87-375-3
April 1998

Technical Update 37

All About Starter Shims (and No Shims)

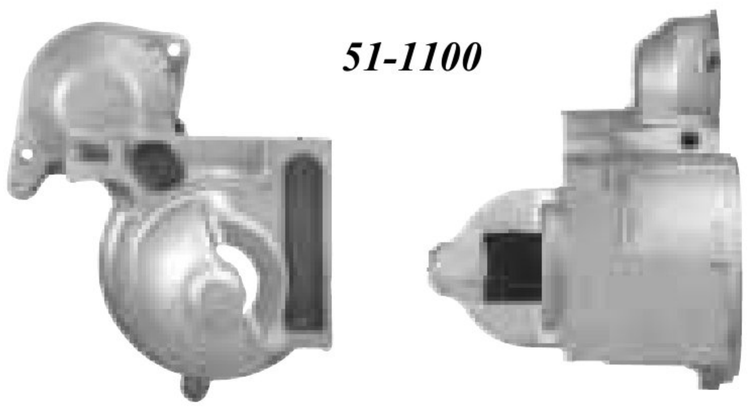
In this issue we'll look at the various uses of starter shims. Most of the discussion will center on the 2mm shim used in a number of Delco starters, but we will also mention the thin 1mm (.040") and .015" shims used by Delco. Then we'll look at a shim you can use in older Ford applications and a shim used by Jeep in certain applications.

Delco shim / no shim

The problem started when Delco produced a few different versions of some of their starters. Some of these versions require 2mm shims and some don't. To make matters even more interesting, Delco has sometimes moved from version to version without doing a supersession. As a result, we've been getting a lot of questions about which of these starters require shims and which don't. Hopefully the following information will straighten out some of this confusion.

Note that the shim/no shim question does not apply to all engines. As you can see in Tables 1 - 6 below, only six starters with passenger-car applications and two 27MTs with diesel applications have shim/no shim versions. You will also note that there are no V8 gas engines included in this list.

In all six tables, the left columns show how Delco superseded the D.E. housings and the right columns show how Delco superseded the complete starters.



51-1100

Table 1. For 3.0L and 3.8L V6 engines

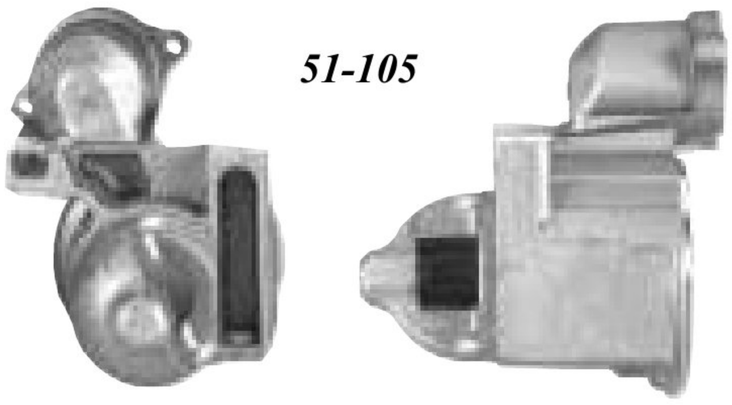
First we'll look at starters for the 3.0L and 3.8L V6 engines from GM. The starter for this application from 1986 to 1995 is a 5MT series (WAIR #2-1516-DR). In 1996 Delco introduced an SD255 series starter for the 3.8L V6 engine (WAIR #2-1797-DR). All these starters use a WAI #51-1100 D.E. housing with a straight-across mounting bolt pattern (E mounting configuration) (*Table 1, below*).

As you can see in Table 1, when Delco superseded starter #10455006 (shim) to #10455024 (no shim) they introduced the no-shim D.E. housing #10467574 but did not show a supersession from the D.E. housing #10495877 (shim). The D.E. housing #10467574 (no shim) was then superseded to #10456437 (no shim).

Table 1.

51-1100				2-1516-DR (5MT with E Mtg. Config.)			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
10495879	Shim	10495877	Shim	1998521 1998544	Shim Shim	10455006 10455006	Shim Shim
10495877	Shim	No supersession		10455006	Shim	10455024	No shim
10467574	No shim	10456437	No shim	10455024	No shim		
51-1100				**2-1797-DR (SD255 with E Mtg. Config.)**			
10456437	No shim			10455066	No shim		

Wetherill Associates, Inc. 1101 Enterprise Drive Royersford, PA 19468 800-877-3340



51-105

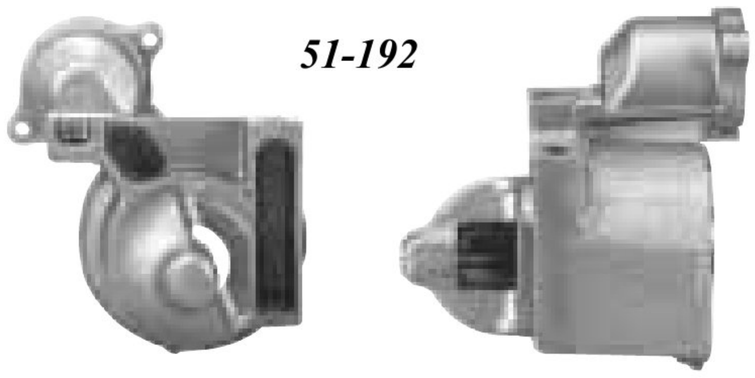
Table 2. For 2.2L L4 and 3.1L V6 engines

Next we'll look at the starter for GM's 2.2L L4 and 3.1L V6 engines (engine code M) The starter for these engines is a Delco SD210 series (WAIR # 2-1412-DR). These starters use a WAI #51-105 D.E. housing with a straight-across mounting bolt pattern (again, an E mounting configuration) (*Table 2, below*).

As you can see in Table 2, when Delco superseded starter #10455048 (shim) to #10455053 (no shim) they also superseded the D.E. housing #10467736 (shim) to #10475298 (no shim).

Table 2.

51-105				2-1412-DR (SD210 with E Mtg. Config.)			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
10467736	Shim	10475298	No shim	10455010	Shim	10455048	Shim
				10455025	Shim	10455048	Shim
				10455048	Shim	10455053	No shim
10475298	No shim			10455053	No shim		
				10455060	No shim		



51-192

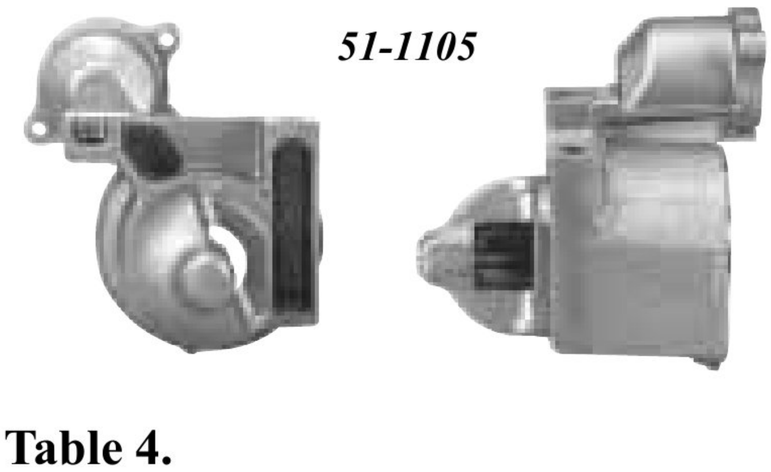
Table 3. For 2.5L L4 engines

The third series we'll look at is for the 2.5L L4 engine. This engine also uses a Delco SD210 series starter (WAIR #2-1520-DR). The D.E. housing is WAI #51-192 with a straight-across mounting bolt pattern (E mounting configuration) (*Table 3, below*). Note that this D.E. housing is not cataloged by WAI because it is made from a 51-1105 housing and a 62-1404 bushing.

In Table 3 you can see that Delco superseded the D.E. housing #10467760 (shim) to #10475286 (no shim) but did not supersede the starter.

Table 3.

51-192				2-1520-DR (SD210 with E Mtg. Config.)			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
10467760	Shim	10475286	No shim	10455026 1st prod	Shim	No supersession	
10475286	No shim			2nd prod	No shim		



51-1105

Table 4. For 3.4L V6 engines

Next we'll consider GM's 3.4L V6 engine (engine code X). This engine uses a Delco SD260 series starter (WAIR #2-1472-DR). The D.E. housing is WAI #51-1105, once again with a straight-across mounting bolt pattern (E mounting configuration) (*Table 4, below*).

This time when Delco superseded D.E. housing #10475289 (shim) to #10475290 (no shim) they also superseded starter #10455047 (shim) to starter #10455051 (no shim). Later they superseded the starter again, this time to #10455061 (no shim).

Table 4.

51-1105				2-1472-DR (SD260 with E Mtg. Config.)			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
10471930	Shim	10475289	Shim	10455047	Shim	10455051	No shim
10475289	Shim	10475290	No shim				
10475290	No shim			10455051	No shim	10455061	No shim
				10455061	No shim		

51-123

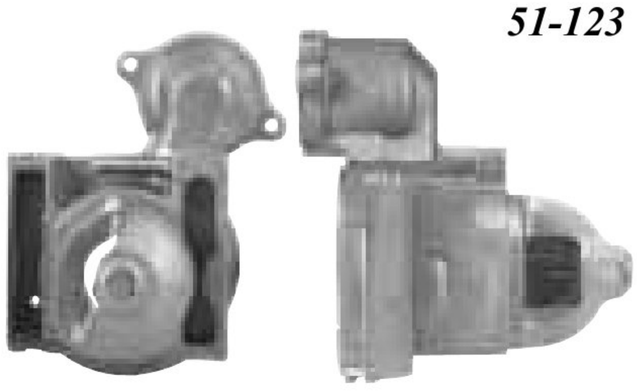


Table 5. For 3.1L and 3.4L V6 engine

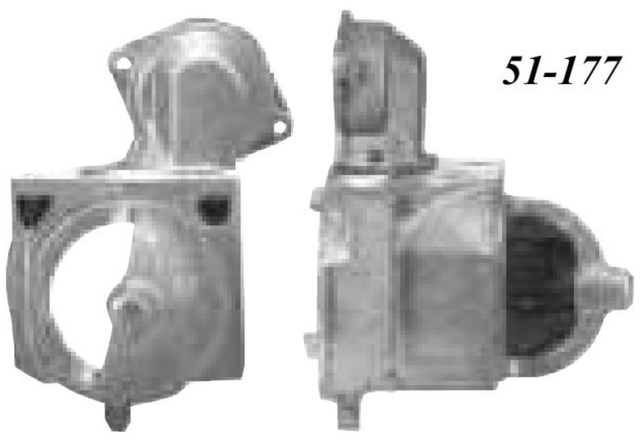
The fifth group of engines we'll discuss are the 3.1L V6's (engine code T) and 3.4L V6's (engine code S). These engines use a Delco SD210 series starter (WAIR #2-1473-DR). The D.E. housing for the starter is WAI #51-123 with a staggered mounting-bolt pattern (F mounting configuration) (*Table 5, below*).

This time when Delco superseded D.E. housing #10467722 (shim) to #10475285 (no shim) they did not supersede the starter #10455011. Instead they created a first-production and then a second-production version. Delco later superseded both productions of starter #10455011 to starter #10455054 (no shim) and introduced D.E. housing #10475307 (no shim) on that starter.

Table 5.

51-123				**2-1473-DR (SD210 with F Mtg. Config.)**			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
10467722	Shim	10475285	No shim	10455011 1st prod	Shim	10455054	No shim
10475285	No shim	No supersession		2nd prod	No shim		
10475307	No shim			10455054	No shim		

51-177



51-1111

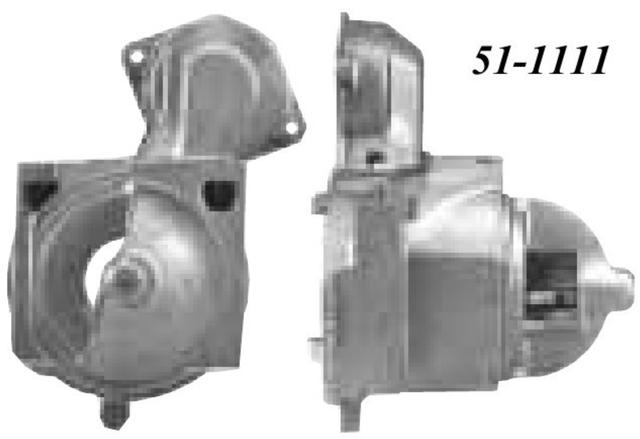


Table 6. For 6.2L diesel engines

Finally we'll look at GM's 6.2L diesel engine. This engine uses a Delco 27MT series starter. The D.E. housing may have a large drive opening (WAI housing #51-177 used on starter WAIR #2-1629-DR), or a small drive opening (WAI housing #51-1111 used on starter WAIR #2-1625-DR). These housings have a staggered mounting-bolt pattern (F mounting configuration) (*Table 6, below*).

Large drive opening (51-177): When Delco superseded D.E. housing #1979443 (shim) to #10496542 (no shim) they also superseded starter #1998442 (shim) to #1113589 (no shim).

Small drive opening (51-1111): When Delco superseded D.E. housing #1985567 (shim) to #10496538 (no shim) they also superseded starter #1998401 (shim) to #1113590 (no shim).

Table 6.

51-177				**2-1629-DR (27MT Lg. Dr. Opng / F Mtg. Config.)**			
Delco DE Hsg	**Type**	**Replaced by**	**Type**	**Delco Starter #**	**Type**	**Replaced by**	**Type**
1979443	Shim	10496542	No shim	1109219 1109563 1998442	Shim Shim Shim	1998442 1998442 1113589	Shim Shim No shim
10496542	No Shim			1113589	No shim		
51-1111				**2-1625-DR (27MT Sm. Dr. Opng / F Mtg. Config.)**			
1985567	Shim	10496538	No shim	1998401	Shim	1113590	No shim
10496538	No shim			1113590	No shim		

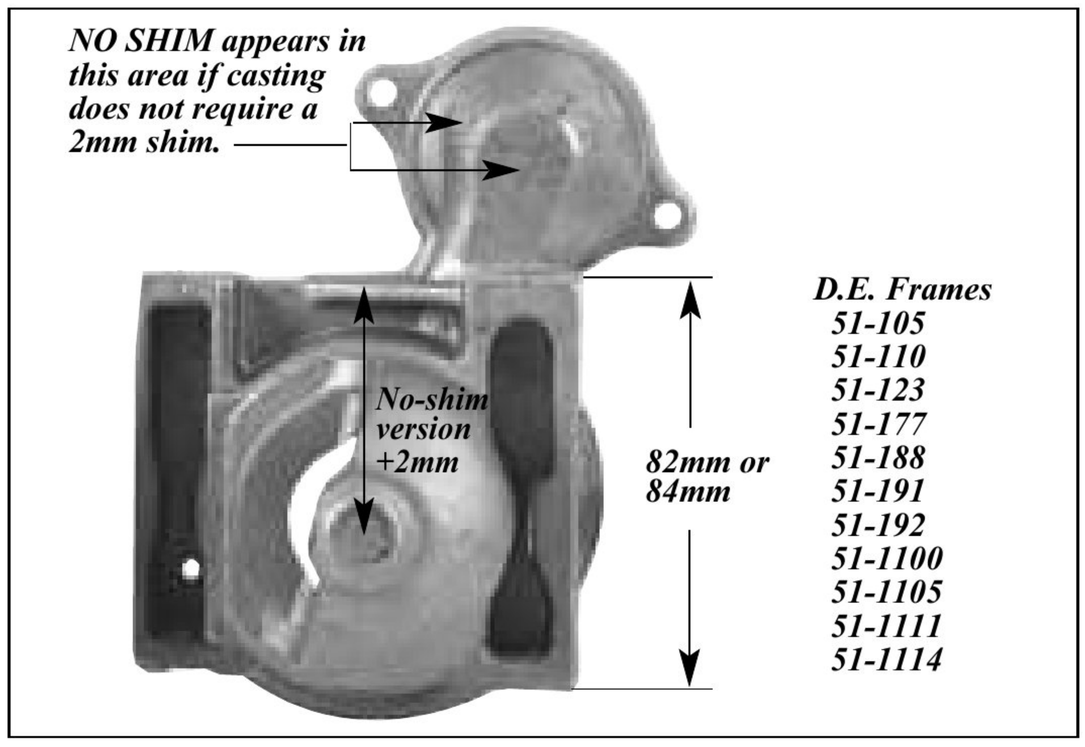


Figure 1. If one of the housings listed in Tables 1-6 does not require a shim, NO SHIM will appear somewhere between the solenoid mounting bolts. The most important dimension is from mounting pad to center of armature. Mounting-hole boss dimension is only for quick identification.

You can consolidate shim/no shim

You can consolidate the shim and no-shim versions of these starters, but you must make sure that the 2mm shim is NOT installed when the D.E. housing is marked "NO SHIM." This mark appears on the face of the D.E. housing between the solenoid mounting bolts (*Figure 1)*.

If a starter requires a 2mm shim, we recommend that you wire the shim to the starter along with a tag warning the installer of the importance of using the shim. If you just throw the shim and warning tag in the box, the installer often doesn't notice them until he has destroyed the starter.

For starters that don't require the 2mm shim, we recommend that a warning tag be wired to these starters telling the installer to remove the old 2mm shim if one exists.

However, as you will see immediately below, there are some other Delco starters, aside from the ones we show in Tables 1-6, that never required a shim. Delco did not think it necessary to mark the D.E. housings for these starters as NO SHIM, because there was never any shim to begin with. So even though these D.E. housings are not marked NO SHIM, a 2mm shim must not be used.

Avoid overconsolidating

You have to be careful not to over-consolidate these starters. You might be tempted, for example, to try to consolidate across an entire series (for instance, all 5MTs for all SD210/260s) but if you aren't careful you can end up with improper drive-to-flywheel alignment, which can then cause the D.E. housing to break.

It's easy to make a mistake with some of these units because certain D.E. housings look alike. Here

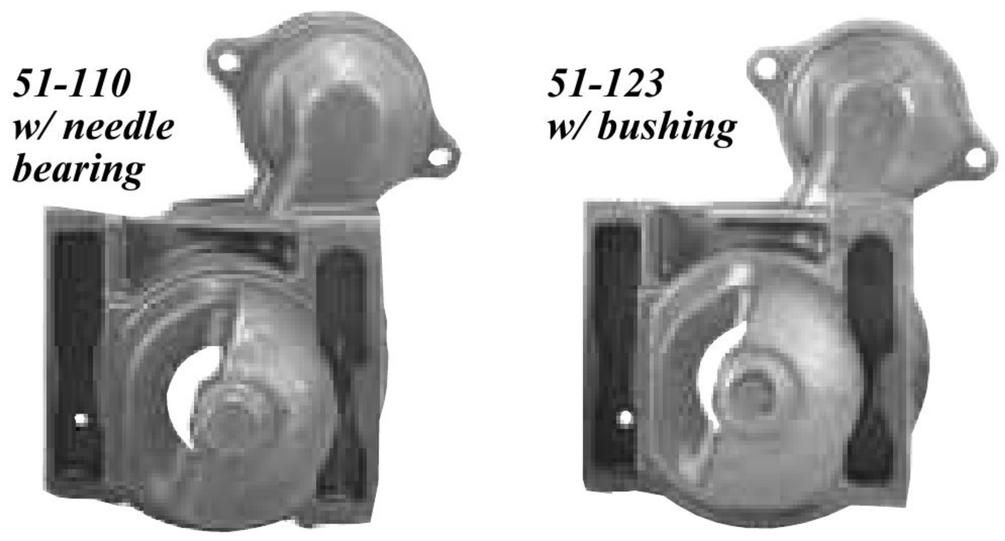


Figure 2. The 51-110 (left) and 51-123 housings for SD210/260 look alike, but the distance from the mounting pad to the center of the D.E. bushing/bearing is different. They are not interchangeable.

is a quick rundown on those look-alikes and what they mean in the world of shim/no shim.

First, two D.E. housings for SD210/260 starters look a lot alike (WAI #51-110 and #51-123). However, on the 51-110, the distance from the mounting pad to the center of the D.E. bushing/bearing is 47mm, whereas on the 51-123, this distance is 49 mm.

Since this is a 2mm difference, it's only natural to think that the 51-110 requires a 2mm shim. After all, it looks the same and doesn't have NO SHIM marked on it. But this is not the case. The 51-110 housing fits WAI starter #2-1470-DR, used on GM engines that never used a 2mm shim. This is why it doesn't have NO SHIM marked on it. The 51-123, on the other hand, is used on the 2-1473-DR starter (*see Table 5*), which is a shim/no shim starter. But regardless of how it looks, these two starters are not interchangeable and neither are the D.E. housings.

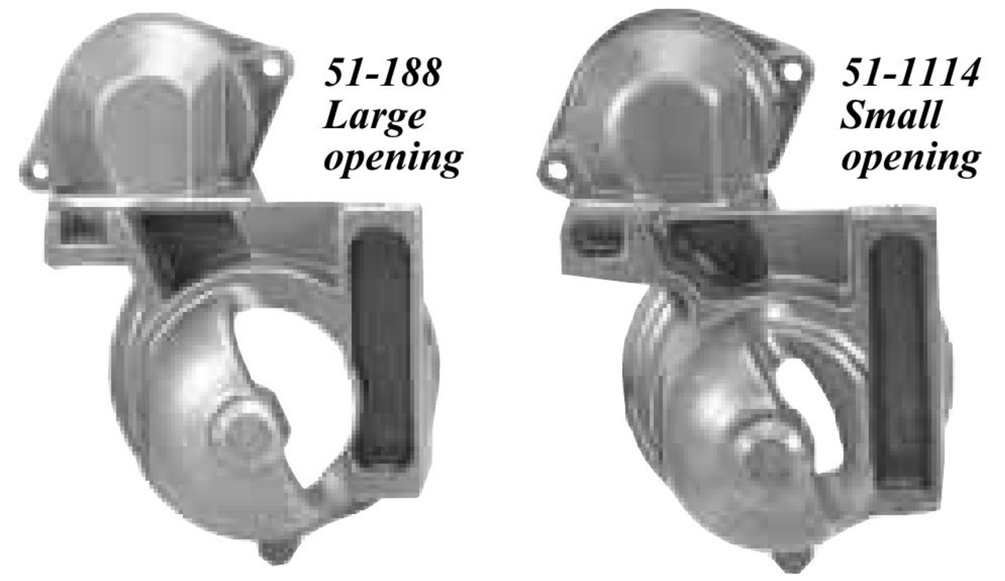
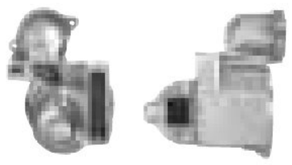
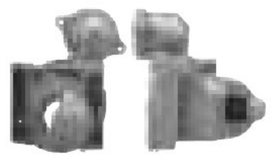
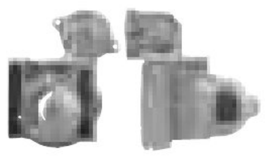
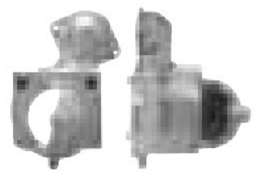
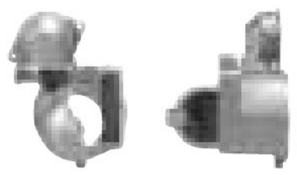
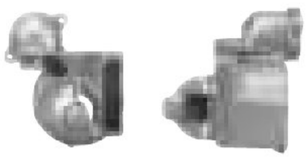
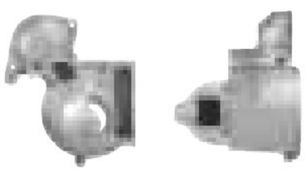
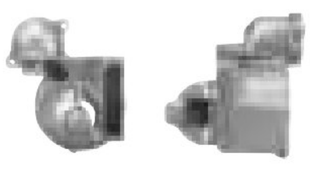
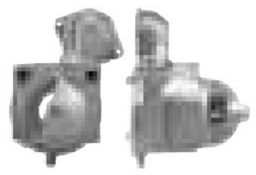
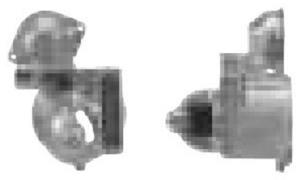


Figure 3. The 51-188 (left) and 51-1114 housings for 5MT also look very similar, but, again, the distance from the mounting pad to the center of the D.E. bushing is different. They are also not interchangeable.

Having said all that, however, there is one other issue we need to clarify. According to the bill of materials for starter 2-1470-DR, there is a 1mm (.040") shim for housing 51-110. Depending on the way the engine block was machined on any particular vehicle, the use of this .040" shim is "as required." The engine may or may not need it.

(continued on page 6)

Table 7. Summary of Delco Shim / No Shim Starters

	WAI # O.E.#	Bushing or Bearing	Bushing to Mtg Pad Dist	Requires 2mm Shim	Mounting Hole Boss*	
	**51-105** 10467736 10475298	Bushing	57mm 55mm 57mm	no yes no	84mm 82mm 84mm	
	**51-110** 10456482 10467626	Needle bearing	47mm 47mm 47mm	no no no	82mm 82mm 82mm	
	**51-123** 10467722 10475285 10475307	Bushing	49mm 47mm 49mm 49mm	no yes no no	84mm 82mm 84mm 84mm	
	**51-177** 1979443 10496542	Bushing	49mm 47mm 49mm	no yes no	84mm 82mm 84mm	
	**51-188** 1978282 1984734	Bushing	55mm 55mm 55mm	no no no	82mm 82mm 82mm	
	**51-192** 10467760 10475286	Bushing	superseded to 51-1105 + 62-1404 bushing 55mm 57mm	 yes no	 82mm 84mm	
	**51-1100** 10495879 10495877 10467574 10456437	Needle bearing	57mm 55mm 55mm 57mm 57mm	no yes yes no no	84mm 82mm 82mm 84mm 84mm	
	**51-1105** 10471930 10475289 10475290	Needle bearing	57mm 55mm 55mm 57mm	no yes yes no	84mm 82mm 82mm 84mm	 Old # 51-191 Old # 51-191
	**51-1111** 1985567 10496538	Bushing	49mm 47mm 49mm	no yes no	84mm 82mm 84mm	
	**51-1114** 10487930	Bushing	57mm 57mm	no no	84mm 84mm	

In the first column of this table we show the WAI part number for the D.E. housings, along with all the Delco OE part numbers that WAI has combined under a given sales number. In column two we indicate whether the D.E. housing has a bushing or needle bearing.

In column three we show the distance from the mounting pad to the center of the D.E. bushing/bearing. In column four we show whether a 2mm shim should or should not be used and in column five we show the mounting-hole boss dimension for each of the housings.

** **Caution:** We have seen aftermarket housings that do not comply with the measurements in column five, but do comply with the measurements in column three, which is the most important dimension.*

Two other D.E. housings also look very similar but are not interchangeable: the 51-188 for 5MT and the 51-1114 for SD205. Again, there is a 2mm difference in the dimension between the mounting pad and the center of the D.E. bushing. However, the 51-188, which is used on 22 different starters with five different WAI numbers, never used a 2mm shim and is not interchangeable with the 51-1114. Neither of these housings is marked NO SHIM because neither one ever used a shim (*Figure 3, page 4*).

Measuring Delco D.E. housings

In these Delco starters it can be hard to determine the distance from the mounting pad to the center of the bushing or bearing in the D.E. housing. Here's a tip that might help: Measure the distance from the mounting pad to the armature shaft and add to that half of the diameter of the armature shaft. This will give you an accurate indication of the distance.

We've noticed that the measurement of the mounting bosses of some aftermarket housings are not consistent. However, the distance from the mounting pad to the bushing or bearing is consistent, and this is the most important dimension.

For a complete summary of what you need to know about Delco shim/no shim D.E. housings, refer to *Table 7, page 5*.

Shims for Delco starters

E mounting configuration		
76-1310	2mm	.079 inches
76-1305	0.4mm	.015 inches
F mounting configuration		
76-1309	1mm	.040 inches
76-1311	2mm	.070 inches

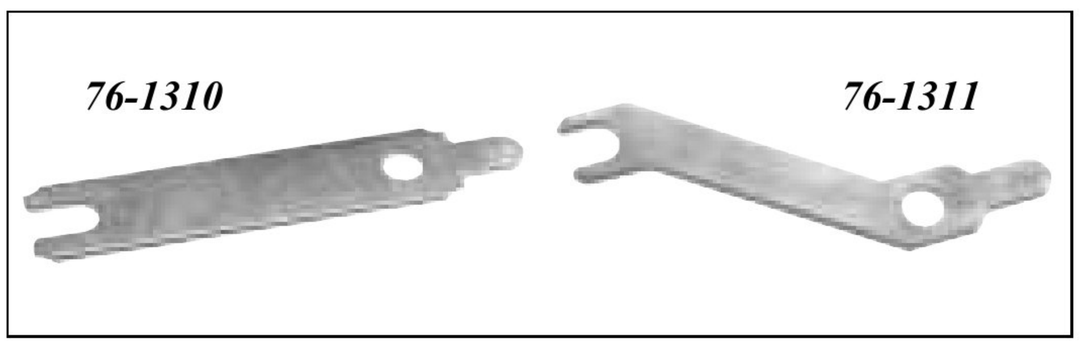


Figure 4. The 76-1310 2mm shim (left) is used on E mounting configurations. The 76-1311 2mm shim is used on F mounting configurations.

You may also need to use .015" shims to adjust the clearance between the drive gear and flywheel on the starters we've discussed here. If this is the case, use the same procedure you've always used to determine the number of thin shims you need. There are several good tools available for making the necessary measurements.

Shim saves starters on worn-out Ford engines

You may sometimes get a Ford starter returned as defective because the cap over the starter drive body has been cut off. This damage can be caused by an engine with worn crankshaft thrust bearings. The excessive crankshaft end-play can cause the flywheel to contact the starter drive cap, cutting it open. To prevent this, you can use a 2.3mm (.090") shim (WAI #76-2306) that will move the flange-mounted starter away from the flywheel. This shim can be used with #2-1668-FD (Lester #3124) with a two-bolt D.E. housing or with #2-1674-FD (Lester #3131) with a three-bolt D.E. housing, as well as other Ford starters that have D.E. housings with the same mounting dimensions.

Shim for Bosch used on Jeep

Starting in 1986, Jeep used a Bosch starter on 2.5L engines in the Cherokee, Comanche, and Wagoneer (WAIR #2-1231-BO, OE #0-001-108-031, 0-001-108-052 and 0-001-108-154). They also started using this unit in 1987 in the Wrangler. This continued through first production 1994. Then they changed the starter, introducing a Mitsubishi unit in the 1994 second production (WAIR #2-1782-MI, OE # M1T79481 and M1T79482).

All the Bosch starters required a .045" shim, but the later Mitsubishi starters do not use this shim. However, Jeep sells the Mitsubishi starter as the replacement unit for both the Bosch and the Mitsubishi. If an installer purchases the replacement starter from a Jeep dealer, he receives an important installation sheet (K6855196). The sheet explains:

> This starter supersedes multiple part numbers dating back to 1986. All vehicles built from 1986 through 5/20/94 used a .045 inch shim (P/N J3241712) between the starter motor and the engine block. That .045 inch shim is not compatible with this improved starter and must not be installed.
>
> Vehicles built 5/20/94 and later did not use the .045 inch shim and are not affected.
>
> Also note: For all vehicles, regardless of built date, if the original starter installation included a .015 inch shim (as required) that .015 inch shim (P/P J3241711) must be reinstalled.

If you compare the measurements of the Bosch and Mitsubishi starters (mounting pad to center of armature), you will find that the difference does not add up to .045". This is because the Bosch has a 9-tooth 25.3mm OD drive pinion, while the Mitsubishi has a 10-tooth 27.9mm OD drive pinion.

To make matters even more interesting, the mounting-hole bosses on the D.E. housing for the early Bosch starter (0-001-108-031) are both 80mm.

However, the mounting-hole bosses on the later Bosch starter (0-001-108-052) measure 80mm and 84mm, even though the part number (1-005-821-147) and the casting number (1-005-821-145) on the D.E. housing are the same for both of these starters.

When we called the Jeep dealer, we found out that the starter mounting bolts are the same for both sides of the early and late Bosch and also for the Mitsubishi starter.

When you are supplying the Bosch starter for these applications, there is no way for you to know if an engine originally had a Bosch unit, which was subsequently replaced with a Mitsubishi unit and the .045" shim discarded. So you must be sure to supply the .045" shim with every rebuilt Bosch unit that you sell, and to add instructions to warn the installer of this potential problem.

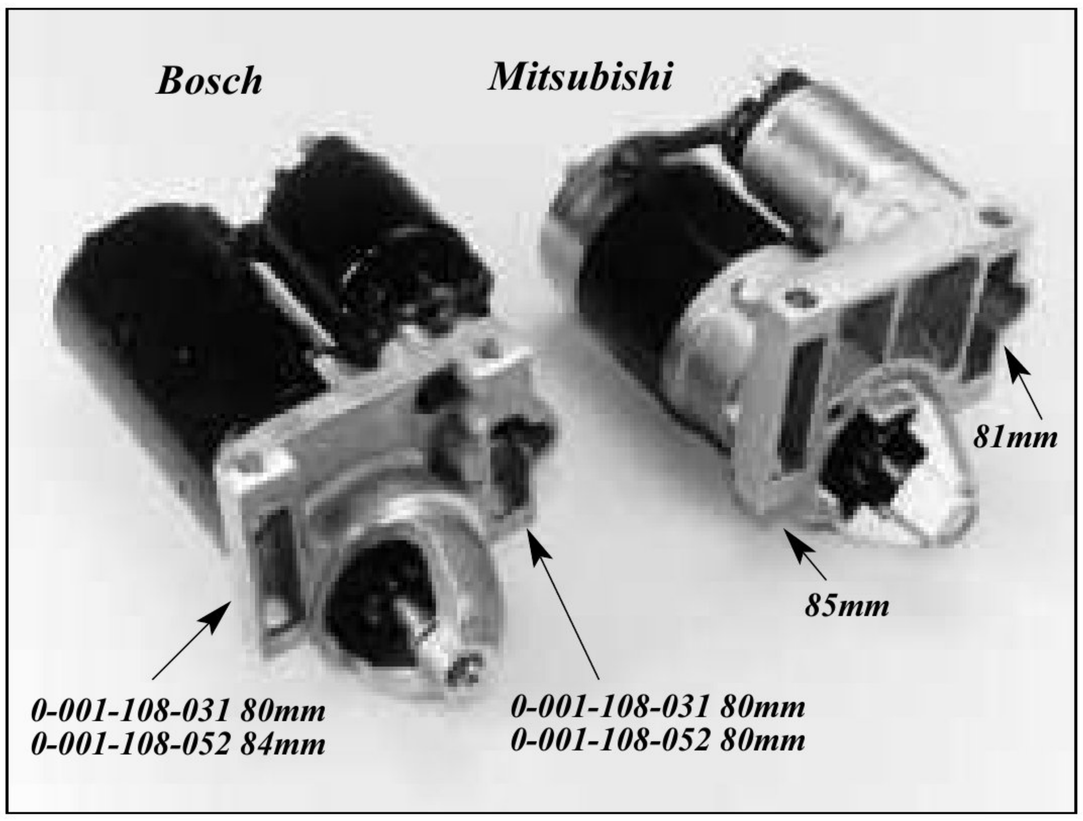


Figure 5. Bosch starter for Jeep is on the left. Both mounting-hole bosses on the D.E. housing for the early version are 80mm. However, the bosses on the later version are 80mm and 84mm, even though the part number and casting number are the same. The bosses on the Mitsubishi starter for Jeep (right) are 85mm and 81mm. Mounting bolts for all of these starters are all the same length.

Notes

Notes

CA • 1-800-832-1032 • 310-329-2942
I L • 1-800-822-2483 • 847-437-2771
PA • 1-800-877-3340 • 610-495-2200

GA • 1-800-227-1959 • 770-739-0081
TX • 1-800-441-4924 • 817-633-7163
(CA, PA and TX: Se Habla Español)