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मानक

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IS 6411 (1985): gel-coated glass fibre reinforced polyester resin bath tubs [CED 3: Sanitary Appliances and Water Fittings]



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“Knowledge is such a treasure which cannot be stolen”

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IS : 6411 - 1985

Indian Standard

SPECIFICATION FOR
GEL-COATED GLASS FIBRE REINFORCED
POLYESTER RESIN BATH TUBS

(First Revision)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR GEL-COATED GLASS FIBRE REINFORCED POLYESTER RESIN BATH TUBS

(First Revision)

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Indian Standard

SPECIFICATION FOR GEL-COATED GLASS FIBRE REINFORCED POLYESTER RESIN BATH TUBS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 September 1985, after the draft finalized by the Sanitary Appliances and Water Fittings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard was first published in 1972. The revision of this standard has been taken up to incorporate further changes necessary in the light of the developments in the industry. The modifications have been carried out in materials, dimensions, workmanship, etc, besides including a test on washability and ink test, etc.

0.3 In the formulation of this standard, due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the requirements for materials, construction, workmanship, finish, performance and testing for gel-coated glass fibre reinforced polyester resin bath tubs.

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Aggregate Defects — This term is used when pin holes, impurities and tracts of mending are present at the rate of more than 5 each or more than 5 in aggregate for all defects.

2.2 Bubbles — Air bubbles entrapped in the bath tub.

2.3 Colour Blot — Colour blots appearing on account of uneven distribution of colouring material, uneven thickness of the gel-coating colour, lack of lustre, etc.

2.4 Crazing — Fine hair crack on the surface.

2.5 Defective Impregnation — Imperfect impregnation of glass fibre with unsaturated polyester resin.

2.6 Filler — The material used in the manufacture of bath tubs other than the glass fibre, resin and pigment specified.

2.7 Gel-Coat — A resin-rich pigmented protective layer provided on the working surface of the bath tub. During moulding care is taken so that it forms a single homogeneous body with the glass fibre laminate.

2.8 Impurities — The foreign matters present.

2.9 Pin Holes — Pores of size less than 1 mm appearing on the surface.

2.10 Superficial Defects — Defects present on the surface.

2.11 Traces of Mending — The traces left over after mending carried out to eliminate small defects.

2.12 Unevenness — Unevenness and wrinkles present on the surface.

2.13 Warpage — Distortion of original shape during manufacturing process.

3. MATERIALS

3.1 Glass Fibre — The fibre glass used in the manufacture of bath tubs shall be low alkali glass (for example, E-glass) compatible with polyester resin.

3.1.1 The glass content of the laminate shall be minimum 30 percent by weight when tested according to the method described in 8.15.

3.2 Polyester Resin — Unsaturated polyester resin used in the manufacture of bath tubs should be resistant to hot water and weathering. A ratio of not less than 1 : 2 of glass fibre to polyester is recommended.

3.3 Fillers and Colouring Materials — When filler and colouring materials are used, their quality and proportion should be compatible to the polyester and the materials should not have any harmful effect on the quality and performance of bath tubs.

3.4 Gel-Coat — The bath tub should possess a uniform gel-coat on the working surface. The gel-coat used shall be based on isophthalic grade of polyester, or epoxy resin or any equally suitable chemical resistant grade of resin.

4. WORKMANSHIP AND FINISH

4.1 The bath tubs shall be free from cracks, crazing, pinholes, porosity, blisters, chipped areas or moulding defects that may affect their appearance and serviceability. There shall be no readily visible wrinkles in any area when viewed with lighting as specified in 8.1.1. The gel-coat shall be free from voids and no voids between the gel-coat and the back-up resin shall be closer than 0.5 mm to the inner face. Blemishes shall not exceed those specified in 8.1.1.

4.2 Colour — The colour shall be as agreed to between the manufacturer and the buyer and shall be substantially permanent under ordinary conditions of use.

4.3 Non-permissible Defects — The defects which shall not be permitted are given in Table 1.

TABLE 1 DEFECTS WHICH CANNOT BE PERMITTED

Sl No.	PART	NON-PERMISSIBLE DEFECTS
(1)	(2)	(3)
i)	Upper rim, inner wall, bottom, apron, other readily visible faces	Small pores, wrinkle, craze, bubbles, defective impregnation, superficial defects injuries, aggregate defects
ii)	Obscure faces	Defective impregnation, superficial defects

4.4 Permissible Range of Defects — The permissible range of various defects are given in Table 2.

TABLE 2 PERMISSIBLE DEFECTS

(Clause 4.4)

SL No.	DEFECTS/PARTS	UPPER RIM	INNER WALL	APRON	BOTTOM	OTHER READILY VISIBLE PARTS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Traces of mending	2	2	2	2	Not conspicuous
ii)	Impurities	2	3	2	3	„ „
iii)	Pin holes	2	3	2	3	„ „
iv)	Colour bolts	Should not be conspicuous				
v)	Unevenness	Should not be conspicuous				
vi)	Deformity	The horizontal section of the upper rim should drain off water readily. The bend of the section in contact with wall should be less than 5 mm. Deformities of the other sections of the bath tubs should not be conspicuous				

5. DIMENSIONS

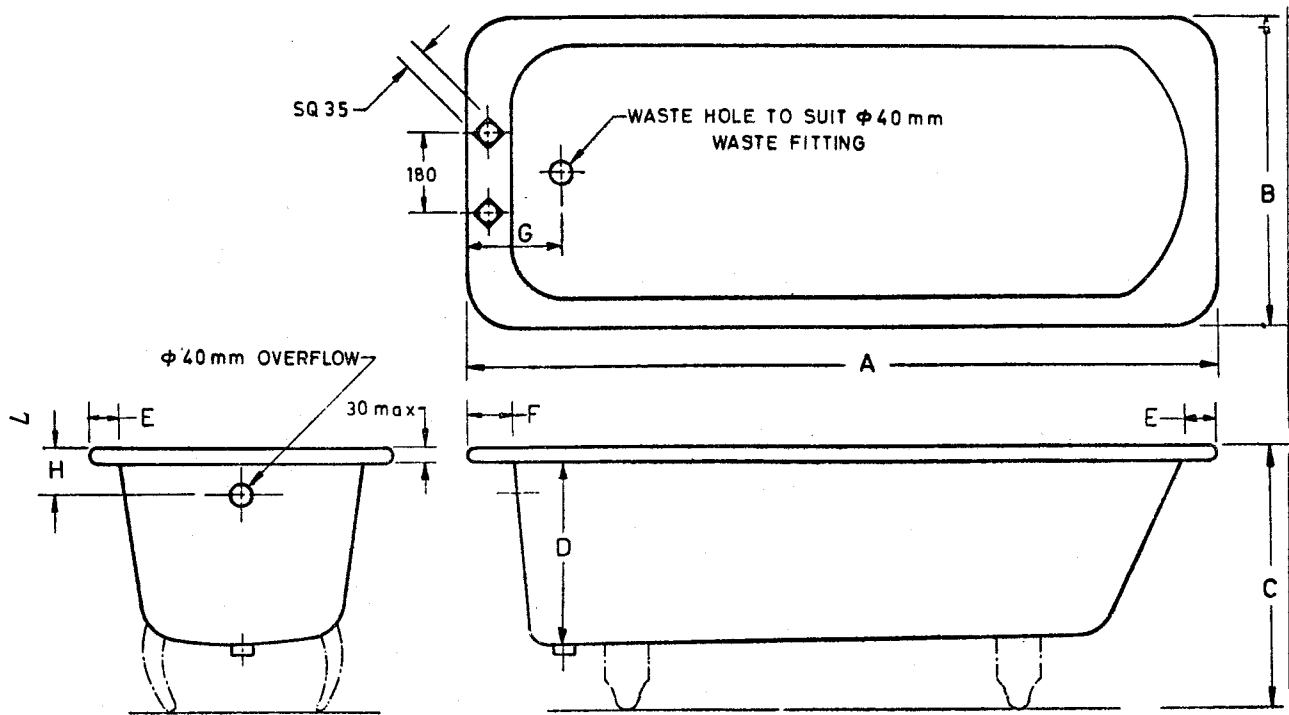
5.1 The bath tubs shall comply with the dimensions specified in Table 3, read with Fig. 1. However, they may be manufactured in other dimensions where so agreed to between the manufacturer and the purchaser.

TABLE 3 DIMENSIONS OF BATH TUBS

(Clause 5.1, and Fig. 1)

All dimensions in millimetres.

Length overall at top, <i>A</i>	1 680 to 1 700
Width overall at top, <i>B</i>	730 to 760
Height overall, <i>C</i>	500 to 570
Depth inside, at waste, <i>D</i>	440
Roll (at head end and sides), <i>E</i>	60 Min to 85 Max
Roll (at tap end), <i>F</i>	75 Min to 100 Max
Distance of tap holes, centre-to-centre	180
Waste hole-horizontal distance from outside edge of roll at tap end to centre of waste hole, <i>G</i>	250
Overflow centre—vertical distance below top edge, <i>H</i>	100



All dimensions in millimetres.

FIG. 1 TYPICAL ILLUSTRATION OF BATH TUB

6. CONSTRUCTION

6.1 Each bath tub shall be one piece unit with an opening for waste outlet with floor sloping towards the outlet. An overflow shall normally be provided on the side near the waste outlet. An apron (side panel) may be provided integrally or separately with the bath tub.

6.2 Drain Fittings Connections — The waste opening shall be suitable for the proper installation of waste fittings which are ordinarily used for the purpose. When the fitting is installed, the bath tub shall withstand the test given in 8.10.

6.3 Support — The bath tub shall be provided with a supporting structure integral to the unit in between the space between the bottom of the bath tub and the floor of the building on which the bath tub rests, unless otherwise specified. The materials of the supporting structures shall be at least equal to the material of the bath tub in resistance to deterioration with age and should meet the requirement of fungus and vermin.

6.3.1 Effectiveness of Support — When the bath tub is installed according to the manufacturer's directions, there shall be no permanent deformation of the bath tub or its supporting structure and no cracking or crazing of the bath tub when load tested in accordance with 8.11. Under this test, there shall be no permanent deformation nor cracking of the rim where attached to the wall and no visible warpage of the bath tub at any point which could detrimentally affect its appearance or drainage. Any unsupported areas shall withstand the load test given in 8.12.

6.4 In forming the roll, the outer edges shall be flanged or rolled back underneath sufficiently to prevent exposure of sharp edges. The vertical height of the flanged or rolled edges shall be not more than 30 mm.

6.5 At the tap end of the roll, there shall be a level area within a radius of at least 25 mm from the centre of each tap hole.

6.6 For the safety of users, bath tubs shall be as flat-bottomed as practicable. The fall along the bottom head end to the outlet shall be adequate for complete emptying.

6.7 The waste hole shall be so formed as to be suitable for receiving a 40 mm waste fitting.

6.8 Thickness — The thickness of the glass fibre reinforced polyester laminate including the gel-coat shall not be less than the following:

Apron	2 mm
Inner wall and bottom	3 mm
Bottom bend	4 mm

7. PERFORMANCE REQUIREMENTS

7.1 Impact Resistance — A specimen cut from the side or bottom of the tub shall not show cracks in the gel-coat when subjected to impact test in accordance with 8.3.

7.2 Hardness — The bath tub surface and backing shall show a minimum reading of 40 points on a barcolimpresor or any other equally suitable apparatus when tested in accordance with 8.4.

7.3 Cracking or Crazing — A complete bath tub or test piece taken from any part of it shall not show on visual inspection any signs of cracking or crazing after the oven test given in 8.5.

7.4 Water Absorption — The bath tub shall not absorb water in excess of 0.5 percent in 24 hours when tested in accordance with 8.6.

7.5 Gel-Coat — The gel-coat shall not be less than 0.25 mm thickness nor more than 1.00 mm thickness when determined in accordance with 8.7.

7.6 Resistance to Boiling Water — There shall be no crazing, bubbles, discolouration when test pieces are subjected to boiling water as described in 8.8.

7.7 Resistance to Hydrochloric Acid — There shall be no crazing, discolouration, exposure of glass fibre, etc, when subjected to the test for hydrochloric acid as described in 8.9.

7.8 Tensile Strength Test for Laminates — The tensile strength of the laminate at any point shall not be less than 6.5 MPa when tested in accordance with procedure given in 8.13.

7.9 Washability — Bath tubs shall withstand 40 000 cycles in the scrub test and only slight brush marks at the completion of the test described in 8.14 shall be permitted.

8. TESTS

8.1 Method of Inspection for Defects of Bath Tubs

8.1.1 The surface of the bath tubs shall be visually inspected for blemishes from a distance of 600 mm after being inked in accordance with 8.1.2. The light source shall be partially diffused daylight supplemented, if necessary, with diffused artificial light to provide illumination comparable to that usually available within a short distance of the outside window facing north but not in direct sunlight. The illumination shall have an intensity of 1 000 to 2 000 lux. Blemishes other than those given in Table 2 shall not be allowable. No stains shall be permitted when ink-tested.

8.1.2 Ink Test — To do the visual inspection of the surface of the bath tub, ink is applied to the area to be inspected as follows:

- a) Wash the entire area to be inspected with a water soluble ink (see IS : 2221-1971*) and allowed to dry completely. (When inspecting coloured bath tub, use a contrasting coloured ink.)
- b) Rinse the surface with fresh water and examine. Ink will be entrapped in crazing, cracks, pores, etc.

8.1.2.1 In this standard all references to visible defects shall refer to defects apparent to the eye upon close inspection, after the surface has been ink tested.

8.2 Samples — The test samples laminate shall be cut from projection provided as integral part of the bath tub. The sample shall be cut from 40 mm away from the edges of the projection. The cut pieces shall be first stabilized at room temperature for 24 h. The sample shall then be cured at 80°C minimum for three hours.

8.3 Impact — The test pieces shall be tested at room temperature of $27 \pm 2^\circ\text{C}$ by supporting and clamping them firmly in a 125 mm diameter frame. A 38 mm diameter steel ball, weighing 225 g shall be dropped on the centre panel and be allowed to fall from a height of 150 mm to strike the reverse side and from a height of 750 mm to strike the gel-coated side. After each drop of the ball the presence of crack shall be determined by applying the ink test to the affected area (see 8.1.2) and carefully examining the area for conformity with 7.1.

8.4 Hardness — With the indenter perpendicular to the test surface, a light hand pressure is exerted against the instrument to drive the spring loaded indenter into the material and the hardness dial reading is taken and recorded after a 10-second interval. An average of at least 5 tests shall be used for determining conformity with 7.2.

8.5 Oven Test for Cracking and Crazing — After 10 days in a circulating air-oven maintained at $80 \pm 2^\circ\text{C}$, the test pieces shall be inspected for conformity with 7.3.

8.6 Water Absorption — Test pieces shall be cut to size 50 mm \times 50 mm or area of diameter 30 mm, the exposed edges of the pieces shall be coated with resin to prevent inter-laminar attack. The sections of the pieces shall be cleaned, dried for 24 h in air bath at $50 \pm 3^\circ\text{C}$ and then allowed to cool in a desiccator. Following this the pieces shall be weighed immediately with the help of a chemical balance. Next the test pieces are immersed in distilled water for 24 h at $27 \pm 2^\circ\text{C}$, taken out, the water wiped out with

*Specification for dye based fountain pen inks (first revision).

a piece of dry cloth and then weighed again immediately. The absorption coefficient shall be determined from the following:

$$A = \frac{W_2 - W_1}{W_1} \times 100$$

where

A = absorption coefficient (percent),

W_2 = weight after immersion, and

W_1 = weight before immersion.

8.7 Gel-Coat Thickness — The thickness of the gel-coat shall be measured by cutting a test section from the area to be measured and sand-papering the edge to the section until smooth. A suitable measuring device shall be kept across the edge, perpendicular to the plane of the gel-coat and the thickness of the gel-coat shall be measured with the aid of the reading glass, if needed, for conformity with 7.5.

8.8 Resistance to Boiling Water — Test pieces shall be of size 50 mm × 50 mm or of diameter above 30 mm. The exposed edges of the test pieces shall be coated with resin to prevent inter-laminar attack. These shall be boiled for 7 h in hot water at 100°C and then left undisturbed for at least 17 h at the atmospheric temperature. Taking this as one cycle, such cycle shall be repeated 15 times. After all these the test pieces shall be inspected for conformity with 7.6.

8.9 Test for Hydrochloric Acid — One millimetre of hydrochloric acid of 3 percent concentration shall be dropped on the test piece and inspected after 60 min for conformity with 7.7. Following this inspection, the surface hardness shall be tested (see 8.4).

8.10 Load Test Drain Fitting Connection — The drain fitting properly installed on the bath tub shall be held by its flanges in a horizontal position as in normal installation. A 22 kg mass shall be applied by means of a level arm 600 mm in length connected to the drain fitting and extending horizontally from it. The arm and weight shall be placed in three radial positions, two of which shall be approximately 180° apart and the effect of the load in each position shall be carefully observed. There shall be no visible damage as determined by the ink test (see 8.1.2) to the bath tub with the weight in any position in order to be considered as conforming to 6.2.

8.11 Load Tests on Rim and Support

8.11.1 Test Method — Without rigidly connecting the drain fitting, a preload mass of 135 kg shall be applied to the centre of the bottom of the

unit on a weight distribution disk 75 mm diameter covered by a 150 mm thickness of sponge rubber or other suitable soft material between the disk and the surface being loaded. The load is left in place for 2 to 3 min to allow for settlement of the test frame and any initial slip in fasteners. Ten to fifteen minutes after removing the pre-load, reapply the 135 kg load for not less than one minute nor more than two minutes with the drain fitting rigid as it would be in actual use. This load shall be placed in the approximate centre of the bottom of the unit, but not over a rib or other support that may be present on the underside of the unit. Measure the deflection under this applied load with a deflectometer or other suitable device with a least reading of 0.02 mm. Measure the residual deflection not more than 10 minutes after removal of the load. The 135 kg load shall also be applied for a period between one and two minutes at two other points on the bottom of the unit, and at two points to the top of the rim, one at the mid-point and one near an end for the purpose of checking for cracks only.

8.11.2 Performance Requirement — Following the test in 8.11.1 there shall be no cracks in the surface of the unit when inspected after again inking as described in 8.1.2. The deflection under the applied load shall not exceed 4 mm. The maximum residual deflection 10 minutes after removal of the load shall not exceed 0.2 mm.

8.12 Load Test on Unsupported Areas

8.12.1 Test Method — A load of 5 kg shall be applied at the central point of at least four unsupported tub wall areas below the rim of the bath tub by means of a 25 mm diameter steel rod rounded to a 15 mm radius at the end in contact with the bath tub. Measure the deflection under the applied load by means of a deflectometer or other suitable device with a least reading 0.02 mm.

8.12.2 Performance Requirement — Following the test in 8.12.1 there shall be no cracks in the bath tub surface when inspected after again inking as described in 8.1.2. The deflection under the applied load shall not exceed 3 mm at any individual load point.

8.13 Tensile Strength Test — The test pieces shall consist of a dumb-bell similar in shape to the tensile test specimen given in IS : 2530-1963* for tensile strength tests, except that two bolt holes, 10 mm in dia shall be drilled in the test piece as shown in Fig. 2. The thickness of the test piece shall be that of the sheet cut from the projection of the bath tub (provided for the purpose) and the thickness shall be measured on the parallel portion by means of micrometer, to the nearest 0.025 mm. The rate of traverse shall be constant within the range 5.0 to 6.5 mm/min. The mean

*Methods of test for polyethylene moulding materials and polyethylene compounds.

of three determinations shall be recorded as the tensile strength of the material but if a test piece breaks in grip the result shall be disregarded and further determination made. The tensile strength shall be calculated by dividing the breaking load by the cross-sectional area which the specimen possessed before testing.

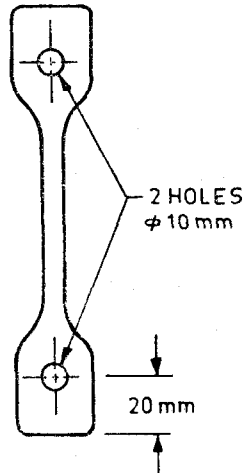


FIG. 2 HOLES IN TENSILE TEST SPECIMEN FOR TENSILE TEST

8.13.1 The test shall be carried out at room temperature of $27 \pm 2^\circ\text{C}$ and the test piece shall be conditioned to this temperature for at least 2 hours before testing.

8.14 Scrub Test — The Gardner Straight Idne Sarub Tester, or equivalent equipped with a 500 g black butt-cut hot bristle brush shall be used for this test. Immerse the brush bristles in water at 25 to 30°C for 30 minutes to a depth of 12 mm. Shake the brush vigorously several times to remove 'free' water then soak for an additional 5 minutes in 0.5 percent detergent solution made with distilled water. Mount the test specimen firmly on the apparatus so that the brush will describe a straight line throughout its entire path and reverse its direction without bobbing (dipping and restoring at the end of stroke). Place the brush saturated with the detergent solution on the specimen, and start the brush moving immediately at approximately 40 cycles per minute. During the test permit additional detergent solution to drop into the middle of the path of the brush from a separatory funnel at a rate of about 12 drops per minute, or at a rate just sufficient to keep the specimen wet. Remove the specimen at the end of 40 000 brush

cycles (80 000 strokes). Immediately wash the specimen with tap water at moderate temperature and inspect the specimen for conformity with 7.9.

8.15 Glass Content — The glass content in the laminate shall be determined using the following procedure. The specimen is first weighed on an analytical balance in a previously weighed, ignited crucible. The specimen is placed in the furnace at a temperature not greater than 343°C. The temperature of the furnace is raised to $565 \pm 28^\circ\text{C}$, at a rate that will not cause blowing or loss of inorganic filler. The specimen and crucible are then ignited at this maximum temperature to constant weight (2 - 6 hours depending on the thickness) and allowed to cool in a desiccator. The loss in weight shall be determined by weighing the residue:

$$\text{Glass content, weight percent} = \frac{W_0 - W_1}{W_0} \times 100$$

where

W_1 = loss in weight, and

W_0 = original weight.

9. MARKING

9.1 Each bath tub shall be clearly marked by stamping and labelling in a prominent place the name and trade-mark of the manufacturer.

9.2 Each bath tub may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

10. MANUFACTURER'S INSTRUCTIONS

10.1 The manufacturer shall furnish with each bath tub, suitable instruction for cleaning and maintenance of bath tubs.

(Continued from page 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²



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