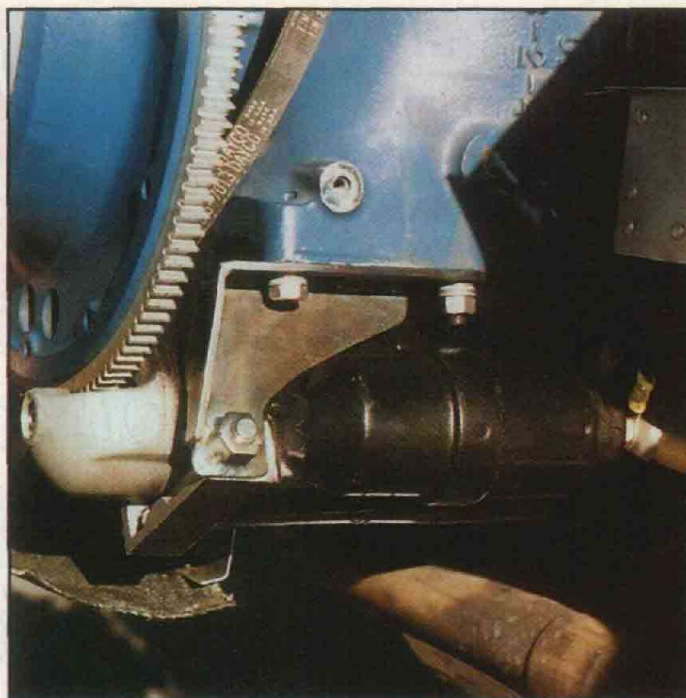


# Starters

## Lightweight . . .

## High Torque . . .

By Ron Denight  
11864 Quam Dr.  
Northglenn, CO 80233  
Phone 303/452-0458



## HOW TO RETROFIT A STARTER

Modern lightweight gear reduction starters can offer weight reduction and increased starting torque. But until now, not lower cost.

What does it take to retrofit a starter to your Lycoming engine? After careful study you can adapt a starter for the engine. With the starter mounted externally to the engine's accessory case, oil leaks are no problem. Also alignment and gear mesh are easily visible.

In the past, an automobile starter, the Chrysler gear reduction unit of the '60s and '70s, was adapted to Lycoming engines during the heyday of the O-290G. This installation offered increased starting torque and low cost but not weight reduction.

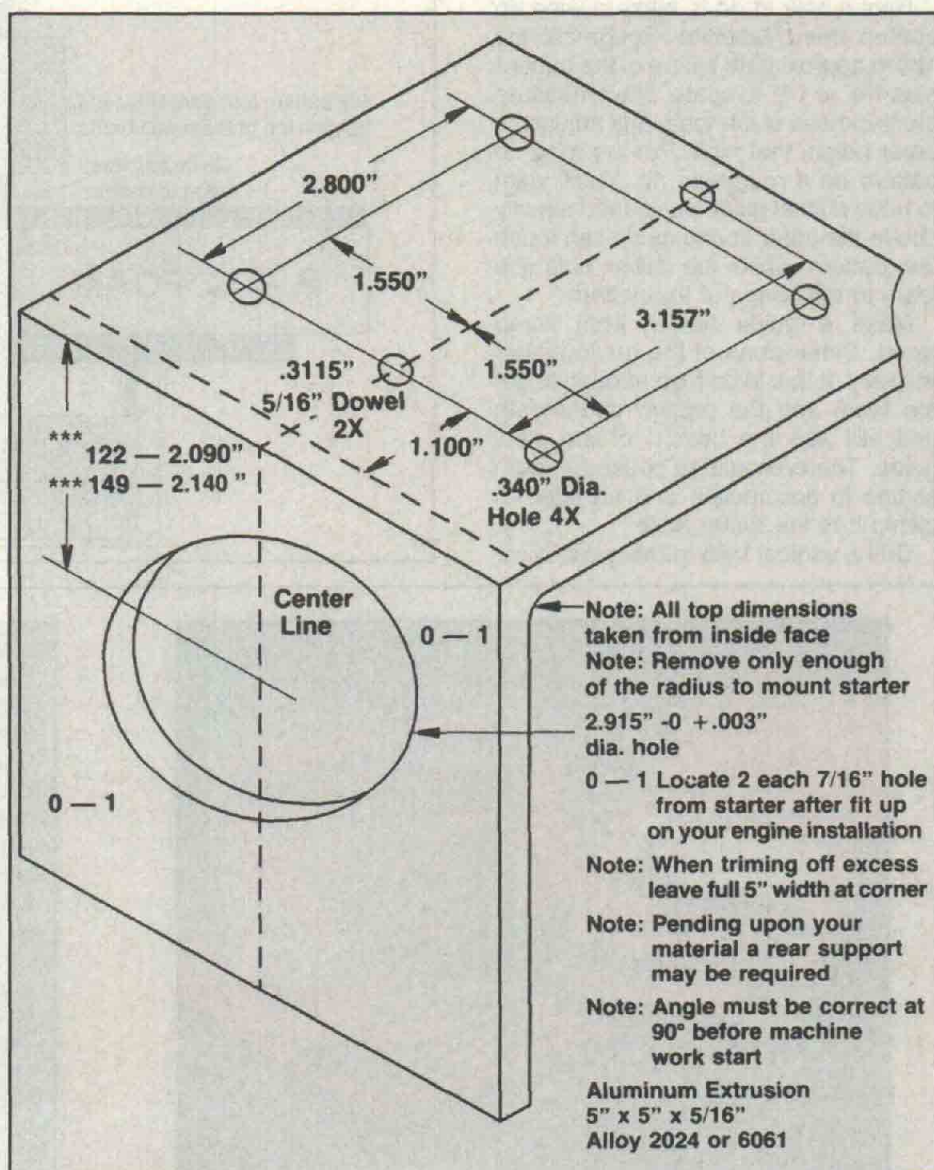
### Engines and Flywheels

Lycoming uses two starters and ring gears on their engines. It is paramount to know which one your engine uses.

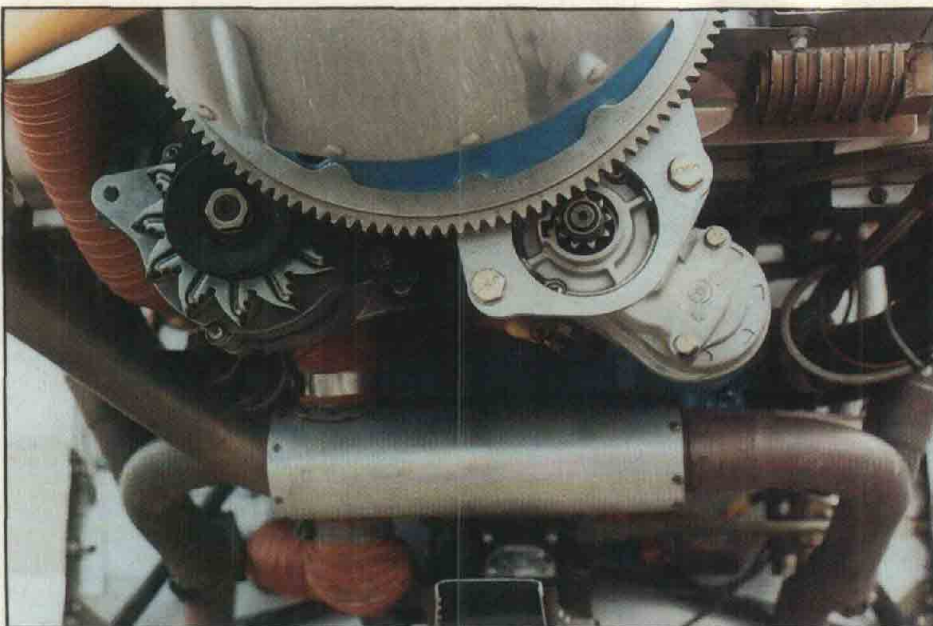
The O-235, O-290 and some O-320 are equipped with a direct drive starter and a ring gear with 122 teeth. This ring gear is a No. 10 pitch (larger tooth size).

The O-320 (later models), O-360 and O-540 are equipped with a gear reduction starter and a ring gear with 149 teeth; this ring gear is a No. 12 pitch (smaller tooth size). With this information on your engine you can proceed to select a starter.

For the selection of the starter, a sample of an old ring gear is very helpful. The selection of the starter should consider the ring gear, the direction of rotation, weight, cranking torque, and ease of mounting on the engine.







Toyota 20R starter and bracket mounted on a Lycoming O-235 with crossover exhaust system. Note that the position of the starter is 6 inches below the Lycoming mounting pad.

### The Toyota 20R and 22R

I chose these starters for the following reasons: no modification necessary to the starter, ease of mounting, readily available at low cost, high cranking torque. This starter is stocked with the 10 pitch coarse gear (9 tooth) for the 122 tooth ring gear. The starter is made by Nippon Denso. They make starters for many other firms, such as Chrysler and the K car with 2.6 liter engine. The 2.6 engine has the 12 pitch fine gear (11 tooth). Therefore, we have one starter for all engines, just change the gear. This K car gear is not available from Chrysler, but larger starter repair shops should have them.

### The Bracket

This starter was mounted with a simple right angle aluminum extrusion 5" x 5" x 5/16" as shown in the drawing. The dimensions were established directly from the Lycoming direct drive starter it replaced in order to place the drive gear mesh exactly where Lycoming has it. Note the starred dimension in the drawing: this is to set the proper gear mesh for the 122 and 149 tooth ring gears.

This simple right angle bracket will fit only the flywheels with a 7-1/2" alternator/generator pulley. The flywheels with the larger 9-3/4" pulley will interfere with the bracket. I have an investment casting which cures this problem.

If you make your bracket from an aluminum extrusion, it may not be a true 90 degree angle. This must be corrected in a hydraulic press before machine work can begin. Note: Neither of the brackets will work on IO-360-A1A

engines with forward mounted throttle body due to interference problems.

### Buying Your Toyota 20R/22R Starter

Toyota produced four starters for what they referred to as the 20R or the later 22R engine. The adapter bracket shown here is for these starters. Of the four, two are for the 20R engine. The first is a direct drive (you don't want this starter); the second is a very nice gear

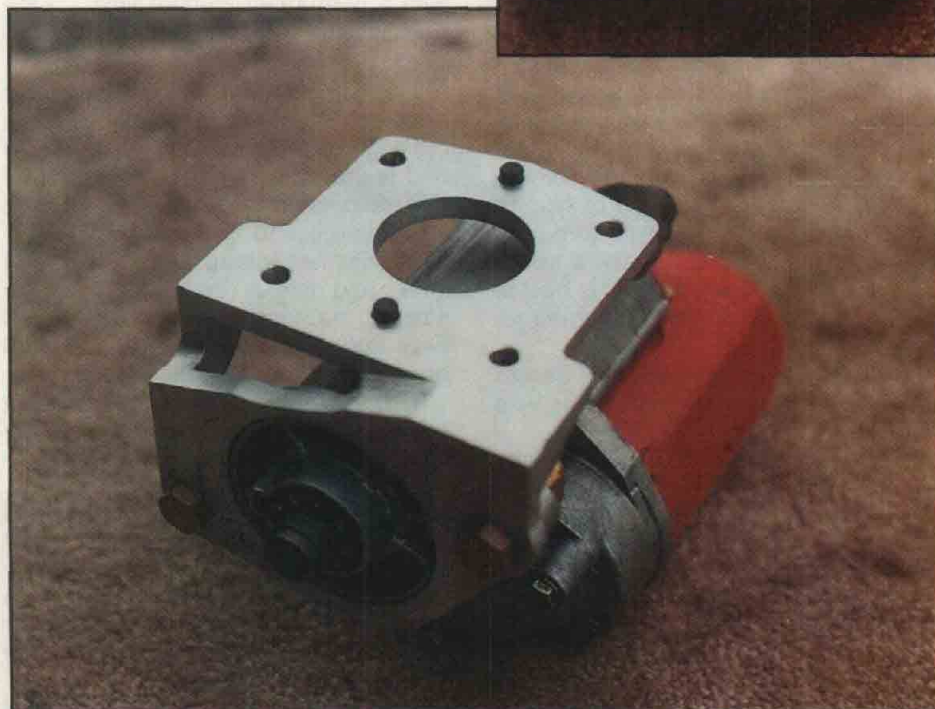
reduction starter. It weighs about 11.0 lbs. and is a very good starter to use. It is rated at 1.4 KW.

The Toyota 20R starter I recommend is the Toyota P/N 28100-34052 or P/N 28100-34053.

Two starters are made for the Toyota 22R engine. The 1.0 KW starter (which is too small), but the 1.4 KW starter, which weighs about 9.7 lbs., is a good one for our purpose. The Toyota 22R starter I recommend is the Toyota P/N 28100-35020 or P/N 28100-35040. REMEMBER: Your satisfaction and reliability of operation depends upon the quality of the starter that you buy.

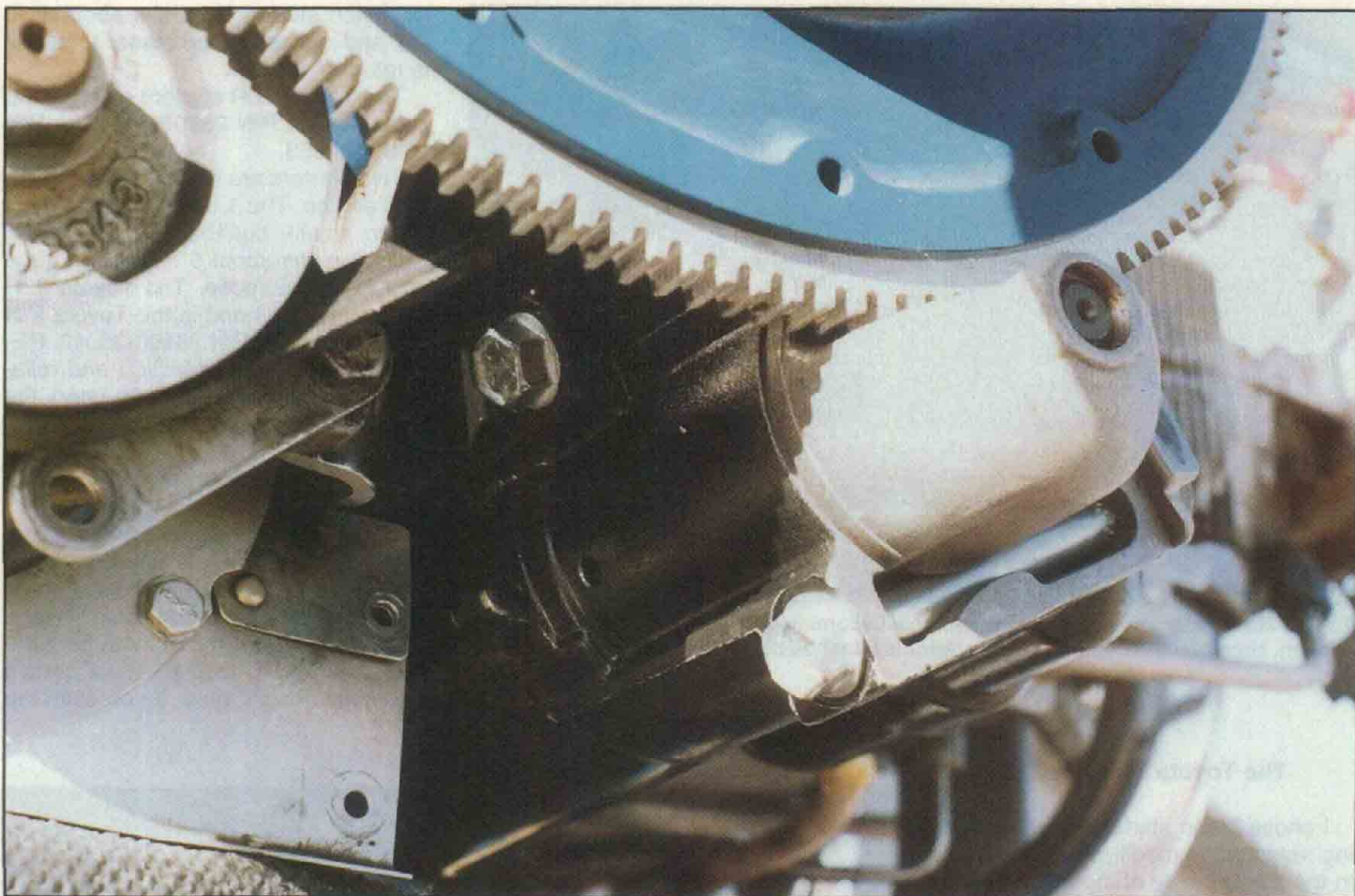
### Mounting Starter

In mounting the starter to the engine, bolt it up securely and pull the starter gear out to mesh the flywheel. It must engage freely without drag. Note: checking the gear mesh must be done before power is applied. Make certain the mags are off, also. If you shim the



Investment casting bracket with Toyota 20R starter mounted. Note the relief for the 9-3/4 inch alternator/generator pulley.





Chevrolet Blazer starter mounted on a 160 hp Lycoming in a Thorp T-18. Note the mounting bolt position . . . GM mounts their starter to the engine block. The driver gear is enclosed.

bracket do not use washers; use sheet aluminum of the desired thickness.

If you are using a Bendix mag switch with the key start position, I strongly advise that you retain the present relay type starter solenoid. Reason: the solenoid on all of the lightweight starters draw 25 amps while engaging the starter to the flywheel and your mag switch cannot handle this for a long time; it will fail. When you retain the original starter relay, you must make a jumper wire with a 5/16" ringlug, a 2" length of No. 14 wire connected to a push-on wire connector to the terminal adjacent to the input terminal of the starter. It is best to get the Toyota wire with the correct retainer clip.

While we are on the subject of Bendix mag switches . . . on installations with key start switch:

1. If you have two impulse mags, the simple twist to start switch is fine.
2. If you have one impulse mag (left only), then the simple twist to start is not recommended. As on a start-give up, with a turning engine you now activate the advanced right mag. This may cause a back fire and starter/flywheel damage.

Solution: use the Bendix twist and push to start switch, then the above situation can be prevented.

#### 1988-1990 Chevrolet Blazer Starter

The 1988-90 Chevrolet Blazer 4.3 liter V6 starter is a gear reduction unit with a permanent magnet field . . . the lightest and most powerful unit I've seen.

This GM product is a No. 12 pitch drive gear that will fit the larger Lycoming engines. It bears Part No. 10465009 and is presently only available through GM dealers at about \$280, including core charge and two 14037732 bolts. This price has increased over the past year, and this is the reason I have stopped further work on this starter. I have three flying on a 150, 160 and 200 hp engine.

This starter will mount on a Lycoming engine with the adapter bracket shown in the photo with one minor modification.

This adapter bracket is a welded 4130 steel unit. If you make this I suggest heliarc welding and careful fitting and tack welding to acquire a proper fit and gear mesh between starter and ring gear. I will not supply any bracket for this starter.

This starter uses the same type of solenoid as the Toyota so you must protect your mag switch. Refer to the

paragraphs for the mag switch and the starter solenoid.

#### Additional Starters

In the 1960s and 1970s Chrysler and GM made many high torque starters for their engines. They may not be lightweight but you might like the price. If your airplane is tail heavy, then a lightweight starter is not for you anyway. Newer lightweight starters are appearing every year in the industry.

#### Conclusion

The purpose of this article is to show the many options available in starters. I have had my airplane at Oshkosh two years with the Toyota starter and, wouldn't you know, two gentlemen walked over in 1989 and said, "I hear you have a neat starter." "Yes," I replied . . . and they wanted to show me theirs.

Score one for Nissan 280Z and one for Toyota Tercel. So with some shopping and ingenuity you can have the starter you've been looking for. I can supply the bracket for \$125 and the No. 12 pitch drive gear for \$20.

As seen in the drawing, I do change the bracket for the 122 or 149 tooth flywheels, due to the difference in pitch dimension.