

Draft report for ISO10110-11 (Non-toleranced data)

OEOSC SC1 WG4 Meeting Photonics West 2010

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Properly written standards include provisions when data is not specified

ISO10110-11 Non-toleranced data (defaults)

Last formal ISO activity circa 2006

New draft in for 2011

This presentation documents the data, decisions, and content of the proposed draft from the US/OEOSC perspective

Realities of writing a “universal” set of default tolerances

Defining “universal” defaults is intractable in one table. Why?

Effects of different materials are significant

Size and thickness impact – what would be a reasonable default

Varying traditional shop practice (fab and metrology)

Diverse processes lead to different meaningful numbers

...

Multiple tables to cover the manufacturing spectrum defeat the purpose of this standard and likely would lead to confusion

Defaults must assume “traditional” germane glass lens fabrication methods in a single table

Makes sense for U.S. position to recommend ISO10110-11 match standard practice

“Loose” defaults preferred from both the design and fabrication perspective

“These tolerances do not represent absolute limits. Even looser tolerances may be used; however they shall then be indicated in the drawing.”

Challenge: determine standard U.S. practice, especially given different sizes, materials, fabrication processes, and metrology?

Effort to garner input has been fivefold, results utilized:

ASC/OP1 WG4

Public domain – old ISO10110-11, shop public information, papers and short courses, glass manufacturer data

Poll for input from U.S. fabrication OEOSC members

Compare with catalog parts

APOMA 2010 workshop and follow-up (verbal + 2 surveys submitted)

Size classifications in the standard

Current size classifications

Up to 10mm

10-30mm

30-100mm

100-300mm

Notes on sizes without defaults:

Optics smaller than 3mm are custom (and often molded)

Larger than 300mm are custom

**Change: taking lowest category from Up to 10mm to 3-10mm
(based on APOMA input)**

Defining default categories is key

Keep in standard:

Lens diameter or edge length

Thickness

Angle deviation of prisms and plates

Chamfer/Bevel widths (value not tolerance), *curved surfaces only*

Stress birefringence

Bubbles and inclusions

Inhomogeneity and striae

Surface form tolerances

Centring

Surface imperfection

Defining default categories is key

Categories to add:

Mean index of refraction

V-number

Clear aperture to part edge distance

Chips standard for prisms and plates (flat)

Will not include in 2011, but keep in mind for 2016:

Index change with temperature (dn/dT)

Slope and sampling criteria for aspheres (-12)

Texture and waviness (-8)

Laser irradiation damage threshold (-17)

Input to keep in mind when reviewing the numbers

The loosest possible value from the references generally chosen (with experience also applied)

Loosest grade for glasses suggested as our position

- Most optical grade glass fabricated outside the US
- Specialty materials (IR, low expansion, etc.) not “in play”

Possible differences to note for ANSI version

- Important differences will be noted (such as wavelength)
- Centration to include total runout in next ISO10110-6
- US imperfection position likely will be scratch-dig (80-50)
- Recategorize as needed to match ANSI versions

Edge length proposed position suggests changes from current standard (units mm)

3-10mm

Current: +/-0.2

Proposed: +0.00/-0.15

10-30mm

Current: +/-0.5

Proposed: +0.00/-0.25

30-100mm

Current: +/-1

Proposed: +0.00/-0.75

100-300mm

Current: +/-1.5

Proposed: +0.00/-1.5

Note: Looser than reference numbers used

Clear aperture to part edge proposed position suggestion new for the standard (units mm)

3-10mm

Current: Not in standard

Proposed: 0.5

10-30mm

Current: Not in standard

Proposed: 1.0

30-100mm

Current: Not in standard

Proposed: 1.0

100-300mm

Current: Not in standard

Proposed: 2.0

Thickness proposed position suggests one minor change from current standard (units mm)

3-10mm

Current: +/-0.1

Proposed: +/-0.1

10-30mm

Current: +/-0.2

Proposed: +/-0.2

30-100mm

Current: +/-0.4

Proposed: +/-0.4

100-300mm

Current: +/-0.8

Proposed: +/-0.8

Width of protective chamfer position suggests minor changes from current standard (units mm)

3-10mm

Current: 0.1 to 0.3

Proposed: No Bevel

10-30mm

Current: 0.2 to 0.5

Proposed: 0.3 to 0.5

30-100mm

Current: 0.3 to 0.8

Proposed: 0.3 to 0.8

100-300mm

Current: 0.5 to 1.6

Proposed: 0.8 to 1.6

Notes

Small parts can chip if beveled, cut out largely by 3-10mm category lower bound

Chips outside clear aperture is new suggestion for the standard

3-10mm

Current: Not in standard

Proposed: Larger than 0.5mm diameter stoned, <30% of any surface edge length can be chipped

10-30mm

Current: Not in standard

Proposed: Larger than 0.5mm diameter stoned, <30% of any surface edge length can be chipped

30-100mm

Current: Not in standard

Proposed: Larger than 0.5mm diameter stoned, <30% of any surface edge length can be chipped

100-300mm

Current: Not in standard

Proposed: Larger than 0.5mm diameter stoned, <30% of any surface edge length can be chipped

Notes

Is this type of specification in the standard at all?

Mean index of refraction and V-number are new to the standard

Mean Index

3-10mm

Current: Not in standard

Proposed: +/-0.001

10-30mm

Current: Not in standard

Proposed: +/-0.001

30-100mm

Current: Not in standard

Proposed: +/-0.0015

100-300mm

Current: Not in standard

Proposed: +/-0.002

V-number (d F C, Abbé only)

3-10mm

Current: Not in standard

Proposed: +/-0.8%

10-30mm

Current: Not in standard

Proposed: +/-0.8%

30-100mm

Current: Not in standard

Proposed: +/-1.0%

100-300mm

Current: Not in standard

Proposed: +/-1.2%

Stress birefringence position suggests no changes from current standard (units nm/cm)

3-10mm

Current: 20

Proposed: 20

10-30mm

Current: 20

Proposed: 20

30-100mm

Current: Not specified

Proposed: 30

100-300mm

Current: Not specified

Proposed: 40

Notes: Loosest grade of single boule material used (O'Hara)

Bubbles and inclusions proposed position suggests changes from current standard (see below on units)

3-10mm

Current: 3 x 0.16

Proposed: 3 x 0.16

10-30mm

Current: 5 x 0.25

Proposed: 5 x 0.25

30-100mm

Current: 5 x 0.4

Proposed: 5 x 0.4

100-300mm

Current: 5 x 0.63

Proposed: 5 x 0.63

Scale numbers
for area

Notes

Reminder: notation is N x A (# max-size defects x square-root of area of max-size defect in mm)

Glass manufacturers use cross-sectional area of bubbles in mm² versus 100 cm³ volume

Loosest grades: Schott 0.1, O'Hara >0.5, CDGM 2 to 4 (in mm² versus 100 cm³)

Could look to assess values for 0.5 mm² versus 100 cm³, scaled for part size, but not crucial as current numbers seem reasonable (not worth any battle)

Inhomogeneity and striae proposed position suggests no changes from current standard (see below on units)

3-10mm

Current: 1;1

Proposed: 1;1

10-30mm

Current: 1;1

Proposed: 1;1

30-100mm

Current: Not specified

Proposed: 1;1

100-300mm

Current: Not specified

Proposed: 1;1

Notes

Only grades allowed

Homogeneity designation means 20 parts-per-million (max refractive index variance)

Striae is challenging to compare to glass grades (they use MIL-G-174B)

ISO10110 striae is % area with 30nm of OPD (thickness ambiguity), grade 1 is <10%

MIL-G-174B is estimated OPD for 50mm thickness (Schott says compliant to ISO grade 1 always, O'Hara and CDGM use qualitative grades)

Surface form tolerances proposed position suggests changes from current standard

3-10mm

Current: 5(1)

Proposed: 5(1)

10-30mm

Current: 10(2)

Proposed: 5(2)

30-100mm

Current: 5(1), 30mm diam. samples

Proposed: 5(2), 30mm diam. samples

100-300mm

Current: 10(2), 30mm diam. samples

Proposed: 8(2), 30mm diam. samples

Notes

Notation is A(B) in fringes at Hg line 546.07nm

A is sagitta specification (radius tolerance)

B is irregularity

Should we put in nm for interferometry?

i.e. would 3-10mm value be written as:

3/1365nm(546nm)

Notes and details for angle deviation for prisms and plates and centring

Lens wedge is tough to find consensus – assuming a 1” optic we have:

Source 1: 5-6'

Source 2: ~17' (125um TIR)

Source 3: 2' in ISO terms but TIR 0.05mm is 7'

Source 4: TIR 0.05mm is 7'

Survey 1: 100um TIR is 13.5'

Survey 2: matched current standard for first two columns (30', 20')

Old default of 10'-30' is still seems quite loose

Initially thought 8' made sense, with surveys, it makes sense to tighten, but not as much as first considered (in keeping with the spirit of having the numbers loose)

Can convert to TIR for ANSI, using lower end of the size for default numbers

Beam deviation was posed as a good metric verbally by one person (but in minority compared to TIR)

Resulting values for centring and angle deviation for prisms and plates (units arcmin, can do ANSI TIR)

Centring

3-10mm

Current: +/-30

Proposed: +/-20

10-30mm

Current: +/-20

Proposed: +/-15

30-100mm

Current: +/-10

Proposed: +/-10

100-300mm

Current: +/-10

Proposed: +/-10

Angle deviation of prisms and plate

3-10mm

Current: +/-30

Proposed: +/-30

10-30mm

Current: +/-30

Proposed: +/-30

30-100mm

Current: +/-30

Proposed: +/-30

100-300mm

Current: +/-30

Proposed: +/-30

Surface imperfection tolerances proposed position suggests changes from current standard

3-10mm

Current: 3 x 0.16

Proposed: 80-50 (ANSI only)

10-30mm

Current: 5 x 0.25

Proposed: 80-50 (ANSI only)

30-100mm

Current: 5 x 0.4

Proposed: 80-50 (ANSI only)

100-300mm

Current: 5 x 0.63

Proposed: 120-80 (ANSI only)

Notes

ISO units are Number x Size of surface imperfections (again using square root of defect area)

Proposed are ANSI only, as scratch-dig similar to MIL-PRF 13830B

ANSI/OEOSC OP1.002:2009 (or current version)

U.S. position should be to avoid giving explicit input to this ISO standard for defaults, unless someone feels strongly that we should do it

The path forward for completing our position on the standard and disseminating information

Proper formal draft for OEOSC completed January, 2011
(pending PW input)?

OEOSC process?

ANSI draft version?

International community reception?

Separate activity: Aikens/Youngworth paper on this part of
the standard invited at Optifab