TECHNICAL REPORT

ISO/TR 19686-1

First edition
2014-09-15

Petroleum products — Equivalency of test method determining the same property —

Part 1: Atmospheric distillation of petroleum products

Produits pétroliers — Équivalence des méthodes d'essai déterminant la même propriété —

Partie 1: Distillation atmosphérique de produits pétroliers

Reference number
ISO/TR 19686-1:2014(E)

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Published in Switzerland

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Foreword

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The committee responsible for this document is ISO/TC 28, *Petroleum products and lubricants*.

ISO/TR 19686 consists of the following parts, under the general title *Petroleum products — Equivalency of test methods determining the same property*:

— *Part 1: Atmospheric distillation of petroleum products*

Introduction

At the 2010 ISO/TC 28 plenary meeting in Porto, ISO/TC 28 established a working group to investigate the development of test method equivalency tables. Motivation for this proposal was the discussion about identities, equivalences or differences of test methods related to fuels. It was concluded that a more structured approach would be useful.

As the task of determining equivalency appeared to be a difficult and complex one, it was decided to take into account each property one after the other. The WG started with distillation. Follow up is to continue with the review of other methods that are intended to be presented in other parts of this Technical Report.

Petroleum products — Equivalency of test method determining the same property —

Part 1: Atmospheric distillation of petroleum products

1 Scope

This Technical Report describes the evaluation executed by ISO in order to determine the equivalency of test methods used on a global scale in quality specifications of petroleum products, lubricants, and fuels. This part of ISO/TR 19686 focuses on whether the standardized test methods for determining atmospheric distillation characteristics are to be considered technically equivalent. This is to guide laboratories that use one standard and wish to know if they can also certify product towards the others.

2 Comparison

2.1 Reasons for divergence

When compared test methods have the same "root", i.e. can be traced back to the same base document(s), then at the time of first publication, these methods can be designated "identical". Over time, however, both methods would undergo independent revision rather, therefore the designation "identical" will slowly move towards "equivalent" or even to "different".

2.2 What does equivalency mean

The designations "identical, equivalent or different" can be factored into a set of important analytical parameters which do affect applicability, results and precision as follows:

a) test method scope (applicability to specific product groups);

b) test method scope (measurement ranges);

c) interferences (matrix effects/disturbances);

d) test equipment/apparatus;

e) procedural items (internal/external standard, calibration, sample preparation, etc);

f) precision, RRT information.

Any comparison of test methods should give comprehensive answers to the above mentioned issues. Several approaches to these "identity questions" sometimes reduce the above findings to categories such as:

— identical: same technical scope, procedures, results, and precision, only editorial differences due to different editorial styles;

— equivalent: some differences introduced in technical aspects such as updated precision, extension of scope or range, etc.;

— different: introduction of significant technical changes such as new equipment, different calibration, or calculations, has changed the test result or the way the test result can be used.

3 Questionnaire for checking similarities of test methods

The questionnaire presented in Table 1 has been used to serve as a starting point for a more structured approach for such test method comparison. When more than one precision statement is available, then it would be prudent to also assess the significance of any differences for r = f(x) and R = f(x) after collection of the details from the round robin data of the test methods.

Seven main issues have been compared for ISO 3405 (which is also known as IP 123 and has been adopted by CEN) and ASTM D86.

a) the measured property;

b) the instrumentation used;

c) the calibration;

d) the sampling and sample handling;

e) the test method procedure as such;

f) the precision information and the data on which it has been determined;

g) any other information of importance.

After the requested details had been compiled, a consensus opinion on the extent to which the compared test methods are identical/equivalent/different and which steps would be necessary to increase test similarities has been developed.

Table 1 — Test method comparison matrix

		ASTM D86–11b	ISO 3405	Comparison
A	**Issues concerning measured properties**			
A.1	Which properties are determined (also which units)?	Boiling range characteristics Percentage evaporated %v/v or percentage recovered %v/v	Distillation characteristics Percentage evaporated %v/v or percentage recovered %v/v	Identical
A.2	What exactly is the principle of measurement?	Sample is assigned in four groups and 100 ml sample distilled under specified conditions	Sample is assigned in four groups and 100ml sample distilled under specified conditions	Identical
A.3	Which products can the test method be applied to?	Light and middle distillates, automotive spark-ignition engine fuels with or without oxygenates, aviation gasolines, aviation turbine fuels, diesel fuels, biodiesel blends up to 20 %, marine fuels, special petroleum spirits, naphthas, white spirits, kerosines, and grades 1 and 2 burner fuels. D86 is applicable to ethanol-fuel blends such as Ed75 and Ed85 or other ethanol-fuel blends with greater than 10 v% ethanol.	Light distillates (automotive engine petrols with up to 10 % v/v ethanol and aviation petrols) and middle distillates (aviation turbine fuels, kerosenes, diesel, diesel with up to 20 % v/v FAME, burner fuels, and marine fuels that have no appreciable quantities of residua) derived from petroleum and having IBP above 0 °C and end points below approximately 400 °C.	Equivalent
A.4	What is the measurement range (per property)?	Automated procedure: IBP: 20 to 70 °C E10: 35 to 95 °C E50: 65 to 220 °C E90: 110 to 245 °C FBP: 135 to 260 °C IBP: 145 to 220 °C T10: 160 to 265 °C T50: 170 to 295 °C T90: 180 to 340 °C T95: 260 to 340 °C FBP: 195 to 365 °C	Automated procedure: IBP: 20 to 70 °C E10: 35 to 95 °C E50: 65 to 220 °C E90: 110 to 245 °C FBP: 135 to 260 °C IBP: 145 to 220 °C T10: 160 to 265 °C T50: 170 to 295 °C T90: 180 to 340 °C T95: 260 to 340 °C FBP: 195 to 365 °C	Identical
A.5	Which components can interfere with the determination?	n.a.	n.a.	
A.6	Are there any matrix effects to consider?	n.a.	n.a.	
B	**Issues concerning instrumentation**			
B.1	List all required equipment including specific manufacturers if any are mentioned	Figures and dimension of apparatus are mentioned	Figures and dimension of apparatus are mentioned	Identical
C	**Issues concerning calibration**			

Table 1 *(continued)*

		ASTM D86–11b	ISO 3405	Comparison
C.1	What procedure is used to prepare calibration standards? If calibration standards are purchased, what requirements are placed on those standards?	Reagent grade toluene and hexadecane	Reagent grade toluene and hexadecane	Identical
C.2	Are the standards Internal or external to the measurement of the tested property in the test sample?	External	External	Identical
C.3	What is the Calibration procedure? What calculations are done to complete the calibration?	The accuracy and the calibration of the electronic circuitry or computer algorithms, or both, shall be verified by the use of a standard precision resistance bench. Verification of the calibration of temperature measuring devices shall be conducted by distilling toluene (or cetane) and comparing the 50 % recovered temperature with that shown in Table 4. The calibration of the level follower assembly shall be verified. The barometric reading shall be verified.	The electronic circuit for resistance thermometers shall be verified against a standard precision resistance. The response of the temperature measurement system itself shall also be verified by procedure 1 or 2: 1) Distil toluene or cetane and compare the 50 % v/v recovered temperature with that shown by the mercury-in-glass thermometer when carrying out a manual test under the same conditions 2) Distill a certified reference fluid of a specific product group under manual conditions using the mercury-in-glass thermometer followed by the alternative temperature measurement device/system. The calibration of the level follower assembly shall be verified. The barometric reading shall be verified.	Equivalent
D	**Sample handling and preparation**			
D.1	Sample handling details?	Yes: sampling (ASTM D4057 or D4177), sample storage, and sample conditioning prior to analysis. Also procedure for wet samples.	Yes: sampling (ISO 3170 or ISO 3171), sample storage, and sample conditioning prior to analysis. Also procedure for wet samples.	Equivalent
D.2	Sample preparation procedure?	See above	See above	Identical
E	**Procedural test method details**			

Table 1 *(continued)*

		ASTM D86–11b	ISO 3405	Comparison
E.1	What is the test method procedure?	A 100 ml true representative retest sample is distilled under specified conditions. Systematic observed thermometers reading, volumes of condensates recovered volumes of residue remains in distillation flask and loss of distillation. Thermometer readings are corrected for barometric pressure.	A 100 ml true representative retest sample is distilled under specified conditions. Systematic observed thermometers reading, volumes of condensates recovered volumes of residue remains in distillation flask and loss of distillation. Thermometer readings are corrected for barometric pressure.	Identical
E.2	What measurement is made?	Volatility of product in term of IBP, % Vol recovery, FBP, and % residue	Volatility of product in term of IBP, % Vol recovery, FBP, and % residue	Identical
E.3	Requirements for reporting/rounding of results?	Report barometric pressure to the nearest 0,1 kPa Manual method: report volumetric readings to the nearest 0,5 and all temperatures to the nearest 0,5 °C Automated method: report volumetric readings to the nearest 0,1 and all temperatures to the nearest 0,1 °C	Manual method: report volumetric readings to the nearest 0,5 and all temperatures to the nearest 0,5 °C Automated method: report volumetric readings to the nearest 0,1 and all temperatures to the nearest 0,1 °C	Identical
E.4	What QC sample is used to check for accuracy?	Not specified	Not specified	Identical
F	Precision information			
F.1	What are the precision statements (r, R)?	Automated procedure: IBP r = 0,0295(E + 51,19); R = 0,0595(E + 51,19) E10: r = 1,33; R = 3,2 E50: r = 0,74; R = 1,88 E90: r = 0,00755(E + 59,77); R = 0,019(E + 59,77) FBP: r = 3,33; R = 6,78 IBP: r = 0,018T ; R = 0,055T T10: r = 0,0094T ; R = 0,022T T50: r = 0,94; R = 2,97 T90 : r = 0,0041T ; R = 0,015T T95 : r = 0,01515(T – 140); R = 0,0423(T – 140) FBP : r = 2,2 ; R = 7,1 R200 to R300 r = 1,07; R = 2,66 E70 to E180: r = 0,00836(150 – X); R = 0,0300(150 – X)	Automated procedure: IBP r = 0,0295(E + 51,19); R = 0,0595(E + 51,19) E10: r = 1,33; R = 3,20 E50: r = 0,74; R = 1,88 E90: r = 0,00755(E + 59,77); R = 0,019(E + 59,77) FBP: r = 3,33; R = 6,78 IBP: r = 0,018T ; R = 0,055T T10: r = 0,0094T ; R = 0,022T T50: r = 0,94; R = 2,97 T90 : r = 0,0041T ; R = 0,015T T95 : r = 0,01515(T – 140); R = 0,04227(T – 140) FBP : r = 2,2 ; R = 7,1 R200, R250, and R350: R = 2,7 %v/v E70: R = 2,7 %v/v E100: R = 2,2 %v/v E150: R = 1,3 %v/v E180: R = 1,1 %v/v	Equivalent
F.2	Dispersion of r(x), R(x) (95 % confidence bands)?	?	?	
F.3	How old are the precision statements?	2005 (automated)	2006 (automated)	Equivalent