stretch/preload will not handle the forces being generated within the engine. If the installation specification for the fastener was not followed, the fastener may be tight but very likely not tight enough to endure the dynamics to which it will be subjected. Follow the fastener manufacturer's installation instructions.

Methods for Tightening Critical Fasteners

Torque Wrench

Tightening a critical fastener with a torque wrench is the most common way to install fasteners; however, it could be the most difficult means to insuring the correct installed preload has been achieved. A torque wrench measures the resistance needed to turn the fastener. There are many factors that affect resistance; the manufacturer's recommendations must always be followed.

Friction will be generated by the bolt head against the connecting rod cap surface and resistance in the threads. Some rod bolt manufacturers recommend oil or specific lubricants to be utilized during rod bolt installation. Tightening the bolt once to the manufacturer's torque specification will begin to somewhat overcome the friction between the various surfaces involved but will not preload the rod bolt sufficiently.

A second tightening will polish the threads on the bolt and the rod cap surface. This also helps to ensure that the bolt is seated in the rod. Installing the rod bolt for a third time will allow for less friction as the surface becomes more evenly polished.

Another big variable in using only a torque wrench to determine the fastener installation torque is that many torque wrenches are not accurate. Torque wrenches used in professional applications should be tested for accuracy, adjusted and then certified annually. Many fasteners on the car can be adequately installed with a torque wrench only, but if you have a choice it would not be our recommendation.

Torque Angle

The torque angle method also known as TTY (Torque to Yield) uses a low torque setting to position the fastener in place. Then, using an angle gauge attached to the torque wrench, the wrench is then turned a predetermined number of degrees to tighten the fastener to its recommended preload.

Friction is generally no longer an issue because the initial torque setting is low. By making the final tightening in degrees, setting the preload is relatively easy. As an example, all bolts are initially tightened to 20 ft-lb, the final torque would then be 30 degrees of clockwise rotation. This method provides a consistent preload between all fasteners. This method does rely significantly on the installation instructions and specifications provided by the fastener manufacturer, as this is the means for ensuring correct settings.

Many original equipment manufacturers utilize this method because load scatter (inconsistencies in final torque setting between fasteners, especially on cylinder heads) is kept to a minimum. However, we would not recommend this method for connecting rod bolt installation.

Rod-Bolt Stretch Gauge

This method uses a gauge to measure the installed length (stretch) of the connecting rod bolts. This method provides the most accurate way to ensure that the fasteners' manufacturer recommended preload has been achieved. Most engine builders rely on this method because of its accuracy, and it provides the best means to avoid future problems. The gauges we have—as well as others we have seen—utilize a dial indicator that provides a clear and accurate means to measure bolt length (stretch). The bolt is measured prior to installation to determine its relaxed length and then tightened down until the specified bolt length (stretch) is achieved. Always follow the instructions and specifications of the rod bolt manufacturer.

Thoughts

With respect to the 2014 GT3 engine, consider that this engine has a 9,000-rpm redline. At this engine speed, the crankshaft makes a complete rotation 150 times per second, each piston comes to a complete stop 300 times per second, and the reciprocating weight at maximum rpm could exceed 40,000 lbs.

For a road car that can be driven daily and revved to redline at your discretion, this is really quite impressive. In fact, the 2014 GT3 engine is the highest-revving engine Porsche has ever manufactured for a production road car. This new engine's output seriously rivals Porsche's own 2007 factory RSR racecar. The GT3 comes in at 475hp at 8,250 rpm and 325 ft-lb of torque at 6,250 rpm on pump gas. The 2007 RSR produced 485hp at 8,250 rpm and 321 ft-lb of torque at 7,250 rpm on race gas. Some have asked if Porsche has gone too far with the engine output and performance of this car. We don't think so; technology has come a long way in the past few years.

Clearly, something was wrong with the connecting rod bolts in the 2014 GT3 engine. We believe what Porsche suggested in their news release: that the fasteners were not optimized for the dynamics of this engine. If the rod bolts really had been left loose, the engine would have likely failed before it left the factory.

Again, we believe that Porsche has done a great job in responding to this issue timely and decisively. ■

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