USSR
STATE STANDARD

GOST 5161—57

LOGARITHMIC RULERS FOR GENERAL PURPOSES GOST 5161—57

Official Publication

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CALCULATING RULES LOGARITHMIC GENERAL PURPOSE

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USSR Committee on Standards, Measures, and Measuring Instruments under the Council of Ministers of the Union of Soviet Socialist Republics	STATE STANDARD LOGARITHMIC CALCULATING RULERS FOR GENERAL PURPOSES	GOST 5161—57 Replaces GOST 5161—49 Group P81

This standard does not apply to special logarithmic slide rules whose scales are designed for specific cases of mathematical calculations.

I. TYPES, BASIC DIMENSIONS, AND PARAMETERS

1. The following types of general-purpose logarithmic rulers are established:
   LSLO — single-sided logarithmic counting rulers;
   LSLD — double-sided counting logarithmic rulers.
2. Rulers shall be manufactured with nominal lengths of the main scales:
   500; 250; 150; and 125 mm.
3. The number of calculation scales on the rulers must correspond to those specified in Table 1.

Table 1

Nominal length of main scales *mm*	Number of calculation scales	
	LSLO type	Type LSLD
500	10–11	14
250	10–11	14
150	10–11	14
125	8–10	10

Note: It is permissible to manufacture LSLD-type rulers with more than 14 calculation scales, provided that the samples are approved in accordance with established procedures.

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4. The rulers shall be manufactured with the following calculation scales:

a) Single-sided rulers with 11 scales

A scale of cubes of numbers on the body.
A scale for the squares of numbers on the body.
A scale for the squares of numbers on the sliding rule.
A reverse number scale on the sliding rule.
Main number scale on the slide.
Main number scale on the housing.
Exponential scale from e to 2×10^4 on the housing.
Exponential function scale from 1.1 to e on the vertical edge.
A scale for the tangents of angles on the back of the slide.
A scale for the sine and tangent of small angles on the back of the slide.
A sine scale on the back of the slide.

b) Single-sided rulers with 10 scales

A scale of cubes of numbers on the body.
A scale for the squares of numbers on the body.
A scale for the squares of numbers on the slide.
Reverse number scale on the slider.
Main number scale on the sliding rule.
The main number scale on the case.
The logarithm mantissa scale on the case.
The angle tangent scale on the back of the slide.
Scale for sine and tangent of small angles on the back of the slide.
The sine scale on the back of the slide rule.

c) Single-sided rulers with 8 scales

A scale for the squares of numbers on the body.
A scale of squares of numbers on the slide.
The main number scale on the slide.
The main number scale on the body.
A logarithmic mantissa scale on the body.
The angle tangent scale on the back of *the slide.*
Scale of sine and tangent values for small angles on the back of the slide.
The sine scale on the back of the slide.

d) Double-sided rulers with 14 scales

On the front side of the ruler:

A cube scale on the body.
A scale for the squares of numbers on the body.
A scale for the squares of numbers on the sliding rule.
Reverse number scale on the sliding rule
Main number scale on the slider.
The main number scale on the body.
A number scale shifted by π on the case.

On the reverse side of the faceplate:

A scale for the exponential function of numbers from 1.01 to 1.10 on the case.
A scale for the exponential function of numbers from 1.10 to e on the case.
A scale for the tangents of angles on the dial.
A scale for the sine and tangent of small angles on the dial.
A sine scale on the dial.
A scale for the exponential function of numbers from e to $2 \cdot 10^4$ on the case.

A scale for the mantissas of logarithms on the body.

e) Double-sided rulers with 10 scales

On the front side of the ruler:

A scale for the squares of numbers on the body.
A scale for the squares of numbers on the slide.
Reverse scale on the sliding rule.
Main number scale on the sliding rule.
Main number scale on the body.

On the back of the ruler:

A scale for the exponential function from 1.1 to e on the body.
A scale for tangents of angles on the spindle.
Scale for the sine and tangent of small angles on the slide.
A sine scale on the slide.
A scale for the exponential function from e to 2×10^4 on the body. The layout of the calculation scales on the rulers is shown in Figs. 1–5.

a) Scale layout on a single-sided slide rule with 11 scales (type LSLO)

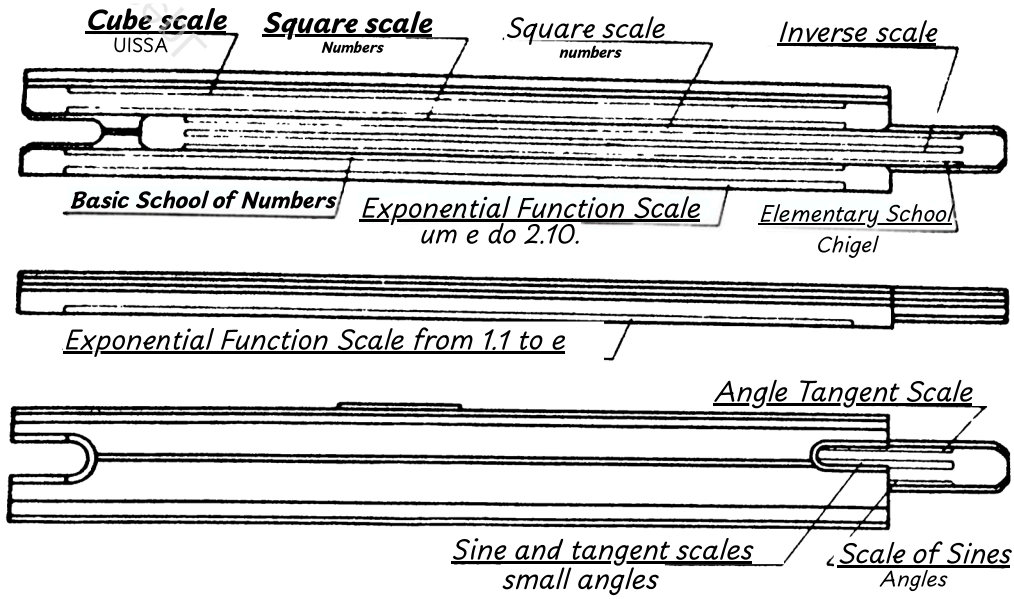

Fig. 1

b) Arrangement of scales on a single-sided ruler with 10 scales (type LSLO-10)

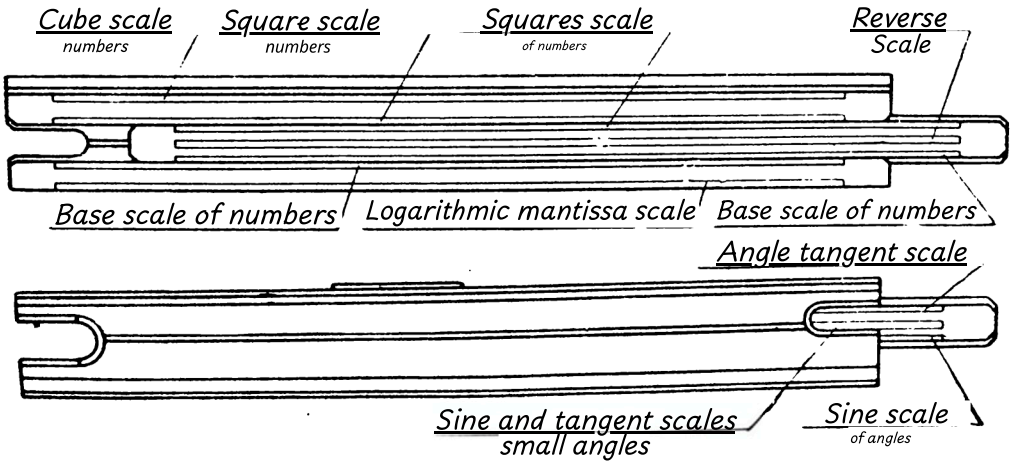

Fig. 2

c) Scale layout on a single-sided ruler with 8 scales (type LSLO-8)

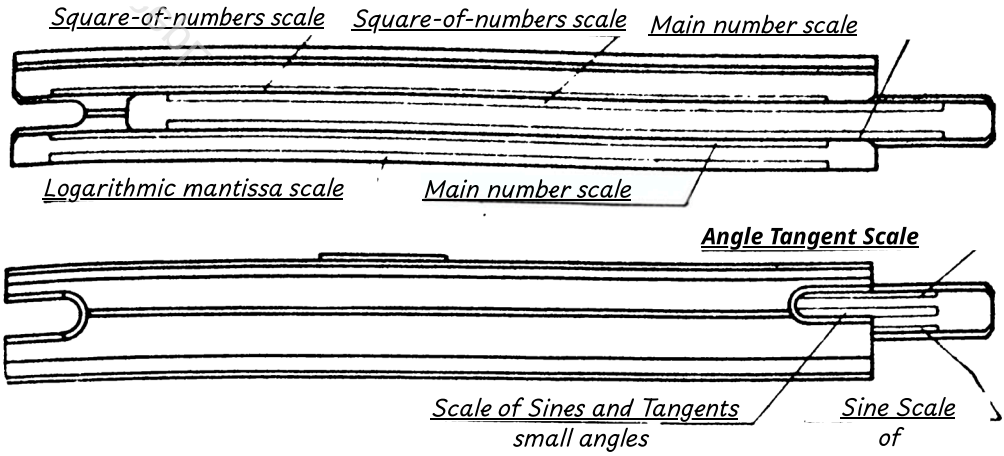

Fig. 3

d) Arrangement of scales on a double-sided ruler with 14 scales (type LSLD-14)

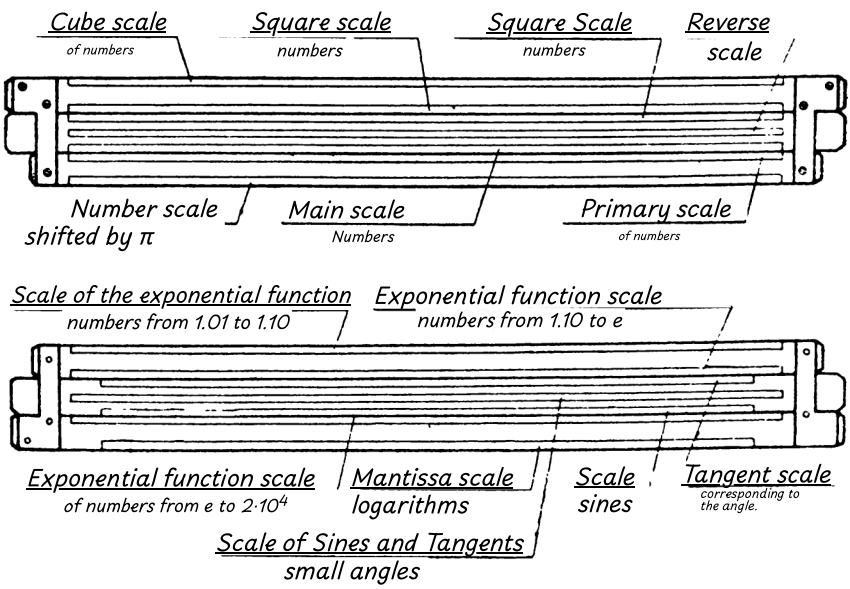

Fig. 4

d) Scale layout on a double-sided ruler with 10 scales (type LSLD-10)

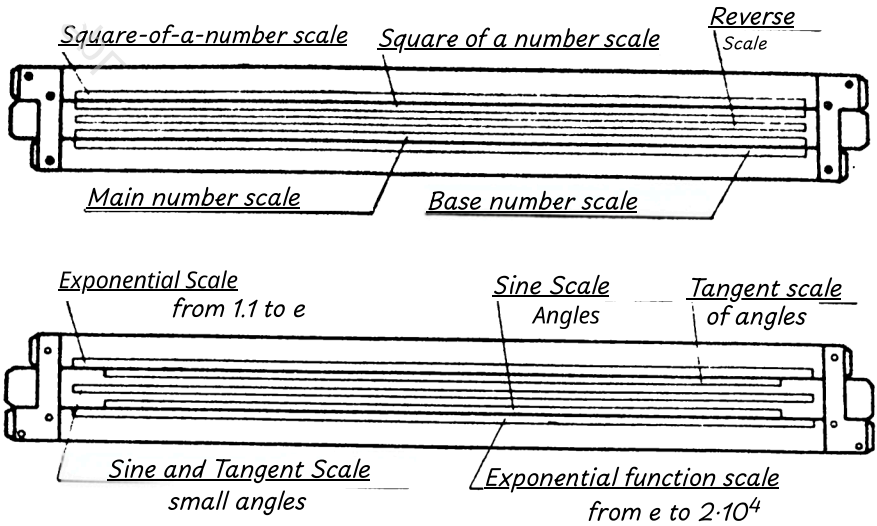

Fig. 5

Example of a Symbolic Designation

Symbolic designation for a single-sided logarithmic counting ruler, 250 *mm* long, with 11 scales:

LSLO-250-11 rulers, GOST 5161-57

II. TECHNICAL REQUIREMENTS

5. General-purpose logarithmic counting rulers shall be manufactured in accordance with the requirements of this standard based on drawings approved in the prescribed manner.

6. The scales of logarithmic rulers shall have graduations in accordance with Table 2.

Table 2

Scale Type	Scale division price for rulers with a nominal length, *mm*			
	500	250	150	125
a) Main and reverse scales				
In section 1—2	0.005	0.01	0.02	0.02
„ „ 2—4	0.01	0.02	0.05	0.05
its mission 4–5.....	0.01	0.05	0.05	0.05
her mission 5–10.....	0.02	0.05	0.10	0.10

Continued

Scale Designation		l. Scale division value for rulers with a nominal length, *mm*			
		500	250	150	125
b) Square scale					
On the section	1–2...	**0.01**	0.02	0.05	**0.05**
	2–3...	**0.02**	0.05	0.05	**0.05**
" "	3–4...	0.02	**0.05**	**0.10**	**0.10**
" "	4–5...	0.05	**0.05**	**0.10**	**0.10**
" "	5–6	0.05	0.10	0.10	0.10
" "	6–10	0.05	0.10	0.20	0.20
" "	10–20	0.10	0.20	0.50	0.50
" "	20–30	0.20	0.50	0.50	0.50
" "	30–40	0.20	0.50	1.00	1.00
" "	40–50	0.50	0.50	1.00	1.00
" "	50–60.....	0.50	**1.00**	1.00	1.00
" "	60–100.....	0.50	**1.00**	2.00	2.00
c) Cube Scale					
In the section	1–2...	0.01	0.02	0.05	0.05
" "	2–4...	0.02	0.05	0.10	0.10
" "	4–5	**0.05**	0.05	**0.20**	**0.20**
" "	5–10	**0.05**	0.10	**0.20**	**0.20**
" "	10–20	0.10	0.20	**0.50**	**0.50**
" "	20–40	0.20	0.50	**1.00**	**1.00**
" "	**40–50**.	0.50	0.50	2.00	**2.00**
" "	**50–100**.	0.50	1.00	2.00	**2.00**
" "	100–200...	**1.00**	2.00	5.00	**5.00**
" "	200–400...	**2.00**	5.00	10.00	**10.00**
" "	400–500	5.00	**5.00**	**20.00**	**20.00**
" "	500–1000	5.00	**10.00**	**20.00**	**20.00**
d) Scale of sine values with decimal degrees					
In the range	5.8–7°.....	0.02	**0.05**	0.1	0.1
" "	7–15°.....	0.05	**0.1**	0.2	0.2
" "	15 -35° ...	**0.1**	0.2	**0.5**	**0.5**
" "	35 -70° ...	**0.2**	0.5	**1.0**	**1.0**
" "	70–80° : : : :	0.5	1.0	2.0	2.0
" "	80–90° : : : :	1.0	2.5	2.5	2.5

Continued

Scale designation	Scale division price for rulers with nominal length, *mm*			
	500	250	150	125
d) Angle tangent scale with decimal divisions of degrees				
In the section 5.8–7°. . . .	**0.02**	**0.05**	**0.1**	**0.1**
» » 7' — 20°	0.05	**0.1**	0.2	0.2
» » 20–45°. . . .	**0.1**	0.2	**0.5**	**0.5**
e) Sine and tangent scale tangent scale for small angles with decimal degree**divisions**				
In the section 0.57– 1° . . .	**0.002**	**0.005**	**0.01**	**0.01**
» » 1 — 2° . . .	0.005	0.01	0.02	0.02
» » 2 — 4° . . .	**0.01**	0.02	0.05	**0.05**
» » 4 — 5° . . .	**0.01**	0.05	0.05	**0.05**
» » 5 —5,7° . . .	0.02	0.05	0.10	0.10
(g) The sine scale in angular measurement				
In the 5°50′ –10°	2′	5′	5′	10′
» » 10°—20°	5′	10′	10′	20′
» » 20°–30°	10′	20′	20′	30′
» » 30°—40°	10′	20′	30′	1°
» » 40°—50°	20′	30′	1°	1°
» » 50°—60°	20′	30′	1°	2°
» » 60° °–70°	30′	1°	1°	2°
» » 70°–80°	1°	2°	2°	5°
» » 80°–85°	1°	2°30′	5°	5°
» » 85°–90°	5°	5°	5°	5°
3) Tangent scale in angular **angle-trigonometry**				
In the section 5°50′–10°	2′	5′	5′	10′
» » 10°–14°	5′	5′	10′	10′
» » 14°–20°	5′	5′	10′	20′
» » 20°–30°	5′	10′	10′	30′
» » 30°–45°	5′	10′	20′	30′
i) The of small calculus **of sine and tangent angles in angular**				
On the segment 0°35′—1°	20″	1′	1′	1′
» » 1° —2°	30″	1′	2′	2′

Continued

Scale Names	Scale division price for rulers with a nominal length of , mm			
	500	250	150	125
In the 2°–3° range	1'	1'	5'	5'
: : 3°–5°	1'	2'	5'	5'
: : 5°–5°40'	2'	5'	5'	5'
k) Functional indicator scale from 1.01 to 1.1				
In the range 1.01–1.02	0.00005	0.0001	0.0002	0.0002
: : 1.02–1.05	0.0001	0.0002	0.0005	0.0005
: : 1.05–1.10	0.0002	0.0005	0.001	0.001
l) Scale of the exponential function from 1.10 to e				
In the range 1.10–1.20	—	0.001	0.002	0.002
: " 1.20–1.40	—	0.002	0.005	0.005
: " 1.40–1.80	—	0.005	0.01	0.01
: " 1.80–2.50	—	1.01	0.02	0.02
: " 2.50–3	—	0.02	0.05	0.05
m) Scale of the exponential function from e to $2 \cdot 10^4$				
In the range 2.5–4.0 . .	0.01	0.02	0.05	0.05
" " 4.0–6.0 . .	0.02	0.05	0.1	0.1
" " 6.0–10.0 . .	0.05	0.1	0.2	0.2
" " 10.0–15.0 . .	0.1	0.2	0.5	0.5
" " 15.0–30.0 . .	0.2	0.5	1.0	1.0
" " 30.0–50.0 . .	0.5	1.0	2.0	2.0
" " 50.0–100.0 . .	1.0	2.0	5.0	5.0
" " 100.0–200.0 . .	2.0	5.0	10.0	10.0
" " 200.0–500.0 . .	5.0	10.0	50.0	50.0
" " 500.0–1,000.0 . .	10.0	50.0	100.0	100.0
" " 1,000.0–2,000.0 . .	50.0	100.0	200.0	200.0
" " 2,000.0–5,000.0 . .	100.0	200.0	500.0	500.0
" " 5,000.0–10^4 . .	200.0	500.0	1,000.0	1,000.0
" " 10^4–$2 \cdot 10^4$ . .	500.0	1,000.0	2,000.0	2,000.0
n) Logarithm mantissa scale	0.001	0.002	0.005	0.005
o) A number scale shifted by π:				
In the interval π— 4	0.01	0.02	0.05	0.05

Continued

Scale Type	Scale division value for rulers with nominal length, *mm*			
	500	250	150	125
In section 4–5	**0.01**	**0.05**	**0.05**	0.05
• • 5–10 ...	**0.02**	**0.05**	**0.10**	0.10
, 10–20...	0.05	**0.1**	0.2	0.2
• • 20–10π • • •	**0.1**	0.2	0.5	0.5

Notes:

1. Calculation scales may have additional scale sections.
2. LSLO-type rulers with more than 11 scales and LSLD-type rulers with more than 14 scales may have additional scales for trigonometric functions with divisions in radians, as well as other scales not specified in this standard.

7. A scale with a division value of 1 *mm* shall be marked on the sloped side edge of LSLO-type rulers; a scale corresponding to GOST 3451—52 shall be marked on the vertical side edge of 10-scale rulers. The scale ratio shall be indicated by numbers at the beginning of the scale.

Note: LSLO-type rulers 125 *mm* in length, where the height of the vertical edge (from the sight groove to the base of the ruler) is less than 3 *mm*, may be manufactured without measurement scales.

8. The deviation of the total length of the measuring scales on rulers and the distance from any mark to the beginning or end of the scale from their nominal values shall not exceed the values specified in Table 3.

Table 3

Dimensions in *mm*

Total length of the measuring scales on the rulers	Permissible deviations
For rulers 125, 150, and 250	±0.2
» » 500	±0.3
» » **125 (with celluloid base)**	±0.3

The error of individual centimeter divisions on the measuring scales of rulers shall not exceed ±0.10 *mm*.

The error of individual millimeter divisions on the measuring scales of rulers shall not exceed ±0.05 *mm*.

9. The appropriate locations on the linear scale shall **be** marked with lines and letter designations for the following constant values:

$$\pi = 3{,}1416;$$

$$C = \sqrt{\frac{4}{\pi}} = 1{,}1284;$$

$$C_1 = \sqrt{10 : \frac{\pi}{4}} = 3{,}5683;$$

$$M = \frac{100}{\pi} = 31{,}8310;$$

· ρ' = 3437.7 (the number of minutes corresponding to one radian) on rulers with scales for trigonometric functions in angular notation; ρ_0 = 57.3° (the number of degrees corresponding to one radian) on rulers with scales for trigonometric functions with decimal degree divisions.

$$\rho'' = 206264{,}81 \text{ и } \rho_{''} = 636620$$

Note: On LSLD-type rulers, the letter designation M = $^{100}/_{\pi}$ = 31.8310 is not marked.

10. Scales for the sine and tangent of large and small angles must be labeled, respectively, as sin, tg, S, and T.

11. Numeric and letter designations on the scales must be arranged as follows: single-digit designations—below or above the line, and two-digit and multi-digit designations—on both sides of the line.

12. The thickness of the lines on calculation scales must be between 0.08 and 0.12 *mm*.

The lines must be clear and unbroken.

13. All lines, numerals, and letters on the scales must be deep-embossed and then filled with black printing ink.

14. Additional sections of the scales, as well as numerals indicating angles up to 90°, may be filled with red ink.

15. The outermost lines of the calculation scales on the body and on the ruler's sliding mechanism must align on a single straight line. The tolerance must not exceed 0.1 *mm*.

16. When performing a single operation on numbers (multiplication, division, exponentiation, etc.), the error in the result must not exceed half the thickness of a scale mark.
17. Transparent plates with sighting lines marked on them must be inserted into the cutouts of the LSLO-type ruler bodies. The thickness of the sighting lines must not exceed 0.15 mm.

When aligning the outermost scale marks on the ruler body and the sliding bar on the front side, the sighting lines on the transparent plate must align with the outermost scale marks on the back side of the sliding bar.

The error in this alignment must not exceed 0.1 *mm.*

Note: Sight lines may be marked on the notches of the ruler body on both sides.

18. The length of the scale marks on the slide must be equal to the length of the corresponding scale marks on the ruler body, with a permissible deviation in length of ±0.3 mm.
19. One or three sighting lines must be marked on the inner side of the sighting plate. The thickness of the sighting lines must not exceed 0.10 mm.

For LSLD-type rulers, a single sighting line is marked on the reverse side of the sighting plate. When the outermost scale marks on the front side are aligned with a mark on the sighting plate, the outermost scale marks on the reverse side must coincide with a mark on the sighting plate. In this case, the error must not exceed 0.1 mm.

20. Sight lines must be straight, without irregularities or breaks.
21. The main sighting line is located at the midpoint of the sighting plate's length and is painted black; the side sighting lines are located on both sides of the main line at a distance of $\lg 4/\pi$ ±0.1 mm (on the scale of the squares of this ruler) and are painted red.
22. When the sight is in a free position on the ruler, all sight lines must be parallel to the scale marks on the body and the sliding bar.
23. The body and sliding piece of the ruler shall be made of pear wood with layer thicknesses not exceeding 3 mm, dried to a moisture content of 9±2% absolute. The wood shall be sound and free from cracks, rot, through knots and unhealed knots, wormholes, and blue stain.

Note: The lower part of the ruler's body may be made from other hardwood species, provided that their use does not violate the requirements of this standard.

24. The remaining parts of the rulers shall be made of the following materials:

a) the facing of the case and slide parts—from white technical celluloid, Grade I, in accordance with OST 10182—39;

b) the housing and sight glass springs—from steel grades 65G per GOST 1050–57 or U10A per GOST 1435–54;

c) the viewfinder frame—made of aluminum grade A1 per GOST 3549–55, stainless steel, or brass followed by nickel plating or chrome plating;

d) The sight glass shall be made of photographic glass in accordance with GOST 683–52 or of a transparent, non-fading plastic that is at least as transparent as the specified photographic glass.

25. All parts and assemblies of the ruler must be securely glued together, with no gaps, clearances, or delamination.

26. The celluloid cover parts on the front and back sides of a single ruler must be of the same shade. In rulers with two-color printing, a slight difference in the shade of the celluloid slats is permitted.

27. The surfaces of the wooden parts and the celluloid covering must be free of pits, cracks, scratches, and burrs on the edges.

28. The slider must fit snugly against the ruler body and move smoothly in any operating position. When positioned anywhere on the main scale of a vertically oriented ruler, the slider must not shift under the influence of its own weight plus 100 g.

29. The clearances between the sliders and the ruler body must not exceed those specified in Table 4.

Table 4

Dimensions in *mm*

Grade	Clearances not exceeding		
	within the main scales when the slide is		outside the main scales
	normal	reversed	
I	0.07	0.1	0.15
II	0.1	0.1	0.2

30. The slider must move smoothly, without jamming, along the entire length of the scale under the following forces: for 500-mm rulers—no more than 600 g; for 250-mm rulers—no more than 400 g; and for 125- and 150-mm rulers—no more than 250 g.

31. The ends of the ruler body and the sliding bar that do not have additional scale sections must be machined flush on both sides.

32. The joint between the body parts must ensure the ruler's tensile strength in the transverse direction under a force (uniformly distributed along the entire length of the ruler) of up to 10 kg for the 500-mm ruler, 8 kg for the 250-mm and 150-mm rulers, and 4 kg for the 125-mm ruler.

33. The surfaces of the scales must be clean, smooth, and free of stains, scratches, and other defects that distort the scale markings or text or detract from the ruler's appearance.

For Grade II rulers, minor scratches and spots on the celluloid surface visible to the naked eye are permitted, with no more than 8 on a 500-mm ruler and no more than 6 on 250-, 150-, and 125-mm rulers; however, the scratches or spots must not interfere with the text or scale marks.

34. The visible wooden surface of the ruler must be coated with a light (transparent) varnish.

35. The sight frame must be free of sharp edges and burrs. The sight plate must be securely fitted into the frame and must not move spontaneously within it.

36. The sight spring must press the sight frame against the ruler body with sufficient force to ensure smooth movement of the sight, while preventing it from moving under its own weight. The sight must move freely along the entire length of the ruler without scratching the scale surfaces.

37. The clearance between the surface of the scales and the lower surface of the sight plate must not exceed 0.3 *mm* at the edges of the ruler and 0.5 *mm* in its central part.

38. Rulers must be flat on the front face.

The deflection of the ruler must not exceed the values specified in Table 5.

Table 5

Dimensions in *mm*

Rulers with a length	Deflection of rulers: no more than			
	in the longitudinal direction		in the transverse direction	
	Grade I	GradeII	GradeI	Grade II
500	1.5	2.0	0.5	0.7
250	0.6	0.8	0.4	0.5
150	0.4	0.7	0.4	0.5
125	0.4	0.6	0.4	0.5

39. The underside of single-sided rulers shall bear reference data such as: the most commonly used mathematical values, specific gravities of materials, linear expansion coefficients, moduli of elasticity of the most commonly used materials, and others.

The list of reference tables and their contents must be approved by the Ministry of Higher Education and the Academy of Sciences of the USSR.

Note: Reference data shall not be printed on rulers 125 *mm* in length.

40. Rulers must be supplied in individual cases of rectangular cross-section.
41. Each ruler must be accompanied by printed instructions on how to store and handle the ruler.
42. The case shall be made of brown wood-based cardboard in accordance with GOST 7933–56 and covered with bookbinding cloth (GOST 5202–57) or leatherette (GOST 5560–50). The covering on the case must be smooth and clean, free of damage, bulges, and stains. For 125-mm rulers, the case may be manufactured as a sleeve that is open on one side or closes with a flap secured by a fastener made of granitole (OST 30243–40) or other materials of equivalent quality.
43. The case must be sturdy and allow the ruler to fit freely, as well as enable the lid to open easily but not spontaneously.
44. The cardboard case must withstand a uniformly distributed load of at least 10 kg without permanent deformation.
45. Each ruler must be accepted by the technical control department (TCD) of the manufacturing plant.
46. The manufacturer must guarantee that all rulers produced comply with the requirements of this standard.

III. TEST METHODS

47. Verification of rulers for compliance with the requirements of paragraphs 6, 8, 12, 15, 16, 17, 18, 19, and 21 of this standard shall be performed using a reading microscope or a measuring magnifier with a scale.
48. Verification of rulers for compliance with the requirements of paragraphs 29 and 37 of this standard shall be performed using a feeler gauge.

49. Verification of rulers for compliance with the requirements of paragraphs 28 and 30 of this standard shall be performed using a dynamometer.

50. The strength of the housing joint (clause 32) is determined by a load test, during which the slider and sighting device are removed from the ruler, and a force is applied to the end marks of the scales in the area of the cutouts in the housing, increasing at a rate not exceeding 4 kg per minute.

51. The strength of the case (clause 44) is tested by placing a 10-kg block on it, the cross-section of which is slightly larger than the longitudinal cross-section of the case.

52. The deflection of the ruler (item 38) must be tested using a special device.

IV. MARKING, PACKAGING, AND STORAGE

53. Each ruler must bear the following:

a) the name or trademark of the manufacturer;
b) the year of manufacture;
c) the number of this standard;
d) grade (for Grade II rulers).

54. Rulers in cases or sleeves shall be packed in cardboard boxes, which must bear labels containing the information specified in paragraph 53 of this standard, as well as the name of the organization under whose jurisdiction the manufacturing enterprise operates.

55. The manufacturer's trademark must be embossed on the cases and covers.

56. For transportation, boxes containing rulers shall be wrapped in thick, moisture-resistant paper and packed into crates made of dry boards 16–19 mm thick, fastened with nails.

The crates must be bound with wire along the slats at both ends.

Packages or boxes must be packed tightly into the crates; any empty spaces must be filled with soft paper or dry wood shavings.

57. The weight of a crate containing rulers must not exceed 50 kg.

58. Each crate must bear the following labels: "Handle with Care," "Do Not Drop."

59. Rulers, whether packaged or unpackaged, must be stored in dry, heated rooms at a temperature between +10° and +35°C with a relative humidity of no more than 80% and must be kept at a distance of at least 1.5 *m* from direct sources of heat.

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