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Test Monitoring Center

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Sequence IIIF Information Letter 13-2
Sequence No. 36
May 9, 2013

ASTM consensus has not been obtained on this information letter. An appropriate ASTM ballot will be issued in order to achieve such consensus.

TO: Sequence III Mailing List

SUBJECT: Use of Hours to 275 % Viscosity Increase

During the April 2, 2013 Sequence III Surveillance Panel meeting, the panel agreed to utilize Hours to 275 % Viscosity Increase to determine reference test acceptability and to correct non-reference oil results for bias. Percent Viscosity Increase is no longer a pass-fail parameter for reference oil tests. It remains a non-reference oil test pass-fail parameter. Section 12.7.9 has been added to define the methods and calculations needed to determine Hours to 275 % Viscosity Increase and to adjust non-reference oil results for bias. Appendix X1 has also been revised to adjust Sequence IIIFHD Percent Viscosity Increase results at 60 h for bias using a similar technique.

The attached new and revised sections of Test Method D6984 are effective May 14, 2013.

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Attachments

c: ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceiii/procedure_and_ils/IIIF/IL13-2.pdf

Distribution: Electronic Mail

12.7.9 Determine the slope of percent viscosity increase beginning at the interval of (30 to 40) h and continuing to calculate at 10 h intervals using the following equation:

$$Slope_t = \left(\frac{\sqrt{PVIS_t} - \sqrt{PVIS_{t-10}}}{10}\right)$$

Where *t* is time in hours (40, 50, 60, 70, 80) and $PVIS$ = Percent Viscosity Increase at denoted hour.

12.7.9.1 If a reference oil test obtains an end of test percent viscosity increase result of 275 % or greater, convert to Hours to 275 % Viscosity Increase by the following Method 1:

(1) Determine the distance in hours from where 275 % viscosity increase occurs to the previous 10 h interval:

$$Distance = \left(\frac{\left(\sqrt{275}\,\% - \sqrt{PVIS_{t-10}}\right)}{Slope_t}\right)$$

Where *t* defines the 10 h increment hour that is greater than where the 275 % Viscosity Increase occurs or hour 80 if the 275 % Viscosity Increase occurs at end of test.

(2) Calculate Hours to 275 % Viscosity Increase as:

$$Hours\ to\ 275\,\%\ Viscosity\ Increase\ = (t - 10) + Distance$$

Where *t* - *10* < the hour where 275 % Viscosity Increase occurred ≤ *t*.

12.7.9.2 If a reference oil test obtains a $Slope_t$ < 0.000 before 70 h, convert to Hours to 275 % Viscosity Increase using the following Method 2 unless Method 1 criteria is met:

$$Hours\ to\ 275\,\%\ Viscosity\ Increase = \left(\frac{\sqrt{275}\,\% - \sqrt{PVIS_{80}}}{r}\right) + 80$$

Where *r* = the larger of the $Slope_{80}$ or 0.42.

12.7.9.3 If a reference oil test obtains a $Slope_{80}$ < 0.000, convert to Hours to 275 % Viscosity Increase using the following Method 3 unless Method 1 criteria is met:

(1) Determine the test hours for bottom out slope of -0.15 using the following:

$$Additional\ Hours(AH) = \frac{-0.15 - r}{-0.015}$$

Where r = the larger of -0.15 or $Slope_{80}$

(2) Determine percent viscosity increase at the bottom out point:

$$\sqrt{PVIS_{BottomOut}} = \sqrt{PVIS_{80}} + (AH * -0.15)$$

(3) Calculate Hours to 275 % Viscosity Increase as follows:

$$Hours\ to\ 275\%\ \ Viscosity\ Increase = \left(\frac{\sqrt{275}\% - \sqrt{PVIS}_{BottomOut}}{0.42}\right) + 80 + AH$$

12.7.9.4 If a reference oil test does not have a negative percent viscosity increase slope ($Slope_t < 0.000$) during any interval (30-40, 40-50, 50-60, 60-70, and 70-80) convert to Hours to 275 % Viscosity Increase using the following Method 4 unless Method 1 criteria is met:

(1) Estimate the slope for (80 to 90) h as follows;

$$Slope_{90} = \left(0.0408 * ln(r)\right) + 0.1022$$

Where $ln()$ is the natural log and r = the larger of 0.002 or $Slope_{80}$

(2) Calculate the Square Root Percent Viscosity Increase at 90 h using the following;

$$\sqrt{PVIS}_{90} = \left(\sqrt{PVIS_{80}}\right) + 10 * Slope_{90}$$

(3) Determine additional hours to bottom out using the following:

$$Additional\ Hours(AH) = \frac{-0.15 - r}{-0.015}$$

Where r = the larger of -0.15 or $Slope_{90}$

(4) Calculate new percent viscosity increase at bottom out:

$$\sqrt{PVIS_{BottomOut}} = \sqrt{PVIS_{90}} + (AH * -0.15)$$

(5) Calculate Hours to 275 % Viscosity Increase as follows:

$$Hours\ to\ 275\%\ \ Viscosity\ Increase = \left(\frac{\sqrt{275}\% - \sqrt{PVIS}_{BottomOut}}{0.42}\right) + 90 + AH$$

12.7.9.5 For reference oil tests completing on or after June 13, 2010 using reference oil 433-1, adjust the Hours to 275 % Viscosity Increase result that was calculated by the above sections by adding 10 h.

12.7.9.6 For non reference oil tests, adjust results by performing the following steps and utilizing an industry correction factor of 10 h:

(1) Determine the interpolation point in hours for EOT viscosity increase:
Interpolation Point in Hours (IPH) = Test Length – Hours to 275 % Viscosity Increase Industry Correction Factor – Lab SA for Hours to 275 % Viscosity Increase

Or

Interpolation Point in Hours (IPH) = 80 – 10 – Lab SA

(2) Find t, where t -10 < $IPH \leq t$ for example if IPH in 12.7.9.6 (1) is 64.7 hours then t = 70 h and t -10 is 60 h.

(3) Calculate Final Corrected Percent Viscosity Increase by interpolation as follows:

$$PVIS_{Final} = \left(x * \sqrt{PVIS_{t-10}} + y * \sqrt{PVIS_t}\right)^2$$

Where $x = (t - IPH)/10$ and y = 1- x and t -10 < $IPH \leq t$

Appendix X1 Sequence IIIF HD Test

X1.3.3 Calculate SA for percent viscosity increase at 60 h for all Sequence IIIF reference oil tests by multiplying the 80 h IIIF SA by 0.5. Adjust results by performing the following steps and utilizing an industry correction factor of 5 h:

(1) Determine the interpolation point in hours for EOT viscosity increase:
Interpolation Point in Hours (IPH) = Test Length – Hours to 275 % Viscosity Increase Industry Correction Factor – Lab SA for Hours to 275 % Viscosity Increase

Or

Interpolation Point in Hours (IPH) = 60 – 5 – Lab SA

(2) Find t, where t -10< $IPH \leq t$ for example if IPH in X1.3.3 (1) is 54.7 hours then t = 60 h and t -10 is 50 h.

(3) Calculate Final Corrected Percent Viscosity Increase by interpolation as follows:

$$PVIS_{Final} = \left(x * \sqrt{PVIS_{t-10}} + y * \sqrt{PVIS_t}\right)^2$$

Where $x = (t - IPH)/10$ and y = 1- x and t -10 < $IPH \leq t$