

NATIONAL PHYSICAL LABORATORY

METROLOGY CENTRE

Ref: **MOY/SCMI/100** **SPECIFICATION OF ACCURACY**
(Issue 1)

for

A UNIVERSAL OPTICAL PROJECTOR

Type: A Hilger Universal Measuring Projector Type TT 551 (Metric measure) intended for engineering precision inspection at magnifications of up to 100 times. The 180 mm (7 in) x 58 mm (2 ¼ in) work-holder motions are controlled by glass scales graduated at intervals of 0.2 mm. The scale graduations are viewed on a projection screen and subdivision is made by means of a micrometer to 0.002 mm. The light source is a 250-watt mercury vapour lamp.

Note: This specification also covers the type TT 501 (inch measure) projector.

Designed and
Made by: Messrs. Hilger & Watts Ltd

LIMITING VALUE OR MAXIMUM PERMISSIBLE ERROR

1. GENERAL

- 1.1 The general workmanship and finish shall be in keeping with a precision instrument of this class.
- 1.2 Each instrument shall be marked with the maker's name or trade-mark and with an identification number.

2. MECHANICAL AND OPTICAL ALIGNMENTS

- 2.1 The slide which controls the focusing motion of the work-holder shall be straight in both the horizontal and vertical planes over its 100 mm (4 in) travel. (This slide shall be the datum against which all other alignments are checked) 0.005 mm (0.0002 in)
- 2.2 The transverse motion of the work-holder shall be straight over its 180 mm (7 in) travel. 0.003 mm (0.0001 in) in the vertical plane
0.010 mm (0.0004 in) in the horizontal plane
- 2.3 The vertical motion of the work-holder shall be straight over its 58 mm (2 ¼ in) travel. 0.003 mm (0.0001 in) in the vertical plane parallel to the transverse motion
0.010 mm (0.0004 in) in the vertical plane at right angles to the transverse motion.

		<u>LIMITING VALUE OR MAXIMUM PERMISSIBLE ERROR</u>
2.4	The transverse and vertical motions of the work-holder shall be mutually square.	
2.5	The focusing and vertical motions of the work-holder shall be mutually square.	0.003 mm per 25 mm (0.0001 in per in)
2.6	The horizontal and vertical surfaces of the work-holder shall be flat and mutually square.	0.005 mm per 25 mm (0.0002 in per in)
2.7	The vertical surface of the work-holder shall be parallel to the vertical and transverse motions.	0.010 mm (0.0004 in)
2.8	The centre rods shall be straight and each pair shall be of equal diameter.	0.005 mm per 25 mm (0.0002 in per in)
2.9	The male and female conical portions of the rods shall be: -	0.008 mm (0.0003 in)
	(i) hard	
	(ii) concentric with the cylindrical portion.	700 HV minimum
2.10	The line of centres shall be parallel to the transverse motion of the work-holder in the horizontal plane.	0.015 mm (0.0006 in) FIM
2.11	The illumination of the glass scales shall be uniform and adequate.	0.005 mm per 25 mm (0.0002 in per in)
2.12	The graduation of the glass scales shall be clear cut and free from blemishes.	
2.13	The projected graduations of each glass scale and its associated setting doublet shall be in focus simultaneously.	
2.14	The two motions of the work-holder controlled by the glass scales shall be accurate.	
2.15	When the work-holder is set square to the focusing motion there shall be no observable error in the zero of the rake scale.	0.005 mm (0.0002 in)
2.16	The rake scale shall be accurate over its range of ± 30 degrees.	
2.17	With the projector lamp set according to the instructions given in the handbook supplied by the makers, and the work-holder set to zero on the rake scale, the out of focus pattern of a projected annular vee-groove held between centres shall be symmetrical.	$\frac{1}{4}$ degree relative to the zero graduation
2.18	The combined readings of the projected protractor scale and the associated minute scale shall be accurate.	
2.19	The cross lines of the protractor screen shall be mutually square.	1 minute of arc
2.20	The point of intersection of the 90 degrees cross-lines on the projector screen shall lie on the axis of rotation of the protractor scale, after the latter has been centred.	1 minute of arc
2.21	The magnification given by each lens shall be correct.	0.06 mm (0.0025 in)
		0.13 mm (0.005 in) as measured over a central

LIMITING VALUE OR
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2.22 The lenses shall not give rise to any appreciable distortion in the field of view.

300 mm (12 in) interval on the screen

The error in the separation between any two points in the field of view shall not exceed 0.25 mm (0.01 in) as measured at the screen

Note: If any of the above lenses are intended to be used for the projection of screw threads, the test enumerated in para 2.22 shall be repeated with the illuminating beam inclined by ± 5 degrees to the optical axis. Under these conditions the permissible error shall not exceed the value quoted in para 2.22 by more than 50%.

3. SURFACE ILLUMINATORS

3.1 When surface illuminators are fitted, they shall be capable of producing a satisfactory projected image of an appropriate surface.

4. PERFORMANCE TEST

4.1 A performance test on the overall accuracy of the motions of the work-holder as controlled by the glass scales shall be made when the work-holder is loaded as follows: -

	<u>Transverse</u>	<u>Vertical</u>
loaded with a mass of 4.5 kg (10 lb)	0.008 mm (0.0003 in)	0.005 mm (0.0002 in)
loaded with a mass above 4.5 kg (10 lb) and up to 9 kg (20 lb)	0.010 mm (0.0004 in)	0.008 mm (0.0003 in)
loaded with a mass above 9 kg (20 lb) and up to 13.5 kg (30 lb)	0.012 mm (0.0005 in)	0.010 mm (0.0004 in)

Note: When testing the transverse motion the vertical slide shall be set to its maximum height.

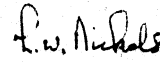
5. **THREAD FORM DIAGRAMS**

5.1 When thread form diagrams are supplied with the projector, their outlines shall be accurate.

The edges of the outline shall be very clearly defined and be free from any noticeable defects.

The whole outline shall not depart from the nominal outline by more than ± 0.13 mm (± 0.005 in) at any point. In addition, the error in inclination of the sloping flanks shall not exceed 0.13 mm (0.005 in) over the length of flank

(Signed)



for Director

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