TECHELP
The Automotive & Smog Training Center

Tech Tip

2013 Honda Civic
1.8 Liter 4 Cylinder

2013 Honda Civic
1.8 Liter 4 Cylinder SOHC
(Single Overhead Camshaft)

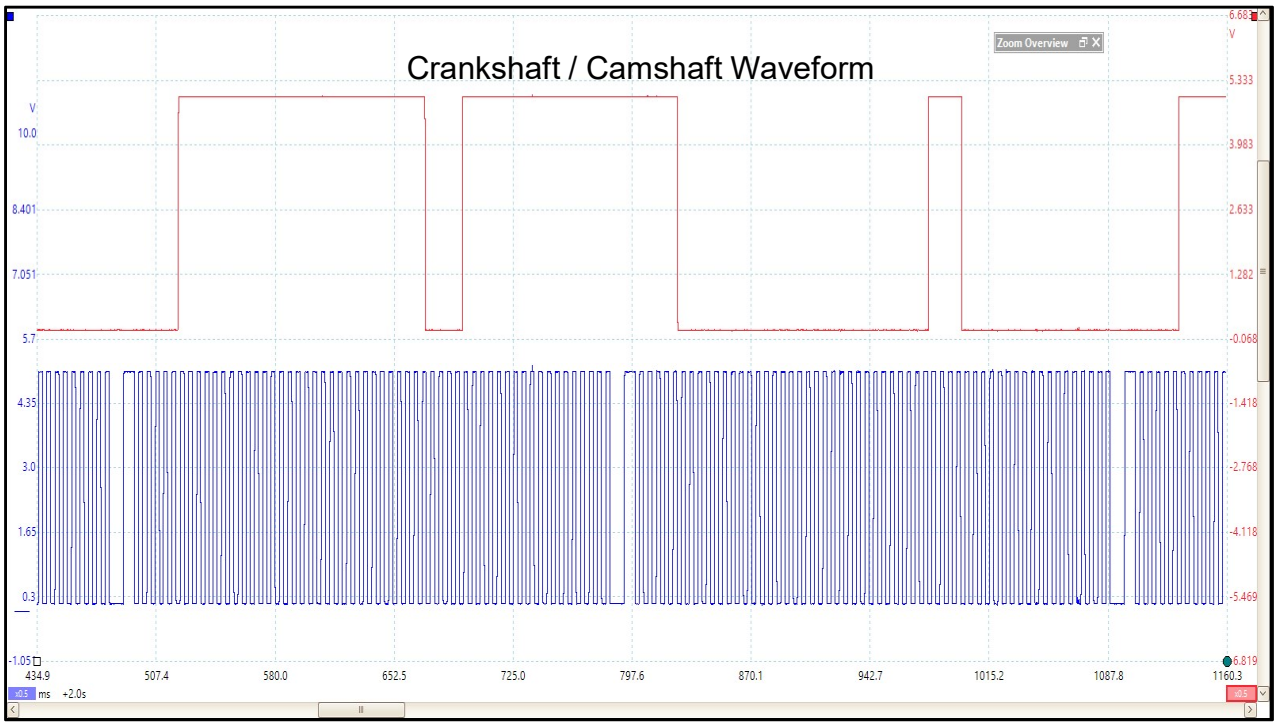
The vehicle was brought in due to a “Rough Running” condition and an Illuminated Malfunction Indicator Light (MIL). The 1.8 Liter engine is timing chain driven and no internal engine work had been performed prior to the start of this issue.

- ✓ The Car has Low Power
- ✓ The Car has been to Four Other Repair Shops including Two Honda Dealerships
- ✓ Even Relative Compression Test
- ✓ 150 – 155 PSI on a Gauge
- ✓ Exhaust Back Pressure 2 – 3 PSI, No Change with Air Fuel Ratio Sensor Removed
- ✓ Fuel Pressure 58 PSI at Wide Open Throttle
- ✓ The Air Fuel Ratio Sensor responds normally to Forced Lean & Forced Rich Conditions
- ✓ Fuel Trim Numbers are a Little Lean -10 to -15% Total Trim (Slightly Rich Condition)
- ✓ 15 PSI Fuel Pressure Drop each Fuel Injector using a 5 milliseconds Pulse Tester
- ✓ Exhaust Gas Recirculation Valve Removed and Check, No Change in Performance when Disconnected
- ✓ V-TEC System Checked (with Valve Cover and Spark Plugs Removed)
- ✓ 16” of Vacuum at Warm Idle (Low for a Honda), Valve Adjustment Performed.
- ✓ The ATS, EScan Software was used for Volumetric Efficiency and the Engine Tested Low by 30%
- ✓ A New Mass Air Flow Sensor was Installed, No Change
- ✓ A New Knock Sensor was Installed, No Change

The above list shows the amount of time and effort that was put into resolving the customer’s concerns.

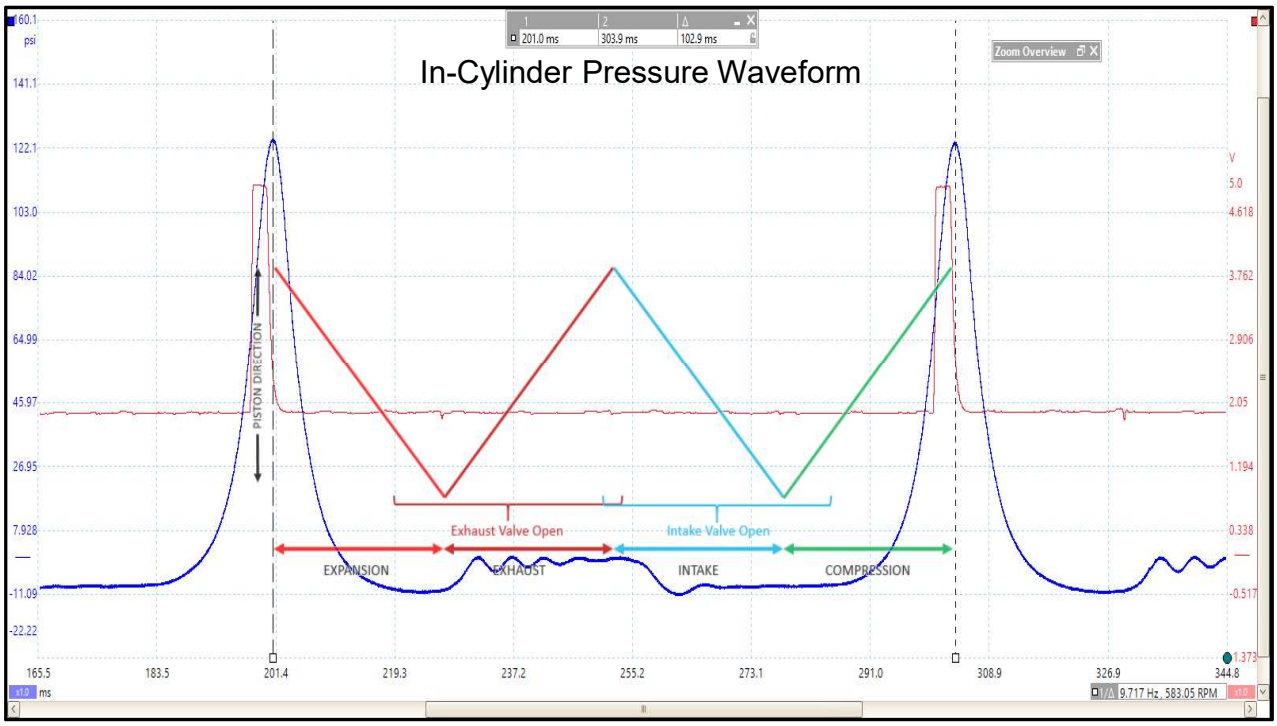
The Honda Civic is now at its 5th auto repair shop, with countless attempts being made to resolve the “Rough Running” condition.

I’d like to thank Jeremiah Lilly for allowing me to assist him with this diagnosis.



The above waveform is the Crankshaft Sensor (in blue, lower trace) and the Camshaft Sensor (in red, upper trace).
The Crankshaft / Camshaft Correlation is un-known, because a “Known Good Waveform” could not be located using all available resources.

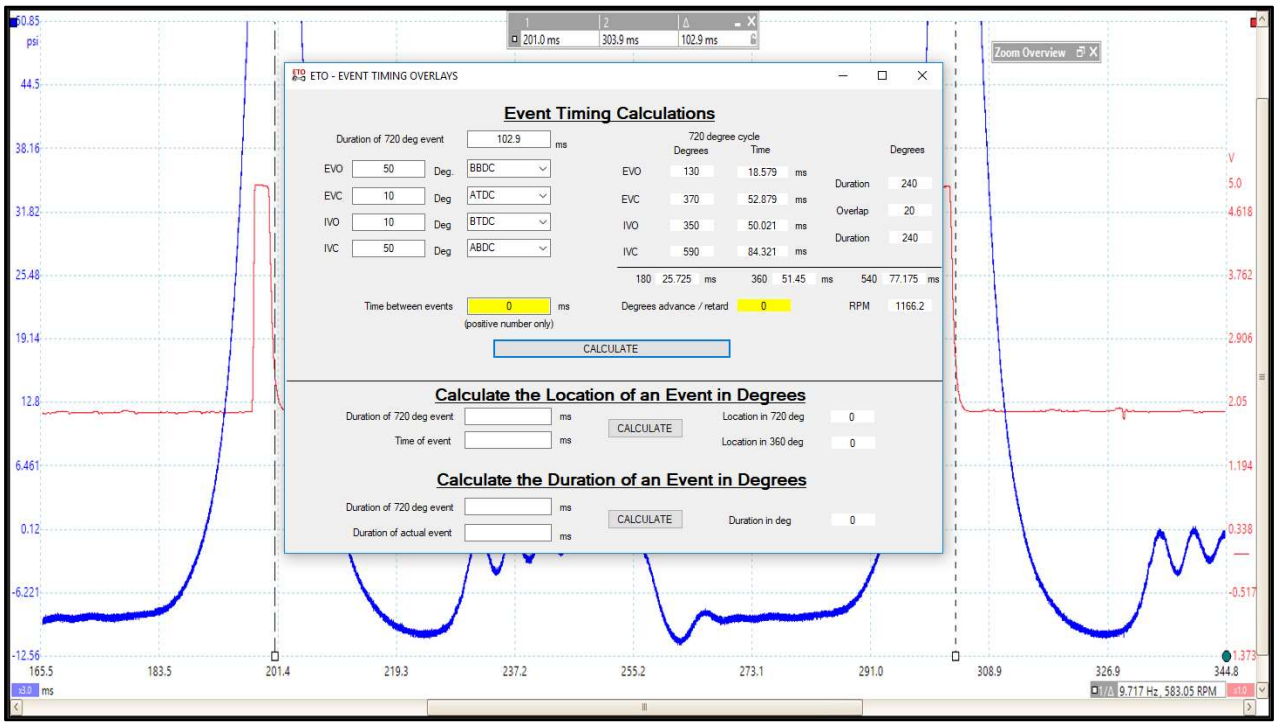
Known Good Waveforms for your customer’s vehicles are extremely important especially when diagnosing issues like this.



Due to the overwhelming amount of work previously performed on the vehicle and the uselessness of the Crankshaft / Camshaft Correlation Waveform it was determined In-Cylinder Pressure Transducer Testing was going to be our best option for pin-pointing the “Route Cause” of the “Rough Running”.

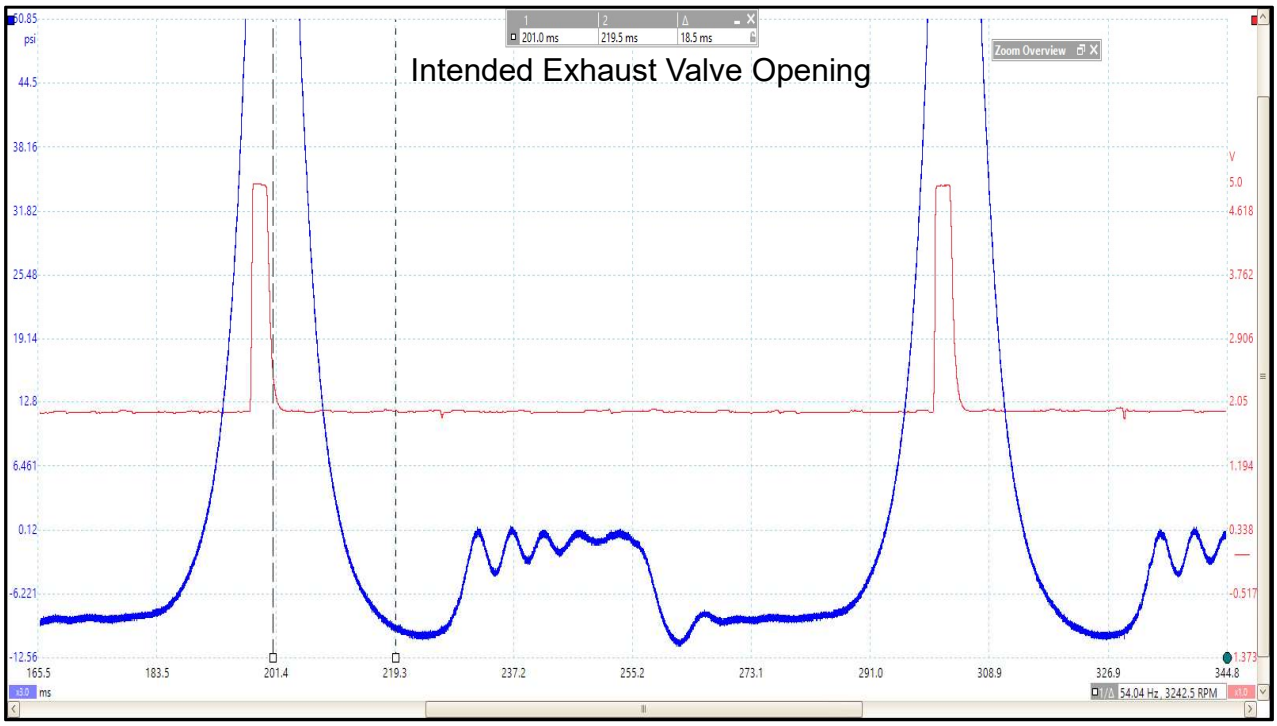
Because this is an In-Line Engine it didn’t matter which cylinder was going to be tested. If the “Camshaft is Out of Time” it will effect all of the engine’s cylinders equally.

The overlay added to the above waveform helps explain the four different strokes of the piston, in relationship to the In-Cylinder Trace (in blue). The red trace is the Ignition Timing signal from the vehicle’s Electronic Control Module (ECM) for the cylinder being tested.



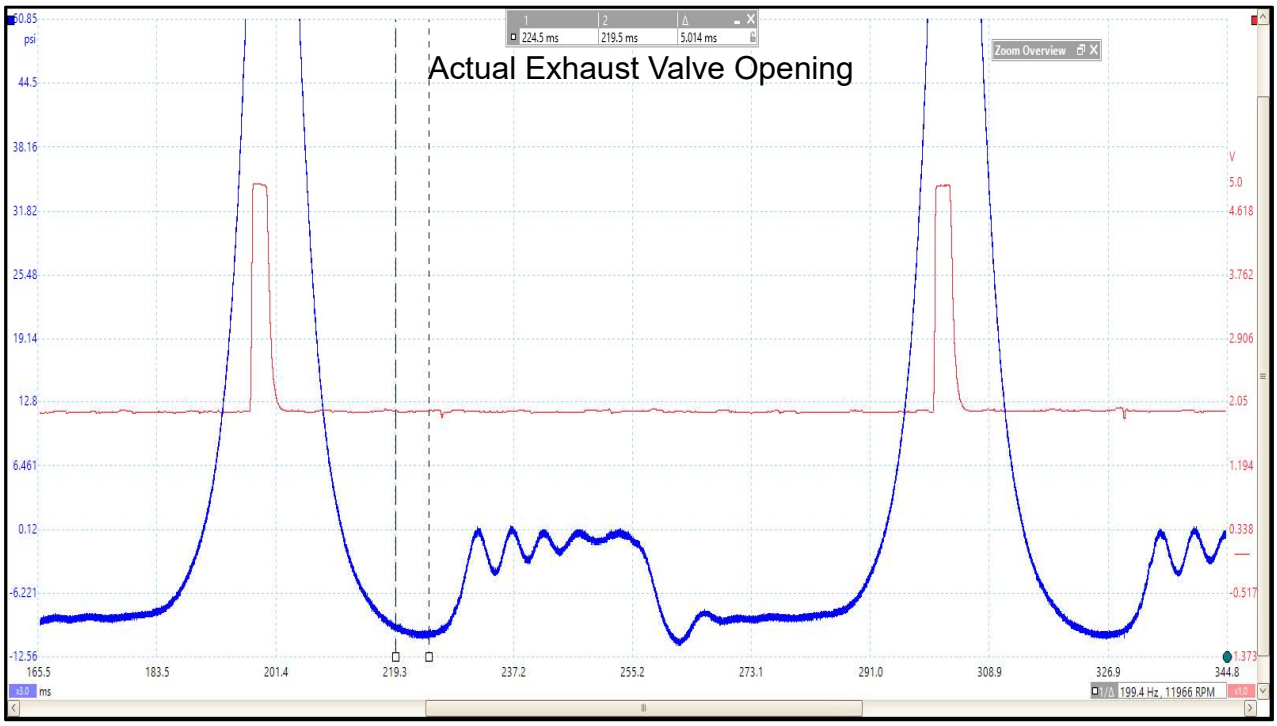
The two peaks of the trace represent Top Dead Center of the Compression Stroke. Between the two peaks is 720 degrees of Crankshaft Rotation. Using the cursors of the lab scope “Time” can be measured between the two peaks. This amount of “Time” will help determine the intended Exhaust Valve Opening & Intake Valve Closing points so an analysis can be made regarding Crankshaft / Camshaft Correlation.

In this example 720 degrees of crankshaft rotation happened in 102.9 milliseconds of time. Inputting this number into the calculator will give the “Intended Time Indicators” for when the Exhaust Valve Opening & Intake Valve Closing events should occur



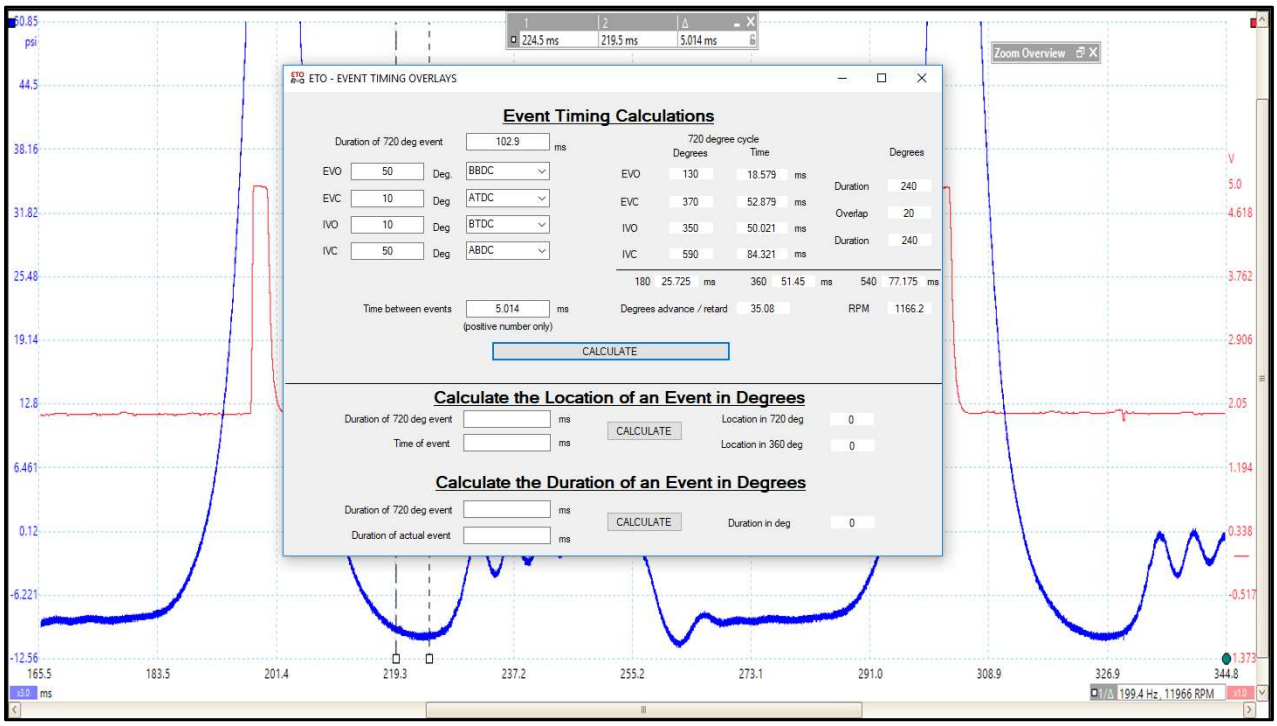
Using the calculator from the previous screen the Exhaust Valve Opening should have occurred where the cursor on the right is placed at 18.5 milliseconds away from the cursor on the left.

Exhaust Valve Openings are determined by when the pressure changes directions between the Expansion Stroke and the Exhaust Stroke. Using the example above the Exhaust Valve Opening did not occur at the intended point in time.



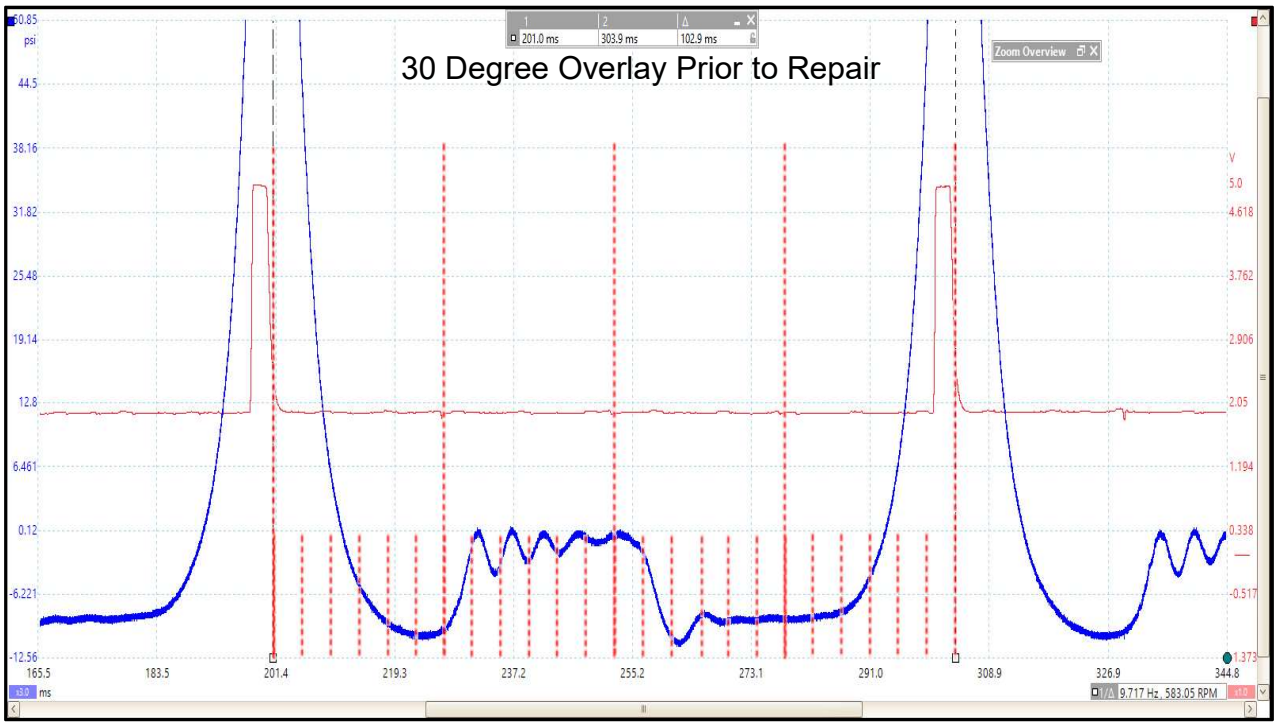
Analyzing the trace and repositioning the cursor from the left the Exhaust Valve Opening actually occurred 5 milliseconds to the right of its intended position.

This proves the Crankshaft / Camshaft Correlation is “Out of Time”, but by how many degrees?



Going back to the calculator the 5 millisecond difference between the Exhaust Valve Opening's intended location versus its actual location can be re-calculated back to "Degrees of Crankshaft Rotation".

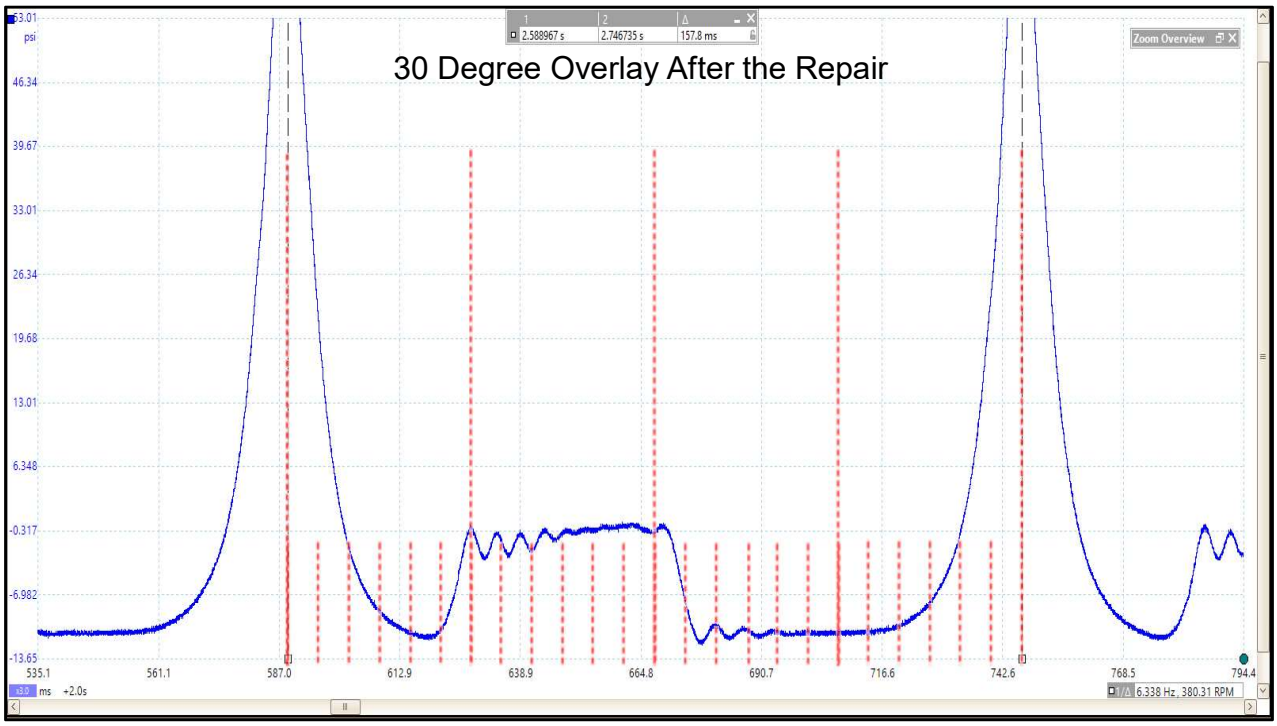
In this example the 5 milliseconds calculates to approx. 35 Degrees of Crankshaft Rotation.



Another option for determining Exhaust Valve Opening and/or Intake Valve Closing is to use a 30 Degree Overlay.

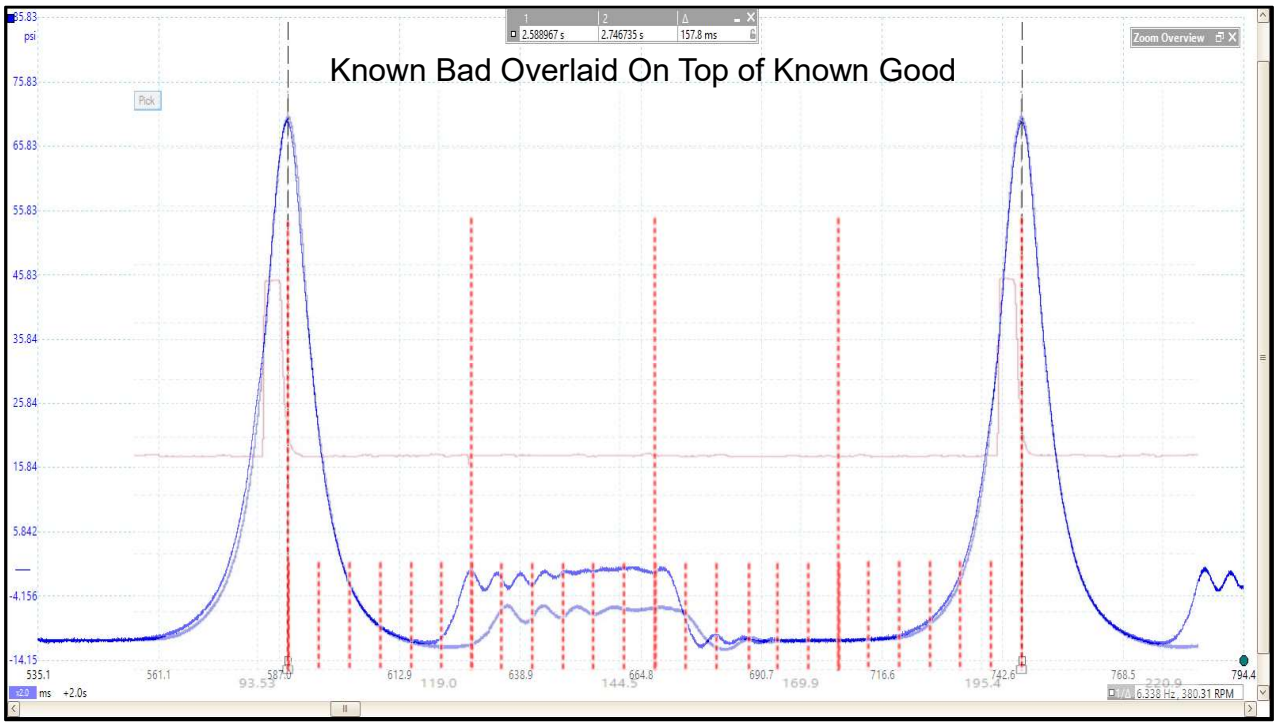
In this example the Exhaust Valve Opening should have happened between the fourth and fifth small red lines from the left side of the waveform (approx. 45 Degrees Before Bottom Dead Center). Each of the small red lines represent 30 degrees of Crankshaft Rotation.

In actuality the Exhaust Valve Opened after the sixth small red line and slightly before the first large red line. This put the Exhaust Valve Opening at approx. 10 Degrees Before Bottom Dead Center (35 Degrees “Out of Time”).



This is the In-Cylinder Waveform after a new cylinder head was installed on the engine. Note the Exhaust Valve Opening is now approx. 40 Degrees Before Bottom Dead Center. Also the point where the cylinder creates Max Vacuum is now 45 Degrees After Top Dead Center.

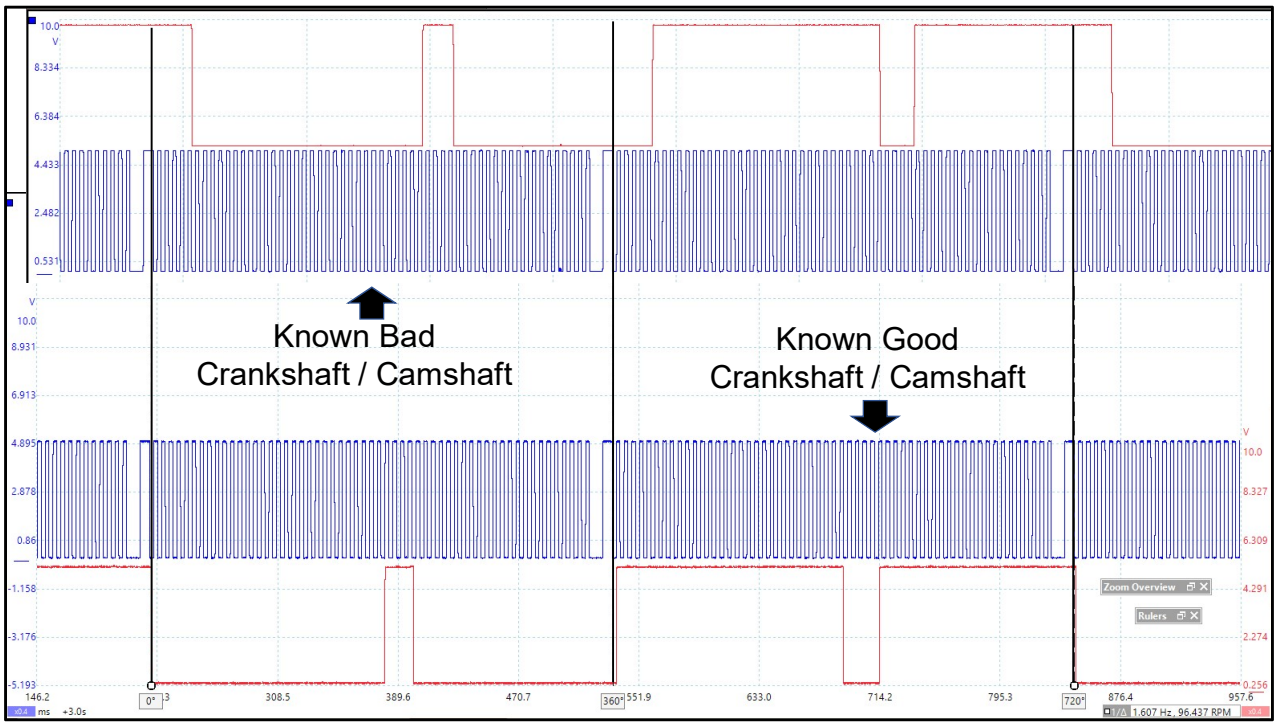
The entire center portion of the waveform has shifted to the left approx. 35 Degrees.



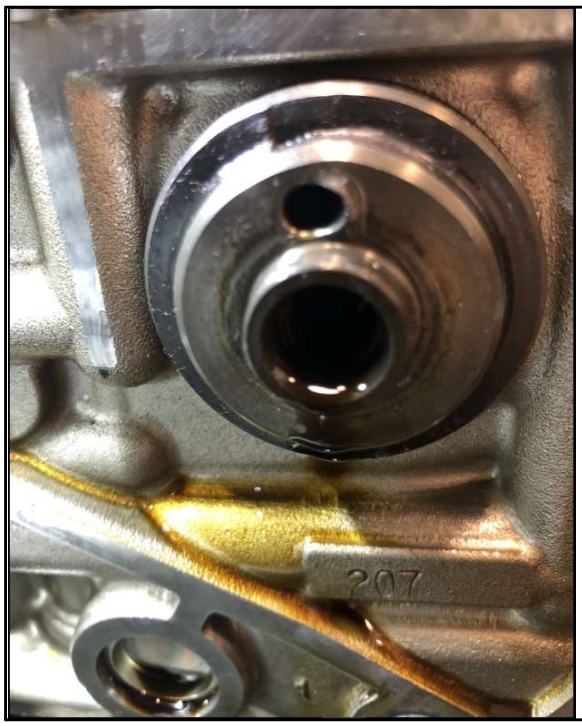
Overlaying the two In-Cylinder Pressure Transducer traces the differences / the shift is easy to see.

The after repairs compression increased to 180 psi., while the warm idle vacuum improved to 21 inches Hg.

These numbers are more in tune with what you should expect from a properly functioning Honda engine.



An after repairs Crankshaft / Camshaft Correlation waveform was captured. Above we inserted both the Known Bad (upper traces) and the Known Good (lower traces).



The “Root Cause” of the Crankshaft / Camshaft Correlation issue was a damaged Camshaft, Camshaft Gear and Alignment Dowel. This was most likely caused by a loose Camshaft Gear Retaining Bolt.

Other potential causes for this issue could have been a Jumped Timing Chain, a Damaged Crankshaft Gear or even a Damaged Crankshaft.

Thank you for taking the time to read this article.

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

Jon Brown
Instructor
TecHelp Training