NATIONAL PHYSICAL LABORATORY

METROLOGY CENTRE

Ref: MOY/SCMI/40 (Issue 1)

SPECIFICATION OF ACCURACY for

A "MICROPTIC" HORIZONTAL MEASURING MACHINE

Type: An optical horizontal measuring machine for internal and external parallel plain and thread measurement reading directly to 0.001 mm (0.000 05 in) and by estimation to 0.000 2 mm (0.000 01 in).

Made by: Messrs. Hilger & Watts Ltd.

LIMITING VALUE OR MAXIMUM PERMISSIBLE ERROR

340 gf (12 ozf)

1. **GENERAL**

- 1.1 The general workmanship and finish shall be in conformity with a precision instrument of this class.
- 1.2 Each instrument shall be marked with the marker's name or trade mark, and with an identification number. The main scale shall also be marked with an identification number.
- 1.3 The illumination of the scales shall be uniform and adequate.
- 1.4 The graduations of the main scale, graticule and optical micrometer shall be clear cut, and free from blemishes.
- 1.5 The main scale, graticule and optical micrometer graduations shall be in focus simultaneously.

2. THE MEASURING HEAD

- 2.1 The measuring head plunger shall run freely without shake between its guides.
- 2.2 The working force shall not exceed

3. TAILSTOCK

- 3.1 The tube shall be a good sliding fit in its bracket.
- 3.2 The action of the clamp of the fine adjustment shall not alter the scale setting. 0.0005 mm (0.000 02 in)

4. MEASURING CONTACTS

4.1	The face of each contact tip shall be well finished and hardened.	850 HV minimum.
4.2	The face of each plane contact tip shall be lapped flat.	0.000 5 mm (0.000 02 in)

5. **ALIGNMENT OF MEASURING CONTACTS**

5.1	It shall be possible, with the adjustments provided, to set the faces of the plane measuring contacts parallel. This parallelism shall be maintained throughout the 100 mm (4 in) travel of the measuring head plunger.	0.000 08 mm (0.000 0	
5.2	The faces of the measuring contacts shall be co-axial. This condition shall be maintained for all separations of the measuring contacts.	0.25 mm (0.01 in)	
FEEL	<u>ER POINTS</u>		
6.1	The diameters of the "Best Size" feeler points for the measurement of the effective diameter of internal threads shall be within the limits laid down by NPL.	NPL Sketch No. 672A attached.	
6.2	All feeler points shall be well finished and hardened.		
6.3	Each feeler point shall be identified by its appropriate tpi.		

7. WORK-TABLES

6.

- 7.1 All work-tables shall be interchangeable.
- 7.2 The upper surfaces of work tables shall be flat.

8. ACCURACY OF SCALES IN MEASURING HEAD

8.1 The main scale shall be accurate with respect to the zero graduation to within the tolerance given in the following table: -

RANG	TOLERANCE		
mm	in	mm	in
0 up to 25	0 up to 1	±0.000 5	±0.000 02
Above 25 & up to 50	Above 1 & up to 2	$\pm 0.000 8$	±0.000 03
" 50 " " " 75	" 2" " " 3	$\pm 0.000 8$	±0.000 03
" 50"""100	"3"""4	± 0.0010	$\pm 0.000~04$

- 8.2 The graticule and optical micrometer scales shall each be accurate with respect to their zero graduation to within
- NOTE: It is clearly not practicable to check the accuracy for every graduation on all three scales. It is considered that a fair assessment of accuracy will be obtained by testing the scales at the following intervals:

SC	INTERVALS		
Description	GRADUATED	OF TEST	
Main Scale	0 to 100 mm by 1.0 mm	Every 5 mm	
	(0 to 4 in by 0.05 in)	(0.2 in)	
Double line graticule	0 to 0.9 mm by 0.1 mm	Every interval	
	(0 to 0.04 in by 0.01 in)	Every interval	
Optical micrometer scale	0 to 0.1 mm by 0.001 mm	Every 0.01 mm	
	(0 to 0.01 in by 0.000 05 in)	(0.001 in)	

±0.0005 mm (±0.000 02 in)

)3 in)

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0.013 mm (0.000 5 in)

8.3 Without the application of any corrections, the functional accuracy of the measuring machine shall be within the tolerances given in the following table.

RANG	TOLERANCE		
mm	in	mm	In
0 up to 25	0 up to 1	±0.000 8	±0.000 03
Above 25 & up to 50	Above 1 & up to 2	± 0.0010	$\pm 0.000~04$
" 50 " " " 75	" 2" " " 3	$\pm 0.001 0$	± 0.00004
" 75"""100	" 3" " " 4	± 0.001 3	±0.000 05

ACCESSORY EQUIPMENT

9. JAW BLADE HOLDER

- 9.1 The jaw blade holder shall stand on the upper surface of each work table without perceptible "rock".
- 9.2 The fixed slip abutment face shall be square to the backing plate.

10.

. <u>PLAN</u>	PLANE PARALLEL JAW BLADES			
10.1	The blades shall have a good lapped finish and be hardened.	800 HV minimum.		
10.2	The working faces of the blades shall be flat.	0.000 3 mm (0.000 01 in)		
10.3	The opposite working faces of each blade shall be parallel.	0.0025 mm (0.000 1 in)		
. <u>GROC</u>	OVED JAW BLADES	over their length.		
11.1	Each blade shall be marked with an identification number and the nominal included angle of the measuring vee.			
11.2	All sharp edges are to be removed.			
11.3	The "outside" and "inside" faces shall be			
	 (i) hard (ii) lapped flat (iii) parallel 	800 HV minimum. 0.0003 mm (0.000 01 in) 0.001 mm (0.000 04 in) over length of blade.		
11.4	The rounded end shall be hard.	800 HV minimum.		
11.5	The distance from the vee-axis to the rounded end of the blade shall be equal on each pair.	0.025 mm (0.001 in)		
11.6	The width of the blade, i.e. the distance between the "outside" and "inside" faces shall be 11.11 mm (0.4375 in).	±0.13 mm (±0.005 in)		
11.7	The depth of the blade shall be 9 mm (0.355 in).	+0 -0.1 mm (-0.004 in)		
11.8	The minimum width of the measuring vee flanks shall be	2.5 mm (0.1 in)		
11.9	The vee flanks shall be hard and lapped flat.	800 HV minimum. 0.001 mm (0.000 04 in)		
11.10	The semi angle of the vee shall be 27° 30' for Whitworth threads and 30° for Metric and Unified threads.	±4 minutes		

0.025 mm (0.001 in) over the length of abutment

face.

	11.11	The vee axis shall be parallel transversely with the "inside" face.	0.0015 mm over 2.5 mm (0.000 06 in over 0.1 in)
	11.12	The vee axis shall be square with the side face.	0.005 mm over 2.5 mm (0.0002 in over 0.1 in)
	11.13	A Certificate or Test Report for this machine shall include values of E_0 for the jaw blades supplied. These values shall be given to the nearest 0.001 mm (0.000 05 in) and shall cover every pitch for which a stylus is provided.	
12.	LENGTH BARS		
	12.1	Each length bar provided shall conform to the requirements of the British Standard Specification for Length Bars, BS 1790.	Inspection Grade.
13.	SLIP GAUGES		
	13.1	Each slip gauge provided shall conform to the requirements of the British Standard Specification for Slip Gauges, BS 888.	Inspection Grade.
14.	ACCURACY OF PERFORMANCE		

14.1 The performance of the instrument shall be checked by using it to measure a series of gauges of known size. The inaccuracies of performance shall not exceed the following amounts:

> External plain measurement Internal plain measurement External screw thread measurement Internal screw thread measurement

0.001 mm (0.000 04 in) 0.001 mm (0.000 04 in) 0.004 mm (0.000 16 in) 0.008 mm (0.000 32 in)

(Signed) L.w. Autolo

for Director

August 1967 MOY/SCMI/40 Issue 1

