TGC – Fuels Task Force

TGC UPDATE

06-25-2017

Current Membership

Member	Company
Jim Matasic - Chair	Lubrizol
Bob Campbell	Afton
Mark Cooper	Chevron Oronite
Mark Sutherland	TEI
Frank Farber	TMC
Pat Lang	SwRI
Mark Overaker	Haltermann
Jim Moritz	IAR
Bill Buscher	IAR
Al Lopez	IAR
Mike Lochte	SwRI
Jim Linden	
Mike Madalian	Infineum
Nancy Somers	GM
Tim Cushing	GM
Jason Bowden	OHT
Chris Taylor	VP
Greg Miranda	LZ
Patrick Joyce	LZ
Matt Bowden	OHT
Rebecca Monroe	GM
Svetlana Kroll	SwRI
Jonathan VanScoyoc	CPChem
Marissa Macagnone	BASF
Jim Carter	Gage

January 31, 2017 Teleconference

- Task Force Reviewed Scope and Objectives
  - Current versions on next two slides
- Action Items
  - Mark Overaker to work with other fuel suppliers and TMC to develop a statement around IP
  - TGC to work with Mark Overaker, Rich Grundza, and Frank Farber to understand what we do today for fuel batches
  - TGC Fuels Task Force to work on recommendation for fuel batch handling going forward
  - TGC Fuels Task Force needs to create outline of standards for severity, batches, timing, etc that can be used by surveillance panels
  - Chris Taylor, Mark Overaker, Mark Cooper, and Mike Lochte to look at CofA’s (using PC-9 as a start)

TGC Fuels Task Force - Scope

The scope of this task force is to create a document including best practices for HD and PC test fuel monitoring, handling, storage, and supply. The task force also needs to establish mechanisms for single and multiple source supply.

TGC Fuels Task Force - Objectives

1. Maintain a data depository for all test fuel data, located in the TMC website. This should include test fuel formulation details (similar to reference oils) and create a procedure to indicate when significant changes occur in a test fuel formulation.

2. Develop test fuel monitoring plans, include what to analyze (what are key parameters) and how to determine what properties of the test fuel affect the parameters the lubricant test is evaluating. Define what a "batch" is.

3. Establish best practices for test fuel transporting, handling, and storage at the suppliers and laboratories.

4. Develop robust back up plans to account for lack of supply, natural disasters, raw material shortages, etc. From original supplier or alternative suppliers.

5. Include test fuel as critical parameter and test fuel suppliers as partners at the start of test development. Start out with multiple supply scenarios in new procedures.

6. Look to reduce the amount of industry test fuels and reduce storage complexity for labs.

7. Develop alternative supplier standards for test fuel across lubricant testing procedures.

March 22, 2017 Teleconference

- Jim Matasic reviewed open action items from 1-31-17 teleconference
- A review of notes from Mark Overaker based on his 1-31-17 action items
- Mike Lochte reviewed fuel analysis and his action items from 1-31-17
  - Jim Moritz brought up question regarding IP on this analysis
- Action Items
  - Haltermann, VP, Chevron Phillips to review Mike Lochte’s analysis and be prepared to discuss any concerns with it being public information moving forward
  - Entire Task Force to review Mark and Mike's info and be prepared to discuss further at the next meeting

May 23, 2017 Teleconference

- Mark Overaker presented on COA's for PC Fuels/EEE (presentation in Appendix 1)
  - Add D5769 (Aromatics)
  - Add D6750 (Olefins)
  - Include ranges for aromatics C6-C10+
  - Report to TMC
    - Evaluate data
  - Labs/suppliers would run analysis on new batch of fuel and load data to TMC
    - Data available like LTMS info
  - Starting point for future specs, etc
- BASF
  - LCTWG Letter (Appendix 2)
- Action Items
  - TMC to create a report form for suppliers to upload data
    - Standardized form for all fuels
  - Need to get EEE supplier in Europe onboard as well
    - TGC Fuels Task Force attendance
  - Mike Lochte will conduct poll of fuel suppliers whether they are willing to publicly share this data

Appendix 1

Fuel C of A's

THE NEED TO ENHANCE ANALYTICAL REPORTING

PREPARED BY:
MARK OVERAKER. HALTERMANN SOLUTIONS™
MIKE LOCHTE, SWRI

Fuel CofA's

- Action Items from TGC Fuels Task Force
  - Can panels determine what should be listed (on CofA)?
    - What, if any, are the drivers affecting test variability?
    - Is there a method to determine if fuel effects are present?
  - Need to go beyond what is currently on the C of A's
    - Current CofA's measure physical properties of the fuel
    - Current CofA's are limited with respect to fuel composition
    - Several routes to produce fuels that satisfy the specifications, but specifications do not define "how" the fuel should look……

Fuel CofA's

- Current look is at Physical Properties
  - Limited view of the actual fuel composition
    - Reporting focused on "historically" accepted values
    - Difficult to ascertain meaningful "changes" in fuel that:
      - May affect test results
        - Shifts in severity
        - Increased test variability
      - Not consistent with other measurement activities

Fuel CofA's

Partial CofA for EEE Lube

TEST	METHOD	UNITS		HALTERMANN Specs		RESULTS	RESULTS	RESULTS
			MIN	TARGET	MAX			
Distillation - IBP	ASTM D86[2]	°C	23.9		35.0	31.6	31.3	32.3
5%		°C				41.7	46.8	45.6
10%		°C	48.9		57.2	49.8	53.2	52.4
20%		°C				61.6	63.3	62.1
30%		°C				74.1	75.8	73.6
40%		°C				90.8	91.7	89.3
50%		°C	93.3		110.0	103.5	104.3	103.3
60%		°C				110.0	111.5	110.7
70%		°C				115.9	117.6	116.6
80%		°C				126.1	128.5	126.8
90%		°C	151.7		162.8	156.2	161.2	159.5
95%		°C				170.5	177.6	172.7
Distillation - EP		°C			212.8	205.1	202.3	202.9
Recovery		vol %		Report		96.1	97.5	97.4
Residue		vol %		Report		1.1	1.1	1.3
Loss		vol %		Report		2.8	1.4	1.3
Gravity @ 60°F/60°F	ASTM D4052[1]	°API	58.7		61.2	59.22	59.1	58.9
Density @ 15° C	ASTM D4052[1]	kg/l	0.734		0.744	0.7417	0.742	0.743
Reid Vapor Pressure	ASTM D5191[1]	kPa	60.1		63.4	62.3	63.4	60.6
Composition, aromatics	ASTM D1319[2]	vol %	26.0		32.5	30.2	31.7	29.3
Composition, olefins	ASTM D1319[2]	vol %			10.0	0.4	0.9	3.0
Composition, saturates	ASTM D1319[2]	vol %		Report		69.4	67.3	67.7
Research Octane Number	ASTM D2699[2]		96.0			96.2	97.2	97.9
Motor Octane Number	ASTM D2700[2]			Report		88.4	88.9	89.3
Sensitivity	D2699/2700[2]		7.5			7.8	8.3	8.6
Net Heating Value, btu/lb	ASTM D3338[2]	btu/lb		Report		18450	18438	18464
Net Heating Value, btu/lb	ASTM D240[2]	btu/lb		Report		18332	18475	18532

Fuel CofA's

- What new approach should we consider?
  - Compositional view important
  - Aromatics and olefins – best place to start
    - Current method, D1319, limited in scope

      ASTM D1319 - Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption

      - Reports total saturates, olefins, and aromatics
      - Does not quantify carbon length – only family/functional group

Fuel CofA's

- So how do we enhance compositional view?
  - Gather data for evaluating aromatic composition using:
    - ***ASTM D6729 - Standard Test Method for Determination of Individual Components in Spark Ignition Engine Fuels by 100 Meter Capillary High Resolution Gas Chromatography***
    - ***ASTM D5580 - Standard Test Method for Determination of Benzene, Toluene, Ethylbenzene, p/m-Xylene, o-Xylene, C9 and Heavier Aromatics, and Total Aromatics in Finished Gasoline by Gas Chromatography***
    - ***ASTM D5769 - Standard Test Method for Determination of Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography/Mass Spectrometry***

Fuel CofA's

- Focus on accuracy - aromatics first
  - Using EEE Lube as the fuel, we
    - Ran DHA's , ASTM D6729 on three batches of fuel
      - Results obtained from two Labs on the three batches of EEE
      - PONA data from DHA questionable. Results not consistent with fuel recipe.
      - Aromatics over reported in all cases
        - Overall average total aromatics 37.19%
        - Expected range 32.5 – 34.5

Tank 111
D6729 PONA results

Functional Group	Expected % range from formula	D6729 Lab A	D6729 Lab B	Average
Iso-P	51 - 53	47.31	51	49.16
Normal-P	8 - 10	9.44	9.1	9.27
Napthenes	3 - 5	1.89	2.27	2.08
Olefins	<1	0.17	0.01	0.09
Aromatics	32.5 - 34.5	39.1	35.44	37.27
Unidentified		2.11	2.18	2.15
Total		100.02	100.00	100.01

Tank 122
D6729 PONA results

Functional Group	Expected % range from formula	D6729 Lab A	D6729 Lab B	Average
Iso-P	51 - 53	49.8	52.35	51.08
Normal-P	8 - 10	6.9	6.41	6.66
Napthenes	3 - 5	3.38	3.48	3.43
Olefins	<1	0.13	0	0.07
Aromatics	32.5 - 34.5	38.23	35.77	37.00
Unidentified		1.55	2	1.78
Total		99.99	100.01	100.00

Tank 133
D6729 PONA results

Functional Group	Expected % range from formula	D6729 Lab A	D6729 Lab B	Average
Iso-P	51 - 53	46.43	49.60	48.02
Normal-P	8 - 10	9.14	8.90	9.02
Napthenes	3 - 5	3.60	3.80	3.70
Olefins	<1	0.12	0.02	0.07
Aromatics	32.5 - 34.5	39.00	35.60	37.30
Unidentified		1.70	2.02	1.86
Total		99.99	99.94	99.97

Average Overall Total Aromatic Content
37.19%
Expected Total Aromatic Content
32.5 – 34.5%

Fuel CofA's

- Focus on accuracy - aromatics first
  - ASTM D5580 - Standard Test Method for Determination of Benzene, Toluene, Ethylbenzene, p/m-Xylene, o-Xylene, C9 and Heavier Aromatics, and Total Aromatics in Finished Gasoline by Gas Chromatography
  - Results obtained from three Labs on the batches of EEE fuel
  - Analytical data inconsistent with fuel recipe.

C6 aromatics (benzene)	<1
C7 aromatics (toluene)	20.0 - 21.5
C8 aromatics	.5 - 1.0
C9 aromatics	8.5 - 10.0
C10+ aromatics	2.0 - 3.0
Total Aromatics	32.5 - 34.5

  - Overall average 33.7% Total Aromatics, BUT
  - No C10+ aromatics reported……

Tank 111 D5580 GC results					
Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.06	0.04	<0.1	0.05
C7 aromatics (toluene)	20.0 - 21.5	18.48	20.81	20.96	20.08
C8 aromatics	.5 - 1.0	0.82	0.84	0.86	0.84
C9 aromatics	8.5 - 10.0	10.96	10.88	12.13	11.32
C10+ aromatics	2.0 - 3.0				
Total Aromatics	32.5 - 34.5	30.32	32.57	34.02	33.30

Tank 122 D5580 GC results					
Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.03	0.01	<0.1	0.02
C7 aromatics (toluene)	20.0 - 21.5	21.2	21.36	21.79	21.45
C8 aromatics	.5 - 1.5	0.83	0.77	0.78	0.79
C9 aromatics	8.5 - 10.0	12.7	11.42	12.67	12.26
C10+ aromatics	2.0 - 3.0				
Total Aromatics	32.5 - 34.5	34.76	33.56	35.29	34.54

Tank 133 D5580 GC results					
Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.07	0.04	<0.1	0.06
C7 aromatics (toluene)	20.0 - 21.5	20.52	20.95	21.01	20.83
C8 aromatics	.5 - 1.5	1.0	0.96	0.96	0.97
C9 aromatics	8.5 - 10.0	12.28	11.10	12.26	11.88
C10+ aromatics	2.0 - 3.0				
Total Aromatics	32.5 - 34.5	33.87	33.05	34.28	33.73

Average Overall Total Aromatic Content
33.37%
Expected Total Aromatic Content
32.5 – 34.5%

Fuel CofA’s

- Focus on accuracy - aromatics first
  - Ran ASTM D5769, Standard Test Method for Determination of Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography/Mass Spectrometry, on three batches of fuel
    - Results obtained from three Labs on the EEE fuel
    - Analytical data consistent with fuel recipe.

C6 aromatics (benzene)	<1
C7 aromatics (toluene)	20.0 - 21.5
C8 aromatics	.5 - 1.0
C9 aromatics	8.5 - 10.0
C10+ aromatics	2.0 - 3.0
Total Aromatics	32.5 - 34.5

    - Overall average 33.22 % Total Aromatics
    - A more complete look at the fuel’s aromatic composition….

Tank 111
D5769 Mass Spec results

Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.08	0.07	<0.1	0.08
C7 aromatics (toluene)	20.0 - 21.5	21.41	19.59	20.76	20.59
C8 aromatics	.5 - 1.0	0.81	0.79	0.86	0.82
C9 aromatics	8.5 - 10.0	9.13	9.26	9.43	9.27
C10+ aromatics	2.0 - 3.0	2.02	1.98	2.16	2.05
Total Aromatics	32.5 - 34.5	33.45	31.69	33.17	32.77

Tank 122
D5769 Mass Spec results

Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.05	0.03	<0.1	0.04
C7 aromatics (toluene)	20.0 - 21.5	21.87	20.27	21.33	21.16
C8 aromatics	.5 - 1.5	0.74	0.71	0.59	0.68
C9 aromatics	8.5 - 10.0	8.95	9.04	9.18	9.06
C10+ aromatics	2.0 - 3.0	2.67	2.57	2.83	2.69
Total Aromatics	32.5 - 34.5	34.28	32.62	34.12	33.67

Tank 133
D5769 Mass Spec results

Aromatic Content % vol	Expected % range from formula	Lab A	Lab B	Lab C	Average
C6 aromatics (benzene)	<1	0.08	0.07	<0.1	0.08
C7 aromatics (toluene)	20.0 - 21.5	21.21	19.81	20.98	20.67
C8 aromatics	.5 - 1.5	0.90	0.90	0.74	0.85
C9 aromatics	8.5 - 10.0	9.19	9.56	9.61	9.45
C10+ aromatics	2.0 - 3.0	2.10	2.05	2.23	2.13
Total Aromatics	32.5 - 34.5	33.48	32.39	33.79	33.22

Average Overall Total Aromatic Content
32.99%
Expected Total Aromatic Content
32.5 – 34.5%

Method Comparison -Total Aromatics and Carbon Numbers.....

Tank 111 Method comparison

Aromatic % vol	Average D6729	Average D5580	Average D5769
C6 aromatics (benzene)	0.06	0.05	0.08
C7 aromatics (toluene)	23.24	20.08	20.59
C8 aromatics	0.86	0.84	0.82
C9 aromatics	9.53	11.32	9.27
C10+ aromatics	3.01		2.05
Total Aromatics	36.70	33.30	32.77

Tank 122 Method comparison

Average D6729	Average D5580	Average D5769
0.03	0.02	0.04
23.23	21.45	21.16
0.77	0.79	0.68
9.18	12.26	9.06
3.23		2.69
36.43	34.54	33.67

Tank 133 Method comparison

Average D6729	Average D5580	Average D5769	Expected Range
0.06	0.06	0.08	<1
23.11	20.83	20.67	20.0 - 21.5
0.96	0.97	0.85	.5 - 1.0
9.63	11.88	9.45	8.5 - 10.0
2.94		2.13	2.0 - 3.0
36.70	33.73	33.22	32.5 - 34.5

C6 aromatics (benzene)	<1
C7 aromatics (toluene)	20.0 - 21.5
C8 aromatics	.5 - 1.0
C9 aromatics	8.5 - 10.0
C10+ aromatics	2.0 - 3.0
Total Aromatics	32.5 - 34.5

Fuel CofA's
Total Aromatics.....

- ASTM D5769 reports aromatics most accurately
  - Mass spec technology
  - Reports thru C10+
  - More consistent reporting of C6 – C10+ and total aromatics.
- ASTM D5580 limited reporting.
  - Ends at C9's.....
- ASTM D6729 DHA
  - Least accurate for reporting toluene and total aromatic concentration.
  - Coelution issues – report based on retention times

Fuel CofA’s
Olefin Concentration…..

- ASTM D6550 Standard Test Method for Determination of Olefin Content of Gasolines by Supercritical-Fluid Chromatography
  - Will result in a more accurate total olefin report
  - EEE Lube is a low olefin fuel (expect <1 %)
  - All 6 (3 results from 2 Labs) results less than 1%

Fuel CofA's

- Continue current CofA generation
- Add D5769 and D6550 as "reports" to CofA
- Include ranges for aromatics C6 – C10+

Continue current data to TMC

Include additional analytical methods as a "report"

- Begin collecting D5769 data
- Begin collecting D6550 data
- Send to TMC

- Further evaluate reporting parameters on ASTM test fuels

Continue CofA enhancement

Appendix 2

American Chemistry Council

Sent via email
December 5, 2016

To: Joe Franklin: ASTM D02.B0 Automotive Lubricants Chair (joe.franklin@intertek.com)
Steven Kennedy: ASTM D02.B0.08 Test Monitoring Center Executive Committee Chair (steven.kennedy@exxonmobil.com)
Patrick Lang: ASTM Technical Guidance Committee Chair (patrick.lang@swri.org)

RE: Equivalent / Replacement of Non-Generic Equipment

The Lubricant Category Testing Work Group (LCTWG), working at the behest of ACC PAPTG, continues to engage industry stakeholders on how ASTM tests procedures address material substitution and procurement of materials. LCTWG remains interested in both a materials procurement process and the ongoing management thereof. The content of this letter pertains to the use of non-generic equipment (apparatus, solvents or other materials) used in the practice of ASTM automotive lubricant engine test methods.

LCTWG fully supports ASTM International's policy *"…to encourage the development of test methods based on generic equipment"*[1]. Although there may be an opportunity for more robust discussion regarding the use of generic and non-generic equipment/materials within lubricant engine test development Task Forces, LCTWG recognizes circumstances exist in which non-generic equipment / material is required.

Facts For Members[2] Attachment 4, Section 7 details the procedure for listing of equivalent / replacement equipment, however it does not describe a *"testing mechanism"* which is mentioned in 3.1.4, and 4.1.2. Section 7 informs steps post-testing, but does not offer any guidance on the testing itself. Industry stakeholders (especially surveillance panels and suppliers interested in supporting ASTM test methods) would benefit from equivalency testing guidelines to clarify protocols and ensure consistency (under technically similar circumstances).

LCTWG proposes that surveillance panels review and summarize historical meeting minutes (from the past 5 years or whatever is permissible under your retention policy) detailing testing conducted to replace non-generic equipment/materials with those from a different supplier. From this exercise, it is believed technical guidelines can be drawn up, based on consensus best practices, for replacement apparatus, parts (e.g. ring, liners, bearings, valve-train), reference oils, and fuel.

We look forward to comments from the committees you chair.

Regards,

[1] Section 15/ Regulations Governing ASTM International Technical Committees, March 2010, and Sections F3 and F4, Form and Style for ASTM International Standards, March 2010
[2] Facts For Members ASTM International Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants, December 2014

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