NATIONAL PHYSICAL LABORATORY

METROLOGY CENTRE

Ref: MOY/SCMI/99 (Issue 1) **SPECIFICATION OF ACCURACY**

for

PRECISION LINEAR SCALES UP TO 1 METER (40 INCHES)

Type: This specification is limited to scales on blanks of homogenous material (plated or unplated) for which the rate of change of length with time due to secular instability of the material is not greater than 0.3 parts in 1 million per annum, and to scales or blanks of 36% nickel-steel for which the rate of change of length due to secular instability is not greater than 1.5 parts in 1 million per annum.

		LIMITING VALUE OR MAXIMUM PERMISSIBLE ERROR
1.	**GENERAL**	
1.1	The scale shall be constructed and finished to a standard suitable for a precision instrument fulfilling the requirements of this specification.	
2.	**MARKING AND NUMBERING**	
2.1	The scale blank shall be marked with its material, an identification number, the maker's name or trade mark, the reference temperature and an indication of the date of manufacture.	
2.2	The scale shall be numbered or the scale blank shall be marked with a conveniently placed finder scale.	
2.3	The scale blank shall be marked with the positions of support. For scales 600 mm (24 in) long or longer these points shall be between 0.55 and 0.60 of the length of the blank apart and shall be symmetrically placed relative to the length of the blank.	
3.	**DIMENSIONS, FORM AND FINISH**	
3.1	Scales 600 mm (24 in) in length or longer shall be of a suitable section (e.g., H-section), approximately 25 mm x 25 mm, with the graduation lines on the horizontal web situated in the neutral plane	±1 mm (±0.04 in)
	Scales up to 600 mm in length may be of rectangular section with thickness between 8 mm (0.3 in) and 12 mm (0.5 in).	
3.2	The graduated surface shall be highly polished and free from surface irregularities in the neighbourhood of the graduation lines. If plated, the surface shall be free from an undesirable degree of crazing in the neighbourhood of the lines.	
3.3	When the scale blank is supported at the marked points, the graduated surface shall be flat.	50 μm (0.002 in) (i.e., all points on the surface shall lie between two parallel planes 50 μm apart).

4. **GRADUATION LINES**

4.1	The graduation lines shall be well-defined, of symmetrical section and have clean edges.	
4.2	The width of each graduation line shall be constant.	±10% of average width or ±0.5 µm, whichever shall be smaller.
4.3	The graduation lines shall not differ in width, one from another.	10% of the average width of all the lines.
4.4	The width of the graduation lines shall lie between 3 µm and 20 µm.	
Note:	Lines with widths between 3 µm and 6 µm should be used with objective magnification from 'scale' to image plane, of at least x 8.	
4.5	The graduation lines shall be straight.	1 µm (40 µin) over the operative length, i.e., between the longitudinal setting lines.
4.6	The graduation lines shall be parallel to one another.	1 µm (40 µin) over the said operative length.
4.7	The graduation lines must be square to the scale axis.	6 minutes of arc.
4.8	When the scale is supported at its marked points, every graduation line in the main scale shall lie within its correct nominal position, measured from the zero of the scale.	±2.5 µm (±0.0001 in) for scales not exceeding 1 m (40 in) in length.
4.9	Where a fine scale is provided for calibrating a micrometer microscope, the spacing of the graduation lines shall be such that any interval from one line to another is at the correct nominal spacing.	1 µm (±40 µin)

5. **SETTING CRITERIA**

Scales with longitudinal setting lines

5.1	A pair of longitudinal setting lines shall traverse the graduation lines and shall be parallel to the scale axis.	1 minute of arc.
5.2	The separation of the longitudinal setting lines shall lie between 0.2 mm and 1.0 mm.	
5.3	Each longitudinal setting line shall be straight.	30 µm (0.0012 in)
5.4	The longitudinal setting lines shall be parallel to each other.	50 µm (0.002 in)

Scales without longitudinal setting lines

5.5	The length of the shortest graduation lines shall lie between 0.2 mm and 1.0 mm.	
5.6	The terminal ends of the shortest graduation lines shall define two lines which are straight and mutually parallel.	30 μm (0.0012 in) 50 μm (0.002 in)

F.W. Nichols (Signed)

for Director

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