Quality Assurance

NOW

A. Glass

Glass specifications are developed by each major glass manufacturer to describe their specific products. Typically, these specifications cover areas such as surface quality, inclusions, edge quality, dimensions, and coating quality if applicable.

A copy of all applicable glass specifications should be obtained from your glass supplier and kept on file as part of this quality assurance program.

A copy of PPG's various specifications for its Glazing Select quality glass is included here for reference.

Flat Glass External Product Specification

Quality Assurance

FLAT GLASS TRADE EXTERNAL THICKNESS SPECIFICATION QA4.FGS.05.02 Revision #1								
Standard Thickness								
	Thickness Range (mm) Thickness Range (in)							
Thickness Designator	Low	High	Low	High				
2.1 mm	2.03	2.24	0.080	0.088				
2.3 mm	2.15	2.37	0.085	0.093				
2.4 mm	2.31	2.49	0.091	0.098				
2.5 mm	2.15	2.57	0.085	0.101				
2.7 mm	2.59	2.90	0.102	0.114				
3.0 mm	2.92	3.41	0.115	0.134				
3.1 mm	2.92	3.13	0.115	0.123				
DST	3.10	3.25	0.122	0.128				
3.4 mm	3.32	3.48	0.131	0.137				
3.6 mm	3.45	3.61	0.136	0.142				
3.9 mm	3.81	3.99	0.150	0.157				
4.0 mm	3.81	4.17	0.150	0.164				
4.1 mm	3.96	4.17	0.156	0.164				
4.9 mm	4.69	4.91	0.185	0.193				
5.0 mm	4.57	4.91	0.180	0.193				
5.5 mm	5.56	5.77	0.219	0.227				
6.0 mm	5.56	5.97	0.219	0.235				
6.2 mm	5.96	6.18	0.235	0.243				
10.0 mm	9.01	10.32	0.355	0.406				
12.0 mm	11.91	13.49	0.469	0.531				
16.0 mm	15.08	16.67	0.594	0.656				
19.0 mm	18.26	19.84	0.719	0.781				

Glazing Select Quality Glass Specification (Abridged)

Quality Assurance

For complete criteria see Specification QC-06-PFG-1d as criteria for individual characteristics may be different than those for grouped characteristics.

VISUAL

Acceptable Characteristics

Cut Size (C/S)	Glazing Selec	t (GL) Quality
Characteristic	≤35 sq. ft.	> 35 sq. ft.
Discrete Included	3/64"	1/16"
Discrete Surface	1/16"	1/16"
Intensity Surface	Medium	Medium
Draw Lines	45° VIA	90° VIA
Ream	45° VIA	90° VIA

Rejectable Characteristics

	Cut Size	Lehr End Uncut	Stock to Cut	Billet
Number Allowed	0	2 per Lite	1 per 100 sq.ft.	2 per Lite
Maximum Size	-	1/4"	1/4"	1/4"

Edge and Dimension

(For > 6.5 mm glass, see complete specification)

Characteristic		Cut Size	Lehr End Uncut	Stock to Cut	Billet
Bevel	≤3.5mm	1/32"	1/8"	1/32"	1/16"
	>3.5mm	1/16"	1/4"	1/16"	-
Corner	≤3.5mm	1/32"	1/4"	1/32"	1/8"
on/off	>3.5mm	1/16"	1/2"	1/16"	-
Flake	≤3.5mm	1/8"	1/4"	1/8"	1/4"
Chip	>3.5mm	1/4"	1/2"	1/4"	-
Flare	≤3.5mm	1/32"	1/8"	1/32"	1/16"
	>3.5mm	1/16"	1/4"	1/16"	-
Size	≤3.5mm	±1/32"	±1/4"	±1/32"	±1/8"
	>3.5mm	±1/16"	±1/4"	±1/16"	-
Square		Same as positive size			

[&]quot;Discrete Included Characteristics" include among others bubbles, knots and stones.

Adhesive Chip (ad chip) - A chip of glass that is fused or is adhering tightly to the surface of the glass.

Bevel - A deviation from a right angle break on a scored and severed glass edge.

Billet (Special Stock Size) - A piece of glass furnished for the purpose of selectively cutting into smaller lites of glass of a required quality grade.

Bubble - A round or elongated gaseous inclusion in the glass, sometimes partially emergent.

Characteristic - An imperfection or blemish; may range from a comparatively unimportant or unobtrusive condition to an important or obtrusive condition.

Corners On or Off - The angle formed by the intersection of two adjacent edge faces where either an excess or lack of glass can occur.

Crater Drip - The large type of "top speck" which appears as a circular spot of tin compound with or without halos, or as a patch of oxides on the top (atmosphere) surface of float glass.

Crush - A small lightly pitted area in the glass surface having a dull grayish appearance.

Cut Size - A piece of glass cut to the dimensions and edge condition characteristics to satisfy fabrication or end use needs.

Dig - A very short deep scratch or puncture in the glass surface.

Draw Lines - Slight surface variations in the form of ridges which run with the flow direction of the float ribbon and which cause interference of the vision when viewed at a sharp angle of sight.

Flake Chip - A shallow shell-like chip of glass removed from the glass surface at an edge. The width is the dimensional extent of the chip on the glass surface face measured from the intersection of the edge face and surface face planes.

Flare - A sharp thin extension of glass at a cut edge where the fracture tends to approach a plane parallel to the surface face.

Knot - A small transparent body of incompletely assimilated glass having an irregular or tangled appearance.

Lehr End Uncut - A piece of glass furnished for the purpose of selectively cutting into smaller lites of glass of a required quality grade.

Medium - Can not be seen beyond 76" when viewed by transmitted fluorescent lighting.

Ream - Included cords, layers or striae which are not homogeneous with the main body of the glass and which cause optical distortion.

Rub - An abrasion of the glass surface having appreciable width and a frosted appearance.

Scratch - A cut or tear in the glass surface that is narrow in width and typically shiny in appearance.

Size - The length and width dimensions of a lite of glass.

Square - A condition of rectangularity referencing the extent which any two adjacent edges of a rectangular lite of glass deviates from a 90° angle.

Stock to Cut - A piece of glass furnished for the purpose of selectively cutting into smaller lites of glass of a required quality grade on special cutting equipment such as the glass optimizers.

Stone - An opaque solid inclusion in the glass.

Tin Deposit - A small particle of metallic tin or oxide adhering to the surface of the glass.

VIA - Vision Interference Angle.



[&]quot;Discrete Surface Characteristics" include among others ad chips, digs, crater drips, crush and tin deposits.

[&]quot;Intensity Surface Characteristics" include among others rubs and scratches.

Glazing Select Quality Glass Specification (Abridged-Cont.)

Quality Assurance

Inspection Methods

1.0 Normal Inspection Method

1.1 Lighting or Environment

A light source consisting of two 20-watt 24" daylight type fluorescent tubes mounted horizontally 12" apart on a flat 30" x 40", background of Schoolboard #90 slate black color or equivalent. Multiples of this set up or larger simulations of it may be used to provide a more extensive background for inspection.

1.2 Procedure

The glass is inspected by looking through it at an angle of 90° normal to the surface with the observer's eye focused at least 36" beyond the glass. The light source is located 36" beyond the glass. This method is used to evaluate all flaws in accordance with Sections 2.1 and 2.2 unless an overriding inspection method or distance is specified.

2.0 Vision Interference Angle (VIA) Inspection Method

2.1 Equipment

A light source the same as for the Normal Inspection Method Section 1.1.

2.2 Procedure

The glass is positioned with the float lines horizontal and the glass is rotated about its horizontal axis. The glass is inspected by looking through it with the angle between the line of sight and the glass surface at the value stated in Sections 2.1 and 2.2 for the characteristic being examined. The observer's eye is located 36" from the glass with the light source 36" beyond the light. The glass must exhibit no readily perceptible interference with vision when examined in this manner.

3.0 Zebra Board Distortion Test

3.1 Equipment

A flat floodlighted board marked with alternate 1" black and white stripes which are angled at 45° from 7:30 o'clock to 1:30 o'clock. The board is located in a darkened area and illuminated to a level of 50 ± 10 foot-candles. A turntable equipped with a vertical mount for the glass and with a protractor which measures the degrees of arc through which the glass has been rotated. The turntable is located 15 feet from the zebra board and the observer is stationed 30 feet from the zebra board.

3.2 Procedure

For the evaluation of lines or general distortion, the glass is positioned vertically at right angle to the zebra board so that the protractor reads 90°. The glass is then rotated slowly counterclockwise while the observer watches the zebra stripes through the glass, using only one eye, until any apparent distortion of the stripes just disappears. The readout is the degrees of arc between the glass surface and the board surface at the position where the distortion disappeared.

4.0 Squareness Inspection Method

4.1 Equipment

A true 90° cutter's square with a long free leg.

4.2 Procedure

The glass is evaluated by positioning the square at one corner, using the long dimension as a base and checking the short dimension against the free leg in order to determine the deviation of that edge in inches either way from 90°. The other three corners are checked in the same manner.



Product Specification Coating Quality Criteria Sungate® 100 & Solarban® 60 Low-E Coated Glasses

Quality Assurance

1.0 Standard Inspection Method

The source of illumination used to detect the presence of coating flaws shall be a uniformly illuminated sky without direct sunlight. The observer is positioned at a distance of 36" from the glass and looks through the glass from the uncoated surface at an angle of 90° to the glass surface.

2.0 Quality Criteria

Given below are the quality criteria for those products which will be further selectively cut into cut size quality. The purchaser bears all responsibility for selecting cut size glass in conformance with the cut size quality. PPG assumes the purchaser practices selective cutting for the best utilization of the product.

The separation requirement stated in the tables is the requirement for a maximum size flaw. For flaws of smaller size, the minimum separation may be proportionately less, based on the larger of the two blemishes. The table below shows typical separation values.

Table 2.0 - Typical Separation

Coating Defect Size	Separation Must Be
1/16"	12"
1/32"	6"
1/64"	3"

2.1 Glass Quality per ASTM Standard C 1036: Specifications for Flat Glass, Glazing Select Cut Size Quality q3, sizes to 25 Square Feet, Central Area.

Coating Quality meets or exceeds ASTM Standard C 1376.

- 2.2 The scientific nature of controlling gas flow, electrical charges, and coating layer densities require production tolerances for light transmittance, reflectance, and color of coated glass products. Glass within allowable production tolerances may yield differences in reflected color or intensity of light transmittance or reflectance or both. Perceivable differences are not immediate cause for rejection.
- **2.3** Glass should be viewed as installed and from the exterior of the building for uniformity comparison. Coating nonuniformity may occur from lite to lite in a building. It may also occur within a lite in the form of edge-to-edge gradation, banding, mottling, or picture framing.
- **2.4** Nonuniformity is defined using DE*ab as defined in ASTM Test Method D 2244 for CIE 1976 L*a*b*, Illuminant D65, and 10° Observer. Allowable DE*ab for exterior reflectance shall be less than five within a lite or between adjacent lites to a reference target sample.
- **2.5** Design professionals and building owners should be aware that certain coated glass products will yield color differences when used in adjacent vision and spandrel area conditions and when used in laminated glass constructions or on different glass thickness.

2.6 Coating and visual quality

Continuous flaws such as ream, color streaks or lines which exceed the intensity permitted in 2.1 or in the following table 2.6, are not permitted.



Product Specification Coating Quality Criteria Quality Assurance Sungate® 100 & Solarban® 60 Low-E Coated Glasses (Cont.)



Table 2.6 - Coating and Visual Quality Requirements

Characteristic		Lehr End Uncut Glass	STC Glass	Cut Size Glass	Other
Coating Voids	1/16"	1/16"	1/16"	1/16"	12" separation
Coating Metallic Spots	1/16"	1/16"	1/16"	1/16"	for defects < 1/16" see table 2.0
Maximum number of glass & coating flaws	3	4	1	0	Number of permitted flaws that exceed the criteria above or that
Largest Flaw Size Permitted	1"	1"	1/4"	1/16"	for glass. Separation criteria does not apply.
Border Area - Residential <6.0 mm	3/8"	1"	3/8"	3/8"	Any flaw that does not adversely affect the function of the panel is permitted in these areas,
Border Area Commercial > or = to 6.0 mm	5/8"	1"	5/8"	5/8"	and is not a part of the "Maximum number of glass + coating flaws"
Scratches in Coating	None visible by the standard inspection method				

2.7 Edge and Dimensional Criteria

Characteristic		Cut Size	Lehr End Uncut	Stock to Cut	Billet	
Bevel	≤3.5mm	1/32"	1/8"	1/32"	1/16"	
	>3.5mm	1/16"	1/4"	1/16"	-	
Corner on/off	≤3.5mm	1/32"	1/4"	1/32"	1/8"	
	>3.5mm	1/16"	1/2"	1/16"	-	
Flake	<3.5mm	1/8"	1/4"	1/8"	1/4"	
Chip	>3.5mm	1/4"	1/2"	1/4"		
Flare	<3.5mm	1/32"	1/8"	1/32"	1/16"	
	>3.5mm	1/16"	1/4"	1/16"	-	
Size ≤3.5mm >3.5mm		<u>+</u> 1/32"	±1/4"	<u>+</u> 1/32"	<u>+</u> 1/8"	
		+1/16"	+1/4"	+1/16"	-	
Squa	re	Same as positive size				

B. Spacer Material

Quality Assurance



InterceptTM spacers may be roll formed from either electrolytic tin plated steel strip or stainless steel strip, and may be formed in two different heights:

Standard height (H=.300")

Low profile (H=.250")

Width may vary in increments of 1/32" from .218" for a 1/4" airspace, to .875" for a 29/32" airspace.

The lip dimension is constant for all sizes (L=.078").

The thermal conductivity of electrolytic tin plated steel is 332.8 BTU-in/hr./sq. ft./°F, which is about 70% less conductive than aluminum.

The thermal conductivity of type 201 stainless steel is 99.2 BTU-in/hr./sq. ft./°F, which is about 90% less conductive than aluminum.

Stainless Steel $Intercept^{TM}$ Spacer

Quality Assurance

	Standard Height Spacer	Low Profile Spacer			
 →>-	Air Space	Spacer	Spacer Finished Width (W) +/005	Slit Width +.000/005	Slit Width +.000/005
	1/4	7/32	0.219	0.882	0.782
	9/32	1/4	0.25	0.913	0.813
.300 +/005 Bearing Surface	5/16	9/32	0.281	0.944	0.844
<u> </u>	11/32	5/16	0.313	0.976	0.876
	3/8	11/32	0.344	1.006	0.906
	13/32	3/8	0.375	1.038	0.938
Standard Height Spacer	7/16	13/32	0.406	1.069	0.969
	15/32	7/16	0.438	1.101	1.001
v	1/2	15/32	0.469	1.131	1.031
	17/32	1/2	0.5	1.163	1.063
.250 +/005 Bearing Surface	9/16	17/32	0.531	1.193	1.093
	19/32	9/16	0.563	1.225	1.125
	5/8	19/32	0.594	1.257	1.157
	21/32	5/8	0.625	1.288	1.188
Low Profile Spacer	11/16	21/32	0.656	1.320	1.220
Stainless Steel	23/32	11/16	0.688	1.351	1.251
Type: 201 or 430 cold rolled strip	3/4	23/32	0.718	1.383	1.283
Temper: Annealed TWS Quality	25/32	3/4	0.75	1.413	1.313
Finish: #1 CBA Edge: #3 edge (ASTM-A480),burr free	13/16	25/32	0.781	1.445	1.345
Coil Size: 16" I.D. 36" O.D. max.	27/32	13/16	0.813	1.475	1.376
Coil Weight: 230 # approx.	7/8	27/32	0.844	1.507	1.407
Linear Ft./coil: 6900 ft. approx.	29/32	7/8	0.875	1.538	1.438

Electrolytic Tin Plated Steel $Intercept^{TM}$ Spacer

Quality Assurance

				Ctandard Usiaht	Low Profile
				Standard Height Spacer	Low Profile Spacer
 v	Air Space	Spacer	Spacer Finished Width (W) +/005	Slit Width +.000/005	Slit Width +.000/005
	1/4	7/32	0.219	0.862	0.762
	9/32	1/4	0.250	0.893	0.793
.300 +/005 Bearing Surface	5/16	9/32	0.281	0.924	0.824
	11/32	5/16	0.313	0.956	0.856
Dutside Wall or Surface	3/8	11/32	0.344	0.986	0.886
	13/32	3/8	0.375	1.018	0.918
Standard Height Spacer	7/16	13/32	0.406	1.049	0.949
	15/32	7/16	0.438	1.081	0.981
L	1/2	15/32	0.469	1.111	1.011
	17/32	1/2	0.500	1.143	1.043
Bearing Surface	9/16	17/32	0.531	1.173	1.073
	19/32	9/16	0.563	1.205	1.105
	5/8	19/32	0.594	1.237	1.137
	21/32	5/8	0.625	1.268	1.168
Low Profile Spacer	11/16	21/32	0.656	1.300	1.200
Single Reduced Electrolytic Tin Plated Steel	23/32	11/16	0.688	1.331	1.231
Weight: 95# per base box,.0105" Thk. Temper: T-4(AIM 58-64 RW 30-t)	3/4	23/32	0.718	1.363	1.263
Continuous Annealing Process Finish: #5 finish (AIM 45+/-15 microinches)	25/32	3/4	0.750	1.393	1.293
Coating: .25# Matte electrolytic (non- reflow) Oil Level: ATBC oil level 1 or minimum	13/16	25/32	0.781	1.425	1.325
Chemtreat: CDC-5 450+/-100 microinches/sq.ft.	27/32	13/16	0.813	1.455	1.356
Edge: Burr free Coil Size: 16" I.D. 36" O.D. max. Coil Weight: 230 # approx.	7/8	27/32	0.844	1.487	1.387
Linear ft./coil: 6900 ft. approx. Coil skidded: 2500# Max.	29/32	7/8	0.875	1.518	1.418

C. Desiccated Matrix

Quality Assurance



The desiccant for Intercept® IG units combines adhesive technology with desiccant powder technology to form a desiccated matrix which adheres to the Intercept™ spacer and keeps the IG air space dry. Matrix materials were developed specifically for this application.

At the present time, the following desiccated matrix products have been used successfully in Intercept® IG units.

Insul DriTM Hot Melt Matrix

HL-5102-A

Insul DriTM Warm Melt Matrix

HL-5157

Insul DriTM Ambient Applied Matrix

TL-5042M

PhonosorbTM MTXTM P-350

AdcothermTM Desiccated Matrix

Courtaulds 525 DM-60 Desiccated Matrix

A copy of all current product technical data sheets should be obtained from your matrix supplier and kept on file as part of this quality assurance program.

Insul Dri is a trademark of H. B. Fuller Company

Phonosorb and MTX are trademarks of Grace Davison

Adcotherm is a trademark of ADCTM Products, Inc.

D. Sealants

Quality Assurance

For long-term IG unit durability, IG sealants must be chemically compatible with glass coatings, spacers, desiccating materials, and all materials with which they come in contact after being installed into a window frame or sash. In addition, sealants must exhibit proper adhesion to glass and spacer surfaces.

Proper selection and specification of sealants for your specific product must be a joint effort among all of your material suppliers.

Individual material specifications and properties must be obtained and reviewed. Adhesion properties must be verified by testing as recommended by your sealant supplier/s. Glass coating edge deletion requirements must be established either by recommendation from your glass supplier or through testing by your sealant supplier/s.

It should be kept in mind that different edge seal systems will provide different IG unit durabilities and performances. The IG manufacturer should consult with sealant manufacturers to determine which seal system meets its needs in the marketplace.

Once a sealant system is selected, a copy of all applicable product and technical data sheets should be obtained from your sealant supplier and kept on file as part of this quality assurance program.

IG Edge Seal System Types

Single Seal

Single seal systems use only one sealant type on both sides and the back of the spacer, typically hot melt butyl.

Dual Seal

Dual seal systems use two different sealants, usually PIB on the spacer sides, and either polysulfide or polyurethane on the spacer back. Silicone may also be used as a back sealant, but it's high MVTR

must be considered.

DSE

DSE is a single sealant system which provides structural performance equivalent to, and in some cases better than that of dual seal systems. DSE sealants are chemically curing materials, which gives them high strength and structural durability.



E. Closure Connector/Gas Fill Plug

Quality Assurance

The following fasteners may be used for both tin plated steel and stainless steel spacers:

1. Closed-end sealing rivet without gaskets.

Sizes: 3mm and 4mm



2. Pan head steel type C screw with preapplied sealant.

Sizes: .125 and .171





F. Muntin Bars and Clips

Quality Assurance



Muntin bar clips have been developed to allow the use of a variety of commercially available standard muntin bar styles and types.

The clips are injection molded of virgin, prime grade nylon, and have been tested and approved for use in Intercept® IG units.

Since outgassing and evaporation from certain polymers, paints, lubricants, and other contaminants in and on muntin bars, can create visual obstruction on both coated and uncoated glass, it is suggested that fog testing be performed to verify the suitability of a specific muntin bar/clip combination before adopting its use.

For a list of available types and sizes of muntin clips for Intercept, contact Ashland Products.

Ashland Products 790 W. Commercial Ave. Lowell, Indiana 46356 Ph. 219-696-5950

G. IG Edge Seal

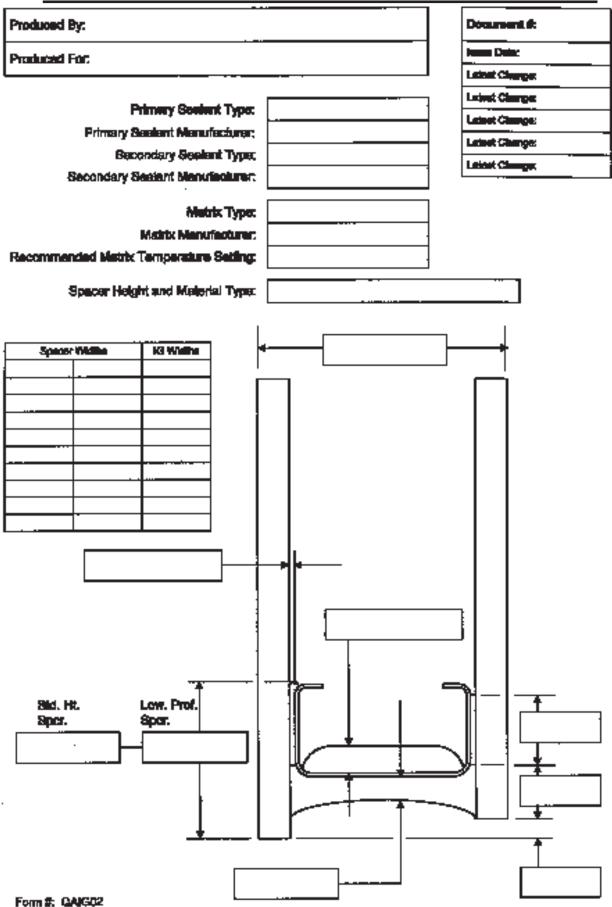
Quality Assurance



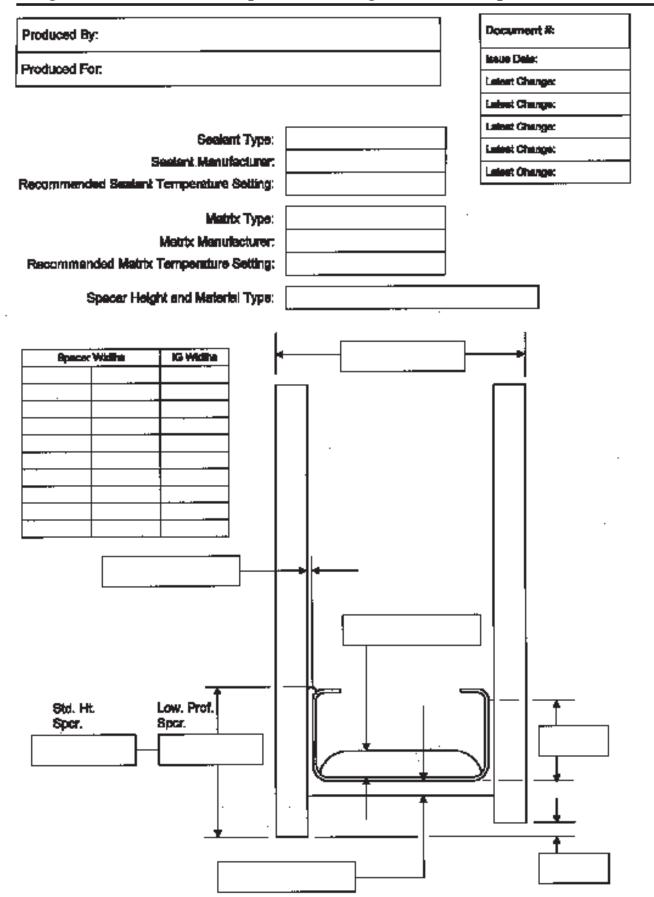
The attached worksheets can be used to record specific data about the product/s you are producing or plan to produce. One is for dual seal, and the other is for single seal or DSE IG units, plus there is a completed sample sheet to show you the type of data to include. When filled in, these forms will be a good quick reference to the specifics of the edge seal configuration of your product/s.

Dual seal, single seal, and DSE guide specifications are also included.

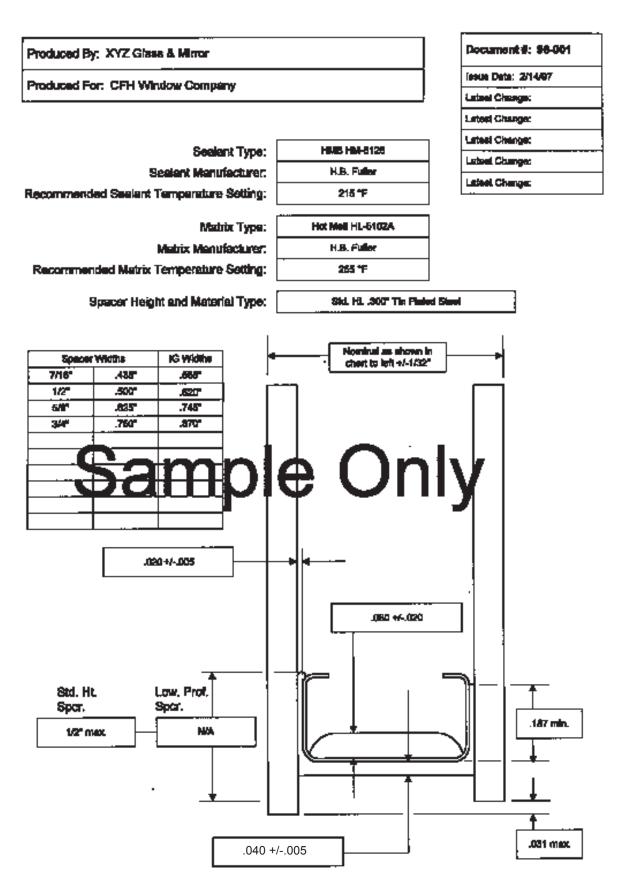
 $Dual Seal \textit{Intercept}^{\circledR} Insulating Glass Unit Specification$



Single Seal / DSE Intercept® Insulating Glass Unit Specification



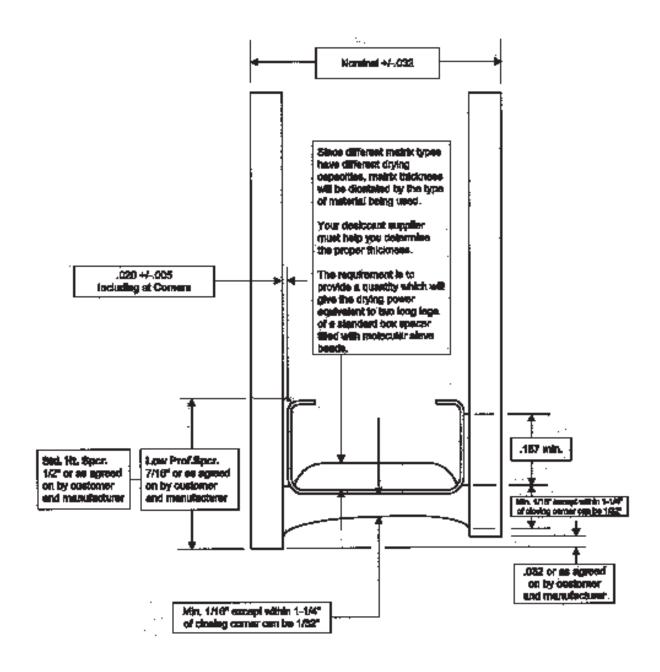
Form #: QAIGO1



Form #: QAIG01

Dual Seal Intercept® Insulating Glass Unit Guide Specification

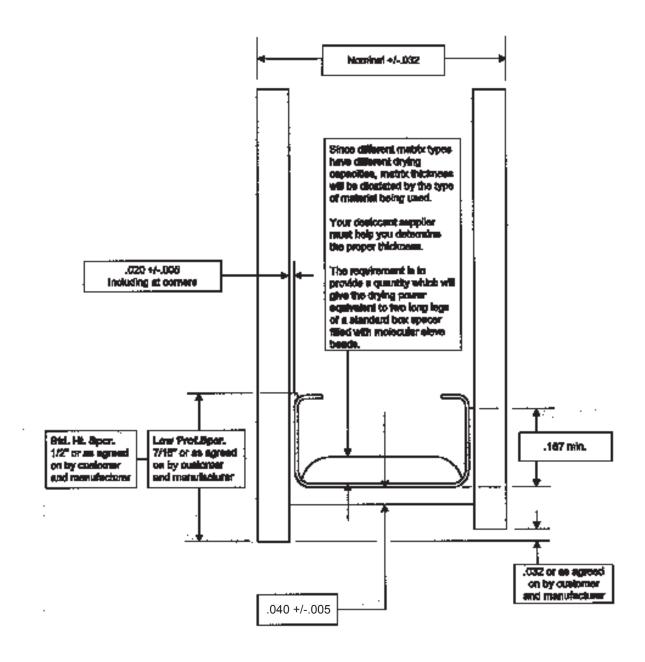
Quality Assurance



The above specification is presented as a guide for creating your own internal insulating glass unit specification. You may wish to vary the given dimensions slightly to fit your specific glazing conditions. However, if a dimension is shown as "min." you should not go below the minimum dimension shown.

Single Seal and DSE Intercept® Insulating Glass Unit Guide Specification

Quality Assurance



The above specification is presented as a guide for creating your own internal insulating glass unit specification. You may wish to vary the given dimensions slightly to fit your specific glazing conditions. However, if a dimension is shown as "min." you should not go below the minimum dimension shown.