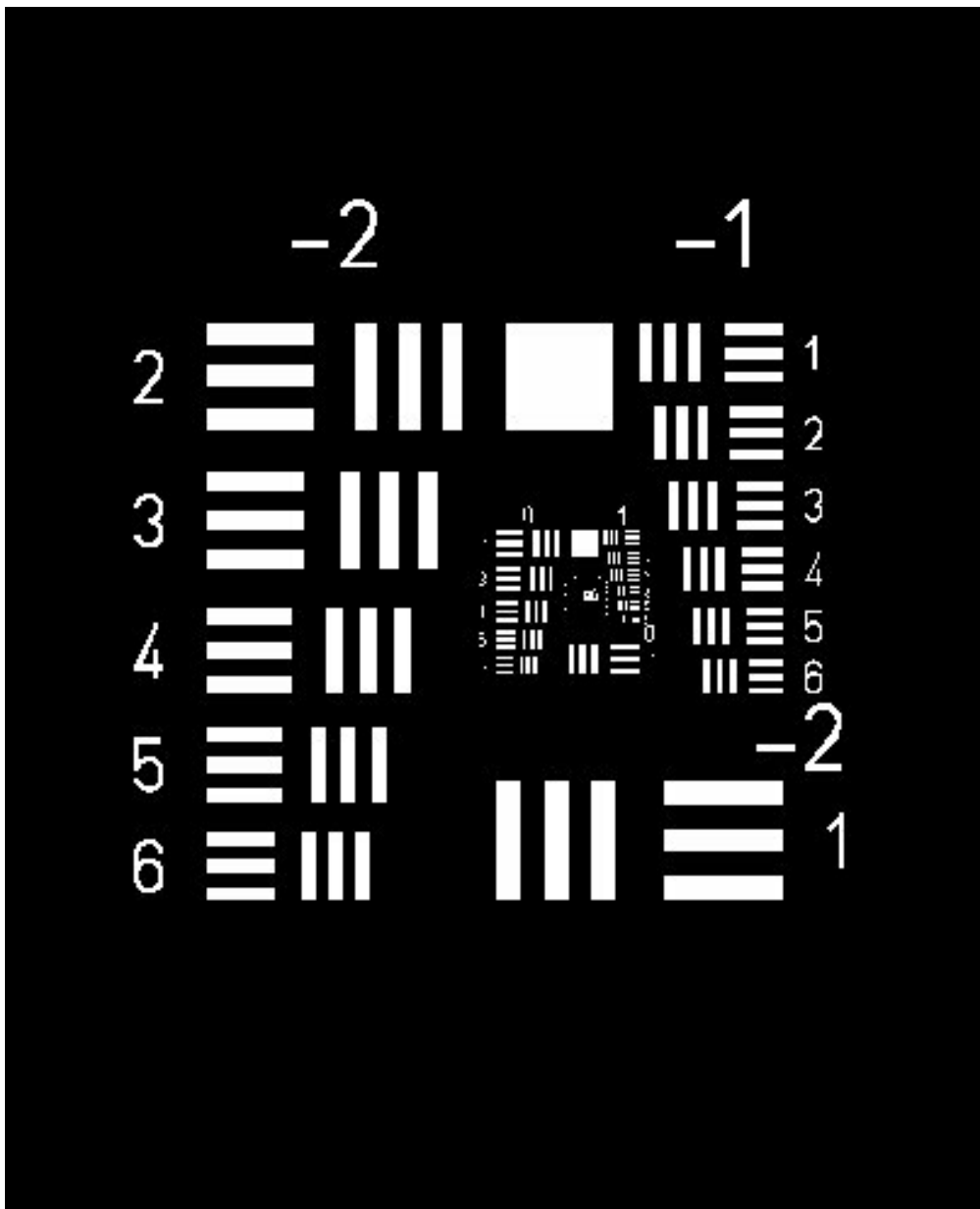


Standard Graticules



Our Company

IMT has been providing top quality microlithographic products since 1954.

From our headquarters near Zurich, Switzerland, and supported by a global customer service organisation, we provide our customers with high-quality custom-made microlithographic products, large area photomasks as well as standard graticules and testing targets.

In our state-of-art production facility using the most modern equipment, our staff of 60 manufactures our products with the keen attention to detail and quality that is associated with Swiss products.

Our products

This brochure contains an overview of our standard graticules and reticules.

IMT is primarily a supplier of complex customized microlithographic solutions as well as large area photo-masks.

The deep technical know-how of our team and the fact that we operate one of the best equipped facilities for microlithography, allows us to offer our customer unique solutions for optical components on flat substrates.

Technical specification

This brochure covers our standard precision graticules.
The standard precision graticules are available from stock in small quantities.

The patterns of the graticules are made with a bright chrome coating. The chrome coating is vacuum deposited onto the substrate.

Glass substrate:	Optical glass
Dimension:	± 0.5 mm, protective chamfer
Layer thickness:	0.1 μ m

Reflection of graduation air side and glass side:	50 – 60%
--	----------

View:	Always seen on layer
-------	----------------------

Residual light transmission:	$\leq 0.1\%$ at 550 nm
------------------------------	------------------------

Index letters “a” and “b” have been added to some of the illustration item numbers to indicate the following designs:

a positive:	opaque pattern on transparent background
b negative:	transparent pattern on opaque background

If the number has no index, the item is only supplied as illustrated.

Other glass substrates or transmissions and reflections are available as to customer specifications.

Measure protocols and calibration charts are available at extra charge.

1a, 1b Large resolution target with USAF pattern

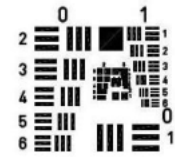
10 line groups each comprising 6 three-bar pairs
 1 to 6 from 4 mm to 4.4 μm pitch*
Glass substr.: 101.6 x 82.6 x 2 mm
777437 (1a positive)
777360 (1b negative)

*) refer to resolution table on page 14

2a, 2b Small resolution target with USAF pattern

Identical to target No.1, but without the 12 peripheral three-bar pairs.
 8 line groups comprising 6 three-bar pairs.
 1 to 6 from 1mm to 4.4μm pitch*
Glass substr.: 38 x 38 x 2mm
778000 (2a positive)
777494 (2b negative)

*) refer to resolution table on page 14



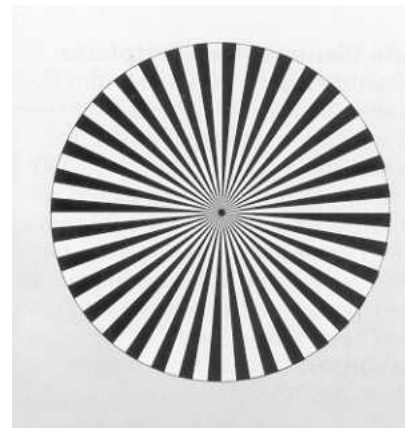
3, 4, 5 Sector star target

Comprising 36 transparent and opaque sectors of equal width.
 Smallest resolved grating pitch at the centre approx. 8.7 μm, corresponding to an unresolved dark core of 0.1 mm dia.

Glass substr.: Ø 10 x 1.5 mm
777687 (3)

Glass substr.: Ø 25 x 1.5 mm
777448 (4)

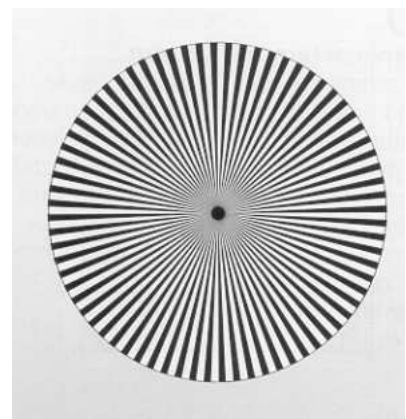
Glass substr.: Ø 60 x 1.5 mm
778001 (5)



6 Sector star target

Comprising 72 transparent and opaque sectors of equal width.
 Smallest resolved grating pitch at the centre approx. 8.7 μm, corresponding to an unresolved transparent core of 0.1 mm dia.

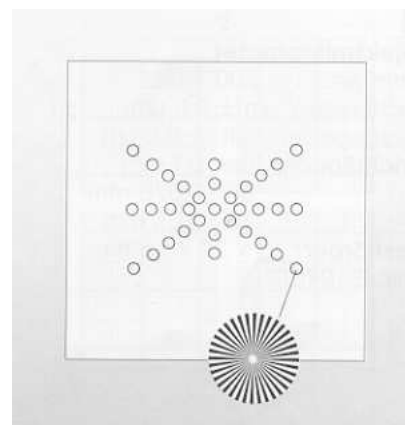
Glass substr.: Ø 60 x 1.5mm
777540 (6)



7 small sector star array

33 sector star targets each 2 mm dia. comprising 36 transparent and opaque sectors of equal width on a common transparent field of approx. 29.2 x 21 mm. Smallest resolved grating pitch at the centre of the sector stars approx. 8.7 μm, corresponding to an unresolved dark core of 0.1 mm dia.

Glass substr.: 50 x 50 x 1.5 mm
778002 (7)

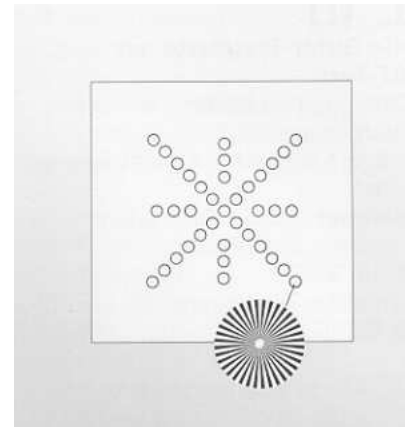


8 Medium sector star array

37 sector star targets each 4 mm dia. comprising 36 transparent and opaque sectors of equal width on a common transparent background.

The array covers a transparent field of 50 x 50 mm. Smallest resolved grating pitch at the centre of the sector stars approx. 17.5 μm , corresponding to an unresolved dark core of 0.2 mm dia.

Glass substr.: 80 x 80 x 1.5 mm
778003 (8)

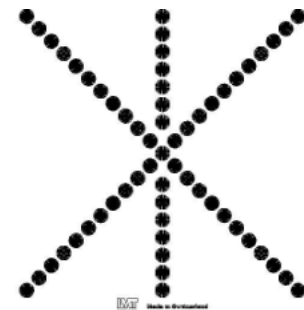


9 Large sector star array

59 sector star targets each 4.5 mm dia. comprising 36 transparent and opaque sectors of equal width on a common transparent background.

The array covers a transparent field of 90 x 90 mm. Smallest resolved grating pitch at the centre of the sector stars approx. 13 μm , corresponding to an unresolved dark core of 0.15 mm dia.

Glass substr.: 101x101x2 mm
778004 (9)



10 Sector star with gratings

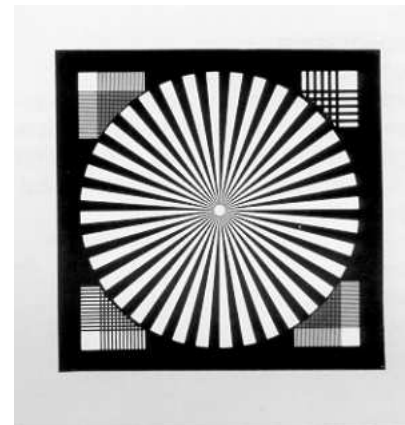
Sector star with 24 mm dia. comprising 36 transparent and opaque sectors of equal width on a common opaque background. Also combining 4 linear gratings with transparent and opaque lines on an opaque background

Glass substr. 40x40x 1.5 mm
778005 (10)

Grating pitch of the four gratings:

Grating 1) 0.64 mm;
Grating 2) 0.32mm;
Grating 3) and 4) 0.16 mm.

Smallest resolved grating pitch at the centre of the sector star approx. 22 μm , corresponding to an unresolved dark core of 0.25 mm.



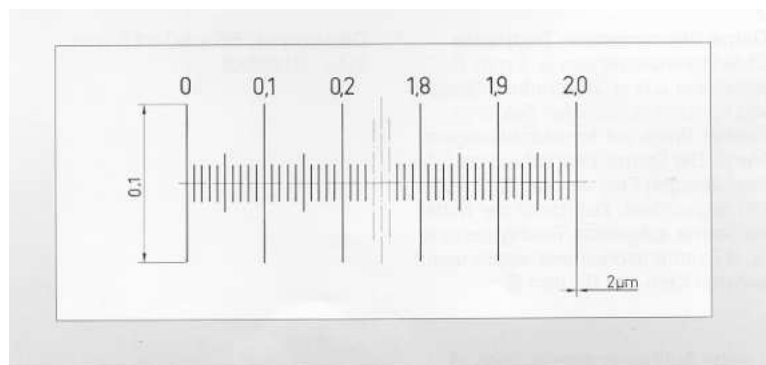
11 Micrometer scale graticule

2 mm in 200 divisions; Line width 2 $\mu\text{m} \pm 0.5\mu\text{m}$. Graduation accuracy: $\pm 0.5 \mu\text{m}$.

Line lengths:

10 mm lines: 0.1 mm
5 mm lines: 0.075 mm
1 mm lines: 0.05 mm

Glass substr.: 76 x 26 x 1.5 mm
777469 (11)

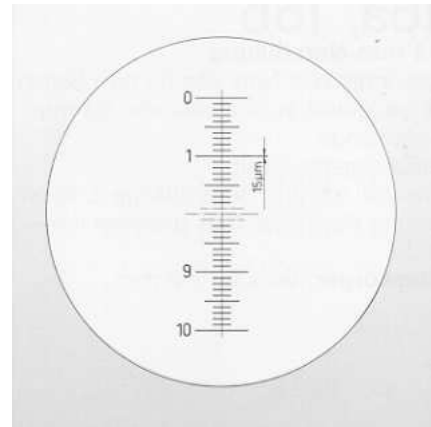


12 Ocular micrometer scale graticule

10 mm in 100 divisions:
Line width $15\ \mu\text{m} \pm 2\ \mu\text{m}$.
Graduation accuracy $\pm 5\ \mu\text{m}$.

Glass substr.: $\varnothing 15 \times 1.5\ \text{mm}$
778006 (12)

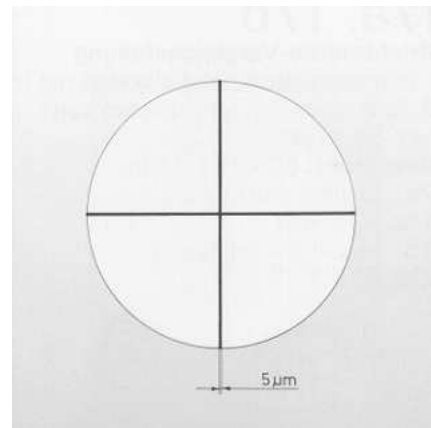
Line lengths:
10 mm lines: 1 mm
5 mm lines: 0.7 mm
1 mm lines: 0.3 mm



13a, 13b Crossline graticule

Continuous crossline.
Line width $5\ \mu\text{m} \pm 1\ \mu\text{m}$
Angular accuracy 1 arc minute

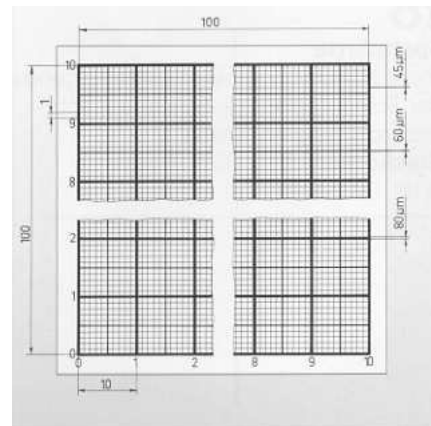
Glass substr.: $\varnothing 15 \times 1.5\ \text{mm}$
777676 (13a positive)
778007 (13b negative)



14 1 mm Grid chart

100 mm square grid subdivided into 1 mm squares.
Graduation accuracy:
Interval $\pm 2\ \mu\text{m}$; Total length $\pm 15\ \mu\text{m}$.
Grid viewed through glass.

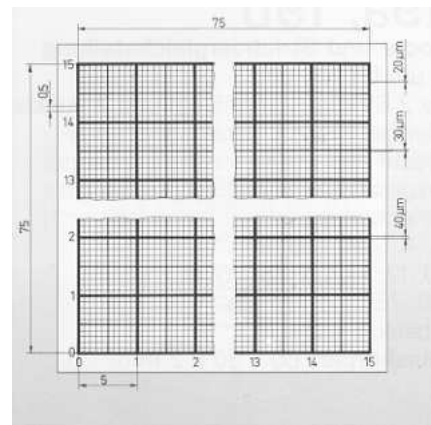
Glass substr. 110x110x3 mm
777396 (14)



15a, 15b 0.5 mm Grid chart

75 mm square grid subdivided into 0.5 mm squares.
Graduation accuracy:
Interval $\pm 3\ \mu\text{m}$; Total length $\pm 10\ \mu\text{m}$.
Grid viewed through glass.

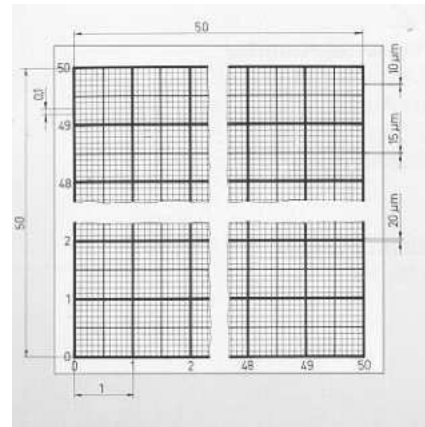
Glass substr.: 85 x 85 x 3 mm
77759 (15a positive)
777507 (15b negative)



16a, 16b 0.1 mm Grid chart

50 mm square grid subdivided into 0.1 mm squares.
 Graduation accuracy:
 Interval $\pm 5 \mu\text{m}$; Total length $\pm 10 \mu\text{m}$.
 Grid viewed through glass

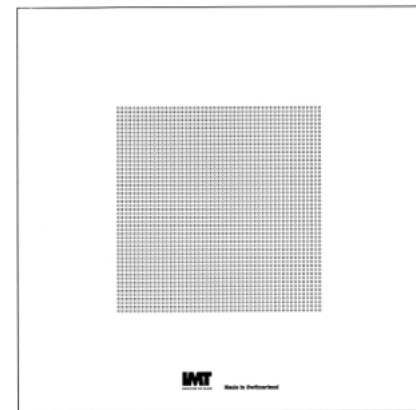
Glass substr.: 60 x 60 x 3 mm
777409 (16a positive)
778008 (16b negative)



17a Dot array

Calibration of Image Systems
 Dot- \varnothing : $0.25 \text{ mm} \pm 1.0 \mu\text{m}$
 Dot to Dot: $0.5 \text{ mm} \pm 1.0 \mu\text{m}$
 Image field: 25 x 25 mm

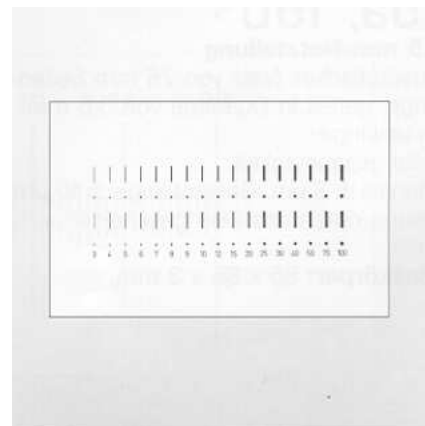
Glass substr.: 50x50x 1.5mm
778796 (17a positive)



19a, 19b Dot and line comparison

3 μm to 100 μm . 2 adjacent rows of 17 dots and lines of equal width: Line length 2 mm with designation numbers.
 Line width:
 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40, 50, 75 and 100 μm .
 2 mm spacing.

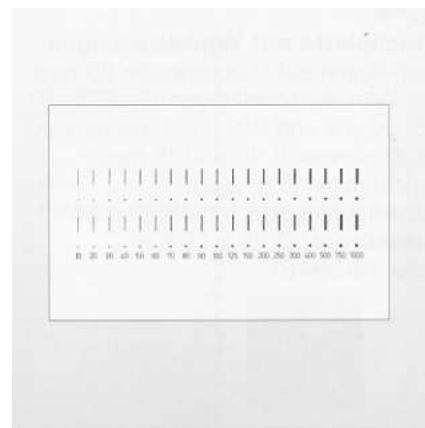
Glass substr.: 60 x 30 x 2 mm
777343 (19a positive)
777744 (19b negative)



20a, 20b Dot and line comparison

10 μm to 1000 μm . As version 19, but with 19 dots and lines with following widths:
 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 200, 250, 300, 400, 500, 750 und 1000 μm .

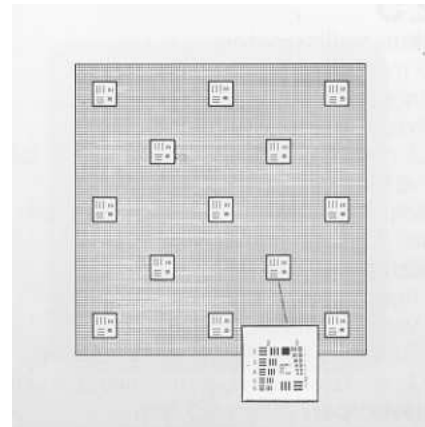
Glass substr.: 60 x 30 x 2 mm
777339 (20a positive)
777666 (20b negative)



21a, 21b Full format resolution target array

0.5 mm grid chart as per version 15 interrupted by 13 single resolution targets each with 6 groups comprising 6 three-bar pairs with grating pitches between 250 to 4.4 μm (as per version 2 group 2 to 7 of the small resolution target*)

Glass substr.: 60 x 60 x 3 mm
777755 (21a positive)
777735 (21b negative)



*) refer to resolution table on page 14

22a, 22b Crossline graticule

Continuous crossline.

Line widths:

- I** 20 \pm 2 μm
- II** 50 \pm 3 μm
- III** 100 \pm 5 μm
- IV** 200 \pm 10 μm

Positive

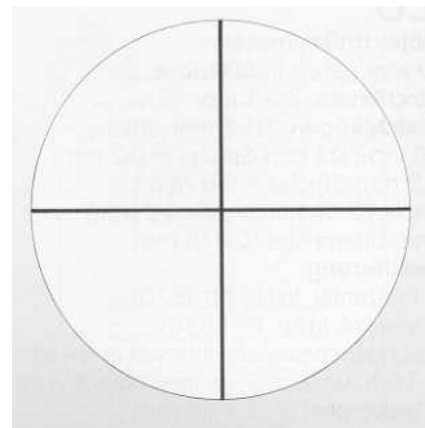
- 778009** (22a I)
- 777939** (22a II)
- 778010** (22a III)
- 778011** (22a IV)

Negative

- 777697** (22b I)
- 777787** (22b II)
- 778012** (22b III)
- 778013** (22b IV)

Angular accuracy within 1 arc minute.

Glass substr.: \varnothing 25 x 1.5 mm



23 Radius graticule

Continuous crossline and concentric circles with following diameters:

- 1, 2, 3, 4, 5, 7.5, 10, 12.5 and 15 mm.

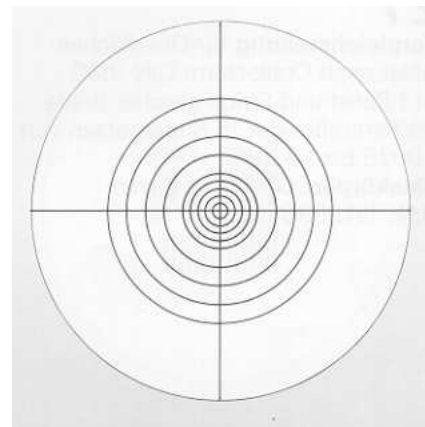
Line width:

- I** 15 \pm 2 μm
- II** 70 \pm 5 μm

Angular accuracy within 1 arc minute.

Concentric circles with radius accuracy within 0.01 mm.

Glass substr.: \varnothing 25 x 1.5 mm
777473 (23 I)
777338 (23 II)



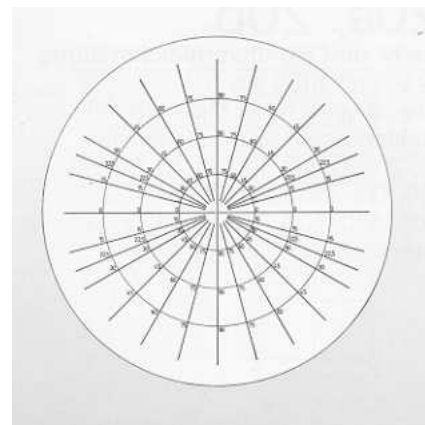
24 Graticule with angle graduations

Radial lines to max. 20 mm dia. Angle divisions 15, 22.5, 30, 45, 60, 75 and 90° with concentric circles dia 5, 10 and 15 mm.

Line width : 15 \pm 2 μm

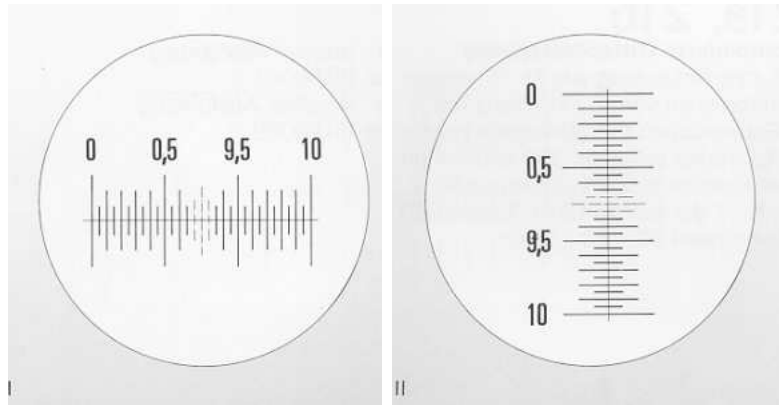
Angular accuracy within \pm 30"

Glass substr.: \varnothing 25 x 1.5 mm
778014 (24)



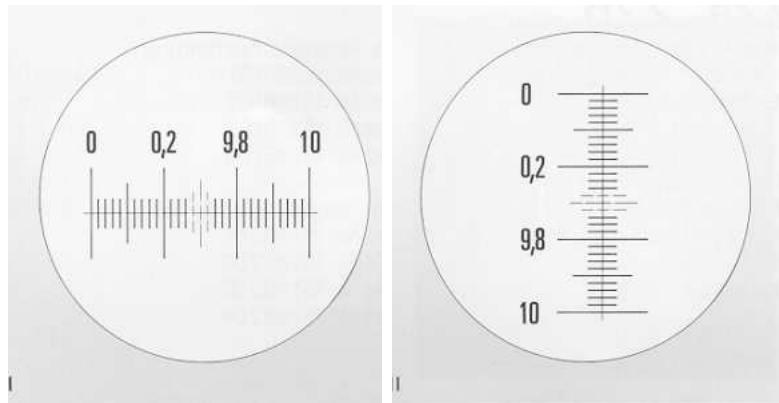
25 Ocular micrometer scale graticule

10 mm in 200 divisions
 Line width: $10 \pm 2 \mu\text{m}$
Line lengths: 0.05mm-line.= 0.2mm, 0.1mm-line.= 0.4mm, 0.5 und 1mm-line= 0.6mm. Every 0.5mm (Height 0.2mm) numbered
 Graduation accuracy: Interval $\pm 1 \mu\text{m}$, total length within $\pm 5 \mu\text{m}$
Glass substr.: $\varnothing 15 \times 1.5 \text{ mm}$
777436 (25 I) horizontal
778015 (25 II) vertical



26 Object micrometer scale graticule

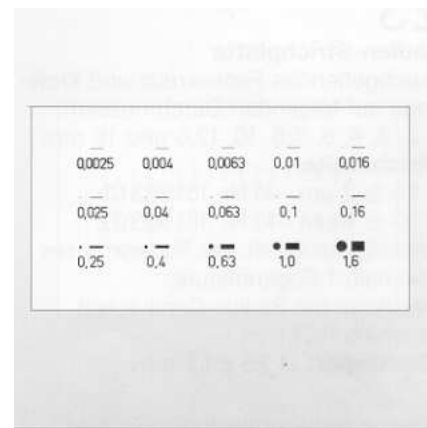
10 mm in 500 divisions
 Line width: $3 - 1 \mu\text{m}$
Line lengths: 0.02mm-line= 0.1mm, 0.1mm-line= 0.2mm, 0.2mm-line= 0.3mm. Every 0.2 mm (Height 0.075 mm) numbered.
 Graduation accuracy: Interval $\pm 1 \mu\text{m}$, total length within $\pm 3 \mu\text{m}$
Glass substr.: $\varnothing 15 \times 1.5 \text{ mm}$
777344 (26 I) horizontal
778016 (26 II) vertical



27 Dot and line comparison chart

For detection of surface flaws to optics standard DIN 10110.
 3 rows of 5 dots and lines of equal width with designation numbers from 0.0025 to 1.6 mm

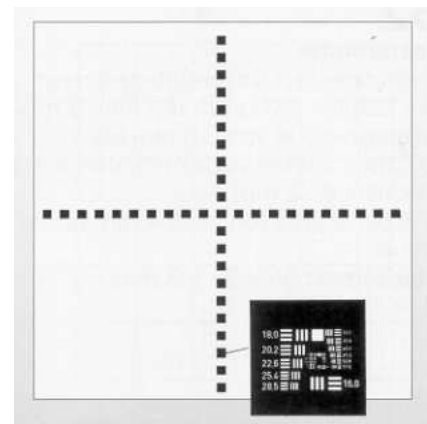
Glass substr.: 60 x 30 x 2 mm
777406 (27)



28a, 28b Resolution target array

41 resolution targets as per target No 1 with groups 4, 5, 6 and 7.
 Largest grating pitch= 0.06 mm (16 lines per mm)
 Finest grating pitch= $4.4 \mu\text{m}^*$ (228 lines per mm) in cross formation.

Glass substr.: 50 x 50 x 3mm
778017 (28a positive)
778018 (28b negative)

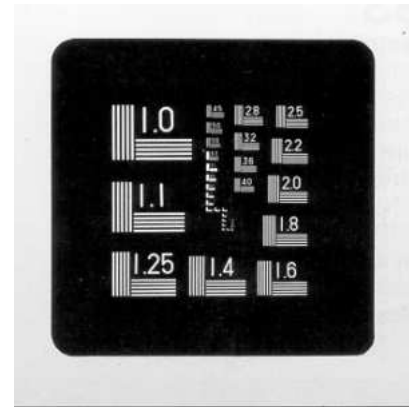


*) refer to resolution table on page 14

29a, 29b Resolution target with NBS pattern

49 groups comprising five-bar lines at right angles to each other. Resolution from 1 line per mm to 250 lines per mm. Finest grating pitch 4 μ m. Each group designated by the number of lines per mm. Line lengths correspond to 12 x the grating pitch.









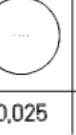
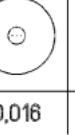
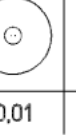

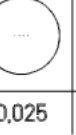
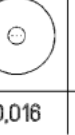
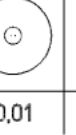
Glass substr.: 70 x 70 x 3mm
777413 (29a positive)
778019 (29b negative)



31a, 31b Surface Comparison plate

For detection of surface flaws to optics standard DIN 10110. Chrome structures (Lines and dots) from 10 μ m up to 1.0 mm

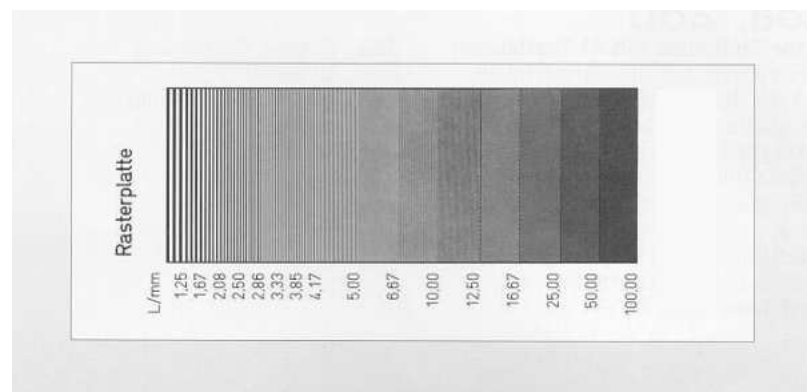
Glass substr.: 90 x 50 x 2 mm
772024 (31a positive)
779563 (31b negative)

10	0,63	0,4	0,25	0,16	0,1	0,063
						
						
						
			0,04	0,025	0,016	0,01

32 Line grating test plate

16 groups of line gratings from 1.25 to 100 lines per mm. Grating pitches from 0.8 mm to 0.01 mm, line-to-space ratio=1:1. Length of lines 22 mm. Group lengths form approx. 2.4 mm to approx. 5 mm

Glass substr.: 85 x 35 x 3 mm
778022 (32)



33 Test plate

Concentric circles and squares on diameters 5, 10, 15, 20 and 25 mm including centre and diagonal lines.

Line widths:

I 15 ± 2 µm

II 70 ± 5 µm

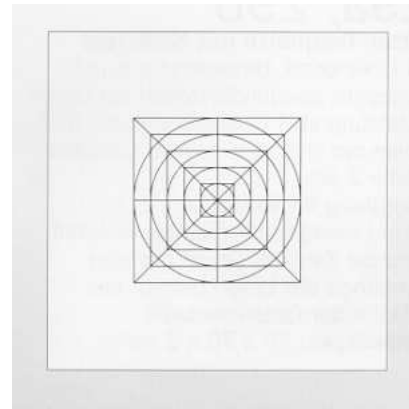
Angular accuracy: 1 arc minute.

Radius accuracy: 0.01mm

Glass substr.: 50x50x1.5 mm

778023 (33 I)

778024 (33 II)



34 0.25 mm Grid chart

50 mm square grid subdivided into 0.25 mm squares.

Line widths: 15 µm, every fourth line 30 µm.

Graduation accuracy:

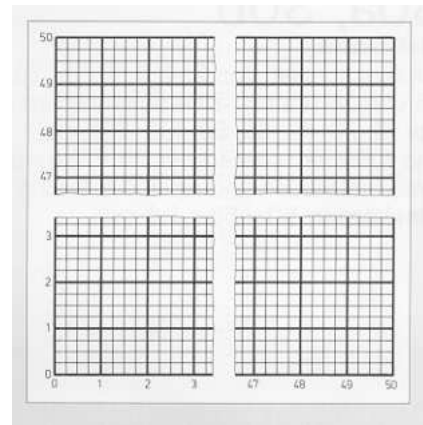
Interval ±2µm

total length ±5µm

Grid viewed through glass.

Glass substr.: 70x70x1.5mm

777870 (34)



35 0.066 mm Grid chart

30 mm square grid subdivided into 0.066 mm squares.

Line widths: 5 µm, every third line 10 µm.

Graduation accuracy:

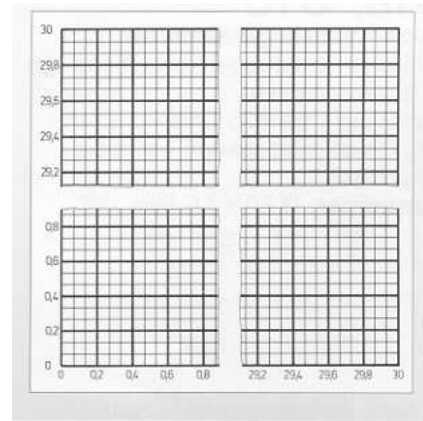
Interval ±2µm;

total length ±5µm

Grid viewed through glass

Glass substr.: 50x50x1.5mm

778025 (35)



36 0.05 mm Grid chart

30 mm square grid subdivided into 0.05 mm squares.

Line widths: 5 µm, every fifth line 10 µm.

Graduation accuracy:

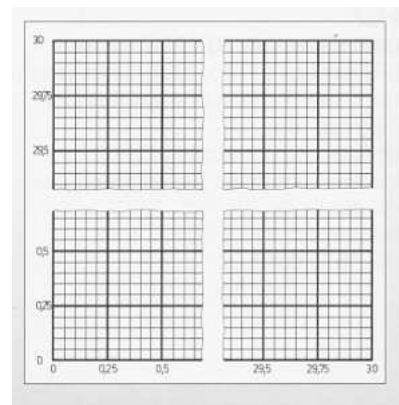
Interval ±2µm;

total length ±5µm

Grid viewed through glass

Glass substr.: 50x50x1.5mm

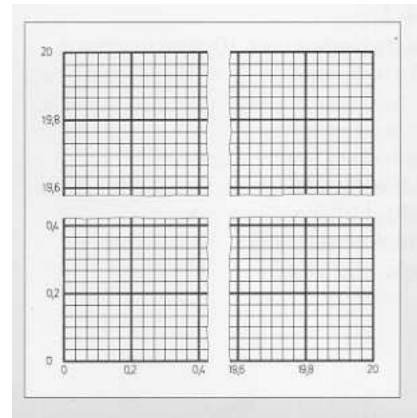
777869 (36)



37 0.033 mm Grid chart

20 mm square grid subdivided into 0.033 mm squares.
Line widths: 3 μm , every sixth line 5 μm .
Graduation accuracy:
Interval $\pm 2\mu\text{m}$;
total length $\pm 5\mu\text{m}$
Grid viewed through glass

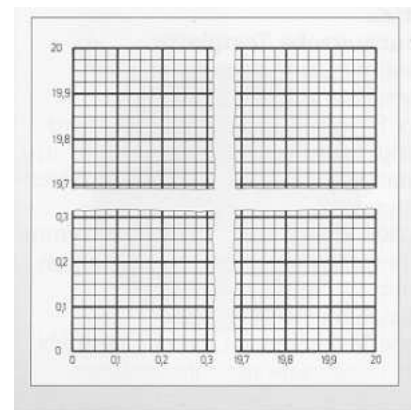
**Glass substr.: 50x50x1.5mm
778026 (37)**



38 0.025 mm Grid chart

20 mm square grid subdivided into 0.025 mm squares.
Line widths: 3 μm , every fourth line 5 μm .
Graduation accuracy:
Interval $\pm 2\mu\text{m}$;
total length $\pm 3\mu\text{m}$
Grid viewed through glass

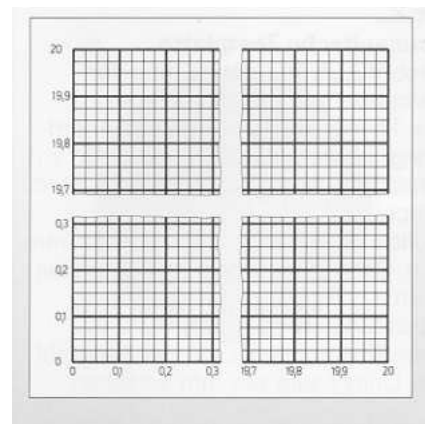
**Glass substr.: 50x50x1.5mm
778027 (38)**



39 0.02 mm Grid chart

20 mm square grid subdivided into 0.02 mm squares.
Line widths: 3 μm , every fifth line 5 μm .
Graduation accuracy:
Interval $\pm 2\mu\text{m}$;
total length $\pm 3\mu\text{m}$
Grid viewed through glass

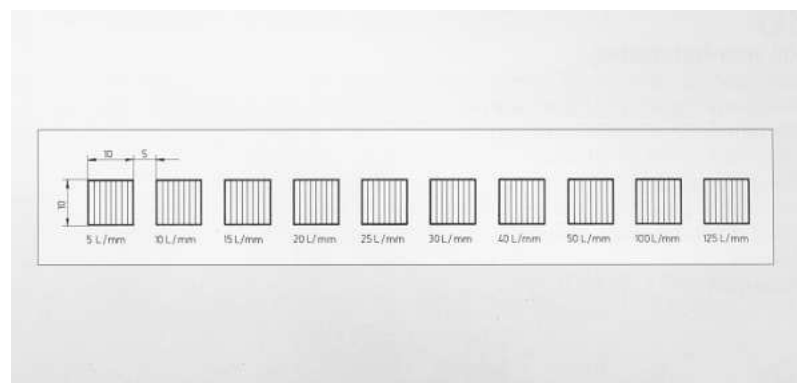
**Glass substr.: 50x50x1.5mm
777499 (39)**



40 Grating test array

10 groups 10 x 10 with gratings of 5 to 125 lines per mm.
Line-to-space ratio = 1:1.
Each group designated by the number of lines per mm.

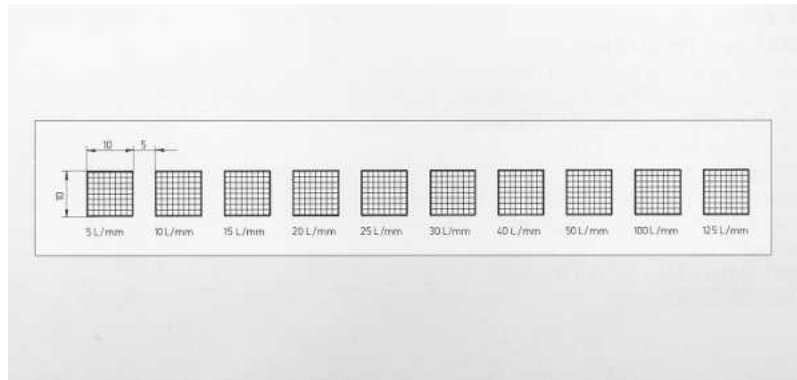
**Glass substr.: 165 x 30x3 mm
778028 (40)**



41 Grid test array

10 groups 10 x 10 with grids of 5 to 125 lines per mm.
Line-to-space ratio = 1:1.
Each group designated by the number of lines per mm.

Glass substr.: 165 x 30x3 mm
778029 (41)



42a, 42b Foucault test plate

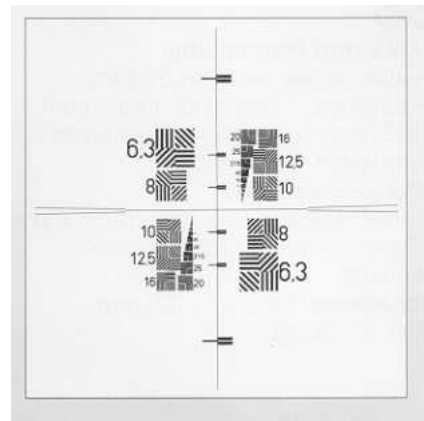
As per VG 95442 for testing binoculars and telescopes.
2x17 groups (double arrangement) comprising line groups with lines arranged at 45° to each other.

Resolution 6.3Lp/mm to 25 Lp/mm i.e. grating pitches from 160 μm to 4 μm
Progression ratio $\sqrt[3]{2}:1$. Each group designated by the number of line pairs per mm.

Glass substr.:
I 50 x 50 x 2 mm
II Ø 12 x 2 mm

Positive 42a
I **778030**
II **778031**

Negative 42b
I **778032**
II **778033**



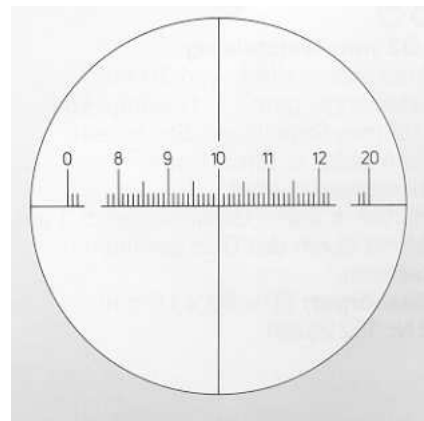
43 Object micrometer

20 mm in 200 divisions, with crosshair;
Line width $15 \pm 2 \mu\text{m}$

Line lengths:

0.1 mm-Line = 0.4 mm
0.5 mm-Line = 0.5 mm
1.0 mm-Line = 0.7 mm
Every tenth line (each mm) 0-20 numbered;
Height of numbers: 0.4 mm

Glass substr.: Ø 26 x 1.5 mm
778034 (43)



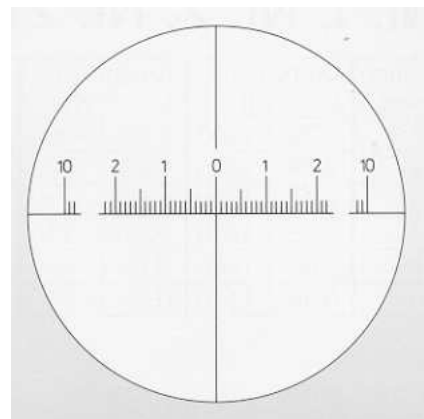
44 Object micrometer

20 mm in 200 divisions, with crosshair;
Line width $15 \pm 2 \mu\text{m}$

Line lengths:

0.1 mm-lines = 0.4 mm
0.5 mm-lines = 0.5 mm
1.0 mm-lines = 0.7 mm
Every tenth line (each mm) 10-0-10 numbered;
Height of numbers: 0.4 mm

Glass substr.: Ø 26 x 1.5 mm
777493 (44)



Resolution tables for targets

For standard graticules

L= Number of line pairs per mm

S= Line/space width in μm

No. 1, No. 2, No. 21 und No. 28 Progression ratio $\sqrt[6]{2}:1$

Element No	Group - 2		Group - 1		Group 0		Group 1		Group 2	
	L	S	L	S	L	S	L	S	L	S
1	0.25	2000	0.5	1000	1.00	500	2.00	250	4.00	125
2	0.28	1780	0.56	890	1.12	445	2.24	223	4.49	112
3	0.31	1590	0.63	790	1.26	395	2.52	198	5.04	99
4	0.35	1410	0.71	710	1.41	355	2.83	178	5.66	89
5	0.40	1260	0.79	630	1.59	315	3.17	158	6.35	79
6	0.44	1120	0.89	560	1.78	280	3.56	140	7.13	70

Element No	Group 3		Group 4		Group 5		Group 6		Group 7	
	L	S	L	S	L	S	L	S	L	S
1	8.00	63	16.0	32	32.0	16	64.0	8	128	4
2	8.98	56	18.0	28	35.9	14	71.8	7	144	3.5
3	10.1	50	20.2	25	40.3	12	80.6	6.2	161	3.1
4	11.3	44	22.6	22	45.3	11	90.5	5.5	181	2.8
5	12.7	40	25.4	20	50.8	10	102	5	203	2.5
6	14.3	35	28.5	18	57.0	9	114	4.4	228	2.2

Other Products

Large area photomasks in sizes up to 24" x 32", used for the following applications;

- Optical Calibration tools
- Photomasks for LCD production
- Bumpmasks for the semiconductor industry (Wafer Level Packaging)
- others

Tailormade graticules, such as:

- Incremental- and coded discs for rotary encoders
- Eye test charts for Ophthalmology
- Graticules for various applications, such as:
 - Medical surgery equipment
 - Research applications
 - Optics
 - etc.

IMT Masken und Teilungen AG
Im Langacher 46, Greifensee
Postfach, CH-8606 Nänikon
Switzerland
Telephone+ 41 44 943 19 00
Internet www.imtag.ch