TECHELP
The Automotive & Smog Training Center

Tech Tip

1995 Chevrolet Camaro
5.7 Liter V8 Vin P

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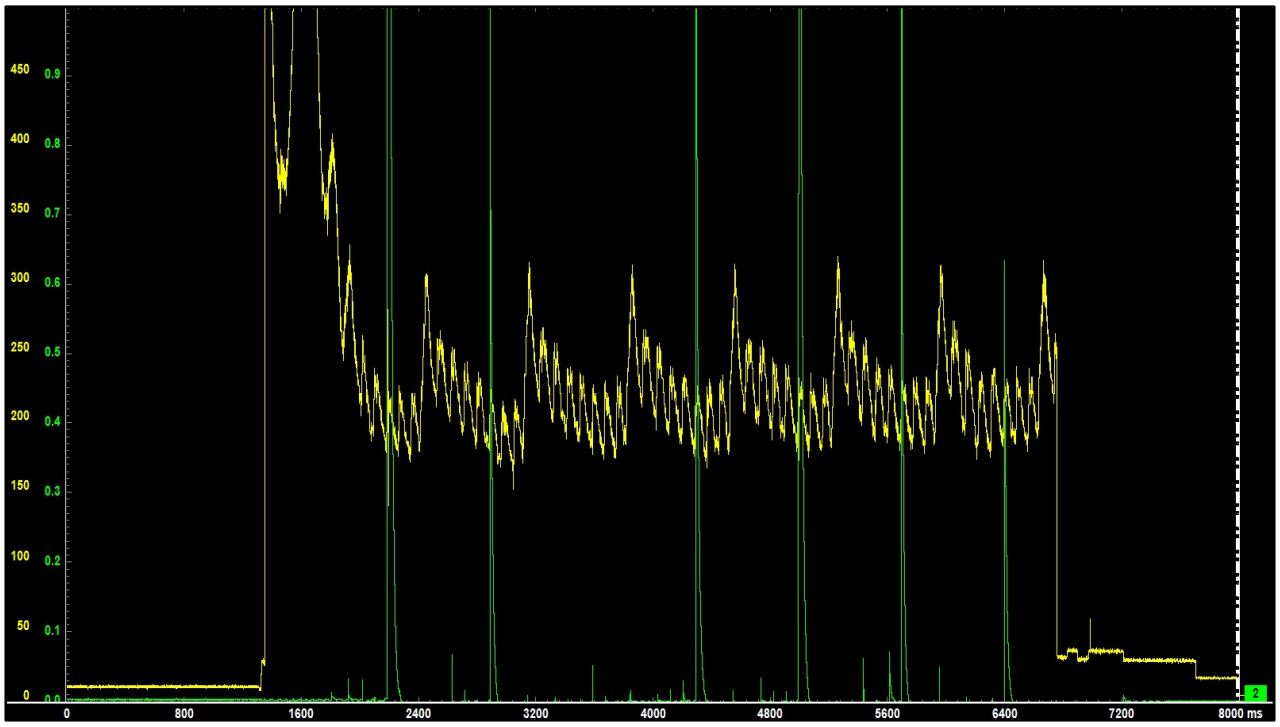
The vehicle came in with a “Rough Running Condition” and because of the year of the vehicle (1995), there was no “Misfire Codes or Misfire Data” using a scan tool.

A Cranking Amps Relative Compression Test was performed and the results are on the following pages.

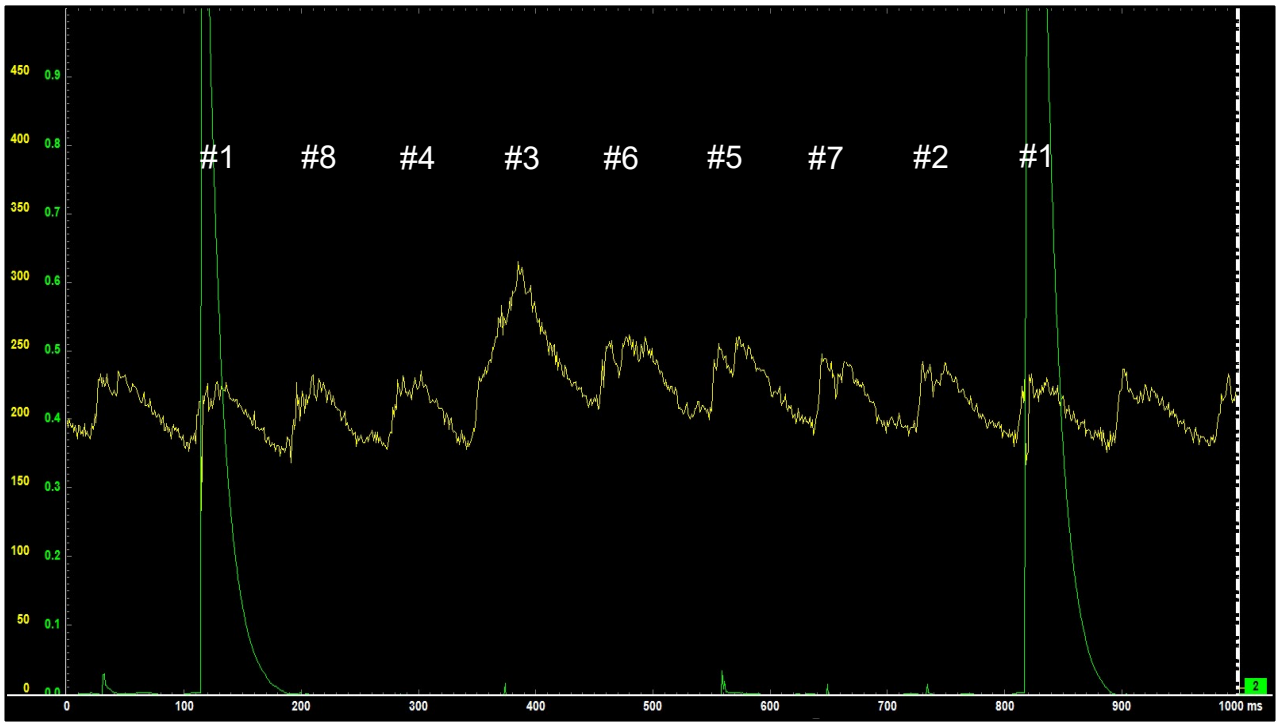
In past Cranking Amps Relative Compression Training Tips the engine problems have presented themselves as “Lower Amperage Draws” relating to “Lower Compression in a Particular Cylinder”. This Technician Training Tip is just the “Opposite”



Using a High Amperage Current Clamp wrapped around either the Positive or Negative Battery Cable, a measurement of the “Current Demand from the Starter Motor” can be graphed over time.

To prevent the engine from “Starting” the Fuel Pump Relay has been removed. The engine was “Cranked” for approx. 10 Seconds

The Second Channel is Secondary Ignition Voltage from the Number 1 Spark Plug Wire. Using this second channel the firing order can be utilized to isolate any anomalies within the pattern.



Zooming into the waveform and inserting the Firing Order the anomaly within the pattern appears on Cylinder #3.

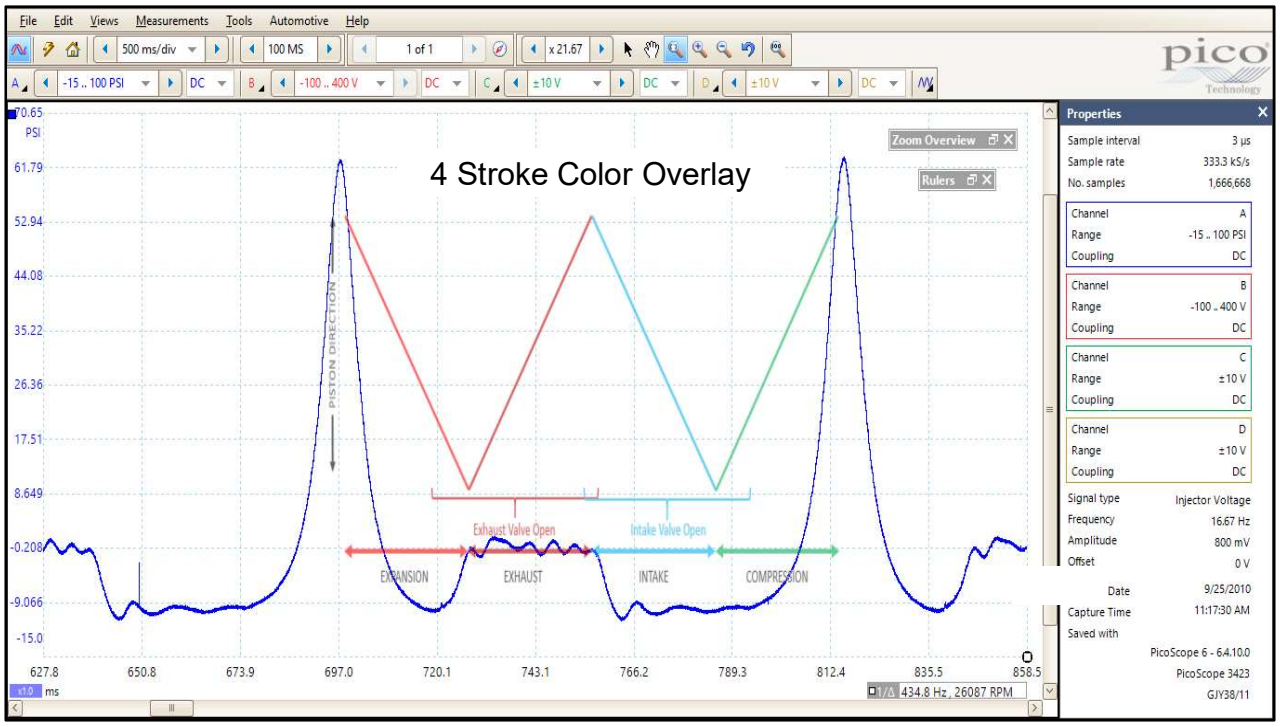
What would cause Cylinder #3 to show more “Current being Drawn from the Battery” during its Compression Stroke.

An understanding of Companion Cylinders (Pistons that travel TBC, BDC, Etc. together) is necessary to perform this diagnosis correctly

The anomaly in the Cranking Amps Relative Compression Waveform that shows up on Cylinder #3 is actually a problem in its Companion Cylinder which is Cylinder #2

In order to find an engine’s companion cylinders simply cut the Engine’s Firing Order in half and put the First Half, on top of the Second Half.

1843
6572

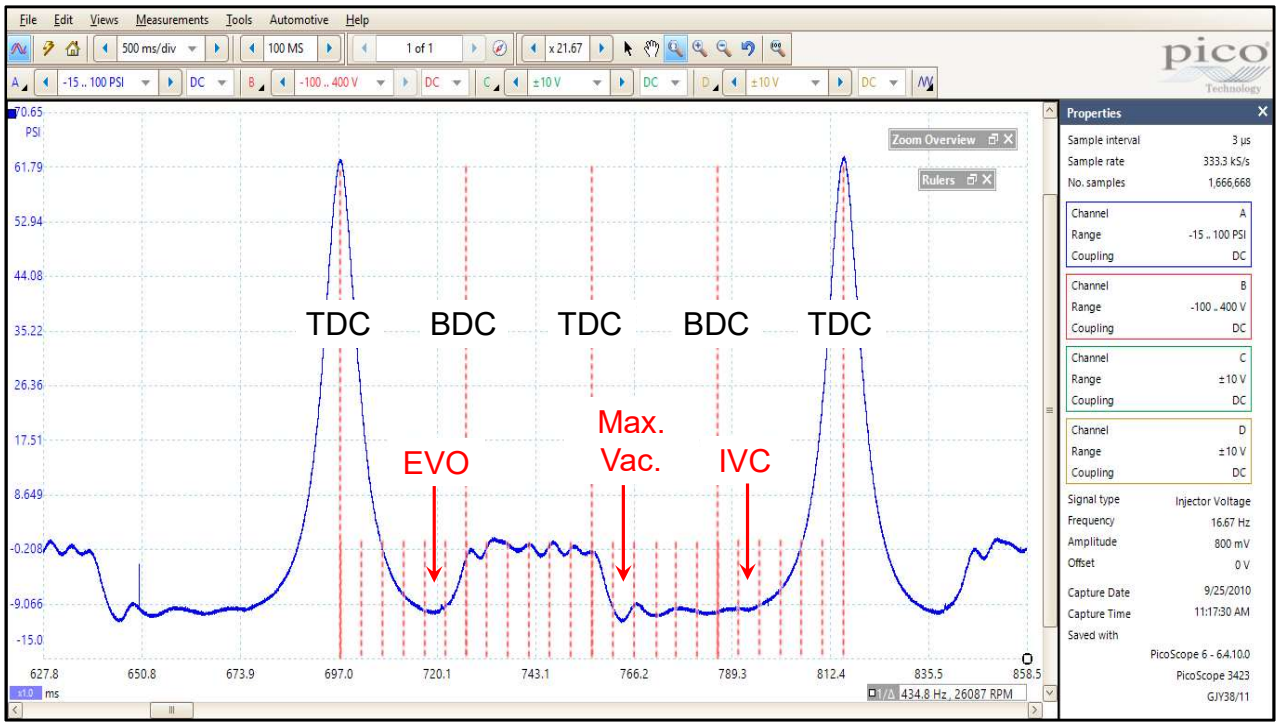


Before we get into the diagnosis of the Chevrolet let's review In-Cylinder Pressure Transducer Testing. Using a in-cylinder pressure transducer and a lab scope a digital image is traced over time which represents the "Volume of Air" moving inside a particular cylinder's combustion chamber. In the image above an overlay has been added to help illustrate what the In-Cylinder Pressure Trace is displaying. The "Peak" on the left side of the screen shot above represents Top Dead Center Compression. The "Peak" on the right side of the screen shot again represents Top Dead Center Compression (720 degrees of Crankshaft Rotation later).

Moving from left to right the In Cylinder Pressure Trace shows the changes in pressure as the cylinder goes through:

The Expansion Stroke
The Exhaust Stroke
The Intake Stroke
The Compression Stroke

Each piston stroke is 180 degrees of crankshaft rotation in duration. 4 strokes of 180 degrees each equals 720 degrees total.
(4 x 180 = 720 degrees total)



Another popular overlay is the 30 Degree Overlay, this overlay breaks up each 180 degree area into 30 degree smaller increments. It is used to accurately measure Valve Opening and Closing Points in relationship to Crankshaft / Piston Position.

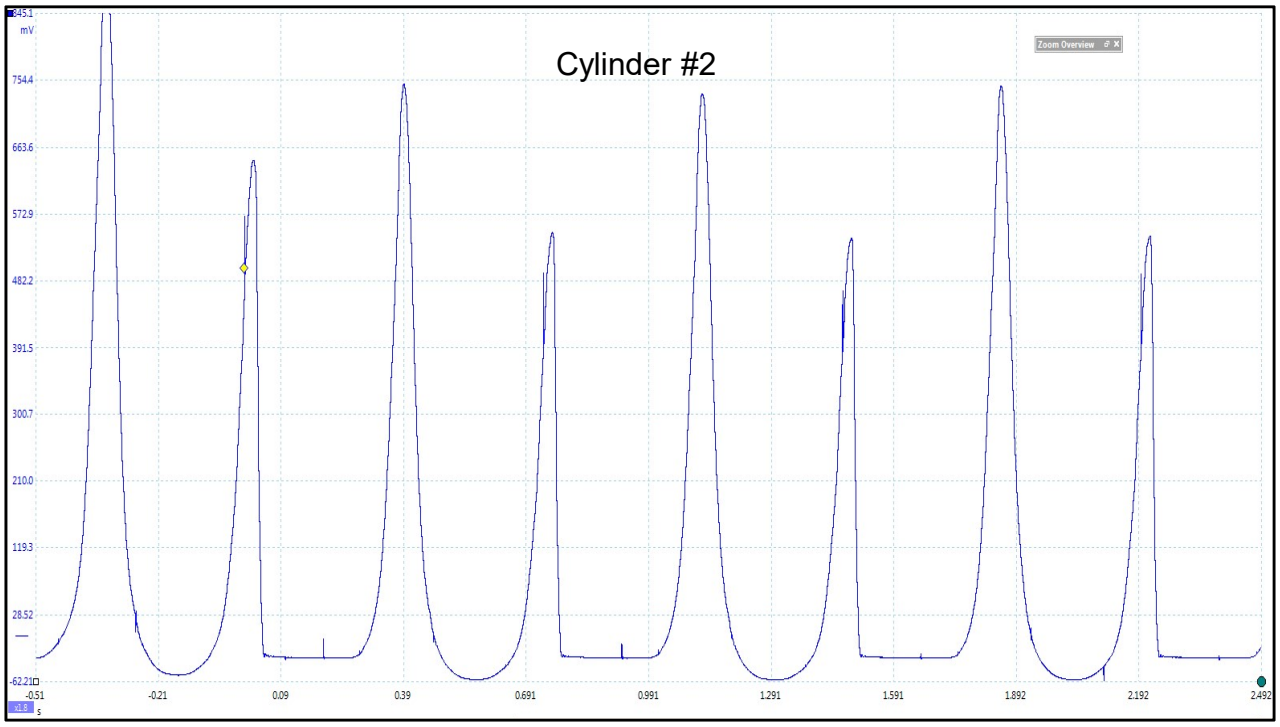
In the image above:

The Exhaust Valve Opens at approx. 45 Crankshaft Degrees Before Bottom Dead Center (EVO)

Maximum Vacuum happens at approx. 45 Crankshaft Degrees After Top Dead Center (Max Vac.)

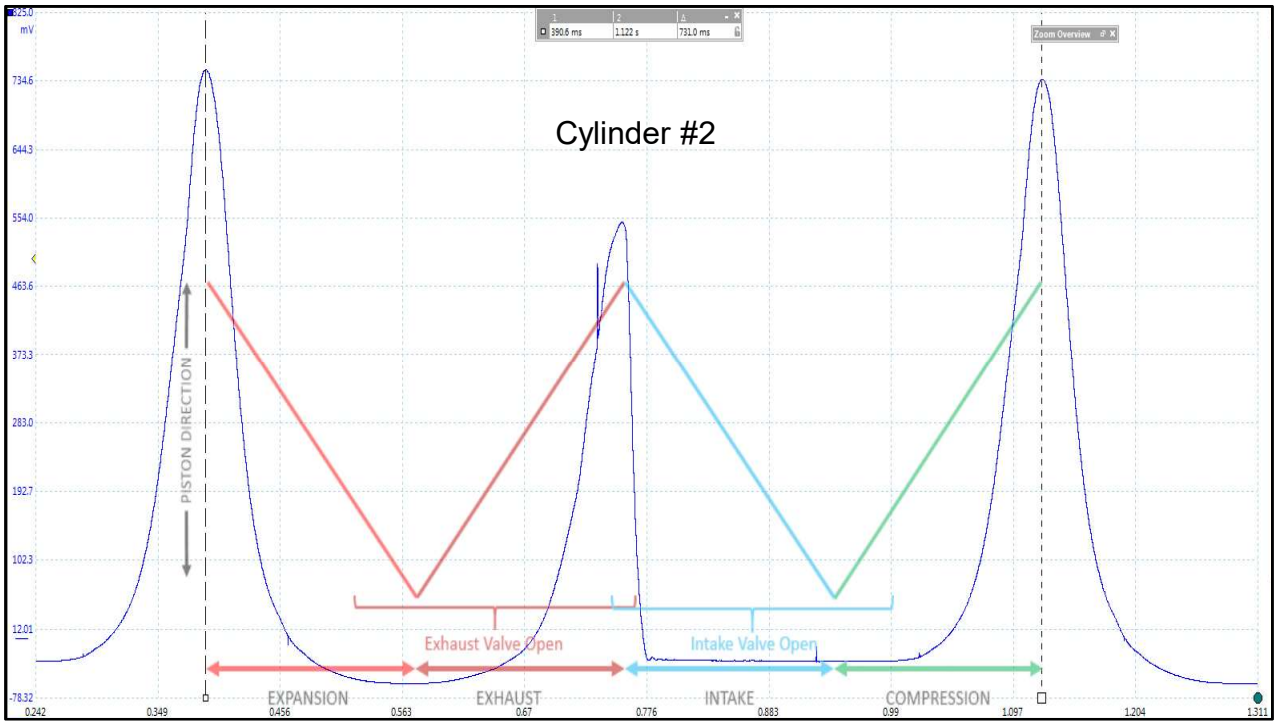
The Intake Valve Closes at approx. 45 Crankshaft Degrees After Bottom Dead Center (IVC)

Understanding this “Known Good Waveform” will help you better understand the waveforms on the following pages.



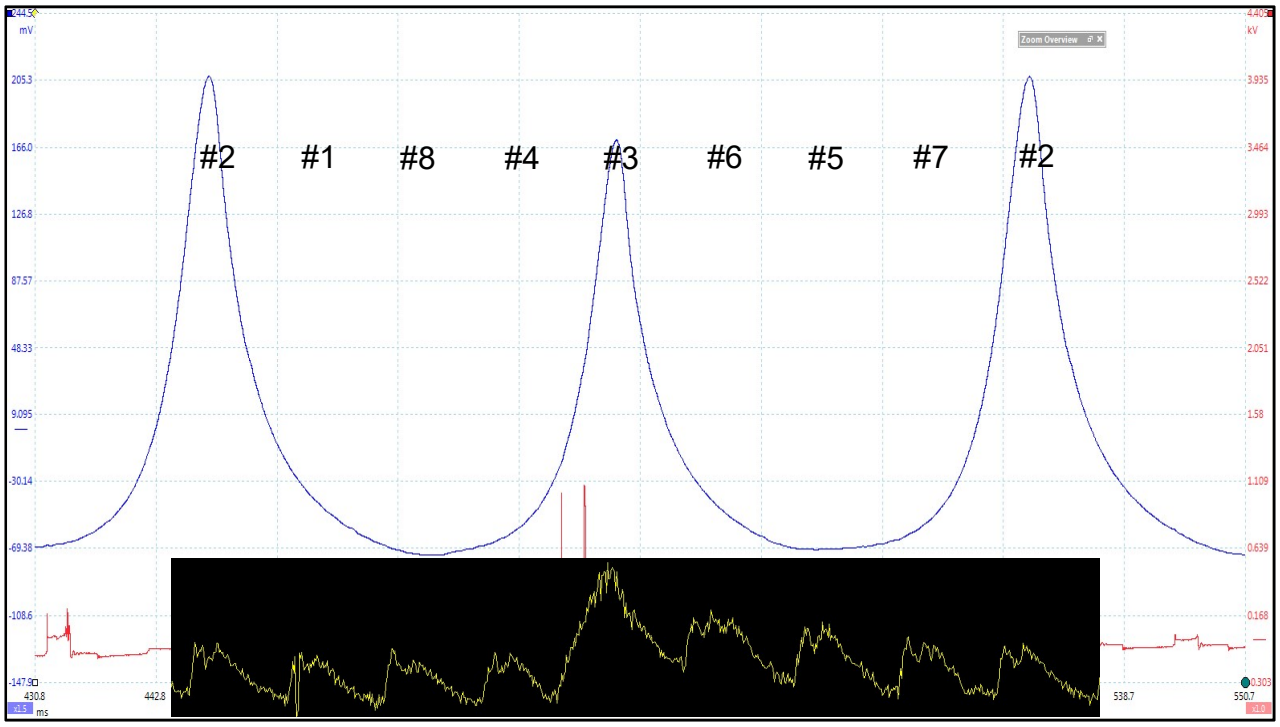
Using an In-Cylinder Pressure Transducer the above waveform was captured from Cylinder #2, while the engine was “Cranking”.

The “Higher Peaks” represent TDC Compression for Cylinder #2. The “Peaks” in the middle is “Unwanted Pressure” within the cylinder during the Exhaust Stroke (which shouldn’t be there). This “Unwanted Pressure” indicates No Exhaust Event happened, Cylinder #2 is “Compressing” and “Recompressing” the same “Gasses” over and over.



Zooming into the waveform to focus on just two Crankshaft Revolutions (one complete cycle of the engine) and utilizing an Overlay Program it is clear the “Unwanted Pressure” is happening during Cylinder #2’s Exhaust Stroke.

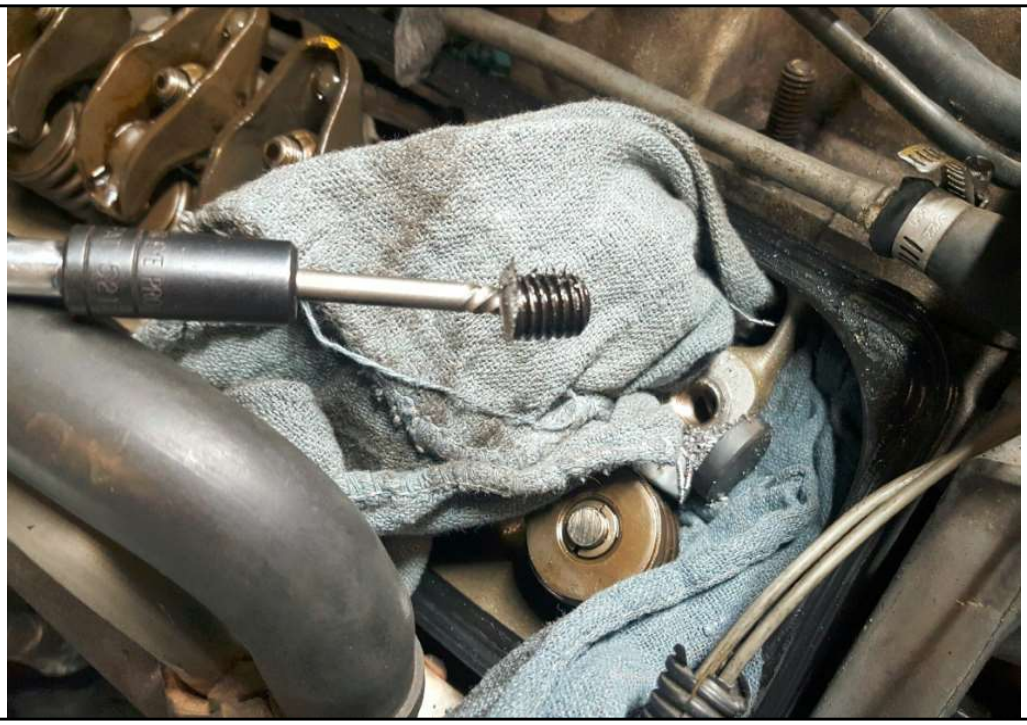
Notice the “Unwanted Pressure” immediately “Falls” once the Cylinder’s Intake Valve Opens. If a Vacuum Transducer was used to measure Intake Manifold Pressure, this condition would show up as a “Positive Pulse” on the waveform each time Cylinder #2’s Intake Valve Opened.



So why does an issue within Cylinder #2 (no Exhaust Event) show up on Cylinder #3 during the Cranking Amps Relative Compression Test.

Explanation: Cylinder #2 is “Compressing” and “Recompressing” the same gasses within the combustion chamber because there is “No Exhaust Event”. When Cylinder #3 is on its Compression Stroke, Cylinder #2 is Recompressing Gasses on its Exhaust Stroke. The Starter Motor is drawing “Current” necessary for both Compression Events thus the Higher Current Demand.

Once the diagnosis was completed the customer was given an estimate for “Tear Down”. The passenger side valve cover was removed and Cylinder #2’s Exhaust Valve Rocker Arm was found laying in the Cylinder Head. The stud holding the Rocker Arm in place had “Broken”.



The broken piece of the Rocker Arm Stud was able to be extracted from the cylinder head and a new stud was installed. The Push Rod was inspected for damage and none was found.

Thank you for taking the time to read this article.

T = Together
E = Everyone
A = Achieves
M = More

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