

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL OF

ASTM D02.B0.02

February 19, 2003

Holiday Inn – O'Hare International, Rosemont, IL

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ACTION ITEMS

- | | | |
|----|---|----------|
| 1. | Range of after-treatment devices planned for use. | EMA |
| 2. | Issue "Exit Ballot" on a PC-10 Noack limit of 13% for volatility. | McGeehan |
| 3. | Bring data on using CI-4 tests in place of older tests. | All |
-

MINUTES

- 1.0 Call to Order
 - 1.1 Chairman Jim McGeehan called the meeting to order at 7:59 a.m. on February 19, 2003, in the Love Room of the Holiday Inn – O'Hare International Hotel of Rosemont, Illinois. There were nine members present or represented and ten guests present. The attendance list is shown as Attachment 2.
- 2.0 Agenda
 - 2.1 The published agenda (Attachment 1) was reviewed, with no changes requested.
- 3.0 Previous Meeting Minutes
 - 3.1 Minutes of the December 10, 2002, meeting were approved with the following comments: Tom Franklin observed an "Action Item" should have been listed for Chairman McGeehan to request of sub-committee D02.B that "Loss of Side Clearance" be withdrawn as a pass/fail parameter from the CF category in D-4485. Chairman McGeehan did take that action at the December "B" meeting. Tom Cousineau observed Chairman McGeehan's slide on HDEOCP members had Mesfin Belay's name reversed.
- 4.0 Membership
 - 4.1 Abdul Cassim has replaced Dwayne Tharp of Caterpillar and Charlie Passut has replaced Tom Cousineau of Ethyl. See Attachment 3.
- 5.0 PC-10 Status

- 5.1 Bill Runkle reviewed the current status of PC-10 within the NCET. See Attachment 4. The Cat C-12 engine availability was moved to June, 2003, and the new elastomer of concern for compatibility was identified as "Vamac".
 - 5.2 There was lots of discussion concerning after-treatment compatibility testing, led by Chairman McGeehan. He asked EMA to report at the next meeting on the range of after-treatment devices they plan to use (traps, absorbers, converters, etc.). He would like the panel to decide at that meeting if an oil / after-treatment test would be feasible or should test development be abandoned and effort spent on developing chemical limits.
 - 5.3 The panel agreed that an "exit ballot" on the proposed PC-10 limit of 13% volatility by Noack be sent to the HDEOCP.
 - 5.4 Bill Runkle reported the NCET "evaluation" of PC-10 is complete and an NCDT "development" team should proceed.
- 6.0 HDEOCP Voting Requirements
- 6.1 This item was raised by the EMA at the last meeting, on how large a majority would be sufficient to pass recommendations on to sub-committee "B". Lew Williams wants more than a simple majority and favors 2/3 to 3/4. Jim McGeehan wants 100%. Other ideas explored allowing one or two dissenting votes. It was also brought up, that whatever the outcome was on a passing vote, that information should be passed on to "B".
- 7.0 Closed Crankcase Ventilation / Turbo Coking T.F.
- 7.1 Jim McGeehan reported on the CCV/TC Task Force meeting. See Attachment 5.
- 8.0 Shear Stability / High Temperature High Shear T.F.
- 8.1 Bill Kleiser reported for the SS/HTHS Task Force and Frank Bondarowicz presented some Cummins "C" field test data. See Attachment 6.
- 9.0 Replacement Test Correlation
- 9.1 Chairman McGeehan again raised the issue of need for data to correlate CI-4 tests to older category tests. No data was presented.
- 10.0 ULSD Fuel for PC-10
- 10.1 Tom Franklin presented a report from the fuel Task Force since Pat Fetterman was unable to attend. See Attachment 7.
- 11.0 Next Meeting
- 11.1 The next was not set and will be at the call of the chairman. It probably will not occur until June in Norfolk.
- 12.0 Adjournment
- 12.1 The meeting was adjourned at 9:54 a.m.

Submitted by:

Jim Wells
Secretary to the HDEOCP

ASTM
SECTION D.02.BO.02
HEAVY-DUTY ENGINE OIL CLASSIFICATION PANELS

Holiday Inn
5440 North River Road, Rosemont, Chicago
February 19th 2003
8:00-1:00 PM

Chairman/ Secretary: Jim Mc Geehan/Jim Wells
Purpose: PC-10
Desired Outcomes: PC-10 Tests and Time-line

TOPIC	PROCESS	WHO	TIME
Agenda Review	<ul style="list-style-type: none"> Desired Outcomes & Agenda 	Group	8:00-8:05
Minutes Approval	<ul style="list-style-type: none"> December 10th 2002 	Group	8:05-8:10
Membership	<ul style="list-style-type: none"> Changes Chairman's comments 	Jim Mc Geehan	8:10:8:15
NCET report	<ul style="list-style-type: none"> PC-10 Up-date 	Greg Shank Bill Runkle	8:15-9:00
HDEOCP voting	<ul style="list-style-type: none"> Define voting rules to move to ballot within HDEOCP Voting rules for Exit-Criteria ballot 	Group	9:00-9:45
Exit -Criteria ballot for 13% Noack	<ul style="list-style-type: none"> Discussion on Noack limit for 13% Noack Vote 	Group	9:45-10:00
Task-Force Reports	<ul style="list-style-type: none"> HT/HS and Shear Stability Turbo-coking and closed crankcase deposit control Elastomer Compatibility Ultra low sulfur reference fuel 	Bill Kleiser Jim Mc Geehan Becky Grinfield Pat Fetterman	10:00-12:00
Replacement of API CH- tests to API CI-4	<ul style="list-style-type: none"> Correlation data for Mack T-9 to Mack T-10 Correlation data fro Cummins M11 to M11-EGR 	Group	12:00-1:00
New or Old business	<ul style="list-style-type: none"> Next meeting 		12:00-1:00

HDEOCP Attendance List February 19, 2003

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Voting Members of HDEOCP

◆ OEMs

- G. Shank, Mack Trucks
- D. Stehouwer, Cummins Inc.
- M. Belay, Detroit Diesel Corporation
- A Cassim, Caterpillar Inc.
- F. Bondarowicz, International Truck and Engine Corporation
- K. Chao, John Deere
- R. T. Stockwell, GM Powertrain Engineering Center

◆ Oil and Additive Companies

- J. A. Mc Geehan, Chairman (HDEOCP), ChevronTexaco Company
- S. Kennedy, ExxonMobil
- M. Urbanak, Shell
- C Passut, Ethyl Corporation
- W. Kleiser, Chevron Oronite Company LLC
- L. Williams, Lubrizol Corporation
- P. Fetterman, Infineum USA



PC-10 NCET UPDATE

ASTM HDEOCP MEETING

Holiday Inn O'Hare

February 19, 2003

Iron Piston Deposits, Oil Consumption

- CI-4 Requirement
- New Test
- New Engine - Caterpillar C-12
- Length - 500 - 650 hours
- Transient (Cyclic) Test
- Matrix Required
- Hardware Available ~ March/April 2003

Aluminum Piston Deposits, Oil Consumption

- CI-4 Requirement
- Caterpillar 1N
- Required for Backward Compatibility
- Matrix Not Required
- May Be Dropped if Industry Shows No Harm

Ring & Liner Wear (Corrosive), Bearing Corrosion

- Mack T-10
- T-10 With New Hardware
- T-10 With ULS Fuel?
- Length - ~ 300 Hours
- Low Temp Used Oil Viscosity?
- Matrix Required
- Hardware Currently Available

Soot Related Valvetrain Wear (Abrasive & Rolling)

- RFWT
- CI-4 Level
- Matrix Not Required

Soot Related Valvetrain Wear (Sliding Follower)

- New Test
- CUMMINS ISB
- 100 Hours Aftertreatment Compatibility
- Plus 250 Hours Wear
- Matrix Required
- Hardware & Procedure Late 2003/Early 2004

EGR Soot Related Valvetrain Wear (Abrasive & Corrosive)

- CUMMINS ISM EGR (May Replace M-11)
@ Lower Soot
- 5% to 6% Soot
- ~ 200 Hours Length
- ULSD
- Matrix Required
- Hardware & Procedure Late 2003/Early
2004

Thermal Stability (Oxidation)

- Sequence III G Probable
- Viscosity Increase Only
- PCEO Procedure
- Matrix Not Required

Turbo Coking Deposits

- European Bench Test?
- New Bench Test?
- Matrix?
- HDEOCP Has Formed Task Force

Closed Crankcase Deposit Control

- European Bench Test?
- New Bench Test?
- Matrix?
- HDEOCP Has Formed Task Force

Soot Related Viscosity Increase

- Mack T-10 Hardware
- Mack Ring & Liner Wear Test or Other Test?
- CI-4+ Level
- (Separate) Matrix Not Required?

EGR Soot Related Viscosity Increase

- Same New Mack Test as Soot Related Viscosity Increase
- Mack Ring and Liner Wear Test or Other Test?
- Same Matrix?

Elastomer Compatibility

- Carryover from CI-4
- EMA to Add One Elastomer Used
- Existing HDEOCP Task Force to Evaluate

Used Oil Viscometrics (Low Temperature)

- Mack T-10A
- Carryover from CI-4
- May Be Redundant With Soot/Viscosity

Catalyst Aftertreatment Compatibility

- Caterpillar C-12
- CUMMINS ISB
- Other New Test (Caterpillar Looking at Bench Test)
- Select Two Most Severe Catalyst Systems
- EMA Monitor European Tests
- Additional Matrix?

High Temperature Corrosion Bench Test

- CI-4 Carryover

HT/HS Limit for Used Oil

- New Requirement
- TBS?
- Ravenfield?
- Other Test?
- HDEOCP Has Formed Task Force (Test Method and Used Oil Generation)

Shear Stability (Improved)

- CI-4 Test Method (Modified?)
- Correlate to New Engines
- EMA to Provide Correlation Data
- HDEOCP Has Formed Task Force to Evaluate Method and Correlation

Volatility

- NOACK
- 13% Maximum

Foaming

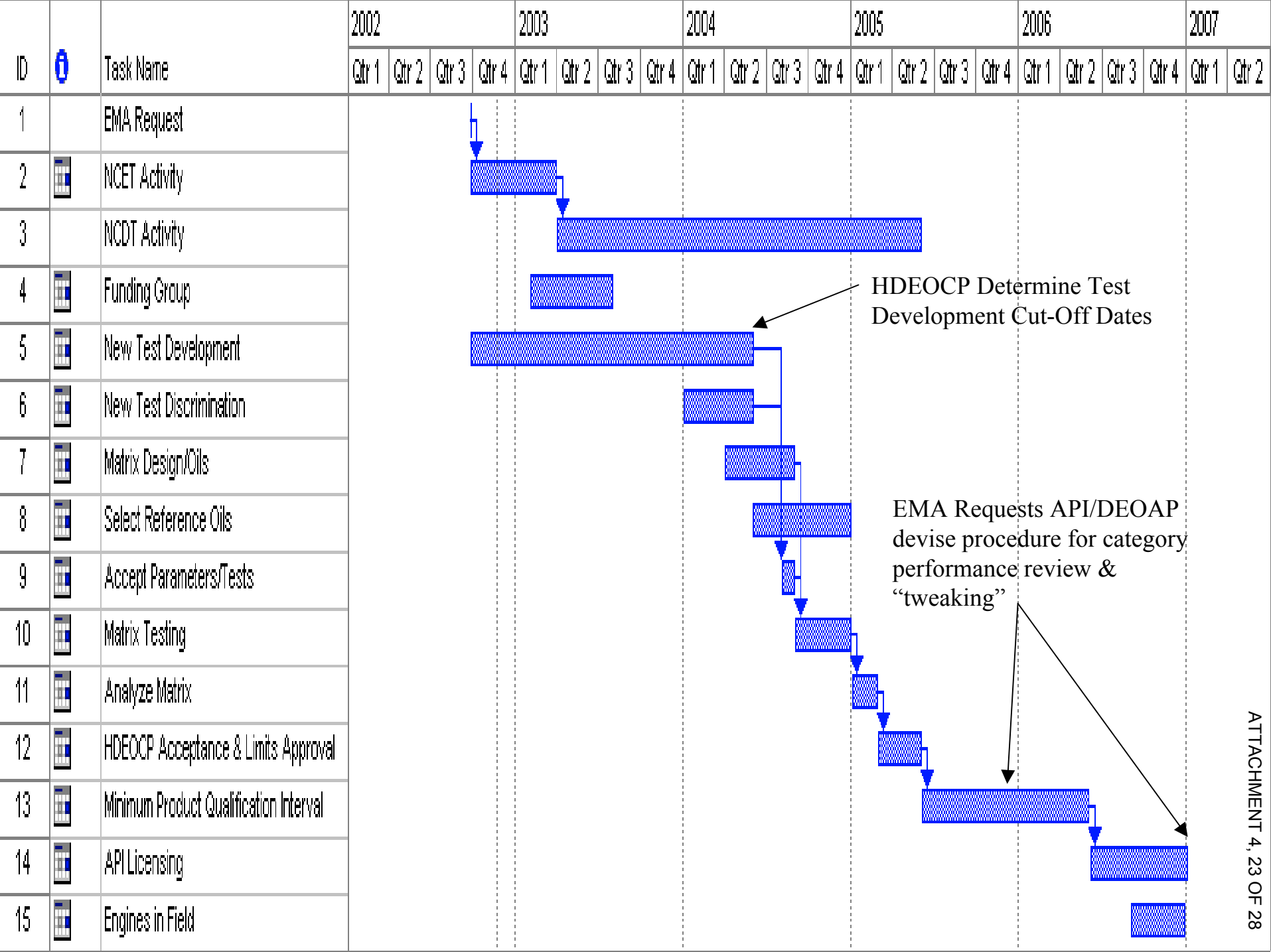
- CI-4 Carryover
- Same Test
- Same Limits

Chemical Property Limits

- Sulfated Ash Limit
- Phosphorus Limit
- Sulfur Limit
- Limits Required, if Aftertreatment Test Not Developed and Accepted
- EMA to Provide Additional Information ~ April/May 2003

Backward Compatibility

- Pre-2007 Engines
- <15 PPM Sulfur Fuel
- <500 PPM Sulfur Fuel
- Catalyst Compatibility May Preclude



Draft User Language

Version 1 - Backward Compatible

The PC-10 requirements describe oils for use in those high-speed four-stroke cycle diesel engines designed to meet exhaust emission standards being implemented between 2007 and 2010. These oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 0.05% by weight.

These oils are especially effective to sustain emission control system durability where NOX adsorbers, particulate filters and other advanced aftertreatment systems are used. Optimum protection is provided for control of catalyst poisoning, particulate filter blocking, piston deposits, low and high temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear.

PC-10 oils are superior in performance to those meeting API CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories.

Draft User Language

Version 2 - Backward Compatible, 15 ppm fuel

The PC-10 requirements describe oils for use in those high-speed four-stroke cycle diesel engines designed to meet exhaust emission standards being implemented between 2007 and 2010. These oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 0.0015% by weight.

These oils are especially effective to sustain emission control system durability where NOX adsorbers, particulate filters and other advanced aftertreatment systems are used. Optimum protection is provided for control of catalyst poisoning, particulate filter blocking, piston deposits, low and high temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear.

When using diesel fuel with less than 0.0015% sulfur, PC-10 oils are superior in performance to those meeting API CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories. They are not recommended for use in engines using diesel fuel with higher sulfur content.

Draft User Language

Version 3 - Not Backward Compatible

The PC-10 requirements describe oils for use in those high-speed four-stroke cycle diesel engines designed to meet exhaust emission standards being implemented between 2007 and 2010. These oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 0.0015% by weight.

These oils are especially effective to sustain emission control system durability where NOX adsorbers, particulate filters and other advanced aftertreatment systems are used. Optimum protection is provided for control of catalyst poisoning, particulate filter blocking, piston deposits, low and high temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear.

Since PC-10 oils are compounded for optimum performance in engines with advanced aftertreatment systems, they may not be suitable for use in pre-2007 engines where API CI-4, CH-4, CG-4 and CF-4 are recommended. Consult your oil supplier regarding use in equipment calling for those API Service Categories.

NCET Proposal Elements

- Need for category validated ✓
- The Category Is Feasible ✓
- Preliminary Timeline Established ✓
- Category language drafted, reviewed by EMA, and accepted, with modifications ✓
- Funding proposal - Funding Group is Being Established & will determine funding method ✓

NCET Proposal

- NCET, by consensus, supports the request for a new category
- All NCET recommendation elements except funding method have been completed
- EMA will provide test cost estimate
- Funding Group will determine method
- NCET requests DEOAP to forward its recommendation to proceed with category development to API Lubricants Committee

Turbo-Coking and close crankcase task-force

February 18 th 2003



Brain Storming Ideas

- ◆ **OM 441LA and MTU deposit test**
- ◆ **Caterpillar C-12 with closed crankcase**
- ◆ **Caterpillar C-12: measure blow-by**
- ◆ **Caterpillar C-12: direct blow-by to a deposit surface**
- ◆ **Caterpillar C-12 filter system**
- ◆ **Caterpillar C-12 measures oil consumption**
- ◆ **Oil consumption effective by Noack**
- ◆ **DC TEOST test at 33 degrees C with oil mist and aluminum parts**

Box-In with Chemical limits

- ◆ **13% Noack**
- ◆ **Possible chemical limits on Ash; P and S**
- ◆ **Limits oil formulating effects**
- ◆ **Focus is on deposits and oil consumption**



Need OEM inputs

- ◆ **Caterpillar opinion on filter use or open crankcase for test.**
- ◆ **Cummins, Mack and Navistar's approach to the problem**
- ◆ **Literature search on the problem**
- ◆ **Cummin's Turbo charger group opinions**



Action Items

- ◆ **Need to search data base on OM 441LA on good and poor performing oils in regard turbo-charger deposits.**
- ◆ **Need to correlate any bench test to engine test.**



Shear Stability and HTHSV Subgroup



- Shear Stability
- Data presented by International, Lubrizol, and Oronite
- Data indicates that extended Kurt Orbahn relates to Shear Stability of more severe engines
- Subgroup of the subgroup will define a matrix of test oils (Michael Covitch)
- Testing plan
- International Engine stand available end March
- Independent lab field test early April (cost TBD)
- Target to get field correlation data by June ASTM if feasible
- HTHS Viscosity Measurement
- Ted Selby presented data indicating that TBS can be used with sooted oils.
- Teleconference will be scheduled mid March.

Unit/Sample	Sample Date	Miles	Fuel	TS	H2O	Vis 100	Grad	Glycol	TBN
1- #1	9/15/2002	839	1	0.5	0.1	13.1	40	Neg	6.94
# 2	9/24/2002	2041	1	0.5	0.1	12.5	30	Neg	6.84
# 3	9/29/2002	2794	1	0.5	0.1	12.4	30	Neg	5.44
# 4	10/15/2002	3762	1	1	0.1	12.3	30	Neg	6.94
# 5	10/15/2002	5155	1	1	0.1	12.1	30	Neg	6.16
# 6	10/20/2002	6000	1	1.5	0.1	12	30	Neg	6.72
2 - #1	9/15/2002	884	1	0.5	0.1	13.1	40	Neg	6.05
# 2	9/24/2002	2235	1	0.5	0.1	12.4	30	Neg	7.14
# 3	9/29/2002	2887	1	0.5	0.1	12	30	Neg	4.94
# 4	10/14/2002	3777	1	0.5	0.1	11.8	30	Neg	6.94
# 5	10/22/2002	5035	1	0.5	0.1	11.8	30	Neg	6.94
# 6	10/20/2002	6000	1	0.5	0.1	11.7	30	Neg	6.94
3 - #1	9/18/2002	958	1	0.5	0.1	13.4	40	Neg	6.5
# 2	9/26/2002	1912	1	0.5	0.1	12.6	40	Neg	7.24
# 3	10/4/2002	3104	1	0.5	0.1	12.2	30	Neg	5.14
# 4	10/11/2002	3821	1	0.5	0.1	12.8	40	Neg	6.94
# 5	10/18/2002	4919	1	0.5	0.1	12.1	30	Neg	6.72
#6	10/21/2002	6000	1	0.5	0.1	12.1	30	Neg	7.5
4 - #1	10/11/2002	764	1	0.5	0.1	13.9	40	Neg	7.5
# 2	10/18/2002	1739	1	0.5	0.1	12.9	40	Neg	7.5
# 3	10/21/2002	1996	1	0.5	0.1	12.8	40	Neg	6.94
# 4	10/23/2002	2469	1	0.5	0.1	12.7	40	Neg	7.5
# 5	10/24/2002	2718	1	0.5	0.1	12.5	30	Neg	7.5
5 - #1	9/19/2002	1385	1	0.5	0.1	13.2	40	Neg	7.17
# 2	9/24/2002	2060	1	0.5	0.1	13	40	Neg	7.04
# 3	9/29/2002	2890	1	0.5	0.1	12.7	40	Neg	5.54
# 4	10/6/2002	3702	1	0.5	0.1	12.6	40	Neg	7.5
# 5	10/18/2002	4692	1	1	0.1	12.4	30	Neg	7.5
# 6	10/27/2002	6000	1	1	0.1	12.2	30	Neg	7.5
6 - #1	9/13/2002	1202	2	0.5	0.2	13.4	40	Neg	6.38
# 2	9/19/2002	2222	1	0.5	0.1	12.4	30	Neg	6.05
# 3	9/26/2002	2990	1	0.5	0.1	12.1	30	Neg	5.64
# 4	10/4/2002	3832	1	0.5	0.1	11.6	30	Neg	4.84
# 5	10/11/2002	4926	1	0.5	0.1	11.4	30	Neg	6.94
# 6	10/17/2002	6000	1	0.5	0.1	11.4	30	Neg	6.94
7 - #1	9/3/2002	1016	2	0.5	0.2	13.3	40	Neg	6.16
# 2	9/11/2002	2134	2	0.5	0.2	12.8	40	Neg	6.38
# 3	9/19/2002	3276	1	0.5	0.1	12.3	30	Neg	5.26
# 4	9/24/2002	3941	1	0.5	0.1	12.2	30	Neg	5.1
# 5	9/29/2002	4855	1	1	0.1	12	30	Neg	5.04
# 6	10/10/2002	6000	1	1.5	0.1	11.7	30	Neg	5.82
Please note that all lab results reflecting a less than amount (<) had to be converted to number									
Example: Mo (Molybdenum) readings that show 5 ppm are actually <5 unless a higher number									
FDD = <2.0			H2O = <.2						

PC-10 Ultra Low Sulfur Test Fuel Task Force

Reviewed with the
ASTM HDEOCP Meeting
February 19, 2003

Task Force Membership

- Pat Fetterman – Infineum, Chairman
- Frank Bondarowicz – International
- Don Burnett – Chevron Phillips Chemical
- Jim Carter – Haltermann
- David Venhaus – Ethyl
- Tom Franklin – PerkinElmer
- Greg Shank – Mack Volvo Powertrain
- Jim Wells – SwRI
- Lew Williams - Lubrizol

Proposed Fuel Task Force Mission Statement

- To develop an ultra low sulfur diesel fuel specification which can be used to define fuels for test engines for bid purchase for Heavy Duty engine oil categories after PC-9. This specification will be sufficiently detailed that fuels purchased against it will produce consistent results with regard to engine deposits, soot generation, wear and exhaust gas composition.

Task Force Status

- A Task Force teleconference was held on Monday, 2/17/03.
- Issues reviewed:
 - Mission statement
 - PC-9 fuel bid specification
 - Possible use as a core for new specification
 - What sulfur level?
 - What cetane number?
 - Need for lubricity?
 - Next steps

PC-10 Test Fuel Task Force
Teleconference 2.17.03
Minutes

CALL TO ORDER: 11:05

MEMBERSHIP REVIEW:

MEMBER	AFFILIATION	PRESENT
Pat Fetterman, Chairman	Infineum	X
Frank Bondarowicz	International	X
Don Burnett	Chevron/Phillips Chemical	X
Dennis Doerr		X
Jim Carter Joel Moreno	Haltermann	X
Tom Cousineau	Ethyl	
Tom Franklin	PerkinElmer	x
Greg Shank	Mack Volvo Powertrain	
Jim Wells	SwRI	X
Lew Williams	Lubrizol	X

SELECT SECRETARY: Tom Franklin “volunteered.”

REVIEW/AGREE MISSION STATEMENT: Accepted as proposed with a motion by Jim Wells, seconded by Joel Moreno.

DISCUSS PC-9 FUEL SPEC. AND HOW IT CAN BE MODIFIED FOR PC-10: Both Chevron/Phillips and Haltermann have produced ULS fuel and will send their specifications to the task force. (Note: these specifications are attached to the minutes) A number of comments were aired and using the Chevron/Phillips PC-9 Fuel Spec as a basis a tentative specification was developed. This is listed below as noted by the secretary, and therefore subject to hearing and understanding limitations!

REVIEW PRESENTATION TO HDEOCP:

The need for lubricity, as pointed out in the presentation was discussed. Frank Bondarowicz indicated that International have a lubricity specification. He suggested ASTM D 6078 as the test with a limit of 3100 grams minimum. He cautioned, however, that European engines with common rail fuel systems, may have more stringent requirements. The task force agreed to go with the 3100 grams as a straw-man. Both fuel suppliers agree that this limit is not a problem. A pending CARB decision on this matter will be reflected as we go forward.

Action: Mark up a new proposed specification and review in another teleconference. Frank Bondarowicz cautioned that going higher on cetane may be a problem, but the refiners expressed comfort with 47-49.

A.O.B. None.

NEXT MEETING: Mid next week for another teleconference. Wednesday, Feb 26th, 11:00 – 12:00 est.

Formerly Diesel PC-9 Test Fuel as altered 2.17.03

(I think!)

Property	Specification	Test Method
Distillation Range, °F		ASTM D 86
10%		
50%		
90%	560 – 630	
Endpoint		
Specific Gravity	0.845 – 0.852 (to be changed)	ASTM D 4052
API Gravity	34.5 – 36 (to be changed)	ASTM D 1298
Corrosion, 3 h at 50 °C	1 max	ASTM D 130
Sulfur, ppm	7 – 15	ASTM D 5453
Flash Point, °F, PM	130 min	ASTM D 93
Pour Point	0 max	ASTM D 97
Cloud Point, °F		ASTM D 2500
Viscosity at 40 °C, cSt	2.0 – 2.6	ASTM D 445
Ash, wt %	0.005 max	ASTM D 482
Carbon Residue on 10% Bottoms	0.35 max	ASTM D 524
Net Heat of Combustion		ASTM D 3338
Water and Sediment, vol %	0.05 max	ASTM D 2709
Total Acid Number	0.05 max	ASTM D 644
Strong Acid Number	0 max	ASTM D 644
Cetane Index		ASTM D 976
Cetane Number	47 – 49(probable)	ASTM D 613
Accelerated Stability, mg/100 mL	1.5 max	ASTM D 2274
Composition, vol %		ASTM D 5186
Aromatics	28 – 33	
Olefins		
Saturates		
Lubricity	3100 g min	ASTM D 6078

Chevron Phillips Chemical Company LP

Specialty Chemicals

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Diesel PC-10 Test Fuel (Developmental)

Property	Diesel 2007 Emission Cert. Fuel	Test Method
Specific Gravity, 60/60 °F	0.840 – 0.865	ASTM D 4052
API Gravity	32 – 37	ASTM D 1298
Corrosion, 3 h at 50 °C		ASTM D 130
Sulfur, ppm	7 – 15	ASTM D 5453
Flash Point, °F, PM	130 min	ASTM D 93
Pour Point, °F	0 max	ASTM D 97
Cloud Point, °F	Report	ASTM D 2500
Viscosity at 40 °C, cSt	2.0 – 2.6	ASTM D 445
Carbon, wt %	Report	Chevron Phillips
Hydrogen, wt %	Report	ASTM D 3343
Net Heat of Combustion, Btu/lb	Report	ASTM D 3338
Particulate Matter, mg/L	15 max	ASTM D 2276
Cetane Index	Report	ASTM D 976
Cetane Number	47 - 49	ASTM D 613
SLBOCLE, g	3100 min	ASTM D 6078
Distillation, °F		ASTM D 86
Initial Boiling Point	Report	
5%	Report	
10%	Report	
50%	Report	
90%	560 – 630	
End Point	Report	
Hydrocarbon Type, vol %		ASTM D 1319
Aromatics	27 – 32	
Olefins	Report	
Saturates	Report	
SFC Aromatics, wt %	27 min	ASTM D 5186
Polynuclear Aromatics, wt %	Report	ASTM D 5186

Revised: 02/17/03

Notice: Since the conditions of handling and use are beyond our control, we make no guarantee of results, nor is any of the above information to be taken as a license to operate under, or recommendation to infringe upon, any patent. The information contained herein is, to the best of our knowledge and belief, accurate, but we assume no liability for damages or penalties resulting from use of or reliance on this information.

PRODUCT: Haltermann 2007 Certification Diesel

PRODUCT CODE: TR 732

TEST	METHOD	UNITS	SPECIFICATIONS			TYPICALS
			MIN	TARGET	MAX	
Distillation - IBP	ASTM D86	°F	340		400	396
5%		°F				417
10%		°F	400		460	424
20%		°F				433
30%		°F				445
40%		°F				460
50%		°F	470		540	478
60%		°F				496
70%		°F				516
80%		°F				540
90%		°F	560		630	571
95%		°F				595
Distillation - EP			°F	610		690
Recovery		vol %				98.4
Residue		vol %				1.6
Loss		vol %				0.0
Gravity	ASTM D4052	°API	32.0		37.0	33.4
Specific Gravity	ASTM D4052	kg/m ³	0.865		0.840	0.858
Flash Point	ASTM D93	°F	130			180
Viscosity, 40°C	ASTM D445	cSt	2.0		3.2	2.3
Sulfur	ASTM D5453	ppm	7		15	12
Composition, aromatics	ASTM D1319	vol %	27			28.8
Composition, olefins	ASTM D1319	vol %				1.2
Composition, saturates	ASTM D1319	vol %				70
Cetane Number	ASTM D613		40.0		50.0	44.3
Cetane Index	ASTM D976		40.0		50.0	40.2