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**Two-pack Polyurethane full gloss enamel
paint— Specification**

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 479 was prepared by Technical Committee RSB/TC 056, *Paints, Varnishes, Adhesives and Related Products*.

In the preparation of this standard, reference was made to the following standard:

IS 13213: Polyurethane full gloss enamel (Two pack) — Specification

The assistance derived from the above source is hereby acknowledged with thanks.

Committee membership

The following organizations were represented on the Technical Committee on *Paints, Varnishes, Adhesives and related Products* (RSB/TC 056) in the preparation of this standard.

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Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Standards for Sustainability

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Introduction

A polyurethane paint (PU paint) is a hard-wearing, highly-resistant coating used in industrial and architectural coating systems for steelwork, concrete, wood, and other substrates. It is a reaction polymer, a combination of a polyol resin and an isocyanate hardener or curing agent. Essentially, a polyurethane coating is a liquid plastic which dries to form a paint-like film on a substrate. The properties of a polyurethane can be manipulated by the types of isocyanates and polyols which are used to make it, and so it can be modified to suit a wide range of projects. Polyurethane paint provides durability, resistance to chemicals, water, abrasion, and temperature, as well as an attractive glossy finish.

The product is intended to be used as a top coat in painting system for the protection of exterior of railway coaches, etc. involving wet and damp areas, high humidity, coastal, marine and industrial fall out. Polyurethane paints shall be suitable for use in those exterior applications where it is desirable to retain colour and gloss for long periods of time in addition to providing excellent chemical and corrosion resistance. It is primarily suitable for application by spraying (conventional air/airless). It may also be applied by brush for touching up small areas.

Two-pack Polyurethane full gloss enamel paint— Specification

1 Scope

This Draft Rwanda Standard prescribes requirements, sampling and test methods for a two-pack polyurethane full gloss enamel paint intended to be used for the protection of exterior of railway coaches, diesel and electric locomotive against atmospheric corrosion.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4618, *Paints and varnishes — Terms and Definitions*

ISO 2431, *Paints and varnishes — Determination of flow time by use of flow cups*

ISO 3668, *Paints and varnishes — Visual comparison of colour of paints*

ISO 9514, *Paints and varnishes — Determination of the pot life of multicomponent coating systems — Preparation and conditioning of samples and guidelines for testing*

ISO 28199-1, *Paints and varnishes — Evaluation of properties of coating systems related to the spray application process — Part 1: Vocabulary and preparation of test panels*

ISO 9117-1, *Paints and varnishes — Drying tests — Part 1: Determination of through-dry state and through-dry time*

ISO 9117-3, *Paints and varnishes — Drying tests — Part 3: Surface-drying test using ballotini*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile matter content*

ASTM F735-17, *Standard test method for abrasion resistance of transparent plastics and coatings using the oscillating sand method*

ISO 17132, *Paints and varnishes — T-bend test*

ISO 1523, *Determination of flash point — Closed cup equilibrium method*

ISO 1524, *Paints, varnishes and printing inks — Determination of fineness of grind*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

ISO 6503, *Paints and varnishes — Determination of total lead — Flame atomic absorption spectrometric method*

ISO 3856-6, *Paints and varnishes — Determination of “soluble” metal content — Part 6: Determination of total chromium content of the liquid portion of the paint — Flame atomic absorption spectrometric method.*

RS OIML R 87, *Quantity of product in pre-packages*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ISO 4618 and the following apply.

3.1

component

a term used to describe each of two parts of the paint, which when mixed together form the pigmented polyurethane paint.

3.2

paint

the mixture of the two components in the proportion recommended by the manufacturer.

3.3

polyurethane paint

a reaction polymer, a combination of a polyol resin and an isocyanate hardener or curing agent.

3.4

two-pack/two components

a term used to describe each of two parts of the paint, which when mixed together form the pigmented epoxy layer

3.5

enamel paint

is loosely used to designate a shiny, glossy, decorative topcoat.

4 Requirements

4.1 General requirements

4.1.1 The paint shall consist essentially of two components: enamel and hardener or catalyst solution to be mixed in such simple proportion preferably by volume.

4.1.2 An enamel shall consist of

- (i) an appropriate polyol, and
- (ii) pigments, extenders, solvents and additives.

4.1.3 Hardener or catalyst solution shall consist of

- (i) an aliphatic polyisocyanate, and
- (ii) solvents and additives.

NOTE To determine whether the polyisocyanate is aliphatic or aromatic in nature, the test shall be carried out as prescribed in Annex A.

4.1.4 The mixture of base and hardener shall be allowed to mature for 20 min. at 27 ± 2 °C. the mixture must be consumed within 4 hours after mixing.

4.1.5 The two component polyurethane finish enamel paint shall be mixed in the ratio recommended by the manufacturer of the paint before conducting the test or tests. Where the enamel is required to be applied on panels, it shall be done so by using suitable spraying apparatus.

4.2 Specific requirements

The product shall comply with the requirements given in Table 1 when tested in accordance with the methods prescribed therein.

Table 1 – Specific requirements for two-pack polyurethane full gloss enamel paint

S/N	Parameters	Requirements	Test methods
1	Drying time, h, max.	Surface dry	3
		Hard dry	8
2	Consistency	Smooth and uniform and suitable for spray application	ISO 2431
3	Finish	Smooth and full glossy	Annex B
4	Colour	Close match to be specified ISO colour or to an agreed colour	ISO 3668
5	Dry film thickness, μm , min.	35	ISO 2808
6	Solids content, % by mass, min.	40	ISO 3251
7	Scratch hardness	No such scratch as to	ASTM F735-17

			show bare metal	
8	Flexibility and adhesion		No visible damage or detachment of film	ISO 17132
9	Flash point (for each component), °C, min.		20	ISO 1523
10	Fineness of grind, µm, max.		10	ISO 1524
11	Pot life at 27 ± 2 °C, h, min.		4	ISO 9514
12	Gloss at 45° angle of incidence, min.		52	ISO 2813
13	Mass in kg/10 L, min.		9	Annex C
14	Accelerated tests	Resistance to sulphuric acid	Shall not show any signs of blistering, wrinkling and lifting. Difference in gloss and colour between immersed and un-immersed area of paint film shall be minimum	Annex D
		Resistance to caustic potash	Do	
		Resistance to oil	Do	
		Resistance to solvents	Do	
15	Durability test	Outdoor exposure	Chalking 10	Annex E
		Accelerated weathering	- Checking 10 - Cracking 10 - Flaking 10 - Spotting 10 - Blistering 10 - Colour change 7 – 8 - Gloss – the film shall have a minimum gloss retention of 90% of its original value - No corrosion	
16	Keeping properties		Not less than 1 year	Annex F
17	Total lead content, mg/kg, max.		90	ISO 6503
18	Chromium content, mg/kg in dried paints, max.		5	ISO 3856-6

5 Packaging and labelling

5.1 Packaging

5.1.1 The paint shall be packaged in a suitable container that prevents it from deterioration during storage, transportation and normal handling.

5.1.2 The quantity of product packaged in a container shall be in accordance with the requirements of RS OIML R 87.

5.2 Labelling

5.2.1 Each container shall be marked legibly and indelibly with the following:

- a) name of the product as: “Two-pack polyurethane full gloss enamel paint”;

- b) name and address of the manufacturer and/or registered trader mark;
- c) net content;
- d) manufacture and expiry dates;
- e) spreading capacity, in m²/L;
- f) instructions for use and disposal;
- g) pot-life life at 25 °C;
- h) an indication of flammability.
- i) storage condition

5.2.2 Each label of the container shall be marked legibly and indelibly with the following:

- a) manufacture and expiry dates;
- b) Instructions for use;
- c) Pot-life;
- d) Colour;
- e) Batch number.

6 Sampling

Sampling shall be done in accordance with ISO 15528.

Annex A (normative)

Method of identifying aromatic and aliphatic isocyanates

A.1 General

Aliphatic polyisocyanates show no colouration while aromatic polyisocyanates show a light brown to a dark reddish brown colouration with hydrogen peroxide.

A.2 Reagents

A.1.1 Acetone

A.1.2 Hydrogen peroxide solution (3%) in acetone

A.3 Procedure

A.3.1 Prepare an approximately 40 – 50 % solution of the polyisocyanate in acetone. To 50 ml of this solution, stir 1 ml of 3 percent hydrogen peroxide solution. Allow it to stand for 5 – 10 min.

A.3.2 The development of any light brown to a dark reddish brown colour indicates aromatic polyisocyanates. No colour indicates aliphatic polyisocyanates.

Annex B (normative)

Determination of finish

B.1 Scope

This test method prescribes the details for determination of finish of paint and varnish films.

B.2 Procedure

The paint when applied on a mild steel panel by brushing or spraying, whichever is specified, to give a dry film mass commensurate with the mass per 10 litres of the paint as given in table B1 and allowed to dry in a vertical position under specified conditions in dust free atmosphere, shall dry to a hard, firmly adherent, flexible and smooth film, free from sagging and wrinkling, with a matt semi-glossy or glossy surface in accordance with the requirements of the paint specification.

Table B1 – relationship between dry film mass of single coat of paint material and mass per 10 litres of the paint material

Mass of the paint material in kg/10L	Dry film mass, g/m ²
Up to and including 10	17 to 22
Above 10 to 11	22 to 27
Above 11 to 12	27 to 34
Above 12 to 14	34 to 44
Above 14 to 16	44 to 54
Above 16 to 18	54 to 68
Above 18	68 to 80

The film so produced shall be of normal opacity and in no way inferior to a film prepared in the same manner and at the same time from approved sample, when examined not earlier than 48 hours and not later than 100 hours after application. In case of failure, the test shall be repeated by keeping the painted panels under standard atmospheric conditions.

Annex C (normative)

Determination of mass per 10 litres of liquid paint

C.1 Scope

This test method prescribes the determination of mass per 10 litres of liquid paints and related products by pycnometer or a mass per volume cup.

C.2 Apparatus

Pycnometer – of capacity 20 to 10 ml as showed in figure 1, 2 and 3

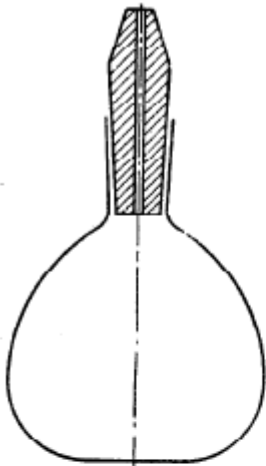


FIG. 1 GAY-LUSSAC PYCNOMETER

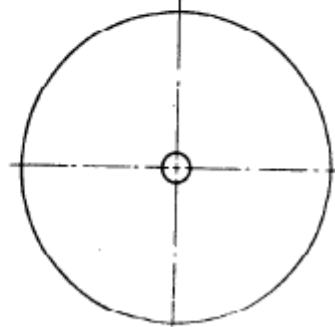
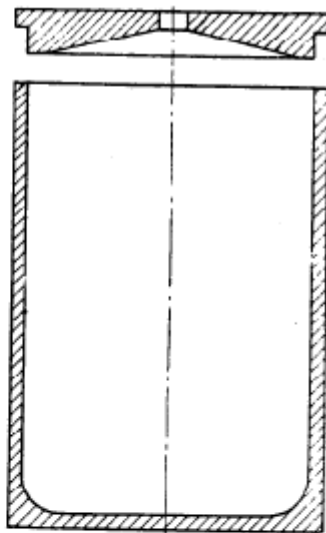


FIG. 3 METAL PYCNOMETER

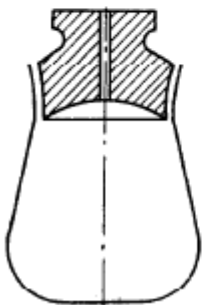


FIG. 2 HUBBARD PYCNOMETER

Thermometer – Graduated in divisions of 0.1 °C and accurate to 0.2 °C.

Water-bath of constant temperature room – capable of being maintained with ± 2 °C.

Analytical balance – accurate to 0.2 mg

C.3 Procedure

C.3.1 Clean the pyknometer suitably (see note 1). Thoroughly dry the pyknometer. Allow the pyknometer to attain room temperature and weight it. Fill the pyknometer with distilled water at a temperature not more than 1 °C below the standard temperature (27 ± 2 °C). Stopper or cap the pyknometer leaving the overflow orifice open. Every care shall be taken to prevent the formation of bubbles in the pyknometer. Place the pyknometer in the constant temperature water-bath or place it in the constant temperature room until the temperature of the pyknometer and its contents is constant. Remove the overflow by wiping with absorbent material (see note 2) and thoroughly dry the outside of the pyknometer by wiping with absorbent material. Do not remove any subsequent overflow (see note 3). Immediately weigh the filled apparatus to the nearest 0.0001 % of its mass (see note 4).

NOTE 1 If it is a glass pyknometer, use chromic acid, distilled water and a solvent. If it is a metal pyknometer, use solvent which leaves no residue on evaporation.

NOTE 2 A paper tissue is recommended for this purpose.

NOTE 3 Handling the pyknometer with bare hands will increase the temperature and cause more overflow from the overflow orifice and will also leave finger prints, hence, handling only with tongs and with hands protected by clean, dry absorbent material is recommended.

NOTE 4 Immediate and rapid weighing of the filled pyknometer is recommended in order to minimize loss in mass due to evaporation and overflow subsequent to the first wiping after attainment of temperature.

C.3.2 Repeat the above procedure using the product in place of distilled water. Remove any residues of paint from the outside of the pyknometer by wiping with absorbent material moistened with a suitable solvent and thoroughly dry by wiping with a clean absorbent material.

C.3.3 When using glass pyknometers with pigmented products, difficulties may be experienced in removing residual pigments, especially from ground-glass surfaces. Such residues may be removed by ultrasonic vibration in a water or solvent bath. To minimize errors, joints shall be firmly seated. For accurate determination, glass pyknometers are preferred. Metal pyknometers are generally used for determination of mass in kg/10litres for production control purposes. If the sample retains air bubbles, which do not readily disperse on standing, the methods described in this standard are unsuitable.

C.4 Calculations

C.4.1 *Calculation of volume of the pyknometer* – calculate the volume of pyknometer in millilitres as follows:

$$V = \frac{m_1 - m_0}{d}$$

Where,

V = volume in ml of pyknometer;

m₁ = mass in g of pyknometer and water;

m₀ = mass in g of the empty pyknometer, and

d = density of water at 27 °C in g/ml (0.996 5 g/ml)

C.4.2 Calculation of density – Calculate the density of the product in g/ml at the test temperature (27 °C) by the following formula:

$$d_t = \frac{m_2 - m_0}{V}$$

Where,

d_t = density of the product at test temperature (27 °C);

m₂ = mass in g of the pyknometer and product;

m₀ = mass in g of empty pyknometer; and

V = volume in ml of the pyknometer at 27 °C

C.4.3 Calculation of mass in kg/10 litres of material – Calculate mass in kg/10 litres of the material from C.4.2 by multiplying the results by 10.

C.4.4 Precision – With accurate control of temperature at ± 0.5 °C level, it is possible to achieve the following precision.

C.4.4.1 Repeatability – The difference between two successive results obtained by the same operator within a short time interval, with the same apparatus under constant operating conditions on identical test material shall not exceed 0.000 6 g/ml at the 95% confidence level.

C.4.4.2 Reproducibility – The difference between single and independent results obtained by different operators in different laboratories on identical test material shall not exceed 0.001 2 g/ml at the 95% confidence level.

C.4.4.3 In case of some liquid paint products, especially those showing structure viscosity or thixotropy, the above precision limits may not be obtainable.

Annex D (normative)

Accelerated tests

D.1 General

These tests of chemical resistance, are included to assure the customer that the coating contains a sufficiency of cured resin to exhibit the long term requirements.

D.2 Procedure

D.2.1 Prepare the panels as per Annex H. For the immersion tests as in D.2.2 to D.2.4, prepare and paint both sides of the panels and protect the edges of the panels by sealing with a chlorinated rubber paint.

D.2.2 Resistance to sulphuric acid

Immerse 3/4th of the panel in 30 percent sulphuric acid for 24 hours. Remove the panel, wash in running fresh water and allow it to dry for an hour. Record the observation.

D.2.3 Resistance to caustic potash

Immerse 3/4th of the panel in 20 percent solution of potassium hydroxide for 24 hours. Remove the panel, wash in running fresh water, allow it to dry for an hour. Record the observation.

D.2.4 Resistance to oil

Immerse 3/4th of the panel in a mineral lubricating oil for 24 hours. Remove the panel and wipe the excess oil with cotton, wash it with mineral turpentine and allow to dry for 30 minutes. Record the observation.

D.2.5 Resistance to solvents

Test one panel each for resistance to xylene, ethanol and acetone respectively. Take a clean white sterilized cotton and soak it in the solvent and place it on the panel without squeezing the cotton. Immediately cover the soaked cotton with a suitable watch glass and the leave it for 6 hours. Remove the watch glass and the soaked cotton, wipe the area with a clean dry cotton. Record the observation immediately.

Annex E (normative)

Durability tests

E.1 General

Both sides of the panels must be prepared and painted as per ISO 28199-1 for normal outdoor exposure test as well as accelerated weathering test.

E.2 Normal outdoor exposure test

E.2.1 Expose the test panels in the open in duplicate at an angle of 45° facing south. The duration of test shall be for a period of 12 months. The test shall be started from any month in a calendar year. Examine the condition of the exposed films at monthly intervals for the first quarter and thereafter quarterly for the rest of the period for the following characteristics:

- a) Gloss
- b) Colour
- c) Checking; cracking and flaking
- d) Chalking
- e) Spotting
- f) Blistering

E.2.2 Wash the right hand half of the surface of the two test panels with 5 percent caustic soda solution followed by 5 percent hydrochloric acid solution and subsequent thorough rinsing with water. Wipe the panel with a clean soft cloth. Examine the same half of the test panels at each examination. As an aid in the examination, magnifying glass may be used, but the valuation shall be based on an assessment with the unaided eye. At the end of the stipulated period for durability test, examine the two halves of the test panels. The sample shall be considered satisfactory if the material surface underneath as well as condition of the film in both the halves, the one washed periodically as well as the one washed only for the final examination is satisfactory. The requirements of this test shall be taken to have been satisfied if performance in respect of the requirements given in table 1.

E.3 Accelerated weathering test

Carry out the test for 1 000 hours in a xenon arc type weatherometer (with rotating day/night device) with a cycle of 3 min. rainfall and 17 min. dry period. The requirements of this test shall be taken to have been satisfied if performance in respect of the requirements given in table 1.

Annex F (normative)

Keeping properties tests

F.1 Scope

This method determines the change in certain properties that may take place when packaged paint of either the solvent thinned or latex type is stored at normal room conditions.

F.2 Apparatus

F.2.1 Spatula weighing 45 ± 1 g with square ended blade, 120 mm in length and approximately 20 mm in width. It is prepared by cutting the tip from an ordinary 127 mm flexible steel laboratory spatula of the specified length.

F.2.2 Paint brush nylon, 25 mm.

F.2.3 Test surface, a smooth-surfaced paper chart coated with a suitable varnish or lacquer so as to render the surface impervious and resistant to paint liquids.

F.3 Procedure

F.3.1 Open the container and note skinning, corrosion and odour of putrefaction, rancidity or souring. The other odours may be ignored. Skinning shall be designated as in Table F1.

Table F1 – Designation of changes in skinning

Grading	Description
5	None
4	Very slight
3	Slight
2	Moderate
1	Considerable
0	Severe

F.3.2 Hold the can without shaking or agitation and examine the sample without the removal of supernatant vehicle. Determine the extent and character of portions of the paint that may have separated during storage by the use of spatula. Hold the spatula perpendicular to and in the centre area of the paint at a height whereby the bottom edge of the spatula is level with the top of the can. Drop the spatula from that position. Rate the conditions of sample in accordance with table F2.

NOTE – This test shall be carried out with the sample stored in one litre or smaller container.

Table F2 – Rating for Degree of settling

Rating	Description of paints condition
--------	---------------------------------

5	Perfect suspension. No change from the original conditions of the paint.
4	A definite feel of settling and a slight deposit brought up on a spatula. No significant resistance to sidewise movement of the spatula.
3	Definite cake of settled pigment. Spatula drops through cake to bottom of container under its own mass. Define resistance to sidewise motion of spatula. Coherent portions of cake may be removed on spatula.
2	Spatula does not fall to the bottom of container under its own mass. Difficult to move spatula through cake sidewise and slight edgewise resistance. Paint can be remixed readily to a homogeneous state.
1	When spatula has been forced through the settled layer, it is very difficult to move spatula sidewise. Definite edgewise resistance to movement of spatula. Paint can be remixed to a homogeneous state.
0	Very firm cake that cannot be reincorporated with the liquid to form a smooth paint by stirring manually.

F.3.3 After examination of the entire sample as described in F.3.2, if a portion of the pigment has separated out to form a firm cake at the bottom of the container, pour the supernatant portion of the liquid into a clean container and hold for subsequent use. Reincorporate the separate cake by hand stirring with the spatula, adding back the liquid in small amounts until the pigment has been reincorporated to form a homogeneous paint suitable for the intended use or until it is determined that the pigment cake cannot be reincorporated by hand stirring. Rate the condition of the sample in accordance with table F2.

F.3.4 Apply the stored paint to one test panel and fresh control paint to the other. After the brushed film has completely dried, examine it for grains 0.8 mm in diameter, even larger gelatinous lumps, and streaks caused by such grains or lumps and designate as in table F1.

NOTE The use of mechanical shaker shall be avoided so that the lumps may not disperse.

F.3.5 Determine the mass per 10 litres of liquid paints prescribed in Annex C. calculate the loss of mass resulting from storage.

Bibliography

- [1] IS 101-3-4, *Methods of sampling and test for paints, varnishes and related products — Part 3: Tests on paint film formation — Section 4: Finish*
- [2] IS 101-1-7, *Methods of sampling and test for paints, varnishes and related products— Part 1: Test on liquid paints (general and physical) — Section 7: Mass per 10 litres*
- [3] IS 101-6-2, *Methods of sampling and test for paints, varnishes and related products — Part 6: Durability test on paint films — Section 2: Keeping properties*

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