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T-90
Ultra High Resolution Target
Product Specifications



Catalog Part No: **T-90-N-CG / T-90-OP**

Product Name: **Ultra High Resolution Target**

Drawing / Photo of part:



The above image is an approximate representation of the actual product.
Specifications are subject to change without notice.

Description: The T-90 Resolution Target includes frequencies from 1.0 to 500 line pair per mm (lp/mm). Each frequency is presented as 15 line pairs, each line having a line width to height ratio of 1:10. Image size is nominally 16x16mm. Group one is marked with one square and is 1-10 lp/mm. Group 2 is marked with 2 squares and is 10-100 lp/mm. Group 3 is marked with 3 squares and is 100-500 lp/mm. Note that there is a slight overlap of the numerical lp/mm between groups. (Frequencies and line widths are tabulated by group in Appendix A.)

Substrate Size: 50.8 x 50.8 x 1.5 mm (2.0 x 2.0 x 0.06 inches)

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Substrate Types: Available substrate types are soda-lime glass or opal glass. A part number suffix specifies material:

CG = chrome glass

OP = Opal Glass

TM= transparent Material (Mylar/polyester photo film)

RM= Reflection Material (Photo Paper)

Image Forming Material: Chromium or photo emulsion

Polarity: Chrome parts; Negative (clear features on an opaque field)

Emulsion Parts: Positive (opaque bars on a clear field)

Reading Direction: Right Read Image side up

Feature Size Accuracy: Typical line width is 2 to 5 percent of aim.

Image Placement Accuracy: ± 0.001 mm per 100 mm

Material Notes: Thermal expansion of soda-lime glass is ± 0.0000045 / deg. F.

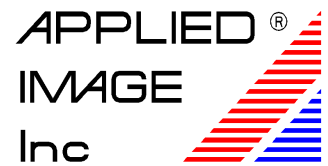
Image Contrast / Density: Chrome transmission density is 2.0 or higher; photo-emulsion transmission density 2.0 or higher (photo-emulsion on polyester); emulsion reflection density 1.3 or higher (photo-emulsion on paper).

History / Typical Use: Evaluation of high resolution optical systems for resolving power.

How to Use Resolution Test Charts: Multi-bar test charts are most often used to determine the overall resolution limit of an entire optical system. Each component of a system adds some degradation to image quality; therefore the comparison of a test chart in the object plane to the resulting image will produce the complete account of all components such as optics, image processing, vibration, color fringing, etc. Test charts may be used in optical systems that reduce, maintain (1:1) or magnify the image size. However, system magnification must be applied as a multiplier to determine the resolving power limit. The frequency of the last

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distinct features in the final image is divided by image reduction or magnification to determine the resolving power or the resolution of the system.

How to Read a Resolution Bar Test Pattern: Resolution is defined as a threshold measurement, therefore the resolution limit is found by identifying the last group of bars that can be seen and correctly counted in both horizontal and vertical directions. Breaks within the bar pattern are acceptable, and do not cause failure of resolution as long as the bars are distinctly identified and accurately counted. A microscope with the necessary magnification is commonly used to view reduced images. The correct number of bars must be counted when determining the resolution limit in order to avoid an inflated measure. This problem can be seen while observing increasingly finer groups. Features will be beyond resolution and then appear again. One cause of this spurious resolution is poor focus causing the bars and spaces in the image to apparently flip polarity. Other causes are artifacts from digital scanning, or image processing algorithms.

Terms:

- *Line pairs per mm (lp/mm):* Sometimes referred to as cycles per mm, each line pair is comprised of one dark line and one clear line of equal width. Line width is equal to one half of pitch or the distance from the leading edge of a dark line to the leading edge of the next dark line. Frequency is equal to the inverse of line pitch.

Related Applied Image Products:

- IAM-3; Ultra-High Resolution Target
 - (5.6 to 510 lp/mm)
- T-10-2; Microscopy Test Target
 - (1.0 to 512 lp/mm)
 - NIST/NBS-1010A & ANSI/ISO#2 Standards
- T-20-2; USAF 1951 Test Target
 - (0.25 to 645 lp/mm)
- T-21-2; USAF 1951 Test Target – Improved Labeling
 - (0.25 to 512 lp/mm)

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Related Applied Image Products: (cont.)

- T-22-2; USAF 1951 Test Target – Improved Labeling & Layout
 - (0.25 to 512 lp/mm)
- T-60-3; Sayce Target
 - (25.0 to 500 lp/mm)

Related Documents:

- T-20_spec.pdf
- T-21_spec.pdf
- T-22_spec.pdf

Appendix A:

T-90 frequencies and line widths tabulated by group.

Group 1	
Frequency	Line Width
<i>lp/mm</i>	<i>microns</i>
1.00	500.0
1.25	400.0
1.50	333.3
2.00	250.0
2.50	200.0
3.00	166.7
4.00	125.0
5.00	100.0
6.00	83.3
8.00	62.5
10.00	50.0

Group 2	
Frequency	Line Width
<i>lp/mm</i>	<i>microns</i>
10.00	50.0
12.50	40.0
15.00	33.3
20.00	25.0
25.00	20.0
30.00	16.7
40.00	12.5
50.00	10.0
60.00	8.3
80.00	6.3
100.00	5.0

Group 3	
Frequency	Line Width
<i>lp/mm</i>	<i>microns</i>
100.00	5.0
125.00	4.0
150.00	3.3
200.00	2.5
250.00	2.0
300.00	1.7
400.00	1.3
500.00	1.0