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# TECUMSEH

TECHNICIAN'S HANDBOOK

This manual covers the DC-24 Volt Battery Unit.

## 24 VOLT CORDLESS ELECTRIC MOTOR



## Contents

<b>CHAPTER 1 GENERAL INFORMATION .....</b>	<b>1</b>
ELECTRICAL TERMS .....	1
MOTOR IDENTIFICATION .....	2
SAFETY GUIDELINES .....	2
MAINTENANCE .....	2
IN SEASON STORAGE .....	3
OFF SEASON STORAGE .....	3
<b>CHAPTER 2 BATTERIES &amp; CHARGING SYSTEM.....</b>	<b>4</b>
GENERAL INFORMATION .....	4
BATTERY AND CHARGER OPERATION THEORY .....	4
COMPONENTS .....	5
TEST PROCEDURES .....	6
<b>CHAPTER 3 ELECTRIC MOTOR AND CONTROLS .....</b>	<b>7</b>
GENERAL INFORMATION .....	7
ELECTRIC MOTOR THEORY AND OPERATION .....	7
INDICATOR OR DISPLAY PANEL .....	7
SERVICE .....	7
ELECTRICAL CHARTS .....	8-15
<b>CHAPTER 4 TORQUE SPECIFICATIONS .....</b>	<b>16</b>

## CHAPTER 1 GENERAL INFORMATION

### ELECTRICAL TERMS

**AMPERE (AMP)** is an amount of electron flow or "current" past an imaginary point.

**ELECTRONS** are negatively charged particles of conductive atoms that move from one atom to another when stimulated by an electromotive force (battery, alternator, etc ...).

**A VOLT** is the amount of electrical push or force.

**MAGNETISM** is a property contained by certain materials to exert mechanical force on a neighboring magnetic material. A measurement of magnetism is called "Flux" and is similar to current flow in an electrical circuit.

**A CONDUCTOR** is a material that easily supplies free electrons to produce an electric current when stimulated by an electromotive force.

An **INSULATOR** is a material that contains no free electrons and does not allow an electric current to flow through it.

**HEAT** is an energy loss produced as electrical energy is converted into mechanical energy in a D. C. motor. The higher the efficiency of the motor, the smaller the amount of heat produced.

**SPEED** is the number of rotations of the armature shaft which is controlled by altering the armature voltage.

A **BATTERY** is a device that converts chemical energy into electrical energy. Battery operation and performance can be grouped into four critical elements. Discharge characteristics, overall life, cycle life, and shelf life.

The **AMP/HOUR** rating is a test to indicate how long a battery is able to supply a constant current for a 20 hour period.

**OVERALL LIFE** is how long a battery is still usable after the date of manufacture even if it is unused. With proper maintenance the typical overall life is 4 to 5 years.

The **CYCLE LIFE** is the number of times the battery can be charged and discharged before it begins to lose its capacity. The batteries in the Tecumseh power package should last approximately 150 cycles before they begin to lose capacity.

**SHELF LIFE** is how long a battery can be stored before it needs to be recharged. Shelf life depends heavily on ambient air temperature. Typically at 60° F (15° C), the battery must be recharged every six months; however at 95° F (35° C) it must be recharged every 2 months.

**BATTERY CHARGING** is accomplished by converting 120 volt A.C. into 24-30 volts D.C. The Tecumseh charger is a two step charger that supplies correct voltage until the overcharge voltage level is achieved, and then a lower "float" voltage completes the charge. Faster charging and extended battery life are a result of this charge method. This is why Tecumseh recommends keeping the charger plugged in when the mower is not in use. The charger also uses a temperature compensation circuit to increase the charging voltage at lower temperatures and decrease the charging voltage in higher temperatures.

**CHARGING TIME** is the amount of time it takes to restore a battery to a fully charged condition. During normal use batteries will typically take 12 - 16 hours to recharge. **NOTE:** If batteries have been fully discharged it could take up to 20 hours for recharging.

**RUN TIME** is the amount of time a fully charged battery pack will operate the motor until the combined battery voltage drops below 19.25 volts for at least ten seconds and the automatic shutdown occurs. Run time is typically over an hour or it can be as short as 40 minutes. Run time is influenced by variables like blade sharpness, type and amount of material cut, air temperature, ground speed, etc...

The **FLOAT CHARGE** is the lower voltage charging cycle that automatically starts after the batteries have reached full charge. Battery run time and life is maximized during this charge cycle. The green charger indicator light will be on during this charge cycle.

## MOTOR IDENTIFICATION

The Tecumseh motor is identified by the type and model number, specification number, and date of manufacture (D.O.M.). This information is imprinted on a decal that is found on the metal shroud.

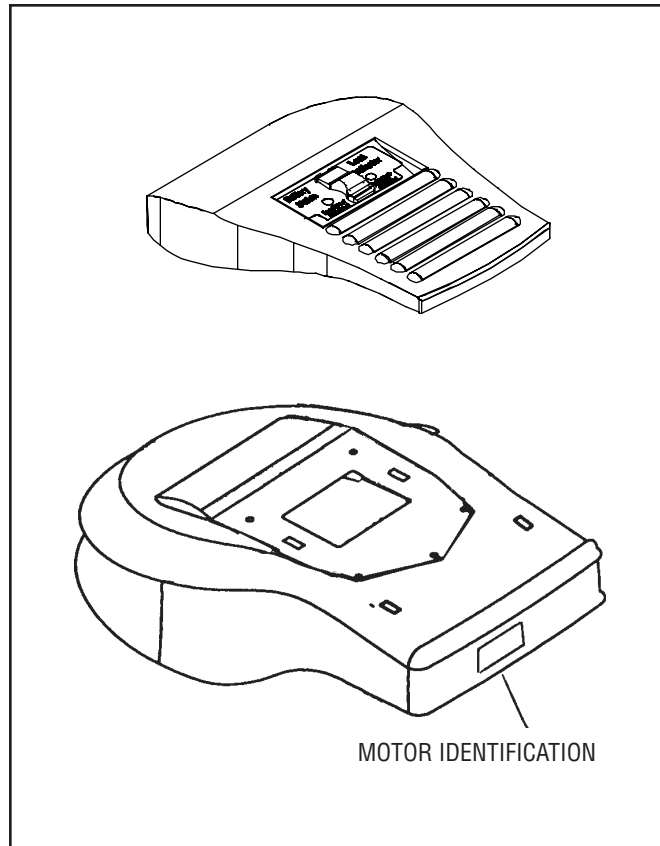
The letter designations indicate the basic type of motor.

The number designations following the letters indicate the voltage requirement of motor.

The date of manufacture (D.O.M.) includes the year, Julian date, and the assembly line the motor was produced on.





Using model DCV 24 - 5001A - D.O.M. 6105C as an example, interpretation is as follows.

<b>DC</b> Direct Current	<b>V</b> Vertical	<b>24</b> Voltage	<b>- 5001A</b> OEM's Specification
<b>D.O.M.</b> Date of Manufacture	<b>6</b> Year of 1996	<b>105</b> 105th day 1996	<b>C</b> Line or Shift made on.



**CAUTION: THIS SYMBOL INDICATES IMPORTANT SAFETY INSTRUCTIONS WHICH IF NOT FOLLOWED CAN RESULT IN SERIOUS PERSONAL INJURY. FOLLOW ALL INSTRUCTIONS.**

## SAFETY GUIDELINES

-  1. Read and fully understand the operator's manual before attempting any maintenance or repair to the motor or controls.
-  2. Always remove 40 amp safety fuse to prevent accidental starting under the following conditions: **TRANSPORTATION, SET-UP, CLEANING, ADJUSTING, OR MAKING REPAIRS.**
-  3. Unplug the charging unit from the 120 volt outlet and the mower before performing any service procedures.
-  4. Do not expose the charging unit or electrical wiring to rain or washing.

## MAINTENANCE

Maintenance on the motor, controller, and battery pack is limited. The charger should be plugged into the charge port and a 120 volt A.C. source whenever the unit is not in use, including in season storage. Cleaning the motor, charger, battery pack, or controller should only be done by compressed air or by wiping with a clean cloth. Consult the Original Equipment Manufacture (O.E.M.) operator's manual for other maintenance to the mower including: blade sharpening, cleaning the deck, height adjustments, and operator presence control and motor start switch operation.

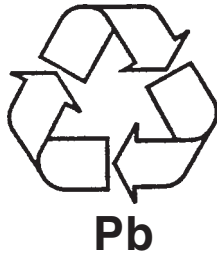
## IN SEASON STORAGE

Whenever the mower is not in use, it is considered in a stand-by or storage mode. Storage or stand-by requires the charger to be plugged in to restore and maintain battery voltage and extend battery life. **NOTE: ALWAYS PLUG THE BATTERY CHARGER INTO THE CHARGE PORT BEFORE PLUGGING INTO THE 120 VOLT A.C. SOURCE.** Batteries left off the charger during storage will slowly lose charge and the service life will not be maximized. The mower and charger should be stored inside a garage, shed, or other area where it is dry and protected from the elements and out of the reach of children.

## OFF SEASON STORAGE

When the mower is not to be used for an extended period beginning at 30 days but not more than 6 months, the following procedure is to be followed for temperatures below 60° F (15° C).

1. Charge batteries following procedure previously listed for at least 20 hours.
2. When the batteries are completely charged the unit can be stored out of the weather in a garage or shed without fear of battery freezing for up to 6 months. Battery can not be stored below -30° F (-35° C) or damage will occur.
3. If the unit is stored in an area with temperatures above 60° F (15° c) you will need to keep the charger plugged into the system to maximize battery life.



THIS PRODUCT CONTAINS A SEALED LEAD ACID BATTERY. MUST BE DISPOSED OF PROPERLY. Local, state, or federal laws may prohibit disposal of lead-acid batteries in ordinary trash. Consult your local waste authority for information regarding available recycling and/or disposal options.

## CHAPTER 2 BATTERIES & CHARGING SYSTEM

### GENERAL INFORMATION

The energy source used to power the motor is two 12 volt 17 AMP/HR lead acid maintenance free batteries. The two batteries are hooked in series to increase the voltage to the motor to 24 volts D.C. The batteries use a gel type electrolyte and are completely sealed. The batteries come fully charged from the factory. However, before the initial use or when not in use the batteries should be recharged fully by the charger (see charging operation).

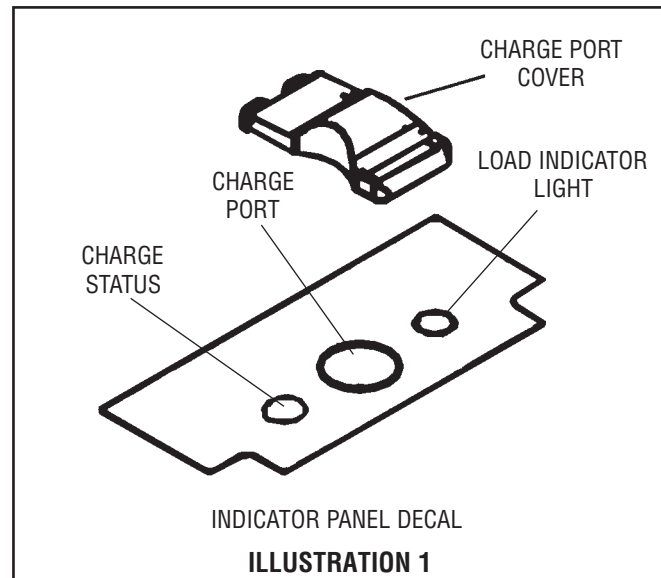


**CAUTION: DO NOT EXPOSE THE CHARGER TO RAIN OR SNOW.**

### BATTERY AND CHARGER OPERATION THEORY

The batteries are charged as a set using a series connection between the batteries. The battery charger converts 120 A.C. voltage into 24-30 volts D.C. and plugs into the charge port located in the indicator panel.

TO BE ABLE TO PROPERLY SENSE BATTERY CONDITION, THE BATTERY CHARGER MUST BE PLUGGED INTO THE CHARGE PORT BEFORE IT IS PLUGGED INTO THE 120 VOLT A.C. SOURCE. The two step Tecumseh charger must "read" battery voltage before selecting either a high voltage charge mode or a lower "float" charge mode. If the charger is plugged into the charge port after the 120 volt A. C. source, the charger will display a false signal that the battery is fully charged and will only charge the battery at the lower "float" voltage. The charge mode can be seen at the indicator lights: green indicates charging at the float voltage and the batteries are fully charged, the red light indicates charging at the higher rate and the batteries are discharged.



**ILLUSTRATION 1**

**NOTE:** When the charger is plugged in the charge port, the switching circuit is disabled and the motor will not start. The 40 Amp. safety fuse must be plugged in to charge the battery.

The charger also features temperature compensation to obtain the best charge based on the ambient air temperature. The charger voltage compensates for temperature variation by increasing or decreasing charge voltage. Without this feature the batteries could be overcharged in elevated temperatures and not fully charged in low temperatures.

The charger is recommended to be left on continuously whenever the mower is not in use except during Off Season storage. (See Off Season Storage)

**REMEMBER, PLUG THE CHARGER INTO THE CHARGE PORT FIRST BEFORE THE POWER SUPPLY.**

**COMPONENTS**

24 Volt Motor

Ref. #	Description	Ref. #	Description
1	Motor Assembly	11	Charger Port Cover
2	Battery Assembly (Includes 13 & 15)	12	Grill
3	Controller Board	13	Screw - Battery
4	Indicator Board / Charge Port	14	Wire Assembly
5	Lead Wire Assembly	15	Clip - Battery
6	Bracket - Battery Support	16	Shroud
7	Bracket - Lower	17	Battery Charger
8	Screw - Shroud	18	Fuse - 40 Amp
9	Screw - Beveled	19	Decal (Indicator Panel / Charge Port)
10	Battery Box	20	Screw, Controller board

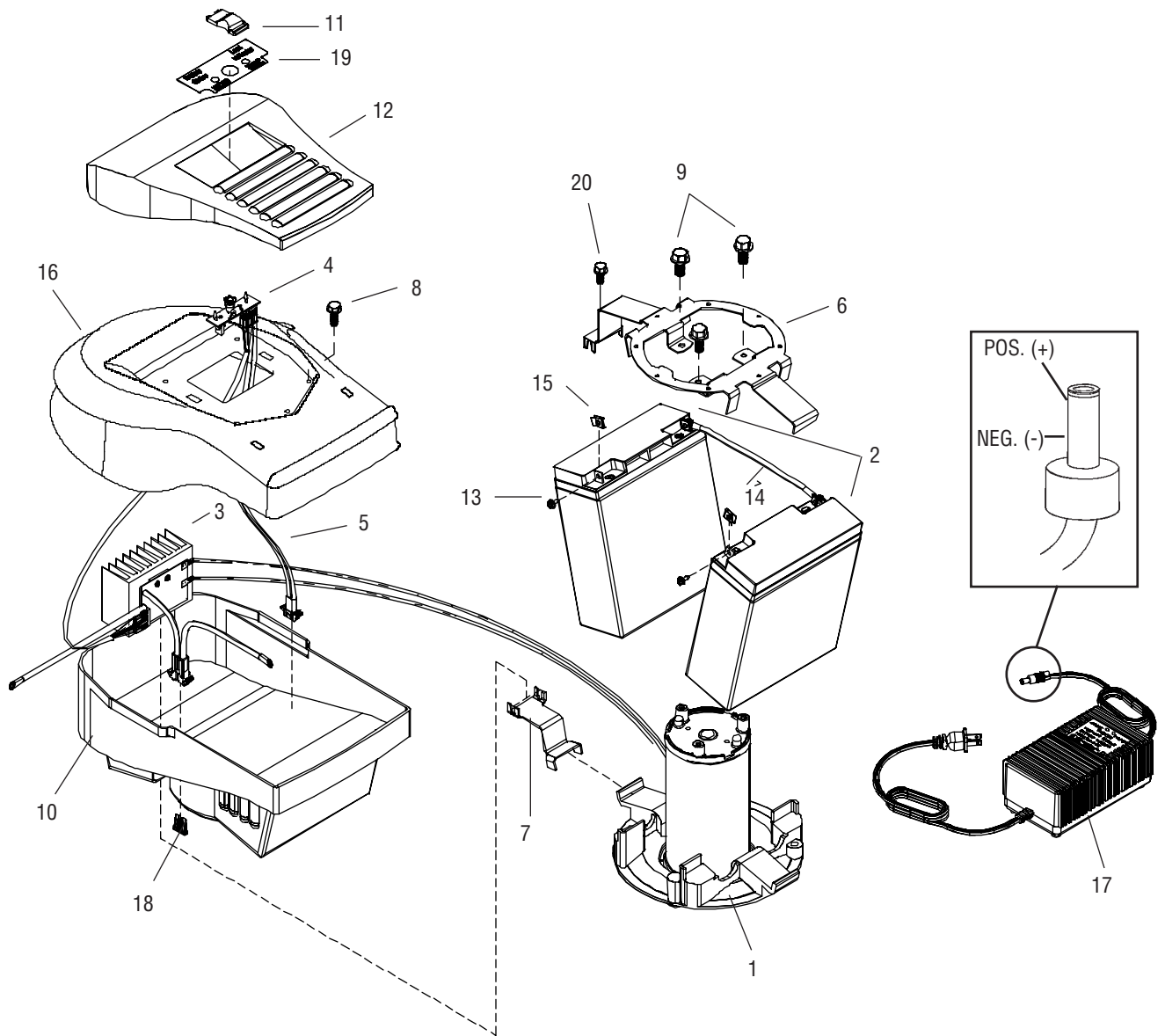


ILLUSTRATION 2

## **TEST PROCEDURES**

If the batteries do not provide sufficient run time or fail to recharge fully, the batteries and charger can be checked to determine if the charger is working properly or if batteries are no longer rechargeable. Before testing, the batteries must be charged the maximum time (20 hours) to achieve the fully charged state. Use the load test found on the troubleshooting chart only as a guideline of the batteries condition. Performance of the complete unit must be considered before battery replacement. Review with the operator how the machine is being used; height of cut, blade condition (sharpness), is grass dry or wet.



## CHAPTER 3 ELECTRIC MOTOR AND CONTROLS

### GENERAL INFORMATION

The Tecumseh electric motor is a simple device that converts the electrical energy supplied by a battery pack to mechanical energy in the form of a rotating shaft. The direct current (D.C.) motor uses high strength permanent magnets instead of field stator windings to provide a strong magnetic field. This results in reduced battery draw, lower motor operating temperature and higher motor efficiency.

The Tecumseh motor is completely sealed to prevent any dirt or moisture from entering the unit.

The motor is controlled by a handlebar mounted operator presence control and electric motor start switch. When the control is depressed and the start switch activated, the motor will continue to run until one of the following occurs. The control is released, the battery voltage drops below 19.25 volts for ten seconds, or there is an excessive load for more than six seconds. The motor controller has many functions such as; stopping the blade within three seconds, motor startup, current limiting, battery protection and thermal protection.

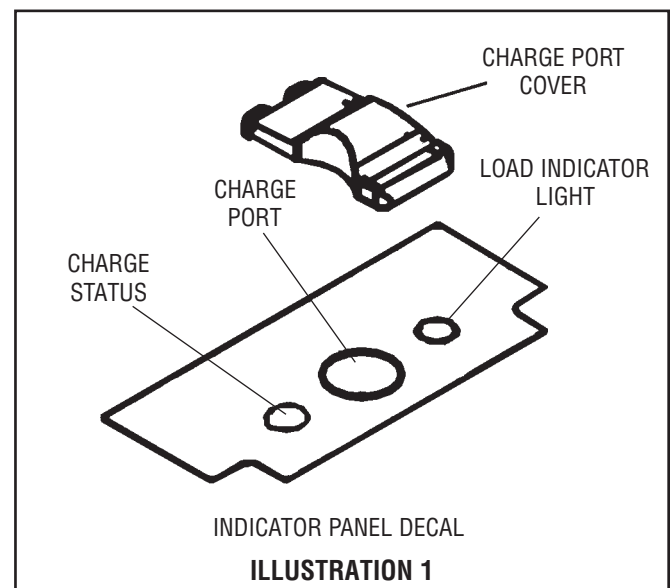
### ELECTRIC MOTOR THEORY AND OPERATION

The theory of electricity and magnetism explains why the motor turns. The housing of the motor contains permanent magnets with magnetic fields running from one pole to the other. The armature in close proximity has coils of wire wound around the laminations. When a conductor (coil of wire) cuts a magnetic field (from the permanent magnets), a current is induced in that wire. Electric motors use this principle in reverse. When the motor start switch is activated, the motor controller allows battery current to flow through the brushes and the coil on the armature. This current flow in the armature creates a strong magnetic field around the coil and lamination. The magnetic fields of the permanent magnets alternately attract and repel the magnetic forces of the windings in the armature when current is applied. This continuous series creates rotation of the armature.

The motor controller protects the motor by shutting the motor off if a high load condition exists for more than ten seconds. The 40 Amp fuse provides a safety system for the mower during service as well as an emergency shut off.

### INDICATOR OR DISPLAY PANEL

The indicator or display panel is a small circuit board that contains two light emitting diodes (LED) and the battery charge port. The load LED will come on and indicate when the load on the motor exceeds 28 Amps. The low battery LED indicates when the battery voltage has dropped below 21.5 volts and the battery is nearly discharged. If the motor shuts itself down at any time, one of the LED indicator lights will be on to inform the operator what triggered the automatic shutdown. If the load light is on, the load on the motor has reached 50 Amps for more than six seconds. Remedy the cause for excessive loading, reset the operator presence control, and press the motor start switch to continue operation. If the battery indicator is on, the battery voltage dropped below 19.25 volts for at least ten seconds the light also indicates that the batteries are discharged (See Illustration 1). Recharge the batteries as long as required and continue operation.

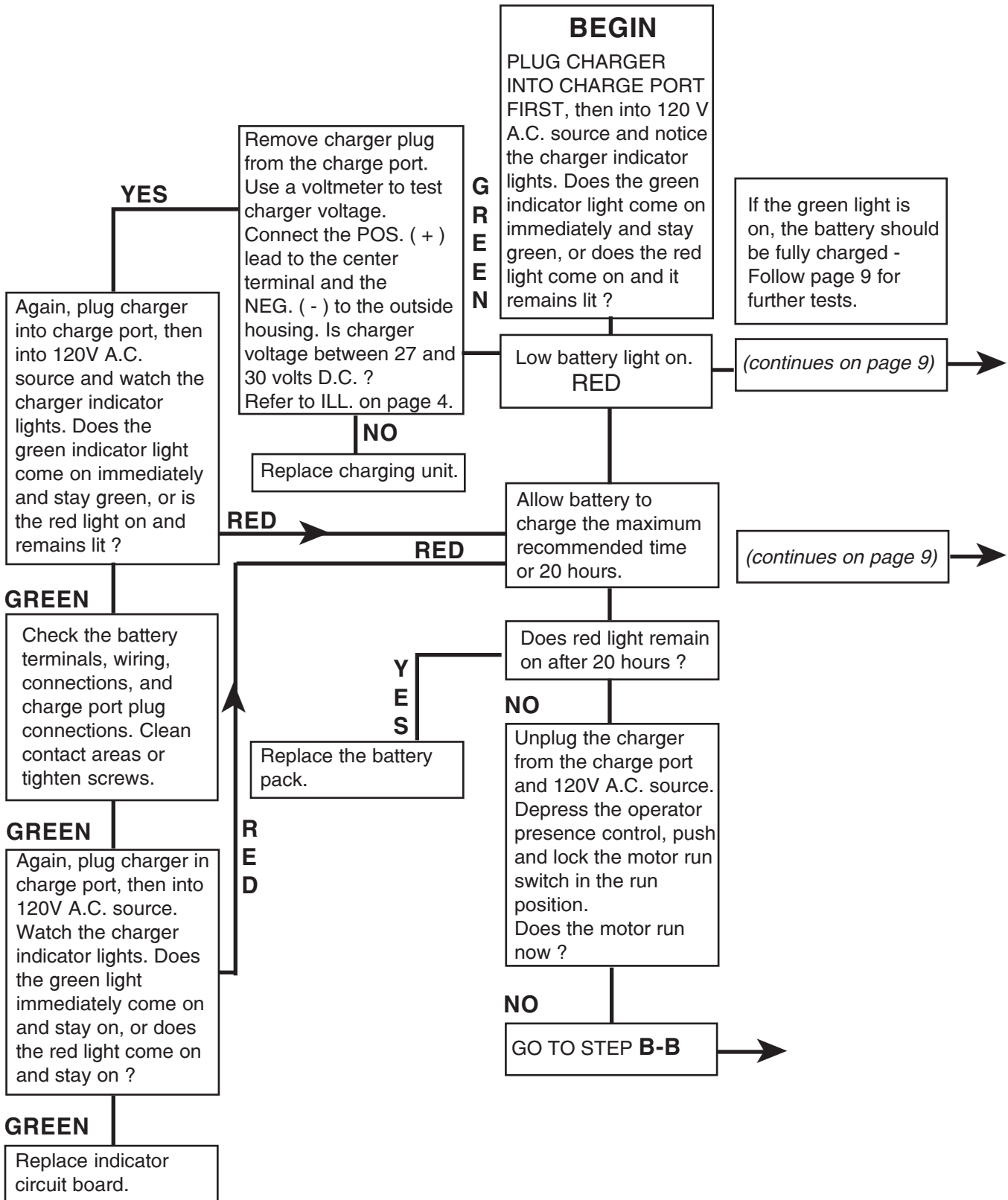


### SERVICE

Service on the motor, indicator panel, or motor controller is limited to replacement of the failed part. Use the troubleshooting charts to find the correct cause of failure.

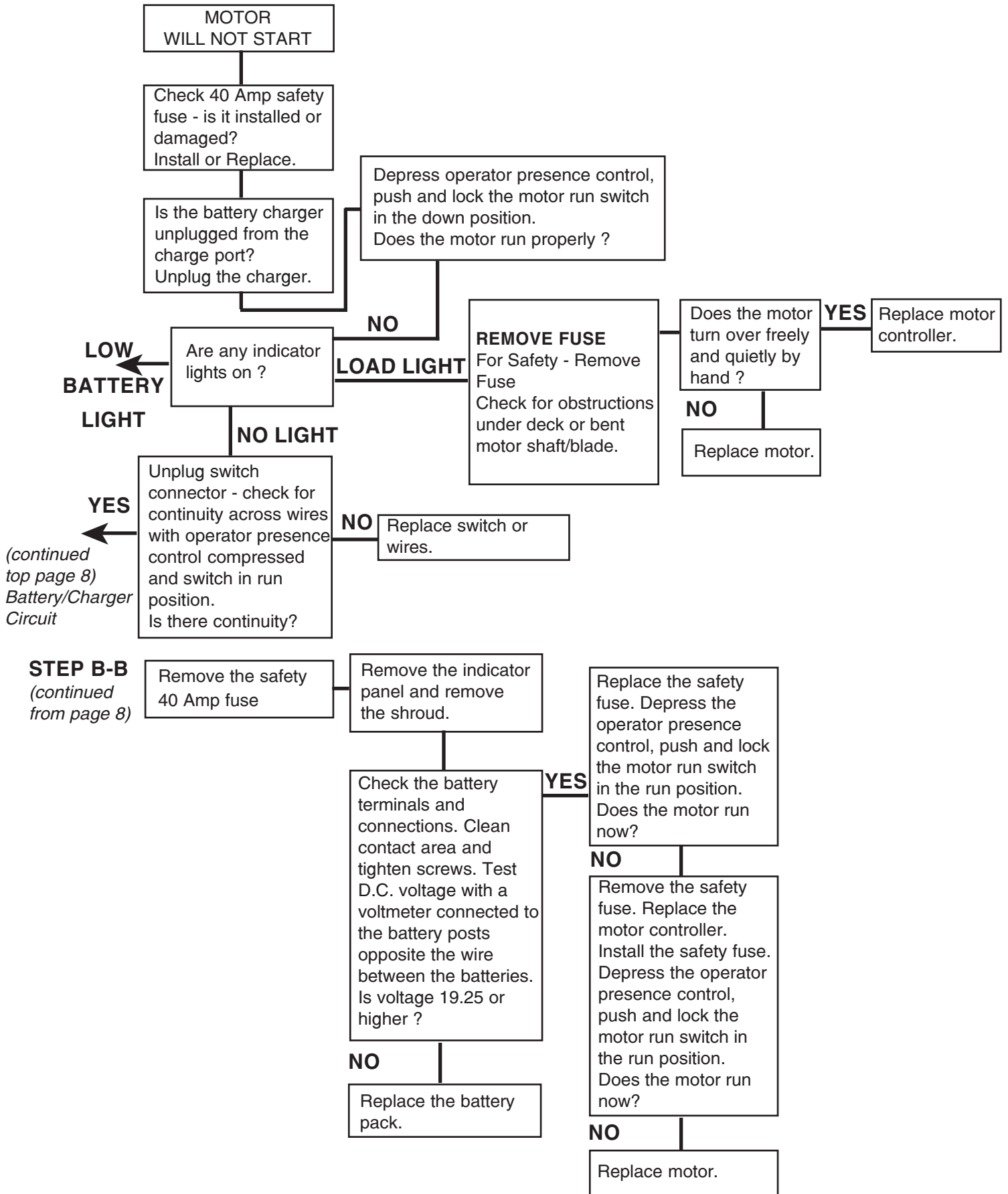
## CHARGER AND BATTERY CIRCUIT

### CHART 1A

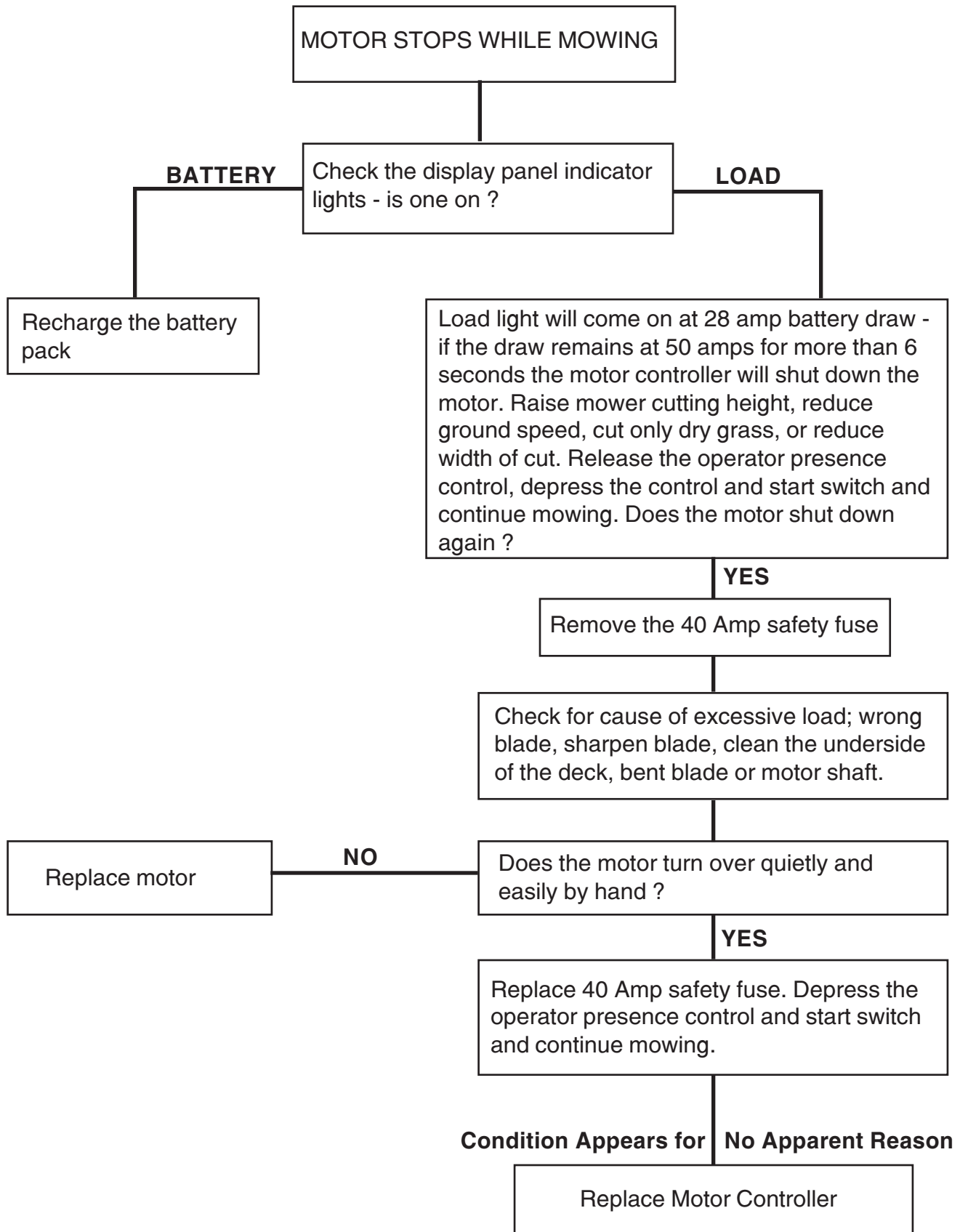


## MOTOR, CONTROLLER, INDICATOR PANEL

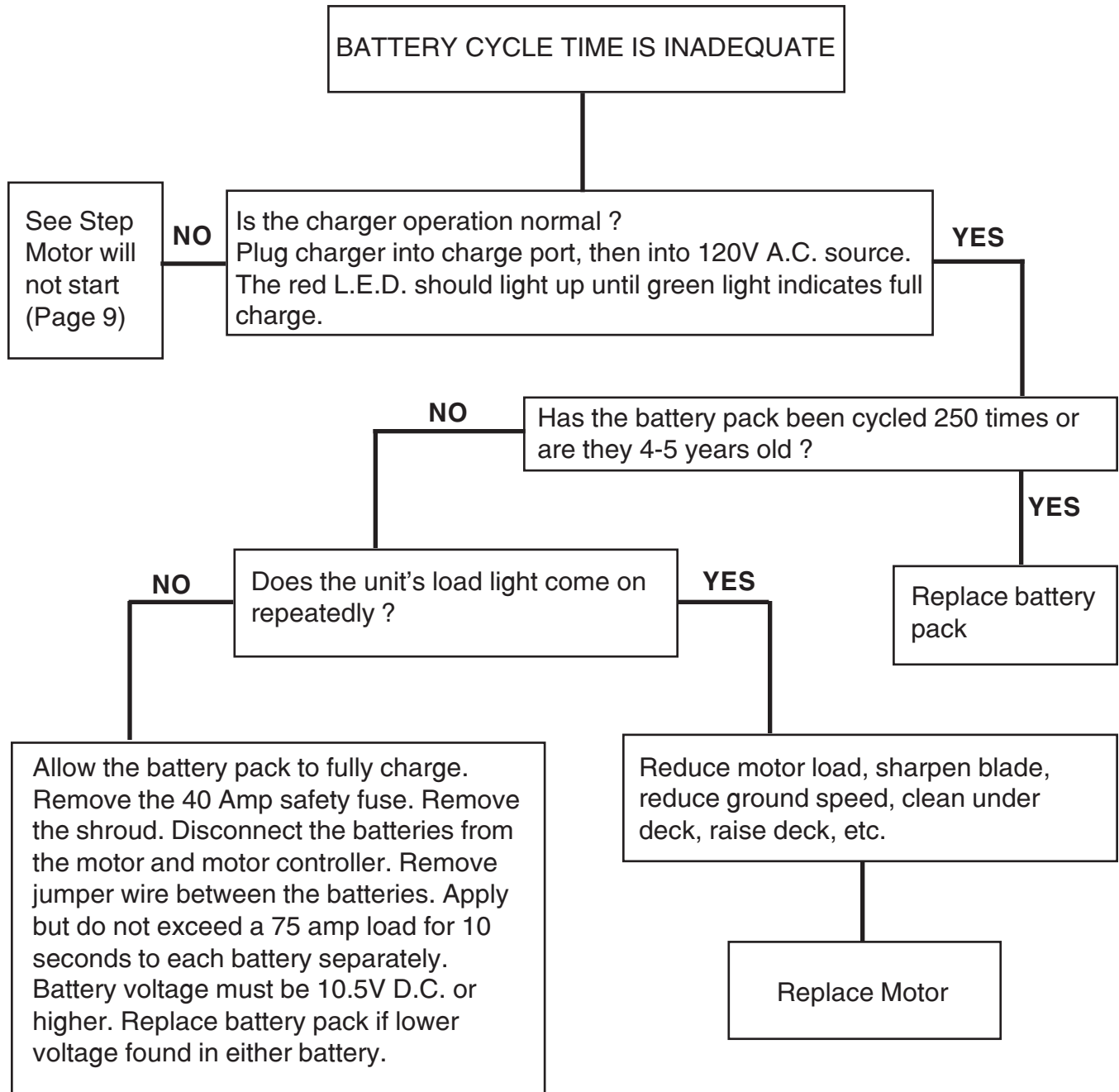
### CHART 1B



**CHART 2**

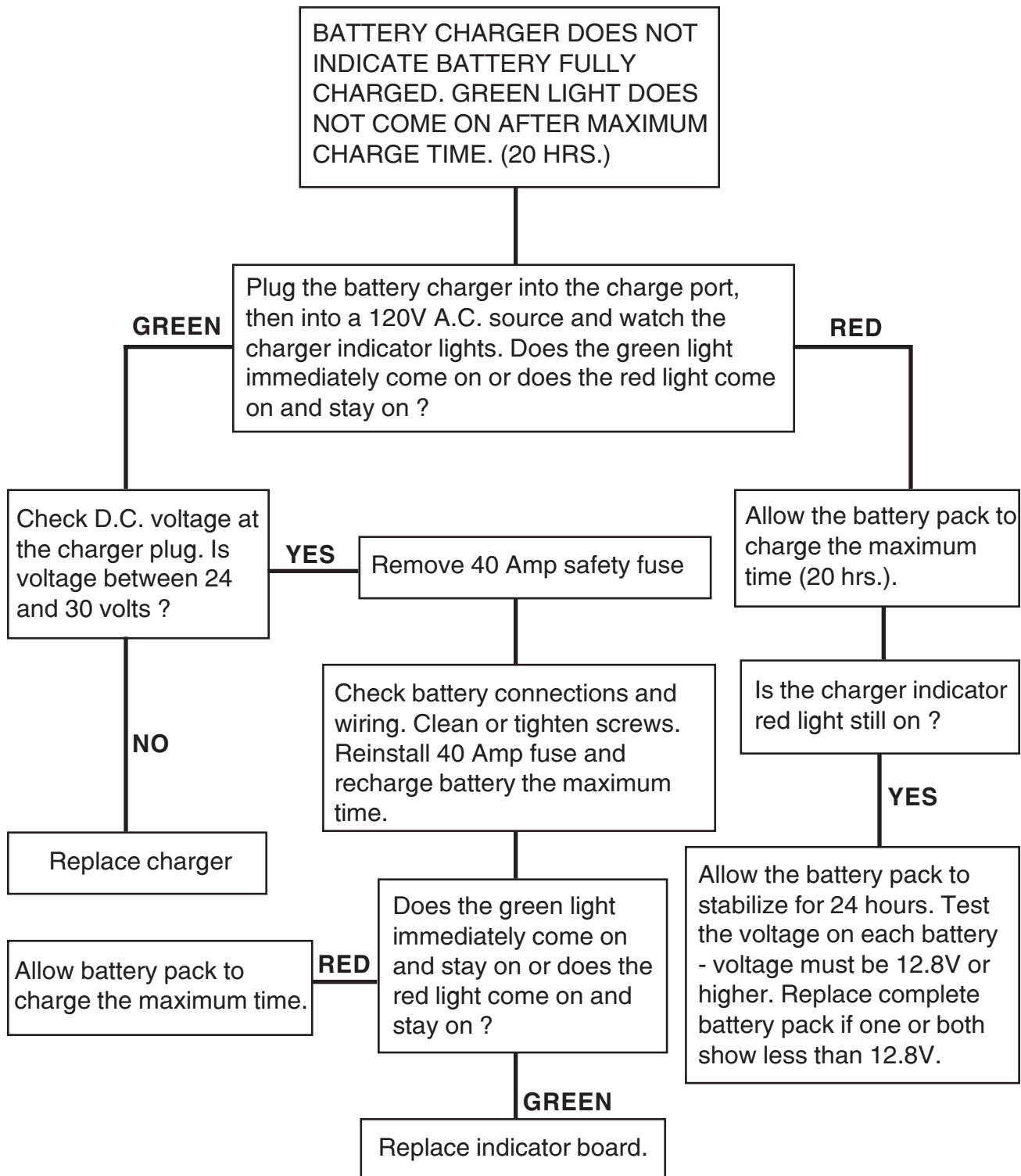


### CHART 3

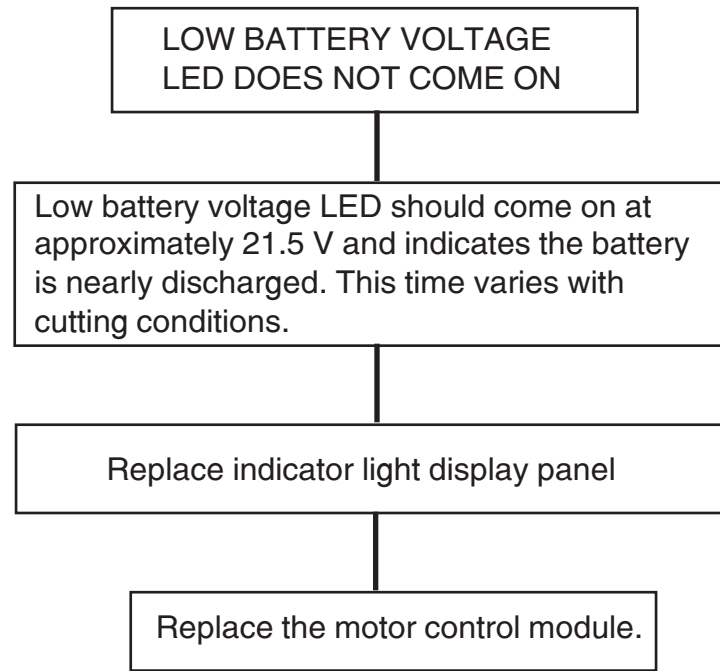


**⚠ CAUTION:** If you choose the option of load testing batteries do not exceed a 70 Amp load. Automotive testers are typically 100-150 Amp load which is excessive and will give a FALSE reading of battery condition. Tecumseh recommends commercially available Motorcycle testers that draw 75 Amps or less draw.

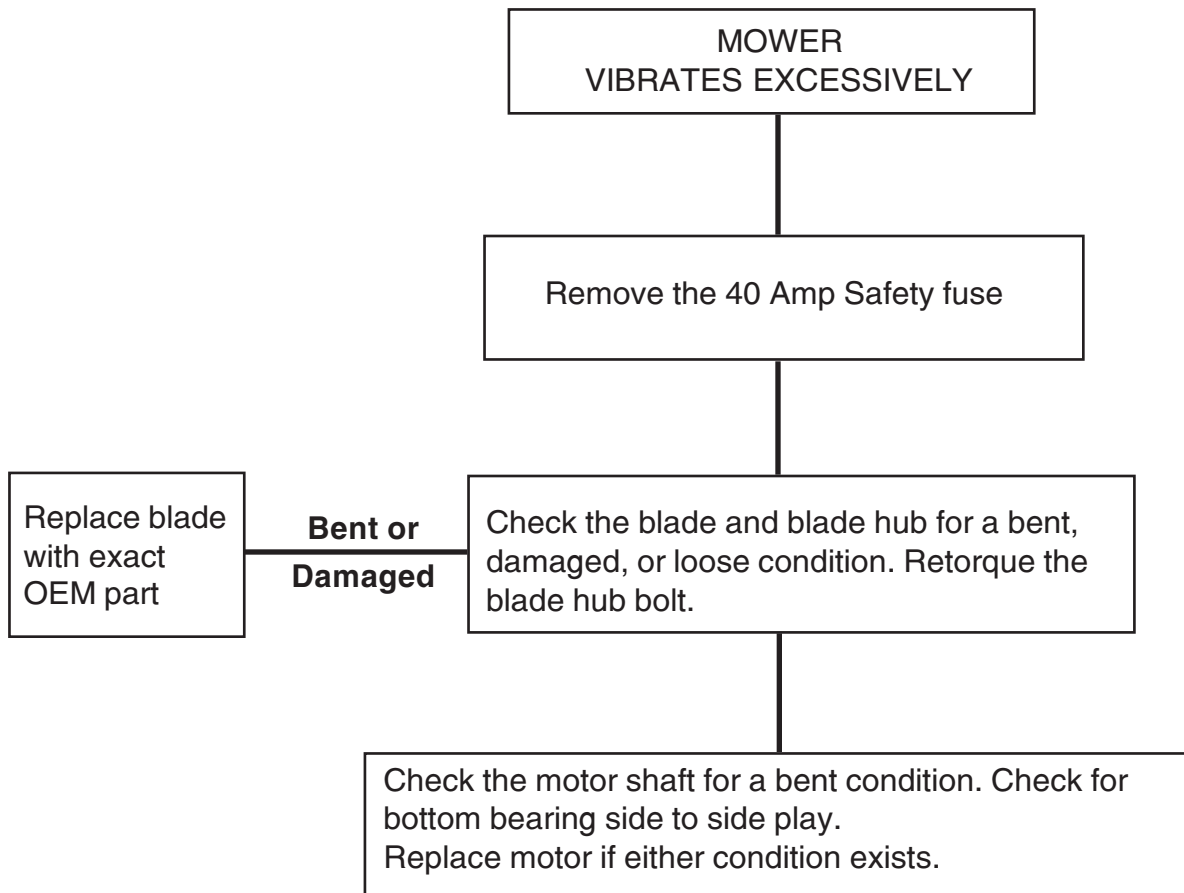
**CHART 4**



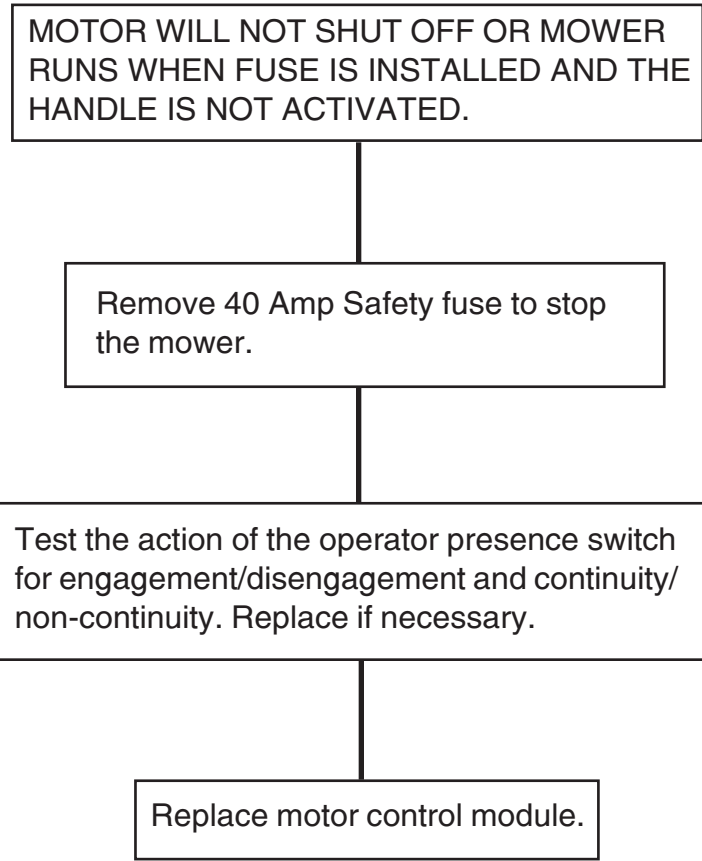
### CHART 5



### CHART 6

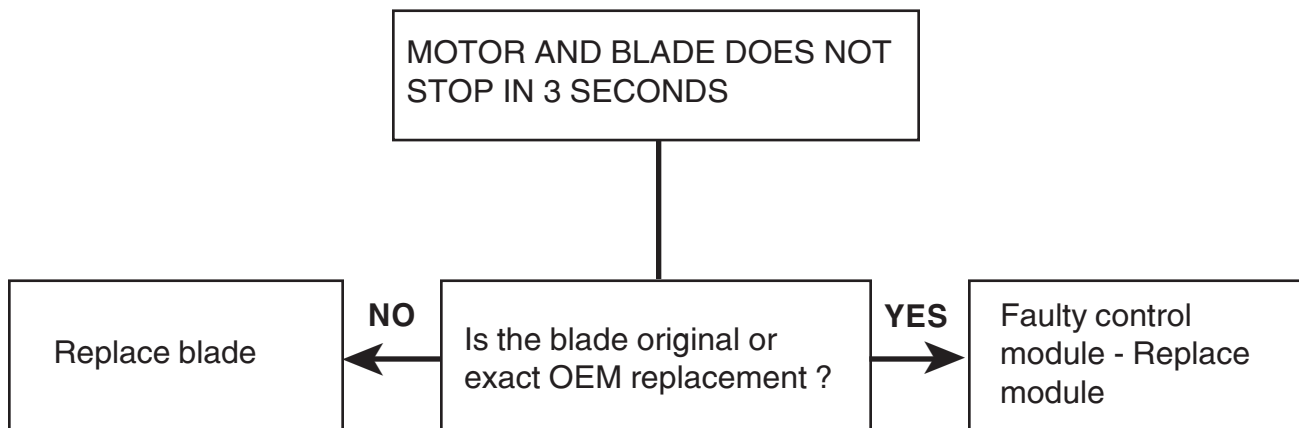


### CHART 7



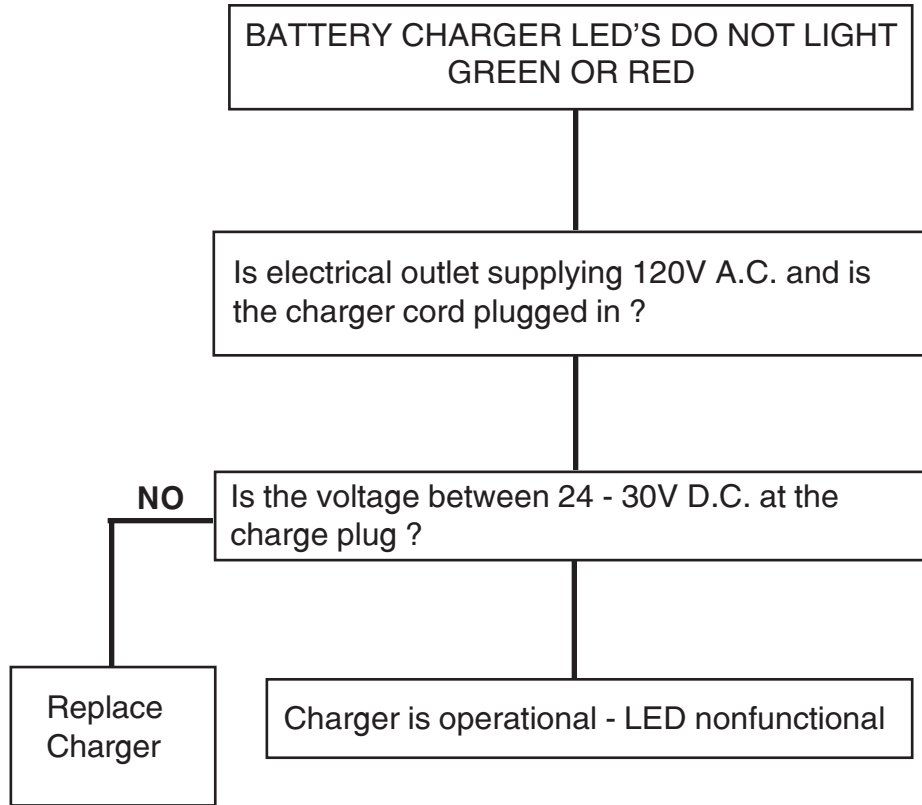
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### CHART 8





**CHART 9**



## CHAPTER 4 TORQUE SPECIFICATIONS

BATTERY POST SCREWS	15 - 20 inch lbs.	1.7 - 2.2 Nm
CONTROLLER BOARD SCREW	20 inch. lbs.	2.2 Nm
BATTERY BRACKET SCREWS	70-100 inch lbs.	7.8 - 11.2 Nm
SHROUD SCREWS	20 inch lbs.	2.2 Nm