

# ISO 10110

Part	Title	Indication
1	General	N/A
2	Material imperfections – Stress birefringence	0/
3	Material imperfections – Bubbles and Inclusions	1/
4	Material Imperfections – Inhomogeneity and Striae	2/
5	Surface form tolerances	3/
6	Centering Tolerances	4/
7	Surface Imperfection tolerances	5/
8	Surface Texture	√
9	Surface Treatment and coating	(λ)
10	Table representing data of a lens element	N/A
11	Non tolerance data	N/A
12	Aspheric surfaces	N/A
13	Laser irradiation damage threshold	6/

## ISO 10110-1 Materials Specs

The following information shall be given, as appropriate:

a) Indication of material, e.g.:

manufacturer, glass type

or international glass code number

or refractive index and Abbe number, including an indication of the reference wavelength

or chemical description (for example for crystalline material);

b) special properties of the material, such as:

tolerances for refractive index, dispersion, transmission, homogeneity class, striae class, crystal properties (e.g. mono- or polycrystalline)

Material data	
√ P3	Glass type N-BK 7
	$n_d$ 1,51680 ±0,0005
	$V_d$ 64,17 ±0,8%
	$Q$ 10
	1/ 3x0,01
∅0,1	2/ -2

## ISO 10110-2 Stress Birefringence

The stress birefringence can be visualized by placing the sample between two crossed polarizers. Glass without any stress will appear completely dark. Figure 8 shows a N-BK7 block that was placed between 2 crossed polarizers. The bright areas indicate the internal stress.



Figure 8: N-BK7 block with internal stress.

TIE-27: Stress in optical glass

**SCHOTT**  
glass made of ideas

The cooling process can create stress within glass. This leads to polarization effects.

## ISO10110-2 Stress Birefringence

The Stress Birefringence tolerance is denoted by the code 0/ followed by a number indicating the permissible OPD in nm/cm of glass path. Several example values are shown below.

Permissible optical path difference (OPD) per cm glass path	Typical applications
< 2 nm/cm	Polarisation instruments Interference instruments
5 nm/cm	Precision optics
10 nm/cm	Astronomical optics Photographic optics
20 nm/cm	Microscope optics Magnifying glasses View finder optics
Without requirement	Illumination optics

Material data		
Glass type N-BK 7		
$n_d$	1,51680	$\pm 0,0005$
$V_d$	64,17	$\pm 0,8\%$
0/	10	
1/	3x0,01	
2/	-2	
E0,1		

## ISO 10110-3 Bubbles & Inclusions

The Bubbles and Inclusions tolerance is denoted by the code 1/ followed by  $N \times A$ , where  $N$  is the maximum number of bubbles of maximal size and  $A$  is the square root of the projected area of the largest allowable bubble in mm.



A larger number of smaller bubbles is acceptable as long as the cumulative value doesn't exceed to  $N \times A^2$

Material data	
P3	
Glass type	N-BK 7
$n_d$	1,51680 ±0,0005
$V_d$	64,17 ±0,8%
0/	10
1/	3x0,01
2/	-2
E0,1	

## ISO 10110-4 Inhomogeneity & Striae

The Inhomogeneity and Striae tolerance is denoted by the code 2/ followed by A; B, where A is the Inhomogeneity Class and B is the Striae Class.

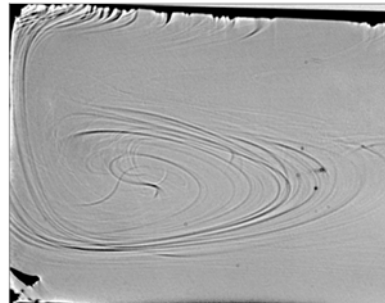
Inhomogeneity Class

Class	Maximum permissible variation of refractive index within a part $10^{-6}$
0	± 50
1	± 20
2	± 5
3	± 2
4	± 1
5	± 0,5

Striae Class

Class	Density of striae causing an optical path difference of at least 30 nm in %
1	≤ 10
2	≤ 5
3	≤ 2
4	≤ 1
5	Extremely free of striae Restriction to striae exceeding 30 nm does not apply Further information to be supplied in a note to the drawing

Material data	
P3	
Glass type	N-BK 7
$n_d$	1,51680 ±0,0005
$V_d$	64,17 ±0,8%
0/	10
1/	3x0,01
2/	-2
E0,1	



## ISO 10110-7 Surface Imperfections

Part 7 describes surface imperfection tolerances. Examples of these are scratches, scuffs, coating blemishes and edge chips. Code 5/ is used to specify these factors for a surface and 15/ for assemblies.

5 or 15/ $N \times A$ ;  $CN' \times A'$ ;  $LN'' \times A''$ ;  $EA'''$

To summarise:

5/ represents surface imperfections and 15/ respectively;

$N \times A$  for surface imperfections; Number x Sqrt( Area in mm)

$CN' \times A'$  for coating blemishes; Number x Sqrt( Area in mm)

$LN'' \times A''$  for long scratches; Number x width in mm

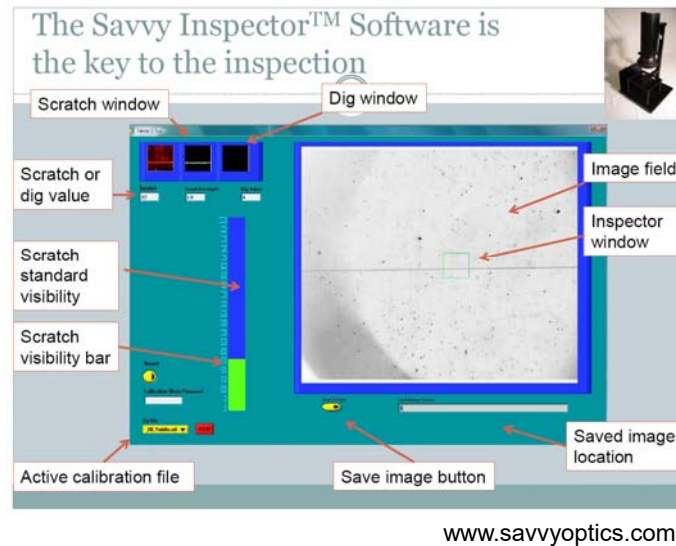
$EA'''$  for edge chips. Sqrt( Area in mm)

Left surface	
R	135,991 CC
$\sigma_e$	65,3
$\lambda$	SN 1062-M400/680
3/	5(1/0,5)
4/	0,8 $\square$
5/	3x0,16,C3x0,16;L3x0,008,E0,1

## MIL-PRF-13830B Surface Imperfections

- Routinely used instead of ISO 10110-7
- Known as Scratch & Dig
- Scratch is an arbitrary number related to a set of master scratches that are used for comparison.
- Scratch is not a dimension or width! Common error in literature and web pages.
- Dig is the size of a pit in the surface in microns divided by 10.

## Scratch & Dig



## Scratch & Dig Specifications

- 80-50 are standard quality
- 60-40 precision quality
- 20-10 high precision quality
- Usually these are cosmetic defects unless surface is near image plane or high power is passing through the system that can cause damage due to scattered light.

## ISO 10110-8 Surface Texture

Part 8 describes surface texture tolerances. There are Matte (Ground) surfaces where the rms surface roughness is  $\gg \lambda$ , and Smooth (Polished or molded) surfaces where the rms surface roughness is  $< \lambda$ .

These features are denoted on the drawings by a labeled “checkmark”. The checkmark can be in the surface description or on the actual drawing.

Left surface	
R	135,991 CC
$\sigma_e$	65,3
$\lambda$	SN 1062-M400/680
3/	5(1/0,5)
4/	0,8 [A]
5/	3x0,16,C3x0,16;L3x0,008,E0,1

## ISO 10110-8 Surface Texture

Matte surfaces are denoted with a G (Ground)  
Rq is the rms surface roughness

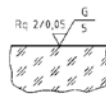


Figure 1 — Indication for ground surface with  $2 \mu\text{m} > Rq > 0,05 \mu\text{m}$  and minimum sampling length of 5 mm

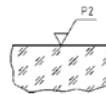


Figure 3 — Indication for smooth surface with  $< 80$  microdefects per 10 mm linear scan of the surface

Table A.1

Polishing grade designation	Number $N$ of microdefects per 10 mm of sampling length
P1	$80 < N < 400$
P2	$16 < N < 80$
P3	$3 < N < 16$
P4	$N < 3$

# ISO 10110-9 Surface Treatments and Coatings

Part 9 describes surface treatments such as protective coatings or paint, as well as optical coatings such as AR and mirror.

