10110-6
Rewrite
update

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January 2009

Status

- I have made some progress on resolving issues and writing proposed text.
- Reinhold Litscher (sp?) has agreed to accept assistance on rewrite.
- His group has already begun work on it.
- It will be interesting to see if we pick the same issues, and similar solutions

My views so far:

PowerPoint doesn't do strikethrough
So…
Black is current text in document
Strikethrough is Blue
My additions are in Red underline
My comments are in Green

3.1

optical system
optical element, subassembly, or assembly

This is vague and allows for circular definitions later, as in 3.11.

Needs more work.

3.2

optical axis (of an optical system)

theoretical axis about which the ideal optical system is nominally rotationally symmetric

Note: Deflecting elements and systems, such as plane mirrors, prisms, etc. are exceptions.

Exceptions to what exactly? Are they to be defined elsewhere?

3.3

datum axis

axis established by one or more datum features

3.4

datum feature

Real feature of a part (such as the outer edge of the lens cylinder or a spherical surface) that is used to establish the location of a datum. The datum is the true geometric counterpart of the datum feature. A datum feature should be accessible and of sufficient size to permit its use.

3.X (bump all one decimal)

datum

The true geometric counterpart of a datum feature.

Current 3.5

cylindrical datum feature

datum of a cylindrical surface (such as the outer diameter of a lens) is the axis of the cylindrical surface datum feature, which is the axis of the smallest circumscribed cylinder that contacts the diameter. rim edge of a lens or inner cylinder of a lens barrel used to establish the cylindrical datum.

3.x

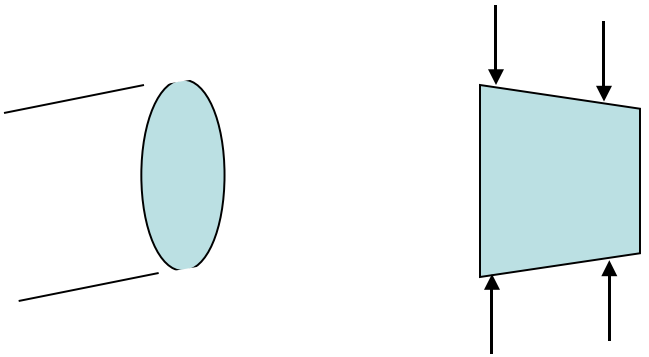
cylindrical datum

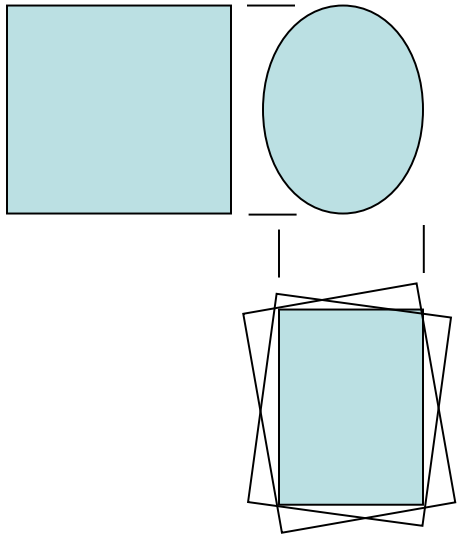
axis of the smallest circumscribed cylinder that touches an exterior cylindrical datum feature; alternately, axis of the largest inscribed cylinder that touches an interior cylindrical datum feature.

3.5

Sorry, not done yet

- The definition is now clear, but it won't be helpful in the real world because we have imperfect cylinders and interacting datums

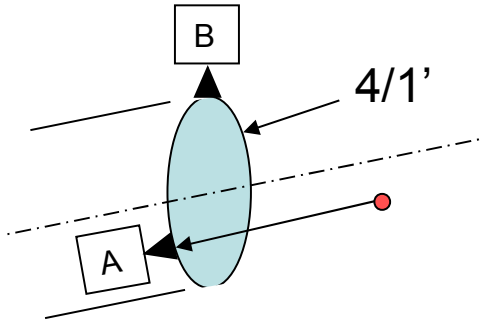




Two "smallest circumscribed diameters"

More 3.5: Geometric impossibility

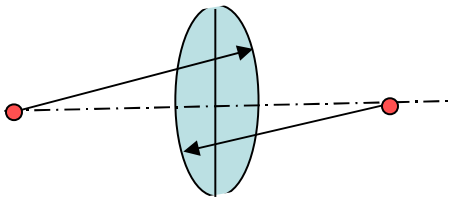
Why? Datum system is defined by intersection of *center of curvature* of A with *axis* of B.

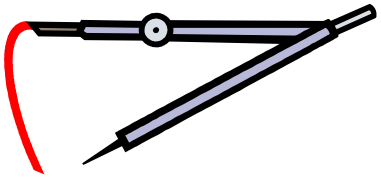


No intersection, so no datum axis exists.

Reference Figure 5

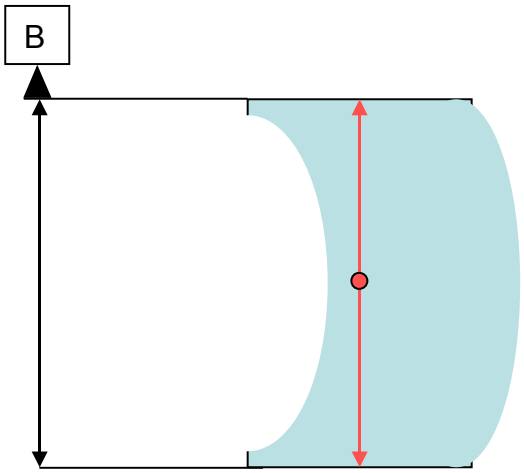
Yet in practice, lens is fine



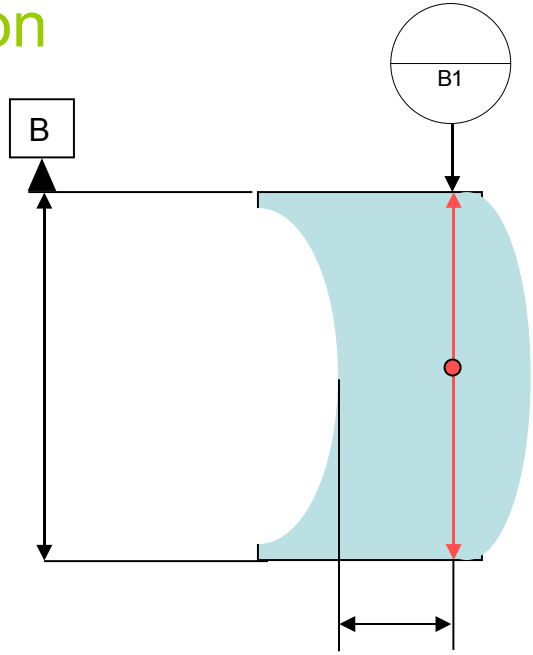


3.5 a proposal

- Define cylinder datum to be the *center point* of a circular target line at the *axial midpoint* of barrel edge, unless another position is specified (as in Figure 4.)
- Revise Figure 4 with correct symbol for circular target line as shown below
- Needs more work and discussion



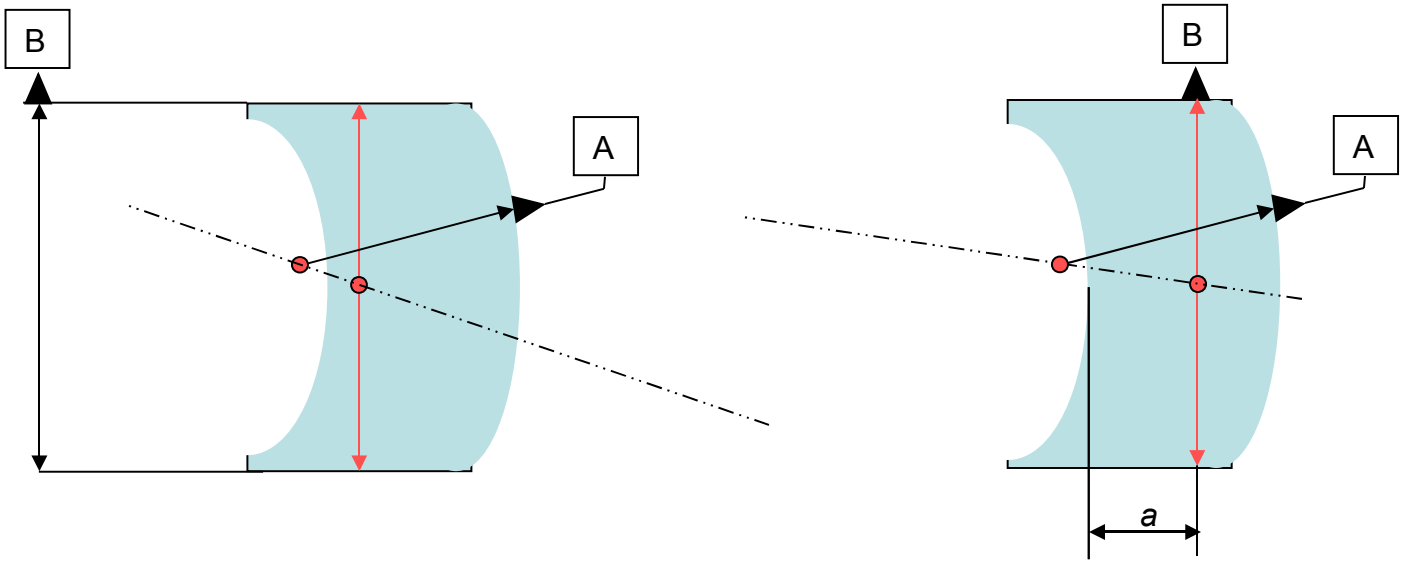
As indicated



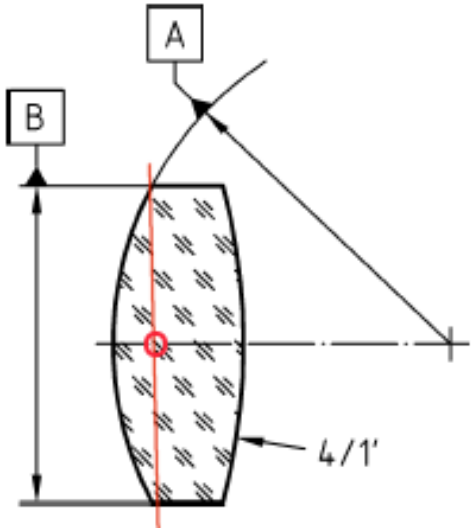
Where applied

Here's why that's important

We now have two completely different datum axes



3.5 alternate proposal



- Chinese comment on figures 5, 6, 7, 9, 12:
  “In the DIN 3140-6 (withdrawn) the datum axis was defined by the centre of curvature and the datum point on the cylinder axis established by a plane of the curvature at the cut-section with the outer edge of the lens cylinder. If the datum point is not in this plane, define the point (distance a) as in figure 4.”

3.6

spherical surface datum feature

point defined by the spherical surface datum feature's centre of curvature

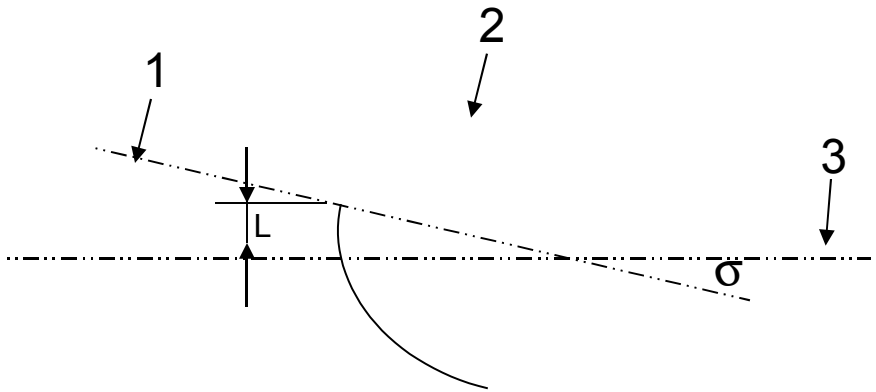
3.7

datum point

specified point on the datum axis. The location of a datum point must be specified adequately by dimension lines to other datum features.

3.9, 3.10

- Both need a figure



1 Rotational axis of aspheric surface
2 Aspheric surface
3 Datum axis
σ Tilt angle of aspheric surface
L Lateral displacement of aspheric surface

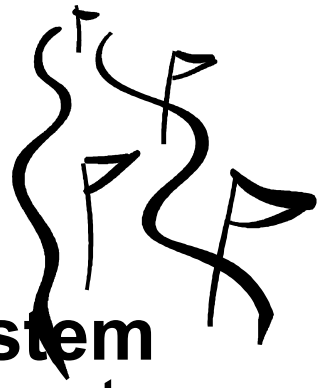
3.10

lateral displacement of an aspheric surface

distance from the point of rotational symmetry vertex of the aspheric surface to the datum axis. The vertex is the intersection of the asphere's axis of rotational symmetry with its surface (or the projection of its surface in the case of off-axis segments.)

reason: the "point of rotational symmetry" is not defined, and the intention is different from the datum of a spherical surface (which is displaced from the surface by one radius.)

3.11



Tilt angle of an optical element or subsystem angle between the datum axis of the element or subsystem and the system datum axis of which the element or subsystem is a part.

Problem 1: 3.1 defines an optical system as an optical element, subassembly, or assembly. So the whole thing is circular and ambiguous.

Problem 2: Now that we're dealing with elements or subsystems in relation to each other, the *orientation* of their tilts and displacements matter.

3.11 ctd

We need to better define what is desired
and intended:

1. Tilt between optical axis and datum axis.
2. Tilt between one datum axis and another.
3. A note explaining that the tilt is in the plane containing the two axes, i.e. the orientation of maximum tilt value, unless otherwise specified.
4. A note stating that if the orientation of the tilt is important then the tilt should be specified in terms of rotations about X, Y, and Z axes in a separate text note.

3.12

Lateral displacement of an optical element or subsystem

Distance between the datum axis of the element or subsystem and the datum axis of the system which the element or subsystem is a part, measured at the datum point of the subsystem.

My head hurts.

Figure 2

I don’t see any hint of how the datum point’s position is defined.

Should we have something in the text?

See 3.7 suggestion:

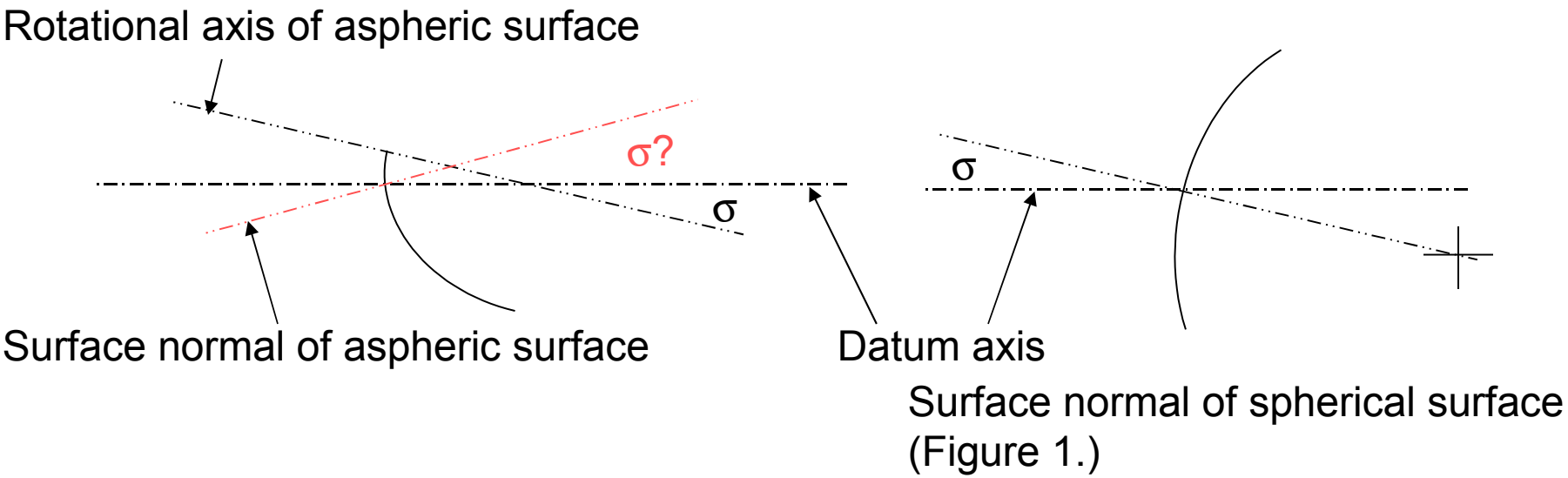
datum point

specified point on the datum axis. The location of a datum point must be specified adequately by dimension lines to other datum features.

4.2

If the aspherical effect of the surface *is small* compared to its spherical power, the centring tolerance may be specified in accordance with 4.1, as if it were a spherical surface.

3.8, 4.1, and Figure 1 vs. 3.9 and 4.2



When does the aspherical deviation become "small enough" to switch from one to the other? We should add an informative note cautioning about the difference.

5.2

Per Russian comment, replace “point of symmetry of the surface” with “vertex of the surface.”

5.3.4

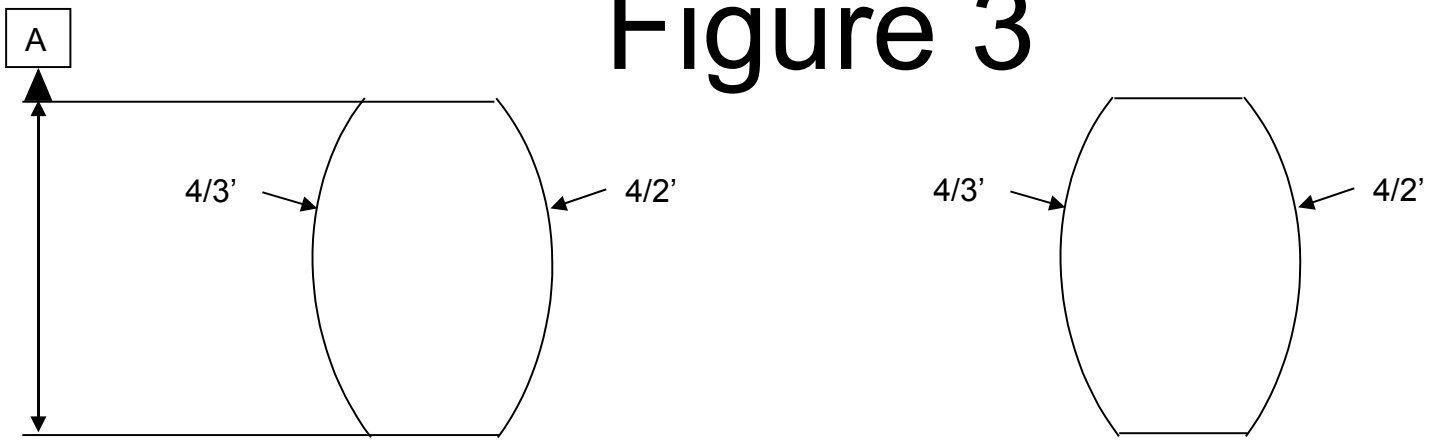
…If more than one datum axis is indicated in the drawing, the reference letters of the appropriate datum *system* axis shall be appended to the tolerance values.

Once around the Maypole

- 3.7 – datum point is “specified point *on datum axis*.”
- 5.2 – datum point *coincides with* point of symmetry of aspheric surface.
- 3.10 – lateral displacement of aspheric surface is distance *from* point of rotational symmetry to datum axis!

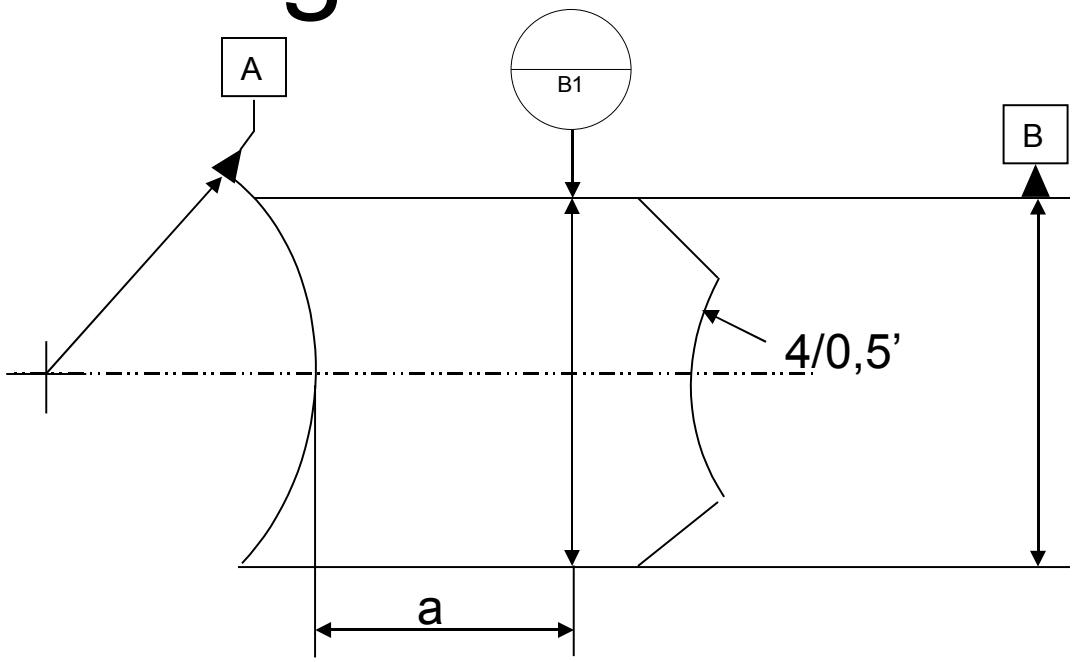
Ideas?

Figure 3



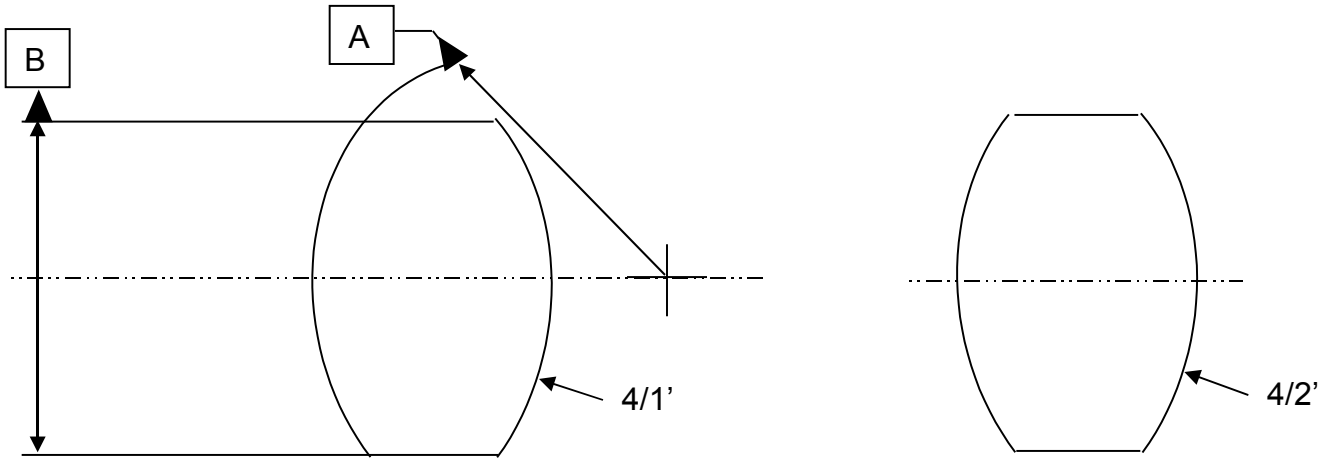
- Impractical for thin lenses: Cylinder edge not “of sufficient size to permit use.” (see 3.4)
- Irrelevant for thin lenses: Few lenses are press-fit into barrels, and diametral tolerance between lens and cell makes it meaningless.
- Suggestion: Guide designers to use this form only for lenses with barrel length > $\phi/2$
- Per Chinese comment, delete 3b because it is a simplification fraught with opportunities for error

Figure 4



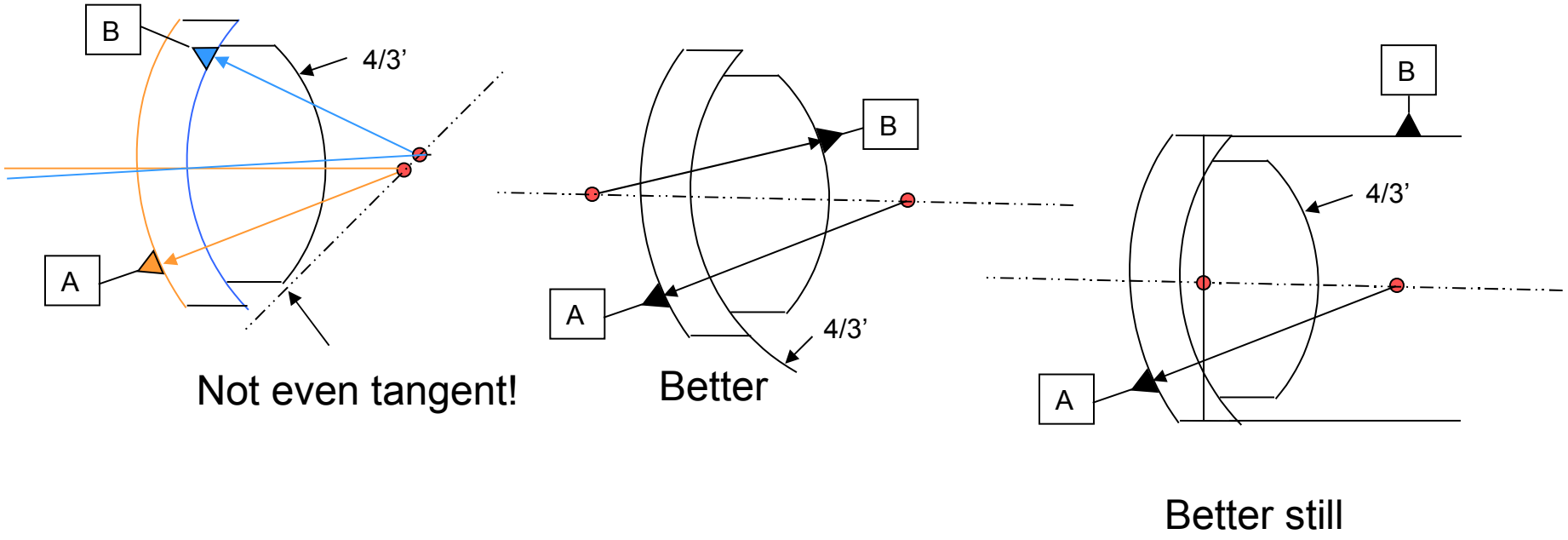
- Legend refers to circular target line B1 but drawing shows datum B. Indicate B1.
- Remove “C1” on left side of drawing .

Figure 5



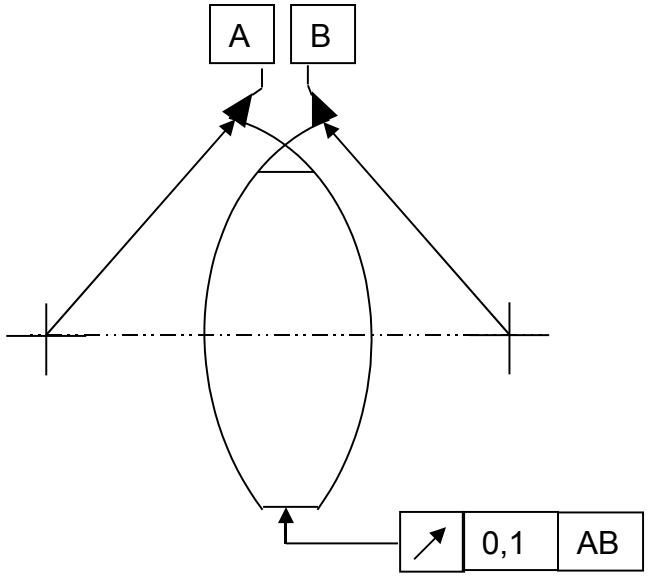
- Per Chinese comment, delete 5b. WAY too easy to misinterpret even with the standard in front of you.

Figure 10 -
A bad example



Don’t select two nearly concentric radii to create a datum axis

Figure 14

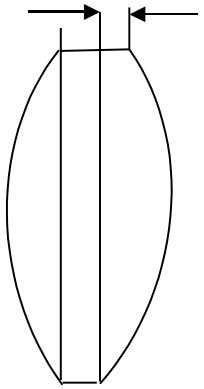


- Legend: “centring tolerance indication for a surface without optical function”
- Really serves as a good figure for TIR discussion

TIR – What is it?

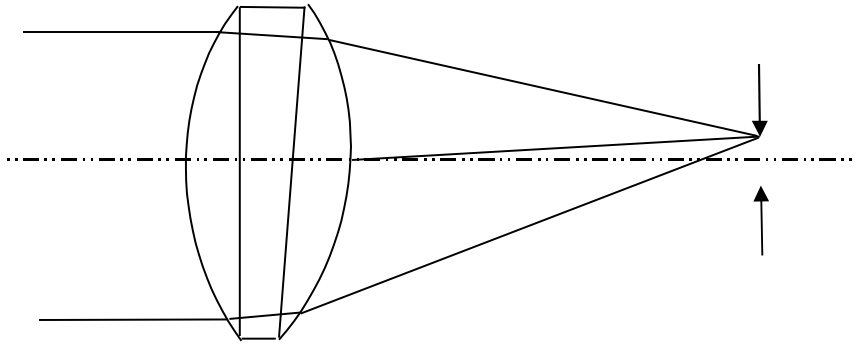
Karow: True Indicator Reading = edge thickness variation

Willey and Parks: Total Indicator Runout = edge thickness variation



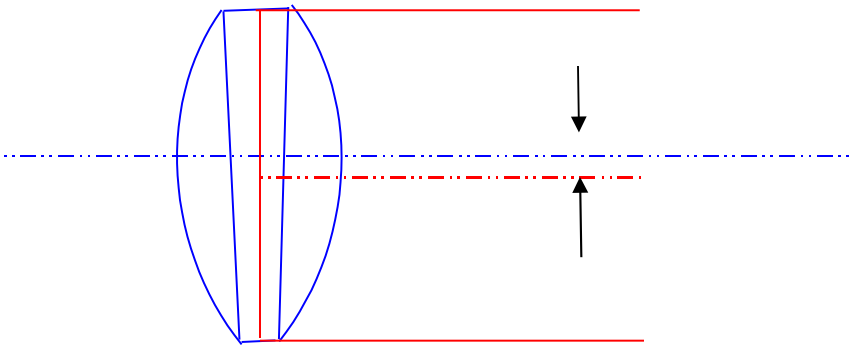
TIR ctd.

Photonics Dictionary: Total Image Runout = circular orbit diameter of image from a lens that is rotated about its rim. (Also total internal reflection.)



TIR ctd.

Machinists community: TIR ≈ 2 X decenter



TIR ctd.

Yoder, Strong, Brown, DeVany, Laikin, Horne, Kinglsake, Shannon, Zschommler, MIL-HDBK-14: No mention

Smith, Zemax manual: Total Internal Reflection (no other mention)

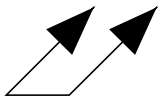
Malacara: No mention (although “decenter” is defined in terms of the system axis)

Meadows, Geometrical Dimensioning and Tolerancing:

- Circular Runout: "provides control of *circular elements of a surface*. The tolerance is applied independently at *any circular line element* as the part is rotated 360°. Where applied to surfaces constructed around a datum axis, circular runout may be used to control the cumulative variations of circularity and coaxiality. Where applied to surfaces constructed at right angles to the datum axis, circular runout controls circular elements of a planar surface (wobble.)"

Meadows, Geometrical Dimensioning and Tolerancing:

- Total Runout: "provides *composite control of all surface elements*. The tolerance is applied *simultaneously to all circular and profile measuring positions* as the part is rotated 360°. Where applied to nominally cylindrical surfaces constructed around a datum axis, total runout is used to control cumulative variations of *circularity, straightness, taper and coaxiality* of a surface. Where applied to surfaces at right angles to a datum axis, total runout controls variations of *perpendicualrity* (to detect wobble) and *flatness* (to detect concavity and convexity.)"



TIR summary

- Need to choose one definition
- Need to explain how to convert


The End