ELECTRICAL

Section 2B – Charging & Starting System

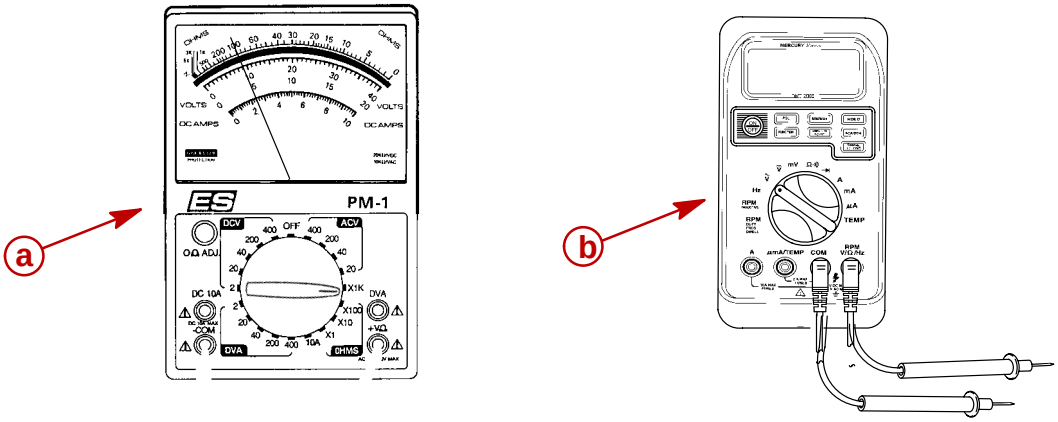
Table of Contents

Specifications

CHARGING SYSTEM	**Alternator Output (Regulated)**	32 - 38 Amperes @ 2000 RPM @ Battery 52 - 60 Amperes @ 2000 RPM @ Alternator
	Brush Length	Std Exposed Length: 0.413 in. (10.5 mm) Min. Exposed Length: 0.059 in. (1.5 mm)
	Voltage Output	13.5 to 15.1 Volts
	Regulator Current Draw	0.5 – 1.0 mA (Ign. Switch Off) 150 – 300 mA (Ign. Switch On)
STARTING SYSTEM	**Starter Draw (Under Load)**	170 Amperes
	Starter Draw (No Load)	60 Amperes
	Minimum Brush Length	0.25 in. (65.4 mm)
	Battery Rating	1000 (Minimum) Marine Cranking Amps (MCA) 750 (Minimum) Cold Cranking Amps (CCA) 105 (Minimum) Amp Hour

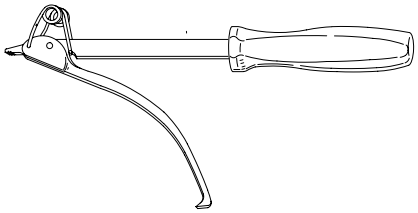
Special Tools

1. Volt/Ohm Meter 91-99750A1 or DMT 2000 Digital Tachometer Multimeter 91-854009A1



a - Volt/Ohm Meter 91-99750A1
b - DMT 2000 Digital Tachometer Multimeter 91-854009A1

2. Ammeter (60 Ampere minimum) (Obtain locally)
3. Flywheel Holder 91-52344



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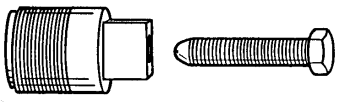
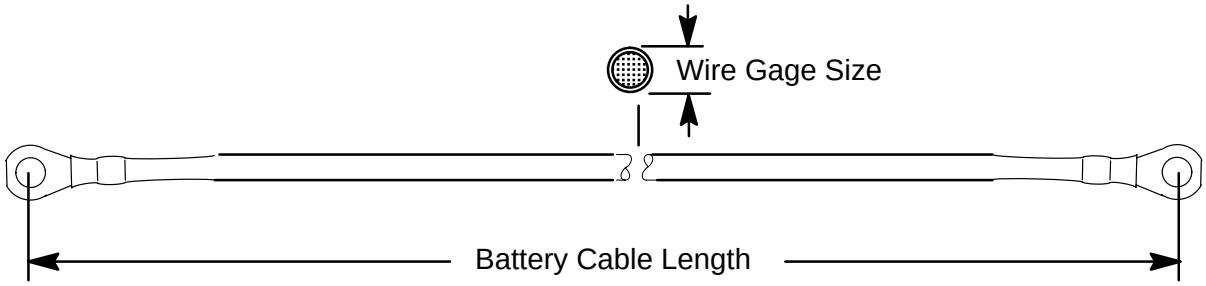
4. Protector Cap 91-24161

5. Flywheel Puller 91-73687A1



Battery Cable Size

If standard (original) battery cables are replaced with longer cables, the wire gauge size must increase. See chart below for correct wire gauge size.



Battery Cable Wire Gage Size Mercury/Mariner Outboards																	
	Battery Cable Length																
	8 ft. 2.4m	9 ft. 2.7m	10ft. 3.0m	11ft. 3.4m	12ft. 3.7m	13ft. 4.0m	14ft. 4.3m	15ft. 4.6m	16ft. 4.9m	17ft. 5.2m	18ft. 5.5m	19ft. 5.8m	20ft. 6.1m	21ft. 6.4m	22ft. 6.7m	23ft. 7.0m	24ft. 7.3m
Models	Wire Gage Size No. SAE																
6-25 Hp	#8*	#8	#6	#6	#6	#6	#4	#4	#4	#4	#4	#4	#4	#4	#2	#2	#2
30-115 Hp	#6*	#4	#4	#4	#4	#4	#2	#2	#2	#2	#2	#2	#2	#2	#0	#0	#0
125-250 Hp (except DFI)			#6*	#6	#4	#4	#4	#4	#4	#4	#2	#2	#2	#2	#2	#2	#2
DFI Models					#4*	#2	#2	#2	#2	#2	#2	#2	#2	#2	#0	#0	#0

* = Standard (original) Cable Length and wire gage size.

Replacement Parts

⚠ WARNING

Electrical, ignition and fuel system components on your Mercury Sport Jet are designed and manufactured to comply with U. S. Coast Guard Rules and Regulations to minimize risks of fire and explosions. Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Recommended Battery

A 12 volt marine battery with a minimum Cold Cranking amperage rating of 750 amperes or 1000 (minimum) Marine Cranking amperes should be used.

Battery

Precautions

⚠ CAUTION

If battery acid comes in contact with skin or eyes, wash skin immediately with a mild soap. Flush eyes with water immediately and see a doctor.

When charging batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through holes in vent plugs and may form an explosive atmosphere around battery if ventilation is poor. This explosive gas may remain in or around battery for several hours after it has been charged. Sparks or flames can ignite this gas and cause an internal explosion which may shatter the battery.

The following precautions should be observed to prevent an explosion.

1. DO NOT smoke near batteries being charged or which have been charged very recently.
2. DO NOT break live circuits at terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Always be careful when connecting or disconnecting cable clamps on chargers. Poor connections are a common cause of electrical arcs which cause explosions.
3. DO NOT reverse polarity of battery terminal to cable connections.

NOTE: *The 240 EFI Sport Jet has a 100 ampere fuseable link between the alternator and the slave solenoid. This fuseable link is designed to protect the alternator from damage due to incorrect battery connection polarity. If battery cables are reversed, the fuseable link may open circuit and must be replaced. With the fuseable link open, the engine can be started but the run time will be limited due to the rapid discharge of the boat battery.*

Charging a Discharged Battery

⚠ WARNING

Hydrogen and oxygen gases are produced during normal battery operation or charging. Sparks or flame can cause this mixture to ignite and explode, if they are brought near the vent openings. Sulphuric acid in battery can cause serious burns, if spilled on skin or in eyes. Flush or wash away immediately with clear water.

The following basic rule applies to any battery charging situation:

1. Any battery may be charged at any rate (in amperes) or as long as spewing of electrolyte (from violent gassing) does not occur and for as long as electrolyte temperature does not exceed 125° F (52° C). If spewing of electrolyte occurs, or if electrolyte temperature exceeds 125° F, charging rate (in amperes) must be reduced or temporarily halted to avoid damage to the battery.
2. Battery is fully charged when, over a 2-hour period at a low charging rate (in amperes), all cells are gassing freely (not spewing liquid electrolyte), and no change in specific gravity occurs. Full charge specific gravity is 1.260-1.275, corrected for electrolyte temperature with electrolyte level at 3/16 in. (4.8 mm) over plate, unless electrolyte loss has occurred (from age or over-filling) in which case specific gravity reading will be lower. For most satisfactory charging, lower charging rates in amperes are recommended.

3. If, after prolonged charging, specific gravity of at least 1.230 on all cells cannot be reached, battery is not in optimum condition and will not provide optimum performance; however, it may continue to provide additional service, if it has performed satisfactorily in the past.
4. To check battery voltage while cranking engine with electric starting motor, place RED (+) lead of tester on POSITIVE (+) battery terminal and BLACK (–) lead of tester on NEGATIVE (–) battery terminal. If the voltage drops below 9-1/2 volts while cranking, the battery is weak and should be recharged or replaced.

Winter Storage of Batteries

Battery companies are not responsible for battery damage either in winter storage or in dealer stock if the following instructions are not observed:

1. Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface by running water over top of battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.
2. When adding distilled water to battery, be extremely careful not to fill more than 3/16 in. (4.8 mm) above perforated baffles inside battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling battery will cause electrolyte to overflow (if filled beyond 3/16″ above baffles).
3. Grease terminal bolts well with 2-4-C Marine Lubricant and store battery in a COOL-DRY place. Remove battery from storage every 30-45 days, check water level and put on charge for 5 or 6 hours at 6 amperes. DO NOT FAST CHARGE.
4. If specific gravity drops below 1.240, check battery for reason and recharge. When gravity reaches 1.260, discontinue charging. To check specific gravity, use a hydrometer, which can be purchased locally.
5. Repeat preceding charging procedure every 30-45 days, as long as battery is in storage, for best possible maintenance during inactive periods to ensure a good serviceable battery in spring. When ready to place battery back in service, remove excess grease from terminals (a small amount is desirable on terminals at all times), recharge again as necessary and reinstall battery.

Flywheel Removal and Installation

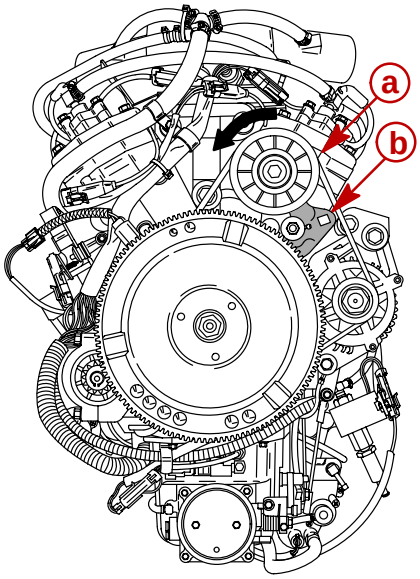
Removal

1. Remove flywheel cover from engine.

⚠ WARNING

Engine could possibly start when turning flywheel during removal and installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

2. Disconnect spark plug leads from spark plugs.
3. Rotate belt tensioner and remove alternator belt.



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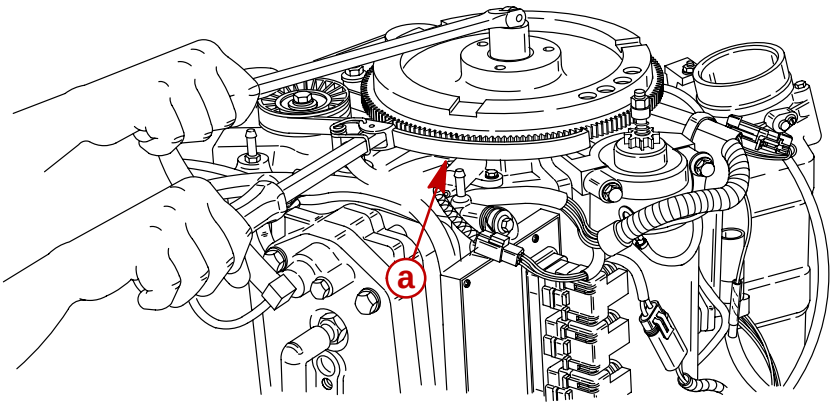
a - Belt Tensioner Assembly
b - 3/8 Drive Access Hole for Relieving Belt Tension

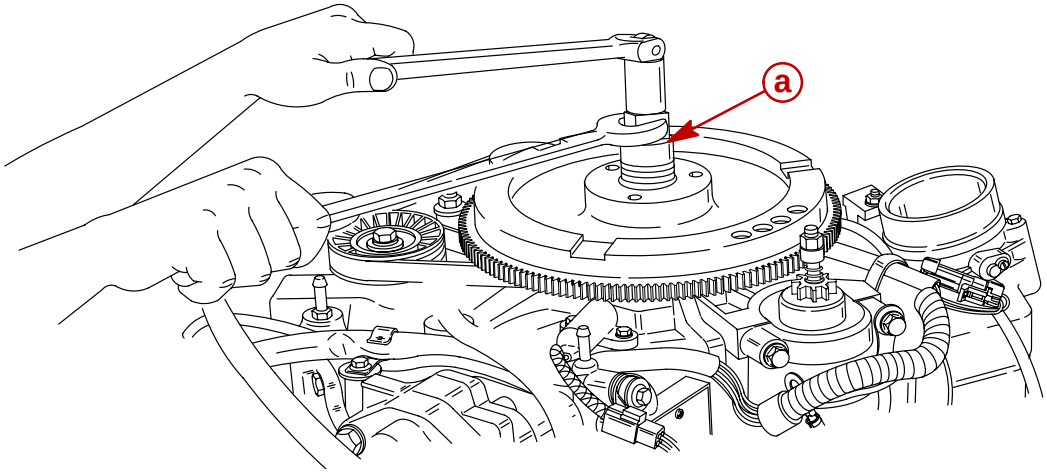
4. While holding flywheel with flywheel holder (91-52344), remove flywheel nut and washer.



58777

a - Flywheel Holder (91-25344)

5. Install a crankshaft Protector Cap (91-24161) on end of crankshaft, then install Flywheel Puller (91-73687A2) into flywheel.
6. Hold flywheel tool with wrench while tightening bolt down on protector cap. Tighten bolt until flywheel comes free.



58775

a - Flywheel Puller (91-73687A2)

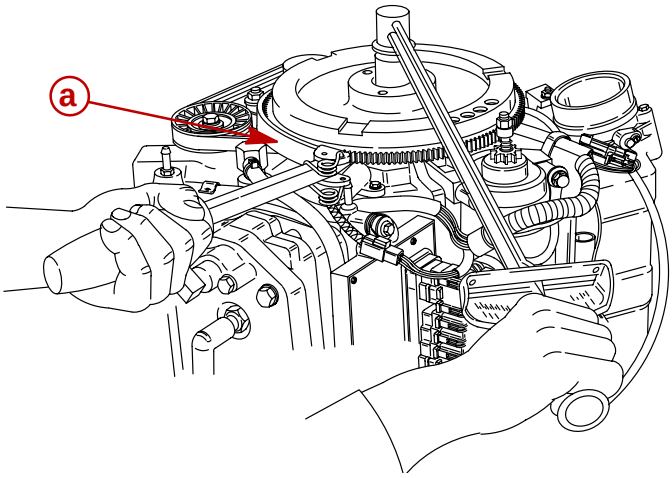
NOTE: *Neither heat or hammer should be used on flywheel to aid in removal as damage to flywheel or electrical components under flywheel may result.*

7. Remove flywheel. Inspect flywheel for cracks or damage.

Installation

IMPORTANT: Clean flywheel/crankshaft taper with solvent and assemble dry.

1. Install flywheel.
2. Install flywheel washer and nut.
3. Hold flywheel with Flywheel Holder (91-52344). Torque nut to 125 lb-ft (169.5 Nm).



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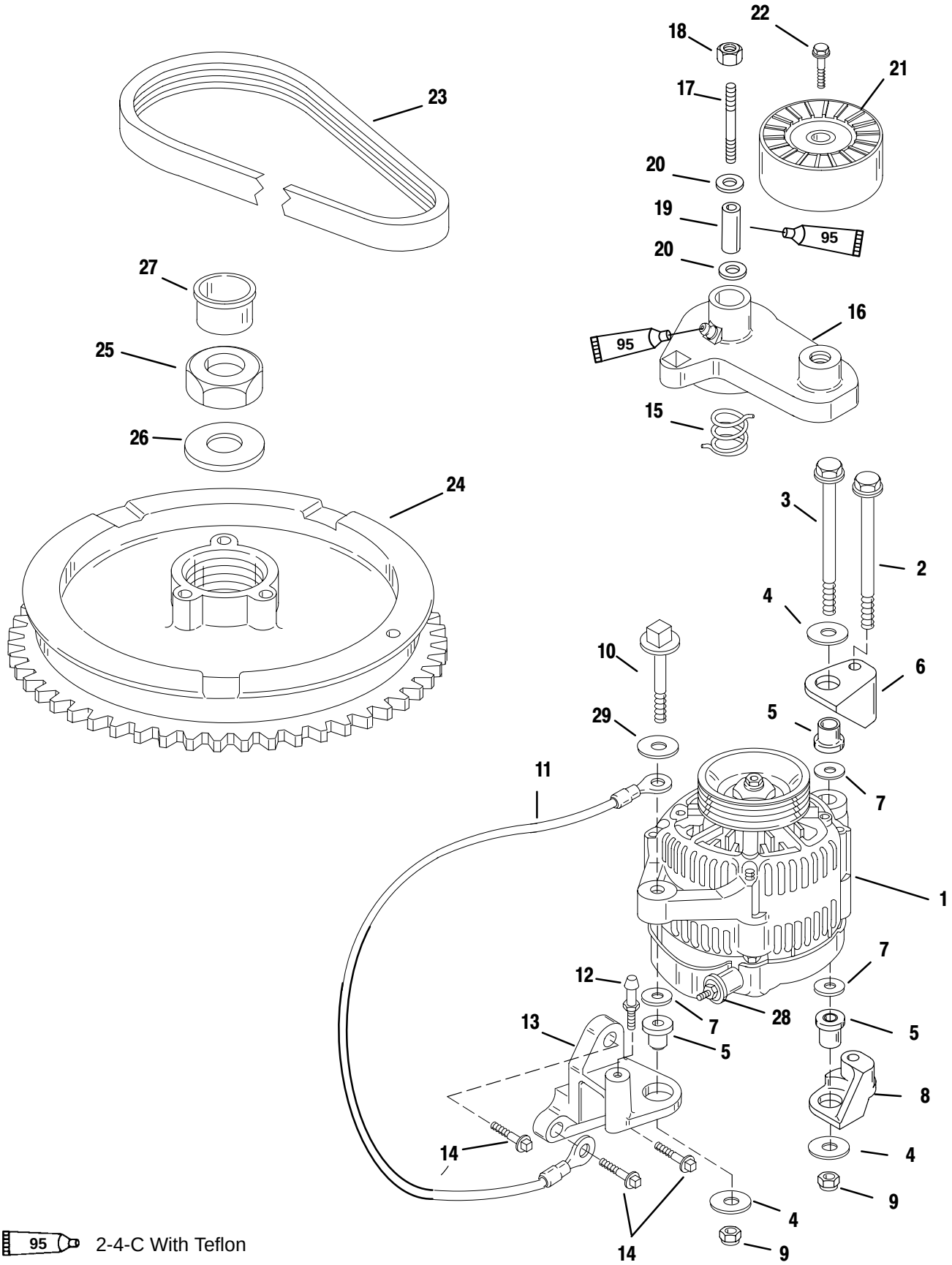
a - Flywheel Holder (91-52344)

Flywheel/Alternator



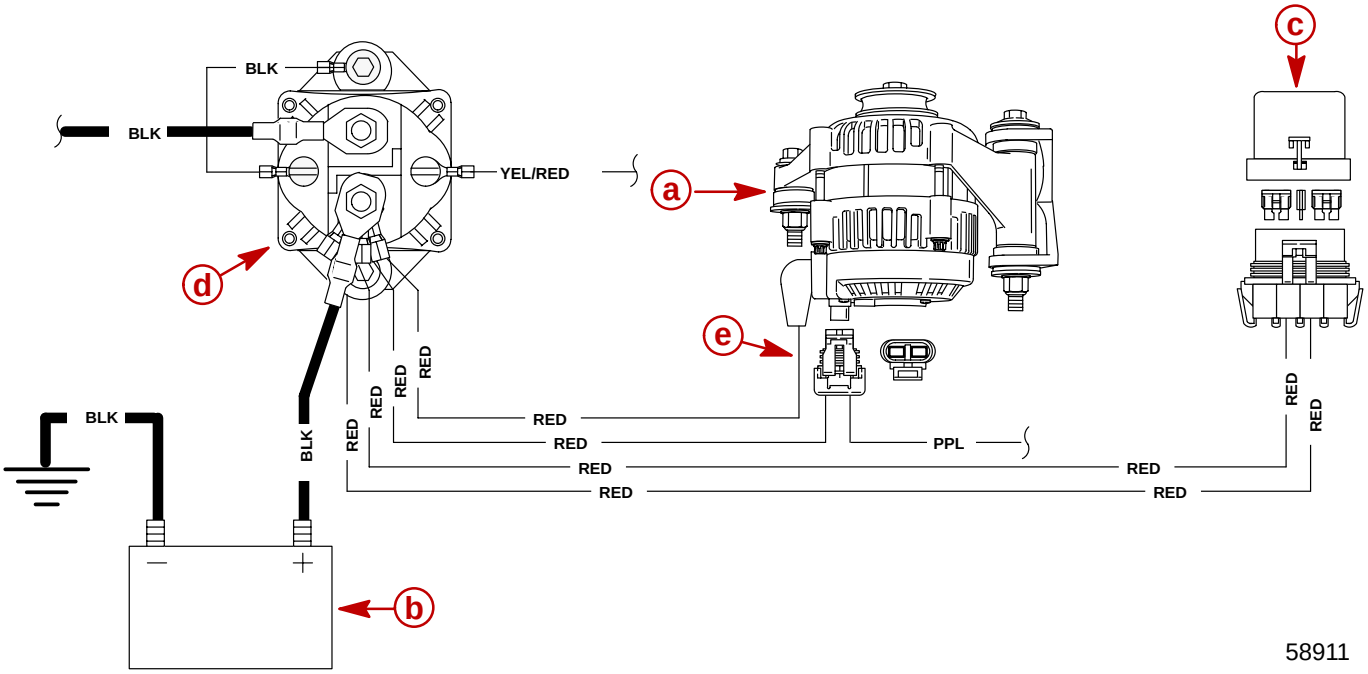
95 2-4-C With Teflon

Flywheel/Alternator

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	Nm
1	1	ALTERNATOR			
2	1	SCREW (M10 x 100)		40	54
3	1	SCREW (M10 x120)		40	54
4	3	WASHER			
5	3	MOUNT			
6	1	BRACKET			
7	3	WASHER			
8	1	BRACKET			
9	2	NUT		25	34
10	1	SCREW (M10 x 55)		25	34
11	1	CABLE			
12	1	PIN			
13	1	BRACKET			
14	3	SCREW (5/16-18 x 1 IN.)		15.5	21
15	1	SPRING			
16	1	BELT TENSIONER ARM ASSY			
17	1	STUD (M10 x 85)			
18	1	NUT		15	20
19	1	BUSHING			
20	2	WASHER			
21	1	PULLEY			
22	1	SCREW (M10 x 35)		25	34
23	1	BELT			
24	1	FLYWHEEL			
25	1	NUT (M16X1.5)		125	170
26	1	WASHER			
27	1	PLUG			
28	1	NUT	110		12
29	1	WASHER			

System Components

The battery charging system consists of the alternator, battery, ignition switch, slave solenoid and the wiring which connects these components.



a - Alternator
b - Battery
c - 20 Ampere Fuse
d - Slave Solenoid
e - 100 Ampere Fuseable Link

Precautions

The following precautions must be observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator system.

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed.
3. Never disconnect the alternator output lead, regulator harness or battery cables when the alternator is being driven by the engine.
4. Always remove NEGATIVE (–) battery cable from battery before working on alternator system.
5. When installing battery, be sure to connect the NEGATIVE (–) (GROUNDED) battery cable to NEGATIVE (–) battery terminal and the POSITIVE (+) battery cable to POSITIVE (+) battery terminal.
6. When using a charger or booster battery, connect it in parallel with existing battery (POSITIVE to POSITIVE; NEGATIVE to NEGATIVE).

Alternator Description

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven at 2.5 times engine speed. The rotor contains a field winding enclosed between 2 multiple-finger pole pieces. The ends of the field winding are connected to 2 brushes which make continuous sliding contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 8 diodes which allows current to flow from ground, through the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge changes this alternating current to direct current which appears at the output terminal. A diode trio is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes prevent the battery from discharging back through the stator.

A small amount of current is supplied by the excitation circuit in the regulator to the rotor field to initially start the alternator charging. Once the alternator begins to produce output, field current is supplied solely by the diode trio.

The alternator is equipped with 2 fans which induce air flow through the alternator to remove heat created by the rectifier and stator.

Diagnosis of Alternator System on Engine

1. If problem is an undercharged battery, verify condition has not been caused by excessive accessory current draw or by accessories which have accidentally been left on.
2. Check physical condition and state of charge of battery. Battery must be at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.

IMPORTANT: RED output lead from alternator must be tight. A darkened RED sleeve indicates lead was loose and becoming hot.

4. Check alternator drive belt for cracks and fraying. Replace if necessary. Check belt tension. Adjust if necessary, as outlined under “**Drive Belt Replacement and Adjustment.**”

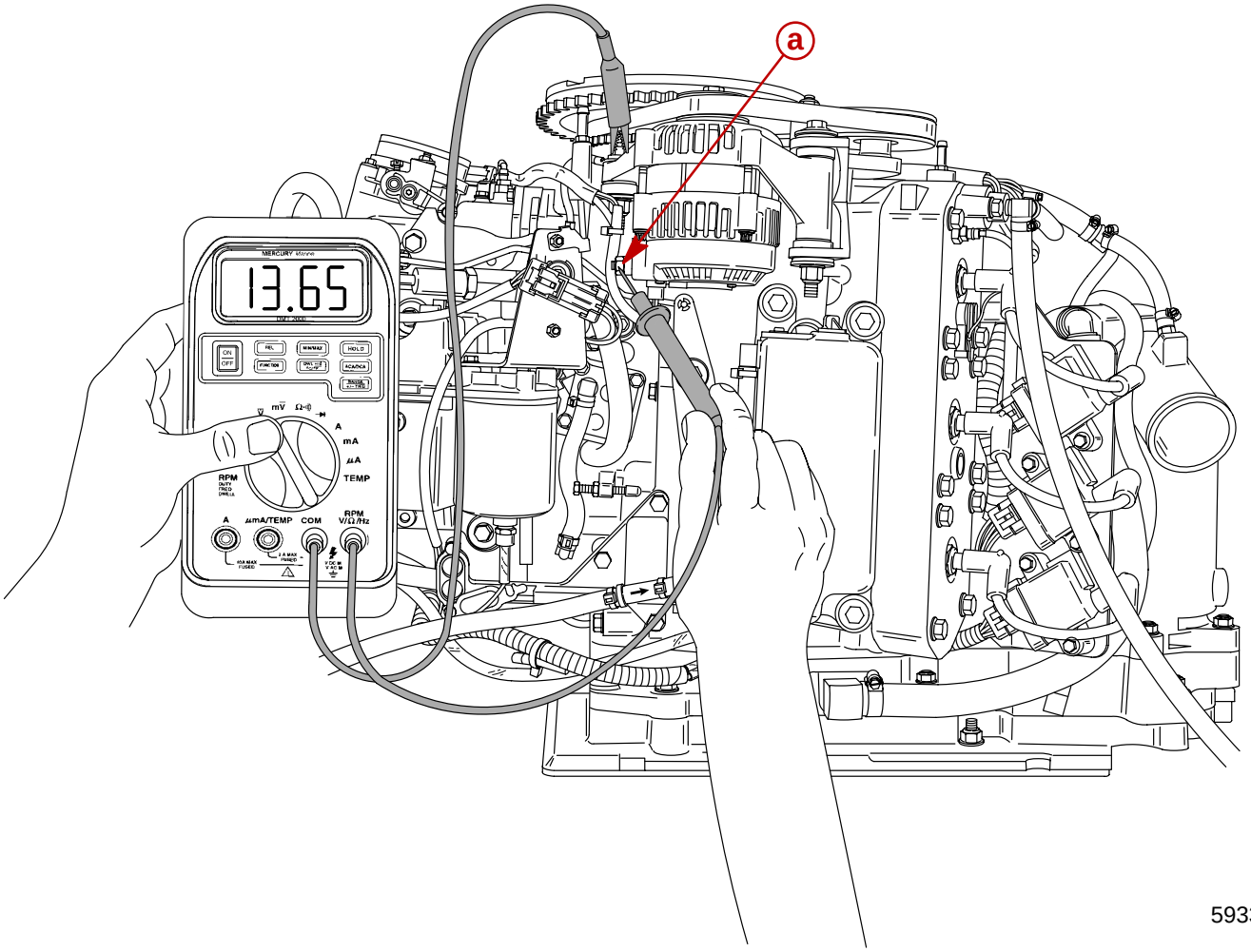
Alternator System Circuitry Test

Using a 0-20 volt DC voltmeter, perform the following tests:

Output Circuit

NOTE: *The 240 EFI Sport Jet has a 100 ampere fuseable link between the alternator and the slave solenoid. This fuseable link is designed to protect the alternator from damage due to incorrect battery connection polarity. If battery cables are reversed, the fuseable link may open circuit and must be replaced. With the fuseable link open, the engine can be started but the run time will be limited due to the rapid discharge of the boat battery.*

1. With key switch turned off, connect POSITIVE (+) voltmeter lead to alternator terminal B (output terminal). Connect NEGATIVE (–) lead to case ground on alternator.
2. Shake alternator wiring harness. Meter should indicate battery voltage and should not vary. If proper reading is not obtained, check for loose or dirty connections or damaged wiring (open circuit in fuseable link) between alternator and slave solenoid.

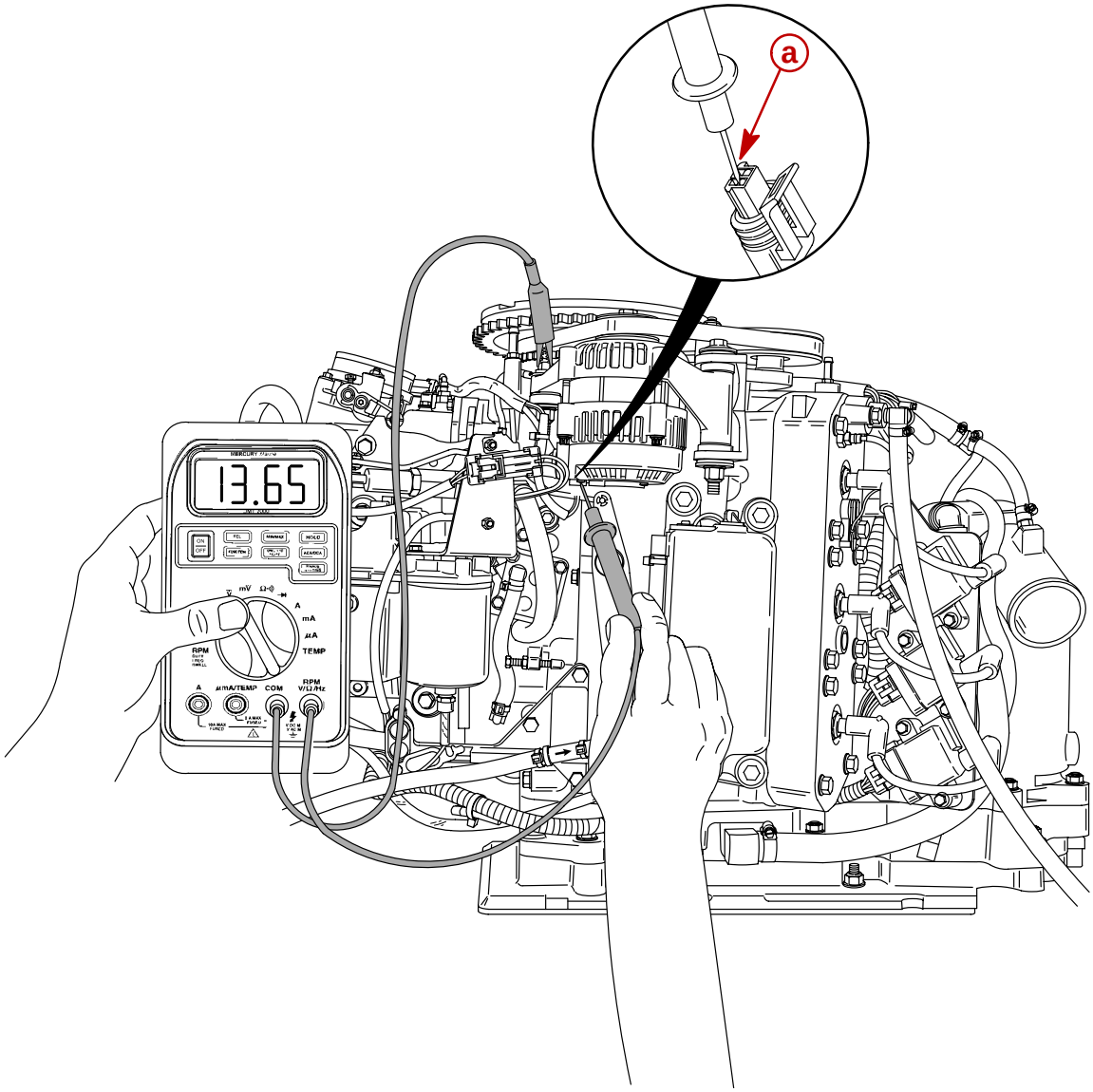


59339

a - Terminal B (Fuseable Link)

Sensing Circuit

1. With key switch turned off, unplug RED and PURPLE lead connector from alternator.
2. Connect POSITIVE (+) voltmeter lead to RED lead and NEGATIVE (–) voltmeter lead to ground.
3. Voltmeter should indicate battery voltage. If correct voltage is not present, check sensing circuit (RED lead) for loose or dirty connections or damaged wiring between alternator and slave solenoid.
4. With key switch turned on, connect POSITIVE (+) voltmeter lead to PURPLE lead and NEGATIVE (–) voltmeter lead to ground. Voltmeter should indicate battery voltage. If correct voltage is not present, check PURPLE lead for loose or dirty connections or damaged wiring between alternator and ignition switch. Check ignition switch for proper function.



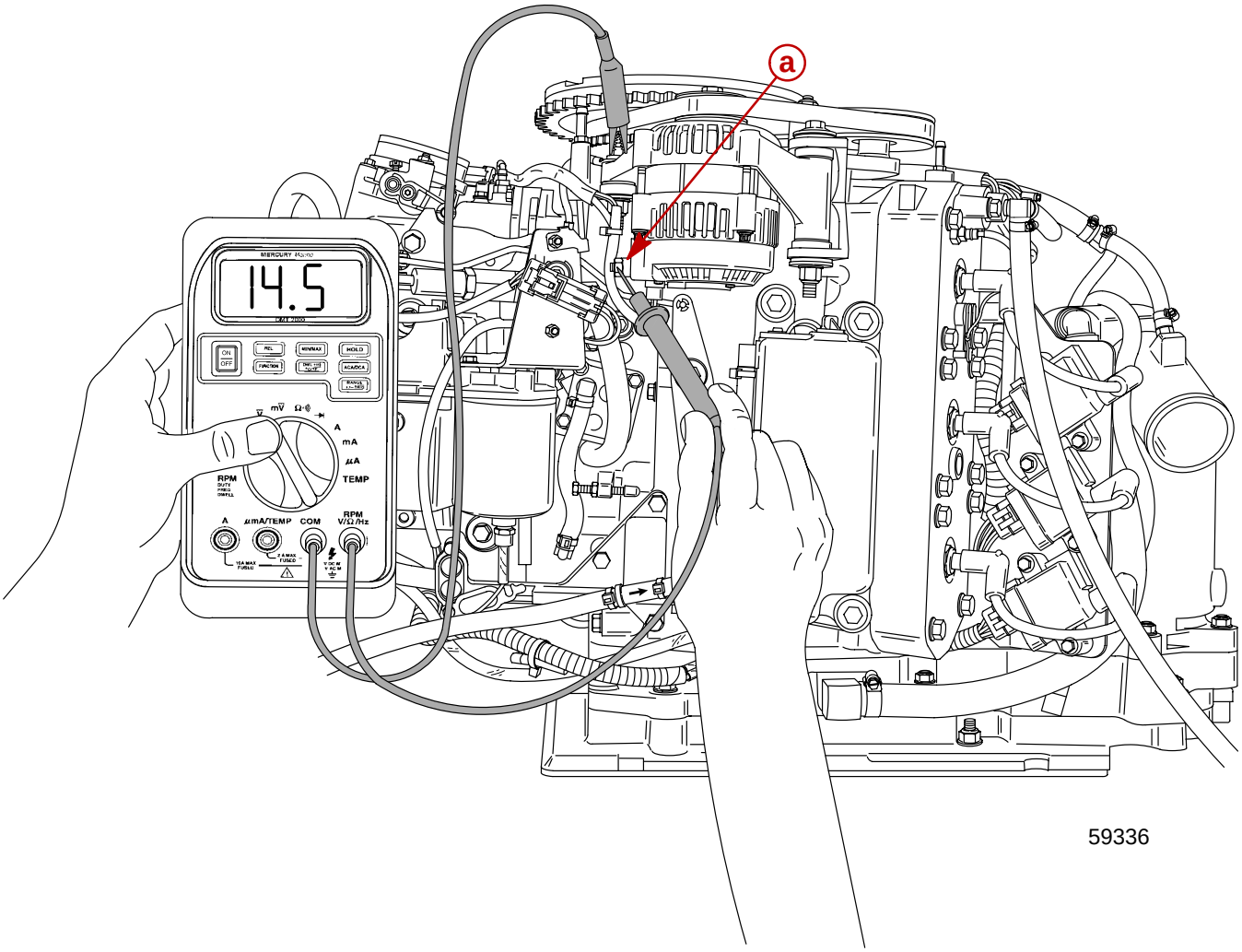
59338

a - Sense Lead (RED and PURPLE)

Voltage Output

1. Using a 0-20 volt DC voltmeter, connect POSITIVE (+) lead of voltmeter to TERMINAL B of alternator and NEGATIVE (–) lead of voltmeter to engine ground.
2. Start engine and allow to warm up. Increase engine RPM from idle to 2000. At ambient temperature normal voltage output should be 14.2 – 15. volts.

NOTE: *If alternator is under-charging check connections. If alternator is over-charging replace alternator.*



59336

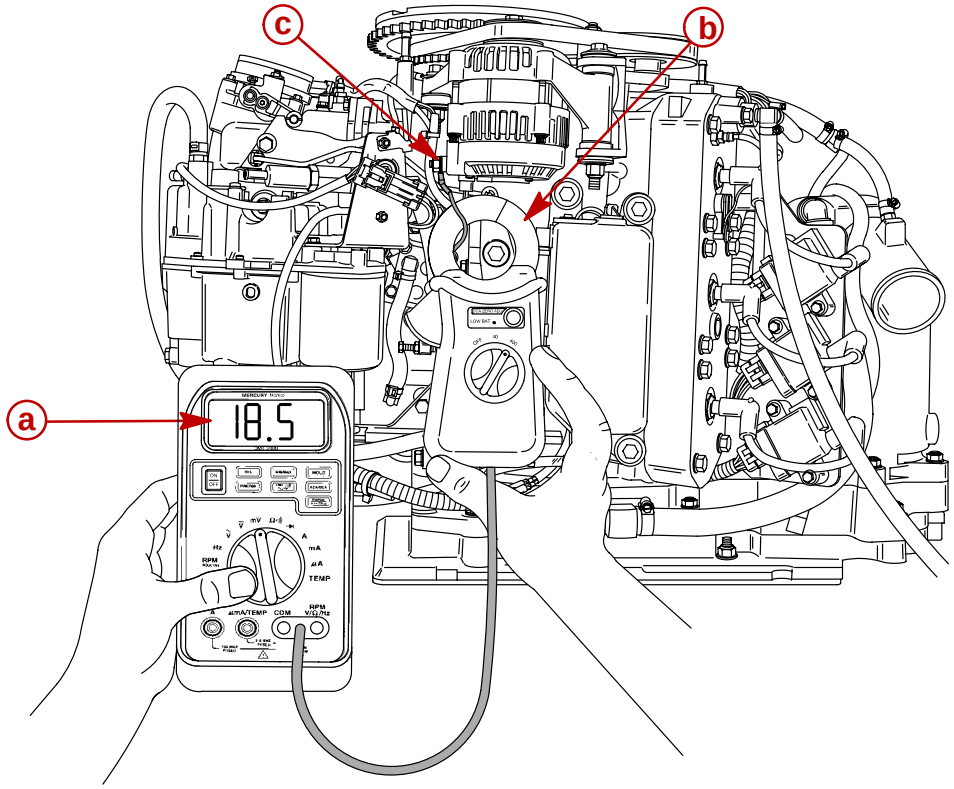
a - Terminal B

Current Output

NOTE: *Before conducting current output test, assure that all boat electrical accessories are turned* ***OFF****.*

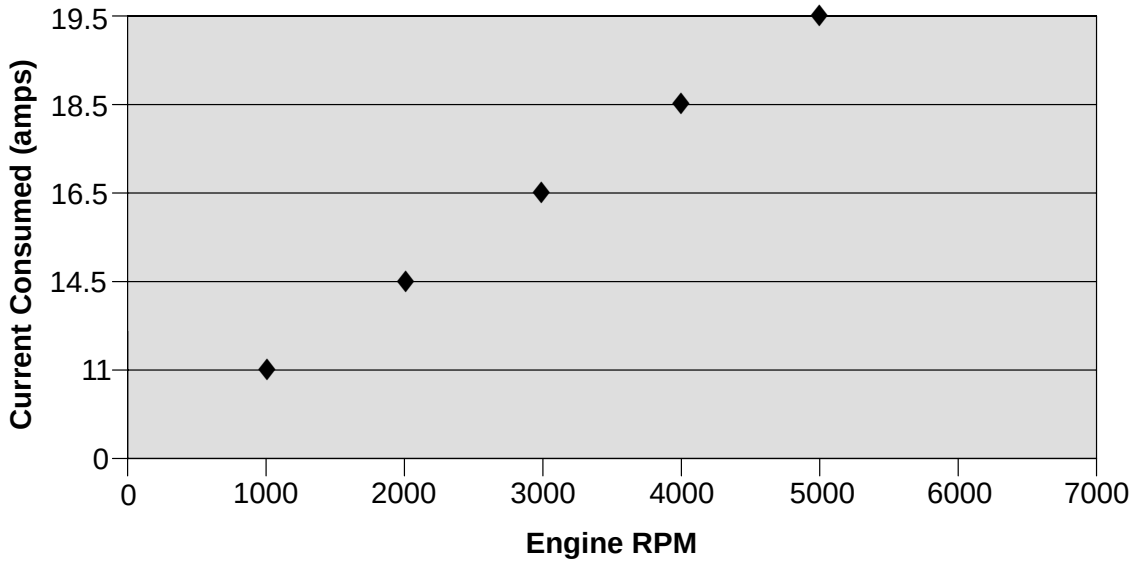
1. With engine shut off, install ammeter with clamp-on current probe (capable of reading 60+ amperes) onto alternator charging conductor (10 AWG Red Wire).
2. Start engine and allow to warm up.
3. Battery voltage should be between 14.2 and 15.0 VDC for all engine RPM's.

Alternator output current should correspond with graph below. **Example:** If engine is revolving at 2000 RPM current meter should be approximately 14.5 ± 3 Amps.



59337

a - Ammeter (DMT 2000 Digital Tachometer Multimeter 91-854009A1)
b - Clamp-On Current Probe (91-802650)
c - Alternator Charging Conductor (10 AWG Red Wire)



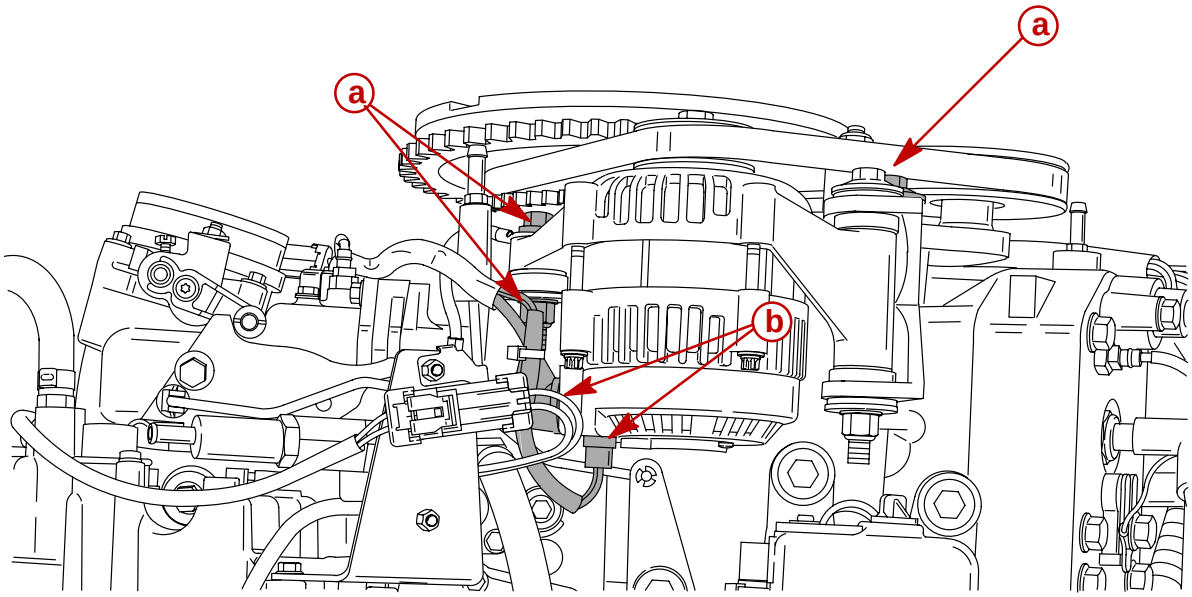
Current Output Troubleshooting

Current Output is Low	Battery Cables are loose or corroded Defective Battery (Open Circuit) Defective Alternator
Current Output is High	Accessories turned on Defective Battery (Internal Short) Defective Alternator

Repair

Removal

1. Remove top cowling.
2. Disconnect battery cables from battery.
3. Disconnect wiring harness from alternator.
4. Remove pivot bolt and tension bolt.



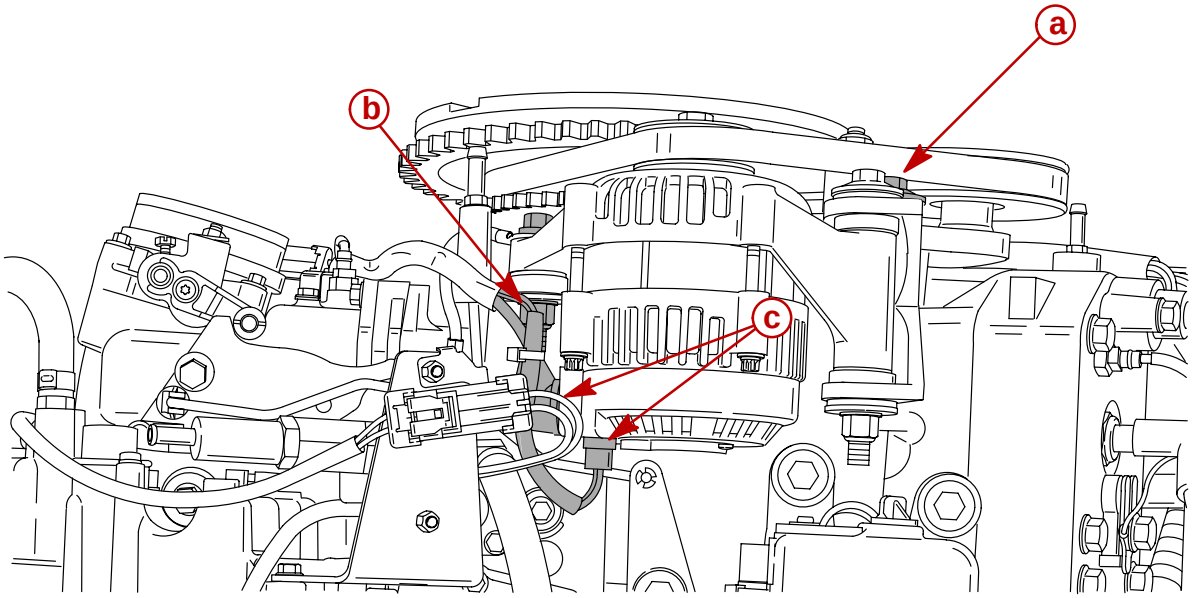
57539

a - Attaching Bolt

b - Harnesses

Installation

1. Secure alternator to engine block with attaching bolts. Torque top bolt to 40 lb-ft (54 Nm). Torque bottom bolt to 25 lb-ft (34 Nm).
2. Install alternator belt in V-groove of flywheel and alternator pulley.
3. Reconnect electrical harness to alternator.

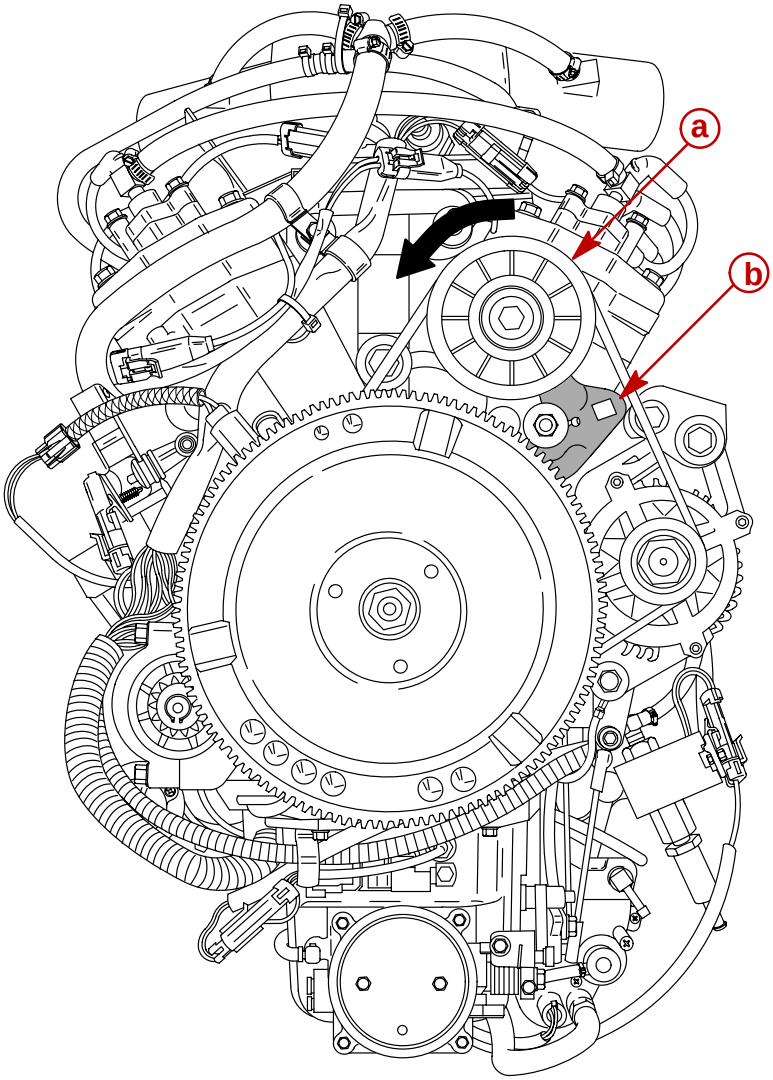


57539

a - Top Bolt [Torque to 40 lb-ft (54 Nm)]
b - Bottom Nut [Torque to 25 lb-ft. (34 Nm)
c - Harnesses

Alternator Belt Tension Adjustment

Correct alternator belt tension is maintained by a belt tensioner assembly.



59317

a - Belt Tensioner Assembly
b - 3/8 Drive Access Hole for relieving Belt Tension

Starter System

Starter Motor Amperes Draw

STARTER MOTOR PART NO.	NO LOAD AMP. DRAW	NORMAL AMP. DRAW
50-833153-1	30 AMPS	165 AMPS
50-853329-1	60 AMPS	170 AMPS

Starter System Components

Battery

Neutral Start Switch (in control box)

Starter Solenoid

Starter Motor

Ignition Switch

Slave Solenoid

Description

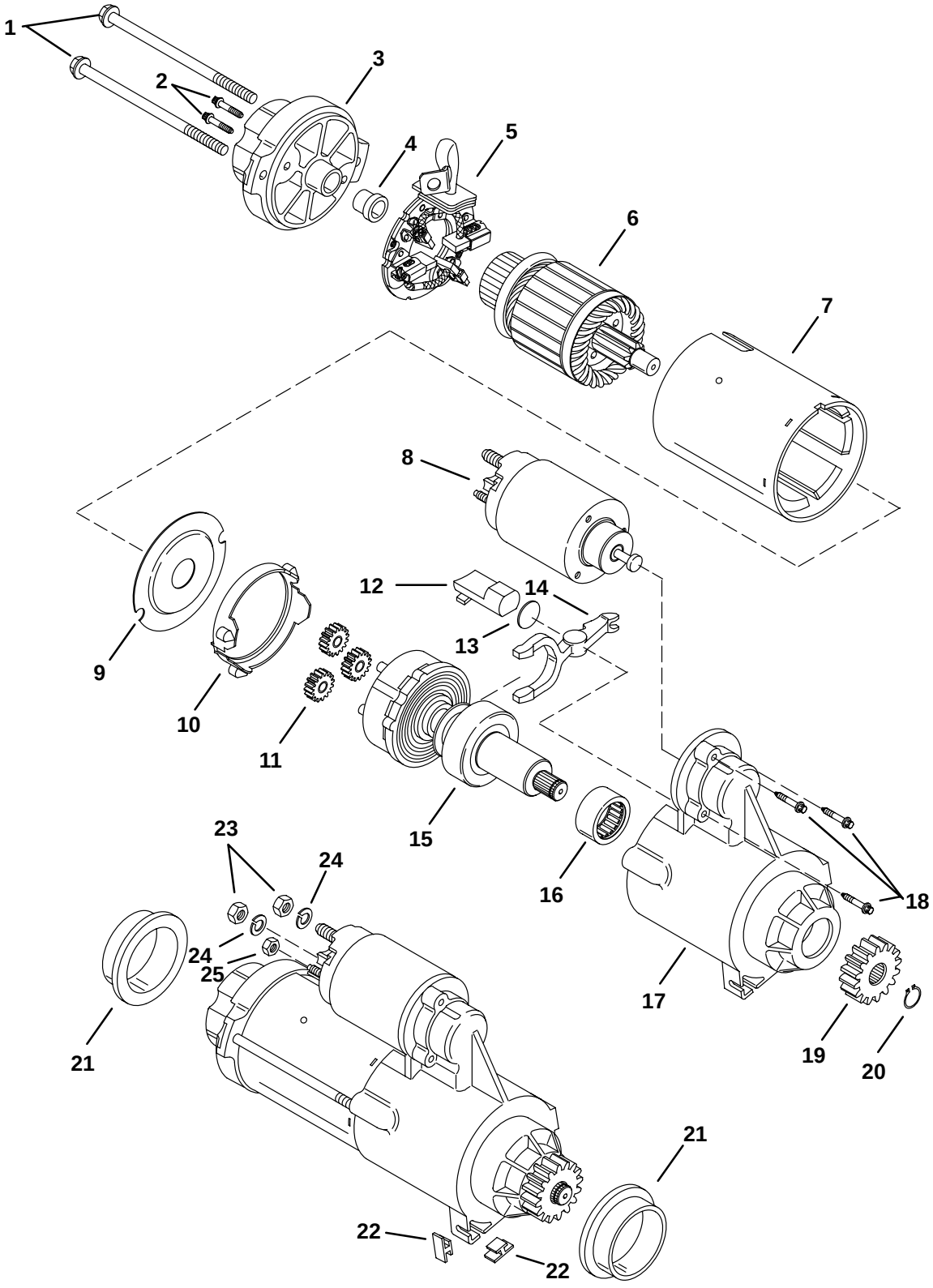
The battery supplies electricity to activate the starter motor. When the ignition is turned to the “START” position, the slave solenoid is energized which in turn activates the starter solenoid, thus completing the starter circuit between the battery and starter.

The neutral start switch opens the starter circuit when the shift control lever is not in neutral thus preventing accidental starting when the engine is in gear.

⚠ CAUTION

The starter motor may be damaged if operated continuously. DO NOT operate continuously for more than 30 seconds. Allow a 2 minute cooling period between starting attempts.

Starter Motor (Solenoid Driven Bendix)



Starter Motor (Solenoid Driven Bendix)

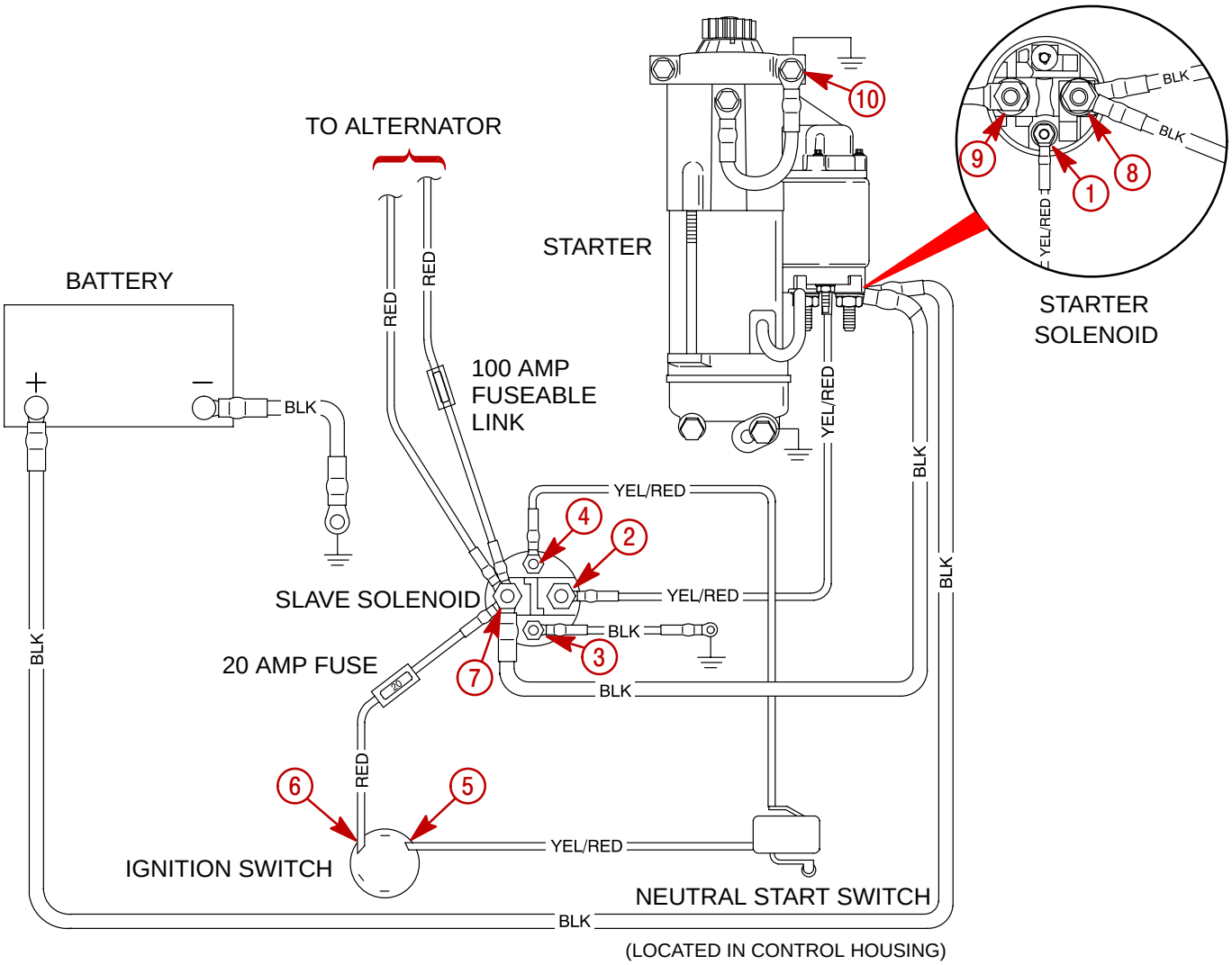
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	2	THRU BOLT	110		12.5
2	2	SCREWS	30		3.4
3	1	END CAP			
4	1	BUSHING			
5	1	BRUSH PLATE ASSEMBLY			
6	1	ARMATURE			
7	1	FIELD FRAME			
8	1	SOLENOID			
9	1	SHIELD			
10	1	CUSHION			
11	3	PLANETARY GEARS			
12	1	PLUG			
13	1	DISC			
14	1	SHIFT FORK			
15	1	GEAR/CLUTCH ASSEMBLY			
16	1	BEARING			
17	1	HOUSING			
18	3	SCREW	40		4.5
19	1	DRIVE GEAR			
20	1	SNAP RING			
21	2	MOUNTING COLLAR			
22	2	STOP			
23	2	NUT	55		6.0
24	2	WASHER			
25	1	NUT	20		2.3

Troubleshooting the Solenoid Driven Bendix Starter Circuit

Before beginning the troubleshooting flow chart, verify the following conditions:

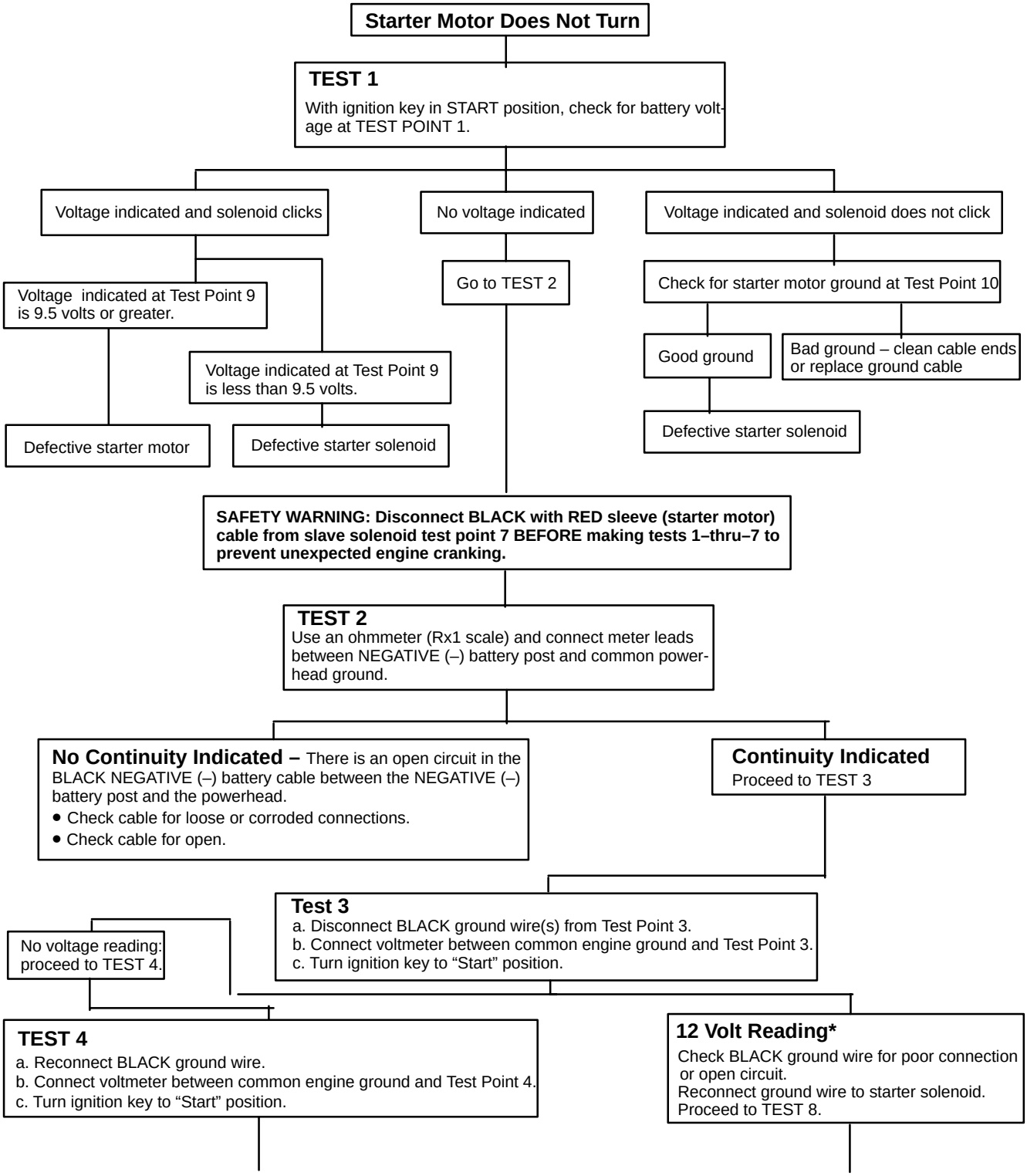
1. Confirm that battery is fully charged.
2. Check that control lever is in “NEUTRAL” position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check 20 amp fuse.

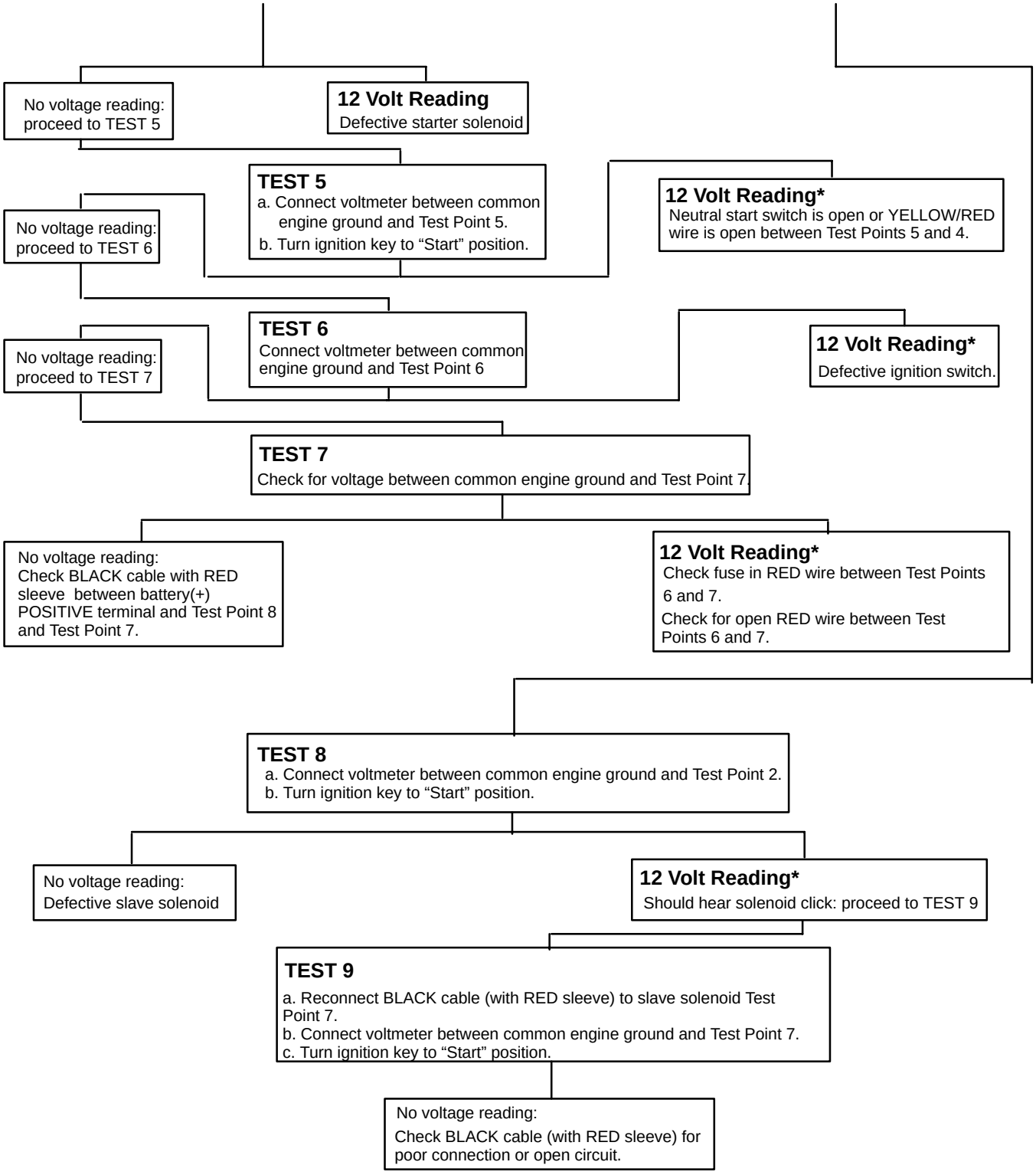
Location of “Test Points” (called out in flow chart) are numbered below.



Solenoid Driven Bendix Starter Circuit 58431

Starter Circuit Troubleshooting Flow Chart (Solenoid Driven Bendix)





*Battery Voltage

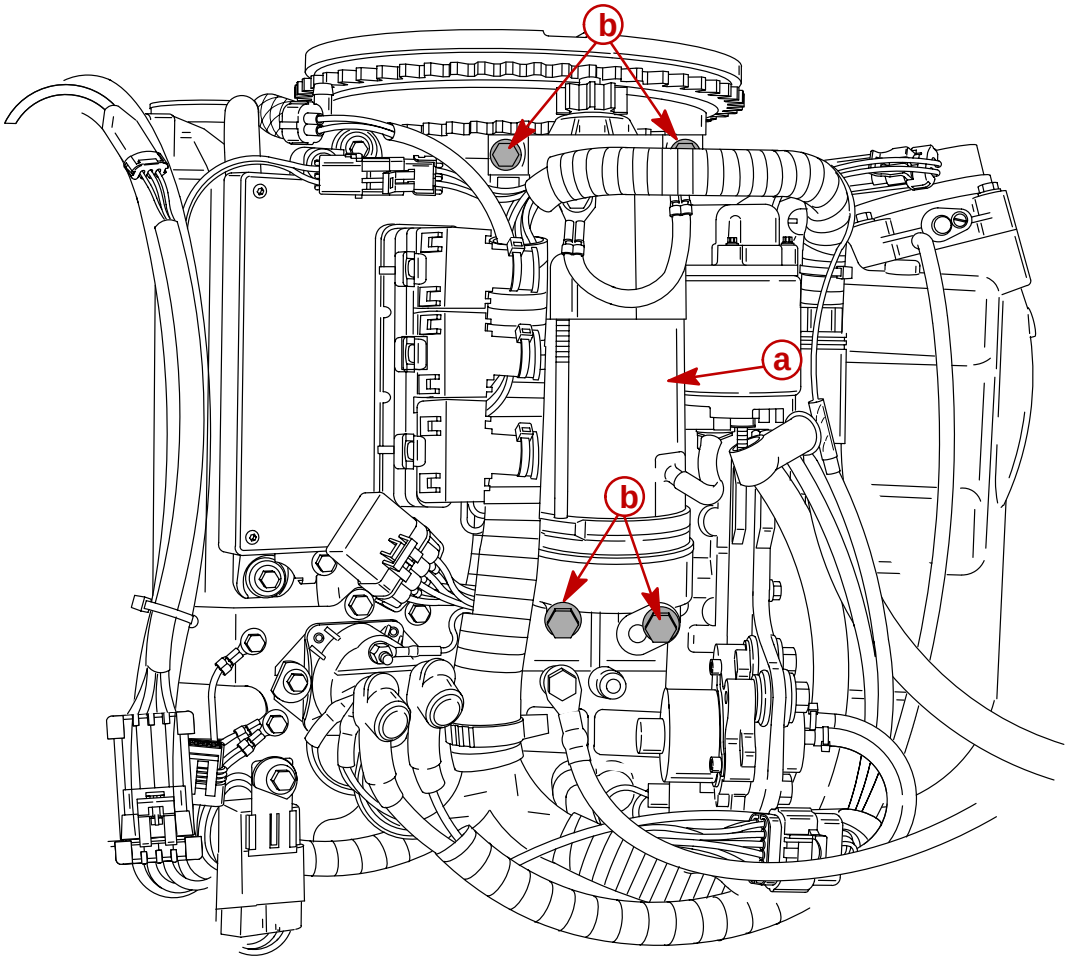
Starter Removal and Installation

Removal

⚠ CAUTION

Disconnect battery leads from battery before removing starter.

1. Disconnect battery cables from battery.
2. Disconnect wires from starter solenoid terminals.
3. Remove starter trunion mounting bolts and remove starter from engine.

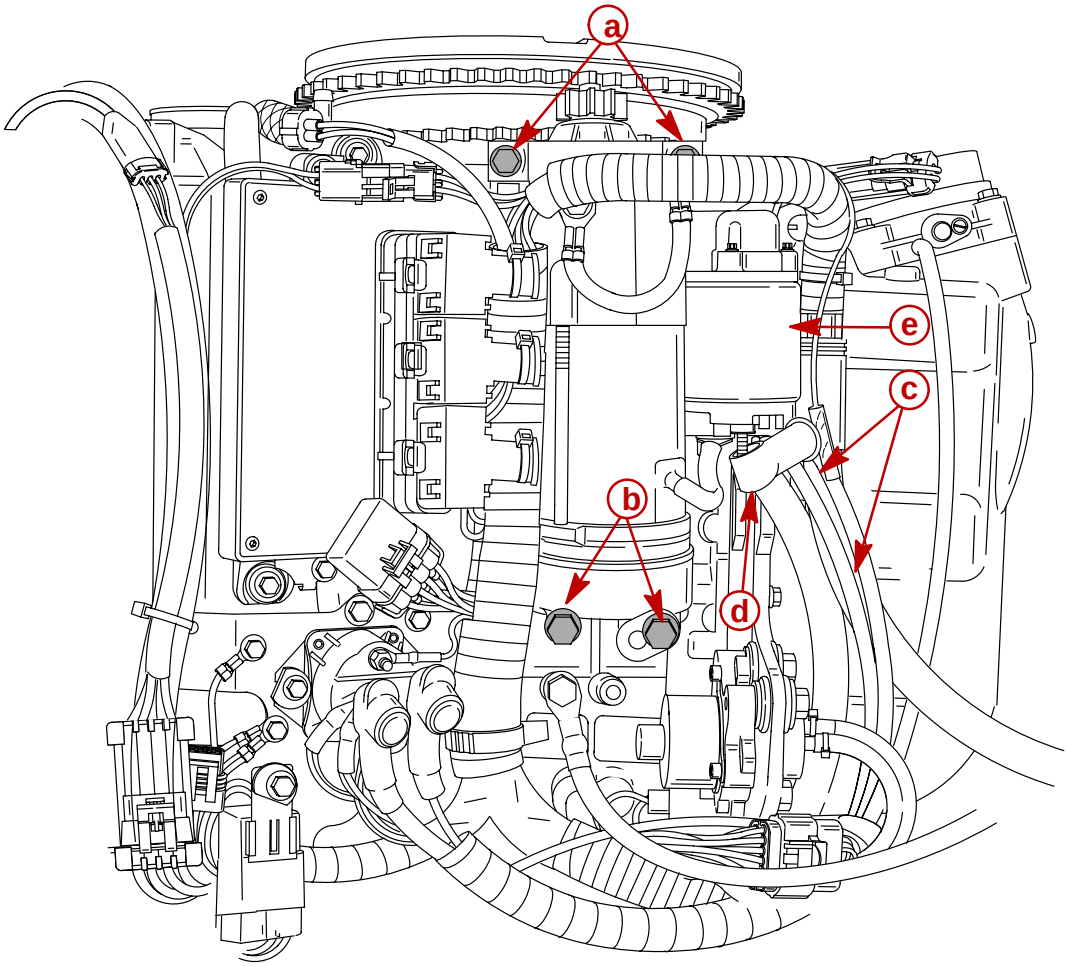


59230

a - Starter Solenoid
b - Mounting Bolts

Installation

1. Secure starter to engine with 4 bolts. Use right top bolt to attach BLACK NEGATIVE. Torque top attaching bolts to 18 lb-ft (24 Nm). Torque bottom attaching bolts to 18 lb-ft. (24 Nm).
2. Secure BLACK cables (with RED sleeves) to POSITIVE (+) terminal on starter solenoid. Torque nut to 55 lb-in (6 Nm).

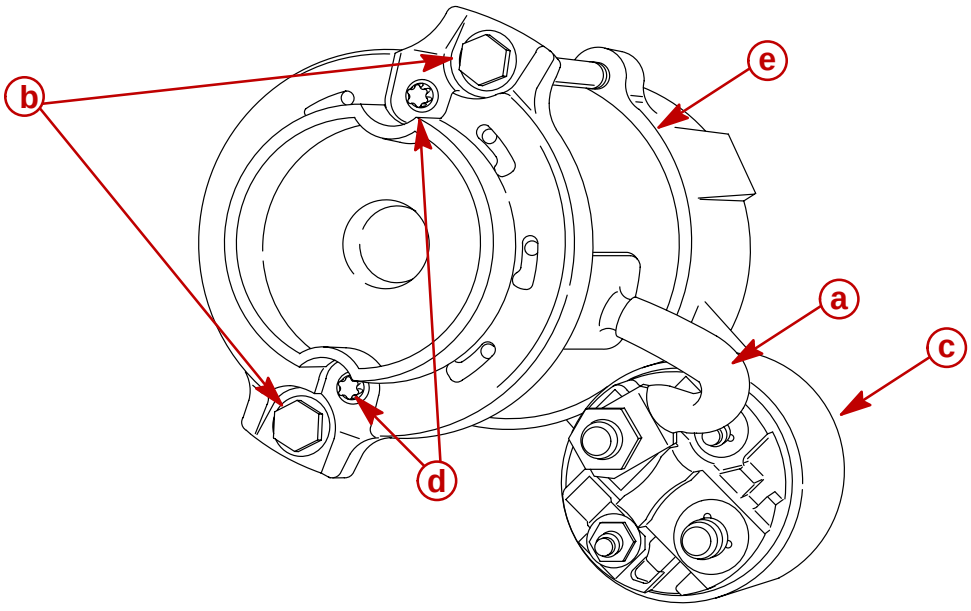


59230

a - Top Bolts [Torque to 18 lb-ft (24 Nm)]
b - Bottom Bolts [Torque to 18 lb-ft (24 Nm)]
c - BLACK Cables (with RED sleeves)
d - Nut (under RED boot) [Torque to 55 lb-in (6 Nm)]
e - Starter Solenoid

Disassembly (Solenoid Driven Bendix Starter)

1. Remove brush lead from solenoid and through bolts from end frame.

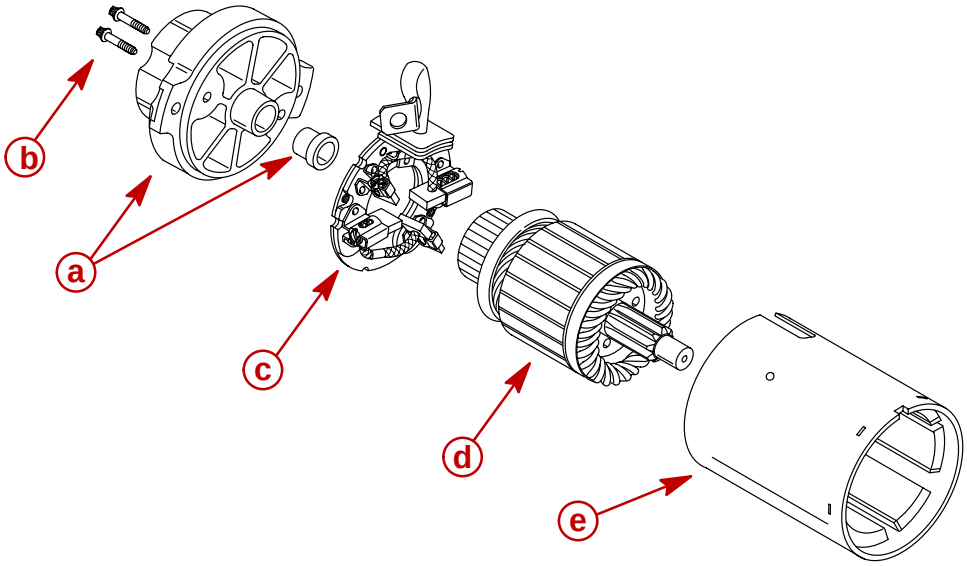


58434

a - Brush Lead
b - Through Bolts
c - Starter Solenoid
d - Brush Plate Screws
e - End Frame

2. Remove armature and field frame from drive housing.

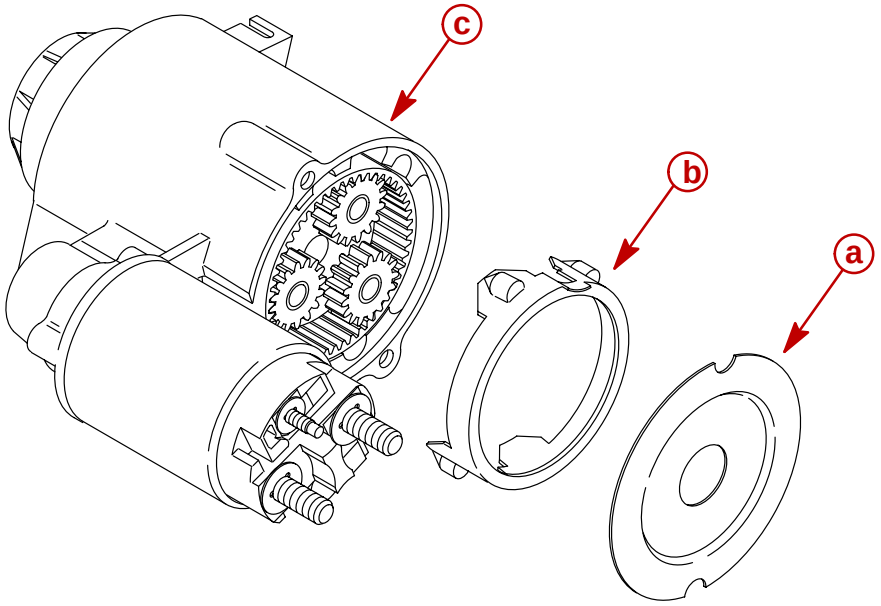
NOTE: *Permanent magnets inside field frame will be holding armature in place.*



58430

a - End Frame and Bearing
b - Screws (2) [Internal Torx – Snap On E6 Socket]
c - Brush Holder
d - Armature
e - Field Frame

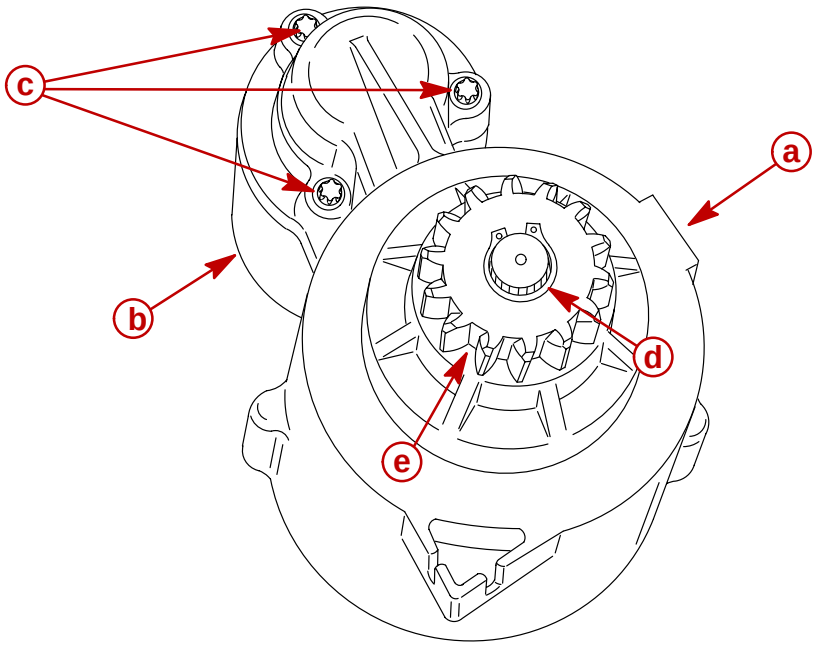
3. Remove shield and cushion from drive housing.



58432

a - Shield
b - Cushion
c - Drive Housing

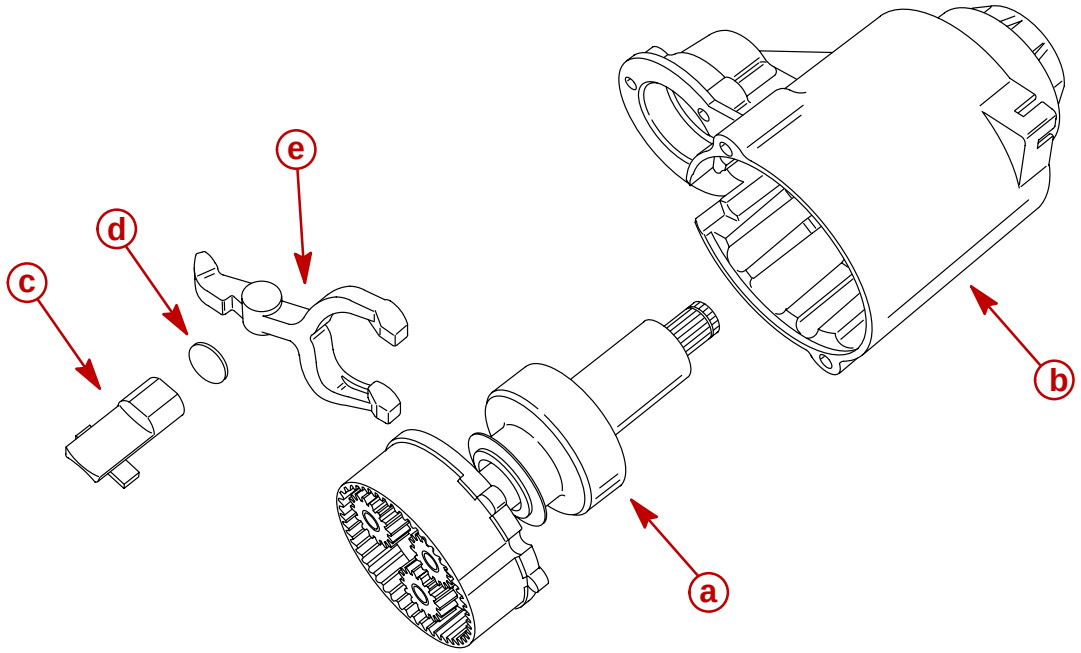
4. Remove 3 screws retaining starter solenoid. Remove solenoid from drive housing.
5. Remove snap ring and gear from starter shaft.



58436

a - Drive Housing
b - Starter Solenoid
c - Screws (3) [Internal Torx– Snap On E6 Socket]
d - Snap Ring
e - Pinion Gear

6. Remove planetary gear and clutch assembly from drive housing.
7. Remove solenoid arm, metal disc and plug from drive housing.

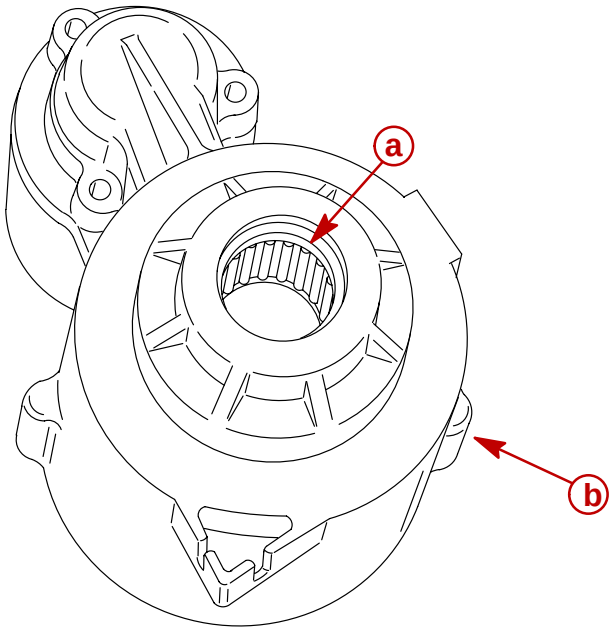


58437

- **a** - Planetary Gear and Clutch Assembly
- **b** - Drive Housing
- **c** - Plug
- **d** - Metal Disc
- **e** - Solenoid Arm

8. Inspect drive housing needle bearing for roughness. If bearing is worn or damaged, bearing can be removed by using an appropriate mandrel to drive/press bearing from drive housing.

NOTE: *If bearing has spun in drive housing bore, drive housing must be replaced.*



58439

- **a** - Needle Bearing
- **b** - Drive Housing

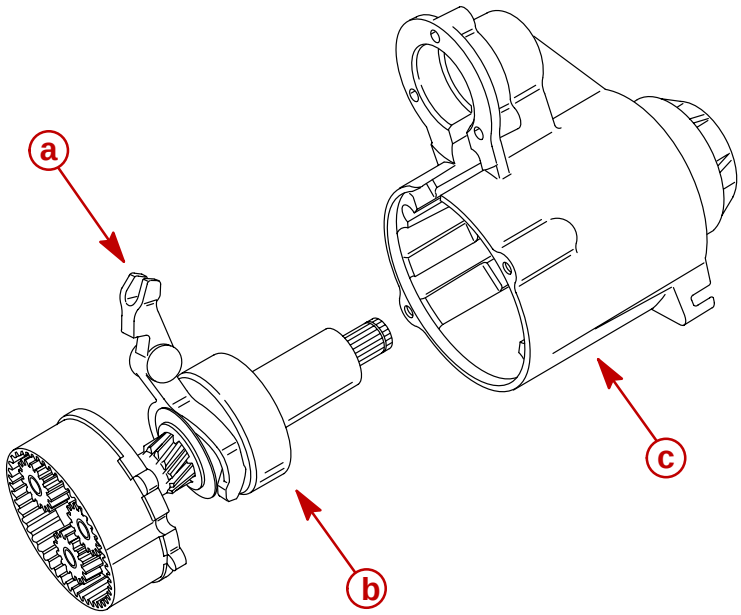
Cleaning and Inspection

IMPORTANT: Do not use grease dissolving solvents to clean electrical components, planetary gears or drive clutch. Solvent will damage insulation and wash the lubricant out of the clutch drive and gears. Use clean rags and compressed air to clean components.

1. Test over-running clutch action of drive. Pinion should turn freely in over-running direction and must not slip in cranking direction.
2. Inspect pinion teeth for wear.
3. Inspect spring for tension and drive collar for wear.
4. Check that bearings roll freely. If any roughness is felt, replace bearing.
5. Inspect planetary gear assembly. Gears must mesh easily and roll freely with no binding.

Reassembly (Solenoid Driven Bendix Starter)

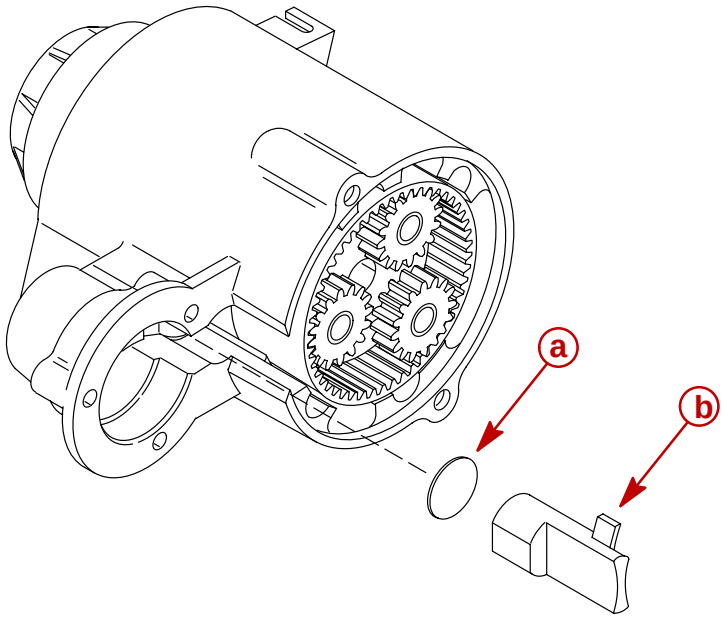
1. Install solenoid arm with planetary gear and clutch assembly into drive housing.



58438

a - Solenoid Arm
b - Planetary Gear and Clutch Assembly
c - Drive Housing

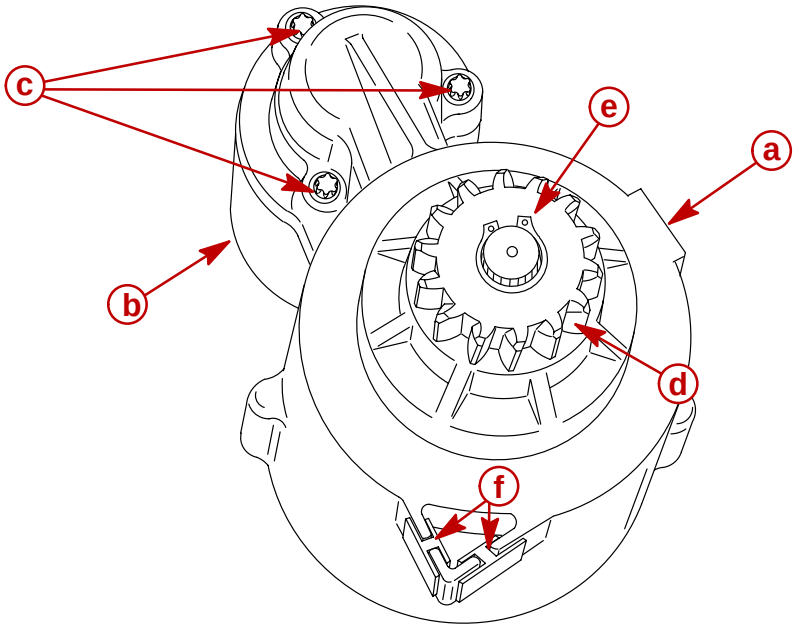
2. Install metal disc and plug into drive housing.



58433

a - Metal Disc
b - Plug

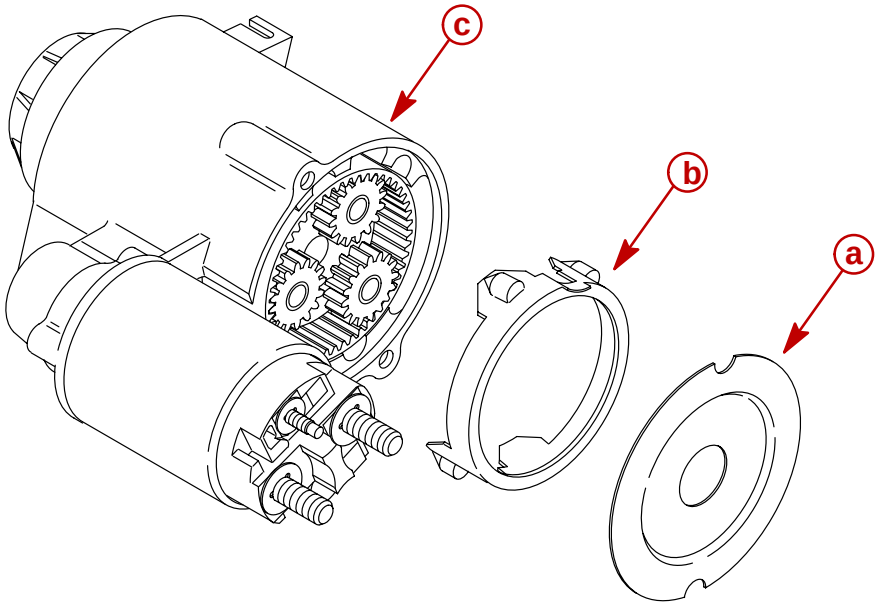
3. Attach solenoid arm to starter solenoid. Install starter solenoid in drive housing and secure with 3 screws. Torque screws to 40 lb-in (4.5 N.m).
4. Install drive gear and secure with snap ring.
5. Reinstall rubber bumpers on housing.



58436

a - Drive Housing
b - Starter Solenoid
c - Screw (3) [Torque to 40 lb-in (4.5 N.m)]
d - Drive Gear
e - Snap Ring
f - Bumpers

6. Install cushion and shield in drive housing.

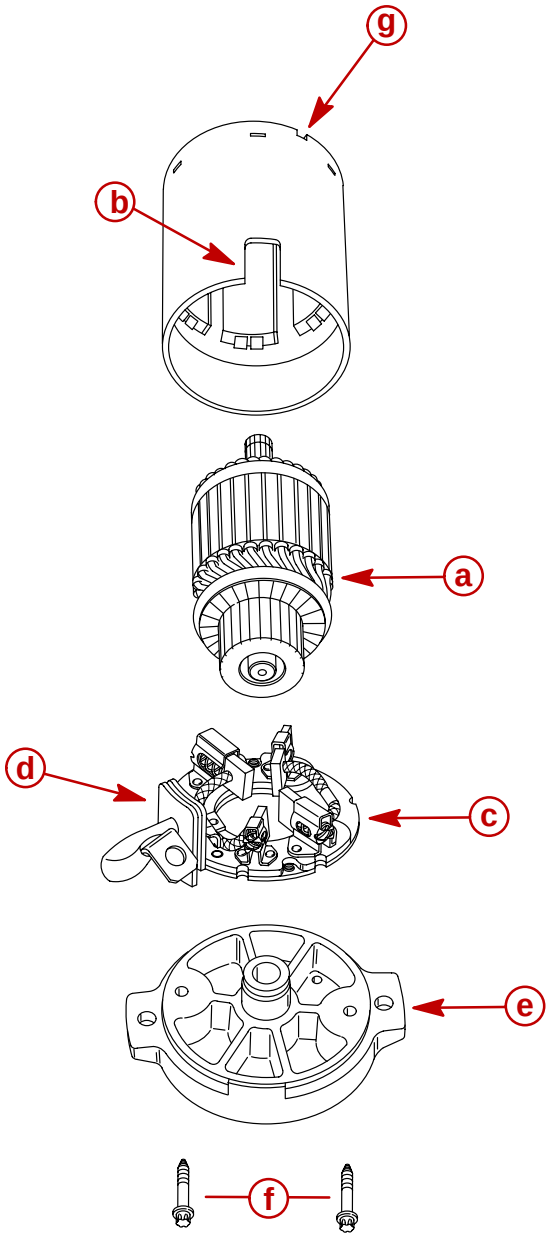


58432

a - Shield
b - Cushion
c - Drive Housing

7. Install field frame over armature.
8. While holding brushes back, slide brush plate onto armature while aligning brush lead grommet with slot in field frame.
9. Secure end plate to brush assembly with 2 screws. Torque screws to 30 lb-in (3.4 Nm).

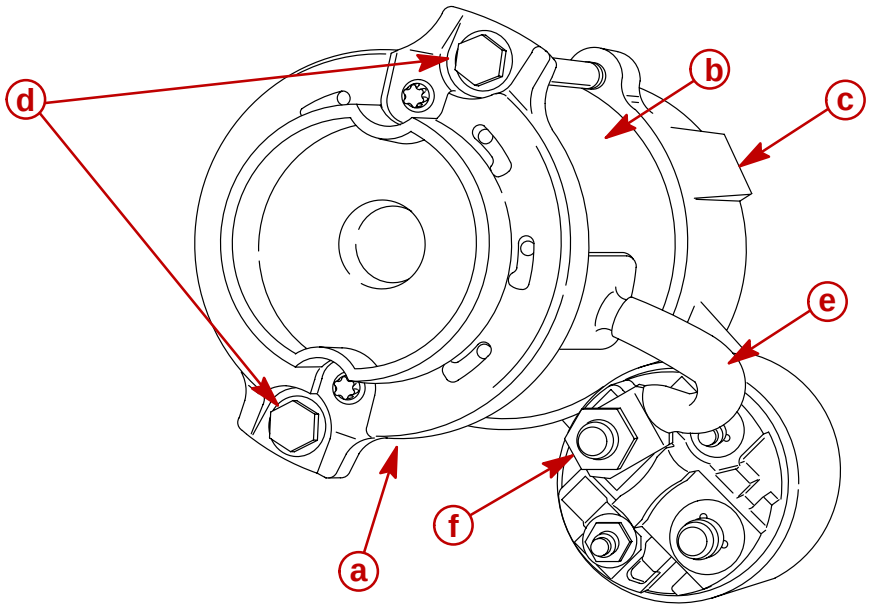
NOTE: *Prior to installing field frame assembly into drive housing, align slot in field frame with plug in drive housing.*



58435

a - Armature
b - Field Frame Grommet Slot
c - Brush Plate
d - Brush Lead Grommet
e - End Plate
f - Screws [Torque to 30 lb-in (3.4 Nm)]
g - Field Frame Plug Slot

10. Install field frame and end frame in drive housing.
11. Install through bolts and brush lead. Torque through bolts to 110 lb-in (12.5 Nm). Torque brush nut to 55 lb-in (6 Nm).



58434

a - End Frame
b - Field Frame
c - Drive Housing
d - Through Bolts [Torque to 110 lb-in (12.5 Nm)]
e - Brush Lead
f - Brush Nut [Torque to 55 lb-in (6 Nm)]

Starter Cleaning, Inspection and Testing

Cleaning and Inspection

1. Clean all starter motor parts.
2. Check pinion teeth for chips, cracks or excessive wear.
3. Replace the drive clutch spring and/or collar if tension is not adequate or if wear is excessive.
4. Inspect brush holder for damage or for failure to hold brushes against commutator.
5. Replace brushes that are pitted or worn to less than 1/4 in. (6.4 mm) in length.
6. Inspect the armature conductor (commutator bar junction) for a tight connection. A loose connection (excessive heat from prolonged cranking melts solder joints) results in a burned commutator bar.
7. Resurface and undercut a rough commutator as follows:

⚠ CAUTION

Do not turn down the commutator excessively.

   a. Resurface the commutator and undercut the insulation between the commutator bars 1/32 in. (0.8mm) to the full width of the insulation and so that the undercut is flat.

   b. Clean the commutator slots after undercutting.

c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then clean the commutator.

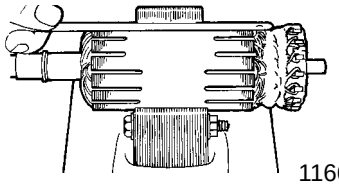
d. Recheck the armature on a growler for shorts as specified in the following procedure (“Testing”).

8. Open-circuited armatures often can be repaired. The most likely place for an open circuit is at the commutator bars, as a result of long cranking periods. Long cranking periods overheat the starter motor so that solder in the connections melts and is thrown out. The resulting poor connections then cause arcing and burning of the commutator bars.
9. Repair bars, that are not excessively burned, by resoldering the leads in bars (using rosin flux solder) and turning down the commutator in a lathe to remove burned material, then undercut the mica.
10. Clean out the copper or brush dust from slots between the commutator bars.
11. Check the armature for ground. See the following procedure (“Testing”).

Testing Solenoid Driven Bendix Starters

Armature Test for Shorts

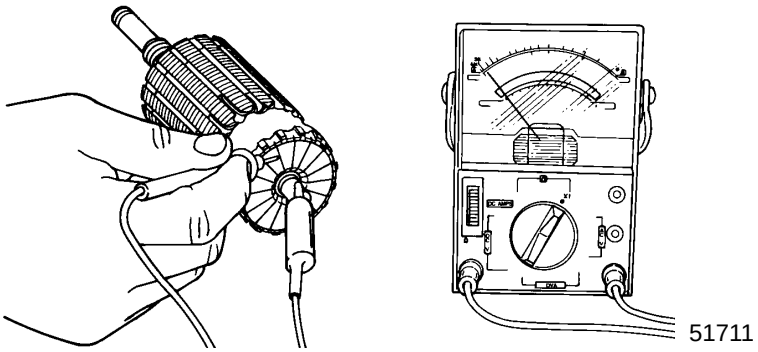
Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



11669

Armature Test for Ground

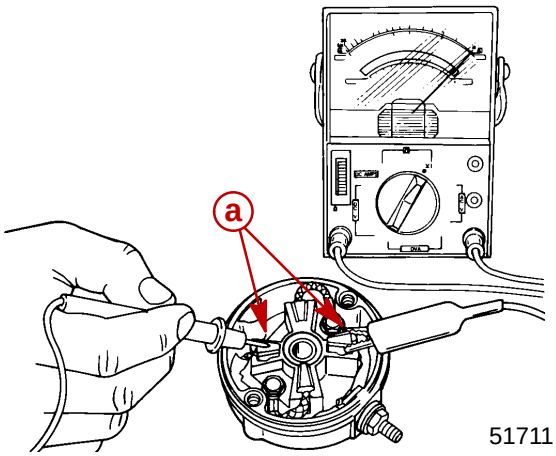
1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.
2. If meter indicates continuity, armature is grounded and must be replaced.



51711

Checking Positive Brushes and Terminal

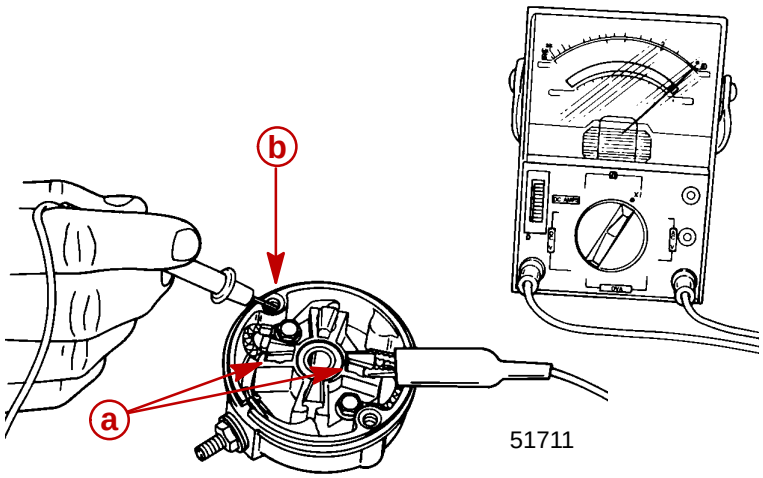
Set ohmmeter to (R x 1 scale). Connect meter leads between POSITIVE brushes. Meter must indicate full continuity or zero resistance. If resistance is indicated, inspect lead to brush and lead to POSITIVE terminal solder connection. If connection cannot be repaired, brushes must be replaced.



a - POSITIVE (+) Brushes

Testing Negative Brushes for Ground

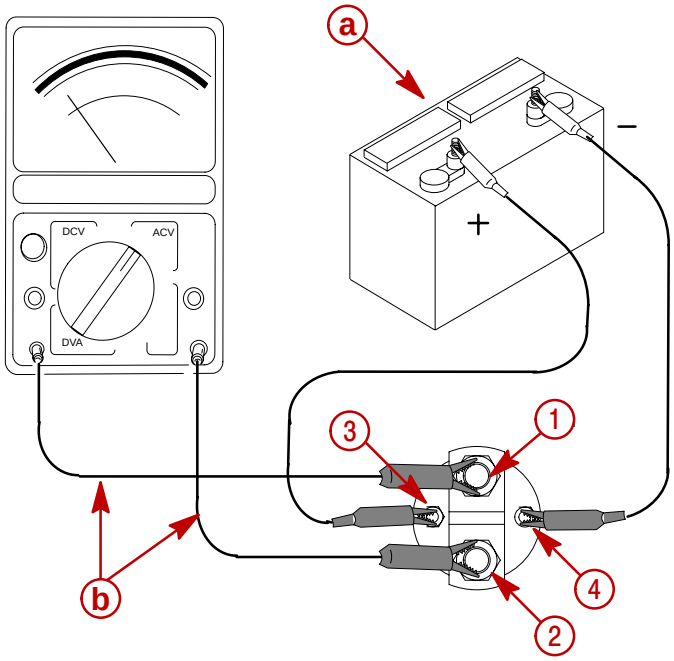
Set ohmmeter to (R x1 scale). Place one lead of the ohmmeter on the NEGATIVE brush and the other lead on the end cap (bare metal). If the meter indicates NO continuity, replace the NEGATIVE brush. Repeat this procedure on the other NEGATIVE brush.



a - NEGATIVE (–) Brushes
b - End Cap

Slave Solenoid Test

1. Disconnect all wires from solenoid.
2. Connect ohmmeter (R x1 scale) between terminals 1 and 2.
3. Connect a 12-volt power supply between terminals 3 and 4. Solenoid should click and meter should read 0 ohms (full continuity).
4. If meter does not read 0 ohms (full continuity), replace solenoid.

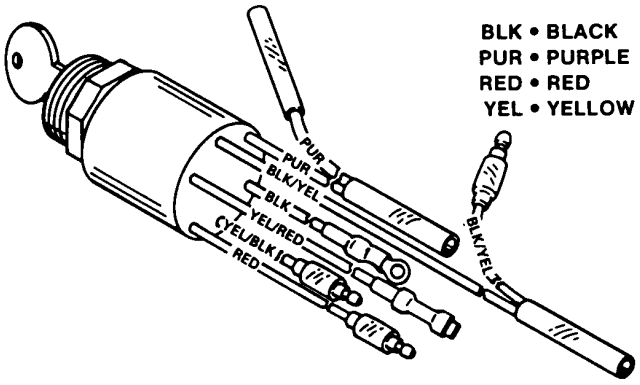


a - 12-VOLT Supply
b - VOA Leads

Commander 2000 Key Switch Test

1. Disconnect remote control wiring harness and instrument panel connector.
2. Set ohmmeter on R x 1 scale for the following tests.
3. If meter readings are other than specified in the following tests, verify that switch and not wiring is faulty. If wiring checks ok, replace switch.

IMPORTANT: Key switch must be positioned to “RUN” or “START” and key pushed in to actuate choke for this test.



KEY POSITION	CONTINUITY SHOULD BE INDICATED AT THE FOLLOWING POINTS: BLK	BLK/YEL	RED	YEL/RED	PUR	YEL/BLK
OFF	○	○				
RUN			○		○	
START			○			
				○	○	
			○		○	
CHOKE*			○			○
			○		○	
					○	○