Message

Sent: 3/7/2019 2:50:25 PM
To: taylor.clark@volvo.com
Subject: RE: Part 86 In-Use Testing Question

Taylor;

Thanks for agreeing to further discuss this issue on the 19th. It is quite possible I have erred in my interpretation of Volvo's data processing.
I know that Volvo, EPA and ARB need to come to some conclusions so that Volvo may have certainty in its current and future HD IUT activities.

I first want to bounce my summary of the exchange between you and James last April (below).

Note that the exchange, clarified explicitly by James, is solely in the context of 86.1370 (g) and (h), not 1370 (f). James states that in the context of those two provisions, "A manufacturer can choose to include or exclude any invalid NTE event during a test."

He also explicitly (twice) expresses that the luxury of choosing (whether or not to exclude) is **not** available for the language of 86.1370 (f)

In other words, there is no flexibility on whether or not exclusions based on .1370 (f) may be utilized by a manufacturer (the manufacturer may not choose).

Also, I want to discuss the language of 86.1370 (d), which we have not had the opportunity to discuss, but which is significant in the ongoing conversation.
A significant issue of the ongoing discussion is that Volvo is, in my opinion (having assessed processed data) choosing to both "include" and "exclude" data *within a single NTE event*. I refer to this as "subdividing" a single event (though that is my own term, with no definition in the CFR).

I present this in the context of a hypothetical 300 second NTE event and applications of 86.1370 (g) exclusions. Consider a single event in which the engine is in the NTE zone for a continuous 300 seconds. EPA treats this as one event. In the context of 1370 (g) and 1370 (h), a manufacturer may include or exclude that single event in the calculation of its pass ratio. It appears to me that Volvo is choosing to subdivide that single event into a number of shorter duration events and then include or exclude the shorter duration events in order to maximize the calculated pass ratio for the test.

I also have come to the conclusion that this practice was not Volvo protocol in the past, but became so with the test order being discussed. Volvo is unique in this interpretation, with no other precedent of this interpretation in the HD IUT program.

If I am mistaken and this is not what Volvo is doing, please explain so that I may better understand.

Best regards,

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:29 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

No I meant (h). Paragraph (h) covers the other exclusion criteria not covered in paragraph (g).

(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Thursday, April 19, 2018 9:25 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

Thanks for getting back to me. Did you mean paragraph (f)?

BR,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:11 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
Yes, paragraph (h) covers the rest of the NTE exclusion criteria and allows you to include those points in your vehicle-pass ratio determination.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM

To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

One more question for you just for completeness. Would the same logic apply to paragraph (f), which is the IMT/IMP exclusion?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology

13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036

Email: taylor.clark@volvo.com

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Appointment

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 11/29/2018 6:44:32 PM
To: Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; taylor.clark@volvo.com; karl.tasik@volvo.com

Subject: Volvo's in-use testing results for 2017 Test Order
Location: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Start: 12/6/2018 8:00:00 PM
End: 12/6/2018 9:30:00 PM
Show Time As: Tentative

Conference Call Information:

Conf. Number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

Appointment

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 3/4/2019 2:51:27 PM
To: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]; Duncan, Allen [duncan.allen@epa.gov]

Subject: RE: Heavy Duty In-Use Testing Data Processing
Location: Jonathan will call Allen at 734 214 4815

Start: 3/5/2019 8:00:00 PM
End: 3/5/2019 8:30:00 PM
Show Time As: Tentative

Recurrence: (none)

---
athan S.
arch 04, 2019 9:49 AM
en'
eavy Duty In-Use Testing Data Processing

Thanks, Allen. Let's aim for tomorrow at 3:00 pm. Then if we need to get others on the phone from Volvo and on your end perhaps we can do that on Thursday at 1:00 pm or on Friday. I'll send you a calendar invitation for tomorrow.

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Monday, March 04, 2019 8:23 AM
To: Martel, Jonathan S.
Subject: RE: Heavy Duty In-Use Testing Data Processing

Jonathan;

Tuesday or Wednesday at 3:00

Thursday at 1:00

Friday is wide open.

Any of those work for you?

Best regards,

Allen

From: Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com>
Sent: Friday, March 1, 2019 3:55 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: Heavy Duty In-Use Testing Data Processing

Allen –

I just left you a voice mail. When we last spoke, I said I would get back to you regarding 40 CFR 86.1370(f), (g) and (h). Can you please let me know when you might have time to speak? Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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Appointment

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 11/29/2018 6:44:35 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; taylor.clark@volvo.com; karl.tasik@volvo.com

Subject: Volvo's in-use testing results for 2017 Test Order
Location: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Start: 12/6/2018 8:00:00 PM
End: 12/6/2018 9:30:00 PM
Show Time As: Busy

→ Join Skype Meeting

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Conference Call Information:

Conf. Number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

Appointment

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 10/16/2018 6:42:30 PM
To: Tasik Karl [karl.tasik@volvo.com]; Clever Timothy [tim.clever@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]

Subject: EPA-Volvo In-Use Test Data Submittal Phone Call
Location: Skype Meeting

Start: 10/22/2018 7:00:00 PM
End: 10/22/2018 8:00:00 PM
Show Time As: Busy

Recurrence: (none)

This is a phone conference to discuss EPA questions relative the Volvo In-Use Test Data Submittal

Call-In Number: Ex. 6 - Personal Privacy
Conference ID: Ex. 6 - Personal Privacy

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: Ex. 6 - Personal Privacy
E-mail: karl.tasik@volvo.com

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EPA-Volvo Phone Call In-Use Test Data Submittal

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Appointment

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/16/2018 6:30:09 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; abraham.lee@arb.ca.gov

Subject: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal
Location: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Start: 10/22/2018 7:00:00 PM
End: 10/22/2018 8:00:00 PM
Show Time As: Busy

Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 3/14/2019 3:18:40 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Duncan, Allen [duncan.allen@epa.gov]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: Discussions with Volvo and for Volvo on next Tue (3/19)
Attachments: CRC_Presentation March 2019_Final.pdf

Hi Abraham,

Per your request, please find attached a copy of Allen's presentation at the 29th CRC Workshop, also, I will send you invitation to all the meetings between Volvo and EPA. If you have any questions, or need any additional information, please feel free to contact me at any time.

Regards,
FJ Hamady

From: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Sent: Thursday, March 14, 2019 10:56 AM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Duncan, Allen <duncan.allen@epa.gov>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>
Subject: Discussions with Volvo and for Volvo on next Tue (3/19)

Hello Fakhri,

As you may know, on last Tue (3/12), I listened Allen's presentation as well as I gave my presentation. It was really great and actually surprising that both presentations were aligned very well, which Allen pointed out several times during his presentation. I attached my presentation, fyi. Also, if you could share the presentation Allen gave, it will be much appreciated.

When I talked with Allen, he mentioned about a meeting with Volvo on next Tue (3/19) and invited us for the meeting. Also, he mentioned a possible meetings between EPA and CARB before and after the meeting with all 3 parties, EPA, Volvo, and CARB.

Could you send me the meeting invitation(s)? Then, I will invite people necessary for the discussion(s).

Thank you!

Sincerely,
Abraham

A Comprehensive Study of Manufacturers In-Use Testing Data Collected from Heavy-Duty Diesel Engines Using Portable Emissions Measurement System (PEMS)

29th CRC Real World Emissions Workshop
Long Beach, California
March 10 -13, 2019

Authors: Fakhri Hamady, Allen Duncan
Presented by: Allen Duncan
Office of Transportation and Air Quality
U.S. EPA

United States Environmental Protection Agency

Overview

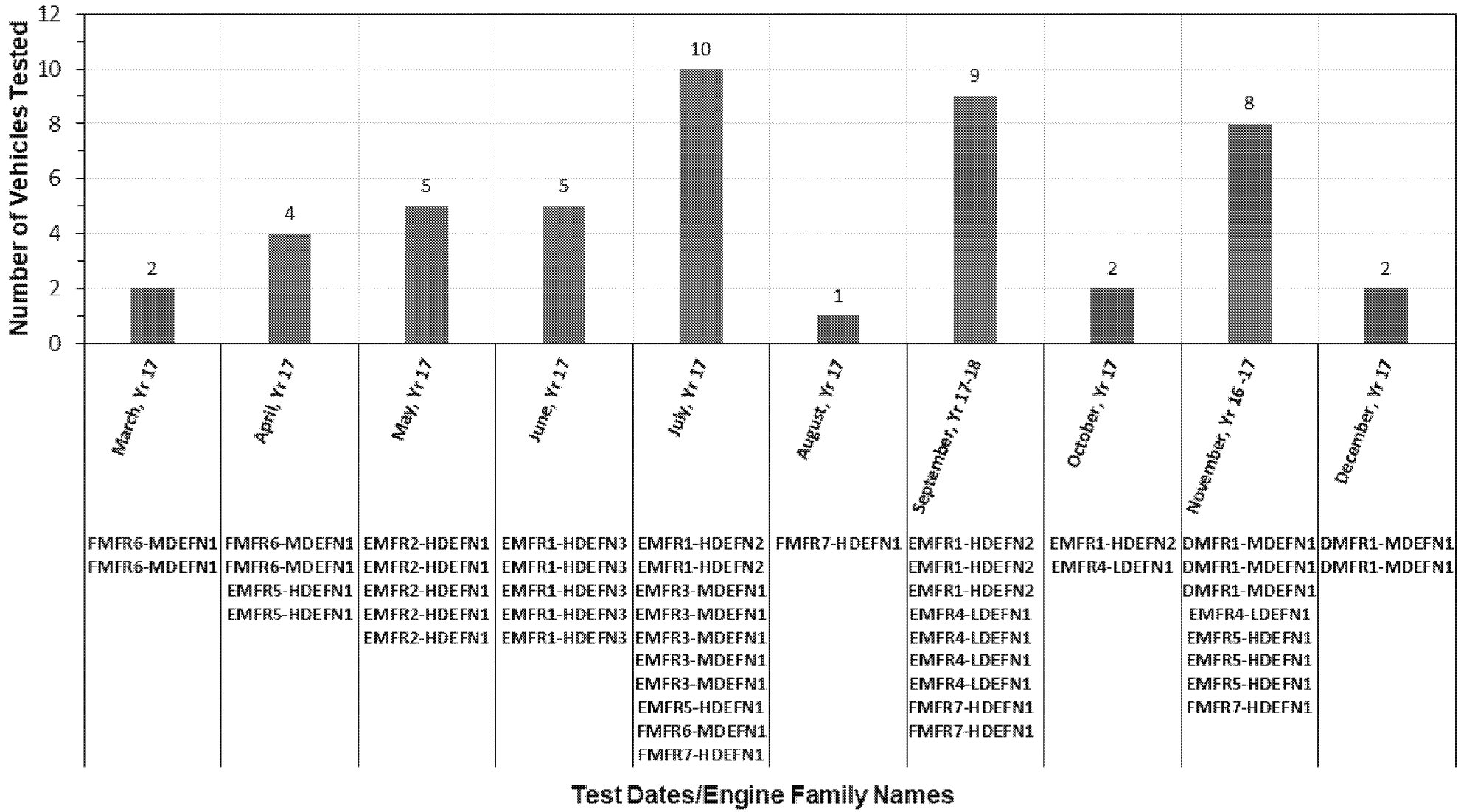
- Manufacturer-Run In-Use Testing Program - Established in 2005
  - Manufacturers (MFRs) Test Order Selection of Engine Families
  - How Does This Program Work?
- In-Use Data Processing and Statistical Analyses to Determine:
  - Vehicle Testing Dates
  - Not-To-Exceed (NTE) Control Area
  - Vehicle Operation
  - Valid NTE Events, and Vehicle-Pass Ratio
  - Overall Average Emissions
  - Heavy-Duty In-Use Testing Details
- Data Summary
- Conclusions and Recommendations
- APPENDIX

Manufacturer-Run In-Use Testing Program

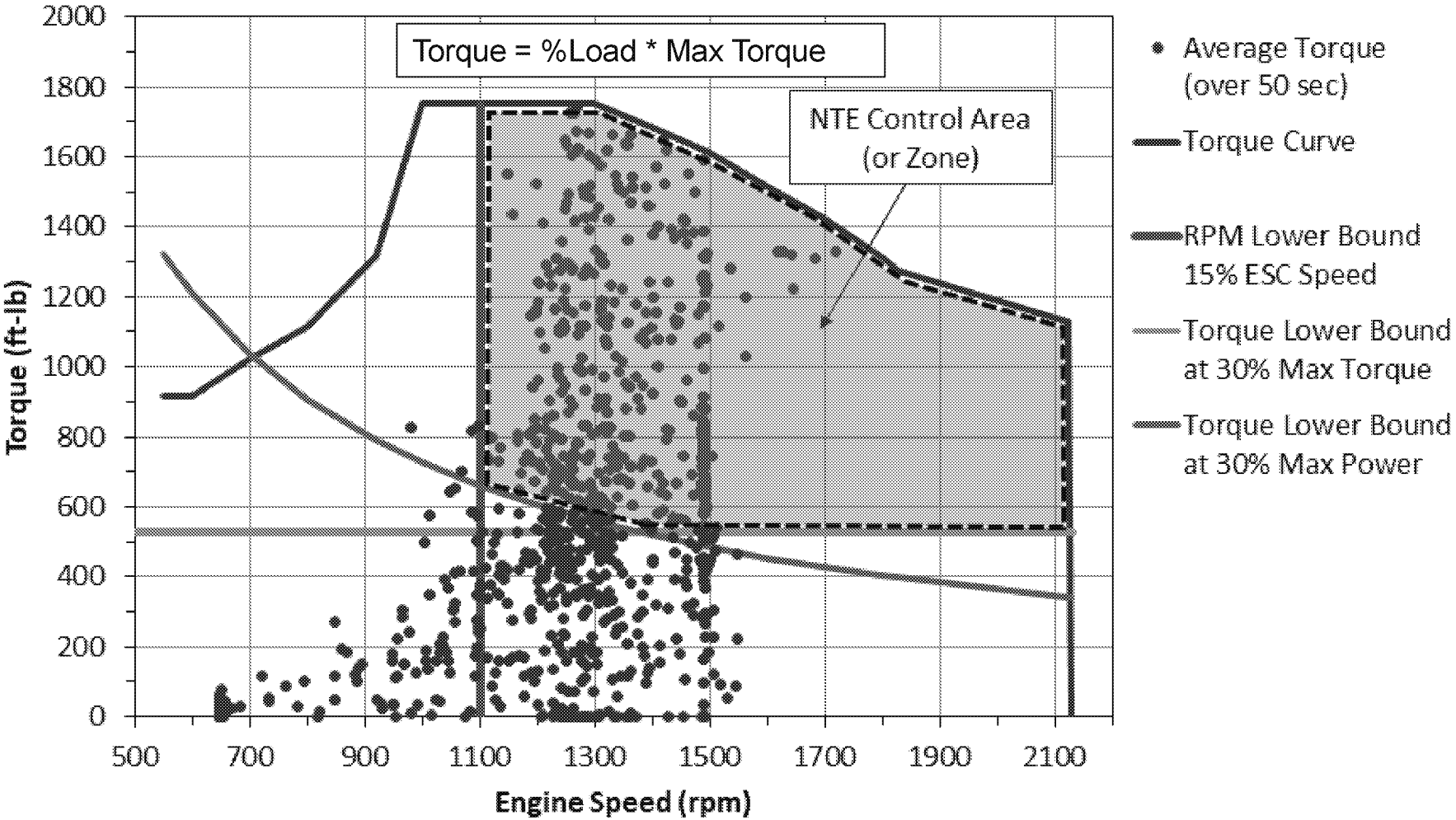
Manufacturers Test Order Selection of Engine Families

- Over any four-year period, EPA will not select more than the average number of engine families that manufacturers have certified over that four-year period. Manufacturers are notified in writing by June 30 of the applicable calendar year about the Test Order, and have 18 months to complete their testing and report results to EPA.
- Selection of engine families is a cooperative effort between EPA and CARB staff, and it's based on information collected from engine certification data, compliance reports, previous in-use testing, and defect and recall reports, etc..
- How does this program work? 40 CFR part 86, Subpart T, provides detailed on manufacturer run in-use testing program.

Vehicle, Engine Family and Testing Dates for Manufacturers 2016 Test Order



NTE Control Area - Engine Family Name: EMFR1-HDEFN3, Vocational Truck



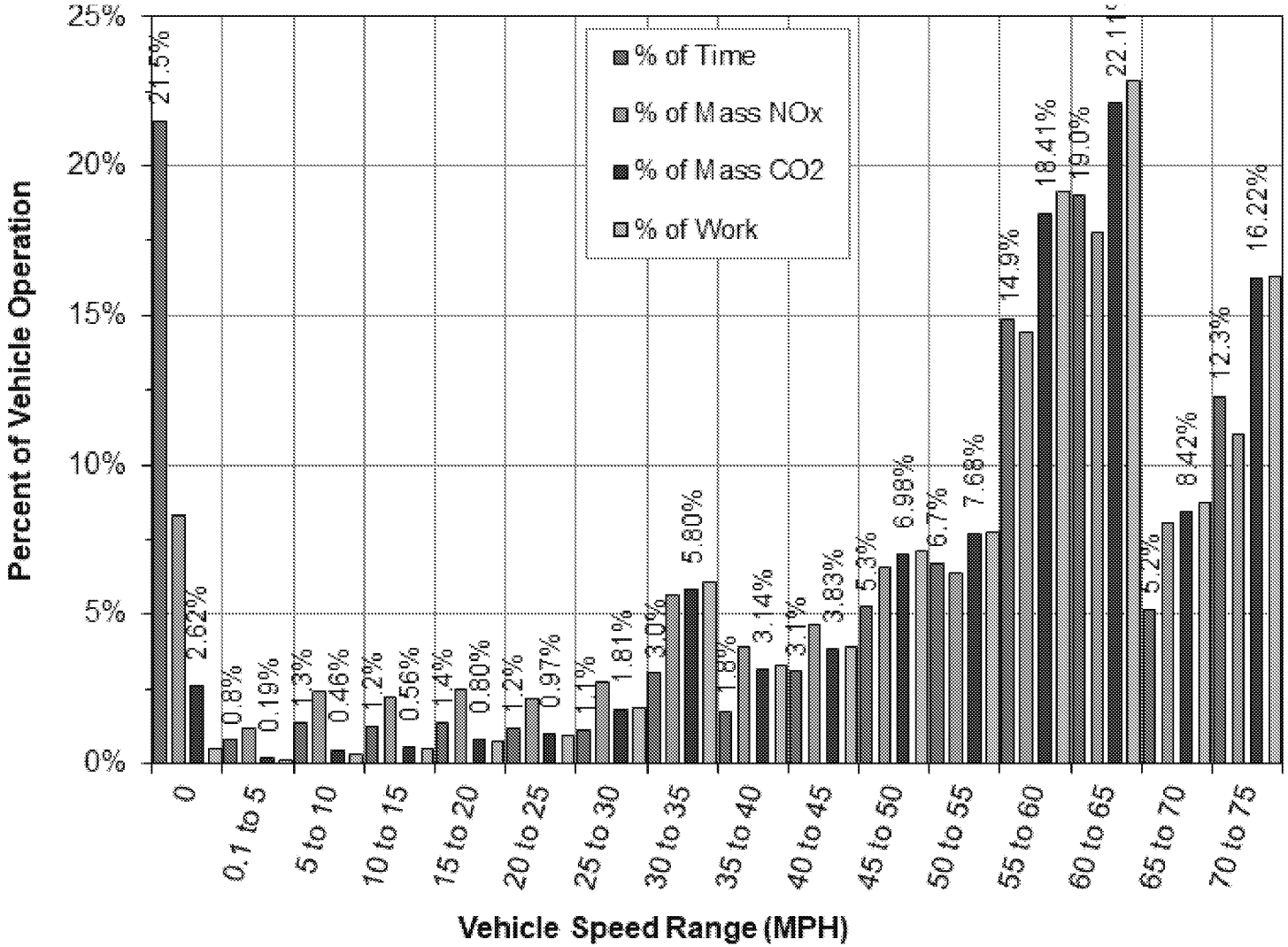
Valid NTE event duration is at least 30 seconds of vehicle continuous operation in the NTE zone with all exclusion set in the current regulation are applied

Each Vehicle has a Distinctive Operation Profile – Engine Family Name: EMFR1-HDEFN3, Vocational Truck

- Test Time = 13 hr.
- Mass NO_X = 340 g
- Mass of CO_2 = 873917 g
- Diesel Fuel = 85.85 gallons
- Work = 1727 hp-hr

For 0 - 50 MPH:

- Mass of NO_X is about 42%
- Mass of CO_2 is about 27%
- Work is about 25%



Valid NTE Events and Vehicle-Pass Ratio - Engine Family Name: EMFR1-HDEFN3, Vocational Truck

- Calculated and MFR reported Vehicle-Pass Ratios with all exclusions applied as set in the current EPA regulation.
- Percent of emissions, work and diesel fuel inside and outside the NTE control area.

Pass Ratios NTEE Min. Time = 30 sec and at 30% Max. Power	Macro Calculated	MFR/XML Reported
NMHC Pass Ratio:	1.00	1.00
CO Pass Ratio:	1.00	1.00
NOx Pass Ratio:	**1.00**	**1.00**
NOx & NMHC Pass Ratio:	N/A	N/A
PM pass ratio:	1.00	1.00
# of NTE Events:	**37**	**38**

Emissions Summary NTEE Min. Time = 30 sec, at 30% Max. Power	Total Emissions (g)							Total Work (hp-hr)	Gallon of Diesel Fuel
	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work	Fuel
Total Throughout Test:	47,471	100.0%	340.33	5.90	626.85	873,916.64	2.45	1,727.03	85.85
	Percent of Total Emissions and Work								
Percent of:	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work	Fuel
Total outside of "Basic" NTE Control Area:	30,080	63.4%	27.3%	64.9%	36.2%	20.6%	63.8%	15.3%	17.65
Total in "Basic" NTE Control Area (w/o exclusions):	17,391	36.6%	72.7%	35.1%	63.8%	79.4%	36.2%	84.7%	68.20
Exclusion 6 (Deficiency):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 7 (EMD/OBD):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 8 (EGR/Cold Temp Operation):	11,563	24.4%	50.9%	18.7%	39.3%	50.3%	17.1%	53.7%	43.15
Exclusion 9 (Aftertreatment/Low Temp Operation):	2,522	5.3%	24.6%	16.8%	8.3%	9.6%	1.7%	10.2%	8.22
Exclusion 10 (Altitude/Amb Temp):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 11 (Zero Check):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total in NTE Control Area (w/ exclusions applied):	5,270	11.1%	13.4%	4.2%	22.5%	26.9%	17.9%	28.6%	23.10
Total in NTE Control Area with LTR flag:	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total in "Basic" NTE w/o excl with Regen flag:	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total of Valid NTE Events in NTE Control Area:	2,431	5.1%	7.3%	0.7%	10.8%	14.4%	10.3%	15.3%	12.40

Valid NTE Events and Vehicle-Pass Ratio - Engine Family Name: EMFR1-HDEFN3, Vocational Truck

Effect of EGR Cold Temperature (Exclusion) on Valid NTE Events (Turning "off" the EGR Cold Temperature Exclusion):

- EGR cold temperature operation is defined as engine meeting either of the following:
  - Intake Manifold Temp IMT (°F) ≤ IMT defined in ***IMP (bars) = 0.0875 x IMT - 7.75***, or
  - Engine Coolant Temp ECT (°F) ≤ ECT defined in ***IMP (bars) = 0.0778 x ECT – 9.8889***

Pass Ratios - No EGR/Cold Temp Operation NTEE Min. Time = 30 sec and at 30% Max. Power	Macro Calculated	MFR/XML Reported
NMHC Pass Ratio:	1.00	1.00
CO Pass Ratio:	1.00	1.00
NOx Pass Ratio:	**0.98**	**1.00**
NOx & NMHC Pass Ratio:	N/A	N/A
PM pass ratio:	1.00	1.00
# of NTE Events:	**152**	**38**

Emissions Summary - No EGR/Cold Temp Operation NTEE Min. Time = 30 sec and at 30% Max. Power	Total Emissions (g)							Total Work (hp-hr)	Gallon of Diesel Fuel
	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work	Fuel
Total Throughout Test:	47,471	100.0%	340.33	5.90	626.85	873,916.64	2.45	1,727.03	85.85
	Percent of Total Emissions, Work and Diesel Fuel								
Percent of:	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work	
Total outside of "Basic" NTE Control Area:	30,080	63.4%	27.3%	64.9%	36.2%	20.6%	63.8%	15.3%	17.65
Total in "Basic" NTE Control Area (w/o exclusions):	17,391	36.6%	72.7%	35.1%	63.8%	79.4%	36.2%	84.7%	68.20
Exclusion 6 (Deficiency):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 7 (EMD/OBD):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 8 (EGR/Cold Temp Operation):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 9 (Aftertreatment/Low Temp Operation):	2,522	5.3%	24.6%	16.8%	8.3%	9.6%	1.7%	10.2%	8.22
Exclusion 10 (Altitude/Amb Temp):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Exclusion 11 (Zero Check):	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total in NTE Control Area (w/o exclusions applied):	14,869	31.3%	48.1%	18.3%	55.5%	69.9%	34.5%	74.5%	59.98
Total in NTE Control Area with LTR flag:	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total in "Basic" NTE w/o excl with Regen flag:	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Total of Valid NTE Events in NTE Control Area:	8,825	18.6%	31.5%	8.7%	33.5%	45.8%	23.9%	48.8%	39.28

Vehicle In-Use Test Information - Engine Family Name: EMFR1-HDEFN3, Vocational Truck

Vehicle Test Information and Average Emission Results	
Test Date = June 6, 2017	Average Valid NTEE NOx = 0.09 g/bhp-hr
Vocaltional Truck Engine Family Name = EMFR1-HDEFN3	Average NOx = 0.19 g/bhp-hr
Test Identification Code = 191	Average NOx (non-idle) = 0.17 g/bhp-hr
Start Odometer = 361511 mi	Average NOx outside NTE = 0.20 g/bhp-hr
End Odometer = 362102 mi	Average Cold NOx = 1.79 g/bhp-hr
Covered Mileage = 591 mi	Average Idle NOx = 19.5 g/hr
Shift Day Testing = 13.19 hr	Total Mass NO_X= 340.33 g
Ambient Temp Range = 53.8 to 82.4 °F	Total Work = 1727 hp-hr
Average Ambient Temp = 65.93 °F	Gallon of Diesel Fuel = 85.85 gallons

MFR Reported Standard/FEL, Multiplier, Accuracy Margin, and NTE Threshold	NOx	NMHC	CO	NOx+NMHC	PM
Standard/FEL	0.31	0.14	15.5	N/A	0.01
Multiplier	1.5	1.5	1.25	N/A	1.5
In use Margin	N/A	N/A	N/A	N/A	N/A
Accuracy Margin	0.15	0.01	0.15	N/A	0.01
Threshold(g/bhp-hr)	0.62	0.22	19.5	N/A	0.03

In-Use Testing Data Statistics – Average Values Calculated from Tested Vehicles

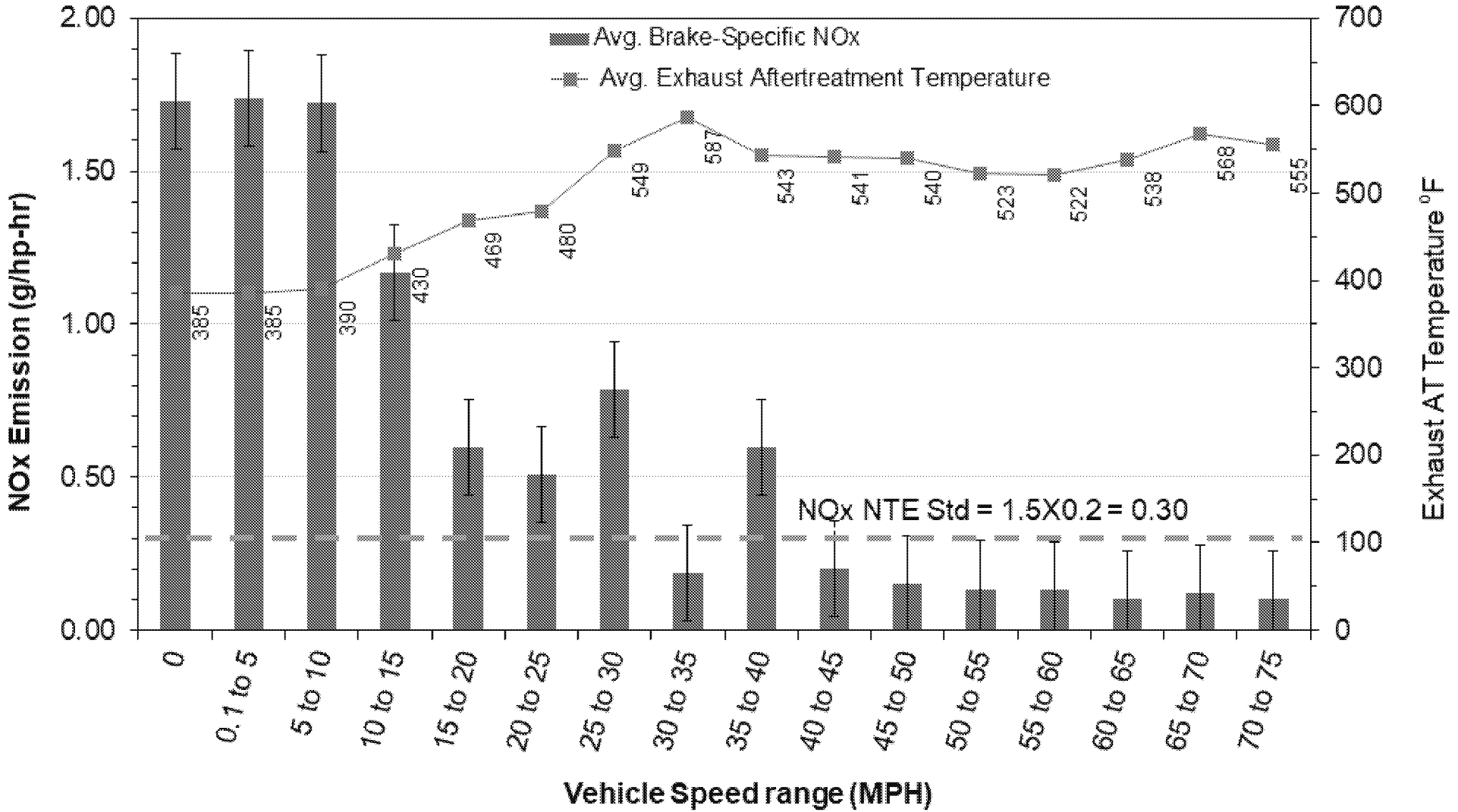
Summary Staistics	Calculated Values
Average Pass Ratio (NOx)	0.98
Max Pass Ratio (NOx)	1
Min Pass Ratio (NOx)	0.84
Number of Vehicles Failed in 2016 Test order	2
Average NOx of Valid NTE Events (g/bhp-hr)	0.10
Average NOx (g/bhp-hr)	0.44
Average NOx Outside NTE Control Zone (g/bhp-hr)	0.66
Average Cold NOx (g/bhp-hr)	2.52
Average NOx (g/mile)	1.04
Total Mass NOx per Test Day (g)	10024
Average Test Duration (hr)	8
Average Covered Mileage (mile)	303
Total Mileage (mile)	13328
Percent **Time and Work** Outside NTE Zone	**67% and 24%**
Percent **Time and Work** in NTE Zone w/o Exclusions	**33% and 76%**
Percent **Time and Work** in NTE Zone w/ Exclusions	**17% and 39%**
Percent **Time and Work** of Valid NTE Events in NTE Zone	**7% and 16%**

Overall NTE NOx Emission and Average Mass NO_X Per Shift Day Calculated from Tested Vehicles

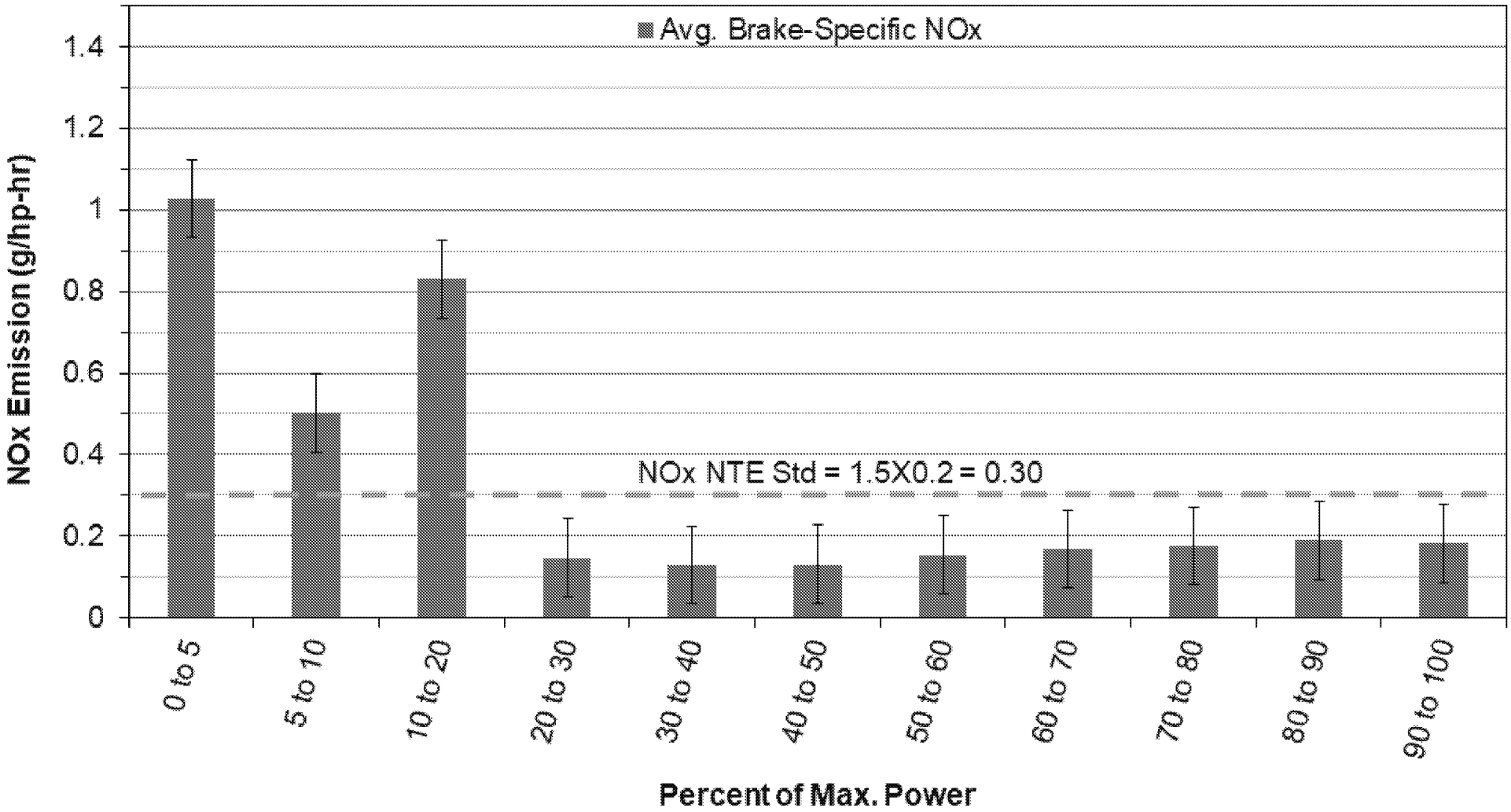
- Average NO_X emissions from valid NTE sampling events are lower than the Standard/FEL NO_X
- Average cold NO_X is always higher than the NTE NO_X

MFR Name	MFR Engine Family	Production Volume for Corresponding	Average Mass NOx per Shift Day	Estimated NOx Production per Shift Day	Standard/ FEL NO_X	Average NO_X	Average NO_X of Valid NTEE	Average NO_X Outside NTE Zone	Average NOx (Non-Idle)	Average NO_X (Idle)	Average Cold NO_X	Distance Specific NO_X
			(g)	(Metric ton)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/hr)	(g/bhp-hr)	(g/mile)
Manufacturer 1 MY2013	DMFR1-MDEFN1	45973	120.52	5.54	**0.20**	**0.67**	**0.13**	0.88	0.59	7.07	1.82	2.28
Manufacturer 1 MY2014	EMFR1-HDEFN2	3178	232.54	0.74	**0.20**	**0.28**	**0.12**	0.59	0.1	43.73	3.87	0.85
Manufacturer 1 MY2014	EMFR1-HDEFN3	42329	450.61	19.07	**0.31**	**0.38**	**0.07**	0.41	0.34	16.67	1.69	1.02
Manufacturer 2 MY2014	EMFR2-HDEFN1	32279	132.23	4.27	**0.20**	**0.25**	**0.04**	0.29	0.12	23	2.81	0.57
Manufacturer 3 MY2014	EMFR3-MDEFN1	2911	104.06	0.30	**0.20**	**0.31**	**0.08**	0.57	0.26	38.81	1.47	0.5
Manufacturer 4 MY2014	EMFR4-LDEFN1	12071	109.23	1.32	**0.20**	**0.56**	**0.2**	0.48	0.34	37.34	2.02	0.52
Manufacturer 5 MY2014	EMFR5-HDEFN1	34196	368.17	12.59	**0.20**	**0.38**	**0.12**	0.54	0.3	73.61	4.05	1.17
Manufacturer 6 MY2015	FMFR6-MDEFN1	7744	110.03	0.85	**0.50**	**0.53**	**0.08**	0.63	0.34	19.31	1.72	0.67
Manufacturer 7 MY2015	FMFR7-HDEFN1	4081	322.82	1.32	**0.20**	**0.61**	**0.02**	1.55	0.13	30.13	3.25	1.78

Urban Brake-Specific NOx Emissions are About 3-5 X NTE Standard – Engine Family Name: EMFR1-HDEFN3, Vocational Truck

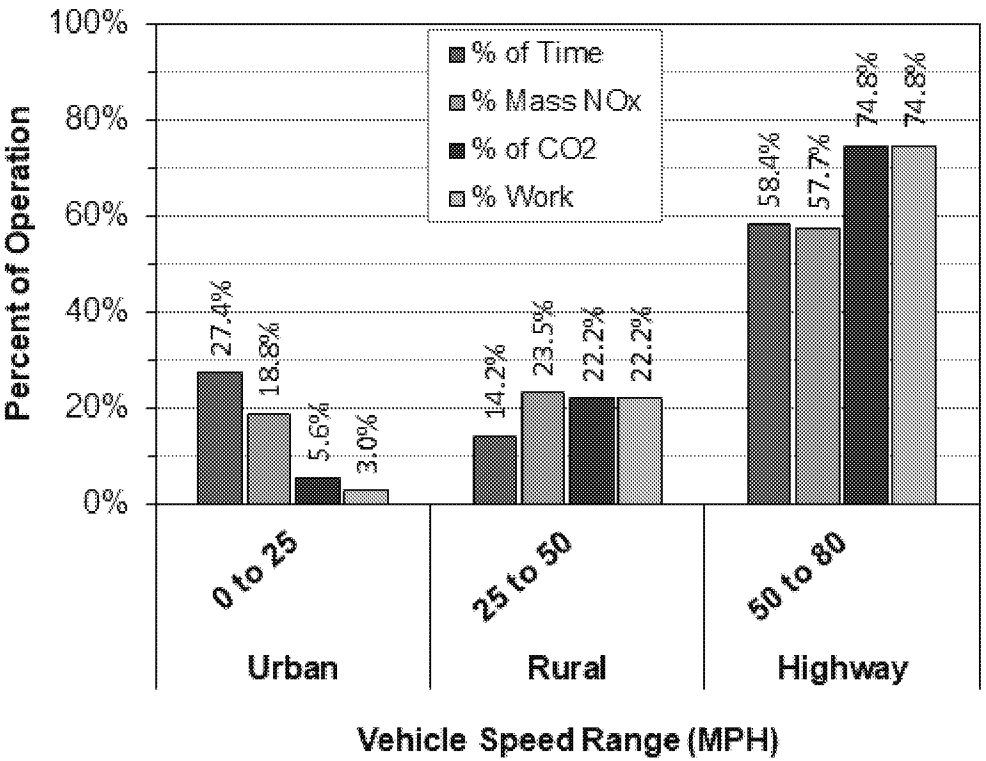


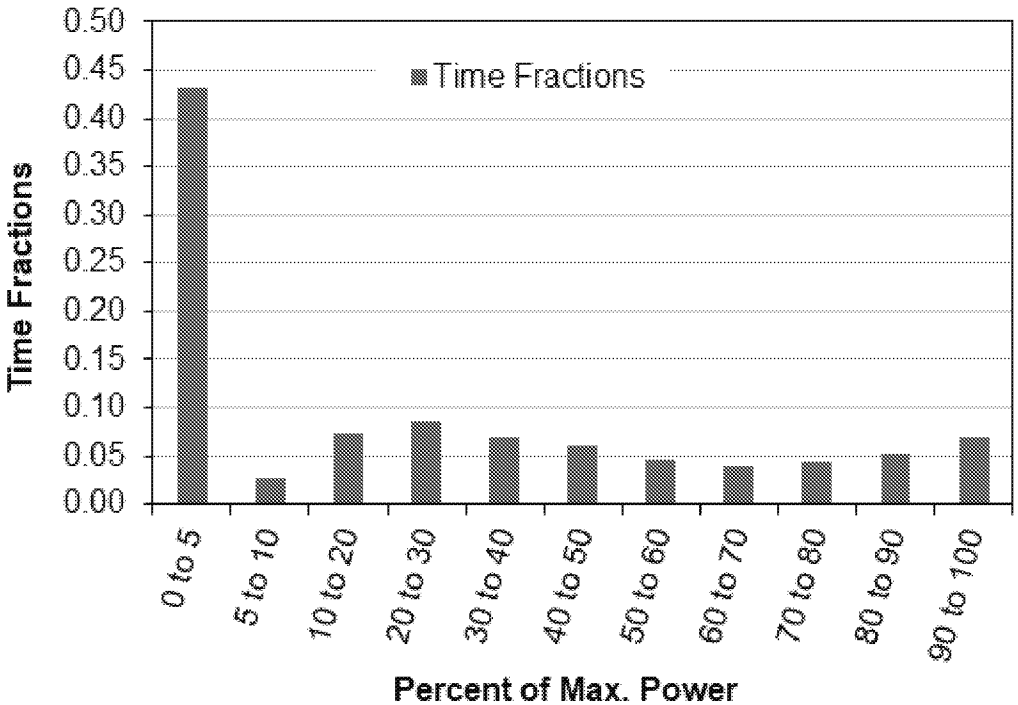
Average Brake-Specific NOx Emissions Increase at Lower Power Especially below 30% of Max Power - Engine Family Name: EMFR1-HDEFN3, Vocational Truck



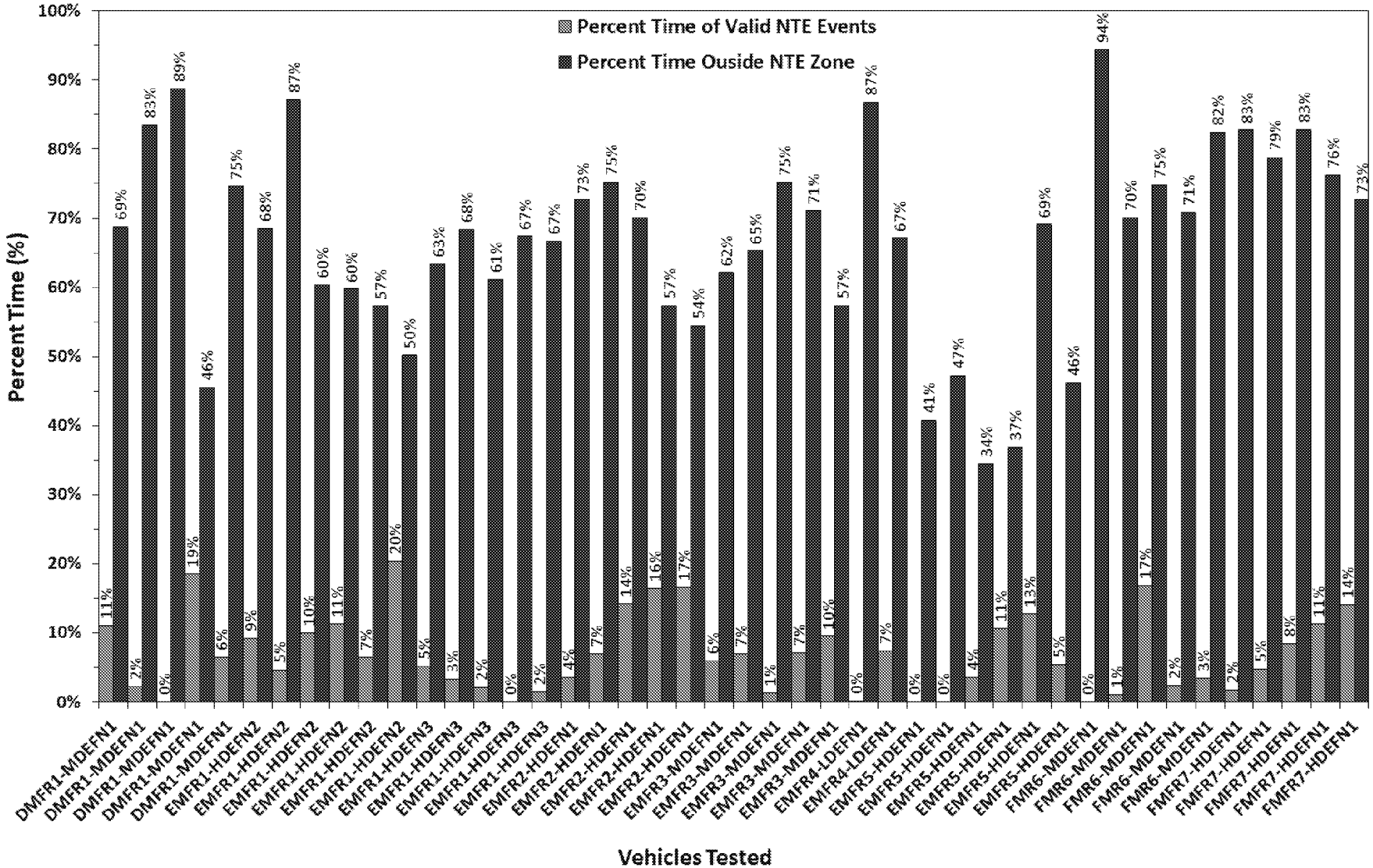
Percent of Time Spent in Urban Driving and Idling - Engine Family Name: EMFR1-HDEFN3, Vocational Truck

- Urban + rural driving represent over 40% of the HD NOx emissions time from vehicles
- In real driving low speed and idling are major part of the duty cycles even for line haul and delivery vehicles





Percent Time of In-Use Testing in the Valid NTE Zone vs. Outside NTE Zone



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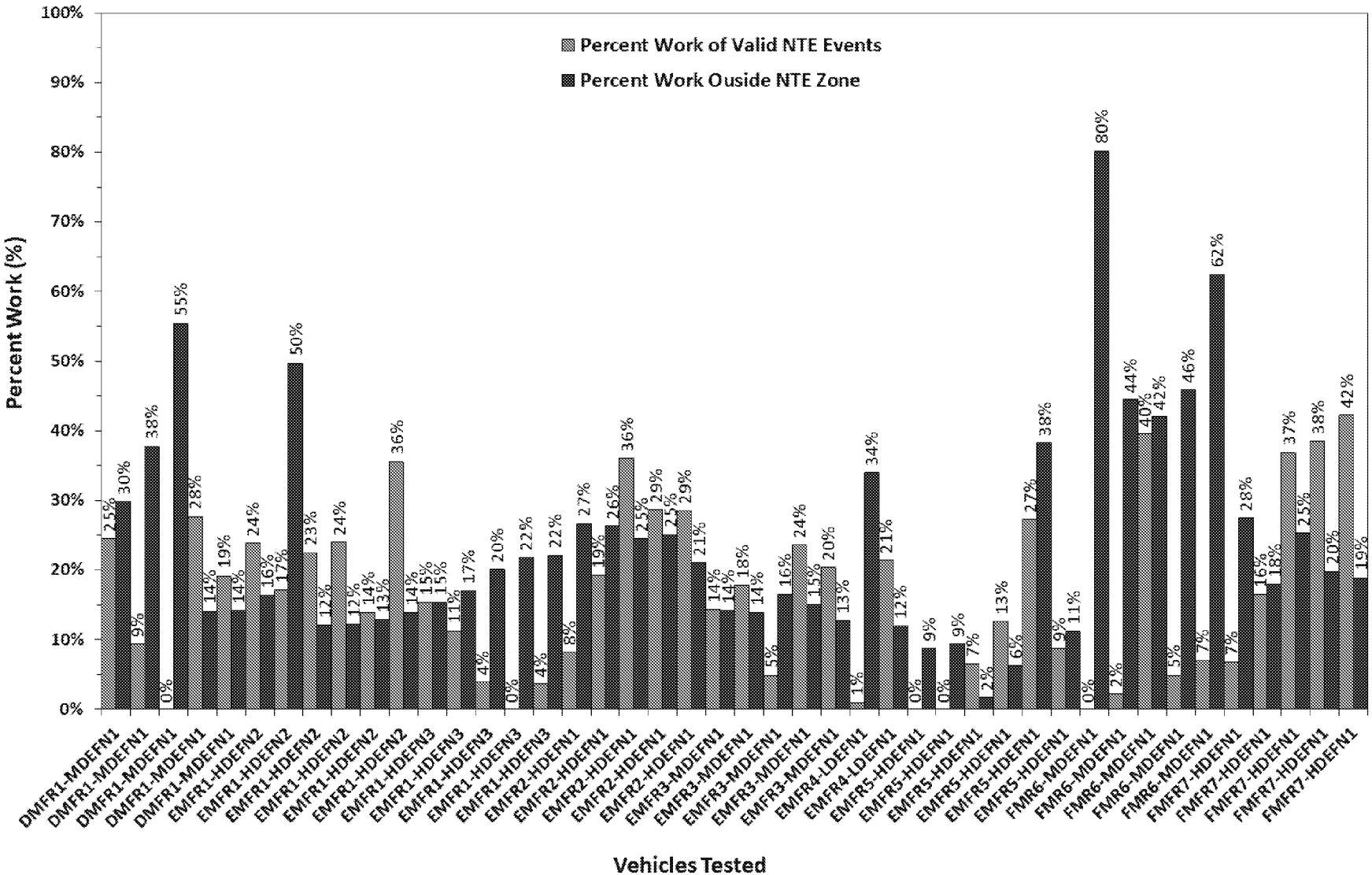
Heavy-Duty In-Use Testing Details

Percent Work of In-Use Testing in the Valid NTE Zone vs. Outside NTE Zone



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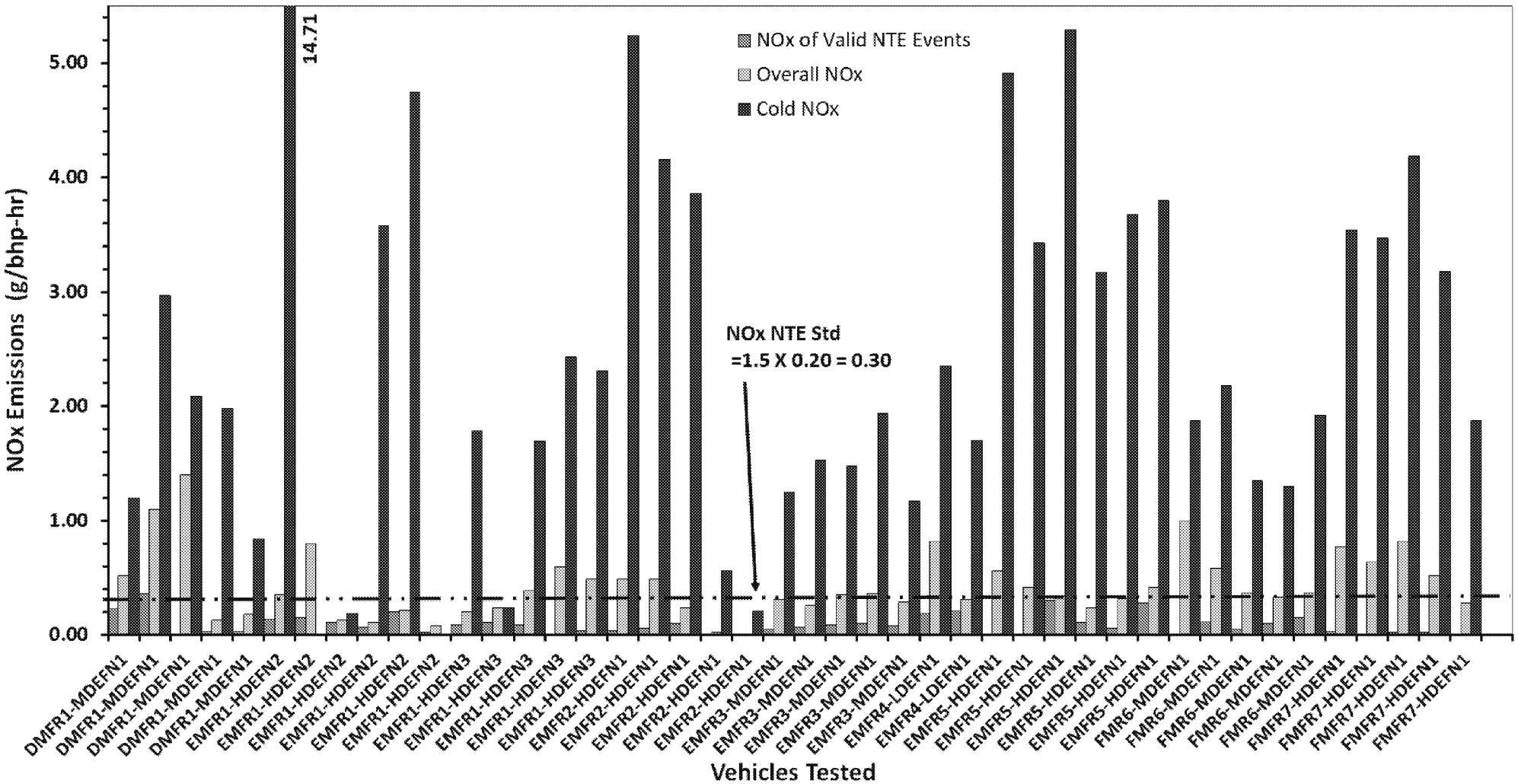
Heavy-Duty In-Use Testing Details

Average NOx Emissions of Valid NTE Events vs. Overall NOx and Cold NOx Emissions



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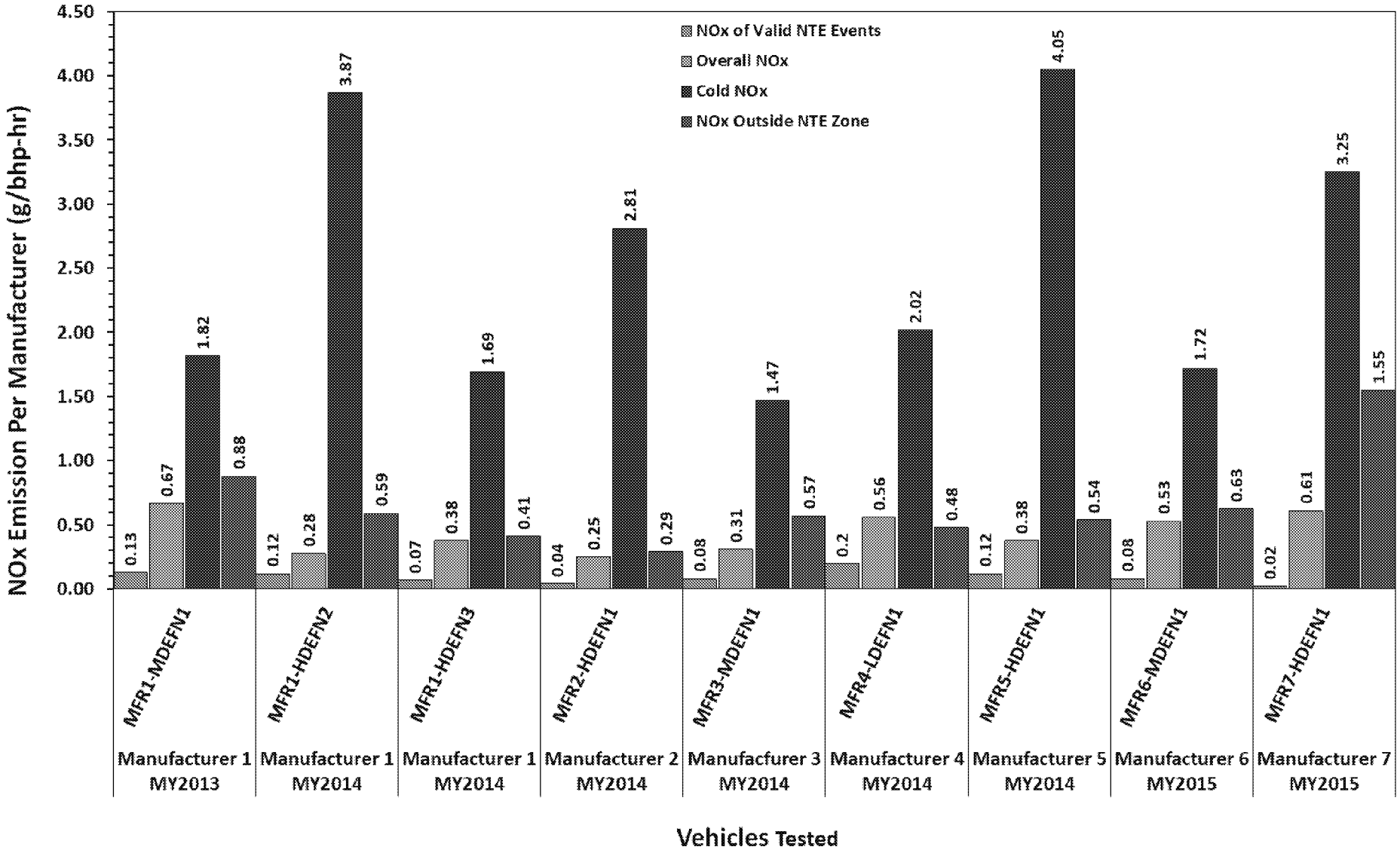
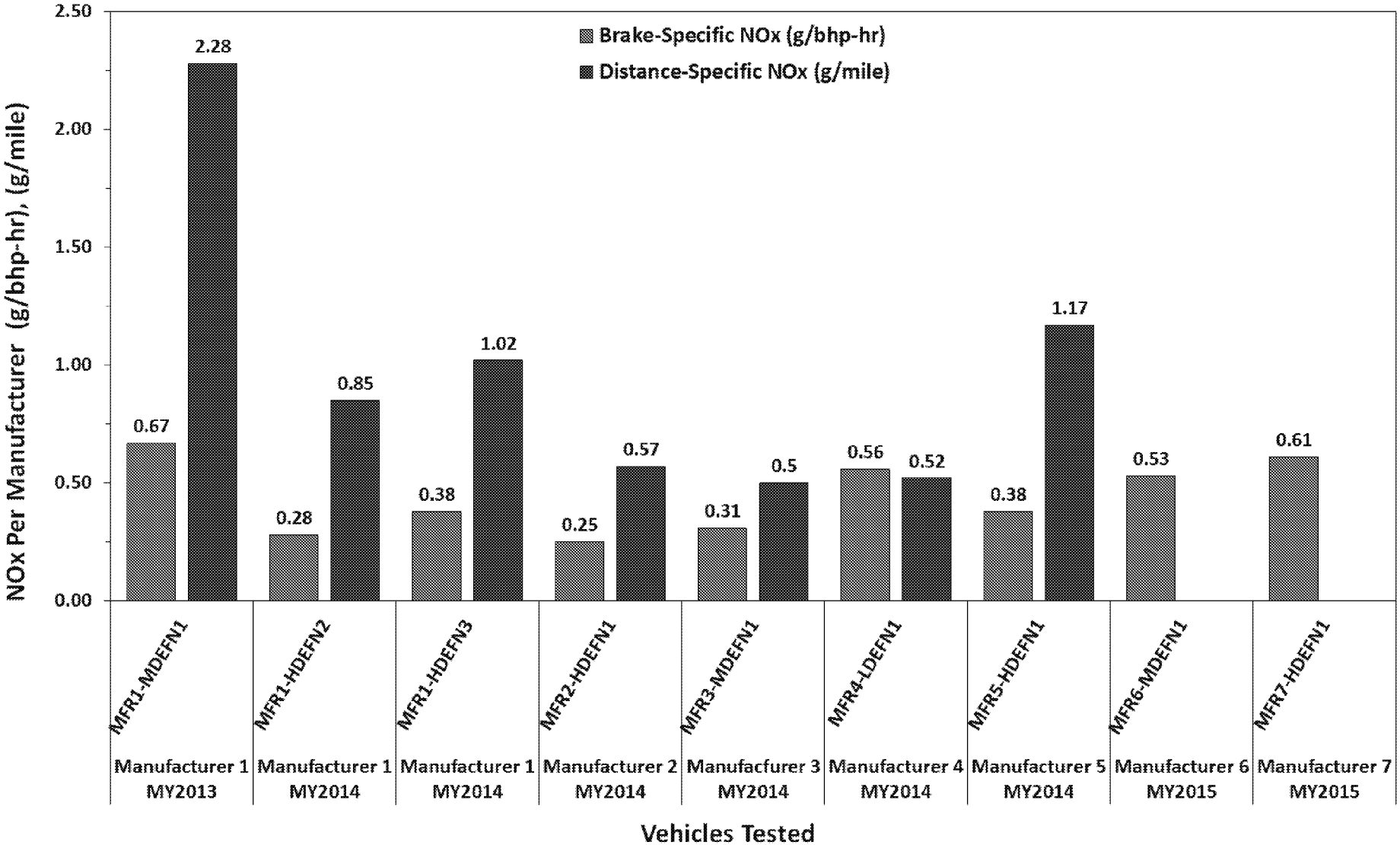
Heavy-Duty In-Use Testing Details

Average Brake-Specific NOx Emissions per Engine Family



Average Brake-Specific vs. Distance Specific NOx Emissions per Engine Family



Summary of Data Submitted for 2012 – 2016 Test Orders

- Overall average vehicle pass ratios submitted since 2012.
  - NOx = 0.97
  - PM = 0.99
  - CO= 1.0

- Percentage of tests meeting or exceeding the 0.90 vehicle-pass ratio threshold since 2012.
  - NO_x = 94%
  - PM = 100%
  - CO = 100%

- Estimated total mileage covered is greater than 200,000 miles.

- Manufacturer-Run In-Use Testing Program Data for Heavy-Duty Diesel Engines from 2009 – 2015 are posted on the EPA website. The data are organized by test order year and have been redacted for Confidential Business Information (CBI). Use the link below to visit the website.

  https://www.epa.gov/compliance-and-fuel-economy-data/manufacturer-run-use-testing-program-data-heavy-duty-diesel-3

Conclusions and Recommendations

- Manufacturers in-use testing is important to ensure on-highway heavy duty diesel engines are in compliance with NTE standards and test procedures.
- Engine selection for in-use testing program forced several manufacturers to initiate voluntary recalls due to defects in the after-treatment system and emission control devices.
- In-use emissions testing can positively influencing air quality by ensuring that manufacturers implement emissions control technologies to achieve emissions reduction under real driving conditions including low speeds and loads.
- Recognizing the difference between type-approval engine emissions and in-use emissions results, adding low load data would more realistically reflect real world operation.
- In addition, data may more realistically reflect real world emissions if NTE Zone(s) boundaries are modified to include:
  - Lower percentage of max. power (e.g., 20%, 10%, etc…), and
  - Cold intake manifold (i.e., removal of exclusion 8).
  - Introduce new NTE multipliers.
- Cold-start and idle NOx emissions, almost without exception exceed the NTE emission limits.

APPENDIX

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2024 EMA Proposed NTE In-Use Testing

EMA Proposal for In-Use Testing Nationwide not Just California (JB, 10/26/2018)				
Standards are in g/bhp-hr	**2024**			**2027 +**
Composite-FTP	0.15			Approximate 50% reduction in real-world in-use NOx
Steady State RMC	0.15			New Paradigm potentially utilizing NOx sensors (depending on sensor development and durability) and telematics to assess aggregate in-use engine family performance
In-Use Program	**NTE Standard: 0.22** (0.15 g/bhp-hr x 1.5)? Increased coverage of in-use operations via expanded NTE parameters:			
		Current	Expanded	
	Min event duration	30 sec	15 sec	
	Max event duration	10 min or 10x shortest event (600 seconds max)	Unlimited	
	Min Torque	30%	20% of Max Torque	
	Min Power	30%	20% of Max Power	
	Min aftertreatment temp	250 °C	230 °C	
	IMT exclusion (8)	Reduce by 20 °C		
	Continue data gathering to support New Paradigm in 2027			
OBD Limit	0.40			New Paradigm
Useful Life	Same as current program			(LHD, MHD, HHD) TBD
Certification Fuel	Non-bio fuel only			Non-bio fuel only

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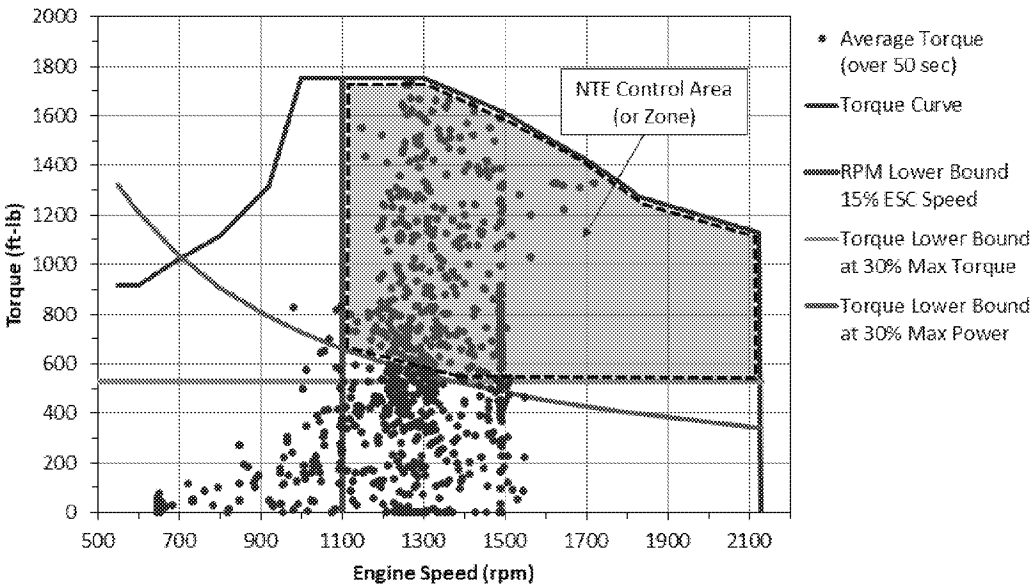
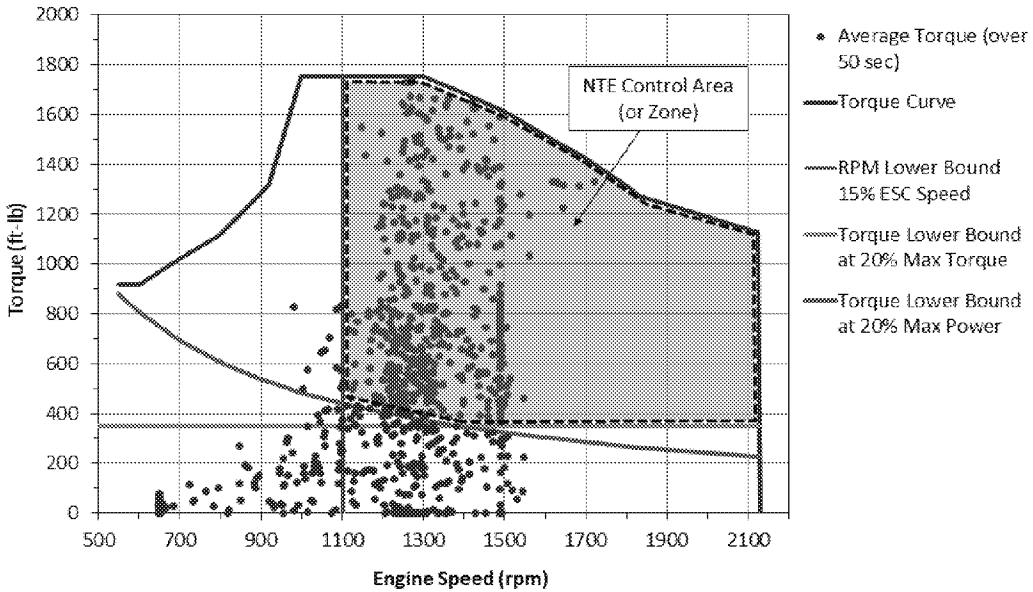
2024 EMA Proposed NTE In-Use Testing

NTE Control Area - Engine Family Name: EMFR1-HDEFN3, Vocational Truck





Current NTE Control Area

Valid NTE event duration is between 30 – 600 seconds of vehicle continuous operation in the NTE zone with all exclusions set in the current regulation are applied

EMA Expanded NTE Control Area

Valid NTE event duration is between 15 to unlimited seconds of vehicle continuous operation in the NTE zone

- *EMA is proposing a 0.15 g/bhp-hr national standard*
- *NTE standard 0.15x1.5= 0.23 g/bhp-hr*
- *IMT exclusion is reduced by 20 °C (68 °F)*

Valid NTE Events and Vehicle-Pass Ratio - Engine Family Name: EMFR1-HDEFN3, Vocational Truck

Pass Ratios for NTEE Min. Time = 15 sec. at 20% Max. Power	Macro Calculated	MFR/XML Reported
NMHC Pass Ratio:	1.00	1.00
CO Pass Ratio:	1.00	1.00
NOx Pass Ratio:	**0.93**	**1.00**
NOx & NMHC Pass Ratio:	N/A	N/A
PM pass ratio:	1.00	1.00
# of NTE Events:	**379**	**38**

MFR Reported Standard/FEL, Multiplier, Accuracy Margin, and NTE Threshold	NOx	NMHC	CO	NOx+NMHC	PM
Standard	0.15	0.14	15.5	N/A	0.01
Multiplier	1.5	1.5	1.25	N/A	1.5
In use Margin	N/A	N/A	N/A	N/A	N/A
Accuracy Margin	0.15	0.01	0.15	N/A	0.01
Threshold(g/bhp-hr)	0.38	0.22	19.5	N/A	0.03

Emissions Summary	Total Emissions (g)							Total Work (hp-hr)
	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work
Total Throughout Test	47,471	100.0%	340.33	5.90	626.85	873,916.64	2.45	1,727.03
	Percent of Total Emissions and Work							
Percent of	Time (sec)	Time (%)	NOx	NMHC	CO	CO2	PM	Work
Total outside of NTE Control Area	**26,120**	**55.0%**	**21.5%**	58.4%	27.0%	13.0%	52.5%	7.8%
Total in NTE Control Area (w/o exclusions)	21,351	45.0%	78.5%	41.6%	73.0%	87.0%	47.5%	92.2%
Exclusion 6 (Deficiency)	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exclusion 7 (EMD/OBD)	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exclusion 8 (EGR/Cold Temp Operation)	**0**	**0.0%**	**0.0%**	0.0%	0.0%	0.0%	0.0%	0.0%
Exclusion 9 (Aftertreatment/Low Temp Operation)	**1,626**	**3.4%**	**19.6%**	18.8%	5.3%	5.4%	8.9%	5.6%
Exclusion 10 (Altitude/Amb Temp)	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exclusion 11 (Zero Check)	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total in NTE Control Area (w/ all exclusions applied)	**19,725**	**41.6%**	**58.9%**	22.8%	67.7%	81.6%	38.6%	86.5%
Total in NTE Control Area with LTR flag	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total in "Basic" NTE w/o excl with Regen flag	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total of Valid NTE Events in NTE Control Area	**16,825**	**35.4%**	**54.7%**	18.8%	57.8%	73.8%	35.3%	78.2%

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Complete List of Exclusions

Exclusions as Set in the Current Regulations

Set EMD/OBD Code	Regeneration Signal	Engine Incapable LTR Encountered Indicator	Zero Check Indicator	Deficiency Encountered Indicator	Time-Weighted Carve-Out Limited Testing Region (TWCOLTR)	EGR Cold Temperature Operation Indicator (8)	NOx and NMHC Aftertreatment Insufficient Warmup Indicator (9)	High Altitude Indicator	NTE Zone Indicator
EMD_Code_Set An indication, if available, of whether an engine manufacturer diagnostics/on-board diagnostics (EMD/OBD) code was set over the previous second of operation as per J1939, 1587, 1708, or 2284 as appropriate. Permitted values: yes, no. Exclude the test point if an EMD code was set (EMD_Code_Set {DE236} = Y). 86.1910(b)(3).	Regen_Signal An indication, if available, of whether any signal from the ECM to initiate or maintain a regeneration event was set over the previous second. Permitted values: yes, no. If yes, the data recorded at this second are not to be used for NTE calculations. (The number of Ys will be counted to determine the length of the regeneration event.)	EI_LTR_Flag An indication of whether the engine was operating in an engine incapable limited testing region (EILTR) or not during the previous second.. Exclude the test point if the engine was operating in the area of one or more approved deficiencies (Def_Flag {DE384} = 1 - 9 and MY {DE40} = 2007 – 2009 indicates that the point should be excluded). 86.007-11(a)(4)(iv)	Zero_Check_Flag An indication of whether the analyzer was performing a periodic zero check. If yes, the data recorded at this second are unusable for NTE calculations.	Def_Flag An indication of whether the engine was operating under an approved deficiency and if so which one (as numbered in the certification application) (1, 2, 3, 4, 5, 6, 7, 8, 9), was not operating under an approved deficiency (N), or readings were not collected or data were not evaluated to determine whether the engine operated in a deficiency (U), during the previous second. If exclusions of records are claimed based on operation in a deficiency (U) cannot be used.	TWCOLTR_Flag An indication of whether the engine was operating in a Time-Weighted Carve-Out Limited Testing Region (TWCOLTR) or not during the previous second.	EGR_Cold_Ops_Flag An indication of whether an engine with EGR (DE120 = Y) was operating in a region of cold temperature conditions [as per 86.1370-2007(f)] or not during the previous second. If yes, the data recorded at this second are not to be used for NTE calculations. ***IMT ≤ IMT found in IMP (absolute pressure in bars) = 0.0875 x IMT(°F) – 7.75, or engine coolant temp ≤ ECT found in IMP(abs bar) = 0.0778 x ECT(°F) – 9.8889***	Aftertreament_Cold_Ops_Flag An indication of whether an engine with an aftertreatment device that reduces NOx (DE123 = Y) or NMHC (DE22 = Y) was operating in a region of cold exhaust gas temperature conditions [as per 86.1370-2007(g)] or not during the previous second. If yes, the data recorded at this second are not to be used for NTE calculations. ***Exclude EGT < 250 °C within 12 inches of the outlet of aftertreatment system.***	High_Altitude_Flag An indication of whether an engine was operating in a region it considers high altitude [as per 86.007-11(a)(4)(ii)] or not during the previous second. If yes, the data recorded at this second are not to be used for NTE calculations. ***All altitudes ≤ 5,500 feet for T(oF) ≤ -0.00254*A(ft)+100***	NTEZ_Flag An indication of whether an engine was operating in the NTE Zone (with all exclusions, LTRs, etc. applied) or not during the previous second. If No, the data recorded at this second are not to be used for NTE calculations.

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Effects of Exclusions on NTE In-Use Testing

Effects of Exclusions 8, 9, Valid NTE Event Duration and % of Max. Power on In-use Testing

	Total Shit Day Testing Time = 47,471 sec (13.20 hr.), and Mass NOx = 340.33 (g)		1 Total Outside of NTE Control Area	2 Total in NTE Control Area without Exclusions	3 Exclusion 8: EGR/Cold Temp	4 Exclusion 9: After treatment Low Temp	5 Total in NTE Control Area with all Exclusions)	6 Total of Valid NTE Events in NTE Control Area	7 Vehicle Pass-Ratio (NOx)	8 Number of Valid NTE Events
1	NTEE Min. Time = 30 sec with Exclusions 8 and 9 at 30% Max. Power	Time (sec)	30,080	17,391	11,563	2,522	5,270	2,431	1.00	37
		Time (%)	63.4%	36.6%	24.4%	5.3%	11.1%	5.1%		
		NOx (%)	27.3%	72.7%	50.9%	24.6%	13.4%	7.3%		
2	NTEE Min. Time = 30 sec without Exclusions 8 and 9 at 30% Max. Power	Time (sec)	30,080	17,391	0	0	17,391	9,854	0.97	171
		Time (%)	63.4%	36.6%	0.0%	0.0%	36.6%	20.8%		
		NOx (%)	27.3%	72.7%	0.0%	0.0%	72.7%	40.8%		
3	NTEE Min. Time = 30 sec with Exclusions 8 and 9 at 20% Max. Power	Time (sec)	26,120	21,351	14,375	3,689	6,142	2,957	1.00	47
		Time (%)	55.0%	45.0%	30.3%	7.8%	12.9%	6.2%		
		NOx (%)	21.5%	78.5%	54.7%	28.2%	13.7%	8.4%		
4	NTEE Min. Time = 30 sec without Exclusions 8 and 9 at 20% Max. Power	Time (sec)	26,120	21,351	0	0	21,351	13,698	0.96	215
		Time (%)	55.0%	45.0%	0.0%	0.0%	45.0%	28.9%		
		NOx (%)	21.5%	21.5%	0.0%	0.0%	78.5%	50.9%		
5	NTEE Min. Time = 30 sec with Exclusions 8 and 9 at 10% Max. Power	Time (sec)	23,050	24,421	16,443	4,634	6,913	3,859	1.00	64
		Time (%)	48.6%	51.4%	34.6%	9.8%	14.6%	8.1%		
		NOx (%)	18.2%	81.8%	56.2%	30.5%	14.0%	9.1%		
6	NTEE Min. Time = 30 sec without Exclusions 8 and 9 at 10% Max. Power	Time (sec)	23,050	24,421	0	0	24,421	18,838	0.96	266
		Time (%)	48.6%	51.4%	0.0%	0.0%	51.4%	39.7%		
		NOx (%)	18.2%	81.8%	0.0%	0.0%	81.8%	60.4%		
7	NTEE Min. Time = 1 sec with Exclusions 8 and 9 at 30% Max. Power	Time (sec)	30,080	17,391	11,563	2,522	5,270	5,270	0.99	809
		Time (%)	63.4%	36.6%	24.4%	5.3%	11.1%	11.1%		
		NOx (%)	27.3%	72.7%	50.9%	24.6%	13.4%	13.4%		
8	NTEE Min. Time = 1 sec without Exclusions 8 and 9 at 30% Max. Power	Time (sec)	30,080	17,391	0	0	17,391	17,391	0.95	2332
		Time (%)	63.4%	36.6%	0.0%	0.0%	36.6%	36.6%		
		NOx (%)	27.3%	72.7%	0.0%	0.0%	72.7%	72.7%		
9	NTEE Min. Time = 1 sec with Exclusions 8 and 9 at 10% Max. Power	Time (sec)	23,050	24,421	16,443	4,634	6,913	6,913	0.99	939
		Time (%)	48.6%	51.4%	34.6%	9.8%	14.6%	14.6%		
		NOx (%)	18.2%	81.8%	56.2%	30.5%	14.0%	14.0%		
10	NTEE Min. Time = 1 sec without Exclusions 8 and 9 at 10% Max. Power	Time (sec)	23,050	24,421	0	0	24,421	24,421	0.94	2869
		Time (%)	48.6%	51.4%	0.0%	0.0%	51.4%	51.4%		
		NOx (%)	18.2%	81.8%	0.0%	0.0%	81.8%	81.8%		

In-use emissions data were collected from 44 heavy-duty (HD) on-highway vehicles that were operated on their representative routes in different states consistent with Not-To-Exceed (NTE) test procedures. These vehicles were selected by EPA and CARB for 2016 Test Order manufacturer run in-use testing program for HD diesel engines from model years 2013- 2015. The selected vehicle classes are light, medium and heavy-duty, with trailers, no trailers, plain closed box, dump trailers, tank and others. All vehicles had engines that were certified to either 0.20, 0.25, 0.31, or 0.50 g/hp-hr NOx standard/family emission limits, and to 0.01 g/hp-hr PM. The NTE limits for these vehicles ranged from 0.45 to 0.90 g/hp-hr.

Our computational and statistical analyses of the in-use data showed that the percent time and work outside the NTE zone are 67% and 24%; in the NTE zone with all exclusions set in the current regulation are 17% and 39%; and without exclusions are 33% and 76% respectively. Consequently, the percent time and work of the valid NTE sampling events are only 7% and 16%. Analyses also revealed that the urban and rural driving represent over 40% of NOx emissions time and the average brake-specific NOx emissions are about 3-4 times the NTE standards. In addition, the brake-specific NOx emissions were significantly higher below 30% of max. power set in the current regulations.

Calculated results showed that the overall average brake-specific NOx from the 44 vehicles ranged from 0.25 to 0.67 g/hp-hr, for NOx outside the NTE zone from 0.29 to 1.55 g/hp-hr, for cold NOx from 1.47 to 4.05 g/hp-hr, and for distance-specific NOx ranged from 0.5 to 2.28 g/mile. For all vehicles, the average NOx emissions from the valid NTE sampling events were lower than the certification values, and the corresponding average vehicle-pass ratio was 98%. Results also indicated that low speed and idling are major part of the duty cycles even for line haul and delivery vehicles.

Finally, without the EGR cold temperature and (NO_X and NMHC) aftertreatment warmup exclusions, the percent time in the NTE zone had remarkably improved, and the vehicle-pass ratio was slightly reduced. Also, changing the valid NTE event duration from 30 to 1 sec, had improved significantly the number of NTE events. In contrast, lowering the percent of maximum power from 30% to 10% had slightly reduced the vehicles-pass ratio. In this study, with all exclusion applied only two vehicles failed the in-use testing and several reported no valid NTE events. However, without applying the EGR cold temperature and (NO_X and NMHC) aftertreatment warmup exclusions more than 10% of the vehicles failed the in-use testing.

Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/16/2018 6:46:14 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
Subject: RE: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal

Thanks Karl.
FJ Hamady

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, October 16, 2018 2:43 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Duncan, Allen <duncan.allen@epa.gov>; Laroo, Chris <laroo.chris@epa.gov>; Clark Taylor <taylor.clark@volvo.com>
Subject: RE: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal

FJ,

I sent out an outlook meeting invitation with a call in number for Monday Oct 22nd at 3:00 EST.

Karl

From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Tuesday, October 16, 2018 2:34 PM
To: Tasik Karl
Cc: Clever Timothy; Duncan, Allen; Laroo, Chris; Clark Taylor
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3_VPT933831_HVE1207	4V4NC9EH3GN933831	Program Information	VPT933831_181001_HVE1207.xml

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Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Thursday, October 11, 2018 1:36 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
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Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

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13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/16/2018 6:33:48 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
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Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

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Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

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13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
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Cell Phone: +1 (240) 500 6101
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herein. If you are not the intended recipient, please advise the sender immediately by replying to this email and permanently delete this message and any attachments from your system.

Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 11/29/2018 5:40:43 PM
To: karl.tasik@volvo.com
CC: Clark Taylor [taylor.clark@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
Subject: Volvo's in-use testing results for 2017 Test Order
Attachments: Questions for Volvo HDIUT Data-For 2017 Test Order.docx

Dear Karl,

Please find attached a list of questions regarding the Volvo's in-use testing Data for 2017 Test Order, in addition, you will receive via FedEx within the next few days two Excel files saved on Scan Disk USB 3.0). The Excel files contain Volvo's in-use testing data and EPA computational and statistical results for Test ID # VPT054464 and Test ID # VPT076146. Within the next two weeks if possible, would like to have a meeting or a conference call with Volvo to discuss further these results. In the meantime, if you have any questions or need any additional information, please feel free to contact me at any time.

Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

U.S. EPA Proprietary and Confidential
November 29, 2018

Volvo HDIUT Data – for 2017 Test order

(Excel worksheets of results and questions are on the enclosed Scan Disk USB 3.0)

Dear Karl,

Based on the in-use data submitted by Volvo for 2017 Test Order, engine family name "FVPTH10.8G01", the following is a list of questions:

For Test ID # VPT054464

1. In the enclosed workbook "FVPTH10.8G01-20180629085143-VPT054464", in the Analysis Inputs worksheet – VPT reported Peak Torque value = 1303 and Maximum HP value = 441. Why then in Engine Map worksheet submitted by Volvo for this tested vehicle, the calculated Peak Torque value = 1590 and Maximum HP value = 402?

2. In the NTEE Stats worksheet - for the NTEE Start Time = 190642 (row:36, column:2) to NTEE End Time = 190915 (row:36, column:3) under the MFR XML NTEE Data - VPT reported Valid NTEE event duration value = 154 (row:36, column:7) and NOx emission value = 0.41 (row:36, column:13). However, in the 1HZ Data worksheet from the Local_Time = 190642 (row:11065, column:1) to Local_Time = 190915 (row:11217, column:1), why the NTEZ_Flag was set always to "Y during the same event for either EGR_Cold_Ops_Flag = "Y", or for EGR_Cold_Ops_Flag = "N"? This pattern was repeated several times within the same NTE event and for many other events. We are unclear of your calculation of the valid NTEE event duration and the corresponding average NOx emission. According to **§86.1370 (f)**, NTE cold temperature operating exclusion, manufacturers can't arbitrarily select EGR_Cold_Ops_Flag = "Y", or EGR_Cold_Ops_Flag = "N" during the same NTE events.

3. As shown In the NTEE Stats and 1HZ Data worksheets, several NTE events were identified where NTEZ_Flag was set always to "Y" for both EGR_Cold_Ops_Flag = "Y", and EGR_Cold_Ops_Flag = "N".

4. For this Test ID Volvo reported NOx Pass Ratio = 0.99 and # of valid NTE Events = 58, however, our calculations showed NOx Pass Ratio = 0.81 and # of valid NTE Events = 8 (see enclosed worksheet).

For Test ID # VPT076146

1. Similar questions as above for this Test ID.

2. Also, for this Test ID Volvo reported NOx Pass Ratio = 0.92 and # of valid NTE Events = 90, however, our calculations showed NOx Pass Ratio = 0.86 and # of valid NTE Events = 52 (see enclosed worksheet).

EPA is willing to have a meeting or a conference call with Volvo to discuss further these results. If you have any questions or concerns regarding this matter, please do not hesitate to contact me at any time.

Regards,

FJ Hamady

cc: Taylor Clark, Volvo
Allen Duncan, EPA
Chris Laroo, EPA

Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/16/2018 2:12:59 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Thanks Karl as always for your prompt response.
Regards,
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To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Duncan, Allen <duncan.allen@epa.gov>; Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

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From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/16/2018 1:03:37 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
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To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: Volvo 2018 In-Use Test Data Submittal
Attachments: FVPTH10.8G01-20180629085143-VPT054464-EPA-1.xlsb

I emailed the 1HZ data file couple times but failed due to its large size. Please find attached the same 1HZ data file but saved in Excel .xlsb. Please let me know if you have any questions.

Regards,
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From: Hamady, Fakhri
Sent: Monday, October 22, 2018 8:42 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Duncan, Allen <duncan.allen@epa.gov>; 'Lee, Abraham@ARB' <abraham.lee@arb.ca.gov>
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1_VPT955666_HVE1275	4V4NC9EH3GN955666	Program Information	VPT955666_20180828_HVE1275.xml
2_VPT933817_HVE1193	4V4NC9EH9GN933817	Program Information	VPT933817_20180829_HVE1193.xml
3_VPT933831_HVE1207	4V4NC9EH3GN933831	Program Information	VPT933831_181001_HVE1207.xml

Also per our discussion, attached is the Volvo NTE logic diagram which we can review further with Tim Clever this week.

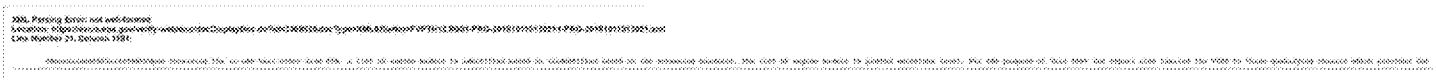
Please let me know if you have any further questions.

Karl

From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Monday, October 15, 2018 9:27 AM
To: Tasik Karl
Cc: Clever Timothy
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Karl,

I couldn't download "FVPTH12.8G01-PRG-20181011013021-VPT955676.xml" due to parsing error, and few files having same test ID.



I would like to discuss the Test ID with you this afternoon.

Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Thursday, October 11, 2018 1:36 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Falkhri,

I have just submitted the first four 2018 in-use testing order files into the EPA Verify System.

Please confirm they have been properly submitted and let me know if you have any questions.

Thanks,
Karl

Karl Tasik

Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/22/2018 1:05:27 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: Volvo 2018 In-Use Test Data Submittal
Attachments: Volvo NTE_Logic_051018.pdf

FYI - resending same email due to large files.

From: Hamady, Fakhri
Sent: Monday, October 22, 2018 8:42 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Duncan, Allen <duncan.allen@epa.gov>; 'Lee, Abraham@ARB' <abraham.lee@arb.ca.gov>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Karl,

Please find attached the two documents would like to discuss with you and Timothy, at our conference call today Oct 22nd at 3:00 EST. If you have any questions or need any additional information, please feel free to contact me at any time.

Regards,
FJ Hamady

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Monday, October 15, 2018 2:20 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

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Also per our discussion, attached is the Volvo NTE logic diagram which we can review further with Tim Clever this week.

Please let me know if you have any further questions.

Karl

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[redacted]

I would like to discuss the Test ID with you this afternoon.

Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
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Please confirm they have been properly submitted and let me know if you have any questions.

Thanks,
Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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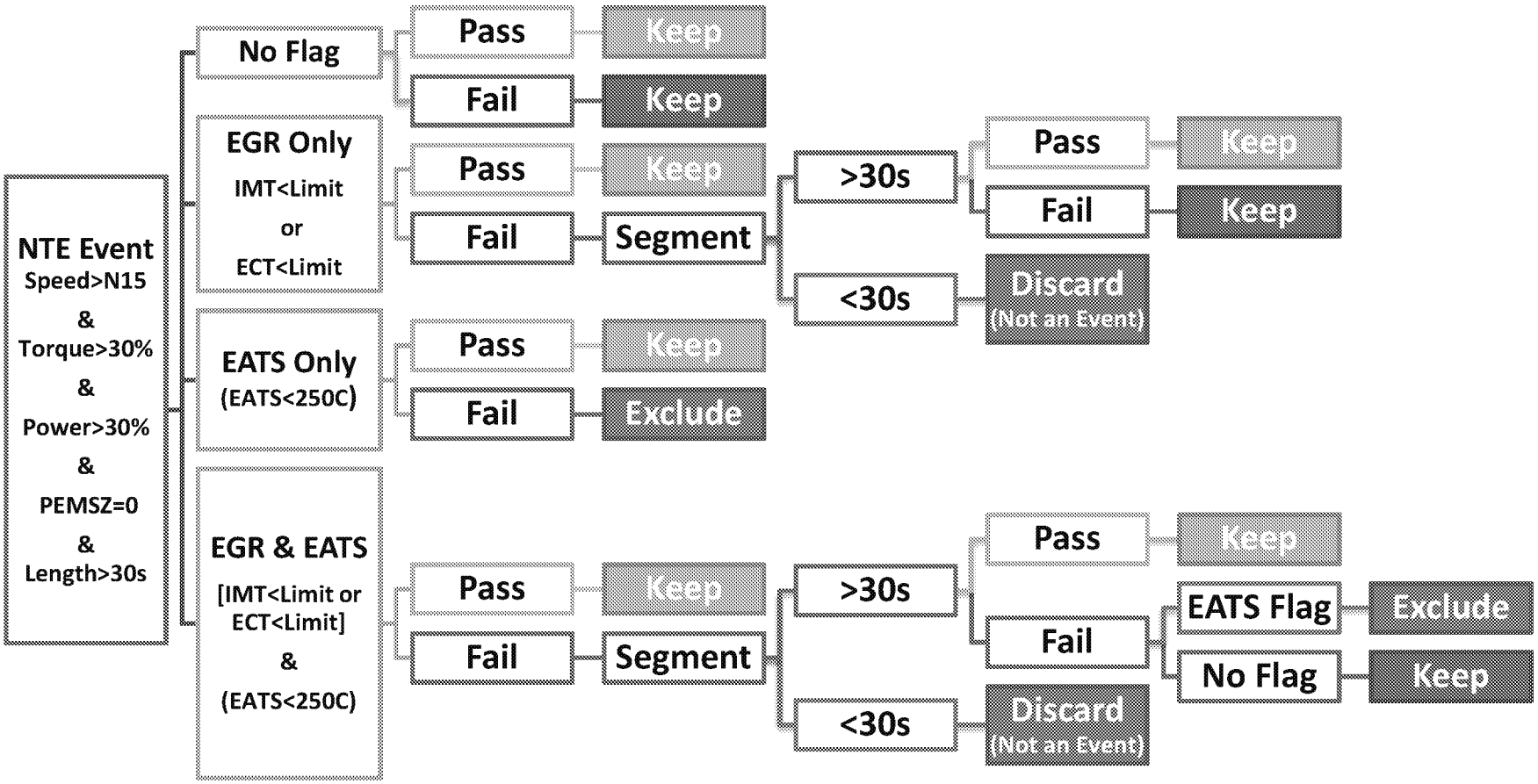

- Any "Keep" is Automatically Discarded due to a DRIFT Error Upon Calculation of Brake Specific Emissions
- Pass or Fail is governed by Brake Specific NOx Emissions for the Event < 0.45 g/bhp-hr

Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 6/28/2018 7:55:58 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Duncan, Allen [duncan.allen@epa.gov]
Subject: RE: CARB's HDIUT letters

You are very welcome.
Regards,
FJ Hamady

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 28, 2018 3:52 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>
Subject: RE: CARB's HDIUT letters

Thank you for such a quick check!

Sincerely,
Abraham

From: Hamady, Fakhri <hamady.fakhri@epa.gov>
Sent: Thursday, June 28, 2018 11:51 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>
Subject: RE: CARB's HDIUT letters

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Abraham,

The letters look good to me.

Best regards,
FJ Hamady

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 28, 2018 11:40 AM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>
Subject: CARB's HDIUT letters

Dear Fakhri,

As discussed on the phone, I attached pdf copies of CARB's HDIUT letters, which will be sent out. Those are basically same with your letters, but we elaborate a little more about compliance of HDIUT requirements.

Please, check them out and let me know if you have any comments.

By the way, have a great vacation next week!

Sincerely,
Abraham

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 10/22/2018 12:42:22 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: Volvo 2018 In-Use Test Data Submittal
Attachments: FVPTH10.8G01-20180629085143-VPT054464-EPA.XLSX; Volvo NTE_Logic_051018.pdf

Hi Karl,

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Regards,
FJ Hamady

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Hi Karl,

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[illegible]

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Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
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Tel: (734) 214-4330
hamady.fakhri@epa.gov

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To: Hamady, Fakhri <hamady.fakhri@epa.gov>
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Thanks,
Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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Message

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 6/28/2018 3:44:49 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Duncan, Allen [duncan.allen@epa.gov]
Subject: RE: CARB's HDIUT letters

Thanks Abraham as always for your time and cooperation.
Regards,
FJ Hamady

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 28, 2018 11:40 AM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>
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By the way, have a great vacation next week!

Sincerely,
Abraham

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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Message

Sent: 3/6/2019 3:50:22 PM
To: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Subject: RE: Part 86 In-Use Testing Question

Jonathan;
I would like (yet another) conversation, if you have time.

From: Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com>
Sent: Tuesday, March 5, 2019 4:32 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: FW: Part 86 In-Use Testing Question

Allen –

Here is the email chain I was referencing. I look forward to hearing back from you about next steps. Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:29 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

No I meant (h). Paragraph (h) covers the other exclusion criteria not covered in paragraph (g).

(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Thursday, April 19, 2018 9:25 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

Thanks for getting back to me. Did you mean paragraph (f)?

BR,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:11 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
Yes, paragraph (h) covers the rest of the NTE exclusion criteria and allows you to include those points in your vehicle-pass ratio determination.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

One more question for you just for completeness. Would the same logic apply to paragraph (f), which is the IMT/IMP exclusion?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor

Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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http://www.arnoldporter.com

Appointment

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 3/4/2019 2:51:24 PM
To: Duncan, Allen [duncan.allen@epa.gov]

Subject: RE: Heavy Duty In-Use Testing Data Processing
Location: Jonathan will call Allen at 734 214 4815

Start: 3/5/2019 8:00:00 PM
End: 3/5/2019 8:30:00 PM
Show Time As: Tentative

Recurrence: (none)

---
athan S.
arch 04, 2019 9:49 AM
en'
eavy Duty In-Use Testing Data Processing

Thanks, Allen. Let's aim for tomorrow at 3:00 pm. Then if we need to get others on the phone from Volvo and on your end perhaps we can do that on Thursday at 1:00 pm or on Friday. I'll send you a calendar invitation for tomorrow.

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Monday, March 04, 2019 8:23 AM
To: Martel, Jonathan S.
Subject: RE: Heavy Duty In-Use Testing Data Processing

Jonathan;

Tuesday or Wednesday at 3:00

Thursday at 1:00

Friday is wide open.

Any of those work for you?

Best regards,

Allen

From: Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com>
Sent: Friday, March 1, 2019 3:55 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: Heavy Duty In-Use Testing Data Processing

Allen –

I just left you a voice mail. When we last spoke, I said I would get back to you regarding 40 CFR 86.1370(f), (g) and (h). Can you please let me know when you might have time to speak? Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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http://www.arnoldporter.com

Message

Sent: 2/21/2019 9:19:37 PM
To: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Subject: discussion about 86.1370 (f)

Jonathan;
For efficiency's sake, I want to send this to you, referring to 86.1370 (f), NTE cold temperature operating exclusion

I argue that, unlike the provisions of 86.1370 (g) ["***you may exclude*** *emission data based on catalytic aftertreatment temperatures as follows*"], the exclusion defined in 83.1370 (f) may not be arbitrarily applied by a manufacturer ["*Engines equipped with exhaust gas recirculation (EGR) whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions*."]

Through and including the CY 2016 test order, no manufacturer arbitrarily chose whether or not to employ the provisions of 86.1370 (f). All manufacturers employed the provisions as written. One manufacturer chose to begin arbitrarily employing those provisions when processing data requested under the CY 2017 test order.

This strategy, to "choose" when to apply the provisions of 86.1370 (f), significantly affected both the number of valid NTE events and the pass ratio associated with that manufacturer's submitted HDIUT data.

My impression is that this manufacturer is inappropriately applying the language of 86.1370 (g) ["you may exclude…"] to 86.1370 (f).

I do have some time tomorrow between 1:00 and 2:00 if you would like to discuss.

I am also available Monday, February 25 between 8:00 and 9:00, 12:30 – 1:30 and 3:00 – 4:30

I look forward to discussing this with you.

Best regards,

Allen

Allen Duncan, Ph.D., P.E.
Director, Diesel Engine Compliance Center
US EPA
Compliance Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
duncan.allen@epa.gov
734.214.4815

VOLVO

Thomas A. Farnen
Volvo Group Truck Technologies
13302 Pennsylvania Ave
Hagerstown MD 21742
PH: +1 301 790 6786
thomas.farnen@volvo.com

Sept 28, 2018

Ms. Sharon Lemieux, Chief, In-Use Programs Branch
California Air Resources Board
Emissions Compliance, Automotive Regulations
& Science Division
9480 Telestar Avenue, Suite #4
El Monte, CA 91731

Re: Not-to-Exceed Test Procedures for Manufacturer-Run In-Use Testing of Heavy-Duty Engines Under 40 C.F.R. § 86.1370

Dear Ms. Lemieux:

I am writing on behalf of Volvo Group North America, Inc. ("Volvo") regarding the Not-to-Exceed ("NTE") test procedures for Manufacturer-Run In-Use Testing of Heavy-Duty Engines ("HDIUT") under 40 C.F.R. § 86.1370.

Volvo has been communicating with California Air Resources Board ("CARB") staff regarding the proper treatment of NTE data collected when catalytic aftertreatment temperatures are less than 250°C. As set forth in greater detail below, the U.S. Environmental Protection Agency ("EPA") has confirmed that, under 40 C.F.R. §§ 86.1370(g) and (h), manufacturers may choose to include or exclude from the vehicle-pass ratio determination any NTE event for which exhaust temperatures are less than 250°C. CARB staff has taken the contrary position, however, that engine manufacturers *cannot* include or exclude NTE events in this manner, and instead must (a) exclude all NTE events for which exhaust temperatures are less than 250°C, or (b) specify an alternative exhaust temperature threshold that is less than 250°C and include *all* NTE events for which exhaust temperatures exceed that threshold.

Respectfully, as explained below, your staff's interpretation of these regulations to impose conditions on the manufacturer's choice of whether to include NTE data in its compliance calculation is not well-founded. Whether or not CARB might seek to revise its regulations to incorporate its recent decision to deviate from the EPA approach (as we understand CARB is considering), CARB may not apply such a change in the regulations retroactively to in-use testing that has already been performed. Manufacturers could not possibly have divined CARB staff's interpretation from the regulatory language, and imposing that interpretation in determining compliance retrospectively would therefore be unfair and unlawful.

* * *

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Regulatory Language. In 2016, EPA amended its NTE in-use test procedures to incentivize low-temperature emissions control and clarify that manufacturers have the option to include low-temperature NTE events that "pass," while excluding those that "fail." The prior regulations specified that, for engines equipped with NOx or NMHC aftertreatment devices, the NTE NOx and NMHC limits do not apply when the exhaust gas temperature measured within 12 inches of the aftertreatment device outlet is less than 250°C. 40 C.F.R. § 86.1370(g). In its 2016 rulemaking, EPA amended subsection (g) and added a new subsection (h) to allow manufacturers to elect whether to exclude emissions data based on exhaust temperature:

> *(g) You may exclude emission data based on catalytic aftertreatment temperatures as follows:*
>
> *(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude NOx emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250°C.*
>
> *(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected if the exhaust temperature is less than 250°C at any time during the NTE event.*
>
> * * *
>
> *(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling even* ***may*** *be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.*

See 81 Fed. Reg. 73,478, 73,982 (Oct. 25, 2016), as codified at 40 C.F.R. §§ 86.1370(g), (h).

Communications with EPA and CARB. By email dated April 16, 2018, James Sanchez at EPA confirmed that 40 C.F.R. §§ 86.1370(g) and (h) "were added in the HD GHG P2 rule to clarify that [manufacturers] 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio," meaning that manufacturers "can choose you [sic] include these points as well." Mr. Sanchez thus confirmed EPA's position that "[a] manufacturer can choose to include or exclude any invalid NTE event during a test."

Abraham Lee of your staff nevertheless has advised in a September 10 email that engine manufacturers do *not* have the option to choose whether to include or exclude NTE data collected when exhaust temperatures are less than 250°C in determining the vehicle-pass ratio. Rather, according to Mr. Lee, based on nothing more than CARB's

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"good engineering judgment," manufacturers should not include any NTE data collected when exhaust temperatures are below 250°C. Alternatively, the manufacturer must specify an exhaust temperature threshold below 250°C and include in the vehicle-pass ratio determination *all* NTE data collected at temperatures that exceed that threshold, regardless of whether those events "pass" or "fail." Mr. Lee explained that "CARB believes this practice follows good engineering judgment," but did not identify any legal authority or other basis for departing from the text of the regulation.

CARB's Interpretation Is Not Valid. CARB's interpretation of 40 C.F.R. §§ 86.1370(g) and (h) conflicts with the plain language of the regulation and EPA's own understanding of the provisions it fashioned. *First*, the regulations state that manufacturers "may" —not "must"— exclude from the determination of the vehicle-pass ratio emission data collected when exhaust temperatures are less than 250°C or that otherwise do not qualify as a valid NTE sampling event. *Second*, the regulations do not specify any limitation on the manufacturer's election of whether to exclude any such data based on "good engineering judgment" or otherwise. Rather, the concept of "good engineering judgment" applies only to the method the manufacturer uses to measure exhaust temperature under subsection (g)(3). *Finally*, there is nothing at all in the regulations imposing on manufacturers a condition to specify a particular exhaust temperature and limiting the data that may be included in the vehicle-pass ratio determination to those NTE events collected at temperatures that exceed the specified threshold. Plainly, manufacturers could not know from the regulations themselves that it would have to specify such a temperature threshold and then include all NTE events that exceed that threshold. CARB, like EPA, must provide advance notice to manufacturers of what requirements apply in determining in-use compliance. *See, e.g.*, *United States v. Approximately 64,695 Pounds of Shark Fins*, 520 F.3d 976, 980 (9th Cir. 2008) ("Due process requires that an agency provide fair notice of what conduct is prohibited . . . .") (internal citations and quotations omitted).

Notably, CARB recently circulated a PowerPoint presentation outlining an approach formally to revise the NTE regulations to comport with the interpretation of 40 C.F.R. §§ 86.1370(g) and (h) communicated to Volvo by Mr. Lee. We understand that CARB has presented these slides at a September 25, 2018 meeting of the Engine Emissions Measurement & Testing Committee. That presentation, including a redline of the current regulatory language showing substantial changes, demonstrates that the current language of 40 C.F.R. §§ 86.1370(g) and (h) does not itself support CARB's interpretation.

* * *

If CARB disagrees with EPA's policy judgment to incentivize low-temperature emissions control by giving manufacturer's unfettered discretion to elect to include or exclude NTE events as specified in the regulations, CARB may seek to modify its rules. But until CARB does so, it cannot reasonably or lawfully impose that position retroactively based on regulatory language that contains no such limitations on

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manufacturers' discretion. To do so would be fundamentally unfair and would not provide fair notice to manufacturers, like Volvo, regarding their regulatory responsibilities in determining their own compliance.

Volvo very much appreciates your attention to this matter and is hopeful that it can be resolved without further dispute. If you could confirm that Volvo's post-processing analysis complies with the regulations and that, consequently, Volvo has satisfied CARB's 2016 test order, we would appreciate it. We would be happy to address any questions or concerns that you or your colleagues might have.

Sincerely,

Thomas A. Farnen

Thomas A. Farnen
North American Emissions Counsel

cc: Michael Balthasar, Global Vice President of Certification & Compliance, Volvo Group

CALIFORNIA
AIR RESOURCES BOARD

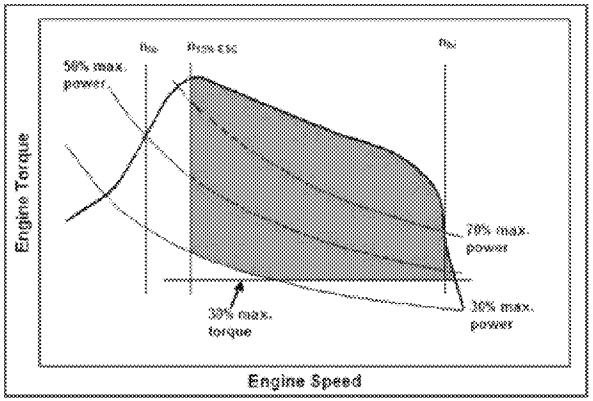
Comparison of CARB HDIUC and Manufacturer-run HDIUT Programs

29th CRC Real World Emissions Workshop
March 12, 2019

Abraham D. Lee, John E. O'Cain, Juan Avila, Sharon C. Lemieux, Ivan Castillo, Emmanuel Fofie, Jenna Latt, Eniko Szarnyasi, John Karim, Stephen Berdahl, Tung Tran, Keshav Sahay, Kwangsam Na, Oliver Chang, and Keith A. Macias

Outline

- Background Information
  - A Brief Overview of Manufacturer-Run Heavy-Duty In-Use Testing (Mfr. HDIUT) Program
- Findings from CARB's Heavy-Duty In-Use Compliance (HDIUC) and Mfr. HDIUT Programs
  - Test Result Comparisons: HDIUC vs. Mfr. HDIUT
  - Reasons that Mfr. HDIUT Program is less effective than CARB's HDIUC Program in identifying noncompliant engines and engine families (EFs)
- Conclusions



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Current Mfr. HDIUT Program – An Overview

- HDIUT program intended to "…**assess compliance** with Not to Exceed (NTE)…and **help ensure overall compliance** with the 2007 emission standards throughout the engine's useful life…" (CARB ISOR 2006)
- Since the program started, no meaningful corrective actions
  - Despite high warranty claims, consumer complaints, and high in-use emissions measured through CARB programs like truck & bus surveillance program (TBSP)
- Upon examination of HDIUT data, staff found two big reasons why HDIUT data has not led to any meaningful corrective actions:
  - Use of "NTE cold temperature operating exclusion" (Intake Manifold Temperature [IMT] exclusion)
    - ✓ – insignificant amount of valid NTE events with many data excluded
  - Biased data processing: Selective towards only compliance
    - ✓ IMT exclusion/inclusion
    - ✓ Catalytic aftertreatment temperature (AT T) exclusion/inclusion

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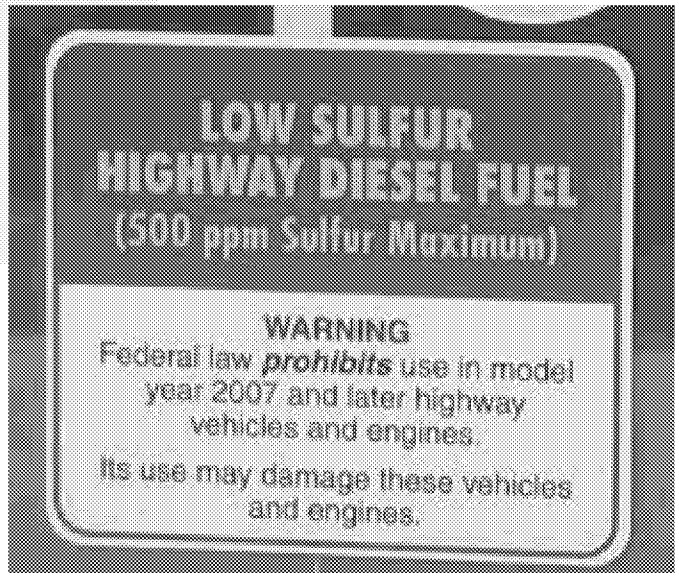
Findings – IMT Exclusion

- Background: Developed in response to manufacturers concerns regarding EGR durability issues at low ambient/engine operating temperatures. (10/6/2000)
  - Corrosion of EGR components from the condensation when intake charge (EGR and intake air) is cooled below the dew point with high amounts of sulfur (S) in fuel – a nominal 350 ppm at pump (at 500 ppm limit)
- Virtually invalid
  - Ultra Low Sulfur Diesel (S ≤ 15 ppm) is now used (mandated in September 2006 in California).
  - SCR systems are main players, not EGR, only.
  - OEMs use EGR even at low IMT.
- IMT Exclusion: Elimination of examinable data
  - No emissions data examination at all for 18% of heavy-duty (HD) engines tested through HDIUT (none through HDIUC) – Mainly, due to IMT exclusion



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Findings – Improper Use of NTE Data Exclusion

- Mfr.'s HDIUT Data Processing
  - Selective inclusion of data: Biased towards only compliance
- OEM's selective inclusion/exclusion of data for vehicle-pas ratio, R_{pass}, determination:
  - For NTE data collected when catalytic AT Ts are less than 250 °C (= 482 °F)
  - For NTE data collected during the IMT exclusion
  - For R_{pass} determination, arbitrary selection based on inclusion of only passing events while excluding failing events

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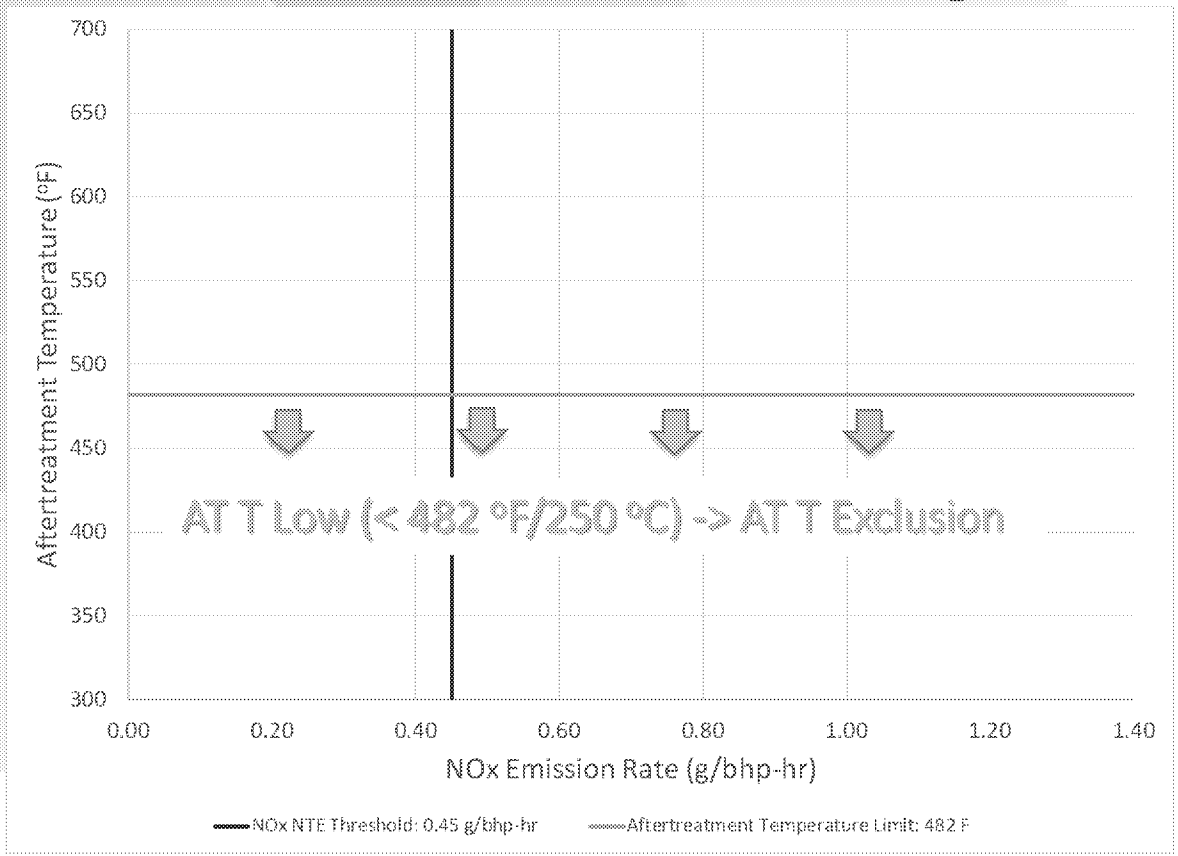
Normal NTE Data Processing I



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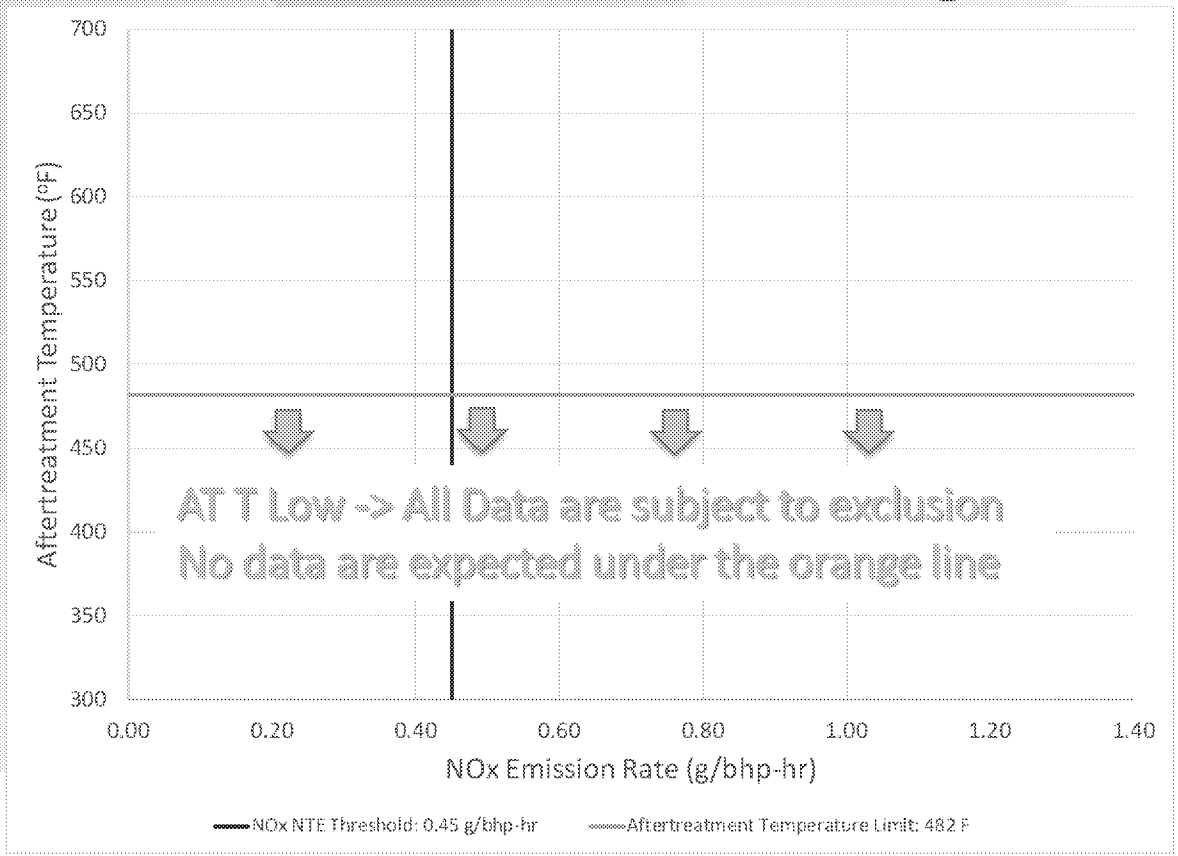
Normal NTE Data Processing II



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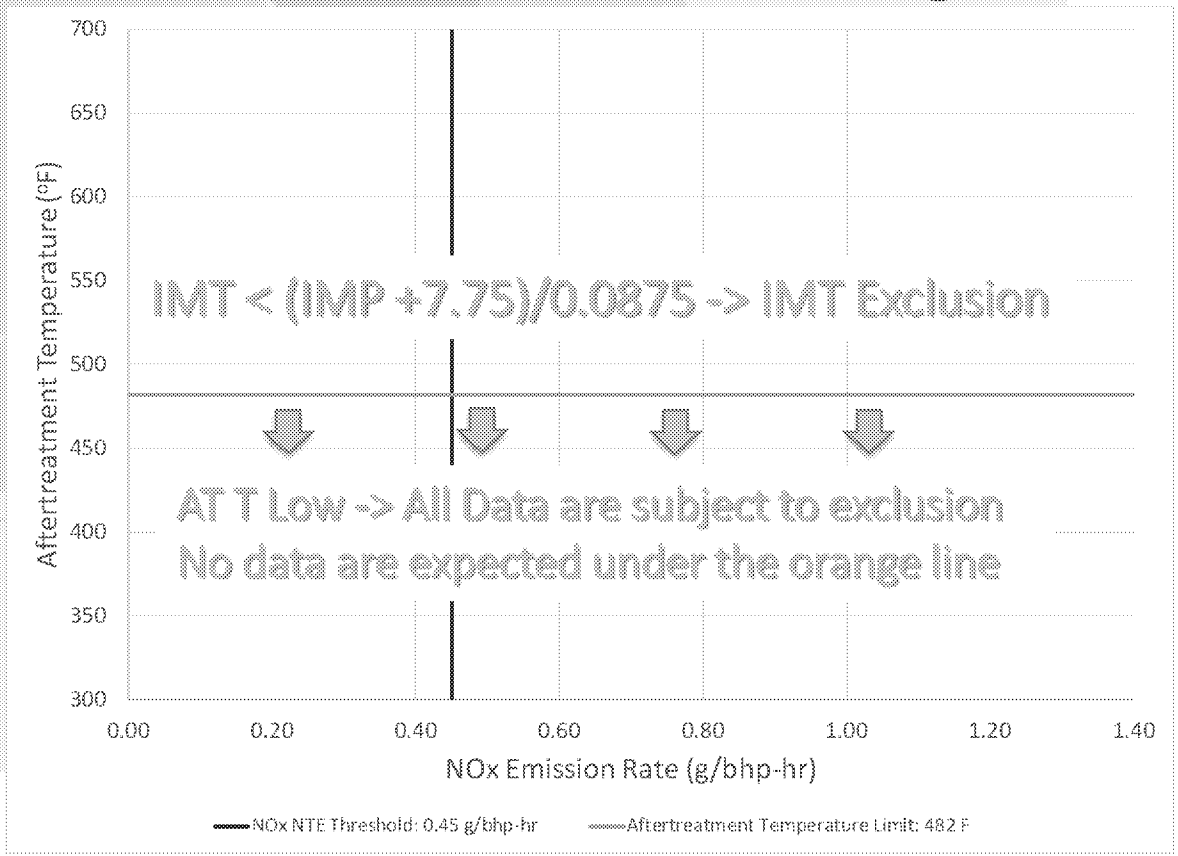
Normal NTE Data Processing III



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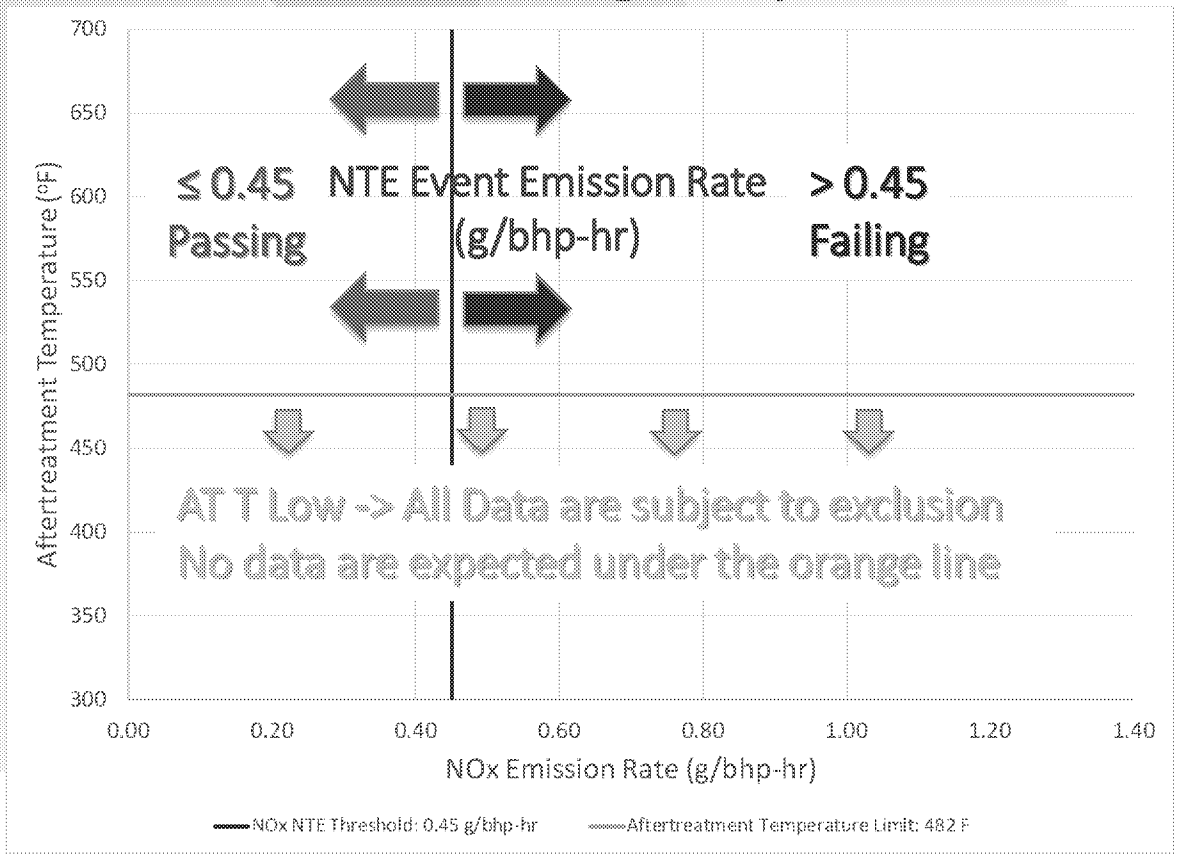
NTE Data Processing – Explanation IV



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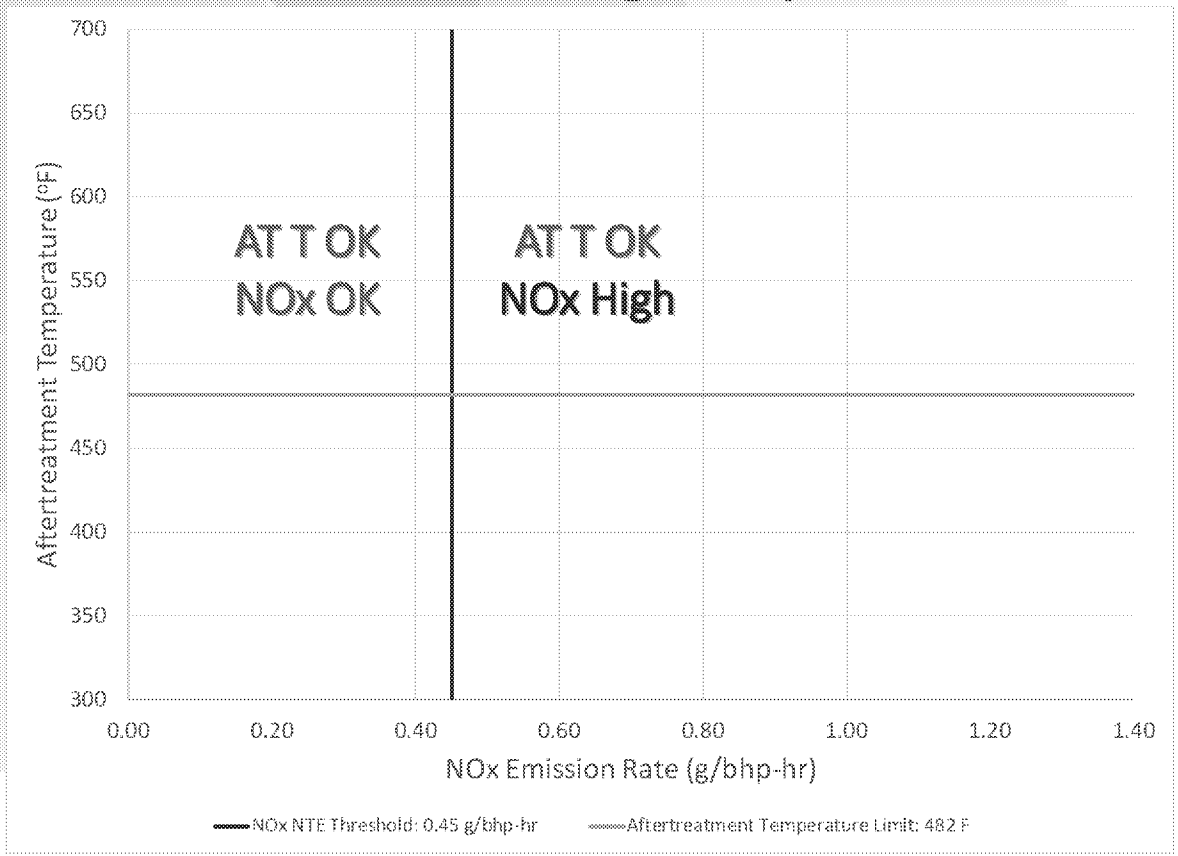
NTE Data Processing – Explanation V



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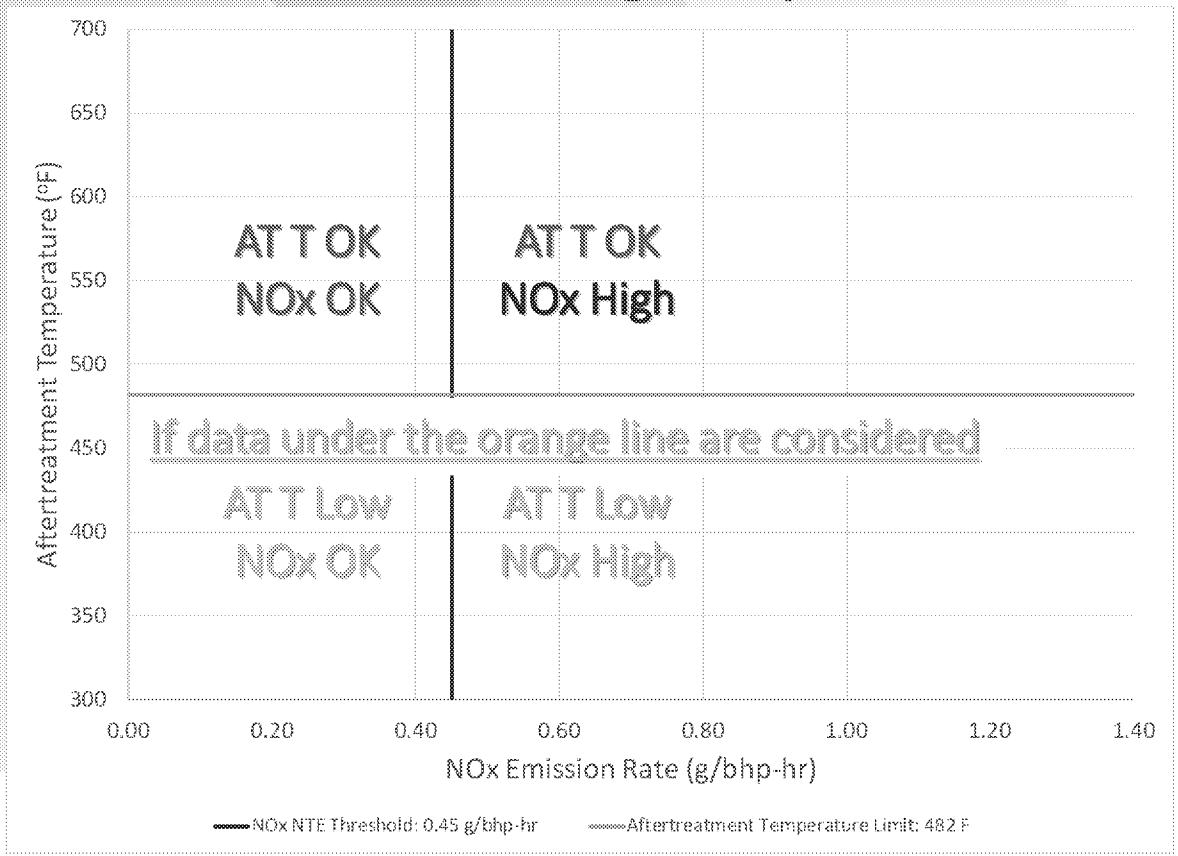
NTE Data Processing – Explanation V



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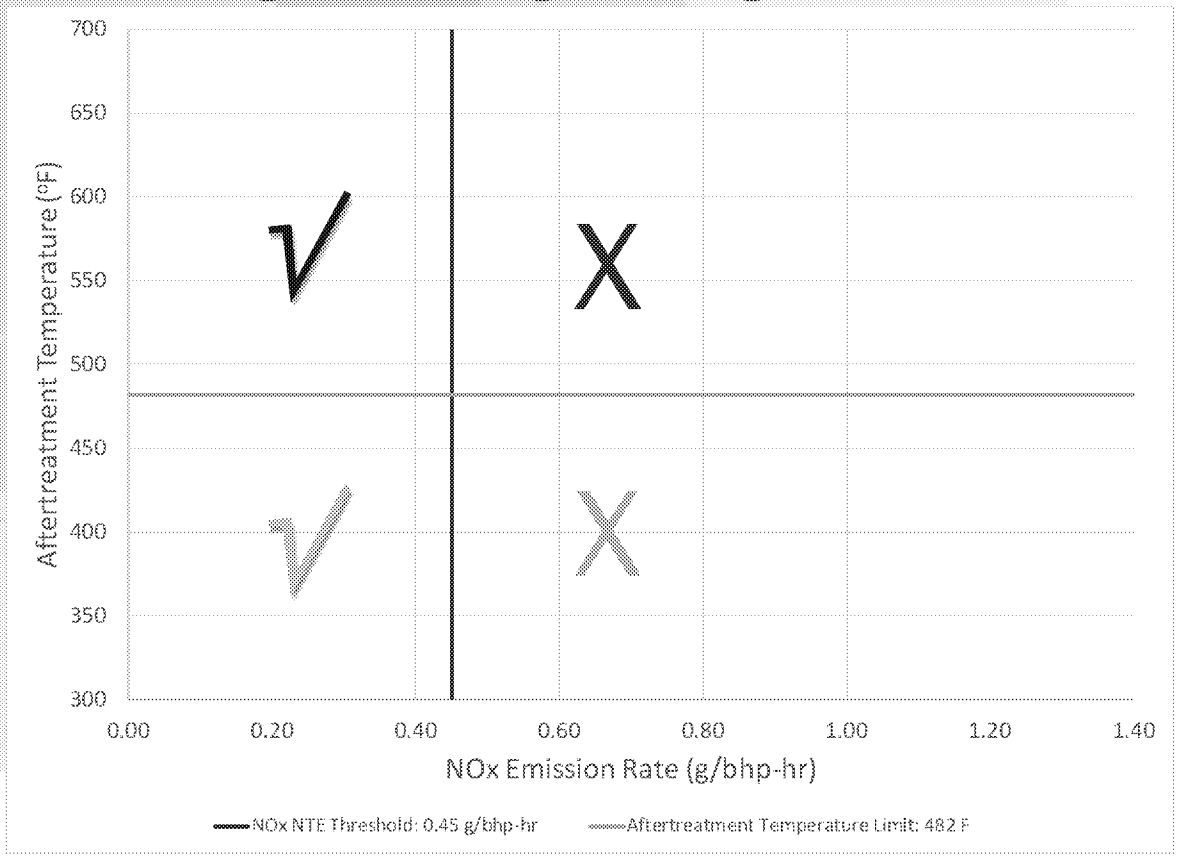
NTE Data Processing – Passing/Failing determination (All Data)



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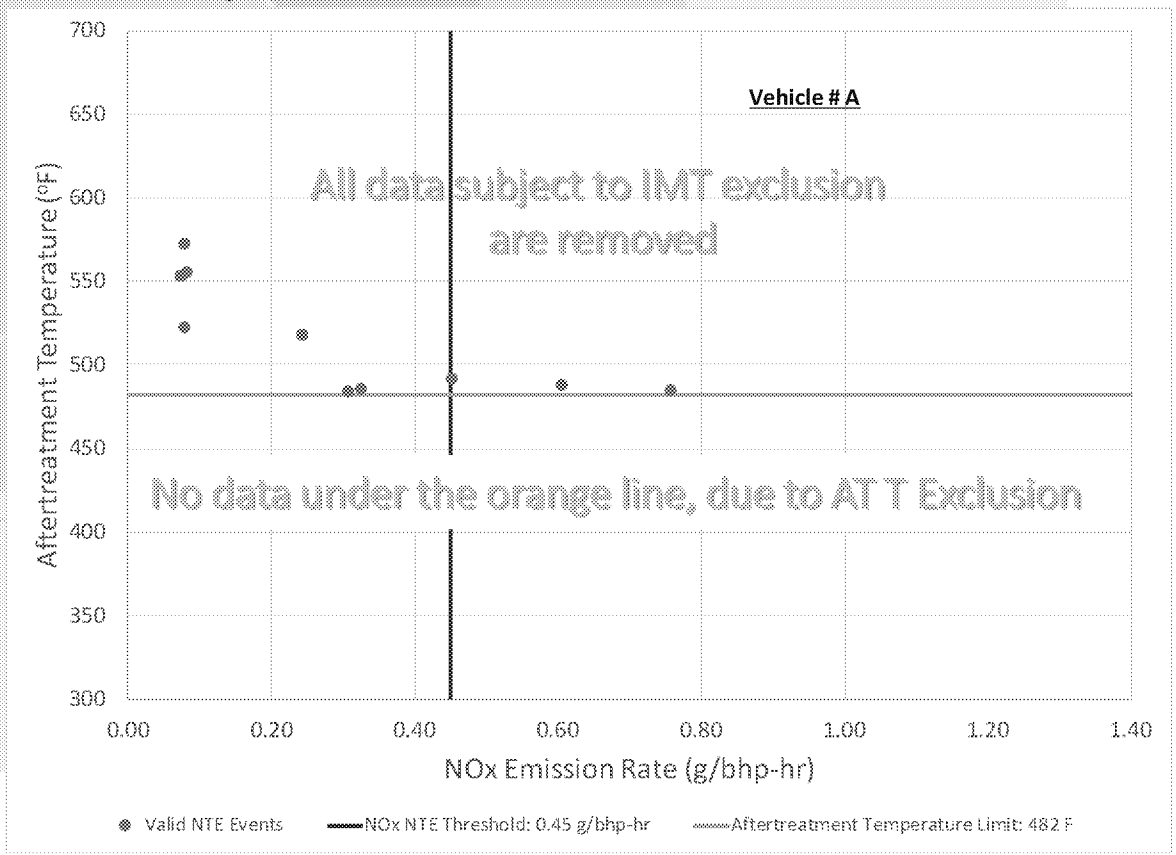
Example 1 – All Exclusion (Normal) I



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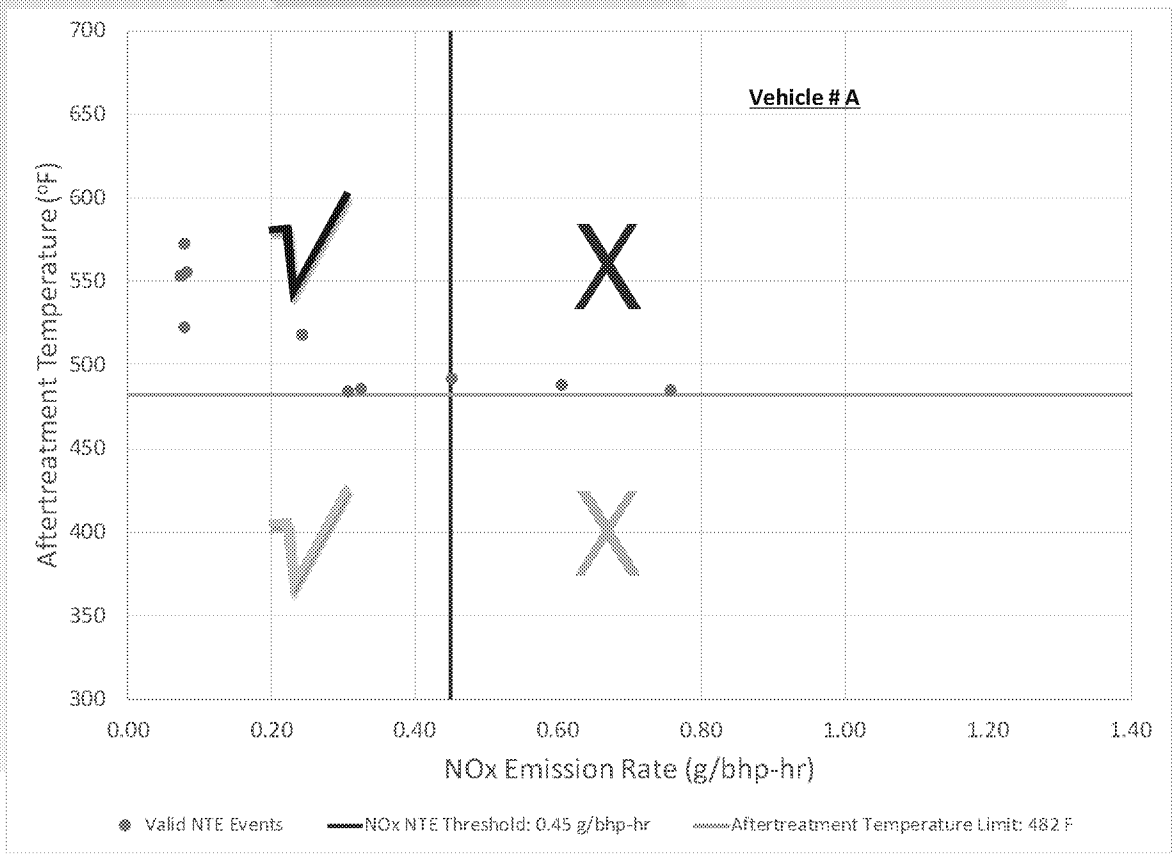
Example 1 – All Exclusion (Normal) II



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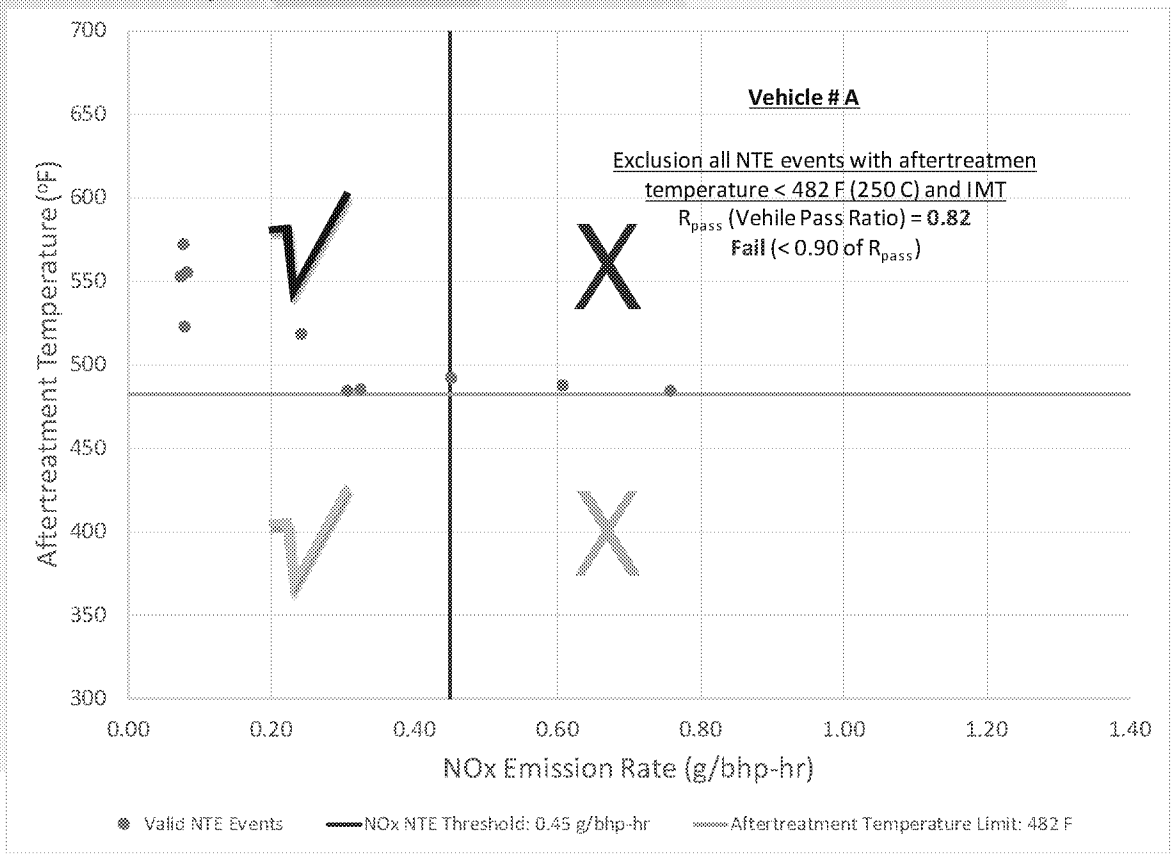
Example 1 – All Exclusion (Normal) III



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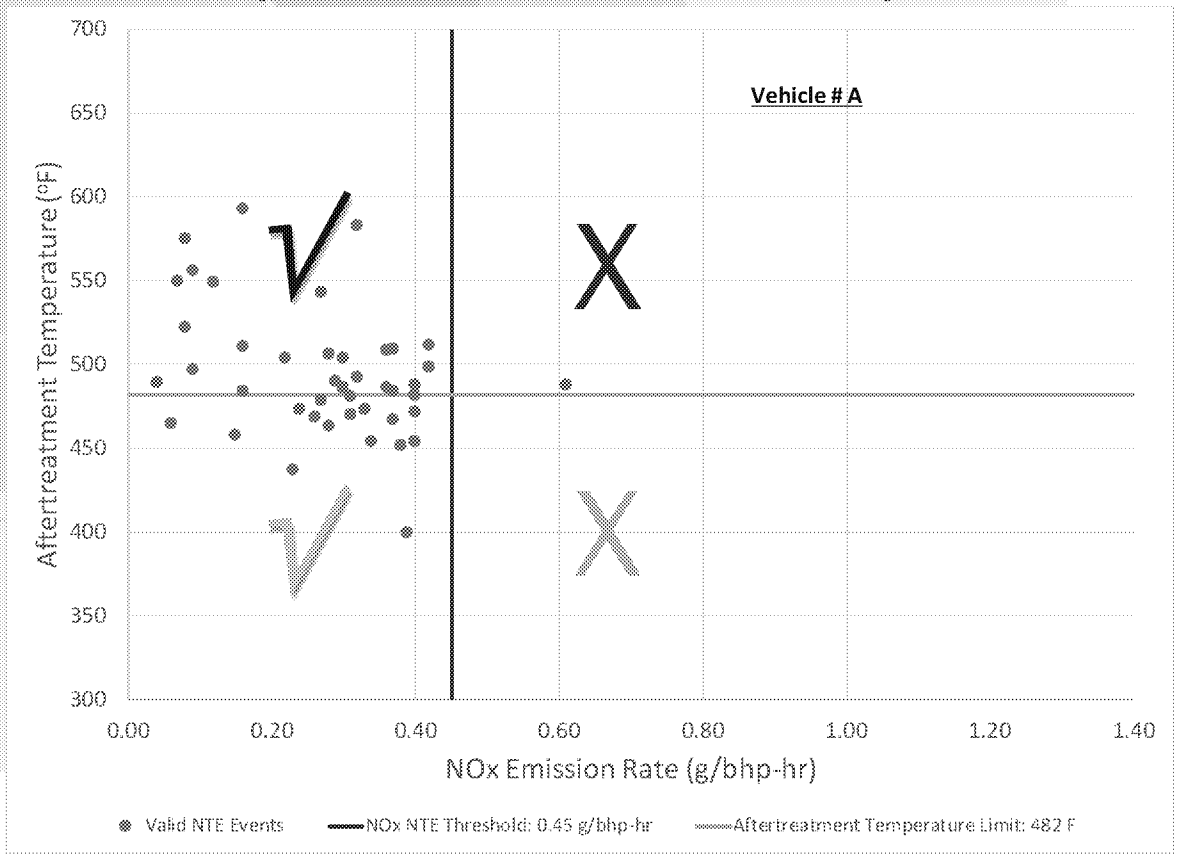
Example 1 – HDIUT Data Reported



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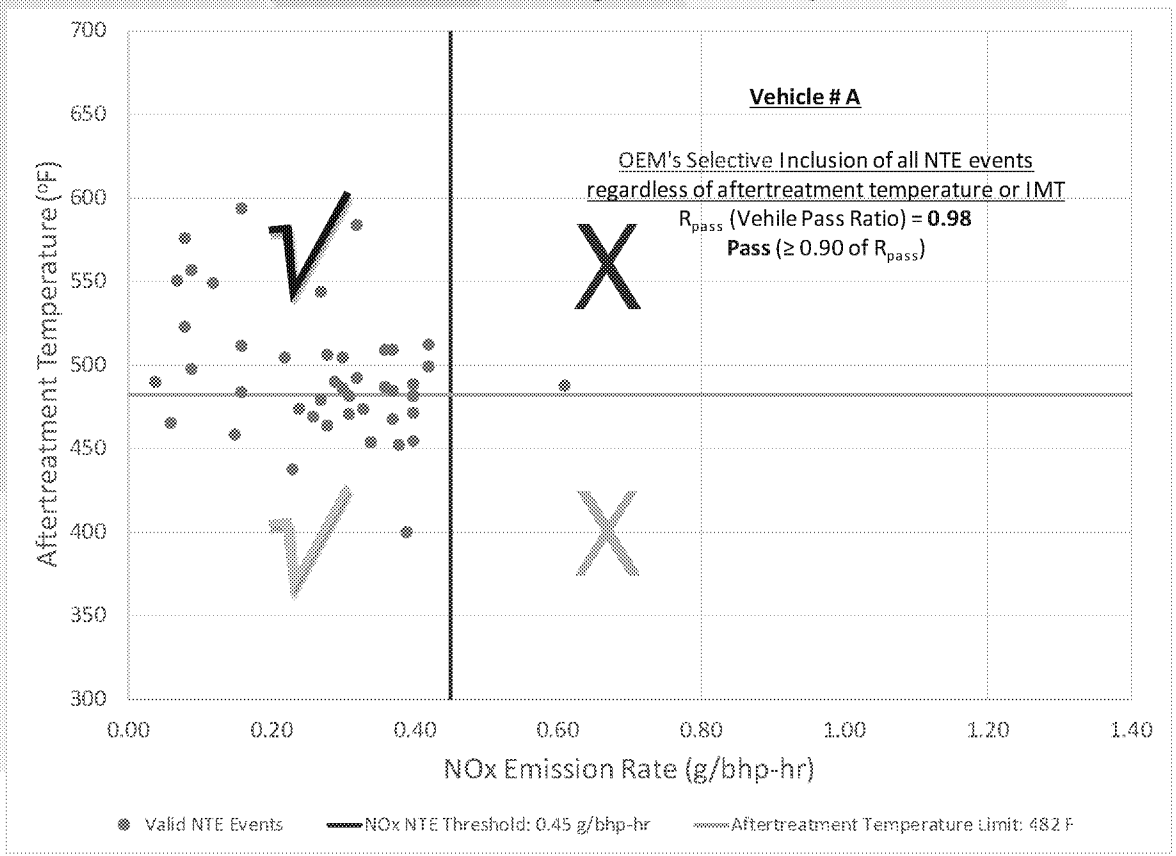
Example 1 – HDIUT Data Reported (Selective Inclusion)



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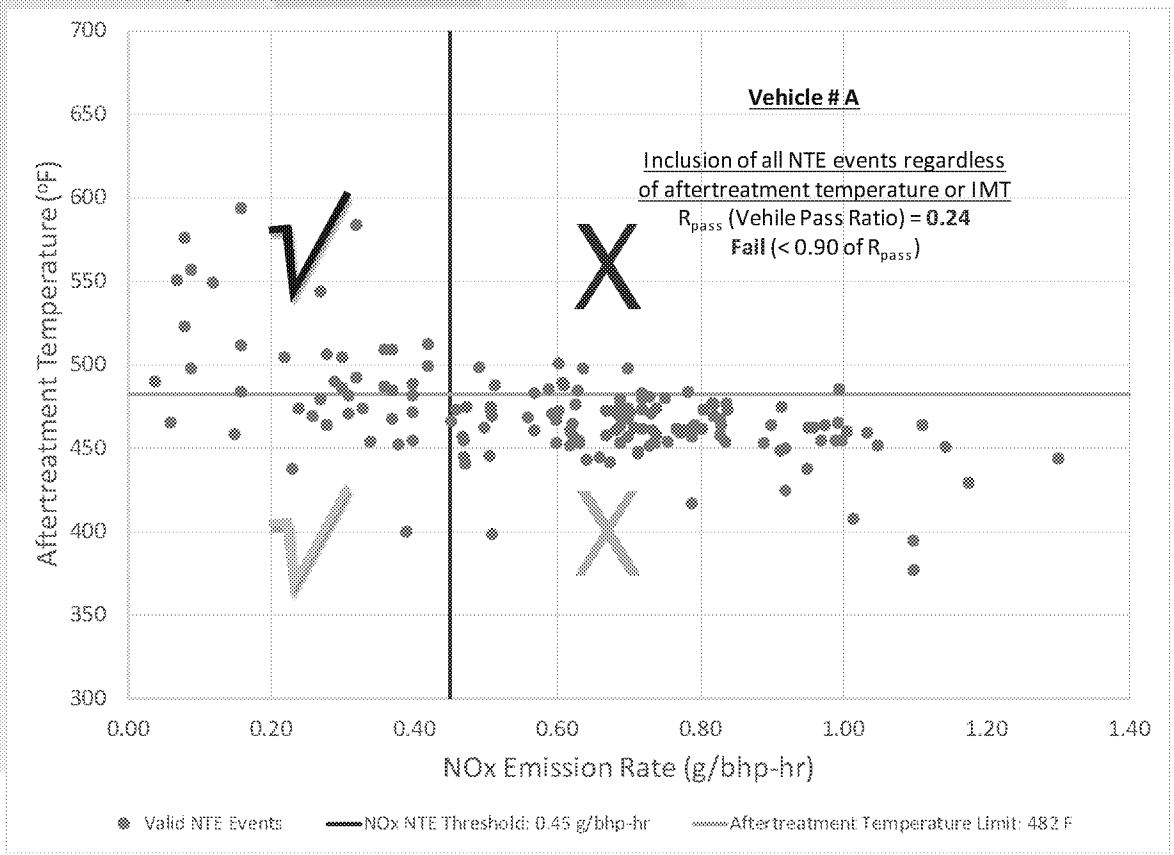
Example 1 – More Data (All AT T/IMT) I



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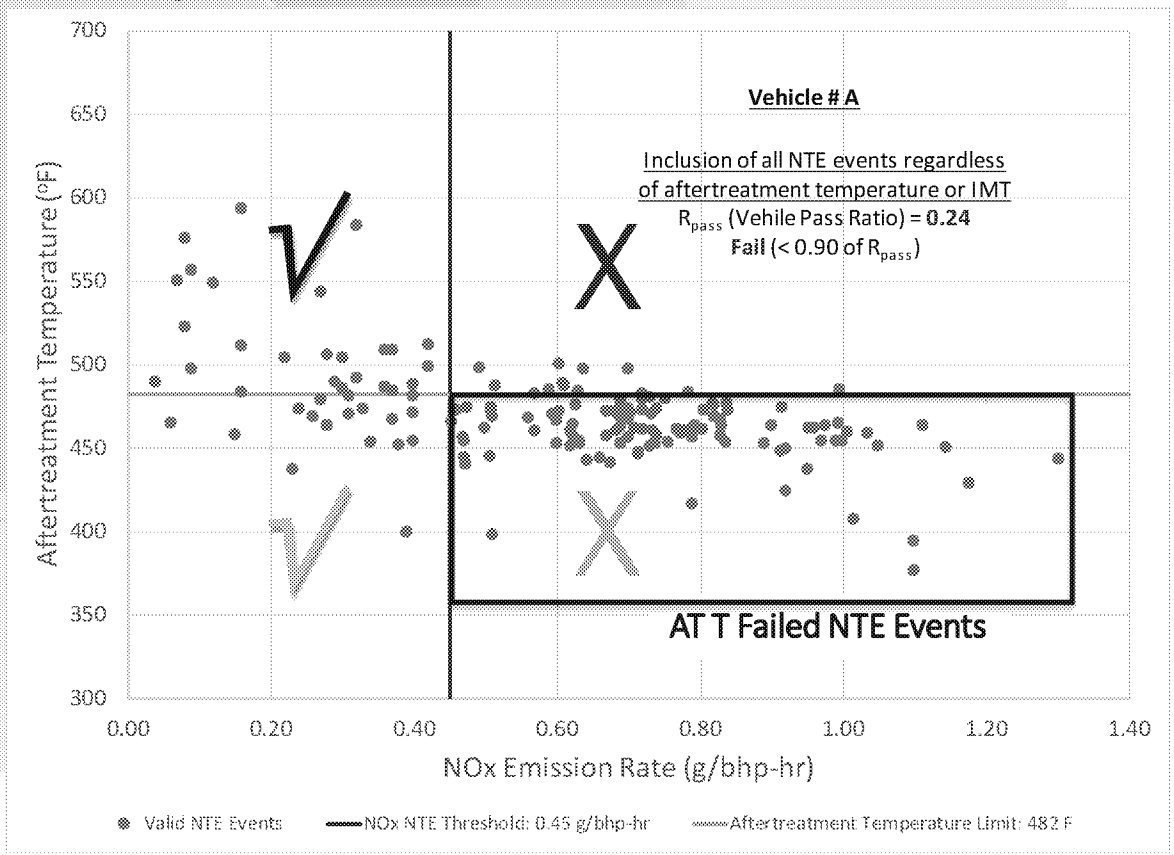
Example 1 – More Data (All AT T/IMT) II



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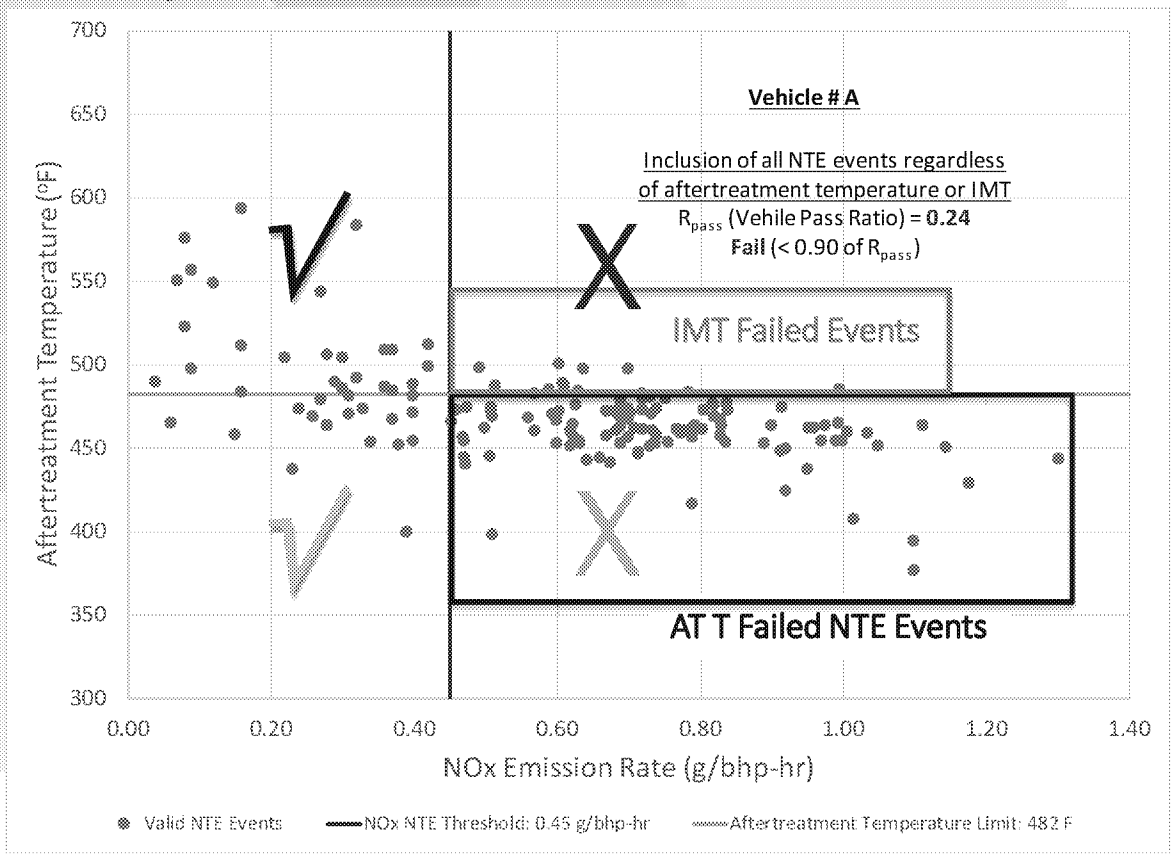
Example 1 – More Data (All AT T/IMT) III



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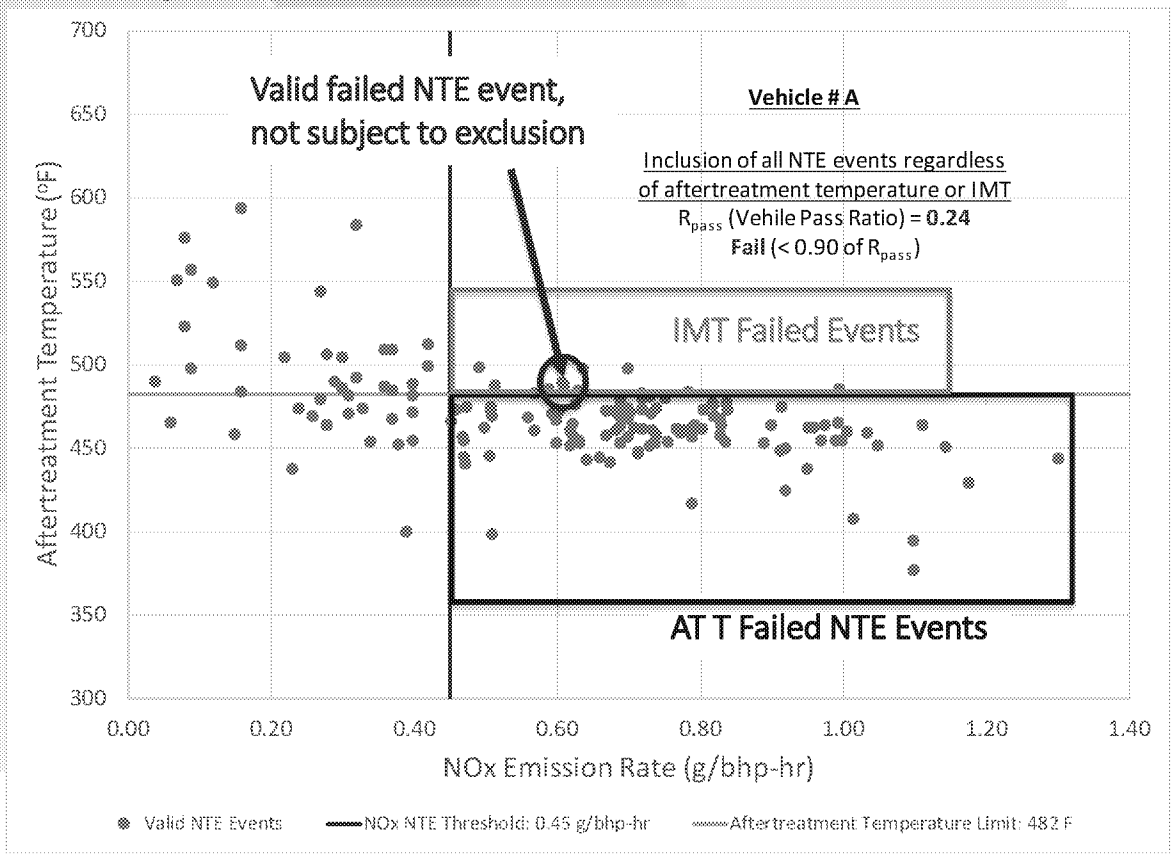
Example 1 – More Data (All AT T/IMT) IV



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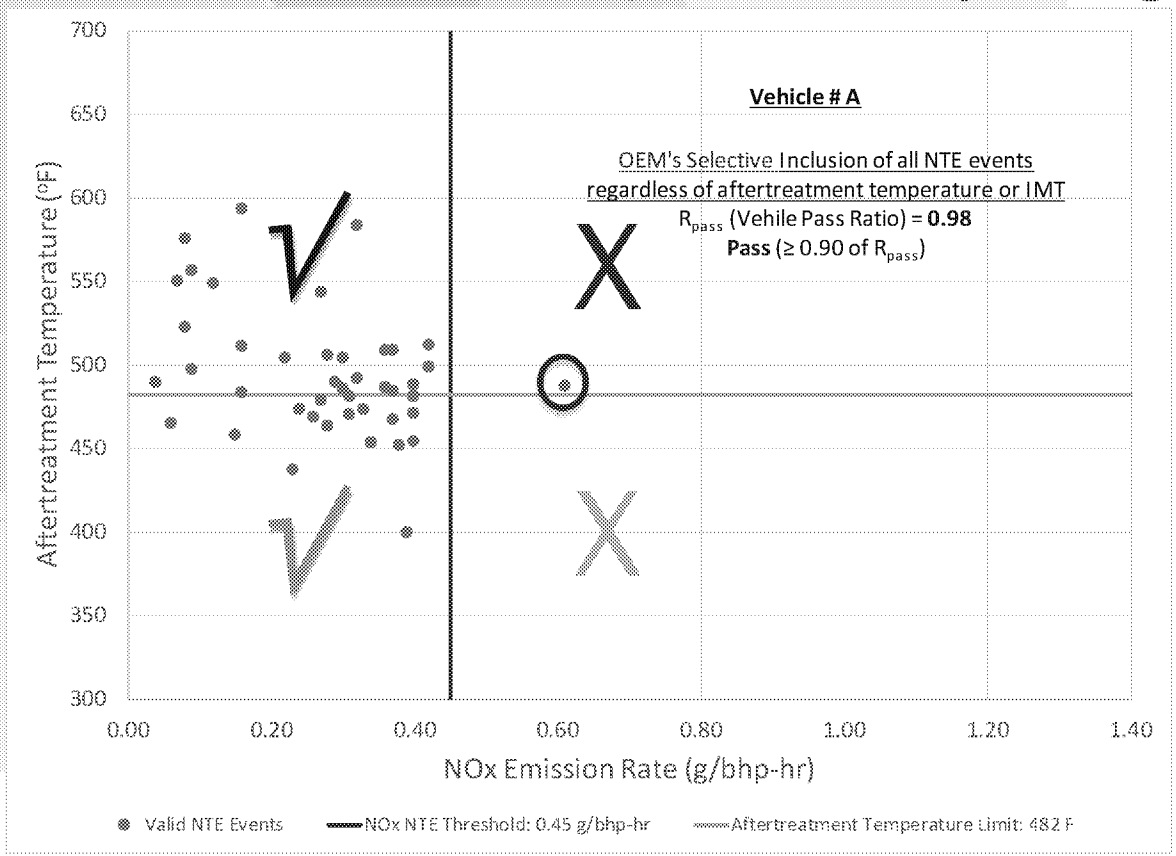
Example 1 – Inclusion of AT T/IMT (Selective – passing events only)



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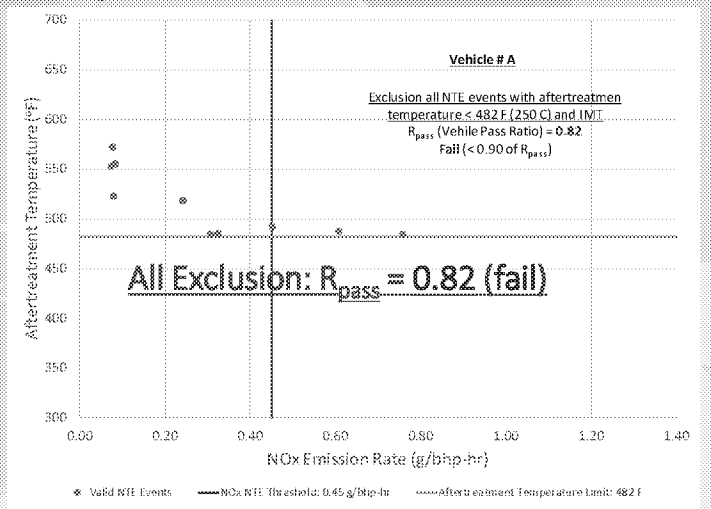
Example 1 – Selective Data Processing (Summary) I



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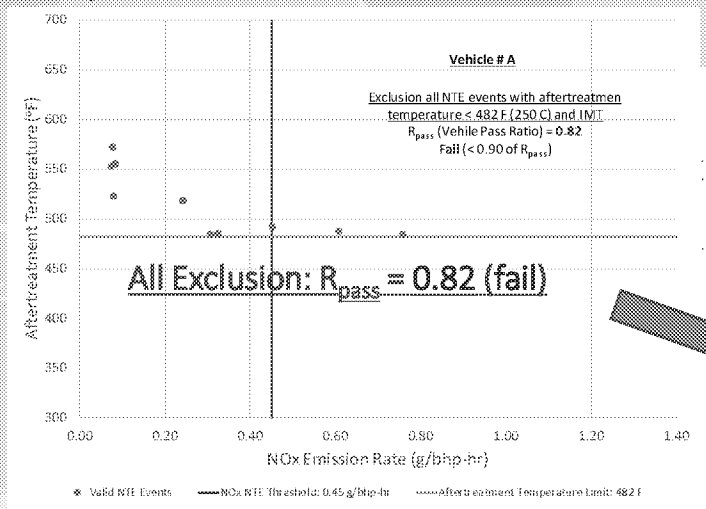
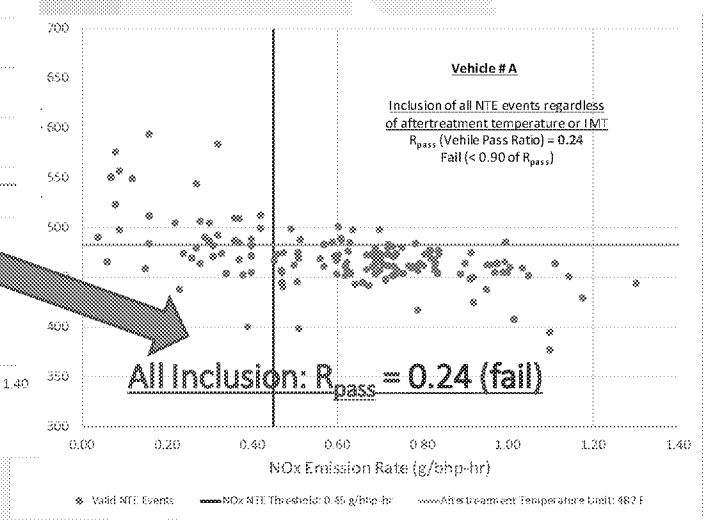
Example 1 – Selective Data Processing (Summary) II





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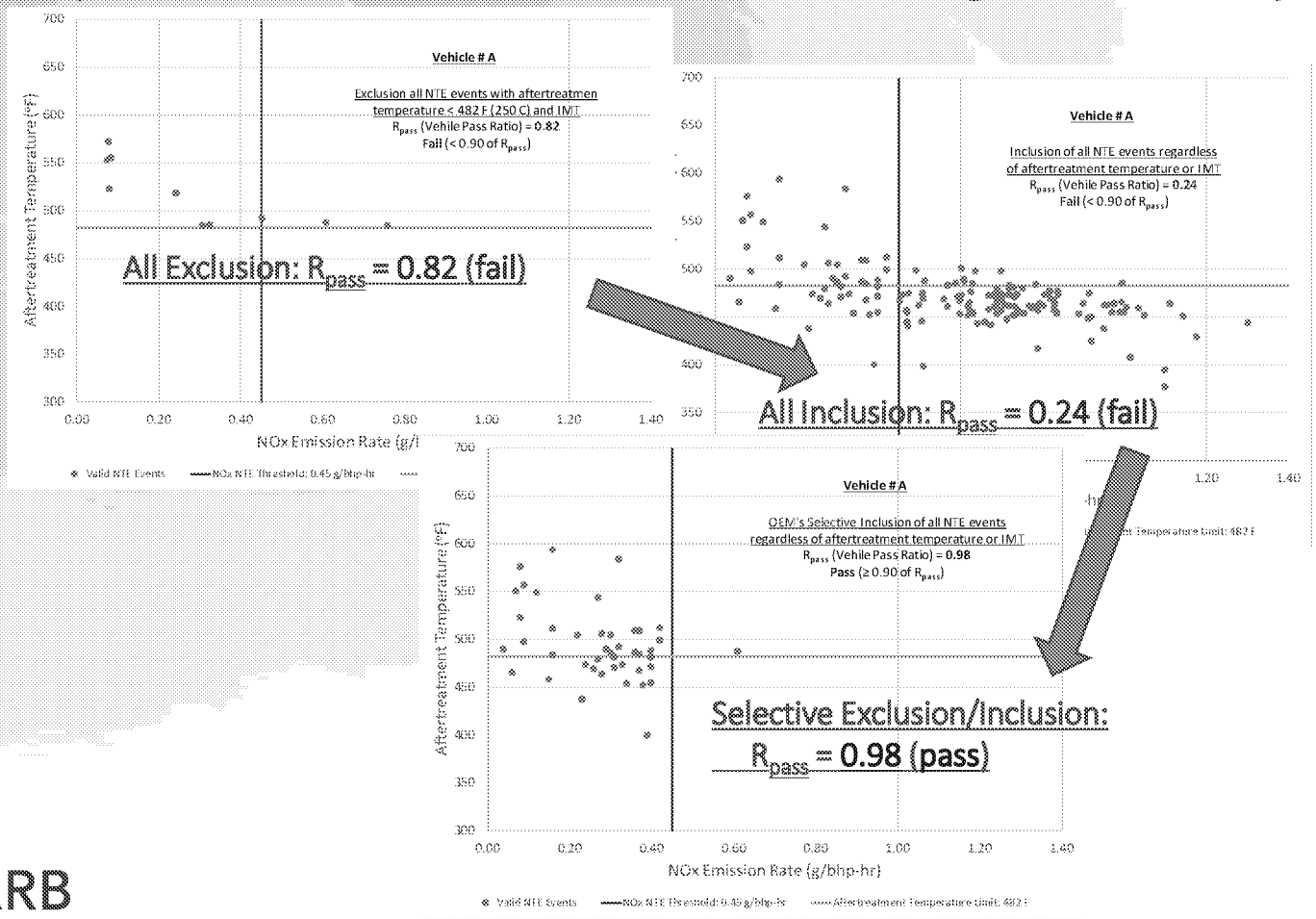
Example 1 – Selective Data Processing (Summary) III



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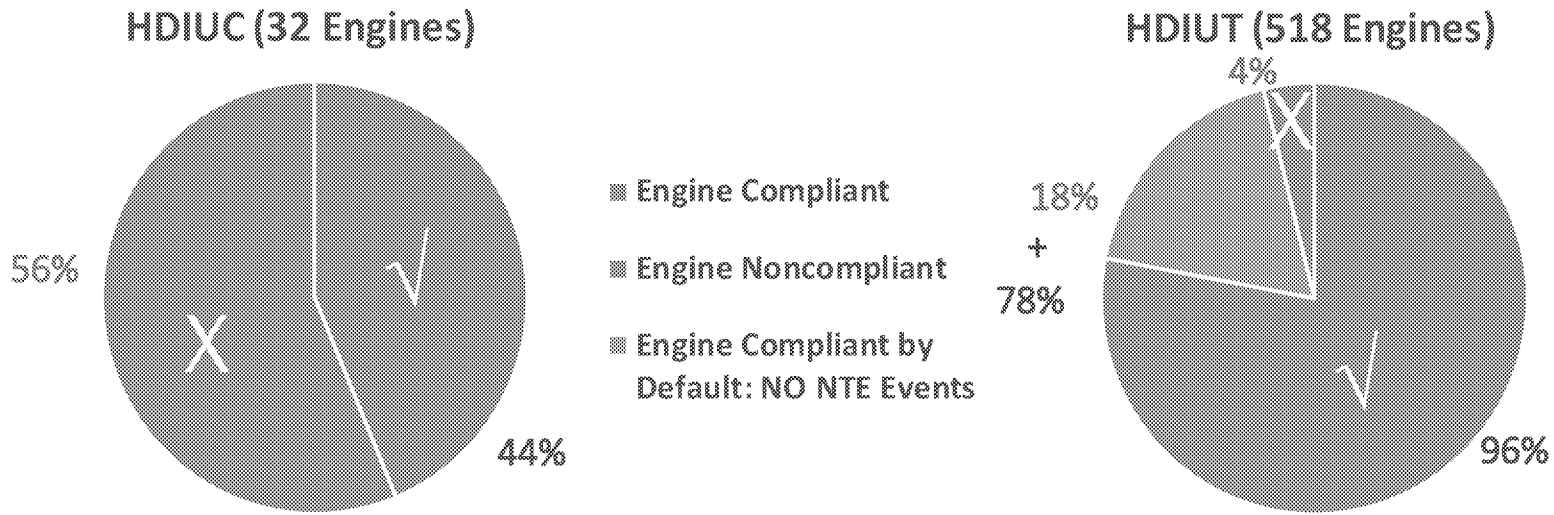
Findings – HDIUC vs. Mfr. HDIUT

- Based on data collected as of January 2019, CARB's HDIUC testing more effective than Mfr. HDIUT program in identifying noncomplying engines in need of corrective actions



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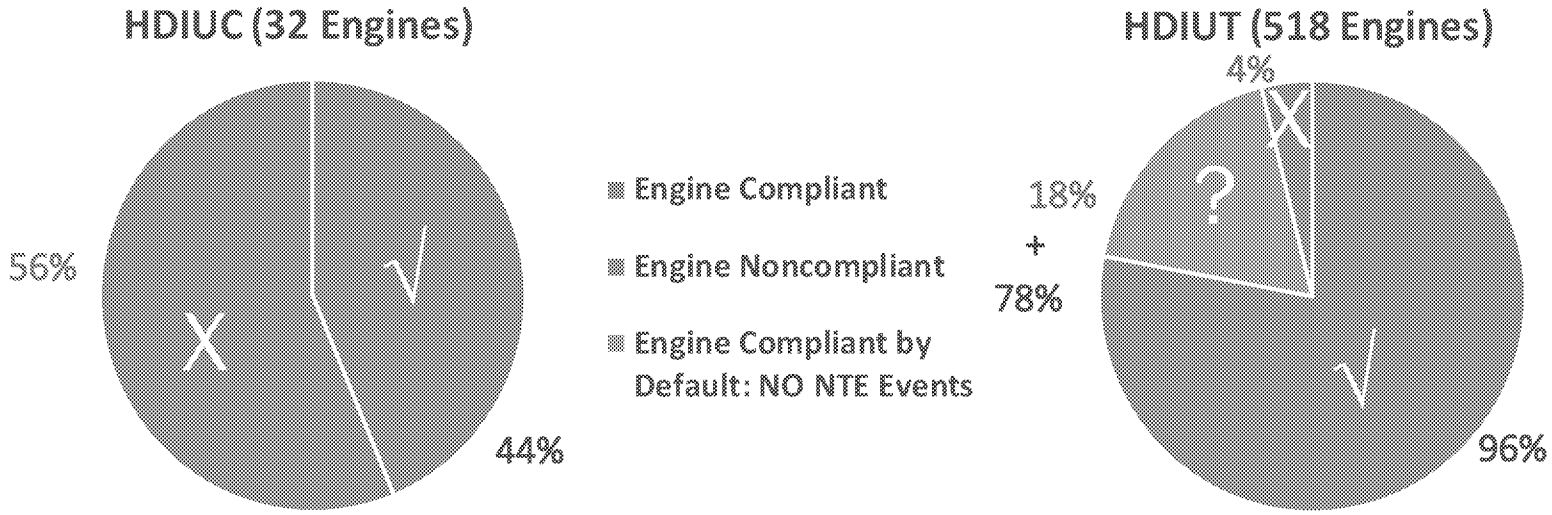
Findings – HDIUC vs. Mfr. HDIUT

- Based on data collected as of January 2019, CARB's HDIUC testing more effective than Mfr. HDIUT program in identifying noncomplying engines in need of corrective actions



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Conclusions

- Current Mfr. HDIUT program needs improvement to meet its own intent.
  - Not able to fully identify noncompliant engines/EFs
- HD Low NOx rulemaking proposal: Significant HDIUT amendments – Moving Average Window (for full duty cycle of PEMS testing) without IMT/AT T exclusion, lower in-use emissions threshold, preapproval of test plan by CARB, etc.
- Interim, OEMs should consider conducting testing and processing data in a similar manner to CARB HDIUC program
  - No selective inclusion/exclusion based on passing or failing status of NTE events:
    - ✓ Exclusion of both passing and failing events or inclusion of both
  - Avoid testing without any valid NTE events, especially, impacted by IMT exclusion
- CARB HDIUC program has completed testing of 2 engine families
  - One EF: Resulted in over 500,000 nationwide heavy-duty trucks recall
  - The other EF: On-going corrective action discussions with the engine manufacturer
  - Testing of more EFs in progress

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Thank you!

Questions?

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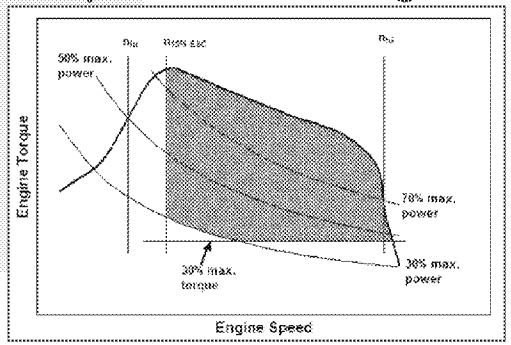
Backup Slides

Background – NTE Testing Requirements

- Heavy-duty in-use engine compliance program is designed to control diesel truck emissions during "*normal vehicle operation and use*" consistent with the not-to-exceed (NTE) requirements (40CFR86.1910(e))
  - Test duration
    - ✓ At least 3 hours of non-idling vehicle operation for testing of a shift-day or two days
  - NTE zone definition
    - ✓ Above 30% max engine power
    - ✓ Above 30% max engine torque
    - ✓ Above 15% ESC RPM
  - Duration and temperature (T) limits
    - ✓ At least 30 consecutive seconds
    - ✓ > 250 °C for Catalytic Aftertreatment (AT)/SCR T
    - ✓ EGR (Cold T Operation) Exclusion: IMT & Engine Coolant T
    - ✓ Ambient T Exclusion
  - Other provisions: BSFC, LTR/TWCOLTR, EMD/OBD, Deficiency, Regeneration, Zero Check



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Message

From: Sponsky John [john.sponsky@volvo.com]
Sent: 10/26/2018 11:58:08 AM
To: Duncan, Allen [duncan.allen@epa.gov]
Subject: RE: NTE Data INclusion and Exclusion

HI Allen,

Thank you for the follow-up.
Hopefully we can work through this quickly.

Best Regards,
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Thursday, October 25, 2018 4:15 PM
To: Sponsky John
Cc: Clark Taylor; Tasik Karl; Hamady, Fakhri; Laroo, Chris
Subject: RE: NTE Data INclusion and Exclusion

John;
I've attached the logic chart provided by Volvo (Page 1) and a modified version (Page 2) that represents the interpretation by FJ and I.

Chris is out of the office and hasn't had an opportunity to weigh in. I've cc'd him and expect he will comment when he returns.

It is possible that FJ and I are not in agreement with Chris. Whatever the case is, we will resolve the issue so that we can all move forward.

Best regards,

Allen

From: Sponsky John <john.sponsky@volvo.com>
Sent: Thursday, October 25, 2018 2:38 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Tasik Karl <karl.tasik@volvo.com>
Subject: NTE Data INclusion and Exclusion

Hi Allen,

I am following up with you on a topic other than our visit to Ann Arbor.

Taylor Clark and Karl Tasik mentioned that EPA had specific questions with regards to how Volvo includes and excludes NTE data.
Taylor is working on a summary to help clarify our process for evaluating data to be included or excluded.
This hopefully will help clarify the matter.
Taylor and Karl had also requested that EPA provide their questions and concerns to Volvo in writing.
This will help us better understand EPA's concerns.
Just wanted to see where we are at with regards to this matter.

Thank you!
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

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February 5, 2019

THOMAS A. FARNEN
U.S. EMISSIONS COUNSEL
THOMAS.FARNEN@VOLVO.COM
(301) 790-6786

Annette Hebert, Chief
California Air Resources Board
Emissions Compliance, Automotive Regulations
& Science Division
9480 Telestar Avenue, Suite #4
El Monte, CA 91731

Re: Not-to-Exceed Test Procedures for Manufacturer-Run In-Use Testing of Heavy-Duty Engines Under 40 C.F.R. § 86.1370 (Reference No. ICE-2018-021)

Dear Ms. Hebert:

I am writing on behalf of Volvo Group North America, Inc. ("Volvo") in response to your letter dated December 19, 2018, postmarked January 3, 2019, which Volvo received by U.S. mail on January 7, 2019. In that letter, you reiterated the California Air Resources Board's ("CARB's") request that Volvo reprocess the Manufacturer-Run In-Use Testing of Heavy Duty Engines ("HDIUT") Not-to-Exceed ("NTE") test data for Test ID #VPT182483 (collected under U.S. EPA's June 20, 2016 test order for Engine Family EVPTH12.8G01), by excluding all NTE events for which aftertreatment temperatures were less than 250°C. You further requested that Volvo resubmit the reprocessed data within 30 days of receipt of your letter.

As explained in my September 28, 2018 letter to Sharon Lemieux and Keith Macias, Volvo does not agree with CARB's interpretation of the applicable regulatory framework. Indeed, we are uncertain what rules CARB believes govern Volvo's processing of data for EPA's June 20, 2016 test order at issue here. Abraham Lee's September 10, 2018 email to Karl Tasik explains as applicable CARB's interpretation of 40 C.F.R. § 86.1370(g) and (h) as promulgated by EPA in 2016. In contrast, your December 19 letter appears to apply CARB rules incorporating EPA regulations as of 2014. Does this mean that CARB has abandoned Mr. Lee's analysis? Nevertheless, Volvo has reprocessed the data for Test ID# VPT182483 under the 2016 test order as CARB has requested by excluding all NTE events for which aftertreatment temperatures were less than 250°C. Those reprocessed data have been submitted directly to Abraham Lee, who normally receives our test data. Notwithstanding this submission, Volvo reserves its rights with respect to the 2016 test order and all subsequent test orders.

Volvo would appreciate the opportunity to meet with you and your colleagues to understand CARB's perspective on this issue moving forward. In particular, we have the following questions and concerns that we would like to discuss further:

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1. Effective Date of New CARB Rules. We understand that CARB has approved for adoption the California Greenhouse Gas Emissions Standards for Medium-and Heavy-Duty Engines and Vehicles (Phase 2), which will specifically incorporate without modification the provisions of 40 C.F.R. § 86.1370, as it was amended on October 25, 2016. CARB submitted that rulemaking package to the Office of Administrative Law ("OAL") on December 21, 2018. Your letter states that the rulemaking, including the October 2016 amendments to 40 C.F.R. § 1370, "only applies to new California certified 2021 and subsequent model year engines and vehicles." We have not been able to find any reference in the rulemaking materials limiting that provision's applicability to 2021 and subsequent model year engines and vehicles. Rather, our read of the Final Regulation Order is that the new test procedures, including the October 2016 amendments to 40 C.F.R. § 1370, apply immediately to all 1985 and subsequent model year heavy-duty diesel engines and vehicles. *See* 13 C.C.R. § 1956.8(b) (as amended). We would appreciate clarification on this issue, including CARB's basis for its interpretation in the regulatory language or any other sources for the limitation to only 2021 and subsequent model year engines.

2. Interpretation of 40 C.F.R. § 86.1370 (Oct. 2016). Your letter states that CARB interprets 40 C.F.R. §§ 86.1370(g) and (h), as amended on October 25, 2016, to allow manufacturers "either to set a specific [aftertreatment temperature] threshold below 250°C and include all NTE data collected when [aftertreatment temperatures] are between the specified [temperature] and 250°C regardless of the 'pass' or 'fail' status of NTE events . . . or to exclude all of the NTE data with [aftertreatment temperatures] below 250°C." We cannot find any discussion of CARB's interpretation or the option of establishing a temperature threshold in CARB's rulemaking proceeding for consideration and comment by stakeholders, and U.S. EPA has confirmed a different interpretation of the language. We would like to understand better CARB's basis for this interpretation of the regulatory language.

3. Applicability of CARB Interpretation. Your letter notes that CARB staff, by email dated September 10, 2018 from Mr. Abraham Lee, previously proposed that Volvo may be able to use the above methodology to process HDIUT data generated when exhaust gas temperatures are below 250°C. Your letter also states, however, that "this methodology only applies to new California certified 2021 and subsequent model year engines and vehicles." As a result, it is unclear whether CARB's position is that Volvo is permitted to use this methodology for the 2016 test order, as contemplated in Mr. Lee's email, or whether Volvo may use this methodology only for 2021 and later model year engines and vehicles.

4. Implementation of Specific Test Orders and Coordination with U.S. EPA. As you know, the reprocessed test data were collected pursuant to U.S. EPA's June 20, 2016 test order, which directed Volvo to sample the engines according to federal regulations and U.S. EPA guidance, and submit a copy of the data to CARB. Notwithstanding reference in your letter to CARB's 2016 test order, we are not aware of any such CARB order. Where EPA and CARB differ on the methodology to

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process in-use test data, we want to clarify with you how Volvo should address specific orders and the potential consequences of processing data differently for the two agencies that potentially could lead to different results.

Volvo very much appreciates your attention to this matter. Please let us know if there is a date and time for Volvo representatives to meet with CARB staff to discuss this issue further.

Sincerely,

Thomas Farnen

cc: Michael Balthasar, Global Vice President of Certification & Compliance, Volvo Group

Message

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 3/1/2019 8:54:37 PM
To: Duncan, Allen [duncan.allen@epa.gov]
Subject: Heavy Duty In-Use Testing Data Processing

Allen –

I just left you a voice mail. When we last spoke, I said I would get back to you regarding 40 CFR 86.1370(f), (g) and (h). Can you please let me know when you might have time to speak? Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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For more information about Arnold & Porter, click here:
http://www.arnoldporter.com

Message

From: Clever Timothy [tim.clever@volvo.com]
Sent: 10/22/2018 2:50:24 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Tasik Karl [karl.tasik@volvo.com]
CC: Duncan, Allen [duncan.allen@epa.gov]; Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: Volvo 2018 In-Use Test Data Submittal
Attachments: ATT00001.txt; NTE Processing Explained.docx

Hello All,

Attached is a text document explaining the NTE evaluation process and flow chart.

Br
Tim

From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Monday, October 22, 2018 9:16 AM
To: Tasik Karl
Cc: Clever Timothy; Duncan, Allen; Lee, Abraham@ARB
Subject: RE: Volvo 2018 In-Use Test Data Submittal

I emailed the 1HZ data file couple times but failed due to its large size. Please find attached the same 1HZ data file but saved in Excel .xlsb. Please let me know if you have any questions.

Regards,
FJ Hamady

From: Hamady, Fakhri
Sent: Monday, October 22, 2018 8:42 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Duncan, Allen <duncan.allen@epa.gov>; 'Lee, Abraham@ARB' <abraham.lee@arb.ca.gov>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Karl,

Please find attached the two documents would like to discuss with you and Timothy, at our conference call today Oct 22nd at 3:00 EST. If you have any questions or need any additional information, please feel free to contact me at any time.

Regards,
FJ Hamady

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Monday, October 15, 2018 2:20 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

FJ,

Per our discussion today, I have updated the following 3 xml files relative to the 2015 FVPTH12.8G01 engine family in-use data submittal.

File Folder	Vehicle VIN	File Content	File Description
1_VPT955666_HVE1275	4V4NC9EH3GN955666	Program Information	VPT955666_20180828_HVE1275.xml
2_VPT933817_HVE1193	4V4NC9EH9GN933817	Program Information	VPT933817_20180829_HVE1193.xml
3_VPT933831_HVE1207	4V4NC9EH3GN933831	Program Information	VPT933831_181001_HVE1207.xml

Also per our discussion, attached is the Volvo NTE logic diagram which we can review further with Tim Clever this week.

Please let me know if you have any further questions.

Karl

From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Monday, October 15, 2018 9:27 AM
To: Tasik Karl
Cc: Clever Timothy
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Karl,

I couldn't download "FVPTH12.8G01-PRG-20181011013021-VPT955676.xml" due to parsing error, and few files having same test ID.

I would like to discuss the Test ID with you this afternoon.

Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Thursday, October 11, 2018 1:36 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Falkhri,

I have just submitted the first four 2018 in-use testing order files into the EPA Verify System.

Please confirm they have been properly submitted and let me know if you have any questions.

Thanks,
Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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NTE Processing Explained

1. Every second is Checked for:
    a. Speed, Torque, Power, PEMS
    b. Altitude, Ambient Temp, IMT, ECT, AT Temp
2. If the speed, torque, power are within the NTE Zone and PEMS is ready, create a "NTE Segment"
3. Check all of the segments for length, if the length is >30s the segment becomes a "Possible NTE Event"
4. For each "Possible Event" calculate the Brake Specific Emissions of the event
5. For each "Possible Event" determine the flags of the event
    a. EATS Flag = AT Temp > 250
    b. EGR Flag = ECT > ECT_EGR or IMT>IMT_EGR
    c. Emission Drift Flag = NOx, CO, NMHC Drift flag
        i. These are defined by AVL Concerto
6. For each "Possible Event" define it by its flags
    a. No Flags
    b. EGR
        i. EGR – defined by 86.1370(f)
        ii. EGR & EATS - defined by 86.1370(f) and 86.1370(g)
        iii. EGR & EATS & DRIFT – defined by 86.1370(f), 86.1370(g), 1065.672(c)
        iv. EGR & DRIFT - defined by 86.1370(f) and 1065.672(c)
    c. EATS
        i. EATS – defined by 86.1370(g)
        ii. EATS & DRIFT - defined by 86.1370(g) and 1065.672(c)
7. For each "Possible Event" categorize it by its flags
    a. No Flags – This event must be kept it will be a final event
    b. Drift Flag – Any event flagged for Drift – even if it had EGR or EATS
    c. EGR Flag – These include events that contain EGR & EATS
    d. EATS Flag – These include events that only contain an EATS Flag
8. Look at EGR Flag events
    a. If the event is below the emissions standards – keep it per 86.1370(h)
        i. (h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in §86.1912 for the specific pollutant.
        ii. Label it as a pass and count it toward the VPR
    b. If the event is above the emissions standards it is labeled as a "Check Event"
        i. it is not subject to the emission limits therefore "may" be excluded
        ii. (f) *NTE cold temperature operating exclusion.* Engines equipped with exhaust gas recirculation (EGR) whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature

conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions.

9. Look at No Flag events
    a. If the event is below the emissions standards – keep it
        i. All points are subject to NTE emissions limits
        ii. Label it as a pass and count it toward the VPR
    b. If the event is below the emissions standards – keep it
        i. All points are subject to NTE emissions limits
        ii. Label it as a fail and count it toward the VPR
10. Look at EATS Flag events
    a. If the event is below emissions standards – keep it
        i. Is kept although it "may be excluded" per 86.1370(g)
        ii. Label it as a pass and count it toward the VPR
    b. If the event is above the emissions standards – keep it
        i. Exclude it from VPR – events may be excluded per 86.1370(g)

            1. (g) You may exclude emission data based on catalytic aftertreatment temperatures as follows:

            (1) For an engine equipped with a catalytic NO_x aftertreatment system, exclude NO_X emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C.

11. Look at "Check Events" from the EGR Category
    a. Go through each second of the event
        i. Start a segment at the first point with no EGR Flag
        ii. If there is no EGR flag at the next point add it to segment of consecutive points
        iii. If there is an EGR Flag at the next second, break the segment and start a new one at the next point with no EGR flag
        iv. Repeat until the end of the "Possible NTE Event"
        v. Look at all the segments to check for lengths longer than 30 seconds
            1. These events will become "New Events"
                a. All points are subject to NTE emissions limits
                b. These events will be submitted and count towards the VPR
            2. All "Possible Events" that did not have a more than 30 consecutive seconds with no EGR Flags are ignored
                a. these are not considered NTE events because they are less than 30 seconds
12. Look at "New Events" that were created from the "Check Events"
    a. If the event is below the emissions standards – keep it
        i. All points are subject to NTE emissions limits
        ii. Label it as a pass and count it toward the VPR
    b. If the event is below the emissions standards – keep it

i. If the event has an EATS Flag at any point
    1. Label it as an exclude per 86.1370(g)
ii. If the event has no EATS Flag at any point
    1. All points are subject to NTE emissions limits
    2. Label it as a fail and count it toward the VPR

Message

From: Clark Taylor [taylor.clark@volvo.com]
Sent: 11/16/2018 2:01:20 PM
To: Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
CC: Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: HDIUT Data Processing
Attachments: NTE EGR Event Example.xlsx

All,

Attached is the example NTE event that we discussed during our meeting this morning.

Thanks again for your time and please let me know if you have any further questions.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Thursday, November 15, 2018 12:25 PM
To: Laroo, Chris; Clark Taylor
Cc: Sponsky John; Hamady, Fakhri
Subject: RE: HDIUT Data Processing

Yes. I will put it in my calendar.

From: Laroo, Chris
Sent: Thursday, November 15, 2018 12:06 PM
To: Duncan, Allen <duncan.allen@epa.gov>; Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Allen,

Would 830 am Friday morning in the lobby work?

Regards,

Chris Laroo
Environmental Protection Specialist

US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Duncan, Allen
Sent: Thursday, November 15, 2018 9:13 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Laroo, Chris <laroo.chris@epa.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Taylor;
That sounds good. I'd like to see if we can get Chris Laroo to join us. I assume he will be in and out of the EMTC meeting.

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, November 15, 2018 8:28 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Sponsky John <john.sponsky@volvo.com>
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

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An event is exported from Concerto with the EGR box unchecked, but the same event would not appear if the EGR box was checked. It would look differently. Concerto uses EGR as a gate parameter to enter or exit the NTE Zone

Point	Concerto EGR Box Unchecked	Concerto EGR Box Checked	IMT flag	ECT flag
#	(NTE Zone?)	(NTE Zone?)	boolean	boolean
1	Yes	No	1	1
2	Yes	No	1	1
3	Yes	No	1	1
4	Yes	No	1	0
5	Yes	No	1	0
6	Yes	Yes	0	0
7	Yes	Yes	0	0
8	Yes	Yes	0	0
9	Yes	Yes	0	0
10	Yes	Yes	0	0
11	Yes	Yes	0	0
12	Yes	Yes	0	0
13	Yes	Yes	0	0
14	Yes	Yes	0	0
15	Yes	Yes	0	0
16	Yes	Yes	0	0
17	Yes	Yes	0	0
18	Yes	Yes	0	0
19	Yes	Yes	0	0
20	Yes	Yes	0	0
21	Yes	Yes	0	0
22	Yes	Yes	0	0
23	Yes	Yes	0	0
24	Yes	Yes	0	0
25	Yes	Yes	0	0
26	Yes	Yes	0	0
27	Yes	Yes	0	0
28	Yes	Yes	0	0
29	Yes	Yes	0	0
30	Yes	Yes	0	0
31	Yes	Yes	0	0
32	Yes	Yes	0	0
33	Yes	Yes	0	0
34	Yes	Yes	0	0
35	Yes	Yes	0	0
36	Yes	Yes	0	0
37	Yes	Yes	0	0
38	Yes	Yes	0	0
39	Yes	Yes	0	0
40	Yes	Yes	0	0

41	Yes	Yes	0	0
42	Yes	Yes	0	0
43	Yes	Yes	0	0
44	Yes	Yes	0	0
45	Yes	Yes	0	0
46	Yes	Yes	0	0
47	Yes	Yes	0	0
48	Yes	Yes	0	0
49	Yes	No	0	1
50	Yes	No	0	1
51	Yes	No	0	1
52	Yes	No	0	1
53	Yes	No	1	1
54	Yes	No	1	1
55	Yes	No	1	1
56	Yes	No	1	0
57	Yes	No	0	0
58	Yes	No	0	0
59	Yes	No	0	0
60	Yes	No	1	1
61	Yes	No	1	0
62	Yes	No	1	0

EGR flag				Point
boolean				#
1				1
1	The Full Event is Evaluated for Emissions: (Nox g/bhp-hr > 0.45)	The Event Fails >>>>>>>>>>>>>>>	The Data Not Subject to Emissions Limits is excluded per 86.1370(h) "may be excluded"	2
1				3
1				4
1				5
0				6
0				7
0				8
0				9
0				10
0				11
0				12
0				13
0	>>>>>>>>>>	or	>>>>>>>>>	14
0				15
0				16
0				17
0		**The event passes and the entire event is kept for submission based on the 86.1370(h) "may be excluded"**		18
0				19
0				20
0				21
0				22
0				23
0				24
0				25
0				26
0				27
0				28
0				29
0				30
0				31
0				32
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0				38
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0				40

0	41
0	42
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0	48
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0	57
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1	60
1	61
1	62

Concerto EGR Box Unchecked	Concerto EGR Box Checked	IMT flag	ECT flag	EGR flag
(NTE Zone?)	(NTE Zone?)	boolean	boolean	boolean
Yes	No	1	1	1
Yes	No	1	1	1
Yes	No	1	1	1
Yes	No	1	0	1
Yes	No	1	0	1
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0

Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	Yes	0	0	0
Yes	No	0	1	1
Yes	No	0	1	1
Yes	No	0	1	1
Yes	No	0	1	1
Yes	No	1	1	1
Yes	No	1	1	1
Yes	No	1	1	1
Yes	No	1	0	1
Yes	No	0	0	0
Yes	No	0	0	0
Yes	No	0	0	0
Yes	No	1	1	1
Yes	No	1	0	1
Yes	No	1	0	1

The remaining data is checked to see if it qualifies as an NTE Event (>30s with no flags)

>>>>>>>>>>

Otherwise it is discarded because it is not considered an Event (<30s)

Point #	Concerto EGR Box Unchecked (NTE Zone?)	Concerto EGR Box Checked (NTE Zone?)
1	Yes	No
2	Yes	No
3	Yes	No
4	Yes	No
5	Yes	No
6	Yes	Yes
7	Yes	Yes
8	Yes	Yes
9	Yes	Yes
10	Yes	Yes
11	Yes	Yes
12	Yes	Yes
13	Yes	Yes
14	Yes	Yes
15	Yes	Yes
16	Yes	Yes
17	Yes	Yes
18	Yes	Yes
19	Yes	Yes
20	Yes	Yes
21	Yes	Yes
22	Yes	Yes
23	Yes	Yes
24	Yes	Yes
25	Yes	Yes
26	Yes	Yes
27	Yes	Yes
28	Yes	Yes
29	Yes	Yes
30	Yes	Yes
31	Yes	Yes
32	Yes	Yes
33	Yes	Yes
34	Yes	Yes
35	Yes	Yes
36	Yes	Yes
37	Yes	Yes
38	Yes	Yes
39	Yes	Yes
40	Yes	Yes

41	Yes	Yes
42	Yes	Yes
43	Yes	Yes
44	Yes	Yes
45	Yes	Yes
46	Yes	Yes
47	Yes	Yes
48	Yes	Yes
49	Yes	No
50	Yes	No
51	Yes	No
52	Yes	No
53	Yes	No
54	Yes	No
55	Yes	No
56	Yes	No
57	Yes	No
58	Yes	No
59	Yes	No
60	Yes	No
61	Yes	No
62	Yes	No

IMT flag	ECT flag	EGR flag
boolean	boolean	boolean
1	1	1
1	1	1
1	1	1
1	0	1
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0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	1	1
0	1	1
0	1	1
0	1	1
1	1	1
1	1	1
1	1	1
1	0	1
0	0	0
0	0	0
0	0	0
1	1	1
1	0	1
1	0	1

	Point	Concerto EGR Box Unchecked	Concerto EGR Box Checked	IMT flag	ECT flag	EGR flag
	#	(NTE Zone?)	(NTE Zone?)	boolean	boolean	boolean
The "New Event" is evaluated for Emissions Criteria and classified as a Pass or a Fail						
	6	Yes	Yes	0	0	0
	7	Yes	Yes	0	0	0
	8	Yes	Yes	0	0	0
	9	Yes	Yes	0	0	0
	10	Yes	Yes	0	0	0
	11	Yes	Yes	0	0	0
	12	Yes	Yes	0	0	0
	13	Yes	Yes	0	0	0
>>>>>>>>>>	14	Yes	Yes	0	0	0
	15	Yes	Yes	0	0	0
	16	Yes	Yes	0	0	0
	17	Yes	Yes	0	0	0
	18	Yes	Yes	0	0	0
	19	Yes	Yes	0	0	0
	20	Yes	Yes	0	0	0
	21	Yes	Yes	0	0	0
	22	Yes	Yes	0	0	0
	23	Yes	Yes	0	0	0
	24	Yes	Yes	0	0	0
	25	Yes	Yes	0	0	0
	26	Yes	Yes	0	0	0
	27	Yes	Yes	0	0	0
	28	Yes	Yes	0	0	0
	29	Yes	Yes	0	0	0
	30	Yes	Yes	0	0	0
	31	Yes	Yes	0	0	0
	32	Yes	Yes	0	0	0
	33	Yes	Yes	0	0	0
	34	Yes	Yes	0	0	0
	35	Yes	Yes	0	0	0
	36	Yes	Yes	0	0	0
	37	Yes	Yes	0	0	0
	38	Yes	Yes	0	0	0
	39	Yes	Yes	0	0	0
	40	Yes	Yes	0	0	0

41	Yes	Yes	0	0	0
42	Yes	Yes	0	0	0
43	Yes	Yes	0	0	0
44	Yes	Yes	0	0	0
45	Yes	Yes	0	0	0
46	Yes	Yes	0	0	0
47	Yes	Yes	0	0	0
48	Yes	Yes	0	0	0

Message

From: Clark Taylor [taylor.clark@volvo.com]
Sent: 11/15/2018 5:54:01 PM
To: Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
CC: Sponsky John [john.sponsky@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: HDIUT Data Processing

8:30am works for me. Thanks!

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Thursday, November 15, 2018 12:25 PM
To: Laroo, Chris; Clark Taylor
Cc: Sponsky John; Hamady, Fakhri
Subject: RE: HDIUT Data Processing

Yes. I will put it in my calendar.

From: Laroo, Chris
Sent: Thursday, November 15, 2018 12:06 PM
To: Duncan, Allen <duncan.allen@epa.gov>; Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Allen,

Would 830 am Friday morning in the lobby work?

Regards,

Chris Laroo
Environmental Protection Specialist
US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Duncan, Allen
Sent: Thursday, November 15, 2018 9:13 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Laroo, Chris <laroo.chris@epa.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Taylor;
That sounds good. I'd like to see if we can get Chris Laroo to join us. I assume he will be in and out of the EMTC meeting.

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, November 15, 2018 8:28 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Sponsky John <john.sponsky@volvo.com>
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

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Message

From: Sponsky John [john.sponsky@volvo.com]
Sent: 10/25/2018 6:38:29 PM
To: Duncan, Allen [duncan.allen@epa.gov]
CC: Clark Taylor [taylor.clark@volvo.com]; Tasik Karl [karl.tasik@volvo.com]
Subject: NTE Data INclusion and Exclusion

Hi Allen,

I am following up with you on a topic other than our visit to Ann Arbor.

Taylor Clark and Karl Tasik mentioned that EPA had specific questions with regards to how Volvo includes and excludes NTE data.
Taylor is working on a summary to help clarify our process for evaluating data to be included or excluded.
This hopefully will help clarify the matter.
Taylor and Karl had also requested that EPA provide their questions and concerns to Volvo in writing.
This will help us better understand EPA's concerns.
Just wanted to see where we are at with regards to this matter.

Thank you!
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

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Message

From: Clark Taylor [taylor.clark@volvo.com]
Sent: 3/8/2019 7:24:50 PM
To: Duncan, Allen [duncan.allen@epa.gov]
Subject: RE: additional relevant text
Attachments: 20181022 EPA Comments on Volvo NTE Logic.pdf

Allen,

In sending me this reg, are you trying to tell me to just use your revision to our flow chart that you sent to us last October (see attached, page 2)?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

From: Duncan, Allen <duncan.allen@epa.gov>
Sent: Thursday, March 7, 2019 11:58 AM
To: Clark Taylor <taylor.clark@volvo.com>
Subject: additional relevant text

From 81.1912 (b)
b) For the purposes of this subpart, a valid NTE sampling event consists of at least 30 seconds of continuous operation in the NTE control area. An NTE event begins when the engine starts to operate in the NTE control area and continues as long as engine operation remains in this area (see §86.1370). When determining a valid NTE sampling event, exclude all engine operation in approved NTE limited testing regions under §86.1370-2007(b)(6) and any approved NTE deficiencies under §86.007-11(a)(4)(iv). Engine operation in the NTE control area of less than 30 contiguous seconds does not count as a valid NTE sampling event; operating periods of less than 30 seconds in the NTE control area, but outside of any allowed deficiency area or limited testing region, will not be added together to make a 30 second or longer event. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for the time-weighted carve-out defined in §86.1370-2007(b)(7). For EGR-equipped engines, exclude any operation that occurs during the cold-temperature operation defined by the equations in §86.1370-2007(f)(1).

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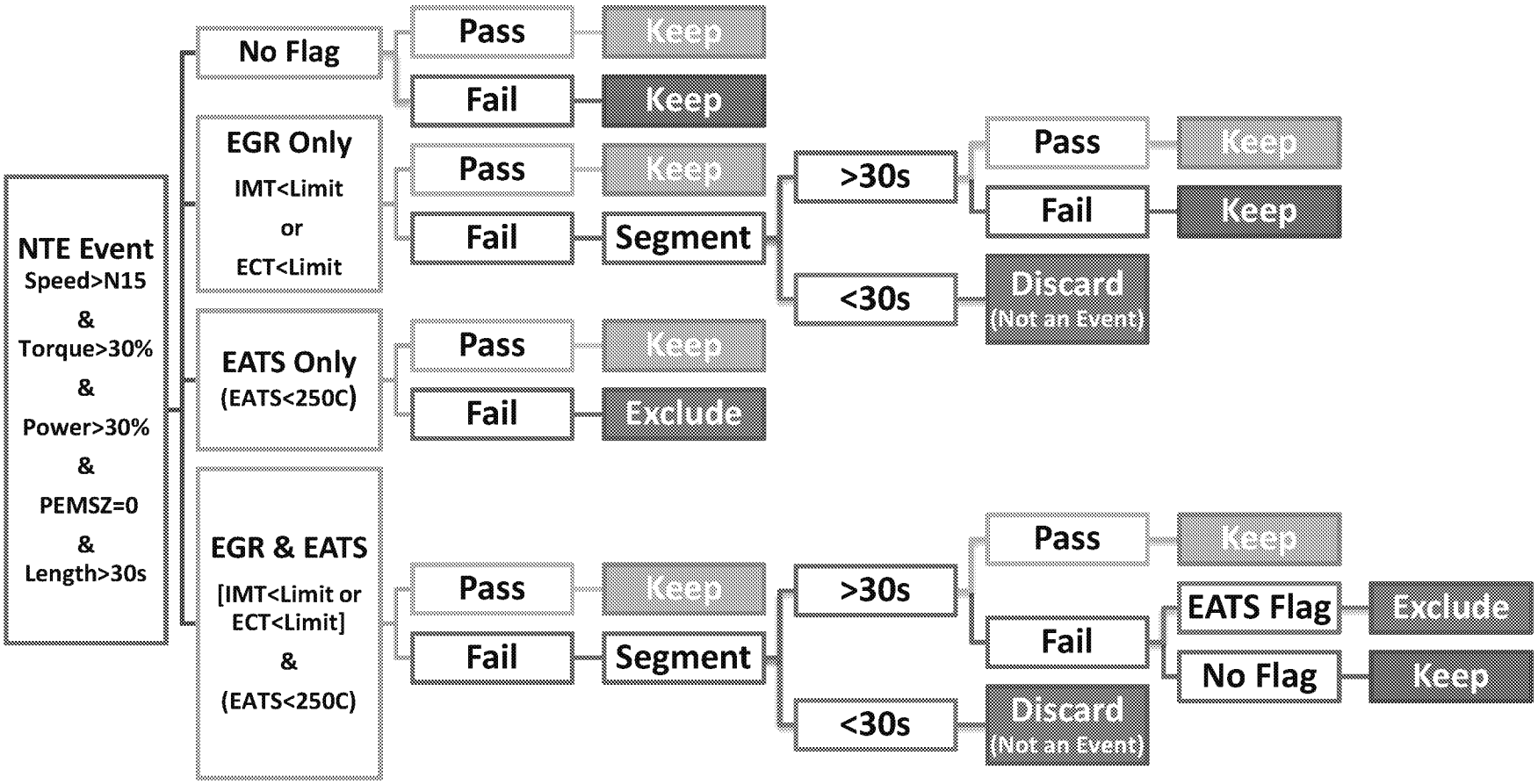
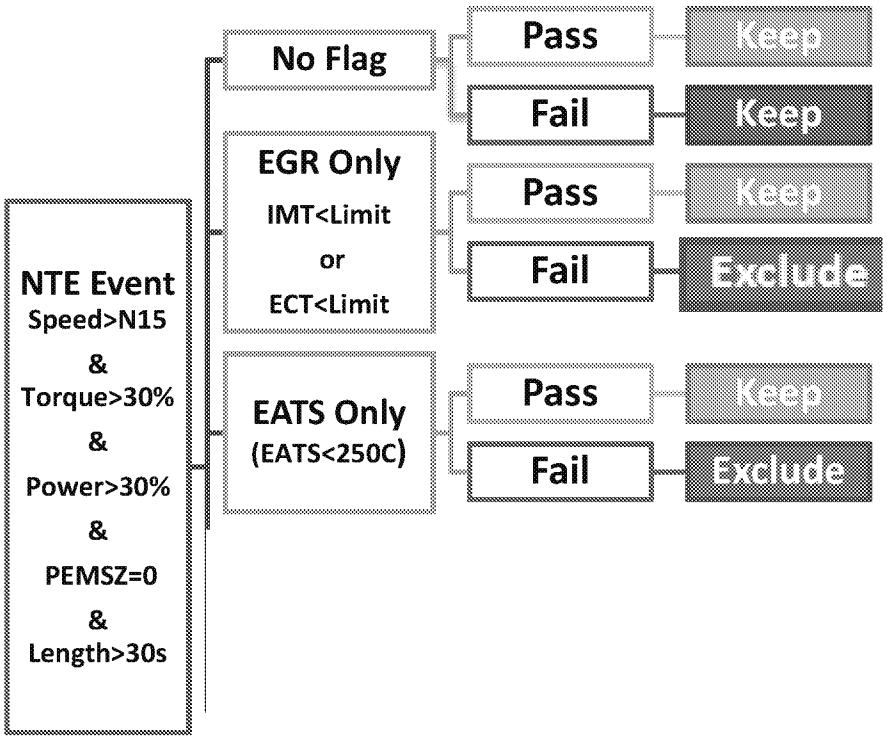
Volvo Flow Chart



- Any "Keep" is Automatically Discarded due to a DRIFT Error Upon Calculation of Brake Specific Emissions
- Pass or Fail is governed by Brake Specific NOx Emissions for the Event < 0.45 g/bhp-hr

EPA Flow Chart



Message

From: Laroo, Chris [laroo.chris@epa.gov]
Sent: 11/15/2018 5:05:53 PM
To: Duncan, Allen [duncan.allen@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
CC: Sponsky John [john.sponsky@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: HDIUT Data Processing

Allen,

Would 830 am Friday morning in the lobby work?

Regards,

Chris Laroo
Environmental Protection Specialist
US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Duncan, Allen
Sent: Thursday, November 15, 2018 9:13 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Laroo, Chris <laroo.chris@epa.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Taylor;
That sounds good. I'd like to see if we can get Chris Laroo to join us. I assume he will be in and out of the EMTC meeting.

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, November 15, 2018 8:28 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Sponsky John <john.sponsky@volvo.com>
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

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Message

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 1/28/2019 9:41:39 PM
To: Duncan, Allen [duncan.allen@epa.gov]
CC: Hamady, Fakhri [hamady.fakhri@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]; Fayne, Zachary [Zachary.Fayne@arnoldporter.com]
Subject: RE: HDIUT NTE

Thanks, Allen. Let us know once you determine a direction, and we can coordinate as needed with Volvo regarding participants and logistics.

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

From: Duncan, Allen [mailto:duncan.allen@epa.gov]
Sent: Monday, January 28, 2019 2:40 PM
To: Martel, Jonathan S.
Cc: Hamady, Fakhri; Laroo, Chris; Sanchez, James
Subject: Re: HDIUT NTE

Jonathan;
Thank you for the offer. I will consult with ARB. EPA will ask ARB to participate in any such conversation.
Best regards
Allen

Sent from my iPhone

On Jan 17, 2019, at 09:18, Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com> wrote:

> Allen –
>
> We understand that you and others at EPA have been in communication with Volvo about the proper interpretation of the Not-to-Exceed test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines, and in particular the optional exclusion for emission data collected when after-treatment temperatures are below 250°C (as specified at 40 C.F.R. 86.1370(g)).
>
> In the email correspondence we have reviewed, EPA confirmed that a manufacturer can choose to include or exclude any invalid NTE event, including an event for which after-treatment temperatures are below 250°C. If EPA intends to revisit that decision, we would appreciate the opportunity to speak with you first to provide our input.
>
> Thank you for your consideration, and please feel free to give me a call at Ex. 6 - Personal Privacy if you would like to discuss.
>
> Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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http://www.arnoldporter.com

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For more information about Arnold & Porter, click here:
http://www.arnoldporter.com

CARB's Proposal for HDIUT Program (NTE Testing) Amendments

Engine Emissions Measurement & Testing Committee (EMTC)
September 25, 2018

CARB

Outline

- Drift Validation Proposed Amendment
  - Background
  - CARB's Policy & Discussions
- Aftertreatment Temperature (AT T) Exclusion/Inclusion Proposed Amendment
  - Overview
  - Background
  - CARB's Proposal & Discussions
- Intake Manifold Temperature (IMT) Exclusion Proposed Amendment
  - Overview
  - Background
  - CARB's Proposal & Discussions

CARB

Drift Validation – Background

- 40 CFR 1065.550(b)(4) allows an optional drift validation criterion to Not-To-Exceed (NTE) data collected under the Manufacturer-Run Heavy-Duty In-Use Testing (HDIUT) requirements.
- The drift criterion was applied to passing events only
- CARB's interpretation presented at EMTC on May 17, 2017: Drift criterion should be applied uniformly to all NTE events
- MAC #2017-02 (HDIUT Data Drift Validation Handling Process) issued on August 9, 2017 and distributed to EMTC members and the public on August 15, 2017

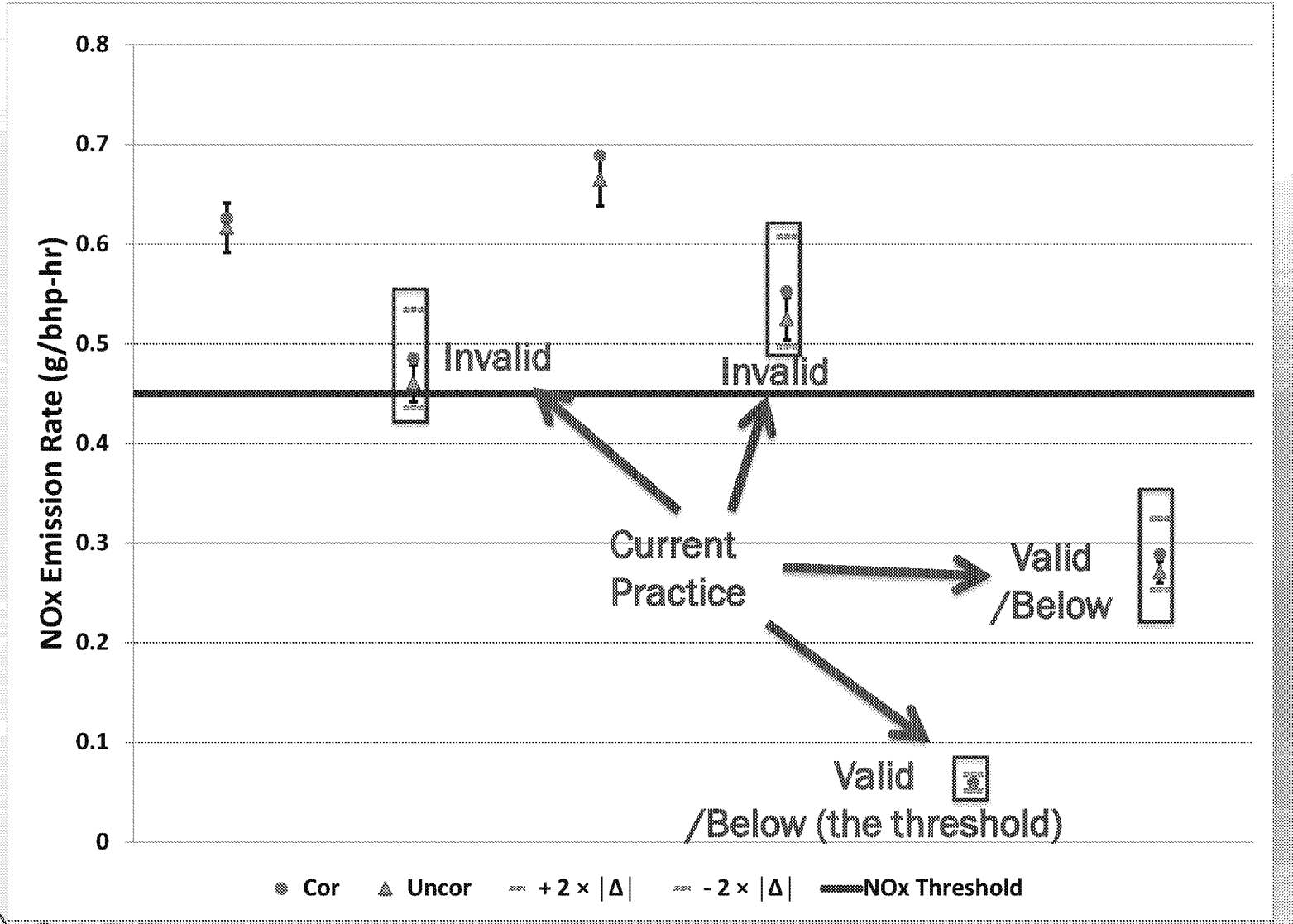
Background – Optional Drift Validation Only for Compliance

- 40 CFR 1065.550(b)(4)

  "If the test is not verified for drift as described in paragraph (b)(1) of this section, you may consider the test results for the duty cycle to be valid only if, using good engineering judgment, the observed drift does not affect your ability to demonstrate compliance with the applicable emission standards. For example, if the drift-corrected value is less than the standard by at least two times the absolute difference between the uncorrected and corrected values, you may consider the data to be verified for demonstrating compliance with the applicable standard."

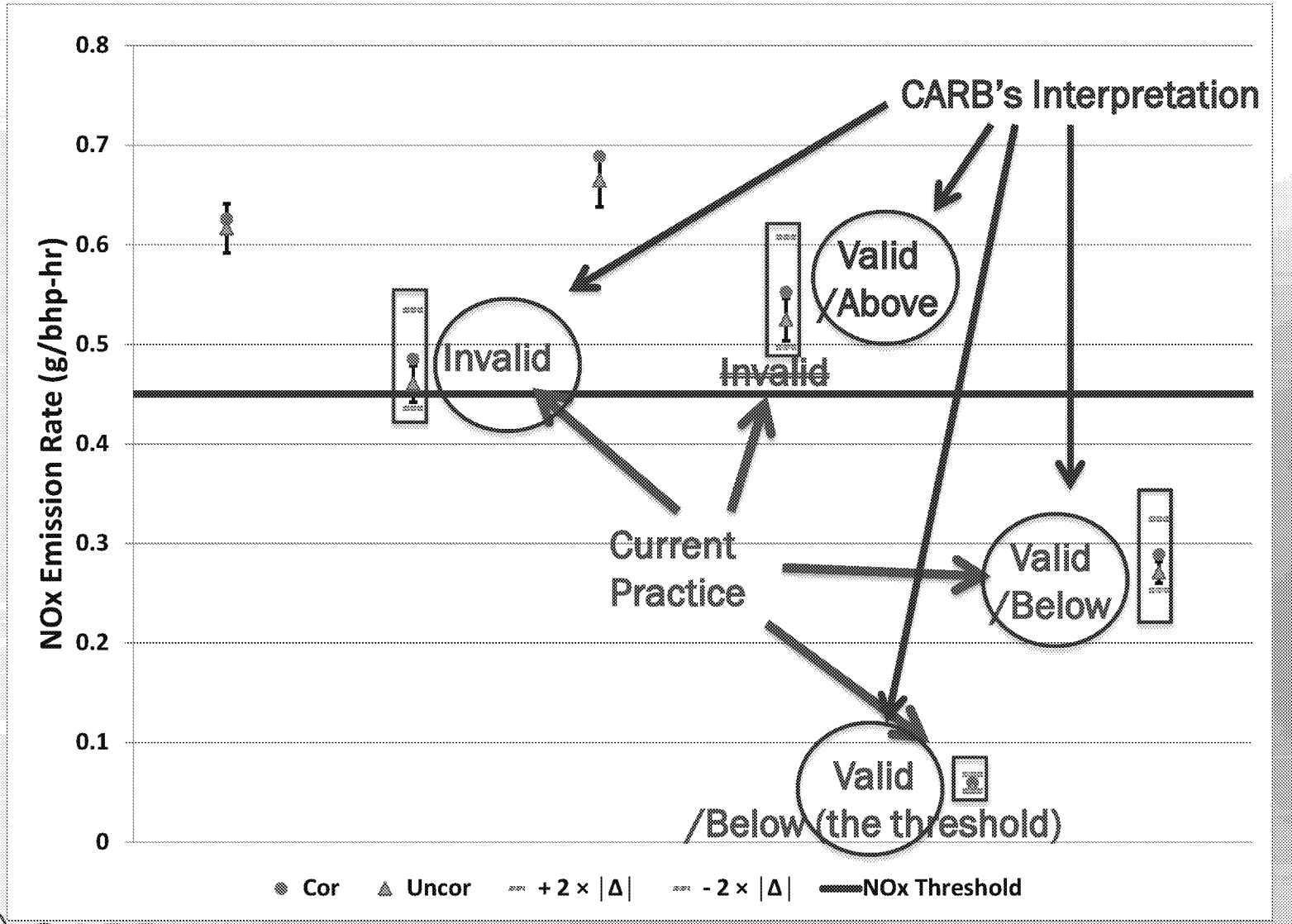
CARB

Background – Field Testing Drift Validation Old practice per 1065.550(b)(4)



CARB

Background – Field Testing Drift Validation CARB Policy



CARB

Background – MAC #2017-02

- POLICY

"Manufacturers that elect to use the drift validation option in Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures [40 CFR 1065.550(b)(4)] must apply the methodology associated with the drift validation option for both sufficiently under and over the standards, which is good engineering judgment; not under only. Otherwise manufacturers should not use this option. In addition, manufacturers should notify CARB whether they use the option when reporting their HDIUT data."

CARB's Proposed Amendment

- Incorporation of MAC #2017-02 into 40 CFR 1065.550(b)(4)
- Addition of the underlined sentences to the current paragraph:

If the test is not verified for drift as described in paragraph (b)(1) of this section, you may consider the test results for the duty cycle to be valid only if, using good engineering judgment, the observed drift does not affect your ability to demonstrate compliance with the applicable emission standards. For example, if the drift-corrected value is less than the standard by at least two times the absolute difference between the uncorrected and corrected values, you may consider the data to be verified for demonstrating compliance with the applicable standard. When using a good engineering judgment procedure under this section to validate the test results for the duty cycle that fail as described in paragraph (b)(1) of this section, you must apply that procedure symmetrically and analogously for all such test results both above and below the applicable standards. Also, explanations of the procedure, if used, must be reported to us.

CARB

Aftertreatment Temperature (AT T) Exclusion/Inclusion – Overview

- Revised 40 CFR 86.1370(g) and (h), dated 10/25/2016, allow an optional inclusion of NTE data collected when catalytic AT Ts are less than 250 ° C for the HDIUT.
- Issue: An OEM include such data selectively for vehicle pass ratio determination by including only passing events while excluding failing events.
- CARB's Interpretation:
  - No selective inclusion or exclusion; that is, either inclusion of both passing and failing events or exclusion of both.
  - For the same EF, the same catalytic AT T must be applied for data inclusion for all vehicles tested when using the inclusion option. The AT T determination must be done and reported to CARB/EPA prior to start the testing.

CARB

Current and Previous AT T Exclusion/Inclusion Requirements

- Revision of 40 CFR 86.1370(g) and (h):
  - **Previous**: § 86.1370(g) NOx and NMHC aftertreatment warm-up. For engines equipped with one or more aftertreatment devices that reduce NOx or NMHC emissions, the NTE NOx and NMHC emission limits do not apply when the exhaust gas temperature is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 ° C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.
  - **Current (as of Oct. 25, 2016)**: § 86.1370(g) You may exclude emission data based on catalytic aftertreatment temperatures as follows:

(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude NOx emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 ° C.

(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected if the exhaust temperature is less than 250 ° C at any time during the NTE event.

(3) Using good engineering judgment, measure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

§ 86.1370(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

Rationale for Current AT T Exclusion/Inclusion Requirements

- Based on the OEM, there were discussions at the EMTC meeting on July 15, 2014 and additional discussions with EPA after the regulation change:
  - EPA at the EMTC:
    - ✓ The low temperature exclusions were reluctantly accepted
    - ✓ In order to incentivize low temperature emissions control, use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass.
  - OEM/EPA after the regulation change – EPA's (Chris Laroo and James Sanchez) confirmation of the interpretation of the OEM

CARB

CARB's Proposed Amendments

- Revision of 40 CFR 86.1370(g) and (h)
- Addition of the underlined sentences, phrases, and words to 40 CFR 86.1370(g) and the ~~double-strikethrough deletion~~ from 40 CFR 86.1370(g) and of 40 CFR 86.1370(h):

§ 86.1370(g) You may exclude emission data based on the catalytic aftertreatment temperatures as follows:

(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude all NOX emission data that is collected during all NTE events when the exhaust temperature at any time during the NTE events is less than 250 ° C threshold. Alternatively, you may predetermine a catalytic NOx aftertreament temperature threshold lower than 250 ° C for this exclusion subject to paragraph (g)(4) of this section. All otherwise valid NTE events above your pre-determined catalytic NOx aftertreatment temperature threshold must be included regardless of emissions passing or failing status of each NTE event.

(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude all NMHC and CO emission data that is collected during all NTE events when~~if~~ the exhaust temperature at any time during the NTE events is less than 250 ° C threshold ~~at any time during the NTE event~~. Alternatively, you may predetermine an oxidizing catalytic aftertreament temperature threshold lower than 250 ° C for this exclusion subject to paragraph (g)(4) of this section. All otherwise valid NTE events above your pre-determined oxidizing catalytic aftertreatment temperature threshold must be included regardless of emissions passing or failing status of each NTE event.

(3) Using good engineering judgment, measure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

(4) The temperature threshold chosen for each paragraph (g)(1) and (g)(2) of this section must be pre-determined and reported to us before performing emissions testing according to the Subpart T of this Part 86 for an engine family for emissions testing of the in-use testing program described in Subpart T of this Part 86. Each of such temperature threshold must applied uniformly to all test vehicles in the engine family when excluding emissions data according to above in this section.

~~§ 86.1370(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.~~

CARB

Intake Manifold Temperature (IMT) Exclusion – Overview

- "NTE cold temperature operating exclusion" for engines equipped with EGR – "intake manifold temperature" exclusion in 86.1370(f)(1)(i) was developed in response to manufacturers concerns regarding condensation in the EGR loop at low ambient/engine operating temperatures. (10/6/2000)
- The concerns: EGR durability issues due to corrosion of EGR components from EGR condensate, water and sulfuric acid, when intake charge (EGR & intake air) is cooled below the dew point.
  - Concerns about sulfuric acid with fuel sulfur (S) limit of 500 ppm at that time
  - Current S in Ultra Low Sulfur Diesel (ULSD): 15 ppm or less
- CARB's Proposal: Removal of the IMT Exclusion 86.1370(f)

IMT Exclusion Technical Justification

- The IMT exclusion was to address concerns about sulfuric acid condensation and corrosion of the EGR components and at the time the fuel S limit was 500 ppm; or a nominal 350 ppm at pumps at that time.
- Contents in the regulation package:
  - The Regulatory Impact Analysis (RIA) document (EPA420-R-00-010; p. 43-44): the IMT and Engine Coolant Temperature (ECT) exclusions based on comments received to the NPRM
  - The Response to Comments document (EPA420-R-00-011; p. 8-19 & 8-20): addition of the exclusions
- ULSD mandated in September 2006 (in California)

CARB's Proposed Amendment

- 40 CFR 86.1370(f)

  NTE cold temperature operating exclusion. Engines equipped with exhaust gas recirculation (EGR) whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions.

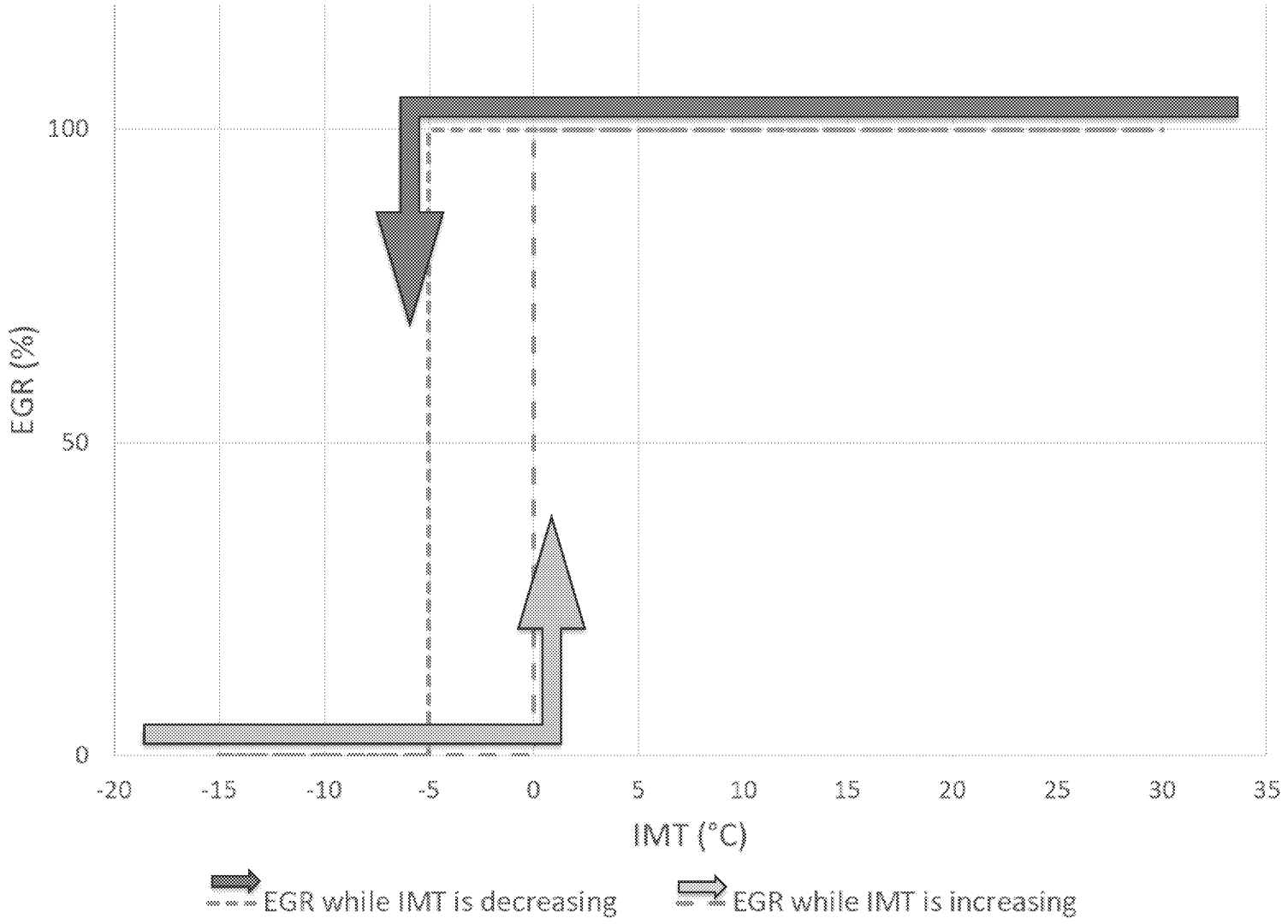
- Obsolete: ULSD is used, and SCR systems are main players, not EGR.
- Double dips: OEMs use EGR even at low IMT.
- CARB's Proposal: Removal of "NTE cold temperature operating exclusion" (86.1370(f))

IMT Exclusion with using EGR Example 1

- Current OEM practices
  - Example 1. Enable EGR at IMT meeting IMT exclusion criteria
    - EGRs are enable until IMT drop to a set-point temperature (Example: For OEM A, IMT = $-5^{o}C\ or\ 23^{o}F$)
    - EGRs become enable when IMT reaches (another) reactivation set-point temperature after being disable due to temperature drop below the set-pot above (Example: For OEM A, IMT = $0^{o}C\ or\ 32^{o}F$)

CARB

Example 1 – OEM A



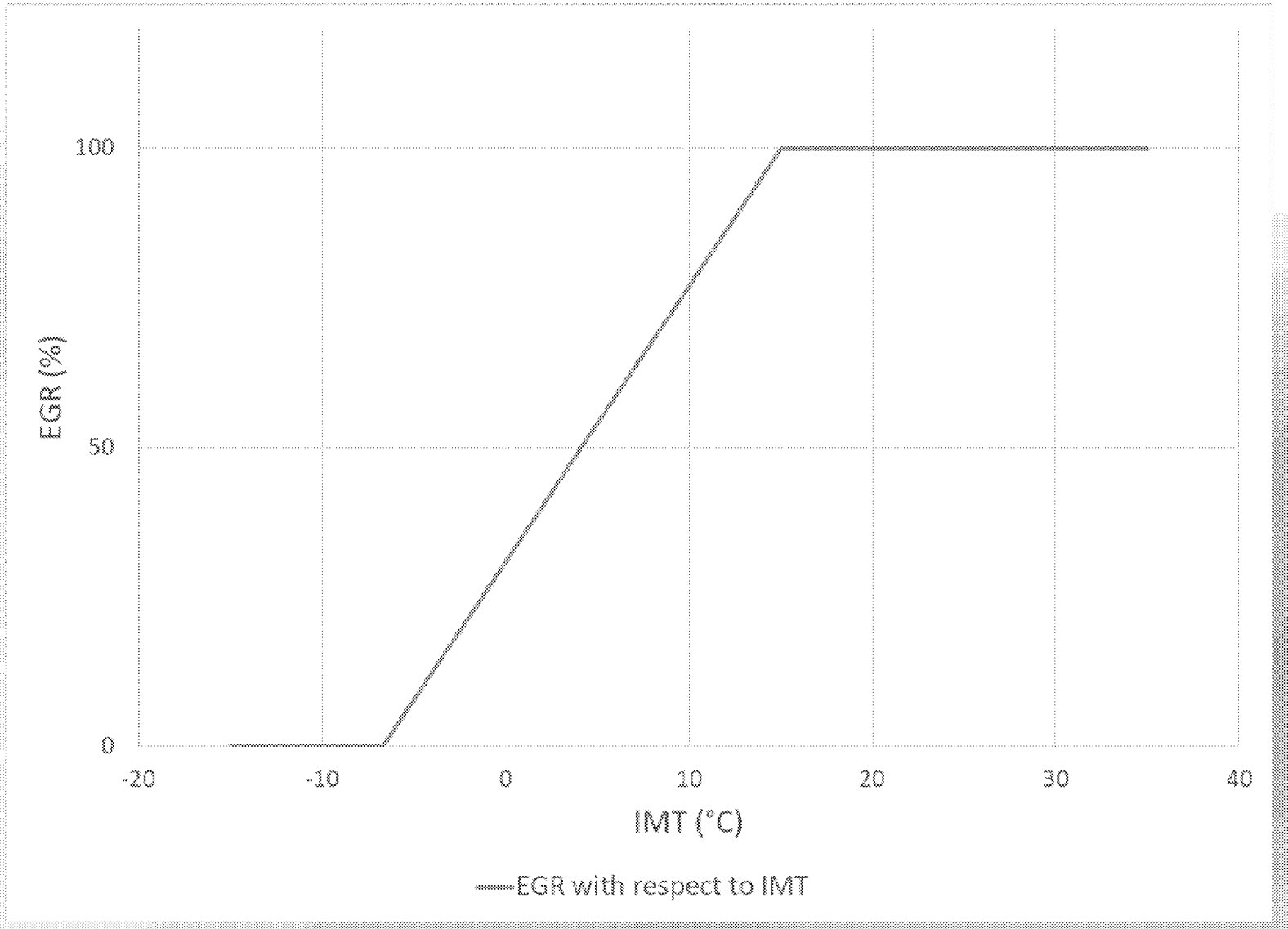
CARB

IMT Exclusion with using EGR Example 2

- Current OEM practices
  - Example 2. Enable EGR Fractioning
    - When IMT drops below a set-point, fractions of EGRs disabled, but EGRs are still enable until IMT falls below another IMT set-point. (Example: For OEM B, fractions of EGRs started to be diabled at $IMT = 15^{o}C\ or\ 59^{o}F$, but still some fractions of EGR enabled until $IMT = -6.7^{0}C\ or\ 19.9^{o}F$)

CARB

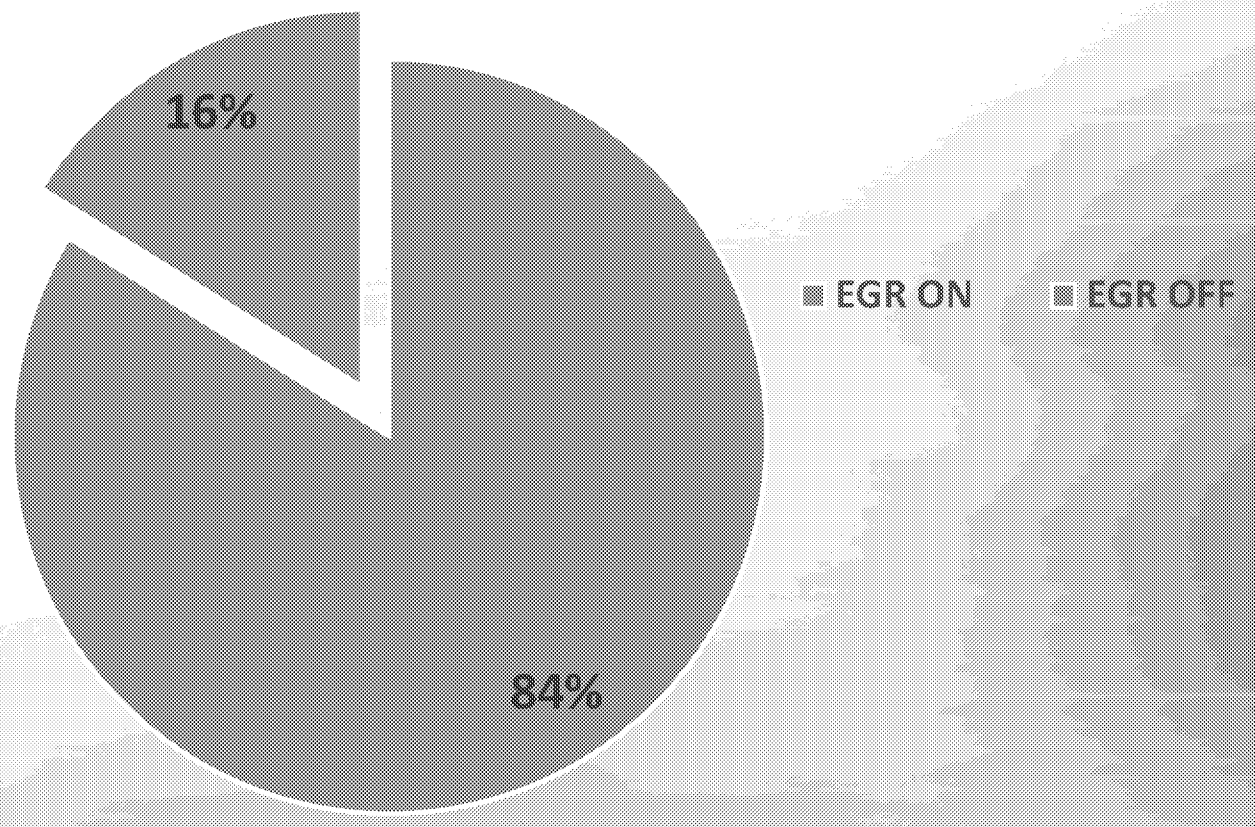
Example 2 - OEM B



CARB

Certification AECD Documents - EGR Use During IMT Exclusion

For 68 Engine Families from MY 2013 -2017



CARB

Thank you!

Questions?

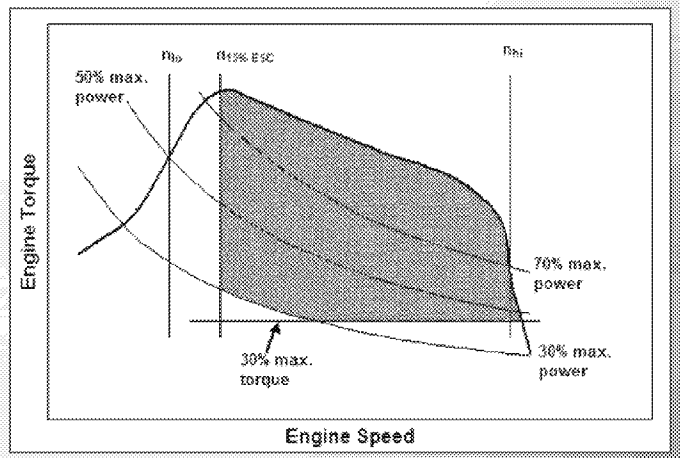
CARB

Backup Slides

CARB

Background – NTE Testing Requirements

- Heavy-duty in-use engine compliance program is designed to control diesel truck emissions during "*normal vehicle operation and use*" consistent with the not-to-exceed (NTE) requirements (40CFR86.1910(e))
  - Test duration
    - ✓ At least 3 hours of non-idling vehicle operation for testing of a shift-day or two days
  - NTE zone definition
    - ✓ Above 30% max engine power
    - ✓ Above 30% max engine torque
    - ✓ Above 15% ESC RPM
  - Duration and temperature (T) limits
    - ✓ At least 30 consecutive seconds
    - ✓ > 250 ° C for Aftertreatment (AT)/SCR T
    - ✓ EGR (Cold T Operation) Exclusion: IMT & ECT
    - ✓ Ambient T Exclusion
  - Other provisions: BSFC, LTR/TWCOLTR, EMD/OBD, Deficiency, Regeneration, Zero Check



CARB

IMT Exclusion

- 40 CFR 86.1370(f) ***NTE cold temperature operating exclusion***. Engines equipped **with exhaust gas recirculation (EGR)** whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions.
- 40 CFR 86.1370(f)(1) Cold temperature operation is defined as engine operating conditions meeting either of the following two criteria:
- 40 CFR 86.1370(f)(1)(i) Intake manifold temperature (IMT) less than or equal to the temperature defined by the following relationship between IMT and absolute intake manifold pressure (IMP) for the corresponding IMP:

$$\boldsymbol{P = 0.0875 \times IMT - 7.75}$$

Where:

P = absolute intake manifold pressure in bars.

IMT = intake manifold temperature in degrees Fahrenheit

- 40 CFR 86.1370(f)(1)(ii) Engine coolant temperature (IMT) less than or equal to the temperature defined by the following relationship between ECT and ...

Message

From: Clark Taylor [taylor.clark@volvo.com]
Sent: 11/15/2018 1:27:30 PM
To: Duncan, Allen [duncan.allen@epa.gov]
CC: Sponsky John [john.sponsky@volvo.com]
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

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Message

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 1/17/2019 2:18:07 PM
To: Duncan, Allen [duncan.allen@epa.gov]
CC: Fayne, Zachary [Zachary.Fayne@arnoldporter.com]
Subject: HDIUT NTE

Allen –

We understand that you and others at EPA have been in communication with Volvo about the proper interpretation of the Not-to-Exceed test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines, and in particular the optional exclusion for emission data collected when after-treatment temperatures are below 250°C (as specified at 40 C.F.R. 86.1370(g)).

In the email correspondence we have reviewed, EPA confirmed that a manufacturer can choose to include or exclude any invalid NTE event, including an event for which after-treatment temperatures are below 250°C. If EPA intends to revisit that decision, we would appreciate the opportunity to speak with you first to provide our input.

Thank you for your consideration, and please feel free to give me a call at Ex. 6 - Personal Privacy if you would like to discuss.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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For more information about Arnold & Porter, click here:
http://www.arnoldporter.com

Message

From: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Sent: 1/7/2019 2:36:45 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Clever Timothy [tim.clever@volvo.com]; Murter Zack [zack.murter@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Wang, Alex@ARB [alex.wang@arb.ca.gov]; Florea, Elena@ARB [Elena.Florea@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Farnen Thomas [thomas.farnen@volvo.com]
Subject: RE: CARB's Response Letter for Volvo's letter we received on September 28, 2018 for Volvo's data processing for 2016 HDIUT order

Karl,

Thank you for informing us the receipt of our letter, ICE-2018-021.

Have a great week!

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Monday, January 7, 2019 4:46 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Duncan, Allen <duncan.allen@epa.gov>; Clever Timothy <tim.clever@volvo.com>; Murter Zack <zack.murter@volvo.com>; Clark Taylor <taylor.clark@volvo.com>; Wang, Alex@ARB <alex.wang@arb.ca.gov>; Florea, Elena@ARB <Elena.Florea@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Farnen Thomas <thomas.farnen@volvo.com>
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Abraham,

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Karl

Karl Tasik
Principal Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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As stated in the letter, please "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts [catalytic Aftertreatment temperatures] were below 250 °C, and resubmit the reprocessed data." Please note that we requested Volvo's submittal of the reprocessed data within 30 days of the receipt of the letter, not from the date of the letter, December 19, 2018.

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When Mr. Farnen and/or you receive the CARB's letter, please let us know.

If you have any questions, please do not hesitate to contact me.

I wish you have great year of 2019.

Sincerely,
Abraham

CALIFORNIA
AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
ECARS Division
Tel: 626-350-6543
abraham.lee@arb.ca.gov

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Message

From: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Sent: 2/6/2019 7:59:03 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Clever Timothy [tim.clever@volvo.com]; Murter Zack [zack.murter@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Wang, Alex@ARB [alex.wang@arb.ca.gov]; Florea, Elena@ARB [Elena.Florea@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Farnen Thomas [thomas.farnen@volvo.com]
Subject: RE: Volvo 2016 HDIUT data processing submittal

Thanks, Karl.

I will check it out and get back to you if I have any questions.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, February 6, 2019 11:56 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Duncan, Allen <duncan.allen@epa.gov>; Clever Timothy <tim.clever@volvo.com>; Murter Zack <zack.murter@volvo.com>; Clark Taylor <taylor.clark@volvo.com>; Wang, Alex@ARB <alex.wang@arb.ca.gov>; Florea, Elena@ARB <Elena.Florea@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Farnen Thomas <thomas.farnen@volvo.com>
Subject: Volvo 2016 HDIUT data processing submittal

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Abraham,

Attached is the requested reprocessed ID# VPT182483 test data per the attached ICE-18-021 received on January 7th 2019.

Karl

Karl Tasik
Principal Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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Sent: Thursday, January 3, 2019 3:55 PM
To: Tasik Karl <karl.tasik@volvo.com>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Duncan, Allen <duncan.allen@epa.gov>; Clever Timothy <tim.clever@volvo.com>; Murter Zack <zack.murter@volvo.com>; Clark Taylor <taylor.clark@volvo.com>; Wang, Alex@ARB <alex.wang@arb.ca.gov>; Florea, Elena@ARB <Elena.Florea@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>
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When Mr. Farnen and/or you receive the CARB's letter, please let us know.

If you have any questions, please do not hesitate to contact me.

I wish you have great year of 2019.

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Abraham

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AIR RESOURCES BOARD

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~~~~~~~~~~~~~~~~~~~~~~~~~~~~
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To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Clever Timothy [tim.clever@volvo.com]; Murter Zack [zack.murter@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Wang, Alex@ARB [alex.wang@arb.ca.gov]; Florea, Elena@ARB [Elena.Florea@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Farnen Thomas [thomas.farnen@volvo.com]
Subject: Volvo 2016 HDIUT data processing submittal
Attachments: ICE-18-021 (To Volvo for 2016 HDIUT order).pdf; VPT182483_170719_ASK1150.xml

Abraham,

Attached is the requested reprocessed ID# VPT182483 test data per the attached ICE-18-021 received on January 7th 2019.

Karl

Karl Tasik
Principal Engineer | Certification & Compliance USA
Powertrain Engineering

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AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
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Tel: 626-350-6543
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CALIFORNIA
AIR RESOURCES BOARD

Mary D. Nichols, Chair
Matthew Rodriquez, CalEPA Secretary
Edmund G. Brown Jr., Governor

December 19, 2018

Reference No. ICE-2018-021

Mr. Thomas A. Farnen
North American Emissions Counsel
Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742

Dear Mr. Farnen:

This letter is in response to your letter, dated September 28, 2018, to the California Air Resources Board (CARB), on behalf of Volvo regarding the Not-to-Exceed ("NTE") test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines ("HDIUT"). CARB staff has been communicating with Volvo staff since June 2018 regarding Volvo's proposed treatment of NTE data collected when catalytic aftertreatment temperatures (AT Ts) are below 250 °C.

The "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", as amended September 2, 2015, incorporates by reference, with specific modifications, provisions of title 40, Code of Federal Regulations (CFR) section 86.1370, as amended on April 28, 2014.[1] That version of 40 CFR 86.1370 clearly excludes NTE data generated when exhaust gas temperatures are below 250 °C:

> For engines equipped with one or more aftertreatment devices that reduce NO_x or NMHC emissions, the NTE NO_x and NMHC emission limits ***do not apply*** when the exhaust gas temperature is measured within 12 inches of the outlet of the aftertreatment device and is less the [sic] 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.

CARB is aware that the United States Environmental Protection Agency (U.S. EPA) subsequently amended 40 CFR 86.1370 in 2016 to provide manufacturers the option to exclude emissions data from engines equipped with catalytic aftertreatment devices if exhaust gas temperatures are below 250 °C, but the 2016 version of 40 CFR 86.1370

[1] The "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" was subsequently amended on September 1, 2017, but the subsequent amendments did not include any modifications to 40 CFR § 86.1370.

does not apply to California certified heavy-duty diesel vehicles and engines unless and until CARB amends the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" to specifically incorporate the provisions of 40 CFR 86.1370, as amended in 2016.

On February 8, 2018, CARB approved for adoption the California Greenhouse Gas Emissions Standards for Medium-and Heavy-Duty Engines and Vehicles (Phase 2), which will specifically incorporate the provisions of 40 CFR 86.1370, as it was amended on October 25, 2016, but that rulemaking action has not yet been finalized, and consequently is not legally applicable. Moreover, that rulemaking, and consequently the October 25, 2016 amendments to 40 CFR 86.1370 only applies to new California certified 2021 and subsequent model year engines and vehicles.

CARB staff has provided a method that Volvo staff may be able to use good engineering judgment to interpret 40 CFR § 86.1370(g) and (h) and to process HDIUT data generated when exhaust gas temperatures are below 250 °C, as described in the email by Mr. Abraham Lee, Air Resources Engineer, CARB, sent to Mr. Karl Tasik, Principal Engineer of Volvo on September 10, 2018:

> [I]f Volvo chooses to include any HDIUT NTE data collected while AT Ts" (which means aftertreatment temperatures) "were below 250 °C, Volvo must specify an AT T threshold below 250 °C, and universally include any HDIUT NTE data collected while AT Ts were between the specified AT T threshold and 250 °C regardless of the emissions passing or failing status of the NTE events and regardless of test vehicles for the same engine family, for the determination of the vehicle-pass ratio."

Assuming, arguendo, that 40 CFR 86.1370(g) and (h) apply to the Volvo engines subject to CARB's 2016 test order, CARB staff believes that this proposal is consistent with both good engineering judgment and common sense to ensure that these provisions will provide a level playing field for all heavy duty engine manufacturers. For example, one manufacturer uses, as you mentioned in the first paragraph of page 2 in your letter, "the option to include low-temperature NTE events that "pass," while excluding those that 'fail,' " while another engine manufacturer may use the option to include low-temperature NTE events that "fail," while excluding those that "pass." Consequently, with good engineering judgment, CARB's interpretation of 40 CFR § 86.1370(g) and (h) is either to set a specific AT T threshold below 250 °C and include all NTE data collected when AT T are between the specified AT T and 250 °C regardless of the "pass" or "fail" status of NTE events, to which the NTE data belong, or to exclude all of the "NTE data with AT T below 250 °C", instead of arbitrary and selective exclusion or inclusion toward compliance or non-compliance of the NTE data with AT T below 250 °C. Additionally, if an AT T threshold is chosen, it should be applied for all

vehicles in the same engine family. Please be aware that CARB uses the NTE data to select engine families for the HDIUC testing program. This methodology would provide a fair and level playing field for all engine manufacturers.

However, please note that this methodology only applies to new California certified 2021 and subsequent model year engines and vehicles. In addition, if an AT T threshold is chosen for an engine family, the chosen AT T threshold should be specified during the certification process. If no chosen AT T threshold is specified during the certification process of an engine family, CARB will consider no AT T threshold is set for the engine family. That is, CARB will consider that all of the "NTE data with AT T below 250 °C" of the engine family are excluded for the determination of the vehicle-pass ratio.

In the September 10, 2018 email, CARB requested that Volvo "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts were below 250 °C, and resubmit the reprocessed data." We are requesting for the second time that Volvo resubmit the reprocessed data for Test ID# VPT182483 for CARB's examination within 30 days of the receipt of this letter. Until CARB staff receives and examines the HDIUT data for Test ID# VPT182483, CARB cannot make a compliance determination of Volvo's 2016 HDIUT test order. If CARB does not receive the requested data within the 30 days, CARB may consider Volvo's 2016 HDIUT test order in noncompliance, and may start the process of an enforcement action for this noncompliance.

Regarding U.S. EPA's policy judgment to incentivize low-temperature emissions control (last paragraph on the third page of your letter), CARB staff is conferring with U.S. EPA. However, CARB is willing to incentivize true low-temperature emissions control from engine manufacturers, when an AT T threshold below 250 °C of an engine family is specified during the certification process, based on good engineering judgment as noted in the September 10, 2018 email.

If you have any questions, please contact Keith Macias, Manager, at (626) 575-6600 or keith.macias@arb.ca.gov or Abraham Lee, Air Resources Engineer, at (626) 350-6543 or abraham.lee@arb.ca.gov

Sincerely,

Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science Division

cc: Bryon Bunker
Division Director
Compliance Division Office
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Allen Duncan
Center Director
Diesel Engine Compliance Center
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Fakhri J. Hamady, PH.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. EPA
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Mark Fuentes
Assistant Division Chief
Emissions Compliance, Automotive Regulations and Science (ECARS) Division

Michael Carter
Assistant Division Chief
Mobile Source Control Division (MSCD)

Sharon Lemieux, Branch Chief
In-Use Programs
ECARS Division

Kim Heroy-Rogalski, Branch Chief
Mobile Source Regulatory Development
MSCD

Jacline Lourenco, Branch Chief
New Vehicle/Engine Programs
ECARS Division

Michael Regenfuss, Branch Chief
On-Board Diagnostic
ECARS Division

Stephan Lemieux, Manager
On-Board Heavy Duty Diesel Section
MSCD

Thomas Montes, Manager
Diesel On-Board Diagnostic Section
ECARS Division

Kimberly Pryor, Manager
Compression Ignition & Heavy Duty Certification Section
ECARS Division

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 1/7/2019 12:46:21 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Clever Timothy [tim.clever@volvo.com]; Murter Zack [zack.murter@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Wang, Alex@ARB [alex.wang@arb.ca.gov]; Florea, Elena@ARB [Elena.Florea@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Farnen Thomas [thomas.farnen@volvo.com]
Subject: RE: CARB's Response Letter for Volvo's letter we received on September 28, 2018 for Volvo's data processing for 2016 HDIUT order
Attachments: ICE-18-021 (To Volvo for 2016 HDIUT order).pdf

Abraham,

Both Tom Farnen and I have received the attached letter today.

Karl

Karl Tasik
Principal Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Sent: Thursday, January 3, 2019 3:55 PM
To: Tasik Karl <karl.tasik@volvo.com>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Duncan, Allen <duncan.allen@epa.gov>; Clever Timothy <tim.clever@volvo.com>; Murter Zack <zack.murter@volvo.com>; Clark Taylor <taylor.clark@volvo.com>; Wang, Alex@ARB <alex.wang@arb.ca.gov>; Florea, Elena@ARB <Elena.Florea@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>
Subject: CARB's Response Letter for Volvo's letter we received on September 28, 2018 for Volvo's data processing for 2016 HDIUT order

Dear Karl,

This email is to inform you that CARB's response letter to Volvo's letter (from Mr. Farnen, on behalf of Volvo, dated September 28, 2018) regarding the Not-to-Exceed test procedures for the Manufacturer-Run In-Use Testing of Heavy-

Duty Engines (HDIUT) for 2016 HDIUT order was mailed to Mr. Farnen. For your information, I attached a pdf copy of the letter.

As stated in the letter, please "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts [catalytic Aftertreatment temperatures] were below 250 °C, and resubmit the reprocessed data." Please note that we requested Volvo's submittal of the reprocessed data within 30 days of the receipt of the letter, not from the date of the letter, December 19, 2018.

I apologize for the delay of our response, due to long but necessary discussions with several groups in CARB, including certification and legal teams, and U.S. EPA, and the delay of actual mail-out of the letter, due to confirmation with U.S. EPA about U.S. EPA's position regarding issues contained in the letter.

When Mr. Farnen and/or you receive the CARB's letter, please let us know.

If you have any questions, please do not hesitate to contact me.

I wish you have great year of 2019.

Sincerely,
Abraham

CALIFORNIA
AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
ECARS Division
Tel: 626-350-6543
abraham.lee@arb.ca.gov

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CALIFORNIA
AIR RESOURCES BOARD

Mary D. Nichols, Chair
Matthew Rodriquez, CalEPA Secretary
Edmund G. Brown Jr., Governor

December 19, 2018

Reference No. ICE-2018-021

Mr. Thomas A. Farnen
North American Emissions Counsel
Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742

Dear Mr. Farnen:

This letter is in response to your letter, dated September 28, 2018, to the California Air Resources Board (CARB), on behalf of Volvo regarding the Not-to-Exceed ("NTE") test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines ("HDIUT"). CARB staff has been communicating with Volvo staff since June 2018 regarding Volvo's proposed treatment of NTE data collected when catalytic aftertreatment temperatures (AT Ts) are below 250 °C.

The "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", as amended September 2, 2015, incorporates by reference, with specific modifications, provisions of title 40, Code of Federal Regulations (CFR) section 86.1370, as amended on April 28, 2014.[1] That version of 40 CFR 86.1370 clearly excludes NTE data generated when exhaust gas temperatures are below 250 °C:

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CARB is aware that the United States Environmental Protection Agency (U.S. EPA) subsequently amended 40 CFR 86.1370 in 2016 to provide manufacturers the option to exclude emissions data from engines equipped with catalytic aftertreatment devices if exhaust gas temperatures are below 250 °C, but the 2016 version of 40 CFR 86.1370

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vehicles in the same engine family. Please be aware that CARB uses the NTE data to select engine families for the HDIUC testing program. This methodology would provide a fair and level playing field for all engine manufacturers.

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In the September 10, 2018 email, CARB requested that Volvo "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts were below 250 °C, and resubmit the reprocessed data." We are requesting for the second time that Volvo resubmit the reprocessed data for Test ID# VPT182483 for CARB's examination within 30 days of the receipt of this letter. Until CARB staff receives and examines the HDIUT data for Test ID# VPT182483, CARB cannot make a compliance determination of Volvo's 2016 HDIUT test order. If CARB does not receive the requested data within the 30 days, CARB may consider Volvo's 2016 HDIUT test order in noncompliance, and may start the process of an enforcement action for this noncompliance.

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If you have any questions, please contact Keith Macias, Manager, at (626) 575-6600 or keith.macias@arb.ca.gov or Abraham Lee, Air Resources Engineer, at (626) 350-6543 or abraham.lee@arb.ca.gov

Sincerely,

Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science Division

cc: Bryon Bunker
Division Director
Compliance Division Office
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Allen Duncan
Center Director
Diesel Engine Compliance Center
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Fakhri J. Hamady, PH.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. EPA
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Mark Fuentes
Assistant Division Chief
Emissions Compliance, Automotive Regulations and Science (ECARS) Division

Michael Carter
Assistant Division Chief
Mobile Source Control Division (MSCD)

Sharon Lemieux, Branch Chief
In-Use Programs
ECARS Division

Kim Heroy-Rogalski, Branch Chief
Mobile Source Regulatory Development
MSCD

EPA-HQ-2019-002891

Jacline Lourenco, Branch Chief
New Vehicle/Engine Programs
ECARS Division

Michael Regenfuss, Branch Chief
On-Board Diagnostic
ECARS Division

Stephan Lemieux, Manager
On-Board Heavy Duty Diesel Section
MSCD

Thomas Montes, Manager
Diesel On-Board Diagnostic Section
ECARS Division

Kimberly Pryor, Manager
Compression Ignition & Heavy Duty Certification Section
ECARS Division

ED_002421_00000397-00005

Message

From: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Sent: 3/5/2019 9:32:27 PM
To: Duncan, Allen [duncan.allen@epa.gov]
Subject: FW: Part 86 In-Use Testing Question

Allen –

Here is the email chain I was referencing. I look forward to hearing back from you about next steps. Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:29 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

No I meant (h). Paragraph (h) covers the other exclusion criteria not covered in paragraph (g).

(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Thursday, April 19, 2018 9:25 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

Thanks for getting back to me. Did you mean paragraph (f)?

BR,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:11 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
Yes, paragraph (h) covers the rest of the NTE exclusion criteria and allows you to include those points in your vehicle-pass ratio determination.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

One more question for you just for completeness. Would the same logic apply to paragraph (f), which is the IMT/IMP exclusion?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM

To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM

To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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http://www.arnoldporter.com

Message

From: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Sent: 1/3/2019 8:54:35 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Macias, Keith@ARB [keith.macias@arb.ca.gov]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Clever Timothy [tim.clever@volvo.com]; Murter Zack [zack.murter@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Wang, Alex@ARB [alex.wang@arb.ca.gov]; Florea, Elena@ARB [Elena.Florea@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]
Subject: CARB's Response Letter for Volvo's letter we received on September 28, 2018 for Volvo's data processing for 2016 HDIUT order
Attachments: ICE-18-021 (To Volvo for 2016 HDIUT order).pdf

Dear Karl,

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As stated in the letter, please "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts [catalytic Aftertreatment temperatures] were below 250 °C, and resubmit the reprocessed data." Please note that we requested Volvo's submittal of the reprocessed data within 30 days of the receipt of the letter, not from the date of the letter, December 19, 2018.

I apologize for the delay of our response, due to long but necessary discussions with several groups in CARB, including certification and legal teams, and U.S. EPA, and the delay of actual mail-out of the letter, due to confirmation with U.S. EPA about U.S. EPA's position regarding issues contained in the letter.

When Mr. Farnen and/or you receive the CARB's letter, please let us know.

If you have any questions, please do not hesitate to contact me.

I wish you have great year of 2019.

Sincerely,
Abraham

CALIFORNIA
AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
ECARS Division
Tel: 626-350-6543
abraham.lee@arb.ca.gov

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CALIFORNIA
AIR RESOURCES BOARD

Mary D. Nichols, Chair
Matthew Rodriquez, CalEPA Secretary
Edmund G. Brown Jr., Governor

December 19, 2018

Reference No. ICE-2018-021

Mr. Thomas A. Farnen
North American Emissions Counsel
Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742

Dear Mr. Farnen:

This letter is in response to your letter, dated September 28, 2018, to the California Air Resources Board (CARB), on behalf of Volvo regarding the Not-to-Exceed ("NTE") test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines ("HDIUT"). CARB staff has been communicating with Volvo staff since June 2018 regarding Volvo's proposed treatment of NTE data collected when catalytic aftertreatment temperatures (AT Ts) are below 250 °C.

The "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", as amended September 2, 2015, incorporates by reference, with specific modifications, provisions of title 40, Code of Federal Regulations (CFR) section 86.1370, as amended on April 28, 2014.[1] That version of 40 CFR 86.1370 clearly excludes NTE data generated when exhaust gas temperatures are below 250 °C:

> For engines equipped with one or more aftertreatment devices that reduce NO_x or NMHC emissions, the NTE NO_x and NMHC emission limits ***do not apply*** when the exhaust gas temperature is measured within 12 inches of the outlet of the aftertreatment device and is less the [sic] 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.

CARB is aware that the United States Environmental Protection Agency (U.S. EPA) subsequently amended 40 CFR 86.1370 in 2016 to provide manufacturers the option to exclude emissions data from engines equipped with catalytic aftertreatment devices if exhaust gas temperatures are below 250 °C, but the 2016 version of 40 CFR 86.1370

[1] The "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" was subsequently amended on September 1, 2017, but the subsequent amendments did not include any modifications to 40 CFR § 86.1370.

does not apply to California certified heavy-duty diesel vehicles and engines unless and until CARB amends the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" to specifically incorporate the provisions of 40 CFR 86.1370, as amended in 2016.

On February 8, 2018, CARB approved for adoption the California Greenhouse Gas Emissions Standards for Medium-and Heavy-Duty Engines and Vehicles (Phase 2), which will specifically incorporate the provisions of 40 CFR 86.1370, as it was amended on October 25, 2016, but that rulemaking action has not yet been finalized, and consequently is not legally applicable. Moreover, that rulemaking, and consequently the October 25, 2016 amendments to 40 CFR 86.1370 only applies to new California certified 2021 and subsequent model year engines and vehicles.

CARB staff has provided a method that Volvo staff may be able to use good engineering judgment to interpret 40 CFR § 86.1370(g) and (h) and to process HDIUT data generated when exhaust gas temperatures are below 250 °C, as described in the email by Mr. Abraham Lee, Air Resources Engineer, CARB, sent to Mr. Karl Tasik, Principal Engineer of Volvo on September 10, 2018:

> [I]f Volvo chooses to include any HDIUT NTE data collected while AT Ts" (which means aftertreatment temperatures) "were below 250 °C, Volvo must specify an AT T threshold below 250 °C, and universally include any HDIUT NTE data collected while AT Ts were between the specified AT T threshold and 250 °C regardless of the emissions passing or failing status of the NTE events and regardless of test vehicles for the same engine family, for the determination of the vehicle-pass ratio."

Assuming, arguendo, that 40 CFR 86.1370(g) and (h) apply to the Volvo engines subject to CARB's 2016 test order, CARB staff believes that this proposal is consistent with both good engineering judgment and common sense to ensure that these provisions will provide a level playing field for all heavy duty engine manufacturers. For example, one manufacturer uses, as you mentioned in the first paragraph of page 2 in your letter, "the option to include low-temperature NTE events that "pass," while excluding those that 'fail,' " while another engine manufacturer may use the option to include low-temperature NTE events that "fail," while excluding those that "pass." Consequently, with good engineering judgment, CARB's interpretation of 40 CFR § 86.1370(g) and (h) is either to set a specific AT T threshold below 250 °C and include all NTE data collected when AT T are between the specified AT T and 250 °C regardless of the "pass" or "fail" status of NTE events, to which the NTE data belong, or to exclude all of the "NTE data with AT T below 250 °C", instead of arbitrary and selective exclusion or inclusion toward compliance or non-compliance of the NTE data with AT T below 250 °C. Additionally, if an AT T threshold is chosen, it should be applied for all

vehicles in the same engine family. Please be aware that CARB uses the NTE data to select engine families for the HDIUC testing program. This methodology would provide a fair and level playing field for all engine manufacturers.

However, please note that this methodology only applies to new California certified 2021 and subsequent model year engines and vehicles. In addition, if an AT T threshold is chosen for an engine family, the chosen AT T threshold should be specified during the certification process. If no chosen AT T threshold is specified during the certification process of an engine family, CARB will consider no AT T threshold is set for the engine family. That is, CARB will consider that all of the "NTE data with AT T below 250 °C" of the engine family are excluded for the determination of the vehicle-pass ratio.

In the September 10, 2018 email, CARB requested that Volvo "reprocess the HDIUT data for Test ID# VPT182483 according to the legally effective Test Procedures 86.1370(g) - April 28, 2014 in California at this time, that is, excluding all data collected while AT Ts were below 250 °C, and resubmit the reprocessed data." We are requesting for the second time that Volvo resubmit the reprocessed data for Test ID# VPT182483 for CARB's examination within 30 days of the receipt of this letter. Until CARB staff receives and examines the HDIUT data for Test ID# VPT182483, CARB cannot make a compliance determination of Volvo's 2016 HDIUT test order. If CARB does not receive the requested data within the 30 days, CARB may consider Volvo's 2016 HDIUT test order in noncompliance, and may start the process of an enforcement action for this noncompliance.

Regarding U.S. EPA's policy judgment to incentivize low-temperature emissions control (last paragraph on the third page of your letter), CARB staff is conferring with U.S. EPA. However, CARB is willing to incentivize true low-temperature emissions control from engine manufacturers, when an AT T threshold below 250 °C of an engine family is specified during the certification process, based on good engineering judgment as noted in the September 10, 2018 email.

If you have any questions, please contact Keith Macias, Manager, at (626) 575-6600 or keith.macias@arb.ca.gov or Abraham Lee, Air Resources Engineer, at (626) 350-6543 or abraham.lee@arb.ca.gov

Sincerely,

Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science Division

cc: Bryon Bunker
Division Director
Compliance Division Office
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Allen Duncan
Center Director
Diesel Engine Compliance Center
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Fakhri J. Hamady, PH.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. EPA
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Mark Fuentes
Assistant Division Chief
Emissions Compliance, Automotive Regulations and Science (ECARS) Division

Michael Carter
Assistant Division Chief
Mobile Source Control Division (MSCD)

Sharon Lemieux, Branch Chief
In-Use Programs
ECARS Division

Kim Heroy-Rogalski, Branch Chief
Mobile Source Regulatory Development
MSCD

Jacline Lourenco, Branch Chief
New Vehicle/Engine Programs
ECARS Division

Michael Regenfuss, Branch Chief
On-Board Diagnostic
ECARS Division

Stephan Lemieux, Manager
On-Board Heavy Duty Diesel Section
MSCD

Thomas Montes, Manager
Diesel On-Board Diagnostic Section
ECARS Division

Kimberly Pryor, Manager
Compression Ignition & Heavy Duty Certification Section
ECARS Division

Message

From: Sponsky John [john.sponsky@volvo.com]
Sent: 12/3/2018 3:29:44 PM
To: Duncan, Allen [duncan.allen@epa.gov]
Subject: RE: Volvo's in-use testing results for 2017 Test Order

Hi Allen,

I see that FJ has set up a meeting to discuss how include/exclude IUT.
I thought that you, Chris Laroo and Taylor Clark had resolved this matter after the EMTC meeting?
Please let me know if something has changed or if we should discuss further.

Thanks!
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

-----Original Appointment-----
From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Thursday, November 29, 2018 1:51 PM
To: Hamady, Fakhri; Clever Timothy; Sponsky John; Duncan, Allen; Laroo, Chris; Clark Taylor; Tasik Karl
Subject: FW: Volvo's in-use testing results for 2017 Test Order
When: Thursday, December 06, 2018 3:00 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

-----Original Appointment-----
From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Thursday, November 29, 2018 1:45 PM
To: Hamady, Fakhri; Duncan, Allen; Laroo, Chris; Clark Taylor; Tasik Karl
Subject: Volvo's in-use testing results for 2017 Test Order
When: Thursday, December 06, 2018 3:00 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Conference Call Information:

Conf. Number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

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Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 3/4/2019 1:22:46 PM
To: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
Subject: RE: Heavy Duty In-Use Testing Data Processing

Jonathan;
Tuesday or Wednesday at 3:00
Thursday at 1:00
Friday is wide open.
Any of those work for you?
Best regards,
Allen

From: Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com>
Sent: Friday, March 1, 2019 3:55 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: Heavy Duty In-Use Testing Data Processing

Allen –

I just left you a voice mail. When we last spoke, I said I would get back to you regarding 40 CFR 86.1370(f), (g) and (h). Can you please let me know when you might have time to speak? Thanks.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 10/25/2018 8:15:01 PM
To: Sponsky John [john.sponsky@volvo.com]
CC: Clark Taylor [taylor.clark@volvo.com]; Tasik Karl [karl.tasik@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: NTE Data INclusion and Exclusion
Attachments: 20181022 EPA Comments on Volvo NTE Logic.pdf

John;
I've attached the logic chart provided by Volvo (Page 1) and a modified version (Page 2) that represents the interpretation by FJ and I.

Chris is out of the office and hasn't had an opportunity to weigh in. I've cc'd him and expect he will comment when he returns.

It is possible that FJ and I are not in agreement with Chris. Whatever the case is, we will resolve the issue so that we can all move forward.

Best regards,

Allen

From: Sponsky John <john.sponsky@volvo.com>
Sent: Thursday, October 25, 2018 2:38 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Tasik Karl <karl.tasik@volvo.com>
Subject: NTE Data INclusion and Exclusion

Hi Allen,

I am following up with you on a topic other than our visit to Ann Arbor.

Taylor Clark and Karl Tasik mentioned that EPA had specific questions with regards to how Volvo includes and excludes NTE data.
Taylor is working on a summary to help clarify our process for evaluating data to be included or excluded.
This hopefully will help clarify the matter.
Taylor and Karl had also requested that EPA provide their questions and concerns to Volvo in writing.
This will help us better understand EPA's concerns.
Just wanted to see where we are at with regards to this matter.

Thank you!
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

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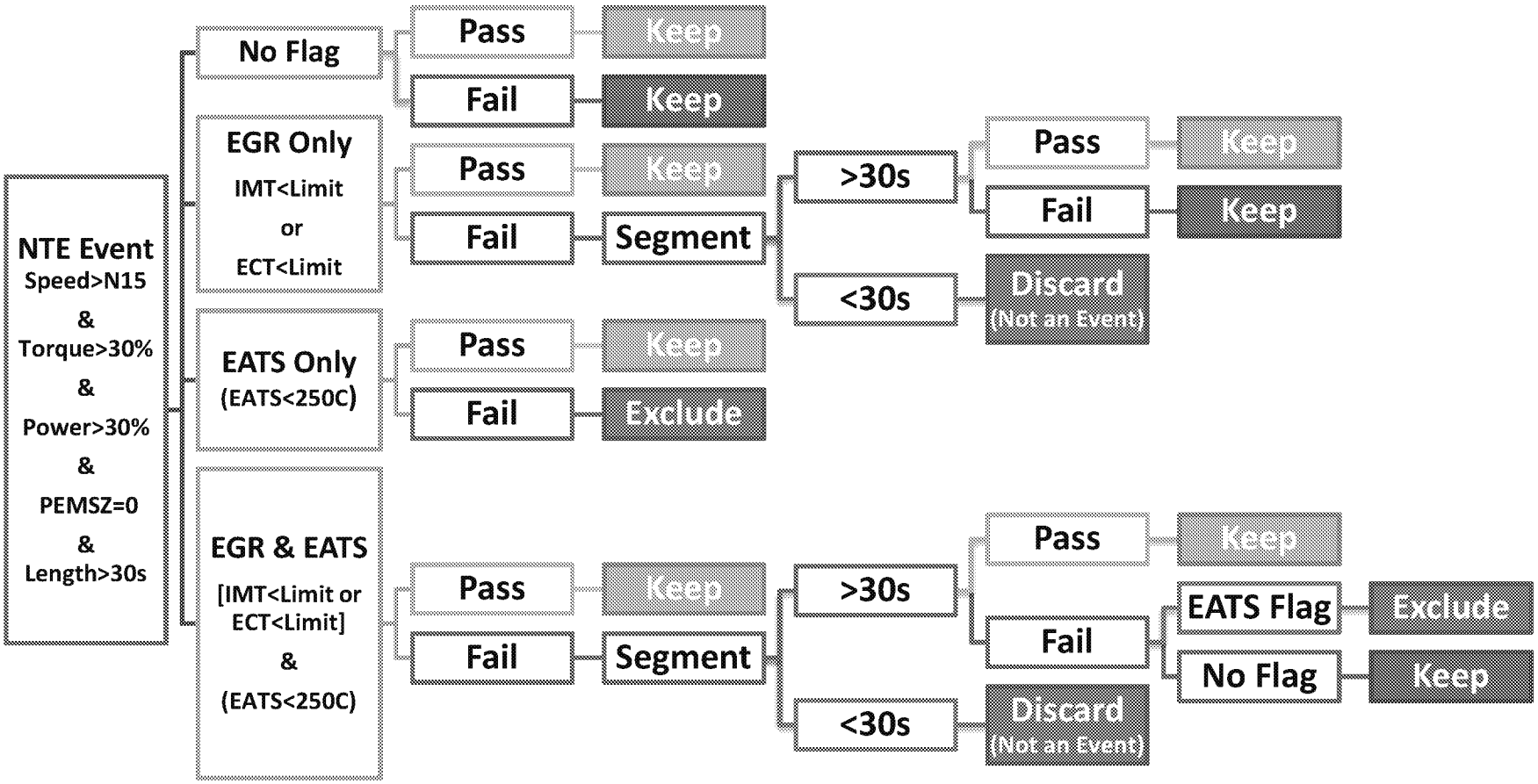
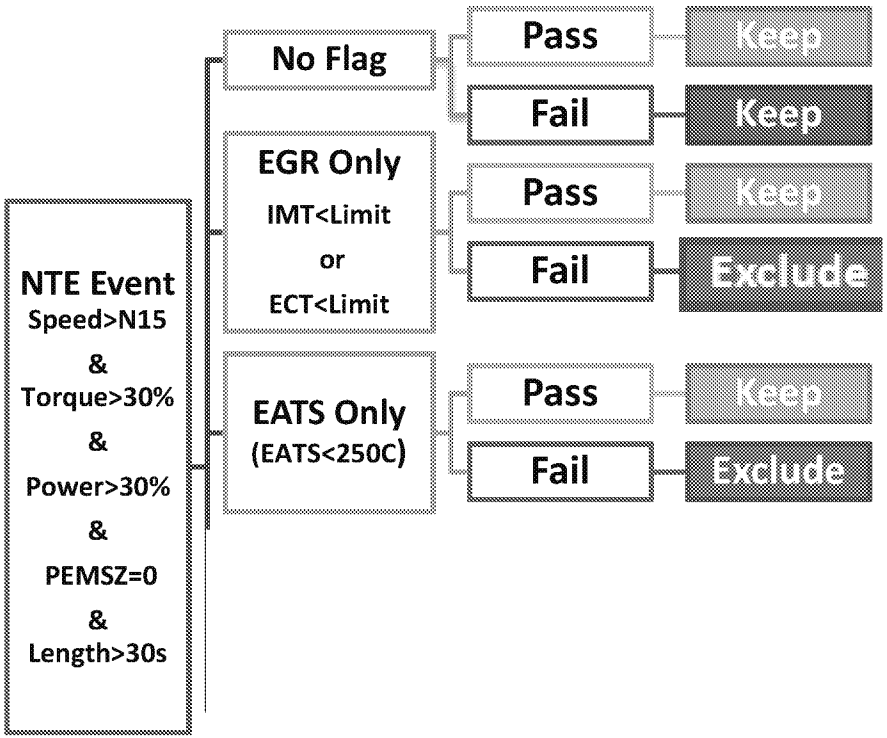
Volvo Flow Chart



- Any "Keep" is Automatically Discarded due to a DRIFT Error Upon Calculation of Brake Specific Emissions
- Pass or Fail is governed by Brake Specific NOx Emissions for the Event < 0.45 g/bhp-hr

EPA Flow Chart



Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 11/15/2018 5:25:24 PM
To: Laroo, Chris [laroo.chris@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
CC: Sponsky John [john.sponsky@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: HDIUT Data Processing

Yes. I will put it in my calendar.

From: Laroo, Chris
Sent: Thursday, November 15, 2018 12:06 PM
To: Duncan, Allen <duncan.allen@epa.gov>; Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Allen,

Would 830 am Friday morning in the lobby work?

Regards,

Chris Laroo
Environmental Protection Specialist
US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Duncan, Allen
Sent: Thursday, November 15, 2018 9:13 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Sponsky John <john.sponsky@volvo.com>; Laroo, Chris <laroo.chris@epa.gov>; Hamady, Fakhri <hamady.fakhri@epa.gov>
Subject: RE: HDIUT Data Processing

Taylor;
That sounds good. I'd like to see if we can get Chris Laroo to join us. I assume he will be in and out of the EMTC meeting.

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, November 15, 2018 8:28 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Sponsky John <john.sponsky@volvo.com>
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

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Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 3/8/2019 7:31:20 PM
To: Clark Taylor [taylor.clark@volvo.com]
Subject: RE: additional relevant text

Taylor;
I'm working through the regulatory language and seeking proper interpretation.

Best regards,
Allen

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Friday, March 8, 2019 2:25 PM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: RE: additional relevant text

Allen,

In sending me this reg, are you trying to tell me to just use your revision to our flow chart that you sent to us last October (see attached, page 2)?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

From: Duncan, Allen <duncan.allen@epa.gov>
Sent: Thursday, March 7, 2019 11:58 AM
To: Clark Taylor <taylor.clark@volvo.com>
Subject: additional relevant text

From 81.1912 (b)
b) For the purposes of this subpart, a valid NTE sampling event consists of at least 30 seconds of continuous operation in the NTE control area. An NTE event begins when the engine starts to operate in the NTE control area and continues as long as engine operation remains in this area (see §86.1370). When determining a valid NTE sampling event, exclude all engine operation in approved NTE limited testing regions under §86.1370-2007(b)(6) and any approved NTE deficiencies under §86.007-11(a)(4)(iv). Engine operation in the NTE control area of less than 30 contiguous seconds does not count as a valid NTE sampling event; operating periods of less than 30 seconds in the NTE control area, but outside of any allowed deficiency area or limited testing region, will not be

added together to make a 30 second or longer event. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for the time-weighted carve-out defined in §86.1370-2007(b)(7). For EGR-equipped engines, exclude any operation that occurs during the cold-temperature operation defined by the equations in §86.1370-2007(f)(1).

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Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 1/28/2019 7:39:37 PM
To: Martel, Jonathan S. [Jonathan.Martel@arnoldporter.com]
CC: Hamady, Fakhri [hamady.fakhri@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]
Subject: Re: HDIUT NTE

Jonathan;
Thank you for the offer. I will consult with ARB. EPA will ask ARB to participate in any such conversation.
Best regards
Allen

Sent from my iPhone

On Jan 17, 2019, at 09:18, Martel, Jonathan S. <Jonathan.Martel@arnoldporter.com> wrote:

Allen –

We understand that you and others at EPA have been in communication with Volvo about the proper interpretation of the Not-to-Exceed test procedures for the Manufacturer-Run In-Use Testing of Heavy-Duty Engines, and in particular the optional exclusion for emission data collected when after-treatment temperatures are below 250°C (as specified at 40 C.F.R. 86.1370(g)).

In the email correspondence we have reviewed, EPA confirmed that a manufacturer can choose to include or exclude any invalid NTE event, including an event for which after-treatment temperatures are below 250°C. If EPA intends to revisit that decision, we would appreciate the opportunity to speak with you first to provide our input.

Thank you for your consideration, and please feel free to give me a call at Ex. 6 - Personal Privacy if you would like to discuss.

Best,

Jonathan

Jonathan S. Martel
Partner

Arnold & Porter
601 Massachusetts Ave., NW | Washington | DC 20001-3743
T: +1 202.942.5470 | M: +1 301.412.2075 | F: +1 202.942.5999
jonathan.martel@arnoldporter.com | www.arnoldporter.com

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Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 11/15/2018 2:12:58 PM
To: Clark Taylor [taylor.clark@volvo.com]
CC: Sponsky John [john.sponsky@volvo.com]; Laroo, Chris [laroo.chris@epa.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: HDIUT Data Processing

Taylor;
That sounds good. I'd like to see if we can get Chris Laroo to join us. I assume he will be in and out of the EMTC meeting.

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, November 15, 2018 8:28 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Cc: Sponsky John <john.sponsky@volvo.com>
Subject: HDIUT Data Processing

Hi Allen,

I am onsite at EPA today and tomorrow for the EMTC meeting and was hoping to meet with you while I'm here to continue our discussion on HDIUT data processing. Please let me know if/when you are available and I can sneak out of the EMTC and meet you in the lobby.

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification & Compliance USA

Volvo Group Trucks Technology
13403 Volvo Way, Hagerstown, MD 21742
Phone: +1 240 500-4036

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Message

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Sent: 3/7/2019 4:57:49 PM
To: taylor.clark@volvo.com
Subject: additional relevant text

From 81.1912 (b)
b) For the purposes of this subpart, a valid NTE sampling event consists of at least 30 seconds of continuous operation in the NTE control area. An NTE event begins when the engine starts to operate in the NTE control area and continues as long as engine operation remains in this area (see §86.1370). When determining a valid NTE sampling event, exclude all engine operation in approved NTE limited testing regions under §86.1370-2007(b)(6) and any approved NTE deficiencies under §86.007-11(a)(4)(iv). Engine operation in the NTE control area of less than 30 contiguous seconds does not count as a valid NTE sampling event; operating periods of less than 30 seconds in the NTE control area, but outside of any allowed deficiency area or limited testing region, will not be added together to make a 30 second or longer event. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for the time-weighted carve-out defined in §86.1370-2007(b)(7). For EGR-equipped engines, exclude any operation that occurs during the cold-temperature operation defined by the equations in §86.1370-2007(f)(1).

Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 3/7/2019 3:31:13 PM
To: taylor.clark@volvo.com
Subject: RE: Part 86 In-Use Testing Question

Taylor;

Thanks for agreeing to further discuss this issue on the 19th. It is quite possible I have erred in my interpretation of Volvo's data processing.
I know that Volvo, EPA and ARB need to come to some conclusions so that Volvo may have certainty in its current and future HD IUT activities.

I first want to bounce my summary of the exchange between you and James last April (below).

Note that the exchange, clarified explicitly by James, is solely in the context of 86.1370 (g) and (h), not 1370 (f). James states that in the context of those two provisions, "A manufacturer can choose to include or exclude any invalid NTE event during a test."

He also explicitly (twice) expresses that the luxury of choosing (whether or not to exclude) is **not** available for the language of 86.1370 (f)

In other words, there is no flexibility on whether or not exclusions based on .1370 (f) may be utilized by a manufacturer (the manufacturer may not choose).

Also, I want to discuss the language of 86.1370 (d), which we have not had the opportunity to discuss, but which is significant in the ongoing conversation.
A significant issue of the ongoing discussion is that Volvo is, in my opinion (having assessed processed data) choosing to both "include" and "exclude" data *within a single NTE event*. I refer to this as "subdividing" (though that is my own term, with no definition in the CFR) a single event into a number of shorter duration events.

I present this in the context of a hypothetical 300 second NTE event and applications of 86.1370 (g) exclusions. Consider a single event in which the engine is in the NTE zone for a continuous 300 seconds. EPA treats this as one NTE event. In the context of 1370 (g) and 1370 (h), a manufacturer may be in a position to include or exclude that single event in the calculation of its pass ratio. It appears to me that Volvo is choosing to subdivide that single event into a number of shorter duration events and then include or exclude the shorter duration events in order to maximize the calculated pass ratio for the test.

I also have come to the conclusion that this practice was not Volvo protocol in the past, but became so with the test order being discussed. Volvo is unique in this interpretation, with no other precedent of this interpretation in the HD IUT program.

If I am mistaken and this is not what Volvo is doing, please explain so that I may better understand.

I look forward to our discussion.

Best regards,

Allen

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:29 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

No I meant (h). Paragraph (h) covers the other exclusion criteria not covered in paragraph (g).

(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Thursday, April 19, 2018 9:25 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

Thanks for getting back to me. Did you mean paragraph (f)?

BR,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:11 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,

Yes, paragraph (h) covers the rest of the NTE exclusion criteria and allows you to include those points in your vehicle-pass ratio determination.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

One more question for you just for completeness. Would the same logic apply to paragraph (f), which is the IMT/IMP exclusion?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,

Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark

Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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http://www.arnoldporter.com

Message

From: Duncan, Allen [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=5F4A476A56C342E7A2EEED96115208AC-DUNCAN, ALL]
Sent: 12/3/2018 4:17:51 PM
To: Sponsky John [john.sponsky@volvo.com]
Subject: RE: Volvo's in-use testing results for 2017 Test Order

John;
We still need discussion. There are questions regarding the submitted data. Taylor has received a list of questions and some files.

Best regards,
Allen

From: Sponsky John <john.sponsky@volvo.com>
Sent: Monday, December 3, 2018 10:30 AM
To: Duncan, Allen <duncan.allen@epa.gov>
Subject: RE: Volvo's in-use testing results for 2017 Test Order

Hi Allen,

I see that FJ has set up a meeting to discuss how include/exclude IUT.
I thought that you, Chris Laroo and Taylor Clark had resolved this matter after the EMTC meeting?
Please let me know if something has changed or if we should discuss further.

Thanks!
John

John Sponsky

Director – Certification & Compliance USA
Volvo Group Trucks Technology
Powertrain Engineering
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA

Telephone: 301.573.7454
Telefax: 301.790.5900

-----Original Appointment-----
From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Thursday, November 29, 2018 1:51 PM
To: Hamady, Fakhri; Clever Timothy; Sponsky John; Duncan, Allen; Laroo, Chris; Clark Taylor; Tasik Karl
Subject: FW: Volvo's in-use testing results for 2017 Test Order
When: Thursday, December 06, 2018 3:00 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

-----Original Appointment-----
From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Thursday, November 29, 2018 1:45 PM
To: Hamady, Fakhri; Duncan, Allen; Laroo, Chris; Clark Taylor; Tasik Karl
Subject: Volvo's in-use testing results for 2017 Test Order
When: Thursday, December 06, 2018 3:00 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Conference Call Information:

Conf. Number: Ex. 6 - Personal Privacy
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Appointment

From: Hamady, Fakhri [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=3bb2f045b5f84ae88ecd1c1a405b59f3-Hamady, Fakhri]
Sent: 11/29/2018 6:44:29 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; taylor.clark@volvo.com; karl.tasik@volvo.com
BCC: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE [AA-Room-Office-C35-ConfRoom@epa.gov]

Subject: Volvo's in-use testing results for 2017 Test Order
Location: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Start: 12/6/2018 8:00:00 PM
End: 12/6/2018 9:30:00 PM
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Conference Call Information:

Conf. Number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

Appointment

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 10/22/2018 8:06:46 PM
To: Tasik Karl [karl.tasik@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]

Subject: FW: CARB-Volvo 2017 Test Order Question Phone Call
Location: Skype Meeting

Start: 10/23/2018 6:00:00 PM
End: 10/23/2018 7:00:00 PM
Show Time As: Busy

Recurrence: (none)

-----Original Appointment-----
From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, October 16, 2018 12:04 PM
To: Tasik Karl; Macias, Keith@ARB; O'Cain, John@ARB; Clark Taylor; Clever Timothy; Lee, Abraham@ARB
Subject: CARB-Volvo 2017 Test Order Question Phone Call
When: Tuesday, October 23, 2018 2:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Skype Meeting

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Karl

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Appointment

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 10/16/2018 6:42:32 PM
To: Tasik Karl [karl.tasik@volvo.com]; Clever Timothy [tim.clever@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Hamady, Fakhri [hamady.fakhri@epa.gov]

Subject: EPA-Volvo In-Use Test Data Submittal Phone Call
Location: Skype Meeting

Start: 10/22/2018 7:00:00 PM
End: 10/22/2018 8:00:00 PM
Show Time As: Busy

Recurrence: (none)

This is a phone conference to discuss EPA questions relative the Volvo In-Use Test Data Submittal

Call-In Number Ex. 6 - Personal Privacy
Conference ID: Ex. 6 - Personal Privacy

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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EPA-Volvo Phone Call In-Use Test Data Submittal

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Appointment

From: Hamady, Fakhri [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=3bb2f045b5f84ae88ecd1c1a405b59f3-Hamady, Fakhri]
Sent: 10/16/2018 6:30:05 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Duncan, Allen [duncan.allen@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; abraham.lee@arb.ca.gov
BCC: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE [AA-Room-Office-N66-ConfRoom@epa.gov]

Subject: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal
Location: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Start: 10/22/2018 7:00:00 PM
End: 10/22/2018 8:00:00 PM
Show Time As: Busy

This is a phone conference to discuss EPA questions relative the Volvo In-Use Test Data Submittal

Call-In Number: Ex. 6 - Personal Privacy
Conference ID: Ex. 6 - Personal Privacy

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

Appointment

From: Hamady, Fakhri [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=3bb2f045b5f84ae88ecd1c1a405b59f3-Hamady, Fakhri]
Sent: 8/14/2018 5:48:31 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]
CC: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; ARB MSCD Meetings And Events [600.mscdcal.ARB@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Macias, Keith@ARB [keith.macias@arb.ca.gov]
BCC: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE [AA-Room-Office-N66-ConfRoom@epa.gov]

Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Volvo Response - 2016 In-Use Test Order Questions
Location: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Start: 8/21/2018 6:00:00 PM
End: 8/21/2018 7:00:00 PM
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Conf. ID: Ex. 6 - Personal Privacy

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 8/7/2018 2:06:38 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Q&As for Volvo HDIUT Data (for 2016 test order).docx

Abraham,

The following is the Volvo response to your attached July 16, 2018 question.

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

Volvo July 21, 2018 Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to? Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez? In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Volvo Response: The origin of this interpretation traces back to an EMA/Agencies (EPA & ARB)/Suppliers meeting at EPA in Ann Arbor, MI on July 15, 2014. It was at this meeting where Chris Laroo of EPA announced that the low temperature exclusions are something they do not like but reluctantly accept. Therefore, in order to incentivize low temperature emissions control, the regulators' position was to use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass. The October 2016 amendment included a language change in the CFR Part 86.1370 which states that "you may exclude emission data". Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the amendment. Volvo has recently confirmed with Chris Laroo and James Sanchez that this interpretation is correct. They stated *"86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well"* and that *" A manufacturer can choose to include or exclude any*

invalid NTE event during a test". Dr. Hamady was not involved in the discussion; however, he has reviewed the test order. In the future Volvo intends to include ARB on discussions regarding interpretation.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, July 16, 2018 4:27 PM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven; Hamady, Fakhri
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range

values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

I am examining your data for 2016 order, especially for three vehicles tested in 2017, and have several questions/comments below:

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731

Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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From: Lee, Doh-Won@ARB
Sent: Monday, November 13, 2017 4:04 PM
To: Trevitz Steven <steven.trevitz@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Murter Zack <zack.murter@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Steve!

Sincerely,
Doh-Won

From: Trevitz Steven [mailto:steven.trevitz@volvo.com]
Sent: Thursday, November 09, 2017 8:08 AM
To: Lee, Doh-Won@ARB
Cc: Clever Timothy; Heltzel Robert; Tasik Karl; Murter Zack
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: Ex. 6 - Personal Privacy
E-mail: steven.trevitz@volvo.com

From: Tasik Karl
Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve,

Please provide a response to Doh-Won's IUT questions.

Thanks
Karl

From: Lee, Doh-Won@ARB [mailto:Doh-Won.Lee@arb.ca.gov]
Sent: Wednesday, November 08, 2017 11:00 AM
To: Tasik Karl
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I have a couple of quick questions.

I was notified that you did not have SCR temperature monitor for the engine family, and I noticed that you put a thermocouple for measuring SCR temperature. "The exhaust elbow on the outlet of the SCR catalyst was replaced with one that accommodates a thermocouple." in the Acceptance History Text (in xml files). How far was it from the outlet of the SCR to the thermocouple? Do you have pictures showing the installation setup?

Thank you for your responses in advance.

Sincerely,
Doh-Won

From: Lee, Doh-Won@ARB
Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov

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From: Tasik Karl [mailto:karl.tasik@volvo.com]
Sent: Wednesday, August 02, 2017 10:10 AM
To: Macias, Keith@ARB

Cc: Sardar, Satya@ARB; Lee, Doh-Won@ARB
Subject: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Keith,

The Volvo 2Q 2017 In-Use Test Data for the 2016 In-Use Test Order is being shipped today via Fedex # Ex. 6 - Personal Privacy.

Best Regards,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to?
Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez?
In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

Thank you for your explanation. I spoke with my colleague, John O'Cain, whom you met during his audit of the Volvo lab. He indicated that you had already been using new PEMS for HDIUT, which would eliminate these types of abnormalities and malfunction. Additionally, our expectation is that you will continue to have good QA/QC practices. Based on your explanation that the old PEMS had systematic problems, we accept the test data. However, please note that, if the same types of problems continue to occur with the new PEMS, we may not accept the test data.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC

concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

> Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

Thank you for your explanation. As similar to the item addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 3 vehicles tested in 2017,
in addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

> Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

Thank you for your explanation along with calibration data sent via email attachments. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

Thank you for your explanation. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. For water ingestion, we recommend you take any necessary actions to prevent it from happening. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

Appointment

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 11/29/2018 7:23:24 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]

Subject: Accepted: Volvo's in-use testing results for 2017 Test Order
Location: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Start: 12/6/2018 8:00:00 PM
End: 12/6/2018 9:30:00 PM
Show Time As: Busy

Recurrence: (none)

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Appointment

From: Clark Taylor [taylor.clark@volvo.com]
Sent: 11/29/2018 6:49:39 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]

Subject: Accepted: Volvo's in-use testing results for 2017 Test Order
Location: AA-Room-Office-C35-ConfRoom/AA-OTAQ-OFFICE

Start: 12/6/2018 8:00:00 PM
End: 12/6/2018 9:30:00 PM
Show Time As: Busy

Recurrence: (none)

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Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 8/7/2018 2:06:38 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Q&As for Volvo HDIUT Data (for 2016 test order).docx

Abraham,

The following is the Volvo response to your attached July 16, 2018 question.

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

Volvo July 21, 2018 Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to? Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez? In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Volvo Response: The origin of this interpretation traces back to an EMA/Agencies (EPA & ARB)/Suppliers meeting at EPA in Ann Arbor, MI on July 15, 2014. It was at this meeting where Chris Laroo of EPA announced that the low temperature exclusions are something they do not like but reluctantly accept. Therefore, in order to incentivize low temperature emissions control, the regulators' position was to use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass. The October 2016 amendment included a language change in the CFR Part 86.1370 which states that "you may exclude emission data". Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the amendment. Volvo has recently confirmed with Chris Laroo and James Sanchez that this interpretation is correct. They stated *"86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well"* and that *" A manufacturer can choose to include or exclude any*

invalid NTE event during a test". Dr. Hamady was not involved in the discussion; however, he has reviewed the test order. In the future Volvo intends to include ARB on discussions regarding interpretation.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, July 16, 2018 4:27 PM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven; Hamady, Fakhri
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range

values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

I am examining your data for 2016 order, especially for three vehicles tested in 2017, and have several questions/comments below:

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
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For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731

Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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From: Lee, Doh-Won@ARB
Sent: Monday, November 13, 2017 4:04 PM
To: Trevitz Steven <steven.trevitz@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Murter Zack <zack.murter@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Steve!

Sincerely,
Doh-Won

From: Trevitz Steven [mailto:steven.trevitz@volvo.com]
Sent: Thursday, November 09, 2017 8:08 AM
To: Lee, Doh-Won@ARB
Cc: Clever Timothy; Heltzel Robert; Tasik Karl; Murter Zack
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: 301.573.1622
E-mail: steven.trevitz@volvo.com

From: Tasik Karl
Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve,

Please provide a response to Doh-Won's IUT questions.

Thanks
Karl

From: Lee, Doh-Won@ARB [mailto:Doh-Won.Lee@arb.ca.gov]
Sent: Wednesday, November 08, 2017 11:00 AM
To: Tasik Karl
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I have a couple of quick questions.

I was notified that you did not have SCR temperature monitor for the engine family, and I noticed that you put a thermocouple for measuring SCR temperature. "The exhaust elbow on the outlet of the SCR catalyst was replaced with one that accommodates a thermocouple." in the Acceptance History Text (in xml files). How far was it from the outlet of the SCR to the thermocouple? Do you have pictures showing the installation setup?

Thank you for your responses in advance.

Sincerely,
Doh-Won

From: Lee, Doh-Won@ARB
Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov

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From: Tasik Karl [mailto:karl.tasik@volvo.com]
Sent: Wednesday, August 02, 2017 10:10 AM
To: Macias, Keith@ARB

Cc: Sardar, Satya@ARB; Lee, Doh-Won@ARB
Subject: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Keith,

The Volvo 2Q 2017 In-Use Test Data for the 2016 In-Use Test Order is being shipped today via Fedex # Ex. 6 - Personal Privacy.

Best Regards,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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CALIFORNIA
AIR RESOURCES BOARD

HEAVY-DUTY IN-USE TESTING PROGRAM WORKGROUP MEETING

AUGUST 2, 2018

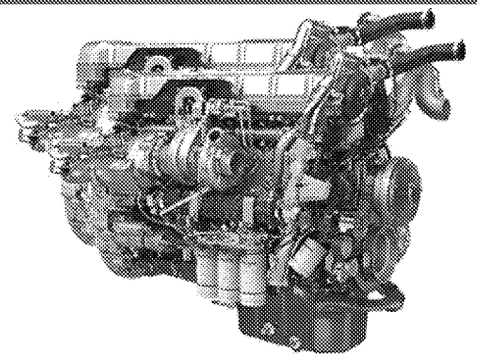
PROPOSED REVISIONS TO THE HEAVY-DUTY IN-USE TESTING PROGRAM AND EMISSION CREDITS PROGRAM

MOBILE SOURCE CONTROL DIVISION

OUTLINE

- Background
- Heavy-Duty In-Use Testing Program
- Credits - Averaging Banking and Trading (ABT)
- Next Steps

PROGRAM ELEMENTS AND TIMEFRAME



- **Elements:**
  - Setting Low-NOx engine standards
  - Developing a supplementary low-load certification test cycle
  - Revising the Heavy-Duty In-Use Testing (HDIUT) program –
    - Replace Not-to-Exceed (NTE) method with moving average window (MAW)
  - Strengthen the current durability demonstration program
  - Extension of useful life and warranty periods
- **Timeframe**:
  - CARB Board date: December 2019
  - Implementation to begin in 2023

LOW NOx DEMONSTRATION PROJECTS

- **Stage 1 – Low NOx Feasibility Demonstration**
  - Funding: $1.6M by CARB with support from MECA and Volvo
  - Final report at: https://www.arb.ca.gov/research/veh-emissions/low-nox/carb_2017-04-30_03-19503_finaledit.pdf
- **Stage 1b – Re-aging of New Set of Stage 1 Aftertreatment Parts**
  - Funding: $480,000 by SCAQMD with support from MECA
- **Stage 2 – Low Load Cycle (LLC) Development / Low Load NOx Control / Load Metrics Accuracy Evaluation**
  - Funding: $1.05M by CARB
- **Stage 3 – Low NOx Demonstration on an Alternative Non-Turbocompound (TC) Engine**
  - Funding: $1.375M by CARB, SCAQMD and POLA with support from Cummins & MECA
- **Stage 3b – Additional Low NOx Related Engine Hardware Development**
  - Funding: $500K by EPA, HD Industry & MECA

Heavy-Duty In-Use Testing (HDIUT)

HDIUT: OUTLINE

- Current HDIUT /NTE program
- Problems with current program
- Proposed changes
  - Administrative and Reporting
  - Testing Conditions and Exclusions
  - Full Duty Cycle Control
  - Moving Average Windows (MAW)
  - Pass Fail Determination
- CARB HDIUC Program provisions

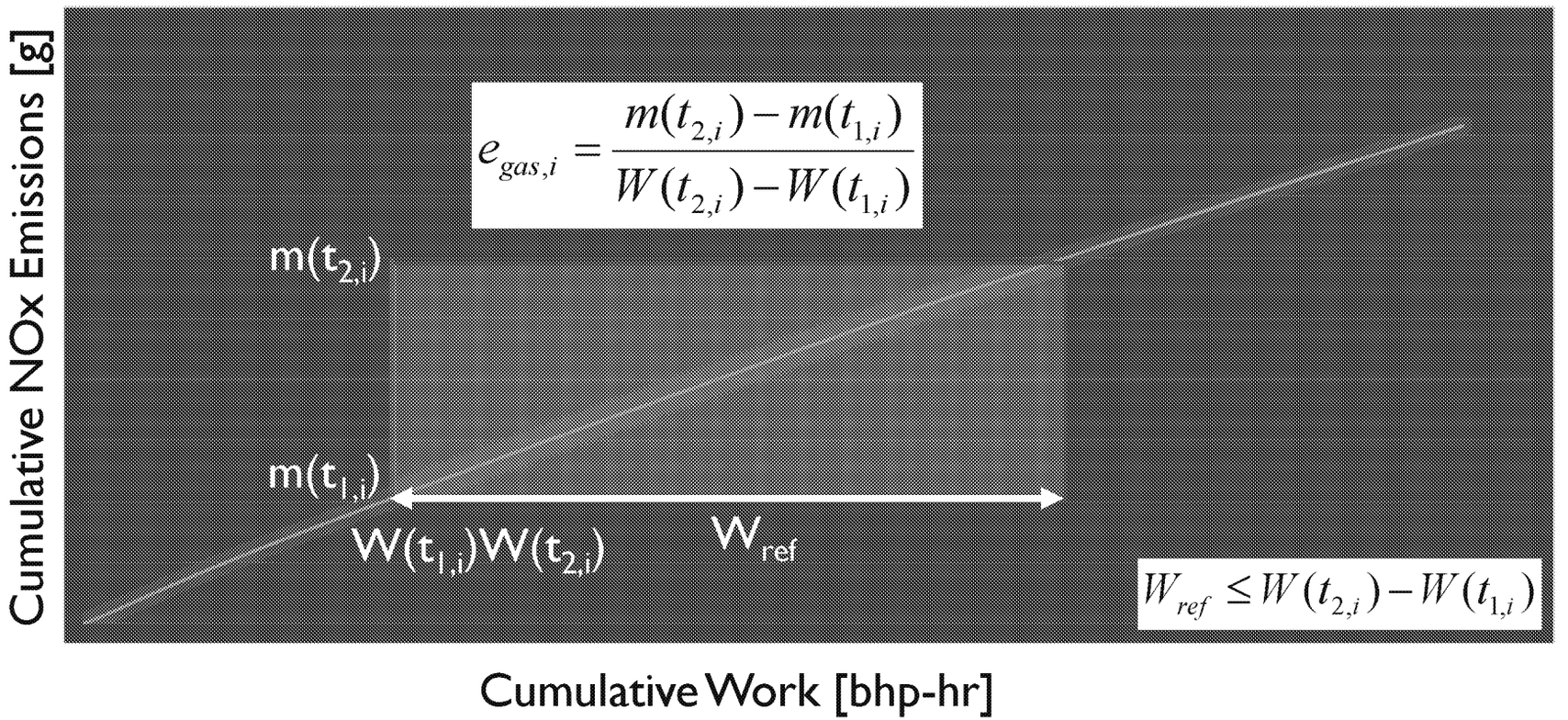
HDIUT: CURRENT REQUIREMENTS (40 CFR PART 86 SUBPART T)

	Current CARB & EPA HDIUT
Request for testing	• CARB & EPA Requested
Engine Selection	• Max 25% engine families produced each year and 100% engine families over 4 year avg
Frequency	• Annually
Vehicle test equipment	• PEMS
Driver	• Regular Fleet Driver
Route	• Regular Fleet Route
Method	• Not-to-Exceed
Exclusions	• Ambient, 30% power, 30% torque, min-rpm, zero check, AT-temp, cold operations, IMT/ECT, OBD/EMD fault code, regeneration
Window Validity	• 30 sec continuous operation within NTE control area without entering exclusions operation
Emissions	• Brake specific [g/bhp-hr]
In Use Thresholds	• 1.5 x Std. + PEMS accuracy margin (0.15 g/bhp-hr for NOx)
Pass Determination	• 90% of time weighted valid NTE events must emit at or less than the In Use Threshold

HDIUT: CURRENT PROBLEMS

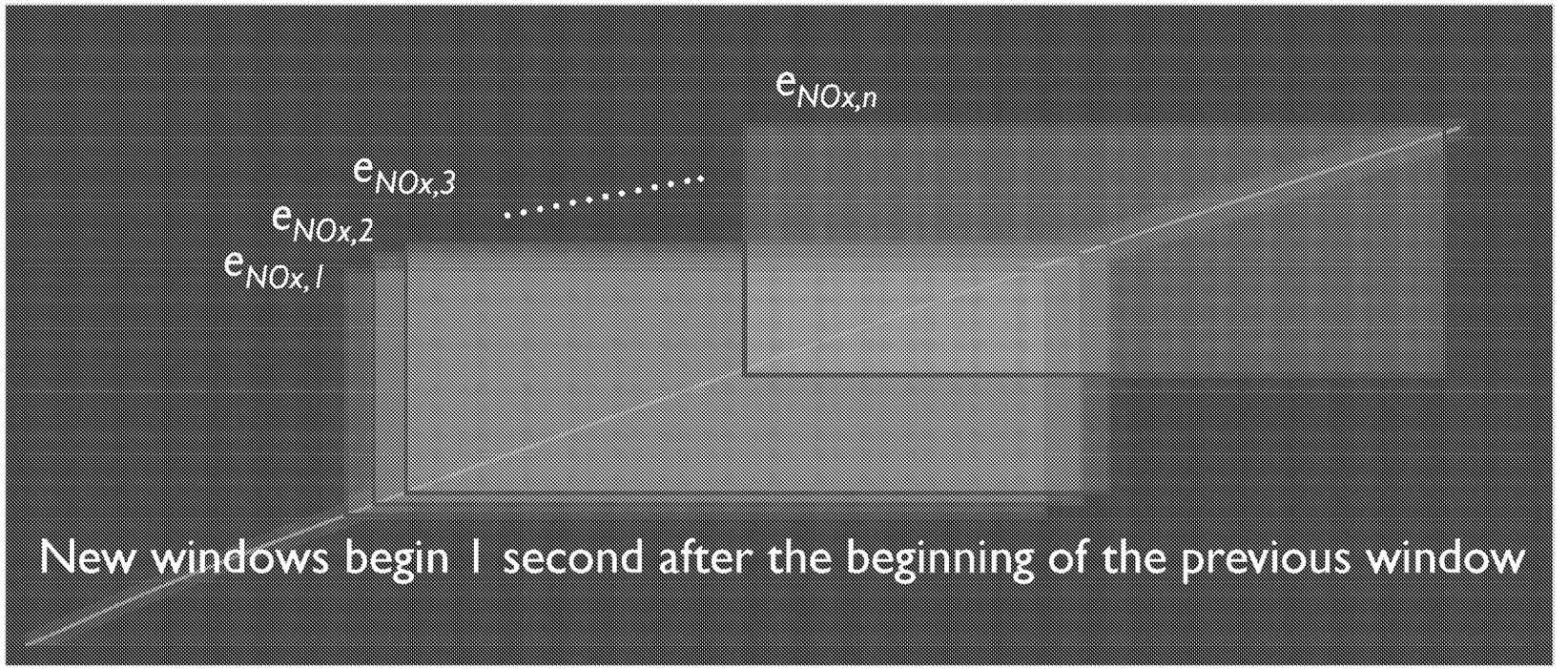
- Current HDIUT program targets sustained high speed and high load operation for gross NOx polluting offenses.
- After applying the current exclusions, valid data from testing represents a small fraction of the total test in terms of time (<5%) and NOx emissions (<6%).
- 24% of tests pass without any valid NTE events.
- Current HDIUT does not represent the full duty cycle emissions.
- There is a discrepancy in the pass rates observed by the manufacturer and CARB-run HDIUT results. (CARB testing: 17 of 23 failed NTE)
- New or revised method needed

EURO VI: DETERMINATION OF EMISSIONS WITHIN A MAW



EURO VI: DETERMINE ALL WINDOWS AND EMISSIONS

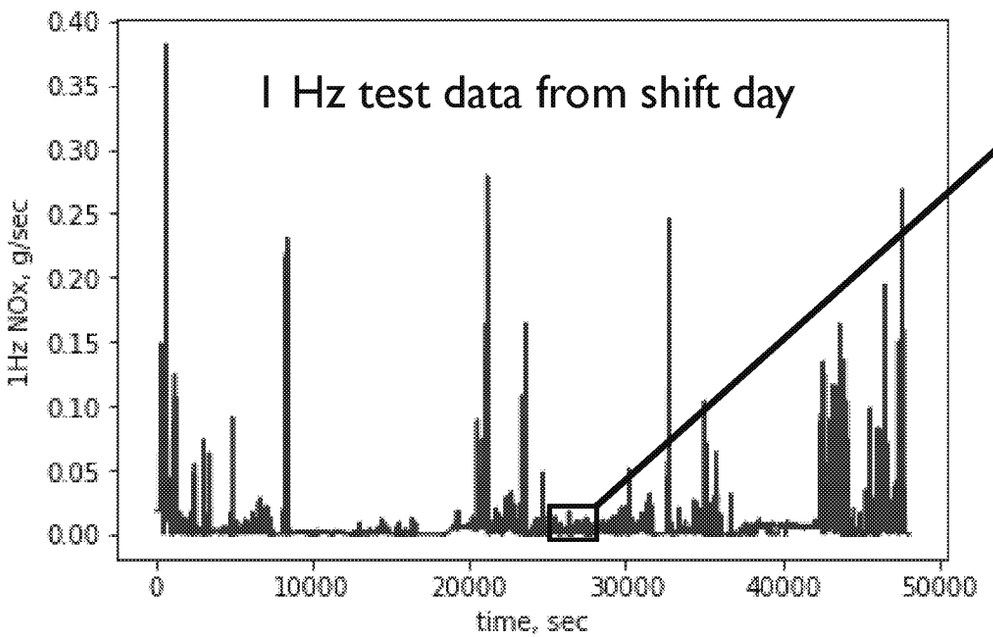
Cumulative NOx Emissions [g]

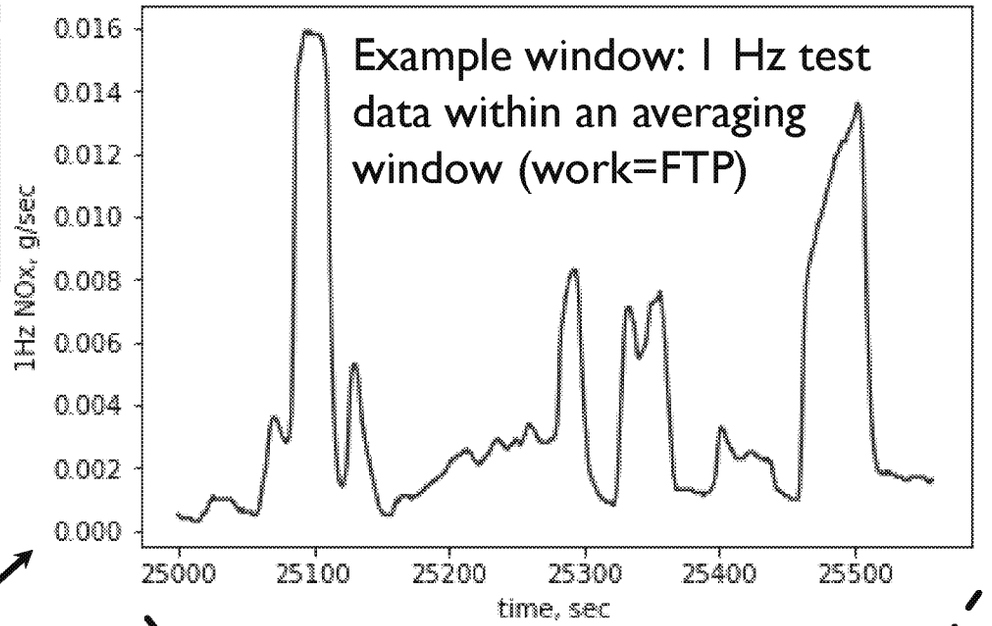


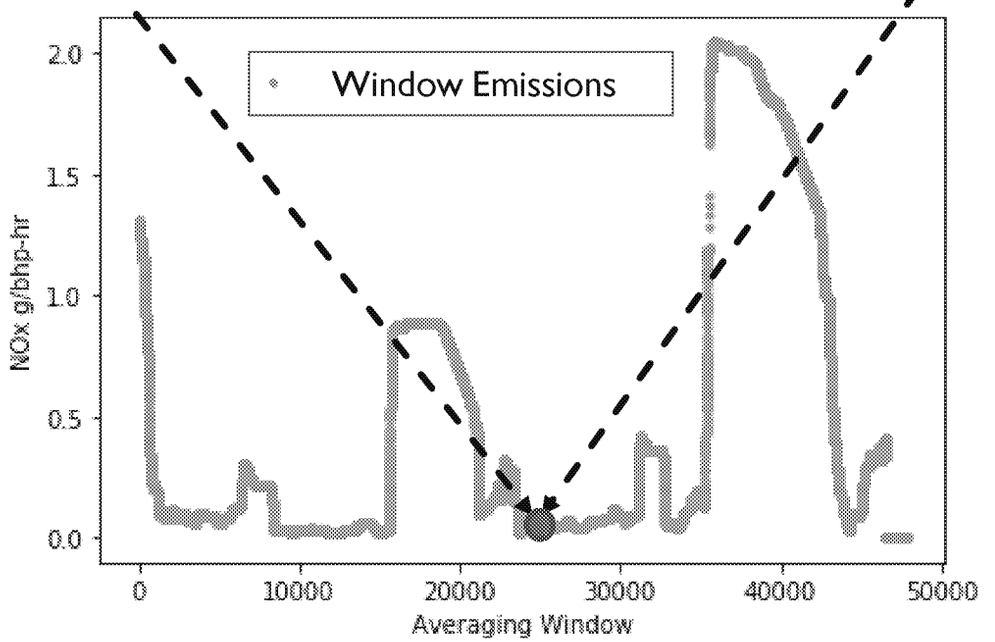
Cumulative Work [bhp-hr]

AVERAGE WINDOW EMISSIONS

- PEMS emissions from the test data collected at 1Hz (red).
- The emission rate over the reference work is averaged for each window (orange).

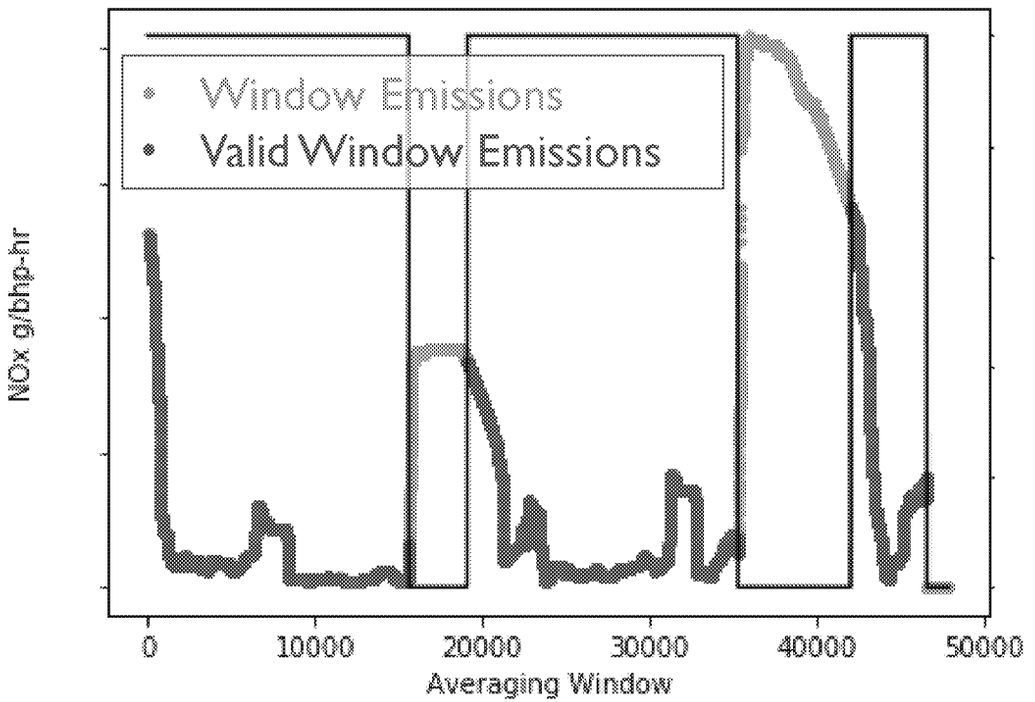


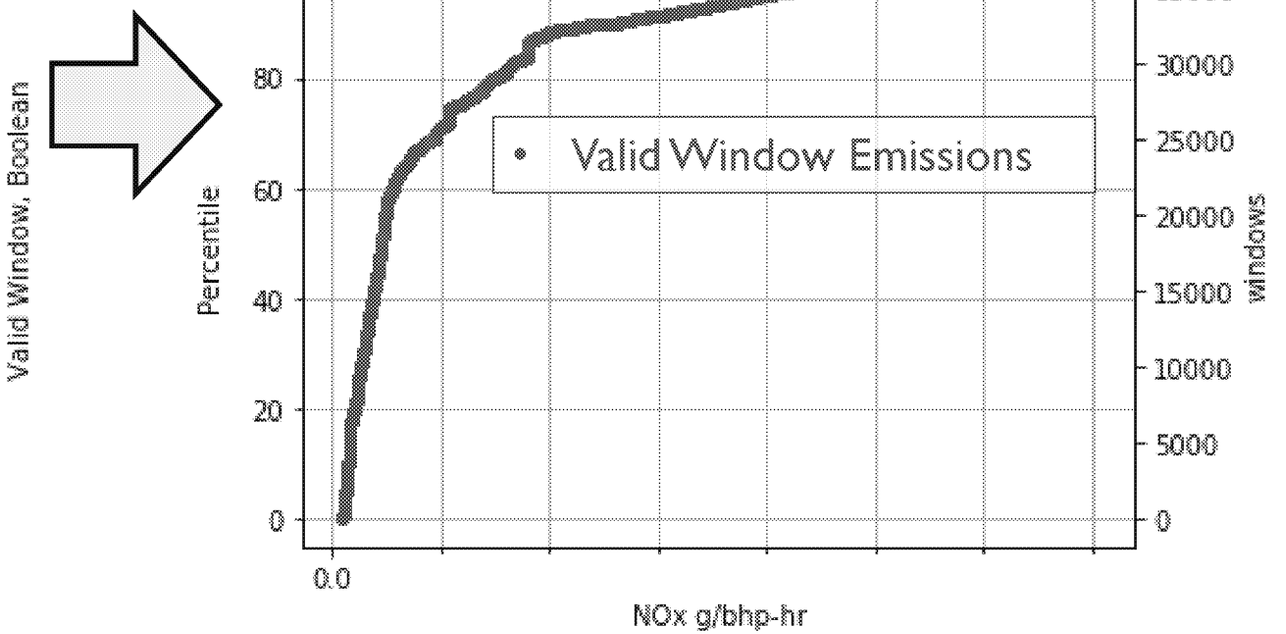




EURO VI: PREPARING DATA FOR COMPLIANCE DETERMINATION

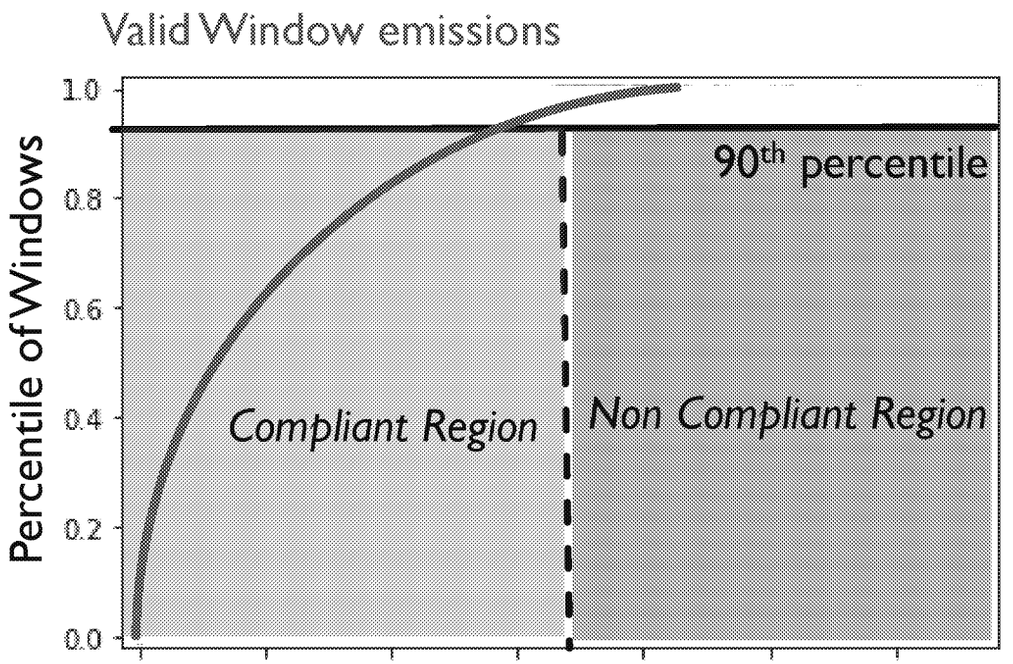
- The average power of a window must be equal to or greater than the power threshold (10% maximum power) to be considered valid.
- The valid windows are sorted in order by emission rate.





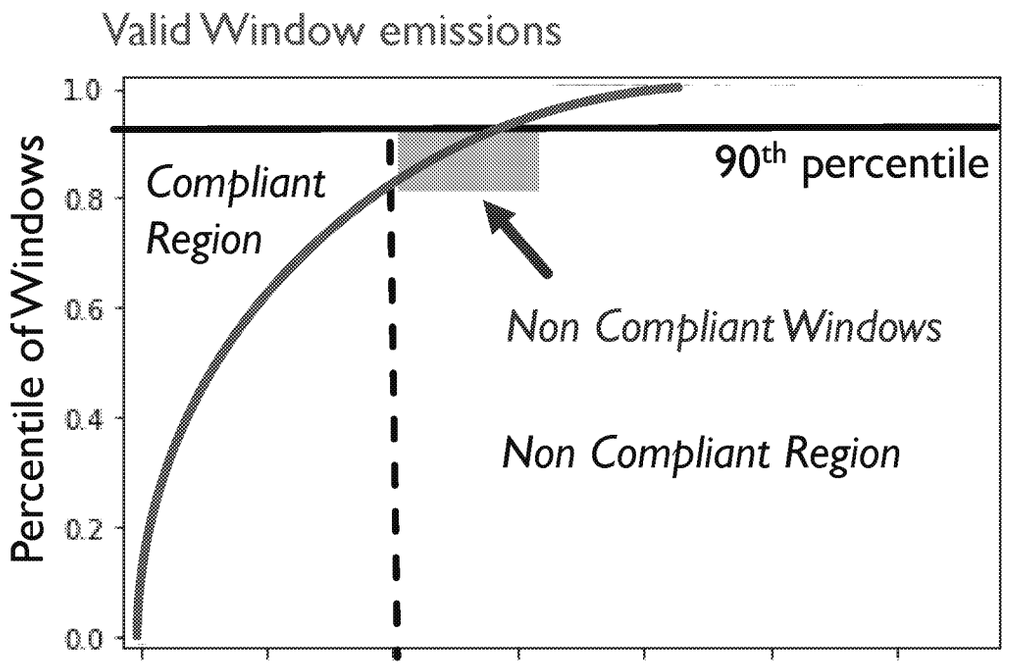
EURO VI: EU COMPLIANCE DETERMINATION

Euro VI **Compliant** Test



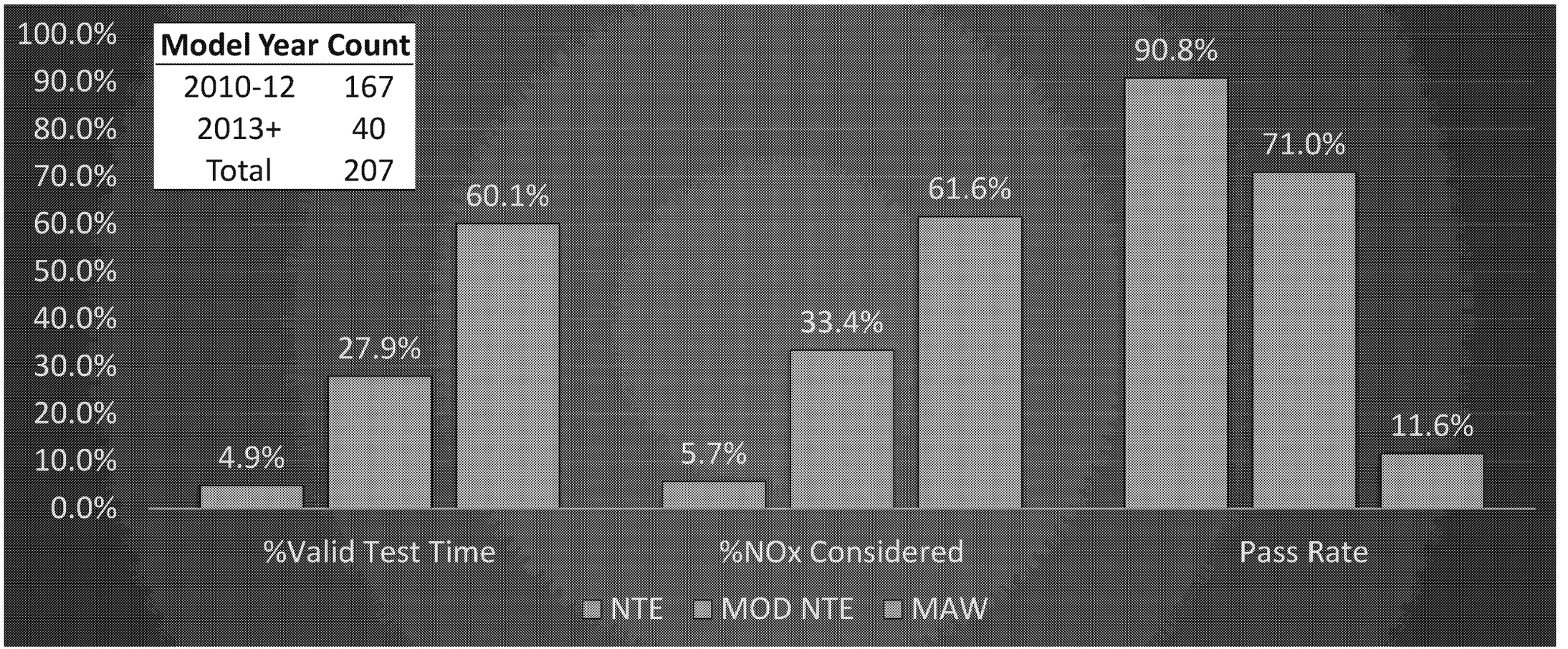
MAW Threshold = 1.5 x Std

Euro VI **Non-Compliant** Test



MAW Threshold = 1.5 x Std

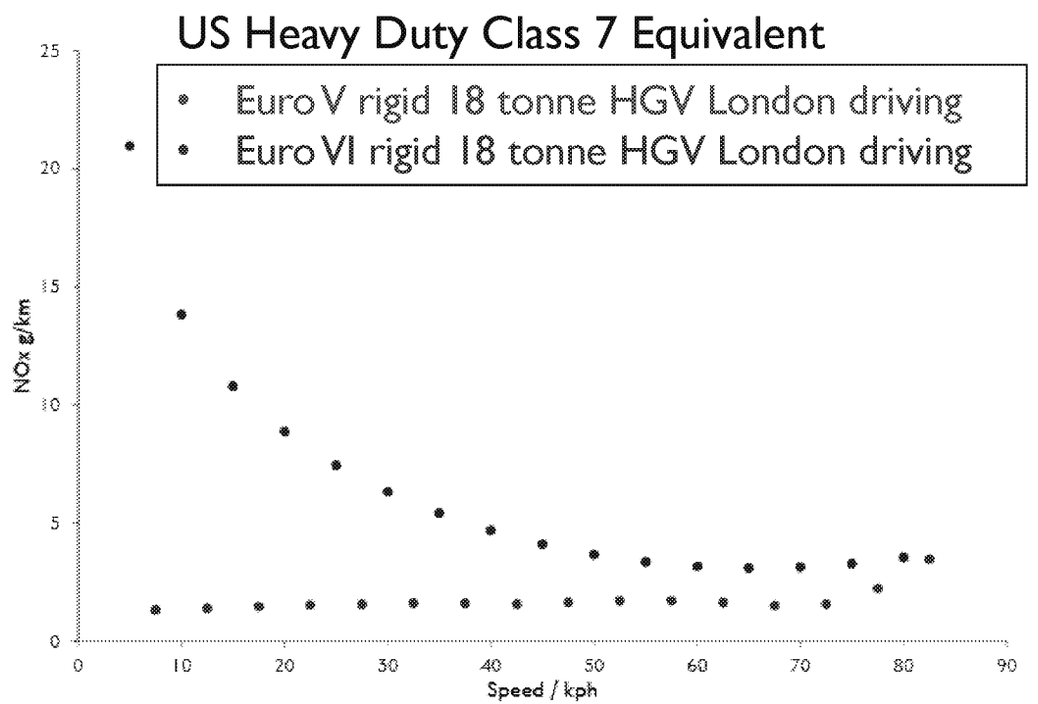
METHOD COMPARISON: MOVING AVERAGE WINDOW CAPTURES MORE OF TEST TIME AND EMISSIONS



- The Moving Average Window method is superior
- Modifying the NTE is not adequate

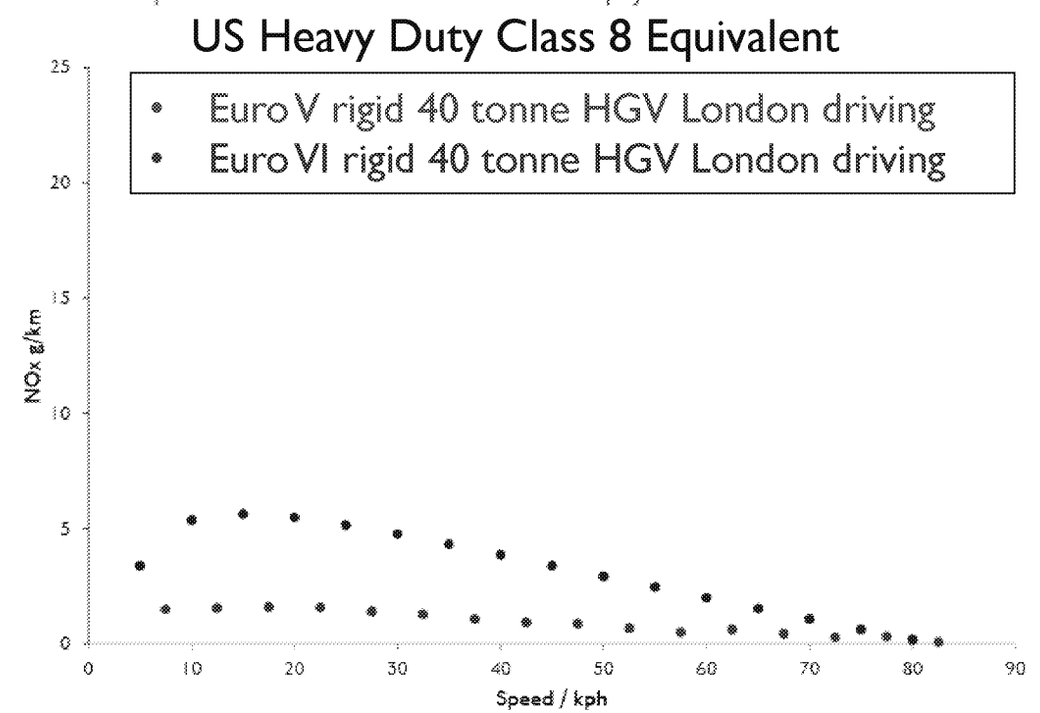
DISTANCE SPECIFIC EMISSIONS DECREASED OVER THE ENTIRE RANGE OF SPEEDS WHEN EURO VI WAS IMPLEMENTED

Figure 5 Comparison of Euro V versus Euro VI NO_x emissions over a range of road speeds: 18 tonne rigid HGV 100% payload



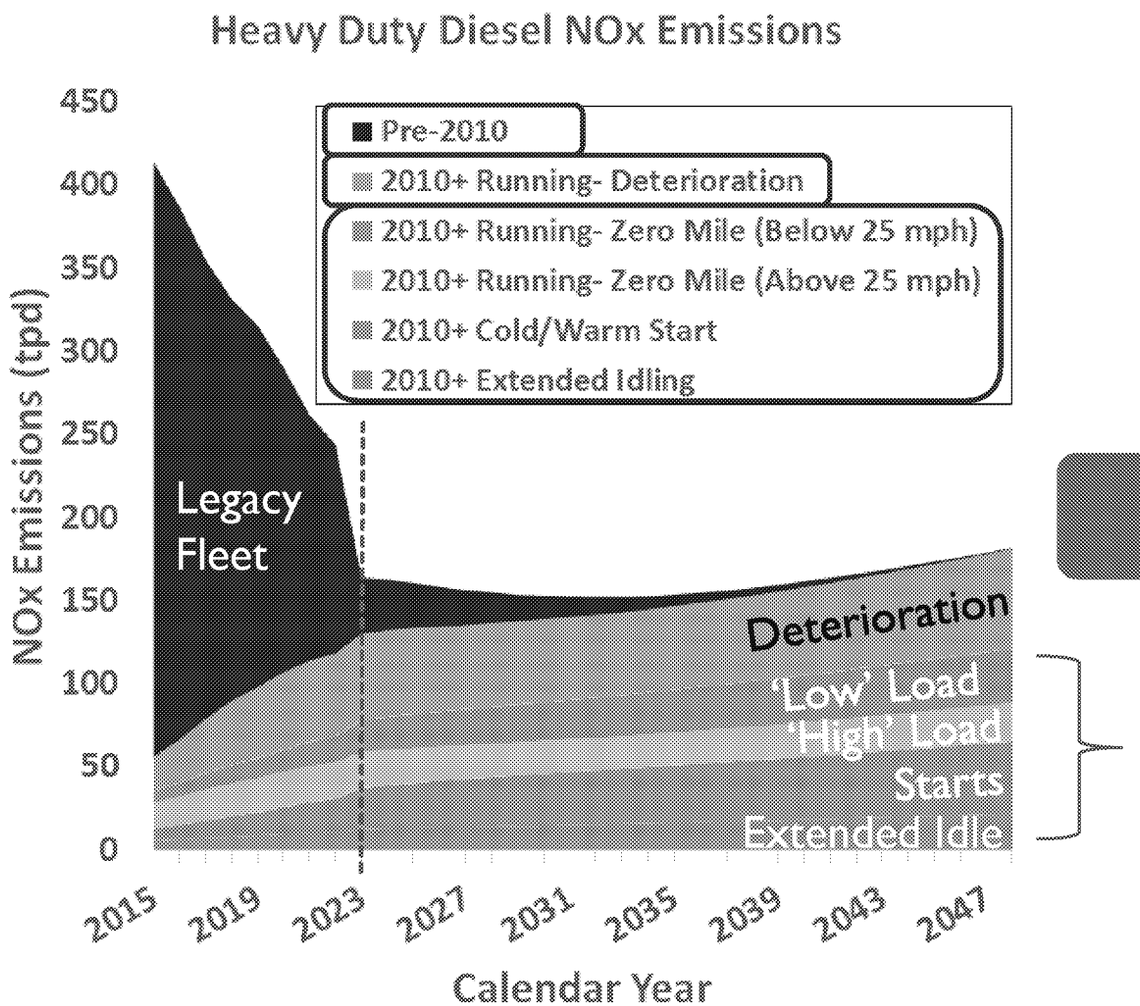
*In-service emissions of Euro 6/VI vehicles. A summary of testing using London drive cycles. Transport for London

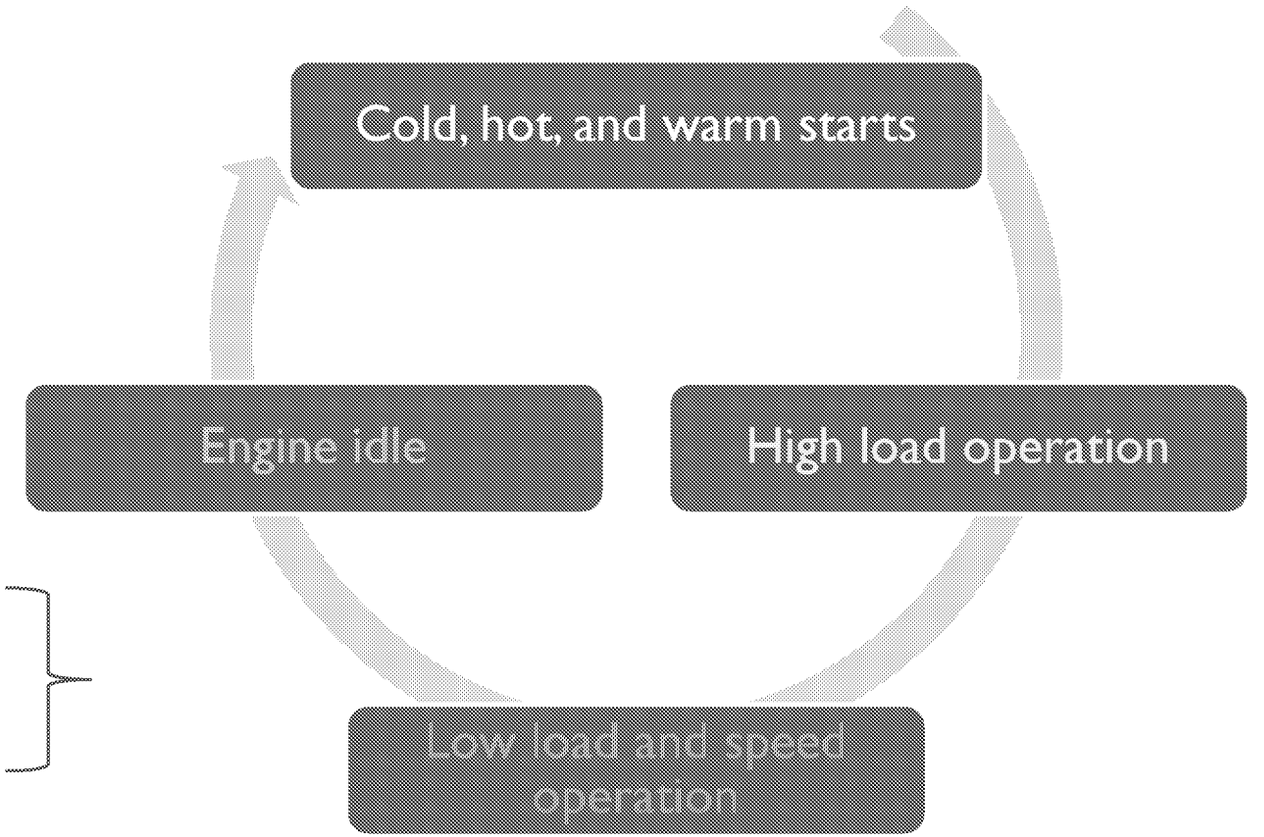
Figure 6 Comparison of Euro V versus Euro VI NOx emissions over a range of road speeds: 40 tonne articulated HGV 100% payload.



*In-service emissions of Euro 6/VI vehicles. A summary of testing using London drive cycles. Transport for London

HDIUT: PROPOSING TO MOVE TO FULL DUTY CYCLE EMISSIONS CONTROL





HDIUT: PROPOSED UPDATES AND CHANGES

- **Remove the following elements:**
  - Discard the Not-to-Exceed method, NTE control area, operation exclusions, and averaging period
  - No longer allow a PEMS accuracy margin allowance
- **Replacement and Addition Concepts:**
  - Lower power threshold for window validation: Use the Euro VI MAW method but with a window threshold power < 10% (exact threshold to be determined)
  - Size the windows based on FTP work or a fraction thereof (to be determined)
  - Require higher fraction of windows to be at or below standard: Raise percentile for pass determination to >90% (to be determined)
  - Potentially have some limits on top windows (i.e., those not required to be at or below standard)
  - Include start emissions
- **Reporting:**
  - CARB pre-approves manufacturer's HDIUT test plans
  - Data quality checklist assuring that valid and complete test data was collected prior to submittal

HDIUT: ENGINE FAMILY SELECTION AND TEST PLAN APPROVAL

- **Engine Selection**
  - CARB and EPA to continue to work together in selection of engine families for HDIUT
  - Rules for number of engine families selected annually and over a 4 year average would stay in place
- **Manufacturer test plan must be approved by CARB**
  - Test vehicle to be driven by fleet operator (manufacturer may also do testing with CARB/EPA approval)
  - Test vehicle to be driven over its regular fleet route (or CARB/EPA approved test route)
  - Season, ambient conditions, and other test conditions to be reviewed and require approval by CARB
- **Testing and Reporting Options**
  1. Use a single set of testing data but use separate analysis and reporting methods for the CARB and federal HDIUT programs
  2. Conduct separate testing and reporting to comply with federal and California HDIUT programs

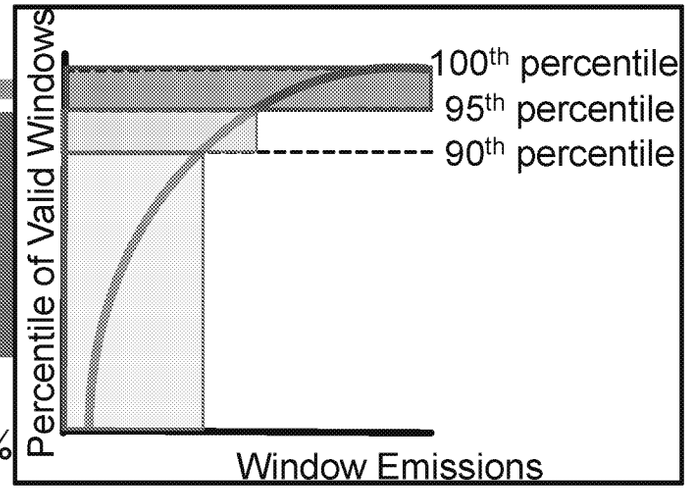
HDIUT: UPDATED AMBIENT CONDITIONS AND DATA EXCLUSIONS

- **Cold Start Requirements (if included)**
  - Test must start with a cold Engine Coolant ≤ 30°C (86°F)
- **Other Requirements**
  - *Maximum Altitude,* h ≤ 5,500 ft
  - *Minimum Ambient Temperature,* $T \geq 20$ °F
  - *Maximum Ambient Temperature,* $T \leq -.00254 * h + 100$ °F
- **PEMS QC Exclusions**
  - Data collected during the periodic instrument zero or drift checks shall not be considered

HDIUT: ANALYSIS METHOD

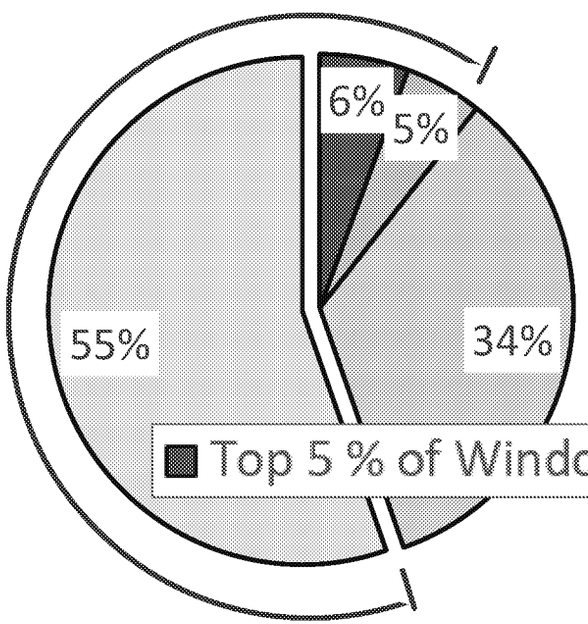
- **Emission Metrics**
  - Emissions at low loads and idle operation will require a method other than brake specific emissions
  - CO_2 and fuel specific among other metrics are being evaluated by SwRI
  - Shorter than FTP equivalent window may be needed to effectively capture low load operation behavior
- **Moving Average Windows**
  - Subsets of continuous overlapping windows
  - Increments of the collection rate, 1Hz
  - Window size based on a reference mass of CO_2 or amount of Work
  - Window average power must be greater than the threshold power to be valid (threshold power may be at idle)
  - Average brake and CO2 specific emissions of windows are reported
- **Advantages**
  - Captures emissions over the full duty cycle
  - Large averaging periods

NOX REPRESENTATION: CHANGES TO POWER THRESHOLD AND COMPLIANCE PERCENTILE

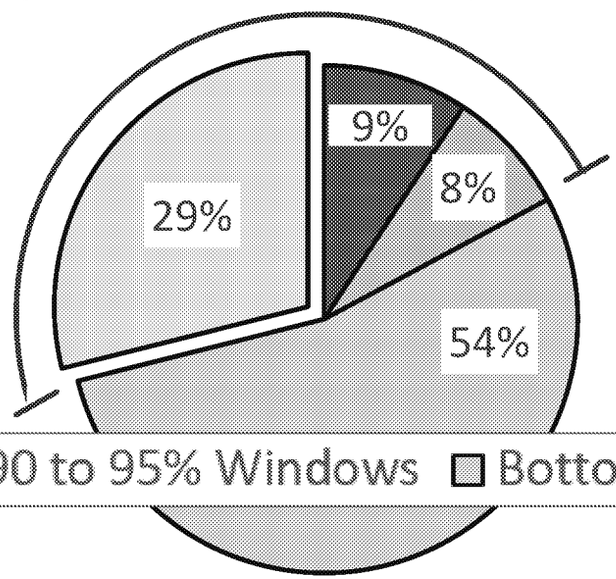


- Emissions in the top 10% of windows can contribute up to 55% of the NOx emissions of the trip
- Decreasing the power threshold to 5% would increase NOx representation in valid windows from 45% to 71%
- 5-8% NOx representation gained by moving the evaluated percentile from the 90th to the 95th

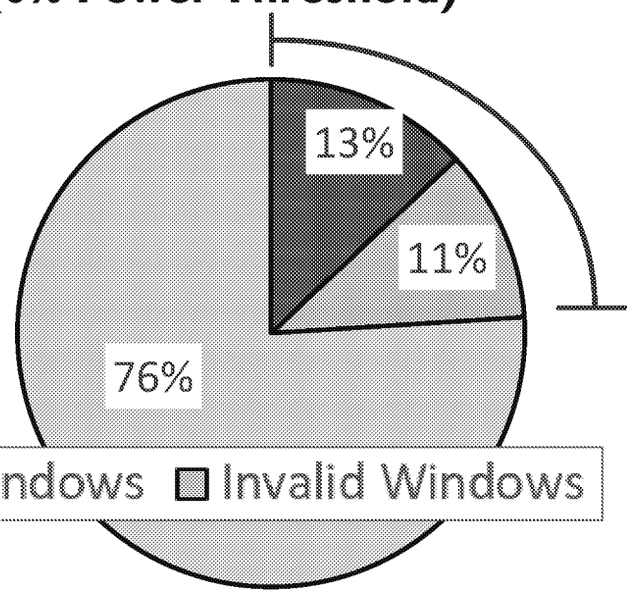
Percent of NOx emissions (10% Power Threshold)



Percent of NOx emissions (5% Power Threshold)



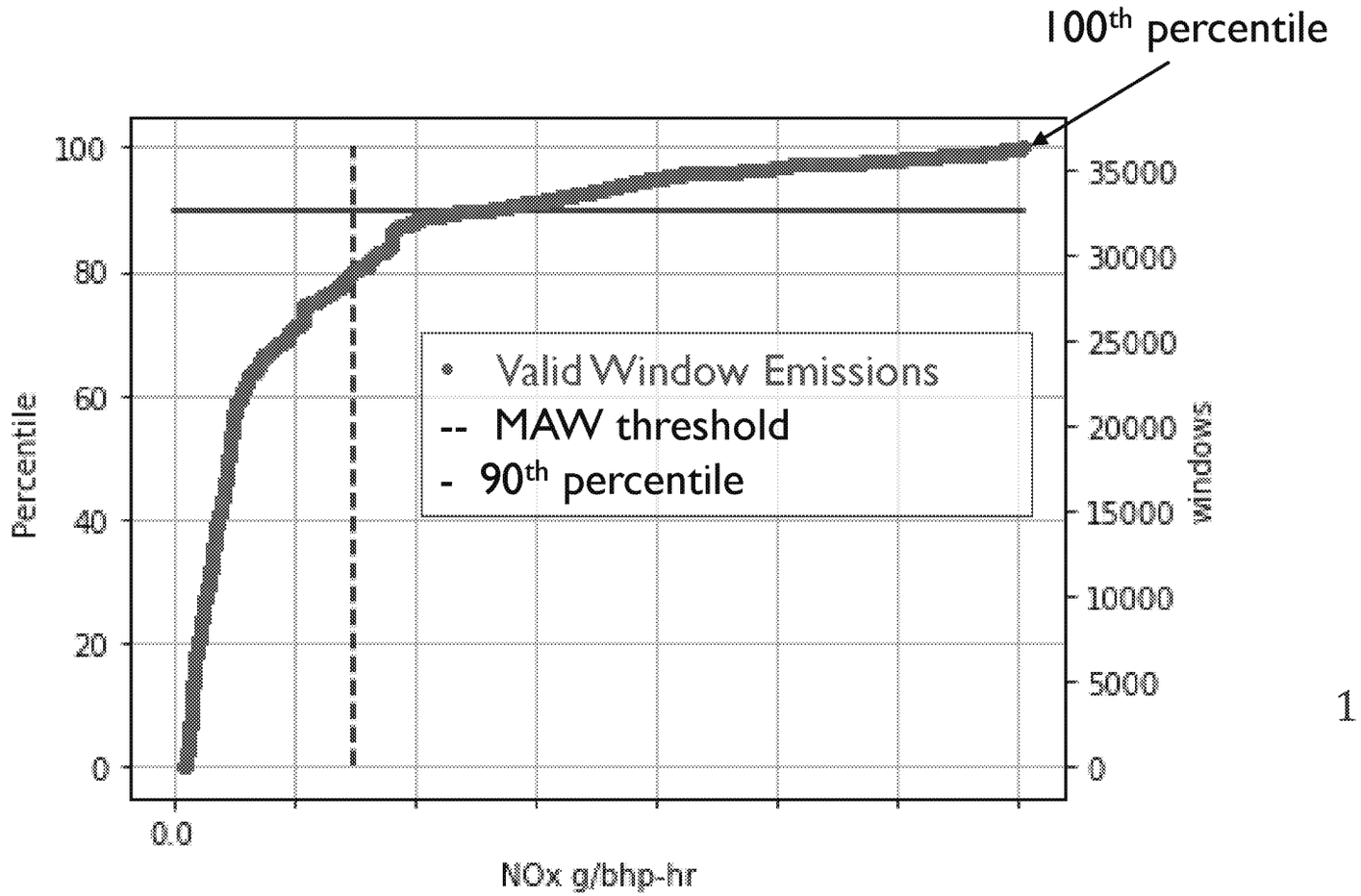
Percent of NOx emissions (0% Power Threshold)



Top 5 % of Windows | 90 to 95% Windows | Bottom 90% Windows | Invalid Windows

*This is not representative of inventory. *Data analyzed from 2010+ MY HDIUT.

HDIUT: EU CONCEPT FOR INCLUSION OF TOP 10% OF WINDOWS



- **Composite CAP**
  - **100th percentile window emissions (cold start)**
  - **90th percentile window emissions (hot running)**

$$1.5\ x\ std \geq \frac{1}{7}\left(100^{th}\ \%\right) + \frac{6}{7}\left(90^{th}\ \%\right)$$

HDIUT: FUTURE CONCEPT SUMMARY

	FUTURE CARB HDIUT
Request for testing	• EPA and CARB Requested
Engine Selection	• Max 25% engine families produced each year and 100% avg engine families over 4 year
Frequency	• Annually
Vehicle test equipment	• PEMS
Test Plan	• Mfr. Submitted for CARB approval
Driver	• Fleet driver (or manufacturer with prior CARB/EPA approval)
Route	• Regular fleet route – full test day (or manufacturer with prior CARB/EPA approval)
Method	• Moving Average Window (MAW)
Exclusions	• ambient, zero check
Window Validity	• $Pwr_{avg} \geq 10\%\ Pwr_{max}$ Include operation less than $10\%\ P_{max}$ Include Start emissions (cold, warm, and hot)
Emissions	• Work or CO2 specific (may include SWRI alternative)
In Use Thresholds	• 1.5 x Std.
Pass Determination	• 90th percentile emissions (or higher) below In Use Threshold • Control highest 10% and invalid windows

Color Key

*Current CFR and CCR
* Borrowed from Euro VI
* CARB proposed additions

PROVISIONS FOR CARB HEAVY DUTY IN-USE COMPLIANCE (HDIUC) PROGRAM (13 CCR 2136-2140)

- CARB to routinely conduct HDIUC testing for compliance
- CARB will utilize a state driver instead of a fleet driver
- CARB will choose appropriate routes for compliance determination
- Addition of chassis dynamometer compliance testing
  - Ramped Modal Cycle (RMC) cycle used to determine compliance
    - Steady-state operation of the RMC provides good correlation to engine dyno testing
  - Ensures compliance with certification emission standards, not HDIUT thresholds

NOx Credits -
Averaging Banking and Trading (ABT) Program

CREDITS – TRANSITION TO A CALIFORNIA BANK OF NOx CREDITS

- Currently, only a national HD ABT program
  (only one pool of credits for both CA and EPA)
- California NOx emissions standards would require a separate credit pool from the existing federal pool
- CA would allow manufacturers to transfer a portion of their national NOx credits into a CA credit account, based on 5-yr average percentage of CA engine sales for each primary intended service class
- After transferring a portion of their pre-2023 credits into CA-only NOx credit account in 2023 MY, manufacturers would track CA and EPA NOx credits separately

CA NOx CREDIT ACCOUNT CONCEPT

- **All NOx credits transferred to CA credit account would expire in 5 years (similar to Phase 2 GHG credit program)**
  - Currently, there is no expiration of accumulated credits - some existing credits have been generated over a decade ago
- **In addition to Phase 2 GHG credits, zero emission powertrains (ZEPs) would also produce CA NOx credits with a credit multiplier**
  - Multiplier = 2
  - ZEPs credit multiplier would be significantly reduced or sunset post 2030
- **Credits are expected to play an important role in the transition to the 0.0x NOx standard**

ABT CALCULATION

- **Credits are calculated for each engine family using the following equation:**

$$\boldsymbol{Emission\ Credits = (Std\ - FEL) \times CF\ \times UL \times Sales\ Volume \times 10^{-6}}$$

Where:

Emission credits/debits for each engine family (Mg)

Std = Applicable Emissions Standard (g/bhp-hr)

FEL = Applicable Family Emission Limit (g/bhp-hr)

CF = Transient Cycle Conversion factor (bhp-hr/mile)

UL = Useful life for the engine family (miles)

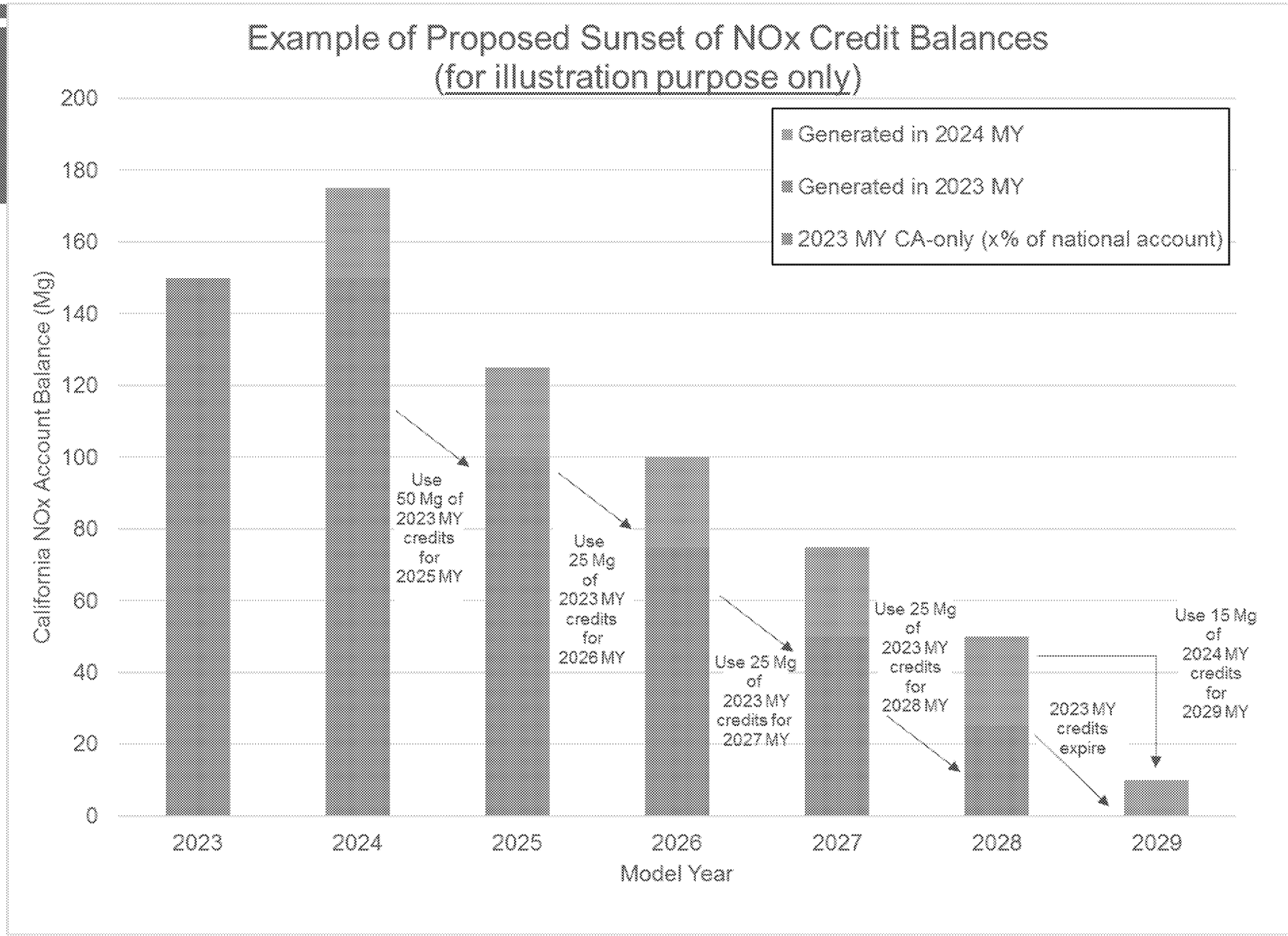
Note – UL extension would result in discounting of existing credits

EXAMPLE OF CREATING CA BANK OF CREDITS

- A manufacturer has accumulated 1,000 Mg of NOx credits through 2022 MY at the national level for HHDD engines
- Average 5-year (2018-2022 MY) CA sales is 10% of 50-state sales
- At the beginning of 2023 MY, CA-NOx account balance would be established by transferring 1000 x 10% = 100 Mg of NOx credits from national bank to CA bank (900 Mg remains in EPA account)
- These NOx credits can be used to certify engines up to the FEL cap for 2023 and subsequent model years
- Example of certifying to an FEL using credits (in 2023+MY) :

$$100 = \sum_{EF=1}^{n} |(0.0x - FEL_{EF})| \times CF_{EF} \times UL_{EF} \times 10^{-6} \times CA\ Sales_{EF}$$

- Where EF represents the engine families in the HHDD primary intended service class
- The California sales volume would be dependent on the FEL selected (up to the FEL cap) and the UL requirement


Example of Proposed Sunset of NOx Credit Balances
(for illustration purpose only)
Generated in 2024 MY
Generated in 2023 MY
2023 MY CA-only (x% of national account)
California NOx Account Balance (Mg)
200
180
160
140
120
100
80
60
40
20
0
2023
2024
2025
2026
2027
2028
2029
Model Year
Use 50 Mg of 2023 MY credits for 2025 MY
Use 25 Mg of 2023 MY credits for 2026 MY
Use 25 Mg of 2023 MY credits for 2027 MY
Use 25 Mg of 2023 MY credits for 2028 MY
2023 MY credits expire
Use 15 Mg of 2024 MY credits for 2029 MY

Credits – NOx Credits for Zero Emission Powertrains (ZEPs)

ZEP MUST BE CERTIFIED TO BE ELIGIBLE FOR ENGINE NOx CREDITS

- **ZEP certification planned to go to Board late 2018**

- **Current Draft Proposal**
  - Applies to battery-electric and fuel-cell electric powertrains to be used in MY 2019+ medium- and heavy-duty vehicles (8501 lbs GVWR+)
  - For more information on ZEP Certification:

    David Eiges, Lead Staff

    Phone: 626-575-6602

    Email: david.eiges@arb.ca.gov

CURRENT ZEP DRAFT PROPOSED CERTIFICATION REQUIREMENTS ADDRESS PERFORMANCE

- Standardized battery capacity testing
  - SAE J1798
- System monitoring and diagnostics
- Warranty
  - 3year/50,000 mile
- Sales Disclaimer Statement
  - Considerations when buying vehicle with ZEP (e.g., range, charging infrastructure…)

ZEP NOx CREDITS

- **Credits are earned at the end of the model year and maintained and reported separately**
- **Credits may be banked for five years after the model year in which they are earned**
- **Banked credits may only be used in the averaging set in which they were generated**
  - 4 Engine Averaging sets
    - Medium-Duty and Light Heavy-Duty CI Engines (CI 3-5)
    - Medium Heavy-Duty CI engines (CI 6-7)
    - Heavy Heavy-Duty CI Engines (CI 8)
    - Medium-Duty and Heavy-Duty Spark Ignited Engines

ZEP NOx CREDIT EQUATION

- **Emission rate of ZEP = 0.0, so benefit is proportional to emission standard of engine it is replacing**

$$\textit{ZEP NOx Emission Credits (Mg)} = (Std) \times (CF) \times (Sales\_Volume) \times (UL) \times 10^{-6} \times Multiplier$$

- Std = NOx emission standard of engine subcategory ZEP is replacing (e.g., ~0.0x g NOx /bhp-hr)
- CF = Transient cycle conversion factor, total integrated hp-hr over test cycle divided by distance traveled during test (miles)
- Sales Volume = CA directed production volume of ZEP
- UL = Useful life of vehicle class (e.g., 435K miles for HHDD, 185K miles for MHDD, 110K miles for LHDD)
- Multiplier = 2

DISCUSSION ISSUES

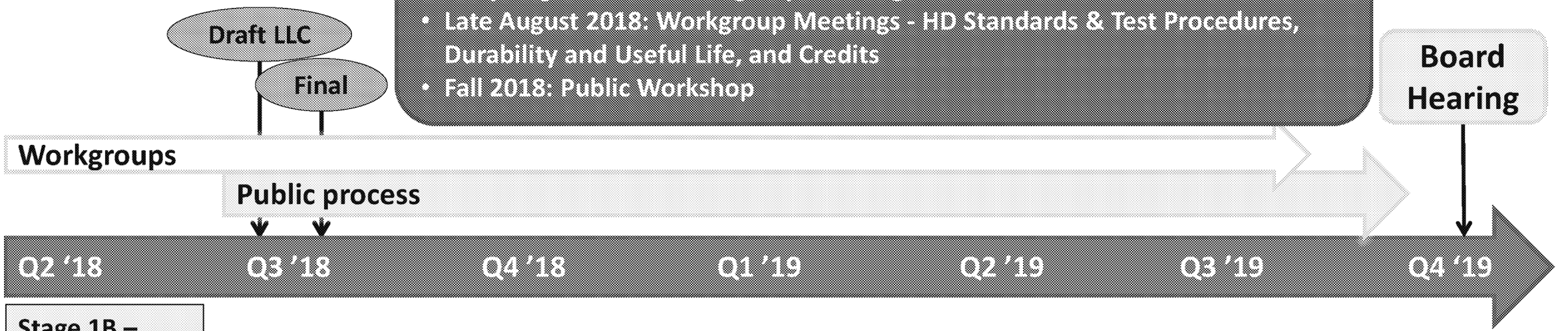
- Factors to consider when setting the ZEP NOx credit multiplier
  - Need to balance ZEP technology advancement needs with near-term air quality needs
  - Credit caps may be needed
  - Sunset multiplier (post -2030)
  - Should credit multiplier be adjusted by "utility factor" representing the ratio of ZEP range (e.g., miles/day) to average range of comparable conventional vehicle
- Should the "useful life" of a ZEP vehicle used in the credit equation be equivalent to the useful life of the diesel vehicle it replaces?

Next Steps

UPCOMING MILESTONES

Upcoming Meetings:

- August 2018: SWRI Advisory Groups re: Stage 1b & 2, low load cycle (LLC)
- Early August 2018: Workgroup Meetings – HDIUT and Credits
- Late August 2018: Workgroup Meetings - HD Standards & Test Procedures, Durability and Useful Life, and Credits
- Fall 2018: Public Workshop



Stage 1B – Re-age parts

Stage 2 – Develop/assess LLC

Stage 3 – Demonstrate low NOx on 2nd engine without turbocompound, including LLC

Stage 3b – Explore additional engine hardware options that can simultaneously reduce NOx and GHG on stage 3 engine – cylinder deactivation, turbine bypass, charge air cooler bypass & EGR cooler bypass

NREL On-Road Heavy-Duty Low-NOx Technology Cost Study

CONTACTS

Kim Heroy-Rogalski, Chief
Mobile Source Regulatory Development Branch
(916) 327-2200
kim.heroy-rogalski@arb.ca.gov

William H. Robertson, Ph.D. ,
Vehicle Program Specialist,
Mobile Source Control Division
(626) 459-4467
bill.robertson@arb.ca.gov

Stephan Lemieux
Manager, On-Road Heavy-Duty Diesel Section
(626) 450-6162
stephan.lemieux@arb.ca.gov

Daniel Hawelti
Staff APS, On-Road Heavy-Duty Diesel Section
(626) 450-6149
daniel.hawelti@arb.ca.gov

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 7/17/2018 11:37:56 AM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Abraham,

We will review and provide a response your questions.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, July 16, 2018 4:27 PM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven; Hamady, Fakhri
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>

Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted.

Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

I am examining your data for 2016 order, especially for three vehicles tested in 2017, and have several questions/comments below:

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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From: Lee, Doh-Won@ARB
Sent: Monday, November 13, 2017 4:04 PM
To: Trevitz Steven <steven.trevitz@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Murter Zack <zack.murter@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Steve!

Sincerely,
Doh-Won

From: Trevitz Steven [mailto:steven.trevitz@volvo.com]
Sent: Thursday, November 09, 2017 8:08 AM
To: Lee, Doh-Won@ARB
Cc: Clever Timothy; Heltzel Robert; Tasik Karl; Murter Zack
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: Ex. 6 - Personal Privacy
E-mail: steven.trevitz@volvo.com

From: Tasik Karl
Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve,

Please provide a response to Doh-Won's IUT questions.

Thanks
Karl

From: Lee, Doh-Won@ARB [mailto:Doh-Won.Lee@arb.ca.gov]
Sent: Wednesday, November 08, 2017 11:00 AM
To: Tasik Karl
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I have a couple of quick questions.

I was notified that you did not have SCR temperature monitor for the engine family, and I noticed that you put a thermocouple for measuring SCR temperature. "The exhaust elbow on the outlet of the SCR catalyst was replaced with one that accommodates a thermocouple." in the Acceptance History Text (in xml files). How far was it from the outlet of the SCR to the thermocouple? Do you have pictures showing the installation setup?

Thank you for your responses in advance.

Sincerely,
Doh-Won

From: Lee, Doh-Won@ARB
Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division

9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov

Message

From: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Sent: 7/16/2018 8:26:35 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order
Attachments: Q&As for Volvo HDIUT Data (for 2016 test order).docx

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

> Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing

according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

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For Test ID# VPT182458,
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If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: 301.573.1622
E-mail: steven.trevitz@volvo.com

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Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Thanks
Karl

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Thank you for your responses in advance.

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Doh-Won

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Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
This e-mail and any files transmitted with it are confidential, and are intended solely for the use of the individual to whom this e-mail is addressed. If you are not one of the named recipients, or otherwise have reason to believe that you have received this message in error, please notify the sender and delete this message immediately from your computer. Any other use, retention, dissemination, forwarding, printing, or copying of this e-mail is strictly prohibited.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

From: Tasik Karl [mailto:karl.tasik@volvo.com]
Sent: Wednesday, August 02, 2017 10:10 AM
To: Macias, Keith@ARB
Cc: Sardar, Satya@ARB; Lee, Doh-Won@ARB
Subject: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Keith,

The Volvo 2Q 2017 In-Use Test Data for the 2016 In-Use Test Order is being shipped today via Fedex # Ex. 6 - Personal Privacy.

Best Regards,
Karl

Karl Tasik

Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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For Test ID# VPT182483,
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> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to?
Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez?
In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

Thank you for your explanation. I spoke with my colleague, John O'Cain, whom you met during his audit of the Volvo lab. He indicated that you had already been using new PEMS for HDIUT, which would eliminate these types of abnormalities and malfunction. Additionally, our expectation is that you will continue to have good QA/QC practices. Based on your explanation that the old PEMS had systematic problems, we accept the test data. However, please note that, if the same types of problems continue to occur with the new PEMS, we may not accept the test data.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC

concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

> Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

Thank you for your explanation. As similar to the item addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 3 vehicles tested in 2017,
in addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

> Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

Thank you for your explanation along with calibration data sent via email attachments. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

Thank you for your explanation. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. For water ingestion, we recommend you take any necessary actions to prevent it from happening. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 10/15/2018 6:20:28 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]
CC: Clever Timothy [tim.clever@volvo.com]
Subject: RE: Volvo 2018 In-Use Test Data Submittal
Attachments: Volvo NTE_Logic_051018.pdf

FJ,

Per our discussion today, I have updated the following 3 xml files relative to the 2015 FVPTH12.8G01 engine family in-use data submittal.

File Folder	Vehicle VIN	File Content	File Description
1_VPT955666_HVE1275	4V4NC9EH3GN955666	Program Information	VPT955666_20180828_HVE1275.xml
2_VPT933817_HVE1193	4V4NC9EH9GN933817	Program Information	VPT933817_20180829_HVE1193.xml
3_VPT933831_HVE1207	4V4NC9EH3GN933831	Program Information	VPT933831_181001_HVE1207.xml

Also per our discussion, attached is the Volvo NTE logic diagram which we can review further with Tim Clever this week.

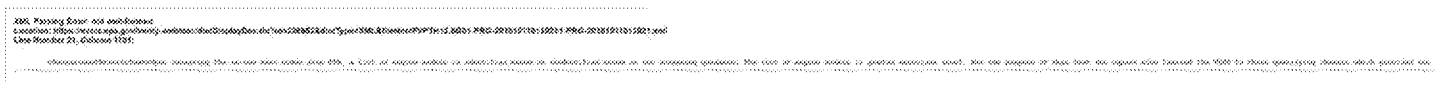
Please let me know if you have any further questions.

Karl

From: Hamady, Fakhri [mailto:hamady.fakhri@epa.gov]
Sent: Monday, October 15, 2018 9:27 AM
To: Tasik Karl
Cc: Clever Timothy
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Karl,

I couldn't download "FVPTH12.8G01-PRG-20181011013021-VPT955676.xml" due to parsing error, and few files having same test ID.



I would like to discuss the Test ID with you this afternoon.

Regards,
FJ Hamady

Fakhri J. Hamady, Ph.D., ME
Technical Advisor
Compliance Division
Office of Transportation & Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Tel: (734) 214-4330
hamady.fakhri@epa.gov

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Thursday, October 11, 2018 1:36 PM
To: Hamady, Fakhri <hamady.fakhri@epa.gov>
Cc: Clever Timothy <tim.clever@volvo.com>
Subject: RE: Volvo 2018 In-Use Test Data Submittal

Hi Falkhri,

I have just submitted the first four 2018 in-use testing order files into the EPA Verify System.

Please confirm they have been properly submitted and let me know if you have any questions.

Thanks,
Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
Cell Phone: +1 (240) 500 6101
E-mail: karl.tasik@volvo.com

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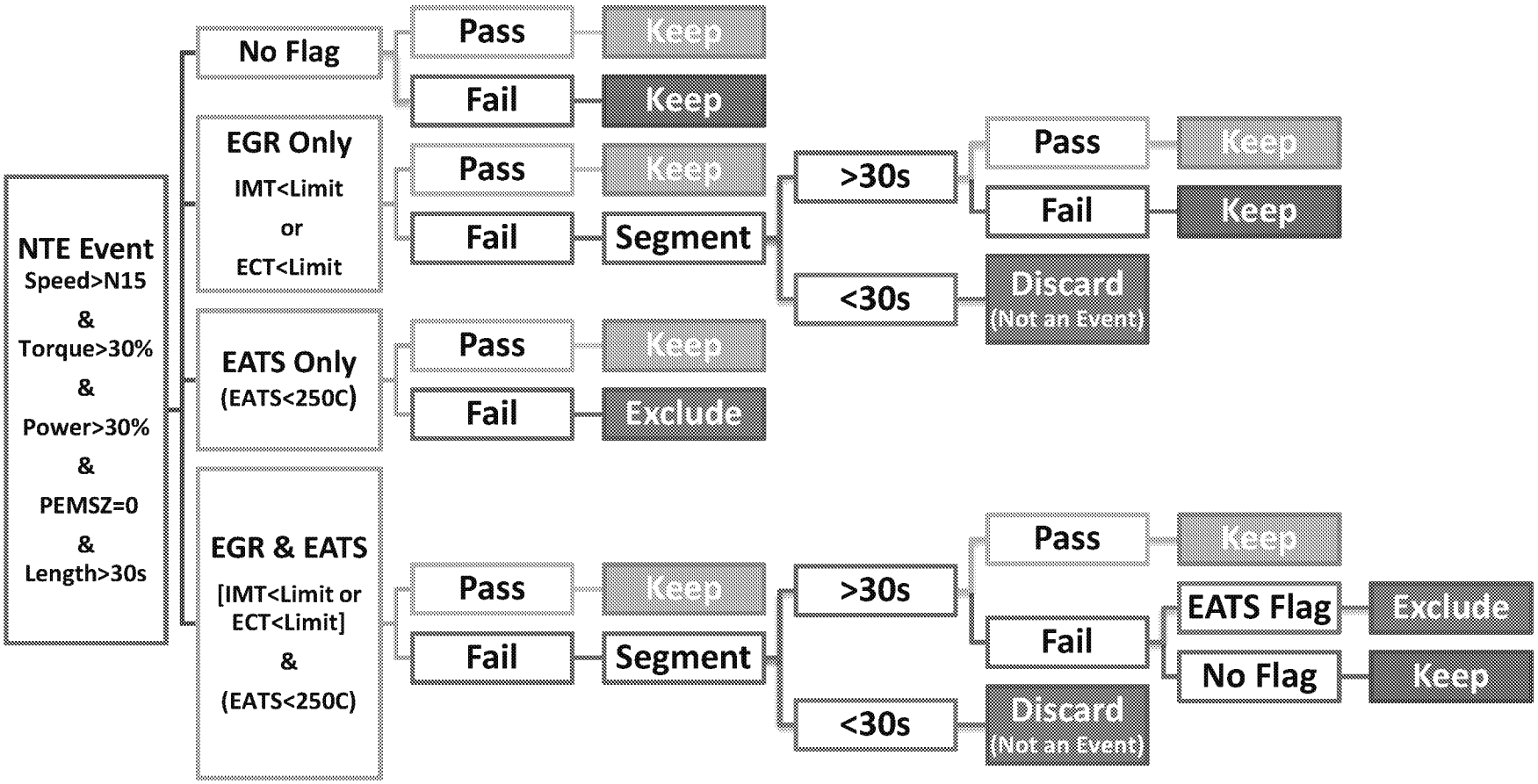

- Any "Keep" is Automatically Discarded due to a DRIFT Error Upon Calculation of Brake Specific Emissions
- Pass or Fail is governed by Brake Specific NOx Emissions for the Event < 0.45 g/bhp-hr

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Thomas A. Farnen
Volvo Group Truck Technologies
13302 Pennsylvania Ave
Hagerstown MD 21742
PH: +1 301 790 6786
thomas.farnen@volvo.com

Sept 28, 2018

Ms. Sharon Lemieux, Chief, In-Use Programs Branch
California Air Resources Board
Emissions Compliance, Automotive Regulations
& Science Division
9480 Telestar Avenue, Suite #4
El Monte, CA 91731

Re: Not-to-Exceed Test Procedures for Manufacturer-Run In-Use Testing of Heavy-Duty Engines Under 40 C.F.R. § 86.1370

Dear Ms. Lemieux:

I am writing on behalf of Volvo Group North America, Inc. ("Volvo") regarding the Not-to-Exceed ("NTE") test procedures for Manufacturer-Run In-Use Testing of Heavy-Duty Engines ("HDIUT") under 40 C.F.R. § 86.1370.

Volvo has been communicating with California Air Resources Board ("CARB") staff regarding the proper treatment of NTE data collected when catalytic aftertreatment temperatures are less than 250°C. As set forth in greater detail below, the U.S. Environmental Protection Agency ("EPA") has confirmed that, under 40 C.F.R. §§ 86.1370(g) and (h), manufacturers may choose to include or exclude from the vehicle-pass ratio determination any NTE event for which exhaust temperatures are less than 250°C. CARB staff has taken the contrary position, however, that engine manufacturers *cannot* include or exclude NTE events in this manner, and instead must (a) exclude all NTE events for which exhaust temperatures are less than 250°C, or (b) specify an alternative exhaust temperature threshold that is less than 250°C and include *all* NTE events for which exhaust temperatures exceed that threshold.

Respectfully, as explained below, your staff's interpretation of these regulations to impose conditions on the manufacturer's choice of whether to include NTE data in its compliance calculation is not well-founded. Whether or not CARB might seek to revise its regulations to incorporate its recent decision to deviate from the EPA approach (as we understand CARB is considering), CARB may not apply such a change in the regulations retroactively to in-use testing that has already been performed. Manufacturers could not possibly have divined CARB staff's interpretation from the regulatory language, and imposing that interpretation in determining compliance retrospectively would therefore be unfair and unlawful.

* * *

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Regulatory Language. In 2016, EPA amended its NTE in-use test procedures to incentivize low-temperature emissions control and clarify that manufacturers have the option to include low-temperature NTE events that "pass," while excluding those that "fail." The prior regulations specified that, for engines equipped with NOx or NMHC aftertreatment devices, the NTE NOx and NMHC limits do not apply when the exhaust gas temperature measured within 12 inches of the aftertreatment device outlet is less than 250°C. 40 C.F.R. § 86.1370(g). In its 2016 rulemaking, EPA amended subsection (g) and added a new subsection (h) to allow manufacturers to elect whether to exclude emissions data based on exhaust temperature:

> *(g) You may exclude emission data based on catalytic aftertreatment temperatures as follows:*
>
> *(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude NOx emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250°C.*
>
> *(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected if the exhaust temperature is less than 250°C at any time during the NTE event.*
>
> * * *
>
> *(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling even* ***may*** *be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.*

See 81 Fed. Reg. 73,478, 73,982 (Oct. 25, 2016), as codified at 40 C.F.R. §§ 86.1370(g), (h).

Communications with EPA and CARB. By email dated April 16, 2018, James Sanchez at EPA confirmed that 40 C.F.R. §§ 86.1370(g) and (h) "were added in the HD GHG P2 rule to clarify that [manufacturers] 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio," meaning that manufacturers "can choose you [sic] include these points as well." Mr. Sanchez thus confirmed EPA's position that "[a] manufacturer can choose to include or exclude any invalid NTE event during a test."

Abraham Lee of your staff nevertheless has advised in a September 10 email that engine manufacturers do *not* have the option to choose whether to include or exclude NTE data collected when exhaust temperatures are less than 250°C in determining the vehicle-pass ratio. Rather, according to Mr. Lee, based on nothing more than CARB's

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"good engineering judgment," manufacturers should not include any NTE data collected when exhaust temperatures are below 250°C. Alternatively, the manufacturer must specify an exhaust temperature threshold below 250°C and include in the vehicle-pass ratio determination *all* NTE data collected at temperatures that exceed that threshold, regardless of whether those events "pass" or "fail." Mr. Lee explained that "CARB believes this practice follows good engineering judgment," but did not identify any legal authority or other basis for departing from the text of the regulation.

CARB's Interpretation Is Not Valid. CARB's interpretation of 40 C.F.R. §§ 86.1370(g) and (h) conflicts with the plain language of the regulation and EPA's own understanding of the provisions it fashioned. *First*, the regulations state that manufacturers "may" —not "must"— exclude from the determination of the vehicle-pass ratio emission data collected when exhaust temperatures are less than 250°C or that otherwise do not qualify as a valid NTE sampling event. *Second*, the regulations do not specify any limitation on the manufacturer's election of whether to exclude any such data based on "good engineering judgment" or otherwise. Rather, the concept of "good engineering judgment" applies only to the method the manufacturer uses to measure exhaust temperature under subsection (g)(3). *Finally*, there is nothing at all in the regulations imposing on manufacturers a condition to specify a particular exhaust temperature and limiting the data that may be included in the vehicle-pass ratio determination to those NTE events collected at temperatures that exceed the specified threshold. Plainly, manufacturers could not know from the regulations themselves that it would have to specify such a temperature threshold and then include all NTE events that exceed that threshold. CARB, like EPA, must provide advance notice to manufacturers of what requirements apply in determining in-use compliance. *See, e.g.*, *United States v. Approximately 64,695 Pounds of Shark Fins*, 520 F.3d 976, 980 (9th Cir. 2008) ("Due process requires that an agency provide fair notice of what conduct is prohibited . . . .") (internal citations and quotations omitted).

Notably, CARB recently circulated a PowerPoint presentation outlining an approach formally to revise the NTE regulations to comport with the interpretation of 40 C.F.R. §§ 86.1370(g) and (h) communicated to Volvo by Mr. Lee. We understand that CARB has presented these slides at a September 25, 2018 meeting of the Engine Emissions Measurement & Testing Committee. That presentation, including a redline of the current regulatory language showing substantial changes, demonstrates that the current language of 40 C.F.R. §§ 86.1370(g) and (h) does not itself support CARB's interpretation.

* * *

If CARB disagrees with EPA's policy judgment to incentivize low-temperature emissions control by giving manufacturer's unfettered discretion to elect to include or exclude NTE events as specified in the regulations, CARB may seek to modify its rules. But until CARB does so, it cannot reasonably or lawfully impose that position retroactively based on regulatory language that contains no such limitations on

VOLVO

manufacturers' discretion. To do so would be fundamentally unfair and would not provide fair notice to manufacturers, like Volvo, regarding their regulatory responsibilities in determining their own compliance.

Volvo very much appreciates your attention to this matter and is hopeful that it can be resolved without further dispute. If you could confirm that Volvo's post-processing analysis complies with the regulations and that, consequently, Volvo has satisfied CARB's 2016 test order, we would appreciate it. We would be happy to address any questions or concerns that you or your colleagues might have.

Sincerely,

Thomas A. Farnen

Thomas A. Farnen
North American Emissions Counsel

cc: Michael Balthasar, Global Vice President of Certification & Compliance, Volvo Group

CARB's Proposal for HDIUT Program (NTE Testing) Amendments

Engine Emissions Measurement & Testing Committee (EMTC)
September 25, 2018

CARB

Outline

- Drift Validation Proposed Amendment
  - Background
  - CARB's Policy & Discussions
- Aftertreatment Temperature (AT T) Exclusion/Inclusion Proposed Amendment
  - Overview
  - Background
  - CARB's Proposal & Discussions
- Intake Manifold Temperature (IMT) Exclusion Proposed Amendment
  - Overview
  - Background
  - CARB's Proposal & Discussions

CARB

Drift Validation – Background

- 40 CFR 1065.550(b)(4) allows an optional drift validation criterion to Not-To-Exceed (NTE) data collected under the Manufacturer-Run Heavy-Duty In-Use Testing (HDIUT) requirements.
- The drift criterion was applied to passing events only
- CARB's interpretation presented at EMTC on May 17, 2017: Drift criterion should be applied uniformly to all NTE events
- MAC #2017-02 (HDIUT Data Drift Validation Handling Process) issued on August 9, 2017 and distributed to EMTC members and the public on August 15, 2017

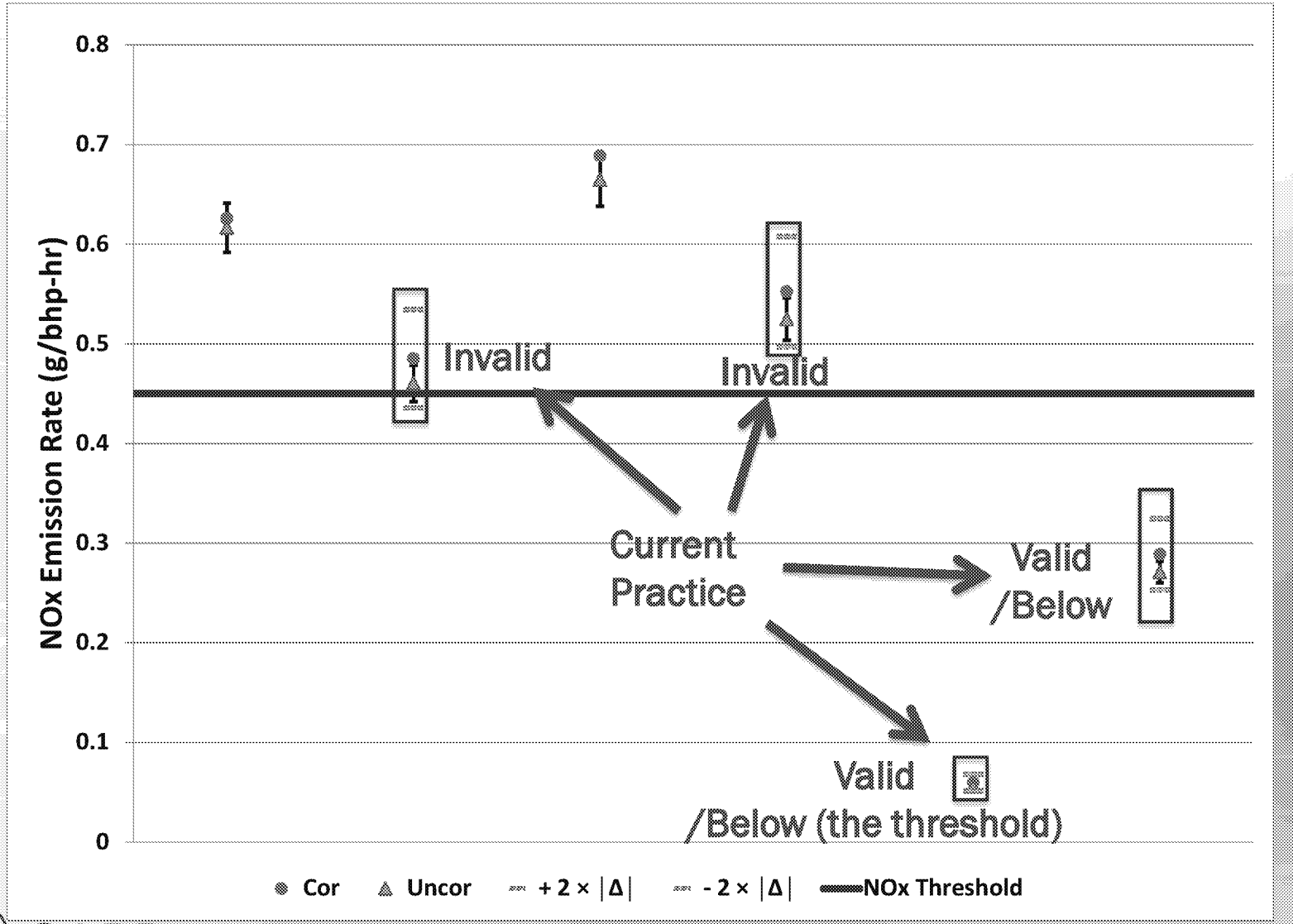
Background – Optional Drift Validation Only for Compliance

- 40 CFR 1065.550(b)(4)

  "If the test is not verified for drift as described in paragraph (b)(1) of this section, you may consider the test results for the duty cycle to be valid only if, using good engineering judgment, the observed drift does not affect your ability to demonstrate compliance with the applicable emission standards. For example, if the drift-corrected value is less than the standard by at least two times the absolute difference between the uncorrected and corrected values, you may consider the data to be verified for demonstrating compliance with the applicable standard."

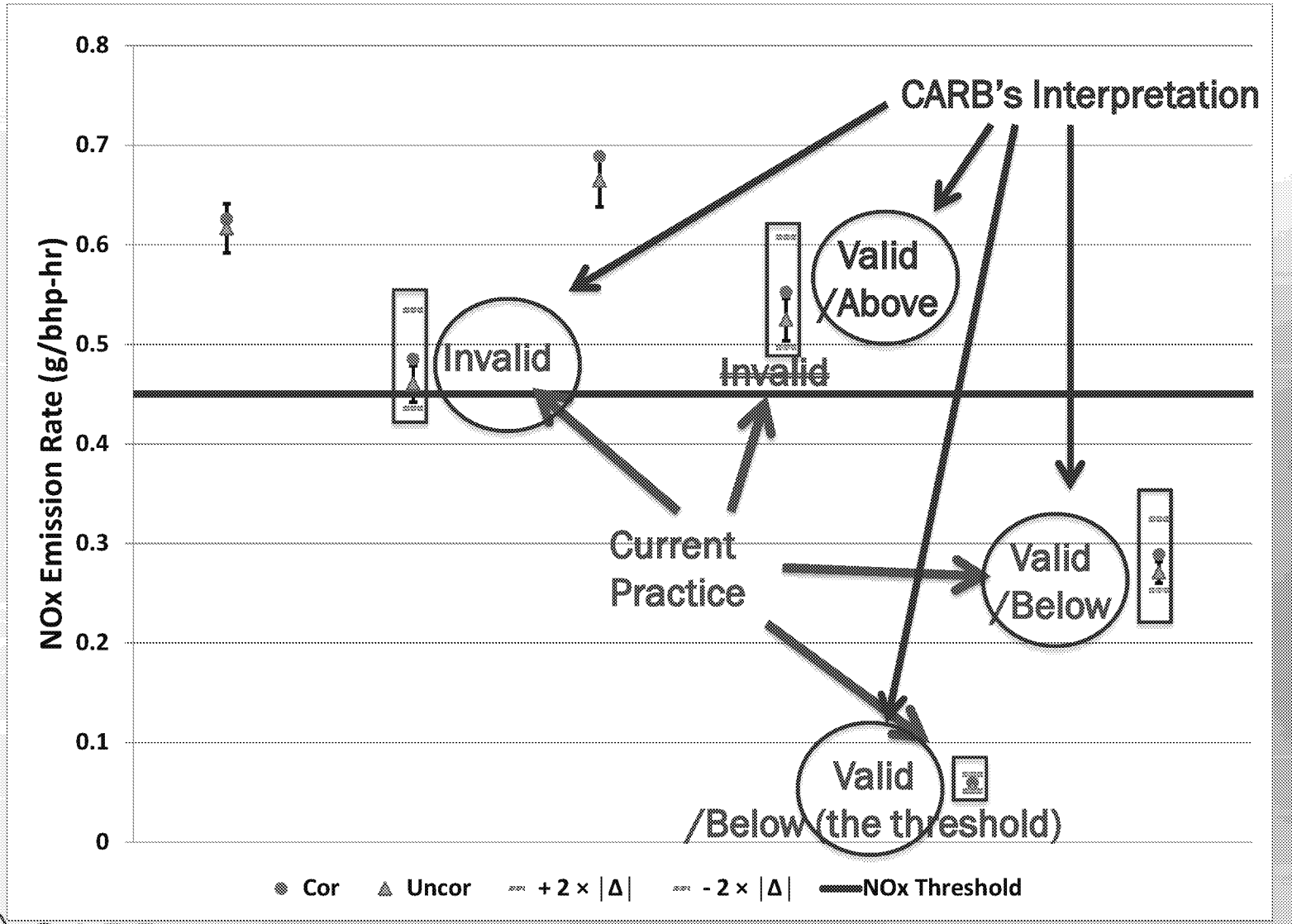
CARB

Background – Field Testing Drift Validation Old practice per 1065.550(b)(4)



CARB

Background – Field Testing Drift Validation CARB Policy



CARB

Background – MAC #2017-02

- POLICY

"Manufacturers that elect to use the drift validation option in Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures [40 CFR 1065.550(b)(4)] must apply the methodology associated with the drift validation option for both sufficiently under and over the standards, which is good engineering judgment; not under only. Otherwise manufacturers should not use this option. In addition, manufacturers should notify CARB whether they use the option when reporting their HDIUT data."

CARB's Proposed Amendment

- Incorporation of MAC #2017-02 into 40 CFR 1065.550(b)(4)
- Addition of the underlined sentences to the current paragraph:

If the test is not verified for drift as described in paragraph (b)(1) of this section, you may consider the test results for the duty cycle to be valid only if, using good engineering judgment, the observed drift does not affect your ability to demonstrate compliance with the applicable emission standards. For example, if the drift-corrected value is less than the standard by at least two times the absolute difference between the uncorrected and corrected values, you may consider the data to be verified for demonstrating compliance with the applicable standard. When using a good engineering judgment procedure under this section to validate the test results for the duty cycle that fail as described in paragraph (b)(1) of this section, you must apply that procedure symmetrically and analogously for all such test results both above and below the applicable standards. Also, explanations of the procedure, if used, must be reported to us.

CARB

Aftertreatment Temperature (AT T) Exclusion/Inclusion – Overview

- Revised 40 CFR 86.1370(g) and (h), dated 10/25/2016, allow an optional inclusion of NTE data collected when catalytic AT Ts are less than 250 ° C for the HDIUT.
- Issue: An OEM include such data selectively for vehicle pass ratio determination by including only passing events while excluding failing events.
- CARB's Interpretation:
  - No selective inclusion or exclusion; that is, either inclusion of both passing and failing events or exclusion of both.
  - For the same EF, the same catalytic AT T must be applied for data inclusion for all vehicles tested when using the inclusion option. The AT T determination must be done and reported to CARB/EPA prior to start the testing.

CARB

Current and Previous AT T Exclusion/Inclusion Requirements

- Revision of 40 CFR 86.1370(g) and (h):
  - **Previous**: § 86.1370(g) NOx and NMHC aftertreatment warm-up. For engines equipped with one or more aftertreatment devices that reduce NOx or NMHC emissions, the NTE NOx and NMHC emission limits do not apply when the exhaust gas temperature is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 ° C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.
  - **Current (as of Oct. 25, 2016)**: § 86.1370(g) You may exclude emission data based on catalytic aftertreatment temperatures as follows:

(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude NOx emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 ° C.

(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected if the exhaust temperature is less than 250 ° C at any time during the NTE event.

(3) Using good engineering judgment, measure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

§ 86.1370(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

Rationale for Current AT T Exclusion/Inclusion Requirements

- Based on the OEM, there were discussions at the EMTC meeting on July 15, 2014 and additional discussions with EPA after the regulation change:
  - EPA at the EMTC:
    - ✓ The low temperature exclusions were reluctantly accepted
    - ✓ In order to incentivize low temperature emissions control, use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass.
  - OEM/EPA after the regulation change – EPA's (Chris Laroo and James Sanchez) confirmation of the interpretation of the OEM

CARB's Proposed Amendments

- Revision of 40 CFR 86.1370(g) and (h)
- Addition of the underlined sentences, phrases, and words to 40 CFR 86.1370(g) and the ~~double-strikethrough deletion~~ from 40 CFR 86.1370(g) and of 40 CFR 86.1370(h):

§ 86.1370(g) You may exclude emission data based on the catalytic aftertreatment temperatures as follows:

(1) For an engine equipped with a catalytic NOx aftertreatment system, exclude all NOX emission data that is collected during all NTE events when the exhaust temperature at any time during the NTE events is less than 250 ° C threshold. Alternatively, you may predetermine a catalytic NOx aftertreament temperature threshold lower than 250 ° C for this exclusion subject to paragraph (g)(4) of this section. All otherwise valid NTE events above your pre-determined catalytic NOx aftertreatment temperature threshold must be included regardless of emissions passing or failing status of each NTE event.

(2) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude all NMHC and CO emission data that is collected during all NTE events when~~if~~ the exhaust temperature at any time during the NTE events is less than 250 ° C threshold ~~at any time during the NTE event~~. Alternatively, you may predetermine an oxidizing catalytic aftertreament temperature threshold lower than 250 ° C for this exclusion subject to paragraph (g)(4) of this section. All otherwise valid NTE events above your pre-determined oxidizing catalytic aftertreatment temperature threshold must be included regardless of emissions passing or failing status of each NTE event.

(3) Using good engineering judgment, measure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

(4) The temperature threshold chosen for each paragraph (g)(1) and (g)(2) of this section must be pre-determined and reported to us before performing emissions testing according to the Subpart T of this Part 86 for an engine family for emissions testing of the in-use testing program described in Subpart T of this Part 86. Each of such temperature threshold must applied uniformly to all test vehicles in the engine family when excluding emissions data according to above in this section.

~~§ 86.1370(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.~~

CARB

Intake Manifold Temperature (IMT) Exclusion – Overview

- "NTE cold temperature operating exclusion" for engines equipped with EGR – "intake manifold temperature" exclusion in 86.1370(f)(1)(i) was developed in response to manufacturers concerns regarding condensation in the EGR loop at low ambient/engine operating temperatures. (10/6/2000)
- The concerns: EGR durability issues due to corrosion of EGR components from EGR condensate, water and sulfuric acid, when intake charge (EGR & intake air) is cooled below the dew point.
  - Concerns about sulfuric acid with fuel sulfur (S) limit of 500 ppm at that time
  - Current S in Ultra Low Sulfur Diesel (ULSD): 15 ppm or less
- CARB's Proposal: Removal of the IMT Exclusion 86.1370(f)

IMT Exclusion Technical Justification

- The IMT exclusion was to address concerns about sulfuric acid condensation and corrosion of the EGR components and at the time the fuel S limit was 500 ppm; or a nominal 350 ppm at pumps at that time.
- Contents in the regulation package:
  - The Regulatory Impact Analysis (RIA) document (EPA420-R-00-010; p. 43-44): the IMT and Engine Coolant Temperature (ECT) exclusions based on comments received to the NPRM
  - The Response to Comments document (EPA420-R-00-011; p. 8-19 & 8-20): addition of the exclusions
- ULSD mandated in September 2006 (in California)

CARB's Proposed Amendment

- 40 CFR 86.1370(f)

  NTE cold temperature operating exclusion. Engines equipped with exhaust gas recirculation (EGR) whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions.

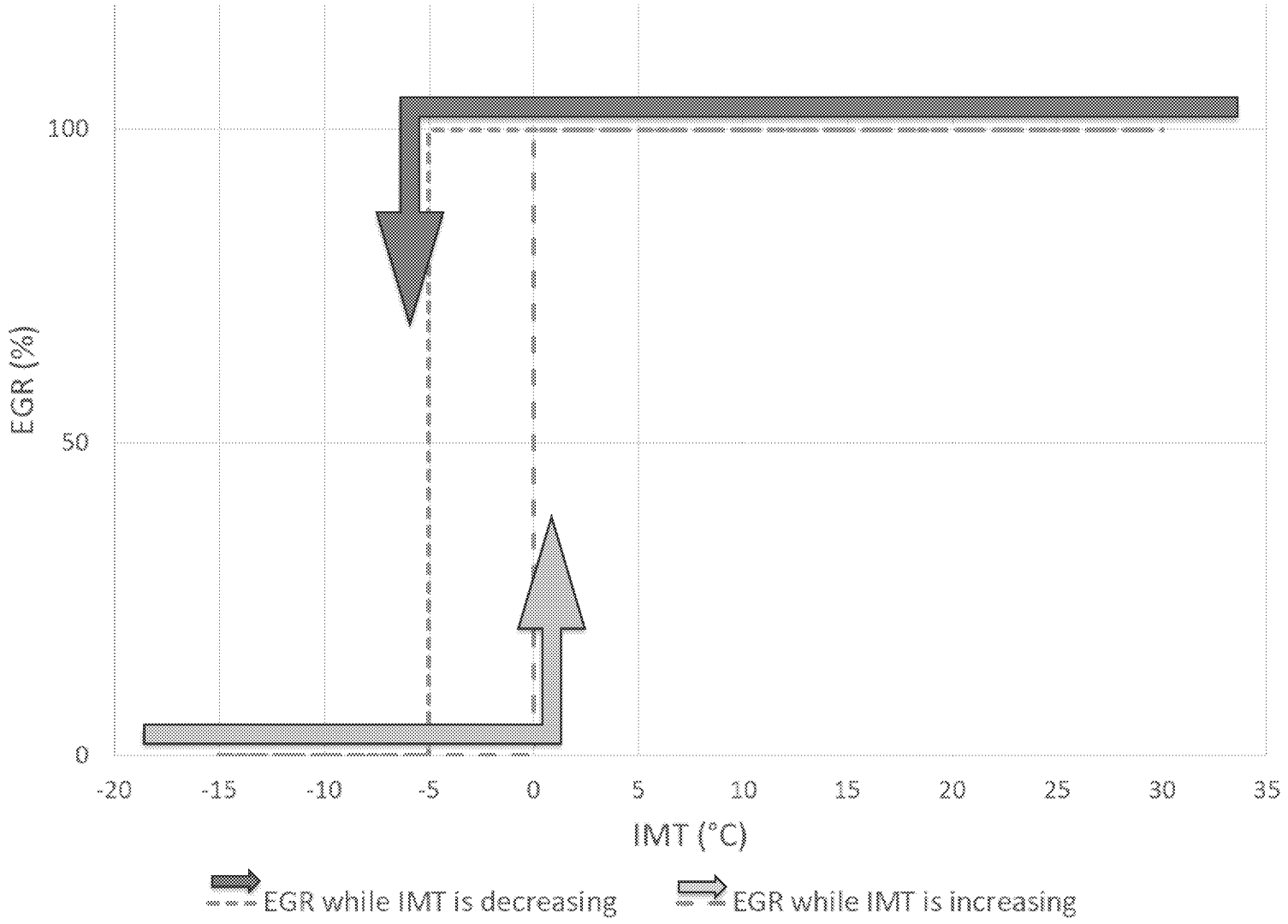
- Obsolete: ULSD is used, and SCR systems are main players, not EGR.
- Double dips: OEMs use EGR even at low IMT.
- CARB's Proposal: Removal of "NTE cold temperature operating exclusion" (86.1370(f))

IMT Exclusion with using EGR Example 1

- Current OEM practices
  - Example 1. Enable EGR at IMT meeting IMT exclusion criteria
    - EGRs are enable until IMT drop to a set-point temperature (Example: For OEM A, IMT = $-5^{o}C\ or\ 23^{o}F$)
    - EGRs become enable when IMT reaches (another) reactivation set-point temperature after being disable due to temperature drop below the set-pot above (Example: For OEM A, IMT = $0^{o}C\ or\ 32^{o}F$)

CARB

Example 1 – OEM A



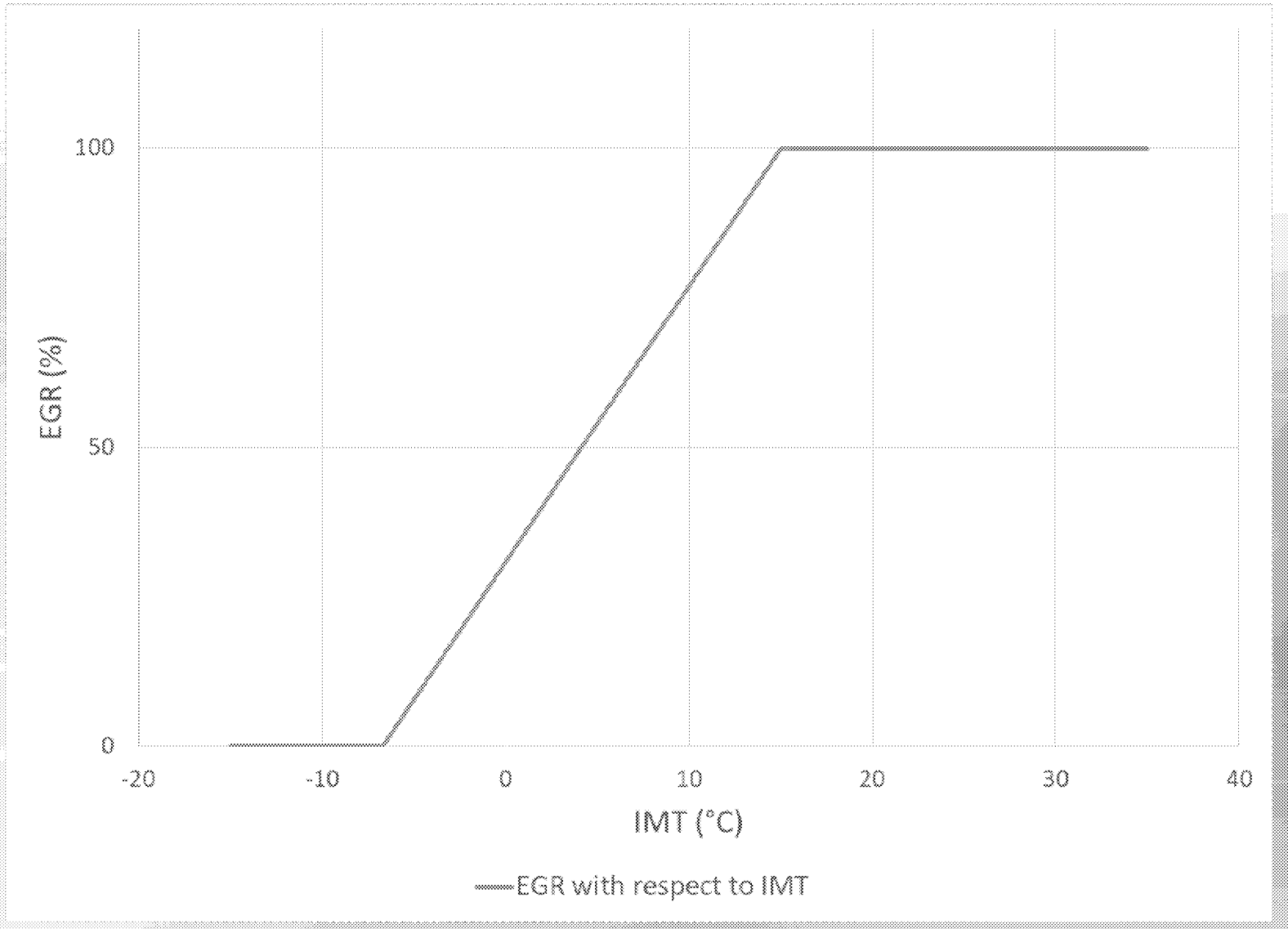
CARB

IMT Exclusion with using EGR Example 2

- Current OEM practices
  - Example 2. Enable EGR Fractioning
    - When IMT drops below a set-point, fractions of EGRs disabled, but EGRs are still enable until IMT falls below another IMT set-point. (Example: For OEM B, fractions of EGRs started to be diabled at $IMT = 15^{o}C\ or\ 59^{o}F$, but still some fractions of EGR enabled until $IMT = -6.7^{0}C\ or\ 19.9^{o}F$)

CARB

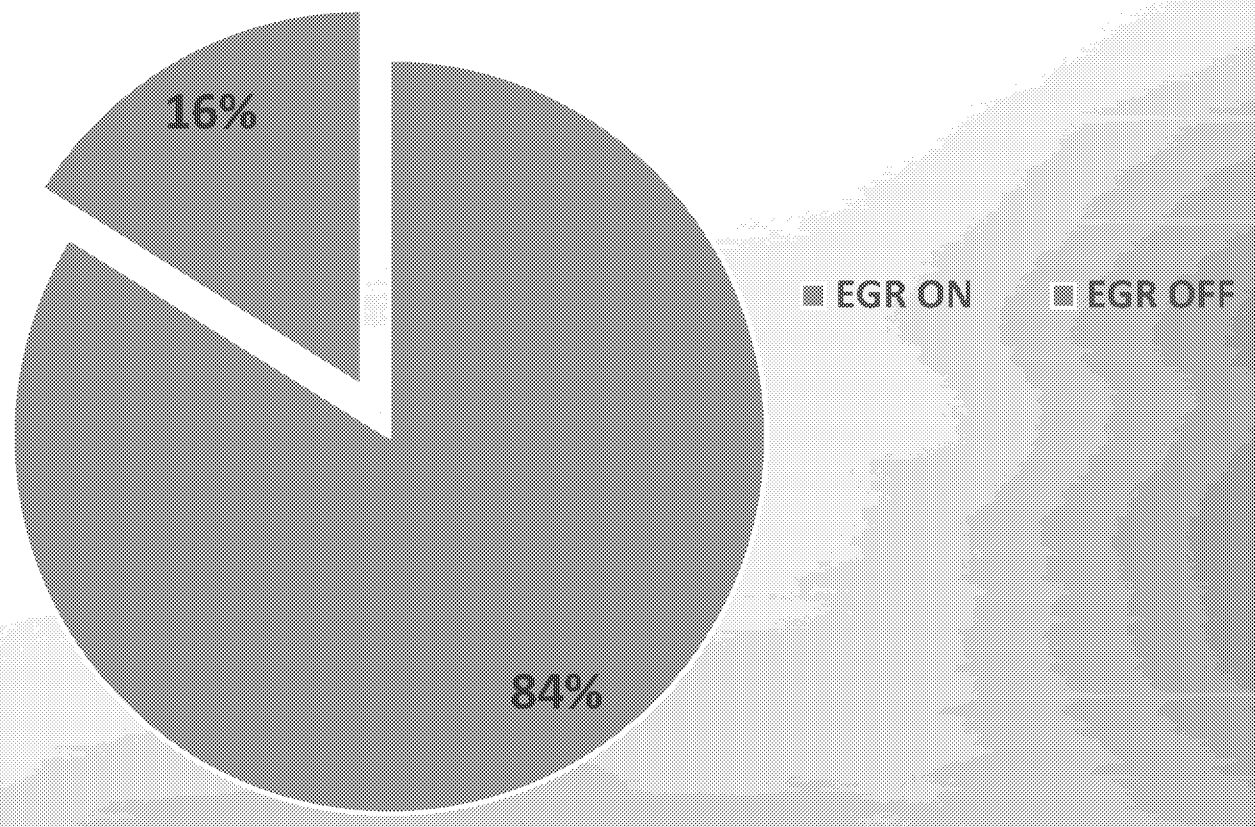
Example 2 - OEM B



CARB

Certification AECD Documents - EGR Use During IMT Exclusion

For 68 Engine Families from MY 2013 -2017



CARB

Thank you!

Questions?

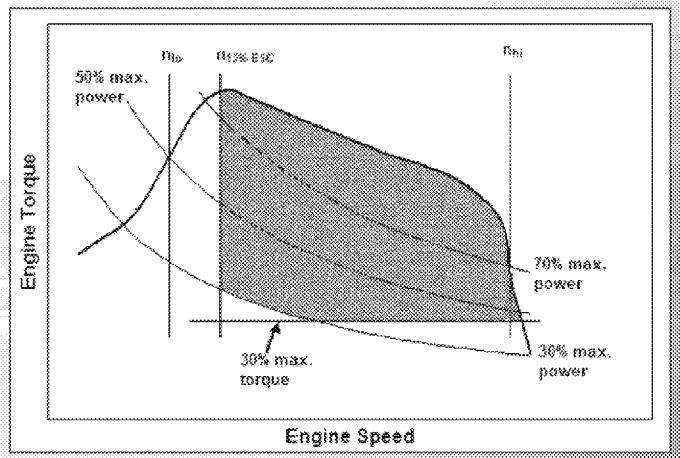
CARB

Backup Slides

CARB

Background – NTE Testing Requirements

- Heavy-duty in-use engine compliance program is designed to control diesel truck emissions during "*normal vehicle operation and use*" consistent with the not-to-exceed (NTE) requirements (40CFR86.1910(e))
  - Test duration
    - ✓ At least 3 hours of non-idling vehicle operation for testing of a shift-day or two days
  - NTE zone definition
    - ✓ Above 30% max engine power
    - ✓ Above 30% max engine torque
    - ✓ Above 15% ESC RPM
  - Duration and temperature (T) limits
    - ✓ At least 30 consecutive seconds
    - ✓ > 250 ° C for Aftertreatment (AT)/SCR T
    - ✓ EGR (Cold T Operation) Exclusion: IMT & ECT
    - ✓ Ambient T Exclusion
  - Other provisions: BSFC, LTR/TWCOLTR, EMD/OBD, Deficiency, Regeneration, Zero Check



CARB

IMT Exclusion

- 40 CFR 86.1370(f) ***NTE cold temperature operating exclusion***. Engines equipped **with exhaust gas recirculation (EGR)** whose operation within the NTE control area specified in paragraph (b) of this section when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature conditions.
- 40 CFR 86.1370(f)(1) Cold temperature operation is defined as engine operating conditions meeting either of the following two criteria:
- 40 CFR 86.1370(f)(1)(i) Intake manifold temperature (IMT) less than or equal to the temperature defined by the following relationship between IMT and absolute intake manifold pressure (IMP) for the corresponding IMP:

$$\boldsymbol{P = 0.0875 \times IMT - 7.75}$$

Where:

P = absolute intake manifold pressure in bars.

IMT = intake manifold temperature in degrees Fahrenheit

- 40 CFR 86.1370(f)(1)(ii) Engine coolant temperature (IMT) less than or equal to the temperature defined by the following relationship between ECT and ...

Message

From: Hamady, Fakhri [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=3BB2F045B5F84AE88ECD1C1A405B59F3-HAMADY, FAKHRI]
Sent: 10/22/2018 8:02:31 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal

Hi Abraham,

Please send me an invite for Volvo's meeting tomorrow.
Thanks, FJ Hamady

-----Original Appointment-----
From: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Sent: Tuesday, October 16, 2018 4:11 PM
To: Hamady, Fakhri
Subject: Accepted: EPA-Volvo Phone Call Volvo 2018 In-Use Test Data Submittal
When: Monday, October 22, 2018 3:00 PM-4:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Message

From: Hamady, Fakhri [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=3BB2F045B5F84AE88ECD1C1A405B59F3-HAMADY, FAKHRI]
Sent: 10/16/2018 8:22:35 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order
Attachments: Volvo NTE_Logic_051018.pdf

Hi Abraham,

Attached FYI is a copy of the Volvo NTE_Logic_051018 which we are going to discuss with them on Monday Oct 22.

Regards,
FJ Hamady

From: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Sent: Tuesday, October 16, 2018 4:04 PM
To: Tasik Karl <karl.tasik@volvo.com>
Cc: Hamady, Fakhri <hamady.fakhri@epa.gov>; Clark Taylor <taylor.clark@volvo.com>; Clever Timothy <tim.clever@volvo.com>
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, October 16, 2018 12:43 PM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Hamady, Fakhri <hamady.fakhri@epa.gov>; Clark Taylor <taylor.clark@volvo.com>; Clever Timothy <tim.clever@volvo.com>
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

Yes please feel free to invite FJ at EPA.

Karl

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Tuesday, October 16, 2018 3:36 PM
To: Tasik Karl
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

Karl,

By the way, is it ok to invite FJ at EPA for this meeting?

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, October 16, 2018 12:01 PM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Clark Taylor <taylor.clark@volvo.com>; Clever Timothy <tim.clever@volvo.com>
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

Then let us plan for 2:00 EDT (11:00 PDT).
I will send out an outlook invitation with a call in number.

Karl

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Tuesday, October 16, 2018 2:56 PM
To: Tasik Karl
Cc: Macias, Keith@ARB; O'Cain, John@ARB; Clark Taylor; Clever Timothy
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

Karl,

How about either 2:00 EDT (11:00 PDT) or 4:00 EDT (1:00 PDT)? My manager, Keith Macias, has a meeting at 3:00 EDT (noon PDT).

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, October 16, 2018 11:49 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Macias, Keith@ARB <keith.macias@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Clark Taylor <taylor.clark@volvo.com>; Clever Timothy <tim.clever@volvo.com>
Subject: RE: Can we have a meeting to discuss about data you submitted for 2017 Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

How about at phone call 3:00 EST on Tuesday Oct 23?

If this works for you, I can provide a call in number.

Karl

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, October 11, 2018 8:33 PM
To: Tasik Karl
Cc: Macias, Keith@ARB; O'Cain, John@ARB
Subject: Can we have a meeting to discuss about data you submitted for 2017 Test Order

Dear Karl,

Thank you for returning my call.
As talked with you on the phone, CARB staff wants to fully understand how Volvo came up with the inclusion and exclusion with the NTE events for the HDIUT data submitted for 2017 test order.

As discussed on the phone, could you set up a meeting?
Currently, most of us will be available for next two weeks. If you could propose some time slots, we may pick one from the slots. I think 30 minutes would be good enough for this meeting.
Basically, at this meeting, we want to hear from you how you processed the data and made determination of validity/inclusion/exclusion of NTE events and rational(s) of the determination.

If you have questions, please let me know.

Sincerely,
Abraham

CALIFORNIA
AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
ECARS Division
Tel: 626-350-6543
abraham.lee@arb.ca.gov

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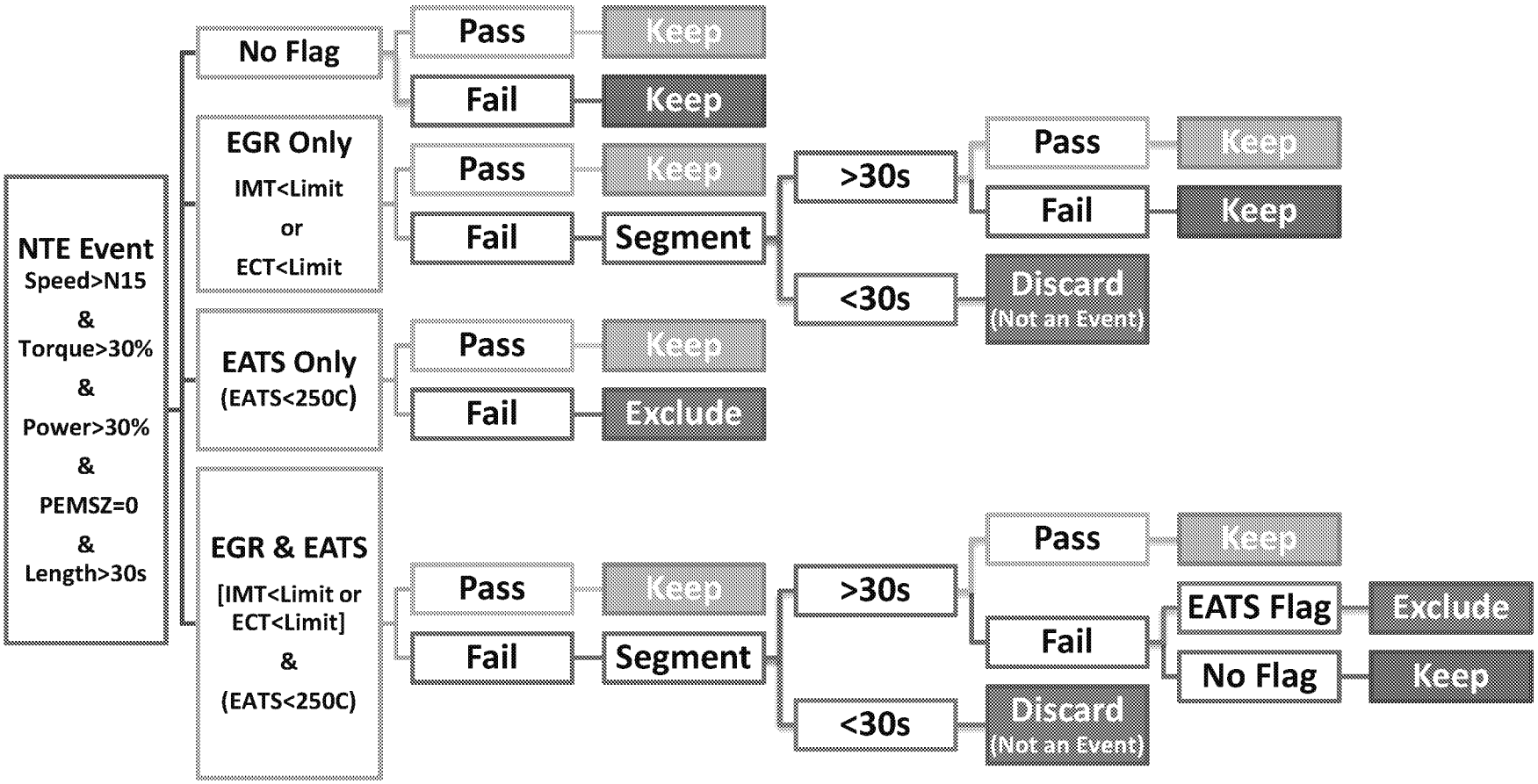

- Any "Keep" is Automatically Discarded due to a DRIFT Error Upon Calculation of Brake Specific Emissions
- Pass or Fail is governed by Brake Specific NOx Emissions for the Event < 0.45 g/bhp-hr

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Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

February 3, 2012

By e-Mail (spears.matt@epa.gov) and
First Class Mail

Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Proposed Technical Amendment to 40 CFR §86.1370-2007(g)

Dear Matt:

As a follow-up to my correspondence dated January 25, 2012, this letter will outline the various reasons that warrant a technical amendment to 40 CFR §86.1370-2007(g), the regulatory provision that allows for an exclusion from the NTE limits for engines equipped with NOx or NMHC-related aftertreatment devices when exhaust gas temperatures are less than 250°C. The technical amendment that EMA is proposing is intended to address a number of significant ambiguities that pertain to the current regulatory language. Specifically, the proposed technical amendment, which is attached for your reference in a red-line format, is intended to address the following issues:

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only the specific exhaust species that are reduced by the aftertreatment device at issue. For example, engines with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emission species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event

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may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

Thank you for your attention to this matter, which we feel is suitable for inclusion (along with the several items referenced in my correspondence of January 25th) in the omnibus rulemaking package that we understand is pending with the Agency. As always, please let me know if you have any questions regarding this matter.

Very truly yours,

Timothy A. French

cc: Donald Kopinski (kopinski.donald@epamail.epa.gov)
Charles Moulis (moulis.charles@epamail.epa.gov)
Alan Stout (stout.alan@epamail.epa.gov)
Michael Samulski (samulski.michael@epa.gov)
Michael Carter (mcarter@arb.ca.gov)
Emissions Measurement Testing Committee

63028_1.DOCX

ED_002421_00002265-00002

~~(g) *NOX and NMHC aftertreatment warm-up*~~ (g) *Aftertreatment cold temperature operating exclusion*. For engines equipped with one or more catalytic aftertreatment devices that reduce ~~NOX or NMHC emissions, the NTE NOX and NMHC emission limits do not apply when~~regulated exhaust constituents, you may exclude the regulated exhaust constituent(s) that is (are) reduced by such aftertreatment device(s) from the vehicle pass ratio calculations for NTE events where the exhaust gas temperature is below 250 °C at any time during the NTE event. This exclusion applies only to the emissions constituent(s) that is (are) reduced by the catalytic aftertreatment device(s). The following restrictions apply to the exhaust gas temperature ~~is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.~~measurement.

(1) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the exhaust gas temperature must be measured downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed.

(2) For other aftertreatment systems where the engine exhaust is split into multiple flow paths, measure the exhaust gas temperature downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents in the major flow path, i.e. the flow path designed to have the highest flow rate. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed. If the system is designed to vary the flow split through the various paths, i.e. designed to change the major flow path during NTE events, use good engineering judgment to identify the major flow path throughout the NTE event and switch the measurement location throughout the NTE event as the major flow path switches. If the system is designed to flow equal amounts through various paths, such as a vee engine or identical parallel devices, select any one of the various paths.

(3) For testing by engine manufacturers, the exhaust gas temperature may instead be measured further upstream with the following restrictions:
(i) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the measurement must be made at a single location throughout the in-use test.
(ii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and where the flow split through the various paths is not designed to vary during NTE events, the measurement must be made at a single location on the major flow path throughout the in-use test. If the system is designed to flow equal amounts through the various paths, select any one of the various paths.
(iii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and the flow split through the various paths is designed to vary during NTE events, i.e. the major flow path changes; the exhaust gas temperature must be determined from a single measurement location in each of the multiple flow paths throughout the in-use test. The exhaust gas temperature during the test must be either the maximum measured value on any of the flow paths or the measurement on the major flow path. Use good engineering judgment to identify the major flow path throughout the NTE event.

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December 14, 2012

Via Email (spears.matt@epa.gov)
and First Class Mail

Mr. Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Necessary Amendments to Heavy-Duty In-Use Testing Program

Dear Matt:

I am writing to summarize the various technical amendments and revisions that need to be incorporated into the regulations relating to the manufacturer-run in-use testing program for heavy-duty vehicles and engines. We have discussed certain of these necessary amendments in prior correspondence. EMA would appreciate the Agency's prompt response on these various issues, since they threaten to frustrate the efficient implementation of the in-use testing program to the extent they remain unresolved.

1. The first set of necessary amendments relates to the low-temperature exclusions that are provided from the NTE limits under 40 CFR §§86.1370-2007(g). As we detailed in our letter to you dated February 3, 2012, amendments to that regulatory provision are needed to: (a) limit the exclusion to the specific exhaust species that is impacted by the temperature-sensitive aftertreatment device at issue; (b) expand the low-temperature exclusion to cover aftertreatment devices that impact CO and PM (in addition to the exclusions available for NOx and NMHC); (c) clarify that any NTE events that are impacted by low-temperature exclusions are not counted for purposes of calculating the 90% vehicle pass ratio; (d) clarify when the relevant exhaust temperature is to be measured during in-use testing; and (e) clarify the location(s) for measuring the relevant exhaust temperatures. Another copy of EMA's February 3rd correspondence, along with a red-line of our recommended technical amendments to section 86.1370-2007(g), are attached for your reference. Your prompt confirmation of those necessary revisions (and when and how they will be codified) would be greatly appreciated.

2. We now have several years' experience in conducting in-use testing pursuant to 40 CFR Subpart T. The experience gained over that time has revealed that it is much more difficult than originally anticipated to ensure that an in-use test will yield at least 3-hours of accumulated non-idle operation. Even when testing is carried over to a second day under 40 CFR §86.1910(g), it has often proved impractical to meet the 3-hour threshold for non-idle operation. The net result to engine manufacturers is that the in-use testing program has proved to be more time-consuming, labor intensive and costly than originally bargained for.

To ameliorate this difficult situation, EMA requests that EPA amend section 86.1910(g) to allow manufacturers, at their option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events have been recorded. Manufacturers would still carefully screen the test vehicles to try to ensure that at least 3 hours of non-idle operation would be captured in-use, but would have the flexibility, at their option (and risk), to conclude the in-use testing after one full shift day if, for unanticipated reasons, the 3 hours of non-idle operation were not obtained.

In sum, practice has shown that the threshold of 3 hours of non-idle operation is far more difficult to achieve than originally anticipated. Manufacturers should not have to bear all of the costs stemming from that original misperception. The proposed amendment is therefore necessary to restore the relative costs of the in-use testing program to the range that was originally bargained for.

3. The regulations do not codify the agreed upon treatment of crankcase emissions for the purposes of in-use testing. To the contrary, the only memorialization of the parties' agreement of how to account for "blow-by" emissions (specifically, by adding a factor of 0.00042 g/bhp-hr to every NTE emission value if the crankcase is vented to the atmosphere) is contained in Appendix B to the Final Report of the PM-PEMS Measurement Allowance Determination. The in-use testing regulations (perhaps at section 86.1912(a)) need to be amended to include the agreed upon accounting for blow-by emissions.

4. Like the accumulation of 3 hours of non-idle operation, the recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. This is compounded by the fact that the Agency has designated engine families having volumes less than 40 units. As a consequence, the time and expense that manufacturers have incurred in trying to recruit vehicles from such low-volume engine families have been excessive and disproportionate. Accordingly, in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing, without first having to incur time and "good faith" efforts trying to track down such a truly negligible number of vehicles. The operative regulations should be amended to include this needed flexibility.

5. During the meetings that led to the development of the in-use measurement allowances, it was agreed that the PEMS used to measure gaseous emissions would be permitted to engage in "zeroing" during in-use testing. It was also agreed that when the PEMS had completed their "zeroing" processes, they would be programmed to wait until the start of the

next NTE event before reinitiating the sampling and calculation of in-use emissions. This was a somewhat arbitrary decision made to avoid the potential need to research the effects of the initiation of emissions sampling and calculation in the midst of an NTE event.

Since that time, PM PEMS have been developed and deployed that generally have the capacity to record markedly fewer NTE events than do gaseous PEMS. This is especially the case with respect to quartz crystal technologies. In addition, the accumulated experience of in-use testing has demonstrated that there are not likely to be any significant problems associated with the initiation of in-use measurements after the commencement of an NTE event. Accordingly, in order to increase the yield of NTE events as recorded by PM PEMS, EMA is proposing the following technical amendment to allow PEMS to start emissions sampling as soon as the PEMS returns to a state where it is ready to initiate sampling, i.e., as soon as it completes zeroing or conditioning. The specific language that we propose is as follows:

> *Section 86.1370(d)(3)(new). Emissions sampling will start as soon as the NTE zone conditions are met, except where the PEMS equipment is still engaged in zeroing or conditioning. In such a case, sampling will begin as soon as the PEMS equipment is ready. For gaseous emissions, NTE event sampling will begin at the same time for all regulated emissions when the PEMS equipment is operational.*

6. Currently, under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things stand currently, manufacturers have felt it necessary to suspend testing so that data collection and results could be tabulated, analyzed and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufacturers able to resume and complete their pending field work.

Interrupting field testing solely to accommodate quarterly reports is wasteful and counter-productive. Moreover, the preparation of quarterly reports has, like other aspects of the in-use testing program, proved to be disproportionally burdensome and time-consuming, as it involves the processing and tabulation of very large amounts of electronic files and data. Accordingly, in light of the foregoing, EPA should delete the quarterly reporting requirements under section 86.1920(b). Instead, the final in-use testing reports should suffice, since they contain all of the relevant data in a duly compiled and summarized format. Importantly, the integrity of the in-use testing program would not be impacted by the elimination of quarterly reports given the fact that manufacturers would still be required to report on any failed in-use tests within fifteen (15) days, as specified under section 86.1920(e).

7. Section 86.1910(j) provides that manufacturers "may ask [EPA] to waive measurement of particular emissions if [they] can show that in-use testing for such emissions is not necessary." As contemplated under that provision, sufficient in-use testing data have been

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collected and submitted to EPA over the past several years clearly demonstrating that in-use testing for PM and NMHC is not necessary. The levels of those emissions as they are being recorded from the engines that are subject to the in-use testing program are truly negligible, to the point of being indistinguishable from zero. Moreover, in-use testing for PM requires the use of separate PEMS, which significantly increases the cost and complexity of in-use testing.

The data collected to date also make it clear that so long as PM aftertreatment systems are in working order - - i.e., so long as the PM filters are not cracked - - PM emissions will be well below the NTE limit. In that regard, today's heavy-duty on-highway engines are equipped with comprehensive OBD systems that can readily detect malfunctioning PM filters and, in response, initiate warnings and inducements to ensure prompt repairs. Thus, the diagnostic features that are integrated into today's engine systems render in-use testing for PM emissions both unnecessary and redundant.

The net result is that the configuration of today's heavy-duty engine systems, in addition to the emissions data gathered to date that show zero-equivalent in-use emission levels, fully warrant a waiver of the in-use testing requirements for PM and NMHC. Accordingly, EPA should grant and codify such a waiver in the in-use testing regulations.

We look forward to working with you and your colleagues to implement the foregoing amendments to the heavy-duty in-use testing program as efficiently and expeditiously as possible. Accordingly, please contact me at your first convenience to coordinate our next steps.

Very truly yours,

Timothy A. French

cc: William Charmley (charmley.william@epa.gov)
Byron Bunker (bunker.byron@epa.gov)
Jed R. Mandel (jmandel@clpchicago.com)

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333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
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www.truckandenginemanufacturers.org

February 3, 2012

By e-Mail (spears.matt@epa.gov) and
First Class Mail

Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Proposed Technical Amendment to 40 CFR §86.1370-2007(g)

Dear Matt:

As a follow-up to my correspondence dated January 25, 2012, this letter will outline the various reasons that warrant a technical amendment to 40 CFR §86.1370-2007(g), the regulatory provision that allows for an exclusion from the NTE limits for engines equipped with NOx or NMHC-related aftertreatment devices when exhaust gas temperatures are less than 250°C. The technical amendment that EMA is proposing is intended to address a number of significant ambiguities that pertain to the current regulatory language. Specifically, the proposed technical amendment, which is attached for your reference in a red-line format, is intended to address the following issues:

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only the specific exhaust species that are reduced by the aftertreatment device at issue. For example, engines with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emission species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event

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may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

Thank you for your attention to this matter, which we feel is suitable for inclusion (along with the several items referenced in my correspondence of January 25th) in the omnibus rulemaking package that we understand is pending with the Agency. As always, please let me know if you have any questions regarding this matter.

Very truly yours,

Timothy A. French

cc: Donald Kopinski (kopinski.donald@epamail.epa.gov)
Charles Moulis (moulis.charles@epamail.epa.gov)
Alan Stout (stout.alan@epamail.epa.gov)
Michael Samulski (samulski.michael@epa.gov)
Michael Carter (mcarter@arb.ca.gov)
Emissions Measurement Testing Committee

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~~(g) *NOX and NMHC aftertreatment warm-up*~~ (g) *Aftertreatment cold temperature operating exclusion.* For engines equipped with one or more catalytic aftertreatment devices that reduce ~~NOX or NMHC emissions, the NTE NOX and NMHC emission limits do not apply when~~regulated exhaust constituents, you may exclude the regulated exhaust constituent(s) that is (are) reduced by such aftertreatment device(s) from the vehicle pass ratio calculations for NTE events where the exhaust gas temperature is below 250 °C at any time during the NTE event. This exclusion applies only to the emissions constituent(s) that is (are) reduced by the catalytic aftertreatment device(s). The following restrictions apply to the exhaust gas temperature ~~is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.~~measurement.

(1) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the exhaust gas temperature must be measured downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed.

(2) For other aftertreatment systems where the engine exhaust is split into multiple flow paths, measure the exhaust gas temperature downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents in the major flow path, i.e. the flow path designed to have the highest flow rate. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed. If the system is designed to vary the flow split through the various paths, i.e. designed to change the major flow path during NTE events, use good engineering judgment to identify the major flow path throughout the NTE event and switch the measurement location throughout the NTE event as the major flow path switches. If the system is designed to flow equal amounts through various paths, such as a vee engine or identical parallel devices, select any one of the various paths.

(3) For testing by engine manufacturers, the exhaust gas temperature may instead be measured further upstream with the following restrictions:
(i) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the measurement must be made at a single location throughout the in-use test.
(ii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and where the flow split through the various paths is not designed to vary during NTE events, the measurement must be made at a single location on the major flow path throughout the in-use test. If the system is designed to flow equal amounts through the various paths, select any one of the various paths.
(iii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and the flow split through the various paths is designed to vary during NTE events, i.e. the major flow path changes; the exhaust gas temperature must be determined from a single measurement location in each of the multiple flow paths throughout the in-use test. The exhaust gas temperature during the test must be either the maximum measured value on any of the flow paths or the measurement on the major flow path. Use good engineering judgment to identify the major flow path throughout the NTE event.

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333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

December 14, 2012

Via Email (spears.matt@epa.gov)
and First Class Mail

Mr. Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Necessary Amendments to Heavy-Duty In-Use Testing Program

Dear Matt:

I am writing to summarize the various technical amendments and revisions that need to be incorporated into the regulations relating to the manufacturer-run in-use testing program for heavy-duty vehicles and engines. We have discussed certain of these necessary amendments in prior correspondence. EMA would appreciate the Agency's prompt response on these various issues, since they threaten to frustrate the efficient implementation of the in-use testing program to the extent they remain unresolved.

1. The first set of necessary amendments relates to the low-temperature exclusions that are provided from the NTE limits under 40 CFR §§86.1370-2007(g). As we detailed in our letter to you dated February 3, 2012, amendments to that regulatory provision are needed to: (a) limit the exclusion to the specific exhaust species that is impacted by the temperature-sensitive aftertreatment device at issue; (b) expand the low-temperature exclusion to cover aftertreatment devices that impact CO and PM (in addition to the exclusions available for NOx and NMHC); (c) clarify that any NTE events that are impacted by low-temperature exclusions are not counted for purposes of calculating the 90% vehicle pass ratio; (d) clarify when the relevant exhaust temperature is to be measured during in-use testing; and (e) clarify the location(s) for measuring the relevant exhaust temperatures. Another copy of EMA's February 3rd correspondence, along with a red-line of our recommended technical amendments to section 86.1370-2007(g), are attached for your reference. Your prompt confirmation of those necessary revisions (and when and how they will be codified) would be greatly appreciated.

2. We now have several years' experience in conducting in-use testing pursuant to 40 CFR Subpart T. The experience gained over that time has revealed that it is much more difficult than originally anticipated to ensure that an in-use test will yield at least 3-hours of accumulated non-idle operation. Even when testing is carried over to a second day under 40 CFR §86.1910(g), it has often proved impractical to meet the 3-hour threshold for non-idle operation. The net result to engine manufacturers is that the in-use testing program has proved to be more time-consuming, labor intensive and costly than originally bargained for.

To ameliorate this difficult situation, EMA requests that EPA amend section 86.1910(g) to allow manufacturers, at their option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events have been recorded. Manufacturers would still carefully screen the test vehicles to try to ensure that at least 3 hours of non-idle operation would be captured in-use, but would have the flexibility, at their option (and risk), to conclude the in-use testing after one full shift day if, for unanticipated reasons, the 3 hours of non-idle operation were not obtained.

In sum, practice has shown that the threshold of 3 hours of non-idle operation is far more difficult to achieve than originally anticipated. Manufacturers should not have to bear all of the costs stemming from that original misperception. The proposed amendment is therefore necessary to restore the relative costs of the in-use testing program to the range that was originally bargained for.

3. The regulations do not codify the agreed upon treatment of crankcase emissions for the purposes of in-use testing. To the contrary, the only memorialization of the parties' agreement of how to account for "blow-by" emissions (specifically, by adding a factor of 0.00042 g/bhp-hr to every NTE emission value if the crankcase is vented to the atmosphere) is contained in Appendix B to the Final Report of the PM-PEMS Measurement Allowance Determination. The in-use testing regulations (perhaps at section 86.1912(a)) need to be amended to include the agreed upon accounting for blow-by emissions.

4. Like the accumulation of 3 hours of non-idle operation, the recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. This is compounded by the fact that the Agency has designated engine families having volumes less than 40 units. As a consequence, the time and expense that manufacturers have incurred in trying to recruit vehicles from such low-volume engine families have been excessive and disproportionate. Accordingly, in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing, without first having to incur time and "good faith" efforts trying to track down such a truly negligible number of vehicles. The operative regulations should be amended to include this needed flexibility.

5. During the meetings that led to the development of the in-use measurement allowances, it was agreed that the PEMS used to measure gaseous emissions would be permitted to engage in "zeroing" during in-use testing. It was also agreed that when the PEMS had completed their "zeroing" processes, they would be programmed to wait until the start of the

next NTE event before reinitiating the sampling and calculation of in-use emissions. This was a somewhat arbitrary decision made to avoid the potential need to research the effects of the initiation of emissions sampling and calculation in the midst of an NTE event.

Since that time, PM PEMS have been developed and deployed that generally have the capacity to record markedly fewer NTE events than do gaseous PEMS. This is especially the case with respect to quartz crystal technologies. In addition, the accumulated experience of in-use testing has demonstrated that there are not likely to be any significant problems associated with the initiation of in-use measurements after the commencement of an NTE event. Accordingly, in order to increase the yield of NTE events as recorded by PM PEMS, EMA is proposing the following technical amendment to allow PEMS to start emissions sampling as soon as the PEMS returns to a state where it is ready to initiate sampling, i.e., as soon as it completes zeroing or conditioning. The specific language that we propose is as follows:

> *Section 86.1370(d)(3)(new). Emissions sampling will start as soon as the NTE zone conditions are met, except where the PEMS equipment is still engaged in zeroing or conditioning. In such a case, sampling will begin as soon as the PEMS equipment is ready. For gaseous emissions, NTE event sampling will begin at the same time for all regulated emissions when the PEMS equipment is operational.*

6. Currently, under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things stand currently, manufacturers have felt it necessary to suspend testing so that data collection and results could be tabulated, analyzed and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufacturers able to resume and complete their pending field work.

Interrupting field testing solely to accommodate quarterly reports is wasteful and counter-productive. Moreover, the preparation of quarterly reports has, like other aspects of the in-use testing program, proved to be disproportionally burdensome and time-consuming, as it involves the processing and tabulation of very large amounts of electronic files and data. Accordingly, in light of the foregoing, EPA should delete the quarterly reporting requirements under section 86.1920(b). Instead, the final in-use testing reports should suffice, since they contain all of the relevant data in a duly compiled and summarized format. Importantly, the integrity of the in-use testing program would not be impacted by the elimination of quarterly reports given the fact that manufacturers would still be required to report on any failed in-use tests within fifteen (15) days, as specified under section 86.1920(e).

7. Section 86.1910(j) provides that manufacturers "may ask [EPA] to waive measurement of particular emissions if [they] can show that in-use testing for such emissions is not necessary." As contemplated under that provision, sufficient in-use testing data have been

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collected and submitted to EPA over the past several years clearly demonstrating that in-use testing for PM and NMHC is not necessary. The levels of those emissions as they are being recorded from the engines that are subject to the in-use testing program are truly negligible, to the point of being indistinguishable from zero. Moreover, in-use testing for PM requires the use of separate PEMS, which significantly increases the cost and complexity of in-use testing.

The data collected to date also make it clear that so long as PM aftertreatment systems are in working order - - i.e., so long as the PM filters are not cracked - - PM emissions will be well below the NTE limit. In that regard, today's heavy-duty on-highway engines are equipped with comprehensive OBD systems that can readily detect malfunctioning PM filters and, in response, initiate warnings and inducements to ensure prompt repairs. Thus, the diagnostic features that are integrated into today's engine systems render in-use testing for PM emissions both unnecessary and redundant.

The net result is that the configuration of today's heavy-duty engine systems, in addition to the emissions data gathered to date that show zero-equivalent in-use emission levels, fully warrant a waiver of the in-use testing requirements for PM and NMHC. Accordingly, EPA should grant and codify such a waiver in the in-use testing regulations.

We look forward to working with you and your colleagues to implement the foregoing amendments to the heavy-duty in-use testing program as efficiently and expeditiously as possible. Accordingly, please contact me at your first convenience to coordinate our next steps.

Very truly yours,

Timothy A. French

cc: William Charmley (charmley.william@epa.gov)
Byron Bunker (bunker.byron@epa.gov)
Jed R. Mandel (jmandel@clpchicago.com)

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Subpart E—TESTING IN-USE ENGINES

Commented [CM1]: May need to adapt for GHG

§~~86.1901~~1036.401 What testing requirements apply to my engines that have gone into service?

~~(a) If you manufacture diesel heavy-duty engines above 8,500 lbs. GVWR that are subject to engine-based exhaust emission standards under this part, you must test them as described in this subpart. You must measure all emissions listed in §86.1910(d) other than PM beginning in calendar year 2005 and you must measure PM emissions beginning in calendar year 2007. See §86.1930 for special provisions that may apply to manufacturers in the early years of this program.~~

(a) If you produce compression-ignition engines that are subject to the requirements of this part, you must test them as described in this subpart. This involves testing engines installed in vehicles.

(b) We may void your certificate of conformity for an engine family if you do not meet your obligations under this subpart. We may also void individual tests and require you to retest those vehicles or take other appropriate measures in instances where you have not performed the testing in accordance with the requirements described in this subpart.

(d) Independent of your responsibility to test in-use engines, we may choose at any time to do our own testing of your in-use engines.

~~(e) In this subpart, the term "you" refers to the certificate holder for any engines subject to the requirements of this subpart.~~

~~(d) In this subpart, round means to round numbers according to NIST Special Publication 811(incorporated by reference in §86.1).~~

§~~86.1905~~1036.405 How does this program work?

(a) You must test in-use engines from the families we select. We may select the following number of engine families for testing, except as specified in paragraph (b) of this section:

(1) We may select up to 25 percent of your engine families in any calendar year, calculated by dividing the number of engine families you certified in the model year corresponding to the calendar year by four and rounding to the nearest whole number. We will consider only engine families with annual U.S.-directed production volumes above 1,500 units in calculating the number of engine families subject to testing each calendar year under the annual 25 percent engine family limit. In addition, for model year 2007 through 2009, identical engine families that are split into two subfamilies under §86.007-15(m)(9) will count as only one engine family. If you have only three or fewer families that each exceed an annual U.S.-directed production volume of 1,500 units, or if you have no engine families above this limit, we may select one engine family per calendar year for testing.

(2) Over any four-year period, we will not select more than the average number of engine families that you have certified over that four-year period (the model year when the selection is made and the preceding three model years), based on rounding the average value to the nearest whole number.

(b) If there is clear evidence of a nonconformity with regard to an engine family, we may select that engine family without counting it as a selected engine family under paragraph (a) of this section. We will consult with you in reaching a conclusion whether clear evidence of a nonconformity exists for any engine family. In general, there is clear evidence of a nonconformity regarding an engine family under this subpart in any of the following cases:

(1) The engine family was not remedied but is a carry-over from an engine family you tested under this subpart and was subsequently remedied based at least in part on the Phase 1 or Phase 2 testing outcomes described in §~~86.1915~~1036.430.

(2) The engine family was not remedied but is a carry-over from an engine family that was remedied based on an EPA in-use testing program.

(c) We may select any individual engine family for testing, regardless of its production volume, as long as we do not select more than the number of engine families described in paragraph (a) of this section. We may select an engine family from the current model year or any previous model year, except that we will not select any engine families from model years before 2007. ~~beginning in the following calendar years:~~

~~(1) 2007 for all emissions testing other than PM testing.~~

~~(2) 2011 for PM testing.~~

(d) You must complete all the required testing and reporting under this subpart within 18 months after we direct you to test a particular engine family. We will typically select engine families for testing and notify you in writing by June 30 of the applicable calendar year. You may ask for up to six months longer to complete Phase 2 testing if there is a reasonable basis for needing more time. In very unusual circumstances you may request an additional six months to complete Phase 2 testing.

(e) If you make a good-faith effort to access enough test vehicles to complete Phase 1 or Phase 2 testing requirements under this subpart for an engine family, but are unable to do so, you must ask us either to modify the testing requirements for the selected engine family or, in the case of Phase 1 testing, to select a different engine family.

(f) After you complete the in-use testing requirements for an engine family that we selected for testing in a given calendar year, we may select that same family in a later year to evaluate the engine family's compliance closer to the end of its useful life. This would count as an additional engine-family selection under paragraph (a) of this section, except as described in paragraph (b) of this section.

~~(g) For any communication related to this subpart, contact the Engine Programs Group Manager (6405-J), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.~~

§~~86.1908~~1036.410 How must I select and screen my in-use engines?

(a) Once we direct you to do testing under this subpart, you must make arrangements to select test vehicles and engines that meet the following criteria:

(1) The engines must be representative of the engine family.

(2) The usage of the vehicles must be representative of typical usage for the vehicles' particular application.

(3) The vehicles come from at least two independent sources.

(4) The key vehicle/engine systems (e.g., power train, drive train, emission control) have been properly maintained and used.

(5) The engines have not been tampered with, rebuilt or undergone major repair that could be expected to affect emissions.

(6) The engines have not been misfueled. For example, an engine may be considered misfueled if operated on a biodiesel fuel blend that is either not listed as allowed or otherwise indicated to be an unacceptable fuel in the vehicle's owner or operator manual.

(7) The engines do not have an illuminated MIL or stored OBD trouble code that lead you to reject the vehicle from the test program as described in §~~86.1910~~1036.415(b)(2).

(8) The vehicles are likely to operate for at least three hours (excluding idle) over a complete shift-day, as described in §~~86.1910~~1036.415(g).

(9) The vehicles have not exceeded the applicable useful life, in miles or years (see subpart B~~A~~ of this part); you may otherwise not exclude engines from testing based on their age or mileage.

(10) The vehicle has appropriate space for safe and proper mounting of the PEMS equipment.

(b) You must keep any records of a vehicle's maintenance and use history you obtain from the owner or operator, as required by §~~86.1925~~1036.445. You must report the engine's maintenance and use history and information related to the OBD system, as described in §~~86.1920~~1036.440.

(c) You must notify us before rejecting a candidate vehicle for reasons other than failing to meet the acceptance criteria in paragraph (a) of this section. A candidate vehicle is any prospective vehicle you have identified to potentially fulfill your testing requirements under this subpart. Include your reasons for rejecting each vehicle. If an owner declines to participate in the test program, you may reject the vehicle without prior notification. Such a rejection must be reported as described in §~~86.1920~~1036.440. We may allow you to replace the rejected vehicle with another candidate vehicle to meet your testing requirements for the specific engine family.

(d) You must report when, how, and why you reject candidate vehicles, as described in §~~86.1920~~1036.440.

§~~86.1910~~1036.415 How must I prepare and test my in-use engines?

(a) You must limit maintenance to what is in the owners manual for engines with that amount of service and age. For anything we consider an adjustable parameter (see §§86.094-21(b)(1)(ii) and 86.094-22(e)), you may adjust that parameter only if it is outside of its adjustable range. You must then set the adjustable parameter to the mid-point of its adjustable range or your recommended setting, unless we approve your request to do otherwise. You must receive permission from us before adjusting anything not considered to be an adjustable parameter. You must keep records of all maintenance and adjustments, as required by §~~86.1925~~1036.445. You must send us these records, as described in §~~86.1920~~1036.440(b)(3)(x), unless we instruct you not to send them.

(b) You may treat a vehicle with an illuminated MIL or stored trouble code as follows:

(1) If the length of MIL illumination or trouble code storage is consistent with proper maintenance and use, either test the prospective test vehicle as received or repair the vehicle before testing. If you elect to repair the vehicle/engine, but ultimately determine that repairs cannot be completed in a timely manner, you may reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(2) If the length of MIL illumination or trouble code storage is inconsistent with proper maintenance and use, either test the prospective test vehicle as received, repair the vehicle before testing, or reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(3) If a MIL is illuminated or a trouble code is set during an in-use test, do one of the following:

(i) Stop the test, repair the vehicle, and restart the testing. In this case, only the portion of the full test results without the MIL illuminated or trouble code set would be used in the vehicle-pass determination as described in §~~86.1912~~1036.425. Describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(ii) Stop the test, repair the vehicle, and initiate a new test. In this case, only the post-repair test results would be used in the vehicle-pass determination as described in §~~86.1912~~1036.425. Describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(iii) If three hours of non-idle operation have been accumulated prior to the time a MIL is illuminated or trouble code set, stop the test and use the accumulated test results in the vehicle-pass determination as described in §~~86.1912~~1036.425.

(iv) If three hours of non-idle operation have not been accumulated prior to the time a MIL is illuminated or trouble code is set, and you elect to repair the vehicle/engine, but ultimately determine that repairs cannot be completed in a timely manner, you may reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(c) Use appropriate fuels for testing, as follows:

(1) You may use any diesel fuel that meets the specifications for No. 2-D S500 or No. 2-D S15 in ASTM D975 (incorporated by reference in §1036.1010~~§86.1~~), as required in the calendar year that in-use testing occurs.

(2) You may use any biodiesel fuel blend that is either expressly allowed or not otherwise indicated as an unacceptable fuel in the vehicle's owner or operator manual or in the engine manufacturer's published fuel recommendations.

(3) You may drain a prospective test vehicle's fuel tank(s) and refill the tank(s) with diesel fuel conforming to ~~ASTM D975~~ the specifications described in paragraph (c)(1) of this section.

(4) Any fuel that is added to the fuel tank(s) of a prospective test vehicle, or during an in-use test, must be purchased at a local retail establishment near the site of vehicle procurement or screening, or along the test route. Alternatively, the fuel may be drawn from a central fueling source, provided that the fuel used is representative of that which is commercially available in the area where the vehicle is operated.

(5) No post-refinery fuel additives are allowed, except that one or more specific fuel additives may be used during in-use testing if you can document that the owner/operator of the prospective test vehicle has a history of normally using the fuel treatment(s), and the fuel additive(s) is not prohibited in the vehicle's owner or operator manual or in the engine manufacturer's published fuel-additive recommendations.

(6) You may take fuel samples from test vehicles to ensure that appropriate fuels were used during in-use testing. If a vehicle fails the vehicle-pass criteria and you can show that an inappropriate fuel was used during the failed test, that particular test may be voided. You may drain the vehicle's fuel tank(s) and refill the tank(s) with diesel fuel conforming to the ~~ASTM D975~~ specifications described in paragraph (c)(1) of this section. You must report any fuel tests that are the basis of voiding a test in your report under §~~86.1920~~1036.440.

(d) You must test the selected engines while they remain installed in the vehicle. Use portable emission-sampling equipment and field-testing procedures as specified in 40 CFR part 1065, subpart J ~~referenced in §86.1375~~. Measure emissions of THC, NMHC (by any method specified

in 40 CFR part 1065, subpart J), CO, NO_x, PM (as appropriate), and CO_2. Measure or determine O_2 emissions using good engineering judgment.

(e) For Phase 1 testing, you must test the engine under conditions reasonably expected to be encountered during normal vehicle operation ~~and use consistent with the general NTE requirements described in §86.1370-2007(a)~~. For the purposes of this subpart, normal operation and use would generally include consideration of the vehicle's normal routes and loads (including auxiliary loads such as air conditioning in the cab), normal ambient conditions, and the normal driver.

(f) For Phase 2 testing, we may give specific directions, as described in §~~86.1915~~1036.430(c)(2).

(g) Once an engine is set up for testing, test the engine for at least one shift-day. To complete a shift-day's worth of testing, start sampling at the beginning of a shift and continue sampling for the whole shift, subject to the calibration requirements of the portable emissions measurement systems. A shift-day is the period of a normal workday for an individual employee. If the first shift-day of testing involves at least ~~3~~2 hours of accumulated non-idle operation ~~or~~with at least one valid NTE event, ~~you may conclude testing at the end of the first shift-day. Otherwise, you may conclude testing only after repeating measurements for a second shift-day. You may also continue testing longer than we require.~~ If the first shift-day of testing does not involve at least ~~3~~ 2 hours of accumulated non-idle operation with at least one valid NTE event, you may conclude testing at the end of the first shift-day. Otherwise, you may conclude testing only after repeating measurements for a second shift-day. You may also continue testing longer than we require ~~repeat the testing for a second shift-day and report the results from both days of testing. If the second shift-day of testing also does not result in at least 3 hours of accumulated non-idle operation, you may choose whether or not to continue testing with that vehicle. If after two shift-days you discontinue testing before accumulating 3 hours of non-idle operation on either day,~~

(h) ~~e~~Evaluate ~~the~~ all valid NTE samples ~~from both days of testing~~ as described in § ~~86.1912~~1036.425 and include the data in the reporting and record keeping requirements specified in §§ ~~86.1920~~1036.440 and 1036.445~~1925~~. Count the engine toward meeting your testing requirements under this subpart and use the data for deciding whether additional engines must be tested under the applicable Phase 1 or Phase 2 test plan. ~~(h) You have the option to test longer than the two shift-day period described in paragraph (g) of this section.~~

(i) You may count a vehicle without a single valid NTE sampling event as meeting the vehicle-pass criteria described in §~~86.1912~~1036.425 if it had at least ~~three~~two hours of non-idle operation in a single shift-day and ~~or if it~~ it is tested over two full shift-days. ~~a shift day of testing or two-shift days of testing (with the requisite non-idle/idle operation time as in paragraph (g) of this section), or if the extended testing you elected under paragraph (h) of this section does not generate a single valid NTE sampling event, as described in §86.1912(b).~~ Count the ~~engine~~ vehicle towards meeting your testing requirements under this subpart.

(j) You may ask us to waive measurement of particular emissions if you can show that in-use testing for such emissions is not necessary.

§1036.420 What is a valid NTE sampling event?

(a) A valid NTE sampling event involves warmed-up engine operation in a zone of certain speed and torque values, subject to certain ambient conditions and engine parameters, as described in §1036.515, except as described in this section. Afiny emission measurements corresponding to engine operationg conditions that does not qualify as a valid NTE sampling event ~~are not valid for~~may be excluded from the determinngation of the vehicle-pass ratio specified in §1036.425.

for the impacted pollutant.

(b) Start emission sampling at the beginning of each valid NTE sampling event, except as needed to allow for zeroing or conditioning the PEMS. For gaseous emissions, PEMS preparation must be complete for all analyzers before starting emission sampling.

(c) Emission results are averaged over a minimum sampling period of 30 seconds of continuous operation in the NTE zone. However, a longer minimum averaging period may apply for engines equipped with aftertreatment systems involving periodic regeneration if they have the capability to record electronic signals to indicate the start and end of regeneration events. See §1036.515 for a description and illustration of the terms and principles that apply for these systems. Calculate an alternate minimum averaging period, $t_{NTE,min}$, for in-use testing under this subpart using the following equation:

$$t_{\mathrm{NTE,min}} = \frac{\sum_{i=1}^{N} t_{\mathrm{B,NTE,i}}}{RF}$$

Where:

i = an indexing variable that represents a time interval within the candidate NTE event during which the electronic signal indicates active regeneration.

N = the total number of discrete intervals within the candidate NTE event during which the electronic signal indicates active regeneration.

$t_{B,NTE,i}$ = the duration of each interval i, in seconds.

RF = the regeneration fraction for the shift-day, as determined in paragraph (c)(1) of this section.

(1) Calculate the regeneration fraction, RF, for a shift-day as follows:

$$RF = \frac{\overline{t}_B}{\overline{t}_{AB} + \overline{t}_0}$$

Where:

$\overline{t}_B$ = the average time in active regeneration for each complete regeneration event during the shift-day. To calculate this value, divide the total time in active regeneration during all the complete regeneration events during the shift-day by the corresponding number of regeneration events.

$\overline{t}_{AB}$ = the average time of each complete regeneration event during the shift-day. To calculate this value, divide the total time when regeneration is either pending or active by the number of complete regeneration events during the shift-day.

$\overline{t}_0$ = the average duration of complete non- regeneration events during the shift-day. To calculate this value, divide the total time for all complete non-regeneration events during the shift-day by the corresponding number of non-regeneration events.

(2) There are no valid NTE sampling events for a whole shift-day if there is active regeneration, but either no complete regeneration event or no complete non-regeneration event. If there is no active regeneration during the shift-day, do not apply the provisions of this section.

(3) If an engine has different regeneration cycles and electronic signals for different types of pollutants, calculate a separate minimum averaging period for each type of regeneration and use the longest one.

(4) The following example illustrates a calculation of the minimum averaging period, $t_{NTE,min}$, for a candidate NTE event:

(i) Consider a shift-day that has two complete regeneration events that occur between three complete non-regeneration events. The three non-regeneration events have durations of 5,424 seconds, 6,676 seconds, and 3,079 seconds. The two complete regeneration events have 2,769 seconds and 2,639 seconds of active regeneration, and total duration of 8,440 seconds and 3,920 seconds. Calculate *RF* for this shift-day as follows:

$$RF = \frac{\frac{2769+2639}{2}}{\frac{5424+6676+3079}{3} + \frac{8440+3920}{2}} = 0.2406$$

(ii) If a candidate NTE event during this shift-day has two periods of active regeneration, one lasting 37 seconds and the other 40 seconds, calculate $t_{NTE,min}$ as follows:

$$t_{NTE,\min} = \frac{37+40}{0.2406} = 320\,\text{seconds}$$

§~~86.1912~~1036.425 How do I determine whether an engine meets the vehicle-pass criteria? In general, the average emissions for each regulated pollutant must remain at or below the NTE threshold in paragraph (a) of this section for at least 90 percent of the valid NTE sampling events, as defined in paragraph (b) of this section. For 2007 through 2009 model year engines, the average emissions from every NTE sampling event must also remain below the NTE thresholds in paragraph (f)(2) of this section. Perform the following steps to determine whether an engine meets the vehicle-pass criteria:

(a) Determine the NTE threshold for each pollutant subject to an NTE standard by adding all three of the following terms and rounding the result to the same number of decimal places as the applicable NTE standard:

(1) The applicable NTE standard.

(2) The in-use compliance testing margin specified in §86.007-11(h), if any.

(3) An accuracy margin for portable in-use equipment when testing is performed under the special provisions of §86.1930, depending on the pollutant, as follows:

(i) NMHC: 0.17 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) CO: 0.60 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NO_x: 0.50 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) PM: 0.10 ~~grams per brake horsepower-hour~~g/hp·hr.

(v) NO_x + NMHC: 0.67 ~~grams per brake horsepower-hour~~g/hp·hr.

(4) Accuracy margins for portable in-use equipment when testing is not performed under the special provisions of § 86.1930 for 2007 through 2009 model year engine families that are selected for testing in any calendar year as follows:

(i) NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.02 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NMHC using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) CO using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.5 ~~grams per brake horsepower-hour~~g/hp·hr.

(v) CO using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(vi) CO using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(vii) NO_x using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.45 ~~grams per brake horsepower-hour~~g/hp·hr.

(viii) NO_x using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(ix) NO_x using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(x) NO_x + NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.47 ~~grams per brake horsepower-hour~~g/hp·hr.

(xi) NO_x + NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.16 ~~grams per brake horsepower-hour~~g/hp·hr.

(xii) NO_x + NMHC using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.16 ~~grams per brake horsepower-hour~~g/hp·hr.

(xiii) PM: 0.006 ~~grams per brake horsepower-hour~~g/hp·hr.

(5) Accuracy margins for portable in-use equipment when testing is not performed under the special provisions of § 86.1930 for 2010 or later model year engines families that are selected for testing in any calendar year as follows:

(i) NMHC using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) CO using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NO_x using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) PM: 0.006 ~~grams per brake horsepower-hour~~g/hp·hr.

~~(b) For the purposes of this subpart, a valid NTE sampling event consists of at least 30 seconds of continuous operation in the NTE control area. An NTE event begins when the engine starts to operate in the NTE control area and continues as long as engine operation remains in this area (see §86.1370). When determining a valid NTE sampling event, exclude all engine operation in approved NTE limited testing regions under §86.1370-2007(b)(6) and any approved NTE deficiencies under §86.007-11(a)(4)(iv). Engine operation in the NTE control area of less than 30 contiguous seconds does not count as a valid NTE sampling event; operating periods of less than 30 seconds in the NTE control area, but outside of any allowed deficiency area or limited testing region, will not be added together to make a 30 second or longer event. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for the time-weighted carve-out defined in §86.1370-2007(b)(7). For EGR-equipped engines, exclude any operation that occurs during the cold-temperature operation defined by the equations in §86.1370-2007(b)(1).~~ (b~~c~~) Calculate the average emission level for each pollutant over each

valid NTE sampling event as specified in 40 CFR part 1065, subpart G, using each NTE event as an individual test interval. This should include valid NTE events from all days of testing.
(c) If the engine has an open crankcase, account for these emissions by adding 0.00042 g/hp-hr to the PM emission result for every NTE event ~~test interval.~~
(d) Calculate a time-weighted vehicle-pass ratio (R_{pass}) for each pollutant. To do this, first sum the time from each valid NTE sampling event whose average emission level is at or below the NTE threshold for that pollutant, then divide this value by the sum of the engine operating time from all valid NTE events for that pollutant. Round the resulting vehicle-pass ratio to two decimal places.

(1) Calculate the time-weighted vehicle-pass ratio for each pollutant as follows:

$$R_{pass} = \frac{\sum_{m=1}^{n_{pass}} t}{\sum_{k=1}^{n_{total}} t}$$

Where:
n_{pass} = the number of valid sampling events for which the average emission level is at or below the NTE threshold.
n_{total} = the total number of valid NTE sampling events.

(2) For both the numerator and the denominator of the vehicle-pass ratio, use the smallest of the following values for determining the duration, t, of any NTE sampling event:

(i) The measured time in the NTE zone ~~control area~~ that is valid for an NTE sampling event.
(ii) 600 seconds.
(iii) 10 times the length of the shortest valid NTE sampling event for all testing with that engine.

(e) The following example illustrates how to select the duration of NTE sampling events for calculations, as described in paragraph (d) of this section:

NTE sample	Duration of NTE sample (seconds)	Duration Limit Applied?	Duration used in calculations (seconds)
1	45	No	45
2	168	No	168
3	605	Yes. Use 10 times shortest valid NTE.	450
4	490	Yes. Use 10 times shortest valid NTE.	450
5	65	No	65

(f) Engines meet the vehicle-pass criteria under this section if they meet both of the following criteria:

(1) The vehicle-pass ratio calculated according to paragraph (d) of this section must be at least 0.90 for each pollutant.

(2) For model year 2007 through 2009 engines, emission levels from every valid NTE sampling event must be less than 2.0 times the NTE thresholds calculated according to paragraph (a) of this section for all pollutants, except that engines certified to a NO_x FEL at

or below 0.50 g/~~b~~hp·hr may meet the vehicle-pass criteria for NO_x if measured NO_x emissions from every valid NTE sample are less than either 2.0 times the NTE threshold for NO_x or 2.0 g/~~b~~hp·hr, whichever is greater.

§~~86.1915~~1036.430 What are the requirements for Phase 1 and Phase 2 testing?
For all selected engine families, you must do the following:
(a) To determine the number of engines you must test from each selected engine family under Phase 1 testing, use the following criteria:
(1) Start by measuring emissions from five engines ~~using the procedures described in §86.1375~~. If all five engines comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(2) If one of the engines tested under paragraph (a)(1) of this section fails to comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for one or more pollutants, test one more engine. If this additional engine complies fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(3) If your testing results under paragraphs (a)(1) and (2) of this section do not satisfy the criteria for completing your testing requirements under those paragraphs for all pollutants, test four additional engines so you have tested a total of ten engines.
(4) An engine that fails to fully comply with the vehicle-pass criteria in §~~86.1912~~1036.425 for any pollutant does not comply with the vehicle-pass criteria in §~~86.1912~~1036.425 for the purposes of determining the number of engines to test from each selected engine family under this paragraph.
(b) For situations where a total of ten engines must be tested under paragraph (a)(3) of this section, the results of Phase 1 testing lead to the following outcomes:
(1) If at least eight of the ten engines comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(2) If six or seven vehicles from the Phase 1 sample of test vehicles comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, then you must engage in follow-up discussions with us to determine whether any further testing (including Phase 2 testing), data submissions, or other actions may be warranted.
(3) If fewer than six of the ten engines tested under paragraph (a) of this section comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, we may require you to initiate Phase 2 testing, as described in paragraph (c) of this section.
(4) You may under any circumstances elect to conduct Phase 2 testing following the completion of Phase 1 testing. All the provisions of paragraph (c) of this section apply to this Phase 2 testing.
(c) If you perform Phase 2 testing for any reason, test your engines as follows:
(1) You must test ten additional engines using the test procedures described in §86.1375, unless we require you to test fewer vehicles.
(2) We may give you any of the following additional directions in selecting and testing engines:

(i) We may require you to select a certain subset of your engine family. This may include, for example, engines within a specific power range, engines used in particular applications, or engines installed in vehicles from a particular manufacturer.
(ii) We may direct you to test engines in a way that simulates the type of driving and ambient conditions associated with high emissions experienced during Phase 1 testing.
(iii) We may direct you to test engines in a specific state or any number of contiguous states.
(iv) We may direct you to select engines from the same sources used for previous testing, or from different sources.
(v) We may require that you complete your testing and reporting under Phase 2 within a certain period. This period may not be shorter than three months and must allow a reasonable amount of time to identify and test enough vehicles. We would generally expect this testing to be completed within the overall time period specified in §~~86.1905~~1036.405(d).

§~~86.1917~~1036.435 How does in-use testing under this subpart relate to the emission-related warranty in Section 207(a)(1) of the Clean Air Act?
(a) An exceedance of the NTE standards found through the in-use testing program under this subpart is not by itself sufficient to show a breach of warranty under Clean Air Act section 207(a)(1) (42 U.S.C. 7541(a)(1)). A breach of warranty would also require one of the following things:

(1) That, at the time of sale, the engine or vehicle was designed, built, and equipped in a manner that does not conform in all material respects reasonably related to emission controls to the engine as described in the application for certification and covered by the certificate; or
(2) A defect in materials or workmanship of a component causes the vehicle or engine to fail to conform to the applicable regulations for its useful life.

(b) To the extent that in-use NTE testing does not reveal such a material deficiency at the time of sale in the design or manufacture of an engine compared with the certified engine, or a defect in the materials and workmanship of a component or part, test results showing an exceedance of the NTE standard by itself would not show a breach of the warranty under 42 U.S.C. 7541(a)(1).

§~~86.1920~~1036.440 What in-use testing information must I report to EPA?
(a) Send us electronic reports at inuse@epa.gov using an approved information format. If you want to use a different format, send us a written request with justification.
(b) Within ~~30~~ 45 days after the end of each calendar quarter, send us reports containing the test data from each engine for which testing was completed during the calendar quarter. Alternatively, you may separately send us the test data within 30 days after you complete testing for an engine. Additional reporting time is allowed with our approval. Once you send us information under this section, you need not send that information again in later reports. Prepare your test reports as follows:

(1) For each engine family, describe how you recruited vehicles. Describe how you used any criteria or thresholds to narrow your search or to screen individual vehicles.
(2) Include a summary of the candidate vehicles you have rejected and the reasons you rejected them, whether you base the rejection on the criteria in §~~86.1908~~1036.410(a) or anything else. If you rejected a candidate vehicle due to misfueling, included the results of any fuel sample tests.

(3) For the test vehicle, include the following background information:

(i) The EPA engine-family designation, and the engine's model number, total displacement, and power rating.

(ii) The applicable test phase (Phase 1 or Phase 2).

(iii) The date EPA selected the engine family for testing.

(iv) The vehicle's make and model and the year it was built.

(v) The vehicle identification number and engine serial number.

(vi) The vehicle's type or application (such as delivery, line haul, or dump truck). Also, identify the type of trailer, if applicable.

(vii) The vehicle's maintenance and use history.

(viii) The known status history of the vehicle's OBD system and any actions the owner or operator took to address OBD trouble codes or MIL illumination over the vehicle's lifetime.

(ix) Any OBD codes or MIL illumination that occur after you accept the vehicle for in-use testing under this subpart.

(x) Any steps you take to maintain, adjust, modify, or repair the vehicle or its engine to prepare for or continue testing, including actions to address OBD trouble codes or MIL illumination. Include any steps you took to drain and refill the vehicle's fuel tank(s) to correct misfueling, and the results of any fuel test conducted to identify misfueling.

(4) For each test, include the following data and measurements:

(i) The date and time of testing, and the test number.

(ii) Shift-days of testing (see §~~86.1910~~1036.415 (g)), duration of testing, and the total hours of non-idle operation.

(iii) Route and location of testing. You may base this description on the output from a global-positioning system.

(iv) The steps you took to ensure that vehicle operation during testing was consistent with normal operation and use, as described in §~~86.1910~~1036.415(e).

(v) Fuel test results, if fuel was tested under §~~86.1908~~1036.410 or §~~86.1910~~1036.415.

(vi) The vehicle's mileage at the start of the test. Include the engine's total lifetime hours of operation, if available.

(vii) Ambient temperature, dewpoint, and atmospheric pressure at the start and finish of each valid NTE event.

(viii) The number of valid NTE events (see §~~86.1912~~1036.425(b)).

(ix) Average emissions for each pollutant over each valid NTE event. Describe the method you used to determine NMHC as specified in 40 CFR part 1065, subpart J. See Appendix I of this subpart for an example of graphically summarizing NTE emission results.

(x) Exhaust-flow measurements.

(xi) Vehicle-pass ratios (see §~~86.1912~~1036.425(d)).

(xii) Recorded one-hertz test data, including, but not limited to, the following parameters:

(A) Ambient temperature.

(B) Ambient pressure.

(C) Ambient humidity.

(D) Altitude.

(E) Emissions of THC, NMHC, CO, CO_2 or O_2, and NO_x (as appropriate). Report results for PM if it was measured in a manner that provides one-hertz test data. Report results for CH_4 if it was measured and used to determine NMHC.
(F) Differential back-pressure of any PEMS attachments to vehicle exhaust.
(G) Exhaust flow.
(H) Exhaust aftertreatment temperatures, if the engine meets the specifications of §1036.515(h)(3)~~§86.1370-2007(g)~~.
(I) Engine speed.
(J) Engine brake torque.
(K) Engine coolant temperature.
(L) Intake manifold temperature.
(M) Intake manifold pressure.
(N) Throttle position.
(O) Any parameter sensed or controlled in order to modulate the emission-control system or fuel-injection timing.

(5) For each engine family, identify the applicable requirements, as follows:
(i) The applicable NTE thresholds.
(ii) Vehicle and engine information needed to identify ~~the~~ limited testing regions ~~under §86.1370-2007(b)(6) and (7)~~.
(iii) Vehicle and engine information needed to identify any approved NTE deficiencies ~~under §86.007-11(a)(4)(iv)~~.

(6) Include the following summary information after you complete testing with the engine:
(i) State whether the engine meets the vehicle-pass criteria in §~~86.1912~~1036.425(f).
(ii) Identify how many engines you have tested from the applicable engine family and how many engines still need to be tested.
(iii) Identify how many engines from an engine family have passed the vehicle-pass criteria and the number that have failed the vehicle-pass criteria (see §~~86.1912~~1036.425(f)).
(iv) If possible, state the outcome of Phase 1 testing for the engine family based on the criteria in §~~86.1915~~1036.430(b).

(c) In your reports under this section, you must do all the following:
(1) Include results from all emission testing required under this subpart.
(2) Describe if any testing or evaluations were conducted to determine why a vehicle failed the vehicle-pass criteria in §~~86.1912~~1036.425.
(3) Describe the purpose of any diagnostic procedures you conduct.
(4) Describe any instances in which the OBD system illuminated the MIL or set trouble codes. Also describe any approved actions taken to address the trouble codes or MIL.
(5) Describe any instances of misfueling, the approved actions taken to address the problem, and the results of any associated fuel sample testing.
(6) Describe any incomplete or invalid tests that were conducted under this subpart.

(d) Send us an electronic notification at inuse@epa.gov describing any voluntary vehicle/engine emission evaluation testing you intend to conduct with portable in-use measurement systems on the same engine families that are being tested under this subpart, from the time that engine family was selected for in-use testing under §~~86.1905~~1036.405 until the final results of all testing for that engine family are reported to us under this section.

(e) Send us an electronic notification at application-ci_cert@epa.gov within 15 days after your initial review of the test data for a selected engine family indicates that three engines in Phase 1 testing have failed to comply with the vehicle-pass criteria. Similarly, send us an electronic notification at the above electronic address within 3 days after your initial review of the test data for a selected engine family indicates that any engine in Phase 2 testing failed to comply with the vehicle-pass criteria.
(f) We may ask you to send us less information in your reports than we specify in this section.
(g) We may require you to send us more information to evaluate whether your engine family meets the requirements of this part, or to help inform potential decisions concerning Phase 2 testing under §~~86.1915~~1036.430.

§~~86.1925~~1036.445 What records must I keep?
(a) Organize and maintain your records as described in this section. We may review your records at any time, so it is important to keep required information readily available.
(b) Keep the following paper or electronic records of your in-use testing for five years after you complete all the testing required for an engine family:
(1) Keep a copy of the reports described in §~~86.1920~~1036.440.
(2) Keep any additional records, including forms you create, related to any of the following:
(i) The procurement and vehicle-selection process described in §~~86.1908~~1036.410, including the vehicle owner's name, address, phone number, and e-mail address.
(ii) Pre-test maintenance and adjustments to the engine performed under §~~86.1910~~1036.415.
(iii) Test results for all void, incomplete, and voluntary testing described in §~~86.1920~~1036.440.
(iv) Evaluations to determine why a vehicle failed the vehicle-pass criteria described in §~~86.1912~~1036.425.
(3) Keep a copy of the relevant calibration results required by 40 CFR part 1065.

~~§86.1930 What special provisions apply from 2005 through 2010?~~
~~(a) We may direct you to test engines under this subpart for emissions other than PM in 2005 and 2006, and for PM emissions in 2007 through 2010. In those interim periods, all the provisions of this subpart apply, except as specified in this paragraph (a). You may apply the exceptions identified in this section for both years of the applicable years for emissions other than PM. You may omit testing and reporting in two of the four applicable years for PM emissions.~~
~~(1) We will select engine families for testing of emissions other than PM only when the manufacturer's Statement of Compliance specifically describes the family as being designed to comply with NTE requirements.~~
~~(2) We will not direct you to do the Phase 2 testing in §86.1915(c), regardless of measured emission levels.~~
~~(3) For purposes of calculating the NTE thresholds under §86.1912(a) for any 2006 and earlier model year engine that is not subject to the emission standards in §86.007–11, determine the applicable NTE standards as follows:~~
~~(i) If any numerical NTE requirements specified in the terms of any consent decree apply to the engine family, use those values as the NTE standards for testing under this subpart.~~

~~(ii) If a numerical NTE requirement is not specified in a consent decree for the engine family, the NTE standards are 1.25 times the applicable FELs or the applicable emission standards specified in §86.004–11(a)(1) or §86.098–11(a)(1).~~

~~(4) In the report required in §86.1920(b), you must submit the deficiencies and limited testing region reports (see §§86.007–11(a)(4)(iv) and 86.1370–2007(b)(6) and (7)) for 2006 and earlier model year engines tested under this section.~~

~~(5) You must notify the Designated Compliance Officer by September 30, 2010 whether or not you will submit test reports for PM emissions for each of the four years from 2007 through 2010. See 40 CFR 1068.30 for the contact information for the Designated Compliance Officer.~~

~~(6) You must submit reports by the deadlines specified in paragraph (b) of this section.~~

~~(b) The following deadlines apply for reporting test results under this subpart.~~

~~(1) You must complete all the required testing and reporting under this subpart related to emissions other than PM by the following dates:~~

~~(i) November 30, 2007 for engine families that we designate for testing in 2005.~~

~~(ii) November 30, 2008 for engine families that we designate for testing in 2006.~~

~~(iii) November 30, 2009 for engine families that we designate for testing in 2007.~~

~~(iv) March 31, 2010 for engine families we designate for testing in 2008.~~

~~(v) April 30, 2011 for engine families we designate for testing in 2009.~~

~~(2) You must complete all the required testing and reporting under this subpart related to PM emissions by the following dates:~~

~~(i) May 31, 2010 for engine families that we designate for testing in 2007.~~

~~(ii) September 30, 2010 for engine families we designate for testing in 2008.~~

~~(iii) April 30, 2011 for engine families we designate for testing in 2009.~~

~~(iv) November 30, 2011 for engine families we designate for testing in 2010.~~

~~(c) For 2007 through 2009 all the provisions of this subpart and paragraph (a) of this section apply, with the following additional exceptions:~~

~~(1) You must complete all the required testing and reporting under this subpart by the following dates:~~

~~(i) November 30, 2009 for engine families that we designate for non-PM testing in 2007.~~

~~(ii) March 31, 2010 for engine families that we designate for non-PM testing in 2008.~~

~~(iii) April 30, 2011 for engine families that we designate for non-PM testing in 2009.~~

~~(2) You may conduct non-PM and PM testing on different vehicles for engine families that we designate in 2007 and 2008.~~

~~(3) You may conduct PM testing as follows for 2007:~~

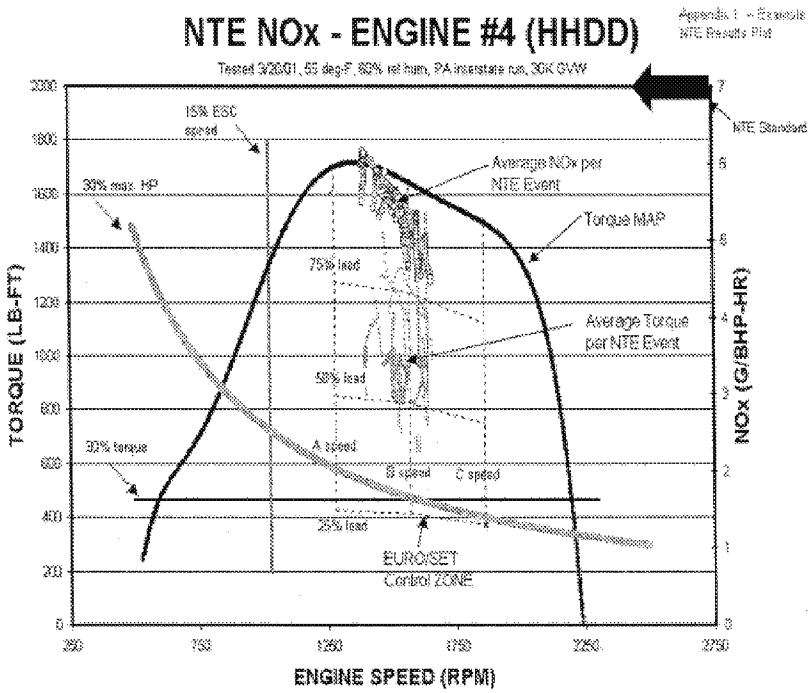
~~(i) Test vehicles may be selected from a vehicle fleet that you own or otherwise directly control.~~

~~(ii) Test vehicles may be operated by a driver that you employ.~~

~~(iii) Each test vehicle must be operated on a route and under operating conditions that reasonably replicate the use of the selected vehicle type when operated in typical revenue service, unless otherwise approved by us.~~

Appendix I to Subpart [illegible]— Sample Graphical Summary of NTE Emission Results

The following figure shows an example of a graphical summary of NTE emission results:



Subpart F—Test Procedures Error! Bookmark not defined.

§ 1036.501 How do I run a valid emission test?{ TC \l1 "}

(a) Use the equipment and procedures for spark-ignition or compression-ignition engines in 40 CFR part 1065 to determine whether engines meet the duty-cycle emission standards in subpart B of this part. Measure the emissions of all the exhaust constituents subject to emission standards as specified in 40 CFR part 1065. Measure CO_2, N_2O, and CH_4 as described in §1036.235. Use the applicable duty cycles specified in this subpart.

(b) Sections 1036.515 describe the supplemental procedures for evaluating whether engines meet the not-to-exceed emission standards in subpart B of this part.

(c) [Reserved]~~Measure smoke using the procedures in 40 CFR part 86, subpart I, for evaluating whether engines meet the smoke standards in §1036.105.~~

(d) Use the fuels specified in 40 CFR part 1065 to perform valid tests, as follows:

(1) For service accumulation, use the test fuel or any commercially available fuel that is representative of the fuel that in-use engines will use.

(2) For diesel-fueled engines, use the ultra low-sulfur diesel fuel specified in 40 CFR part 1065 for emission testing.

(3) For gasoline-fueled engines, use the appropriate E10 fuel specified in 40 CFR part 1065; however, through model year 2021 you may instead use the appropriate E0 fuel specified in 40 CFR part 1065, with the exception that the E0 fuel must have sulfur concentration between 0.0015 and 0.008 weight percent and research octane of at least 93. Starting in model year 2022, you may certify up to 5 percent of your nationwide sales volume of engines certified under subpart A of this part in a given model year based on this E0 test fuel if those engines are certified with carryover data.

(e) The following provisions apply for engines using aftertreatment technology with infrequent regeneration events that may occur during testing:

(1) Adjust measured emissions to account for aftertreatment technology with infrequent regeneration as described in §1036.520.

(2) If your engine family includes engines with one or more AECDs for emergency vehicle applications approved under §1036.115(g)(4), do not consider additional regenerations resulting from those AECDs when developing adjustments to measured values under this paragraph (e).

(3) Invalidate any test interval with respect to demonstrating compliance with CO_2, N_2O, and CH_4 emission standards if active regeneration starts during the test interval.

~~(4) Invalidate a smoke test if active regeneration starts to occur during the test.~~

(f) Test hybrid engines as described in §1036.525 and 40 CFR part 1065.

(g) You may disable any AECDs that have been approved solely for emergency vehicle applications under §1036.115(g)(4).

(h) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.

(i) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.

~~(a) Use the equipment and procedures specified in 40 CFR 86.1305 to determine whether engines meet the emission standards in §1036.108.~~

~~(b) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.~~

Commented [CM2]: Need to add regs for fuel maps and idles modes.

Commented [CM3]: Update?

~~(c) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.~~
~~(d) For engines that use aftertreatment technology with infrequent regeneration events, invalidate any test interval in which such a regeneration event occurs with respect to CO2, N2O, and CH4 measurements.~~
~~(e) Test hybrid engines as described in 40 CFR part 1065 and §1036.525.~~
~~(f) [Reserved]~~
~~(g) If your engine requires special components for proper testing, you must provide any such components to us if we ask for them.~~

§ 1036.505 Ramped-modal testing procedures.
Measure emissions using the ramped-modal duty cycle shown in the following table to determine whether compression-ignition engines meet the steady-state emission standards specified in subpart B of this part:

Table 1 of §1036.505—Ramped-modal Duty Cycle

RMC mode	Time in mode (seconds)	Engine speed [1,2]	Torque (percent) [2,3]
1a Steady-state	170	Warm Idle	0
1b Transition	20	Linear Transition	Linear Transition
2a Steady-state	173	A	100
2b Transition	20	Linear Transition	Linear Transition
3a Steady-state	219	B	50
3b Transition	20	B	Linear Transition
4a Steady-state	217	B	75
4b Transition	20	Linear Transition	Linear Transition
5a Steady-state	103	A	50
5b Transition	20	A	Linear Transition
6a Steady-state	100	A	75
6b Transition	20	A	Linear Transition
7a Steady-state	103	A	25
7b Transition	20	Linear Transition	Linear Transition
8a Steady-state	194	B	100
8b Transition	20	B	Linear Transition
9a Steady-state	218	B	25
9b Transition	20	Linear Transition	Linear Transition
10a Steady-state	171	C	100
10b Transition	20	C	Linear Transition
11a Steady-state	102	C	25
11b Transition	20	C	Linear Transition
12a Steady-state	100	C	75
12b Transition	20	C	Linear Transition
13a Steady-state	102	C	50
13b Transition	20	Linear Transition	Linear Transition
14 Steady-state	168	Warm Idle	0

[1]Speed terms are defined in 40 CFR part 1065.
[2]Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the speed or torque setting of the current mode to the speed or torque setting of the next mode.
[3]The percent torque is relative to maximum torque at the commanded engine speed.

§1036.510 Transient testing procedures.{ TC \l1 "}

This section describes how to test engines under transient conditions.

(a) Test spark-ignition and compression-ignition engines using the normalized transient duty cycles specified in paragraphs (f)(1) and (f)(2), respectively, of 40 CFR part 86, Appendix I.

Commented [SA4]: Copy cycles into part 1036 for FRM.

(b) Denormalize the duty cycle as follows:

(1) Denormalize engine speed values using one of the following equations, where speed terms are defined in 40 CFR part 1065:

(i) For spark-ignition engines—

$$\text{Target engine speed (rpm)} = \frac{\%\,\text{rpm} \cdot (\text{maximum test speed} - \text{warm idle speed})}{100} + \text{warm idle speed}$$

Field Code Changed

(ii) For compression-ignition engines—

$$\text{Target engine speed (rpm)} = \frac{\%\,\text{rpm} \cdot (\text{maximum test speed} - \text{warm idle speed})}{112} + \text{warm idle speed}$$

Field Code Changed

(2) Normalized torque values are expressed as a percentage of maximum torque at a given engine speed; therefore, denormalize engine torque values relative to the torque mapping described in 40 CFR part 1065.

(3) The following example illustrates denormalizing a test point from the duty cycle for a compression-ignition engine with maximum test speed of 3,800 rpm and curb idle speed of 600 rpm:

(i) For a normalized speed target of 43 percent, the denormalized speed is--

$$\text{Target engine speed (rpm)} = \frac{43 \cdot (3800 - 600)}{112} + 600 = 1829 \text{ rpm}$$

Field Code Changed

(ii) If the torque target is 82 percent and the engine's torque map shows that maximum torque at an engine speed of 1,829 rpm is 485 N·m, the denormalized torque at that speed is 485·0.82 = 398 N·m.

Commented [AS5]: Check precision

(c) The transient test sequence consists of an initial run through the transient duty cycle from a cold start, 20 minutes with no engine operation, then a final run through the same transient duty cycle. Calculate the official transient emission result from the following equation:

Commented [AS6]: hp or kW?

$$\text{Official transient emission result} = \frac{\text{cold-start emissions (g)} + 6 \cdot \text{hot-start emissions (g)}}{\text{cold-start work (kW·hr)} + 6 \cdot \text{hot-start work (kW·hr)}}$$

Field Code Changed

§1036.515 Test procedures related to not-to-exceed standards.{ TC \l1 "}

(a) This section describes the procedures to determine whether compression-ignition engines meet the not-to-exceed emission standards in §1036.104(d). These procedures may include any normal engine operation and ambient conditions that the engines may experience in use. Paragraphs (c) through (e) of this section define the limits of what we will consider normal engine operation and ambient conditions.

(b) Measure emissions with one of the following procedures:

(1) Test the selected engines while they remain installed in a vehicle. Use the equipment and procedures specified in 40 CFR part 1065, subpart J, to conduct field testing. Use fuel meeting the specifications of 40 CFR part 1065, subpart H, or a fuel typical of what you would expect the engine to use in service. Subpart E of this part describes how to use these procedures to perform in-use testing.

(2) Remove the selected engines for testing in a laboratory. You may use an engine dynamometer to simulate normal operation, as described in this section. Use the equipment and procedures specified in 40 CFR part 1065 to conduct laboratory testing.

(c) Engine testing may occur at locations up to 1,676 meters above sea level at any humidity. You must select one of the following approaches regarding ambient air temperature:

(1) Testing may occur at any ambient air temperature.

(2) Testing may occur at any ambient temperature up to the limit defined by the following equation:

T_{max} (°C) = –0.00459 · A + 37.8

Where:

A = altitude above sea level corresponding to the highest point of testing, in meters.

(d) For testing under the following ranges of ambient conditions, determine emission results without correcting measured emission levels:

(1) Ambient air temperature above 12.8 °C. For testing conducted under paragraph (c)(1) of this section, an upper bound of 35.0 °C also applies.

(2) Ambient humidity between 7.14 and 10.71 grams of moisture per kilogram of dry air.

(e) Engine testing may occur outside of the ranges specified in paragraph (d) of this section, as long as measured values are corrected to be equivalent to the nearest end of the specified range, using good engineering judgment. Correct NO_x emissions for humidity as specified in 40 CFR part 1065, subpart G.

(f) The sampling period may not begin until the engine has reached stable operating temperatures. For example, this would include only engine operation after starting and after the engine thermostat starts modulating the engine's coolant temperature. The sampling period may not include engine starting.

(g) Apply the NTE standards specified in §1036.104(d) to an engine family based on engine operation limited to an NTE zone. Except for the modifications described in paragraph (h) of this section, the NTE zone for an engine family is defined by the following parameters:

(1) The default NTE zone includes all engine speed and torque points not excluded by either the following criteria:

(i) Engine torque values below 30 percent of maximum test torque, and engine speed at or below $n_{lo}+0.15\cdot(n_{hi}-n_{lo})$, where speed terms are defined in 40 CFR part 1065.

(ii) Engine speed and torque values corresponding to engine power below 30 percent of maximum engine power.

(2) The default NTE zone may include some engine speed and torque points otherwise excluded under paragraph (g)(1)(i) of this section as described in this paragraph (g)(2). To determine which additional speed and torque points to apply, first establish the minimum value for brake-specific fuel consumption (BSFC) across the engine map, then multiply this value by 1.05 to calculate a BSFC threshold. Determine BSFC values across the engine map based on testing performed for certification testing under 40 CFR part 1065. The speed and torque points corresponding to BSFC values at or below the BSFC threshold are part of the default NTE zone, except for either of the following circumstances:

Commented [AS7]: This should be clearer regarding resolution of test points.

(i) This paragraph (g)(2) does not apply for an engine that is installed in a vehicle with a manual transmission or with an automatic transmission that has a finite number of gears.

Commented [AS8]: This isn't all-or-nothing for the whole engine family, or?

(ii) If you show us that engines are not expected to operate at certain speed and torque points identified in this paragraph (g)(2) during normal vehicle operation and use, we will approve your request to exclude those points from the NTE zone.

(h) An engine family's NTE zone may be modified as follows:

(1) You may ask us to approve a narrower NTE zone for an engine family at the time of certification as follows:

(i) For diesel-fueled engines, you may ask us to exclude certain speed and torque points from the NTE zone for a particular engine-vehicle combination if the installed engine cannot operate at those speed and torque points.

(ii) For other engines, you may ask us to exclude certain speed and torque points from the NTE zone if the engine is not expected to operate at those speed and torque points during normal vehicle operation and use.

(2) You may ask us to approve a Limited Testing Region (LTR). An LTR is a region of engine operation, within the applicable NTE zone, where you have demonstrated that your

engine family operates for no more than 5.0 percent of its normal in-use operation, on a mileage-weighted basis or some other weighting that we approve. This demonstration must include operational data from representative in-use vehicles. Specify LTR boundaries based on engine speed and torque such that the LTR boundaries coincide with some portion of the boundary defining the overall NTE zone. The shape of the LTR must generally be rectangular or elliptical. Any emission data collected within an LTR for a time duration that exceeds 5.0 percent of the duration of its respective NTE sampling period (as defined in paragraph (j) of this section) will be excluded when determining compliance with the applicable NTE standards. Any emission data collected within an LTR for a time duration of 5.0 percent or less of the duration of the respective NTE sampling period will be included when determining compliance with the NTE standards.

(3) You may exclude emission data based on catalytic aftertreatment temperatures as follows:

(i) For an engine equipped with a catalytic NO_x aftertreatment system, exclude NO_x emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C.

(ii) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C.

(iii) Using good engineering judgment, mMeasure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

(4) Engines with exhaust gas recirculation are not subject to the NTE standards as long as either of the following indicates a cold temperature condition:

(i) For turbocharged engines, intake manifold temperature, T_{im}, is at or below the temperature defined by the following relationship to absolute intake manifold pressure, P_{im}:

$$T_{im}\,(\mathrm{K}) = 0.0635 \cdot P_{im}(\mathrm{kPa}) + 305$$

(ii) Engine coolant temperature, T_{ec}, is at or below the temperature defined by the following relationship to absolute intake manifold pressure, P_{im}:

$$T_{ec}\,(\mathrm{K}) = 0.00714 \cdot P_{im}(\mathrm{kPa}) + 326$$

(i) [Reserved]

(j) Except as described in this paragraph (j), a valid NTE sampling event consists of a minimum averaging period of 30 seconds of continuous operation in the NTE zone. An NTE event begins when the engine starts to operate in the NTE zone and continues as long as engine operation remains in this area. When determining a valid NTE sampling event, exclude all engine operation in an approved LTR under paragraph (h)(2) of this section and exclude operation covered by approved NTE deficiencies. Engine operation in the NTE zone of less than the minimum averaging period does not count as a valid NTE sampling event. Do not combine separate operating periods to meet the minimum averaging period. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for BSFC-related provision described in paragraph (g)(2) of this section. Exclude certain operation for engines equipped with aftertreatment or EGR as described in paragraphs (h)(3) and (4) of this section. Manufacturers may choose to count emission results for a candidate NTE event even though it is

Commented [AS9]: Keep the idea of selecting an LTR based on a "configuration (or sufficiently similar engines)"?

Commented [CAL10]: EMA will consider commenting on breaking (i) down further by technology (oxidizing NOx aftertreatment vs. SCR) and to maybe tweak the exclusion temperature.

Commented [AS11]: Part 86 doesn't limit this to turbocharged engines.

Do we need to clarify how to measure IMT or IMP?
The first equation clearly presumes turbocharged operation. Should we say anything about naturally aspirated? It looks like IMT would need to be above 100 F for a valid test.

This is based on a curve fit to a data set. If you are using a lot of charge air cooling, this equation becomes problematic.

Field Code Changed

Field Code Changed

shorter than the minimum averaging period; if you do this, you must include valid measurements for all regulated pollutants. A longer alternate minimum averaging period may apply for engines that have aftertreatment systems involving discrete regeneration events, as follows:

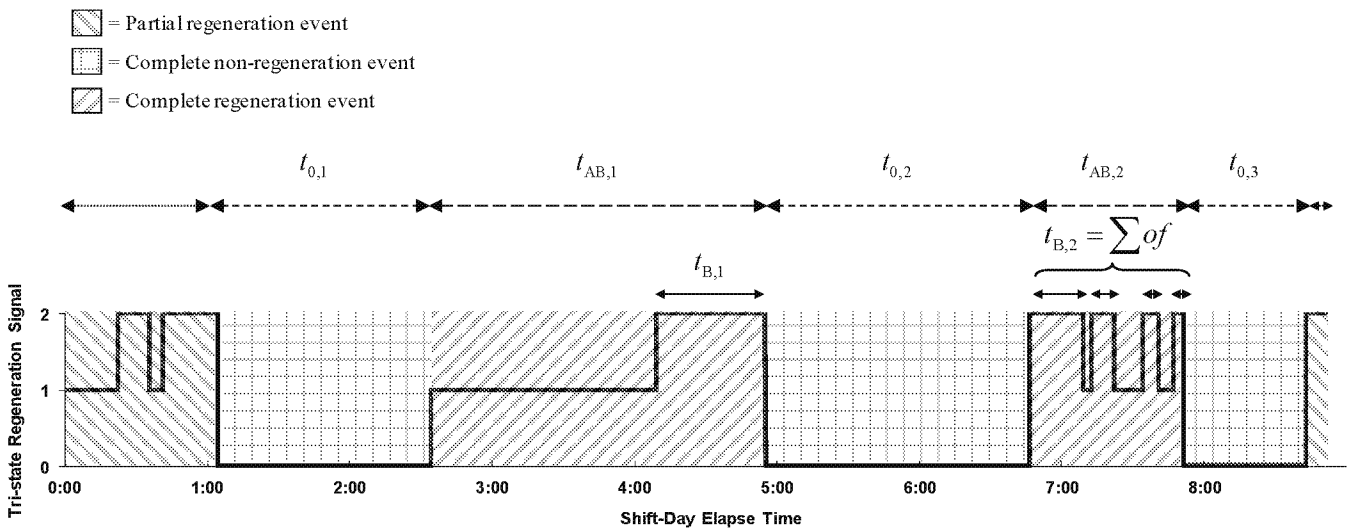
(1) A longer alternate minimum averaging period applies under the in-use testing program in subpart E of this part as described in §1036.420. For any other testing with engines that send an electronic signal indicating the start of the regeneration event, emission sampling is not valid for NTE testing if it includes any active regeneration, unless the emission averaging period includes the complete regeneration event(s) and the full period of engine operation until the start of the next regeneration event.

(2) The following principles apply for determining how regeneration affects the determination of valid NTE sampling events:

(i) The engine's electronic signal indicates the start and end of each regeneration event. A regeneration event may be further divided into active and pending regeneration. Periods of non-regeneration are referred to as state 0; periods of pending regeneration are referred to as state A; and periods of active regeneration are referred to as state B. Regeneration events with combined (alternating) pending and active states may be referred to together as "AB". You may not further differentiate regeneration states for calculating an alternate minimum averaging period. If the electronic signal identifies a pending regeneration state, take the regeneration signal to mean active regeneration.

(ii) A complete non-regeneration event is a period of engine operation that is preceded and followed by regeneration events (pending or active). A complete regeneration event is a period of engine operation that is preceded and followed by non-regeneration events; a complete regeneration event includes any time in the event where regeneration is pending. The following figure illustrates a sequence of regeneration and non-regeneration events:

Figure 1 of §1036.515—Regeneration events during a shift-day.



§1036.520 Adjusting emission levels to account for infrequently regenerating aftertreatment devices.

For engines using aftertreatment technology with infrequent regeneration events that may occur during testing, take one of the following approaches to account for the emission impact of regeneration:

(a) You may use the calculation methodology described in 40 CFR 1065.680 to adjust measured emission results. Do this by developing an upward adjustment factor and a downward adjustment factor for each pollutant based on measured emission data and observed regeneration frequency as follows:

(1) Adjustment factors should generally apply to an entire engine family, but you may develop separate adjustment factors for different configurations within an engine family. Use the adjustment factors from this section for all testing for the engine family.

(2) You may use carryover or carry-across data to establish adjustment factors for an engine family as described in the §1036.235, consistent with good engineering judgment.

(3) Determine the frequency of regeneration, F, as described in 40 CFR 1065.680 from in-use operating data or from running replicate tests. For any replicate transient testing in the laboratory, use good engineering judgment to include cold-start operation in proportion to the weighting factors specified in §1036.510(c). If the engine is designed for regeneration at fixed time intervals, you may apply good engineering judgment to determine F based on those design parameters. All adjustment factors for regeneration are additive. You may calculate adjustment factors using separate values of F for steady-state and transient testing. You may alternatively establish a composite value of F to apply for both steady-state and transient testing based on the following weightings:

(i) For heavy heavy-duty engines, 75 percent steady-state operation and 25 percent transient operation.

(ii) For all other engines, 60 percent for steady-state operation and 40 percent transient operation.

(4) Treat cold-start testing and hot-start testing together as a single test segment as described in §1036.510(c) for adjusting measured emission results under this paragraph (a). Apply the adjustment factor to the composite emission result.

(5) Identify the value of F in each application for the certification for which it applies.

(b) You may ask us to approve an alternate methodology to account for regeneration events. We will generally limit approval to cases where your engines use aftertreatment technology with extremely infrequent regeneration and you are unable to apply the provisions of this section.

(c) You may choose to make no adjustments to measured emission results if you determine that regeneration does not significantly affect emission levels for an engine family (or configuration) or if it is not practical to identify when regeneration occurs. If you choose not to make adjustments under paragraph (a) or (b) of this section, your engines must meet emission standards for all testing, without regard to regeneration.

CFR Citation
§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1370-2007(g) which is now §1036.420(a)
§86.1370-2007(g) which is now §1036.515(h)(3)

§86.1370-2007(g) which is now §1036.515(h)(3)

§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1910(g) - which is now §1036.415(g)
§86.1912(a) - which is now 1036.425(c)
86.1905(a)(1) which is now 1036.405(a)(1)

§86.1370-2007 (d)(3) which is now 1036.420(b)
§86.1920(b) which is now 1036.440(b)
§86.1910(j) which is now 1036.415(j)

EMA Comment

EMA Letter Dated February 3, 2012

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only specific exhaust species that are reduced by the aftertreatment device at issue. For example, engine with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emisison species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

EMA Letter Dated December 14, 2012

(1) This request is a repeat of what is in the letter dated 2/3/12 and has been addressed via items i - v above.
(2) EMA would like EPA to allow, at the manufacturer's option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events is recorded.
(3) Part 86 does not give guidance on how to address crankcase emissions with respect to in-use PM emissions if the crankcase is vented to the atmosphere. EMA requests that EPA add that every PM NTE emission value have 0.00042 g/hp-hr added to it. This value was agreed upon as the means to account for blow-by emissions in the PM-PEMS Measurement Allowance Determination program.
(4) Recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. EMA requests that in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing.

(5) In order to increase NTE yield, EMA would like use NTE events which are only partially sampled because the analyzer was zeroing at the start of the event.
(6) Under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things currently stand, manufacturers have felt it necessary to suspend testing so that data colelection and results could be tablulated, analyzed, and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufactuers able to resume and complete their pending field work. Instead the final in-use testing reports should suffice, since they contain all of the relevant data in a duly complied and sumarized format.
(7) EMA requests that in-use PM measurement not be required for future in-use tests. The reasoning given is that data collection to date makes it clear that as long as the DPF is not cracked, PM emissions will be well below the NTE limit. EMA cites that 86.1910(j) states that manufacturers may ask EPA to waive measurement of particular emissions if they can show that in-use testing for such emissions is not necessary. Based on data collected, EMA believes that 86.1910(j) should be invoked across the board for all engine manufactuers to eliminate in-use PM measurement.

EPA Response 7/15/14
EPA agrees with this and will revise §1036.515(h)(3) using language similar to what was used in §1042.515 as the basis, which separates the exclusions based on catalyst function.
EPA will add CO to §1036.515(h)(3), but we will not add PM. We are not aware of any aftertreatment technology used on HD highway engines where catalyst temperature would effect PM emission levels.
EPA recognizes that there is no continuous, real time parameter that defines the beginning and end of an NTE event. We agree that the period of the event is not defined until it has reached the end, as determined by speed and load. We agree that emissions impacted by the exhaust gas temperature dropping below 250°C should be reported, however that NTE event should not be included in calcuation of the vehicle pass ratio for the affected pollutant. 1036.515(h)(3) already makes it optional to exclude data when aftertreatment temperatures don't meet specifications.
EPA agrees that the temperature should be measured throughout the entire NTE event. If that temperature falls below 250°C at any point during the event, then the NTE should be excluded from the pass ratio calculation. EPA has made a change to 1036.515(h)(3)(i) and (ii) to reflect this.

EPA agrees that the regulations could use some additional detail on how to handle temperature measurments for systems with multiple devices. EPA has added a new 1036.515(h)(3)(iii) that is based off of EMA's included language changes to 86.1370-2007(g)(1) and (2). EPA has also added a good engineering judgment clause to provide the manufacturer added flexibility in determing the measurement location to account for the location of factory installed temperature sensors. If would be ideal if the manufacturers could, using good engineering judgment, utilize sensors and ECU calculations already installed from the factory in monitring aftertreatment temperature.

See responses above.
EPA understands EMA's concern with not always being able to predict the amount of non-idle operation for a given test vehicle. EPA has modified 1036.415(g), (h), and (i) to address EMA's request. This modificaiton has reduced the required hours of non-idle operation from 3 to 2, per the outcome of discussions between EPA and EMA.
EPA understands that this was the agreed upon value in the PM Measurment Allowance program and will add a new 1036.425(c) as the means to account for blow-by.
EPA does not request families with sales below 1500 units, unless the engine manufacturer doesn't have any families with sales of 1500 units or greater. If, in fact, an engine manufacturer determines that EPA mistakenly requested a family with sales of under 1500 units, contradicting 86.1905(a)(1), EPA will designate another engine family at the request of the engine manufacturer.

Based on experience gained to date, EPA does not believe that there will be any problems associated with initiation of measurement after the start of an NTE event. EPA also understands EMA's desire to increase NTE yield for a given shift day. EPA has added a new 1036.420(b) to address this issue.
EPA has increased the time frame on quarterly report submissions from 30 days to 45 days. We have also added in a provision to allow a request for additional time with Administrator approval.
86.1910(j) was intended to address manufacturers' requests on a case-by-case basis. Manufacturers that would like to get out of having to perform in-use PM measurement should submit the request, along with supporting data, in writing to EPA OTAQ's Compliance Division. EPA does not intend to honor the requested change at this time as we do not have enough high milage data to determine whether or not increased PM from DPFs is a problem.

Truck & Engine Manufacturers Association™
Bringing Cleaner Power to the World Since 1966™

333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

February 3, 2012

By e-Mail (spears.matt@epa.gov) and
First Class Mail

Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Proposed Technical Amendment to 40 CFR §86.1370-2007(g)

Dear Matt:

As a follow-up to my correspondence dated January 25, 2012, this letter will outline the various reasons that warrant a technical amendment to 40 CFR §86.1370-2007(g), the regulatory provision that allows for an exclusion from the NTE limits for engines equipped with NOx or NMHC-related aftertreatment devices when exhaust gas temperatures are less than 250°C. The technical amendment that EMA is proposing is intended to address a number of significant ambiguities that pertain to the current regulatory language. Specifically, the proposed technical amendment, which is attached for your reference in a red-line format, is intended to address the following issues:

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only the specific exhaust species that are reduced by the aftertreatment device at issue. For example, engines with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emission species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event

EPA-HQ-2019-002891

may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

Thank you for your attention to this matter, which we feel is suitable for inclusion (along with the several items referenced in my correspondence of January 25th) in the omnibus rulemaking package that we understand is pending with the Agency. As always, please let me know if you have any questions regarding this matter.

Very truly yours,

Timothy A. French

cc: Donald Kopinski (kopinski.donald@epamail.epa.gov)
Charles Moulis (moulis.charles@epamail.epa.gov)
Alan Stout (stout.alan@epamail.epa.gov)
Michael Samulski (samulski.michael@epa.gov)
Michael Carter (mcarter@arb.ca.gov)
Emissions Measurement Testing Committee

63028_1.DOCX

ED_002421_00002274-00002

~~(g) *NOX and NMHC aftertreatment warm-up*~~ (g) *Aftertreatment cold temperature operating exclusion.* For engines equipped with one or more catalytic aftertreatment devices that reduce ~~NOX or NMHC emissions, the NTE NOX and NMHC emission limits do not apply when~~regulated exhaust constituents, you may exclude the regulated exhaust constituent(s) that is (are) reduced by such aftertreatment device(s) from the vehicle pass ratio calculations for NTE events where the exhaust gas temperature is below 250 °C at any time during the NTE event. This exclusion applies only to the emissions constituent(s) that is (are) reduced by the catalytic aftertreatment device(s). The following restrictions apply to the exhaust gas temperature ~~is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.~~measurement.

(1) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the exhaust gas temperature must be measured downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed.

(2) For other aftertreatment systems where the engine exhaust is split into multiple flow paths, measure the exhaust gas temperature downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents in the major flow path, i.e. the flow path designed to have the highest flow rate. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed. If the system is designed to vary the flow split through the various paths, i.e. designed to change the major flow path during NTE events, use good engineering judgment to identify the major flow path throughout the NTE event and switch the measurement location throughout the NTE event as the major flow path switches. If the system is designed to flow equal amounts through various paths, such as a vee engine or identical parallel devices, select any one of the various paths.

(3) For testing by engine manufacturers, the exhaust gas temperature may instead be measured further upstream with the following restrictions:
(i) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the measurement must be made at a single location throughout the in-use test.
(ii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and where the flow split through the various paths is not designed to vary during NTE events, the measurement must be made at a single location on the major flow path throughout the in-use test. If the system is designed to flow equal amounts through the various paths, select any one of the various paths.
(iii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and the flow split through the various paths is designed to vary during NTE events, i.e. the major flow path changes; the exhaust gas temperature must be determined from a single measurement location in each of the multiple flow paths throughout the in-use test. The exhaust gas temperature during the test must be either the maximum measured value on any of the flow paths or the measurement on the major flow path. Use good engineering judgment to identify the major flow path throughout the NTE event.

Truck & Engine Manufacturers Association™
Bringing Cleaner Power to the World Since 1968®

333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

December 14, 2012

Via Email (spears.matt@epa.gov)
and First Class Mail

Mr. Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Necessary Amendments to Heavy-Duty In-Use Testing Program

Dear Matt:

I am writing to summarize the various technical amendments and revisions that need to be incorporated into the regulations relating to the manufacturer-run in-use testing program for heavy-duty vehicles and engines. We have discussed certain of these necessary amendments in prior correspondence. EMA would appreciate the Agency's prompt response on these various issues, since they threaten to frustrate the efficient implementation of the in-use testing program to the extent they remain unresolved.

1. The first set of necessary amendments relates to the low-temperature exclusions that are provided from the NTE limits under 40 CFR §§86.1370-2007(g). As we detailed in our letter to you dated February 3, 2012, amendments to that regulatory provision are needed to: (a) limit the exclusion to the specific exhaust species that is impacted by the temperature-sensitive aftertreatment device at issue; (b) expand the low-temperature exclusion to cover aftertreatment devices that impact CO and PM (in addition to the exclusions available for NOx and NMHC); (c) clarify that any NTE events that are impacted by low-temperature exclusions are not counted for purposes of calculating the 90% vehicle pass ratio; (d) clarify when the relevant exhaust temperature is to be measured during in-use testing; and (e) clarify the location(s) for measuring the relevant exhaust temperatures. Another copy of EMA's February 3rd correspondence, along with a red-line of our recommended technical amendments to section 86.1370-2007(g), are attached for your reference. Your prompt confirmation of those necessary revisions (and when and how they will be codified) would be greatly appreciated.

2. We now have several years' experience in conducting in-use testing pursuant to 40 CFR Subpart T. The experience gained over that time has revealed that it is much more difficult than originally anticipated to ensure that an in-use test will yield at least 3-hours of accumulated non-idle operation. Even when testing is carried over to a second day under 40 CFR §86.1910(g), it has often proved impractical to meet the 3-hour threshold for non-idle operation. The net result to engine manufacturers is that the in-use testing program has proved to be more time-consuming, labor intensive and costly than originally bargained for.

To ameliorate this difficult situation, EMA requests that EPA amend section 86.1910(g) to allow manufacturers, at their option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events have been recorded. Manufacturers would still carefully screen the test vehicles to try to ensure that at least 3 hours of non-idle operation would be captured in-use, but would have the flexibility, at their option (and risk), to conclude the in-use testing after one full shift day if, for unanticipated reasons, the 3 hours of non-idle operation were not obtained.

In sum, practice has shown that the threshold of 3 hours of non-idle operation is far more difficult to achieve than originally anticipated. Manufacturers should not have to bear all of the costs stemming from that original misperception. The proposed amendment is therefore necessary to restore the relative costs of the in-use testing program to the range that was originally bargained for.

3. The regulations do not codify the agreed upon treatment of crankcase emissions for the purposes of in-use testing. To the contrary, the only memorialization of the parties' agreement of how to account for "blow-by" emissions (specifically, by adding a factor of 0.00042 g/bhp-hr to every NTE emission value if the crankcase is vented to the atmosphere) is contained in Appendix B to the Final Report of the PM-PEMS Measurement Allowance Determination. The in-use testing regulations (perhaps at section 86.1912(a)) need to be amended to include the agreed upon accounting for blow-by emissions.

4. Like the accumulation of 3 hours of non-idle operation, the recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. This is compounded by the fact that the Agency has designated engine families having volumes less than 40 units. As a consequence, the time and expense that manufacturers have incurred in trying to recruit vehicles from such low-volume engine families have been excessive and disproportionate. Accordingly, in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing, without first having to incur time and "good faith" efforts trying to track down such a truly negligible number of vehicles. The operative regulations should be amended to include this needed flexibility.

5. During the meetings that led to the development of the in-use measurement allowances, it was agreed that the PEMS used to measure gaseous emissions would be permitted to engage in "zeroing" during in-use testing. It was also agreed that when the PEMS had completed their "zeroing" processes, they would be programmed to wait until the start of the

next NTE event before reinitiating the sampling and calculation of in-use emissions. This was a somewhat arbitrary decision made to avoid the potential need to research the effects of the initiation of emissions sampling and calculation in the midst of an NTE event.

Since that time, PM PEMS have been developed and deployed that generally have the capacity to record markedly fewer NTE events than do gaseous PEMS. This is especially the case with respect to quartz crystal technologies. In addition, the accumulated experience of in-use testing has demonstrated that there are not likely to be any significant problems associated with the initiation of in-use measurements after the commencement of an NTE event. Accordingly, in order to increase the yield of NTE events as recorded by PM PEMS, EMA is proposing the following technical amendment to allow PEMS to start emissions sampling as soon as the PEMS returns to a state where it is ready to initiate sampling, i.e., as soon as it completes zeroing or conditioning. The specific language that we propose is as follows:

> *Section 86.1370(d)(3)(new). Emissions sampling will start as soon as the NTE zone conditions are met, except where the PEMS equipment is still engaged in zeroing or conditioning. In such a case, sampling will begin as soon as the PEMS equipment is ready. For gaseous emissions, NTE event sampling will begin at the same time for all regulated emissions when the PEMS equipment is operational.*

6. Currently, under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things stand currently, manufacturers have felt it necessary to suspend testing so that data collection and results could be tabulated, analyzed and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufacturers able to resume and complete their pending field work.

Interrupting field testing solely to accommodate quarterly reports is wasteful and counter-productive. Moreover, the preparation of quarterly reports has, like other aspects of the in-use testing program, proved to be disproportionally burdensome and time-consuming, as it involves the processing and tabulation of very large amounts of electronic files and data. Accordingly, in light of the foregoing, EPA should delete the quarterly reporting requirements under section 86.1920(b). Instead, the final in-use testing reports should suffice, since they contain all of the relevant data in a duly compiled and summarized format. Importantly, the integrity of the in-use testing program would not be impacted by the elimination of quarterly reports given the fact that manufacturers would still be required to report on any failed in-use tests within fifteen (15) days, as specified under section 86.1920(e).

7. Section 86.1910(j) provides that manufacturers "may ask [EPA] to waive measurement of particular emissions if [they] can show that in-use testing for such emissions is not necessary." As contemplated under that provision, sufficient in-use testing data have been

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collected and submitted to EPA over the past several years clearly demonstrating that in-use testing for PM and NMHC is not necessary. The levels of those emissions as they are being recorded from the engines that are subject to the in-use testing program are truly negligible, to the point of being indistinguishable from zero. Moreover, in-use testing for PM requires the use of separate PEMS, which significantly increases the cost and complexity of in-use testing.

The data collected to date also make it clear that so long as PM aftertreatment systems are in working order - - i.e., so long as the PM filters are not cracked - - PM emissions will be well below the NTE limit. In that regard, today's heavy-duty on-highway engines are equipped with comprehensive OBD systems that can readily detect malfunctioning PM filters and, in response, initiate warnings and inducements to ensure prompt repairs. Thus, the diagnostic features that are integrated into today's engine systems render in-use testing for PM emissions both unnecessary and redundant.

The net result is that the configuration of today's heavy-duty engine systems, in addition to the emissions data gathered to date that show zero-equivalent in-use emission levels, fully warrant a waiver of the in-use testing requirements for PM and NMHC. Accordingly, EPA should grant and codify such a waiver in the in-use testing regulations.

We look forward to working with you and your colleagues to implement the foregoing amendments to the heavy-duty in-use testing program as efficiently and expeditiously as possible. Accordingly, please contact me at your first convenience to coordinate our next steps.

Very truly yours,

Timothy A. French

cc: William Charmley (charmley.william@epa.gov)
Byron Bunker (bunker.byron@epa.gov)
Jed R. Mandel (jmandel@clpchicago.com)

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HDIUT WORKGROUP SUMMARY(AUG 2, 2018)

- The moving average window (MAW) method is superior to the NTE method in ability to include a greater percentage of time and NO_x from the test data
  - Tweaks to the NTE method do not adequately cover actual operation or emissions
  - Euro VI with MAW for in-use conformity testing appears to have pushed European manufacturers to significantly reduce NOx emissions over the full duty cycle
- CARB staff proposes a MAW method similar to Euro VI(d) for the next generation HDIUT program
- CARB staff proposes enhancements to the Euro VI(d) MAW protocols:
  - The driver and test route criteria will remain the same as 40 CFR 86.1910(e) to include real world operation
  - Windows with average power or CO_2 emissions down to idle values will be considered valid windows
  - Introduction of a carbon based in-use standard and threshold (examples: g NO_x/CO_2 , g NO_x/fuel)

HDIUT: FUTURE CONCEPT SUMMARY (AUG 2, 2018)

	FUTURE CARB HDIUT
Request for testing	• EPA and CARB Requested
Engine Selection	• Max 25% engine families produced each year and 100% avg engine families over 4 year
Frequency	• Annually
Vehicle test equipment	• PEMS
Test Plan	• Mfr. Submitted for CARB approval
Driver	• **Fleet driver** (or manufacturer with prior CARB/EPA approval)
Route	• **Regular fleet route – full test day** (or manufacturer with prior CARB/EPA approval)
Method	• Moving Average Window (MAW)
Exclusions	• ambient, zero check
Window Validity	• $Pwr_{avg} \geq 10\%\ Pwr_{max}$ Include operation down to idle power or CO_2 values Include start emissions (cold, warm, and hot)
Emissions	• Work or carbon specific (may include SWRI alternative)
In Use Thresholds	• 1.5 x standard
Pass Determination	• 90th percentile emissions (or higher) below In Use Threshold • Control highest 10% and invalid windows

Color Key

*Current CFR and CCR
* Adopt from Euro VI
* CARB proposed enhancements

NEW HDIUT CONCEPTS: CARB STAFF IS CURRENTLY EVALUATING

- Start emissions compliance evaluation
  - Remove engine coolant temperature exclusions in Euro VI method to include start emissions containing windows
  - Method (I): Use a weighted hot-cold composite in-use emission rate to compare with in-use threshold
    - *Previously introduced at Aug 2nd workgroup meeting*
  - Method (II): Average of the top 10% of emitting windows and compare with the in-use threshold
- Phase in for HDIUT requirements
  - 2022: Euro VI(d) exclusions as implemented in European In-Use Conformity Testing
  - Implementation of CARB enhancements to the MAW technique
    - Applies to Low Load Cycle (LLC) certified engines

CREDIT WORKGROUP SUMMARY (AUG 2, 2018)

- NOx Credits – Averaging Banking and Trading (ABT) Program
  - California NOx emission standards would require a separate credit pool from existing federal pool
    - Portion of pre-2023 MY national credits transferred into California credit account (transferred credits expire in 5 yrs.)
    - Portion allowed to be transferred equivalent to the national credit balance at the beginning of 2023 MY multiplied by the CA sales percentage of 50-state sales in 2018-2022 MYs
    - After transfer, California and federal credits tracked separately
  - Zero Emission Powertrains (ZEPs) would produce California NOx credits with multiplier (=2)
    - ZEP must be certified to be eligible for NOx Credits
    - ZEP credit multiplier would be significantly reduced or sunset post 2030
    - ZEP credits may only be used in the averaging sets in which they were generated
    - ZEP multiplier currently at 2, but may be adjusted in consideration of other factors

UPCOMING MILESTONES

Upcoming Meetings:

- Oct 2018: Durability Demonstration/ Warranty/Useful Life/EWIR – HD Low NOx Workgroup Meeting
- Nov/Dec 2018: SWRI Advisory Groups Meeting re: Stage 1b & 2, low load cycle (LLC)
- Dec 2018: Low Load Cycle – HD Low NOx Workgroup Meeting
- Dec 2018/Jan 2019: Public Workshop
- Jan 2019: Advisory group meeting on SwRI Stage 3

Board Hearing

Workgroups

Public process

Q2 '18 | Q3 '18 | Q4 '18 | Q1 '19 | Q2 '19 | Q3 '19 | Q4 '19

Stage 1B – Re-age parts

Stage 2 – Develop/assess LLC

Stage 3 – Demonstrate low NOx on 2nd engine without turbocompound, including LLC

Stage 3b – Explore additional engine hardware options that can simultaneously reduce NOx and GHG on stage 3 engine – cylinder deactivation, turbine bypass, charge air cooler bypass & EGR cooler bypass

NREL On-Road Heavy-Duty Low-NOx Technology Cost Study

Appointment

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 8/14/2018 5:48:37 PM
To: Hamady, Fakhri [hamady.fakhri@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]
CC: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; ARB MSCD Meetings And Events [600.mscdcal.ARB@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Macias, Keith@ARB [keith.macias@arb.ca.gov]

Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Volvo Response - 2016 In-Use Test Order Questions
Location: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Start: 8/21/2018 6:00:00 PM
End: 8/21/2018 7:00:00 PM
Show Time As: Busy

EPA Conference Call Info:

Conf. call number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 8/7/2018 2:06:38 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Q&As for Volvo HDIUT Data (for 2016 test order).docx

Abraham,

The following is the Volvo response to your attached July 16, 2018 question.

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

Volvo July 21, 2018 Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to? Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez? In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Volvo Response: The origin of this interpretation traces back to an EMA/Agencies (EPA & ARB)/Suppliers meeting at EPA in Ann Arbor, MI on July 15, 2014. It was at this meeting where Chris Laroo of EPA announced that the low temperature exclusions are something they do not like but reluctantly accept. Therefore, in order to incentivize low temperature emissions control, the regulators' position was to use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass. The October 2016 amendment included a language change in the CFR Part 86.1370 which states that "you may exclude emission data". Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the amendment. Volvo has recently confirmed with Chris Laroo and James Sanchez that this interpretation is correct. They stated *"86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well"* and that *" A manufacturer can choose to include or exclude any*

invalid NTE event during a test". Dr. Hamady was not involved in the discussion; however, he has reviewed the test order. In the future Volvo intends to include ARB on discussions regarding interpretation.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, July 16, 2018 4:27 PM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven; Hamady, Fakhri
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range

values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

I am examining your data for 2016 order, especially for three vehicles tested in 2017, and have several questions/comments below:

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731

Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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From: Lee, Doh-Won@ARB
Sent: Monday, November 13, 2017 4:04 PM
To: Trevitz Steven <steven.trevitz@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Murter Zack <zack.murter@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Steve!

Sincerely,
Doh-Won

From: Trevitz Steven [mailto:steven.trevitz@volvo.com]
Sent: Thursday, November 09, 2017 8:08 AM
To: Lee, Doh-Won@ARB
Cc: Clever Timothy; Heltzel Robert; Tasik Karl; Murter Zack
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: 301.573.1622
E-mail: steven.trevitz@volvo.com

From: Tasik Karl
Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve,

Please provide a response to Doh-Won's IUT questions.

Thanks
Karl

From: Lee, Doh-Won@ARB [mailto:Doh-Won.Lee@arb.ca.gov]
Sent: Wednesday, November 08, 2017 11:00 AM
To: Tasik Karl
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I have a couple of quick questions.

I was notified that you did not have SCR temperature monitor for the engine family, and I noticed that you put a thermocouple for measuring SCR temperature. "The exhaust elbow on the outlet of the SCR catalyst was replaced with one that accommodates a thermocouple." in the Acceptance History Text (in xml files). How far was it from the outlet of the SCR to the thermocouple? Do you have pictures showing the installation setup?

Thank you for your responses in advance.

Sincerely,
Doh-Won

From: Lee, Doh-Won@ARB
Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov

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From: Tasik Karl [mailto:karl.tasik@volvo.com]
Sent: Wednesday, August 02, 2017 10:10 AM
To: Macias, Keith@ARB

Cc: Sardar, Satya@ARB; Lee, Doh-Won@ARB
Subject: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Keith,

The Volvo 2Q 2017 In-Use Test Data for the 2016 In-Use Test Order is being shipped today via Fedex # Ex. 6 - Personal Privacy.

Best Regards,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to?
Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez?
In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

Thank you for your explanation. I spoke with my colleague, John O'Cain, whom you met during his audit of the Volvo lab. He indicated that you had already been using new PEMS for HDIUT, which would eliminate these types of abnormalities and malfunction. Additionally, our expectation is that you will continue to have good QA/QC practices. Based on your explanation that the old PEMS had systematic problems, we accept the test data. However, please note that, if the same types of problems continue to occur with the new PEMS, we may not accept the test data.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC

concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

> Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

Thank you for your explanation. As similar to the item addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 3 vehicles tested in 2017,
in addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

> Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

Thank you for your explanation along with calibration data sent via email attachments. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

Thank you for your explanation. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. For water ingestion, we recommend you take any necessary actions to prevent it from happening. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

CALIFORNIA
AIR RESOURCES BOARD

HEAVY-DUTY IN-USE TESTING PROGRAM WORKGROUP MEETING

AUGUST 2, 2018

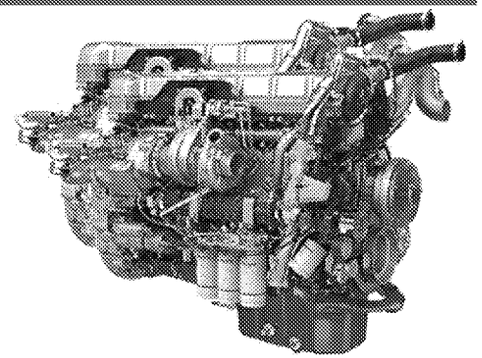
PROPOSED REVISIONS TO THE HEAVY-DUTY IN-USE TESTING PROGRAM AND EMISSION CREDITS PROGRAM

MOBILE SOURCE CONTROL DIVISION

OUTLINE

- Background
- Heavy-Duty In-Use Testing Program
- Credits - Averaging Banking and Trading (ABT)
- Next Steps

PROGRAM ELEMENTS AND TIMEFRAME



- **Elements:**
  - Setting Low-NOx engine standards
  - Developing a supplementary low-load certification test cycle
  - Revising the Heavy-Duty In-Use Testing (HDIUT) program –
    - Replace Not-to-Exceed (NTE) method with moving average window (MAW)
  - Strengthen the current durability demonstration program
  - Extension of useful life and warranty periods
- **Timeframe**:
  - CARB Board date: December 2019
  - Implementation to begin in 2023

LOW NOx DEMONSTRATION PROJECTS

- **Stage 1 – Low NOx Feasibility Demonstration**
  - Funding: $1.6M by CARB with support from MECA and Volvo
  - Final report at: https://www.arb.ca.gov/research/veh-emissions/low-nox/carb_2017-04-30_03-19503_finaledit.pdf
- **Stage 1b – Re-aging of New Set of Stage 1 Aftertreatment Parts**
  - Funding: $480,000 by SCAQMD with support from MECA
- **Stage 2 – Low Load Cycle (LLC) Development / Low Load NOx Control / Load Metrics Accuracy Evaluation**
  - Funding: $1.05M by CARB
- **Stage 3 – Low NOx Demonstration on an Alternative Non-Turbocompound (TC) Engine**
  - Funding: $1.375M by CARB, SCAQMD and POLA with support from Cummins & MECA
- **Stage 3b – Additional Low NOx Related Engine Hardware Development**
  - Funding: $500K by EPA, HD Industry & MECA

Heavy-Duty In-Use Testing (HDIUT)

HDIUT: OUTLINE

- Current HDIUT /NTE program
- Problems with current program
- Proposed changes
  - Administrative and Reporting
  - Testing Conditions and Exclusions
  - Full Duty Cycle Control
  - Moving Average Windows (MAW)
  - Pass Fail Determination
- CARB HDIUC Program provisions

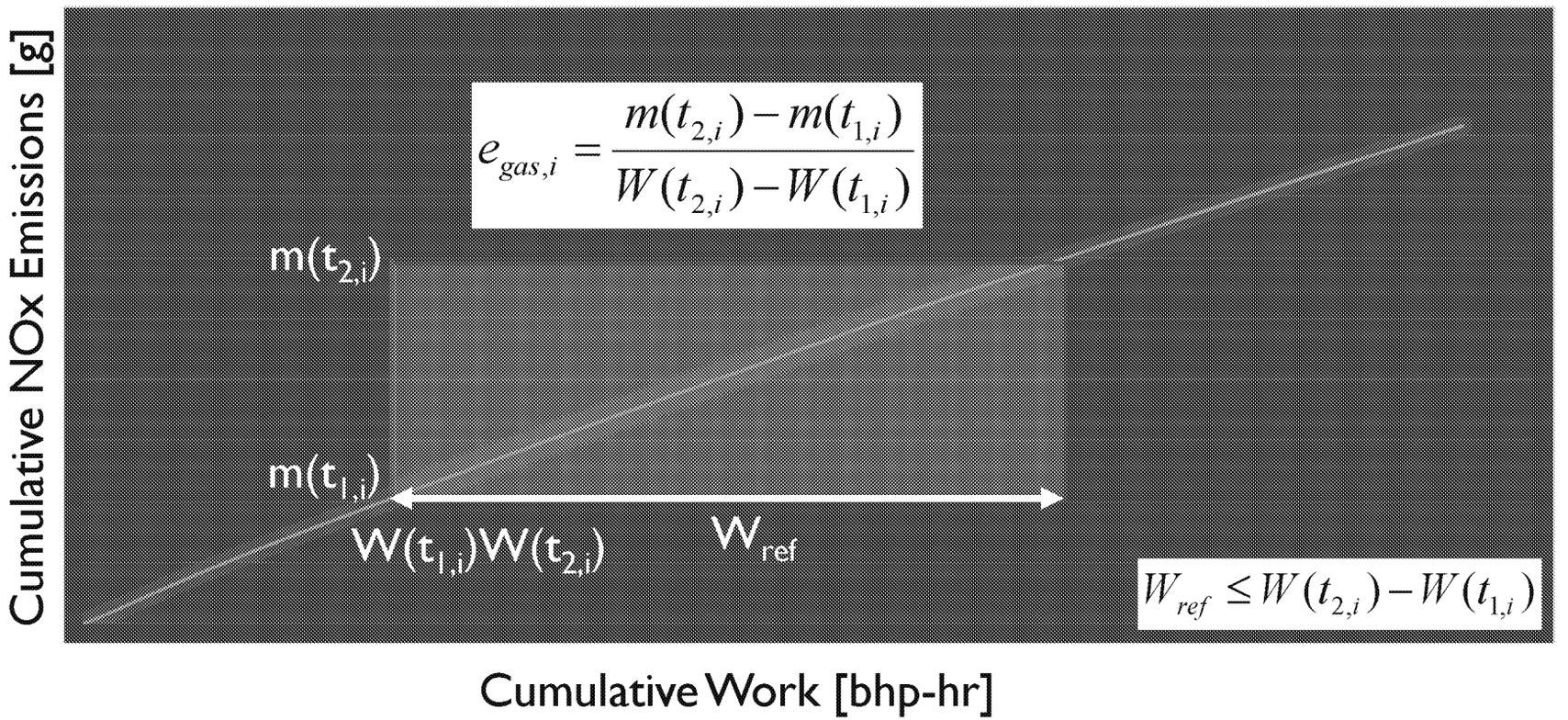
HDIUT: CURRENT REQUIREMENTS (40 CFR PART 86 SUBPART T)

	Current CARB & EPA HDIUT
Request for testing	• CARB & EPA Requested
Engine Selection	• Max 25% engine families produced each year and 100% engine families over 4 year avg
Frequency	• Annually
Vehicle test equipment	• PEMS
Driver	• Regular Fleet Driver
Route	• Regular Fleet Route
Method	• Not-to-Exceed
Exclusions	• Ambient, 30% power, 30% torque, min-rpm, zero check, AT-temp, cold operations, IMT/ECT, OBD/EMD fault code, regeneration
Window Validity	• 30 sec continuous operation within NTE control area without entering exclusions operation
Emissions	• Brake specific [g/bhp-hr]
In Use Thresholds	• 1.5 x Std. + PEMS accuracy margin (0.15 g/bhp-hr for NOx)
Pass Determination	• 90% of time weighted valid NTE events must emit at or less than the In Use Threshold

HDIUT: CURRENT PROBLEMS

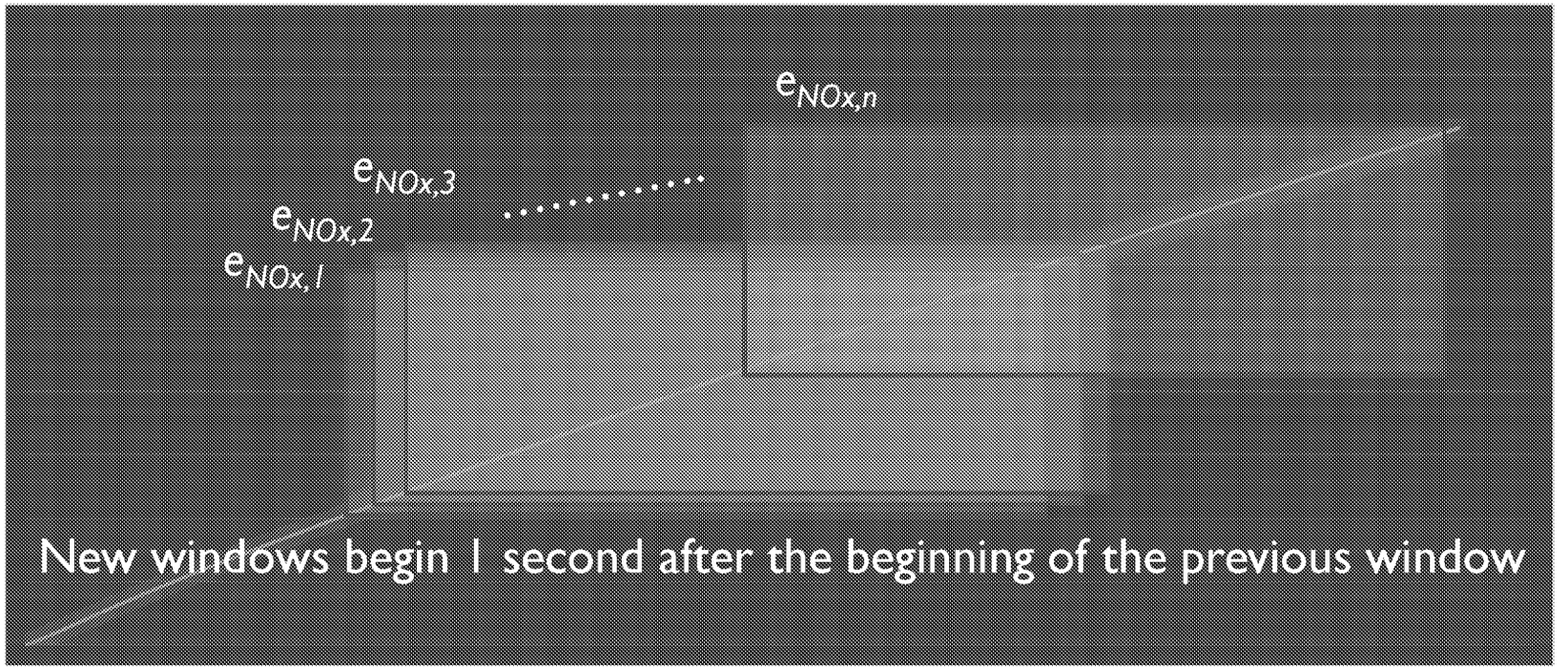
- Current HDIUT program targets sustained high speed and high load operation for gross NOx polluting offenses.
- After applying the current exclusions, valid data from testing represents a small fraction of the total test in terms of time (<5%) and NOx emissions (<6%).
- 24% of tests pass without any valid NTE events.
- Current HDIUT does not represent the full duty cycle emissions.
- There is a discrepancy in the pass rates observed by the manufacturer and CARB-run HDIUT results. (CARB testing: 17 of 23 failed NTE)
- New or revised method needed

EURO VI: DETERMINATION OF EMISSIONS WITHIN A MAW



EURO VI: DETERMINE ALL WINDOWS AND EMISSIONS

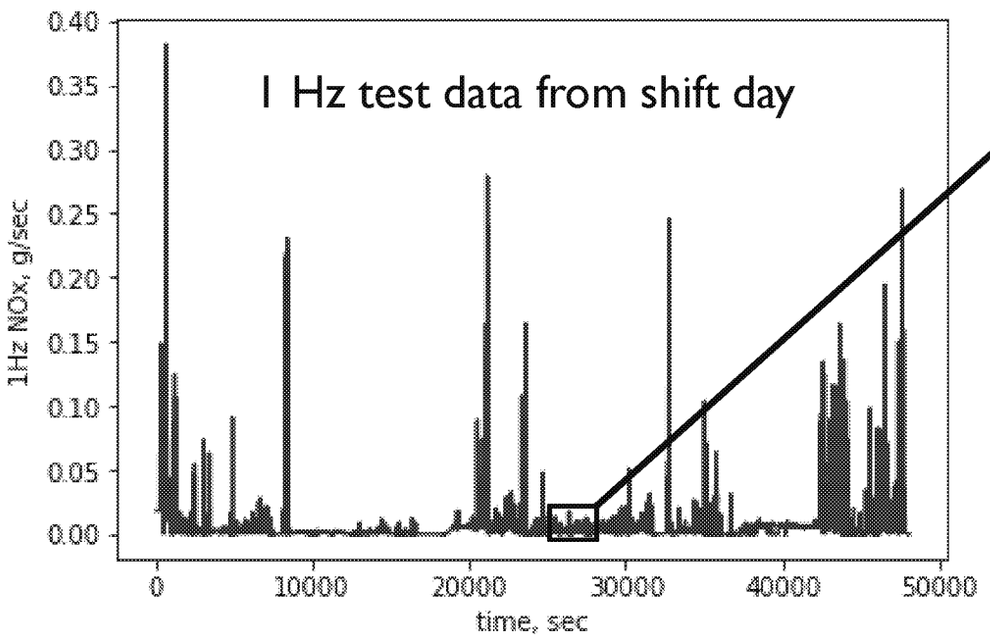
Cumulative NOx Emissions [g]

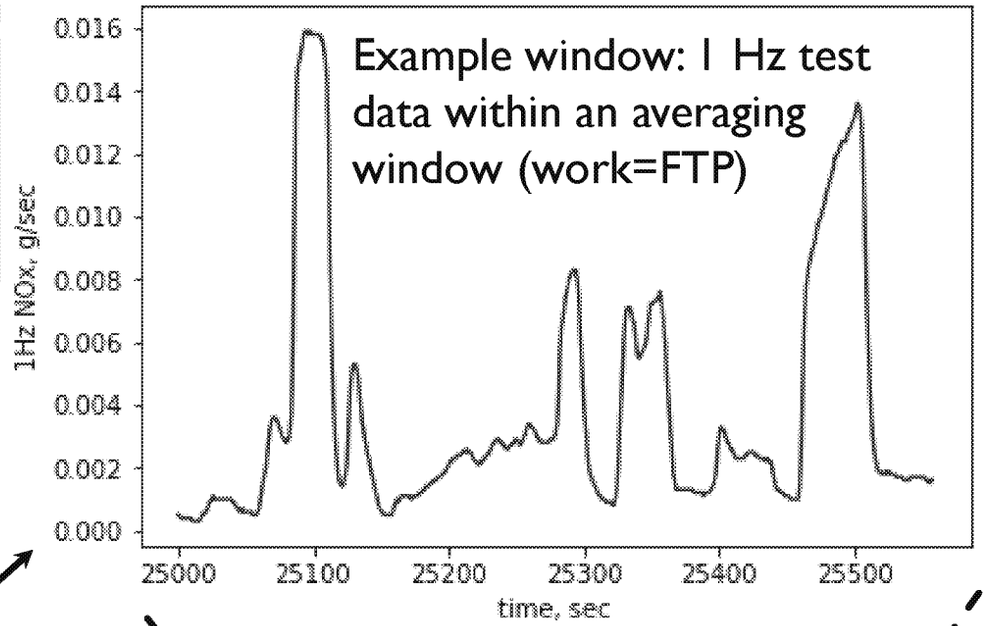


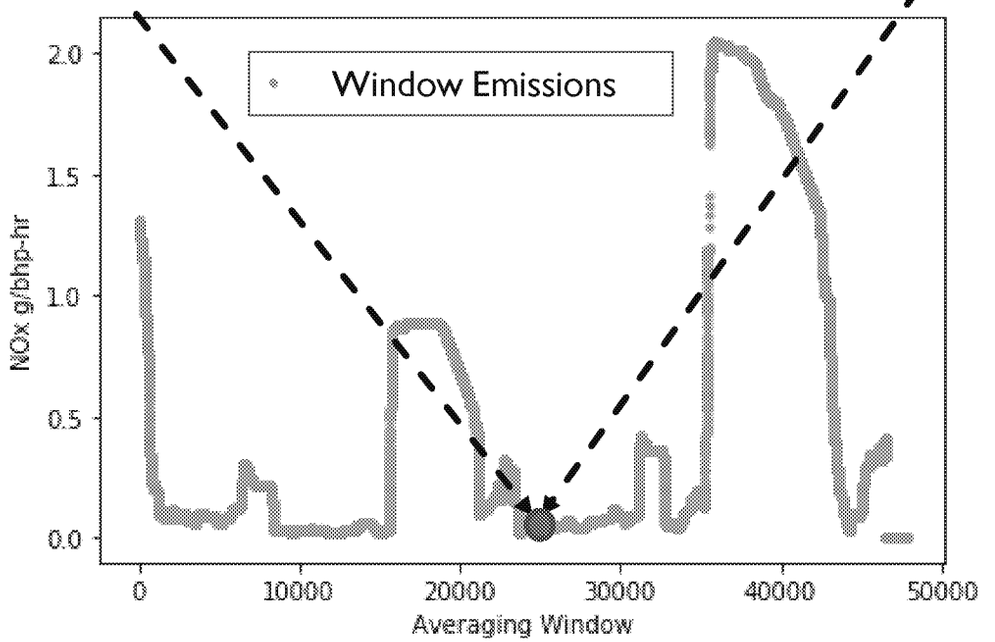
Cumulative Work [bhp-hr]

AVERAGE WINDOW EMISSIONS

- PEMS emissions from the test data collected at 1Hz (red).
- The emission rate over the reference work is averaged for each window (orange).

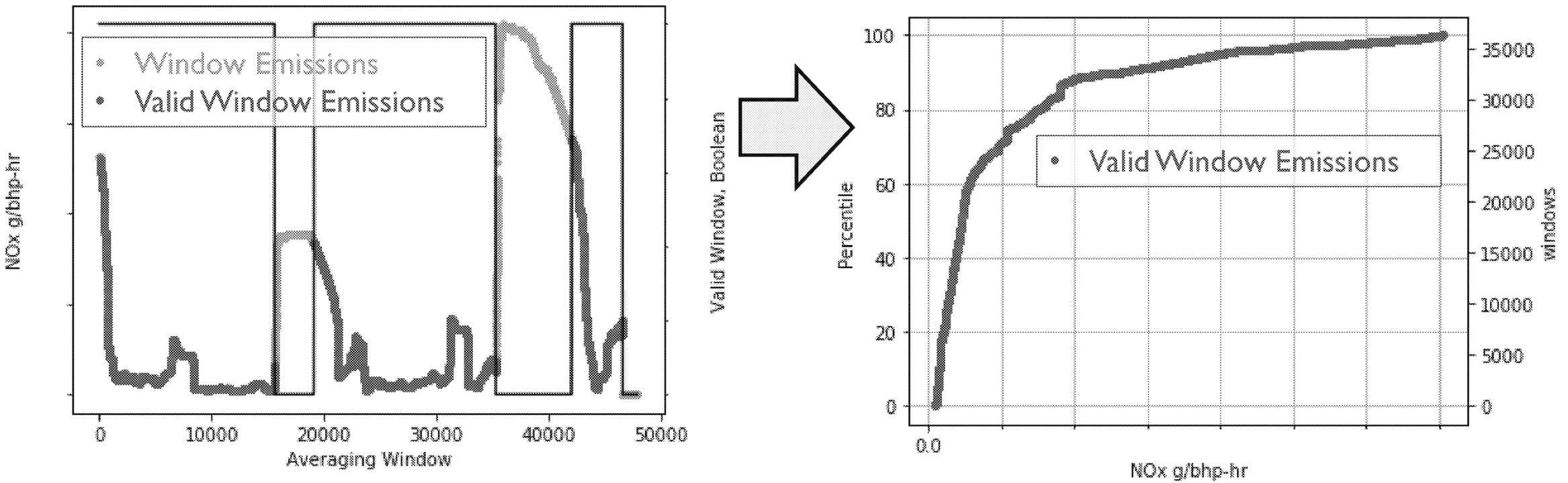






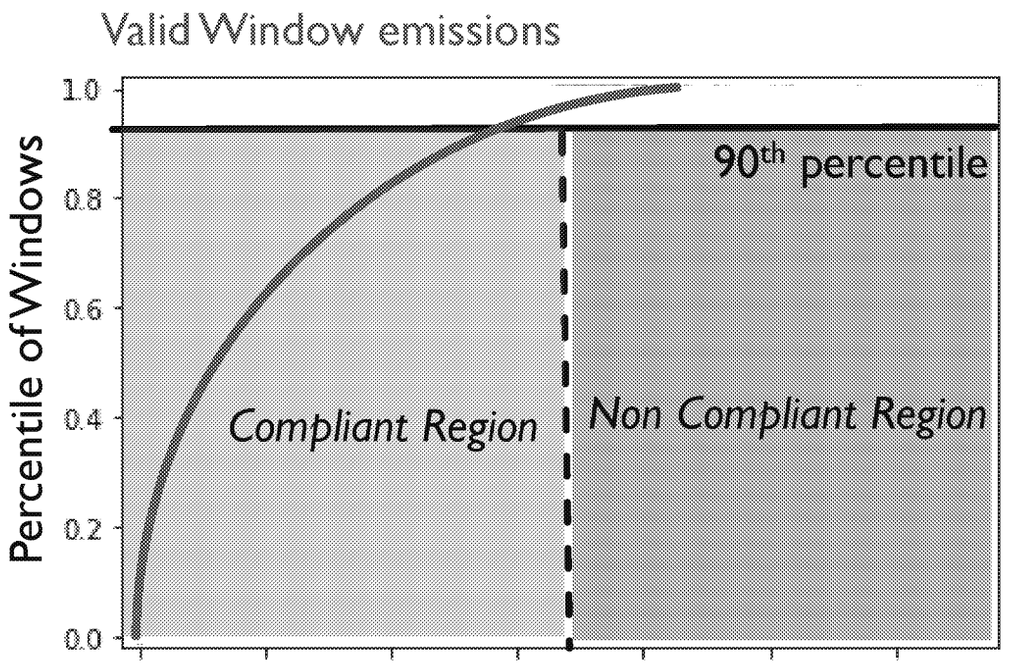
EURO VI: PREPARING DATA FOR COMPLIANCE DETERMINATION

- The average power of a window must be equal to or greater than the power threshold (10% maximum power) to be considered valid.
- The valid windows are sorted in order by emission rate.



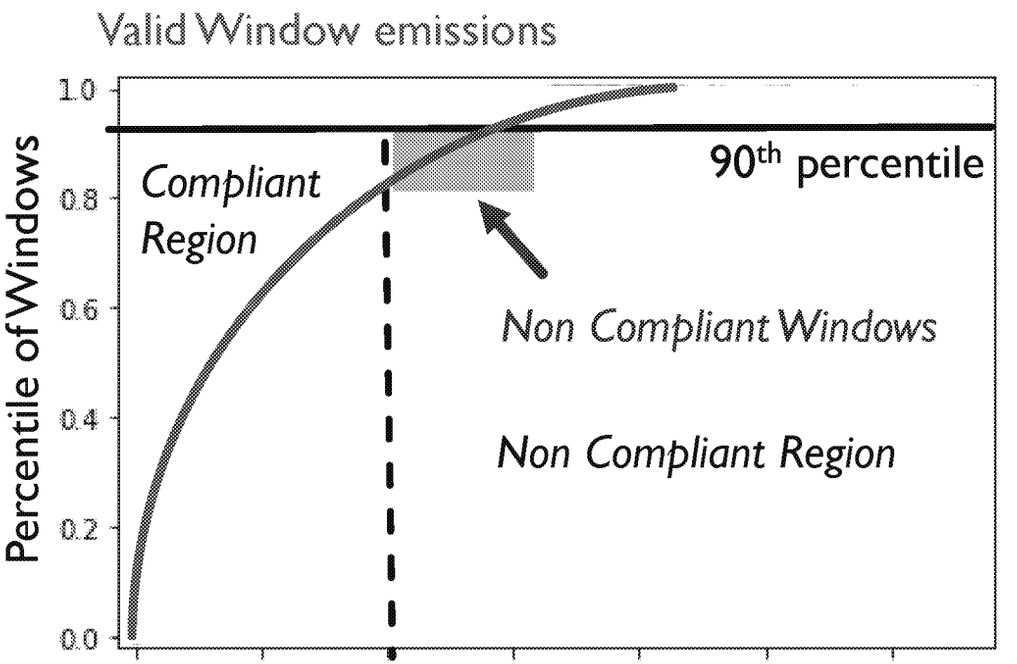
EURO VI: EU COMPLIANCE DETERMINATION

Euro VI **Compliant** Test



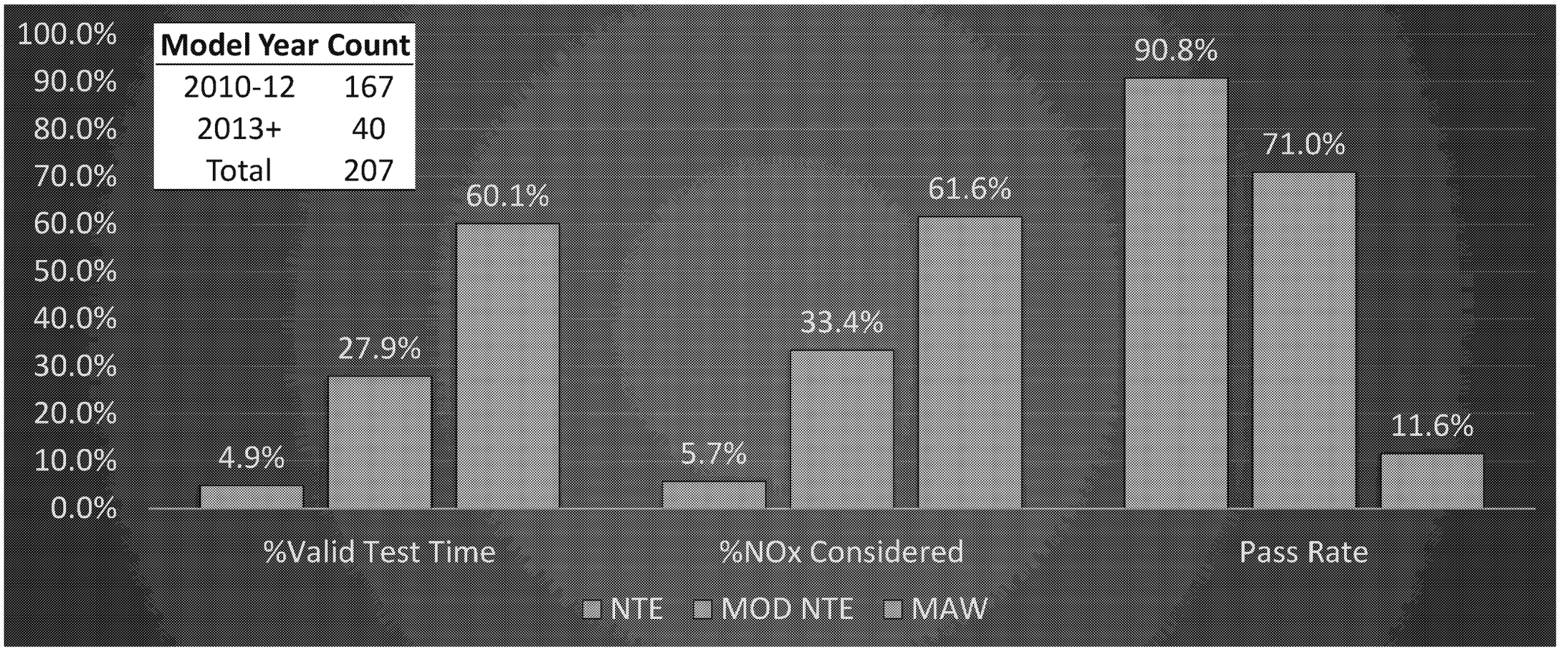
MAW Threshold = 1.5 x Std

Euro VI **Non-Compliant** Test



MAW Threshold = 1.5 x Std

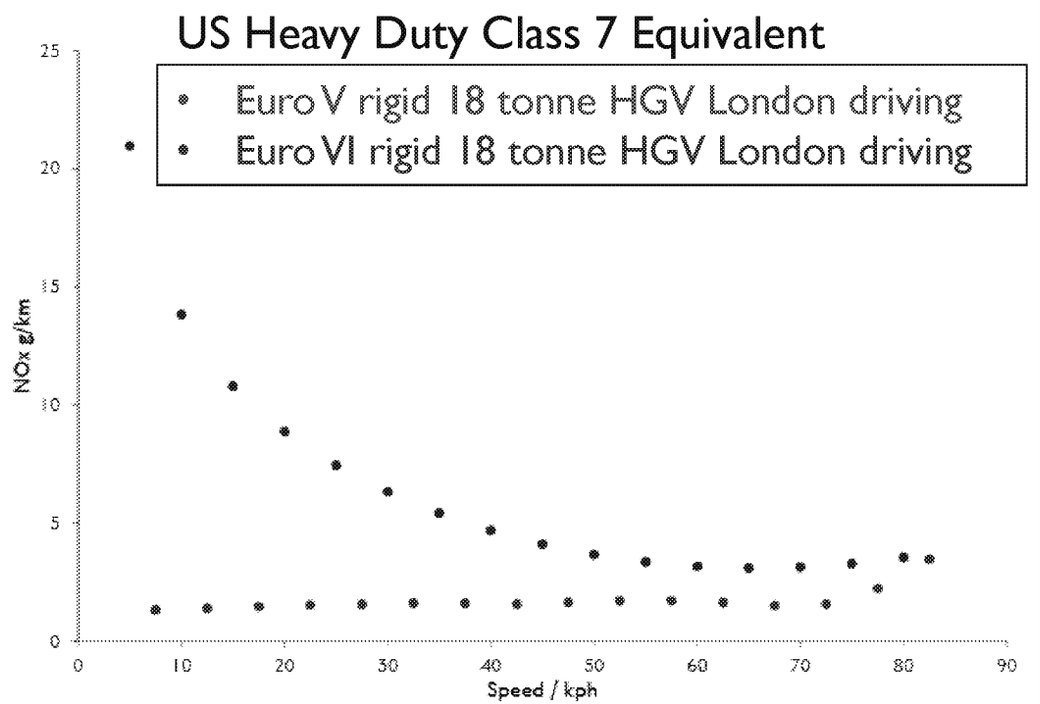
METHOD COMPARISON: MOVING AVERAGE WINDOW CAPTURES MORE OF TEST TIME AND EMISSIONS



- The Moving Average Window method is superior
- Modifying the NTE is not adequate

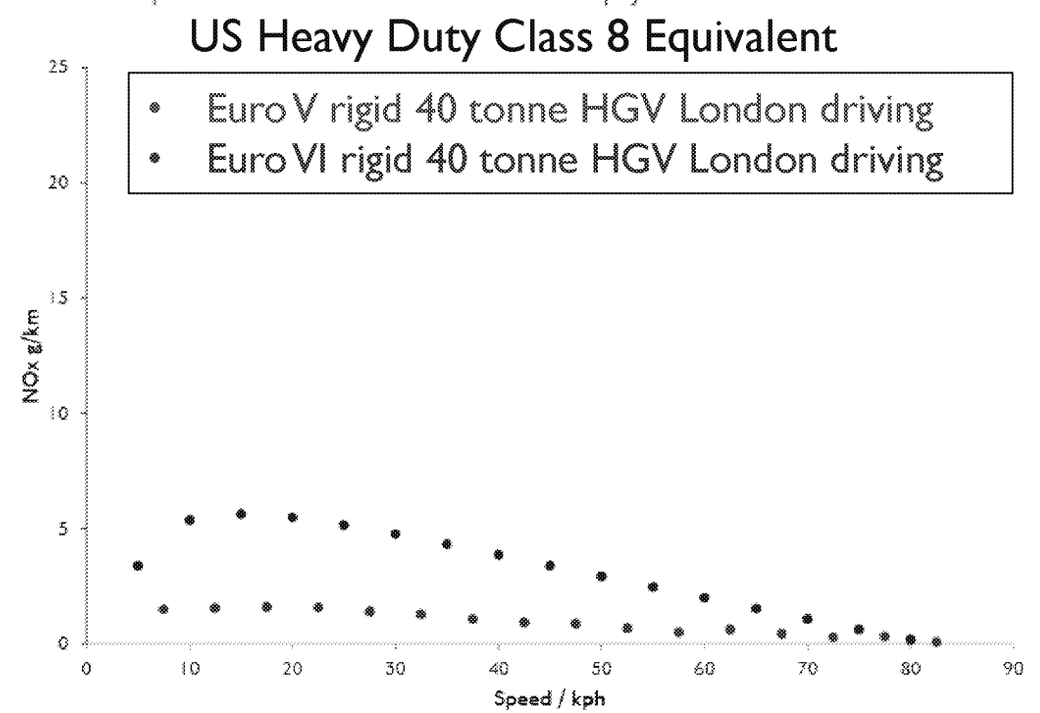
DISTANCE SPECIFIC EMISSIONS DECREASED OVER THE ENTIRE RANGE OF SPEEDS WHEN EURO VI WAS IMPLEMENTED

Figure 5 Comparison of Euro V versus Euro VI NO_x emissions over a range of road speeds: 18 tonne rigid HGV 100% payload



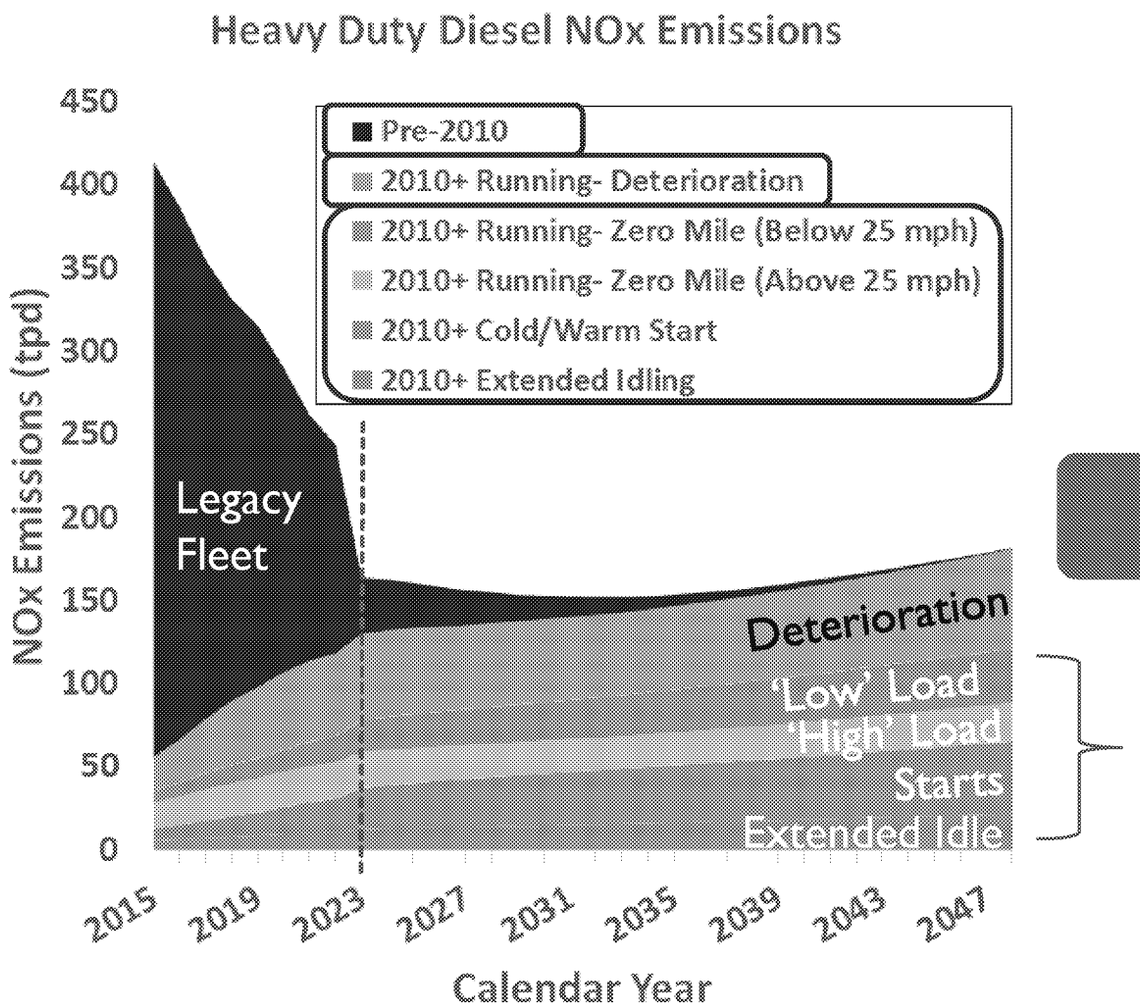
*In-service emissions of Euro 6/VI vehicles. A summary of testing using London drive cycles. Transport for London

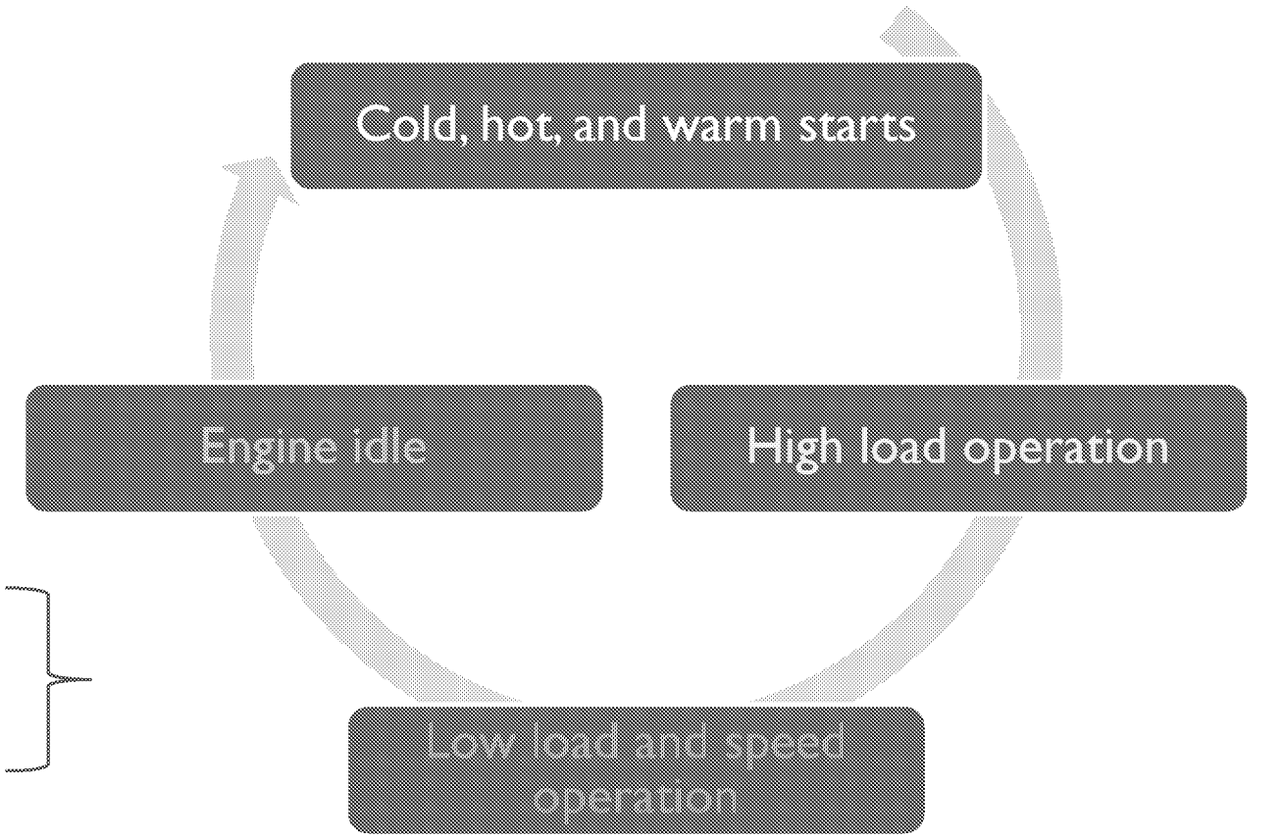
Figure 6 Comparison of Euro V versus Euro VI NOx emissions over a range of road speeds: 40 tonne articulated HGV 100% payload.



*In-service emissions of Euro 6/VI vehicles. A summary of testing using London drive cycles. Transport for London

HDIUT: PROPOSING TO MOVE TO FULL DUTY CYCLE EMISSIONS CONTROL





HDIUT: PROPOSED UPDATES AND CHANGES

- **Remove the following elements:**
  - Discard the Not-to-Exceed method, NTE control area, operation exclusions, and averaging period
  - No longer allow a PEMS accuracy margin allowance
- **Replacement and Addition Concepts:**
  - Lower power threshold for window validation: Use the Euro VI MAW method but with a window threshold power < 10% (exact threshold to be determined)
  - Size the windows based on FTP work or a fraction thereof (to be determined)
  - Require higher fraction of windows to be at or below standard: Raise percentile for pass determination to >90% (to be determined)
  - Potentially have some limits on top windows (i.e., those not required to be at or below standard)
  - Include start emissions
- **Reporting:**
  - CARB pre-approves manufacturer's HDIUT test plans
  - Data quality checklist assuring that valid and complete test data was collected prior to submittal

HDIUT: ENGINE FAMILY SELECTION AND TEST PLAN APPROVAL

- **Engine Selection**
  - CARB and EPA to continue to work together in selection of engine families for HDIUT
  - Rules for number of engine families selected annually and over a 4 year average would stay in place
- **Manufacturer test plan must be approved by CARB**
  - Test vehicle to be driven by fleet operator (manufacturer may also do testing with CARB/EPA approval)
  - Test vehicle to be driven over its regular fleet route (or CARB/EPA approved test route)
  - Season, ambient conditions, and other test conditions to be reviewed and require approval by CARB
- **Testing and Reporting Options**
  1. Use a single set of testing data but use separate analysis and reporting methods for the CARB and federal HDIUT programs
  2. Conduct separate testing and reporting to comply with federal and California HDIUT programs

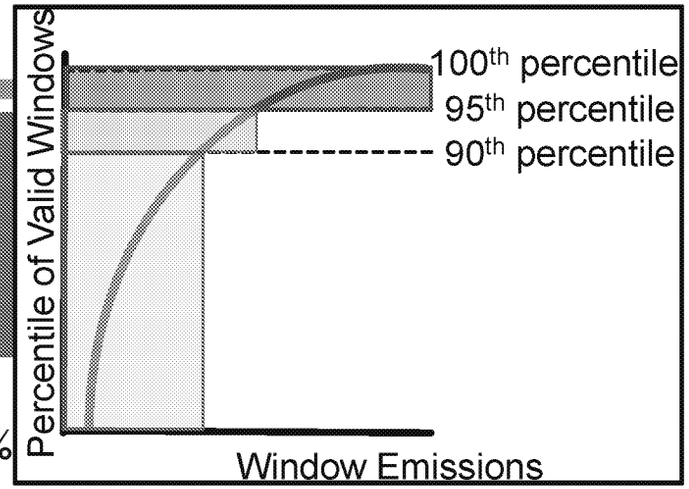
HDIUT: UPDATED AMBIENT CONDITIONS AND DATA EXCLUSIONS

- **Cold Start Requirements (if included)**
  - Test must start with a cold Engine Coolant ≤ 30°C (86°F)
- **Other Requirements**
  - *Maximum Altitude,* h ≤ 5,500 ft
  - *Minimum Ambient Temperature,* $T \geq 20$ °F
  - *Maximum Ambient Temperature,* $T \leq -.00254 * h + 100$ °F
- **PEMS QC Exclusions**
  - Data collected during the periodic instrument zero or drift checks shall not be considered

HDIUT: ANALYSIS METHOD

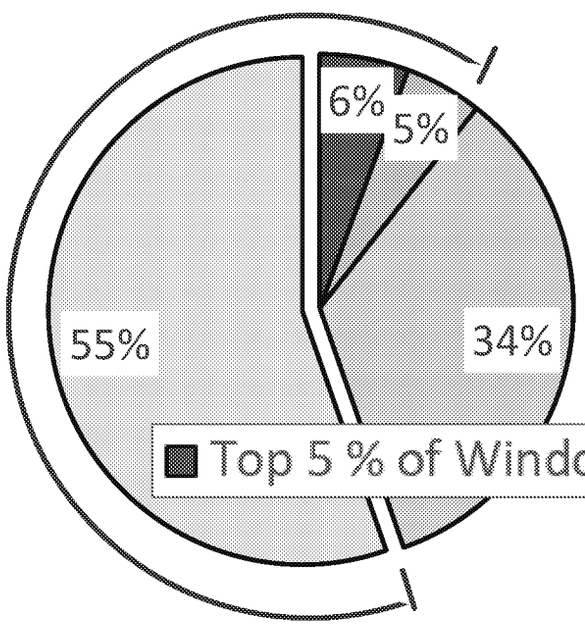
- **Emission Metrics**
  - Emissions at low loads and idle operation will require a method other than brake specific emissions
  - CO_2 and fuel specific among other metrics are being evaluated by SwRI
  - Shorter than FTP equivalent window may be needed to effectively capture low load operation behavior
- **Moving Average Windows**
  - Subsets of continuous overlapping windows
  - Increments of the collection rate, 1Hz
  - Window size based on a reference mass of CO_2 or amount of Work
  - Window average power must be greater than the threshold power to be valid (threshold power may be at idle)
  - Average brake and CO2 specific emissions of windows are reported
- **Advantages**
  - Captures emissions over the full duty cycle
  - Large averaging periods

NOX REPRESENTATION: CHANGES TO POWER THRESHOLD AND COMPLIANCE PERCENTILE

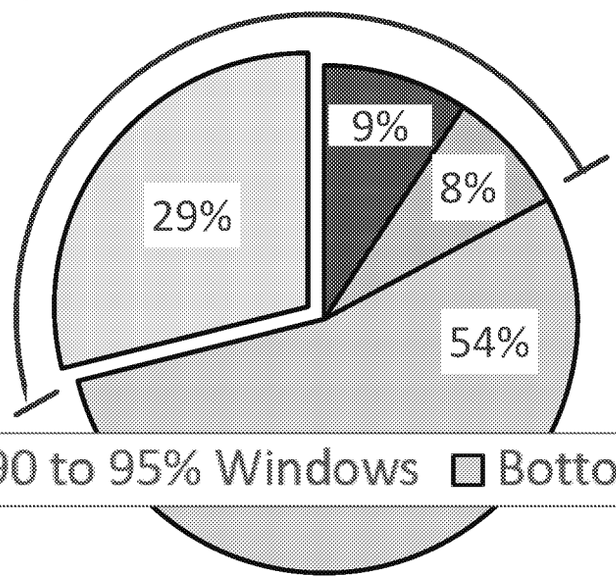


- Emissions in the top 10% of windows can contribute up to 55% of the NOx emissions of the trip
- Decreasing the power threshold to 5% would increase NOx representation in valid windows from 45% to 71%
- 5-8% NOx representation gained by moving the evaluated percentile from the 90th to the 95th

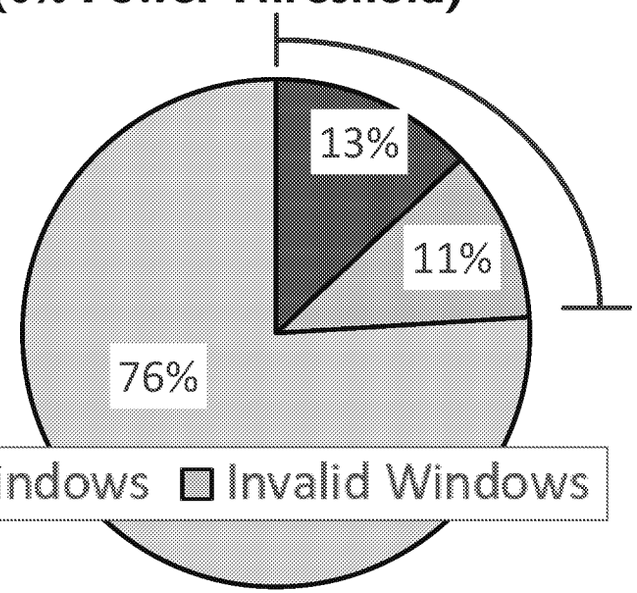
Percent of NOx emissions (10% Power Threshold)



Percent of NOx emissions (5% Power Threshold)



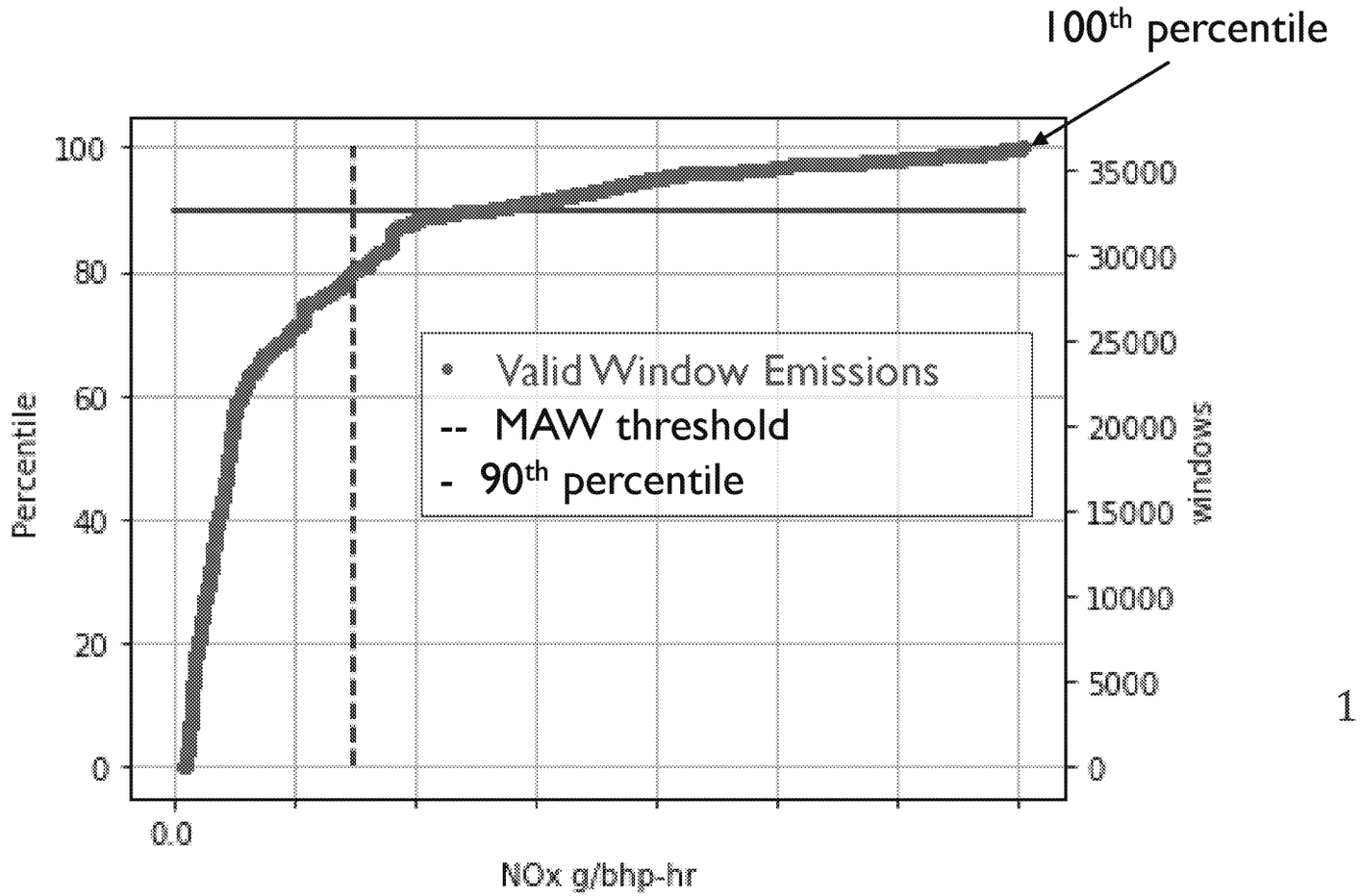
Percent of NOx emissions (0% Power Threshold)



Top 5 % of Windows | 90 to 95% Windows | Bottom 90% Windows | Invalid Windows

*This is not representative of inventory. *Data analyzed from 2010+ MY HDIUT.

HDIUT: EU CONCEPT FOR INCLUSION OF TOP 10% OF WINDOWS



- **Composite CAP**
  - **100th percentile window emissions (cold start)**
  - **90th percentile window emissions (hot running)**

$$1.5\ x\ std \geq \frac{1}{7}\left(100^{th}\ \%\right) + \frac{6}{7}\left(90^{th}\ \%\right)$$

HDIUT: FUTURE CONCEPT SUMMARY

	FUTURE CARB HDIUT
Request for testing	• EPA and CARB Requested
Engine Selection	• Max 25% engine families produced each year and 100% avg engine families over 4 year
Frequency	• Annually
Vehicle test equipment	• PEMS
Test Plan	• Mfr. Submitted for CARB approval
Driver	• Fleet driver (or manufacturer with prior CARB/EPA approval)
Route	• Regular fleet route – full test day (or manufacturer with prior CARB/EPA approval)
Method	• Moving Average Window (MAW)
Exclusions	• ambient, zero check
Window Validity	• $Pwr_{avg} \geq 10\%\ Pwr_{max}$ Include operation less than $10\%\ P_{max}$ Include Start emissions (cold, warm, and hot)
Emissions	• Work or CO2 specific (may include SWRI alternative)
In Use Thresholds	• 1.5 x Std.
Pass Determination	• 90th percentile emissions (or higher) below In Use Threshold • Control highest 10% and invalid windows

Color Key

*Current CFR and CCR
* Borrowed from Euro VI
* CARB proposed additions

PROVISIONS FOR CARB HEAVY DUTY IN-USE COMPLIANCE (HDIUC) PROGRAM (13 CCR 2136-2140)

- CARB to routinely conduct HDIUC testing for compliance
- CARB will utilize a state driver instead of a fleet driver
- CARB will choose appropriate routes for compliance determination
- Addition of chassis dynamometer compliance testing
  - Ramped Modal Cycle (RMC) cycle used to determine compliance
    - Steady-state operation of the RMC provides good correlation to engine dyno testing
  - Ensures compliance with certification emission standards, not HDIUT thresholds

NOx Credits -
Averaging Banking and Trading (ABT) Program

CREDITS – TRANSITION TO A CALIFORNIA BANK OF NOx CREDITS

- Currently, only a national HD ABT program
  (only one pool of credits for both CA and EPA)
- California NOx emissions standards would require a separate credit pool from the existing federal pool
- CA would allow manufacturers to transfer a portion of their national NOx credits into a CA credit account, based on 5-yr average percentage of CA engine sales for each primary intended service class
- After transferring a portion of their pre-2023 credits into CA-only NOx credit account in 2023 MY, manufacturers would track CA and EPA NOx credits separately

CA NOx CREDIT ACCOUNT CONCEPT

- **All NOx credits transferred to CA credit account would expire in 5 years (similar to Phase 2 GHG credit program)**
  - Currently, there is no expiration of accumulated credits - some existing credits have been generated over a decade ago
- **In addition to Phase 2 GHG credits, zero emission powertrains (ZEPs) would also produce CA NOx credits with a credit multiplier**
  - Multiplier = 2
  - ZEPs credit multiplier would be significantly reduced or sunset post 2030
- **Credits are expected to play an important role in the transition to the 0.0x NOx standard**

ABT CALCULATION

- **Credits are calculated for each engine family using the following equation:**

$$\boldsymbol{Emission\ Credits = (Std\ - FEL) \times CF\ \times UL \times Sales\ Volume \times 10^{-6}}$$

Where:

Emission credits/debits for each engine family (Mg)

Std = Applicable Emissions Standard (g/bhp-hr)

FEL = Applicable Family Emission Limit (g/bhp-hr)

CF = Transient Cycle Conversion factor (bhp-hr/mile)

UL = Useful life for the engine family (miles)

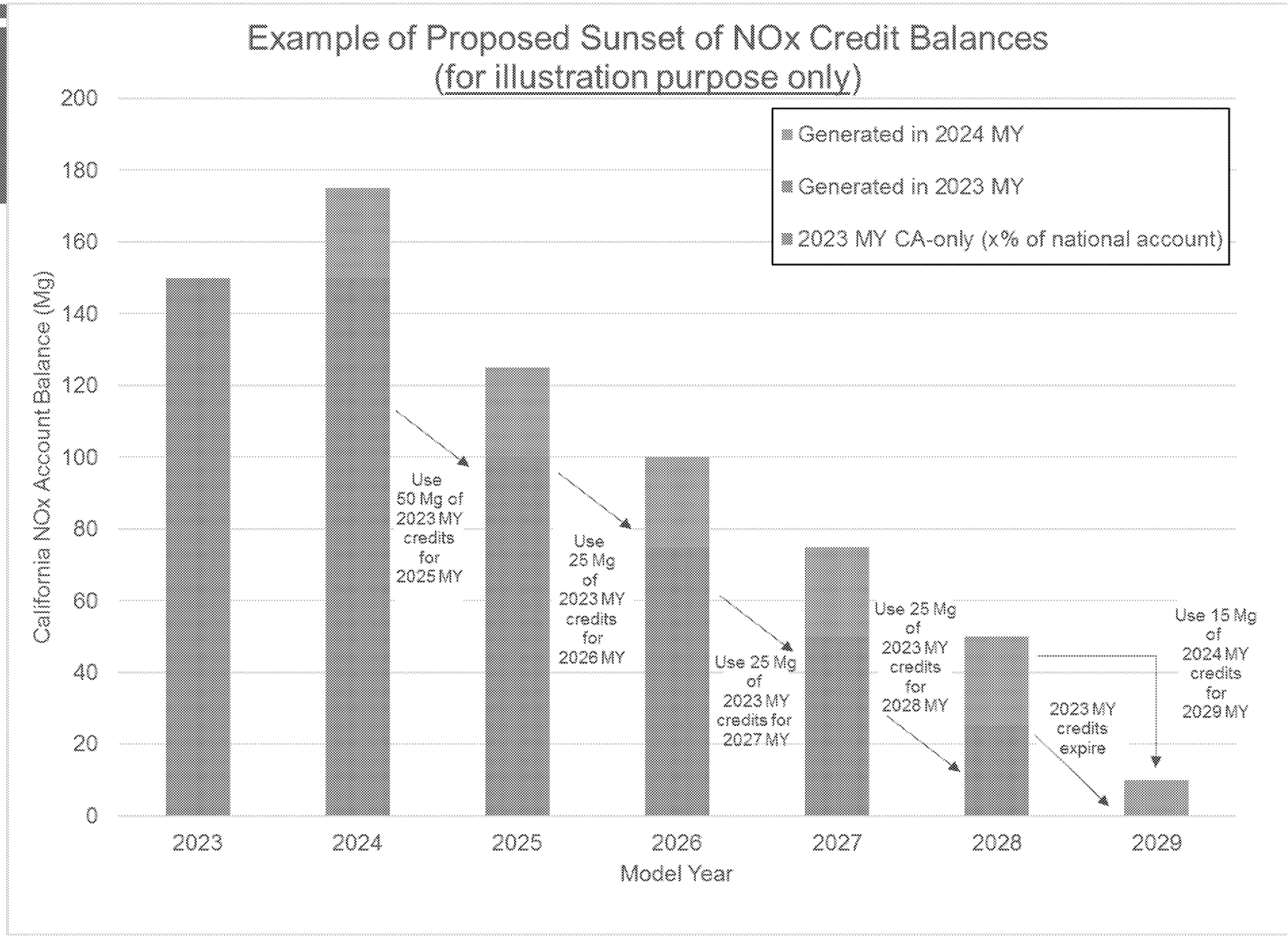
Note – UL extension would result in discounting of existing credits

EXAMPLE OF CREATING CA BANK OF CREDITS

- A manufacturer has accumulated 1,000 Mg of NOx credits through 2022 MY at the national level for HHDD engines
- Average 5-year (2018-2022 MY) CA sales is 10% of 50-state sales
- At the beginning of 2023 MY, CA-NOx account balance would be established by transferring 1000 x 10% = 100 Mg of NOx credits from national bank to CA bank (900 Mg remains in EPA account)
- These NOx credits can be used to certify engines up to the FEL cap for 2023 and subsequent model years
- Example of certifying to an FEL using credits (in 2023+MY) :

$$100 = \sum_{EF=1}^{n} |(0.0x - FEL_{EF})| \times CF_{EF} \times UL_{EF} \times 10^{-6} \times CA\ Sales_{EF}$$

- Where EF represents the engine families in the HHDD primary intended service class
- The California sales volume would be dependent on the FEL selected (up to the FEL cap) and the UL requirement


Example of Proposed Sunset of NOx Credit Balances
(for illustration purpose only)
Generated in 2024 MY
Generated in 2023 MY
2023 MY CA-only (x% of national account)
California NOx Account Balance (Mg)
200
180
160
140
120
100
80
60
40
20
0
2023
2024
2025
2026
2027
2028
2029
Model Year
Use 50 Mg of 2023 MY credits for 2025 MY
Use 25 Mg of 2023 MY credits for 2026 MY
Use 25 Mg of 2023 MY credits for 2027 MY
Use 25 Mg of 2023 MY credits for 2028 MY
2023 MY credits expire
Use 15 Mg of 2024 MY credits for 2029 MY

Credits – NOx Credits for Zero Emission Powertrains (ZEPs)

ZEP MUST BE CERTIFIED TO BE ELIGIBLE FOR ENGINE NOx CREDITS

- **ZEP certification planned to go to Board late 2018**

- **Current Draft Proposal**
  - Applies to battery-electric and fuel-cell electric powertrains to be used in MY 2019+ medium- and heavy-duty vehicles (8501 lbs GVWR+)
  - For more information on ZEP Certification:

    David Eiges, Lead Staff

    Phone: 626-575-6602

    Email: david.eiges@arb.ca.gov

CURRENT ZEP DRAFT PROPOSED CERTIFICATION REQUIREMENTS ADDRESS PERFORMANCE

- Standardized battery capacity testing
  - SAE J1798
- System monitoring and diagnostics
- Warranty
  - 3year/50,000 mile
- Sales Disclaimer Statement
  - Considerations when buying vehicle with ZEP (e.g., range, charging infrastructure…)

ZEP NOx CREDITS

- **Credits are earned at the end of the model year and maintained and reported separately**
- **Credits may be banked for five years after the model year in which they are earned**
- **Banked credits may only be used in the averaging set in which they were generated**
  - 4 Engine Averaging sets
    - Medium-Duty and Light Heavy-Duty CI Engines (CI 3-5)
    - Medium Heavy-Duty CI engines (CI 6-7)
    - Heavy Heavy-Duty CI Engines (CI 8)
    - Medium-Duty and Heavy-Duty Spark Ignited Engines

ZEP NOx CREDIT EQUATION

- **Emission rate of ZEP = 0.0, so benefit is proportional to emission standard of engine it is replacing**

$$\textit{ZEP NOx Emission Credits (Mg)} = (Std) \times (CF) \times (Sales\_Volume) \times (UL) \times 10^{-6} \times Multiplier$$

- Std = NOx emission standard of engine subcategory ZEP is replacing (e.g., ~0.0x g NOx /bhp-hr)
- CF = Transient cycle conversion factor, total integrated hp-hr over test cycle divided by distance traveled during test (miles)
- Sales Volume = CA directed production volume of ZEP
- UL = Useful life of vehicle class (e.g., 435K miles for HHDD, 185K miles for MHDD, 110K miles for LHDD)
- Multiplier = 2

DISCUSSION ISSUES

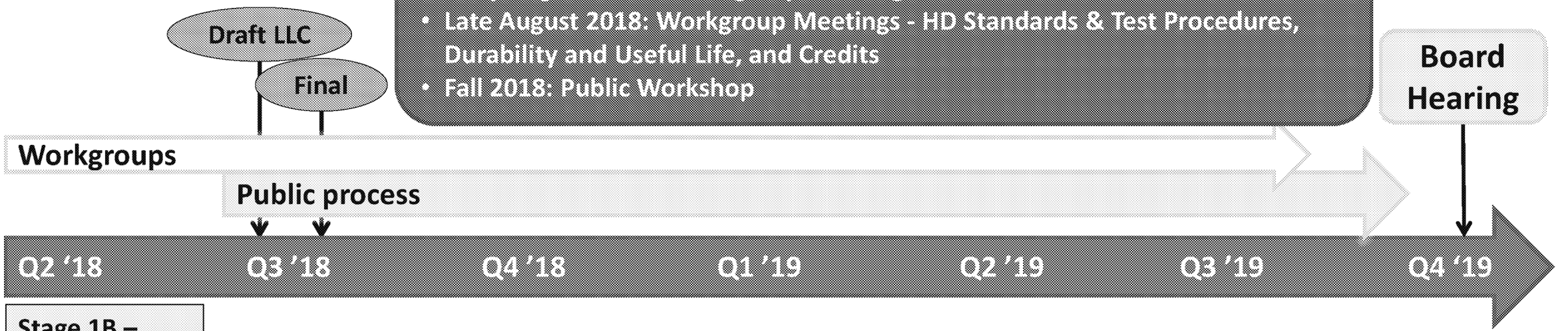
- Factors to consider when setting the ZEP NOx credit multiplier
  - Need to balance ZEP technology advancement needs with near-term air quality needs
  - Credit caps may be needed
  - Sunset multiplier (post -2030)
  - Should credit multiplier be adjusted by "utility factor" representing the ratio of ZEP range (e.g., miles/day) to average range of comparable conventional vehicle
- Should the "useful life" of a ZEP vehicle used in the credit equation be equivalent to the useful life of the diesel vehicle it replaces?

Next Steps

UPCOMING MILESTONES

Upcoming Meetings:

- August 2018: SWRI Advisory Groups re: Stage 1b & 2, low load cycle (LLC)
- Early August 2018: Workgroup Meetings – HDIUT and Credits
- Late August 2018: Workgroup Meetings - HD Standards & Test Procedures, Durability and Useful Life, and Credits
- Fall 2018: Public Workshop



Stage 1B – Re-age parts

Stage 2 – Develop/assess LLC

Stage 3 – Demonstrate low NOx on 2nd engine without turbocompound, including LLC

Stage 3b – Explore additional engine hardware options that can simultaneously reduce NOx and GHG on stage 3 engine – cylinder deactivation, turbine bypass, charge air cooler bypass & EGR cooler bypass

NREL On-Road Heavy-Duty Low-NOx Technology Cost Study

CONTACTS

Kim Heroy-Rogalski, Chief
Mobile Source Regulatory Development Branch
(916) 327-2200
kim.heroy-rogalski@arb.ca.gov

William H. Robertson, Ph.D. ,
Vehicle Program Specialist,
Mobile Source Control Division
(626) 459-4467
bill.robertson@arb.ca.gov

Stephan Lemieux
Manager, On-Road Heavy-Duty Diesel Section
(626) 450-6162
stephan.lemieux@arb.ca.gov

Daniel Hawelti
Staff APS, On-Road Heavy-Duty Diesel Section
(626) 450-6149
daniel.hawelti@arb.ca.gov

Appointment

From: Heltzel Robert [robert.heltzel@volvo.com]
Sent: 5/8/2018 1:10:23 PM
To: Heltzel Robert [robert.heltzel@volvo.com]; Sanchez, James [sanchez.james@epa.gov]; Laroo, Chris [laroo.chris@epa.gov]
CC: Clark Taylor [taylor.clark@volvo.com]; Marley Jeffrey [jeff.marley@volvo.com]

Subject: Part 86 In-Use Testing Question
Attachments: HDIUT_NTE_EPA_050918.pptx
Location: Skype Meeting

Start: 5/9/2018 2:00:00 PM
End: 5/9/2018 2:30:00 PM
Show Time As: Busy

Recurrence: (none)

Meeting to Discuss NTE Evaluation as discussed.

→ Join Skype Meeting

Trouble Joining? Try Skype Web App

Join by phone

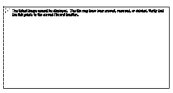
Ex. 6 - Personal Privacy (USA, Toll free - USA Only) English (United States)
Find a local number
Conference ID: Ex. 6 - Personal Privacy
Forgot your dial-in PIN? | Help

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Tuesday, May 08, 2018 8:23 AM
To: Laroo, Chris; Heltzel Robert
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question
9 doesn't work for me but 10 or 11 do.

James
From: Laroo, Chris
Sent: Tuesday, May 08, 2018 8:22 AM
To: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Marley Jeffrey <jeff.marley@volvo.com>
Subject: Re: Part 86 In-Use Testing Question

Ok. Just set it up for either 9 am, 10, or 11.

Chris



From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Tuesday, May 8, 2018 8:12 AM
To: Laroo, Chris; Sanchez, James

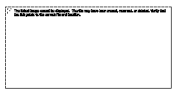
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question
Chris,
That will work for us here. Would you like to set up a WebEx or Skype meeting so that we could share some information with you? The meeting should not take long.
Thanks,

Rob
From: Laroo, Chris [mailto:laroo.chris@epa.gov]
Sent: Tuesday, May 08, 2018 6:58 AM
To: Heltzel Robert; Sanchez, James
Cc: Clark Taylor; Marley Jeffrey
Subject: Re: Part 86 In-Use Testing Question

Rob,

I have time on Wednesday. Would something in the morning work for you?

Chris



From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Monday, May 7, 2018 4:05 PM
To: Sanchez, James; Laroo, Chris
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question
James and Chris,

Would you gentlemen have some time this week to review a quick analysis of NTE event evaluation based on our previous conversations?
Thanks,
Rob
From: Clark Taylor
Sent: Monday, April 16, 2018 8:31 AM
To: Sanchez, James; Laroo, Chris
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question
James,
Thank you very much for the quick response on this.
Best regards,
Taylor

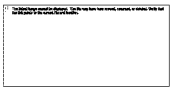
Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA
Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com
From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question
Clark,

86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.
Regards,
James
From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris



From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question
Hi Chris,
Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.
Please let me know when would be best to call.
Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA
Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com
This email message and any attachments may contain confidential information and may be privileged. If you are not the intended recipient or otherwise not authorized to receive this message, you are prohibited to use, copy, disclose or take any action based on this email or any information contained herein. If you are not the intended recipient, please advise the sender immediately by replying to this email and permanently delete this message and any attachments from your system.

Message

From: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
Sent: 9/10/2018 9:55:11 PM
To: Tasik Karl [karl.tasik@volvo.com]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Clark Taylor [taylor.clark@volvo.com]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Lemieux, Stephan@ARB [stephan.lemieux@arb.ca.gov]; Robertson, Bill@ARB [bill.robertson@arb.ca.gov]; Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]; Pryor, Kimberly@ARB [Kim.Pryor@arb.ca.gov]
Subject: RE: Volvo Response - 2016 In-Use Test Order Questions

Dear Karl,

The California Air Resources Board (CARB) does not agree that engine manufacturers, who are subject to perform Manufacturer-Run In-Use Testing for Heavy-Duty engines (HDIUT) according to 40 CFR 86 Subpart T, can arbitrarily and selectively exclude or include any not-to-exceed (NTE) data collected when catalytic aftertreatment temperatures (AT Ts) are less than 250 °C with respect to the status of NTE events, that is, depending on whether those are emissions passing or failing events, for the determination of the vehicle-pass ratio. CARB's interpretation of the paragraph, 40 CFR 86.1370(g) and (h), for data exclusion/inclusion with respect to AT Ts below 250 °C, based on a good engineering judgment, is that Volvo should not include any HDIUT NTE data collected while AT Ts were below 250 °C for Test ID# VPT1824863 because Volvo excluded all HDIUT NTE data collected while AT Ts were below 250 °C for Test ID# VPT182458, for the same engine family. Please reprocess the HDIUT data for Test ID# VPT182483 according to our interpretation above, that is, excluding all data collected while AT Ts were below 250 °C, and resubmit the reprocessed data for CARB's examination. Failure to properly analyze and submit NTE emissions data may be considered noncompliance with Volvo's test order.

In follow-up, if Volvo chooses to include any HDIUT NTE data collected while AT Ts were below 250 °C, Volvo must specify an AT T threshold below 250 °C, and universally include any HDIUT NTE data collected while AT Ts were between the specified AT T threshold and 250 °C regardless of the emissions passing or failing status of the NTE events and regardless of test vehicles for the same engine family, for the determination of the vehicle-pass ratio. That is, if Volvo chooses to include some HDIUT NTE data collected while AT Ts were at or higher than for a certain Volvo specified AT T threshold temperature for Test ID# VPT182458, Volvo must include all HDIUT NTE data collected while AT Ts were at or above that certain AT T threshold temperature Volvo specifies for the determination of the vehicle-pass ratio, regardless of the emissions passing or failing status of the NTE events, and must apply the same AT T threshold to all test data for all test vehicles for the same engine family. If Volvo chooses this option described and explained above in this paragraph, please specify the AT T threshold and report the specified AT T threshold to CARB, and reprocess the HDIUT data for all test vehicle with including all HDIUT NTE data collected with their AT Ts above the specified AT T threshold, and resubmit the reprocessed data for all tests for CARB's examination. CARB believes this practice follows good engineering judgement. Going forward, CARB will specify that manufacturers must declare in writing prior to testing any engine families where they intend to include NTE events below 250 °C and the OEM specified AT T thresholds for those families.

For your information, CARB staff will present this interpretation of 40 CFR 86.1370(g) and (h) at the EMTC meeting.

If you want to have further discussions about CARB's good engineering judgment interpretation and practice of 40 CFR 86.1370(g) and (h), CARB is willing to have a meeting or a conference call with Volvo. Please let me know if Volvo wants to have any further discussions.

If you have any questions, please do not hesitate to contact me or Mr. Keith A. Macias, Manager, In-Use Compliance and Evaluation Section, at (626) 575-6600.

Sincerely,
Abraham

CALIFORNIA
AIR RESOURCES BOARD

Abraham D Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
ECARS Division
Tel: 626-350-6543
abraham.lee@arb.ca.gov

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From: Lee, Abraham@ARB
Sent: Wednesday, August 8, 2018 8:07 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Clark Taylor <taylor.clark@volvo.com>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; Lemieux, Stephan@ARB <stephan.lemieux@arb.ca.gov>; Robertson, Bill@ARB <bill.robertson@arb.ca.gov>
Subject: RE: Volvo Response - 2016 In-Use Test Order Questions

Thanks, Karl.

CARB will discuss about Volvo's interpretation and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Tuesday, August 7, 2018 7:07 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>; Hamady, Fakhri <hamady.fakhri@epa.gov>; Clark Taylor <taylor.clark@volvo.com>
Subject: Volvo Response - 2016 In-Use Test Order Questions

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Abraham,

The following is the Volvo response to your attached July 16, 2018 question.

> For Test ID# VPT182483,
> In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
>
> > Volvo July 21, 2018 Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.
> >
> > > We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to? Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez? In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.
> > >
> > > > Volvo Response: The origin of this interpretation traces back to an EMA/Agencies (EPA & ARB)/Suppliers meeting at EPA in Ann Arbor, MI on July 15, 2014. It was at this meeting where Chris Laroo of EPA announced that the low temperature exclusions are something they do not like but reluctantly accept. Therefore, in order to incentivize low temperature emissions control, the regulators' position was to use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass. The October 2016 amendment included a language change in the CFR Part 86.1370 which states that "you may exclude emission data". Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the amendment. Volvo has recently confirmed with Chris Laroo and James Sanchez that this interpretation is correct. They stated "*86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well*" and that " *A manufacturer can choose to include or exclude any invalid NTE event during a test*". Dr. Hamady was not involved in the discussion; however, he has reviewed the test order. In the future Volvo intends to include ARB on discussions regarding interpretation.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774

E-mail: karl.tasik@volvo.com

CFR Citation
§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1370-2007(g) which is now §1036.420(a)
§86.1370-2007(g) which is now §1036.515(h)(3)

§86.1370-2007(g) which is now §1036.515(h)(3)

§86.1370-2007(g) which is now §1036.515(h)(3)
§86.1910(g) - which is now §1036.415(g)
§86.1912(a) - which is now 1036.425(c)
86.1905(a)(1) which is now 1036.405(a)(1)

§86.1370-2007 (d)(3) which is now 1036.420(b)
§86.1920(b) which is now 1036.440(b)
§86.1910(j) which is now 1036.415(j)

EMA Comment

EMA Letter Dated February 3, 2012

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only specific exhaust species that are reduced by the aftertreatment device at issue. For example, engine with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emisison species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

EMA Letter Dated December 14, 2012

(1) This request is a repeat of what is in the letter dated 2/3/12 and has been addressed via items i - v above.
(2) EMA would like EPA to allow, at the manufacturer's option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events is recorded.
(3) Part 86 does not give guidance on how to address crankcase emissions with respect to in-use PM emissions if the crankcase is vented to the atmosphere. EMA requests that EPA add that every PM NTE emission value have 0.00042 g/hp-hr added to it. This value was agreed upon as the means to account for blow-by emissions in the PM-PEMS Measurement Allowance Determination program.
(4) Recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. EMA requests that in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing.

(5) In order to increase NTE yield, EMA would like use NTE events which are only partially sampled because the analyzer was zeroing at the start of the event.
(6) Under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things currently stand, manufacturers have felt it necessary to suspend testing so that data colelection and results could be tablulated, analyzed, and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufactuers able to resume and complete their pending field work. Instead the final in-use testing reports should suffice, since they contain all of the relevant data in a duly complied and sumarized format.
(7) EMA requests that in-use PM measurement not be required for future in-use tests. The reasoning given is that data collection to date makes it clear that as long as the DPF is not cracked, PM emissions will be well below the NTE limit. EMA cites that 86.1910(j) states that manufacturers may ask EPA to waive measurement of particular emissions if they can show that in-use testing for such emissions is not necessary. Based on data collected, EMA believes that 86.1910(j) should be invoked across the board for all engine manufactuers to eliminate in-use PM measurement.

EPA Response 7/15/14
EPA agrees with this and will revise §1036.515(h)(3) using language similar to what was used in §1042.515 as the basis, which separates the exclusions based on catalyst function.
EPA will add CO to §1036.515(h)(3), but we will not add PM. We are not aware of any aftertreatment technology used on HD highway engines where catalyst temperature would effect PM emission levels.
EPA recognizes that there is no continuous, real time parameter that defines the beginning and end of an NTE event. We agree that the period of the event is not defined until it has reached the end, as determined by speed and load. We agree that emissions impacted by the exhaust gas temperature dropping below 250°C should be reported, however that NTE event should not be included in calcuation of the vehicle pass ratio for the affected pollutant. 1036.515(h)(3) already makes it optional to exclude data when aftertreatment temperatures don't meet specifications.
EPA agrees that the temperature should be measured throughout the entire NTE event. If that temperature falls below 250°C at any point during the event, then the NTE should be excluded from the pass ratio calculation. EPA has made a change to 1036.515(h)(3)(i) and (ii) to reflect this.

EPA agrees that the regulations could use some additional detail on how to handle temperature measurments for systems with multiple devices. EPA has added a new 1036.515(h)(3)(iii) that is based off of EMA's included language changes to 86.1370-2007(g)(1) and (2). EPA has also added a good engineering judgment clause to provide the manufacturer added flexibility in determing the measurement location to account for the location of factory installed temperature sensors. If would be ideal if the manufacturers could, using good engineering judgment, utilize sensors and ECU calculations already installed from the factory in monitring aftertreatment temperature.

See responses above.
EPA understands EMA's concern with not always being able to predict the amount of non-idle operation for a given test vehicle. EPA has modified 1036.415(g), (h), and (i) to address EMA's request. This modificaiton has reduced the required hours of non-idle operation from 3 to 2, per the outcome of discussions between EPA and EMA.
EPA understands that this was the agreed upon value in the PM Measurment Allowance program and will add a new 1036.425(c) as the means to account for blow-by.
EPA does not request families with sales below 1500 units, unless the engine manufacturer doesn't have any families with sales of 1500 units or greater. If, in fact, an engine manufacturer determines that EPA mistakenly requested a family with sales of under 1500 units, contradicting 86.1905(a)(1), EPA will designate another engine family at the request of the engine manufacturer.

Based on experience gained to date, EPA does not believe that there will be any problems associated with initiation of measurement after the start of an NTE event. EPA also understands EMA's desire to increase NTE yield for a given shift day. EPA has added a new 1036.420(b) to address this issue.
EPA has increased the time frame on quarterly report submissions from 30 days to 45 days. We have also added in a provision to allow a request for additional time with Administrator approval.
86.1910(j) was intended to address manufacturers' requests on a case-by-case basis. Manufacturers that would like to get out of having to perform in-use PM measurement should submit the request, along with supporting data, in writing to EPA OTAQ's Compliance Division. EPA does not intend to honor the requested change at this time as we do not have enough high milage data to determine whether or not increased PM from DPFs is a problem.

Truck & Engine Manufacturers Association™
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333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

February 3, 2012

By e-Mail (spears.matt@epa.gov) and
First Class Mail

Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Proposed Technical Amendment to 40 CFR §86.1370-2007(g)

Dear Matt:

As a follow-up to my correspondence dated January 25, 2012, this letter will outline the various reasons that warrant a technical amendment to 40 CFR §86.1370-2007(g), the regulatory provision that allows for an exclusion from the NTE limits for engines equipped with NOx or NMHC-related aftertreatment devices when exhaust gas temperatures are less than 250°C. The technical amendment that EMA is proposing is intended to address a number of significant ambiguities that pertain to the current regulatory language. Specifically, the proposed technical amendment, which is attached for your reference in a red-line format, is intended to address the following issues:

(i) The current regulatory language provides an NTE limit exclusion for both NOx and NMHC even if the aftertreatment device only controls one of the two. The exclusion should be limited to only the specific exhaust species that are reduced by the aftertreatment device at issue. For example, engines with only a DOC should not be allowed to apply this NTE limit exclusion to NOx emissions.

(ii) Current engines also utilize catalytic aftertreatment devices to control CO and PM emissions, and those devices also require minimum exhaust temperatures to function properly. Accordingly, the NTE limit exclusion should be expanded to include CO and PM emissions as well.

(iii) The current regulatory language is unclear how the NTE limit exclusion is to be applied with respect to the determination of an NTE event. Is it another continuous (1 Hz) parameter that defines the beginning and end of an NTE event, or is it applied after the NTE event (beginning and end) is determined? EMA interprets it to be the later, where, if the exhaust gas temperature drops below 250°C, then the emission species (NOx, NMHC, CO, and/or PM) that are reduced by the impacted aftertreatment device are reported, but the impacted NTE event

EPA-HQ-2019-002891

may be excluded from the vehicle pass ratio calculation. If it is the former, then this exclusion would generate different NTE events for different emission species depending on which emissions are reduced by the impacted aftertreatment device.

(iv) The current regulatory language is unclear about when the exhaust gas temperature is to be measured. EMA interprets the language to require that temperature be measured continuously throughout the NTE event, and if the minimum value observed during the NTE event falls below 250°C, then the NTE limit exclusion may be used.

(v) The current regulatory language regarding the temperature measurement location(s) is unclear for systems with multiple devices, which can be in various series and parallel combinations. In the attached proposal, EMA includes different language for systems with and without branched flows.

Thank you for your attention to this matter, which we feel is suitable for inclusion (along with the several items referenced in my correspondence of January 25th) in the omnibus rulemaking package that we understand is pending with the Agency. As always, please let me know if you have any questions regarding this matter.

Very truly yours,

Timothy A. French

cc: Donald Kopinski (kopinski.donald@epamail.epa.gov)
Charles Moulis (moulis.charles@epamail.epa.gov)
Alan Stout (stout.alan@epamail.epa.gov)
Michael Samulski (samulski.michael@epa.gov)
Michael Carter (mcarter@arb.ca.gov)
Emissions Measurement Testing Committee

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~~(g) *NOX and NMHC aftertreatment warm-up*~~ (g) *Aftertreatment cold temperature operating exclusion*. For engines equipped with one or more catalytic aftertreatment devices that reduce ~~NOX or NMHC emissions, the NTE NOX and NMHC emission limits do not apply when~~regulated exhaust constituents, you may exclude the regulated exhaust constituent(s) that is (are) reduced by such aftertreatment device(s) from the vehicle pass ratio calculations for NTE events where the exhaust gas temperature is below 250 °C at any time during the NTE event. This exclusion applies only to the emissions constituent(s) that is (are) reduced by the catalytic aftertreatment device(s). The following restrictions apply to the exhaust gas temperature ~~is measured within 12 inches of the outlet of the aftertreatment device and is less the 250 °C. For multi-bed systems, it is the temperature at the outlet of the device with the maximum flow rate that determines whether the NTE limits apply.~~measurement.

(1) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the exhaust gas temperature must be measured downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed.

(2) For other aftertreatment systems where the engine exhaust is split into multiple flow paths, measure the exhaust gas temperature downstream of the most downstream aftertreatment device that controls any of the regulated exhaust constituents in the major flow path, i.e. the flow path designed to have the highest flow rate. The temperature must be measured within 12 inches of the outlet of that device's catalyst bed. If the system is designed to vary the flow split through the various paths, i.e. designed to change the major flow path during NTE events, use good engineering judgment to identify the major flow path throughout the NTE event and switch the measurement location throughout the NTE event as the major flow path switches. If the system is designed to flow equal amounts through various paths, such as a vee engine or identical parallel devices, select any one of the various paths.

(3) For testing by engine manufacturers, the exhaust gas temperature may instead be measured further upstream with the following restrictions:
(i) For aftertreatment systems that flow all engine exhaust through a single device or series of devices, the measurement must be made at a single location throughout the in-use test.
(ii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and where the flow split through the various paths is not designed to vary during NTE events, the measurement must be made at a single location on the major flow path throughout the in-use test. If the system is designed to flow equal amounts through the various paths, select any one of the various paths.
(iii) For aftertreatment systems where the engine exhaust is split into multiple flow paths and the flow split through the various paths is designed to vary during NTE events, i.e. the major flow path changes; the exhaust gas temperature must be determined from a single measurement location in each of the multiple flow paths throughout the in-use test. The exhaust gas temperature during the test must be either the maximum measured value on any of the flow paths or the measurement on the major flow path. Use good engineering judgment to identify the major flow path throughout the NTE event.

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333 West Wacker Drive, Suite 810
Chicago, Illinois 60606
Tel: (312) 929-1970 | Fax: (312) 929-1975
www.truckandenginemanufacturers.org

December 14, 2012

Via Email (spears.matt@epa.gov)
and First Class Mail

Mr. Matthew W. Spears
Center Director, Heavy-Duty Diesel Programs
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
Mail Code: ASD1
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Re: Necessary Amendments to Heavy-Duty In-Use Testing Program

Dear Matt:

I am writing to summarize the various technical amendments and revisions that need to be incorporated into the regulations relating to the manufacturer-run in-use testing program for heavy-duty vehicles and engines. We have discussed certain of these necessary amendments in prior correspondence. EMA would appreciate the Agency's prompt response on these various issues, since they threaten to frustrate the efficient implementation of the in-use testing program to the extent they remain unresolved.

1. The first set of necessary amendments relates to the low-temperature exclusions that are provided from the NTE limits under 40 CFR §§86.1370-2007(g). As we detailed in our letter to you dated February 3, 2012, amendments to that regulatory provision are needed to: (a) limit the exclusion to the specific exhaust species that is impacted by the temperature-sensitive aftertreatment device at issue; (b) expand the low-temperature exclusion to cover aftertreatment devices that impact CO and PM (in addition to the exclusions available for NOx and NMHC); (c) clarify that any NTE events that are impacted by low-temperature exclusions are not counted for purposes of calculating the 90% vehicle pass ratio; (d) clarify when the relevant exhaust temperature is to be measured during in-use testing; and (e) clarify the location(s) for measuring the relevant exhaust temperatures. Another copy of EMA's February 3rd correspondence, along with a red-line of our recommended technical amendments to section 86.1370-2007(g), are attached for your reference. Your prompt confirmation of those necessary revisions (and when and how they will be codified) would be greatly appreciated.

2. We now have several years' experience in conducting in-use testing pursuant to 40 CFR Subpart T. The experience gained over that time has revealed that it is much more difficult than originally anticipated to ensure that an in-use test will yield at least 3-hours of accumulated non-idle operation. Even when testing is carried over to a second day under 40 CFR §86.1910(g), it has often proved impractical to meet the 3-hour threshold for non-idle operation. The net result to engine manufacturers is that the in-use testing program has proved to be more time-consuming, labor intensive and costly than originally bargained for.

To ameliorate this difficult situation, EMA requests that EPA amend section 86.1910(g) to allow manufacturers, at their option, to conclude in-use testing after one full shift day, regardless of the number of accumulated hours of non-idle operation, so long as one or more valid NTE events have been recorded. Manufacturers would still carefully screen the test vehicles to try to ensure that at least 3 hours of non-idle operation would be captured in-use, but would have the flexibility, at their option (and risk), to conclude the in-use testing after one full shift day if, for unanticipated reasons, the 3 hours of non-idle operation were not obtained.

In sum, practice has shown that the threshold of 3 hours of non-idle operation is far more difficult to achieve than originally anticipated. Manufacturers should not have to bear all of the costs stemming from that original misperception. The proposed amendment is therefore necessary to restore the relative costs of the in-use testing program to the range that was originally bargained for.

3. The regulations do not codify the agreed upon treatment of crankcase emissions for the purposes of in-use testing. To the contrary, the only memorialization of the parties' agreement of how to account for "blow-by" emissions (specifically, by adding a factor of 0.00042 g/bhp-hr to every NTE emission value if the crankcase is vented to the atmosphere) is contained in Appendix B to the Final Report of the PM-PEMS Measurement Allowance Determination. The in-use testing regulations (perhaps at section 86.1912(a)) need to be amended to include the agreed upon accounting for blow-by emissions.

4. Like the accumulation of 3 hours of non-idle operation, the recruitment of vehicles from low volume engine families has proved more difficult than originally anticipated. This is compounded by the fact that the Agency has designated engine families having volumes less than 40 units. As a consequence, the time and expense that manufacturers have incurred in trying to recruit vehicles from such low-volume engine families have been excessive and disproportionate. Accordingly, in cases where EPA selects an engine family that turns out to have less than 1500 in unit sales, the engine manufacturer should have the option to request that EPA designate a different engine family for in-use testing, without first having to incur time and "good faith" efforts trying to track down such a truly negligible number of vehicles. The operative regulations should be amended to include this needed flexibility.

5. During the meetings that led to the development of the in-use measurement allowances, it was agreed that the PEMS used to measure gaseous emissions would be permitted to engage in "zeroing" during in-use testing. It was also agreed that when the PEMS had completed their "zeroing" processes, they would be programmed to wait until the start of the

next NTE event before reinitiating the sampling and calculation of in-use emissions. This was a somewhat arbitrary decision made to avoid the potential need to research the effects of the initiation of emissions sampling and calculation in the midst of an NTE event.

Since that time, PM PEMS have been developed and deployed that generally have the capacity to record markedly fewer NTE events than do gaseous PEMS. This is especially the case with respect to quartz crystal technologies. In addition, the accumulated experience of in-use testing has demonstrated that there are not likely to be any significant problems associated with the initiation of in-use measurements after the commencement of an NTE event. Accordingly, in order to increase the yield of NTE events as recorded by PM PEMS, EMA is proposing the following technical amendment to allow PEMS to start emissions sampling as soon as the PEMS returns to a state where it is ready to initiate sampling, i.e., as soon as it completes zeroing or conditioning. The specific language that we propose is as follows:

> *Section 86.1370(d)(3)(new). Emissions sampling will start as soon as the NTE zone conditions are met, except where the PEMS equipment is still engaged in zeroing or conditioning. In such a case, sampling will begin as soon as the PEMS equipment is ready. For gaseous emissions, NTE event sampling will begin at the same time for all regulated emissions when the PEMS equipment is operational.*

6. Currently, under section 86.1920(b), manufacturers are required to submit quarterly reports covering any in-use testing conducted during the calendar quarter. This quarterly reporting has proved in practice to be burdensome and counter-productive. Specifically, there are many instances where field testing may overlap the end of one calendar quarter and the beginning of another. In those instances, as things stand currently, manufacturers have felt it necessary to suspend testing so that data collection and results could be tabulated, analyzed and recorded up to the time of the quarter's end for reporting purposes. Only after completing that purely administrative function were manufacturers able to resume and complete their pending field work.

Interrupting field testing solely to accommodate quarterly reports is wasteful and counter-productive. Moreover, the preparation of quarterly reports has, like other aspects of the in-use testing program, proved to be disproportionally burdensome and time-consuming, as it involves the processing and tabulation of very large amounts of electronic files and data. Accordingly, in light of the foregoing, EPA should delete the quarterly reporting requirements under section 86.1920(b). Instead, the final in-use testing reports should suffice, since they contain all of the relevant data in a duly compiled and summarized format. Importantly, the integrity of the in-use testing program would not be impacted by the elimination of quarterly reports given the fact that manufacturers would still be required to report on any failed in-use tests within fifteen (15) days, as specified under section 86.1920(e).

7. Section 86.1910(j) provides that manufacturers "may ask [EPA] to waive measurement of particular emissions if [they] can show that in-use testing for such emissions is not necessary." As contemplated under that provision, sufficient in-use testing data have been

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collected and submitted to EPA over the past several years clearly demonstrating that in-use testing for PM and NMHC is not necessary. The levels of those emissions as they are being recorded from the engines that are subject to the in-use testing program are truly negligible, to the point of being indistinguishable from zero. Moreover, in-use testing for PM requires the use of separate PEMS, which significantly increases the cost and complexity of in-use testing.

The data collected to date also make it clear that so long as PM aftertreatment systems are in working order - - i.e., so long as the PM filters are not cracked - - PM emissions will be well below the NTE limit. In that regard, today's heavy-duty on-highway engines are equipped with comprehensive OBD systems that can readily detect malfunctioning PM filters and, in response, initiate warnings and inducements to ensure prompt repairs. Thus, the diagnostic features that are integrated into today's engine systems render in-use testing for PM emissions both unnecessary and redundant.

The net result is that the configuration of today's heavy-duty engine systems, in addition to the emissions data gathered to date that show zero-equivalent in-use emission levels, fully warrant a waiver of the in-use testing requirements for PM and NMHC. Accordingly, EPA should grant and codify such a waiver in the in-use testing regulations.

We look forward to working with you and your colleagues to implement the foregoing amendments to the heavy-duty in-use testing program as efficiently and expeditiously as possible. Accordingly, please contact me at your first convenience to coordinate our next steps.

Very truly yours,

Timothy A. French

cc: William Charmley (charmley.william@epa.gov)
Byron Bunker (bunker.byron@epa.gov)
Jed R. Mandel (jmandel@clpchicago.com)

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Subpart E—TESTING IN-USE ENGINES

Commented [CM1]: May need to adapt for GHG

§~~86.1901~~1036.401 What testing requirements apply to my engines that have gone into service?

~~(a) If you manufacture diesel heavy-duty engines above 8,500 lbs. GVWR that are subject to engine-based exhaust emission standards under this part, you must test them as described in this subpart. You must measure all emissions listed in §86.1910(d) other than PM beginning in calendar year 2005 and you must measure PM emissions beginning in calendar year 2007. See §86.1930 for special provisions that may apply to manufacturers in the early years of this program.~~

(a) If you produce compression-ignition engines that are subject to the requirements of this part, you must test them as described in this subpart. This involves testing engines installed in vehicles.

(b) We may void your certificate of conformity for an engine family if you do not meet your obligations under this subpart. We may also void individual tests and require you to retest those vehicles or take other appropriate measures in instances where you have not performed the testing in accordance with the requirements described in this subpart.

(d) Independent of your responsibility to test in-use engines, we may choose at any time to do our own testing of your in-use engines.

~~(e) In this subpart, the term "you" refers to the certificate holder for any engines subject to the requirements of this subpart.~~

~~(d) In this subpart, round means to round numbers according to NIST Special Publication 811(incorporated by reference in §86.1).~~

§~~86.1905~~1036.405 How does this program work?

(a) You must test in-use engines from the families we select. We may select the following number of engine families for testing, except as specified in paragraph (b) of this section:

(1) We may select up to 25 percent of your engine families in any calendar year, calculated by dividing the number of engine families you certified in the model year corresponding to the calendar year by four and rounding to the nearest whole number. We will consider only engine families with annual U.S.-directed production volumes above 1,500 units in calculating the number of engine families subject to testing each calendar year under the annual 25 percent engine family limit. In addition, for model year 2007 through 2009, identical engine families that are split into two subfamilies under §86.007-15(m)(9) will count as only one engine family. If you have only three or fewer families that each exceed an annual U.S.-directed production volume of 1,500 units, or if you have no engine families above this limit, we may select one engine family per calendar year for testing.

(2) Over any four-year period, we will not select more than the average number of engine families that you have certified over that four-year period (the model year when the selection is made and the preceding three model years), based on rounding the average value to the nearest whole number.

(b) If there is clear evidence of a nonconformity with regard to an engine family, we may select that engine family without counting it as a selected engine family under paragraph (a) of this section. We will consult with you in reaching a conclusion whether clear evidence of a nonconformity exists for any engine family. In general, there is clear evidence of a nonconformity regarding an engine family under this subpart in any of the following cases:

(1) The engine family was not remedied but is a carry-over from an engine family you tested under this subpart and was subsequently remedied based at least in part on the Phase 1 or Phase 2 testing outcomes described in §~~86.1915~~1036.430.

(2) The engine family was not remedied but is a carry-over from an engine family that was remedied based on an EPA in-use testing program.

(c) We may select any individual engine family for testing, regardless of its production volume, as long as we do not select more than the number of engine families described in paragraph (a) of this section. We may select an engine family from the current model year or any previous model year, except that we will not select any engine families from model years before 2007. ~~beginning in the following calendar years:~~

~~(1) 2007 for all emissions testing other than PM testing.~~

~~(2) 2011 for PM testing.~~

(d) You must complete all the required testing and reporting under this subpart within 18 months after we direct you to test a particular engine family. We will typically select engine families for testing and notify you in writing by June 30 of the applicable calendar year. You may ask for up to six months longer to complete Phase 2 testing if there is a reasonable basis for needing more time. In very unusual circumstances you may request an additional six months to complete Phase 2 testing.

(e) If you make a good-faith effort to access enough test vehicles to complete Phase 1 or Phase 2 testing requirements under this subpart for an engine family, but are unable to do so, you must ask us either to modify the testing requirements for the selected engine family or, in the case of Phase 1 testing, to select a different engine family.

(f) After you complete the in-use testing requirements for an engine family that we selected for testing in a given calendar year, we may select that same family in a later year to evaluate the engine family's compliance closer to the end of its useful life. This would count as an additional engine-family selection under paragraph (a) of this section, except as described in paragraph (b) of this section.

~~(g) For any communication related to this subpart, contact the Engine Programs Group Manager (6405-J), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.~~

§~~86.1908~~1036.410 How must I select and screen my in-use engines?

(a) Once we direct you to do testing under this subpart, you must make arrangements to select test vehicles and engines that meet the following criteria:

(1) The engines must be representative of the engine family.

(2) The usage of the vehicles must be representative of typical usage for the vehicles' particular application.

(3) The vehicles come from at least two independent sources.

(4) The key vehicle/engine systems (e.g., power train, drive train, emission control) have been properly maintained and used.

(5) The engines have not been tampered with, rebuilt or undergone major repair that could be expected to affect emissions.

(6) The engines have not been misfueled. For example, an engine may be considered misfueled if operated on a biodiesel fuel blend that is either not listed as allowed or otherwise indicated to be an unacceptable fuel in the vehicle's owner or operator manual.

(7) The engines do not have an illuminated MIL or stored OBD trouble code that lead you to reject the vehicle from the test program as described in §~~86.1910~~1036.415(b)(2).

(8) The vehicles are likely to operate for at least three hours (excluding idle) over a complete shift-day, as described in §~~86.1910~~1036.415(g).

(9) The vehicles have not exceeded the applicable useful life, in miles or years (see subpart ~~B~~A of this part); you may otherwise not exclude engines from testing based on their age or mileage.

(10) The vehicle has appropriate space for safe and proper mounting of the PEMS equipment.

(b) You must keep any records of a vehicle's maintenance and use history you obtain from the owner or operator, as required by §~~86.1925~~1036.445. You must report the engine's maintenance and use history and information related to the OBD system, as described in §~~86.1920~~1036.440.

(c) You must notify us before rejecting a candidate vehicle for reasons other than failing to meet the acceptance criteria in paragraph (a) of this section. A candidate vehicle is any prospective vehicle you have identified to potentially fulfill your testing requirements under this subpart. Include your reasons for rejecting each vehicle. If an owner declines to participate in the test program, you may reject the vehicle without prior notification. Such a rejection must be reported as described in §~~86.1920~~1036.440. We may allow you to replace the rejected vehicle with another candidate vehicle to meet your testing requirements for the specific engine family.

(d) You must report when, how, and why you reject candidate vehicles, as described in §~~86.1920~~1036.440.

§~~86.1910~~1036.415 How must I prepare and test my in-use engines?

(a) You must limit maintenance to what is in the owners manual for engines with that amount of service and age. For anything we consider an adjustable parameter (see §§86.094-21(b)(1)(ii) and 86.094-22(e)), you may adjust that parameter only if it is outside of its adjustable range. You must then set the adjustable parameter to the mid-point of its adjustable range or your recommended setting, unless we approve your request to do otherwise. You must receive permission from us before adjusting anything not considered to be an adjustable parameter. You must keep records of all maintenance and adjustments, as required by §~~86.1925~~1036.445. You must send us these records, as described in §~~86.1920~~1036.440(b)(3)(x), unless we instruct you not to send them.

(b) You may treat a vehicle with an illuminated MIL or stored trouble code as follows:

(1) If the length of MIL illumination or trouble code storage is consistent with proper maintenance and use, either test the prospective test vehicle as received or repair the vehicle before testing. If you elect to repair the vehicle/engine, but ultimately determine that repairs cannot be completed in a timely manner, you may reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(2) If the length of MIL illumination or trouble code storage is inconsistent with proper maintenance and use, either test the prospective test vehicle as received, repair the vehicle before testing, or reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(3) If a MIL is illuminated or a trouble code is set during an in-use test, do one of the following:

(i) Stop the test, repair the vehicle, and restart the testing. In this case, only the portion of the full test results without the MIL illuminated or trouble code set would be used in the vehicle-pass determination as described in §~~86.1912~~1036.425. Describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(ii) Stop the test, repair the vehicle, and initiate a new test. In this case, only the post-repair test results would be used in the vehicle-pass determination as described in §~~86.1912~~1036.425. Describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(iii) If three hours of non-idle operation have been accumulated prior to the time a MIL is illuminated or trouble code set, stop the test and use the accumulated test results in the vehicle-pass determination as described in §~~86.1912~~1036.425.

(iv) If three hours of non-idle operation have not been accumulated prior to the time a MIL is illuminated or trouble code is set, and you elect to repair the vehicle/engine, but ultimately determine that repairs cannot be completed in a timely manner, you may reject the vehicle from the test program and replace it with another vehicle. If you repair or reject the vehicle, you must describe the MIL or trouble code information in your report under §~~86.1920~~1036.440.

(c) Use appropriate fuels for testing, as follows:

(1) You may use any diesel fuel that meets the specifications for No. 2-D S500 or No. 2-D S15 in ASTM D975 (incorporated by reference in §1036.1010~~§86.1~~), as required in the calendar year that in-use testing occurs.

(2) You may use any biodiesel fuel blend that is either expressly allowed or not otherwise indicated as an unacceptable fuel in the vehicle's owner or operator manual or in the engine manufacturer's published fuel recommendations.

(3) You may drain a prospective test vehicle's fuel tank(s) and refill the tank(s) with diesel fuel conforming to ~~ASTM D975~~ the specifications described in paragraph (c)(1) of this section.

(4) Any fuel that is added to the fuel tank(s) of a prospective test vehicle, or during an in-use test, must be purchased at a local retail establishment near the site of vehicle procurement or screening, or along the test route. Alternatively, the fuel may be drawn from a central fueling source, provided that the fuel used is representative of that which is commercially available in the area where the vehicle is operated.

(5) No post-refinery fuel additives are allowed, except that one or more specific fuel additives may be used during in-use testing if you can document that the owner/operator of the prospective test vehicle has a history of normally using the fuel treatment(s), and the fuel additive(s) is not prohibited in the vehicle's owner or operator manual or in the engine manufacturer's published fuel-additive recommendations.

(6) You may take fuel samples from test vehicles to ensure that appropriate fuels were used during in-use testing. If a vehicle fails the vehicle-pass criteria and you can show that an inappropriate fuel was used during the failed test, that particular test may be voided. You may drain the vehicle's fuel tank(s) and refill the tank(s) with diesel fuel conforming to the ~~ASTM D975~~ specifications described in paragraph (c)(1) of this section. You must report any fuel tests that are the basis of voiding a test in your report under §~~86.1920~~1036.440.

(d) You must test the selected engines while they remain installed in the vehicle. Use portable emission-sampling equipment and field-testing procedures as specified in 40 CFR part 1065, subpart J ~~referenced in §86.1375~~. Measure emissions of THC, NMHC (by any method specified

in 40 CFR part 1065, subpart J), CO, NO_x, PM (as appropriate), and CO_2. Measure or determine O_2 emissions using good engineering judgment.

(e) For Phase 1 testing, you must test the engine under conditions reasonably expected to be encountered during normal vehicle operation ~~and use consistent with the general NTE requirements described in §86.1370-2007(a)~~. For the purposes of this subpart, normal operation and use would generally include consideration of the vehicle's normal routes and loads (including auxiliary loads such as air conditioning in the cab), normal ambient conditions, and the normal driver.

(f) For Phase 2 testing, we may give specific directions, as described in §~~86.1915~~1036.430(c)(2).

(g) Once an engine is set up for testing, test the engine for at least one shift-day. To complete a shift-day's worth of testing, start sampling at the beginning of a shift and continue sampling for the whole shift, subject to the calibration requirements of the portable emissions measurement systems. A shift-day is the period of a normal workday for an individual employee. If the first shift-day of testing involves at least ~~3~~2 hours of accumulated non-idle operation ~~or~~with at least one valid NTE event, ~~you may conclude testing at the end of the first shift-day. Otherwise, you may conclude testing only after repeating measurements for a second shift-day. You may also continue testing longer than we require.~~ If the first shift-day of testing does not involve at least ~~3~~ 2 hours of accumulated non-idle operation with at least one valid NTE event, you may conclude testing at the end of the first shift-day. Otherwise, you may conclude testing only after repeating measurements for a second shift-day. You may also continue testing longer than we require ~~repeat the testing for a second shift-day and report the results from both days of testing. If the second shift-day of testing also does not result in at least 3 hours of accumulated non-idle operation, you may choose whether or not to continue testing with that vehicle. If after two shift-days you discontinue testing before accumulating 3 hours of non-idle operation on either day,~~

(h) ~~e~~Evaluate ~~the~~ all valid NTE samples ~~from both days of testing~~ as described in § ~~86.1912~~1036.425 and include the data in the reporting and record keeping requirements specified in §§ ~~86.1920~~1036.440 and 1036.445~~1925~~. Count the engine toward meeting your testing requirements under this subpart and use the data for deciding whether additional engines must be tested under the applicable Phase 1 or Phase 2 test plan. ~~(h) You have the option to test longer than the two shift-day period described in paragraph (g) of this section.~~

(i) You may count a vehicle without a single valid NTE sampling event as meeting the vehicle-pass criteria described in §~~86.1912~~1036.425 if it had at least ~~three~~two hours of non-idle operation in a single shift-day and ~~or if it~~ it is tested over two full shift-days. ~~a shift day of testing or two-shift days of testing (with the requisite non-idle/idle operation time as in paragraph (g) of this section), or if the extended testing you elected under paragraph (h) of this section does not generate a single valid NTE sampling event, as described in §86.1912(b).~~ Count the ~~engine~~ vehicle towards meeting your testing requirements under this subpart.

(j) You may ask us to waive measurement of particular emissions if you can show that in-use testing for such emissions is not necessary.

§1036.420 What is a valid NTE sampling event?

(a) A valid NTE sampling event involves warmed-up engine operation in a zone of certain speed and torque values, subject to certain ambient conditions and engine parameters, as described in §1036.515, except as described in this section. Afiny emission measurements corresponding to engine operationg conditions that does not qualify as a valid NTE sampling event ~~are not valid for~~may be excluded from the determinngation of the vehicle-pass ratio specified in §1036.425.

for the impacted pollutant.

(b) Start emission sampling at the beginning of each valid NTE sampling event, except as needed to allow for zeroing or conditioning the PEMS. For gaseous emissions, PEMS preparation must be complete for all analyzers before starting emission sampling.

(c) Emission results are averaged over a minimum sampling period of 30 seconds of continuous operation in the NTE zone. However, a longer minimum averaging period may apply for engines equipped with aftertreatment systems involving periodic regeneration if they have the capability to record electronic signals to indicate the start and end of regeneration events. See §1036.515 for a description and illustration of the terms and principles that apply for these systems. Calculate an alternate minimum averaging period, $t_{NTE,min}$, for in-use testing under this subpart using the following equation:

$$t_{\mathrm{NTE,min}} = \frac{\sum_{i=1}^{N} t_{\mathrm{B,NTE,i}}}{RF}$$

Where:

i = an indexing variable that represents a time interval within the candidate NTE event during which the electronic signal indicates active regeneration.

N = the total number of discrete intervals within the candidate NTE event during which the electronic signal indicates active regeneration.

$t_{B,NTE,i}$ = the duration of each interval i, in seconds.

RF = the regeneration fraction for the shift-day, as determined in paragraph (c)(1) of this section.

(1) Calculate the regeneration fraction, RF, for a shift-day as follows:

$$RF = \frac{\overline{t}_B}{\overline{t}_{AB} + \overline{t}_0}$$

Where:

$\overline{t}_B$ = the average time in active regeneration for each complete regeneration event during the shift-day. To calculate this value, divide the total time in active regeneration during all the complete regeneration events during the shift-day by the corresponding number of regeneration events.

$\overline{t}_{AB}$ = the average time of each complete regeneration event during the shift-day. To calculate this value, divide the total time when regeneration is either pending or active by the number of complete regeneration events during the shift-day.

$\overline{t}_0$ = the average duration of complete non- regeneration events during the shift-day. To calculate this value, divide the total time for all complete non-regeneration events during the shift-day by the corresponding number of non-regeneration events.

(2) There are no valid NTE sampling events for a whole shift-day if there is active regeneration, but either no complete regeneration event or no complete non-regeneration event. If there is no active regeneration during the shift-day, do not apply the provisions of this section.

(3) If an engine has different regeneration cycles and electronic signals for different types of pollutants, calculate a separate minimum averaging period for each type of regeneration and use the longest one.

(4) The following example illustrates a calculation of the minimum averaging period, $t_{NTE,min}$, for a candidate NTE event:

(i) Consider a shift-day that has two complete regeneration events that occur between three complete non-regeneration events. The three non-regeneration events have durations of 5,424 seconds, 6,676 seconds, and 3,079 seconds. The two complete regeneration events have 2,769 seconds and 2,639 seconds of active regeneration, and total duration of 8,440 seconds and 3,920 seconds. Calculate *RF* for this shift-day as follows:

$$RF = \frac{\frac{2769+2639}{2}}{\frac{5424+6676+3079}{3} + \frac{8440+3920}{2}} = 0.2406$$

(ii) If a candidate NTE event during this shift-day has two periods of active regeneration, one lasting 37 seconds and the other 40 seconds, calculate $t_{NTE,min}$ as follows:

$$t_{NTE,\min} = \frac{37+40}{0.2406} = 320\,\text{seconds}$$

§~~86.1912~~1036.425 How do I determine whether an engine meets the vehicle-pass criteria? In general, the average emissions for each regulated pollutant must remain at or below the NTE threshold in paragraph (a) of this section for at least 90 percent of the valid NTE sampling events, as defined in paragraph (b) of this section. For 2007 through 2009 model year engines, the average emissions from every NTE sampling event must also remain below the NTE thresholds in paragraph (f)(2) of this section. Perform the following steps to determine whether an engine meets the vehicle-pass criteria:

(a) Determine the NTE threshold for each pollutant subject to an NTE standard by adding all three of the following terms and rounding the result to the same number of decimal places as the applicable NTE standard:

(1) The applicable NTE standard.

(2) The in-use compliance testing margin specified in §86.007-11(h), if any.

(3) An accuracy margin for portable in-use equipment when testing is performed under the special provisions of §86.1930, depending on the pollutant, as follows:

(i) NMHC: 0.17 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) CO: 0.60 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NO_x: 0.50 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) PM: 0.10 ~~grams per brake horsepower-hour~~g/hp·hr.

(v) NO_x + NMHC: 0.67 ~~grams per brake horsepower-hour~~g/hp·hr.

(4) Accuracy margins for portable in-use equipment when testing is not performed under the special provisions of § 86.1930 for 2007 through 2009 model year engine families that are selected for testing in any calendar year as follows:

(i) NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.02 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NMHC using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) CO using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.5 ~~grams per brake horsepower-hour~~g/hp·hr.

(v) CO using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(vi) CO using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(vii) NO_x using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.45 ~~grams per brake horsepower-hour~~g/hp·hr.

(viii) NO_x using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(ix) NO_x using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(x) NO_x + NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(1): 0.47 ~~grams per brake horsepower-hour~~g/hp·hr.

(xi) NO_x + NMHC using the emission calculation method specified in 40 CFR 1065.650(a)(3): 0.16 ~~grams per brake horsepower-hour~~g/hp·hr.

(xii) NO_x + NMHC using an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.16 ~~grams per brake horsepower-hour~~g/hp·hr.

(xiii) PM: 0.006 ~~grams per brake horsepower-hour~~g/hp·hr.

(5) Accuracy margins for portable in-use equipment when testing is not performed under the special provisions of § 86.1930 for 2010 or later model year engines families that are selected for testing in any calendar year as follows:

(i) NMHC using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.01 ~~grams per brake horsepower-hour~~g/hp·hr.

(ii) CO using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.25 ~~grams per brake horsepower-hour~~g/hp·hr.

(iii) NO_x using any emission calculation method specified in 40 CFR 1065.650(a) or an alternative emission calculation method we approve ~~as approved by the Administrator~~ under 40 CFR 1065.915(d)(5)(iv): 0.15 ~~grams per brake horsepower-hour~~g/hp·hr.

(iv) PM: 0.006 ~~grams per brake horsepower-hour~~g/hp·hr.

~~(b) For the purposes of this subpart, a valid NTE sampling event consists of at least 30 seconds of continuous operation in the NTE control area. An NTE event begins when the engine starts to operate in the NTE control area and continues as long as engine operation remains in this area (see §86.1370). When determining a valid NTE sampling event, exclude all engine operation in approved NTE limited testing regions under §86.1370-2007(b)(6) and any approved NTE deficiencies under §86.007-11(a)(4)(iv). Engine operation in the NTE control area of less than 30 contiguous seconds does not count as a valid NTE sampling event; operating periods of less than 30 seconds in the NTE control area, but outside of any allowed deficiency area or limited testing region, will not be added together to make a 30 second or longer event. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for the time-weighted carve-out defined in §86.1370-2007(b)(7). For EGR-equipped engines, exclude any operation that occurs during the cold-temperature operation defined by the equations in §86.1370-2007(b)(1).~~ (b~~c~~) Calculate the average emission level for each pollutant over each

valid NTE sampling event as specified in 40 CFR part 1065, subpart G, using each NTE event as an individual test interval. This should include valid NTE events from all days of testing.
(c) If the engine has an open crankcase, account for these emissions by adding 0.00042 g/hp-hr to the PM emission result for every NTE event ~~test interval.~~
(d) Calculate a time-weighted vehicle-pass ratio (R_{pass}) for each pollutant. To do this, first sum the time from each valid NTE sampling event whose average emission level is at or below the NTE threshold for that pollutant, then divide this value by the sum of the engine operating time from all valid NTE events for that pollutant. Round the resulting vehicle-pass ratio to two decimal places.

(1) Calculate the time-weighted vehicle-pass ratio for each pollutant as follows:

$$R_{pass} = \frac{\sum_{m=1}^{n_{pass}} t}{\sum_{k=1}^{n_{total}} t}$$

Where:
n_{pass} = the number of valid sampling events for which the average emission level is at or below the NTE threshold.
n_{total} = the total number of valid NTE sampling events.

(2) For both the numerator and the denominator of the vehicle-pass ratio, use the smallest of the following values for determining the duration, t, of any NTE sampling event:

(i) The measured time in the NTE zone ~~control area~~ that is valid for an NTE sampling event.
(ii) 600 seconds.
(iii) 10 times the length of the shortest valid NTE sampling event for all testing with that engine.

(e) The following example illustrates how to select the duration of NTE sampling events for calculations, as described in paragraph (d) of this section:

NTE sample	Duration of NTE sample (seconds)	Duration Limit Applied?	Duration used in calculations (seconds)
1	45	No	45
2	168	No	168
3	605	Yes. Use 10 times shortest valid NTE.	450
4	490	Yes. Use 10 times shortest valid NTE.	450
5	65	No	65

(f) Engines meet the vehicle-pass criteria under this section if they meet both of the following criteria:

(1) The vehicle-pass ratio calculated according to paragraph (d) of this section must be at least 0.90 for each pollutant.

(2) For model year 2007 through 2009 engines, emission levels from every valid NTE sampling event must be less than 2.0 times the NTE thresholds calculated according to paragraph (a) of this section for all pollutants, except that engines certified to a NO_x FEL at

or below 0.50 g/~~b~~hp·hr may meet the vehicle-pass criteria for NO_x if measured NO_x emissions from every valid NTE sample are less than either 2.0 times the NTE threshold for NO_x or 2.0 g/~~b~~hp·hr, whichever is greater.

§~~86.1915~~1036.430 What are the requirements for Phase 1 and Phase 2 testing?
For all selected engine families, you must do the following:
(a) To determine the number of engines you must test from each selected engine family under Phase 1 testing, use the following criteria:
(1) Start by measuring emissions from five engines ~~using the procedures described in §86.1375~~. If all five engines comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(2) If one of the engines tested under paragraph (a)(1) of this section fails to comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for one or more pollutants, test one more engine. If this additional engine complies fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(3) If your testing results under paragraphs (a)(1) and (2) of this section do not satisfy the criteria for completing your testing requirements under those paragraphs for all pollutants, test four additional engines so you have tested a total of ten engines.
(4) An engine that fails to fully comply with the vehicle-pass criteria in §~~86.1912~~1036.425 for any pollutant does not comply with the vehicle-pass criteria in §~~86.1912~~1036.425 for the purposes of determining the number of engines to test from each selected engine family under this paragraph.
(b) For situations where a total of ten engines must be tested under paragraph (a)(3) of this section, the results of Phase 1 testing lead to the following outcomes:
(1) If at least eight of the ten engines comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, you may stop testing. This completes your testing requirements under this subpart for the applicable calendar year for that engine family.
(2) If six or seven vehicles from the Phase 1 sample of test vehicles comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, then you must engage in follow-up discussions with us to determine whether any further testing (including Phase 2 testing), data submissions, or other actions may be warranted.
(3) If fewer than six of the ten engines tested under paragraph (a) of this section comply fully with the vehicle-pass criteria in §~~86.1912~~1036.425 for all pollutants, we may require you to initiate Phase 2 testing, as described in paragraph (c) of this section.
(4) You may under any circumstances elect to conduct Phase 2 testing following the completion of Phase 1 testing. All the provisions of paragraph (c) of this section apply to this Phase 2 testing.
(c) If you perform Phase 2 testing for any reason, test your engines as follows:
(1) You must test ten additional engines using the test procedures described in §86.1375, unless we require you to test fewer vehicles.
(2) We may give you any of the following additional directions in selecting and testing engines:

(i) We may require you to select a certain subset of your engine family. This may include, for example, engines within a specific power range, engines used in particular applications, or engines installed in vehicles from a particular manufacturer.
(ii) We may direct you to test engines in a way that simulates the type of driving and ambient conditions associated with high emissions experienced during Phase 1 testing.
(iii) We may direct you to test engines in a specific state or any number of contiguous states.
(iv) We may direct you to select engines from the same sources used for previous testing, or from different sources.
(v) We may require that you complete your testing and reporting under Phase 2 within a certain period. This period may not be shorter than three months and must allow a reasonable amount of time to identify and test enough vehicles. We would generally expect this testing to be completed within the overall time period specified in §~~86.1905~~1036.405(d).

§~~86.1917~~1036.435 How does in-use testing under this subpart relate to the emission-related warranty in Section 207(a)(1) of the Clean Air Act?
(a) An exceedance of the NTE standards found through the in-use testing program under this subpart is not by itself sufficient to show a breach of warranty under Clean Air Act section 207(a)(1) (42 U.S.C. 7541(a)(1)). A breach of warranty would also require one of the following things:

(1) That, at the time of sale, the engine or vehicle was designed, built, and equipped in a manner that does not conform in all material respects reasonably related to emission controls to the engine as described in the application for certification and covered by the certificate; or
(2) A defect in materials or workmanship of a component causes the vehicle or engine to fail to conform to the applicable regulations for its useful life.

(b) To the extent that in-use NTE testing does not reveal such a material deficiency at the time of sale in the design or manufacture of an engine compared with the certified engine, or a defect in the materials and workmanship of a component or part, test results showing an exceedance of the NTE standard by itself would not show a breach of the warranty under 42 U.S.C. 7541(a)(1).

§~~86.1920~~1036.440 What in-use testing information must I report to EPA?
(a) Send us electronic reports at inuse@epa.gov using an approved information format. If you want to use a different format, send us a written request with justification.
(b) Within ~~30~~ 45 days after the end of each calendar quarter, send us reports containing the test data from each engine for which testing was completed during the calendar quarter. Alternatively, you may separately send us the test data within 30 days after you complete testing for an engine. Additional reporting time is allowed with our approval. Once you send us information under this section, you need not send that information again in later reports. Prepare your test reports as follows:

(1) For each engine family, describe how you recruited vehicles. Describe how you used any criteria or thresholds to narrow your search or to screen individual vehicles.
(2) Include a summary of the candidate vehicles you have rejected and the reasons you rejected them, whether you base the rejection on the criteria in §~~86.1908~~1036.410(a) or anything else. If you rejected a candidate vehicle due to misfueling, included the results of any fuel sample tests.

(3) For the test vehicle, include the following background information:

(i) The EPA engine-family designation, and the engine's model number, total displacement, and power rating.

(ii) The applicable test phase (Phase 1 or Phase 2).

(iii) The date EPA selected the engine family for testing.

(iv) The vehicle's make and model and the year it was built.

(v) The vehicle identification number and engine serial number.

(vi) The vehicle's type or application (such as delivery, line haul, or dump truck). Also, identify the type of trailer, if applicable.

(vii) The vehicle's maintenance and use history.

(viii) The known status history of the vehicle's OBD system and any actions the owner or operator took to address OBD trouble codes or MIL illumination over the vehicle's lifetime.

(ix) Any OBD codes or MIL illumination that occur after you accept the vehicle for in-use testing under this subpart.

(x) Any steps you take to maintain, adjust, modify, or repair the vehicle or its engine to prepare for or continue testing, including actions to address OBD trouble codes or MIL illumination. Include any steps you took to drain and refill the vehicle's fuel tank(s) to correct misfueling, and the results of any fuel test conducted to identify misfueling.

(4) For each test, include the following data and measurements:

(i) The date and time of testing, and the test number.

(ii) Shift-days of testing (see §~~86.1910~~1036.415 (g)), duration of testing, and the total hours of non-idle operation.

(iii) Route and location of testing. You may base this description on the output from a global-positioning system.

(iv) The steps you took to ensure that vehicle operation during testing was consistent with normal operation and use, as described in §~~86.1910~~1036.415(e).

(v) Fuel test results, if fuel was tested under §~~86.1908~~1036.410 or §~~86.1910~~1036.415.

(vi) The vehicle's mileage at the start of the test. Include the engine's total lifetime hours of operation, if available.

(vii) Ambient temperature, dewpoint, and atmospheric pressure at the start and finish of each valid NTE event.

(viii) The number of valid NTE events (see §~~86.1912~~1036.425(b)).

(ix) Average emissions for each pollutant over each valid NTE event. Describe the method you used to determine NMHC as specified in 40 CFR part 1065, subpart J. See Appendix I of this subpart for an example of graphically summarizing NTE emission results.

(x) Exhaust-flow measurements.

(xi) Vehicle-pass ratios (see §~~86.1912~~1036.425(d)).

(xii) Recorded one-hertz test data, including, but not limited to, the following parameters:

(A) Ambient temperature.

(B) Ambient pressure.

(C) Ambient humidity.

(D) Altitude.

(E) Emissions of THC, NMHC, CO, CO_2 or O_2, and NO_x (as appropriate). Report results for PM if it was measured in a manner that provides one-hertz test data. Report results for CH_4 if it was measured and used to determine NMHC.
(F) Differential back-pressure of any PEMS attachments to vehicle exhaust.
(G) Exhaust flow.
(H) Exhaust aftertreatment temperatures, if the engine meets the specifications of §1036.515(h)(3)~~§86.1370-2007(g)~~.
(I) Engine speed.
(J) Engine brake torque.
(K) Engine coolant temperature.
(L) Intake manifold temperature.
(M) Intake manifold pressure.
(N) Throttle position.
(O) Any parameter sensed or controlled in order to modulate the emission-control system or fuel-injection timing.

(5) For each engine family, identify the applicable requirements, as follows:
(i) The applicable NTE thresholds.
(ii) Vehicle and engine information needed to identify ~~the~~ limited testing regions ~~under §86.1370-2007(b)(6) and (7)~~.
(iii) Vehicle and engine information needed to identify any approved NTE deficiencies ~~under §86.007-11(a)(4)(iv)~~.

(6) Include the following summary information after you complete testing with the engine:
(i) State whether the engine meets the vehicle-pass criteria in §~~86.1912~~1036.425(f).
(ii) Identify how many engines you have tested from the applicable engine family and how many engines still need to be tested.
(iii) Identify how many engines from an engine family have passed the vehicle-pass criteria and the number that have failed the vehicle-pass criteria (see §~~86.1912~~1036.425(f)).
(iv) If possible, state the outcome of Phase 1 testing for the engine family based on the criteria in §~~86.1915~~1036.430(b).

(c) In your reports under this section, you must do all the following:
(1) Include results from all emission testing required under this subpart.
(2) Describe if any testing or evaluations were conducted to determine why a vehicle failed the vehicle-pass criteria in §~~86.1912~~1036.425.
(3) Describe the purpose of any diagnostic procedures you conduct.
(4) Describe any instances in which the OBD system illuminated the MIL or set trouble codes. Also describe any approved actions taken to address the trouble codes or MIL.
(5) Describe any instances of misfueling, the approved actions taken to address the problem, and the results of any associated fuel sample testing.
(6) Describe any incomplete or invalid tests that were conducted under this subpart.

(d) Send us an electronic notification at inuse@epa.gov describing any voluntary vehicle/engine emission evaluation testing you intend to conduct with portable in-use measurement systems on the same engine families that are being tested under this subpart, from the time that engine family was selected for in-use testing under §~~86.1905~~1036.405 until the final results of all testing for that engine family are reported to us under this section.

(e) Send us an electronic notification at application-ci_cert@epa.gov within 15 days after your initial review of the test data for a selected engine family indicates that three engines in Phase 1 testing have failed to comply with the vehicle-pass criteria. Similarly, send us an electronic notification at the above electronic address within 3 days after your initial review of the test data for a selected engine family indicates that any engine in Phase 2 testing failed to comply with the vehicle-pass criteria.
(f) We may ask you to send us less information in your reports than we specify in this section.
(g) We may require you to send us more information to evaluate whether your engine family meets the requirements of this part, or to help inform potential decisions concerning Phase 2 testing under §~~86.1915~~1036.430.

§~~86.1925~~1036.445 What records must I keep?
(a) Organize and maintain your records as described in this section. We may review your records at any time, so it is important to keep required information readily available.
(b) Keep the following paper or electronic records of your in-use testing for five years after you complete all the testing required for an engine family:
(1) Keep a copy of the reports described in §~~86.1920~~1036.440.
(2) Keep any additional records, including forms you create, related to any of the following:
(i) The procurement and vehicle-selection process described in §~~86.1908~~1036.410, including the vehicle owner's name, address, phone number, and e-mail address.
(ii) Pre-test maintenance and adjustments to the engine performed under §~~86.1910~~1036.415.
(iii) Test results for all void, incomplete, and voluntary testing described in §~~86.1920~~1036.440.
(iv) Evaluations to determine why a vehicle failed the vehicle-pass criteria described in §~~86.1912~~1036.425.
(3) Keep a copy of the relevant calibration results required by 40 CFR part 1065.

~~§86.1930 What special provisions apply from 2005 through 2010?~~
~~(a) We may direct you to test engines under this subpart for emissions other than PM in 2005 and 2006, and for PM emissions in 2007 through 2010. In those interim periods, all the provisions of this subpart apply, except as specified in this paragraph (a). You may apply the exceptions identified in this section for both years of the applicable years for emissions other than PM. You may omit testing and reporting in two of the four applicable years for PM emissions.~~
~~(1) We will select engine families for testing of emissions other than PM only when the manufacturer's Statement of Compliance specifically describes the family as being designed to comply with NTE requirements.~~
~~(2) We will not direct you to do the Phase 2 testing in §86.1915(e), regardless of measured emission levels.~~
~~(3) For purposes of calculating the NTE thresholds under §86.1912(a) for any 2006 and earlier model year engine that is not subject to the emission standards in §86.007–11, determine the applicable NTE standards as follows:~~
~~(i) If any numerical NTE requirements specified in the terms of any consent decree apply to the engine family, use those values as the NTE standards for testing under this subpart.~~

~~(ii) If a numerical NTE requirement is not specified in a consent decree for the engine family, the NTE standards are 1.25 times the applicable FELs or the applicable emission standards specified in §86.004–11(a)(1) or §86.098–11(a)(1).~~

~~(4) In the report required in §86.1920(b), you must submit the deficiencies and limited testing region reports (see §§86.007–11(a)(4)(iv) and 86.1370–2007(b)(6) and (7)) for 2006 and earlier model year engines tested under this section.~~

~~(5) You must notify the Designated Compliance Officer by September 30, 2010 whether or not you will submit test reports for PM emissions for each of the four years from 2007 through 2010. See 40 CFR 1068.30 for the contact information for the Designated Compliance Officer.~~

~~(6) You must submit reports by the deadlines specified in paragraph (b) of this section.~~

~~(b) The following deadlines apply for reporting test results under this subpart.~~

~~(1) You must complete all the required testing and reporting under this subpart related to emissions other than PM by the following dates:~~

~~(i) November 30, 2007 for engine families that we designate for testing in 2005.~~

~~(ii) November 30, 2008 for engine families that we designate for testing in 2006.~~

~~(iii) November 30, 2009 for engine families that we designate for testing in 2007.~~

~~(iv) March 31, 2010 for engine families we designate for testing in 2008.~~

~~(v) April 30, 2011 for engine families we designate for testing in 2009.~~

~~(2) You must complete all the required testing and reporting under this subpart related to PM emissions by the following dates:~~

~~(i) May 31, 2010 for engine families that we designate for testing in 2007.~~

~~(ii) September 30, 2010 for engine families we designate for testing in 2008.~~

~~(iii) April 30, 2011 for engine families we designate for testing in 2009.~~

~~(iv) November 30, 2011 for engine families we designate for testing in 2010.~~

~~(c) For 2007 through 2009 all the provisions of this subpart and paragraph (a) of this section apply, with the following additional exceptions:~~

~~(1) You must complete all the required testing and reporting under this subpart by the following dates:~~

~~(i) November 30, 2009 for engine families that we designate for non-PM testing in 2007.~~

~~(ii) March 31, 2010 for engine families that we designate for non-PM testing in 2008.~~

~~(iii) April 30, 2011 for engine families that we designate for non-PM testing in 2009.~~

~~(2) You may conduct non-PM and PM testing on different vehicles for engine families that we designate in 2007 and 2008.~~

~~(3) You may conduct PM testing as follows for 2007:~~

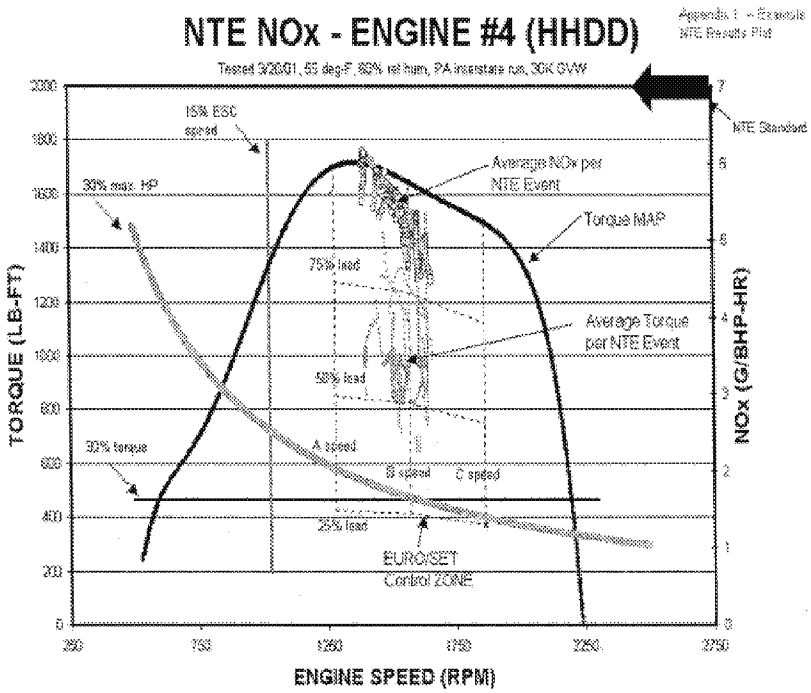
~~(i) Test vehicles may be selected from a vehicle fleet that you own or otherwise directly control.~~

~~(ii) Test vehicles may be operated by a driver that you employ.~~

~~(iii) Each test vehicle must be operated on a route and under operating conditions that reasonably replicate the use of the selected vehicle type when operated in typical revenue service, unless otherwise approved by us.~~

Appendix I to Subpart ET— Sample Graphical Summary of NTE Emission Results

The following figure shows an example of a graphical summary of NTE emission results:



Subpart F—Test Procedures Error! Bookmark not defined.

§ 1036.501 How do I run a valid emission test?{ TC \l1 "}

(a) Use the equipment and procedures for spark-ignition or compression-ignition engines in 40 CFR part 1065 to determine whether engines meet the duty-cycle emission standards in subpart B of this part. Measure the emissions of all the exhaust constituents subject to emission standards as specified in 40 CFR part 1065. Measure CO_2, N_2O, and CH_4 as described in §1036.235. Use the applicable duty cycles specified in this subpart.

(b) Sections 1036.515 describe the supplemental procedures for evaluating whether engines meet the not-to-exceed emission standards in subpart B of this part.

(c) [Reserved]~~Measure smoke using the procedures in 40 CFR part 86, subpart I, for evaluating whether engines meet the smoke standards in §1036.105.~~

(d) Use the fuels specified in 40 CFR part 1065 to perform valid tests, as follows:

(1) For service accumulation, use the test fuel or any commercially available fuel that is representative of the fuel that in-use engines will use.

(2) For diesel-fueled engines, use the ultra low-sulfur diesel fuel specified in 40 CFR part 1065 for emission testing.

(3) For gasoline-fueled engines, use the appropriate E10 fuel specified in 40 CFR part 1065; however, through model year 2021 you may instead use the appropriate E0 fuel specified in 40 CFR part 1065, with the exception that the E0 fuel must have sulfur concentration between 0.0015 and 0.008 weight percent and research octane of at least 93. Starting in model year 2022, you may certify up to 5 percent of your nationwide sales volume of engines certified under subpart A of this part in a given model year based on this E0 test fuel if those engines are certified with carryover data.

(e) The following provisions apply for engines using aftertreatment technology with infrequent regeneration events that may occur during testing:

(1) Adjust measured emissions to account for aftertreatment technology with infrequent regeneration as described in §1036.520.

(2) If your engine family includes engines with one or more AECDs for emergency vehicle applications approved under §1036.115(g)(4), do not consider additional regenerations resulting from those AECDs when developing adjustments to measured values under this paragraph (e).

(3) Invalidate any test interval with respect to demonstrating compliance with CO_2, N_2O, and CH_4 emission standards if active regeneration starts during the test interval.

~~(4) Invalidate a smoke test if active regeneration starts to occur during the test.~~

(f) Test hybrid engines as described in §1036.525 and 40 CFR part 1065.

(g) You may disable any AECDs that have been approved solely for emergency vehicle applications under §1036.115(g)(4).

(h) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.

(i) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.

~~(a) Use the equipment and procedures specified in 40 CFR 86.1305 to determine whether engines meet the emission standards in §1036.108.~~

~~(b) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.~~

Commented [CM2]: Need to add regs for fuel maps and idles modes.

Commented [CM3]: Update?

~~(c) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.~~
~~(d) For engines that use aftertreatment technology with infrequent regeneration events, invalidate any test interval in which such a regeneration event occurs with respect to CO2, N2O, and CH4 measurements.~~
~~(e) Test hybrid engines as described in 40 CFR part 1065 and §1036.525.~~
~~(f) [Reserved]~~
~~(g) If your engine requires special components for proper testing, you must provide any such components to us if we ask for them.~~

§ 1036.505 Ramped-modal testing procedures.
Measure emissions using the ramped-modal duty cycle shown in the following table to determine whether compression-ignition engines meet the steady-state emission standards specified in subpart B of this part:

Table 1 of §1036.505—Ramped-modal Duty Cycle

RMC mode	Time in mode (seconds)	Engine speed [1,2]	Torque (percent) [2,3]
1a Steady-state	170	Warm Idle	0
1b Transition	20	Linear Transition	Linear Transition
2a Steady-state	173	A	100
2b Transition	20	Linear Transition	Linear Transition
3a Steady-state	219	B	50
3b Transition	20	B	Linear Transition
4a Steady-state	217	B	75
4b Transition	20	Linear Transition	Linear Transition
5a Steady-state	103	A	50
5b Transition	20	A	Linear Transition
6a Steady-state	100	A	75
6b Transition	20	A	Linear Transition
7a Steady-state	103	A	25
7b Transition	20	Linear Transition	Linear Transition
8a Steady-state	194	B	100
8b Transition	20	B	Linear Transition
9a Steady-state	218	B	25
9b Transition	20	Linear Transition	Linear Transition
10a Steady-state	171	C	100
10b Transition	20	C	Linear Transition
11a Steady-state	102	C	25
11b Transition	20	C	Linear Transition
12a Steady-state	100	C	75
12b Transition	20	C	Linear Transition
13a Steady-state	102	C	50
13b Transition	20	Linear Transition	Linear Transition
14 Steady-state	168	Warm Idle	0

[1]Speed terms are defined in 40 CFR part 1065.
[2]Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the speed or torque setting of the current mode to the speed or torque setting of the next mode.
[3]The percent torque is relative to maximum torque at the commanded engine speed.

§1036.510 Transient testing procedures.{ TC \l1 "}

This section describes how to test engines under transient conditions.

(a) Test spark-ignition and compression-ignition engines using the normalized transient duty cycles specified in paragraphs (f)(1) and (f)(2), respectively, of 40 CFR part 86, Appendix I.

Commented [SA4]: Copy cycles into part 1036 for FRM.

(b) Denormalize the duty cycle as follows:

(1) Denormalize engine speed values using one of the following equations, where speed terms are defined in 40 CFR part 1065:

(i) For spark-ignition engines—

$$\text{Target engine speed (rpm)} = \frac{\%\,\text{rpm} \cdot (\text{maximum test speed} - \text{warm idle speed})}{100} + \text{warm idle speed}$$

Field Code Changed

(ii) For compression-ignition engines—

$$\text{Target engine speed (rpm)} = \frac{\%\,\text{rpm} \cdot (\text{maximum test speed} - \text{warm idle speed})}{112} + \text{warm idle speed}$$

Field Code Changed

(2) Normalized torque values are expressed as a percentage of maximum torque at a given engine speed; therefore, denormalize engine torque values relative to the torque mapping described in 40 CFR part 1065.

(3) The following example illustrates denormalizing a test point from the duty cycle for a compression-ignition engine with maximum test speed of 3,800 rpm and curb idle speed of 600 rpm:

(i) For a normalized speed target of 43 percent, the denormalized speed is--

$$\text{Target engine speed (rpm)} = \frac{43 \cdot (3800 - 600)}{112} + 600 = 1829 \text{ rpm}$$

Field Code Changed

(ii) If the torque target is 82 percent and the engine's torque map shows that maximum torque at an engine speed of 1,829 rpm is 485 N·m, the denormalized torque at that speed is 485·0.82 = 398 N·m.

Commented [AS5]: Check precision

(c) The transient test sequence consists of an initial run through the transient duty cycle from a cold start, 20 minutes with no engine operation, then a final run through the same transient duty cycle. Calculate the official transient emission result from the following equation:

Commented [AS6]: hp or kW?

$$\text{Official transient emission result} = \frac{\text{cold-start emissions (g)} + 6 \cdot \text{hot-start emissions (g)}}{\text{cold-start work (kW·hr)} + 6 \cdot \text{hot-start work (kW·hr)}}$$

Field Code Changed

§1036.515 Test procedures related to not-to-exceed standards.{ TC \l1 "}

(a) This section describes the procedures to determine whether compression-ignition engines meet the not-to-exceed emission standards in §1036.104(d). These procedures may include any normal engine operation and ambient conditions that the engines may experience in use. Paragraphs (c) through (e) of this section define the limits of what we will consider normal engine operation and ambient conditions.

(b) Measure emissions with one of the following procedures:

(1) Test the selected engines while they remain installed in a vehicle. Use the equipment and procedures specified in 40 CFR part 1065, subpart J, to conduct field testing. Use fuel meeting the specifications of 40 CFR part 1065, subpart H, or a fuel typical of what you would expect the engine to use in service. Subpart E of this part describes how to use these procedures to perform in-use testing.

(2) Remove the selected engines for testing in a laboratory. You may use an engine dynamometer to simulate normal operation, as described in this section. Use the equipment and procedures specified in 40 CFR part 1065 to conduct laboratory testing.

(c) Engine testing may occur at locations up to 1,676 meters above sea level at any humidity. You must select one of the following approaches regarding ambient air temperature:

(1) Testing may occur at any ambient air temperature.

(2) Testing may occur at any ambient temperature up to the limit defined by the following equation:

T_{max} (°C) = –0.00459 · A + 37.8

Where:

A = altitude above sea level corresponding to the highest point of testing, in meters.

(d) For testing under the following ranges of ambient conditions, determine emission results without correcting measured emission levels:

(1) Ambient air temperature above 12.8 °C. For testing conducted under paragraph (c)(1) of this section, an upper bound of 35.0 °C also applies.

(2) Ambient humidity between 7.14 and 10.71 grams of moisture per kilogram of dry air.

(e) Engine testing may occur outside of the ranges specified in paragraph (d) of this section, as long as measured values are corrected to be equivalent to the nearest end of the specified range, using good engineering judgment. Correct NO_x emissions for humidity as specified in 40 CFR part 1065, subpart G.

(f) The sampling period may not begin until the engine has reached stable operating temperatures. For example, this would include only engine operation after starting and after the engine thermostat starts modulating the engine's coolant temperature. The sampling period may not include engine starting.

(g) Apply the NTE standards specified in §1036.104(d) to an engine family based on engine operation limited to an NTE zone. Except for the modifications described in paragraph (h) of this section, the NTE zone for an engine family is defined by the following parameters:

(1) The default NTE zone includes all engine speed and torque points not excluded by either the following criteria:

(i) Engine torque values below 30 percent of maximum test torque, and engine speed at or below $n_{lo}+0.15\cdot(n_{hi}-n_{lo})$, where speed terms are defined in 40 CFR part 1065.

(ii) Engine speed and torque values corresponding to engine power below 30 percent of maximum engine power.

(2) The default NTE zone may include some engine speed and torque points otherwise excluded under paragraph (g)(1)(i) of this section as described in this paragraph (g)(2). To determine which additional speed and torque points to apply, first establish the minimum value for brake-specific fuel consumption (BSFC) across the engine map, then multiply this value by 1.05 to calculate a BSFC threshold. Determine BSFC values across the engine map based on testing performed for certification testing under 40 CFR part 1065. The speed and torque points corresponding to BSFC values at or below the BSFC threshold are part of the default NTE zone, except for either of the following circumstances:

Commented [AS7]: This should be clearer regarding resolution of test points.

(i) This paragraph (g)(2) does not apply for an engine that is installed in a vehicle with a manual transmission or with an automatic transmission that has a finite number of gears.

Commented [AS8]: This isn't all-or-nothing for the whole engine family, or?

(ii) If you show us that engines are not expected to operate at certain speed and torque points identified in this paragraph (g)(2) during normal vehicle operation and use, we will approve your request to exclude those points from the NTE zone.

(h) An engine family's NTE zone may be modified as follows:

(1) You may ask us to approve a narrower NTE zone for an engine family at the time of certification as follows:

(i) For diesel-fueled engines, you may ask us to exclude certain speed and torque points from the NTE zone for a particular engine-vehicle combination if the installed engine cannot operate at those speed and torque points.

(ii) For other engines, you may ask us to exclude certain speed and torque points from the NTE zone if the engine is not expected to operate at those speed and torque points during normal vehicle operation and use.

(2) You may ask us to approve a Limited Testing Region (LTR). An LTR is a region of engine operation, within the applicable NTE zone, where you have demonstrated that your

engine family operates for no more than 5.0 percent of its normal in-use operation, on a mileage-weighted basis or some other weighting that we approve. This demonstration must include operational data from representative in-use vehicles. Specify LTR boundaries based on engine speed and torque such that the LTR boundaries coincide with some portion of the boundary defining the overall NTE zone. The shape of the LTR must generally be rectangular or elliptical. Any emission data collected within an LTR for a time duration that exceeds 5.0 percent of the duration of its respective NTE sampling period (as defined in paragraph (j) of this section) will be excluded when determining compliance with the applicable NTE standards. Any emission data collected within an LTR for a time duration of 5.0 percent or less of the duration of the respective NTE sampling period will be included when determining compliance with the NTE standards.

(3) You may exclude emission data based on catalytic aftertreatment temperatures as follows:

(i) For an engine equipped with a catalytic NO_x aftertreatment system, exclude NO_x emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C.

(ii) For an engine equipped with an oxidizing catalytic aftertreatment system, exclude NMHC and CO emission data that is collected when the exhaust temperature at any time during the NTE event is less than 250 °C.

(iii) Using good engineering judgment, mMeasure exhaust temperature within 30 cm downstream of the last applicable catalytic aftertreatment device. Where there are parallel paths, use good engineering judgment to measure the temperature within 30 cm downstream of the last applicable catalytic aftertreatment device in the path with the greatest exhaust flow.

(4) Engines with exhaust gas recirculation are not subject to the NTE standards as long as either of the following indicates a cold temperature condition:

(i) For turbocharged engines, intake manifold temperature, T_{im}, is at or below the temperature defined by the following relationship to absolute intake manifold pressure, P_{im}:

$$T_{im}\,(\mathrm{K}) = 0.0635 \cdot P_{im}(\mathrm{kPa}) + 305$$

(ii) Engine coolant temperature, T_{ec}, is at or below the temperature defined by the following relationship to absolute intake manifold pressure, P_{im}:

$$T_{ec}\,(\mathrm{K}) = 0.00714 \cdot P_{im}(\mathrm{kPa}) + 326$$

(i) [Reserved]

(j) Except as described in this paragraph (j), a valid NTE sampling event consists of a minimum averaging period of 30 seconds of continuous operation in the NTE zone. An NTE event begins when the engine starts to operate in the NTE zone and continues as long as engine operation remains in this area. When determining a valid NTE sampling event, exclude all engine operation in an approved LTR under paragraph (h)(2) of this section and exclude operation covered by approved NTE deficiencies. Engine operation in the NTE zone of less than the minimum averaging period does not count as a valid NTE sampling event. Do not combine separate operating periods to meet the minimum averaging period. Exclude any portion of a sampling event that would otherwise exceed the 5.0 percent limit for BSFC-related provision described in paragraph (g)(2) of this section. Exclude certain operation for engines equipped with aftertreatment or EGR as described in paragraphs (h)(3) and (4) of this section. Manufacturers may choose to count emission results for a candidate NTE event even though it is

Commented [AS9]: Keep the idea of selecting an LTR based on a "configuration (or sufficiently similar engines)"?

Commented [CAL10]: EMA will consider commenting on breaking (i) down further by technology (oxidizing NOx aftertreatment vs. SCR) and to maybe tweak the exclusion temperature.

Commented [AS11]: Part 86 doesn't limit this to turbocharged engines.

Do we need to clarify how to measure IMT or IMP?
The first equation clearly presumes turbocharged operation. Should we say anything about naturally aspirated? It looks like IMT would need to be above 100 F for a valid test.

This is based on a curve fit to a data set. If you are using a lot of charge air cooling, this equation becomes problematic.

Field Code Changed

Field Code Changed

shorter than the minimum averaging period; if you do this, you must include valid measurements for all regulated pollutants. A longer alternate minimum averaging period may apply for engines that have aftertreatment systems involving discrete regeneration events, as follows:

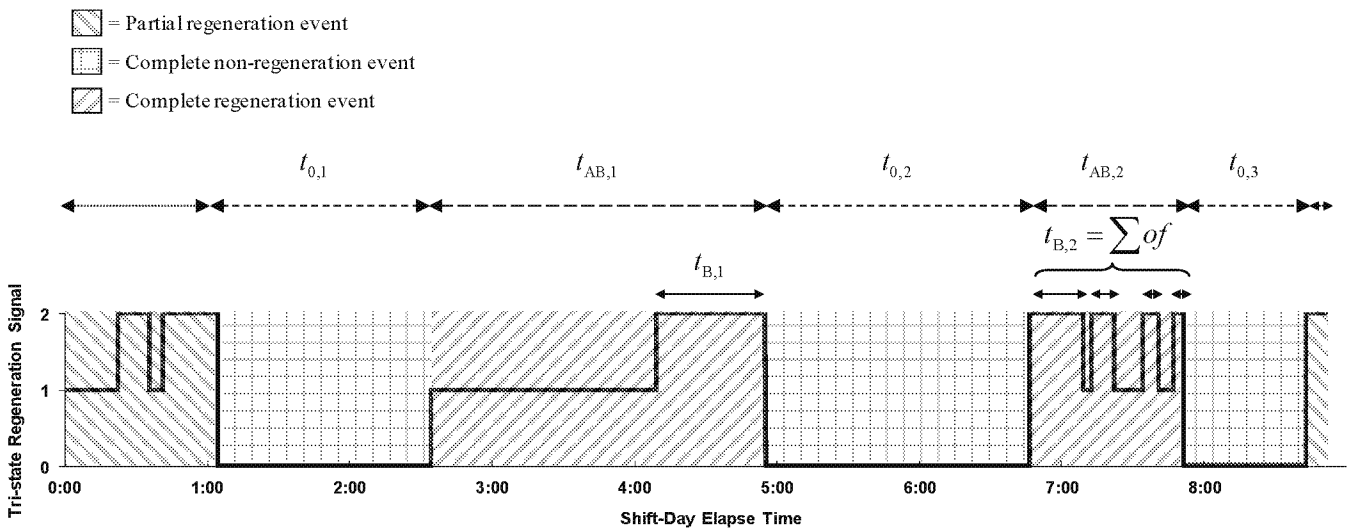
(1) A longer alternate minimum averaging period applies under the in-use testing program in subpart E of this part as described in §1036.420. For any other testing with engines that send an electronic signal indicating the start of the regeneration event, emission sampling is not valid for NTE testing if it includes any active regeneration, unless the emission averaging period includes the complete regeneration event(s) and the full period of engine operation until the start of the next regeneration event.

(2) The following principles apply for determining how regeneration affects the determination of valid NTE sampling events:

(i) The engine's electronic signal indicates the start and end of each regeneration event. A regeneration event may be further divided into active and pending regeneration. Periods of non-regeneration are referred to as state 0; periods of pending regeneration are referred to as state A; and periods of active regeneration are referred to as state B. Regeneration events with combined (alternating) pending and active states may be referred to together as "AB". You may not further differentiate regeneration states for calculating an alternate minimum averaging period. If the electronic signal identifies a pending regeneration state, take the regeneration signal to mean active regeneration.

(ii) A complete non-regeneration event is a period of engine operation that is preceded and followed by regeneration events (pending or active). A complete regeneration event is a period of engine operation that is preceded and followed by non-regeneration events; a complete regeneration event includes any time in the event where regeneration is pending. The following figure illustrates a sequence of regeneration and non-regeneration events:

Figure 1 of §1036.515—Regeneration events during a shift-day.



§1036.520 Adjusting emission levels to account for infrequently regenerating aftertreatment devices.

For engines using aftertreatment technology with infrequent regeneration events that may occur during testing, take one of the following approaches to account for the emission impact of regeneration:

(a) You may use the calculation methodology described in 40 CFR 1065.680 to adjust measured emission results. Do this by developing an upward adjustment factor and a downward adjustment factor for each pollutant based on measured emission data and observed regeneration frequency as follows:

(1) Adjustment factors should generally apply to an entire engine family, but you may develop separate adjustment factors for different configurations within an engine family. Use the adjustment factors from this section for all testing for the engine family.

(2) You may use carryover or carry-across data to establish adjustment factors for an engine family as described in the §1036.235, consistent with good engineering judgment.

(3) Determine the frequency of regeneration, F, as described in 40 CFR 1065.680 from in-use operating data or from running replicate tests. For any replicate transient testing in the laboratory, use good engineering judgment to include cold-start operation in proportion to the weighting factors specified in §1036.510(c). If the engine is designed for regeneration at fixed time intervals, you may apply good engineering judgment to determine F based on those design parameters. All adjustment factors for regeneration are additive. You may calculate adjustment factors using separate values of F for steady-state and transient testing. You may alternatively establish a composite value of F to apply for both steady-state and transient testing based on the following weightings:

(i) For heavy heavy-duty engines, 75 percent steady-state operation and 25 percent transient operation.

(ii) For all other engines, 60 percent for steady-state operation and 40 percent transient operation.

(4) Treat cold-start testing and hot-start testing together as a single test segment as described in §1036.510(c) for adjusting measured emission results under this paragraph (a). Apply the adjustment factor to the composite emission result.

(5) Identify the value of F in each application for the certification for which it applies.

(b) You may ask us to approve an alternate methodology to account for regeneration events. We will generally limit approval to cases where your engines use aftertreatment technology with extremely infrequent regeneration and you are unable to apply the provisions of this section.

(c) You may choose to make no adjustments to measured emission results if you determine that regeneration does not significantly affect emission levels for an engine family (or configuration) or if it is not practical to identify when regeneration occurs. If you choose not to make adjustments under paragraph (a) or (b) of this section, your engines must meet emission standards for all testing, without regard to regeneration.

Message

From: Laroo, Chris [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=6F4E3F827D6648AE8F3A5DE78A5F4E16-LAROO, CHRIS]
Sent: 5/9/2018 6:26:13 PM
To: Heltzel Robert [robert.heltzel@volvo.com]; Sanchez, James [sanchez.james@epa.gov]
CC: Clark Taylor [taylor.clark@volvo.com]; Marley Jeffrey [jeff.marley@volvo.com]
Subject: RE: Part 86 In-Use Testing Question

Rob,

Yes, you should discuss this with your compliance rep, however, per our discussion of 40 CFR part 86.1370, you can submit NTE events from segments of data greater than 30 s when engine operation is in an exclusion zone.

Regards,

Chris Laroo
Environmental Protection Specialist
US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Heltzel Robert [mailto:robert.heltzel@volvo.com]
Sent: Wednesday, May 09, 2018 11:29 AM
To: Sanchez, James <sanchez.james@epa.gov>; Laroo, Chris <laroo.chris@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Marley Jeffrey <jeff.marley@volvo.com>
Subject: RE: Part 86 In-Use Testing Question

Chris and James,

We appreciate the time you took in meeting with us this morning and were encouraged by the conversation. We would just like to confirm that you agree and we should discuss with our compliance representative before submittal of this year's test order.

Thanks,

Rob

-----Original Appointment-----
From: Heltzel Robert
Sent: Wednesday, May 09, 2018 10:03 AM
To: Sanchez, James; Laroo, Chris
Cc: Clark Taylor; Marley Jeffrey
Subject: Part 86 In-Use Testing Question
When: Wednesday, May 09, 2018 10:00 AM-10:30 AM (UTC-05:00) Eastern Time (US & Canada).
Where: Skype Meeting

Meeting to Discuss NTE Evaluation as discussed.

<< File: HDIUT_NTE_EPA_050918.pptx >>

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Ex. 6 - Personal Privacy USA, Toll free - USA Only) English (United States)

Find a local number

Conference ID: Ex. 6 - Personal Privacy

Forgot your dial-in PIN? | Help

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Tuesday, May 08, 2018 8:23 AM
To: Laroo, Chris; Heltzel Robert
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question

9 doesn't work for me but 10 or 11 do.

James

From: Laroo, Chris
Sent: Tuesday, May 08, 2018 8:22 AM
To: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Marley Jeffrey <jeff.marley@volvo.com>
Subject: Re: Part 86 In-Use Testing Question

Ok. Just set it up for either 9 am, 10, or 11.

Chris

From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Tuesday, May 8, 2018 8:12 AM
To: Laroo, Chris; Sanchez, James
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question

Chris,

That will work for us here. Would you like to set up a WebEx or Skype meeting so that we could share some information with you? The meeting should not take long.

Thanks,

Rob

From: Laroo, Chris [mailto:laroo.chris@epa.gov]
Sent: Tuesday, May 08, 2018 6:58 AM
To: Heltzel Robert; Sanchez, James
Cc: Clark Taylor; Marley Jeffrey
Subject: Re: Part 86 In-Use Testing Question

Rob,

I have time on Wednesday. Would something in the morning work for you?

Chris

From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Monday, May 7, 2018 4:05 PM
To: Sanchez, James; Laroo, Chris
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question

James and Chris,

Would you gentlemen have some time this week to review a quick analysis of NTE event evaluation based on our previous conversations?

Thanks,

Rob

From: Clark Taylor
Sent: Monday, April 16, 2018 8:31 AM
To: Sanchez, James; Laroo, Chris
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

James,

Thank you very much for the quick response on this.

Best regards,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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To: Laroo, Chris; Clark Taylor
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Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
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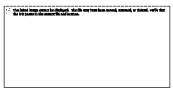
From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris



From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
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Subject: Part 86 In-Use Testing Question

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Please let me know when would be best to call.

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Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
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Email: taylor.clark@volvo.com

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Message

From: Laroo, Chris [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=6F4E3F827D6648AE8F3A5DE78A5F4E16-LAROO, CHRIS]
Sent: 5/8/2018 12:21:36 PM
To: Heltzel Robert [robert.heltzel@volvo.com]; Sanchez, James [sanchez.james@epa.gov]
CC: Clark Taylor [taylor.clark@volvo.com]; Marley Jeffrey [jeff.marley@volvo.com]
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To: Laroo, Chris; Clark Taylor
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Regards,
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To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
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Message

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Sent: 5/8/2018 10:58:08 AM
To: Heltzel Robert [robert.heltzel@volvo.com]; Sanchez, James [sanchez.james@epa.gov]
CC: Clark Taylor [taylor.clark@volvo.com]; Marley Jeffrey [jeff.marley@volvo.com]
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To: Clark Taylor <taylor.clark@volvo.com>
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Message

From: Laroo, Chris [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=6F4E3F827D6648AE8F3A5DE78A5F4E16-LAROO, CHRIS]
Sent: 4/12/2018 1:59:59 PM
To: Clark Taylor [taylor.clark@volvo.com]
CC: Heltzel Robert [robert.heltzel@volvo.com]; Sanchez, James [sanchez.james@epa.gov]
Subject: Re: Part 86 In-Use Testing Question

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Message

From: Hawelti, Daniel@ARB [daniel.hawelti@arb.ca.gov]
Sent: 7/16/2018 5:58:39 PM
To: Alexander Sappok [Alexander.Sappok@ctscorp.com]; Anne-Marie Williams [Anne-Marie.Williams@Navistar.com]; Arvind Thiruvengadam [Arvind.Thiruvengadam@mail.wvu.edu]; Charles Benoit Chaumette [Charles-benoit.Chaumette@Daimler.com]; Chris Wright [Chris.Wright@PACCAR.com]; Craig Kazmierczak [Craig.Kazmierczak@Daimler.com]; David Piech [david.piech@cnhind.com]; Dr. Tue Johannessen [TJ@amminex.com]; Francisco Posada [francisco@theicct.org]; Heejung Jung [heejung@engr.ucr.edu]; Sanchez, James [sanchez.james@epa.gov]; Jeff Foor [jeff.foor@fcagroup.com]; Joanna Bellamy [joanna.bellamy@canada.ca]; Josephine Davidson [Josephine.davidson@canada.ca]; Julie Deschatelets [Julie.deschatelets@canada.ca]; Karl Tasik [karl.tasik@volvo.com]; Mead, Kathleen@ARB [kathleen.mead@arb.ca.gov]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Kirk Wu [ctwu@artc.org.tw]; Matt Psota [matthew.psota@cummins.com]; Matthew R. Smith [Matt.Smith@Navistar.com]; Matthew Spears [MSpears@emamail.org]; Mike Geller [mgeller@meca.org]; mike mccarthy [michael.mccarthy@arb.ca.gov]; Rachel Muncrief [rachel@theicct.org]; rbrezny@meca.org; Ray J. Minjares [ray@theicct.org]; Rey Agama [agama_rey@cat.com]; Sanjay V Pimple [sanjay.pimple@cummins.com]; Lemieux, Sharon@ARB [sharon.lemieux@arb.ca.gov]; Tim French [TFrench@clpchicago.com]; Victor Miranda [victor.miranda@navistar.com]; Xavier Faucon [FauconXavier@JohnDeere.com]; Heroy-Rogalski, Kim@ARB [kim.heroy-rogalski@arb.ca.gov]; Aaron Neuman [Aaron.Neuman@Daimler.com]; Cullen, Angela [cullen.angela@epa.gov]; Arvind Thiruvengadam [Arvind.Thiruvengadam@mail.wvu.edu]; Berry Steve [steve.berry@volvo.com]; Robertson, Bill@ARB [bill.robertson@arb.ca.gov]; Brent Keppy [Brent.Keppy@us.bosch.com]; Charles Benoit Chaumette [Charles-benoit.Chaumette@Daimler.com]; Laroo, Chris [laroo.chris@epa.gov]; Costi Nedelcu [costi.nedelcu@paccar.com]; David Kayes [David.Kayes@Daimler.com]; David Piech [david.piech@cnhind.com]; Don Keski-Hynnila [Donald.Keski-Hynnila@Daimler.com]; Dr. Tue Johannessen [TJ@amminex.com]; Mitchell, George [Mitchell.George@epa.gov]; Greg Siuchta [Gregory.Siuchta@Navistar.com]; Heejung Jung [heejung@engr.ucr.edu]; Zhang, Houshun [Zhang.Houshun@epa.gov]; Inderpal Singh [inderpal.singh@daimler.com]; Jackie Yeager [jackie.m.yeager@cummins.com]; James Cigler [James.Cigler@Navistar.com]; Sanchez, James [sanchez.james@epa.gov]; Jeff Zsoldos [jeffrey.zsoldos@volvo.com]; Joanna Bellamy [joanna.bellamy@canada.ca]; Josephine Davidson [josephine.davidson@canada.ca]; Julie Deschatelets [Julie.deschatelets@canada.ca]; Jaw, Kathy@ARB [Kathy.Jaw@arb.ca.gov]; Wang, Lee@ARB [Lee.Wang@arb.ca.gov]; Lisa Farrell [lisa.a.farrell@cummins.com]; Matt Spears [spears.matthew@epa.gov]; Matthew R. Smith [Matt.Smith@Navistar.com]; Mike Geller [mgeller@meca.org]; O'Connor, Susan@ARB [susan.o'connor@arb.ca.gov]; Rajani Modiyani [rajani.modiyani@cummins.com]; rbrezny@meca.org; Rey Agama [agama_rey@cat.com]; Shirish Shimpi [shirish.a.shimpi@cummins.com]; Lemieux, Stephan@ARB [stephan.lemieux@arb.ca.gov]; Steve Musselman [Steven.Musselman@Daimler.com]; Thomas Lawson [Thomas@cngvc.org]; Timothy A. French [tfrench@emamail.org]; Tom Durbin [durbin@cert.ucr.edu]; Victor Miranda [victor.miranda@navistar.com]; Xavier Faucon [FauconXavier@JohnDeere.com]
CC: Heroy-Rogalski, Kim@ARB [kim.heroy-rogalski@arb.ca.gov]; Lemieux, Stephan@ARB [stephan.lemieux@arb.ca.gov]; Bartolome, Christian@ARB [Christian.Bartolome@arb.ca.gov]; Adnani, Paul@ARB [Paul.Adnani@arb.ca.gov]; Santos, Alex@ARB [Alex.Santos@arb.ca.gov]; O'Connor, Susan@ARB [susan.o'connor@arb.ca.gov]; Wang, Lee@ARB [Lee.Wang@arb.ca.gov]; Carter, Michael@ARB [michael.carter@arb.ca.gov]
Subject: Save the Date: August 2, 2018 Heavy-duty Low NOx Workgroup Meeting

Dear HD Low NOx Workgroup members,

California Air Resources Board staff is planning to have a workgroup meeting on August 2, 2018 at 10 am PST to discuss preliminary concepts on revisions to the Heavy-Duty In-Use Testing program and on early introduction of low NOx heavy-duty vehicles and advanced technology credits. The meeting will be conducted through a GoToMeeting and conference call. Agenda and other necessary information will be provided in the next few days. Let me know if you have any question regarding this workgroup meeting

Regards.

Daniel Howelti
California Air Resources Board
Mobile Source Regulatory Development Branch
On-Road Heavy-Duty Diesel Section
(626) 450-6149

HDIUT WORKGROUP SUMMARY(AUG 2, 2018)

- The moving average window (MAW) method is superior to the NTE method in ability to include a greater percentage of time and NO_x from the test data
  - Tweaks to the NTE method do not adequately cover actual operation or emissions
  - Euro VI with MAW for in-use conformity testing appears to have pushed European manufacturers to significantly reduce NOx emissions over the full duty cycle
- CARB staff proposes a MAW method similar to Euro VI(d) for the next generation HDIUT program
- CARB staff proposes enhancements to the Euro VI(d) MAW protocols:
  - The driver and test route criteria will remain the same as 40 CFR 86.1910(e) to include real world operation
  - Windows with average power or CO_2 emissions down to idle values will be considered valid windows
  - Introduction of a carbon based in-use standard and threshold (examples: g NO_x/CO_2 , g NO_x/fuel)

HDIUT: FUTURE CONCEPT SUMMARY (AUG 2, 2018)

	FUTURE CARB HDIUT
Request for testing	• EPA and CARB Requested
Engine Selection	• Max 25% engine families produced each year and 100% avg engine families over 4 year
Frequency	• Annually
Vehicle test equipment	• PEMS
Test Plan	• Mfr. Submitted for CARB approval
Driver	• Fleet driver (or manufacturer with prior CARB/EPA approval)
Route	• Regular fleet route – full test day (or manufacturer with prior CARB/EPA approval)
Method	• Moving Average Window (MAW)
Exclusions	• ambient, zero check
Window Validity	• $Pwr_{avg} \geq 10\%\ Pwr_{max}$ Include operation down to idle power or CO_2 values Include start emissions (cold, warm, and hot)
Emissions	• Work or carbon specific (may include SWRI alternative)
In Use Thresholds	• 1.5 x standard
Pass Determination	• 90th percentile emissions (or higher) below In Use Threshold • Control highest 10% and invalid windows

Color Key

*Current CFR and CCR
* Adopt from Euro VI
* CARB proposed enhancements

NEW HDIUT CONCEPTS: CARB STAFF IS CURRENTLY EVALUATING

- Start emissions compliance evaluation
  - Remove engine coolant temperature exclusions in Euro VI method to include start emissions containing windows
  - Method (I): Use a weighted hot-cold composite in-use emission rate to compare with in-use threshold
    - *Previously introduced at Aug 2nd workgroup meeting*
  - Method (II): Average of the top 10% of emitting windows and compare with the in-use threshold
- Phase in for HDIUT requirements
  - 2022: Euro VI(d) exclusions as implemented in European In-Use Conformity Testing
  - Implementation of CARB enhancements to the MAW technique
    - Applies to Low Load Cycle (LLC) certified engines

CREDIT WORKGROUP SUMMARY (AUG 2, 2018)

- NOx Credits – Averaging Banking and Trading (ABT) Program
  - California NOx emission standards would require a separate credit pool from existing federal pool
    - Portion of pre-2023 MY national credits transferred into California credit account (transferred credits expire in 5 yrs.)
    - Portion allowed to be transferred equivalent to the national credit balance at the beginning of 2023 MY multiplied by the CA sales percentage of 50-state sales in 2018-2022 MYs
    - After transfer, California and federal credits tracked separately
  - Zero Emission Powertrains (ZEPs) would produce California NOx credits with multiplier (=2)
    - ZEP must be certified to be eligible for NOx Credits
    - ZEP credit multiplier would be significantly reduced or sunset post 2030
    - ZEP credits may only be used in the averaging sets in which they were generated
    - ZEP multiplier currently at 2, but may be adjusted in consideration of other factors

UPCOMING MILESTONES

Upcoming Meetings:

- Oct 2018: Durability Demonstration/ Warranty/Useful Life/EWIR – HD Low NOx Workgroup Meeting
- Nov/Dec 2018: SWRI Advisory Groups Meeting re: Stage 1b & 2, low load cycle (LLC)
- Dec 2018: Low Load Cycle – HD Low NOx Workgroup Meeting
- Dec 2018/Jan 2019: Public Workshop
- Jan 2019: Advisory group meeting on SwRI Stage 3

Board Hearing

Workgroups

Public process

Q2 '18 | Q3 '18 | Q4 '18 | Q1 '19 | Q2 '19 | Q3 '19 | Q4 '19

Stage 1B – Re-age parts

Stage 2 – Develop/assess LLC

Stage 3 – Demonstrate low NOx on 2nd engine without turbocompound, including LLC

Stage 3b – Explore additional engine hardware options that can simultaneously reduce NOx and GHG on stage 3 engine – cylinder deactivation, turbine bypass, charge air cooler bypass & EGR cooler bypass

NREL On-Road Heavy-Duty Low-NOx Technology Cost Study

Appointment

From: Hamady, Fakhri [hamady.fakhri@epa.gov]
Sent: 8/14/2018 6:52:20 PM
To: Laroo, Chris [laroo.chris@epa.gov]; Sanchez, James [sanchez.james@epa.gov]
CC: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]

Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Volvo Response - 2016 In-Use Test Order Questions
Location: AA-Room-Office-N66-ConfRoom/AA-OTAQ-OFFICE

Start: 8/21/2018 6:00:00 PM
End: 8/21/2018 7:00:00 PM
Show Time As: Tentative

EPA Conference Call Info:

Conf. call number: Ex. 6 - Personal Privacy
Conf. ID: Ex. 6 - Personal Privacy

Message

From: Tasik Karl [karl.tasik@volvo.com]
Sent: 8/7/2018 2:06:38 PM
To: Lee, Abraham@ARB [abraham.lee@arb.ca.gov]
CC: Clever Timothy [tim.clever@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Murter Zack [zack.murter@volvo.com]; Macias, Keith@ARB [keith.macias@arb.ca.gov]; Szarnyasi, Eniko@ARB [eniko.szarnyasi@arb.ca.gov]; Latt, Jenna@ARB [Jenna.Latt@arb.ca.gov]; Castillo, Ivan@ARB [Ivan.Castillo@arb.ca.gov]; Fofie, Emmanuel@ARB [emmanuel.fofie@arb.ca.gov]; O'Cain, John@ARB [John.O'Cain@arb.ca.gov]; Avila, Juan@ARB [juan.avila@arb.ca.gov]; Trevitz Steven [steven.trevitz@volvo.com]; Hamady, Fakhri [hamady.fakhri@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
Subject: Volvo Response - 2016 In-Use Test Order Questions
Attachments: Q&As for Volvo HDIUT Data (for 2016 test order).docx

Abraham,

The following is the Volvo response to your attached July 16, 2018 question.

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

Volvo July 21, 2018 Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to? Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez? In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Volvo Response: The origin of this interpretation traces back to an EMA/Agencies (EPA & ARB)/Suppliers meeting at EPA in Ann Arbor, MI on July 15, 2014. It was at this meeting where Chris Laroo of EPA announced that the low temperature exclusions are something they do not like but reluctantly accept. Therefore, in order to incentivize low temperature emissions control, the regulators' position was to use the language "may" to denote that manufacturers may exclude low temp events that fail, but may also keep those that pass. The October 2016 amendment included a language change in the CFR Part 86.1370 which states that "you may exclude emission data". Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the amendment. Volvo has recently confirmed with Chris Laroo and James Sanchez that this interpretation is correct. They stated *"86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that 'may' exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well"* and that *" A manufacturer can choose to include or exclude any*

invalid NTE event during a test". Dr. Hamady was not involved in the discussion; however, he has reviewed the test order. In the future Volvo intends to include ARB on discussions regarding interpretation.

Karl

Karl Tasik
Principle Engineer | Certification & Compliance USA
Powertrain Engineering

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742 USA
Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, July 16, 2018 4:27 PM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven; Hamady, Fakhri
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I checked your response, and I have additional questions and comments. Those questions and comments are in the attached Word file in purple.
Please, check them out and response to those questions and comments.

If you have any questions, please let me know.

Sincerely,
Abraham

From: Lee, Abraham@ARB
Sent: Thursday, July 12, 2018 10:16 AM
To: 'Tasik Karl' <karl.tasik@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

I will check your response and data, and get back to you.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Wednesday, July 11, 2018 10:38 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: Volvo Responses - 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

The following are the Volvo responses to your June 21, 2018 questions.

Karl

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range

values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Monday, June 25, 2018 10:16 AM
To: Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB; Trevitz Steven
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Karl.

Sincerely,
Abraham

From: Tasik Karl <karl.tasik@volvo.com>
Sent: Friday, June 22, 2018 9:00 AM
To: Lee, Abraham@ARB <abraham.lee@arb.ca.gov>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Murter Zack <zack.murter@volvo.com>; Macias, Keith@ARB <keith.macias@arb.ca.gov>; Szarnyasi, Eniko@ARB <eniko.szarnyasi@arb.ca.gov>; Latt, Jenna@ARB <Jenna.Latt@arb.ca.gov>; Castillo, Ivan@ARB <Ivan.Castillo@arb.ca.gov>; Fofie, Emmanuel@ARB <emmanuel.fofie@arb.ca.gov>; O'Cain, John@ARB <John.O'Cain@arb.ca.gov>; Avila, Juan@ARB <juan.avila@arb.ca.gov>; Trevitz Steven <steven.trevitz@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

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Abraham,

Steve and I will look into your questions and provide a response after our review.

Have a good day,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

From: Lee, Abraham@ARB [mailto:abraham.lee@arb.ca.gov]
Sent: Thursday, June 21, 2018 8:16 PM
To: Trevitz Steven; Tasik Karl
Cc: Clever Timothy; Heltzel Robert; Murter Zack; Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Latt, Jenna@ARB; Castillo, Ivan@ARB; Fofie, Emmanuel@ARB; O'Cain, John@ARB; Avila, Juan@ARB
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve and/or Karl,

I am examining your data for 2016 order, especially for three vehicles tested in 2017, and have several questions/comments below:

For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.
Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

For all 3 vehicles tested in 2017,
In addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

If you have any questions, please do not hesitate to contact me.

Sincerely,
Abraham (Doh-Won)

Please note of changes of my legal name from Doh-Won Lee to Abraham Dohwon Lee and email from doh-won.lee@arb.ca.gov to abraham.lee@arb.ca.gov.

Abraham Dohwon Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731

Voice: (626) 350-6543 | Email: abraham.lee@arb.ca.gov

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From: Lee, Doh-Won@ARB
Sent: Monday, November 13, 2017 4:04 PM
To: Trevitz Steven <steven.trevitz@volvo.com>
Cc: Clever Timothy <tim.clever@volvo.com>; Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Murter Zack <zack.murter@volvo.com>
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Thanks, Steve!

Sincerely,
Doh-Won

From: Trevitz Steven [mailto:steven.trevitz@volvo.com]
Sent: Thursday, November 09, 2017 8:08 AM
To: Lee, Doh-Won@ARB
Cc: Clever Timothy; Heltzel Robert; Tasik Karl; Murter Zack
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Hello Doh-Won,

Attached are images of the instrumented exhaust elbow shown both loose and installed. The thermocouple is placed 8 inches downstream of the SCR outlet.

Best regards,
Steve Trevitz

Steven S. Trevitz
Volvo Group Trucks Technology
Powertrain Engineering
Engine Development Laboratory, Z-41
13302 Pennsylvania Ave.
Hagerstown, MD 21742 USA

Cell: 301.573.1622
E-mail: steven.trevitz@volvo.com

From: Tasik Karl
Sent: Wednesday, November 08, 2017 5:15 PM
To: Trevitz Steven
Cc: Clever Timothy; Heltzel Robert
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Steve,

Please provide a response to Doh-Won's IUT questions.

Thanks
Karl

From: Lee, Doh-Won@ARB [mailto:Doh-Won.Lee@arb.ca.gov]
Sent: Wednesday, November 08, 2017 11:00 AM
To: Tasik Karl
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

I have a couple of quick questions.

I was notified that you did not have SCR temperature monitor for the engine family, and I noticed that you put a thermocouple for measuring SCR temperature. "The exhaust elbow on the outlet of the SCR catalyst was replaced with one that accommodates a thermocouple." in the Acceptance History Text (in xml files). How far was it from the outlet of the SCR to the thermocouple? Do you have pictures showing the installation setup?

Thank you for your responses in advance.

Sincerely,
Doh-Won

From: Lee, Doh-Won@ARB
Sent: Tuesday, August 08, 2017 10:02 AM
To: 'Tasik Karl'
Cc: Macias, Keith@ARB; Szarnyasi, Eniko@ARB; Hamady, Fakhri
Subject: RE: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Karl,

Thank you for the data.
I am examining them and will contact you shortly regarding test #4.

Sincerely,
Doh-Won

Doh-Won Lee, Ph.D., P.E.
Air Resources Engineer
In-Use Compliance & Evaluation Section
In-Use Programs Branch
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
9480 Telstar Avenue, Suite 4
El Monte, CA 91731
Voice: (626) 350-6543 | Email: doh-won.lee@arb.ca.gov

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From: Tasik Karl [mailto:karl.tasik@volvo.com]
Sent: Wednesday, August 02, 2017 10:10 AM
To: Macias, Keith@ARB

Cc: Sardar, Satya@ARB; Lee, Doh-Won@ARB
Subject: Volvo 2Q 2017 Data File Shipment for the 2016 In-Use Test Order

Keith,

The Volvo 2Q 2017 In-Use Test Data for the 2016 In-Use Test Order is being shipped today via Fedex # Ex. 6 - Personal Privacy

Best Regards,
Karl

Karl Tasik
Certification & Compliance USA
Volvo Group Trucks Technology - Powertrain Engineering
13302 Pennsylvania Avenue, Zip 58
Hagerstown, MD 21742 USA

Telephone: +1 (301) 790 6774
E-mail: karl.tasik@volvo.com

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For Test ID# VPT182483,
In the test comment text (DE 265), it is written that "... NTE events with EATS-out exhaust temp below 250C that excluded NOx: 1, 38, 60, 81. NTE events with EATS-out exhaust temp below 250C that included NOx: 2, 10, 20, 21, 39, 61, 74, 75, 82, 89, 90. ..." I understand the first sentence, but I do not for the second. Please provide explanation(s) for the second sentence.

> Volvo Response: The distinction between included vs. excluded NTE events during which EATS-out temp dips below 250C stems from the §86.1370 amendment published on Oct 25, 2016 as part of the GHG-P2 rule. Volvo began making the distinction of keeping the passing results on this test order because it was the first one to be reported subsequent to the October 2016 amendment. Volvo has recently received confirmation from EPA (Chris Laroo and James Sanchez) that this interpretation is correct. As a result, going forward, Volvo will include passing data that would be otherwise excluded by the EATS-out temp criteria.

We are unclear of your interpretation allowing only passing NTE events for vehicle pass ratio (R_{pass}) while failing events are excluded. Please, let us know exactly which section(s) you referred to?
Also, please forward your communication with Chris Laroo and James Sanchez at EPA regarding your interpretation. Have you discussed with Fakhri Hamady about it or with only Chris Laroo and James Sanchez?
In the future, please include CARB in the loop regarding any HDIUT issues, confirmations, concerns, and/or problems, in order to avoid possible test data invalidation after all testing and data submission are completed.

Also, I found that "FID cessation" in the xml file and no report of THC/NMHC concentrations from about 7.2 hours after starting of the test. Please explain to us what happened to the FID and why.

> Volvo Response: The Horiba PEMS is limited by its ability to handle shock, vibration, and temperature extremes. Our testing was historically reliable when we mounted the equipment inside the truck cab. For safety and legal reasons, we converted to an external enclosure for the PEMS; and, as a result, reliability was seriously impacted. Typically, the FID will be the first to cease operation because there is a flame involved. The cessation usually stems from the motherboard or the supporting laptop. In this particular case, there was no physical damage to any equipment and, therefore, considered to be an electronic malfunction. This was the last test for our legacy PEMS utilizing the Horiba 2200. We have since commissioned 2 full AVL M.O.V.E systems which have been integrated into a frame-mount back-of-cab enclosure and successfully deployed.

Thank you for your explanation. I spoke with my colleague, John O'Cain, whom you met during his audit of the Volvo lab. He indicated that you had already been using new PEMS for HDIUT, which would eliminate these types of abnormalities and malfunction. Additionally, our expectation is that you will continue to have good QA/QC practices. Based on your explanation that the old PEMS had systematic problems, we accept the test data. However, please note that, if the same types of problems continue to occur with the new PEMS, we may not accept the test data.

For Test ID# VPT182458,
I found that the post span value of THC for Hour 5 is "942.0" while pre span value for the same hour is "485.8". Please provide explanation(s) about it. By the way, in the 1 Hz file, I do not see any THC

concentrations of 942.0 or so. Also, please explain to us how it affected drift correction of THC/NMHC during the Hour 5.

> Volvo Response: The value of "942.0" for the hour 5 post-test THC span is confirmed by checking the original instrument output files. Additionally, a review of the 10-hz raw data does confirms the occurrence of a THC spike during the span period. Similarly, the 1hz report shows the spike maximum of 822 ppm. The incident is real and any HC measurements would have likely failed drift validation had there been any NTE events during this time period.

Thank you for your explanation. As similar to the item addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 3 vehicles tested in 2017,
in addition to the above, there are many occasions showing CO zero values above 100 ppm or below -100 ppm (more than 10% of span values of about 1000 ppm) and a few occasions of NOx span drift about or above 4%. Were there any issues with PEMS analyzers? Have you performed linearity checks of the analyzers regularly within 35days of testing according to 1065.307 and 1065.303? Please provide linearity check records showing compliance for Test ID# #VPT182450, VPT182458, and #VPT182483.

> Volvo Response: The requested Gas PEMS calibrations for the subject time period are attached as a zip file. We are confident that the equipment was functioning properly. As is universally true for PEMS, the CO instrument is designed for an extremely high range. In the case of the OBS-2200, the maximum range is 10% and its minimum range is 5000 ppm. Horiba specially modified their operational software to allow the 1000 ppm range. We requested this for the safety of the test personnel and the drivers of the test vehicles over concerns of a high concentration of CO leaking. The typical NTE value for CO is 2 orders of magnitude lower than the compliance threshold. The maximum NTE levels are still less than 1 order of magnitude below the compliance threshold. We are simply trying to provide as accurate of data as possible for where the engines really emit in addition to the aforementioned safety concerns associate with handling high concentration of CO calibration gas in a field test environment. The instability at low concentrations for zero are native to the instrument. Additionally, when switched into sample mode, the compensation for water interference has an exaggerated effect at low CO concentrations. NOx is an entirely different situation. Here, we have an extremely accurate lab-grade analyzer (Chemiluminscent), but the compliance threshold is challengingly low. Our system was designed to minimize the drift error exclusions by using bottled air for zero and performing the zero/span cal on an hourly basis. Drift error exclusions for NOx are rare, but do happen. In the case of the tests under question herein, 1 NTE event out of 91 was excluded for drift error in the last test. The first 2 tests did not have any drift error exclusions; however, there we not so many NTE events in these.

Thank you for your explanation along with calibration data sent via email attachments. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

For all 6 vehicles tested,
Also, I found that minimum CO concentrations were lower than "-350" (negative 350) and maximum were all over 1,100 ppm (which, I believe, exceed span values) with a couple of extremely high CO concentrations: 57,183 ppm for Test ID# VPT918463 and 2.3E+07 ppm for Test ID# VPT182458. We have questions on CO and/or CO analyzer data quality/integrity. Please give us explanations of what happened with CO analyzers. Also, provide us CO analyzer QA/QC data.

Volvo Response: It is instructive to understand the OBS-2200 is a "wet" instrument that uses a water concentration analyzer to compensate for interference with the emissions analyzers. In the case of CO, the water correction is extremely influential. The 1hz report values for concentration are required to be raw from the analyzers. Therefore, there is no attempt to cap values that are out of limit. At low concentrations of CO, the water compensation will drive the value negative. There is, in effect, a minimum concentration for which the analyzer is useful. When there is a finite concentration of CO, the compensated reading begins to stabilize. When the instrument is calibrated on dry gas, such as the hourly span/cal period, the water compensation is inactive.

For the tests mentioned, VPT918463 had 2 highly negative spikes including the -57183 ppm and VPT18245 also had 2 highly negative spikes including the -2343300 ppm value. In all cases this was a result of the water analyzer railing due to liquid water ingestion. Since there is no capping of the raw value, it must be reported as observed. The QA/QC occurs with the subsequent post-processing in which the occurrence of out-of-range values for concentrations of emissions and water are flagged. For NTE events evidencing the railing of water concentration, the measurements are voided. The NTE analysis process flags events where the measured concentration of an emission exceeds the span value. We don't simply void the results in this case, but rather, make an engineering judgment as to whether this event could plausibly fail. If failure was deemed plausible by good engineering judgment, we would count it as a fail while still showing the measurement as invalid. The CO periodic integrity data is included as part of all the calibrations provided in response to the previous question.

Thank you for your explanation. As similar to the items we addressed above, we accept the test data based on your explanation and the fact that the old PEMS was used for the testing. For water ingestion, we recommend you take any necessary actions to prevent it from happening. Additionally, our expectation is that you will continue to have good QA/QC practices. Please note that, if the same types of problems continue to occur with the new PEMS, we may not accept your data.

Message

From: Sanchez, James [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=BDA5AFDC21DA4149B352B6423214F268-SANCHEZ, JAMES]
Sent: 5/8/2018 12:22:52 PM
To: Laroo, Chris [laroo.chris@epa.gov]; Heltzel Robert [robert.heltzel@volvo.com]
CC: Clark Taylor [taylor.clark@volvo.com]; Marley Jeffrey [jeff.marley@volvo.com]
Subject: RE: Part 86 In-Use Testing Question

9 doesn't work for me but 10 or 11 do.

James

From: Laroo, Chris
Sent: Tuesday, May 08, 2018 8:22 AM
To: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Cc: Clark Taylor <taylor.clark@volvo.com>; Marley Jeffrey <jeff.marley@volvo.com>
Subject: Re: Part 86 In-Use Testing Question

Ok. Just set it up for either 9 am, 10, or 11.

Chris

From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Tuesday, May 8, 2018 8:12 AM
To: Laroo, Chris; Sanchez, James
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question

Chris,

That will work for us here. Would you like to set up a WebEx or Skype meeting so that we could share some information with you? The meeting should not take long.

Thanks,

Rob

From: Laroo, Chris [mailto:laroo.chris@epa.gov]
Sent: Tuesday, May 08, 2018 6:58 AM
To: Heltzel Robert; Sanchez, James
Cc: Clark Taylor; Marley Jeffrey
Subject: Re: Part 86 In-Use Testing Question

Rob,

I have time on Wednesday. Would something in the morning work for you?

Chris

From: Heltzel Robert <robert.heltzel@volvo.com>
Sent: Monday, May 7, 2018 4:05 PM
To: Sanchez, James; Laroo, Chris
Cc: Clark Taylor; Marley Jeffrey
Subject: RE: Part 86 In-Use Testing Question

James and Chris,

Would you gentlemen have some time this week to review a quick analysis of NTE event evaluation based on our previous conversations?

Thanks,

Rob

From: Clark Taylor
Sent: Monday, April 16, 2018 8:31 AM
To: Sanchez, James; Laroo, Chris
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

James,

Thank you very much for the quick response on this.

Best regards,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor

Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology

13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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Message

From: Sanchez, James [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=BDA5AFDC21DA4149B352B6423214F268-SANCHEZ, JAMES]
Sent: 4/19/2018 1:28:45 PM
To: Clark Taylor [taylor.clark@volvo.com]
CC: Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: Part 86 In-Use Testing Question

No I meant (h). Paragraph (h) covers the other exclusion criteria not covered in paragraph (g).

(h) Any emission measurements corresponding to engine operating conditions that do not qualify as a valid NTE sampling event may be excluded from the determination of the vehicle-pass ratio specified in § 86.1912 for the specific pollutant.

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Thursday, April 19, 2018 9:25 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

Thanks for getting back to me. Did you mean paragraph (f)?

BR,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Thursday, April 19, 2018 9:11 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
Yes, paragraph (h) covers the rest of the NTE exclusion criteria and allows you to include those points in your vehicle-pass ratio determination.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

Hey James,

One more question for you just for completeness. Would the same logic apply to paragraph (f), which is the IMT/IMP exclusion?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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Message

From: Sanchez, James [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=BDA5AFDC21DA4149B352B6423214F268-SANCHEZ, JAMES]
Sent: 4/19/2018 1:11:01 PM
To: Clark Taylor [taylor.clark@volvo.com]
CC: Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: Part 86 In-Use Testing Question

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From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Wednesday, April 18, 2018 8:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

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Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
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Sent: Monday, April 16, 2018 10:00 AM
To: Clark Taylor
Cc: Laroo, Chris
Subject: RE: Part 86 In-Use Testing Question

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A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

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Sent: Monday, April 16, 2018 9:40 AM

To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

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Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

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From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

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Subject: Re: Part 86 In-Use Testing Question

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To: Laroo, Chris
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Taylor Clark
Emissions Compliance Engineer
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Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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Message

From: Sanchez, James [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=BDA5AFDC21DA4149B352B6423214F268-SANCHEZ, JAMES]
Sent: 4/18/2018 11:42:31 AM
To: Berry Steve [steve.berry@volvo.com]; Heltzel Robert [robert.heltzel@volvo.com]; Tasik Karl [karl.tasik@volvo.com]; Moulis, Charles [moulis.charles@epa.gov]; Mitchell, George [Mitchell.George@epa.gov]; Cullen, Angela [cullen.angela@epa.gov]; Marley Jeffrey [jeff.marley@volvo.com]; Clark Taylor [taylor.clark@volvo.com]; Miller Marc [marc.miller@volvo.com]; Nelson, Brian [nelson.brian@epa.gov]
CC: Matthew Spears (MSpears@emamail.org) [MSpears@emamail.org]
Subject: RE: Volvo/EPA/EMA bi-weekly conference calls

Hi Steve,
We don't have any materials that we can share with you today, but we can certainly have a discussion. Also, we don't have any additional items for this call.

Regards,
James

From: Berry Steve [mailto:steve.berry@volvo.com]
Sent: Wednesday, April 18, 2018 7:17 AM
To: Heltzel Robert <robert.heltzel@volvo.com>; Tasik Karl <karl.tasik@volvo.com>; Moulis, Charles <moulis.charles@epa.gov>; Mitchell, George <Mitchell.George@epa.gov>; Cullen, Angela <cullen.angela@epa.gov>; Sanchez, James <sanchez.james@epa.gov>; Marley Jeffrey <jeff.marley@volvo.com>; Clark Taylor <taylor.clark@volvo.com>; Miller Marc <marc.miller@volvo.com>; Nelson, Brian <nelson.brian@epa.gov>
Cc: Matthew Spears (MSpears@emamail.org) <MSpears@emamail.org>
Subject: RE: Volvo/EPA/EMA bi-weekly conference calls

Sorry this request is late....

In today's meeting, I would like to discuss the need for an understanding from EPA the scope and timeline of activities that are informative to a NOx rule. Don't need the info today, but it's becoming crucial for industry to determine the plan by which we can derail a 0.02g FTP standard, and EMA's activities are delayed somewhat. If some information about these EPA programs can be made available....

Any other topics for discussion today?
[Matt Spears cannot join today]

-----Original Appointment-----
From: Berry Steve
Sent: Tuesday, January 02, 2018 1:08 PM
To: Berry Steve; Heltzel Robert; Tasik Karl; Moulis, Charles; mitchell.george@epa.gov; Cullen, Angela; sanchez.james@epa.gov; Marley Jeffrey; Clark Taylor; Miller Marc; Nelson, Brian
Subject: Volvo/EPA/EMA bi-weekly conference calls
When: Wednesday, April 18, 2018 10:00 AM-11:00 AM (UTC-05:00) Eastern Time (US & Canada).
Where: CALL IN: (877) 748-8068 ID: 963164452 / Skype Meeting

CALL IN: Ex. 6 - Personal Privacy **ID:** Ex. 6 - Personal Privacy → Join Skype Meeting

Hello
A 2018 continuation of recurring calls. Set up now for every other week.
Agenda items will be requested/proposed for each meeting.

Steve Berry

Steve Berry
Director, Regulatory Affairs NA
Volvo Group Trucks Product Planning

2900 K St NW
House of Sweden, Suite 410
Washington, DC 20007
Office 202-536-1557
Cell. 301-660-0037
steve.berry@volvo.com

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Message

From: Sanchez, James [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=BDA5AFDC21DA4149B352B6423214F268-SANCHEZ, JAMES]
Sent: 4/16/2018 1:59:32 PM
To: Clark Taylor [taylor.clark@volvo.com]
CC: Laroo, Chris [laroo.chris@epa.gov]
Subject: RE: Part 86 In-Use Testing Question

Taylor,
A manufacturer can choose to include or exclude any invalid NTE event during a test.

James

From: Clark Taylor [mailto:taylor.clark@volvo.com]
Sent: Monday, April 16, 2018 9:40 AM
To: Sanchez, James <sanchez.james@epa.gov>
Cc: Laroo, Chris <laroo.chris@epa.gov>
Subject: RE: Part 86 In-Use Testing Question

James,

Thanks again for getting back to me on this question. After a brief discussion with my group, they wanted me to get some more clarification.

So, just to confirm that I'm interpreting what you said correctly, a manufacturer can choose to include or exclude any invalid events during a test? Or do you have to either include or exclude all invalid events during the test?

Thanks,
Taylor

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

From: Sanchez, James [mailto:sanchez.james@epa.gov]
Sent: Monday, April 16, 2018 8:23 AM
To: Laroo, Chris; Clark Taylor
Cc: Heltzel Robert
Subject: RE: Part 86 In-Use Testing Question

Clark,
86.1370 (g)&(h) were added in the HD GHG P2 rule to clarify that "may" exclude invalid NTE events from the determination of the vehicle-pass ratio. So you can choose you include these points as well.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

Clark,

I am in the UK on travel. It would probably be easiest if you tried James Sanchez first. He can be reached at (734) 214-4439.

Chris

From: Clark Taylor <taylor.clark@volvo.com>
Sent: Thursday, April 12, 2018 8:31 AM
To: Laroo, Chris
Cc: Heltzel Robert
Subject: Part 86 In-Use Testing Question

Hi Chris,

Do you have time for a quick call this morning? I have a question for you regarding interpretation of 86.1370.

Please let me know when would be best to call.

Thanks,

Taylor Clark
Emissions Compliance Engineer
Certification and Compliance USA

Volvo Group Trucks Technology
13302 Pennsylvania Avenue
Hagerstown, MD 21742
Work: +1 (240)500-4036
Email: taylor.clark@volvo.com

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Sent: 4/16/2018 12:23:17 PM
To: Laroo, Chris [laroo.chris@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
CC: Heltzel Robert [robert.heltzel@volvo.com]
Subject: RE: Part 86 In-Use Testing Question

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To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
Subject: Re: Part 86 In-Use Testing Question

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Sent: 4/12/2018 8:18:27 PM
To: Laroo, Chris [laroo.chris@epa.gov]; Clark Taylor [taylor.clark@volvo.com]
CC: Heltzel Robert [robert.heltzel@volvo.com]
Subject: RE: Part 86 In-Use Testing Question

Clark,
I believe that I have the answer to your question but since I wasn't involved in the drafting of 86.1370 (g) and (h) I will need to check with Chris when he is back in the office.

Regards,
James

From: Laroo, Chris
Sent: Thursday, April 12, 2018 10:00 AM
To: Clark Taylor <taylor.clark@volvo.com>
Cc: Heltzel Robert <robert.heltzel@volvo.com>; Sanchez, James <sanchez.james@epa.gov>
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