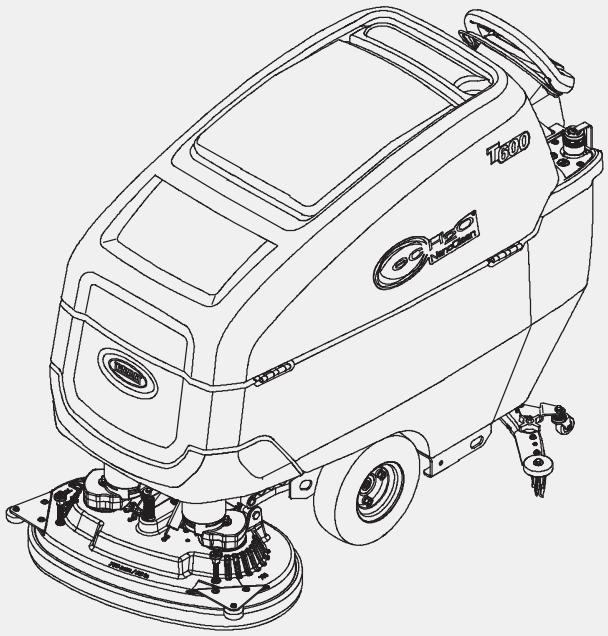
T600 / T600e



Walk Behind Floor Scrubber

English EN
Service Manual

Hygenic® Fully Cleanable Recovery Tank
Tennant*True®* *Parts*
IRIS® a Tennant Technology
Pro-Panel® Controls
Insta-Fit™ Adapter
Smart-Fill™ Automatic Battery Watering

ec H2O® NanoClean

Powered by LITHIUM-ION

For the latest Parts Manuals and other language Operator Manuals, visit:

www.tennantco.com/manuals

9016605
Rev. 02 (01-2022)

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 machine maintenance instructions provided.
- The machine is maintained with manufacturer supplied or equivalent parts.

To view, print or download manuals online visit www.tennantco.com/manuals

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
10400 Clean Street
Eden Prairie, MN 55344-2650
Phone: (800) 553- 8033 or (763) 513- 2850
www.tennantco.com

INTENDED USE

The T600e/T600 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 this manual.

MACHINE DATA

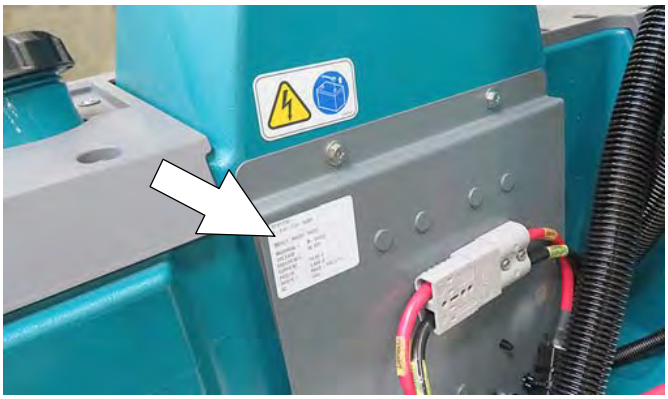
Please fill out at time of installation for future reference.

Model No. - _____

Serial No. - _____

Installation Date - _____

SERIAL NUMBER LABEL 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

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 that could result in severe personal injury or death.

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

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

WARNING: 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.
- **Lead-acid 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 (Option) - 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 not in proper operating condition.
   - With pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.
   - In outdoor areas. This machine is for indoor use only.
   - In areas where flammable vapors/liquids or combustible dusts are present.
   - In areas that are too dark to safely see the controls or operate the machine.
   - In areas with possible falling objects.
2. Before operating machine:
   - Check machine for fluid leaks.
   - Make sure all safety devices are in place and operate properly.
   - Check steering for proper operation.
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.
   - Always be aware of surroundings while operating machine.
   - Drive slowly through doorways and narrow openings.
   - Be cautious of the squeegee near bystanders and obstacles.
   - Do not access the video / help screens while machine is moving (Pro-Panel)

- Do not scrub or transport on inclines that
- exceed 2% grade.
- Follow site safety guidelines concerning wet floors.
- Follow mixing, handling and disposal instructions on chemical containers.
- Do not carry passengers on any part of the 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.
- Park machine on level surface when filling solution tank with auto-fill feature.

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

5. When servicing machine:
   - Disconnect battery connection and charger cord before working on machine.
   - Do not pull on battery charger cord to unplug. Grasp plug at outlet and pull.
   - 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.
   - Do not push or tow the machine without an operator controlling the machine.
   - Do not push the machine on inclines with brake disabled.
   - 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.
   - Do not plug in charger if prongs are wet.
   - Open recovery tank to vent batteries if temperature is above 80°F/27°C when charging batteries.
   - Keep work area well ventilated.
   - Avoid contact with battery acid.
   - Always follow site safety rules when disposing battery compartment liquid.
   - Follow site safety rules concerning battery removal.
   - Keep all metal objects off batteries.
   - Use a non-conductive battery removal device.
   - 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.

For Safety: wear protective gloves.

For Safety: wear eye protection.

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.
   - Do not drive on a slippery ramp.
   - Use caution when operating on ramp.
   - 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.
   - Block machine wheels.
   - Use tie-down straps to secure machine.

7. When using Lithium- ion Battery Model:
   - Battery service to be performed by Tennant Service only.
   - Battery installation requires a specific service kit which includes a hoisting strap and proper lifting instructions Contact Tennant Service.
   - Do not attempt to lift battery by hand or by any other unauthorized method.

SAFETY PRECAUTIONS

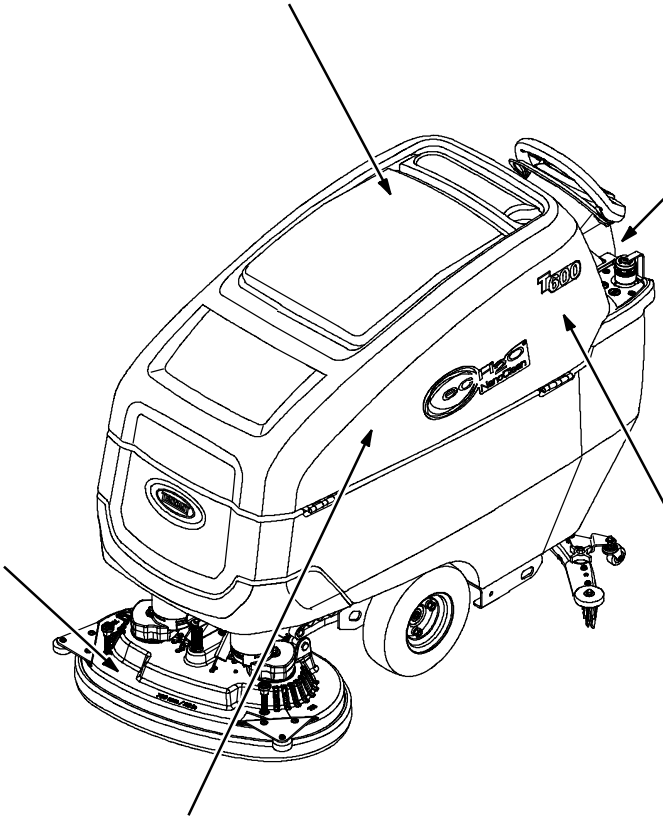
- Battery pack is designed exclusively for specific Tennant machine applications. Do not install battery pack in unapproved machines.
- Dispose of battery in accordance with local regulations. Contact Tennant Service.
- Contact Tennant Service or your local regulatory authorities for proper transporting instructions of lithium- ion batteries.
- Disconnect battery cable connector, battery management system (BMS) connector and charger cord before working on machine.
- Use only OEM approved battery charger supplied with lithium- ion battery.
- Do not expose battery to temperatures below -22°F (-30°C), above 140°F (60°C).
- Do not use machine immediately after long-term extreme temperature storage. Before use, return battery module temperature range to 50°F (10°C)~95°F (35°C).
- Do not operate or store battery in hazardous environment (electrically charged, humidity, extreme temperatures and magnetic fields).
- Do not expose battery to flame or plasma.
- Do not disassemble or mistreat battery. Do not tear seal tape or will void warranty.
- Do not drop, crush or subject battery to impact, as it may cause battery to heat up or catch fire.
- Do not put battery in fire or water to avoid battery explosion.
- Do not touch battery with wet hand, avoid electric shock.
- Stop using or charging the battery immediately if battery has abnormal temperature, leakage or other abnormal conditions.

The following safety labels are mounted on the machine in the locations indicated. Replace damaged / missing labels.

WARNING LABEL - Located on recovery tank cover.

WARNING LABEL - Spinning brush. Keep hands away.

Located on scrub head.

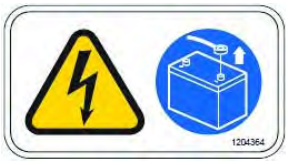


FOR SAFETY LABEL - Read manual. Battery compartment drain hose. Avoid contact with battery acid.

Located above battery compartment drain hose.

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 above battery cable connectors.

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

Located near control console.

FOR SAFETY LABEL - Do not power spray or hose off machine. Electrical malfunction may occur.

Located on control console

FOR SAFETY LABEL - Read manual before operating machine.

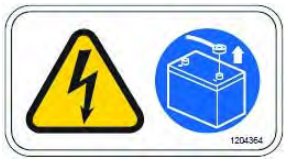
Located near control console.

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

Located near solution tank fill-port.

FOR SAFETY LABEL - Read manual. Battery compartment drain hose. Avoid contact with battery acid.

Located above battery compartment drain hose.



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

Located above battery cable connectors.

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 control console and bottom side of recovery tank.

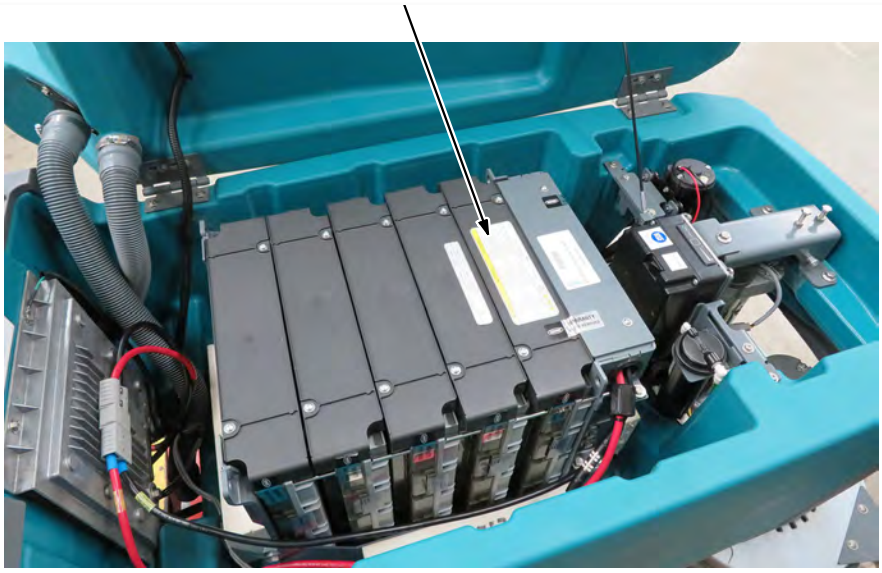
WARNING LABEL - Do not charge batteries with damaged cord. Electric shock can result. Disconnect charger cord before servicing.

Located on control console.

Lithium- ion Battery Model: The safety label appears on the lithium- ion battery pack in the location indicated. Replace damaged labels.

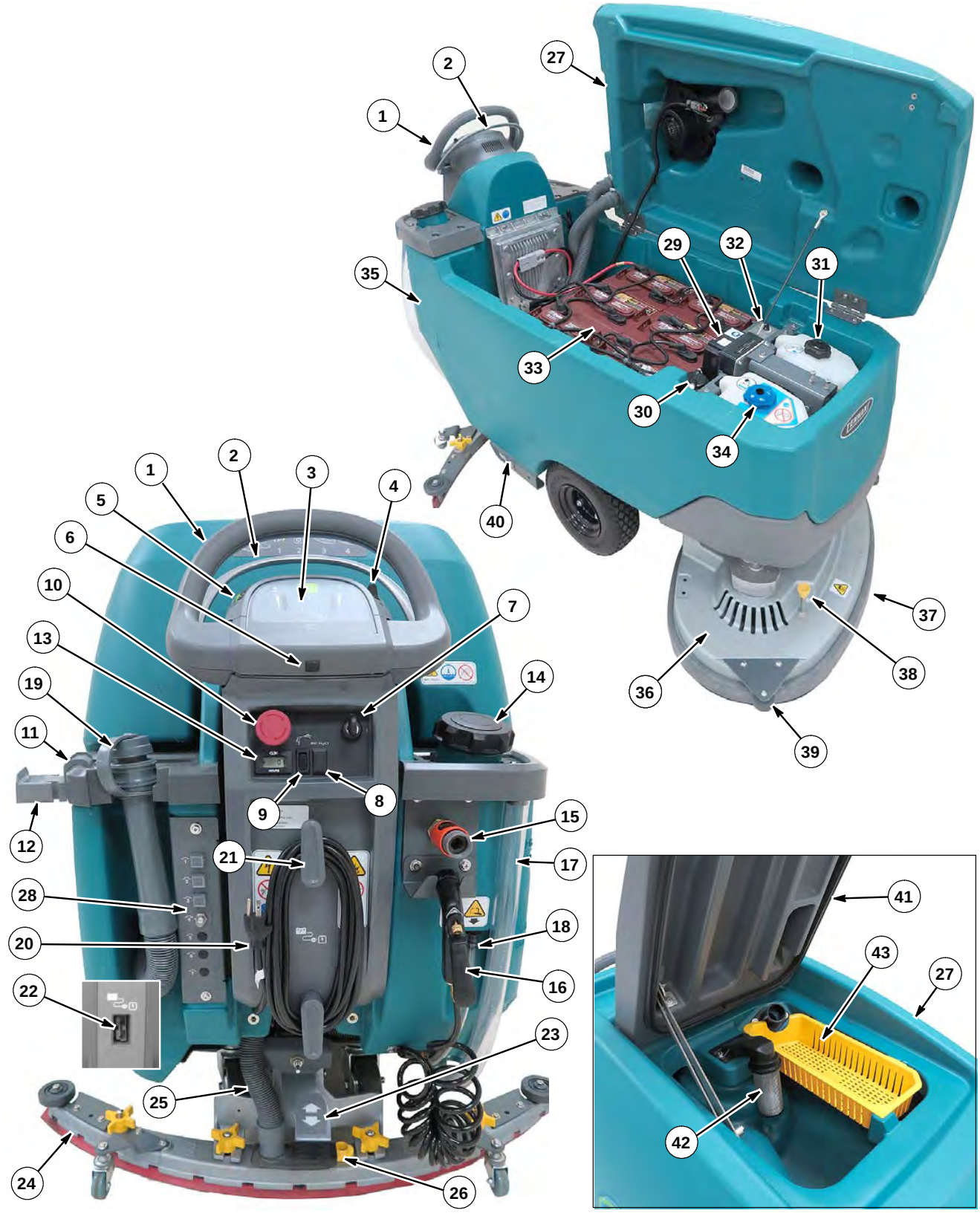
LITHUIM BATTERY CAUTION LABEL - Located on top of battery pack.

⚠ CAUTION	⚠ ATTENTION	⚠ ATENCIÓN
1. Do not expose battery to temperatures below -30° C(-22°F), above 60°C (140°F). 2. Do not disassemble or mistreat battery. Do not crush. 3. Do not drop or subject it to impact. 4. Use only OEM approved charger. 5. Failure to follow these instructions may present risk of explosion, fire, or high temperatures. 6. See owner's manual for additional safety instructions. 7. Recommended torque for stud assembly is; M8 = 9.1Nm / M12 = 24.5Nm. 8. Refer to owner's manual for lifting instructions. 9. Service by Tennant Personnel only.	1. No exponga la batería a temperaturas por debajo de-30 ° C(-22°F), por encima de 60 ° C (140 ° F). 2. No desarmar ni maltratar la batería. No la aplaste. 3. No deje caer ni la someta a impactos. 4. Use sólo el cargador Original aprobado. 5. El incumplimiento de estas instrucciones puede presentar riesgo de explosión, fuego o altas temperaturas. 6. Véase el manual del propietario para instrucciones adicionales de seguridad. 7. El par recomendado de apriete para el poste es de; M8 - 9.1Nm / M12 = 24.5Nm. 8. Consulte el manual del propietario para las instrucciones de elevación. 9. Servicio por técnicos de Tennant exclusivamente.	1. N'exposez pas la batterie à des températures inférieures à -30 ° C (supérieures à 60 ° C). 2. Ne pas démonter ni maltraiter la batterie. Ne pas écraser. 3. Ne la laissez pas tomber et ne la soumettez pas à un impact. 4. Utilisez uniquement un chargeur approuvé par l'OEM. 5. Le non-respect de ces instructions peut présenter un risque d'explosion, d'incendie ou de températures élevées. 6. Voir le manuel du propriétaire pour les consignes de sécurité supplémentaires. 7. Le couple recommandé pour le montage des goujons est de; M8 - 9.1Nm / M12 = 24,5 Nm. 8. Reportez-vous au manuel du propriétaire pour les instructions de levage. 9. Service réservé au personnel Tennant.
c UL us LISTED Tennant Co File Number: MH63465		Battery Disposal contact Tennant Technical Service 1-800-553-8033 1247721



GENERAL INFORMATION

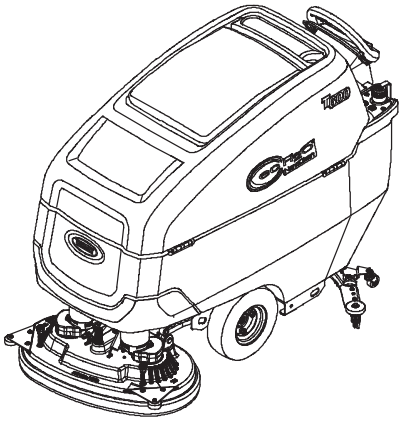
COMPONENT LOCATOR



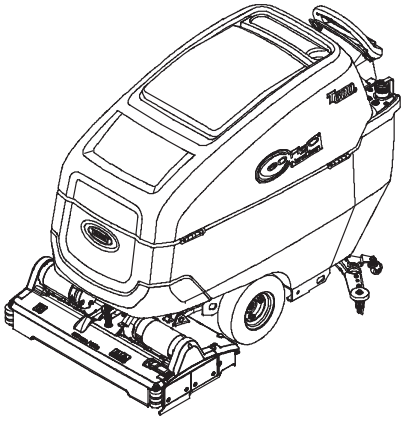
MACHINE COMPONENTS

1. Control handle
2. Variable speed control start bail
3. Control panel
4. Directional lever
5. Speed control dial
6. USB port (Service only)
7. Key switch
8. ec-H2O on/off switch (option)
9. Spray nozzle on/off switch (T600 option)
10. Emergency shut-off button
11. Accessory rails
12. Accessory rail clip (option)
13. Hour meter
14. Solution tank fill port
15. Solution tank auto-fill hose port (option)
16. Tank rinse out spray nozzle (T600 option)
17. Solution tank level/drain hose
18. Battery compartment drain hose
19. Recovery tank drain hose
20. On-board battery charger cord
21. On-board battery charger cord hooks
22. Off-board battery charger receptacle (off-board battery charger model)
23. Squeegee lower/lift foot pedal
24. Squeegee assembly
25. Squeegee vacuum hose
26. Squeegee debris/drip tray
27. Recovery tank
28. Circuit breaker panel
29. ec-H2O module (option)
30. ec-H2O water conditioning cartridge
31. Severe environment detergent tank (T600 ec-H2O option)
32. Detergent mixing ratio knob (T600 Severe environment option)
33. Battery compartment
34. Automatic battery watering tank (option)
35. Solution tank
36. Scrub head
37. Scrub head skirt
38. Pad release plunger
39. Wall rollers
40. Transport tie-down bracket
41. Recovery tank lid
42. Recovery tank float shut-off screen
43. Recovery tank debris tray

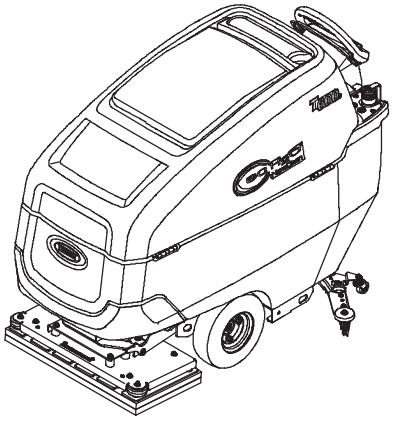
SCRUB HEAD TYPES



28 in / 700 mm Dual Disk
32 in / 800 mm Dual Disk
36 in / 900 mm Dual Disk

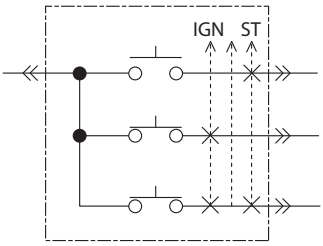


28 in / 700 mm Cylindrical Brush
32 in / 800 mm Cylindrical Brush

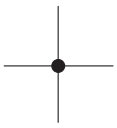


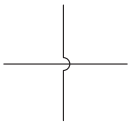
28 in / 700 mm Orbital Pad

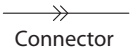
ELECTRICAL SCHEMATIC SYMBOLS



Key Switch


Connected


Not Connected


Connector


Energized


Adaptor Harness


Notes


Assembly


AC Plug

Capacitor

Battery

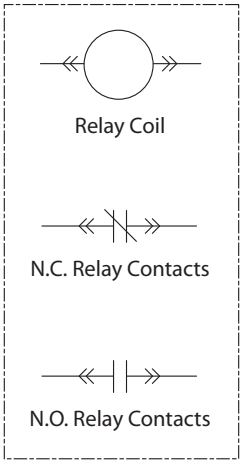

Circuit Breaker

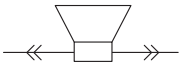

Fuse

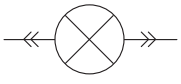

Diode

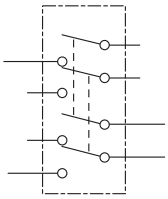

Single Continuation Tab

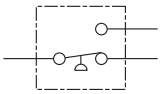

Double Continuation Tab

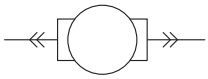


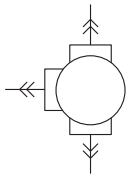

Horn or Alarm

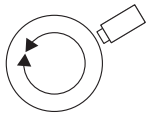

Light


DPDT Switch


Pressure Switch

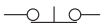

Motor


3 Phase AC
Induction Motor


Motor Encoder


Sensor
(Variable Resistor)


Momenary Switch N.O.

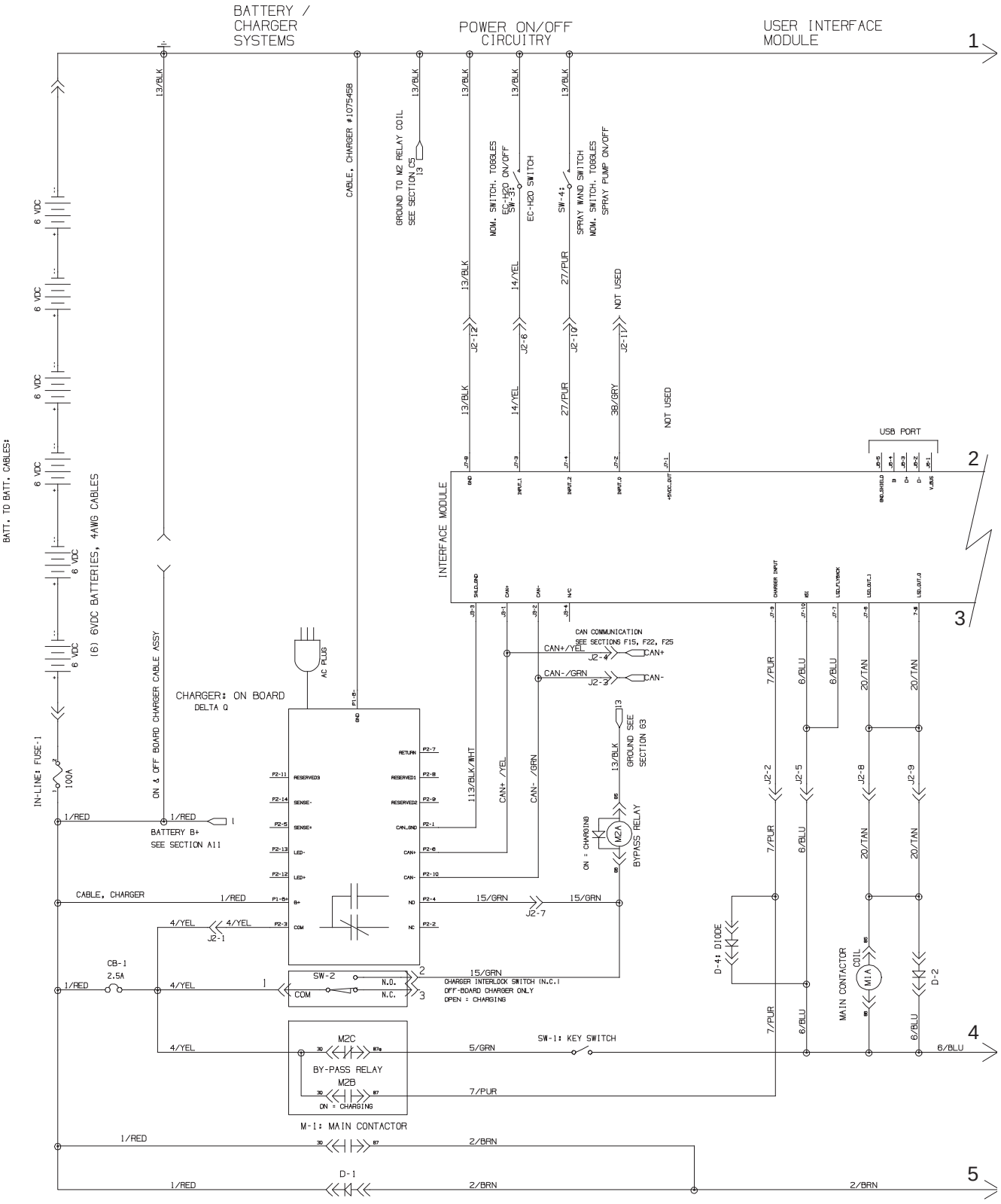

Contact Switch N.C.


Solenoid Valve

ELECTRICAL DIAGRAM T600 - PAGE 1 OF 10

WET LEAD ACID BATTERY DIAGRAM

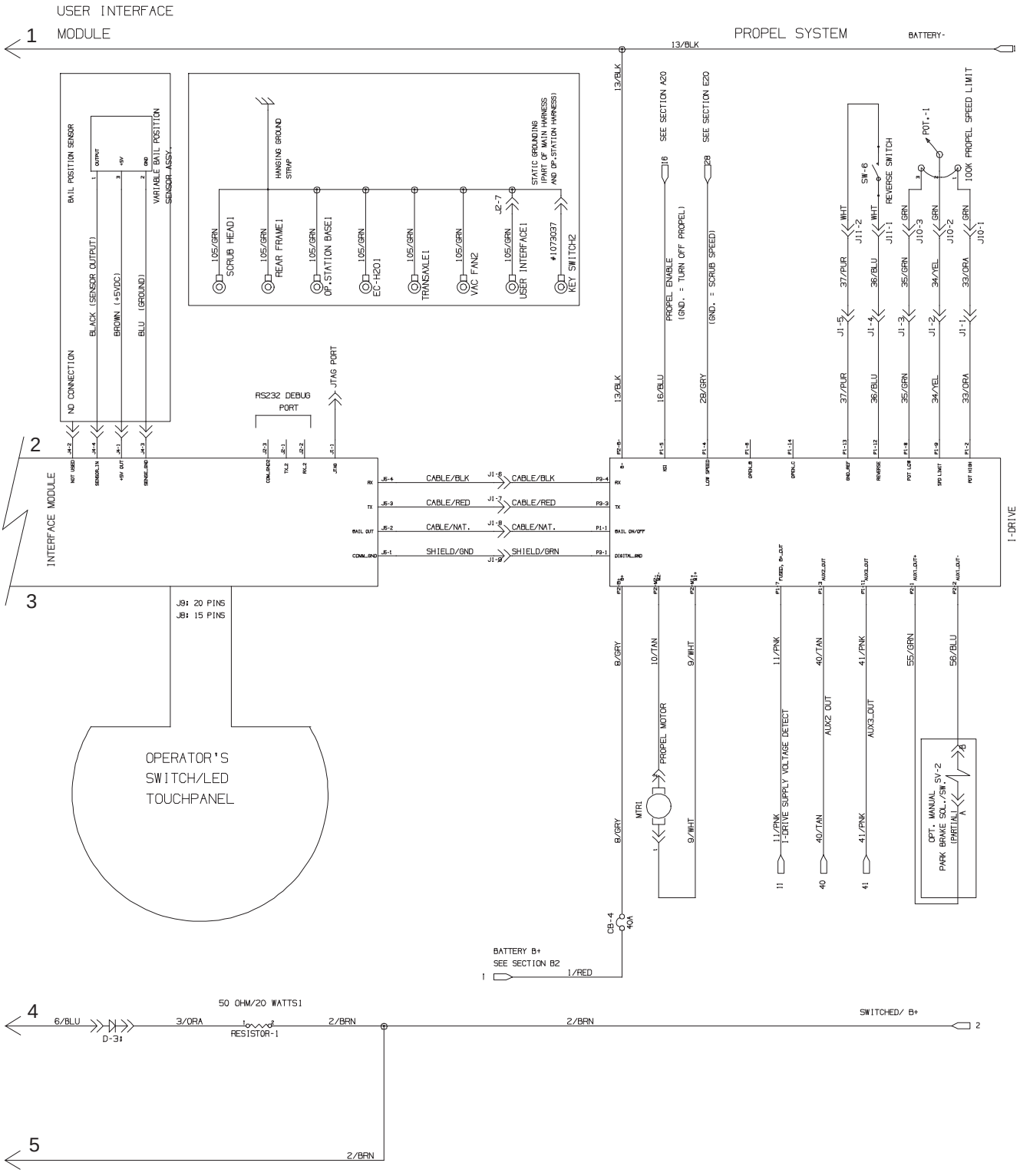
1076325_01



ELECTRICAL DIAGRAM T600 - PAGE 2 OF 10

WET LEAD ACID BATTERY DIAGRAM - Cont'd

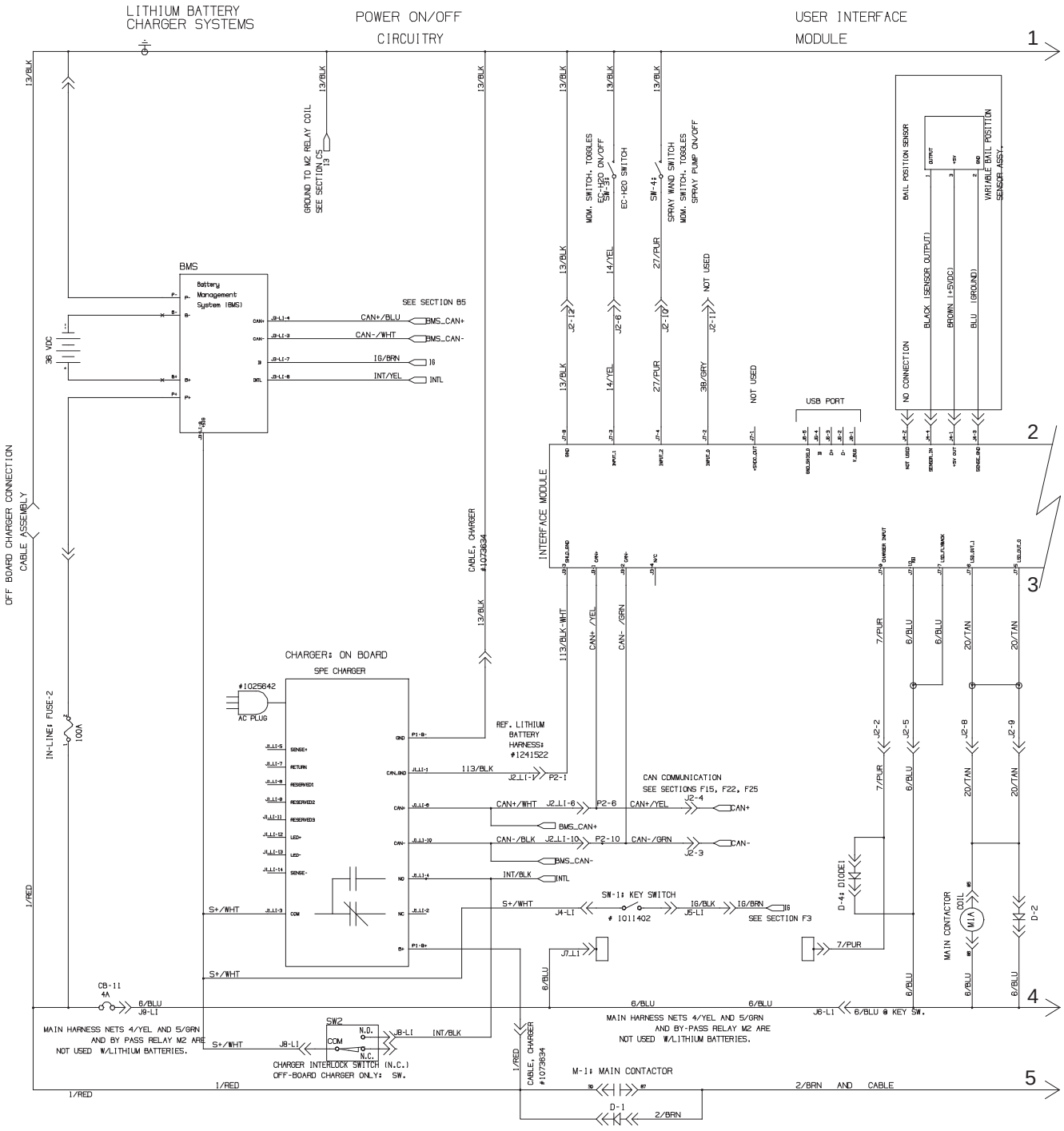
1076325_01



ELECTRICAL DIAGRAM T600 - PAGE 3 OF 10

1076325_01

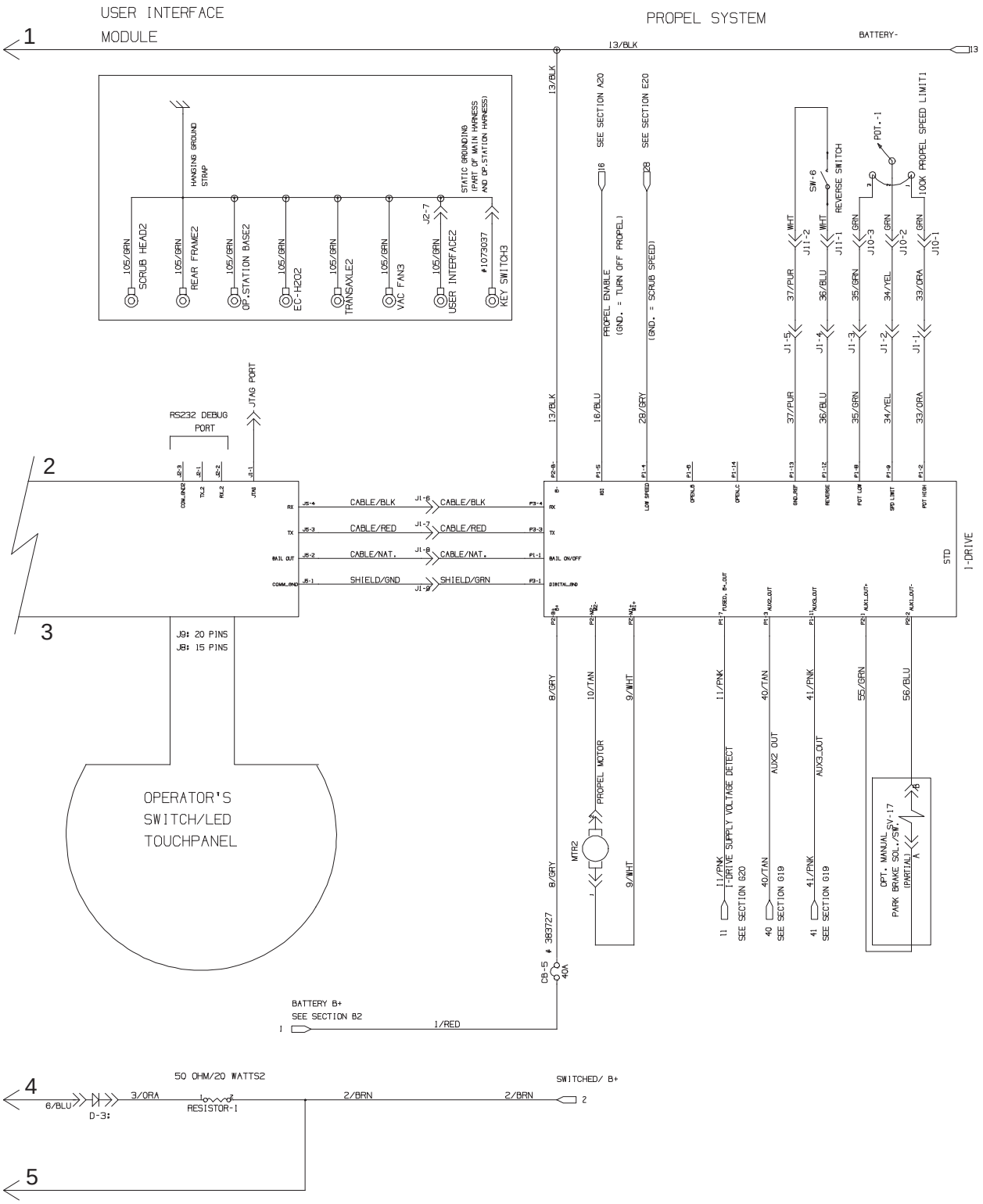
LITHIUM ION BATTERY DIAGRAM



ELECTRICAL DIAGRAM T600 - PAGE 4 OF 10

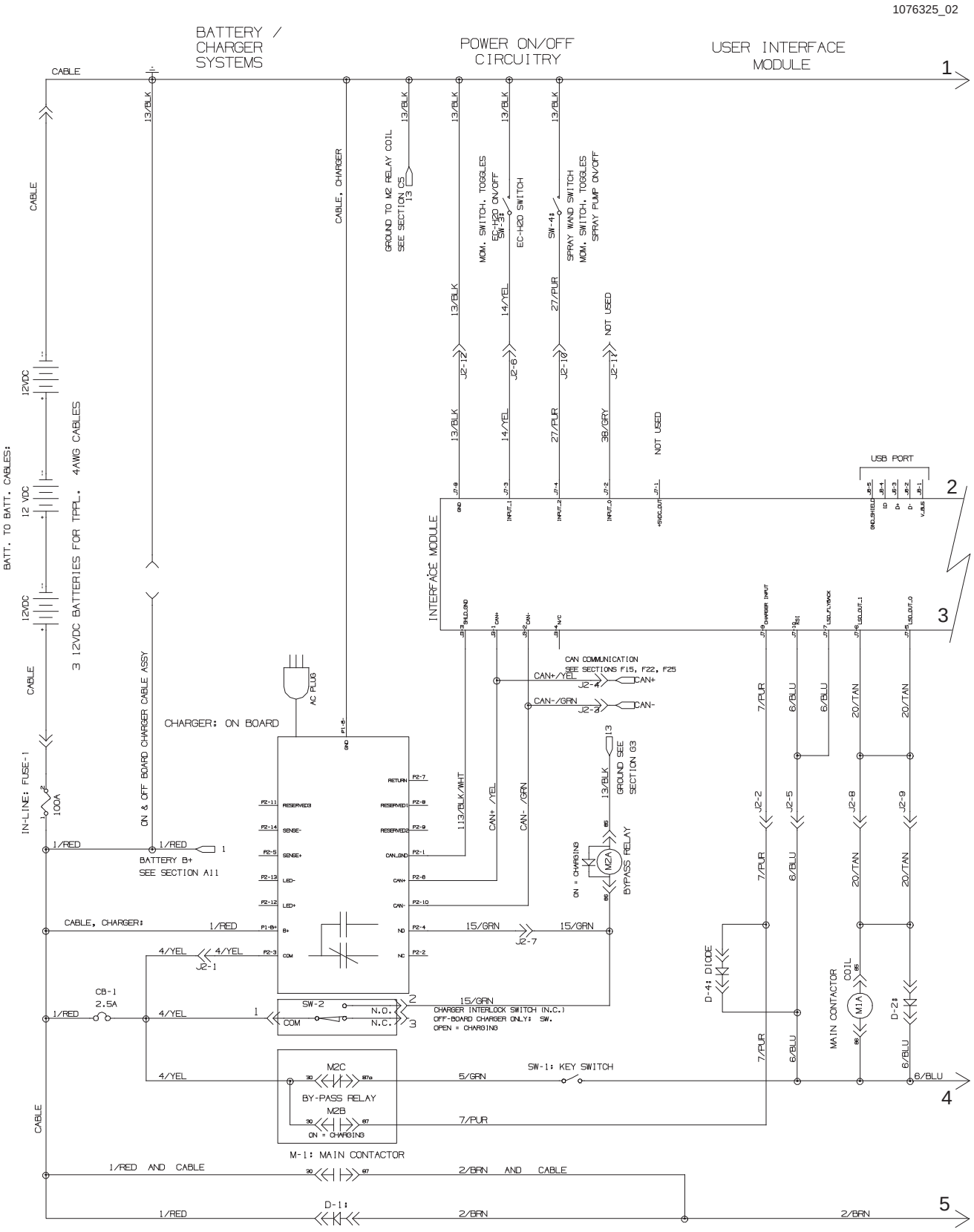
LITHIUM ION BATTERY DIAGRAM - Cont'd

1076325_01



ELECTRICAL DIAGRAM T600 - PAGE 5 OF 10

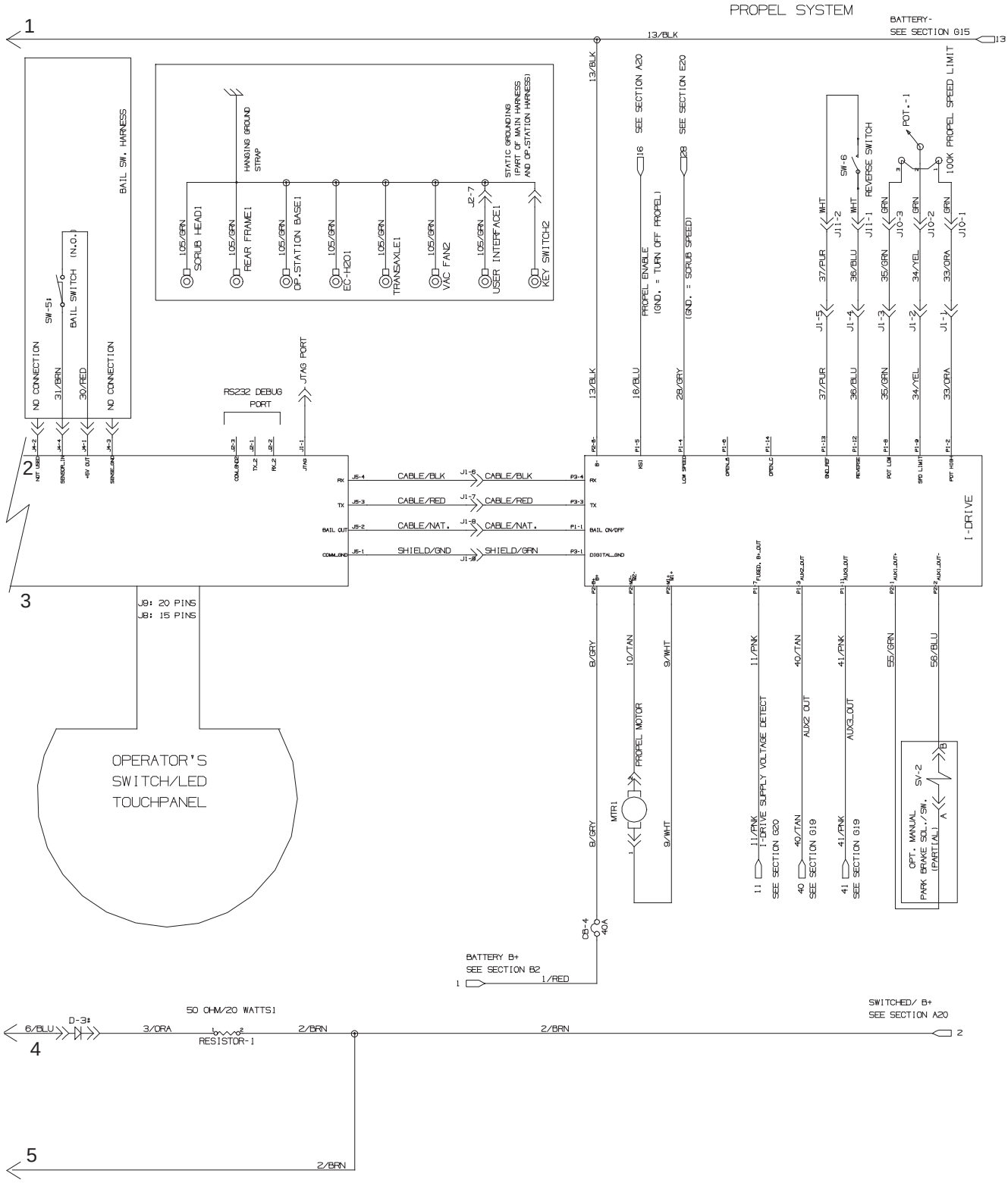
TPPL BATTERY DIAGRAM



ELECTRICAL DIAGRAM T600 - PAGE 6 OF 10

TPPL BATTERY DIAGRAM - Cont'd

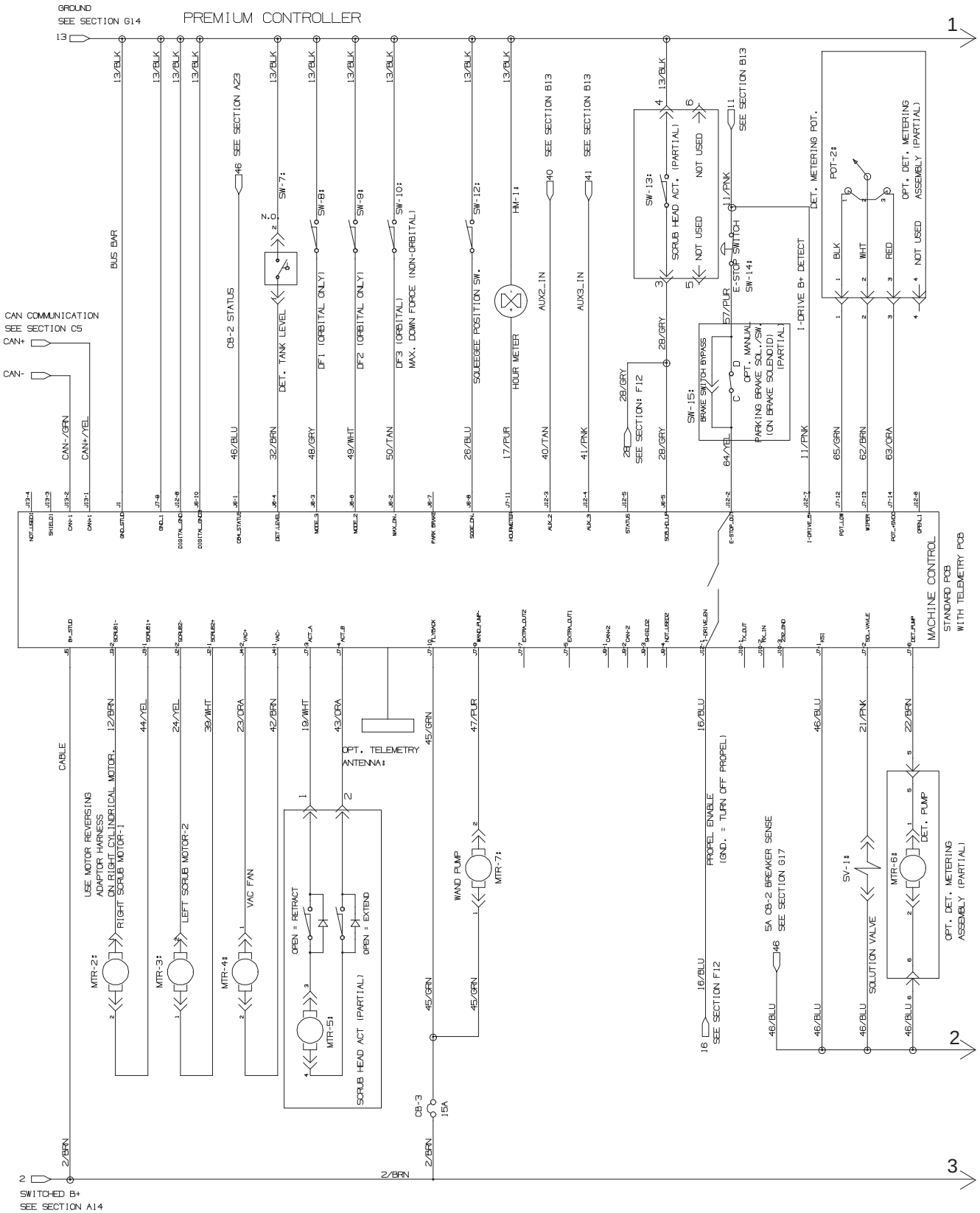
1076325_02



ELECTRICAL DIAGRAM T600 - PAGE 7 OF 10 (S/N 11011872-)

ec- H2O & ABW OPTION

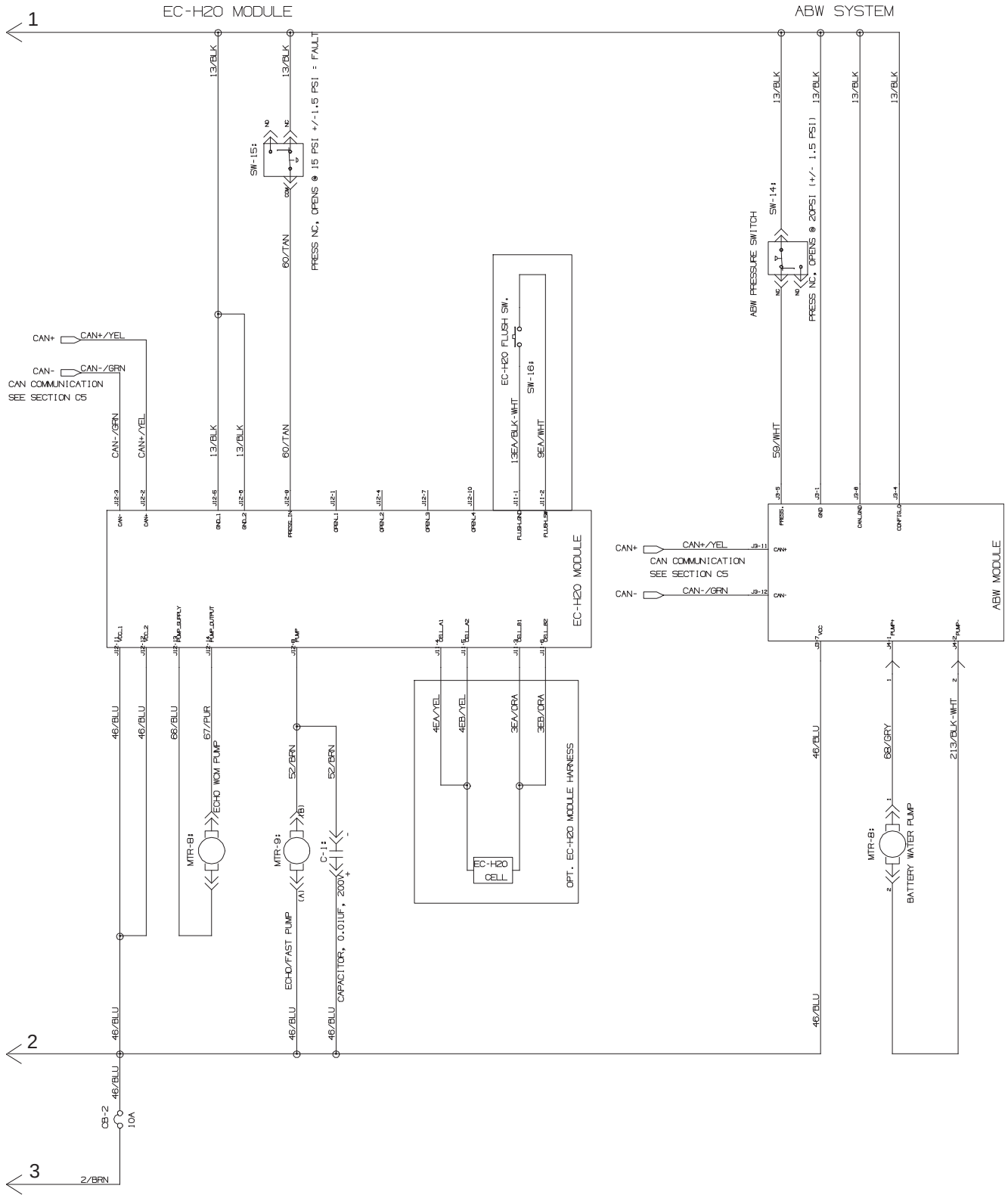
1076325_02



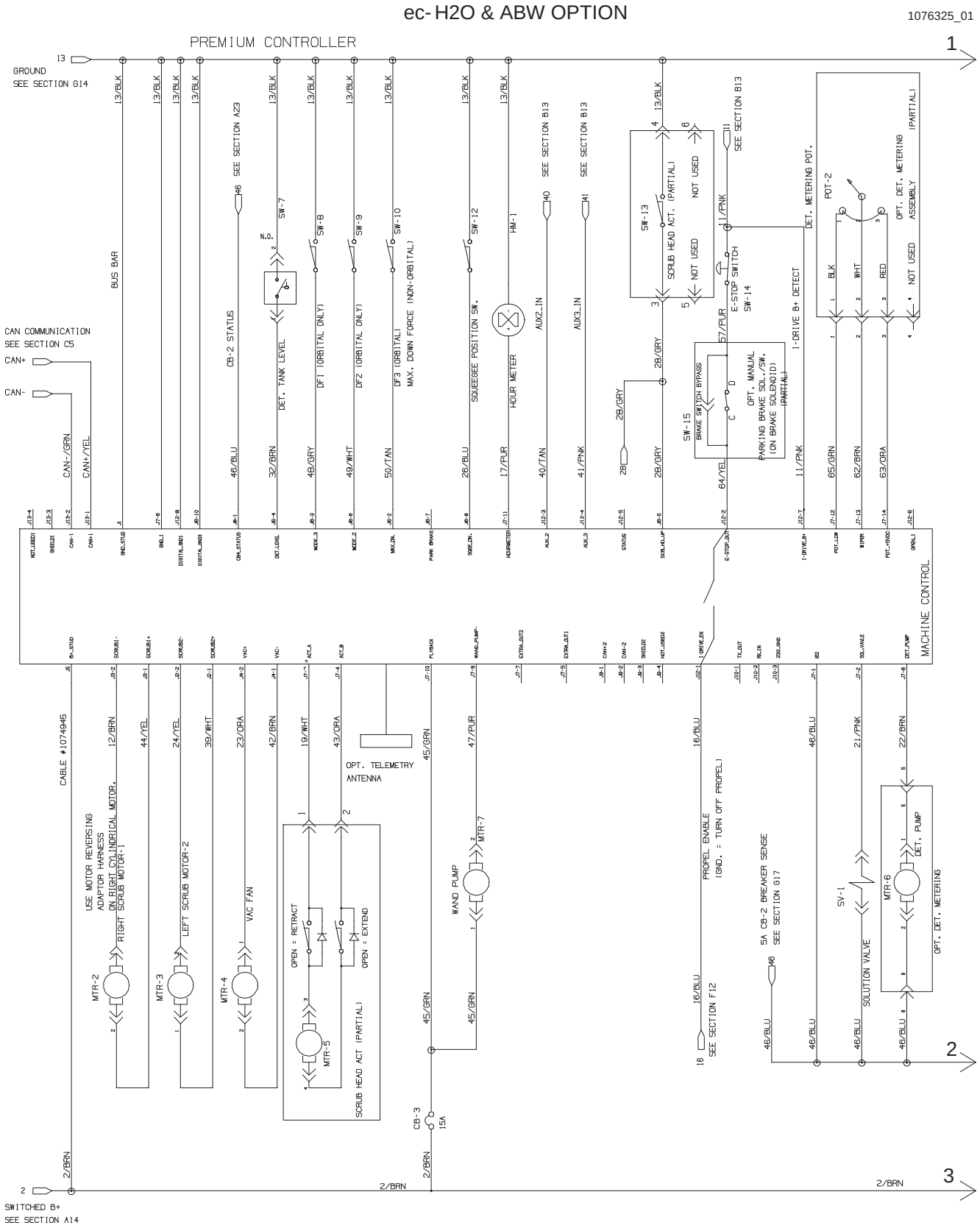
ELECTRICAL DIAGRAM T600 - PAGE 8 OF 10 (S/N 11011872-)

ec- H2O & ABW OPTION - Cont'd

1076325_02



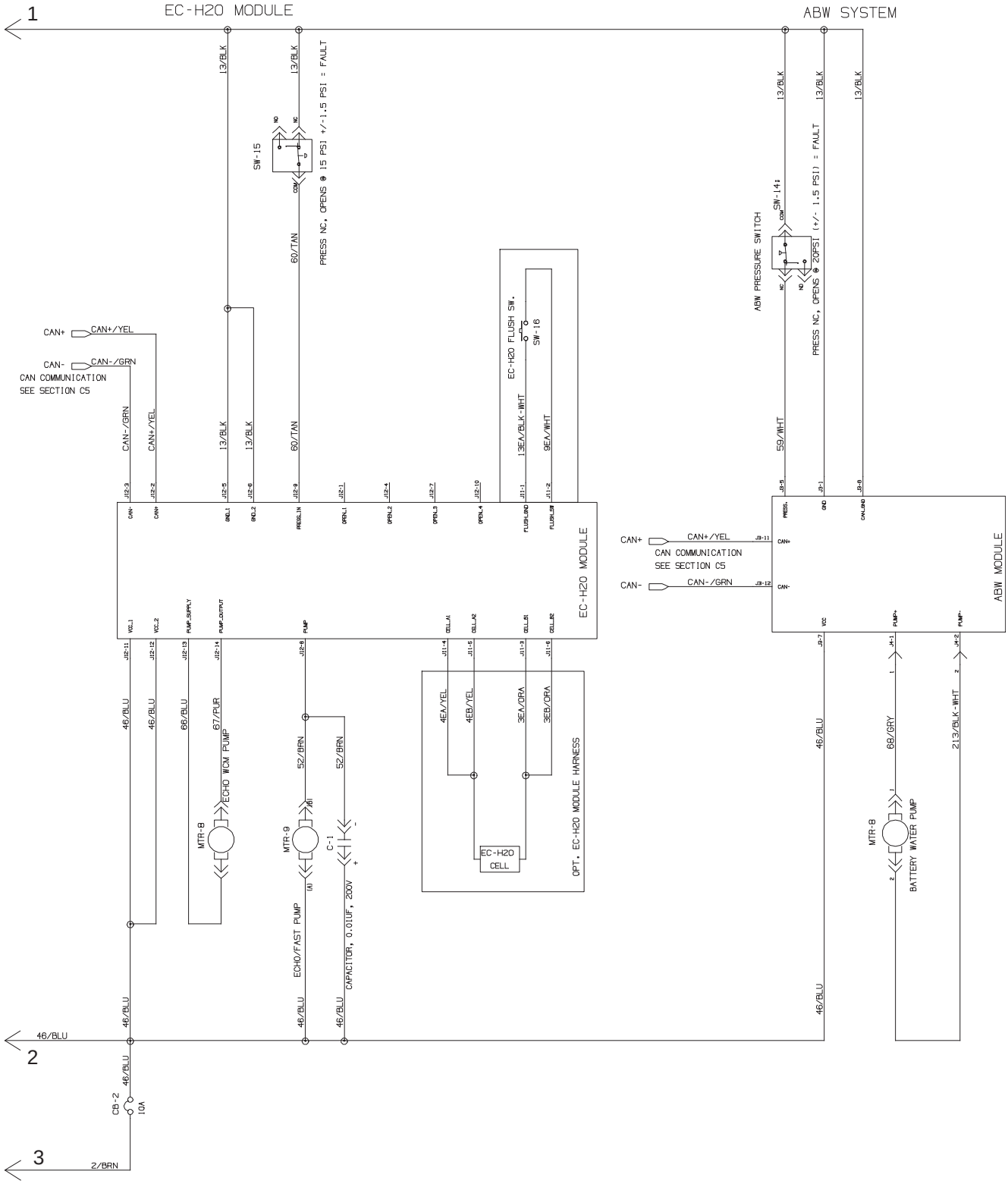
ELECTRICAL DIAGRAM T600 - PAGE 9 OF 10 (S/N 10000000-11011871)



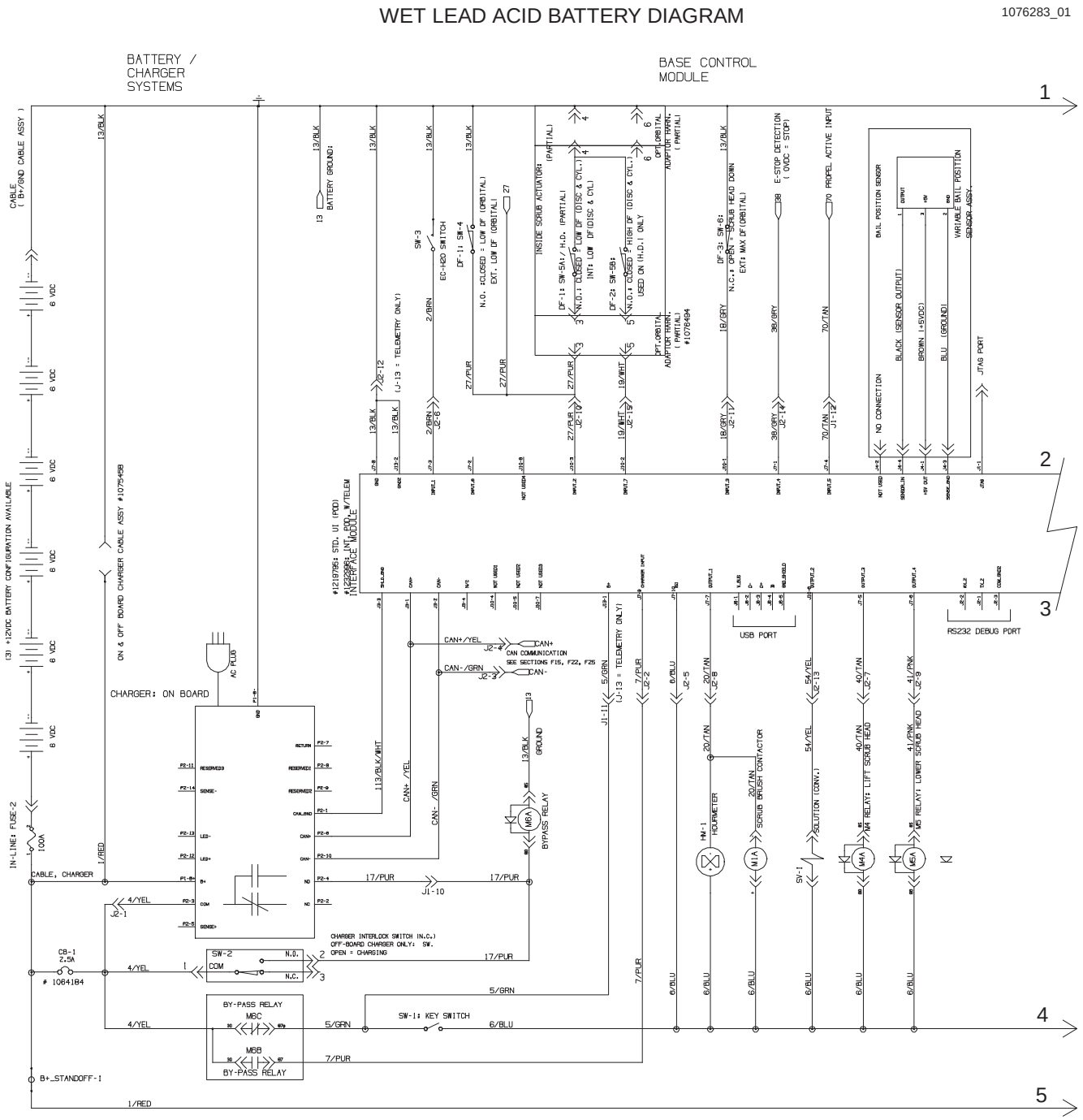
ELECTRICAL DIAGRAM T600 - PAGE 10 OF 10 (S/N 10000000-11011871)

ec-H2O & ABW OPTION - Cont'd

1076325_01



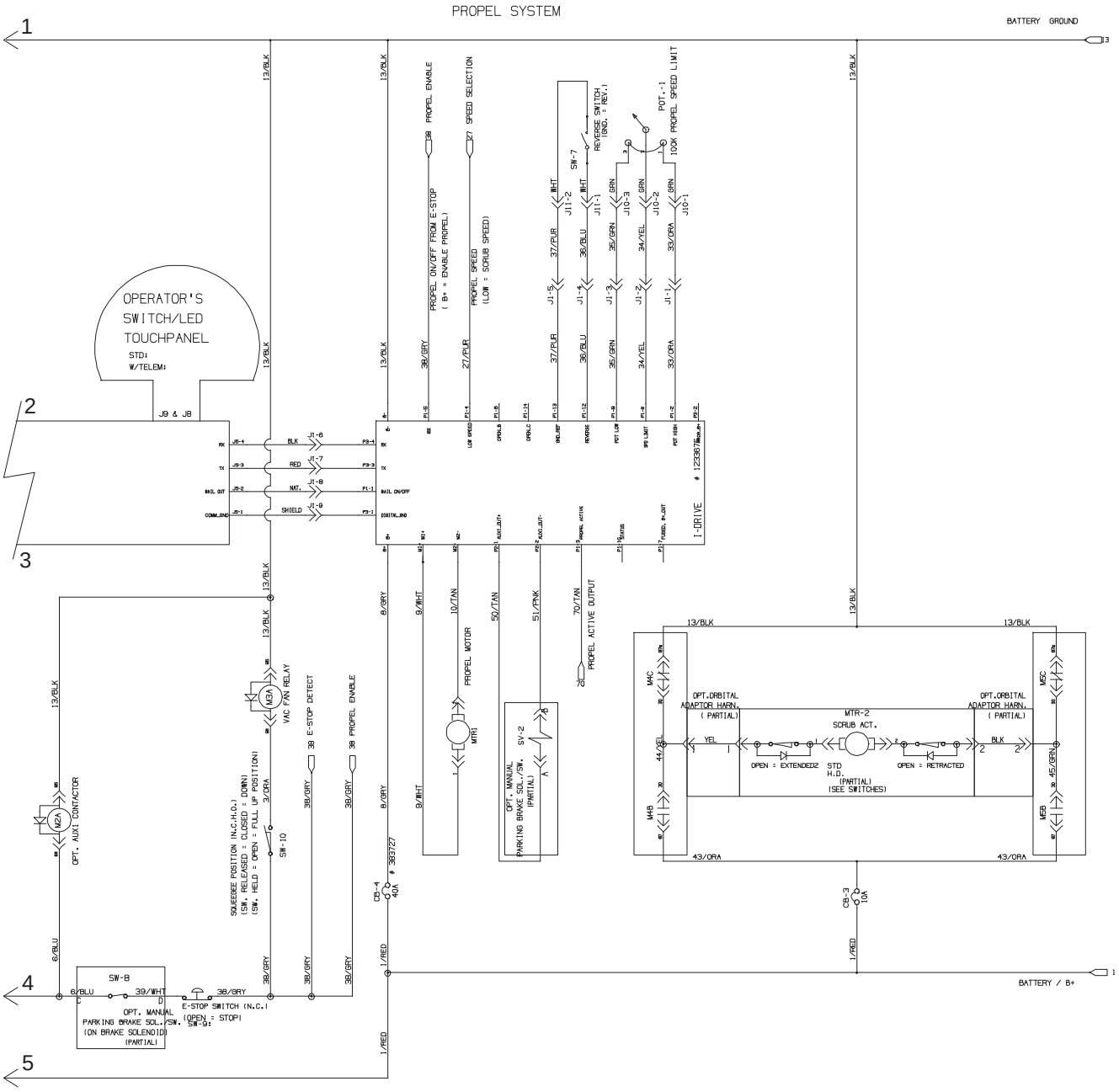
ELECTRICAL DIAGRAM T600e - PAGE 1 OF 9



ELECTRICAL DIAGRAM T600e - PAGE 2 OF 9

1076283_01

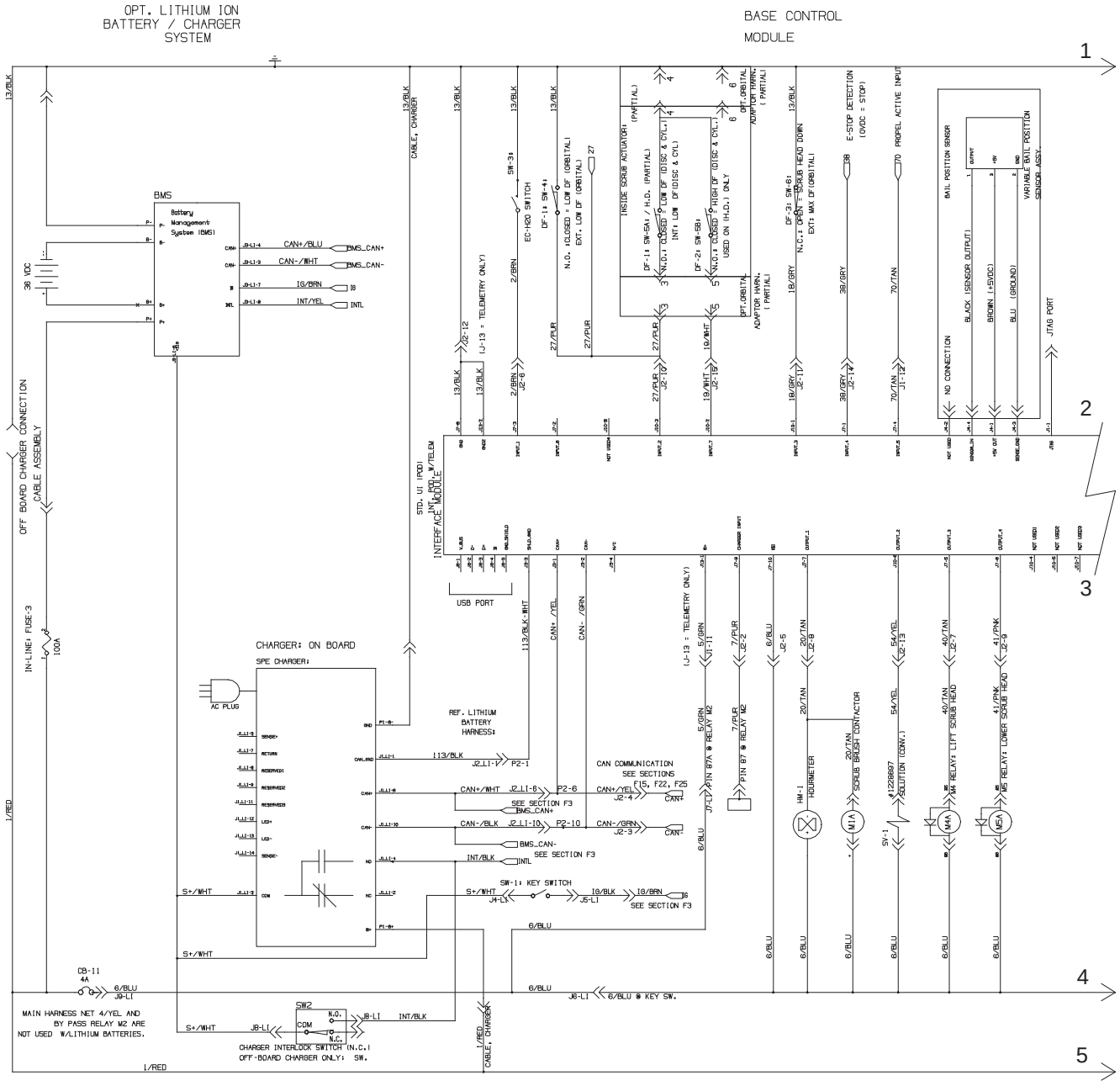
WET LEAD ACID BATTERY DIAGRAM - Cont'd



ELECTRICAL DIAGRAM T600e - PAGE 3 OF 9

LITHIUM ION BATTERY DIAGRAM

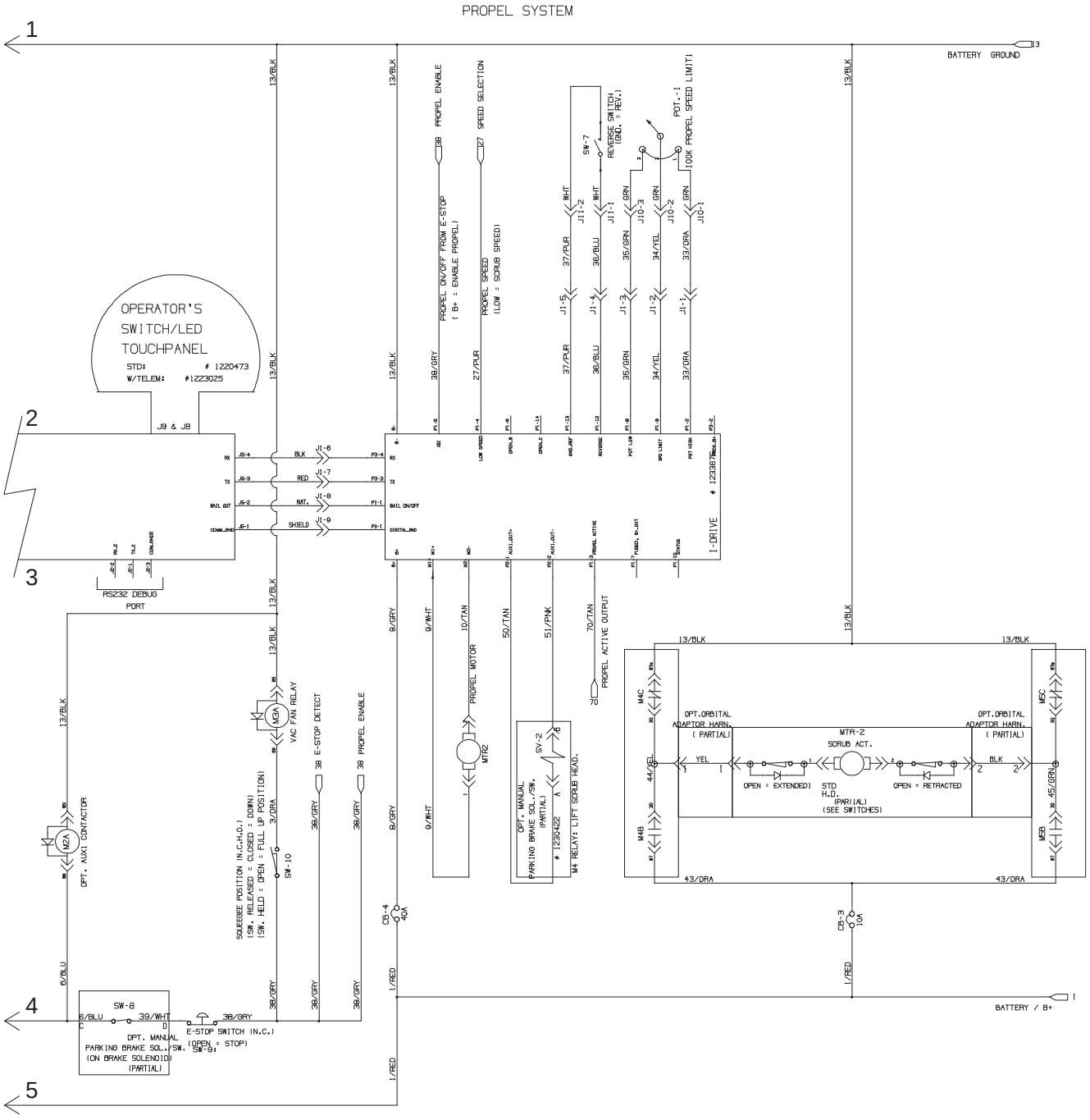
1076283_01



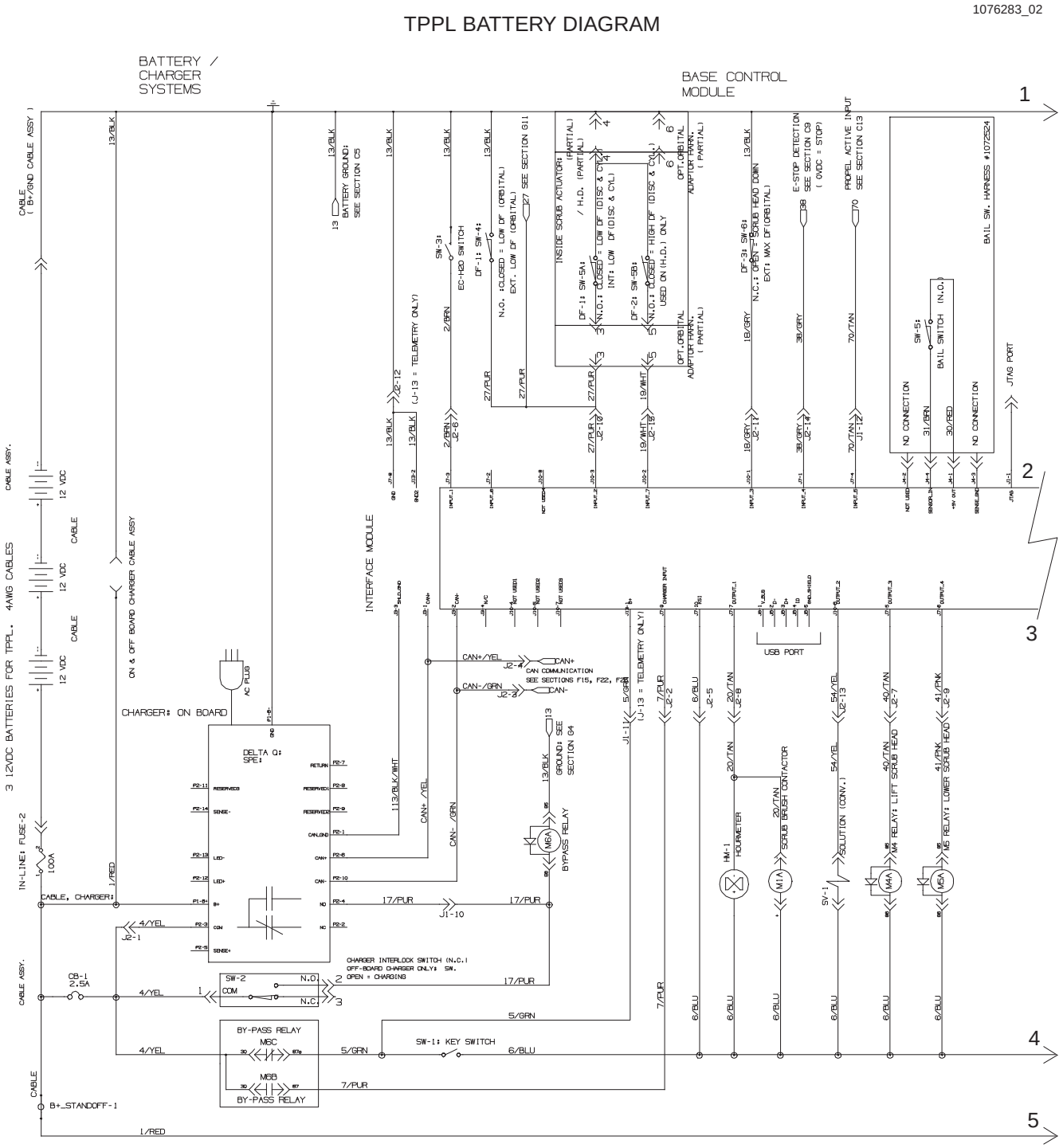
ELECTRICAL DIAGRAM T600e - PAGE 4 OF 9

LITHIUM ION BATTERY DIAGRAM - Cont'd

1076283_01



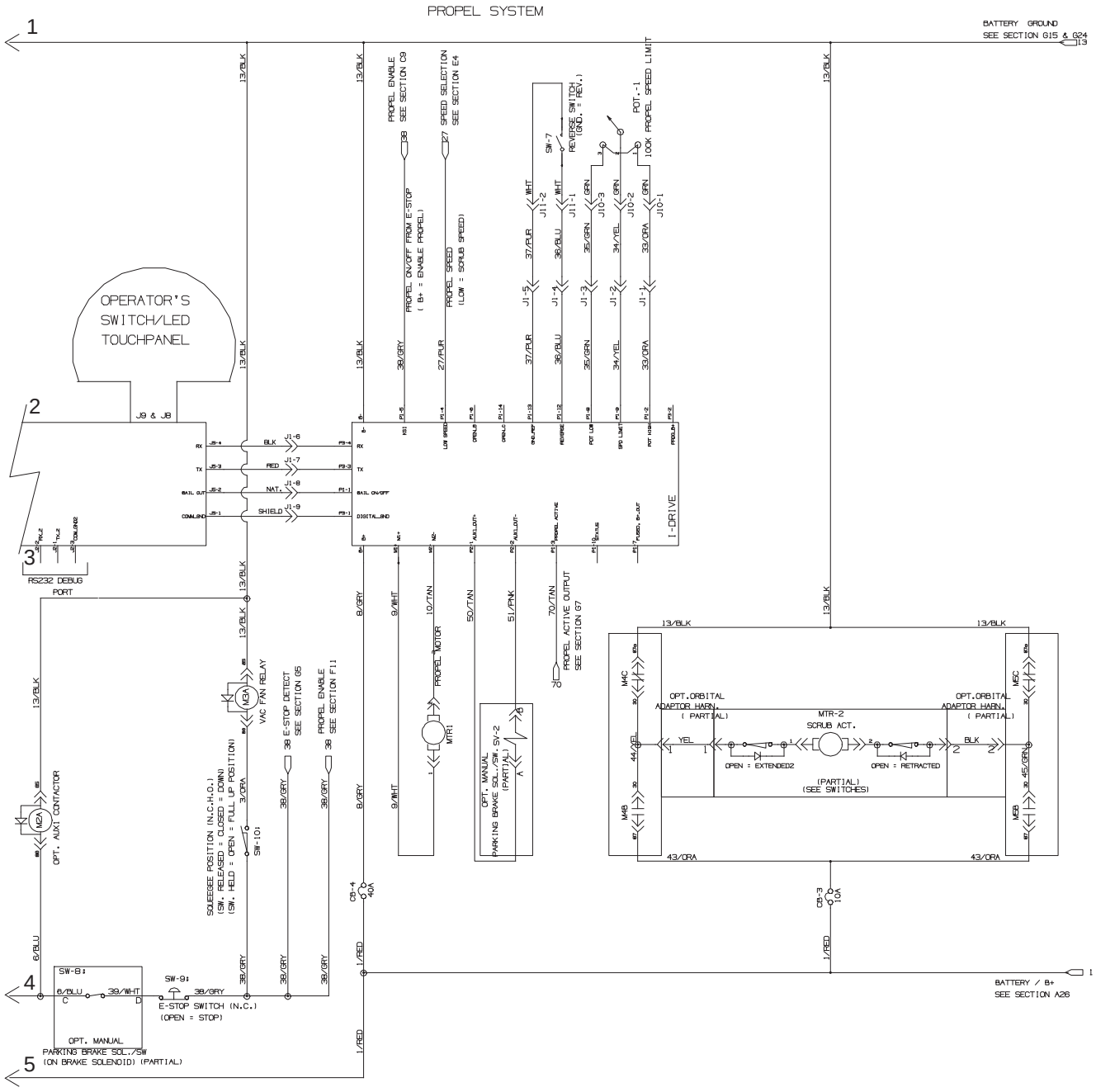
ELECTRICAL DIAGRAM T600e - PAGE 5 OF 9



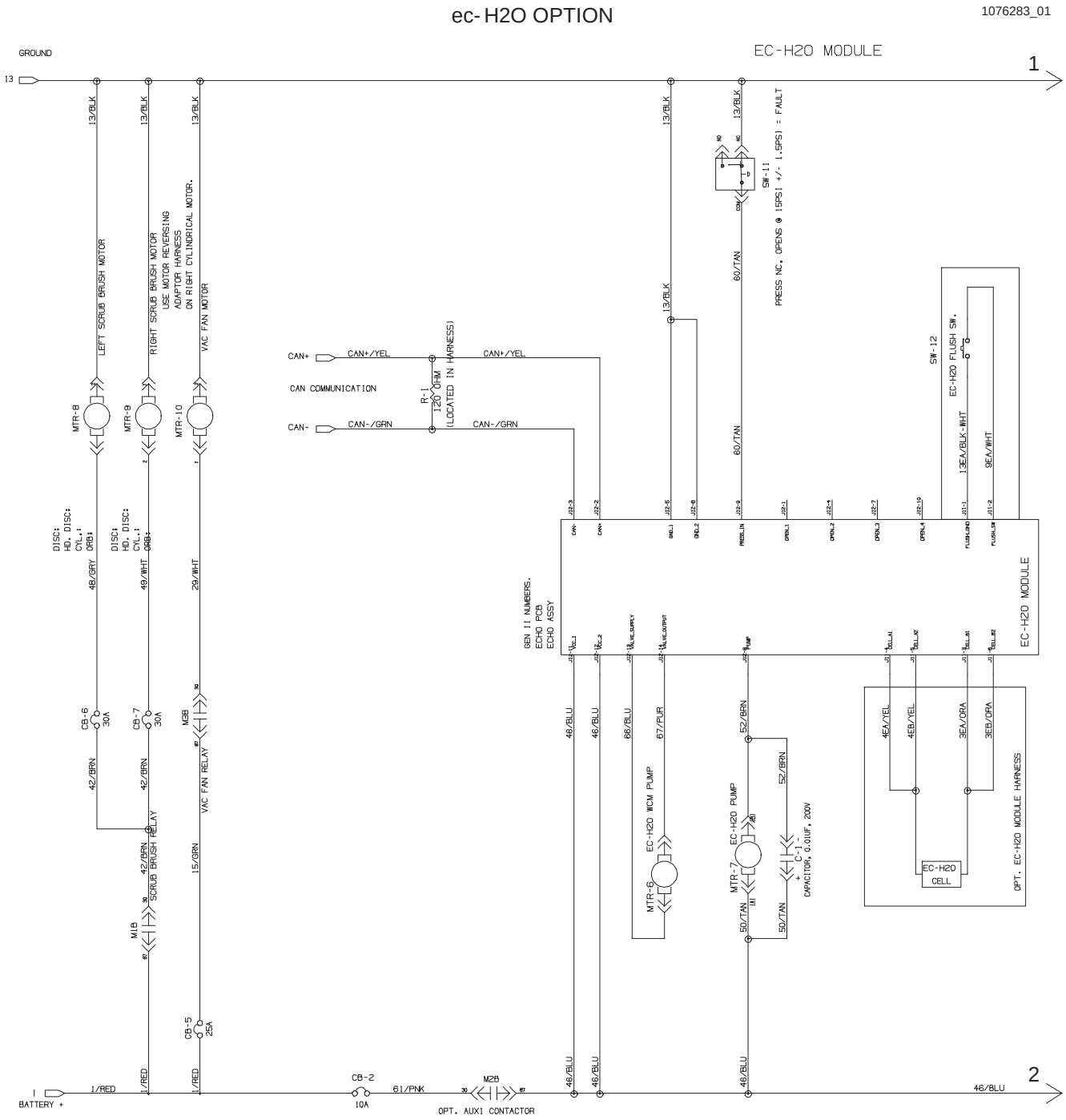
ELECTRICAL DIAGRAM T600e - PAGE 6 OF 9

TPPL BATTERY DIAGRAM - Cont'd

1076283_02



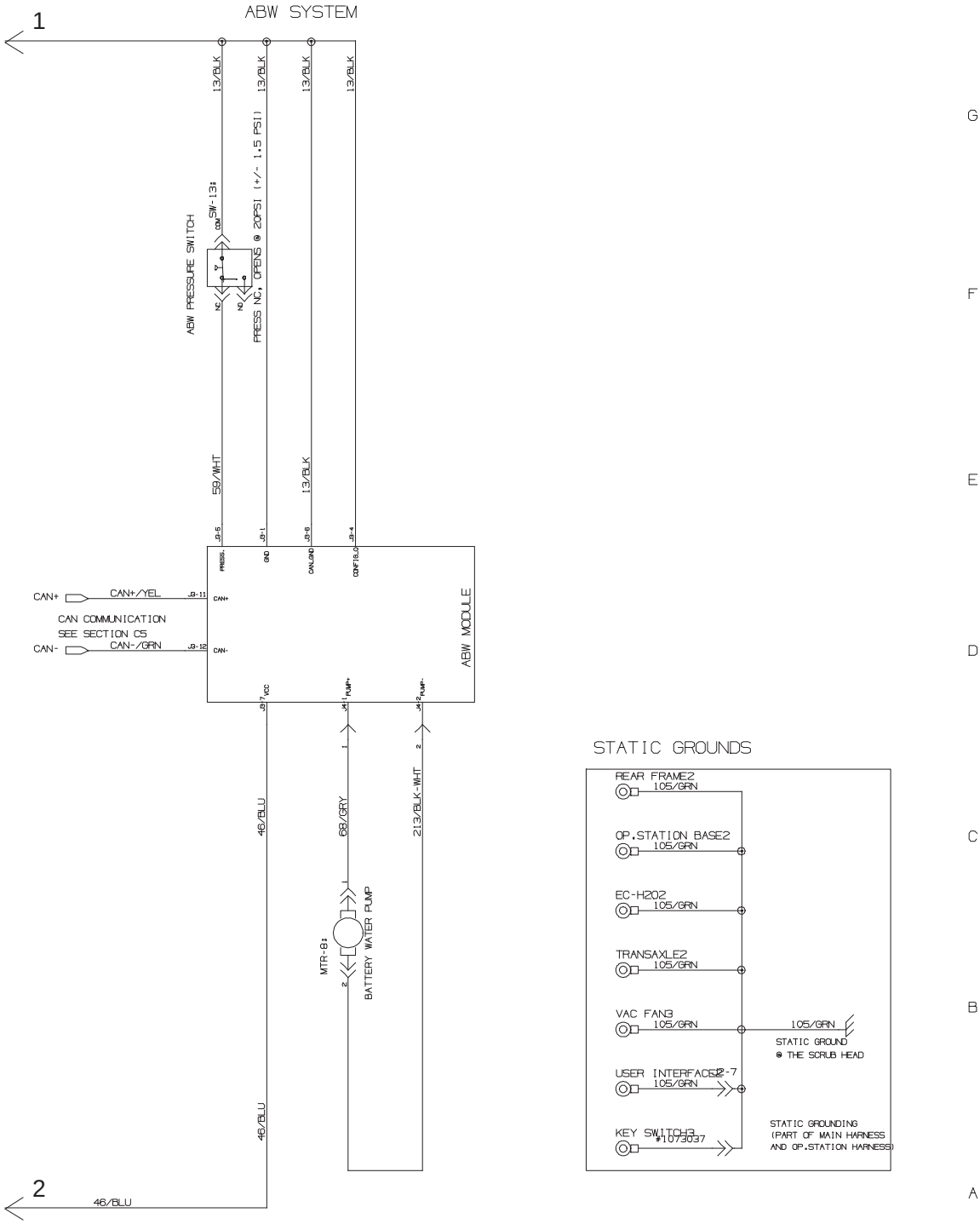
ELECTRICAL DIAGRAM T600e - PAGE 7 OF 9



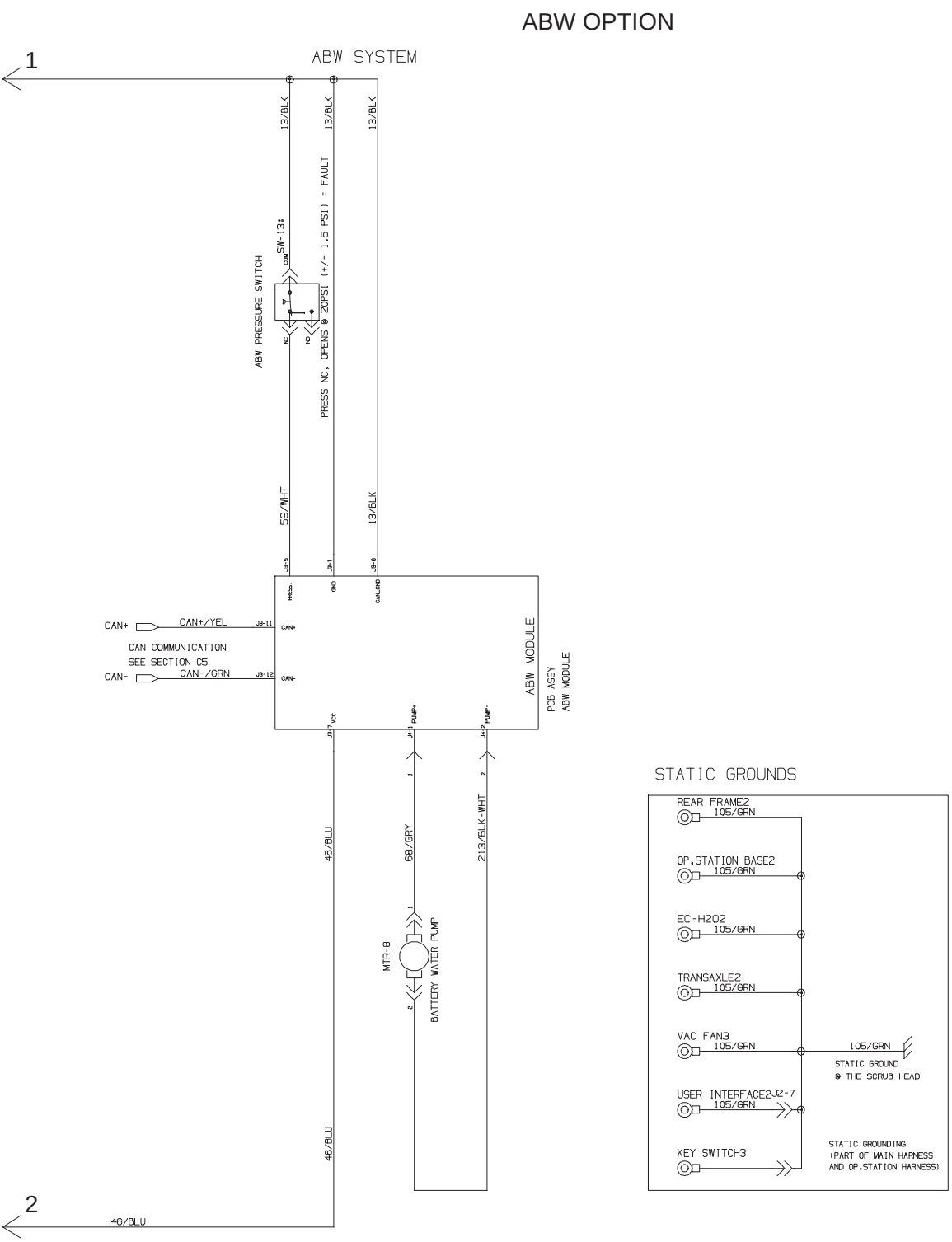
ELECTRICAL DIAGRAM T600e - PAGE 8 OF 9 (S/N 11011883-)

ABW OPTION

1076283_02



ELECTRICAL DIAGRAM T600e - PAGE 9 OF 9 (S/N 10000000-11011882)



OPERATIONAL MATRIX

FUNCTION	ENABLED	DISABLED
Propel	• Key ON (I) • Forword/Reverse Switch In FORWORD or REVERSE	• Key OFF (O) • Neutral - Bail Released • Spray Nozzle Button ON (T600 Only) • Propel Motor Controller Fault • Battery Charger ON Interlock
Vacuum Fan	• Key ON (I) • Squeegee Lowered - Foot Pedal	• Key OFF (O) • Squeegee Raised - 1-Step OFF • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Scrub Head Actuator	• Key ON (I) • Scrub Head Lowered - 1-Step ON	• Key OFF (O) • Scrub Head Raised - 1-Step OFF • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Main Scrub Motor(s)	• Key ON (I) • Scrub Head Lowered - 1-Step ON • Forword/Reverse Switch - FORWORD or REVERSE • Bail Activated	• Key OFF (O) • Scrub Head Raised - 1-Step OFF • Neutral - Bail Released • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Solution Control (Conventional)	• Key ON (I) • Scrub Head Lowered - 1-Step ON • Solution Control ON • Forword/Reverse Switch - FORWORD or REVERSE • Bail Activated	• Key OFF (O) • Scrub Head Raised - 1-Step OFF • 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)	• Key ON (I) • Scrub Head Lowered - 1-Step ON • Solution Control ON • ecH2O Switch ON • Forword/Reverse Switch - FORWORD or REVERSE • Bail Activated	• Key OFF (O) • Scrub Head Raised - 1-Step OFF • Solution Control OFF • ecH2O Switch OFF • SE (Severe Environment) System Activated • Neutral - Bail Released • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • ecH2O System Fault • Battery Charger ON Interlock
Severe Environment (T600 Only - ec-H2O NanoClean - Option required)	• Key ON (I) • Scrub Head Lowered - 1-Step ON • Severe Environment ON (30 seconds or continuous) • Forword/Reverse Switch - FORWORD or REVERSE • Bail Activated • Detergent Tank Not Empty	• Key OFF (O) • Scrub Head Raised - 1-Step OFF • Solution Control OFF • Neutral - Bail Released • Detergent Tank Empty • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Spray Nozzle (T600 Only - Optional)	• Key ON (I) • Spray Nozzle Button ON • Solution Tank Not Empty	• Key OFF (O) • Spray Nozzle Button OFF • Solution Tank Empty

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

MODEL	28 in / 700 mm Disk	32 in / 800 mm Disk	36 in / 900 mm Disk
Length	63.7 in / 1617 mm	65.8 in / 1671 mm	69.3 in / 1761 mm
Width	30.1 in / 764 mm	33.7 in / 865 mm	37.6 in / 955 mm
Height	43.6 in / 1107 mm	43.6 in / 1107 mm	43.6 in / 1107 mm
Weight (less batteries)	463 lb / 210 kg	466 lb / 212 kg	470 lb / 214 kg
Weight (with lead-acid batteries)	1033 lb / 470 kg	1036 lb / 471 kg	1040 lb / 473 kg
Weight (with Lithium-ion battery pack)	575 lb / 261 kg (2-pack)	578 lb / 262 kg (2-pack)	582 lb / 264 kg (2-pack)
	646 lb / 293 kg (4-pack)	649 lb / 294 kg (4-pack)	653 lb / 296 kg (4-pack)
	680 lb / 308 kg (5-pack)	683 lb / 310 kg (5-pack)	687 lb / 312 kg (5-pack)
GVW (with lead-acid batteries)	1301 lb / 591 kg	1304 lb / 593 kg	1308 lb / 595 kg
GVW (with Lithium-ion battery pack)	843 lb / 382 kg (2-pack)	846 lb / 384 kg	850 lb / 386 kg (2-pack)
	914 lb / 415 kg (4-pack)	917 lb / 416 kg	921 lb / 418 kg (4-pack)
	948 lb / 430 kg (5-pack)	951 lb / 431 kg	955 lb / 433 kg (5-pack)
Solution tank capacity	32 gal / 121 L		
Recovery tank capacity	37 gal / 140 L		
Severe Environment tank capacity	1.1 gal / 4 L		
Automatic battery watering tank capacity	1.1 gal / 4 L		
Scrubbing path width	28 in / 700 mm	32 in / 800mm	36 in / 900 mm
Squeegee width	38.3 in / 973 mm	41.3 in / 1049 mm	46.6 in / 1234 mm
Down pressure (T600e)	Low: 150 lbs / 68 kg, High: 200 lbs / 90 kg		
Down pressure (T600)	Low: 100 lbs / 45 kg, Med: 150 lbs / 68 kg, High: 200 lbs / 90 kg		
Down pressure (T600e Heavy Duty down pressure model)	n/a	Low: 150 lbs / 68 kg, High: 200 lbs / 90 kg Heavy Duty: 300 lbs / 136 kg	n/a
Down pressure (T600 Heavy Duty down pressure model)	n/a	Low: 100 lbs / 45 kg, Med: 150 lbs / 68 kg, High: 200 lbs / 90 kg Heavy Duty: 300 lbs / 136 kg	n/a
Scrubbing speed, variable	3.0 mph / 4.8 km/h (260 fpm / 79 mpm)		
Transport speed, variable	3.3 mph / 5.3 km/h (290 fpm / 88 mpm)		
Reverse speed, variable	1.6 mph / 2.6 km/h (140 fpm / 43 mpm)		
Aisle turnaround width	65 in / 1650 mm	67 in / 1700 mm	70 in / 1775 mm
Tires	12.6 in / 320 mm solid, non-marking (Standard)		
	12.6 in / 320 mm foamed-fill, 12.6 in / 320 mm pneumatic (Pressure: 60-65 psi / 415-450 kPA)		
Productivity rate - estimated actual	24,005 ft^2/hr / 2230 m^2/hr	27,698 ft^2/hr / 2573 m^2/hr	31,391 ft^2/hr / 2916 m^2/hr
ec-H2O productivity rate - est. actual	28,863 ft^2/hr / 2681 m^2/hr	33,304 ft^2/hr / 3094 m^2/hr	34,964 ft^2/hr / 3248 m^2/hr
Maximum operating gradient	2% / 1.15°		
Solution flow rate	Low: .50 gpm / 1.89 L/min, Med: .75 gpm / 2.84 L/min, High: 1.0 gpm / 3.78 L/min		
ec-H2O solution flow rate	Low: .22 gpm / 0.83 L/min, Med: .33 gpm / 1.25 L/min, High: .44 gpm / 1.66 L/min		
Brush motor (T600e)	2-36 VDC, 0.75 hp/0.56 kW, 22 A, 200 rpm		
Brush motor (T600)	2-36 VDC, 1.00 hp/0.75 kW, 30 A, 300 rpm		
Brush actuator motor	36 VDC		
Propel motor	36 VDC, 0.5 hp 380 W, 12.6 A		
Vacuum motor	36 VDC, 0.75 hp / .56 kW, 15.6 A		
Water lift	50 in / 1270 mm		
ec-H2O solution pump	36 VDC, 5 A, 1.5 gpm / 5.7 L/min, min open flow		
Severe environment detergent pump (T600)	24 VDC, 2.0 oz/min / .06 L/min, max open flow		
Automatic battery watering pump	12 VDC, 4 A, 0.9 gpm / 3.5 L/min, min open flow		
Spray nozzle pump (T600)	36 VDC, 2.3 A, 4.9 gpm / 18.5 L/min, max open flow		
Machine voltage	36 VDC		
Battery capacity	6-6V 240AH C/20 Wet, 6-6V 360AH C/20 Wet, 3-12V 210AH C/20 TPPL		
Lithium-ion Battery capacity	4.1 kWh (2-pack), 8.2 kWh (4-pack), 10.2 kWh (5-pack), 36 VDC		
Total power consumption	50 A nominal / 1.8 kW		
Battery Charger - on-board (global)	100-240VAC, 50/60Hz, 36VDC, 25A		
Battery Charger - on-board, TPPL	100-240VAC, 50/60Hz, 36VDC, 33A		
Battery Charger - off-board (Smart)	100-240VAC, 50/60Hz, 36VDC, 25A		
Lithium-ion Battery Chargers - Standard	100-240VAC, 50/60Hz, 36VDC, 900W, 25A		
Lithium-ion Battery Chargers - Fast	100-240VAC, 50/60Hz, 36VDC, 1200W, 33A		

MODEL	28 in / 700 mm Disk	32 in / 800 mm Disk	36 in / 900 mm Disk
Protection grade	IPX3		
Sound pressure level L_{pA}*	69.5 dB(A)		
Sound pressure level L_{pA}* - Quiet mode	62.2 dB(A)		
Sound uncertainty K_{pA}*	3 dB(A)		
Sound power level Lw_A + uncertainty Kw_A*	89.3 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 AMERICAN

MODEL	28 in / 700 mm Cylindrical	32 in / 800 mm Cylindrical	28 in / 700 mm Orbital
Length	64.4 in / 1637 mm	64 in / 1625 mm	62.6 in / 1590 mm
Width	31.2 in / 792 mm	35.1 in / 892 mm	29.4 in / 746 mm
Height	43.6 in / 1107 mm	43.6 in / 1107 mm	43.6 in / 1107 mm
Weight (less batteries)	479 lb / 218 kg	482 lb / 219 kg	489 lb / 222 kg
Weight (with lead-acid batteries)	1049 lb / 477 kg	1052 lb / 478 kg	1059 lb / 481 kg
Weight (with Lithium-ion battery pack)	591 lb / 268 kg (2-pack)	594 lb / 269 kg (2-pack)	601 lb / 273 kg (2-pack)
	662 lb / 300 kg (4-pack)	665 lb / 302 kg (4-pack)	672 lb / 305 kg (4-pack)
	696 lb / 316 kg (5-pack)	699 lb / 317 kg (5-pack)	706 lb / 320 kg (5-pack)
GVW (with lead-acid batteries)	1317 lb / 599 kg	1320 lb / 600 kg	1327 lb / 603 kg
GVW (with Lithium-ion battery pack)	859 lb / 390 kg (2-pack)	862 lb / 391 kg	869 lb / 394 kg (2-pack)
	930 lb / 422 kg (4-pack)	933 lb / 423 kg	940 lb / 426 kg (4-pack)
	964 lb / 437 kg (5-pack)	967 lb / 439 kg	974 lb / 442 kg (5-pack)
Solution tank capacity	32 gal / 121 L		
Recovery tank capacity	37 gal / 140 L		
Severe Environment tank capacity	1.1 gal / 4 L		
Automatic battery watering tank capacity	1.1 gal / 4 L		
Scrubbing path width	28 in / 700 mm	32 in / 800mm	28 in / 700 mm
Squeegee width	38.3 in / 973 mm	41.3 in / 1049 mm	38.3 in / 973 mm
Down pressure (T600e)	Low: 50 lbs / 23 kg High: 90 lbs / 41 kg		Low: 105 lbs / 48 kg High: 170 lbs / 77 kg
Down pressure (T600)	Low: 50 lbs / 23 kg Med: 70 lbs / 32 kg High: 90 lbs / 41 kg		Low: 105 lbs / 48 kg Med: 135 lbs / 61 kg High: 170 lbs / 77 kg
Scrubbing speed, variable	3.0 mph / 4.8 km/h (260 fpm / 79 mpm)		
Transport speed, variable	3.3 mph / 5.3 km/h (290 fpm / 88 mpm)		
Reverse speed, variable	1.6 mph / 2.6 km/h (140 fpm / 43 mpm)		
Aisle turnaround width	67 in / 1700 mm	67.5 in / 1713 mm	60 in / 1540 mm
Tires	12.6 in / 320 mm solid, non-marking (Standard)		
	12.6 in / 320 mm foamed-fill, 12.6 in / 320 mm pneumatic (Pressure: 60-65 psi / 415-450 kPA)		
Productivity rate - estimated actual	24,005 ft^2/hr / 2230 m^2/hr	27,698 ft^2/hr / 2573 m^2/hr	24,005 ft^2/hr / 2230 m^2/hr
ec-H2O productivity rate - est. actual	28,863 ft^2/hr / 2681 m^2/hr	33,304 ft^2/hr / 3094 m^2/hr	28,863 ft^2/hr / 2681 m^2/hr
Maximum operating gradient	2% / 1.15°		
Solution flow rate	Low: .50 gpm / 1.89 L/min, Med: .75 gpm / 2.84 L/min, High: 1.0 gpm / 3.78 L/min		
ec-H2O solution flow rate	Low: .22 gpm / 0.83 L/min, Med: .33 gpm / 1.25 L/min, High: .44 gpm / 1.66 L/min		
Brush motor (T600e)	2-36 VDC, 0.9 hp/0.67 kW, 22 A, 1800 rpm Brush speed: 760 rpm		36 VDC, 0.75 hp/0.56 kW, 18.5 A, 2200 rpm
Brush motor (T600)	2-36 VDC, 0.9 hp/0.67 kW, 22 A, 1800 rpm Brush speed: 760 rpm		36 VDC, 0.75 hp/0.56 kW, 18.5 A, 2200 rpm
Brush actuator motor	36 VDC		
Propel motor	36 VDC, 0.5 hp / 380 W, 12.6 A		
Vacuum motor	36 VDC, 0.75 hp / .56 kW, 15.6 A		
Water lift	50 in / 1270 mm		
ec-H2O solution pump	36 VDC, 5 A, 1.5 gpm / 5.7 L/min, min open flow		
Severe environment detergent pump (T600)	24 VDC, 2.0 oz/min / .06 L/min, max open flow		
Automatic battery watering pump	12 VDC, 4 A, 0.9 gpm / 3.5 L/min, min open flow		
Spray nozzle pump (T600)	36 VDC, 2.3 A, 4.9 gpm / 18.5 L/min, max open flow		
Machine voltage	36 VDC		
Battery capacity	6-6V 240AH C/20 Wet, 6-6V 360AH C/20 Wet, 3-12V 210AH C/20 TPPL		
Lithium-ion Battery capacity	4.1 kWh (2-pack), 8.2 kWh (4-pack), 10.2 kWh (5-pack), 36 VDC		
Total power consumption	50 A nominal / 1.8 kW		
Battery Charger - on-board (global)	100-240VAC, 50/60Hz, 36VDC, 25A		
Battery Charger - on-board, TPPL	100-240VAC, 50/60Hz, 36VDC, 33A		
Battery Charger - off-board (Smart)	100-240VAC, 50/60Hz, 36VDC, 25A		
Lithium-ion Battery Chargers - Standard	100-240VAC, 50/60Hz, 36VDC, 900W, 25A		
Lithium-ion Battery Chargers - Fast	100-240VAC, 50/60Hz, 36VDC, 1200W, 33A		
Protection grade	IPX3		

MODEL	28 in / 700 mm Cylindrical	32 in / 800 mm Cylindrical	28 in / 700 mm Orbital
Sound pressure level L_{pA}*	69.2 dB(A)		69.5 dB(A)
Sound pressure level L_{pA}* - Quiet mode	62.2 dB(A)		62.3 dB(A)
Sound uncertainty K_{pA}*	3 dB(A)		
Sound power level Lw_A + uncertainty Kw_A*	87.8 dB(A)		88.8 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 - EMEA

MODEL	700 mm Disk	800 mm Disk	900 mm Disk
Length	1617 mm	1671 mm	1761 mm
Width	764 mm	865 mm	955 mm
Height	1107 mm	1107 mm	1107 mm
Weight (less batteries)	210 kg	212 kg	214 kg
Weight (with heaviest batteries)	470 kg	471 kg	473 kg
GVW	591 kg	593 kg	595 kg
Solution tank capacity	121 L		
Recovery tank capacity	140 L		
Severe Environment tank capacity (T600)	4 L		
Automatic battery watering tank capacity	4 L		
Scrubbing path width	700 mm	800mm	900 mm
Squeegee width	973 mm	1049 mm	1234 mm
Brush down pressure (T600e)	Low: 68 kg, High: 90 kg		
Brush down pressure (T600)	Low: 45 kg, Med: 68 kg, High: 90 kg		
Scrubbing speed, variable	4.8 km/h (79 mpm)		
Transport speed, variable	5.3 km/h (88 mpm)		
Reverse speed, variable	2.6 km/h (43 mpm)		
Aisle turnaround width	1650 mm	1700 mm	1775 mm
Tires	320 mm solid, non-marking (Standard)		
	320 mm foamed-fill, 320 mm pneumatic (Pressure: 60-65 psi / 415-450 kPA)		
Productivity rate - estimated actual	2230 m^2/hr	2573 m^2/hr	2916 m^2/hr
ec-H2O productivity rate - est. actual	2681 m^2/hr	3094 m^2/hr	3248 m^2/hr
Maximum operating gradient	2%		
Solution flow rate	Low: 1.89 L/min, Med: 2.84 L/min, High: 3.78 L/min		
ec-H2O solution flow rate	Low: 0.83 L/min, Med: 1.25 L/min, High: 1.66 L/min		
Brush motor (T600e)	2-36 VDC, 0.56 kW, 22 A, 200 rpm		
Brush motor (T600)	2-36 VDC, 0.75 kW, 30 A, 300 rpm		
Brush actuator motor (T600e)	36 VDC		
Brush actuator motor (T600)	36 VDC		
Propel motor	36 VDC, 380 W, 12.6 A		
Vacuum motor	36 VDC, .56 kW, 15.6 A		
Water lift	1270 mm		
ec-H2O solution pump	36 VDC, 5 A, 5.7 L/min, min open flow		
Severe environment detergent pump (T600)	24 VDC, .06 L/min, max open flow		
Automatic battery watering pump	12 VDC, 4 A, 3.5 L/min, min open flow		
Spray nozzle pump (T600)	36 VDC, 2.3 A, 18.5 L/min, max open flow		
Machine voltage	36 VDC		
Battery capacity (EMEA)	6-6V 180AH C/5 Wet, 6-6V 210AH C/5 Wet, 6-6V 180AH C/5 Gel, 3-12V 210AH C/20 TPPL		
Battery capacity (APAC)	6-6V 240AH C/20 Wet, 6-6V 360AH C/20 Wet		
Total power consumption	50 A nominal / 1.8 kW		
Battery Charger - on-board (global)	100-240VAC, 50/60Hz, 36VDC, 25A		
Battery Charger - off-board (Smart)	100-240VAC, 50/60Hz, 36VDC, 25A		
Protection grade	IPX3		
Sound pressure level L_{pA}*	69.5 dB(A)		
Sound pressure level L_{pA}* - Quiet mode	62.2 dB(A)		
Sound uncertainty K_{pA}*	3 dB(A)		
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	89.3 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.

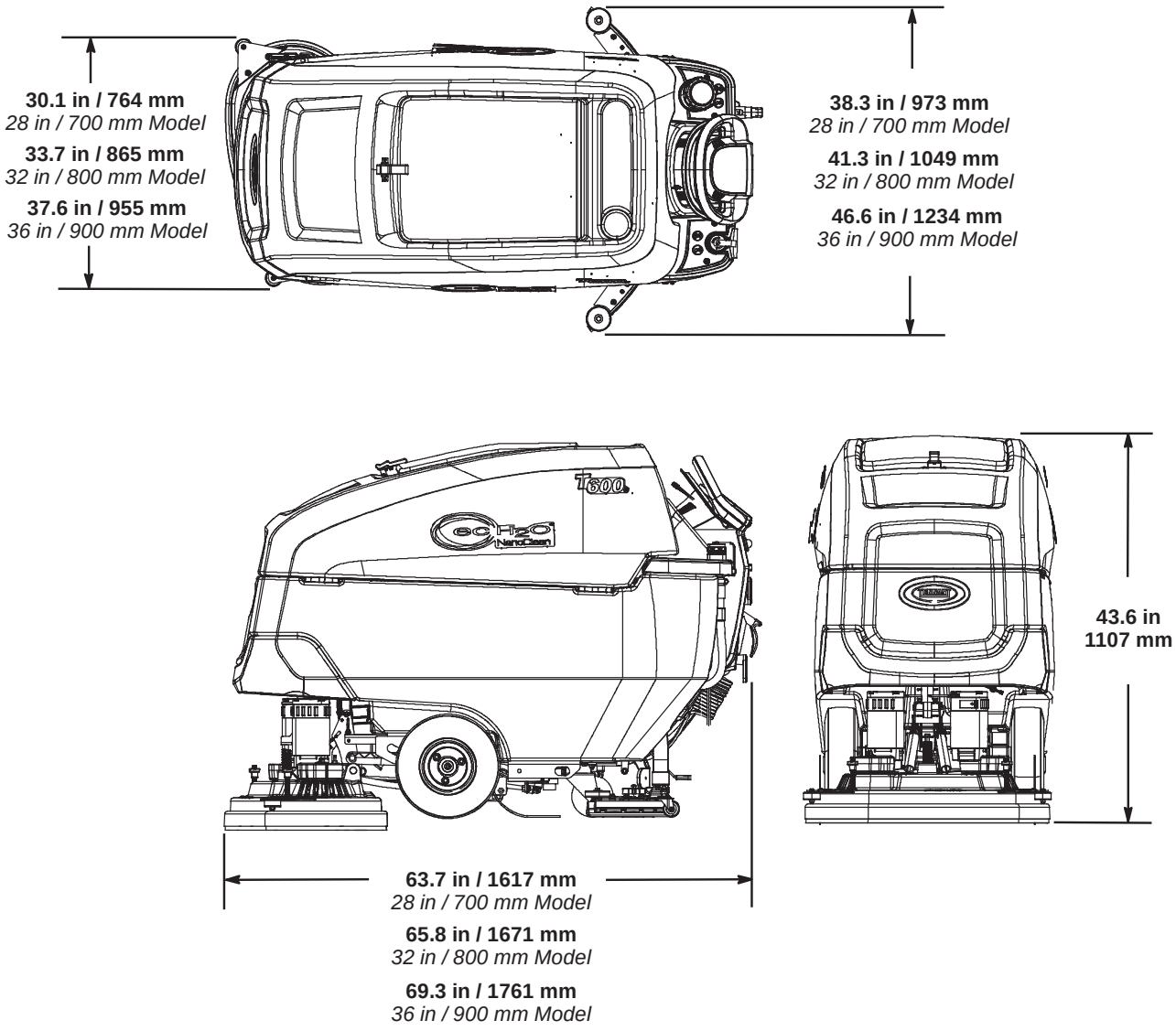
GENERAL MACHINE DIMENSIONS/CAPACITIES/PERFORMANCE - EMEA

MODEL	700 mm Cylindrical	800 mm Cylindrical	700 mm Orbital
Length	1637 mm	1625 mm	1590 mm
Width	792 mm	892 mm	746 mm
Height	1107 mm	1107 mm	1107 mm
Weight (less batteries)	218 kg	219 kg	222 kg
Weight (with heaviest batteries)	477 kg	478 kg	481 kg
GVW	599 kg	600 kg	603 kg
Solution tank capacity	121 L		
Recovery tank capacity	140 L		
Severe Environment tank capacity (T600)	4 L		
Automatic battery watering tank capacity	4 L		
Scrubbing path width	700 mm	800mm	700 mm
Squeegee width	973 mm	1049 mm	973 mm
Brush down pressure (T600e)	Low: 23 kg High: 41 kg		Low: 48 kg High: 77 kg
Brush down pressure (T600)	Low: 23 kg Med: 32 kg High: 41 kg		Low: 48 kg Med: 61 kg High: 77 kg
Scrubbing speed, variable	4.8 km/h (79 mpm)		
Transport speed, variable	5.3 km/h (88 mpm)		
Reverse speed, variable	2.6 km/h (43 mpm)		
Aisle turnaround width	1700 mm	1713 mm	1540 mm
Tires	320 mm solid, non-marking (Standard)		
	320 mm foamed-fill, 320 mm pneumatic (Pressure: 60-65 psi / 415-450 kPA)		
Productivity rate - estimated actual	2230 m^2/hr	2573 m^2/hr	2230 m^2/hr
ec-H2O productivity rate - est. actual	2681 m^2/hr	3094 m^2/hr	2681 m^2/hr
Maximum operating gradient	2%		
Solution flow rate	Low: 1.89 L/min, Med: 2.84 L/min, High: 3.78 L/min		
ec-H2O solution flow rate	Low: 0.83 L/min, Med: 1.25 L/min, High: 1.66 L/min		
Brush motor (T600e)	2-36 VDC, 0.67 kW, 22 A, 1800 rpm		36 VDC, 0.56 kW, 18.5 A, 1900 rpm
Brush motor (T600)	2-36 VDC, 0.67 kW, 22 A, 1800 rpm		36 VDC, 0.56 kW, 18.5 A, 1900 rpm
Brush actuator motor (T600e)	36 VDC		
Brush actuator motor (T600)	36 VDC		
Propel motor	36 VDC, 380 W, 12.6 A		
Vacuum motor	36 VDC, .56 kW, 15.6 A		
Water lift	1270 mm		
ec-H2O solution pump	36 VDC, 5 A, 5.7 L/min, min open flow		
Severe environment detergent pump (T600)	24 VDC, .06 L/min, max open flow		
Automatic battery watering pump	12 VDC, 4 A, 3.5 L/min, min open flow		
Spray nozzle pump (T600)	36 VDC, 2.3 A, 18.5 L/min, max open flow		
Machine voltage	36 VDC		
Battery capacity (APAC)	6-6V 240AH C/20 Wet, 6-6V 360AH C/20 Wet, 3-12V 210AH C/20 TPPL		
Battery capacity (EMEA)	6-6V 180AH C/5 Wet, 6-6V 210AH C/5 Wet, 6-6V 180AH C/5 Gel		
Total power consumption	50 A nominal / 1.8 kW		
Battery Charger - on-board (global)	100-240VAC, 50/60Hz, 36VDC, 25A		
Battery Charger - off-board (Smart)	100-240VAC, 50/60Hz, 36VDC, 25A		
Protection grade	IPX3		
Sound pressure level L_{pA}*	69.2 dB(A)		69.5 dB(A)
Sound pressure level L_{pA}* - Quiet mode	62.2 dB(A)		62.3 dB(A)
Sound uncertainty K_{pA}*	3 dB(A)		
Sound power level uncertainty L_{pA} - uncertainty K_{pA}*	87.8 dB(A)		88.8 dB(A)
Machine vibration at hand-arm*	<2.5 m/s^2		
Ambient operating temperature	Min: 2˚C, Max: 43˚C		

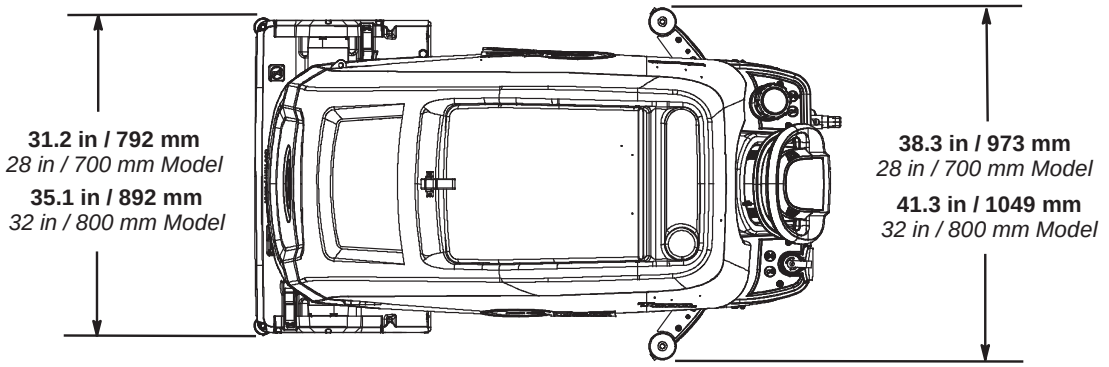
*Values per IEC 60335-2-72. Specifications are subject to change without notice.

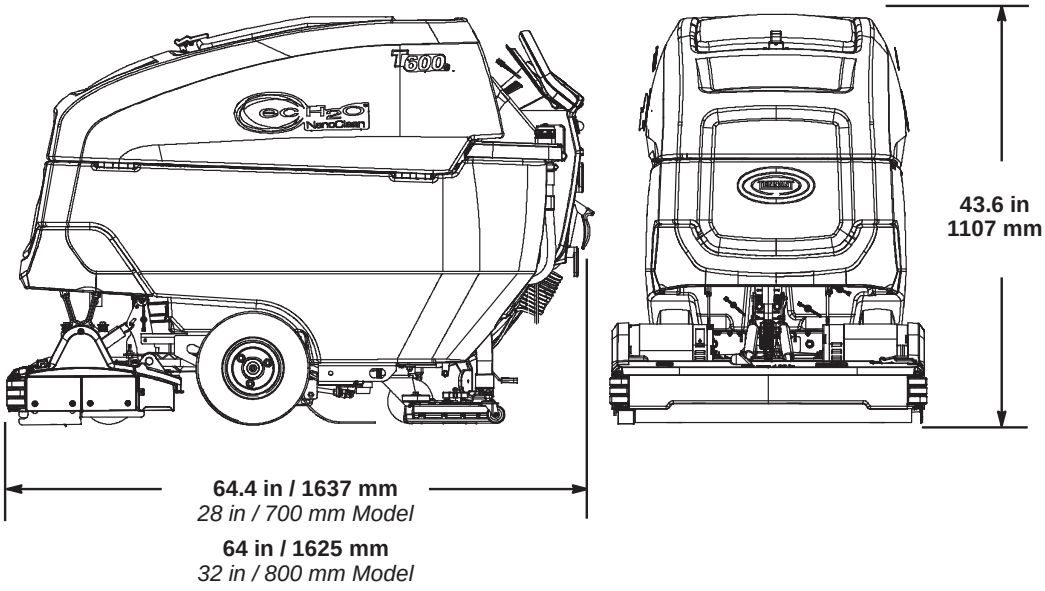
MACHINE DIMENSIONS

DISK BRUSH MODEL

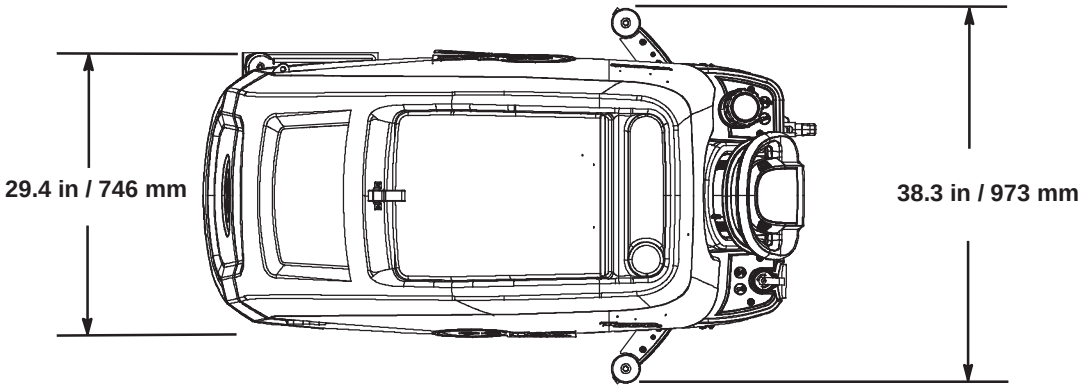


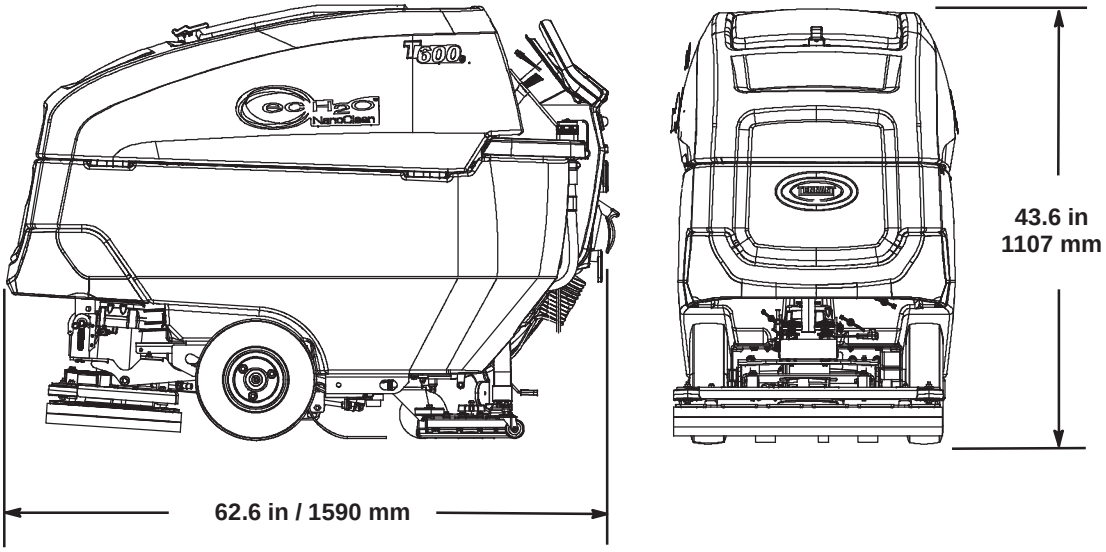
CYLINDRICAL BRUSH MODEL





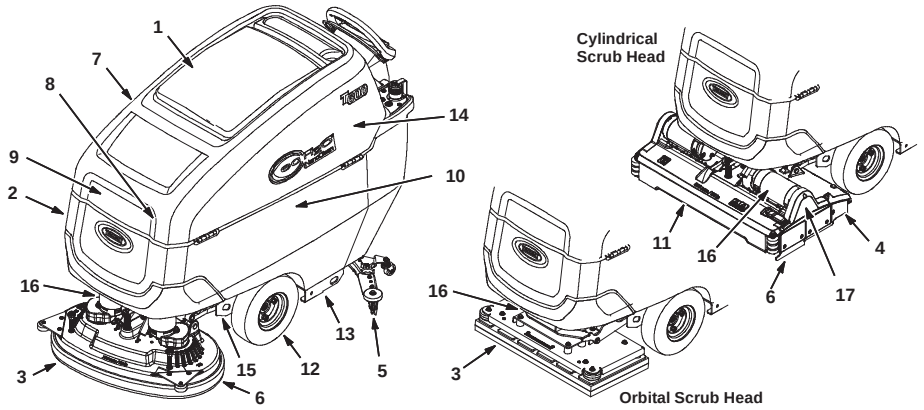
ORBITAL PAD MODEL





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	Recovery tank	Drain, rinse, clean float shut-off screen and debris tray
	O	2	Solution tank	Drain, rinse
	O	3	Pads	Check, flip or replace
	O	3	Brushes	Check, clean
	O	4	Debris trough (Cylindrical Brush)	Clean
	O	5	Squeegee	Clean, check for damage and wear
	O	6	Scrub head skirt	Check for damage and wear
	O	7	Machine	Clean with damp cloth
	O	8	Severe environment tank (option)	Check, refill
	O	9	Automatic battery watering tank (option)	Check, refill
	O	10	Batteries	Charge if necessary
Weekly	O	10	Battery cells	Check electrolyte level
	O	10	Battery compartment	Check for liquid
	O	5	Squeegee assembly drip trap reservoir	Check. Clean
50 Hours	O	11	Cylindrical brushes	Rotate brushes. Check for wear
	O	11	Cylindrical scrub head	Clean underside of scrub head
	O	1	Recovery tank lid seal	Check for wear
	O	2	Solution tank filter	Remove and clean
	O	12	Pneumatic air-filled tires (option)	Check pressure
100 Hours	O	10	Battery watering system (option)	Check hoses for damage and wear
	O	13	Rear casters	Lubricate
200 Hours	O	10	Batteries, terminals and cables	Check and clean
500 Hours	O	5	Squeegee casters	Inspect for wear. Replace if sleeve bearings are worn
750 Hours	T	14	Vacuum motor	Replace carbon brushes
1250 Hours	T	15	Propel motor	Replace carbon brushes
	T	16	Brush motor	Replace carbon brushes
	T	17	Brush belt (Cylindrical Brush)	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, and remove key.

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

YELLOW TOUCH POINTS

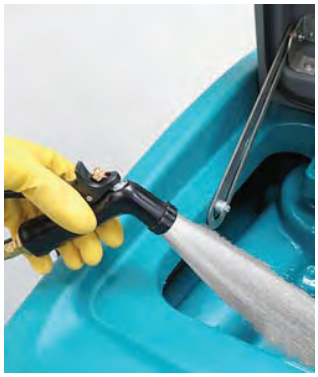
This machine features easy to find yellow touch points for simple service items. No tools are required to perform these maintenance operations.


AFTER DAILY USE

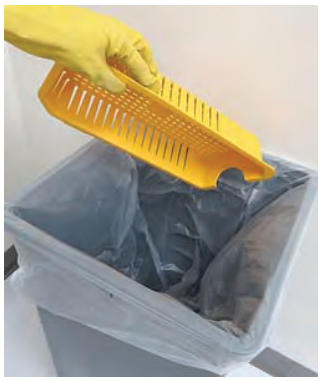
1. Drain and rinse out the recovery tank. See DRAINING TANKS.


If machine is equipped the spray nozzle option, use spray nozzle to rinse out recovery tank. If cleaning detergent was added to solution tank, do not use spray nozzle for rinsing purposes..

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

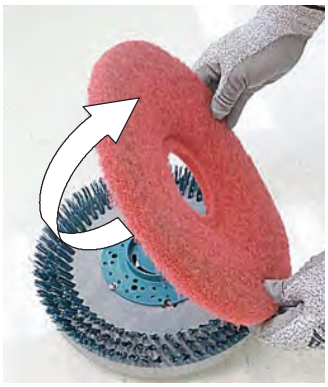
2. Remove the debris tray and empty. Reinstall tray after cleaning.

3. Remove and clean the float shut-off screen. Reinstall screen after cleaning.

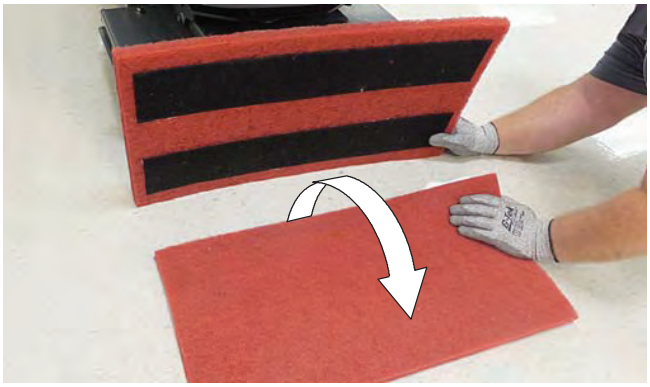

4. Drain and rinse out the solution tank.


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




6. 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.



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

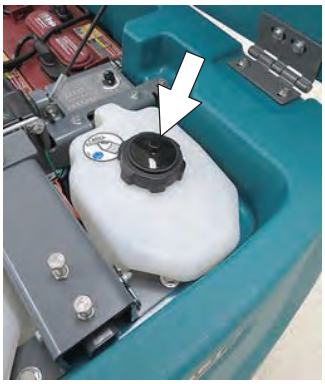

8. Clean scrub head skirt. Check for wear or damage. Replace if worn or damaged.

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

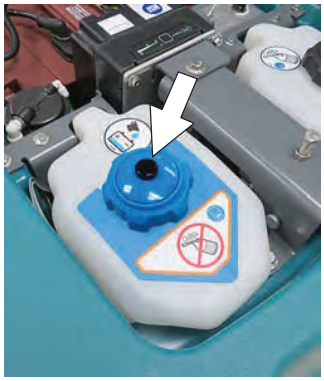
FOR SAFETY: When servicing machine, do not power spray or hose off machine. Electrical malfunction may occur. Use damp cloth.

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

11. Severe environment option - Refill the severe environment tank with a recommended cleaning detergent at full concentration. Replace cap.



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



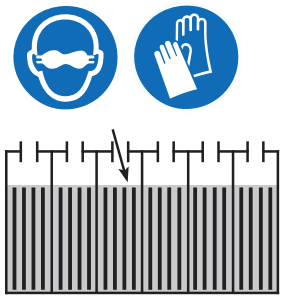
13. Charge batteries. See BATTERIES.

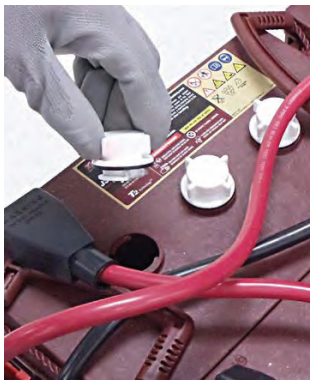
ATTENTION: Do not disconnect battery cables while charger is plugged in, circuit board damage may result.

AFTER WEEKLY USE

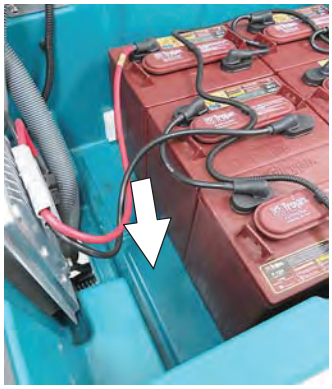
1. Check the electrolyte level in all batteries. See BATTERIES.

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





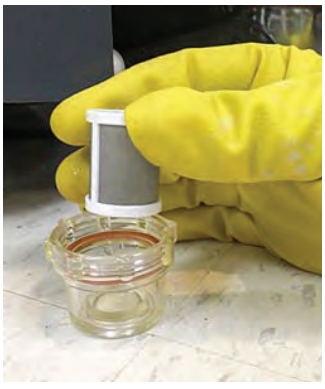
2. Check for liquid in the battery compartment. See BATTERY COMPARTMENT. DRAIN HOSE for further details.



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

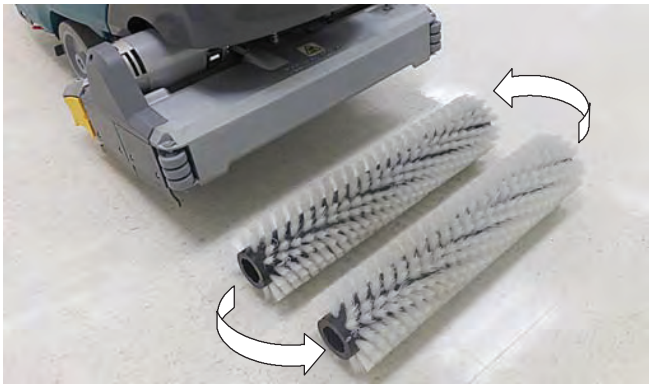
AFTER EVERY 50 HOURS OF USE

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



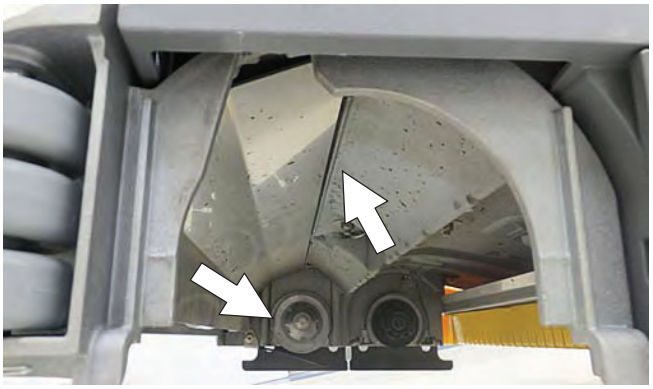
2. Inspect and clean the seal on the recovery tank lid. Replace seal if damaged.

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



4. Check tire pressure if equipped with the pneumatic (air-filled) tires. The proper tire pressure is 60 to 65 psi (415 to 450 kPA).

5. 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.

Lubricate rear casters with a grease gun. Use Lubriplate EMB grease (Tennant part no. 01433-1).

AFTER EVERY 200 HOURS OF USE

Check batteries for loose battery and clean the surface of the batteries, including terminals and cable clamps to prevent corrosion. See BATTERIES.

FOR SAFETY: When servicing machine, all repairs must be performed by trained personnel.

ELECTRIC MOTORS

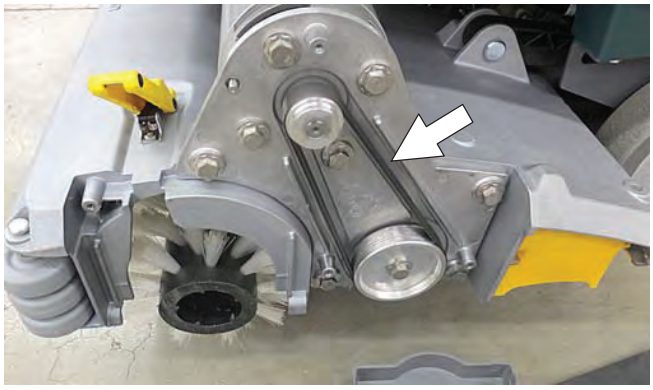
Replace motor carbon brushes as indicated. Contact trained personnel for carbon brush replacement.

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 and remove key.

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



BATTERIES

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

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

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

FLOODED (WET) AND MAINTENANCE FREE SEALED LEAD ACID 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 temperatures between 32ºF/0ºC and 80ºF/27ºC.
- Allow the charger to complete charging the batteries before re-using the machine.
- Maintain the proper electrolyte levels of flooded (wet) batteries by checking battery cell levels weekly.

FOR SAFETY: When servicing machine, battery installation must be done by trained personnel.

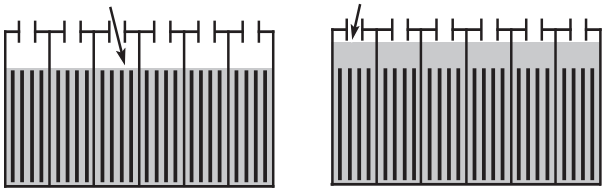
FOR SAFETY: When servicing machine, keep all metal objects off batteries. Avoid contact with battery acid.

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

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 (ALL BATTERY TYPES)

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.

LITHIUM-ION BATTERY PACK

The lithium-ion battery pack is a maintenance-free battery protected by a battery management system (BMS). To achieve the maximum battery life, carefully follow the instructions below:

- Carefully follow the Important Safety Instructions section in the manual when using the Lithium-ion Battery Model.
- Only use the lithium-ion battery charger supplied with machine.
- Charge battery pack in well-ventilated areas. For best charging performance, charge the battery pack in temperatures below 80°F/27°C and above 32°F/0°C. Battery pack may shut down and not take a charge in elevated or freezing temperatures.
- It is recommended to only recharge battery pack when discharge level is fully depleted (i.e. when discharge indicator reaches red light). If red light begins to flash, the scrub function will automatically be disabled. This allows user to use the remaining power to propel the machine back to charging station. Do not storemachine for a long period at depleted level, the battery pack may further discharge to a level that is unrecoverable.
- When the machine shuts down due to a depleted battery pack, do not repeatedly cycle the key on and off. This may cause permanent battery pack damage. Recharge battery pack immediately to avoid damage.
- Allow charge cycle to completely charge battery pack.
- Avoid frequent complete charge cycles if battery pack was not fully depleted.
- Opportunity charging (i.e. partial charge cycle of a half hour or more) is only recommended if discharge level is below 80% (i.e. when discharge indicator is at or beyond second green light).
- Do not operate machine in temperatures above 110°F / 43°C or below -4°F / -20°C. Machine may shutdown if exceed these temperatures.
- When removing or replacing the lithium-ion battery pack, a specific lifting kit is recommended. It's important to use non-conductive lifting straps positioned at all four lift points with straps angled at 45° or greater when hoisting battery pack.
- Contact Tennant Service for lithium-ion battery service and replacement.

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 owners manual for operating instructions. Contact distributor or Tennant for battery charger recommendations.

FOR SAFETY: Do not use incompatible battery chargers as this may damage battery packs and potentially cause a fire.

IMPORTANT NOTICE: 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 (i.e. flooded (wet) lead-acid, maintenance-free, sealed, AGM batteries, etc.), the charger's 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.

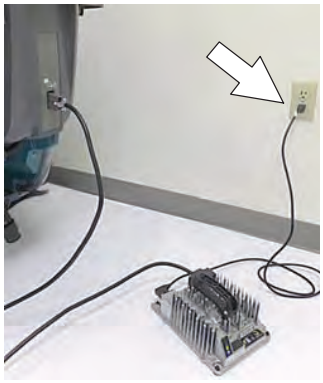
FOR SAFETY: When servicing batteries, stop on level surface, turn off machine, and remove key.

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 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 DC cord into the machine battery charge receptacle then plug the AC power supply cord into a properly grounded wall outlet. Refer to the off-board battery charger owners 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.

NOTE: Lithium-ion Battery Model - If the key is in the off position when charging (recommended), the battery discharge indicator will automatically shut off 5 minutes after the charge cycle has completed to conserve energy. To see the charge status, turn the key to the on position.

Pro-membrane

Pro-panel

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

NOTE: The following instructions only apply to battery chargers that are equipped with machines that use lead-acid batteries.

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 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 machines shipped without batteries and supplied with an Off-Board Charger, the off-board battery charger is set for 180-240 AH wet lead-acid batteries from the factory. The machine is set for GEL batteries as the default. The machine must be reprogrammed to match charger settings (See OFF-BOARD BATTERY CHARGER below)..

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, contact Tennant Service Department.*

OFF-BOARD BATTERY CHARGER:

1. To change the off-board battery charger settings, see OFF-BOARD BATTERY CHARGER SETTINGS.
2. To reprogram the machine to match the off-board charger setting, see below:

T600e Membrane and T600 Pro-Membrane Models - Service application software required, contact service.

T600 Pro-Panel Model - See SELECTING BATTERY TYPE.

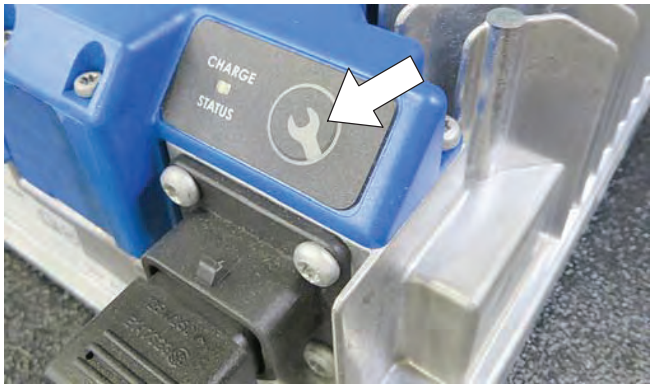
OFF-BOARD BATTERY CHARGER SETTINGS:

NOTE: The following instructions are intended for Delta-Q off-board charger model RC-900-U36 supplied by Tennant.

1. To display the current profile setting, press and release the Select Charge Profile Button. The profile setting is indicated by the number of consecutive green flashes after the initial two red flashes. This code is repeated twice.

   ex. Profile Setting 3: ☼☼☼☼☼
   (Flashes: Red-Red-Green-Green-Green)

   ex. Profile Setting 4-3: ☼☼☼☼☼☼☼ ‖ ☼☼☼
   (Flashes: Red-Red, Green-Green-Green-Green - pause - Green-Green-Green)



2. To enter the battery select mode to choose a new profile setting, press and hold the Select Charge Profile Button for 5 seconds. Fast red flashes will confirm select mode entry.

3. Indicator will then display current profile setting. This is repeated 4 times.

   ex. Profile Setting 3: ☼☼☼☼☼
   (Flashes: Red-Red-Yellow-Yellow-Yellow)

4. To change profile setting, press the Select Charge Profile Button while the current setting is repeating 4 times. Continue to press button until desired profile setting is flashing as described in table.

Profile setting	Battery Description
3	Wet, Trojan 180-240 AH
7	Wet, Trojan 270-360 AH
2-1	Wet, TAB/Enersys 180-260 AH
2-8	Gel, Deka 180-200 AH
4-3	AGM, Discover 200-400 AH
5-1	Gel, Sonnenschein 150-250 AH
1-6-8	TPPL, 12XFC48 / 12XFC58 / 12XFC60

5. To save new setting, press the button for 7 seconds until new setting is displayed by green flashes. The new setting will repeat two times with two red flashed between repeats.

6. Confirm new setting by repeating Step 1.

ON-BOARD BATTERY CHARGER SETTINGS:

T600e Membrane and T600 Pro-Membrane Models - To change the on-board battery charger settings and to reprogram the machine's battery discharge indicator, service application software is required. Contact service.

T600 Pro-Panel Model - To change the on-board battery charger settings, see SELECTING BATTERY TYPE. The battery discharge indicator will automatically reprogram to match battery selection.

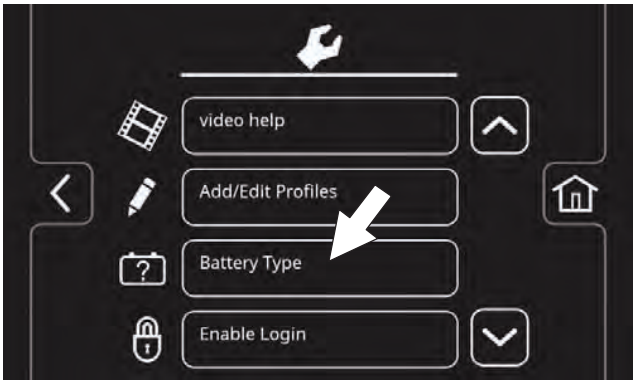
SELECTING BATTERY TYPE
(T600 Pro-Panel model)

NOTE: To perform this procedure, machine must be in supervisor mode. See SUPERVISOR CONTROLS instructions at back of manual.

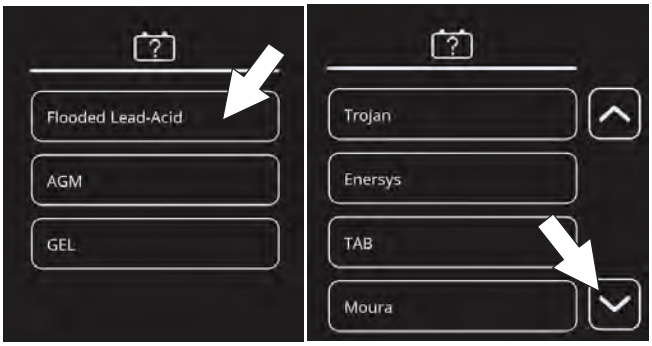
1. Turn the key to the on position.

2. Press the settings button located on the home screen.

3. Press the Battery Type button.



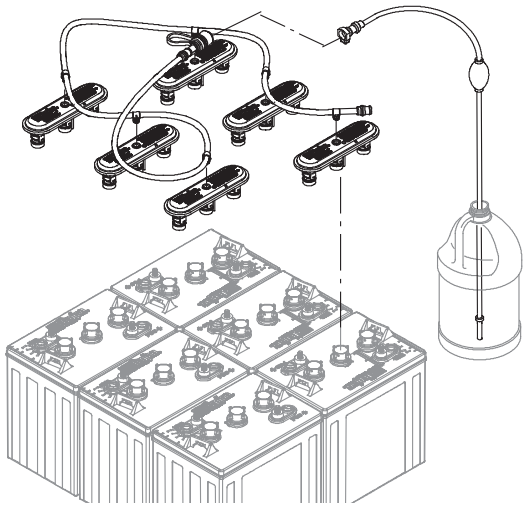
4. Select battery type and brand installed in machine. See battery label to determine type and brand. Press the up and down arrows to scroll through battery selection.



NOTE: The battery charger profile and battery discharge indicator will automatically reprogram when battery type is selected.

HYDROLINK® BATTERY WATERING SYSTEM (Trojan® Battery)

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



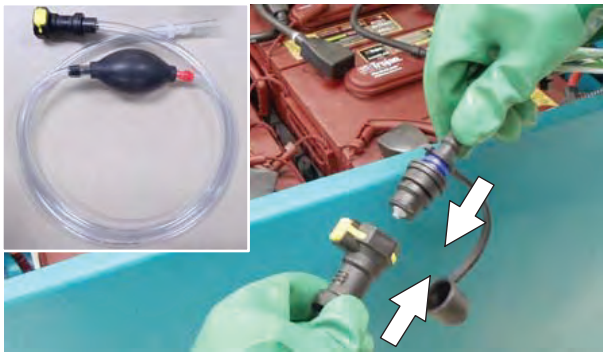
The optional HydroLink battery watering system provides a safe and easy way to maintain the proper electrolyte levels in your batteries. It is designed exclusively for Trojan flooded (wet) lead-acid batteries.

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.

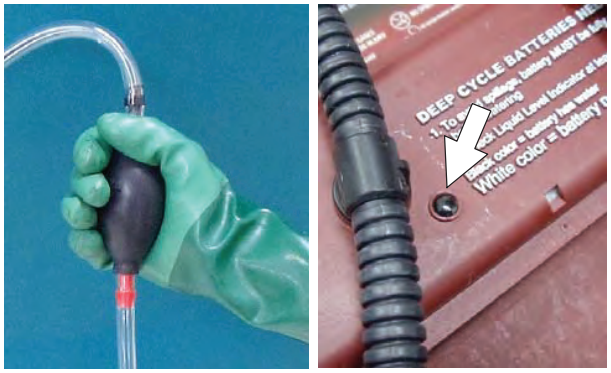
1. Fully charge batteries prior to using the battery watering system. Do not add water to batteries before charging, the electrolyte level will expand and may overflow when charging.
2. After charging batteries, check the battery electrolyte level indicators located on the battery covers. If the level 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.

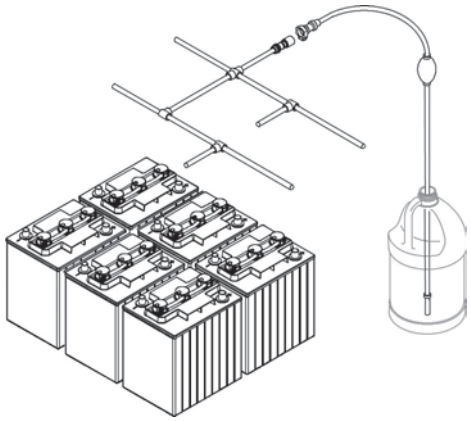
5. Squeeze the bulb on the hand pump hose until firm. The level indicators will turn black when full.



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

MANUAL HAND PUMP BATTERY WATERING SYSTEM (TAB BATTERY)

The following instructions are for machines equipped with the manual 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.

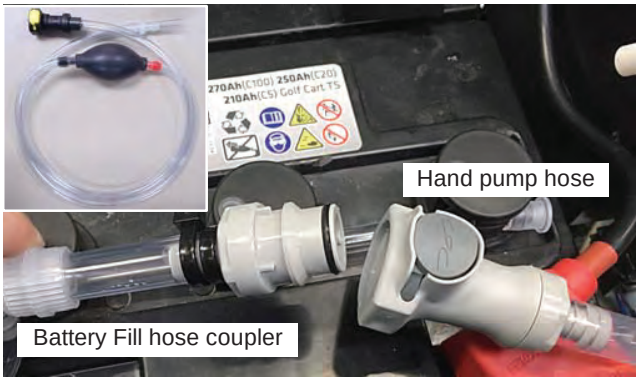
1. Fully charge batteries prior to using the battery watering system. Do not add water to batteries before charging, the electrolyte level will expand and may overflow when charging.

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.

Low

Full

3. Locate the battery fill 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 battery compartment for future use.

MANUAL BATTERY WATERING SYSTEM

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

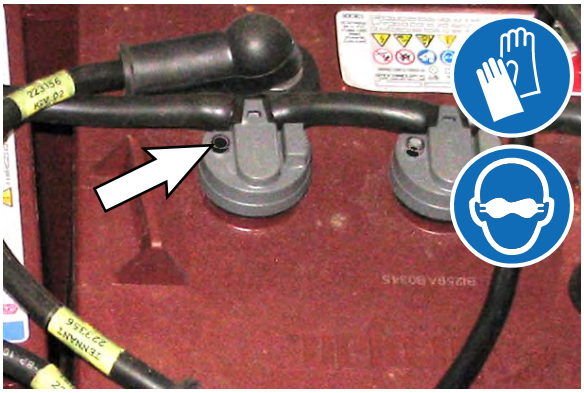
The optional manual battery watering system provides a safe and easy way to maintain the proper electrolyte levels in your batteries. It is designed exclusively for flooded (wet) lead-acid batteries.

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

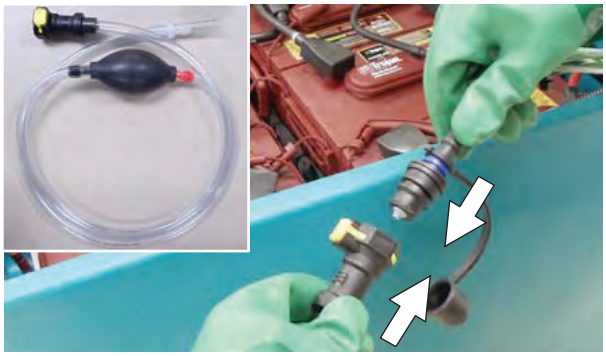
Before using the battery watering system check hoses and connections for damage or wear.

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 black add water as described in the following instructions. If the level indicators are white the electrolyte is at the correct level, no water is required.

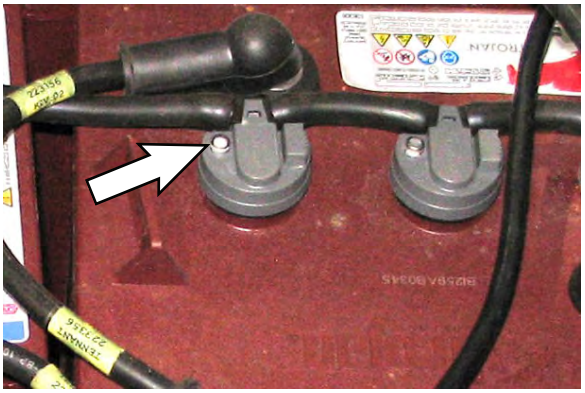


3. Locate the battery fill hose coupler inside the battery compartment. Remove the dust cap and connect the hand pump hose.



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 white when full.



6. After adding water, reinstall the dust cap onto the battery fill hose and store the hand pump hose inside the battery compartment for future use.

AUTOMATIC BATTERY WATERING (Trojan® Battery)

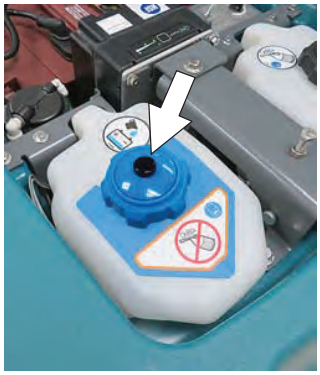
FOR SAFETY: When servicing machine, wear personal protection equipment as needed. Avoid contact with battery acid.

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.



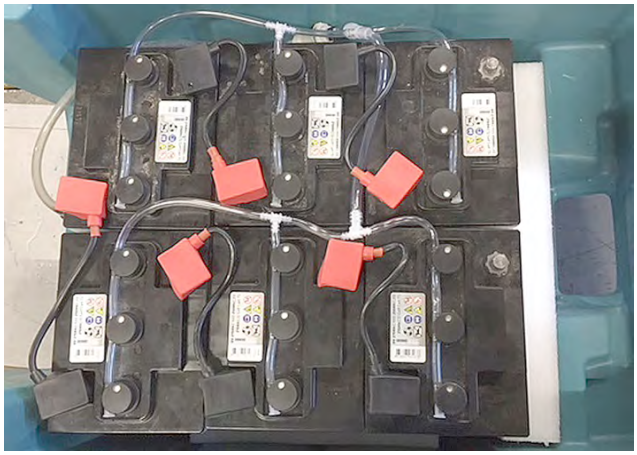
The automatic battery watering indicator also alerts user to add distilled water when tank is empty. See CONTROL PANEL OPERATION for further details.

AUTOMATIC BATTERY WATERING SYSTEM (TAB BATTERY)

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

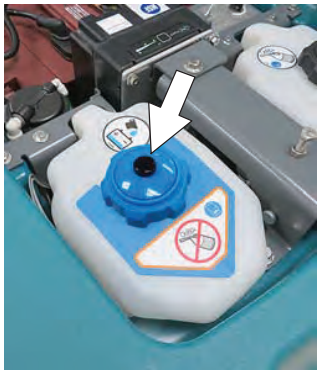
The automatic battery watering system is designed to automatically refill the batteries after the machine reaches a limited number of charge cycles. Do not remove battery caps and manually add water to the batteries.

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 CONTROL PANEL OPERATION for further details.

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

BATTERY COMPARTMENT DRAIN HOSE

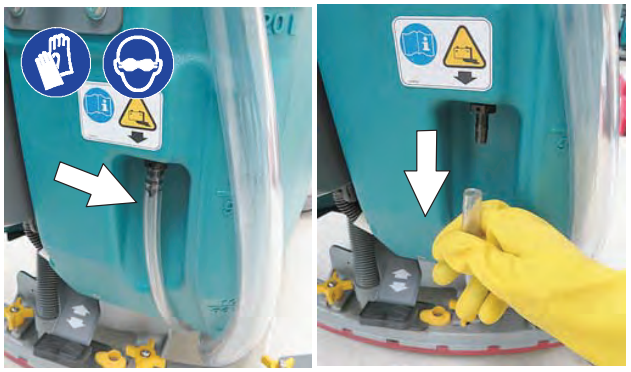
Use the battery compartment drain hose to drain liquid from the battery compartment.

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

FOR SAFETY: When servicing machine, always follow site safety rules when disposing battery compartment liquid.

1. Position rear of machine over area where battery compartment can be safely drained, turn off the machine, and remove the key.
2. Pull the battery compartment drain hose from hose holder and carefully drain liquid from battery compartment.

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



3. Firmly reconnect the drain hose to holder after draining battery compartment.

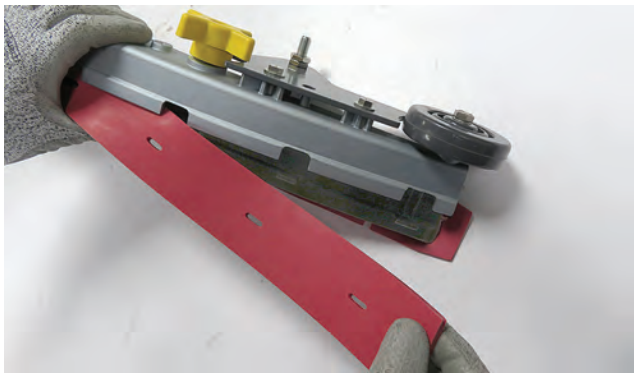
SQUEEGEE BLADE REPLACEMENT AND ADJUSTMENT

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

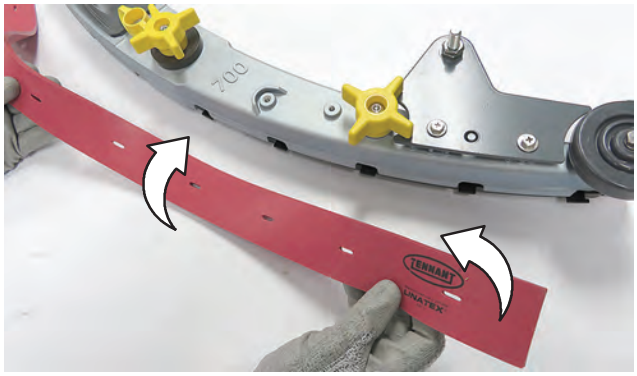
Each squeegee blade has four wiping edges. When the blades become worn, simply rotate the blades end-for-end or top-to-bottom for a new wiping edge. Replace blade if all four edges are worn.

1. Remove the squeegee assembly from the machine.
2. Fully loosen all four star 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.

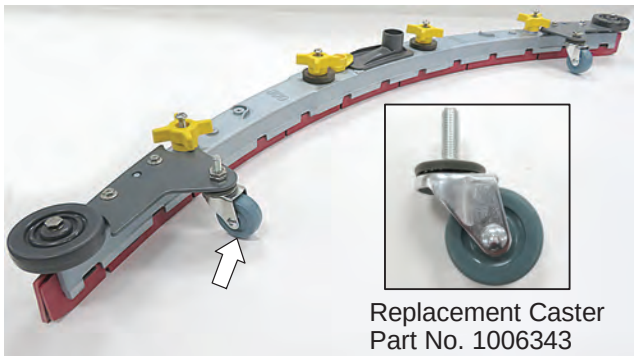


4. Rotate the rear blade to a new wiping edge and reinstall blade. Make sure to align the slots in the blade with retainer tabs.



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

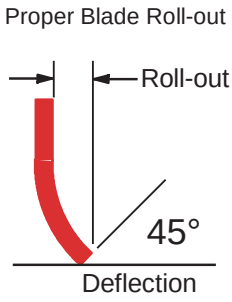
6. Replace the squeegee casters every 5th replacement blade set or 500 hours or 12 months of machine use, whichever comes first. Uneven floor types may require more frequent replacements.



Replacement Caster
Part No. 1006343

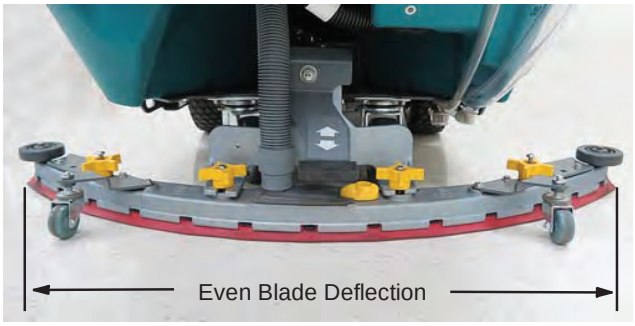
7. Check squeegee blade for proper deflection. Lower squeegee to floor and propel machine forward for a short distance. The rear blade should deflect evenly across the full length of the squeegee at a 45° deflection.

NOTE: The two squeegee casters are factory set and should not require any adjustment.

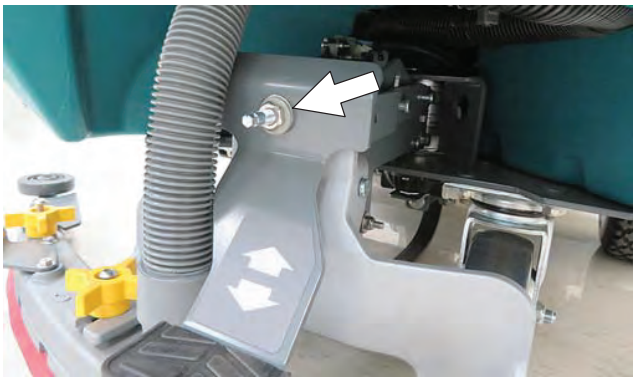


8. If the squeegee blade does not deflect evenly across the full length of the squeegee, the blade pitch may be out of adjustment

NOTE: The blade pitch adjustment is factory set and should not require further adjustment. However, if blade tips are higher or lower than center of squeegee, blade pitch adjustment is required.



9. To readjust blade deflection, loosen locking nut on adjustment shaft and rotate shaft counterclockwise to raise squeegee tips or clockwise to lower squeegee tips. 7 mm and 17 mm wrench required.



BRUSH AND PAD REPLACEMENT

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

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

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

INSTALLING AND REMOVING DISK BRUSHES/ PADS (Disk Scrub Head Model)

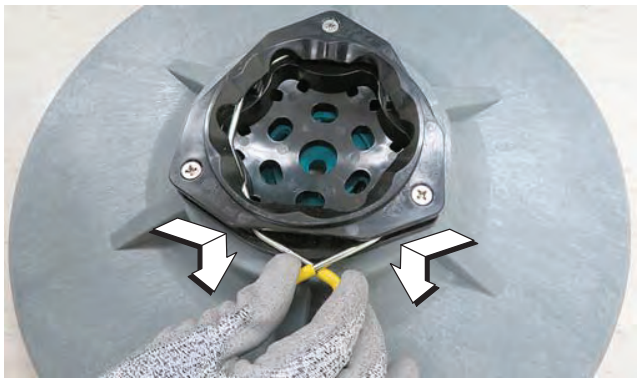
1. Raise scrub head off floor and remove key.

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

2. Attach the pad to the pad driver before installing the driver. Secure pad with center-lock.

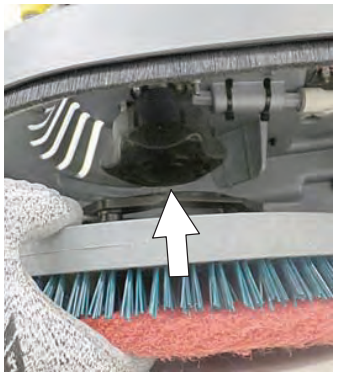
FOR SAFETY: Do not operate machine with pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.

3. Set the yellow spring clips to the open position to make brush installation easier. Press spring clips together then downward to set.

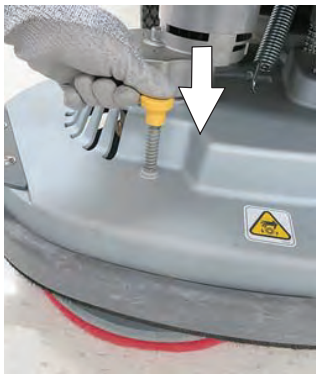


4. Align the pad driver or brush under the motor hub and push it upward to engage hub.

   Replace pads or brushes when they no longer clean effectively or when the bristles on the brush disk are worn to the yellow indicator.

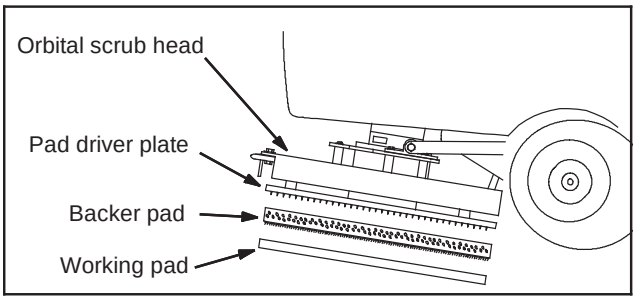


5. To remove the pad drivers/brushes, raise the scrub head and press down on the yellow pad release plunger. Pad will drop to floor.



INSTALLING ORBITAL PADS (Orbital Scrub Head Model)

For best cleaning performance and to avoid damaging the pad driver plate or floor surface, always use backer pad with working pads.



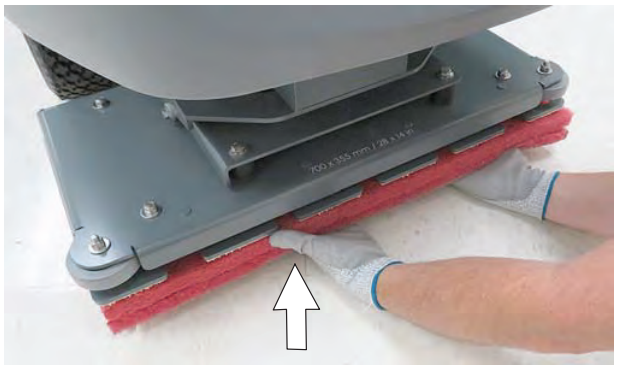
1. Raise scrub head off floor and remove key.

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

FOR SAFETY: Do not operate machine with pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.

2. Attach backer pad, retaining strips facing downward, to working pad.

3. Attach the two pads to the bottom of the scrub head. Make sure pad is centered on scrub head.



INSTALLING CYLINDRICAL BRUSHES (Cylindrical Brush Scrub Head Model)

1. Raise scrub head off floor and remove key.

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

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

3. Attach idler plate to brush end with double row of bristles.

4. Guide brush onto the drive hub and refasten latch.

ec-H2O WATER CONDITIONING CARTRIDGE REPLACEMENT

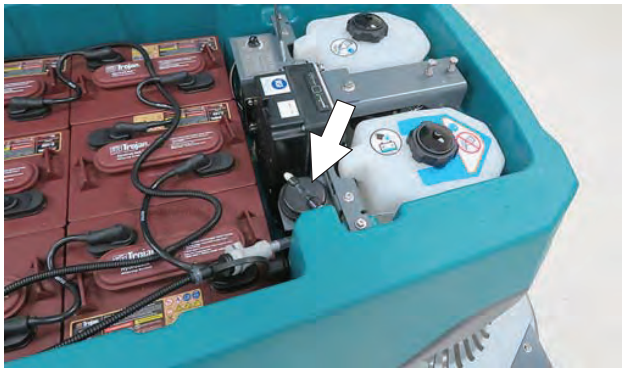
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and remove key.

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's 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 and remove the key.
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.

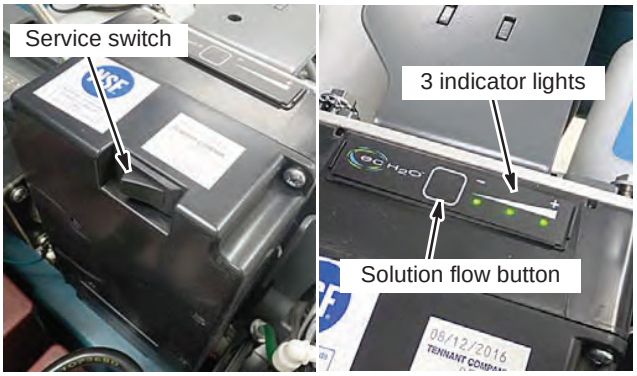
4. Fill in the installation date on the new cartridge label.

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 the following procedure.

   a. Turn key on.
   b. Press and hold the service switch, located on the ec-H2O module, for 10 seconds. After releasing service switch, the three solution flow indicator lights will begin to (ripple) move back and forth.
   c. Within 5 seconds 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.

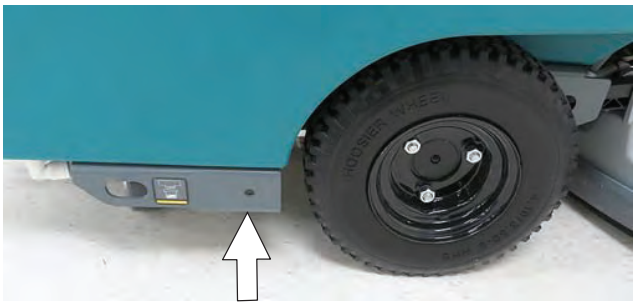


MACHINE JACKING

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

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. Stay clear from the solution tank filter bowl when 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.



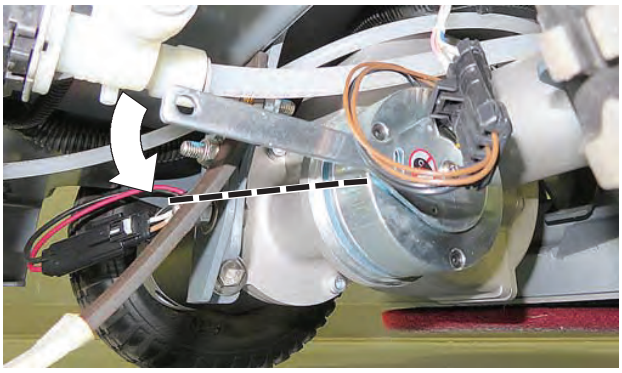
PUSHING AND TRANSPORTING MACHINE

PUSHING MACHINE

If the machine becomes disabled, it can be pushed as describe below.

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

For models equipped with an electronic parking brake system, the brake must be disengaged before pushing machine. To disengage brake, position the brake lever on the transaxle to the down position.



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

Immediately after pushing the machine, re- engage the brake lever to prevent a roll hazard.

NOTE: When brake lever is disengaged, the propel will be disabled and a fault will be detected until lever is re-engaged.

FOR SAFETY: When servicing machine, do not push the machine on inclines with brake disabled.

TRANSPORTING MACHINE

FOR SAFETY: When transporting Lithium-ion Battery Model, contact Tennant or your local regulatory authorities for proper transporting instructions.

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

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

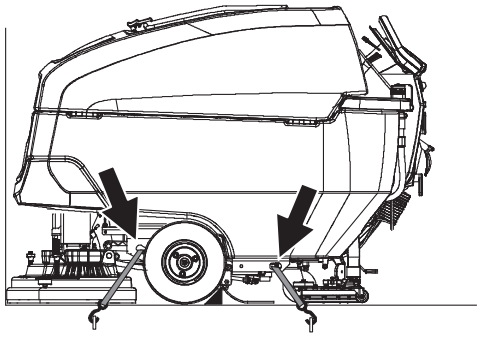
FOR SAFETY: When loading/unloading, use a ramp that can support the machine weight and operator.

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

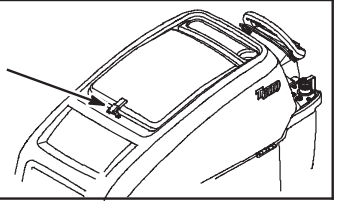
3. Once loaded, position the front of the machine up against the front of the trailer or truck. Lower the scrub head and turn key off.
4. Place a block behind each wheel.
5. Using tie-down straps, secure the machine using the four tie-down brackets located on the machine frame. It may be necessary to 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 rails for tie-down locations, damage may occur.



Optional Transport Kit
Part No. 9042166
Recovery Tank Lid Latch



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. Recharge Lithium-ion battery pack once a year.
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.

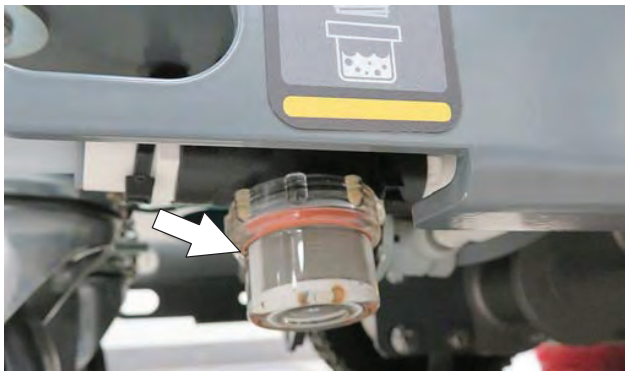
FOR SAFETY: When storing Lithium-ion Battery Model, do not expose battery to temperatures below -22°F/-30°C, above 140°F/60°C. Do not use machine immediately after long-term extreme temperature storage. Before use, return battery module temperature range to 50°F/10°C~95°F/35°C

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

FREEZE PROTECTION

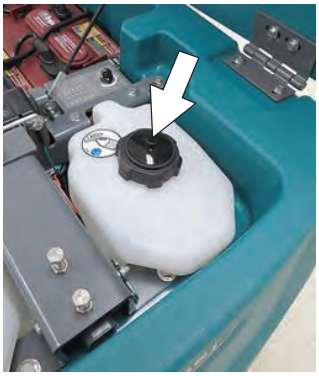
Storing machine in freezing temperatures.

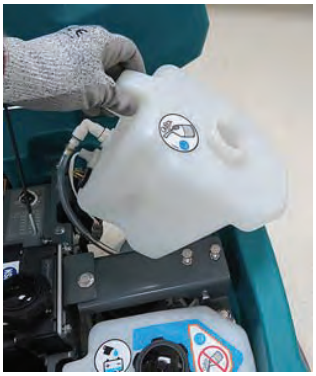
1. Completely drain solution tank and recovery tank.
2. Empty the water from the solution tank filter located under machine. Replace filter.



3. Pour 1 gallon / 4 liters of propylene glycol based recreational vehicle (RV) antifreeze into the solution tank.

   Models equipped with optional Severe Environment detergent tank - Lift tank from machine and empty the detergent from tank. Return tank. Pour a 1/4 gallon / 1 liter of propylene glycol based recreational vehicle (RV) antifreeze into the detergent 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.

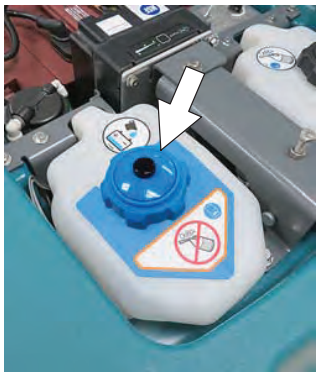
   Models equipped with ec-H2O system and Severe Environment mode - Set the detergent ratio dial to the highest flow rate. Turn machine on and set solution flow rate to high. Operate ec-H2O scrubbing and press the severe environment button to cycle the antifreeze through both systems. Turn machine off when antifreeze is visible on the floor. This may take up to two minutes.

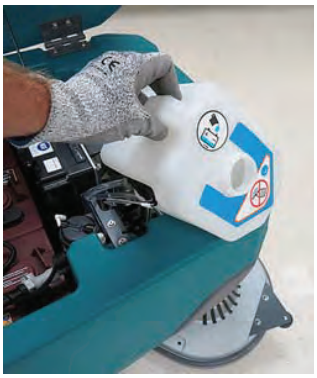
   Models equipped with ec-H2O system - Turn machine on and set the solution flow rate to high and operate ec-H2O scrubbing to cycle antifreeze through system. Turn machine off when antifreeze is visible on the floor. This may take up to two minutes.

   Models equipped with spray nozzle option - Operate the spray nozzle to cycle antifreeze through pump.

5. Models equipped with optional automatic battery watering tank - Lift tank from machine and empty the water from tank.

   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 and from the optional Severe Environment detergent tank. Add clean water to solution tank and to optional detergent tank and operate the machine and spray nozzle to flush system.

7. Refill the automatic battery watering tank with distilled water, if equipped.

TROUBLESHOOTING

Problem	Cause	Solution
Service indicator icon is flashing	Machine or on-board battery charger fault has been detected	See SERVICE INDICATOR CODES
ec-H2O icon is red or flashing red	ec-H2O system fault has been detected	See SERVICE INDICATOR CODES
ec-H2O icon is flashing red and blue	ec-H2O cartridge has reached maximum water usage or expiration	Change ec-H2O cartridge
Machine will not operate	Emergency shut-off button activated	Turn button to reset
	Machine fault detected	See SERVICE INDICATOR CODES
	Batteries discharged	Recharge batteries
	Loose battery cable(s)	Tighten loose cables
	Faulty battery(s)	Replace battery(s)
	Faulty key switch	Contact service
	Faulty start bail switch	Contact service
	Circuit breaker tripped	Reset circuit breaker
	Faulty control board	Contact service
On-board battery charger will not operate	Plug not connected to power supply	Check plug connection
	Batteries over discharged	Replace batteries
	Battery charger fault detected	See SERVICE INDICATOR CODES
	Faulty charger	Replace charger
	Faulty power supply cord	Replace power supply cord
Machine will not propel	Propel fault has been detected	See SERVICE INDICATOR CODES
	Circuit breaker tripped (T600e)	Reset circuit breaker
	Electronic parking brake system is disengaged (option)	See PUSHING AND TRANSPORTING MACHINE
	Faulty propel motor or wiring	Contact service
	Worn carbon brushes in motor	Contact service
Brush motor will not operate	Brush motor fault has been detected	See SERVICE INDICATOR CODES
	Faulty pad motor or wiring	Contact service
	Circuit breaker tripped (T600e)	Reset circuit breaker
	Worn carbon brushes in motor	Contact service
	Broken or loose belt (cylindrical brush model)	Contact service
Vacuum motor will not operate	Squeegee assembly is raised off floor	Lower squeegee assembly to floor
	Vacuum motor fault has been detected	See SERVICE INDICATOR CODES
	Faulty vacuum motor or wiring	Contact service
	Circuit breaker tripped	Reset circuit breaker

Problem	Cause	Solution
Poor scrubbing performance	Debris caught in brush/pad	Remove debris
	Worn brush/pad	Replace brush/pad
	Incorrect brush pressure	Adjust brush pressure
	Wrong brush/pad type	Use correct brush/pad for application
	Low battery charge	Recharge batteries
	Uneven brush pressure	Scrub head/brushes not level. Contact service
	Broken or loose belt (cylindrical brush model)	Contact service
Trailing water - poor or no water pickup	Full recovery tank or excessive foam buildup	Drain recovery tank
	Loose drain hose cap or flow control valve is open	Replace cap or close flow control valve on drain hose
	Worn squeegee blades	Rotate or replace squeegee blades
	Squeegee casters are worn	Replace casters
	Squeegee blade deflection out of adjustment	Adjust blade deflection
	Clogged drip trap (Squeegee assembly)	Remove cover and clean
	Clogged squeegee assembly	Clean squeegee assembly
	Loose vacuum hose connection	Secure vacuum hose connection
	Clogged vacuum hose	Flush vacuum hose
	Damaged vacuum hose	Replace vacuum hose
	Clogged float shut-off screen in recovery tank	Clean screen
	Recovery tank lid not completely closed	Check lid for obstructions
	Defective seals on recovery tank lid	Replaced seal
Little or no solution flow	Empty solution tank	Refill solution tank
	Low solution flow rate set	Increase solution flow rate
	Clogged solution tank filter	Clean filter
	Plugged solution supply line	Flush solution supply line
Severe Environment tank does not dispense detergent	No detergent	Refill tank
	Faulty float switch	Contact service
	Defective pump	Contact service
	Defective pump potentiometer	Contact service
	Faulty control panel	Contact service
Automatic battery watering tank does not dispense water	Tank is empty	Refill tank
	Defective pump	Contact service
	Pump not priming	Contact service
	Faulty control board	Contact service

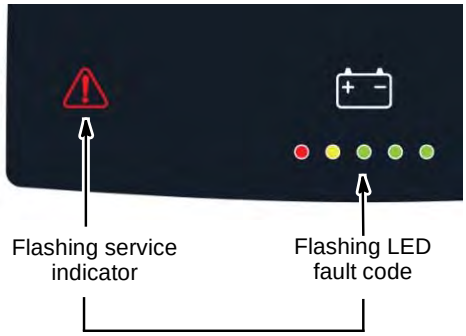
Problem	Cause	Solution
Short run time	Low battery charge	Charge batteries
	Batteries need maintenance	See BATTERIES
	Defective battery or end of battery life	Replace batteries
	Battery discharge indicator (BDI) programmed incorrectly	See CHARGING BATTERIES
	Faulty charger	Replace battery charger
	Brush pressure set too high	Lower brush pressure
Solution tank auto-fill does not function properly	Coupler not properly connected	Connect coupler
	Faulty shut-off float	Replace float. Contact service
	Machine not on level surface	Machine must be on level surface
Excessive scrub head noise (Orbital model)	Damaged scrub head isolators	Replace isolators. Contact service

TROUBLESHOOTING

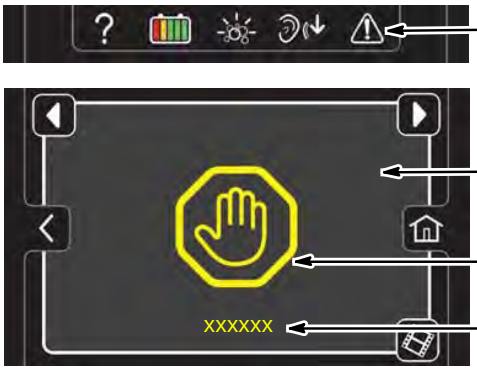
FAULTS AND WARNINGS

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



Pro-Panel Controls (LCD)



BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ☼ ☼ ☼ ☼	0xFFF0	E-Stop Activate Fault or Optional Brake Mechanically Released	1. E-Stop pressed. 2. Parking brake lever is mechanically released (Optional). 3. Large white i-Drive connector unplugged. 4. Large white i-Drive connector pin 7 disconnected. 5. i-Drive power wire unplugged. 6. Scrub Controller board connector J12 pin 2 disconnected. 7. Scrub controller board connector J12 pin 1 disconnected. 8. Brake switch bypass disconnected.	Release E-Stop button and power cycle machine. If that does not clear fault, check connections/wiring. Ensure solenoid brake (if equipped) is not mechanically disengaged.
● ● ● ☼ ●	0x0201	Actuator Open Warning	Wiring, connector, or control board issue on actuator.	1. Check connectors and connector pins.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
● ● ● ☼ ☼	0x0101	Scrub Motor 1 Open Warning	1. Wiring, connector, or control board issue on scrub motor. 2. J3 connector on scrub controller board unplugged. 3. Scrub controller board power disconnected. 4. Scrub controller inline power fuse defective/blown. 5. Scrub controller board problem. 6. Main contactor disconnected.	1. Check connections. Board gets power from key switch, main contactor, and battery. 2. If connections are good, replace control board.
	0x0111	Scrub Motor 2 Open Warning	1. Wiring, connector or control board issue on scrub motor. 2. J2 connector on scrub controller board unplugged. 3. Scrub controller board power disconnected. 4. Scrub controller inline power fuse defective/blown. 5. Scrub controller board problem. 6. Main Contactor disconnected.	1. Check connections. Board gets power from key switch and battery. 2. If connections are good, replace control board.
☼ ☼ ☼ ☼ ●	0x0102	Scrub Motor 1 Voltage/Power Loss	1. Scrub Controller board not detecting power. 2. Intermittent control board power loss.	1. Check wiring, main contactor, and/or inline fuse for bad connection.
	0x0112	Scrub Motor 2 Voltage/Power Loss	1. Scrub Controller board not detecting power. 2. Intermittent control board power loss.	1. Check wiring, main contactor, and/or inline fuse for bad connection.
	0x8001	Scrubbing Feature Disabled Remotely	1. Scrubbing feature remotely disabled by Tennant Admin.	1. Contact Tennant Admin/ Service to remotely enable scrubbing feature.
	0xFF13	Power On Both The Keyswitch And Charger Power Inputs	1. Power detected at both key switch input and charger input on user interface board.	1. Check wiring between charger and user interface module. 2. Test for power at key switch input and charger input on user interface board. If power not present at both inputs, replace user interface. 3. If power is measured at both inputs, check integrity of charger bypass circuit components (M6 bypass relay and off-board charger bypass switch).
● ☼ ☼ ● ☼	0x0208	Actuator stalled	1. Object/debris blocking actuator. 2. Mechanical issue with scrub head.	1. Clear blockage from actuator.
● ☼ ● ● ☼	0x0301	Valve Open Warning	1. Wiring, connector or control board issue with valve. 2. Scrub controller board connector J7 pin 2 disconnected.	1. Check connections/wiring.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
● ☼ ● ☼ ☼	0x0303	Valve Over Current Fault	1. Valve connections shorted. 2. Faulty valve. 3. Scrub controller board damaged.	1. Check connections/wiring. 2. Check supply voltage to control board. Should be equal to B+. 3. Check voltage drop across main contactor. 4. Replace valve. 5. Replace scrub controller board.
● ● ☼ ● ●	0x0501	Vacuum Motor Open Warning	1. Wiring, connector or control board issue on the vacuum. 2. J4 connector on scrub controller board unplugged. 3. Scrub controller board power disconnected. 4. Scrub controller inline power fuse defective/blown.	1. Check connections. Board gets power from key switch, main contactor, and battery. 2. If connections are good, replace control board.
● ● ☼ ● ☼	0x0601	Detergent Pump Open Warning	1. Wiring, connector, or control board issue on detergent pump. 2. Detergent pot connector unplugged. 3. Detergent pot connector Pin 5 or 6 disconnected. 4. Scrub controller board J7 pin 2 or 6 disconnected.	1. Check connections/wiring.
● ● ☼ ☼ ●	0x0910	Propel Breaker Tripped Fault	1. Circuit breaker tripped. 2. Issue with propel motor, wiring or i-Drive module. 3. Large white i-Drive connector unplugged. 4. Large white i-Drive connector pin 7 disconnected. 5. i-Drive power wire unplugged. 6. Scrub controller board connector J12 unplugged and bail activated. 7. Scrub controller board connector J12 pin 7 disconnected.	1. Disconnect battery and reset circuit breaker. 2. Check connections/wiring.
● ● ☼ ☼ ☼	0x0901	Propel Motor Open Warning	1. Motor on propel i-Drive is not connected.	1. Check connections/wiring.
☼ ● ● ● ☼	0x0900	Propel i-Drive Fault	1. Generic i-Drive fault. 2. Large white i-Drive connector pin 1, 2, or 3 disconnected. 3. User Interface speed pot connector unplugged.	1. Power cycle machine. 2. Check connections/wiring.
	0x090A	Propel Tiller Low Reference	Propel controller not configured properly.	1. Check propel controller for proper configuration with Tennant Service Application software.
			Controller detects throttle low reference is outside of normal range. Throttle low reference is located on pin 8 of 14-way tiller connector.	1. Check throttle potentiometer, connectors, and relevant wiring to controller. 2. If trip is still present after potentiometer, connectors, and wiring have been checked, controller may be defective. Replace defective controller.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ● ● ☼ (continued)	0x0903	Propel i-Drive Communication Lost Warning	1. Large white i-Drive connector pin 5 disconnected. 2. Small white i-Drive connector unplugged. 3. Small white i-Drive connector pin 3 or 4 disconnected. 4. Scrub controller board connector J12 or J7 unplugged. 5. Scrub controller board J12 pin 1 or 2 disconnected. 6. Scrub controller board J7 pin 7 disconnected. 7. Smaller of the two console connectors unplugged. 8. User interface board connector J4 or J5 unplugged.	1. Power cycle machine. 2. Check connections/wiring.
	0X0904	Propel Power Cycle Needed	1. i-Drive just programmed by service tech with new parameters. 2. i-Drive unit is faulty.	1. Power cycle machine to clear. 2. Replace i-Drive.
	0x0905	Propel Current Limit Fault	1. Propel motor drawing too much current.	1. Power cycle machine. 2. Check propel wheels and transaxle assembly for obstructions or anything under machine that may be causing excess drag/friction. 3. Check scrub head down pressure. Reduce if necessary. 4. Operate machine on level surface and avoid prolonged use on ramps and inclines.
	0x0906	Propel Motor Short Low Fault	1. Motor connections are shorted to (-) voltage. 2. Higher current draw than hardware design limit.	1. Check motor wires.
	0x0907	Propel Motor Short High Fault	1. Motor connections are shorted to (+) voltage. 2. Higher current draw than hardware design limit.	1. Check motor wires.
	0x0918	Propel Relay Interlock Fail	1. Propel voltage at propel controller too low or unstable. 2. The i-Drive hardware is damaged.	1. Check wiring at propel controller. 2. Check voltage drop across main contactor, and replace if voltage drop detected. 3. If no voltage drop across main contactor, replace i-Drive.
	0x0920	Propel Speed Control Wiper Warning	1. Propel speed control wiper out of bounds. 2. Speed control wiper is failing.	1. Check wiring to speed control potentiometer. Set speed control wiper to minimum or maximum speeds. 2. Power cycle machine.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ● ● ● ☼ (continued)	0x0921	Propel Speed Control Reference Warning	1. Propel speed control reference incorrect.	1. Check wiring to speed control potentiometer. 2. Power cycle machine.
	0x0922	Propel Throttle Trip Reference Warning	1. Propel throttle trip reference incorrect.	1. Check wiring to the bail sensor. 2. Power cycle machine.
	0x0923	Propel High Battery Voltage 1 Warning	1. Battery voltage at propel controller is too high.	1. Occurs when controller detects battery voltage has exceeded approximately 45V on 36V controllers. Check condition of batteries, connectors and relevant wiring to controller. 2. If trip is still present after the batteries, connectors and wiring have been checked, replace controller.
	0x0924	Propel High Battery Voltage 2 Warning	1. Battery voltage at propel controller is too high.	1. Check battery wires going to i-Drive. 2. Power cycle machine.
	0x0925	Propel Inhibit 1 Warning	1. Propel controller inhibit 1 fault tripped.	1. Power cycle machine.
	0x0926	Propel Inhibit 2 Warning	1. Propel controller inhibit 2 fault tripped.	1. Power cycle machine.
	0x0927	Propel Inhibit 3 Warning	1. Propel controller inhibit 3 fault tripped.	1. Power cycle machine.
	0x0928	Propel Watchdog Warning	1. Propel controller watchdog tripped.	1. Power cycle machine.
	0x0929	Propel Bad Setting Warning	1. A bad setting programmed to i-Drive.	1. Reprogram i-Drive.
	0x093A	Propel Trip Sense Active	1. Propel voltage at propel controller too low or unstable. 2. The i-Drive hardware is damaged.	1. Check wiring at propel controller. 2. Check voltage drop across main contactor, and replace if voltage drop detected. 3. If no voltage drop across main contactor, replace i-Drive.
	0x0930	Propel ROM Check Warning	1. The i-Drive memory is corrupted.	1. Replace damaged i-Drive.
	0x0931	Propel EEPROM Check Warning	1. The i-Drive settings are corrupted.	1. Replace damaged i-Drive.
	0x0932	Propel Internal 12V Error	1. The i-Drive hardware is damaged.	1. Replace damaged i-Drive.
	0x0933	Propel Low Battery	1. Battery voltage at propel controller is very low.	1. Ensure batteries are fully charged. 2. Check cables. 3. If voltage supplied to i-Drive is within range and issue persists, replace i-Drive.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ● ● ☼ (continued)	0x0934	Propel Very Low Battery	1. Battery voltage at propel controller is extremely low.	1. Ensure batteries are fully charged. 2. Check cables. 3. If voltage supplied to i-Drive is within range and issue persists, replace i-Drive.
	0x0950	Propel Incorrect Profile	1. Software profile in i-Drive does not match programmed machine configuration. 2. Bad setting programmed to i-Drive.	1. Reprogram i-Drive configuration via Tennant Service Diagnostics PC application.
	0x0951	Propel Module Bail Switch Timeout	1. 'Propel Active' signal from i-Drive not being detected by user interface.	1. Use Service Diagnostics tool to verify proper i-Drive configuration. 2. Verify bail switch is working properly and connected to user interface. 3. Verify bail switch signal is being received at P1-1 on i-Drive. 4. Verify 'Propel Active' output (P1-3, wire 70/TAN) is connected to user interface J7-4, and that signal is low when machine is stationary and high when machine is moving. 5. If problem persists, replace i-Drive. 6. If problem persists, replace user interface board.
☼ ● ● ☼ ☼	0x0103	Scrub Motor 1 Hardware Over Current Fault	1. Current draw higher than expected. 2. Some higher current draw than hardware design limit.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0104	Scrub Motor 1 Software Over Current Fault	1. Current draw higher than expected.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0105	Scrub Motor 1 Over Current 2 Fault	1. Current draw higher than expected.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0106	Scrub Motor 1 Short Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check wire harness and repair as needed.
	0x0109	Scrub Motor 1 Over Heat Fault	1. Motor is drawing too much current and is overheating.	1. Inspect scrub brushes to see if they are completely worn. 2. If scrub brushes are not worn, motor is defective. Replace scrub motor.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ☼ ● ☼ ☼	0x0113	Scrub Motor 2 Hardware Over Current Fault	1. Current draw higher than expected. 2. Some higher current draw than hardware design limit.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0114	Scrub Motor 2 Software Over Current 1 Fault	1. Current draw higher than expected.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0115	Scrub Motor 2 Over Current 2 Fault	1. Current draw higher than expected.	1. Verify floor, pad, and down pressure combination are appropriate for machine. 2. Check actuator.
	0x0116	Scrub Motor 2 Short Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1 Check wire harness and repair as needed.
	0x0119	Scrub Motor 2 Over Heat Fault	1. Motor is drawing too much current and is overheating.	1. Inspect scrub brushes to see if they are completely worn. 2. If scrub brushes are not worn and head is not orbital head, motor is defective. Replace scrub motor. If head is orbital, eccentric or motor might be bad.
☼ ● ☼ ● ☼	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.	1. Release bail or bail obstruction before turning on machine.
☼ ● ☼ ☼ ●	0x0107	Scrub Motor 1 FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0117	Scrub Motor 2 FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0207	Actuator FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0307	Valve FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0507	Vacuum FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0607	Detergent Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0617	Wand Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.
	0x0B17	Battery Watering Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ● ☼ ☼ ☼	0x0503	Vacuum Over Current Fault	1. Current draw higher than expected.	1. Check harness and vacuum.
	0x0504	Vacuum Over Current 1 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.
	0x0505	Vacuum Over Current 2 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.
	0x0506	Vacuum Shorted Load Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check harness and vacuum.
☼ ☼ ● ● ●	0x0613	Wand Pump Over Current Fault	1. Current draw higher than expected. 2. Some higher current draw than hardware design limit.	1. Check harness and pump.
	0x0614	Wand Pump Over Current 1 Fault	1. Current draw higher than expected.	1. Verify wand pump load, damage and/or usage conditions.
	0x0615	Wand Pump Over Current 2 Fault	1. Current draw higher than expected.	1. Verify wand pump load, damage and/or usage conditions.
	0x0616	Wand Pump Short Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check wire harness and repair as needed.
☼ ● ● ● ●	0x0306	Valve Short Fault	1. Wiring, connector, or control board issue with valve. 2. Faulty valve.	1. Check connections/wiring. 2. If all wiring and connections are good, disconnect wiring from solenoid valve and check for solenoid coil resistance. Resistance measured should be 120Ω +/-10%. If no resistance is measured (short), valve coil is damaged/shorted. Replace solenoid valve. 3. If valve is good, driver may be damaged and board replacement is necessary.
	0x0611	Wand Pump Open Warning	1. Wiring, connector or control board issue on the wand pump.	1. Verify wand pump is connected to machine harness and pump is functional.
☼ ☼ ● ● ☼	0x0603	Detergent Pump Over Current Fault	1. Current draw higher than expected.	1. Check harness and pump.
	0x0604	Detergent Pump Over Current 1 Fault	1. Current draw higher than expected.	1. Verify detergent pump load, damage and/or usage conditions.
	0x0605	Detergent Pump Over Current 2 Fault	1. Current draw higher than expected.	1. Verify detergent pump load, damage and/or usage conditions.
	0x0606	Detergent Pump Shorted Load Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check harness, pump and control boards.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
☼ ● ● ☼ ●	0x0B09	Battery Watering Pressure Switch Open Fault	1. Battery watering pressure switch unexpectedly detected as OPEN by ABW control module, meaning switch is disconnected or faulty.	1. Check battery watering pressure switch wiring, ensure switch is connected and wiring back to control module is intact. 2. Disconnect battery watering pressure switch from system and verify contacts are closed. 3. If problem persists, replace battery watering pressure switch.
	0x0B11	Battery Watering Pump Open Warning	1. Wiring, connector, or control board issue on battery watering pump.	1. Check if battery watering pump is connected to machine harness. 2. Verify pump is operable.
	0x8002	ABW Feature Disabled Remotely	1. ABW feature remotely disabled by Tennant Admin.	1. Contact Tennant Admin/Service to remotely enable ABW feature.
☼ ☼ ● ☼ ●	0x0B01	Battery Watering System Timed Out Warning	1. System is running longer than it should.	1. Check for leaks in pump housing and battery vents. 2. Check for water in battery tray and on floor around machine. 3. Replace stuck open valves. 4. Check if batteries are defective.
	0x0B13	Battery Watering Pump Over Current Fault	1. Current draw higher than expected.	1. Check harness and pump.
	0x0B14	Battery Watering Pump Over Current 1 Fault	1. Current draw higher than expected.	1. Verify battery watering pump load, battery watering tank contents, damage, and/or usage conditions.
	0x0B15	Battery Watering Pump Over Current 2 Fault	1. Current draw higher than expected.	1. Verify battery watering pump load, battery watering tank contents, damage, and/or usage conditions.
	0x0B16	Battery Watering Pump Shorted Load Fault	1. Shorted load condition 2. Some higher current draw than hardware design limit.	1. Check harness, pump, and control boards.
☼ ☼ ☼ ● ☼	0x1006	Scrub Head Imbalance	1. Scrub head motor currents unbalanced.	1. Power cycle machine. 2. Check brushes for uneven wear. Replace brush(es) as necessary. 3. Check wire/cable connections to scrub motors.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
● ☼ ☼ ☼ ●	0xFF20	Scrub Controller 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 CAN open troubleshooting techniques. 3. Replace control board.
	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. 4. ABW connector unplugged. 5. ABW connector pin 11 or 12 disconnected. 6. ABW connector power pin disconnected.	1. Power cycle machine. 2. No communication with a network module. Use CAN open troubleshooting techniques. 3. Check connections.
● ● ● ● ☼	0xFFFF	Unknown Fault	1. Unknown.	1. Power cycle machine. 2. Replace control board.
	0x0B00	ABW Generic Fault	1. Unrecognized fault code received. User Interface firmware does not align with ABW node firmware.	1. Use Service Diagnostics tool to ensure user interface and ABW firmware are up to date.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (T600 Only)	Fault Condition	Reason	Correction
NA	NA	Hour Meter Not Powered	1. Hour meter wires disconnected. 2. Scrub Controller board connector J7 pin 11 disconnected.	1. Check connections/wiring.
NA	NA	Bail Not Responding	1. Bail sensor is unplugged. 2. User Interface board defective.	1. Check connections/wiring. 2. Replace user interface board.
NA	NA	Scrub Head Switch Not Functioning	1. Scrub head switch disconnected. 2. Faulty wiring. 3. Scrub controller board connector J6 pin 5 disconnected. 4. Scrub Controller board connector J6 pin 2 disconnected.	1. Check connections/wiring.
NA	NA	Vacuum Squeegee Switch Not Functioning	1. Vacuum squeegee switch disconnected. 2. Faulty wiring. 3. Scrub Controller board connector J6 pin 8 disconnected. 4. T600e - Vacuum fan relay	1. Check connections/wiring. 2. T600e - Check vacuum fan relay.
NA	NA	Reverse Switch Inoperable	1. Reverse switch connector unplugged. 2. Large white i-Drive connector pin 12 or 13 disconnected.	1. Check connections/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.	1. Check connections/wiring.
NA	NA	No Charge Mode LEDs	User Interface board is not receiving power from charger at J7-9.	1. 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.

ON-BOARD BATTERY CHARGER SERVICE INDICATOR CODES

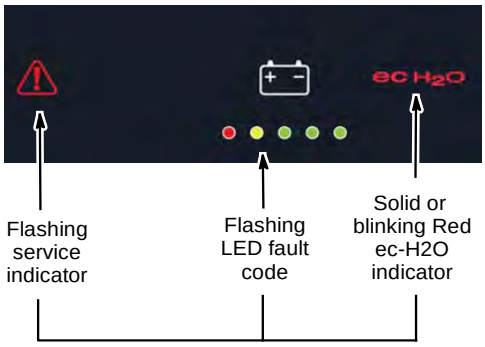
LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ☼ ☼ ● ●	0xF100	Charger Generic Warning	Charger error condition.	Check charger and battery connections.
	0xF104	Charger Timer Phase 1 Warning	Batteries unable to charge correctly.	Check charger and battery connections.
● ☼ ☼ ● ●	0xF101	Charger No Load Warning	Charger is not connected to battery pack.	Check cable connections. If fault code persists, replace charger.
● ☼ ● ● ●	0xF102	Charger Overheat Warning	Charger overheated.	Let charger cool. Move machine to well ventilated area. If fault persists, replace charger.
● ☼ ☼ ☼ ●	0xF103	Charger CAN Communication Fault	1. Control boards 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 CAN open troubleshooting techniques. See page 116.

ABW (AUTOMATIC BATTERY WATERING) SYSTEM ICON INDICATOR CODES

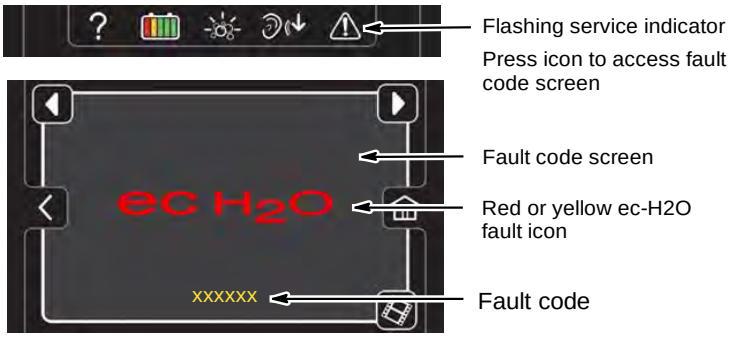
Fault Code Icon Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
 Solid	0x0B05	Battery Watering Plumbing Warning	1. Battery watering process completed earlier than expected.	1. Check ABW hoses for kinks/ obstructions. In some conditions this may occur if battery did not need water when system ran. If this is the case, key cycle to reset counters.
 Slow Flash	0x0B06	Battery Watering Tank Empty	1. Battery watering tank empty. 2. Pump current is below expected threshold when pumping water.	1. Fill battery watering tank. 2. Check pump current when system is functioning.
 Rapid Flash	0x0B07	Battery Watering Suspend Scrub Lockout	Machine has had continued use with battery watering tank empty fault active (0x0B06).	1. Refill ABW tank. 2. Key cycle the machine. See (0x0B06) if fault persists.

T600/T600e ec-H2O NANOCLEAN ICON FAULTS

Membrane Control Panel



Pro-Panel Controls (LCD)



LED Fault Code and Icon ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Correction
● ☼ ☼ ☼ ●	0x0704	ec-H2O CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue) 3. Control board may be damaged. 4. ec-H2O connector unplugged (never plugged in). 5. ec-H2O connector pin 2 or 3 disconnected. 6. ec-H2O connector power pin disconnected.	1. Power cycle machine. 2. If error persists, carefully check all connectors and wiring at ec-H2O module. 3. Check if CB-2 is tripped. 4. Check relay M2 (aux contactor). Ensure contacts are closed, as this relay provides switched power to ec-H2O module. 5. Check for B+ (J12-11 and J12-12) and B- (J12-5 and J12-6). Ensure module powers on. Check blue for LED at top of module. If power is verified but ec-H2O module does not power up, it may need to be replaced. 6. Further CAN network troubleshooting guidance can be found at *CAN (CONTROLLER AREA NETWORK) CHECKOUT PROCEDURE* and *CAN (CONTROLLER AREA NETWORK) OPEN TROUBLESHOOTING*.
● ☼ ● ☼ ● ec H2O	0x0711	ec-H2O Pump Open Fault	1. ec-H2O pump wiring, connector or control board issue.	1. Control board is not detecting pump current. Check connections for voltage and verify if pump is operating.
● ☼ ☼ ☼ ☼ ec H2O	0x0713	ec-H2O Pump Over Current Fault	1. Current draw higher than expected.	1. Check pump operating current.
	0x0714	ec-H2O Pump High Current Warning	1. Current has exceeded set threshold for longer than 300mS. Could be caused by stalled motor.	1. Key cycle machine. 2. Check ec-H2O pump operating current. 3. If problem persists, replace ec-H2O pump.
	0x0715	ec-H2O Pump Higher Than Normal Current Warning	1. Current has exceeded set threshold for longer than 3000mS. Could be caused by a motor slowing down.	1. Key cycle machine. 2. Check ec-H2O pump operating current. 3. If problem persists, replace ec-H2O pump.

LED Fault Code and Icon ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Correction
☼ ● ● ● ● ec H2O	0x0717	ec-H2O Pump FET short fault	1. Driver on control board damaged/shorted.	1. Key cycle machine. 2. If problem persists, replace ec-H2O module.
☼ ● ☼ ● ● ec H2O	0x0703	ec-H2O Circuit Breaker Tripped Warning	1. Detected module circuit breaker trip. 2. Scrub controller board J6 connector unplugged. 3. Scrub controller board J6 connector pin 1 disconnected.	1. Reset breaker. 2. Power cycle machine. 3. Check connector/wire connections.
	0x0712	ec-H2O Pump Circuit Breaker Tripped	1. Detected module circuit breaker trip. 2. Scrub controller board J6 connector unplugged. 3. Scrub controller board J6 connector pin 1 disconnected.	1. Reset breaker. 2. Power cycle machine. 3. Check connector/wire connections.
ec H2O Solid	0x0700	ec-H2O Generic Fault	1. Unrecognized fault code received. User interface firmware does not align with ec-H2O node firmware.	1. Use Service Diagnostics tool to ensure user interface and ec-H2O firmware are up to date.
	0x0716	ec-H2O Pump Short Fault	1. Current draw higher than expected, detected in <5 seconds when commanded to run.	1. Check wiring and pump for shorts. Repair/replace as necessary. See ec-H2O NanoClean troubleshooting guide for detailed troubleshooting instructions.
	0x072A	ec-H2O Cell Electrode Fault	1. Cell current is operating below allowed operating condition.	1. Refer to ec-H2O NanoClean Troubleshooting Guide. Guidance provided indicates addition of 1/2 tsp of salt per 10 gal of water to solution tank. 2. If problem persists, replace ec-H2O module.
	0x0720	ec-H2O Cell Generic Fault	1. Generic ec-H2O cell fault.	1. Refer to ec-H2O NanoClean Troubleshooting Guide.
	0x0727	ec-H2O Cell FET Faults	1. Control board problem. 2. Power/battery issue on startup.	1. Replace ec-H2O module.
	0x0741	ec-H2O WCM Pump Open Warning	1. Wiring, connector or control board issue on the ec-H2O pump.	1. Verify the water conditioning module micro pump is connected to machine harness and pump is functional.
	0x0746	ec-H2O WCM Pump Short Warning	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check harness. 2. Verify water conditioning module micro pump is functional.
	0x0747	ec-H2O WCM Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	1. Replace control board. FET detection includes motor, actuator, detergent pump, vacuum and battery watering pump.

LED Fault Code and Icon ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Correction
 Flashing	0x0702	ec-H2O Pressure Switch Active	1. The system pressure switch is detecting a trip or unconnected.	1. System pressure too high. 2. Check connections. Verify functionality of scrub head switch and parking brake switch. Connectors possibly wired to incorrect switches.
	0x0708	ec-H2O System Over Regulation Warning	1. Cell has operated over target current condition for last 50 treated gallons.	1. Check water in solution tank for presence of detergents.
	0x0721	ec-H2O Cell Open Fault	1. ec-H2O cell wiring, connector or control board issue.	1. Check connector/wire connections.
	0x0726	ec-H2O Cell Short Warning	1. Shorted load condition. 2. Higher current draw than hardware design limit.	1. Refer to ec-H2O NanoClean Troubleshooting Guide.
	0x0728	ec-H2O Cell Over Regulation	1. Cell current exceeds set point for expected operation. Fault is indicated via a flashing blue light on ec-H2O module.	1. Ensure there is no detergent in solution tank. If there is, thoroughly drain and rinse tank, and add clean tap water. 2. If problem persists, refer to ec-H2O NanoClean Troubleshooting Guide.
	0x0729	ec-H2O Cell Under Regulation	1. Cell Current under set point for expected operation. Fault is indicated via a flashing blue light on ec-H2O module.	1. Fault typically occurs when very low-conductivity water is present in e-cell. No action required.
	0x0781	Detergent Tank Empty	1. Detergent tank is empty.	1. Fill detergent tank.
ec-H2O indicator blinking blue/ red	0x0707	ec-H2O Water Conditioning Cartridge Expired Warning	1. ec-H2O water conditioning cartridge is expired.	1. Replace ec-H2O water conditioning cartridge.

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.

LITHIUM ION BATTERY INDICATOR CODES

LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ☼ ☼ ☼ ☼ Hardware Fault	0x0D00	BMS General Fault	This is a general (undefined) fault occurrence in the BMS.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D0A	BMS Charger Protection (Cross Conduction)	Occurs when the charger interlock is active and a reversed current is detected for more than 5 sec.	Verify that charger cables are not swapped + for -, Restart charge cycle. If fault repeats, replace BMS.
	0x0D17	BMS Current Sensor Short	The current sensor in the BMS is shorted and not presenting a current measurement.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D18	BMS Current Sensor Open	The current sensor is an open circuit and not presenting a current measurement.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D19	BMS Relay On Error	The BMS internal contactor is closed (shorted) when it is supposed to be open.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D1A	Relay Off Error	The BMS internal contactor is open when it is supposed to be closed.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D1B	BMS B+ Sensor Error	Failure to measure cell module voltage at the B+ input to the BMS.	Verify wiring to the BMS from the Cell Modules. Measure raw battery voltage between B+ and B-. If voltage is greater than 30V, replace the BMS. If voltage is less than 30V, replace the battery Pack.
	0x0D1F	BMS Module Number Error	A wrong number of cell modules is connected to the BMS. Generally means that one or more cell modules are disconnected from the COM cable.	Verify that the M/S cable is connected to the BMS and fully tightened, and that the other connectors are all connected to the Cell Modules and fully tightened. If problem persists, measure raw battery voltage between B+ and B-. If voltage is greater than 30V, replace the BMS. If voltage is less than 30V, replace the Battery Pack.
	0x0D20	BMS Cell ID Error	Incompatible Cell Module type.	
	0x0D21	BMS Cell Series Error	Incompatible Cell Module type.	
	0x0D22	BMS Cell Parallel Error	Incompatible Cell Module type.	
	0x0D23	BMS Master Board Type Error	BMS hardware failure.	
	0x0D25	BMS Master-Slave Communication Error	The communication between the BMS and Cell Modules has failed.	Verify that the M/S cable is connected to the BMS and fully tightened, and that the other connectors are all connected to the Cell Modules and fully tightened. If problem persists, measure raw battery voltage between B+ and B-. If voltage is greater than 30V, replace the BMS. If voltage is less than 30V, replace the Battery Pack.
	0x0D26	BMS Thermistor Error	A thermistor in the BMS has failed.	Recycle power to BMS. If fault repeats, replace BMS.

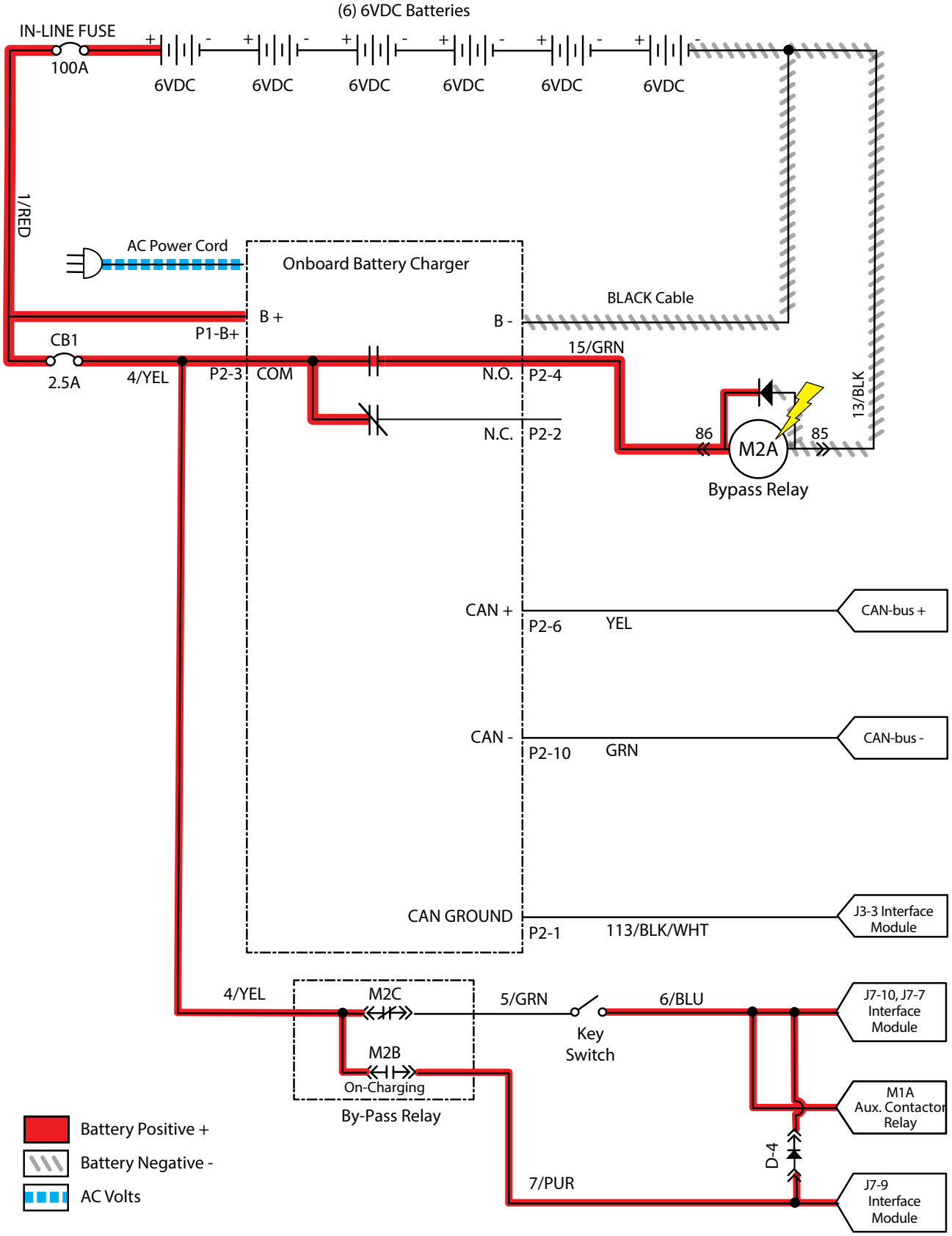
LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ☼ ☼ ☼ ☼ Hardware Fault	0x0D27	BMS Cell Voltage Sensing Error	An error occurred in the cell voltage sensing internal to one or more of the Cell Modules.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D28	BMS NVM Read/Write/Erase Error	BMS hardware failure.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D29	BMS Initial Data Error	BMS hardware failure.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D2A	BMS ROM Checksum Error	BMS hardware failure.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D2B	BMS Abnormal Charge Protection	BMS hardware failure.	Recycle power to BMS. If fault repeats, replace BMS.
	0x0D35	BMS Incorrect Battery Type	Incompatible Cell Module type.	
☼ ☼ ☼ ☼ ● Over Current Fault	0x0D03	BMS Over Current Charge Protection	An over-current error is determined during charging. Will shut down the charging operation.	Unplug charger from power. Wait 2 minutes. Re-plug charger into power. If fault repeats, may indicate a failure in the charger, or use of wrong charger.
	0x0D04	BMS Over Current Discharge Protection 1	The machine is drawing too much current from the battery pack. Will cause the BMS to shut down.	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
	0x0D05	BMS Over Current Discharge Protection 2	The machine is drawing too much current from the battery pack. Will cause the BMS to shut down.	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
	0x0D15	BMS Over Current Discharge Warning 1	The machine is drawing too much current from the battery pack. Will cause the machine to stop operation.	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
	0x0D16	BMS Over Current Charge Warning	The machine is drawing too much current from the battery pack. Will cause the machine to stop operation.	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
	0x0D24	BMS Over Current Discharge Warning 2	The machine is drawing too much current from the battery pack. Will cause the machine to stop operation.	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.

LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ☼ ☼ ● ☼ Cell Voltage Fault	0x0D01	BMS Cell Over Voltage Protection 1	A cell in one or more cell modules has too high a voltage on it. (above 4.05 volts per cell) Will cause the BMS to turn off.	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
	0x0D02	BMS Cell Under Voltage Protection 1	A cell in one or more cell modules has too low a voltage on it. (below 3.0 volts per cell) Will cause the BMS to turn off.	Stop use of machine and recharge battery. If fault repeats, contact service.
	0x0D0B	BMS Cell Over Voltage Protection 2	A cell in one or more cell modules has too high a voltage on it. (above 4.05 volts per cell) Will cause the BMS to turn off.	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
	0x0D0C	BMS Cell Under Voltage Protection 2	A cell in one or more cell modules has too low a voltage on it. (below 3.0 volts per cell) Will cause the BMS.	Stop use of machine and recharge battery. If fault repeats, contact service.
	0x0D0D	BMS Cell Over Voltage Warning 1	A cell in one or more cell modules has too high a voltage on it. (above 4.05 volts per cell) Will cause the machine to stop operation.	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
	0x0D0E	BMS Cell Over Voltage Warning 2	A cell in one or more cell modules has too high a voltage on it. (above 4.05 volts per cell) Will cause the machine to stop operation.	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
	0x0D0F	BMS Cell Under Voltage Warning 1	A cell in one or more cell modules has too low a voltage on it. (below 3.0 volts per cell) Will cause the machine to stop operation.	Stop use of machine and recharge battery. If fault repeats, contact service.
	0x0D10	BMS Cell Under Voltage Warning 2	A cell in one or more cell modules has too low a voltage on it. (below 3.0 volts per cell) Will cause the machine to stop operation.	Stop use of machine and recharge battery. If fault repeats, contact service.
	0x0D1C	BMS Cell Deep Discharge Failure	This is a permanent failure of one or more cell modules that has been discharged beyond recovery.	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires the replacement of the Battery Pack.
	0x0D1D	BMS Cell Imbalance Failure	This is a failure of the automatic cell balancing circuit to keep the cell voltages in balance within spec.	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires the replacement of the Battery Pack.
	0x0D1E	BMS Module Voltage Delta Error	Too great a difference between the lowest and highest cell voltages.	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires the replacement of the Battery Pack.
	0x0D36	BMS Over Charge Cell Voltage Threshold Warning	A cell in one or more cell modules has too high a voltage on it. (above 4.05 volts per cell) Will cause the machine to stop operation.	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires the replacement of the Battery Pack.

LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ● ☼ ☼ ☼ CAN Comm Lost	0x0D34	BMS CAN Communication Lost	The CAN communication between the User Interface and the BMS has been interrupted.	Verify that the Tap Harness (COM) connector is properly connected to the BMS. Verify that no other connectors of the Tap Harness has been disconnected. If problem persists, contact service for possible replacement of the BMS or other components on the CAN bus.
☼ ● ● ● ☼ Pack Temperature Fault	0x0D06	BMS Over Temp Charge Protection	An over temperature condition has been detected during a charge operation. The battery pack will shut down.	Stop charging. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
	0x0D07	BMS Under Temp Charge Protection	An under temperature condition has been detected during a charge operation. The battery pack will shut down.	Stop charging. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting charging. If fault repeats, contact service.
	0x0D08	BMS Over Temp Discharge Protection	An over temperature condition has been detected during a cleaning operation. The battery pack will shut down.	Stop operating machine. Move machine to cooler location. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
	0x0D09	BMS Under Temp Discharge Protection	An under temperature condition has been detected during a cleaning operation. The battery pack will shut down.	Stop operating machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting operation.
	0x0D11	BMS Over Temp Charge Warning	An over temperature condition has been detected during a charge operation. The machine will stop operation.	Stop charging. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
	0x0D12	BMS Under Temp Charge Warning	An under temperature condition has been detected during a charge operation. The machine will stop operation.	Stop charging. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting charging. If fault repeats, contact service.
	0x0D13	BMS Over Temp Discharge Warning	An over temperature condition has been detected during a cleaning operation. The machine will stop operation.	Stop operating machine. Move machine to cooler location. Allow battery to cool down, before restarting operation. If fault repeats, contact service.

LED Fault Code ☼ = Flashing	LCD Fault Code (T600 Only)	Fault Condition	Cause	Solution
☼ ● ● ● ☼ Pack Temperature Fault (continued)	0x0D14	BMS Under Temp Discharge Warning	An under temperature condition has been detected during a cleaning operation. The machine will stop operation.	Stop operating machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting operation.
	0x0D31	BMS Bus-Bar Temp Error	The temperature of the BMS has exceeded specification. The battery pack will shut down.	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
	0x0D32	BMS Bus-Bar Temp Protection	The temperature of the BMS has exceeded specification. The battery pack will shut down.	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
	0x0D33	BMS Bus-Bar Temp Warning	The temperature of the BMS has exceeded specification. The machine will stop operation.	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
	0x0D37	BMS Under Temp Charge Threshold Warning	An under temperature condition has been detected during a charging operation. The machine will stop operation.	Stop charging machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting charging. If fault repeats, contact service.
	0x0D38	BMS Over Temp Charge Threshold Warning	An over temperature condition has been detected during a charging operation. The machine will stop operation.	Stop charging machine. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
	0x0D39	BMS Under Temp Discharge Threshold Warning	An under temperature condition has been detected during a cleaning operation. The machine will stop operation.	Stop operating machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting operation. If fault repeats, contact service.
	0x0D3A	BMS Over Temp Discharge Threshold Warning	An over temperature condition has been detected during a cleaning operation. The machine will stop operation.	Stop operating machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
● ☼ ☼ ☼ ☼	0x0D3B	Overcurrent Protection Warning	Battery pack over-discharged and wrong charger or charge profile being used to recharge. Over-discharged battery packs need to be recharged starting with a very low charge rate (“pre-charge” phase).	Ensure correct charger and correct charge profile are being used. Disconnect and reconnect charger. If fault repeats, contact service.
	0x0D3C	Overcurrent Protection BMS shutdown	Battery pack over-discharged and wrong charger or charge profile being used to recharge. Over-discharged battery packs need to be recharged starting with a very low charge rate (“pre-charge” phase).	Ensure correct charger and correct charge profile are being used. Disconnect and reconnect charger. If fault repeats, contact service.

T600 ON-BOARD BATTERY CHARGING ON



T600 BATTERIES FAIL TO CHARGE/REDUCED RUN TIME (ONBOARD CHARGER)

Step	Action	Value(s)	Yes	No
1	• Key ON • Is there a flashing BDI fault or LCD Pro-Panel (option) fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #1 to reset • Is circuit breaker #1 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 4	Check AC supply circuit protection
4	• See BATTERY CHARGER SETTINGS in MAINTENANCE section of this manual and confirm proper charger settings • Is the onboard charger set properly?		Proceed to STEP 5	Reprogram battery char-ger
5	• 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 6
6	• Proceed to STEP 8 for machines equipped with sealed, AGM, or TPPL batteries • Key OFF • Disconnect batteries • Check water level in all battery cells • Are the lead plates submerged?		Proceed to STEP 7	Add distilled water as nec-essary until lead plates are covered
7	• 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
8	• Key OFF • Measure voltage on each battery • Are all batteries within 0.5V of each other?		Proceed to STEP 9	Replace bat-teries
9	• Plug battery charger into an AC outlet • Is charger functioning (Is there current going into batteries)?		Proceed to STEP 10	Replace bat-tery charger
10	• Perform a “Machine Run Time Test” • Does Machine Run Time Test meet expectations?			Replace bat-teries

Terms:

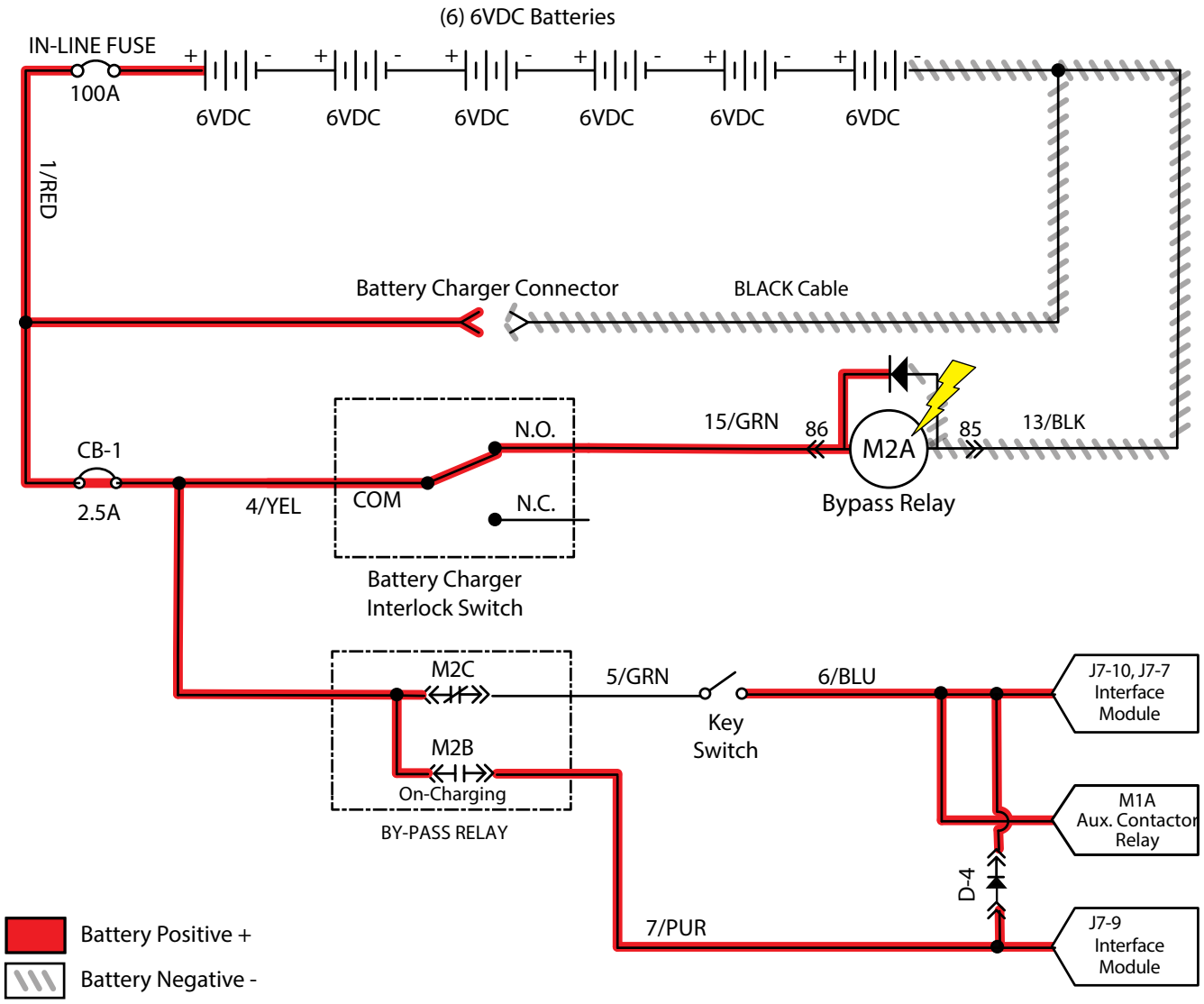
AC = Alternating Current

AGM = Absorbed Glass Mat

TPPL = Thin Plate Pure Lead

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

T600 OFF BOARD BATTERY CHARGING ON



T600 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 • Firmly press circuit breaker #1 to reset • Is circuit breaker #1 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 4	Check AC supply circuit protection
4	• Key OFF • Inspect battery and charger cables for damage/corrosion/ contamination/terminal problems		Repair or replace battery/battery charger cables	Proceed to STEP 5
5	• Proceed to STEP 7 for machines equipped with sealed, AGM, or TPPL 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 necessary 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 battery charger or batteries
7	• Key OFF • Measure voltage on each battery • Are all batteries within 0.5V of each other?		Proceed to STEP 8	Replace batteries
8	• Plug battery charger into an AC outlet • Is charger functioning (Is there current going into batteries)?		Proceed to STEP 9	Replace battery charger
9	• Perform a “Machine Run Time Test” • Does Machine Run Time Test meet expectations?			Replace batteries

Terms:

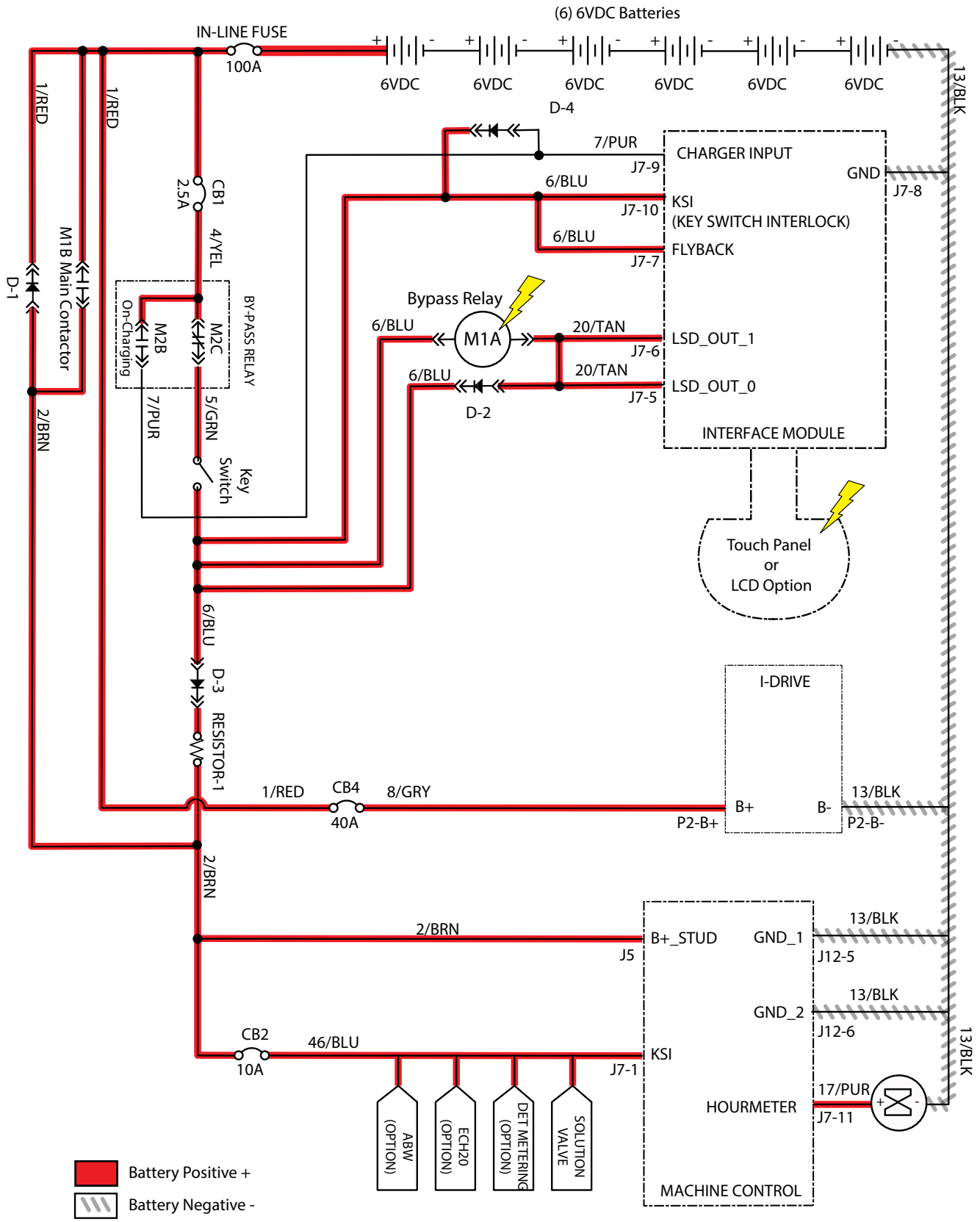
AC = Alternating Current

AGM = Absorbed Glass Mat

TPPL = Thin Plate Pure Lead

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

T600 POWER UP ON



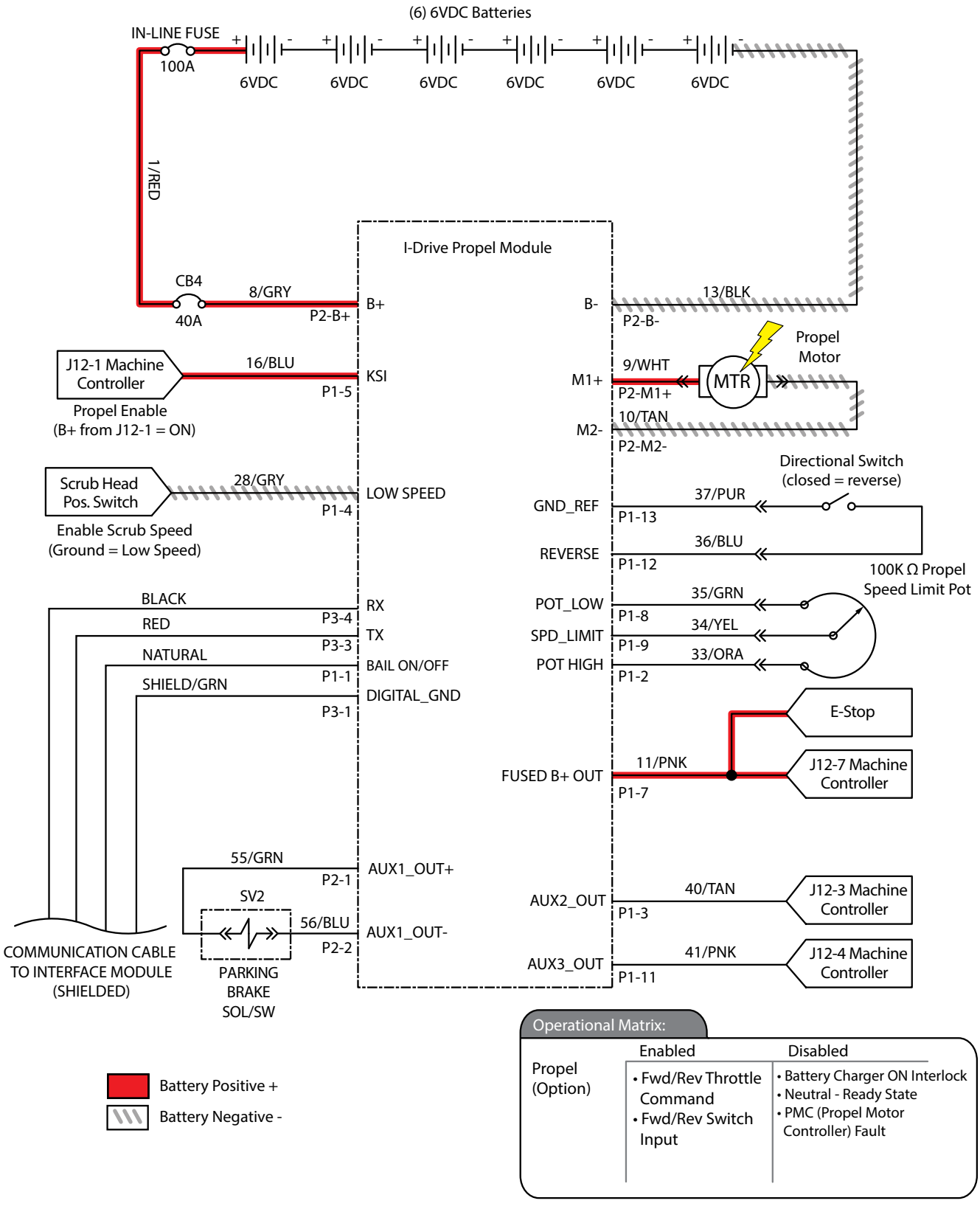
T600 MACHINE FAILED TO POWER UP

Step	Action	Value(s)	Yes	No
1	• Key ON • Use a voltmeter to test the total battery voltage • Is total battery voltage greater than 31 VDC?		Proceed to STEP 2	Recharge batteries and test power-up circuit operation
2	• Key OFF • Firmly press circuit breaker #1/circuit breaker #2/ circuit breaker #4 to reset • Are circuit breaker #1/circuit breaker #2/ circuit breaker #4 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

T600 PROPEL SUBSYSTEM



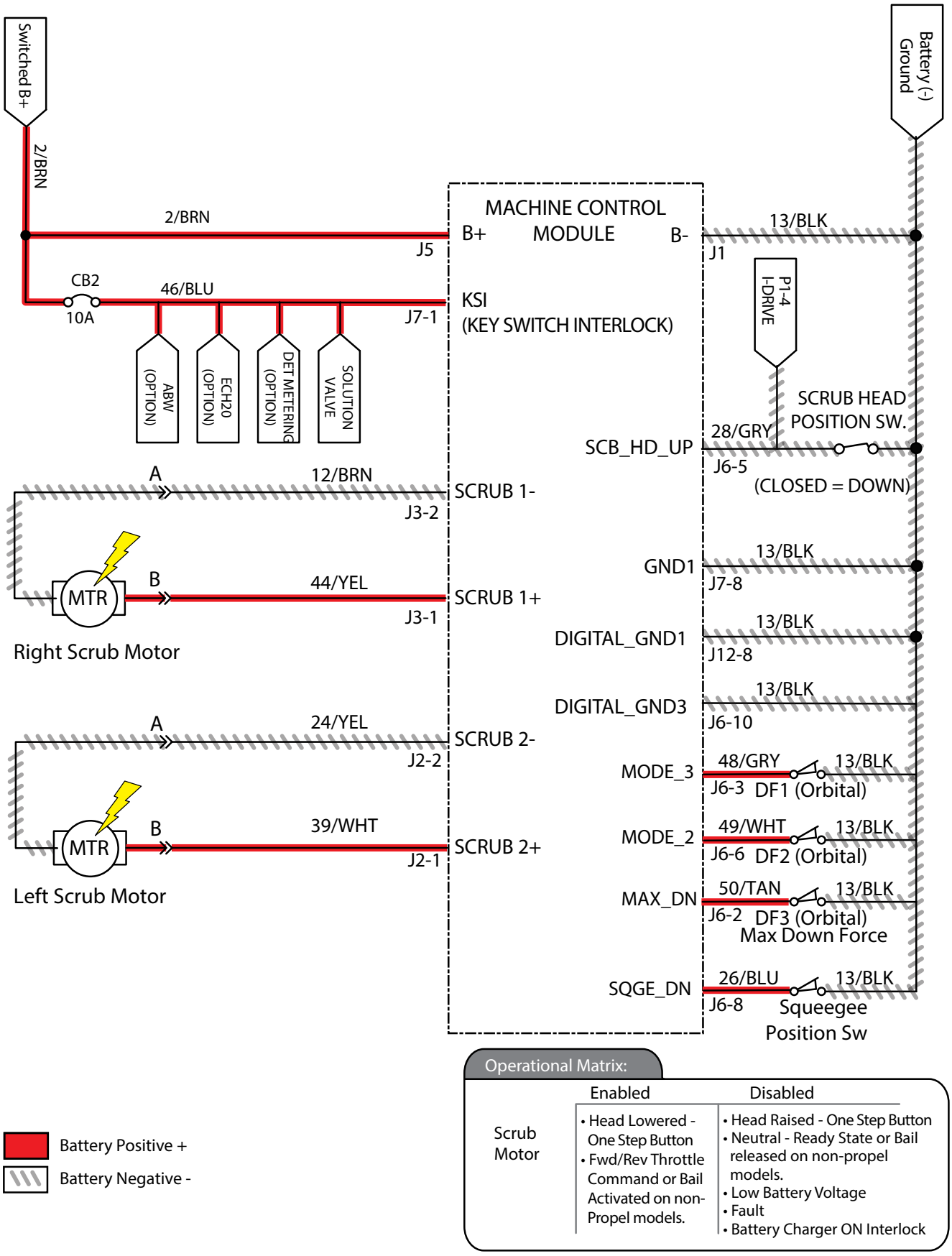
T600 MACHINE FAILED TO PROPEL

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable propel • Is there a flashing BDI fault or LCD Pro-Panel (option) 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	• 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 neces-sary compo-nents

Terms:

BDI = Battery Discharge Indicator

T600 SCRUB MOTOR ON



Operational Matrix:

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

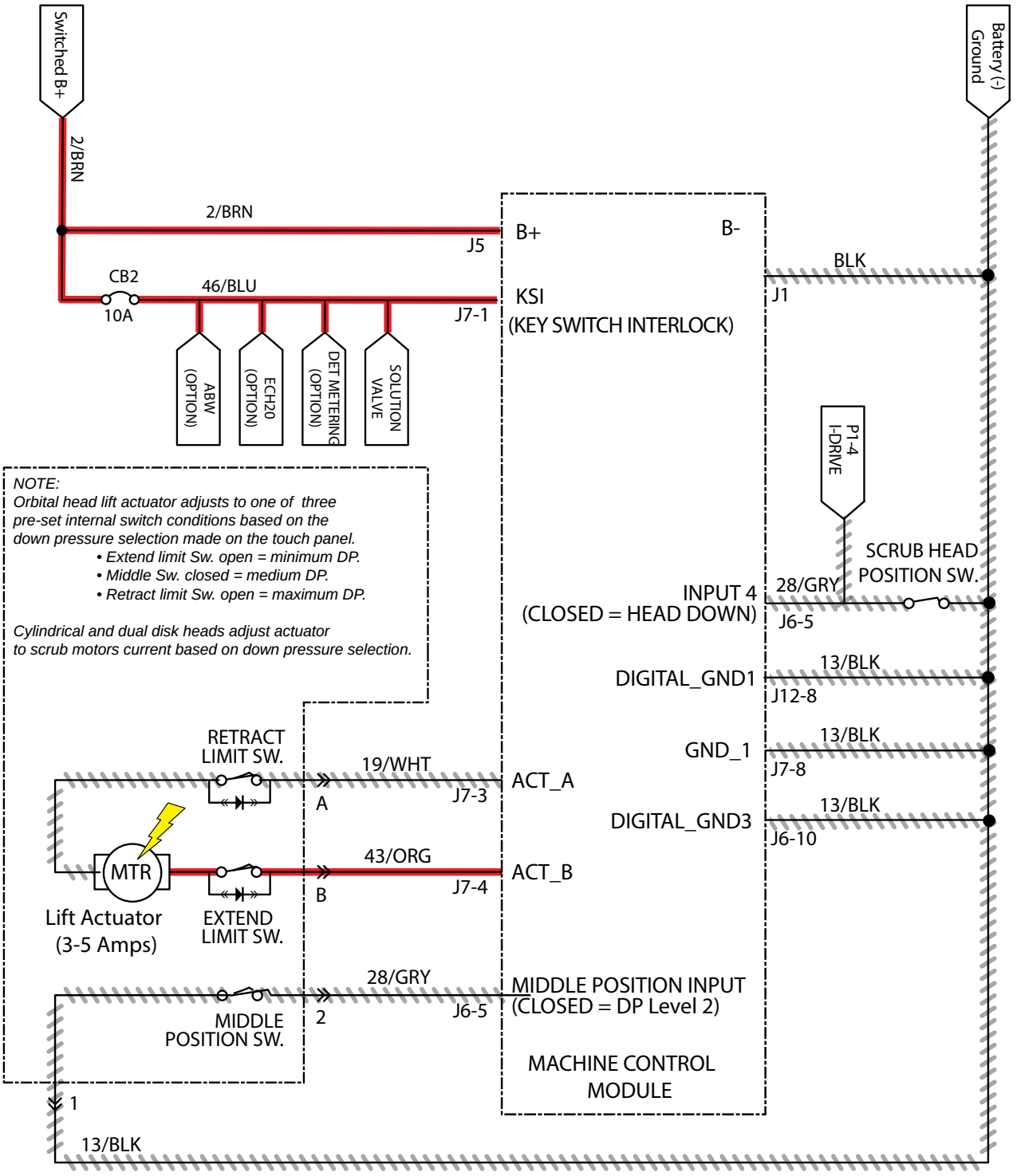
T600 SCRUB MOTOR FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable scrub motor • Is there a flashing BDI fault or LCD Pro-Panel (option) 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 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

T600 SCRUB HEAD LIFT ACTUATOR



Operational Matrix:

	Enabled	Disabled
Lift Actuator (Option)	• Head Lowered - One Step Button	• Head Raised - One Step Button • Low Battery Voltage • Load Current Fault • Battery Charger ON Interlock

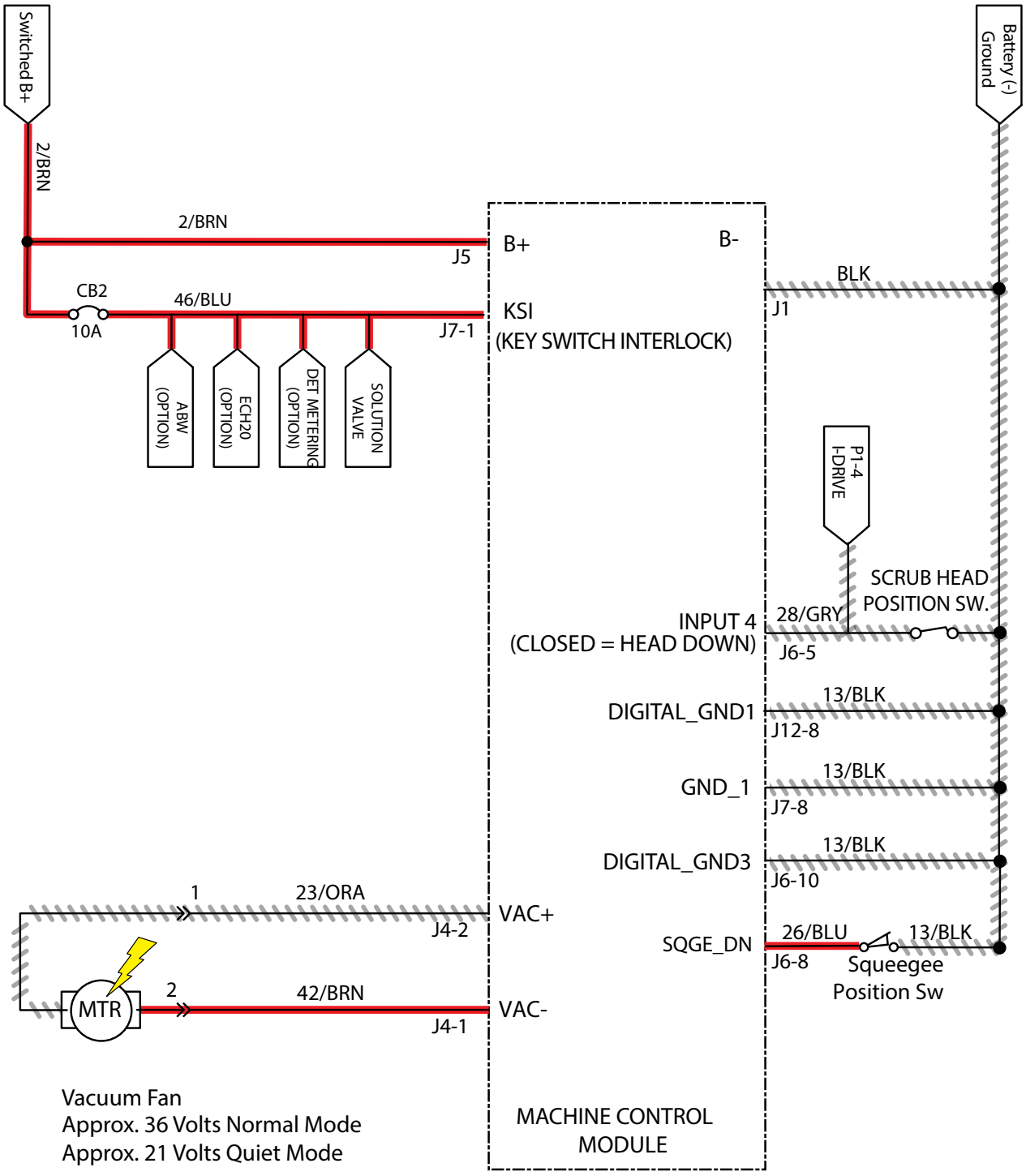
T600 SCRUB HEAD FAILED TO LIFT/LOWER

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable lift actuator • Is there a flashing BDI fault or LCD Pro-Panel (option) fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 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
2	• See SERVICE DIAGNOSTICS TOOL in SERVICE section of this manual and confirm software is properly configured to enable automated down pressure • Is software configured properly?		Proceed to STEP 4	Reprogram software
3	• Key ON • Enable scrub motor • Enable propel • Test voltage applied to actuator 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 neces-sary compo-nents

Terms:

BDI = Battery Discharge Indicator

T600 VACUUM FAN ON



Operational Matrix:

	Enabled	Disabled
Vacuum Fan	• Squeegee Lowered	• Squeegee Raised • Low Battery Voltage • Fault • Battery Charger ON Interlock • E-Stop Pushed

Battery Positive +

Battery Negative -

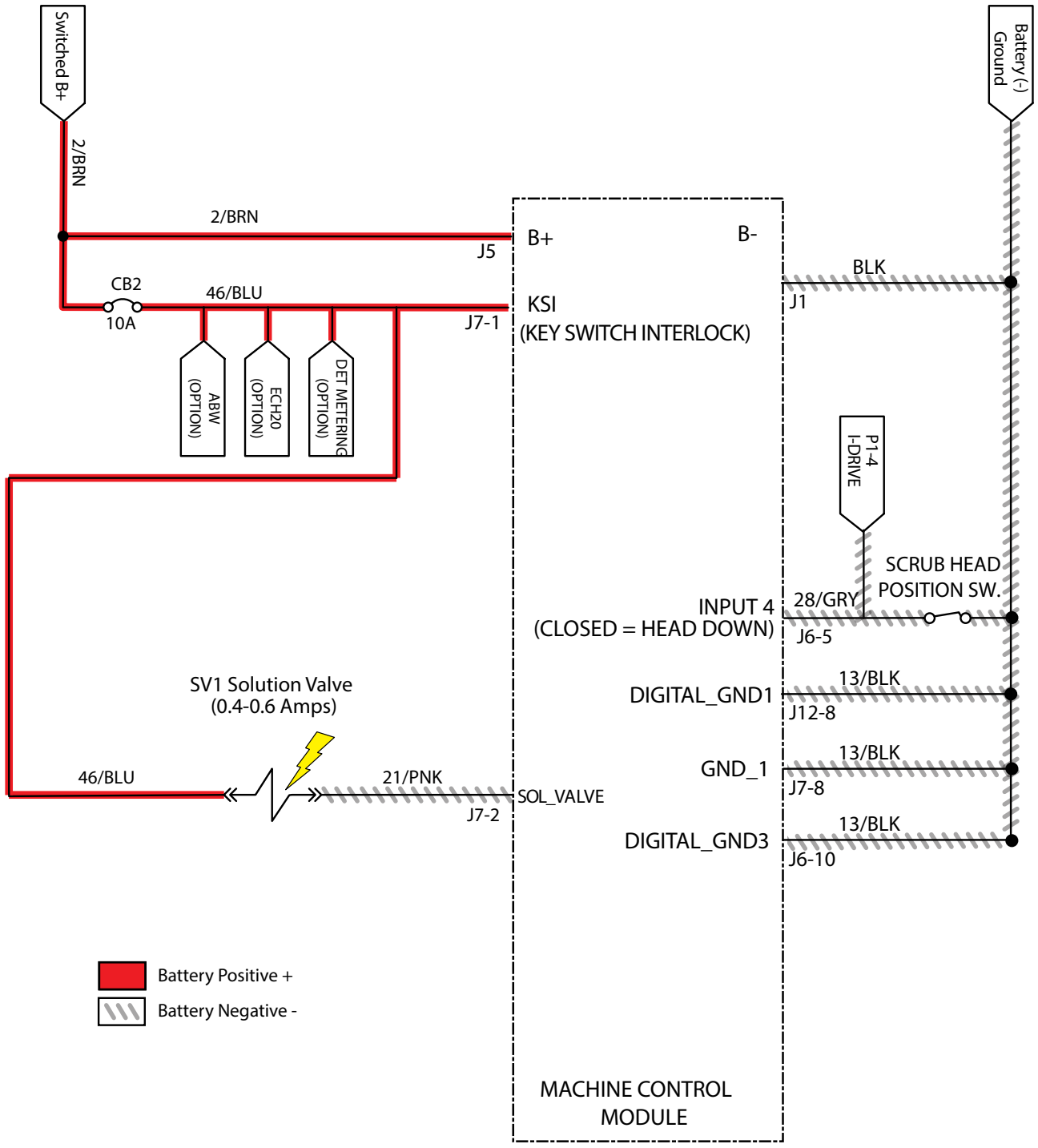
T600 VACUUM FAN FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable vacuum fan • Is there a flashing BDI fault or LCD Pro-Panel (option) 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 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

T600 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

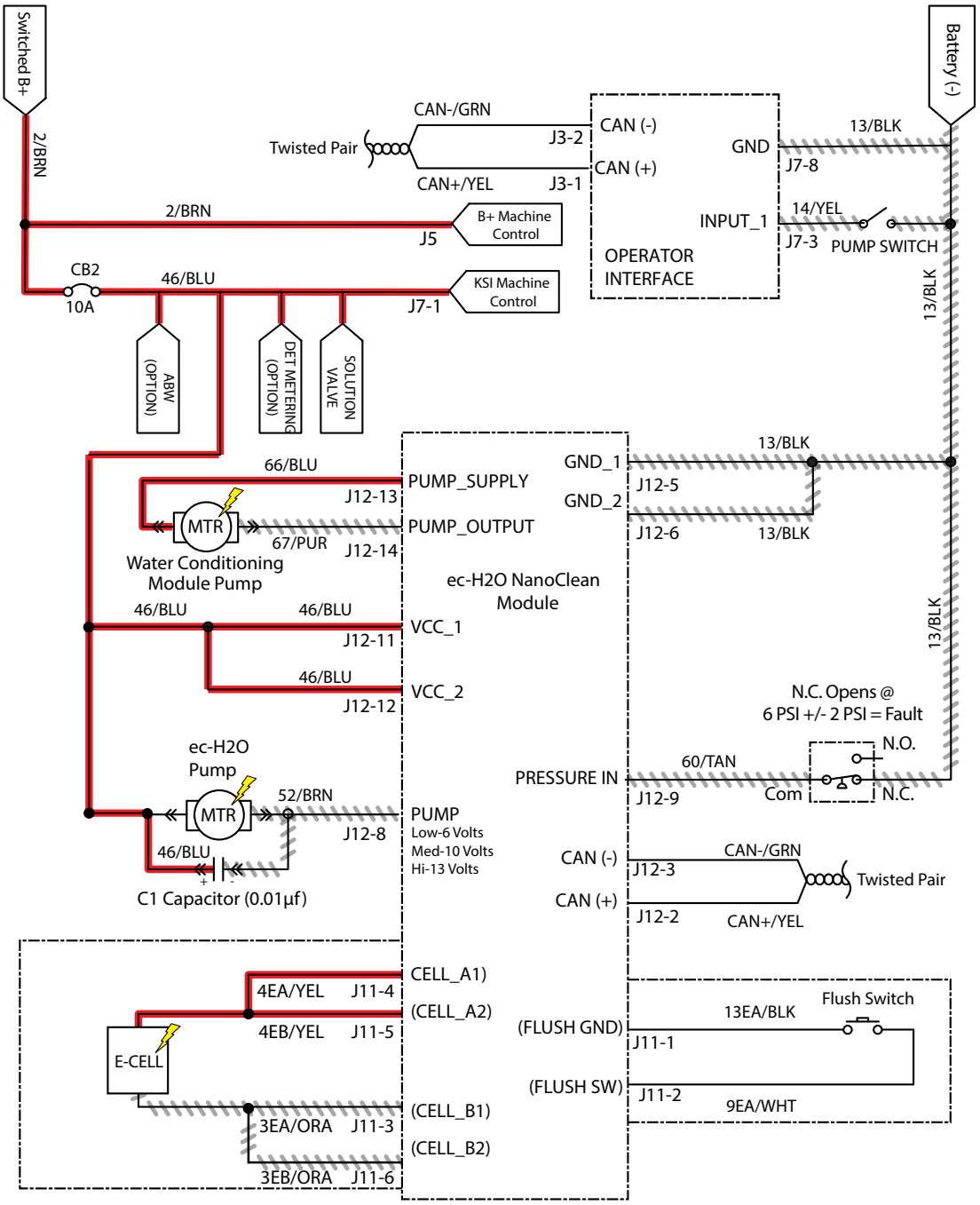
T600 SOLUTION CONTROL FAILED TO TURN ON (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable solution control (conventional) • Is there a flashing BDI fault or LCD Pro-Panel (option) 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 (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

T600 SOLUTION CONTROL ON (ec-H2O) (OPTION)



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

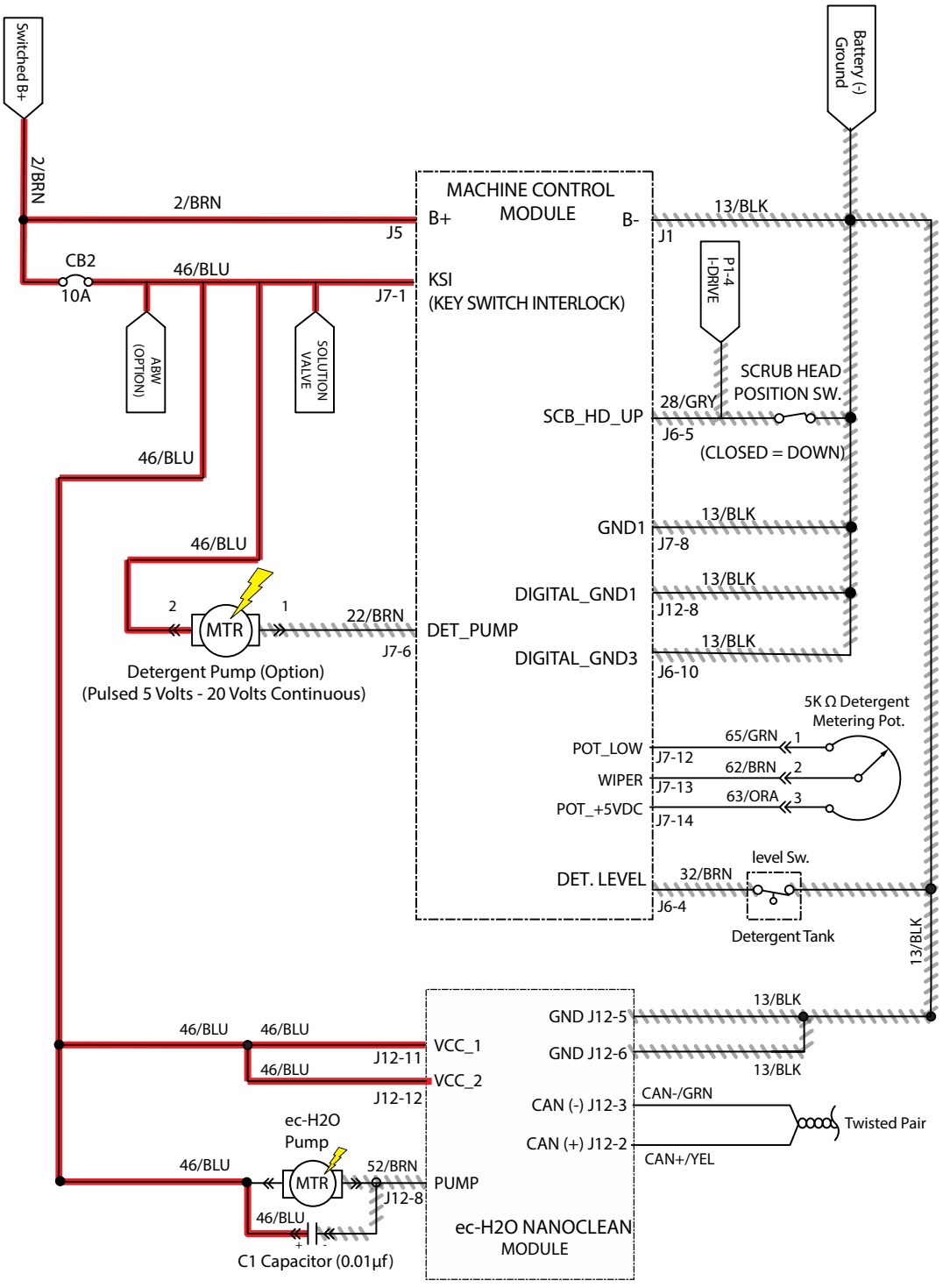
T600 SOLUTION CONTROL FAILED TO TURN ON (ec-H2O)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable solution control (ec-H2O) • Is there a flashing BDI fault or LCD Pro-Panel (option) 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

T600 SE (SEVERE ENVIRONMENT) ON (OPTION)



Battery Positive +

Battery Negative -

Operational Matrix:

	Enabled	Disabled
SE (Severe Environment) Detergent Pump (Option)	• Head Lowered - One Step Button • Severe Environment On (30 seconds or continuous) • Fwd/Rev Throttle Command or Bail activated • Detergent Tank Not Empty	• Head Raised - One Step Button • Solution Control OFF • Neutral - Ready State or bail released • Detergent Tank Empty • Low Battery Voltage • Fault • Battery Charger ON Interlock

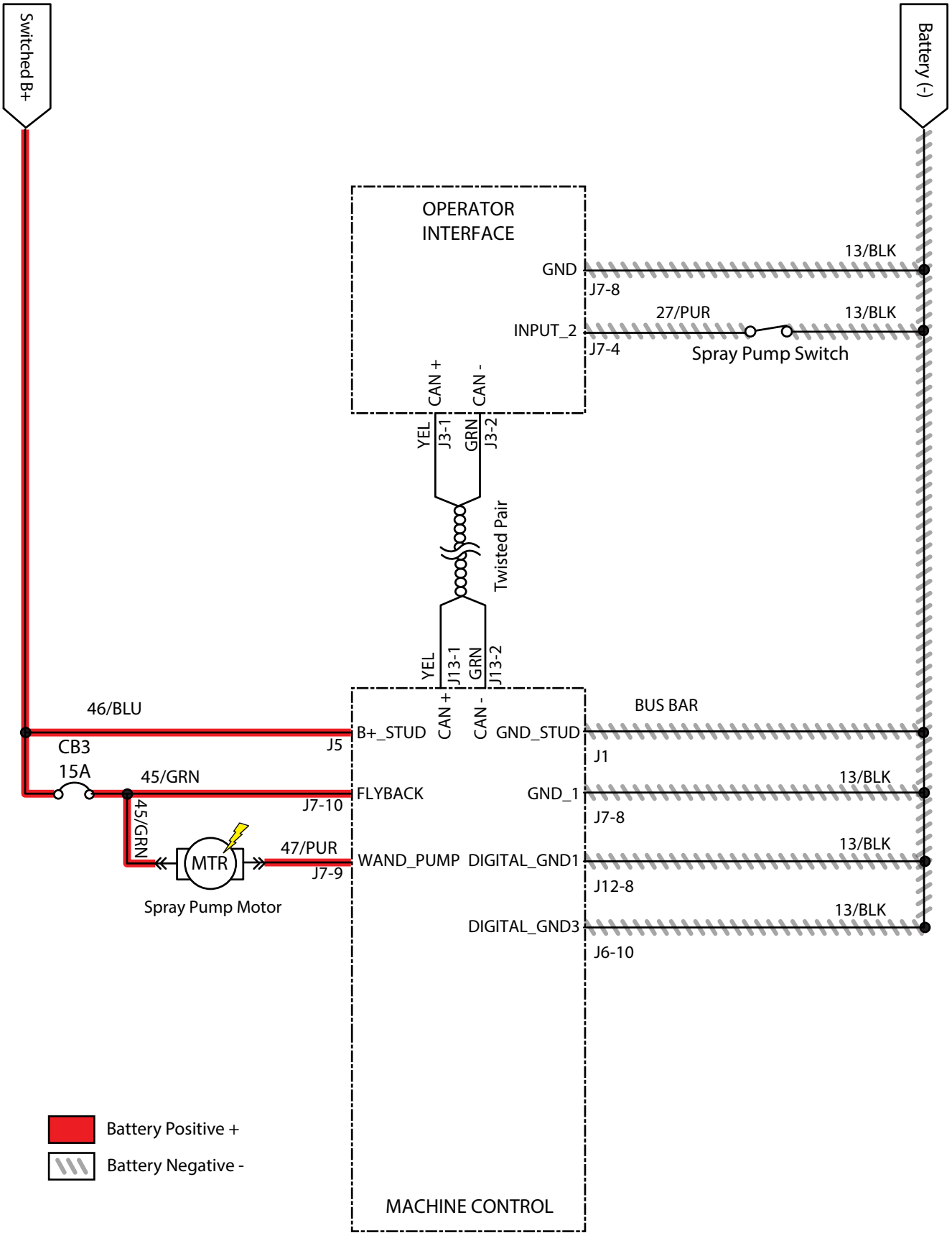
T600 SE (SEVERE ENVIRONMENT) FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable SE (Severe Environment) detergent pump • Is there a flashing BDI fault or LCD Pro-Panel (option) 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 SE (Severe Environment) detergent pump • Test voltage applied to SE 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

T600 SPRAY PUMP (OPTION)



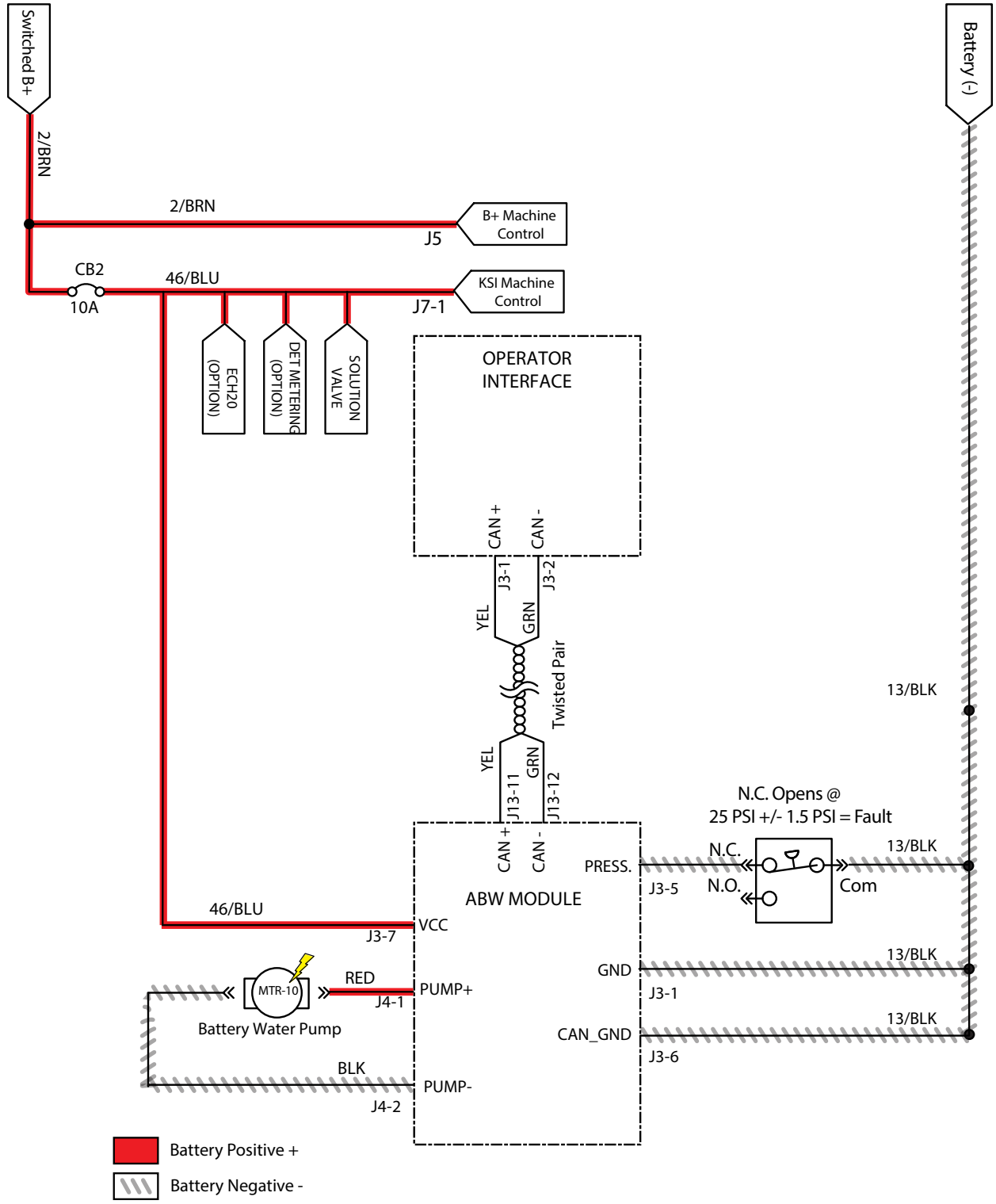
T600 SPRAY PUMP FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable spray pump • Is there a flashing BDI fault or LCD Pro-Panel (option) fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
2	• Key OFF • Firmly press circuit breaker #3 to reset • Is circuit breaker #3 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key ON • Enable spray pump • Test voltage applied to spray pump 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

T600 AUTOMATIC BATTERY WATERING (OPTION)



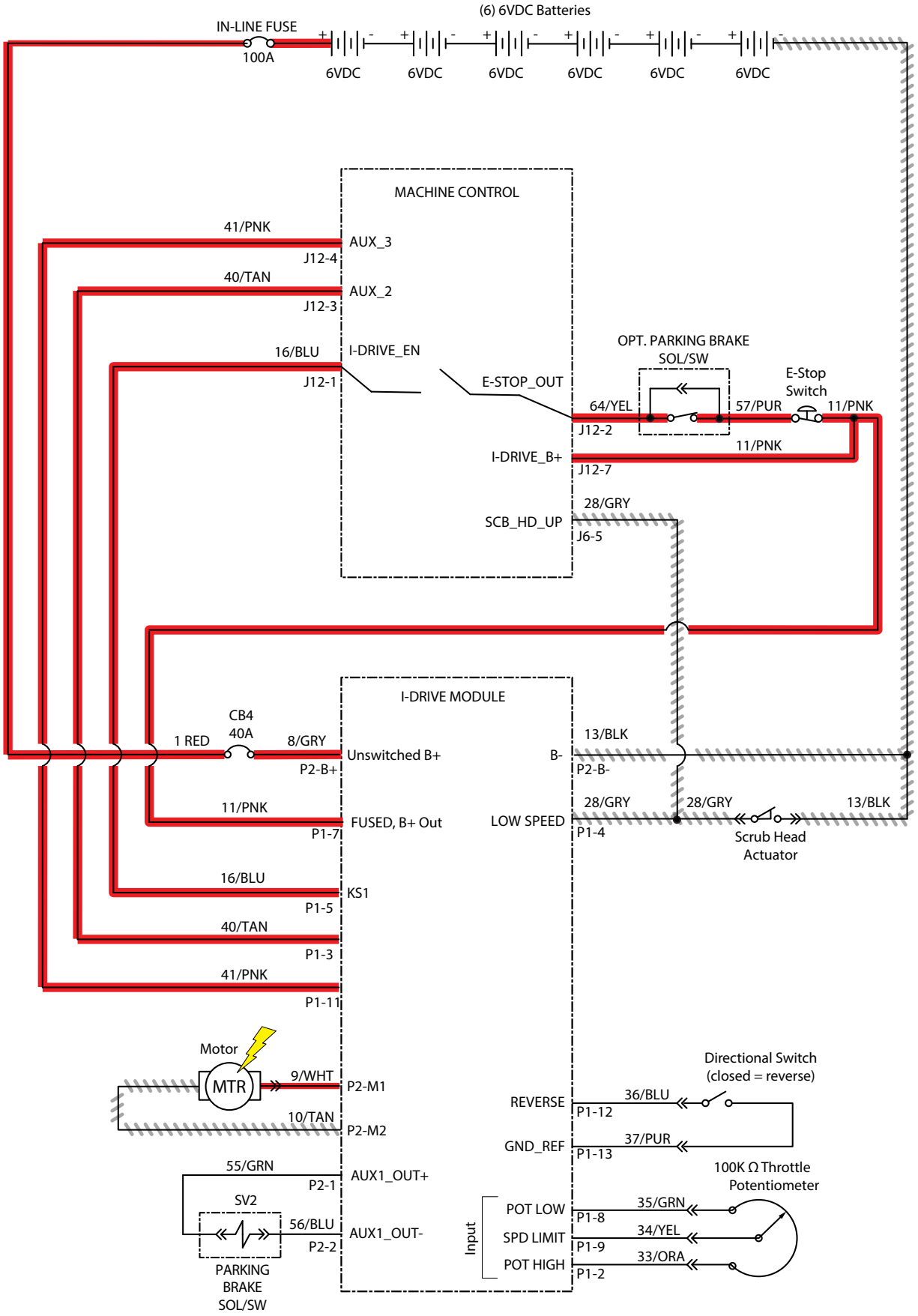
T600 AUTOMATIC BATTERY WATERING SYSTEM FAILED TO TURN ON (OPTION)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable ABW if previously faulted or operate manually • Is there a flashing BDI fault or LCD Pro-Panel (option) 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

T600 i-DRIVE TESTING (UNIVERSAL SCHEMATIC)



T600 i-DRIVE TESTING PROCEDURE

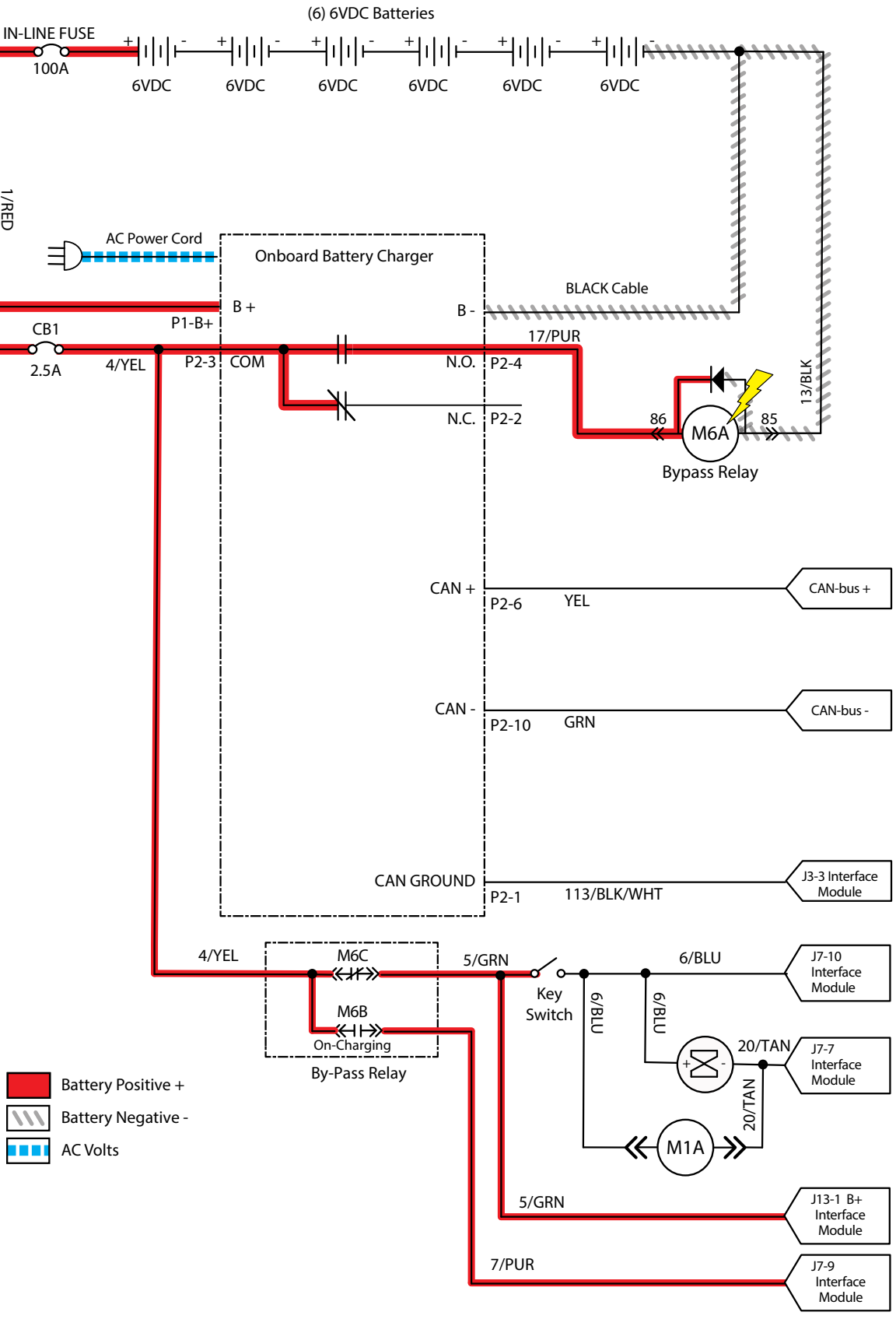
Step	Action	Value(s)	Yes	No
1 ✓Switched (+)*	• Key ON/circuits loaded (preferred) • All electrical components remain connected to wire harness • Use an electrical schematic to identify all switched (+) power supply wires • Is there *switched battery voltage* (+) applied to circuit board?	Applied voltage 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

T600e ON-BOARD BATTERY CHARGING ON



T600e 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 • Firmly press circuit breaker #1 to reset • Is circuit breaker #1 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 4	Check AC supply circuit protection
4	• See BATTERY CHARGER SETTINGS in MAINTENANCE section of this manual and confirm proper charger settings • Is the onboard charger set properly?		Proceed to STEP 5	Reprogram battery char-ger
5	• 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 6
6	• Proceed to STEP 8 for machines equipped with sealed, AGM, or TPPL batteries • Key OFF • Disconnect batteries • Check water level in all battery cells • Are the lead plates submerged?		Proceed to STEP 7	Add distilled water as nec-essary until lead plates are covered
7	• 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
8	• Key OFF • Measure voltage on each battery • Are all batteries within 0.5V of each other?		Proceed to STEP 9	Replace bat-teries
9	• Plug battery charger into an AC outlet • Is charger functioning (Is there current going into batteries)?		Proceed to STEP 10	Replace bat-tery charger
10	• Perform a “Machine Run Time Test” • Does Machine Run Time Test meet expectations?			Replace bat-teries

Terms:

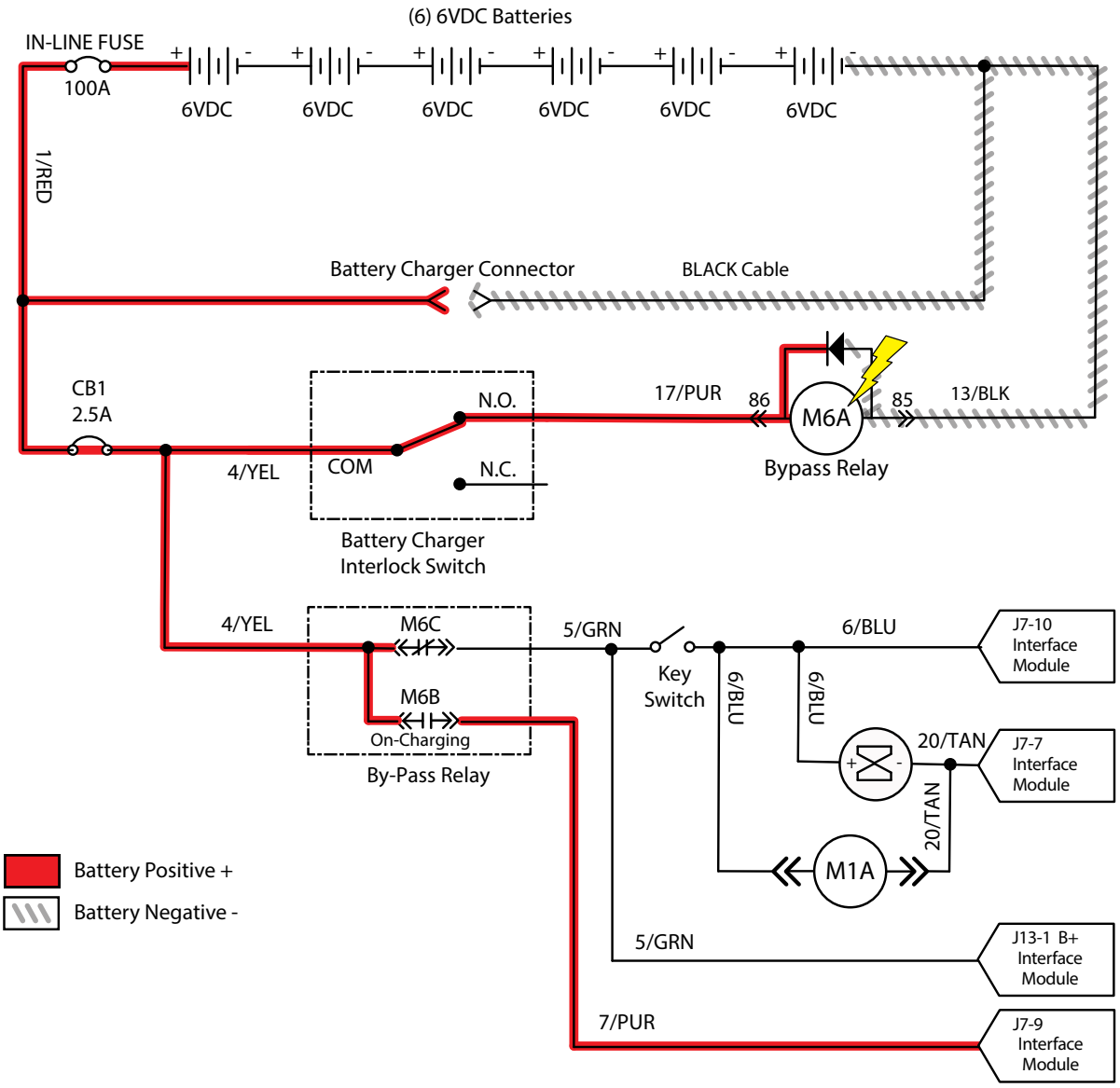
AC = Alternating Current

AGM = Absorbed Glass Mat

TPPL = Thin Plate Pure Lead

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

T600e OFF BOARD BATTERY CHARGING ON



T600e 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 • Firmly press circuit breaker #1 to reset • Is circuit breaker #1 tripped?		Reset and test power-up circuit operation	Proceed to STEP 3
3	• Key OFF • Check AC power supply • Is the rated AC supply voltage present?		Proceed to STEP 4	Check AC supply circuit protection
4	• Key OFF • Inspect battery and charger cables for damage/corrosion/ contamination/terminal problems		Repair or replace battery/battery charger cables	Proceed to STEP 5
5	• Proceed to STEP 7 for machines equipped with sealed, AGM, or TPPL 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 necessary 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 battery charger or batteries
7	• Key OFF • Measure voltage on each battery • Are all batteries within 0.5V of each other?		Proceed to STEP 8	Replace batteries
8	• Plug battery charger into an AC outlet • Is charger functioning (Is there current going into batteries)?		Proceed to STEP 9	Replace battery charger
9	• Perform a “Machine Run Time Test” • Does Machine Run Time Test meet expectations?			Replace batteries

Terms:

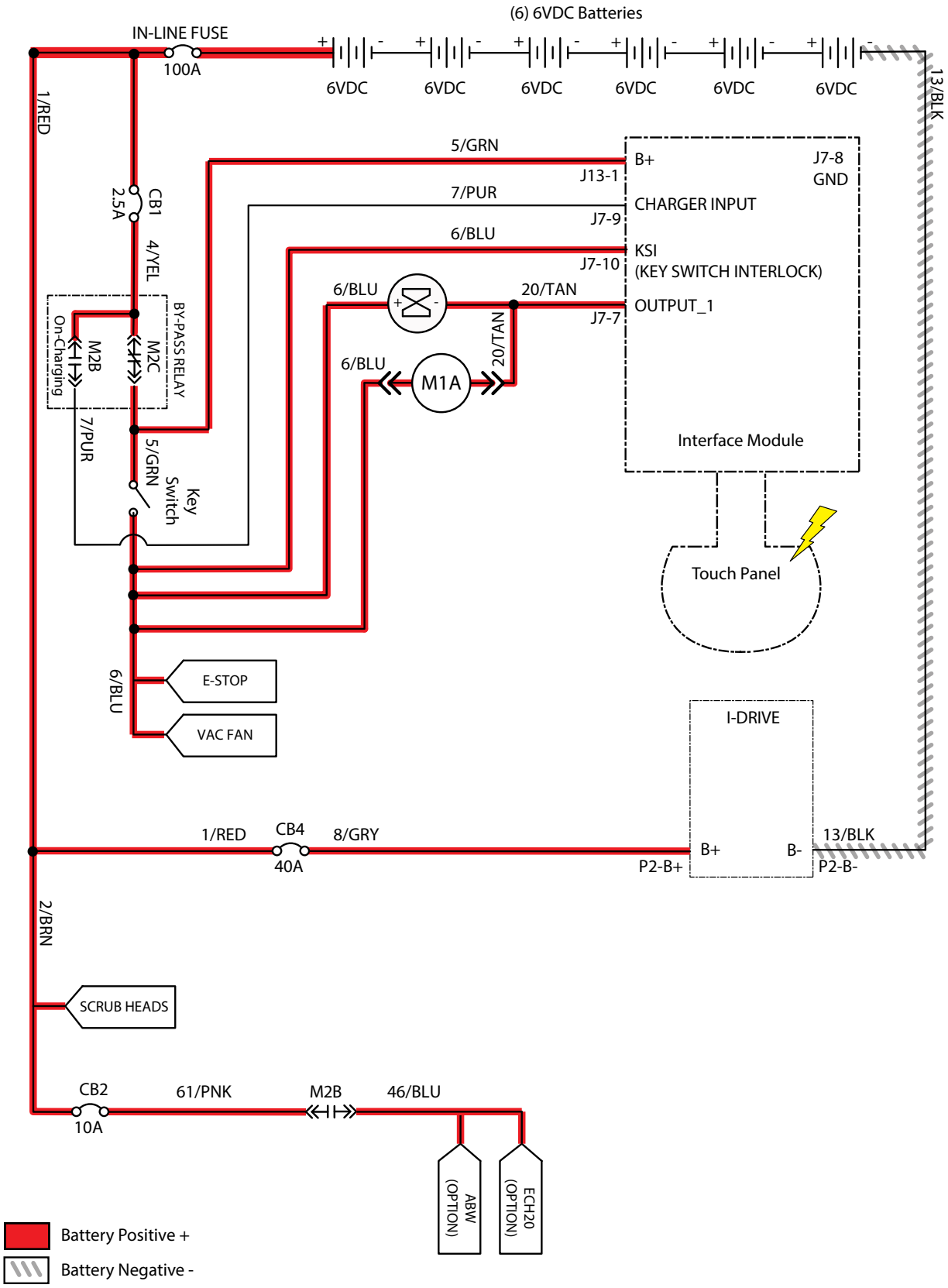
AC = Alternating Current

AGM = Absorbed Glass Mat

TPPL = Thin Plate Pure Lead

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

T600e POWER UP ON



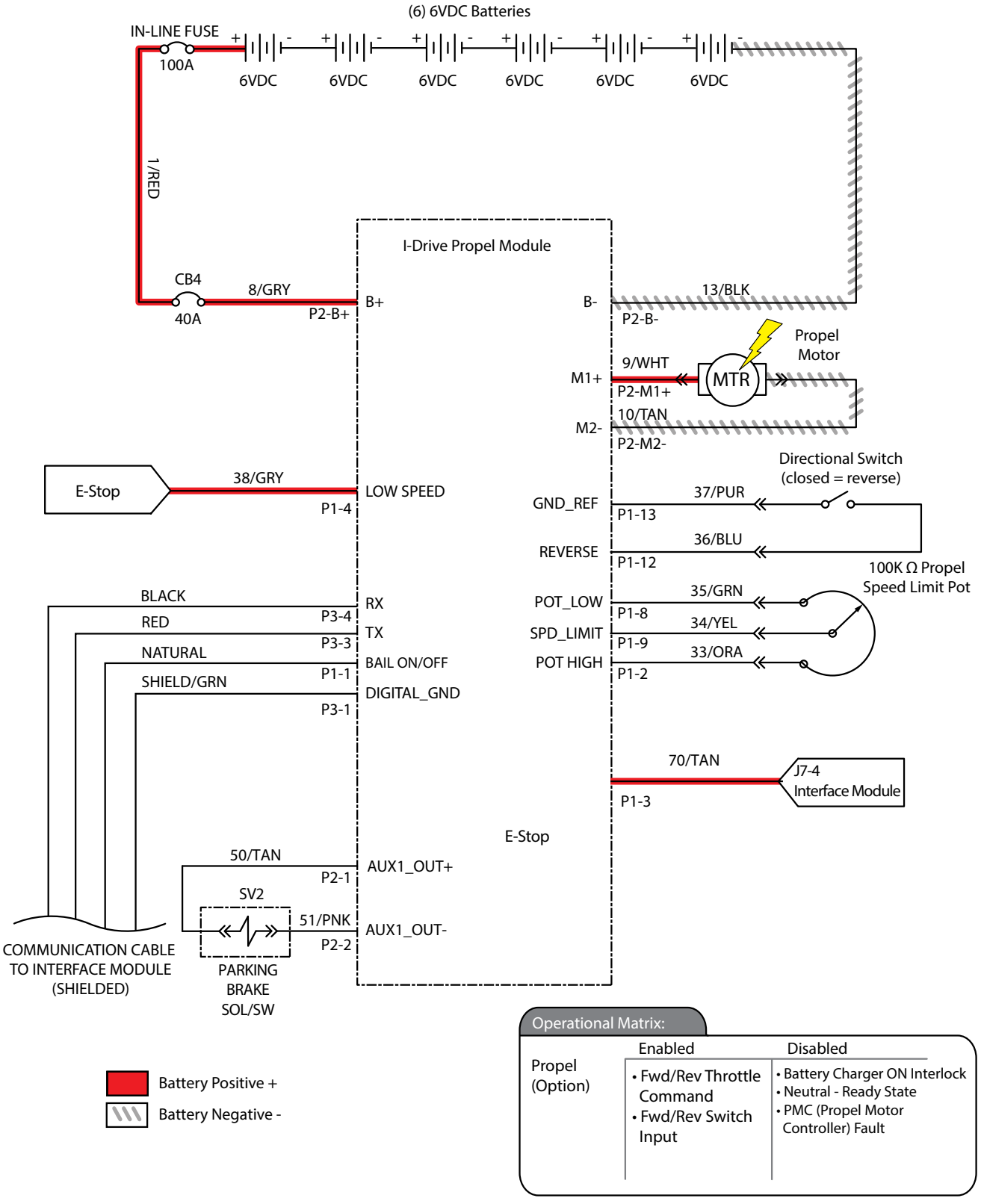
T600e MACHINE FAILED TO POWER UP

Step	Action	Value(s)	Yes	No
1	• Key ON • Use a voltmeter to test the total battery voltage • Is total battery voltage greater than 31 VDC?		Proceed to STEP 2	Recharge batteries and test power-up circuit operation
2	• Key OFF • Firmly press circuit breaker #1/circuit breaker #2/ circuit breaker #4 to reset • Are circuit breaker #1/circuit breaker #2/ circuit breaker #4 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

T600e 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

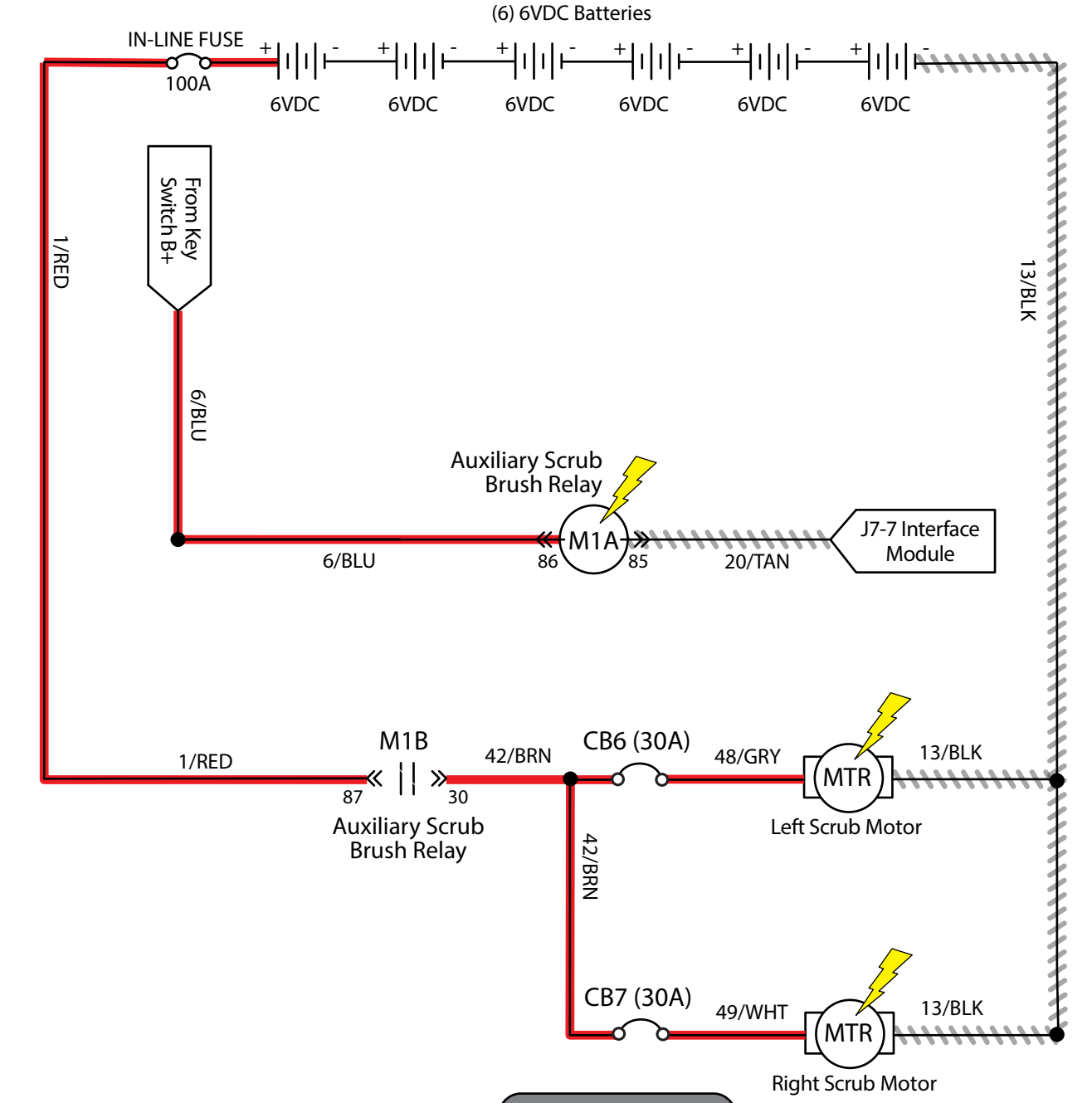
T600e MACHINE FAILED TO PROPEL

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 #4 to reset • Is circuit breaker #4 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 neces-sary compo-nents

Terms:

BDI = Battery Discharge Indicator

T600e 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

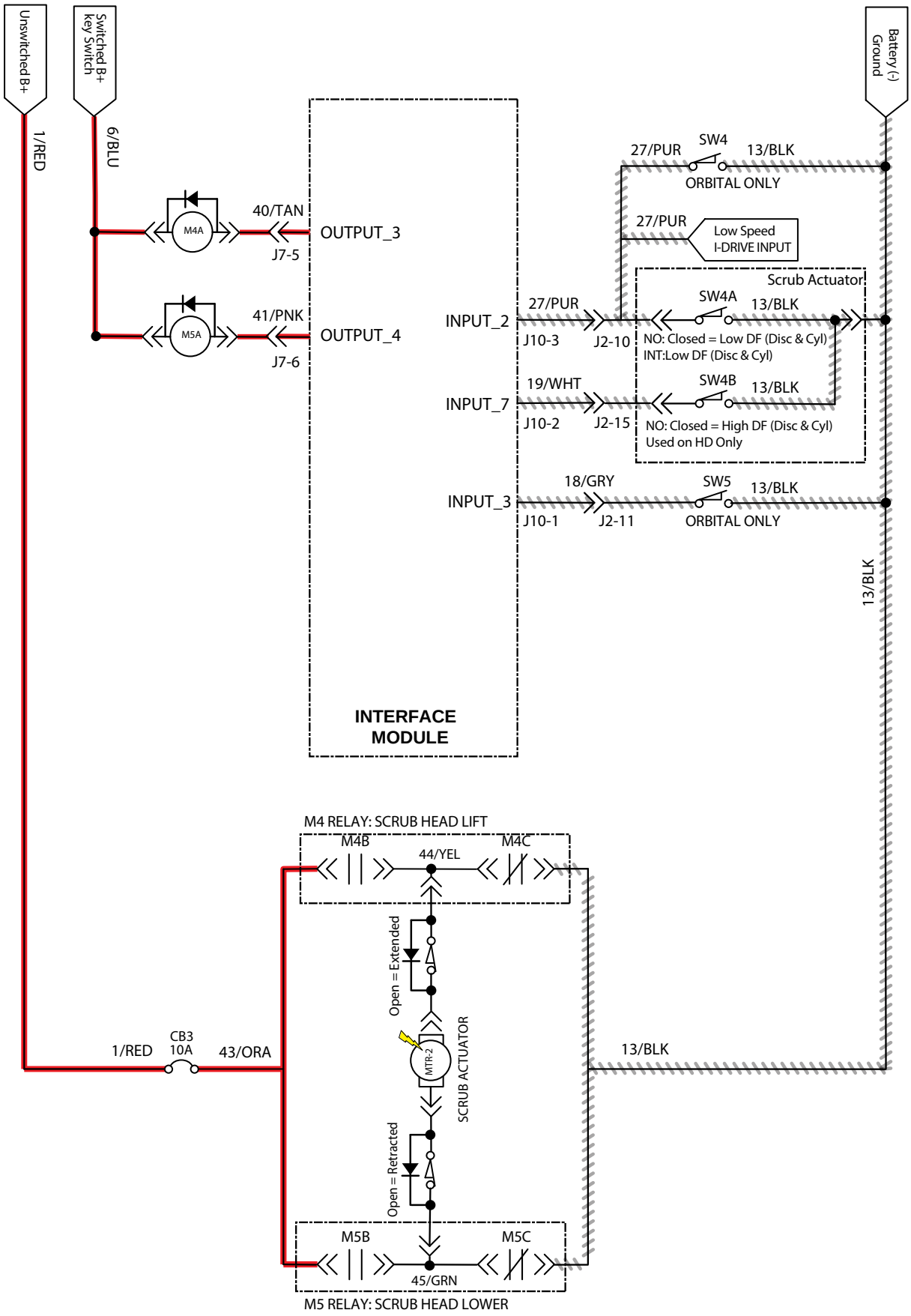
T600e SCRUB MOTOR FAILED TO TURN ON

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 #6/circuit breaker #7 to reset • Are circuit breaker #6/circuit breaker #7 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

T600e SCRUB HEAD LIFT ACTUATOR



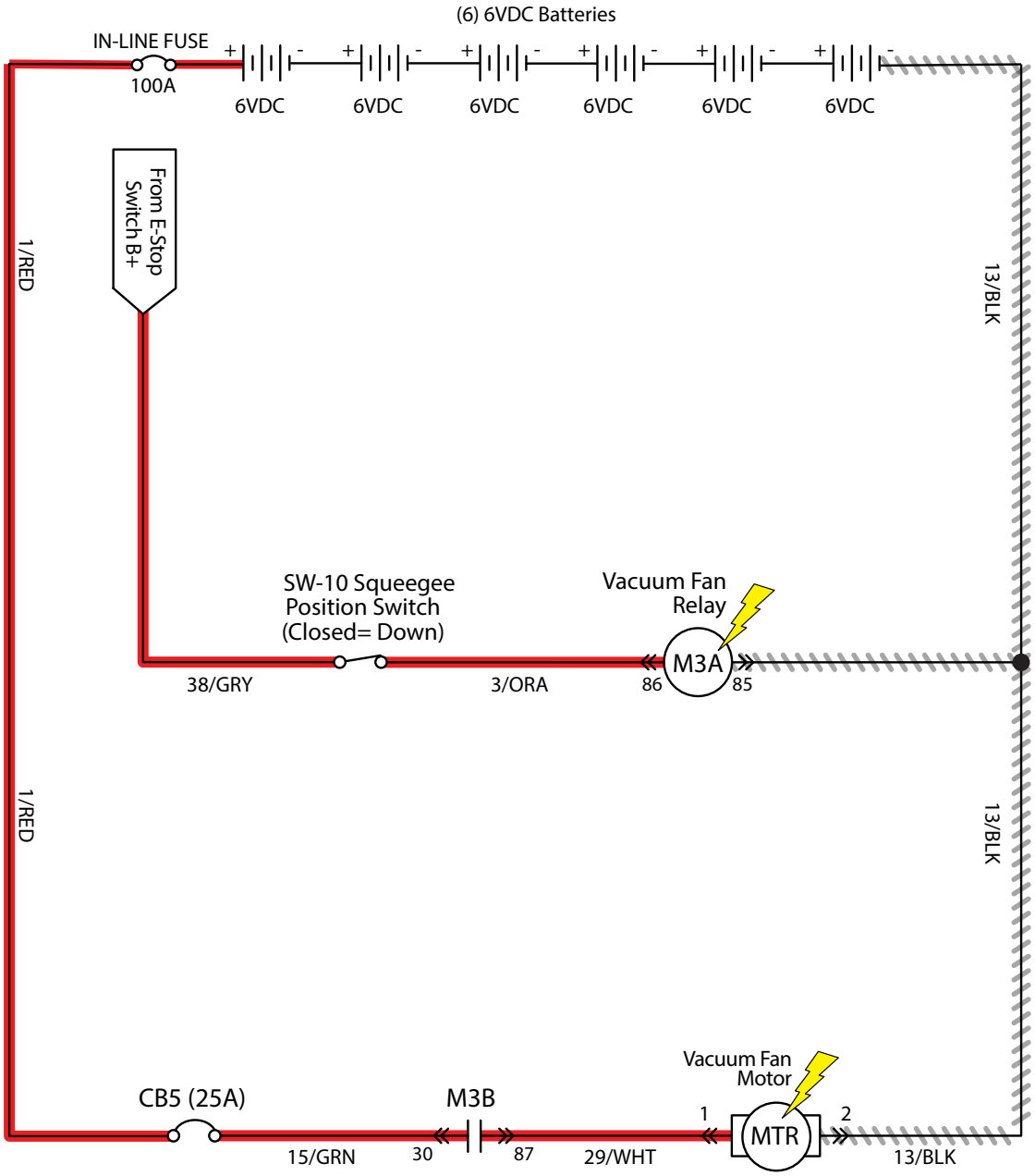
T600e SCRUB HEAD FAILED TO LIFT/LOWER

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable lift actuator • Is actuator functioning (lifting/lowering the scrub head)? • 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 #3 to reset • Is circuit breaker #3 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 automated down pressure • Is software configured properly?		Proceed to STEP 4	Reprogram software
4	• Key ON • Enable scrub motor • Enable propel • Test voltage applied to actuator 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 neces-sary compo-nents

Terms:

BDI = Battery Discharge Indicator

T600e 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-5 Popped

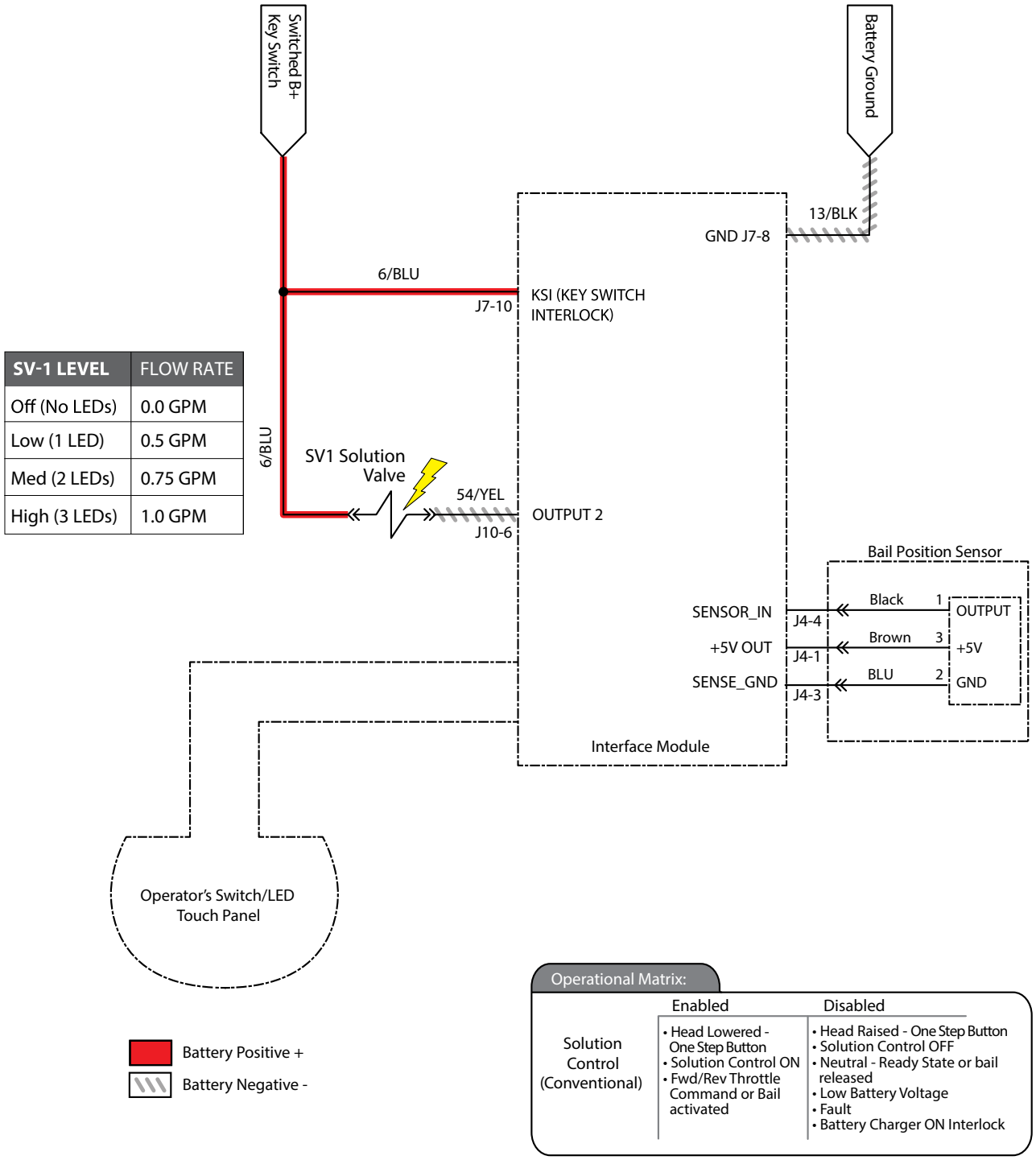
T600e VACUUM FAN FAILED TO TURN ON

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 #5 to reset • Is circuit breaker #5 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

T600e SOLUTION CONTROL ON (CONVENTIONAL)



SV-1 LEVEL	FLOW RATE
Off (No LEDs)	0.0 GPM
Low (1 LED)	0.5 GPM
Med (2 LEDs)	0.75 GPM
High (3 LEDs)	1.0 GPM

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

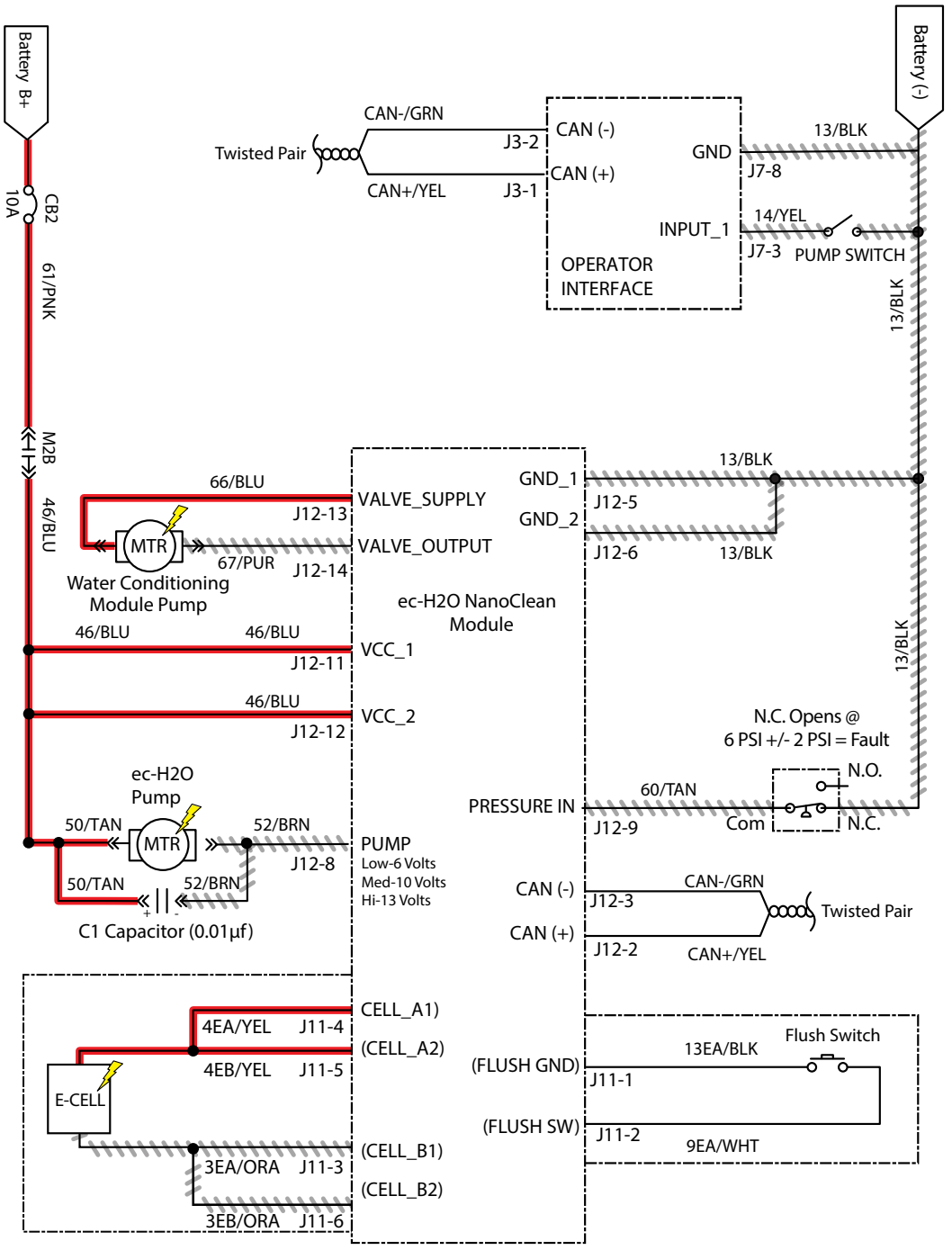
T600e SOLUTION CONTROL FAILED TO TURN ON (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON • Enable solution control (conventional) • Is there a flashing BDI fault code present?		See FAULTS in TROUBLE-SHOOTING section of this manual	Proceed to STEP 2
3	• 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

T600e SOLUTION CONTROL ON (ec-H2O) (OPTION)



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

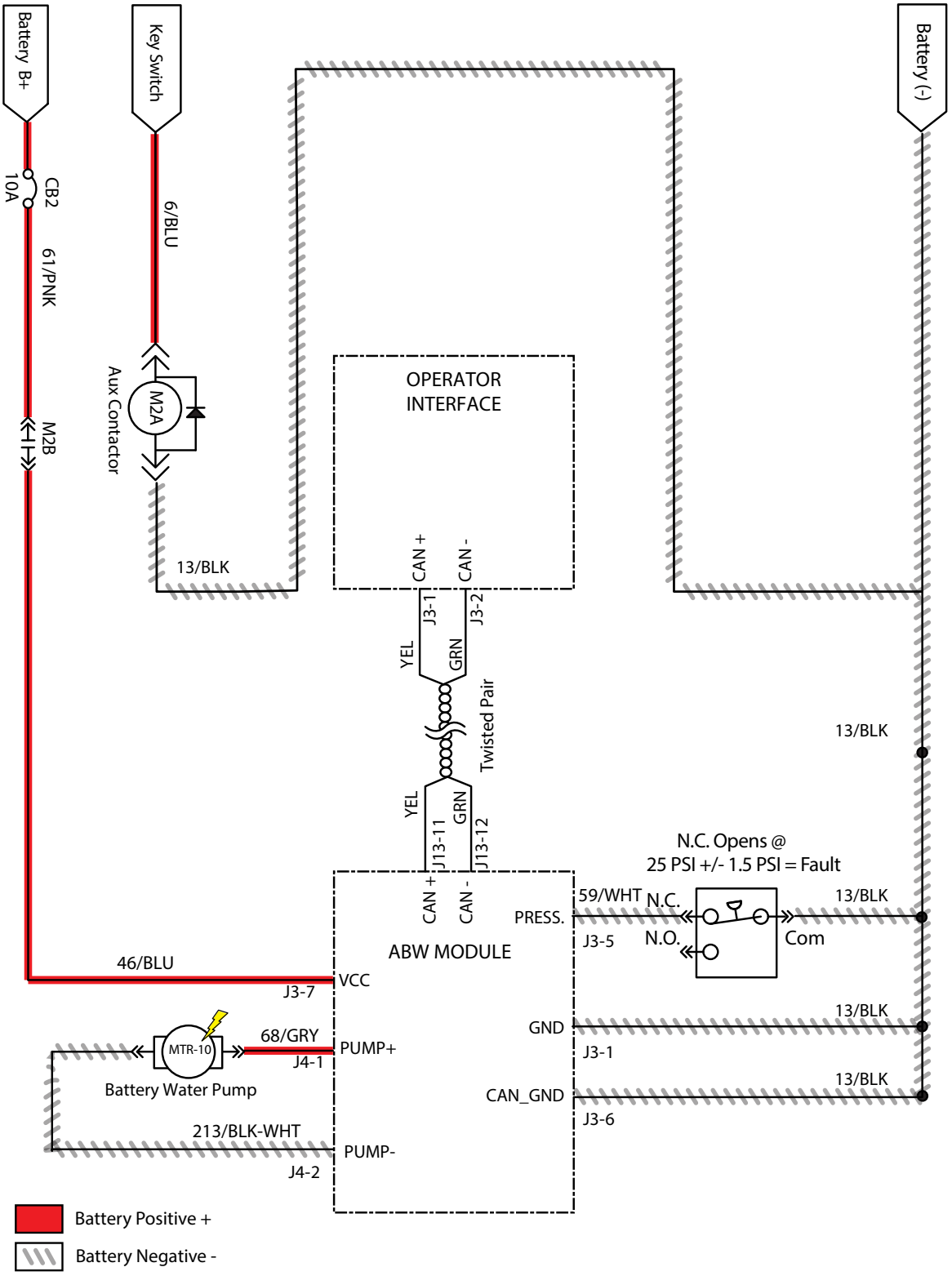
T600e SOLUTION CONTROL FAILED TO TURN ON (ec-H2O)

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

T600e AUTOMATIC BATTERY WATERING (OPTION)



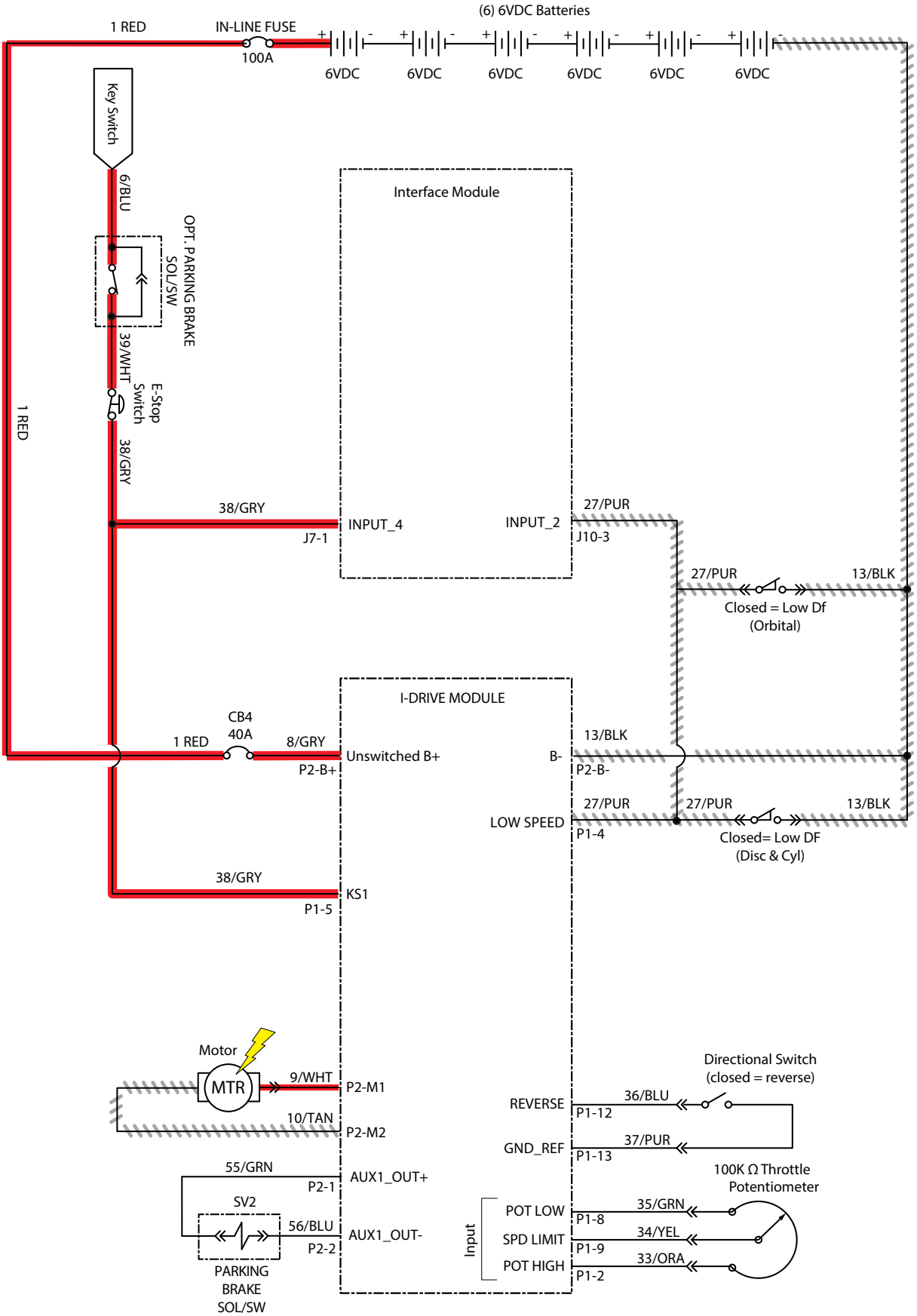
T600e AUTOMATIC BATTERY WATERING SYSTEM FAILED TO TURN ON (OPTION)

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

T600e i-DRIVE TESTING (UNIVERSAL SCHEMATIC)



T600e 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

CAN (CONTROLLER AREA NETWORK) OPEN TROUBLESHOOTING

TROUBLESHOOTING START

Refer to the table below to determine the next steps in troubleshooting the issue when a machine is reporting a CAN offline fault. Note there may be network nodes that are not powered or operational in certain machine operating modes. These slave nodes do not report offline if they should not be powered (ex. On-board CAN charger). A non-powered node is still connected to the CAN bus network and should be included in the investigation processes.

NOTE: If machine has an on-board charger, begin with step #1a below. If not, start at step #1b

Step	Action	Yes	No
1a	• Plug in Charger • Wait for the machine to initiate charging sequence (<10 seconds) • Is the machine reporting CAN offline faults?	Unplug charger, proceed to Step 1b	No issues - Charger node and User Interface node are operating correctly
1b	• Key on • Wait for the machine to finish powering up • Wait about 10 more seconds • Is the machine reporting CAN offline faults?	Proceed to Step 3	Nodes are currently operating. Proceed to Step 2
2	• Attempt machine operation • Run the machine for a period of time • Does a CAN fault displayed?	Points to a harness or wiring issue. May be a pinched CAN wire or a damaged GND wire someplace in the machine. Inspect harness wires and repair or replace harness if necessary	Try turning on additional features to generate more electrical “noise” on the system as the fault may be intermittent. Repeat this Step
3	• Is machine indicating a single node offline?	Proceed to table “Troubleshooting an Offline Node” to complete investigation	Proceed to Step 4
4	• Check the Nodes table for the machine model • Are the off-line nodes on the same control module and are the only two nodes off-line?	Points to a wiring connection issue to the control module containing multiple nodes. In the table “Troubleshooting an Offline Node”, proceed to Step 2	If multiple nodes are offline, proceed to section “ Troubleshooting Multiple Slave Nodes Offline”

TROUBLESHOOTING MULTIPLE SLAVE NODES OFFLINE OR COMM ERROR

The machine may have one or more slave nodes. If all nodes are reporting offline except the master, refer to the table below for troubleshooting guidance.

Step	Action	Yes	No
1	• Check the Nodes table for the machine model • Are the off-line nodes on the same control module and are the only two nodes off-line?	Points to a wiring connection issue to the control module containing multiple nodes. In the table “Troubleshooting an Offline Node”, proceed to Step 2	Proceed to Step 2
2	• Locate the master node for the machine • Is the master module powered?	Proceed to Step 3	Identify voltage drop location and repair or replace necessary components.
3	• Verify offline module is supposed to be there • Is the module present?	Machine is configured properly. Proceed to Step 4	Machine may have been configured for an option it does not have. Reconfigure machine for proper operation
4	• Confirm that a CAN signal is being applied to the offline module • Proceed to Step 6 if offline node does not contain power and/or CAN indicators • Is yellow CAN LED on the control board blinking?	Node is receiving CAN messages from network. Key cycle machine to reset network. Node may have gone offline momentarily due to intermittent connectivity issue. Proceed to Step 5 if this is suspected issue	Proceed to Step 5
5	• Ensure the module CAN connector is fully seated. See section “Verify Connectors Fully Seated” for picture • Is the connector latched properly?	Proceed to Step 6	Push in the connector and key cycle machine to clear fault
6	• Inspect all electrical connections for damage, corrosion, contamination, or pin problems. See section “Verify Pin Fully Seated” for diagram • Do any of the above conditions exist?	Repair or replace faulty components. Key cycle machine to clear fault	Proceed to Step 7
7	• Key off • For each module, disconnect one at a time from the network • Measure between the green and yellow CAN bus wires at each slave node CAN connection • Is the resistance 62Ω or 122Ω between yellow and green wires at each disconnected slave location (refer to Table 1 for help if needed)?	Proceed to Step 8	Repair or replace CAN wires as needed

Step	Action	Yes	No
8	• Key off • Disconnect master node and slave node with termination • Proceed to Step 10 if termination resistor is located in harness • Measure between the green and yellow CAN bus wires at removed node location • Is the resistance less than 10k Ω?	Non-terminating slave node module is bad. Proceed to Step 9	It is not possible to detect which terminating node is failing. Replace modules of terminating nodes. Reconnect all nodes and retest. *On Commercial machines with User Interface module as master node, replace ONLY the User Interface module first. If problem persists, then replace other terminating module
9	• Key off • Disconnect a non-terminating node one at a time • Measure between the green and yellow CAN bus wires at node locations • Is the resistance less than 10k Ω?	Repeat Step 9 until resistance is greater than 10k Ω	Replace the module of the last removed node for it contains bad CAN transceiver. Reconnect all nodes and retest
10	• Disconnect a non-terminating node one at a time • Measure module resistance between CAN bus inputs (See section “Check Node Resistance” for help) • Is the resistance less than 10k Ω?	Replace the module on machine. Reconnect all nodes and retest	Repeat Step 10. If all boards check out, replace terminating node module (harness contains other termination)

TROUBLESHOOTING AN OFFLINE NODE

This section can be applied to one or two slave nodes reporting offline.

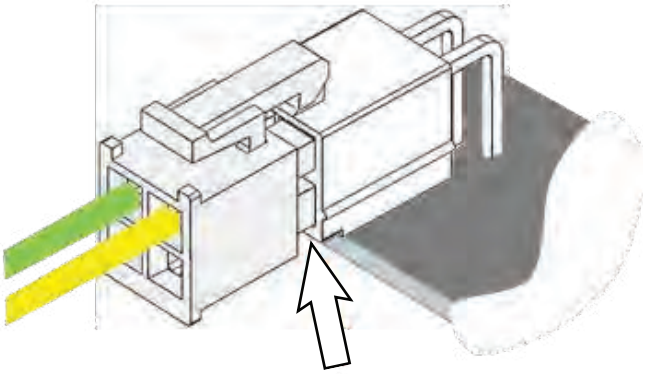
Step	Action	Yes	No
1	• Key On • Is machine indicating a single node offline?	Proceed to Step 2	If multiple nodes are offline, proceed to section “Troubleshooting Multiple Slave Nodes Offline”
2	• Does the offline module have voltage at the proper inputs?	Proceed to Step 3	Check circuit breakers and/or harness connections.
3	• Verify offline module is supposed to be there.Is the module present?	Machine is configured properly. Proceed to Step 4	Machine may be configured for an option it does not actually have. Reconfigure machine for proper operation.
4	• Confirm that a CAN signal is being applied to the offline module • Proceed to step 6 if offline node does not contain power and/or CAN indicators • Is the yellow CAN LED on the control board blinking?	Node is receiving CAN messages from network. Key cycle machine to reset the network. Node may have gone offline momentarily due to intermittent connectivity issue. Proceed to Step 5 if this is suspected issue	Proceed to Step 5
5	• Ensure module CAN connector is fully seated. See section “Verify Connectors Fully Seated” for picture • Is the connector latched properly?	Proceed to Step 6	Push in the connector and key cycle machine to clear fault
6	• Inspect all electrical connections for damage, corrosion, contamination or pin problems. See section “Verify Pin Fully Seated” for diagram • Do any of the above conditions exist?	Repair or replace faulty components. Key cycle machine to clear fault	Proceed to Step 7
7	• Key Off • Check harness continuity back to the master node. See section “Check wire continuity to Node” for reference • Do both wires show end-to-end continuity?	Proceed to Step 8	There is a break in the harness someplace. Repeat Steps 5 and 6 for connectors within harness. Break can be found by testing other wire harness locations for continuity
8	• Confirm offline node(s) have power connected • Test the module voltage • Is the power supply present?	Module power is confirmed. *Replace module. *If troubleshooting a Commercial machine with an on-board charger, and a Charger CAN communication fault exists, along with other slave node CAN communication faults, replace User Interface module first, since master CAN node transceiver may be faulty	Identify voltage drop location and repair or replace necessary components

CAN (CONTROLLER AREA NETWORK) CHECKOUT PROCEDURES

This section lists common procedures to help investigate an issue with a CAN open network on the machine.

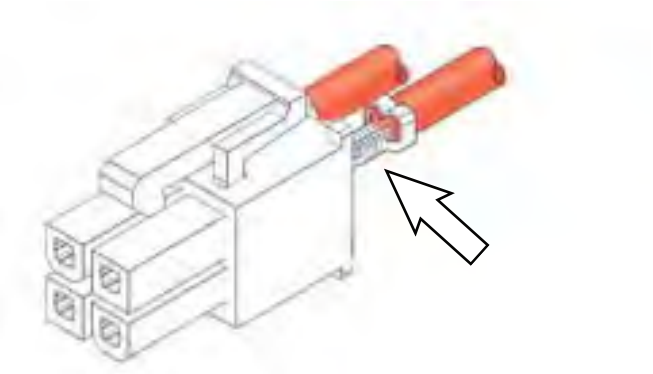
VERIFY CONNECTOR FULLY SEATED

Each node on the network has a connector for the CAN communication wires. Check each board individually to make sure the connectors are fully seated. There may also be other connectors within the harness that should be checked. If connector not seated, push in and power cycle machine to see if fault clears.



VERIFY PIN FULLY SEATED

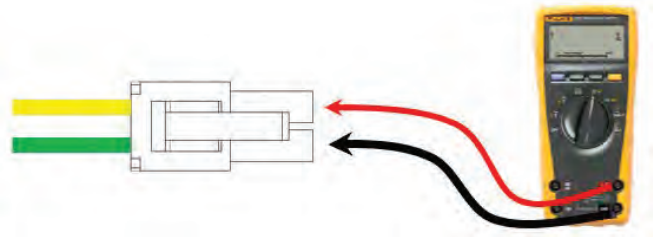
Sometimes a pin in the harness side of the connector may not be fully seated and may work loose over time. Verify the CAN communication wires are snapped into the connector. If pin is not seated, push in and power cycle machine to see if fault clears.



VERIFY NETWORK RESISTANCE

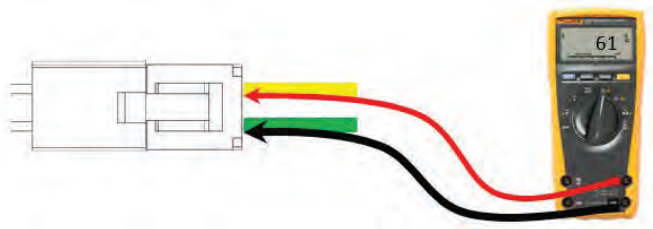
The network resistance must be correct for the network to operate correctly. Depending on which node the measurement is taken at and the method of measurement, the resistance may be one of two values: 121Ω or 61Ω. Any value other than these two means something is wrong with the network.

Method 1



1. Turn off the machine.
2. Locate a CAN node location on the machine.
3. Disconnect the connector containing the CAN wires.
4. Measure the resistance between the green and yellow wires.
5. Depending which nodes are still connected, resistance should be 61Ω of 121Ω .

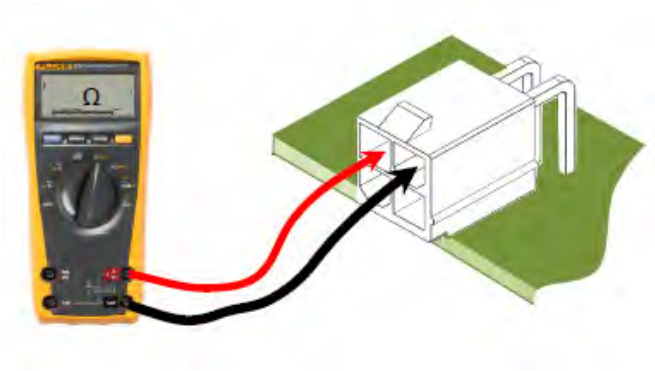
Method 2



1. Turn off the machine.
2. Locate a CAN node location on the machine.
3. Carefully push probes into the back of the connector containing the CAN wires.
4. Since the network remains connected in this node, resistance should measure approximately 61Ω .

CHECK NODE (MODULE) RESISTANCE

Each node on the network has a connector for the CAN communication wires. Check each board individually to make sure the CANH and CANL resistance measurements are > 1M Ω for non-terminating nodes and 122 Ω for terminating nodes. The CAN connections may be on their own connector (pictured below) or combined into another connector. See specific machine schematic for more details.



CHECK WIRE CONTINUITY TO NODE

A check can be made between two points on the harness verifying continuity of the wire harness. Check the yellow to yellow connections and the green to green.

DISPLAYING FAULT CODES/WARNINGS (PRO-PANEL MACHINES ONLY)

SYSTEM REQUIREMENTS: Windows® 7 OS, 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.

Authorized service providers can download the Service Diagnostics software. Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on optional 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.

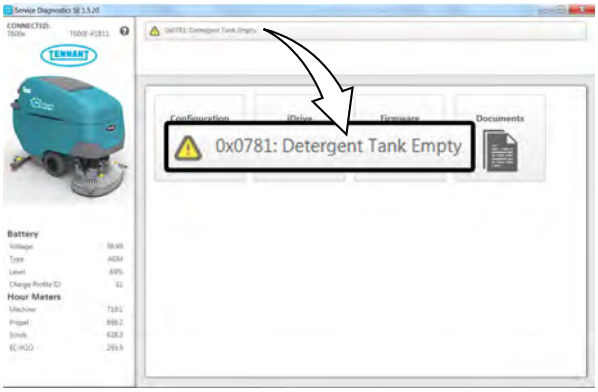
1. Connect a USB cable from the computer to the machine.

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

4. Active faults scroll across the top of the home screen.

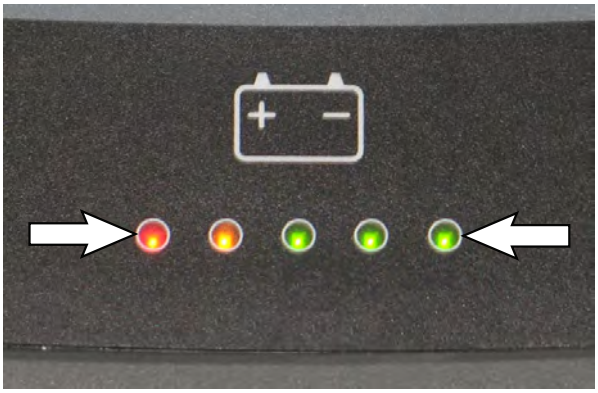


NOTE: Service Diagnostics tool is available to all Tennant Service personnel and authorized distributors. Contact Tennant Field Service for more information.

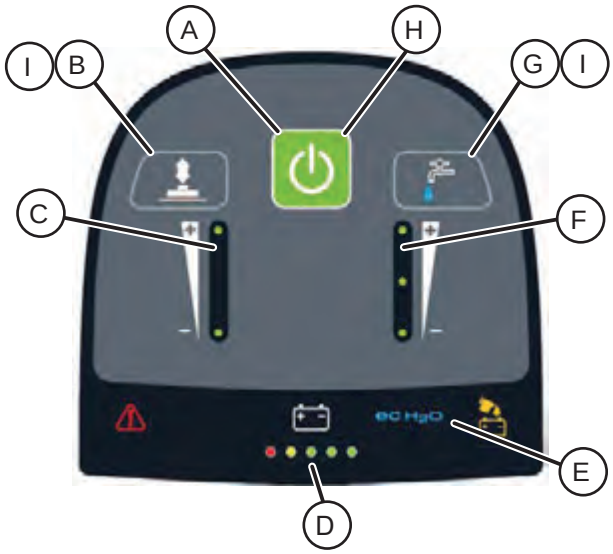
ENTERING THE MANUAL MODE (T600e CONTROL PANEL MACHINES ONLY)

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. Use the bail to control the actuator. 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. LEDs indicate 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.

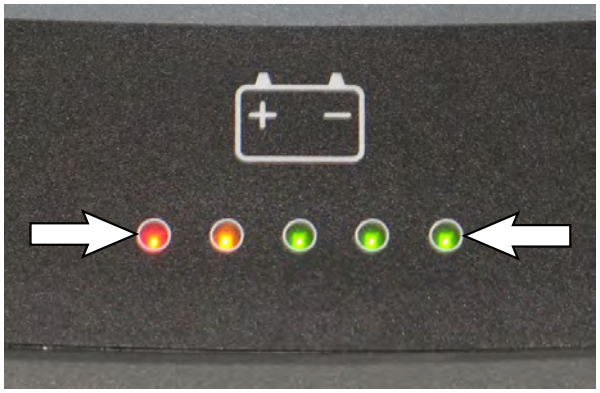
I. B and G pressed together simultaneously toggle between ABW pump on or ABW pump off.

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

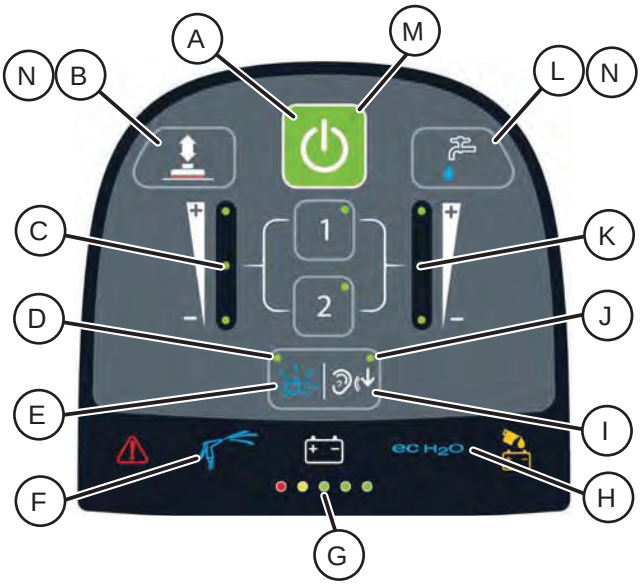
ENTERING THE MANUAL MODE (T600 PRO-MEMBRANE CONTROL PANEL MACHINES ONLY)

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. Use the bail to control the actuator. 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. LED indicates whether severe environment subsystem is active.

E. Turns Severe Environment subsystem on or off. Turns off ec-H2O if ec-H2O is enabled.

F. Indicates Spray Hose option is active. Turned on and off from respective rocker switch on accessory panel.

G. Indicates battery discharge level.

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

I. Turns the quiet mode on or off.

J. LED Indicates quiet mode active setting.

K. LEDs display flow rate setting.

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

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

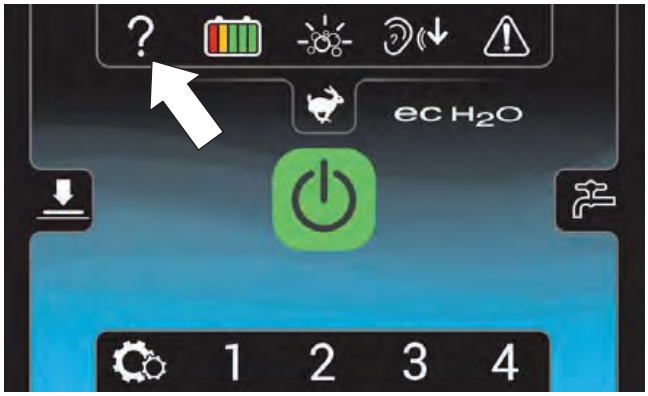
N. B and L pressed together simultaneously toggle between ABW pump on or ABW pump off.

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

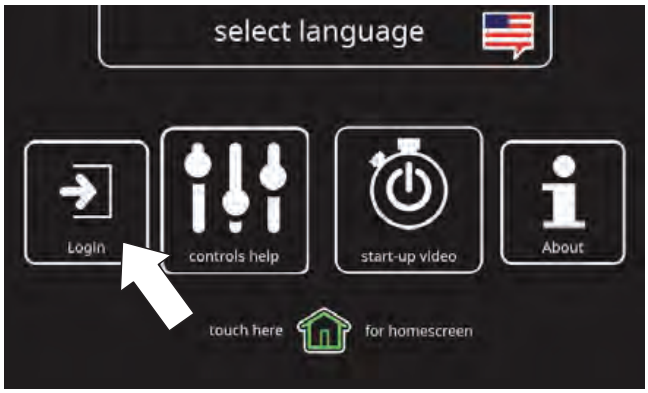
ENTERING THE MANUAL MODE (PRO-PANEL MACHINES ONLY)

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

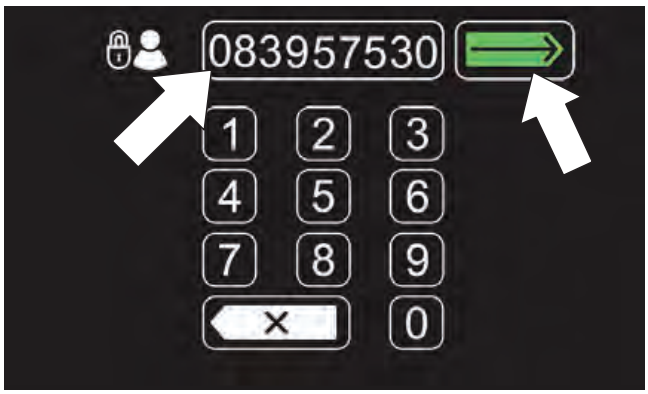
1. Turn the key switch to the ON position.
2. Press the help button [?] to the help screen to enter the manual mode.



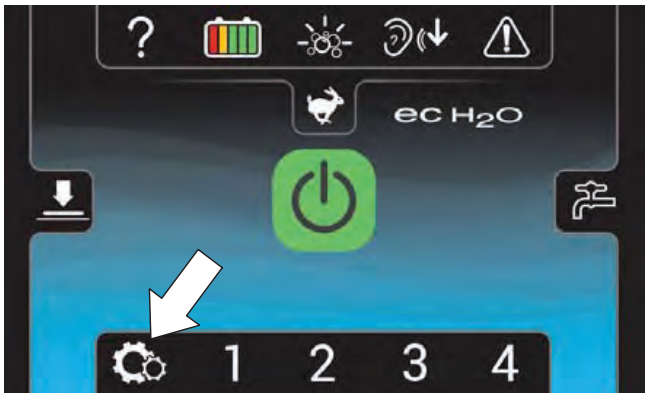
3. Press the Login button.



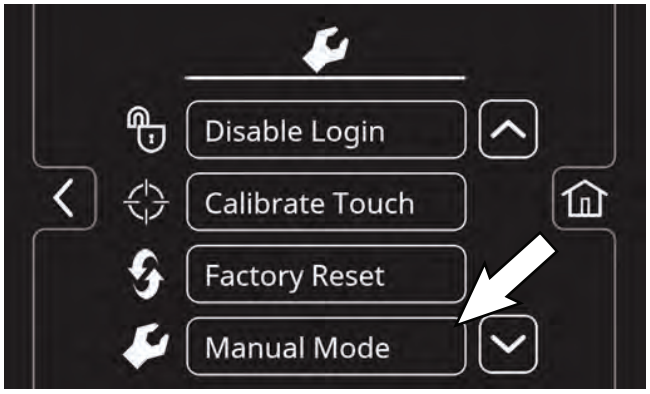
4. Enter the manual mode code 083957530 and press the green arrow.



5. Press the machine settings button.



6. When logged in as service user, the Manual Mode button will appear as a selection in the Setting menu. Scroll down and press the Manual Mode button.



7. Select Manual Mode from the Setting menu.
8. Use the right arrow button or left arrow button to scroll through the various manual mode screens.

Pro-Panel Manual Mode Screens:

M01: Scrub Actuator: Press the - (minus) button to set the actuator in the retract direction and the + (plus) button to set the actuator in the extend direction. Squeeze the bail to move the actuator. Displays E (extend) or R (retract), the scrub actuator PWM (pulse width modulation) duty cycle, and the motor current.

M02: Scrub Motor 1: Press the - (minus) button to set the actuator in the retract direction and the + (plus) button to set the actuator in the extend direction. Squeeze the bail to move the actuator. Press the check box to turn scrub motor 1 on or off. Displays the average voltage, PWM duty cycle, and motor current.

M03: Scrub Motor 2: Press the - (minus) button to set the actuator in the retract direction and the + (plus) button to set the actuator in the extend direction. Squeeze the bail to move the actuator. Press the check box to turn scrub motor 2 on or off. Displays the average voltage, PWM duty cycle, and motor current.

M04: Normal Vac: Press the check box to turn the vacuum motor on or off at normal full speed. Displays the average voltage, PWM duty cycle, and motor current.

M05: Quiet Vac: Press the check box to turn the vacuum motor on or off at reduced speed. Displays the average voltage, PWM duty cycle, and motor current.

M06: Water Valve: Press the check box to turn the water valve cycling on or off. Press the - button to decrease the water flow setting and the + button to decrease the water flow setting. Displays the water flow setting and motor current.

M07: Detergent Pump: Press the check box to turn the detergent pump on or off. Press the - (minus) button and the + (plus) button to change the ec-H2O flow setting (three settings and off). Displays the average voltage, PWM duty cycle, and motor current.

M08: Spray Pump: Press the check box to turn the spray pump on or off. Displays the average voltage, PWM duty cycle, and motor current.

M09: Ec Pump: Press the check box to turn the ec-H2O pump on or off. Press the - (minus) button and the + (plus) button to change the ec-H2O flow setting (three settings and off). Displays the PWM duty cycle and motor current.

M10: Ec Cell: Press the check box to turn the ec-H2O cell plates on or off. Press the - (minus) button and the + (plus) button to change the ec-H2O flow setting (three settings and off). Displays the cell PWM duty cycle and cell current.

M11: ABW Pump: Press the check box to turn the automatic battery watering pump on or off. Displays the flow meter measured flow rate and motor current.

9. Turn the key switch to the OFF position to turn off the machine and exit the Manual Mode.

SERVICE

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. 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 (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on options. 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.
- **Automatic Battery Watering (ABW) Module (option):** The ABW module is located above the scrub head 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.

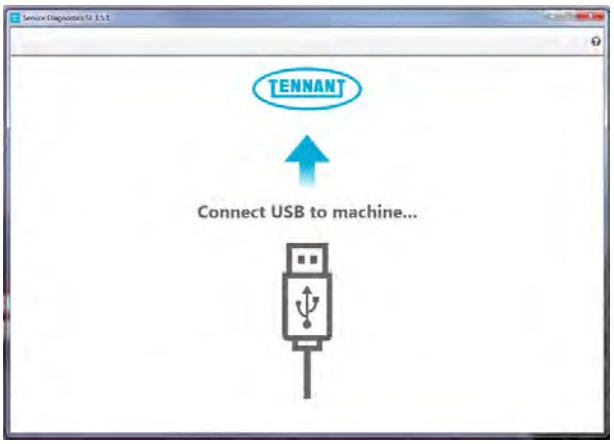
1. Connect a USB cable from a computer to the machine.

2. Turn the key switch ON.

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

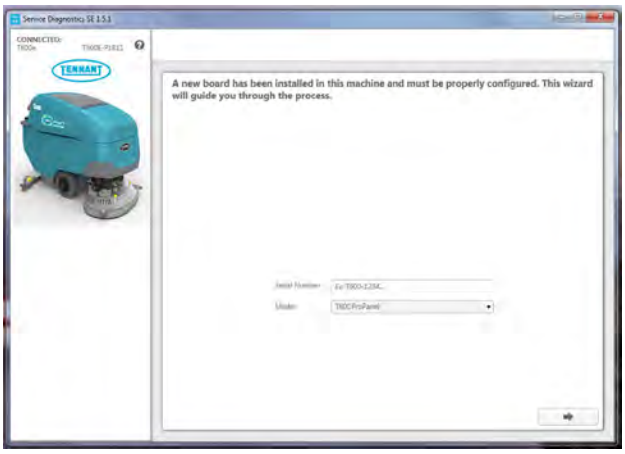
NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

NOTE: Confirm key switch is ON and check USB cable connection to the machine if the screen below appears on the 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 if a new interface module was installed. Enter the model and serial number and then click the arrow button.

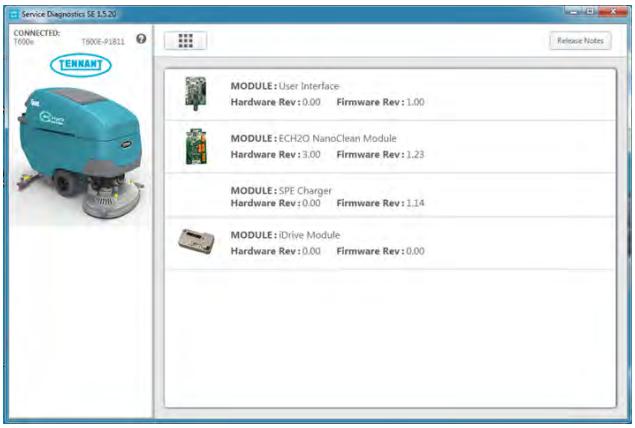


6. Inspect the actual machine configuration and match applicable configurations from the drop-down menus and then click on the arrow button.

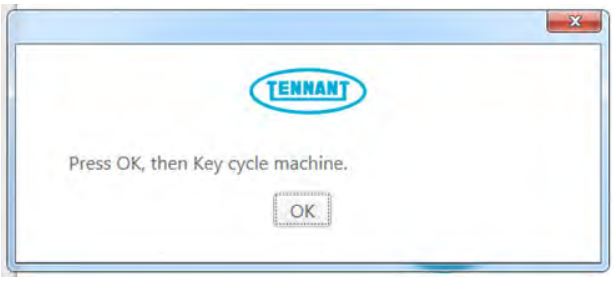
NOTE: Reconfiguration may take several minutes.

NOTE: Configurations may differ from what is shown, depending on the options/features equipped on the machine. If no interface module was installed, this screen will appear first. First confirm there is no Firmware update available. If a Firmware update is available, the Firmware update should be done first.

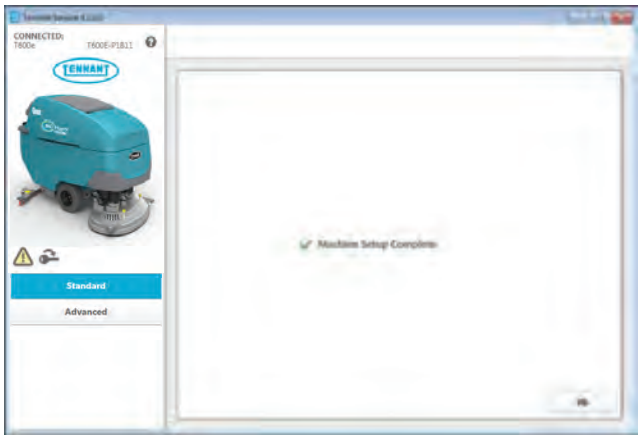
7. The programming process begins and all control modules are updated (if applicable).



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. Do not interrupt process unless prompted to do so.



9. Cycle the key switch to save selections after Machine Setup Complete appears on the screen.



UPDATING THE MACHINE FIRMWARE

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. 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 (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on options. 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.

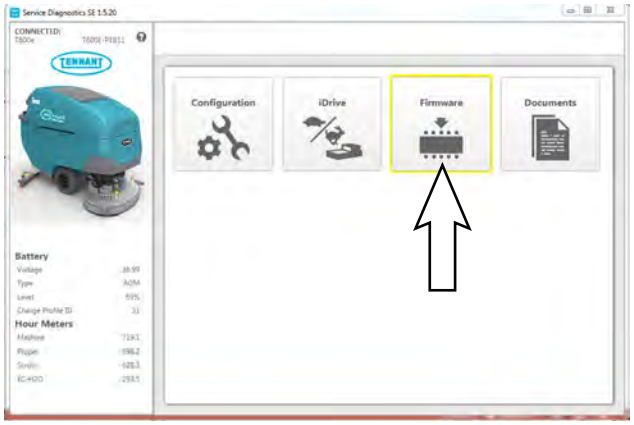
2. Turn the key switch ON.

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

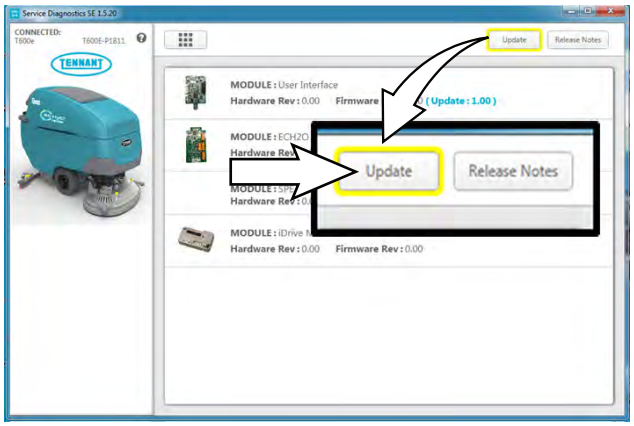
NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

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

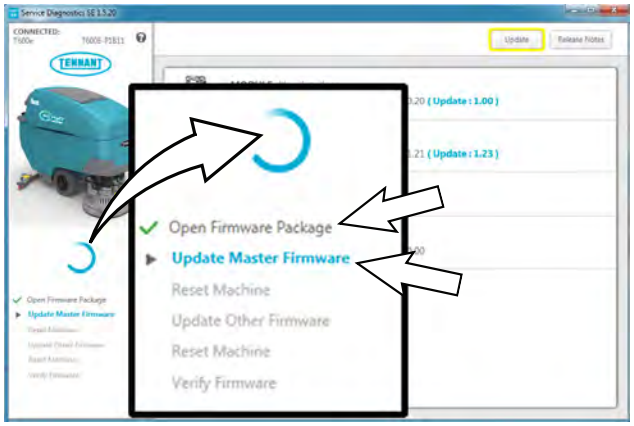
NOTE: Update installation may take several minutes. Do not interrupt process unless prompted.



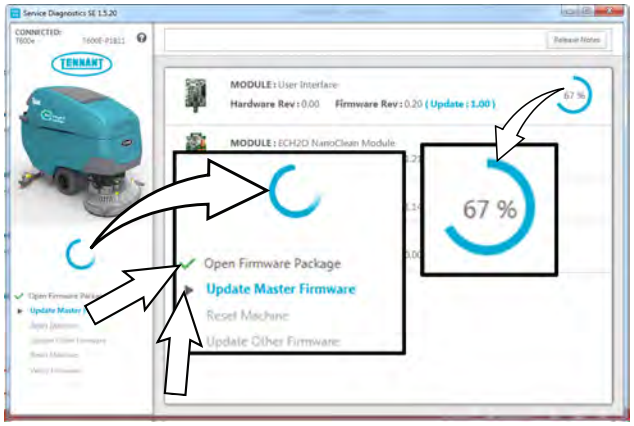
5. Click on the Update button to begin updating the modules.



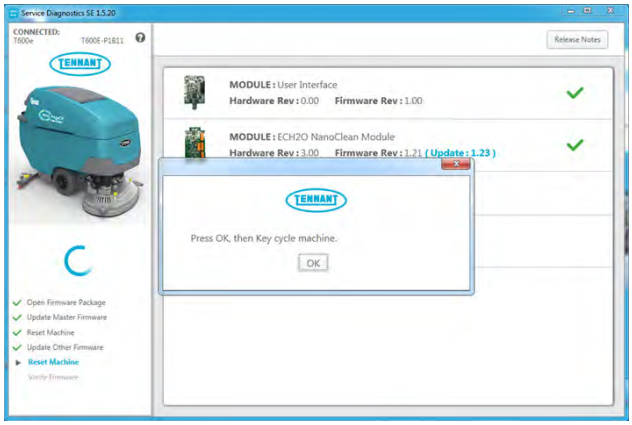
6. The firmware package opens and “Update Master Firmware” begins. The process indicator and firmware update status bar appear on the left side of the screen.



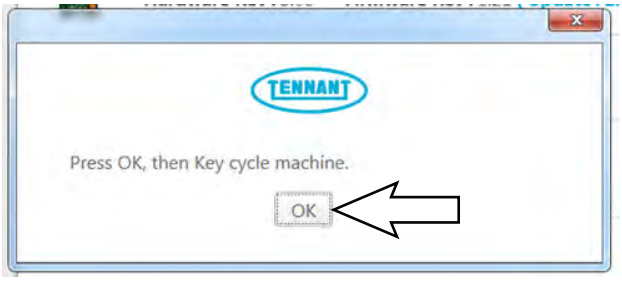
Allow the firmware update package to update the machine operating system. Various update status indicators appear on the screen while the firmware updates are occurring. Watch the on screen status indicators for the firmware update status.



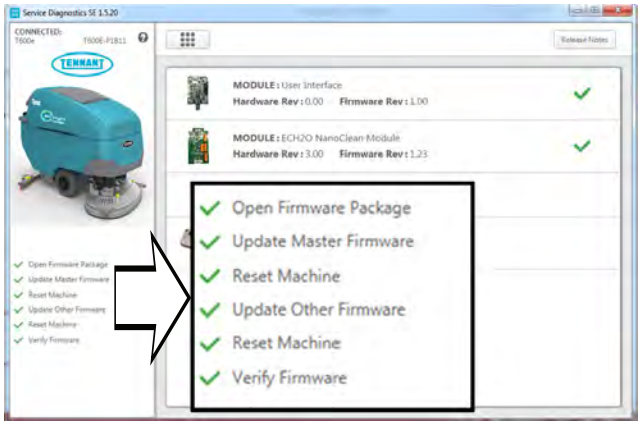
A prompt box to “Press OK, the Key cycle machine” will appear on the screen.



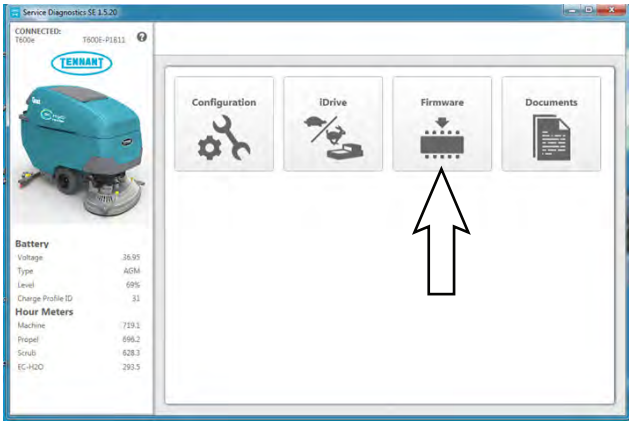
7. Press the OK button in the “Press OK, then Key cycle machine” prompt box and cycle the key switch.



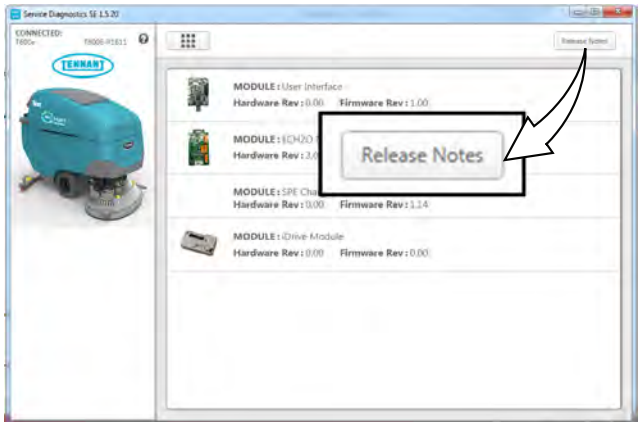
8. Allow the firmware update package to continue to update the machine operating system. The process indicator will eventually disappear from the screen and all items in the firmware update status bar will have check marks to the left to verify the firmware has occurred.



The firmware updates are complete when there is no longer a yellow highlight surrounding the Firmware button.



9. Click the Release Notes button to access the attached PDF notes for the firmware updates.



10. Refer to the PDF notes to confirm the firmware updates and fixes to the machine.

PROGRAMMING THE i-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. 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 (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on options. 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.

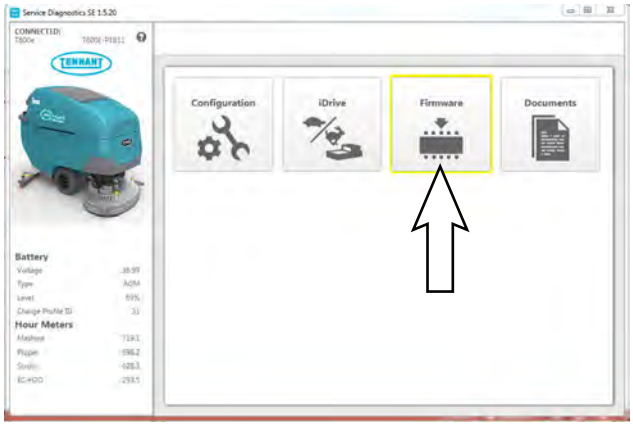
2. Turn the key switch ON.

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

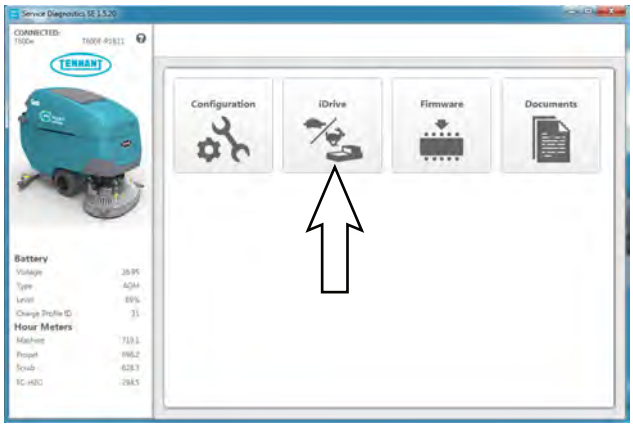
NOTE: Computer may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics, and relaunch Service Diagnostics.

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. If there are no Firmware updates, proceed to the next step.

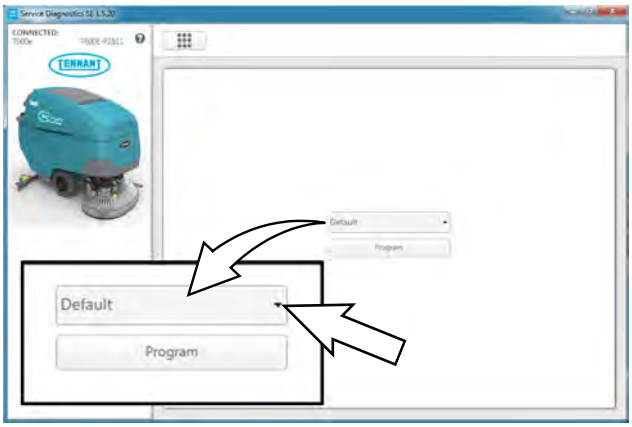
NOTE: Update installation may take several minutes.



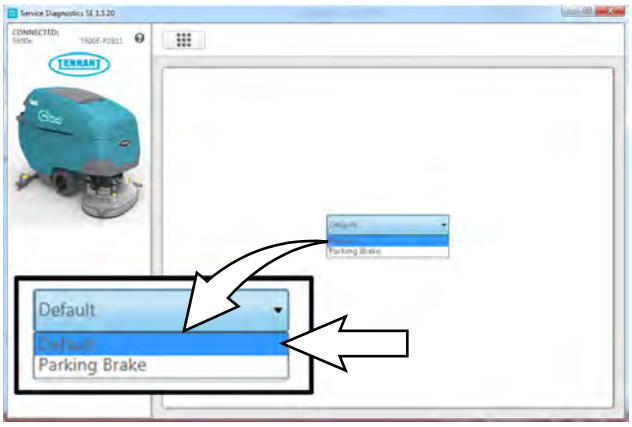
5. Click on the i-Drive button.



6. Click on the Default pull down menu.



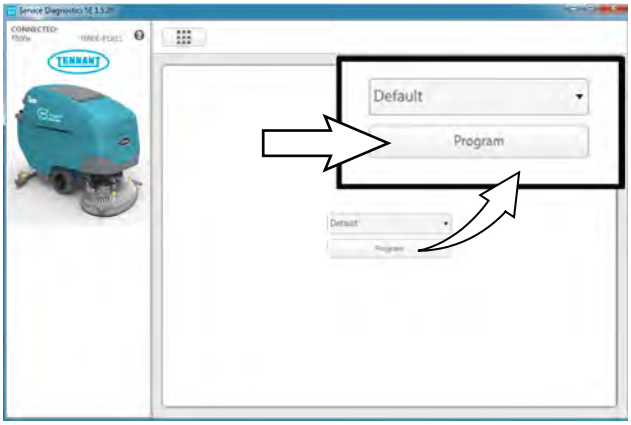
7. Select item(s) from pull down menu to program into the i-Drive.



In the above example the only two options are
Default = No parking brake, and
Reverse Alarm = Having a parking brake.
User definable hardware is present in all machines.

NOTE: This feature can also be set up in machine Configuration. Use the Warning Lights and Alarms tab. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION.

8. Click on the Program button to program the drive module.



9. 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 Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices.

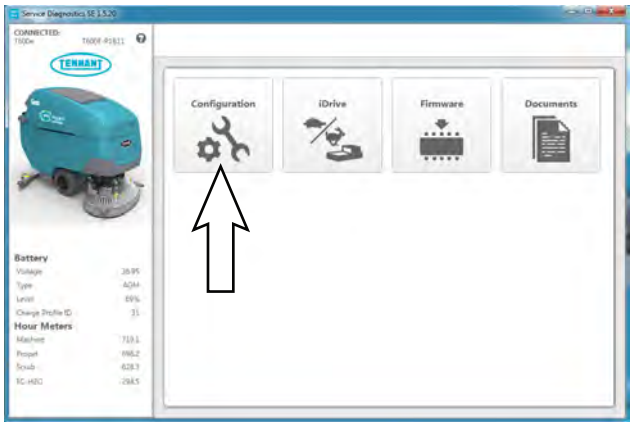
A USB cable connects from the notebook to an external port on the control console (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on options. The interface module stores configuration data and communicates via RS232 serial communication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

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

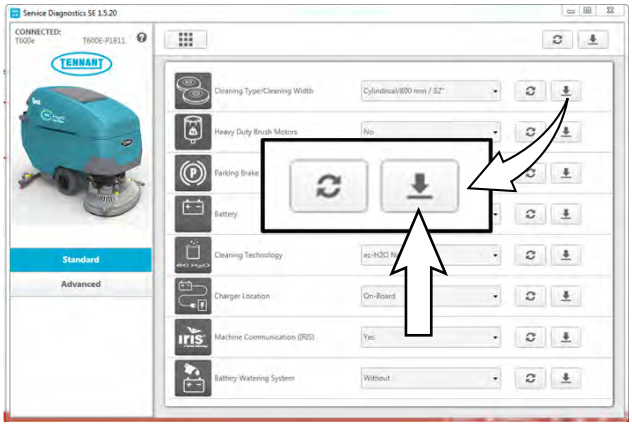
2. Turn the key switch ON.

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

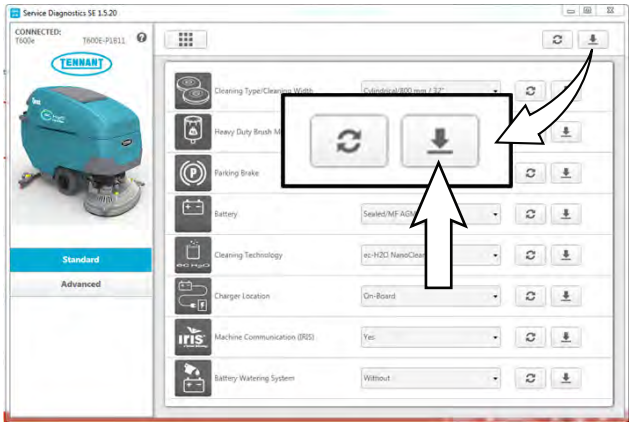
4. Click on the Configuration button to display a list of configurable options.



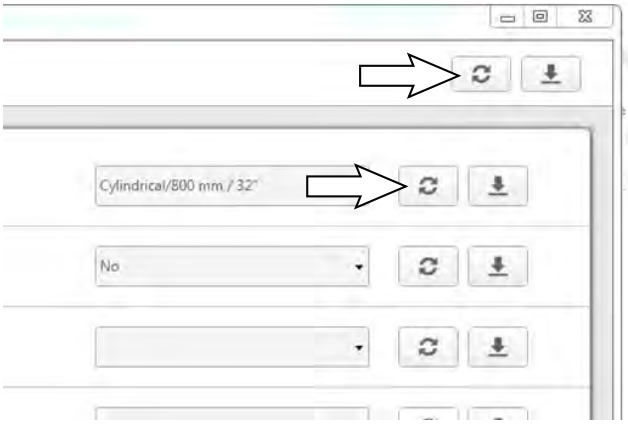
5. Select the configurable options that apply from the drop down menus and then click individual arrow buttons to launch individual module reprogramming (this is faster).



Or click the header arrow button to launch all module reprogramming (this is slower).



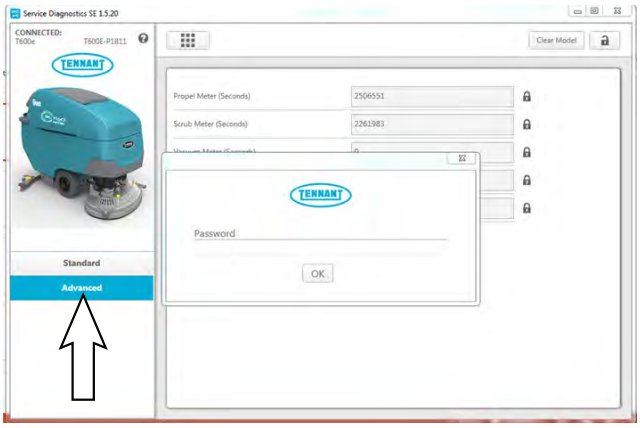
6. Click the refresh button to display the new configuration after reprogramming is completed.



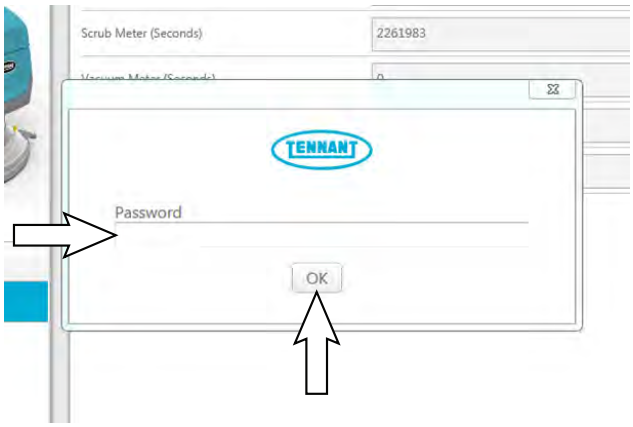
7. Cycle the key switch to save.

It is possible to perform advanced configuration updates, but a password is required to access the Advanced configuration options.

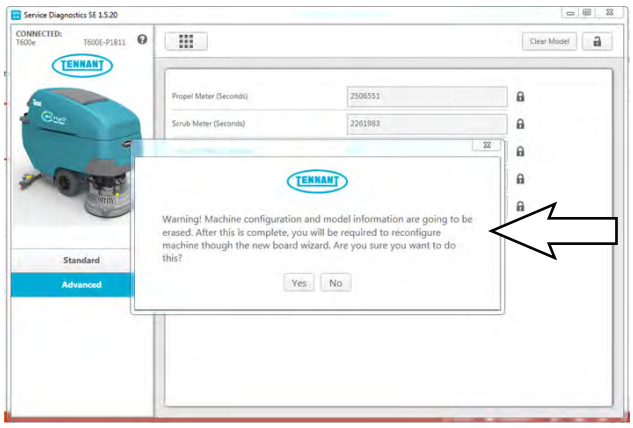
8. Click on the menu located on the left side of the screen. A password box will appear on the screen.



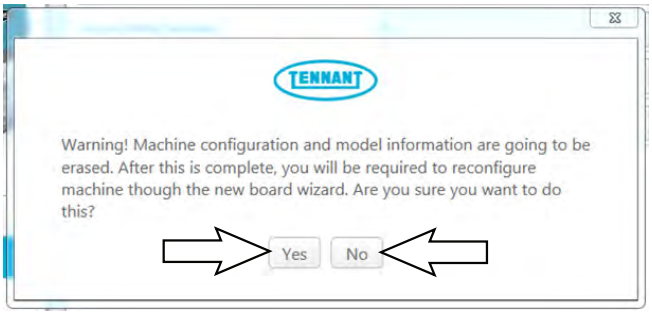
9. Enter the password into the password box and click the OK button. Contact T.A.C. (Tennant Assistance Center) for required password.



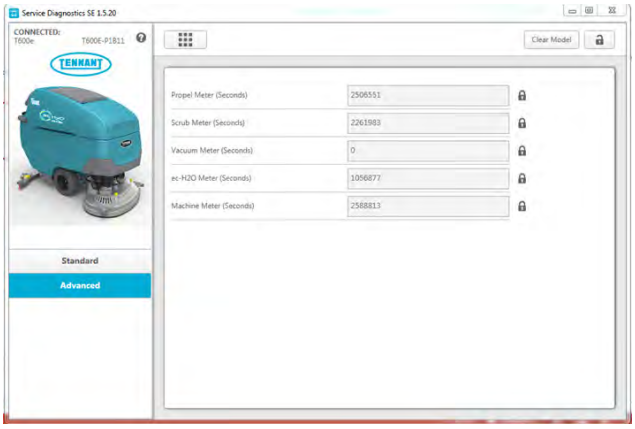
10. A warning box stating “Warning! Machine configuration and model information are going to be erased. After this is complete, you will be required to reconfigure machine through the new board wizard. Are you sure you want to do this?” appears.



Select the Yes button if reconfiguring the machine for new hardware or option. Select the No button if not reconfiguring the machine.



11. Access the advanced configuration screen to reset component hours or record old hours on repair order for warranty purposes.



12. Cycle the key switch to save and exit the Advanced Configuration screen.

ACCESSING SUPPORT DOCUMENTATION

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. 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 (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL configures up to seven control modules depending on options. 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.

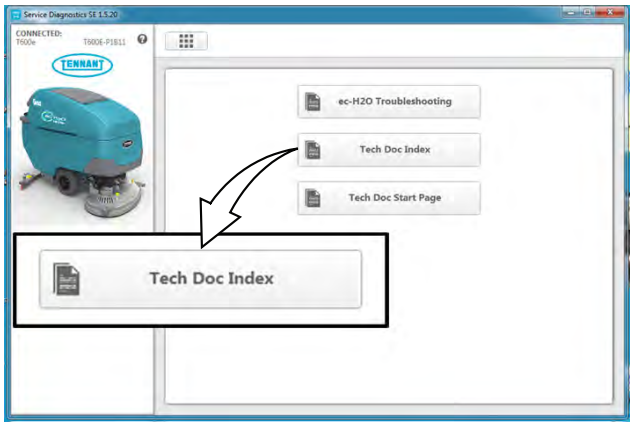
2. Turn the key switch ON.

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

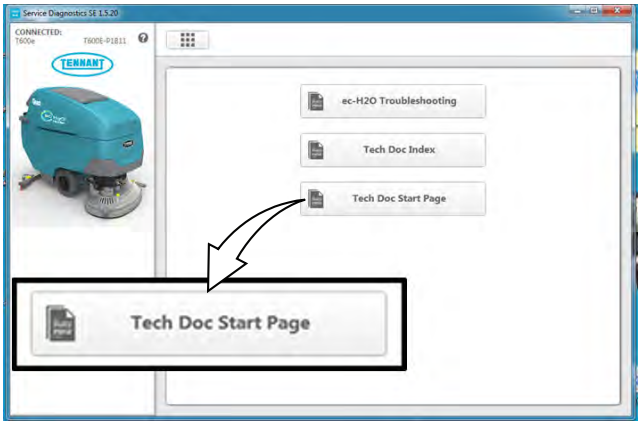
4. Click on the Documentation button to display a list of support documentation.

5. Click on the appropriate button to access needed support documentation. Click on the ec-H2O Troubleshooting button to access ec-H2O troubleshooting documentation.

Click on the Tech Doc Index button to access the Technical Documentation Index.

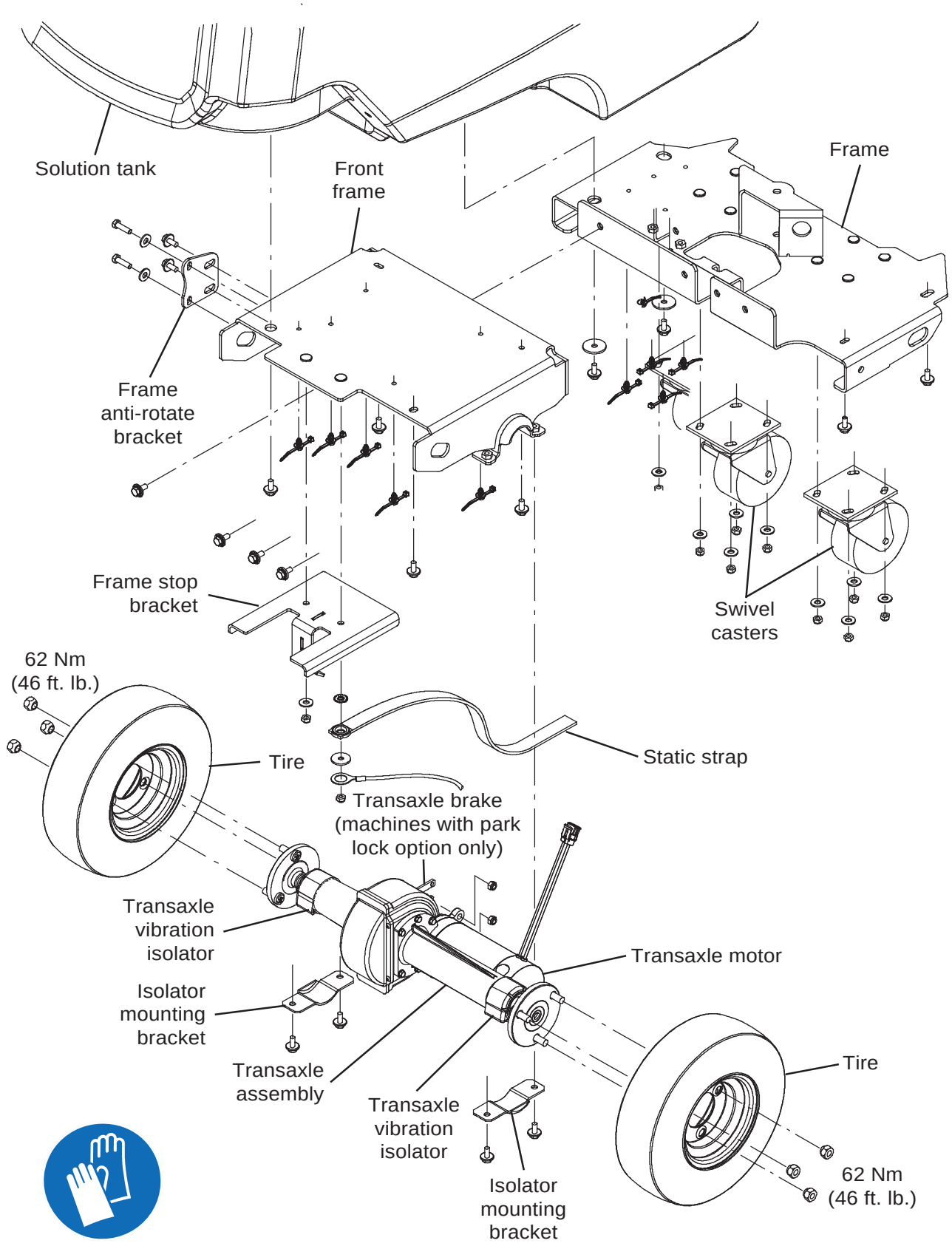


Click on the Tech Doc Start Page button to access the Technical Publications Start Page.



CHASSIS

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.

1. Completely empty the solution tank and the recovery tank.
2. Machines equipped with Smart-Fill ABW (Automatic Battery Watering): Empty the ABW solution tank.
3. Machines equipped with SE (Severe Environment): Completely empty the SE solution tank.
4. Turn the key switch OFF.
5. Disconnect the battery cable from the machine.

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

6. Remove the batteries from the machine.

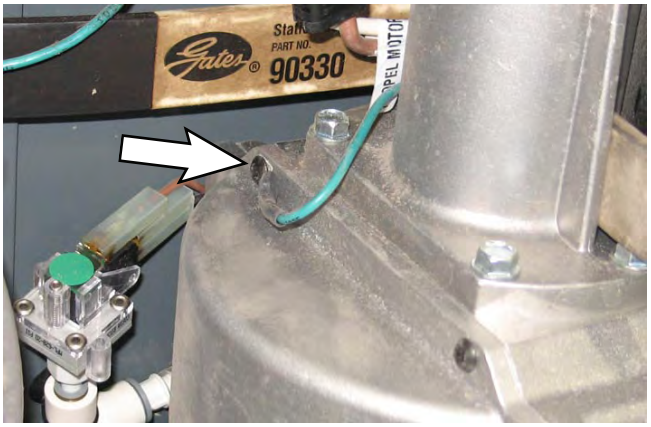
FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries. Use a non-conductive battery removal device.

7. Remove the rear squeegee assembly from the machine.
8. Close the recovery tank.
9. Position a protective blanket or large section of cardboard next to the side of the machine that will be tipped onto the floor.

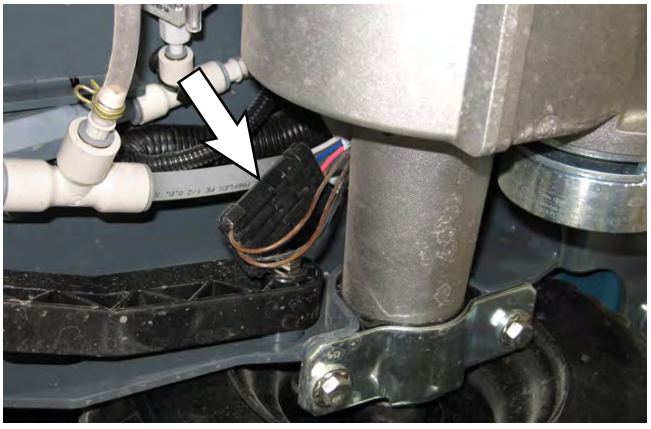
NOTE: Do Not allow the machine to drop when tipping it onto the blanket/cardboard. The scrub head and other components could be damaged if machine is allowed to drop. If necessary, remove the scrub head from the machine before tipping the machine onto its side.

10. Carefully tip the machine onto the blanket/ cardboard.
11. Disconnect the main wire harness from the transaxle assembly.

12. Disconnect the main wire harness ground wire from the transaxle assembly.



13. Machines equipped with park lock option: Disconnect the main wire harness from the park lock assembly.



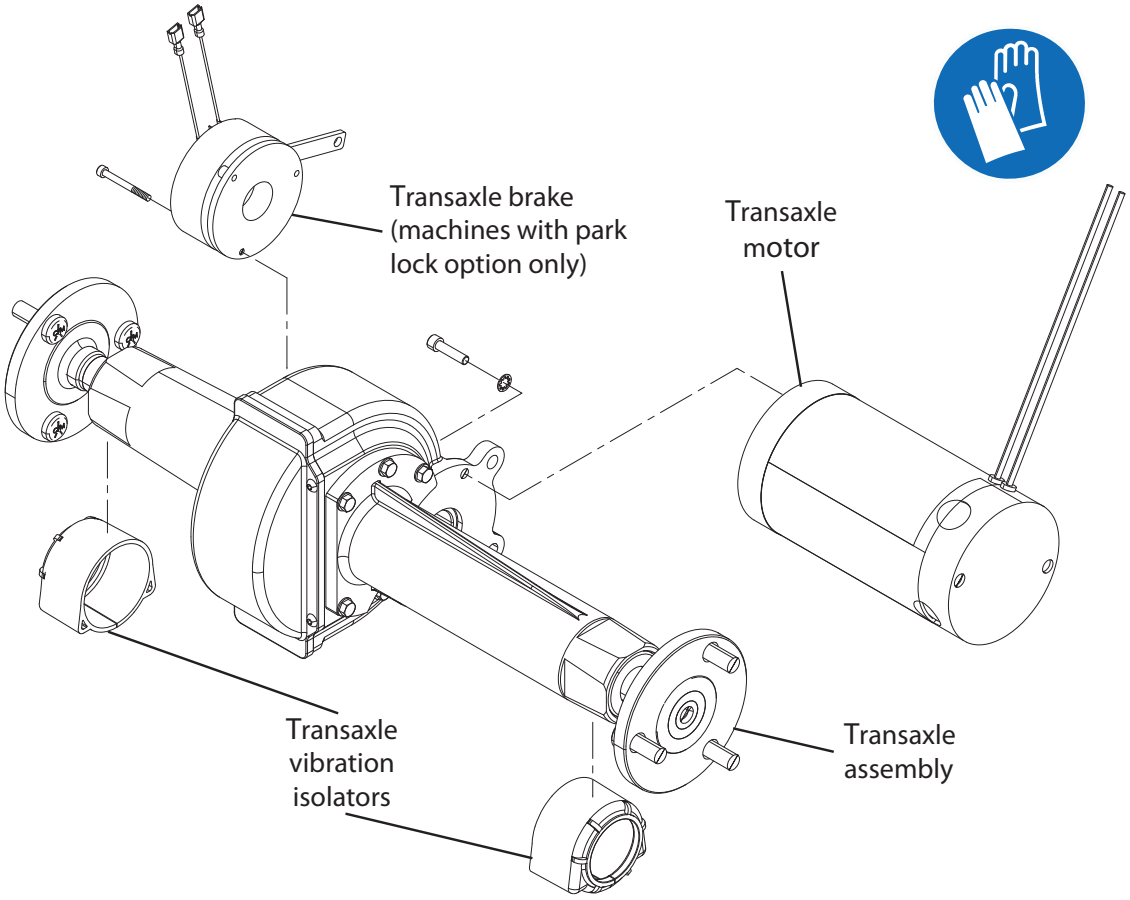
14. Remove the hardware securing each isolator mounting bracket to the machine.

15. Remove both tires from the transaxle assembly.

16. If replacing/servicing the drive motor, remove the motor assembly from the transaxle assembly. If replacing the drive motor carbon brushes,see REMOVING/INSTALLING THE DRIVE MOTOR CARBON BRUSHES. Reinstall drive motor/install new drive motor in reverse order of disassembly.

17. If replacing/servicing the park lock, remove the park lock from the transaxle assembly. Reinstall park lock/install new park lock in reverse order of disassembly.

18. Reinstall the transaxle assembly/install the new transaxle assembly in the reverse order of disassembly.



REMOVING/INSTALLING THE TRANSAXLE VIBRATION ISOLATORS

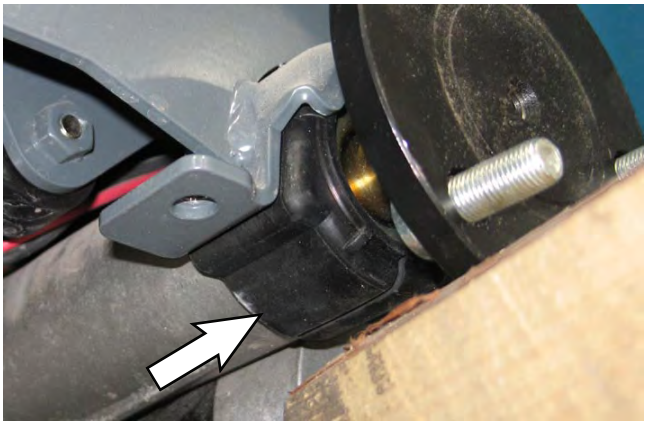
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Jack up the back end of the machine until the machine is resting on the scrub head.

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.

2. Position a block under the transaxle hub to support the transaxle hub off from the floor. Do not place the block under the isolator mounting brackets. It must be possible to remove the isolator mounting brackets from the transaxle assembly.
3. Remove the wheel from the machine.
4. Remove the isolator mounting bracket from the transaxle assembly.

5. Remove the transaxle vibration isolator from the transaxle assembly.



6. Install the new transaxle vibration isolator into the transaxle assembly.
7. Reinstall the isolator mounting bracket onto the transaxle assembly.
8. Remove the block from under the transaxle hub and reinstall the wheel onto the machine.
9. Lower the machine to the floor.
10. Repeat procedure to check/replace the transaxle vibration isolator located on the other side of the machine.

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.

NOTE: Carbon brushes should be replaced as sets.

1. Remove the transaxle assembly from the machine. See REMOVING/INSTALLING THE FRONT DRIVE WHEEL ASSEMBLY.
2. Remove the drive motor from the transaxle assembly.
3. Remove the plastic plug securing the carbon brush inside the drive motor.

4. Carefully remove the carbon brush from the drive motor.

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

6. Use compressed air to clean dust from inside the motor.
7. Repeat procedure to check/replace the remaining three carbon brushes.
8. Reinstall the drive motor onto the transaxle assembly in reverse order of disassembly.

REMOVING/INSTALLING THE SWIVEL CASTERS

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

1. Jack up the back end of the machine until the machine is resting on the scrub head.

OR 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.

2. Position a jack stand/jack stands/block under the machine as necessary to keep the back end of the machine safely elevated from the floor.

3. Remove the swivel casters from the machine.

4. Reinstall removed swivel caster/new swivel casters in reverse order of disassembly.

TIRES

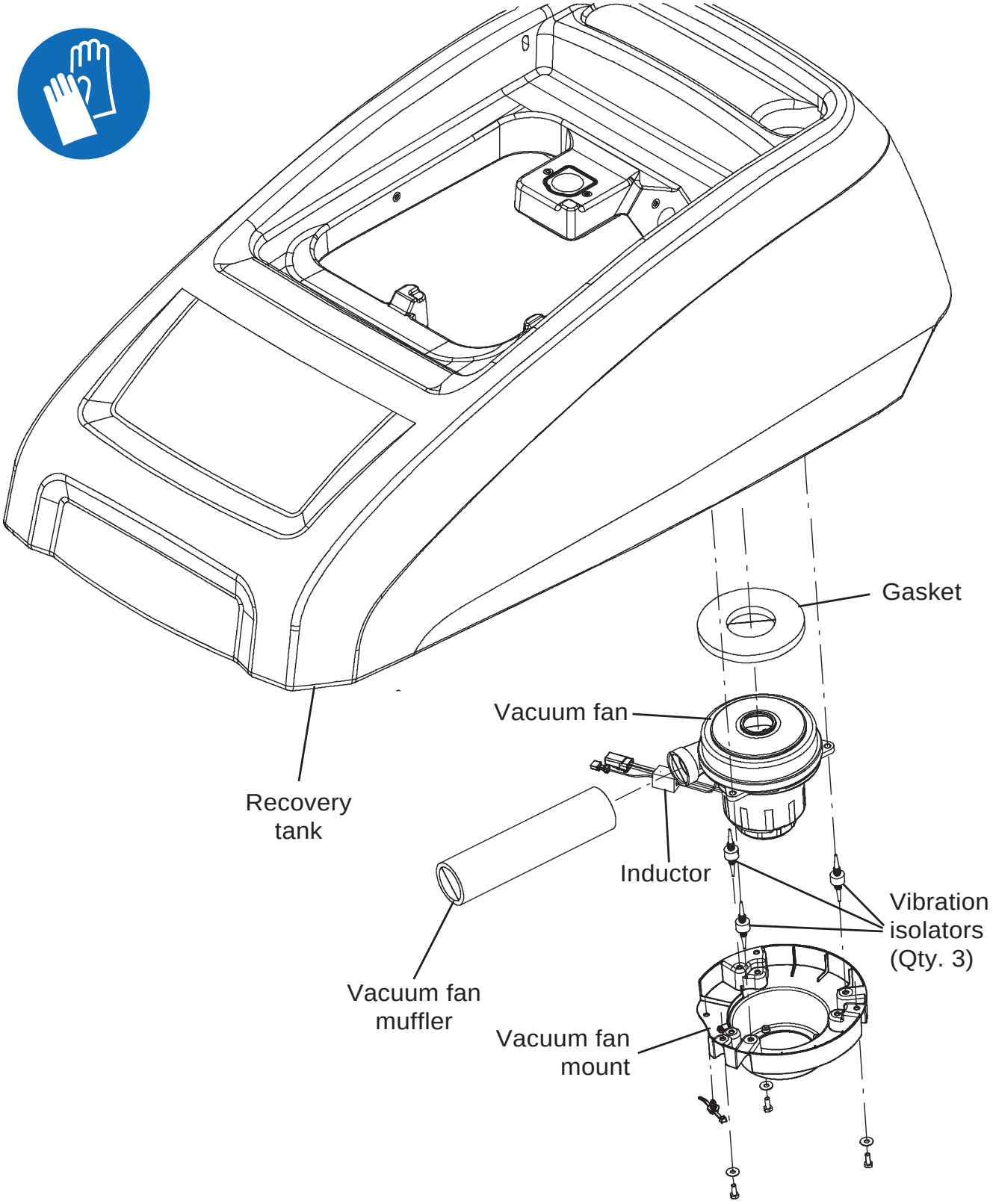
The standard front tires are solid.

If machine is equipped with pneumatic tires: The proper tire air pressure is 415 to 450 kPa (60 to 65 psi).

Tighten the front wheel lug nuts to 102 to 115 Nm (75 to 85 ft lb).

SOLUTION SYSTEMS

REMOVING/REPLACING/INSTALLING THE VACUUM FAN

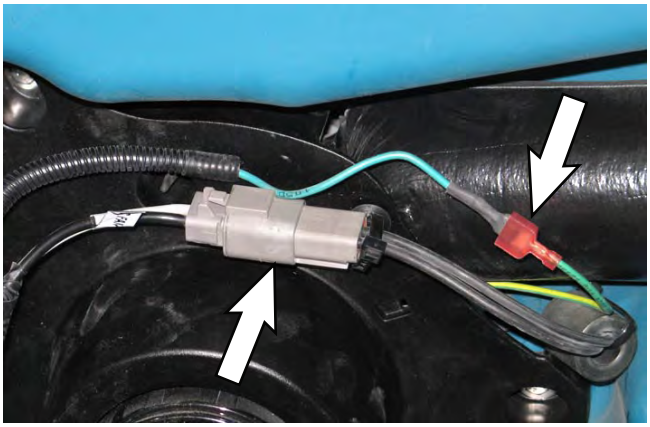


FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

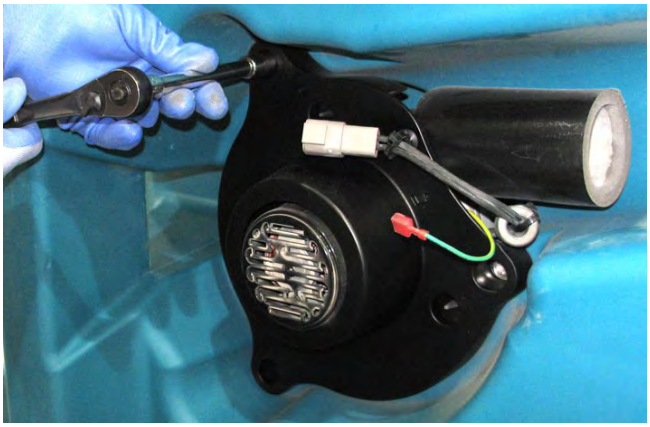
1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. Lift the recovery tank completely open.
5. Disconnect the main wire harness from the vacuum fan.

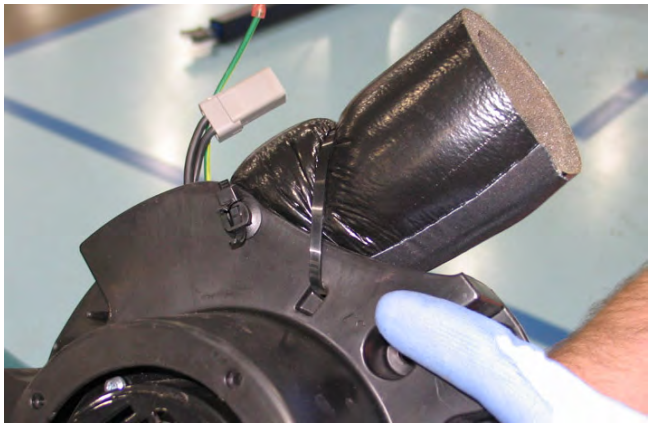


6. Remove hardware securing the vacuum fan to the machine.



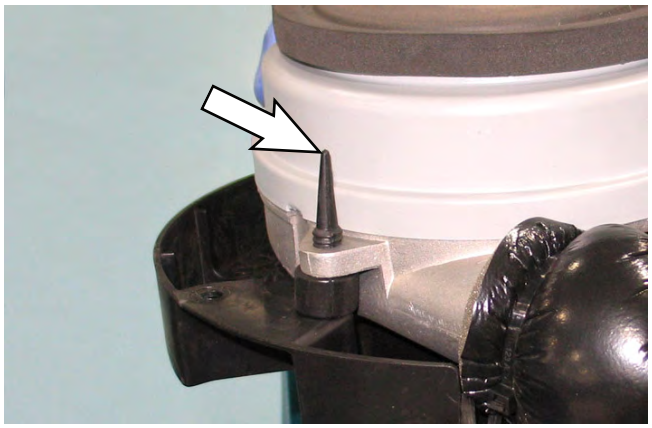
7. Remove the vacuum fan assembly from the machine.

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 disassembly.

REMOVING/INSPECTING/REPLACING THE RECOVERY TANK VACUUM FAN CARBON BRUSHES

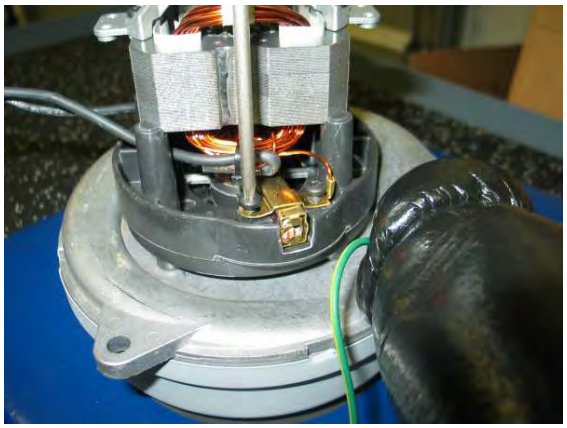
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

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

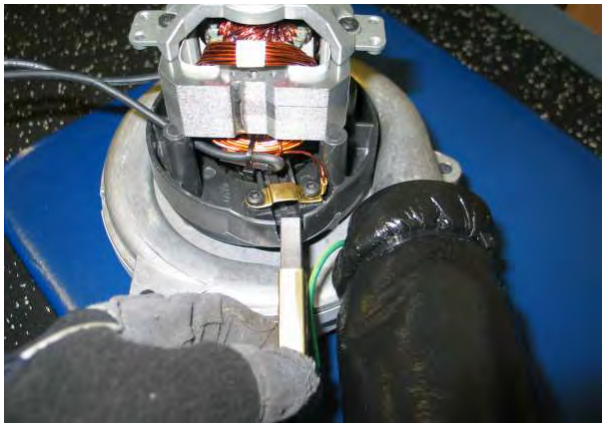
NOTE: Carbon brushes should be replaced as sets.

1. Remove the vacuum fan from the machine. See REMOVING/INSTALLING THE VACUUM FAN.
2. Remove the hardware securing the vacuum fan cover assembly to the motor and remove the vacuum fan cover assembly from the vacuum fan motor.

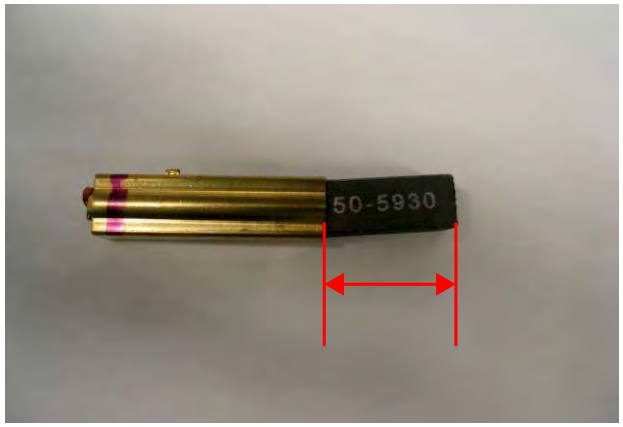
3. Loosen the carbon brush mounting hardware.



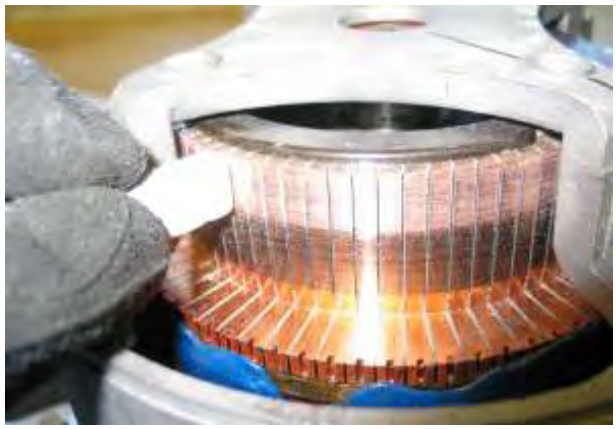
4. Remove the carbon brushes from the vacuum fan motor.



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



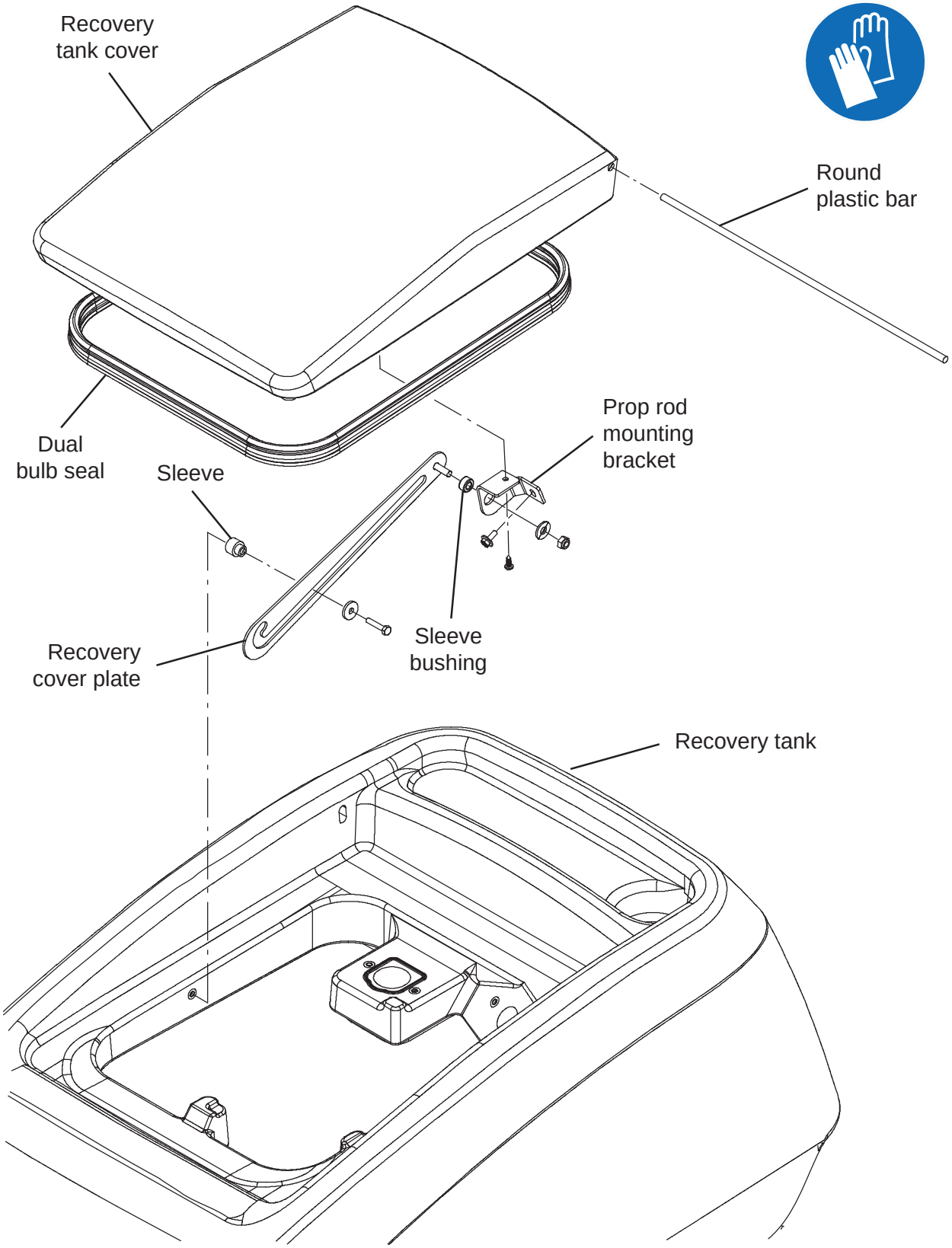
6. Use a stone to clean the commutator and then use compressed air to clean dust from inside the motor.

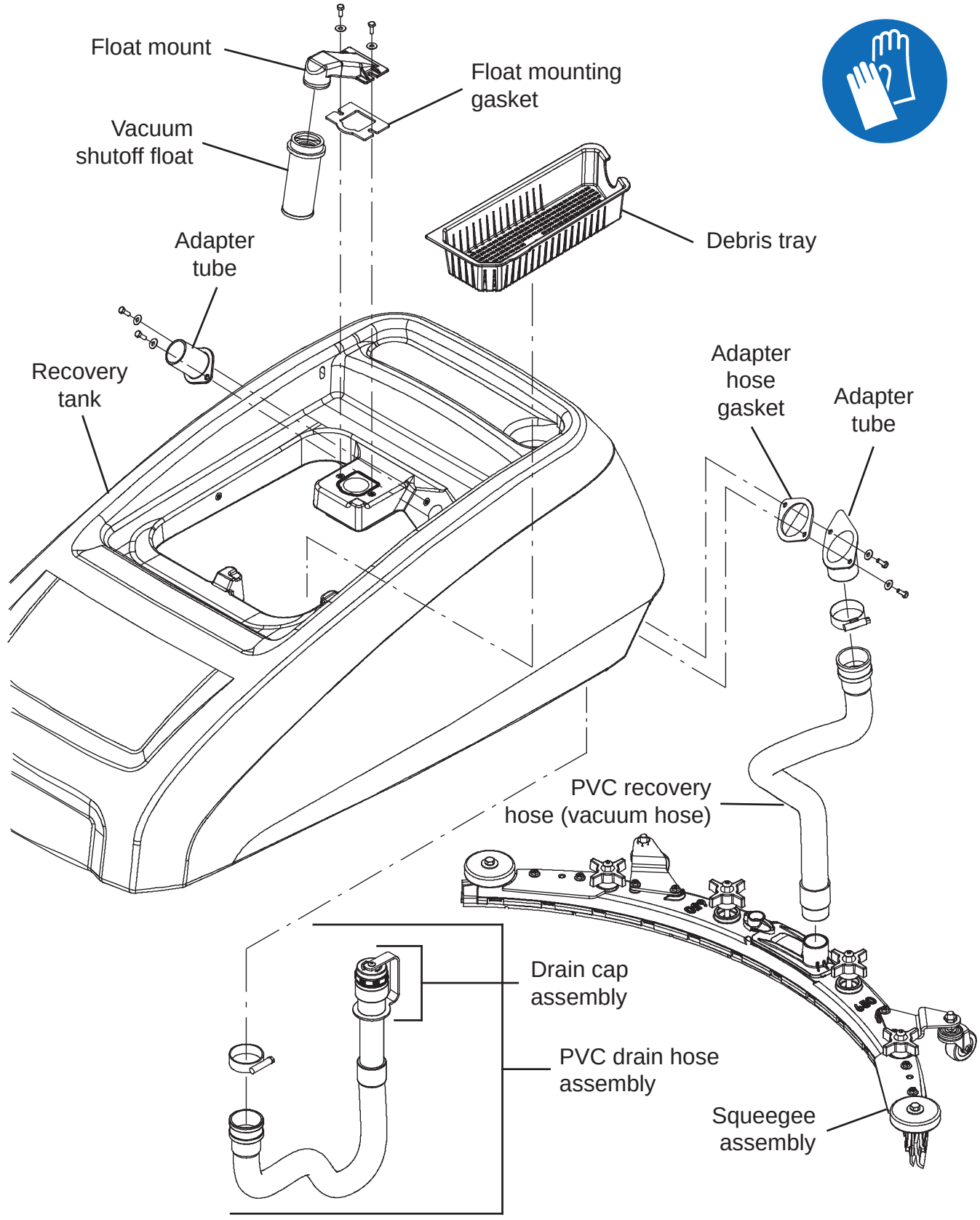


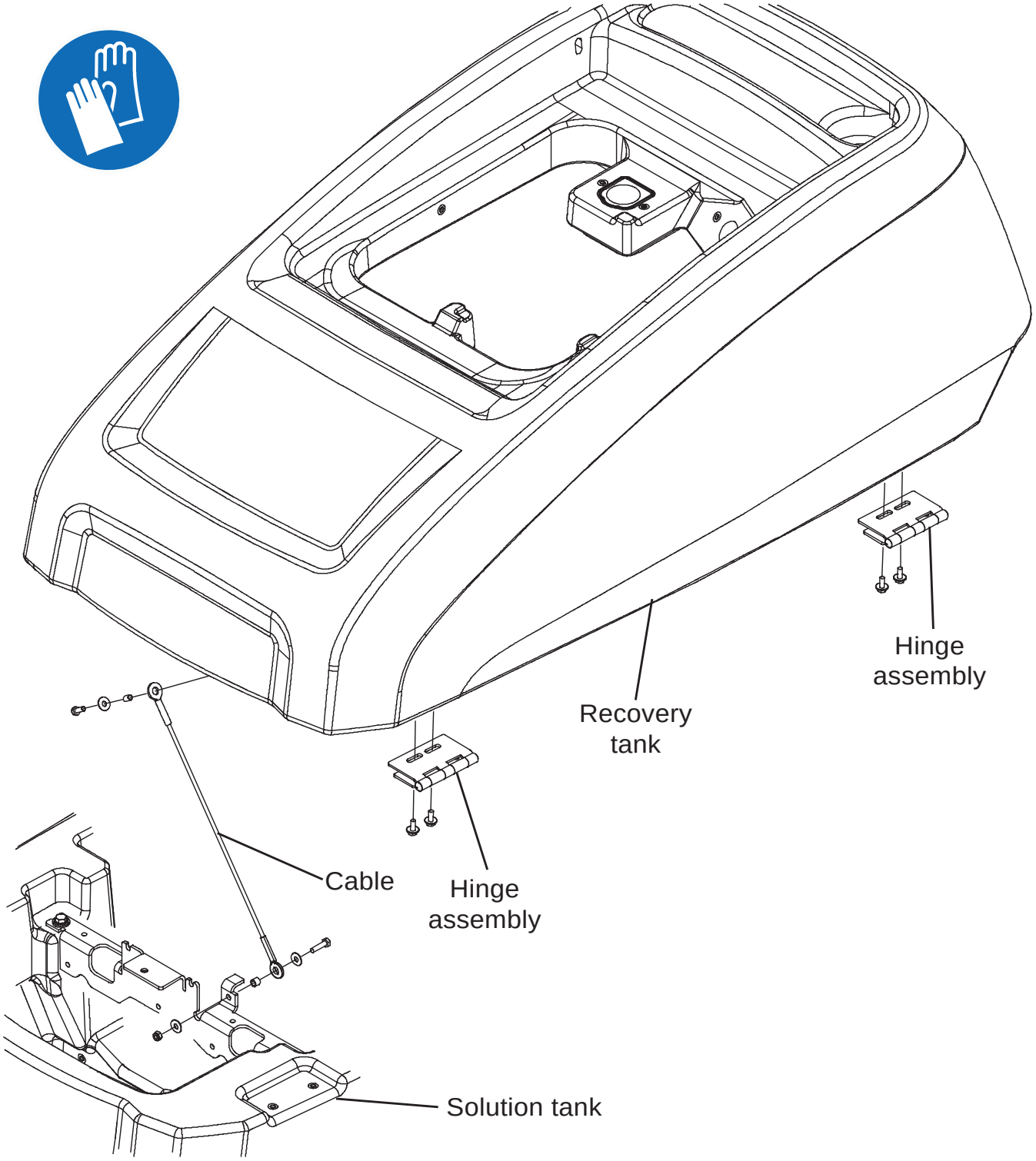
7. Reinstall the removed vacuum fan brushes/install the new vacuum fan brushes in reverse order of disassembly.

8. Reinstall the vacuum fan onto the machine. See REMOVING/INSTALLING THE VACUUM FAN.

REMOVING/REPLACING THE RECOVERY TANK




Float mount
Float mounting gasket
Vacuum shutoff float
Debris tray
Adapter tube
Recovery tank
Adapter hose gasket
Adapter tube
PVC recovery hose (vacuum hose)
Drain cap assembly
PVC drain hose assembly
Squeegee assembly


Hinge
assembly
Recovery
tank
Cable
Hinge
assembly
Solution tank

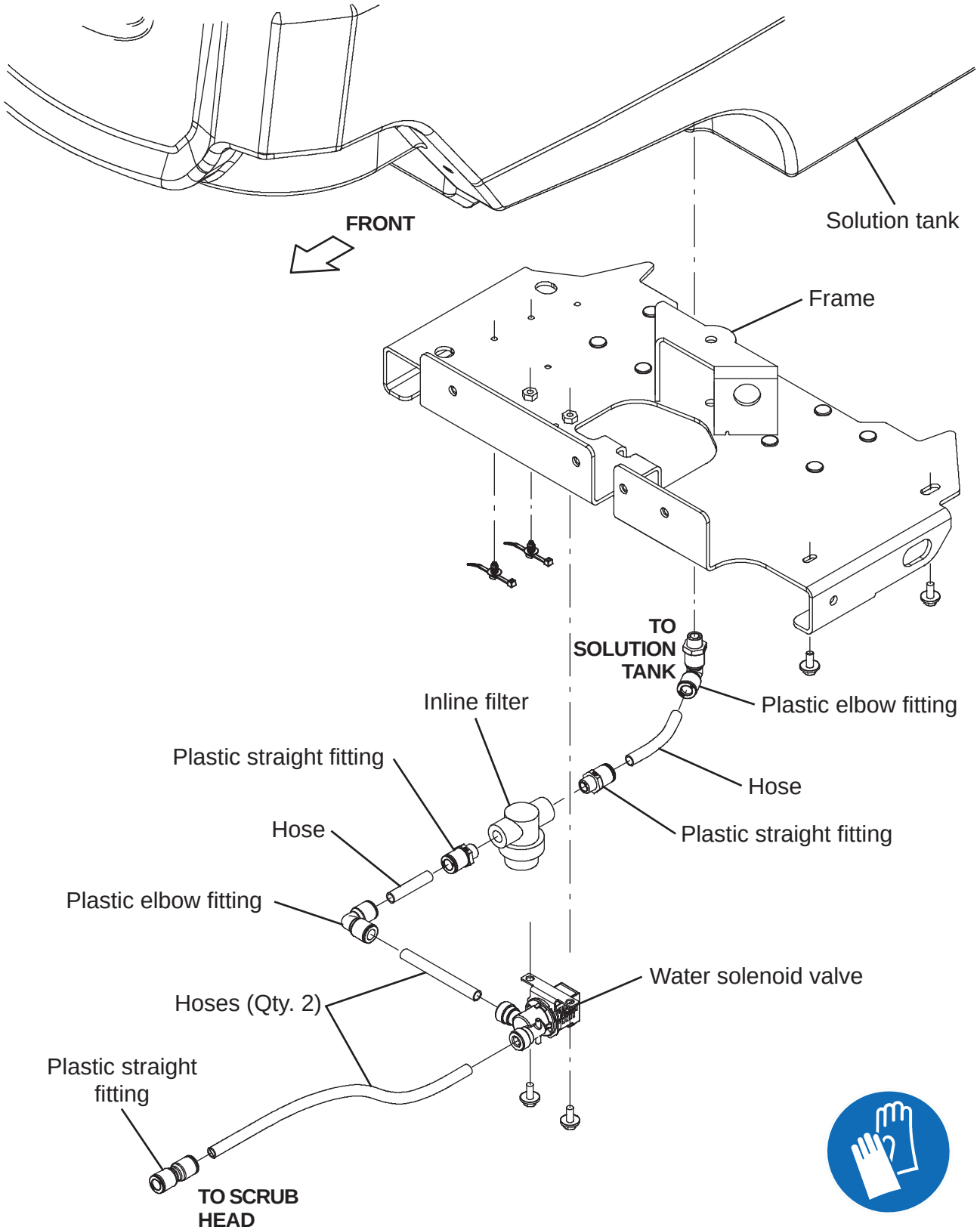
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. Lift the recovery tank completely open.
5. Disconnect the main wire harness from the vacuum fan assembly.
6. Disconnect the vacuum hose from the recovery tank.
7. Disconnect the drain hose from the recovery tank.
8. Remove all parts and components from the recovery tank.
9. Remove the recovery tank from the machine.
10. Assemble components onto the recovery tank in reverse order of disassembly.
11. Reinstall the recovery tank onto the machine.

REMOVING/INSTALLING THE WATER SOLENOID VALVE



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

2. Completely lower the scrub head.

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

3. Turn the key switch OFF.

4. Disconnect the battery cable from the machine.

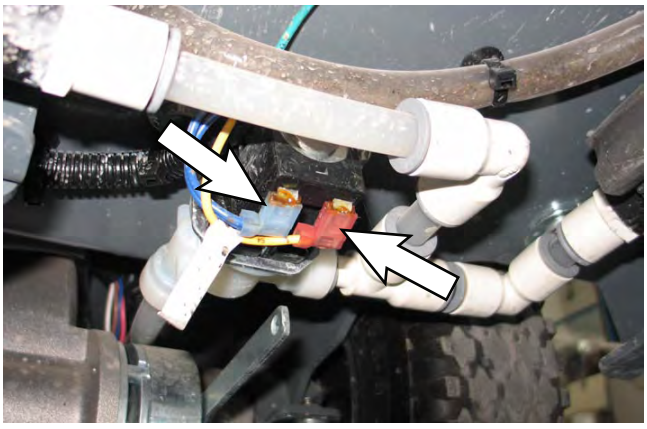
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

5. Jack up the machine until the machine is resting on the scrub head.

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.

6. Position a jack stand/jack stands/block under the machine as necessary to keep the back end of the machine safely elevated from the floor.

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

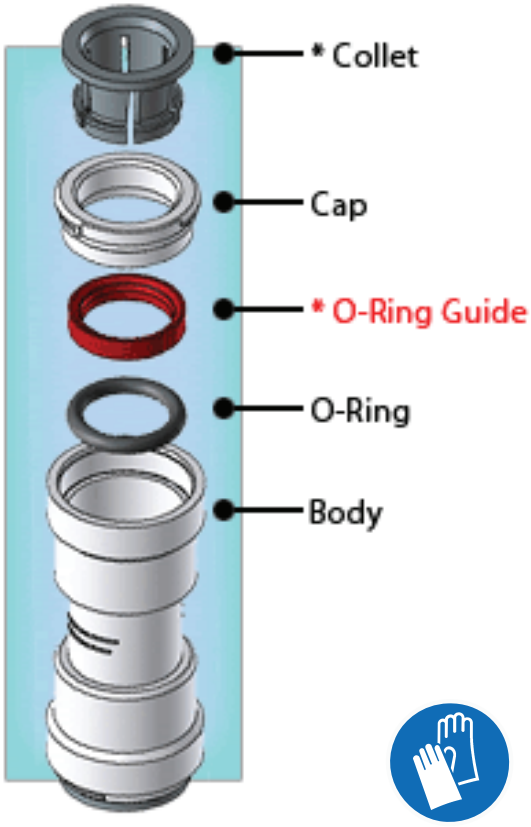


8. Remove the hardware securing the water solenoid to the frame of the machine.

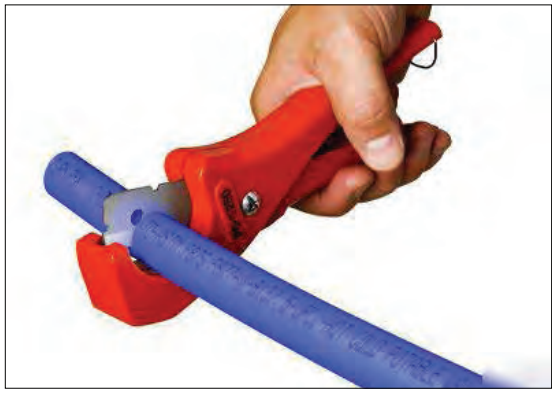
9. Disconnect the solution supply hoses from the water solenoid valve and remove the water solenoid valve from the machine.

10. Reinstall removed water solenoid valve/install new water solenoid valve in reverse order of disassembly.

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

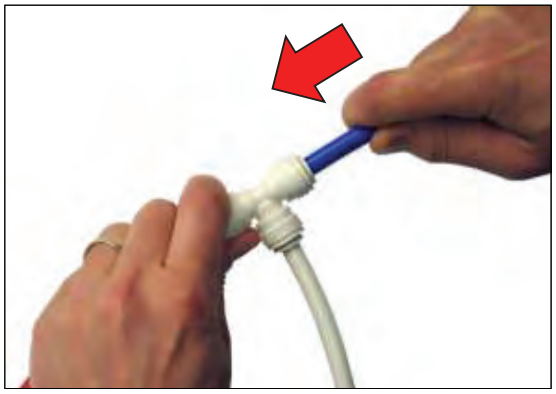


1. Cut the tube square. The outer diameter of the tubing must be free of score marks, burrs, or sharp edges.



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.

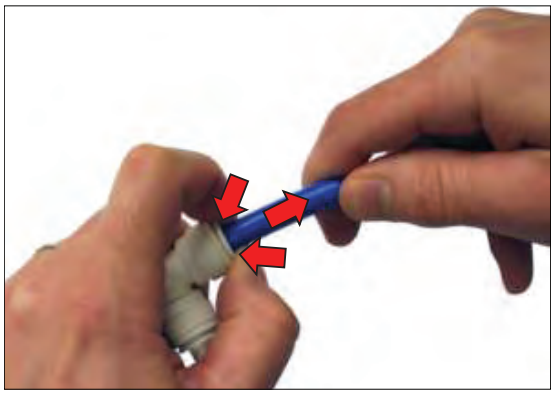


4. Pull on the fitting to ensure the hose connection is secure.

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

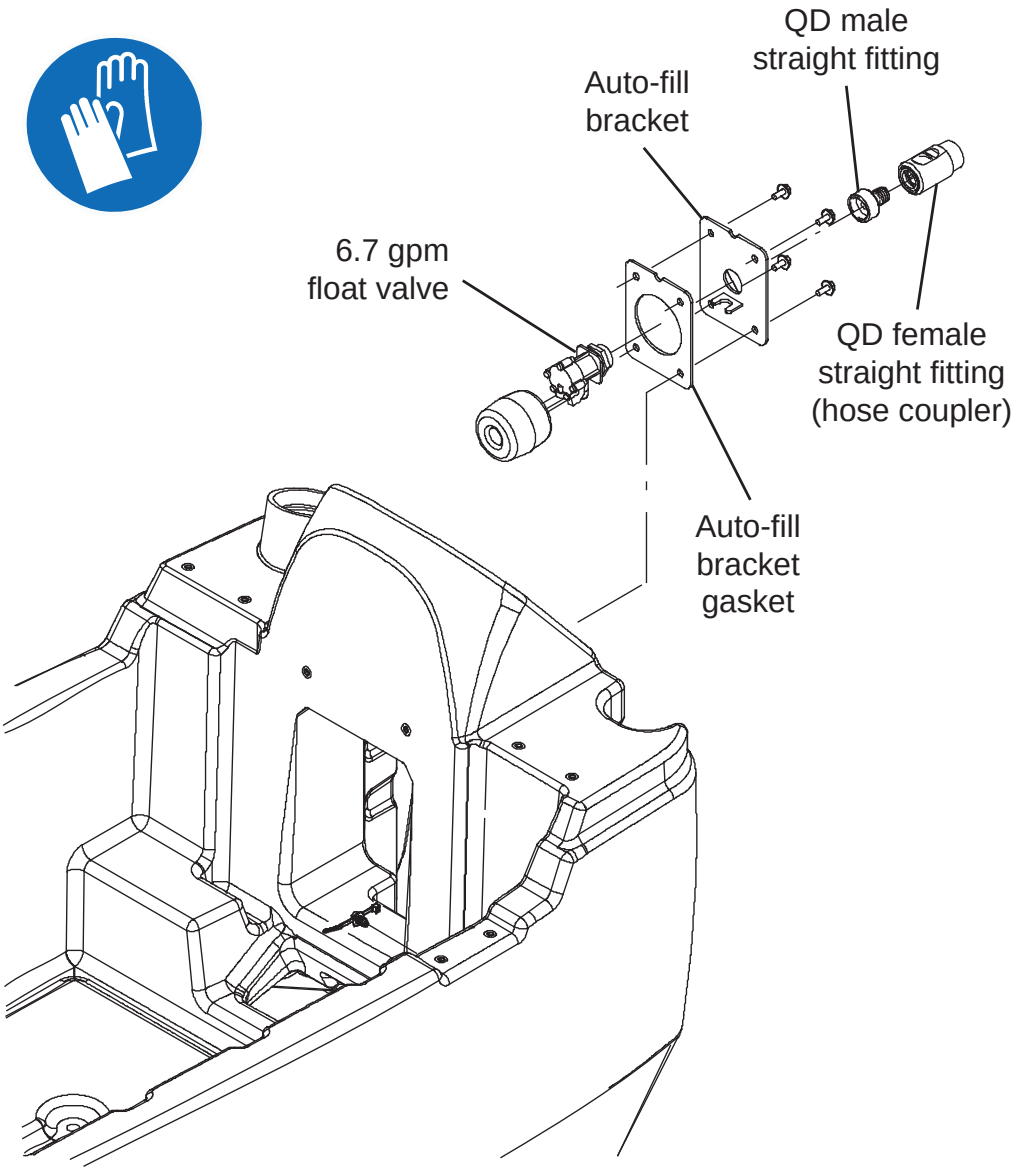
DISCONNECT HOSES FROM PTC (PUSH-TO-CONNECT) FITTINGS

1. Push the hose into the fitting and 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.

REMOVING/REPLACING/INSTALLING THE AUTO-FILL ASSEMBLY

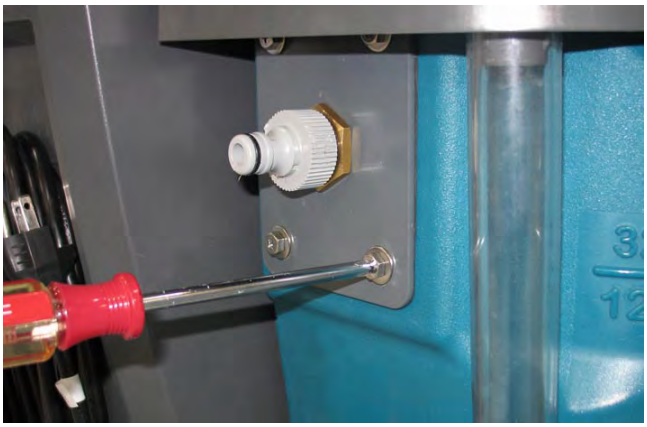


1. Completely empty the recovery tank.
2. Drain the solution tank until the water level is below the auto-fill assembly. Check solution level in the solution tank on the solution tank level/drain hose.

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

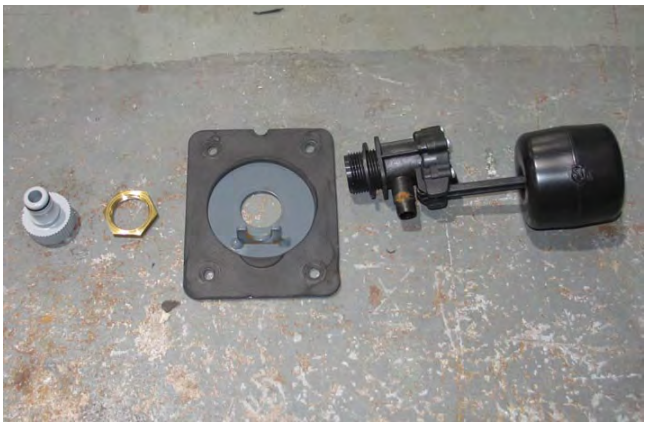
3. Turn the key switch OFF.
4. Remove the hose coupler from the auto-fill assembly.

5. Remove the hardware securing the auto-fill assembly to the solution tank.



6. Carefully pry and pull the auto-fill assembly from the solution tank. Do not damage the gasket when removing the auto-fill assembly from the solution tank.

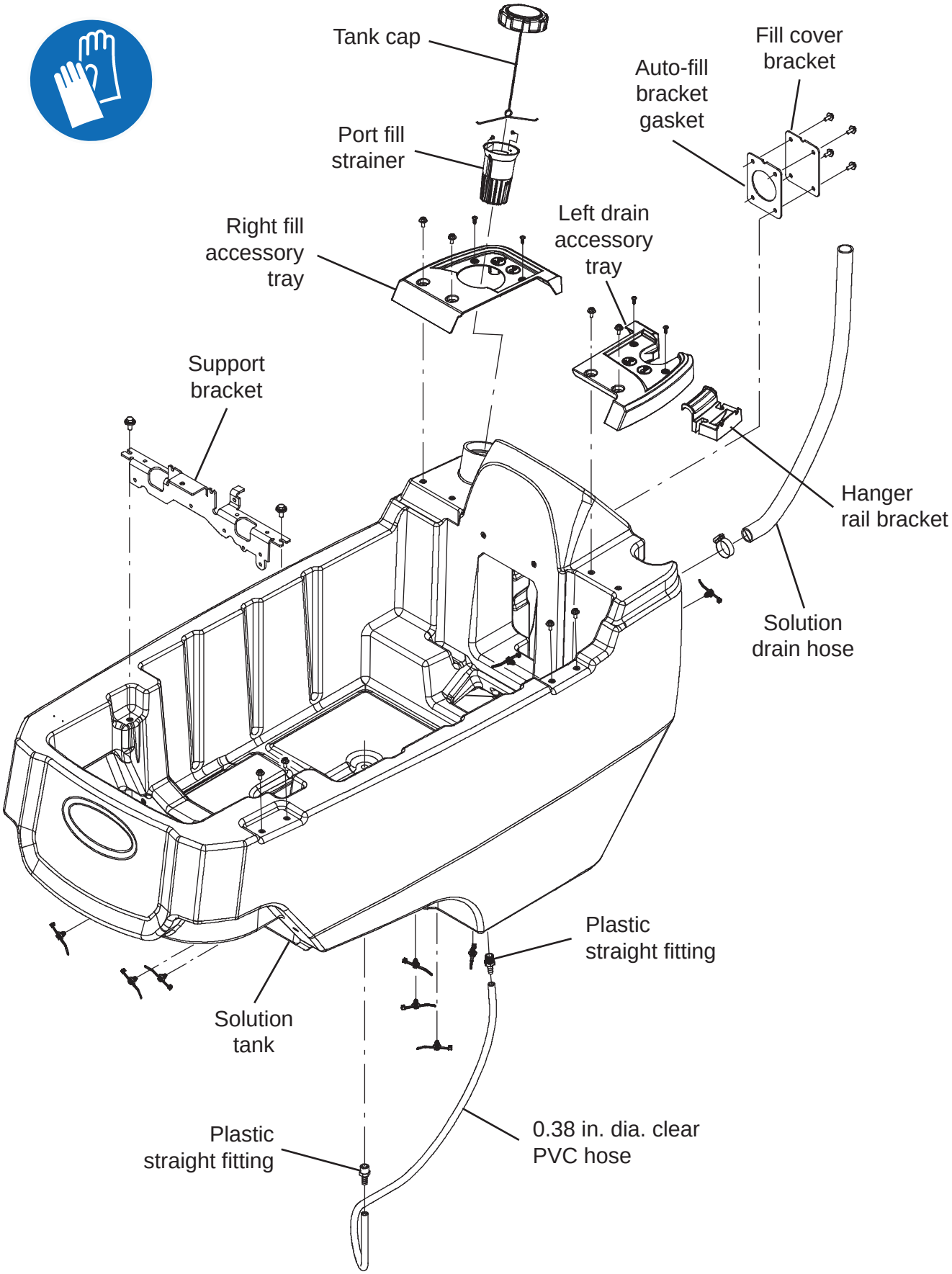
7. Disassemble the auto-fill assembly. Replace parts as necessary.



8. Reassemble the auto-fill assembly in reverse order of disassembly.

9. Reinstall the auto-fill assembly into the solution tank in reverse order of disassembly.

REPLACING THE SOLUTION TANK



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

1. Completely empty the recovery tank and solution tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. Lift the recovery tank completely open.

NOTE: Do Not discard any items removed from the solution tank. All removed items must be installed onto the new solution tank.

5. 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. Use a non-conductive battery removal device.

6. Remove the rear squeegee assembly from the machine.
7. Remove the recovery tank from the machine. See REMOVING/REPLACING THE RECOVERY TANK.
8. Remove the scrub head from the machine. See applicable section for removing the scrub head from the machine.
9. Remove the scrub head lift assembly from the machine.
10. Remove optional ec-H2O, Severe Environment, recovery tank rinse, and/or auto-fill assemblies from the solution tank.
11. Remove the support bracket, right fill accessory tray, left drain accessory tray, solution drain hose, and tank cap/port fill strainer from the solution tank.
12. Remove all electronic components, control handle assembly, and controls from the machine. Place circuit board/electronic components in a safe place where they cannot be damaged. See applicable sections for removing electronic components and controls.

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.

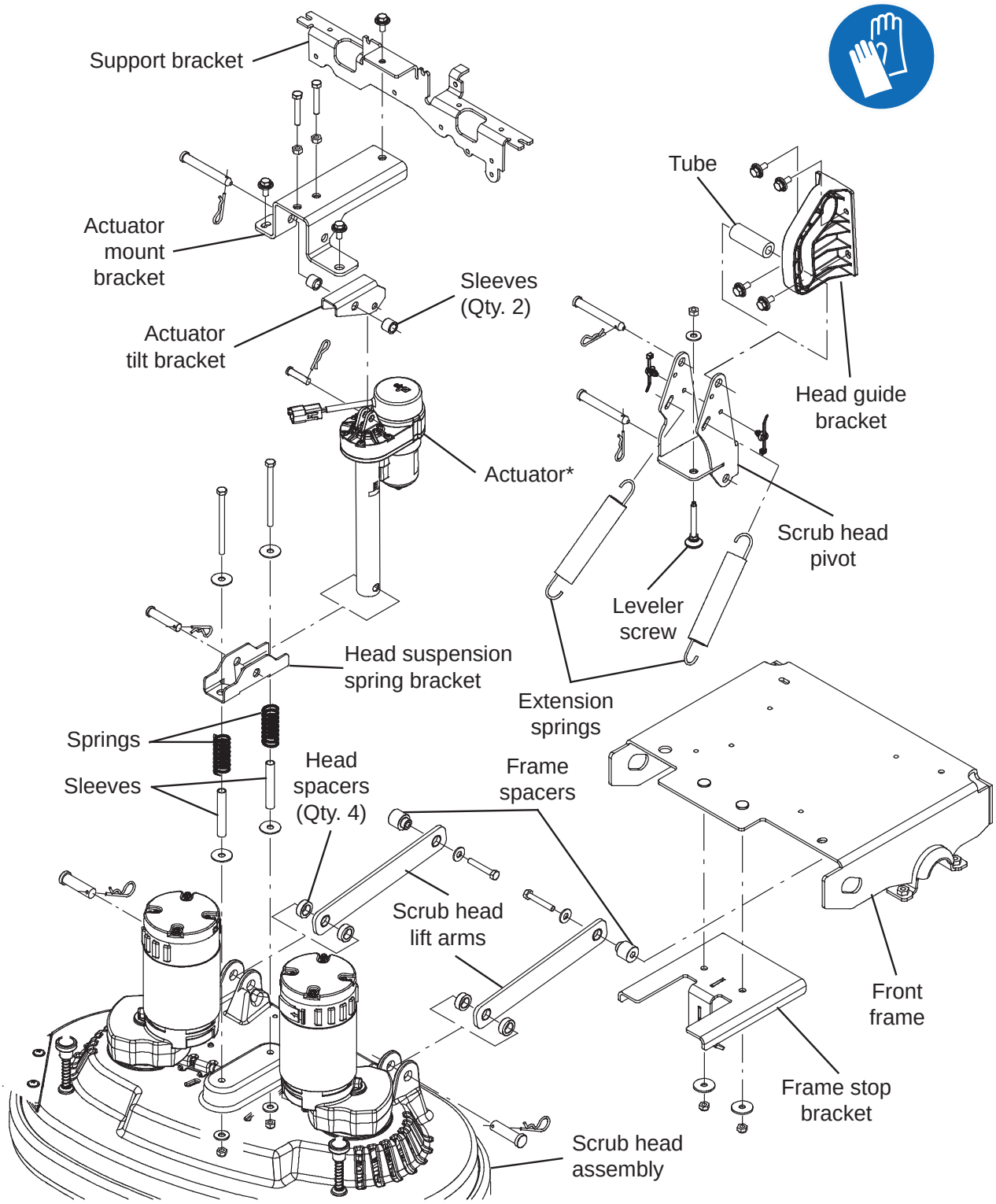
13. Position a protective blanket or large section of cardboard next to the side of the machine that will be tipped onto the floor.

NOTE: Do Not allow the machine to drop when tipping it onto the blanket/cardboard. 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.

14. Carefully tip the machine onto the blanket/ cardboard.
15. Remove the transaxle assembly from the machine. See REMOVE/INSTALL THE TRANSAXLE ASSEMBLY.
16. Remove all fittings, hoses, and remaining components from the bottom of the machine.
17. Remove the frame and all remaining parts and components from the recovery tank.
18. Place the new solution tank onto the protective blanket/cardboard.
19. Install removed parts and components onto the new recovery tank in the reverse order of disassembly.
20. Assemble components onto the recovery tank in reverse order of disassembly.

SCRUBBING SYSTEMS

REMOVING/REPLACING/INSTALLING THE DISK SCRUB HEAD



* Note: Actuator may be different depending on model of machine. Consult Parts Manual for additional information

1. Completely empty the solution tank and recovery tank.

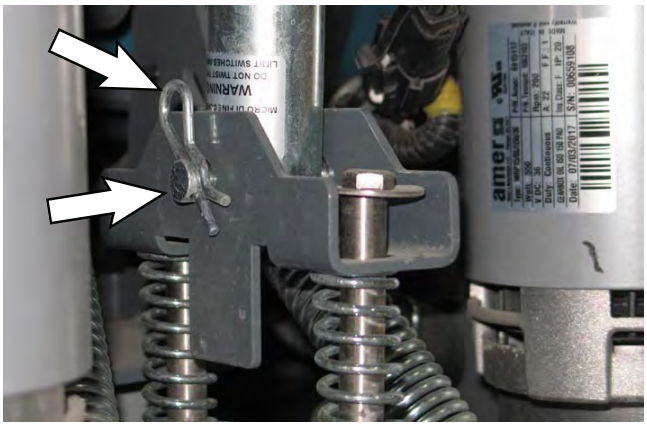
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

2. Turn the key switch OFF.
3. Remove the brushes from the scrub head.
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 cable from the machine.

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

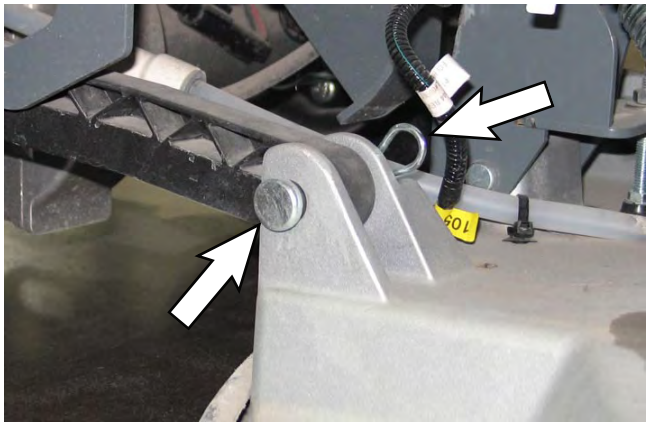
6. Remove the front scrub head cover from the machine.

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

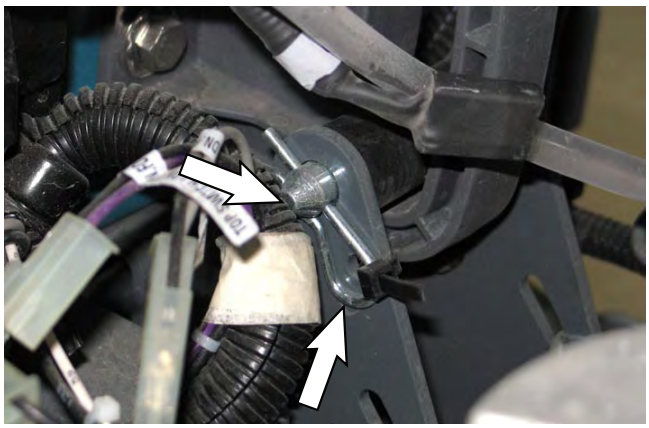


NOTE: Do Not turn the actuator barrel after removing the cotter pin/clevis pin securing the actuator to the head suspension spring bracket. The actuator must be readjusted if the barrel is turned out of adjustment. See REMOVING/REPLACING/ADJUSTING THE ACTUATOR for instructions how to readjust the actuator.

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

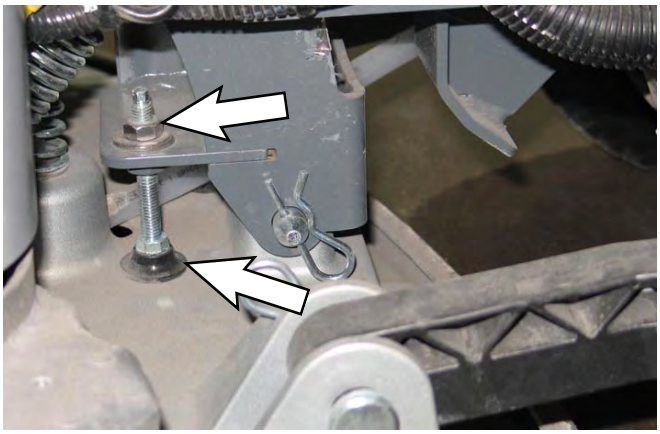


11. Remove the clevis pin and cotter pin securing the scrub head pivot to the head guide bracket.



12. Reinstall the removed scrub head/install the new scrub head onto the machine in the reverse order of disassembly.

13. Check the scrub head leveling. Loosen the jam nut and adjust the leveler screw until both brushes touch the floor evenly around the entire circumference of each brush. Tighten the jam nut.



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

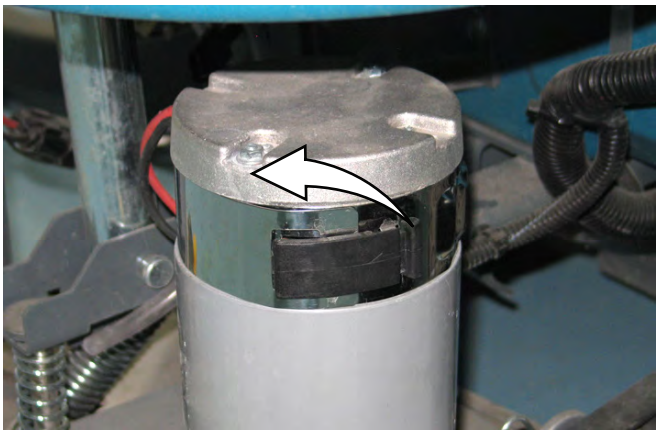
REMOVING/INSTALLING THE DISK SCRUB HEAD MOTOR CARBON BRUSHES

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

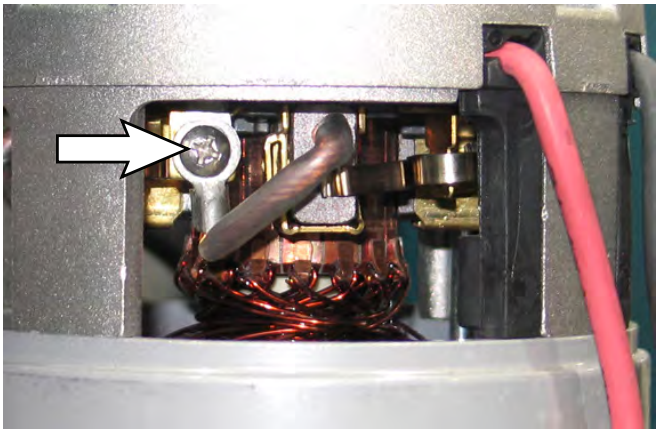
1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

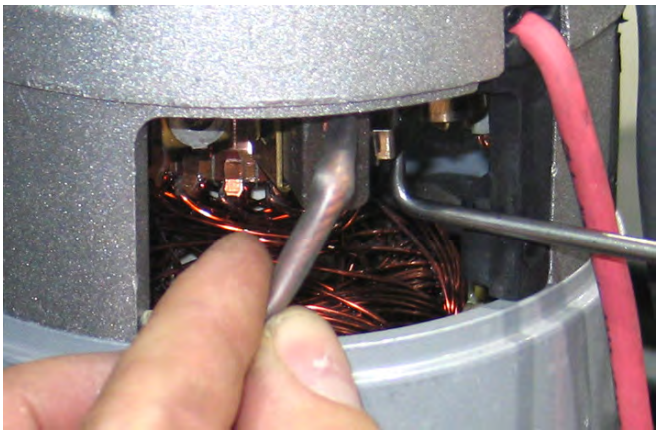
3. Remove the front scrub head cover from the machine.
4. Loosen and remove the band covering the carbon brushes from the scrub head motor.



5. Remove the hardware securing the carbon brush cable to the brush motor.

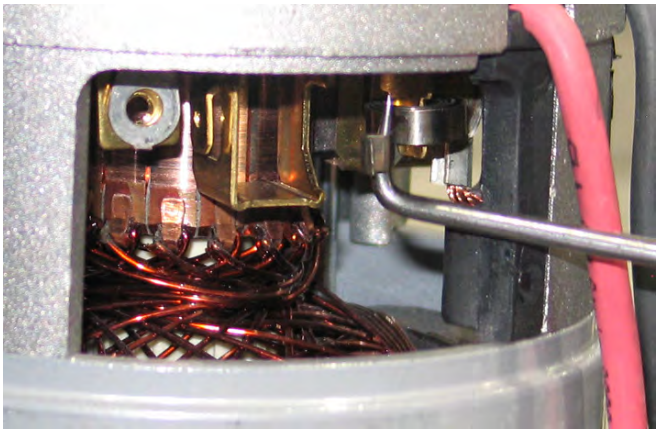


6. Pull the retainer to release the carbon brush and pull the carbon brush from the brush motor.



7. Use compressed air to clean dust from inside the motor.

8. Pull the retainer and insert the new carbon brush into the brush motor.

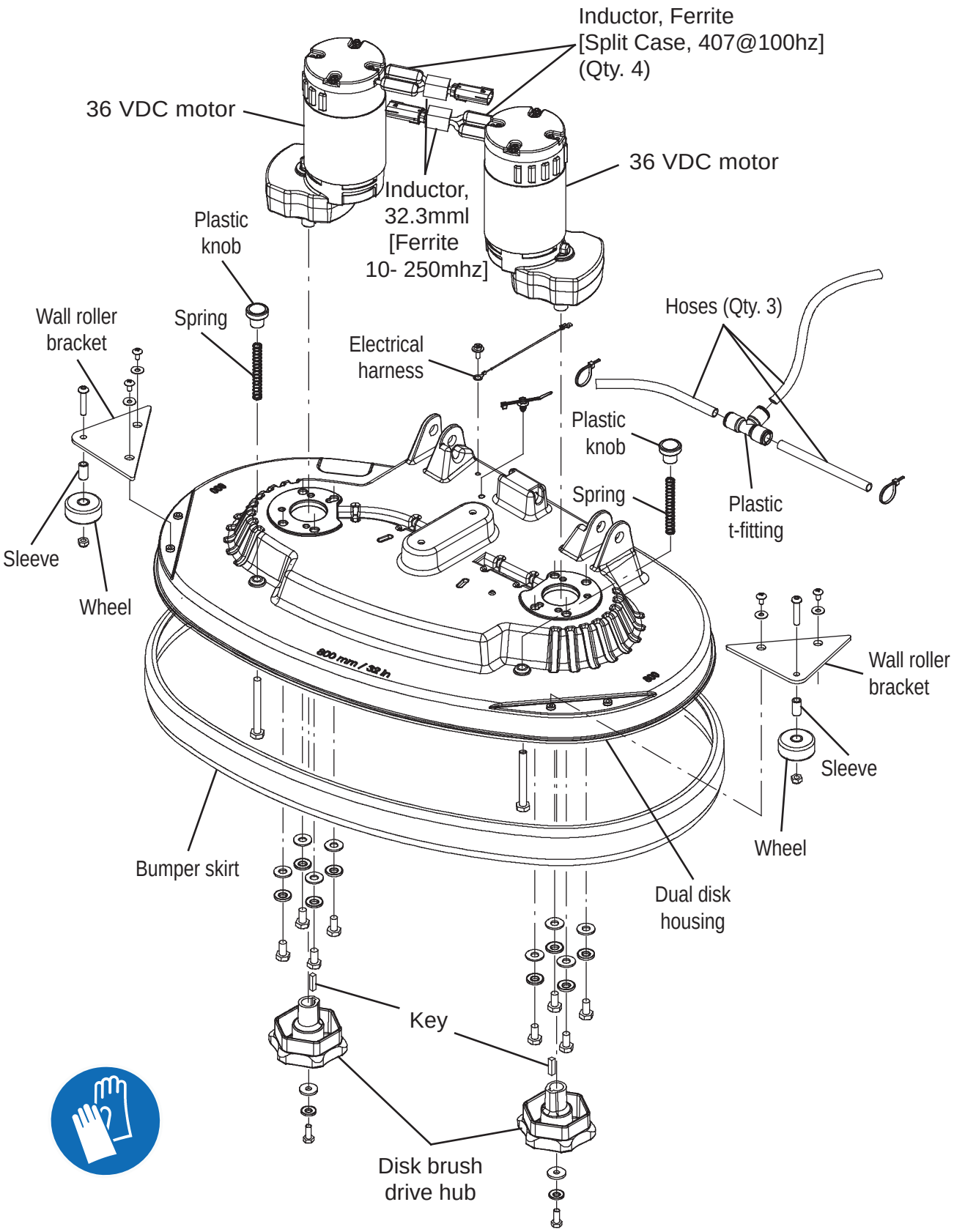


9. Repeat previous steps to service the remaining carbon brushes.

NOTE: Carbon brushes should be replaced as sets.

10. Reinstall the removed carbon brushes/install the new carbon brushes into the disk brush motor in the reverse order of disassembly.
11. Reinstall the retaining band onto the motor.

DISK SCRUB HEAD MAINTENANCE



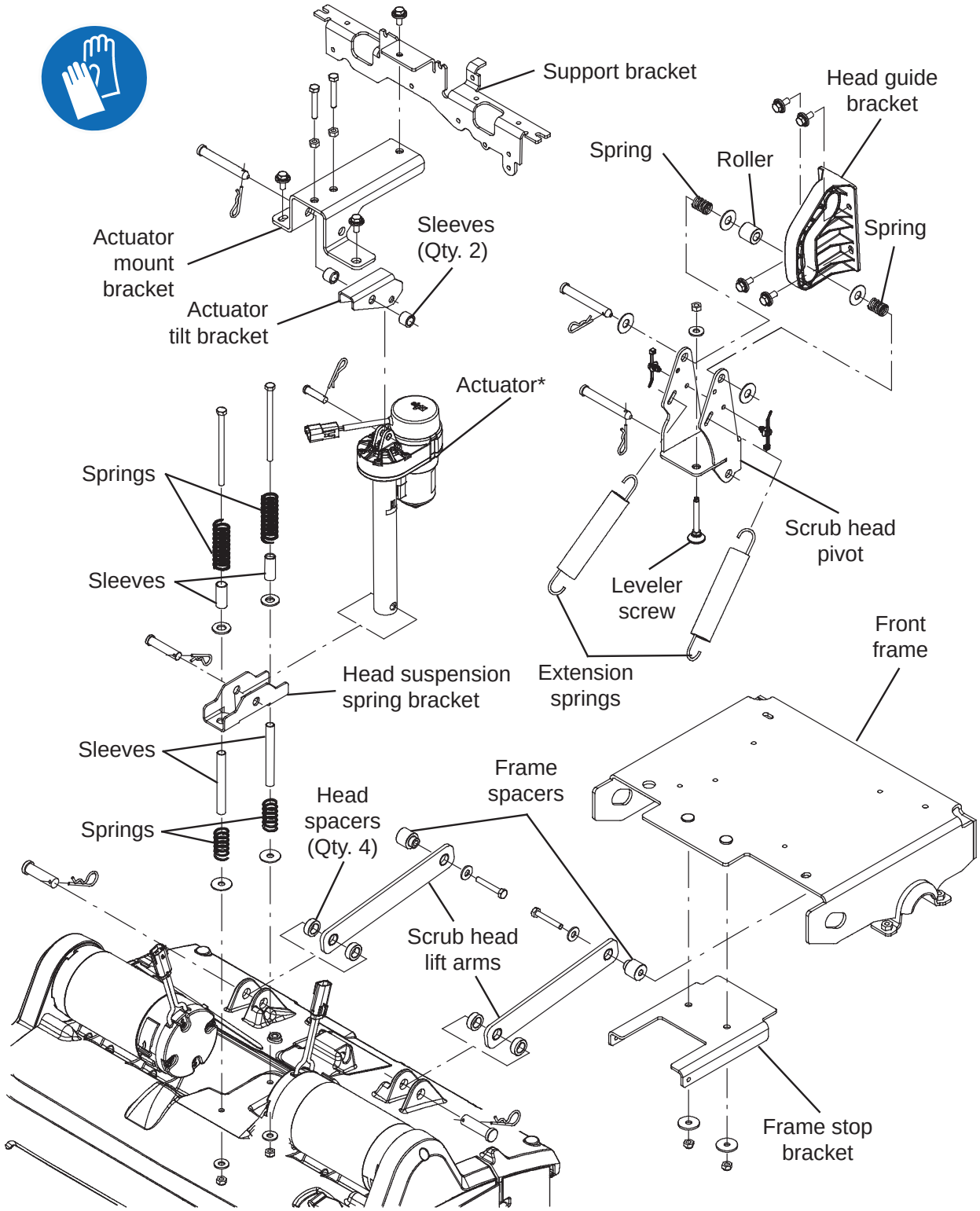
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

3. Remove the front scrub head cover from the machine.
4. Remove the scrub head from the machine. Refer to REMOVING/REPLACING/INSTALLING THE DISK SCRUB HEAD ASSEMBLY.
5. Remove components necessary to complete maintenance from the scrub head.
6. Replace parts as needed.
7. Reassemble the scrub head in reverse order of disassembly.
8. Reinstall the scrub head onto the machine. See REMOVING/REPLACING/INSTALLING THE DISK SCRUB HEAD ASSEMBLY.
9. Reinstall the front scrub head cover onto the machine.

REMOVING/REPLACING/INSTALLING THE CYLINDRICAL SCRUB HEAD



* Note: Actuator may be different depending on model of machine. Consult Parts Manual for additional information

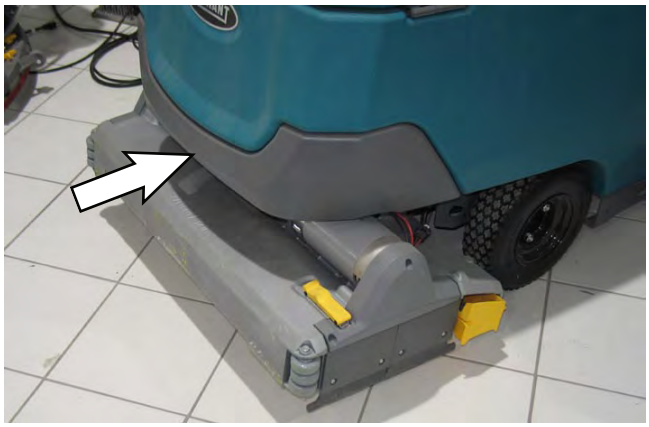
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

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

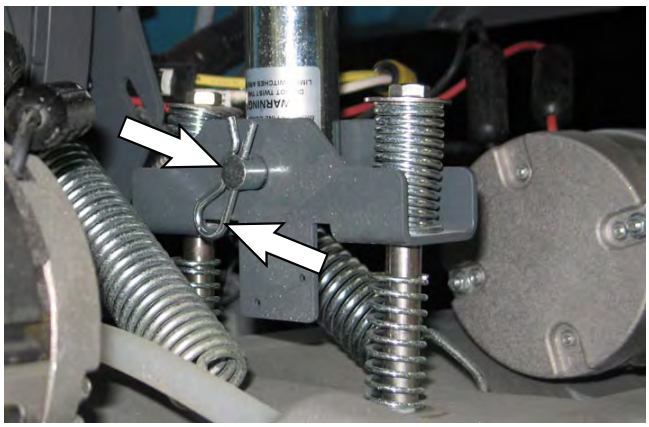
2. Turn the key switch OFF.
3. Remove the brushes from the scrub head.
4. Turn the key switch ON, completely lower the scrub head to the floor, turn the key switch OFF, and remove the key.
5. Disconnect the battery cable from the machine.

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

6. Remove the front scrub head cover from the machine.

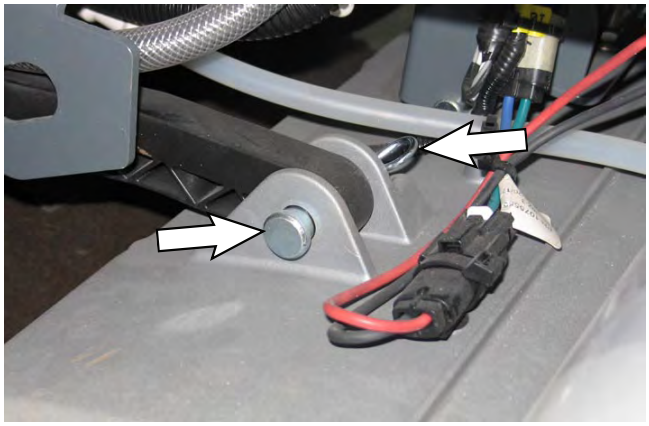


7. Cut the cable ties from the main wire harness/ brush motor connection and disconnect the main wire harness from the brush motors.
8. Disconnect all solution supply hoses from the scrub head.
9. Cut all wire ties securing the main wire harness to the scrub head and disconnect main wire harness connections from the brush drive motors.
10. Remove the cotter pin and clevis pin securing the actuator to the head suspension spring bracket.

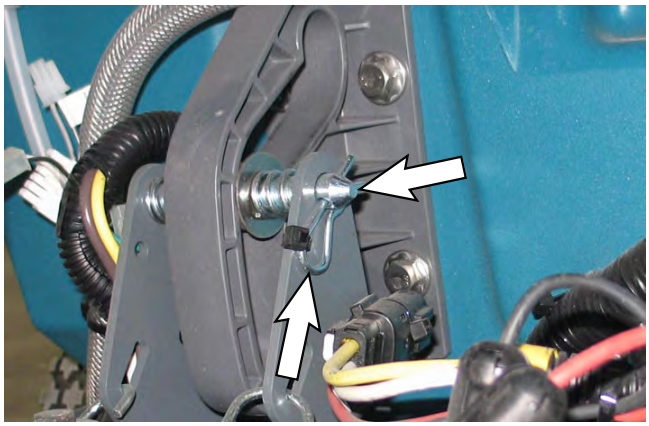


NOTE: Do Not turn the actuator barrel after removing the cotter pin/clevis pin securing the actuator to the head suspension spring bracket. The actuator must be readjusted if the barrel is turned out of adjustment. See REMOVING/REPLACING/ADJUSTING THE ACTUATOR *for instructions how to readjust the actuator.*

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 disassembly.
14. Adjust the scrub head. See CHECKING/ ADJUSTING THE CYLINDRICAL SCRUB BRUSH PATTERN.
15. If removed scrub head was replaced with new orbital scrub head, reconfigure the machine for the orbital scrub head. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION.

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.

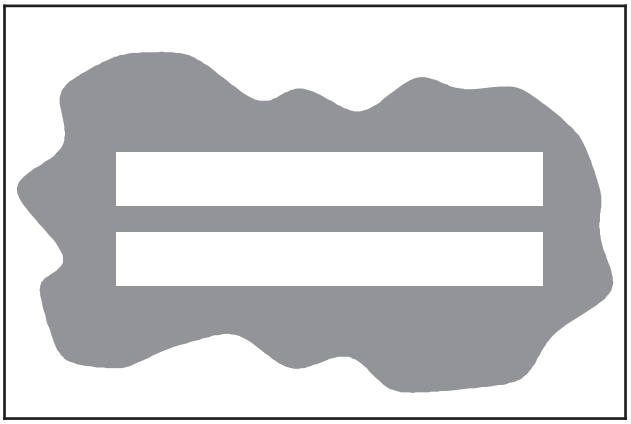
1. Apply chalk to a flat, level surface.

NOTE: Do Not check brushes on gloss or finished surfaces that can be easily damaged by brushes remaining stationary on the surface for extended periods.

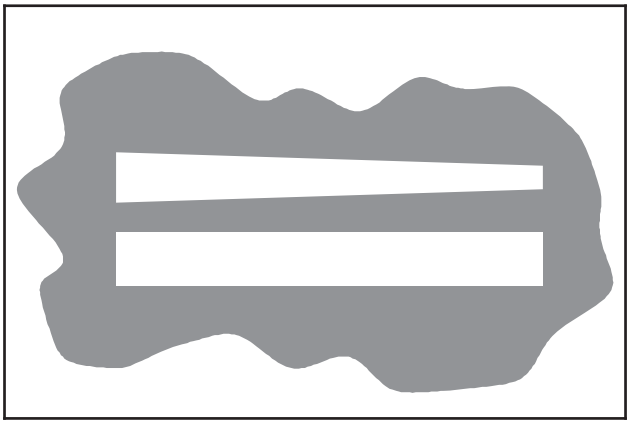
2. Turn the key switch ON.
3. Turn off the ec-H2O system (if equipped).
4. Turn off the solution flow.
5. Adjust the speed dial to the lowest setting.
6. Position the scrubber so the brushes are over the chalked area.
7. Lower the scrub head into the chalked area on the floor.
8. Place the directional lever into the reverse position.
9. 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.

10. Raise the scrub head and pull the machine away from the pattern test area.
11. Turn the key switch OFF.
12. 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.

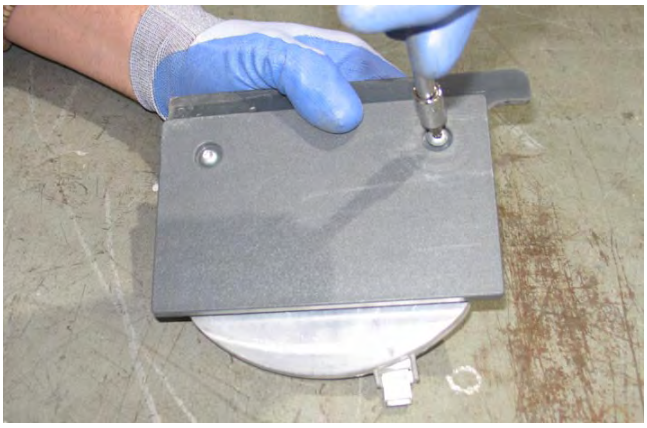


13. If the brush patterns are tapered, proceed to the following steps to adjust the patterns.



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

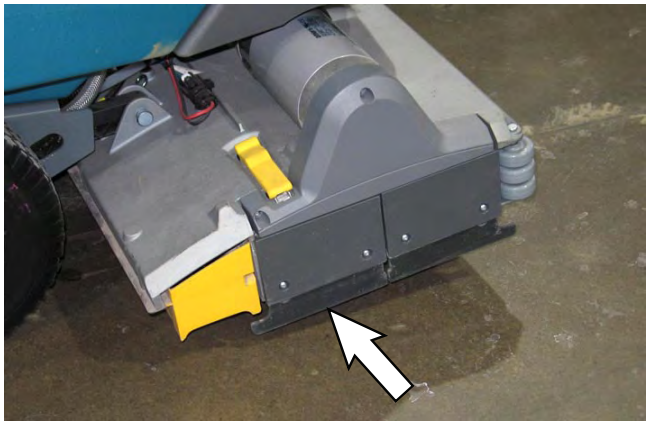
15. Remove the skirt cover from the idler plate.



16. 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.

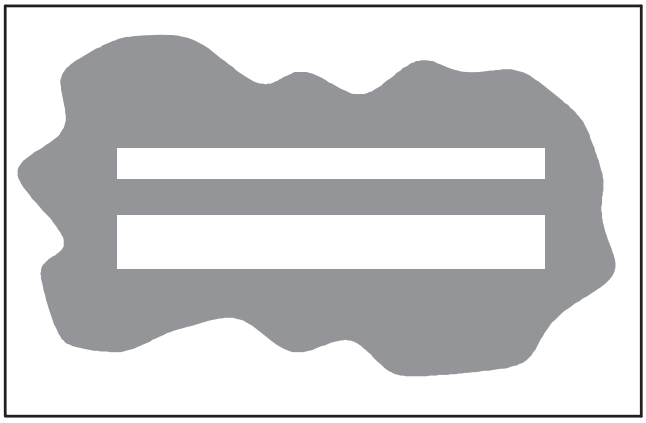
17. Reinstall the skirt cover onto the idler plate and reinstall the idler plate assembly onto the scrub head.

18. If necessary, repeat Step 14 through Step 17 to adjust the taper for the other brush (idler plate is located on the other side of the scrub head).

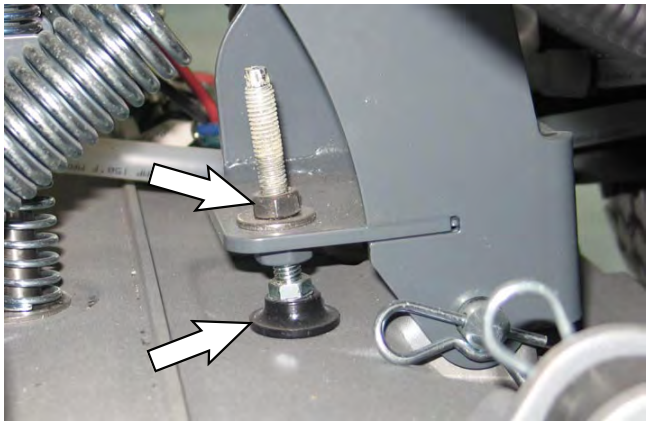


19. Reapply chalk and repeat Step 6 through Step 17 as necessary.

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



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

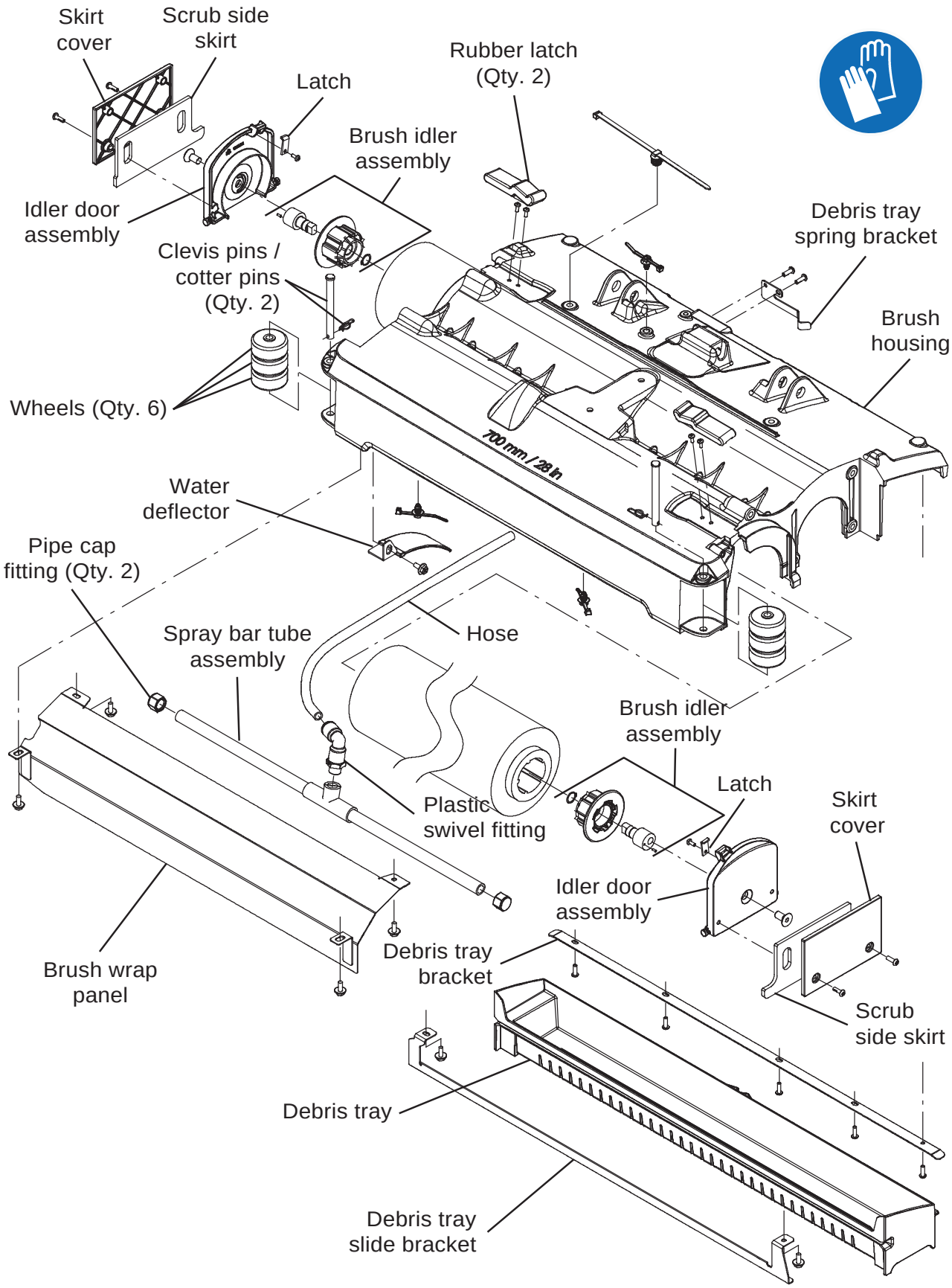


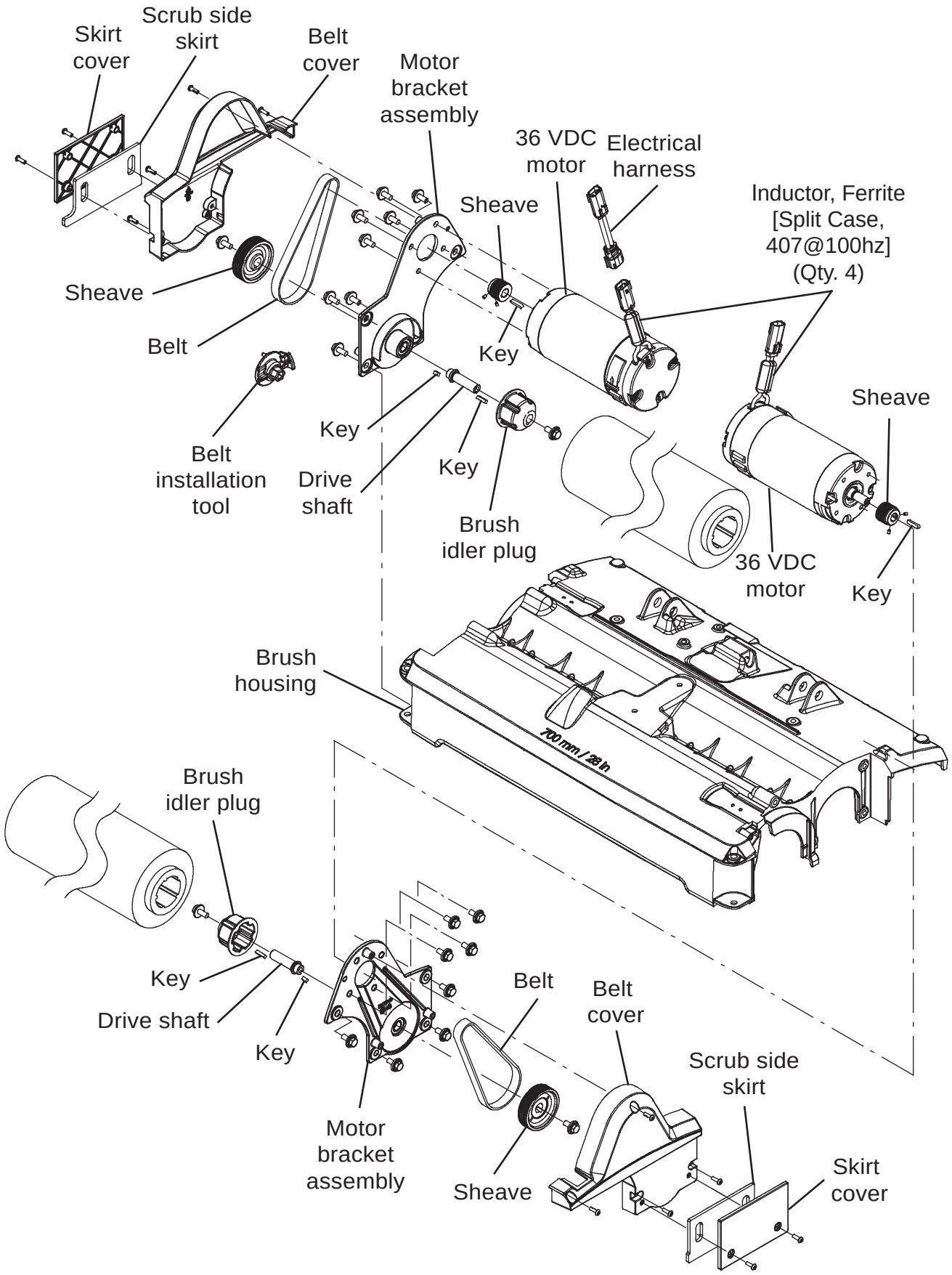
22. Adjust the leveler screw up to decrease the rear brush width and down to increase the rear brush width.

23. Tighten the previously loosened hex screw.

24. Recheck the brush width. Repeat Step 20 through Step 23 as necessary.

CYLINDRICAL SCRUB HEAD MAINTENANCE




Skirt cover
Scrub side skirt
Belt cover
Motor bracket assembly
36 VDC motor
Electrical harness
Inductor, Ferrite [Split Case, 407@100hz] (Qty. 4)
Sheave
Sheave
Belt
Key
Belt installation tool
Key
Drive shaft
Key
Brush idler plug
36 VDC motor
Sheave
Key
Brush housing
700 mm / 28 in
Brush idler plug
Key
Drive shaft
Key
Belt
Belt cover
Scrub side skirt
Motor bracket assembly
Sheave
Skirt cover

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

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

3. Remove the front scrub head cover from the machine.
4. Remove the scrub head from the machine. Refer to REMOVING/REPLACING/INSTALLING THE CYLINDRICAL SCRUB HEAD ASSEMBLY.
5. Remove components necessary to complete maintenance from the scrub head.
6. Replace parts as needed.
7. Reassemble the scrub head in reverse order of disassembly.
8. Reinstall the scrub head onto the machine. Refer to REMOVING/REPLACING/INSTALLING THE CYLINDRICAL SCRUB HEAD ASSEMBLY.
9. Reinstall the front scrub head cover onto the machine.

REMOVING/REINSTALLING/REPLACING THE CYLINDRICAL BRUSH DRIVE BELT

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

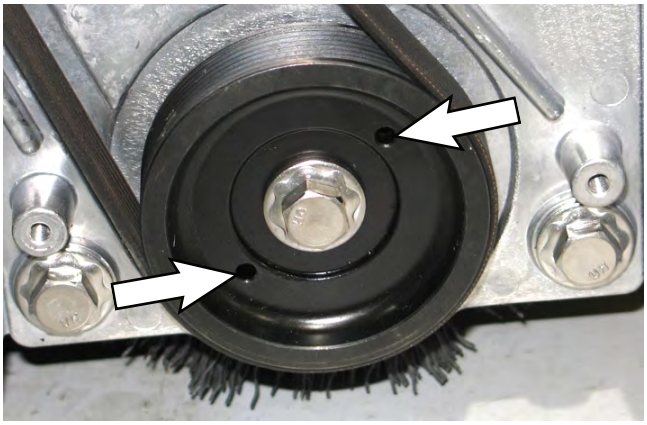
1. Turn the key switch OFF.
2. Remove the front scrub head cover from the machine.
3. Unfasten yellow latch and remove the idler plate assembly from the scrub head.

4. Remove the skirt cover/scrub side skirt from the belt cover.

5. Remove the belt cover from the scrub head.

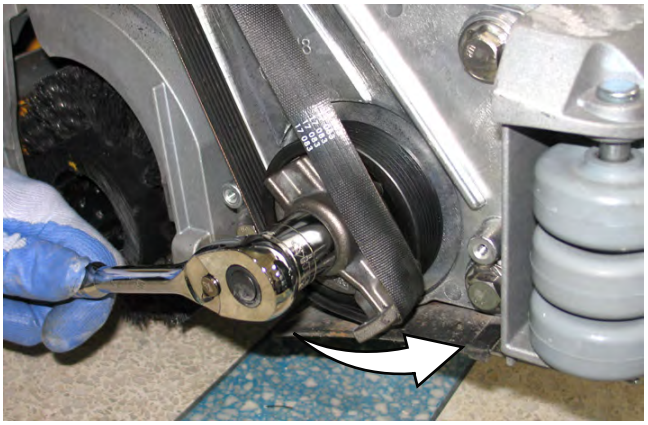
6. Insert the belt installation tool guide into the holes in the sheave.

NOTE: The belt installation tool used in this procedure is included in the cylindrical brush drive belt replacement kits. Do Not discard the belt installation tool after installing a new cylindrical brush drive belt onto the machine.



7. Turn the belt installation tool clockwise and pull the brush drive belt away from sheave to remove the brush drive belt from the machine.

8. Turn the belt installation tool counter clockwise to reinstall the removed belt/install the new brush drive belt onto the scrub head. If necessary, use hand to help push the brush drive belt onto the sheave.



9. Remove the belt installation tool from the sheave.

10. Reinstall all items removed to access the brush drive belt in the reverse order of disassembly.

REMOVING/REPLACING/INSTALLING THE CYLINDRICAL BRUSH DRIVE MOTOR

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

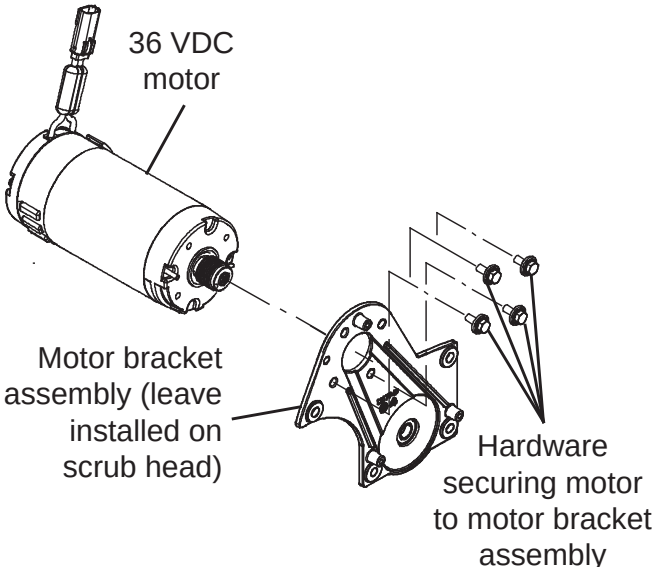
1. Remove the brush drive belt from the scrub head. See REMOVING/REINSTALLING/REPLACING THE CYLINDRICAL BRUSH DRIVE BELT.

2. Disconnect the battery cable from the machine.

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

3. Disconnect the main wire harness from the brush drive motor.

4. Remove the brush drive motor from the scrub head.



5. Reinstall the cylindrical brush drive motor onto the machine in reverse order of disassembly.

6. Reinstall the brush drive belt onto the scrub head. See REMOVING/REINSTALLING/REPLACING THE CYLINDRICAL BRUSH DRIVE BELT.

7. Reinstall other components removed to access the brush drive motor in reverse order of disassembly.

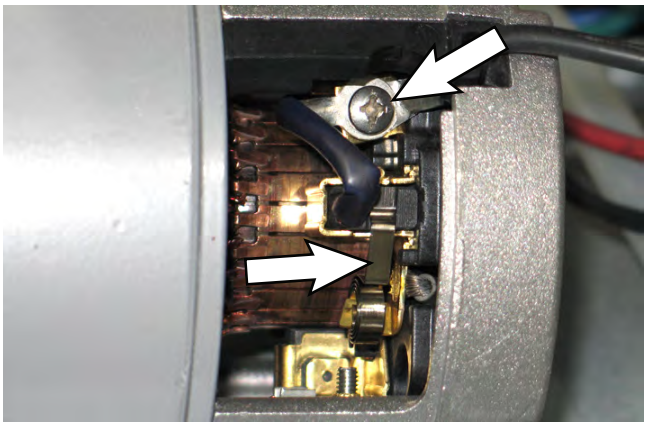
REMOVING/INSTALLING THE CYLINDRICAL SCRUB HEAD MOTOR CARBON BRUSHES

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. Remove the front scrub head cover from the machine.
2. Remove the brush drive motor from the machine. See REMOVING/REPLACING/INSTALLING THE CYLINDRICAL BRUSH DRIVE MOTOR.
3. Loosen and remove the latch securing the retaining band to the brush motor.

4. Remove the pan screw securing the carbon brush wire to the cylindrical brush motor, remove the spring securing the carbon brush inside the motor, and remove the carbon brush assembly from the motor.



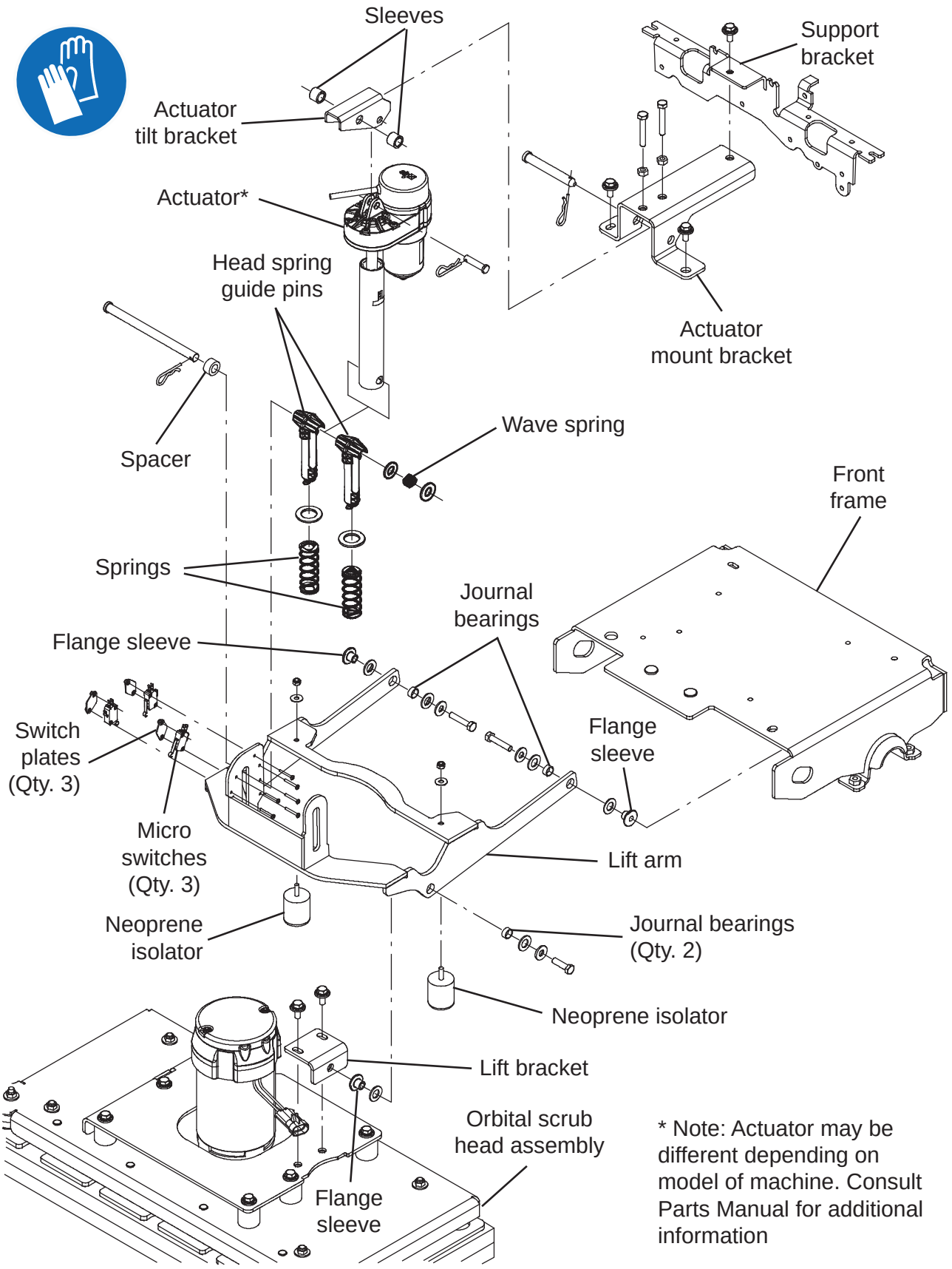
5. Use compressed air to clean dust from inside the motor.

6. Repeat previous steps to service the remaining carbon brushes.

NOTE: Carbon brushes should be replaced as sets.

7. Reinstall the removed carbon brushes/install the new carbon brushes into the disk brush motor in the reverse order of disassembly.
8. Reinstall the retaining band onto the motor.
9. Reinstall the motor in reverse order of disassembly. See REMOVING/REPLACING/INSTALLING THE CYLINDRICAL BRUSH DRIVE MOTOR.

REMOVING/REPLACING/INSTALLING THE ORBITAL SCRUB HEAD ASSEMBLY



* Note: Actuator may be different depending on model of machine. Consult Parts Manual for additional information

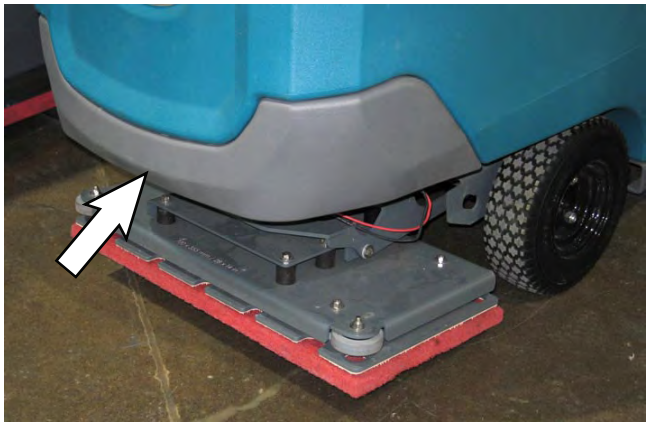
1. Completely empty both the solution tank and the recovery tank.

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

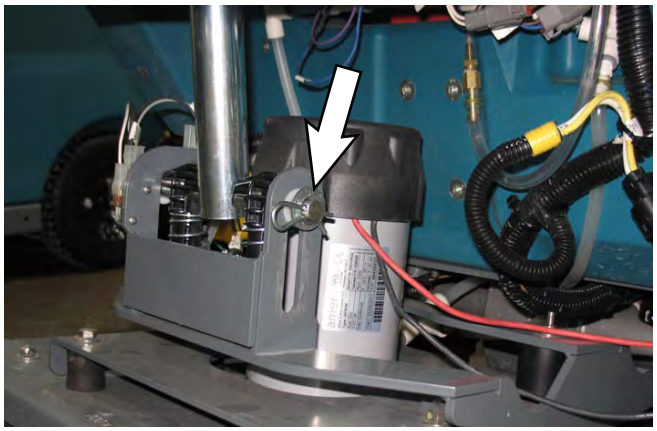
2. Turn the key switch OFF.
3. Remove the brushes from the scrub head.
4. Turn the key switch ON, completely lower the scrub head to the floor, turn the key switch OFF, and remove the key.
5. Disconnect the battery cable from the machine.

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

6. Remove the front scrub head cover from the machine.

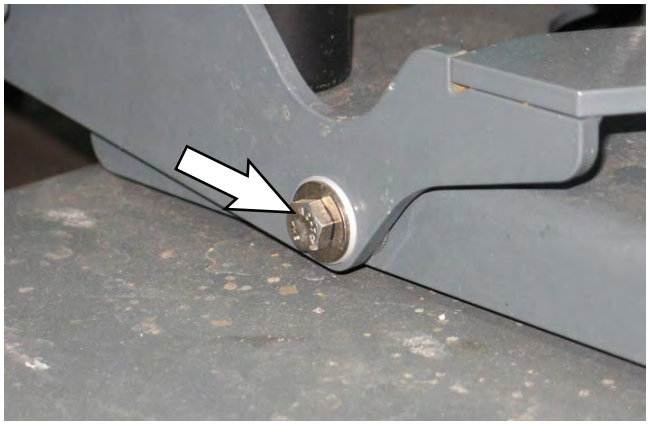


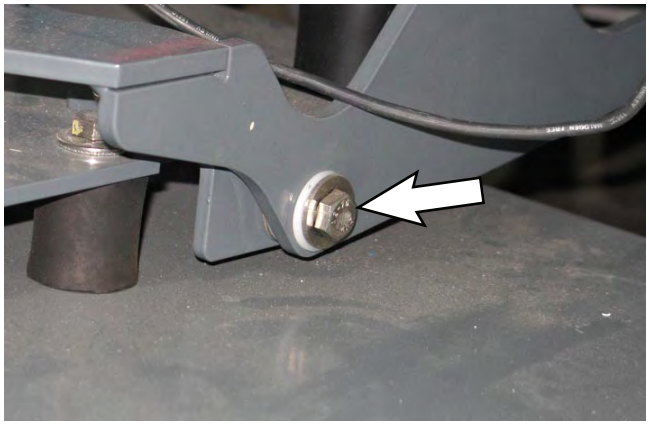
7. Disconnect the main wire harness from the scrub head motor and the switch plates.
8. Disconnect all solution supply hoses from the scrub head.
9. Cut all wire ties securing the main wire harness to the scrub head and disconnect main wire harness connections from the brush drive motors.
10. Remove the cotter pin and clevis pin securing the actuator to the head suspension spring bracket.



NOTE: Do Not turn the actuator barrel after removing the cotter pin/clevis pin securing the actuator to the head suspension spring bracket. The actuator must be readjusted if the barrel is turned out of adjustment. See REMOVING/REPLACING/ADJUSTING THE ACTUATOR *for instructions how to readjust the actuator.*

Remove the hardware securing the head lift bracket to the scrub head.





11. Proceed to REMOVING/INSTALLING THE LOWER ORBITAL HEAD ISOLATORS if replacing the lower isolators.

12. Reinstall the removed scrub head/new scrub head onto the machine in reverse order of disassembly.

REMOVING/INSTALLING THE ORBITAL SCRUB HEAD MOTOR CARBON BRUSHES

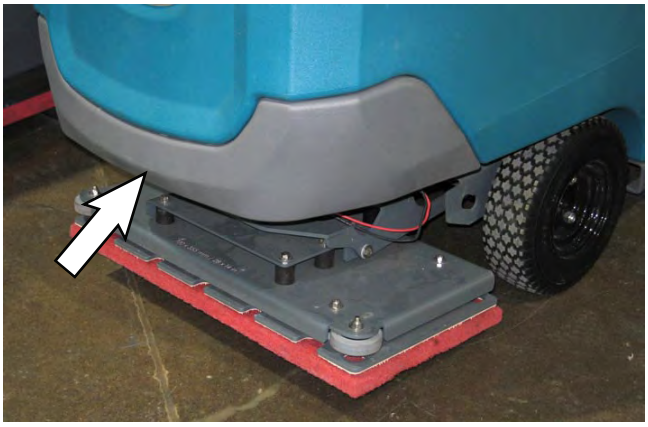
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.

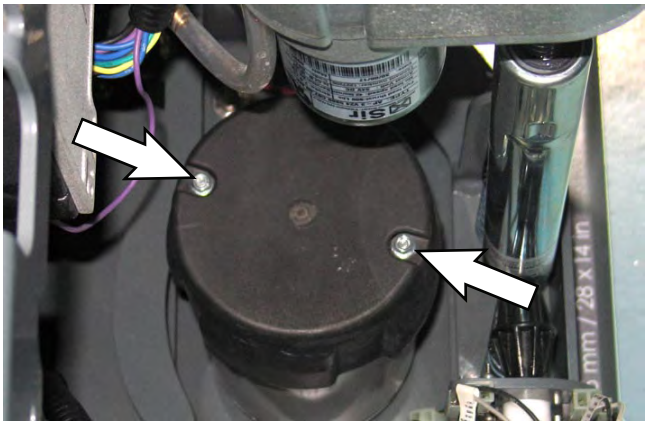
2. Disconnect the battery cable from the machine.

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

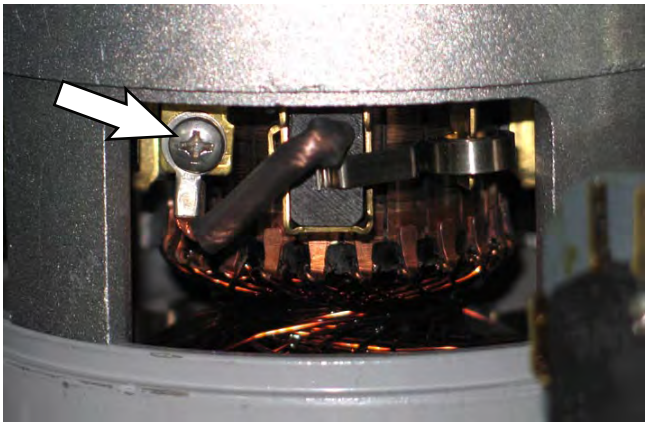
3. Remove the front scrub head cover from the machine.



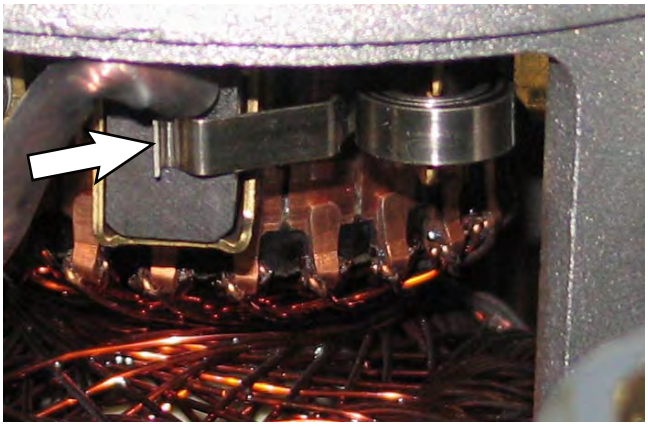
4. Remove the hardware securing the cap to the motor and remove the cap from the motor.



5. Remove the screw securing the carbon brush to the motor.



6. Remove the spring pressing the carbon brush into the motor from over the carbon brush and pull the carbon brush from the motor.



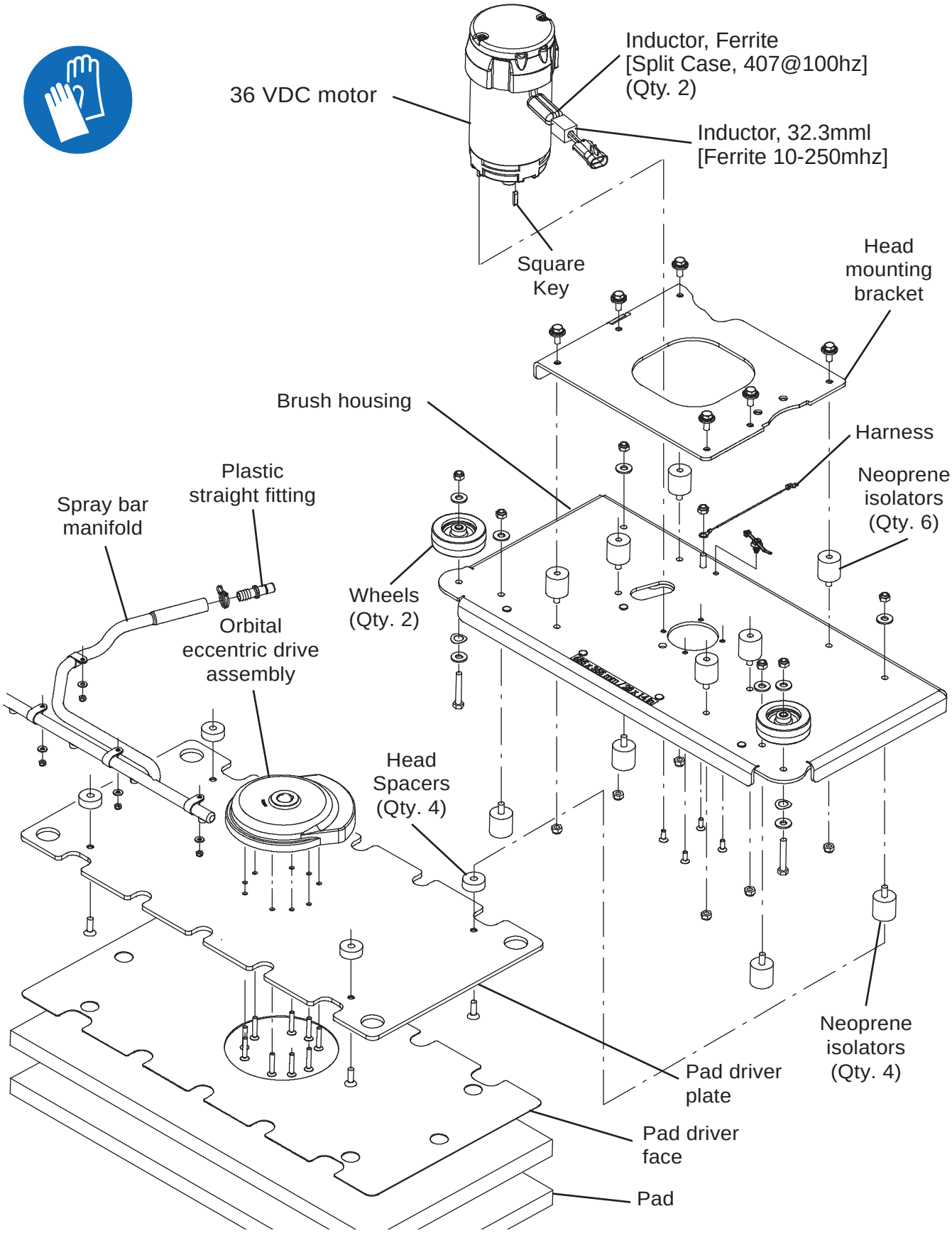
7. Use compressed air to clean dust from inside the motor.

8. Repeat previous steps to service the carbon brush located on the other side of the disk brush motor.

NOTE: Carbon brushes should be replaced as sets.

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

ORBITAL SCRUB HEAD MAINTENANCE



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

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

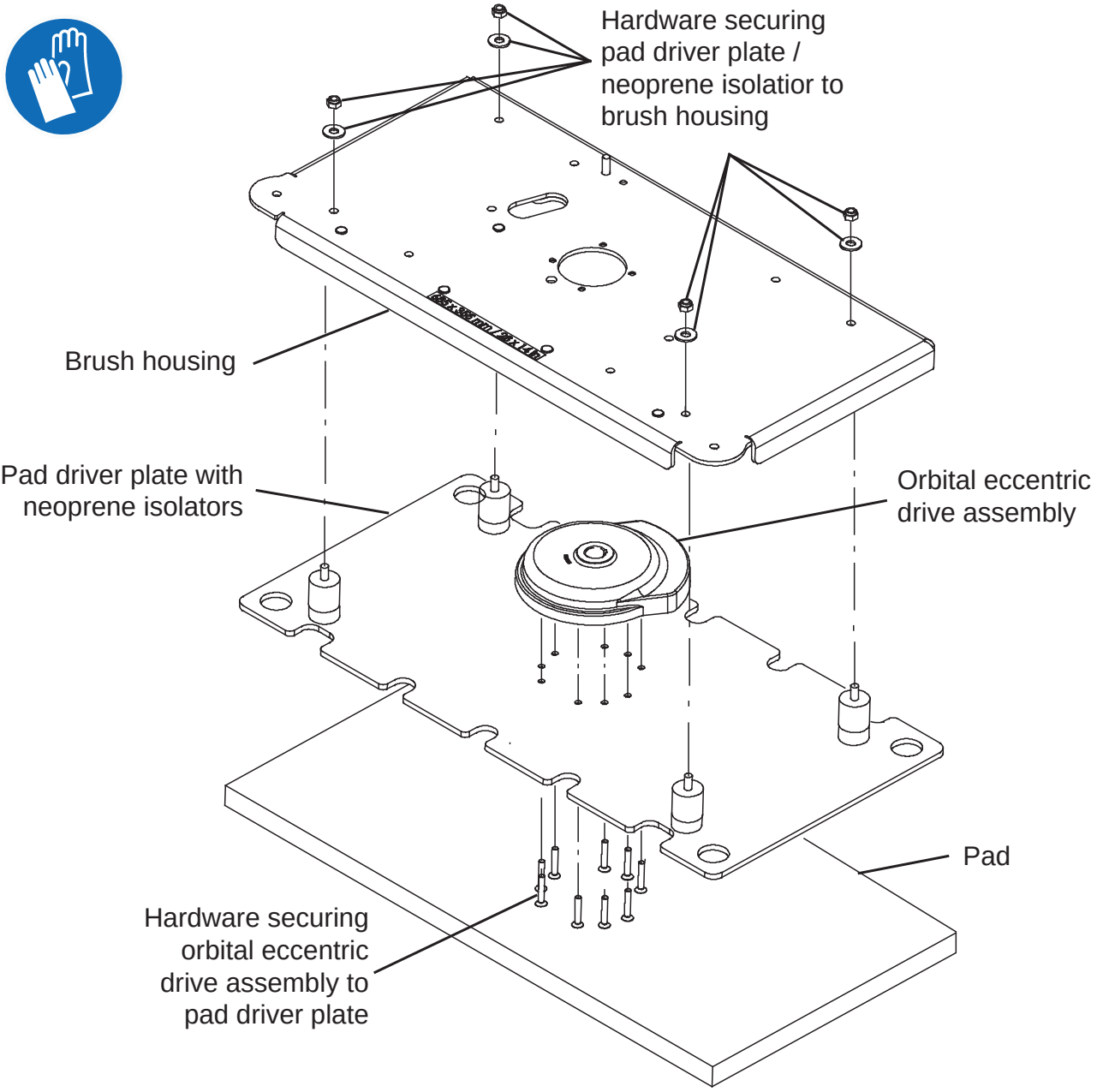
3. Remove the front scrub head cover from the machine.
4. Remove the scrub head from the machine. Refer to REMOVING/REPLACING/INSTALLING THE ORBITAL SCRUB HEAD ASSEMBLY.
5. Remove components necessary to complete maintenance from the scrub head.
6. Replace parts as needed.
7. Reassemble the scrub head in reverse order of disassembly.
8. Reinstall the scrub head onto the machine. Refer to REMOVING/REPLACING/INSTALLING THE ORBITAL SCRUB HEAD ASSEMBLY.
9. Reinstall the front scrub head cover onto the machine.

REMOVING/INSTALLING THE LOWER ORBITAL SCRUB 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 REMOVING/INSTALLING THE ORBITAL SCRUB HEAD ASSEMBLY.
2. Place the scrub head on a work bench.
3. Loosen the hardware securing the lower isolators to the orbital scrub head assembly.
4. Turn the orbital scrub head assembly upside down and remove the pads.
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 new lower orbital head isolators in the reverse order in which the old lower orbital head isolator were removed.

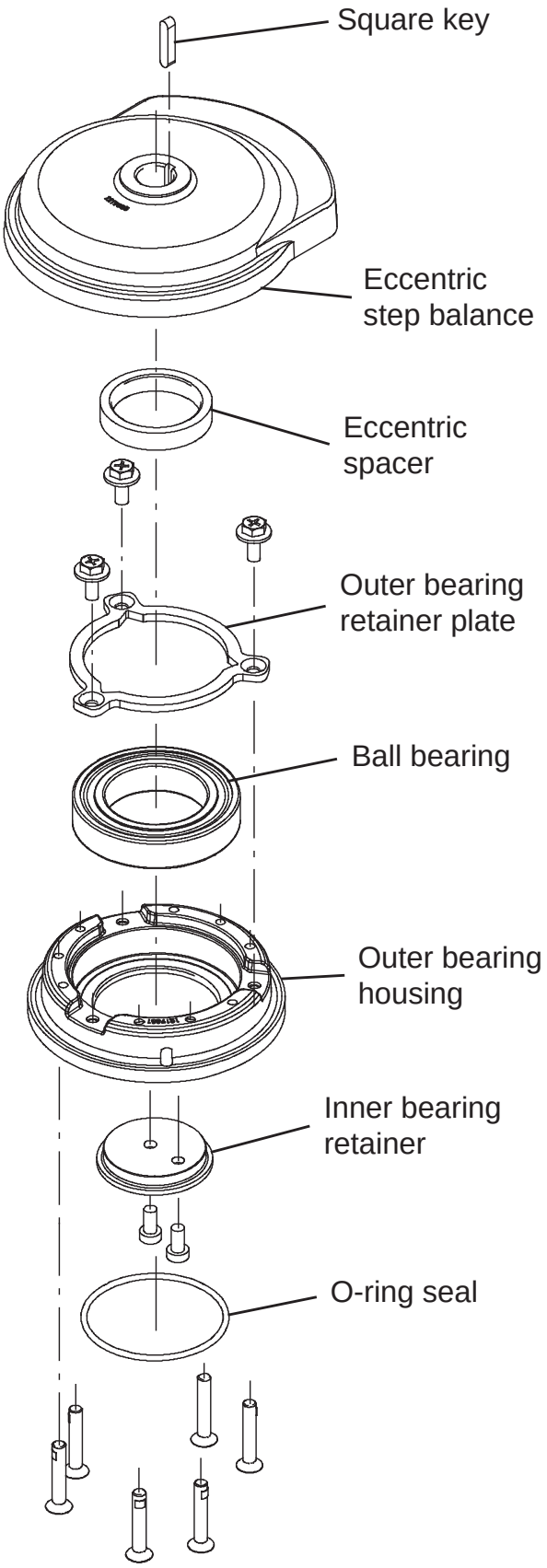
REMOVING/INSTALLING/REPLACING THE ORBITAL SCRUB HEAD ECCENTRIC DRIVE ASSEMBLY



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

1. Raise the scrub into the completely raised position.
2. Turn the key switch OFF.
3. Remove the scrub pad from the machine.
4. Remove the hardware securing the orbital eccentric drive assembly to the pad driver plate.
5. Remove the hardware securing the lower isolators and pad driver plate to the brush housing.
6. Remove the orbital eccentric drive assembly from the motor. Do not lose the square key when removing the orbital eccentric drive assembly from the motor.

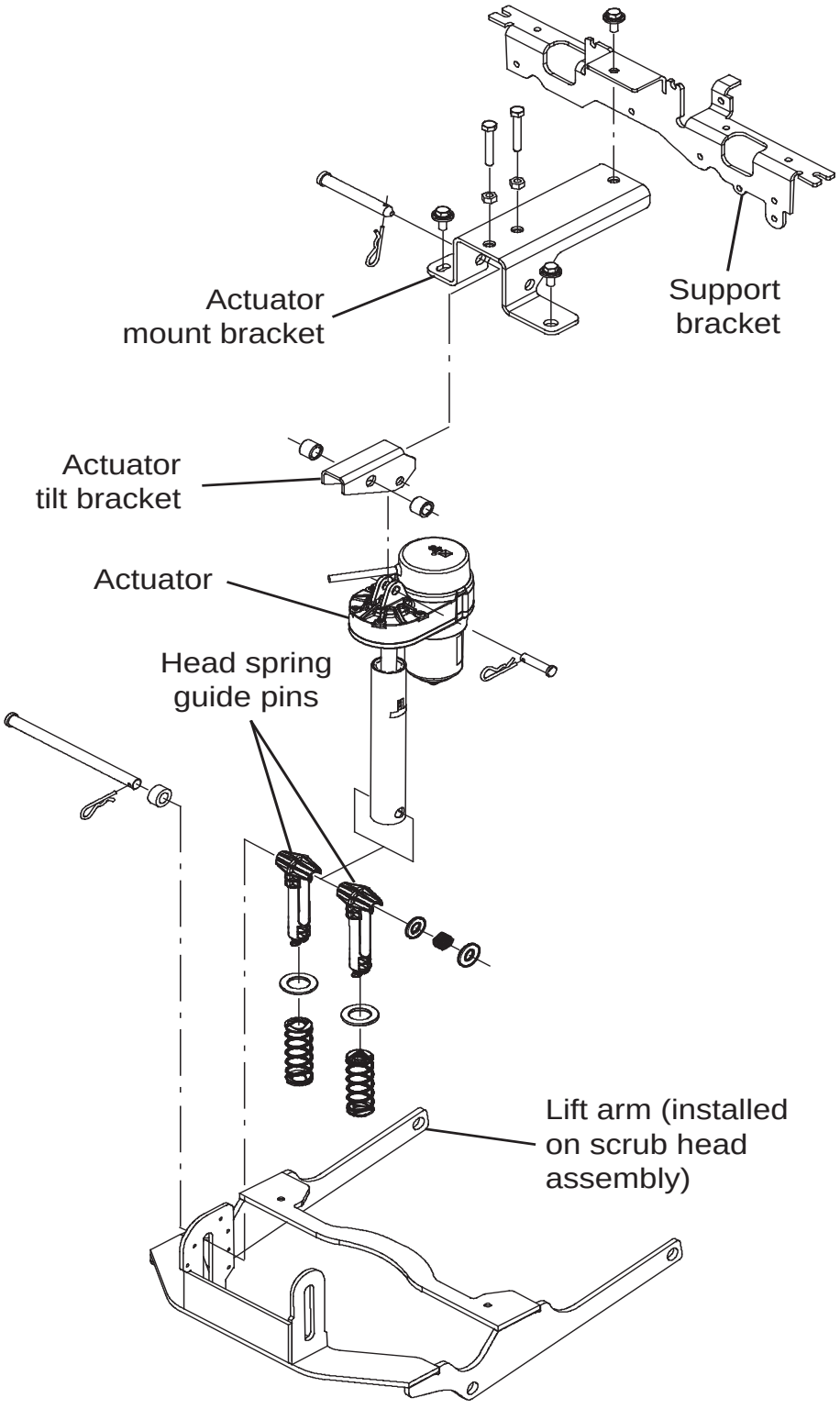
7. Disassemble the orbital eccentric drive assembly as necessary to perform maintenance.



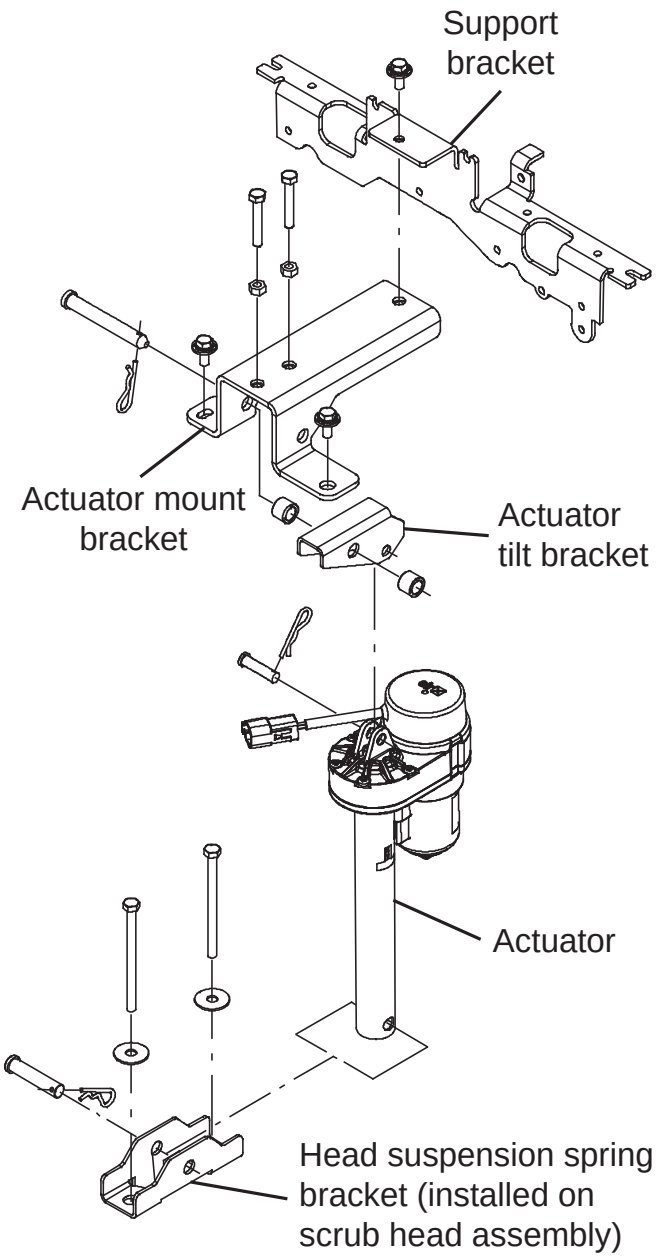
8. Reassemble the orbital eccentric drive assembly in reverse order of disassembly.
9. Reinstall the orbital eccentric drive assembly onto the machine in reverse order of disassembly.
10. Reinstall the lower isolators and pad driver plate onto the machine.
11. Reinstall the hardware securing the orbital eccentric drive assembly to the pad driver plate.
12. Reinstall the scrub pad onto the machine.

REMOVING/REPLACING/ADJUSTING THE ACTUATOR

Orbital Scrub Heads



Cylindrical and Disk Scrub Heads



REMOVING THE ACTUATOR

1. Completely empty the recovery tank and the solution tank.
2. Turn the key switch OFF.

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

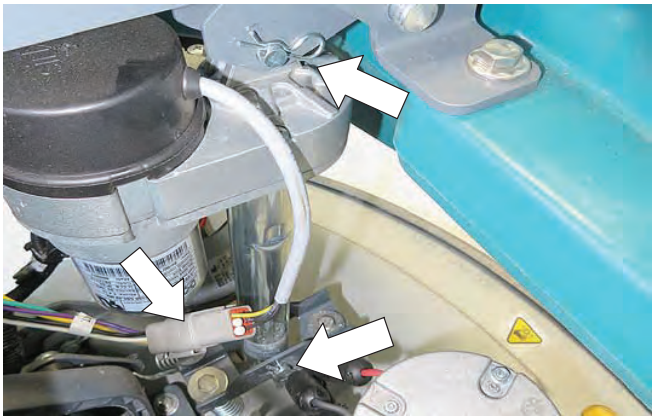
3. Open the recovery tank to access the actuator.
4. Remove the front scrub head cover from the machine.
5. If actuator is inoperable, proceed to Step 6.

   Turn the key switch ON, press the 1-Step button to begin lowering the scrub head to floor, but stop the scrub head right before it starts to apply pressure on floor by turning the key switch OFF. This will relieve the tension on the actuator for easy clevis pin removal.

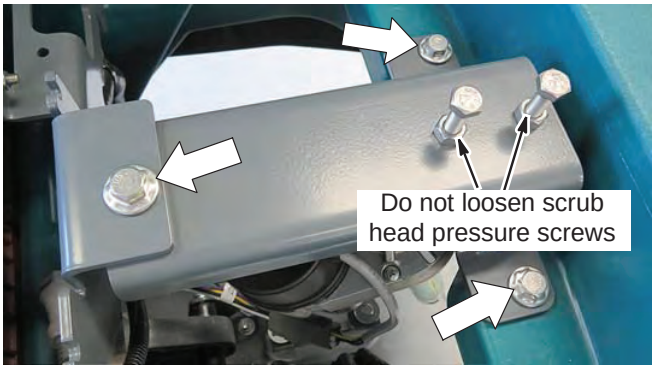
FOR SAFETY: When servicing machine, disconnect battery connection and charger cord before working on machine.

6. Disconnect the battery cable from the machine

7. Disconnect the actuator wire harness connector from machine. Remove the lower and upper clevis from the defective actuator. If there is tension on the pins, slightly lift the scrub head by hand to remove the pins.



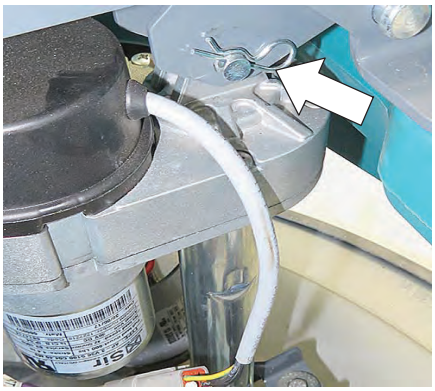
NOTE: If the actuator is stuck in the down forced position, making it difficult to remove the pins, loosen the three mounting screws on the actuator bracket to relieve the tension on the pins.

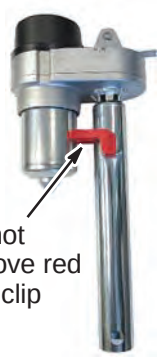


INSTALLING THE NEW ACTUATOR

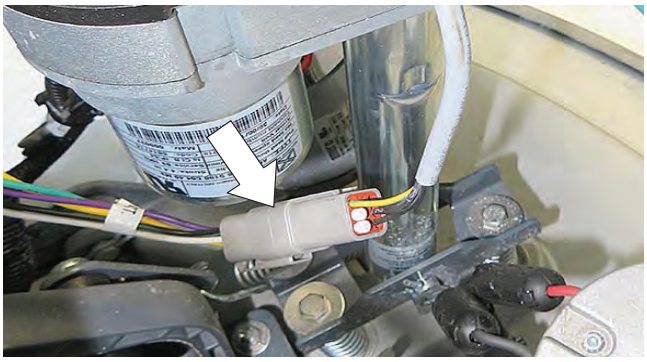
1. Install the top end of actuator to machine.

   IMPORTANT: DO NOT remove the red lock clip from actuator tube or attempt to connect the lower tube end at this time.





2. Connect the actuator wire harness to the main wire harness.



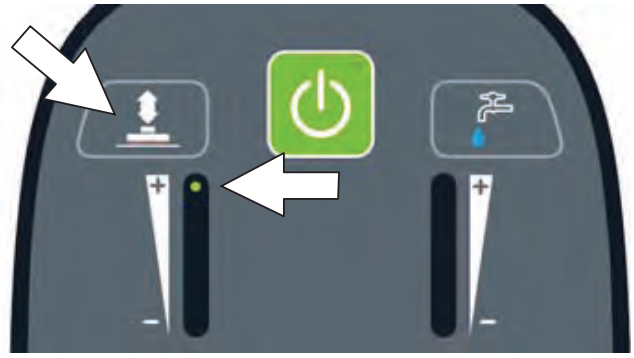
3. Make sure the scrub head is not elevated from the floor. Scrub head must be flat on the floor.

4. Use the machine manual mode to connect the actuator lower tube to scrub head as described below.

Machines equipped with Membrane Panel:

1. To activate manual mode, press and hold the 1- Step button while turning the key switch ON. Release the button when the brush pressure light is illuminated.

   Confirm the brush pressure light is at the (+) brush pressure setting as shown below. If the light is not at the (+) setting, press the brush pressure button.

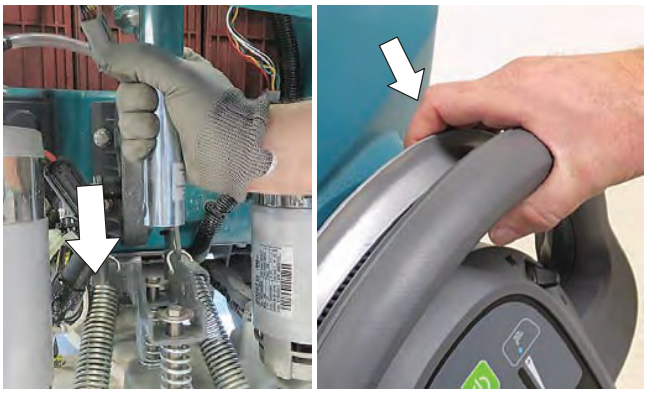


2. Carefully remove the red lock clip from the actuator tube. DO NOT turn tube from the factory set position.

3. This step may require an assistant. Firmly grip the actuator tube by hand and slowly pull the start bail to lower the tube into position. Insert the clevis pin when the tube holes are aligned with the scrub head bracket. Secure clevis pin with cotter pin.

   IMPORTANT: DO NOT allow tube to spin freely. The factory set point will be lost.

   If the actuator tube was extended too far, beyond the mounting holes, reverse the actuator direction by pressing the brush pressure button to the (-) setting as described above. Continue to grip actuator tube.

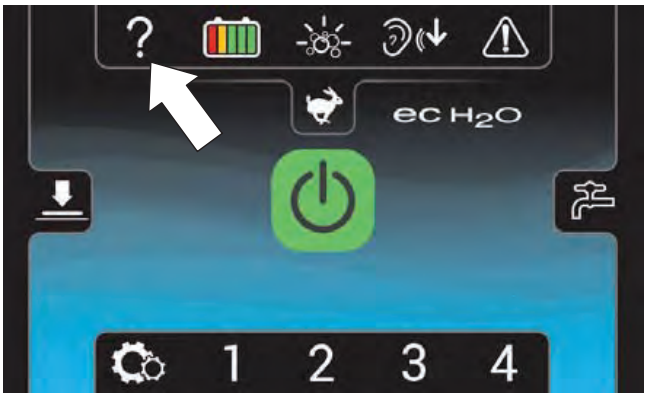


4. Turn the key switch OFF to exit the manual mode.

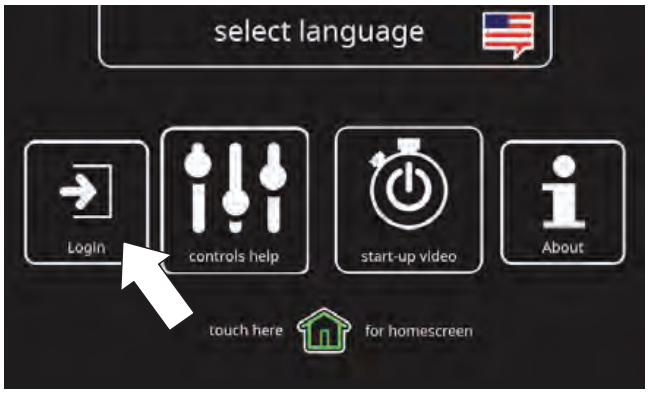
NOTE: If the actuator does not operate properly, the factory set point may have been lost. See RESETTING THE ACTUATOR TO THE FACTORY SET POINT.

Machines equipped with an LCD Pro- Panel:

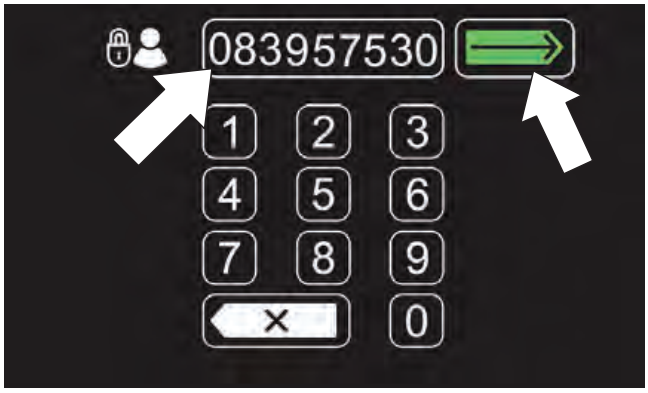
1. To enter the manual mode, press the help button [?] to the help screen.



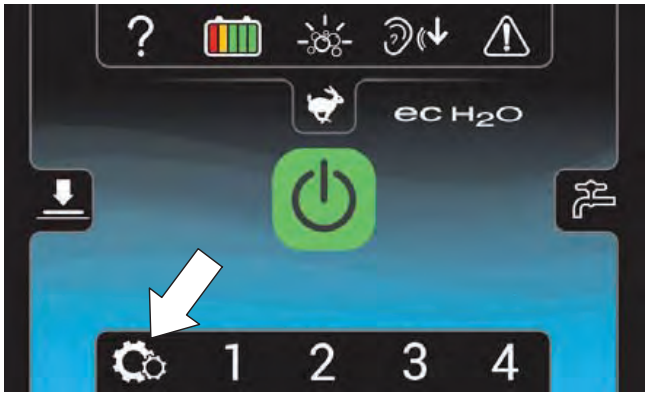
2. Press the Login button.



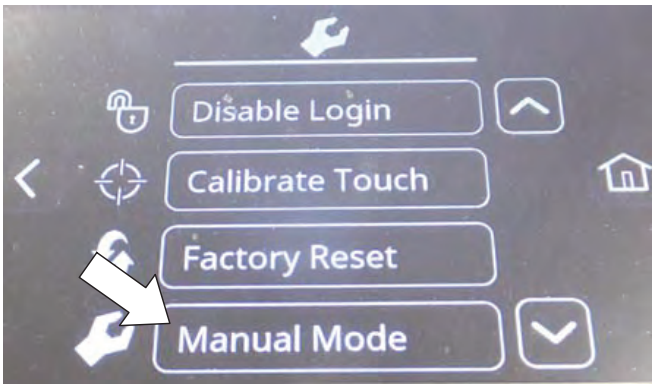
3. Enter the manual mode code 083957530 and press the green arrow.



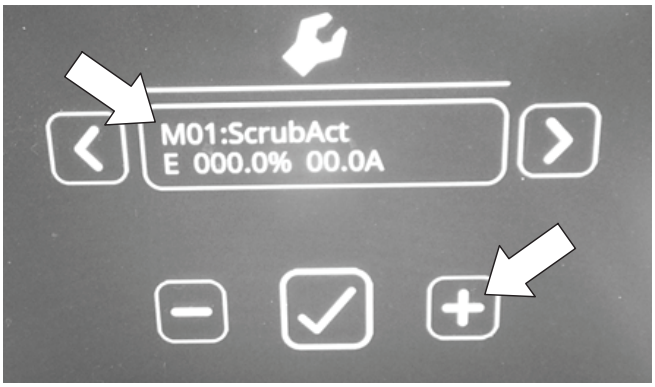
4. Press the machine settings button.



5. Scroll down and press the Manual Mode button.



6. Scroll to the “M01:ScrubAct” mode. Press the [+] button to set the actuator in the extend direction.

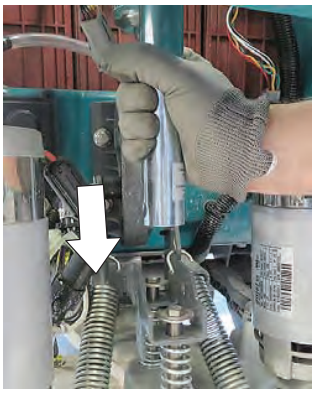


7. Carefully remove the red lock clip from the actuator tube. DO NOT turn tube from the factory set position.

8. This step may require an assistant. Firmly grip the actuator tube by hand and slowly pull the start bail to lower the tube into position. Insert the clevis pin when the tube holes are aligned with the scrub head bracket.

   IMPORTANT: DO NOT allow tube to spin freely. The factory set point will be lost.

   If the actuator tube was extended too far, beyond the mounting holes, set the actuator direction to the retract (-) setting as described above.



9. Turn the key switch OFF to exit the manual mode.

10. Test machine for proper operation.

11. If necessary, adjust the scrub head down pressure. See *ADJUSTING SCRUB HEAD DOWN PRESSURE (T600E MACHINES ONLY).*

NOTE: The scrub head down pressure is set at the factory. Only in rare instances/circumstances should the scrub head down pressure need to be adjusted.

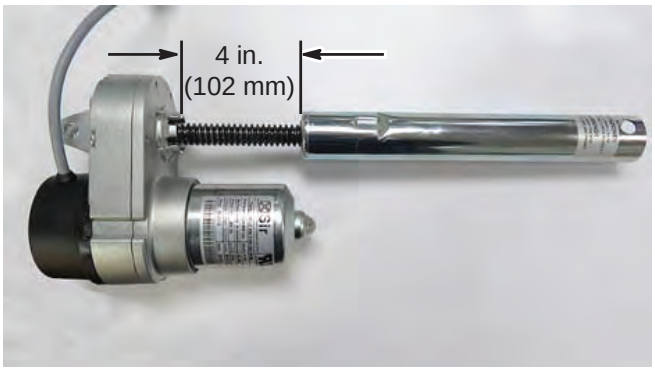
NOTE: If the actuator does not operate properly, the factory set point may have been lost. See RESETTING THE ACTUATOR SET POINT.

RESETTING THE ACTUATOR TO THE FACTORY SET POINT

If the actuator set point is out of adjustment, carefully follow the below instructions.

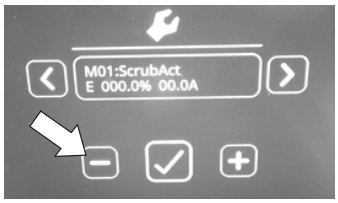
1. Remove the actuator from the machine, but leave the wire harness connected to the actuator.

2. Extend the actuator tube by turning it out by hand approximately 4 in. (102 mm) to allow clearance to retract.

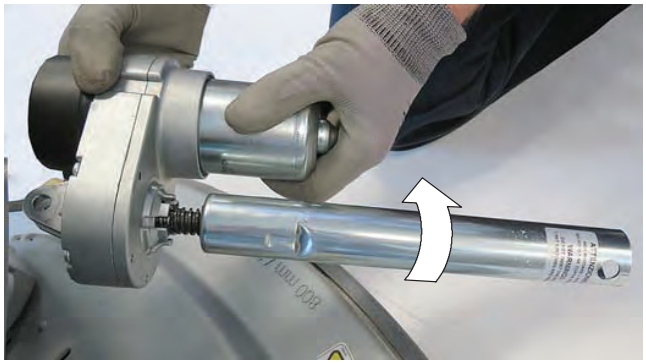


3. Use the manual mode as described in these installation instructions to select the (-) setting and fully retract the actuator until it stops. Allow the tube to spin freely.

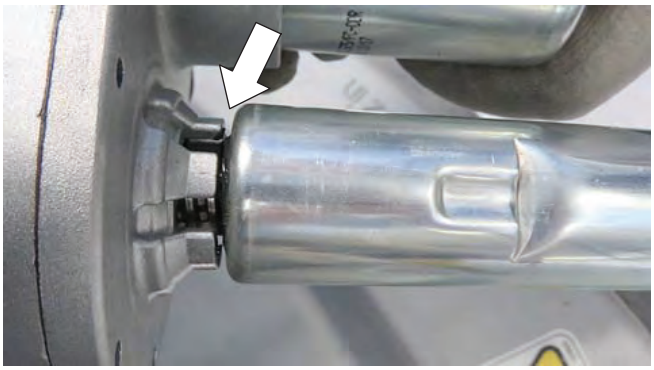
Membrane Panel Model



Pro-Panel Model



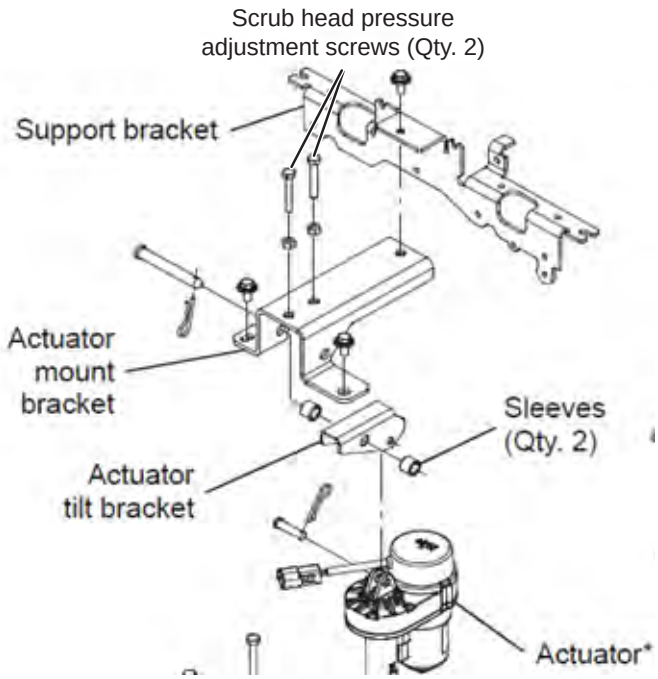
4. To reset the factory set point, turn the tube completely in by hand until it stops then out approximately a half turn.



5. Repeat the INSTALLING NEW ACTUATOR instructions.

ADJUSTING SCRUB HEAD DOWN PRESSURE

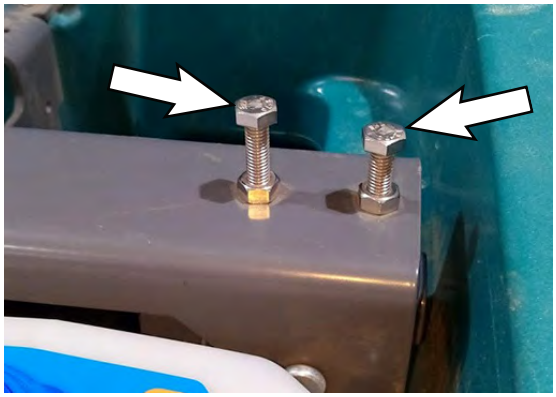
NOTE: The scrub head down pressure is set at the factory. Only in rare instances/circumstances should the scrub head down pressure need to be adjusted.



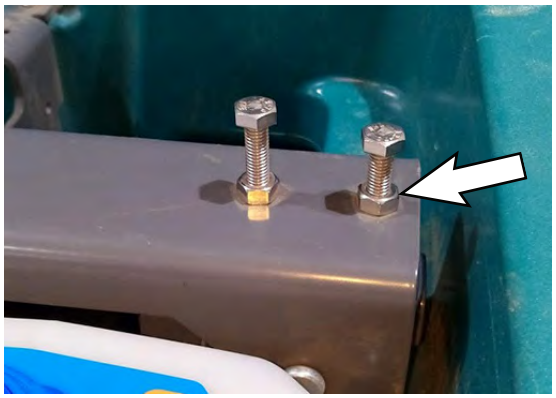
1. Completely empty the recovery tank and the solution tank.
2. Turn the key switch ON, completely lower the scrub head, and turn the key switch OFF.

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

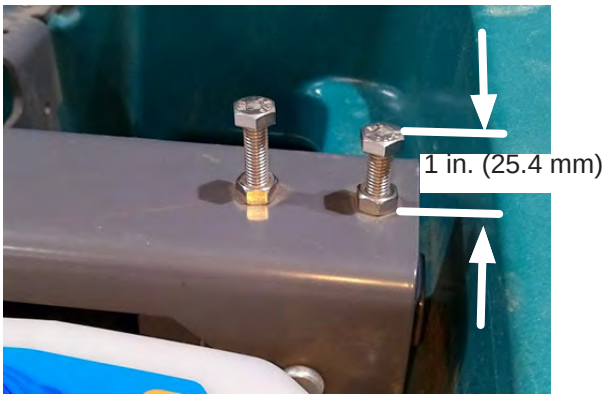
3. Open the recovery tank to access the actuator adjustment screws.



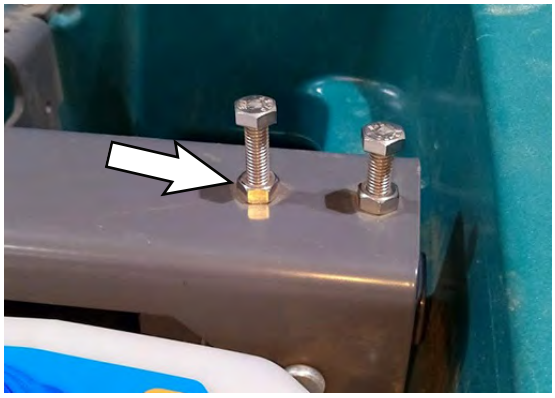
4. Loosen the nut on the front screw.



5. Adjust screw so the head of the screw is 1 in. (25.4 mm) from the bracket. Retighten the nut.



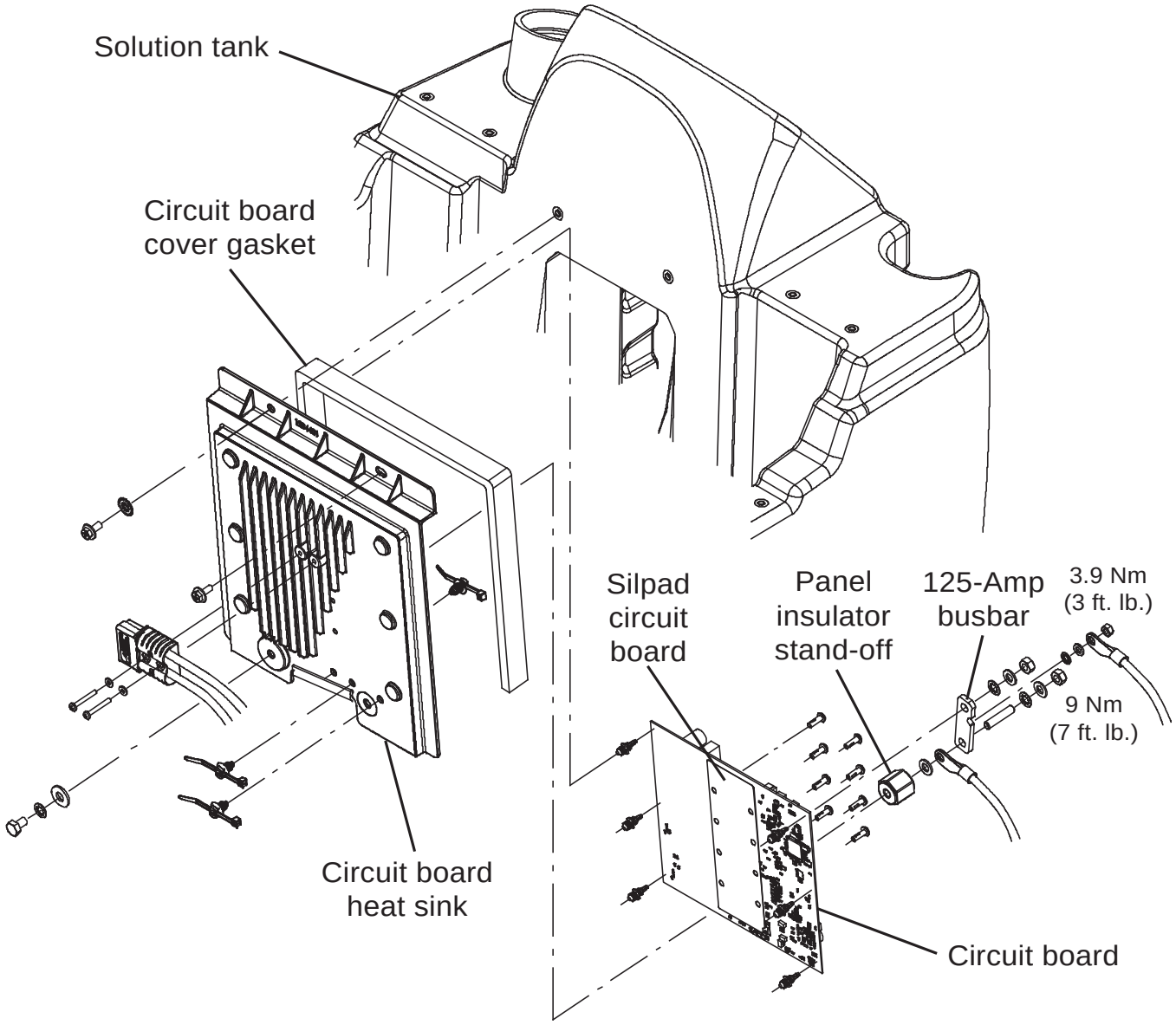
6. Loosen the nut on the rear screw.



7. Thread the screw into the mounting bracket until it touches the tilt bracket. Retighten the nut.

CONTROL MODULES/CONTROLS/ELECTRICAL

REMOVING/INSTALLING THE CONTROL MODULE - T600 MACHINES ONLY



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

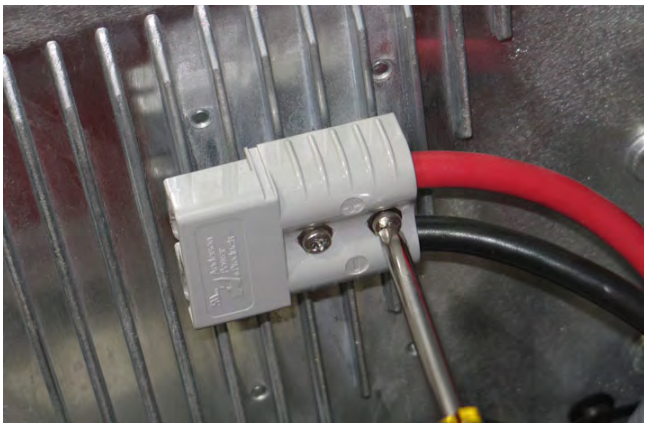
1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. If necessary, 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. Use a non-conductive battery removal device.

5. If removing the circuit board heat sink/circuit board from the machine, remove the battery cable from the heat sink.



6. Remove the hardware securing the circuit board heat sink 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.

7. Carefully pull the circuit board/circuit board heat sink from the electrical enclosure.

8. If necessary or replacing the circuit board, disconnect all main wire harness connections from the main circuit board and busbar and remove the circuit board/circuit board heat sink from the machine.

9. Remove the main circuit board from the five standoffs holding the main circuit board off the circuit board mounting heat sink.

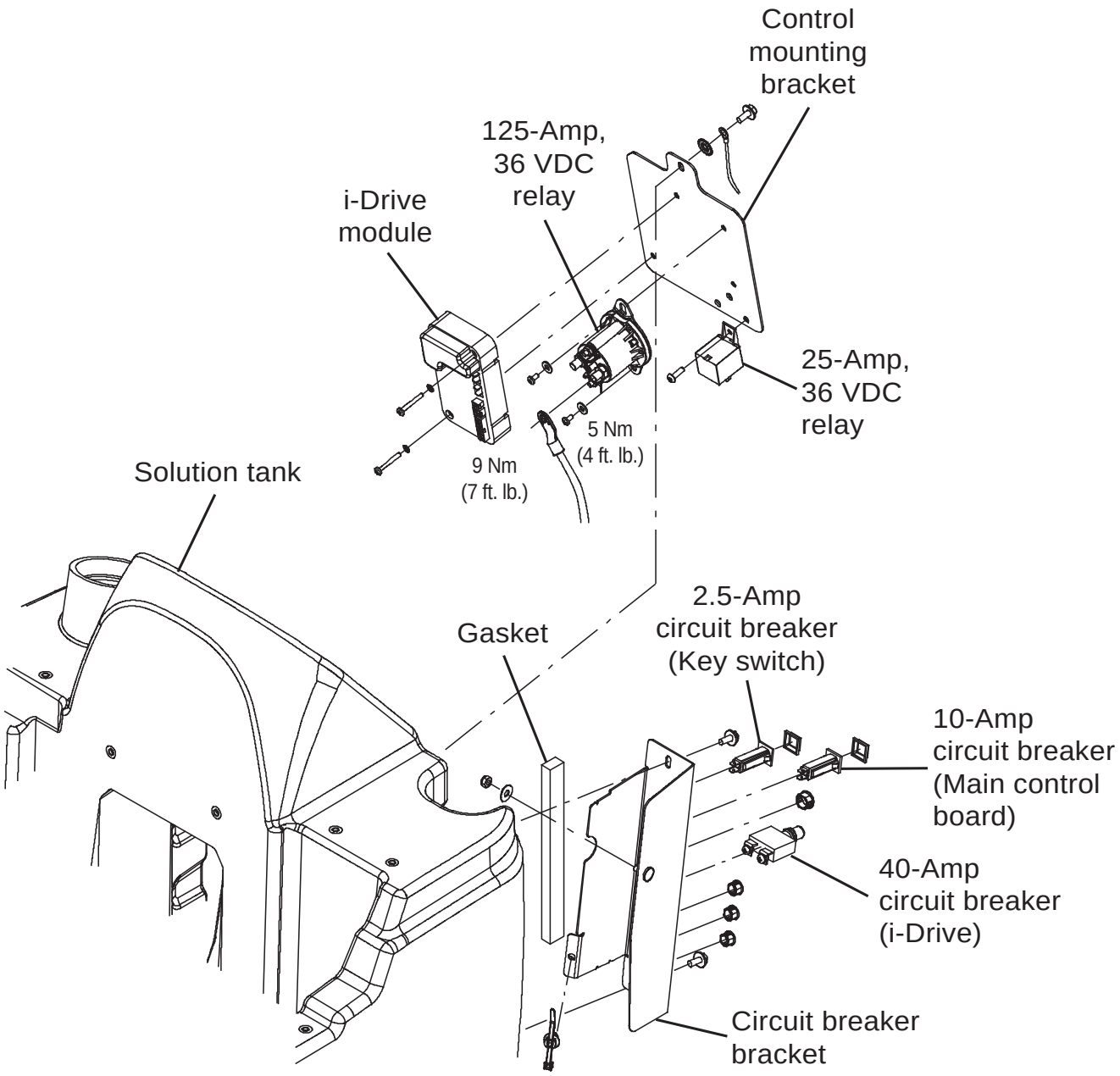
10. Install the new circuit board onto the circuit board heat sink.

11. Reconnect the main wire harness to the circuit board and busbar.

12. Reinstall the circuit board/circuit board heat sink onto the machine in reverse order of disassembly.

13. Program the machine for the new control module. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION.

REMOVING/INSTALLING THE i-DRIVE MODULE OR 25-AMP, 36 VDC RELAY - T600 MACHINES ONLY



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

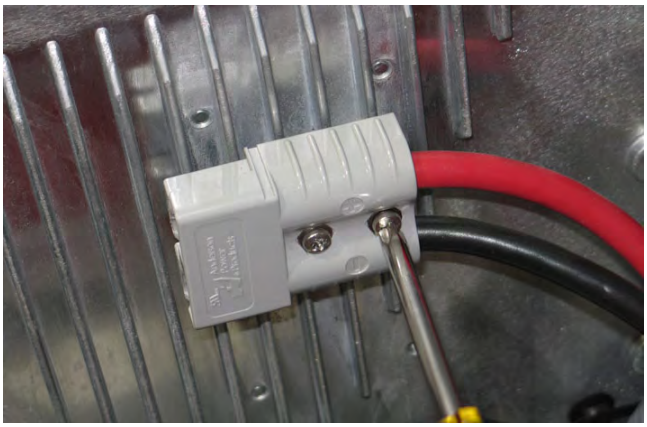
1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. Remove the control panel to access the top area of the i-Drive mounting bracket. See REMOVING/ INSTALLING THE CONTROL PANEL for instructions how to remove the control panel.
5. If necessary, 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. Use a non-conductive battery removal device.

6. If necessary, remove the battery cable from the circuit board heat shrink.



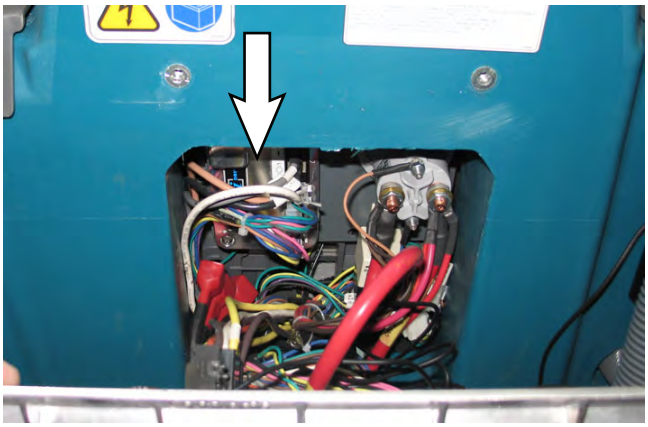
7. Remove the hardware securing the circuit board heat sink to the machine.

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.

8. Carefully pull the circuit board/circuit board heat sink from the electrical enclosure.

9. If necessary to access the i-Drive module or relay, disconnect all main wire harness connections from the main circuit board and busbar and remove the circuit board/circuit board heat sink from the machine.

10. Disconnect the main wire harness from the i-Drive module or relay.



11. Remove the i-Drive module or relay from the from the control mounting bracket located inside electrical enclosure.

12. Install the new i-Drive module or relay onto the control mounting bracket.

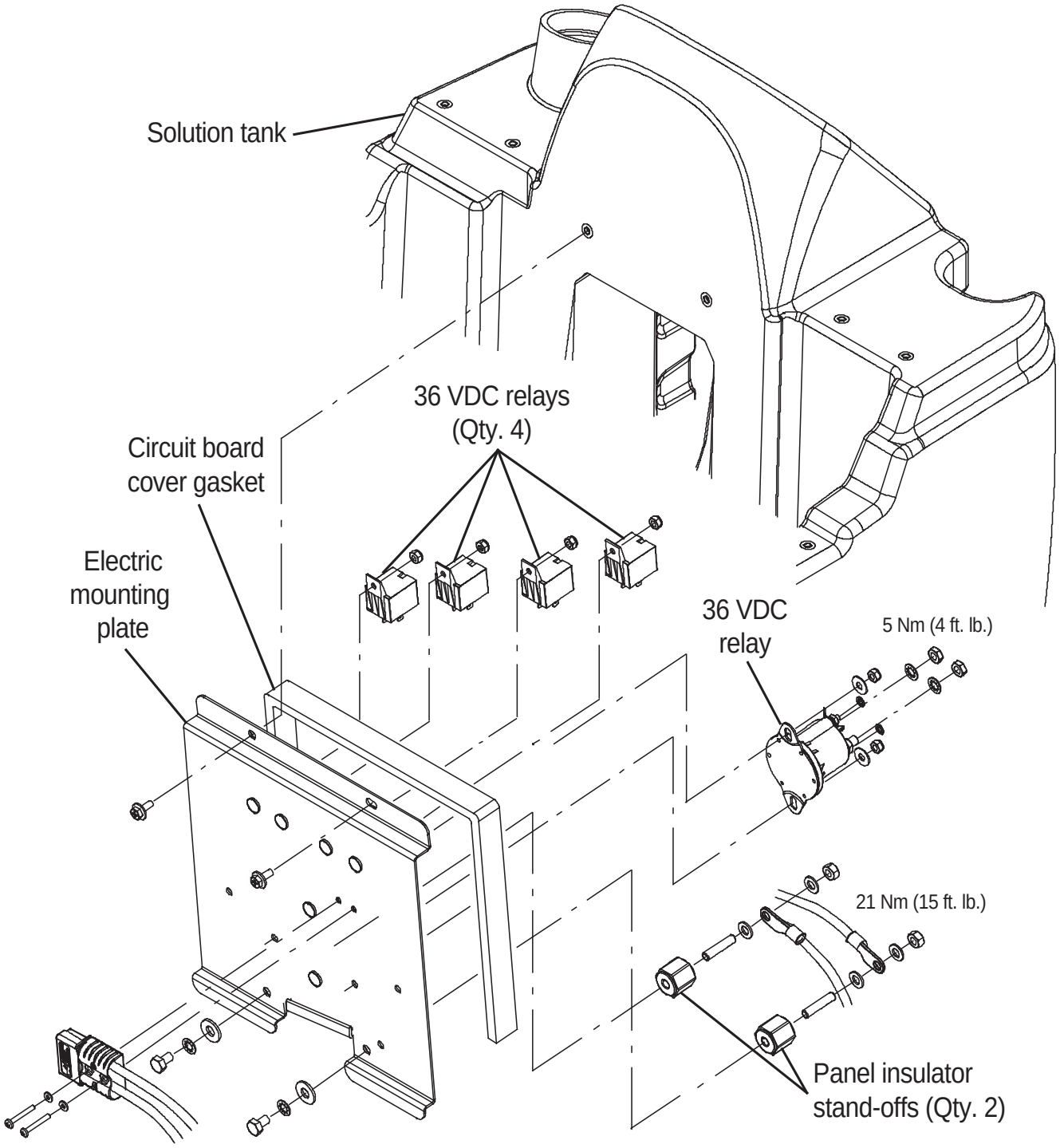
13. Connect the main wire harness to the new i-Drive module or relay.

14. If the electric mounting plate was removed to access the i-Drive or relay, place the electric mounting plate back into the machine and reconnect the main wire harness to all components on the electric mounting plate.

15. Reassemble items removed to access/replace the i-Drive module back onto the machine in the reverse order of disassembly.

16. Program the machine for the new i-Drive module. See PROGRAMMING THE i-DRIVE MODULE

REMOVING/INSTALLING/REPLACING THE RELAYS - T600e MACHINES ONLY



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

1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. If necessary, remove the batteries from the machine.

5. If necessary, remove the batteries from the machine.

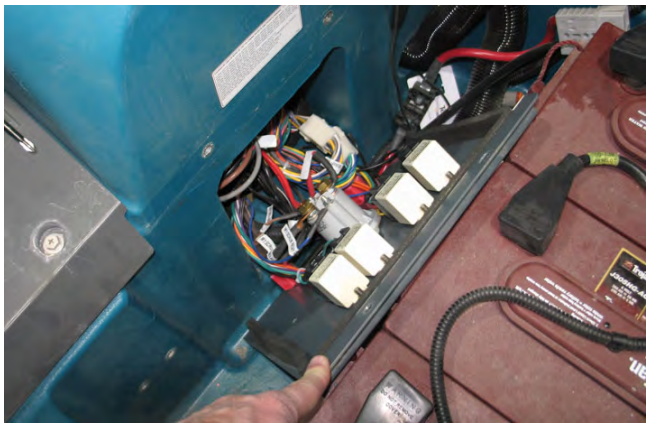
FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries. Use a non-conductive battery removal device.

6. If necessary, remove the battery cable from the electric mounting plate.

7. Remove the hardware securing the electric mounting plate 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.

8. Carefully pull the electric mounting plate from the electrical enclosure.



9. If removing the electric mounting plate, disconnect the main wire harness from all components installed on the electric mounting plate and remove the relays being replaced from the electric mounting plate.

10. If not removing the electric mounting plate, disconnect the main wire harness from the relays being replaced and remove the relays from the electric mounting plate.

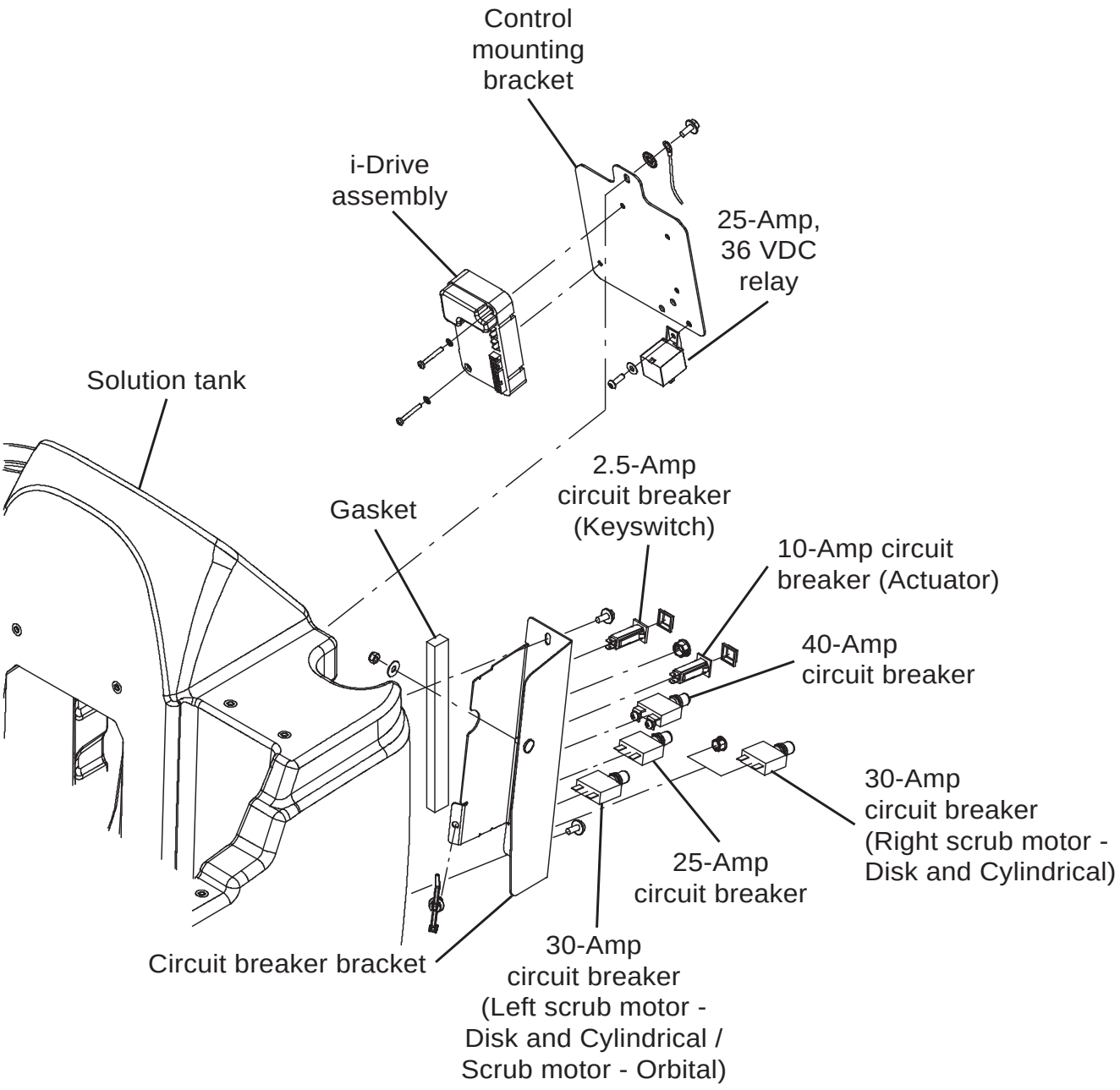
11. Install new relays onto the electric mounting plate.

12. If the electric mounting plate was removed from the machine, place the electric mounting plate back into the machine so the main wire harness can be easily attached to all components located on the electric mounting plate.

13. Connect the main wire harness to the new relays, or to all components if the electric mounting plate was removed from the machine.

14. Reinstall the electric mounting plate onto the machine in reverse order of disassembly.

REMOVING/INSTALLING THE i-DRIVE MODULE OR 25-AMP, 36 VDC RELAY - T600e MACHINES ONLY



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

1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. If necessary, remove the batteries from the machine.

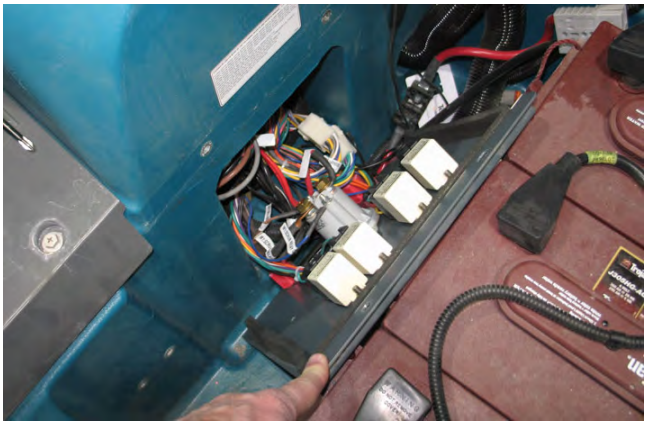
FOR SAFETY: When servicing machine, avoid contact with battery acid, keep all metal objects off batteries, and use a hoist or adequate assistance when lifting batteries. Use a non-conductive battery removal device.

5. If necessary, remove the battery cable from the electric mounting plate.

6. Remove the hardware securing the electric mounting plate to the machine.

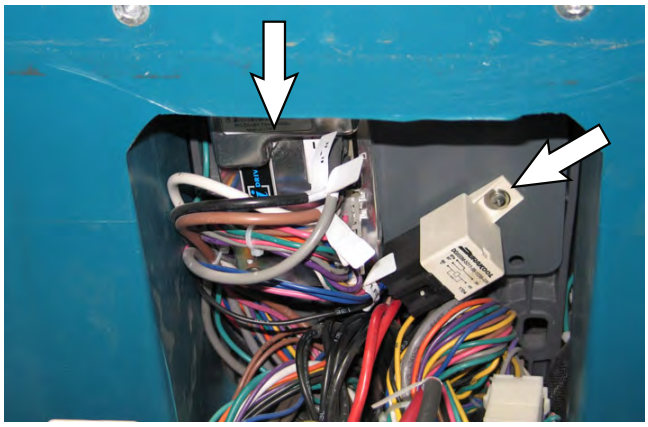
NOTE: To avoid damaging electronic components, a static ground strap must be worn at all times while handling circuit boards/control modules. Attach the other end of the static ground strap to the machine chassis.

7. Carefully pull the electric mounting plate from the electrical enclosure.



8. If necessary to access the i-Drive module or relay, disconnect the main wire harness from all components installed on the electric mounting plate and remove the electric mounting plate from the machine.

9. Disconnect the main wire harness from the i-Drive module or the relay.



10. Remove the i-Drive module or relay from the control mounting bracket located inside the electrical enclosure.

11. Install the new i-Drive module or relay onto the control mounting bracket.

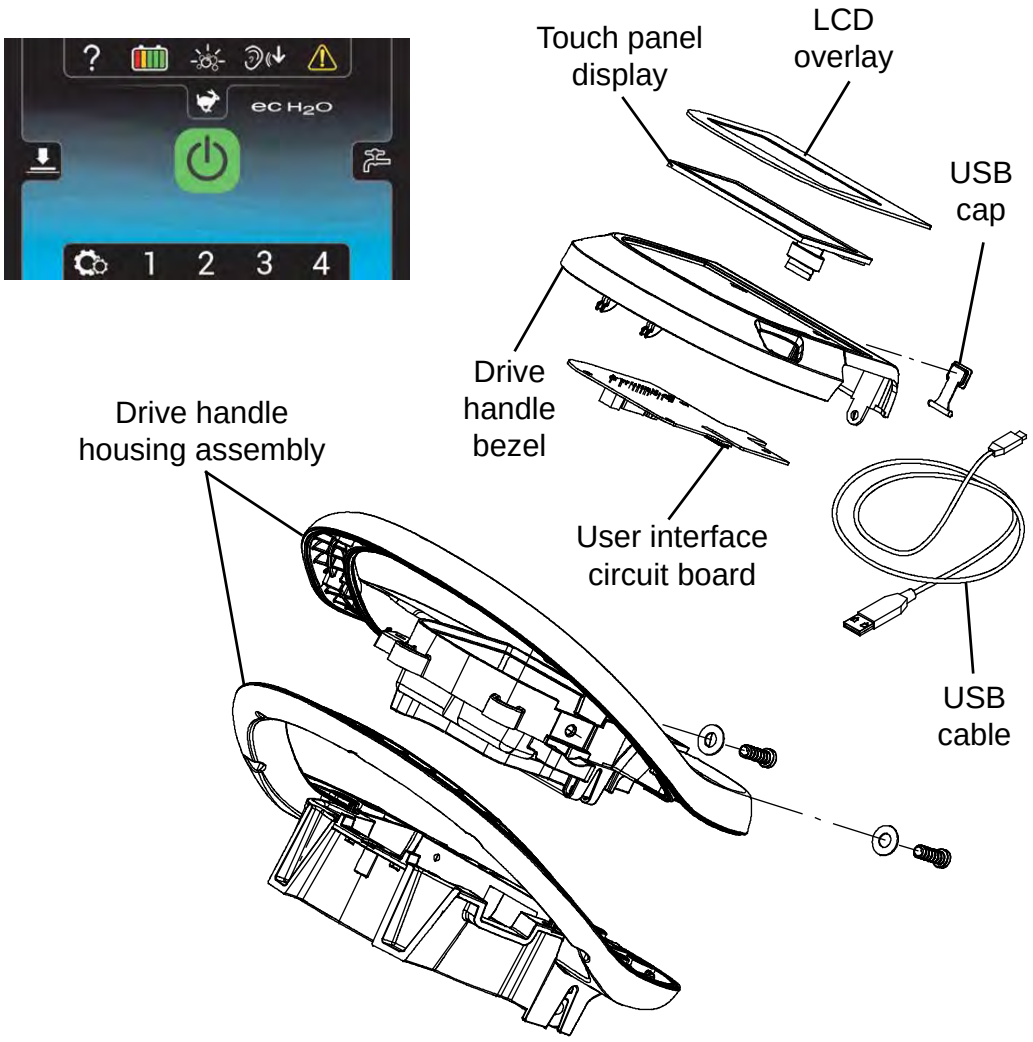
12. Connect the main wire harness to the new i-Drive module or relay.

13. If the electric mounting plate was removed to access the i-Drive or relay, place the electric mounting plate back into the machine and reconnect the main wire harness to all components on the electric mounting plate.

14. Reassemble items removed to access/replace the i-Drive module or relay back onto the machine in the reverse order of disassembly.

15. Program the machine for the new i-Drive module. See PROGRAMMING THE i-DRIVE MODULE.

REMOVING/REPLACING THE PRO-PANEL (T600) CONTROL PANEL/CONTROL BOARD



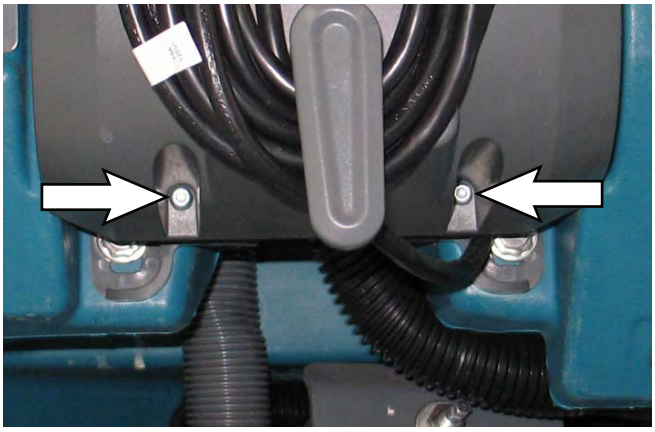
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

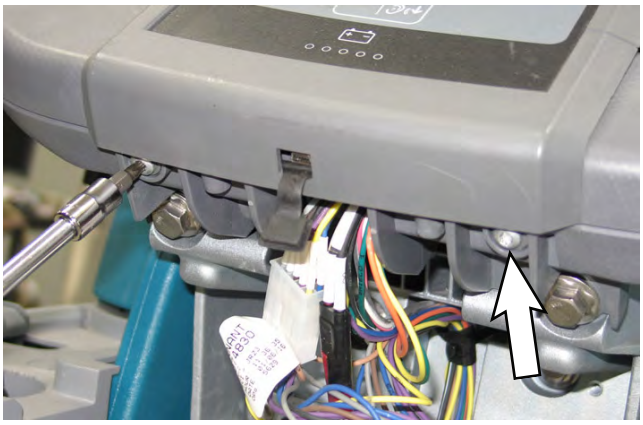
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

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.

3. Remove the hardware securing the control column cover to the machine, remove the on-board battery charger cable from the cord hooks (if machine is equipped with on-board battery charger), and carefully lower the control column cover.



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

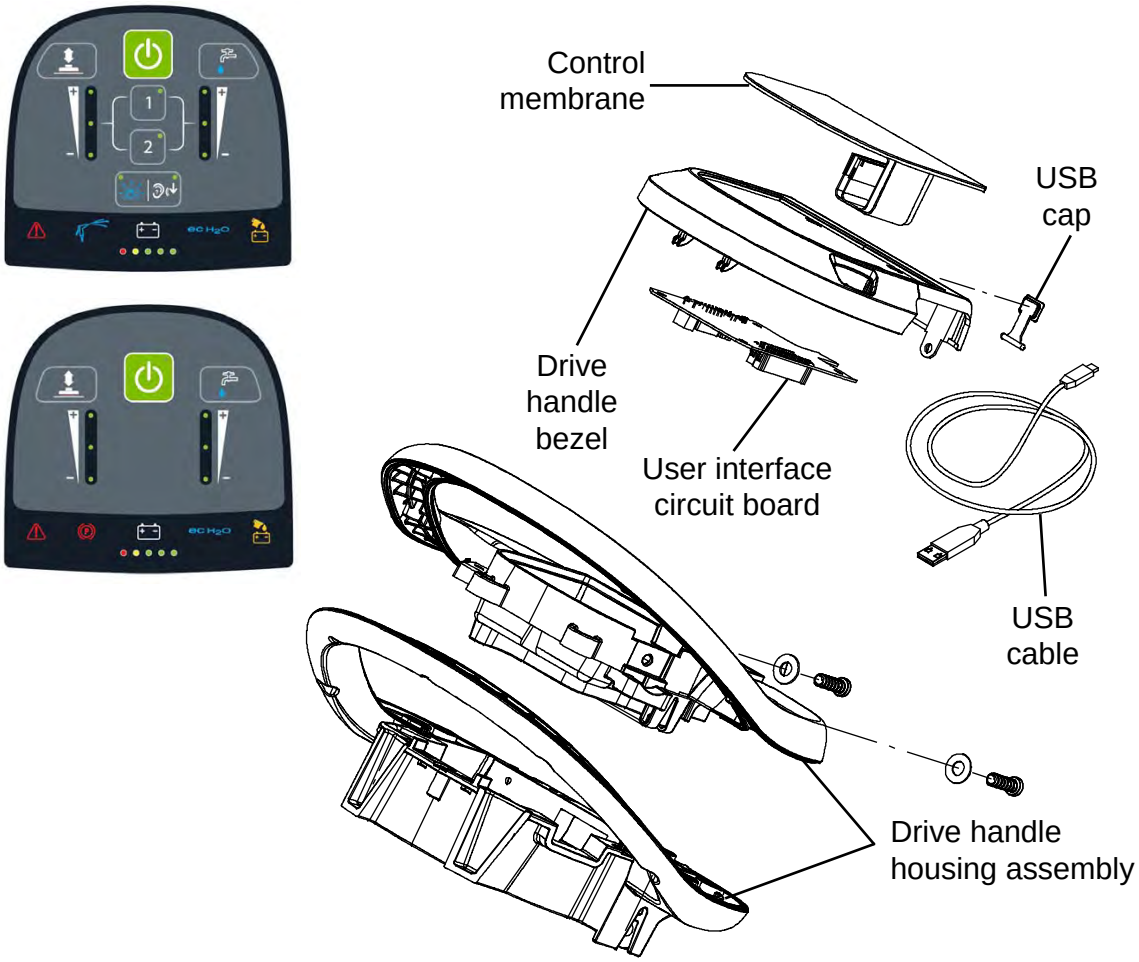


5. Carefully separate the touch panel from the console.

6. Disconnect the main wire harness connections from the circuit board located behind the control panel.

7. Remove the circuit board from the control panel.
8. Reinstall the removed circuit board install the new circuit board in reverse order of disassembly.
9. If a new control board is installed, the new control board must be programmed for the machine onto which it was installed. See PROGRAMMING A NEW INTERFACE MODULE.

REMOVING/INSTALLING THE MEMBRANE (T600e) AND PRO-MEMBRANE (T600) CONTROL PANELS



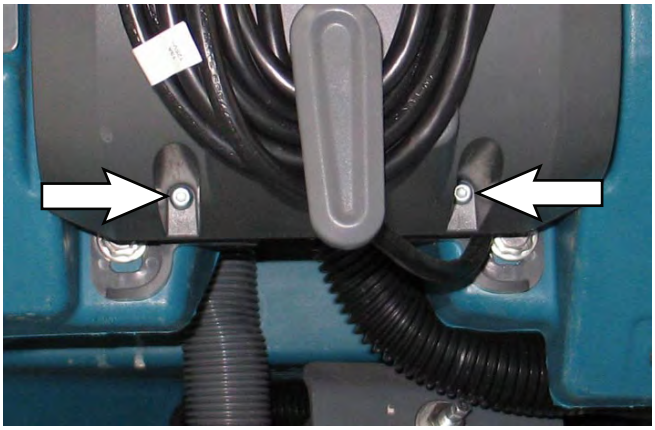
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

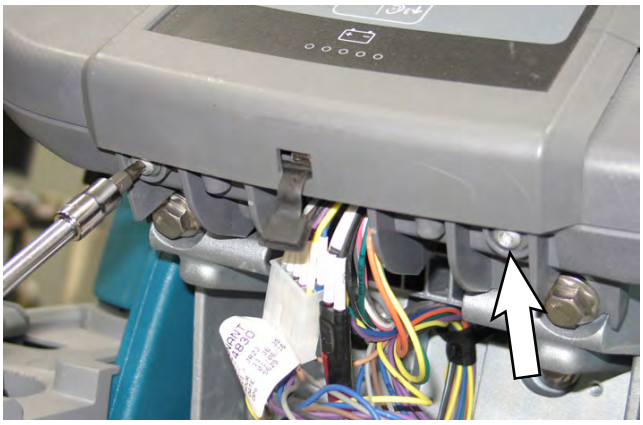
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

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.

3. Remove the hardware securing the control column cover to the machine, remove the on-board battery charger cable from the cord hooks (if machine is equipped with on-board battery charger), and carefully lower the control column cover.



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

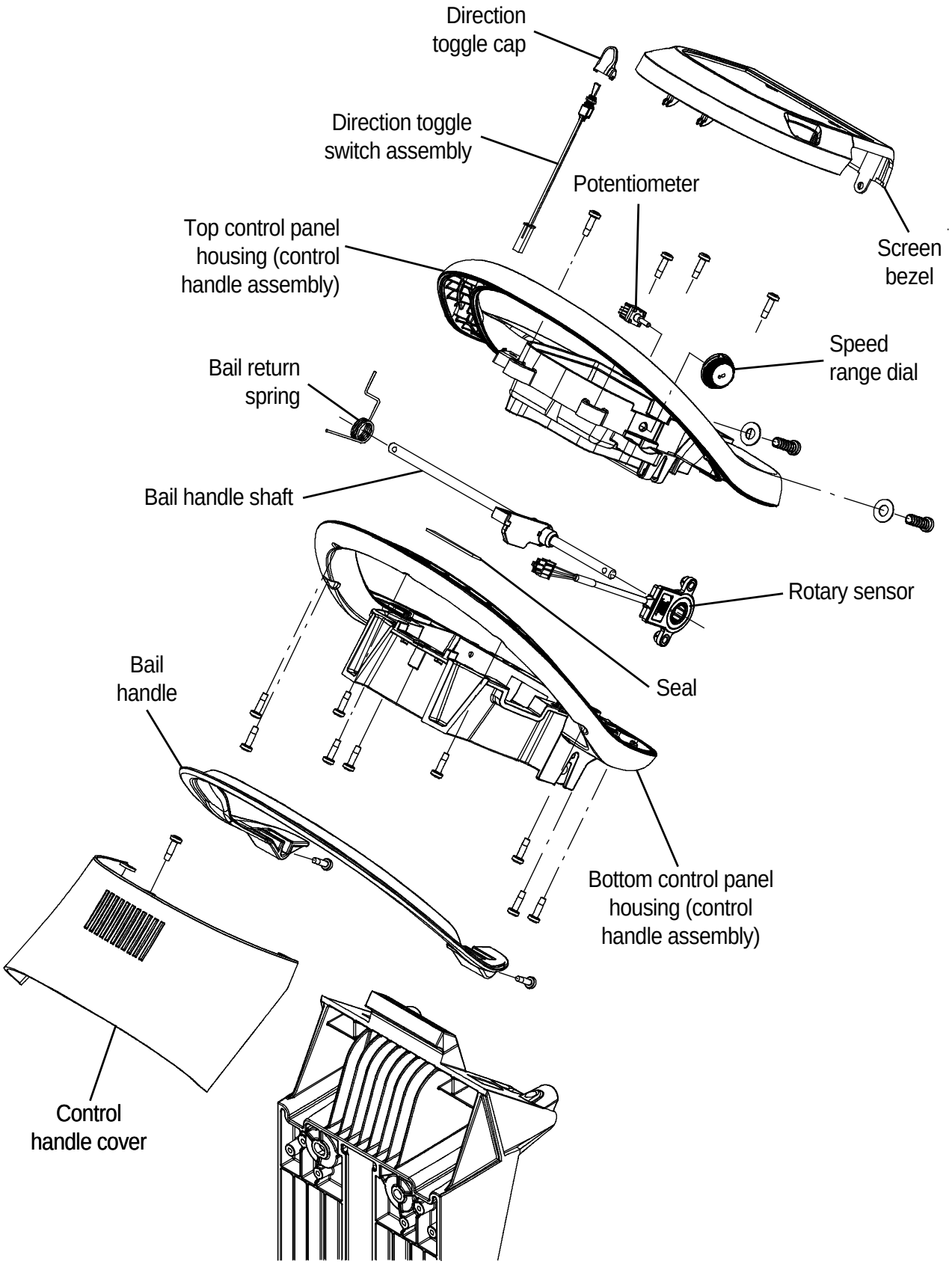


5. Carefully separate the touch panel from the console.

6. Disconnect the main wire harness connections from the circuit board located behind the control panel.

7. Remove the circuit board from the control panel.
8. Reinstall the removed circuit board install the new circuit board in reverse order of disassembly.
9. If a new control board is installed, the new control board must be programmed for the machine onto which it was installed. See PROGRAMMING A NEW INTERFACE MODULE.

DISASSEMBLING THE CONTROL HANDLE ASSEMBLY

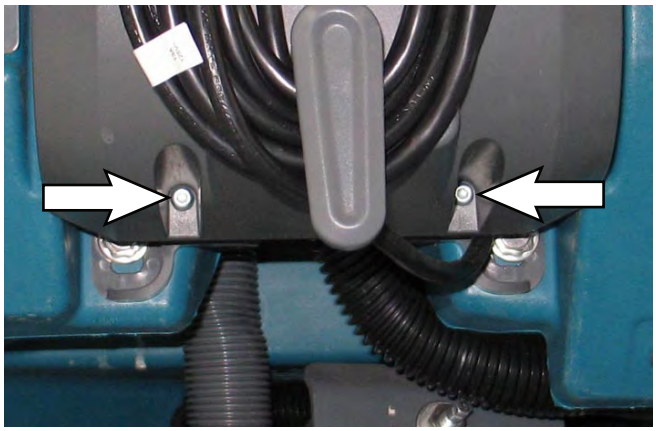


FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

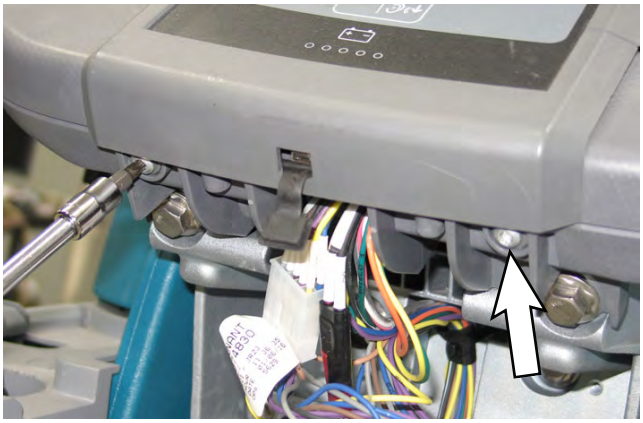
1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

3. Remove the hardware securing the control column cover to the machine, remove the on-board battery charger cable from the cord hooks (if machine is equipped with on-board battery charger), and carefully lower the control column cover.



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



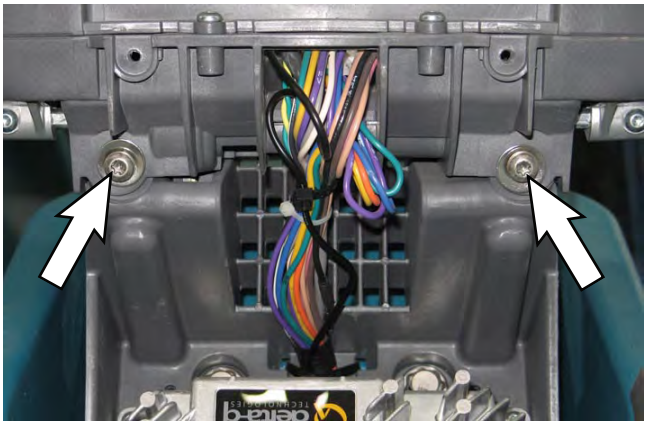
5. Carefully separate the touch panel from the console.

6. If replacing/removing the speed range potentiometer, see REMOVING/INSTALLING THE SPEED RANGE POTENTIOMETER.
7. If replacing/removing the direction switch, see REMOVING/INSTALLING THE DIRECTION SWITCH.
8. Remove the cover from the console.

9. Disconnect the main wire harness connections from the circuit board located behind the control panel.

10. Disconnect the main wire harness from the speed control potentiometer and the direction switch.

11. Remove the hardware securing the control panel housing assembly to the machine.

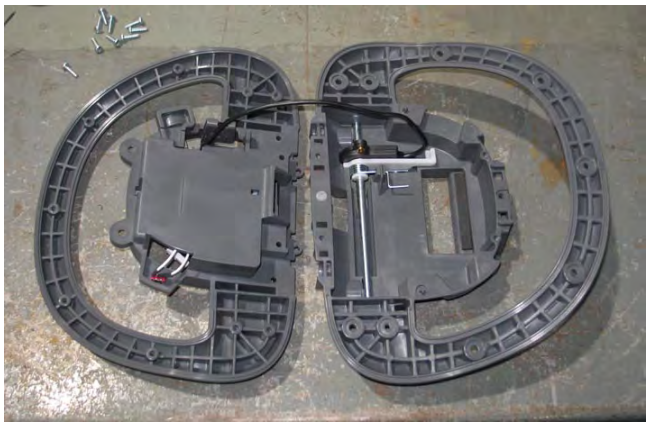


12. Lift up and forward to remove the operator console from the machine.

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

14. Remove the self tap screws from the front and rear of the operator console.

15. Separate the top control panel housing from the bottom control panel housing.



16. If replacing/removing the bail switch, see REMOVING/INSTALLING THE BAIL SWITCH.

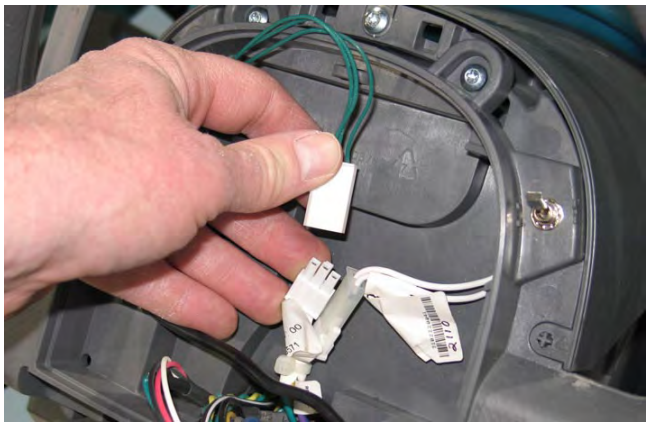
17. Reassemble the control handle assembly in reverse of disassembly.

REMOVING/INSTALLING THE SPEED RANGE POTENTIOMETER

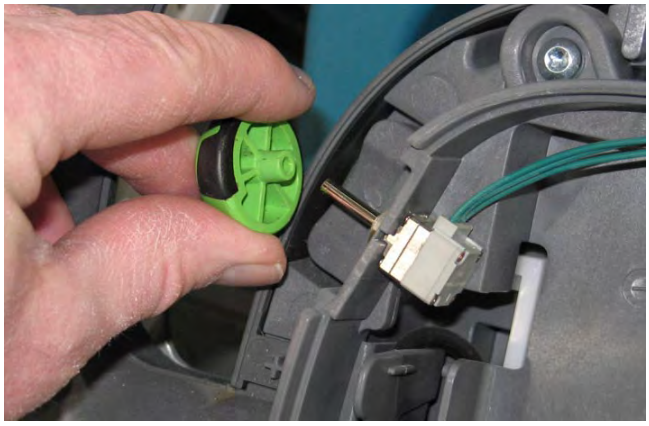
1. Disassemble the control panel housing assembly. See DISASSEMBLING THE CONTROL HANDLE ASSEMBLY.

2. Cut the cable tie securing the speed range potentiometer wires to the top control panel housing.

1. Disconnect the main wire harness from the speed range potentiometer.



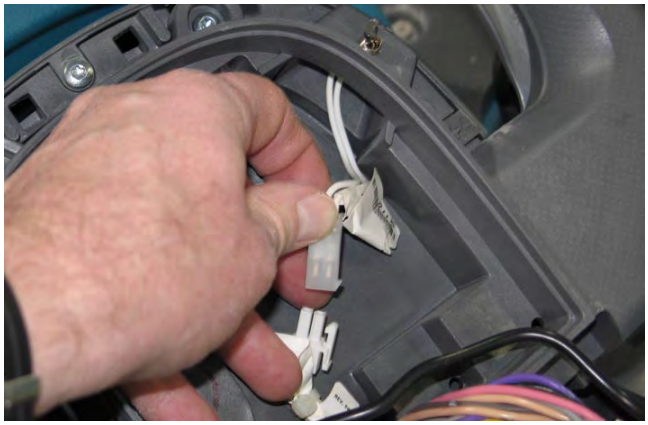
3. Remove the knob from the speed range potentiometer, remove the hardware securing the potentiometer to the top control panel housing, and remove the potentiometer from the top control panel housing.



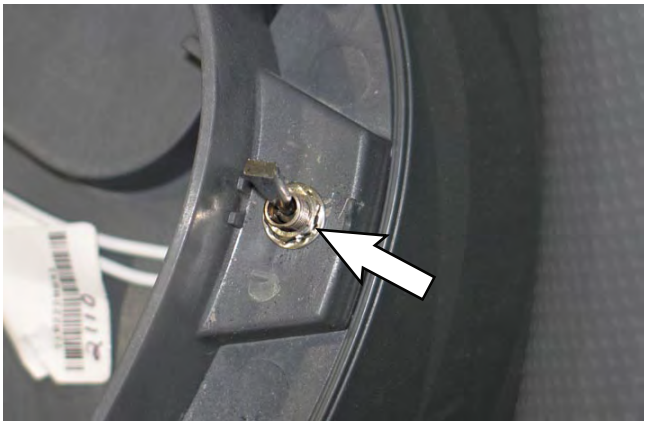
4. Reinstall speed range potentiometer and reassemble the control handle assembly in reverse order of disassembly if only replacing the speed range potentiometer.

REMOVING/INSTALLING THE DIRECTION SWITCH

1. Disassemble the control handle assembly. See DISASSEMBLING THE CONTROL HANDLE ASSEMBLY.
2. Disconnect the main wire harness from the direction switch.



3. Remove the knob from the direction switch, remove the hardware securing the switch to the top control panel housing, and remove the switch from the top control panel housing.



4. Reinstall the direction switch and reassemble the control handle assembly in reverse order of disassembly if only replacing the direction switch.

REMOVING/INSTALLING THE BAIL SWITCH

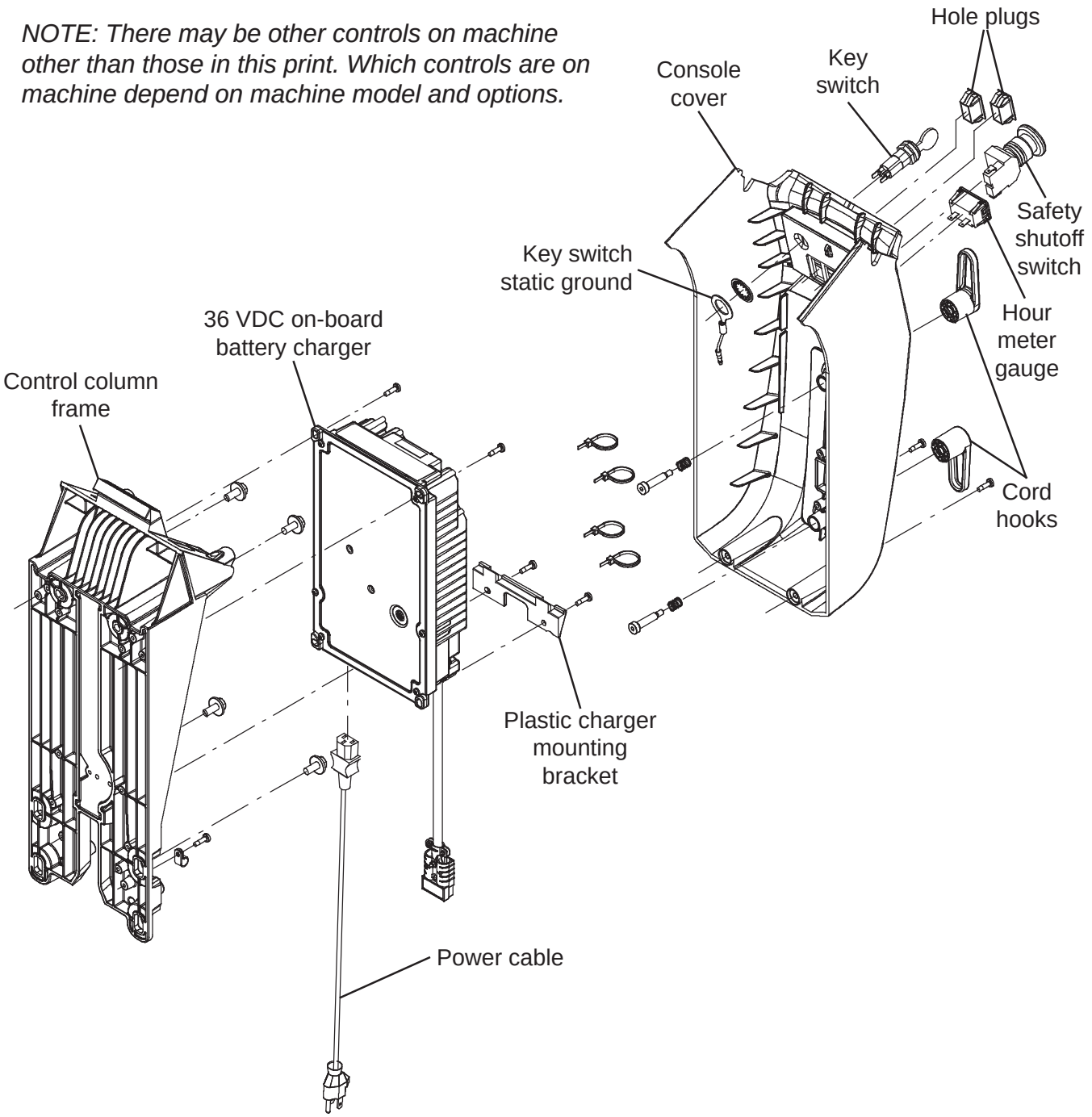
1. Disassemble the control handle assembly. See DISASSEMBLING THE CONTROL HANDLE ASSEMBLY.

2. Release the bail return spring, rotate the bail handle shaft toward the bottom of the bottom control panel housing, and slide the bail handle shaft to the side to remove the shaft and rotary sensor from the bottom control panel housing.

3. Replace/reinstall the bail switch and reassemble the control handle assembly in reverse order of disassembly.

REMOVING/REPLACING/INSTALLING THE CONTROLS LOCATED ON THE LOWER CONSOLE

NOTE: There may be other controls on machine other than those in this print. Which controls are on machine depend on machine model and options.

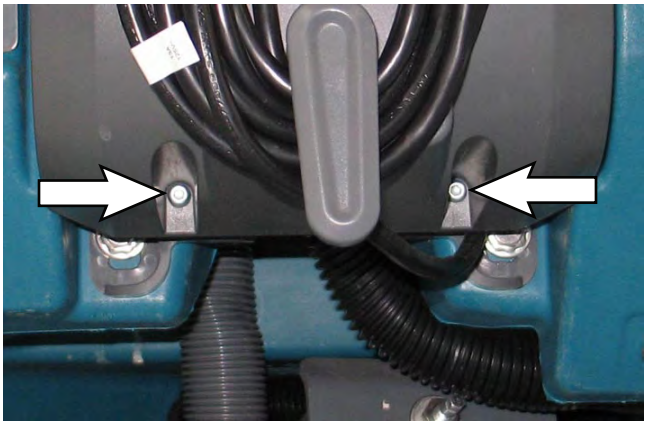


FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

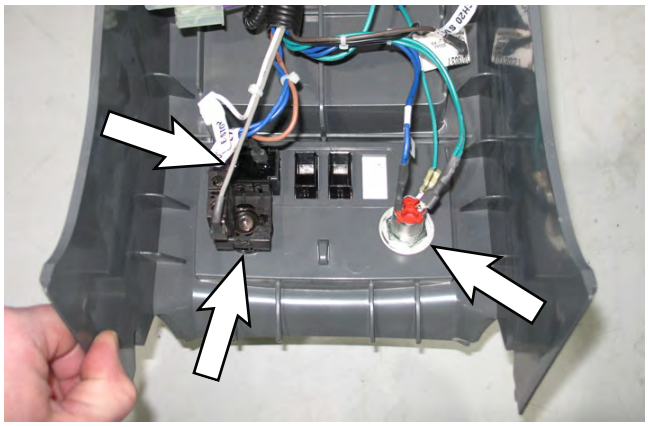
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

3. Remove the hardware securing the control column cover to the machine, remove the on-board battery charger cable from the cord hooks (if machine is equipped with on-board battery charger), and carefully lower the control column cover.

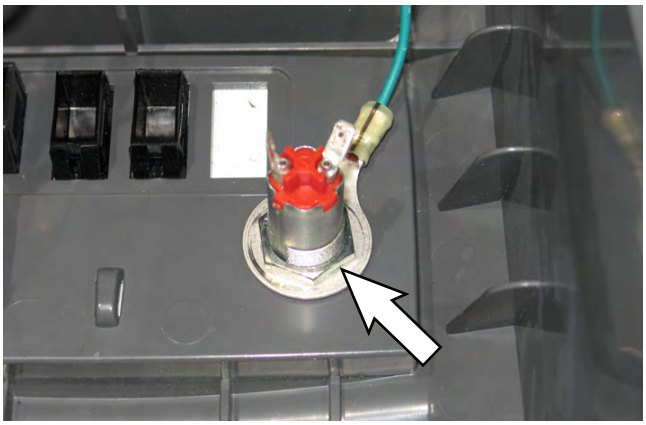


4. Disconnect the main wire harness from the control(s) being removed/replaced.

NOTE: There may be other controls on the machine other than those in the photographs below. The controls on the machine depend on the machine model and options.



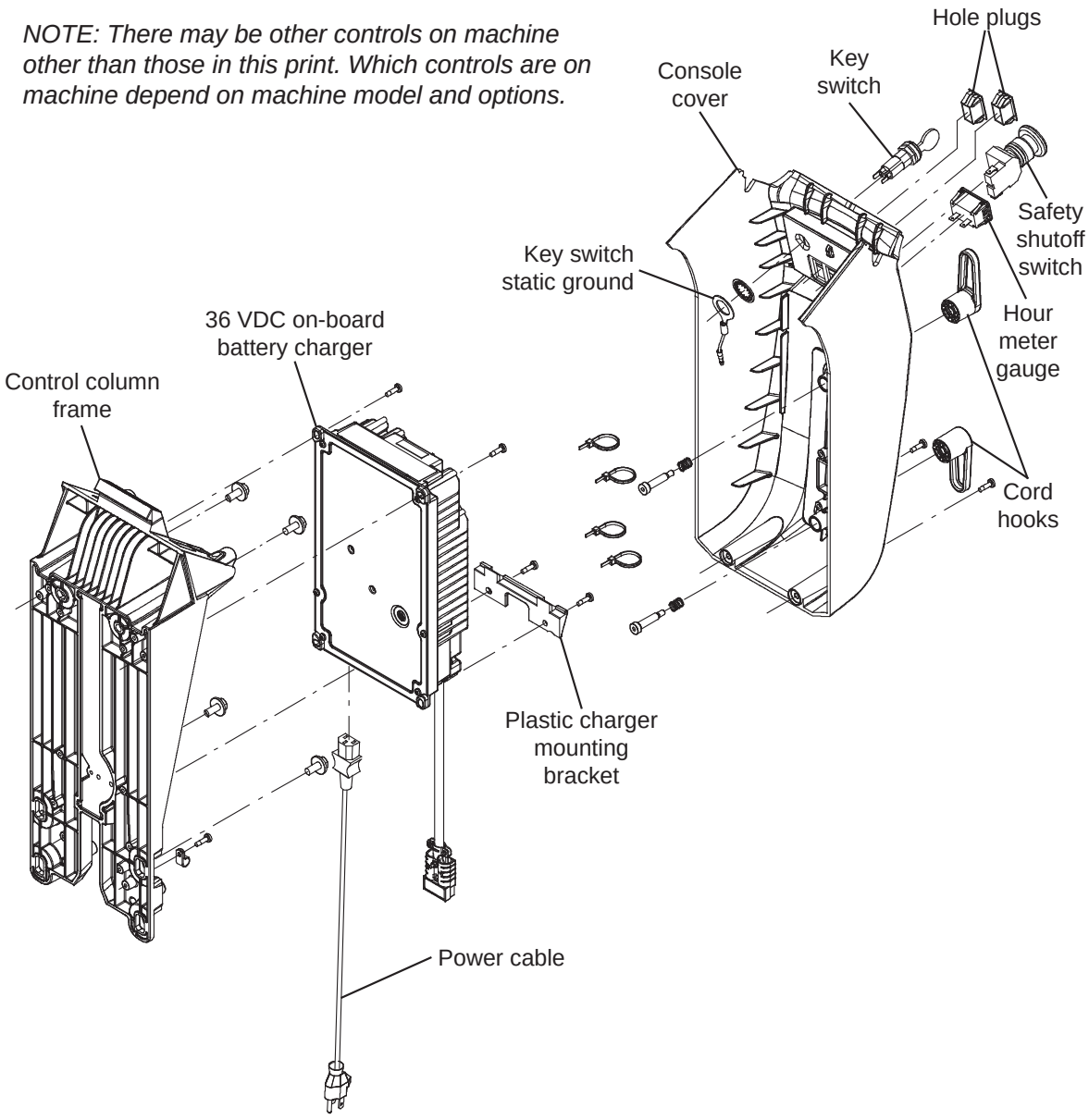
5. Remove the control(s) from the lower console.



6. Install the new control(s) into the console.
7. Connect the main wire harness to the new control(s).
8. Reassemble the lower console onto the machine.
9. If the machine is equipped with an on-board battery charger, reinstall the battery charger cable onto the cord hooks.

REMOVING/INSTALLING THE ON-BOARD BATTERY CHARGER

NOTE: There may be other controls on machine other than those in this print. Which controls are on machine depend on machine model and options.



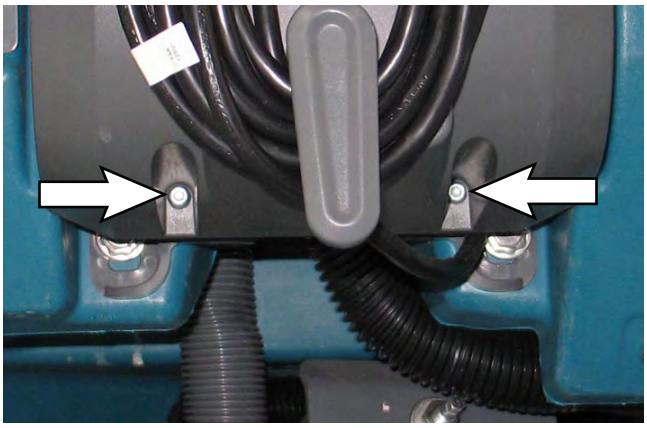
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

10. Turn the key switch OFF

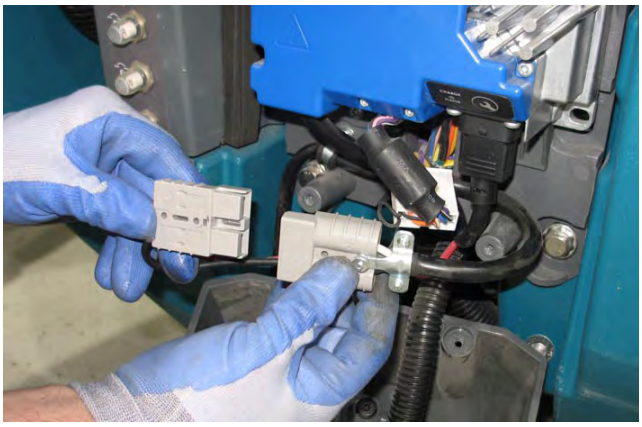
11. Disconnect the battery cable from the machine.

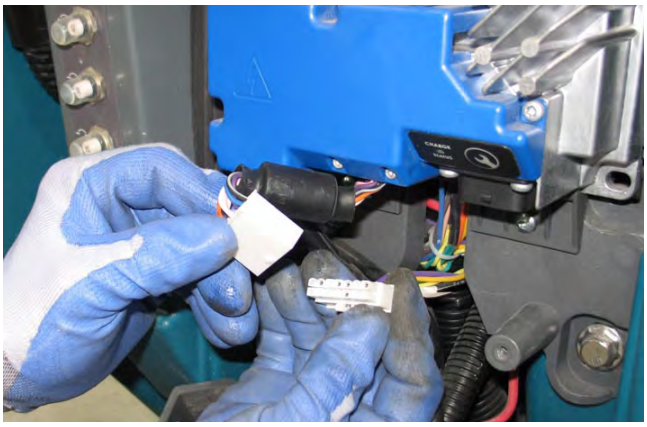
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

12. Remove the hardware securing the control column cover to the machine, remove the on-board battery charger cable from the cord hooks (if machine is equipped with on-board battery charger), and carefully lower the control column cover.

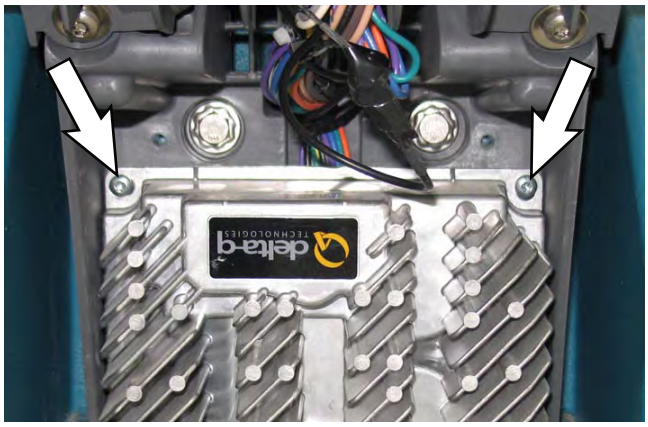


13. Disconnect the cables from the on-board battery charger.





14. Remove the hardware securing the top of the on-board battery charger to the machine.



15. Carefully lower the on-board battery charger from the machine.

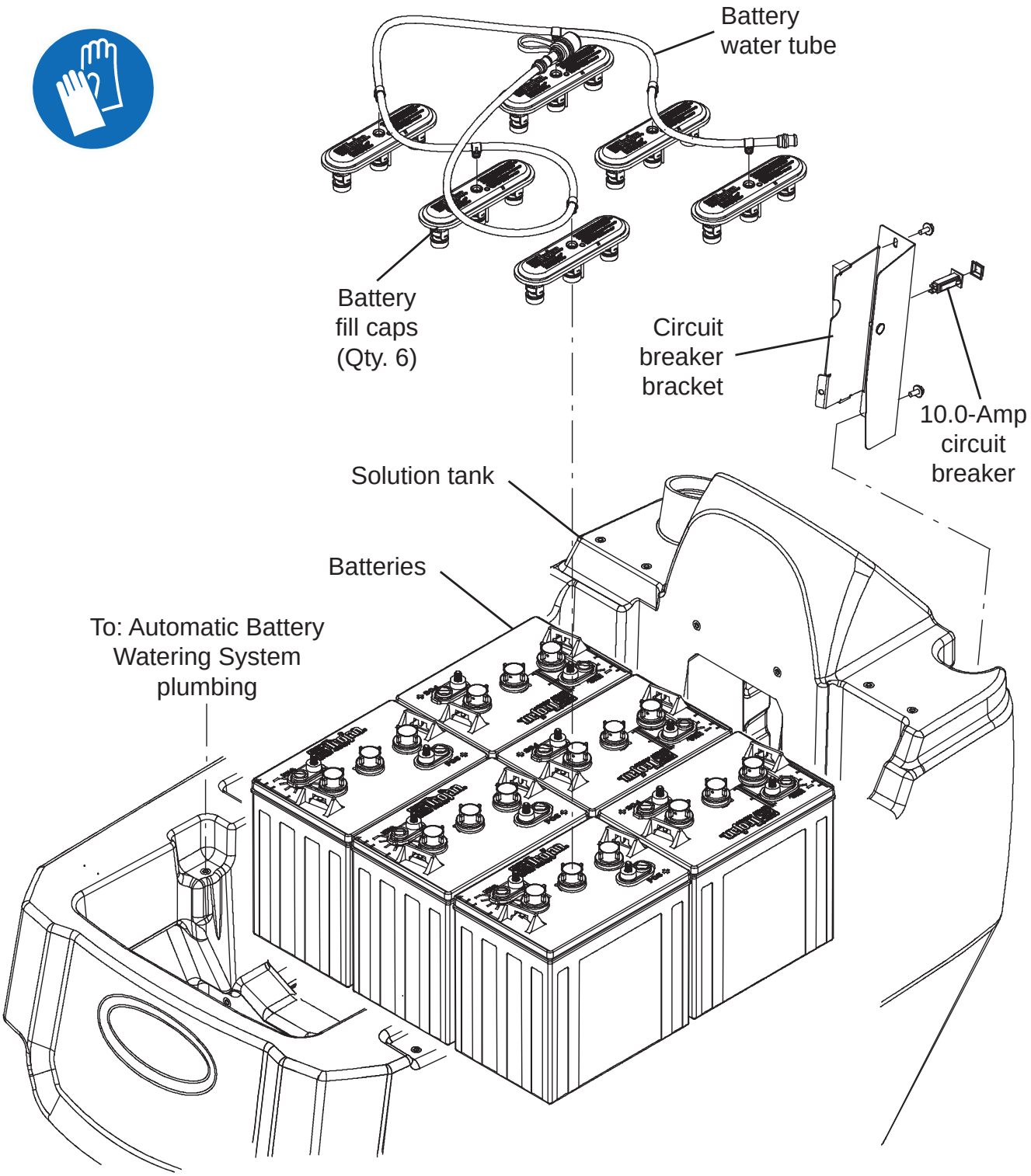
16. Reinstall the on-board battery/install the new onboard battery in reverse order of disassembly.

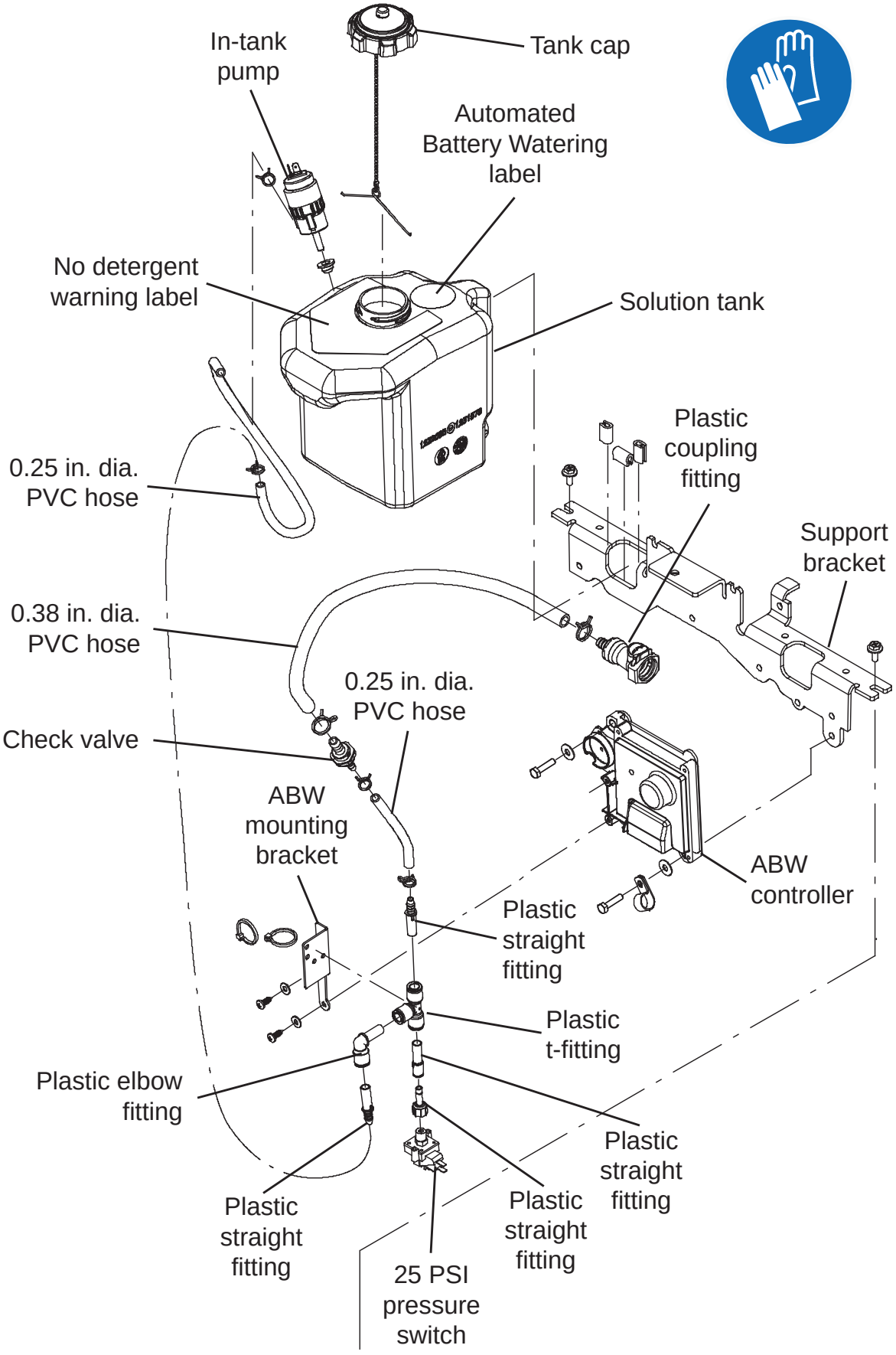
NOTE: The on-board charger can be programmed for multiple battery configurations. This configuration data is stored in the interface module and will automatically configure a replacement battery charger once installed and following a power-up cycle. Reprogramming is required if the interface module has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

Models equipped with the PRO-Panel LCD Touch Panel can be configured through the touch panel. All other models must be configured through separate configuration software via a mini-USB programming port on the back of the operator console. (See SERVICE DIAGNOSTICS TOOL)

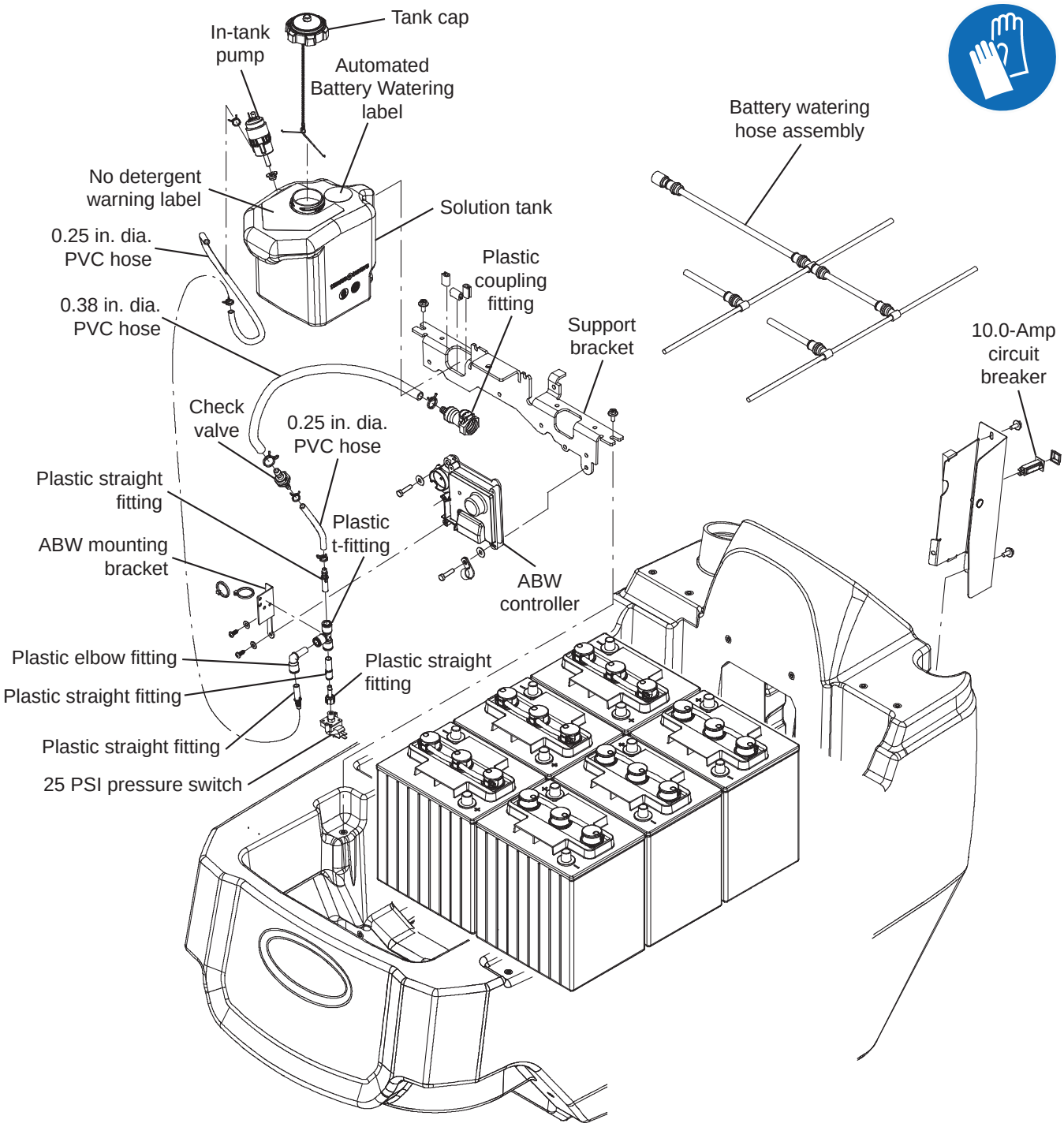
OPTIONS

SMART-FILL ABW (AUTOMATIC BATTERY WATERING) SYSTEM (OPTION)




In-tank pump
Tank cap
Automated Battery Watering label
No detergent warning label
Solution tank
Plastic coupling fitting
0.25 in. dia. PVC hose
Support bracket
0.38 in. dia. PVC hose
0.25 in. dia. PVC hose
Check valve
ABW mounting bracket
ABW controller
Plastic straight fitting
Plastic t-fitting
Plastic elbow fitting
Plastic straight fitting
Plastic straight fitting
Plastic straight fitting
25 PSI pressure switch

TAB ABW (AUTOMATIC BATTERY WATERING) SYSTEM (OPTION) - EMEA MACHINES ONLY



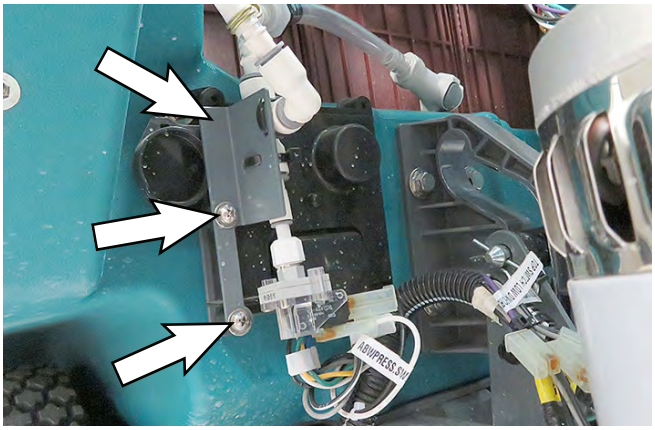
REPLACING THE SMART-FILL ABW (AUTOMATIC BATTERY WATERING) CONTROLLER

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

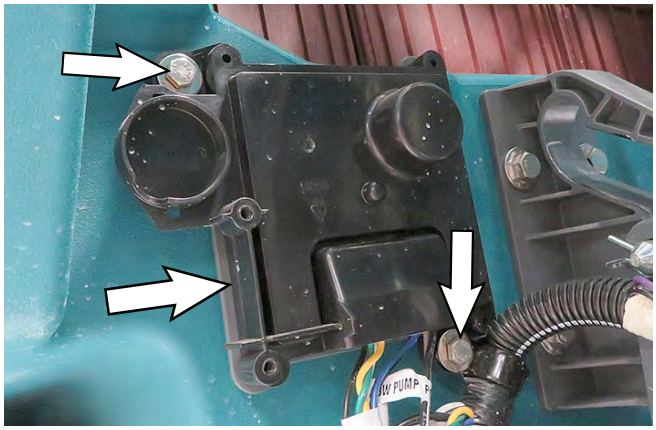
1. Completely empty the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

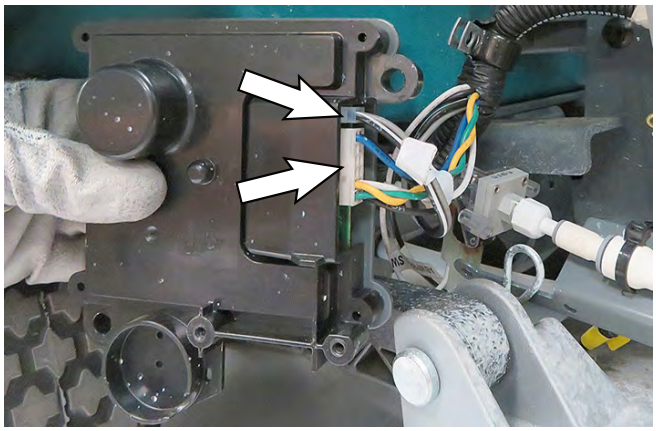
4. Remove the front scrub head cover from the machine.
5. Remove the solution hose bracket from the ABW controller.



6. Remove the ABW controller from the machine.



7. Disconnect the main wire harness connections from the automatic battery watering controller.



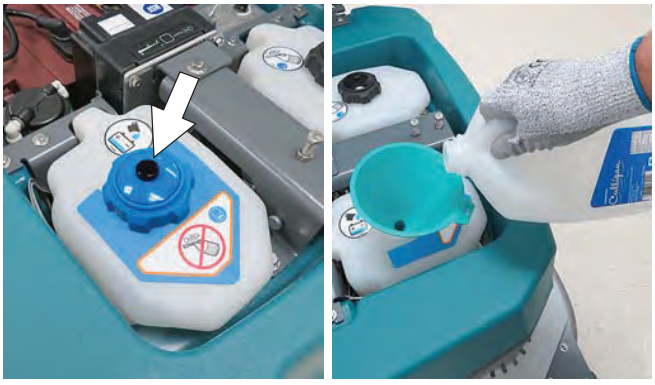
8. Reinstall the ABW controller/install the new automatic battery watering controller in the reverse order of disassembly.

ABW PUMP IS TIMING OUT (1 MINUTE)

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

9. Turn the key switch OFF.
10. Check for water/electrolyte residue on top of batteries and in the battery tray.
11. 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.

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



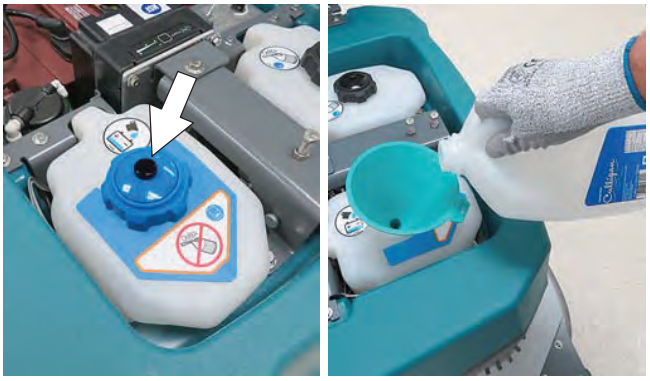
15. Turn the key switch ON.
16. Verify the ABW pump is functioning and the fault is cleared.

ABW OVERFILLS THE BATTERIES

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

1. Turn the key switch OFF.
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 switch ON.
8. Verify ABW pump is functioning properly and the fault is cleared.

REPLACING THE ABW IN TANK PUMP

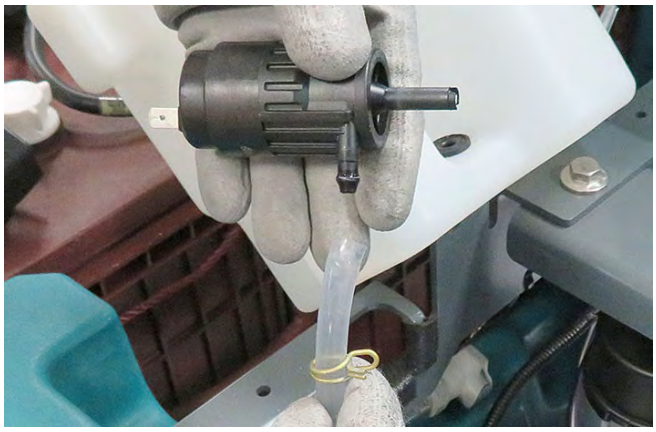
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Completely empty the ABW tank.

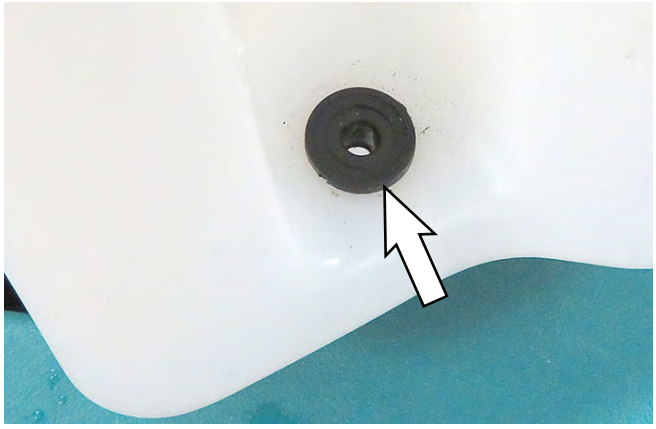
3. Carefully pull the ABW pump from the ABW tank.

4. Disconnect the main wire harness from the ABW pump.

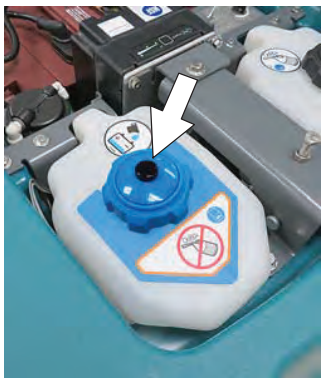
5. Disconnect the hose from the ABW pump.



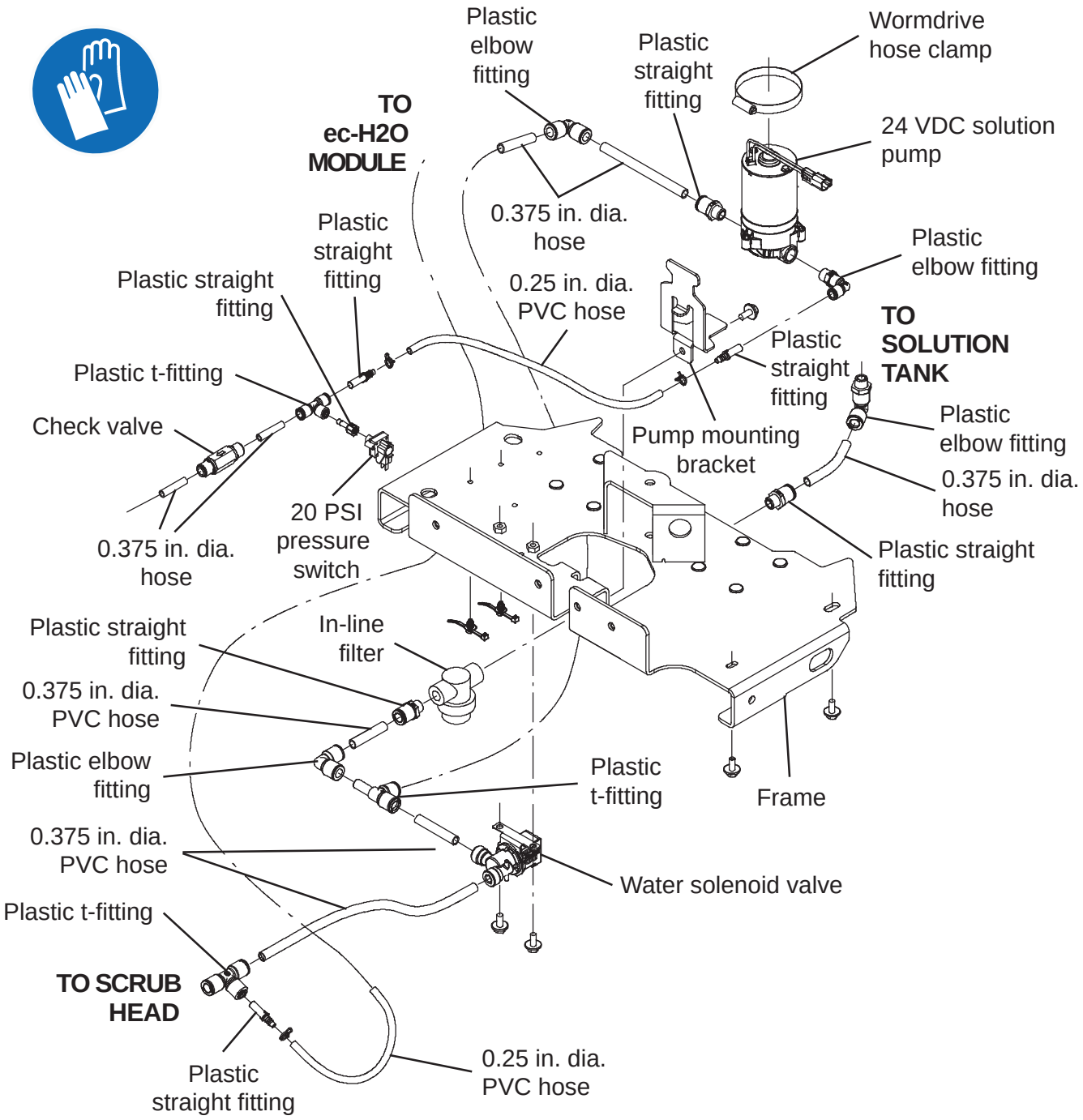
6. Remove the grommet form the ABW tank.



7. Reinstall the ABW pump/install the new ABW pump in reverse order of disassembly.
8. Add distilled water to the ABW system tank.



REMOVING/INSTALLING THE ec-H2O SOLUTION PUMP (OPTION)



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

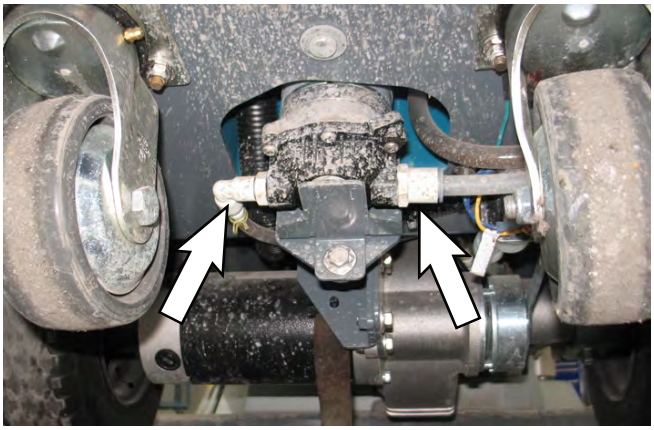
1. Completely empty the solution tank and the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

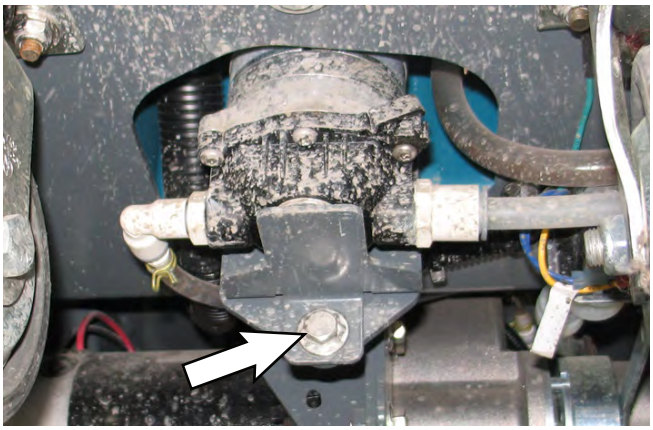
4. Jack up the back end of the machine until the machine is resting on the scrub head.

OR 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.

5. Position a jack stand/jack stands/block under the machine as necessary to keep the back end of the machine safely elevated from the floor.
6. Disconnect both solution hoses from the ec-H2O pump.



7. Remove the hardware securing the pumping mounting bracket to the frame of the machine.



8. Pull the ec-H2O pump and pump mounting bracket down from in the machine.
9. Disconnect the main wire harness from the ec-H2O pump.
10. Loosen the hose clamp securing the ec-H2O pump to the pump mounting bracket and remove the ec-H2O pump from the pump mounting bracket.
11. Reinstall the ec-H2O pump/install the new ec-H2O pump onto the pump mounting bracket and install the ec-H2O pump and pump mounting bracket into the machine in the reverse order of disassembly.
12. Lower the machine to the floor.

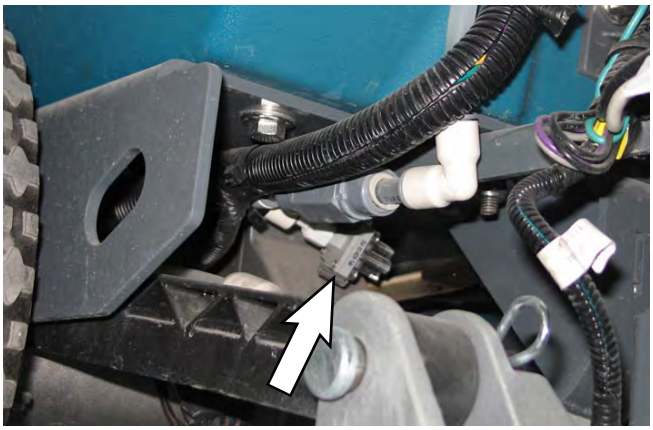
REMOVING/REPLACING/INSTALLING THE ec-H2O PRESSURE SWITCH (OPTION)

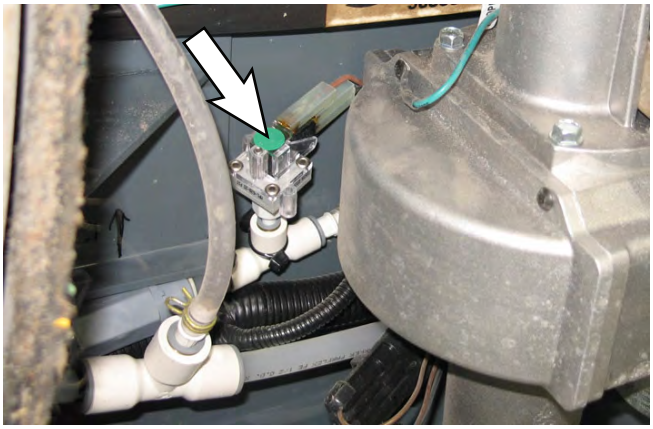
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Completely empty the solution tank and the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

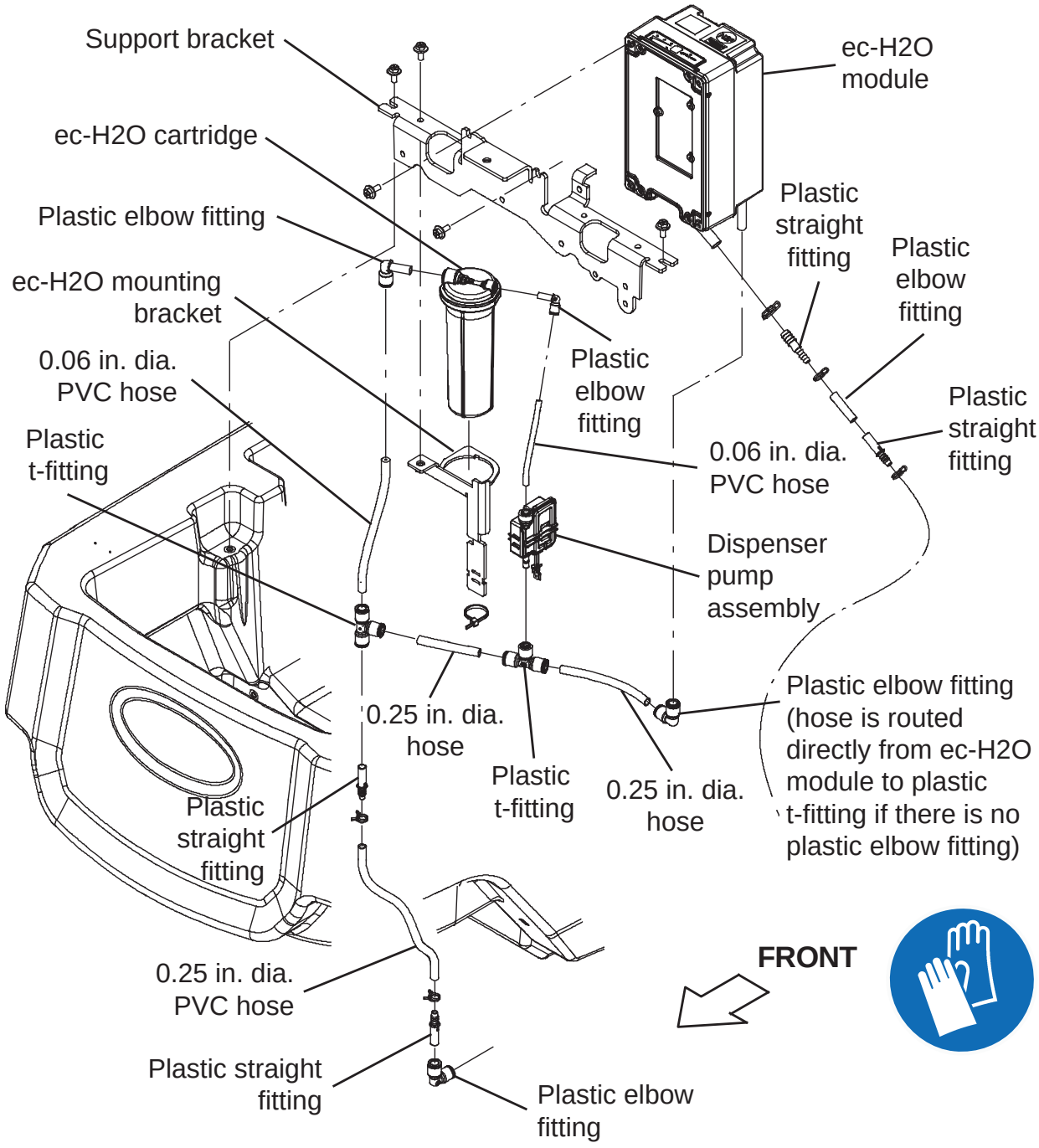
4. Remove the front scrub head cover from the machine.
5. If necessary to access/remove the pressure switch, remove the scrub head from the machine to make access to the pressure switch easier. See procedures for removing the various scrub heads in the SCRUBBING SYSTEMS section of this manual.
6. Disconnect the main wire harness from the pressure switch.





7. Remove the pressure switch from the t-fitting.
8. Reinstall removed pressure switch/install new pressure switch in reverse order of disassembly.

REMOVING/INSTALLING THE ec-H2O MODULE (OPTION)



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

1. Completely empty the solution tank and the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

4. Remove the front scrub head cover from the machine.
5. Remove the hardware securing the ec-H2O module to the support bracket.

6. Disconnect all main wire harness connection from the ec-H2O module.
7. Disconnect all solution hoses from the ec-H2O module.
8. Carefully remove the ec-H2O module from the machine.
9. Reinstall removed ec-H2O module/install new ec-H2O module in the reverse order of disassembly.

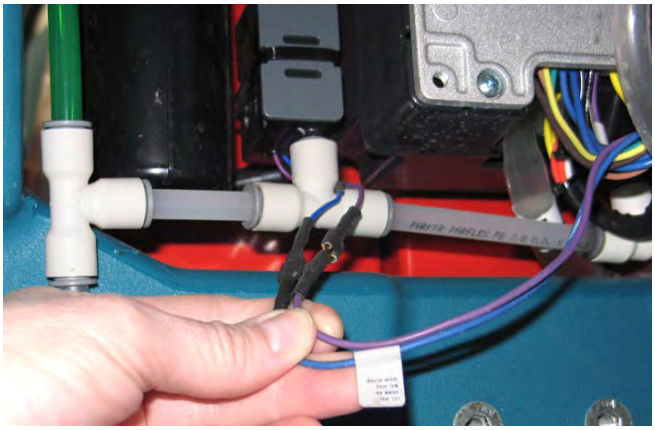
REMOVING/INSTALLING THE ec-H2O DISPENSER PUMP (OPTION)

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

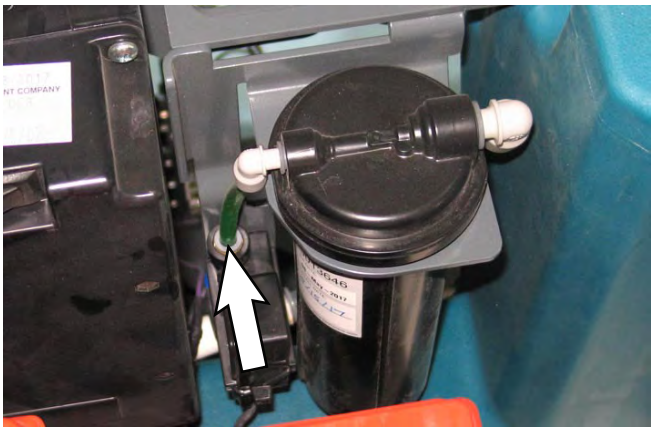
1. Completely empty the solution tank and the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

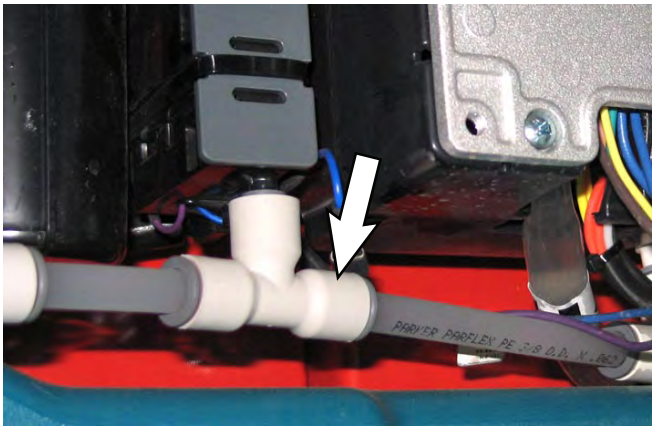
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

4. Remove the front scrub head cover from the machine.
5. Disconnect the main wire harness from the ec-H2O dispenser pump.

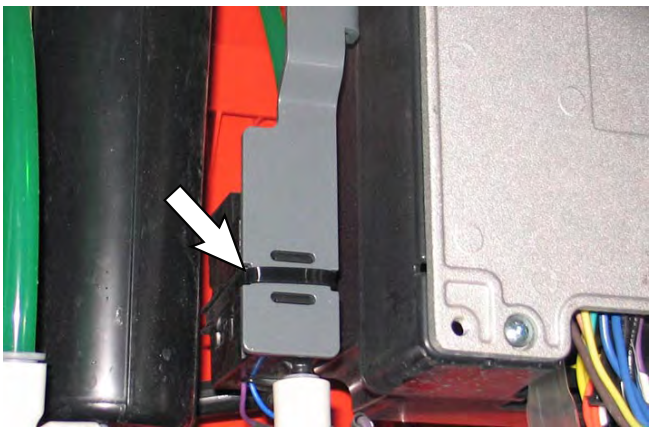


6. Disconnect hose from both the inlet port and the t-fitting from the outlet port on the ec-H2O dispenser pump.





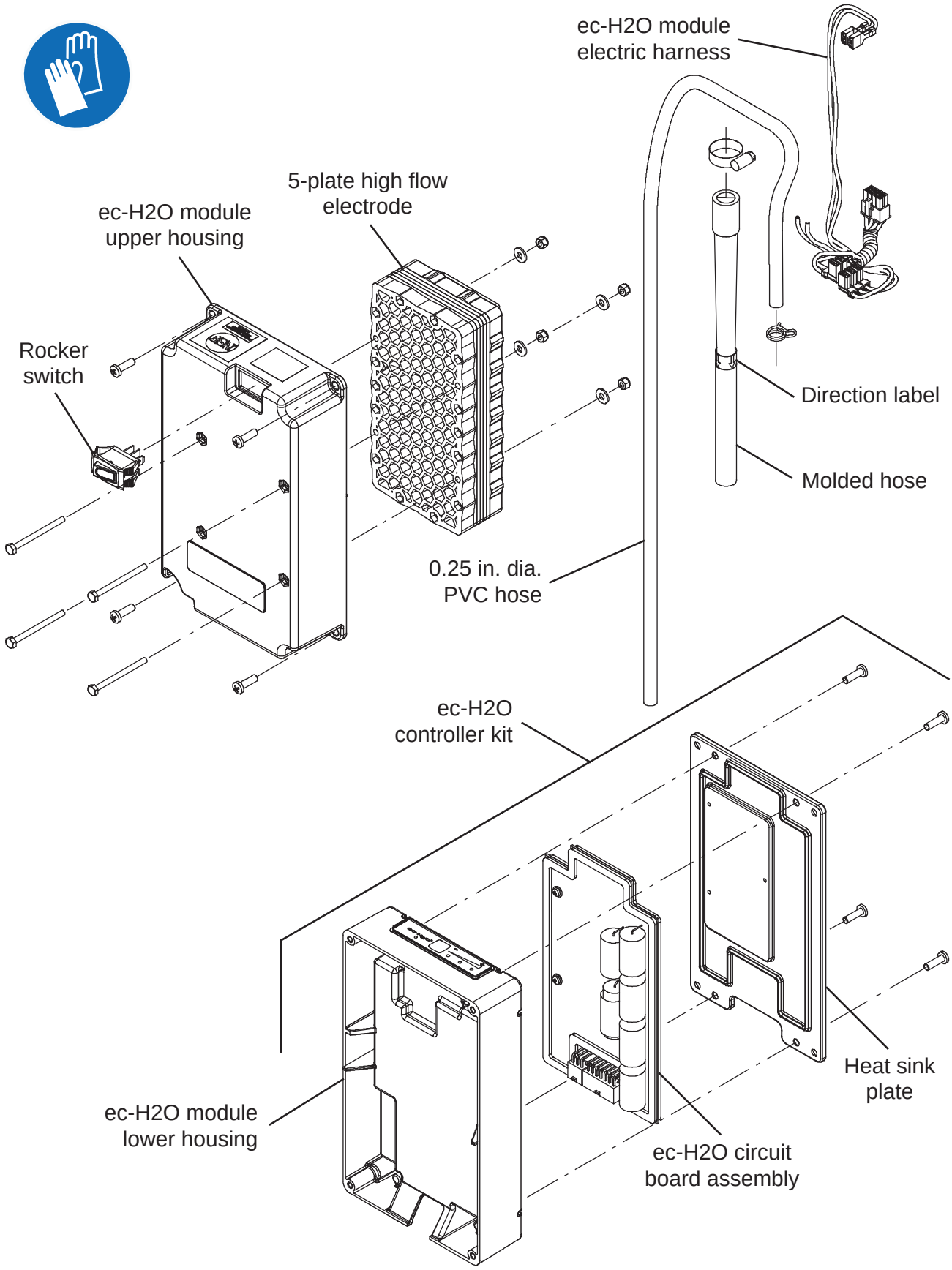
7. Cut the cable tie securing the ec-H2O dispenser pump to the ec-H2O mounting plate and remove the ec-H2O dispensing pump from the machine.



8. Remove the ec-H2O dispensing pump from the machine.

9. Reinstall the ec-H2O dispenser pump/install the new ec-H2O dispenser pump in reverse order of disassembly.

SERVICING THE ec-H2O MODULE (OPTION)



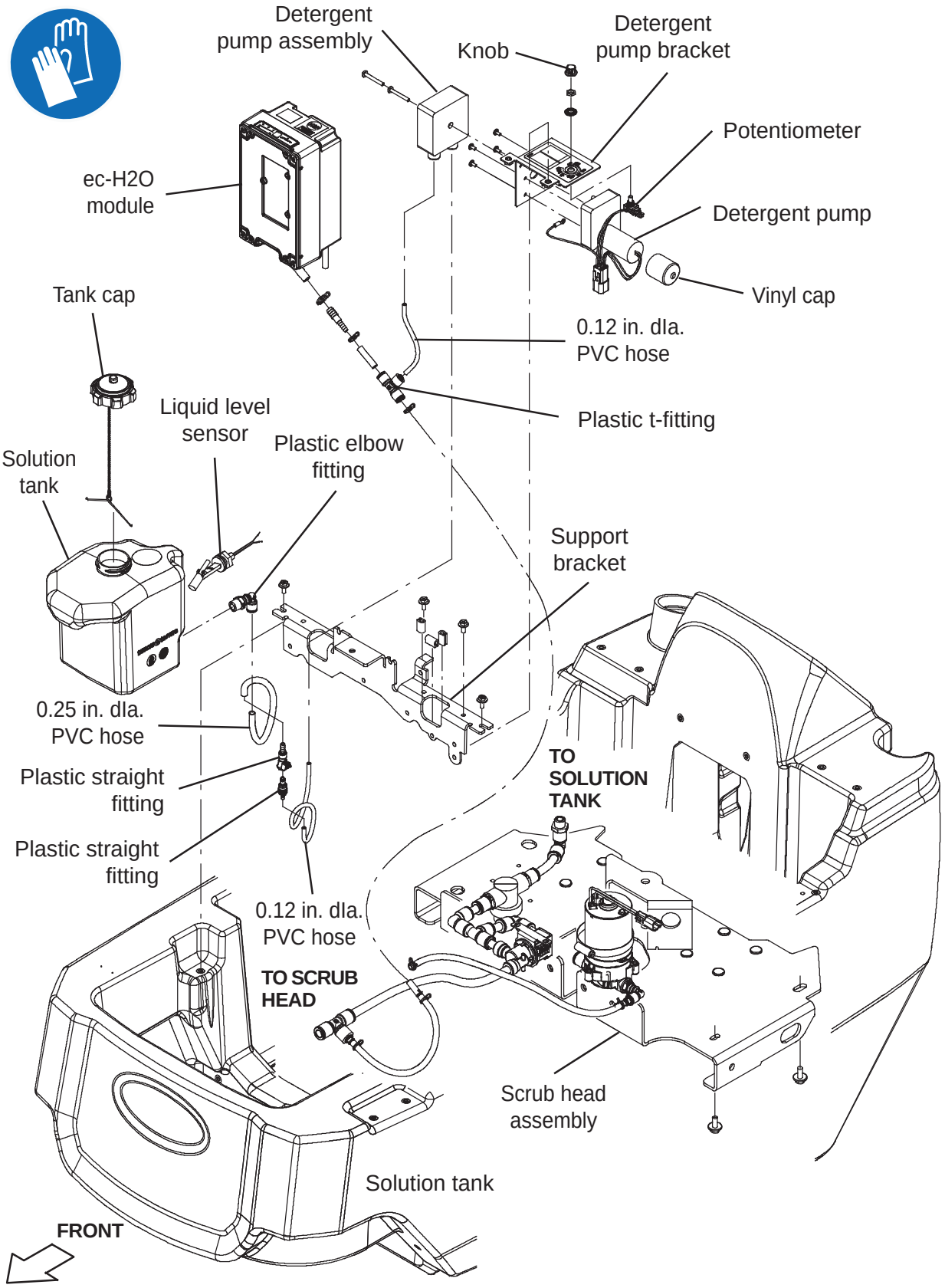
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.

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

3. Remove the ec-H2O module from the machine. See REMOVING/INSTALLING THE ec-H2O MODULE (OPTION).
4. Remove the ec-H2O upper module housing from the ec-H2O module.
5. Further disassemble the ec-H2O module as necessary to access and replace parts.
6. Reassemble the ec-H2O module in the reverse order of disassembly.
7. Reinstall the ec-H2O module onto the machine. See REMOVING/INSTALLING THE ec-H2O MODULE (OPTION).

SE (SEVERE ENVIRONMENT) GROUP MAINTENANCE (OPTION)



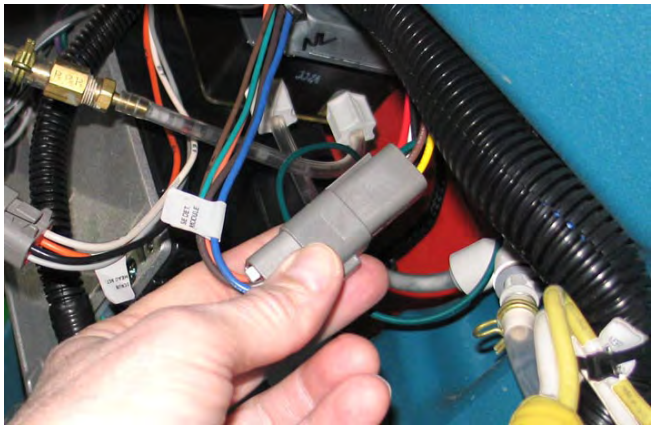
REMOVING/INSTALLING THE DETERGENT PUMP ASSEMBLY

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

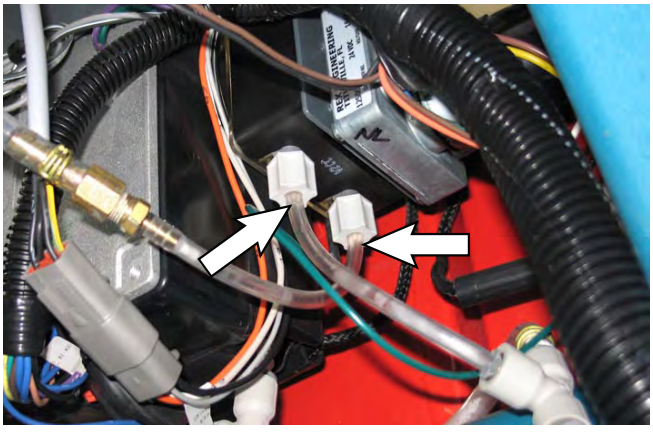
1. Completely empty the solution tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

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

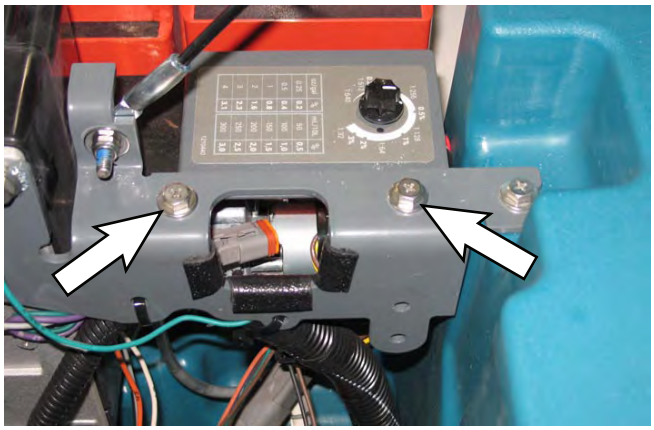
4. Remove the front scrub head cover from the machine.
5. Completely empty all solution from the Severe Environment tank.
6. Disconnect the main wire harness from the detergent metering assembly.



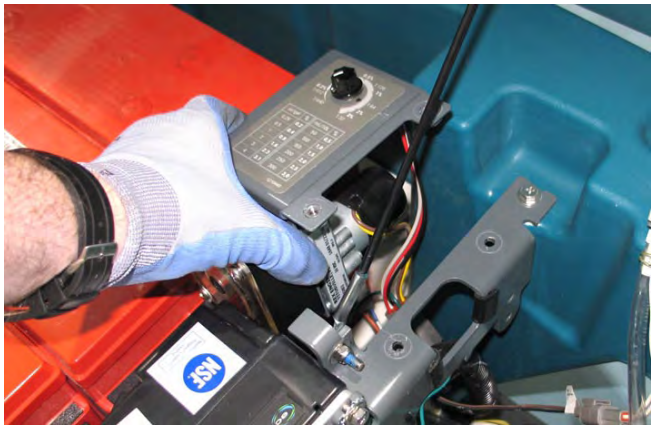
7. Disconnect the solution hoses from the detergent pump assembly IN and OUT ports.



8. Remove the hardware securing the detergent pump assembly to the support bracket.



9. Carefully pull the detergent pump assembly out from the support bracket.



10. Disassemble the detergent pump assembly as necessary to service and/or replace parts.

11. Reassemble the detergent pump assembly in reverse order of disassembly.
12. Reinstall the detergent pump assembly onto the machine in reverse order of disassembly.

REMOVING/INSTALLING THE DETERGENT METERING LIQUID LEVEL SENSOR

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

1. Completely empty the solution tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

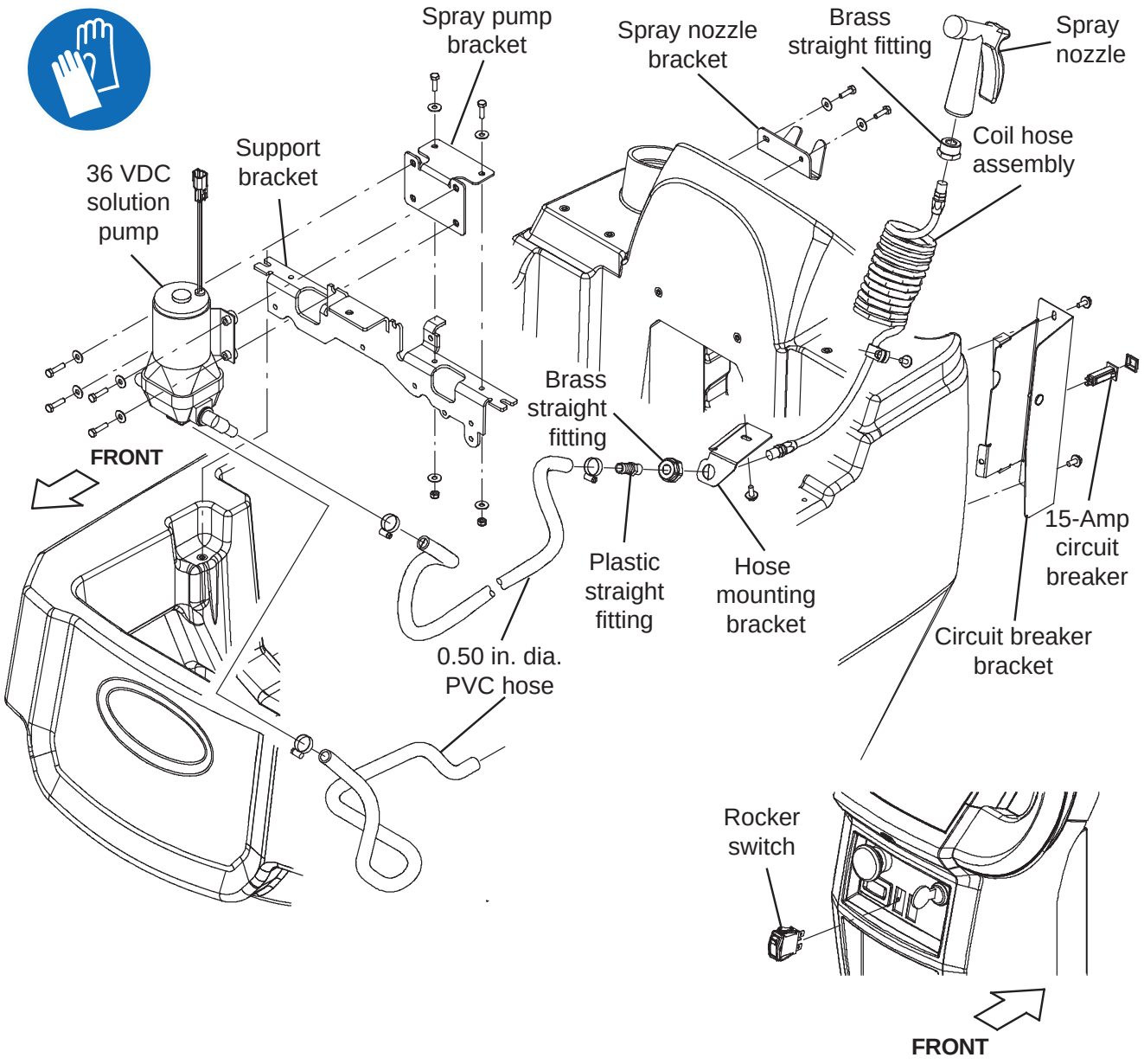
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

4. Completely empty all solution from the Severe Environment tank.
5. Disconnect the main wire harness from the liquid level sensor.

6. Disconnect the solution hose from the solution tank.
7. Remove the plastic nut securing the liquid level sensor inside the Severe Environment tank and remove the liquid sensor from the tank.

8. Reinstall the liquid level sensor/install the new liquid sensor into the Severe Environment tank in the reverse order of disassembly.

REMOVING/INSTALLING THE RECOVERY TANK RINSE PUMP (OPTION))



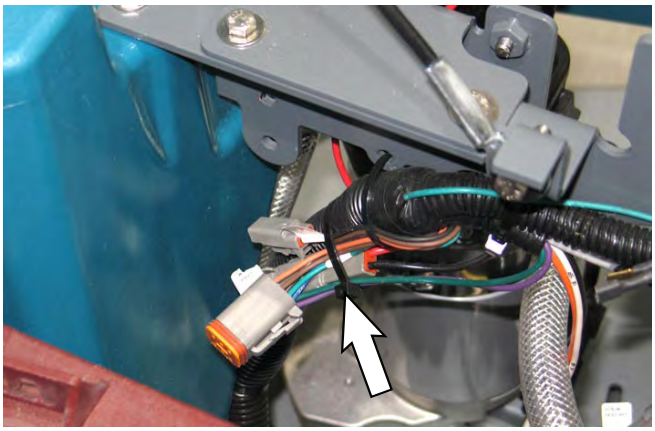
FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key, and set parking brake if equipped.

1. Completely empty the solution tank and the recovery tank.
2. Turn the key switch OFF.
3. Disconnect the battery cable from the machine.

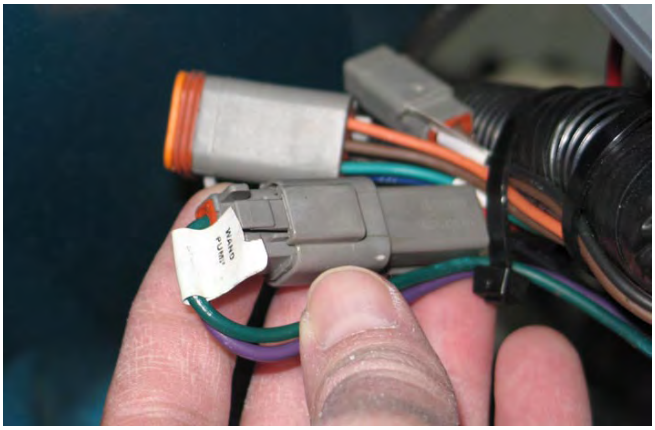
FOR SAFETY: When servicing machine, Disconnect battery connection and charger cord before working on machine.

4. Remove the front scrub head cover from the machine.

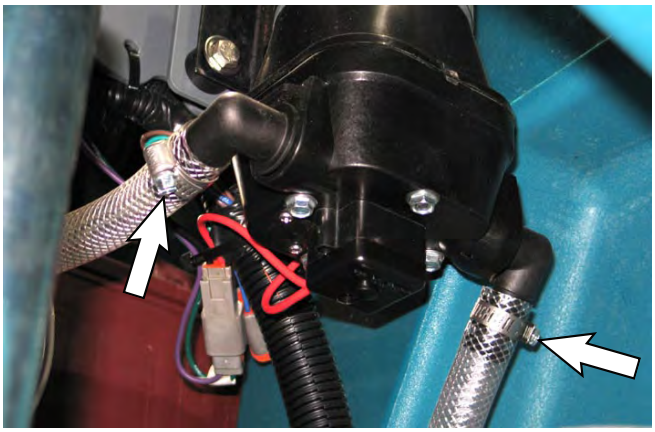
5. If necessary, cut the cable tie securing the wand pump connectors to the rest of the connectors/ cables bundled together.



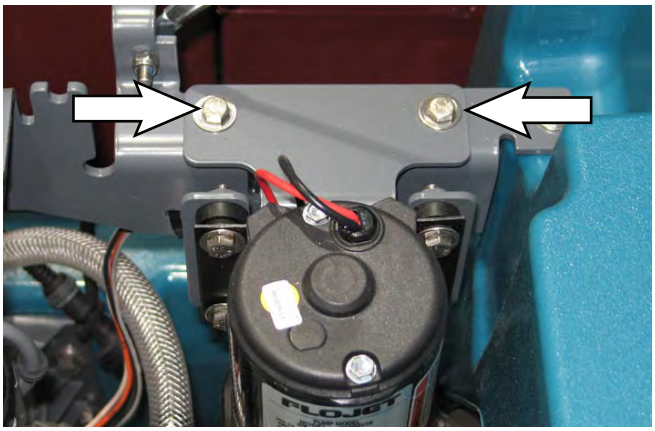
6. Disconnect the main wire harness from the 36 VDC solution pump.



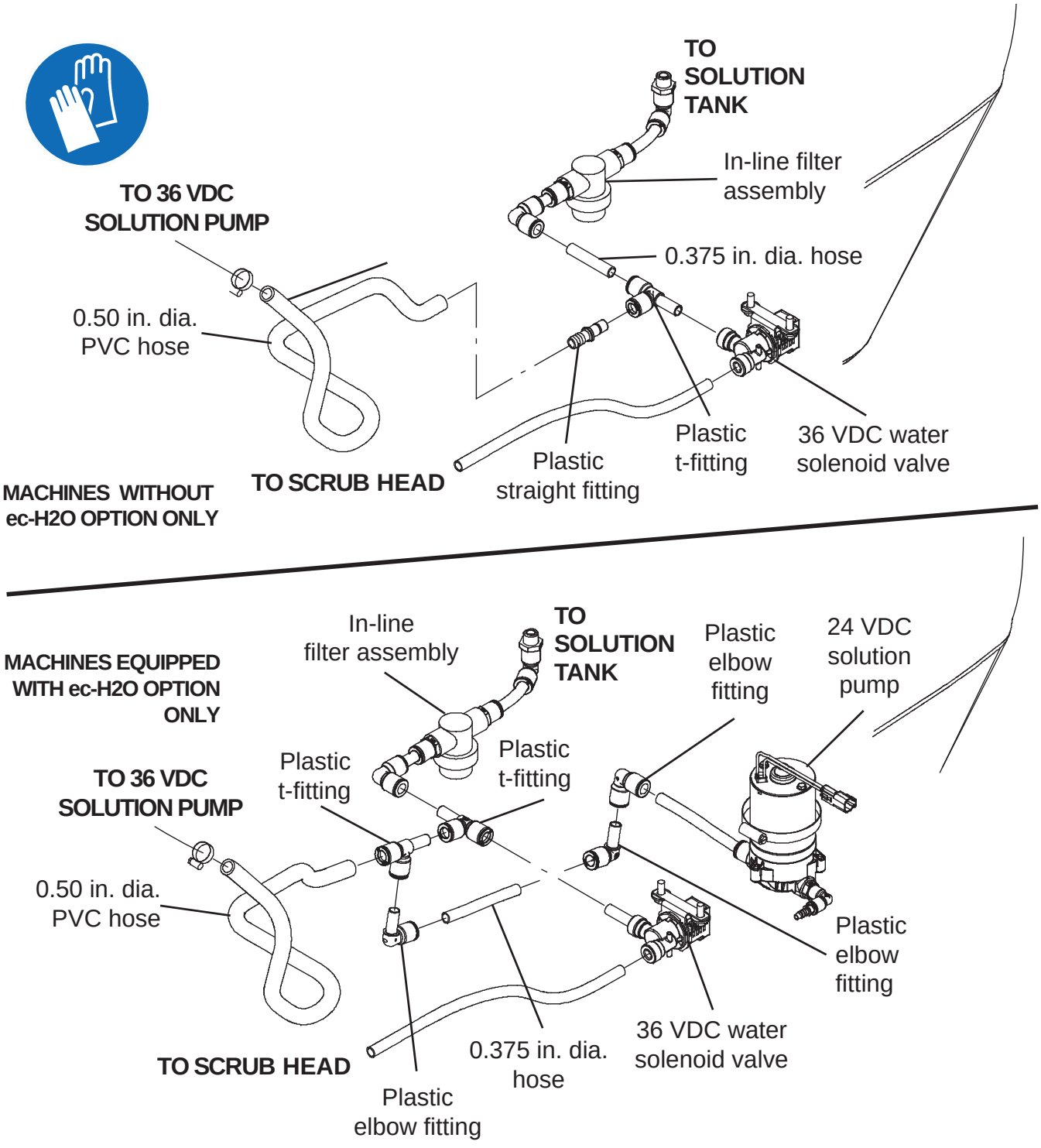
7. Disconnect the solution hoses from the 36 VDC solution pump.



8. Remove the hardware securing the spray pump bracket to the support bracket.



9. Remove the 36 VDC solution pump/spray pump bracket from the machine.
10. Remove the 36 VDC spray pump from the spray pump bracket.
11. Reinstall the 36 VDC pray pump/install new 36 VDC spray pump onto the spray pump bracket.
12. Reinstall the 36 VDC solution pump/spray pump bracket in reverse order of disassembly.


TO SOLUTION TANK
In-line filter assembly
TO 36 VDC SOLUTION PUMP
0.375 in. dia. hose
0.50 in. dia. PVC hose
Plastic t-fitting
36 VDC water solenoid valve
Plastic straight fitting
TO SCRUB HEAD
MACHINES WITHOUT ec-H2O OPTION ONLY
MACHINES EQUIPPED WITH ec-H2O OPTION ONLY
In-line filter assembly
TO SOLUTION TANK
Plastic elbow fitting
24 VDC solution pump
Plastic t-fitting
Plastic t-fitting
TO 36 VDC SOLUTION PUMP
0.50 in. dia. PVC hose
Plastic elbow fitting
36 VDC water solenoid valve
0.375 in. dia. hose
TO SCRUB HEAD
Plastic elbow fitting

SERVICING LITHIUM ION BATTERIES

REPLACING THE BATTERY MANAGEMENT SYSTEM (BMS)

NOTE: Service to the Lithium Ion battery must only be performed by Tennant Service.

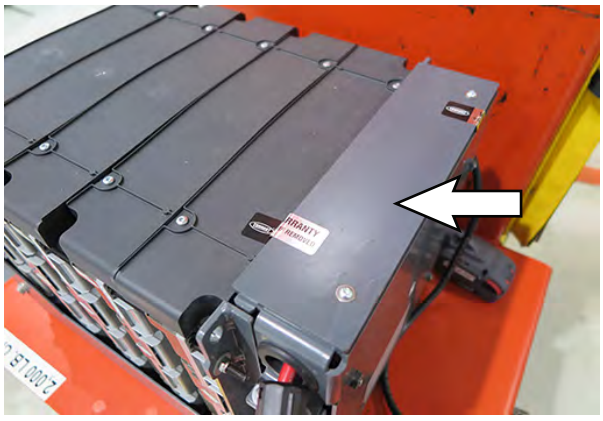
The replacement of the battery management system can be performed with the battery in the machine or removed from the machine.

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

1. Turn the key switch OFF.
2. Disconnect the battery cable from the machine.
3. Remove the Lithium-Ion battery pack from the machine.

FOR SAFETY: When using Lithium- ion Battery Model: Battery installation requires a specific service kit which includes a hoisting strap and proper lifting instructions Contact Tennant Service. Do not attempt to lift battery by hand or by any other unauthorized method.

4. Place the Lithium-ion battery pack in an area where there is adequate space to perform maintenance.
5. Remove the cover from the Lithium-ion battery pack.

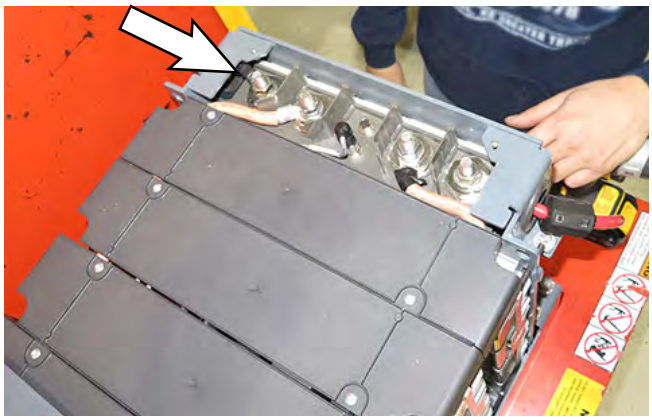


6. Cut the Warranty labels from the Lithium-ion battery pack.

NOTE: Warranty is void if the Warranty label has been removed or tampered with. Contact T.A.C. (Tennant Assistance Center) if label has been removed or damaged due to removal.

7. Remove the cover from the Lithium-ion battery pack.
8. Disconnect the Lithium-ion battery pack control cable and COM cable from the battery controller.

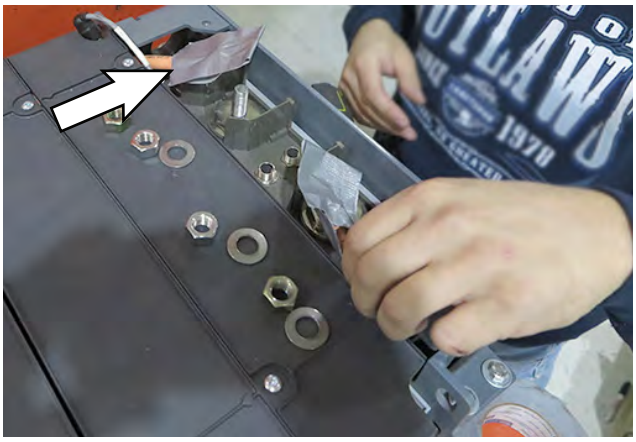
9. Disconnect the Lithium-ion battery pack power cables from the battery controller. Disconnect the negative (-) terminal connection first.



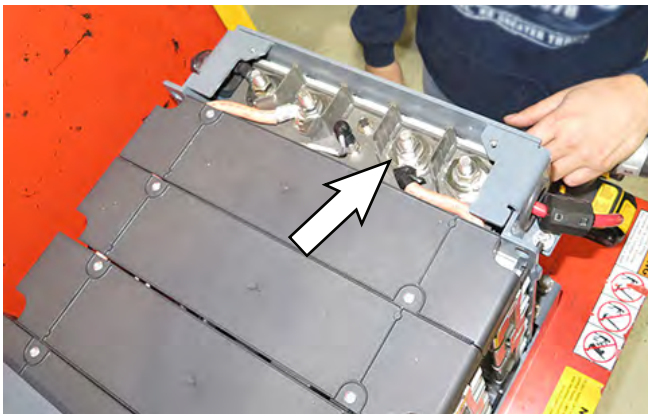
Disconnect the positive (+) terminal after the negative (-) has been disconnected.

10. Disconnect the Lithium-ion battery pack bus cables from the battery controller. Disconnect the negative (-) terminal connection first.

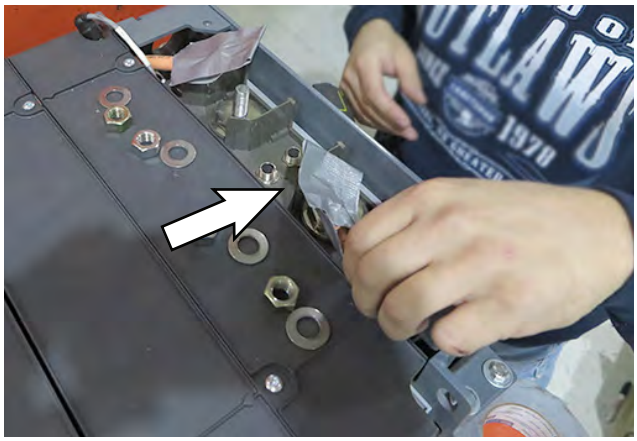
11. Wrap the Lithium-ion battery pack cable connector with tape to prevent the cables from arcing.



12. Disconnect the positive (+) terminal after the negative (-) has been disconnected.

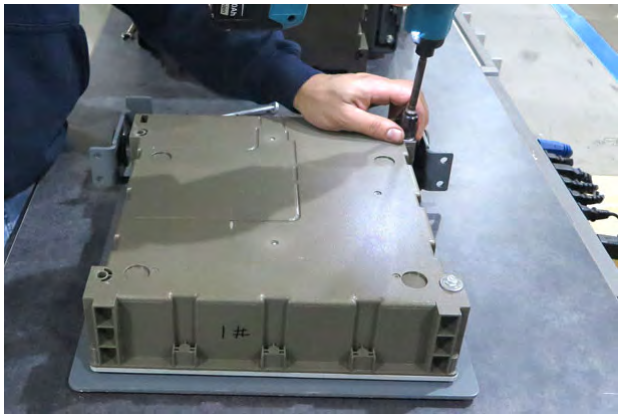


13. Wrap the Lithium-ion battery pack cable connector with tape to prevent the cables from arcing.

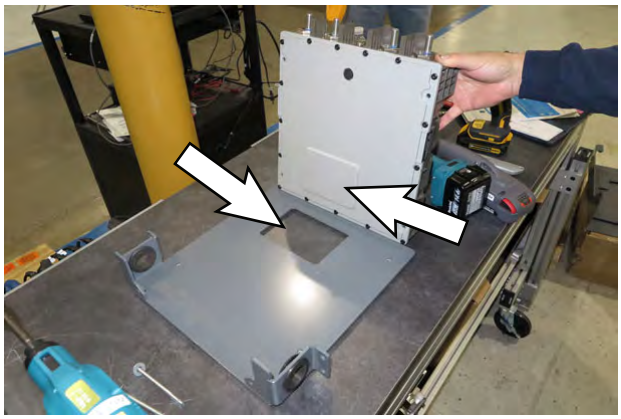


14. Remove the battery controller from the Lithium-ion battery pack

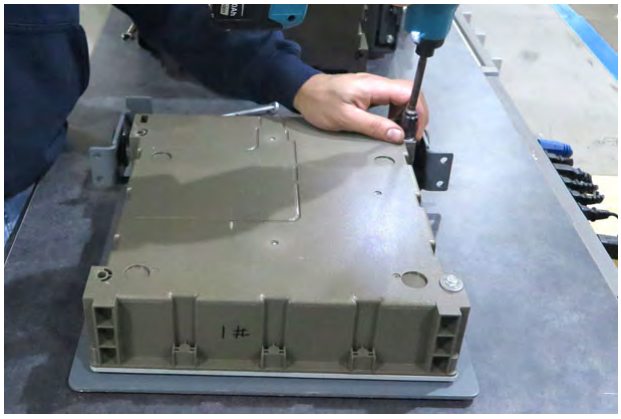
15. Remove the bracket from the battery controller.



16. Reassemble the bracket onto the new battery controller Be sure the protruded area on the battery controller goes back into the cut out section in the bracket.

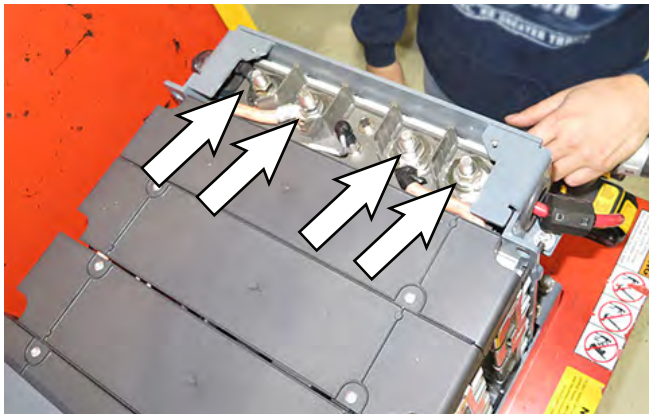


17. Apply blue thread sealant onto screws and reattach battery controller to bracket. Torque screws to 3.8 Nm +/- 0.7 Nm (2.8 ft lbs +/- 0.5 ft lbs).



18. Install the battery controller onto the Lithium-ion battery pack in reverse order of disassembly.

19. Torque the nuts on each battery terminal to 24.5 Nm +/- 3.4 Nm (18 ft lbs +/- 2.5 ft lbs).



20. Clean old warranty label and label residue from the Lithium-ion battery pack and cover.

21. Install the new warranty label onto the bracket and Lithium-ion battery pack where the old label was previously located.

22. Reinstall the Lithium-ion battery pack into the battery compartment.

23. Reconnect the battery cables to the machine.