



Sweeper-Scrubber





ES® Extended Scrub System Tennant True® Parts IRIS® a Tennant Technology Pro-Panel[™] Controls Insta-Fit[™] Adapter





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INTRODUCTION

This manual is furnished with 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.

PROTECT THE ENVIRONMENT	MACHINE DATA	
Please dispose of packaging materials, used components such as batteries and fluids in an environmentally safe way according to local waste disposal regulations. Always remember to recycle.	Please fill out at time of installation for future reference. Model No Serial No Installation Date	

INTENDED USE

The M17 is an industrial rider machine designed to wet scrub and sweep both rough and smooth hard surfaces (concrete, tile, stone, synthetic, etc). Typical applications include schools, hospitals/health care facilities, office buildings, and retail centers. Do not use this machine on soil, grass, artificial turf, or carpeted surfaces. This machine is intended for indoor use only. This machine is not intended for use on public roadways. Do not use this machine other than described in this Operators Manual.

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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.



CAUTION: To warn of unsafe practices that could result in minor or moderate personal injury.

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

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



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



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



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



WARNING: Raised hopper may fall. Engage hopper support bar.



WARNING: Lift arm pinch point. Stay clear of hopper lift arms.



WARNING: Heavy object. Back injury could result from improper lifting. Use hoist when removing.



WARNING: Do not spray people or animals. Severe personal injury can result. Wear eye protection. Hold sprayer with two hands.



WARNING: Electrical Hazard

 Disconnect Battery Cables and Charger Plug Before Servicing Machine.

- Do Not Charge Batteries with Damaged Power Supply Cord. Do Not Modify Plug. If the charger supply cord is damaged or broken, it must be replaced by the manufacturer or its service agent or a similarly qualified person in order to avoid a hazard.

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

FOR SAFETY:

- 1. Do not operate machine:
 - Unless trained and authorized.
 - Unless operator manual is read and understood.
 - Under the influence of alcohol or drugs.
 - While using a cell phone or other types of electronic devices.
 - Unless mentally and physically capable of following machine instructions.
 - With brake disabled.
 - Without filters in place or with clogged filters.
 - In dusty environments without the vacuum fan on.
 - If it is not in proper operating condition.
 - With pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.
 - In outdoor areas. This machine is for indoor use only.
 - In areas where flammable vapors/liquids or combustible dusts are present.
 - In areas that are too dark to safely see the controls or operate the machine unless operating / headlights are turned on.
 - In areas with possible falling objects unless equipped with overhead guard.
 - With the rear bumper door / step in the lowered position.
- 2. Before Starting Machine:
 - Check machine for fluid leaks.
 - Make sure all safety devices are in place and operate properly.
 - Check brakes and steering for proper operation.
 - Check parking brake pedal for proper operation.
 - Adjust seat and fasten seat belt (if equipped).

- 3. When using machine:
 - Use only as described in this manual.
 - Use brakes to stop machine.
 - Do not pick up burning or smoking debris, such as cigarettes, matches or hot ashes.
 - Go slowly on inclines and slippery surfaces.
 - Do not scrub or sweep on ramp inclines that exceed 10.5% grade for Dual Force and 5% for Direct Throw. Do not transport on ramp inclines that exceed 13% grade for Dual Force and 5% for Direct Throw (with hopper lowered).
 - Reduce speed when turning.
 - Keep all parts of body inside operator station while machine is moving.
 - Always be aware of surroundings while operating machine.
 - Do not access the video / help screens while the machine is moving. (Pro-Panel)
 - Use care when reversing machine.
 - Move machine with care when hopper is raised.
 - Make sure adequate clearance is available before raising hopper.
 - Do not raise hopper when machine is on an incline.
 - Keep children and unauthorized persons away from machine.
 - Do not carry passengers on any part of the machine.
 - Always follow safety and traffic rules.
 - Report machine damage or faulty operation immediately.
 - Follow mixing, handling and disposal instructions on chemical containers.
 - Follow site safety guidelines concerning wet floors.
 - 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.
 - Set parking brake.
 - Turn off machine and remove key.
- 5. When servicing machine:
 - All work must be done with sufficient lighting and visibility.
 - Keep work area well ventilated.
 - Avoid moving parts. Do not wear loose clothing, jewelry and secure long hair.
 - Block machine tires before jacking machine up.
 - Jack machine up at designated locations only. Support machine with jack stands.
 - Use hoist or jack that will support the weight of the machine.

- Do not push or tow the machine without an operator in the seat controlling the machine.
- Do not push or tow the machine on inclines with the brake disabled.
- Use cardboard to locate leaking hydraulic fluid under pressure.
- Do not power spray or hose off machine near electrical components.
- Disconnect battery connections and charger cord before working on machine.
- Do not pull on battery charger cord to unplug. Grasp plug at outlet and pull.
- Do not use incompatible battery chargers as this may damage battery packs and potentially cause a fire.
- Inspect charger cord regularly for damage.
- Do not disconnect the off-board charger's DC cord from the machine receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging, disconnect the AC power supply cord first.
- Avoid contact with battery acid.
- Keep all metal objects off batteries.
- Use a non-conductive battery removal device.
- Use a hoist and adequate assistance when lifting batteries.
- Battery installation must be done by trained personnel.
- Follow site safety guidelines concerning battery removal.
- All repairs must be performed by a trained service mechanic.
- Do not modify the machine from its original design.
- Use Tennant supplied or approved replacement parts.
- Wear personal protective equipment as needed and where recommended in this manual.



For Safety: wear hearing protection.



For Safety: wear protective gloves.



For Safety: wear eye protection.



For Safety: wear protective dust mask.

- 6. When 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.
 - 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 longterm 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.

- 7. When loading/unloading machine onto/off truck or trailer:
 - Use ramp, truck or trailer that will support the weight of the machine and operator.
 - Drain tanks before loading machine.
 - Empty debris hopper before loading machine.
 - Do not drive on a slippery ramp.
 - Use caution when driving on a ramp.
 - Do not load/unload Direct Throw machines on ramp inclines that exceed 13% / 7°. Do not load/unload Dual Force machines on ramp inclines that exceed 20% / 11°.
 - Stop on a level surface, set parking brake and leave the key in the ON position until all tie-down straps are secure.
 - Lower scrub head and squeegee before tying down machine.
 - Tie machine down to truck or trailer.
 - Block machine tires.
 - Turn off machine and remove key.

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

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



Located on circuit board cover and electrical panel.



Located on electrical panel.

Located on hopper support bar.

WARNING LABEL - Heavy object. Back injury could result from improper lifting. Use hoist when lifting.



Located under high pressure washer cover.



WARNING LABEL - Do not spray people or animals. Severe personal injury can result. Wear eye protection. Hold sprayer with two hands.



Located on high pressure washer cover.

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

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

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



MACHINE COMPONENTS



- A. Hopper
- B. Hopper cover
- C. Solution tank
- D. Solution tank cover
- E. Battery compartment cover
- F. Backup alarm / flashing light (Option)
- G. Recovery tank cover
- H. Recovery tank
- I. Left shroud
- J. Rear bumper door / step
- K. Rear squeegee
- L. Overhead guard (Option)
- M. Steering wheel
- N. Operator seat

- O. ec-H2O System Module compartment (Option) – located behind right shroud
- P. Right shroud
- Q. Hopper dust filter located under hopper cover
- R. Sweeping side brushes
- S. Sweeping main brushes
- T. Scrubbing side brush (Option)
- U. Scrub head
- V. Scrubbing main brushes
- W. Side squeegees
- X. Recovery tank drain hose
- Y. Vacuum hose
- Z. Solution tank drain hose
- AA. High pressure washer (Option)
- AB. Live wand dry vacuum (Option)

INSTRUMENTS AND CONTROLS







Standard Control Panel

- A. Key switch
- B. Directional switch
- C. Emergency shut-off button
- D. Operating lights / hazard lights switch (Option)
- E. Spray nozzle switch (Option) / High pressure washer (Option)
- F. Parking brake pedal
- G. Brake pedal
- H. Propel pedal

- I. Hopper raise / lower switch
- J. Filter shaker switch
- K. Severe environment switch (Option)
- L. Hopper rollout switch

STANDARD TOUCH PANEL





- M. ec-H2O / ES (Extended Scrub) button (Option)
- N. Scrubbing buttons (Indicated in blue)
- O. Scrubbing main brush button
- P. Scrubbing vacuum fan / squeegee button
- Q. Scrubbing side brush button (Option)
- R. Sweeping buttons (Indicated in brown)
- S. Sweeping main brush button
- T. Sweeping vacuum fan button
- U. Sweeping side brush button
- V. Solution on / off buttons
- W. Solution decrease button (-)
- X. Solution flow indicator lights
- Y. Solution increase button (+)
- Z. USB port (Service only)

- A. Horn
- B. Fault/Alert indicator light
- C. Contrast control button
- D. Battery discharge indicator
- E. Hour meter
- F. Configuration mode button
- G. Recovery tank full indicator
- H. LCD display
- I. Solution tank indicator
- J. Main scrub brush pressure button
- K. Main scrub brush pressure indicator lights
- L. 1-STEP button

PRO-PANEL CONTROLS



- A. Horn
- B. Fault / alert indicator button
- C. ec-H2O / ES (Extended Scrub) button
- D. Severe environment button (Option)
- E. Machine status button
- F. Help button
- G. Filter shaker button
- H. Main scrub brush pressure access button
- I. Sweeping buttons (Indicated in brown)
- J. Sweeping main brush button
- K. Sweeping vacuum fan button
- L. Sweeping side brush button
- M. Rearview camera button
- N. Solution control access button

- O. Scrubbing buttons (Indicated in blue)
- P. Scrubbing main brush button
- Q. Scrubbing vacuum fan / squeegee button
- R. Scrubbing side brush button (Option)
- S. 1-STEP button
- T. Video help
- U. Zone control 1 button
- V. Zone control 2 button
- W. Zone control 3 button
- X. Hopper control button
- Y. USB port (Service only)
- Z. Solution on / off buttons

SYMBOL DEFINITIONS

These symbols are used on the machine to identify controls, displays, and features.





Pro-Panel Symbols



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Date / Time set

SCHEMATICS

ELECTRICAL SCHEMATIC (000000-010999)



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HOPPER/SWEEPER MODULES



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OPT. HIGH PRESS. SPRAY



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Light

Solenoid Valve

Capacitor

FASTENER TORQUES

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)		
5 (.125)	(6) - (8)					(9) - (11)		Inch
6 (.138)	(7) - (9)		(20) - (24)			(9) - (11)		Po
8 (.164)	(12) - (16)		(40) - (47)			(17) - (23)		bur
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	
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	Ţ
7/16 (.438)	20 - 26	26 - 34		43 - 56	53 - 76	33 - 39	106 - 124	Of P
1/2 (.500)	27 - 35	39 - 51		65 - 85	89 - 116	48 - 56	162 - 188	oun
5/8 (.625)		80 - 104		130 - 170	171 - 265		228 - 383	ds
3/4 (.750)		129 - 168		215 - 280	313 - 407		592 - 688]
1 (1.000)		258 - 335		500 - 650	757 - 984		1281 - 1489	1

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	

SPECIFICATIONS

GENERAL MACHINE DIMENSIONS/ CAPABILITIES

Item	Dimension / Capacity
Length (S/N 011000-)	2865 mm (112.8)
Length (S/N 00000-010999)	2850 mm (112.1 in)
Width (Body)	1370 mm (54 in)
Width (Body with side scrub brush)	1405 mm (55.3 in)
Wheel base	1163 mm (46 in)
Height (top of steering wheel)	1480 mm (58.25 in)
Height (with high pressure washer option)	1680 mm (66.2 in)
Height (with dry vacuum - Pro-Panel)	1766 mm (69.5 in)
Height (with dry vacuum - w/ rear view mirror)	1979 mm (77.9 in)
Height (with overhead guard)	2096 mm (82.5 in)
Track	1041 mm (41 in)
Disk brush diameter	510 mm (20 in)
Cylindrical brush diameter (scrubbing)	230 mm (9 in)
Cylindrical brush length (scrubbing)	1015 mm (40 in)
Cylindrical brush diameter (Dual force sweeping)	203 mm (8 in)
Cylindrical brush length (Dual force sweeping)	915 mm (36 in)
Cylindrical brush diameter (Direct throw sweeping)	254 mm (10 in)
Cylindrical brush length (Direct throw sweeping)	863 mm (34 in)
Disk brush diameter for scrubbing side brush (option)	330 mm (13 in)
Disk brush diameter for sweeping side brush	480 mm (19 in)
Scrubbing path width	1015 mm (40 in)
Scrubbing path width (with scrubbing side brush)	1220 mm (48 in)
Squeegee width (rear squeegee)	1245 mm (49 in)
Sweeping path width - Dual force main sweep	915 mm (36 in)
Sweeping path width - Direct throw main sweep	889 mm (35 in)
Sweeping path width (with dual sweeping side brushes)	1700 mm (67 in)
Solution tank capacity	285 L (75 gallons)
Recovery tank capacity	346 L (91.1 gallons)
Solution capacity (ES)	435 L (115 gallons)
Detergent tank capacity (option)	17.6 L (4.6 gallons)
Demisting chamber	61 L (16.1 gallons)
Dual force plastic hopper capacity (light litter)	85 L (3.0 ft ³)
Direct throw steel hopper capacity (light litter)	30 L (1.0 ft ³)
Dual force plastic hopper weight capacity	136 Kg (300 lbs)
Direct throw steel hopper weight capacity	57 Kg (125 lbs)
Hopper minimum ceiling dump height	2134 mm (84 in)
Hopper maximum dump height	1525 mm (60 in)

Item	Dimension / Capacity
Dust filter area	5.1 m ² (54.9 ft ²)
Weight (Empty)	1515 Kg (3335 lbs)
Weight (with standard 510 AH batteries)	2165 Kg (4770 lbs)
Weight (with optional 930 AH batteries)	2475 Kg (5450 lbs)
GVWR	3245 Kg (7150 lbs)
Protection Grade	IPX3

Values determined as per IEC 60335-2-72	Measure - Cylindrical scrub head	Measure - Disk scrub head
Sound pressure level LpA	75 dB	75 dB
Sound pressure uncertainty KpA	3 dB	3 dB
Sound power level LWA + Uncertainty KWA	94.63 dB + 2.98 dB	94.63 dB + 2.98 dB
Vibration - Hand-arm	<2.5 m/s ²	<2.5 m/s ²
Vibration - Whole body	<0.5 m/s ²	<0.5 m/s ²

GENERAL MACHINE PERFORMANCE

Item	Measure
Aisle turnaround width (less side brush)	3003 mm (118.25 in)
Travel Speed (Forward)	9 Km/h (5.5 mph)
Travel Speed while sweeping / scrubbing (Forward)	6.5 Km/h (4 mph)
Travel Speed lifted hopper or live wand (option)(Forward)	3.25 Km/h (2 mph)
Travel Speed (Reverse)	5 Km/h (3 mph)
Maximum ramp incline for loading - Empty (Dual Force)	20%
Maximum ramp incline for loading - Empty (Direct throw option with hopper raised)	13%
Maximum ramp incline for sweeping / scrubbing (Dual Force)	10.5%
Maximum ramp incline for sweeping / scrubbing (Direct throw option)	5%
Maximum ramp incline for transporting (GVWR) (Dual Force)	13%
Maximum ramp incline for transporting (GVWR) (Direct throw option with hopper raised)	13%
Maximum ramp incline for transporting (GVWR) (Direct throw option with hopper lowered)	5%
Maximum ambient temperature for machine operation	43° C (110° F)
Minimum temperature for operating machine scrubbing functions	0° C (32° F)

POWER TYPE

Туре	Quantity	Volts	Ah Rating	Weight
Lead-acid Batteries	1	36	510 @ 6 hr rate	661 kg (1458 lb)
(Max. battery dimensions):	1	36	750 @ 6 hr rate	963 kg (2124 lb)
406 mm (15.98 in) W x 963 mm (37.91 in) L x 775 mm (30.51 in) H	1	36	930 @ 6 hr rate	988 kg (2178 lb)
Lithium-ion Battery	1	36	1049	414 kg (914 lb)

Туре	Use	VDC	k W (hp)
Electric Motors	Scrub brush (disk)	36	1.125 (1.50)
	Scrub brush (cylindrical)	36	1.125 (1.50)
	Side srub brush	36	0.90 (1.25)
	Main sweep brush	36	0.75 (1.00)
	Side sweep brush	36	0.06 (0.08)
	Vacuum fan (sweep)	36	0.85 (1.10)
	Vacuum fan (scrub)	36	0.6 (0.80)
	Propelling	36	2.25 (3.00)
	High pressure washer (Option)	36	2.25 (3.0)
	Live wand (Option)	36	1.125 (1.5)

Туре	VDC	amp	Hz	Phase	VAC
Charger (Smart)	36	80	50-60	1	200-240
Charger (Smart)	36	120	50-60	1	380-415
Charger (Smart)	36	150	50-60	1	480-600
Charger (Opportunity)	36	240	50-60	1	480
Charger, Lithium-Ion Battery	36	80	50-60	1	200-240
Charger, Lithium-Ion Battery	36	80	50-60	3	200-240
Charger, Lithium-Ion Battery	36	100	50-60	3	480
Charger, Lithium-Ion Battery	36	215	50-60	3	480

TIRES

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

SCRUBBING SIDE BRUSH SOLUTION FLOW RATE (OPTION)

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

ec-H2O SYSTEM (OPTION)

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

HIGH PRESSURE WASHER (OPTION)

Item	Measure
Pump pressure (max)	Up to 17236 kpa (2500 psi)
Solution flow rate (max @ 2500psi)	Up to 7.57 LPM (2.0 GPM)

MACHINE DIMENSIONS







MAINTENANCE CHART

The table below indicates the Person Responsible for each procedure.

O = Operator. T = Trained Personnel.

NOTE: Check procedures indicated (•) after the first 50 hours of operation.

Interval	Person Resp.	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
Daily	0	22	Hydraulic reservoir	Check hydraulic fluid level	HYDO	1
	0	1	Side and rear squeegees	Check for damage and wear. Check deflection.	-	4
	0	2	Main brushes and pads	Check for damage, wear, and debris	-	2
	0	3	Recovery tank	Clean tank, top sensor, and check cover seal	-	1
	0	4	Solution tank	Check cover seal	-	1
	0	3	ES machines only: Recovery tank	Clean tank and level sensor	-	2
	0	4	ES machines only: Solution tank	Clean tank and level sensor	-	1
	0	5	Vacuum fan inlet filter, screen, and debris tray	Clean	-	1
	0	6	Cylindrical brushes only: Debris trough	Clean	-	1
	0	7	Sweeping side brush(es)	Check for damage, wear, debris	-	1 (2)
	0	8	Scrubbing side brush	Check for damage, wear, debris	-	1
	0	9	Scrubbing side brush squeegee	Check for damage and wear	-	1
	0	10	Hopper dust filter	Shake to clean	-	1
	0	26	Live wand vacuum debris tray	Clean	-	1
Weekly	Т	11	Battery cells	Check electrolyte level	DW	Multiple
50 Hours	Т	1	Side and rear squeegees	Check leveling	-	4
	0	2	Main scrub brushes (cylindrical)	Rotate brushes from front to rear	-	2
				Rotate end for end	-	2
	0	23	Main sweeping brushes Dual Force (cylindrical)	Rotate brushes from front to rear	-	2
				Rotate end for end	-	2
	0	23	Main sweeping brush Direct Throw (cylindrical)	Rotate end for end	-	1

The table below indicates the Person Responsible for each procedure.

O = Operator. T = Trained Personnel.

i – Italieu Personnei.

NOTE: Check procedures indicated (**•**) after the first 50 hours of operation.

Interval	Person Resp	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
50 Hours	0	12	Scrub head skirts (disk)	Check for damage and wear	-	2
	0	23	Sweeping skirts	Check for damage and wear	-	4
	0	7	Sweeping side brush(es)	Check brush pattern	-	2
	0	25	Solution supply filter	Check screen and clean	-	1
	0	26	Live wand vacuum seals (Option)	Check for damage and wear	-	3
	Т	27	High pressure washer oil	Change oil after initial 50 hours of high pressure washer operation	HYDO	1
100 Hours	Т	11	Battery watering system (option)	Check hoses and connections for damage and wear	-	Multiple
	Т	10	Hopper seals	Check for damage and wear	-	2
	Т	10	Hopper	Clean hopper, dust filter and Perma-Filter		1
200	Т	13	Brakes	Check adjustments	-	1
Hours	Т	11	Battery terminals and cables	Check and clean	-	Multiple
	Т	14	Cylindrical brush drive belts	Check for damage and wear	-	1 (2)
	Т	18	Sweeping brush drive belts	Check for damage and wear	-	2
	Т	15	Drive wheel pivot	Lubricate	SPL	1
	Т	15	Steering chain	Lubricate and check for dam- age and wear.	GL	1
		16	Steering gear chain	Lubricate and check for dam- age and wear	GL	1
	Т	24	Hopper chains	Lubricate and check for dam- age and wear.	GL	2
	Т	17	Hopper lift arm pivots	Lubricate	SPL	3
500 Hours	Т	19	Scrub vacuum fan motor(s)	Check motor brushes	-	1 (2)
	0	21	Tires	Check for damage and wear	-	3
	Т	24	Hopper chains	Check tension.	-	2

Interval	Person Resp	Key	Description	Procedure	Lubricant/ Fluid	No. of Service Points
800	Т	22	Hydraulic hoses	Check for wear and damage	-	Multiple
Hours	Т	15	Drive wheel motor	Change oil	HYDO	1
1000 Hours	Т	7	Sweeping side brush motors	Check motor brushes (Check every 100 hours after initial 1000 hour check)	-	2
2400 Hours	Т	22	Hydraulic reservoir	Change hydraulic fluid	HYDO	1

LUBRICANT/FLUID

DW Distilled water.

- Special lubricant, Lubriplate EMB grease SPL (Tennant part number 01433-1) GL SAE 90 weight gear lubricant HYDO **Tennant** *True* premium hydraulic fluid or
- equivalent

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

YELLOW TOUCH POINTS

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



LUBRICATION

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

STEERING CHAIN

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



STEERING GEAR CHAIN

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



DRIVE WHEEL PIVOT

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



DRIVE WHEEL OIL

The drive wheel oil plug is located near the bottom of the drive wheel assembly. Change the drive wheel oil after every 800 hours.



HOPPER LIFT ARM PIVOTS

Lubricate the hopper lift arm pivots after every 200 hours of operation.







HOPPER CHAINS

The hopper chains are located on the left hand side of the machine. Check for damage or wear and lubricate the hopper chains after every 200 hours..



HIGH PRESSURE WASHER OIL

Change the high pressure washer oil after the initial 50 hours of high pressure washer operation.

NOTE: Remove high pressure washer cover to access both the high pressure washer drain plug and vented fill cap.





HOPPER CHAINS

The hopper chains are located on the left hand side of the machine. Check the tension of the hopper chains after the first 50 hours of operation then every 500 hours after that.

With the hopper in the lowered position; the longer arm chain (A) should not move more than 25 mm (1 in) and the shorter lintel chain (B) should not move more than 12 mm (0.5 in).



HYDRAULICS

Check the hydraulic fluid level at operating temperature daily. The hydraulic fluid level should be between the MIN and MAX markings on the hydraulic reservoir. The hopper must be down when checking hydraulic fluid level.



ATTENTION! Do not overfill the hydraulic fluid reservoir or operate the machine with a low level of hydraulic fluid in the reservoir. Damage to the machine hydraulic system may result.

Drain and refill the hydraulic fluid reservoir with new **Tennant***True* premium hydraulic fluid after every 2400 hours of operation.



HYDRAULIC FLUID

Tennant <i>True</i> premium hydraulic fluid (Extended Life)				
Part Number	Capacity	ISO Grade Viscosity Index (VI)		
1057707	3.8 L (1 gal)	ISO 32		
1057708	19 L (5 gal)	VI 163 or higher		

If using a locally-available hydraulic fluid, be sure the specifications match Tennant hydraulic fluid specifications. Substitute fluids can cause premature failure of hydraulic components.

ATTENTION! Hydraulic components depend on system hydraulic fluid for internal lubrication. Malfunctions, accelerated wear, and damage will result if dirt or other contaminants enter the hydraulic system.

HYDRAULIC HOSES

Check the hydraulic hoses after every 800 hours of operation for wear or damage.

FOR SAFETY: When servicing machine, use cardboard to locate leaking hydraulic fluid under pressure.

High pressure fluid escaping from a very small hole can almost be invisible, and can cause serious injuries.



00002

Consult a physician immediately if injury results from escaping hydraulic fluid. Serious infection or reaction can occur if proper medical treatment is not given immediately.

Contact a mechanic or supervisor if a leak is discovered.

BATTERY



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

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

- Do not leave the battery partially discharged for long period of time.
- Only charge the battery in a well ventilated area to prevent gas build up. Charge batteries in areas with ambient temperatures 27°C (80°F) or less.
- Maintain the proper electrolyte levels of the flooded (wet) battery by checking levels weekly.

The following steps do not apply if Opportunity charging (See *OPPORTUNITY CHARGING* section.

- Do not charge the battery more than once a day and only after running the machine for a minimum of 15 minutes.
- Allow the charger to completely charge the battery before reusing the machine.

CHECKING THE ELECTROLYTE LEVEL

The flooded (wet) lead-acid battery requires routine maintenance as described below. Check the battery electrolyte level weekly.

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



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

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

MAINTENANCE-FREE BATTERIES

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

CHECKING CONNECTIONS / CLEANING

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



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 the discharge level is fully depleted (i.e. when discharge indicator reaches red light). If the red light begins to flash, the scrub function will automatically be disabled. This allows the user to use the remaining power to propel the machine back to charging station. Do not store the machine for a long period at this 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, 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 THE BATTERY

IMPORTANT: Before charging, make sure that the machine and charger settings are properly set for the battery type.

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

NOTE: Do not opportunity charge standard batteries since doing so can shorten battery life.

- 1. Drive the machine to a flat, dry surface in a well-ventilated area.
- 2. Stop the machine and turn off the machine power.

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

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

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

- 4. Plug the charger AC power supply cord into a properly grounded outlet.
- Disconnect the battery side cable connector from the machine by pulling down on the connector or the battery quick-disconnect lever (option). Do not pull on the cables.





NOTE: The Lithium-Ion Battery Pack's battery management system (BMS) is active for five minutes after the machine cable is disconnected. If the charger is not connected and charging within this five minutes, the BMS will shut off and the charger will not be able to charge. Reconnect the machine cable to the battery pack and remove it again to restart the BMS active period.

6. Connect the charger connector to the battery cable.



TO CHARGE WITH TENNANT BRANDED CHARGER

1. Turn on the battery charger if required.



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

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



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



Charger Display:



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

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



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



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



5. After the batteries have completely charged, disconnect the charger connector from the battery cable connector.



6. Reconnect the battery connector to the machine connector.





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

TO CHARGE WITH ENERSYS BATTERY CHARGER

1. Turn on battery charger if required.



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

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



2. Observer the charger display. The charging indicator will illuminate on the display when the battery is charging. This is the charger default screen.



Charger Display:



- A. Charge profile number
- C. Charger rating (Volts and current)
- D. Battery voltage (Volts)
- E. Charger current (Amperes)
- F. Ampere hours charged
- G. Time charged
- H. Percent of charge
- If necessary, press the navigation buttons to access additional screens. Press the charger stop/start/enter button to enter the selection. The charger will return to the default screen. Refer to manufacture's operator manual for additional information.



NOTE: If the charger cable must be disconnected from the battery before they are fully charged, press the charger stop / start / enter button to stop charging. Be sure the charging indicator is no longer illuminated before disconnecting the battery charger cable.



4. The yellow charging indicator will illuminate while the battery is charging. Once the charging is complete the yellow charging indicator light will go out and the green charge complete indicator will be illuminated. The charger will stop charging when the battery is completely charged.



5. After the batteries have completely charged, disconnect the charger connector from the battery cable connector.



6. Reconnect the battery connector to the machine connector.



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

7. Close the battery compartment top cover.

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

BATTERY CHARGER USB PORT

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



OPPORTUNITY CHARGING (OPTION)

Opportunity charging is used to extend machine run time and productivity by allowing batteries to be charged during breaks, lunch, between shifts, or whenever there is an "opportunity" to charge.

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).

IMPORTANT: Before charging, make sure that the machine and charger settings are properly set for the battery type.

NOTE: The machine must be equipped with a lithium-ion battery or a battery capable of being opportunity charged. Do not opportunity charge standard batteries since doing so can shorten battery life.

- 1. Drive the machine to a flat, dry surface in a well-ventilated area.
- 2. Stop the machine and turn off the machine power.

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

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

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

4. Disconnect the battery side cable connector from the machine by pulling down on the connector. Do not pull on the cables.





NOTE: The Lithium-Ion Battery Pack's battery management system (BMS) is active for five minutes after the machine cable is disconnected. If the charger is not connected and charging within this five minutes, the BMS will shut off and the charger will not be able to charge. Reconnect the machine cable to the battery pack and remove it again to restart the BMS active period.

5. Connect the charger connector to the battery cable.



6. The battery will be opportunity charged during the break.

7. When ready to start using the machine again press the charger stop / start button to stop the charger.

Lead Acid:



Lithium-Ion:



FOR SAFETY: When servicing machine do not disconnect the off-board charger's DC cord from the machine receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging, press charger stop / start button to stop charger.

8. Disconnect the charger connector from the battery cable connector.



9. Reconnect the battery connector to the machine connector.



10. Close the battery compartment top cover.

WEEKLY EQUALIZATION CHARGE

The opportunity charger is programmed to automatically provide a full equalization charge at a designated weekly interval.

IMPORTANT: The weekly equalization charge must be completed in its entirety. If it is interrupted during charging, it must be allowed to complete the equalization charge the next time it is started or it could damage the battery or severely shorten the battery life.

NOTE: Sunday is the default day for the charger to conduct a full equalization charge to the battery. The default day can be changed to another day if necessary. Consult a Tennant service representative about changing the default day.

Allow the charger to fully complete the equalization charge. The yellow charging indicator will be illuminated and the charging status will be displayed in the graphic display.



The yellow charging indicator will go out and the green charge complete indicator will be illuminated when the battery equalization charge is complete.



BATTERY WATERING SYSTEM (OPTION)

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

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

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

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



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

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

NOTE: The water supply to the battery water system must always be 7.57 LPM (2 GPM) or more. Use the purger to confirm the water supply pressure. Refer to manufacturer Operator Manual for additional information. 4. Connect the battery watering system hose to the battery fill hose.



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



- 6. Disconnect the battery watering system hose from the water supply hose.
- 7. Turn off the water supply.
- 8. After adding water, return the battery watering system hose to the storage location for future use.

FUEL CELL BATTERY (OPTION)

Machines can be equipped for use with fuel cell battery systems. Contact the fuel cell battery provider for all fuel cell battery information.



CIRCUIT BREAKERS, FUSES, AND RELAYS

CIRCUIT BREAKERS

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

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



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



Circuit breakers 16 through 20 are located in the hopper compartment.



Circuit breaker 21 is located inside the optional light assembly.



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

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

Circuit Breaker	Rating	Circuit Protected
CB1	60A	Water pickup module
CB2	-	Not used
CB3	35A	Side scrub brush module (Option)
CB4	2.5A	Key switch
CB5	2.5A	Water pick up module
CB6	2.5A	Scrub module
CB7	2.5A	Side brush scrub module (Option)
CB8	2.5A	ec-H2O power module (Option)
CB9	2.5A	ec-H2O pump module (Option)
CB10	15A	Spray nozzle (Option)/High pressure washer (Option)
CB11	15A	Lights (Option)
CB12	2.5A	Headlights/Taillights
CB13	2.5A	Strobe light/Flashing light on overhead guard (Option)
CB14	2.5A	Strobe light/Flashing light on recovery tank (Option)
CB15	30A	Power steering
CB16	60A	Lift module
CB17	15A	Sweep module
CB18	40A	Sweep vacuum fan 1
CB19	40A	Sweep vacuum fan 2
CB20	-	Not used
CB21	2.5A	Alarm/Flashing light (Option)

FUSES

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



The fuses are located in the control box behind the circuit breaker panel or inline on harnesses and cables.

Fuse	Rating	Circuit Protected
Fuse-1	150A	Propelling
Fuse-2	100A	Scrub module power
Fuse-3	2A	Telemetry (inline, Option)
Fuse-4	150A	Sweep (inline)
Inline fuse	100A	High pressure washer (Option)
Inline fuse	40A	Live wand (Option)

RELAYS

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

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

Relay	Rating	Circuit Controlled
M1	36 VDC, 200 A	Main contactor
M2	36 VDC, 5 A	Backup alarm / light (Option)
M3	36 VDC, 100 A	Auxiliary line contactor
M4	36 VDC, 200A	Sweep contactor

ELECTRIC MOTORS

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

Carbon Brush Inspection	Hours
Side brush motors - Sweeping (Option)	1000*
Scrubbing vacuum fan motor	500

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

SOLUTION SUPPLY FILTER

Check the solution supply filter screen after every 50 hours of operation and clean if necessary. Lower the scrub head for easier access.



HOPPER DUST FILTER / PERMA-FILTER

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

REMOVING / REPLACING THE HOPPER DUST FILTER

Shake the dust filter at the end of every shift and before removing the filter from the machine. Inspect and clean the filter after every 100 hours of operation. Replace damaged dust filters.

NOTE: Clean the filter more often if used in extremely dusty conditions.

1. Remove the hopper cover from the hopper.



2. Remove the dust filter cover.

3. Remove the dust filter from the hopper.



- 4. Clean or discard the dust filter element. Refer to *CLEANING THE DUST FILTER*.
- 5. Clean dust and debris from the dust filter tray.



- 6. Reinstall the dust filter.
- 7. Reinstall the dust filter cover.
- 8. Reinstall the hopper cover.


CLEANING THE HOPPER DUST FILTER

Use one of the following methods to clean the dust filter:

SHAKING-Press the filter shaker switch.

TAPPING-Tap the filter gently on a flat surface. **Do not damage the edges of the filter.** The filter will not seal properly if the edges of the filter are damaged.



AIR-Always wear eye protection when using compressed air. Blow air through the center of the filter and out toward the exterior. Never use more than 550 kPa (80 psi) of air pressure with a nozzle no smaller than 3 mm (0.13 in) and never hold the nozzle closer than 50 mm (2 in) to the filter.



THERMO-SENTRY

The Thermo-Sentry, located inside the hopper, senses the temperature of the air pulled up from the hopper. If there is a fire in the hopper, the Thermo-Sentry stops the vacuum fan and cuts off the air flow. The Thermo-Sentry automatically resets after cooling down. **INSPECTING / CLEANING THE PERMA-FILTER**

Inspect and clean the Perma-Filter after every 100 hours of operation.



MAIN SCRUB BRUSHES

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

DISK BRUSHES AND PADS

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



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

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

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

REPLACING DISK SCRUB BRUSHES OR PAD DRIVERS

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

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

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



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



5. Squeeze the spring handles and let the brush drop to the floor. Remove the brush from under the scrub head.



6. Set the brush spring open on the new brush to make installation easier.



7. Push the new brush under the scrub head, align the brush drive socket with the brush drive hub, and lift the brush up onto the brush drive hub until the brush locks onto the hub.



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

REPLACING DISK SCRUB PADS

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



3. Remove the scrub pad from the pad driver.



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

CYLINDRICAL SCRUB BRUSHES

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

Replace the brushes when they no longer clean effectively.

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

REPLACING CYLINDRICAL SCRUB BRUSHES

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

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



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



3. Remove the idler plate from the scrub head.



4. Remove the brush from the scrub head.



- 5. Position the brush with the *double row end towards the scrub head opening*. Guide the new brush onto the drive hub.
- 6. If rotating the brushes, always rotate the front with the back so that they wear evenly. They may be rotated end for end as well.



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



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



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

- 9. Close and secure the squeegee support door and close the main brush access door.
- 10. Repeat for the brush on the other side of the scrub head.

MAIN SWEEP BRUSHES

The machine may be equipped with a standard dual force sweeping compartment or an optional single brush direct through sweeping compartment.

Check the brush daily for wear or damage. Remove any string or wire tangled on the main brush, main brush drive hub, or main brush idler hub.



Rotate the brush end-for-end after every 50 hours of operation, for maximum brush life and best sweeping performance. Refer to REPLACING OR ROTATING THE MAIN BRUSH.

Replace the brushes when they no longer clean effectively.

REPLACING THE DUAL FORCE MAIN SWEEPING BRUSHES

1. Raise the sweeping main brush and turn off the machine.

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

2. Open the main sweeping brush compartment access door.



3. Remove the knob and the main sweep brushes idler plate.





4. Pull the brushes from the main sweep compartment.



- 5. Replace or rotate the main brushes as needed. If rotating the brushes, always rotate the front with the back so that they wear evenly. They may be rotated end for end as well.
- Slide the brushes into the main sweep brush compartment and all the way onto the drive hubs.
- 7. Reinstall the main sweep brushes idler plate.
- 8. Close the main sweeping brush compartment access door.

REPLACING THE DIRECT THROW MAIN SWEEPING BRUSH (OPTION)

- 1. Raise and support the hopper on the hopper support bar. SEE ENGAGING THE HOPPER SUPPORT BAR.
- 2. Raise the sweeping main brush and turn off the machine.

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

3. Open the main sweeping brush compartment access door.



4. Remove the two knobs, idler side skirt and plate.





5. Remove the knob and main sweep brush idler plate.



6. Pull the brush from the sweep compartment.



- 7. Replace or rotate the main brush as needed.
- Slide the brush into the main sweep brush compartment and completely onto the drive hub.
- 9. Reinstall the main sweep brush idler plate.
- 10. Reinstall the idler side skirt and plate.
- 11. Close the main sweeping brush compartment access door.
- 12. Lower the hopper.

SIDE BRUSH(ES)

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

REPLACING THE SWEEPING SIDE BRUSHES

Replace the brushes when they no longer clean effectively.

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

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

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



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



4. Place the side brush underneath the side brush assembly and align the channel in the retainer with the retainer pin in the side brush hub.



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

ADJUSTING THE SWEEPING SIDE BRUSHES

Check the side brush pattern after every 50 hours of operation. The right side brush bristles should touch the floor between 10 o'clock and 3 o'clock and the left side brush bristles should touch the floor between 9 o'clock and 2 o'clock when the brushes are in motion.



TO ADJUST SWEEPING SIDE BRUSH -STANDARD PANEL

- 1. Turn on the machine.
- 2. Press and hold the *sweeping side brush button* until the side brush height adjustment screen appears in the LCD display.



NOTE: The Contrast Control and Configuration Mode buttons are used for selecting and adjusting the side brush height.

3. Press the desired sweeping side brush button to select it. The selected side brush will lower and spin.



4. Observe the brush pattern

5. Press the left (-) button to raise the brush or the right (+) button to lower it to obtain the correct brush pattern. The indicator bars increase as the brush gets lower.



- 6. Press the *sweeping side brush button* to save the setting and return to the side brush adjustment text prompt.
- 7. Repeat previous instructions to adjust the other sweeping side brush.
- 8. Recheck the brush patterns. Adjust brush height as necessary.

NOTE: Contact a Tennant service representative if there is a flat pattern (full circle) after the sweeping side brushes have been adjusted.

TO ADJUST SWEEPING SIDE BRUSH - PRO-PANEL

- 1. Turn on the machine.
- 2. Press and hold the *sweeping side brush button* until the side brush height adjustment screen appears in the display.



3. Press the yes button.



4. Press the desired sweeping side brush button to adjust it. The selected brush will lower and spin.



- 5. Observe the brush pattern.
- 6. Press the up button to raise the brush or the down button to lower it to obtain the correct brush pattern. The indicator moves up / down to show the change in brush height.





Press the home button to save the setting and navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

- 7. Press the *back button* to return to the "select side to adjust" screen.
- 8. Repeat previous instructions to adjust the other sweeping side brush.
- 9. Recheck the brush patterns. Adjust brush pressure as necessary.

NOTE: Contact a Tennant service representative if there is a flat pattern (full circle) after the sweeping side brushes have been adjusted.

REPLACING THE SCRUBBING SIDE BRUSH (OPTION)

Replace the pads when they no longer clean effectively. Replace the brushes when they no longer clean effectively or when the bristles are worn down to the yellow indicators.



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

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

2. If necessary, remove the scrubbing side brush squeegee assembly to make access to the scrubbing side brush easier.



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



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



5. Set the brush spring open on the new brush to make installation easier.



- 6. Place the new side brush underneath the side brush assembly and lift the side brush up onto the side brush hub until the brush locks onto the hub.
- 7. Reinstall the scrubbing side brush squeegee assembly.

SQUEEGEE BLADES

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

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

REPLACING (OR ROTATING) THE REAR SQUEEGEE BLADES

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

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

2. Disconnect the vacuum hose from the rear squeegee assembly



3. Loosen both squeegee mounting handles.





4. Pull the rear squeegee assembly from the machine.



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





6. Remove the rear squeegee from the squeegee assembly.



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



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



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





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





12. Remove the front squeegee from the squeegee assembly.



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



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



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





- 15. Reinstall the rear squeegee assembly onto the machine
- 16. Raise the *rear bumper door / step* if it was lowered to access the rear squeegee assembly.

LEVELING THE REAR SQUEEGEE

Leveling the squeegee ensures the entire length of the squeegee blade is in even contact with the surface being scrubber.

- 1. Lower the squeegee and drive the machine several meters (feet) forward and slowly bring the machine to a stop.
- 2. Check the squeegee deflection over the full length of the squeegee blade.

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

- 3. Lower the rear bumper door / step.
- 4. If the deflection is not the same over the full length of the blade, use the tilt adjust knob to make adjustments.

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

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



6. Turn the squeegee tilt adjust knob counterclockwise to decrease the deflection at the ends of the squeegee blade.

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



- 7. Tighten the tilt lock knob.
- 8. Drive the machine forward with the squeegee down to recheck the squeegee blade deflection if adjustments were made.
- 9. Readjust the squeegee blade deflection if necessary.
- 10. Raise the Rear bumper door / step when finished leveling the rear squeegee.

ADJUSTING THE REAR SQUEEGEE BLADE DEFLECTION

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

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

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

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

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



3. Lower the rear bumper door / step.

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



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



- 6. Retighten the lock knobs.
- 7. Drive the machine forward again to recheck the squeegee blade deflection.
- 8. Readjust the squeegee blade deflection if necessary.
- 9. Raise the *rear bumper door / step* when finished adjusting the rear squeegee blade deflection.

REPLACING OR ROTATING THE SIDE SQUEEGEE BLADES

1. If necessary, raise the scrub head.

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

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



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



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



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



- 6. Install the rotated or new rear squeegee blade onto the side squeegee assembly.
- 7. Hook the retaining band onto the retaining band retainer tab on the side squeegee assembly.



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



- 9. Close and secure the squeegee support door and close the main brush access door.
- 10. Repeat for the side squeegee on the other side of the scrub head.

REPLACING OR ROTATING THE SCRUBBING SIDE BRUSH SQUEEGEE BLADES (OPTION)

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

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

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



2. Loosen the retaining band latch.



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



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



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



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



5. Fasten the side brush retaining band latch.



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





SKIRTS AND SEALS

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

SWEEPING RECIRCULATION SKIRTS

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



SWEEPING SIDE SKIRTS

The side skirts are located on both sides of the main sweeping brushes. The side skirts should be just touching the floor. Check the skirts after every 50 hours of operation for damage and wear.



Dual Force Sweeping Skirts



Direct Throw Sweeping Skirts (Option)

RECOVERY TANK SEAL

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



SOLUTION TANK SEAL

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



SCRUB HEAD SKIRTS (DISK SCRUB HEADS ONLY)

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



HOPPER SEALS

Check the seals for damage and wear after every 100 hours of operation.



Plastic Hopper





HOPPER DUST FILTER SEAL

Check the hopper dust filter cover seal for wear or damage every 100 hours of operation. Clean dust and debris from the seal as necessary.



Metal Hopper (Option)

LIVE WAND VACUUM SEALS (OPTION)

Check the live wand vacuum seals for damage and wear after every 50 hours of operation.



BELTS

SWEEPING BRUSH DRIVE BELTS

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

The sweeping brush drive belts are located on the left side of the main sweep head. Check the belts for damage and wear after every 200 hours of operation.



Dual Force Sweeping Drive Belts



Direct Throw Sweeping Drive Belt (Option)

CYLINDRICAL BRUSH DRIVE BELTS

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

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



BRAKES

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

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

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



TIRES

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

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



PUSHING, TOWING, AND TRANSPORTING THE MACHINE

PUSHING OR TOWING THE MACHINE

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

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

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

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

TRANSPORTING THE MACHINE

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

- 1. Raise the squeegee, scrub head, and brushes.
- Raise the hopper enough to clear the ground before loading. The Direct Throw machine can be loaded onto a ramp up to 13%/7°. The Dual Force machine can be loaded onto a ramp of up to 20%/11° but the rear squeegee will need to be removed if it is over 13%/7°.

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

- 3. Park the trailer on a level surface and apply parking brake.
- 4. Position the back end of the machine at the loading edge of the truck or trailer.

NOTE: The machine ability to climb a ramp is affected by tire wear, ramp surface, weather conditions, and other factors. Trailering should only be performed by personnel trained on how to safely load a machine.

 Back the machine onto the trailer or truck. Position the machine so the weight of the machine is safely distributed and can be safely strapped down to the trailer or truck.



NOTE: Do not position the front of machine against the trailer. The hopper/sweeping assemblies could be damaged due to contact of the front of the machine with the trailer during transport.



FOR SAFETY: When loading/unloading machine onto/off truck of trailer, stop on a level surface, set parking brake, and leave the key in the ON position until all tie-down straps are secure.

NOTE: The drive wheel dynamic brake system is active when the key is in the ON position.

- 6. Place a block behind each wheel to prevent the machine from rolling.
- 7. Lower the hopper, scrub head, and rear squeegee.
- 8. Connect the tie-down straps to the holes in the rear jacking brackets at the front of the machine.





9. Turn off machine and remove the key.

MACHINE JACKING

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

Empty the hopper, recovery and solution tanks before jacking the machine.

Jacking point locations at the front of all machines.





Jack stand locations at the front of the machine.





Jacking point location at the rear of all machines.



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

ec-H2O MODULE FLUSH PROCEDURE

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

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

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



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



3. Remove the drain hose from the *ec-H2O* compartment.

4. Connect the drain hose to the *ec-H2O* outlet hose.



5. Place the drain hose into a empty container.



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



- 7. Turn on the machine.
- 8. Press and release the ec-H2O module flush switch to start the flush cycle.



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

- 9. Pour 2 gallons (7.6 liters) of cool clean water into the solution tank.
- 10. Press and release the flush switch to rinse any remaining vinegar from the module. After 1-2 minutes, press the flush switch to turn off the module.
- 11. Disconnect the drain hose from the *ec-H*20 manifold hose.
- 12. Reconnect the outlet hose to the *ec-H2O* manifold hose.
- 13. Return the drain hose to storage location in the *ec-H2O* compartment.
- 14. Close the right shroud.

STORAGE INFORMATION

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

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

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

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

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

FREEZE PROTECTION

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

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

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



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



NOTE: Machines equipped with optional ES system will need to fill the pump lines with Propylene Glycol Based/Recreational Vehicle (RV) antifreeze.

- 4. Turn on the machine.
- 5. Press the 1-STEP button.



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



Standard Panel

Pro-Panel

7. Standard control panel machines with severe environment switch option only: Press the bottom of the severe environment switch to activate the severe environment scrubbing system.

Pro-Panel machines with severe environment button option only: Press and hold the severe environment button to activate the severe environment scrubbing



Standard Panel

Pro-Panel

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



- 9. Drive the machine to circulate the antifreeze completely through all the systems and clear out any remaining water.
- **10. Machines with scrubbing side brush option only:** Press the side brush switch to turn off the side brush.
- 11. Stop the machine.
- **12. Machines with spray nozzle option only:** Operate the wand for a few seconds to protect the pump.
- **13. Machines with high pressure washer option only:** Prime the high pressure washer with the antifreeze and operate the high pressure washer for a few seconds to protect the pump. See PRIMING THE HIGH PRESSURE WASHER PUMP.
- 14. Press the 1-STEP button to turn off the system.
- 15. Turn off the machine.
- 16. The remaining antifreeze does not need to be drained from the solution tank, recovery tank, or detergent tank.

PREPARING THE MACHINE FOR OPERATION AFTER STORAGE

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

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

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



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



5. Turn on the machine.

6. Press the 1-STEP button.



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



Standard Panel

Pro-Panel

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

8. Standard control panel machines with severe environment switch option only: Press the bottom of the severe environment switch to activate the severe environment scrubbing system.

Pro-Panel machines with severe environment button option only: Press and hold the severe environment button to activate the severe environment scrubbing



Standard Panel

Pro-Panel

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



- 10. Drive the machine until all water and antifreeze is emptied from the tanks.
- **11. Machines with scrubbing side brush option only:** Press the side brush switch to turn off the side brush.

NOTE: Machines equipped with optional ES system will need to drain the antifreeze from the pump lines.

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

- 14. Press the 1-STEP button to turn off the system.
- **15. Machines with high pressure washer option only:** Unhook the return line to the solution tank and place into a bucket.



Operate the pressure washer for a few seconds to drain antifreeze from the pump. Release the trigger for a few more seconds which will drain the antifreeze from the return line into the bucket. Turn off the pressure washer switch and reconnect the return line to the solution tank.



WARNING: Do not spray people or animals. Severe personal injury can result. Wear eye protection. Hold sprayer with two hands.



16. Turn off the machine.

PRIMING THE EC-H2O SYSTEM

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

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

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



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



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



- 4. Remove the drain hose from the *ec-H*2O compartment.
- 5. Connect the drain hose to the *ec-H2O* outlet hose.



6. Place the drain hose into a empty container.



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



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

SUPERVISOR CONTROLS

SUPERVISOR CONTROLS

PRO-PANEL SUPERVISOR CONTROLS

The supervisor controls feature allows a supervisor to program the machine scrubbing settings for operator use. The lockout functionality will prevent the operator from changing or saving the settings.

The supervisor controls feature will lower machine variability for consistent, repeatable cleaning results, machine quality assurance regardless of user experience, and reduce user training requirements.

There are two types of user modes that will interface with the operator home screen:

Operator Mode - Capable of machine operation with permissions and restrictions controlled by the supervisor.

Supervisor Mode - Capable of machine operation with full use of all controls, along with configuring permissions and restrictions for the operator mode.

A new machine from the factory will automatically start in the supervisor mode with a preassigned default supervisor profile. The factory-assigned supervisor login number is "1234". This login number is not required until it is enabled. The default supervisor profile name and login number can be changed as described in this section. If the new assigned supervisor mode login number is forgotten, please contact Tennant service.

ENTERING THE SUPERVISOR MODE - FIRST TIME USE ONLY

- 1. Turn on the machine. The main operating screen will appear in the display..
- 2. Press the help button to access the help screen.



3. Press the login button.



 Use the keypad to enter the factory assigned supervisor login number 1234 into the display above the keypad. Press the enter button when finished entering the supervisor login number.





Press the backspace button if necessary to delete and reenter a number.

5. The supervisor machine operation screen should appear in the display. Press the settings button to access the supervisor settings screen.



6. Proceed to ADDING / EDITING PROFILES.

SUPERVISOR CONTROLS

ENTERING THE SUPERVISOR MODE

- 1. Turn on the machine. The login screen will appear on the display.
- 2. Use the keypad to enter the supervisor login number into the display above the keypad. Press the enter button when finished entering the supervisor login number.





Press the backspace button if necessary to delete and reenter a number.

3. The supervisor machine operation screen should appear in the display. Press the settings button to access the supervisor settings screen.


SUPERVISOR SETTING SCREEN/SCREEN **ICONS**

Use the supervisor maintenance screen to setup / change user passwords, user machine settings, and other machine setup items.





Checklist Setup

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Press the up arrow button to navigate up through the menu items.



Press the down arrow button to navigate down through the menu items.



Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

Use the below menu buttons to access the various supervisor setup menus / screens.



Press the video help button to access the various machine help videos.



Press the Add / Edit Profiles button to add, delete, and / or change machine user and supervisor profiles. See ADDING / EDITING PROFILES.



Press the Battery Type button to change the type battery being used in the machine. See CHANGING BATTERY TYPE.



Press the Enable Login button to activate a required login number at machine start up for all user profiles to operate machine.

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	U.

Press the Disable Login button to deactivate a login number at machine start up for all user profiles to operate machine. See DISABLING LOGIN



Press the Calibrate Touch button to calibrate the touch screen if the touch points become misaligned.



Press the Export Checklists button to access the Export Checklists menu. See EXPORTING CHECKLISTS.



Press the Checklists Setup button to access the Checklist Setup menu. See DISABLING / ENABLING THE PRE-OPERATION CHECKLIST.



Press the Camera Settings button to access the Camera Settings screen. See CHANGING REARVIEW CAMERA SETTINGS.



Press the SYSTEM TIME button to access the date / time screen. See SETTING / CHANGING THE TIME AND DATE



Press the Screen Lock button to access the Screen Lock setting Screen. See SETTING THE SCREEN LOCK.

ADDING/EDITING PROFILES

- 1. Turn on the machine, log into the supervisor screen, and press the settings button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Add/Edit Profiles button to access the Add/Edit Profiles screen.



3. Press the Add Profile button to access the Add Profile screen.





Press the Add Profile button to access the screens and menus to add a new profile.



Press the Edit Profile button to edit an existing profile.



Press the Copy Profile button to copy an existing profile.



Press the Delete Profile button to delete an existing profile.



Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

 Press the Operator button to add a new operator, or Supervisor button to add a new supervisor.



NOTE: The default supervisor cannot be deleted from the profile list.



Press the Operator button to add / edit / copy / delete an operator profile .



Press the Supervisor button to add / edit / copy / delete a supervisor profile.

 Use the keypad to enter the new user / supervisor name. Press the enter button.



 Use the keypad to assign the new user / supervisor a login number. The new login number can be any combination of numbers ranging from 3 to 8 digits in length. Press the enter button. The "maximum speed" screen will appear.





Press the backspace button if necessary to delete and reenter a number.

7. Set the maximum speed for the machine.





Press the increase arrow button to increase the maximum speed.



Press the decrease arrow button to decrease the maximum speed.



Press the mph button to set the machine speed to miles per hour.



Press the km/h button to set the machine speed to kilometers per hour.



Press the enter button to set the maximum speed for the machine.

 Select the controls the new user should have access to use. Green represents unlocked controls and gray represents locked controls. Press the flashing save button to save the new profile.





Press the help button to access the help screen.





Press the back button to return to the user access page.

 The new user profile is now saved to the operator profile list. Multiple operator and supervisor user profiles can be added. Press the back arrow button to return to the previous screen to add more user profiles or to enable login.

10. To enable the login number at start up, press the Enable Login button.



The Enable Login button will change from Enable Login to Disable Login. See *DISABLING LOGIN* for instructions how to disable login.



- 11. Now at machine start up, a login screen will display. The new user will need to enter their assigned login number to operate machine.
- 12. When the user is done operating the machine, it is recommended the user log out by pressing the help button, and then pressing the logout button. Turning the key to the off position is another way to also logout.
- 13. Use the Edit Profile button, Copy Profile button, and Delete Profile button to manage the current user profiles.

ENABLING THE LOGIN

- 1. Turn on the machine, log into the supervisor screen, and press the settings button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Enable Login button.



3. Press the yes button to enter the Default User screen.



4. Press either the Operator button or Supervisor button to select the desired default user.



DISABLING THE LOGIN

- 1. Turn on the machine, log into the supervisor screen, and press the settings button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Disable Login button.



3. Press the yes button to enter the Default User screen.



4. Press either the Operator button or Supervisor button to select the desired default user.



5. Select a pre-assigned user profile. Turn off the machine to apply the setting.



6. At start up, the home screen is now set without a login requirement for the operator profile as the default.

CHANGING BATTERY TYPE

Changing the battery type allows the machine to be programmed for the correct battery type if the battery has been changed.

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

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

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Battery Type button to access the battery selection screen.



3. Press the button for the applicable battery from the list. If necessary, use the up arrow button and the down arrow button to navigate through the list of batteries.



4. If a battery sub list appears on the screen, press the button for the applicable battery from the list.



5. If Are You Sure appears on the screen, press either the yes button or the no button.



NOTE: If yes button is pushed the supervisor settings screen will reappear in the display. If the no button is pushed the applicable battery sub list will reappear in the display.

CALIBRATING THE TOUCH

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Calibrate Touch button to recalibrate touch. If the touch points become misaligned.

EXPORTING CHECKLISTS

Exporting the checklists allows the checklists to be exported from the machine and to a flash drive.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Plug the flash drive into the USB port.



3. Press the Export Checklists button to access the export screen.



4. Export the Pre-Operation Checklists from the machine to the memory stick.





Press the Export New button to export the newly completed Pre-Operation Checklists from the machine.



Press the Export All button to export all completed Pre-Operation Checklists from the machine.



Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

5. Remove the flash drive from USB port and turn off the machine.

CHECKLIST SETUP

Checklist setup allows the checklist to be setup / changed to meet machine usage demands.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Checklist Setup button to access the Pre-Operation checklist setup screen.



3. Press the Select Questions button to access the Pre-Operation Checklist master list screen.









Press the up arrow button to scroll up through Pre-Operation Checklist items.



Press the check box button to select a new checklist item to add to the checklist.



Press either the video help button to view the video related to a particular Pre-Operation Checklist item.



Press the Enter button to add the selected Pre-Operation Checklist items(s) to the Pre-Operation Checklist.



Press the help button to access the Pre-Operation Checklist help screen.





Press the back button to return to the Pre-Operation Checklist Master List screen.

4. Press the Every 12 hours button or the Every Time button to set the interval the operator must complete the Pre-Operation Checklist. A check mark appears in the chosen interval.





Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

DISABLING/ENABLING THE PRE-OPERATION CHECKLIST

Disabling / enabling the Pre-Operation checklist allows the Pre-Operation checklist to be disabled if it is not necessary for the operator to complete the checklist prior to operating the machine and enabled if it is necessary for the operator to complete the checklist prior to operating the machine.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the Checklist Setup button to access the Pre-Operation Checklist setup screen.



3. Press the Disable Checklist button / Enable Checklist button to disable / enable the Pre-Operation Checklist.







Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.

CHANGING THE REAR VIEW CAMERA SETTINGS

Changing the rear view camera settings allows the time the rearview camera remains on when the *rearview camera button* is pushed to be changed. The rearview camera can be set to any time between 5 seconds and 2 minutes.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the *Camera Settings button* to access the rear view camera settings screen.







Press the *increase button* to increase the time the rear view camera remains on when the operator presses the *rearview camera button*.



Press the *decrease button* to decrease the time the rear view camera remains on when the operator presses the *rearview camera button*.



Press the *home button* to navigate back to the main operating screen.



Press the *back button* to navigate back to the previous screen.

PROGRAMMING THE ZONE CONTROL BUTTONS

Programming the zone control buttons allows the parameters for the zone control buttons to be changed / updated to meet scrubbing / sweeping demands.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Use the brush pressure increase (+) button and the brush pressure decrease (-) button to set the zone brush pressure.



3. Use the solution increase (+) button and the solution decrease (-) button to set the zone solution flow level.



4. Press and hold the zone control button until the "name preset" screen appears.



 Press the yes button to set the zone settings. Press the no button to return to the main operating screen.



6. Use the key pad to enter the name for the zone control button.







Press the home button to navigate back to the main operating screen.



Press the back button to navigate back to the previous screen.



Press the enter button to set the zone button name.



Press the backspace button if necessary to delete and reenter a number.



Press the space button to place space between letters / numbers.



Press the pound button to toggle between the number keypad and the letter keypad.

 Press the enter button to set the zone button settings. The main operating screen returns to the display with the zone button named. The brush pressure and solution flow setting also briefly appear in the display.



SETTING/CHANGING THE DATE AND TIME

Setting / changing the date and time allow the system date and time to be set / changed.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See *ENTERING THE SUPERVISOR MODE*.
- 2. Press the *System Time button* to access the date / time screen.







Press the *date button* to change the system date.



Press the *time button* to change the system time.



Press the *toggle button* to toggle between hours, minutes, and AM / PM on the time screen and the month, day, and year on the date screen.



Press the *increase button* advance the time / date parameters.



Press the *decrease button* to reverse the time / date parameters.



Press the *home button* to navigate back to the main operating screen.



Press the *back button* to navigate back to the previous screen.

3. Press the *home button* when finished setting / changing the system date and time to return to the main operating screen.

SETTING/CHANGING THE SCREEN LOCK

The screen lock setting adjusts the amount of time the screen remains unlocked before going into the screen lock mode during operation.

- 1. Turn on the machine, login to the main operation screen, and press the setting button to access the supervisor settings screen. See ENTERING THE SUPERVISOR MODE
- 2. Scroll down and press the Screen Lock button to access the screen lock screen.



The screen lock delay can be set to never, 30 seconds, or one minute intervals up to 5 minutes.

	Never	
<	30 Seconds	
	1 Minute	
	2 Minutes	



Press the *home button* to navigate back to the main operating screen.



Press the *back button* to navigate back to the previous screen.



Press the down arrow button to scroll down through screen lock times.



Press the up arrow button to scroll up through screen lock times.

3. Press the home button when finished setting / changing the screen lock time to return to the main operating screen.

INITIAL TROUBLESHOOTING MATRIX

Use the Troubleshooting Matrix to begin preliminary troubleshooting. Some errors may be caused by a blocked vacuum hose or debris preventing the actuator(s) from moving in the complete range of motion. Always check these items before conducting more labor intensive troubleshooting procedures.

TROUBLESHOOTING MATRIX

Output	Pin(s)	Enable	Input	Disable	Input
Vacuum Fan,	Combo Module	1-Step ON	Interface Module	1-Step OFF	Interface Module
Scrubbing ((Water Pickup):	Squeegee/Vacuum ON	Interface Module	Squeegee/Vacuum OFF	Interface Module
	J7-1, J7-2 Fan #2			Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
	J7-3, J7-4			Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Rear Squeegee	Combo Module	1-Step ON	Interface Module	1-Step OFF	Interface Module
Down	(Water Pickup):	Squeegee/Vacuum ON	Interface Module	Squeegee/Vacuum OFF	Interface Module
	J6-17, J6-18			Reverse Propel	Propel Controller, J1-33 High
				Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Main Scrub	Main Scrub/	1-Step ON	Interface Module	1-Step OFF	Interface Module
Brushes	Solution Delivery Module: Left Motor J10-1, J10-2, J10-3, J9-1, J9-2, J9-3, J9-4,	Main Scrub Selected	Interface Module	Main Scrub Deselected	Interface Module
		Forward/Reverse Command	Propel Controller, J1-16 ≈ 0.2-5 VDC	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
				Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
	79-5 Right Motor J11-4, J11-5,			Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
	J11-6, J9-6, J9-7, J9-8, J9-9,			Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
	J9-10			Circuit Fault	CAN to Interface Module

Output	Pin(s)	Enable	Input	Disable	Input
Scrub Head	Main Scrub/	1-Step ON	Interface Module	1-Step OFF	Interface Module
Down	Solution Delivery	Scrub Selected	Propel Controller, J1-6 ≈ 0.2-5 VDC	Scrub Deselected	Propel Controller, $J1-6 \approx 0 VDC$
	J4-9, J4-10			Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
	(J4-9, J4-18, J4-10, J4-14 Module #1242620 only)			Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
	#1243029 0111y)			Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Side Scrub	Side Scrub	1-Step ON	Interface Module	1-Step OFF	Interface Module
Brush Extend/ Down (Option)	Module (Option):	Side Scrub Brush Selected	Side Scrub Module (Option), J4-6 Ground	Side Brush Deselected	Side Scrub Module, J4-6 Not Grounded
	J4-7, J4-8			Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
				Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Side Sweep	Side Sweep/	1-Step ON	Interface Module	1-Step OFF	Interface Module
Brushes	Vacuum Module:	Side Sweep Selected	Interface Module	Side Sweep Deselected	Interface Module
	Left Motor J3-2 CB-17,	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
	J4-17 Pight Motor		VDC	Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
	J3-2 CB-17, J4-16			Circuit Fault	CAN to Interface Module

Output	Pin(s)	Enable	Input	Disable	Input
Side Scrub	Side Scrub	1-Step ON	Interface Module	1-Step OFF	Interface Module
Brush Motor (Option)	Module (Option):	Side Brush Selected	Side Scrub Module (Option), J4-6 Ground	Side Brush Deselected	Side Scrub Module, J4-6 Not Grounded
	J6-1, J6-2, J6-3, J4-11, J4-12,	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
	J4-14, J4-15 J4-16		VDC	Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
				Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73$ VDC
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Solution Control	Main Scrub/	1-Step Scrub ON	Interface Module	1-Step OFF	Interface Module
(Conventional)	Solution Delivery	Main Scrub Selected	Interface Module	Main Scrub Deselected	Interface Module
	Main Valve J4-17, CB-6	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$ VDC	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
	Side Scrub Module (Option): Side Pump <i>J4-10, CB-7</i> Side Valve <i>J4-9, CB-7</i>	Side Scrub Selected	Side Scrub Module (Option), <i>J4-6 ≈ Grounded</i>	Side Scrub Deselected	Side Scrub Module, J4-6 ≈ Not Grounded
				Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
				Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Side Sweep Brushes Down	Side Sweep/ Vacuum	1-Step ON	Interface Module, CAN	1-Step OFF	Interface Module, CAN
	Module: Left Side Actuator J4-11, J4-12 Right Side Actuator	Side Sweep Selected	Interface Module, CAN	Side Sweep Deselected	Interface Module, CAN

Output	Pin(s)	Enable	Input	Disable	Input
Solution Control ec-H2O (Option)	ec-H2O Module:	1-Step ON	Interface Module, CAN	1-Step OFF	Interface Module, CAN
	Side Brush.	ec-H2O Enabled	Interface Module, CAN	Solution Control OFF	Interface Module, CAN
	J4-5, CB-8	Main Scrub Selected	Interface Module, CAN	Main Scrub Deselected	Interface Module, CAN
	Pump <i>J4-4, CB-</i> 9	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
	Sparger <i>J5-1, J5-2</i>		VDC	Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 Low</i>
	e-Cell J5-3, J5-4			Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				<i>ec-H2O</i> System Fault (see <i>ec-</i> <i>H2O</i> system troubleshooting)	<i>ec-H2O</i> Module to CAN
				Circuit Fault	CAN to Interface Module
				Flush Mode	ec-H2O Module, J5-5 and J5-6 = Closed
				System Over Pressure (≈ > 20 psi)	ec-H2O Module, J4-9 = Not Grounded
				Severe Environment Mode	Main Scrub/Solution Delivery Module, J4-8 Low or J4-7 Low
ES (Extended Scrub) Pump	Combo Module (Water Pickup): Water Pump	1-Step ON	Interface Module, CAN	1-Step OFF	Interface Module, CAN
(Option)		Main Scrub Selected	Interface Module, CAN	Main Scrub Deselected	Interface Module, CAN
NOTE: 45		ES Enabled	Interface Module, CAN	ES Disabled	Interface Module, CAN
seconds/10 seconds Off until recovery		Recovery Tank 1/2 Full	Combo Module (Water Pickup), <i>J6-9 = Ground</i>	Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 = Ground</i>
than 1/2 full and solution tank is not full.		Solution Tank Not Full	Main Scrub/ Solution Delivery Module,	Solution Tank Full	Main Scrub/Solution Delivery Module, $J4-1 \approx > 1.34 VDC$
			J4-1 ≈ < 1.34 VDC	Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module

Output	Pin(s)	Enable	Input	Disable	Input
ES Detergent Pump: (Option)	Main Scrub/ Solution	1-Step ON	Interface Module, CAN	1-Step OFF	Interface Module, CAN
Delivery Module:		Main Scrub Selected	Interface Module, CAN	Main Scrub Deselected	Interface Module, CAN
NOTE: Does not operate on	Detergent Pump J4-14, CB-6	ES Enabled	Interface Module, CAN	ES Disabled	Interface Module, CAN
one solution level LED.		Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
			VDC	Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 = Ground</i>
				Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Severe Environment	Main Scrub/ Solution	1-Step ON	Interface Module, CAN	1-Step OFF	Interface Module, CAN
Pump: (Option) Del Mo De	Delivery Module: Detergent Pump	Severe Environment Enabled	Main Scrub/ Solution Delivery Module, <i>J4-8 Low</i> or <i>J4-7 Low</i>	Severe Environment Disabled	Main Scrub/Solution Delivery Module, J4-8 Not Low and J4-7 Not Low
and Long cycle duration times can be adjusted	J4-14, CD-0	Forward/Reverse Command	Propel Controller, J1-16 ≈ 0.2-5 VDC	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
in configuration mode.		Configured for 1%, 2%, or 3% Mix Ratio	Interface Module, CAN	Configured for 0% Mix Ratio	Interface Module, CAN
				Recovery Tank Full	Combo Module (Water Pickup), <i>J6-10 = Ground</i>
				Solution Tank Empty	Main Scrub/Solution Delivery Module, $J4-1 \approx < 0.73 VDC$
				Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Main Sweep Brushes	Main Sweep/ Hopper Lift Module	1-Step ON	Interface Module, CAN	1-Step OFF	Main Sweep/Hopper Lift Module: <i>J4-4 and J4-6 = Not</i> <i>Grounded</i>
	Front J7-1, J7-2	Main Sweep Selected	Interface Module, CAN	Main Sweep Deselected	Interface Module, CAN
	Rear <i>J7-1, J7-3</i>	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
			VDC	Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module

Output	Pin(s)	Enable	Input	Disable	Input
Main Sweep Actuator	Main Sweep/ Hopper Lift Module:	1-Step ON	Interface Module, CAN	1-Step OFF	Main Sweep/Hopper Lift Module: <i>J4-4 = Not Grounded</i>
	Actuator <i>J4-16, J4-17</i>	Main Sweep Selected	Interface Module, CAN	Main Sweep Deselected	CAN to Interface Module
Dust Vacuum Fan	Side Sweep/ Vacuum Module:	1-Step ON Dust Vacuum Selected	Side Sweep/ Vacuum Module: <i>J4-7, J4-15 =</i> <i>Grounded</i>	1-Step OFF Dust Vacuum Deselected	Main Sweep/Hopper Lift Module: <i>J4-4 = Not Grounded</i> <i>J4-15 = Grounded</i>
	Vacuum J4-3, J4-8, CB-20	Forward/Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
			VDC	Low Battery Voltage	Propel Controller, J1-1 ≈ < 32 VDC
				Circuit Fault	CAN to Interface Module
Propel	Propel Controller	Parking Brake Disengaged		Parking Brake Engaged	
		Forward/Reverse Command	Propel Controller, $J1-6 \approx 0.2-5 VDC$	Neutral - Ready State	Propel Controller, $J1-6 \approx 0 VDC$
		Forward/Reverse Switch Input	Propel Controller, J1-22 or J1-33 ≈ Battery Voltage	Brake Switch Input	Propel Controller, J1-11 ≈ Battery Voltage
				Rollout Battery Switch Input	Propel Controller, J1-11 ≈ Battery Voltage
				Propel Controller Fault	See Propel Controller Diagnostics.
Back-Up Alarm/ Lights (Option)		Reverse Switch Input	Propel Controller, J1-33 ≈ Battery Voltage	Forward Switch Input	Propel Controller, J1-22 ≈ Battery Voltage
		Reverse Command	Propel Controller, $J1-16 \approx 0.2-5$	Neutral - Ready State	Propel Controller, J1-16 ≈ 0 VDC
			VDC	Propel Controller Fault	See Propel Controller Diagnostics.
Filter Shaker	Main Sweep/ Hopper Lift	Filter Shaker Button ON		Filter Shaker Button OFF	
	Module	Main Sweep Deselected		1-Step ON	
	CB-17	Dust Vacuum Deselected		Sweep Function Enabled	
		1-Step OFF		Hopper Not Home	Main Sweep/Hopper Lift Module: <i>J4-4 = Not Grounded</i>

Output	Pin(s)	Enable	Input	Disable	Input
High Pressure Spray (Option)	Combo Module (Water Pickup) High Pressure Wire Harness <i>J6-16, CB-10</i>	High Pressure Washer Switch ON		High Pressure Washer Switch OFF	
Dry Vacuum System (Option)	Main Scrub/ Solution Delivery Module: Dry Vacuum Wire Harness J4-1, J4-2, J4-3, J4-4, J4-5, J4-6	Dry Vacuum Switch ON		Dry Vacuum Switch OFF	

FAULTS AND WARNINGS

When the machine detects a fault, the service indicator will flash. A fault code is provided to determine the problem. See *FAULT CODES TABLE* for fault codes, conditions, reasons, and corrective action(s) for the fault codes.

FAULT/ALERT INDICATORS - STANDARD PANEL

This machine is equipped with two visual indicators, a red indicator light and an LCD (liquid crystal display).

The red indicator light will blink continuously indicating that a fault has occurred.



The LCD will display a fault code. If there is more than one fault, each fault code will alternately display.

FAULT/ALERT INDICATORS - PRO-PANEL

The fault / alert indicator button will flash continuously indicating a fault / alert has occurred. The multicolored background will change to a black background.



Press the flashing red fault indicator button to view the faults. A fault / alert screen will appear in the display. Press the flashing yellow alert indicator button to view the alerts. A fault / alert screen will appear in the display.

Fault/alert text will appear under the icon in the center of the screen.



FAULT CODES TABLE

Fault Code Number	Fault Code - Standard Panel	Fault Code - Pro-Panel	Cause(s)	Remedy
0xFFF0	E Stop	Emergency Stop Fault	 E-Stop pressed. E-Stop wiring problem. 	 Key off machine. Press and reset E-Stop button. Key on machine. If fault persists, check harness connections between E-Stop and Propel Controller. Replace or repair harness. Replace E-Stop.
0xFF11	Low Battery	Low Battery Warning	1. Battery voltage too low.	1. Charge battery.
0xFF12	Low Battery	Very Low Battery Warning	1. Battery voltage too low.	1. Charge battery.
0xFF20	M Scrub CAN	Main Scrub CAN Communication Fault	 Main Scrub/Solution Delivery Module is not communicating properly. Main Scrub/Solution Delivery Module lost power (wiring issue). Circuit breaker supplying power to Main Scrub/Solution Delivery Module tripped. Main Scrub/Solution Delivery Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Main Scrub/Solution Delivery Module. No communication with Main Scrub/ Solution Delivery Module - Check CAN Line reference (2.2v each line) and 5VDC voltage regulator and to Motor Encoders.
0xFF21	WPickup CAN	Water Pickup CAN Communication Fault	 Combo Module (Water Pickup) is not communicating properly. Combo Module (Water Pickup) lost power (wiring issue). Circuit breaker supplying power to Combo Module (Water Pickup) tripped. Combo Module (Water Pickup) may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Combo Module (Water Pickup). No communication with Combo Module (Water Pickup).
0xFF22	S Scrub CAN	Side Scrub CAN Communication Fault	 Side Scrub Module is not communicating properly. Side Scrub Module lost power (wiring issue). Circuit breaker supplying power to Side Scrub Module tripped. Side Scrub Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Side Scrub Module. No communication with Side Scrub Module - Check CAN Line reference (2.2v ea. line) and 5VDC voltage regulator and to Motor Encoders.
0xFF23	EcH2O CAN	EcH2O CAN Communication Fault	 ec-H2O Module is not communicating properly. ec-H2O Module lost power (wiring issue). Circuit breaker supplying power to ec-H2O Module tripped. ec-H2O Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to <i>ec-H2O</i> Module. No communication with <i>ec-H2O</i> Module.
0xFF24	S Sweep CAN	Side Sweep CAN Communication Fault	 Side Sweep/Vacuum Module is not communicating properly. Side Sweep/Vacuum Module lost power (wiring issue). Circuit breaker supplying power to Side Sweep/Vacuum Module tripped. Side Sweep/Vacuum Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Side Sweep/Vacuum Module. No communication with Side Sweep/ Vacuum Module.

Fault Code Number	Fault Code - Standard Panel	Fault Code - Pro-Panel	Cause(s)	Remedy
0xFF25	M Sweep CAN	Main Sweep CAN Communication Fault	 Main Sweep/Hopper Lift Module is not communicating properly. Main Sweep/Hopper Lift Module lost power (wiring issue). Circuit breaker supplying power to Main Sweep/Hopper Lift Module tripped. Main Sweep/Hopper Lift Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Main Sweep/Hopper Lift Module. No communication with Main Sweep/ Hopper Lift Module .
0xFF26	Propel Comm	Propel CAN Communication Fault	 Propel Controller is not communicating properly. Propel Controller lost power (wiring issue). Circuit breaker supplying power to Propel Controller tripped. Propel Controller may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to Propel Controller. No communication with Propel Controller.
0x0010	Parking Brk	Parking Brake	1. Flashing indicator indicates manual parking brake is engaged, locking brake pedal.	1. Release parking brake.
0x0101	L Scrub Opn	Left Scrub Motor Open Warning	1. Wiring, connector, or Main Scrub/ Solution Delivery Module issue with circuit to motor.	1. Check connections, Main Scrub/Solution Delivery Module gets power from key switch and battery. If connections are good, replace Main Scrub/Solution Delivery Module.
0x0106	L Scrub Srt	Left Scrub Motor Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0107	L Scrub FET	Left Scrub Motor FET Fault	 Main Scrub/Solution Delivery Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Scrub/Solution Delivery Module.
0x0111	R Scrub Opn	Right Scrub Motor Open Warning	1. Wiring, connector or Main Scrub/ Solution Delivery Module issue with circuit to motor.	1. Check connections, Main Scrub/Solution Delivery Module gets power from key switch and battery. If connections are good, replace Main Scrub/Solution Delivery Module.
0x0116	R Scrub Srt	Right Scrub Motor Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0117	R Scrub FET	Right Scrub Motor FET Fault	 Main Scrub/Solution Delivery Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Scrub/Solution Delivery Module.
0x0120	S Scrub Flt	Side Scrub Motor Generic	1. Side scrub brush motor issue.	1. Replace side scrub brush motor.
0x0121	S Scrub Opn	Side Scrub Motor Open Warning	1. Wiring, connector or Side Scrub Module issue with circuit to motor.	1. Check connections, Side Scrub Module gets power from key switch and battery. If connections are good, replace Side Scrub Module.
0x0122	S Scrub VIt	Side Scrub Motor Voltage Loss	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness and repair as needed.
0x0127	S Scrub FET	Side Scrub Motor FET Fault	 Side Scrub Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Scrub Module.
0x0129	S Scrub Tmp	Side Scrub Motor Overheat	1. Motor temperature too high (over 104F).	 Check motor temp. Repair or replace.
0x0131	M Swp 1 Opn	Main Sweep Brush Motor 1 Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module gets power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.

Fault	Fault Code -	Fault Code -	Cause(s)	Remedy
Code Number	Standard Panel	Pro-Panel		
0x0136	M Swp 1 Srt	Main Sweep Brush Motor 1 Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0137	M Swp 1 FET	Main Sweep Brush Motor 1 FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0141	M Swp 2 Opn	Main Sweep Brush Motor 2 Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.
0x0146	M Swp 2 Srt	Main Sweep Brush Motor 2 Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0147	M Swp 2 FET	Main Sweep Brush Motor 2 FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0151	R Sweep Opn	Right Sweep Brush Motor Open Warning	1. Wiring, connector, or Side Sweep/ Vacuum Module issue with circuit to motor.	1. Check connections, Side Sweep/ Vacuum Module gets power from key switch and battery. If connections are good, replace Side Sweep/Vacuum Module.
0x0156	R Sweep Srt	Right Sweep Brush Motor Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0157	R Sweep FET	Right Sweep Brush Motor FET Fault	 Side Sweep/Vacuum Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Sweep/Vacuum Module.
0x0161	L Sweep Opn	Left Sweep Brush Motor Open Warning	1. Wiring, connector, or Side Sweep/ Vacuum Module issue with circuit to motor.	1. Check connections, Side Sweep/ Vacuum Module gets power from key switch and battery. If connections are good, replace Side Sweep/Vacuum Module.
0x0166	L Sweep Srt	Left Sweep Brush Motor Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0167	L Sweep FET	Left Sweep Brush Motor FET Fault	 Side Sweep/Vacuum Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Sweep/Vacuum Module.
0x0171	FltShkr Opn	Filter Shaker Motor Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module gets power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.
0x0176	FltShkr Srt	Filter Shaker Motor Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0177	FltShkr FET	Filter Shaker Motor FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0231	MSwpAct Opn	Main Sweep Actuator Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module gets power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.
0x0237	MSwpAct FET	Main Sweep Actuator FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0247	RSwpAct FET	Right Sweep Actuator FET Fault	 Side Sweep/Vacuum Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Sweep/Vacuum Module.

Fault Code Number	Fault Code - Standard Panel	Fault Code - Pro-Panel	Cause(s)	Remedy
0x0257	LSwpAct FET	Left Sweep Actuator FET Fault	 Side Sweep/Vacuum Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Sweep/Vacuum Module.
0x0261	LiftAct Opn	Hopper Lift Actuator Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module gets power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.
0x0266		FAULT_ ACTUATOR7_ SHORT	1. Hopper lift actuator over software current limit.	 Check pump. Check Main Sweep/Hopper Lift Module.
0x0267	LiftAct FET	Hopper Lift Actuator FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0271	RollAct Opn	Hopper Roll Actuator Open Warning	1. Wiring, connector, or Main Sweep/ Hopper Lift Module issue with circuit to motor.	1. Check connections, Main Sweep/Hopper Lift Module gets power from key switch and battery. If connections are good, replace Main Sweep/Hopper Lift Module.
0x0276		FAULT_ ACTUATOR8_ SHORT	1. Hopper roll actuator over software current limit.	 Check roll out actuator. Check Main Sweep/Hopper Lift Module.
0x0277	RollAct FET	Hopper Roll Actuator FET Fault	 Main Sweep/Hopper Lift Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Sweep/Hopper Lift Module.
0x0278	RollAct Stl	Hopper Roll Actuator Stall	 Over current. Binding issue. 	 Check amp preferences. Check actuator for binding.
0x0301	M Water Opn	Main Water Valve Open Warning	1. Wiring, connector, or Main Scrub/ Solution Delivery Module issue with circuit to motor.	1. Check connections, Main Scrub/Solution Delivery Module gets power from key switch and battery. If connections are good, replace Main Scrub/Solution Delivery Module.
0x0306	M Water Srt	Main Water Valve Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness and repair as needed.
0x0307	M Water FET	Main Water Valve FET Fault	 Main Scrub/Solution Delivery Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Scrub/Solution Delivery Module.
0x0311	Horn Opn	Horn Open Warning	1. Wiring, connector, or Main Scrub/ Solution Delivery Module issue with circuit to motor.	1. Check connections, Main Scrub/Solution Delivery Module gets power from key switch and battery. If connections are good, replace Main Scrub/Solution Delivery Module.
0x0316	Horn Srt	Horn Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0317	Horn FET	Horn FET Fault	 Main Scrub/Solution Delivery Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Scrub/Solution Delivery Module.
0x0321	Alarm Opn	Alarm Open Warning	1. Wiring, connector, or Propel Controller issue with circuit to motor.	1. Check connections, Propel Controller gets power from key switch and battery. If connections are good, replace Propel Controller.
0x0326	Alarm Srt	Alarm Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0327	Alarm FET	Alarm FET Fault	 Propel Controller problem. Power/battery issue on startup. 	 Check voltage references. Replace Propel Controller.

Fault	Fault Code -	Fault Code -	Cause(s)	Remedy
Number	Panel	Pro-Panel		
0x0331	S Scrub Opn	Side Scrub Valve Open Warning	1. Wiring, connector, or Side Scrub Module issue with circuit to motor.	1. Check connections, Side Scrub Module gets power from key switch and battery. If connections are good, replace Side Scrub Module.
0x0336	S Scrub Srt	Side Scrub Valve Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0337	S Scrub FET	Side Scrub Valve FET Fault	 Side Scrub Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Scrub Module.
0x0341	SAF VIv Opn	Solution AutoFill Valve Open Warning	1. Wiring, connector, or Combo Module (Water Pickup) issue with circuit to motor.	1. Check connections, Combo Module (Water Pickup) gets power from key switch and battery. If connections are good, replace Combo Module (Water Pickup).
0x0346	SAF VIv Srt	Solution AutoFill Valve Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0347	SAF VIv FET	Solution AutoFill Valve FET Fault	 Combo Module (Water Pickup) problem. Power/battery issue on startup. 	 Check voltage references. Replace Combo Module (Water Pickup).
0x0351	RAF VIv Opn	Recovery AutoFill Valve Open Warning	1. Wiring, connector, or Combo Module (Water Pickup) issue with circuit to motor.	1. Check connections, Combo Module (Water Pickup) gets power from key switch and battery. If connections are good, replace Combo Module (Water Pickup).
0x0356	RAF VIv Srt	Recovery AutoFill Valve Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0357	RAF VIv FET	Recovery AutoFill Valve FET Fault	 Combo Module (Water Pickup) problem. Power/battery issue on startup. 	 Check voltage references. Replace Combo Module (Water Pickup).
0x0401	S Swp Relay	Side Sweep Contactor Open Fault	1. Sweep Auxiliary Contactor (M2) is bad.	1. Replace Sweep Auxiliary Contactor (M2).
0x0501	Vac 1 Opn	Pickup Vac 1 Electrical Open Alert	1. Wiring, connector, or Combo Module (Water Pickup) issue with circuit to motor.	1. Check connections, Combo Module (Water Pickup) gets power from key switch and battery. If connections are good, replace Combo Module (Water Pickup).
0x0503		FAULT_VACUUM1_ OVERCURRENT	1. Pickup Vacuum 1 has hit hardware current limit.	1. Check vacuum fan 1 2. Check Combo Module (Water Pickup).
0x0504	Vac 1 OC1	Pickup Vac 1 Over Current 1 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.
0x0505	Vac 1 OC2	Pickup Vac 1 Over Current 2 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.
0x0507	Vac 1 FET	Pickup Vac 1 FET Fault	 Combo Module (Water Pickup) problem. Power/battery issue on startup. 	 Check voltage references. Replace Combo Module (Water Pickup).
0x0511	Vac 2 Opn	Pickup Vac 2 Electrical Open Alert	1. Wiring, connector, or Combo Module (Water Pickup) issue with circuit to motor.	1. Check connections, Combo Module (Water Pickup) gets power from key switch and battery. If connections are good, replace Combo Module (Water Pickup).
0x0513		FAULT_VACUUM2_ OVERCURRENT	1. Pickup Vacuum 2 has hit hardware current limit.	1. Check vacuum fan 1 2. Check Combo Module (Water Pickup.
0x0514	Vac 2 OC1	Pickup Vac 2 Over Current 1 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.
0x0515	Vac 2 OC2	Pickup Vac 2 Over Current 2 Fault	1. Current draw higher than expected.	1. Verify vacuum load, damage and/or usage conditions.

Fault Code Number	Fault Code - Standard Panel	Fault Code - Pro-Panel	Cause(s)	Remedy
0x0517	Vac 2 FET	Pickup Vac 2 FET Fault	 Combo Module (Water Pickup) problem. Power/battery issue on startup. 	 Check voltage references. Replace Combo Module (Water Pickup).
0x0520	DstVac1 Flt	Dust Vac 1 Underspeed Fault	1. Dust fan motor operating too slow.	 Verify vacuum load, damage and/or usage conditions.
0x0530	DstVac2 Flt	Dust Vac 2 Underspeed Fault	1. Dust fan motor operating too slow.	 Verify vacuum load, damage and/or usage conditions.
0x0601	SdePump Opn	Side Scrub Pump Open Warning	1. Wiring, connector, or Side Scrub Module issue with circuit to motor.	1. Check connections, Side Scrub Module gets power from key switch and battery. If connections are good, replace Side Scrub Module.
0x0606	SdePump Srt	Side Scrub Pump Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0607	SdePump FET	Side Scrub Pump FET Fault	 Side Scrub Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Side Scrub Module.
0x0611	DetPump Opn	Detergent Pump Open Warning	1. Wiring, connector, or Main Scrub/ Solution Delivery Module issue with circuit to motor.	1. Check connections, Main Scrub/Solution Delivery Module gets power from key switch and battery. If connections are good, replace Main Scrub/Solution Delivery Module.
0x0616	DetPump Srt	Detergent Pump Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness and repair as needed.
0x0617	DetPump FET	Detergent Pump FET Fault	 Main Scrub/Solution Delivery Module problem. Power/battery issue on startup. 	 Check voltage references. Replace Main Scrub/Solution Delivery Module.
0x0621	ES Pump Opn	Extended Scrub Pump Open Warning	1. Wiring, connector, or Combo Module (Water Pickup) issue with circuit to motor.	1. Check connections, Combo Module (Water Pickup) gets power from key switch and battery. If connections are good, replace Combo Module (Water Pickup).
0x0626	ES Pump Srt	Extended Scrub Pump Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	1. Check wire harness. Repair as needed.
0x0627	ES Pump FET	Extended Scrub Pump FET Fault	 Combo Module (Water Pickup) problem. Power/battery issue on startup. 	 Check voltage references. Replace Combo Module (Water Pickup).
0x0701	Ec Flsh Flt	EC-H2O System Flush Needed	1. <i>ec-H2O</i> module needs a manually triggered flush.	1. Press switch on <i>ec-H2O</i> module.
0x0702	Ec Press Sw	EC-H2O Pressure Switch Active	1. System pressure switch is detecting a trip or is unconnected.	 System pressure too high, check connections. Verify functionality of scrub head switch and parking brake switch; connectors possibly connected to incorrect switches.
0x0704	Ec CAN	EC-H2O CAN Communication Fault	 ec-H2O Module is not communicating properly. ec-H2O Module lost power (wiring issue). Circuit breaker supplying power to ec-H2O Module. ec-H2O Module may be damaged. 	 Power cycle machine. Check circuit breaker supplying power to <i>ec-H2O</i> Module. No communication with a network module.
0x0711	Ec Pump Opn	EC-H2O Pump Open Fault	1. Wiring, connector, or <i>ec-H2O</i> Module issue with circuit to motor.	1. <i>ec-H2O</i> Module is not detecting pump current. Check connections for voltage and verify pump is operating.

Fault	Fault Code -	Fault Code -	Cause(s)	Remedy
Code	Standard	Pro-Panel		
0x0716	Ec Pump Srt	EC-H2O Pump Short	1. Shorted load condition.	1. Check wiring for shorted condition.
		Fault	2. Higher current draw than hardware design limit.	2. Replace pump.
0x0717	Ec Pump FET	EC-H2O Pump FET Fault	 <i>ec-H2O</i> Module problem. Power/battery issue on startup. 	 Check voltage references. Replace ec-H2O Module.
0x0720	Ec Cell Flt	EC-H2O Cell Generic Fault	1. <i>ec-H2O</i> generic fault.	 Check voltage references. Replace <i>ec-H2O</i> Module.
0x0727	Ec Cell FET	EC-H2O Cell FET Faults	 ec-H2O Module problem. Power/battery issue on startup. 	 FET detection includes motor, actuator, detergent pump, vacuum and battery watering pump. Replace <i>ec-H2O</i> Module.
0x0730	Ec Spgr Flt	EC-H2O Sparger Generic Fault	1. ec-H2O sparger generic fault.	1. Use trouble-shooting tree to diagnosis.
0x0737	Ec Spgr FET	EC-H2O Sparger FET Fault	 <i>ec-H2O</i> Module problem. Power/battery issue on startup. 	 Check voltage references. Replace <i>ec-H2O</i> Module.
0x0751	Ec VIv Opn	EC-H2O Valve Open Fault	1. Wiring, connector, or <i>ec-H2O</i> Module issue on <i>ec-H2O</i> valve.	1. <i>ec-H2O</i> Module is not detecting pump current. Check connections for voltage and verify pump is operating.
0x0756	Ec VIv Srt	EC-H2O Valve Short Fault	 Shorted load condition. Higher current draw than hardware design limit. 	 Check valve and wiring. Replace if out of specifications.
0x0757	Ec VIv FET	EC-H2O Valve FET Fault	1. ec-H2O Module problem. 2. Power/battery issue on startup.	1. Check voltage references. 2. Replace <i>ec-H2O</i> Module.
0x0761		FAULT_ECH2O_ SIDE_VALVE_OPEN	 ec-H2O valve. Wire/cable connection broken. 	 Check <i>ec-H2O</i> valve. Check <i>ec-H2O</i> valve wiring connections. Check <i>ec-H2O</i> Module.
0x0766		FAULT_ECH2O_ SIDE_VALVE_ SHORT	 <i>ec-H2O</i> valve shorted. Connection shorted. 	 Check <i>ec-H2O</i> valve. Check <i>ec-H2O</i> valve wiring connections. Check <i>ec-H2O</i> Module.
0x0767		FAULT_ECH2O_ SIDE_VALVE_FET_ SHORT	 <i>ec-H2O</i> valve shorted. <i>ec-H2O</i> Module damaged. 	1. Check <i>ec-H2O</i> valve. 2. Check <i>ec-H2O</i> Module.
0x0790	SolTnkEmpty	Solution Tank Empty	 Solution tank empty. Wiring, connector, or solution tank switch issue. 	1. If tank is not empty, check tank switch and wiring.
0x0791	RcvTnk Full	Recovery Tank Full	 Recovery tank full. Wiring, connector, or recovery tank switch issue. 	1. If tank is not full, check tank switch and wiring.
0x07A0		Clogged Filter Warning	1. Filter clogged with dust and debris.	1. Engage filter shaker. 2. Clean filter.
0x07A1	Hopper Fire	Hopper on Fire	1. Hopper on fire.	1. Extinguish hopper fire.
0x07A2		Hopper not in Home position	1. Hopper not completely lowered.	 Completely lower hopper. Check actuator for binding.

Fault Code Number	Fault Code - Standard Panel	Fault Code - Pro-Panel	Cause(s)	Remedy
0x1003	Dwn Pressure	Down Pressure Unattainable	1. Unable to achieve target brush motor current following down shift(s) to lowest down pressure level.	1. SET: Main Scrub/Solution Delivery Module unable to achieve target brush motor current in desired down pressure setting. Main Scrub/Solution Delivery Module attempts to "down shift" to lower setting(s) until it is unable to achieve target current in lowest down pressure setting. CLEAR: Power cycle machine.
0x1004		FAULT_SWEEP_ DOWN_ PRESSURE_ UNATTAINABLE	1. Unable to achieve target brush motor current following down shift(s) to lowest down pressure level.	1. SET: Main Sweep/Hopper Lift Module unable to achieve target brush motor current in desired down pressure setting. Main Sweep/Hopper Lift Module attempts to "down shift" to lower setting(s) until it is unable to achieve target current in lowest down pressure setting. CLEAR: Power cycle machine.
0x2000	Pascal Flt	Touchscreen Error	1. Touchscreen control board problem.	1. Replace pod.

A Service Diagnostics tool is available to provide additional fault detail. See *SERVICE DIAGNOSTICS TOOL* in *SERVICE* section.

LITHIUM ION BATTERY INDICATOR CODES

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

Fault Code Number	Fault Code	Fault Condition	Cause	Solution
0x0D26	FAULT_LPBMS_ HWTF_THERMISTOR	A thermistor in BMS has failed.	BMS Thermistor Error	Recycle power to BMS. If fault repeats, replace BMS.
0x0D27	FAULT_LPBMS_ HWTV_CVSENS	Error occurred in cell voltage sensing internal to one or more Cell Modules.	BMS Cell Voltage Sensing Error	Recycle power to BMS. If fault repeats, replace BMS.
0x0D28	FAULT_LPBMS_ SWTV_NVM	BMS hardware failure.	BMS NVM Read/Write/Erase Error	Recycle power to BMS. If fault repeats, replace BMS.
0x0D29	FAULT_LPBMS_ SWTF_INITDATA	BMS hardware failure.	BMS Initial Data Error	Recycle power to BMS. If fault repeats, replace BMS.
0x0D2A	FAULT_LPBMS_ SWTF_CHKSUM_ ROM	BMS hardware failure.	BMS ROM Checksum Error	Recycle power to BMS. If fault repeats, replace BMS.
0x0D2B	FAULT_LPBMS_ CHARGE	BMS hardware failure.	BMS Abnormal Charge Protection	Recycle power to BMS. If fault repeats, replace BMS.
0x0D35		Incompatible Cell Module type.	BMS Incorrect Battery Type	
0x0D03	FAULT_LPBMS_ OVERCURRENT_ CHARGE_ PROTECTION	An over-current error is determined during charging. Will shut down charging operation.	BMS Over Current Charge Protection	Unplug charger from power. Wait 2 minutes. Re-plug charger into power. If fault repeats, may indicate a charger failure, or use of wrong charger.
0x0D04	FAULT_LPBMS_ OVERCURRENT_DC_ PROTECTION_1	Machine is drawing too much current from battery pack. Will cause BMS to shut down.	BMS Over Current Discharge Protection 1	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
0x0D05	FAULT_LPBMS_ OVERCURRENT_DC_ PROTECTION_2	Machine is drawing too much current from battery pack. Will cause BMS to shut down.	BMS Over Current Discharge Protection 2	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
0x0D15	FAULT_LPBMS_ OVERCURR_DC_ WARN_1	Machine is drawing too much current from battery pack. Will cause machine to stop operation.	BMS Over Current Discharge Warning 1	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
0x0D16	FAULT_LPBMS_ OVERCURR_ CHARGE_WARN	Machine is drawing too much current from battery pack. Will cause machine to stop operation.	BMS Over Current Charge Warning	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
0x0D24	FAULT_LPBMS_ OVERCURR_DC_ WARN_2	Machine is drawing too much current from battery pack. Will cause machine to stop operation.	BMS Over Current Discharge Warning 2	Look for obstruction and restart machine. If fault repeats look for machine component drawing too much current.
0x0D01	FAULT_LPBMS_ CELL_OVERVOLT_ PROTECTION_1	A cell in one or more cell modules has too high a voltage (above 4.05 volts per cell). Will cause BMS to turn off.	BMS Cell Over Voltage Protection 1	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
0x0D02	FAULT_LPBMS_ CELL_UNDERVOLT_ PROTECTION_1	A cell in one or more cell modules has too high a voltage (above 3.0 volts per cell). Will cause BMS to turn off.	BMS Cell Under Voltage Protection 1	Stop use of machine and recharge battery. If fault repeats, contact service.

Fault Code Number	Fault Code	Fault Condition	Cause	Solution
0x0D0B	FAULT_LPBMS_ CELL_OVERVOLT_ PROT_2	A cell in one or more cell modules has too high a voltage (above 4.05 volts per cell). Will cause BMS to turn off.	BMS Cell Over Voltage Protection 2	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
0x0D0C	FAULT_LPBMS_ CELL_UNDERVOLT_ PROT_2	A cell in one or more cell modules has too low a voltage (below 3.0 volts per cell). Will cause BMS to turn off.	BMS Cell Under Voltage Protection 2	Stop use of machine and recharge battery. If fault repeats, contact service.
0x0D0D	FAULT_LPBMS_ CELL_OVERVOLT_ WARN_1	A cell in one or more cell modules has too high a voltage (above 4.05 volts per cell). Will cause machine to stop operation	BMS Cell Over Voltage Warning 1	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
0x0D0E	FAULT_LPBMS_ CELL_OVERVOLT_ WARN_2	A cell in one or more cell modules has too high a voltage (above 4.05 volts per cell). Will cause machine to stop operation	BMS Cell Over Voltage Warning 2	Stop charging. Restart machine in scrubbing mode. If fault repeats, contact service.
0x0D0F	FAULT_LPBMS_ CELL_UNDERVOLT_ WARN_1	A cell in one or more cell modules has too low a voltage (below 3.0 volts per cell). Will cause machine to stop operation	BMS Cell Under Voltage Warning 1	Stop use of machine and recharge battery. If fault repeats, contact service.
0x0D10	FAULT_LPBMS_ CELL_UNDERVOLT_ WARN_2	A cell in one or more cell modules has too low a voltage (below 3.0 volts per cell). Will cause machine to stop operation.	BMS Cell Under Voltage Warning 2	Stop use of machine and recharge battery. If fault repeats, contact service.
0x0D1C	FAULT_LPBMS_ CELL_DEEP_DC_ FAILURE	Permanent failure of one or more cell modules that has been discharged beyond recovery.	BMS Cell Deep Discharge Failure	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires replacement of Battery Pack.
0x0D1D	FAULT_LPBMS_ CELL_IMBALANCE_ FAILURE	Failure of automatic cell balancing circuit to keep cell voltages in balance within specification.	BMS Cell Imbalance Failure	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires replacement of Battery Pack.
0x0D1E	FAULT_LPBMS_ MOD_VOLT_DELTA_ ERROR	Too great a difference between lowest and highest cell voltages.	BMS Module Voltage Delta Error	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires replacement of Battery Pack.
0x0D36		A cell in one or more cell modules has too high a voltage. (above 4.05 volts per cell) Will cause machine to stop operation.	BMS Over Charge Cell Voltage Threshold Warning	Restart machine in scrubbing mode. If fault repeats, this is a permanent failure that requires replacement of Battery Pack.
0x0D34	FAULT_LPBMS_ CAN_LOST	CAN communication between User Interface (UI) and BMS has been interrupted.	BMS CAN Communication Lost	Verify Tap Harness (COM) connector is properly connected to BMS. Verify no other connectors of Tap Harness have been disconnected. If problem persists, contact service for possible replacement of BMS or other components on CAN bus.

Fault Code Number	Fault Code	Fault Condition	Cause	Solution
0x0D06	FAULT_LPBMS_ OVERTEMP_ CHARGE_ PROTECTION	Over temperature condition detected during a charge operation. Battery pack will shut down.	BMS Over Temp Charge Protection	Stop charging. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
0x0D07	FAULT_LPBMS_ UNDERTEMP_ CHARGE_ PROTECTION	Under temperature condition detected during a charge operation. Battery pack will shut down.	BMS Under Temp Charge Protection	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	FAULT_LPBMS_ OVERTEMP_DC_ PROTECTION	Over temperature condition detected during a cleaning operation. Battery pack will shut down.	BMS Over Temp Discharge Protection	Stop operating machine. Move machine to cooler location. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
0x0D09	FAULT_LPBMS_ UNDERTEMP_DC_ PROTECTION	Under temperature condition detected during a cleaning operation. Battery pack will shut down.	BMS Under Temp Discharge Protection	Stop operating machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting operation.
0x0D11	FAULT_LPBMS_ OVERTEMP_ CHARGE_WARN	Over temperature condition detected during a charge operation. Machine will stop operation.	BMS Over Temp Charge Warning	Stop charging. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
0x0D12	FAULT_LPBMS_ UNDERTEMP_ CHARGE_WARN	Under temperature condition detected during a charge operation. Machine will stop operation.	BMS Under Temp Charge Warning	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	FAULT_LPBMS_ OVERTEMP_ DISCHARGE_ WARN	Over temperature condition detected during a cleaning operation. Machine will stop operation.	BMS Over Temp Discharge Warning	Stop operating machine. Move machine to cooler location. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
0x0D14	FAULT_LPBMS_ UNDERTEMP_ DISCHARGE_WARN	Under temperature condition detected during a cleaning operation. Machine will stop operation.	BMS Under Temp Discharge Warning	Stop operating machine. Move machine to warmer location. Allow battery to warm up above 0°C (-32°F), before restarting operation.
0x0D31	FAULT_LPBMS_BUS_ BAR_TEMP_ERR	BMS temperature has exceeded specification. Battery pack will shut down.	BMS Bus-Bar Temp Error	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
0x0D32	FAULT_LPBMS_BUS_ BAR_TEMP_PROT	BMS temperature has exceeded specification. Battery pack will shut down.	BMS Bus-Bar Temp Protection	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.
0x0D33	FAULT_LPBMS_BUS_ BAR_TEMP_WARN	BMS temperature has exceeded specification. Machine will stop operation.	BMS Bus-Bar Temp Warning	Stop using or charging machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.

Fault Code Number	Fault Code	Fault Condition	Cause	Solution
0x0D37		Under temperature condition detected during a charging operation. Machine will stop operation.	BMS Under Temp Charge Threshold Warning	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		Over temperature condition detected during a charging operation. Machine will stop operation.	BMS Over Temp Charge Threshold Warning	Stop charging machine. Move machine to cooler location. Allow battery to cool down, before restarting charging. If fault repeats, contact service.
0x0D39	FAULT_LPBMS_ THRESH_ UNDERTEMP_ DISCHARGE_WARN	Under temperature condition detected during a cleaning operation. Machine will stop operation.	BMS Under Temp Discharge Threshold Warning	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	FAULT_LPBMS_ THRESH_ OVERTEMP_ DISCHARGE_WARN	Over temperature condition detected during a cleaning operation. Machine will stop operation.	BMS Over Temp Discharge Threshold Warning	Stop operating machine. Allow battery to cool down, before restarting operation. If fault repeats, contact service.

SERVICE MODES

SELF-TEST MODE - PRO-PANEL

Use the Self-Test Mode diagnostic utility to test for open or shorted output circuits. Once completed, open and/or shorted output pins are displayed on the LCD (Liquid Crystal Display).

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



4. Use the keypad to enter the Service login number into the display above the keypad. Press the enter button when finished entering the supervisor login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



7. The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until SELF TEST appears.



8. Press the Check button to start the self-test mode. All self-test mode settings will appear on the screen as the particular system is being tested. See the table on the following page for a list of self-tests.

NOTE: Machines functions are briefly automatically activated while each function is being tested.
9. The controller sequentially tests each output circuit listed below. The self-test only tests systems that have been configured on the machine. If an option has not been configured, it will not be tested.

Testing L Main Scrub Brush
Testing R Main Scrub Brush
Testing Side Scrub Brush
Testing R Side Sweep Brush
Testing L Side Sweep Brush
Testing F Main Sweep Brush
Testing R Main Sweep Brush
Testing Dust Vac Motor 1
Testing Dust Vac Motor 2
Testing Pick-up Vac Motor 1
Testing Pick-up Vac Motor 2
Testing Filter Shaker
Testing Main Scrub Actuator
Testing Side Scrub Actuator
Testing Main Sweep Actuator
Testing L Side Sweep Actuator
Testing R Side Sweep Actuator
Testing Squeegee Actuator
Testing Main Water Valve
Testing Detergent Pump
Testing Side Pump
Testing Ec-H2O WaterSystem
Testing Ec-H2O Side Valve
Testing Ec-H2O Pump
Testing ES Pump
Testing Side Valve
Testing Solution Auto-Fill Valve
Testing Recovery Auto-Fill Valve
Testing Horn
Testing Alarm
Test Propel CAN Communication

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

MESSAGE	MESSAGE	
S1:Self Test "Done" or " <results>"</results>	S38:R Side Swp Act J4-1,2	
S2:L Main F/L Scrub Br J10-1,2,3	S39:Squeegee Act J6-17,18	
S3:L Main F/L Scrub Br J10-1,2,3	S40:Squeegee Act J6-17,18	
S4:R Main R/R Scrub Br J11-4,5,6	S41:Squeegee Act J6-17,18	
S5:R Main R/R Scrub Br J11-4,5,6	S42:Main Water VIv J4-17	
S6:Side Scrub Br J6-1,2,3	S43:Main Water VIv J4-17	
S7:Side Scrub Br J6-1,2,3	S44:Detergent Pmp J4-14	
S8:L Side Swp Br J4-17	S45:Detergent Pmp J4-14	
S9:L Side Swp Br J4-17	S46:Side Scrub Pmp J4-4,10	
S10:R Side Swp Br J4-16	S47:Side Scrub Pmp J4-4,10	
S11:R Side Swp Br J4-16	S48:EcH2O Cell J5-3,4	
S12:L Main Swp Br J7-1,2	S49:EcH2O Cell J5-3,4	
S13:L Main Swp Br J7-1,2	S50:EcH2O Spargr J5-1,2	
S14:R Main Swp Br J7-1,3	S51:EcH2O Spargr J5-1,2	
S15:R Main Swp Br J7-1,3	S52:EcH2O Sde Vlv J4-1,2,5	
S16:Dust Vac 1 J4-5,10	S53:EcH2O Sde Vlv J4-1,2,5	
S17:Dust Vac 1 J4-5,10	S54:EcH2O Pump J4-4	
S18:Dust Vac 2 J4-4,9	S55:EcH2O Pump J4-4	
S19:Dust Vac 2 J4-4,9	S56:ES Pump J6-13,14	
S20:Pickup Vac 1 J7-1,2	S57:ES Pump J6-13,14	
S21:Pickup Vac 1 J7-1,2	S58:Side Valve J4-9	
S22:Pickup Vac 2 J7-3,4	S59:Side Valve J4-9	
S23:Pickup Vac 2 J7-3,4	S60:Sol AF Vlv J6-7,12	
S24:Filter Shkr J4-11,12	S61:Sol AF Vlv J6-7,12	
S25:Filter Shkr J4-11,12	S62:Rcvr AF VIv J6-7,11	
S26:Main Scrub Act J4-9,10	S63:Rcvr AF VIv J6-7,11	
S27:Main Scrub Act J4-9,10	S64:Horn J4-16	
S28:Main Scrub Act J4-9,10	S65:Horn J4-16	
S29:Side Scrub Act J4-7,8	S66:Alarm J4-15	
S30:Side Scrub Act J4-7,8	S67:Alarm J4-15	
S31:Side Scrub Act J4-7,8	S68:Main Scrub	
S32:Main Swp Act J4-16,17	S69:Side Scrub	
S33:Main Swp Act J4-16,17	S70:Water Pickup	
S34:Main Swp Act J4-16,17	S71:EcH2O Module	
S35:L Side Swp Act J4-11,12	S72:Main Sweep	
S36:L Side Swp Act J4-11,12	S73:Side Sweep	
S37:R Side Swp Act J4-1,2	S74:Propel Ctrl	

NOTE: LCD messages above can be seen as an open or a short.

11. Turn key switch OFF after self-test is completed.

SELF-TEST MODE - STANDARD CONTROL PANEL

Use the Self-Test Mode diagnostic utility to test for open or shorted output circuits. Once completed, open and/or shorted output pins are displayed on the LCD (Liquid Crystal Display).

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



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



6. The controller sequentially tests each output circuit listed below. The self-test only tests systems that have been configured on the machine. If an option has not been configured, it will not be tested.

Testing L Main Scrub Brush
Testing R Main Scrub Brush
Testing Side Scrub Brush
Testing R Side Sweep Brush
Testing L Side Sweep Brush
Testing F Main Sweep Brush
Testing R Main Sweep Brush
Testing Dust Vac Motor 1
Testing Dust Vac Motor 2
Testing Pick-up Vac Motor 1
Testing Pick-up Vac Motor 2
Testing Filter Shaker
Testing Main Scrub Actuator
Testing Side Scrub Actuator
Testing Main Sweep Actuator
Testing L Side Sweep Actuator
Testing R Side Sweep Actuator
Testing Squeegee Actuator
Testing Main Water Valve
Testing Detergent Pump
Testing Side Pump
Testing Ec-H2O WaterSystem
Testing Ec-H2O Side Valve
Testing Ec-H2O Pump
Testing ES Pump
Testing Side Valve
Testing Solution Auto-Fill Valve
Testing Recovery Auto-Fill Valve
Testing Horn
Testing Alarm
Test Propel CAN Communication

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

LCD MESSAGE	LCD MESSAGE	
S1:Self Test "Done" or " <results>"</results>	S38:R Side Swp Act J4-1,2	
S2:L Main F/L Scrub Br J10-1,2,3	S39:Squeegee Act J6-17,18	
S3:L Main F/L Scrub Br J10-1,2,3	S40:Squeegee Act J6-17,18	
S4:R Main R/R Scrub Br J11-4,5,6	S41:Squeegee Act J6-17,18	
S5:R Main R/R Scrub Br J11-4,5,6	S42:Main Water VIv J4-17	
S6:Side Scrub Br J6-1,2,3	S43:Main Water Vlv J4-17	
S7:Side Scrub Br J6-1,2,3	S44:Detergent Pmp J4-14	
S8:L Side Swp Br J4-17	S45:Detergent Pmp J4-14	
S9:L Side Swp Br J4-17	S46:Side Scrub Pmp J4-4,10	
S10:R Side Swp Br J4-16	S47:Side Scrub Pmp J4-4,10	
S11:R Side Swp Br J4-16	S48:EcH2O Cell J5-3,4	
S12:L Main Swp Br J7-1,2	S49:EcH2O Cell J5-3,4	
S13:L Main Swp Br J7-1,2	S50:EcH2O Spargr J5-1,2	
S14:R Main Swp Br J7-1,3	S51:EcH2O Spargr J5-1,2	
S15:R Main Swp Br J7-1,3	S52:EcH2O Sde Vlv J4-1,2,5	
S16:Dust Vac 1 J4-5,10	S53:EcH2O Sde Vlv J4-1,2,5	
S17:Dust Vac 1 J4-5,10	S54:EcH2O Pump J4-4	
S18:Dust Vac 2 J4-4,9	S55:EcH2O Pump J4-4	
S19:Dust Vac 2 J4-4,9	S56:ES Pump J6-13,14	
S20:Pickup Vac 1 J7-1,2	S57:ES Pump J6-13,14	
S21:Pickup Vac 1 J7-1,2	S58:Side Valve J4-9	
S22:Pickup Vac 2 J7-3,4	S59:Side Valve J4-9	
S23:Pickup Vac 2 J7-3,4	S60:Sol AF Vlv J6-7,12	
S24:Filter Shkr J4-11,12	S61:Sol AF Vlv J6-7,12	
S25:Filter Shkr J4-11,12	S62:Rcvr AF VIv J6-7,11	
S26:Main Scrub Act J4-9,10	S63:Rcvr AF VIv J6-7,11	
S27:Main Scrub Act J4-9,10	S64:Horn J4-16	
S28:Main Scrub Act J4-9,10	S65:Horn J4-16	
S29:Side Scrub Act J4-7,8	S66:Alarm J4-15	
S30:Side Scrub Act J4-7,8	S67:Alarm J4-15	
S31:Side Scrub Act J4-7,8	S68:Main Scrub	
S32:Main Swp Act J4-16,17	S69:Side Scrub	
S33:Main Swp Act J4-16,17	S70:Water Pickup	
S34:Main Swp Act J4-16,17	S71:EcH2O Module	
S35:L Side Swp Act J4-11,12	S72:Main Sweep	
S36:L Side Swp Act J4-11,12	S73:Side Sweep	
S37:R Side Swp Act J4-1,2	S74:Propel Ctrl	

NOTE: LCD messages above can be seen as an open or a short.

CONFIGURATION MODE - PRO-PANEL

Use the Configuration Mode diagnostic utility to configure controller software to operate optional equipment and to electronically adjust certain output functions.

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



7. The first service menu to appear will be the Config Mode setting. Touch the Check button to select CONFIG MODE. The first configuration mode item will appear.



8. Touch and release the left arrow to scroll forward chronologically through the list and the right arrow to scroll back chronologically thought the list. Press the Check button to select the configuration mode to be changed/updated. See the table below for a list of Configuration Mode utilities and a description of each Configuration Mode utility.



TEXT	DESCRIPTION	
C1:Disk/Cyl	Configure scrub head type	
C2:Ec/ES/None	Configure ec-H2O, ES or none	
C3:Set Det Level	Set ratio of detergent for ES option to 1%, 2%, or 3%	
C4:SE/None	Enable Severe Environment feature for machines equipped with <i>ec-H2O</i>	
C5:SE Short Time	Set Severe Environment Short On-Time. Default 30 seconds.	
C6:SE Long Time	Set Severe Environment Long On-Time. Default 3600 seconds.	
C7:Side Scrub	Configure unit for side scrub brush.	
C8:Reset Press.?	Reset down pressures to factory default settings.	
C9:Transprt Spd	Adjust maximum forward transport speed	
C10:Scrub Spd	Adjust maximum scrubbing speed.	
C11:Main Press #1**	Set max down pressure #1 (12-18 Amps, Default 14D, 13C)	
C12:Main Press #2**	Set max down pressure #2 (18-28 Amps, Default 25D, 26C)	
C13:Main Press #3**	Set max down pressure #3 (28-35 Amps, Default 35 Amps)	
C14:Main Water	Set conventional solution flow range; Low, Med, or High	
C15:Propel H.M.	View propel hourmeter.	
C17:Scrub H.M.	View scrub hourmeter.	
C19:Reset	Resets scrub head type, solution con- figuration, down pressure targets, flow range, side option, travel speeds, autofill option, SE option to default settings.	
C20:Battery Type	Configure battery type.	
C21:Dust Vac	Configure dust vacuums	
C22:Side Sweep	Configure side sweep motors	

TEXT	DESCRIPTION
C23:Main Sweep	
C24:Main Swp Act	
C25:Side Scb Low	
C28:Pick Vac Eco	
C29:Dryvac Power	
C30:DustVac Duty	
C33:Diag Mode Yes/No	Enable technical data during normal ma- chine operation. Scroll through LCD data by pressing contrast or configuration mode buttons during normal operation. Cycle key 1x to enable, 2x to disable.
Exit Config Mode	Exit Configuration Mode menu

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

** C12, C13, and C14 Main Press (Main Brush Pressure) adjustments set the maximum brush motor amp draw for each down pressure setting; 1 LED, 2 LEDs, or 3 LEDs.

 Touch and release the Check button to enable the change. A "<" and ">" symbol will appear around the setting to be changed indicating the configuration utility is now enabled.



10. Touch and release the left arrow and the right arrow to buttons to change settings.



- 11. Touch and release the Check button to save the change.
- 12. To exit Configuration Mode, either turn key switch OFF, or exit Configuration Mode and return to the SERVICE MODE menu.

NOTE: If making multiple changes, do not turn key switch OFF. Return to the Configuration Mode menu to make additional changes. If machine is turned off it will be necessary to log back into the main service menu and return to the Configuration Mode to make additional changes.

CONFIGURATION MODE - STANDARD CONTROL PANEL

Use the Configuration Mode diagnostic utility to configure controller software to operate optional equipment and to electronically adjust certain output functions.

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



5. Press and release the configuration mode button to scroll through the list of utilities. See the table on the next page for a list of utilities.



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

TEXT	DESCRIPTION	
C1:Disk/Cyl	Configure scrub head type	
C2:Ec/ES/None	Configure ec-H2O, ES or none	
C3:Set Det Level	Set ratio of detergent for ES option to 1%, 2%, or 3%	
C4:Autofill/None	Enable Autofill feature (w/ ES option)	
C5:SE/None	Enable Severe Environment feature for machines equipped with <i>ec-H2O</i>	
C6:SE Short Time	Set Severe Environment Short On- Time. Default 30 seconds.	
C7:SE Long Time	Set Severe Environment Long On- Time. Default 3600 seconds.	
C8:Side Scrub	Configure unit for side scrub brush.	
C9:Reset Press.?	Reset down pressures to factory default settings.	
C10:Transprt Spd	Adjust maximum forward transport speed	
C11:Scrub Spd	Adjust maximum scrubbing speed.	
C12:Main Press #1**	Set max down pressure #1 (12-18 Amps, Default 14D, 13C)	
C13:Main Press #2**	Set max down pressure #2 (18-28 Amps, Default 25D, 26C)	
C14:Main Press #3**	Set max down pressure #3 (28-35 Amps, Default 35 Amps)	
C15:Main Water	Set conventional solution flow range; Low, Med, or High	
C16:Propel H.M.	View propel hourmeter.	
C17:Chge Propel HM	Change Propel hourmeter.	
C18:Scrub H.M.	View scrub hourmeter.	
C19:Chge Scrub HM	Change hourmeter.	
C20:Reset	Resets scrub head type, solution configuration, down pressure targets, flow range, side option, travel speeds, autofill option, SE option to default settings.	
C21:Battery Type	Configure battery type.	
C22:Dust Vac	Configure dust vacuums	
C23:Side Sweep	Configure side sweep motors	
C24:Diag Mode Disabled/Enabled	Enable technical data during normal machine operation. Scroll through LCD data by pressing contrast or con-figuration mode buttons during normal operation. Cycle key 1x to enable, 2x to disable.	
Exit Config Mode	Exit Configuration Mode	

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

** C12, C13, and C14 Main Press (Main Brush Pressure) adjustments set the maximum brush motor amp draw for each down pressure setting; 1 LED, 2 LEDs, or 3 LEDs. Press and release the brush pressure button to enable the change. A "<" symbol will appear on the bottom line of the LCD indicating the configuration utility is now enabled.



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



PROPEL DIAGNOSTIC MODE - PRO-PANEL

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

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



7. The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until PROPEL DIAG MODE appears.



8. Touch and release the left arrow button or right arrow button until the desired M17 Propel Diagnostic Mode appears. See table below for how each input operates.



M17 Propel Diagnostic Mode				
CODE LCD MESSAGE DESCRIPTION		DESCRIPTION		
P1	P1:Curtis Online/ Error	Curtis/ M17 controllers CAN-bus connection status		
P2	P2:Throttle XXXX.X v	Displays foot throttle commanded voltage (0-5V).		
P 3	P3:Brake Pedal On/O [~]	Displays brake pedal command (On/O [~]).		
P4	P4:Direction Fwd/ Rev	Displays directional switch input (Fwd/Rev).		
P5	P5:Speed XXXX.X Mph	Displays propel speed from motor encoder located in drive assembly.		
P6	P6:Motor Current XXXX.X A			
P7	P7:Motor Temp XXX.X C			

PDM004

9. To exit PROPEL DIAG MODE, either turn key switch OFF, or exit PROPEL DIAG MODE and return to the Service Modes menu.

PROPEL DIAGNOSTIC MODE - STANDARD CONTROL PANEL

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

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



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



 Press and release the configuration mode button to scroll through a list of Curtis 1234 controller inputs. See the table below for a list of utilities



M17 Propel Diagnostic Mode				
CODE	LCD MESSAGE	DESCRIPTION		
P1	P1:Curtis Online/ Error	Curtis/ M17 controllers CAN-bus connection status		
P2	P2:Throttle XXXX.X v	Displays foot throttle commanded voltage (0-5V).		
P3	P3:Brake Pedal On/O [~]	Displays brake pedal command (On/O [~]).		
P4	P4:Direction Fwd/ Rev	Displays directional switch input (Fwd/Rev).		
P5	P5:Speed XXXX.X Mph	Displays propel speed from motor encoder located in drive assembly.		
P6	P6:Motor Current XXXX.X A			
P7	P7:Motor Temp XXX.X C			

PDM004

PROPEL CONTROLLER DIAGNOSTIC LED OPERATION

PMC002





ANA OUT

ΤХ

BRK

WIPER

+5V

COIL

RETURN

THR POT

HI

SW1/ANA1

ENC

PHASE B

DRIVER 6

CAN TERM L

CAN H

CAN TERM H

Types of LED Display			
Display		Status	
Neither LED illuminated		Controller is not power or is severely damaged	red on, has a dead battery, I.
Yellow LED flashing		Controller is operating	normally.
Yellow and red LEDs both on solic	l	Controller is in Flash pr	ogram mode.
Red LED on solid		Watchdog failure. Cycle	e KSI to restart.
Red LED and yellow LED flashing alternately		Controller has detected a fault. 2-digit code* flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.	
*The red LED flashes once to indica appropriate number of times for th will follow; the yellow LED flashes	ate that the first digit of the first digit. The red LED find the appropriate number of	e code will follow; the yellow lashes twice to indicate that of times for the second digit.	w LED then flashes the the second digit of the code
Example: Battery Undervolta	age (Code 23)	250	
RED	YELLOW	KED	YELLOW
*	\$\$ \$\$	* *	* * *
(first digit)	(2)	(second digit)	(3)

Curtis Controller Diagnostics LED Operation and Curtis Diagnostic Codes taken from the Curtis 1234/36/38 Manual.

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PROPEL CONTROLLER DIAGNOSTIC CODES

	TROUBLESHOOTING CHART				
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS		
12	Controller Overcurrent ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 External short of phase U,V, or W motor connections. Motor parameters are mis-tuned. Controller defective. Speed encoder noise problems. 	<i>Set</i> : Phase current exceeded the current measurement limit. <i>Clear</i> : Cycle KSI.		
13	Current Sensor Fault ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 Leakage to vehicle frame from phase U, V, or W (short in motor stator). Controller defective. 	Set: Controller current sensors have invalid offset reading. Clear: Cycle KSI.		
14	Precharge Failed ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging. See Monitor menu » Battery: Capacitor Voltage. 	<i>Set:</i> Precharge failed to charge the capacitor bank to the KSI voltage. <i>Clear:</i> Cycle Interlock input or use VCL function Precharge().		
15	Controller Severe Undertemp ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 See Monitor menu » Controller: Temperature. Controller is operating in an extreme environment. 	Set: Heatsink temperature below -40°C. <i>Clear</i> : Bring heatsink temperature above -40°C, and cycle interlock or KSI.		
16	Controller Severe Overtemp ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 See Monitor menu » Controller: Temperature. Controller is operating in an extreme environment. Excessive load on vehicle. Improper mounting of controller. 	Set: Heatsink temperature above +95°C. Clear: Bring heatsink temperature below +95°C, and cycle interlock or KSI.		
17	Severe Undervoltage Reduced drive torque.	 Battery Menu parameters are misadjusted. Non-controller system drain on battery. Battery resistance too high. Battery disconnected while driving. See Monitor menu » Battery Capacitor Voltage. Blown B+ fuse or main contactor did not close. 	Set: Capacitor bank voltage dropped below the Severe Undervoltage limit (see page 55) with FET bridge enabled. <i>Clear</i> : Bring capacitor voltage above Severe Undervoltage limit.		

Terms:

KSI = Key Switch Interlock FET = Field Effect Translator

$\left(\right)$	TROUBLESHOOTING CHART				
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS		
18	Severe Overvoltage ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 See Monitor menu » Battery: Capacitor Voltage. Battery menu parameters are misadjusted. Battery resistance too high for given regen current. Battery disconnected while regen braking. 	Set: Capacitor bank voltage exceeded the Severe Overvoltage limit (see page 55) with FET bridge enabled. <i>Clear</i> : Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.		
22	Controller Overtemp Cutback Reduced drive and brake torque.	 See Monitor menu » Controller: Temperature. Controller is performance-limited at this temperature. Controller is operating in an extreme environment. Excessive load on vehicle. Improper mounting of controller. 	Set: Heatsink temperature exceeded 85°C. <i>Clear</i> : Bring heatsink temperature below 85°C.		
23	Undervoltage Cutback <i>Reduced drive torque.</i>	 Normal operation. Fault shows that the batteries need recharging. Controller is performance limited at this voltage. Battery parameters are misadjusted. Non-controller system drain on battery. Battery resistance too high. Battery disconnected while driving. See Monitor menu » Battery: Capacitor Voltage. Blown B+ fuse or main contactor did not close. 	Set: Capacitor bank voltage dropped below the Undervoltage limit (see page 55) with the FET bridge enabled. <i>Clear</i> : Bring capacitor voltage above the Undervoltage limit.		
24	Overvoltage Cutback Reduced brake torque.	 Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. Battery parameters are misadjusted. Battery resistance too high for given regen current. Battery disconnected while regen braking. See Monitor menu » Battery: Capacitor Voltage. 	Set: Capacitor bank voltage exceeded the Overvoltage limit (see page 55) with the FET bridge enabled. <i>Clear</i> . Bring capacitor voltage below the Overvoltage limit.		
25	+5V Supply Failure None, unless a fault action is programmed in VCL.	 External load impedance on the +5V supply (pin 26) is too low. See Monitor menu » outputs: 5 Volts and Ext Supply Current. 	Set: +5V supply (pin 26) outside the +5V±10% range. <i>Clear</i> : Bring voltage within range.		
26	Digital Out 6 Overcurrent Digital Output 6 driver will not turn on.	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	Set: Digital Output 6 (pin 19) current exceeded 15 mA. <i>Clear</i> : BRemedy the overcurrent cause and use the VCL function Set_DigOut() to turn the driver on again.		
//					

Terms: KSI = Key Switch Interlock FET = Field Effect Translator

	TROUBLESHOOTING CHART			
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS	
27	Digital Out 7 Overcurrent Digital Output 7 driver will not turn on.	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	Set: Digital Output 7 (pin 20) current exceeded 15 mA. <i>Clear</i> . Remedy the overcurrent cause and use the VCL function <i>Set_DigOut()</i> to turn the driver on again.	
28	Motor Temp Hot Cutback <i>Reduced drive torque.</i>	 Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back. Motor Temperature Control Menu parameters are mis-tuned. See Monitor menu » Motor: Temperature and » Inputs: Analog2. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off. 	Set: Motor temperature is at or above the Temperature Hot parameter setting. <i>Clear</i> : Bring the motor temperature within range.	
29	Motor Temp Sensor Fault MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.	 Motor thermistor is not connected properly. If the application doesn't use a motor thermistor, Motor Temp Sensor Enable should be programmed Off. See Monitor menu » Motor: Temperature and » Inputs: Analog2. 	<i>Set</i> : Motor thermistor input (pin 8) is at the voltage rail (0 or 10V). <i>Clear</i> . Bring the motor thermistor input voltage within range.	
31	Coil1 Driver Open/Short ShutdownDriver1.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	Set: Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off. <i>Clear</i> : Correct open or short, and cycle driver.	
31	Main Open/Short ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	<i>Set</i> : Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = On. <i>Clear</i> : Correct open or short, and cycle driver.	
32	Coil2 Driver Open/Short ShutdownDriver2.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	Set: Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0. <i>Clear</i> : Correct open or short, and cycle driver.	
32	EMBrake Open/Short ShutdownEMBrake; ShutdownThrottle; FullBrake.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	Set: Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type > 0. <i>Clear</i> : Correct open or short, and cycle driver.	
33	Coil3 Driver Open/Short ShutdownDriver3.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	Set: Driver 3 (pin 4) is either open or shorted. Clear: Correct open or short, and cycle driver.	
34	Coil4 Driver Open/Short ShutdownDriver4.	 Open or short on driver load. Dirty connector pins. Bad crimps or faulty wiring. 	Set. Driver 4 (pin 3) is either open or shorted. Clear. Correct open or short, and cycle driver.	

Terms:

KSI = Key Switch Interlock FET = Field Effect Translator VCL = Vehicle Control Language

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

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

$\left(\right)$	TROUBLESHOOTING CHART			
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS	
44	Pot2 Wiper Low <i>FullBrake.</i>	 See Monitor menu » Inputs: Pot2 Raw. Pot2 wiper voltage too low. 	Set: Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function Setup_Pot_Faults()). Clear: Bring Pot2 wiper voltage above the fault threshold.	
45	Pot Low Overcurrent ShutdownThrottle; FullBrake.	 See Monitor menu » Outputs: Pot Low. Combined pot resistance connected to pot low is too low. 	Set: Pot low (pin 18) current exceeds 10mA. <i>Clear:</i> Clear pot low overcurrent condition and cycle KSI.	
46	EEPROM Failure ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	Set: Controller operating system tried to write to EEPROM memory and failed. <i>Clear:</i> Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.	
47	HPD/Sequencing Fault ShutdownThrottle.	 KSI, interlock, direction, and throttle inputs applied in incorrect sequence. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. See Monitor menu » Inputs. 	Set: HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. <i>Clear:</i> Reapply inputs in correct sequence.	
47	Emer Rev HPD ShutdownThrottle; ShutdownEMBrake.	1. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.	Set: At the conclusion of Emergency Reverse, the fault was set because various inputs were not returned to neutral. <i>Clear:</i> If EMR_Interlock = On, clear the interlock, throttle, and direction inputs. If EMR_Interlock = Off, clear the throttle and direction inputs.	
49	Parameter Change Fault ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate. 	Set: Adjustment of a parameter setting that requires cycling of KSI. <i>Clear:</i> Cycle KSI.	
51–67	OEM Faults (See OEM documentation.)	1. These faults can be defined by the OEM and are implemented in the application-specific VCL code. See OEM documentation.	Set: See OEM documentation. Clear: See OEM documentation.	

Terms:

KSI = Key Switch Interlock FET = Field Effect Translator

VCL = Vehicle Control Language

\bigcap	TROUBLESHOOTING CHART,			
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS	
68	VCL Run Time Error ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.	 VCL code encountered a runtime VCL error. See Monitor menu » Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file. 	Set: Runtime VCL code error condition. Clear: Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.	
69	External Supply Out of Range None, unless a fault action is programmed in VCL.	 External load on the 5V and 12V supplies draws either too much or too little current. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned. See Monitor menu » Outputs: Ext Supply Current. 	Set: The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings (page 52). <i>Clear</i> : Bring the external supply current within range.	
71	OS General ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.	1. Internal controller fault.	Set: Internal controller fault detected. Clear: Cycle KSI.	
72	PDO Timeout ShutdownInterlock; CAN NMT State set to Pre-operational.	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	Set: Time between CAN PDO messages received exceeded the PDO Timeout Period. <i>Clear:</i> Cycle KSI or receive CAN NMT message.	
73	Stall Detected ShutdownEMBrake; ShutdownThrottle; Control Mode changed to LOS (Limited Operating Strategy).	 Stalled motor. Motor encoder failure. Bad crimps or faulty wiring. Problems with power supply for the motor encoder. See Monitor menu » Motor: Motor RPM. 	Set: No motor encoder movement detected. Clear: Either cycle KSI, or detect valid motor encoder signals while operating in LOS mode and return Throttle Command = 0 and Motor RPM = 0.	
74	Fault On Other Traction Controller	Dual Drive fault: see Dual Drive manual.		
75	Dual Severe Fault	Dual Drive fault: see Dual Drive manual.		

Terms:

KSI = Key Switch Interlock

FET = Field Effect Translator

VCL = Vehicle Control Language

CAN = Controller Area Network

$\left(\right)$	TROUBLESHOOTING CHART			
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS	
87	Motor Characterization Fault ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0=none 1=encoder signal seen, but step size not determined; set Encoder Step Size manu 2=motor temp sensor fault 3=motor temp hot cutback fault 4= controller overtemp cutback fault 5=controller undertemp cutback fault 6=undervoltage cutback fault 7=severe overvoltage fault 8=encoder signal not seen, or one or both channels missing 9=motor parameters out of characterization range. 	Set: Motor characterization failed during the motor characterization process. <i>Clear:</i> Correct fault; cycle KSI.	
89	Motor Type Fault ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	1. The Motor_Type parameter value is out of range.	Set: Motor_Type parameter is set to an illegal value. <i>Clear:</i> Set Motor_Type to correct value and cycle KSI.	
91	VCL/OS Mismatch ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump.	1. The VCL software in the controller does not match the OS software in the controller.	Set: VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. <i>Clear:</i> Download the correct VCL and OS software into the controller.	
92	EM Brake Failed to Set ShutdownEMBrake; ShutdownThrottle.	 Vehicle movement sensed after the EM Brake has been commanded to set. EM Brake will not hold the motor from rotating. 	Set: After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. <i>Clear:</i> Activate the throttle.	
93	Encoder LOS (Limited Operating Strategy) Enter LOS control mode.	 Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). Motor encoder failure. Bad crimps or faulty wiring. Vehicle is stalled. 	Set: Encoder Fault (Code 36) or Stall Detect Fault (Code 73) was activated, and Brake or Interlock has been applied to activate LOS control mode, allowing limited motor control. <i>Clear:</i> Cycle KSI or, if LOS mode was activated by the Stall Fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.	

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

	TROUBLESHOOTING CHART				
CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET/CLEAR CONDITIONS		
94	Emer Rev Timeout ShutdownEMBrake; ShutdownThrottle.	 Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. The emergency reverse input is stuck On. 	Set: Emergency Reverse was activated and ran until the EMR Timeout timer expired. <i>Clear:</i> Turn the emergency reverse input Off.		
98	Illegal Model Number ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.	 Model_Number variable contains illegal value. For 1234/36/38 models, a value other than 1234, 1236, 1238, or 1298 is illegal. For 1232 models, a value other than 1232 is illegal. Software and hardware do not match. Controller defective. 	Set: Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. <i>Clear:</i> Download appropriate software for your controller model.		
99	Dualmotor Parameter Mismatch	Dual Drive fault: see Dual Drive manual.			

Terms:

KSI = Key Switch Interlock FET = Field Effect Translator EMR = Emergency Reverse

M17 CONTROLLER CUSTOM FAULTS

Code	Condition	Cause of Condition	Clear Condition	Action
51	Throttle SRO Fault	Throttle is active at same time service brake is pressed.	Release throttle to neutral	Shutdown Throttle
52	HPD Fault	 Throttle is active immediately after timer set by "Throttle PowerUp Check Delay" parameter (500ms) has expired or Throttle is active after operator has lifted from seat for longer than "Seat Switch Debounce Delay" parameter (2.0 sec). 	Release throttle to neutral	Shutdown Throttle
53	Emergency Stop (E-Stop) Fault	 E-Stop button is Open (Pushed In) and Key switch voltage is greater than "Low Voltage Switch Check Threshold" parameter (22 V) and Timer set to "E-Stop Switch Powerup Check Delay" parameter (3.0 sec) has expired and "E-Stop Reporting" parameter = On Note: When E-Stop button is Open, throttle is shutdown immediately but fault is not reported unless above conditions are met. 	E-Stop button is closed (pulled out) and Key switch is cycled	Shutdown Throttle
54	CAN Startup Fault	An initial heartbeat is not received over CAN bus upon power up from Tennant Master Controller within "Master Heartbeat Startup Period" parameter (15.0 sec)	Restore CAN communication and cycle key switch	Speed Limit is set to "Fault Max Speed" parameter (311 rpm)
55	CAN Operational Fault	After initial heartbeat, subsequent heartbeats are not received over CAN bus from Tennant Master Controller within "Master Heartbeat Time out Period" parameter (2.5 sec)	Restore CAN communication and cycle key switch	Speed Limit is set to "Fault Max Speed" parameter (311 rpm)
56	CAN Transmission Stopped	CAN engine has been set to a "non- operational" state by Tennant Master Controller. Following NMT messages will set fault: "Enter Pre-Operational State" (Command Specifier = 0x80), "Stop Remote Node" (Command Specifier = 0x02), "Reset Communication" (Command Specifier = 0x82)	Master Tennant controller resets Curtis controller via NMT message "Reset Node" (Command Specifier = 0x81) or cycle key switch	Shutdown CAN PDO transmission Speed Limit is set to "Fault Max Speed" parameter (311 rpm)

INPUT DISPLAY MODE - PRO-PANEL

Use the Input Display Mode diagnostic utility to display controller input conditions. Input Display Mode displays text messages for hard-wired switch, sensor, and touch panel button inputs.

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



 The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until INPUT DISPLAY appears.



8. Touch and release the left arrow button or right arrow button until the desired Input Display Mode appears. See the table below for a list of Input Display Mode conditions.



MESSAGE	MESSAGE
I1:Sltn Sensor	l6:Flush Button
Level: X X.XX V	Not Flushing / Flushing
I2:Recovery Tank	I7:Hopper Temp
Full / Not Full	Closed / Open
I3:Hlf Rcvr Tank	I8:Hopper
Not Half Full / Half Full	Down / Raised
I4:Seat Switch	I9:Filter Input
Seated / Unseated	Clogged / Not Clogged
I5:Pressure Sw	Exit
Closed / Open	Yes / No

- 9. Touch any other button to display a corresponding text message. The message confirms the control module received the input.
- 10. To exit Input Display Mode, either turn key switch OFF, or exit Input Display Mode and return to the main Service Modes menu.

INPUT DISPLAY MODE - STANDARD CONTROL PANEL

Use the Input Display Mode diagnostic utility to display controller input conditions. Input Display Mode displays LCD text messages for hard-wired switch, sensor, and touch panel button inputs.

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



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



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



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

MANUAL MODE - PRO-PANEL

Use the Manual Mode diagnostic utility to manually activate machine functions and display output current in "XX.X Amps" format. This mode bypasses interlocking inputs and should be used for diagnostic purposes only.

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



7. The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until MANUAL MODE appears.



8. Touch the Check button to access the various manual mode output functions. The Manual Mode screen will appear.

9. Touch the and release the left arrow button or right arrow button until the desired Manual Mode output function appears. See the table in the next column for a list of manual mode functions.



10. Touch the Check button to manually activate the function.



- 11. Touch the Check button again to stop the function.
- 12. To exit MANUAL MODE, either turn key switch OFF, or exit Manual Mode and return to the Service Modes menu.

MESSAGE	MESSAGE
M01:Left Brush	M19:Ec Valve
XX.XA XX.XRPM	SSSSSS FF X.XXA
M02:Right Brush	M20:Sol AF Valve
XX.XA XX.XRPM	SSSSSS FF X.XXA
M03:Side Scrub Br	M21:Recvr Valve
XX.XA XX.XRPM	SSSSSS FF X.XXA
M04:Main Swp Act	M22:Ec Sparger
RP XXX.X% XX.XA	XX% X.XXA
M05:Main Sweep Br1	M23:Ec Cell
XX% XX.XA	XX% X.XXA
M06:Main Sweep Br2	M24:Scrub Act
XX% XX.XA	R XXX.X% XX.XA
M07:Left Swp Br	M25:Side Scrub Act
XX% XX.XA	R XXX.X% XX.XA
M08:L Swp Act	M26:Squeegee Act
R P XXX.X% XX.XA	XX.X% XX.XA
M09:Right Swp Br	M27:Dust Vac 1
XX% XX.XA	XXXXX RPM
M10:R Sweep Act	M28:Dust Vac 2
R P XXX.X% XX.XA	XXXXX RPM
M11:Wtr Vac 1	M29:Filter Shaker
XX% XX.XA	XX% XX.XA
M12:Wtr Vac 2	M30:Roll Act H
XX% XX.XA	Pos XXX.X D XX.X
M13:Side Pump	M31:Lift Pump
XX.XXV XX% X.XXA	D XX% XX.XA
M14:Ec Pump	M32:Set Roll Home
XX.XXV XX% X.XXA	H XXX.X (X.XXX)
M15:ES Pump	M33:Set Roll Max
XX.XXV XX% X.XXA	H XXX.X (X.XXX)
M16:Det Pump	M34:Set Roll Min
XX.XXV XX% X.XXA	H XXX.X (X.XXX)
M17:Water Valve	M35:Fact Set Roll
SSSSSS FF X.XXA	H XXX.X (X.XXX)
M18:Side Valve	Exit Manual Mode
SSSSSS FF X.XXA	Yes / No

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

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

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

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

MANUAL MODE - STANDARD CONTROL PANEL

Use the Manual Mode diagnostic utility to manually activate machine functions and display output current in "XX.X Amps" format. This mode bypasses interlocking inputs and should be used for diagnostic purposes only.

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



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



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

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

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

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

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



MOTORS MODE - PRO-PANEL

Use the Motors Mode diagnostic utility to operate various motors independently for service testing purposes only.

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



7. The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until MOTORS MODE appears.



8. Touch the Check button to access the various motors mode output functions. The Motors Mode screen will appear.

 Touch and release the left arrow button or right arrow button until the desired Motor Mode appears. See the table below for a list of the various motor modes.



10. Touch the Check button to open/test/activate the selected motor. Motor operational parameters will appear on the screen while the test is occurring. Touch the Check button again to stop the test and return to previous motor mode screen.



MESSAGE	MESSAGE
MM1:Main Scrub	MM5:All Sweeps
MM2:Side Scrub	MM6:Run ec-H2O
MM3:Main Sweeps	Exit Motors Mode (Yes / No)
MM4:Side Sweeps	

11. To exit MOTORS MODE, either turn key switch OFF, or exit Motors Mode and return to the Service Modes menu.

NOTE: Once MM1 or MM2 is activated, the down pressure button can be used to adjust the down pressure setting. Use the Check button to turn the motor(s) off

MOTORS MODE - STANDARD CONTROL PANEL

Use the Motors Mode diagnostic utility to operate various motors independently for service testing purposes only.

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



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



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

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



MEMBRANE TEST - PRO-PANEL

Use the Membrane Test to test the membrane buttons on machines equipped with Pro-Panel controls.

- 1. Turn key switch ON.
- 2. Touch the Help button to access the Help screen.



3. Touch the Login button to go to the Login screen.



 Use the keypad to enter the Service login number (083957530) into the display above the keypad. Touch the enter button when finished entering the Service login number.



5. Touch the settings button to access the service settings screen.



6. Scroll down to and touch the SERVICE MODES button to access the main Service Modes menu.



 The first service setting to appear will be the Config Mode setting. Touch and release the left arrow button or right arrow button until MEMBRANE TEST appears.


8. Touch the Check button to access the membrane tests. The horn membrane test will appear on the screen.



9. Press the horn button. S2: Press Left Water On/Off Btn should appear on the screen if the horn button passed the membrane test.



NOTE: If there was an issue with the horn button where it did not pass the membrane test an error message (S19: Failed) will appear on the screen.

NOTE: An error message (S19: Failed) will also appear on the screen if the button being tested is not pressed within approximately 10 seconds of the test appearing on the screen. Press the button for the test appearing on the screen as soon as possible.



10. Press the left water on/off button. S3: Press Right Water On/Off Btn should appear on the screen if the left water on/off button passed the membrane test.



11. Press the right water on/off button. S20: PASSED will appear on the screen if all membrane buttons passed the membrane test.



12. Turn key switch OFF to exit the Membrane Test.

MEMBRANE TEST - STANDARD PANEL

Use the Membrane Test to test the membrane buttons on machines equipped with standard panel controls.

- 1. Turn key switch OFF.
- 2. Press and hold the configuration mode button and turn key switch ON while continuing to hold the configuration mode button.



3. Release the configuration mode button when CONFIG MODE appears on the LCD.



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



5. Press and release the brush pressure button to select and begin the membrane test.



6. Follow the prompts on the LCD screen to test all membrane buttons on the panel. Immediately press each button when prompted to do so on the LCD.

NOTE: The membrane test will end if no button is pressed within 10 seconds of the prompt appearing on the LCD screen.

7. Message PASSED appears on the LCD screen if all buttons and LEDs successfully pass the membrane test. Key cycle the machine to resume normal operation.

If a button or LED do not pass the membrane test a FAILED message appears on the LCD screen. Replace the pod if it does not pass the membrane test. See *REMOVING/REPLACING THE PRO-PANEL/STANDARD PANEL POD*.

NOTE: The membrane test immediately ends after the first button or LED fails the test. The membrane test does not continue after the first button or LED fails.

POWER STEERING STATUS LED (OPTION)

- 1. Remove the front panel below the steering wheel to access the power steering components.
- 2. Observe the status LED and use the table below to determine derate level.

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

SYSTEM TROUBLESHOOTING

BACKUP ALARM/LIGHT ON



BACKUP ALARM/LIGHT FAILED TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable back-up alarm/lights 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key ON		Correct fault condition	Proceed to STEP 3
	 Enable back-up alarm/lights 			
	See PROPEL CONTROLLER DIAGNOSTIC CODES			
	 Is there a Propel Controller fault displayed? 			
3	Key OFF		Proceed to STEP 4	Correct fault condition
	See PROPEL DIAGNOSTIC MODE section of this manual			
	 Check P4:Direction Fwd/Rev input from the directional switch 			
	 Check P2:Throttle (0-5 VDC) input from the directional pedal 			
	 Are the P2 and P4 inputs operating properly? 			
4	Key OFF		Proceed to STEP 5	Replace relay
	Remove M2 relay from connector (see component locator)			
	 Connect ohmmeter between relay terminals 30 and 87 (should test open or "O.L.) 			
	 Use fuse-protected jumper leads to apply battery voltage to relay terminals 86 (+) and 85 (-) 			
	 Does relay "click" and do N.O. (normally open) terminals 30 and 87 close? 			
5	• Key OFF		Proceed to STEP 6	Replace Backup Alarm/
	Disconnect back-up alarm/light from main harness			Light
	 Use fuse-protected jumper leads to apply battery voltage to back-up alarm/light 			
	 Does the back-up alarm/light turn On? 			
6	• Key ON		Repair or replace wire	Replace Curtis 1234
	 Reconnect back-up alarm/light to main harness 		harness	Controller
	Enable back-up alarm/light			
	 Use voltmeter to back probe between 15/GRN and 17/PUR at the Propel Controller connection 			
	 Is there battery voltage applied? 			

Terms:

Back probe = To insert voltmeter probe(s) into back of a connector to contact a terminal(s) while circuit operates or should be operating. VDC = DC Voltage

LIGHTS ON



LIGHTS FAIL TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Light switch ON Firmly press circuit breaker #11 to reset Is circuit breaker #11 tripped? 		Reset and Test Lighting Operation	Proceed to STEP 2
2	 Key ON Light switch ON Firmly press circuit breaker #12 (Option) to reset Is circuit breaker #12 tripped? 		Reset and Test Lighting Operation	Proceed to STEP 3
3	 Key ON Light switch ON Firmly press circuit breaker #13 (Option) to reset Is circuit breaker #13 tripped? 		Reset and Test Lighting Operation	Proceed to STEP 4
4	 Key ON Light switch ON Firmly press circuit breaker #14 (Option) to reset Is circuit breaker #14 tripped? 		Reset and Test Lighting Operation	Proceed to STEP 5
5	 Key ON Light switch ON Test voltage applied to light subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

MAIN SCRUB BRUSHES ON (S/N 000000-010999)



MAIN SCRUB BRUSHES FAIL TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable main scrub brushes subsystem 		section of this manual	
	 Is there a fault/code message displayed? 			
2	• Key OFF	ĺ	Proceed to STEP 6	Proceed to STEP 3
	 See MOTORS MODE section of this manual 			
	 Activate main scrub brushes in Motors Mode 			
	 Do the scrub brushes turn On? 			
3	• Key OFF		Correct open or short	Proceed to STEP 4
	 See SELF-TEST MODE section of this manual 		circuit condition	
	 Does Self-Test display output circuits J10-1, 2, 3 or J11-4, 5, 6 as open or shorted? 			
4	 Proceed to Step #5 for disk scrub head models 		Repair or replace	Proceed to STEP 5
	• Key OFF		necessary cylindrical scrub head components	
	 Remove cylindrical brushes from scrub head 			
	 Check for worn out brushes (see MAINTENANCE section of this manual) 			
	 Check brushes for entangled debris 			
	 Check brush idler plugs and bearings for excessive wear, damage, seizure, etc 			
	 Check main brush drive belts for excessive wear, damage, etc 			
	 Do any of above conditions exist? 			
5	 Proceed to STEP #6 if both brush motors fail to turn ON 		Repair or replace main scrub brush motors	Proceed to STEP 5
	Lower main scrub head			
	• Key OFF			
	 Swap motor leads between left and right motors 			
	 Does the same motor fail to turn on? 			
6	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect main scrub brush motors to correct main harness connectors 			location and repair or replace necessary
	• Key ON			components
	Enable main scrub brush motors			
	 Test voltage applied to main scrub brush motor subsystem 			
	Are electrical circuits operating?			

Terms:

J5-5 = Main Scrub/Solution Delivery Module Connector #5, Pin #5 J5-4 = Main Scrub/Solution Delivery Module Connector #5, Pin #4 J5-2 = Main Scrub/Solution Delivery Module Connector #5, Pin #2 J5-1 = Main Scrub/Solution Delivery Module Connector #5, Pin #1

MAIN SCRUB BRUSHES ON (S/N 011000-



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MAIN SCRUB BRUSHES FAIL TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable main scrub brushes subsystem 		section of this manual	
	 Is there a fault/code message displayed? 			
2	• Key OFF		Proceed to STEP 6	Proceed to STEP 3
	 See MOTORS MODE section of this manual 			
	 Activate main scrub brushes in Motors Mode 			
	 Do the scrub brushes turn On? 			
3	Key OFF		Correct open or short	Proceed to STEP 4
	 See SELF-TEST MODE section of this manual 		circuit condition	
	 Does Self-Test display output circuits J10-1, 2, 3 or J11-4, 5, 6 as open or shorted? 			
4	 Proceed to Step #5 for disk scrub head models 		Repair or replace	Proceed to STEP 5
	• Key OFF		necessary cylindrical	
	 Remove cylindrical brushes from scrub head 		components	
	 Check for worn out brushes (see MAINTENANCE section of this manual) 			
	 Check brushes for entangled debris 			
	 Check brush idler plugs and bearings for excessive wear, damage, seizure, etc 			
	 Check main brush drive belts for excessive wear, damage, etc 			
	 Do any of above conditions exist? 			
5	 Proceed to STEP #6 if both brush motors fail to turn ON 		Repair or replace main scrub brush motors	Proceed to STEP 5
	Lower main scrub head			
	• Key OFF			
	 Swap motor leads between left and right motors 			
	 Does the same motor fail to turn on? 			
6	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect main scrub brush motors to correct main harness connectors 			location and repair or replace necessary
	• Key ON			components
	Enable main scrub brush motors			
	 Test voltage applied to main scrub brush motor subsystem 			
	 Are electrical circuits operating? 			

Terms:

J5-5 = Main Scrub/Solution Delivery Module Connector #5, Pin #5 J5-4 = Main Scrub/Solution Delivery Module Connector #5, Pin #4 J5-2 = Main Scrub/Solution Delivery Module Connector #5, Pin #2 J5-1 = Main Scrub/Solution Delivery Module Connector #5, Pin #1

SIDE SCRUB BRUSH ON/DOWN



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SIDE SCRUB BRUSH FAILS TO TURN ON/LOWER

Step	Action	Value(s)	Yes	No
1	 Key ON Enable side scrub brush subsystem Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MOTORS MODE section of this manual Activate side scrub brush in Motors Mode Do side scrub brushes turn on? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE Does Self-Test display output circuits J4-7,8 or J6- 1,2,3 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF Check brush for entangled debris or damage Do any of the above conditions exist? 		Repair or replace necessary components	Proceed to STEP 5
5	 Key ON Enable side scrub brush motor Test voltage applied to side scrub brush motor and lift actuator subsystems as shown on electrical schematic Are electrical circuits operating as shown on electrical schematic? NOTE: Side scrub motor can be tested using main brush motor connections of wire harness. Side scrub motor must be removed to reach main brush motor connections. 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-7,8 = Side Scrub Module Connector #4, Pin #7 or 8

J6-1,2,3 = Side Scrub Module Connector #6, Pin #1, 2, or 3

POWER UP ON (S/N 000000-010999)

(B-)



MACHINE FAILS TO POWER UP

Step	Action	Value(s)	Yes	No
1	 Key ON Test total battery voltage using a voltmeter Is the total battery voltage greater than 30 VDC? 		Proceed to STEP 2	Recharge batteries and test power-up circuit operation
2	 Key OFF Firmly press circuit breaker 4 to reset Is circuit breaker #4 tripped? 		Reset and test power up circuit operation	Proceed to STEP 3
3	 Key ON Test voltage applied to power up subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

VDC = DC Voltage



MACHINE FAILS TO POWER UP

Step	Action	Value(s)	Yes	No
1	 Key ON Test total battery voltage using a voltmeter Is the total battery voltage greater than 30 VDC? 		Proceed to STEP 2	Recharge batteries and test power-up circuit operation
2	 Key OFF Firmly press circuit breaker 4 to reset Is circuit breaker #4 tripped? 		Reset and test power up circuit operation	Proceed to STEP 3
3	 Key ON Test voltage applied to power up subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

VDC = DC Voltage

PROPEL SUBSYSTEM, FORWARD



MACHINE FAILS TO PROPEL

Step	Action	Value(s)	Yes	No
1	• Key ON		Correct fault condition	Proceed to STEP 2
	 See PROPEL CONTROLLER DIAGNOSTIC CODES section of this manual 			
	Does a Propel Controller fault condition exist?			
2	• Key ON		Proceed to STEP 3	Correct faulty input
	 See PROPEL DIAGNOSTIC MODE section of this manual 			condition
	Is P1: Curtis Online?			
	 Does P2: Throttle input voltage (0-5 VDC) change proportionally with throttle pedal movement? 			
	 Does P3: Brake pedal input turn On/Off with brake pedal activation? 			
	 Does P4: Direction input correspond with Fwd/Rev rocker switch position? 			
	 Does P5: Speed input from drive assembly encoder (speed, direction, position sensor) read 0000.0 MPH? 			
	Does P8: Propel motor current read 0000.0 Amps?			
	 Is answer "Yes" to all of above? 			
3	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Place machine on jack stands so drive wheel is lifted off the floor 			location and repair or replace necessary
	Enable forward propel			components
	 Test voltage applied to propel subsystem 			
	Are electrical circuits operating?			

Terms: VDC = Direct Current

VDC = Direct Current Voltage

REAR SQUEEGEE DOWN, OFF



	Operationa	l Matrix:	
		Enabled	Disabled
Battery Positive + Battery Negative -	Squeegee Down	• 1-STEP Scrub ON • Squeegee/Vac ON	 1-STEP Scrub OFF Squeegee/Vac OFF Reverse Propel Recovery Tank Full Very Low Batt Voltage Circuit Fault

SQUEEGEE FAILS TO RAISE/LOWER

Step	Action	Value(s)	Yes	No
1	 Key ON Enable rear squeegee down Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate the rear squeegee in Manual Mode Does the rear squeegee raise/lower? 		Proceed to STEP 5	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does the Self-Test display output circuits J5-3 and J5-2 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See TESTING REAR SQUEEGEE LIFT ACTUATOR section of this manual Does the rear squeegee lift actuator pass the testing? 	See TESTING REAR SQUEEGEE LIFT ACTUATOR section of this manual.	Proceed to STEP 5	Replace rear squeegee lift actuator
5	 Key OFF Reconnect rear squeegee lift actuator to main wire harness Test voltage applied to rear squeegee lift subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J6-18 = Combo Module (Water Pickup) Connector #6, Pin #18 J6-17 = Combo Module (Water Pickup) Connector #6, Pin #17

SCRUB HEAD LIFT (S/N 000000-010999)



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

SCRUB HEAD FAILS TO RAISE/LOWER

Step	Action	Value(s)	Yes	No
1	 Key ON Enable scrub head down Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate scrub head in Manual Mode Does the scrub head raise/lower? 		Proceed to STEP 5	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-9 and J4-10 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See TESTING MAIN BRUSH LIFT ACTUATOR in SERVICE section of this manual Does the scrub head lift actuator pass the testing? 	See TESTING MAIN BRUSH LIFT ACTUATOR section of this manual	Proceed to STEP 5	Replace scrub head lift actuator
5	 Key OFF Reconnect scrub head lift actuator to main wire harness Test voltage applied to scrub head lift subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-9 = Main Scrub/Solution Delivery Module Connector #4, Pin #9 J4-10 = Main Scrub/Solution Delivery Module Connector #4, Pin #10 SCRUB HEAD LIFT (S/N 011000-

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

SCRUB HEAD FAILS TO RAISE/LOWER

Step	Action	Value(s)	Yes	No
1	 Key ON Enable scrub head down Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate scrub head in Manual Mode Does the scrub head raise/lower? 		Proceed to STEP 5	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-9, J4-10, J4-13, J4-18 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See TESTING MAIN BRUSH LIFT ACTUATOR section of this manual Does the scrub head lift actuator pass the testing? 	See TESTING MAIN BRUSH LIFT ACTUATOR section of this manual	Proceed to STEP 5	Replace scrub head lift actuator
5	 Key OFF Reconnect scrub head lift actuator to main wire harness Test voltage applied to scrub head lift subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-9 = Combo Module (Water Pickup) Connector #4, Pin #9 J4-10 = Combo Module (Water Pickup) Connector #4, Pin #10 J4-13 = Combo Module (Water Pickup) Connector #4, Pin #13 J4-18 = Combo Module (Water Pickup) Connector #4, Pin #18

SIDE SWEEP BRUSH(ES) ON



SIDE SWEEP BRUSH(ES) FAIL(S) TO TURN ON

Step	Action	Value(s)	Yes	No
1	Key ONEnable side brushIs there a fault code/message displayed?		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate the side brush in Manual Mode Does/do side brush(es) turn On? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits CB17 or J4-16, J4-17 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See INPUT DISPLAY MODE section of this manual Does I6: Side Sweep On/Off input correspond with side brush rocker switch position? 		Proceed to STEP 5	Correct faulty input condition
5	 Key OFF See <i>TESTING SIDE SWEEP BRUSH MOTOR</i> section of this manual Does the side brush motor pass the testing? 	See TESTING SIDE SWEEP BRUSH MOTOR section of this manual	Proceed to STEP 5	Replace side brush motor
6	 Key OFF Reconnect side brush motor to main wire harness Test voltage applied to side brush subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

CB17 = High Side J4-16 = Side Sweep/Vacuum Module Connector #4, Pin #16 J4-17 = Side Sweep/Vacuum Module Connector #4, Pin #17

SIDE SWEEP BRUSH(ES) EXTEND/DOWN, OFF



SIDE SWEEP BRUSH(ES) FAIL(S) TO EXTEND/ LOWER

Step	Action	Value(s)	Yes	No
1	 Key ON Enable side brush extend/down Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Extend/Lower the side brush in Manual Mode Does the side brush extend/lower? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-1, 2 or J4-11, 12 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See INPUT DISPLAY MODE section of this manual Does I6: Side Sweep On/Off input correspond with side brush rocker switch position? 		Proceed to STEP 5	Correct faulty input condition
5	 Key OFF See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR section of this manual Does side brush lift actuator pass testing? 	See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR section of this manual	Proceed to STEP 6	Replace side brush lift actuator
6	 Key OFF Reconnect side brush lift actuator to main wire harness Key ON Side brush extend/down enabled Test voltage applied to side brush lift subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-1,2 = Side Sweep/Vacuum Module Connector #4, Pin #1 or 2 J4-11,12 = Side Sweep/Vacuum Module Connector #4, Pin #11 or 12

SIDE SWEEP BRUSH(ES) RETRACT/UP, OFF



SIDE SWEEP BRUSH(ES) FAIL(S) TO RETRACT/ RAISE

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	Enable side brush retract/up		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Proceed to STEP 3	Correct faulty input
	See SELF-TEST MODE section of this manual			condition
	 Does Self-Test display output circuits J4-1, 2 or J4-11, 12 as open or shorted? 			
3	• Key OFF		Proceed to STEP 4	Correct faulty input
	 See INPUT DISPLAY MODE section of this manual 			condition
	 Does I6: Side Sweep On/Off input correspond with side brush rocker switch position? 			
4	Key OFF	See TESTING	Proceed to STEP 5	Replace side brush
	See TESTING SIDE SWEEP BRUSH LIFT ACTUATOR section of this manual	SIDE SWEEP BRUSH LIFT		lift actuator
	 Does the side brush lift actuator pass the testing? 	section of this manual		
5	• Key ON		Repeat STEP 1	Identify voltage drop
	Side brush switch OFF			location and repair or replace necessary components
	Test voltage applied to side brush lift subsystem			
	Are electrical circuits operating?			

Terms:

J4-1,2 = Side Sweep/Vacuum Module Connector #4, Pin #1 or 2 J4-11,12 = Side Sweep/Vacuum Module Connector #4, Pin #11 or 12

SOLUTION CONTROL ON - MAIN BRUSH (CONVENTIONAL) (S/N 000000-010999)



SOLUTION CONTROL FAILS TO TURN ON - MAIN BRUSH (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable solution control (conventional) 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Proceed to STEP 7	Proceed to STEP 3
	 See MANUAL MODE section of this manual 			
	 Activate solution control in manual mode 			
	Does the machine dispense water to the floor?			
3	• Key OFF		Correct open or short	Proceed to STEP 4
	 See SELF-TEST MODE section of this manual 		circuit condition	
	 Does Self-Test display output circuit J4-17 as open or shorted? 			
4	• Key OFF		Reset and test solution	Proceed to STEP 5
	 Firmly press circuit breaker #6 to reset 		control operation	
	 Is circuit breaker #6 tripped? 			
5	• Key OFF		Proceed to STEP 6	Repair or replace SV3
	 Disconnect SV3 from main wire harness 			
	 Apply battery voltage to SV3 using fuse-protected jumper leads 			
	 Does main brush dispense solution? 			
6	Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect SV3 to main wire harness 		location and repair	
	• Key ON			components
	Enable solution control (conventional)			
	Test voltage applied to solution control subsystem			
	Are electrical circuits operating?			

Terms:

J4-17 = Main Scrub/Solution Delivery Module Connector #4, Pin #17 SV3 = Solenoid Valve #3 (Main Brush)

SOLUTION CONTROL ON - MAIN BRUSH (CONVENTIONAL) (S/N 011000-)



SOLUTION CONTROL FAILS TO TURN ON -MAIN BRUSH (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	 Key ON Enable solution control (conventional) Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate solution control in manual mode Does the machine dispense water to the floor? 		Proceed to STEP 7	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuit J4-17 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF Firmly press circuit breaker #6 to reset Is circuit breaker #6 tripped? 		Reset and test solution control operation	Proceed to STEP 5
5	 Key OFF Disconnect SV3 from main wire harness Apply battery voltage to SV3 using fuse-protected jumper leads Does main brush dispense solution? 		Proceed to STEP 6	Repair or replace SV3
6	 Key OFF Reconnect SV3 to main wire harness Key ON Enable solution control (conventional) Test voltage applied to solution control subsystem as shown on 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:

J4-17 = Main Scrub/Solution Delivery Module Connector #4, Pin #17 SV3 = Solenoid Valve #3 (Main Brush)

SOLUTION CONTROL ON - SIDE BRUSH (CONVENTIONAL) (S/N 000000-010999)



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

Battery Positive + Battery Negative -

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SOLUTION CONTROL FAILS TO TURN ON -SIDE BRUSH (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable side brush solution control (conventional) 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Proceed to STEP 7	Proceed to STEP 3
	 See MANUAL MODE section of this manual 			
	 Activate solution control in Manual Mode 			
	 Does the machine dispense water to the side brush? 			
3	• Key OFF		Correct open or short	Proceed to STEP 4
	 See SELF-TEST MODE section of this manual 		circuit condition	
	Does Self-Test display output circuits J4-10 or J4-9 as open or shorted?			
4	• Key OFF		Reset and test solution	Proceed to STEP 5
	 Firmly press circuit breaker #3 to reset 		control operation	
	 Is circuit breaker #3 tripped? 			
5	• Key OFF		Reset and test solution	Proceed to STEP 6
	 Firmly press circuit breaker #7 to reset 		control operation	
	 Is circuit breaker #7 tripped? 			
6	• Key OFF		Proceed to STEP 7	Repair or replace
	 Disconnect SV6 and side brush water pump from main wire harness 			SV6 or side brush water pump
	 Apply battery voltage to SV6 and side brush water pump using fuse-protected jumper leads 			
	 Does the side brush dispense solution? 			
7	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect SV6 and side brush water pump to main wire harness 			location and repair or replace necessary
	• Key ON			components
	Enable side brush solution control (conventional)			
	 Test voltage applied to side brush solution control subsystem 			
	 Are electrical circuits operating? 			

Terms:

J4-9 = Side Scrub Module Connector #4, Pin #9

J4-10 = Side Scrub Module Connector #4, Pin #10

SV6 = Solenoid Valve #6 (Side Brush)

SOLUTION CONTROL ON - SIDE BRUSH (CONVENTIONAL) (S/N 011000-)



SOLUTION CONTROL FAILS TO TURN ON -SIDE BRUSH (CONVENTIONAL)

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	Enable side brush solution control (conventional)		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Reset and test solution	Proceed to STEP 3
	 Firmly press circuit breaker #3 to reset 		control operation	
	Is circuit breaker #3 tripped?			
3	• Key OFF		Reset and test solution	Proceed to STEP 4
	 Firmly press circuit breaker #7 to reset 		control operation	
	 Is circuit breaker #7 tripped? 			
4	• Key OFF		Proceed to STEP 7	Proceed to STEP 5
	 See MANUAL MODE section of this manual 			
	 Activate solution control in Manual Mode 			
	 Does the machine dispense water to the side brush? 			
5	• Key OFF		Correct open or short	Proceed to STEP 6
	See SELF-TEST MODE section of this manual		circuit condition	
	Does Self-Test display output circuits J4-10 or J4-9 as open or shorted?			
6	• Key OFF		Proceed to STEP 7	Repair or replace
	 Disconnect SV6 and side brush water pump from main wire harness 			SV6 or side brush water pump
	 Apply battery voltage to SV6 and side brush water pump using fuse-protected jumper leads 			
	 Does the side brush dispense solution? 			
7	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect SV6 and side brush water pump to main wire harness 			location and repair or replace necessary
	• Key ON			components
	Enable side brush solution control (conventional)			
	 Test voltage applied to side brush solution control subsystem 			
	 Are electrical circuits operating? 			

Terms:

J4-9 = Side Scrub Module Connector #4, Pin #9

J4-10 = Side Scrub Module Connector #4, Pin #10

SV6 = Solenoid Valve #6 (Side Brush)

SOLUTION CONTROL ON (ec-H2O)



SOLUTION CONTROL FAILS TO TURN ON (ec-H2O)

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable solution control (<i>ec-H2O</i>) 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Reset and test ec-	Proceed to STEP 3
	 Firmly press circuit breakers #8 and #9 to reset 		H2O solution control	
	 Is a circuit breaker tripped? 			
3	• Key OFF		See ec-H2O	Proceed to STEP 5
	 Enable solution control (<i>ec-H2O</i>) 		PROCEDURE section	
	 Is ec-H2O LED flashing RED, indicating a system restriction or low water conductivity? 		in this manual. Proceed to STEP 4	
4	• Key OFF		System OK	See TESTING ec-
	 See ec-H2O MODULE FLUSH PROCEDURE section of this manual 			SWITCH
	Did the flush procedure fix the problem?			
5	• Key OFF		Proceed to STEP 8	Proceed to STEP 6
	See MANUAL MODE section of this manual			
	• Activate solution control (<i>ec-H2O</i>) in Manual Mode			
	Does solution control (ec-H2O) turn On?			
6	Key OFF	See SELF-	Correct open or short	Proceed to STEP 7
	See SELF-TEST MODE section of this manual	MODE		
	 Does Self-Test display output circuits J4-4,5 or J5- 1,2 or J5-3,4 as open or shorted? 	section of this manual		
7	• Key OFF		Proceed to STEP 8	Repair or replace
	Disconnect <i>ec-H2O</i> water pump from wire harness			ec-H2O water pump
	 Apply battery voltage to <i>ec-H2O</i> water pump using fuse-protected jumper leads 			
	Does the ec-H2O water pump dispense water?			
8	• Key OFF		Proceed to STEP 9	Identify voltage drop
	 Reconnect ec-H2O water pump to wire harness 			location and repair
	• Key ON			components
	 Enable solution control (<i>ec-H2O</i>) 			
	 Test voltage applied to solution control (<i>ec-H2O</i>) system 			
	Are electrical circuits operating?			
9	• Key ON		Replace ec-H2O	Repeat STEP 1
	 Enable solution control (ec-H2O) 		module	
	 Is ec-H2O LED solid RED, indicating an over current condition on a system component? 			

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

Terms:

LED = Light Emitting Diode

J4-4 = *ec-H2O* Module Connector #4, Pin #4

J4-5 = *ec-H2O* Module Connector #4, Pin #5

J5-1 = *ec-H2O* Module Connector #5, Pin #1 J5-2 = *ec-H2O* Module Connector #5, Pin #2 J5-3 = *ec-H2O* Module Connector #5, Pin #3

J5-4 = *ec-H2O* Module Connector #5, Pin #4

SEVERE ENVIRONMENT - SPOT CLEANING (S/N 000000-010999)



SEVERE ENVIRONMENT - SPOT CLEANING FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable severe environment - spot clean Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #6 to reset Is circuit breaker #6 tripped? 		Reset and test solution control operation	Proceed to STEP 3
3	 Key OFF See <i>MANUAL MODE</i> section of this manual Activate detergent pump in Manual Mode Does pump dispense detergent? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-14, J4- 12, or J4-11 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF Check to be sure there is detergent in concentrate tank Disconnect detergent pump from main wire harness Apply battery voltage to detergent pump using fuse protected jumper leads Does pump dispense detergent? 		Proceed to STEP 6	Repair or replace detergent pump
6	 Key OFF Reconnect detergent pump to main wire harness Key ON Enable severe environment subsystem Test voltage applied to severe environment subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-14 = Main Scrub/Solution Delivery Module Connector #4, Pin #14 J4-12 = Main Scrub/Solution Delivery Module Connector #4, Pin #12 J4-11 = Main Scrub/Solution Delivery Module Connector #4, Pin #11

SEVERE ENVIRONMENT - SPOT CLEANING (S/N 011000-)



SEVERE ENVIRONMENT - SPOT CLEANING FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable severe environment - spot clean Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #6 to reset Is circuit breaker #6 tripped? 		Reset and test solution control operation	Proceed to STEP 3
3	 Key OFF See MANUAL MODE section of this manual Activate detergent pump in Manual Mode Does pump dispense detergent? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-14, J4- 12, or J4-11 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF Check to be sure there is detergent in concentrate tank Disconnect detergent pump from main wire harness Apply battery voltage to detergent pump using fuse protected jumper leads Does pump dispense detergent? 		Proceed to STEP 6	Repair or replace detergent pump
6	 Key OFF Reconnect detergent pump to main wire harness Key ON Enable severe environment subsystem Test voltage applied to severe environment subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-14 = Main Scrub/Solution Delivery Module Connector #4, Pin #14 J4-12 = Main Scrub/Solution Delivery Module Connector #4, Pin #12 J4-11 = Main Scrub/Solution Delivery Module Connector #4, Pin #11

ES DETERGENT PUMP (S/N 000000-010999)

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



ES DETERGENT PUMP FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable ES scrubbing technology Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #6 to reset Is circuit breaker #6 tripped? 		Reset and test ES detergent pump operation	Proceed to STEP 3
3	 Key OFF See <i>MANUAL MODE</i> section of this manual Activate solution control in manual mode Does the pump dispense detergent? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does the Self-Test display output circuits J4-14 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF Ensure there is detergent in concentrate tank Disconnect detergent pump from main wire harness Apply battery voltage to detergent pump using fuse protected jumper leads Does the pump dispense detergent? 		Proceed to STEP 6	Repair or replace detergent pump
6	 Key OFF Reconnect detergent pump to main wire harness Key ON Enable ES detergent pump Test voltage applied to ES detergent pump Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-14 = Main Scrub/Solution Delivery Module Connector #4, Pin #14

ES DETERGENT PUMP (S/N 011000-

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

)



ES DETERGENT PUMP FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable ES scrubbing technology Is there a fault code/message displayed? 		See FAULT CODES section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #6 to reset Is circuit breaker #6 tripped? 		Reset and test ES detergent pump operation	Proceed to STEP 6
3	 Key OFF See MANUAL MODE section of this manual Activate solution control in manual mode Does the pump dispense detergent? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does the Self-Test display output circuits J4-14 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF Ensure there is detergent in concentrate tank Disconnect detergent pump from main wire harness Apply battery voltage to detergent pump using fuse protected jumper leads Does the pump dispense detergent? 		Proceed to STEP 6	Repair or replace detergent pump
6	 Key OFF Reconnect detergent pump to main wire harness Key ON Enable ES detergent pump Test voltage applied to ES detergent pump Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-14 = Main Scrub/Solution Delivery Module Connector #4, Pin #14

ES WATER PUMP



Circuit Fault

ES WATER PUMP FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES section of this manual	Proceed to STEP 2
	Enable ES scrubbing technology			
	Is there a fault code/message displayed?			
2	Key OFF		Reset and test ES	Proceed to STEP 5
	 Firmly press circuit breaker #1 to reset 			
	 Is circuit breaker #1 tripped? 			
3	• Key OFF		Proceed to STEP 6	Proceed to STEP 4
	See MANUAL MODE section of this manual			
	 Activate ES pump in manual mode 			
	Does the ES pump turn On?			
4	• Key OFF		Correct open or short	Proceed to STEP 5
	 See SELF-TEST MODE section of this manual 		circuit condition	
	 Does Self-Test display output circuits J6-13,14 as open or shorted? 			
5	• Key OFF		Proceed to STEP 6	Repair or replace ES
	 Ensure there is water in the recovery tank and solution tank is not full 			pump
	 Disconnect ES pump from main wire harness 			
	 Apply battery voltage to ES pump using fuse- protected jumper leads 			
	 Does ES pump transfer water from recovery tank to solution tank? 			
6	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect ES pump to main wire harness 			location and repair
	• Key ON			components
	Enable ES pump			
	 Test voltage applied to ES pump 			
	 Are electrical circuits operating? 			

Terms:

J6-14,13 = Combo Module (Water Pickup) Connector #6, Pin #14,13

SPRAY NOZZLE ON (OPTION)





Battery Negative -

SPRAY NOZZLE FAILS TO TURN ON (OPTION)

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODES	Proceed to STEP 2
	 Enable spray nozzle subsystem 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Reset and test spray	Proceed to STEP 3
	 Firmly press circuit breaker #10 to reset 		nozzle operation	
	 Is circuit breaker #10 tripped? 			
3	Key OFF		Proceed to STEP 4	Repair or replace
	 Disconnect spray nozzle water pump from wire harness 			spray nozzle water pump
	 Apply battery voltage to spray nozzle water pump using fuse-protected jumper leads 			
	Does spray nozzle water pump dispense water?			
4	Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect spray nozzle water pump to wire harness 			location and repair or replace necessary
	• Key ON			components
	 Turn spray nozzle switch ON 			
	 Test voltage applied to spray nozzle subsystem 			
	Are electrical circuits operating?			

SCRUB VACUUM FANS ON



The Vacuum Fan Motors (M7)/(M8) are controlled by PWM (pulse width modulation control): The setting will reduce the duty cycle to conserve battery energy and reduce noise when the scrub system is activated.

	Operational	Matrix:	
		Enabled	Disabled
Battery Positive + Battery Negative -	Vacuum Fans	• 1-STEP Scrub ON • Squeegee/Vac ON	 1-STEP Scrub OFF Squeegee/Vac OFF Recovery Tank Full Very Low Batt Voltage Circuit Fault

SCRUB VACUUM FAN(S) FAIL(S) TO TURN ON

Step	Action	Value(s)	Yes	No
1	Key ONEnable scrubbing vacuum fansIs there a fault code/message displayed?		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate vacuum fans in Manual Mode Do vacuum fans turn ON? 		Proceed to STEP 5	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J7-1,2 or J7-3,4 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See <i>TESTING VACUUM FAN (SCRUBBING)</i> section of this manual Do vacuum fan motors pass testing? 	See TESTING VACUUM FAN (SCRUBBING) section of this manual	Proceed to STEP 5	Repair or replace vacuum fan motor
5	 Key OFF Reconnect vacuum fan motor to main wire harness Key ON Enable scrubbing vacuum fan subsystem Test voltage applied to scrubbing vacuum fan subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J7-1,2 = Combo Module (Water Pickup) Connector #7, Pin #1 or 2 J7-3,4 = Combo Module (Water Pickup) Connector #7, Pin #3 or 4

SWEEP VACUUM FANS ON



 [•] Neutral (Ready State)

SWEEP VACUUM FAN(S) FAIL(S) TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable sweep vacuum fans Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #18 and/or #19 to reset Is circuit breaker #18 and/or #19 tripped? 		Reset and test vacuum fan(s) operation	Proceed to STEP 3
3	 Key OFF See MANUAL MODE section of this manual Activate sweep vacuum fans in Manual Mode Do sweep vacuum fans turn ON? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-5,10 or J4-4,9 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF See <i>TESTING VACUUM FAN (SCRUBBING)</i> section of this manual Do vacuum fan motors pass testing? 	See TESTING VACUUM FAN (SCRUBBING) section of this manual	Proceed to STEP 6	Repair or replace vacuum fan motor
6	 Key OFF Reconnect sweep vacuum fan motor to main wire harness Key ON Enable sweep vacuum fan subsystem Test voltage applied to sweep vacuum fan subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms: J4-5,10 = Side Sweep/Vacuum Module Connector #4, Pin #5 or 10 J4-4,9 = Side Sweep/Vacuum Module Connector #4, Pin #4 or 9

HOPPER LIFT PUMP, UP



HOPPER FAILS TO LIFT

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODE	DDE Proceed to STEP 2 manual
	Enable hopper lift		section of this manual	
	 Is there a fault code/message displayed? 			
2	Key OFF		Proceed to STEP 5	Proceed to STEP 3
	 See MANUAL MODE section of this manual 			
	 Activate hopper lift in Manual Mode 			
	Does hopper lift?			
3	• Key OFF		Correct open or short	ort Proceed to STEP 4
	See SELF-TEST MODE section of this manual		circuit condition	
	 Does Self-Test display output circuits J5-1 or J5-3 as open or shorted? 			
4	• Key OFF	See TESTING	NG Proceed to STEP 5 FAN NG) his	Repair or replace vacuum fan motor
	 See TESTING THE HOPPER LIFT PUMP MOTOR section of this manual 	VACUUM FAN (SCRUBBING)		
	 Does hopper lift pump pass testing? 	manual		
5	• Key OFF		Repeat STEP 1	Identify voltage drop location and repair or replace necessary
	 Reconnect hopper lift pump to main wire harness 			
	• Key ON			components
	 Enable hopper lift subsystem 			
	 Test voltage applied to hopper lift subsystem 			
	 Are electrical circuits operating? 			

Terms:

J5-1 = Main Sweep/Hopper Lift Module Connector #5, Pin #1 J5-3 = Main Sweep/Hopper Lift Module Connector #5, Pin #3

HOPPER LIFT PUMP, DOWN



HOPPER FAILS TO LOWER

Step	Action	Value(s)	Yes	No
1	• Key ON		See FAULT CODE	Proceed to STEP 2
	 Enable sweep vacuum fans 		section of this manual	
	 Is there a fault code/message displayed? 			
2	• Key OFF		Proceed to STEP 5	Proceed to STEP 3
	 See MANUAL MODE section of this manual 			
	 Lower hopper in Manual Mode 			
	Does the hopper lower?			
3	• Key OFF		Correct open or short	Proceed to STEP 4
	See SELF-TEST MODE section of this manual		circuit condition	
	 Does Self-Test display output circuits J5-2 or J5-3 as open or shorted? 			
4	• Key OFF	See TESTING	Proceed to STEP 5	Repair or replace vacuum fan motor
	 See TESTING THE HOPPER LIFT PUMP MOTOR section of this manual 	VACUUM FAN (SCRUBBING)		
	 Does hopper lift pump pass testing? 	manual		
5	• Key OFF		Repeat STEP 1	Identify voltage drop
	 Reconnect hopper lift pump to main wire harness 			location and repair or replace necessary
	• Key ON			components
	 Enable hopper lower subsystem 			
	 Test voltage applied to hopper lower subsystem 			
	Are electrical circuits operating?			

Terms:

J5-2 = Main Sweep/Hopper Lift Module Connector #5,

Pin #1

J5-3 = Main Sweep/Hopper Lift Module Connector #5, Pin #3

HOPPER ROLL ACTUATOR, EXTEND/OUT, OFF



Actuator

HOPPER FAILS TO EXTEND OUT

Step	Action	Value(s)	Yes	No
1	 Key ON Enable hopper roll out Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See <i>MANUAL MODE</i> section of this manual Extend hopper in Manual Mode Does the hopper roll (extend) out? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-9,18 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See <i>INPUT DISPLAY MODE</i> section of this manual Does I6: Roll switch in/out correspond with rocker switch position? 		Proceed to STEP 5	Correct faulty input condition
5	 Key OFF See TESTING THE HOPPER ROLL OUT/ ROLL IN ACTUATOR section of this manual Does hopper roll out/roll in actuator pass testing? 	See TESTING VACUUM FAN (SCRUBBING) section of this manual	Proceed to STEP 6	Repair or replace vacuum fan motor
6	 Key OFF Reconnect hopper roll in/out actuator to main wire harness Key ON Enable hopper roll in/out subsystem Test voltage applied to hopper roll in/out subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-9,18 = Main Sweep/Hopper Lift Module Connector #4, Pin #9 or #18

HOPPER ROLL ACTUATOR, RETRACT/IN, OFF



HOPPER FAILS TO RETRACT IN

Step	Action	Value(s)	Yes	No
1	 Key ON Enable hopper roll in Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See <i>MANUAL MODE</i> section of this manual Retract hopper in Manual Mode Does the hopper roll (retract) in? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-9,18? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See INPUT DISPLAY MODE section of this manual Does I6: Roll switch in/out correspond with rocker switch position? 		Proceed to STEP 5	Correct faulty input condition
45	 Key OFF See TESTING THE HOPPER ROLL OUT/ ROLL IN ACTUATOR section of this manual Does hopper roll out/roll in actuator pass testing? 	See TESTING THE HOPPER ROLL OUT/ ROLL IN ACTUATOR section of this manual	Proceed to STEP 6	Repair or replace vacuum fan motor
6	 Key OFF Reconnect hopper roll in/out actuator to main wire harness Key ON Enable hopper roll in/out subsystem Test voltage applied to hopper roll in/out subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-9,18 = Main Sweep/Hopper Lift Module Connector #4, Pin #9 or #18

MAIN SWEEP UP/DOWN, ACTUATOR



MAIN SWEEP FAILS TO RAISE/LOWER

Step	Action	Value(s)	Yes	No
1	Key ONEnable middle sweep up/down actuatorIs there a fault code/message displayed?		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Raise/lower the middle sweep up/down actuator in Manual Mode Does the middle sweep up/down actuator raise/lower? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-16 and J4-17? 		Correct open or short circuit condition	Proceed to STEP 4
4	Key OFFTest voltage applied to actuatorAre electrical circuits operating?		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF See <i>TESTING THE MAIN SWEEP UP/DOWN</i> <i>ACTUATOR</i> section of this manual Does middle sweep actuator pass testing? 	See TESTING THE MAIN SWEEP UP/DOWN ACTUATOR section of this manual	Proceed to STEP 6	Repair or replace vacuum fan motor
6	 Key OFF Reconnect middle sweep actuator to main wire harness Key ON Enable middle sweep up/down actuator subsystem Test voltage applied to middle sweep up/down actuator subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-17 = Main Sweep/Hopper Lift Module Connector #4, Pin #17 J4-16 = Main Sweep/Hopper Lift Module Connector #4, Pin #16

MAIN SWEEP MOTORS



MAIN SWEEP MOTORS FAIL TO ACTIVATE

Step	Action	Value(s)	Yes	No
1	 Key ON Enable middle sweep motors Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See <i>MANUAL MODE</i> section of this manual Activate middle sweep motors in Manual Mode Do the middle sweep motors activate? 		Proceed to STEP 6	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J7-2, J7-1, and J7-3? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF Test voltage applied to brush motors Are the electrical circuits operating? 		Proceed to STEP 5	Correct faulty input condition
5	 Key OFF See <i>TESTING THE MAIN SWEEP MOTORS</i> section of this manual Does hopper roll out/roll in actuator pass testing? 	See TESTING THE MAIN SWEEP MOTORS section of this manual	Proceed to STEP 6	Repair or replace vacuum fan motor
6	 Key OFF Reconnect hopper roll in/out actuator to main wire harness Key ON Enable hopper roll in/out subsystem Test voltage applied to hopper roll in/out subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms: J7-1,2 = Main Sweep/Hopper Lift Module Connector #7, Pin #1,2 J7-1,3 = Main Sweep/Hopper Lift Module Connector #7, Pin #1,3

FILTER SHAKER MOTOR



SHAKER MOTOR NOT FUNCTIONING

Step	Action	Value(s)	Yes	No
1	 Key ON Enable filter shaker switch Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF Firmly press circuit breaker #17 to reset Is circuit breaker #17 tripped? 		Reset and test filter shaker operation	Proceed to STEP 3
3	 Key OFF See MANUAL MODE section of this manual Activate filter shaker in Manual Mode Does filter shaker motor turn ON? 		Proceed to STEP 6	Proceed to STEP 4
4	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4-11,12 and J3-2, J4-18 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 5
5	 Key OFF See TESTING THE FILTER SHAKER MOTOR section of this manual Does filter shaker motor pass testing? 	See TESTING THE FILTER SHAKER MOTOR section of this manual	Proceed to STEP 6	Repair or replace filter shaker motor
6	 Key OFF Reconnect filter shaker motor to main wire harness Key ON Enable filter shaker subsystem Test voltage applied to filter shaker subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-11,12 = Main Sweep/Hopper Lift Module Connector #4, Pin #11,12 J3-2 = Side Sweep/Vacuum Module Connector #3, Pin #2 J4-18 = Side Sweep/Vacuum Module Connector #4, Pin #18

DRY VACUUM WAND (OPTION)


DRY VACUUM WAND FAILS TO TURN ON

Step	Action	Value(s)	Yes	No
1	 Key ON Enable dry vacuum wand switch Is there a fault code/message displayed? 		See FAULT CODE section of this manual	Proceed to STEP 2
2	 Key OFF See MANUAL MODE section of this manual Activate dry vacuum wand in Manual Mode Does dry vacuum wand fan turn ON? 		Proceed to STEP 5	Proceed to STEP 3
3	 Key OFF See SELF-TEST MODE section of this manual Does Self-Test display output circuits J4- 1,2,3,4,5,6 as open or shorted? 		Correct open or short circuit condition	Proceed to STEP 4
4	 Key OFF See <i>TESTING THE DRY VACUUM WAND</i> <i>FAN</i> section of this manual Do dry vacuum wand fan motor pass testing? 	See TESTING THE DRY VACUUM FAN section of this manual	Proceed to STEP 5	Repair or replace dry vacuum wand fan motor
5	 Key OFF Reconnect dry vacuum wand fan motor to main wire harness Key ON Enable dry vacuum wand subsystem Test voltage applied to dry vacuum wand fan subsystem Are electrical circuits operating? 		Repeat STEP 1	Identify voltage drop location and repair or replace necessary components

Terms:

J4-1,2,3,4,5,6 = Main Scrub/Solution Delivery Module Connector #4, Pin #1, #2, #3, #4, #5, #6

HIGH PRESSURE WASHER ON (OPTION)





HIGH PRESSURE WASHER FAILS TO TURN ON (OPTION)

Step	Action	Value(s)	Yes	No	
1	• Key ON		See FAULT CODE	Proceed to STEP 2	
	 Enable pressure washer switch 		section of this manual		
	 Is there a fault code/message displayed? 				
2	• Key OFF		Reset and test filter	Proceed to STEP 3	
	 Firmly press circuit breaker #10 to reset 		shaker operation		
	 Is circuit breaker #10 tripped? 				
3	• Key OFF		Proceed to STEP 4	Repair or replace high pressure sprayer water pump	
	 Disconnect high pressure sprayer water pump from wire harness 				
	 Apply battery voltage to high pressure sprayer water pump using fuse-protected jumper leads 				
	 Does high pressure sprayer water pump dispense water? 				
4	• Key OFF		Repeat STEP 1	Identify voltage drop	
	 Reconnect high pressure sprayer water pump to wire harness 			location and repair or replace necessary components	
	• Key ON				
	 Turn high pressure sprayer switch ON 				
	 Test voltage applied to high pressure sprayer subsystem as shown on electrical schematic 				
	 Are electrical circuits operating as shown on electrical schematic? 				

Terms:

TROUBLESHOOTING CAN (CONTROLLER AREA NETWORK) ISSUES

Procedures to investigate a fault related to a CAN open network.

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

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

CONNECTOR FULLY SEATED

Each node on the network has a connector for the CAN communication wires. A loose connection could cause a fault. Check each board to ensure all connectors are fully seated. There may also be other connectors within the harness that should be checked. If the connector is not fully seated, fully seat the connector and power cycle the machine to see if the fault clears.



PIN FULLY SEATED

A pin within the harness side of the connector may not be fully seated or may come loose over time causing a fault. If the pin is not fully seated, push it back in and power cycle the machine to see if the fault clears.



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 approximate values: 121Ω or 61Ω . Any value other than 121Ω or 61Ω means there is a network issue.

Method 1



- 1. Turn key switch OFF.
- 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. Depending which nodes are still connected, resistance should be either 61Ω or 121Ω .

Method 2



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

CAN SYSTEM OVERVIEW



INITIAL CAN TROUBLESHOOTING

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

1. Turn key switch ON. Wait for machine to completely power up.

NOTE: When turning on the machine while troubleshooting, always wait for the machine to completely power up before continuing troubleshooting.

- 2. Check battery voltage. The machine must have adequate power from the battery in order to continue troubleshooting procedures.
- Ensure the emergency shut-off button is not engaged. Release the emergency shut-off button if it is engaged.
- 4. If pod is operable, observe the pod for fault codes. See *FAULT CODES* in the *FAULTS AND WARNINGS* sections for fault codes/causes of the fault codes.

If pod is inoperable, proceed to *TROUBLE*-*SHOOTING THE STANDARD POD* to troubleshoot machines equipped with the standard pod or *TROUBLESHOOTING THE PRO-PANEL POD* to troubleshoot machines equipped with the Pro-Panel pod.

- 5. Turn key switch OFF.
- 6. Connect the service device to the machine.



- 7. Turn key switch ON.
- 8. Observe the service device for fault codes and ensure the machine has the latest firmware installed. If necessary, update the machine to the latest firmware revision.
- 9. If firmware was updated, turn key switch OFF.
- 10. Wait at least eight seconds for the pre-charge (capacitors) to discharge.

- 11. After the eight-second wait, turn key switch ON.
- 12. Observe service device and pod for fault codes. Proceed to the following step to continue troubleshooting procedure if problem persists.
- 13. Turn key switch OFF.
- Ensure the circuit breaker(s) to the system(s) in question are not tripped. Reset tripped circuit breaker(s).

Open the right side access door to access scrub system and *ec-H2O* system circuit breakers.



Main Scrub/Solution Delivery Module, Combo Module (Water Pickup), and/or Side Scrub Module (Option) circuit breakers:



Circuit Breaker	Rating	Circuit Protected
CB1	60A	Water pickup module
CB2	-	Not used
CB3	35A	Side scrub brush module (Option)
CB4	2.5A	Key switch
CB5	2.5A	Water pick up module
CB6	2.5A	Scrub module
CB7	2.5A	Side brush scrub module (Option)

ec-H2O Module circuit breakers:



Circuit Breaker	Rating	Circuit Protected
CB8	2.5A	ec-H2O power module (Option)
CB9	2.5A	ec-H2O pump module (Option)

Remove the hopper cover from the hopper to access the sweep system circuit breakers.



Main Sweep/Hopper Lift Module and Side Sweep/ Vacuum Module



Circuit Breaker	Rating	Circuit Protected
CB16	60A	Lift module
CB17	15A	Sweep module

- 15. Turn key switch ON.
- Observe service device and pod for fault codes. Proceed to the following step to continue troubleshooting procedure if problem persists.

If no fault codes appear, reinstall items removed to access circuit breakers and prepare machine to be put back into service.

17. If fault code(s) still persist, open the area of the machine where the module in question is located to access the module and begin CAN troubleshooting procedures.

To troubleshoot the scrub modules see TROUBLESHOOTING THE MAIN SCRUB/ SOLUTION DELIVERY MODULE, COMBO MODULE (WATER PICK UP), and/or SIDE SCRUB MODULE (OPTION).

To troubleshoot the *ec-H2O* Module, see *TROUBLESHOOTING THE ec-H2O MODULE*.

To troubleshoot the sweep see TROUBLESHOOTING THE MAIN SWEEP/ HOPPER LIFT MODULE and/or SIDE SWEEP/ VACUUM MODULE.

To troubleshoot the Propel Controller, see *TROUBLESHOOTING THE PROPEL CONTROLLER*.

TROUBLESHOOTING THE MAIN SCRUB/ SOLUTION DELIVERY MODULE



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

- 1. Turn key switch OFF.
- Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.



- 3. Turn key switch ON.
- Confirm there is power to the Main Scrub/ Solution Delivery Module (Green LED (LED1_G1) illuminates and pod is powered ON).



If the green LED (LED1_G1) is not illuminated there is no power to the module. Proceed to Step 6.

 Confirm there is CAN communication to the Main Scrub/Solution Delivery Module (Yellow LED (LED2_Y1) on module illuminates/pod responds).



If the yellow LED (LED2_Y1) is not illuminated there is no CAN communication to the module. Proceed to Step 10.

- 6. Turn key switch OFF.
- 7. Disconnect the battery cable from the machine.

NOTE: Always disconnect the battery cable from the machine before disconnecting/repairing electrical connections.

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

 Ensure wire connections at the 2.5-Amp circuit breaker (CB6) are secure and undamaged. Secure/ repair connections as necessary. Continue testing/ troubleshooting procedure if problem persists.



9. Reconnect the battery cable to the machine.

10. Check in-line 100-Amp fuse (Fuse-2/main electrical enclosure). Secure/repair connections. Continue testing/troubleshooting if still no power at the module.



 Inspect connections at Main Contactor (M1). Secure/repair connections. Continue testing/ troubleshooting if still no power at the module.



 Confirm connections at Main Scrub/Solution Delivery Module. Secure/repair connections. Call T.A.C. for further assistance if there is still no power at the module.



 Disconnect the main wire harness CAN connector from J1 on the Main Scrub/Solution Delivery Module and verify connectors and connector pins are fully seated and connector pins are not damaged.



14. Reconnect the main wire harness CAN connector to J1 on the Main Scrub/Solution Delivery Module. Call T.A.C. for further assistance if there is still no CAN communication to the module.





TROUBLESHOOTING THE COMBO MODULE (WATER PICKUP)



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

- 1. Turn key switch OFF.
- Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.



- 3. Turn key switch ON.
- Confirm there is power to the Combo Module (Water Pickup) (Green LED (LED1_G1) illuminates and pod is powered ON).



If the green LED (LED1_G1) is not illuminated there is no power to the module. Proceed to Step 6.

 Confirm there is CAN communication to the Combo Module (Water Pickup) (Yellow LED (LED2_Y1) on module illuminates/pod responds).



If the yellow LED (LED2_Y1) is not illuminated there is no CAN communication to the module. Proceed to Step 13.

- 6. Turn key switch OFF.
- 7. Disconnect the battery cable from the machine.

NOTE: Always disconnect the battery cable from the machine before disconnecting/repairing electrical connections.

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

8. Ensure wire connections at the 60-Amp circuit breaker circuit breaker (CB1) are secure and undamaged. Secure/repair connections. Continue testing/troubleshooting if problem persists.



9. Reconnect the battery cable to the machine.

 Ensure wire connections at the 2.5-Amp circuit breaker (CB5) are secure and undamaged. Secure/ repair connections as necessary. Continue testing/ troubleshooting procedure if problem persists.



11. Check in-line 100-Amp fuse (Fuse-2/main electrical enclosure). Secure/repair connections. Continue testing/troubleshooting if still no power at the module.



12. Confirm connections at Main Contactor (M1). Secure/repair connections. Continue testing/ troubleshooting if still no power at the module.



13. Disconnect the main wire harness connector from J5 on the Combo Module (Water Pickup).



- 14. Verify connectors and connector pins are fully seated and connector pins are not damaged and back probe the connector at J5-1 and J5-2 to verify power to the Combo Module (Water Pickup).
- 15. Reconnect the main wire harness connector to J5 on the Combo Module (Water Pickup). Call T.A.C. for further assistance if there is still no power at the module.
- 16. Disconnect the main wire harness CAN connector from Combo Module (Water Pickup) J1.



- 17. Verify connectors and connector pins are fully seated and connector pins are not damaged.
- Reconnect the main wire harness CAN connector to J1 on the Combo Module (Water Pickup). Call T.A.C. for further assistance if there is still no CAN communication to the module.



Operational Matrix:

	Battery Positive +
///	Battery Negative -

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

M17 9017358 (02-2020)

TROUBLESHOOTING THE SIDE SCRUB MODULE (OPTION)



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

- 1. Turn key switch OFF.
- Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.



- 3. Turn key switch ON.
- 4. Confirm there is power to the Side Scrub Module (Option) (Green LED (LED1_G1) illuminates and pod is powered ON).



If the green LED (LED1_G1) is not illuminated there is no power to the module. Proceed to Step 6.

 Confirm there is CAN communication to the Side Scrub Module (Option) (Yellow LED (LED2_Y1) on module illuminates/pod responds).



If the yellow LED (LED2_Y1) is not illuminated there is no CAN communication to the module. Proceed to Step 13.

- 6. Turn key switch OFF.
- 7. Disconnect the battery cable from the machine.

NOTE: Always disconnect the battery cable from the machine before disconnecting/repairing electrical connections.

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

 Ensure wire connections at the 35-Amp circuit breaker (CB3) are secure and undamaged. Secure/ repair connections as necessary. Continue testing/ troubleshooting procedure if problem persists.



9. Reconnect the battery cable to the machine.

 Ensure wire connections at the 2.5-Amp circuit breaker (CB7) are secure and undamaged. Secure/ repair connections as necessary. Continue testing/ troubleshooting procedure if problem persists.



11. Check in-line 100-Amp fuse (Fuse-2/main electrical enclosure). Secure/repair connections. Continue testing/troubleshooting if still no power at the module.



12. Confirm connections at Main Contactor (M1). Secure/repair connections. Continue testing/ troubleshooting if still no power at the module.



13. Disconnect the main wire harness connector from J5 on the Side Scrub Module (Option).



- 14. Verify connectors and connector pins are fully seated and connector pins are not damaged and back probe the connector at J5-1 and J5-2 to verify power to the Side Scrub Module (Option).
- 15. Reconnect the main wire harness connector to J5 on the Side Scrub Module (Option). Call T.A.C. for further assistance if there is still no power at the module.
- 16. Disconnect the main wire harness CAN connector from J1 on the Side Scrub Module (Option).



- 17. Verify connectors and connector pins are fully seated and connector pins are not damaged.
- Reconnect the main wire harness connector to J1 on the Side Scrub Module (Option). Call T.A.C. for further assistance if there is still no CAN communication to the module.



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

TROUBLESHOOTING THE ec-H2O MODULE

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Open the right side access door.



NOTE: Always disconnect the battery cable from the machine before disconnecting/testing/repairing electrical connections.

 Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.





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

 Ensure wire connections at the 2.5-Amp circuit breakers (CB8/CB9) are secure and undamaged. Secure/repair connections as necessary. Continue testing/troubleshooting procedure if problem persists.



6. Disconnect the 6-pin *ec-H2O* cable from the main wire harness.



- 7. Inspect the 6-pin *ec-H2O* connector pins for damage. Replace connector if damaged.
- 8. Reconnect the 6-pin *ec-H2O* connector to the main wire harness.
- 9. Reconnect the battery cable to the machine.
- 10. Turn key switch ON.
- 11. Observe for an *ec-H2O* fault code. If problem persists, troubleshoot the *ec-H2O* module per instructions in the *ec-H2O* Troubleshooting Guide and perform necessary repairs/maintenance. If problem persists, replace the *ec-H2O* assembly and/or inoperable ec-H2O components.





TROUBLESHOOTING THE SIDE SWEEP/VACUUM MODULE



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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Remove the left lintel cover from the machine.



4. Remove the hardware securing the board support plate to the electrical enclosure channel.



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

 Carefully pull the board support plate far enough from the electrical enclosure channel to access both the Main Sweep/Hopper Lift Module and Side Sweep/Vacuum Module. <u>Do Not</u> break any cable/ wire connections.



- 6. Reconnect the battery cable to the machine.
- 7. Turn key switch ON.
- 8. Confirm there is power to the Side Sweep/Vacuum Module (Green LED (LED1_G2)).



If the green LED (LED1_G1) is not illuminated there is no power to the module. Proceed to Step 10.

 Confirm there is CAN communication to the Side Sweep/Vacuum Module (Yellow LED (LED2_Y1)).



If the yellow LED (LED2_Y1) is not illuminated there is no CAN communication to the module. Proceed to Step 21.

- 10. Turn key switch OFF.
- 11. Disconnect the battery cable from the machine.
- Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.



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

13. Check in-line 150-Amp fuse (Fuse-4/main electrical enclosure). Secure/repair connections. Continue testing/troubleshooting if still no power at the module.



14. Remove the hardware securing the electrical enclosure bracket to the frame of the machine and carefully pull the enclosure far enough from the frame to access the secondary contactor and circuit breakers.



15. Ensure wire connections to the 15-Amp circuit breaker are secure and undamaged. Secure/ repair connections as necessary. Continue troubleshooting procedure if problem persists.



16. Reconnect the battery cable to the machine.

17. Ensure wire connections to the 15-Amp circuit Check for battery voltage on 19/White and 191 Pink (J4-14) at the sweep auxiliary (secondary) contactor (M4).



- 18. Inspect connections to sweep auxiliary (secondary) contactor (M4).
- 19. If 19/White has power, but the module does not, turn the key switch OFF.
- 20. Disconnect connector J3 from the Side Sweep/ Vacuum Module and examine pin terminals for deformations/enlarged ends.



21. Verify connectors and connector pins are fully seated and connector pins are not damaged and back probe the connector J3-1 and J3-2 to verify power to the Side Sweep/Vacuum Module.

NOTE: Older design contactors have open knockouts in the black housing. Ensure there is no debris inside the contactors.

22. Reconnect the main wire harness connector to J3 on the Side Sweep/Vacuum Module. Call T.A.C. for further assistance if there is still no power at module.



23. Disconnect the main wire harness CAN connector from J5 on the Side Sweep/Vacuum Module.



- 24. Verify connectors and connector pins are fully seated and connector pins are not damaged.
- 25. Reconnect the main wire harness connector to J5 on the Side Sweep/Vacuum Module. Call T.A.C. for further assistance if there is still no CAN communication to the module.
- 26. Turn key switch OFF.



TROUBLESHOOTING THE MAIN SWEEP/HOPPER LIFT MODULE



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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Remove the left lintel cover from the machine.



4. Remove the hardware securing the board support plate to the electrical enclosure channel.



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

 Carefully pull the board support plate far enough from the electrical enclosure channel to access both the Main Sweep/Hopper Lift Module and Side Sweep/Vacuum Module. <u>Do Not</u> break any cable/ wire connections.



- 6. Reconnect the battery cable to the machine.
- 7. Turn key switch ON.
- 8. Confirm there is power to the Main Sweep/Hopper Lift Module (Green LED (LED1_G2)).



If the green LED (LED1_G1) is not illuminated there is no power to the module. Proceed to Step 10.

 Confirm there is CAN communication to the Main Sweep/Hopper Lift Module (Yellow LED (LED2_Y1)).



If the yellow LED (LED2_Y1) is not illuminated there is no CAN communication to the module. Proceed to Step 21.

- 10. Turn key switch OFF.
- 11. Disconnect the battery cable from the machine.
- Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
 <u>Do Not</u> break any cable/wire connections.



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

13. Check in-line 150-Amp fuse (Fuse-4/main electrical enclosure). Secure/repair connections. Continue testing/troubleshooting if still no power at the module.



14. Remove the hardware securing the electrical enclosure bracket to the frame of the machine and carefully pull the enclosure far enough from the frame to access the secondary contactor and circuit breakers.



15. Ensure wire connections to the 60-Amp circuit breaker are secure and undamaged. Secure/ repair connections as necessary. Continue troubleshooting procedure if problem persists.



16. Reconnect the battery cable to the machine.

17. Check for battery voltage on 19/White and 191 Pink (J4-14) at the sweep auxiliary (secondary) contactor (M4).



- Inspect connections to sweep auxiliary (secondary) contactor (M4).
- 19. If 19/White has power, but the module does not, turn the key switch OFF.
- 20. Disconnect connector J6 from the Main Sweep/ Hopper Lift Module and examine pin terminals for deformations/enlarged ends.



21. Verify connectors and connector pins are fully seated and connector pins are not damaged and back probe the connector J6-1 and J6-2 to verify power to the Main Sweep/Hopper Lift Module.

NOTE: Older design contactors have open knockouts in the black housing. Ensure there is no debris inside the contactors.

22. Reconnect the main wire harness connector to J6 on the Main Sweep/Hopper Lift Module. Call T.A.C. for further assistance if there is still no power at module.



23. Disconnect the main wire harness CAN connector from J3 on the Main Sweep/Hopper Lift Module.



- 24. Verify connectors and connector pins are fully seated and connector pins are not damaged.
- 25. Reconnect the main wire harness connector to J5 on the Side Sweep/Vacuum Module. Call T.A.C. for further assistance if there is still no CAN communication to the module.
- 26. Turn key switch OFF.


CONFIRM THE PRE-CHARGE CIRCUIT IS FUNCTIONING



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

1. Remove the left lintel cover from the front frame to access the Main Sweep/Hopper Lift Module and Side Sweep/Vacuum Module.



2. Remove the hardware securing the board support plate to the electrical enclosure channel.



 Carefully pull the board support plate far enough from the electrical enclosure channel to observe the status lights on both the Main Sweep/Hopper Lift Module and Side Sweep/Vacuum Module. <u>Do</u> <u>Not</u> break any cables/connections when pulling the board support plate.



4. Turn key switch ON.

Propel controller monitors the Main Contactor (M1) and Auxiliary Contactor (M3) to close.

Side Sweep begins Pre-Charge of Sweep System and monitors sweep bulk capacitance.

5. Observe the Pre-Charge Circuit status on the Side Sweep/Vacuum Module.

Side Sweep/Vacuum Module Green LED (LED1_ G1) – Successful Pre-Charge. Sweep Auxiliary (Secondary) Contactor (M4) should close. Pre-Charge is successful.



Side Sweep/Vacuum Module Red LED (LED1_ R1) – Pre-Charge has failed. Side Sweep and Main Sweep transition to OFF, Sweep Auxiliary Contactor has not closed.



Do Not test any functions via SELF-TEST or MANUAL MODE. This may permanently damage the Sweep Modules.

- 6. If a Red LED is active, turn key switch OFF.
- 7. Wait at least eight seconds for the pre-charge (capacitors) to discharge.
- 8. Turn key switch ON.
- Observe the status lights. If the Red LED is no longer illuminated, continue troubleshooting/ complete remaining tasks.

If the Red LED remain illuminated, call T.A.C. for further guidance.

TROUBLESHOOTING THE PROPEL CONTROLLER



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

- 1. Turn key switch OFF.
- 2. Remove the access panel from the machine.



- 3. Turn key switch ON.
- 4. Observe the lights on the Propel Controller.

Flashing yellow light: Continually flashes approximately one flash per second when Propel Controller is functioning properly.



Flashing red fault code light: Flashes when there is a fault/issue with the Propel Controller.



If there is a flashing red fault code see *PROPEL CONTROLLER DIAGNOSTIC LED OPERATION* and *PROPEL CONTROLLER DIAGNOSTIC CODES* sections of this manual.

TROUBLESHOOTING THE STANDARD POD

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

- 1. Turn key switch ON.
- 2. Observe the pod. Does the pod power on? Is the pod functioning properly?
 - Blank/dark screen
 - Tennant logo then a blank screen
 - Pod is not retaining the configuration
 - Pod is not retaining the machine serial number
 - Lines, poor image quality, illegible text, etc...
 - Buttons not responsive
 - USB port(s) not functioning
- 3. If pod powers on, record the version number or date that appears on the screen during the start up sequence.





4. Observe pod for fault codes and record all active displayed fault codes. See *FAULT CODES* in *FAULTS AND WARNINGS*.

NOTE: Although machine configuration is set at the pod, the pod functions only as a pass through for the other modules. The pod displays only information it receives from the modules. Fault codes from the other modules signify an issue with the module, <u>not</u> the pod.

- 5. Confirm all control modules have the latest versions of the firmware.
- 6. Key cycle the machine.
- 7. Note any fault code changes or changes in how the machine operates/functions. May be necessary to briefly operate the machine for fault codes to appear.
- If it is determined that there is an issue with the pod
- 8. Determine cause of failure(s). Is it a component issue/failure? Or a pod issue/failure?
- 9. Continue observing the screen. Does the screen go blank shortly after initial start up? Does the screen freeze?
- 10. Check configuration. Is the configuration retained?
- 11. Initiate a membrane test. See *MEMBRANE TEST STANDARD PANEL*.
- 12. If it is determined there is an issue with a component/module, did it function when the self-test was conducted?

Example: Did horn function when self-test was conducted, but does not function when the horn button is pressed.

If horn functions during self-test, there may be damaged pod buttons.

- 13. Determine which module/component is affected.
- 14. Confirm machine is properly configured.
- 15. What type of failure? Was there a fault code? Did issue occur while machine was in use? Why did component/module fail? Was cause of failure due to machine abuse/misuse?
- 16. Confirm harnesses, connectors, fuses, circuit breakers for the suspected module(s) are not damaged and are functioning properly.

TROUBLESHOOTING THE PRO-PANEL POD

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

- 1. Turn key switch ON.
- 2. Observe the pod. Does the pod power on? Is the pod functioning properly?
 - Blank/dark screen
 - Tennant logo then a blank screen
 - Pod is not retaining the configuration
 - Pod is not retaining the machine serial number
 - Lines, poor image quality, illegible text, etc...
 - Touch screen not responsive
 - USB port(s) not functioning

Replace the pod if there are screen artifacts, a USB port is not functioning, or it there is a memory card failure.

If pod powers on and is functioning properly continue troubleshooting.

3. Press the *help button* to access the help screen.



4. Press the *about button* for the firmware information screen.



5. Record the firmware/GUI version on the information screen.



- 6. Exit the information screen and return to the main operation screen
- 7. Observe pod for fault codes. See FAULT CODES in FAULTS AND WARNINGS.

NOTE: Although the machine configuration is set at the pod, the pod functions only as a pass through for the other modules. The pod displays only information it receives from the modules. Fault codes from the other modules signify an issue with that particular module, <u>not</u> the pod.

If it is determined that there is an issue with the pod

- 8. Determine cause of failure(s). Is it a component issue/failure? Or a pod issue/failure.
- 9. Continue observing the screen. Does the screen go blank shortly after initial start up? Does the screen freeze?
- 10. Check configuration. Is the configuration retained?
- Operate various machine functions and observe if pod buttons and functioning/functioning properly. Do all pod button and lights function?
- 12. If a component is not functioning, did it function when the self-test was conducted?

Example: Did horn function when self-test was conducted, but does not function when the horn button is pressed.

If horn functions during self-test, there may be damaged buttons on the pod.

If it is determined there is an issue with a component/ module

- 13. Determine which module/component is affected.
- 14. Confirm machine is properly configured.
- 15. What type of failure? Was there a fault code? Did issue occur while machine was in use? Why did component/module fail? Was cause of failure due to machine abuse/misuse?
- Confirm harnesses, connectors, fuses, circuit breakers for the suspected module(s) are functioning properly.

TROUBLESHOOTING THE HORN

When the horn button is pressed the pod/UI (User Interface) reads the signal and then sends a signal to the main scrub module to turn the horn on. When the horn button is released, the pod/UI sends a signal to the main scrub module to turn the horn off.

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

HORN SOUNDS BUT NOT CORRECT

1. Turn key switch OFF.

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

- 2. Disconnect the battery cable from the machine.
- 3. Check horn bracket position on the frame of the machine and ensure all hardware is completely tightened.



4. Check horn for physical damage.

5. Ensure the main harness connections to the horn are secure and the and the terminals are not corroded.



- 6. Ensure main harness wires to the horn are not damaged (pinched, discolored, etc...).
- 7. If there are no signs of external damage and all harness connections are secure, but horn sound remains noticeably different, remove the horn from the machine and install a new horn.
- 8. Reconnect the battery cable to the machine.
- Read voltage across pins while new horn is active. If voltage is not ~19V to 23V (when battery is between 31.5V and 38V), replace the Main Scrub/ Solution Delivery Module and reconfigure all modules.



- 10. Main scrub/solution delivery module issue (Silver Horns Only): Replace horn if horn sound is quieter or pod displays Horn Open fault (0311).
- Replace the Main Scrub/Solution Delivery Module if new black horn shows Horn Short fault (0316). If this fault is seen on machines outside of serial numbers 011000 and above, call T.A.C. for assistance.

HORN DOES NOT SOUND

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

- 1. Turn key switch OFF.
- 2. Ensure the 2.5-Amp circuit breaker (CB6) is not tripped.



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

3. Open the right side access door.



 Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.
<u>Do Not</u> break any cable/wire connections.



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

5. Inspect the wire connections at circuit breaker (CB6).



6. Check horn for physical damage.



7. Inspect connections at pins/terminals for signs of corrosion/damage.



- 8. Check the pins for shorts (possibly due to moisture/ debris between pins).
- Run ~31V to 38V across pins to directly test horn. If horn sounds incorrect or does not sound, the horn is damaged. Replace the horn.
- 10. If cause is not yet determined troubleshoot pod issues.

POD ISSUE

- 1. Turn key switch ON.
- 2. Perform Horn Self-Test through UI.
- 3. Replace pod and reprogram all modules If horn functions when tested through self-test but not when the horn button is pressed on the pod, and no faults appear on the display.
- 4. If faults are shown or the horn does not function, troubleshoot for a CAN and Main Scrub/Solution Delivery Module issue.
- Replace the Main Scrub/Solution Delivery Module if new black horn shows horn short fault (0316). If this fault is seen on machines outside of serial number 011000 and higher call T.A.C. for further assistance.

CAN ISSUE

- 1. Turn key switch ON.
- 2. Press any button for another machine function to verify another feature functions via CAN by pod activation.
- 3. If the feature from the previous step is not functioning, continue troubleshooting. See *TROUBLESHOOTING THE MAIN SCRUB/ SOLUTION DELIVERY MODULE.* If problem persists, call T.A.C. for assistance.

SCRUB MODULE ISSUE

 Check harness, confirm continuity in 20/tan wire (Horn P2-1 to Main Scrub/Solution Delivery Module J4-16).

NOTE: A jumper/extension lead may be required to connect the voltmeter to P2-1 on the horn and J4-16 on the Main Scrub/Solution Delivery Module.





2. Read voltage across horn while horn button is pressed. If voltage is not ~19V to 23V (when battery is between 31.5V and 38V), check wires and connections for damage.



3. If issue persists, replace the Main Scrub/Solution Delivery Module (horn driver has failed). See *REMOVING/REPLACING THE MAIN SCRUB/ SOLUTION DELIVERY MODULE.* HORN DOES NOT STOP/UNINTENTIONALLY SOUNDS (ACTIVATES WITHOUT PRESSING HORN BUTTON) POD ISSUE

- 1. Turn key switch ON.
- 2. Press any button on the pod except the horn button. If horn sounds when another button is pushed, the membrane has a short. Replace the pod.
- 3. If horn sounds when key switch is turned ON there may be a short in the membrane.

Troubleshoot the Main Scrub/Solution Delivery Module. See *TROUBLESHOOTING THE MAIN SCRUB/SOLUTION DELIVERY MODULE/COMBO MODULE (WATER PICK UP)/SIDE SCRUB MODULE (OPTION).* If problem persists, call T.A.C. for further assistance.

4. Turn key switch OFF.

COMPONENT TESTING

TESTING THE RECOVERY TANK LEVEL SENSOR

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

1. Use and ohmmeter to test the resistance of the recovery tank level sensor. The tank level switch should test as "O. L." or open.



2. Use an ohmmeter to test the resistance of the recovery tank level sensor. The tank level switch should test at $0-1\Omega$ or closed.



3. The recovery tank full and half-full sensor conditions are also viewable in Input Display Mode. See *INPUT DISPLAY MODE*.





TESTING THE SOLUTION TANK LEVEL SENSOR

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

- 1. Turn key switch ON.
- 2. Use a voltmeter to back probe solution tank level sensor connector terminals A and B. The voltmeter should display 10-12 volts.



- 3. Turn key switch ON.
- 4. Use a voltmeter to back probe solution tank level sensor connector terminals A and C. The voltmeter should display 1-5 volts depending on solution tank water level.



5. Drain the solution tank.

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

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

7. The solution tank level sensor output voltage is also viewable in Input Display Mode. See *INPUT DISPLAY MODE*.





TESTING THE PROPEL MOTOR

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

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

- 1. Turn key switch OFF.
- 2. Remove terminal box cover.



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



4. Use an ohmmeter to test the resistance of all three motor windings. The resistances of each winding should not be open (O. L). An open winding indicates a faulty motor.



 Test the resistance between all three motor terminals and the motor case. The ohmmeter should read "O. L." or open. A shorted winding indicates a faulty motor.



6. The drive motor temperature sender and motor encoder are non-serviceable components. The motor encoder senses rotor position, speed, and direction. The encoder is integrated into an internal roller bearing assembly. See *PROPEL CONTROLLER DIAGNOSTIC CODES* for encoder related faults.

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



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

TESTING THE PROPEL MOTOR CABLES

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

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

- 1. Turn key switch OFF.
- 2. Remove terminal box cover.



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



4. Disconnect U, V, and W cables from the Propel Controller.



5. Reconnect battery connection and test each cable using an ohmmeter for a short to battery +. Each cable should test as "O. L." or open to battery +.

Replace shorted cable(s).



 Use an ohmmeter to test each cable for a short to battery -. Each cable should test as "O. L." or open to battery -.

6 Volt 6 Volt 6 Volt 6 Volt 6 Volt 6 Volt 41111 ╧┥╽╽┝╴ Hılı⊨ ilılı⊦ ±⊣ılıl ∸վվվե U V W PMT008

Replace shorted cable(s).

 Test each cable using an ohmmeter for a short to chassis as shown below. Each cable should test as "O. L." or open to chassis.

Replace shorted cable(s).



8. Use an ohmmeter to test each cable for end-to-end continuity. Each cable should test between $0-1\Omega$ resistance.

Replace open cable(s).



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

Replace broken cables.



TESTING THE THROTTLE SENSOR

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

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

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

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



Pin/Cavity	Notes	Color
A	Power (Battery +)	Red.
В	Pro Pel Output (0-5 VDC)	Yellow
С	Not Used	Blue
D	Ground (Battery -)	Black
E	Not Used	N/A
F	Gate B	N/A

- 3. Turn key switch ON.
- 4. Use a voltmeter to back probe the power supply to the throttle sensor terminals A and D. The voltmeter should display battery voltage.



- 5. Turn key switch ON.
- 6. Use a voltmeter to back probe the throttle sensor output terminals B and D. The voltmeter should display 0-5 volts proportional to 0-100% propel pedal movement.



7. See *PROPEL DIAGNOSTIC MODE*. The voltage in Step 3 should match the LCD displayed voltage in Propel Diagnostic Mode.





TESTING THE SIDE SCRUB BRUSH LIFT ACTUATOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the side brush lift actuator from the wire harness.



Pin Assignment		
2	Black	
1	Black	

Use fuse-protected jumper leads to apply battery voltage to the lift actuator. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 2. The actuator should retract completely.

Replace the actuator if it fails to retract.



4. Reverse polarity and apply battery voltage to the lift actuator using fuse-protected jumper leads. Connect battery negative (-) to terminal 1 and battery positive (+) to terminal 2. The actuator should extend completely.



TESTING THE MAIN SCRUB BRUSH LIFT ACTUATOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the main brush lift actuator from the wire harness.



MSLA001

Pin Assignment	
2	Red
1	Black

Use fuse-protected jumper leads to apply battery voltage to the lift actuator. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 2. The actuator should retract completely.

Replace the actuator if it fails to retract.



 Use fuse-protected jumper leads to reverse polarity and apply battery voltage to the lift actuator. Connect battery negative (-) to terminal 1 and battery positive (+) to terminal 2. The actuator should extend completely.



TESTING THE REAR SQUEEGEE LIFT ACTUATOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the rear squeegee lift actuator from the wire harness.



Pin Assignment		
2	Red	
1	Black	

Use fuse-protected jumper leads to apply battery voltage to the lift actuator. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 2. The actuator should retract completely.

Replace the actuator if it fails to retract.



 Use fuse-protected jumper leads to reverse polarity and apply battery voltage to the lift actuator. Connect battery negative (-) to terminal 1 and battery positive (+) to terminal 2. The actuator should extend completely.



TESTING THE VACUUM FAN

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the vacuum fan.



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



4. Use fuse-protected jumper leads to apply battery voltage to the vacuum fan(s). The fan should turn On.

Replace the vacuum fan if it fails to turn on.



 Reconnect vacuum fan(s) to wire harness. See MANUAL MODE. Activate the vacuum fan in Manual Mode. The amperage displayed should be approximately 14-20 Amps (average 16 Amps)





TESTING THE SIDE SWEEP BRUSH MOTOR

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the side brush motor from the wire harness.



4. Use fuse-protected jumper leads to apply battery voltage to the side brush motor. The side brush motor should turn On.

Replace the side brush stop motor if it fails to turn on.



DIVIOUT

Pin Assignment		
2	Black	
1	Red	

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



TESTING THE ec-H2O PUMP

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

- 1. Turn key switch OFF.
- 2. Disconnect *ec-H2O* pump outlet hose.



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



5. Enter Manual Mode and enable the *ec-H2O* system. See *MANUAL MODE* section of this manual.

 Use a stop watch to time how long it takes to fill a 5-gallon bucket. The open flow specification for the *ec-H2O* pump is 1.8 GPM. The pump should fill the 5-gallon bucket in approximately 2.7 - 3.0 minutes.

Replace the pump if it takes longer than 3.5 minutes to fill the bucket.

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



ADJUSTING ec-H2O FLOW RATE

See CONFIGURATION MODE in this section of this manual.

TESTING THE ec-H2O PRESSURE SWITCH

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the pressure switch from the wire harness and remove the switch from the machine.



3. Use an ohmmeter to test the resistance of the switch between the common and normally closed terminals. There should be $0-1\Omega$ resistance.

Replace the switch if the N.C. contacts are open.



 Use an ohmmeter to test the resistance of the switch between the common and normally open terminals. The switch should test as "O. L." or open.

Replace the switch if the N.O. contacts are shorted.



 Use a bicycle pump with pressure gauge to apply pressure to the switch. The normally open contacts should close at 20 +/- 2 psi (1.4 Bar), increasing pressure.

Replace the switch if it does not open correctly.



TESTING THE HOPPER LIFT PUMP MOTOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the hopper lift pump.



 Use fuse-protected jumper leads to apply battery voltage to the lift pump motor. Connect battery positive (+) to green wire and battery negative (-) black wire. The motor should engage hydraulic cylinder to lower.

Replace the pump if it fails to function properly in either direction.



 Use fuse-protected jumper leads to apply battery voltage to the lift pump motor. Connect battery positive (+) to blue wire and battery negative (-) to black wire. The motor should engage hydraulic cylinder to raise.

Replace the pump if it fails to function properly in either direction.



TESTING THE ROLL OUT ACTUATOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the roll out actuator.



 Use fuse-protected jumper leads to apply battery voltage to the actuator. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 3. The actuator should extend completely.

Replace the actuator if it fails to extend.



 Use fuse-protected jumper leads to apply battery voltage to the roll out actuator. Connect battery positive (+) to terminal 3 and battery negative (-) to terminal 1. The actuator should retract completely.

Replace the actuator if it fails to retract.



Pin Assignment		
1	Positive (+) Motor Extend	
2	Open	
3	Negative (-) Motor Extend	
4	Positive (+) Potentiometer	
5	Potentiometer Signal	
6	Negative (-) Potentiometer	

TESTING THE MAIN SWEEP LIFT ACTUATOR

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

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

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

- 1. Turn key switch OFF
- 2. Disconnect the wire harness from the main sweep lift actuator.



Pin Assignment	
1	Black
2	Red

Use fuse-protected jumper leads to apply battery voltage to the lift actuator. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 2. The actuator should retract completely.

Replace the actuator if it fails to retract.



 Use fuse-protected jumper leads to reverse polarity and apply battery voltage to the lift actuator. Connect battery negative (-) to terminal 1 and battery positive (+) to terminal 2. The actuator should extend completely.



TESTING THE MAIN SWEEP BRUSH MOTORS

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the brush motor(s).



Pin Assignment		
1	Red	
2	Black	

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





4. Use fuse-protected jumper leads to apply battery voltage to the brush motor. The brush motor should turn On, swap test leads and motor should turn On opposite direction.

Replace the brush motor if it fails to turn on.



Motor Rotation		
Left	Right	
Red (+)	Black (+)	
Black (-)	Red (-)	

TESTING THE FILTER SHAKER MOTOR

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the shaker motor.



3. Use fuse-protected jumper leads to apply battery voltage to the shaker motor. The shaker motor should turn ON.

Replace the shaker motor if it fails to turn on.



Motor Rotation		
Pin 1	Red (+)	
Pin 2	Green (grd)	
Pin 3	Black (-)	

TESTING THE DRY VACUUM FAN

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

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the wire harness from the dry vacuum fan.



Use fuse-protected jumper leads to apply battery voltage to the vacuum fan. Connect battery positive (+) to terminal 1 and battery negative (-) to terminal 2. The vacuum fan should come on.

Replace the vacuum fan if it fails to come on.


DISPLAYING FAULT CODES ON SERVICE DEVICE

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

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

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



2. Turn key switch ON.



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.

CONNECTED:	Grafitz Nopeer Nat Home
TENNANT	
	Configuration Firm 7 Documents
Sugar A	Ov0742: Honner Not Home
Battery	
Voltage 35.88	
Type (and Acid (Flooded)	
Hour Meters	
Machine 6.7	
Propel 0.7	

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

SERVICE DIAGNOSTICS TOOL

Machine software configuration, which is stored in the interface module, must be programmed if the control/ interface modules are replaced or if optional features are installed.

Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices. Authorized service providers can download the Service Diagnostics software. Authorized service providers must uninstall and reinstall the service diagnostic program to get firmware updates. The authorized service provider version does not self update.

A USB cable connects from the service device to the control console (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL can configure multiple control modules. The interface module stores configuration data and communicates via RS232 serial communication with the main control module and through a CAN (controller area network) to all other modules.

- Interface Module: Located inside the pod.
- Main Scrub/Solution Delivery Module: Located inside the electrical box beneath the operator compartment.
- Combo Module (Water Pickup): Located inside the electrical box beneath the operator compartment.
- Side Scrub Module (option): Located inside the electrical box beneath the operator compartment.
- Main Sweep/Hopper Lift Module: Located inside the sweep electrical box on the left lintel on the front machine frame.
- Side Sweep/Vacuum Module: Located inside the sweep electrical box on the left lintel of the machine frame.
- **Propel Controller:** Located on the steering support channel.
- **Power Steering Module:** Located on the steering support channel.
- **IRIS Module (option):** Mounted to the lower front left side of the machine frame.
- ec-H2O NanoClean Module (option): Located next to the electrical box beneath the operator compartment.

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 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 computer screen.



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



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

Service Diagnostics SE 14.0	
CONNECTED: M17 ProPanel P2-3	
	A new board has been installed in this machine and must be properly configured. This wizard will guide you through the process.
	Sand Number Model •
	•

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

NOTE: Reconfiguring 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).





 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.



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

Sensce Diagnostics 57 1.6.0	
CONCUENTS IS	
Advanced	🖌 Machine Setup Completes

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 control/ interface modules are replaced or if optional features are installed.

Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices. Authorized service providers can download the Service Diagnostics software. Authorized service providers must uninstall and reinstall the service diagnostic program to get firmware updates. The authorized service provider version does not self update.

A USB cable connects from the service device to the control console (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL can configure multiple control modules. The interface module stores configuration data and communicates via RS232 serial communication with the main control module and through a CAN (controller area network) to all other modules.

1. Connect a USB cable from the service device to the machine.



2. Turn key switch ON.



 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.

Service Diagnostics SE 1.6.0		
CONNECTED: M17 ProPanel P2-3		
	Configuration	ints
Battery 35.89 Type Level Acid (Poodeel Level 83% Hour Meters 03 Peopel 0.7		

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 visual status indicators on the screen for the update status.



The process indicator will disappear from the screen and all items in the firmware update status bar with have check marks to the left to verify the firmware has occurred.

M17 ProPanel P2-3		fierwa
TENNANT		Rateaux Notes
<u>S</u>	MODULE: LCD Interface Hardware Rev: 0.00 Firmware Rev: 2.17	
- HE - CA	MODULE: Main Scrub Hardware Rev: 0.00)
	MODULE : Water Pickup Controller Hardware Rev: 0.00 Firmware Rev: 0.00 (Update : 1.	19)
Open Firmware Package Update Master Firmware Feset Machine	MODULE: Main Sweep Controller Hardware Rev: 1.00 Firmware Rev: 1.07	
Update Other Familyare Reset Machine Verity Familyare	MODULE: Curtis Propel Controller Hardware Rev:1.00 Firmware Rev:0.01	
	MODULE: Side Scrub Controller Hardware Rev: 0.00 Firmware Rev: 1.18	

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



- 7. Cycle the key switch to save the firmware updates.
- 8. Click the Release Notes button to access the attached PDF notes for the firmware updates.



9. Read the PDF notes to confirm the firmware updates and fixes to the machine.

M17 ProPanel Firmware Release Notes

Package Version	Release Date	Firmware Revision			Changes
1.26/1.27	2018.03.26	User Interface:	1.29		Fixed Main sweep actuator over extension issue
		Main Sweep:	1.06		Fixed the fault code text display for Vac Fan Fault
		Side Sweep:	1.06		Sweeping system will shut down if contactor relay
		Main Scrub:	1.57		opens
		Water Pickup:	1.17		Battery selection indicated by green checkmark in
		Side Scrub	1.13		Battery menu
		EC-h2o:	1.51		Progress bar added to checklist export screen
				•	Fixed Boost Icon bug on Home Screen



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 control/ interface modules are replaced or if optional features are installed.

Factory-Direct Tennant Service personnel have this software installed on their ServiceLink devices. Authorized service providers can download the Service Diagnostics software. Authorized service providers must uninstall and reinstall the service diagnostic program to get firmware updates. The authorized service provider version does not self update.

A USB cable connects from the service device to the control console (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL can configure multiple control modules. The interface module stores configuration data and communicates via RS232 serial communication with the main control module and through a CAN (controller area network) to all other modules.

1. Connect a USB cable from the service device to the machine.



2. Turn key switch ON.



 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 the new configuration setting(s).

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.



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

Dry Vac Voltage (Percent)	0.0	
Password	TENNANT	

- 10. Access the advanced configuration screen to reset component hours or record old hours on repair order for warranty purposes.
- 11. Cycle the key switch to save and exit the Advanced Configuration screen.

Service Diagnostics SE L.6.0 DNNECTED: 17 ProPanel 92-3					actives.
TENNANT	Clear Model				
ATR.	Sweep Config	weep Config Dual Force		ø	Ł
	Main Flow Range	Normal	•	0	<u>+</u>
	Severe Environment Flow Range	Firm 3		0	±
	Side Scrub RPM	23.00		0	<u>+</u>
	Main Sweep Actuator Current Limit (Am	4.00		0	<u>*</u>
Standard	Vac Economy Voltage (Volts)	28.75		C	<u>*</u>
Advanced	Pressure Washer Config	No	•	0	<u>*</u>
		Disk Low Pressure	34.0		
		Disk Med Pressure	25.0		
	Current Tamets (Amos)	Disk High Pressure	35.0	0	4
		Cyl. Low Pressure	13.0	~	-



DNNECTED: 27 ProPanei P2-3			0x07A2h Hogper Not Home
TENNANT			Ceer Model 2
AL	Dry Vac Voltage (Percent)	0.0	O ±
LILL AND	Propel Meter (Seconds)	2561	a
	Scrub Meter (Seconds)	182	A
	Side Scrub Meter (Seconds)	190	£
	Vacuum Meter (Seconds)	227	A
Standard	es-H2D Meter (Seconds)	36	Ð
Advanced	ES Meter (Seconds)	0	a
	Detergent Meter (Seconds)	0	A
	Main Sweep Meter (Seconds)	130	θ.
	Side Sweep Meter (Seconds)	125	A
	Machine Meter (Seconds)	2606	8

12. A check appears next to the item reconfigured after reconfiguring is complete.



Cycle the key switch to save the new advanced configuration setting(s). That setting(s) will not be saved until the machine is key cycled.

Service Diagnostics SE 1.6.0			(Cardinal Street)
DNNECTED: 17 ProPanel P2-3		0x07A2: Hopper Not Home	£3
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13. If the machine must be completely reconfigured, select the Clear Model button to completely clear all previous machine configuration parameters and completely reconfigure the machine.

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14. A warning box appears 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?" Select the Yes button to continue complete reconfiguring the machine.

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Select the No button to cancel complete machine configuration and return to Advanced configuration screen.

ACCESSING SUPPORT DOCUMENTATION (AVAILABLE TO FACTORY-DIRECT SERVICE PERSONNEL ONLY)

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 control/ interface modules are replaced or if optional features are installed.

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

A USB cable connects from the service device to the control console (USB to mini USB adapter cable required). The SERVICE DIAGNOSTICS TOOL can configure multiple control modules. The interface module stores configuration data and communicates via RS232 serial communication with the main control module and through a CAN (controller area network) to all other modules.

1. Connect a USB cable from the service device to the machine.



2. Turn key switch ON.



 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.

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 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.



CLEANING SYSTEMS- SCRUBBING

REMOVING THE REAR SQUEEGEE LIFT ACTUATOR



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

1. Remove the rear squeegee.



2. Jack up the back end of the machine. See *MACHINE JACKING* in the *MAINTENANCE* section for additional machine jacking and safety information.

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

3. Proceed to the following step if actuator failed in lowered position. Use a spacer block to support rear squeegee mounting bracket and remove spring tension from the lift cable.



4. Turn key switch ON. Enter Manual Mode and completely lower the scrub head (See *MANUAL MODE* in the *TROUBLESHOOTING* section of this manual). Turn key switch OFF immediately when the head touches the floor.

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

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





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





7. Remove the rear squeegee lift actuator.



1. Reinstall the rear squeegee lift actuator in reverse of disassembly.

REAR SQUEEGEE LINKAGE ROD ADJUSTMENT

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



REMOVING/REPLACING/INSTALLING THE RECOVERY TANK VACUUM FAN(S)



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

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

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

4. Disconnect vacuum fan from wire harness connections.



5. Remove vacuum fan mounting hardware (5).



6. Remove the vacuum fan assembly.



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



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



- 9. Disconnect muffler from vacuum fan assembly.
- 10. Proceed to REMOVING/INSPECTING/ REPLACING THE RECOVERY TANK VACUUM FAN CARBON BRUSHES if replacing the brushes.
- 11. Reassemble the vacuum fan is reverse order of disassembly. Note the orientation of the vacuum fan exhaust port to the rubber indicators.



12. Reassemble the vacuum fan onto the recovery tank in reverse order of disassembly.

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

NOTE: Carbon brushes should be replaced as sets

- 1. Remove the vacuum fan from the machine. See *REMOVING/INSTALLING THE RECOVERY TANK VACUUM FAN(S)* in this section manual.
- 2. Remove hardware securing the vacuum fan cover assembly to the vacuum fan motor and remove the vacuum fan cover assembly from the motor.



3. Loosen the carbon brush mounting hardware.



4. Lift up to release and remove 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.
- NOTE: Carbon brushes should be replaced as sets.





6. Use a stone to clean the commutator,



- 7. Use compressed air to clean dust from inside the vacuum fan motor.
- 8. Reinstall the removed vacuum fan brushes/install the new vacuum fan brushes in reverse order of disassembly.
- 9. Reinstall the vacuum fan onto the machine. See *REMOVING/INSTALLING THE RECOVERY TANK VACUUM FAN(S)* in this section of manual.

REMOVING/REINSTALLING THE SCRUB HEAD LIFT ACTUATOR



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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Remove the scrub brushes.
- 4. Carefully remove front linkage pivot bolts (Qty. 2).

NOTE: The front of the scrub head will drop to the floor once the mounting hardware is removed.



5. Carefully remove rear linkage pivot bolts (Qty. 2).

NOTE: The rear of the scrub head will drop to the floor once the mounting hardware is removed.



6. Jack up the front of machine. See *MACHINE JACKING* in the *MAINTENANCE* section for additional machine jacking and safety information.

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

- 7. Disconnect the wire harness from the lift actuator.
- 8. Remove lift actuator mounting pins (Qty. 2).



9. Remove the scrub head lift actuator.



10. Reinstall the scrub head lift actuator in reverse order of disassembly.

NOTE: The scrub head actuator does not require an installation adjustment. This actuator is controlled via current, not limits or switches. Turn the actuator tube manually to align the mounting holes and insert clevis and cotter pins.

REMOVING/REINSTALLING THE SCRUB HEAD (CYLINDRICAL AND DISK)





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

- 1. Drain solution tank.
- 2. Turn key switch OFF.
- 3. Disconnect the battery cable from the machine.
- 4. Remove scrub brushes.
- 5. Remove the debris tray (machines with cylindrical scrub heads only).

6. Jack up the front of machine. See *MACHINE JACKING* in the *MAINTENANCE* section for additional machine jacking and safety information.

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

- 7. Turn key switch ON. Enter Manual Mode and completely lower the scrub head (See *MANUAL MODE* in the *TROUBLESHOOTING* section of this manual). Turn key switch OFF immediately when head touches the floor.
- 8. Carefully remove front linkage pivot bolts (Qty. 2).

NOTE: The front of the scrub head will drop to the floor when the mounting hardware is removed.



9. Carefully remove rear linkage pivot bolts (Qty. 2).

NOTE: The rear of the scrub head will drop to the floor when the mounting hardware is removed.



- 10. Disconnect the main wire harness from the lift actuator.
- 11. Remove lift actuator mounting pins (Qty. 2).



12. Disconnect the main wire harness from the main solution delivery manifold.



- 13. Disconnect the solution hose from the main solution delivery manifold.
- 14. Use a ratchet strap to support the lift mechanism to avoid interference during scrub head removal.



- 15. Remove the scrub head.
- 16. Reinstall the scrub head back onto the machine in reverse order of disassembly.

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

17. Cylindrical scrub head only: Check and adjust the scrub brush pattern. See CHECKING/ADJUSTING THE CYLINDRICAL SCRUB BRUSH PATTERN section of this manual.

MAIN SCRUB CYLINDRICAL BRUSH ASSEMBLY





REMOVING/REPLACING THE SCRUB DRIVE BELT

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

- 1. Turn key switch ON, completely lower the scrub head, turn key switch OFF, and remove the key.
- 2. Open the main brush access door and side squeegee support door.



3. Remove the scrubbing drive belt cover from the scrub head.





4. If removing/replacing the motor, proceed to *REMOVE SCRUB CYLINDRICAL BRUSH MOTORS.* If replacing the drive belt, proceed to the following step 5. Use two of hex screws/washers removed when the scrubbing belt cover was removed to install the belt installation tool onto the sheave.



6. Position the new cylindrical brush drive belt onto the smaller sheave installed on the electric motor and belt installation tool.



7. Turn the sheave clockwise and coax the belt over the belt installation tool and onto both sheaves. Be sure the belt is completely seated into the grooves in both sheaves.



8. Reassemble items removed to install the new belt in reverse order of disassembly.

REMOVING THE SCRUB CYLINDRICAL BRUSH MOTOR(S)

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

1. Jack up the front of machine. See *MACHINE JACKING* in the *MAINTENANCE* section for additional machine jacking and safety information.

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

- 2. Remove scrub brushes.
- Turn key switch ON. Enter Manual Mode and lower scrub head completely (See MANUAL MODE in the TROUBLESHOOTING section of this manual). Turn key switch OFF immediately when scrub head is completely lowered to the floor.
- 4. Disconnect the battery cable from the machine.

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

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



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



7. Remove motor mounting hardware (Qty. 4).



8. Disconnect the main wire harness from the scrub brush motor.

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





 Reinstall the cylindrical brush motor(s) in reverse order of disassembly. See *REMOVING/ REPLACING THE SCRUB DRIVE BELT* for instructions how to reinstall the scrub brush drive belt.

CHECKING/ADJUSTING THE CYLINDRICAL SCRUB BRUSH PATTERN

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

NOTE: Machine must be on level/flat surface before testing motor currents. Variations in current may occur if machine is not parked on a level/flat surface.

- 1. Turn key switch ON.
- 2. Place the machine into the Manual Mode. See *MANUAL MODE* in the *TROUBLESHOOTING* section for information how to place machine into the Manual Mode.
- 1. Verify the motor current for each brush. The current for each brush motor should be as close as possible and be between 12-15 amps.
- 2. Turn key switch OFF. Leave the sweep head in the lowered position. It is easier to access adjustment hardware with sweep head lowered.
- 3. If current is low, loosen the eye bolt attached to the extension spring.

If current is high, tighten the eye bolt attached to the extension spring.

- 4. Recheck current measurements. Adjust as necessary.
- 5. Reassemble all parts removed from the machine.
- Turn key switch ON, place machine in Manual Mode, and run the sweep brushes on a smooth level surface for approximately 15-20 seconds. Raise the sweep head and back the machine away from where the brushes were tested.

7. Observe the brush pattern.



- 8. Loosen the bolt on the handle.
- 9. Tighten the adjustment screw to raise the right side of the brush if pattern is too heavy to the right side of the machine

Loosen the adjustment screw to lower the right side of the brush if pattern is too heavy to the left side of the machine

10. Adjust the front to rear sweep brush pattern. The patterns should be approximately 1.5 in. across each pattern and vary no more than 0.25 in.



11. Adjust the rod ends to adjust the front to rear brush pattern. When adjusting with rod-ends always use the same number of turns per side. Turn clockwise to tilt the sweep head to the rear, making the pattern lighter in the front and heavier to the rear of the machine.

Turn counterclockwise to tilt the sweep head to the front, making the pattern heavier in the front and lighter to the rear of the machine



12. If pattern is even between the front and back sweep brushes and the tape is still under 1.25 in. at the smallest width, adjust the lift spring. Loosen the eye bolt a thread to make the pattern heavier.



REMOVING/REINSTALLING THE SIDE SCRUB LIFT ACTUATOR


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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Jack up the front of machine. Be sure to use wheel chocks and jack stands. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.

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

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



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



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



8. Remove cotter and clevis pin from actuator.



9. Remove lift actuator from machine.



10. Reinstall the side brush lift actuator in reverse order of disassembly.

ADJUSTING THE SCRUB SIDE BRUSH SPRING TUBE ASSEMBLY

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

1. Jack up the front of machine. Be sure to use wheel chocks and jack stands. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.

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

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



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





- 4. Inspection the side scrub brush in the raised/ retracted position. The bottom of the brush hub should be 3.75-4.00 in (9.5-10.2 cm) from the floor to allow for brush replacement clearance. Tighten the jam nut when the desired height has been reached.
- 5. Turn key switch ON, 1-Step scrub On, side brush switch On. Allow the side brush to completely lower and turn key switch OFF.



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



7. Turn the spring tube assembly clockwise to shorten the tube (opening the adjustment gap). Turn the spring tube assembly counterclockwise to lengthen the tube (closing the adjustment gap). Cycle the side brush up down to check the gap.



8. Tighten the jam nut.

REMOVING/REINSTALLING THE SCRUB SIDE BRUSH MOTOR (OPTION)



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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Jack up the front of machine. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.

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

- 4. Remove side brush and side brush squeegee assembly and set aside.
- 5. Remove side brush hub mounting bolt (Qty. 1) and hub.



6. Remove motor mounting hardware (Qty. 4).



7. Turn key switch ON, 1-Step Scrub On, side brush On and allow side brush motor to completely lower. Turn key switch OFF. 8. Remove side brush cover mounting hardware (Qty. 2).





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

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



10. Remove the scrubbing side brush motor.



11. Reinstall the scrubbing side brush motor in reverse of disassembly.

REMOVING/INSTALLING THE SOLUTION TANK DRAIN HOSE



- 1. Completely empty both the solution tank and the recovery tank.
- 2. Completely empty the hopper.
- 3. Remove the main scrub brushes from the machine.
- 4. Turn key switch ON and completely lower the scrub head.
- 5. 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.

6. Chock the right rear wheel.

7. Jack up the left side of the machine enough to access the solution tank drain hose. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual for additional information.

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

NOTE: If necessary, the scrub head can also be removed to gain additional access to the solution drain hose.

- 8. Remove the cable clamp securing the solution tank drain hose to the frame of the machine.
- 9. Remove the clamp securing the solution tank drain hose to the solution tank.
- 10. Remove the solution tank drain hose from the machine.
- 11. Use the previously removed clamp to secure the new solution tank drain hose to the solution tank.
- 12. Carefully route the solution tank drain hose along the frame of the machine where the removed solution tank hose was previously located and out the back of the machine.

NOTE: <u>DO NOT</u> allow the recovery tank drain hose to be torn or damaged while routing it to the back of the machine. Be sure the hose is not resting on or against any sharp hardware or components that could potentially tear or damage the hose.

13. Reinstall the cable clamp to secure the recovery tank drain hose to the frame of the machine.

- 14. Secure the solution tank drain hose to the back of the recovery tank.
- 15. Raise the machine off the jack stands, remove the jack stands from under the machine, and lower the machine to the floor.
- 16. Fill the solution tank with several gallons of water.
- 17. Observe where the solution tank drain hose is connected to the solution tank and along where the solution tank drain hose is routed to the back of the machine for leaks,
- 18. Reinstall the brushes onto the scrub head.

CLEANING SYSTEMS - SWEEPING



REMOVING/REPLACING THE DUAL FORCE MAIN SWEEP DRIVE BELT(S)

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

- 1. Turn key switch OFF.
- 2. Remove the left brush panel from the sweep brush assembly.
- 3. Remove the sweeping drive belt cover from the machine.



- 4. Remove the sweeping brush drive belt(s) from the machine
- 5. Use two M4 hex screws to install the belt installation tool onto one of the large sheaves.



6. Position the belt onto the motor sheave and then position the belt onto the belt installation tool.



7. Turn the belt installation tool/sheave clockwise to install the belt onto both sheaves.





8. Rotate the belt on the sheaves and use fingers to work the belt the rest of the way onto the sheaves

NOTE: Take care to not pinch fingers in the belt(s) and the sheaves while rotating the belt onto the sheaves



- 9. Remove the belt installation tool from the sheave.
- 10. If reinstalling/replacing other belt, repeat procedure to install the other belt.
- 11. Reinstall the sweeping drive belt cover onto the machine
- 12. Reinstall the left brush panel onto the machine

REMOVING/REPLACING THE DUAL FORCE MAIN SWEEP BRUSH MOTOR(S)

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

- 1. If the sweeping main brush is not raised, turn key switch ON, completely raise the sweeping main brush, and turn key switch OFF.
- 2. Disconnect the battery cable from the machine

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

3. Open the main sweeping brush compartment access door.



4. Remove the idler plate.





5. Remove the brushes from the main sweep compartment



- 6. Place chocks behind both rear wheels.
- 7. Jack up the front of the machine and place jack stands under both front jack points. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.
- 8. Remove the left brush panel from the sweep brush assembly.



9. Remove the sweeping drive belt cover from the machine.



- 10. Disconnect all main wire harness connections from the brush motor(s).
- 11. Remove the drive belt from the main sweeping brush motor.
- 12. Remove the sweeping brush motor(s) from the machine.
- 13. Proceed to *REMOVING/REPLACING/INSTALLING THE SWEEP MOTOR CARBON BRUSHES* if replacing the carbon brushes.
- 14. Reinstall the sweeping brush motor(s) onto machine in reverse order of disassembly. See *REMOVING/REPLACING THE SWEEP DRIVE BELTS* for reinstalling the belts on the main sweep assembly.



REMOVING/REPLACING/INSTALLING THE DUAL FORCE SWEEP MOTOR CARBON BRUSHES

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

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

- 1. Remove the brushes from the sweep head.
- 2. Turn key switch ON and completely lower the sweep head. Turn key switch OFF.
- 3. Disconnect the battery cable from the machine.
- 4. Remove the left brush panel from the sweep brush assembly.



5. Remove the sweeping drive belt cover from the machine.



- 6. Remove the sweeping brush drive belt(s) from the machine. See *REMOVING/REPLACING THE SWEEP BELT(S)*.
- 7. Remove the sweeping brush motor(s) from the machine. See *REMOVE/REPLACE THE SWEEP BRUSH MOTOR(S)*.

8. Loosen and remove the band covering the carbon brushes from the sweep motor.



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



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



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



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



- 13. Repeat previous steps to remove the carbon brush located on the other side of the disk brush motor.
- NOTE: Carbon brushes should be replaced as sets.
- 14. Reinstall the retaining band onto the motor.
- 15. Reinstall the sweep brush motor onto the machine See *REMOVING/REINSTALLING THE SWEEP BRUSH MOTOR(S)*.

REMOVING THE DUAL FORCE MAIN SWEEP LIFT ACTUATOR



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

1. Remove the left brush panel from the sweep brush assembly.



- 2. Turn key switch ON, place the machine into the Manual Mode, use the Manual Mode to completely lower the sweep head, and turn key switch OFF. See MANUAL MODE-PRO-PANEL or MANUAL MODE-STANDARD CONTROL MODULE.
- 3. Disconnect the battery cable from the machine.
- 4. Disconnect the main wire harness from the sweep head lift actuator.
- 5. Remove hardware securing the sweep head lift actuator to the main sweep lift weldment/sweep head.



6. Remove hardware securing the sweep head lift actuator to the frame of the machine and remove the actuator from the machine.



- 7. Connect the main wire harness to the new sweep head lift actuator.
- 8. Install the sweep head lift actuator shaft onto the weep lift weldment/sweep head.
- 9. Reconnect the battery cable to the machine.
- 10. Turn the key switch ON, place the machine into the Manual Mode, use the Manual Mode to extend the sweep head lift actuator, and turn key switch OFF.
- 11. Install the other end of the sweep head lift actuator onto the frame of the machine.
- 12. Turn key switch ON, allow the sweep head to raise, and turn key switch OFF.
- 13. Reinstall the left brush panel onto the machine.
- 14. Check the main weep brush pattern and adjust the pattern as necessary. See *ADJUSTING THE MAIN SWEEP BRUSH PATTERN*.

ADJUSTING THE DUAL FORCE MAIN SWEEP BRUSH PATTERN

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

NOTE: Machine must be on level/flat surface before testing motor currents. Variations in current may occur if machine is not parked on a level/flat surface.

- 1. Turn key switch ON.
- 2. Place the machine into the Manual Mode. See *MANUAL MODE* in the *TROUBLESHOOTING* section for information how to place machine into the Manual Mode.
- 3. Verify the motor current for each brush. The current for each brush motor should be as close as possible and be between 12-15 amps.
- 4. Turn key switch OFF. Leave the sweep head in the lowered position. It is easier to access adjustment hardware with sweep head lowered.
- 5. Remove the left brush panel from the sweep brush assembly.



6. If current is low, loosen the eye bolt attached to the extension spring.

If current is high, tighten the eye bolt attached to the extension spring.

- 7. Recheck current measurements. Adjust as necessary.
- 8. Reassemble all parts removed from the machine.
- Turn key switch ON, place machine in Manual Mode, and run the sweep brushes on a smooth level surface for approximately 15-20 seconds. Raise the sweep head and back the machine away from where the brushes were tested.

10. Observe the brush pattern.



- 11. Loosen the bolt on the handle.
- 12. Tighten the adjustment screw to raise the right side of the brush if pattern is too heavy to the right side of the machine

Loosen the adjustment screw to lower the right side of the brush if pattern is too heavy to the left side of the machine



13. Adjust the front to rear sweep brush pattern. The patterns should be approximately 1.5 in. across each pattern and vary no more than 0.25 in.



14. Adjust the rod ends to adjust the front to rear brush pattern. When adjusting with rod-ends always use the same number of turns per side. Turn clockwise to tilt the sweep head to the rear, making the pattern lighter in the front and heavier to the rear of the machine.

Turn counterclockwise to tilt the sweep head to the front, making the pattern heavier in the front and lighter to the rear of the machine



15. If pattern is even between the front and back sweep brushes and the tape is still under 1.25 in. at the smallest width, adjust the lift spring. Loosen the eye bolt a thread to make the pattern heavier.



REPLACING THE DIRECT THROW SWEEP ACTUATOR (OPTION)



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

1. Remove the left brush panel from the sweep brush assembly.



 Position two 2 in. X 4 in. (50.8 mm X 101.6 mm) blocks under the sweep head so that when it is lowered in the following step tension will be removed from both the lift cable and extension spring.



- 3. Turn key switch ON and lower the sweep head until it is resting on the blocks placed underneath in the previous step. Turn 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. Disconnect the main wire harness from the sweep assembly actuator.

6. Remove the hex screws/washers (Qty. 3 each) securing the actuator bracket to the machine.



- 7. Remove the clevis pin/cotter pin/flat washer securing the actuator and both cables to the actuator bracket.
- 8. Remove the clevis pin/cotter pin securing the actuator to the frame of the machine and remove the actuator from the machine.



9. Situate the new actuator as near possible to where it is installed on the machine and use the clevis pin/ cotter pin/both flat washers to install both cables and the actuator shaft into the actuator bracket.







NOTE: **<u>Do</u>** <u>Not</u> turn the actuator shaft any more than necessary to install the actuator onto the machine. The actuator shaft length is factory set and should not be turned any more than necessary to install the actuator onto the machine.

- 10. Use the hex screws/washers (Qty. 3 each) to install the actuator bracket onto the machine.
- 11. Connect the main wire harness to the actuator.
- 12. Reconnect the battery cable to the machine.
- 13. Attempt to install the other end of the actuator onto the frame of the machine. If it is possible to completely install the actuator on to the machine, procedure is complete. Proceed to Step 17.

If it is not possible to install the other end of the actuator onto the frame of the machine, proceed to the following step.

- 14. Turn on the machine and place the machine into the manual mode. See *MANUAL MODE* in the *TROUBLESHOOTING* section of this manual.
- 15. Use Manual Mode to adjust the actuator shaft as necessary until it possible to completely install the actuator onto the machine.
- 16. Turn the key switch OFF to exit the Manual Mode.
- 17. Use the cotter pin/clevis pin to install the actuator onto the machine.
- 18. Turn the key switch ON, lift the sweep head, and turn the key switch OFF.
- 19. Remove the block from under the sweep head.
- 20. Turn the key switch ON, turn on sweep mode, and drive the machine a short distance to completely lower the sweep head.

21. Observe position of sweep head frame with the floor. If the frame is touching the floor use the sweep head stop adjustment to adjust the sweep head so only the brush, and not the sweep head frame is touching the floor.



22. Reinstall the left brush panel onto the machine.

DIRECT THROW SWEEP BRUSH ASSEMBLY (OPTION)



REMOVING/REPLACING THE DIRECT THROW SWEEP BRUSH MOTOR (OPTION)

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

- 1. If the sweeping main brush is not raised, turn key switch ON. Completely raise the sweeping main brush. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Remove the left brush panel from the sweep brush assembly.



4. Remove the belt cover from the sweep head.



- 5. Remove the sweep brush drive belt from the sweep head. See *REMOVING/INSTALLING THE DIRECT THROW SWEEP BRUSH DRIVE BELT*
- 6. Disconnect the main wire harness from the sweep brush drive motor.

- 7. Remove the sweep brush drive motor from the sweep drive arm weldment.
- 8. Install the new sweep brush drive motor/reinstall the sweep brush drive motor onto the sweep drive arm weldment.
- 9. Reinstall all parts removed to remove the sweep brush drive motor onto the sweep head in reverse order of disassembly.

REMOVING/INSTALLING THE DIRECT THROW SWEEP BELT

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

- 1. If the sweeping main brush is not raised, turn key switch ON. Completely raise the sweeping main brush. Turn key switch OFF.
- 2. Remove the left brush panel from the sweep brush assembly.



3. Remove the belt cover from the sweep head.



4. Remove the sweep brush drive belt from the sweep head.

5. Use two M4 hex screws to install belt installation tool onto the larger sweep brush drive sheave.



- 6. Position the belt onto the smaller sheave and then position the belt onto the belt installation tool.
- 7. Turn the belt installation tool/sheave clockwise to install the belt onto both sheaves.



8. Rotate the belt on the sheaves and use fingers to work the belt the rest of the way onto the sheaves

NOTE: Take care to not pinch fingers in the belt(s) and the sheaves while rotating the belt onto the sheaves

- 9. Remove the belt installation tool from the sheave.
- 10. Reinstall the belt cover onto the machine.
- 11. Reinstall the left brush panel onto the machine.

CONTROL MODULES/CONTROLS



REMOVING/REPLACING THE PRO-PANEL/ STANDARD PANEL POD

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

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

- 1. Turn key switch OFF.
- 2. Disconnect battery cable from the machine.
- 3. Remove electrical access panel.



- 4. Cut zip tie securing instrument panel wire harness connections.
- 5. Disconnect the main wire harness from the instrument panel.



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



7. Remove instrument panel assembly from the steering assembly.



- 8. Reinstall the pod in reverse order of disassembly.
- 9. Reconfigure the new pod assembly. See CONFIGURATION MODE in the TROUBLESHOOTING section of this manual to configure the new instrument panel.
- 10. Turn key switch ON. Raise and lower the hopper. If the hopper stops during either the raising or lowering the hopper actuator will need to be reprogrammed. See *ROLL OUT ACTUATOR PROGRAMMING/ADJUSTMENT.*

ADJUSTING THE STEERING WHEEL TIMING



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

1. Remove electrical access panel.



2. Loosen steering shaft hardware.



3. Lift steering u-joint off splined shaft.



4. Align the front drive tire with the center line of the machine.



5. Orientate the steering wheel as shown below.



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

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



CALIBRATING THE POWER STEERING

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

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

- 1. Turn key switch ON.
- 2. Drive the machine for a short distance and straighten the steering wheel. The steering wheel must be positioned straight when the power steering motor is calibrated.



3. Remove the access panel from the machine.



4. Turn key switch OFF.

 Connect power steering wire harness YEL- 1 wire and YEL- 2 wire located near the power steering controller to the snap switch (Switch, Snap, 25A SPDT - part number 1008142).





- 6. If battery cable is disconnected from the machine, reconnect the battery cable to the machine.
- Turn OFF all machine functions and options. All functions/options (spray nozzle, lights, etc...) must be OFF when the power steering motor is calibrated. The power steering motor will not calibrate if other functions/options are on.

 Quickly squeeze/activate the switch lever four times within 3 seconds. The power steering controller LED will illuminate each time the snap switch lever is squeezed. The LED will remain illuminated for 2 seconds the fourth time the snap switch lever is squeezed to show the sequence is completed.



9. Test the machine. Turn the steering wheel in the complete range of motion in both directions. The machine should steer smoothly and with the same amount of resistance in both directions. Center the steering wheel again and repeat this procedure if the steering is not functioning smoothly with the same amount of resistance when turned in either direction. <u>Do Not</u> turn on any machine functions/ options when testing the machine.

NOTE: All functions and options must remain OFF until after the key switch is turned to the OFF position to complete calibration.

- 10. Turn key switch OFF.
- 11. Disconnect the power steering wire harness YEL- 1 wire and YEL- 2 wire from the snap switch.
- 12. Reinstall the access panel onto the machine.

POWER STEERING - WIRING



REPLACING THE MAIN SCRUB/ SOLUTION DELIVERY MODULE



NOTE: DO NOT replace either Main Scrub/ Solution Delivery Module or Combo Module (Water Pickup) without first consulting T.A.C. (Technical Assistance Center). Troubleshooting procedures must first be completed to determine possible machine issues before modules are replaced.


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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Open right side access door.



4. Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.



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

5. Disconnect all main wire harness connections from the module.



6. Remove both pan screws and nylon washers securing the module to the electrical enclosure panel.



7. Carefully squeeze the plastic standoffs (Qty. 4) located at each corner of the module to release the module from the electrical enclosure panel.



NOTE: Replace damaged plastic standoffs. The standoffs secure the module into place and support the module away from the electrical enclosure panel. The standoffs must be replaced if damaged.

- 8. Remove the module from the electrical enclosure panel.
- Install the new/reinstall the module into the electrical enclosure panel in reverse order of disassembly. Do Not overtighten the hardware securing the module to the electrical enclosure. The module could be damaged if hardware is overtightened.

NOTE: Always use two wrenches when securing the power supply terminals or damage to the circuit board will occur. Connect power supply terminals to the new board before installation. Torque to 30-36 in-lbs (339-407 Ncm).

- 10. Reinstall remaining parts and components removed from the machine in reverse order of disassembly.
- 11. Reconfigure the machine. See *PROGRAMMING A NEW INTERFACE MODULE* and *RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION* at the beginning of this section of the manual.

REPLACING THE COMBO MODULE (WATER PICKUP)



NOTE: DO NOT replace either Main Scrub/ Solution Delivery Module or Combo Module (Water Pickup) without first consulting T.A.C. (Technical Assistance Center). Troubleshooting procedures must first be completed to determine possible machine issues before modules are replaced.

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Open right side access door.



 Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.



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

5. Disconnect the main wire harness connectors from the module.



6. Remove both pan screws and nylon washers securing the module to the electrical enclosure panel.



7. Carefully squeeze the plastic standoffs (Qty. 4) located at each corner of the module to release the module from the electrical enclosure panel.



NOTE: Replace damaged plastic standoffs. The standoffs secure the module into place and support the module away from the electrical enclosure panel. The standoffs must be replaced if damaged.

- Install the new/reinstall the module into the electrical enclosure panel in reverse order of disassembly. Do Not overtighten the hardware securing the module to electrical enclosure. The module could be damaged if hardware is overtightened.
- 9. Reinstall remaining parts and components removed from the machine in reverse order of disassembly.
- 10. Reconfigure the machine. See *PROGRAMMING A NEW INTERFACE MODULE* and *RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION* at the beginning of this section of the manual.

REPLACING THE SIDE SCRUB MODULE (OPTION)



NOTE: DO NOT replace either Main Scrub/ Solution Delivery Module or Combo Module (Water Pickup) without first consulting T.A.C. (Technical Assistance Center). Troubleshooting procedures must first be completed to determine possible machine issues before modules are replaced.

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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Open right side access door.



 Remove the hardware securing the electrical enclosure cover to the electrical enclosure panel and carefully lower the electrical enclosure cover.



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

5. Disconnect the main wire harness connectors from the side scrub control module.



6. Remove both pan screws and nylon washers securing the side scrub control module to the electrical enclosure panel.



7. Carefully squeeze the plastic standoffs (Qty. 4) located at each corner of the side scrub control module to release the side scrub control module from the electrical enclosure panel.



NOTE: Replace damaged plastic standoffs. The standoffs secure the module into place and support the module away from the electrical enclosure panel. The standoffs must be replaced if damaged.

- Install the new/reinstall the module into the electrical enclosure panel in reverse order of disassembly. Do Not overtighten the hardware securing the module to the electrical enclosure. The module could be damaged if hardware is overtightened.
- 9. Reinstall remaining parts and components removed from the machine in reverse order of disassembly.
- 10. Reconfigure the machine. See *PROGRAMMING A NEW INTERFACE MODULE* and *RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION* at the beginning of this section of the manual.

REPLACING THE SIDE SWEEP/VACUUM MODULE



NOTE: DO NOT replace either Main Scrub/ Solution Delivery Module or Combo Module (Water Pickup) without first consulting T.A.C. (Technical Assistance Center). Troubleshooting procedures must first be completed to determine possible machine issues before modules are replaced.

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

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

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

3. Remove the left lintel cover from the machine.



4. Remove the hardware securing the board support plate to the electrical enclosure channel.



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

5. Carefully remove the board support plate from the electrical enclosure channel. Do Not break any cables/connections when removing the board support plate.



6. Disconnect the main wire harness connectors from the module.



7. Carefully squeeze the plastic standoffs (Qty. 5) to release the module from the board support plate.



NOTE: Replace damaged plastic standoffs. The standoffs secure the module into place and support the module away from the electrical enclosure panel. The standoffs must be replaced if damaged.

- 8. Install the new/reinstall the module onto the board support plate in reverse order of disassembly.
- 9. Reinstall the board support plate onto the electrical enclosure channel.
- 10. Reinstall remaining parts and components removed from the machine in reverse order of disassembly.
- 11. Reconfigure the machine. See *PROGRAMMING A NEW INTERFACE MODULE* and *RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION* at the beginning of this section of the manual.

REPLACING THE MAIN SWEEP/HOPPER LIFT MODULE



NOTE: DO NOT replace either Main Scrub/ Solution Delivery Module or Combo Module (Water Pickup) without first consulting T.A.C. (Technical Assistance Center). Troubleshooting procedures must first be completed to determine possible machine issues before modules are replaced.

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

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

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

3. Remove the left lintel cover from the machine.



4. Remove the hardware securing the board support plate to the electrical enclosure channel.



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

5. Carefully pull the board support plate from the electrical enclosure channel. Do Not break any cables/connections when removing the board support plate.



6. Disconnect the main wire harness connectors from the module.



7. Remove both pan screws and nylon washers securing the module to the electrical enclosure channel.



8. Carefully squeeze the plastic standoffs (Qty. 5) to release the module from the electrical enclosure channel.



NOTE: Replace damaged plastic standoffs. The standoffs secure the module into place and support the module from the electrical enclosure panel. The standoffs must be replaced if damaged.

- Install the new/reinstall the module into the electrical enclosure channel in reverse order of disassembly. Do Not overtighten the hardware securing the module to the electrical enclosure channel. The module could be damaged if hardware is overtightened.
- 10. Reinstall the board support plate onto the electrical enclosure channel.
- 11. Reinstall remaining parts and components removed from the machine in reverse order of disassembly.
- 12. Reconfigure the machine. See *PROGRAMMING A NEW INTERFACE MODULE* and *RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION* at the beginning of this section of the manual.

REPLACING THE PROPEL CONTROLLER



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

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

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

3. Remove the access panel from the machine.



- 4. Disconnect all harness/cable connections from the Propel Controller.
- 5. Remove the Propel Controller from the steering support channel.
- 6. Install the new Propel Controller into the steering support channel.
- 7. Connect all harness/cable connections to the Propel Controller.
- 8. Configure the Propel Controller. See RECONFIGURING THE MACHINE AFTER NEW HARDWARE/OPTION INSTALLATION.

ELECTRICAL BOX WIRES GROUP



WHEEL DRIVE ASSEMBLY/BRAKES





REMOVING/REPLACING/INSTALLING THE DRIVE WHEEL ASSEMBLY



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

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

- 1. Turn key switch OFF.
- 2. Disconnect the battery cable from the machine.
- 3. Chock both rear wheels.
- 4. Jack up the front end of the machine enough to access the drive wheel assembly/remove the drive wheel assembly from under the machine. Place jack stands under the machine frame and lower the machine onto the jack stands. See *MACHINE JACKING* in the *MAINTENANCE* section for safety information and additional instructions.

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

- 5. Remove the terminal cover from the drive wheel assembly.
- Disconnect all main harness connectors from the drive wheel. Note locations of nuts and washers securing the main wire harness connectors to the drive wheel. Nuts and washers must be arranged the same when connecting the main wire harness to the new drive wheel.
- 7. Loosen the M12 socket screws (Qty. 4) securing the drive wheel assembly to the output housing. Do not remove the socket screws.



- 8. Jack the machine up off the jack stands, remove the jack stands from under the machine, and lower the machine to the floor.
- 9. Raise the jack until it is touching the frame on one side of the machine, but not enough to raise the machine from the floor, and position a jack stand under that side of the machine.
- 10. Repeat the previous step to slightly raise the other side of the machine.
- 11. Remove the drive assembly socket head screws (Qty. 4) from the drive wheel assembly/machine.
- 12. Jack the machine back up off the floor until the drive wheel can be easily removed from under the machine, position the jack stands under the machine, and lower the machine onto the jack stands.

NOTE: Use caution when removing the drive wheel since the brake is not engaged during the removal process. Carefully lower the drive wheel onto the floor.

- 13. Carefully remove the drive wheel assembly from under the machine.
- 14. If replacing the drive wheel assembly, remove the terminal cover from the new drive wheel.
- 15. If replacing the drive wheel assembly, remove hardware necessary to connect main wire harness connectors to the drive wheel assembly.
- 16. Place the drive wheel assembly onto the jack, position the jack underneath the machine, and raise the drive wheel up to the output housing.
- 17. Use the M12 socket screws (Qty. 4) to secure the drive wheel (1) to the output housing.
- 18. Remove the jack from under the machine.
- 19. Torque the M12 socket screws (Qty. 4) to 125 Nm (92 ft. lbs).

20. Connect all main wire harness connectors to the drive wheel assembly. Position/route cables exactly as shown so the terminal cover can be installed.



21. Install the terminal cover onto the drive wheel assembly.



- 22. Slightly raise machine from jack stands, remove the jack stands from under the machine, and lower the machine to the floor
- 23. Reconnect battery cable to the machine.

REMOVING THE DRIVE WHEEL

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

- 1. Turn key switch ON.
- 2. If scrub head is not raised, completely raise the scrub head.
- 3. Turn the steering wheel as far to the left as possible.
- 4. Turn key switch OFF.
- 5. Disconnect the battery cable from the machine.

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

- 6. Place a chock behind both rear tires.
- 7. Loosen the socket screws (Qty. 4) on the drive wheel.



8. Jack up the front end of the machine enough to access the drive wheel assembly. Place jack stands under the machine and lower the machine onto the jack stands. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.



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

- 9. Remove the main scrub brush and side scrub brush from the machine.
- 10. Turn the steering wheel as far to the right as possible to allow easier access to the other side of the drive wheel assembly.
- Use M10-1.5 x 70 (Class 12.9) hex screws (Qty. 2) to press the wheel from the drive wheel assembly. Tighten the screws evenly until the wheel comes freely from the drive wheel assembly.





CHANGING THE DRIVE WHEEL ASSEMBLY OIL

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

- 1. Remove the drive wheel from the machine. See *REMOVING THE DRIVE WHEEL* section of the manual.
- 2. Turn the steering wheel as far to the left as possible until the drive wheel hub is oriented to the front of the machine to allow easier access to the oil drain and fill plugs.
- 3. Position a drain pan underneath the drive wheel assembly drain plug.
- 4. Remove the fill plug from the drive wheel assembly to allow the oil to drain easier.



5. Remove the drain plug from the drive wheel assembly and allow the oil to drain into the drain pan.



6. Clean the drive wheel assembly drain plug.

- 7. Tighten the drain plug into the drive wheel assembly.
- 8. Use a pump to fill the drive wheel assembly with oil.
- 9. Tighten the fill plug into the drive wheel assembly. Torque the plug to 16-18 Nm.
- 10. Mark the drain plug/fill plug as correctly torqued with a permanent marker.
- 11. Replace drive wheel. See *INSTALLING DRIVE WHEEL* section of the manual.

REPLACING THE DRIVE WHEEL TIRE

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

- 1. Remove the drive wheel from the machine. See *REMOVING THE DRIVE WHEEL* section of the manual.
- 2. Remove the socket head screws (Qty. 10) securing the tire to the drive wheel assembly hub.



- 3. Use the socket head screws (Qty. 10) to install the tire onto the new drive wheel assembly hub.
- 4. Replace drive wheel. See *INSTALLING DRIVE WHEEL* section of the manual.

INSTALLING DRIVE WHEEL

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

1. Place the wheel onto the drive wheel assembly and use two dowels to align the holes in the wheel with the holes in the drive wheel assembly.



- 5. Apply red thread sealant onto the threads of the two remaining hex screws needed to secure the wheel onto the drive wheel assembly.
- 6. Loosely hand tighten the two hex screws from the previous step into the wheel and the drive wheel assembly.
- Tighten the previously installed hex screws (Qty. 4) to 75 Nm (55.3 ft. lbs.). Use a star pattern to evenly tighten the hex screws.

NOTE: It maybe not be possible to achieve final torque with machine jacked up from the floor. It may be necessary to lower machine to the floor to tighten the hex screws to correct torque.

- 8. Jack the machine up off the jack stands, remove the jack stands from under the machine, and lower the machine to the floor.
- 9. If necessary, tighten the hex screws (Qty. 4) to the correct torque.
- 10. Reconnect the battery cable to the machine.



- 2. Apply red thread sealant onto the threads of two of the hex screws needed to secure the wheel onto the drive wheel assembly.
- 3. Loosely hand tighten the two hex screws from the previous step into the wheel and the drive wheel assembly until the wheel is loosely secured into place.
- 4. Remove the alignment dowels from the drive wheel assembly.

ADJUSTING THE REAR BRAKE



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

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

- 1. Turn key switch OFF.
- 2. Open main brush doors.
- 3. Remove rear squeegee and set aside.



- 4. Place wheel chocks on both sides of the front wheel.
- 5. Jack rear of machine until rear wheel is off the floor. See *MACHINE JACKING* in the *MAINTENANCE* section of this manual.

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



6. Be sure the parking brake is released. Rear wheel should spin freely.



7. Loosen jam nut on rear adjustment rod.



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



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

DEBRIS HOPPER





INSPECTING/ADJUSTING THE HOPPER SNAP SWITCH

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

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

1. Remove the left lintel cover from the machine.



2. Observe position of hopper against the snap switch. The hopper should be flush.





- 3. Turn key switch ON.
- 4. Raise the hopper approximately half way and then lower the hopper. Is the hopper completely seated into the lowered position when lowered? If hopper is completely seated when lowered, no further adjustments are necessary. If the hopper does not completely seat when lowered, the snap switch requires additional adjustment.
- 5. Use hopper controls to again raise the hopper.



- 6. Place jack stands underneath the hopper.
- 7. Turn key switch OFF.
- 8. Disconnect the battery cable from the machine.
- 9. Loosen the switch mounting bracket and slide the switch back towards the machine in small increments.
- 10. Reconnect the battery cable to the machine.
- 11. Turn key switch ON.
- 12. Repeat Step 5.
- 13. Repeat Step 4 through Step 12 until the hopper is flush.

REMOVING/INSTALLING/REPLACING THE ROLL OUT ACTUATOR

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

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



WARNING: Lift arm pinch point. Stay clear of hopper lift arms.

1. Turn key switch ON. Position and raise the hopper enough to allow the hopper to rotate and clear machine (hopper approximately half raised). Turn key switch OFF.



2. Place jack stands underneath the hopper.



3. Turn key switch ON. Slowly lower the hopper onto the jack stands. Turn key switch OFF.

4. Disconnect the main wire harness from the hopper roll out actuator.



5. Confirm hopper arm weldment and sprocket do not rotate. if the hopper arm weldment and sprocket do rotate, adjust position of jack stands under the hopper.



6. Remove the pins securing the top of the actuator to the machine.



7. Remove the pin securing the bottom of the actuator to the machine.



- 8. Reinstall the removed scrub head/install the new scrub head and all parts previously removed from the machine onto the machine in the reverse order of removal.
- 9. Reinstall the actuator in reverse order of disassembly.

PROGRAMMING/ADJUSTING THE ROLL OUT ACTUATOR

NOTE: See MANUAL MODE in TROUBLESHOOTING for more detailed instructions for accessing screens in the MANUAL MODE.

- 1. Pro-Panel: Turn key switch ON.
- 2. Pro-Panel: Use the Service Login number to log into the Service Mode.



Standard Panel: Press and hold the configuration mode button and turn the key switch ON. Release the configuration mode button when CONFIG MODE appears on the LCD.



3. Pro-Panel: Use the SERVICE MODES button to access the Service Modes menu.



Standard Panel: Use the configuration mode button to access the Service Modes menu.



4. Place the machine into the MANUAL MODE.

NOTE: The machine must be left in the MANUAL MODE for the remainder of the actuator/hopper adjustment procedure. The machine must not be taken out of the MANUAL MODE until instructed to do so at the end of the procedure. 5. Pro-Panel: Use the left/right arrows to scroll to the M30:Roll Act H screen. Press the Check Mark button to choose the selection.



Standard Panel: Scroll to the M30:Set Roll H Pos and use the brush pressure button to choose the selection.



6. Pro-Panel: Roll hopper out to "Seal Breakaway Position" and raise the hopper until it can safely roll fully without touching the machine (try not to raise beyond horizontal so there enough room for the hopper to roll without the bumper touching the arms).



Standard Panel: Roll hopper out to "Seal Breakaway Position" and use Hopper raise/lower switch located on the right control panel to raise the hopper.



7. Pro-Panel: Use hopper roll in button located on the panel to completely retract the actuator/roll in the hopper.



Standard Panel: Use Hopper roll out switch located on the right control panel to completely retract the actuator/roll in the hopper.



8. Use a permanent marker to mark the rod at the end of the cylindrical housing it moves within. This will be used as a reference point for the next step.



 Pro-Panel: Use hopper rollout button located on the panel to slightly extend the actuator 0.5 in (12.7 mm) from the fully retracted position.



Standard Panel: Use Hopper roll out switch located on the right control panel to slightly extend the actuator 0.5 in (12.7 mm) from the fully retracted position.


10. Pro-Panel: Scroll to and select the 'Set Roll Min' screen and press the 'check mark' button to store the minimum roll value.



Standard Panel: Scroll to and select the 'Set Roll Min' screen and press the down pressure button to store the minimum roll value.



11. Pro-Panel: Use the hopper roll out button to completely extend the actuator/roll hopper out until the hopper stops.



Standard Panel: Use Hopper roll out switch located on the right control panel to completely extend the actuator/roll the hopper out.



SERVICE

12. Use a permanent marker to mark the rod 0.5 in (12.7 mm) from the end of the cylindrical housing. This will be used as a reference point for the next step.



13. Pro-Panel: Use hopper roll in button to slightly retract the actuator to align the mark with the end of the cylindrical housing.



Standard Panel: Use Hopper roll out switch located on the right control panel to slightly retract the actuator/roll in the hopper.



14. Pro-Panel: Scroll to and select the 'Set Roll Max' screen and press the 'check mark' button to store the maximum roll value.



Standard Panel: Scroll to and select the 'Set Roll Max' screen and press the down pressure button to store the maximum roll value.



15. Pro-Panel: Use the hopper roll in button to roll the hopper in until it stops. Use the hopper roll out button to roll the hopper out until the mark on the cylinder is 0.5 in (12.7 mm) from the cylinder end (This prevents damaging the hopper seal when lowering the hopper).

Standard Panel: Use Hopper roll out switch located on the right control panel to roll the hopper in until it stops. Use the hopper roll out switch to roll the hopper out until the mark on the cylinder is 0.5 in (12.7 mm) from the cylinder end (This prevents damaging the hopper seal when lowering the hopper). 16. Pro-Panel: Completely lower the hopper. Roll the hopper in until it is sealed. Scroll to the 'Set Roll Home' screen and press the 'check mark' button to store the hopper home value.



Standard Panel: Completely lower the hopper. Roll the hopper in until it is sealed. Scroll to the 'Set Roll Home' screen and press the down pressure button to store the hopper home value



NOTE: The first time this is done is to provide a hopper close position for the machine to use in its normal mode to seal the bumper against the frame.

17. Key cycle the machine and test the newly entered values. Verify the hopper lift, roll in/out, and lower features function properly.

OPTIONS

COMPLETELY OPENING BATTERY COMPARTMENT COVER (MACHINES EQUIPPED WITH OPTIONAL PRESSURE WASHER OR LIVE WAND)

This procedure is used to fully open the battery compartment cover for service when equipped with an optional pressure washer or live wand.

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

 Machines equipped with optional pressure washer: Remove the breather cap from the pressure washer assembly. Set the breather cap aside. <u>Do</u> <u>Not</u> lose or discard the breather cap since it must be reinstalled onto the pressure washer assembly after maintenance/service is complete.



2. Machines equipped with pressure washer: Thread the plug tethered to the pressure washer assembly cover into the port where the breather plug was previously installed.



3. Machines equipped with optional live wand: Remove debris tray from the vacuum chamber and empty the debris tray. Reinstall the debris tray into the vacuum chamber.



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



5. Disconnect the battery cable from the machine.

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

6. Carefully pry the retainer from the gas spring enough to disconnect the gas spring from the hinge weldment installed on the battery compartment cover and disconnect the gas spring.





7. Lift the battery compartment cover completely open and engage the support completely open.



8. Remove the battery from the battery compartment or perform required maintenance.

- 9. Reinstall the battery into the battery compartment if battery was removed.
- 10. Disengage the support and carefully lower the battery compartment cover onto the lower support position.
- 11. Reconnect the gas springs to the hinge weldment.
- 12. Reconnect the battery cable to the machine.
- 13. Disengage the support and lower the battery compartment cover.
- 14. Machines equipped with pressure washer: Remove the tethered plug from the pressure washer assembly.



 Machines equipped with pressure washer: Reinstall the breather cap into the pressure washer assembly/



SERVICE

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. Disconnect the battery cable from the machine.
- 2. 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.

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



5. Cut the Warranty label from the Lithium-ion battery pack.



NOTE: Warranty is void if the Warranty label has been removed or tampered with. Contact Customer Service if label has been removed or damaged due to removal.

6. Remove the cover from the Lithium-ion battery pack.





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



NOTE: If Lithium-ion battery pack is equipped with two COM cables, disconnect both COM cables from the battery controller.

8. 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.



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



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



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



SERVICE

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





12. Remove the bracket from the battery controller.



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



 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).



- 15. Install the battery controller onto the Lithium-ion battery pack in reverse order of disassembly.
- 16. Torque the nuts on each battery terminal to 24.5 Nm +/- 3.4 Nm (18 ft lbs +/- 2.5 ft lbs).



- 17. Clean old warranty label and label residue from the Lithium-ion battery pack and cover.
- 18. Install the new warranty label onto the bracket and Lithium-ion battery pack where the old label was previously located.



- 19. Reinstall the Lithium-ion battery pack into the battery compartment.
- 20. Reconnect the battery cable to the machine.