INSTALLATION INSTRUCTIONS
CHEVY STARTERS

P/N 3510

P/N 3555

P/N 3655

P/N 3631

P/N 3689

Proper mounting of the starter is important because this determines whether the starter pinion will engage properly with the ring gear. When the starter is positioned correctly, the starter pinion will engage the ring gear without binding and there will be no chance of starter pinion and/or ring gear damage.

INSTALLATION:

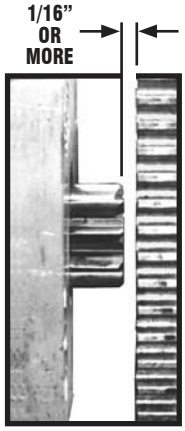


FIGURE 1

[1] **MOUNT STARTER.** Make sure the mounting surface of the engine block is smooth, flat and free of paint buildup. Torque starter mounting bolts to engine manufacturer's specifications, typically 32 ft. lbs.

[2] **CHECK PINION CLEARANCE.** There should be 1/16" minimum from the back side of ring gear to the front edge of the teeth on the starter pinion. Check in at least three locations on the ring gear (see Figure 1). If not in spec, verify that the ring gear is properly mounted.

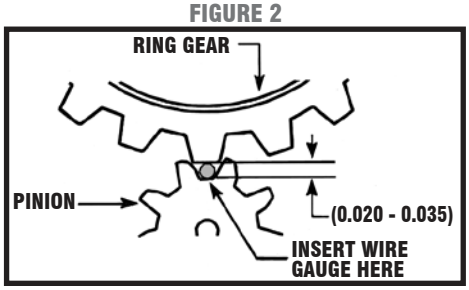
[3] **CHECK PINION ENGAGEMENT.** Pull pinion out to engage ring gear. This can be done by:

– Using a tool to pry the pinion out of the starter or connect 12 VDC to the "Switch" terminal ONLY (DO NOT connect battery cable to "BAT" terminal on the starter solenoid). This engages the solenoid but does not spin the starter. CAUTION: Do not leave the solenoid engaged like this for more than 30 seconds at a time as the solenoid will overheat.

[PLEASE NOTE: After releasing the solenoid, the pinion may STAY ENGAGED in the ring gear until the engine is started. This is normal for gear reduction starters and does NOT require shimming to correct.]

– Insert a wire gauge to check for proper clearance between the ring gear and starter pinion (see Figure 2). There should be a 0.020" to 0.035" clearance measured from the valley of the starter pinion to the tip of the ring gear tooth. (NOTE: A #1 standard paper clip is usually about 0.035" in diameter and makes an easy tool.) Check clearance at least three places on the ring gear. If the clearance is too small, add one shim at a time between the starter and engine block to bring it into specifications. In many installations, no shims are necessary.

FIGURE 2



[4] **ATTACH BATTERY CABLE AND SWITCH WIRE.** The switch wire should be capable of handling 15A, typically a 14AWG wire. The battery cable must be the proper size for the length of the cable (see chart). All connections should be clean and tight and terminals should be soldered if possible. The ground cable to the frame should be the same size as the starter cable. Also, a ground strap should be installed from the frame to the motor. If the original solenoid had a connection to the "R" terminal (ballast resistor bypass), this wire can usually be eliminated.

(See explanation on the reverse side.)

DISTANCE	3'	5'	7'	10'	+10'
AWG	4	2	1	0	00

CABLE RECOMMENDATIONS

[CONT'D ON REVERSE SIDE]

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INSTALLATION (CONT'D)

[5] OPERATE STARTER. It should operate quietly. Any loud grinding noises must be corrected. If the starter makes a high pitched whine during cranking the pinion to ring gear engagement is too great. If the starter makes a high pitched whine after cranking as the button or key is released, the clearance is too small. The cables and connectors themselves should be checked for voltage drop with a voltmeter. To check any wire or cable for voltage drop, connect one side of the voltmeter to one end of the cable and the other side of the voltmeter to the other end. OPERATE THE CIRCUIT and simultaneously measure the volt drop. It should be 0.5VDC or less. High voltage drops indicate a bad connector or undersized cable. The ground circuit can be checked in the same manner. Measure input voltage by connecting the positive probe of a voltmeter to the "MOTOR" terminal of the solenoid and connecting the negative to the starter housing [should be 9.0V minimum while cranking].

!CAUTION: NEVER OPERATE A STARTER MORE THAN 30 SECONDS AT A TIME WITHOUT ALLOWING TIME TO COOL (AT LEAST 2 MINUTES). OVERHEATING WILL DAMAGE THE STARTER.

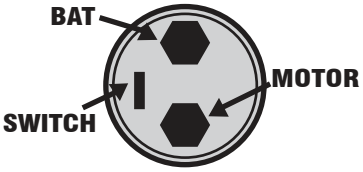
COMMON QUESTIONS

1. *WHY DO THE TEETH ON THE STARTER PINION WEAR OFF PREMATURELY?* This is caused by excessive starter pinion gear to ring gear clearance. The solution is to remove any shims between the starter and the engine block. If no shims are installed, then either shim under the outboard bolt only or machine excess material from the mounting surface of the starter.

2. *WHY DOES THE STARTER CRANK SLOWLY?* This condition can be caused by several things. The most common cause is excessively low input voltage, which can be caused by undersized starter cables, high resistance or defective batteries, high resistance battery disconnect switches or poor connectors. If the input voltage to the starter is satisfactory [9 volts or higher], then a second possible cause could be an underpowered starter. It is important that the starter have the torque characteristics to handle the load of the engine. If the engine turns too slow it may require a higher torque starter.

3. *CAN I USE A REMOTE SOLENOID?* Yes. Connect the battery cable from the remote solenoid to the starter in the normal way. Connect the starter's solenoid switch terminal to the remote solenoid's switch terminal.

4. *WHAT DO I DO WITH THE WIRE THAT CONNECTED TO THE 'R' TERMINAL ON THE ORIGINAL STARTER?* In early original wiring harnesses the 'R' circuit was a ballast resistor bypass. This terminal is 'no connection' when the starter is at rest and is +12VDC *while cranking*. This circuit provided +12VDC to the ignition coil during cranking for easier engine starting. Cars that do not have a ballast resistor (i.e. HEI, MSD or other aftermarket ignition systems) should not need this connection. In most cases this wire can be eliminated. If the engine has no ignition during cranking, then the wiring of the coil is going to require an 'R' terminal signal. To accomplish this, order PN 600 R-Terminal kit or, connect a 10A/250V diode in line with the *MOTOR SIDE* of the solenoid. The cathode or banded end of the diode goes toward the starter. This allows current to go from the starter to the coil and not from the coil to the starter. Some Powermaster replacement solenoids are available with an 'R' terminal. Ask your dealer.



TYPICAL SOLENOID

ADDITIONAL NOTES ON INSTALLATION

1. *A NOTE ABOUT RING GEARS.* There is alot of variation in the quality of the flexplates/flywheels on the market today and in the ring gears that are installed on them. It is important for long starter life that the ring gear be round and true. Check the ring gear in at least six places verifying that the clearance for the starter is the same in all locations. If not remove the ring gear and make sure the mounting surface of the crankshaft is clean and free of paint buildup or rust. Reinstall the ring gear and properly torque the mounting bolts. If this does not correct the problem, replace the ring gear.

2. *DISCONNECT SWITCHES.* The switch used for a battery disconnect is very important. All of the starter current will go across this switch during cranking which, depending on the starter, can be as high as 700A! After the engine is running, all of the current from the alternator will be running across this switch. Therefore make sure that the switch that is being used can handle these amounts of current. Switches are rated in intermittent amps and continuous amps. The intermittent rating should match or exceed the amount the starter will pull and the continuous rating should match or exceed the amount the alternator can produce. Using a switch that is too small will result in voltage loss and possible switch failure.

3. *CLOCKABLE STARTERS.* Some Powermaster starters are clockable meaning that the starter motor can be rotated in relation to the mounting block. Currently this includes part numbers 9000, 9004, 3500, 9102, 9132, 9142, and 9152. Simply remove the socket cap bolts securing the mounting block to the front of the starter and rotate it to another setting. Powermaster starters 9000, 9004, and 3500 are made to mount on either side of the engine. Owners of DART and other high performance engines can take advantage of this by mounting the starter on the driver side.

4. *"CAST IRON" STARTERS.* Some early model manual transmission engines came stock with a starter that has a cast iron "nose" or front housing instead of an aluminum one. Apparently there is a difference in the block itself and this difference can cause problems when installing a high performance starter. High performance starters are designed to replace the aluminum housing original Delco starter. If you have an engine that came with a cast iron housing starter, then you will need to add up to an 1/8" (0.125") of shims to get proper pinion to ring gear engagement.

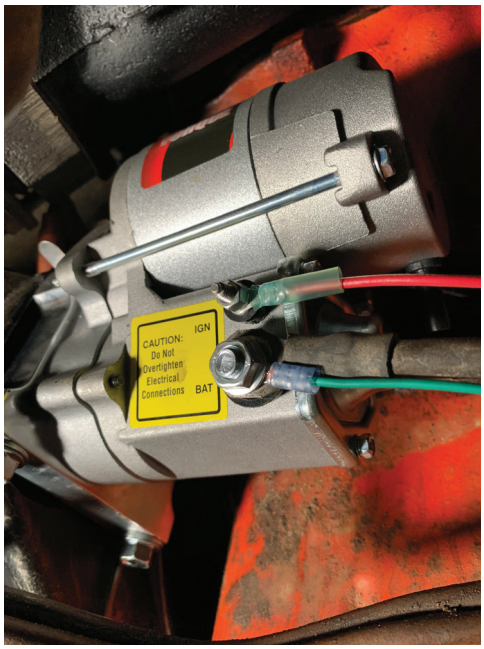
5. *HEAT SHIELDS.* Heat is the enemy of any electrical device. Therefore, heat shields between the headers and starter, or velcro starter wraps, are recommended to prolong the life of the starter.

POWERMASTER Performance

TECH BULLETIN

Checking Starter Supply Voltage

When it comes to starter performance issues, the most common cause is low voltage supply. If you're experiencing intermittent cranking, clicking, grinding or erratic operation, there is likely low voltage supply to one of the two starter circuits. Low voltage at either the battery connection or the smaller ignition terminal can lead to internal solenoid damage which also affects the clutch assembly that controls the pinion gear. Also, note that the ignition wire may go through a park/neutral switch or an OEM resistor causing a low voltage issue.



Low voltage supply can be caused by a weak battery, too small gauge of cable, internal cable corrosion and even poor quality crimps on the cable. Low voltage on the ignition terminal can be due to factory resistor wiring, excessive engine heat or how it is routed through a park/neutral switch.

The good news is that these can easily be checked and remedied. Two things you'll need for the test – a volt meter and a friend to help.

TEST PROCEDURE

The goal is to check the voltage with a digital volt meter at BOTH, the battery cable connection and the ignition terminal of the starter WHILE CRANKING the engine.

1. Make sure the battery is fully charged. The battery must be at least 12.6 volts before checking the voltage values at the starter terminals. If the battery does not read 12.6 or higher, charge it or replace it.

2. With the battery at full charge, connect your volt meter to the battery terminal of the starter. It should read the same at the starter as it did across the battery terminals. If not, there is an issue within the cable/terminals from the battery positive post to the starter terminal.

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3. If the voltage is the same at the battery as the starter, have your partner crank the engine for about 3-5 seconds and note the voltage on the battery terminal of the starter while cranking. It should stay above 11 volts.

4. Next, connect your volt meter to the small terminal of the starter (ignition) and to ground. Have your partner crank the starter for 3-5 seconds and note the voltage. It should also be over 11 volts.

If less than 11 volts:

1. For block mounted starters, ensure the engine block mount is clean of all paint. This is the ground source for hundreds of amps being used by the starter. A poor ground will affect the voltage values and performance of the starter.

2. Inspect the wiring. Original cables need to be replaced. Corrosion can build up inside an older cable which you'll never see. Also, the gauge may be too small to carry the current and voltage needed for a high torque starter. We recommend a high quality, multi-strand copper wire and remember that trunk mounted batteries require heavier gauge cables. You can't go too big on the battery cable!

3. Inspect the ring lug/terminals. Use the proper ring lugs and ensure they are crimped to the bare wire strands – not the insulation!

If you have any questions about checking the starter supply voltage or other starter concerns, please contact our tech team at 630-957-4019.

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