Dimensions

Capabilities and Tolerances

The size capability and tolerance to which a specification can be held are influenced by the cutting and edging process. The above listed size and tolerance capabilities are a guideline only. These tolerances are used as defaults for the listed sizes and shapes. Tighter tolerances may be available upon request.

Edge Type	Raw Edge			Hand Edge			CNC Edge			Water Jet		
Shape	Min/Max	Size	Tolerance	Min/Max	Size	Tolerance	Min/Max	Size	Tolerance	Min/Max	Size	Tolerance
Rectangle	Minimum	5mm	+/- .2mm	Minimum	10mm	+/- .2mm	Minimum	25mm	+/- .1mm	Minimum	25mm	+/- .25mm
	Maximum	1000mm	+/-.5mm	Maximum	1000mm	+/-.5mm	Maximum	500mm	+/-.2mm	Maximum	350mm	+/-.25mm
Diameter	Minimum	7mm	+/- .2mm	Minimum	25mm	+/- .2mm	Minimum	25mm	+/- .1mm	Minimum	25mm	+/- .25mm
	Maximum	500mm	+/-.5mm	Maximum	500mm	+/-.5mm	Maximum	300mm	+/-.2mm	Maximum	350mm	+/-.25mm
Custom	Minimum	5mm	+/- .2mm	Minimum	TBD	TBD	Minimum	25mm	+/- .1mm	Minimum	25mm	+/- .25mm
	Maximum	1000mm	+/-.5mm	Maximum	TBD	TBD	Maximum	300mm	+/-.2mm	Maximum	350mm	+/-.25mm

*All dimensions are provided in millimeters.

Customer Input Required: ☐ Yes ☑ No — Default Specification: +/- 0.20mm

Thickness

Capabilities

Coresix maintains a variety of equipment and processes which are capable of fabricating glass from and to a wide range of thickness. Though we have limitations within certain processes, the versitility of our equiment allows us to be creative in meeting extreme specifications. The chart to the right is provided as a general guideline for some standard operations.

Process	Minimum	Maximum
Scribe & Break	.050mm	12.0mm
Water Jet	.400mm	50.0mm
Wire Saw	200.0mm	.560mm
CNC Edge	.400mm	25.0mm
Lap & Polish	.350mm	100.0mm

Tolerances

The glass materials with which we work most often have a wide variety of thickness tolerance (+/-) and total thickness variation (TTV) or parallelism which can be discussed upon request. Coresix can generally improve upon these characteristics through a lapping and polishing process. Though we are capable of tolerances to +/- 10µm, TTV of within a part to 2µm and TTV from part to part of <5µm, actual capabilities will vary and should be established per part requirements.

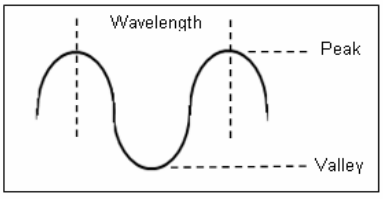
Customer Input Required: ☐ Yes ☑ No — Default Specification: Manufacturers Tolerance

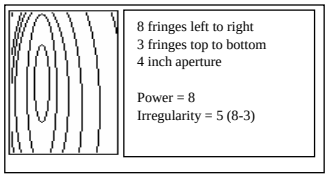
Flatness

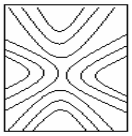
Improved optical flatness of a glass component is achieved through the lapping process. By conditioning the lapping plates and monitoring variables on the lapping machines, the top and bottom surface of the glass part are ground parallel in an extremely controlled process. Depending on the material and thickness, Coresix can generally produce to a quarter wave flatness.

Common Terms

Microns	A common way of expressing flatness is a peak to valley measurement in microns, either within a specified area or across the entire part.
Lambda (λ)	Greek letter commonly used to designate wavelength
Fringes	Using an interferometer with a monochromatic light source, the object part is measured against an optical flat. As light reflects in the gap between the object and the optical flat, the light will interfere with itself creating light and dark fringes or bands. As commonly measured on a helium neon laser at a waavelength of 632.8nm, each fringe is equal to .316 microns. These fringes can be counted to express flatness over a given area or evaluated as a contour map and interpreted for shape and flatness.
Wavelength	The distance between repeating units of a wave pattern.
Power & Irregularity	This is a common way of interpreting the results of an interferometer as described the the "fringes" definition above. Counting the fringes from left to right, then top to bottom, the larger number is the "power". Subtract the smaller number from the larger number to get the irregularity. The final number being the size of the aperture, the spec then reads P/I/A. For the example below, the flatness is 8/5/4 (8 fringes power, 5 fringes
Bow or Warp	A curve, bend or other deviation from flatness.
Stigmatism	Irregularities within the glass which cause an interuption to the transmitted flow of light through the glass.
Saddle	A negative curvature or irregularity in the glass surface which produces a saddle shape (see figure 1)






Saddle Shape

Customer Input Required: ☐ Yes ☑ No — Default Specification: No Spec

Roughness — Is a measurement of the small-scale variations in the height of a physical surface. A common measure of surface roughness is the rms (root-mean-square) heighth of the surface bumps

Cosmetics

Defect Size

Scratch and Dig - (MIL Spec XX)

Definition: The first number represents the maximum allowable scratch width in microns (20/10 = no scratches greater than 20um wide allowed). The second number represents the maximum allowable dig in 10's of microns as measured LxW/2 (20/10 = no digs greater than 100um allowed).

Typical Scratch and Dig Specifications:

120/80	Defects are clearly visible in normal room lighting. This is generally a commercial specification for glass that will be exposed to further wear.
80/50	Defects are discrete but visible in normal room lighting. This specification is typical for commercial and non critical optical applications.
60/40	Defects are visible under fluorescent lighting (1.5K Lux). This specification is common for non-magnified optical applications.
40/20	Defects difficult to detect under fluorescent light and may require low-intensity halogen lamp (5K Lux). Typical optical applications.
20/10	Defects require Hi-Intensity halogen lighting to identify (10K Lux). Common specification for critical optical applications.
10/5	Defects require Hi-Intensity halogen lighting to identify (15K Lux or greater). Common specification for the most critical optical applications.

A scratch and dig spec can be written and inspection standard developed around any known requirements. The sample specifications listed above are intended to provide a general guideline and encompass the most commonly used values.

Customer Input Required: ☐ Yes ☑ No — Default Specification: 60/40

Light Condition

Intensity

Definition: Coresix uses a standard "K Lux" to describe the required light intensity for a given inspection criterion. Any existing or known light intensity such as foot candle, wattage, etc. can generally be converted to a K Lux standard. Once the standard is defined, the specification states "no defects visible with the unaided eye" under the specified *light intensity* , in the specified *position* and within the specified inspection *time* .

Typical Light Intensity Specification

1.5K Lux	Typically used to identify scratches beyond 60um wide and digs greater than 400um for low-end optical or high end industrial applications.
5K Lux	Typically used to identify scratches beyond 40um wide and digs greater than 200um for common optical applications.
10K Lux	Typically used to identify scratches beyond 20um wide and digs greater than 100um for high end optical applications.
15K - 50K Lux	Various collumated lighting used to identify defects to 1um for critical optical applications.

Customer Input Required ☐ Yes ☑ No Default Specification: 1.5K Lux

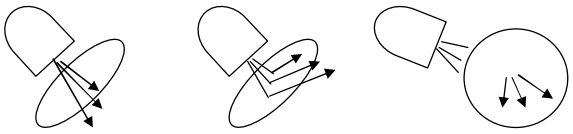
Position

Definition: The angle, distance and/or orientation of the glass being inspected to the light source.

Angle: The angle at which the part is held to the light source can influence the visibility of a defect. The specified angle may be driven by the final application (coatings to be applied, angle to be viewed, etc.) or to achieve maximum effectiveness. Unless otherwise specified, the angle will be defined by the standard to orientation.

Orientation: The orientation of the part to the light source can influence the visibility of a defect. The specified orientation may be driven by the final application or to achieve maximum effectiveness. Unless otherwise specified, the standard orientation of inspection will be transmissive.

Distance: The distnance of the glass from the light source is generally defined by the specified light intensity. However, under certain conditions it may be necessary to specify distance in conjunction with light intensity. If no specification is provided, distance from the light source will be defined by the specified light intensity.



Transmissive (standard 45o to surface) | Reflective (standard 45o to surface) | Edge Light (standard 90o to edge)

Customer Input Required ☐ Yes ☑ No Default Specification:

Time

Definition: The longer an inspector looks at a glass component under any condition, the more likely he or she is to identify defects. For production efficiency the specification is designed to identify the necessary cosmetic quality level in a minimal inspection time. Our standard inspection time averages 5-10 seconds per part

Customer Input Required ☐ Yes ☑ No Default Specification:

Cleanliness

Process: The standard cleaning procedure for most glass components produced at Coresix is a *Mechanical Scrub* followed by a ten stage *Ultrasonic Wash* which feeds directly into a class 100 *Optical Clean Room* .

Mechanical Wash: As a standard, glass components are scrubbed to remove heavy particulate such as glass residue from grinding operations, polishing compounds and other elements typically not effected by ultrasonics.

Ultrasonic Wash: Unless otherwise specified, all glass components less than 300mm diagonal are cleaned through our 10 stage Ultrasonic Line. The first and and third stages us an optical soap, the second and fourth through ninth are progressively filtered DI water rinses. The final stage is an IPA vapor bath which removes residual moisture from the parts.

Clean Room: Our optical clean room is a completely darkened environment for maximum effectiveness of the inspection lighting and is certified to class 100. All cleanliness and surface quality critical components are inspected and packaged within the clean room.

Spots and Stains

Definition: (see Webster) Any non particulate residue or pattern left on the surface of the glass after final preparation such as water spots, haze, streaks, etc.
Specification: Unless otherwise specified, the specification will

Customer Input Required ☐ Yes ☑ No Default Specification:

Particulate:

Definition: (see webster) Any debris which is external to the glass component. For our purposes, we consider non-temovable particulate as debris which can not be removed with an airgun.

Capabilities:

Customer Input Required ☐ Yes ☑ No Default Specification:

Edging

Definition: A grinding process performed to remove the sharp, raw edge of a glass component. Edging is done for various reasons including safety of handling, protection from chipping, promotion of cleanliness, improved dimensional tolerance and mechanical function.

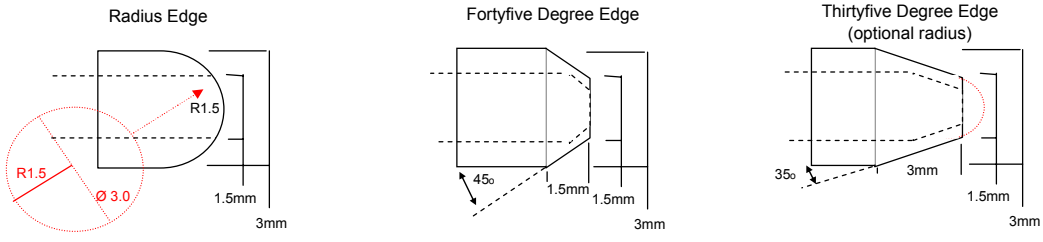
Edging Terms:

Bevel - generally describes a well defined size and angle to be ground on one or more edges. A bevel is usually specified for a cosmetic or functional purpose and requires a CNC or mechanical operation to achieve the required precision.
Ground or Milled Edge - refers to the processing of the entire edge (usually all edges of the part) including top, bottom, and sidewall through a CNC or Mechanical operation.
Chamfer - typically describes a uniform grind on the top and bottom of all edges with defined tolerances. Chamfers are most commonly applied with CNC grinding or other mechanical operation, though small components are "hand chamfered" on a grinding wheel.
Seam - is usually used to describe a less critical edge treatment - often a "safety seam" or "edge break" with the primary purpose to remove sharp edges.

Edging Process:

CNC Edging - performed on a precision CNC grinding station, this process is used for very tight control of the edge profile and tolerance as well as overall dimensional tolerances of the part. Standard or custom edge profiles can be applied to a wide variety of component shapes.
Hand Edging - performed by an operator on a grinding wheel, this method is used primarily for small parts or for economic application of noncritical edges.

Edge Profiles:

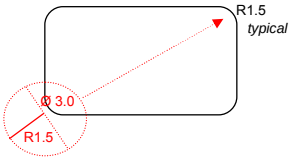


Edge Profiles illustrated with 3mm thickness and 1.5mm thickness for example only and can be applied to any thickness with some limitations below .5mm.

Customer Input Required			
	☐	Yes	
	☑	No	Default Specification: 45 Degree

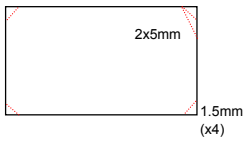
Corner Profiles:

Radius Corners



With CNC edge grinding stations, corners can be rounded to any prefered radius with a tolerance of +/- 0.20mm. Radius corners offer the best protection against chipping and breakage due to the elimination of sharp points.

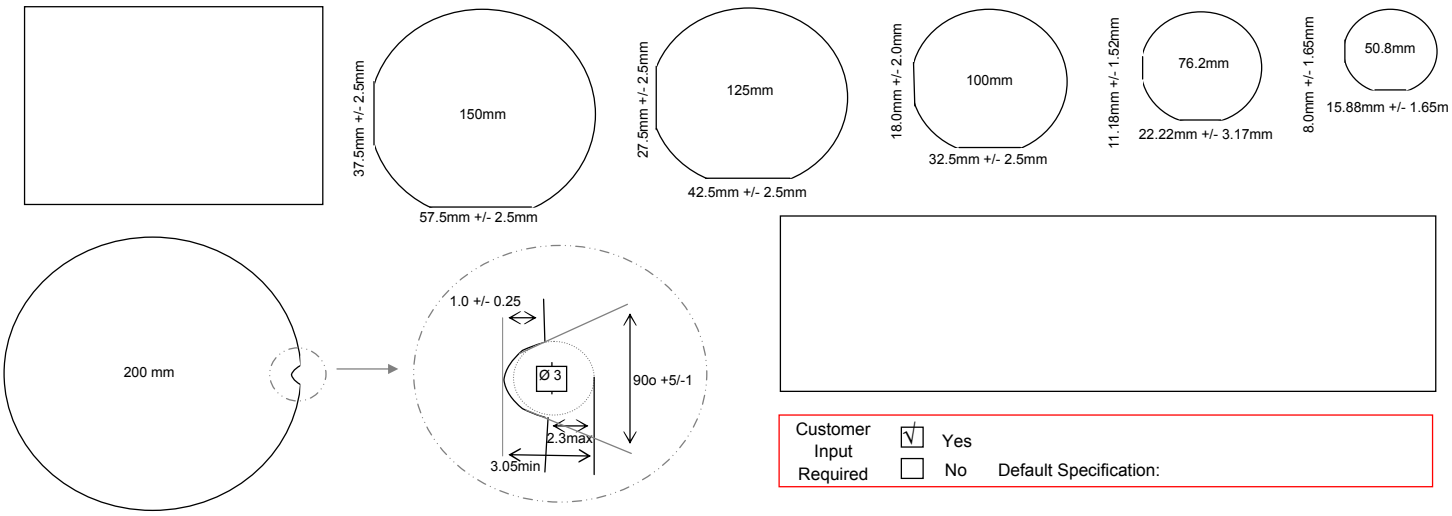
Fortyfive Degree Corners



A typical 45o corner "cut" or "dub" can be applied by CNC edging or by hand edging operations (tolerance depends on operation). An optional 2x5 or other odd corner can be applied for orientation purpose.

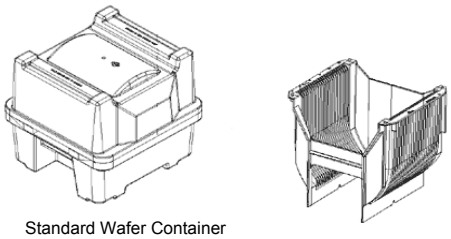
Customer Input Required			
	☐	Yes	
	☑	No	Default Specification: Dub (< 0.50mm @ 45 degrees)

Wafer Notches and Flats:



Customer Input Required			
	☑	Yes	
	☐	No	Default Specification:

Packaging



Standard Wafer Container

Type	Substrate Size			Cleanliness	Shape	Class 100 Compatible	Cost Effectiveness	
	Standards	Min.	Max.				Low Vol.	High Vol.
Box/Tissue	Flexible	20mm	150mm	Fair	Any	No	Good	Good
Box/Paper	Flexible	50mm	300mm	Poor	Rectangle	No	Excellent	Excellent
Crate/Paper	Flexible	200mm	1200mm	Poor	Rectangle	No	Good	Good
Nitto Tape	Flexible	20mm	400mm	Fair	Rectangle	Yes	Fair	Good
Shrink Wrap	Flexible	50mm	400mm	Fair	Any	No	Excellent	Excellent
Standard Containers	Standards	25mm	300mm	Excellent	Diameter	Yes	Fair	Fair
Custom Tray	Flexible	10mm	400mm	Excellent	Any	Yes	Poor	Good
Corner Protectors	Flexible	300mm	650mm	Good	Rectangle	Yes	Fair	Good
Choroplast Wrap	Flexible	30mm	300mm	Good	Rectangle	Yes	Fair	Fair