2O* manifold.



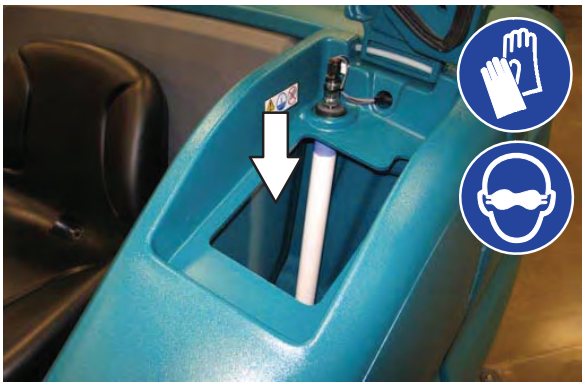
NOTE: Look for arrows on the hose near where the hose is coming from the bottom of the ec–H2O assembly to determine which hose is the outlet hose.



3. Remove the drain hose from the *ec–H2O* compartment.
4. Connect the drain hose to the *ec–H2O* outlet hose.

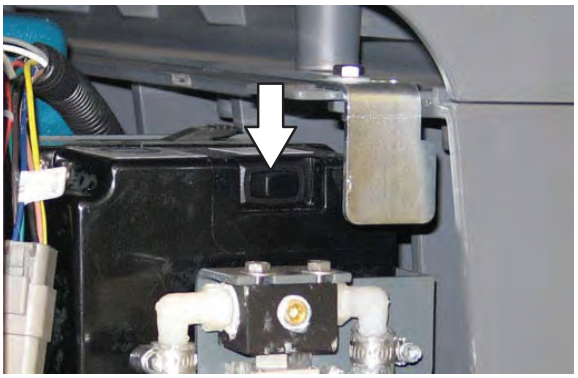
5. Place the drain hose into a empty container.

6. Pour 2 gallons (7.6 liters) of white or rice vinegar into the solution tank.



7. Start the machine.

8. Press and release the *ec–H2O* module flush switch to start the flush cycle.



NOTE: The module will automatically shut off when the flush cycle is complete (approximately 7 minutes). The module must run the full 7–minute cycle in order to reset the system indicator light and alarm.

9. Pour 2 gallons (7.6 liters) of cool clean water into the solution tank.

10. Press and release the flush switch to rinse any remaining vinegar from the module. After 1–2 minutes, press the flush switch to turn off the module.

11. Disconnect the drain hose from the *ec–H2O* manifold hose.

12. Reconnect the outlet hose to the *ec–H2O* manifold hose.

13. Return the drain hose to storage location in the *ec–H2O* compartment.

14. Close the right shroud.

STORAGE INFORMATION

The following steps should be taken when storing the machine for extended periods of time.

1. Charge the batteries before storing machine to prolong the life of the batteries.
2. Thoroughly drain and rinse the solution and recovery tanks.
3. Store the machine in a dry area with the squeegee and scrub head in the up position.

ATTENTION: Do not expose machine to rain, store indoors.

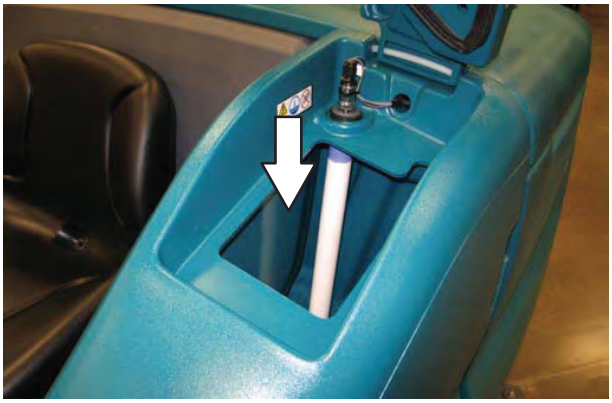
4. Open the recovery tank cover to promote air circulation.
5. If storing machine in freezing temperatures, proceed to *FREEZE PROTECTION*.

NOTE: To prevent potential machine damage store machine in a rodent and insect free environment.

FREEZE PROTECTION

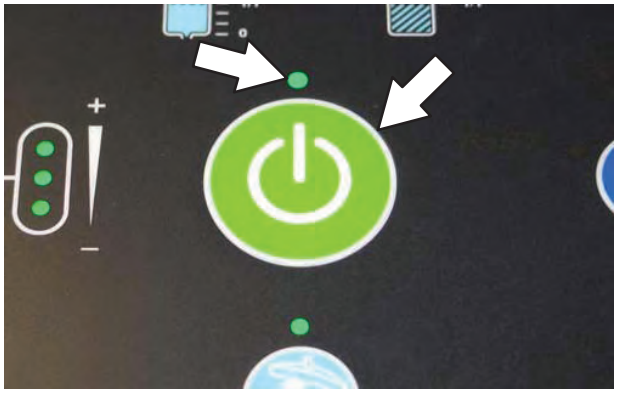
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and set parking brake.

1. Completely drain the solution tank, recovery tank, and detergent tank.
2. Pour 7.6 L (2 gal) of Propylene Glycol Based / Recreational Vehicle (RV) antifreeze into the solution tank.

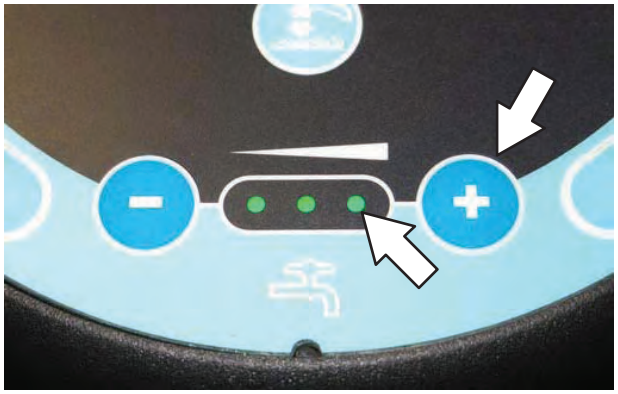


3. Machines equipped with optional detergent tank only: Pour 1.9 L (1/2 gal) of Propylene Glycol Based / Recreational Vehicle (RV) antifreeze into the detergent tank.

4. Turn on the machine.
5. Press the *1–Step button*.

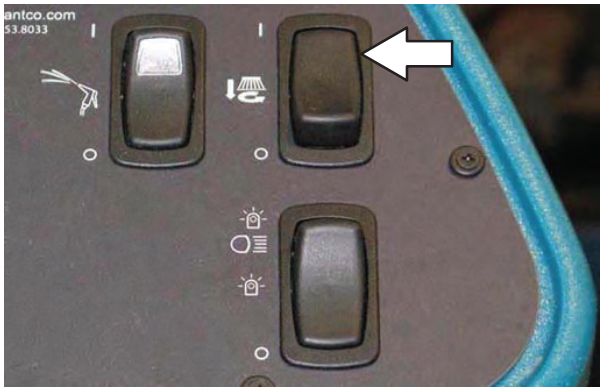


6. Repeatedly press the *Solution increase button (+)* until the solution flow is at the highest setting.



7. **Machines with severe environment switch option only:** Press the bottom of the *severe environment switch* to activate the severe environment scrubbing system.

8. **Machines with scrubbing side brush option only:** Press the *side brush switch* to activate the side brush.



9. Drive the machine to circulate the antifreeze completely through all the systems and clear out any remaining water.

10. **Machines with scrubbing side brush option only:** Press the *side brush switch* to turn off the side brush.

11. Stop the machine.

12. **Machines with spray nozzle option only:** Operate the wand for a few seconds to protect the pump.

13. Press the *1–STEP button* to turn off the system.

14. Turn off the machine.

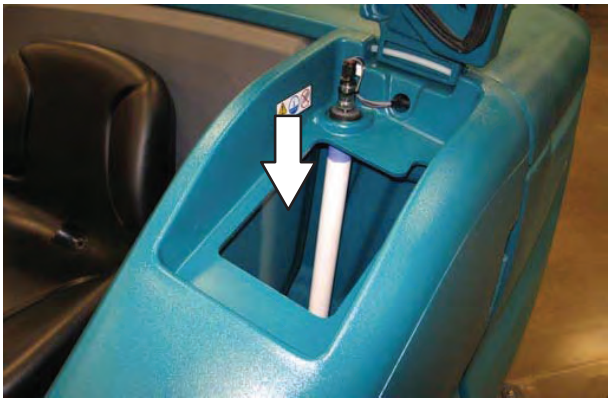
15. The remaining antifreeze does not need to be drained from the solution tank. recovery tank, or detergent tank.

PREPARING THE MACHINE FOR OPERATION AFTER STORAGE

All antifreeze must be completely cleaned from the scrubbing system before the machine can be used for scrubbing.

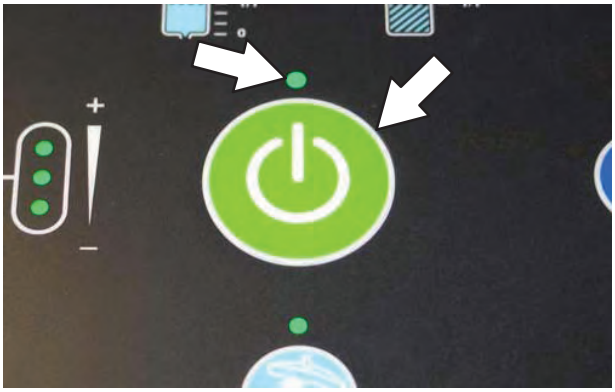
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and set parking brake.

1. Completely drain all antifreeze from the solution tank.
2. Rinse out the solution tank. Refer to *DRAINING AND CLEANING THE SOLUTION TANK in the OPERATION* section for instructions how to clean the solution tank.
3. Pour 11.4 L (3 gal) of cool clean water into the solution tank.

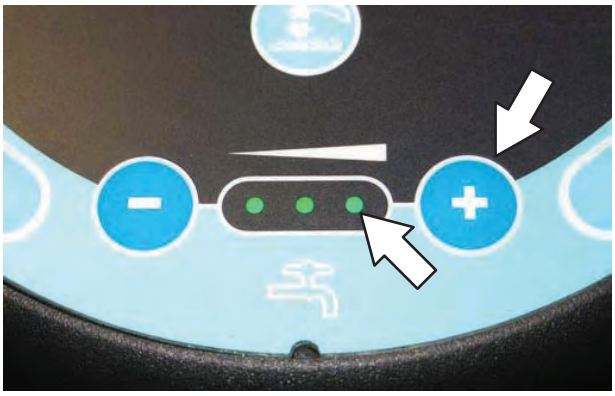


4. Machines equipped with optional detergent tank only: Pour 1.9 L (1/2 gal) of cool clean water into the detergent tank.

5. Start the machine
6. Press the *1–STEP button*.



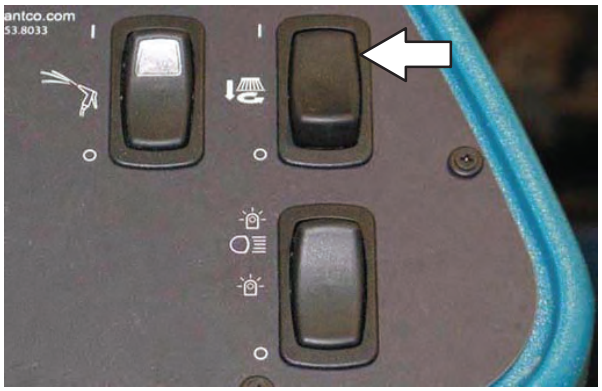
7. Repeatedly press the *Solution increase button (+)* until the solution flow is at the highest setting.



NOTE: The ec–H2O systems on machines equipped with ec–H2O must be primed before the machine is ready for operation. See PRIMING THE ec–H2O SYSTEM for additional instructions.

8. **Machines with severe environment switch option only:** Press the bottom of the *severe environment switch* to activate the severe environment scrubbing system.

9. **Machines with scrubbing side brush option only:** Press the *side brush switch* to activate the side brush.



10. Drive the machine until all water and antifreeze is emptied from the tanks.

11. **Machines with scrubbing side brush option only:** Press the *side brush switch* to turn off the side brush.

12. Stop the machine.

13. **Machines with spray nozzle option only:** Operate the wand for a few seconds to clean the antifreeze from the pump.

14. Press the *1–STEP button* to turn off the system.

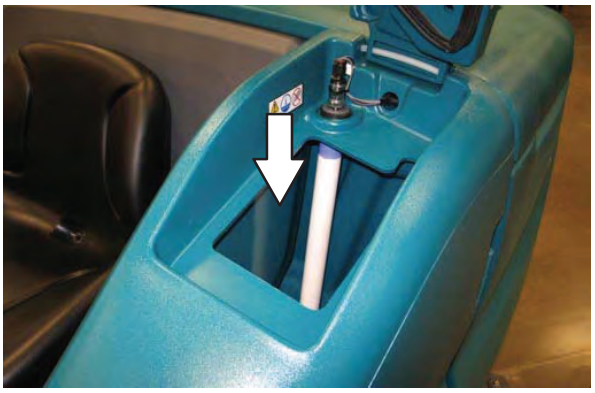
15. Turn off the machine.

PRIMING THE *ec–H2O* SYSTEM

Prime the *ec–H2O* system if the machine has been stored for a long period with no water in the solution tank / *ec–H2O* system.

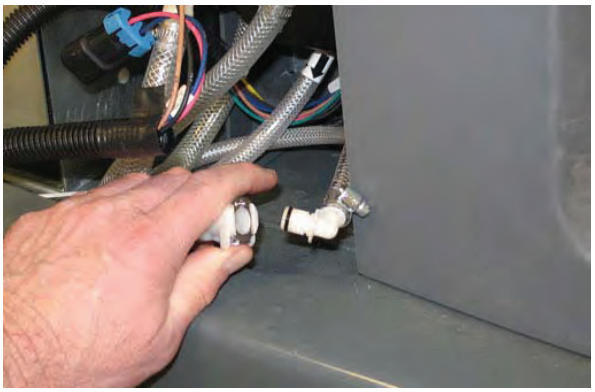
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and set parking brake.

1. Fill the solution tank with clean cool water. See *FILLING THE SOLUTION TANK* section of this manual.

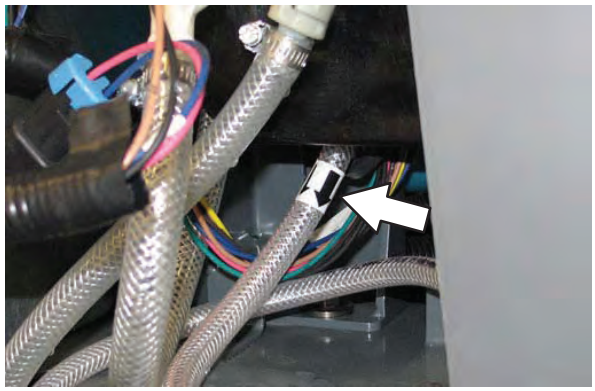


2. Open the right shroud to access the *ec–H2O* assembly.

3. Press the connector button to disconnect the outlet hose from the *ec–H2O* manifold.



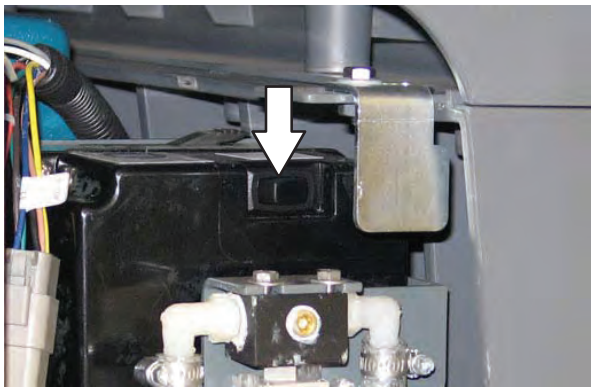
NOTE: Look for arrows on the hose near where the hose is coming from the bottom of the ec–H2O assembly to determine which hose is the outlet hose.



4. Remove the drain hose from the *ec–H2O* compartment.
5. Connect the drain hose to the *ec–H2O* outlet hose.

6. Place the drain hose into a empty container.

7. Start the machine.
8. Press and release the *ec–H2O* module flush switch. Allow the system to drain water into the container for 2 minutes.



9. Press the *ec–H2O* module flush switch to shut off the system.
10. Disconnect the drain hose from the *ec–H2O* manifold hose.
11. Reconnect the outlet hose to the *ec–H2O* manifold hose.
12. Place the drain hose back into the *ec–H2O* compartment.
13. Close the right shroud.

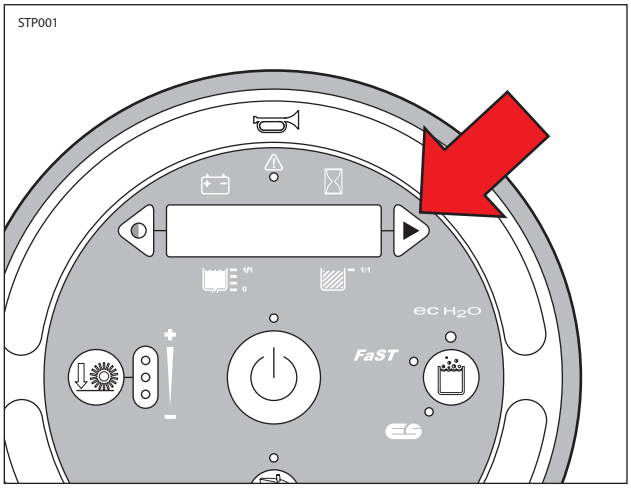
SECTION 4

Contents **Page**

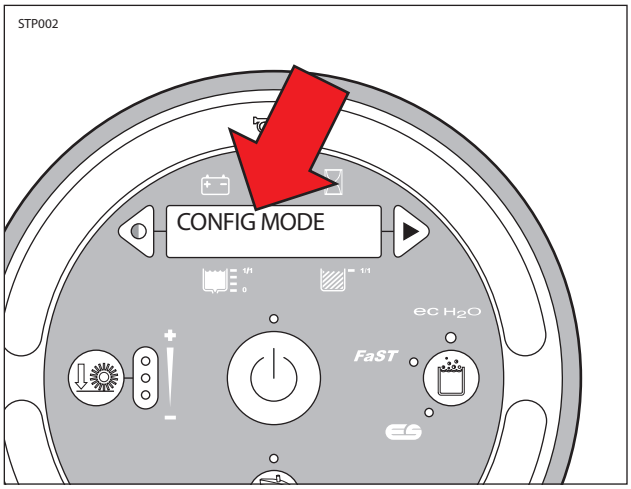
SELF TEST MODE

Self Test Mode is an onboard diagnostic utility that tests for open or shorted output circuits. Once completed, open and/or shorted output pins are displayed on the LCD (liquid crystal display).

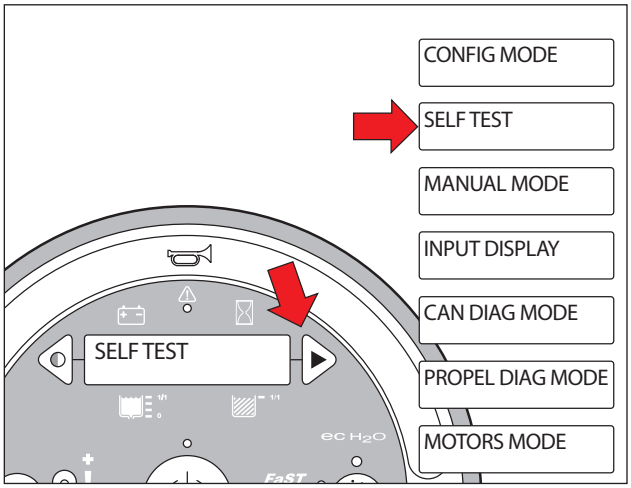
1. Key switch Off. Press and hold the configuration mode button.



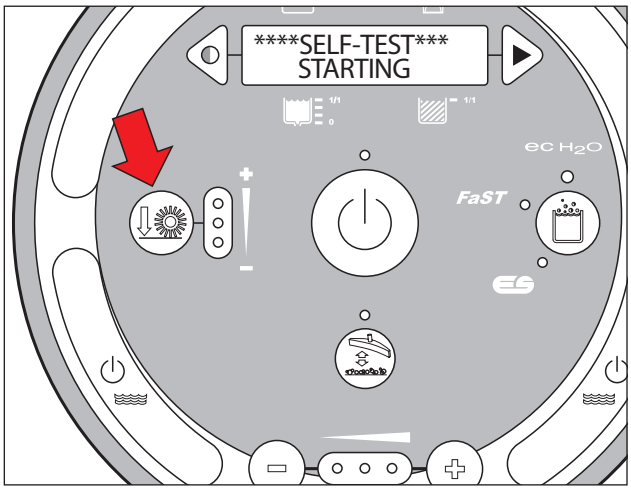
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



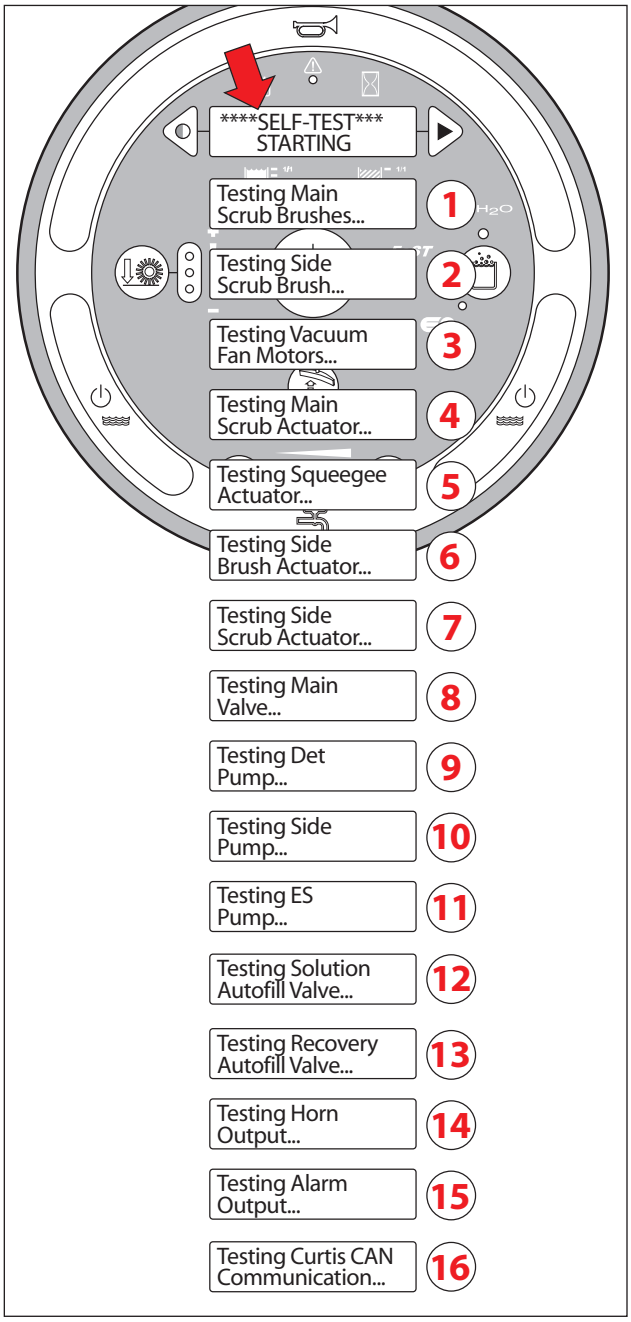
3. Press and release the configuration mode button to scroll through a list of utilities until "SELF TEST" appears on the LCD.



4. Press and release the brush pressure button to activate the self test. "SELF-TEST STARTING" will appear on the LCD.



5. The controller sequentially tests each output circuit as shown below.



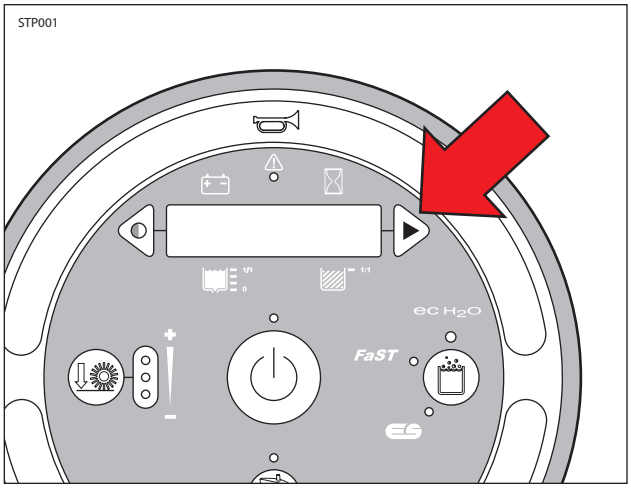
6. The self test results are displayed in "JX-X,X" format. JX = Connector, "-X,X" = Control board output pins as shown on the electrical schematic.

LCD MESSAGE	LCD MESSAGE
S1:Self Test "Done" or "<Results>"	S36:LSideSweepBr J7-1,2 Open
S2:Front/Left Br J10-1,2,3 Open	S37:LSideSweepBr J7-1,2 Short
S3:Front/Left Br J10-1,2,3 Short	S38:RSideSweepBr J7-3,4 Open
S4:Rear/Right Br J11-4,5,6 Open	S39:RSideSweepBr J7-3,4 Short
S5:Rear/Right Br J11-4,5,6 Short	S40:LSideSwepAct J6-17,18 Open
S6:Main Act J4-9,10 Open	S41:LSideSwepAct J6-17,18 Short
S7:Main Act J4-9,10 Short	S42:RSideSwepAct J6-14,16 Open
S8:Main Sol Vlv J4-17 Open	S43:RSideSwepAct J6-14,16 Short
S9:Main Sol Vlv J4-17 Short	S44:L PreSweepBr J6-15,16 Open
S10:Horn J4-16 Open	S45:L PreSweepBr J6-15,16 Short
S11:Horn J4-16 Short	S46:M PreSweepBr J7-3,4 Open
S12:Alarm J4-15 Open	S47:M PreSweepBr J7-3,4 Short
S13:Alarm J4-15 Short	S48:R PreSweepBr J6-13,14 Open
S14:Vac Fan 1 J7-1,2 Open	S49:R PreSweepBr J6-13,14 Short
S15:Vac Fan 1 J7-1,2 Short	S50:PreSweep Vac J7-1,2 Open
S16:Vac Fan 2 J7-3,4 Open	S51:PreSweep Vac J7-1,2 Short
S17:Vac Fan 2 J7-3,4 Short	S52:PreSweep Act J6-17,18 Open
S18:Det Pump J4-14 Open	S53:PreSweep Act J6-17,18 Short
S19:Det Pump J4-14 Short	S58:Ec Pump J4-4 Open
S20:Squeegee Act J6-17,18 Open	S59:Ec Pump J4-4 Short
S21:Squeegee Act J6-17,18 Short	S60:Ec Side Vlv J4-5 Open
S22:ES Pump J6-13,14 Open	S61:Ec Side Vlv J4-5 Short
S23:ES Pump J6-13, 14 Short	S62:Curtis CAN Offline
S24:Sol AF Valve J6-12 Open	S64:Scrub Module Offline
S25:Sol AF Valve J6-12 Short	S65:PickupModule Offline
S26:Rcvr AF Vlv J6-11 Open	S66:ECH2O Module Offline
S27:Rcvr AF Vlv J6-11 Short	S67:SScrubModule Offline
S28:Side ScrubBr J6-1,2,3 Open	S68:SSweepModule Offline
S29:Side ScrubBr J6-1,2,3 Short	S69:PSweepModule Offline
S30:SideScrubAct J4-7,8 Open	
S31:SideScrubAct J4-7,8 Short	
S32:Side Pump J4-10 Open	
S33:Side Pump J4-10 Short	
S34:Side Valve J4-9 Open	
S35:Side Valve J4-9 Short	

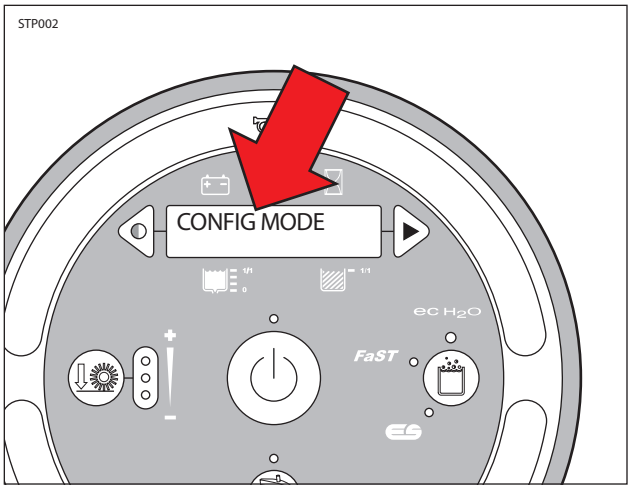
CONFIGURATION MODE

Configuration Mode is an onboard diagnostic utility that configures controller software to operate optional equipment and to electronically adjust certain output functions.

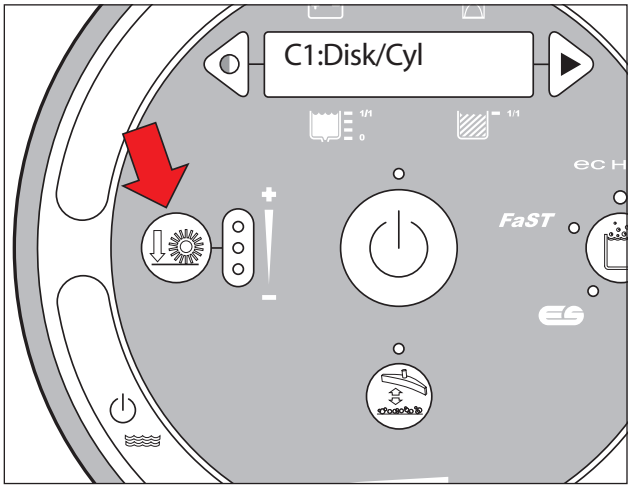
1. Key switch Off. Press and hold the configuration mode button.



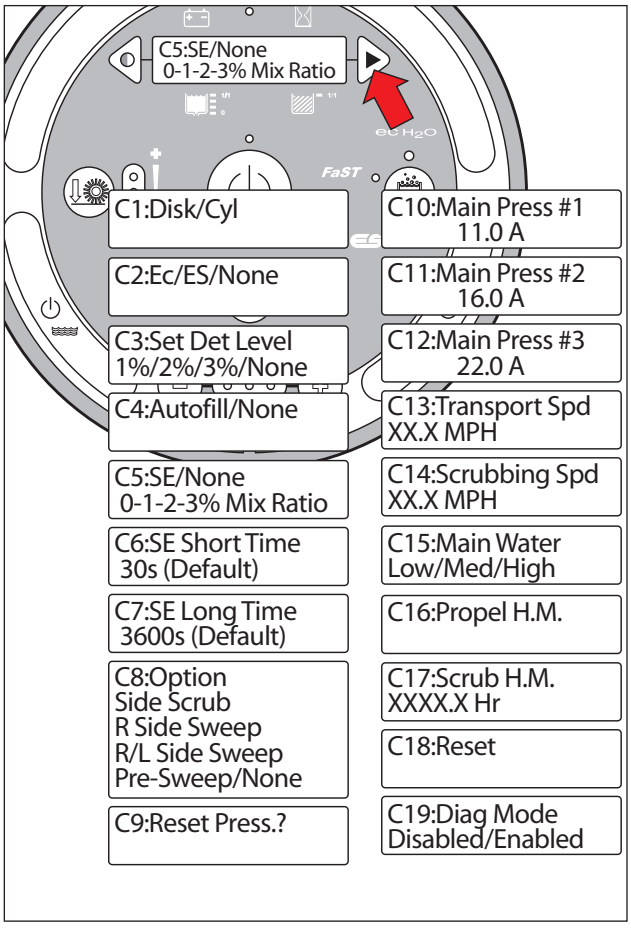
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



3. Press and release the brush pressure button to enter Configuration Mode. "C1:Disk/Cyl" will appear on the LCD.



4. Press and release the configuration mode button to scroll through a list of utilities as shown below.



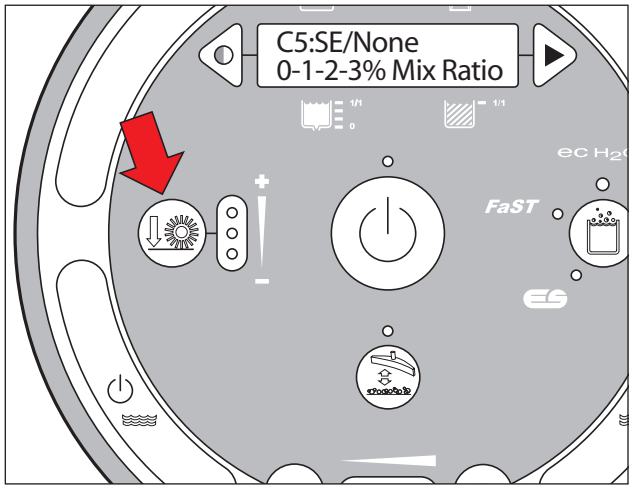
5. Use the table below for further description of each Configuration Mode utility.

LCD TEXT	DESCRIPTION
C1:Disk/Cyl	Configure scrub head type
C2:Ec/ES/None	Configure ec-H2O, ES or none
C3:Set Det Level	Set ratio of detergent for ES option to 1%, 2%, or 3%
C4:Autofill/None	Enable Autofill feature (w/ ES option)
C5:SE/None	Enable Severe Environment feature for machines equipped with ec-H2O
C6:SE Short Time	Set Severe Environment Short On-Time. Default 30 seconds.
C7:SE Long Time	Set Severe Environment Long On-Time. Default 3600 seconds.
C8:Option	Configure unit for side scrub brush, side sweep brush, dual side sweep brush, or Pre-Sweep side brushes.
C9:Reset Press.?	Reset down pressures to factory default settings.
C10:Main Press #1**	Set max down pressure #1 (12-18 Amps, Default 14D, 13C)
C11:Main Press #2**	Set max down pressure #2 (18-28 Amps, Default 25D, 26C)
C12:Main Press #3**	Set max down pressure #3 (28-35 Amps, Default 35 Amps)
C13:Transport Spd	Adjust maximum forward transport speed.
C14:Scrub Spd	Adjust maximum scrubbing speed.
C15:Main Water	Set conventional solution flow range; Low, Med, or High
C16:Propel H.M.	View propel hourmeter.
C17:Scrub H.M.	View scrub hourmeter.
C18:Reset	Resets scrub head type, solution configuration, down pressure targets, flow range, side option, travel speeds, autofill option, SE option to default settings.
C19:Diag Mode Disabled/Enabled	Enable techncial data during normal machine operation. Scroll through LCD data by pressing the contrast or configuration mode buttons during normal operation. Cycle key 1x to enable, 2x to disable.

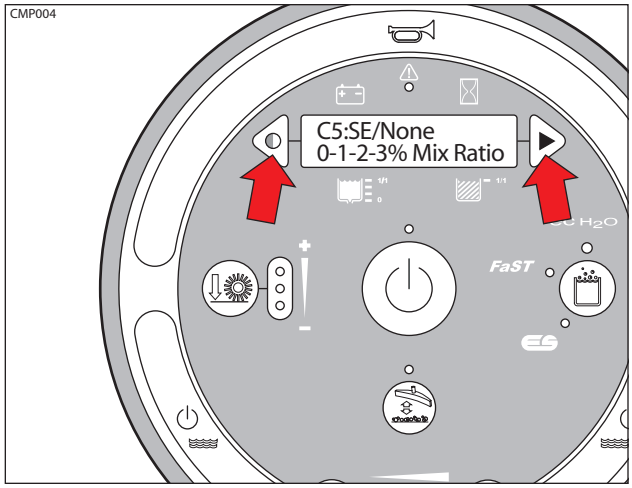
** C9:Reset Press.? mode. Press the brush pressure button after "No" changes to "Yes" following step 7. This completes the reset process.*

*** C10, C11, and C12 Main Press (Main Brush Pressure) adjustments set the maximum brush motor amp draw for each down pressure setting; 1 LED, 2 LEDs, or 3 LEDs.*

6. Press and release the brush pressure button to enable the change. A **"<"** symbol will appear on the bottom line of the LCD indicating the configuration utility is now enabled.



7. Press and release the contrast or configuration mode buttons to change settings. Turn key Off to save selection.



T17 LCD WARNING MESSAGES

LCD WARNING CODE	MESSAGE	DESCRIPTION	SET/CLEAR
W1	W1:Batt Low	Low Battery	*SET:* Battery discharge threshold of 30-32 Volts at KSI terminal or 32-33 Volts at batteries. *CLEAR:* Charge batteries to BDI reset threshold of 37 Volts at KSI terminal or 38 Volts at batteries.
W2	W2:Unavailable	No optional solution enabled	*SET:* Operator selects a solution technology that is not configured on the machine. *CLEAR:* Release button.
W3	W3:No [Side/Sweep] Config	No side option enabled	*SET:* Operator selects the side brush when the side brush is not enabled in configuration mode. *CLEAR:* Release button.
W4	W4:Not Active	Inactive feature	*SET:* Operator selects a button and the related function is inactive. *CLEAR:* Correct warning condition.
W5	W5:Solution Off	Solution water is off	*SET:* Solution is OFF during scrub mode for 15 seconds. *CLEAR:* Correct warning condition.
W6	W6:Brake On	Parking brake on	*SET:* Parking brake engaged (switch closed) *CLEAR:* Release parking brake (switch open)
W7	W7:Side Br. Wrn [##]	BLDC Side Scrub Motor Circuit Warning: *VF, OT, HW, Com*, or *MF*	*SET* - VF: Voltage Fault - Complete SUN-I/O testing on side scrub module *SET* - OT: Over Temperature - Side scrub module overheat. *SET* - HW: Hardware Fault - System overcurrent *SET* - Com: Communications Fault - Interface module has lost communications with side scrub module. Complete SUN-I/O testing on the side scrub module. *SET* - MF: Motor Fault - Locked rotor or mechanical problem with the motor or brush drive mechanism. *CLEAR:* Correct warning condition and cycle key switch.
W8	W8:LSide Br Short	Left side sweep motor shorted	*SET:* Left side sweep brush motor circuit shorted *CLEAR:* Correct warning condition.
W9	W9:RSide Br Short	Right side sweep motor shorted	*SET:* Right side sweep brush motor circuit shorted *CLEAR:* Correct warning condition.
W10	W10:LSweepBrShrt	Left Pre-Sweep motor shorted	*SET:* Left side pre-sweep brush motor circuit shorted *CLEAR:* Correct warning condition.
W11	W11:MSweepBrShrt	Middle Pre-Sweep motor shorted	*SET:* Main pre-sweep brush motor circuit shorted *CLEAR:* Correct warning condition.
W12	W12:RSweepBrShrt	Right Pre-Sweep motor shorted	*SET:* Right side pre-sweep brush motor circuit shorted *CLEAR:* Correct warning condition.
W13	W13:Open [Frnt/Left] Br	Open front/left motor	*SET:* [Front/Left] main brush motor circuit open *CLEAR:* Correct warning condition.
W14	W14:Open [Rear/Rght] Br	Open right/rear motor	*SET:* [Rear/Right] main brush motor circuit open *CLEAR:* Correct warning condition.

T17 LCD WARNING MESSAGES

LCD WARNING CODE	MESSAGE	DESCRIPTION	SET/CLEAR
W15	W15:OpenSideBrush	Open side scrub brush motor	*SET:* Side scrub brush motor circuit open *CLEAR:* Correct warning condition.
W16	W16:Open LSideBr	Open left side sweep brush motor	*SET:* Left side sweep brush motor circuit open *CLEAR:* Correct warning condition.
W17	W17:Open RSideBr	Open right side sweep brush motor	*SET:* Right side sweep brush motor circuit open *CLEAR:* Correct warning condition.
W18	W18:OpenLSweepBr	Open left Pre-Sweep brush motor	*SET:* Left side pre-sweep brush motor circuit open *CLEAR:* Correct warning condition.
W19	W19:OpenMSweepBr	Open middle Pre-Sweep brush motor	*SET:* Main pre-sweep brush motor circuit open *CLEAR:* Correct warning condition.
W20	W20:OpenRSweepBr	Open right Pre-Sweep brush motor	*SET:* Right side pre-sweep brush motor circuit open *CLEAR:* Correct warning condition.
W21	W21:SweepVacShrt	Shorted Pre-Sweep vacuum motor	*SET:* Pre-sweep vacuum motor circuit shorted *CLEAR:* Correct warning condition.
W22	W22:Open Vac 1	Vacuum fan motor 1 no current	*SET:* Scrub vacuum motor circuit #1 open *CLEAR:* Correct warning condition.
W23	W23:Open Vac 2	Vacuum fan motor 2 no current	*SET:* Scrub vacuum motor circuit #2 open *CLEAR:* Correct warning condition.
W24	W24:OpenSweepVac	Open Pre-Sweep vacuum motor	*SET:* Pre-sweep vacuum motor circuit open *CLEAR:* Correct warning condition.
W25	W25:SqueegeeStall	Rear squeegee actuator stalled	*SET:* Rear squeegee actuator stall condition. *CLEAR:* Correct warning condition.
W26	W26:SideActStall	Side scrub brush actuator stalled	*SET:* Side scrub brush actuator stall condition. *CLEAR:* Correct warning condition.
W27	W27:L Side Stall	Left side sweep actuator stalled	*SET:* Left side sweep brush actuator stall condition. *CLEAR:* Correct warning condition.
W28	W28:R Side Stall	Right side sweep actuator stalled	*SET:* Right side sweep brush actuator stall condition. *CLEAR:* Correct warning condition.
W29	W29:Sweep Stall	Pre-Sweep actuator stalled	*SET:* Pre-sweep actuator stall condition. *CLEAR:* Correct warning condition.
W30	W30:DetPumpShort	Shorted detergent pump	*SET:* Detergent pump motor circuit shorted *CLEAR:* Correct warning condition.
W31	W31:ES PumpShort	Shorted ES pump	*SET:* ES pump motor circuit shorted *CLEAR:* Correct warning condition.
W32	W32:SidePumpShrt	Shorted side scrub pump	*SET:* Side scrub pump motor circuit shorted *CLEAR:* Correct warning condition.
W33	W33:Ec Pump Shrt	Shorted ec-H2O pump	*SET:* ec-H2O pump motor circuit shorted *CLEAR:* Correct warning condition.
W34	W34:DetPumpOpen	Open detergent pump	*SET:* Detergent pump motor circuit open *CLEAR:* Correct warning condition.
W35	W35:ES PumpOpen	Open ES pump	*SET:* ES pump motor circuit open *CLEAR:* Correct warning condition.
W36	W36:SidePumpOpen	Open side scrub pump	*SET:* Side scrub pump motor circuit open *CLEAR:* Correct warning condition.

T17 LCD WARNING MESSAGES

LCD WARNING CODE	MESSAGE	DESCRIPTION	SET/CLEAR
W37	W37:Ec Pump Open	Open ec-H2O pump	*SET:* ec-H2O pump motor circuit open *CLEAR:* Correct warning condition.
W38	W38: [Side/Sweep] Offline	Side module offline	*SET:* Side module CAN-Bus connectivity, power supply, or faulty side module *CLEAR:* Correct warning condition.
W39	W39:EcH2OOffline	ec-H2O module offline	*SET:* ec-H2O module CAN-Bus connectivity, power supply, or faulty ec-H2O module *CLEAR:* Correct warning condition.

T17 LCD FAULT MESSAGES

LCD WARNING CODE	MESSAGE	DESCRIPTION	SET/CLEAR
F1	F1:Rcv Tank Full	Recovery Tank Full	*SET:* Battery discharge threshold of 30-32 Volts at KSI terminal or 32-33 Volts at batteries. *CLEAR:* Charge batteries to BDI reset threshold of 37 Volts at KSI terminal or 38 Volts at batteries.
F2	F2:SolTank Empty	Solution Tank Empty	*SET:* Operator selects a solution technology that is not configured on the machine. *CLEAR:* Release button.
F3	F3:Batt Very Low	Very Low Battery Voltage	*SET:* Battery discharge threshold of 30.2 Volts at KSI terminal of PMC or 31.6 Volts at battery. *CLEAR:* Charge batteries to BDI reset threshold of 37 Volts at KSI terminal of PMC or 38.3 Volts at batteries and cycle key switch.
F4	F4:F/L Br Flt #	BLDC Front/Left Main Scrub Motor Circuit Fault: *VF, OT, HW, Com*, or *MF*	*SET* - VF: Voltage Fault - Complete SUN-I/O testing on scrub module *SET* - OT: Over Temperature - Scrub module overheat. *SET* - HW: Hardware Fault - System overcurrent *SET* - Com: Communications Fault - Interface module has lost communications with scrub module. Complete SUN-I/O testing on the scrub module. *SET* - MF: Motor Fault - Locked rotor or mechanical problem with the motor or brush drive mechanism. *CLEAR:* Correct warning condition and cycle key switch.
F5	F5:R/R Br Flt #	BLDC Right/Rear Main Scrub Motor Circuit Fault: *VF, OT, HW, Com*, or *MF*	*SET* - VF: Voltage Fault - Complete SUN-I/O testing on scrub module *SET* - OT: Over Temperature - Scrub module overheat. *SET* - HW: Hardware Fault - System overcurrent *SET* - Com: Communications Fault - Interface module has lost communications with scrub module. Complete SUN-I/O testing on the scrub module. *SET* - MF: Motor Fault - Locked rotor or mechanical problem with the motor or brush drive mechanism. *CLEAR:* Correct warning condition and cycle key switch.
F6	F6:Vac 1 Short	Vacuum fan motor #1 circuit is shorted	*SET:* Vacuum fan motor #1 circuit shorted *CLEAR:* Correct fault condition and cycle key switch.
F7	F7:Vac 2 Short	Vacuum fan motor #2 circuit is shorted	*SET:* Vacuum fan motor #2 circuit shorted *CLEAR:* Correct fault condition and cycle key switch.
F8	F8:Check Brushes	Unable to achieve target brush motor current following down shift(s) to lowest down pressure level	*SET:* Scrub module unable to achieve target brush motor current in desired down pressure setting. Scrub module attempts to "down shift" to lower setting(s) until it is unable to achieve target current in lowest down pressure setting. *CLEAR:* Correct fault condition and cycle key switch.

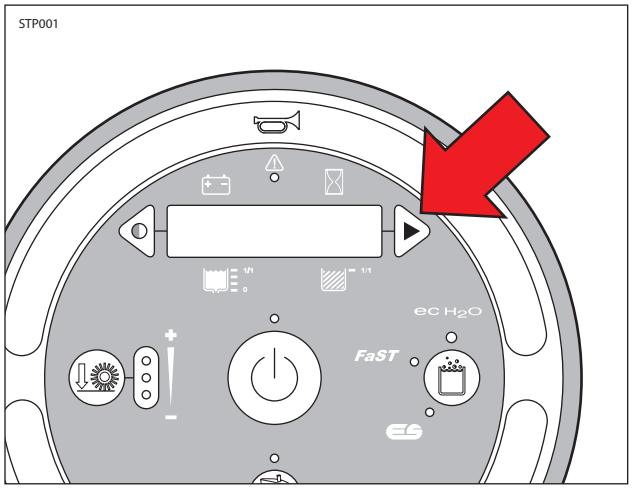
T17 LCD FAULT MESSAGES

LCD WARNING CODE	MESSAGE	DESCRIPTION	SET/CLEAR
F9	F9:Propel Error	Propel Controller CAN-bus Connectivity Error	*SET:* Curtis PMC to T17 interface module CAN-bus connectivity problem or Curtis PMC power supply problem. *CLEAR:* See "Curtis PMC Diagnostics" and cycle key switch.
F10	F10:Pickup Error	Pickup module CAN Fault	*SET:* CAN connectivity to pickup module failed. *CLEAR:* Correct fault condition and cycle key switch.
F11	F11:Scrub Error	Scrub module CAN Fault	*SET:* CAN connectivity to scrub module failed. *CLEAR:* Correct fault condition and cycle key switch.

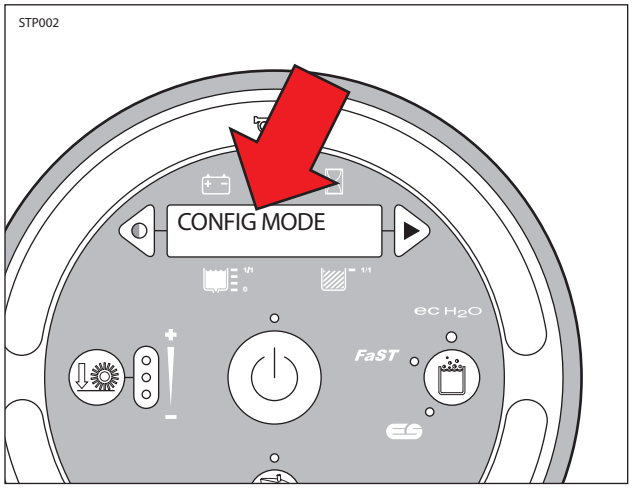
PROPEL DIAGNOSTIC MODE

Propel Diagnostic Mode (Propel Input Mode) is an on-board diagnostic utility that displays Curtis 1234 controller inputs on the instrument panel LCD (Liquid Crystal Display). The input data is transmitted to the T12 controller through a CAN-bus (Controller Area Network).

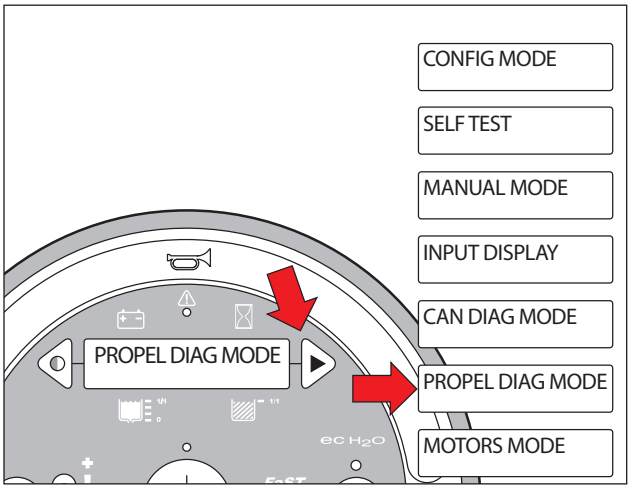
1. Key switch Off. Press and hold the configuration mode button.



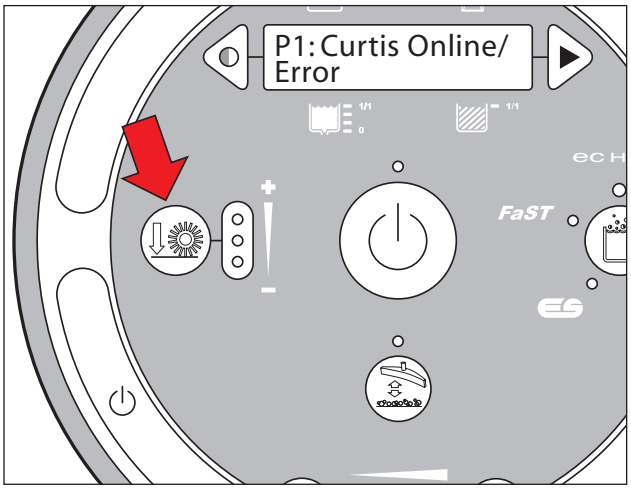
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



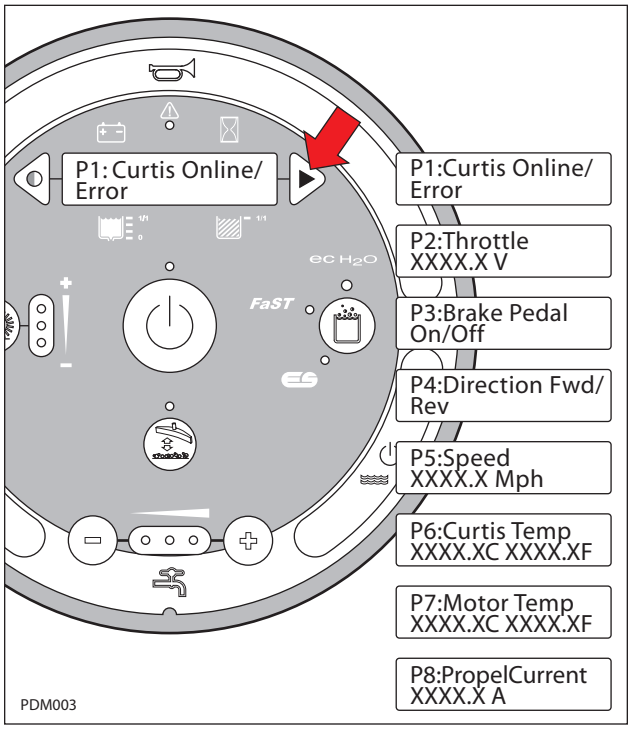
3. Press and release the configuration mode button to scroll through a list of utilities until "PROPEL DIAG MODE" appears on the LCD.



4. Press and release the brush pressure button to enter Propel Diagnostic Mode. "P1:Curtis Online..." will appear on the LCD.



5. Press and release the configuration mode button to scroll through a list of Curtis 1234 controller inputs.



6. The table below describes how each input operates.

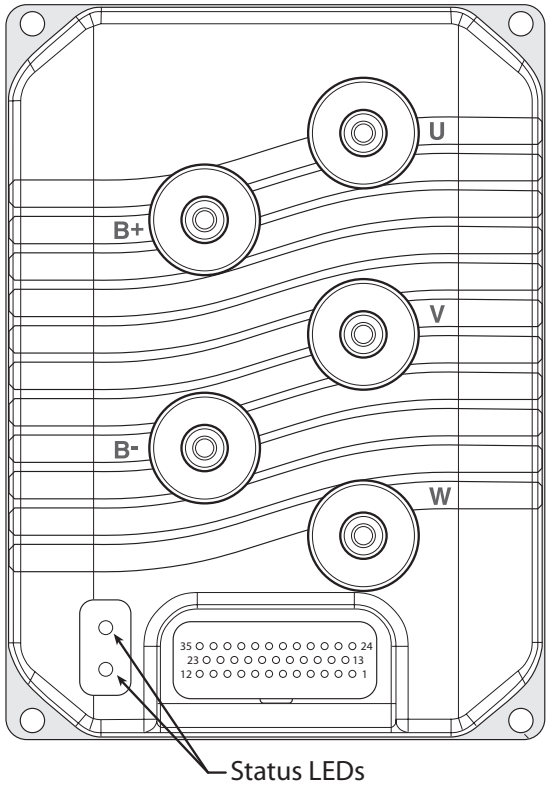
T17 Propel Diagnostic Mode

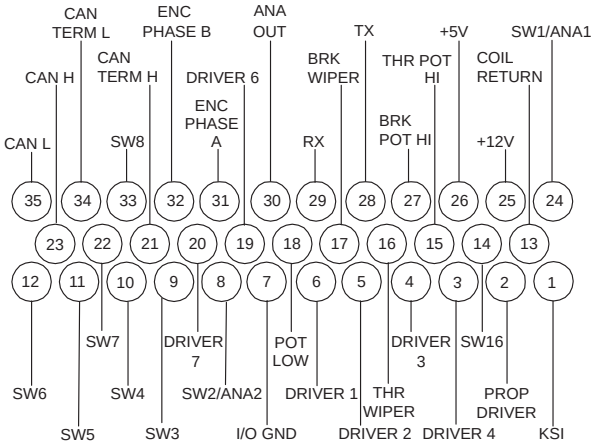
CODE	LCD MESSAGE	DESCRIPTION
P1	P1:Curtis Online/ Error	Curtis/T17 controllers CAN-bus connection status
P2	P2:Throttle XXXX.X v	Displays foot throttle commanded voltage (0-5V).
P3	P3:Brake Pedal On/Off	Displays brake pedal command (On/Off).
P4	P4:Direction Fwd/ Rev	Displays directional switch input (Fwd/Rev).
P5	P5:Speed XXXX.X Mph	Displays propel speed from motor encoder located in drive assembly.
P6	P6:Curtis Temp XXXX.XC XXXX.XF	Displays Curtis 1234 controller temperature
P7	P7:Motor Temp XXXX.XC XXXX.XF	Displays drive motor temperature. Thermistor located in drive assembly.
P8	P8:PropelCurrent XXXX.X A	Displays propel motor current.

PDM004

Curtis 1234 Controller Diagnostic LED Operation

PMC002





Types of LED Display	
Display	**Status**
Neither LED illuminated	Controller is not powered on, has a dead battery, or is severely damaged.
Yellow LED flashing	Controller is operating normally.
Yellow and red LEDs both on solid	Controller is in Flash program mode.
Red LED on solid	Watchdog failure. Cycle KSI to restart.
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code* flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.

*The red LED flashes once to indicate that the first digit of the code will follow; the yellow LED then flashes the appropriate number of times for the first digit. The red LED flashes twice to indicate that the second digit of the code will follow; the yellow LED flashes the appropriate number of times for the second digit.

Example: Battery Undervoltage (Code 23)

RED	YELLOW	RED	YELLOW
✱	☼ ☼	✱ ✱	☼ ☼ ☼
(first digit)	(2)	(second digit)	(3)

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
12	Controller Overcurrent *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. External short of phase U, V, or W motor connections. 2. Motor parameters are mis-tuned. 3. Controller defective.	*Set:* Phase current exceeded the current measurement limit. *Clear:* Cycle KSI.
13	Current Sensor Fault *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	*Set:* Controller current sensors have invalid offset reading. *Clear:* Cycle KSI.
14	Precharge Failed *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging. 2. See Monitor menu » Battery: Capacitor Voltage.	*Set:* Precharge failed to charge the capacitor bank to the KSI voltage. *Clear:* Cycle interlock input or use VCL function.
15	Controller Severe Undertemp *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	*Set:* Heatsink temperature below -40˚C. *Clear:* Bring heatsink temperature above -40˚C, and cycle interlock or KSI.
16	Controller Severe Overtemp *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	*Set:* Heatsink temperature above +95˚C. *Clear:* Bring heatsink temperature below +95˚C, and cycle interlock or KSI.
17	Severe Undervoltage *Reduced drive torque.*	1. Battery Menu parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See Monitor menu » Battery: Capacitor Voltage. 6. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the severe undervoltage limit with FET bridge enabled. *Clear:* Bring capacitor voltage above severe undervoltage limit.

PMC003

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
18	Severe Overvoltage *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. See Monitor menu»Battery: Capacitor Voltage. 2. Battery menu parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.	*Set:* Capacitor bank voltage exceeded the Severe Overvoltage limit with FET bridge enabled. *Clear:* Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.
22	Controller Overtemp Cutback *Reduced drive and brake torque.*	1. See Monitor menu»Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	*Set:* Heatsink temperature exceeded 85˚C. *Clear:* Bring heatsink temperature below 85˚C.
23	Undervoltage Cutback *Reduced drive torque.*	1. Normal operation. Fault shows that the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu»Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the Undervoltage limit with the FET bridge enabled. *Clear:* Bring capacitor voltage above the Undervoltage limit.
24	Overvoltage Cutback *Reduced brake torque.*	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See Monitor menu»Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage exceeded the Overvoltage limit with the FET bridge enabled. *Clear:* Bring capacitor voltage below the Overvoltage limit.
25	+5V Supply Failure *None, unless a fault action is programmed in VCL.*	1. External load impedance on the +5V supply (pin 26) is too low. 2. See Monitor menu»outputs: 5 Volts and Ext Supply Current.	*Set:* +5V supply (pin 26) outside the +5V +/-10% range. *Clear:* Bring voltage within range.
26	Digital Out 6 Overcurrent *Digital Output 6 driver will not turn on.*	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	*Set:* Digital Output 6 (pin 19) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function *Set_DigOut()* to turn the driver on again.

VIC004

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
27	Digital Out 7 Overcurrent *Digital Output 7 driver will not turn on.*	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	*Set:* Digital Output 7 (pin 20) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function Set_DigOut() to turn the driver on again.
28	Motor Temp Hot Cutback *Reduced drive torque.*	1. Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back. 2. Motor Temperature Control Menu parameters are mis-tuned. 3. See Monitor menu»Motor: Temperature and »Inputs: Analog2. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.	*Set:* Motor temperature is at or above the Temperature Hot parameter setting. *Clear:* Bring the motor temperature within range.
29	Motor Temp Sensor Fault *MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.*	1. Motor thermistor is not connected properly. 2. If the application does not use a thermistor, Temp Compensation and Temp Cutback should be programmed Off. 3. See Monitor menu»Motor: Temperature and »Inputs: Analog2.	*Set:* Motor thermistor input (pin 8) is at the voltage rail (0 or 10V). *Clear:* Bring the motor thermistor input voltage within range.
31	Coil1 Driver Open/Short *ShutdownDriver1.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 1 (pin 6) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
32	EMBrake Open/Short *ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Electromagnetic brake driver (pin 5) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
33	Coil3 Driver Open/Short *ShutdownDriver3.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 3 (pin 4) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
34	Coil4 Driver Open/Short *ShutdownDriver4.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 4 (pin3) is either open or shorted. *Clear:* Correct open or short, and cycle driver.

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor
VCL = Vehicle Control Language

PMC005

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
35	PD Open/Short *ShutdownPD.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Proportional driver (pin 2) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
36	Encoder Fault *ShutdownEMBrake.*	1. Motor encoder failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	*Set:* Motor encoder phase failure detected. *Clear:* Cycle KSI.
37	Motor Open *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Motor phase is open. 2. Bad crimps or faulty wiring.	*Set:* Motor phase U, V, or W detected open. *Clear:* Cycle KSI.
38	Main Contactor Welded *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	*Set:* Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. *Clear:* Cycle KSI
39	Main Contactor Did Not Close *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact. 3. External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.	*Set:* With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. *Clear:* Cycle KSI.
41	Throttle Wiper High *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	*Set:* Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function Setup_Pot_Faults()) *Clear:* Bring throttle pot wiper voltage below the fault threshold.
42	Throttle Wiper Low *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too low.	*Set:* Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults()). *Clear:* Bring throttle pot wiper voltage above the fault threshold.
43	Pot2 Wiper High *FullBrake.*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too high.	*Set:* Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function Setup_Pot_Faults()). *Clear:* Bring Pot2 wiper voltage below the fault threshold.

PMC006

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor
VCL = Vehicle Control Language

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
44	Pot2 Wiper Low *FullBrake.*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too low.	*Set:* Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults()). *Clear:* Bring Pot2 wiper voltage above the fault threshold.
45	Pot Low Overcurrent *ShutdownThrottle;* *FullBrake.*	1. See Monitor menu » Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	*Set:* Pot low (pin 18) current exceeds 10 mA. *Clear:* Clear pot low overcurrent condition and cycle KSI.
46	EEPROM Failure *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *ShutdownInterlock;* *ShutdownDriver1;* *ShutdownDriver2;* *ShutdownDriver3;* *ShutdownDriver4;* *ShutdownPD;* *FullBrake;* *ShutdownPump.*	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	*Set:* Controller operating system tried to write to EEPROM memory and failed. *Clear:* Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.
47	HPD/Sequencing Fault *ShutdownThrottle.*	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. 3. See Monitor menu » Inputs.	*Set:* HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction and throttle inputs. *Clear:* Reapply inputs in correct sequence.
49	Parameter Change Fault *ShutdownMotor;* *ShutdownMainContactor;* *ShutdownEMBrake;* *ShutdownThrottle;* *FullBrake;* *ShutdownPump.*	1. This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	*Set:* Adjustment of a parameter setting that requires cycling of KSI. *Clear:* Cycle KSI
51	Throttle SRO Fault *ShutdownThrottle/brake.* *Shutdown Motor.*	1. Both throttle and brake inputs are active at the same time. 2. Faulty throttle and/or brake inputs.	*Set:* Throttle and brake inputs applied at the same time. *Clear:* Release throttle and brake pedals.
52	HPD Fault *ShutdownThrottle/brake.* *Shutdown Motor.*	1. Throttle is pressed before key switch is turned on. 2. Throttle is pressed before operator presses the seat switch.	*Set:* Throttle is pressed before key switch is turned on or throttle is pressed before operator sits on the seat switch. *Clear:* Release throttle and properly sequence key switch, seat switch and then throttle.

PMC007

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor
VCL = Vehicle Control Language

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
68	VCL Run Time Error *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.*	1. VCL code encountered a runtime VCL error. 2. See Monitor menu » Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	*Set:* Runtime VCL code error condition. *Clear:* Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
69	External Supply Out of Range *None, unless a fault action is programmed in VCL.*	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned. 3. See Monitor menu » Outputs: Ext Supply Current.	*Set:* The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings. *Clear:* Bring the external supply current within range.
71	OS General *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.*	1. Internal controller fault.	*Set:* Internal controller fault detected. *Clear:* Cycle KSI
72	PDO Timeout *ShutdownInterlock; CAN NMT State set to Pre-operational.*	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	*Set:* Time between CAN PDO messages received exceeded the PDO Timeout Period. *Clear:* Cycle KSI.
73	Stall Detected *ShutdownEMBrake.*	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See Monitor menu » Motor: Motor RPM.	*Set:* No motor encoder movement detected. *Clear:* Either cycle KSI, or detect valid motor encoder signals while operating in LOS mode and return Throttle Command = 0 and Motor RPM= 0

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor
VCL = Vehicle Control Language
CAN = Controller Area Network

PMC008

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
87	Motor Characterization Fault *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0=none 1=encoder signal seen, but step size not determined; set Encoder Step Size manually 2=motor temp sensor fault 3=motor temp hot cutback fault 4= controller overtemp cutback fault 5=controller undertemp cutback fault 6=undervoltage cutback fault 7=severe overvoltage fault 8=encoder signal not seen, or one or both channels missing 9=motor parameters out of characterization range.	*Set:* Motor characterization failed during the motor characterization process. *Clear:* Correct fault; cycle KSI.
88	Motor Phase Fault	1. The motor encoder output signal does not match the commanded direction.	Set: Motor phase cables U, V, and W possibly installed incorrectly. Clear: Correct faulty cable installation and cycle KSI.
89	Motor Type Fault *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. The Motor_Type parameter value is out of range.	Set: Motor_Type parameter is set to an illegal value. Clear: Set Motor_Type to correct value and cycle KSI.
91	VCL/OS Mismatch *ShutdownMotor; ShutdownMainContactor;*	1. The VCL software in the controller does not match the OS software in the controller.	*Set:* VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. *Clear:* Download the correct VCL and OS software into the controller.
92	EM Brake Failed to Set *ShutdownEMBrake; ShutdownThrottle.*	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	*Set:* After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. *Clear:* Activate the throttle.
93	Encoder LOS (Limited *Operating Strategy)* *Enter LOS control mode.*	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	*Set:* Encoder Fault (Code 36) or Stall Detect Fault (Code 73) was activated, and Brake or Interlock has been applied to activate LOS control mode, allowing limited motor control. *Clear:* Cycle KSI, or if LOS mode was activated by the Stall Fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.

PMC009

Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor VCL = Vehicle Control Language

Curtis 1234 Controller Diagnostic Codes, continued

TROUBLESHOOTING CHART, continued

CODE	FAULT CONDITION / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
94	Emer Rev Timeout *ShutdownEMBrake; ShutdownThrottle.*	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	*Set:* Emergency Reverse was activated and ran until the EMR Timeout timer expired. *Clear:* Turn the emergency reverse input Off.
98	Illegal Model Number *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.*	1. Model_Number variable contains illegal value (not 1234, 1236, 1238, or 1298). 2. Software and hardware do not match. 3. Controller defective.	*Set:* Illegal Model_Number variable; when KSI cycles a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. *Clear:* Download appropriate software for your controller model.

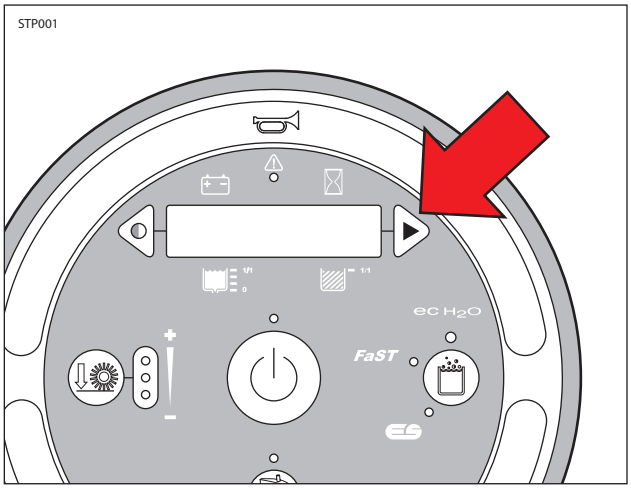
Terms:
KSI = Key Switch Interlock
FET = Field-Effect Transistor
EMR = Emergency Reverse

PMC010

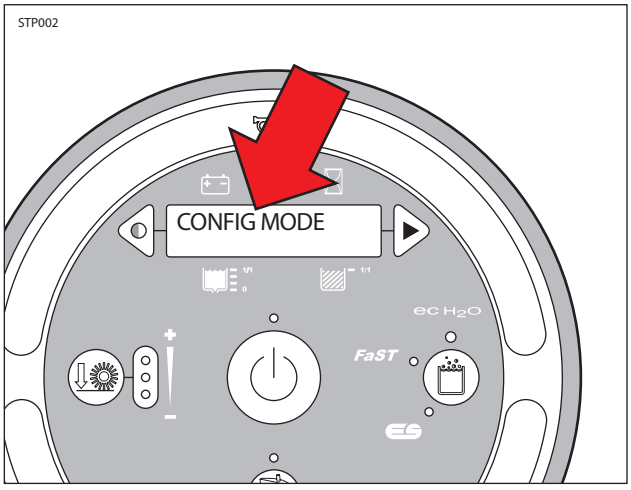
INPUT DISPLAY MODE

Input Display Mode is an onboard diagnostic utility that displays controller input conditions. Input Display Mode displays LCD text messages for hard-wired switch, sensor, and touch panel button inputs.

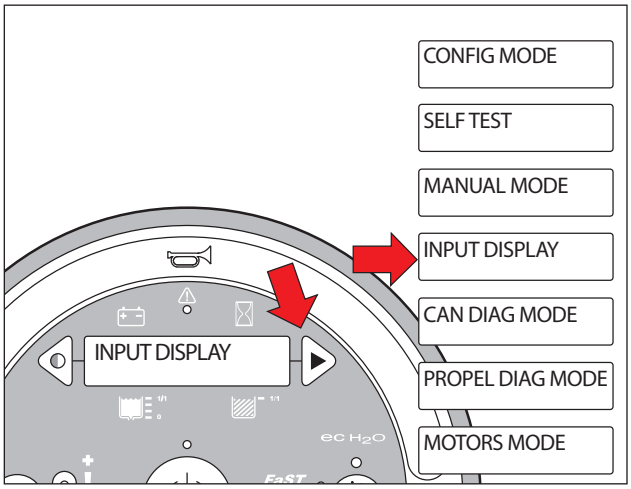
1. Key switch Off. Press and hold the configuration mode button.



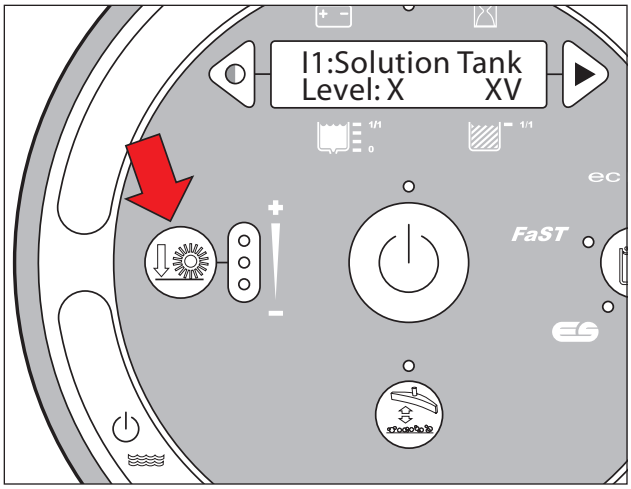
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



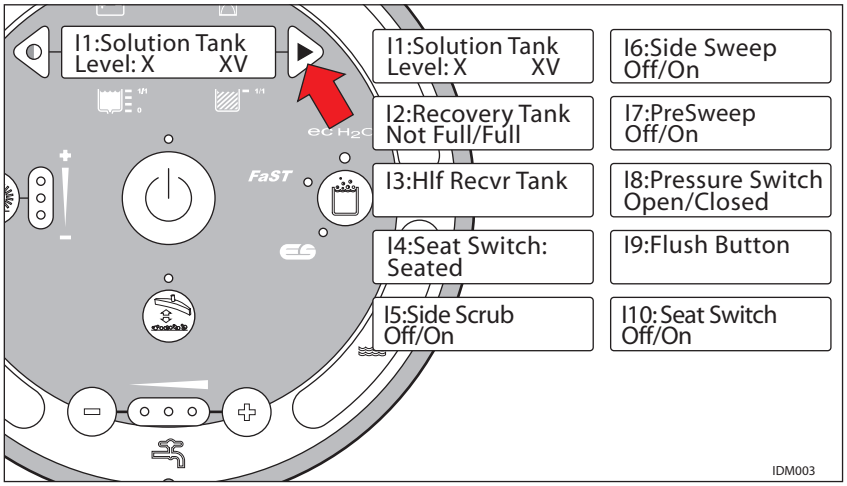
3. Press and release the configuration mode button to scroll through a list of utilities until "INPUT DISPLAY" appears on the LCD.



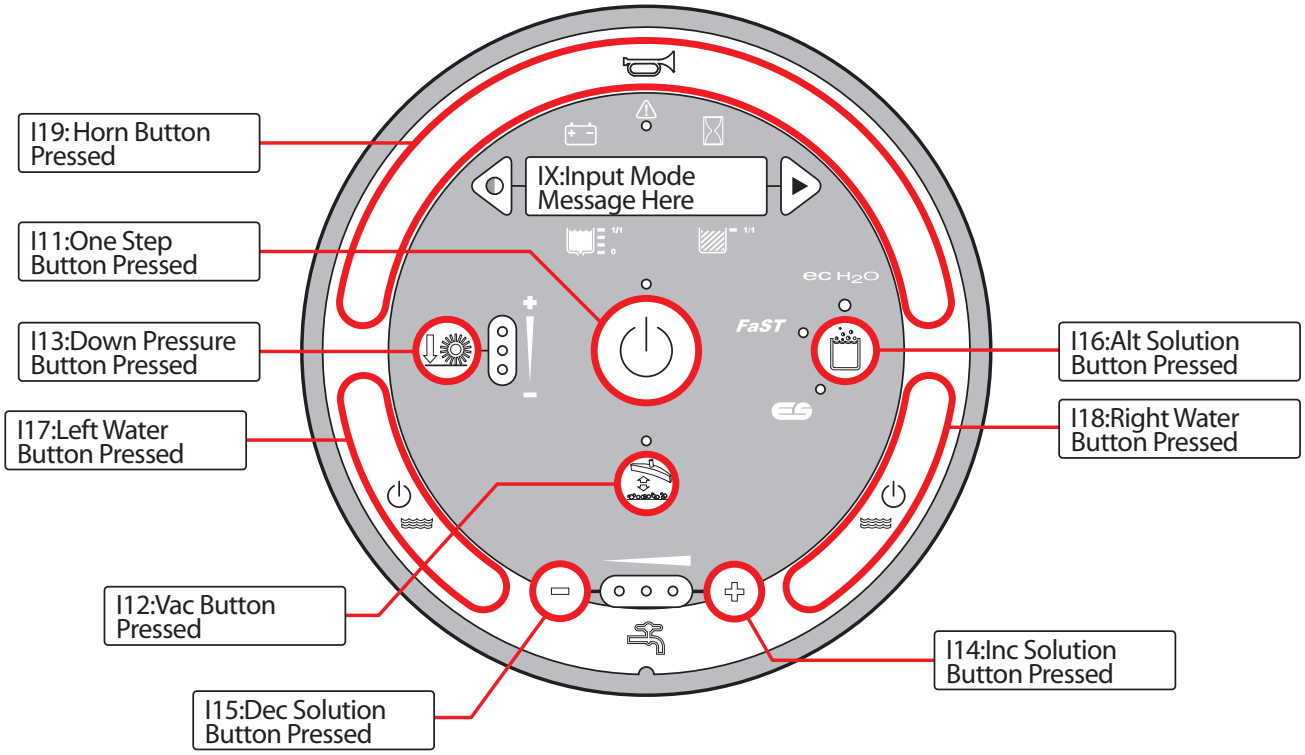
4. Press and release the brush pressure button to enter Input Display Mode. "I1:Solution Tank Level:X XV" will appear on the LCD.



5. Press and release the configuration mode button to scroll through a list of hard-wired switch and sensor inputs.



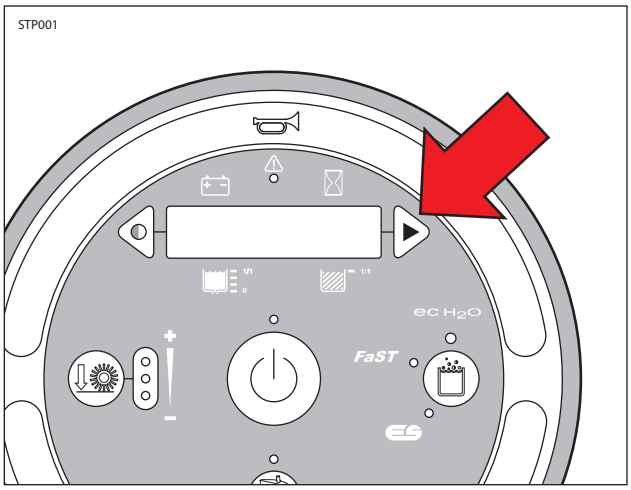
6. Press any other touch panel button to display a corresponding LCD text message. The message confirms that the control board received the input.



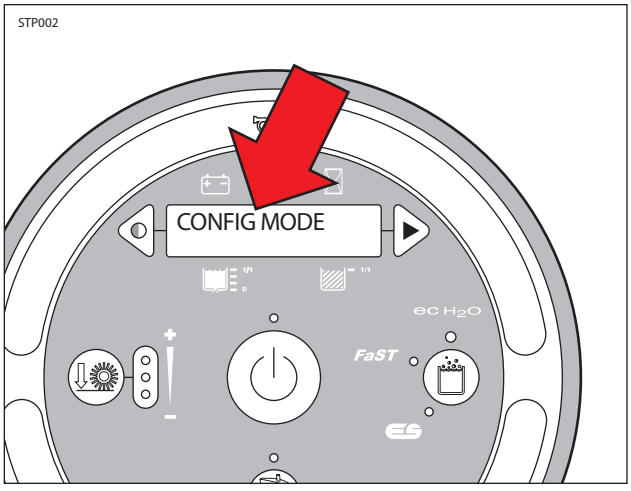
MANUAL MODE

Manual Mode is an onboard diagnostic utility that manually activates machine functions and displays output current in "XX.X Amps" format. This mode bypasses interlocking inputs and should be used for diagnostic purposes only.

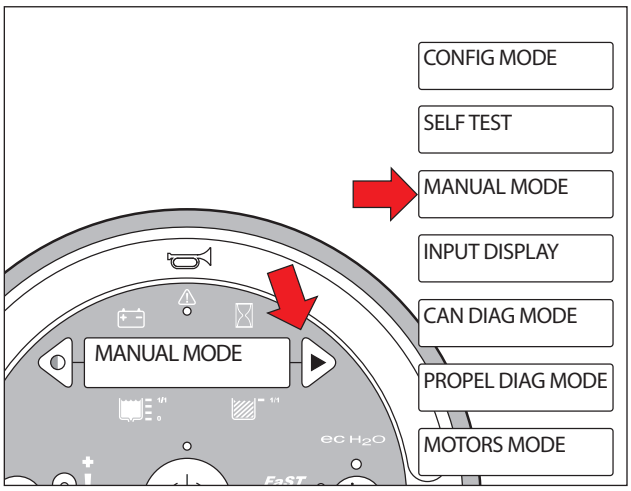
1. Key switch Off. Press and hold the configuration mode button.



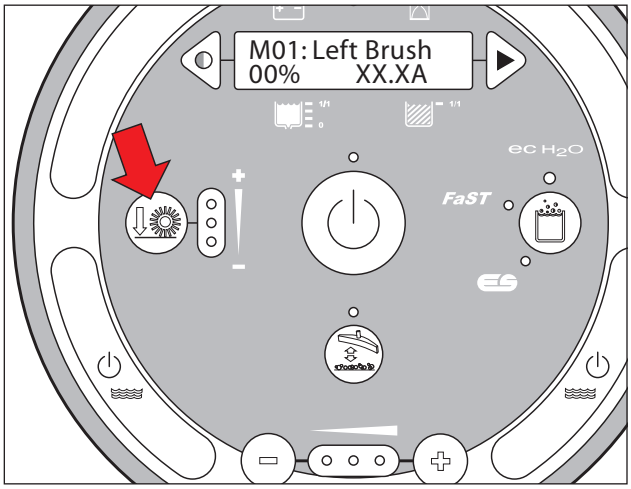
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



3. Press and release the configuration mode button to scroll through a list of utilities until "MANUAL MODE" appears on the LCD.



4. Press and release the brush pressure button to enter Manual Mode. "M01: Left Brush, 00% XX.XA" will appear on the LCD.



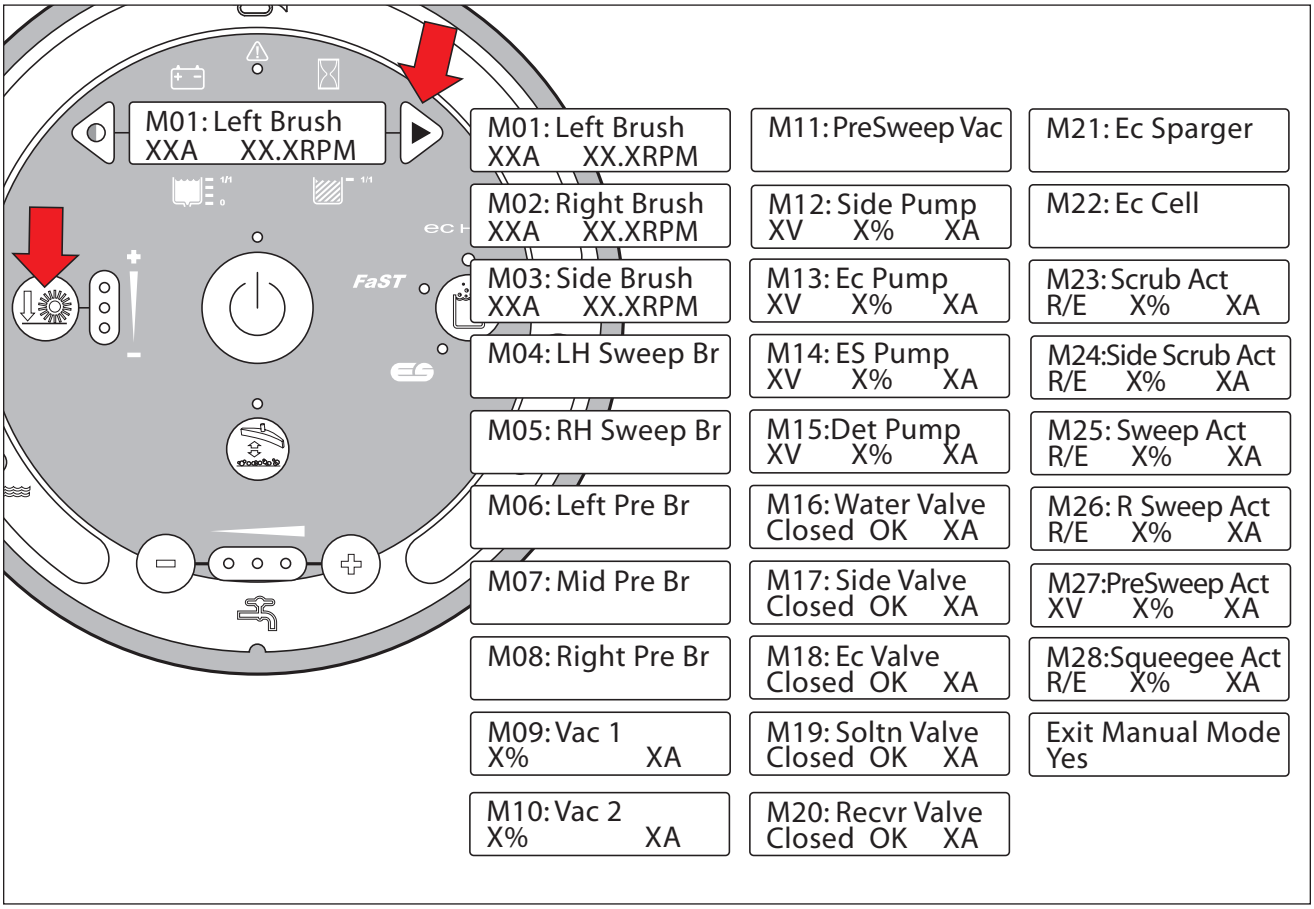
5. Press and release the configuration mode button to scroll through a list of output functions. ***Press the brush down pressure button to activate the function displayed on the LCD.***

NOTE: "XX.X A" format indicates that the actual amperage value will vary. See the "Specifications" section of this manual for approximate amp draw values.

NOTE: "R" or "E" in the lower left corner of the LCD indicates Retracted or Extended actuator position.

NOTE: "XX%" refers to the duty cycle of the ciruit load when activated.

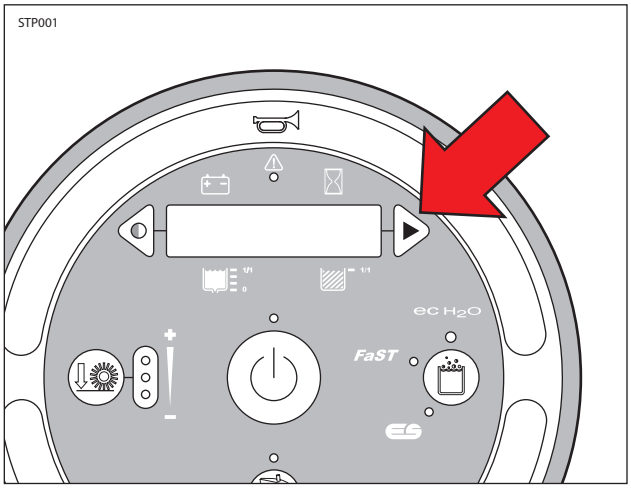
NOTE: "OK" indicates that the displayed function is not open or shorted.



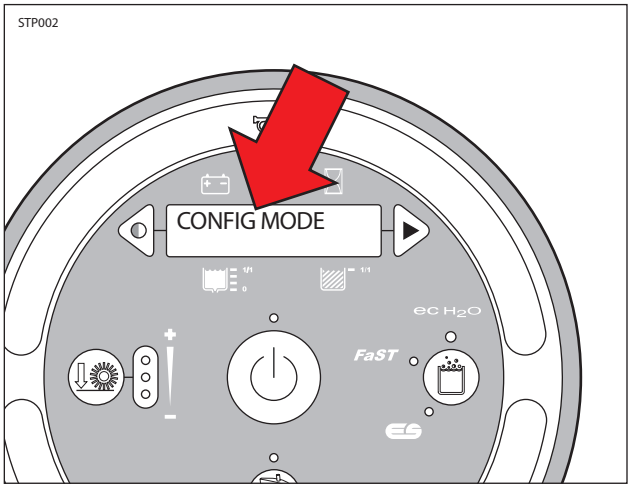
CAN DIAGNOSTIC MODE

CAN (Controller Area Network) Diagnostic Mode is an on-board diagnostic utility that displays connectivity status and a software revision date for each module.

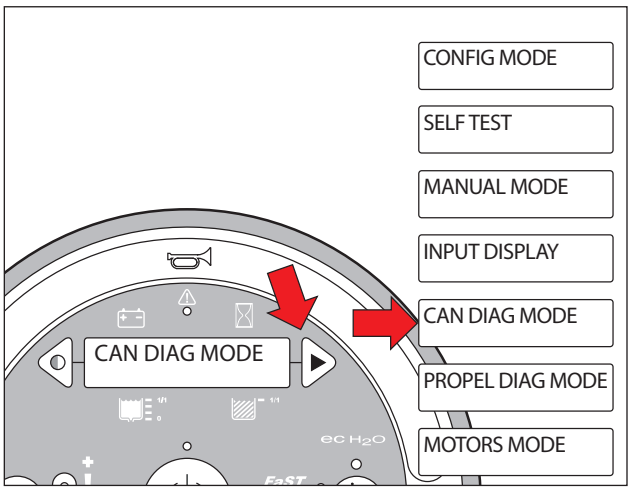
1. Key switch Off. Press and hold the configuration mode button.



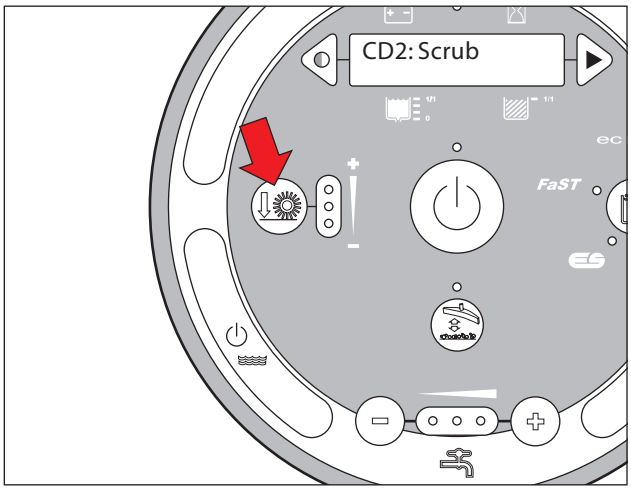
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



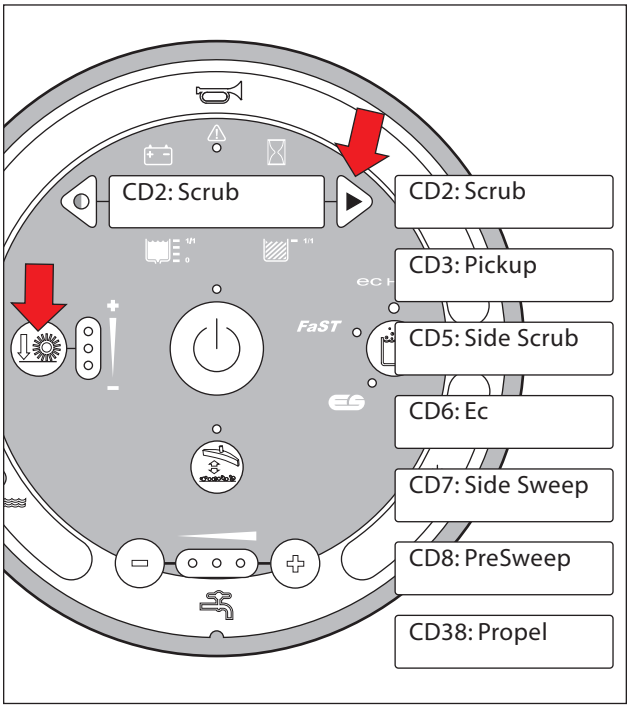
3. Press and release the configuration mode button to scroll through a list of utilities until "CAN DIAG MODE" appears on the LCD.



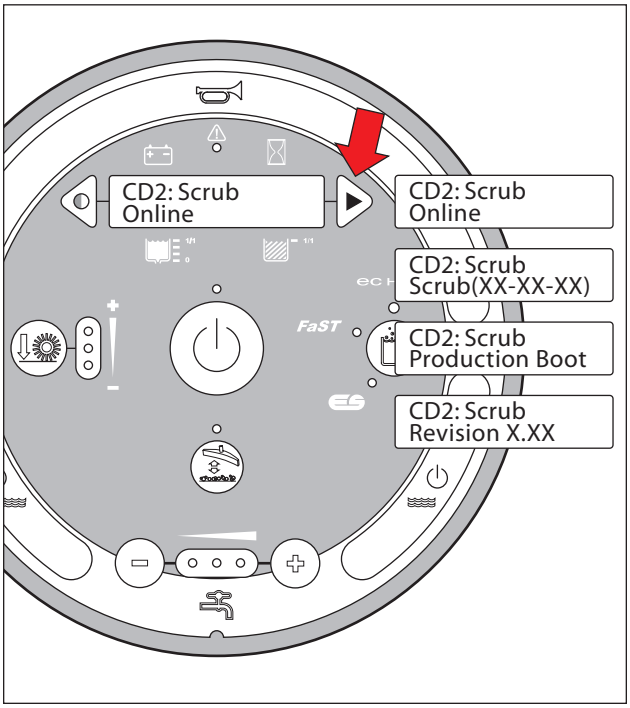
4. Press and release the brush pressure button to enter CAN Diagnostic Mode. "CD2: Scrub" will appear on the LCD.



5. Press and release the configuration mode button to scroll through a list of CAN modules. Press the brush down pressure button to select a specific module.



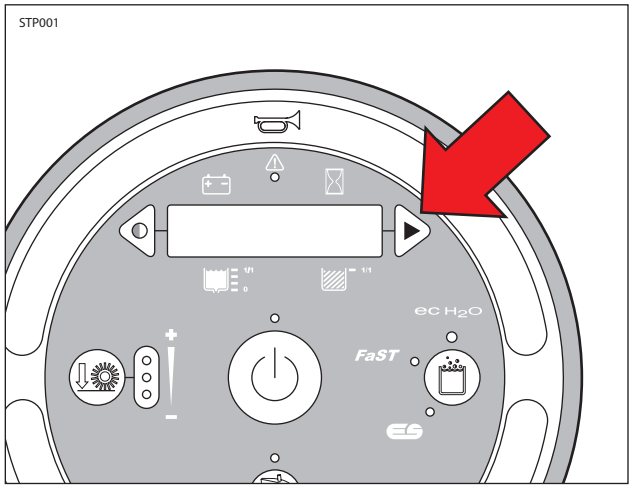
6. Press and release the configuration mode button to scroll through a list of CAN module information.



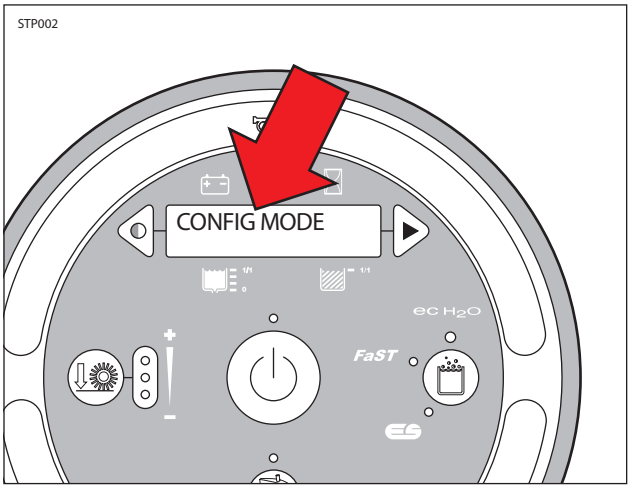
MOTORS MODE

Motors Mode is an onboard diagnostic utility that allows trained service personnel to operate various motors independently for service testing purposes only.

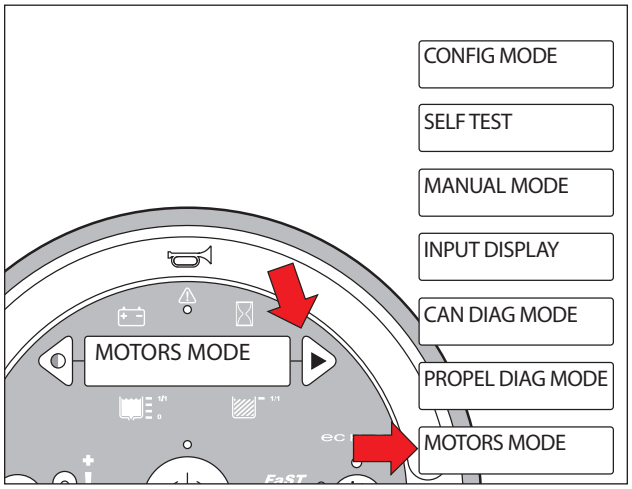
1. Key switch Off. Press and hold the configuration mode button.



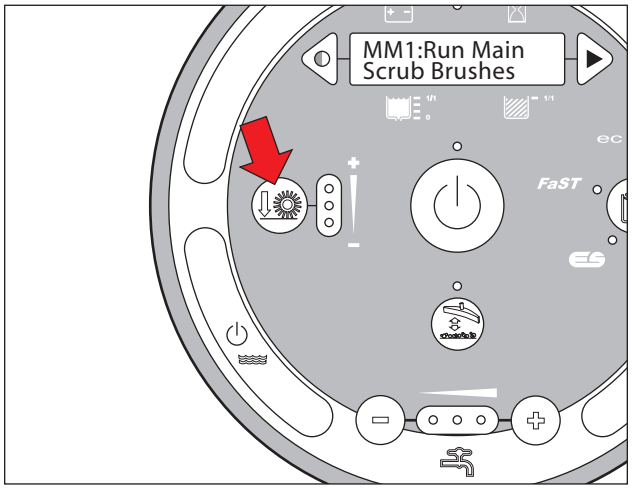
2. Key switch On. Release the configuration mode button when "CONFIG MODE" appears on the LCD.



3. Press and release the configuration mode button to scroll through a list of utilities until "MOTORS MODE" appears on the LCD.

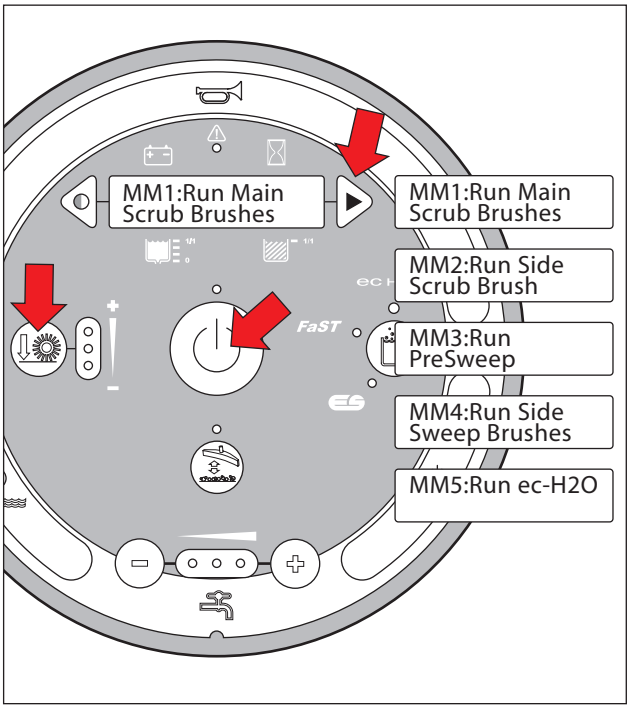


4. Press and release the brush pressure button to enter Motors Mode. "MM1: Run Main Scrub Brushes" will appear on the LCD.



5. Press and release the configuration mode button to scroll through a list of motors. Press the brush down pressure button to activate the selected motor(s) and the 1-STEP button to deactivate the selected motor(s).

NOTE: Once MM1 or MM2 is activated, the down pressure button can be used to adjust the down pressure setting and the 1-STEP button must be used to turn the motor(s) off.



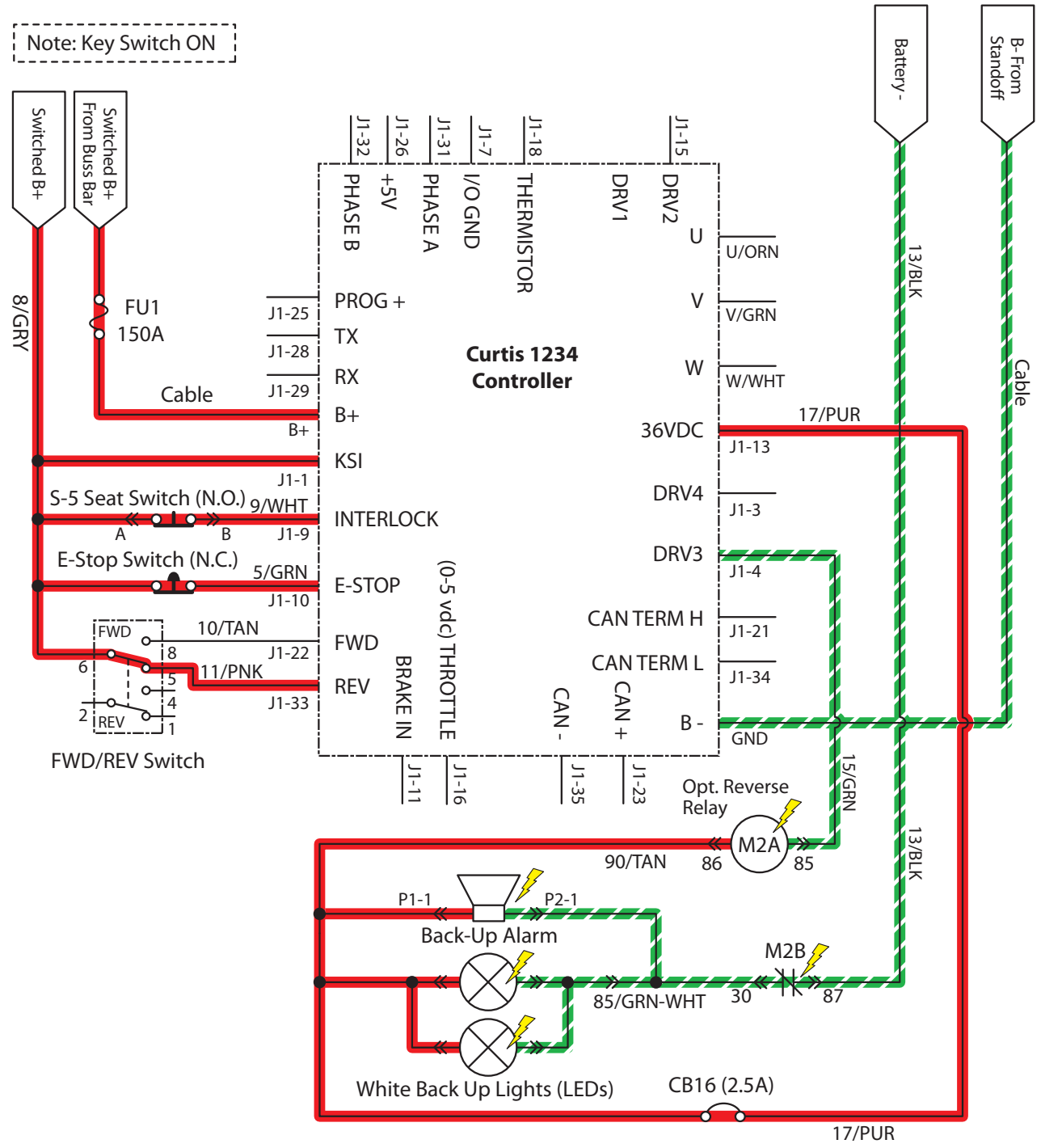
POWER STEERING STATUS LED (OPTION)

1. Remove the front panel below the steering wheel to gain access to the power steering components.

2. Observe status LED and use the table below to determine derate level.

LED	DESCRIPTION
Off	Normal Operation, Up to 100% of Maximum Torque Output
	No LED may also indicate a power supply failure to the power steering control module. Turn steering wheel completely to one side and hold pressure for 30 seconds to see if the LED flashes for derate as listed below:
Purple, Blinking	Derate Level 1, Up to 75% of Maximum Torque Output
Yellow, Blinking	Derate Level 2, Up to 50% of Maximum Torque Output
Red, Blinking	Derate Level 3, Up to 20% of Maximum Torque Output

Back-Up Alarm/Light ON



Battery Positive +

Battery Negative -

Operational Matrix:

	Enabled	Disabled
Back-Up Alarm/Lights	• Rev Switch Input • Rev Throttle Command	• Fwd Switch Input • Neutral - Ready State • Curtis 1234 Fault

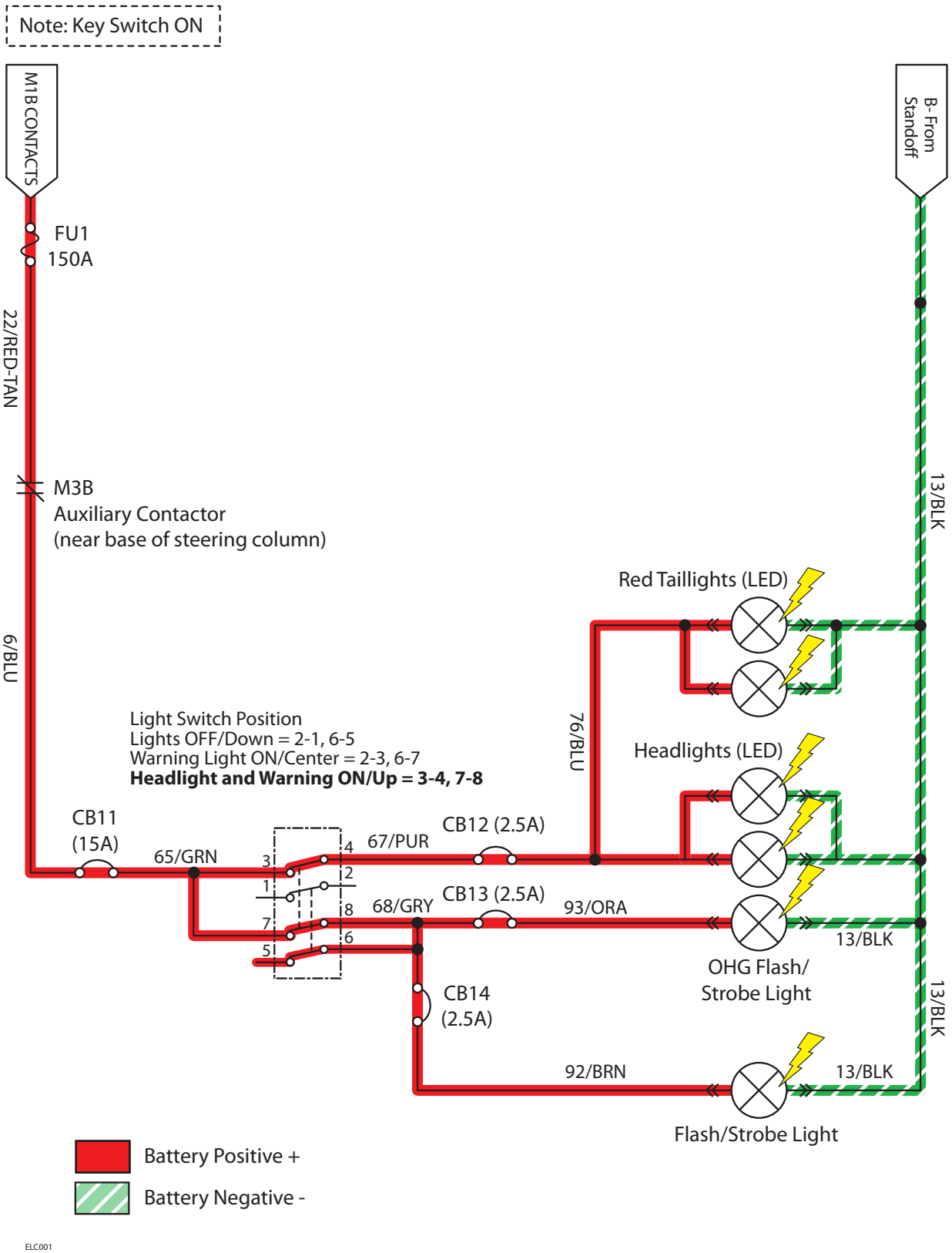
PMC011

Back-Up Alarm/Light Failed to Turn ON

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable back-up alarm/lights • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key On • Enable back-up alarm/lights • See "Curtis 1234 Controller Diagnostics" • Is there a pertinent Curtis 1234 fault displayed?		Correct Fault Condition	Go to Step #3
3	• Key Off • See "Propel Diagnostic Mode" section of this manual • Check the "P4:Direction Fwd/Rev" input from the directional switch • Check the "P2:Throttle" (0-5 vdc) input from the directional pedal • Are the P2 and P4 inputs operating properly?		Go to Step # 4	Correct Faulty Input Condition
4	• Key Off • Remove M2 relay from connector (see component locator) • Connect an Ohmmeter between relay terminals 30 and 87 (should test open or "O.L.") • Apply battery voltage to relay terminals 86 (+) and 85 (-) using fuse-protected jumper leads • Does the relay "click" and do the N.O. (normally open) terminals 30 and 87 close?		Go to Step #5	Replace Relay
5	• Key Off • Disconnect back-up alarm/light from main harness • Apply battery voltage to back-up alarm/light using fuse-protected jumper leads • Does the back-up alarm/light turn On?		Go to Step #6	Replace Back-Up Alarm/ Light
6	• Key On • Reconnect back-up alarm/light to main harness • Enable back-up alarm/light • Backprobe using a voltmeter between 15/GRN and 17/PUR at the Curtis 1234 controller connection • Is there battery voltage applied?		Repair or Replace Wire Harness	Replace Curtis 1234 Controller

Terms:
LCD = Liquid Crystal Display
Backprobe = To insert voltmeter probe(s) into the back of a connector to contact a terminal(s) while the circuit operates or should be operating.
VDC = DC Voltage

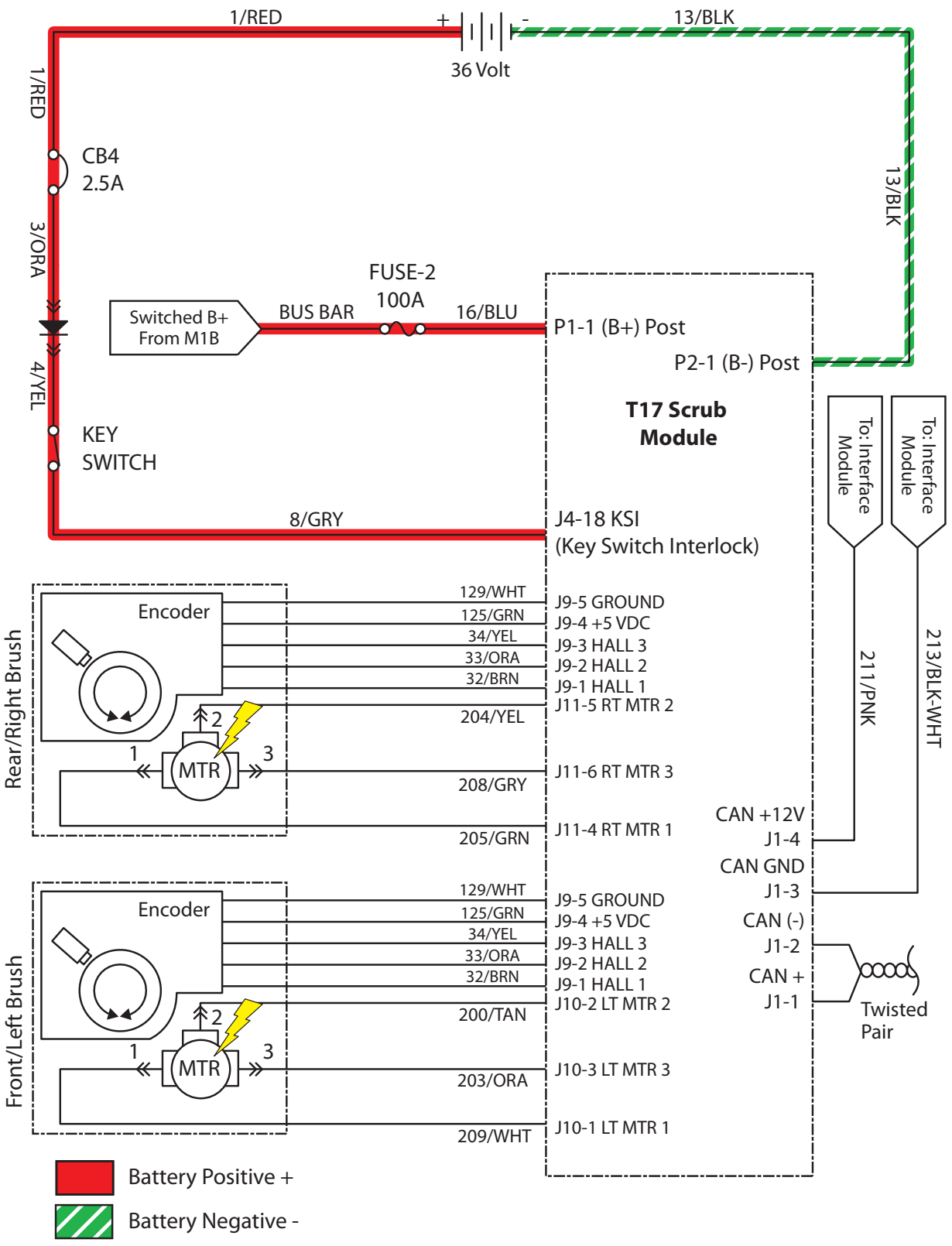
Lighting ON


Note: Key Switch ON
M1B CONTACTS
B- From Standoff
FU1
150A
22/RED-TAN
M3B
Auxiliary Contactor
(near base of steering column)
6/BLU
13/BLK
Red Taillights (LED)
76/BLU
Headlights (LED)
Light Switch Position
Lights OFF/Down = 2-1, 6-5
Warning Light ON/Center = 2-3, 6-7
Headlight and Warning ON/Up = 3-4, 7-8
CB11
(15A)
65/GRN
67/PUR
CB12 (2.5A)
68/GRY
CB13 (2.5A)
93/ORA
13/BLK
OHG Flash/
Strobe Light
CB14
(2.5A)
92/BRN
13/BLK
Flash/Strobe Light
Battery Positive +
Battery Negative -
ELC001

Lighting Failed to Turn ON

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Light switch On • Firmly press circuit breaker #11 to reset • Is circuit breaker #11 tripped?		Reset and Test Lighting Operation	Go to Step #2
2	• Key On • Light switch On • Firmly press circuit breaker #12 (Option) to reset • Is circuit breaker #12 tripped?		Reset and Test Lighting Operation	Go to Step #3
3	• Key On • Light switch On • Firmly press circuit breaker #13 (Option) to reset • Is circuit breaker #13 tripped?		Reset and Test Lighting Operation	Go to Step #4
4	• Key On • Light switch On • Firmly press circuit breaker #14 (Option) to reset • Is circuit breaker #14 tripped?		Reset and Test Lighting Operation	Go to Step #5
5	• Key On • Light switch On • Test voltage applied to the lighting subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Main Scrub Brushes ON

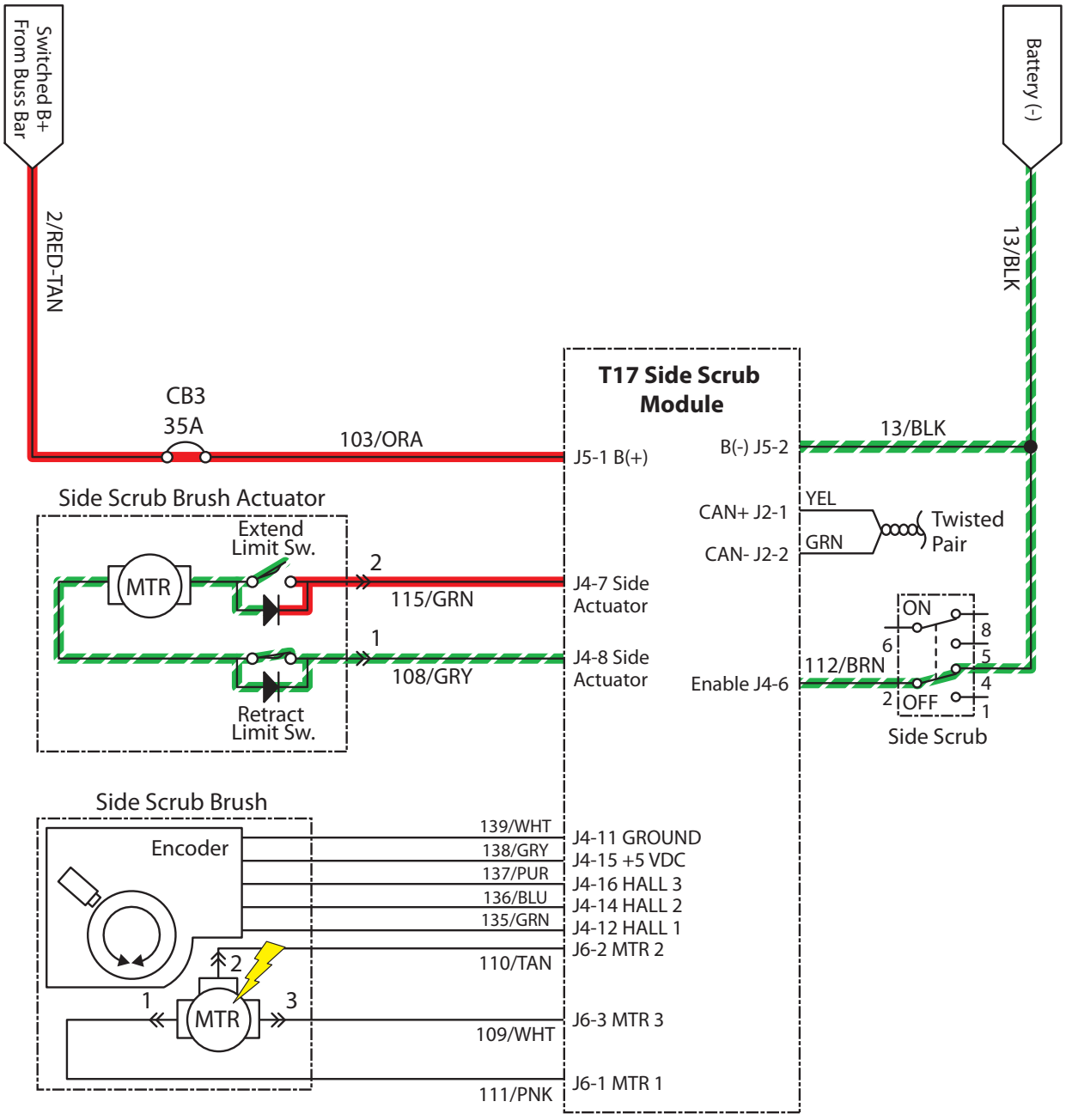


Main Scrub Brushes Failed to Turn ON

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable main scrub brushes subsystem • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Motors Mode" section of this manual • Activate the main scrub brushes in Motors mode • Do the scrub brushes turn On?		Go to Step #6	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J10-1, 2, 3 or J11-4, 5 ,6 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Proceed to Step #5 for disk scrub head models • Key Off • Remove cylindrical brushes from scrub head • Check for worn out brushes (see maintenance section) • Check brushes for entangled debris • Check brush idler plugs and bearings for excessive wear, damage, seizure, etc. • Check main brush drive belts for excessive wear, damage, etc • Do any of the above conditions exist?		Repair or Replace Necessary Cylindrical Scrub Head Components	Go to Step #5
5	• Proceed to Step #6 if ***both*** brush motors fail to turn On • Lower main scrub head • Turn key off • Swap motor leads between left and right motors • Does the same motor fail to turn on?		Repair or Replace Main Scrub Brush Motors	Go to Step #6
6	• Key Off • Reconnect main scrub brush motors to correct main harness connectors • Key On • Enable main scrub brush motors • Test voltage applied to the main scrub brush motor subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J5-5 = T12 Scrub Module Connector #5, Pin #5
J5-4 = T12 Scrub Module Connector #5, Pin #4
J5-2 = T12 Scrub Module Connector #5, Pin #2
J5-1 = T12 Scrub Module Connector #5, Pin #1

Side Scrub Brush ON /Down



Operational Matrix:

	Enabled	Disabled
Side Scrub Brush On/ Down	• 1-STEP Scrub ON • Side Brush Switch ON	• 1-STEP Scrub OFF • Side Brush Switch OFF • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault • Neutral (Ready State)

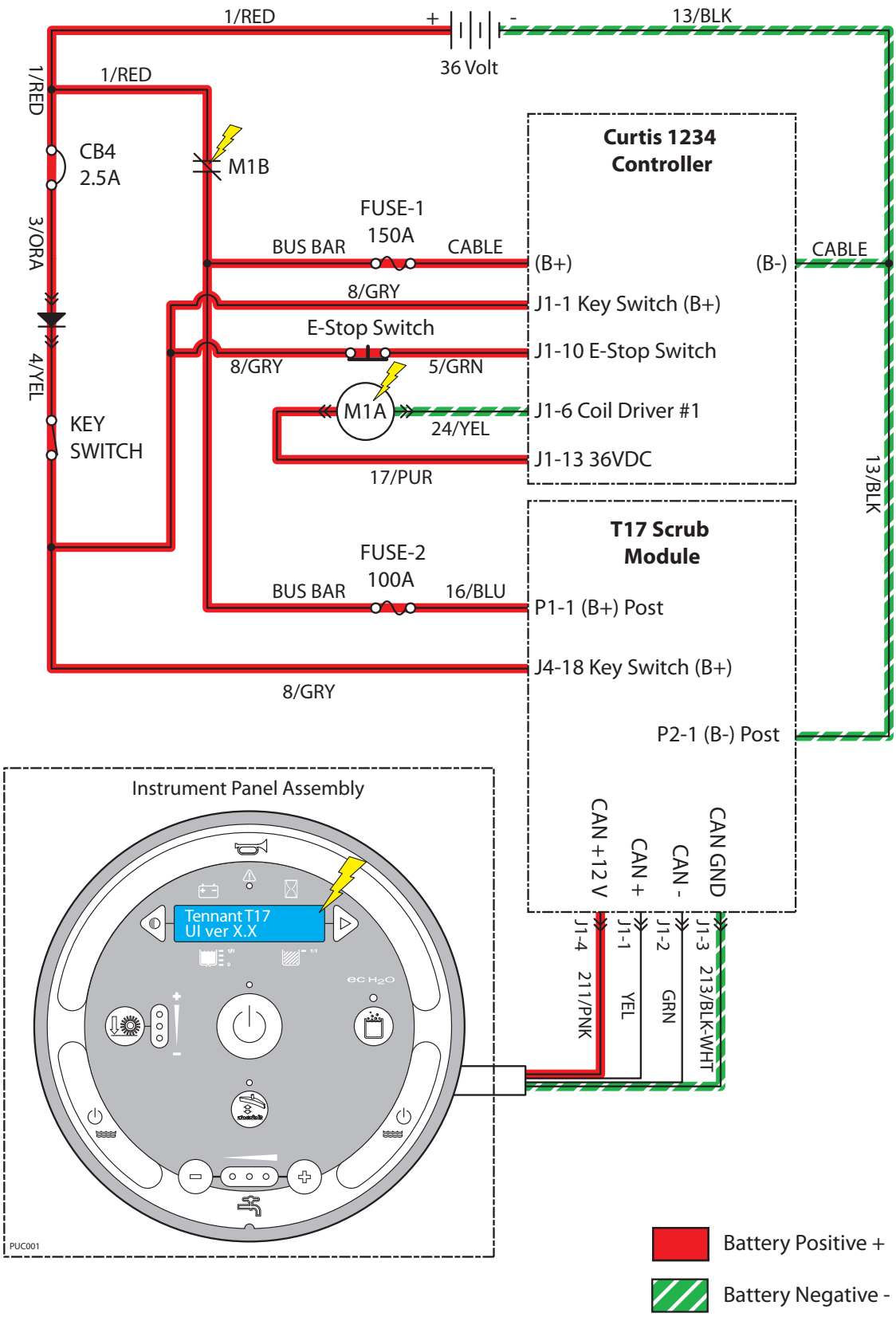
SBC004

Side Scrub Brush Failed to Turn ON/Lower

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable side scrub brush subsystem • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Motors Mode" section of this manual • Activate the side scrub brush in Motors mode • Do the scrub brushes turn On?		Go to Step #6	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-7,8 or J6-1,2,3 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Check brush for entangled debris or damage • Do any of the above conditions exist?		Repair or Replace Necessary Components	Go to Step #5
6	• Key On • Enable side scrub brush motor • Test voltage applied to the side scrub brush motor and lift actuator subsystems as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic? • *NOTE: The side scrub motor can be tested using the main brush motor connections of the wire harness. The side scrub motor must be removed to reach the main brush motor connections.*		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-7,8 = Side Scrub Module Connector #4, Pin #7 or 8
J6-1,2,3 = Side Scrub Module Connector #6, Pin #1, 2, or 3

Power-Up ON

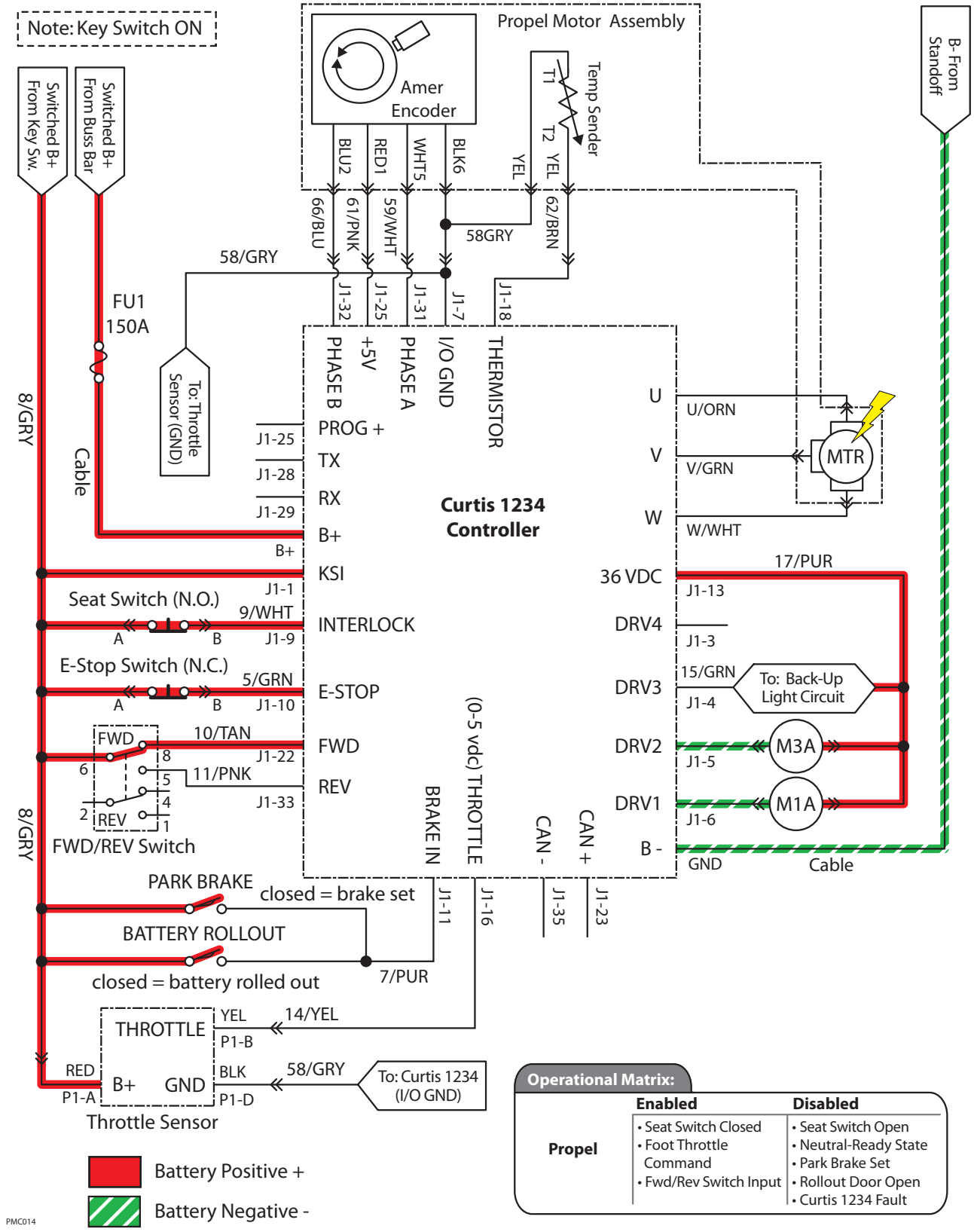

1/RED
+
-
13/BLK
36 Volt
1/RED
1/RED
CB4
2.5A
M1B
3/ORA
FUSE-1
150A
BUS BAR
CABLE
Curtis 1234
Controller
(B+)
(B-)
CABLE
8/GRY
J1-1 Key Switch (B+)
E-Stop Switch
J1-10 E-Stop Switch
8/GRY
5/GRN
4/YEL
M1A
J1-6 Coil Driver #1
24/YEL
KEY
SWITCH
J1-13 36VDC
17/PUR
13/BLK
T17 Scrub
Module
FUSE-2
100A
BUS BAR
16/BLU
P1-1 (B+) Post
J4-18 Key Switch (B+)
8/GRY
P2-1 (B-) Post
Instrument Panel Assembly
Tennant T17
UI ver X.X
CAN +12 V
CAN +
CAN -
CAN GND
J1-4
J1-1
J1-2
J1-3
211/PNK
YEL
GRN
213/BLK-WHT
PUC001
Battery Positive +
Battery Negative -

Machine Failed to Power Up

STEP	ACTION	VALUE(S)	YES	NO
1	• Key in On Position • Test the total battery voltage using a voltmeter • Is the total battery voltage greater than 30 VDC?		Go to Step #2	Recharge Batteries and Test Power-Up Circuit Operation
2	• Key Off • Firmly press circuit breaker 4 to reset • Is circuit breaker #4 tripped?		Reset and Test Power-Up Circuit Operation	Go to Step #3
3	• Key On • Test voltage applied to the power-up subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
VDC = DC Voltage

Propel Subsystem, Forward



Operational Matrix:

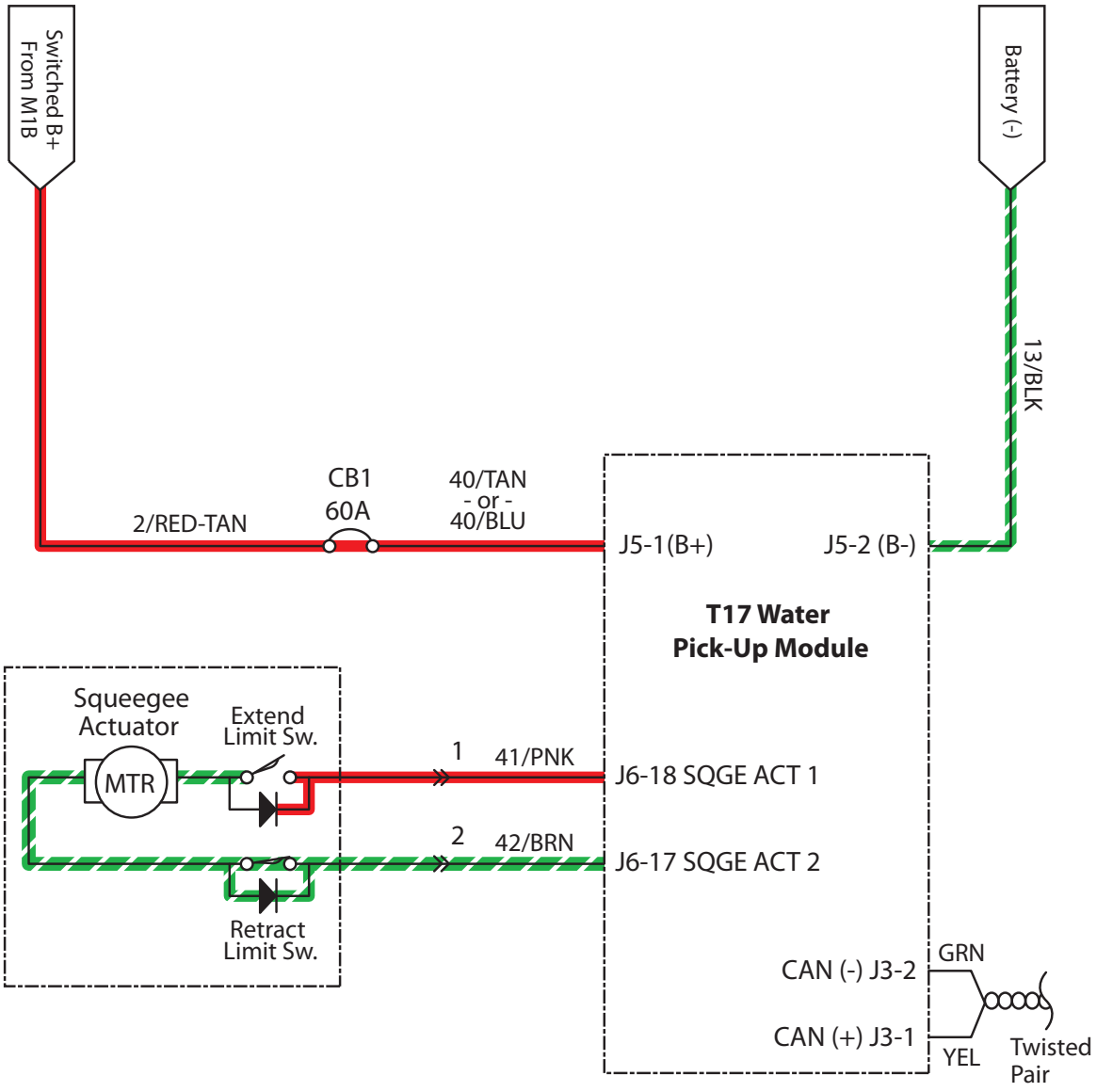
	Enabled	Disabled
Propel	• Seat Switch Closed • Foot Throttle Command • Fwd/Rev Switch Input	• Seat Switch Open • Neutral-Ready State • Park Brake Set • Rollout Door Open • Curtis 1234 Fault

Machine Failed to Propel

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • See "Curtis 1234 Controller Diagnostics" section of this manual • Does a Curtis 1234 controller fault condition exist?		Correct Fault Condition	Go to Step #2
2	• Key Off • See "Propel Diagnostic Mode" • Is P1:Curtis Online? • Does P2: Throttle input voltage (0-5 vdc) change proportionally with throttle pedal movement? • Does P3 :Brake pedal input turn On/Off with brake pedal activation? • Does P4: Direction input correspond with Fwd/Rev rocker switch position? • Does P5:Speed input from drive assembly encoder (speed, direction, position sensor) read "0000.0 Mph?" • Does P8:Propel motor current read "0000.0 Amps?" • Is the answer "Yes" to all of the above?		Go to Step #3	Correct Faulty Input Condition
3	• Key Off • Place machine on jackstands so drive wheel is lifted off the floor • Enable forward propel • Test voltage applied to the propel subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
VDC = Direct Current Voltage

Rear Squeegee Down, OFF



Battery Positive +

Battery Negative -

Operational Matrix:

	Enabled	Disabled
Squeegee Down	• 1-STEP Scrub ON • Squeegee/Vac ON	• 1-STEP Scrub OFF • Squeegee/Vac OFF • Reverse Propel • Recovery Tank Full • Very Low Batt Voltage • Circuit Fault

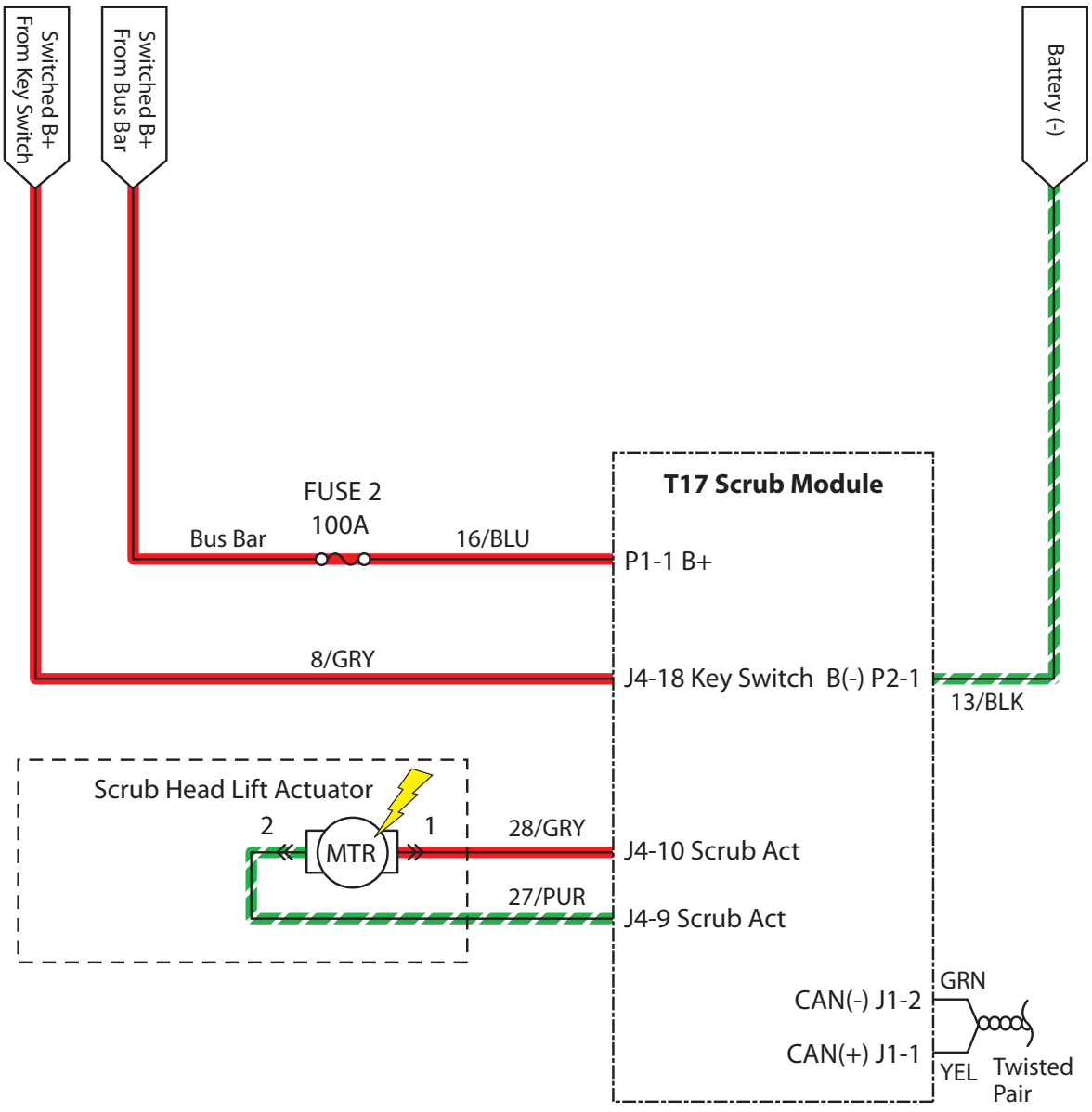
RSL001

Rear Squeegee Failed to Raise/Lower

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable rear squeegee down • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate the rear squeegee in manual mode • Does the rear squeegee raise/lower?		Go to Step #5	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J5-3 and J5-2 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • See TESTING REAR SQUEEGEE LIFT ACTUATOR in the SERVICE section of this manual • Does the rear squeegee lift actuator pass the testing?	See TESTING REAR SQUEEGEE LIFT ACTUATOR in the SERVICE section of this manual.	Go to Step #5	Replace Rear Squeegee Lift Actuator
5	• Key Off • Reconnect rear squeegee lift actuator to main wire harness • Test voltage applied to rear squeegee lift subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J5-3 = Water PU Module Connector #5, Pin #3
J5-2 = Water PU Module Connector #5, Pin #2

Scrub Head Lift



Battery Positive +

Battery Negative -

MSL001

Operational Matrix:

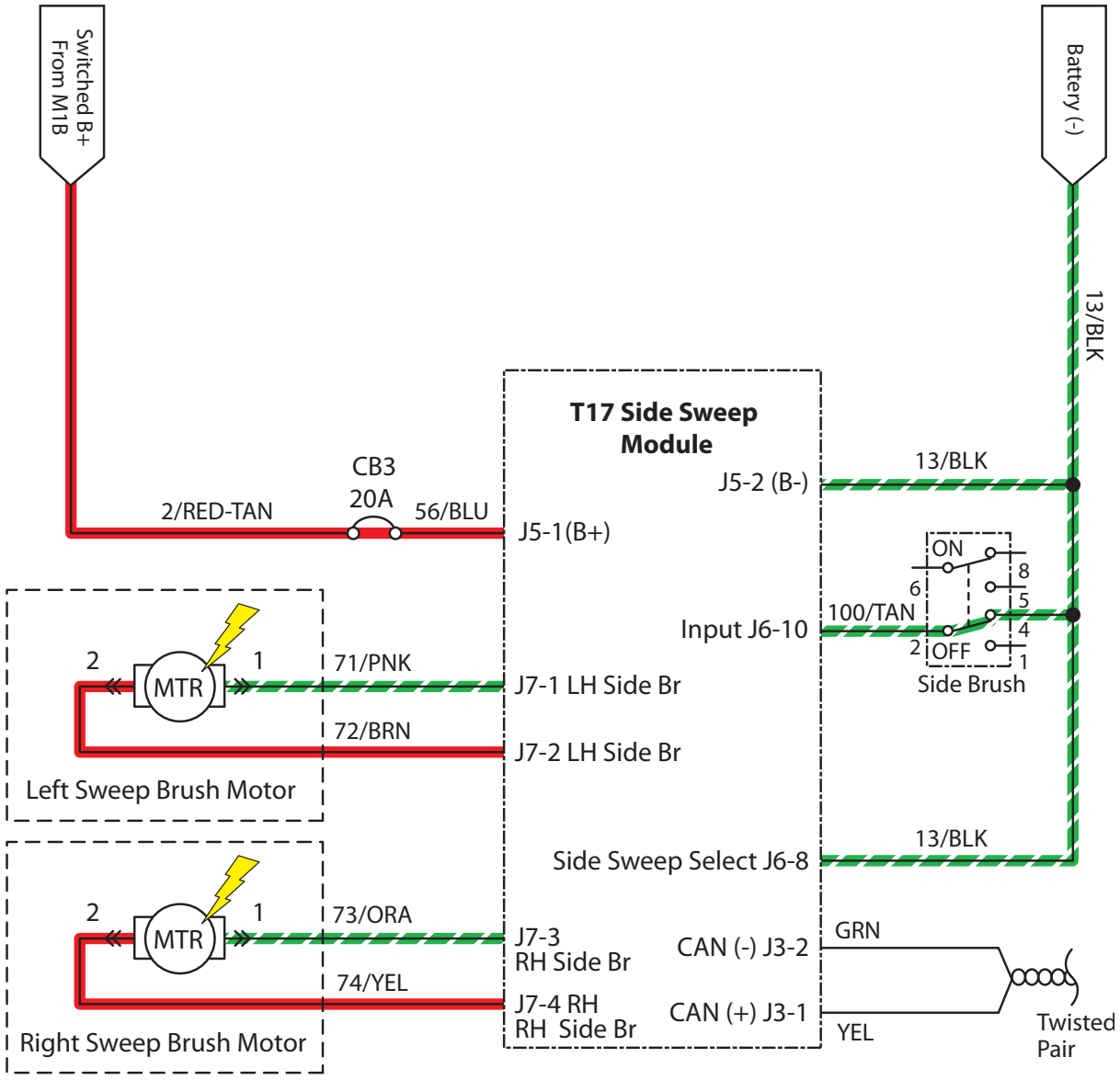
	Enabled	Disabled
Scrub Head Down	• 1-STEP Scrub ON • Fwd/Rev Propel	• 1-STEP Scrub OFF • Neutral-Ready State • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault

Scrub Head Failed to Raise/Lower

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable scrub head down • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate the scrub head in manual mode • Does the scrub head raise/lower?		Go to Step #5	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-9 and J4-10 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • See TESTING MAIN BRUSH LIFT ACTUATOR in the SERVICE section of this manual • Does the scrub head lift actuator pass the testing?	See TESTING MAIN BRUSH LIFT ACTUATOR	Go to Step #5	Replace Scrub Head Lift Actuator
5	• Key Off • Reconnect scrub head lift actuator to main wire harness • Test voltage applied to scrub head lift subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-9 = Scrub Module Connector #4, Pin #9
J4-10 = Scrub Module Connector #4, Pin #10

Side Sweep Brush(es) ON (Option)



Operational Matrix:

	Enabled	Disabled
Side Sweep Brush(es)	• 1-STEP Scrub ON • Side Brush Switch ON • Fwd/Rev Propel	• 1-STEP Scrub OFF • Side Brush Switch OFF • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault • Neutral (Ready State)

Battery Positive +

Battery Negative -

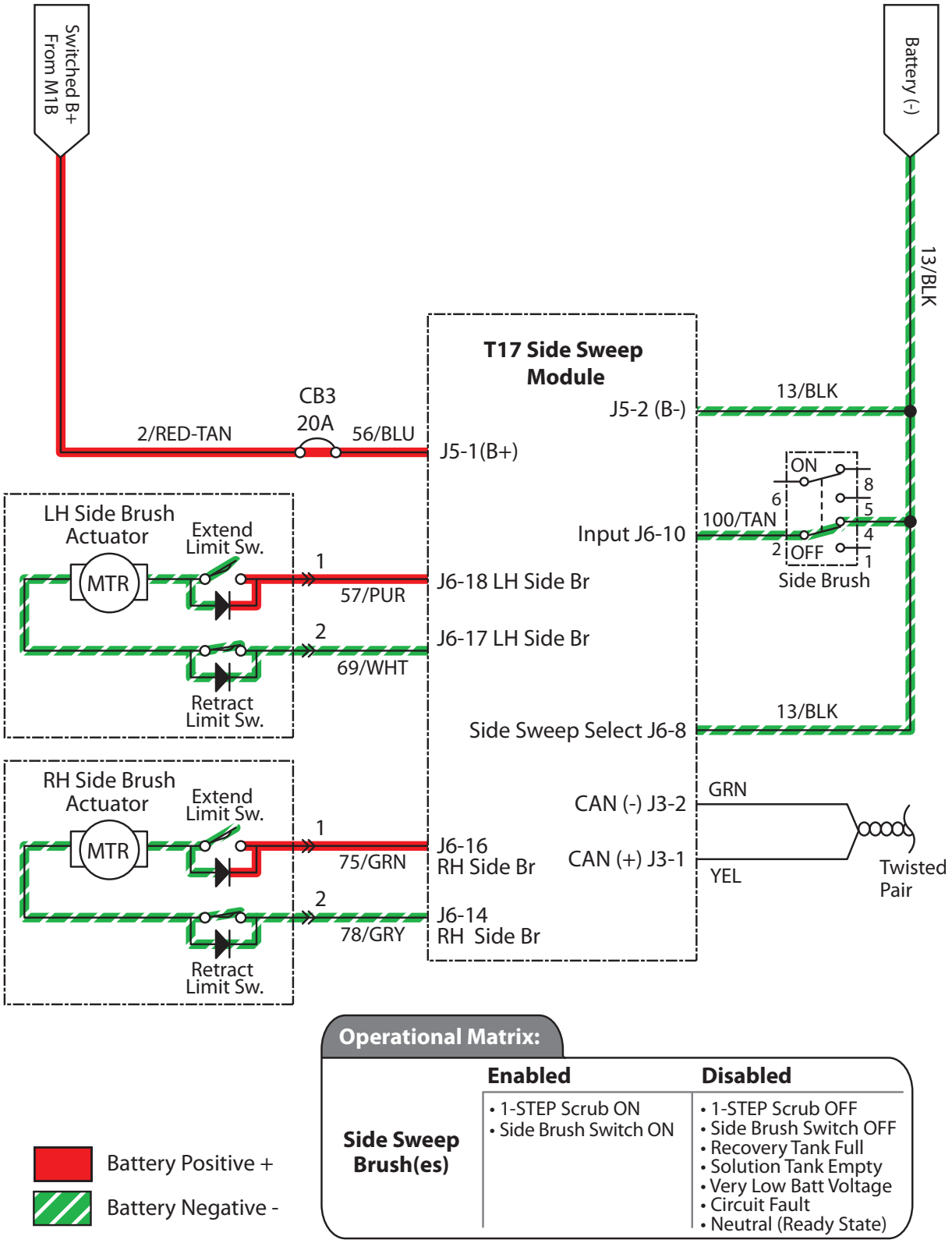
RSL001

Side Sweep Brush(es) Failed to Turn ON (Option)

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable side brush • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate the side brush in manual mode • Do the side brush turn On?		Go to Step #6	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J7-1,2 or J7-3,4 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • See "Input Display Mode" • Does I6: Side Sweep On/Off input correspond with side brush rocker switch position?		Go to Step #5	Correct Faulty Input Condition
5	• Key Off • See TESTING SIDE SWEEP BRUSH MOTOR in the SERVICE section of this manual • Does the side brush motor pass the testing?	See TESTING SIDE SWEEP BRUSH MOTOR	Go to Step #6	Replace Side Brush Motor
6	• Key Off • Reconnect side brush motor to main wire harness • Test voltage applied to side brush subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J7-1,2 = Side Sweep Module Connector #7, Pin #1 or 2
J7-3,4 = Side Scrub Module Connector #7, Pin #3 or 4

Side Sweep Brush(es) Extend/Down, OFF (Option)



Operational Matrix:

	Enabled	Disabled
Side Sweep Brush(es)	• 1-STEP Scrub ON • Side Brush Switch ON	• 1-STEP Scrub OFF • Side Brush Switch OFF • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault • Neutral (Ready State)

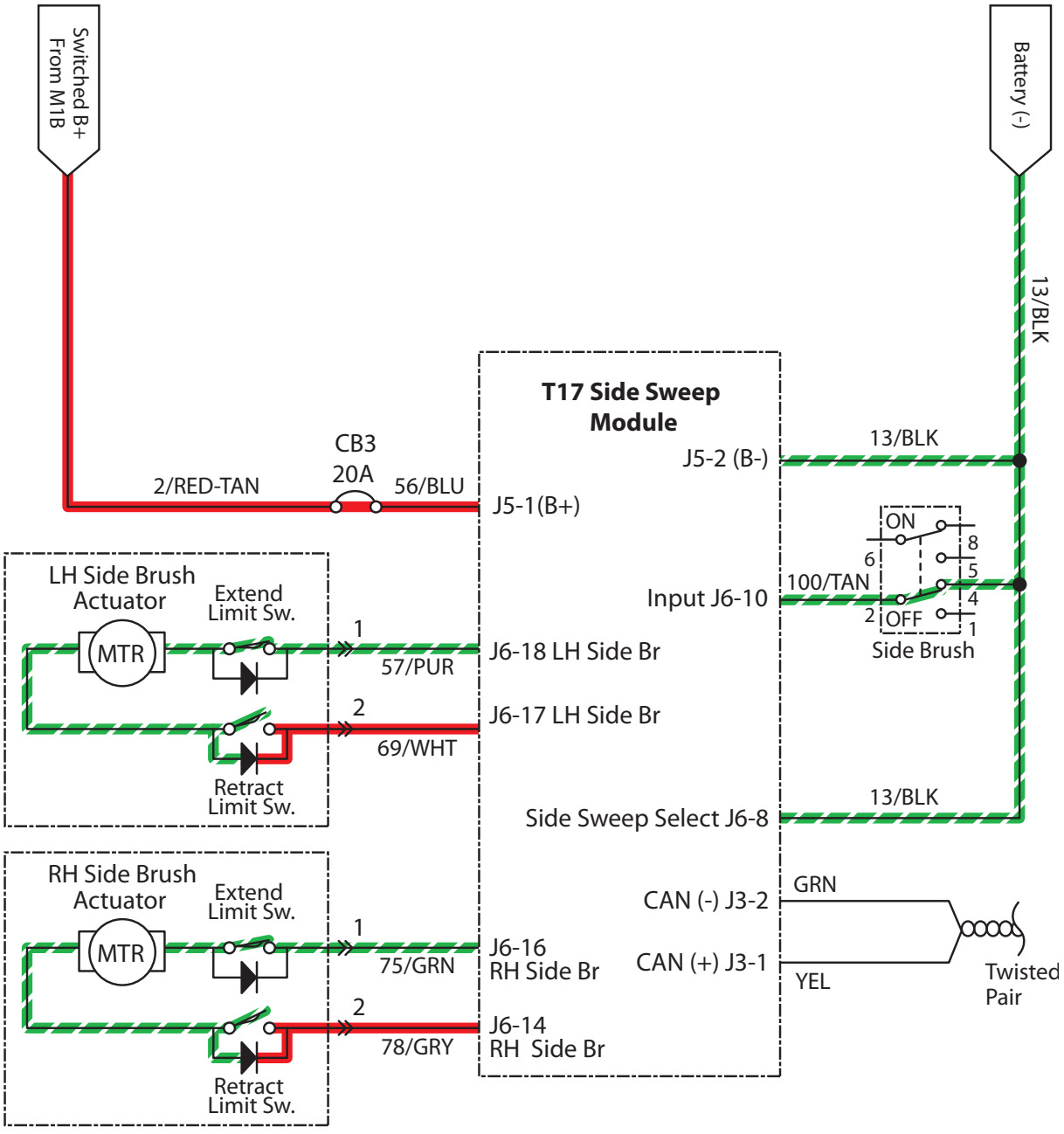
RSL001

Side Sweep Brush(es) Failed to Extend/Lower (Option)

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable side brush extend/down • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Extend/Lower the side brush in manual mode • Does the side brush extend/lower?		Go to Step #6	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J6-17,18 or J6-14,16 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • See "Input Display Mode" • Does I6: Side Sweep On/Off input correspond with side brush rocker switch position?		Go to Step #5	Correct Faulty Input Condition
5	• Key Off • See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR in the SERVICE section of this manual • Does the side brush lift actuator pass the testing?	See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR	Go to Step #6	Replace Side Brush Lift Actuator
6	• Key Off • Reconnect side brush lift actuator to main wire harness • Key On • Side brush extend/down enabled • Test voltage applied to side brush lift subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J6-17,18 = Side Sweep Module Connector #6, Pin #17 or 18
J6-14,16 = Side Scrub Module Connector #6, Pin #14 or 16

Side Sweep Brush(es) Retract/Up, OFF (Option)



Operational Matrix:

	Enabled	Disabled
Side Sweep Brush(es) Retract/Up	• 1-STEP Scrub OFF • Side Brush Switch OFF • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault	• 1-STEP Scrub ON • Side Brush Switch ON

Battery Positive +

Battery Negative -

RSL001

Side Sweep Brush(es) Failed to Retract/Raise (Option)

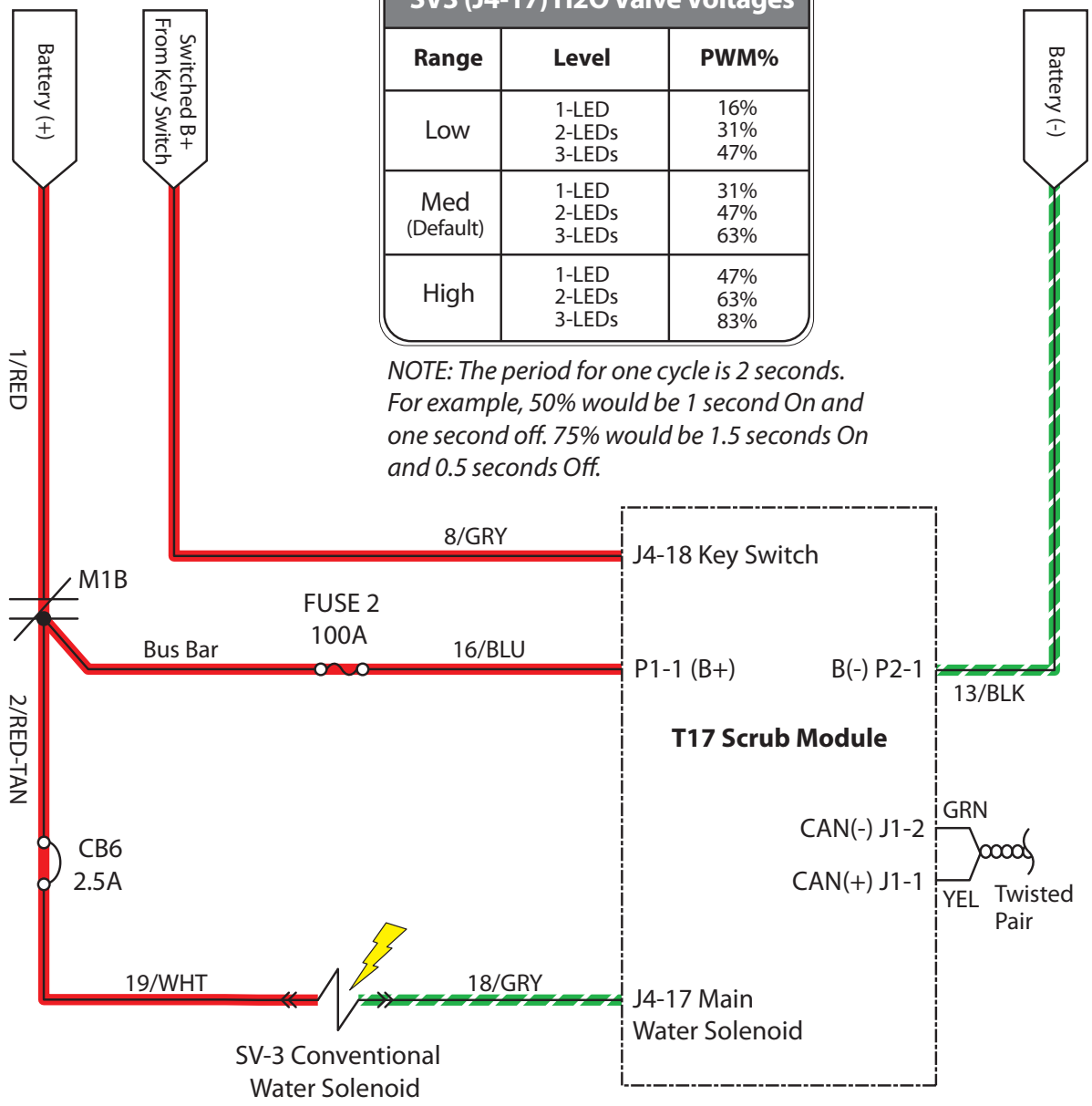
STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable side brush retract/up • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J6-17,18 or J6-14,16 as open or shorted?		Go to Step #3	Correct Faulty Input Condition
3	• Key Off • See "Input Display Mode" • Does I6: Side Sweep On/Off input correspond with side brush rocker switch position?		Go to Step #4	Correct Faulty Input Condition
4	• Key Off • See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR in the SERVICE section of this manual • Does the side brush lift actuator pass the testing?	See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR	Go to Step #5	Replace Side Brush Lift Actuator
5	• Key On • Side brush switch Off • Test voltage applied to side brush lift subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J6-17,18 = Side Sweep Module Connector #6, Pin #17 or 18
J6-14,16 = Side Scrub Module Connector #6, Pin #14 or 16

Solution Control ON - Main Brush (Conventional)

* SV3 (J4-17) H2O Valve Voltages		
Range	**Level**	**PWM%**
Low	1-LED 2-LEDs 3-LEDs	16% 31% 47%
Med (Default)	1-LED 2-LEDs 3-LEDs	31% 47% 63%
High	1-LED 2-LEDs 3-LEDs	47% 63% 83%

NOTE: The period for one cycle is 2 seconds. For example, 50% would be 1 second On and one second off. 75% would be 1.5 seconds On and 0.5 seconds Off.



Operational Matrix:

	Enabled	Disabled
Solution Control - Main (Conventional)	• 1-STEP Scrub ON • Solution Control ON • Fwd/Rev Propel	• 1-STEP Scrub OFF • Solution Control OFF • Neutral-Ready State • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault

Battery Positive +

Battery Negative -

CSC002

Solution Control Failed to Turn ON - Main Brush (Conventional)

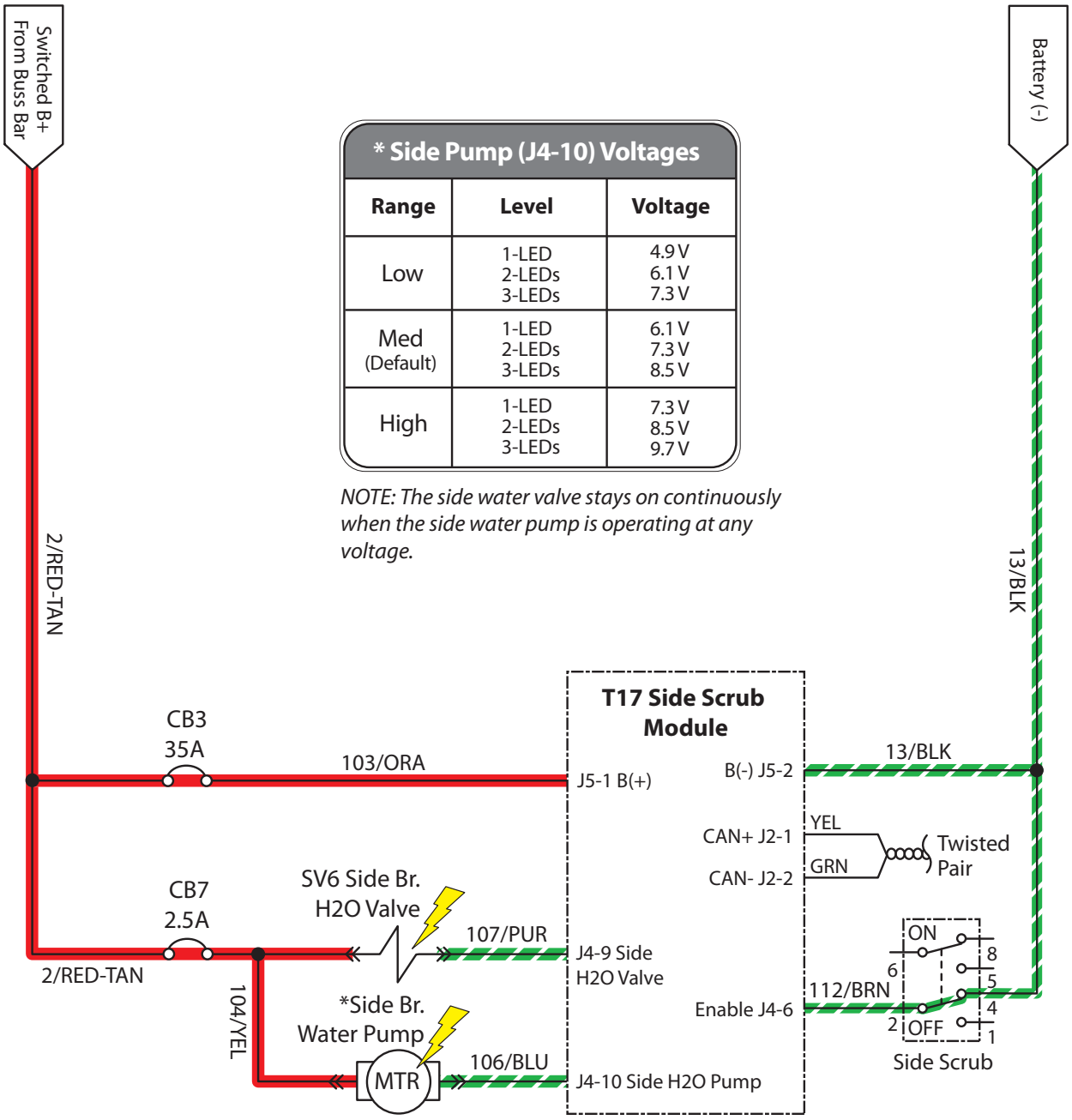
STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable solution control (conventional) • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate solution control in manual mode • Does the machine dispense water to the floor?		Go to Step #7	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuit J4-17 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Firmly press circuit breaker #6 to reset • Is circuit breaker #6 tripped?		Reset and Test Solution Control Operation	Go to Step #5
5	• Key Off • Disconnect SV3 from main wire harness • Apply battery voltage to SV3 using fuse-protected jumper leads • Does the main brush dispense solution?		Go to Step #6	Repair or Replace S3
6	• Key Off • Reconnect SV3 to main wire harness • Key On • Enable solution control (conventional) • Test voltage applied to solution control subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-17 = Scrub Module Connector #4, Pin #17
SV3 = Solenoid Valve #3 (Main Brush)

Solution Control ON - Side Brush (Conventional)

* Side Pump (J4-10) Voltages		
Range	**Level**	**Voltage**
Low	1-LED 2-LEDs 3-LEDs	4.9 V 6.1 V 7.3 V
Med (Default)	1-LED 2-LEDs 3-LEDs	6.1 V 7.3 V 8.5 V
High	1-LED 2-LEDs 3-LEDs	7.3 V 8.5 V 9.7 V

NOTE: The side water valve stays on continuously when the side water pump is operating at any voltage.



Operational Matrix:		
	Enabled	**Disabled**
Solution Control-Side (Conventional)	• 1-STEP Scrub ON • Side Brush Switch ON • Fwd/Rev Propel	• 1-STEP Scrub OFF • Side Brush Switch OFF • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault • Neutral (Ready State)

Battery Positive +

Battery Negative -

SBC004

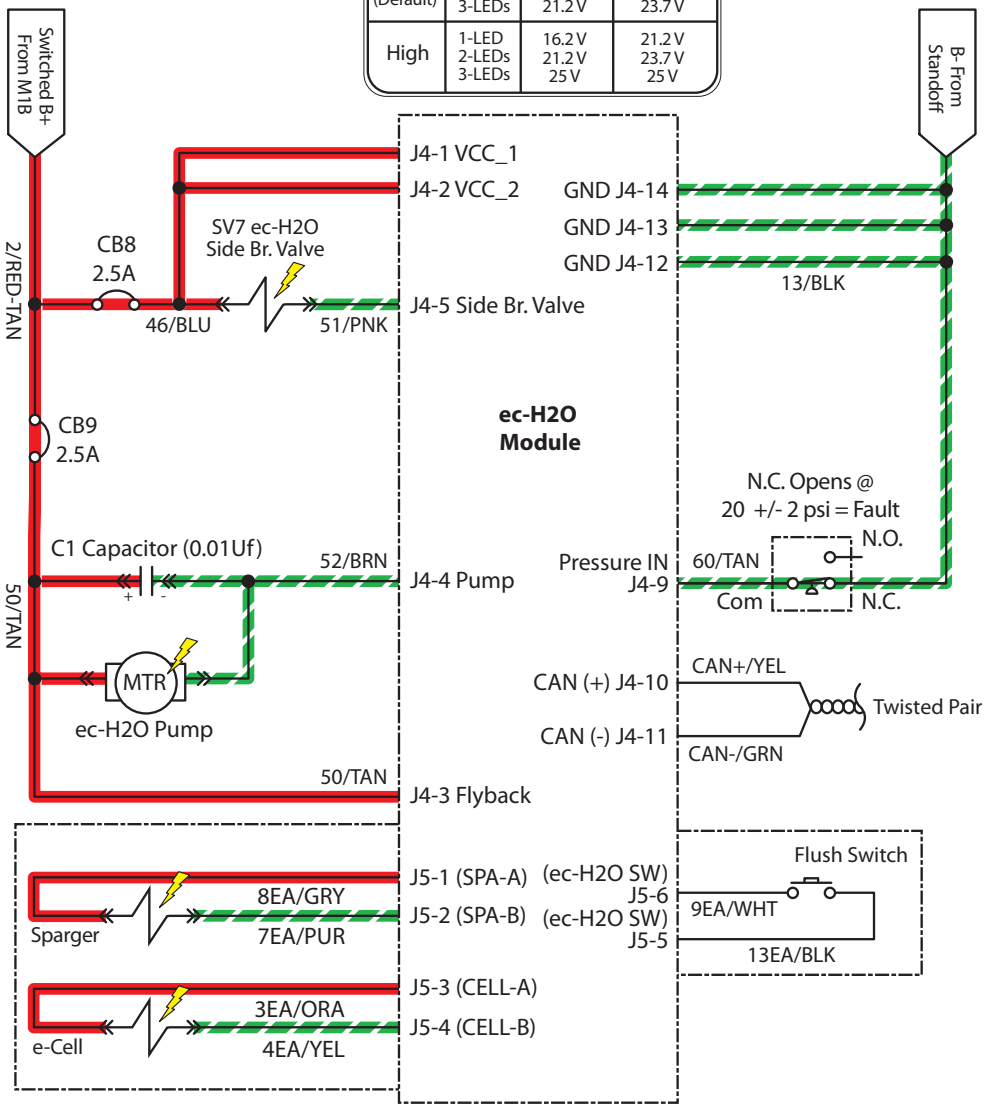
Solution Control Failed to Turn ON - Side Brush (Conventional)

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable side brush solution control (conventional) • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate solution control in manual mode • Does the machine dispense water to the side brush?		Go to Step #7	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-10 or J4-9 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Firmly press circuit breaker #3 to reset • Is circuit breaker #3 tripped?		Reset and Test Solution Control Operation	Go to Step #5
5	• Key Off • Firmly press circuit breaker #7 to reset • Is circuit breaker #7 tripped?		Reset and Test Solution Control Operation	Go to Step #6
6	• Key Off • Disconnect SV6 and side brush water pump from main wire harness • Apply battery voltage to SV6 and side brush water pump using fuse-protected jumper leads • Does the side brush dispense solution?		Go to Step #7	Repair or Replace SV6 or Side Brush Water Pump
7	• Key Off • Reconnect SV6 and side brush water pump to main wire harness • Key On • Enable side brush solution control (conventional) • Test voltage applied to the side brush solution control subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-9 = Side Scrub Module Connector #4, Pin #9
J4-10 = Side Scrub Module Connector #4, Pin #10
SV6 = Solenoid Valve #6 (Side Brush)

Solution Control ON *(ec-H2O)*

* Ec Pump (J4-4) Voltages			
Range	**Level**	**Voltage**	**+ Side Br**
Low	1-LED 2-LEDs 3-LEDs	7.5 V 11.2 V 16.2 V	12.5 V 16.2 V 21.2 V
Med (Default)	1-LED 2-LEDs 3-LEDs	11.2 V 16.2 V 21.2 V	17.5 V 21.2 V 23.7 V
High	1-LED 2-LEDs 3-LEDs	16.2 V 21.2 V 25 V	21.2 V 23.7 V 25 V



Battery Positive +

Battery Negative -

ECC001

Operational Matrix:

	Enabled	Disabled
Solution Control (ec-H2O)	• 1-STEP Scrub ON • Solution Control ON • ec-H2O Button ON • Fwd/Rev Propel	• 1-STEP Scrub OFF • Solution Control OFF • ec-H2O Button OFF/SE ON • Neutral-Ready State • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • ec-H2O System Fault • Circuit Fault

Solution Control Failed to Turn ON *(ec-H2O)*

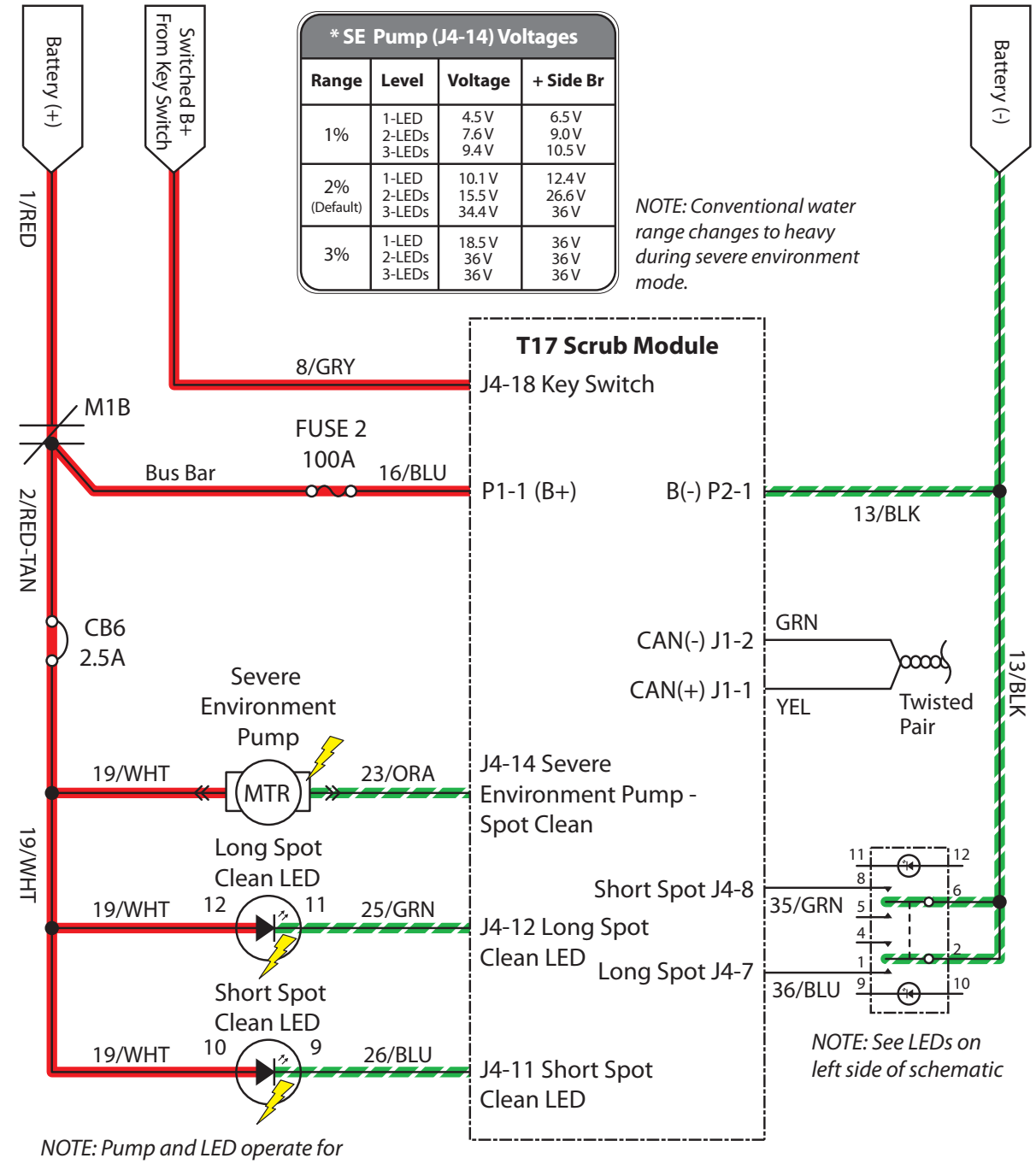
STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable solution control (*ec-H2O*) • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • Firmly press circuit breakers #8 and #9 to reset • Is a circuit breaker tripped?		Reset and Test *ec-H2O* Solution Control Operation	Go to Step #3
3	• Key Off • Enable solution control (*ec-H2O*) • Is the *ec-H2O* LED flashing RED, indicating a system restriction or low water conductivity*?		See "*ec-H2O* Module Flush Procedure" Section. Then Proceed to Step #4	Go to Step #5
4	• Key Off • See "ec-H2O Module Flush Procedure" section of this manual • Did the flush procedure fix the problem?		System OK	See "Testing *ec-H2O* Pressure Switch"
5	• Key Off • See "Manual Mode" section of this manual • Activate solution control (ec-H2O) in manual mode • Does solution control (ec-H2O) turn On?		Go to Step #8	Go to Step #6
6	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-4,5 or J5-1,2 or J5-3,4 as open or shorted?	See "Self-Test Mode"	Correct Open or Short Circuit Condition	Go to Step #7
7	• Key Off • Disconnect *ec-H2O* water pump from wire harness • Apply battery voltage to *ec-H2O* water pump using fuse-protected jumper leads • Does the *ec-H2O* water pump dispense water?		Go to Step #8	Repair or Replace *ec-H2O* Water Pump
8	• Key Off • Reconnect *ec-H2O* water pump to wire harness • Key On • Enable solution control (*ec-H2O*) • Test voltage applied to solution control (*ec-H2O*) system as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go to Step #9	Identify Voltage Drop Location and Repair or Replace Necessary Components
9	• Key On • Enable solution control (*ec-H2O*) • Is the *ec-H2O* LED solid RED, indicating an overcurrent condition on a system component?		Replace *ec-H2O* Module	Go Back to Step #1

**NOTE: Add 1/2 tablespoon of salt for every 10 gallons of water in the solution tank to increase water conductivity.*

Terms:

LCD = Liquid Crystal Display
LED = Light Emitting Diode
J4-4 = ec-H2O Module Connector #4, Pin #4
J4-5 = ec-H2O Module Connector #4, Pin #5
J5-1 = ec-H2O Module Connector #5, Pin #1
J5-2 = ec-H2O Module Connector #5, Pin #2
J5-3 = ec-H2O Module Connector #5, Pin #3
J5-4 = ec-H2O Module Connector #5, Pin #4

Severe Environment - Spot Cleaning



* SE Pump (J4-14) Voltages			
Range	**Level**	**Voltage**	**+ Side Br**
1%	1-LED 2-LEDs 3-LEDs	4.5 V 7.6 V 9.4 V	6.5 V 9.0 V 10.5 V
2% (Default)	1-LED 2-LEDs 3-LEDs	10.1 V 15.5 V 34.4 V	12.4 V 26.6 V 36 V
3%	1-LED 2-LEDs 3-LEDs	18.5 V 36 V 36 V	36 V 36 V 36 V

NOTE: Conventional water range changes to heavy during severe environment mode.

NOTE: Pump and LED operate for duration set in configuration mode. Default duration is 30 seconds (short) and 36 minutes (long).

Battery Positive +

Battery Negative -

CSC003

Operational Matrix:

	Enabled	Disabled
Severe Environment Spot Clean	• 1-STEP Scrub ON • Solution Control ON • Fwd/Rev Propel • SE Switch On	• 1-STEP Scrub OFF • Solution Control OFF • Neutral-Ready State • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault

Severe Environment - Spot Cleaning Failed to Turn On

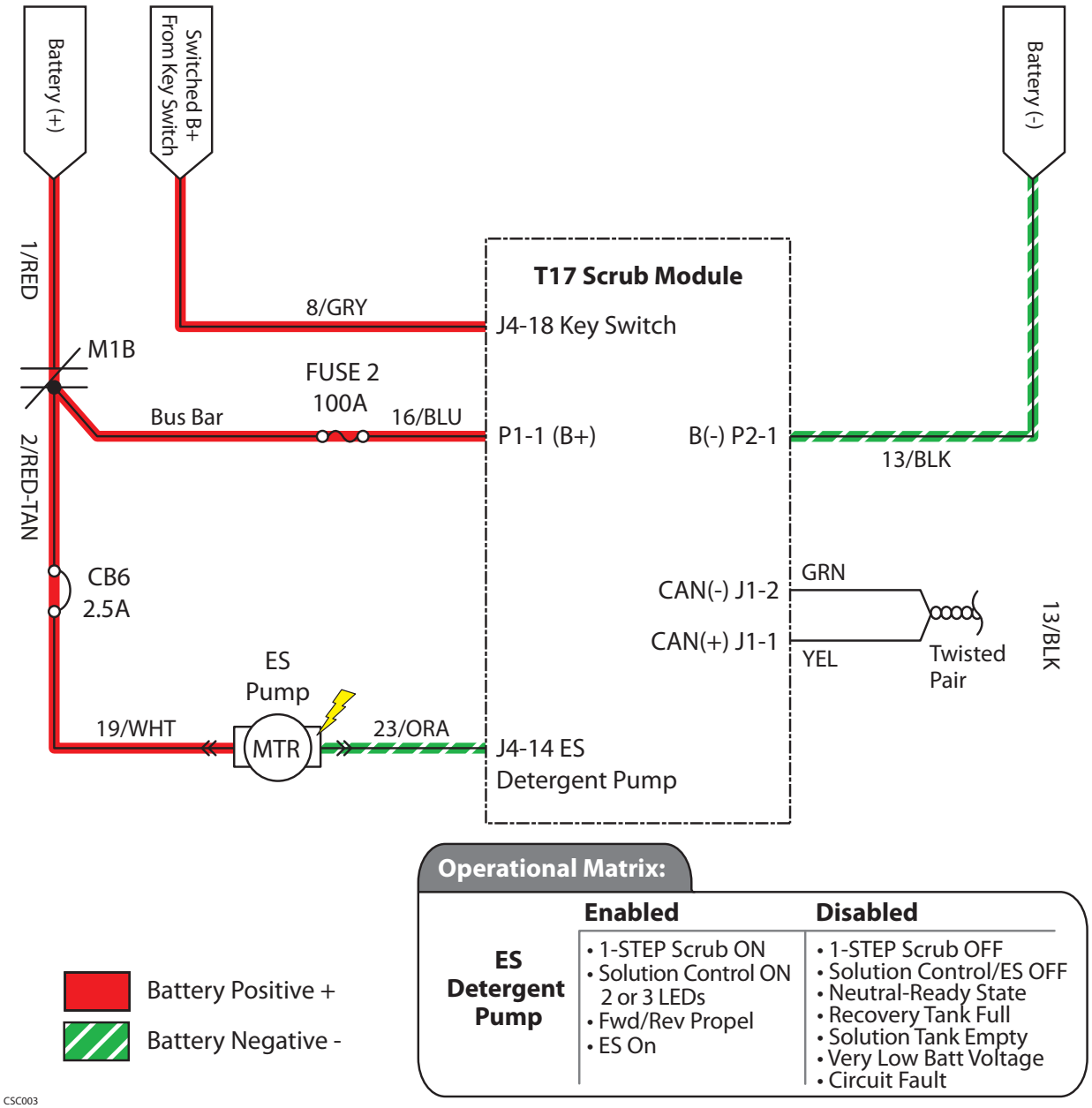
STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable severe environment - spot clean • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate detergent pump in manual mode • Does the pump dispense detergent?		Go to Step #7	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-14, J4-12, or J4-11 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Firmly press circuit breaker #6 to reset • Is circuit breaker #6 tripped?		Reset and Test SE-Spot Clean Operation	Go to Step #5
5	• Key Off • Check to be sure there is detergent in the concentrate tank • Disconnect detergent pump from main wire harness • Apply battery voltage to detergent pump using fuse-protected jumper leads • Does the pump dispense detergent?		Go to Step #6	Repair or Replace detergent pump
6	• Key Off • Reconnect detergent pump to main wire harness • Key On • Enable severe environment subsystem • Test voltage applied to the severe environment subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-14 = Scrub Module Connector #4, Pin #14
J4-12 = Scrub Module Connector #4, Pin #12
J4-11 = Scrub Module Connector #4, Pin #11

ES Detergent Pump

ES Detergent Pump Voltages

ES w/o Side Brush	Economy 1 LED	Economy 2 LEDs	Economy 3 LEDs	Normal 1 LED	Normal 2 LEDs	Normal 3 LEDs	Heavy 1 LED	Heavy 2 LEDs	Heavy 3 LEDs
1% Dilution	0V	2.0V	4.5V	0V	6.8V	10.1V	0V	9.8V	18.5V
2% Dilution	0V	4.5V	7.6V	0V	10.1V	15.5V	0V	18.5V	36V
3% Dilution	0V	7.6V	9.4V	0V	15.5V	34.4V	0V	36V	36V
ES w/ Side Brush	**Economy 1 LED**	**Economy 2 LEDs**	**Economy 3 LEDs**	**Normal 1 LED**	**Normal 2 LEDs**	**Normal 3 LEDs**	**Heavy 1 LED**	**Heavy 2 LEDs**	**Heavy 3 LEDs**
1% Dilution	0V	3.0V	6.5V	0V	9.0V	12.4V	0V	12.7V	36V
2% Dilution	0V	6.5V	9.0V	0V	12.4V	26.6V	0V	36V	36V
3% Dilution	0V	9.0V	10.5V	0V	26.6V	36V	0V	36V	36V



Operational Matrix:

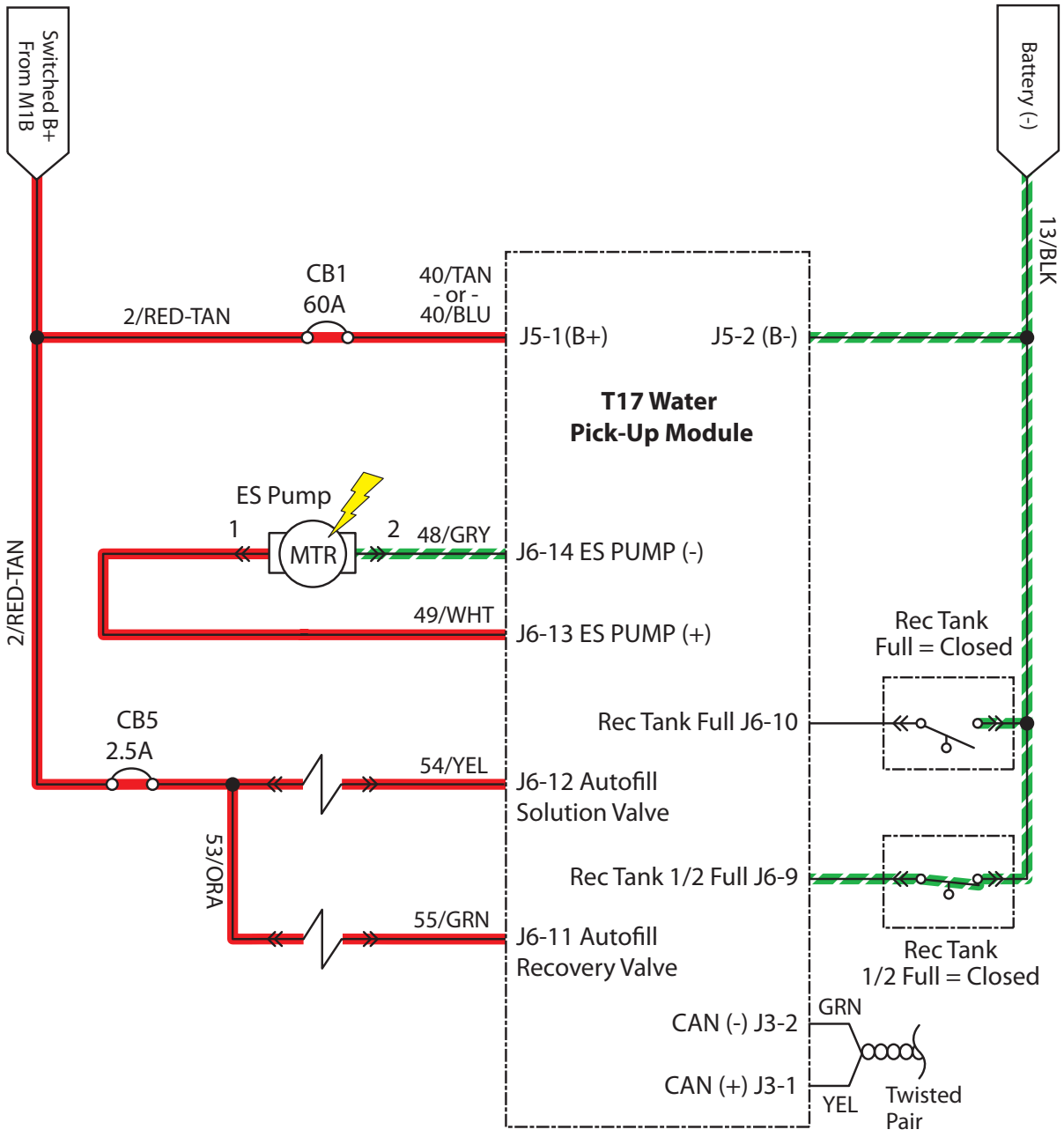
	Enabled	Disabled
ES Detergent Pump	• 1-STEP Scrub ON • Solution Control ON 2 or 3 LEDs • Fwd/Rev Propel • ES On	• 1-STEP Scrub OFF • Solution Control/ES OFF • Neutral-Ready State • Recovery Tank Full • Solution Tank Empty • Very Low Batt Voltage • Circuit Fault

ES Detergent Pump Failed to Turn On

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable ES scrubbing technology • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate detergent pump in manual mode • Does the pump dispense detergent?		Go to Step #7	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J4-14 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Firmly press circuit breaker #6 to reset • Is circuit breaker #6 tripped?		Reset and Test ES Detergent Pump Operation	Go to Step #5
5	• Key Off • Check to be sure there is detergent in the concentrate tank • Disconnect detergent pump from main wire harness • Apply battery voltage to detergent pump using fuse-protected jumper leads • Does the pump dispense detergent?		Go to Step #6	Repair or Replace detergent pump
6	• Key Off • Reconnect detergent pump to main wire harness • Key On • Enable ES detergent pump • Test voltage applied to the ES detergent pump as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J4-14 = Scrub Module Connector #4, Pin #14

ES Water Pump



Operational Matrix:

	Enabled	Disabled
ES Water Pump	• 1-STEP Scrub ON • Squeegee/Vac ON • ES On • Rec Tank 1/2 Full • Sol Tank Not Full	• 1-STEP Scrub OFF • Squeegee/Vac OFF • Sol/Rec Tank Full • ES Off • Very Low Batt Voltage • Circuit Fault

Battery Positive +

Battery Negative -

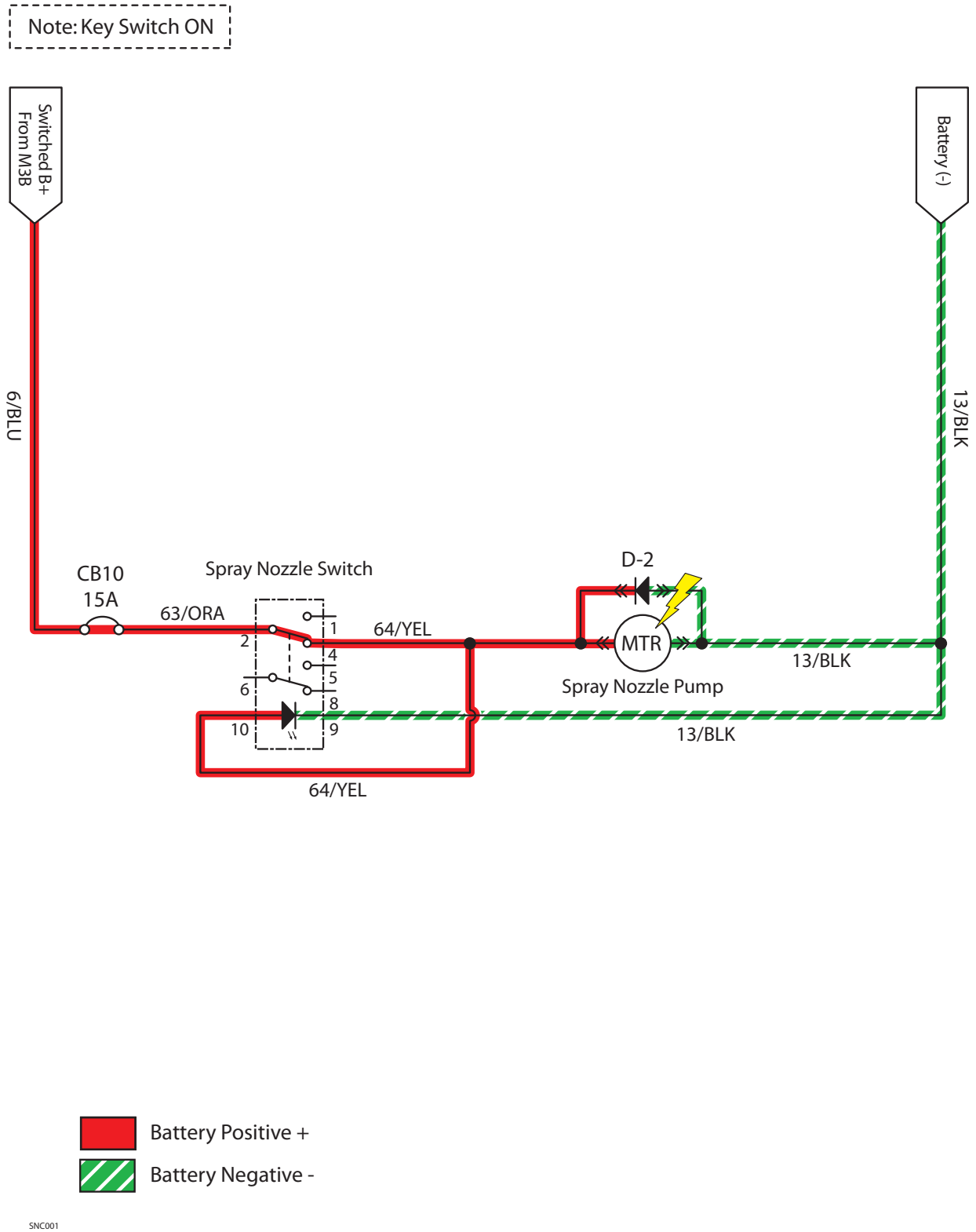
RSL001

ES Water Pump Failed to Turn On

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable ES scrubbing technology • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate ES pump in manual mode • Does the ES pump turn On?		Go to Step #7	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J6-13,14 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • Firmly press circuit breaker #1 to reset • Is circuit breaker #1 tripped?		Reset and Test ES Pump Operation	Go to Step #5
5	• Key Off • Check to be sure there is water in the recovery tank and that the solution tank is not full • Disconnect ES pump from main wire harness • Apply battery voltage to ES pump using fuse-protected jumper leads • Does the ES pump transfer water from the recovery tank to the solution tank?		Go to Step #6	Repair or Replace ES pump
6	• Key Off • Reconnect ES pump to main wire harness • Key On • Enable ES pump • Test voltage applied to the ES pump as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J6-14 = Scrub Module Connector #6, Pin #14

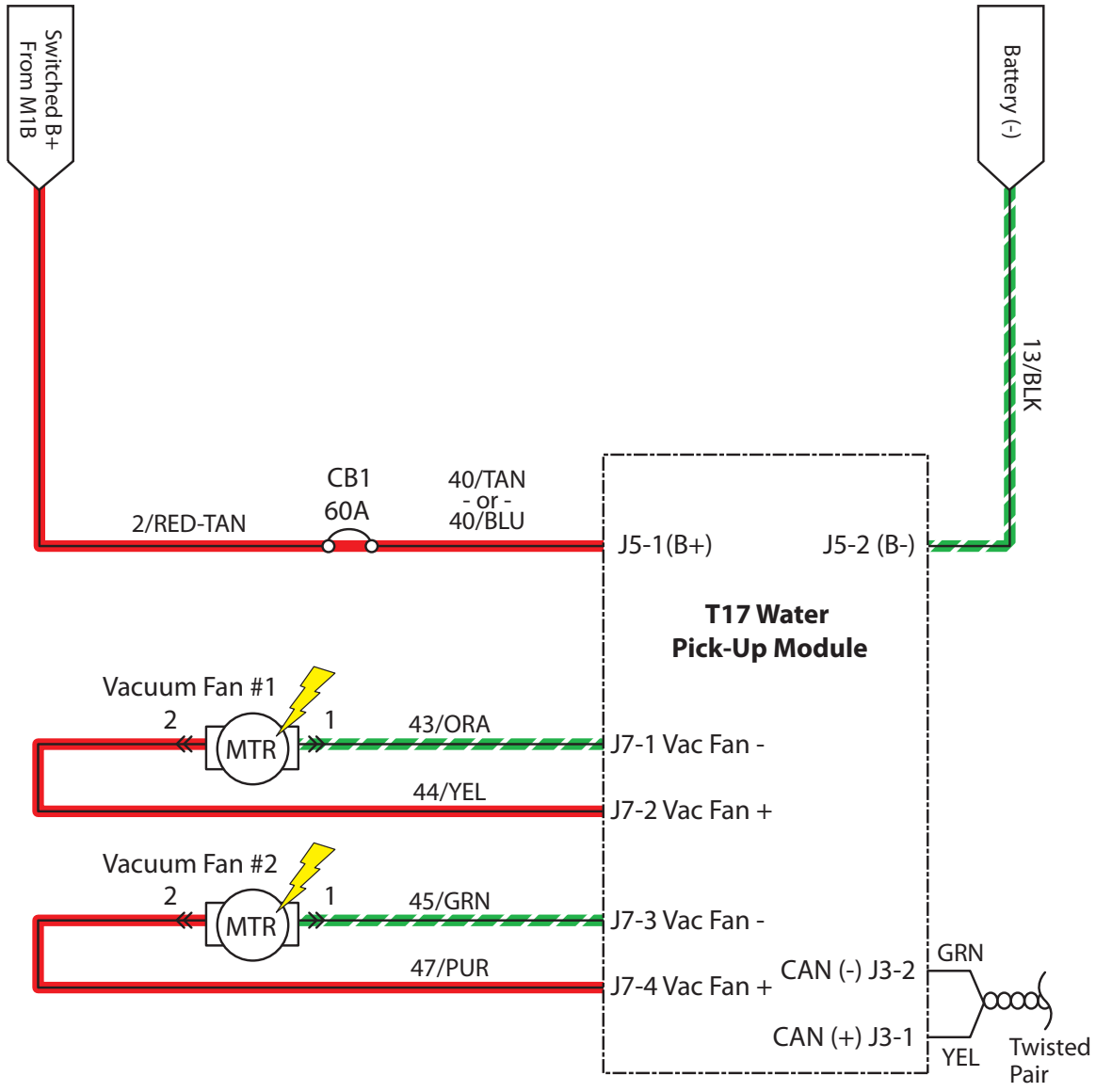
Spray Nozzle ON (Option)



Spray Nozzle Failed to Turn ON (Option)

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable spray nozzle subsystem • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • Firmly press circuit breaker #10 to reset • Is circuit breaker #10 tripped?		Reset and Test Spray Nozzle Operation	Go to Step #3
3	• Key Off • Disconnect spray nozzle water pump from wire harness • Apply battery voltage to spray nozzle water pump using fuse-protected jumper leads • Does the spray nozzle water pump dispense water?		Go to Step #4	Repair or Replace Spray Nozzle Water Pump
4	• Key Off • Reconnect spray nozzle water pump to wire harness • Key On • Turn spray nozzle switch On • Test voltage applied to spray nozzle subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Scrub Vacuum Fans ON



Battery Positive +

Battery Negative -

Operational Matrix:

	Enabled	Disabled
Vacuum Fans	• 1-STEP Scrub ON • Squeegee/Vac ON	• 1-STEP Scrub OFF • Squeegee/Vac OFF • Recovery Tank Full • Very Low Batt Voltage • Circuit Fault

RSL001

Scrub Vacuum Fan(s) Failed to Turn ON

STEP	ACTION	VALUE(S)	YES	NO
1	• Key On • Enable scrubbing vacuum fans • Is there a pertinent LCD warning or fault message displayed?		See "LCD Warnings" or "LCD Faults" Sections	Go to Step #2
2	• Key Off • See "Manual Mode" section of this manual • Activate vacuum fans in manual mode • Do the vacuum fans turn On?		Go to Step #5	Go to Step #3
3	• Key Off • See "Self-Test Mode" • Does the Self-Test display output circuits J7-1,2 or J7-3,4 as open or shorted?		Correct Open or Short Circuit Condition	Go to Step #4
4	• Key Off • See TESTING VACUUM FAN (SCRUBBING) in the SERVICE section of this manual • Do the vacuum fan motors pass the testing?	See TESTING VACUUM FAN (SCRUBBING)	Go to Step #5	Repair or Replace Vacuum Fan Motor
5	• Key Off • Reconnect vacuum fan motor to main wire harness • Key On • Enable scrubbing vacuum fan subsystem • Test voltage applied to the scrubbing vacuum fan subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic?		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:
LCD = Liquid Crystal Display
J7-1,2 = Water PU Module Connector #7, Pin #1 or 2
J7-3,4 = Water PU Module Connector #7, Pin #3 or 4

SECTION 5

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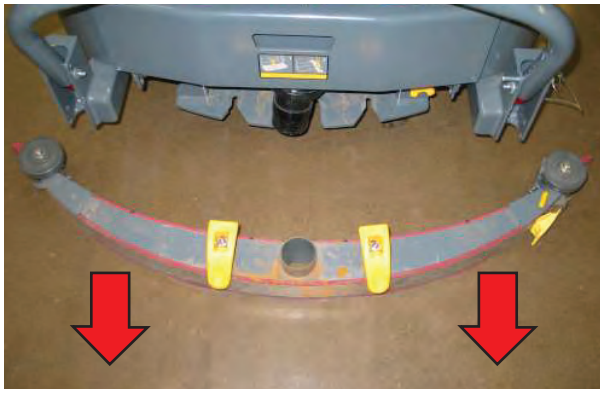
REAR SQUEEGEE LIFT

REMOVING REAR SQUEEGEE LIFT ACTUATOR

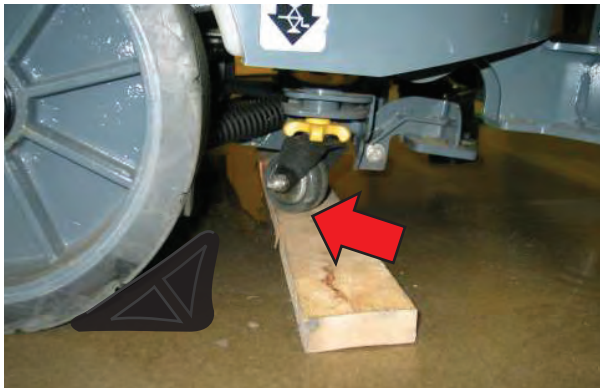
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Remove rear squeegee and set aside.

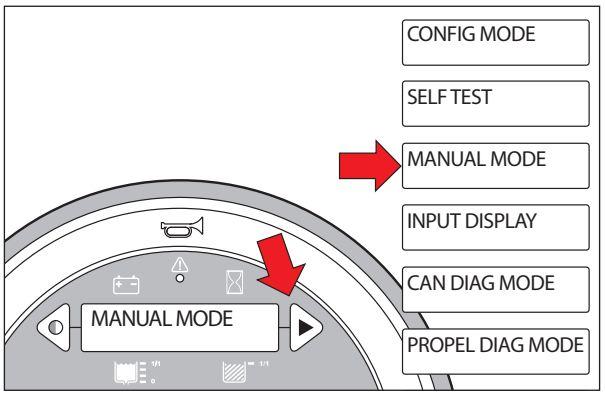


2. Lift front of machine as shown below. Be sure to use wheel chocks and jack stands.

3. *Proceed to next step if actuator failed in lowered position.* Carefully support rear squeegee mounting bracket using a spacer block. This removes any spring tension from the lift cable.

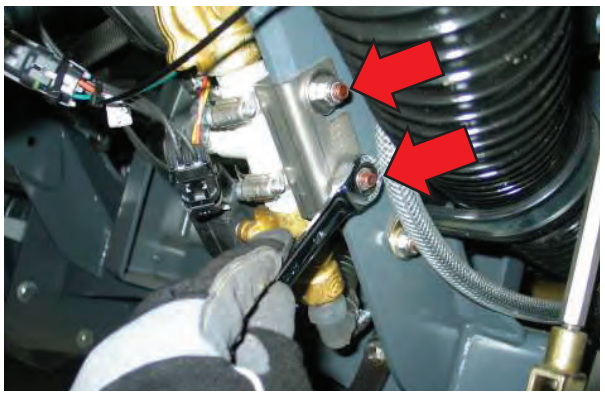


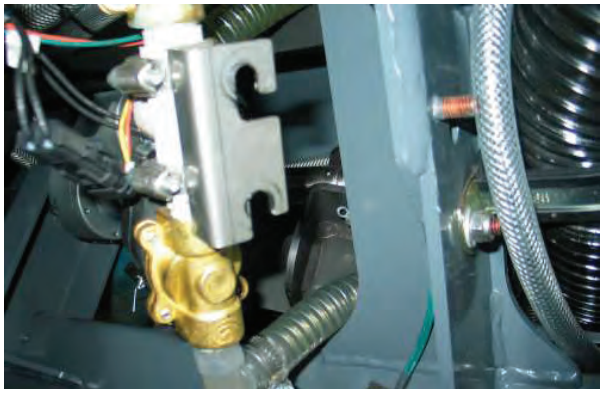
4. Enter Manual Mode and lower scrub head completely (See Manual Mode in the Troubleshooting section of this manual). Turn key Off immediately when head touches the floor.



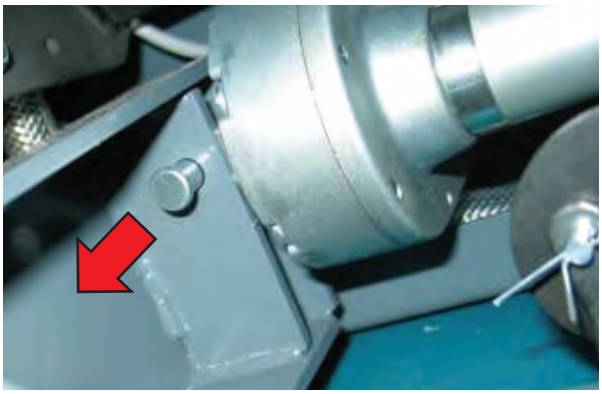
NOTE: Cylindrical Scrub Head Only: Remove debris tray from rear of scrub head to allow for additional clearance.

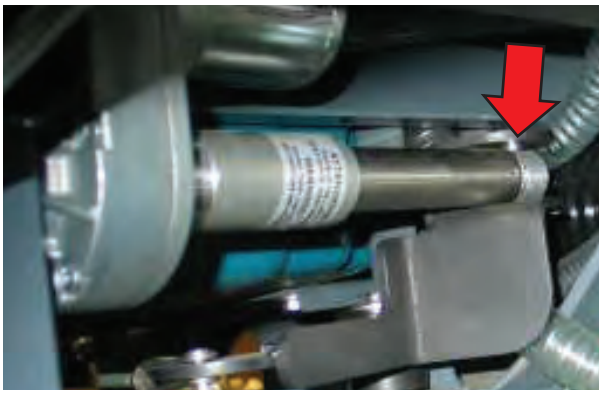
5. Loosen autofill valve mounting bracket (option) and carefully move the valve assembly aside to allow access to the lift actuator clevis pin.



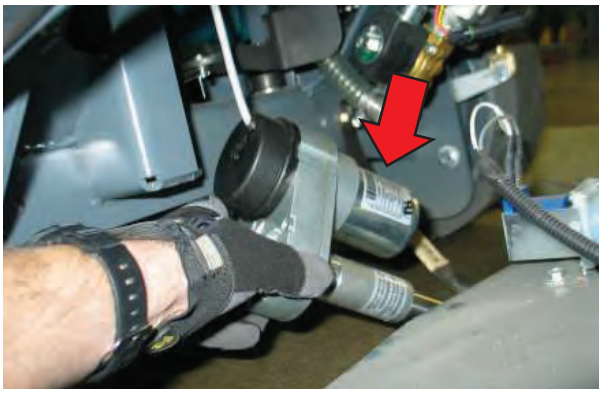


6. Remove lift actuator cotter and clevis pins and set hardware aside. Cut zip tie and disconnect lift actuator from wire harness.





7. Remove lift actuator.

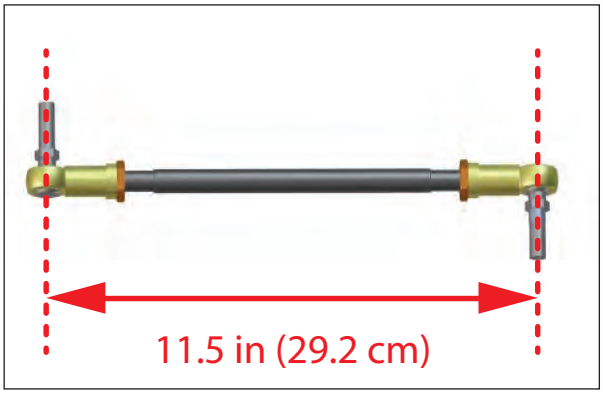


INSTALLING REAR SQUEEGEE LIFT ACTUATOR

1. Installation is reverse of removal.

REAR SQUEEGEE LINKAGE ROD ADJUSTMENT

1. The initial squeegee linkage rod adjustment is 11.5 in (29.2 cm) center-to-center.



SIDE BRUSH LIFT ACTUATOR

REMOVING SIDE BRUSH LIFT ACTUATOR

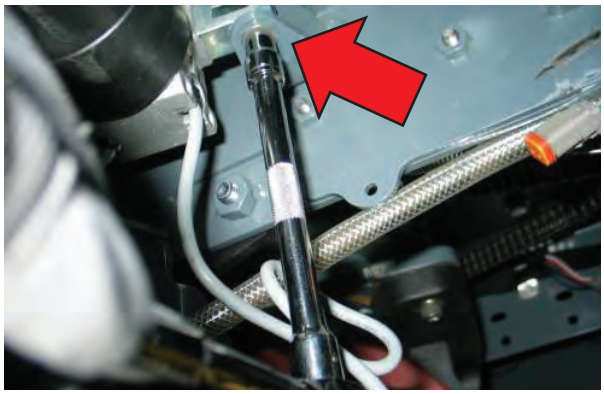
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Lift front of machine as shown below. Be sure to use wheel chocks and jack stands.

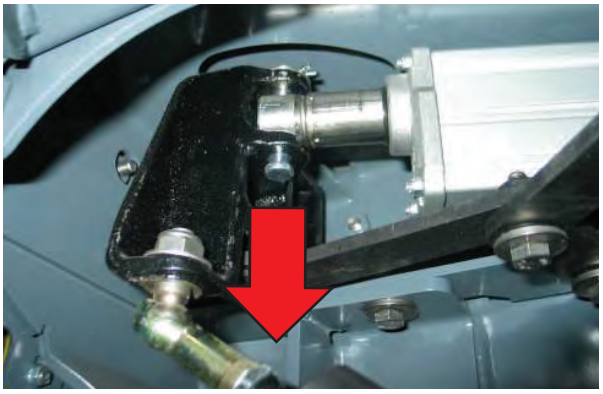
2. Remove side brush side squeegee assembly and side brush and set aside

3. Remove side brush assembly mounting bolt and carefully lower the side brush mechanism to the floor.

4. Cut zip tie securing actuator connector to wire harness and disconnect actuator from wire harness.
5. Remove actuator mounting clevis (2) and cotter (2) pins.



6. Remove cotter and clevis pin from actuaotor.



7. Remove lift actuator from machine.

INSTALLING SIDE BRUSH LIFT ACTUATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

NOTE: The side brush spring tube assembly must be adjusted following the installation of the lift actuator or machine damage will occur.

1. Installation is the reverse of removal.

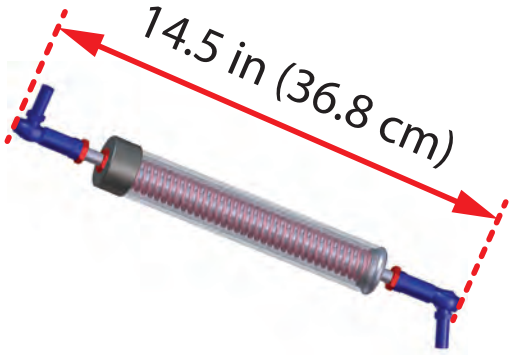
ADJUSTING SIDE BRUSH SPRING TUBE ASSEMBLY

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Lift front of machine as shown below. Be sure to use jack stands and chock rear wheels.

2. Activate and lower the side brush to provide access to the spring-tube assembly. Turn key off after brush has lowered.

3. Loosen the jam nut on the spring-tube assembly and turn the body of the spring tube until the initial end-to-end dimension is 14.5 in (36.8 cm).

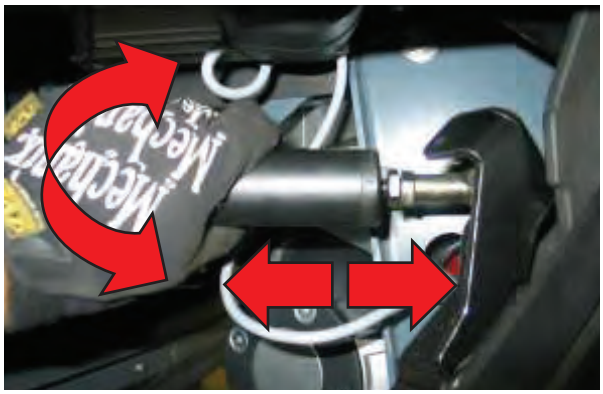


4. The final adjustment should be made following an inspection of the side scrub brush in the raised/retracted position. The bottom of the brush hub should be 3.75-4.00 in (9.5-10.2 cm) from the floor to allow for brush replacement clearance. Tighten the jam nut when the desired height has been reached.

3. Key On, 1-STEP scrub On, side brush switch On. Allow the side brush to lower completely and then turn the key off.

4. Loosen forward jam nut on side brush spring tube assembly.

5. Turn the spring tube assembly CW to shorten the tube, thereby opening the adjustment gap in Step 2. Turn the spring tube assembly CCW to lengthen the tube, therby closing the adjustment gap in Step 2. Cycle the side brush up down to check the gap.



6. Tightent the jam nut.

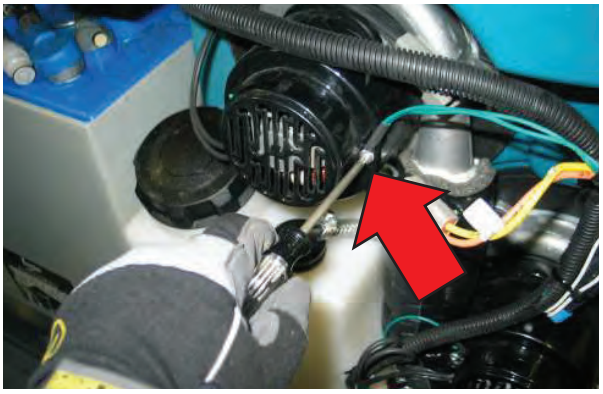
VACUUM FAN ASSEMBLY

REMOVING VACUUM FAN ASSEMBLY

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

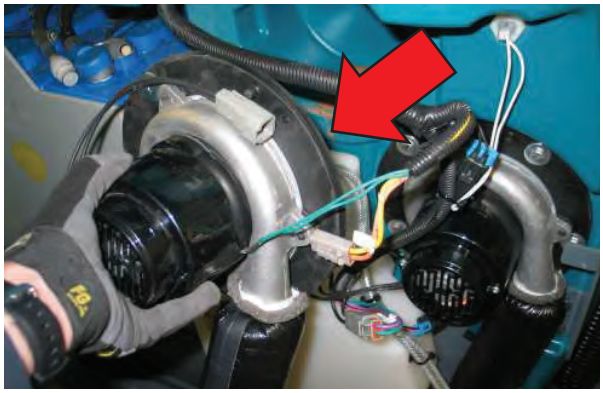
1. Key Off and disconnect battery.

2. Disconnect vacuum fan from wire harness connections.



3. Remove vacuum fan mounting hardware (5).

4. Remove vacuum fan assembly.



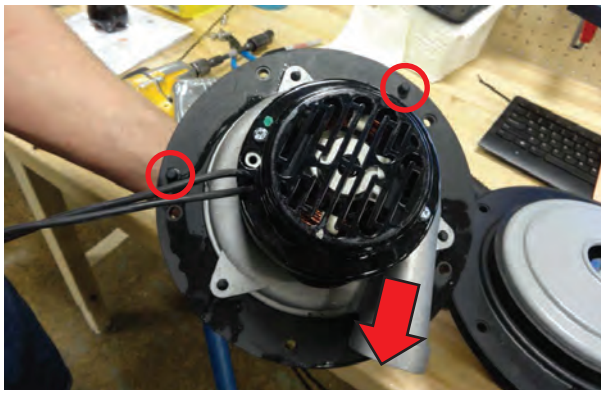
5. Draw a line across the vacuum fan assembly and the mounting flange as an orientation indicator for re-assembly.

6. Loosen the clamp and remove mounting flange from vacuum fan assembly.

7. Disconnect muffler from vacuum fan assembly.

INSTALLING VACUUM FAN ASSEMBLY

1. Note the orientation of the vacuum fan exhaust port to the rubber indicators for proper installation.



2. Remainder of installation is reverse of removal.

SIDE BRUSH MOTOR

REMOVING SIDE BRUSH MOTOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface.

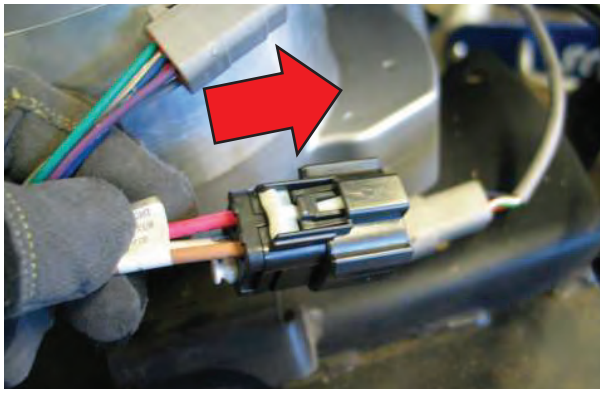
1. Jack front of machine and support using jack stands or support blocks.
2. Remove side brush and side brush squeegee assembly and set aside.
3. Remove side brush hub mounting bolt (1) and hub and set aside.

4. Remove motor mounting hardware (4) and set aside.

5. Key On, 1-STEP Scrub On, side brush On and allow side brush motor to lower completely. Turn Key Off.
6. Remove side brush cover mounting hardware (2) and set aside.

7. Disconnect side brush motor from wire harness and remove side brush motor.

NOTE: Slide white locking tab inward and then press the release button.



8. Remove side brush motor.

INSTALLING SIDE BRUSH MOTOR

1. Installation is the reverse of removal. .

NOTE: Apply anti-seize to side brush motor shaft and motor/hub mounting hardware.

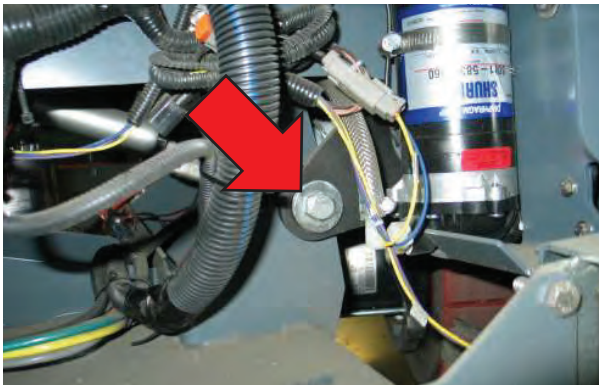
MAIN BRUSH LIFT ACTUATOR

REMOVING MAIN BRUSH LIFT ACTUATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Key Off. Disconnect batteries.
2. Remove Scrub Brushes.
3. Carefully remove front linkage pivot bolts (2).

NOTE: THE FRONT OF THE SCRUB HEAD WILL DROP TO THE FLOOR ONCE THE MOUNTING HARDWARE IS REMOVED.

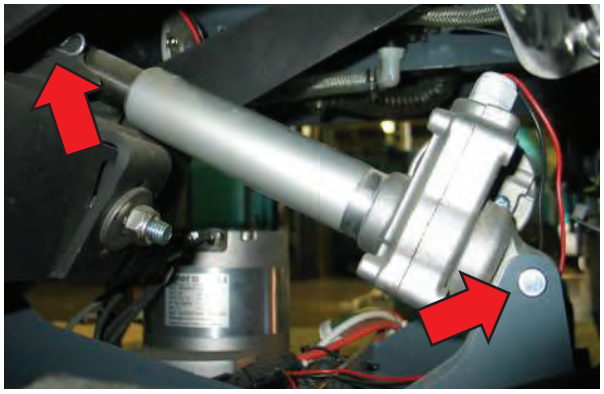


4. Carefully remove rear linkage pivot bolts (2).

NOTE: THE REAR OF THE SCRUB HEAD WILL DROP TO THE FLOOR ONCE THE MOUNTING HARDWARE IS REMOVED.

5. Jack front of machine and support using jack stands or support blocks.

6. Disconnect lift actuator from wire harness.
7. Remove lift actuator mounting pins (2).



8. Remove lift actuator.

INSTALLING MAIN BRUSH LIFT ACTUATOR

1. Key Off. Disconnect batteries.

2. Installation is the reverse of removal.

NOTE: This actuator does not require an installation adjustment. Turn the actuator tube manually to align the mounting holes and insert clevis and cotter pins.

MAIN SCRUB HEAD

REMOVING MAIN SCRUB HEAD

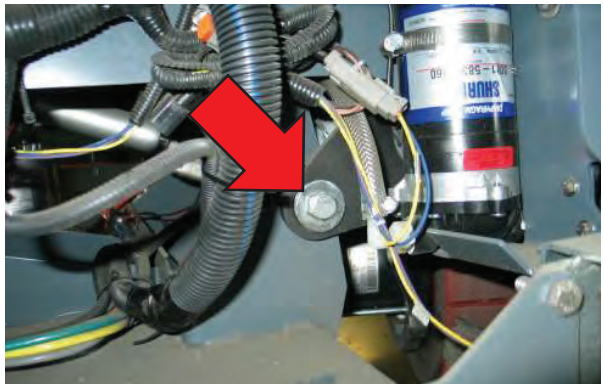
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Drain solution tank and turn key Off.
2. Remove scrub brushes and debris tray (cylindrical only).
3. Lift front of machine as shown below. Be sure to use wheel chocks and jack stands or support blocks.

4. Enter Manual Mode and lower scrub head completely (See Manual Mode in the Troubleshooting section of this manual). Turn key Off immediately when head touches the floor.

5. Carefully remove front linkage pivot bolts (2).

NOTE: THE FRONT OF THE SCRUB HEAD WILL DROP TO THE FLOOR ONCE THE MOUNTING HARDWARE IS REMOVED.



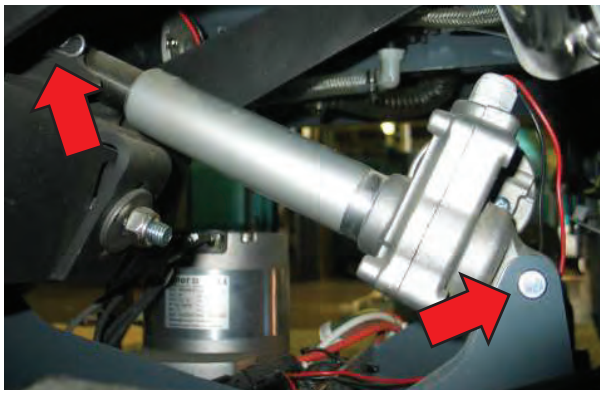
6. Carefully remove rear linkage pivot bolts (2).

NOTE: THE REAR OF THE SCRUB HEAD WILL DROP TO THE FLOOR ONCE THE MOUNTING HARDWARE IS REMOVED.

7. Jack front of machine and support using jack stands or support blocks.

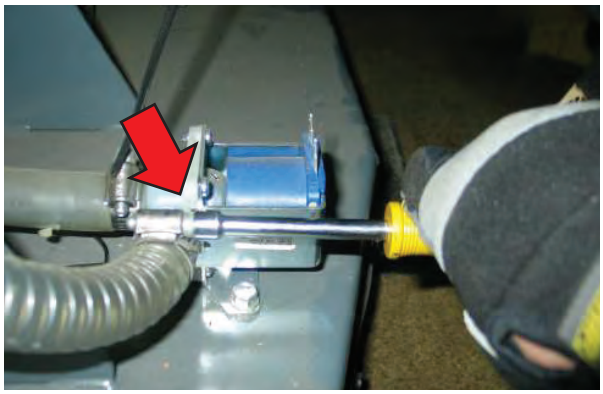
8. Disconnect lift actuator from wire harness.

9. Remove lift actuator mounting pins (2).



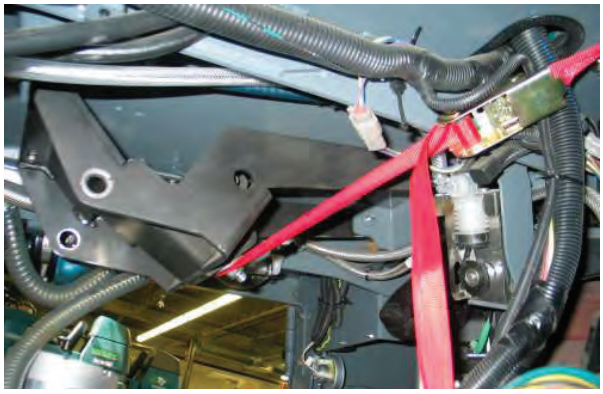
10. Remove lift actuator.

11. Disconnect water valve from wire harness and solution hose.



NOTE: THE SOLUTION TANK WILL DRAIN FROM THIS HOSE. BE SURE TO DRAIN THE SOLUTION TANK PRIOR TO REMOVING THE HOSE (see Step 1.)

12. Use a ratchet strap to support the lift mechanism to avoid interference during scrub head removal.



13. Remove scrub head.

INSTALLING MAIN SCRUB HEAD

1. Key Off. Disconnect batteries.

2. Installation is the reverse of removal.

NOTE: This actuator does not require an installation adjustment. Turn the actuator tube manually to align the mounting holes and insert clevis and cotter pins.

3. *CYLINDRICAL SCRUB HEAD ONLY:* See CYLINDRICAL PATTERN ADJUSTMENT PROCEDURE in the maintenance section of this manual.

MAIN SCRUB BRUSH MOTOR (CYLINDRICAL)

REMOVING MAIN BRUSH MOTOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

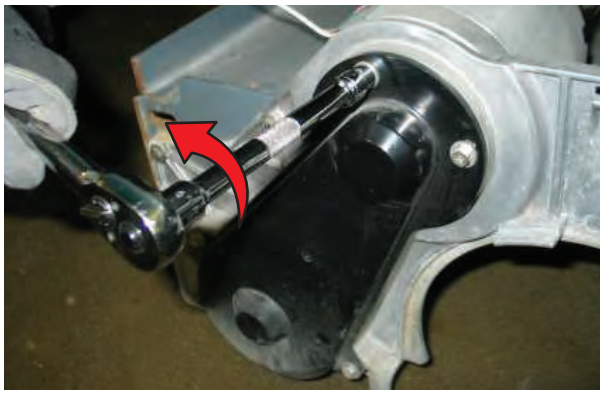
FOR SAFETY: When servicing machine, jack machine up at designated locations only. Block machine up with jack stands.

1. Jack front of machine and support using jack stands or support blocks.

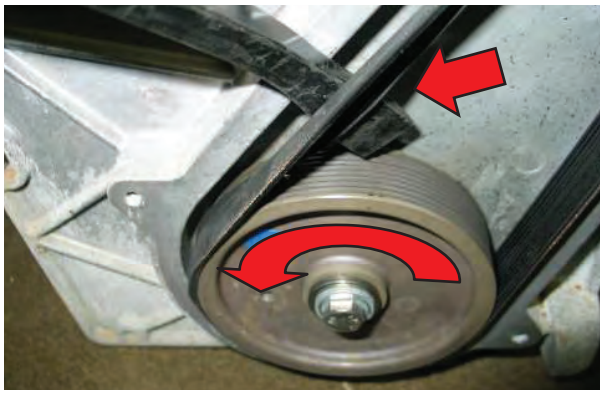
2. Remove scrub brushes.

3. Enter Manual Mode and lower scrub head completely (See Manual Mode in the Troubleshooting section of this manual). Turn key Off immediately when head touches the floor.

4. Remove belt cover bolts (2) and set cover and hardware aside.



5. Remove belt by turning pulleys and applying outward pressure on the belt.

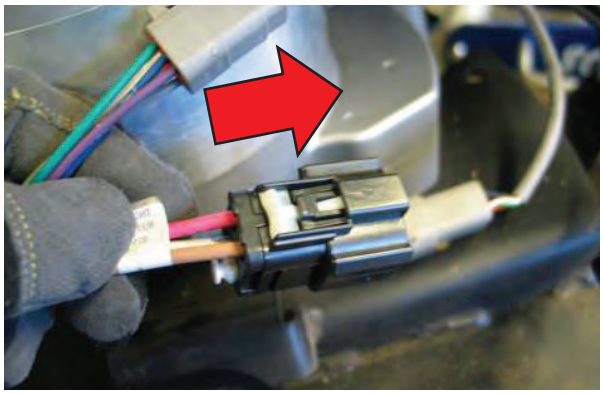


6. Remove motor mounting hardware (4) and set aside.

7. Remove motor mounting hardware (4) and set aside.

8. Disconnect main brush motor from wire harness and remove main brush motor.

NOTE: Slide white locking tab inward and then press the release button.



INSTALLING MAIN BRUSH MOTOR

1. Installation is the reverse of removal.

INSTRUMENT PANEL

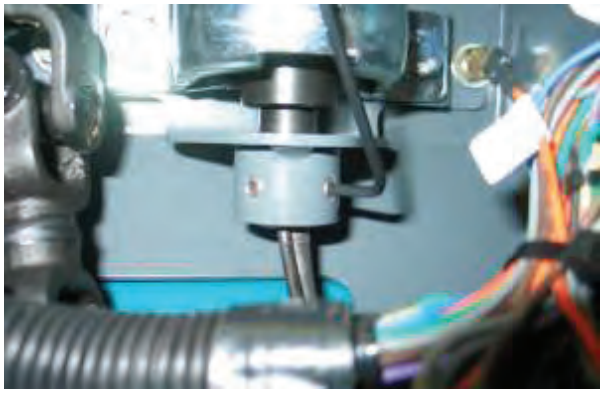
REMOVING INSTRUMENT PANEL

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Key Off. Disconnect battery.
2. Remove front access panel.

3. Cut zip tie securing instrument panel wire harness connections.
4. Disconnect instrument panel connector.

5. Loosen set screws (2) securing instrument panel mounting tube.



6. Remove instrument panel assembly.

INSTALLING INSTRUMENT PANEL

1. Installation is the reverse of removal.
2. See CONFIGURATION MODE in the troubleshooting section of this manual to configure the new instrument panel.

LOGIC BOARD REPLACEMENT

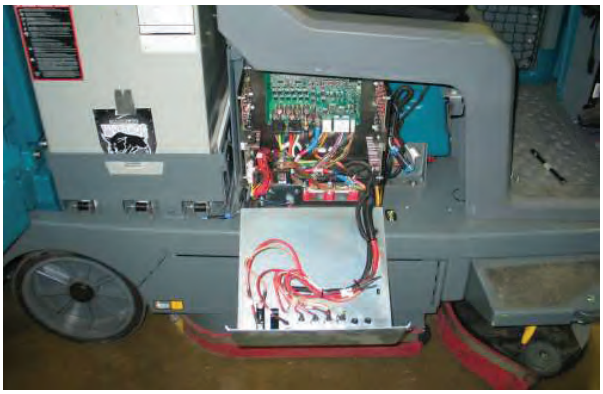
REMOVING LOGIC BOARD

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Key Off. Disconnect batteries.

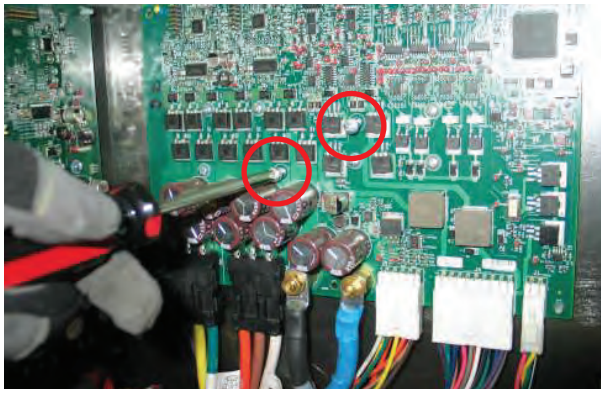
2. Open RH side access door.

3. Remove electrical box cover mounting bolts (2) and carefully lower the cover.

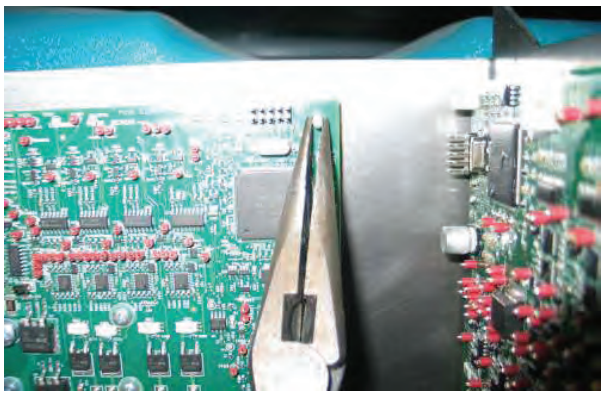


4. Attach a wrist static strap tool to a bare metal surface.

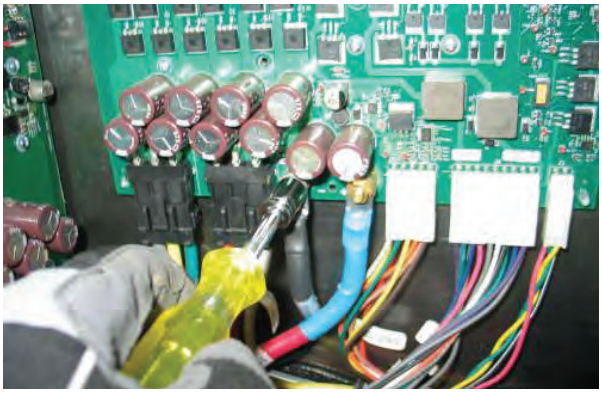
5. Remove logic board mounting screws (2).



6. Carefully squeeze to release the plastic mounting clips securing the logic board to the control box.



7. Disconnect cables and connectors from logic board.



NOTE: Always use two wrenches when securing the power supply terminals or damage to the circuit board will occur. Also, make sure the power supply terminals are secured on the new board before installation. The torque specification is 30-36 in-lbs (339-407 Ncm).

8. Remove logic board.

INSTALLING LOGIC BOARD

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Attach a wrist static strap tool to a metal surface.

2. Remainder of installation is the reverse of removal.

NOTE: Always use two wrenches when securing the power supply terminals or damage to the circuit board will occur. Also, make sure the power supply terminals are secured on the new board before installation. The torque specification is 30-36 in-lbs (339-407 Ncm).

STEERING WHEEL TIMING

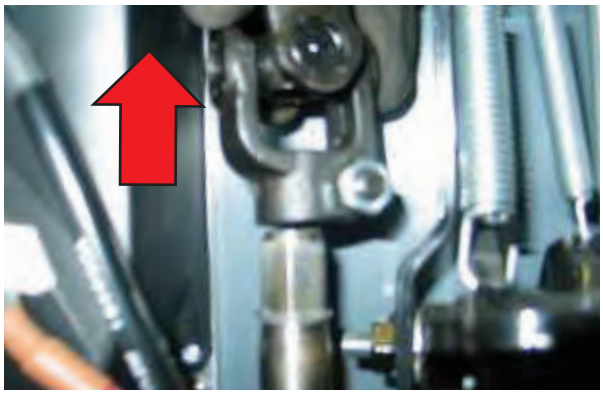
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

1. Key Off. Disconnect batteries.

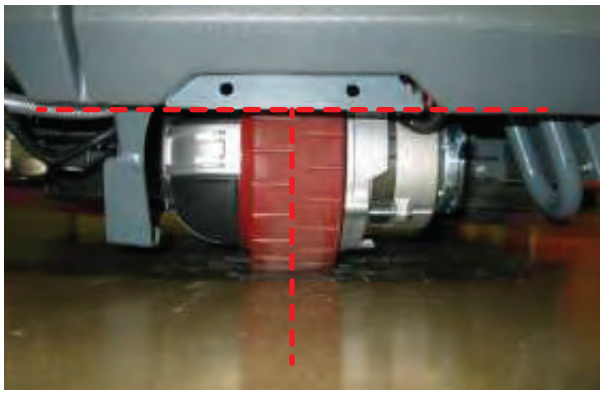
2. Remove front access panel.

3. Loosen steering shaft hardware.

4. Lift steering u-joint off splined shaft.



5. Align the front drive tire with the centerline of the machine.



6. Orientate the steering wheel as shown below.

7. Carefully reinstall the steering u-joint onto the splined steering shaft without changing the orientation of the steering wheel or drive assembly.

NOTE: Check for rotational interference between the hardware and the adjacent pedal assembly. If necessary, raise the steering u-joint enough to clear the pedal assembly.

WHEEL DRIVE ASSEMBLY

REMOVING WHEEL DRIVE ASSEMBLY

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, jack machine up at designated locations only. Block machine up with jack stands.

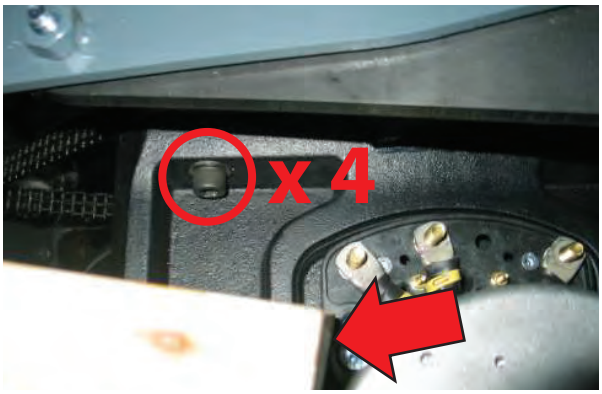
FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

1. Key Off. Disconnect batteries.

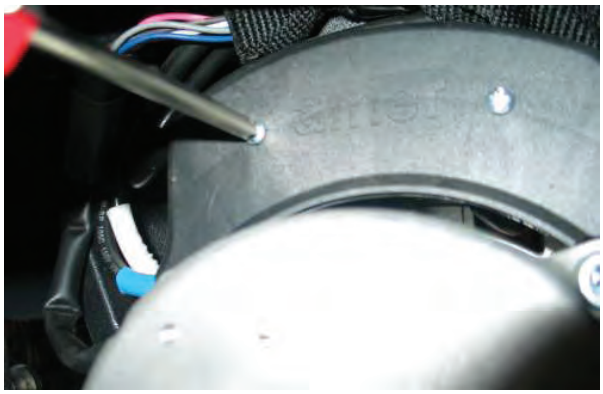
2. Jack front of machine and support using jack stands or support blocks and chock rear tires.

3. Loosen **(DO NOT REMOVE)** drive assembly socket head screws (4).

NOTE: Place a spacer block between the drive assembly and the frame to prevent the drive assembly from rotating while loosening fasteners.



4. Remove terminal cover and disconnect cables from drive assembly.



5. Remove cable clamp hardware and set aside.

6. Jack front of machine up and remove the jack stands. Place support blocks below both tip legs. The front wheel must contact the floor.

7. Remove drive assembly socket head screws (4) and set aside.

8. Jack front of machine up, raise jack stands high enough to allow for drive assembly removal, and lower machine onto jack stands.

INSTALLING WHEEL DRIVE ASSEMBLY

1. Installation is the reverse of removal.

2. Drive assembly socket head screw torque specification: **92 ft-lbs.**

REPLACING THE DRIVE TIRE

1. Remove (4) socket head screws.

2. Remove (10) socket head screws.

3. Use (4) M10-1.5 x 70 (Class 12.9) bolts and a spacer block to mechanically press off the tire. Tighten the bolts evenly in a diagonal pattern. REMOVE THE BOLTS AFTER THIS STEP IS COMPLETE.

NOTE: Alternative method - Tap on the wheel using a rubber mallet. This works if the wheel is not stuck on the drive assembly.

4. Replace the drive tire.

5. Installation is the reverse of removal. Use a plastic mallet to reassemble the wheel drive assembly. Torque M6 hardware to 15Nm (11 ft-lbs) and M8 hardware to 22 Nm (16 ft-lbs).

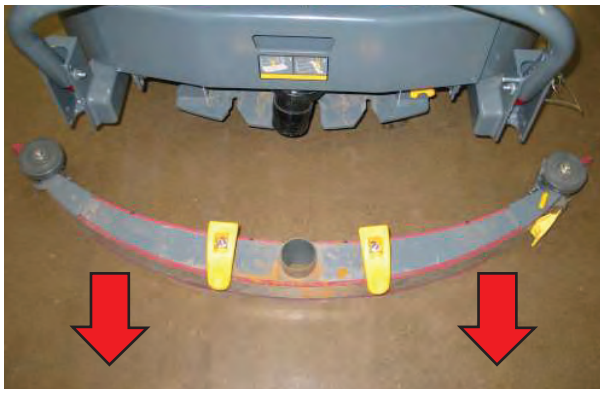
REAR BRAKE ADJUSTMENT

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine and remove key.

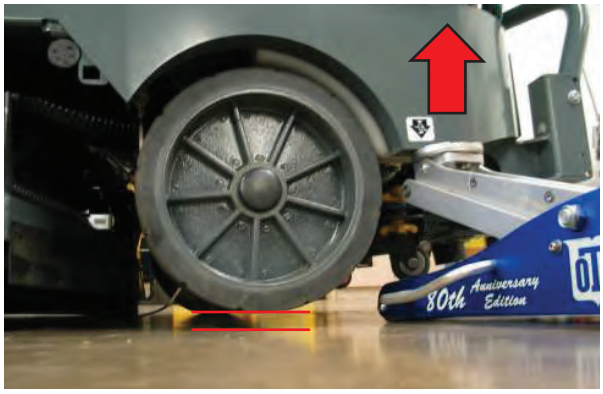
FOR SAFETY: Chock front wheel when jacking rear of machine to prevent machine from rolling.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

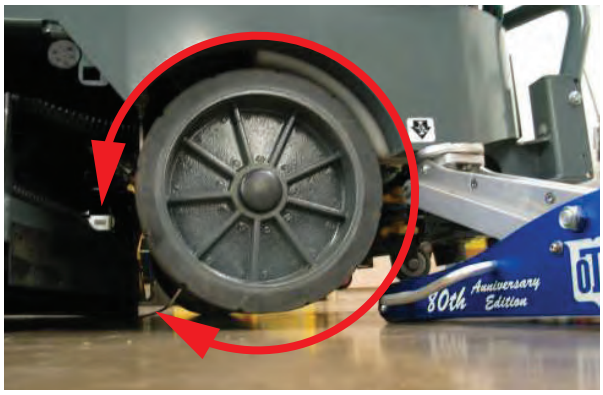
1. Key off. Open main brush doors.
2. Remove rear squeegee and set aside.



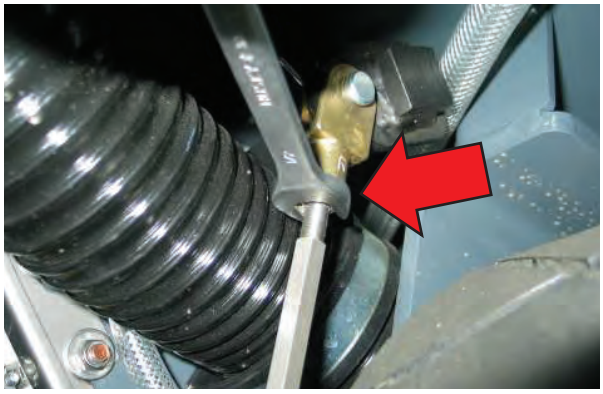
3. Place wheel chocks on both sides of the front wheel.
4. Jack rear of machine until rear wheel is off the floor.



5. Be sure that parking brake is released. Rear wheel should spin freely.



6. Loosen jam nut on rear adjustment rod.



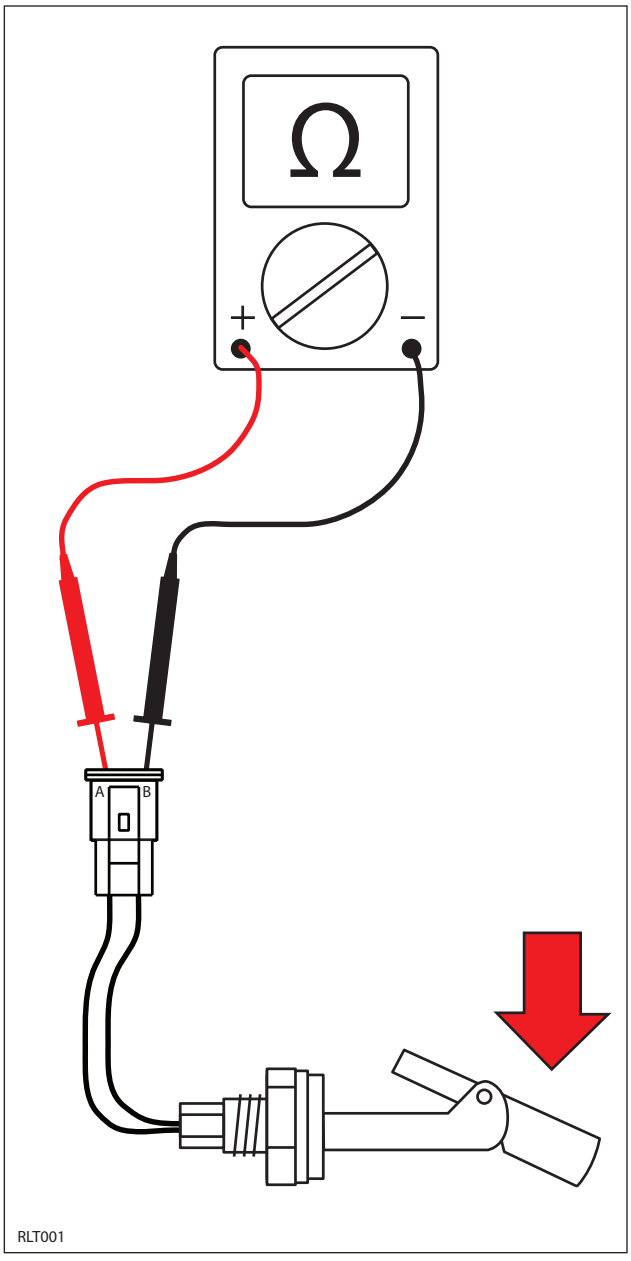
7. Turn the adjuster until the wheel stops spinning freely and then back off two turns.

8. Tighten jam nut and repeat process for other wheel.

TESTING RECOVERY TANK LEVEL SENSORS

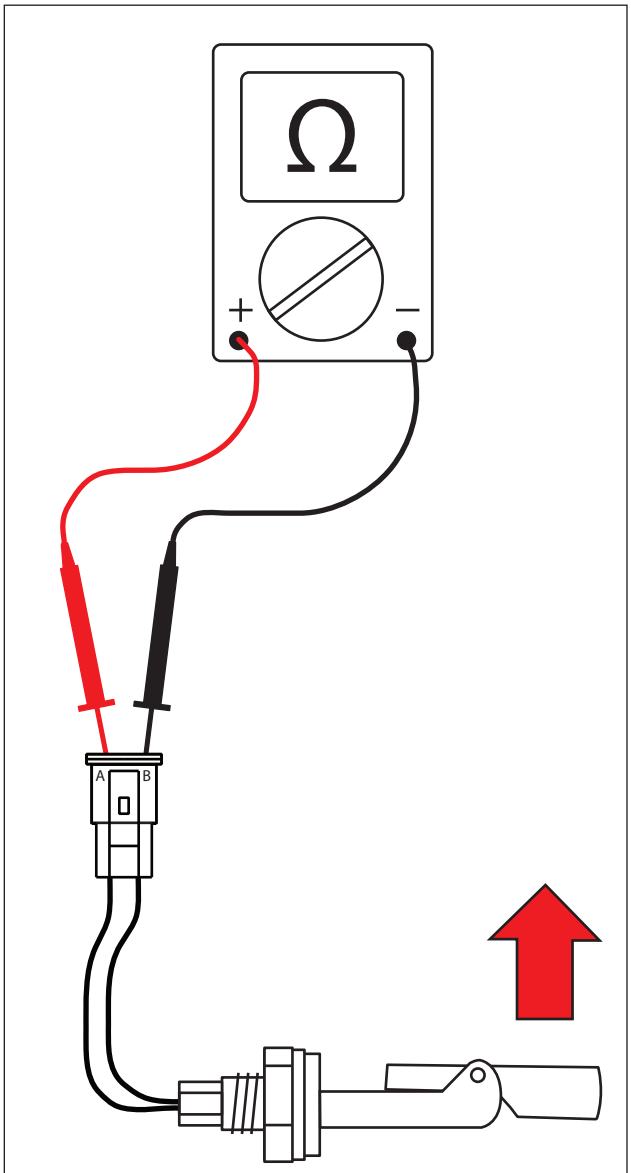
FOR SAFETY: Before leaving or servicing machine, stop on level surface.

1. Test the resistance of the recovery tank level sensor using an ohmmeter as shown below. The tank level switch should test as "O.L." or open.



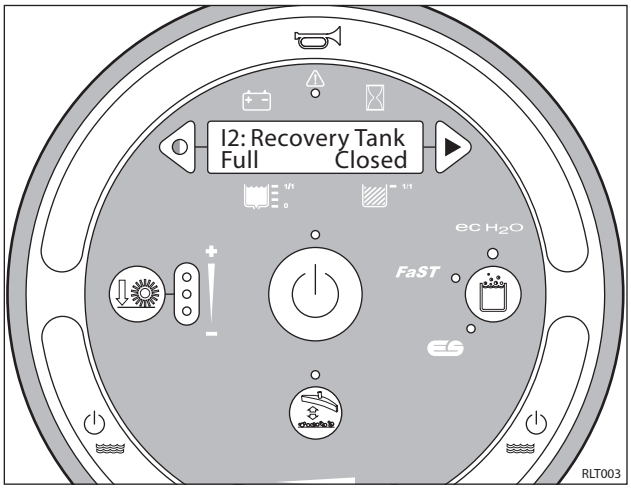
RLT001

2. Test the resistance of the recovery tank level sensor using an ohmmeter as shown below. The tank level switch should test at 0-1 ohms or closed.



RLT002

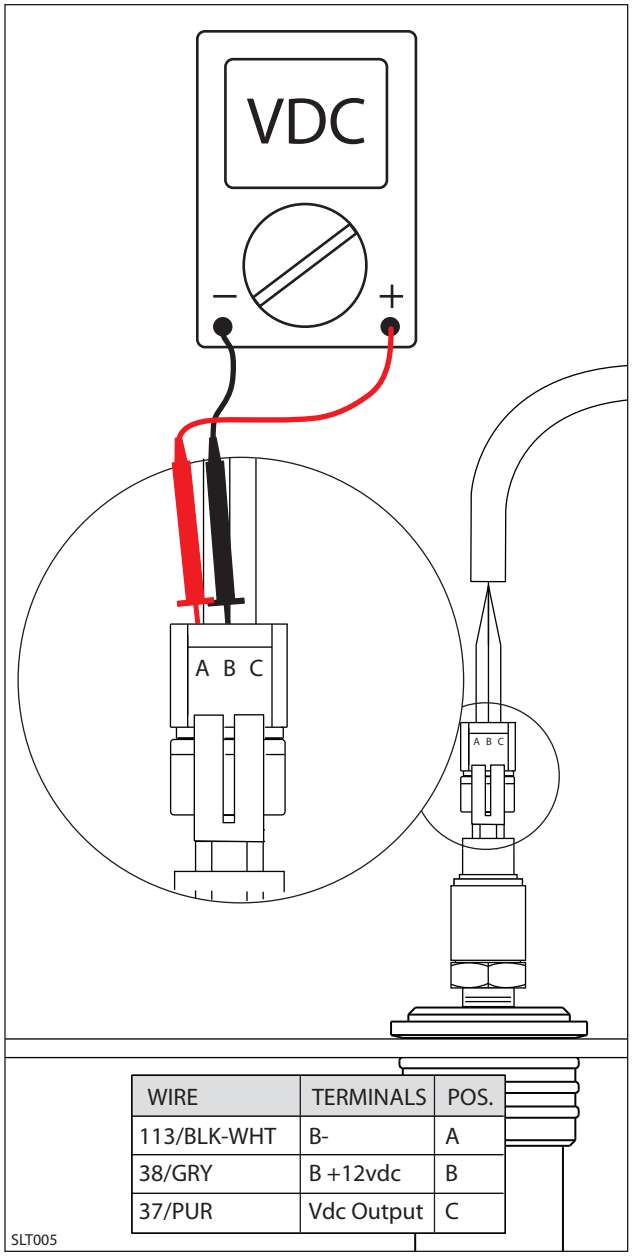
3. The recovery tank full and half-full sensor conditions are also viewable in Input Display Mode. See "Input Display Mode" in the TROUBLESHOOTING section of this manual.



TESTING SOLUTION TANK LEVEL SENSOR

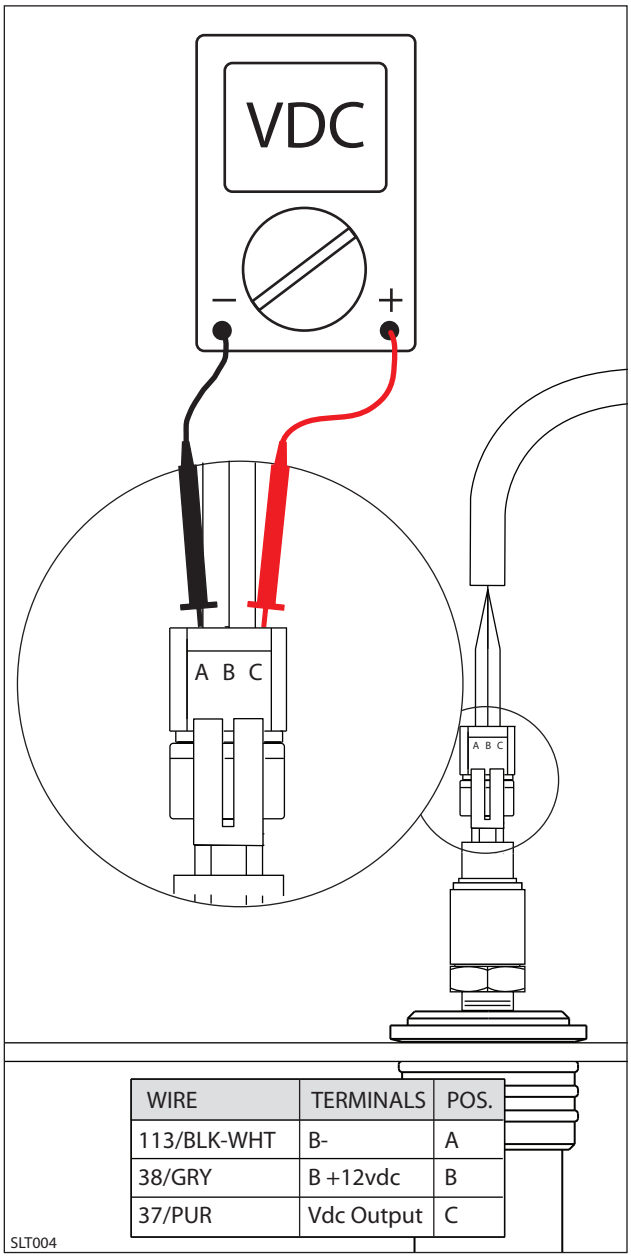
FOR SAFETY: Before leaving or servicing machine, stop on level surface.

1. Key On. Backprobe solution tank level sensor connector terminals A and B using a voltmeter as shown below. The voltmeter should display 10-12 volts.



WIRE	TERMINALS	POS.
113/BLK-WHT	B-	A
38/GRY	B +12vdc	B
37/PUR	Vdc Output	C

2. Key On. Backprobe solution tank level sensor connector terminals A and C using a voltmeter as shown below. The voltmeter should display 1-5 volts depending on solution tank water level.



WIRE	TERMINALS	POS.
113/BLK-WHT	B-	A
38/GRY	B +12vdc	B
37/PUR	Vdc Output	C

3. Drain the solution tank.

4. Slowly fill the solution tank with water and compare the actual voltmeter readings to the chart below. Replace the sensor if the values are not within specification.

Solution Tank Sensor Output

Tank Level	Output Voltage
0 BARS - EMPTY	0.0 - 0.72 Volts
1 BAR - 20%	0.73 - 0.87 Volts
2 BARS - 40%	0.88 - 0.98 Volts
3 BARS - 60%	0.99 - 1.11 Volts
4 BARS - 80%	1.12 - 1.33 Volts
5 BARS - FULL	1.34 + Volts

SLT002

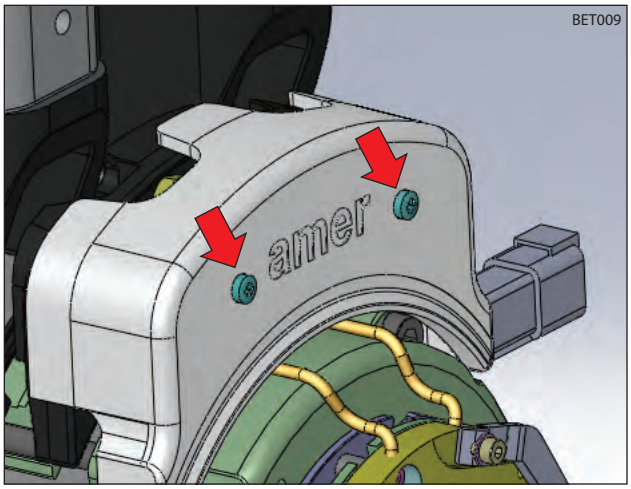
5. The solution tank level sensor output voltage is also viewable in Input Display Mode. See "Input Display Mode" in the TROUBLESHOOTING section.

TESTING PROPEL MOTOR

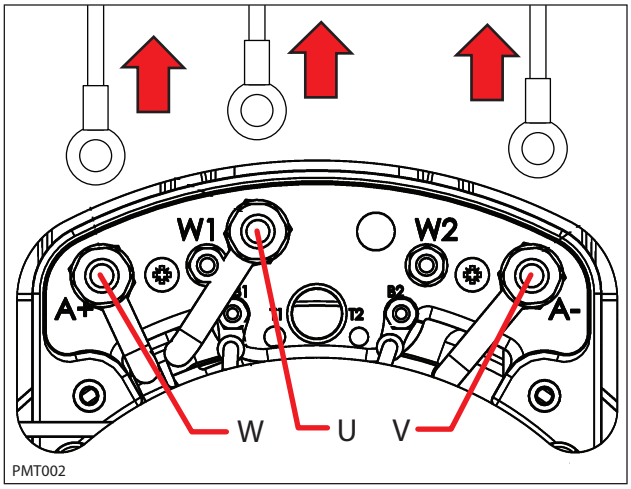
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

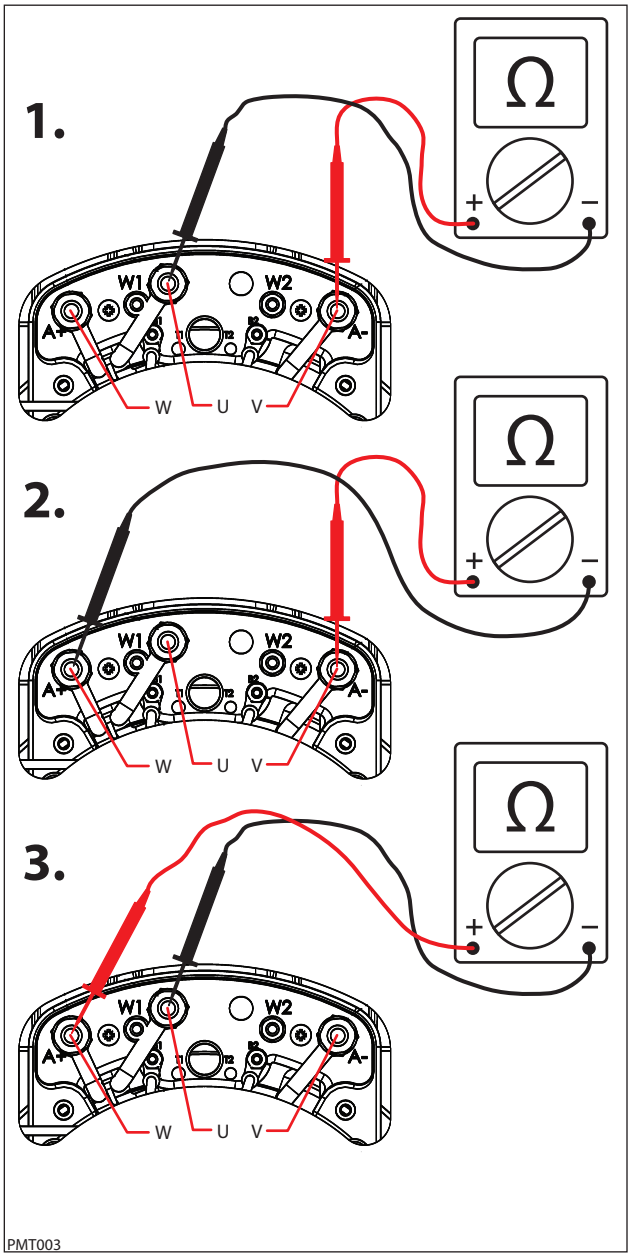
1. Key Off. Remove terminal box cover screws and set cover aside.



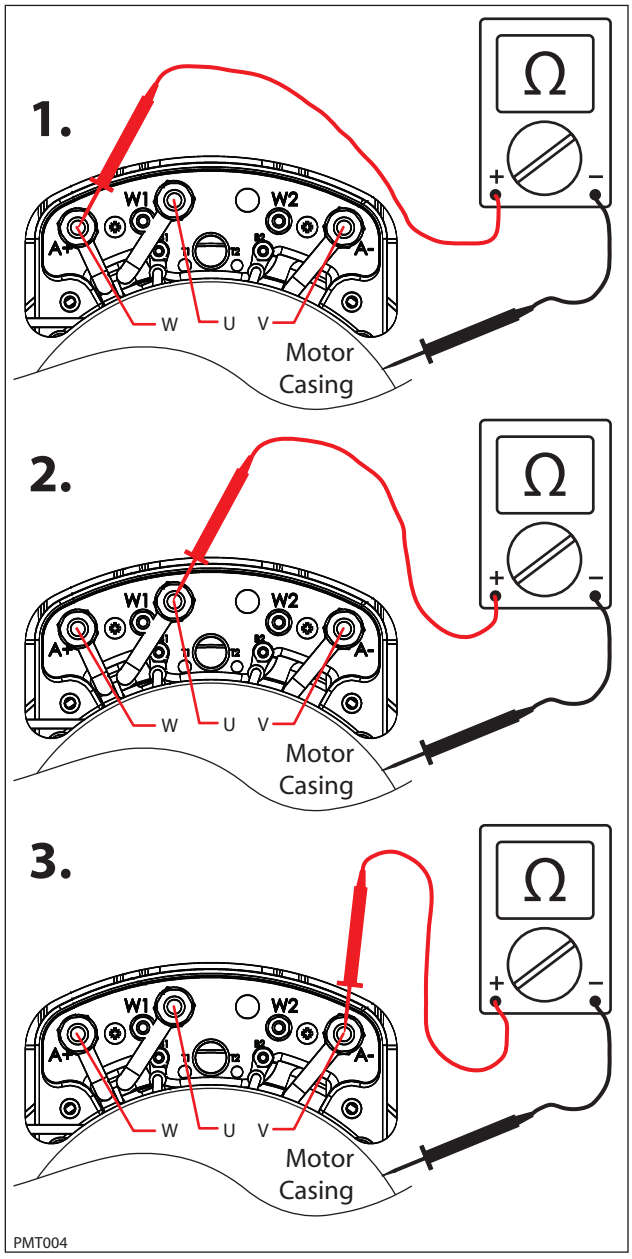
2. Disconnect U, V, and W cables from W1, A-, and A+ terminals (respectively).



3. Test the resistance of all three motor windings using an ohmmeter as shown below. The resistances of each winding should not be open (O.L). An open winding indicates a faulty motor.

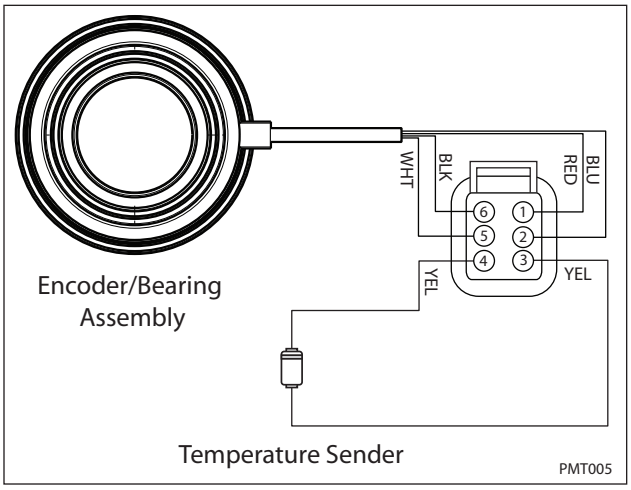


4. Test the resistance between all three motor terminals and the motor case as shown below. The ohmmeter should read "O.L." or open. A shorted winding indi cates a faulty motor.



5. The motor encoder and temperature sender are non-serviceable components of the drive motor. The motor encoder senses rotor position, speed, and direction. The encoder is integrated into an internal roller bearing assembly. See "Curtis 1232 LED Faults" in the TROUBLESHOOTING section for encoder related faults.

   The temperature sender senses the propel motor temperature. Test the resistance of the temperature sender using an ohmmeter and then compare the values to the chart below. Replace the motor assembly if the resistance values are out of the specified range.



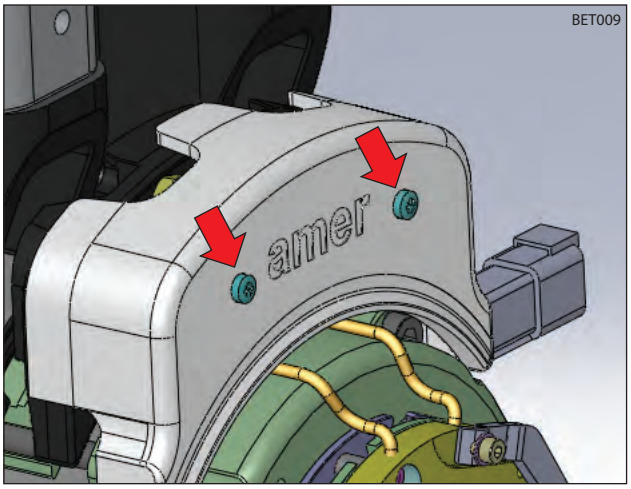
TEMPERATURE		RESISTANCE (Ω)		
(°C)	(°F)	MIN.	TYP.	MAX
-30	-22	362	381	368
0	32	464	486	507
25	77	565	588	611
30	86	587	610	633
50	122	679	704	728
70	158	781	806	831
80	176	835	860	885
100	212	950	975	1000
110	230	1007	1036	1064

TESTING PROPEL MOTOR CABLES

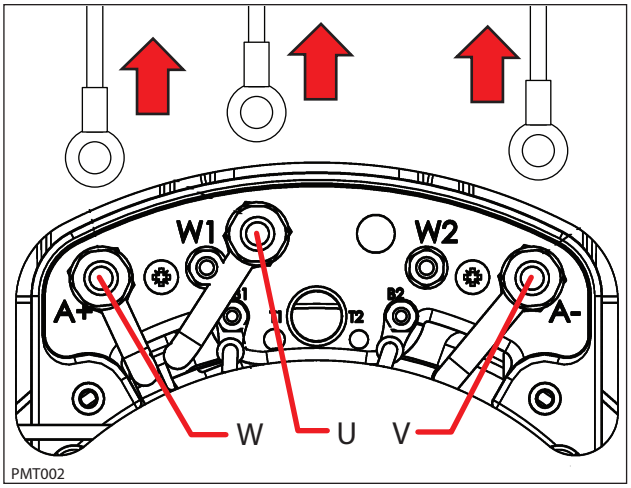
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

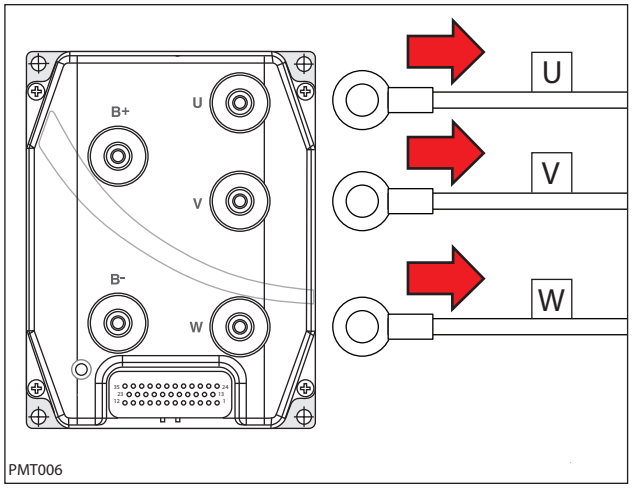
1. Key Off. Disconnect batteries. Remove terminal box cover screws and set cover aside.



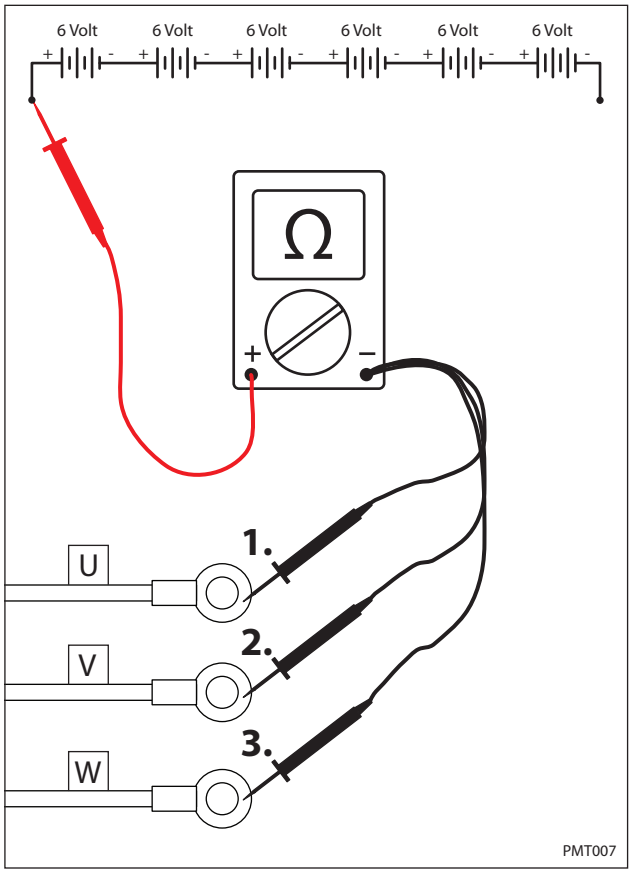
2. Disconnect U, V, and W cables from W1, A-, and A+ terminals (respectively).



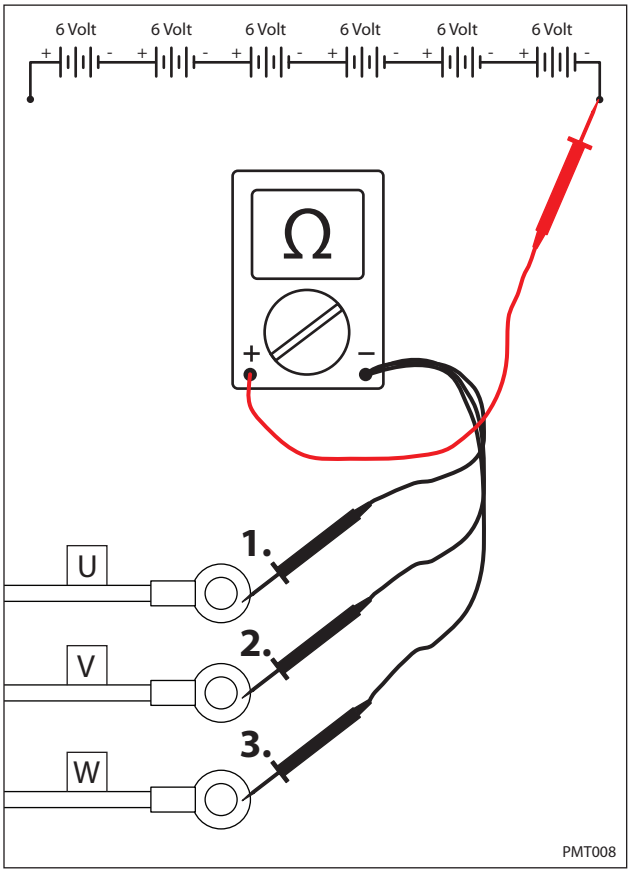
3. Disconnect U, V, and W cables from Curtis 1232 controller as shown below.



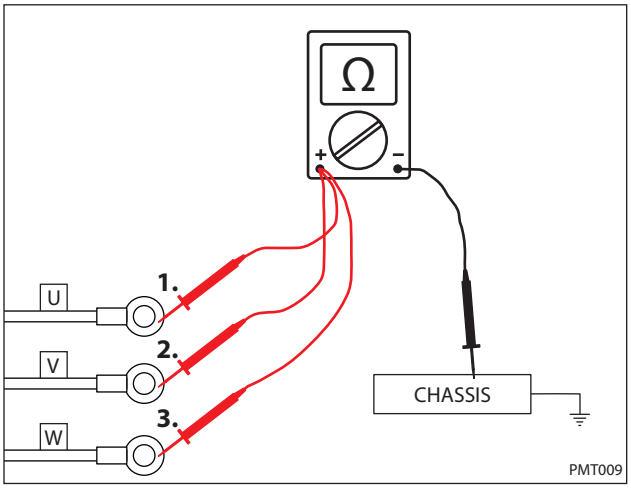
4. Reconnect battery connection and test each cable using an Ohmmeter for a short to battery + as shown below. Each cable should test as "O.L." or open to battery +. Replace shorted cable(s).



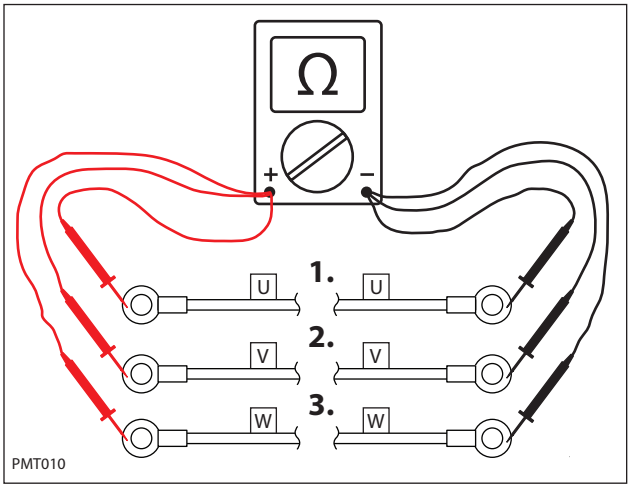
5. Test each cable using an ohmmeter for a short to battery - as shown below. Each cable should test as "O.L." or open to battery -. Replace shorted cable(s).



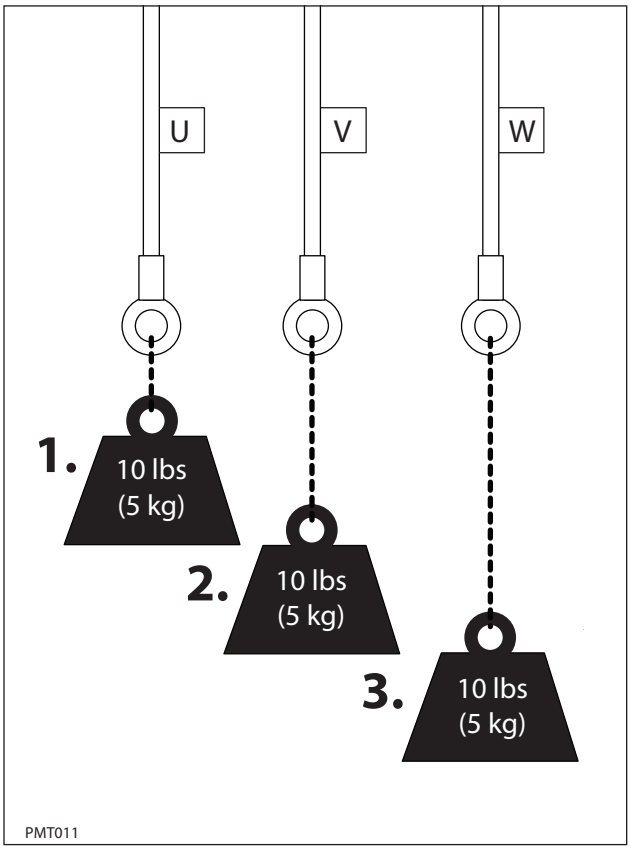
6. Test each cable using an ohmmeter for a short to chassis as shown below. Each cable should test as "O.L." or open to chassis. Replace shorted cable(s).



7. Test each cable using an ohmmeter for end-to-end continuity. Each cable should test between 0-1 ohm resistance. Replace open cable(s).



8. "Tug test" each cable (motor end) to determine if a cable is broken inside the insulation. Do not exceed 10 lbs (45 N) of force as cable damage may occur. Replace broken cables.



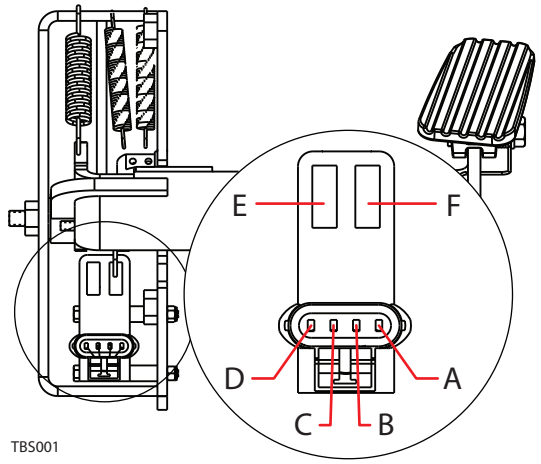
TESTING THROTTLE SENSOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface.

FOR SAFETY: When servicing machine, jack machine up at designated locations only. Block machine up with jack stands.

FOR SAFETY: When servicing machine, avoid moving parts. Do not wear loose jackets, shirts, or sleeves when working on machine .

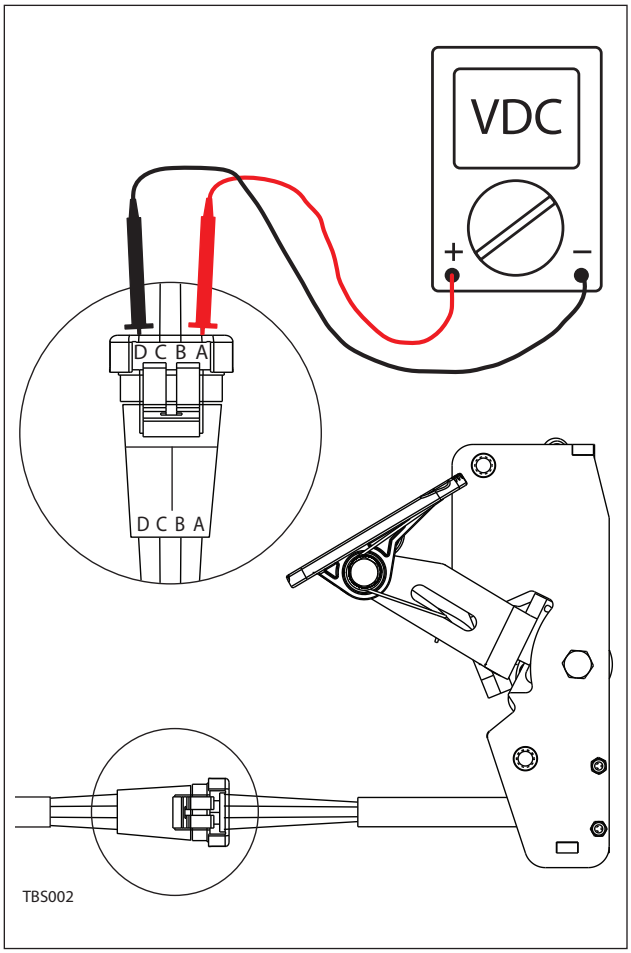
1. Jack machine up so front drive wheel is not touching the floor. Block machine up with jack stands.
2. The throttle hall effect sensor is a component of the pedal subassembly.



TBS001

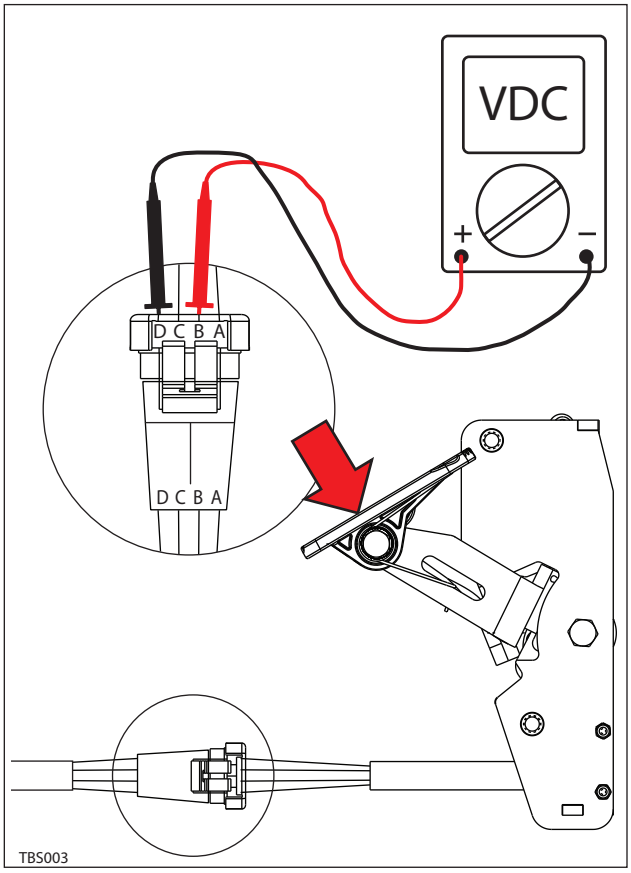
PIN/CAVITY	NOTES	COLOR
A	POWER (BATTERY +)	RED
B	PROPEL OUTPUT (0-5Vdc)	YELLOW
C	NOT USED	BLUE
D	GROUND (BATTERY -)	BLACK
E	NOT USED	N/A
F	GATE B	N/A

3. Key On. Backprobe the power supply to the throttle sensor terminals A and D using a voltmeter as shown below. The voltmeter should display battery voltage.

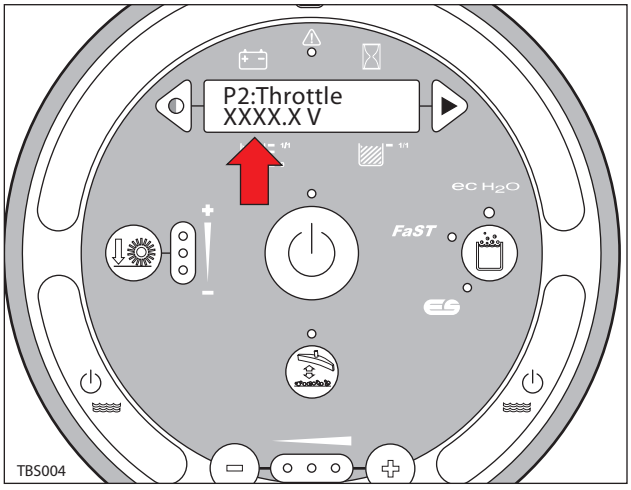


TBS002

4. Key On. Backprobe the throttle sensor output terminals B and D using a voltmeter as shown below. The voltmeter should display 0-5 volts proportional to 0-100% propel pedal movement.



5. See "Propel Diagnostic Mode" in the TROUBLE SHOOTING section. The voltage in step 3 should match the LCD displayed voltage in Propel Diagnostic Mode.



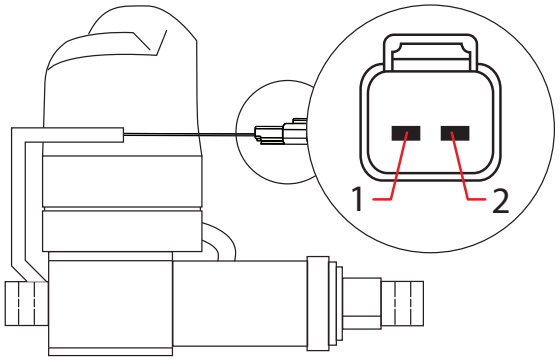
TESTING SIDE BRUSH LIFT ACTUATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

FOR SAFETY: When servicing machine, avoid moving parts. Do not wear loose jackets, shirts, or sleeves when working on machine .

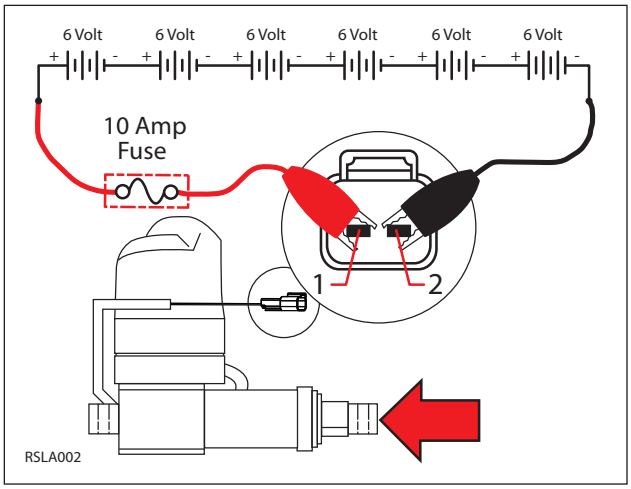
1. Key Off. Disconnect the side brush lift actuator from the wire harness.



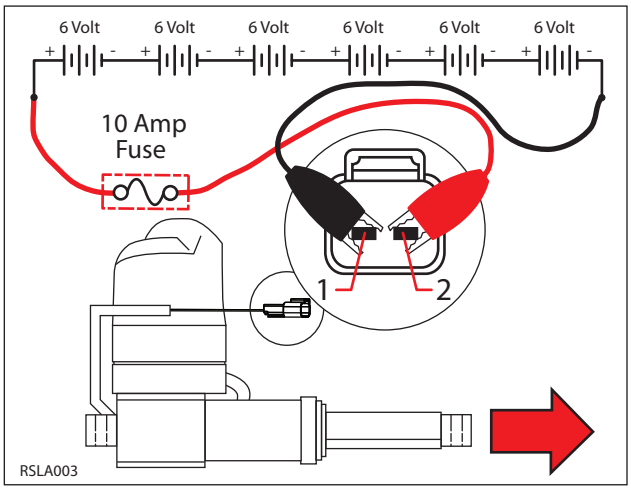
RSLA001

PIN ASSIGNMENT	
2	BLACK
1	BLACK

2. Apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Be sure to connect battery + to terminal 1 and battery - to terminal 2. The actuator should retract completely. Replace the actuator if it fails to retract.



3. Reverse polarity and apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Connect battery - to terminal 1 and battery + to terminal 2. The actuator should extend completely. Replace the actuator if it fails to extend.



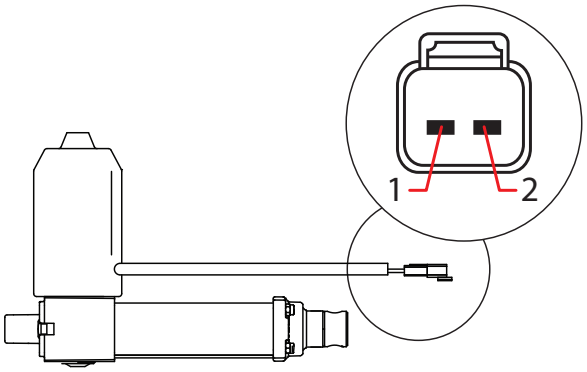
TESTING MAIN BRUSH LIFT ACTUATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

FOR SAFETY: When servicing machine, avoid moving parts. Do not wear loose jackets, shirts, or sleeves when working on machine .

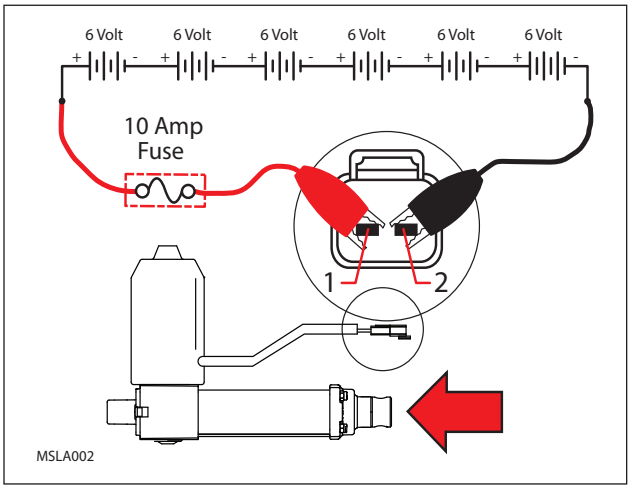
1. Key Off. Disconnect the main brush lift actuator from the wire harness.



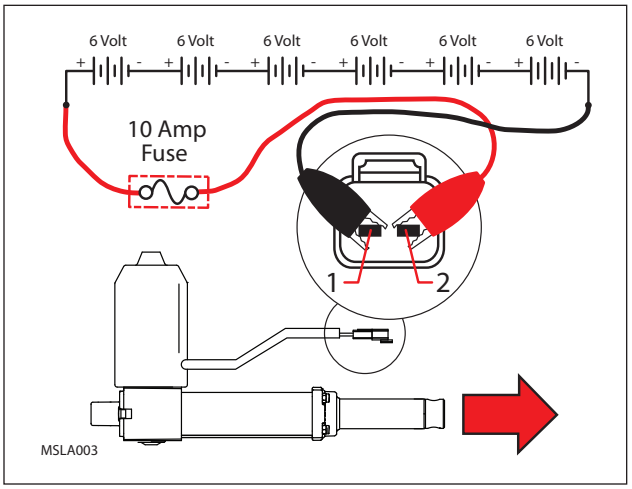
MSLA001

PIN ASSIGNMENT	
2	RED
1	BLACK

2. Apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Be sure to connect battery + to terminal 1 and battery - to terminal 2. The actuator should retract completely. Replace the actuator if it fails to retract.



3. Reverse polarity and apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Connect battery - to terminal 1 and battery + to terminal 2. The actuator should extend completely. Replace the actuator if it fails to extend.



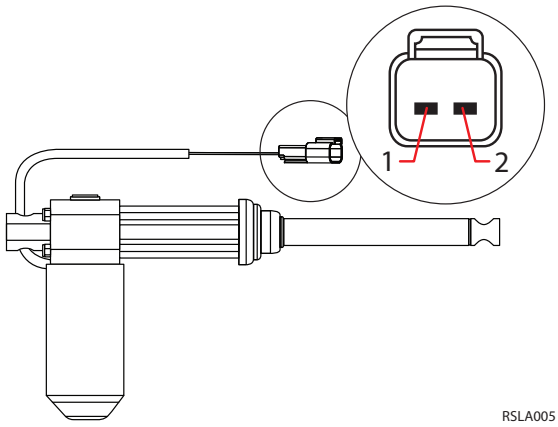
TESTING REAR SQUEEGEE LIFT ACTUATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

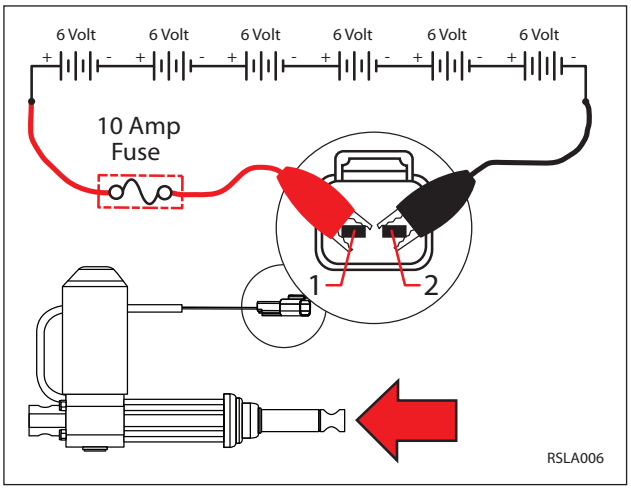
FOR SAFETY: When servicing machine, avoid moving parts. Do not wear loose jackets, shirts, or sleeves when working on machine .

1. Key Off. Disconnect the rear squeegee lift actuator from the wire harness.

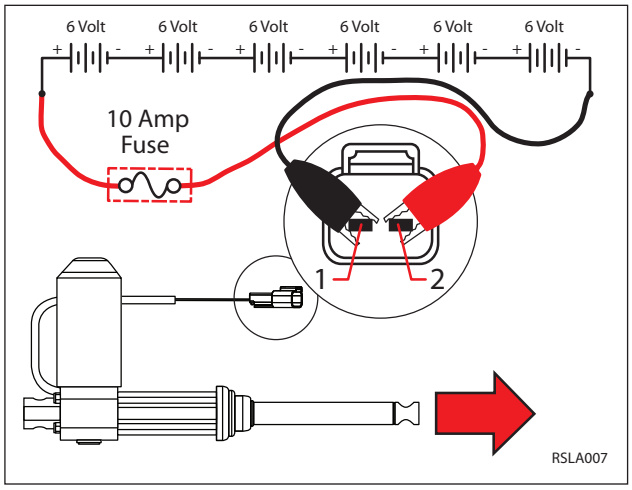


PIN ASSIGNMENT	
2	BLUE
1	BROWN

2. Apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Be sure to connect battery + to terminal 1 and battery - to terminal 2. The actuator should retract completely. Replace the actuator if it fails to retract.



3. Reverse polarity and apply battery voltage to the lift actuator using fuse-protected jumper leads as shown below. Connect battery - to terminal 1 and battery + to terminal 2. The actuator should extend completely. Replace the actuator if it fails to extend.

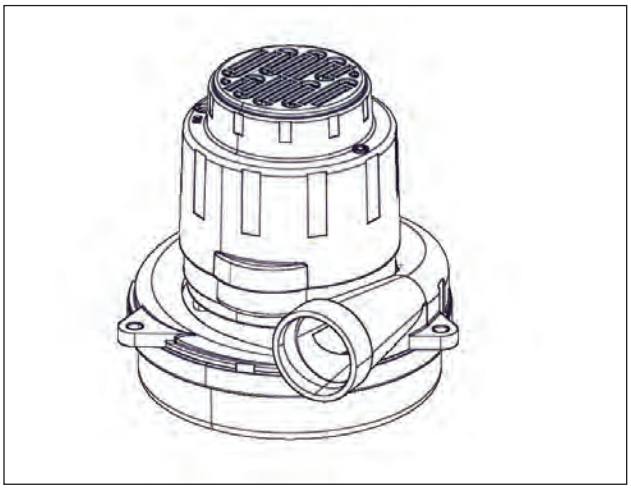


TESTING VACUUM FAN

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

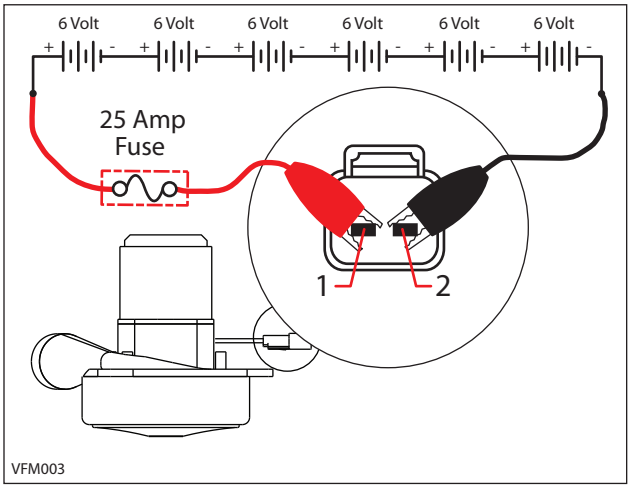
FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

1. Key Off. Disconnect vacuum fan from wire harness.

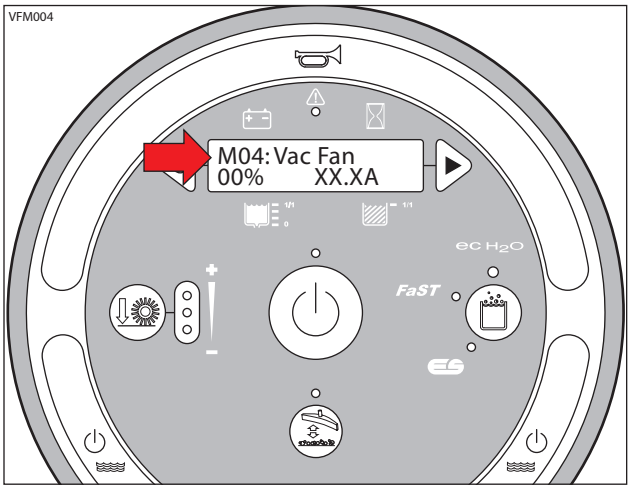


2. Key Off. Inspect carbon brushes. Replace carbon brushes if they are shorter than 10mm (0.375 in).

3. Apply battery voltage to the vacuum fan(s) using fuse-protected jumper leads as shown below. The fan should turn On. Replace the vacuum fan if it fails to turn On.



4. Reconnect vacuum fan(s) to wire harness. See "Manual Mode" in the TROUBLESHOOTING section. Activate the vacuum fan in Manual Mode. The amperage displayed should be approximately 14-20 Amps (avg. 16 Amps)

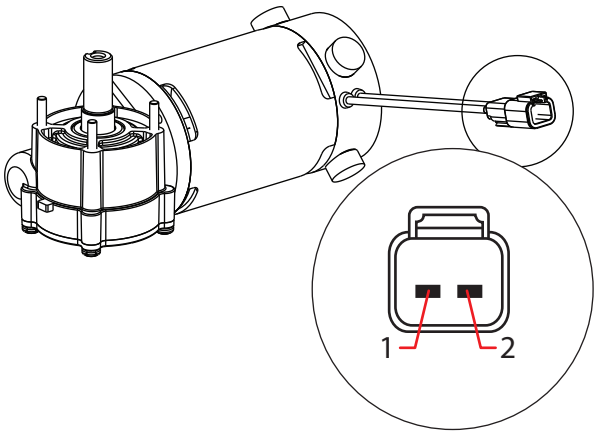


TESTING SIDE SWEEP BRUSH MOTOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

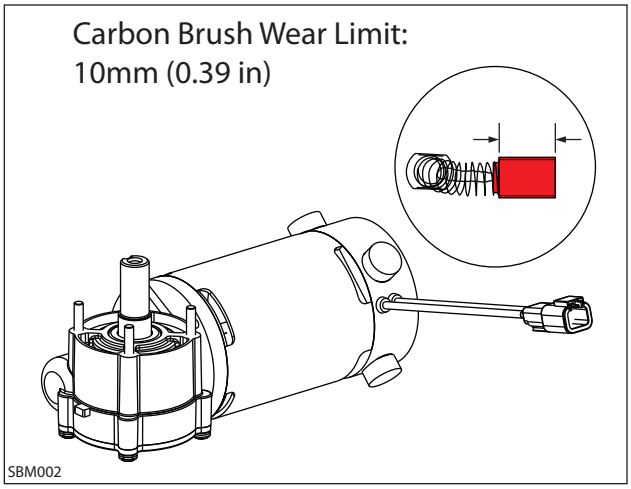
1. Key Off. Disconnect the side brush motor from the wire harness.



SBM001

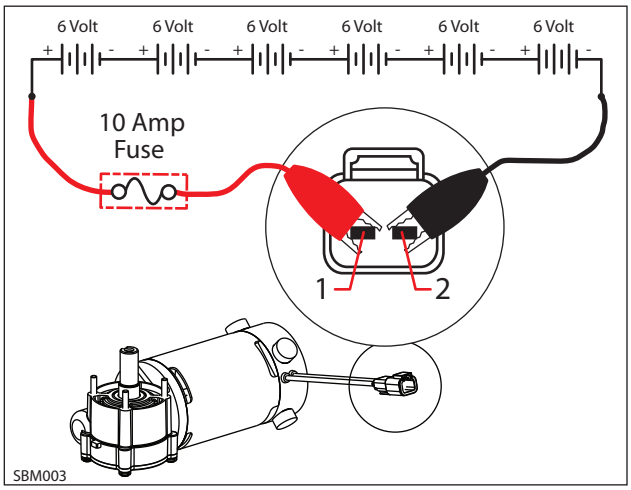
PIN ASSIGNMENT	
2	BLACK
1	RED

2. Key Off. Inspect carbon brushes. Replace carbon brushes if they are shorter than 10mm (0.375 in).



SBM002

3. Apply battery voltage to the side brush motor using fuse-protected jumper leads as shown below. The side brush motor should turn On. Replace the side brush motor if it fails to turn On.

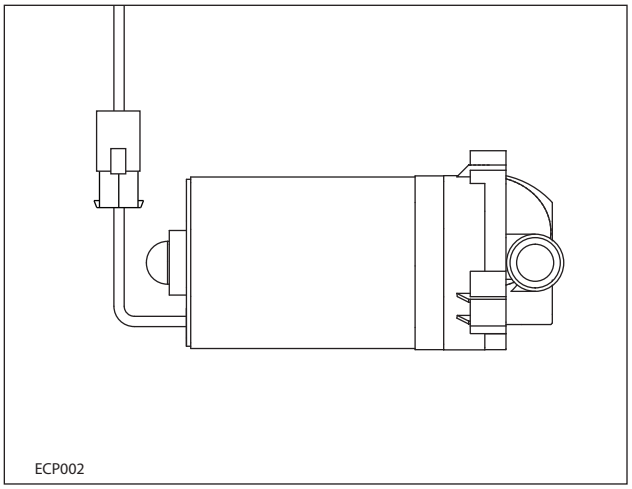


SBM003

TESTING ec-H20 PUMP

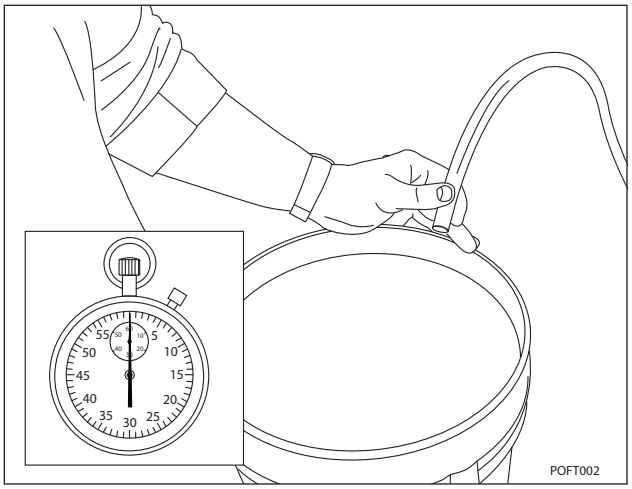
FOR SAFETY: Before leaving or servicing machine, stop on level surface.

1. Key Off. Disconnect ec-H2O pump outlet hose.



2. Fill the solution tank.

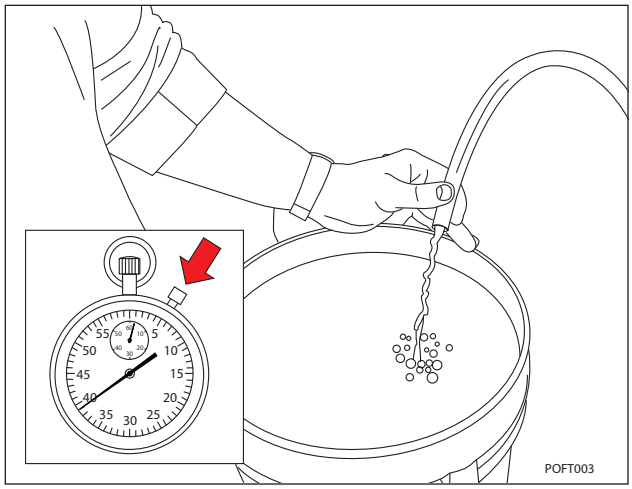
3. Connect a temporary outlet hose to the pump. The hose must be long enough to reach a 5 gallon bucket.



4. Enter Manual Mode and enable the ec-H2O system. See Manual Mode in the Troubleshooting section of this manual.

5. Use a stop watch to time how long it takes to fill a 5 gallon bucket. The open flow specification for the ec-H2O pump is 1.8 GPM. The pump should fill the 5 gallon bucket in approximately 2.7 - 3.0 minutes. Replace the pump if it takes longer than 3.5 minutes and the pump has an adequate water supply.

NOTE: Open flow is different than system flow and should not be used for scrubbing mode water consumption calculations.



ADJUSTING ec-H2O FLOW RATE

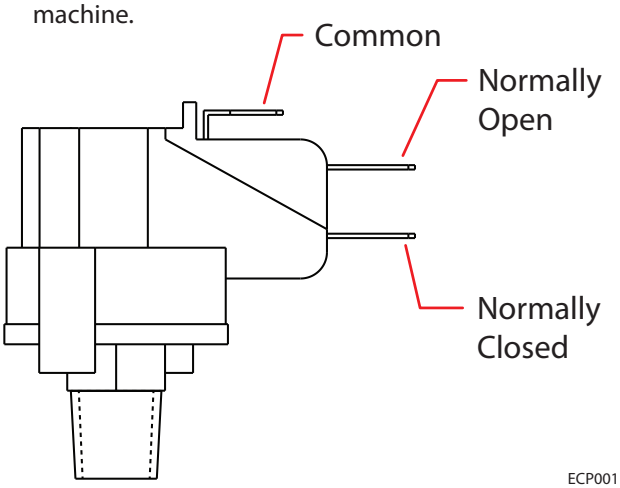
See Configuration Mode in the Troubleshooting section of this manual.

TESTING ec-H2O PRESSURE SWITCH

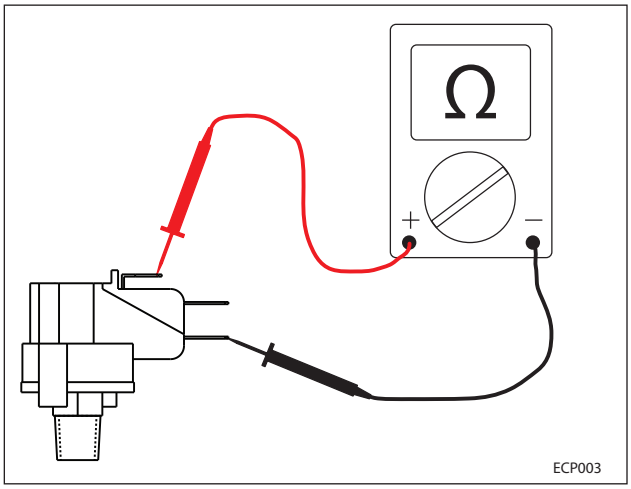
FOR SAFETY: Before leaving or servicing machine, stop on level surface, set parking brake, turn off machine and remove key.

FOR SAFETY: When servicing machine, disconnect battery connection before working on machine.

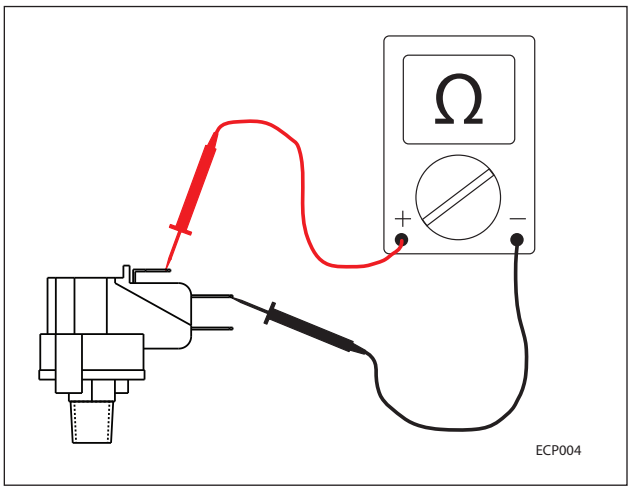
1. Key Off. Disconnect the pressure switch from the wire harness and remove the switch from the machine.



2. Test the resistance of the switch using an ohmmeter between the common and normally closed terminals. There should be 0-1 ohms resistance. Replace the switch if the N.C. contacts are open.



3. Test the resistance of the switch using an ohmmeter between the common and normally open terminals. The switch should test as "O.L." or open. Replace the switch if the N.O. contacts are shorted.



4. Use a bicycle pump with pressure gauge to apply pressure to the switch as shown below. The normally open contacts should close at 20 +/- 2 psi (1.4 Bar), increasing pressure. Replace the switch if it does not open correctly.