Engine Polygraph Case Histories (shorter time to detection)

2015-10-04

Engine Polygraph Assessment examples

Results

Based on the experiences over the past several years we can provide the financial benefit from a routine, scheduled Engine Polygraph Signature Management Assessment program for a fleet of 100 class 8 semi-tractor/trailers that travel about 100,000 mi per year. The benefit is only calculated based on fuel savings, but there are additional benefits such as increased asset life, more driver hours, fewer roadside service calls.

The calculation will assume an average Drive Fuel Economy of 7.8 mpg at $2.30 per gal. The data collected was based on an Assessment every 25,000 mi at oil changes. The assumption is that if the Assessment score is 6 or higher, the vehicle will not be dispatched again until a repair service is provided. The assumptions also state that the repair duration and cost will not be changed by this process, since it would have been delayed a relatively short while (3 or 4 months). But it is believed that the delay increases the likelihood of additional cost from occasionally needed roadside service calls and additional stress on the engine, shortening its useful life.

Results (continued)

The total Drive Fuel bill for 100 vehicles travelling 100,000 miles per year at 7.8 mpg of $2.30 / gal is **$ 2,948,718.**

The examples that we have studied showed a DFE drop from between 24% to 8% with an average about 16%; that indicates a DFE of 6.55 mpg following a EP score of 6 or greater. Again, based on the examples, the 'problem' was usually addressed by the next oil change. In our sample, we observed 23% of the EP assessments resulted in the score of 6 or greater.

Thus the Fleet average DFE is calculated as 9,425,000 miles at 7.8 mpg and 575,000 mi at 6.55 mpg = (1,208,333 gal plus 87,786 gal) at $2.30/gal = $2,981,074 or an **increase of $32,356**.

- The cost to implement the program is 15 minutes of technician time for every oil change or .25 [15 min] * 400 [oil changes] * $85 [Absorbed technician cost per hour] = $8,500 plus
- $40 per Assessment = $16,000 plus
- **One-time** charge of $3,600 for the Engine Polygraph Diesel kit
- For a total cost of **$27,100** and a return of **$32,356** for first year.
- Following year cost/benefit = $24,500 / $32,356 based on DFE only.

Background on these observations

From 2010 through most of 2014, Predictive Fleet Technologies (PFT) has been collecting data with the cooperation of a line-haul carrier in mid-Michigan with 100 class 8 semi-trucks hauling goods from coast-to-coast. All of these vehicles are Freightliners with Detroit® engines.

The purpose of this data was to evaluate the usefulness of the Engine Polygraph Technology's FirstLook® sensors with a PC oscilloscope. Our objective changed during this study to include developing software to perform an analysis of the engine (the Assessment), providing a score for recommending remedial action before dispatching the vehicle further.

In 2015, PFT developed the software to accept the 'signature' file and score it by a self-learning program to provide the score. If the score equals or exceeds (high score is bad) 6, an email is sent to the email associated with the Fleet's Maintenance Manager. In all cases a PDF report is sent to the shop conducting the assessment.

Much of the collected data was used for developing the overall methodology and was not used in a timely fashion for the WDS operations. We are showing the data and conclusions in retrospect to highlight the cost-savings opportunities missed by not having the analysis capability earlier.

Study background, continued

During the data collection and process design phases, we ended with useful data for 39 vehicles, a number with more than one signature, taken at oil changes. (Many more signatures were collected and analyzed in this interval, but not with our final procedure.) Of these, 11 were assigned a score of 3 or better (good to very good) and 9 were assigned a value of 6 or larger (engine physical integrity problem causing performance degradation).

In this report, we describe the fuel savings benefit potential identified by this methodology. Additional value is realized because the planning for the repair can be better coordinated with dispatch and the drivers. The forward visibility also allows earlier action, reducing the chances of a roadside service call and remote repairs.

On the following pages, we describe some of the situations observed with comments we think might be useful for your consideration. We show the Assessment output of the Engine Polygraph (www.EnginePolygraph.com) and the ECM data from Detroit Diesel engines as presented by the Engine Angel software (www.engineangel.com).

Process

The process was done after oil change with a short warm-up period. An Engine Polygraph kit was connected to a PicoScope PC oscilloscope with one sensor inserted into the oil dipstick tube to measure pressures in the crankcase and the other was attached to a **Shepherd's hook vertical exhaust sampling unit** available through Predictive Fleet Technologies.

The engine was set to run at 1500 rpm and allowed to stabilize in a few seconds. The simultaneous signature waveforms from the exhaust and crankcase readings were captured on the PC for a duration of 500 ms. The recommended PC oscilloscope settings are described in the EP Users Manual, available for download from the EnginePolygraph.com website.

The technician then accessed the web-based www.Engine Polygraph.com screen to add the new signature and an assessment was requested. The Assessment report was sent to the email address of the technician and sent to Engine Angel for automatic integration into the vehicle data.

Process (continued)

Before the oil was changed, the technician extracted the DDEC ECM data from the engine computer to the PC. Now, the PC has an Engine Angel component, ECMDataSync, installed on the extract PC to automatically send the ECM trip data to the web-based Engine Angel application for integration to the vehicle data in Engine Angel. (Back when the process was being developed, the DDEC data was manually carried on thumb drives to Engine Angel.)

The time to run the Engine Polygraph data collection and get the information back is 10 - 15 minutes.

The report results shown are standard reports in Engine Angel.

#192

Potential savings of $ 805

Background for #192

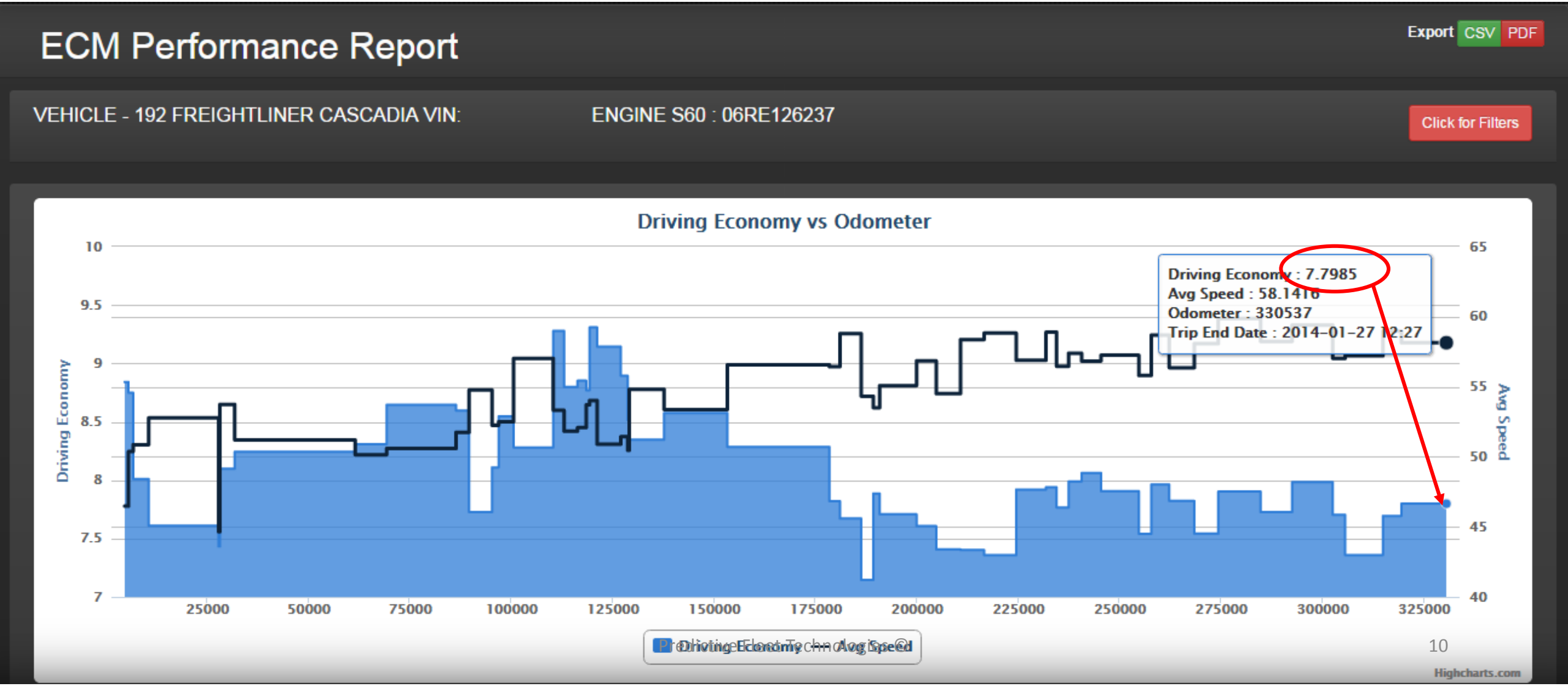
Class 8 Semi-tractor came in for an oil change on Jan 27, 2014. Normal practice of running a Engine Polygraph engine assessment showed poor engine condition with Overall score of 9 out of 10, with 1 being best. There was no noticeable exhaust coming from one cylinder.

ECM reports did not show a significant problem, although Drive Fuel Economy had been lower for the past year than the year before. (Winter of 2014 was much worse than winter of 2013.)

The trip **following** the poor Engine Polygraph Assessment showed significant loss of Drive Fuel Economy.

$ 805 could have been saved.

ECM Report: 2014-01-27



Engine Polygraph Assessment: 2014-01-27

SenX TECHNOLOGY

ASSESSMENT

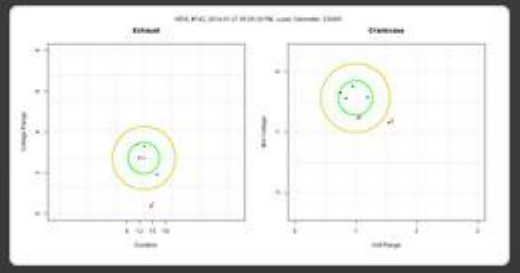
9

Engine	DD S60
Serial #	06RE126237
Odometer	330491
Date	2014-01-27
RPM	1495.1
Engine Temp	81
File Name	636fb4b6-0b86-4d7c-aec7-26fc37395f35

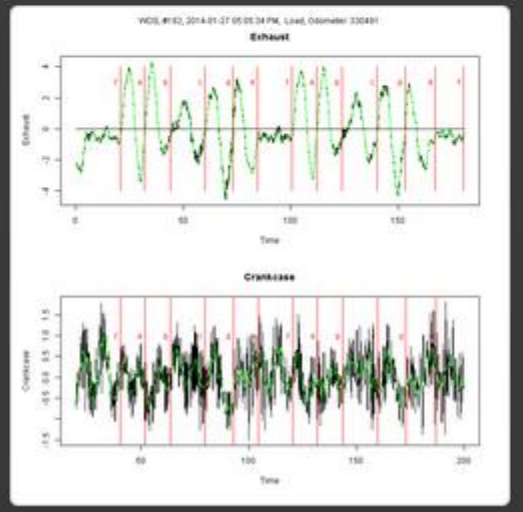
Upper Engine	9
Lower Engine	6
Valve Lash	1
Valve Seating	3

Scale 1 2 3 4 5 6 7 8 9 10

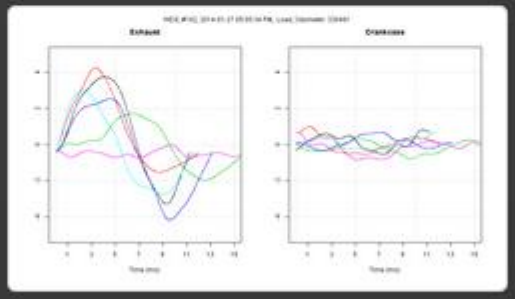
Comments:



EXHAUST & CRANKCASE CYLINDER DATA

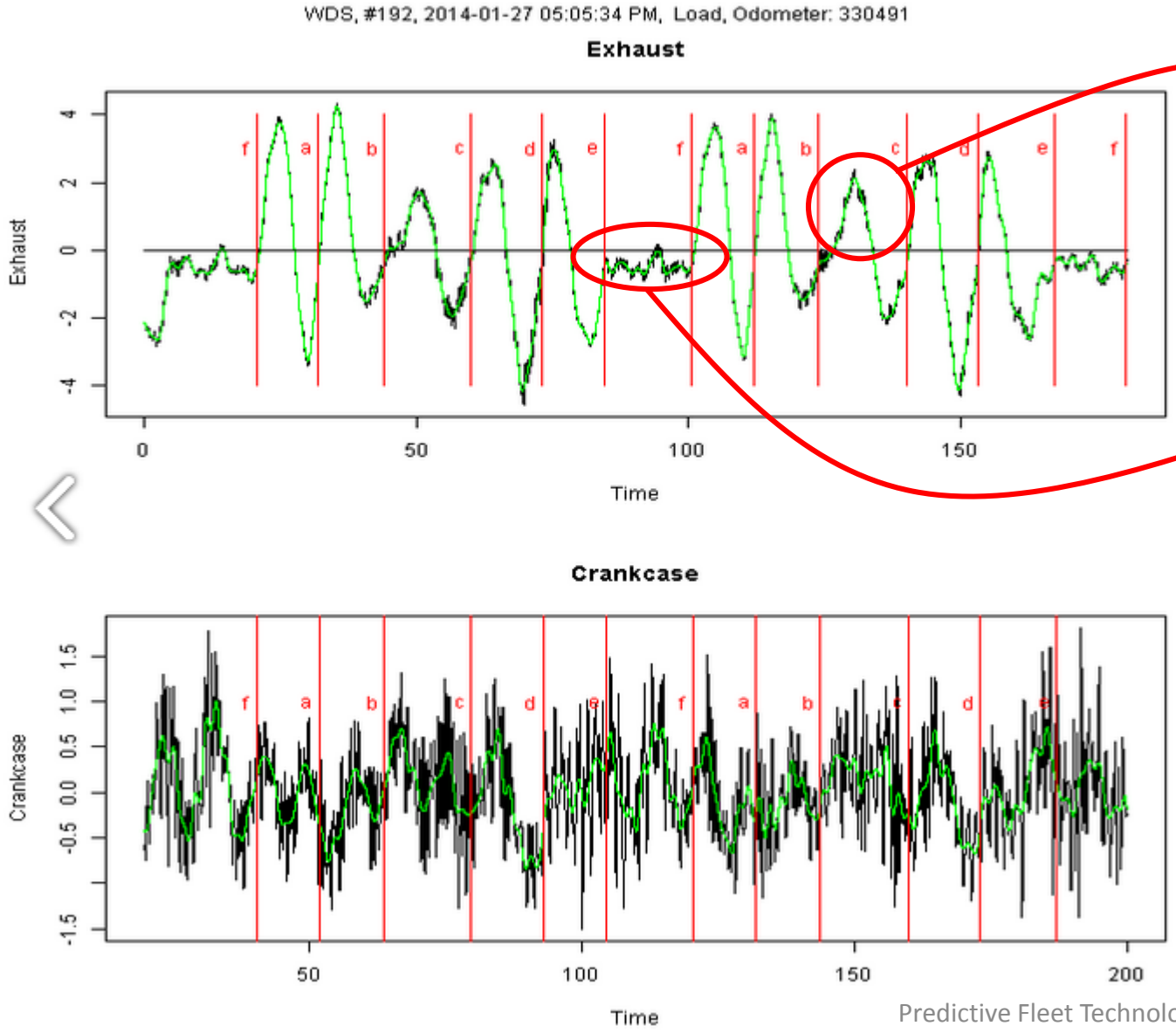


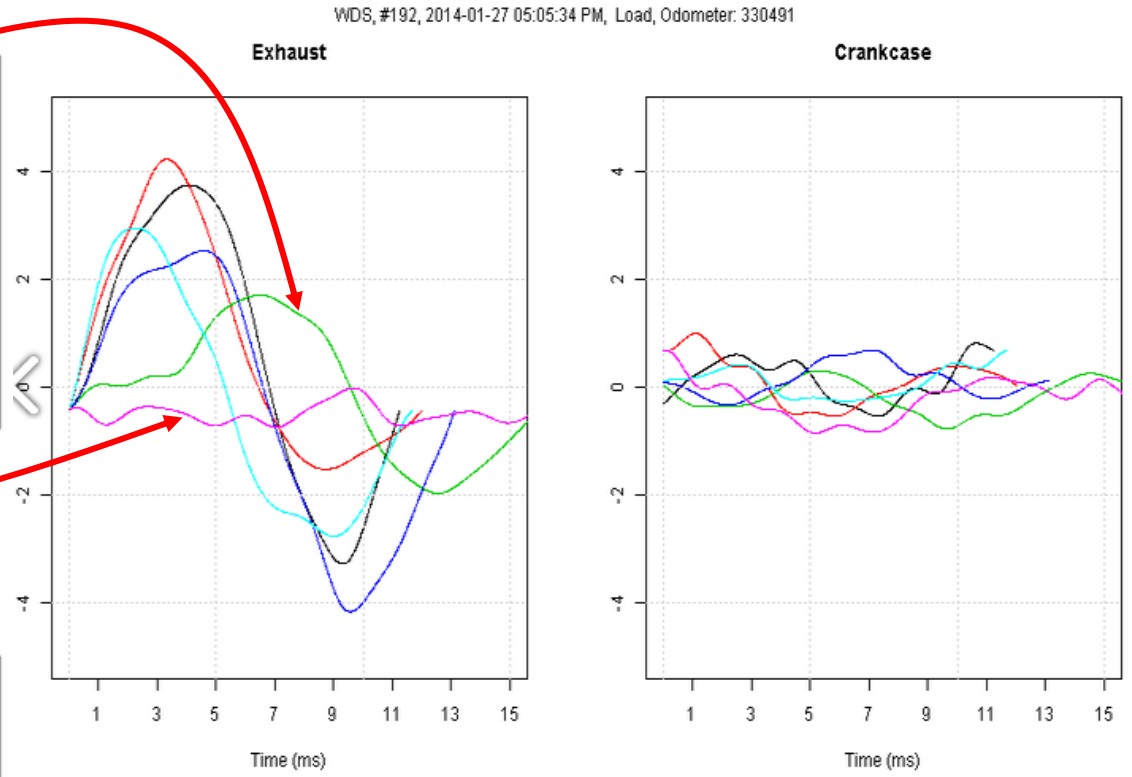
EXHAUST & CRANKCASE MODEL



EXHAUST & CRANKCASE PROFILES

Engine Polygraph Assessment: 2014-01-27





Enlarged views of two panels from the previous screen. Cylinder f shows no combustion; cyl c is relatively weak. No significant blow-by.

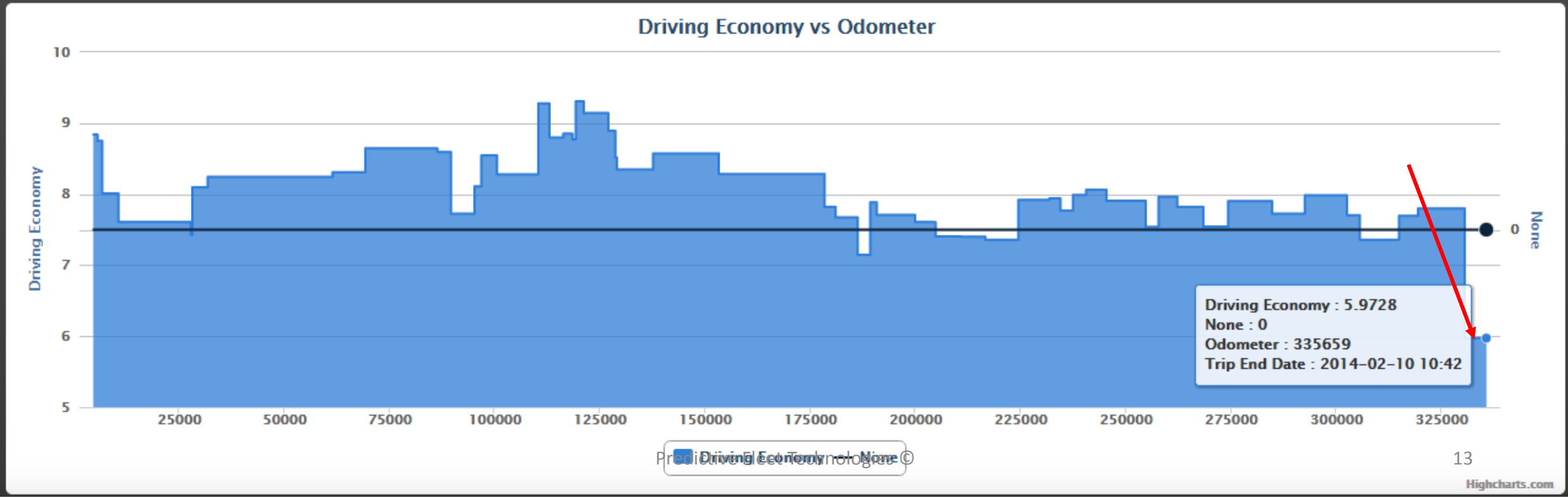
ECM Report: 2014-02-10

ECM Performance Report

Export CSV PDF

VEHICLE - 192 FREIGHTLINER CASCADIA VIN: ENGINE S60 : 06RE126237

Click for Filters

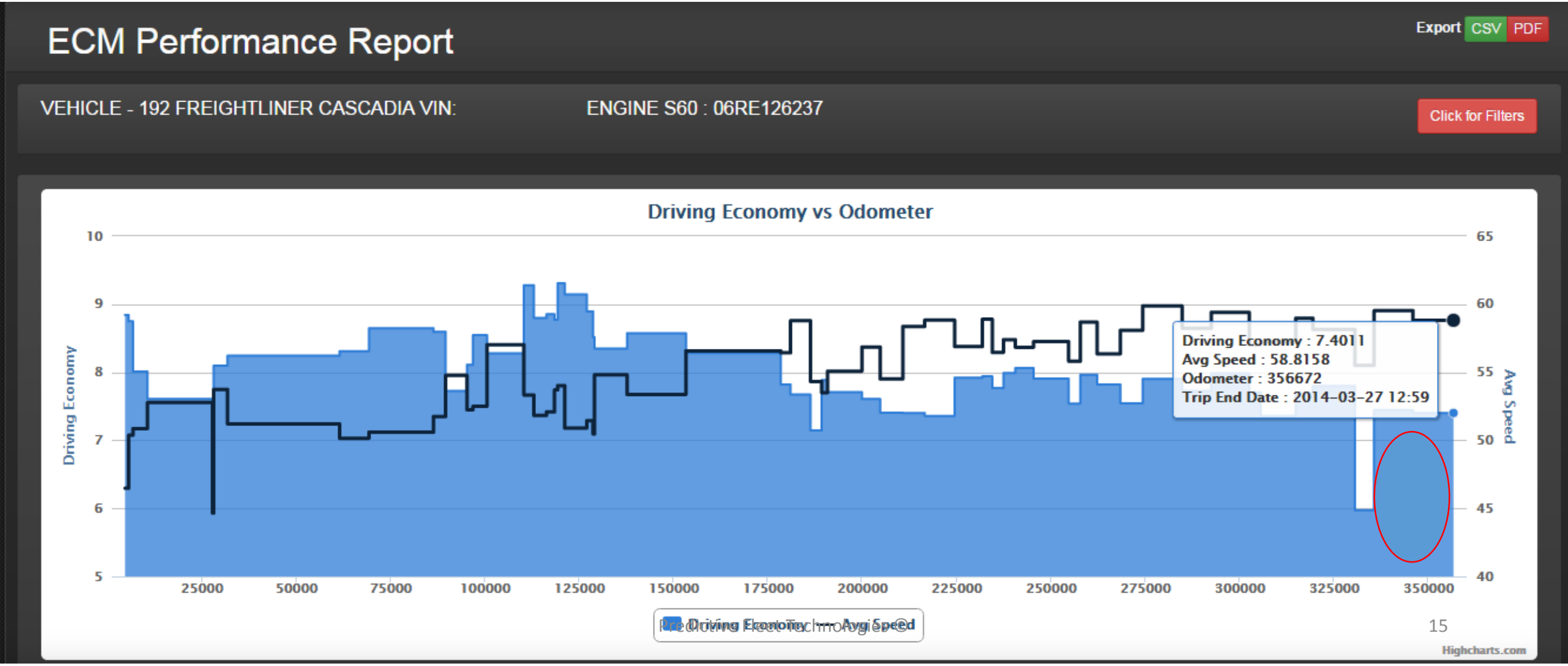


New Injectors

- In Feb 2014, the injectors were replaced in 192. The loss of Drive Fuel Economy from 7.80 mpg to 5.97 mpg represents an extra 201.3 gal fuel on that 5,122.4 mi trip **($805 more**). You might notice that the average speed for that last trip before the injector replacement was slower than normal, suggesting the engine power was not where it should be.

- The next trip report shows the Drive Fuel Economy returned to more normal rates and the next Engine Polygraph Assessment showed an engine in good condition.

ECM Report after injectors replaced



Next Engine Polygraph Assessment: 2014-12-09

SenX TECHNOLOGY

ASSESSMENT

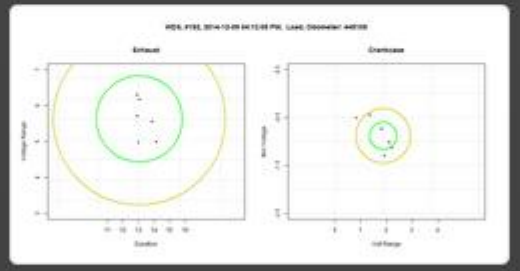
4

Engine	DD S60
Serial #	06RE126237
Odometer	445105
Date	2014-12-09
RPM	1496.0
Engine Temp	100
File Name	840fa3bc-0c03-469e-871d-9d41025a6e7d

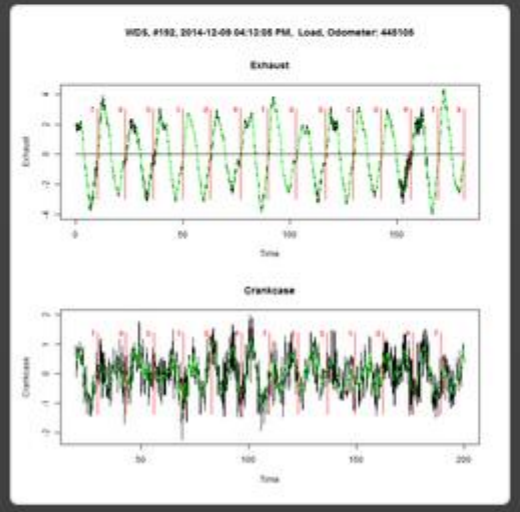
Upper Engine	1
Lower Engine	4
Valve Lash	5
Valve Seating	4

Scale: 1 2 3 4 5 6 7 8 9 10

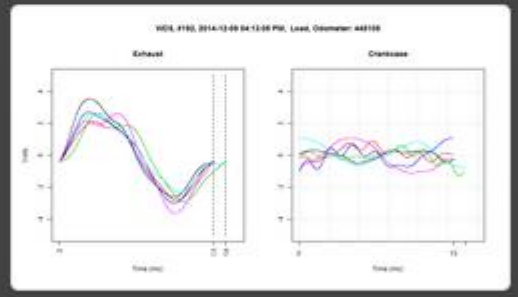
Comments:



EXHAUST & CRANKCASE CYLINDER DATA



EXHAUST & CRANKCASE MODEL



EXHAUST & CRANKCASE PROFILES

#175

Potential savings of $ 1,484.

Background

On Jan 19th, 2014, Vehicle 175 came in for an oil change and Engine Polygraph Assessment with odometer reading near 465,000 miles. The engine scored a 6 and just completed a trip at 7.2 mpg after a history of 7.8 mpg. (Actually, if there had been a Engine Polygraph Assessment at the previous oil change, it appears that it would have seen a coming problem and potentially saved about the same amount again.)

The repair did not occur for another 10,000 miles indicating a potential savings of $ 424. The earlier Assessment would have shown the growing problem another 25,000 sooner for a **potential savings of $1,484.**

SenX TECHNOLOGY

ASSESSMENT

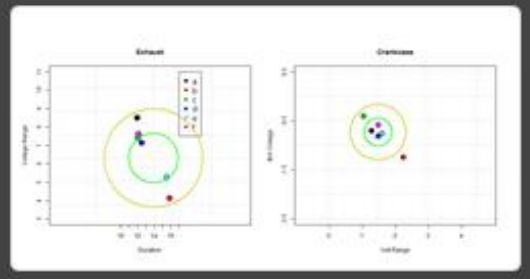
6

Engine	DD S60 14L
Serial #	06RE125964
Odometer	464965
Date	2014-01-19
RPM	1505.0
Engine Temp	100
File Name	9277fcd0-62c0-4c10-8c0c-fc5bacdeb610

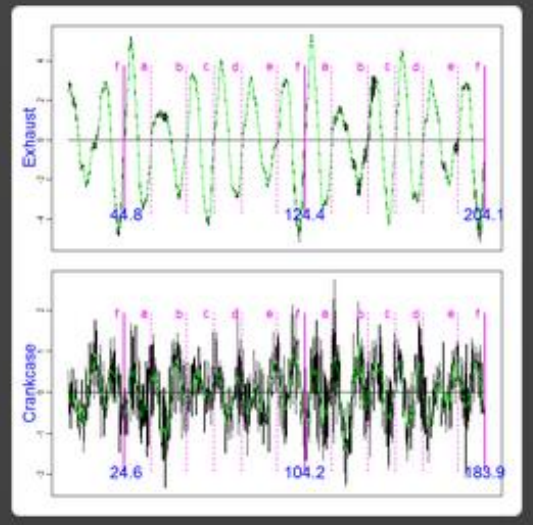
Upper Engine	6
Lower Engine	3
Valve Lash	5
Valve Seating	2

Scale 1 2 3 4 5 6 7 8 9 10

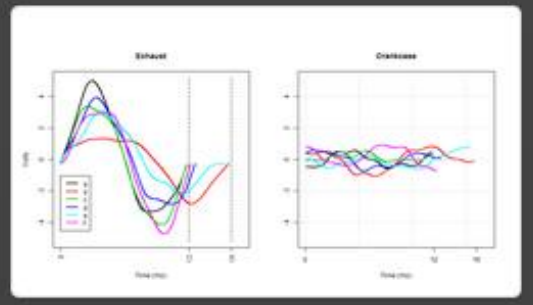
Comments:



EXHAUST & CRANKCASE CYLINDER DATA



EXHAUST & CRANKCASE MODEL



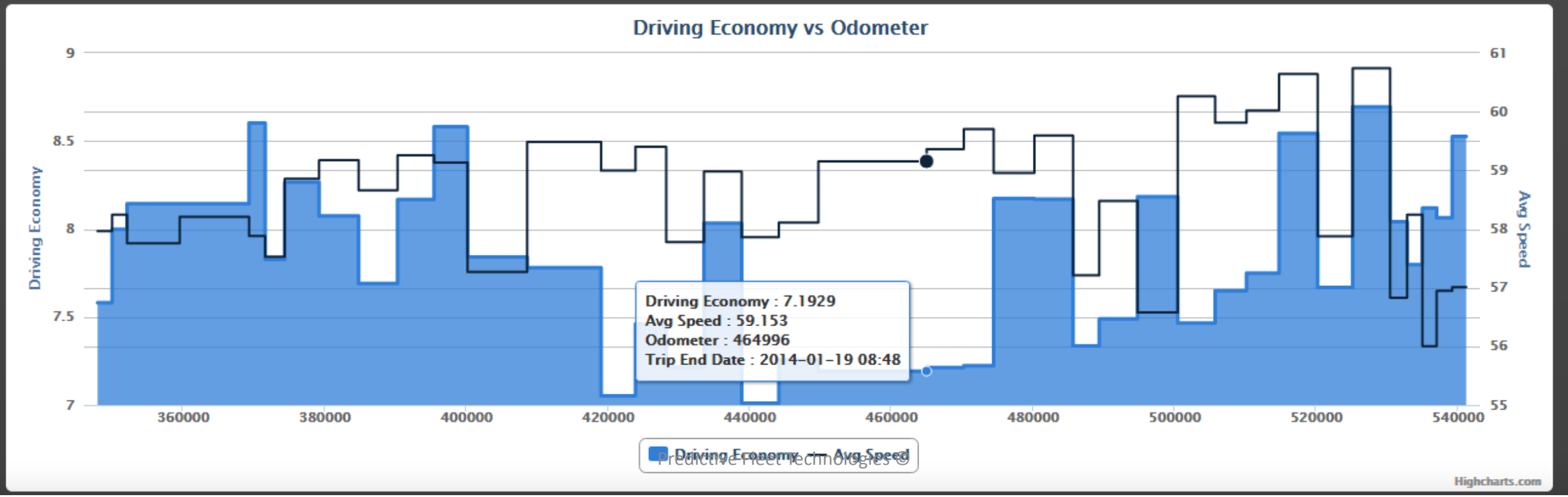
EXHAUST & CRANKCASE PROFILES

ECM Performance Report

Export CSV PDF

VEHICLE - 175 FREIGHTLINER CASCADIA VIN: ENGINE S60 14L : 06RE125964

Click for Filters



#193

$638 might have been saved.

Background

On 2013-12-28, Vehicle 193 was tested using the Engine Polygraph Assessment procedure when its oil was changed. It was given a score of 4. It was showing signs of a problem. Over the next 25,000 mi the DFE went from near 8.5 mpg down to 7.51 when the next oil change occurred.

On 2015-03-07, it was tested again and given a score of 6. Clearly problems were obvious, but the response time of analysis was too late to stop the next dispatch and so the problem was not corrected until 7,500 mi later where the fuel economy averaged 6.95 mpg.

Taking the average DFE to be 8.0 mpg from the first sign of a problem until it was obvious as a base for the 7,500 mi after, using $4.00 per gal at that time, results in an **unnecessary expense of $638**.

2013-12-28 Engine Polygraph Assessment

SenX TECHNOLOGY

ASSESSMENT

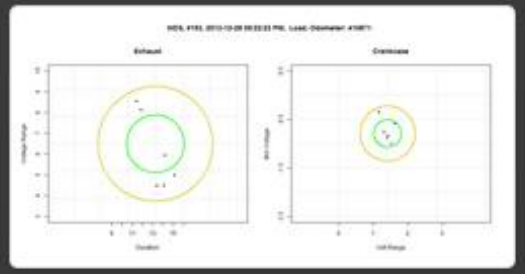
4

Engine	DD S60 14L
Serial #	06RE126293
Odometer	410871
Date	2013-12-28
RPM	1494.0
Engine Temp	125
File Name	168cd091-4c64-4c1e-8fce-b73fed12bcd8

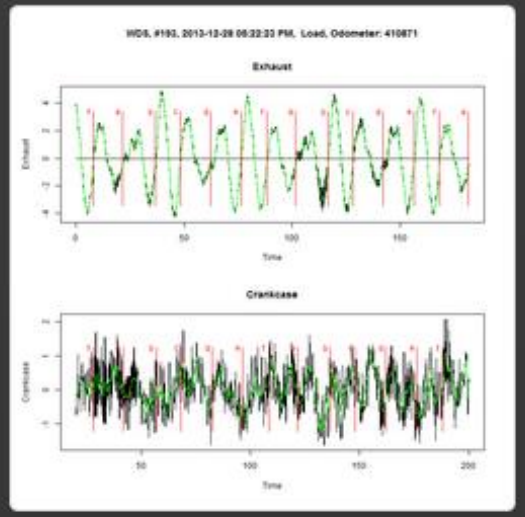
Upper Engine	4
Lower Engine	3
Valve Lash	3
Valve Seating	3

Scale 1 2 3 4 5 6 7 8 9 10

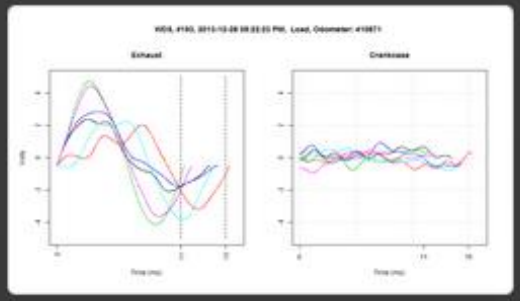
Comments:



EXHAUST & CRANKCASE CYLINDER DATA

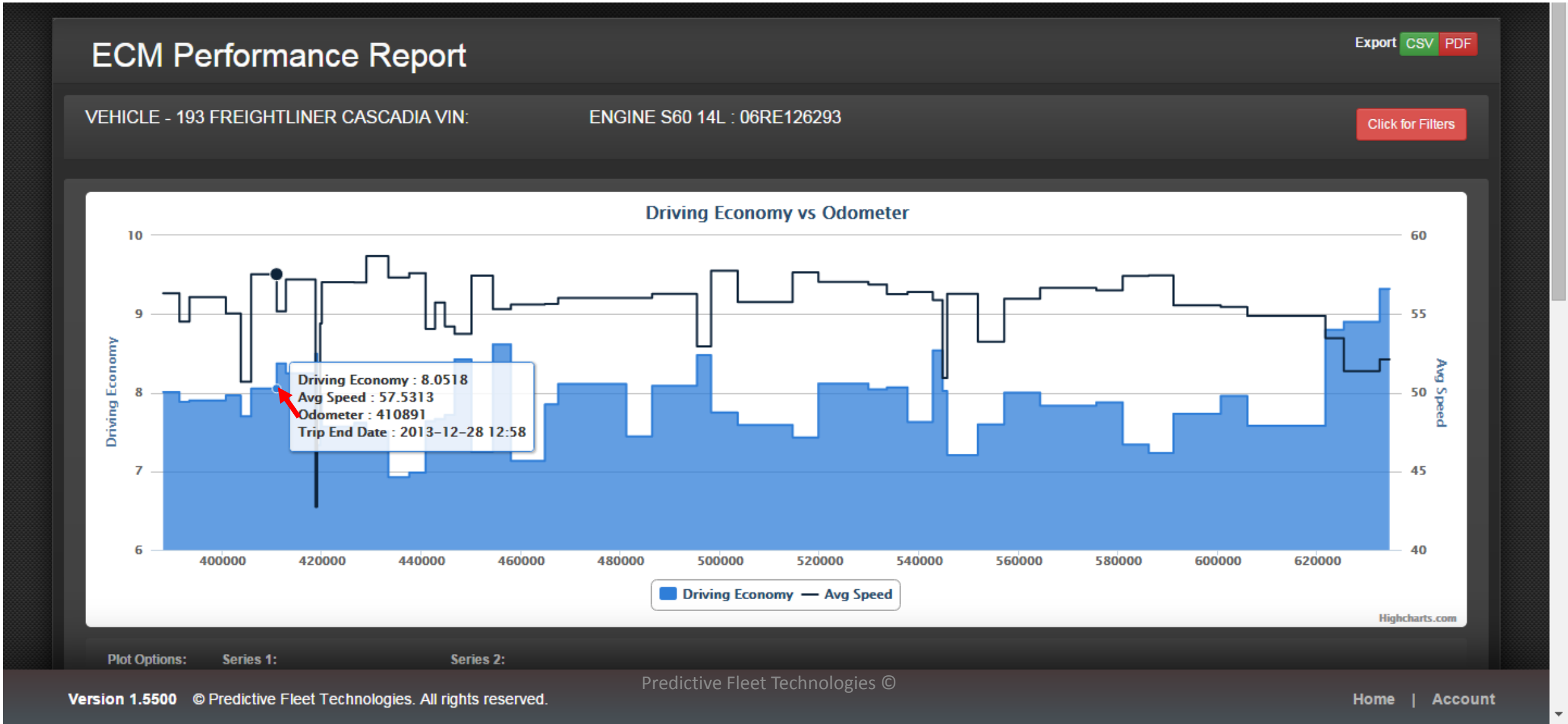


EXHAUST & CRANKCASE MODEL



EXHAUST & CRANKCASE PROFILES

2013-12-28 Engine Polygraph Assessment of #193



SenX TECHNOLOGY

ASSESSMENT

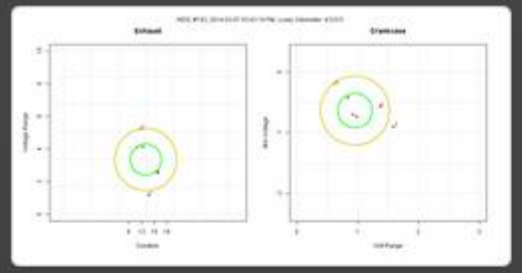
6

Engine	DD S60 14L
Serial #	06RE126293
Odometer	433331
Date	2014-03-07
RPM	1476.3
Engine Temp	
File Name	2234b8e6-30e5-4743-90bc-0ffadf8c343d

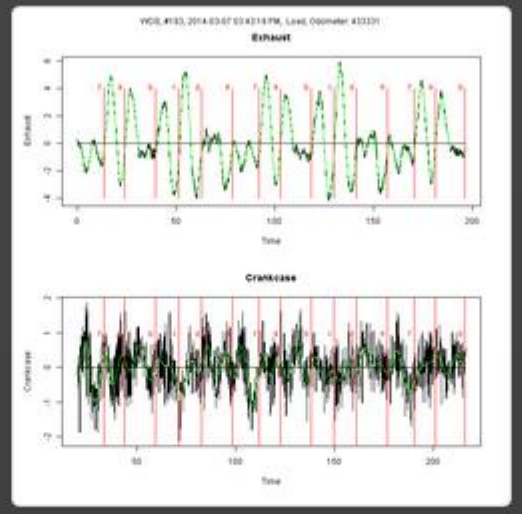
Upper Engine	6
Lower Engine	6
Valve Lash	2
Valve Seating	1

Scale 1 2 3 4 5 6 7 8 9 10

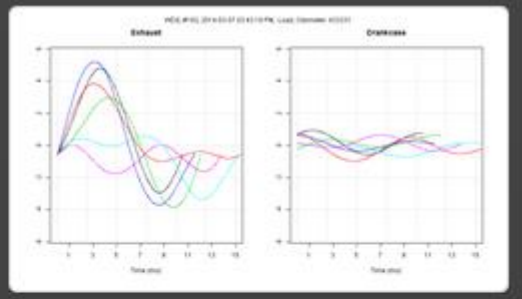
Comments:



EXHAUST & CRANKCASE CYLINDER DATA

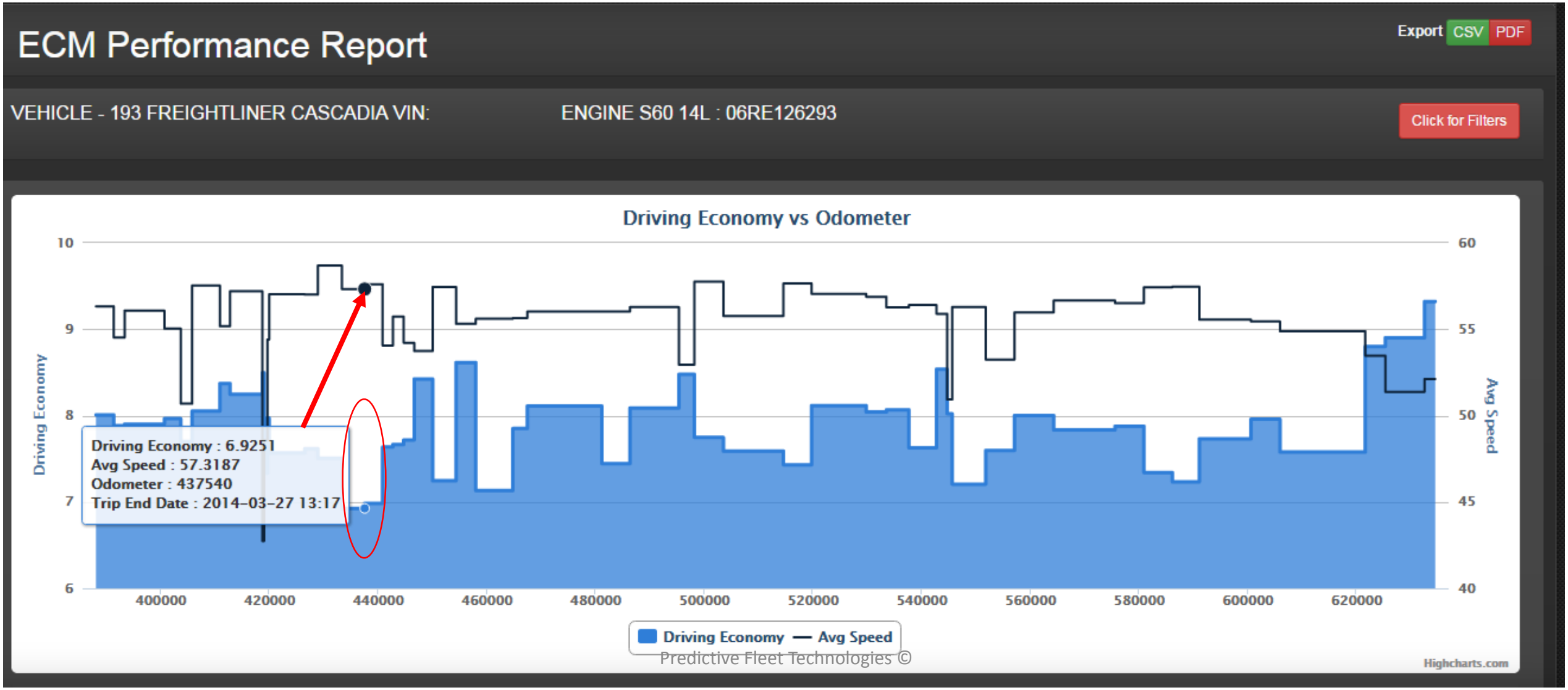


EXHAUST & CRANKCASE MODEL



EXHAUST & CRANKCASE PROFILES

#193: Showing the low DFE at time of score =6



#179

$780 savings potential.

Background #179

Drive Fuel Economy dropped fairly steady from Oct 2013 until 2014-01-12. On the 13th of Jan, the Engine Polygraph Assessment was requested and delivered a score of 8.

Over the next two trips, the DFE was 5.67 mpg compared with 7.00 for the preceding months. So over the next 5,813 miles, that represents 830.4 gal vs. 1025.2; at $4.00 for fuel, **that is a $779.20 increase in cost**.

#179 on 2014-01-13

SenX TECHNOLOGY

ASSESSMENT

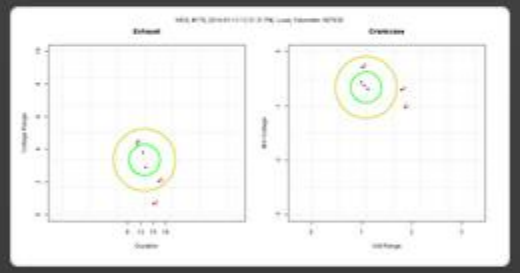
8

Engine	DD S60 14L
Serial #	06RE126236
Odometer	567639
Date	2014-01-13
RPM	1495.7
Engine Temp	60
File Name	891b0d11-2a00-49ef-aedd-d9d8040e2526

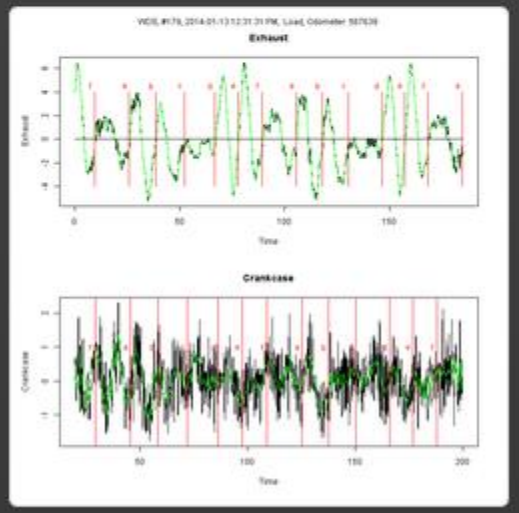
Upper Engine	8
Lower Engine	7
Valve Lash	5
Valve Seating	3

Scale: 1 2 3 4 5 6 7 8 9 10

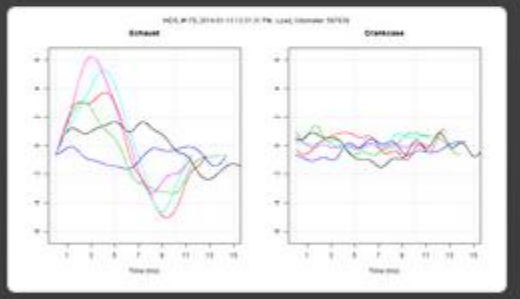
Comments:



EXHAUST & CRANKCASE CYLINDER DATA



EXHAUST & CRANKCASE MODEL



EXHAUST & CRANKCASE PROFILES

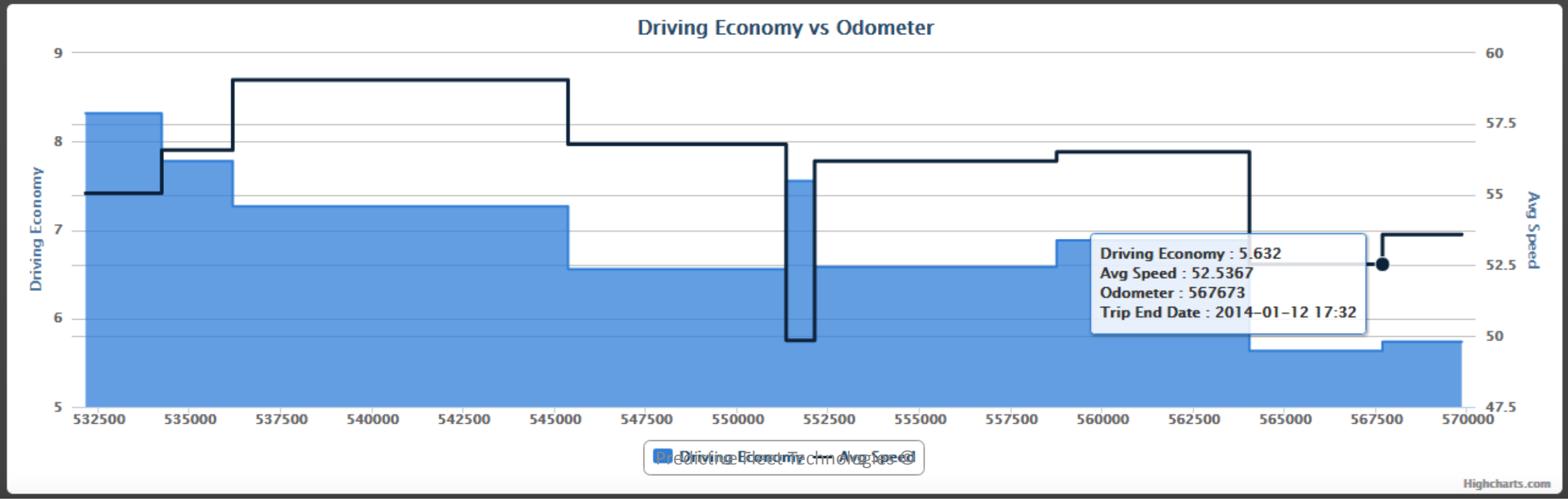
#179 Drive Fuel Economy and Average Speed from 532,500 mi to 570,000 miles

ECM Performance Report

Export CSV PDF

VEHICLE - 179 FREIGHTLINER CASCADIA VIN: ENGINE S60 14L : 06RE126236

Click for Filters



Conclusions

These few examples show the benefits of the Engine Angel methodology for Fleet operators. Notice that the main value identified here comes from the EP Assessment reports and responding to the high scores quickly to reduce fuel cost (and risk of roadside service).

Value obtained from other uses/processes employing Engine Polygraph Signature Manager and Engine Angel are covered separately. These include:

- Triage for engine problem diagnosis (repair shop)
- Assessments for buying and selling used vehicles
- Evaluation of Aftermarket technologies
- Keep vs. Cull decisions

For more information, watch the videos on the EngineAngel (engineangel.com) and Engine Polygraph (enginepolygraph.com) websites.