

NAVISTAR, INC.		
CEMS (CORPORATE ENGINEERING MATERIAL SPECIFICATION)		NUMBER: CEMS BT-40
TITLE: Determination Of Equilibrium Boiling Range And High Boiling Impurities in Air Conditioner Refrigerant		CURRENT ISSUE DATE: August 2009
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<i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i>		
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1.0 SCOPE

This is a method for determining the boiling range, defined by the boiling points at 5% and 85% evaporation, and the volume percentage of high boiling impurities in air conditioner refrigerant. (This method is adapted from "Methods of Analysis for Fluorocarbon Refrigerants," Du Pont, Inc., Test Method B-8.)

2.0 APPARATUS

- 2.1 Thermometer, ASTM E-1, 62C or equivalent.
- 2.2 Centrifuge tube, De Laval 14209.
- 2.3 Two constant temperature baths capable of maintaining $25 \pm 1^{\circ}\text{C}$ and $0 \pm 1^{\circ}\text{C}$, respectively.
- 2.4 22 gage (0.6 mm) nichrome wire.
- 2.5 Barometer readable to 0.1 mm.
- 2.6 Timer capable of measuring 30 ± 0.1 minutes.

3.0 PROCEDURE

- 3.1 Record the barometric pressure to ± 0.1 mm.
- 3.2 Fill a De Laval centrifuge tube to the 100 milliliter mark with liquid sample.
- 3.3 Suspend the thermometer in the tube to the 15 milliliter mark and insert the nichrome wire alongside the thermometer. The wire should extend to the tip of the tube. See Figure, page 3.
- 3.4 Immerse the tube to the 0.05 milliliter mark in a constant temperature bath at $25 \pm 1^{\circ}\text{C}$.
- 3.5 Observe and record the boiling temperature when the volume has diminished to the 95 milliliter mark (5% evaporation) and again at the 15 milliliter mark (85% evaporation).
- 3.6 Remove the tube and reimmerse to the 0.05 milliliter mark in a constant temperature bath at $0 \pm 1^{\circ}\text{C}$.
- 3.7 Allow the remainder of the sample to evaporate for 30 ± 0.1 minutes. Then read and record the volume of high boiling impurities remaining to ± 0.001 milliliter. As evaporation approaches the 0.05 milliliter mark, remove the nichrome wire to facilitate reading of the impurities.

4.0 CALCULATIONS

- 4.1 Calculate the boiling point and range at standard pressure (760 mm) for the 95 milliliter (5%) and 15 milliliter (85%) evaporation points by applying the suitable correction factor for different barometric pressures as shown in the table on page 2.

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CALCULATIONS (Continued)

Barometric Pressure, mm	Temperature Correction °C		Barometric Pressure, mm	Temperature Correction °C		Barometric Pressure, mm	Temperature Correction °C
730	+0.50		750	-0.10		764	-0.55
731	+0.47		751	-0.13		766	-0.58
732	+0.44		752	-0.16		767	-0.61
733	+0.41		753	-0.19		768	-0.64
734	+0.38		754	-0.22		769	-0.67
735	+0.35		755	-0.25		770	-0.70
736	+0.32		756	-0.28		771	-0.73
737	+0.29		757	-0.31		772	-0.76
738	+0.26		758	-0.34		773	-0.79
739	+0.23		759	-0.37		774	-0.82
740	+0.20		760	-0.40		775	-0.85
741	+0.17		761	-0.43		776	-0.88
742	+0.14		762	-0.46		777	-0.91
743	+0.11		763	-0.49		778	-0.94
744	+0.08		764	-0.52		779	-0.97
745	+0.05						
746	+0.02						
747	-0.01						
748	-0.04						
749	-0.07						

4.2 Calculate the percentage by volume of high boiling impurities as follows:

$$\text{Percent high boiling impurities} = \frac{R}{S} (100)$$

where:

R = volume of residue remaining in test tube at the conclusion of step (3.7) of the procedure, ml
S = initial volume of sample used, ml

5.0 REPORT

5.1 Report the corrected equilibrium boiling temperatures and range for the 5% and 85% evaporated volume points in degrees centigrade.

5.2 Report the percentage by volume of high boiling impurities.

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