

## Ford PMGR Update

OVER THE PAST SEVERAL years, we've covered the following topics about Ford PMGR starters:

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However, Ford has made so many changes to these starters that we need another one to update you on the most recent developments.

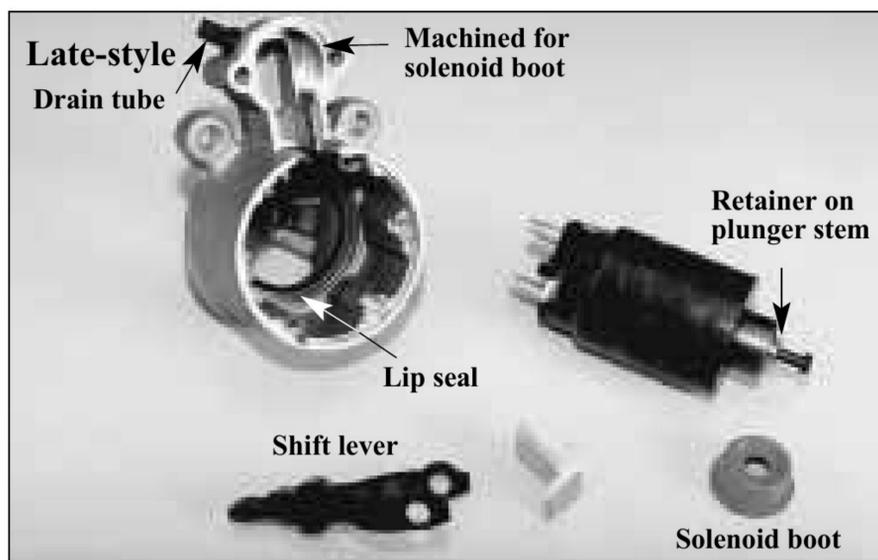
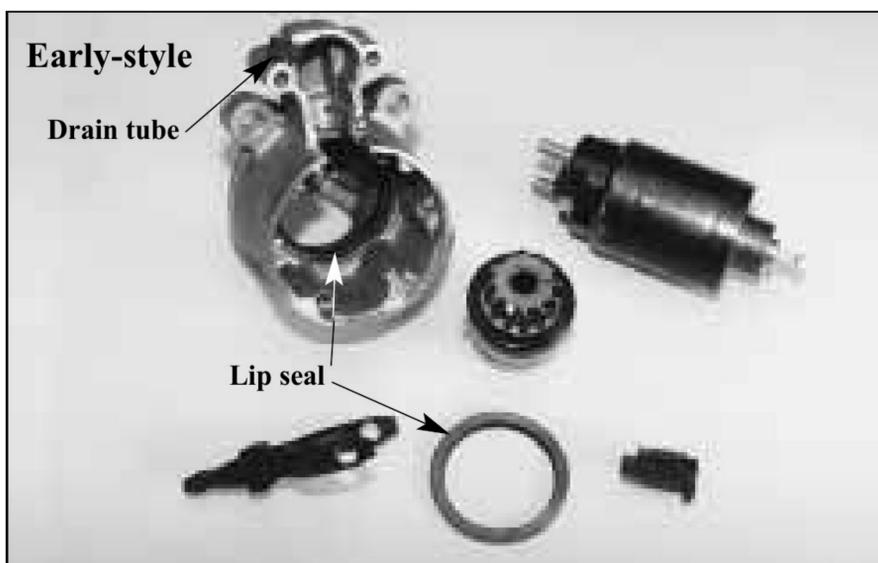
### Sealed units

As we discussed on page 2 of *Technical Update 13*, Ford PMGR starters used on 1992 and 1993 Lincoln, Ford and Mercury with 4.6 L V8 engines had a problem with moisture entering the solenoid area.\* Because moisture in the solenoid has continued to be a problem, Ford has made several changes to try to remedy it, as follows:

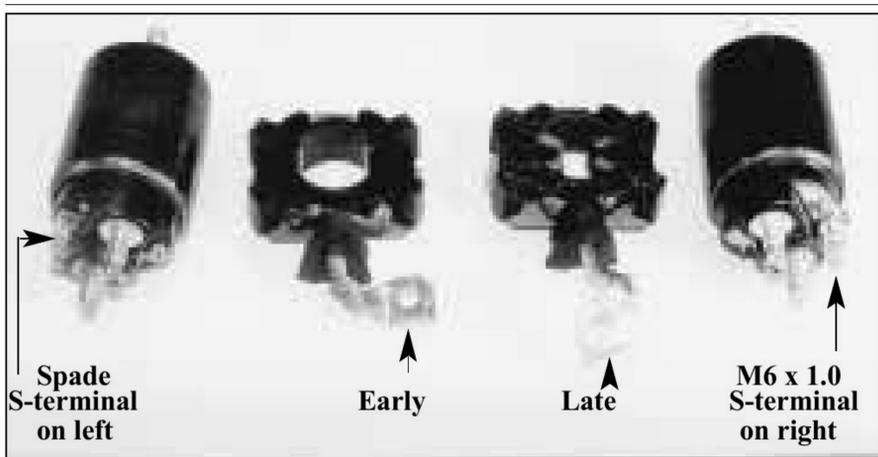
1. Further modifications to the D.E. frame
2. New solenoid shift-lever seal
3. Boot added to the solenoid plunger.

To allow for the boot on the plunger, Ford made several changes to the starter. First, they moved the drain tube inward away from the machined edge of the D.E. frame and machined the solenoid-attaching area to accommodate the boot. In addition, they needed to add a retainer on the plunger stem so that this area would also be sealed. Now they are using this plunger with the retainer in all their solenoids, even if the solenoids don't have the boot. However, because this retainer interferes with the early shift lever, Ford has introduced a new shift lever, which can also replace the early-style shift lever (*Figure 1*).

\*We now know that this is a problem for other starters (WAIR 2-1567-FD and 2-1799-FD) covering many OE numbers and many applications.



**Figure 1. Top:** To prevent moisture from entering the solenoid, Ford added an external silicone seal. **Middle:** The early-style lip seal. **Bottom:** The latest configuration, using a boot on the solenoid, a retainer on the plunger stem and different shift lever, in addition to the lip seal.



**Figure 2.** Left: Early solenoid with spade S-terminal and early brush holder. Right: Later solenoid with M6 x 1.0 S-terminal and late-style brush holder. Note change in position of flag on brush holder leads.

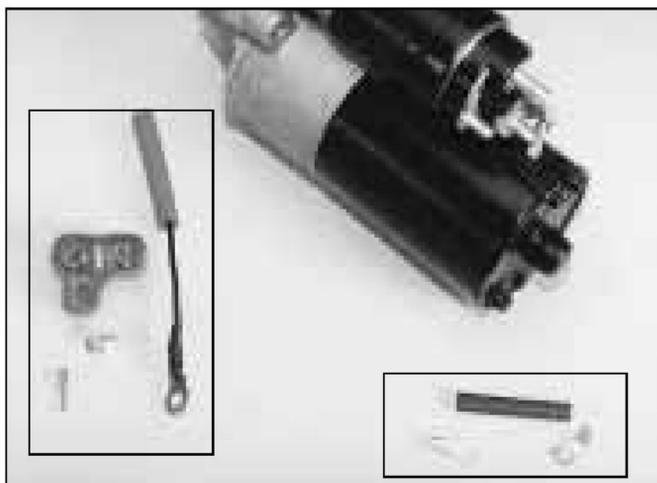
### Solenoid and brush holder

Ford PMGR starters initially used a solenoid with a spade-type S-terminal. This spade terminal was on the left side of the solenoid, with the motor terminal at the bottom. This configuration allowed the motor lead on the brush holder to bolt onto the solenoid's motor terminal without interfering with the S-terminal (Figure 2).

Then in 1995 Ford introduced a number of starters that use a solenoid with an M6 x 1.0 S-terminal located on the right side. This design is used on applications that have the vehicle wiring coming in on that side. However, because of the position of this S-terminal, Ford also had to put a different flag on the brush holder's motor lead, so the lead could bolt on without interfering with the S-terminal. In Figure 2, note where the flag is attached to the motor lead. This brush holder, using the late-design motor-lead configuration, can replace the early-style brush holder, as well.

### Solution to spade-terminal corrosion

Sometime after they introduced the solenoid with the M6 x 1.0 S-terminal on the right, Ford began using another solenoid with an M6 x 1.0 S-terminal – this time on the left. By then they had realized that the spade-type S-terminal was having a problem with corrosion, and since then, all the starters we have purchased from Motorcraft use a solenoid with an M6 x 1.0 S-terminal, instead of a spade terminal.



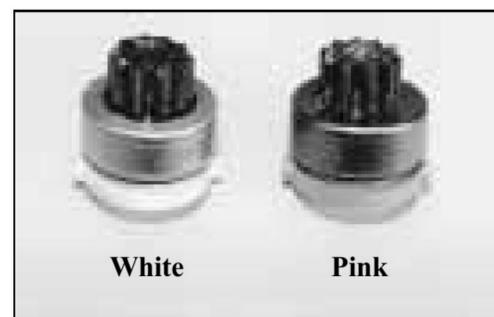
**Figure 3.** Ford conversion kit is on the left. WAI kit is on the right.

Because of this tendency for the spade-type S-terminal to corrode, Ford developed a terminal-conversion kit that they provide with retrofit units. This kit allows the installer to convert the wiring of the vehicle from a spade-type to an eyelet-type S-terminal. The part number for the kit is WT-5673-B or F6VY-14A411-AA (Figure 3).

WAI also offers a conversion kit (79-2503), which gives the installer two options: They can convert the wiring on these units to the stud-type terminal or bolt on an angle male-spade terminal to the M6 x1.0 S-terminal, and use the original female spade connector. However, in our opinion, if the installer continues to use the spade connector, rebuilders will see a higher rate of returns (Figure 3).

### Be careful of drives that look alike

The most popular drive for Ford PMGR starters has 10 teeth, a white plastic ring and a gear OD of 28mm (54-212). But be careful! The 1995-1997 Contours and Mystiques with a 4-cylinder, 2 L engine also use a 10-tooth drive (54-216) -- but the gear OD on this drive is only 27mm and the plastic ring is pink. If the wrong drive is installed, this one-millimeter difference will cause the starter to either be very noisy or to not crank at all (Figure 4).



**Figure 4.** 10-tooth drive on the left, with white plastic ring, is not interchangeable with 10-tooth drive on the right, with pink plastic ring.

You may already know that starter drives for Ford PMGR were originally produced by Mitsubishi. However, Ford then took the operation in-house and now produces all these drives themselves.

Listed below are the drives produced by Ford to date. These drives look slightly different from the Mitsubishi drives, but are functionally identical to the drives they replace.

Ford No.	WAI No.	Teeth	Ring color
F5DU-11350-AA	54-212	10	White
F5CU-11350-A	54-214	9	Black
F5RU-11350-AA	54-216	10	Pink
F5VU-11350-AA	54-215	12	Green

### Changes in armature and planetary-drive shaft

Ford made a running change in the armature shaft used in PMGR starters. The tip of the armature has been shortened by 2mm and the depth of the bore

in the drive shaft has been decreased by 2mm to accommodate the shorter tip on the armature (Figure 5). The trick is to determine which armature and drive shaft you have. The chart below Figure 5 shows the differences between these two armatures.

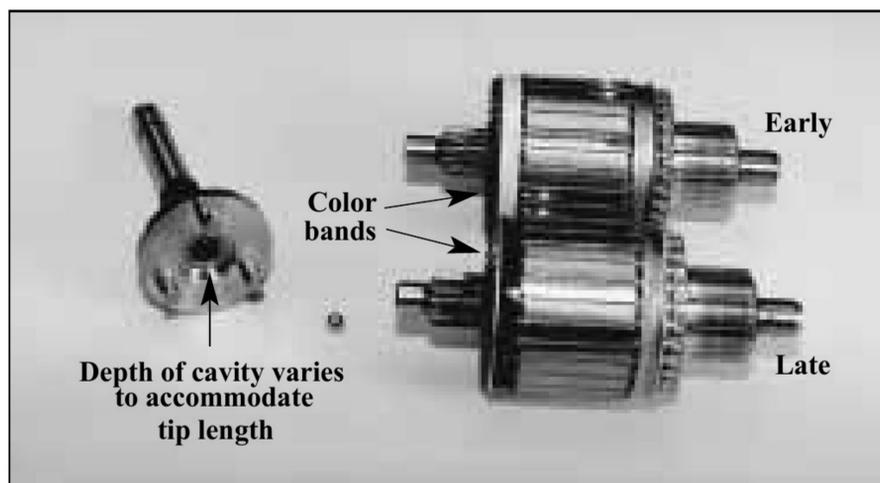


Figure 5. The tip of the later armature is 2mm shorter than the tip of the early one.

<b>Armature</b>		
Short tip (new)	61-211	127mm length
Long tip (old)	61-210	129mm length
<b>Drive shaft</b>		
New drive shaft	76-2822	16mm cavity
Old drive shaft	76-2809	18mm cavity
<b>Bushing</b>		
New bushing	62-2301	8.5mm long
Old bushing	62-2300	10mm long

According to a Ford publication, two armatures were originally used for Ford PMGR: E9OF-11005-AA for low-output applications (1.2KW) and F2TU-11005-DA for high-output applications (1.4 and 1.5KW). The only difference between these two armatures was the material used in their bands. The high-output version used non-magnetic stainless steel and the low-output used less expensive magnetic steel. However, they were easily identifiable by the color of the bands. The high-output version used yellow bands and the low-output version used black or brown bands.

The Ford publication notes that in early 1996, the material used in all the bands for PMGR armatures was changed to aluminum, which provides the same performance as stainless steel, so all the armatures became high-output. As a result, the low-output version was discontinued, and it was no longer necessary to color-code the bands.

However, the new aluminum high-output armature had black bands, so it looked just like the original low-output version. Needless to say, this caused some problems because the armatures could no longer be sorted visually. As a result, you now have

to check black and brown armature bands with a magnet to determine their output level. If they are magnetic, the armature is low output; non-magnetic, the armature is high-output.

### Clips for retaining tracking gear to drive shaft

You should also note that Ford changed the depth of the groove for the clip that retains the tracking gear on the drive shaft. This change is almost impossible to detect visually, but can be easily determined by measuring the diameter of the shaft at the bottom of the groove. On early versions, the diameter of the shaft, measured at the bottom of the groove, was 16mm and required an "E" clip (76-2808). The diameter of the shaft at the bottom of the groove for the later version is 17mm and requires a "C" clip (76-2819). To determine which clip you need, fabricate a simple "Go / No Go" gauge to check the shaft diameter (Figures 6 and 7).

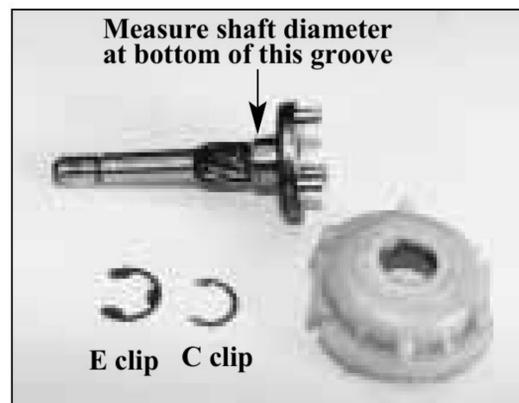


Figure 6. The E clip on left fits shafts that have a 16mm diameter, measured at the bottom of the groove. The C clip on right fits shafts that have a 17mm diameter, measured at the bottom of the groove.

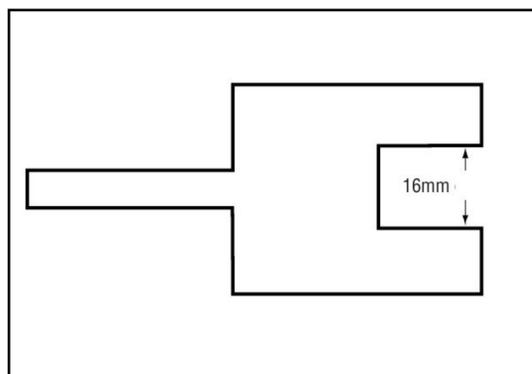


Figure 7. Make this simple Go/No Go gauge to determine whether you need an E clip or C clip.

### Part missing?

Ford is no longer installing the stop collar (WAI #76-2801) over the drive-retaining clip on PMGR starters. This is possible because the thrust movement



Figure 8. Stop collar on the right (76-2801) is no longer needed on Ford PMGR starters.

of the drive shaft is controlled by the tracking ring and the E or C retaining clip (described above). This cup was needed in non-PMGR Ford starters so the thrust of the armature shaft into the D.E. frame would not destroy the D.E. frame or dislodge the drive-retaining clip (Figure 8).

### Side-mounted starters

Here are a few interesting things you need to be aware of on side-mounted Ford PMGR starters (Figure 9).

When you are disassembling these units, in order to remove the idler-gear shaft, you must first remove a small retaining pin. However, this pin may be hard to see because it is usually covered with dirt and grease. Also note that in the idler gear itself there is a small ridge that prevents the bushings from being

pressed straight through. The bushings must be extracted, each from its own end.

The thickness of the starter-drive body on these side-mounted starters is critical because it must fit into the groove of the idler gear. If the body of the drive is too wide, the starter may crank slowly or may not crank at all. If it is too narrow, the idler gear will engage the flywheel late, possibly causing a milling condition – or the idler gear may be slow to exit the flywheel, thus staying engaged (Figure 10).

### Final note

One last thing to remember about all Ford PMGR starters is that the entire amount of cranking current travels through the brush ground tab, which is held to the C.E. cap with a small screw. This connection must be tight, clean and free of paint.

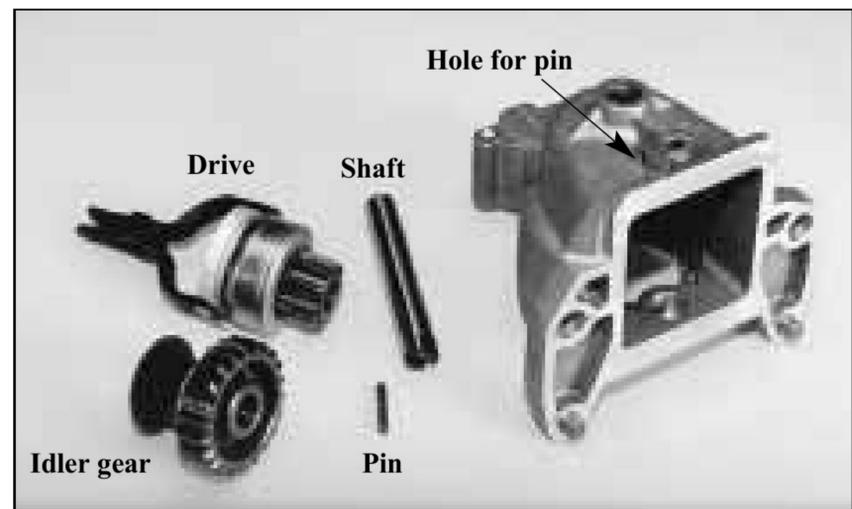


Figure 9. Side-mounted PMGR starters are a little tricky to disassemble.

Figure 10. The thickness of the starter drive body is critical on side-mounted PMGR starters.

WAI No.	Description	WAI No.	Description
54-212	10-tooth starter drive	62-2301	8.5mm bushing
54-214	9-tooth starter drive	76-2801	stop collar
54-215	12-tooth starter drive	76-2808	E clip for drive shaft
54-216	10-tooth starter drive	76-2809	drive shaft with 18mm cavity
61-210	129mm armature	76-2819	C clip for drive shaft
61-211	127mm armature	76-2822	drive shaft w/ 16mm cavity
62-2300	10mm bushing	79-2503	terminal-conversion kit

### Notes

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