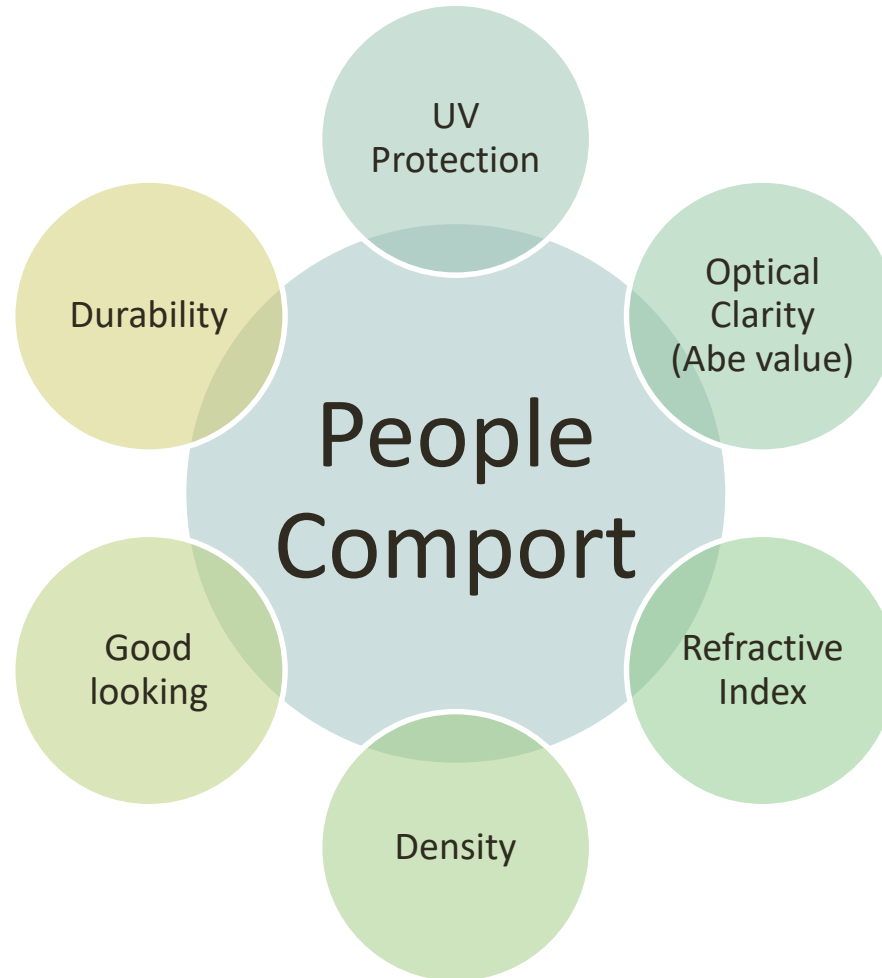


The Development of Eyeglass Lens Materials

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Development Background



Thinner Lenses are More Attractive

- Minimizing lens thickness
 - Using a small frame sizes
 - Using a higher-index materials
 - Using an aspheric lens design to reduce thickness
 - Using an antireflection coating to reduce lens visibility

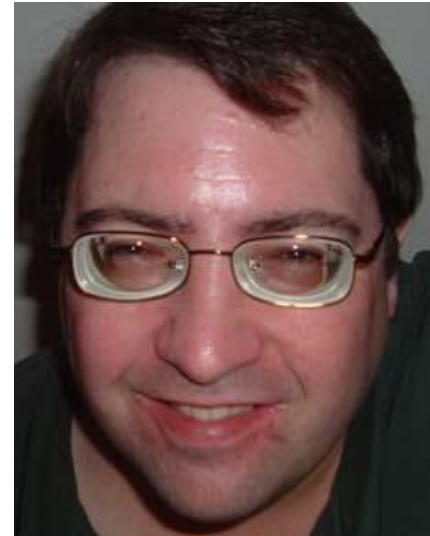


Fig 1



Fig 2

(Fig 1 and fig 2 are taken from www.optical4less.com and www.aliexpress.com)

Thin Lens vs Chromatic Aberration

- The higher lens's index, the lower it's Abbe number, and therefore the worse its color aberration will be.

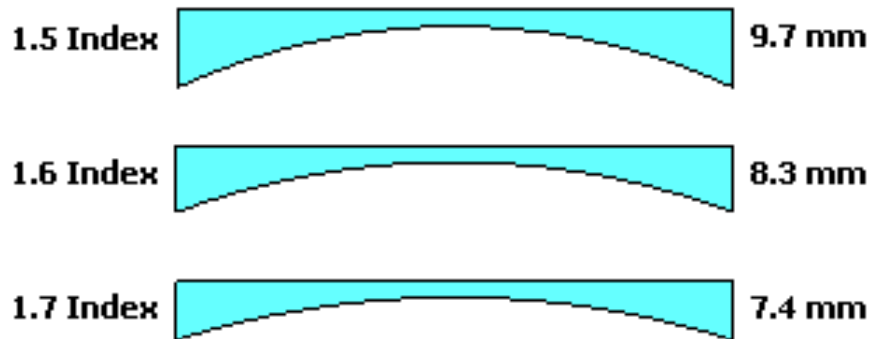


Fig 3. Index versus Edge Thickness for Minus Lenses
(source: opticampus.com)

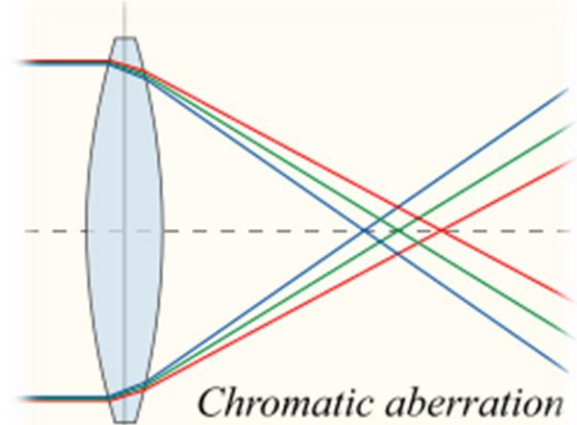


Figure 4. Chromatic aberration
(source: wikipedia)



Figure 5. Severe Chromatic aberration
(source: wikipedia)

Development Timeline

Year	Lens Material	Refractive Index	Abbe Value	Density	UV cut-off (up to)	Prescription Range
1285	Crown Glass	1.523	59	2.59 g/cm ³	320 nm	0.00 – 2.00
1947	(Hard Resin) CR-39	1.498	58	1.31 g/cm ³	350 nm	0.00 – 1.75
1970	Polycarbonate	1.586	30	1.20 g/cm ³	~385 nm	2.00 – 4.00
1980	Tibrid	1.6	41	1.3 g/cm ³	380 nm	4.00 – 6.00
1990	Mid High-Index Plastics	1.6 – 1.67	36-32	1.36 g/cm ³	~395 nm	6.00 – 9.00
2000	Trivex	1.54	45	1.11 g/cm ³	~395 nm	2.00 – 4.00
	Very High Index Plastics	1.70 – 1.74	36 – 33	1.47 g/cm ³	400 nm	Above 9.00

Plastic Lens Materials Overview

Lens Material	Chemistry	Properties	Structure
CR-39	<ul style="list-style-type: none"> Organic (Carbon-Based) 	<ul style="list-style-type: none"> Less impact resistant (but better than glass) High tensile strength High resistance to heat High Abbe number Lighter than glass 	<ul style="list-style-type: none"> Thermoset Highly cross-linked
Poly-carbonate	<ul style="list-style-type: none"> Organic (Carbon-Based) 	<ul style="list-style-type: none"> High impact resistant (provide a flexible lens) Low tensile strength Low resistance to heat Low Abbe Value 	<ul style="list-style-type: none"> Thermoplastic <i>resin</i> Long independent chain Not cross-linked
High Index	<ul style="list-style-type: none"> Organic (Carbon-Based) Polyurethane with added sulfur to increase refractive index 	<ul style="list-style-type: none"> Thinner lens Less impact resistant good tensile strength and surface hardness Lower optical performance Higher density 	<ul style="list-style-type: none"> Thermoset Highly cross-linked

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