KENYA STANDARD **KS 163-3: 2012**

Methods of test for paints, varnishes, lacquers and enamels
Part 3. Determination of flow time by use of a flow cup

(First revision, 2012)

TECHNICAL COMMITTEE REPRESENTATION

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Galaxy Paints
Sadolin Paints
Kenya Ferry Services
Kenya Ports Authority
Southern Engineering company
Crown Berger Paints Ltd.
Kenya Industrial research and training Institute
Ministry of Roads Materials Brach
National Environment Management Authority
Government chemist Department
Consumer Information Network
Kenya Paints Association
Kenya Pipeline Co. Ltd.
Basco paints
Kenya Bureau of Standards — Secretariat

REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

KENYA STANDARD

KS 03-812: 2011

Methods of test for paints, varnishes, lacquers and enamels

Part 3. Determination of flow time by use of a flow cup

(First revision, 2012)

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Foreword

This Kenya Standard was prepared by the Technical Committee on Paints and Allied Products under the guidance of the Standards Project Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

During the second Revision of this standard the Committee revised the requirement of temperature adjustment from 23 ± 0.5 ^{0}C to 25 ± 1 ^{0}C respectively.

Performance requirement of the paints stated in the standard includes the determination of flow time.

During the revision of this standard, reference was made to the information provided by the Industry.

The assistance derived from these sources is hereby acknowledged.

Kenya standard

Methods of test for paints, varnishes, lacquers and enamels Part 3. Determination of flow time by use of a flow cup

(First revision, 2012)

1. Scope and field of application

1.1 This Kenya Standard specifies a method for the determination of the flow time of paints, varnishes and related products that may be used to control consistency. A method for the adjustment of paints to the correct application consistency at the application temperature is described in Appendix A.

1.2 Three flow cups of similar dimensions, but having orifice diameters of 3 mm, 4 mm and 6 mm are specified. The method for their calibration is given.

1.3 The method is limited to testing materials for which the break-point of the flow from the orifice of the flow cup can be determined with certainty. This point is difficult to determine and reproduce for materials with flow time in excess of 100 s due to slowing-down effects.

2. Definitions

2.1

flow time

the elapsed time from the moment when the material under test starts to flow from the orifice of the filled cup to the moment when the flow stream of material first breaks close to the orifice

2.2

newtonian flow

the type of flow exhibited by a material in which the ratio of the sheet stress to the velocity gradient does not vary either with time or with the velocity gradient. When variations in this ratio are small, the effect on viscosity of mechanical disturbance, such as stirring, is negligible and the material is said to have near newtonian flow.

2.3

anomalous flow

the type of flow exhibited by a material in which, at a constant temperature, the ratio of the shear stress to the velocity gradient varies either with time or with rate of shear. For example, with so-called thixotropic materials, stirring or other such mechanical disturbance immediately before test will reduce the flow time below that for an unstirred sample. With such materials, uncertain and variable values for flow time are obtained in all flow cups.

2.4

dynamic viscosity

the ratio of the applied shear stress to the velocity gradient.

2.5

kinematic viscosity

the ratio of the dynamic viscosity to the density of the liquid.

3. Temperature considerations

The effect of temperature on flow time is highly significant in respect of application properties and varies with the type of product. For reference purposes, it is essential to standardize one test temperature, and $25 \pm 1\ ^0C$ is specified in this standard. However, it may be more convenient to carry out comparative testing at some other agreed temperature (for example, 25 ^OC) because of prevailing temperature conditions. For control by flow time, it is normal practice to condition the test sample to an agreed temperature and to ensure that the temperature variation does not exceed 0.5 $_oC$ during testing.

4. Apparatus

4.1 Flow Cups

4.1.1 ***Dimensions*** — The dimensions of the ISO flow cups and the tolerances allowed in manufacture shall be as given in Figure 1. The most critical tolerance is the internal diameter of the jet of the cup, because the flow time is inversely proportional to the fourth power of this dimension. The jet of the cup shall be made of stainless steel or sintered carbide unless otherwise specified, and the body of the cup shall be made of material, which is corrosion resistant and is not affected by the products to be tested.

4.1.2 ***Construction*** — The dimension not specified, such as well thickness, shall be such that no distortion of the cup can occur in use. The external shape shown in Figure 1 is recommended, but may be modified for convenience of use, or manufacture, provide that the protruding jet of the cup is protected from accidental damage as far as possible by an external protective sleeve. Such a protective sleeve shall not be immediately adjacent to the jet, so as to prevent a capillary action when the material under test flows out.

4.1.3 ***Finish*** — The interior surfaces of the cups, including the orifice, shall be smooth and free from turning marks, crevices, ledges and burrs which may cause random flow or trap sample or cleaning material. The standard of finish required is equivalent to a maximum roughness of not more than0.5 µm.

4.1.4 ***Calibration*** — Dimensionally similar cups will give, with Newtonian liquids, similar flow times, provided that the temperature of testing is precisely the same. The use of such liquids to calibrate cups provides a useful means of initially checking that dimensionally similar cups are within the accepted tolerances or performance and also for checking from time to time whether any wear or damage has taken place sufficient to bring a cup outside the accepted tolerances. For calibration of any particular cup, use a standard oil of know kinematic viscosity and draw a graph of kinematic viscosity versus temperature from the data given by the supplier for the oil. Using the relevant procedure described in Clause **6**, determine the flow time of the oil at a known temperature within the range 20 ^0C, to 30 ^0C, measured to the nearest 0.1 0C. Record this flow time, which shall be in the range 30 s to 100 s and preferably near the mid-point of this range, to an accuracy of 0.2 s. From the prepared graph, read the kinematic viscosity at the test temperature. Using the appropriate calibration graph of Figures 2, 3 or 4, read the flow time corresponding to this kinematic viscosity. If the two values of flow time obtained do not differ by more than 3 per cent, the cup may be deemed satisfactorily for use.

For reference purposes, a correction factor corresponding to the flow time deviation from that obtained using the oil may be applied.

4.1.5 Marking

Each flow cup shall have the following inscriptions permanently and legibly marked on it:

(i) Designation of cup: ISO 2431 No. 3, 4, or 6;

(ii) Manufacturer's identification number;

(iii) Manufacturer's name or trade mark.

4.1.6 Care and Checking of Flow Cups

Clean the cup immediately after use and before the sample starts to dry using a suitable solvent. Never use metal cleaning tools or wire. If the orifice becomes contaminated with dried deposits, soften these with a suitable solvent and clean carefully, for example with a soft cloth pulled through the orifice.

Check the cups periodically for wear or damage by the calibration procedure specified in **4.1.4.5**

4.2 Supplementary Apparatus

4.2.1 ***Thermometer*** — Accurate to 0.2 oC and graduated at 0.1 oC intervals.

4.2.2 *Stand* — Suitable for holding the flow cup and provided with levelling screws.

4.2.3 ***Spirit Level*** — Preferably of the circular type.

4.2.4 Flat glass plate or straight- edge scrapper.

4.2.5 ***Stop-watch*** — Or other suitable timing-device with scale divisions of 0.5 s or finer and accurate to within 0.2 per cent when tested over a 60 min period.

4.2.6 T*emperature-controlled Room or Enclosure* — Capable of maintaining the cup and sample at a recommended, constant temperature. (*See* Clause **3**.)

5. Sampling

Take a representative sample of the material to be tested. Examine and prepare the sample for testing as described in Part 1 of this standard. Before testing, it is advisable to strain the sample through an appropriate sieve into a clean dry container. This is mandatory for referee purposes.

150 mL of strained material is sufficient for carrying out one test. Take care to mix the material thoroughly, while at the same time avoiding, as far as possible, loss of solvent by evaporation.

6. Procedure

6.1 Preliminary Check

Note: This check is carried out to show that the material is suitable for the test (i.e. is Newtonian or near newtonian).

6.1.1 Choose a flow cup that will give flow time of between 30 s and 100 s for the material.

6.1.2 Determine the flow time by the procedure specified in **6.2** making sure that the material is well agitated before pouring into the cup. Remove the finger within 5 s of filling the flow cup.

6.1.3 Repeat the determination but this time allows the material to remain in the flow cup for 60 s before removing the finger.

6.1.4 If the second result differs from the first result by more than 10 per cent, the material shall be

deemed to be non-newtonian and therefore unsuitable for consistency control by flow-time measurement.

6.2 Determination of flow time

6.2.1 Choice of Flow Cup — Choose a flow cup that will give a flow time between 20 s and 100 s, but preferably between 30 s and 100 s, for the test material.

6.2.2 Temperature Adjustment — Adjust the temperature of the strained sample, and the flow cup, to 23 ± 0.5 oC, or to an alternative agreed temperature (*see* Clause **3**). If the temperature-controlled enclosure (*see* **4.2.6**) is used, as recommended, it is advisable to condition the cup and the sample before straining, by placing them in the enclosure before use. The sample shall be considered ready for test immediately after any air bubbles entrained during the preparation and sieving procedures have dispersed. Carry out a final check that the temperature of the sample is with 0.5 ^{0}C of the agreed test temperature immediately prior to filling the cup.

6.2.3 Preparation of the Flow Cup — Place the flow cup on the stand (*see* **4.2.2**), in a position free from draughts and, by using the spirit level (*see* **4.2.3**) and adjusting the levelling screws of the stand, ensure that the upper rim of the flow cup is in a horizontal plane.

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6.2.4 Filling the Flow Cup — With the orifice closed by a finger, fill the cup with the freshly strained, bubble-free sample, pouring slowly to avoid the formation of air bubbles. If any bubbles are formed,allow them to rise to the surface and remove them. If the cup has been properly levelled, the sample will overflow evenly over the rim into the gallery. Remove any meniscus formed either by the straight-edge scrapper (*see* **4.2.4**) over the entire rim of the cup or by sliding over the rim a flat glass plate with rounded edges so that no air bubbles form between the glass and the surface of the sample. Then draw this plate horizontally across the rim of the cup so that, when the plate is removed, the level of the sample coincides with the top rim of the cup.

6.2.5 Measurement of Flow Time — Place a suitable receiver under the flow cup so that the distance between the orifice of the flow cup and the surface of the received sample is never less than 100mm. Remove the finger from the orifice and simultaneously start the timing-device (*see* **4.2.5**) stopping it as soon as the first break occurs in the stream of sample close to the orifice. Record the flow time to the nearest 0.5 s.If the test is not carried out in the temperature-controlled enclosure, place the thermometer (*see***4.2.1**) in the stream of sample so as not to interfere with observation of the break in the flow. This is conveniently done by holding the thermometer in a suitable clamping device with the bulb so placed that it is at an angle to the direction of flow and completely immersed in the emergent stream and not less than 100 mm from the orifice. It is convenient to use the same thermometer as is used to adjust the temperature of the sample initially. Any difference in temperature from the initially adjusted temperature shall not be greater than 0.5 ^{0}C.

6.2.6 Repeat Determination — Carry out a second determination on another portion of the originally prepared sample and check carefully that the temperature of testing is within the prescribed limits. Record the flow time to the nearest 0.5 s. Calculate the mean of the two determinations.

If the two determinations differ by more than 5 per cent, carry out a third determination. If the third determination and either of the previous determinations do not differ by more than 5 per cent, discard the other determination. Calculate the result as the mean of the two accepted determinations. If the third determination does not provide this measure of agreement, the method of test is unlikely be suitable because of anomalous flow behavior, and consideration shall be given to other methods of test.

7. Precision

The precision of the method, as obtained by statistical examination of inter-laboratory test results, is as follows:

7.1 Repeatability (R) — The different between two results (each the mean of two accepted determinations) obtained by the same operator with the same apparatus under constant operating conditions on identical test material shall, at the 95 per cent confidence level not exceed 5 per cent.

7.2 Reproducibility (R) — The difference between two results (each the mean of two accepted determinations) obtained by different operators in different laboratories on identical test material shall, at the 95 per cent confidence level, not exceed 10 per cent.

8. Test report

The test report shall include at least the following information:

(i) The type and identification of the product tested;

(ii) A reference to this standard and to the designation (No. 3, 4 or 6) of the cup used;

(iii) The manufacturer's identification number of the flow cup used.

(iv) The temperature of testing;

(v) The flow time (for referee purposes, individual values shall also be reported);

(vi) Any deviation, by agreement or otherwise, from the test procedure described;

(vii) The date of the test.

Annex A
(normative)

Use of flow cups for the adjustment of paint consistency

A1. INTRODUCTION

In certain circumstances it may be necessary to adjust the consistency of paint to the required flow time at the temperature of application. Since paint consistency varies with temperature, it shall be helpful if manufacturers of a paint supplied a chart showing the relationship of temperature to the quality of thinner to be added to obtain a desired consistency.

A2. Use of flow cups to determine the quantity of thinner required to adjust a paint to a specified flow time.

A2.1 The application consistency of paints is readily adjusted by addition of thinner to give the required flow time at the temperature of application. When the application conditions are known to vary over a range of temperatures, such as seasonal variations or in different work places, the volume ratios of thinner to paint can be predetermined and expressed graphically or in tabular form for the convenience of the applicator. Even so, the actual flow time shall be checked and adjustment made in necessary, just prior to application.

A2.2 When thinning paint to a specified consistency, the user shall have either:

(*a*) A graph or table indicating the volume ratio of thinner to paint required to give a predetermined flow time depending on temperature variations at the work place; or

(*b*) Information from the supplier indicating the application flow time and the approximate thinning ratio.

A2.3 The flow cup specified shall give, for the material under test, a flow time in excess of 20 s to allow a sufficient degree of accuracy in the test.

A2.4 Thin a representative sample of the bulk paint with the appropriate volume of thinner and stir until it is well mixed.

A2.5 Place the clean flow cup in the stand provided and ensure that the top of the cup is level when it is seated in the stand.

A2.6 With the orifice closed by the finger, fill the cup with the thinned paint until it flows evenly over the rim of the gallery.

(If the cup is level, the overflow will be even over the rim.)

A2.7 Remove the finger from the orifice and simultaneously start the timing-device, stopping it as soon as the first break occurs in the stream of paint close to the orifice. Record the flow time to the nearest second.

Add more thinner if the flow time is too longer more paint if the flow time is too short. After each addition, mix the thinned paid well and re-determine the flow time until the required limits are met.

A3. Test report

The test report shall include the required ratio of thinner to paint and, if required, items (i), (ii), (iii) and (iv) of Clause **8**, together with a record of the temperature of test, to the nearest 0.5 oC, and the flow time, report to the nearest second.

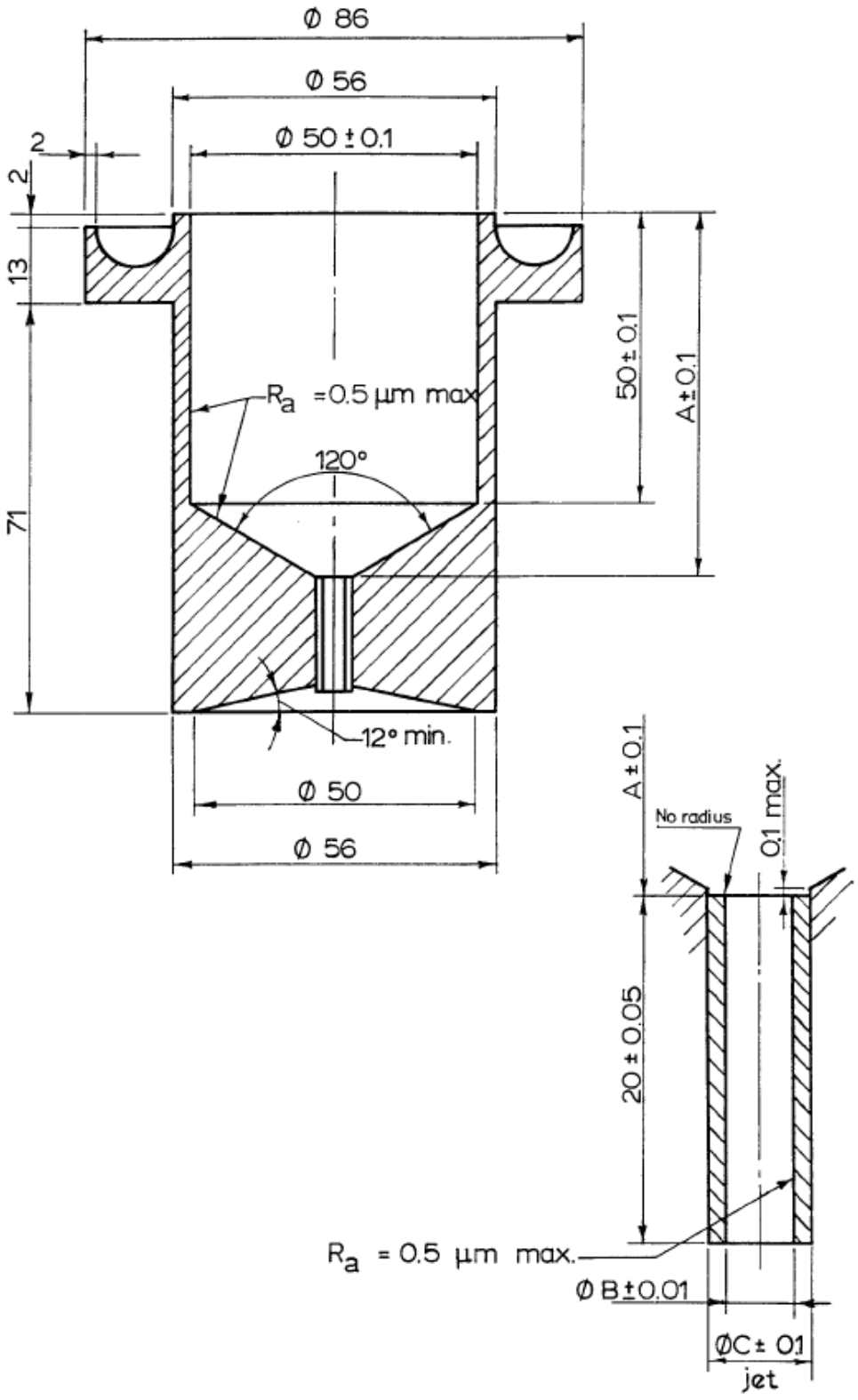

FIG. 1 — FLOW CUP ISO 2431

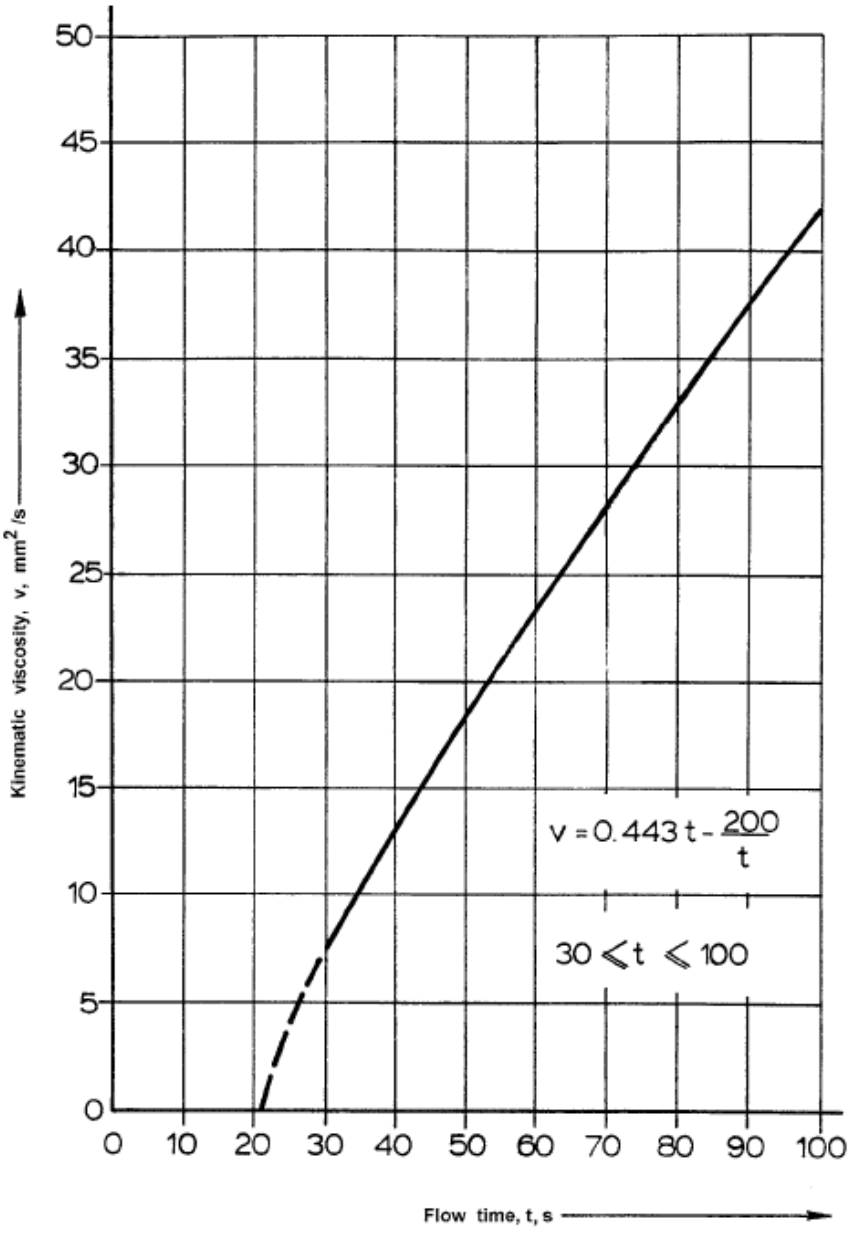

FIG. 2 — CALIBRATION CURVE FOR 3 mm CUP

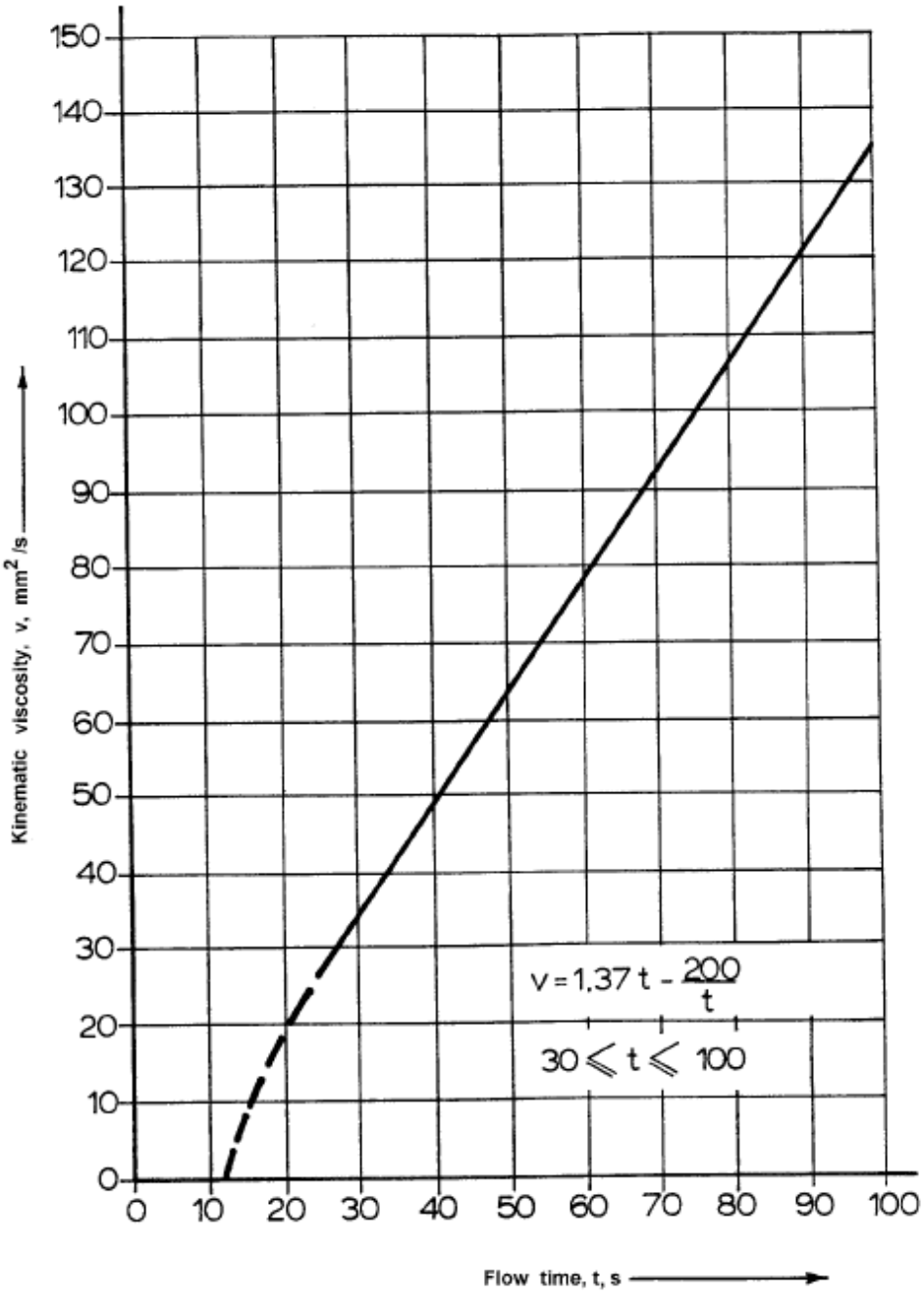

FIG. 3 — CALIBRATION CURVE FOR 4 mm CUP

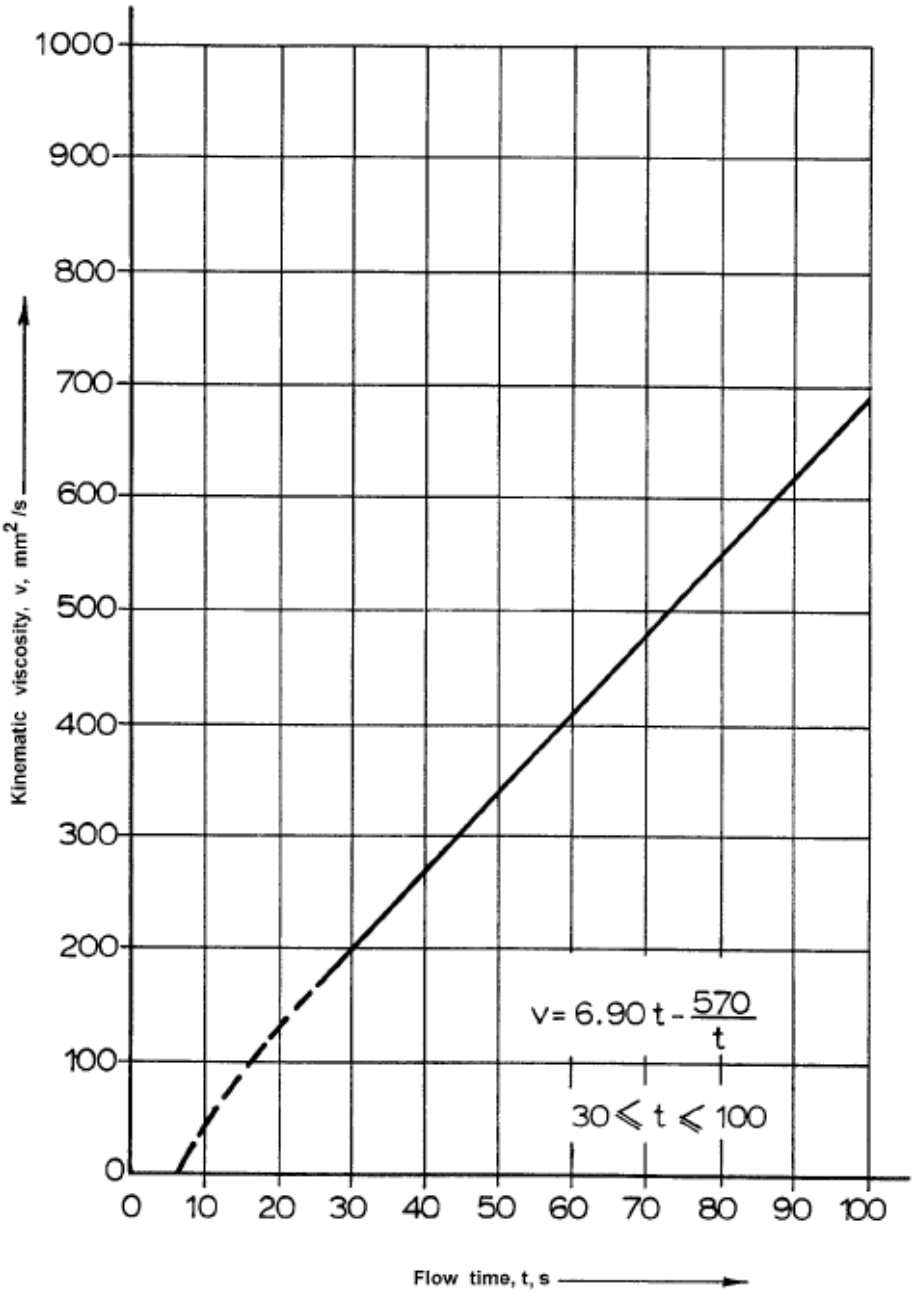

FIG. 4 — CALIBRATION CURVE FOR 6 mm CUP