

More Solenoid Peculiarities

IN THIS ISSUE WE CONTINUE our discussion of solenoids and their peculiarities. For our first two installments on solenoids, see *Technical Update 33* (November 1996) and *Technical Update 34* (February 1997). Sorry we made you wait a year for this. Thanks for your patience.

The well-adjusted starter

In order for a starter to operate properly, so you don't get either a milling or a "click-click" condition, the starter-drive pinion and the solenoid contacts must be in the proper positions. If the solenoid contacts



Figure 1. Adjust some import starters by adding or subtracting shims.

close too early, you will get a milling condition. If the starter-drive pinion hits the stop collar before the solenoid contacts close, you will get a click-click condition (see *Technical Update 34* for a full explanation of these two conditions).

On some starters, you can actually adjust the position of the starter drive in relation to the solenoid contacts. For example, on many types of import starters you can make this adjustment by adding or subtracting shims between the solenoid mounting and the

D.E. frame (*Figure 1*). Other starters allow you to lengthen or shorten the plunger stem on the solenoid to get the correct position for the starter-drive pinion (*Figure 2*). Still others allow you to make this adjustment using a cam-action (eccentric) pivot for the starter-drive shift lever (*Figure 3*).

To know how much adjustment you need to make on a particular starter, you need to check the clearance



Figure 2. Adjust some import starters by changing the length of the plunger stem.

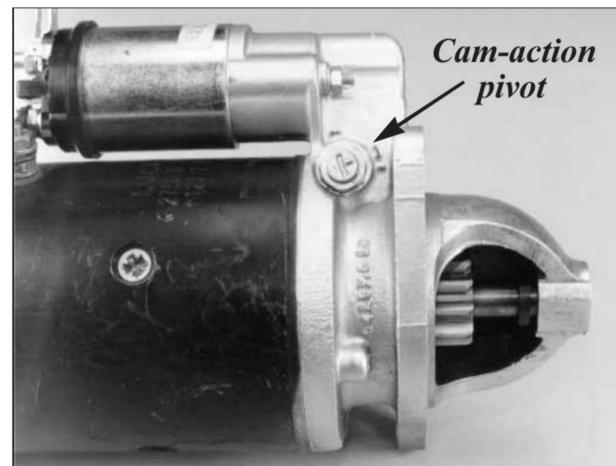


Figure 3. Adjust other import starters using a cam-action pivot for the starter-drive shift lever.

between the pinion and stop collar. We've found the following procedure works well for checking that clearance:

After the starter is built, take a 6-volt battery and connect the negative terminal to the starter's ground and the positive terminal to the solenoid's S-terminal. This will engage the drive and allow you to measure the amount of clearance between the end of the starter-drive pinion and the stop collar. See the chart in *Figure 4* on page 2 for clearance specifications for selected starters.

Pinion Adjustments	
Lucas (Distance between pinion and thrust washer/stop collar)	Delco (Distance between pinion and D.E. housing)
M50 & M127 .015 - .025	40MT } $23/64 \pm 1/32$
M35G .005 - .015	42MT } $.360 \quad .031$
M418G .005 - .015	50MT }
M45G, M (roller clutch style) .005 - .015	
M45G (S.I.D. clutch disc style) .020 - .030	

Figure 4. For Bosch, Mitsubishi, Nippondenso and Hitachi solenoids, adjustment specifications vary for each make and model. Refer to your Mitchell manual or OE service manuals for these specifications.

WARNING:

1. Do not make a connection to the battery terminal on the solenoid.
2. Do not use a 12-volt battery for this test. With a 12-volt battery the solenoid will draw twice the amount of current, which will cause it to heat up excessively and possibly destroy the solenoid windings.
3. Finally, if the armature starts turning when you conduct this test, you should ground the motor terminal of the solenoid to prevent the armature from turning.

Lucas M50 starters have a unique set of problems when they are not properly adjusted because of the way they index the starter drive with the flywheel. On these starters, if the drive pinion hits the flywheel but doesn't engage, a secondary set of contacts in the solenoid allows current to flow only in the fourth coil of the field coils. The armature then turns slowly, allowing the drive pinion to align itself with the flywheel. Once the drive is engaged with the flywheel, the primary solenoid contacts also close, allowing current to flow to the other three field coils as well as the fourth coil, so the starter cranks properly.

If the starter is out of adjustment so that when the drive pinion hits the flywheel the secondary set of contacts will not close, you will get a click-click condition when the starter is on the engine—even though it checks fine on the test bench. If, on the other hand, the starter is out of adjustment so the drive pinion hits the stop collar before the primary set of contacts closes, the starter will be operating only on the fourth field coil and this coil will burn up.

Nippondenso industrial starters

On some Nippondenso starters used on industrial equipment, the starter drive may stay engaged with the flywheel after the start switch has been returned to the run position. However, the starter operates properly on the test bench.

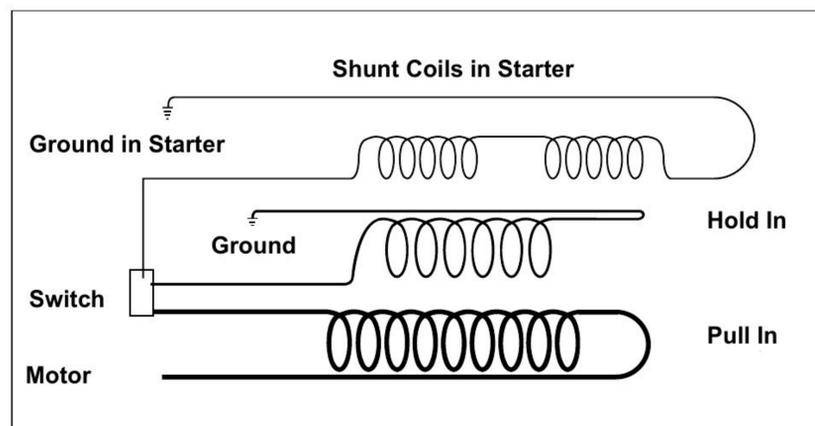


Figure 5. Some Nippondenso industrial starters have two shunt coils connected in parallel with the hold-in winding.

This can sometimes be caused by a battery that is insufficiently charged. But there can be another reason for this problem. These starters have two shunt coils in the field case that are connected in parallel with the solenoid hold-in winding (Figure 5). If the shunt coils have a problem with high resistance (causing low amp flow) or if they are shorted or grounded (causing high amp flow), the solenoid will be unbalanced. As a result, the plunger will not return properly, which will keep the drive engaged with the flywheel.

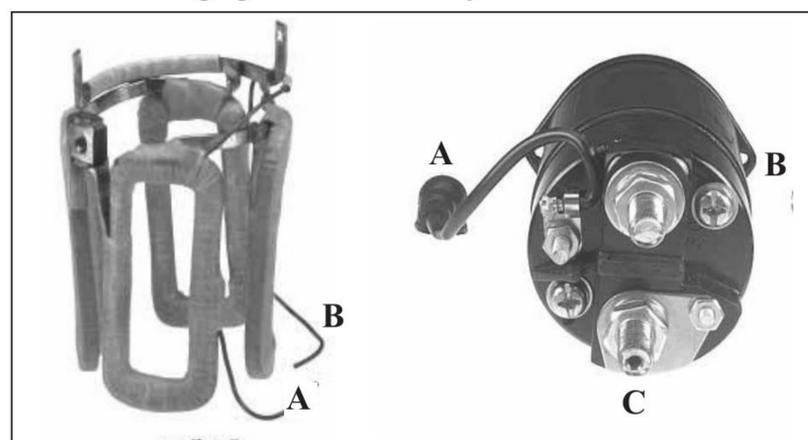


Figure 6. For a solenoid balance test, connect lead A with S-terminal A; connect lead B and solenoid case B to negative. Field coils should be in the case and the case connected to negative.

To find the source of this problem you can do a solenoid balance test after you have taken the starter apart. First, connect one shunt-coil lead to the S-terminal (A to A, as shown in Figure 6). Then connect battery-positive to the solenoid motor terminal (C in Figure 6). Finally, connect

the other shunt-coil lead (B) and the solenoid case (B) to negative. For best results, field coils should be in the field case and the case connected to negative. If the solenoid is balanced, the plunger will have no magnetic pull. If the solenoid is unbalanced, the problem is either in the shunt coils or in the solenoid itself.

Sliding armatures

On starters that use sliding armatures there are two coils in the field case that resemble shunt coils but are actually the solenoid pull-in and hold-in windings. One end of each of these coils is connected to the S-terminal. The other end of the pull-in winding is connected to the positive brush. The other end of the hold-in winding is connected to the negative brush.

Starters with sliding armatures have a lockout that will not let the solenoid contacts (battery to motor) close until the armature has moved forward and the drive is engaged with the flywheel.

Some Bosch sliding-armature starters have an auxiliary relay that applies current to the solenoid S-terminal. (See *Technical Update 33* for an explanation of auxiliary relays.)

The problem isn't always the starter: Factory service bulletins

While starters can sometimes be the problem in a vehicle, in certain cases a starter may appear to be the problem when, in fact, the problem is really something else.

To help technicians remedy certain tricky problems, manufacturers have published their findings in factory service bulletins. Following are the bulletins we know of to date concerning starter problems.

Delco 28MT

Freightliner Medium Duty Trucks (built before February 4, 1994).

In trucks with Cummins B5.9 and MB OM 377LA the starter stays engaged in a running engine after the key is released from the start position.

The problem is in the way the fuel solenoid receives its power.

For more detail see Freightliner Technical Service Bulletin (TSB) #15-3, May 1994 or the APRA *Electrical Connection*, July 1995.

1993-95 Ford Medium / Heavy Trucks

Cargo Series, F & B Series, L Series with FD1060 engines.

The starter can stay engaged when the key is released to the run position. This may be caused by an imbalance in the starter solenoid pull-in / hold-in coils due to the way the fuel solenoid receives its power.

For more details see Ford TSB #94-26-13.

1994-97 Ford Medium / Heavy Trucks

Cargo Series, F & B Series, L Series with an Allison MD 3000 transmission built through 8/1/96.

The engine may not start, the starter may not engage and/or the starter may cycle, engage-disengage-engage when the ignition key is turned to the start position.

This may be caused by incorrect voltage to the transmission Electrical Control Unit (ECU) which will incorrectly sense that the transmission is not in "Neutral" or "Park" thus interrupting starter operation.

For more details see Ford TSB #96-22-18.

Ford PMGR

1993 Mark VIII 4.6L

A no-crank or intermittent no-crank condition in temperatures of 25° F or lower may be caused by moisture in the starter solenoid that has frozen and will not allow the starter to engage.

The replacement starter motor has a lip seal and drain tube in the DE housing and silicone sealant at the solenoid / DE housing area.

For more details see Ford TSB # 93-7-4 or starters 2-1567-FD and 2-1799-FD in WAI's Domestic Core-ID Guide pages 176 and 177.

Ford with PMGR Starters. ALL

A no-crank or intermittent no-crank condition.

The problem can be corrosion at the S-terminal on the solenoid.

Replace the corroded connector with a Ford F4VY-14A411 wiring and connector assembly. Also apply dielectric gel to the connector to prevent further corrosion.

For more details see Ford TSB #94-18-3 and TSB #94-26-3.

Recently we have found that Ford is superseding

the PMGR starters that use a spade-type S-terminal to starters using a solenoid with an M6 x 1.0 post-type S-terminal. They include a terminal kit with the starter that lets you convert the wiring harness from a spade to an eyelet. Kit #WT5673-B (F6VY14A411-AA).

Delco PMGR and SD210 / 260

1991-93 Buick, Chevrolet, Oldsmobile and Pontiac w/3.1L and 3.4L engines

When attempting to start the engine, the customer may hear a click but the starter will not crank. This condition is usually intermittent.

Possible causes:

- 1) The connection to the starter, battery, or ground may be loose or corroded. The battery may also have insufficient charge.
- 2) The starter motor may have insufficient internal lubrication and/or too high drive-spring force.
- 3) The installation of an aftermarket theft alarm system (including the "Goodwrench" system) may add enough additional resistance to the starter solenoid circuit to prevent the starter from

engaging. The wiring in the alarm system package may not be able to carry the total current of the starter solenoid circuit under all conditions.

To correct the #2 condition listed above, the use of a special lubricant (WAI #89-273 or 89-276) on the bore of the solenoid may be required.

For more details on the use of this special grease see *Technical Update 34*. Also see GM Service Bulletin 338113 dated 11/93.

WAI No.	Description
59-8200-1	Field coil for Nippondenso
59-8204	Field coil for Nippondenso
59-9201	Field coil for Lucas
59-9203	Field coil for Lucas
59-92900	Field coil (4th coil) for Lucas
66-205	Solenoid for Ford w/ spade
66-208	Solenoid for Ford w/ M6 x 1.0 post
66-8202	12V solenoid for Nippondenso
66-8212	24V solenoid for Nippondenso
89-273	Solenoid plunger grease - 1 oz. tube
89-276	Solenoid plunger grease - 1 lb. tub



CA 1-800-832-1032 310-329-2942 GA 1-800-227-1959 770-739-0081
 IL 1-800-822-2483 847-437-2771 TX 1-800-441-4924 817-633-7163
 PA 1-800-877-3340 610-495-2200 (CA, PA and TX: Se Habla Español)

