



SAE TC-1 Open Forum: Improving Emission System Compatibility of Passenger Car Motor Oils

- 📍 **When: April 17, 2007**
- 📍 **Time: 2 – 5 pm**
- 📍 **Where: SAE Annual Congress**
- 📍 **Location: Cobo Hall, Detroit, MI**
- 📍 **Forum Organizer: Greg Guinther, Afton Chemical**

SPEAKERS NEEDED FOR FOLLOWING TOPICS:

- 1. Current and future emission regulations**
- 2. The need for engine oil related improvements in emission system compatibility**
- 3. Advancements in emission control technology**
- 4. Susceptibility of emission controls to oil-related contamination**
- 5. Trade-offs between engine protection and emission system protection**
- 6. Catalyst Contamination profiles**
- 7. Test methods to assess the compatibility of PCMO's with advanced emission controls**



Afton “Phosphorus Merit” Approach to GF-5

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The  symbol is a service mark of Afton Chemical Corporation.

A Passion for Solutions.



Concept

- A system that takes into account the two mechanisms of phosphorus-based catalyst poisoning
 1. Phosphorus consumption through bulk oil consumption (past rings and valve stems)
 2. Volatile phosphorus depletion (through PCV and evaporation from cylinder walls)

- 1. Traditionally we have set limits on maximum allowable phosphorus in new oil, and thereby focusing on BULK oil consumption

- 2. We are now attempting to control volatile phosphorus depletion based on observations from severe-service field testing and high-temperature engine testing

- This Phos Merit system is a way to control both routes of phosphorus entry into the catalytic converter

- It would give formulators lee-way to formulate low-P oils with higher volatility, or high-P oils with low volatility



Phosphorus Merit System

Concept is to provide a means of improving catalyst system protection either by finished oil phosphorus level or phosphorus volatility or a combination of the two.

Proposed analysis tool is a merit system that provides:

- ▲ **A specified merit weighting for P level and P volatility**
- ▲ **A specified range for P level and P volatility**
- ▲ **Data for P volatility can be generated from a bench test that has been correlated to an engine or the field**
- ▲ **Ability to relate candidate performance to “best” and “worst” in class reference oils**
- ▲ **Flexibility for oil formulations**

Phosphorus Merit System Strawman

An example of a possible P merit system based on EOT IIIIG P volatility:

Phosphorus Merit System	Minimum	Anchor	Maximum	Weight
Phosphorus Level, wt %	0.05	0.08	0.10	500
EOT IIIIG P Volatility, grams	0.5	1.1	1.6	500

Equal merit weighting chosen for P content and P volatility. This can be changed depending on relative importance of one parameter over the other.

Minimum, Anchor, and Maximum values chosen from TMC reference oil and commercial candidate oil experience. This proposal would allow and encourage oils down to 0.05 wt% P level.

Calculations:

- If candidate value equals the minimum, merit = 2x the weight
- If candidate value equals the anchor, merit = 1x the weight
- If candidate value equals the maximum, merit = 0x the weight
- If candidate value falls between two points, extrapolate the merit value
- 1,000 merits minimum required for passing result

Phosphorus Merit System Strawman

Oil	P Level, wt%	EOT IIIG P Vol, g	P Level Merit	P Vol Merit	Total Merits
TMC 434	0.08	1.13	500	470	970
TMC 435	0.08	0.78	500	767	1267
TMC 438	0.1	1.25	0	350	350
Oil A 5W-20	0.046	0.5	1067	1000	2067
Oil B 5W-20	0.073	0.996	617	604	1221
Oil C 5W-30	0.046	0.506	1067	995	2062
Oil D 5W-30	0.073	0.996	617	604	1221
Oil E 10W-30	0.073	0.867	617	694	1311

Above spreadsheet provides details on how the merits are calculated.

This allows TMC 434 to be borderline fail and TMC 435 to be passing oil as desired by ESCIT. TMC 438 is by definition a failing oil due to 0.1 % P level.

Details of how to handle oils falling outside the minimum and maximum merit range would need to be determined.



We Need a Bench Test

- ▶ **The Sequence III G variability is too great**
- ▶ **We need a bench test that correlates to the field as well as our known engine tests like the III G**
- ▶ **Candidates:**
 - ▶ Savant PEI165
 - ▶ Rohmax ROBO
 - ▶ CIBA VIT