Tolerances in the Dimension Stone Industry

An excerpt from the *Dimension Stone Design Manual*,
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TOLERANCES IN THE DIMENSION STONE INDUSTRY

1.0 Nothing in manufacturing, construction, or commerce is exact. Whether it's the weight of a product purchased at the market, the concentration of a chemical solution, or the length of a stone panel, none of them will measure exactly what they are specified to measure. More sophisticated methods, machines and controls will produce results with lesser amounts of error, yet no techniques will produce exact results. For these reasons, all things must have a tolerance, which is an allowable deviation from a specified, or designed value. In some cases, like the machining of critical machine parts, that allowable deviation may be so small that it is measured in micro-inches or microns. While the stone industry does not have tolerances requiring this level of precision, there exist critical dimensions that directly affect visual appearance and structural integrity of stone installations.

1.1. Tolerances are established to protect both the buyer and seller of a product or service. The buyer is protected by knowing that the workmanship must result in products that fall within the range of the prescribed tolerances. The seller is protected by having an accepted variation from the specified values or measurements, so as not to be held to unattainable expectations.

1.2. Units of measure in this document are expressed on both United States Customary Units and SI units. The values stated in each system are not exact equivalents of each other, as the conversions have been "rationalized" to provide rounded, convenient numbers in both systems. Each system of measurement shall be used exclusively and independently of the other, as combining values from both systems may result in incompatibilities.

2.0 Tolerances should not be confused with the difference between nominal and actual dimensions. Perhaps the best known example of nominal dimensions exists in the dimension lumber industry, where the common 2 by 4 does not measure 2 inches by 4 inches, but instead has an actual cross-section of 1½ inches by 3½ inches. A similar situation exists in stone supply, where a nominal paver size of 12 inches by 24 inches might have an actual size of 11¾ inches by 23¾ inches, allowing for ¼ inch joints while still maintaining a 12 inch by 24 inch installed grid. The fabrication tolerances in these cases, would be applied to the actual dimensions, and not the nominal.

3.0 There are several different types of tolerance expressions:

3.1. Bilateral Tolerance. This is the most frequently encountered type of tolerance in the stone industry. A bilateral tolerance is one that expresses an allowable deviation that can be either greater or lesser than the desired value. These are often referred to as "plus or minus" tolerances.

3.1.1. Bilateral tolerances are usually symmetrical. A **symmetrical bilateral** tolerance is one that allows the same amount of deviation for both greater and lesser than the target value. For instance, considering a 1¼" (30 mm) thick slab, a tolerance of plus or minus ⅛" (3 mm) is considered to be a symmetrical bilateral tolerance. Most often these types of tolerances are expressed using the "±" symbol, and would be written as ±⅛", or ±3 mm.

3.1.2. Some bilateral tolerances are asymmetrical. An **asymmetrical bilateral** tolerance is one that describes a condition where the actual value is allowed to deviate both greater and lesser than the specified, but not to the same extent. For instance, the depth of a continuous kerf is allowed to be either deeper or shallower than specified, but it is only allowed to be $^{1}/_{16}$" (1.5 mm) shallower,

while it is allowed to be ⅛" (3 mm) deeper. This would be an asymmetrical bilateral tolerance, and is expressed as -1/16", +⅛" (-1.5, +3 mm).

3.2. Unilateral Tolerance. This term is used where deviation is allowed only in one direction. For example, the depth of a back anchor is allowed to be 1/16" (1.5 mm) deeper than specified, but never shallower. This tolerance is expressed as -0, +1/16" (-0, +1.5 mm).

3.3. Limit tolerances are those that simply prescribe the minimum and maximum dimensions allowable, without defining an actual target dimension. This method is sometimes referred to as a "Go – No Go" expression. A limit tolerance would typically be written as "1⅛" min, 1⅜" max". Limit tolerances are infrequently used in the stone or construction industries.

3.4. Percentage tolerances are sometimes used when the allowable deviation varies with the value of the target dimension. Percentage tolerances can be either bilateral or unilateral, and simply state the percentage of variation that is acceptable. These types of tolerances are most often used for things that affect visual characteristics only. For example, one's eye may be able to detect an error in the width of a ⅛" (3 mm) joint when it approaches 1/32" (0.8 mm), but on a ½" (12 mm) joint, the error would need to be much greater to be visually detectable. Stating that the allowable tolerance is ±25% is a simple way of having a self-adjusting tolerance which gets larger as the specified dimension gets larger.

3.5. Percentage tolerances are frequently coupled with an absolute dimensional limit, either a maximum or a minimum. Such limits are typically referred to as "Not Less Than" (NLT) or "Not to Exceed" (NTE). These limits are used when the percentage tolerance represents a very small or very large tolerance at either end of the target value range. Joint width variation, for example, is allowed to be ±25%. But that would mean that a stone setter working with 1/16" joints has an acceptable variation of only 1/64", which would be unattainable in most scenarios. To address this, the tolerance is expressed as ±25%, NLT 1/32". This means that the setter is allowed to have joint widths that are 25% larger or smaller than the specified, but in no case shall he/she be held to a tolerance of less than ±1/32".

3.6. The same tolerance can be communicated by writing it as a bilateral, unilateral, or limit tolerance. The only difference is the format of the expression. For example, the five examples below describe exactly the same allowable range of dimension:

Examples of Tolerance Formatting Differences

Tolerance Type	Unit of Measure	SI Equivalent
Bilateral (symmetrical)	1¼" ±⅛"	30 ±3 mm
Bilateral (asymmetrical)	1 3/16" -1/16", +3/16"	29 -2,+4 mm
Unilateral	1⅛" -0, +¼"	27 -0, +6 mm
Limit	1⅛" min, 1⅜" max	27 mm min, 33 mm max
Percentage	1¼" ±10%	30 mm ±10%

5.0 Measurement of stone units to determine compliance with published tolerances shall be done with instruments that are appropriate for the level of precision required. A common tape measure is adequate for most dimension checks, but when a feature must be measured to fine degrees of accuracy, a caliper or feeler gauge may be necessary. All instruments used for measuring should be calibrated, or checked for accuracy, prior to use. Normal usage of a tape measure, for example, will frequently result in the loosening or bending of the end hook, which will produce significant errors in linear measurements.

6.0 Applicability of this Document.

6.1. There are a variety of sources from which stone fabrication and installation tolerances can be obtained. This document was cross-referenced with tolerances published by a variety of organizations. While most of the published tolerances are in agreement or exhibit only slight differences, some conflicts may exist between this document and those published by other organizations.

6.2. This document is considered to be a voluntary standard. It has been drafted and reviewed by industry stakeholders and represents a consensus opinion of industry participants. When specified as the enforceable standard, it becomes part of a binding agreement.

6.3. When no document has been specified to govern the tolerances of a stone project or a stone purchase, this document, by default, may be cited as the appropriate industry standard for those products.

6.4. More or less stringent tolerances may be specified or adopted for any particular product or purchase. When alternate tolerances have been agreed upon between the buyer and seller, those tolerances supersede the tolerances listed herein.

6.5. The natural stone industry works with a nearly limitless variety of products in a nearly limitless variety of installation methods. Extreme circumstances may exist for which the tolerances listed herein are either not appropriate or not attainable. Tolerances for such conditions shall be established on a project specific basis.

7.0 A chart of stone fabrication, installation, and substrate condition tolerances is provided following these pages.

8.0 Some of the tolerance expressions included in the chart require a graphic to ensure correct and uniform interpretation. These graphics are provided immediately following the chart in drawing D-22-1.

NOTES:

STONE INDUSTRY TOLERANCES

SECTOR	ISSUE	ITEM	TOLERANCE	
FABRICATION	Thickness	Thickness ranging from $^{1}/_{4}$" to $^{5}/_{8}$" (6 mm to 15 mm) with Smooth Finishes sold as "Calibrated"	±$^{1}/_{32}$"	±0.8 mm
		Thickness ranging from $^{1}/_{4}$" to $^{5}/_{8}$" (6 mm to 15 mm) with Flame or Textured Finishes sold as "Calibrated"	Depth of Finish Relief, NTE $^{1}/_{8}$"	±1.5 mm
		Thickness ranging from >$^{5}/_{8}$" to 1¼" (>15 to 30 mm) with Smooth Finishes	±$^{1}/_{8}$"	±3 mm
		Thickness ranging from >$^{5}/_{8}$" to 1¼" (>15 to 30 mm) with Flamed or Sanded Finishes	Depth of Finish Relief, NTE $^{3}/_{16}$"	Depth of Finish Relief, NTE 5 mm
		Thickness ranging from >$^{5}/_{8}$" to 1¼" (>15 to 30 mm) Finished 2 Faces with Smooth Finishes	±$^{1}/_{16}$"	±1.5 mm
		Slab thickness of >1¼" to 2" (>30 to 50 mm)	±$^{1}/_{8}$"	±3 mm
		Slab thicknesses over 2" (>50 mm)	±$^{1}/_{4}$"	±6 mm
	Face Size	Face Dimension of Calibrated Tiles (see graphic)	±$^{1}/_{32}$"	±0.8 mm
		Face Dimension of Pieces with Lengths up to 6'-0" (2 m) (see graphic)	±$^{1}/_{16}$"	±1.5 mm
		Face Dimension of Pieces with Lengths > 6'-0" (2 m) and Areas ≤ 50 ft² (5 m²) (see graphic)	±$^{3}/_{32}$"	±2.5 mm
		Face Dimension of Pieces with Areas > 50 ft² (5 m²) (see graphic)	±$^{1}/_{8}$"	±3 mm
	Squareness	Maximum Deviation from Square - Calibrated Tiles (see graphic)	Governed by Face Dimension Tolerance - See Graphic	
		Maximum Deviation from Square - Cut-to-Size Dimension Stone (see graphic)	Governed by Face Dimension Tolerance - See Graphic	
		Perpendicularity Error of Edge to Face, Exposed Edge with Smooth Finish	±1.0° (about $^{1}/_{64}$" per in)	±1.0° (about 0.18 mm in 10 mm)
		Perpendicularity Error of Edge to Face, Concealed Edge with Smooth Finish	±2.0° (about $^{1}/_{32}$" per in)	±2.0° (about .35 mm in 10 mm)
	Flatness	Maximum Deviation from Flat Plane - Calibrated Tile with Smooth Finish	±$^{1}/_{32}$" in 2'-0"	0.8 mm in 600 mm
		Maximum Deviation from Flat Plane - Back Surface of Calibrated Tile	±$^{1}/_{32}$" in 2'-0"	0.8 mm in 600 mm
		Maximum Deviation from Flat Plane - Cut-to-Size Dimension Stone with Smooth Finish	±$^{1}/_{16}$" in 4'-0"	±1.5 mm in 1.2 m
		Maximum Deviation from Flat Plane - Cut-to-Size Dimension Stone with 4-Cut, 6-Cut, 8-Cut Finish	±$^{1}/_{8}$" in 4'-0"	±3 mm in 1.2 m
		Maximum Deviation from Flat Plane - Cut-to-Size Dimension Stone with Flamed or Coarse Stipple Finish	±$^{3}/_{16}$" in 4'-0"	±5 mm in 1.2 m
		Maximum Deviation from Flat Plane - Cut-to-Size Dimension Stone with Pointed or Rough Cut Finish	±1" in 4'-0"	±25 mm in 1.2 m
		Maximum Deviation from Flat Plane - Cut-to-Size Dimension Stone with Splitface Finish	Per Stock	Per Stock

STONE INDUSTRY TOLERANCES

SECTOR	ISSUE	ITEM	TOLERANCE	
FABRICATION (Continued)	Edge Conditions	Exposed Heads/Calibrated edges (see graphic)	±1/16"	±1.5 mm
		Quirk miters (when width of nose ≤ ¼"; ≤6 mm) (see graphic)	-0, +25% of dim	-0, +25% of dim
		Quirk miters (when width of nose > ¼"; >6 mm) (see graphic)	-0; +1/16"	-0; +1.5 mm
		Chamfers (when dimension ≤ ¼"; ≤6 mm) (see graphic)	-0, +25% of dim	-0, +25% of dim
		Chamfers (when dimension > ¼"; >6 mm) (see graphic)	-0; +1/16"	-0; +1.5 mm
		Bullnose, Semi-Bullnose, & Rounds for thickness up to 1¼" (30 mm) (see graphic)	±1/32" from Theoretical Surface	±0.8 mm from Theoretical Surface
		Bullnose, Semi-Bullnose, & Rounds for thickness greater than 1¼" (30 mm) (see graphic)	±1/16" from Theoretical Surface	±1.5 mm from Theoretical Surface
	Anchor Preps	Plunge Cut Anchor Slots: From face to C/L of slot	±1/16"	±1.5 mm
		Plunge Cut Anchor Slots: Lateral placement	±1/4"	±6 mm
		Plunge Cut Anchor Slots: Width of Slot	-0; +1/16"	-0; +1.5 mm
		Plunge Cut Anchor Slots: Depth of Slot at maximum	±1/8"	±3 mm
		Back Anchors: Location	±1/8"	±3 mm
		Back Anchors: Depth	-0; +1/16"	-0; +1.5 mm
		Anchor Holes: From face to C/L of slot	±1/16"	±1.5 mm
		Anchor Holes: Lateral placement	±1/8"	±3 mm
		Anchor Holes: Diameter	±1/16"	±1.5 mm
		Anchor Holes: Depth	±1/8"	±3 mm
		Anchor Holes: Depth of Anchor Sinkages:	-0, +1/8"	-0, +3 mm
		Continuous Kerfs: From face to C/L of kerf	±1/16"	±1.5 mm
		Continuous Kerfs: Maximum bow in 4'-0"	±1/16"	±1.5 mm
		Continuous Kerfs: Width of Kerf	-0; +1/16"	-0; +1.5 mm
		Continuous Kerfs: Depth of Kerf	-1/16", +1/8"	-1.5, +3 mm
		Rebated Kerfs: Elevation of Bearing Surface	±1/16"	±1.5 mm
		Bearing Checks: Elevation of Bearing Surface	±1/16"	±1.5 mm
		Bearing/Clearance Checks: Lateral Location	±1/2"	±13 mm
		Bearing/Clearance Checks: Setback from Face	±1/16"	±1.5 mm

STONE INDUSTRY TOLERANCES

SECTOR	ISSUE	ITEM	TOLERANCE	
INSTALLATION	Lippage	Lippage, Maximum on Calibrated Tile (Smooth Surfaces)	$^1/_{32}$"	0.8 mm
		Lippage, Maximum on Calibrated Tile (Flamed or Textured Surfaces)	Depth of Finish Relief, NTE $^3/_{16}$"	Depth of Finish Relief, NTE 5 mm
		Lippage, Maximum on Stone Pavement Walking Surfaces (smooth surfaces)	$^1/_{32}$"	0.8 mm
		Lippage, Maximum on Stone Pavement Walking Surfaces (Flamed or Textured surfaces)	Depth of Finish Relief, NTE $^3/_{16}$"	Depth of Finish Relief, NTE 5 mm
		Lippage, Maximum on Interior Vertical Panels ≤20 ft² (≤2 m²) (smooth surfaces)	$^1/_{32}$"	0.8 mm
		Lippage, Maximum on Interior Vertical Panels ≤20 ft² (≤2 m²) (Flamed or Textured surfaces)	Depth of Finish Relief, NTE $^3/_{16}$"	Depth of Finish Relief, NTE 5 mm
		Lippage, Maximum on Interior Vertical Panels >20 ft² (>2 m²) (smooth surfaces)	$^1/_{16}$"	1.5 mm
		Lippage, Maximum on Interior Vertical Panels >20 ft² (>2 m²) (Flamed or Textured surfaces)	Depth of Finish Relief, NTE $^3/_{16}$"	Depth of Finish Relief, NTE 5 mm
		Lippage, Maximum on Countertop @ Front	0	0
		Lippage, Maximum on Countertop @ Back	$^1/_{32}$"	0.8 mm
		Lippage, Maximum on Island Top @ Center	$^1/_{32}$"	0.8 mm
	Joint Width	Joint Width, Variation from Specified	±25% of Specified Dimension, NLT ±$^1/_{32}$"	±25% of Specified Dimension, NLT ±0.8 mm"
		Seam (Joint) Width, Countertop (Stone to Stone)	±25%, NLT ±$^1/_{64}$"	±25%, NLT ±0.4 mm
		Seam (Joint) Width, Countertop (Stone to Other)	±$^1/_{16}$"	±1.5 mm
		Seam (Joint) Width, Countertop (Full-Height Backsplash to Upper Cabinet)	±$^1/_8$"	±3 mm
		Joints, Variation from Straight Line	$^1/_8$" in 10'-0" $^1/_4$" in 20'-0" $^3/_8$" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum
	Alignment	Maximum Variation from Flat & Level, Interior Flooring	$^1/_8$" in 10'-0" $^1/_4$" in 20'-0" $^3/_8$" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum
		Maximum Variation from Flat & Level, Flooring underneath a Revolving Door	±$^1/_{16}$"	±1.5 mm
		Maximum Variation from Plumb, Walls & Vertical Lines , Interior Cladding	$^1/_8$" in 8'-0" $^1/_4$" Maximum	3 mm in 2.5 m 6 mm Maximum
		Maximum Variation from Level (Sills, Lintels, Etc.), Interior Cladding	$^1/_8$" in 10'-0" $^1/_4$" in 20'-0" $^3/_8$" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum

STONE INDUSTRY TOLERANCES

SECTOR	ISSUE	ITEM	TOLERANCE	
INSTALLATION (Continued)	ALIGNMENT (Continued)	Maximum Variation from Building Line Position, Interior Cladding	1/8" in 10'-0" 1/4" in 20'-0" 3/8" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum
		Maximum Variation from Flat & Level, Countertop	1/8" in 10'-0"	3 mm in 3 m
		Maximum Variation of Riser Height in Stairs	3/8" Max Difference Between Largest & Smallest Risers; NTE 3/16" Difference Between Consecutive Risers	10 mm Max Difference Between Largest & Smallest Risers; NTE 5 mm Difference Between Consecutive Risers
		Maximum Variation from Plumb, Walls & Vertical Lines , Exterior Cladding	1/4" in 10'-0" 3/8" in 20'-0" 1/2" Maximum	6 mm in 3 m 10 mm in 6 m 12 mm Maximum
		Maximum Variation from Plumb, Exterior Corners or Conspicuous Lines	1/8" in 10'-0" 1/4" in 20'-0" 3/8" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum
		Maximum Variation from Level (Sills, Lintels, Etc.), Exterior Cladding	1/8" in 10'-0" 1/4" in 20'-0" 3/8" Maximum	3 mm in 3 m 6 mm in 6 m 10 mm Maximum
		Maximum Variation from Building Line Position, Exterior Cladding	1/4" in 20'-0" 1/2" Maximum	6 mm in 6 m 12 mm Maximum
SUBSTRATES	Surface Plane	Maximum Variation from Flat & Level; Substrate for Thinset Interior Flooring	1/8" in 10'-0"	3 mm in 3 m
		Maximum Variation from Flat & Plumb, Adhered Interior Wall	1/8" in 10'-0"	3 mm in 3 m
		Maximum Variation from Flat & Plumb, Adhered Exterior Cladding	1/4" in 10'-0"	6 mm in 3 m
		Maximum Variation from Flat & Level, Countertop	1/8" in 10'-0"	3 mm in 3 m

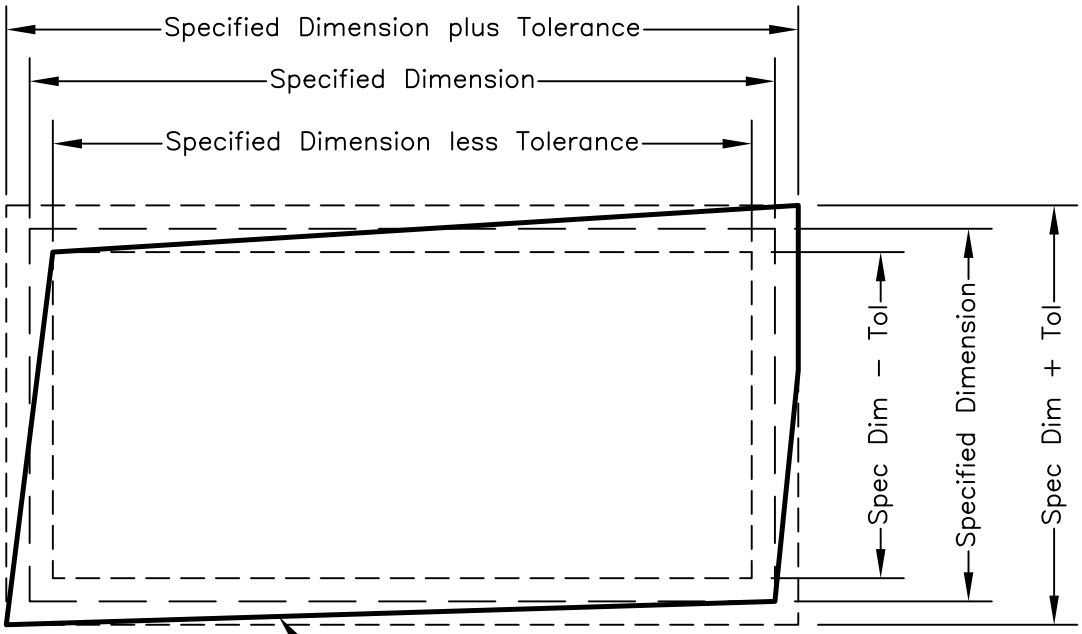

FIGURE 1: FACE SIZE TOLERANCE

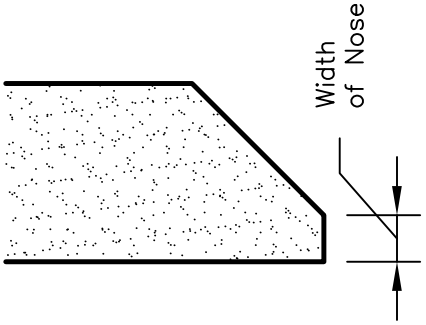

FIGURE 2
QUIRK MITER

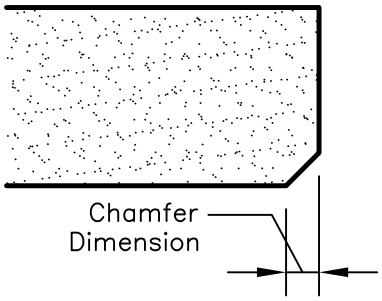

FIGURE 3
CHAMFER

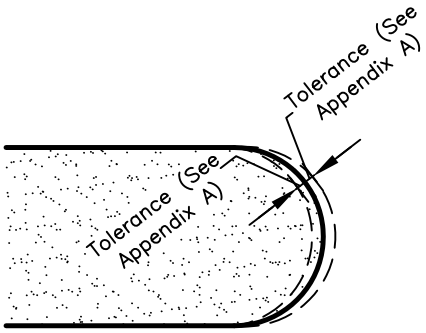

FIGURE 4
BULLNOSE

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REV	DATE
0	May, 2014
1	Aug, 2014

GRAPHIC INTERPRETATION OF TOLERANCES
MIA DIMENSION STONE DESIGN MANUAL VIII

DRWG NO: 22-D-1

SCALE: Not to Scale

NOTES: