CODE BULLETIN C-54

American Chemistry Council
Product Approval Code of Practice
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To: **Practitioners of the American Chemistry Council Product Approval Code of Practice Interested Parties**

Original Issue date: **September 21, 2017**

Effective Date: **October 20, 2017**

Re: **Appendix F Revision- Defining MTEP for the Sequence IIIH, Sequence IIIHA, Sequence IIIHB, Sequence VIE, Sequence VIF Product Approval Code of Practice – December 2010 Edition**

The American Chemistry Council's (ACC) Product Approval Protocol Task Group (PAPTG) reached consensus to revise Appendix F for the purpose of defining Multiple Test Evaluation Procedures (MTEP) for the Sequence IIIH, Sequence IIIHA, Sequence IIIHB, Sequence VIE, Sequence VIF engine tests. Existing text and proposed edits to Appendix F are provided below.

Existing Text on Page F-4 through F-7

Test	Type of MTEP	Parameter (Units) (note 1)
Sequence IIIF	MTAC MTAC MTAC MTAC (note 2)	*Kinematic Viscosity (% increase at 40° C*) Avg. piston skirt varnish (merits) Weighted piston deposit (merits) Screened avg. cam plus lifter wear (µm) Hot stuck rings
Sequence IIIFHD	MTAC	*Kinematic Viscosity @ 60 h* (% increase)

Sequence IIIG	MTAC MTAC MTAC (note 2)	*Kinematic Viscosity (% increase at 40° C*) Weighted piston deposit (merits) *Avg. cam plus lifter wear (µm)* Hot stuck rings
Sequence IIIGA	None	No MTEP, No MTAC
Sequence IIIGB	MTAC	Phosphorus retention (%)
Test	**Type of MTEP**	**Parameter (Units) (note 1)**
Sequence IVA	MTAC	Avg. cam wear (µm)
Sequence VG	MTAC MTAC MTAC MTAC MTAC (note 3)	Avg. engine sludge (merits) Rocker arm cover sludge (merits) Avg. piston skirt varnish (merits) Avg. engine varnish (merits) *Oil screen clogging (%)* Hot stuck compression rings
Sequence VIB	MTA MTA MTAC	FEI 1 (%) FEI 2 (%) FEI 1 + FEI 2 (%)
Sequence VID	MTA MTA MTA	FEI 2 (%) FEI SUM (%) FEI 1 + FEI 2 (%)
Sequence VIII	MTAC	Bearing weight loss (mg)
Caterpillar 1K	TLM TLM TLM TLM (note 4) (note 5)	WDK (demerits) Top Groove Fill (%) *Top Land Heavy Carbon (%)* Avg. Oil Consumption (g/kW·h) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1MPC (note 5)	MTAC (note 6) MTAC (note 4) (note 7)	WTD (demerits) Top Groove Fill (%) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1N	TLM TLM TLM TLM (note 4) (note 5)	WDN (demerits) Top Groove Fill (%) *Top Land Heavy Carbon (%)* Oil Consumption (g/kWh) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)

Caterpillar 1P	TLM TLM TLM TLM TLM (note 5)	WDP (demerits) Top Groove Carbon (demerits) Top Land Carbon (demerits) *Avg. Oil Consumption (0-360h) (g/h) Final* *Oil Consumption (312-360h) (g/h)* Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1R	TLM TLM TLM TLM TLM (note 5)	WDR (demerits) Top Groove Carbon (demerits) Top Land Carbon (demerits) Avg. Initial (0-252 h) Oil Consumption (g/h) Avg. Final (432-504 h) Oil Consumption (g/h) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar C13	MRS (note 4) (note 8)	Caterpillar C13 Merits *Delta Oil Consumption (g/*h) Average Top Land Carbon (Demerits) Average Top Groove Carbon (Demerits) *Second Ring Top Carbon (Demerits)*

Test	**Type of MTEP**	**Parameter (Units) (note 1)**
Cummins ISM	MRS (note 8) TLM	Cummins ISM Merits Crosshead Weight Loss (mg) Injector Screw Wear (mg) *Oil Filter Pressure Delta (kPa)* Sludge (merits) Top Ring Weight Loss (mg)
Cummins ISB	TLM TLM	Average Camshaft Wear (µm) Average Tappet Weight Loss (mg)
Mack T-8	TLM TLM TLM	Viscosity Increase at 3.8% soot (cSt) Filter Plugging, Differential Pressure (kPa) Oil Consumption (g/kWh)
Mack T-8E	TLM TLM	Viscosity Increase at 3.8% soot (cSt) Relative Viscosity at 4.8% soot (unitless number)
Mack T-11	TLM	TGA % Soot @ 4.0 cSt increase @ 100° C TGA % Soot @ 12.0 cSt increase @ 100° C TGA % Soot @ 15.0 cSt increase @ 100° C
Mack T-12 (note 9)	TLM	Liner Wear, µm Top Ring Mass Loss, mg Lead Content at EOT, mg/kg
Mack T-12 (note 10)	MRS	Cylinder Liner Wear, µm Top Ring Mass Loss, mg Delta Lead, Final, mg/kg
Mack T-12 (note 11)	MTAC (note 12)	Top Ring Mass Loss, mg Cylinder Liner Wear, µm

Volvo T-13	TLM	IR Peak at EOT, Abs., cm^{-1} Kinematic Viscosity Increase at 40°C, %
COAT	MTAC (note 12)	Average Aeration, 40h to 50h, %

Notes:

1) Units for parameters in italics are transformed. See next section for specific transformations.
2) The majority of retained tests must not have ring sticking (hot stuck).
3) The majority of retained tests must not have compression ring sticking (hot stuck).
4) None of the retained tests may have piston ring sticking.
5) If three or more operationally valid tests have been run, the majority of these tests must not have scuffing. Any scuffed tests are considered non-interpretable, and no data from these tests are to be used in MTEP calculations.
6) Two methods of calculating WTD are used, one for API Category CF and a different one for API Category CF-2. Both methods use MTAC for handling test results.
7) None of the retained tests may have piston, ring or liner scuffing.
8) The parameters used in calculating the Merit Rating value are shown.
9) This TLM applies to Mack T-12 used in API Category CH-4.
10) This MRS applies to Mack T-12 used in API Category CI-4 and CJ-4.
11) This MTAC applies to Mack T-12 used in API Category CK-4 and FA-4.
12) The MTAC provision to discard any valid test result is not applicable (See Appendix F, pg. F-3, Three or More Tests, Number 2).

List of Transformations of Rated Parameters

Test	**Parameter**	**Transformation**
Sequence IIIF	Viscosity, % Increase	1/square root of the % increase at 80 hours
Sequence IIIFHD	Viscosity, % Increase	LN (PVISH060)
Sequence IIIG	Viscosity, % Increase Avg. cam plus lifter wear	LN (PVISH100) LN (ACLW)
Sequence VG	Oil Screen Clogging	LN (oil screen clogging +1)
Caterpillar 1K	Top Land Heavy Carbon	LN (TLHC + 1)
Caterpillar 1N	Top Land Heavy Carbon	LN (TLHC + 1)
Caterpillar 1P	Average Oil Consumption Final Oil Consumption	LN (AOC) LN (FOC)
Caterpillar C13	Delta Oil Consumption (g/h) Second Ring Top Carbon	Square root (Delta OC) LN(R2TC)
Mack T-12	Delta Pb @ EOT Delta Pb 250 to 300 hours Oil Consumption	LN (DPbEOT) LN (DPb250300) LN (OC)
Cummins ISM	Oil Filter Pressure Delta	LN (OFDP)

Volvo T-13	Kinematic Viscosity Increase at 40°C	Square root (KV40)

Proposed Text on Page F-6 through F-7

Test	Type of MTEP	Parameter (Units) (note 1)
Sequence IIIF	MTAC MTAC MTAC MTAC (note 2)	*Kinematic Viscosity (% increase at 40° C*) Avg. piston skirt varnish (merits) Weighted piston deposit (merits) Screened avg. cam plus lifter wear (µm) Hot stuck rings
Sequence IIIFHD	MTAC	*Kinematic Viscosity @ 60 h* (% increase)
Sequence IIIG	MTAC MTAC MTAC (note 2)	*Kinematic Viscosity (% increase at 40°C*) Weighted piston deposit (merits) *Avg. cam plus lifter wear (µm)* Hot stuck rings
Sequence IIIGA	None	No MTEP, No MTAC
Sequence IIIGB	MTAC	Phosphorus retention (%)
Sequence IIIH	MTAC MTAC	*Kinematic Viscosity (% increase at 40° C)* Weighted piston deposit (merits)

Test	Type of MTEP	Parameter (Units) (note 1)
Sequence IIIHA	MTAC	*MRV Viscosity (%)*
Sequence IIIHB	MTAC	Phosphorus retention (%)
Sequence IVA	MTAC	Avg. cam wear (µm)
Sequence VG	MTAC MTAC MTAC MTAC MTAC (note 3)	Avg. engine sludge (merits) Rocker arm cover sludge (merits) Avg. piston skirt varnish (merits) Avg. engine varnish (merits) *Oil screen clogging (%)* Hot stuck compression rings
~~Sequence VIB~~	~~MTAC~~ ~~MTAC~~ ~~MTAC~~	~~FEI 1 (%)~~ ~~FEI 2 (%)~~ ~~FEI 1 + FEI 2 (%)~~
Sequence VID	MTAC MTAC ~~MTAC~~	FEI 2 (%) FEI SUM (%) ~~FEI 1 + FEI 2 (%)~~

Sequence VIE	MTAC MTAC	FEI 2 (%) FEI SUM
Sequence VIF	MTAC MTAC	FEI 2 (%) FEI SUM
Sequence VIII	MTAC	Bearing weight loss (mg)
Caterpillar 1K	TLM TLM TLM TLM (note 4) (note 5)	WDK (demerits) Top Groove Fill (%) *Top Land Heavy Carbon (%)* Avg. Oil Consumption (g/kW·h) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1MPC (note 5)	MTAC (note 6) MTAC (note 4) (note 7)	WTD (demerits) Top Groove Fill (%) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1N	TLM TLM TLM TLM (note 4) (note 5)	WDN (demerits) Top Groove Fill (%) *Top Land Heavy Carbon (%)* Oil Consumption (g/kWh) Piston Ring Sticking (yes or no) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1P	TLM TLM TLM TLM TLM (note 5)	WDP (demerits) Top Groove Carbon (demerits) Top Land Carbon (demerits) *Avg. Oil Consumption (0-360h) (g/h)* *Final Oil Consumption (312-360h) (g/h)* Piston, Ring and Liner Scuffing (yes or no)
Caterpillar 1R	TLM TLM TLM TLM TLM (note 5)	WDR (demerits) Top Groove Carbon (demerits) Top Land Carbon (demerits) Avg. Initial (0-252 h) Oil Consumption (g/h) Avg. Final (432-504 h) Oil Consumption (g/h) Piston, Ring and Liner Scuffing (yes or no)
Caterpillar C13	MRS (note 4) (note 8)	Caterpillar C13 Merits *Delta Oil Consumption (g/*h) Average Top Land Carbon (Demerits) Average Top Groove Carbon (Demerits) *Second Ring Top Carbon (Demerits)*

Test	**Type of MTEP**	**Parameter (Units) (note 1)**

Cummins ISM	MRS (note 8) TLM	Cummins ISM Merits Crosshead Weight Loss (mg) Injector Screw Wear (mg) *Oil Filter Pressure Delta (kPa)* Sludge (merits) Top Ring Weight Loss (mg)
Cummins ISB	TLM TLM	Average Camshaft Wear (µm) Average Tappet Weight Loss (mg)
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Mack T-12 (note 10)	MRS	Cylinder Liner Wear, µm Top Ring Mass Loss, mg ~~Delta Lead, Final, mg/kg~~ *Delta Pb @ EOT, mg/kg* *Delta Pb 250 to 300 hours, mg/kh* *Oil Consumption, g/hr*
Mack T-12 (note 11)	MTAC (note 12)	Top Ring Mass Loss, mg Cylinder Liner Wear, µm
Volvo T-13	TLM	IR Peak at EOT, Abs., cm^{-1} *Kinematic Viscosity Increase at 40°C, %*
COAT	MTAC (note 12)	Average Aeration, 40h to 50h, %

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Mack T-12	Delta Pb @ EOT Delta Pb 250 to 300 hours Oil Consumption	LN (DPbEOT) LN (DPb250300) LN (OC)
Cummins ISM	Oil Filter Pressure Delta	LN (OFDP)
Volvo T-13	Kinematic Viscosity Increase at 40°C	Square root (KV40)
Sequence IIIH	Kinematic Viscosity (% increase at 400 C)	LN (PVIS)
Sequence IIIHA	MRV Viscosity (%)	LN(MRV)

The Code is available online at http://www.americanchemistry.com/paptg. Comments to this Code Bulletin (C-54) should be sent to the PAPTG Manager W.D. (Doug) Anderson prior to October 20, 2017.