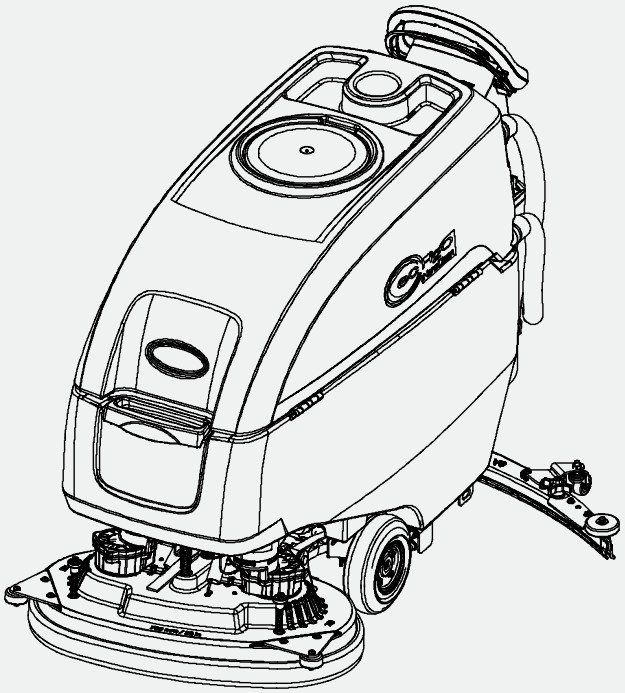
T500e
(Battery)

Automatic Floor Scrubber Service Information Manual



Tennant True® Parts
IRIS® a Tennant Technology
Insta-Fit™ Adapter
Smart-Fill™ Automatic Battery Watering

ec H2O
An ORBIO™ Technology

North America / International

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www.tennantco.com/manuals

9015511
Rev. 01 (01-2018)

INTRODUCTION

This manual is available for each new model. It provides necessary operation and maintenance instructions.

Read this manual completely and understand the machine before operating or 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 maintenance instructions provided.
- The machine is maintained with manufacturer supplied or equivalent parts.

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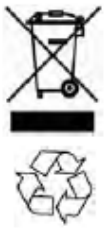


PROTECT THE ENVIRONMENT

Please dispose of packaging materials and used machine components such as batteries in an environmentally safe way according to your local waste disposal regulations.

Always remember to recycle.

Tennant Company
PO Box 1452
Minneapolis, MN 55440
Phone: (800) 553-8033
www.tennantco.com

INTENDED USE

The T500e walk-behind floor scrubber is intended for commercial use, for example in hotels, schools, hospitals, factories, shops, offices and rental businesses. It is designed to scrub hard floor surfaces (concrete, tile, stone, synthetic, etc.) in an indoor environment. This machine is not intended for cleaning carpets or sanding wood floors. Use only recommended pads/brushes and commercially available floor cleaning detergents. Do not use this machine other than described in the Operator Manual.

MACHINE DATA

Please fill out at time of installation for future reference.

Model No. - _____

Serial No. - _____

Installation Date - _____

MACHINE SERIAL NUMBER LOCATION

UNCRATING MACHINE

Carefully check machine for signs of damage. Report damages at once to carrier. Contact distributor or Tennant for missing items.

To uncrate the machine, remove straps, wheel blocks and shipping brackets. Using the supplied ramp carefully back the machine off the pallet. Make sure scrub head is in the raised position.

ATTENTION: Do not remove machine from pallet without using ramp, machine damage may occur.

CONTENTS

IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

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

WARNING: To warn of hazards or unsafe practices which 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: To Reduce the Risk of Fire, Explosion, Electric Shock or Injury:

- **Read manual before operating machine.**
- **Do not use or pick up flammable materials or reactive metals.**
- **Do not use near flammable liquids, vapors or combustible dusts.**
- **This machine is not equipped with an explosion proof motor. The electric motor will spark upon start up and during operation which could cause a flash fire or explosion if machine is used in an area where flammable vapors/liquids or combustible dusts are present.**
- **Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away when charging.**
- **Disconnect battery cables and charger cord before cleaning and servicing machine.**
- **Do not charge batteries with damaged 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.**
- **Do not use outdoors. Store indoors.**
- **Spinning pad/brush, keep hands away.**

WARNING: This machine contains chemicals known to the state of California to cause cancer, birth defects, or other reproductive harm.

IRIS Telemetry - This machine may be equipped with technology that automatically communicates over the cellular network. If the 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.
   - Unless mentally and physically capable of following machine instructions.
   - Under the influence of alcohol or drugs.
   - While using a cell phone or other types of electronic devices.
   - If it is not in proper operating condition.
   - In outdoor areas. This machine is for indoor use only.
   - In areas where flammable vapors/liquids or combustible dusts are present.
   - With pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.
   - In areas with possible falling objects.
   - In areas that are too dark to safely see the controls or operate the machine.
2. Before operating machine:
   - Check machine for fluid leaks.
   - Make sure all safety devices are in place and operate properly.
3. When operating machine::
   - Use only as described in this manual.
   - Report machine damage or faulty operation immediately.
   - Wear closed-toe, non-slip work shoes.
   - Reduce speed when turning.
   - Go slowly on inclines and slippery surfaces.
   - The machine may only be operated on gradients up to 2%.
   - Follow site safety guidelines concerning wet floors.
   - Follow mixing, handling and disposal instructions on chemical containers.
   - Do not carry passengers on machine.
   - Use care when reversing machine.
   - Keep children and unauthorized persons away from machine.

- Do not allow machine to be used as a toy.
- Do not use spray nozzle for off-aisle cleaning, slip hazard may occur.
- Do not leave machine unattended when filling solution tank with auto-fill feature.

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

5. When servicing machine:
   - Disconnect battery connection and charger cord before working on machine.
   - All work must be done with sufficient lighting and visibility.
   - All repairs must be performed by trained personnel.
   - Use Tennant supplied or approved replacement parts.
   - Do not modify the machine from its original design.
   - Block machine tires before jacking machine up.
   - Jack machine up at designed locations only. Support machine with jack stands.
   - Use hoist or jack that will support the weight of the machine.
   - Avoid moving parts. Do not wear loose clothing or jewelry and secure long hair.
   - Do not disconnect the off-board charger's DC cord from the machine's receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging cycle, disconnect the AC power supply cord first.
   - Do not use incompatible battery chargers as this may damage battery packs and potentially cause a fire hazard.
   - Inspect charger cord regularly for damage.
   - Keep work area well ventilated.
   - Avoid contact with battery acid.
   - Keep all metal objects off batteries.
   - Do not power spray or hose off machine. Electrical malfunction may occur. Use damp cloth.
   - Use a hoist or adequate assistance when lifting batteries.
   - Battery installation must be done by trained personnel.
   - Only use distilled water when filling the automatic battery watering tank.
   - Wear personal protection equipment as needed and where recommended in this manual.

6. When loading/unloading machine onto/off truck or trailer:
   - Drain tanks before loading machine.
   - Use a ramp that can support the machine weight and operator.
   - The machine may only be operated on gradients up to 2%.
   - Lower the scrub head and squeegee before tying down machine.
   - Turn machine off and remove key.
   - Set parking brake (if equipped).
   - Block machine wheels.
   - Use tie-down straps to secure machine.

For Safety: wear protective gloves.

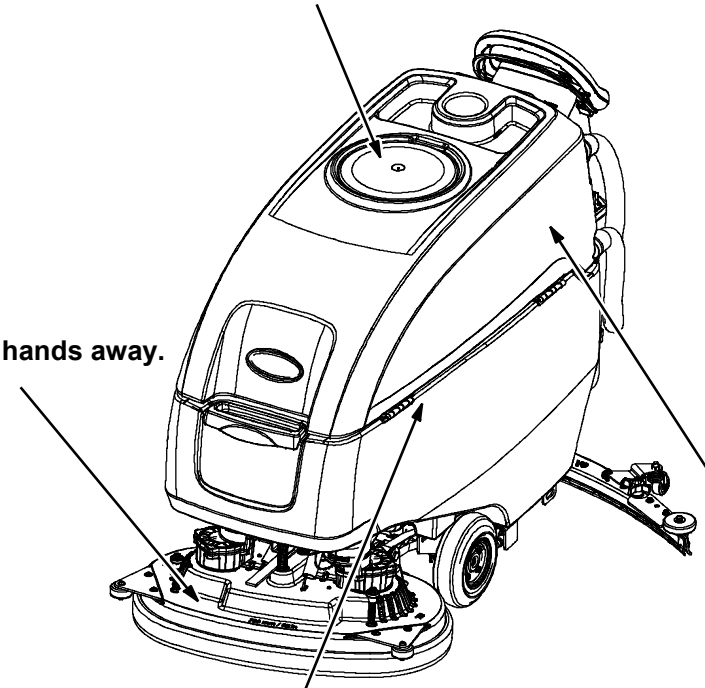
For Safety: wear eye protection.

SAFETY LABELS - NORTH AMERICA

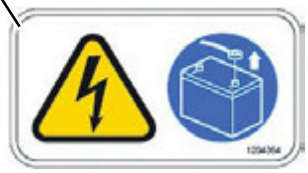
The safety labels appear on the machine in the locations indicated. Replace labels if they are missing or become damaged or illegible.

WARNING LABEL - Located on recovery tank cover.

WARNING LABEL -
Spinning brush. Keep hands away.
Located on scrub head.



WARNING LABEL -
Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away when charging.
Located on bottom side of recovery tank.



WARNING LABEL -
Electrical hazard. Disconnect battery cables before servicing machine.
Located on circuit breaker panel.

SAFETY LABELS - EU / INTL

The safety labels appear on the machine in the locations indicated. Replace labels if they are missing or become damaged or illegible.

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

Located near control console.

FOR SAFETY LABEL - Read manual before operating machine.

Located near control console.

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

Located on backside of solution tank cover.

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

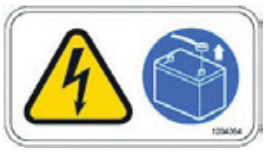
Located on control console and bottom side of recovery tank.

WARNING LABEL - Spinning brush. Keep hands away.

Located on scrub head.

WARNING LABEL - Do not charge batteries with damaged cord. Electric shock can result. Disconnect charger cord before servicing.

Located on control console.

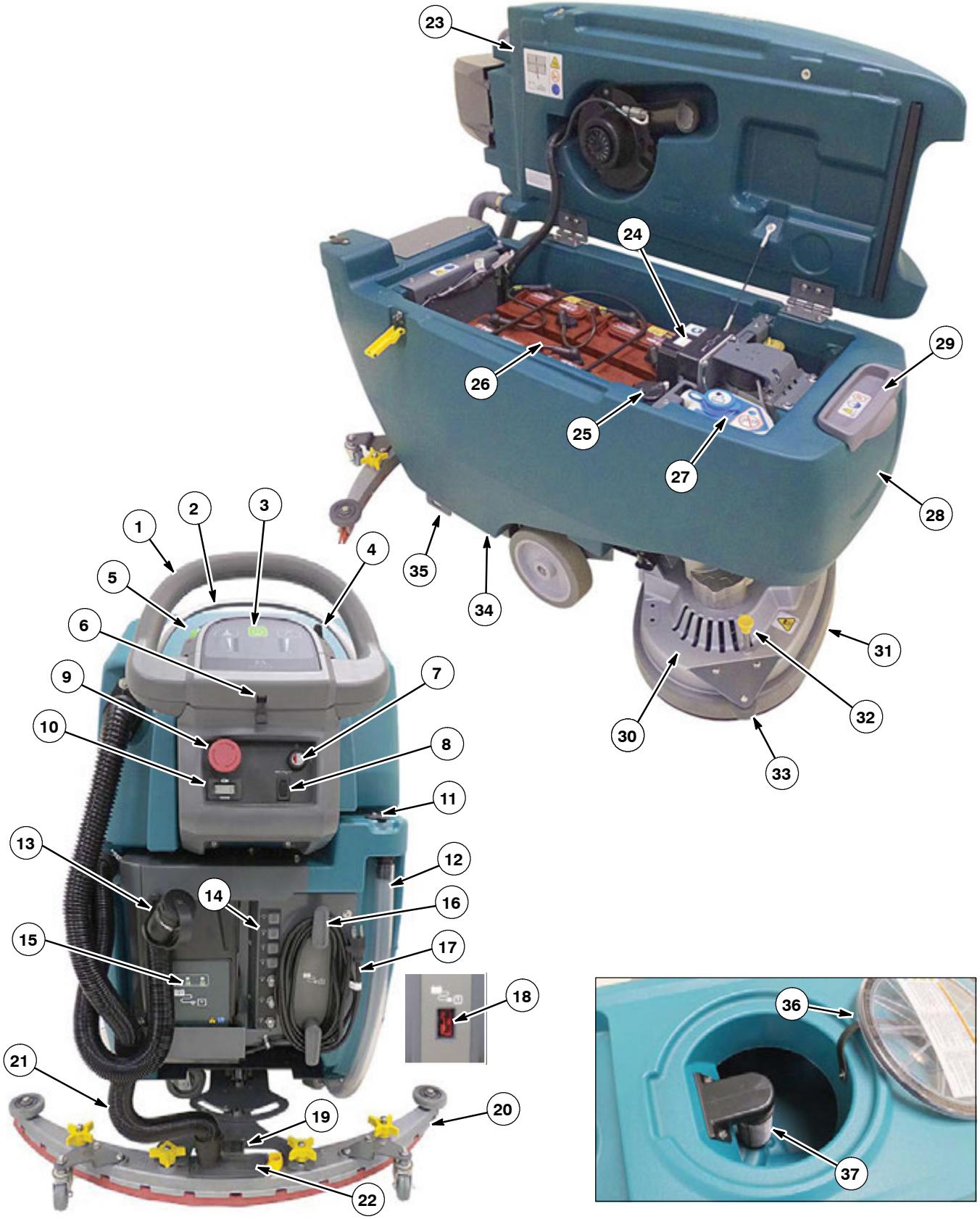


WARNING LABEL - Electrical Hazard. Disconnect battery cables before servicing machine.

Located on circuit board panel.

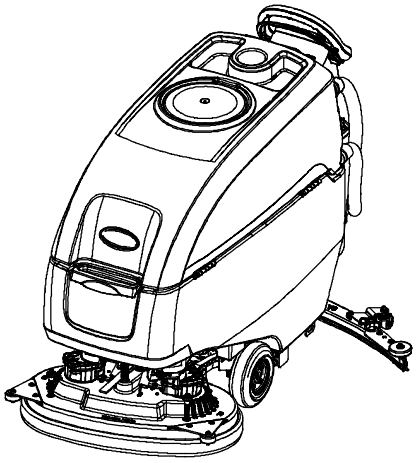
GENERAL INFORMATION

MACHINE COMPONENTS

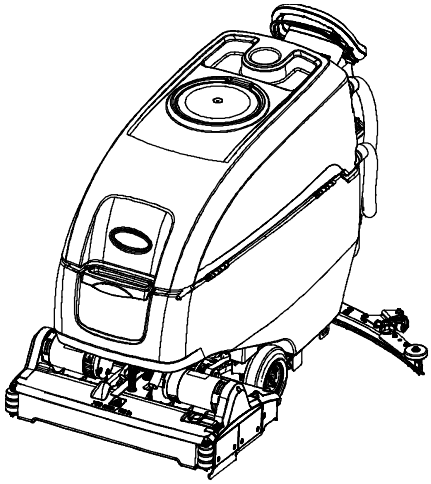


1. Control handle
2. Control handle start bail
3. Control panel
4. Forward/Reverse lever
5. Speed control knob
6. USB port (Service only)
7. Key switch
8. ec-H2O on/off switch (option)
9. Emergency shut-off button
10. Hour meter
11. Solution tank rear hose fill-port
12. Solution tank level/drain hose
13. Recovery tank drain hose
14. Circuit breaker panel
15. On-board battery charger
16. On-board battery charger cord hooks
17. Off-board battery charger cord
18. Off-board battery charger receptacle
19. Squeegee lower/lift foot pedal
20. Squeegee assembly
21. Squeegee vacuum hose
22. Squeegee debris/drip tray
23. Recovery tank
24. ec-H2O module (option)
25. ec-H2O water conditioning cartridge
26. Battery compartment
27. Automatic battery watering tank (option)
28. Solution tank
29. Solution tank front bucket fill-port
30. Scrub head
31. Scrub head skirt
32. Pad release plunger
33. Wall rollers
34. Parking brake (option)
35. Transport tie-down bracket
36. Recovery tank lid
37. Recovery tank float shut-off screen

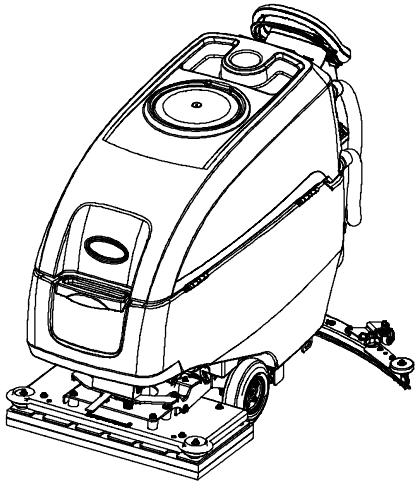
SCRUB HEAD TYPES



26 in / 650 mm Dual Disk
28 in / 700 mm Dual Disk
32 in / 800 mm Dual Disk



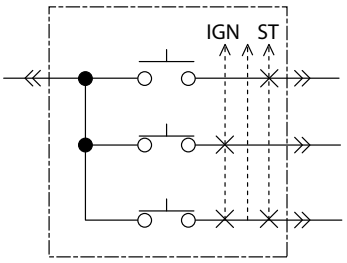
28 in / 700 mm Cylindrical Brush



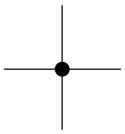
28 in / 700 mm Orbital Pad

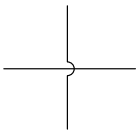
ELECTRICAL SCHEMATICS

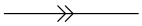
SCHEMATIC SYMBOLS



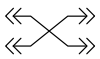
Key Switch

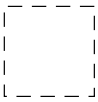

Connected


Not Connected

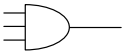

Connector

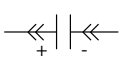

Energized


Adaptor Harness


Notes


Assembly


AC Plug


Capacitor

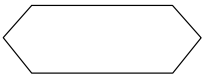
Battery

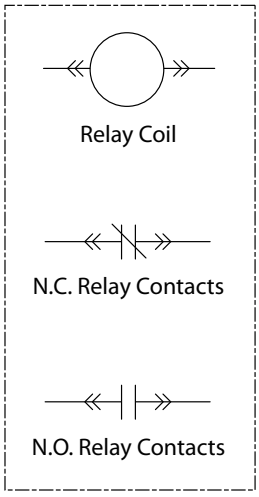

Circuit Breaker

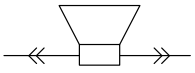

Fuse

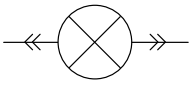

Diode

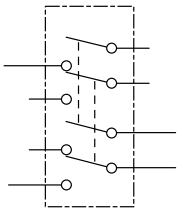

Single Continuation Tab

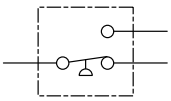

Double Continuation Tab

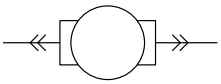


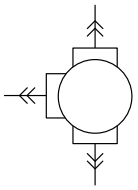

Horn or Alarm

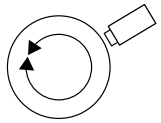

Light


DPDT Switch

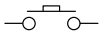

Pressure Switch

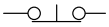

Motor


3 Phase AC
Induction Motor


Motor Encoder

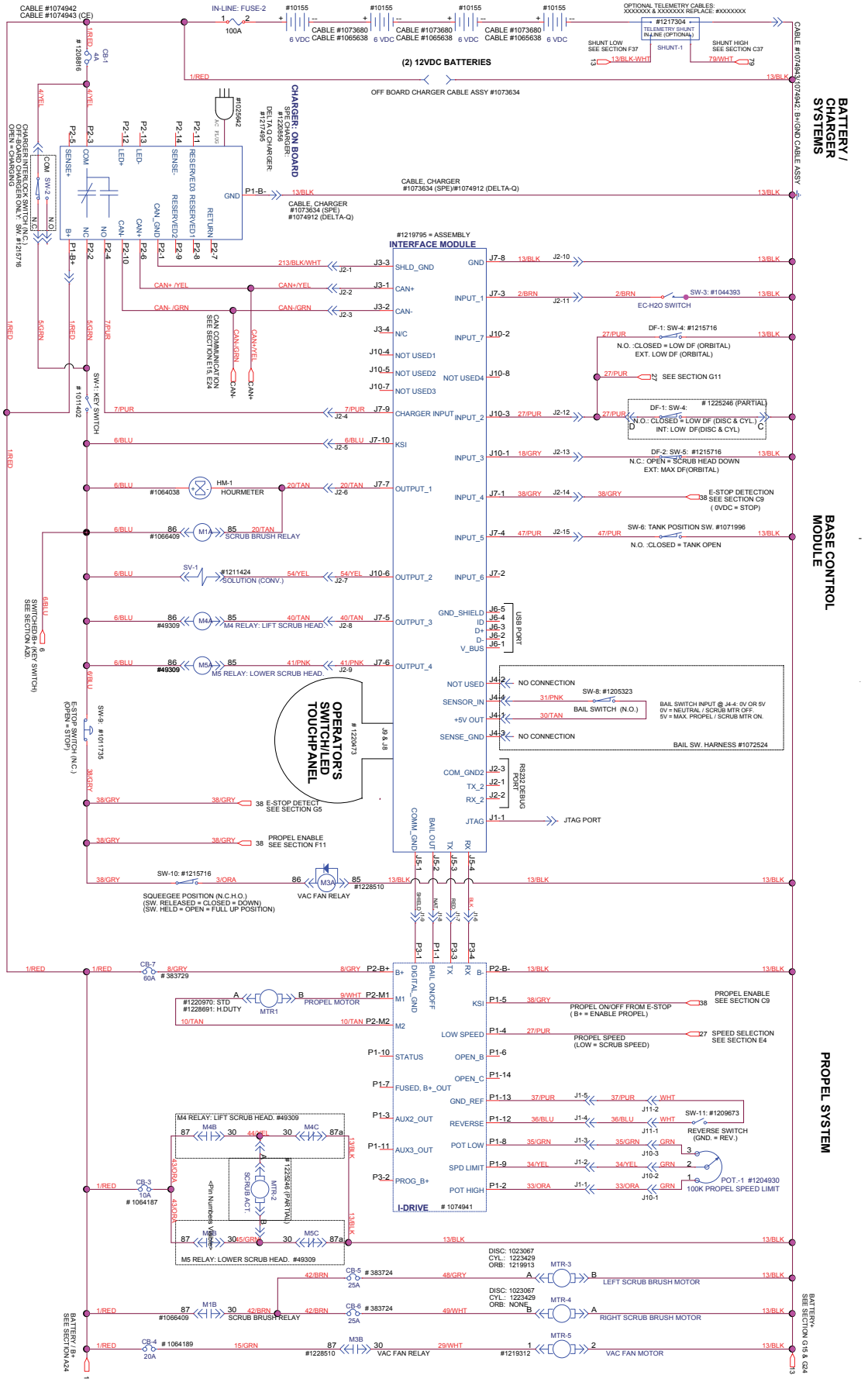

Sensor
(Variable Resistor)

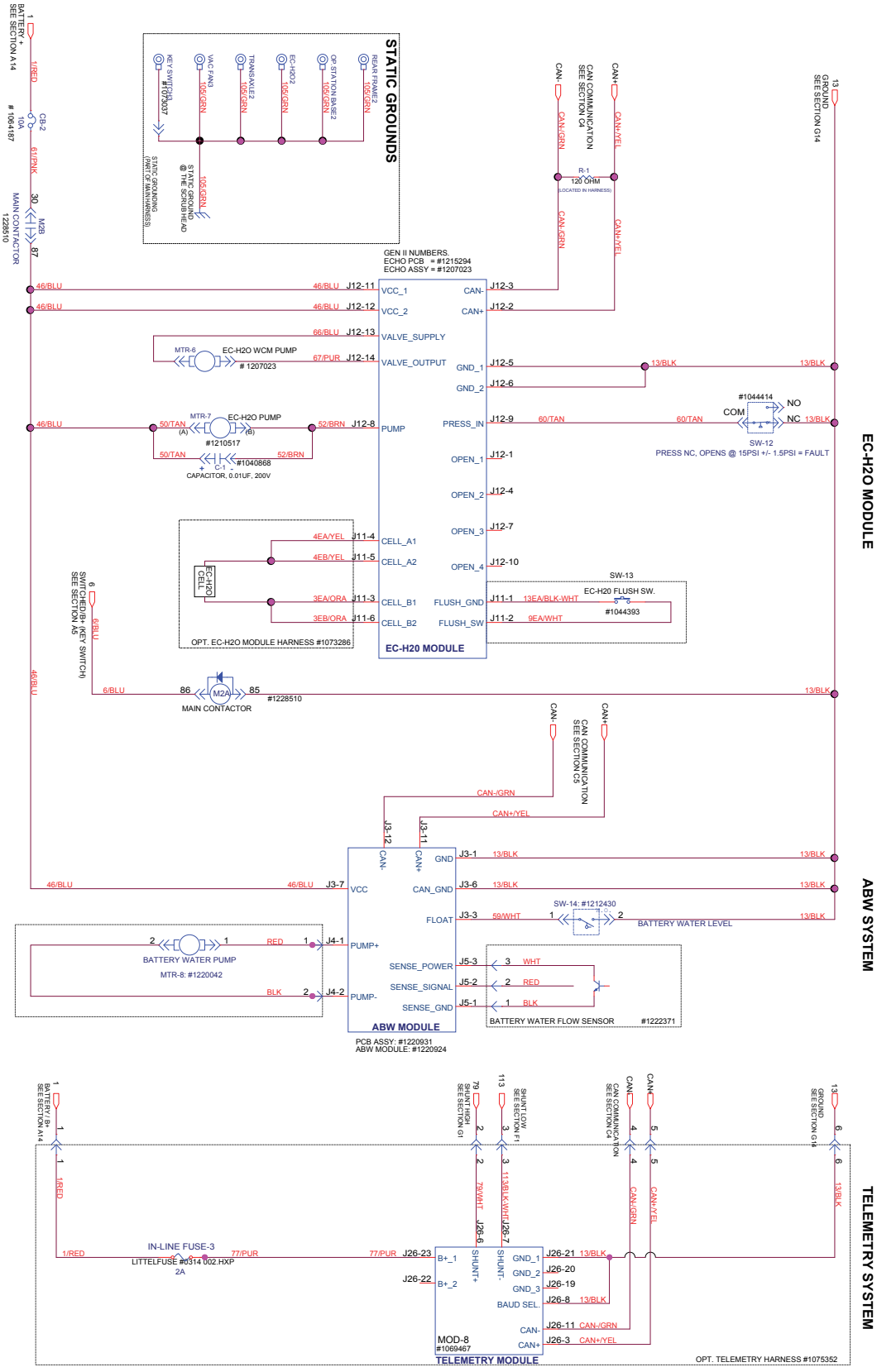

Momenary Switch N.O.


Contact Switch N.C.


Solenoid Valve

SCHEMATICS


BATTERY / CHARGER SYSTEMS
BASE CONTROL MODULE
PROPEL SYSTEM
(2) 12VDC BATTERIES
CHARGER: ON BOARD
INTERFACE MODULE
I-DRIVE
OPERATOR'S SWITCH/LED TOUCHPAD PANEL
VAC FAN RELAY
SCRUB BRUSH RELAY
PROPEL MOTOR
LEFT SCRUB BRUSH MOTOR
RIGHT SCRUB BRUSH MOTOR
VAC FAN MOTOR
HOURMETER
SOLUTION (CONV.)
EC-H2O SWITCH
E-STOP DETECTION
SEE SECTION C9
(0VDC = STOP)
SW-6: TANK POSITION SW. #1071996
N.O. :CLOSED = TANK OPEN
BAIL SWITCH (N.O.)
BAIL SW. HARNESS #1072524
PROPEL ENABLE
SEE SECTION C9
PROPEL ON/OFF FROM E-STOP
(B+ = ENABLE PROPEL)
PROPEL SPEED
(LOW = SCRUB SPEED)
SPEED SELECTION
SEE SECTION E4
REVERSE SWITCH
(GND. = REV.)
100K PROPEL SPEED LIMIT
JTAG PORT
USB PORT
RS232 DEBUG PORT
SQUEEGEE POSITION (N.C.H.O.)
(SW. RELEASED = CLOSED = DOWN)
(SW. HELD = OPEN = FULL UP POSITION)
CHARGER INTERLOCK SWITCH (N.C.)
OPEN = CHARGING
CLOSED = NOT CHARGING OR POWER ONLY
SW-1: KEY SWITCH
E-STOP SWITCH (N.C.)
(OPEN = STOP)
SWITCHED B+ (KEY SWITCH)
SEE SECTION A20
BATTERY / B+
SEE SECTION A24
BATTERY+
SEE SECTION G16 & G24
CABLE #1074942
CABLE #1074943 (CE)
CABLE #1074943; B+/GND CABLE ASSY
CABLE, CHARGER
#1073634 (SPE)/#1074912 (DELTA-Q)
#1219795 = ASSEMBLY
IN-LINE: FUSE-2
100A
CABLE #1073680
CABLE #1065638
6 VDC
OPTIONAL TELEMETRY CABLES:
XXXXXXX & XXXXXXX REPLACE: #XXXXXXX
#1217304
TELEMETRY SHUNT IN-LINE (OPTIONAL)
SHUNT-1
SHUNT LOW
SEE SECTION F37
SHUNT HIGH
SEE SECTION C37
13/BLK-WHT
79/WHT
OFF BOARD CHARGER CABLE ASSY #1073634
#1025942
DELTA Q CHARGER: #1217495
#1220856
CHARGER
CAN COMMUNICATION
SEE SECTION E15, E24
CAN-
CAN+
CAN-/GRN
CAN+/YEL
213/BLK/WHT
SHLD_GND
CAN+
CAN-
N/C
NOT USED1
NOT USED2
NOT USED3
CHARGER INPUT
KSI
HM-1
#1064038
HOURMETER
20/TAN
M1A
#1066409
85
SCRUB BRUSH RELAY
SV-1
#1211424
SOLUTION (CONV.)
54/YEL
M4A
#49309
M4 RELAY: LIFT SCRUB HEAD.
40/TAN
M5A
M5 RELAY: LOWER SCRUB HEAD.
41/PNK
OUTPUT_1
OUTPUT_2
OUTPUT_3
OUTPUT_4
INPUT_1
INPUT_2
INPUT_3
INPUT_4
INPUT_5
INPUT_6
INPUT_7
NOT USED4
GND_SHIELD
ID
D+
D-
V_BUS
NOT USED
SENSOR_IN
+5V OUT
SENSE_GND
COM_GND2
TX_2
RX_2
JTAG
COMM_GND
BAIL OUT
TX
RX
SHIELD
NOT USED
RED
BLK
DIGITAL_GND
BAIL ON/OFF
B+
B-
M1
M2
KSI
LOW SPEED
STATUS
OPEN_B
OPEN_C
FUSED, B+_OUT
GND_REF
AUX2_OUT
REVERSE
AUX3_OUT
POT LOW
SPD LIMIT
PROG_B+
POT HIGH
M3A
#1228510
M3B
#1219312
M4 RELAY: LIFT SCRUB HEAD. #49309
M5 RELAY: LOWER SCRUB HEAD. #49309
M4B
M4C
M5B
M5C
MTR1
MTR-2
MTR-3
MTR-4
MTR-5
#1220970: STD
#1228691: H.DUTY
#1225246 (PARTIAL)
<Pin Numbers Vary>
SCRUB ACT.
DISC: 1023067
CYL.: 1223429
ORB: 1219913
ORB: NONE
#383724
#1064187
#1064189
#1066409
CB-1
CB-3
CB-4
CB-5
CB-6
CB-7
POT.-1 #1204930


EC-H2O MODULE
ABW SYSTEM
TELEMETRY SYSTEM
STATIC GROUNDS
EC-H20 MODULE
ABW MODULE
TELEMETRY MODULE
EC-H2O WCM PUMP
EC-H2O PUMP
MAIN CONTACTOR
CAPACITOR, 0.01UF, 200V
EC-H20 FLUSH SW.
BATTERY WATER LEVEL
BATTERY WATER PUMP
BATTERY WATER FLOW SENSOR
IN-LINE FUSE-3
OPT. EC-H2O MODULE HARNESS #1073286
OPT. TELEMETRY HARNESS #1075352

OPERATIONAL MATRIX

FUNCTION	ENABLED	DISABLED
Propel	• Key ON (I) • Forward/Reverse Switch In FORWARD or REVERSE	• Key OFF (O) • Neutral - Bail Released • Recovery tank lifted • Propel Motor Controller Fault • Battery Charger ON Interlock
Vacuum Fan	• Key ON (I) • Squeegee Lowered - Foot Pedal	• Key OFF (O) • Squeegee Raised • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Scrub Head Actuator	• Key ON (I) • Head Lowered - 1-Step	• Key OFF (O) • Head Raised - 1-Step • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Main Scrub Motor	• Key ON (I) • Head Lowered - 1-Step • Forward/Reverse Switch - FORWARD or REVERSE • Bail Activated	• Key OFF (O) • Head Raised - 1-Step • Neutral - Bail Released • Recovery tank lifted • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Solution Control (Conventional)	• Head Lowered - 1-Step • Solution Control ON • Forward/Reverse Switch - FORWARD or REVERSE • Bail Activated	• Head Raised - 1-Step • Solution Control OFF • Neutral - Bail Released • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Solution Control (ec-H2O NanoClean - Optional)	• Head Lowered - Foot Pedal • Solution Control ON • ec-H2O Switch ON • Forward/Reverse Switch - FORWARD or REVERSE • Bail Activated	• Head Raised - 1-Step • Solution Control OFF • ec-H2O Switch OFF • Neutral - Bail Released • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • ec-H2O System Fault • Battery Charger ON Interlock

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	

GENERAL MACHINE DIMENSIONS/CAPACITIES/ PERFORMANCE (NORTH AMERICA / INTL)

MODEL	26 in / 650 mm Dual Disk	28 in / 700 mm Dual Disk	32 in / 800 mm Dual Disk
Length	58.5 in / 1486 mm	59.1 in / 1501 mm	61.1 in / 1552 mm
Width	27.5 in / 700 mm	29.5 in / 750 mm	33.5 in / 850 mm
Height	43.3 in / 1100 mm	43.3 in / 1100 mm	43.3 in / 1100 mm
Weight	320 lb / 145 kg	330 lb / 150 kg	355 lb / 161 kg
Weight (with batteries)	610 lb / 277 kg	620 lb / 281 kg	645 lb / 293 kg
GVW	800 lb / 363 kg	810 lb / 367 kg	835 lb / 379 kg
Squeegee width	38.3 in / 973 mm	41.3 in / 1049 mm	46.6 in / 1234 mm
Solution tank capacity	22.5 gal / 85 L		
Recovery tank capacity	27 gal / 102 L		
Automatic battery watering tank capacity	0.66 gal / 2.5 L		
Scrubbing path width	26 in / 650 mm	28 in / 700 mm	32 in / 800 mm
Down pressure	Low: 65 lbs / 29.5 kg, High: 120 lbs / 54.5 kg	Low: 70 lbs / 32 kg, High: 120 lbs / 54.5 kg	Low: -75 lbs / 34 kg, High: 120 lbs / 54.5 kg
Scrubbing speed	2.5 mph / 4.0 km/h (220 fpm / 67 mpm)		
Transport speed	2.7 mph / 4.4 km/h (240 fpm / 73 mpm)		
Reverse speed	1.6 mph / 2.6 km/h (144 fpm / 44 mpm)		
Productivity rate - estimated actual	20,571 ft^2/hr / 1911 m^2/hr	22,286 ft^2/hr / 2070 m^2/hr	25,714 ft^2/hr / 2389 m^2/hr
ec-H2O productivity rate - est. actual	23,124 ft^2/hr / 2148 m^2/hr	23,680 ft^2/hr / 2200 m^2/hr	27,323 ft^2/hr / 2538 m^2/hr
Aisle turnaround width	59 in / 1499 mm	59.6 in / 1514 mm	61.6 in / 1565 mm
Maximum operating gradient	2%		
Solution flow rate	Low: .30 gpm / 1.1 L/min, Med: .40 gpm / 1.5 L/min, High: .50 gpm / 1.9 L/min		
ec-H2O solution flow rate	Low: .15 gpm / 0.57 L/min, Med: .22 gpm / 0.84 L/min, High: .30 gpm / 1.14 L/min	Low: .22 gpm / 0.84 L/min, Med: .33 gpm / 1.25 L/min, High: .44 gpm / 1.67 L/min	Low: .22 gpm / 0.84 L/min, Med: .33 gpm / 1.25 L/min, High: .44 gpm / 1.67 L/min
Brush motor	2-24 VDC, 0.75 hp/0.55 kW, 29 A, 220 rpm		
Propel motor	24 VDC, 0.63 hp / 0.48 kW, 20A		
Vacuum motor	24 VDC, 0.46 hp / .34 kW, 14.3 A		
Water lift	34 in / 864 mm		
ec-H2O solution pump	24 VDC, 2 A, 1.0 gpm / 3.8 L/min, min open flow		
Automatic battery watering pump	12 VDC, 1.8 A, 0.37 gpm / 1.4 L/min, min open flow		
Machine voltage	24 VDC		
Battery capacity	4-6V 225AH C/20 Wet, 4-6V 260AH C/20 Wet, 4-6V 220AH C/20 AGM		
Total power consumption	66 A nominal / 1.6 kW		
Battery Charger - on-board	115-240VAC, 50/60Hz, 24VDC, 25A		
Battery Charger - smart off-board	85-265VAC, 50/60Hz, 24VDC, 25A		
Protection grade	IPX3		
Sound pressure level L_{pA}*	67.4 dB(A)	67.4 dB(A)	67.4 dB(A)
Sound uncertainty K_{pA}*	0.8 dB(A)	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	83.1 dB(A)	83.1 dB(A)	83.1 dB(A)
Machine vibration at hand-arm*	<2.5 m/s^2		
Ambient operating temperature	Min: 36 F/2 C, Max: 110 F/43 C		

*Values per IEC 60335-2-72. Specifications are subject to change without notice.

GENERAL MACHINE DIMENSIONS/CAPACITIES/ PERFORMANCE - NORTH AMERICA / INTL (continued)

MODEL	28 in / 700 mm Cylindrical Brush	28 in / 700 mm Orbital
Length	59.1 in / 1501 mm	58.5 in / 1486 mm
Width	30.7 in / 780 mm	28 in / 710 mm
Height	43.3 in / 1100 mm	43.3 in / 1100 mm
Weight	370 lb / 168 kg	370 lb / 168 kg
Weight (with batteries)	660 lb / 299 kg	660 lb / 299 kg
GVW	850 lb / 386 kg	850 lb / 386 kg
Squeegee width	46.6 in / 1234 mm	41.3 in / 1049 mm
Solution tank capacity	22.5 gal / 85 L	
Recovery tank capacity	27 gal / 102 L	
Automatic battery watering tank capacity	0.66 gal / 2.5 L	
Scrubbing path width	28 in / 700 mm	
Down pressure	Low: 85 lbs / 38.5 kg High: 120 lbs / 54.5 kg	Low: 110 lbs / 50 kg High: 170 lbs / 77 kg
Scrubbing speed	2.5 mph / 4.0 km/h (220 fpm / 67 mpm)	
Transport speed	2.7 mph / 4.4 km/h (240 fpm / 73 mpm)	
Reverse speed	1.6 mph / 2.6 km/h (144 fpm / 44 mpm)	
Productivity rate - estimated actual	22,286 ft^2/hr / 2070 m^2/hr	20,260 ft^2/hr / 1882 m^2/hr
ec-H2O productivity rate - est. actual	23,680 ft^2/hr / 2200 m^2/hr	21,527 ft^2/hr / 2000 m^2/hr
Aisle turnaround width	59.6 in / 1514 mm	59 in / 1499 mm
Maximum operating gradient	2%	
Solution flow rate	Low: .30 gpm / 1.1 L/min, Med: .40 gpm / 1.5 L/min, High: .50 gpm / 1.9 L/min	
ec-H2O solution flow rate	Low: .22 gpm / 0.84 L/min, Med: .33 gpm / 1.25 L/min, High: .44 gpm / 1.67 L/min	
Brush motor	2-24 VDC, 0.63 hp/0.47 kW, 23 A, 1500 rpm	24 VDC, 0.75 hp/0.55 kW, 28 A, 2200 rpm
Propel motor	24 VDC, 0.63 hp / 0.48 kW, 20A	
Vacuum motor	24 VDC, 0.46hp / .34 kW, 14.3 A	
Water lift	34 in / 864 mm	
ec-H2O solution pump	24 VDC, 2 A, 1.0 gpm / 3.8 L/min, min open flow	
Automatic battery watering pump	12 VDC, 1.8 A, 0.37 gpm / 1.4 L/min, min open flow	
Machine voltage	24 VDC	
Battery capacity	4-6V 225AH C/20 Wet, 4-6V 260AH C/20 Wet, 4-6V 220AH C/20 AGM	
Total power consumption	66 A nominal / 1.6 kW	
Battery Charger - on-board	115-240VAC, 50/60Hz, 24VDC, 25A	
Battery Charger - smart off-board	85-265VAC, 50/60Hz, 24VDC, 25A	
Protection grade	IPX3	
Sound pressure level L_{pA}*	68.3 dB(A)	66.9 dB(A)
Sound uncertainty K_{pA}*	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	84.3 dB(A)	83.4 dB(A)
Machine vibration at hand-arm*	<2.5 m/s^2	
Ambient operating temperature	Min: 36 F/2 C, Max: 110 F/43 C	

*Values per IEC 60335- 2- 72. Specifications are subject to change without notice.

GENERAL MACHINE DIMENSIONS/CAPACITIES/ PERFORMANCE (EU)

MODEL	650 mm Dual Disk	700 mm Dual Disk	800 mm Dual Disk
Length	1486 mm	1501 mm	1552 mm
Width	700 mm	750 mm	850 mm
Height	1100 mm	1100 mm	1100 mm
Weight	145 kg	150 kg	161 kg
Weight (with batteries)	277 kg	281 kg	293 kg
GVW	363 kg	367 kg	379 kg
Squeegee width	973 mm	1049 mm	1234 mm
Solution tank capacity	85 L		
Recovery tank capacity	102 L		
Automatic battery watering tank capacity	2.5 L		
Scrubbing path width	650 mm	700 mm	800 mm
Down pressure	Low: 29.5 kg, High: 54.5 kg	Low: 32 kg, High: 54.5 kg	Low: 34 kg, High: 54.5 kg
Scrubbing speed (Europe model)	84 mpm / 5.0 km/h		
Transport speed (Europe model)	91 mpm / 5.5 km/h		
Reverse speed (Europe model)	44 mpm 2.6 km/h		
Productivity rate - estimated actual (Europe model)	2389 m^2/hr	2588 m^2/hr	2986 m^2/hr
ec-H2O productivity rate - est. Actual (Europe model)	2685 m^2/hr	2750 m^2/hr	3173 m^2/hr
Scrubbing speed (Export Model)	67 mpm / 4.0 km/h		
Transport speed (Export Model)	73 mpm / 4.4 km/h		
Reverse speed (Export Model)	44 mpm / 2.6 km/h		
Productivity rate - estimated actual (Export model)	1911 m^2/hr	2070 m^2/hr	2389 m^2/hr
ec-H2O productivity rate - est. Actual (Export model)	2148 m^2/hr	2200 m^2/hr	2538 m^2/hr
Aisle turnaround width	1499 mm	1514 mm	1565 mm
Maximum operating gradient	2%		
Solution flow rate	Low: 1.1 L/min, Med: 1.5 L/min, High: 1.9 L/min		
ec-H2O solution flow rate	Low: 0.57 L/min, Med: 0.84 L/min, High: 1.14 L/min	Low: 0.84 L/min, Med: 1.25 L/min, High: 1.67 L/min	Low: 0.84 L/min, Med: 1.25 L/min, High: 1.67 L/min
Brush motor	2-24 VDC, 0.55 kW, 29 A, 220 rpm		
Propel motor	24 VDC, 0.48 kW, 20A		
Vacuum motor	24 VDC, .34 kW, 14.3 A		
Water lift	864 mm		
ec-H2O solution pump	24 VDC, 2 A, 3.8 L/min, min open flow		
Automatic battery watering pump	12 VDC, 1.8 A, 1.4 L/min, min open flow		
Machine voltage	24 VDC		
Battery capacity (Europe Model)	4-6V 210AH C/5 Wet, 4-6V 180AH C/5 Wet		
Battery capacity (Export Model)	4-6V 225AH C/20 Wet, 4-6V 260AH C/20 Wet, 4-6V 220AH C/20 AGM		
Total power consumption	66 A nominal / 1.6 kW		
Battery Charger - on-board	115-240VAC, 50/60Hz, 24VDC, 25A		
Battery Charger - smart off-board	85-265VAC, 50/60Hz, 24VDC, 25A		
Protection grade	IPX3		
Sound pressure level L_{pA}*	67.4 dB(A)	67.4 dB(A)	67.4 dB(A)
Sound uncertainty K_{pA}*	0.8 dB(A)	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	83.1 dB(A)	83.1 dB(A)	83.1 dB(A)
Machine vibration at hand-arm*	<2.5 m/s^2		
Ambient operating temperature	Min: 2 C, Max: 43 C		

*Values per IEC 60335-2-72. Specifications are subject to change without notice.

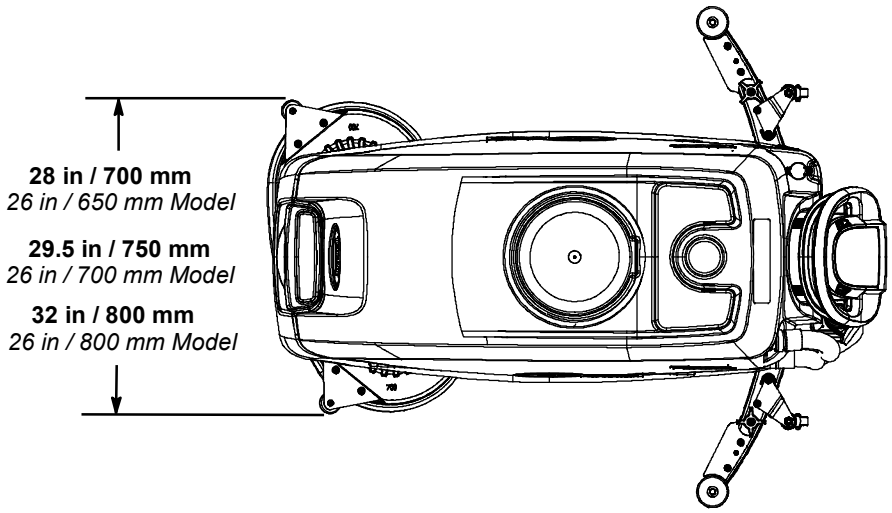
GENERAL MACHINE DIMENSIONS/CAPACITIES/ PERFORMANCE - EU continued

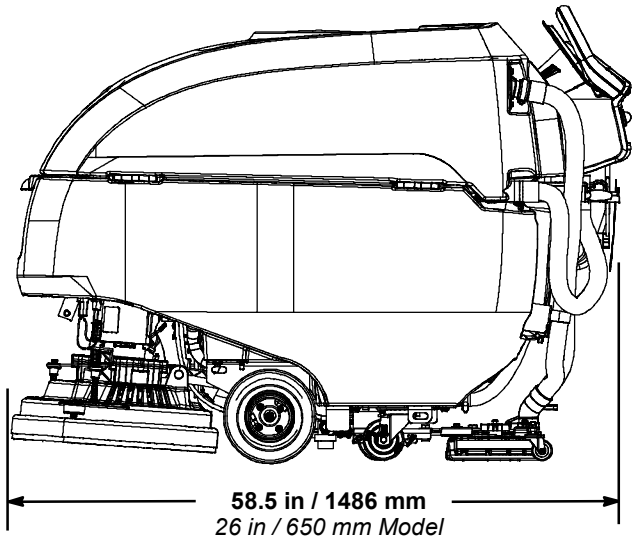
MODEL	700 mm Cylindrical Brush	700 mm Orbital
Length	1501 mm	1486 mm
Width	780 mm	710 mm
Height	1100 mm	1100 mm
Weight	168 kg	168 kg
Weight (with batteries)	299 kg	299 kg
GVW	386 kg	386 kg
Squeegee width	1234 mm	1049 mm
Solution tank capacity	85 L	
Recovery tank capacity	102 L	
Automatic battery watering tank capacity	2.5 L	
Scrubbing path width	700 mm	
Down pressure	Low: 38.5 kg High: 54.5 kg	Low: 50 kg High: 77 kg
Scrubbing speed (Europe model)	84 mpm / 5.0 km/h	61 mpm / 3.7 km/h
Transport speed (Europe model)	91 mpm / 5.5 km/h	73 mpm / 4.4 km/h
Reverse speed (Europe model)	44 mpm / 2.6 km/h	44 mpm / 2.6 km/h
Productivity rate - estimated actual (Europe model)	2588 m^2/hr	1882 m^2/hr
ec-H2O productivity rate - est. Actual (Europe model)	2750 m^2/hr	2000 m^2/hr
Scrubbing speed (Export Model)	67 mpm / 4.0 km/h	61 mpm / 3.7 km/h
Transport speed (Export Model)	73 mpm / 4.4 km/h	73 mpm / 4.4 km/h
Reverse speed (Export model)	44 mpm / 2.6 km/h	44 mpm / 2.6 km/h
Productivity rate - estimated actual (Export Model)	2070 m^2/hr	1882 m^2/hr
ec-H2O productivity rate - est. Actual (Export Model)	2200 m^2/hr	2000 m^2/hr
Aisle turnaround width	1514 mm	1499 mm
Maximum operating gradient	2%	
Solution flow rate	Low: 1.1 L/min, Med: 1.5 L/min, High: 1.9 L/min	
ec-H2O solution flow rate	Low: 0.84 L/min, Med: 1.25 L/min, High: 1.67 L/min	
Brush motor	2-24 VDC, 0.47 kW, 23 A, 1500 rpm	24 VDC, 0.55 kW, 28 A, 2200 rpm
Propel motor	24 VDC, 0.48 kW, 20A	
Vacuum motor	24 VDC, .34 kW, 14.3 A	
Water lift	864 mm	
ec-H2O solution pump	24 VDC, 2 A, 3.8 L/min, min open flow	
Automatic battery watering pump	12 VDC, 1.8 A, 1.4 L/min, min open flow	
Machine voltage	24 VDC	
Battery capacity (Europe Model)	4-6V 210AH C/5 Wet, 4-6V 180AH C/5 Wet	
Battery capacity (Export Model)	4-6V 225AH C/20 Wet, 4-6V 260AH C/20 Wet, 4-6V 220AH C/20 AGM	
Total power consumption	66 A nominal / 1.6 kW	
Battery Charger - on-board	115-240VAC, 50/60Hz, 24VDC, 25A	
Battery Charger - smart off-board	85-265VAC, 50/60Hz, 24VDC, 25A	
Protection grade	IPX3	
Sound pressure level L_{pA}*	68.3 dB(A)	66.9 dB(A)
Sound uncertainty K_{pA}*	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	84.3 dB(A)	83.4 dB(A)
Machine vibration at hand-arm*	<2.5 m/s^2	
Ambient operating temperature	Min: 2 C, Max: 43 C	

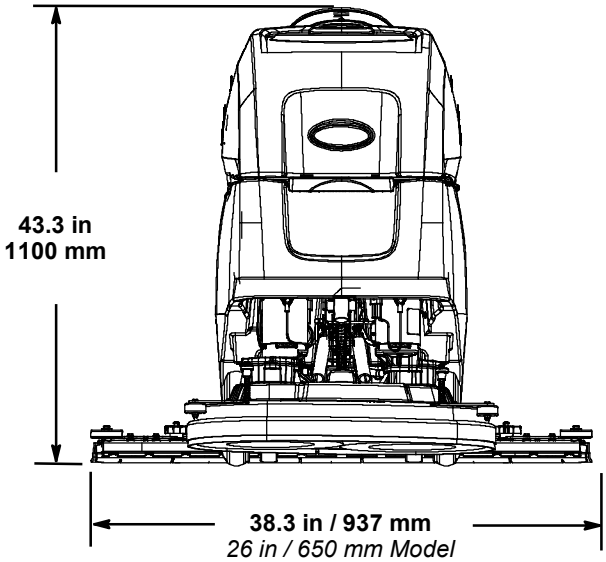
*Values per IEC 60335- 2- 72. Specifications are subject to change without notice.

MACHINE DIMENSIONS

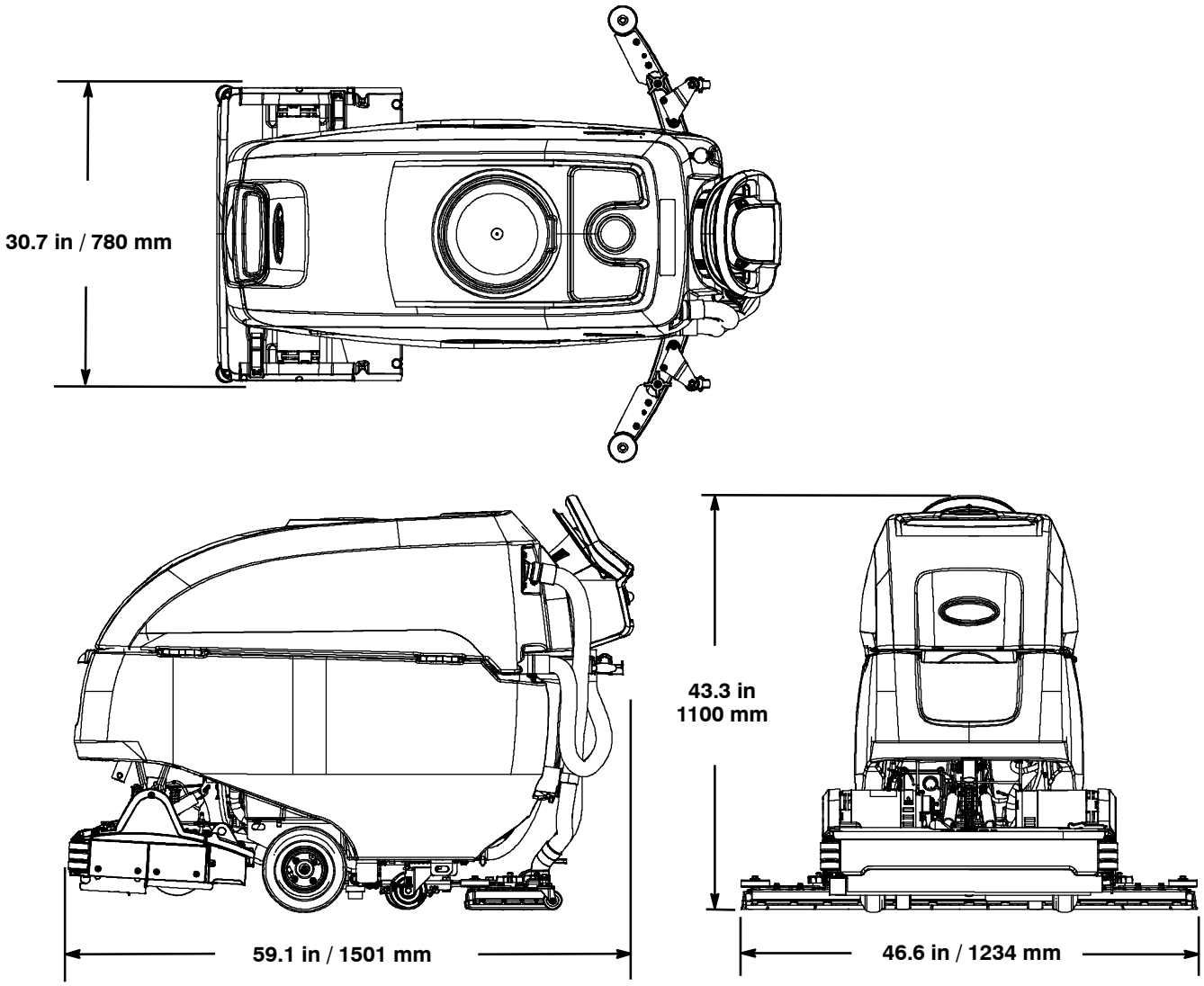
DUAL DISK MODEL



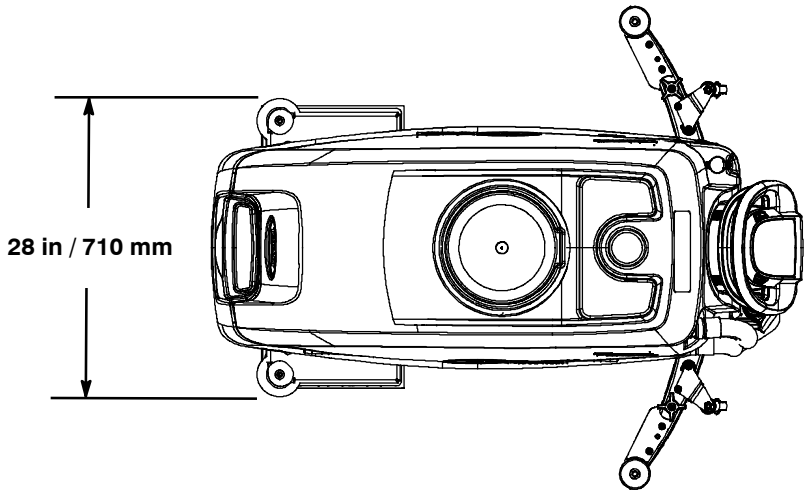


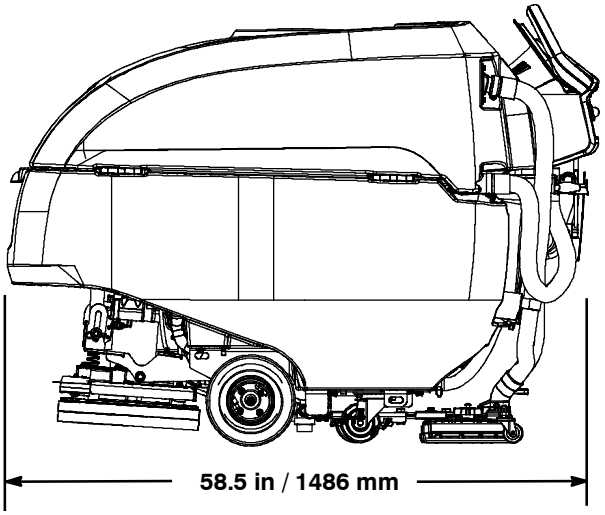


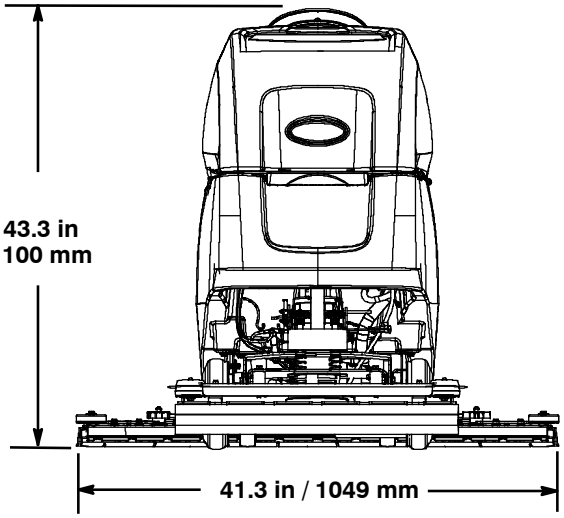
CYLINDRICAL BRUSH MODEL



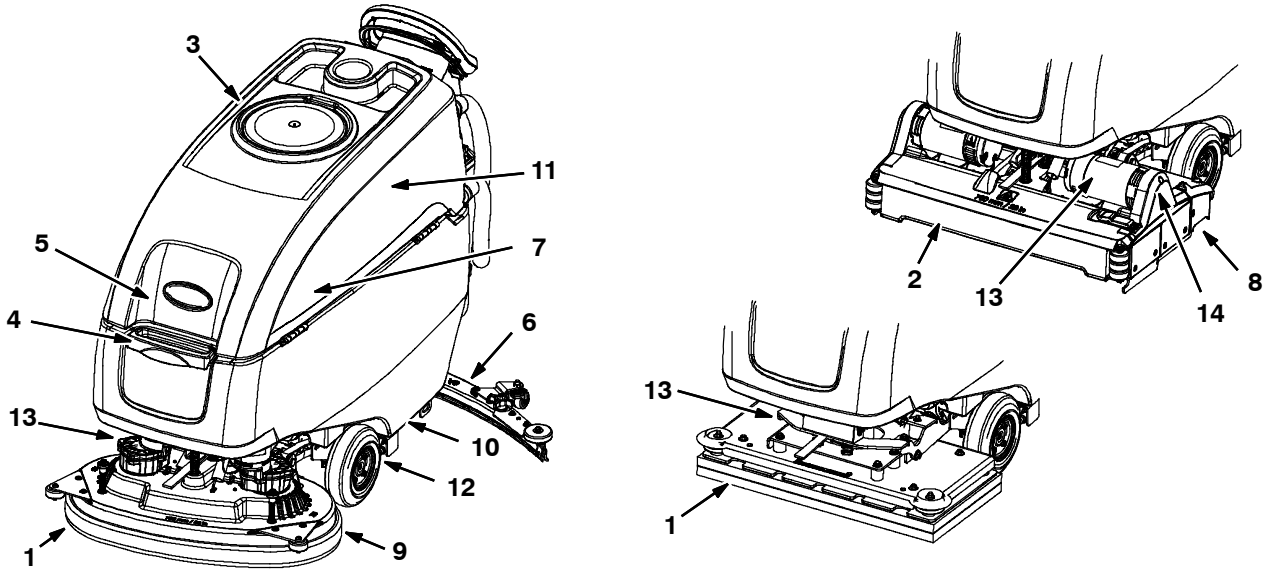
ORBITAL PAD MODEL







MAINTENANCE



MAINTENANCE CHART

The table below indicates the Person Responsible for each procedure.

O = Operator T = Trained Personnel

Interval	Person Resp.	Key	Description	Procedure
Daily	O	1	Pads	Check, flip, or replace
	O	1	Brushes	Check, clean
	O	2	Cylindrical brushes	Check, clean
	O	3	Recovery tank	Drain, rinse, clean float shut-off screen and debris tray
	O	4	Solution tank	Drain, rinse
	O	5	Automatic battery watering tank (option)	Check, refill
	O	6	Squeegee	Clean, check for damage and wear
	O	7	Batteries	Charge if necessary
	O	8	Debris trough	Clean
	O	9	Scrub head skirt	Check for damage and wear
Weekly	O	7	Battery cells	Check electrolyte level
	O	6	Squeegee assembly drip trap reservoir	Check, clean
50 Hours	O	2	Cylindrical brushes	Rotate brushes. Check for wear
	O	2	Cylindrical scrub head	Clean underside of scrub head
	O	3	Recovery tank lid seal	Check for wear.
	O	10	Solution tank filter	Remove and clean
100 Hours	O	7	Battery watering system (option)	Check hoses for damage and wear
200 Hours	O	7	Batteries, terminals and cables	Check and clean
750 Hours	T	11	Vacuum motor	Replace carbon brushes
1250 Hours	T	12	Propel motor	Replace carbon brushes
	T	13	Brush motor	Replace carbon brushes
	T	14	Brush belt	Replace belt

MACHINE MAINTENANCE

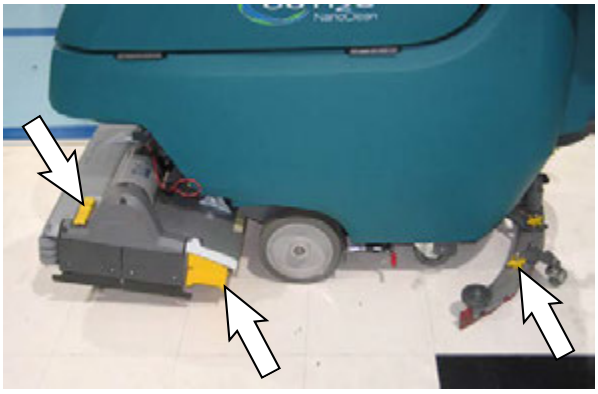
To keep the machine in good working condition, simply perform the following maintenance procedures.

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

FOR SAFETY: When servicing machine wear personal protection equipment as needed. All repairs must be performed by trained personnel

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.

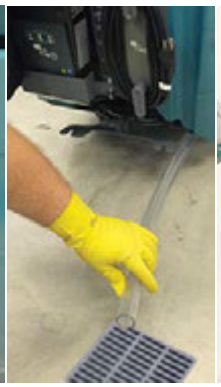


AFTER DAILY USE

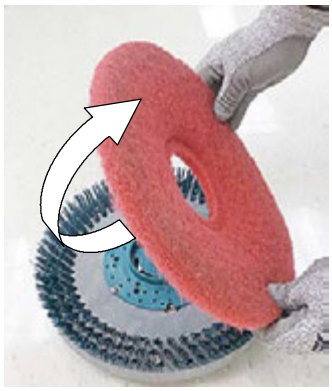
1. Drain and rinse out the recovery tank.

2. Remove and clean the float shut-off screen.

3. Drain and rinse out the solution tank.

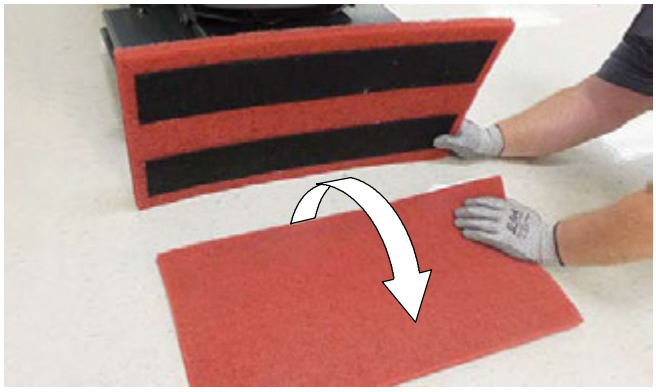


4. Disk scrub head - Turn pad over or replace when worn



5. Replace brushes when they no longer clean effectively or when the bristles are worn to the yellow indicator

Orbital scrub head - Turn the working pad over or replace when worn



6. Wipe the squeegee blades clean. Inspect blades for wear and damage. Rotate blade if worn. See SQUEEGEE BLADE REPLACEMENT.

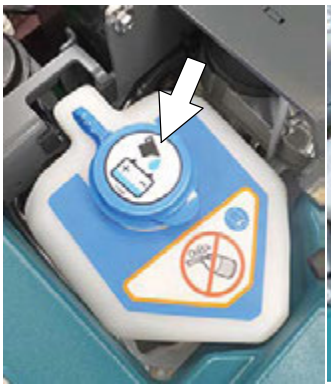
7. Clean scrub head skirt. Check for wear or damage. Replace if worn or damaged

8. Clean the outside surface of the machine with an all purpose cleaner and damp cloth.

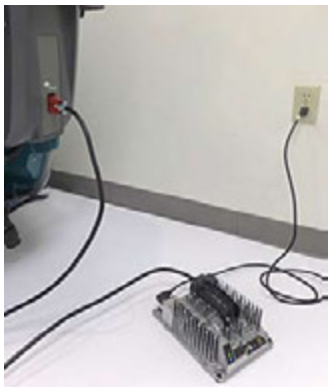
FOR SAFETY: When servicing machine, do not power spray or hose off machine. Electrical malfunction may occur. Use damp cloth.

9. Cylindrical brush scrub head - Remove and clean debris trough.

10. Automatic battery watering option - Refill tank with distilled water. Replace cap.



11. Charge batteries. See BATTERIES.

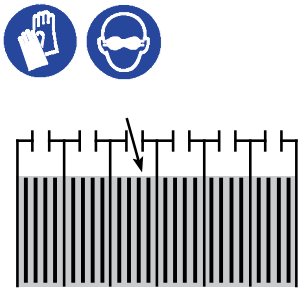


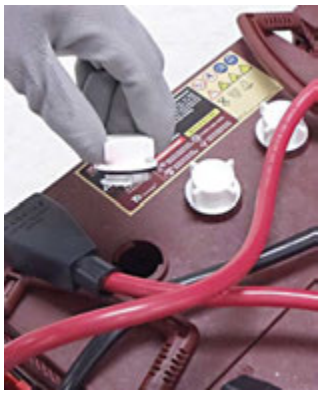
ATTENTION: Do not disconnect battery cables while charger is plugged in, circuit board damage may result.

AFTER WEEKLY USE

1. Check the electrolyte level in all batteries. See BATTERIES.

NOTE: If machine is equipped with the automatic or manual battery watering system, See BATTERIES.



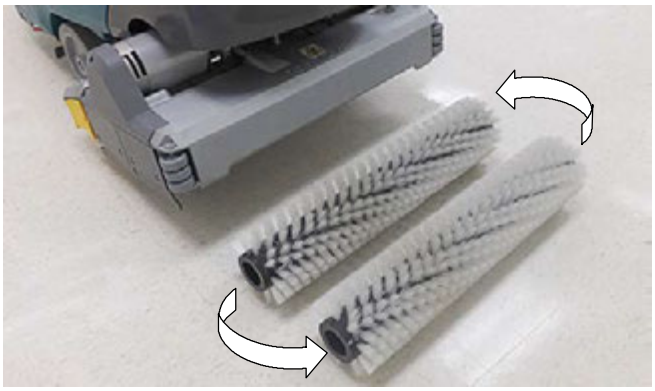


2. Remove the drip trap cover from the squeegee assembly and clean reservoir.

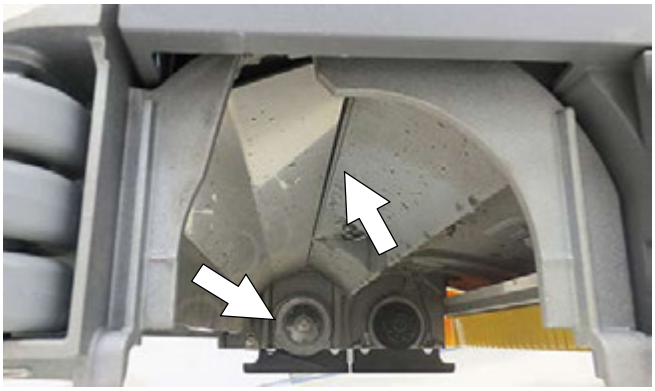
AFTER EVERY 50 HOURS OF USE

1. Drain solution tank. Remove the solution tank filter and clean screen (Figure 109). Turn the filter bowl counter-clockwise to remove.

2. Cylindrical brushes - Rotate brushes from front to rear. Replace brushes when they no longer clean effectively.



3. Cylindrical scrub head - Remove debris buildup from underside of scrub head, including the idler plates and drive hubs



AFTER EVERY 100 HOURS OF USE

If machine is equipped with the optional battery watering system, check hoses for leaks, loose hose connections and for damage or wear. Replace system if damaged.

FOR SAFETY: When servicing batteries, wear personal protection equipment as needed. Avoid contact with battery acid.

ELECTRIC MOTORS

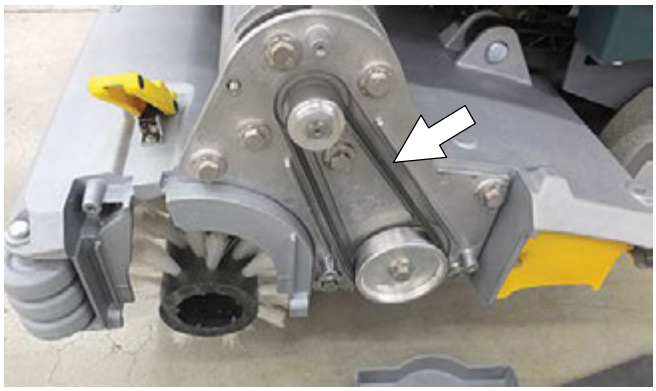
Replace motor carbon brushes as indicated. Contact trained personnel for carbon brush replacement.

Carbon Brush Replacement	Hours
Vacuum motor	750
Propel motor	1250
Disk brush motors	1250
Cylindrical brush motors	1250
Orbital brush motor	1250

BELTS (Cylindrical Brush Model)

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

Replace belts every 1250 hours. Contact trained personnel for belt replacement.



BATTERIES

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

The lifetime of the batteries depends on their proper maintenance. To get the most life from the batteries;

- Do not charge the batteries more than once a day and only after running the machine for a minimum of 15 minutes.
- Do not leave the batteries partially discharged for long period of time.
- Only charge the batteries in a well-ventilated area to prevent gas build up. Charge batteries in areas with ambient temperatures 80ºF/27ºC or less.
- Allow the charger to complete charging the batteries before re-using the machine.
- Maintain the proper electrolyte levels of flooded (wet) batteries by checking levels weekly.

This machine is equipped with either flooded (wet) lead-acid or maintenance-free (Sealed AGM) batteries supplied by Tennant.

FOR SAFETY: When servicing machine, keep all metal objects off batteries. Avoid contact with battery acid.

MAINTENANCE-FREE BATTERIES

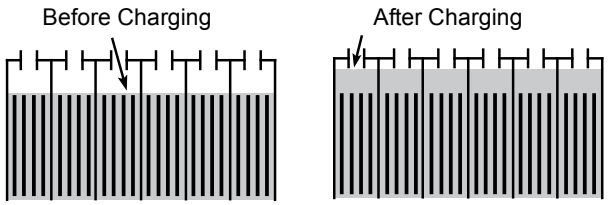
Maintenance-free (Sealed AGM) batteries do not require watering. Cleaning and other routine maintenance is still required.

FLOODED (WET) LEAD-ACID BATTERIES

The flooded (wet) lead-acid batteries require routine watering as described below. Check the battery electrolyte level weekly.

NOTE: If machine is equipped with the automatic or manual battery watering system, proceed to the BATTERY WATERING SYSTEM instructions.

The electrolyte 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. After charging, distilled water can be added up to about 3 mm (0.12 in) below the sight tubes.



NOTE: Make sure the battery caps are in place while charging. There may be a sulfur smell after charging batteries. This is normal.

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 to prevent battery corrosion. Use a scrub brush with a strong mixture of baking soda and water. Do not remove battery caps when cleaning batteries.

CHARGING BATTERIES

The charging instructions in this manual are intended for the battery charger supplied with your machine. The use of other battery chargers that are not supplied and approved by Tennant are prohibited.

If machine is equipped with an off-board battery charger refer to the charger's owners manual for operating instructions. Contact distributor or Tennant for battery charger recommendations if machine is not equipped with charger.

FOR SAFETY: The use of incompatible battery chargers may damage battery packs and potentially cause a fire hazard.

IRIS® Battery Charging Metrics Notification: Machines equipped with capability to report battery charging data via IRIS are supplied with a charger and set of batteries from the factory. When a battery reaches its end of life and must be replaced, Tennant highly recommends that the same battery type be used to continue to maximize the machines performance. In the event a battery with a different amp hour (AH), type (Flooded, AGM, Gel), or manufacturer is selected for replacement please contact Tennant technical service department for assistance in determining the feasibility of the replacement batteries and if so, selecting the correct charging profile. Availability of IRIS battery metric reporting is not guaranteed with third party supplied batteries.

IMPORTANT NOTICE: The battery charger is set to charge the battery type supplied with the machine. If it is necessary to change to a different battery type or capacity (i.e. flooded (wet) lead-acid, maintenance-free, sealed, AGM batteries, etc...), the charger charging profile must be changed to prevent battery damage. See BATTERY CHARGER SETTINGS.

1. Transport the machine to a well-ventilated area.

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

2. Park the machine on a flat, dry surface, turn off machine and remove key.

FOR SAFETY: When servicing batteries, stop on level surface, turn off machine, remove key and set parking brake if equipped.

3. If the machine is equipped with flooded (wet) lead-acid batteries check the battery electrolyte level weekly before charging. For models equipped with the automatic battery watering system, check if the automatic battery water tank needs refilling. Add distilled water if low.

4. For models equipped with an on-board charger, remove the charger's power cord from the storage hooks and plug power cord into a properly grounded wall outlet.

For models equipped with off-board chargers, first connect the charger's DC cord into the machine's battery charge receptacle then plug the AC power supply cord into a properly grounded wall outlet. Refer to the off-board battery charger's owner manual for operating instructions.

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

5. The charger will automatically begin charging and shut off when fully charged. The maximum charging cycle may take up to 6-12 hours depending on battery type.

   On-board battery charger: The battery discharge indicator lights will ripple back and forth during the charging cycle. When all five lights repeatedly flash two times, the charging cycle is complete.

ATTENTION: Do not disconnect battery cables while charger is plugged in, circuit board damage may result.

6. After charging batteries unplug the power supply cord and wrap cord around the cord hooks.

   For models equipped with an off-board charger, always disconnect the AC power supply cord first before disconnecting charger from machine

BATTERY CHARGER SETTINGS

The battery charger is set to charge the battery type supplied with your machine. If you choose to change to a different battery type or capacity, the charger's charging profile must be changed to prevent battery damage.

The machine's battery discharge indicator (BDI) must also be reprogrammed to match battery type to prevent battery damage and/or short run-time.

NOTE: For machines shipped without batteries, the battery discharge indicator and the on-board battery charger are set for GEL batteries as the default. If you choose to use a different battery type, the settings must be changed as described as below.

NOTE: For Pro-Membrane models shipped without batteries and an Off-Board Charger, the off-board battery charger is set for wet lead-acid batteries from the factory. The machine's battery discharge indicator is set for GEL batteries as the default. The battery discharge indicator must be reprogrammed to match charger settings, contact service.

IRIS MODELS: For models equipped with capability to report battery charging data via IRIS, Tennant recommends using the same battery type. If a different amp hour or battery type is desired, Call Tennant Technical Support to report new battery type.

OFF-BOARD BATTERY CHARGER

To change the off-board battery charger settings, refer to the off-board charger's owner manual.

To reprogram the machine's battery discharge indicator (BDI), service application software is required, contact service.

ON-BOARD BATTERY CHARGER

To change the on-board battery charger settings, service application software required, contact service.

As an alternative, the charger profile may be manually changed. See CHANGING ON-BOARD BATTERY CHARGER SETTINGS. The battery discharge indicator will automatically reprogram to match battery type when the battery charger profile is changed.

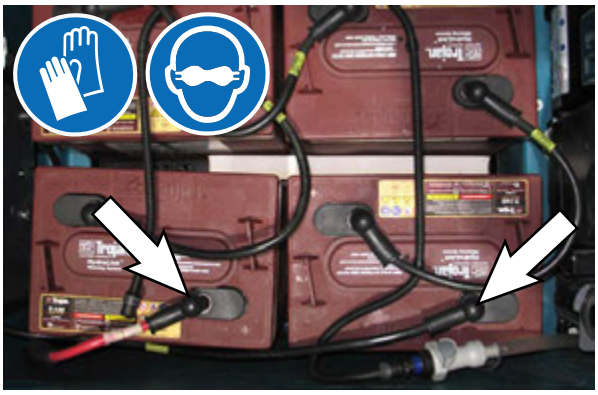
CHANGING ON-BOARD BATTERY CHARGER SETTINGS

To manually change the on-board battery charger settings for a different battery type, carefully follow instructions as described below

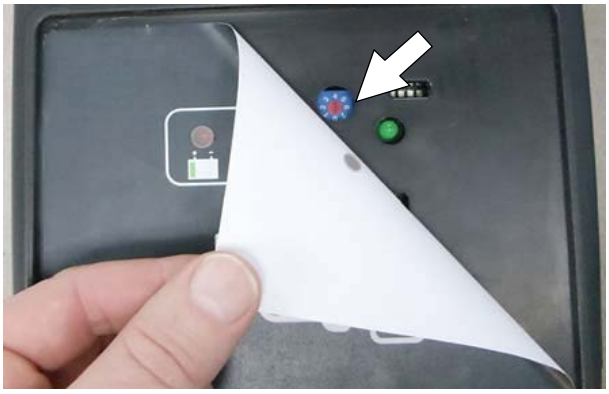
NOTE: The manual method is only an alternative if unable to change setting by use of the Service Application Software performed by Service.

1. Disconnect the battery cable connection at machine.

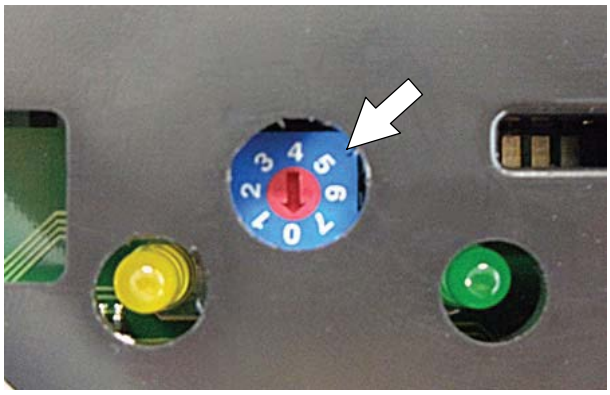
FOR SAFETY: When servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.



2. Carefully peel back the charger display label to access the dial settings.



3. Using a small standard screwdriver, turn the dial to the appropriate battery type according to the following chart.



Dial Position	Battery Description Settings with AH Ranges
0	CAN-BUS setting*
1	Wet, Trojan 180-260 AH
2	Wet, Trojan 270-360 AH
3	Wet, Enersys/Tab 200-350 AH
4	AGM, Tianneng 180-260 AH
5	AGM, Discover 200-350 AH
6	Gel, Sonnenschein 80-150 AH

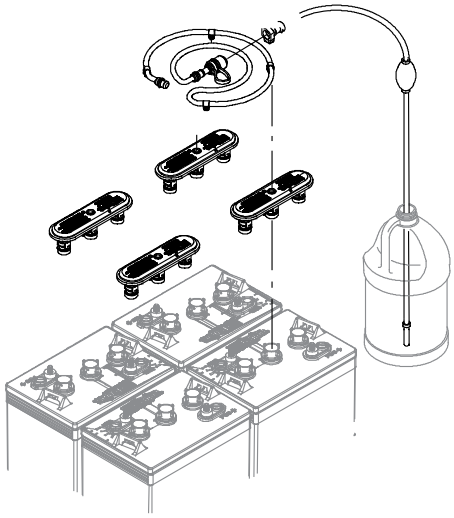
** The CAN-BUS setting, dial position "0", is the software setting that is programmed to match battery type supplied with machine. When the dial is manually changed to a different setting, it should not be reset back to "0" otherwise battery damage may result. Service Application Software is required to reset dial back to "0". Contact Service.*

4. Re-apply the display label.

5. To set the BDI for the new battery type, plug the on-board battery charger cord into an electrical outlet. The machine's software will automatically reprogram the BDI to the new battery type.

HYDROLINK® BATTERY WATERING SYSTEM (Trojan® Battery OPTION)

The following instructions are for models equipped with the HydroLink battery watering system option.



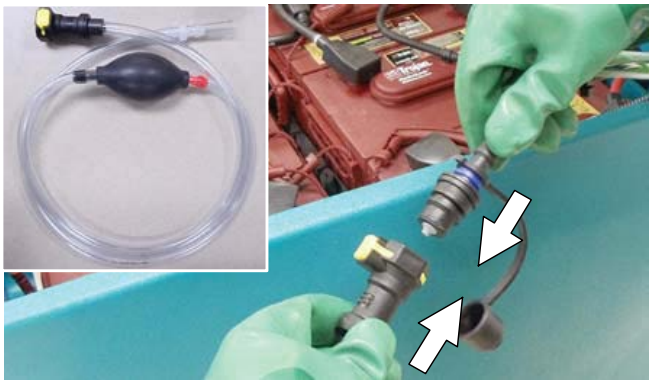
The optional HydroLink battery watering system provides a safe and easy way to maintain the proper electrolyte levels in your batteries. It is designed exclusively for Trojan flooded (wet) lead-acid batteries.

FOR SAFETY: When servicing machine, wear personal protection equipment as needed. Avoid contact with battery acid.

Before using the battery watering system check hoses and connections for damage or wear.

1. 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.
2. After charging batteries, check the battery electrolyte level indicators located on the battery covers. If the level indicator is white add water as described in the following instructions. If the level indicators are black the electrolyte is at the correct level, no water is required.

3. Locate the battery fill hose coupler inside the battery compartment. Remove the dust cap and connect the hand pump hose.



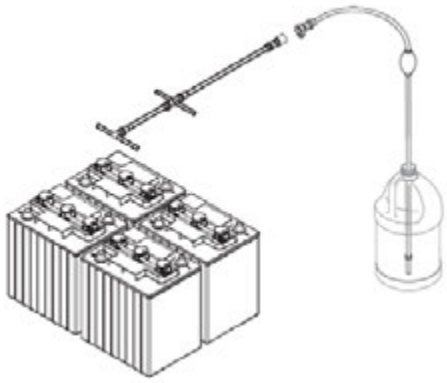
4. Submerge the other end of the hand pump hose into a bottle of distilled water

5. Squeeze the bulb on the hand pump hose until firm. The level indicators will turn black when full.

6. After adding water, replace the dust cap on the battery fill hose and store the hand pump hose inside the machine's battery compartment for future use.

MANUAL HAND PUMP BATERY WATERING SYSTEM (TAB BATTER OPTION)

The following instructions are for machines equipped with the manual hand pump battery watering system option.



This optional manual battery watering system provides a safe and easy way to maintain the proper electrolyte levels in your batteries. It is designed for Wet BFS TAB batteries only.

FOR SAFETY: When servicing machine, wear personal protection equipment as needed. Avoid contact with battery acid.

Before using the battery watering system check hoses and connections for damage or wear.

1. 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 overfl ow when charging.
2. After charging batteries, check the battery electrolyte level indicators located on the battery covers. If the white level indicator is at the low position, add distilled water as described in the following instructions. If the white level indicator is at the full position (against the transparent window), the electrolyte is at the correct level, no water is required.

3. Locate the battery fi ll hose coupler inside the battery compartment. Connect the hand pump hose to the battery watering system.

4. Submerge the other end of the hand pump hose into a bottle of distilled water.

5. Squeeze the bulb on the hand pump hose until firm The white level indicators will raise to the full position.

6. After adding water, store the hand pump hose inside the machine’s battery compartment for future use.

AUTOMATIC BATTERY WATERING SYSTEM

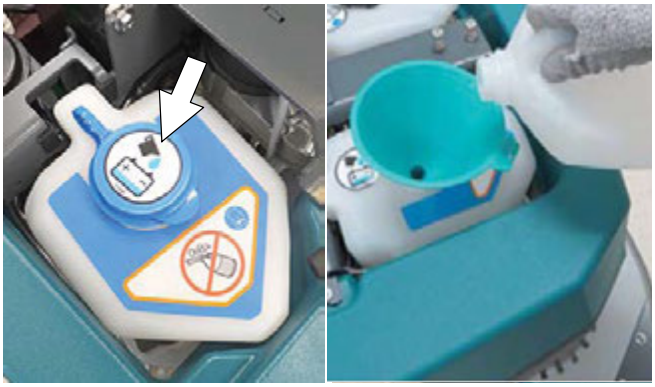
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

The automatic battery watering system is designed to automatically refill the batteries after the machine reaches a limited number of charge cycles. Do not remove battery caps and manually add water to the batteries.

Check the automatic battery watering system for leaks, loose hose connections and for damage or wear. Replace if damaged.

Check the water level in the automatic watering tank periodically. Add distilled water when low.

FOR SAFETY: When servicing machine, only use distilled water when filling the automatic battery watering tank.



The automatic battery watering indicator will also alert user to add distilled water when tank is empty. See OPERATOR MANUAL for further details.

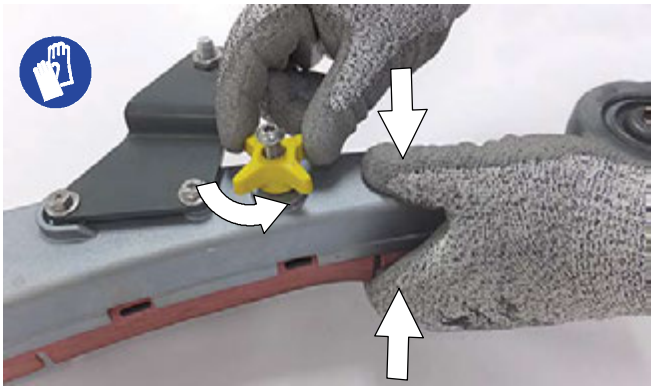
To store machine equipped with the automatic battery watering system in freezing temperatures, see STORING MACHINE/FREEZE PROTECTION.

SQUEEGEE BLADE REPLACEMENT

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

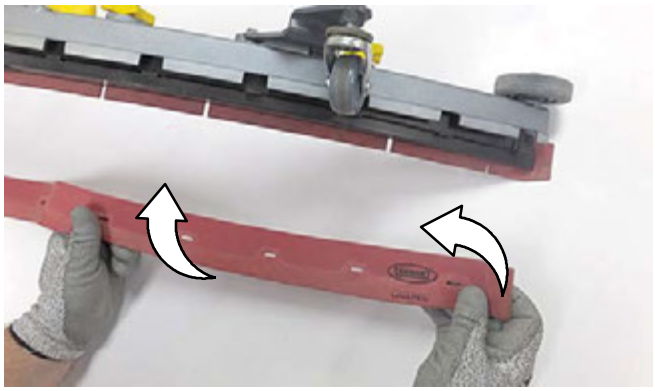
Each squeegee blade has four wiping edges. When the blades become worn, simply rotate the blades end-for-end or top-to-bottom for a new wiping edge. Replace blade if all four edges are worn.

1. Remove the squeegee assembly from the machine.
2. Fully loosen the two outside knobs on squeegee assembly. This will separate the spring loaded blade retainer from squeegee frame. To loosen the knobs quickly, squeeze the blade retainer and squeegee frame together

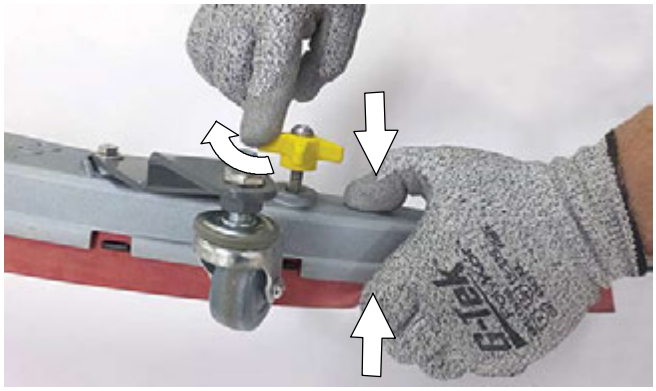


3. Remove worn blade(s) from the blade retainer.

4. Rotate the rear blade to a new wiping edge and Reinstall blade. Make sure to align the slots in the blade with retainer tabs.



5. Squeeze the squeegee frame and blade retainer together and re-tighten the two outside knobs.



ec-H2O WATER CONDITIONING CARTRIDGE REPLACEMENT

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

The water conditioning cartridge is required to be replaced when it reaches its maximum water usage or expiration time of when the cartridge was activated, which ever comes first. The control panel will signal a code when it is time to replace cartridge. See CONTROL PANEL OPERATION for further details.

Depending on machine usage, on average, a new cartridge can last anywhere from 12 months for heavy machine usage to 24 months for light machine usage.

ATTENTION: *During first time use and after replacing the water conditioning cartridge, the ec-H2O system will automatically override the selected solution flow rate for up to 75 minutes.*

1. Park the machine on a level surface, remove the key and set parking brake, if equipped.
2. Lift the recovery tank to access the ec-H2O water conditioning cartridge. Drain recovery tank before lifting tank.

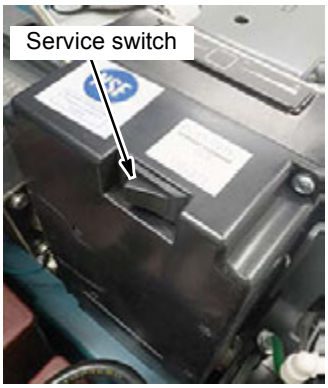
3. Disconnect the two hose connectors from the top of the cartridge by pressing the gray collars inward and pulling the connectors outward. Lift cartridge to remove.

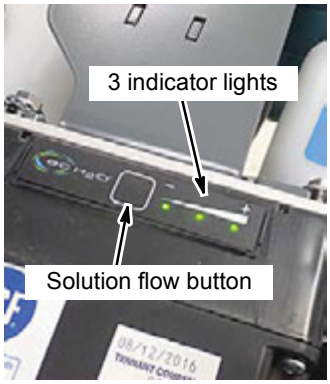
4. Fill in the installation date on the new cartridge label.

5. Install the new cartridge and reconnect the two hoses. Make sure the hose connectors are fully inserted into the cartridge.
6. Reset timer for new cartridge

   Carefully read and understand all steps first before performing procedure.

   a. Turn key on.
   b. Press and hold the service switch, located on the ec-H2O module, <u>for 10 seconds</u>. After releasing service switch, the three solution flow indicator lights will begin to (ripple) move back and forth.
   c. <u>Within 5 seconds</u> after releasing the service switch, while the three indicator lights are moving back and forth, quickly press and release the solution flow button located on ec-H2O module.
   The three indicator lights will then blink three times to indicate timer has been reset. Repeat process if the three indicator lights do not blink three times.



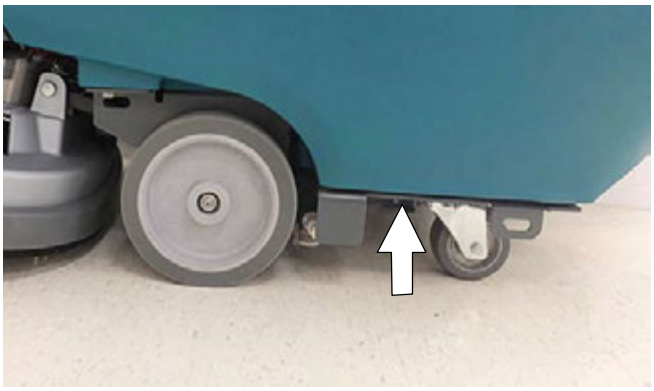


MACHINE JACKING

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

Use the designated locations to jack up the machine for service. Empty the recovery and solution tanks and position the machine on a level surface before jacking.

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



TRANSPORTING MACHINE

When transporting the machine by use of trailer or truck, carefully follow loading and tie-down procedure.

1. Drain tanks, raise the scrub head and the remove squeegee assembly.
2. Carefully load machine in trailer or on truck.

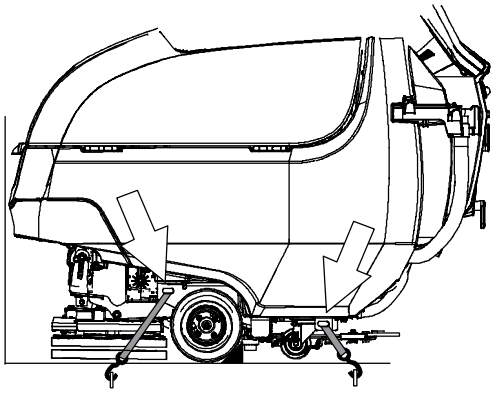
FOR SAFETY: When loading/unloading, use a ramp that can support the machine weight and operator.

FOR SAFETY: When loading/unloading, the machine may only be operated on gradients up to 2%.

3. Once loaded, position the front of the machine up against the front of the trailer or truck. Lower the scrub head, turn key off and set parking brake, if equipped.
4. Place a block behind each wheel.
5. Using tie-down straps, secure the machine using the four tie-down brackets located on the machine frame. It may be necessary to install tie-down brackets to the floor of your trailer or truck.

NOTE: When transporting machine in an open truck or trailer, secure recovery tank lid.

ATTENTION: Do not use control console area or accessory storage rails for tie-down locations, damage may occur.



STORING MACHINE

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. Recharge batteries once a month.
2. Disconnect batteries before storing.
3. Drain and rinse recovery tank and solution tank.
4. Store the machine in a dry area with squeegee and scrub head in the up position.

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

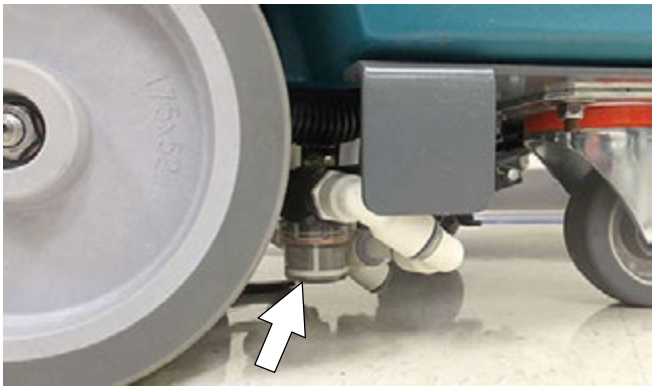
5. Open the recovery tank lid to promote air circulation.
6. If storing machine in freezing temperatures, proceed to FREEZE PROTECTION.

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

FREEZE PROTECTION

Storing machine in freezing temperatures.

1. Completely drain solution tank and recovery tank.
2. Empty the water from the solution tank filter located under machine. Replace filter.



3. Pour 1 gallon / 4 liters of propylene glycol based recreational vehicle (RV) antifreeze into the solution tank.
4. Models not equipped with ec-H2O system - Turn machine on and operate the solution flow system. Turn the machine off when the antifreeze is visible on the floor.

   Models equipped with ec-H2O system - Turn machine and set the solution flow rate on and operate ec-H2O scrubbing to cycle antifreeze through system. Turn machine off when antifreeze is visible on the floor. This may take up to two minutes.
5. Models equipped with optional automatic battery watering tank - Lift tank from machine and empty the water from tank.

Drain remaining water from system by removing the drain hose cap located below the tank. Leave cap off tank when draining system. After draining, replace cap on drain hose.

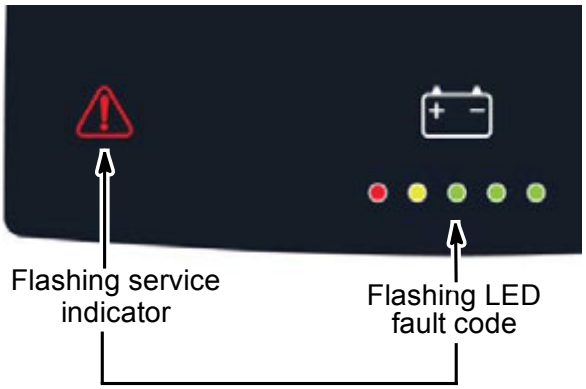
IMPORTANT: DO NOT add antifreeze to the automatic battery watering tank.

6. After storing machine in freezing temperatures, drain any remaining antifreeze from the solution tank. Add clean water to solution tank and to optional detergent tank and operate the machine to flush system.
7. Refill the automatic battery watering tank with distilled water, if equipped.

FAULTS AND WARNINGS

When the machine or battery charger detects a fault, the service indicator will flash. A fault code is provided to determine problem. Refer to the Faults and Warnings table for fault codes, conditions, reasons, and correction for the various fault codes.

Pro-Membrane Control Panel



BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ☼ ☼ ☼ ☼	0xFFF0	E-Stop activate fault	1. E-Stop pressed. 2. Large white i-Drive connector unplugged. 3. Large white i-Drive connector pin 7 disconnected. 4. i-Drive power wire unplugged.	Release E-Stop button and power cycle machine. If that does not clear fault, check connections/wiring.
● ☼ ☼ ● ☼	0x0206	Actuator Shorted Fault	1. Actuator relays connections shorted. 2. Faulty actuator relays.	Check connections. Check actuator relays.
● ☼ ● ● ☼	0x0307	Valve Open Load or FET Short Fault	1. Control board issue with User Interface board. 2. Harness problem between User Interface board and valve. 3. Valve is defective.	1. Check for continuity from User Interface board pin (J10 pin 6) and scrub motor relay. If there is no continuity, harness needs repair/replacement. 2. Replace valve if defective. 3. Replace User Interface board if defective.
● ☼ ● ☼ ☼	0x0306	Valve Shorted Fault	1. Valve connections shorted. 2. Faulty valve.	Check connections. Check valve.
● ● ☼ ● ●	0x0107	Scrub Motor Relay Open Load or FET Short Fault	1. Control board issue with User Interface board. 2. Harness problem between User Interface board and scrub motor relay. 3. Scrub motor relay is defective.	1. Check for continuity from User Interface board pin (J7 pin 7) and scrub motor relay. If there is no continuity, harness needs repair/replacement. 2. Replace relay if defective. 3. Replace User interface board if defective.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
● ● ☼ ● ☼	0x0207	Actuator Relays Open Load or FET Short Fault	1. Control board issue with User Interface board. 2. Harness problem between User Interface board and actuator relays. 3. Actuator relay(s) is/are defective.	1. Check for continuity from User Interface board pins (J7 pins 5 and 6) and actuator relays. If there is no continuity, harness needs repair/ replacement. 2. Replace relays if defective. 3. Replace User interface board if defective.
● ● ☼ ☼ ☼	0x0901	Propel Motor Open Warning	1. Motor on propel i-Drive is not connected.	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
☼ ● ● ● ☼	0x0900	Propel Generic Fault	1. Generic i-Drive Fault 2. Large white i-Drive connector pin 2, 8, or 9 disconnected. 3. User Interface speed pot connector disconnected.	Power cycle machine. Check connections.
	0x0903	Propel Communication Lost Warning	1. Large white i-Drive connector pin 5 disconnected. 2. Small white i-Drive connector disconnected. 3. Small white i-Drive connector pin 3 or 4 disconnected. 4. Smaller of two console connectors disconnected. 5. User Interface board connector J4 or J9 disconnected.	Power cycle machine. Check connections.
	0x0904	Propel Power Cycle Needed	1. i-Drive just programmed with new parameters. Power cycle to clear. 2. i-Drive unit is faulty.	Power cycle machine. Replace faulty i-Drive.
	0x0905	Propel Current Limit Fault	Controller detects motor is drawing excessive current	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, the controller may be defective. Replace defective controller.
	0x0906	Propel Motor Short Low Fault	Controller detects motor wiring is shorted to battery negative (-).	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, the controller may be defective. Replace defective controller.
	0x0907	Propel Motor Short High Fault	Controller detects motor wiring is shorted to battery positive (+).	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, the controller may be defective. Replace defective controller.
	0x0908	Propel RAM Check Error	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x0909	Propel Data Check Error	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x090A	Propel Tiller Low Reference	Controller detects Throttle Low Reference is outside of normal range. Throttle Low Reference is located on pin 8 of 14-way Tiller Connector.	Check throttle potentiometer, connectors, and relevant wiring to controller. If trip is still present after potentiometer, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x090B	Propel Gone to Sleep	Controller enters Sleep Mode.	Turn controller off and then on to wake system. To disable Sleep Mode, program parameter Sleep Timer to 0 minutes.
	0x090C	Propel EEPROM Write Error	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x090D	Propel EEPROM Write Time Out	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x090E	Propel EEPROM Busy at Startup	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x090F	Propel EEPROM Address Range	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0910	Propel Breaker Tripped Fault	1. Issue with propel motor, wiring or i-Drive module. 2. Large white i-Drive connector disconnected. 3. Large white iDrive connector pin 7 disconnected. 4. i-Drive power wire disconnected.	Disconnect battery and reset circuit breaker. Check connections.
	0x0911	Propel Forward ISO Test Fail	Controller detects Series Speed Limit Potentiometer Wiper is shorted to throttle reference(s), either high or low. Series Speed Limit Potentiometer Wiper input is located on pin 1 of 14-way Tiller Connector.	Trip is only applicable if an ISO-test resistor is fitted and programmed correctly. Check throttle potentiometer, programming, connectors, and relevant wiring to controller. If trip is still present after potentiometer, programming, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0912	Propel Forward Input Range	Controller detects an error with Throttle Wiper. Throttle Wiper input is located on pin 1 of 14-way Tiller Connector.	Check throttle potentiometer, programming, connectors, and relevant wiring to controller. If trip is still present after potentiometer, programming, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0913	Propel Joystick Error Right 2	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ● ☼	0x0914	Propel Solenoid Brake	Controller detects a short circuit in solenoid brake.	Check solenoid brake, connectors, and relevant wiring to controller. If trip is still present after brake, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0915	Propel Brake Status Low	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0916	Propel Brake Not Connected	Controller detects an open circuit in solenoid brake at start-up or in standby.	Check solenoid brake, connectors, and relevant wiring to controller. If trip is still present after brake, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0917	Propel Brake Interlock Fault	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0918	Propel Relay Interlock Fault	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0919	Propel Relay Stuck Closed	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091A	Propel Relay Coil Voltage	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091B	Propel Watchdog Tripped	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091C	Propel Positive Current Feedback Null	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091D	Propel Positive Current Feedback Out of Range	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091E	Propel Negative Current Feedback Null	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x091F	Propel Negative Current Feedback Out of Range	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0920	Propel Speed Control Wiper Warning	Controller detects Parallel Speed Limit Potentiometer Wiper is open circuit or has been shorted to throttle reference(s). Parallel Speed Limit Potentiometer Wiper input is located on pin 9 of 14-way Tiller Connector.	1. Check wiring to speed control potentiometer. 2. Power cycle machine. 3. If warning persists, replace speed control potentiometer. 4. Test high and low speed functions.
	0x0921	Propel Speed Control Reference	1. Propel speed control reference incorrect.	Check wiring to speed control potentiometer. Power cycle machine.
	0x0922	Propel Throttle Trip Reference Warning	1. Propel throttle trip reference incorrect.	Check wiring to bail sensor. Power cycle machine.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x0923	Propel High Battery Voltage Warning	Controller detects battery voltage has exceeded approximately 35V on 24V controllers and approximately 45V on 36V controllers.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0924	Propel High Battery Voltage 2 Warning	Controller detects battery voltage has exceeded approximately 45V on 24V controllers and approximately 49.5V on 36V controllers.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0925	Propel Inhibit 1 Warning	Controller detects Inhibit 1 input is active, Inhibit 1 Speed has been set to '0' and Inhibit 1 Operation has been set to 'Latched'.	Check state of input, Inhibit 1 programming, connectors, and relevant wiring to controller. If trip is still present after state of input, programming, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0926	Propel Inhibit 2 Warning	Controller detects Inhibit 2 input is active, Inhibit 2 Speed has been set to '0' and Inhibit 2 Operation has been set to 'Latched'.	Check state of input, Inhibit 2 programming, connectors, and relevant wiring to controller. If trip is still present after state of input, programming, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0927	Propel Inhibit 3 Warning	Controller detects Inhibit 3 input is active, Inhibit 3 Speed has been set to '0' and Inhibit 3 Operation has been set to 'Latched'.	Check state of input, Inhibit 3 programming, connectors, and relevant wiring to controller. If trip is still present after state of input, programming, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0928	Propel Watchdog Warning	1. Propel controller watchdog tripped.	Power cycle machine.
	0x0929	Propel Bad Setting Warning	1. Bad setting programmed to i-Drive.	Reprogram i-Drive.
	0x092A	Propel Direction Inputs Disagree	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x092B	Propel Positive Feedback Voltage Null	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x092C	Propel Positive Feedback Voltage Out of Range	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x092D	Propel Output Voltage Tracking	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x092E	Propel Negative Feedback Voltage Null	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x092F	Propel Negative Feedback Voltage Out of Range	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0930	Propel ROM Check Warning	1. The i-Drive memory is corrupted.	Replace damaged i-Drive.
	0x0931	Propel EEPROM Check Warning	1. The i-Drive settings are corrupted.	Replace damaged i-Drive.
	0x0932	Propel Internal 12V Error	1. The i-Drive hardware is damaged.	Replace damaged i-Drive.
	0x0933	Propel Low Battery	Controller detects battery voltage has fallen below approximately 13.5V.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0934	Propel Very Low Battery	Controller detects a sudden drop in battery voltage.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0935	Propel Out of Time	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0936	Propel Low Bridge Voltage	1. Power surge on propel module inputs causing damage to i-Drive circuitry.	Replace i-Drive.
	0x0937	Propel Bridge Voltage Greater Then Battery	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0938	Propel Stack Overflow	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0939	Propel Illegal State	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x093A	Propel Trip Sense Active	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x093B	Propel Trip Sense Not Active	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x093C	Propel Trip Latch Not Armed	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x093D	Propel Failed To Arm Trip Latch	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x093E	Propel Trip Latch Became Unarmed	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x093F	Propel Left Motor Shorted Low	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0940	Propel Controller Fault	Each time controller trips with a suspected controller error, it records one instance of code '4401' in controller System Log. Actual controller trip code is also recorded in controller Control Log. Number of '4401' trips shown in System Log should equal cumulative number of trip occurrences shown in Control Log.	If controller continues to trip after batteries, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0941	Propel Soft Belly Button Active	Controller detects Belly Button Switch has been operated at power-up.	Check Belly Button Switch, connectors, and relevant wiring to controller. If trip is still present after the switch, connectors, and wiring have been checked, controller may be defective. Replace defective controller.
	0x0942	Propel Internal Temperature Sensor	General i-Drive fault.	Cycle machine power. If problem persists, replace i-Drive.
	0x0950	Propel Incorrect Profile	1. Software profile in i-Drive does not match programmed machine configuration.	Select and download correct configuration for correct scrub head type, size, and transaxle using Configuration screen in Tennant Service Diagnostics PC application to correct configuration and i-Drive.
☼ ● ● ☼ ●	0x0B11	Battery Watering Pump Open Warning	1. Wiring, connector or control board issue on battery watering pump.	Check if battery watering pump is connected to machine harness and verify pump is good.
☼ ● ● ☼ ☼	0x0106	Scrub Motor Relay Short Fault	1. Scrub motor relay connections shorted. 2. Faulty scrub motor relay.	Check connections. Check scrub motor relay.
☼ ● ☼ ● ☼	0x0902	Propel High Throttle Fault	1. Bail is activated before turning on machine. 2. Bail did not release to full rest position due to obstruction. Controller detects Throttle Potentiometer has been displaced at start-up and parameter Throttle Operated At Power-Up has been set to 'Trip'.	1. Release bail. 2. Key off and on. 3. If error persists, check for obstruction or damaged bail switch. 4. Replace switch or bail handle if damaged.

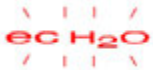
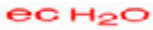
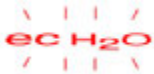
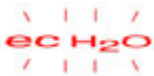
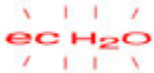
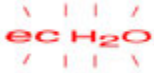
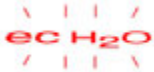
BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ● ☼ ☼ ●	0x0B17	Battery Watering Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, wand pump, detergent pump, vacuum, and battery watering pump.
	0x0717	ec-H2O FET Faults	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
☼ ☼ ● ☼ ●	0x0B01	Battery Watering System Timed Out Warning	1. The system is running longer than it should. Pump ends at 1 minute.	Check for leaks in pump housing and battery vents. Check for water in battery tray and on floor around machine. Replace stuck open valves. Check if batteries are defective.
	0x0B02	Battery Watering System No Feedback Warning	1. System is running for 10 seconds with no feedback telling board there is water flow. 2. Kinks in hoses. 3. Batteries full. 4. Bad flow sensor. 5. Pump not operating.	Check if hose is kinked and/or batteries are full. *Note: There must be a flow of 0.1 liters per minute for at least 3 seconds to reset system and a stop in flow (pump stops pumping water - batteries full) to allow board to clear fault.*
	0x0B13	Battery Watering Pump Over Current Fault	1. Current draw higher than expected.	Check harness and pump.
	0x0B14	Battery Watering Pump Over Current 1 Fault	1. Current draw higher than expected.	Verify detergent pump load, damage and/or usage conditions.
	0x0B15	Battery Watering Pump Over Current 2 Fault	1. Current draw higher than expected.	Verify detergent pump load, damage and/or usage conditions.
	0x0B16	Battery Watering Pump Shorted Load Fault	1. Shorted load condition. 2. Higher current draw than hardware design limit.	Check harness, pump, and control boards.
● ☼ ☼ ☼ ●	0x0B04	Battery Watering CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue). 3. Control board may be damaged.	1. Power cycle machine. 2. No communication with a network module. Use CANopen troubleshooting techniques.
	0xF103	Charger CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue). 3. Control board may be damaged.	1. Power cycle machine. 2. No communication with a network module. Use CANopen troubleshooting techniques.
☼ ☼ ☼ ● ●	0xF100	Charger Generic Warning	1. An error condition has occurred with charger unit.	Replace battery charger.
	0xF104	Charger Timer Phase I Warning	1. Batteries not able to charge correctly.	Check for low battery voltage.
● ☼ ☼ ● ●	0xF101	Charger No Load Warning	1. Battery pack may not be plugged into charger.	Check battery cables and connections.
● ☼ ● ● ●	0xF102	Charger Overheat Warning	1. Charger environment not cool enough and cannot complete charge.	Move machine to well-ventilated area.
☼ ☼ ☼ ☼ ●	0xFF13	Invalid Key Switch Voltage	1. AM2 jumper harness installed to User Interface board J7 connector.	Remove AM2 jumper harness.
● ☼ ● ☼ ●	0x0711	ec-H2O Pump Open Warning	1. Wiring, connector, or control board issue on ec-H2O pump.	Control board is not detecting pump current. Check connections for voltage. Verify pump is operating.
● ☼ ☼ ☼ ☼	0x0713	ec-H2O Pump Over Current Warning	1. Current draw higher than expected.	Check pump operating current.
● ● ● ● ☼	0xFFFF	Unknown Fault	Fault / problem unknown.	Contact Tennant Technical Support.

BDI (Battery Discharge Indicator) ☼ = Flashing	Fault Codes	Fault Condition	Reason	Correction
NA	NA	Hour Meter Not Powered	1. Hour meter wires disconnected.	Check connections and wiring.
NA	NA	Bail Not Responding	1. Bail sensor is unplugged. 2. User Interface board defective.	Check connections and wiring. Replace user interface board.
NA	NA	Reverse Switch Not Working	1. Reverse switch connector unplugged. 2. Large white iDrive connector pin 12 or 13 disconnected.	Check connections and wiring.
NA	NA	Vacuum Squeegee Switch Not Functioning	1. Vacuum squeegee switch disconnected. 2. Faulty wiring.	Check connections and wiring.
NA	NA	Scrub Head Not Spinning	1. Reverse switch connector unplugged. 2. Large white i-Drive connector pin 12 or 13 disconnected.	Check connections and wiring.
NA	NA	No Propel Response (no faults reporting)	1. Propel Motor lead unplugged. 2. Large white i-Drive connector pin 1 disconnected. 3. Bail sensor is unplugged.	Check connections and wiring.
NA	NA	No Charge Mode LEDs	User Interface board is not receiving power from charger at J7-9.	Ensure pin connections between UI and charger connectors are not broken or unseated.

A Service Diagnostics tool is available to provide additional fault detail. See SERVICE DIAGNOSTICS TOOL in the SERVICE section of this manual.

ec-H2O NANOCLEAN ICON FAULTS

Icon	Code	Fault Condition	Reason	Correction
	0x0700	ec-H2O Generic Fault	1. Generic fault with ec-H2O.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
	0x0702	ec-H2O Pressure Switch Active	1. The system pressure switch is detecting a trip or unconnected.	1. System pressure too high; needs repair. 2. Check connections. Verify functionality of scrub head switch and parking brake switch.
	0x0704	ec-H2O CAN Communication Fault	1. Board lost power or CAN connection (wiring issue) 2. ec-H2O board may be damaged. 3. ec-H2O connector disconnected. 4. ec-H2O connector pin 2 or 3 disconnected.	1. Power cycle machine. 2. No communication with a network module. 3. Check connections.
	0x0707	ec-H2O WCM Expired	1. ec-H2O WCM cartridge expired.	1. Replace with new cartridge.
	0x0708	ec-H2O System Over Regulation Warning	1. Cell has been operating over target current condition for last 50 treated gallons.	Check water condition in solution tank for presence of detergents.
	0x0711	ec-H2O Pump Open Fault	1. Wiring, connector, or control board issue on ec-H2O pump.	Control board is not detecting pump current. Check connections for voltage and verify pump is operating.
	0x0713	ec-H2O Pump Over Current Fault	1. Current draw higher than expected.	Check pump operating current.
	0x0716	ec-H2O Pump Short Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Check ec-H2O pump and harness
	0x0717	ec-H2O FET Faults	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum and battery watering pump.
	0x0720	ec-H2O Cell Generic Fault	1. Generic fault with ec-H2O cell.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
	0x0721	ec-H2O Cell Open Warning	1. Wiring, connector, or control board issue on ec-H2O cell.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
	0x0723	ec-H2O Cell Over Current Warning	1. Current draw higher than expected.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
	0x0726	ec-H2O Cell Short Warning	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.

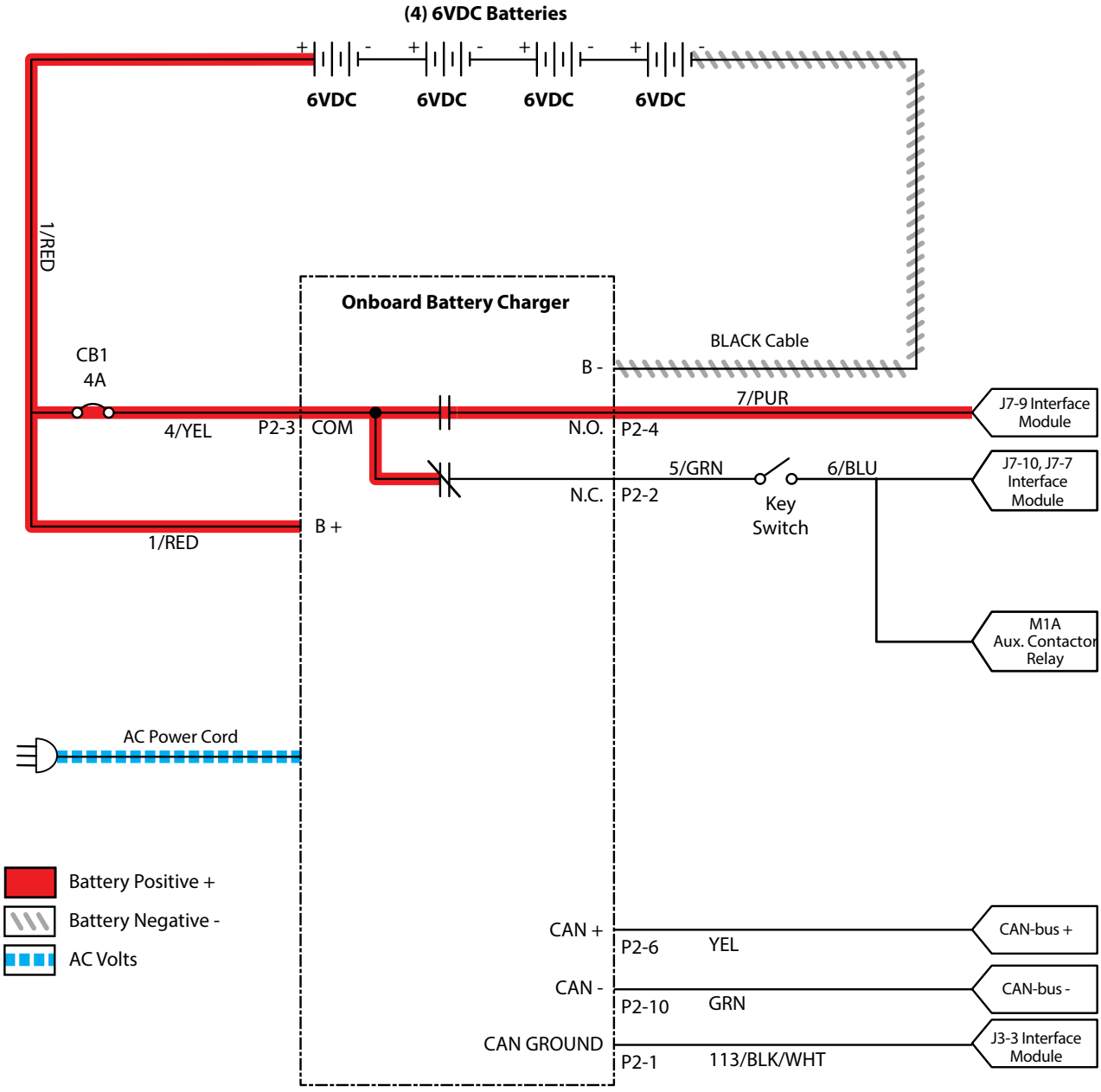
Icon	Code	Fault Condition	Reason	Correction
ec H2O	0x0727	ec-H2O Cell FET Faults	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum and battery watering pump.
ec H2O	0x0728	ec-H2O Cell Over Regulation	1. Control board problem.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
ec H2O	0x0729	ec-H2O Cell Under Regulation	1. Control board problem.	Refer to ec-H2O NanoClean troubleshooting guide or contact Tennant Technical Support.
ec H2O	0x072A	ec-H2O Cell Electrode Fault	1. Cell current is operating below allowed operating condition.	See NanoClean troubleshooting guide. Replace plumbing half of ec-H2O module.
ec H2O	0x072B	ec-H2O Cell Overcurrent Warning	1. Cell short condition. 2. High Conductivity Water. 3. Detergent in solution.	Warning condition will resolve within 60 seconds if condition clears. If condition remains after timeout, a cell short fault will occur.
ec H2O	0x0741	ec-H2O WCM Pump Open Warning	1. Wiring, connector or control board issue on the ec-H2O pump.	Check Water Conditioning Module micro pump is connected to machine harness and verify pump is good.
ec H2O	0x0746	ec-H2O WCM Pump Short Warning	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Check harness and verify Water Conditioning Module micro pump is good.
ec H2O	0x0747	ec-H2O WCM Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum and battery watering pump.

OFF-BOARD CHARGER ERROR AND FAULT CODES

Code	Description	Cause	Solution
E-0-0-1 E-0-2-1	Battery high voltage	1. Wrong battery voltage for charger. 2. Other charger also attached. 3. Resistive battery.	Check battery voltage and cable connections. Check battery size and condition. Error will automatically clear once voltage is in range.
E-0-0-2 E-0-2-2	Battery low voltage	1. Battery disconnected. 2. Battery over discharged.	Check battery voltage and cable connections. Check battery size and condition. Error will automatically clear once voltage is in range.
E-0-0-3	Charge time out caused by battery pack not reaching required voltage within safe time limit. (charge profile dependent)	1. Charger output reduced due to high temperatures. 2. Poor battery health. 3. Very deeply discharged battery. 4. Poorly connected battery.	Operate at lower ambient temperature. Replace battery pack. Check DC connections. Error will clear once charger is reset by cycling DC or AC.
E-0-0-4	Battery could not meet minimum voltage (charge profile dependent)	1. Shorted or damaged cells.	Replace battery pack. Check DC connections. Error will automatically clear once charger is reset by cycling DC or AC.
E-0-0-7	Battery amp hour limit exceeded	1. Poor battery health. 2. Very deeply discharged battery. 3. Poorly connected battery. 4. High parasitic loads on battery while charging	Replace battery pack. Check DC connections. Disconnect parasitic loads. Error will automatically clear once charger is reset by cycling DC or AC.
E-0-0-8	Battery temperature is out of range	1. Possible battery temperature sensor error.	Check temperature sensor and connections. Reset charger. Error will clear once condition has been corrected.
E-0-1-2	Reverse polarity error	1. Battery incorrectly connected to charger.	Check battery connections. Error will clear once condition has been corrected
E-0-1-6 E-0-1-8 E-0-2-6	USB operation failed (software)	1. Software upgrade failure. 2. Script operation failure.	Ensure USB flash drive is properly formatted and reinsert USB flash drive.
E-0-1-7	USB operation failed (hardware)	1. Hardware upgrade failure.	Remove and reinsert USB drive. If condition persists, cycle AC and retry by reinserting USB drive.
E-0-2-3	High AC voltage error (>270VAC)	1. Voltage error.	Connect charger to an AC source that provides stable AC between 85 - 270 VAC / 45-65 Hz. Error will clear once condition has been corrected.
E-0-2-4	Charger failed to initialize	1. Charger has failed to turn on properly	Disconnect AC input and battery for 30 seconds before retrying.
E-0-2-5	Low AC voltage oscillation error	1. AC source is unstable. 2. Undersized generator. 3. Severely undersized input cables	Connect charger to an AC source that provides stable AC between 85 - 270 VAC / 45-65 Hz. Error will clear once condition has been corrected.
F-0-0-1 F-0-0-2 F-0-0-3 F-0-0-4 F-0-0-6	Internal charger fault	1. Internal charger fault.	Remove AC and battery for minimum 30 seconds and retry charger. If it fails again, contact the vehicle or machine manufacturer.

Off-Board Charger Error and Fault Codes table taken from the Delta-Q IC650 Charger Manual.

ONBOARD BATTERY CHARGING ON



BATTERIES FAIL TO CHARGE / REDUCED RUN TIME (ONBOARD CHARGER)

Step	Action	Value(s)	Yes	No
1	• Key ON • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 3	Check AC supply circuit protection
3	• See BATTERY CHARGER SETTINGS in MAINTENANCE section of this manual and confirm proper charger settings • Is the onboard charger set properly?		Proceed to STEP 4	Reprogram battery char-ger
4	• Key OFF • Inspect battery and charger cables for damage / corrosion / contamination / terminal problems • Do any of the above conditions exist?		Repair or replace battery / battery charger cables	Proceed to STEP 5
5	• Proceed to STEP 6 for machines equipped with sealed or AGM batteries • Key OFF • Disconnect batteries • Check water level in all battery cells • Are the lead plates submerged?		Proceed to STEP 6	Add distilled water as nec-essary until lead plates are covered
6	• Key OFF • Use a hydrometer or refractometer to test specific gravity of each cell (Lead-Acid) • Are all battery cells within 0.050 (50 points) specific gravity of each other?		Replace battery charger	Replace bat-tery charger or batteries

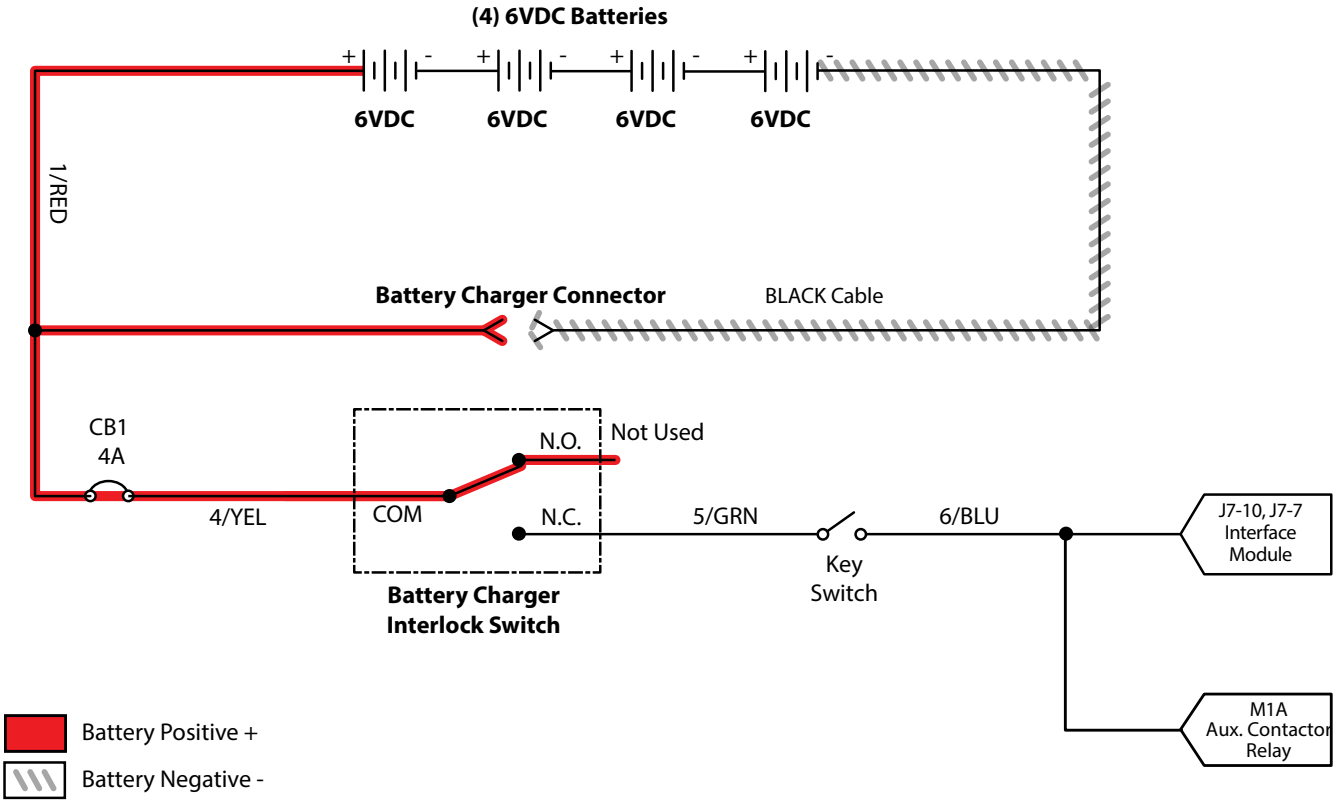
Terms:

AC = Alternating Current

AGM = Absorbed Glass Mat

Specific Gravity = Relative density of a substance compared to water (1.000 specific gravity)

OFF BOARD BATTERY CHARGING ON



BATTERIES FAIL TO CHARGE / REDUCED RUN TIME (OFF BOARD CHARGER)

Step	Action	Value(s)	Yes	No
1	• Key ON • Is there an LCD fault present on the Off Board Charger?		See OFF BOARD BATTERY CHARGER FAULTS in TROUBLESHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 3	Check AC supply circuit protection
3	• Key OFF • Inspect battery and charger cables for damage / corrosion / contamination / terminal problems		Repair or replace battery / battery charger cables	Proceed to STEP 4
4	• Proceed to STEP 6 for machines equipped with sealed or AGM batteries • Key OFF • Disconnect batteries • Check water level in all battery cells • Are the lead plates submerged?		Proceed to STEP 5	Add distilled water as necessary until lead plates are covered
5	• Key OFF • Use a hydrometer or refractometer to test specific gravity of each cell (Lead-Acid) • Are all battery cells within 0.050 (50 points) specific gravity of each other?		Replace battery charger	Replace battery charger or batteries

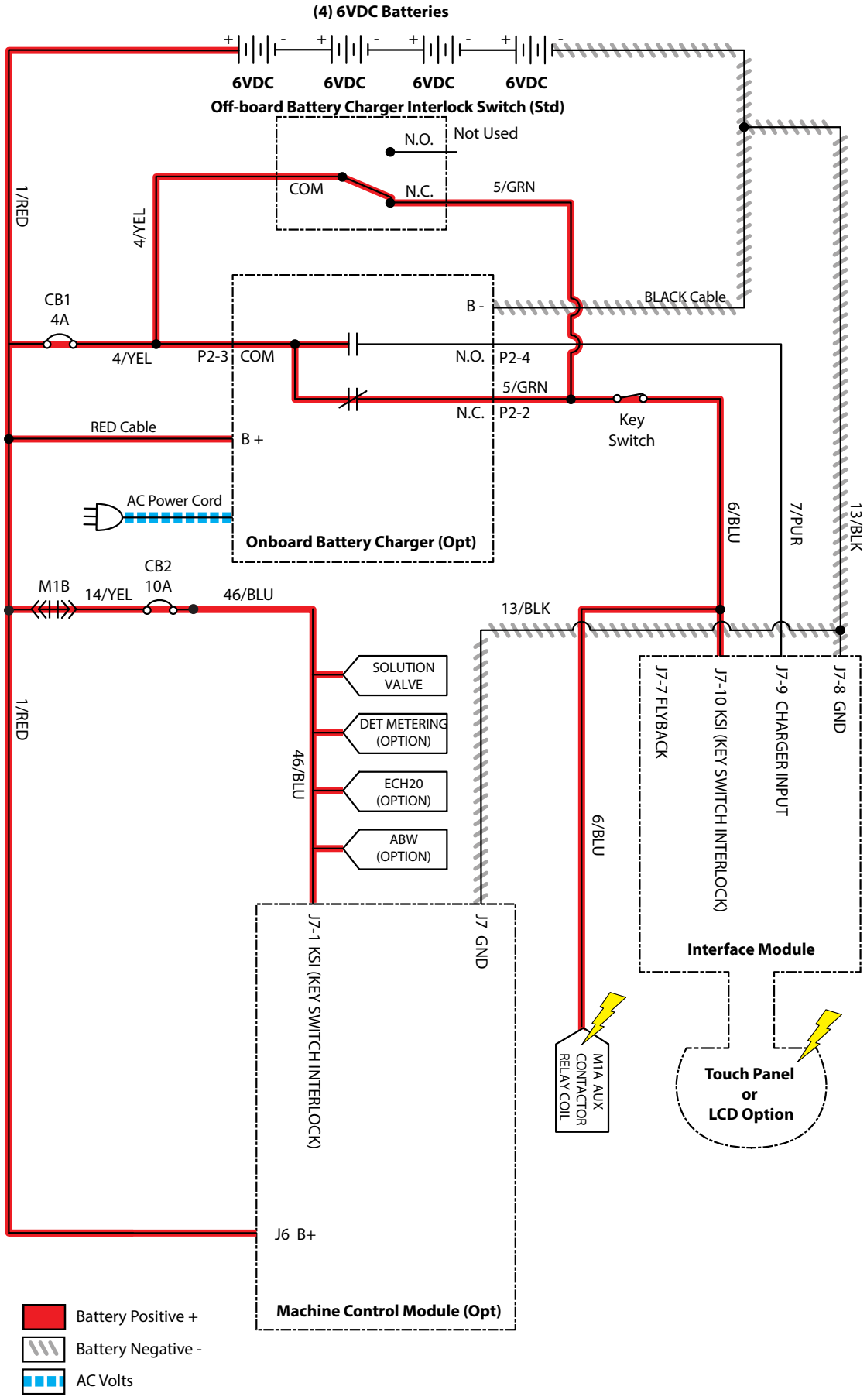
Terms:

AC = Alternating Current

AGM = Absorbed Glass Mat

Specific Gravity = Relative density of a substance compared to water (1.000 specific gravity)

POWER UP ON


(4) 6VDC Batteries
6VDC
6VDC
6VDC
6VDC
Off-board Battery Charger Interlock Switch (Std)
N.O.
Not Used
COM
N.C.
5/GRN
1/RED
4/YEL
CB1
4A
4/YEL
P2-3
COM
N.O.
P2-4
5/GRN
N.C.
P2-2
Key
Switch
B -
BLACK Cable
RED Cable
B +
AC Power Cord
Onboard Battery Charger (Opt)
6/BLU
7/PUR
13/BLK
M1B
14/YEL
CB2
10A
46/BLU
13/BLK
SOLUTION
VALVE
DET METERING
(OPTION)
ECH20
(OPTION)
ABW
(OPTION)
46/BLU
1/RED
J7-7 FLYBACK
J7-10 KSI (KEY SWITCH INTERLOCK)
J7-9 CHARGER INPUT
J7-8 GND
Interface Module
6/BLU
M1A AUX
CONTACTOR
RELAY COIL
Touch Panel
or
LCD Option
J7-1 KSI (KEY SWITCH INTERLOCK)
J7 GND
J6 B+
Machine Control Module (Opt)
Battery Positive +
Battery Negative -
AC Volts

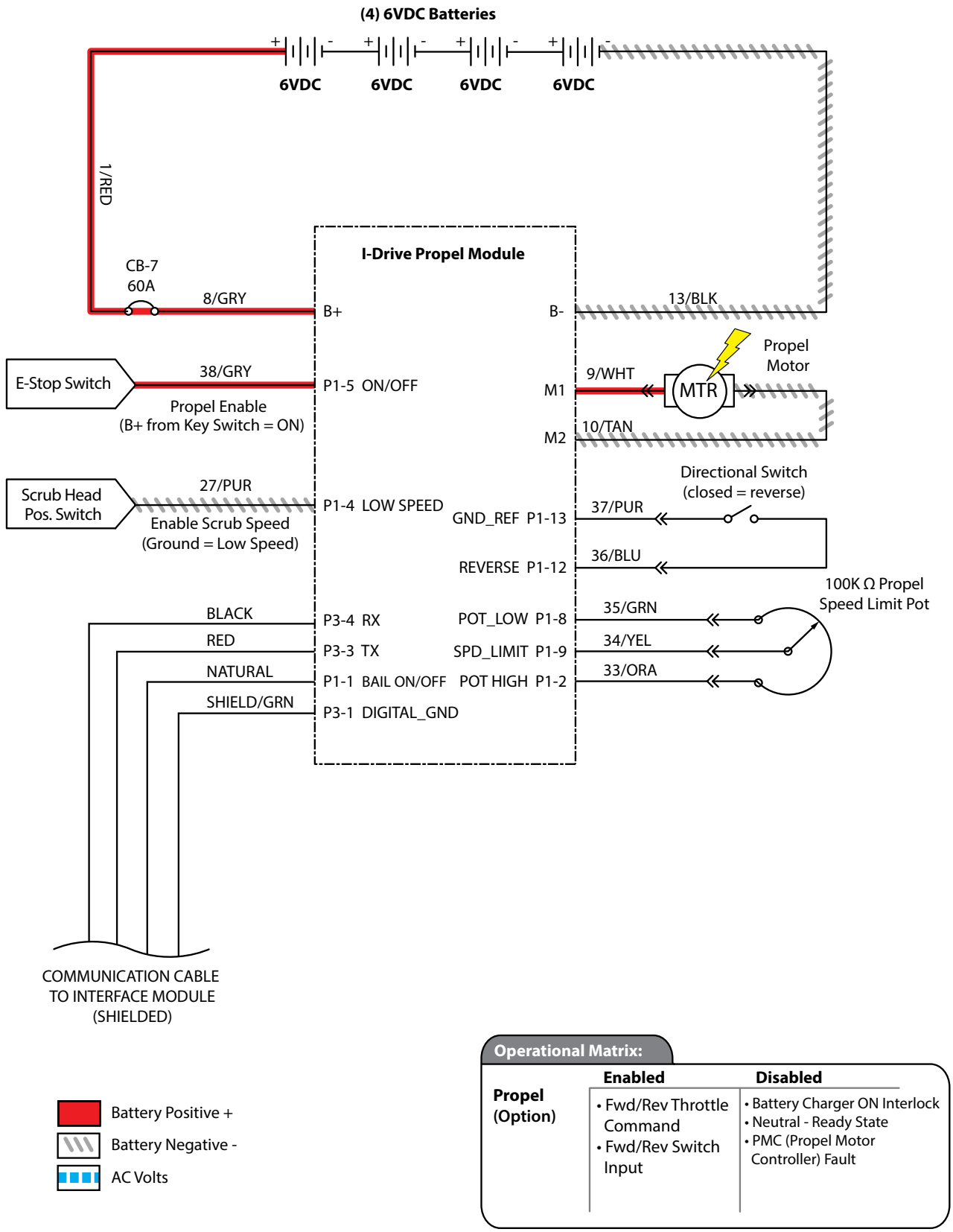
MACHINE FAILED TO POWER UP

Step	Action	Value(s)	Yes	No
1	• Key ON • Use a voltmeter to test the total battery voltage • Is total battery voltage greater than 20 VDC?		Proceed to STEP 2	Recharge batteries and test power-up circuit operation
2	• Key OFF • Firmly press circuit breaker #1 / circuit breaker #2 to reset • Are circuit breaker #1 / circuit breaker #2 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key ON • Test voltage applied to power-up subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

VDC = DC Voltage

PROPEL SUBSYSTEM



Operational Matrix:

	Enabled	Disabled
Propel (Option)	• Fwd/Rev Throttle Command • Fwd/Rev Switch Input	• Battery Charger ON Interlock • Neutral - Ready State • PMC (Propel Motor Controller) Fault

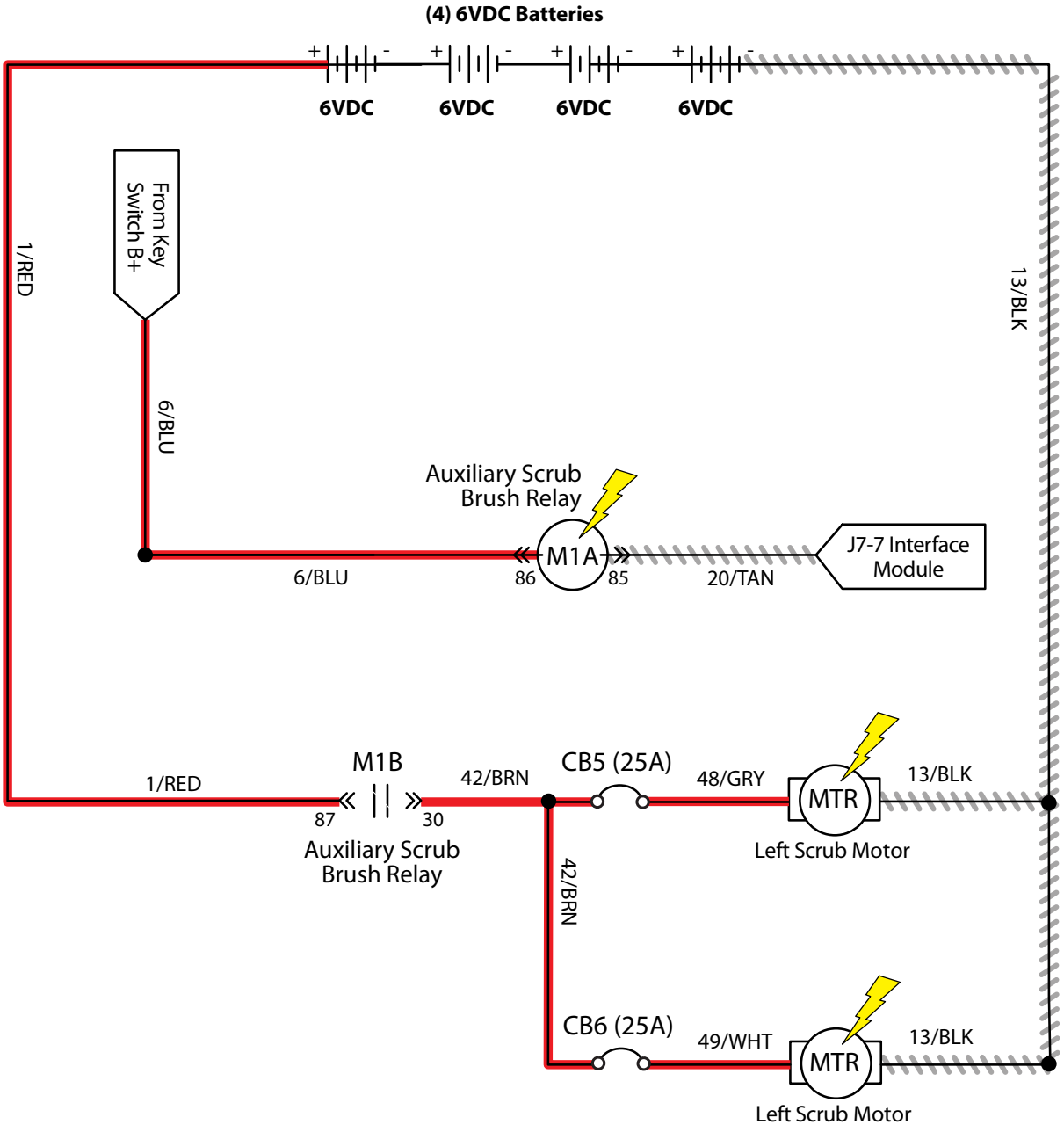
MACHINE FAILED TO PROPEL

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable propel • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #7 to reset • Is circuit breaker #7 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• See SERVICE DIAGNOSTICS TOOL in SERVICE section of this manual and confirm software is properly configured to enable propel • Is software configured properly?		Proceed to STEP 4	Reprogram software
4	• Key OFF • Place machine on blocks so drive wheels are lifted from floor • Key ON • Enable propel • Test voltage applied to propel subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

SCRUB MOTOR ON



Operational Matrix:

	Enabled	Disabled
Scrub Motor	• Head Lowered - Foot Pedal • Fwd/Rev Throttle Command or Bail Activated on non-Propel models.	• Head Raised - Foot Pedal • Neutral - Ready State or Bail released on non-propel models. • Low Battery Voltage • Fault • Battery Charger ON Interlock

Battery Positive +

Battery Negative -

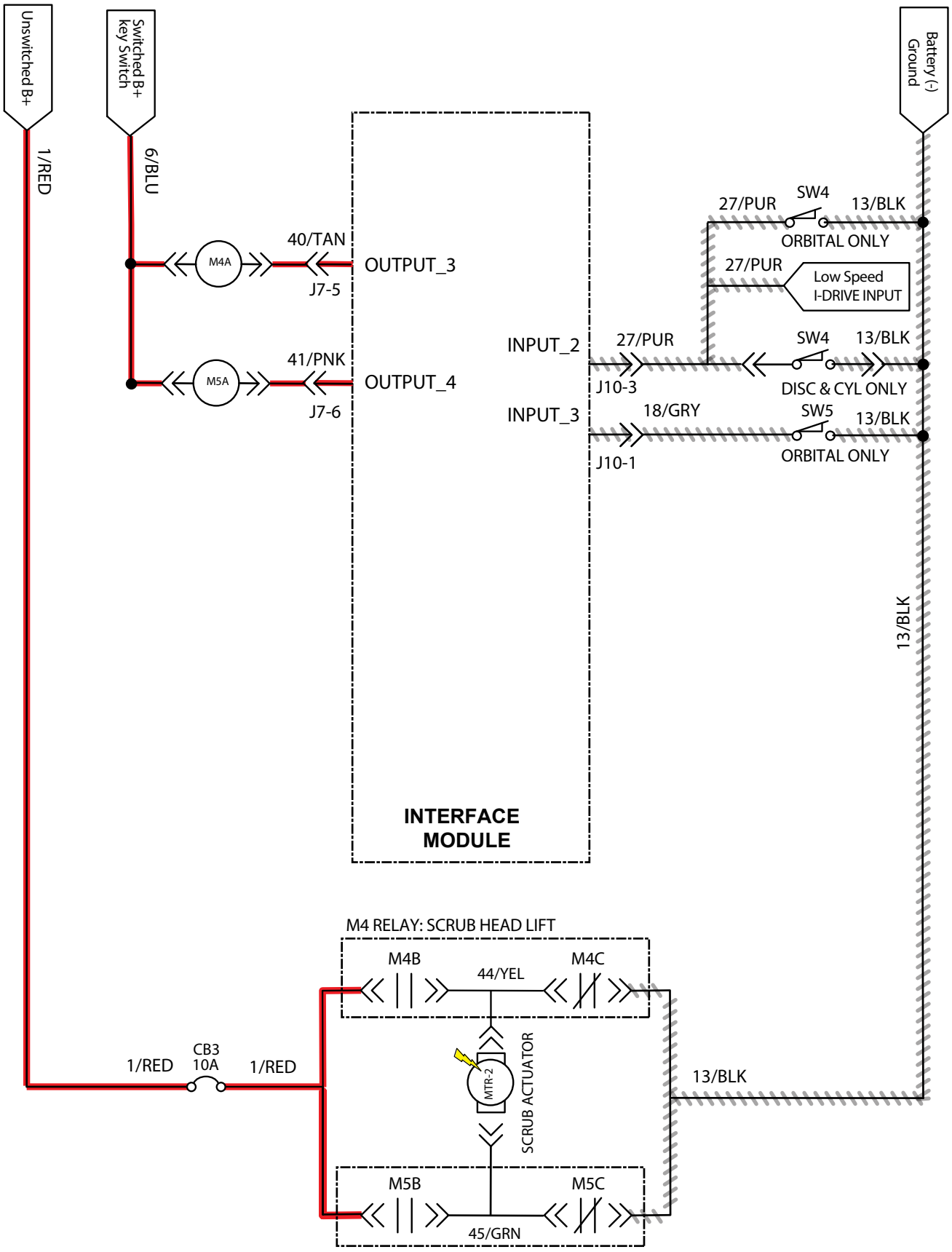
SCRUB MOTOR FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable scrub motor • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #5 / circuit breaker #6 to reset • Are circuit breaker #5 / circuit breaker #6 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key ON • Enable scrub motor • Test voltage applied to scrub motor subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

SCRUB HEAD LIFT ACTUATOR



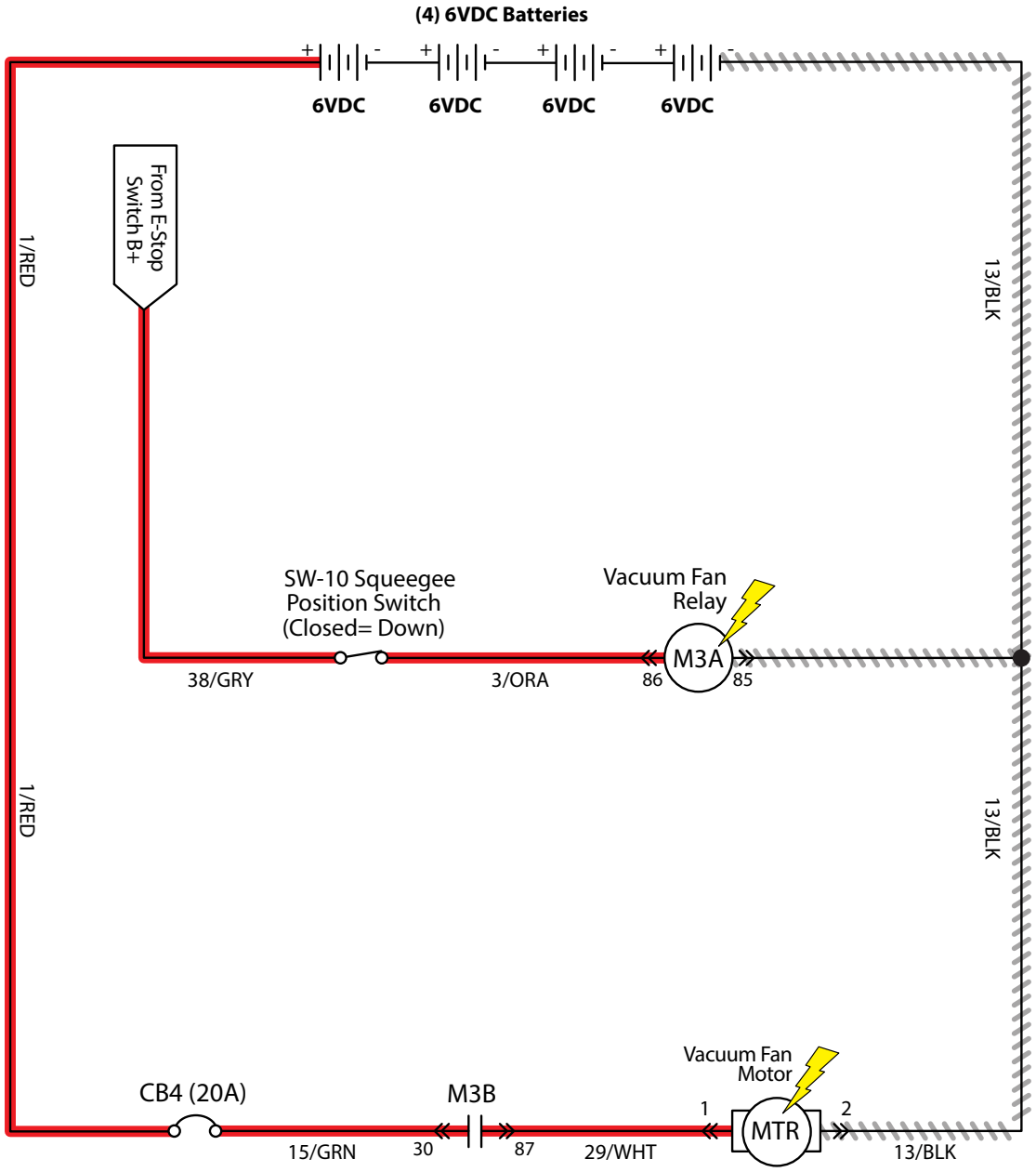
SCRUB HEAD FAILED TO LIFT / LOWER

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable lift actuator by pressing “One Step” button • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Check actuator wiring • Are all connections intact?		Proceed to STEP 3	Fix connections and repeat STEP 1
3	• Key OFF • Disconnect actuator from main harness and place voltmeter probes on actuator motor control terminals on main harness connector • KEY ON • Enable lift actuator by pressing “One Step” button • Test voltage applied to actuator subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic		Check actuator and head lift assembly for any obstruc-tions. If actuator is not installed due to blockage, replace actuator	Identify voltage drop location and repair or replace necessary compo-nents

Terms:

BDI = Battery Discharge Indicator

VACUUM FAN ON



Battery Positive +

Battery Negative -

Operational Matrix:

	Enabled	Disabled
Vacuum Fan	• Squeegee Lowered	• Squeegee Raised • Battery Charger ON Interlock • E-Stop Pushed • CB-4 Popped

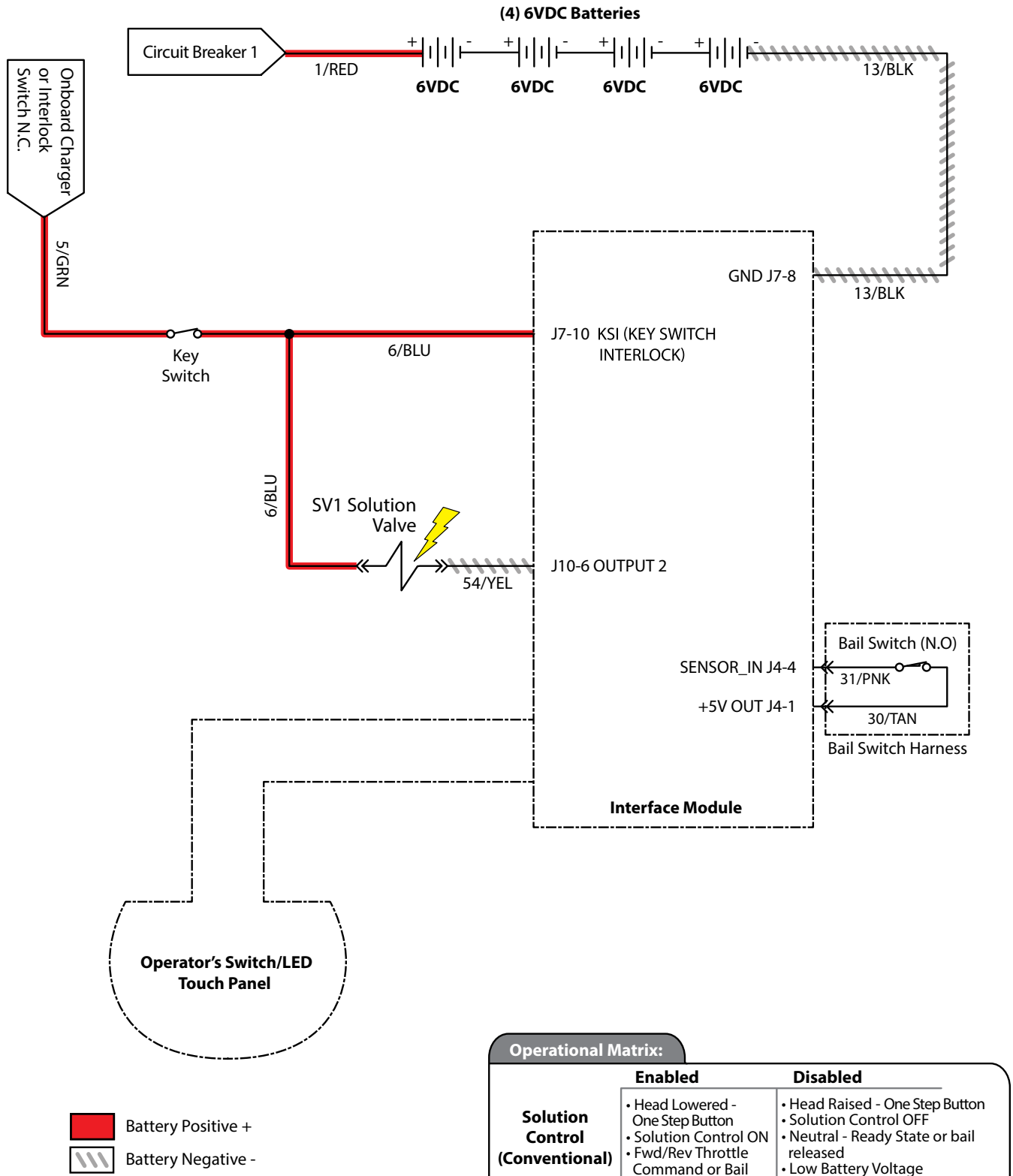
VACUUM FAN FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable vacuum fan • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #4 to reset • Is circuit breaker #4 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key ON • Enable vacuum fan • Test voltage applied to scrub motor subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

SOLUTION CONTROL ON (CONVENTIONAL)



Operational Matrix:

	Enabled	Disabled
Solution Control (Conventional)	• Head Lowered - One Step Button • Solution Control ON • Fwd/Rev Throttle Command or Bail activated	• Head Raised - One Step Button • Solution Control OFF • Neutral - Ready State or bail released • Low Battery Voltage • Fault • Battery Charger ON Interlock

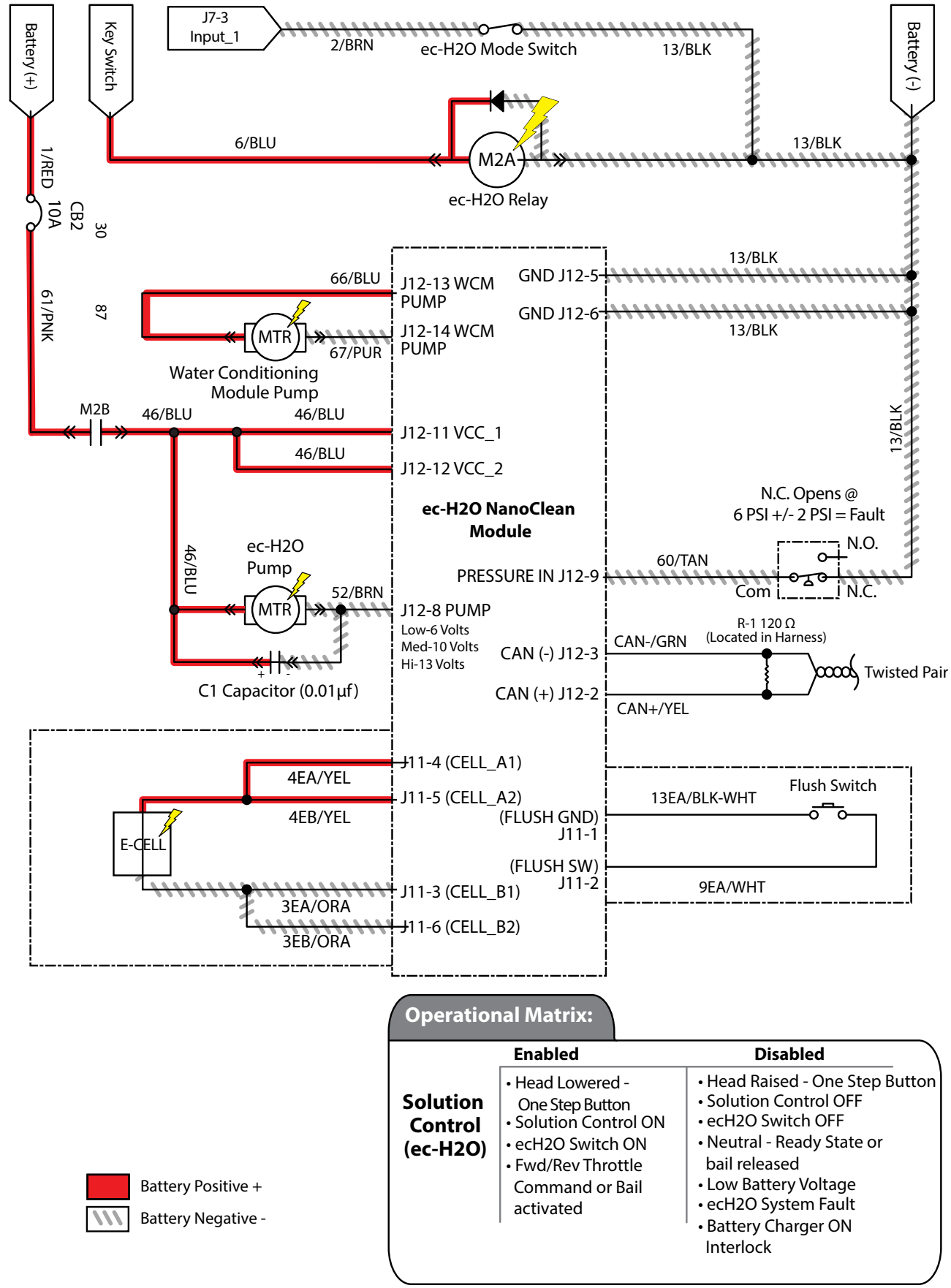
SOLUTION CONTROL FAILED TO TURN ON (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable solution control (conventional) • Is there a flashing BDI fault code present?		See FAULTS in TROUBLESHOOTING section of this manual	Proceed to STEP 2
2	• Key ON • Enable solution control (conventional) • Test voltage applied to solution control (conventional) subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

SOLUTION CONTROL ON (ec-H2O)



Operational Matrix:

	Enabled	Disabled
Solution Control (ec-H2O)	• Head Lowered - One Step Button • Solution Control ON • ecH2O Switch ON • Fwd/Rev Throttle Command or Bail activated	• Head Raised - One Step Button • Solution Control OFF • ecH2O Switch OFF • Neutral - Ready State or bail released • Low Battery Voltage • ecH2O System Fault • Battery Charger ON Interlock

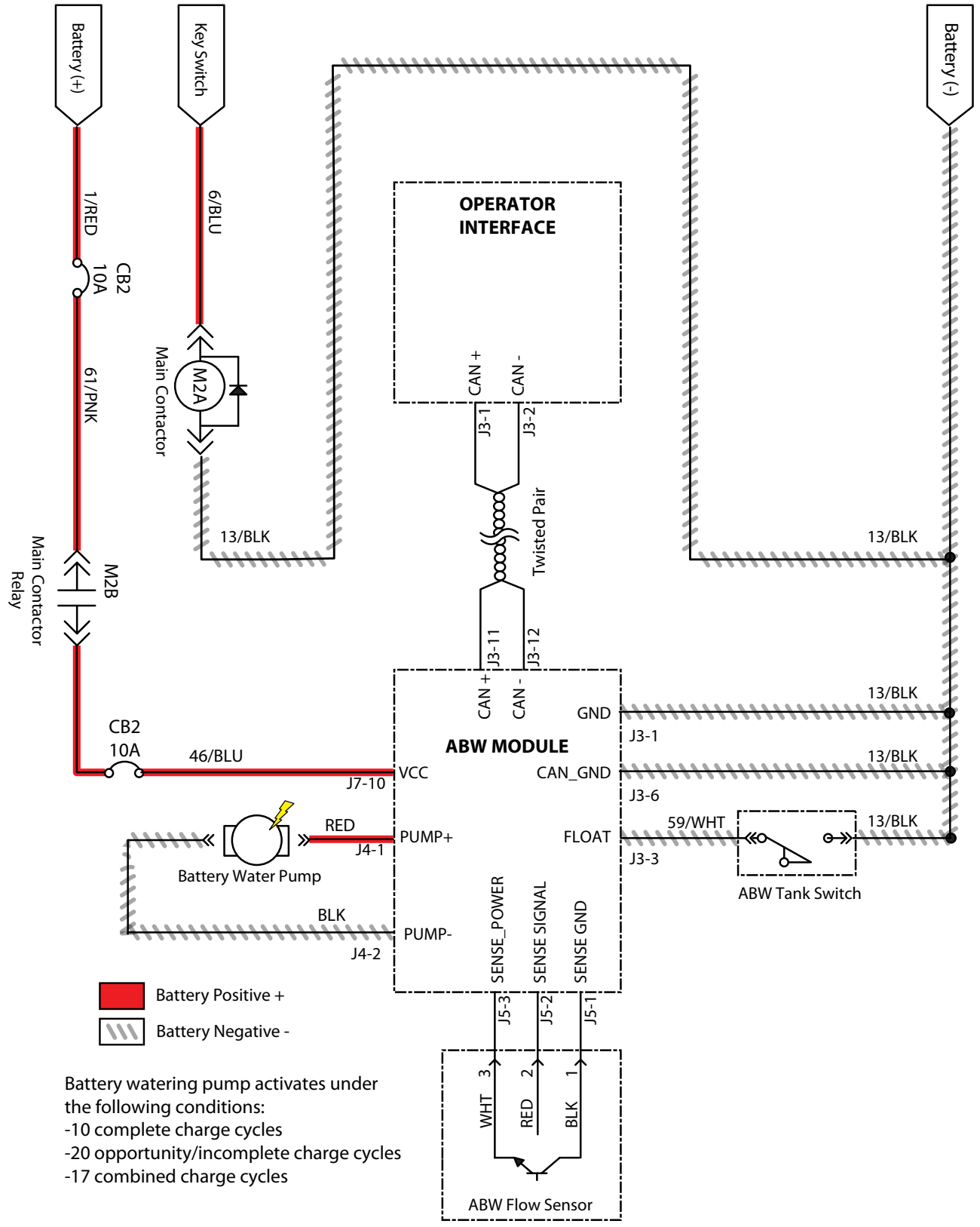
SOLUTION CONTROL FAILED TO TURN ON (ec-H2O)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable solution control (ec-H2O) • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #2 to reset • Is circuit breaker #2 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key ON • Enable solution control (ec-H2O) • Test voltage applied to solution control (ec-H2O) subsystem as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

ABW (AUTOMATIC BATTERY WATERING) (OPTION)



Battery watering pump activates under the following conditions:
-10 complete charge cycles
-20 opportunity/incomplete charge cycles
-17 combined charge cycles

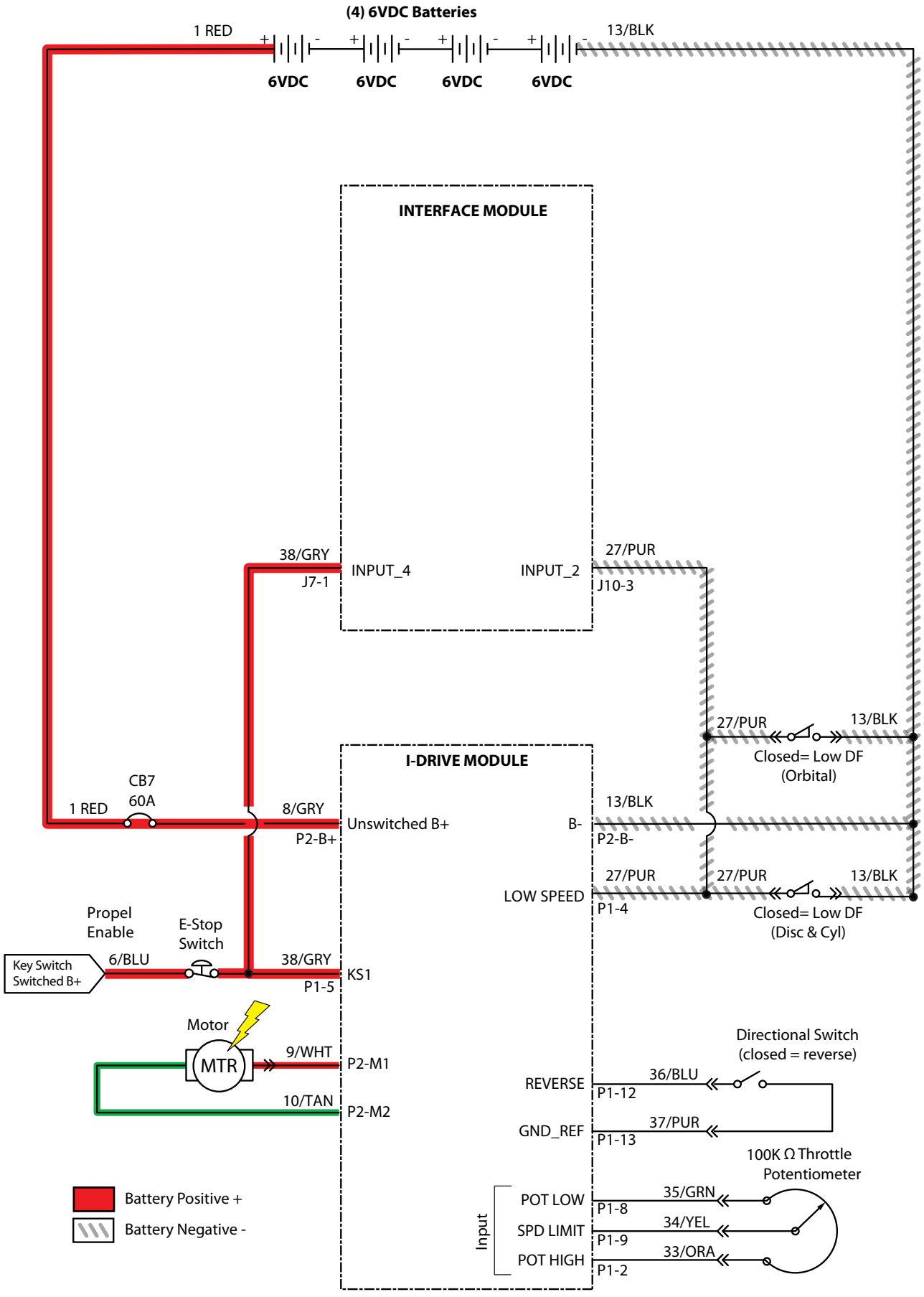
ABW (AUTOMATIC BATTERY WATERING) SYSTEM FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable ABW if previously faulted or operate manually • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Ensure there is water in ABW tank • Operate ABW manually if not priming		Fill ABW tank with water	Proceed to STEP 3
3	• Key OFF • Firmly press circuit breaker #2 to reset • Is circuit breaker #2 tripped?		Reset and test power-up circuit operation	Proceed to STEP 4
4	• Key ON • Test voltage applied to ABW pump subsystem, ABW module, ABW flow sensor, and ABW tank switch as shown on electrical schematic • Are electrical circuits operating as shown on electrical schematic?		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

BDI = Battery Discharge Indicator

i-DRIVE TESTING (UNIVERSAL SCHEMATIC)



i-DRIVE TESTING PROCEDURE

Step	Action	Value(s)	Yes	No
1 ✓Switched (+)*	• Key ON / circuits loaded (preferred) • All electrical components remain connected to wire harness • Use an electrical schematic to identify all switched (+) power supply wires • Is there *switched battery voltage* (+) applied to circuit board?	Applied voltage must be within 1 volt of actual battery voltage	Proceed to STEP 2	Identify voltage drop location and repair or replace necessary components[1]
2 ✓Unswitched (+)*	• Key ON / circuits loaded (preferred) • All electrical components remain connected to wire harness • Use an electrical schematic to identify all unswitched (+) power supply wires • Is there *switched battery voltage* (+) applied to circuit board?	Applied voltage must be within 1 volt of actual battery voltage	Proceed to STEP 3	Identify voltage drop location and repair or replace necessary components[1]
3 ✓Negative (-)*	• Key ON / circuits loaded (preferred) • All electrical components remain connected to wire harness • Use an electrical schematic to identify all negative (-) / ground supply wires • Is there battery negative (-) applied to circuit board?	Applied voltage must be within 1 volt of actual battery voltage	Proceed to STEP 4	Identify voltage drop location and repair or replace necessary components[1]
4 ✓Inputs	• Key ON • Manually exercise all input devices and use a multimeter to observe status change • Use an electrical schematic to identify all input circuits • Do all inputs function correctly?		Proceed to STEP 5	Repair or replace necessary input components[1]
5 ✓Outputs	• Key ON • Disconnect battery and circuit board from wire harness and use a Ohmmeter to test output circuits for open or shorted circuits • Use an electrical schematic to identify all output circuits • Is there an *open* or *shorted* [2] output circuit causing the trouble symptom?		Repair or replace necessary output components[1]	Replace circuit board

[1] Wire harnesses are components

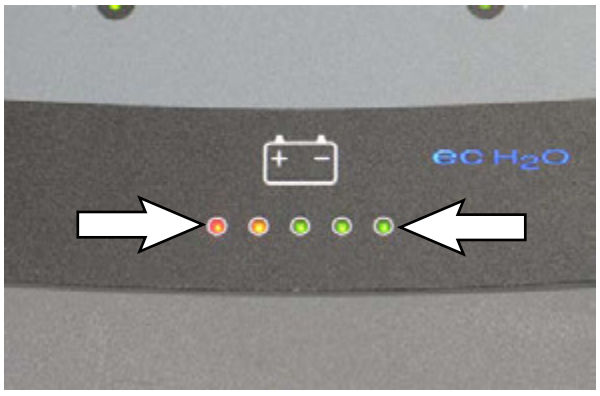
[2] An open circuit has infinite resistance “O.L.”. A shorted circuit has 0 (zero) resistance. Always test through entire circuit.

* Switched (+) and Unswitched (+) indicate positive battery voltage applied to circuit board. Negative (-) indicates battery negative (ground) as part of power supply to circuit board.

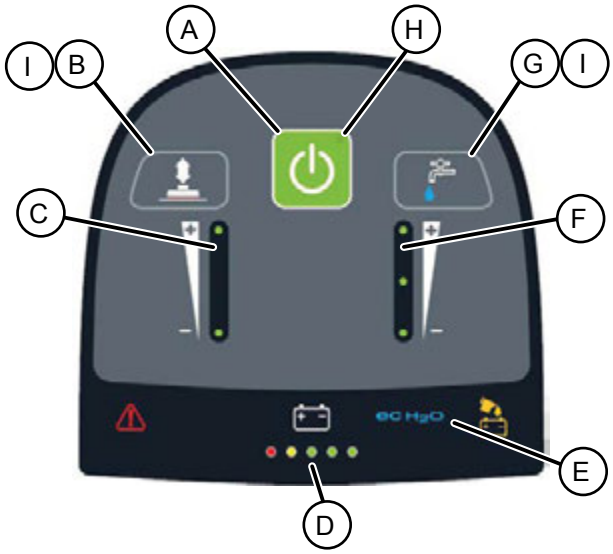
ENTERING THE MANUAL MODE

Note: Propel functionality is disabled while the machine is in the manual mode.

1. Turn the key switch to the OFF position.
2. Press and hold the center of the 1-Step button and turn the key switch to the ON position. Continue holding the 1-Step button until the BDI (battery discharge indicator) indicator lights illuminate.



3. Release the 1-Step button.
4. Press the applicable button to access the corresponding function. Squeeze the bail to start the actuator and release the bail to stop the actuator.



A. Toggles scrub motor(s) on or off.

B. Toggles actuator direction.

C. LEDs display actuator direction.

D. Indicates battery discharge level.

E. Indicates ec-H2O option is active. Turned on and off from rocker switch on accessory panel.

F. LEDs display flow rate setting.

G. Cycles between four solution flow setting options (Off, 1, 2, 3). When ec-H2O is enabled, ec-H2O will function instead of conventional solution.

H. LED indicates if scrub motor(s) are on or off.

I. B and G pressed together simultaneously toggle between ABW pump on or ABW pump off.

10. Turn the key switch to OFF position to exit manual mode and return to operating mode.

SERVICE DIAGNOSTICS TOOL

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal at www.tennantco.com. Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

- **Interface Module:** The interface module is located in the operator console.
- **Machine Control Module:** The machine control module is located beneath the circuit board mounting heat shrink at the rear of the battery compartment.
- **Propel Module:** The propel module is located at the rear of the solution tank, behind the control module.
- **IRIS Module (option):** The IRIS module is attached to the machine control module as an assembly.
- **Onboard Battery Charger Module (option):** The onboard battery charger is located beneath the plastic cover at the rear of the machine.
- **ec-H2O NanoClean Module (option):** The ec-H2O module is located beneath the recovery tank at the front of the machine.

PROGRAMMING A NEW INTERFACE MODULE

SYSTEM REQUIREMENTS: Windows® 7 Operating System, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

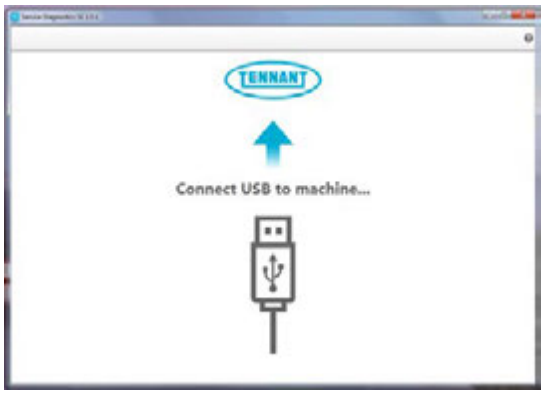
1. Connect a USB cable from a computer to the machine.

2. Turn the key switch to the ON position.

3. Double click the Service Diagnostics desktop shortcut or find the software in All Programs to launch the software.

NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

NOTE: Check USB cable connection to the machine if the screen below appears on the computer screen.



4. The Service Diagnostics tool now connects to the control module network.

5. The Service Diagnostics tool automatically detects a new interface module installation. Enter the model and serial number and then click the arrow button.

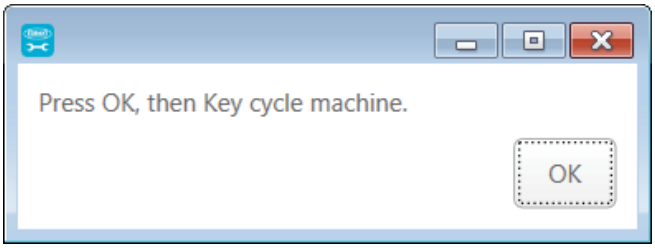
6. Inspect the actual machine configuration and match applicable configurations from the drop-down menus and then click on the arrow button.

NOTE: Reconfiguration may take several minutes.

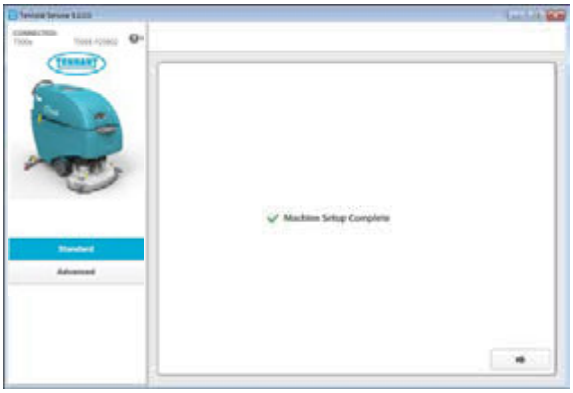
NOTE: Configurations may differ from what is shown, depending on the options / features are equipped on the machine.

7. The programming process begins and all control modules are updated (if applicable).

8. The Service Diagnostic tool may prompt to cycle the key switch OFF/ON during the process. If prompted, click the OK button and then cycle the key switch to allow the programming to continue.



9. Cycle the key switch to save selections.



RECONFIGURING EXISTING MODULES

SYSTEM REQUIREMENTS: Windows® 7 Operating System, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

1. Connect a USB cable from the computer to the machine.

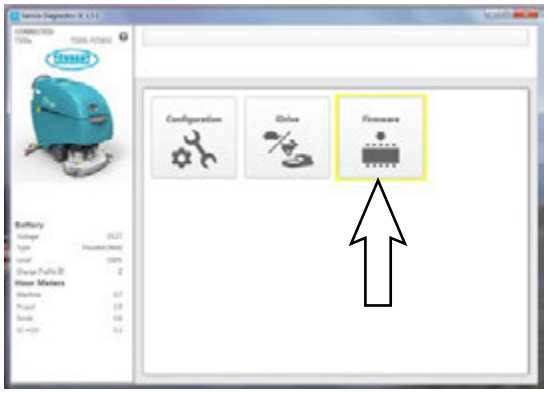
2. Turn the key switch to the ON position.

3. Double click the Service Diagnostics desktop shortcut or find the software in All Programs to launch the software.

NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

4. Check for machine software updates. A yellow highlight surrounding the Firmware button indicates that updates are available. Click on the Firmware button to install updates.

NOTE: Update installation may take several minutes.



5. Click on the Configuration button to display a list of configurable options.

6. Select the configurable options that apply from the drop down menus and then click individual arrow buttons to launch individual module reprogramming (this is faster) or the header arrow button to launch all module reprogramming (this is slower). Click the refresh button to display the new configuration after reprogramming is completed.

7. Cycle the key switch to save changes.

PROGRAMMING THE DRIVE MODULE

SYSTEM REQUIREMENTS: Windows® 7 Operating System, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

1. Connect a USB cable from a notebook computer to the machine.

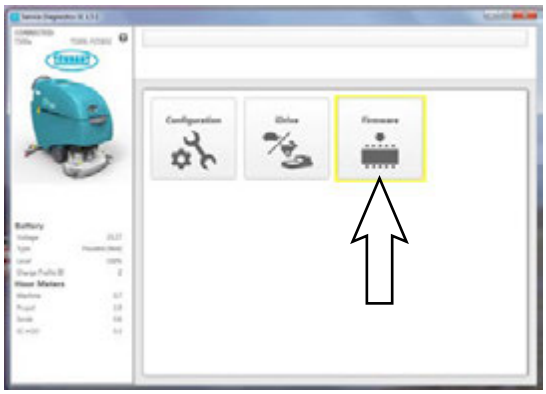
2. Turn the key switch to the ON position.

3. Double click the Service Diagnostics desktop shortcut or find the software in All Programs to launch the software.

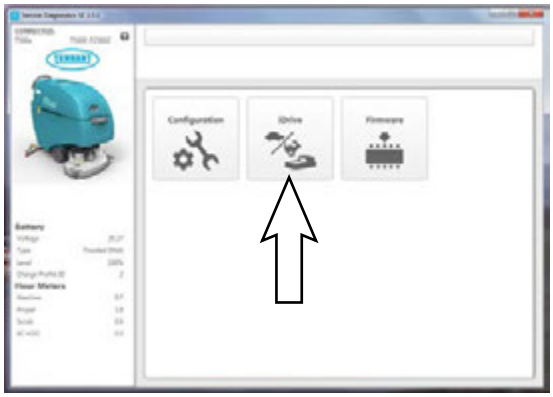
NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

4. Check for machine software updates. A yellow highlight surrounding the Firmware button indicates that updates are available. Click on the Firmware button to install updates.

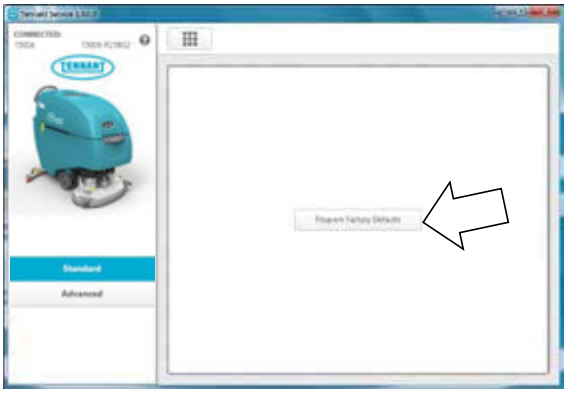
NOTE: Update installation may take several minutes.



5. Click on the i-Drive button.



6. Click on the Program Factory Defaults button to program the drive module.



7. Cycle the key switch to save.

RECONFIGURING THE MACHINE AFTER NEW HARDWARE / OPTION INSTALLATION

SYSTEM REQUIREMENTS: Windows® 7 Operating System, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

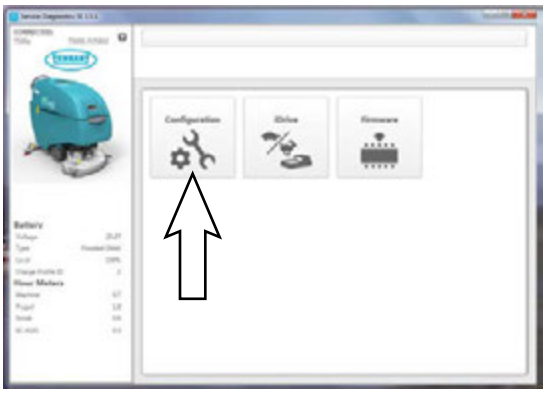
A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

1. Connect a USB cable from the computer to the machine.

2. Turn the key switch to the ON position.

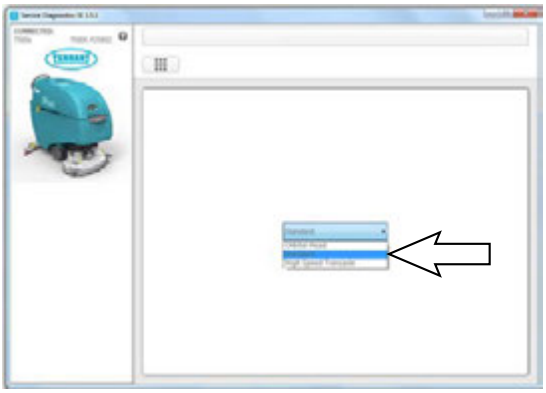
3. Double click the Service Diagnostics desktop shortcut or find the software in All Programs to launch the software.

4. Click on the Configuration button to display a list of configurable options.

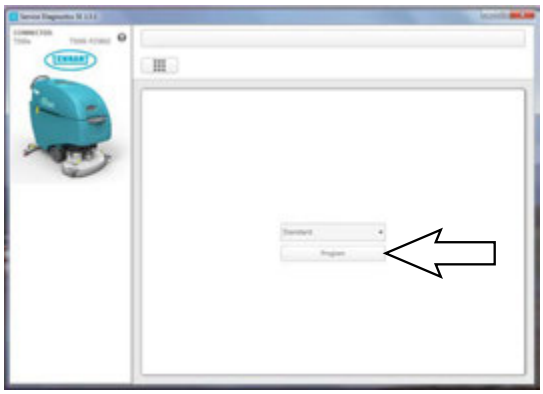


5. Select the configurable changes that apply from the drop down menus.

6. Select the new hardware setting from the pull down menu.



7. Click on the Program button to configure the machine for the new hardware / option. Reprogramming for new hardware should take several minutes to complete.



CHANGING THE OFF-BOARD BATTERY CHARGER SETTINGS

NOTE: The battery charger algorithm profile is programmed for Trojan flooded (wet) lead acid batteries 160-260 AH range (Algorithm position 003 - factory default). Program the charger algorithm profile according to specific battery type as described below to prevent battery damage.

1. Disconnect the charger power cable from the wall outlet or the charger. Wait 30 seconds for the input relay to open.

2. While reconnecting AC input, press and hold the Select Charge Profile Button for approximately 10 seconds, through the light check function, until the Error Indicator is illuminated (amber) and Battery Charging Indicator starts flashing (green).

3. Press and release the Select Charge Profile Button to advance through the charge profiles. The selected charging profile will be displayed up to three times.

NOTE: Process will time out and profile will remain unchanged if there is 15 seconds of inactivity. A profile number is allowed to display three times.

4. When the new charging profile is displayed, press and hold the Select Charge Profile button for 10 seconds to confirm selection and exit Profile Selection Mode. When the charge profile is confirmed, the Error Indicator and Battery Charging Indicator lights will turn off and the blue AC Power Indicator will remain illuminated. Release the Select Charge Profile button.

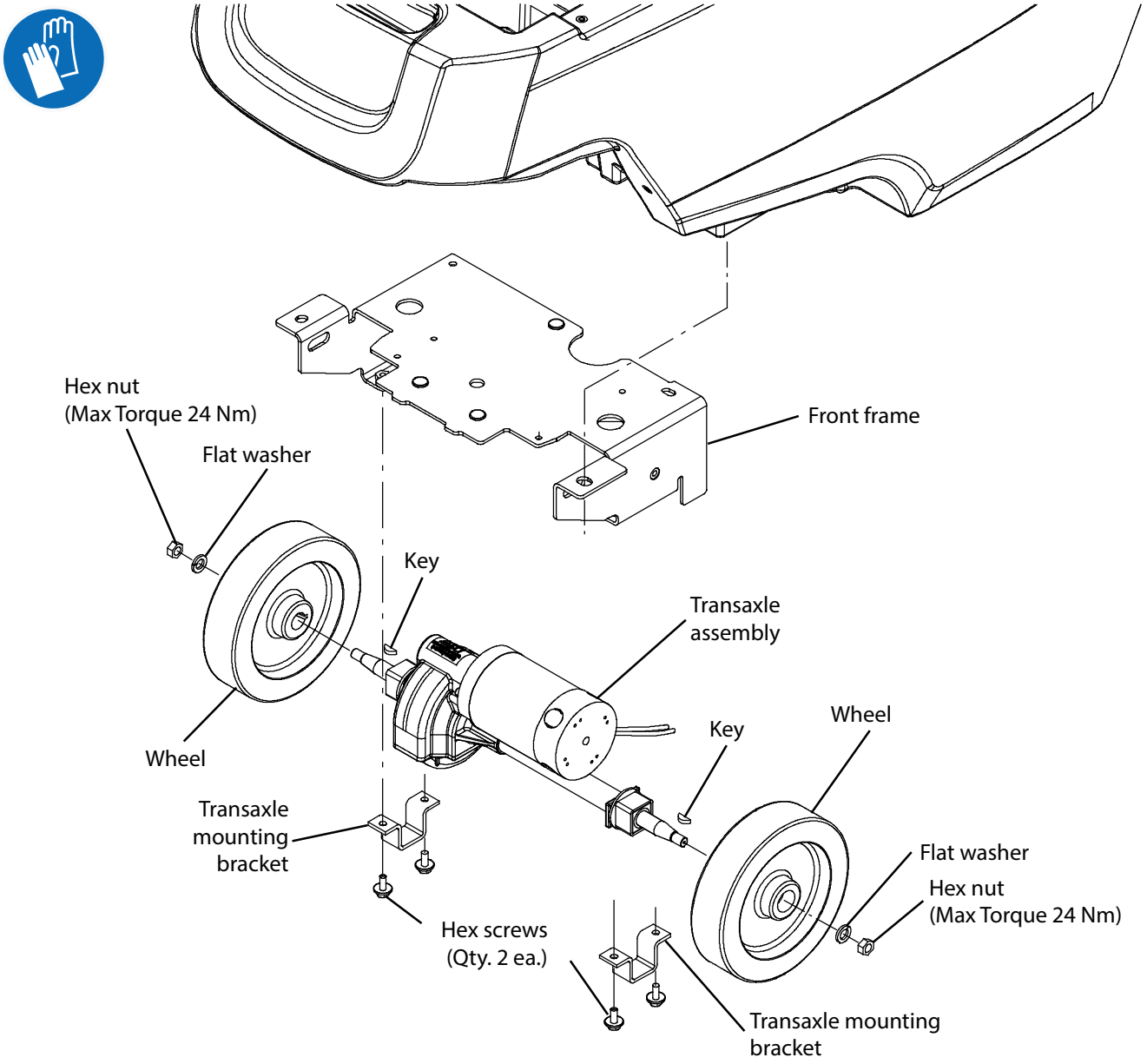
5. Press the Select Charge Profile Button to ensure the new profile is selected.

Algorithm Profile ID	Battery Description
003	Trojan flooded batteries 160-260 AH range
021	TAB/ENERSYS flooded batteries 180-260AH Range
028	DEKA GEL batteries 180-200 AH range
043	DISCOVER AGM batteries 200-400 AH range
051	SONNENSCHEIN GEL batteries 200-400 AH range
168	TPPL, 12XFC48/12XFC58/12XFC60

Changing the Off-Board Battery Charger Setting instructions and photos taken from the Delta-Q IC650 Charger Manual.

CLEANING SYSTEMS

REMOVE / INSTALL THE TRANSAXLE ASSEMBLY



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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain the solution tank and the recovery tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cables from the batteries.
4. Remove the batteries from the machine.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

5. Remove the rear squeegee assembly from the machine.

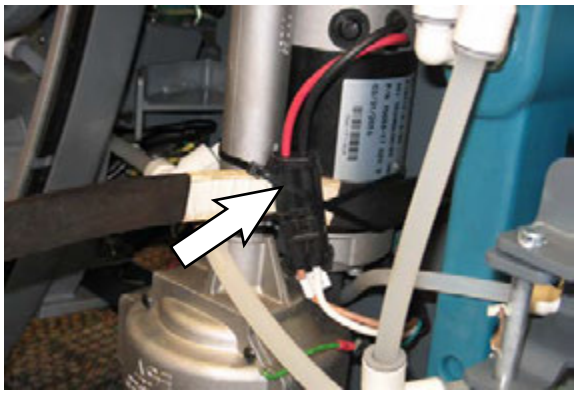
6. Position a protective blanket next to the side of the machine that will be tipped onto the floor.

*NOTE: **Do** **Not** allow the machine to drop when tipping it onto the protective blanket. The scrub head and other components could be damaged if machine is allowed to drop. If necessary, remove the scrub head from the machine before tipping the machine onto its side.*

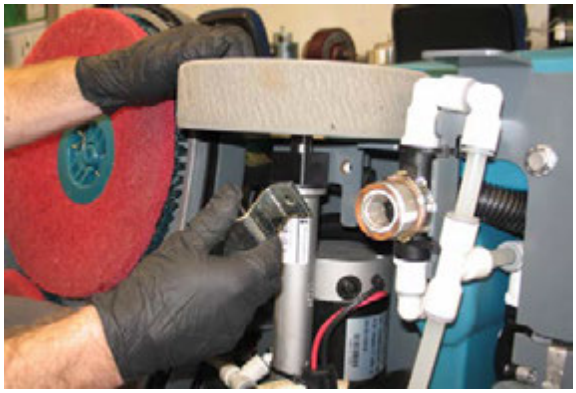
7. Carefully tip the machine onto the protective blanket.

8. Disconnect hoses as necessary to access the transaxle assembly.

9. Cut the wire tie from the main wire harness / transaxle connection and disconnect the main wire harness from the transaxle assembly.



10. Remove both transaxle mounting brackets securing the transaxle assembly / wheels to the machine. Set the transaxle mounting brackets, flat washers, and hex screws aside.



11. If replacing the transaxle assembly only: Remove both wheels from the transaxle motor. Set the wheels, both keys, flat washers, and hex nuts aside. Discard the removed transaxle.

12. If installing a new transaxle assembly only: Install the wheels onto the new transaxle assembly.

13. Install the new transaxle assembly / reinstall removed transaxle assembly in the reverse order of disassembly.

REMOVING / INSTALLING THE DRIVE MOTOR CARBON BRUSHES

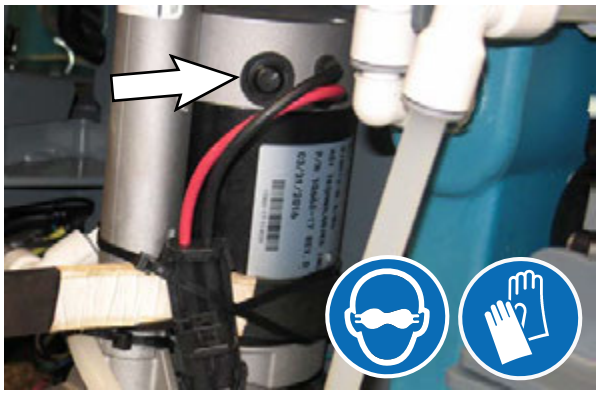
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain the solution tank and the recovery tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cable from the machine.
4. Remove the batteries from the machine.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

5. Remove the rear squeegee from the machine.
6. Position a protective blanket next to the side of the machine that will be tipped onto the floor.
7. Carefully tip the machine onto the protective blanket.
8. Remove the access cover from the drive motor.

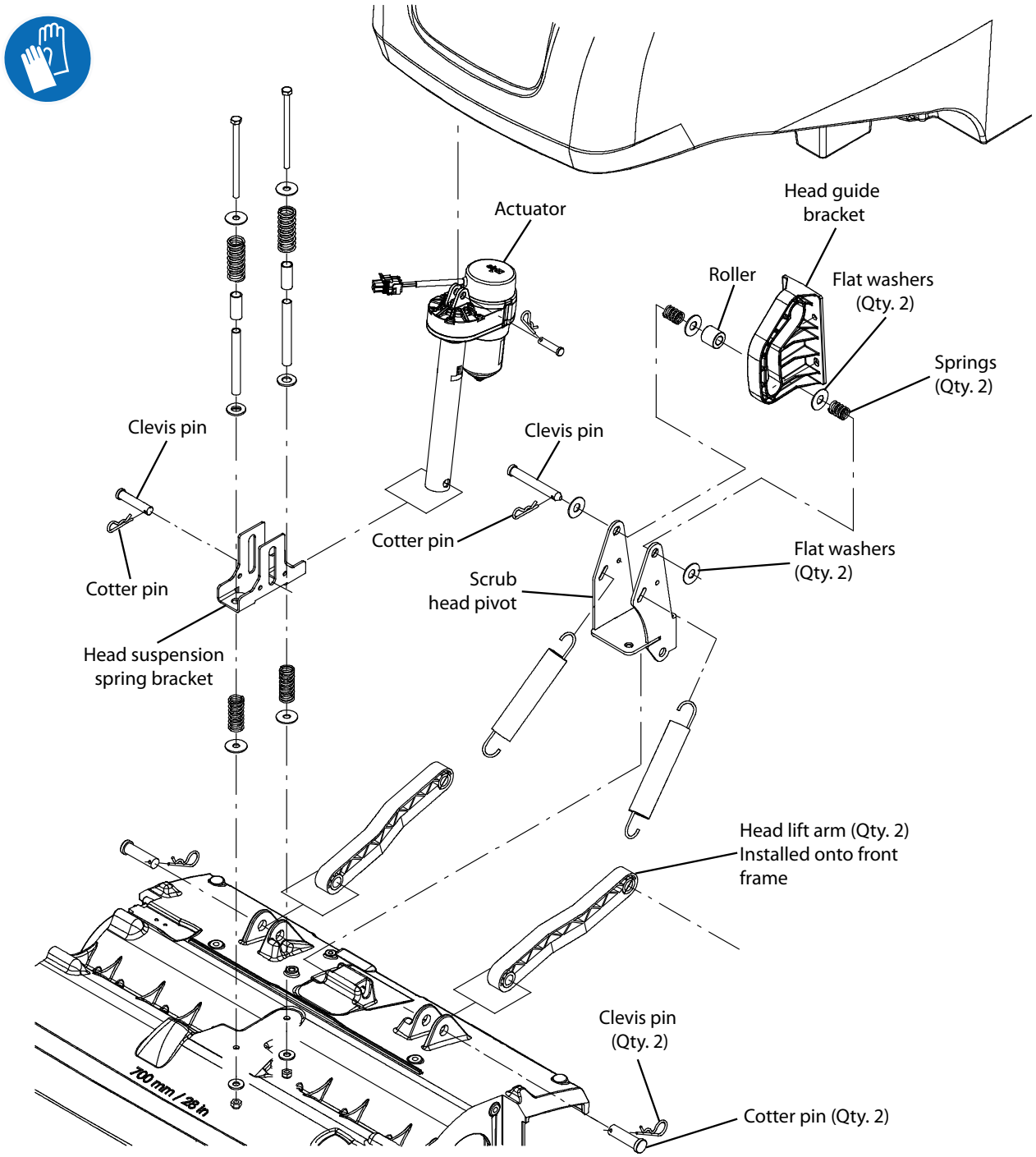


9. Remove the hardware securing the carbon brush in the drive motor.
10. Remove the carbon brush from the drive motor.
11. Use compressed air to clean any dust from inside the drive motor.
12. Repeat previous steps to remove the remaining carbon brushes from the drive motor.

NOTE: Carbon brushes should be replaced as sets.

13. Reinstall the removed carbon brushes / install the new carbon brushes into the drive motor in the reverse order of removal.

REMOVE / INSTALL THE CYLINDRICAL SCRUB HEAD ASSEMBLY



1. Completely empty both the solution tank and the recovery tank.

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

2. Turn the key to the OFF position and remove the key.
3. Remove debris tray from the scrub head. Set the debris tray aside.
4. Remove scrub brushes from the scrub head. Set the scrub brushes aside.

5. Turn ON the machine, completely lower the scrub head to the floor, turn OFF the machine, and remove the key.

6. Disconnect the battery cables from the batteries.

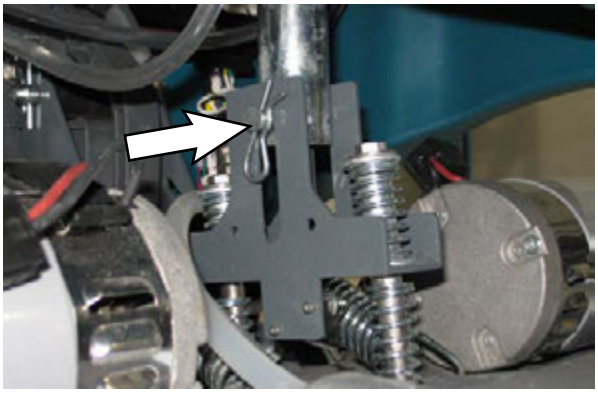
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

7. Cut the cable ties from the main wire harness / brush motor connection and disconnect the main wire harness from the brush motors.

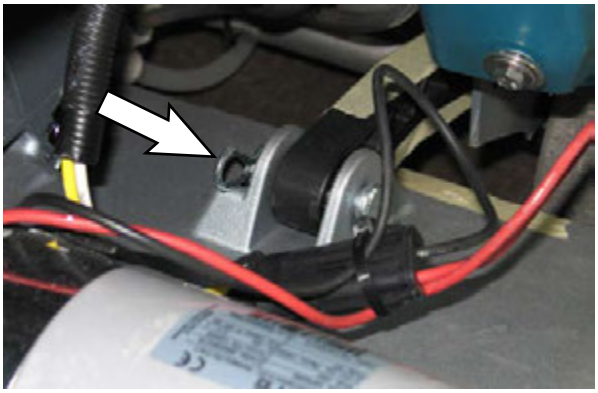
8. Disconnect all solution supply hoses from the scrub head.

9. Cut all wire ties securing the main wire harness to the scrub head and disconnect main wire harness connections from the brush drive motors.

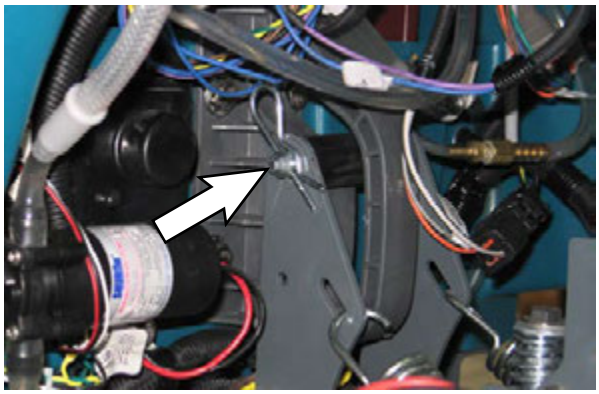
10. Remove the cotter pin and clevis pin securing the actuator to the head suspension spring bracket.



11. Remove the cotter pins and clevis pins securing the head lift arms to the scrub head assembly.



12. Remove the clevis pin and cotter pin securing the scrub head pivot to the head guide bracket.



13. Reinstall the removed scrub head / install the new scrub head onto the machine in the reverse order of removal.

14. If the removed scrub head was replaced with a different scrub head, reconfigure the machine for the new scrub head. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE / OPTION INSTALLATION in this section of the manual.

CHECKING / ADJUSTING THE CYLINDRICAL SCRUB BRUSH PATTERN

NOTE: This procedure must be completed using a new set of brushes. Performing procedure with worn brushes may result in uneven brush wear and / or shortened brush life.

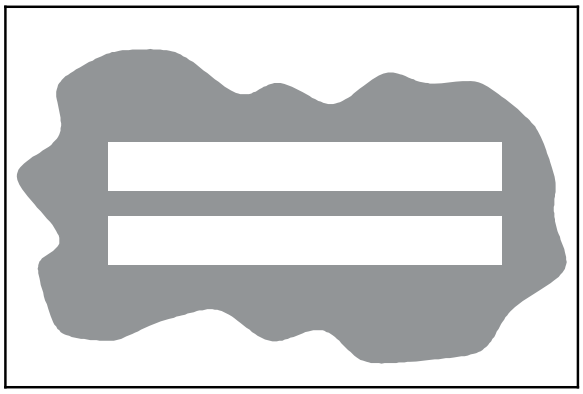
1. Apply chalk to a flat, level surface.

NOTE: The main wire harness must be disconnected from the transaxle motor so the machine remains stationary during the brush pattern test.

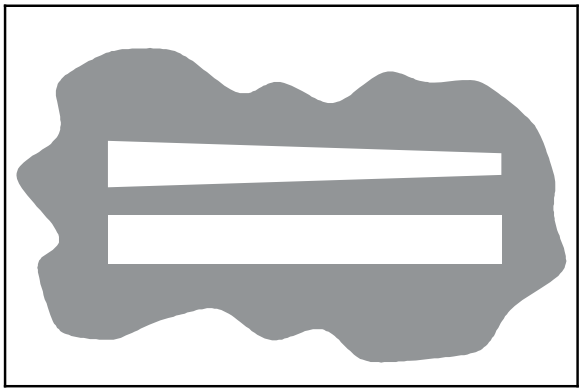
2. Turn off ec-H2O system (if equipped).
3. Turn off the solution flow.
4. Adjust the speed dial to the lowest setting.
5. Position the scrubber so the brushes are over the chalked area.
6. Lower the scrub head into the chalked area on the floor.
7. Place the directional lever into the reverse position.
8. Firmly hold the machine so it does not move and squeeze the bail handle to activate the scrub brushes. Hold the bail handle for 20 seconds and then release the bail handle.

Note: Parking brake can be used to hold machine in place if machine is equipped with the optional parking brake.

9. Raise the scrub head and pull the machine away from the pattern test area.
10. Observe the brush pattern. If the brush pattern is the same width across the entire length of each brush and both brushes are the same width, no adjustment is necessary.

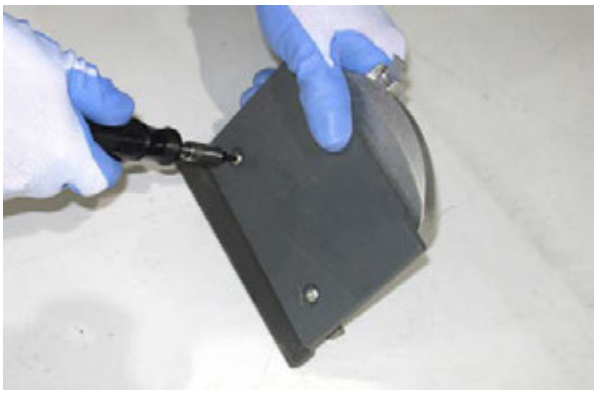


11. If the brush patterns are tapered, proceed to the following steps to adjust the patterns.



12. Unfasten yellow latch and remove the idler plate assembly from the scrub head.

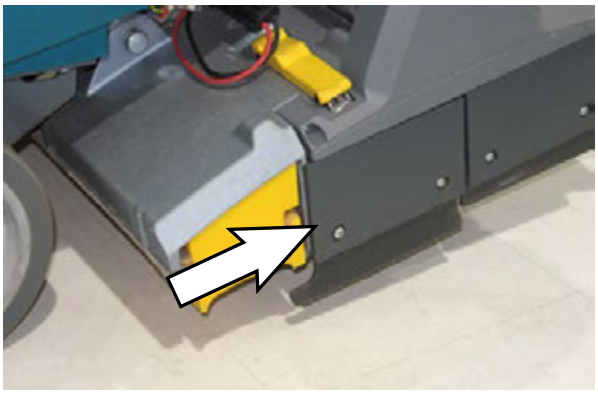
13. Remove the skirt cover from the idler plate.



14. Adjust the brush taper. Turn the idler plug clockwise to increase the taper at that end of the brush and counterclockwise to decrease the taper at that end of the brush.

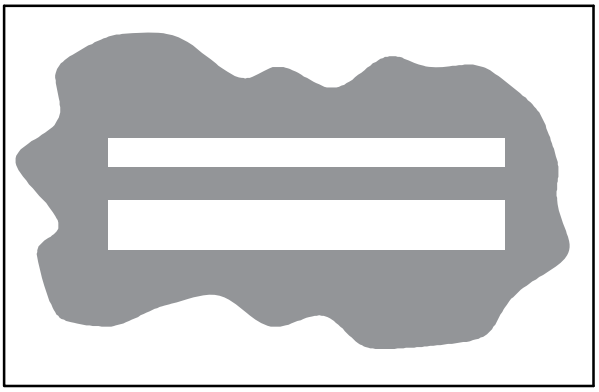
15. Reinstall the skirt cover onto the idler plate and reinstall the idler plate assembly onto the scrub head.

16. If necessary, repeat step 12 through step 15 to adjust the taper for the other brush (idler plate is located on the other side of the scrub head).

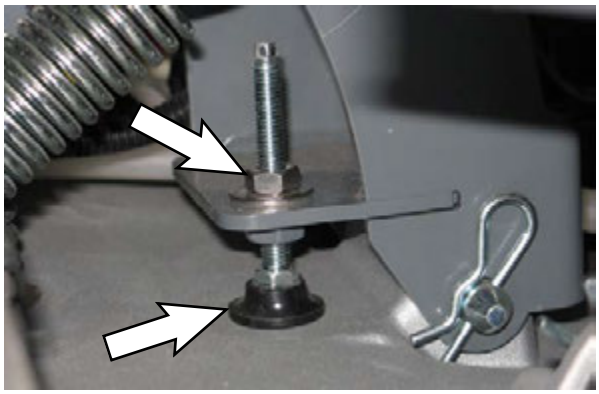


17. Reapply chalk and repeat step 5 through step 16 as necessary.

18. If the brushes are not the same width front-to-rear, proceed to the following steps.



19. Loosen the hex screw securing the leveler screw into place on the scrub head pivot.



20. Adjust the leveler screw up to decrease the rear brush width and down to increase the rear brush width.

21. Tighten the previously loosened hex screw.

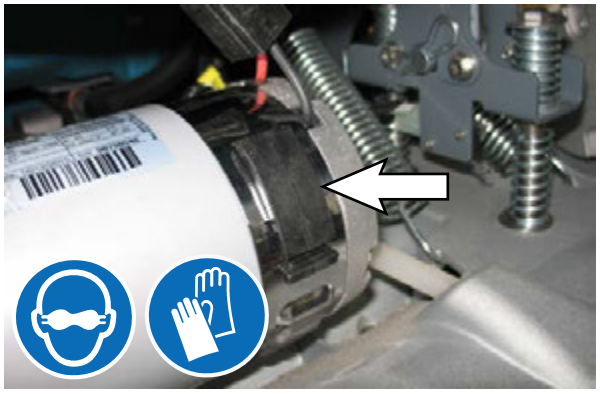
22. Recheck the brush width. Repeat step 19 through step 22 as necessary.

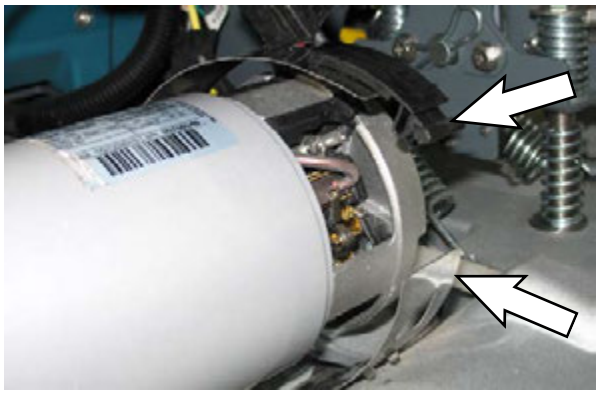
REMOVING / INSTALLING THE CYLINDRICAL SCRUB HEAD MOTOR CARBON BRUSHES

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

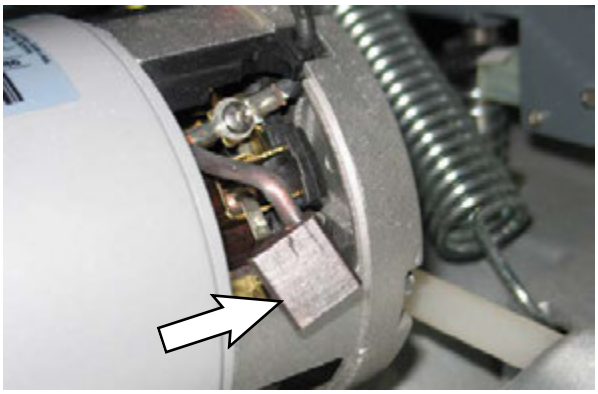
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Turn the key to the OFF position.
2. Disconnect the battery cables from the batteries.
3. Loosen and remove the latch securing the retaining band to the brush motor.





4. Carefully pull the carbon brush from the cylindrical brush motor.



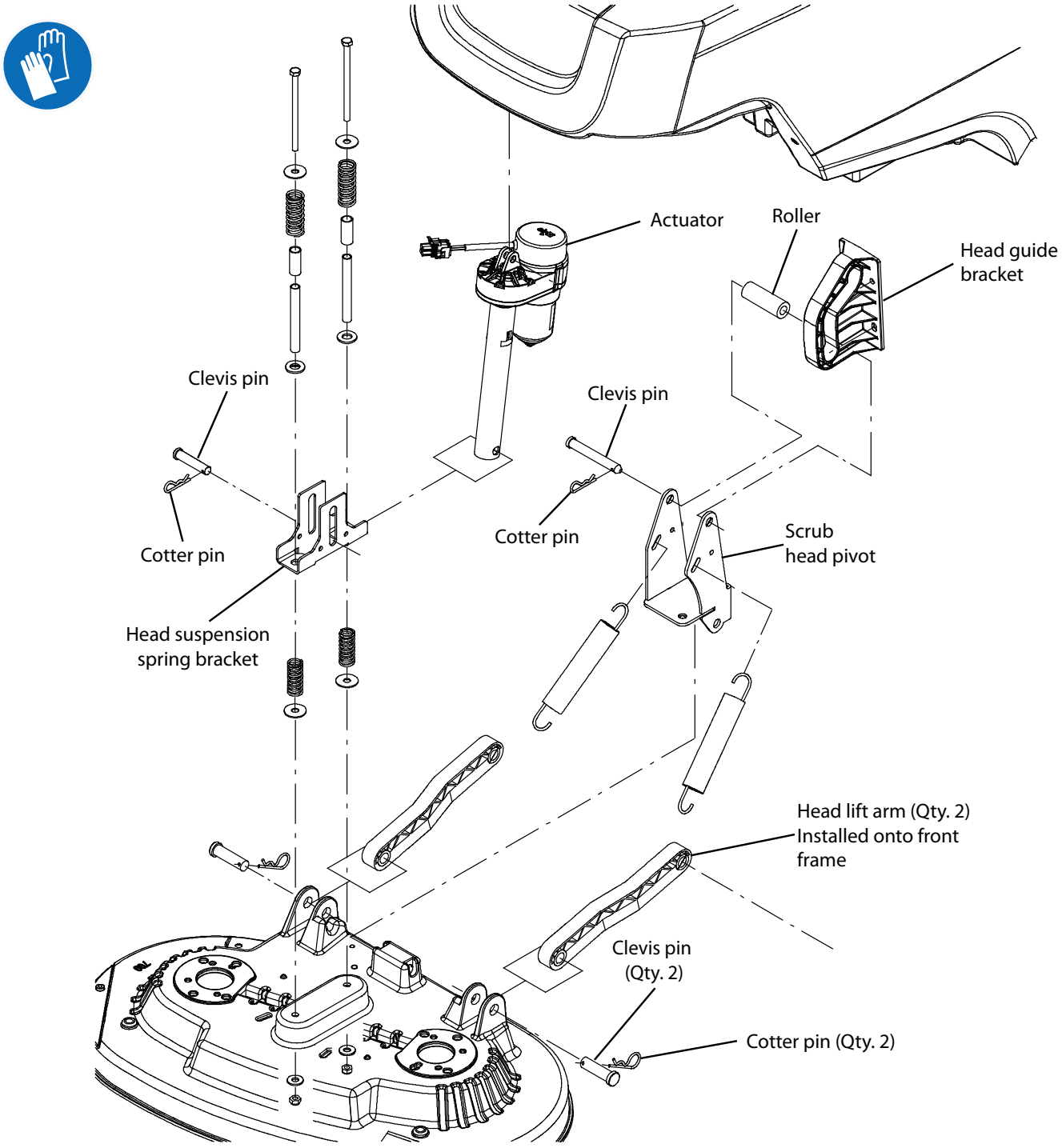
5. Remove the pan screw securing the carbon brush assembly in the cylindrical brush motor and remove the carbon brush assembly from the machine.

6. Use compressed air to clean any dust from inside the motor.
7. Repeat previous steps to remove the carbon brush located on the other side of the cylindrical brush motor.

NOTE: Carbon brushes should be replaced as sets.

8. Reinstall the removed carbon brushes / install the new carbon brushes into the cylindrical brush motor in the reverse order of removal.

REMOVE / INSTALL THE DISK SCRUB HEAD ASSEMBLY



1. Completely empty both the solution tank and the recovery tank.

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

2. Turn the key to the OFF position and remove the key.

3. Remove scrub brushes from the scrub head. Set the scrub brushes aside.

4. Turn ON the machine, completely lower the scrub head to the floor, turn OFF the machine, and remove the key.

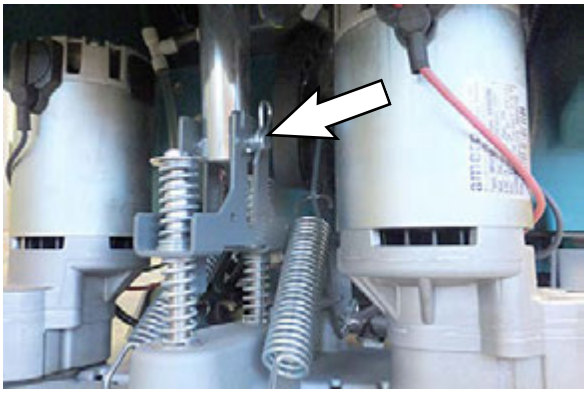
5. Disconnect the battery cables from the batteries.

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

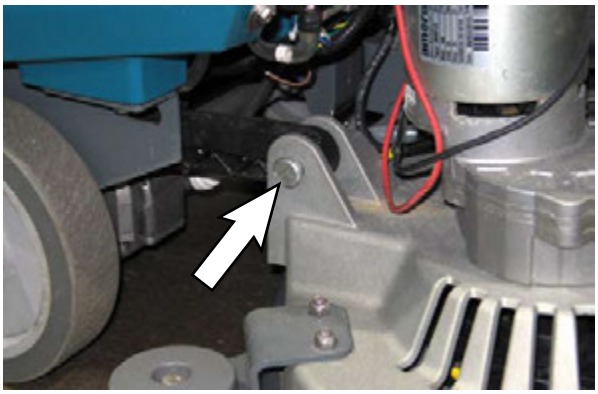
6. Cut the cable ties from the main wire harness / brush motor connection and disconnect the main wire harness from the brush motors.

7. Disconnect all solution supply hoses from the scrub head.

8. Remove the cotter pin and clevis pin securing the actuator to the head suspension spring bracket.



9. Remove the cotter pins and clevis pins securing the head lift arms to the scrub head assembly.



10. Remove the clevis pin and cotter pin securing the scrub head pivot to the head guide bracket.

11. Reinstall the removed scrub head / install the new scrub head onto the machine in the reverse order of removal.

12. If the removed scrub head was replaced with a different scrub head, reconfigure the machine for the new scrub head. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE / OPTION INSTALLATION in this section of the manual.

REMOVING / INSTALLING THE DISK SCRUB HEAD MOTOR CARBON BRUSHES

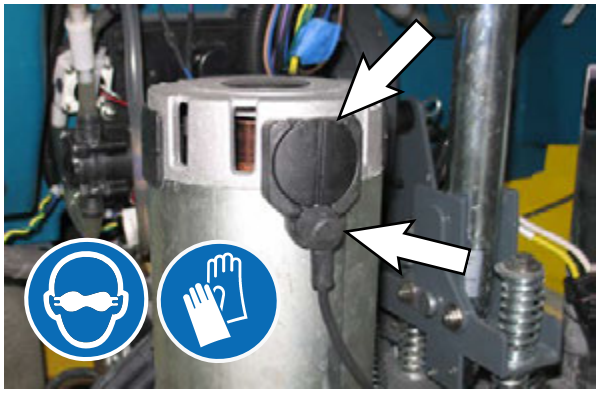
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

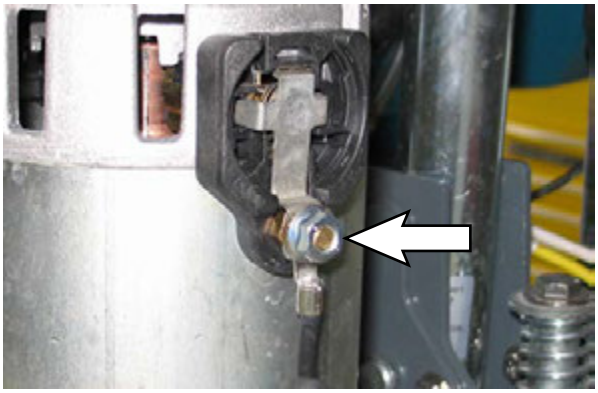
1. Turn the key to the OFF position.

2. Disconnect the battery cable from the machine.

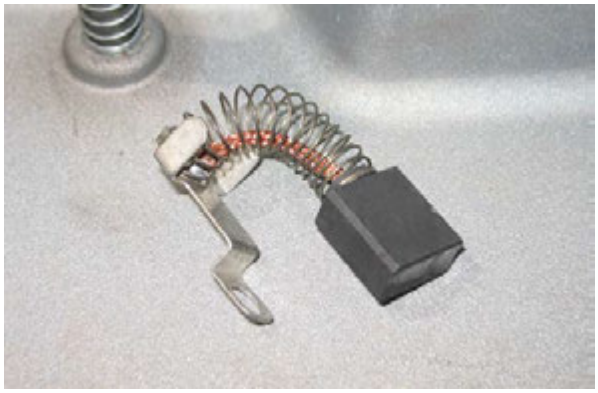
3. Remove the access plug from the motor and slide the terminal boot from the terminal.



4. Remove the hex nut securing the cable to the brush motor.



5. Carefully pull the carbon brush assembly from the brush motor.



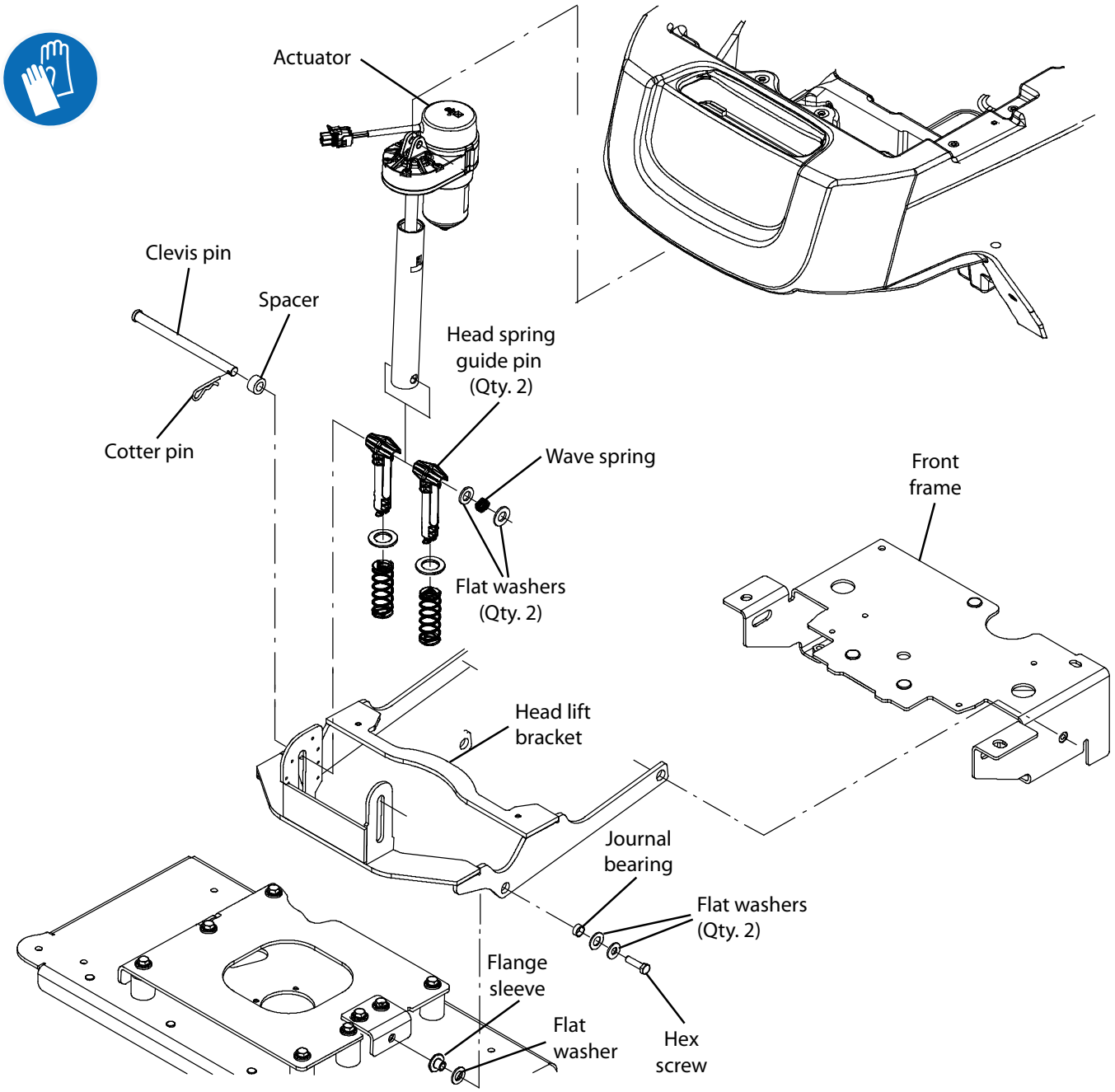
6. Use compressed air to clean any dust from inside the motor.

7. Repeat previous steps to remove the carbon brush located on the other side of the disk brush motor.

NOTE: Carbon brushes should be replaced as sets.

8. Reinstall the removed carbon brushes / install the new carbon brushes into the disk brush motor in the reverse order of removal.

REMOVE / INSTALL THE ORBITAL SCRUB HEAD ASSEMBLY



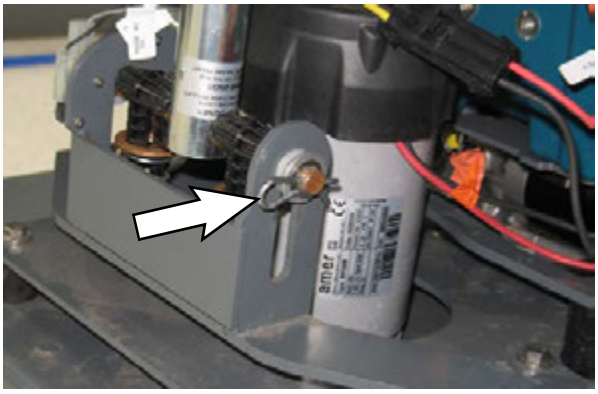
1. Completely empty both the solution tank and the recovery tank.

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

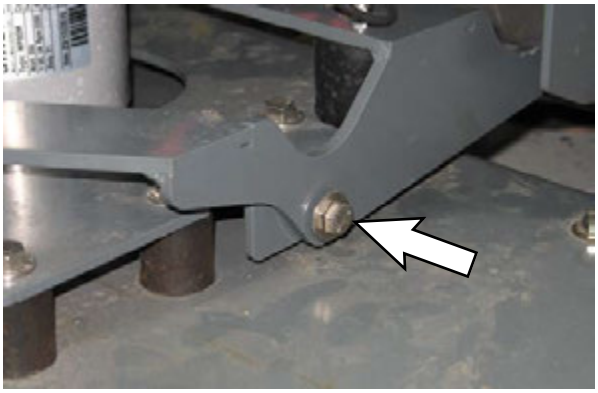
2. Turn the key to the OFF position and remove the key.
3. Disconnect the battery cables from the batteries.

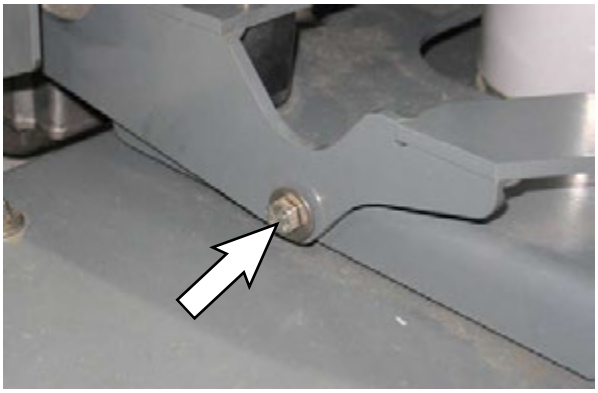
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

4. Cut the cable ties from the main wire harness / brush motor connection and disconnect the main wire harness from the brush motors.
5. Disconnect all solution supply hoses from the scrub head.
6. Remove the cotter pin and clevis pin securing the actuator to the head suspension spring bracket.



7. Remove the hex screws and flat washers securing the head lift bracket to the scrub head.





8. Reconnect the battery cable to the machine.
9. Turn on the machine, allow the scrub head to completely raise, and turn off the machine.
10. Disconnect the battery cable from the machine.
11. Remove the batteries from the machine.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

12. Lift the machine from the scrub head.
13. Proceed to REMOVE / INSTALL THE LOWER ORBITAL HEAD ISOLATORS if replacing the lower isolators.
14. Reinstall the removed scrub head / install the new scrub head onto the machine in the reverse order of removal.
15. If the removed scrub head was replaced with a different scrub head, reconfigure the machine for the new scrub head. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE / OPTION INSTALLATION in this section of the manual.

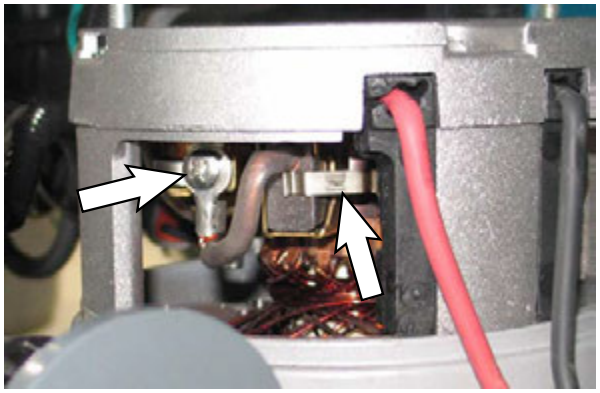
REMOVING / INSTALLING THE ORBITAL SCRUB HEAD MOTOR CARBON BRUSHES

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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Turn the key to the OFF position.
2. Disconnect the battery cable from the machine.
3. Remove the front scrub head cover from the machine.
4. Remove the cap from the motor.

5. Remove the pan screw and spring clip securing the carbon inside the motor and carefully pull the carbon brush assembly from the brush motor.

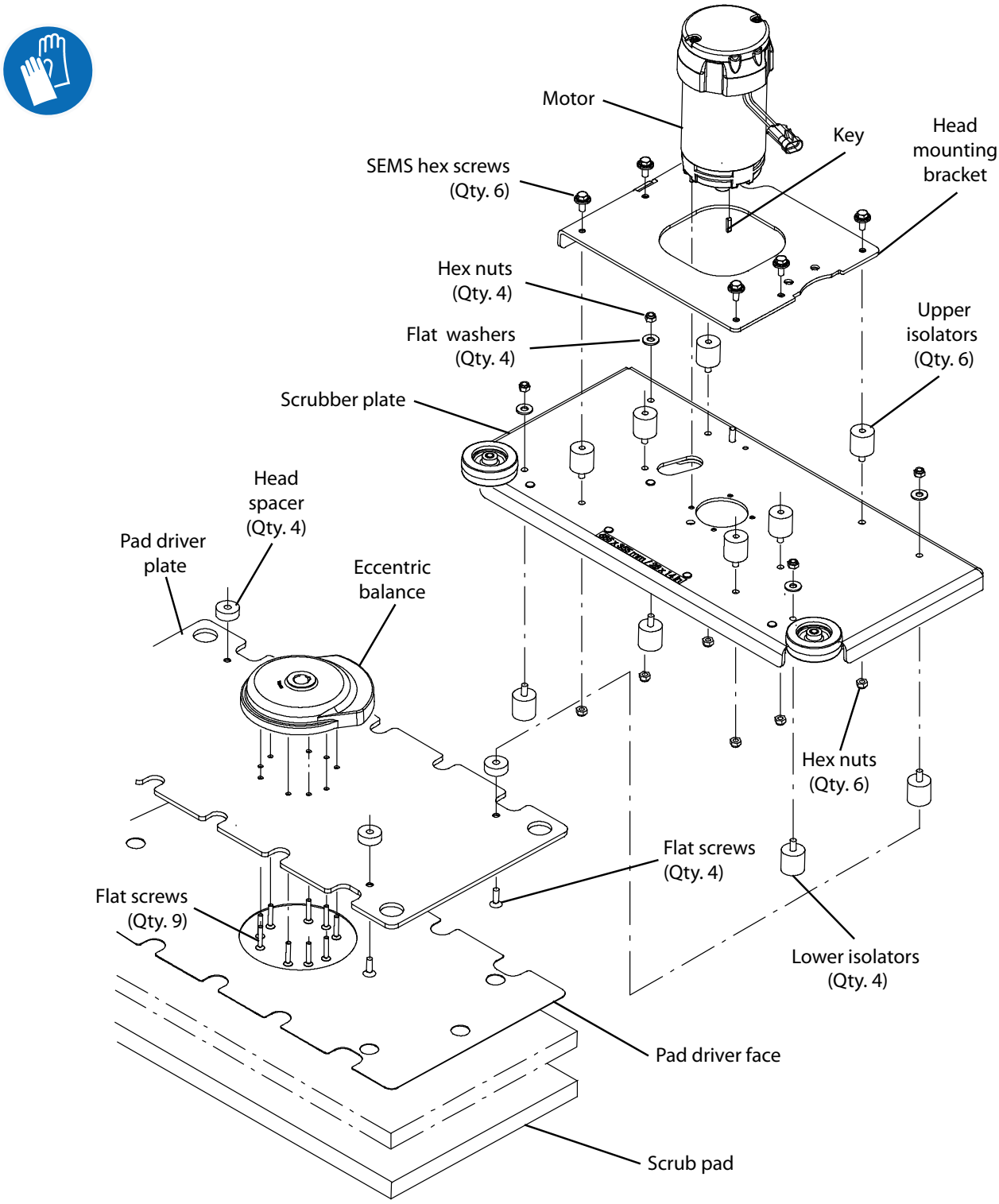


6. Use compressed air to clean any dust from inside the motor.
7. Repeat previous steps to remove the carbon brush located on the other side of the disk brush motor.

NOTE: Carbon brushes should be replaced as sets.

8. Reinstall the removed carbon brushes / install the new carbon brushes into the disk brush motor in the reverse order of removal.

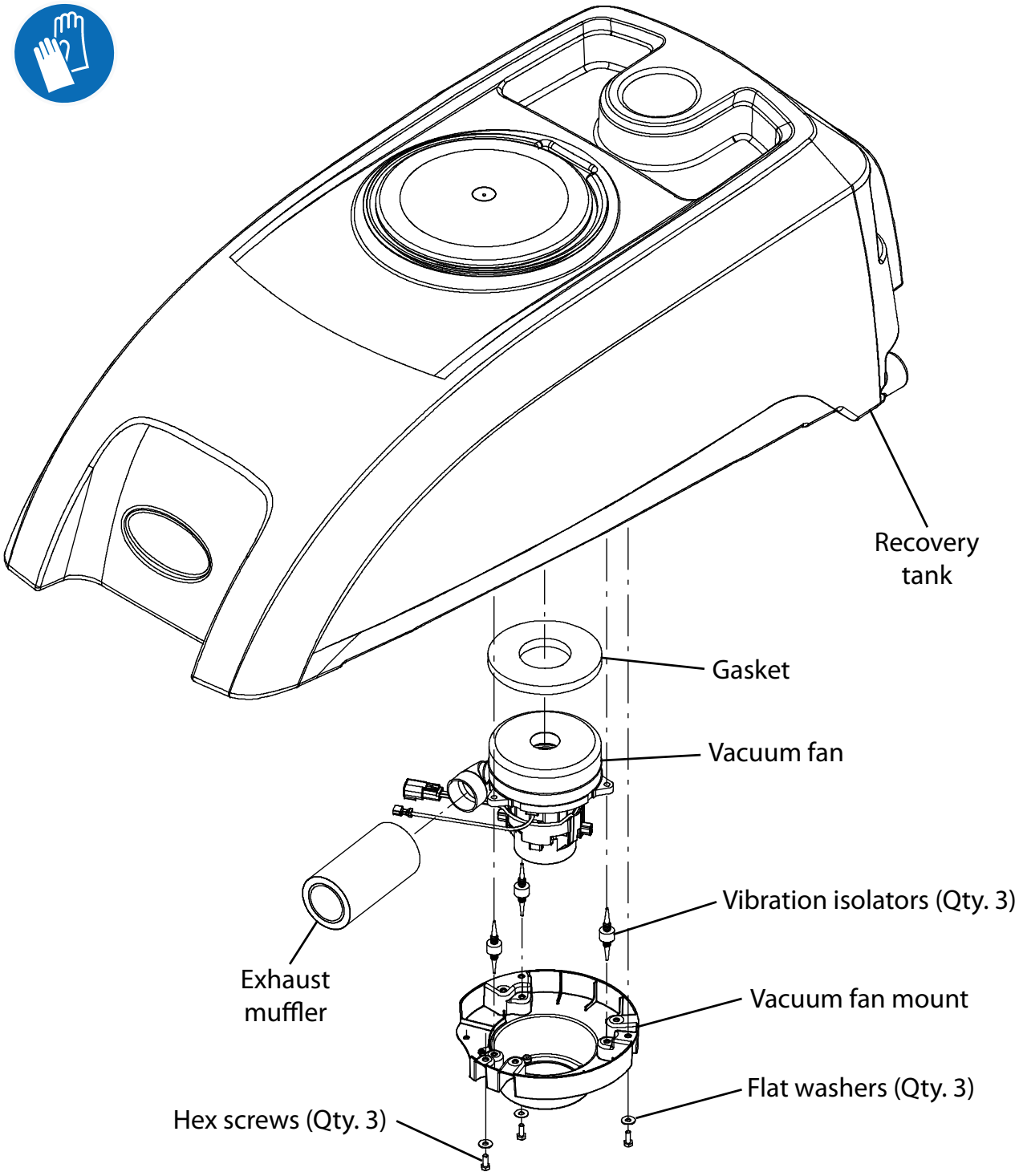
REMOVE / INSTALL THE LOWER ORBITAL HEAD ISOLATORS



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

1. Remove the orbital scrub head assembly from the machine. See *REMOVE / INSTALL THE ORBITAL SCRUB HEAD ASSEMBLY* in this section of the *SERVICE MANUAL.*
2. Place the scrub head on a work bench.
3. Loosen the nyloc nuts securing the lower isolators to the orbital scrub head assembly.
4. Turn the orbital scrub head assembly upside down and remove the pads. Set the pads aside.
5. Remove hardware securing the lower plate to the lower isolators.
6. Loosen the set screw securing the concentric motor weight to the motor shaft.
7. Remove the lower plate and the lower isolators.
8. Install the lower orbital head isolators in the reverse order in which they were removed.

REMOVING / INSTALLING THE VACUUM FAN



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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain the recovery tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cables from the batteries.
4. Lift the recovery tank completely open.

5. Cut the zip tie securing the main wire connections to the vacuum fan and disconnect the main wire harness from the vacuum fan.

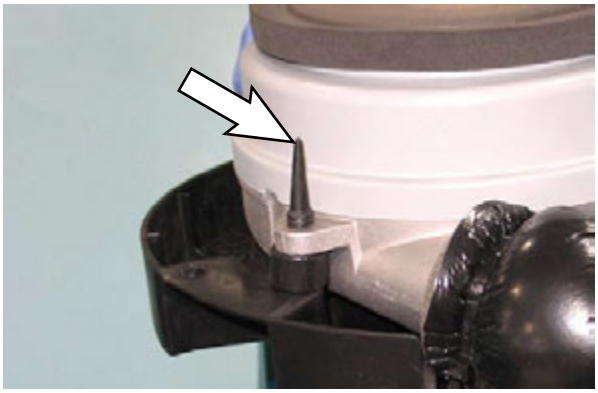
6. Remove hardware securing the vacuum fan to the machine.

7. Remove the vacuum fan assembly from the machine.

8. Cut the cable tie securing the vacuum fan / exhaust muffler to the vacuum fan mount.

9. Separate the vacuum fan from the vacuum fan mount bracket.

10. Install the new vacuum fan onto the mount bracket. Be sure the vibration isolators are completely inserted into the vacuum fan.



11. Install new vacuum fan assembly / reinstall the removed vacuum fan assembly in the reverse order of removal.

REMOVING THE VACUUM FAN CARBON BRUSHES

1. Remove the vacuum fan from the machine. See REMOVING / INSTALLING THE VACUUM FAN in this section manual.
2. Remove hardware securing the vacuum fan cover assembly to the motor.

3. Loosen the carbon brush mounting hardware.

4. Lift up to release and remove carbon brushes.

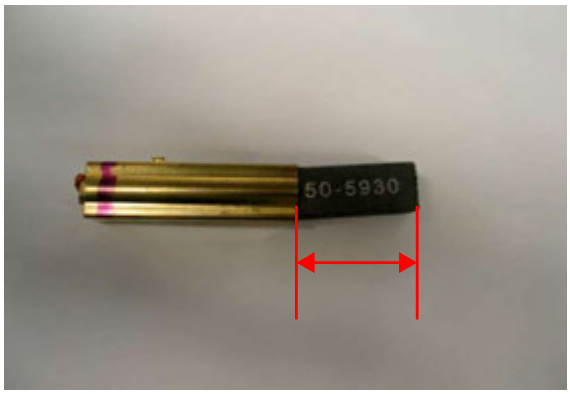
NOTE: Carbon brushes should be replaced as sets.

INSTALLING CARBON BRUSHES

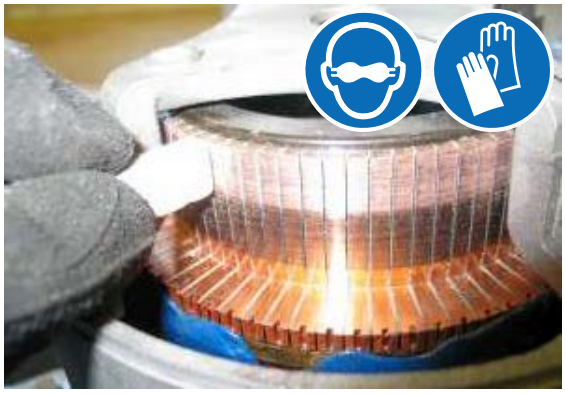
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, set parking brake, and remove key.

1. Inspect carbon brushes. Replace carbon brushes if they are stuck or are less than 10 mm (0.375 in) in length.

NOTE: Carbon brushes should be replaced as sets.

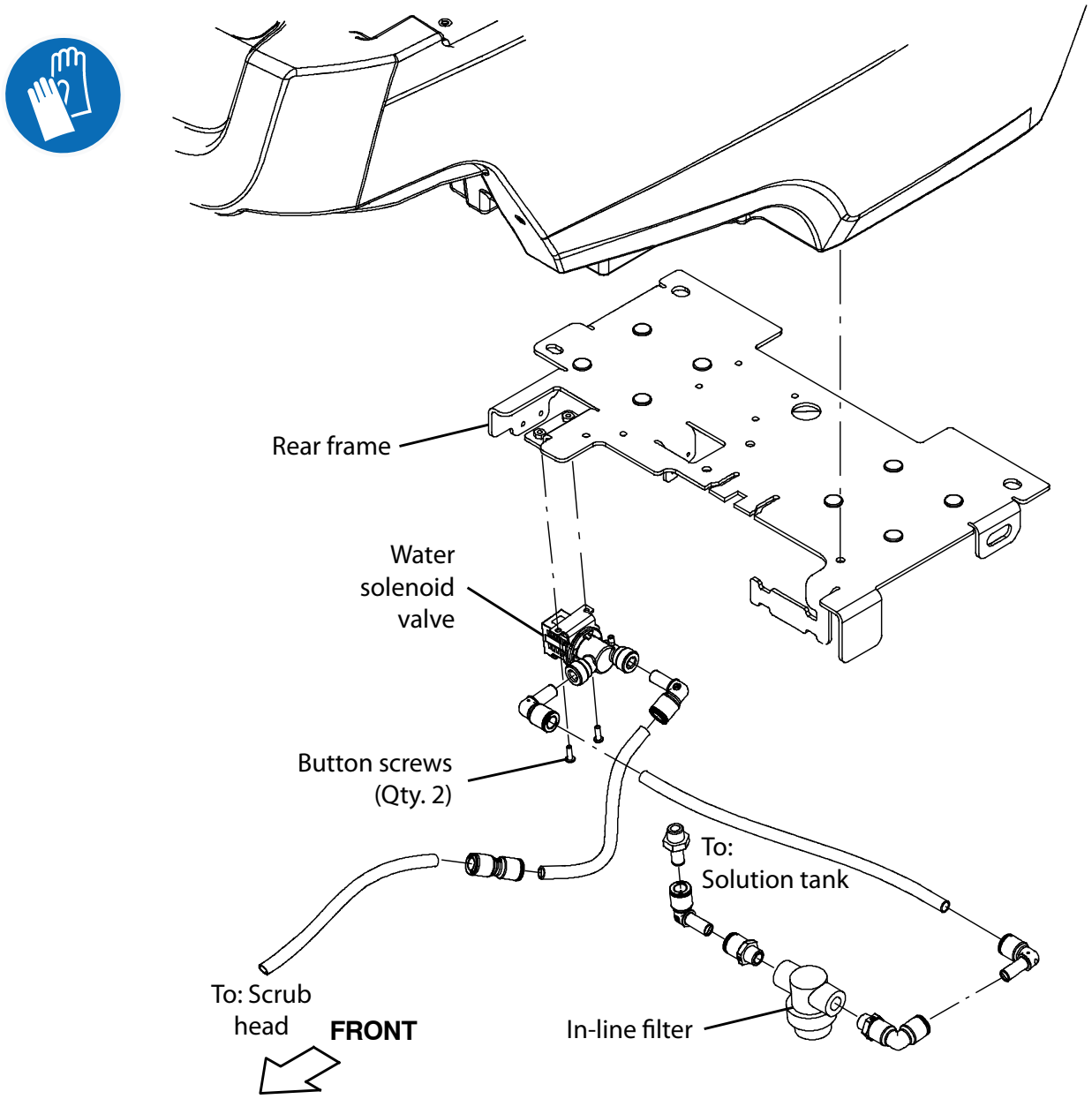


2. Use a stone to clean the commutator and then use compressed air to clean any dust from inside the motor.



3. Reinstall the vacuum fan onto the machine. See REMOVING / INSTALLING THE VACUUM FAN in this section of manual.

REMOVING / INSTALLING THE WATER SOLENOID VALVE



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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain both the recovery tank and the solution tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cables from the batteries.
4. Remove the batteries from the machine and set the batteries aside.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

5. Remove the rear squeegee assembly from the machine. Set the rear squeegee assembly aside and hardware aside.

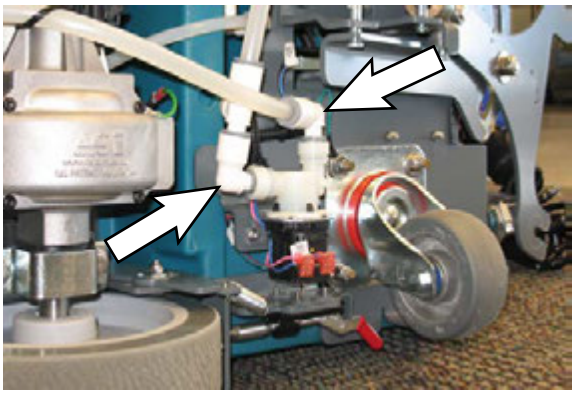
6. Position a protective blanket next to the side of the machine that will be tipped onto the floor.

*NOTE: **Do** **Not** allow the machine to drop when tipping it onto the protective blanket. The scrub head and other components could be damaged if machine is allowed to drop. If necessary, remove the scrub head from the machine before tipping the machine onto its side.*

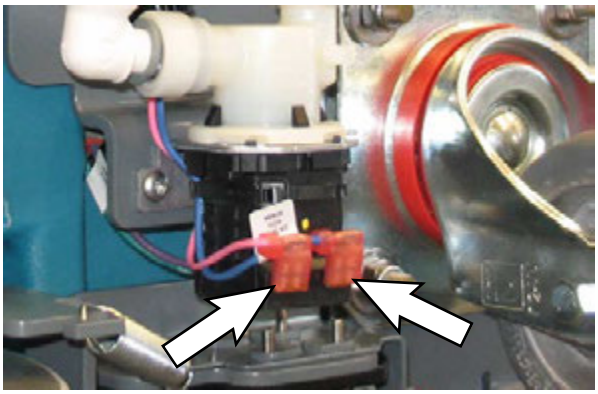
7. Carefully tip the machine onto the protective blanket.

8. Disconnect hoses as necessary to access the transaxle assembly.

9. Disconnect all hoses from the water solenoid valve.



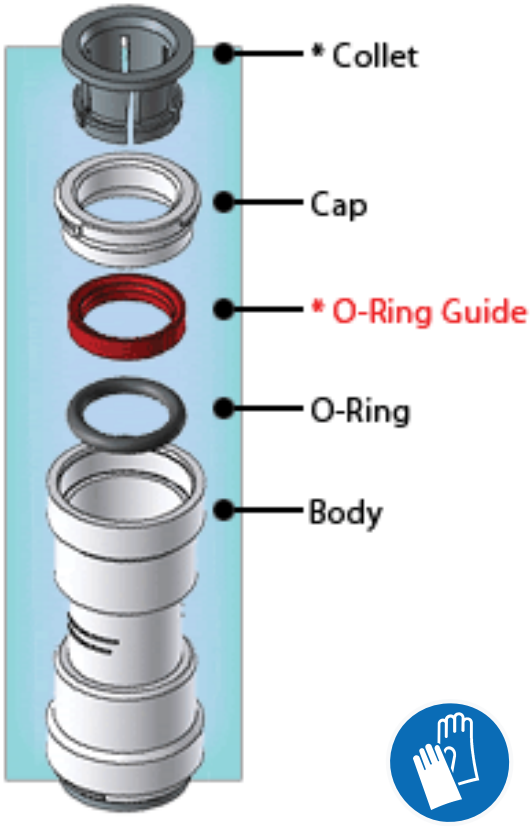
10. Disconnect the main wire harness from the water solenoid valve.



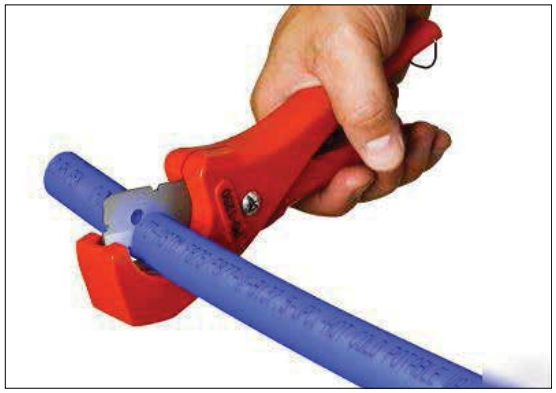
11. Remove the water solenoid valve from the machine.

12. Reinstall the interface module / install the new water solenoid valve in reverse order of disassembly.

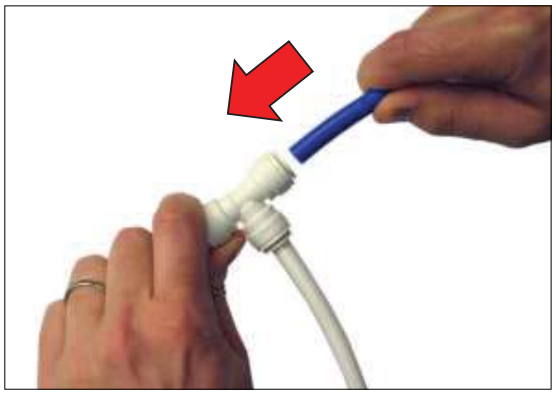
CONNECTING HOSES TO PTC (PUSH-TO-CONNECT) FITTINGS



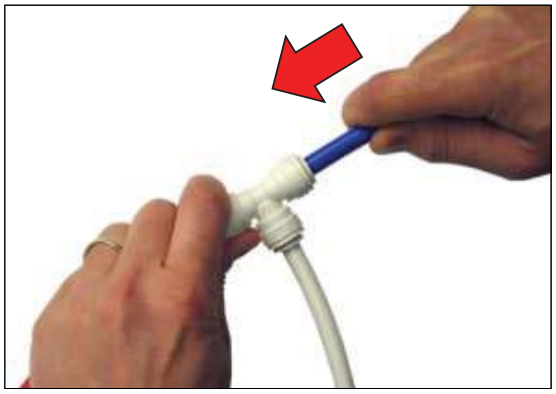
1. Cut the tube square. The outer diameter of the tubing must be free of score marks, burrs, or sharp edges.



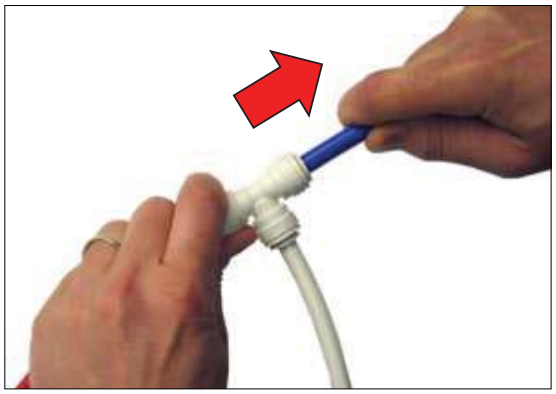
2. Insert tube into the fitting. The fitting will grip the hose before it seals.



3. Push into the tube stop. The stainless steel teeth inside the collet firmly hold the tube in position and the o-ring provides a permanent leak-proof seal.



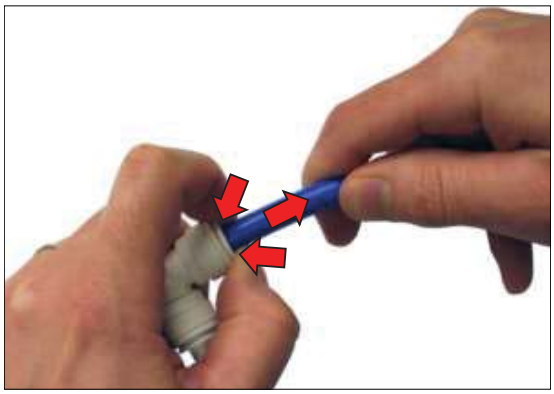
4. Pull on the fitting to ensure the hose connection is secure.



5. Test the fitting / hose connections for leaks prior to leaving the site.

DISCONNECT HOSES FROM PTC (PUSH-TO-CONNECT) FITTINGS

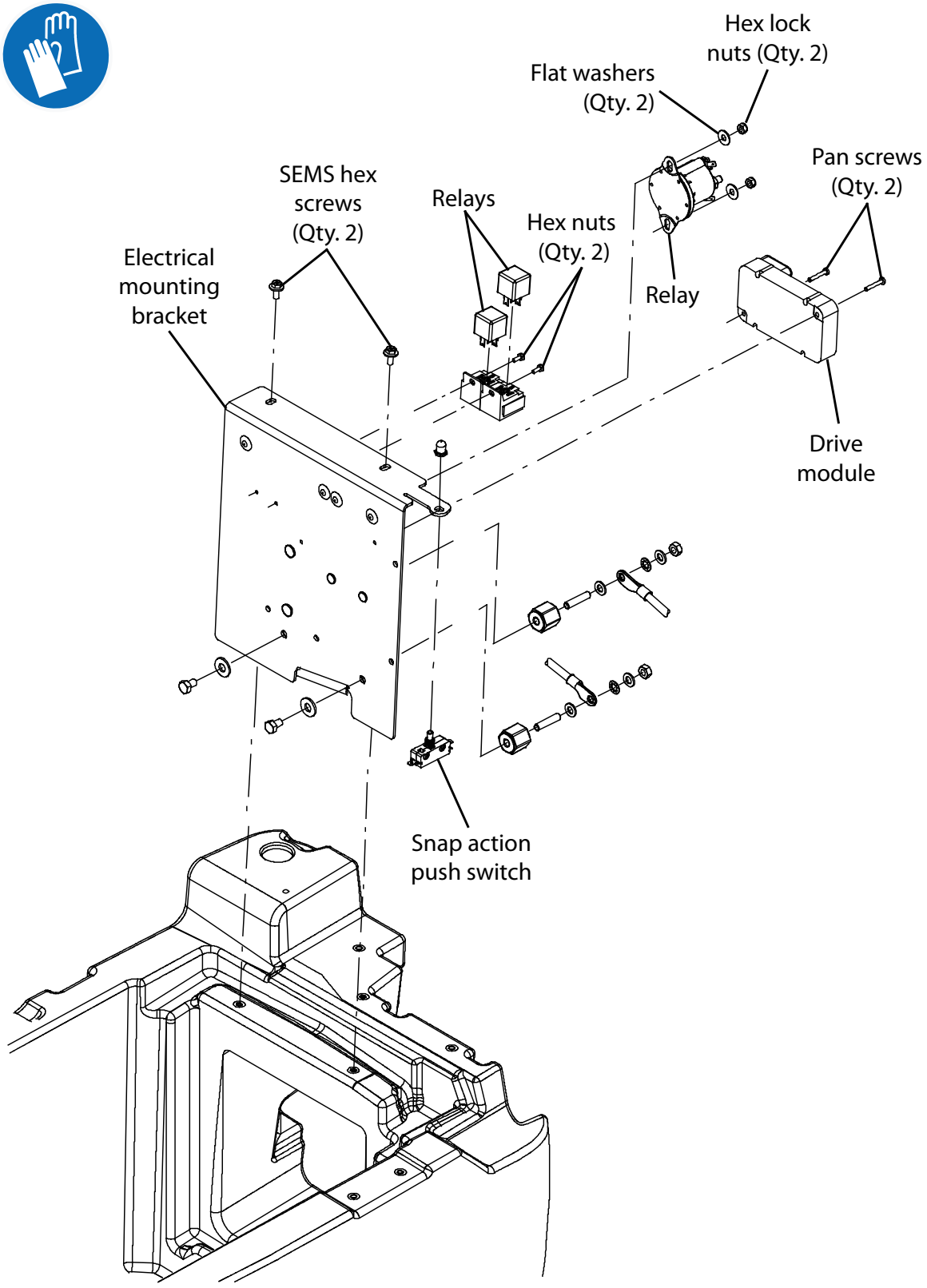
1. Push the collet squarely in against face of fitting to release the hose from the fitting. Continue to hold the collet held in against the fitting and pull the hose from the fitting.



NOTE: Be sure there is no pressure in the system and the system is emptied of all solution before disconnecting hose(s) from the fitting.

CONTROL MODULES

REMOVING / INSTALLING THE ELECTRICAL MOUNTING BRACKET / RELAYS



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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain the recovery tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cables from the batteries.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

4. Remove the hardware securing the electrical mounting bracket to the machine.

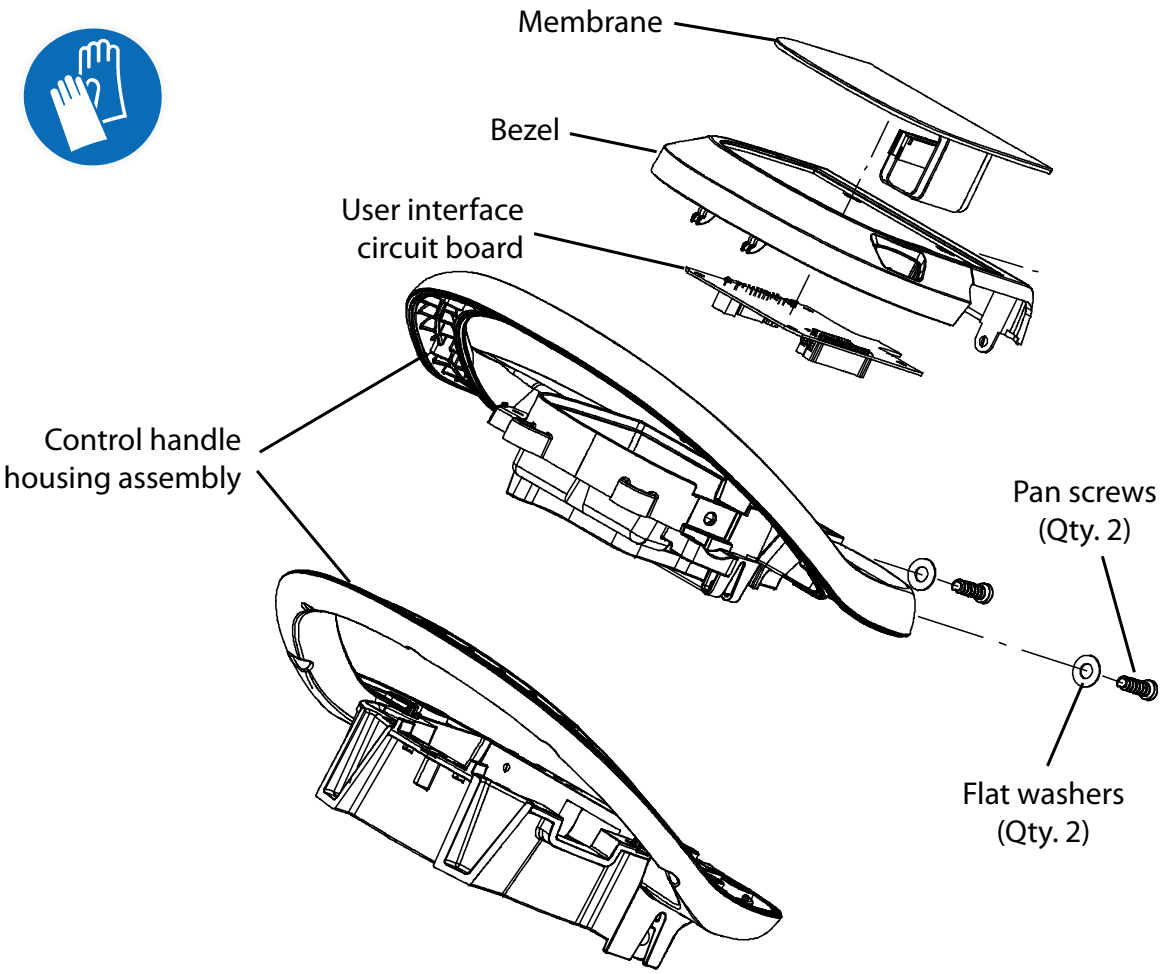
NOTE: To avoid damaging electronic components, a static ground strap must be worn at all times while handling circuit boards / control modules. Attach the other end of the static ground strap to the machine chassis.

5. Carefully pull the electrical mounting bracket away from the machine.

NOTE: If necessary, remove the two rear batteries and / or cut the cable ties securing the shunt / cables to the electrical mounting bracket to ease accessing relays on the electrical mounting bracket.

6. Disconnect cable connections from the relay(s) and / or drive module being replaced.
7. Replace relay(s) and / or drive module as necessary.
8. Connect cable connections to replaced relay(s) and / or drive module.
9. Reinstall the electrical mounting bracket in reverse order of disassembly.

REMOVING / INSTALLING THE INTERFACE MODULE



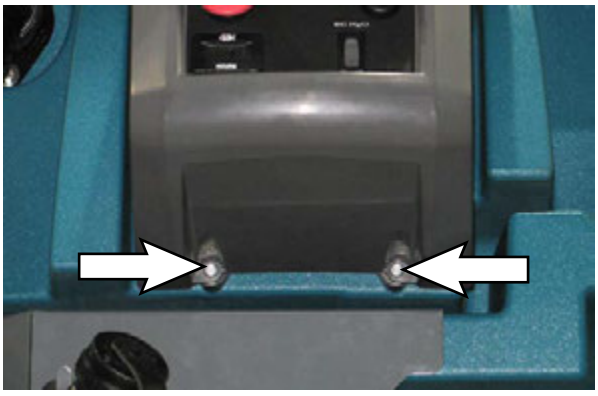
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

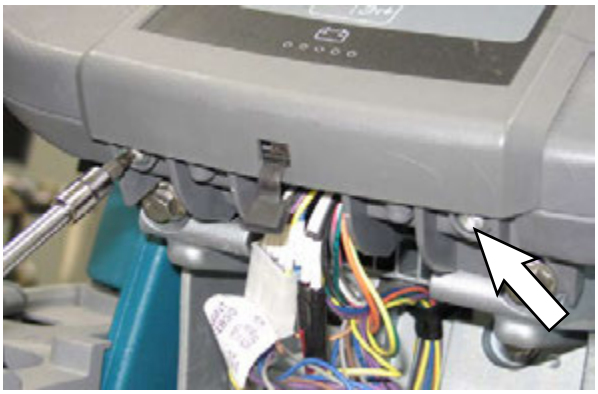
1. Turn the key to the OFF position.
2. Disconnect the battery cables from the batteries.

NOTE: To avoid damaging electronic components, a static ground strap must be worn at all times while handling circuit boards / control modules. Attach the other end of the static ground strap to the machine chassis.

3. Remove the button screws securing the lower console cover to the machine and carefully lower the lower console cover away from the console.



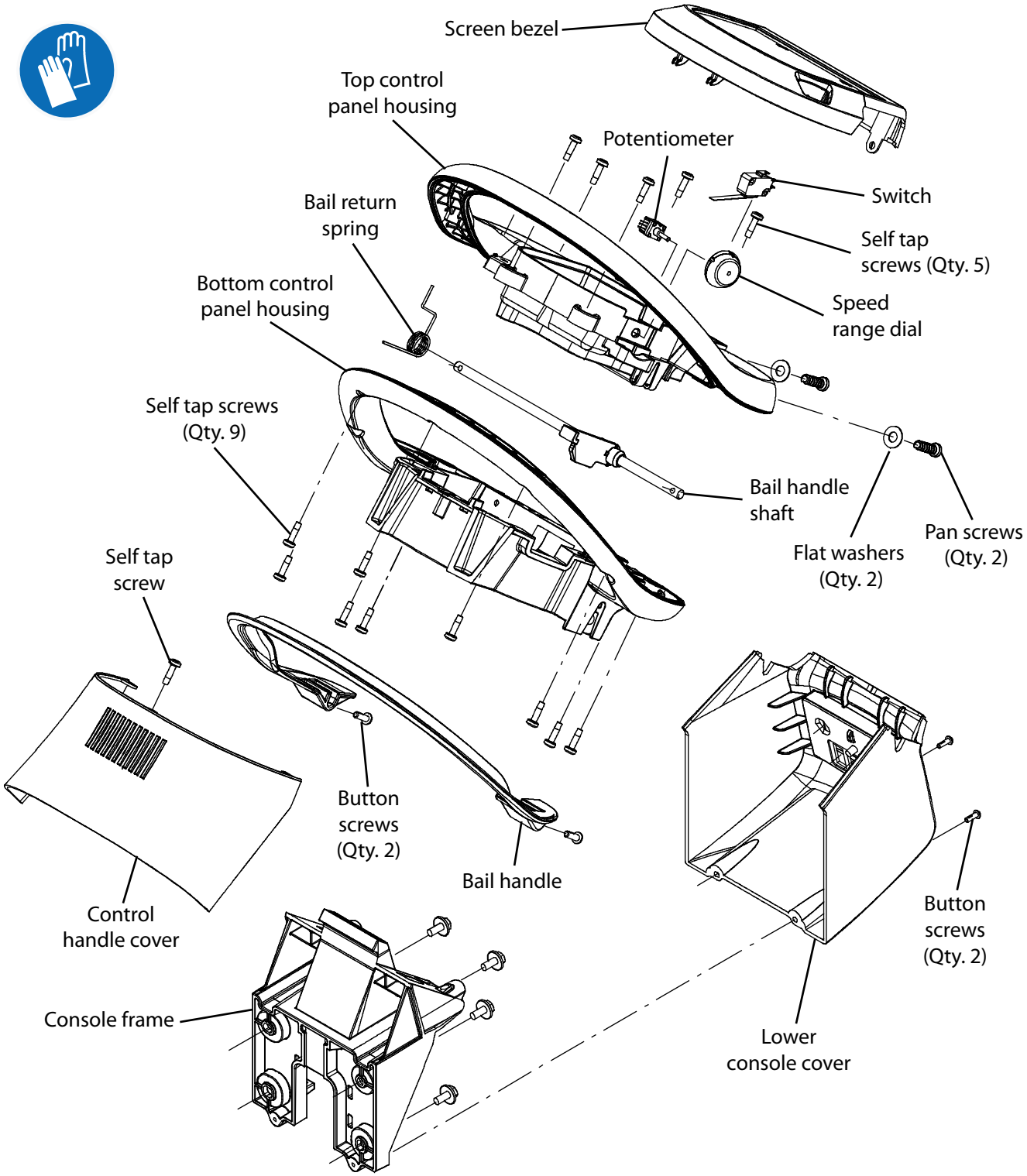
4. Remove the hardware securing the instrument panel to the console.



5. Lift up on the bottom of the panel and slide downward to remove.

6. Disconnect all electrical connections from the interface module.
7. Remove the interface module from the machine.
8. Reinstall the interface module / install the new interface module in reverse order of disassembly.
9. If a new interface module was installed, the new interface module must be programmed for the machine onto which it was installed. See PROGRAMMING A NEW INTERFACE MODULE in this section of the manual.

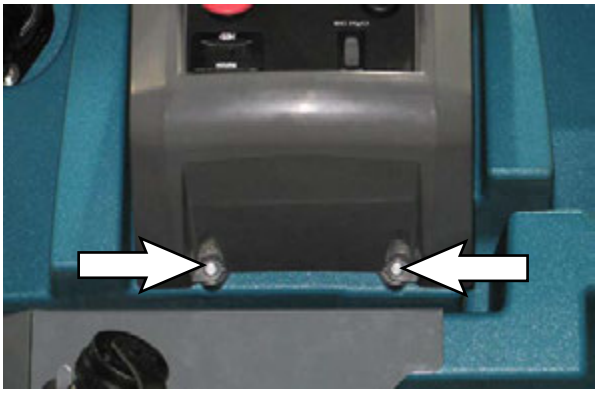
REMOVING / INSTALLING THE BAIL SWITCH, SPEED POTENTIOMETER, OR DIRECTIONAL SWITCH



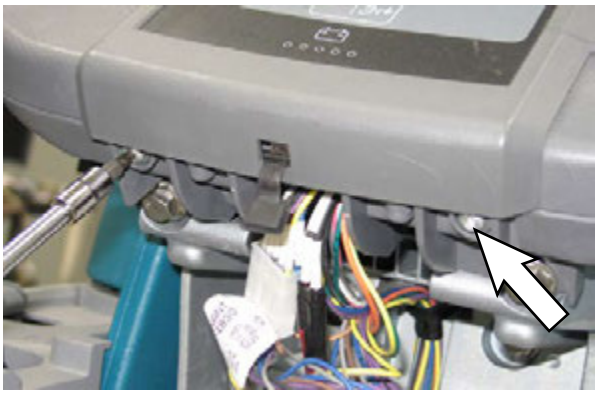
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Turn the key to the OFF position.
2. Disconnect the battery cables from the batteries.
3. Remove the button screws securing the lower console cover to the machine and carefully lower the lower console cover away from the console.



4. Remove the pan screws and flat washers securing the instrument panel to the console.



5. Carefully separate the touch panel from the console.
6. Disconnect all wire harness / electrical connections from the instrument panel. Set the instrument panel aside.
7. Remove the cover from the console.

8. Remove the pan screws securing the operator console to the machine.

9. Lift up and forward to remove the operator console from the machine.

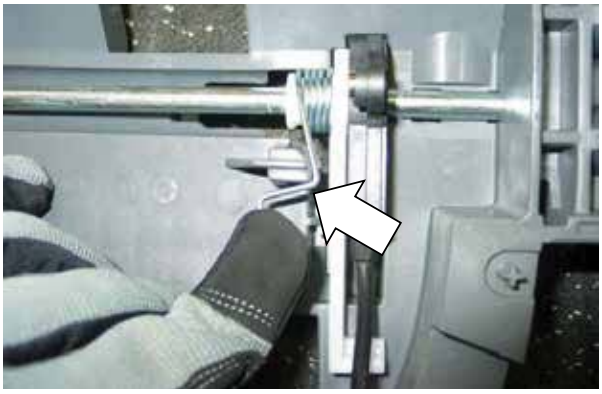
10. Remove the speed range dial and set aside. If replacing the potentiometer or directional switch, remove the nut securing the potentiometer or directional switch.

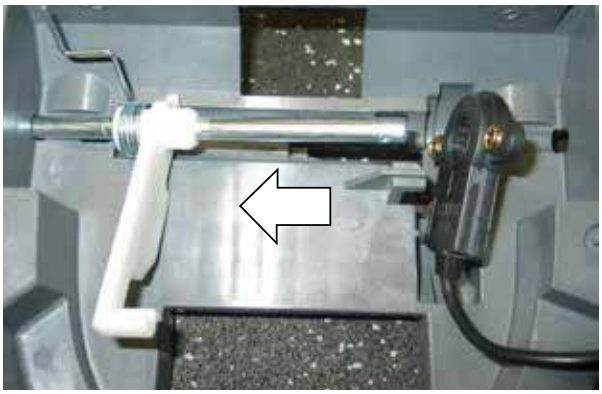
11. Remove the bail handle from the bottom control housing.

12. Remove the self tap screws from the front of the operator console.

13. Remove the self tap screws from rear of the operator console and separate the console assembly.

14. Release the bail return spring, rotate the bail handle shaft toward the bottom of the operator console, and slide the bail handle shaft to the side to remove.

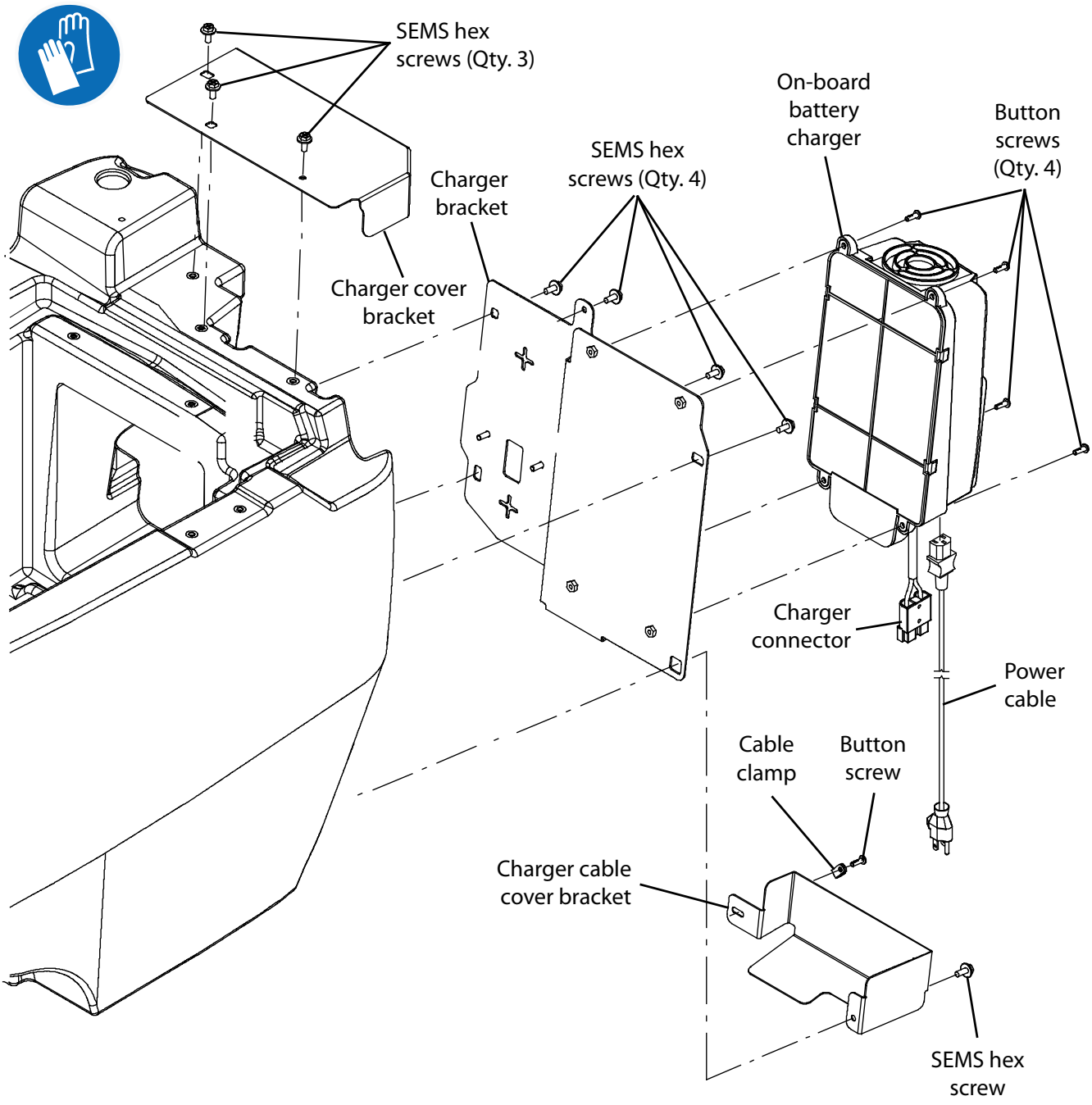




15. Remove the bail switch.

16. Reinstall the bail switch, speed potentiometer, and / or directional switch in the reverse order of disassembly.

REMOVING / INSTALLING THE ON-BOARD BATTERY CHARGER



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

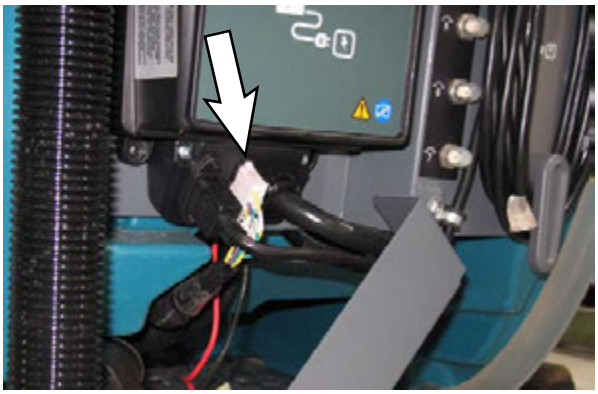
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Turn the key to the OFF position.
2. Disconnect the battery cables from the batteries.

3. Remove the charger cover bracket from the machine.

4. Remove the SEMS hex screw securing the charger cable cover to the machine and position the charger cable cover down away from the on-board charger.

5. Disconnect the cables from the on-board battery charger.



6. Remove the on-board battery charger from the machine.

7. Reinstall the on-board battery / install the new on-board battery in reverse order of disassembly.

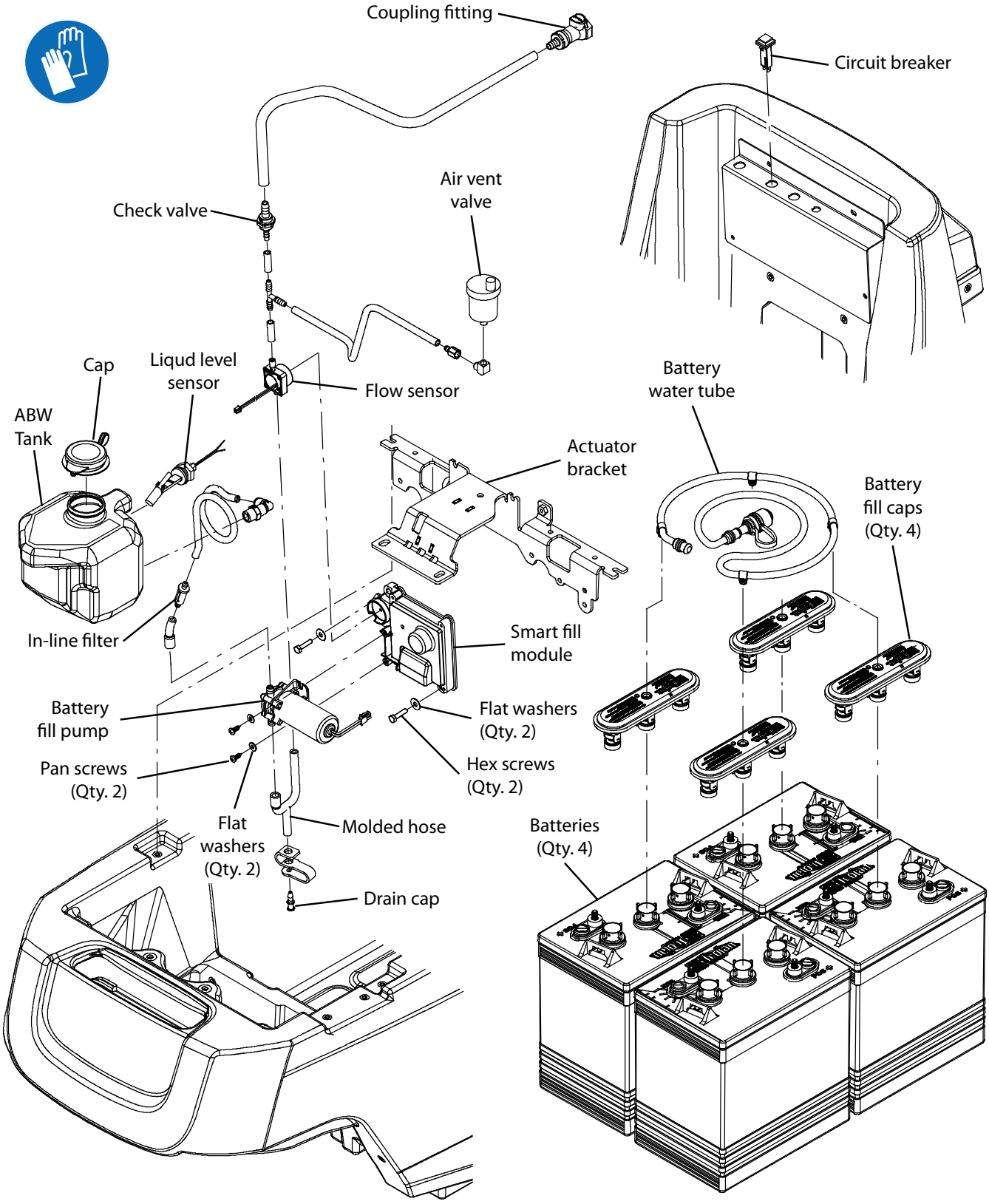
NOTE: The on-board charger can be programmed for multiple battery configurations. This configuration data is stored in the interface module and will automatically configure a replacement battery charger once installed and following a power-up cycle. Reprogramming is required if the interface module has been replaced, or if a different type of battery is used (other than factory-installed equipment). (See SERVICE DIAGNOSTICS TOOL section in this manual)

Machine must be configured through separate configuration software via a mini-USB programming port on the operator console. (See SERVICE DIAGNOSTICS TOOL in this section of the manual)

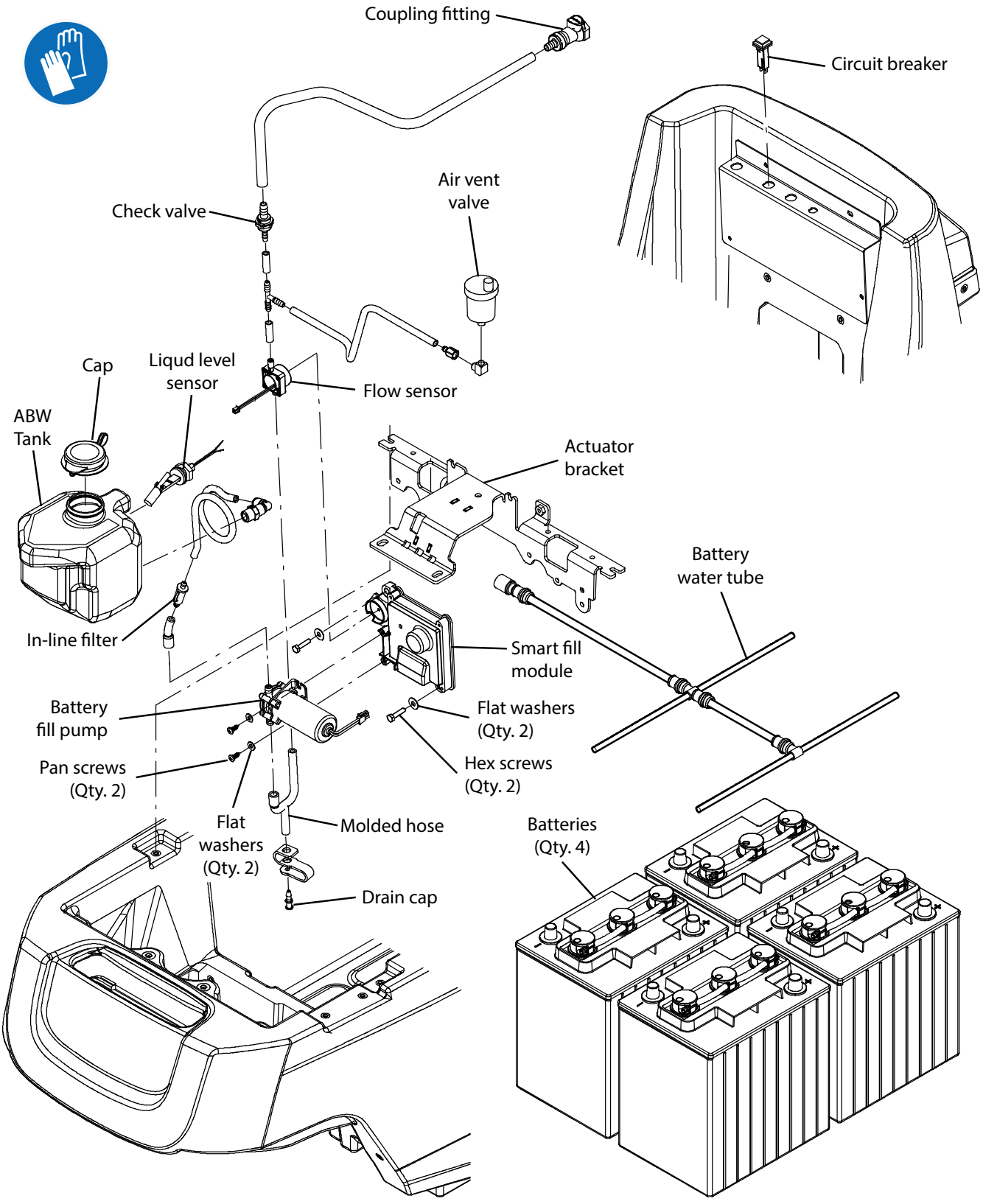
OPTIONS

ABW (AUTOMATIC BATTERY WATERING) SYSTEM MAINTENANCE

TROJAN® BATTERY OPTION



TAB BATTERY OPTION



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

FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

ABW PUMP NOT PRIMING (AIR IN THE SYSTEM)

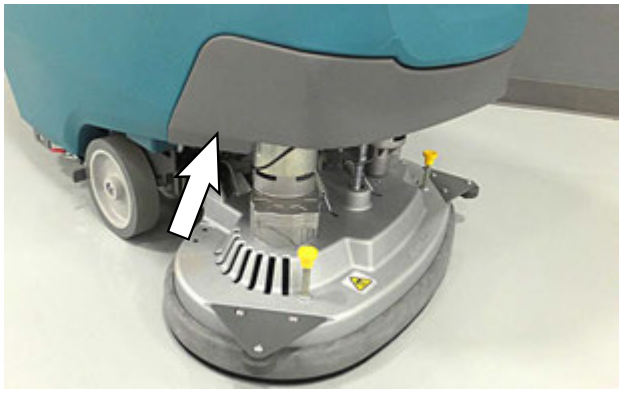
1. Turn the key to the OFF position.
2. Disconnect the hoses at the quick disconnect connector.
3.

4. Turn the key to the ON position.
5. Observe for water to begin pumping out from the hoses.
6. If water is pumping from the hoses, turn the key to the OFF position, reconnect the hoses, turn key to ON position, and observe panel for a fault code.

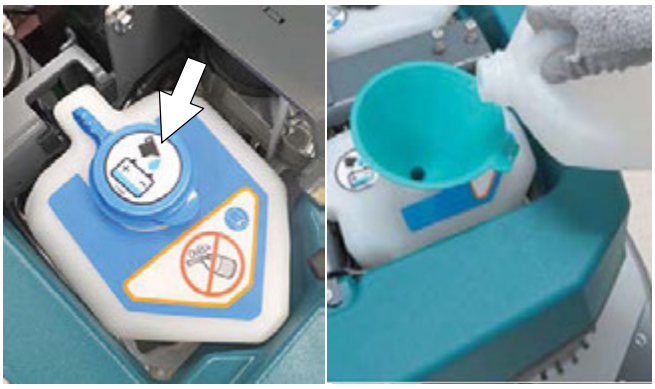
   If there is no fault code, the machine is again ready for use.

   If there is a fault code, proceed to the following steps to eliminate air from the ABW system.

7. Remove the drain cap from the molded hose to purge air from the system. Allow the water to drain until there is a steady stream. The drain cap is located behind the front scrub head cover and directly below the ABW tank.



8. Reinstall the drain cap onto the molded hose.
9. Add distilled water to the battery watering system tank.

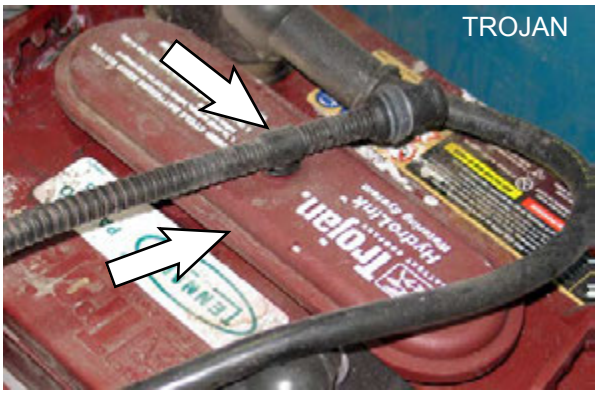


10. Verify pump is functioning and the fault is cleared.

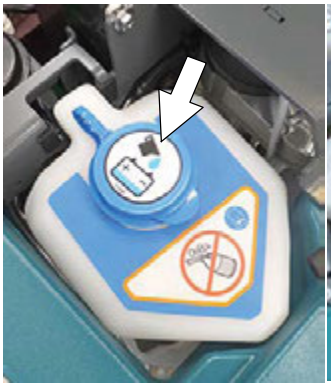
NOTE: If necessary, can also perform freeze protection procedure to start over with an empty tank. See FREEZE PROTECTION in MAINTENANCE section of this manual.

ABW PUMP IS TIMING OUT (1 MINUTE)

1. Turn the key to the OFF position.
2. Check for water / electrolyte residue on top of batteries and in the battery tray.
3. Identify the source of the leaks. Check all ABW system hoses, connections, fittings, and battery caps for leaks / damage. Ensure battery caps are properly tightened.



4. Replace damaged / worn fittings, hoses, and battery caps as necessary.
5. Clean all water / electrolyte from the tops of the batteries and from inside battery tray.
6. Add distilled water to the battery watering system tank.

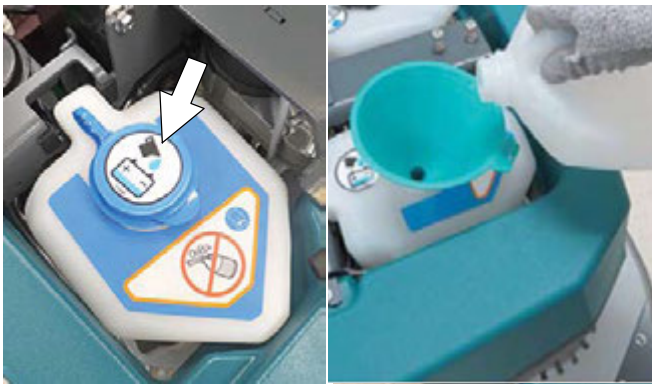


7. Turn the key to the ON position.
8. Verify the ABW pump is functioning and the fault is cleared.

ABW OVERFILLS THE BATTERIES

1. Turn the key to the OFF position.
2. Inspect the tops of the batteries and battery tray for water / electrolyte residue.
3. Ensure all battery vent caps are snuggly tightened.

4. Replace the vent cap if it still leaks after tightening.
5. Clean all water / electrolyte from the tops of the batteries and from inside battery tray.
6. Add distilled water to the battery watering system tank.



7. Turn the key to the ON position.
8. Verify ABW pump is functioning properly and the fault is cleared.

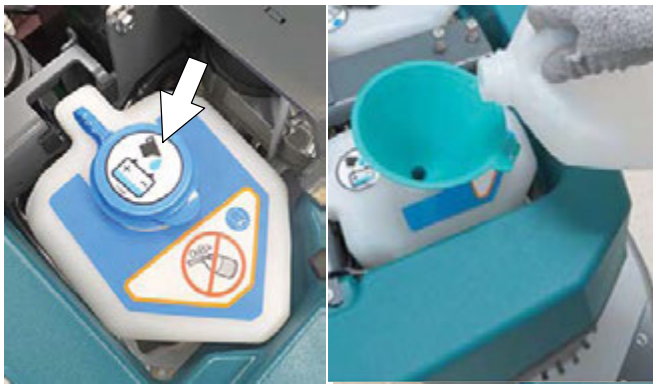
REPLACING THE ABW LIQUID LEVEL SENSOR

1. Turn the key to the OFF position.
2. Disconnect the battery cables from the batteries.
3. Carefully lift the tank from the machine.

4. If necessary empty the solution from the tank.
5. Disconnect the main wire harness from the liquid level sensor.

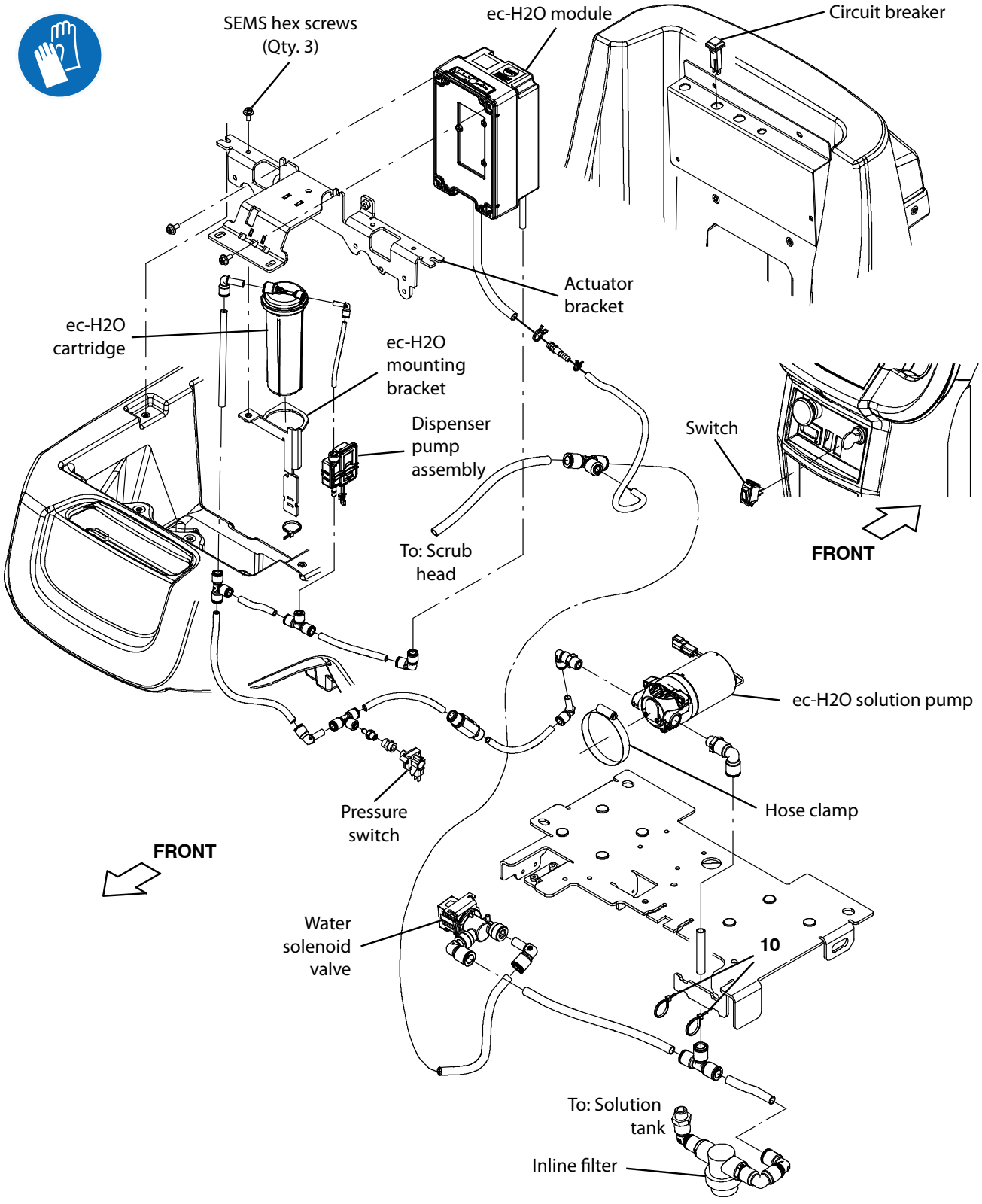
6. Remove the liquid level sensor from the tank.

7. Reinstall the liquid level sensor in reverse order of disassembly.
8. Add distilled water to the battery watering system tank.



9. Reconnect the battery cables to the batteries.
10. Turn the key to the ON position.
11. Verify the fault is cleared.

REMOVING / INSTALLING THE ec-H2O PUMP (OPTION)



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

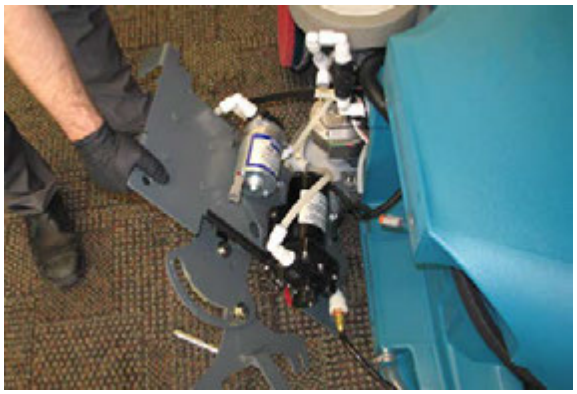
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

1. Completely drain the solution tank and the recovery tank.
2. Turn the key to the OFF position.
3. Disconnect the battery cables from the batteries.
4. Remove the batteries from the machine.

FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries.

5. Remove the rear squeegee assembly from the machine.
6. Position a protective blanket next to the side of the machine that will be tipped onto the floor.
7. Carefully tip the machine onto the protective blanket.
8. Remove the hex screws securing the rear frame to the machine.

9. Carefully pull the rear frame from the machine.



10. Disconnect the main wire harness from the pump.
11. Disconnect all hoses from the pump.
12. Loosen the hose clamp and remove the pump from the rear frame.
13. Reinstall the pump in the reverse order of disassembly.