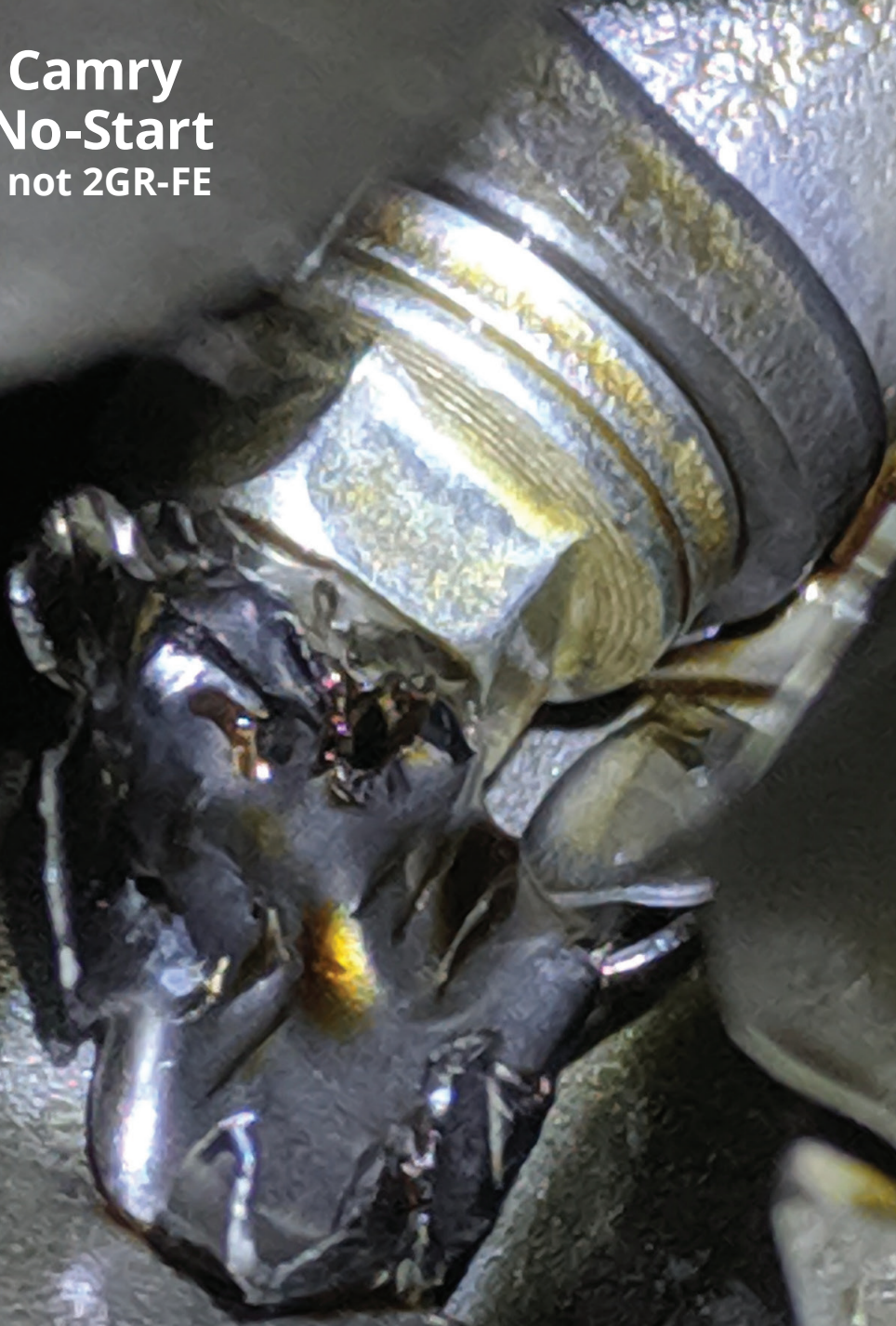


TOYOTAtech

An AutomotiveTechInfo.com publication

ToyotaTech.net

Toyota Camry Crank No-Start 2GR-FE or not 2GR-FE



*Twisted metal found
below the cams*

The flashing lights of the tow truck made my heart sink. The last few vehicles that had been towed in should have gone straight to the salvage yard, not a repair shop. I was relieved when a clean, newer model Toyota Camry came off the back of the flatbed. This Camry was a 2007 and had the 3.5 L V6 engine installed. Toyota calls this engine a 2GR-FE, and according to their engine coding system the number 2 means it is the second generation of the 'GR' engine family. The 'F' and 'E' indicate the engine is equipped with dual overhead camshafts and electronic fuel injection. This particular 2GR-FE had an exceptionally clean engine bay and had only been driven 37,000 miles.

My first thought was that this Camry probably had a dead battery, so I was surprised when I read 'Cranking No Start' at the top of the repair order. The repair order also stated that the owner of the vehicle was driving in town when the engine suddenly shut off and would not restart. My next thought was that this Camry may be out of fuel, but I didn't want to jump ahead in the diagnostic process.

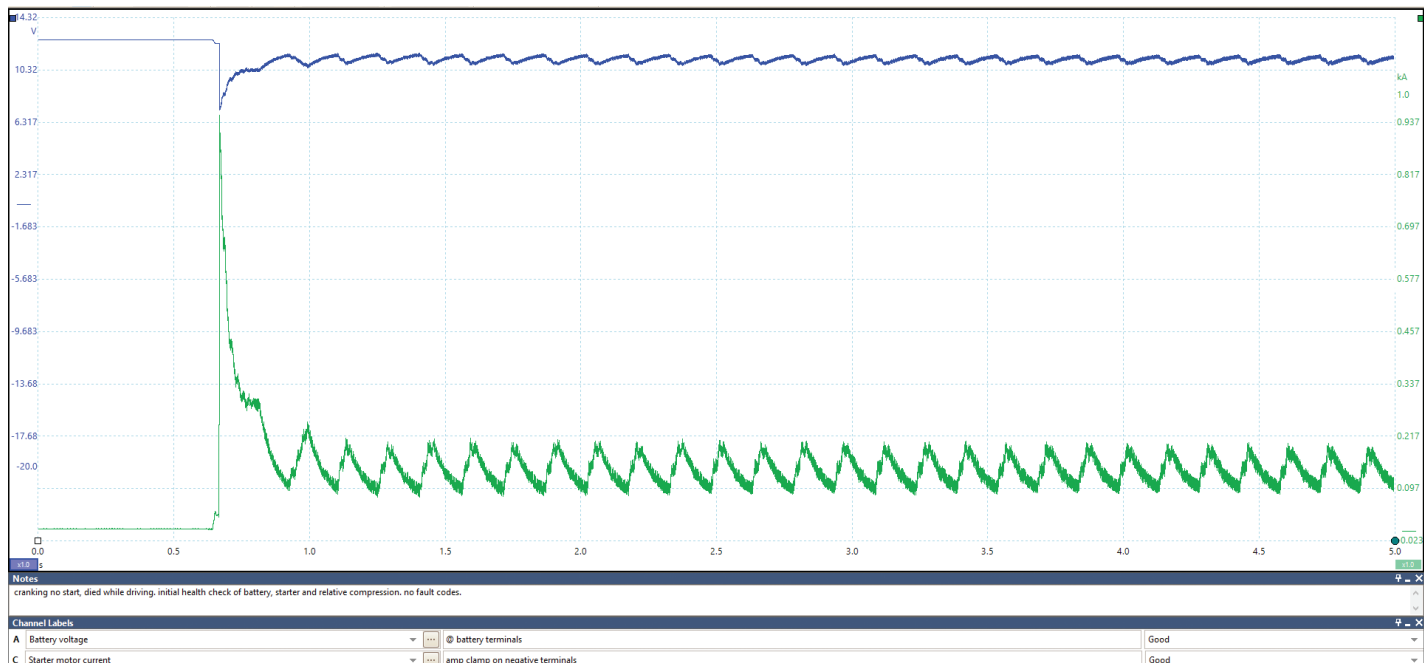
I tried to start the vehicle, secretly hoping it would fire right up and would not need to be pushed into the shop. No such luck though, the engine cranked and cranked but wouldn't start. The cranking rhythm was even and strong, but there was a slightly strange

sound to it. The engine seemed to be cranking over a little too fast, like the compression may be low. The sound was nowhere near as drastic as an engine with a broken timing belt, but it was noticeable. I made a mental note of the cranking sound and moved on.

With help from a couple fellow technicians, I pushed the Camry into an open service bay to begin testing. I like to start by checking vital signs, much like a nurse measures a patient's height, weight, blood pressure, temperature, and pulse before addressing the main reason for the doctor's appointment. This vehicle's vitals were good. The engine oil was clean and full. The coolant level was right where it should be. The battery terminals were tight and free of any corrosion.

Next, I connected my PicoScope. I took advantage of the crank/no-start to perform a relative compression test. I connected one channel to the positive and negative battery terminals, and the other to an inductive amp clamp, which I placed around the negative battery cable.

The resulting waveform showed a strong battery (blue trace) and it also dispelled any fears I had about the compression of the engine. The cranking amperage of the starter motor showed consistent peaks and amplitudes (green trace). This indicated even compression across the six-cylinder engine. Satisfied



PicoScope waveform shows strong battery (blue) and starter motor consistent peaks and amplitudes (green).

with the engine's compression, I chalked up the odd cranking sound to the cylinders being slightly washed from all the attempted starts.

A full scan of the vehicle showed a clean bill of health. There were no faults stored in any modules and all of the Readiness Monitors were complete. Furthermore, this vehicle was too old to use Mode 0A: Permanent Diagnostic Trouble Codes. The live scan tool data did not shed any light on the vehicle's condition either. The data PIDs were all normal, showing a RPM reading, correct MAP pressure, and coolant temperature.

Subsequent checks of spark, injection pulse and fuel pressure all came back good. At this point I was a little lost. I had an engine with compression, ignition and fuel that would crank but not start. After a few minutes of reviewing the facts, I decided to circle back to the odd cranking sound.

I performed a relative compression test with the PicoScope again, but this time I added an ignition sync channel. I connected a second scope channel to the ignition control signal (IGT) for cylinder six (red trace).

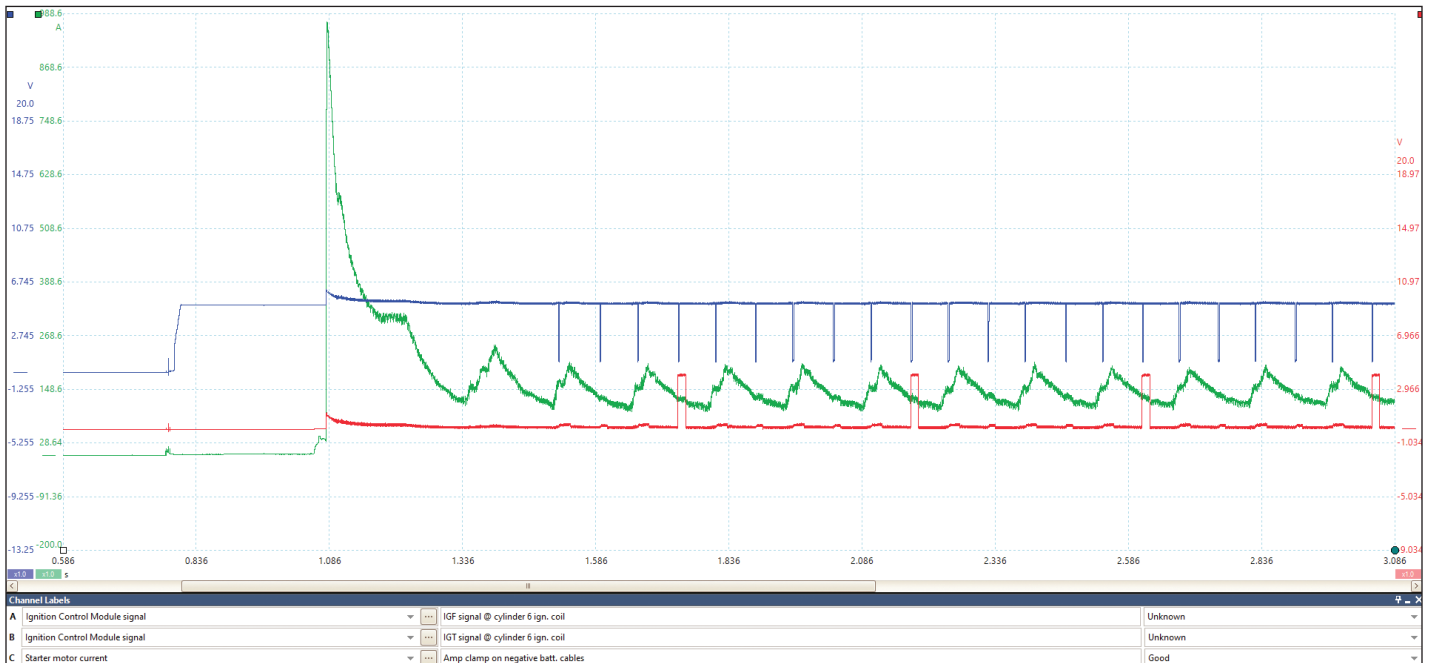
The results were quite startling. There were only three starter motor current peaks, which represent compression strokes, in between each ignition event for

cylinder six. Furthermore the ignition event was not close to a compression peak, as one would expect. Ignition timing should be very close or right at TDC while cranking. There were two possibilities on this vehicle: either the ECM was firing the ignition coils at the wrong time, or there were three missing compression peaks.

An additional scope capture with the ignition feedback signal (IGF – blue trace) proved the latter to be true. The IGF pattern confirmed six ignition events. This engine had three dead cylinders.

DTC Scan Report

VEHICLE INFORMATION	
2007 Toyota Camry LE 3.5	
DTCS	
ENGINE 2GR-FE	
Pending Codes	No Diagnostic Trouble Codes
Current Codes	No Diagnostic Trouble Codes
TRANSMISSION	
Pending Codes	No Diagnostic Trouble Codes
Current Codes	No Diagnostic Trouble Codes
IMMOBILIZER	
Pending Codes	No Diagnostic Trouble Codes
Current Codes	No Diagnostic Trouble Codes
BODY CONTROL MODULE	
Pending Codes	No Diagnostic Trouble Codes
Current Codes	No Diagnostic Trouble Codes



Cranking current, IGT, and IGF waveforms

I used a mechanical compression gauge to confirm that cylinders 2, 4 and 6 had no compression. My first relative compression test indicated a healthy engine, when in fact there were three cylinders not contributing. Due to the cylinder layout and firing order of this V6 engine the three dead cylinders fell in between the three good cylinders and were effectively hidden from view on the relative compression test waveform. This explained the no start condition and the odd cranking sound too.

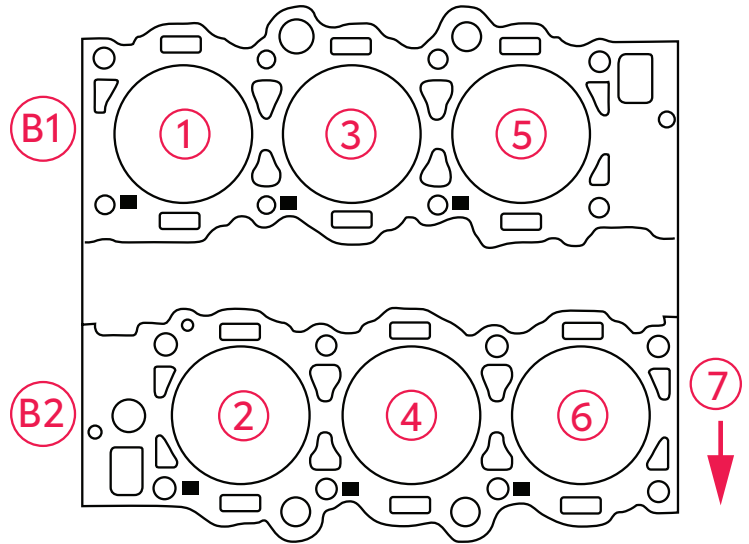
The most likely explanation for the three cylinders on Bank 2 having no compression was incorrect camshaft timing. A known-good waveform is very useful for determining the correct relationship between the camshaft sensor and crankshaft sensor signals.

As luck would have it a Sienna van with the same 2GR-FE engine was in the shop for regular maintenance. I used my lunch hour to capture a known good cam/crank waveform from the Sienna. I removed the fuel pump fuse to simulate a cranking no start condition and scoped the crankshaft and camshaft sensors.

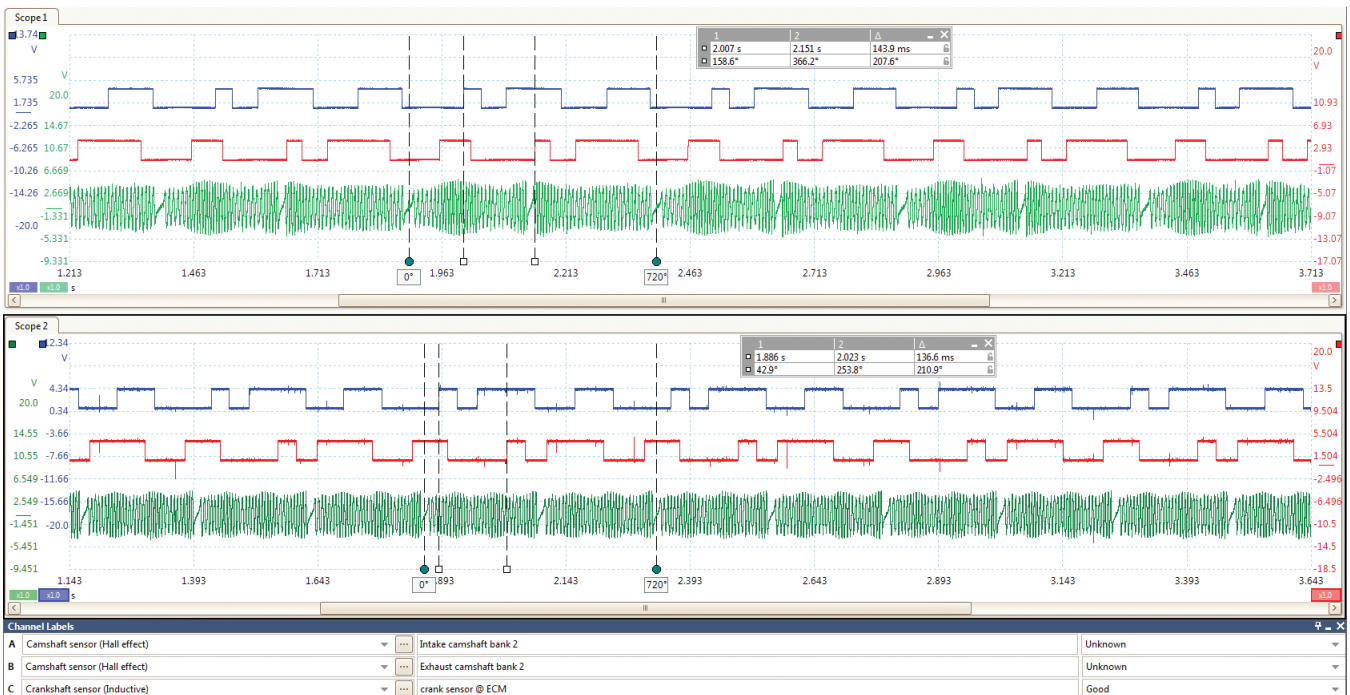
PicoScope offers many powerful features that allow captures to be analyzed quickly and easily.

By utilizing PicoScope's multi scope views, reference waveforms, and rotation rulers, I was able to compare my no start Camry waveform with the donor Sienna capture on the same screen. After comparing both cam/crank waveforms, it was clear that the Bank 2 camshafts were way out of alignment on the Camry.

My next question was, "Why would this well maintained, low mileage engine be running perfect one moment and then have two camshafts out of alignment the next moment?" I decided I had enough



Engine Bank Identification: 2GR-FE, 1MZ-FE, 3MZ-FE



Comparing a known-good 2GR-FE cam timing waveform



Only a small jagged piece of baffle was left on one of the rivets.

evidence to warrant an exploratory surgery. I got approval from the owner of the Camry to remove the Bank 2 valve cover. I was glad the issue was with Bank 2 because it's the front bank and therefore not under the intake plenum.

Once the valve cover was removed, I found a piece of twisted metal below the cams.

At first, I could not tell what this piece of metal was, or where it had come from. It wasn't until I inspected the inside of the valve cover that I realized what the piece was. The piece of metal was in fact the baffle from the valve cover. There was only a small, jagged piece of the baffle left on one of the rivets.

This baffle is directly below the oil filler cap on the front valve cover. The baffle is designed to deflect oil that is slung by the camshafts, but it also has the unintended consequence of making the process of filling the engine with oil slow and frustrating. Seeing the broken baffle jogged my memory and I suddenly remembered a service bulletin from Toyota about cylinder head cover baffles. The bulletin states that engine damage can occur if the baffle is damaged

during the oil fill process, which is clearly what happened to this 2GR-FE engine.

The vehicle's owner was informed of my findings and he in turn contacted the service center where the Camry's oil service was recently performed. The vehicle was towed to that facility to repair the engine damage. I was disappointed to not have the opportunity to repair this vehicle, but it was still a great learning experience for me.

This vehicle was a reminder about the pitfalls of jumping to conclusions. The low mileage of the vehicle had me assuming there would not be any major issues with the engine and the relative compression test results confirmed that assumption. Psychologists refer to this as confirmation bias.

This vehicle was also a good reminder about the limitations of testing methods. The relative compression test is a very powerful tool, but without a reference to a crank signal pattern or an ignition event, the results can be misleading. In the end, the owner of the Camry got his vehicle repaired at no charge, and I took away several valuable lessons from this 2GR-FE. ■

T-SB-0038-08

Cylinder Head Cover Baffle Precautions

Service Category General

Section Maintenance

Market USA

Oil Filling Precautions

WARNING

Use care when inserting oil fill devices into the head cover. Forcefully inserting oil fill devices or funnels into the oil fill hole may result in baffle damage during the oil fill process. If the baffle **DOES** become damaged, repair it to prevent any additional engine damage from occurring.

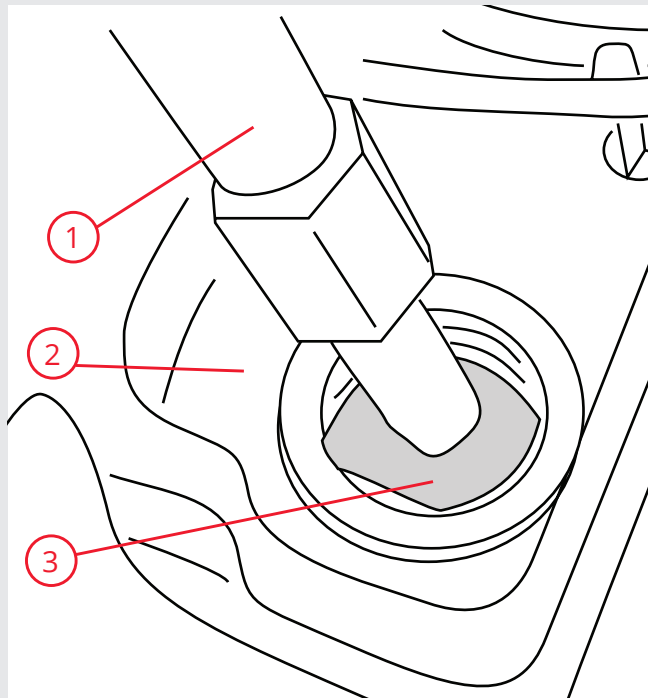


Figure 1. Example of Correct Oil Filling Procedure

1	Oil Fill Gun	3	Oil Baffle
2	Valve Cover		

TOYOTAtech

An AutomotiveTechInfo.com publication

TOYOTAtech is written by professional automotive aftermarket technicians for professional automotive aftermarket technicians. TOYOTAtech is a publication of Automotive Tech Info (ATI). No part of this newsletter may be reproduced without the express written permission of ATI.

Publisher
Tamra Ayers Banz
tbanz@automotivedatamedia.com

Editorial Director
Paul Cortes
pcortes@automotivedatamedia.com

Technical Writers
Scott Brown, Ken Coleman, Jordan Hill,
Chris Ligocki, Gary Smith,
Christian Strohm, Frank Walker

Creative Director
Christopher Ayers III
ayersc3@automotivedatamedia.com

Group Publisher
Christopher M. Ayers Jr.
cayers@automotivedatamedia.com

Editorial and Circulation Offices:
134B River Road
Montague, NJ 07827
Phone: 330.620.3929
automotivedatamedia.com

CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR OTHERS. INFORMATION CONTAINED IN THIS PUBLICATION IS INTENDED FOR USE BY TRAINED, PROFESSIONAL AUTO REPAIR TECHNICIANS ONLY. THIS INFORMATION IS PROVIDED TO INFORM THESE TECHNICIANS OF CONDITIONS WHICH MAY OCCUR IN SOME VEHICLES OR TO PROVIDE INFORMATION WHICH MAY ASSIST THEM IN PROPER SERVICING OF THESE VEHICLES. PROPERLY TRAINED TECHNICIANS HAVE THE EQUIPMENT, TOOLS, SAFETY INSTRUCTIONS, AND KNOW-HOW TO PERFORM REPAIRS CORRECTLY AND SAFELY. IF A CONDITION IS DESCRIBED, DO NOT ASSUME THAT A TOPIC COVERED IN THESE PAGES AUTOMATICALLY APPLIES TO YOUR VEHICLE OR THAT YOUR VEHICLE HAS THAT CONDITION.