MOTORCRAFT POSITIVE ENGAGEMENT

Ford, Jeep 6-Cyl. & V8

DESCRIPTION

Unit is a 4-pole, 4-brush starter with 3 series coils and 1 shunt coil. Shunt coil is wound around a movable pole piece, which operates integral positive engagement drive mechanism.

Solenoids for Jeep vehicles with automatic and manual transmissions differ in their method of grounding solenoid pull-in windings.

TESTING

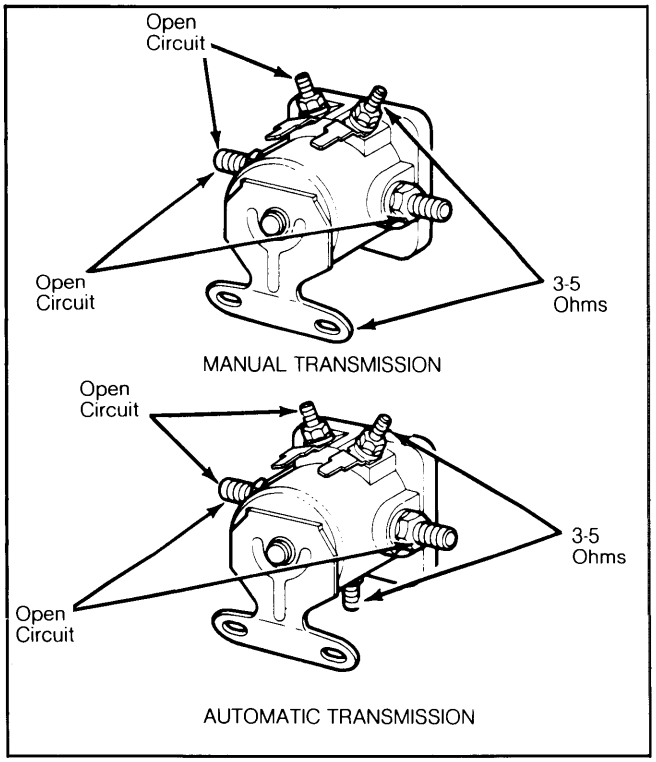
HOLD-IN WINDING TEST

Insert a piece of paper between contact points to serve as an insulator. Touch ohmmeter leads to starter frame and input terminal. Resistance should be 2.0-3.5 ohms. If not, replace field winding assembly.

PULL-IN WINDING TEST

1) Disconnect wire from solenoid "S" terminal. Connect ohmmeter test probes to "S" terminal and mounting bracket (ground terminal on Jeep vehicles with automatic transmission). *See Fig. 1.* If not to specifications, replace solenoid.

Fig. 1: Ford & Jeep Ohmmeter Test Connections for Solenoid.



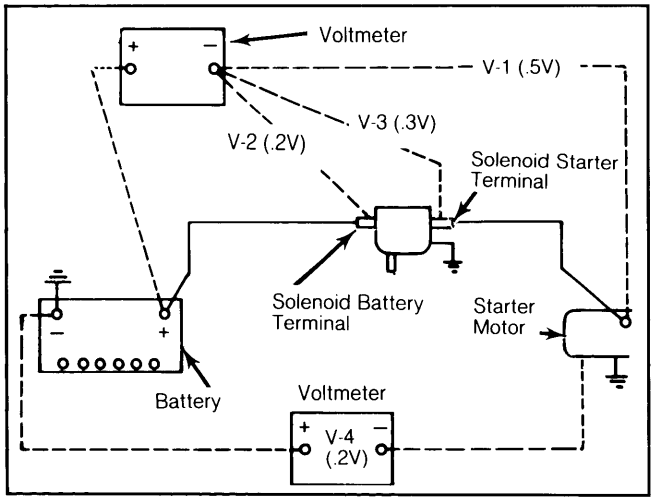
Connections must be clean and tight to make proper test.

2) Check for a poor ground by connecting ohmmeter leads to battery negative terminal and "S" terminal. If reading is greater than results received between "S" terminal and mounting bracket, solenoid has poor ground.

STARTER CRANKING CIRCUIT TESTS

Before performing tests, remove and ground coil secondary wire (disconnect at distributor). Place transmission in "Neutral" or "PARK" and apply parking brake. Be sure battery is fully charged. When making voltmeter connections, be sure to connect leads to battery posts or threaded terminals and not just to cable ends.

Fig. 2: Connections for Cranking Circuit Test Ford & Jeep



Voltages are shown for each connection.

Battery-to-Starter Motor Voltage Drop (V-1)

1) Connect voltmeter positive lead to battery positive post and negative lead to starter motor terminal. While cranking engine, note voltmeter reading. Reading should be .5 volts or less at specified load test amperage.

2) If reading is greater, move negative lead to starter cable at starter and retest. If voltage is now .5 volt or less, remove cable and clean connections, and retest at starter motor terminal. If voltage is still above specifications, test individual cables between battery and starter as follows:

Battery-to-Solenoid Voltage Drop (V-2)

1) Connect voltmeter positive lead to battery positive post and negative lead to battery terminal of solenoid. While cranking engine, note voltmeter reading. Reading should be .2 volt or less at specified load test amperage.

2) If just below or at specification, repair solenoid. If reading is greater, remove cable, clean connections, and retest. If reading is still above maximum .2 volt, replace cable.

Solenoid Voltage Drop (V-3)

1) Connect voltmeter positive lead to battery positive post and negative lead to starter CABLE at solenoid. While cranking engine, note voltmeter reading. Reading should be .3 volt or less at specified load test amperage.

2) If at or just below maximum reading, repair solenoid-to-starter cable. If reading is above maximum, move negative lead to starter TERMINAL at solenoid and retest.

3) If reading is now .3 volt or less, remove and clean cable connector, and retest. If still in excess of .3 volt, replace solenoid. If battery-to-starter circuit (V-1) reading is now greater than .5 volt, replace solenoid-to-starter cable.

Starters

MOTORCRAFT POSITIVE ENGAGEMENT (Cont.)

Starter Motor Ground Voltage Drop (V-4)

1) Connect voltmeter negative lead to starter motor housing and positive lead to battery negative post. While cranking engine, note voltmeter reading. Reading should be .2 volt or less at specified load test amperage.

2) If more, move positive lead to ground cable attaching bolt at engine and retest. If reading is now less than .2 volt, check starter motor for loose mounting bolts, corrosion or dirt on mounting surface. If reading is now more than .2 volt, examine ground cable for bad connections or bad cable.

STARTER LOAD TEST

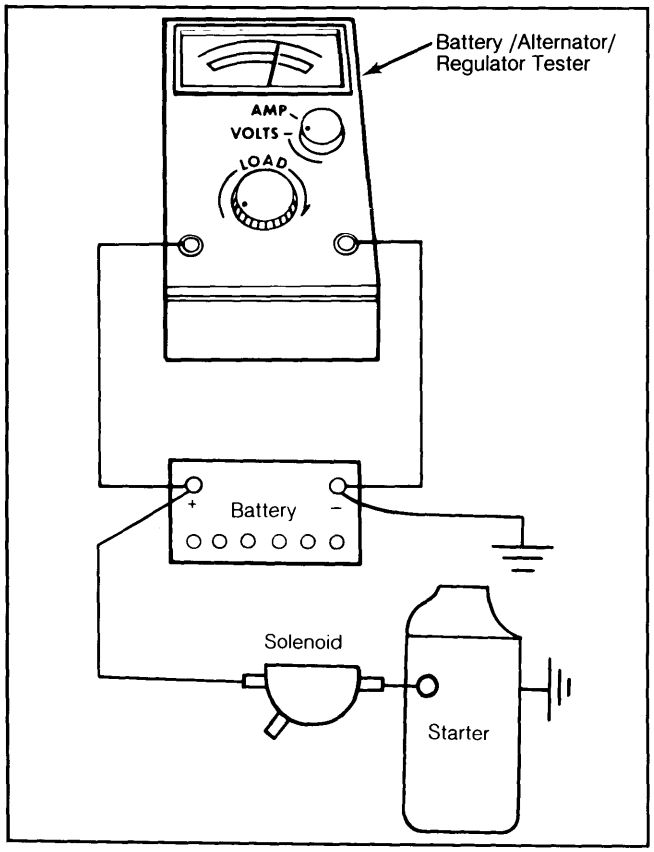
1) Connect a tester and battery into starter circuit. *See Fig. 3.* Crank engine with ignition coil secondary wire grounded and note voltage on tester.

2) Stop cranking engine and turn load control knob until voltage reading is exactly the same as it was when engine was cranking. Read current draw on ammeter scale. If not within specifications, starter is defective and must be overhauled.

LOAD TEST SPECIFICATIONS

Application	Amperes
Ford	
4" Starter	150-200
4½" Starter	150-180
Jeep	
6-Cyl.	150-180
V8	160-210

Fig. 3: Ford & Jeep Connections for Load Test



Take amperage draw reading with starter at maximum RPM.

STARTER NO-LOAD TEST

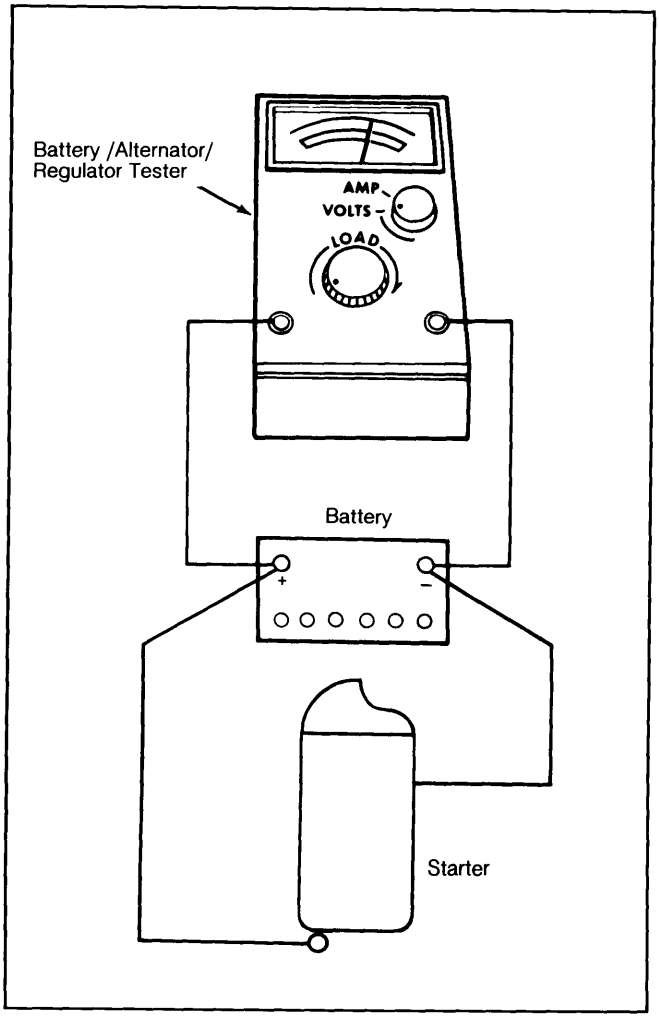
1) With tester and battery connected to starter, operate starter motor and note voltage reading and tachometer reading. *See Fig. 4.* Disconnect starter from battery. Turn load control knob until voltage reading is same as when starter is connected.

2) Read amperage draw, and if amperage reading is less than specifications, starter has high electrical resistance. If starter RPM is less than specifications, starter has high electrical resistance. If starter RPM is less than specifications starter has worn bushings or bent armature shaft.

NO-LOAD SPECIFICATIONS

Application	Specification
Voltage	12 Volts
Amperage	
Ford	
4" Starter	70 Amps.
4½" Starter	80 Amps.
Jeep	67 Amps.
RPM Range	7,380-9,356

Fig. 4: Ford & Jeep Connections for No-Load Test



Test results will indicate faults such as open or shorted windings.

MOTORCRAFT POSITIVE ENGAGEMENT (Cont.)

OVERHAUL

DISASSEMBLY

1) Remove cover screw, cover, through bolts, starter drive end housing and starter drive plunger lever return spring. Remove pivot pin retaining plunger lever and remove plunger lever and armature.

2) Remove stop ring retainer, stop ring from starter drive gear and starter drive gear assembly. Remove brush end plate and insulator assembly. Remove brushes from brush holder and lift out brush holder. Note location of brush holder with respect to end terminal.

3) Remove ground brushes-to-frame retaining screws. On field coil which operates drive gear actuating lever, bend edges on retaining sleeve and remove sleeve and retainers.

4) Remove 3 coil retaining screws with Generator Pole Screw Wrench (10044-A) and an arbor press. Cut field coil connection at switch post lead and remove small diameter ground wire from upper tab riveted to frame.

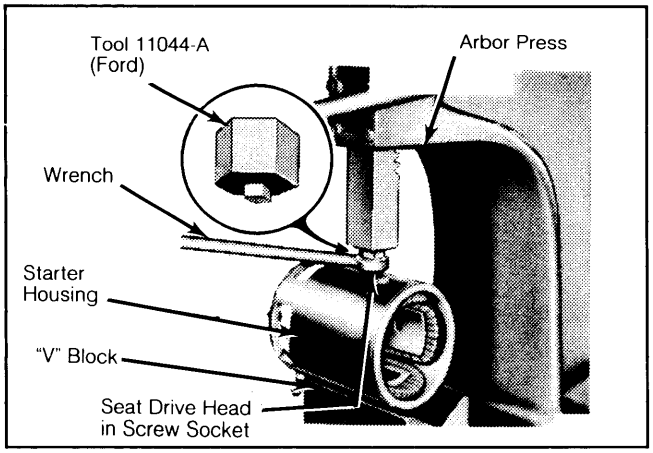
5) Remove pole shoes and coils from frame. Cut positive brush leads from fields coils as close to field connection point as possible.

PARTS REPLACEMENT & TESTING

Brushes & Springs

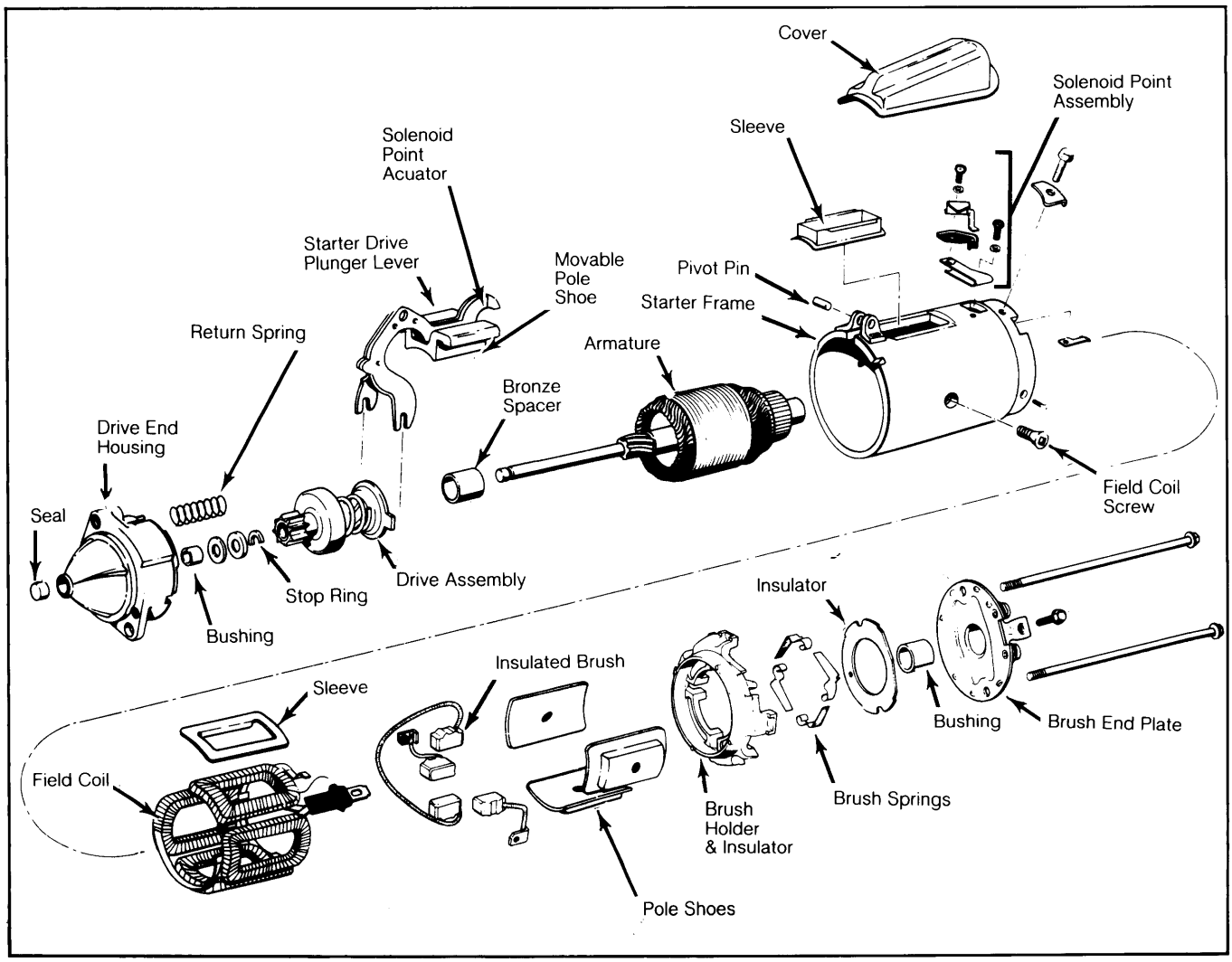
1) Check brush holders for broken springs and insulated brush holders for shorts to ground. Tighten any

Fig. 5: Removing Pole Shoe Screw from Starter Housing.



Use arbor press to hold generator pole screw wrench.

Fig. 6: Exploded View of Motorcraft Starter Motor Assembly Used On Ford & Jeep



MOTORCRAFT POSITIVE ENGAGEMENT (Cont.)

loose rivets. Replace brushes if worn to ¼" in length. Measure spring tension with spring scale hooked under spring near end.

2) Pull on line parallel to edge of brush and note reading just as spring end leaves brush. Spring tension should be 40 ozs. (1.134 kg) on 4" starters, 80 ozs. (2.263 kg) on 4½" starters. If replacing brushes, use a 300 watt soldering iron and rosin core solder.

Field Coil Assembly

Inspect field coils for burned or broken insulation and continuity. Check field brush connections and lead insulation. Check for grounds in field coil windings.

Armature

1) Check armature for shorted coils with a growler and a test light. Touch 1 test lead to armature core and the other to each commutator bar 1 at a time. If light lights, armature is shorted to ground and must be replaced.

2) Place switch on growler in GROWLER position and hold steel blade parallel to and touching armature core. Rotate armature and if blade vibrates at any point, that area is shorted and armature must replaced.

3) Inspect armature shaft for excessive wear. Inspect windings for broken or burned insulation. If commutator is rough or more than .005" (.13 mm) out of round, turn down in a lathe, removing only enough material to provide a smooth, even surface.

REASSEMBLY

1) Position 3 coils and pole pieces and install attaching screws. As pole shoe screws are tightened, strike frame with a soft hammer to seat and align pole shoes, then stake screws.

2) Install remaining coil and retainer. Bend tabs to secure coil to frame. Position new field brush lead on field coil terminal. Install clip to hold brush lead to terminal. Solder lead, clip and terminal together with a 300 watt iron and rosin core solder.

3) Ground coil around retaining sleeve by placing small diameter wire from coil under copper tab which attaches contact to frame. Install ground brushes to frame with screws.

4) Lubricate armature shaft splines with Lubriplate (or equivalent). Install drive gear assembly on armature shaft. Install new retaining stop ring and stop retainer.

5) Install armature in frame. Partially fill drive end housing bearing bore with grease and position drive gear plunger lever to frame and starter drive assembly and install pivot pin.

6) Install plunger lever return spring and drive end housing to frame. Install brush holder, brushes and springs. Install brush holder insulator.

7) Position end plate to frame and align plate locator with frame slot. Install and tighten through bolts. DO NOT pinch brush leads when installing end plate. Position drive gear plunger lever cover on starter and tighten cover screw.