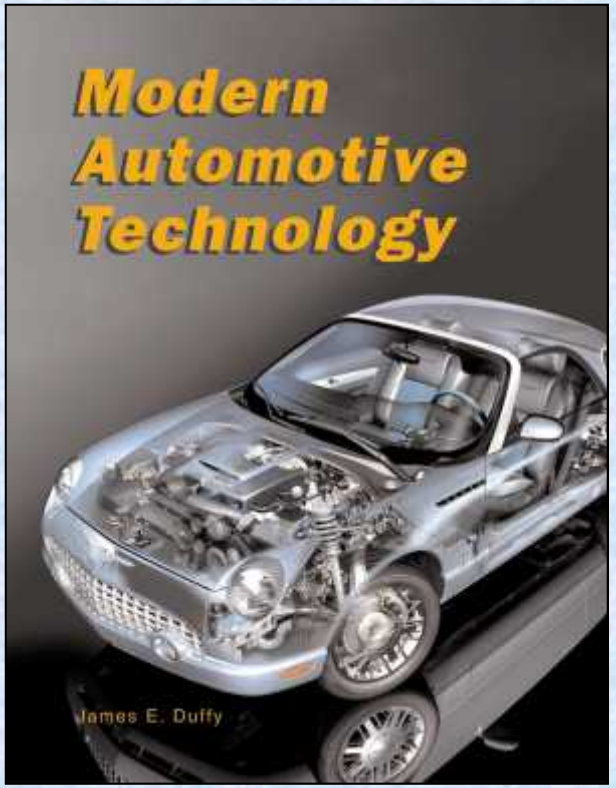
PowerPoint for

Modern Automotive Technology



by

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Chapter 32

Starting System Testing and Repair

Contents

- Starting system diagnosis
- Battery cable service
- Starter solenoid service
- Ignition switch service
- Starter relay service
- Neutral safety switch service
- Starter service

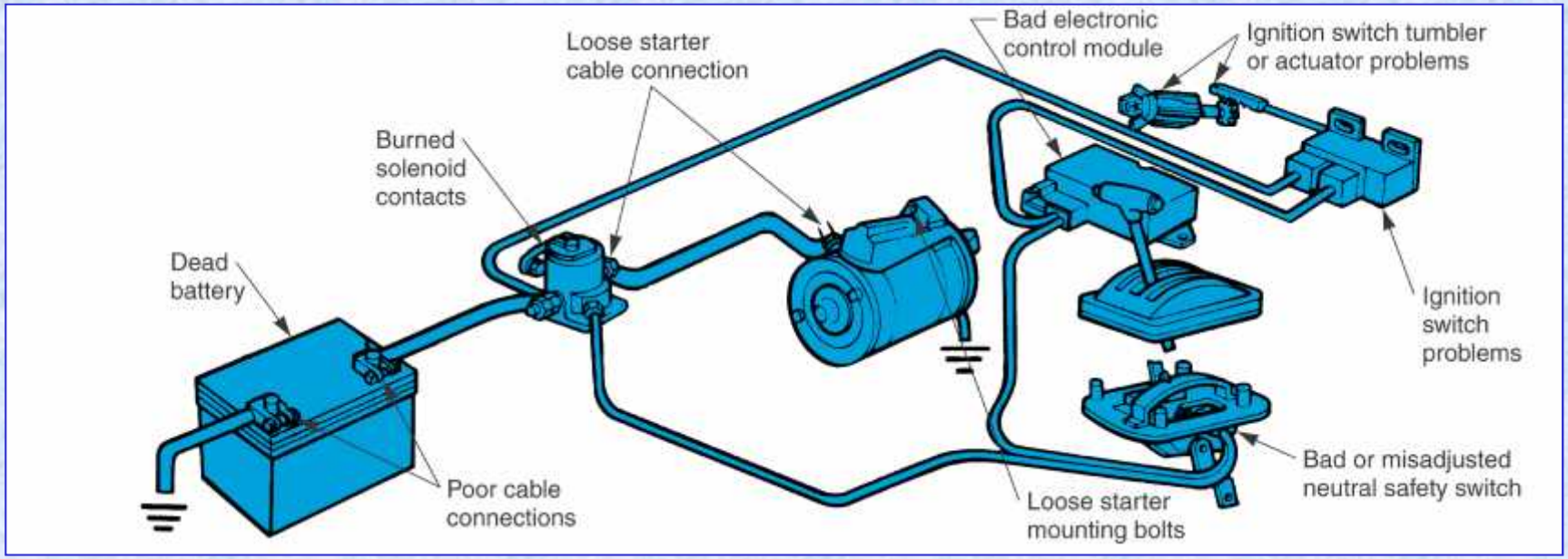
Starting System Diagnosis

Common Problems

- No-crank problem
  - crankshaft does not rotate
- Slow-cranking condition
  - crankshaft rotates slower than normal
- Solenoid clicking
  - caused by low battery or poor connections
- Noises
  - caused by overrunning clutch or flywheel tooth wear

Common Problems

Check for these kinds of problems

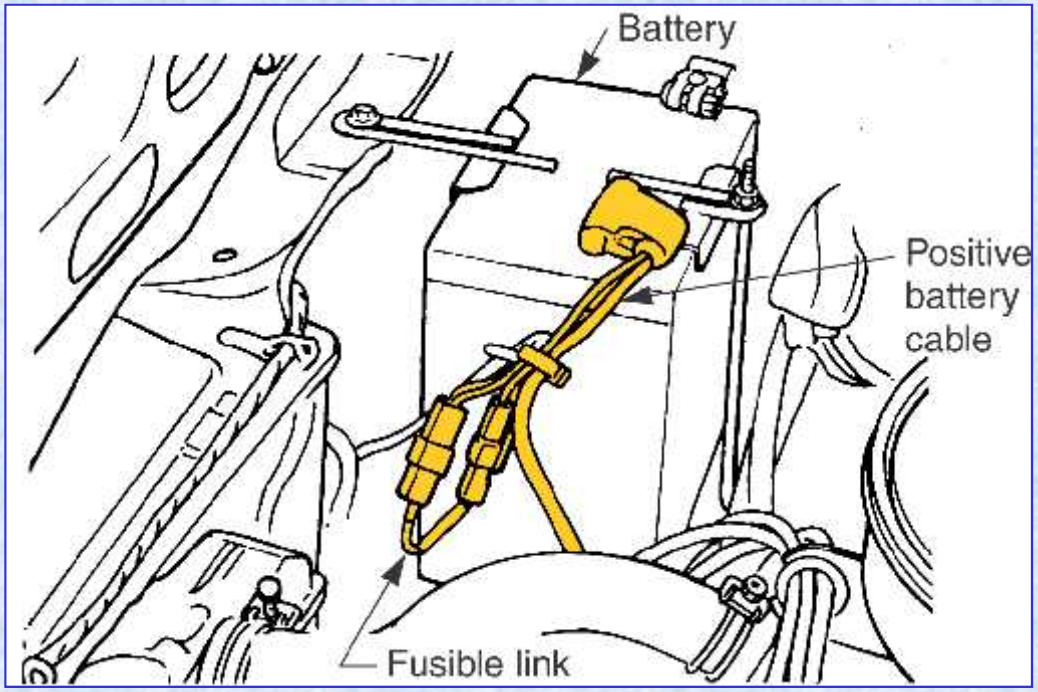


Starting Headlight Test

- Turn on headlights; try to start engine
- No cranking with no headlights
  - dead battery
  - open in the electrical system
- Headlights go out when cranking
  - heavy current draw (starter), low battery, or engine too hard to crank
- Headlights stay bright, no cranking
  - high resistance or open in starting circuit

Fusible Link

If major components are dead, check fusible links



Checking the Battery

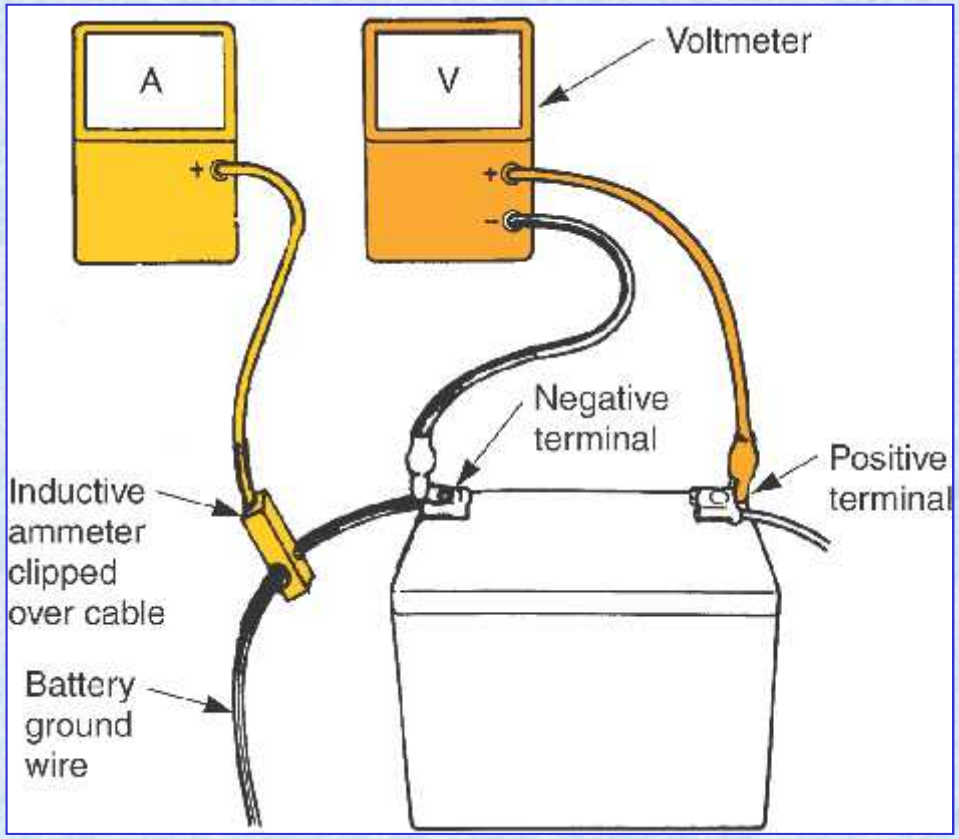
- Verify battery condition
- Load test if necessary
- Starter current flow may exceed 200 amperes, requiring high battery output

Starter Current Draw Test

- Measures the current used by the starting system
- Connect a voltmeter and ammeter
- Disable the engine
  - disconnect the coil primary supply
  - ground the coil wire
  - disable the electric fuel pump
- Crank the engine for 15 seconds while noting voltage and current readings
- Compare the readings to specifications

Equipment Connection

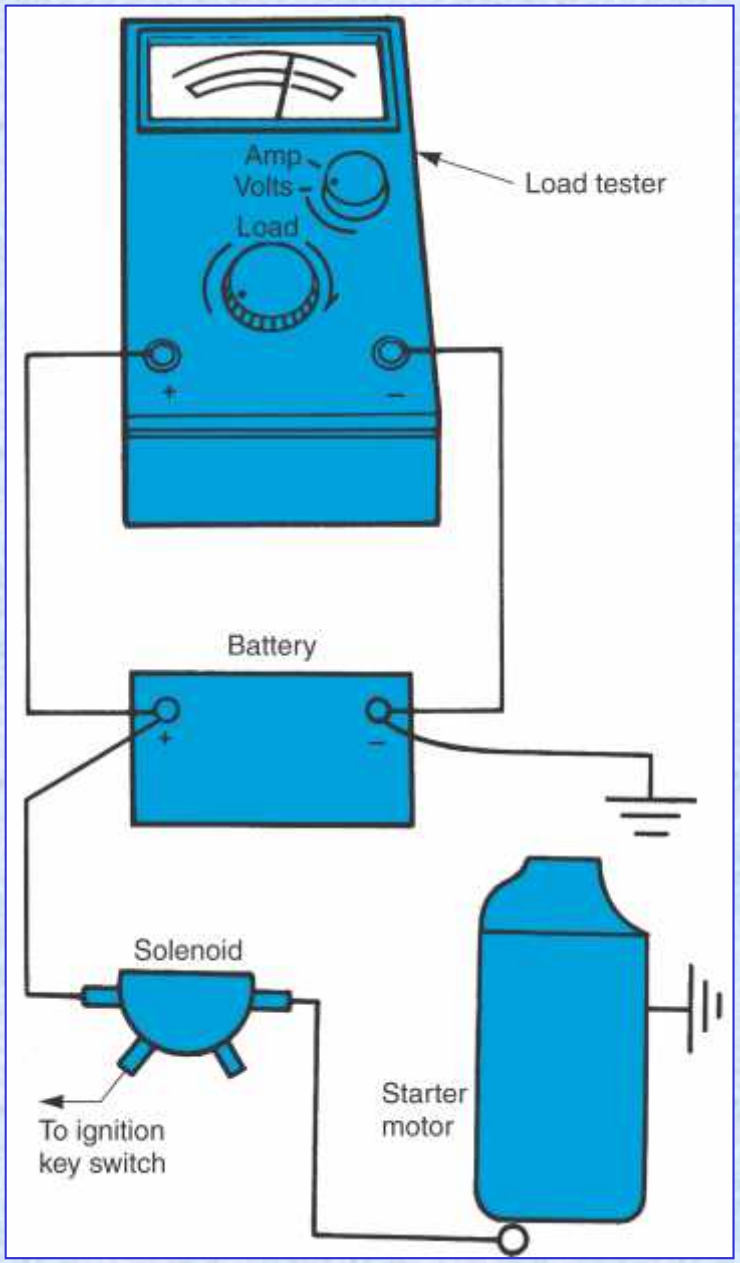
A voltmeter is needed to verify battery condition



Starter Current Draw Test—Load Tester

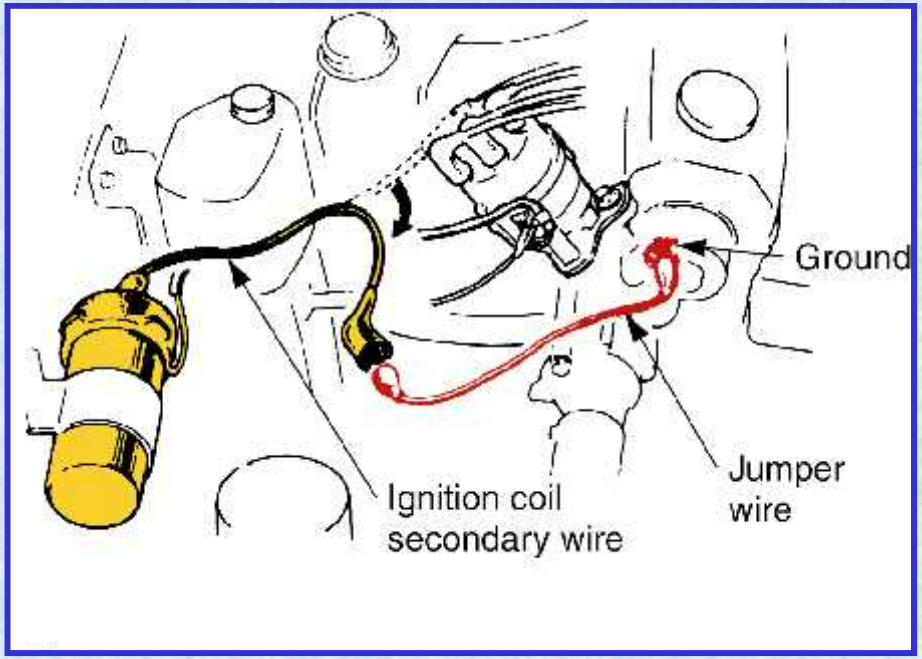
- Crank the engine, noting the voltage
- Load the battery to the same voltage
- The amperage will equal starter current draw

Load Tester Connection



Disabling the Ignition

On a distributor ignition system, ground the coil wire



Disabling the Ignition

With a coil pack, disconnect the primary wires

Starter Current Draw Test Values

ENGINE DISPLACEMENT	12-VOLT SYSTEM MAX. CURRENT
Most 4–6 Cylinders	125–175 Amps Max.
Under 300 C.I.D.	150–200 Amps Max.
Over 300 C.I.D.	175–250 Amps Max.

CRANKING CIRCUIT TROUBLESHOOTING CHART

Cranking Voltage	Cranking Amps	Possible Problem
Voltage OK	Current OK	System OK
Voltage OK	Current Low Engine Cranks Slowly	Starter Circuit Connections Faulty
Voltage Low	Current Low Engine Cranks Slowly	Battery Low
Voltage Low	Current High	Starter Motor Faulty

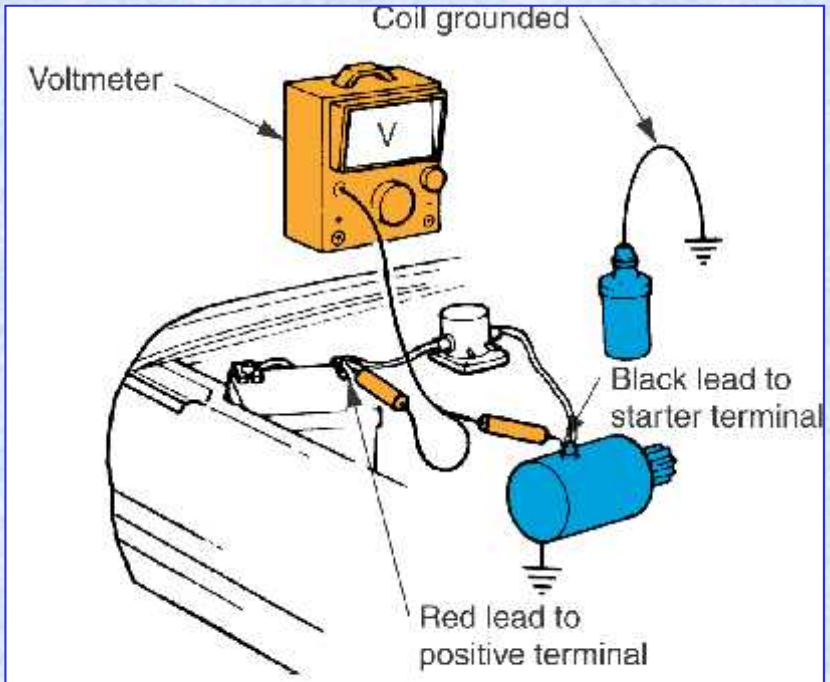
Voltage Drop Tests

- Locates higher-than-normal resistance
- Whenever current flows through a circuit, electrical resistance causes a voltage drop

Insulated Circuit Resistance Test

- Connect the voltmeter between the battery positive and the starting motor terminal
- Crank the engine, noting voltage
- Maximum should be 0.5 volts
- Excessive voltage indicates dirty or loose connections, or burned or pitted solenoid contacts
- Test each part if necessary

Insulated Circuit Resistance Test

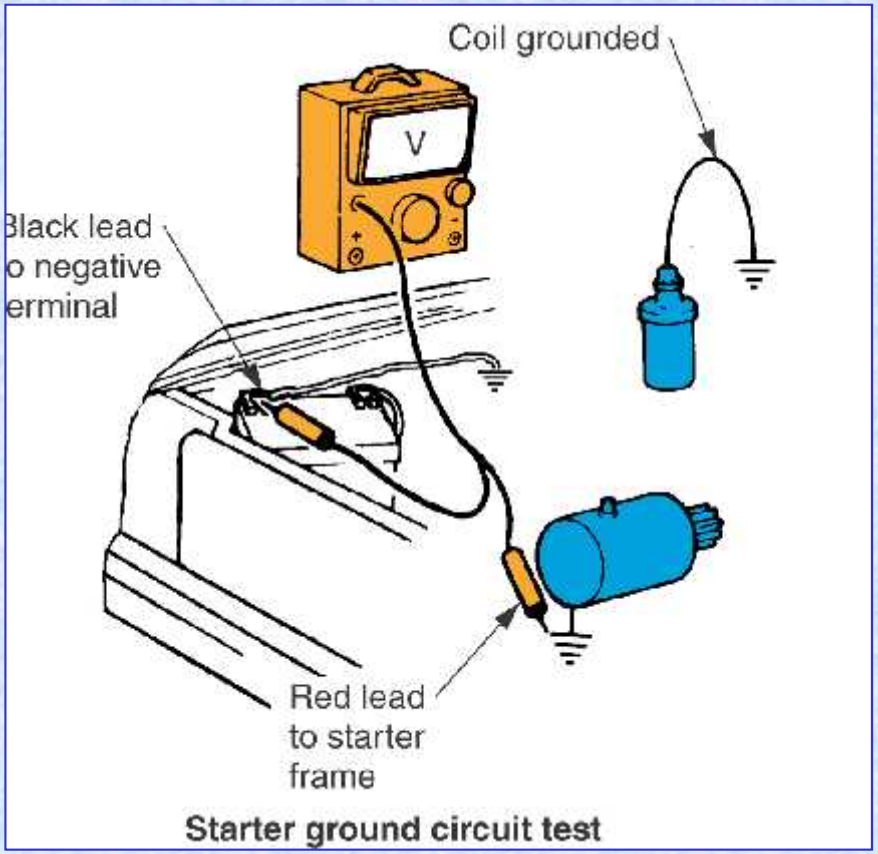


Insulated circuit resistance test

Starter Ground Circuit Test

- Connect the voltmeter between the starting motor ground and battery negative
- Crank the engine, noting voltage
- Maximum should be 0.5 volts
- Excess voltage indicates dirty or loose connections

Starter Ground Circuit Test

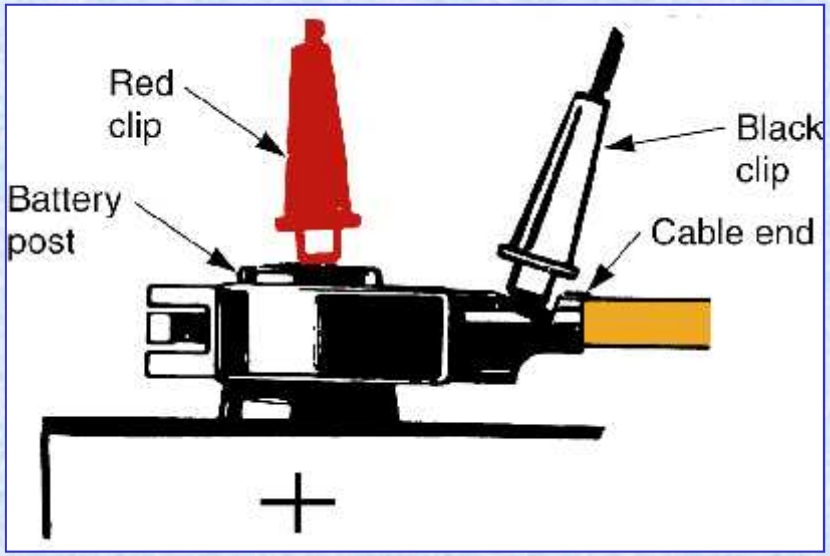


Starter ground circuit test

Battery Cable Service

- To test connections, connect a voltmeter between the battery post and cable
- Crank the engine, noting voltage drop
- Maximum drop should be 0.3 volts
- Clean and tighten the connections if the voltage drop is too high
- If cable replacement is necessary, use comparable cable

Testing Battery Cables



Checking the terminal for corrosion and high resistance

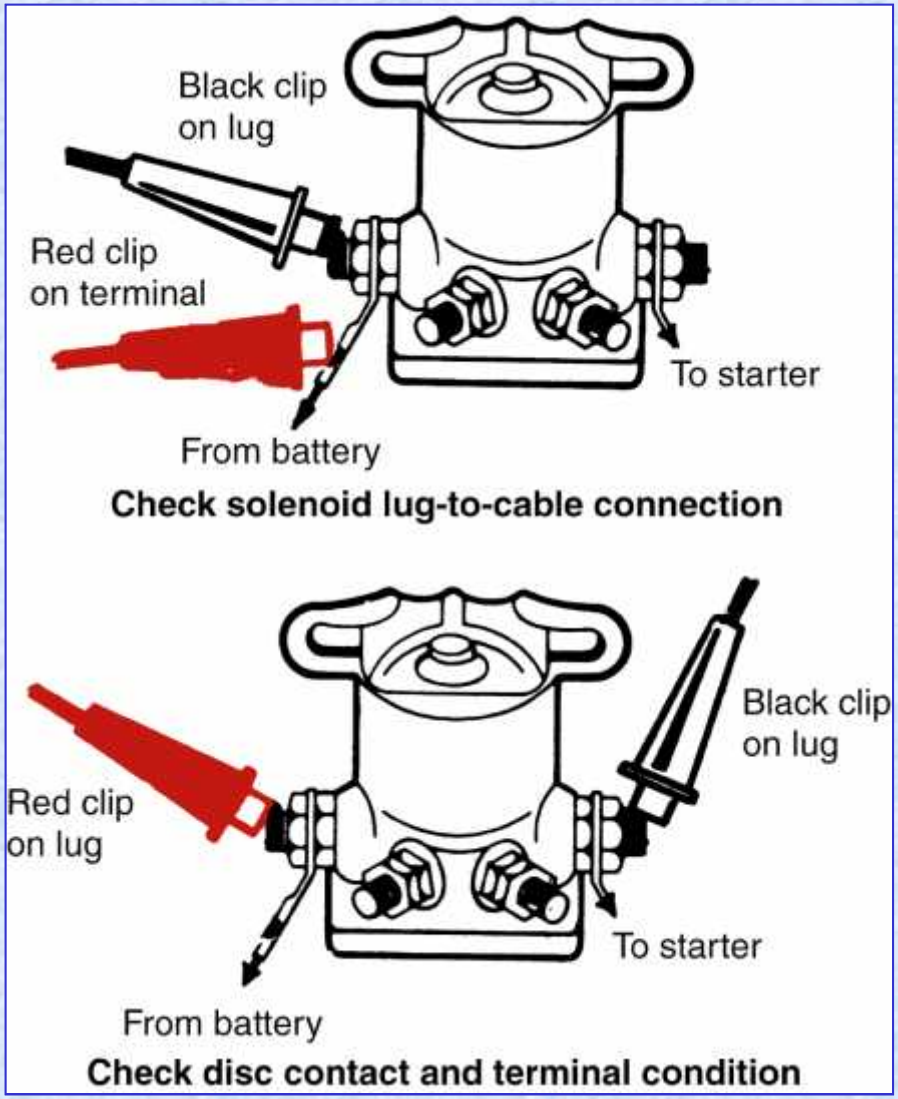
Starter Solenoid Service

- Solenoid problems can cause slow cranking, no cranking, or keep the starter cranking after engine start-up
- The large disc-shaped contact can burn and pit
- Windings can open or short

Solenoid Testing

- Connect the voltmeter across the specified terminals
- Crank the engine
- Maximum 0.3 volts drop
- Replace the solenoid if the voltage drop is too high

Solenoid Testing



Ignition Switch Service

- Ignition switch problems can prevent the solenoid from working normally
- Contacts can wear or burn
- Open circuit causes no-crank condition
- Short circuit causes the engine to crank all the time

Ignition Switch Testing

- Touch a grounded test light to the solenoid “S” terminal
- The test light should glow when the key is turned to the “start” position
- The test light should go out when the key is released

Starter Relay Service

- Relay problems will keep power from the starter solenoid and prevent cranking
- Winding or contact points could be faulty
- Use a test light or voltmeter to test for voltage going into and coming out of the relay terminals

Neutral Safety Switch Service

- A misadjusted or faulty switch can keep the engine from cranking
- Move the transmission gear shift lever into various positions while trying to start the engine
- If the switch allows cranking in the wrong gear, adjust it

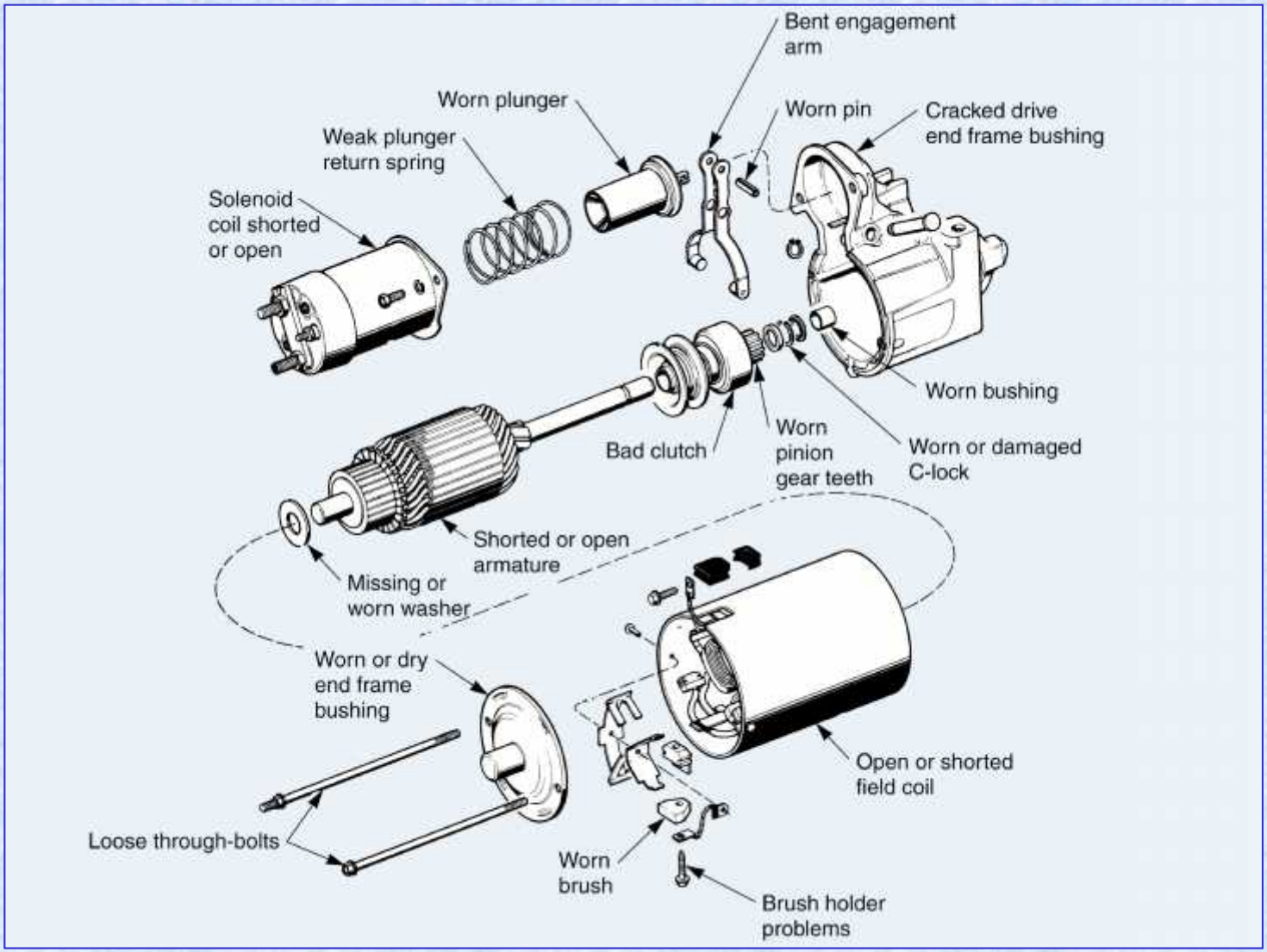
Switch Testing

- Touch a grounded test light to the switch output while moving the shift lever
- The test light should glow in park and neutral
- The test light should not glow in other positions

Starter Service

- A faulty motor may cause several symptoms:
  - slow cranking
  - no cranking
  - overheating cables
  - noise

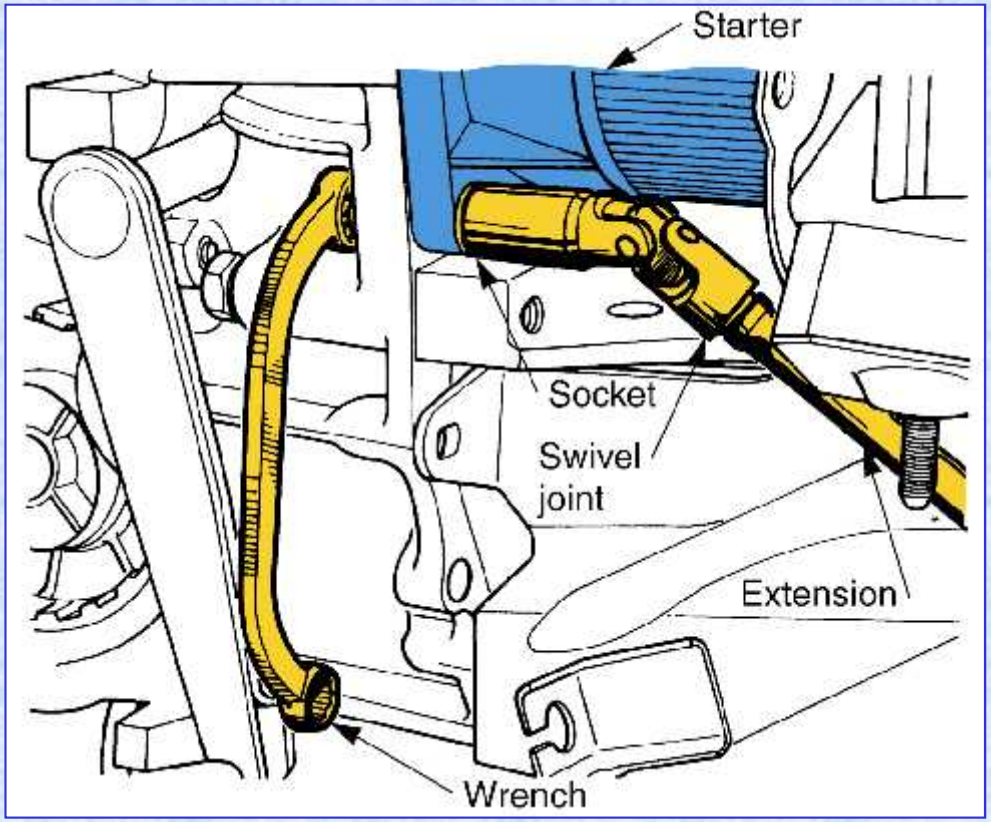
Starting Motor Problems



Starting Motor Removal

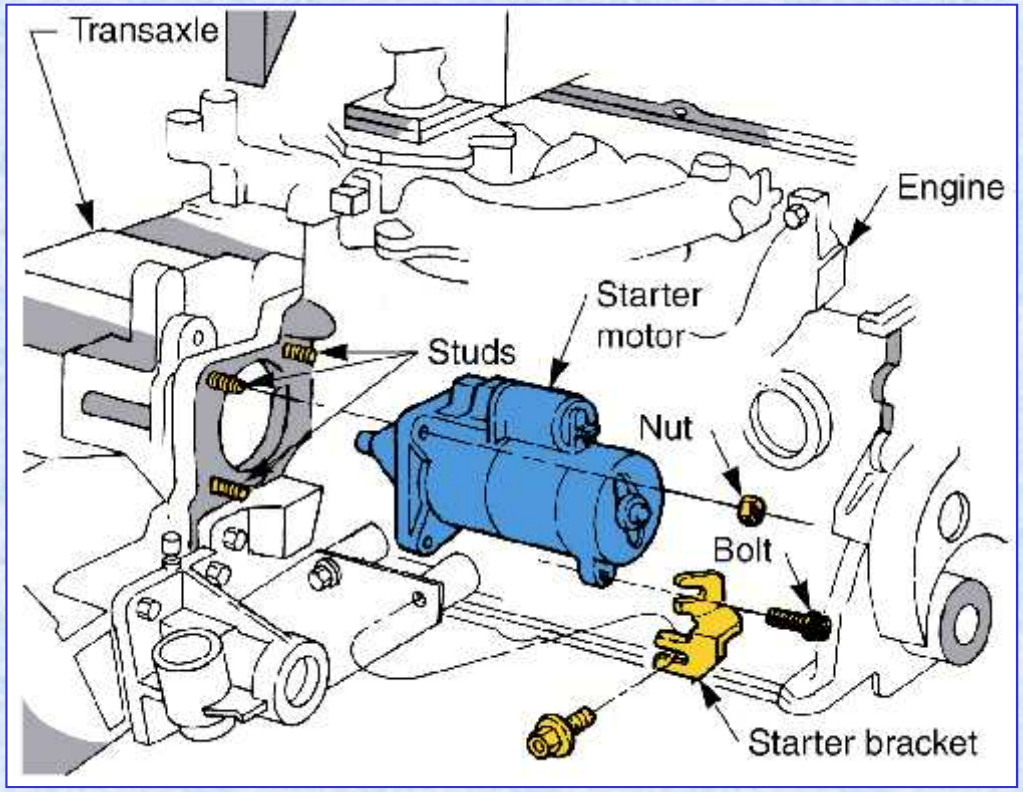
- Disconnect battery
- Unbolt cable and wires
- Unscrew bolts while holding motor
- Note the position of any adjustment shims

Starting Motor Removal



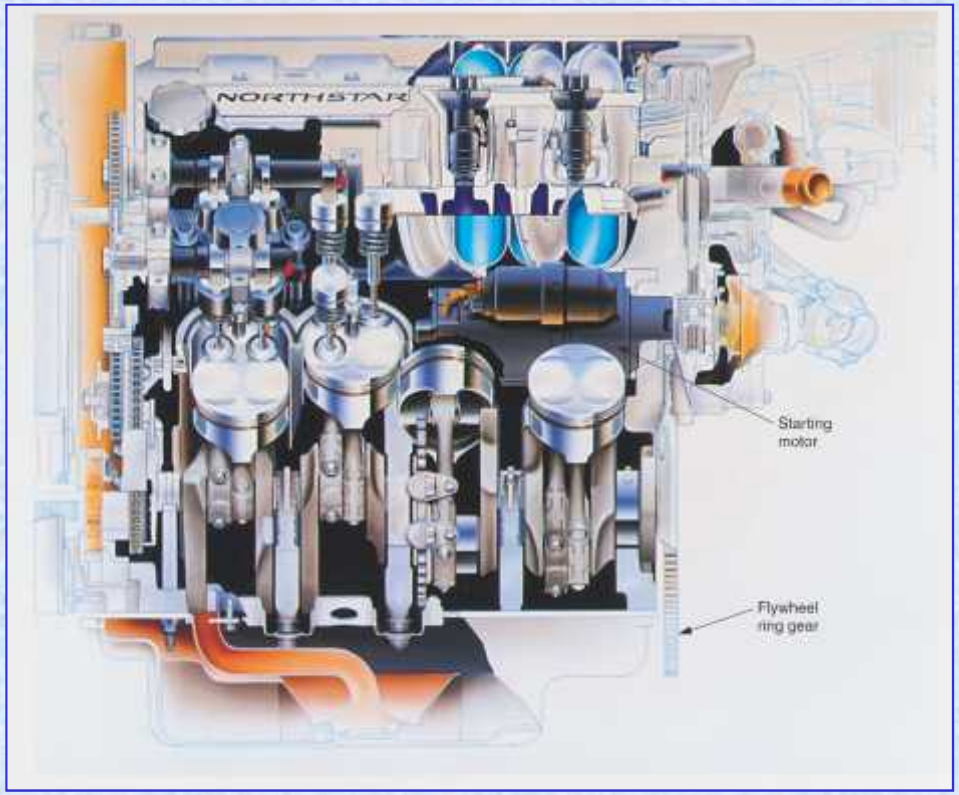
When fasteners are hard to reach, a swivel, extension, and ratchet may help

Starting Motor Removal



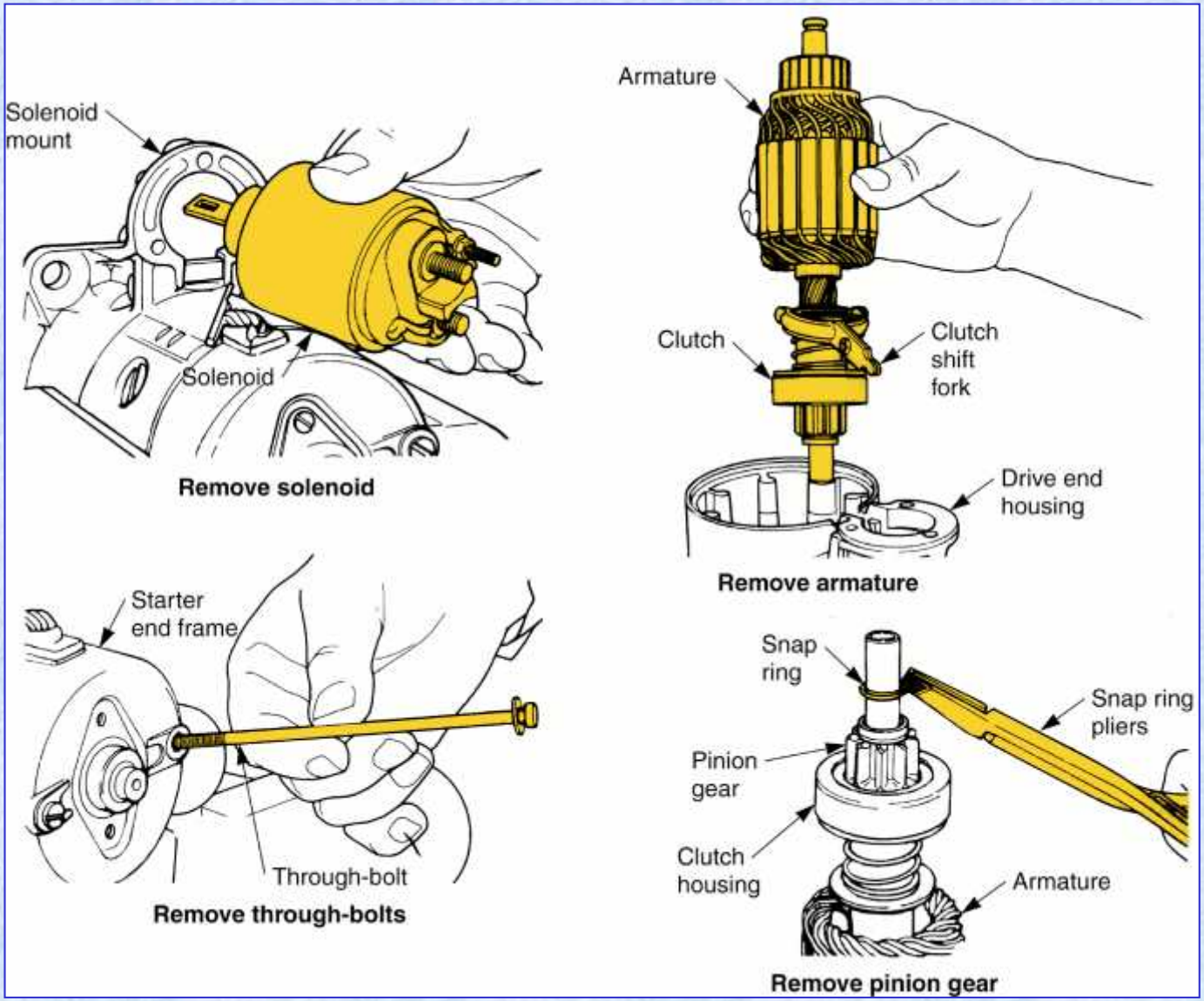
Hold the starter firmly, because it is fairly heavy

Top-Mounted Starter



Remove the intake manifold to access the starting motor

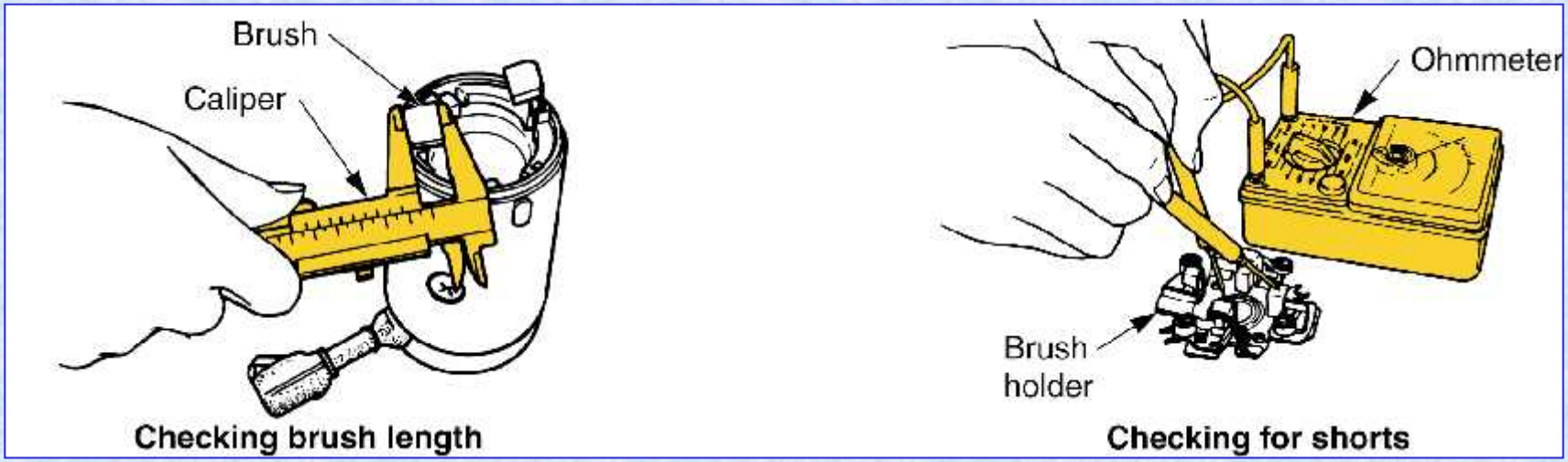
Starter Disassembly



Inspecting Parts

- Wear safety glasses
- Blow parts clean with compressed air
- Wipe components with a clean, dry cloth
- Do not use solvent, as it may damage insulation, soak into the brushes, or wash lubricant from the clutch

Brush Service



Compare brush length to specifications.
Check for shorts

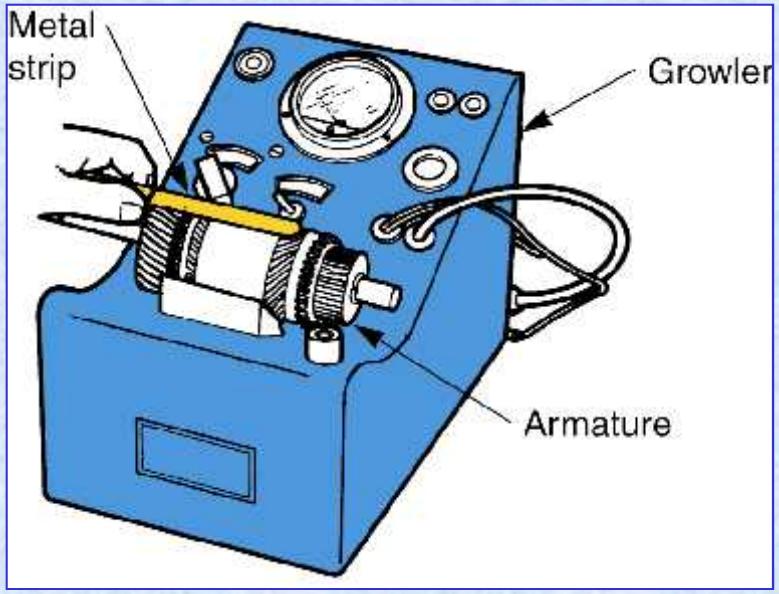
Armature Service

- Visual inspection for wear and damage
  - look for signs of burning or overheating on the windings and commutator
  - check the armature shaft for bends, wear, and burrs
- Test for:
  - short circuits
  - open circuits
  - shorts-to-ground

Short-Circuit Check

- Check for a short circuit on a *growler*
- Following tool instructions, hold a metal strip or hacksaw blade next to the armature
- Rotate the armature
- The blade should not vibrate
- The blade will vibrate when passed over a shorted leg

Short-Circuit Check

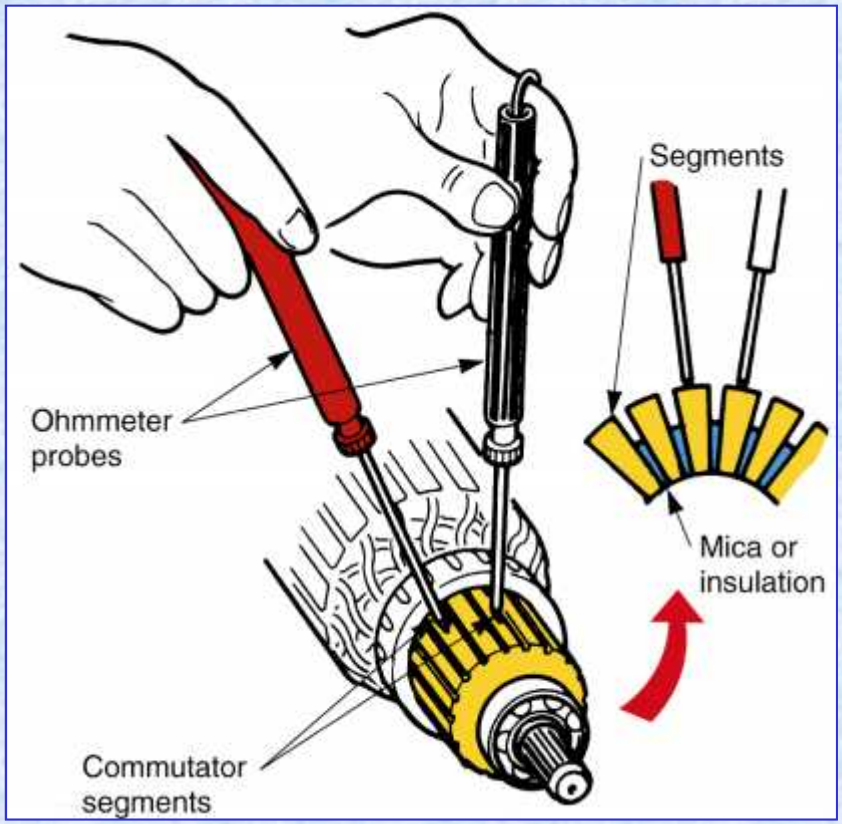


If the metal strip vibrates, replace the armature

Open-Circuit Check

- Use growler leads or an ohmmeter
- Touch the meter leads to each commutator segment
- If infinite resistance is indicated on any segment, that segment winding is open

Open-Circuit Check

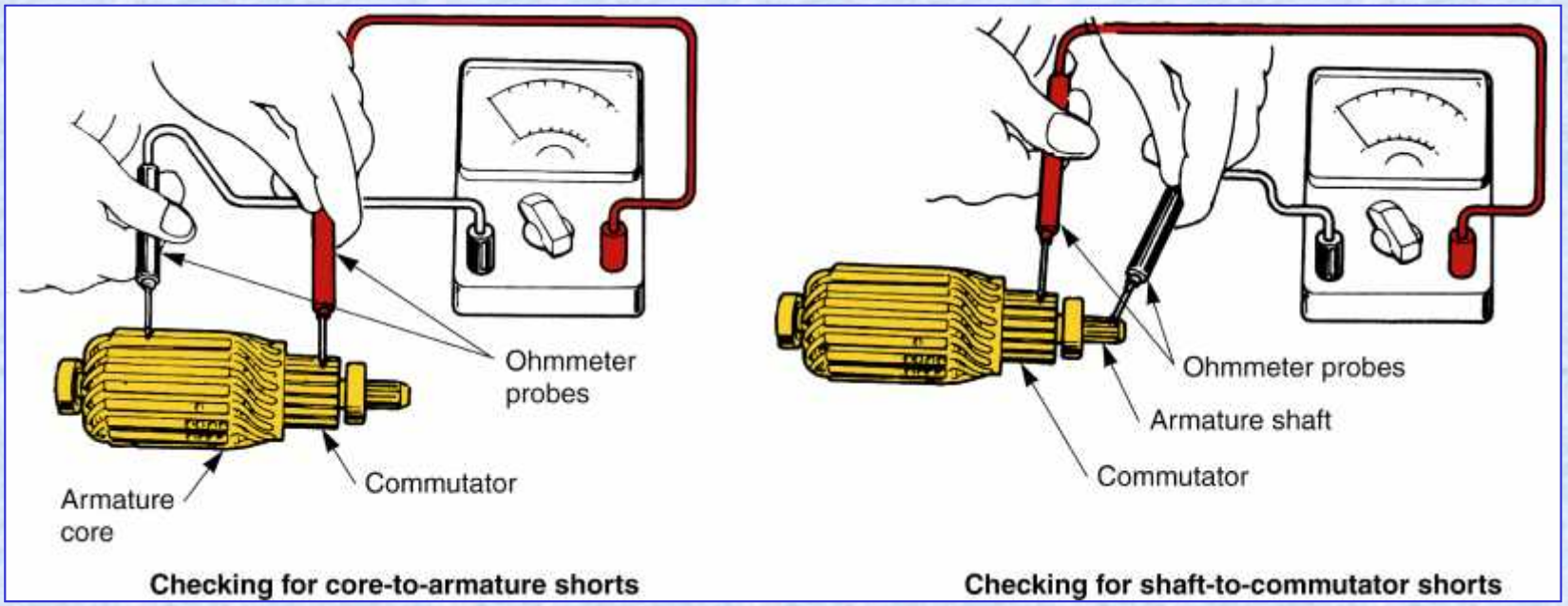


If an open exists between any commutator segment, replace the armature

Short-to-Ground Check

- Use an ohmmeter
- Touch leads on the coil core and the commutator segments
- Repeat the test with the leads on the armature shaft and the commutator segments
- Continuity or low resistance in either test indicates a grounded armature

Short-to-Ground Check

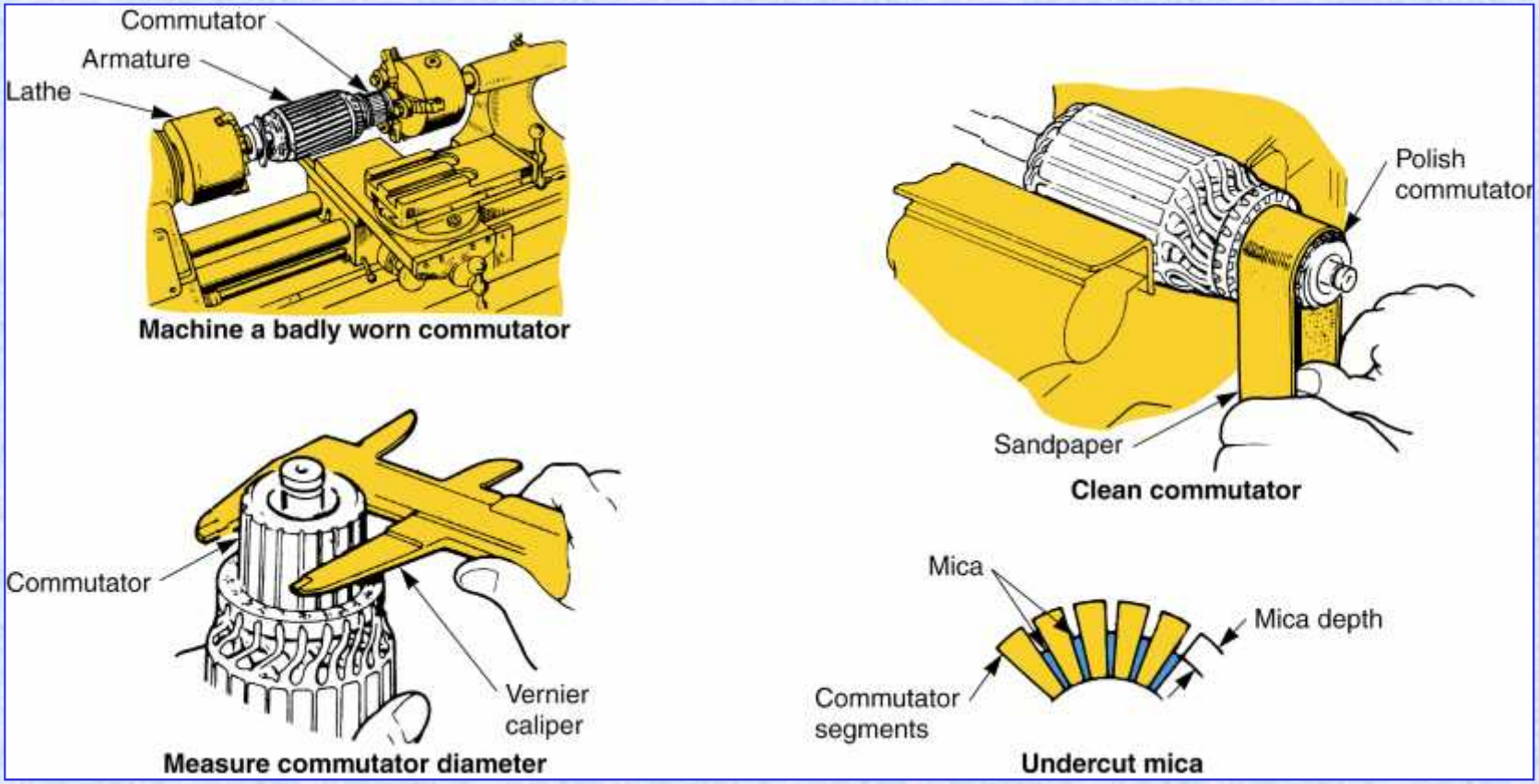


If shorted to ground, replace the armature

Commutator Service

- A commutator in good condition may be sanded with fine sandpaper
- A badly worn commutator may be turned on a lathe and the insulating mica between the segments undercut using a special tool or hacksaw blade

Commutator Service



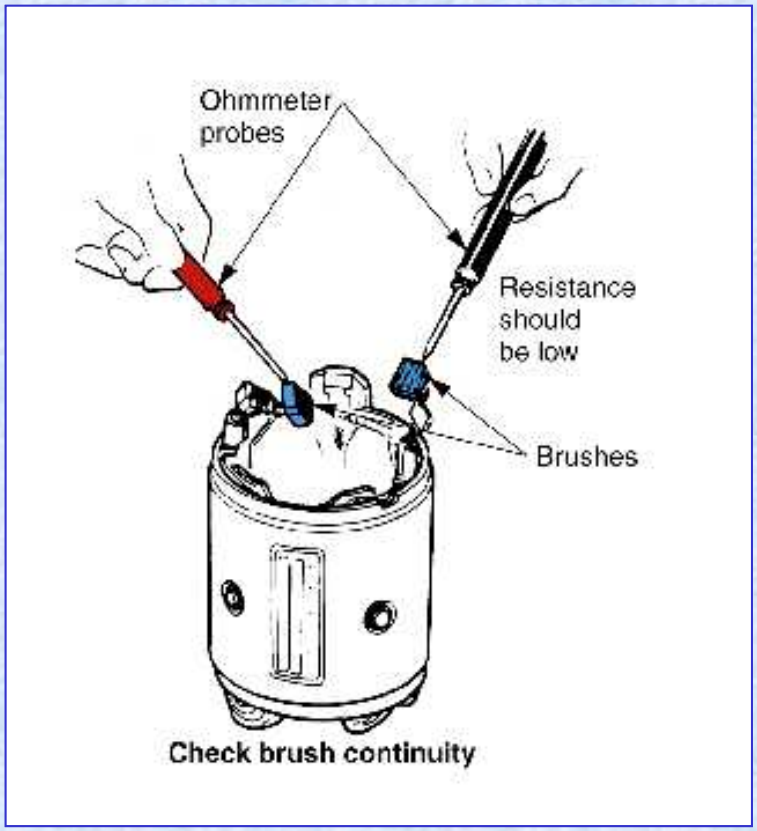
Field Coil Service

- Visual inspection for damage or burning
- Test for:
  - open circuits
  - shorts-to-ground

Open Circuit Check

- Test for opens between brushes using a self-powered test light or an ohmmeter
- Touch the leads to each insulated brush
- The test light should glow or the resistance should be low
- If the test light does not glow or the resistance is high, there is an open in the circuit
- Connections may vary–see service manual

Open Circuit Check



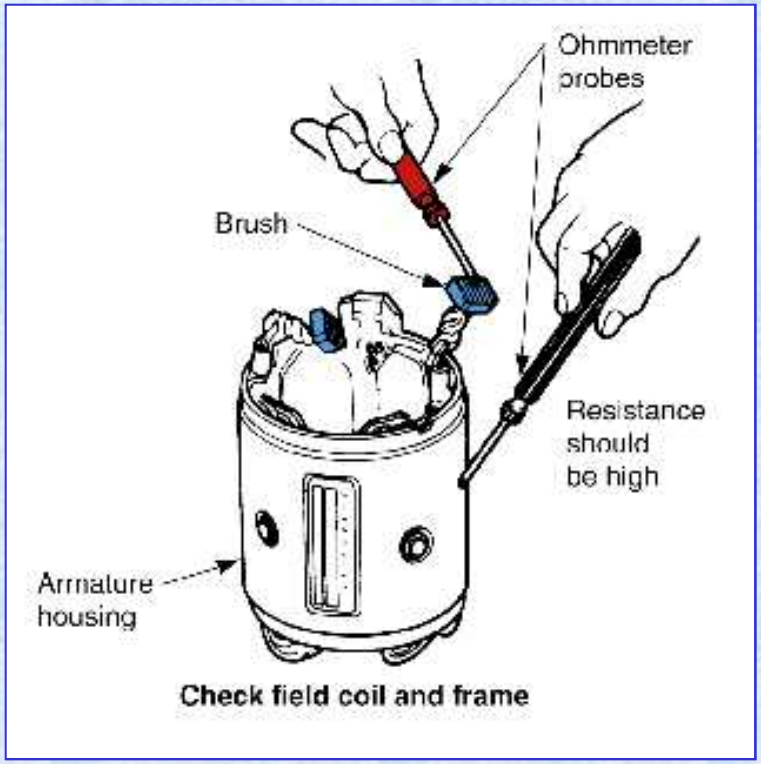
Check brush continuity

If resistance is high, replace the field winding

Short-to-Ground Check

- Test for grounds using a self-powered test light or an ohmmeter
- Touch one lead to the insulated brush and the other lead to the starter housing
- The light should not glow or the meter should read infinite resistance
- If the light glows or there is low resistance, there is a short-to-ground
- Remove any shunt winding for this check

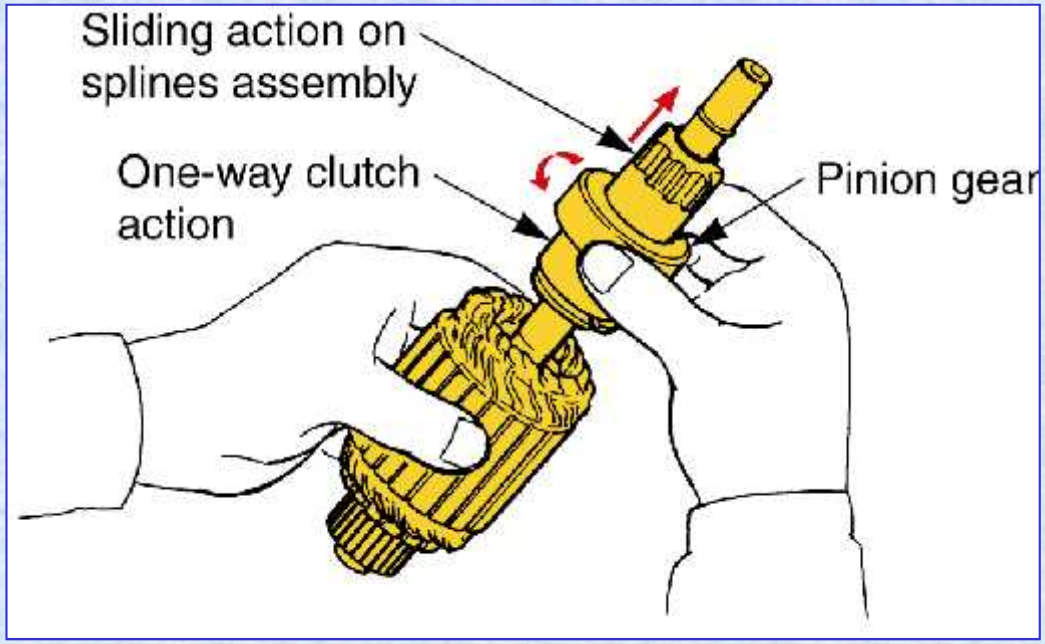
Short-to-Ground Check



Check field coil and frame

If resistance is low, replace the field winding

Overrunning Clutch Service

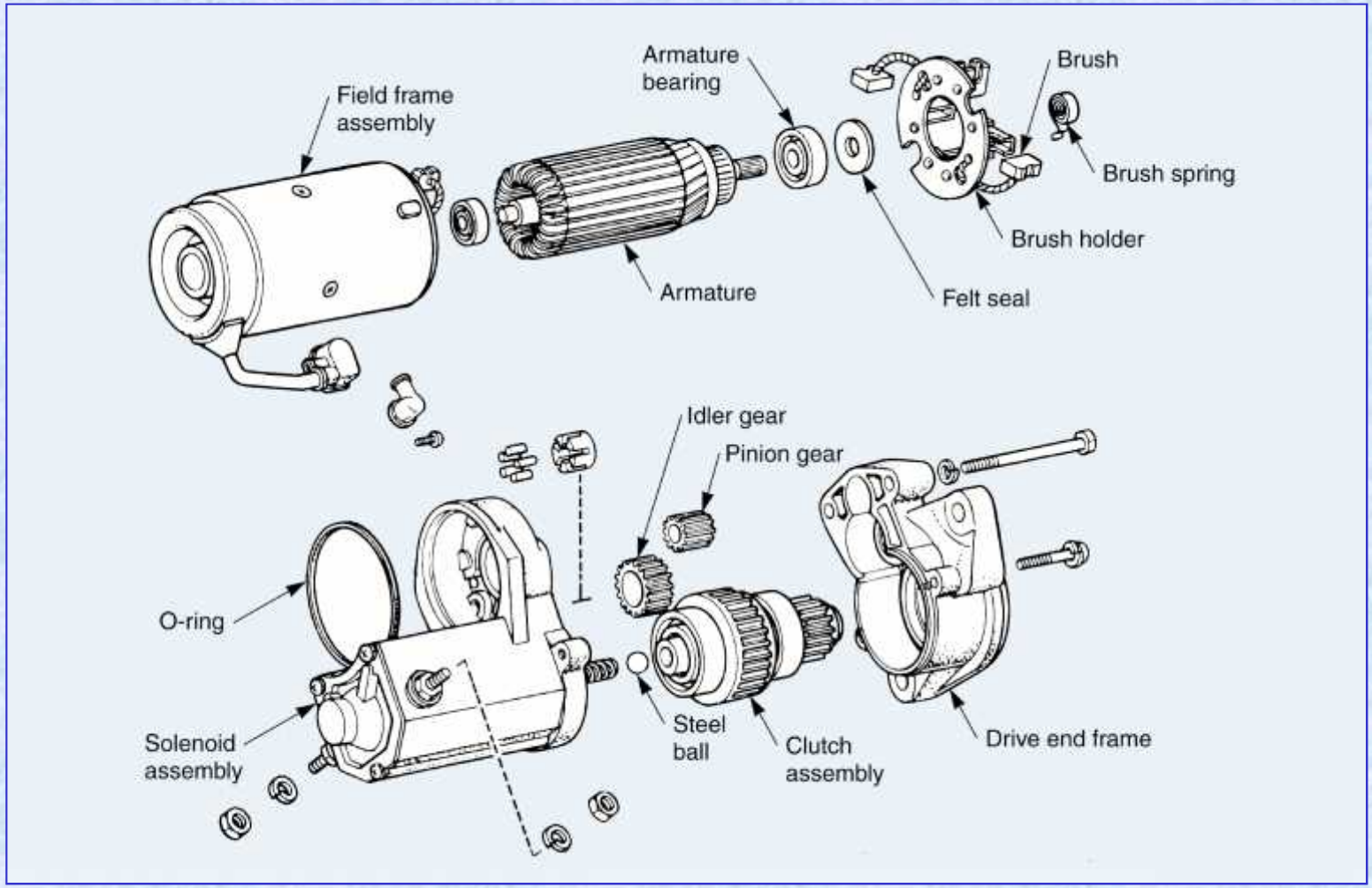


Check clutch action, as well as gear and bushing condition

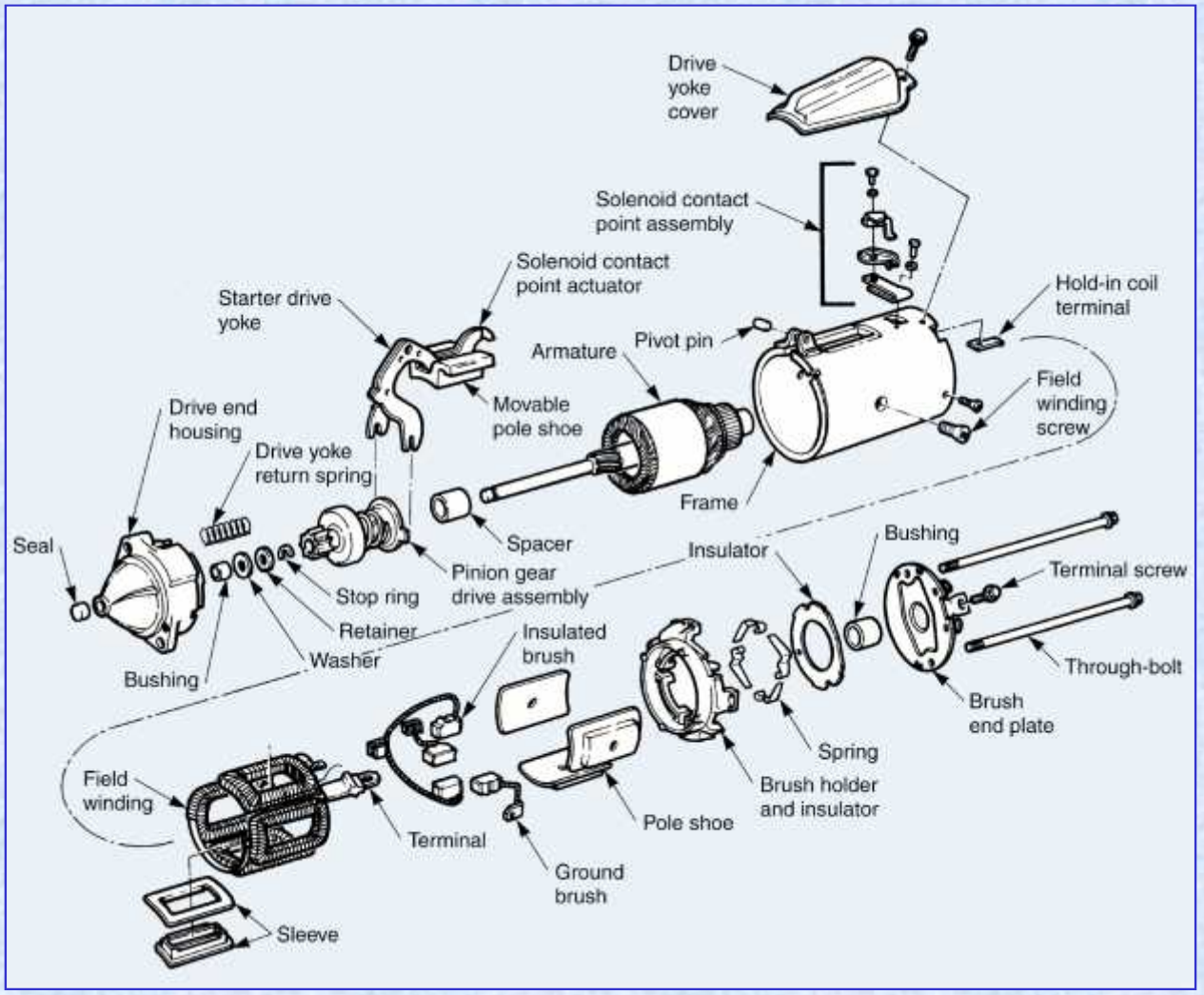
Starter Reassembly

- Lubricate bushings, pinion splines, and other parts as recommended
- Reassemble the starter in the reverse order of disassembly
- Bench test as recommended, checking pinion gear clearance
  - distance between the pinion and drive end frame

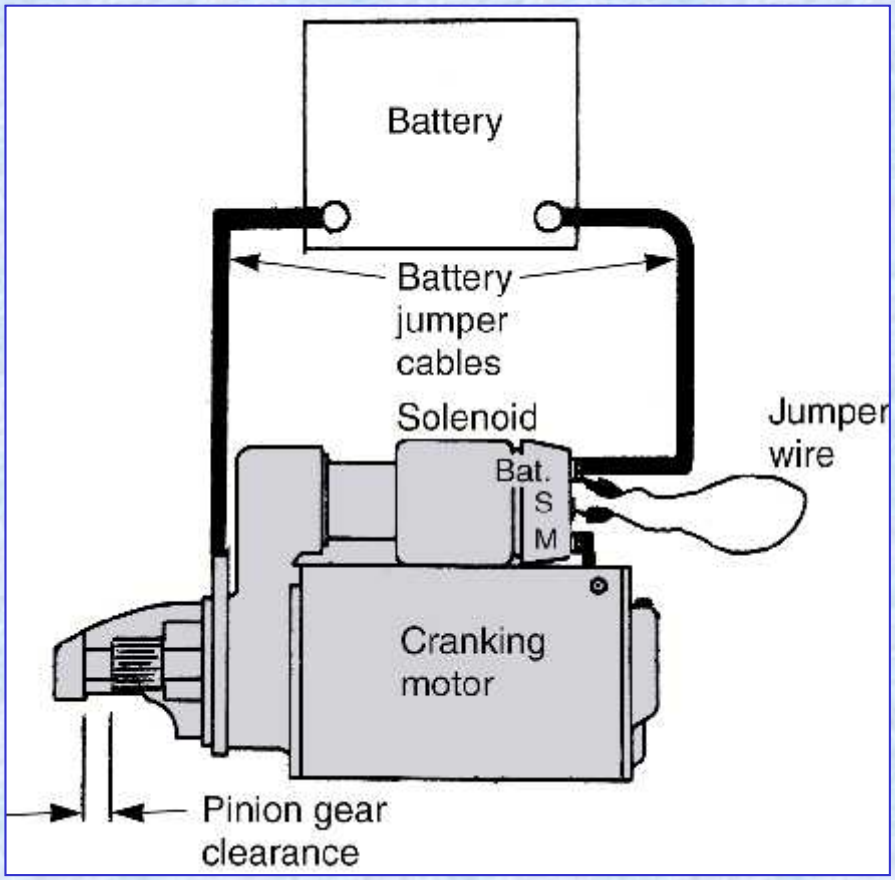
Reduction-Type Starter Parts



Direct-Drive Starter Parts



Starter Bench Test

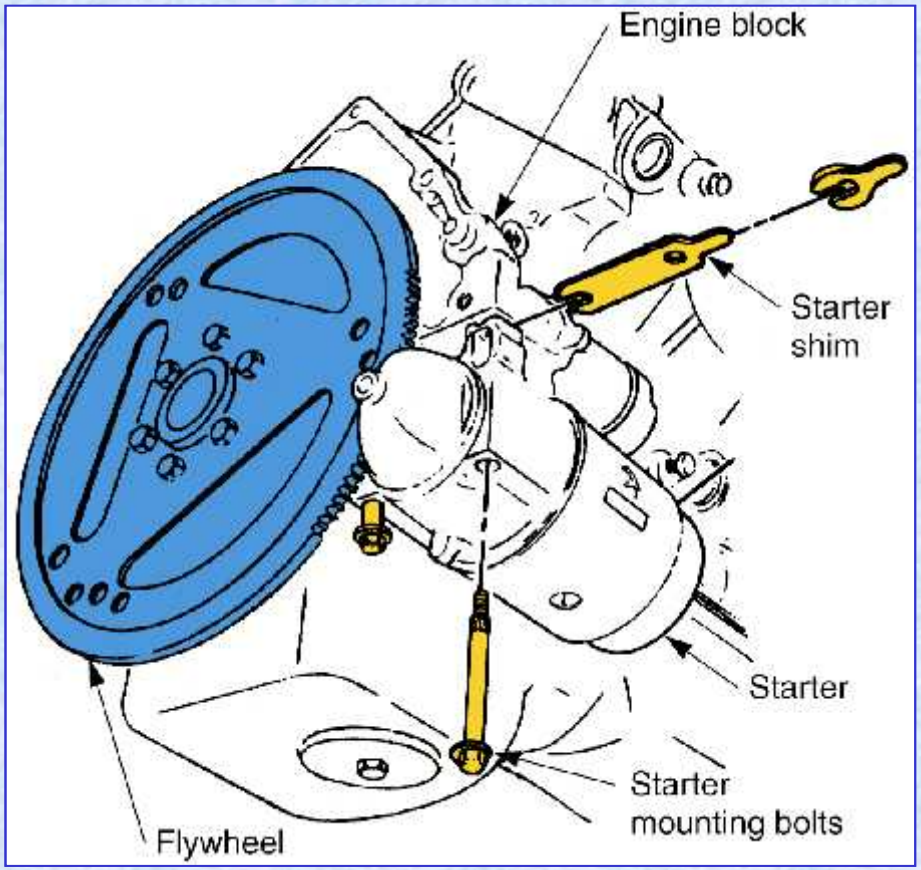


Connect a battery and check operation

Starter Installation

- Replace any spacer shims
- Replace mounting bolts and torque them to specification
- Install wires and cables
  - if the starter has a solenoid on it, connect the wires on the solenoid before bolting the starter to the engine
- Replace any brackets or shields
- Reconnect the battery and crank the engine several times to check starting motor operation

Starter Installation



Note starter shim location