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## **Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS**

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Issued: April 12, 2013  
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These are the unapproved minutes of the 04.03.2013 Sequence VI Surveillance Panel meeting.

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The meeting was called to order at 9:05 AM by Chairman Charlie Leverett.

### Agenda

The Agenda is the included as **Attachment 1**.

#### 1.0 Roll Call

The Attendance list **Attachment 2**.

Tracy King is the voting member for Haltermann.

## 2.0 Approval of minutes

2.1 Approval of the minutes of the 02.13.2012 conference call.

**Motion** – Accept the minutes of the 02.13.2012 VID SP CC.  
Charlie Leverett, Jason Bowden, second. Unanimous.

## 3.0 Action Item Review **The Motions and Actions are Attachment 3.**

3.1 OHT to report Vix engine usage.

There are 31 VID 2009 engines left. No further 2012 engines will be shipped until the life issue is resolved.

3.2 A Task Force is reviewing the VIE Draft Procedure. Dave Glaenzer is the Chair.

The Task Force Report is included as Attachment 4.

## 4.0 Old Business

4.1 The VIE Procedure Task Force has completed their review.

There are a few Action Items. Hap Thompson is the facilitator.

4.1.1 During the review process a correction was found for the load cell temperature. The “±” will be added by E-ballot for the VID. It was corrected for the VIE procedure.

4.1.2 As the engines are running longer for each test, calibration period, engine hours during the calibration period and down time limits will be reviewed.

4.1.3 Per section 11.6.16, maximum oil consumption will remain at 1400 ml.

4.1.4 New reference oil targets will be generated by a matrix.

4.1.5 There was discussion on how EEE fuel batches are tracked.

4.1.6 There is a Word version of the VIE procedure for review.

4.1.7 The report was accepted.

**Action Item** – VIE test procedure task force to review fuel batch requirements for the VIE test.

4.2 VIE engines are experiencing early failure due to burned valves. The background is three of 4 Labs currently running the VIE have experienced burnt valves anywhere from 1000 – 3500 hrs. It seems that the heads on the 2012 engines were designed for E85 fuel and have a different seat material. GM suggested a 5000 rpm run prior to each test so the valves would rotate and clean off any deposits. One Lab adopted this suggestion but still experienced the burnt valve issue. SwRI tried a “Top End Cleaner” and the results were not promising.

The Lubrizol presentation on valves is included as Attachment 5. Several labs indicated concerns with running the engines at high RPMs. SwRI used the top end cleaner on an engine with low hours and not showing the valve damage. They will try it on an engine with more hours.

4.2.1 Lubrizol has been running the 5 minutes at 5000 RPM before each test and doing a compression test every other test.

4.2.2 There is a spike in fuel consumption as valves begin to fail. The 2012 heads do show more deposits around the intake valves and in the combustion chambers.

4.2.3 There is further information in the body of the Agenda.

Bruce Matthews: The chambers and lower intakes are the same. There has also been exhaust pitting issues on the 2009 engines. The coolant and oil passages may have been changed. He will check.

Dave Glaenger: There are also timing chain/guide wear issues.

Bruce Matthews: GM would be willing to supply an engine if Haltermann could supply a fuel with an additive package included.

Charlie Leverett: IAR agreed to run this test. They would also perform compression and leakdown and additional valve/deposit inspections.

4.2.4 Afton has recommended a top end rebuild after the 3 new engine references and 10 candidate tests, including new exhaust valves, timing chains and tensioners. They feel the seat will clean up with lapping.

4.2.5 There are also differences in exhaust temperatures. Further data will be collected.

Action Item – GM to supply Intertek with a MY2012 3.6L engine with fixed gears for Intertek to test with an additized test fuel. Lubrizol will also participate in this study.

Action Item – Haltermann to blend a quantity of additized test fuel (EEE with an approved top tier fuel additive system) for the VIE test and supply it to Intertek for testing.

Action Item – Surveillance panel chair and GM to develop a testing plan for investigating the use of an additized test fuel in the VIE test.

Action Item – Form a task force with Christian Porter as chair to investigate and develop a recommendation for VIE engine reworking to extend the life of these engines.

## 5.0 New Business

5.1 The new batch of BL-4 and FO-4 are being delivered to labs. SwRI started the comparison matrix the day of the meeting. IAR will also start their matrix the following week.

5.2 The new reference oil 541-1 is giving comparable results so data will continue to be collected.

### 5.3 TMC Lab Visits

5.3.1 Section 6.9.5.1 states *Oil Inlet (Gallery)*—Insert the thermocouple into the modified oil filter adapter plate so that the thermocouple tip is flush with the face of the adapter and located in the center of the stream of flow.

*This may seem confusing as one lab has asked me whether it is to be flush with the adapter or in the center of flow.*

5.3.2 Section 9.4.12.1 states *Fuel Injectors*—Use fuel injectors, OHT6D-042-1. Refer to Annex A9 for injector flow specifications. Verification of each injector is required prior to use.

The consensus was that original injectors should be replaced with flowed units for each new engine installation.

5.4 The reblend of 542 is ready to be shipped.

Introduction will follow the same format as 541-1.

**6.0 Next Meeting or Conference Call**

At the call of the Chairman

**7.0 Meeting Adjourned**

The meeting adjourned at 11:10 AM.

# Sequence VI Surveillance Panel conference Call

April 3, 2013

9:00 – 2:00

Meeting will be held in Building 209, Conference Room 103 at SwRI

Call in #: 800-391-9177  
Pass Code: 4875645502

## Agenda

### 1.0) Roll Call

### 2.0) Approval of minutes

2.1) Approve the minutes from the February 13, 2013 Sequence VI Surveillance Panel conference call.

### 3.0) Action Item Review

3.1 OHT to report VID engine usage and expected depletion date .

3.2 A Task Force will be setup to review the current VID Standard with the Scope/Goal being to better standardize for use in the VIE, Dave has agreed to chair the task force. **Dave will present the TF recommendations today.**

### 4.) Old Business

4.1 Task Force review of the proposed VIE ASTM Standard.



Report to SP  
20130403.pdf

4.2 Discussion of the issue of early engine failures related to burnt valves. The background is three of 4 Labs currently running the VIE have experienced burnt valves anywhere from 1000 – 3500 hrs. It seems that the heads on the 2012 engines were designed for E85 fuel and have different seat material, GM suggested a 5000 rpm run prior to each test so the valves would rotate and clean off any deposits. One Lab adopted this suggestion but still experienced the burnt valve issue. SwRI tried a “Top End Cleaner” and the results were not promising.



LZ Burnt Valves  
42013.xps

## 5.) New Business

5.1 Update from TMC on the next batch of BL & FO.

5.2 541 Update 541– Rich

5.3 Items for discussion from Rich's Lab visits:

5.3.1 Section 6.9.5.1 states *Oil Inlet (Gallery)*—Insert the thermocouple into the modified oil filter adapter plate so that the thermocouple tip is flush with the face of the adapter and located in the center of the stream of flow.

*This may seem confusing as one lab has asked me whether it is to be flush with the adapter or in the center of flow.*

5.3.2 Section 9.4.12.1 states *Fuel Injectors*—Use fuel injectors, OHT6D-042-1. Refer to Annex A9 for injector flow specifications. Verification of each injector is required prior to use.

*I don't believe this means that injectors need to be pulled from new engines and flowed, though some labs do flow the injectors prior to testing a new engine. Many labs reuse injectors. Some points for discussion here.*

5.4 The reblend of 542 is ready to be shipped, I'd like to discuss introduction of this oil.

5.5 Engine Freshening – Dave has submitted the following – I would like to consider “freshening” an engine following the first reference oil calibration period **if** the use of rotators on the exhaust valves is not feasible.

Here is the gist of a note I sent on February 28.

We recently retired a 2012 dealer engine due to valve train and timing chain noise. There were aluminum particles in the oil that came from the timing chain striking the front cover.

The engine had 2837 hour of VIE testing. There was no evidence of exhaust valve burning; however, the engine was well on its way to burning a valve or two.

We did an inspection of the exhaust valves and found severe pitting on all of them.

Although the exhaust valve faces and seats were pitted, the seats could clean up with lapping compound and new valves.

This engine had a measure of compression pressures on 01/03/2013.

Engine Number	Dealer
Hours	C12
Cranking speed	2642
Cylinder 1	330
Cylinder 3	195
Cylinder 5	210
Cylinder 2	190
Cylinder 4	200
Cylinder 6	215
	195

The cylinders look to be in good condition and the only reason we lost the engine was due to noise, chain stretch, etc. Oil consumption was still reasonable with ~1000 to 1100ml per 100 hour aging test w/5.4L oil charge.

If an engine could be reworked **before catastrophic failure** with new chains, guides and valves, we could extend the life of these engines. As it stands today, if we run break-in, three ASTM ROs and ten tests, we will accumulate between 2700 and 2800 hours. At that time the engine could be “freshened” followed by a calibration test.




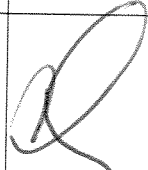
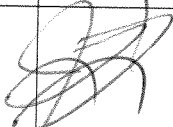




I do believe the light viscosity oils the Sequence VIE test is destined to evaluate may have a significant impact on engine life. If we can extend that engine life before the engine goes too far, we will be able to test more hours on an engine. As we stand today, to replace an engine requires 150 hour break-in plus three 200 hour tests, the better part of 5 weeks.

## 6.) Next Meeting

Call of the chairman


## 7.) Meeting Adjourned

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Sequence VI Surveillance Panel  
April 3, 2013  
9:00AM – 2:00PM  
Southwest Research Institute  
San Antonio, TX

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1. Action Item – GM to supply Intertek with a MY2012 3.6L engine with fixed gears for Intertek to test with an additized test fuel.
2. Action Item – Haltermann to blend a quantity of additized test fuel (EEE with an approved top tier fuel additive system) for the VIE test and supply it to Intertek for testing.
3. Action Item – Surveillance panel chair and GM to develop a testing plan for investigating the use of an additized test fuel in the VIE test.
4. Action Item – VIE test procedure task force to review fuel batch requirements for the VIE test.
5. Action Item – Form a task force with Christian Porter as chair to investigate and develop a recommendation for VIE engine reworking to extend the life of these engines.



# ASTM D7589 Re-write for Sequence VIE use

Report to ASTM Sequence VI Surveillance Panel

April 03, 2013

San Antonio, TX

USA

David Glaenzer

Task Force Chairman

Passion for Solutions™

# Sequence VID transitioned to VIE with MY2012 Engine

- ▲ Significant changes to operations protocol due to changes made by Test Quality Improvement Task Force
  - ▲ Changes to oil charge volume
  - ▲ Changes to aging duration
  - ▲ Starting point was ASTM D7589-12 Standard
- 
- ▲ October, 2012 Surveillance Panel Chairman Leverett called for the formation of a Procedure Review Task Force
  - ▲ December, 2012 David Glaenzer accepted lead of Task Force

## Task Force Formed in January, 2013

- ▲ Hap Thompson appointed ASTM Facilitator
- ▲ Task Force formed consisting of interested individuals from Test Labs, Test Sponsor, Central Parts Distributor, Additive Companies as well a Facilitator
- ▲ Teleconferences held over five week period from late January to early March.
- ▲ Members “championed” areas of procedure and reported to group who agreed on changes.
- ▲ Mostly editorial with changes to hardware and some operating conditions.
- ▲ Re-ordered Section 11.6 to more accurately represent flow of test operation

# Open Items Requiring Surveillance Panel Action

## Section 6.4.2.3

### Current Wording in D7589

#### **6.4.2.3 *Dynamometer Load Cell Temperature Control*—**

**Control the load cell temperature. Enclose the dynamometer load cell to protect it from the variability of laboratory ambient temperatures. Maintain air in the enclosure within the operating temperature range specified by the load cell manufacturer within a variability of no more than 6° C. Control temperature by a means that does not cause uneven temperatures on the body of the load cell.**

## Open Items (continued)

### Proposed Wording Changes in Bold Black

#### 6.4.2.3 *Dynamometer Load Cell Temperature Control*—

Control the load cell temperature. Enclose the dynamometer load cell to protect it from the variability of laboratory ambient temperatures. Maintain air in the enclosure within the operating temperature range specified by the load cell manufacturer within a variability of no more than  $\pm 6^{\circ}$  C.

**Plumbing the engine intake air supply to the enclosure has been found to be a suitable method for temperature control.**

Control temperature by a means that does not cause uneven temperatures on the body of the load cell.



## Open Items (continued)

### Sections 10.1.1.2, 10.1.1.3 & 10.1.1.4

Calibration period engine hours and number of days needs to be considered for update due to changes made in test duration.

### Section 11.6.1.1

Maximum downtime hour duration needs to be considered for update due to changes made in test duration.

### Sections 11.6.2.1 (8) & 11.6.2.2 (8)

New verbiage added for consistency.

### Section 11.6.2.4 (13-17)

New verbiage added due to additional flushing to BLA.

## Open Items (continued)

### **Section 11.6.16**

**Maximum oil consumption TBD.**

### **Section 11.6.17**

**Added requirement to purge oil sample line prior to taking Candidate 2 (End of Test) oil sample.**

### **Table 8**

**Reference Oil Precision Statistics TBD by future testing.**

**Annex A7.2.2 and A7.2.7 TBD by value defined in 11.6.16.**

### **Annex A8.2.7**

**Oil level full measurement relative to oil pan tab TBD.**

Thanks to all who participated

**Bruce Matthews**

**Charlie Leverett**

**Christian Porter**

**Dan Worcester**

**Hap Thompson**

**Jason Bowden**

**Jerry Brys**

**Johnny DeLezerda**

**Mark Mosher**

**Mike McMillan**

**Natahaniel Moles**

**Richard Grundza**

**Terry Hoffman**

**GM Powertrain**

**Intertek Automotive Research**

**Afton Chemical Corporation**

**Southwest Research Institute**

**ASTM Facilitator**

**OH Technologies**

**Lubrizol Corporation**

**Intertek Automotive Research**

**ExxonMobil**

**Infineum**

**Lubrizol Corporation**

**ASTM Test Monitoring Center**

**Afton Chemical Corporation**



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# 2012 Malibu Engine Burnt Exhaust Valves

April 3, 2013

# Timeline



- In October of 2012, began running test on the new 2012 Malibu crate engine purchased from dealership
- Noted a loss of compression after about 2000 hours of operation which was later attributed to a burnt exhaust valve
- GM and other labs made aware of the issue and asked to check compression; other occurrence were noted by IAR & SWRI
- GM made a recommendation that the industry implement a 5000rpm condition for 5mins for each tests to promote valve rotation
- LZ installed a second Malibu engine supplied by OHT with the updated 5000rpm condition
- A burnt exhaust valve was found after about 1000 hours of operation using only industry provided reference oils
- LZ alerted GM and the industry of this second occurrence and sent the head to GM for further investigation
- GM suggested increasing the speed to 6400rpm to promote valve rotation (“a study that was done on a similar engine showed valves would start to rotate at 5000 rpm and the final valve to begin rotation would occur around 6400rpm”)
- SWRI currently investigating top treatment option

# First Burnt Exhaust Valve

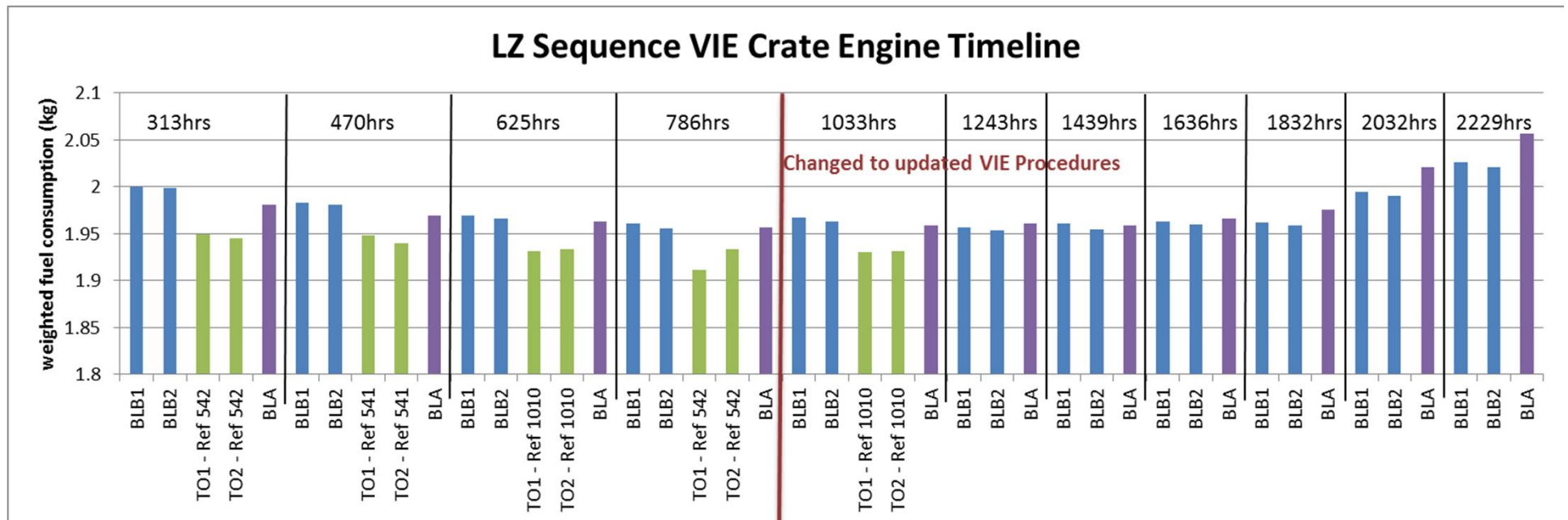


- Create engine purchased from dealership
- Issue occurred over the Thanksgiving holidays and continued to run after some indications of a potential issue
- Implemented a few extra precautions to detect the issue earlier
  - Close monitoring of fuel consumption from test to test
  - Close monitoring of exhaust temperatures
  - Compression checks performed every two tests

# Fuel Consumption



- Timeline for fuel consumption over the lifetime of the engine showed increased fuel consumption last to tests
- At 786hours, changed to updated Seq. VIE procedures
  - 50/50 water/coolant (from 100% coolant)
  - Longer stabilization time (from 60 to 90 minutes)
  - Doubled the number of BLA oil flushes (from 3 to 6)
  - Increased oil line sizes (standardization within industry)
  - Additional 25hours of aging for TO2



# Results of Compression Check



Compression test performed after last test:

#1 1150 kpa

#2 400 kpa

#3 1100 kpa

#4 900 kpa

#5 1100 kpa

#6 1100 kpa

Confirmed by leak down check:

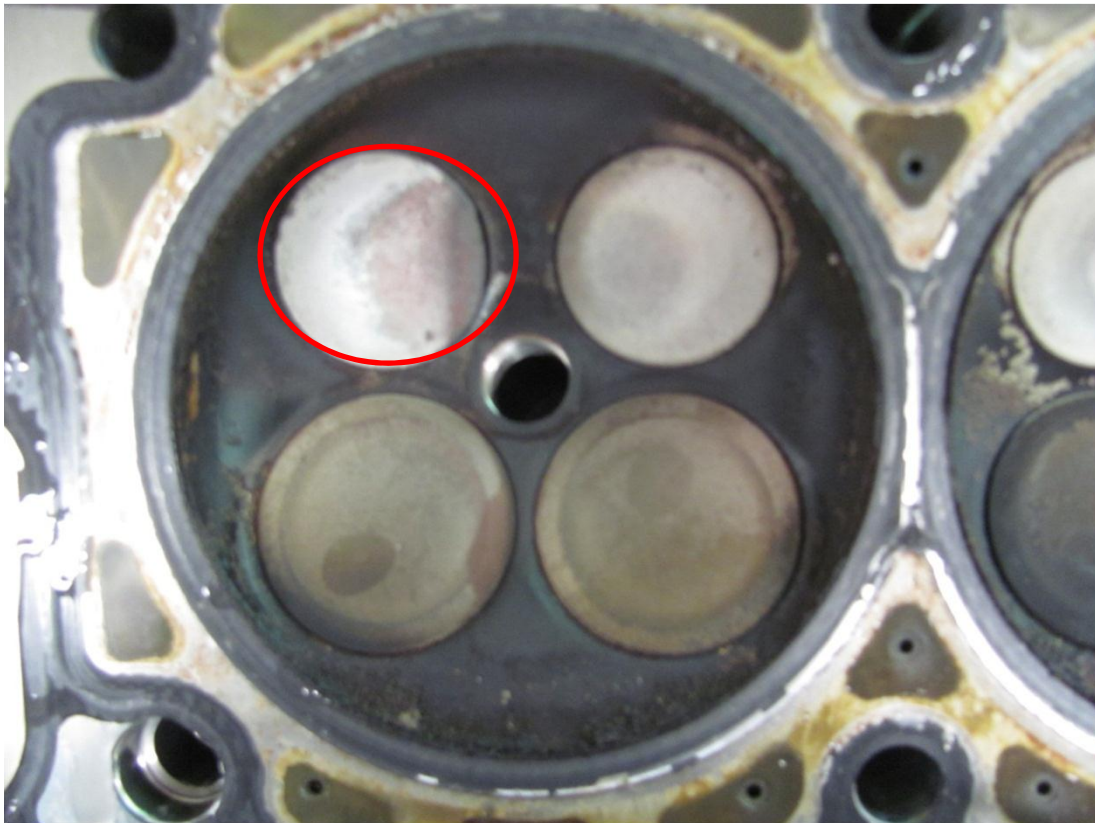
@ 84% on #2

@ 60% on #4

@ 10% on #6



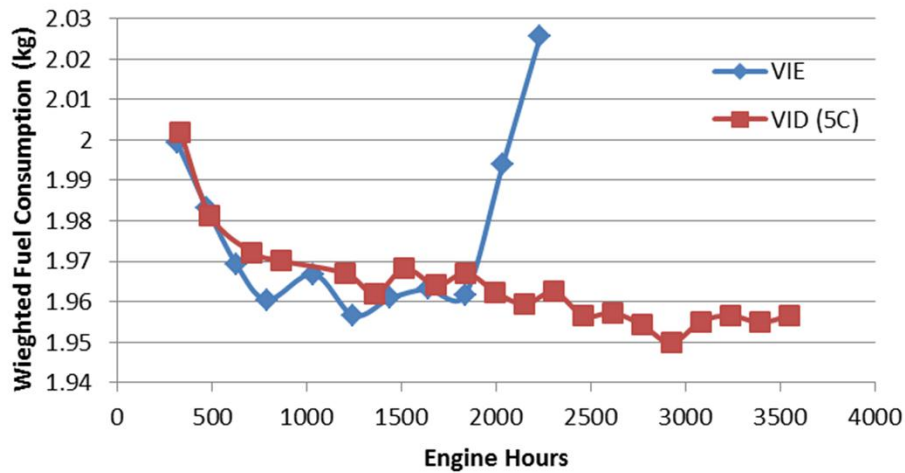
# Burnt Exhaust Valve on Cylinder #2



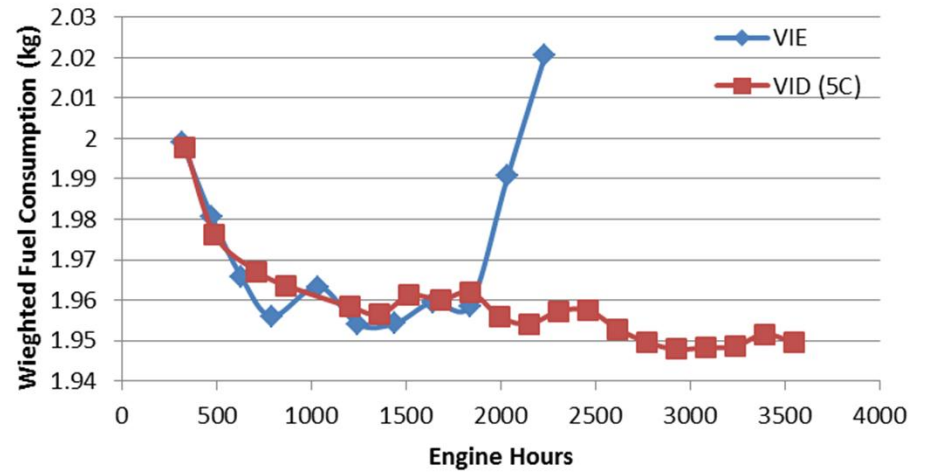
# Fuel Consumption Increase Comparison (BL Oil)



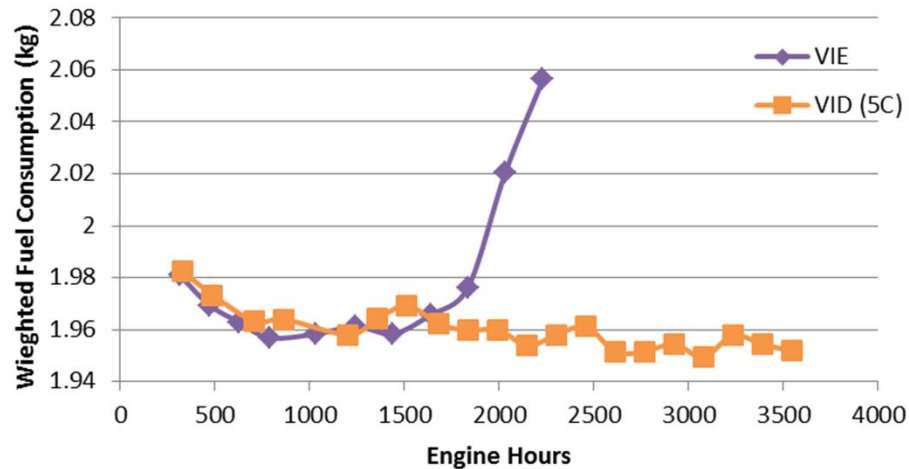
LZ Sequence VIE Crate Engine Timeline BLB1 Oil Only



LZ Sequence VIE Crate Engine Timeline BLB2 Oil Only



LZ Sequence VIE Crate Engine Timeline BLA Oil Only



# Second Burnt Exhaust Valve



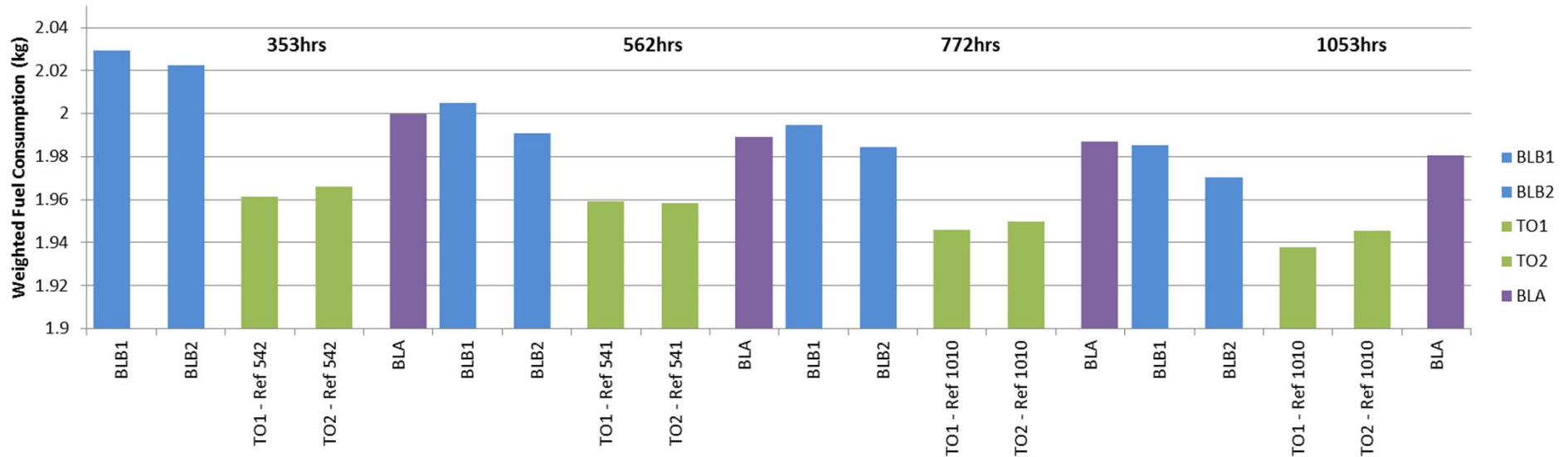
- OHT supplied engine #046
- Issued occurred while running reference oils
- 5000rpm condition ran for 5mins prior to beginning each test

# VIE Engine Operational Background



- 50/50 water/coolant (from 100% coolant)
- Longer stabilization time (from 60 to 90 minutes)
- Doubled the number of BLA oil flushes (from 3 to 6)
- Increased oil line sizes (standardization within industry)
- Additional 25hours of aging for TO2
- 5min 5000rpm condition ran at beginning of each test

VIE Engine Timeline



# Results of Compression Check



Compression test performed after last test:

#1 160 psi

#2 155 psi

#3 160 psi

#4 160 psi

#5 155 psi

#6 60 psi

- Following previous test:

- #1 160, #3 160, #3 150, #4 160, #5 155, #6 150

Confirmed by leak down check:

@ 25% on #2

@ 8% on #1

@ 6% on #4

@ 8% on #3

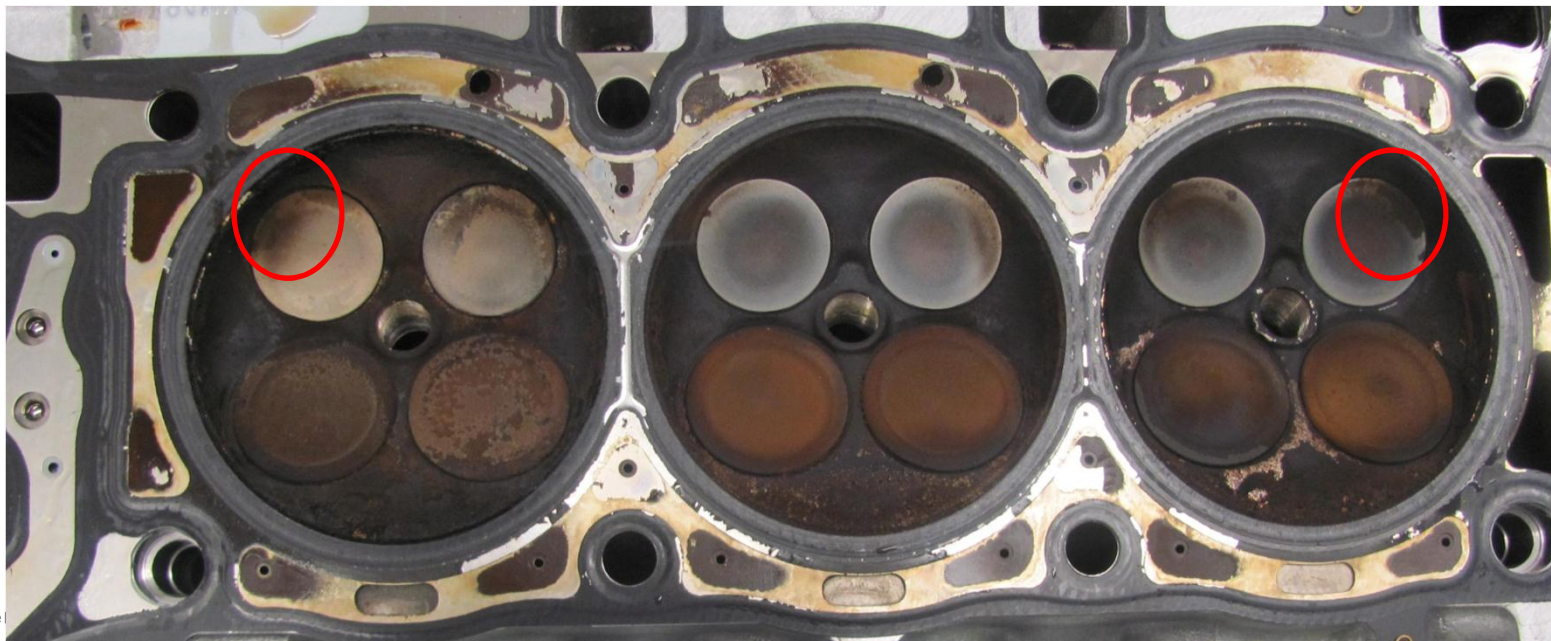
@ 78% on #6

@ 6% on #5

# Burnt Exhaust Valve



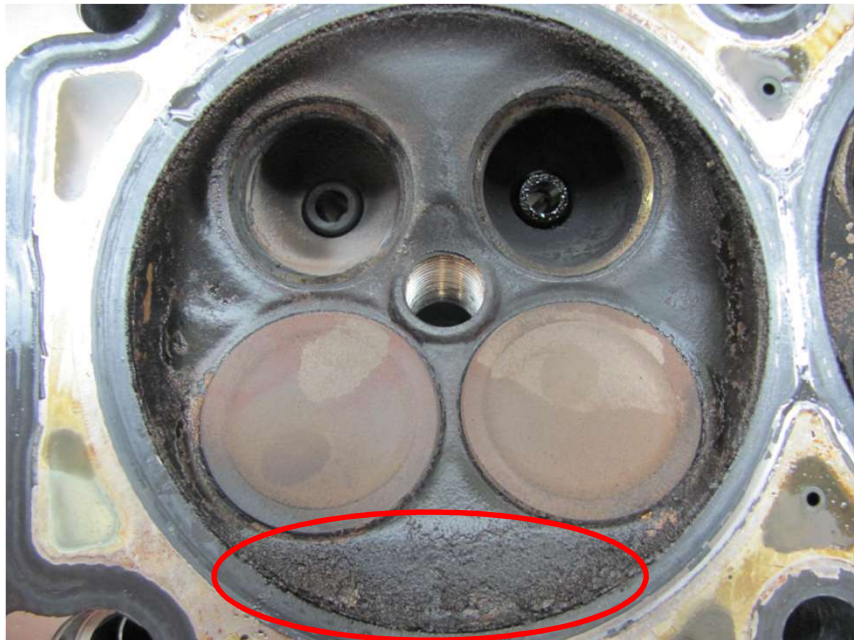
- Caught issue very quickly, minimal visible deformation of valve seat
- Operation parameters at each stage were within normal operating ranges
  - Only indication was high BLA shift -0.64% and high oil consumption 1600ml



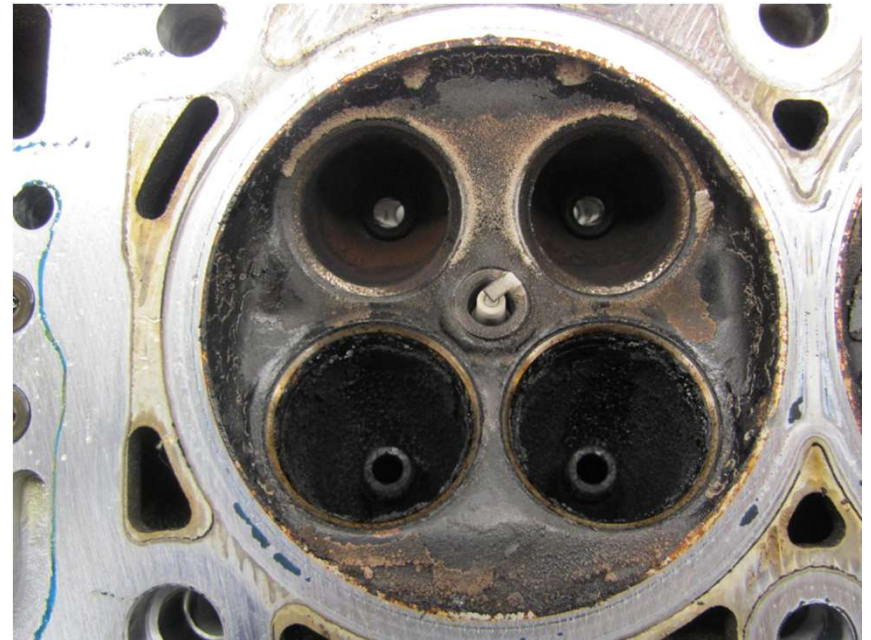
# Intake Valve Deposits



- Malibu Head Deck



- Cadillac Head Deck

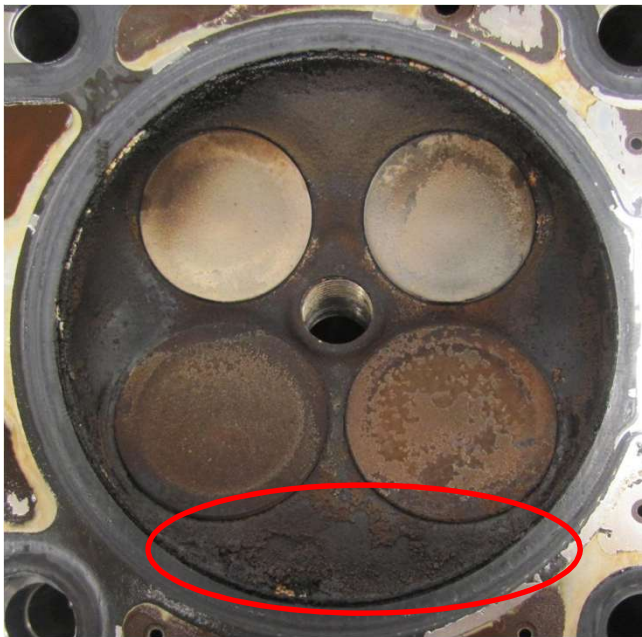


- Deposit build up found on the intake side of the combustion area of the head deck on left side (cylinder #2 shown above)

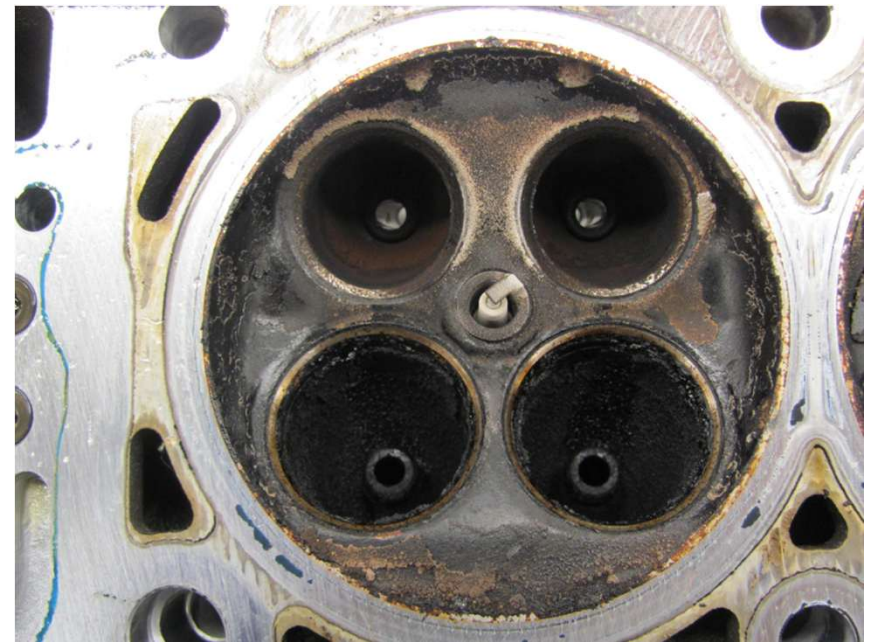
# Intake Valve Deposits



- Malibu Head Deck



- Cadillac Head Deck



- Deposit build up found on the intake side of the combustion area of the head deck on left side (cylinder #6 shown above)