M&M GLASS COMPANY

STANDARD PRODUCT SPECIFICATIONS FOR TEMPERED GLASS WHEN APPLIED IN SHOWER ENCLOSURE APPLICATIONS

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The information provided in this document represents the expected quality specifications for tempered glass when used in the manufacturing of shower enclosures. It includes how to correctly apply these standards physically and visually in consideration of the enclosure application. All shower enclosure glass is safety tempered per ANSI Z97.1 and SGCC 2144 specifications. These specifications meet or exceed American Society for Testing and Materials (ASTM) as shown below.

1. DIMENSIONAL TOLERANCE

Glass Size and Dimensional Tolerance per ASTM C 1048. *(Reference Table 1)* Specialized machining is necessary for providing the desired finished size and edge preparation of glass used in shower enclosure applications.

TABLE 1 — **TOLERANCE FOR LENGTH & WIDTH DIMENSIONS**

ASTM C 1048

Glass Thickness	Finished Size Tolerance	
	Plus – or – Minus	Total
(inches)	*(inches)*	*(inches)*
3/16”	1/16”	1/8”
1/4"	1/16”	1/8”
3/8”	3/32”	3/16”
1/2"	1/8”	1/4"

M&M GLASS COMPANY STANDARD Finished Size Tolerance			
Standard Application			
Plus 0” - Minus			
(inches)			
1/16”			
1/16”			
3/32”			
1/8”			

- TOLERANCE APPLICATION:
  - M&M Glass Standard is plus 0” – minus 1/16”
    - ***Example:*** Glass = 28” x 72” • Tolerance = 27 15/16” to 28” x 71 15/16” to 72”
- INSPECTION PROCEDURE:

  Glass is measured using a properly calibrated measuring tool such as a measuring tape. The measuring tape is placed adjacent and parallel to the glass surface while viewing the glass edge at 90° to the glass surface. Measuring tool must be positioned across surface at 90° to the edge of the glass.

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2. BOW TOLERANCE

Glass Bow Tolerance per ASTM C 1048. (*Reference Table 2*)

9.4 Flatness – Due to the nature of the processes used in manufacturing tempered glass, it is not as flat as annealed glass. The deviation in flatness depends on thickness, width, length, a corner notch, size of corner notch as relates to the whole, size of leg created by a corner notch as relates to the whole, and other factors.

TABLE 2 ASTM C 1048	Overall Bow & Warp Maximum									
Largest Dimension	0 - 20"	>20" - 35"	>35" - 47"	>47"- 59"	>59" - 71"	>71" - 83"	>83"- 94"	>94"-106"	>106"-118"	>118"-130"
Glass Thickness	Maximum Bow and Warp • Inches									
3/16"	.12"	.16"	.20"	.28"	.35"	.47"	.55"	.67"	.75"	...
1/4"	.08"	.12"	.16"	.20"	.28"	.35"	.47"	.55"	.67"	.75"
5/16"	.08"	.08"	.12"	.16"	.20"	.24"	.31"	.39"	.51"	.59"
3/8"	.08"	.08"	.08"	.16"	.20"	.24"	.28"	.35"	.47"	.55"
1/2" – 7/8"	.04"	.08"	.08"	.08"	.16"	.20"	.20"	.28"	.39"	.47"

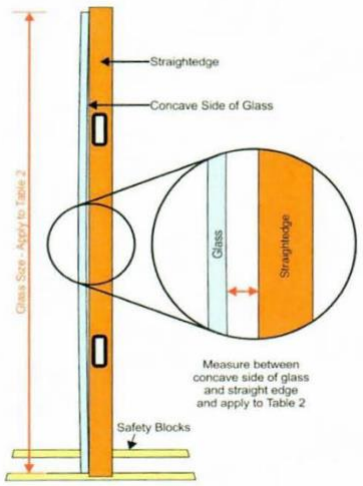
TABLE 2 M&M GLASS STANDARD	Overall Bow & Warp Maximum									
Largest Dimension	0 - 20"	>20" - 35"	>35" - 47"	>47"- 59"	>59" - 71"	>71" - 83"	>83"- 94"	>94"-106"	>106"-118"	>118"-130"
Glass Thickness	Maximum Bow and Warp • Inches									
3/16"	.12"	.16"	**.188"**	**.188"**	**.188"**	**.250"**	**.313"**	**.375"**	**.438"**	**...**
1/4"	.08"	.12"	.16"	**.188"**	**.188"**	**.188"**	**.250"**	**.313"**	**.375"**	**.438"**
5/16"	.08"	.08"	.12"	**.125"**	**.125"**	**.125"**	**.188"**	**.250"**	**.313"**	**.375"**
3/8"	.08"	.08"	.08"	**.125"**	**.125"**	**.125"**	**.188"**	**.250"**	**.313"**	**.375"**
1/2" – 7/8"	.04"	.08"	.08"	**.125"**	**.125"**	**.125"**	**.188"**	**.250"**	**.313"**	**.375"**

◇ INSPECTION PROCEDURE:

- Place sample glass in a freestanding vertical position, resting safely on blocks at the quarter points.
- With the glass in this position, place a straightedge across the concave surface, parallel to and within 1 in. (25.4mm) of the edge. Be careful to allow the straightedge to contact the glass only at each end and apply no pressure that will distort the natural position of the freestanding glass in relation to the straightedge.
- Measure the gap between the straightedge and the glass to determine actual physical bow. Apply this dimension to the charted info in **Table 2.** (*See Illustration A*).

Note: Mounting hardware and surface conditions can contribute to actual physical bow. Glass cannot be properly inspected while secured by hardware.

Illustration A



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3. SURFACE & VISUAL IMPERFECTIONS

The primary function of glass used in a shower enclosure is to assist in directing water toward the drain. While shower enclosures are intended to enhance the beauty and style of the shower or bathing area, glass is intended to be looked through, not looked at. Tempered glass will have visual imperfections as a result of the processes necessary to fabricate and safety temper. For these same reasons, larger size glass will have a higher percentage of allowed imperfections.

The following information provides guidelines for correctly identifying acceptable and unacceptable visual imperfections. Surface and visual imperfections allowed per *ASTM C 1036 - Classification Quality - Q3*. Including scratches, rubs/scuffs, digs, pits, stones, knots, dirt, inclusions, shell chips, etc.

6.1.1 Viewing conditions for blemish detection – All visual inspections shall be made with 20/20 vision (naked eye or corrected). Place samples in the vertical position at the distance specified in the sections to follow. The viewer shall look through the sample at an angle of 90° (perpendicular) to the surface using the following lighting unless otherwise specified: daylight (without direct sunlight) or other uniform diffused background lighting that simulates daylight, with a minimum luminance of 1700 lux (160 foot-candles) measured at the surface of the glass facing the light source.

3.2.3 blemish, n — imperfection in the body or on the surface of the glass; for the purpose of this specification, blemishes are divided into two categories:

3.2.3.1 linear blemish, n — scratches, rubs, digs, and other similar imperfections.

3.2.19 scratch, n — damage on a glass surface in the form of a line caused by the movement of an object across and in contact with the glass surface.

3.2.18 rub/scuff, n — abrasion of a glass surface producing a frosted appearance.

3.2.9 dig, n — deep, short scratch

3.2.3.2 - point blemish, n — knots, dirt/pitting, stones, crush, gaseous inclusions, and other similar imperfections.

3.2.14 knot, n — homogeneity in the form of a vitreous lump.

3.2.10 dirt/pitting, n — small particle of foreign matter embedded in the surface of flat glass.

3.2.22 stone, n — crystalline inclusion in glass

3.2.7 crush, n — lightly pitted condition with a dull gray appearance

3.2.13 gaseous inclusion, n — round or elongated bubble in the glass.

◇ INSPECTION PROCEDURE:

Linear Blemish (*scratches, rubs, digs, and other similar imperfections*) Glass is to be inspected in a vertical position and viewed at 90° to the glass surface with light conditions as stated above in **6.1.1.** Begin viewing glass at a distance approximately 132" (3.3m) and slowly move forward until a blemish (if any) is detected. The distance from the viewer to the glass surface is defined as the detection distance. Apply the detection distance to **Table 3** to determine if the blemish is allowed.

TABLE 3 — Allowable Linear Blemish Size & Distribution

Detection Distance	Linear Blemish Size		Quality Q3 Distribution	Detection Distance	Linear Blemish Size		Quality Q3 Distribution
	Intensity	*Length*			*Intensity*	*Length*	
>132”	Heavy	<6”	None Allowed	90” to 40”	Medium 1	<3”	Allowed with min. separation of 24”
132” to 90”	Medium 2	>6”	None Allowed	40” to 8”	Light	>3”	Allowed with min. separation of 30”
132” to 90”	Medium 2	<6”	Allowed with min. separation of 18”	40” to 8”	Light	<3”	Allowed
90” to 40”	Medium 1	>3”	Allowed with min. separation of 18”	<8”	Faint	>3”	Allowed

◇ For glass ≥ 45 sq. ft. the Detection Distance is increased by 25%

◇ For glass ≥ 55 sq. ft. the Detection Distance is increased by 45%

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◇ INSPECTION PROCEDURE:

Point Blemish (*knot, dirt/pitting, stone, crush, gas inclusion, and other similar imperfections*) Glass is to be inspected in a vertical position and viewed at 90° to the glass surface with light conditions as stated above in **6.1.1.** at the distance of 39" (1m). If a blemish is detected, refer to **Table 4** to determine if the blemish is allowed.

Point Blemish size shall be determined by measuring the maximum length and perpendicular width of the blemish and calculating the average of the two dimensions.

TABLE 4 — Allowable Point Blemish Size & Distribution

1/4" GLASS		3/8" GLASS		1/2" GLASS	
Blemish Size *inches*	**Quality Q3 Distribution**	**Blemish Size** *inches*	**Quality Q3 Distribution**	**Blemish Size** *inches*	**Quality Q3 Distribution**
≥ .03 < .05	Allowed	≥ .05 < .08	Allowed	≥ .06 < .10	Allowed
≥ .05 < .06	Allowed with min. separation of 30"	≥ .08 < .09	Allowed with min. separation of 30"	≥ .10 < .12	Allowed with min. separation of 30"
≥ .06 < .08	Allowed with min. separation of 24"	≥ .09 < .12	Allowed with min. separation of 24"	≥ .12 < .16	Allowed with min. separation of 24"
≥ .08 < .10	None Allowed	≥ .12 < .15	None Allowed	≥ .16 < .20	None Allowed

3.2.20 shell chip, n — circular indentation in the glass edge as a result of breakage of a small fragment out of an otherwise regular surface.

3.2.4 chip depth, n — measured distance of a chip from the face of the glass into the thickness.

3.2.5 chip length, n — distance parallel to the edge of the glass from one edge of a chip to the other.

3.2.6 chip width, n — perpendicular distance from the edge of the glass to the inner edge of the chip.

◇ INSPECTION PROCEDURE: *(Reference Table 5)*

- Depth measured from glass surface to bottom of void.
- Lenth measured along the glass edge.
- Width measured from glass edge at 90°.

TABLE 5 — Allowable Shell Chip Size

STRUCTURAL APPLICATION

Description	Quality 3			
	3/16"	1/4"	3/8"	1/2"
Chip Depth	≤ 3/32	≤ 1/8	≤ 3/16	≤ 1/4
Chip Length – *Along Edge*	≤ 1/4	≤ 1/4	≤ 3/4	≤ 1
Chip Width – *From Edge*	≤ 1/2	≤ 1/2	≤ 3/8	≤ 1/2

VISUAL APPLICATION

Description	Quality 3							
	3/16"		1/4"		3/8"		1/2"	
	Seamed	PFE	Seamed	PFE	Seamed	PFE	Seamed	PFE
Chip Depth	≤ 3/32	≤ 3/32	≤ 1/8	≤ 1/8	≤ 3/16	≤ 3/16	≤ 1/4	≤ 1/4
Chip Length – *Along Edge*	≤ 1/2	≤ 1/4	≤ 1/2	≤ 1/4	≤ 5/8	≤ 5/16	≤ 5/8	≤ 5/16
Chip Width – *From Edge*	≤ 1/4	≤ 1/8	≤ 1/4	≤ 1/8	≤ 5/16	≤ 5/32	≤ 5/16	≤ 5/32