

CHARGING SYSTEM

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
ELECTRO SPECIALTIES BATTERY LOAD TESTER.....	710	7
EXTECH INDUCTIVE AMMETER	380941	2

GENERAL

SYSTEM DESCRIPTION

The purpose of the charging system is to maintain the battery at a full state of charge and to provide the electrical system with the required electrical power for normal vehicle operation.

Magneto

The magneto is the primary source of electrical energy. It transforms a magnetic field into an electric current (AC).

The magneto has a 3 phase, delta wound, 18 pole stator. Refer to *TECHNICAL SPECIFICATIONS* for rated output.

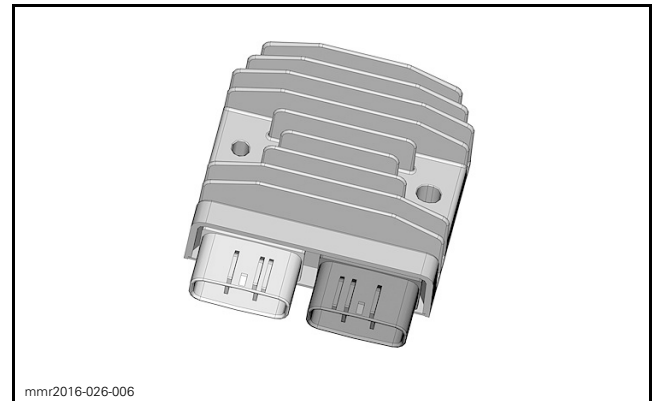


TYPICAL

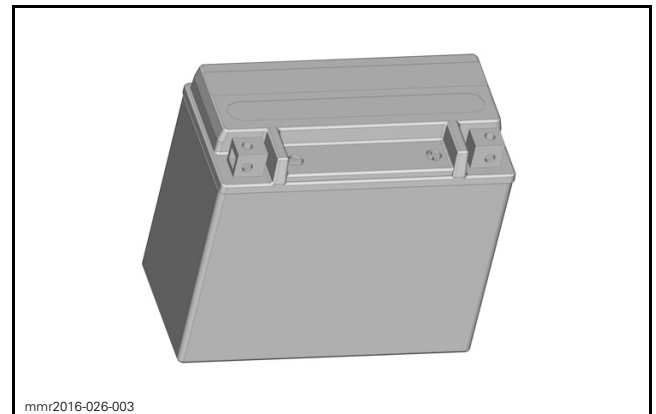
Voltage Regulator/Rectifier

The rectifier receives AC current from the magneto and transforms it into direct current (DC).

The voltage regulator, included in the same unit, limits voltage to a maximum level to prevent any damage to electrical components.



Battery



The battery supplies DC power to the electric starter for cranking the engine. During engine starting, it also supplies DC power to every electrical and electronic system in the vehicle as well as all accessories.

At low engine RPM operation and high current load conditions, it supplements the magneto output and helps to maintain a steady system voltage.

INSPECTION

CHARGING SYSTEM OUTPUT

First ensure that battery is in good condition prior to performing the following tests.

Subsection 03 (CHARGING SYSTEM)

NOTE: It is good practice to check for fault codes using the B.U.D.S. as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

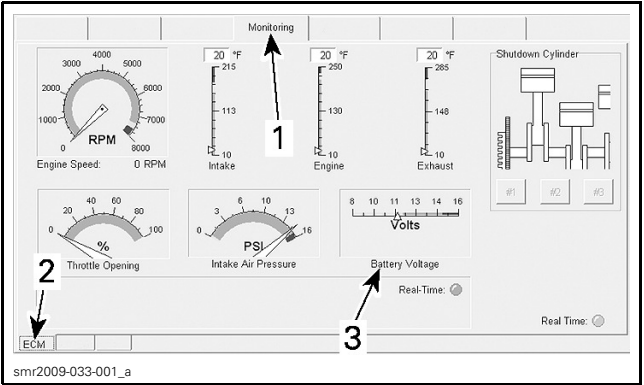
Testing Output Voltage Using B.U.D.S.

- 1. Connect to the latest applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 2. Select the **Monitoring** and **ECM** tabs.
- 3. Start engine.

NOTE: Connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

- 4. Increase engine RPM as specified in the following table and read voltage in B.U.D.S.

OUTPUT VOLTAGE TEST USING B.U.D.S.	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc



TYPICAL
1. Monitoring tab
2. ECM tab
3. Battery voltage

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING, MAGNETO AND STARTER* subsection.

Testing Output Voltage Using a Multimeter

For battery access, refer to *BATTERY ACCESS* in this subsection.

- 1. Set multimeter to Vdc.
- 2. Connect multimeter to battery posts.
- 3. Start engine.

NOTE: Connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

- 4. Increase engine RPM as specified in the following table and read voltage with the multimeter.

OUTPUT VOLTAGE TEST USING A MULTIMETER	
TEST ENGINE SPEED	VOLTAGE (DC)
5500 RPM	14.5 ± .5 Vdc

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator output and wiring harness prior to concluding that voltage regulator/rectifier is defective. Refer to *PTO HOUSING, MAGNETO AND STARTER* subsection.

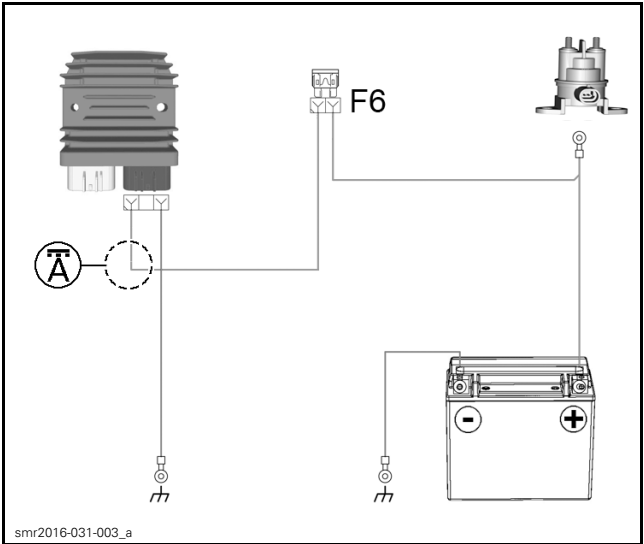
Testing Output Current with an Inductive Ammeter

Use an inductive ammeter such as the EXTECH INDUCTIVE AMMETER (P/N 380941) or equivalent.

- 1. Turn on the ammeter and select 40 Adc.

NOTE: Zero set the ammeter before use or reading may be erroneous.

VOLTAGE REGULATOR
RE1-1



2. Start engine.

NOTE: Connect a garden hose to cool exhaust system. Refer to *EXHAUST SYSTEM* subsection.

3. Increase engine RPM as specified in the following table and read current with the ammeter.

TEST ENGINE SPEED	CURRENT
5500 RPM	Approx. 10 A

NOTE: Initial current reading will be higher than specified due to the battery drain from the engine start. This is an indication that the charging system is operating normally. Current load will come down as the battery recovers its charge.

If current reading is far below specification, test stator output and wiring harness prior to concluding the voltage regulator/rectifier is faulty.

NOTE: If the battery is in poor condition or is not at a full state of charge, current reading will be above specification. Refer to *BATTERY* in this subsection for battery testing.

TROUBLESHOOTING

DISCHARGED OR WEAK BATTERY

1. Battery posts and/or cable terminal oxidized.
 - Clean battery terminals, posts, and coat with dielectric grease.
2. Loose or bad connections.
 - Check for wiring and connector tightness, frayed or broken wires. Repair or replace cables or connectors.
3. Worn or faulty battery (sulfated, fretting, shorted plates or cell, damaged casing, loose post).
 - Test BATTERY VOLTAGE (LOAD APPLIED).
 - Replace battery.
4. Burnt fuse(s) or faulty rectifier.
 - First check fuse(s). If in good condition, check voltage regulator/rectifier.
5. Faulty stator.
 - Test stator and replace as required.

6. Parasitic or "Key Off" current loads.

- Isolate, reduce or eliminate such loads.
- Recharge battery as recommended if vehicle is not used for extended periods of time.

NOTE: "Key Off" or parasitic loads may be loads due to installed accessories. Parasitic loads may also be due to water infiltration in connectors, or partial short circuits that slowly drain a battery without causing a fuse to burn.

LOW OR NO CHARGING SYSTEM VOLTAGE

1. Blown F6 fuse.
 - Check F6 fuse.
2. Defective stator.
 - Test stator. Refer to PTO HOUSING, MAGNETO, AND STARTER subsection.
3. Defective charging system wiring or connections.
 - Check for damaged wiring.
 - Check for damaged or loose connections.

REPETITIVE BLOWN F6 FUSE

1. Voltage regulator/rectifier internal circuit shorted to ground.
 - Refer to TESTING VOLTAGE REGULATOR/RECTIFIER FOR BLOWN F6 FUSE in this subsection.

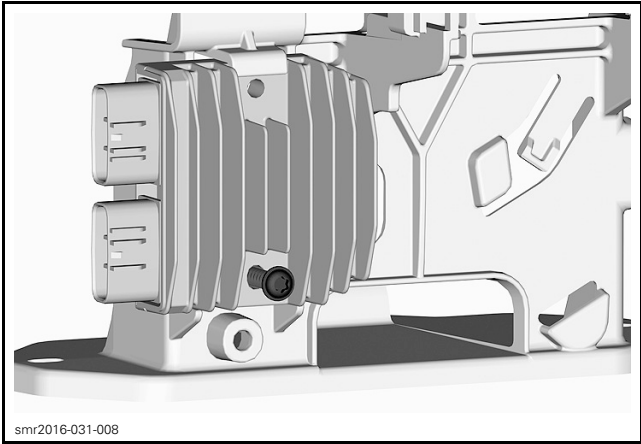
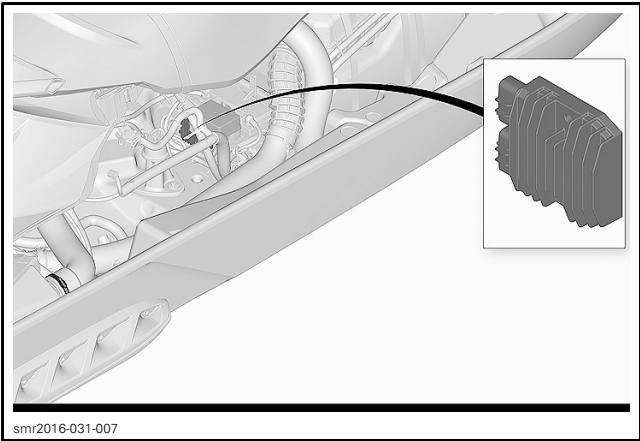
PROCEDURES

VOLTAGE REGULATOR/RECTIFIER

Testing the Voltage Regulator Continuity

Due to internal circuitry, there is no static test available to check continuity.

Voltage Regulator/Rectifier Location



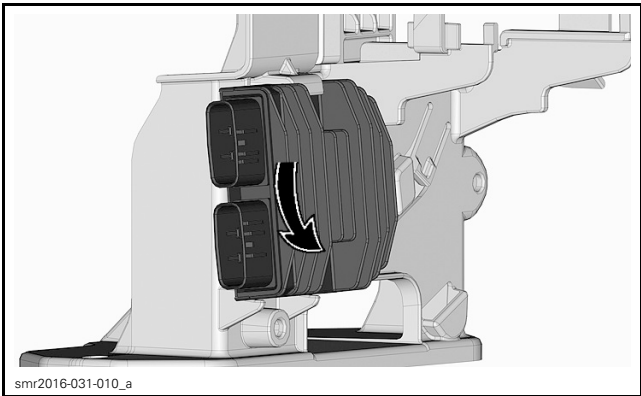
3. Rotate and remove regulator/rectifier.

Testing Voltage Regulator/Rectifier for Blown F6 Fuse

1. Detach the voltage regulator/rectifier from the electrical component support. Refer to *REMOVING THE VOLTAGE REGULATOR/RECTIFIER* in this subsection.
2. Disconnect the voltage regulator/rectifier 2-wire connector.
3. Install a new fuse.

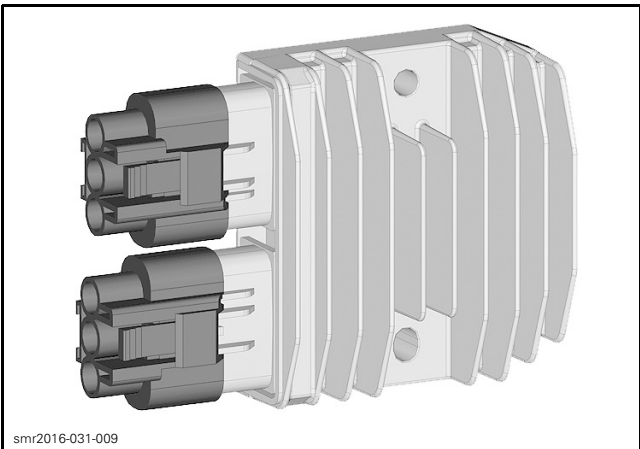
If the fuse still burns, check for a shorted wire or connector pin.

If fuse does not burn, replace regulator/rectifier.



Removing the Voltage Regulator/Rectifier

1. Disconnect both connectors from the voltage regulator/rectifier.



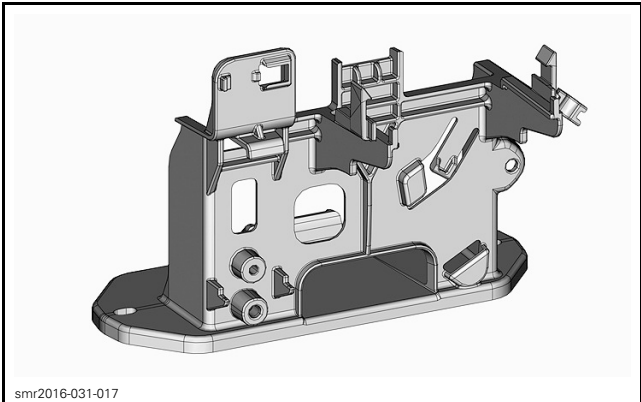
2. Remove screw.

Installing the Voltage Regulator/Rectifier

Installation is the reverse of the removal procedure

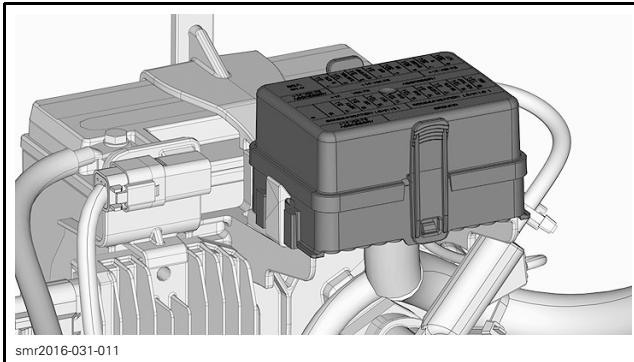
TIGHTENING TORQUE	
Regulator/Rectifier Screw	5 N•m ± 1 N•m (44 lbf•in ± 9 lbf•in)

ELECTRICAL COMPONENT SUPPORT

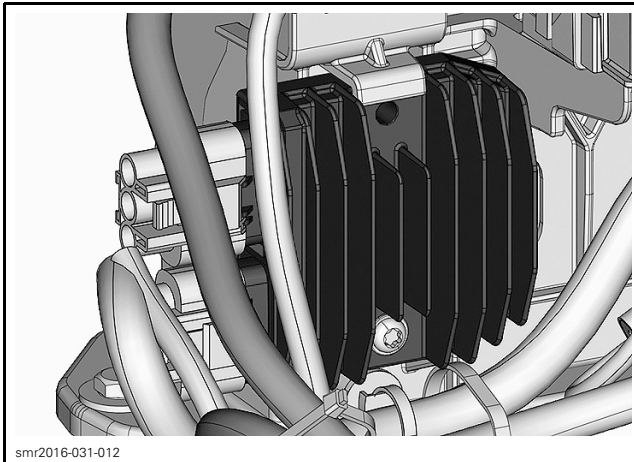


Removing the Electrical Component Support

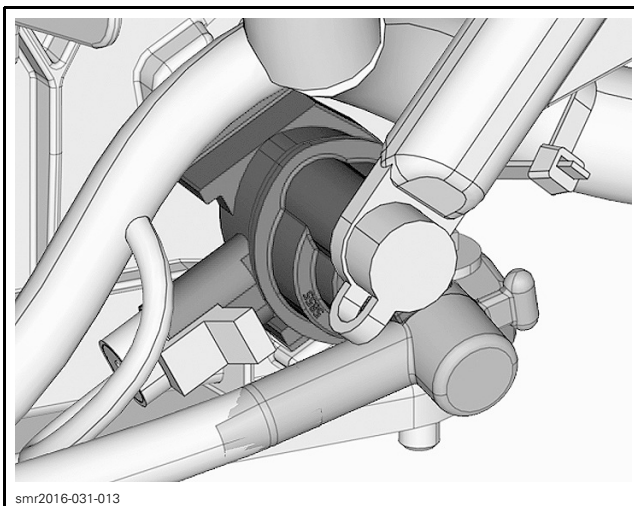
Remove the following components from the electrical component support.



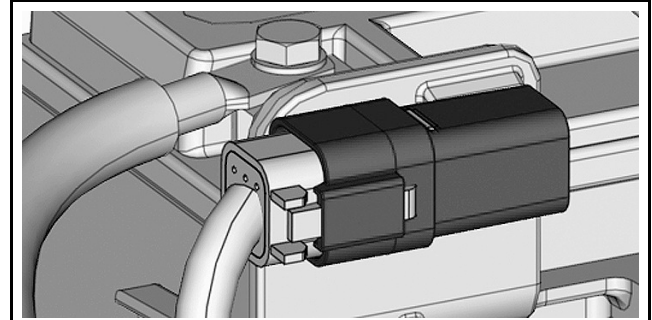
FUSE BOX



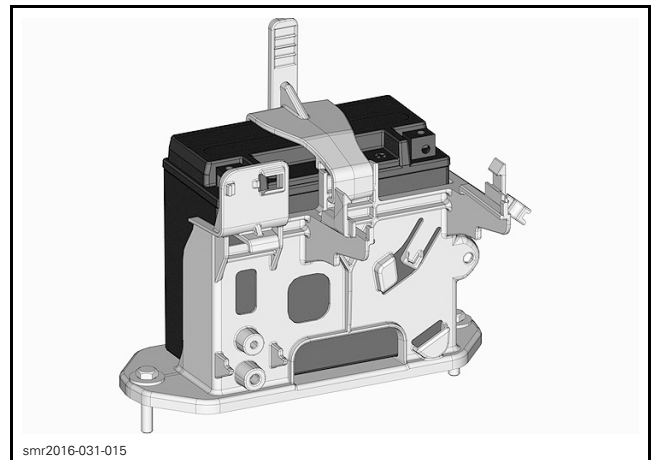
REGULATOR/RECTIFIER



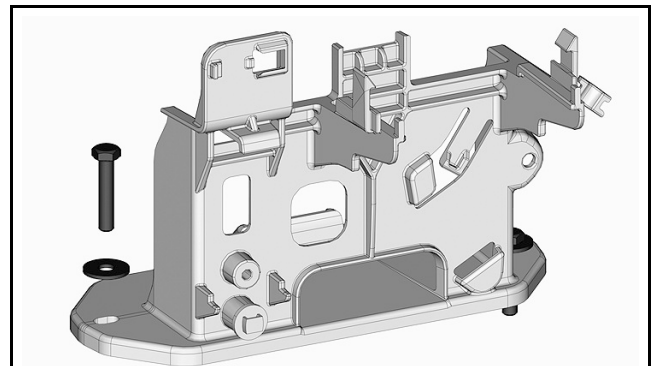
STARTER SOLENOID



DIAGNOSTIC CONNECTOR



BATTERY



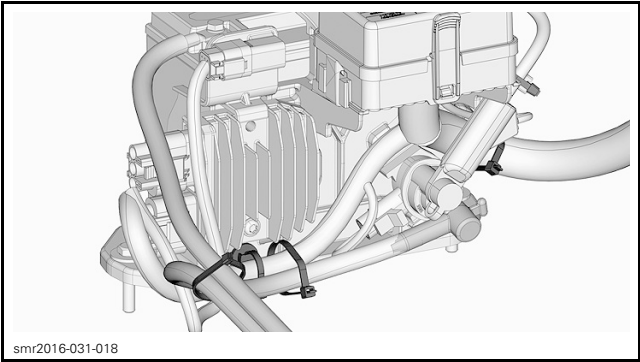
RETAINING SCREWS

Installing the Electrical Component Support

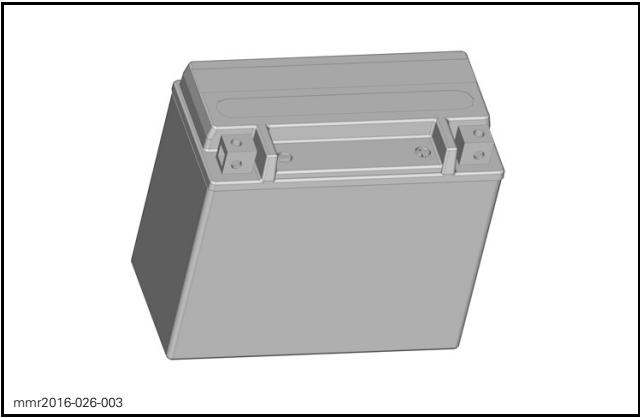
Installation is the reverse of removal procedure.

TIGHTENING TORQUE	
Retaining Screws	16 N•m ± 2 N•m (142 lbf•in ± 18 lbf•in)

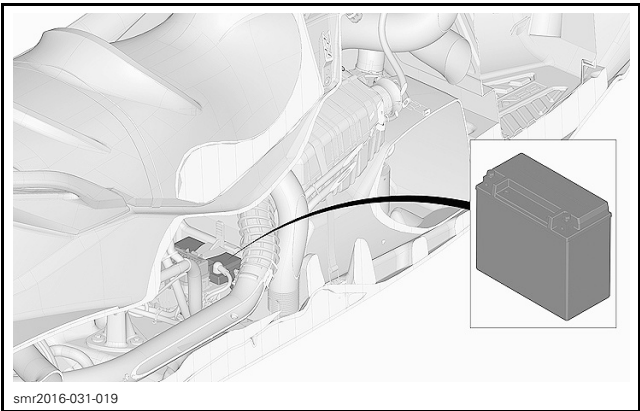
⚠ WARNING
Replace all locking ties.



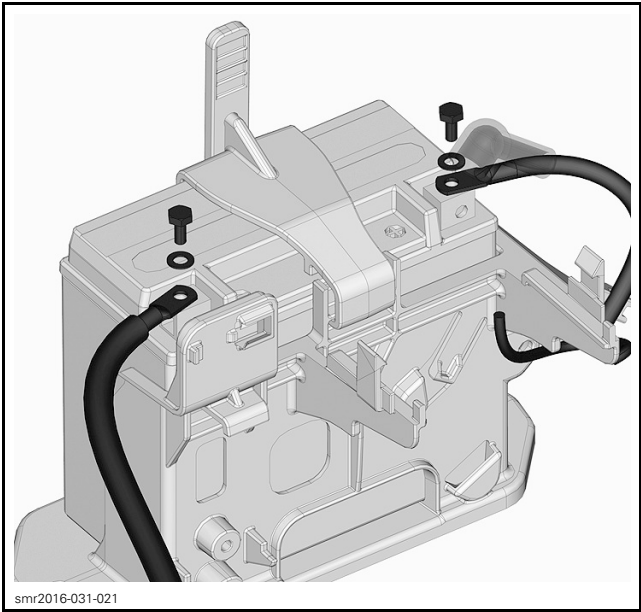
BATTERY



Battery Location



Removing the Battery



Cleaning the Battery

Clean the battery casing, caps, cables and battery posts using a solution of baking soda and water.

NOTICE Do not allow cleaning solution to enter battery.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Rinse with clear water then dry well.

Inspecting the Battery

- Keep the top free of grime
- Check casing, cables, clamps, and case for obvious damage or loose connections.
- Clean terminals and connectors as necessary

Refer to battery manufacturer guidelines.

Battery Testing

There are 3 types of battery tests.

TEST METHOD	COMMENT
Testing voltage (load applied)	A dynamic voltage test with a load applied gives an accurate indication of the condition of the battery. This is the most recommended method.
Testing voltage (no load)	A static voltage test is carried out without discharging current. It is the simplest and most commonly used but the most likely to give false results.

Testing Battery Voltage(Load Applied)

Use a load testing device such as the ELECTRO SPECIALTIES BATTERY LOAD TESTER (P/N 710). It has a 500 A carbon pile adjustable load.

Follow battery load tester instructions.

Apply a load of 3 times the ampere-hour rating of the battery for 14 seconds, then check battery voltage.

BATTERY VOLTAGE TEST (LOAD APPLIED)	
TIME TO MEASURE INTO TEST	VOLTAGE (WITH LOAD APPLIED)
14 seconds	10.5 Vdc min.

If battery voltage has dropped below specification, the battery storage capacity has decreased appreciably and the battery should be replaced.

Testing Battery Voltage(No Load)

NOTE: Be aware that the voltage test can indicate that the battery is in good condition even though the battery does not have enough stored energy to crank the engine. A load test gives a more accurate indication of the condition of the battery.

If the battery has just received a charge, wait 1-2 hours before taking a voltage reading.

Set multimeter to Vdc and measure voltage at battery terminals.

FULLY CHARGED BATTERY VOLTAGE (NO LOAD)
12.6 Vdc minimum

Storing the Battery

Disconnect and remove battery from watercraft as explained in *BATTERY REMOVAL*.

NOTICE Battery storage is critical for battery life. Regularly charging the battery during storage will prevent cell sulfation. Keeping the battery in vehicle for storage may lead to contacts degradation/corrosion and case damage if freezing occurs. A discharged battery will freeze and crack in areas where freezing conditions are experienced. Electrolyte leakage will damage surrounding parts. Always remove battery from vehicle for storage and regularly recharge it to keep an optimal condition.

The battery must always be stored fully charged. If required, recharge until the recommended specific gravity is obtained prior to storage.

NOTICE Battery electrolyte temperature must not exceed 50°C (122°F) during charging. The battery casing should not feel hot to the touch.

Clean battery terminals and cable connections using a wire brush.

Apply a light coat of dielectric grease on terminals.

Clean battery casing and caps using a solution of baking soda and water.

Rinse battery with clear water and dry well using a clean cloth.

Store battery in a cool dry place. Such conditions reduce self-discharging and keep fluid evaporation to a minimum. Keep battery away from dew, high moisture and direct sunlight.

AMBIENT TEMPERATURE	CHARGING FREQUENCY
Below 16°C (60°F)	Every month
Above 16°C (60°F)	Every 2 weeks

⚠ WARNING

Batteries must always be stored out of reach of children.

Activating a New Battery

YTX20-L batteries are factory activated. Test and charge battery as required before installing it.

Charging a Used Battery

To find the recommended charger current output in amps for a specific battery, divide the battery amp hour rating by 10. For example a 14 AH battery should be charged at 1.4 amps ($14 \text{ AH} \div 10 = 1.4 \text{ amp current}$).

⚠ WARNING

Never charge battery while installed in watercraft.

For best results, battery should be charged when it is at room temperature. A battery that is cold may not accept current for several hours after charging has begun.

Do not charge a frozen battery. If the battery charge is very low, the battery may freeze. If you suspect the battery to be frozen, move it to a heated area for about 2 hours (or more if required) to let it thaw out before charging.

Subsection 03 (CHARGING SYSTEM)

WARNING

Always charge a battery in a well ventilated area.

The time required to charge a battery will vary depending on several factors, such as:

- Battery temperature: The charging time is increased for a cold battery as charging current accepted by a cold battery will be lower than for a warm battery. As the battery warms up, it will accept a higher rate of charge.
- State of charge: As a battery discharges, it gives up its stored energy. The greater the discharge, the longer it will take to fully recharge it.
- Type of charger: Battery chargers vary in the amount of voltage and current that they can supply.

Charging a Very Flat or Completely Discharged Battery

The battery charger used should have an adjustable charging rate. A unit which can be adjusted in small increments is acceptable.

The battery charger must be equipped with an ammeter capable of accurately measuring current of less than 1 ampere.

Unless this procedure is properly followed, a good battery may be needlessly replaced.

1. Measure the voltage at the battery posts with an accurate voltmeter. If it is below 10 volts, the battery will accept current at very low rate. It could be some time before the charging rate increases. Such low current flow may not be detectable on some charger ammeters and the battery will not seem to accept the charge.
2. Exceptionally for this particular case, set the charger to a high rate.

NOTE: Some chargers have a polarity protection feature which prevents charging unless the charger leads are connected to the correct battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly. This will make it appear that the battery will not accept a charge. Follow the charger manufacturer's instruction on how to bypass or override this circuitry so that the charger will turn on and charge a low-voltage battery.

3. Since battery chargers vary in the amount of voltage and current they provide, the time required for the battery to accept a measurable charger current may be up to 10 hours or more.

4. If the charging current is not up to a measurable amount after 10 hours, the battery should be replaced.
5. If the charging current is measurable before the end of the 10 hour period, the battery is good and charging should be completed at a lower rate.
6. It is recommended that any battery recharged using this procedure be tested under load prior to returning it to service.

Installing the Battery

Installation is the reverse of removal procedure.

WARNING

Always connect battery cables in the specified order, RED positive cable first, BLACK negative cable last.

1. Connect RED (+) cable.
2. Connect BLACK (-) cable last.
3. Apply dielectric grease on battery posts.
4. Verify cable routing and attachments.