INTERNATIONAL STANDARD

ISO 26422

Second edition
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Petroleum and related products — Determination of shear stability of lubricating oils containing polymers — Method using a tapered roller bearing

Pétrole et produits connexes — Détermination de la stabilité au cisaillement des huiles lubrifiantes contenant des polymères — Méthode avec roulement à rouleaux coniques

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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

This second edition cancels and replaces the first edition (ISO 26422:2011), which has been technically revised. The objective of the revision is to harmonize the test methodology of ISO 26422 with that of CEC L-45-99 regarding reference fluids, referencing procedure, and the precision statement, thereby avoiding differences between two test methods which are technically equivalent.

ISO 26422 is based upon DIN 51350-6,[1] which has also been adopted by the Co-ordinating European Council (CEC) as CEC-L-45-99. ISO/TC 28 acknowledges permission granted by Coordinating European Council to reproduce selected parts of CEC Test Method L-45-99[2] to assist with the preparation of this International Standard.

Petroleum and related products — Determination of shear stability of lubricating oils containing polymers — Method using a tapered roller bearing

WARNING — The use of this International Standard can involve hazardous materials, operations, and equipment. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a method of determining the shear stability of polymer-containing lubricating oils by the four-ball machine as specified in ISO 20623, but using a tapered roller bearing. The test results allow prediction of the in-service permanent viscosity loss.

NOTE Other International Standards exist which evaluate viscosity loss of polymer-containing oils. The method specified within this International Standard subjects fluids to a higher shear rate than, for example, the diesel injector nozzle shear test described within ISO 20844.[3] It is particularly appropriate for lubricants being used in high shear applications, such as components with gears and roller bearings. In such applications, the shear rate in the ISO 20844 test method can be too low to generate a realistic permanent loss in viscosity of the fluid.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3105, *Glass capillary kinematic viscometers — Specifications and operating instructions*

ISO 20623, *Petroleum and related products — Determination of the extreme-pressure and anti-wear properties of fluids — Four ball method (European conditions)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
percentage viscosity loss
R_V
measure of shear stability calculated in accordance with the following equation:

$$R_V = \frac{v_0 - v_1}{v_0} \times 100$$

where

ν_0 is the kinematic viscosity at 100° C of the fluid before shear, expressed in $mm^2 \cdot s^{-1}$;

ν_1 is the kinematic viscosity at 100° C of the fluid after shear, expressed in $mm^2 \cdot s^{-1}$.

Note 1 to entry: A small value indicates a high resistance to viscosity shear loss.

Note 2 to entry: The tapered roller bearing test is also referred to as the KRL (Kegelrollenlager) principle.

4 Principle

Using the splash lubrication method, a volume of 40 ml of the lubricating fluid is tested at a constant temperature of 60 °C in a tapered roller bearing driven in the four-ball machine. The test is performed at constant speed and the load applied during a given running time is 5 000 N. The kinematic viscosity of the lubricating fluid is determined at a temperature of 100 °C before and after the test. The percentage viscosity loss, R_V, is calculated from these two viscosity measurements.

NOTE Some classification systems specify that the kinematic viscosity before and after shear is determined at temperatures other than 100 °C, e.g. at 40 °C.

5 Reagents and materials

5.1 Cleaning solvents, appropriate to the last fluid type tested. For fluids based upon petroleum mineral oil, aliphatic hydrocarbons, and acetone are usually suitable. For some hydraulic fluids, a low molecular mass alcohol can assist in the initial stages of cleaning.

6 Apparatus

6.1 Four-ball machine, as specified in ISO 20623.

6.2 Tapered roller bearing, type SKF 32008 X/Q, which incorporates optimised contact geometry and surface finish. The single row tapered roller bearing consists of an inner ring with cage and roller assembly and an outer ring.

It is advisable that the inner and outer rings be considered to be a matched pair when obtained from the supplier and these components should not be interchanged with those of other sets of bearings.

Precision has been established using the 32008 X/Q test bearing manufactured by SKF. It is strongly recommended that only bearings of this specification manufactured by SKF are used. The use of ISO 355 dimension series 3CD bearings of alternative specification and manufacturer requires validation by inter-laboratory exercises to establish technical suitability, test precision, and service life.

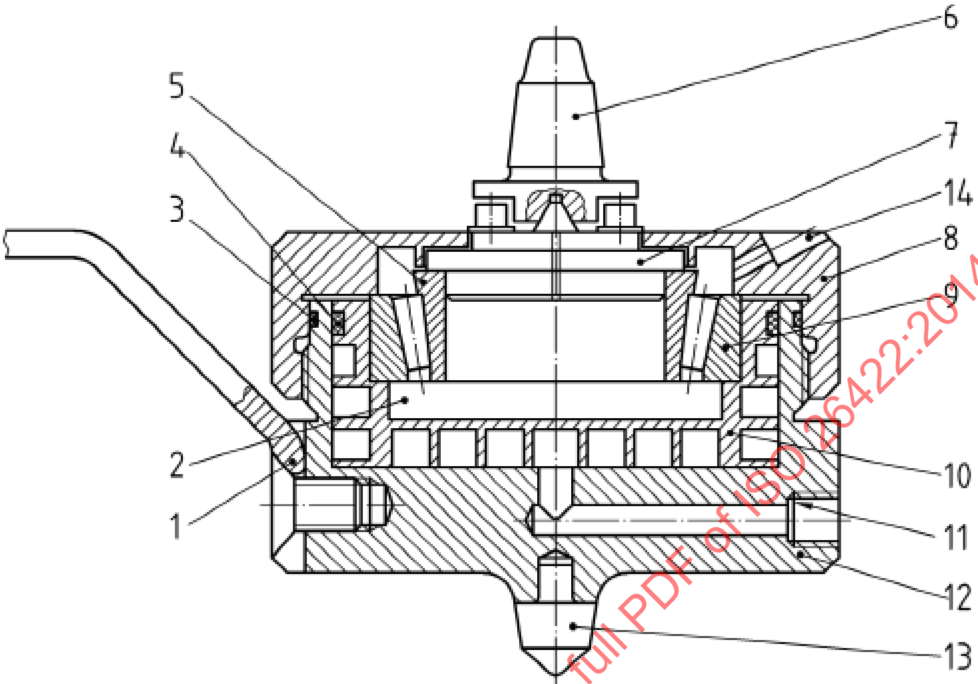
6.3 Shear stability testing apparatus[1)], as shown in Figure 1.

This is available from several manufacturers. It is recommended that only apparatus which has been proven in tests run in accordance with CEC L-45-99[2] or DIN 51350-6[1] is used.

6.4 Temperature control device, for controlling the temperature of the fluid to a temperature of 60 °C ± 1 °C. This typically comprises of an electrical heating band clamped around the housing, galleries within the housing through which cooling water can be passed, a temperature sensor and a control system to automatically energize and de-energize the heating, and cooling circuits as required.

1) Information on suitable products available commercially can be obtained from DIN-Bezugsquellen für normgerechte Erzeugnisse im DIN Deutsches Institut für Normung e.V., Burggrafenstraße 6, D-10787 Berlin, Germany. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.

6.5 Viscometer, an appropriate glass capillary viscometer meeting the requirements of ISO 3105 or a suitable automatic viscometer should be used for the determination of kinematic viscosity in accordance with ISO 3104.



Key

1 torque reaction arm
2 test fluid chamber
3 O-ring
4 O-ring
5 tapered roller bearing inner ring with cage and rollers
6 drive spindle
7 drive assembly for tapered roller bearing inner ring assembly
8 housing cover
9 tapered roller bearing outer ring
10 cooling galleries for temperature control
11 coolant inlet
12 housing
13 conical mounting point
14 location of temperature sensor

Figure 1 — Shear stability testing apparatus

7 Preparation

NOTE The numbers in parentheses in this clause correspond to the items detailed in Figure 1.

7.1 Preparing the tapered roller bearing and testing apparatus assembly

7.1.1 Prior to the test, clean the housing, housing cover, and the tapered roller bearing assembly with a cleaning solvent, e.g. n-heptane, and dry in a stream of dry air or with a clean, dry, lint-free cloth.

7.1.2 Inspect the O-rings fitted to the housing and housing cover (3) and (4) and ensure that they are properly located and free from damage.

7.1.3 The outer ring and inner ring with cage and roller assembly of the test bearing should be carefully inspected for evidence of mechanical damage, surface deposits, corrosion, and thermal staining. Normal wear of the outer ring and rollers is indicated by a matt grey surface with light circumferential scratching.

If damage due to pitting, scoring, or surface staining is observed, the outer ring and inner ring with cage and rollers should be replaced as an assembly. If surface deposits cannot be removed by the cleaning procedure detailed in 7.1.1, the test bearing assembly should be discarded and replaced.

7.2 Assembly of the shear stability apparatus

NOTE The numbers in parentheses in this clause correspond to the items detailed in Figure 1.

7.2.1 Fit the test bearing outer ring (9) into the cleaned housing (12) and fill with 40,0 ml ± 0,5 ml of the test fluid.

7.2.2 Press the cleaned inner ring with cage and roller assembly (5) onto the drive assembly (7) and check to ensure that it is seated correctly.

7.2.3 Place the inner ring with cage and roller assembly and drive assembly into the prepared housing ensuring that the rollers are fully seated in the outer ring. Screw the housing cover into position and fully tighten it using hand pressure only.

7.2.4 Locate the assembled testing apparatus into the four-ball machine ensuring that the drive spindle (6) engages with the drive assembly for the inner ring with cage and roller assembly (7). Apply a load of 5 000 N ± 200 N.

7.2.5 Connect the temperature sensor (located at position 14) to the temperature control unit and check their correct function.

7.3 Running-in of the tapered roller bearing

Before starting the test, ensure that the SKF 32008 X/Q test bearing has been run-in in accordance with the running-in procedure detailed in Figure 2.

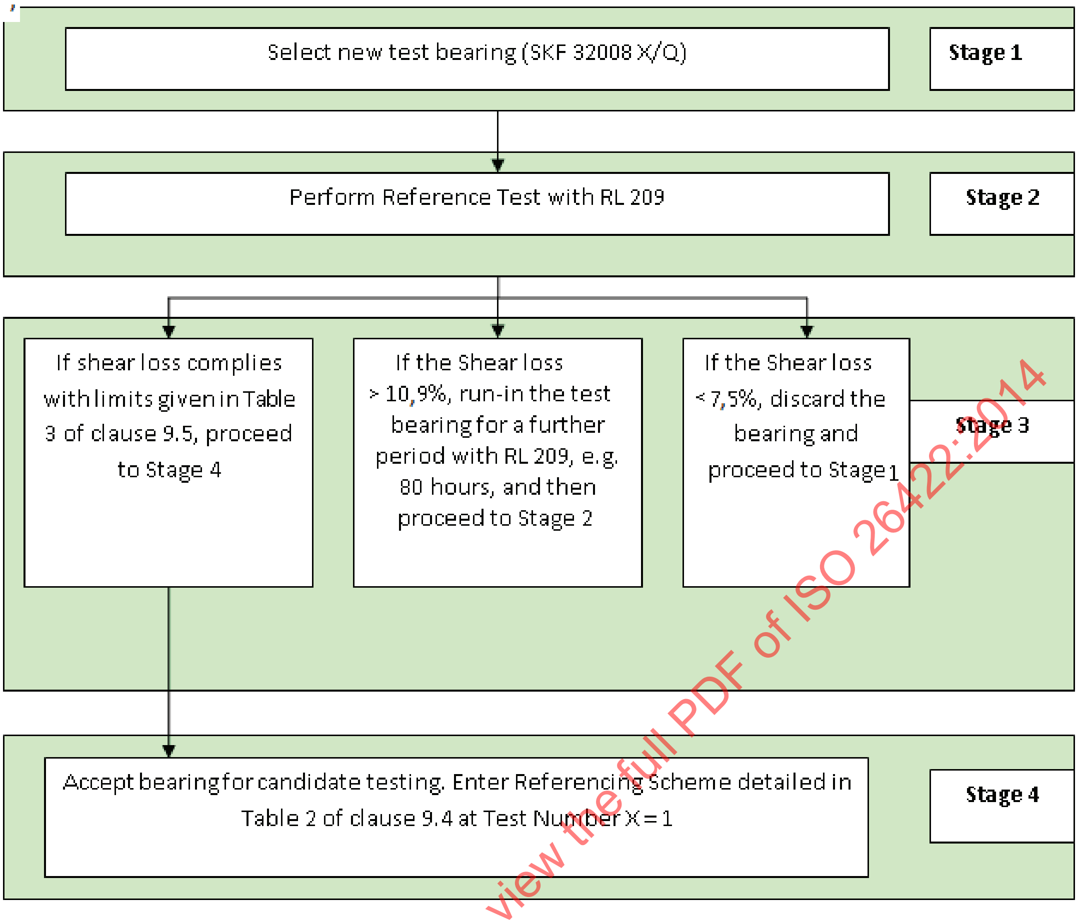


Figure 2 — Running-in procedure flowchart: Validation for new test bearings

7.4 Test conditions

The test conditions are specified in Table 1.

Table 1 — Test conditions

Test parameter	Test condition
Drive motor speed	1 475 min^{-1} ± 25 min^{-1}
Lubricant temperature	60 °C ± 1 °C
Lubricant quantity	40,0 ml ± 0,5 ml
Test load	5 000 N ± 200 N
Test duration	1 740 000 ± 500 motor revolutions, equivalent to approximately 20 h

Test runs of shorter or greater duration than 1 740 000 revolutions (approximately 20 h) might be more appropriate for certain applications. For example, longer duration tests of 200 h have shown good correlation with some high severity applications conditions as found in manual transmissions or axles, whereas shorter duration tests of 4 h or 8 h might be of appropriate severity for high viscosity index hydraulic fluids and shock absorber fluids. The precision of tests conducted for durations other than 1 740 000 revolutions has not been established.

7.5 Validation of test bearings

Flowcharts detailing the processes for running-in and validation of new test bearings and validation of test bearings in service are given in Figure 2 and Figure 3, respectively.

8 Procedure

8.1 After performing the check on the function of the thermal sensor and controller as described in 7.2.5, and before starting the drive motor, switch on the heater control unit and pre-heat the test oil to 50 °C ± 1 °C.

8.2 Once the temperature has achieved 50 °C ± 1 °C, set the heater control unit to a test fluid temperature of 60 °C ± 1 °C and start the motor. Allow the test to run under the conditions of applied load and number of motor revolutions as specified in Table 1.

8.3 Once the required number of revolutions of the motor has been achieved, stop the test. Switch off the heater control unit and then remove the tapered roller bearing assembly from the four-ball machine. Dismantle the assembly and decant the test fluid into a clean container.

8.4 Using test method ISO 3104 or equivalent, determine the kinematic viscosity of the test fluid at 100 °C before and after the test. Calculate the relative change in viscosity, R_V, and express the result in units of percentage change in accordance with Clause 10.

9 Referencing

9.1 General

In order to verify that the test rig is functioning correctly, reference tests shall be conducted according to the scheme detailed in Table 2. The control limits for each of the reference fluids are detailed in Table 3. Evaluation of candidates can only commence once the referencing requirements detailed in this clause have been satisfied. All reference tests shall be conducted in accordance with the test conditions detailed in Table 1.

9.2 Validation of new test bearings

New test bearings shall be run-in using RL 209. When a test result that complies with the limits detailed in Table 3 has been obtained with RL 209, the referencing scheme detailed in Table 2 shall then be entered at test number X = 1. If the reference test with RL 209 fails to comply with the upper limit detailed in Table 3, further running-in of the test bearing with RL 209 should be attempted and the validation procedure repeated. In the event that a reference test with RL 209 fails to comply with the lower limit detailed in Table 3, the test bearing should be discarded and another test bearing selected for running-in.

9.3 Referencing in service

Referencing in service is detailed in Figure 3. If a reference test result for either RL 209 or RL 210 fails to satisfy the limits detailed in Table 3, a reference test using RL 209 should be conducted as the next test to verify the performance of the test bearing. If the viscosity loss result of this test complies with the limits detailed in Table 3, it is permissible for candidate testing to recommence. The referencing sequence should be re-joined at the position in Table 2 that testing was suspended. If the viscosity loss fails to comply with the limits detailed in Table 3, the bearing should be considered to be at the end of its service life and taken out of service. The test bearing should be retained.

Test bearings that were originally run-in and validated using RL 181 can continue to be used in service providing that they satisfy the Control Limits detailed in Table 3 for RL 209 and RL 210.

NOTE The use of RL 181 as the running-in fluid for new test bearings and as a reference fluid for bearings in service was discontinued in August 2012 following the validation of RL 209 with revised Control Limits as its replacement.

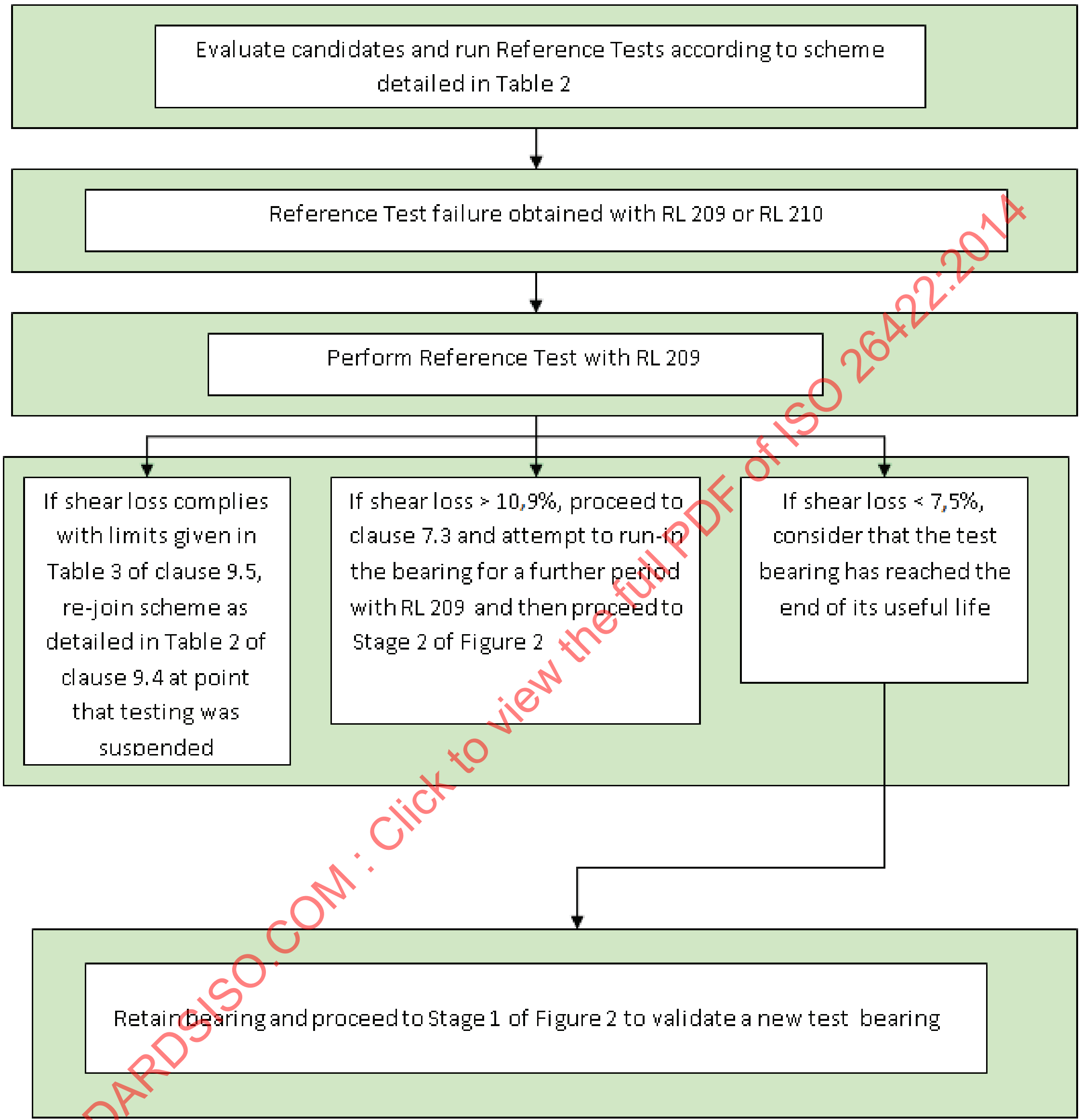


Figure 3 — Flowchart for referencing in service

9.4 Frequency of reference testing

With reference to Table 2 and Table 3, Test Number X = 1 is the acceptance test for RL 209 with a percentage viscosity loss of between 7,5 % and 10,9 %.

Table 2 — Frequency of referencing testing

Test number	RL 209	RL 210
X = 1	√	
10	√	
11		√

Table 2 *(continued)*

Test number	RL 209	RL 210
20	√	
30	√	
31		√
40	√	
50	√	
51		√

9.5 Reference fluid control limits

See Table 3 for the viscosity shear loss limits.

Table 3 — Reference fluid viscosity shear loss limits

Fluid	Lower limit	Upper limit
RL 209	7,5 %	10,9 %
RL 210	16,5 %	26,3 %

9.6 Reference fluids

The following shall be used as reference fluid

— **CEC RL 209,** a commercially-marketed SAE 75W/80 automotive gear lubricant. RL 209 is also used for the running-in of new test bearings and

— **CEC RL 210**, a commercially marketed API GL5 automotive gear lubricant.

NOTE 1 The use of RL 181 was discontinued as a reference fluid in August 2012 following exhaustion of stock of the final batch.

NOTE 2 The CEC Secretariat can be contacted at Interlynk Administrative Services Limited, 17 Peckleton Lane, Desford, Leicestershire, LE9 9JU, United Kingdom, for further advice and information on the availability of CEC Reference Fluids.

10 Reporting of results

Report the following:

— viscosity shear loss, R_V, as a percentage, rounded to the nearest 0,1 %, in accordance with 3.1, and

— test duration.

EXAMPLE The percentage viscosity loss after a test run of 1 740 000 motor revolutions is determined at 29,55 %, R_V = 29,6 %.

11 Precision

The precision of this International Standard has been determined using ISO 4259[4] from reference tests generated by participating laboratories of CEC Technical Working Group SG-T-045. The reference tests were conducted between October 2010 and September 2011. The reference fluids tested were RL 181, RL 209, and RL 210. Eighteen laboratories participated and generated a total of 390 test results (110 test results for RL 181, 142 test results for RL 209, and 138 test results for RL 210).

The precision statistics are summarized in Table 4.