Operation, Repair, Parts

LineDriver™ ES

3A6623C

EN

For the propulsion of line striping and removal equipment. Not approved for use in explosive atmospheres or hazardous locations. For professional use only.

Models: 25N555, 25N556

10 mph (16 kph) Maximum Operating Speed

Important Safety Instructions

Read all warnings and instructions in this manual and in related LineLazer, GrindLazer and ThermoLazer manuals before using the equipment. Save these instructions.

Related Manuals:	
710-0138	Delta-Q Battery Charger
3A6720	Hitch Receiver Kit

LineDriver ES		
	Model	**Cord Adapter**
---	25N555	North America
CE EAC	25N556	North America Australia CEE 7/7 Denmark Italy Switzerland United Kingdom

Use only genuine Graco replacement parts.
The use of non-Graco replacement parts may void warranty.

Contents

Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbols refer to procedure-specific risks. When these symbols appear in the body of this manual or on warning labels, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

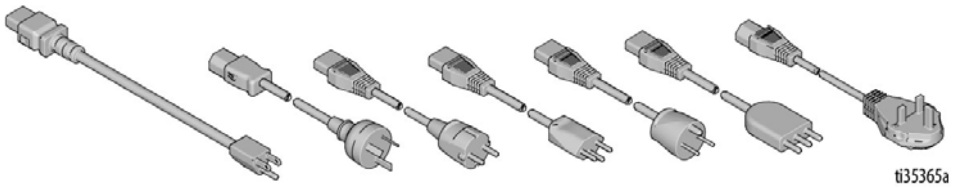
⚠WARNING

GROUNDING

This product must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This product is equipped with a cord having a grounding wire with an appropriate grounding plug. The plug must be plugged into an outlet that is properly installed and grounded in accordance with all local codes and ordinances.

- Improper installation of the grounding plug is able to result in a risk of electric shock.
- When repair or replacement of the cord or plug is required, do not connect the grounding wire to either flat blade terminal.
- The wire with insulation having an outer surface that is green with or without yellow stripes is the grounding wire.
- Check with a qualified electrician or serviceman when the grounding instructions are not completely understood, or when in doubt as to whether the product is properly grounded.
- Do not modify the plug provided; if it does not fit the outlet, have the proper outlet installed by a qualified electrician.
- This product is for use on a nominal 120V or 230V circuit and has a grounding plug similar to the plugs illustrated below.

120V US 230V



- Only connect the product to an outlet having the same configuration as the plug.
- Do not use an adapter with this product.

TRAFFIC HAZARD

Vehicle strikes may result in serious injury or death.

- Do not operate in traffic.
- Use traffic control.

⚠WARNING

MOVING VEHICLE HAZARD

Careless and reckless behavior causes accidents. Falling from vehicle, running into people or object, or being struck by other vehicles may result in serious injury or death.

- Do not operate unless attached to line striping or line removal equipment.
- Do not step on forward/reverse pedals.
- Make turns slowly. Do not make turns greater than 45°.
- Loss of traction may occur going downhill.
- Do not operate on slopes greater than 7.5°.
- **Do not carry passengers.**
- Do not tow.
- Use with line striping or line removal equipment only.
- Use appropriate traffic control in all traffic areas. Refer to manual on Uniform Traffic Control Devices (MUTCD), U.S. Department of Transportation, Federal Highway Administration or local highway and transportation regulations.

ELECTRIC SHOCK HAZARD

This equipment must be grounded. Improper grounding, setup, or usage of the system can cause electric shock.

- Turn off and disconnect power cord before servicing equipment.
- Connect only to grounded electrical outlets.
- Use only 3-wire extension cords.
- Ensure ground prongs are intact on power and extension cords.
- Do not expose to rain. Store indoors.

EQUIPMENT MISUSE HAZARD

Misuse can cause death or serious injury.

- Do not operate the unit when fatigued or under the influence of drugs or alcohol.
- Check equipment daily. Repair or replace worn or damaged parts immediately with genuine manufacturer's replacement parts only.
- Do not alter or modify equipment. Alterations or modifications may void agency approvals and create safety hazards.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Use equipment only for its intended purpose. Call your distributor for information.
- Keep children and animals away from work area.
- Comply with all applicable safety regulations.

BURN HAZARD

Equipment surfaces and fluid that is heated can become very hot during operation. To avoid severe burns:

- Do not touch hot fluid or equipment.

BATTERY HAZARD

Lead-acid batteries produce explosive gases and contain sulfuric acid that can cause severe burns. To avoid sparks and injury when handling or working with a lead-acid battery:

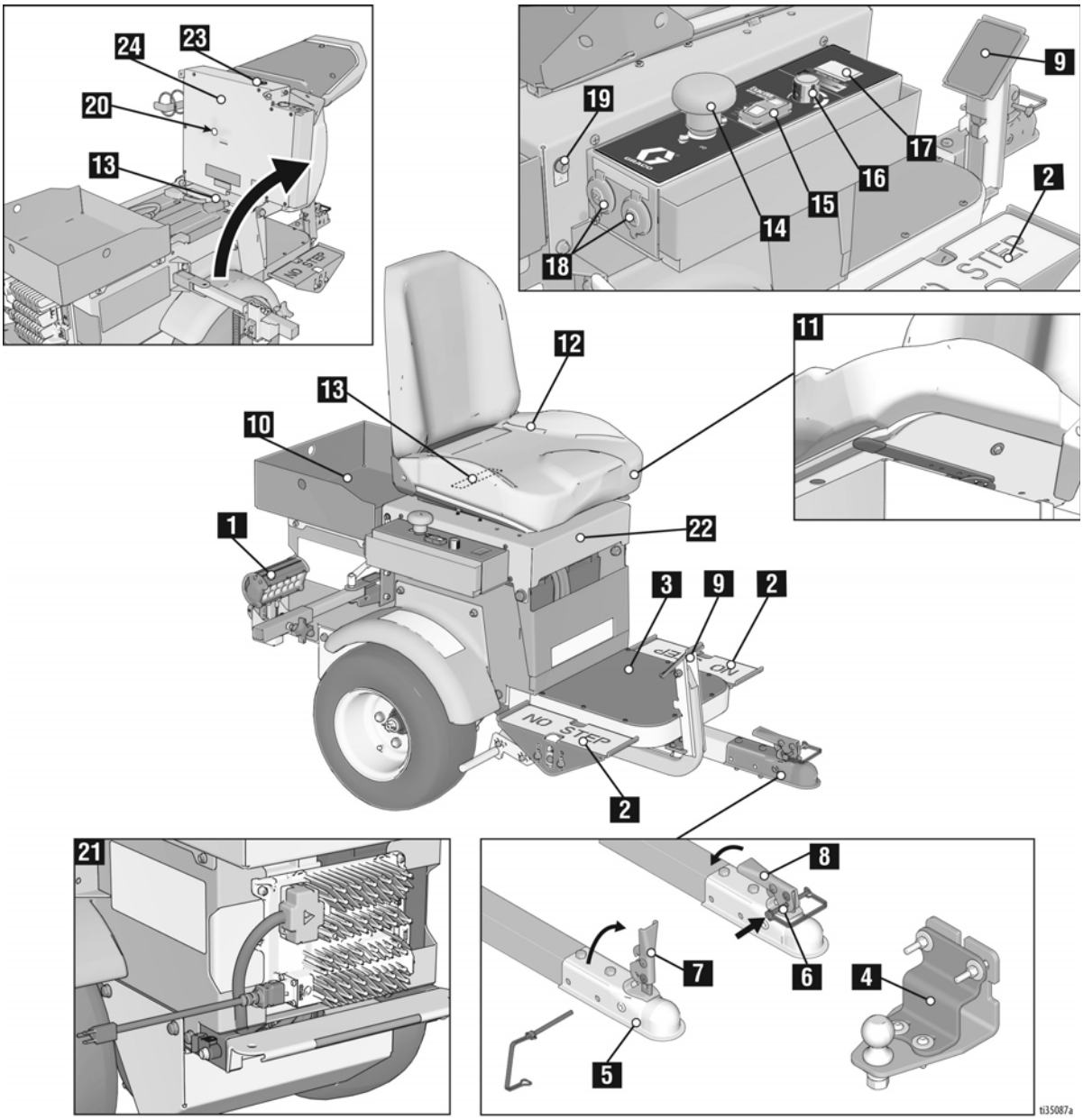
- Only use the battery type specified for use with the equipment. See **Technical Data**.
- Read and follow the battery manufacturer's warnings.
- Exercise caution when working with metallic tools or conductors to prevent short circuits and sparks.
- Keep all sparks, flames, and cigarettes away from batteries.
- Always wear protective eyewear and protective equipment for face, hands, and body.
- If you have direct contact with battery fluid, flush with water and consult a physician immediately.
- Installation and maintenance must be performed by knowledgeable personnel only.

PERSONAL PROTECTIVE EQUIPMENT

Wear appropriate protective equipment when in the work area to help prevent serious injury, including eye injury, hearing loss, inhalation of toxic fumes, and burns. Protective equipment includes but is not limited to:

- Protective eyewear, and hearing protection.
- Respirators, protective clothing, and gloves as recommended by the fluid and solvent manufacturer.

Component Identification



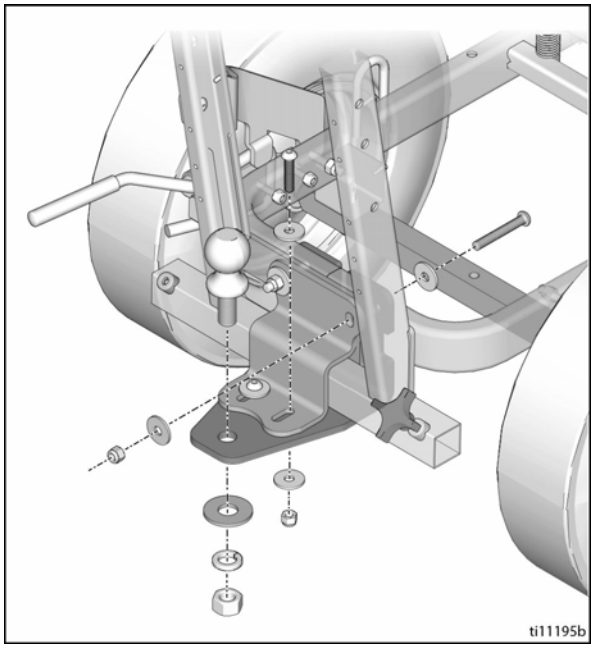
1	Headlight
2	Direction/Speed Pedals
3	Step Plate
4	Hitch
5	Coupler
6	Safety Pin Location
7	Handle Open
8	Handle Locked
9	Manual Brake
10	Tool Tray
11	Seat Adjustment
12	Operator Seat

13	Serial ID
14	Power Switch
15	Speed Switch
16	ExactMil™ Speed Control
17	Voltage Meter
18	12V Aux. Power
19	Light Socket
20	Motor Controller Diagnostic Light
21	Battery Charger
22	Seat Lid
23	Buzzer
24	Seat Cover

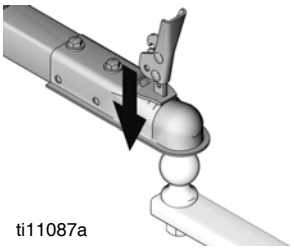
Operation

Setup

1. Install supplied ramp onto pallet.
2. Connect Hitch Receiver to line striping or line removal equipment - **Hitch Receiver Kit 25N787 Manual 3A6720.**

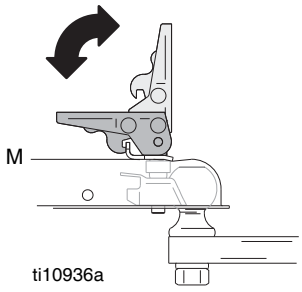


3. Install LineDriver coupler to striper or grinder hitch ball.

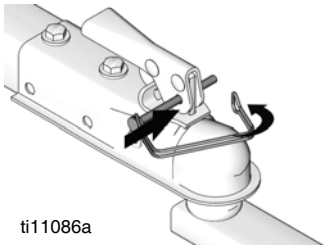


4. Latch coupler to locked position (M).

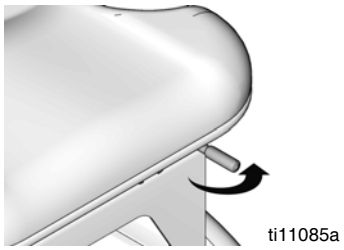
NOTE: If coupler is too tight to latch or is loose after latching, coupler needs adjustment. Refer to **Hitch Adjustment**, page 13.



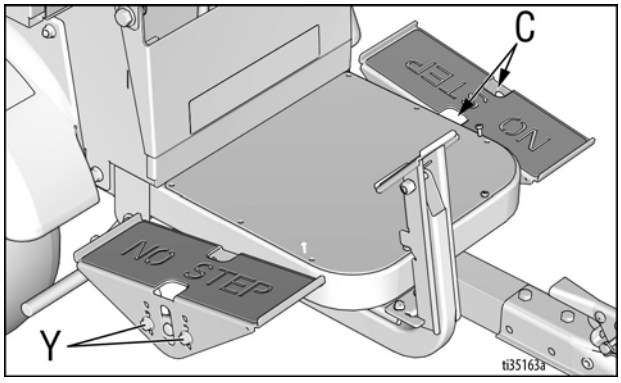
5. Insert safety pin in latch



6. Adjust seat forward/backward with lever below seat.



7. Adjust height of pedals to desired position by removing/replacing bolts (Y).
8. Loosen two bolts (C) on topside of pedals. Rotate pedal to desired position. Tighten bolts.



9. Continue onto **Startup**, page 7.

Startup

1. Check battery charge level. Charge if not fully charged.
2. Sit on seat to actuate safety switch. Ensure pedals are not depressed.
3. Disengage Manual Brake on LineDriver and attached equipment.
4. Turn power switch ON. Buzzer will sound in a few seconds.
5. Operate control to release attached equipment.

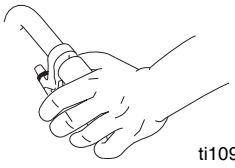
NOTE: Interlocks in the LineDriver control system remove drive power if the Power Switch is OFF, the Direction/Speed Pedals are engaged when switching power ON, or the driver lifts themself off the seat.

FREEWHEEL HAZARD

Loss of drive power causes LineDriver to freewheel, which allows it to roll freely.

- Stay fully seated in the driver's seat while operating the LineDriver.
- If loss of drive power occurs while LineDriver is in motion, use the Manual Brake to bring LineDriver to a stop.
- Always engage Manual Brake before turning Power Switch OFF or standing up from seat.

NOTE: LineDriver motion is forward and reverse. Turns are made with the striper or grinder.



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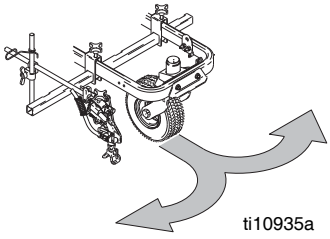
6. Push striper or grinder handle bars to begin desired turn.



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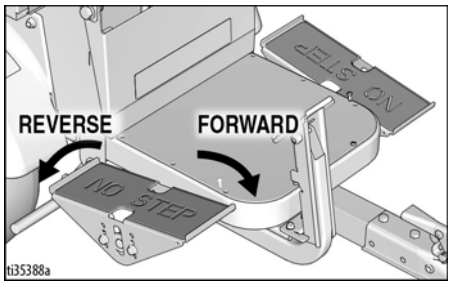
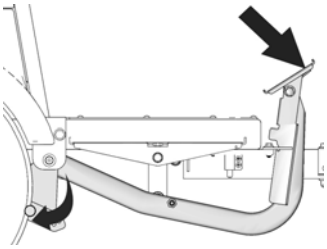
7. Move pedals to drive LineDriver, as shown below. Switching from forward to reverse creates a braking action.

NOTE: LineDriver stops when both feet are removed from pedals.



8. Set Manual Brake when not operating LineDriver. This prevents rolling when on an incline.



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Operating on an Incline

- Engage the Manual Brake before turning the Power Switch to OFF when parking on an incline.
- Turn the Power Switch to ON and allow the machine to initialize before releasing the Manual Brake when starting on an incline.

Enable ExactMil™ Speed Control

ExactMil ensures a consistent paint thickness by holding the speed steady.

1. Stop moving. Turn speed control knob all the way counterclockwise.
2. Set Speed Switch to ExactMil position.
3. Depress foot pedal to go forward. Adjust speed control knob to desired speed setting.

NOTE: ExactMil speed control is only active when moving forward. Reverse speed is not impacted. ExactMil speed control limits the maximum speed that can be obtained with the pedal.

Disable ExactMil Speed Control

- Return Speed Switch to center position.

Enable ECO Mode

ECO Mode can be compared to half-throttle on a gas powered unit. It is helpful when greater control is needed, such as loading and unloading, driving in congested areas, and operating on slopes. It also extends battery life.

- Set Speed Switch to ECO position.

NOTE: ECO Mode limits forward speed to 4 mph and reverse speed to 2.6 mph.

Disable ECO Mode

- Return Speed Switch to center position.

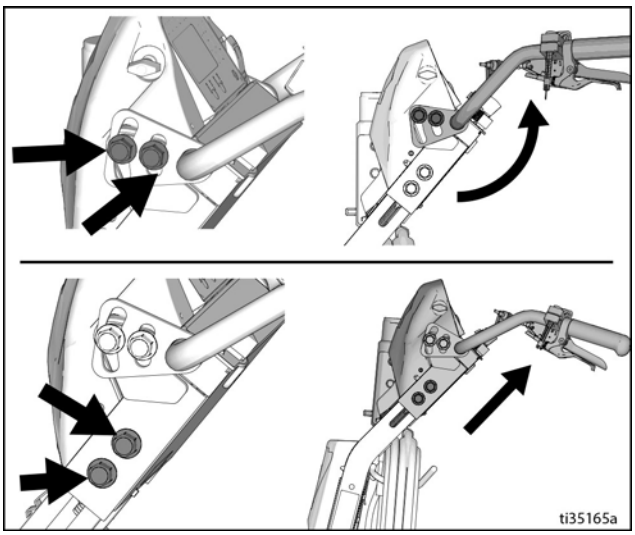
12V Auxiliary Ports

- 12V auxiliary power ports are provided to power accessories.

NOTICE
12V auxiliary ports must be used to power accessories. Battery damage can result if other means are used to power accessories.

Trailer Loading & Unloading

1. Always keep LineDriver connected to striper or grinder.
2. Use a level surface to load and unload. Leave sufficient space behind ramps.
3. Use loading ramps sufficiently long and capable of handling weight of unit and operator.
4. Adjust striper or grinder handlebar to highest position. Slide seat back as far as possible.



5. Use right foot to engage Manual Brake. Use left foot to control speed. Use ECO Mode to limit speed.
6. Slowly drive straight up/down ramps (do not drive at an angle).
7. Keep a firm grip on handlebars as the ramp is negotiated.

NOTE: Striper or grinder handlebars swing up/down as the ramp is engaged/disengaged. Keep legs clear.

NOTE: Check Manual Brake clearance to tire and tire pressure to ensure they are adjusted properly. Refer to **Manual Brake Adjustment or Replacement**, page 11.

Charging the Batteries

Replace and charge battery only in well-ventilated area and away from flammable or combustible materials, including paints and solvents. The charger may become hot while charging. Do not touch. Refer to Charger Manual for additional information.

The charger may be used any time the LineDriver is not being used. When the batteries are fully charged, the charger automatically stops. If the LineDriver is stored for an extended period, the batteries may self-discharge enough for the charger to automatically recharge the batteries. For optimum battery life, always leave the charger plugged in.

NOTICE

Lead acid batteries can self-discharge in as little as 3 months depending on storage temperatures. The hotter the storage temperature, the faster the self-discharge occurs. To prevent damage to the battery, it is important to keep the battery in a charged state.

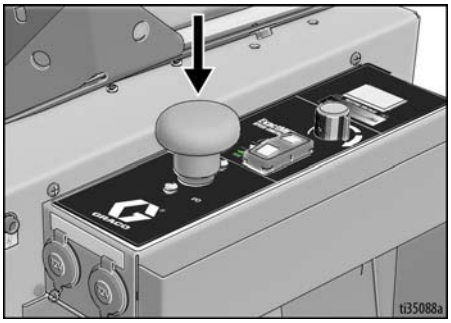
Batteries are fully charged when leaving the factory. Due to self-discharging of the battery, charge battery before first use. It takes ~18 hours to charge a fully depleted battery, and ~8 hours to charge the battery 3/4 full.

NOTE: Battery life depends on the depth of discharge per cycle. A battery that is discharged to 50% depth will get over twice as many cycles in its life compared to it being discharged to 100% depth each cycle.

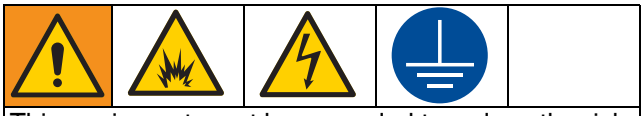
1. Place unit in dry, well-ventilated area and away from flammable or combustible materials, including paints and solvents.

2. Position the driver so the wheels are on a true grounded surface, not on pavement.

3. Ensure power switch is in **OFF** position.



4. Plug charging cord into charging port on the unit. Connect an extension cord, per charger manual, to the charging cord and plug it into wall power.



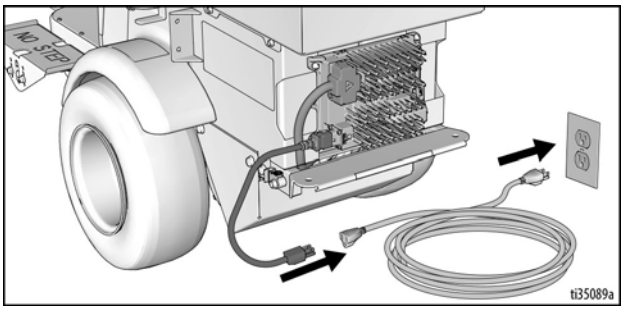
This equipment must be grounded to reduce the risk of static sparking and electric shock. An electric shock or static spark can cause fumes to ignite or explode. An improper ground can cause electric shock. A good ground provides an escape wire for the electric current.

Always use an outlet that is properly installed and grounded in accordance with all local codes and ordinances.

Do not modify the plug provided; if it does not fit the outlet, have the proper outlet installed by a qualified electrician.

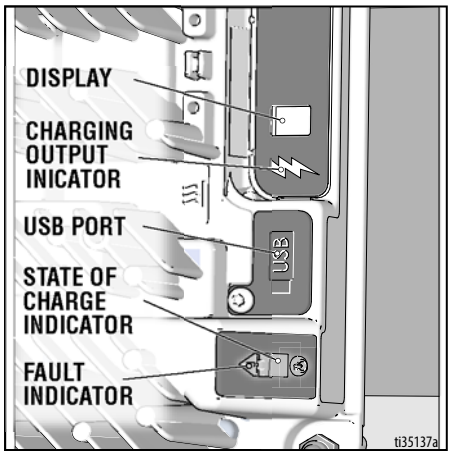
Power Requirements

- All models use the same battery charger. Refer to **Technical Specifications**, page 32, for power requirements.



5. The Charging Output Indicator means that the charger output is active.
6. When power is connected, charger will immediately begin charging.

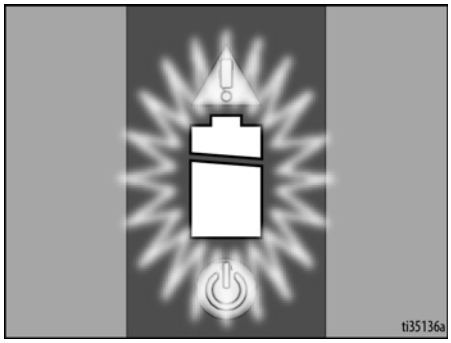
NOTE: Battery will charge to ~30 volts while charging and then it will come back down to ~27 volts after fully charging.



NOTE: The Charge Display may show codes to indicate different conditions. **Refer to charger manual for additional information.**

- 'F' codes meaning that an internal fault condition has caused charging to stop.
- 'E' codes meaning that an external error condition has caused charging to stop.

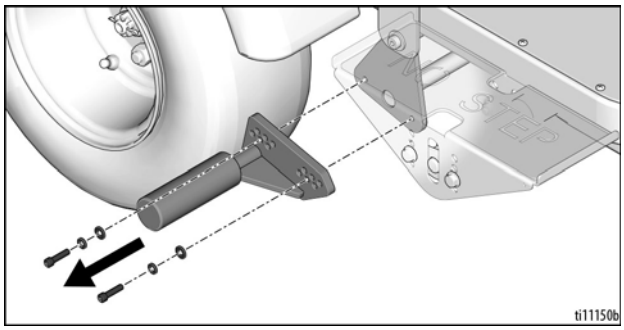
7. When battery charge indicator is solid green, the charge is complete.



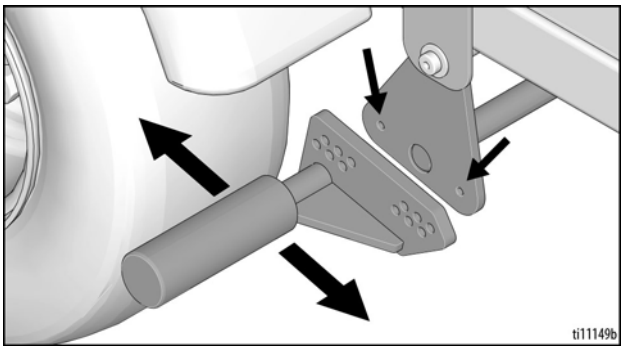
Maintenance

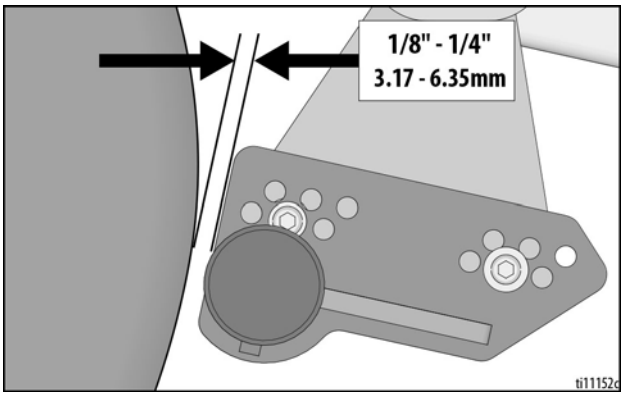
Manual Brake Adjustment or Replacement

1. Block tires so LineDriver will not move. Release Manual Brake.
2. Ensure power switch is in OFF position.
3. Inflate tires to operating pressure per tire sidewall. Remove two bolts securing brake rod.

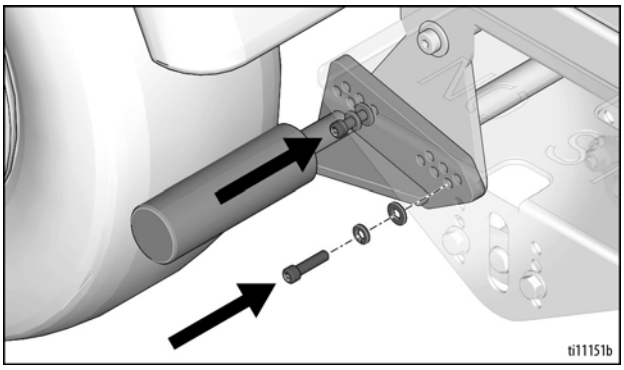


4. Select a hole pattern that positions the brake rod 1/8 to 1/4 in. from the tire.



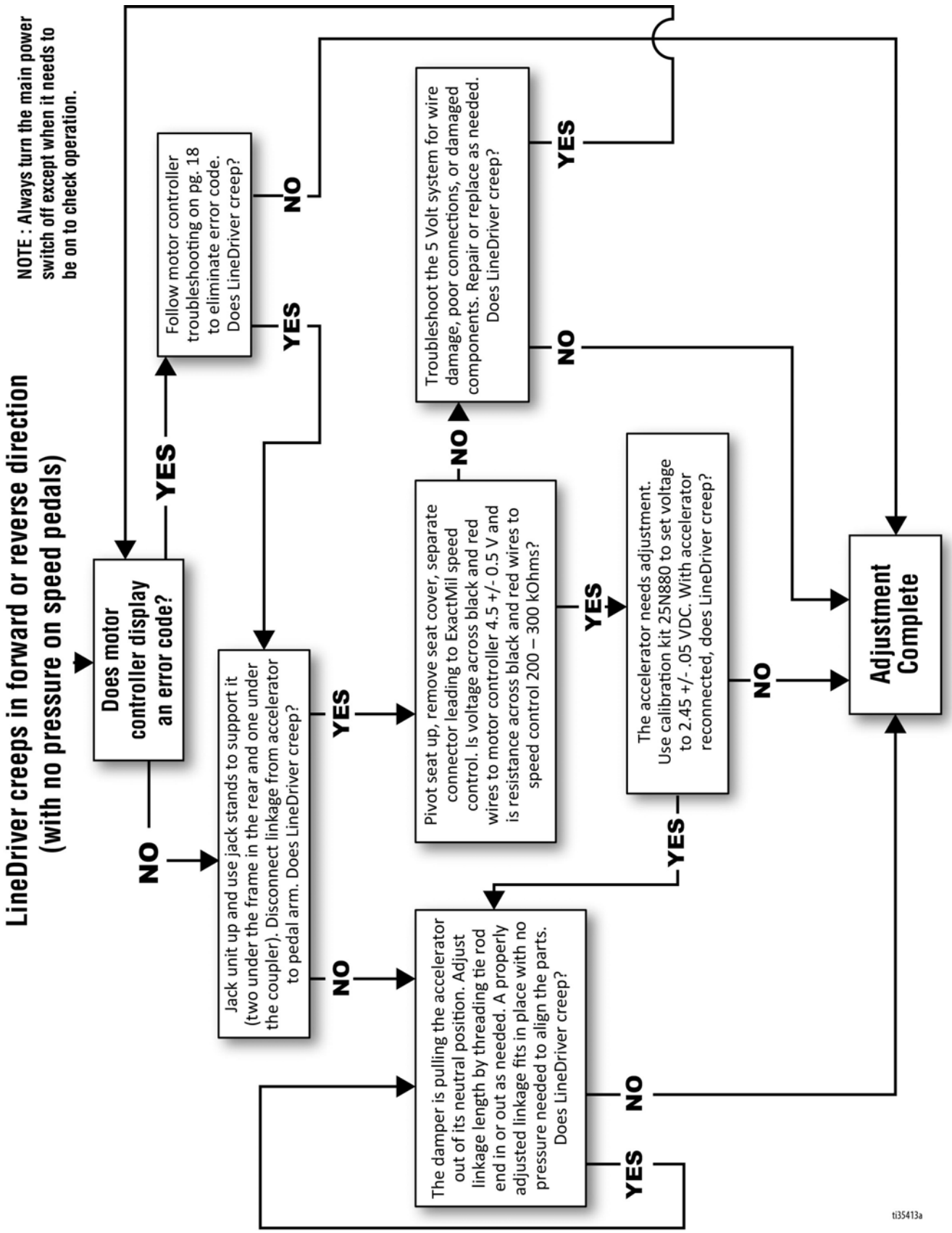


5. Install two bolts and secure brake rod. Repeat for second tire.



NOTE: Brake rods are not interchangeable from side to side. Model shown in the graphic above is the right side version.

Throttle Linkage Adjustment

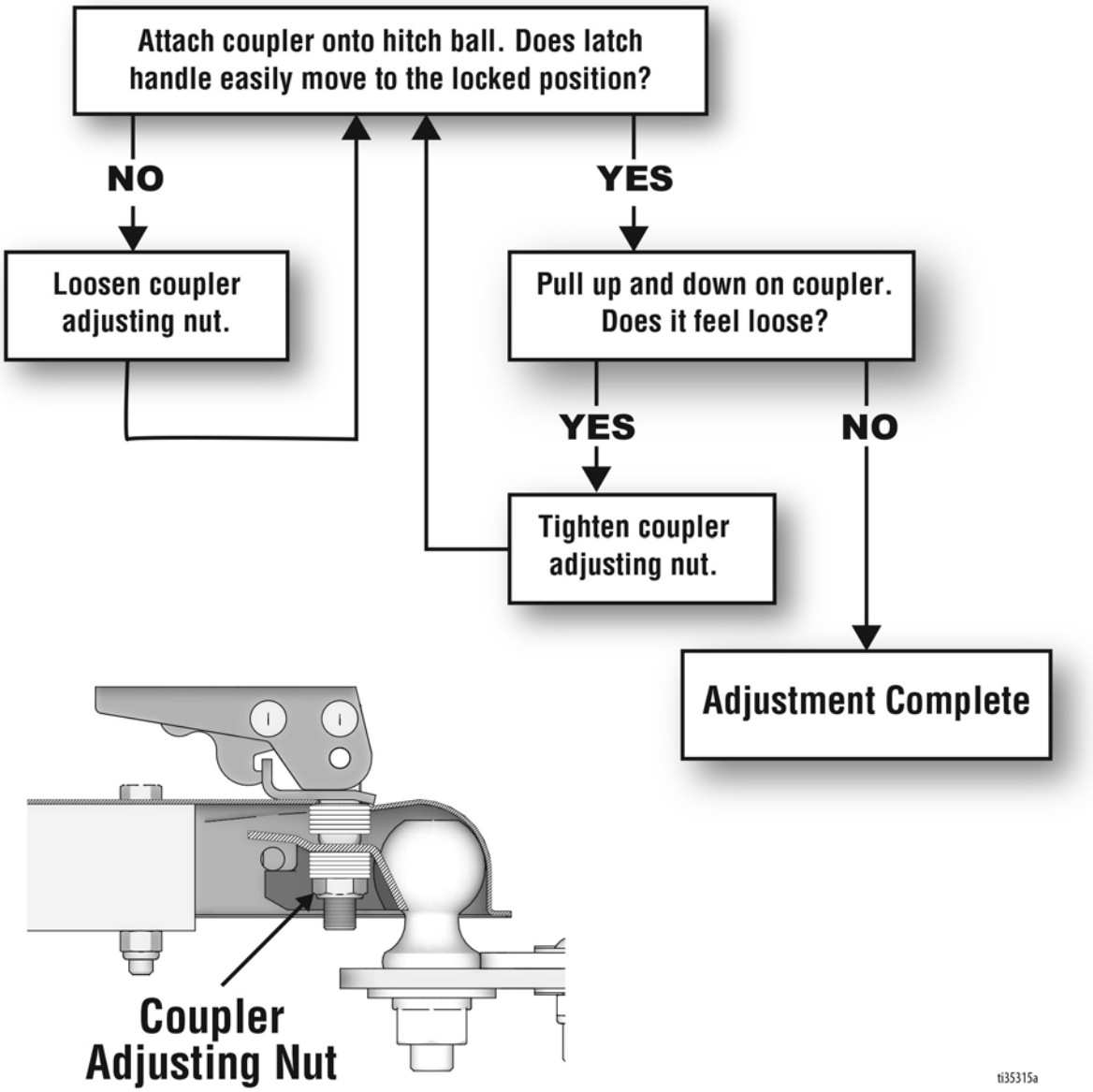


Hitch Adjustment

A coupler too tight or too loose needs to be adjusted.

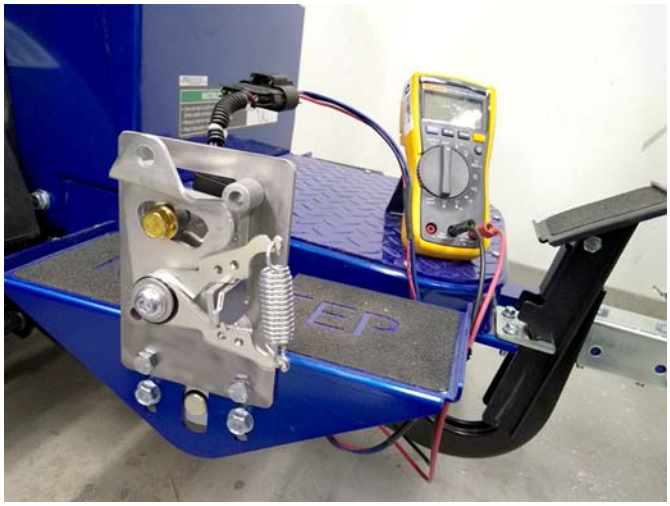
Before adjusting, check ball and coupler for wear. Replace worn components.

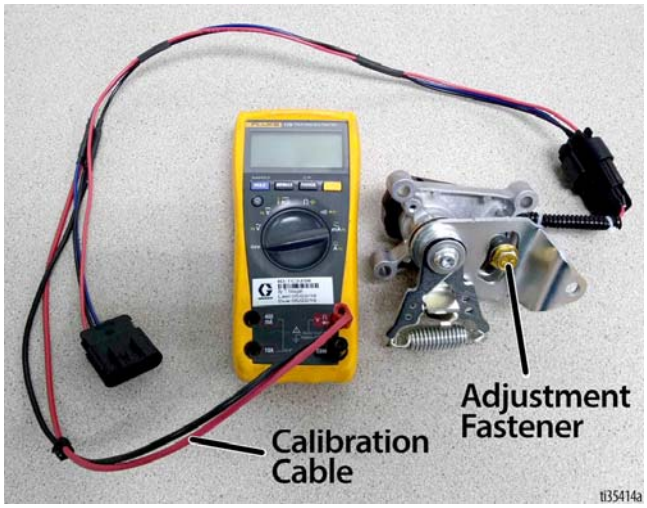
Ensure power switch is in OFF position.



Accelerator Calibration (Using Kit 25N880)

1. Turn power OFF. Engage Manual Brake.
2. Slowly raise hitch coupler until LineDriver rests on rear bumper.
3. Remove accelerator from LineDriver.
4. Connect calibration cable per illustration. Use a Digital Multi-Meter to measure volts DC.
5. Mount accelerator to calibration plate and plate to pedal. This makes it easier to torque fasteners.
6. Ensure nothing is on the operator's seat so the safety system prevents wheel movement. Turn power ON.
7. Loosen adjustment fastener and set neutral position voltage to 2.45 ± .05 volts. Use calibration plate to hold accelerator in this position. Torque adjustment fastener to 90-100 in-lbs.
8. Rotate accelerator arm back and forth, then return it to neutral position. Re-adjust voltage if necessary. Turn power OFF.
9. Install accelerator onto LineDriver. When connecting linkage, adjust tie rod end so no pressure is needed to align parts. Otherwise the LineDriver will creep.
10. LineDriver may creep forward or reverse when turned on. As a precaution, jack unit up and use jack stands to support it (two under the frame in the rear and one under the coupler).
11. Connect the LineDriver to a striper or grinder, sit on the seat and turn on. If wheels do not turn (with no pressure on speed pedals), calibration is complete. If they do turn, follow **Throttle Linkage Adjustment**, page 12.



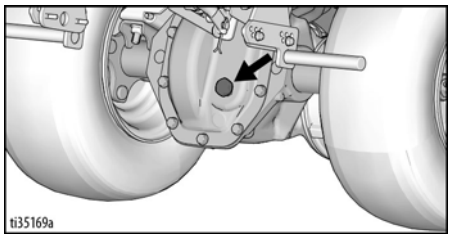


Transaxle Service

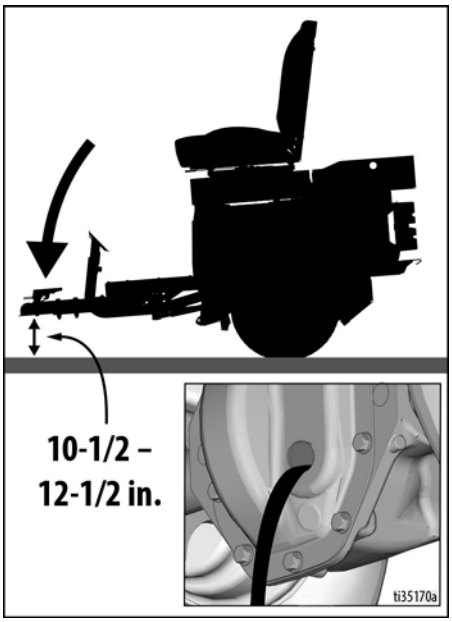
Check Oil Level (Annually)

1. Turn power OFF. Engage Manual Brake.
2. Slowly raise hitch coupler until LineDriver rests on rear bumper.

3. Remove fill plug from transaxle cover.



4. Slowly lower hitch coupler. Oil will begin to flow out of transaxle when hitch coupler is lowered to 10.5 - 12.5” from the floor. Add or remove oil as needed.



5. Reinstall plug.

Change Oil (recommended every 3 years)

1. Turn power OFF. Engage Manual Brake.
2. Slowly raise hitch coupler until LineDriver rests on rear bumper.
3. Place pan under transaxle cover. Remove screws and cover.

NOTE: Sealant may hold cover on. If necessary, pry cover off.

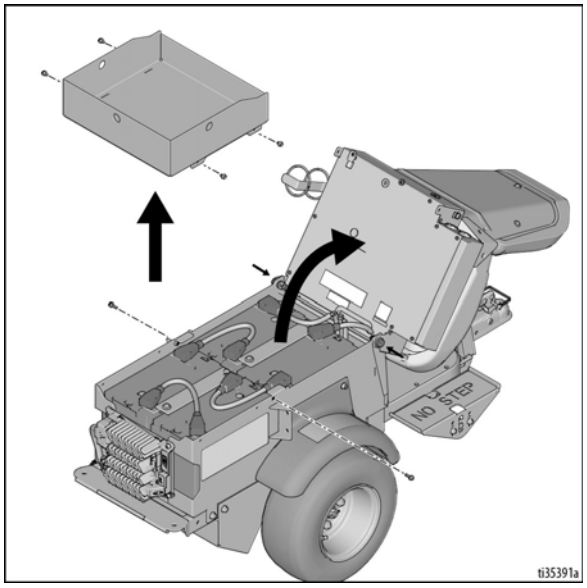
4. Allow oil to drain completey. Follow local ordinances and regulations for disposal.
5. Clean cover and housing where sealant is used. Apply new sealant (recommended is RTV silicone).
6. Reinstall cover with screws.
7. Remove drain plug. Fill with 22 oz. of Mobilfluid™ 424.
8. Check oil level per above. Reinstall plug.
9. Check for oil leaks. Fix if necessary.

Repair

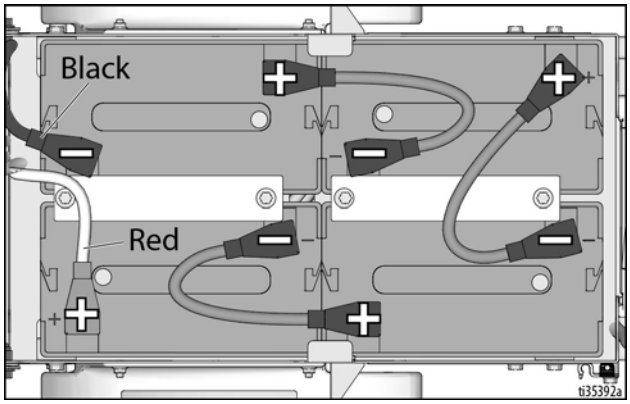
Battery Pack Replacement

NOTE: Prior to replacing batteries, use **Troubleshooting - LineDriver**, page 18, to determine if the batteries are the cause of the problem. Also, use a battery load tester to confirm the batteries need replacement. Always replace all four batteries.

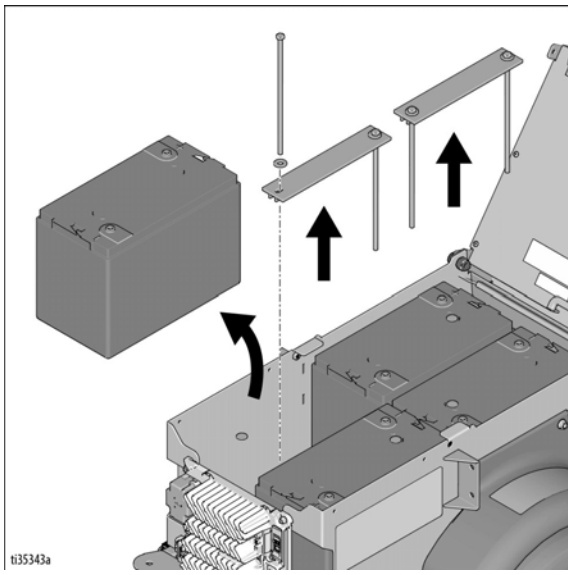
1. Turn power switch OFF. Turn lights OFF. Disconnect 12V accessories.
2. Remove Tool Tray.
3. Remove rear screws of Seat Lid.
4. Pivot Operator Seat forward slowly.



5. Remove battery cables.



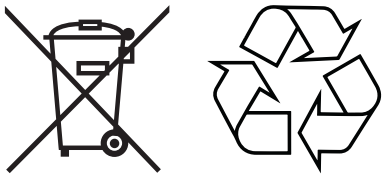
6. Remove battery holders. Remove batteries and recycle according to below.



7. Install new batteries in orientation shown. Install holders and cables.
8. Reinstall seat and Tool Tray.
9. Charge batteries. See **Charging the Batteries**, page 9.

Battery Disposal

Do not place batteries in the trash. Recycle batteries according to local regulations.



Transaxle Replacement

1. Turn power OFF.
2. Remove rear screws of Seat Lid. Pivot seat forward slowly.
3. Disconnect battery cables to motor controller.
4. Jack unit up and use jack stands to support unit (two jacks at the rear and one jack in the front). Raise wheels about 2 inches off the floor, leaving enough room to pull the transaxle out.
5. Remove wheels.
6. Remove motor cover.
7. Disconnect wires attached to motor.
8. Place a support under motor and remove transaxle.
9. Place new transaxle under unit. Lay motor wires on transaxle.
10. Bolt new transaxle to frame.
11. Connect wires to motor. Take care when attaching the three large cables to prevent damage to the plastic terminal block on the motor.
12. Install motor cover.
13. Install wheels.
14. Lower unit to the floor and reconnect the battery cables.
15. Reinstall Operator Seat.

Traction Motor Replacement

Follow **Transaxle Replacement**, page 17.

Motor Controller Replacement

1. Turn power OFF.
2. Remove rear screws of Seat Lid. Pivot seat forward slowly.
3. Disconnect battery cables to motor controller. Tape over terminals to prevent accidental contact.
4. Remove Seat Cover to expose motor controller.
5. Disconnect wires from motor controller.
6. Remove nuts holding motor controller in place.
7. Install new motor controller.
8. Connect wires to new motor controller. Be sure 35 pin connector latches.
9. Install Seat Cover.
10. Reconnect battery cables. Pivot seat back and reinstall rear screws of Seat Lid.
11. LineDriver may creep forward or reverse when turned on. As a precaution, jack unit up and use jack stands to support it (two under the frame in the rear and one under the coupler).
12. Sit on the seat and turn on. If wheels turn with no pressure on speed pedals, follow the **Accelerator Calibration Procedure**, page 14.

Troubleshooting - LineDriver

PROBLEM	CAUSE	SOLUTION
Manual Brake does not keep Line-Driver from moving	Marking Brake needs adjustment	Adjust Marking Brake
	Tire pressure too low	Adjust pressure per tire sidewall
LineDriver creeps in forward or reverse direction	Throttle linkage too long or too short	Adjust throttle linkage
Head light does not turn on	Connections	Repair connections
	LED	Replace light
	Open 10 amp fuse	Address cause of high current Replace fuse
	Switch	Replace switch
LineDriver does not move forward or reverse - Voltage Meter ON	Batteries discharged	Charge batteries at least 2 hours
	Seat safety switch	Sit on seat
	Speed pedals engaged while turning unit on	Disengage pedals then turn unit on
	Speed pedals engaged for 15 seconds with no LineDriver movement	Turn power switch OFF then back ON to reset motor controller
	Motor Controller fault	Follow **Troubleshooting - Motor Controller** instructions, page 19
LineDriver does not move forward or reverse - Voltage Meter OFF	Batteries discharged	Charge batteries at least 2 hours
	Power Switch OFF	Pull knob up
	Open 20 amp fuse	Address cause of high current Replace fuse
	Open 300 amp fuse	Address cause of high current Replace fuse
LineDriver only moves slowly	Manual Brake engaged	Disengage Manual Brake
	Batteries discharged	Charge batteries at least 2 hours
	ExactMil™ Speed Control ON	Increase speed setting or turn OFF
	ECO Mode ON	Turn OFF
	Motor Controller fault	Follow **Troubleshooting - Motor Controller** instructions, page 19
Battery charger not charging	Batteries already charged	Charge batteries after voltage drops below 25.0V
	Charger has error or fault code	Clear code. See charger manual
Batteries discharge within 6 hours of usage (even when charged overnight)	Manual Brake engaged	Disengage brake while operating
	Wheels rubbing	Clear material away from wheels
	Batteries unable to hold charge	Replace all four batteries
	Charger has error or fault code	Clear code. See charger manual
Hitch coupler too tight to latch or too loose after latching	LineDriver hitch coupler too loose or tight on ball	Adjust coupler
Voltmeter flashes ON/OFF	Batteries discharged and less than one hour of runtime left	Charge batteries at least 2 hours
Buzzer sounds about once per second	Batteries deeply discharged and system about to shut off	Charge batteries at least 2 hours

Troubleshooting - Motor Controller

Diagnostics

Diagnostics information can be obtained by observing the fault codes issued by the Status LEDs. See Table 1 for a summary of LED display formats.

The pair of LEDs built into the controller (one red, one yellow) produce flash codes displaying all the currently set faults in a repeating cycle. Each code consists of two digits. The red LED flashes once to indicate that the first digit of the code will follow: the yellow LED then flashes the appropriate number of times for the first digit. The red LED flashed twice to indicate that the second digit of the code will follow; the yellow LED flashes the appropriate number of times for the second digit.

Example:

B+ Undervoltage Cutback (code 23) and Stall Detected (code 73).

The controller's two LEDs will display this repeating pattern:

Code	Display
23	One red, two yellow, two red, three yellow
73	One red, seven yellow, two red, three yellow

The numerical codes used by the yellow LED are listed in **Table 2**, page 20, which also lists possible fault causes and describes the conditions that set and clear each fault.

NOTE: If there are more than one errors active at one time, the control will cycle through them and repeat.

Summary of LED Display Formats

The two LEDs have four different display modes, indicating the type of information they are providing.

Table 1

Display	Status
Neither LED illuminated	Controller is not powered on, or Vehicle has dead battery, or Severe damage
Yellow LED flashing	Controller is operating normally
Yellow and red LEDs both on solid	Controller is in Flash program mode
Red LED on solid	Internal hardware fault detected by the Supervisor or Primary microprocessor. Missing or corrupt software. Interrupting a software download may cause corruption of the software. Cycle power switch to clear. Reload software or replace controller if necessary.
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.

NOTE: When a fault is encountered, shut off the power switch and turn it back on to see if the fault clears. If it does not, shut off the power switch and remove the 35-pin connector. Check the connector for corrosion or damage, clean if necessary, and re-insert connector. If the fault persists, follow the instructions below. When inspecting a cable, always check for a loose terminal fastener, a loose crimp, corrosion, and connector or insulation damage. Repair or replace components as needed.

Table 2

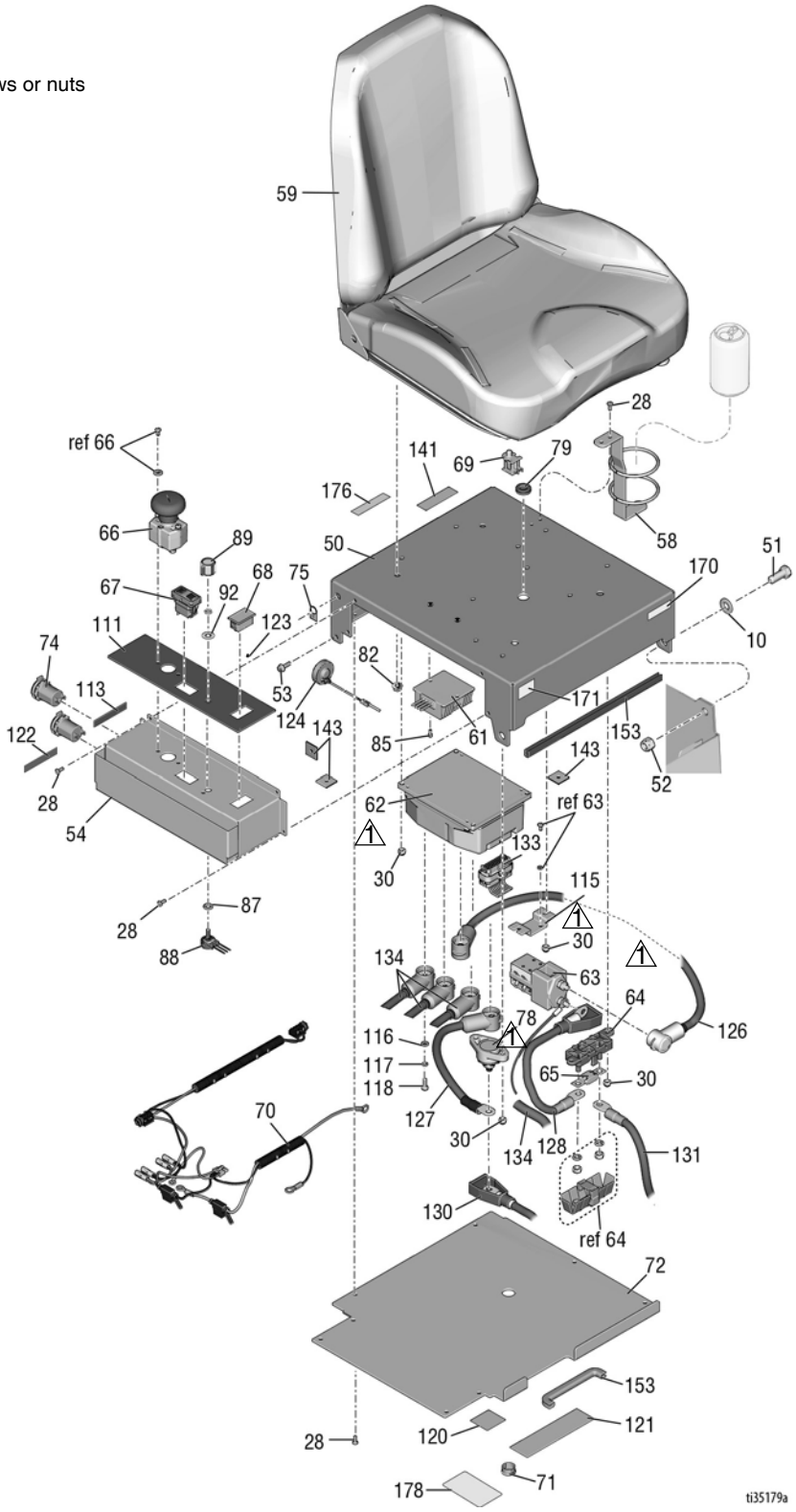
CODE	DESCRIPTION	POSSIBLE CAUSE	SET / CLEAR CONDITIONS	SOLUTION
12	Controller Overcurrent	1. External short of phase U, V, or W motor connections. 2. Controller defective.	*Set:* Phase current exceeded the current measurement limit. *Clear:* Cycle power switch.	1. Inspect motor cables U,V,W. Visually inspect motor terminal block for external short circuit. 2. Measure resistance between U, V, W cables and frame of motor. If resistance is less than 1 megaohm, replace motor or controller.
13	Current Sensor Fault	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	*Set:* Controller current sensors have invalid offset reading. *Clear:* Cycle power switch.	1. Inspect motor cables U,V,W. Visually inspect motor terminal block for external short circuit. 2. Measure resistance between U, V, W cables and frame of motor. If resistance is less than 1 megaohm, replace motor or controller.
14	Precharge Failed	1. External load on battery pack (B+ connection terminal) that prevents the controller from charging.	*Set:* The precharge failed to charge the capactior bank. *Clear:* Cycle power switch.	1. Inspect all cables and connectors from batteries to controller. 2. Remove any after market devices that could draw power during system power up. Only use designated auxiliary ports for after market devices.
15	Controller Severe Undertemp	1. Controller is operating in an extreme environment.	*Set:* Heatsink temperature below -40°C. *Clear:* Bring heatsink temperature above -40°C, and cycle power switch.	1. Move the unit to a warmer area.
16	Controller Severe Overtemp	1. Controller is operating in an extreme environment. 2. Excessive load on vehicle. 3. Improper mounting of controller.	*Set:* Heatsink temperature above +95°C. *Clear:* Bring heatsink temperature below +95°C, and cycle power switch.	1. Move the unit to a cooler area. 2. Reduce operating load on vehicle. 3. Inspect controller heatsink mounting for air gaps and tighten fasteners.
17	Severe B+ Undervoltage	1. Non-controller system drain on battery. 2. Battery resistance too high. 3. Battery disconnected while driving. 4. Open B+ fuse or main contractor did not close	*Set:* Battery pack voltage dropped below the Severe Undervoltage limit with FET bridge enabled. *Clear:* Bring battery pack voltage above Severe Undervoltage limit.	1. Inspect all cables and connectors from batteries to controller. 2. Let battery cool then fully recharge battery. If error happens again, load test battery and replace if needed. 3. Inspect 300 amp fuse and replace if open. 4. Inspect contactor for corroded contacts and replace if needed.
	Severe Power Switch Undervoltage	1. Non-controller system drain on battery/power switch circuit wiring. 2. Power switch disconnected while driving. 3. Open 20 amp fuse.	*Set:* Below Brownout Voltage for 2 seconds. *Clear:* Bring power switch voltage above Brownout Voltage.	1. Inspect all power switch cables and connectors. 2. Inspect 20 amp fuse and replace if open.
18	Severe B+ Overvoltage	1. Battery resistance too high for given regen current. 2. Battery disconnected while regen braking.	*Set:* Battery pack voltage exceeded the Severe Overvoltage limit with FET bridge enabled. *Clear:* Bring battery pack voltage below Severe Overvoltage limit, and then cycle power switch.	1. Let battery cool then fully recharge battery. If error happens again, load test batteries and replace if needed. 2. Inspect all cables and connectors from batteries to controller.
	Severe Power Switch Overvoltage	1. Incorrect (too high) battery-voltage applied to power switch (pin 1). NOTE: Prevents Main Contactor closure if power switch is greater than the Severe Overvoltage limit.	*Set:* Power switch voltage exceeded Severe Overvoltage limit. *Clear:* Bring power switch voltage below the Severe Overvoltage limit.	1. Check the voltage of each 6V battery with a digital volt meter. Inspect power switch and battery wiring for insulation damage and proper wiring.

CODE	DESCRIPTION	POSSIBLE CAUSE	SET / CLEAR CONDITIONS	SOLUTION
22	Controller Overtemp Cutback	1. Controller is performance-limited at this temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	*Set:* Heatsink temperature exceeded 85°C. *Clear:* Bring heatsink temperature below 85°C.	1. Move the unit to a cooler area. 2. Reduce operating load on vehicle. 3. Inspect controller heatsink mounting for air gaps and tighten fasteners.
23	B+ Undervoltage Cutback	1. Normal operation. Fault indicates the batteries need recharging. Controller is performance limited at this voltage. 2. Battery resistance too high. 3. Battery disconnected while driving. 4. Open 300 amp fuse or main contactor did not close. 5. Non-controller system drain on battery.	*Set:* Battery pack voltage dropped below the Undervoltage limit with the FET bridge enabled. *Clear:* Bring battery pack voltage above the Undervoltage limit (19V).	1. Charge batteries. 2. Let battery cool then fully recharge battery. If error happens again, load test batteries and replace if needed. 3. Inspect all cables and connectors from batteries to controller. 4. Inspect 300 amp fuse and replace if needed. 5. Inspect contactor for damaged, corroded or contaminated contacts. Repair or replace as needed.
24	B+ Overvoltage Cutback	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery disconnected while regen braking.	*Set:* Battery pack voltage exceeded the Overvoltage limit. *Clear:* Bring battery pack voltage below the Overvoltage limit (30V).	1. Continue using the unit. 2. Inspect all cables and connectors from batteries to controller.
25	+5V Supply Failure	1. Bad crimps or faulty wiring. 2. Shorted motor encoder. 3. Shorted throttle. 4. Shorted ExactMil potentiometer.	*Set:* +5V supply (pin 26) outside the 5 V±10% range. *Clear:* Bring voltage within range.	1. Inspect motor encoder/thermistor cable and connector. Disconnect motor encoder and cycle unit power. If the 5V supply fault clears, replace the motor. If the 5V supply fault persists, reconnect encoder and repeat this process for the throttle assembly and ExactMil potentiometer.
28	Motor Temp Hot Cutback	1. Motor temperature is at or above the programmed Temperature Hot setting, and the current is being cut back.	*Set:* Motor temperature is at or above the Temperature Hot parameter setting. *Clear:* Bring the motor temperature within range.	1. Move to cooler area, reduce operating load.
29	Motor Temp Sensor Fault	1. Motor thermistor is not connected properly.	*Set:* Motor thermistor input (pin 8) is at the voltage rail (0V or 10 V). *Clear:* Bring the motor thermistor input voltage within range.	1. Inspect motor encoder/thermistor cable and connector.
31	Main Contactor Open/Short	1. Open or short across contractor coil. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = ON. *Clear:* Correct open or short, and cycle power switch.	1. Inspect contactor coil cables and connectors. 2. Test the contactor coil and replace contactor if needed.
36	Encoder Fault	1. Motor encoder failure. 2. Bad crimps or faulty wiring.	*Set:* Motor encoder phase failure detected. *Clear:* Cycle power switch.	1. Inspect motor encoder/thermistor cable and connector. 2. Replace motor.
37	Motor Open	1. Motor phase is open. 2. Bad crimps or faulty wiring.	*Set:* Motor phase U, V, or W detected open. *Clear:* Cycle power switch.	1. Inspect U, V, W cables. 2. Replace motor.
38	Main Contactor Welded	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path is bypassing the contractor between battery and B+ on the controller before the contractor engages.	*Set:* Just prior to the main contactor closing, the battery pack voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. *Clear:* Cycle power switch.	1. Inspect contactor for welded contacts and replace if necessary. 2. Inspect all cables from the battery pack to controller looking for insulation damage. 3. Inspect U, V, W cables.

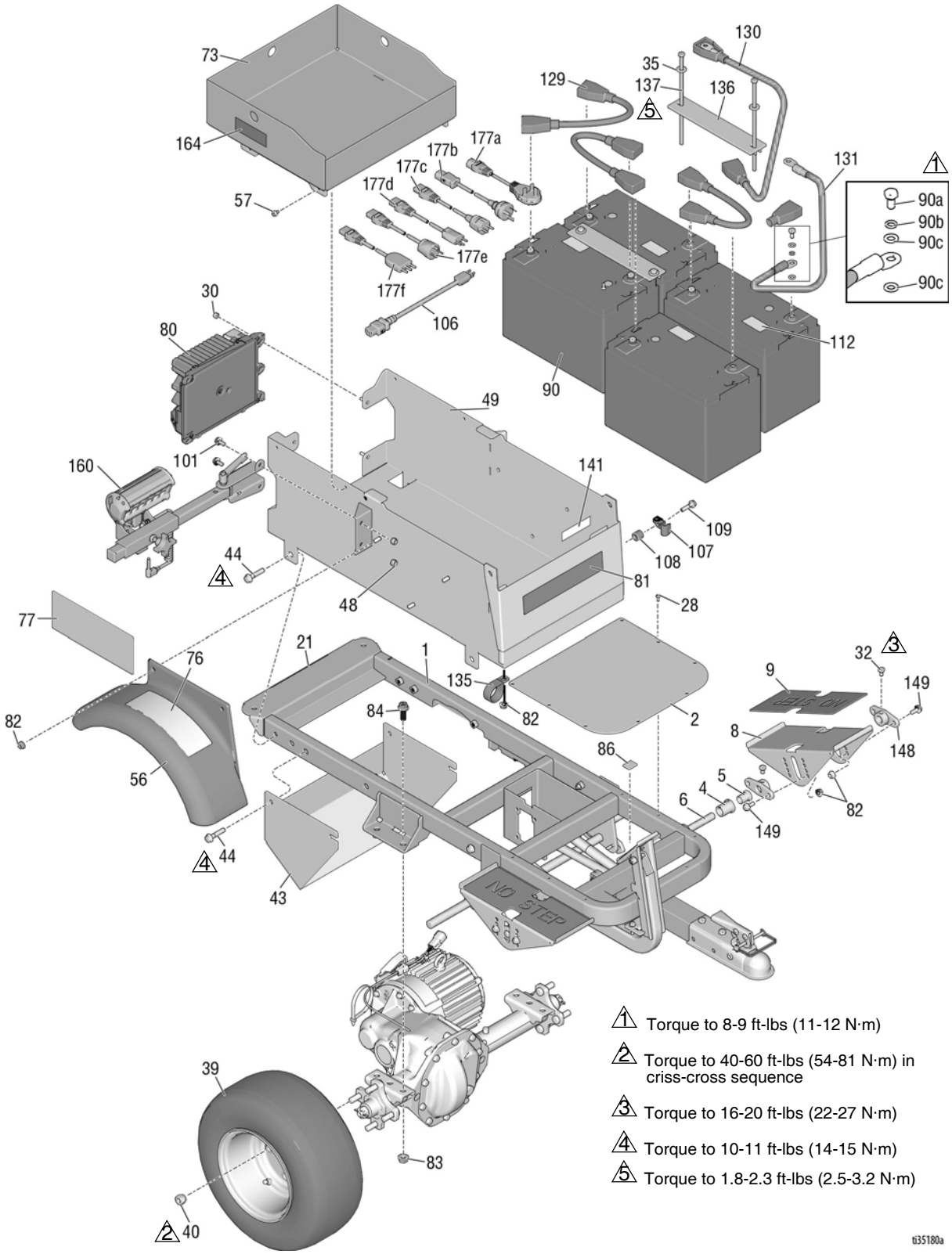
CODE	DESCRIPTION	POSSIBLE CAUSE	SET / CLEAR CONDITIONS	SOLUTION
39	Main Contactor Did Not Close	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact. 3. External load on battery pack (B+ connection terminal) that prevents battery pack from charging. 4. Blown 300 amp fuse.	*Set:* With the main contactor commanded closed, the battery pack voltage (B+ connection terminal) did not charge to B+. *Clear:* Cycle power switch.	1. Inspect contactor cable and connectors. 2. Inspect all cables and connectors from batteries to controller. 3. Inspect contactor contacts for damage or corrosion and repair or replace contactor. 4. Inspect 300 amp fuse and replace if needed.
41	Throttle Open	1. Throttle wiper voltage too high.	*Set:* Throttle wiper (pin 16) voltage is higher than the high fault threshold. *Clear:* Bring throttle wiper voltage below the fault threshold.	1. Inspect throttle cable insulation and connectors for damage and repair or replace where needed. 2. Replace throttle assembly.
42	Throttle Short	1. Throttle wiper voltage too low.	*Set:* Throttle wiper (pin 16) voltage is lower than the low fault threshold. *Clear:* Bring throttle wiper voltage above the fault threshold.	1. Inspect throttle cable and connectors. 2. Replace throttle assembly.
47	HPD/Sequencing Fault	1. Power switch, seat, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps, or switches at power switch, seat, or throttle inputs.	*Set:* HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of power switch, seat, and throttle inputs. *Clear:* Reapply inputs in correct sequence (neutral throttle, power, seat switch).	1. Cycle power with no pressure on Speed Pedals. 2. If error persists, inspect throttle and seat switch cables. 3. Recalibrate the accelerator assembly. Refer to **Accelerator Calibration**, page 14. 4. Replace throttle assembly.
73	Stall Detected	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder.	*Set:* No motor encoder movement detected. *Clear:* Cycle power switch.	1. Reduce load on driver so it can move with applied throttle. 2. Inspect encoder/thermistor cable. Verify motor wires U, V, W are properly wired. 3. Replace motor. 4. Replace controller.
88	Encoder Pulse Count Fault	1. Encoder Steps parameter does not match the actual motor encoder.	*Set:* Detected wrong setting of the Encoder Steps parameter. *Clear:* Cycle power switch.	1. Inspect motor encoder/thermistor cable. 2. Replace motor.

Parts Drawing

⚠1 Torque cable cap screws or nuts to 7-8 ft-lbs (9-11 N·m)



Parts Drawing



1 Torque to 8-9 ft-lbs (11-12 N·m)

2 Torque to 40-60 ft-lbs (54-81 N·m) in criss-cross sequence

3 Torque to 16-20 ft-lbs (22-27 N·m)

4 Torque to 10-11 ft-lbs (14-15 N·m)

5 Torque to 1.8-2.3 ft-lbs (2.5-3.2 N·m)

Parts Drawing - Detail Views

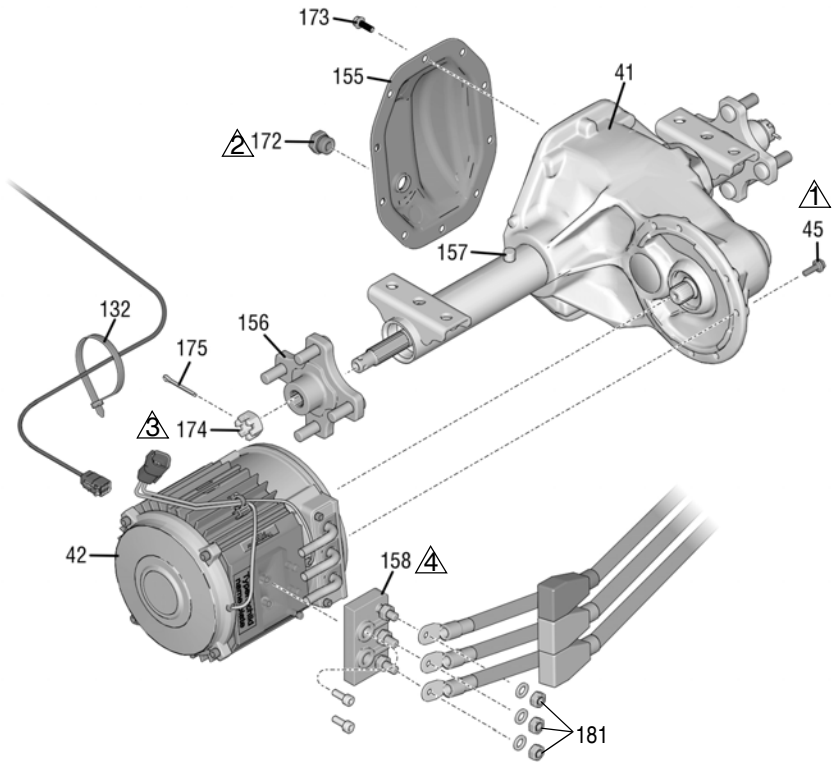
1 Torque to 6-7 ft-lbs. (8-9 N·m)

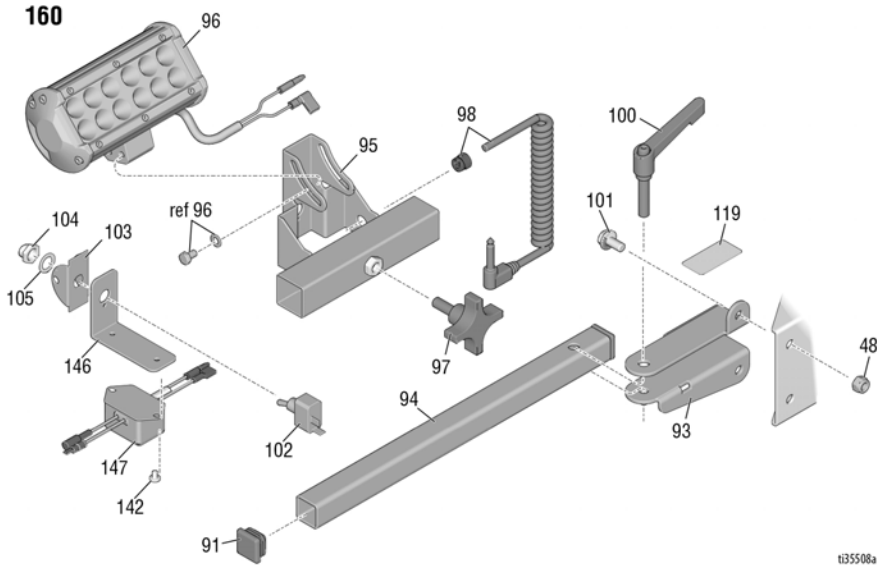
2 Torque to 20-25 ft-lbs (27-34 N·m)

3 Torque to 90-115 ft-lbs (122-156 N·m)

4 Torque to 95-105 in-lbs (10.7-11.9 N·m)

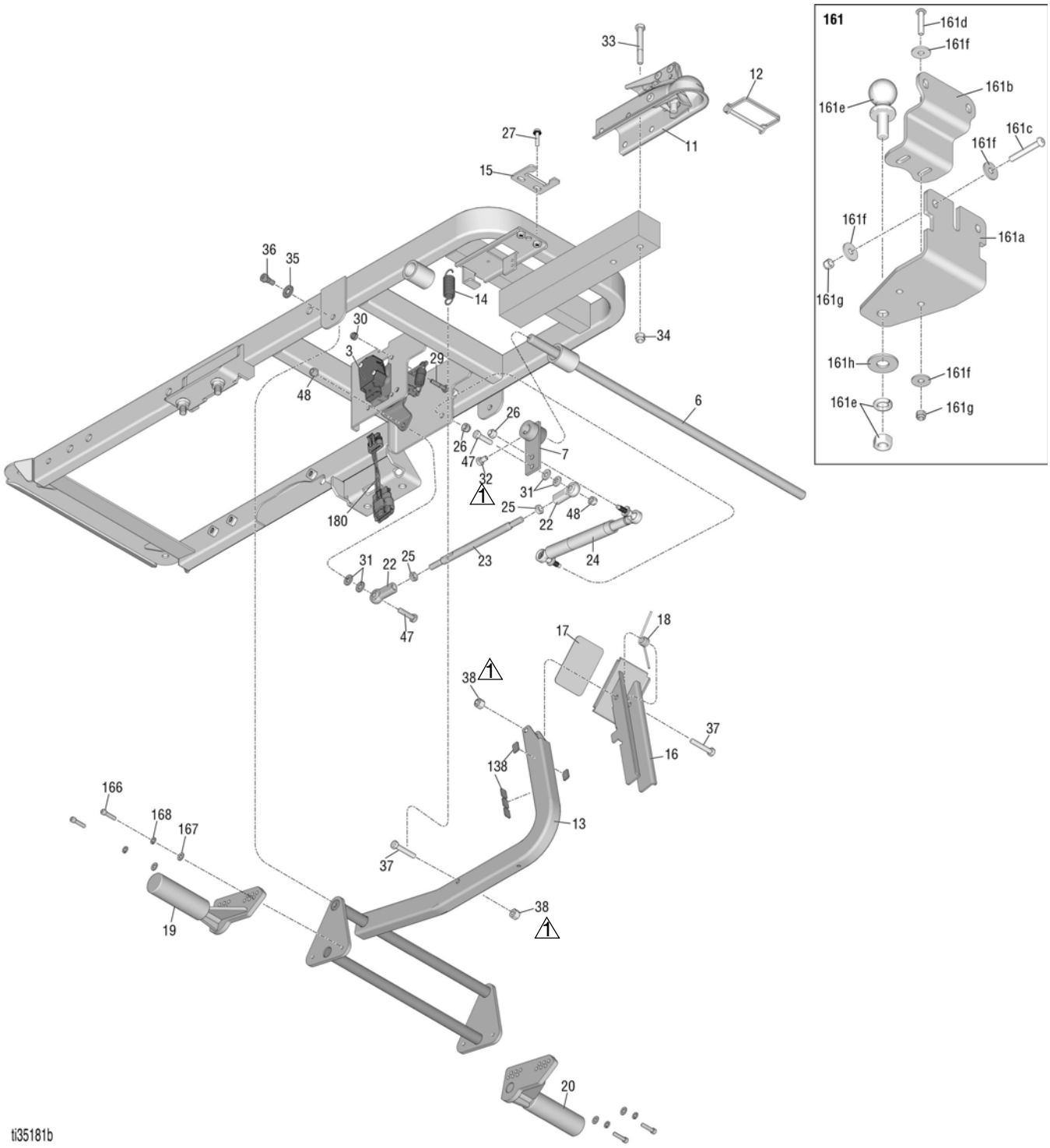
Use a wrench to support backup nuts firmly while tightening.





Parts Drawing

⚠1 Clamped parts must move freely after tightening



Parts List

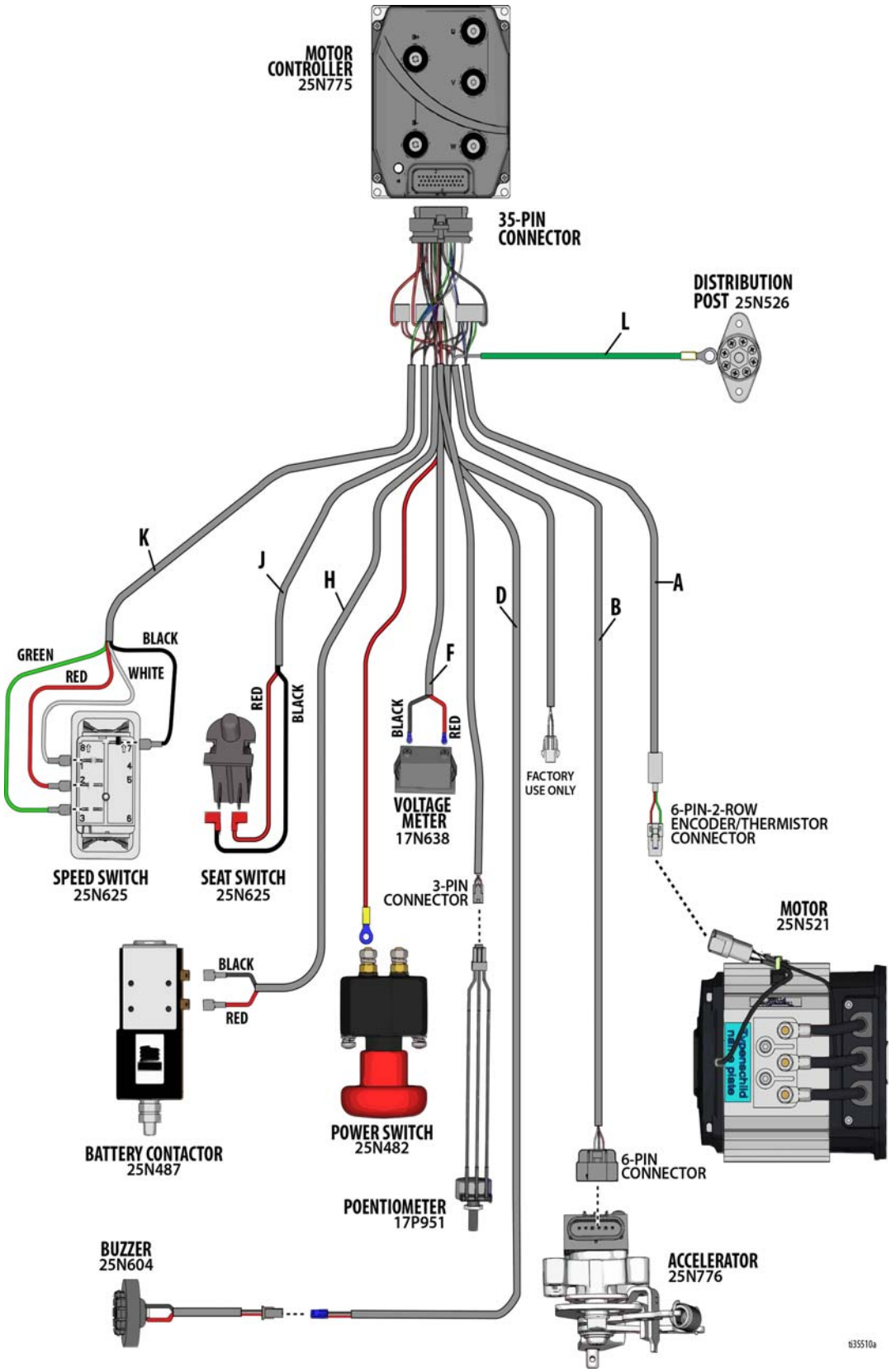
Ref.	Part	Description	Qty
1	25N649	FRAME, electric LineDriver	1
2	15N470	PLATE, floor	1
3	25N776	KIT, throttle, *includes 180*	2
4	15R872	INSERT, bearing, flange	2
5	116887	BEARING, flanged, bronze	2
6	15R794	SHAFT, foot pedal	1
7	247901	PLATE, linkage	1
8	25N760	PEDAL, foot, adjustment	2
9	121234	PAD, non-slip, pedal	2
10	109570	WASHER, plain	2
11	116889	COUPLER, ball	1
12	113696	PIN, ball coupler	1
13	247571	BRACKET, brake	1
14	15R123	SPRING	1
15	15R068	LATCH, brake	1
16	247572	PEDAL, foot brake	1
17	15R409	PAD, non-slip, brake	1
18	15R122	SPRING	1
19	19B111	BRAKE, adjustment, right	1
20	19B112	BRAKE, adjustment, left	1
21	290159	LABEL, reflective	1
22	17C773	BALL, joint, rod end	2
23	17Z351	ROD, straight linkage	1
24	25N527	DAMPENER, pedal	1
25	103746	NUT, jam, hex, 3/8-24	2
26	104541	NUT, lock, M8	2
27	15R472	FASTENER, hex hd, flanged	2
28	110037	SCREW, mach, pnh	22
29	125585	SCREW, cap, hex hd	4
30	102040	NUT, lock, hex	18
31	100527	WASHER, plain	4
32	121280	SCREW, cap, hex hd	6
33	115348	SCREW, cap, 3/8-16 hex hd, 5/16-18	2
34	101566	NUT, lock, 3/8-16	2
35	100023	WASHER, flat	2
36	121256	SCREW, shoulder, skt hd	2
37	802127	SCREW, cap, hex hd	2
38	110838	NUT, lock	2
39	249083	WHEEL pneumatic, assy	2
40	125481	NUT, wheel	8
41	25N488	AXLE, transaxle, *includes 155, 156, 157, 172, 173, 174, 175*	1
42	25N521	MOTOR, transaxle, *includes 158*	1
43	17Y182	GUARD, motor	1
44	116780	SCREW, hexed, hd, flanged	8
45	16X378	SCREW, hex flange, M6	6
47	100521	SCREW, cap, hex head	2
48	111040	NUT, lock, insert, nylock, 5/16	4
49	25N471	CARRIAGE	1
50	25N476	LID, seat, paint	1
51	100424	SCREW, cap, hex hd	2
52	801020	NUT, lock, hex	2
53	113796	SCREW, flanged, hex hd	2
54	25N477	BASE, controls, paint	1
56	17X959	FENDER	1
57	112798	SCREW, thread forming, hex hd	4
58	247544	HOLDER, bottle	1
59	245341	SEAT, *includes 69, 82 (x4)*	1
61	25N483	CONVERTER, power	1
62	25N775	MOTOR, controller	1
63	25N487	BATTERY, contactor	1
64	17N816	HOLDER, fuse	1
65	131738	FUSE, 300 amp	1
66	25N482	SWITCH, push button, shut off	1
67	25N625	SWITCH, rocker	1
68	17N638	METER, volt, digital	1
69	116833	SWITCH, safety, seat	1
70	25E406	CABLE, harness, 12 vdc supply	1
71	25N649	PLUG, panel	1
72	25N475	COVER, seat, paint	1
73	17X949	TRAY, tool	1
74	17Y217	SOCKET, 12V	2
75	16P138	LABEL, energy source	2
76▲	198918	LABEL, warning	2
77	25N529	LABEL	2
78	25N526	POST, distribution	1
79	16V700	GROMMET	1
80	25N480	BATTERY, charger	1
81	15T120	LABEL, instruction	1
82	110996	NUT, hex, flange hd	19
83	125943	NUT, serrated flange, 7/16-14	4
84	17M849	BOLT, flange, serrated	4
85	103229	SCREW, cap sch	2
86	187797	SPACER, duct	1
87	17X783	ISOLATOR, hvlp	1
88	17P951	POTENTIOMETER, assy	1
89	17N957	KNOB, potentiometer	1
90	25N884	BATTERY, deep cycle, 6v, *includes 90a, 90b, 90c,112*	4
90a		M8x1.25x16mm capscrew	8
90b		M8 lockwasher	8
90c		M8 flatwasher	16
91	116895	CAP, tube, square	2

Ref.	Part	Description	Qty
92	17X783	WASHER, nylon	1
93	15R063	BRACKET, light	1
94	15R064	SUPPORT, light	1
95	17R099	TUBE, bracket, light, LED	1
96	17R098	LIGHT, LED	1
97	111145	KNOB, pronged	1
98	114425	BUSHING, strain relief	1
99	15R308	CORD, power	1
100	15R864	KNOB	1
101	111800	SCREW, cap, hex hd	2
102	111930	SWITCH, toggle	1
103	107255	GUARD, switch	1
104	195428	BOOT, toggle	1
105	105658	RING, locking	1
106	17N758	CORD, power, 125V, US	1
107	278204	CLIP, drain line	1
108	129627	SPACER, nylon, 3/8 ID	1
109	15C753	SCREW, mach, hex wash hd	1
111	17Y311	LABEL, controls	1
112	17Y312	LABEL, battery, 6v	4
113	17Y313	LABEL, max wattage	1
115	17Y315	BRACKET, contactor	1
116	117018	WASHER	5
117	108050	WASHER, lock, spring	5
118	112117	SCREW, cap, hex hd, M6	5
119	15T112	LABEL	1
120▲	195793	LABEL, warning	1
121▲	17K396	LABEL, safety	1
122▲	17Y094	LABEL, safety, prop 65	1
123	129696	SCREW, pan hd	2
124	25N604	INDICATOR, buzzer	1
126	25E392	CABLE, red, dia. .525 x 15 in.	1
127	25E393	CABLE, black, dia. .525 x 13 in.	1
128	25E391	CABLE, red, dia. .525 x 10 in.	1
129	25E388	CABLE, black, dia. polarized	3
130	25E389	CABLE, black, dia. .525 x 20 in.	1
131	25E390	CABLE, red, dia. .525 x 20 in.	1
132	404989	STRAP, tie	1
133	25N661	HARNESS, controls	1
134	25N660	HARNESS, assembly	1
135	25N652	CLAMP, loop	1
136	25N647	HOLDER, battery	2
137	17Y588	SCREW, cap	4
138	15R608	SPACER, duct, .50 x .75 x .062	5
141		SERIAL ID	2
142	109032	SCREW, mach, pnh	2
143	25N750	PAD, adhesive mounting	5
146	25N758	BRACKET	1
147	25N757	FILTER, LED	1
148	25N759	COLLAR	4
149	110963	SCREW, cap, flange hd	18
153	126215	TRIM, edge, protection	1.5
155	17Z070	KIT, carrier, cover	1
156	17Z071	KIT, axle, hub	2
157	17Z072	AXLE, vent, cap	1
158	17Z073	KIT, terminal, block	1
159	25N762	KIT, transaxle, assembly, *includes 41, 42, 45*	1
160	25N778	KIT, LineDriver ES light	1
161	25N787	KIT, hitch	1
161a	17Z155	BRACKET, hitch mount	1
161b	17Z156	BRACKET, hitch brace	1
161c	17Z209	BOLT, button HD, 3/8-16 x 2.75	2
161d	129602	SCREW, cap, button hd, 3/8 x 1.75	2
161e	116913	BALL, trailer	1
161f	108851	WASHER, plain	8
161g	101566	NUT, lock	4
161h	110947	WASHER, plain	1
164	17P202	LABEL	2
170	17P925	LABEL, A+ service	1
171	16D576	LABEL, made in USA	1
172	120765	FITTING, plug	1
173	110963	SCREW, cap, flange head	10
174	867021	NUT, hex slotted, 5/8-18	2
175	100103	PIN, cotter	2
176		ARTWORK, identification	1
177a*	17S135	CORD, power, UK	1
177b*	17R033	CORD, power, Australia	1
177c*	17R034	CORD, power, CEE 7/7	1
177d*	17R035	CORD, power, Switzerland	1
177e*	17R036	CORD, power, Denmark	1
177f*	17R037	CORD, power, Italy	1
178	17Z423	LABEL, battery wiring	1
179	25N899	BRACKET, throttle adapter (used on early models only)	1
180	25N722	HARNESS, accelerator	1
181	100214	WASHER, lock	3

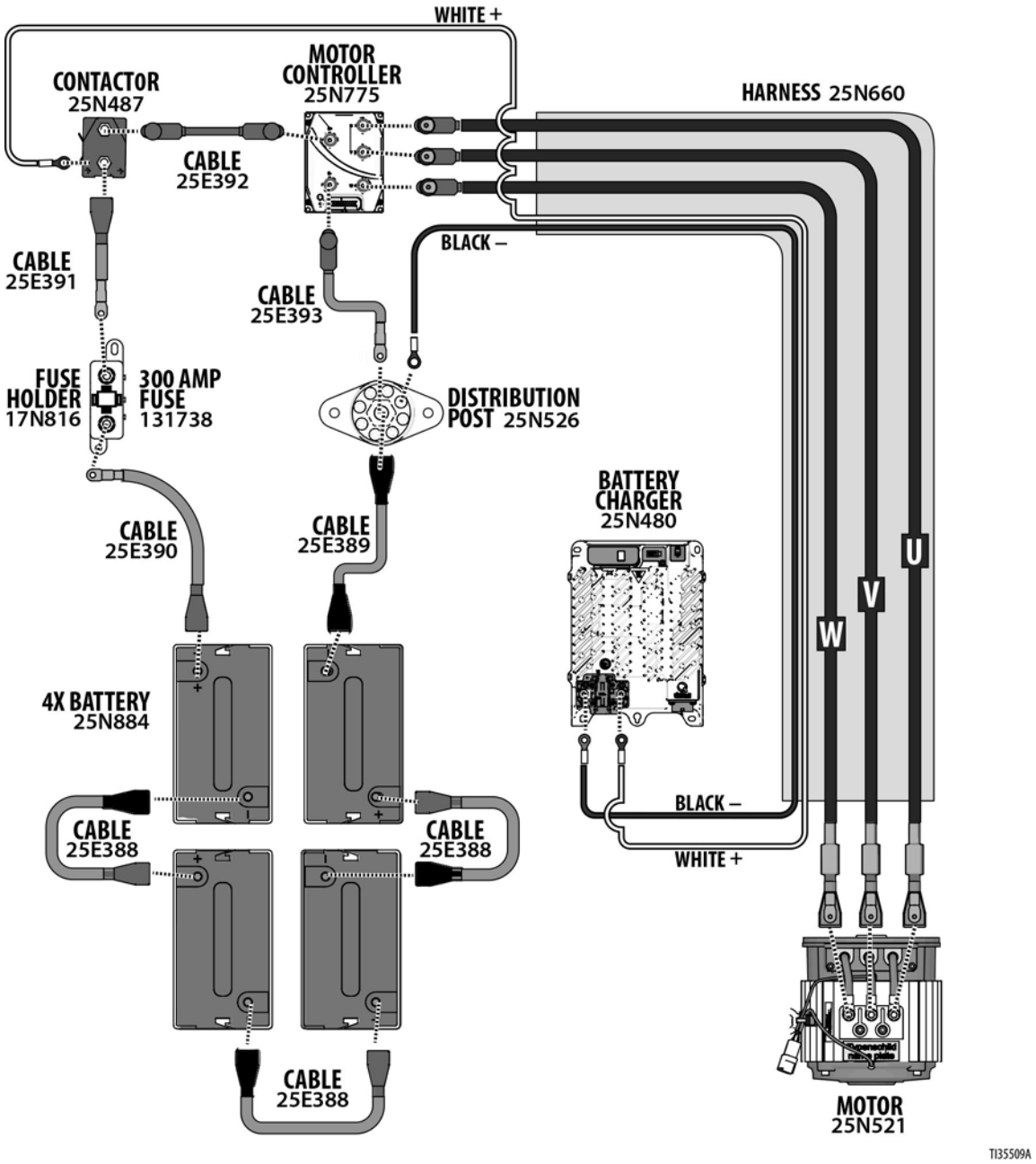
* Included in 25N556

▲ *Replacement safety labels, tags, and cards are available at no cost.*

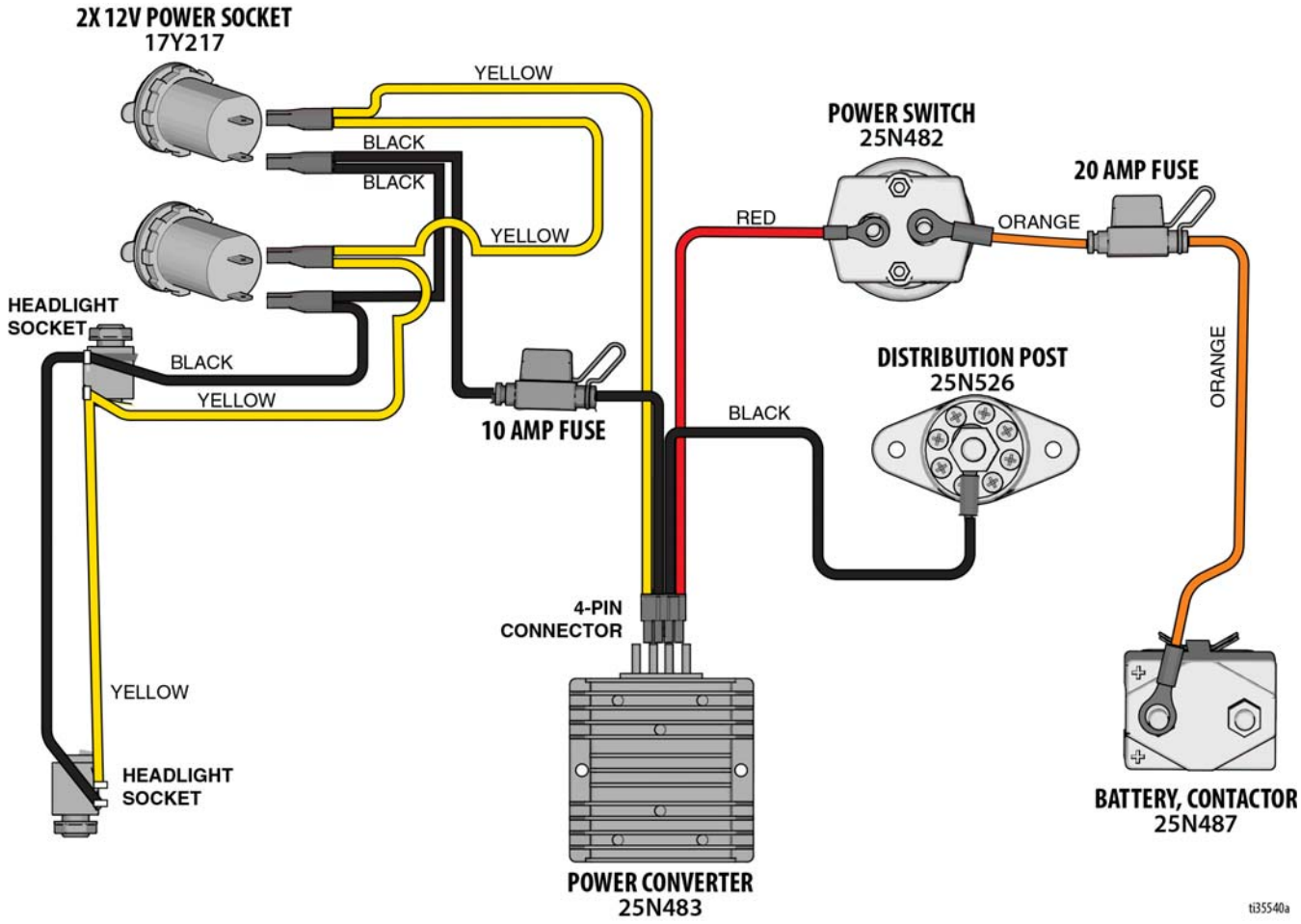
Wiring Diagram - Harness 25N661



Wiring Diagram



Wiring Diagram - Harness 25E406



Technical Specifications

LineDriver ES		
	U.S.	**Metric**
Dimensions		
Height	48.5 in.	1232 mm
Width	29.3 in.	744 mm
Length	58.2 in.	1478 mm
Weight	620 lbs.	281 kg
Speed		
Forward	0-10 mph	0-16 kph
Reverse	0-6 mph	0-10 kph
Batteries		
Nominal Battery Pack Voltage	24 VDC	
Quantity	4	
Type	Deep Cycle Absorbent Glass Mat (AGM)	
Voltage (Nominal)	6 VDC	
Dimensions	12.6” x 6.93” x 8.86”	320 mm x 176 mm x 225 mm
Capacity (Nominal, 10hr rate)	225 Amp-hour	
Maximum Charging Current	67.5 Amps	
Battery Charger		
Input Voltage Range	85-270 VAC	
Input Voltage Frequency	50-60 Hz	
Nominal AC input current	6.0A @ 120VAC	3.1A @ 230VAC
Max. Charger Output	650 W	
Charger Profile	28	
Battery Temperature		
Operating	-4-140°F	-20-60°C
Charging	14-140°F	-10-60°C
Storaging	-4-140°F	-20-60°C
Noise Levels (dBa): measured at 3.1 ft (1 meter) per ISO 3744*		
Sound Power:	< 70	
Sound Pressure:	< 70	
* Does not include sound from propelled equipment - see relevant manual.		
Vibration (m/s^2) (8 hours daily exposure)*		
Seat and Pedals	< 0.5	
* Does not include vibration from propelled equipment - see relevant manual.		

CALIFORNIA PROPOSITION 65

WARNING: This product can expose you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized Graco distributor for verification of the claimed defect. If the claimed defect is verified, Graco will repair or replace free of charge any defective parts. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation.

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Graco's sole obligation and buyer's sole remedy for any breach of warranty shall be as set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within two (2) years of the date of sale.

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In no event will Graco be liable for indirect, incidental, special or consequential damages resulting from Graco supplying equipment hereunder, or the furnishing, performance, or use of any products or other goods sold hereto, whether due to a breach of contract, breach of warranty, the negligence of Graco, or otherwise.

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For patent information, see www.graco.com/patents.

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All written and visual data contained in this document reflects the latest product information available at the time of publication.
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Original instructions. This manual contains English. MM 3A6623
Graco Headquarters: Minneapolis
International Offices: Belgium, China, Japan, Korea

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