



IHES-N1

WELDED HONEYCOMB CORE SPECIFICATION

Generated: Sergiy Papyshev
Engineering

DATE

Approved: Zachary Kraft
Manufacturing

DATE

Approved: Merzuk Ramic
Quality

DATE

Approved: Don Prys
Administrative

DATE

REVISIONS

Revision	Date	Description of change	Paragraph affected	Approved by / Date

TABLE OF CONTENTS

1. SCOPE

2. APPLICABLE DOCUMENTS

3. DEFINITIONS

4. REQUIREMENTS

4.1 Cell Size

4.2 Welding

4.3 Configurations

4.3.1 Segments

4.3.1.1 Simple Segments

4.3.1.2 Chamfer/Contour Segments

4.3.1.3 Stepped Segments

4.3.2 Rings

4.3.2.1. Simple Rings

4.3.1.2. Chamfer/Contour Rings

4.3.1.3 Stepped Rings

4.4 Machining

4.4.1 Conventional Machining

4.4.2 Non-Conventional Machining

4.4.3 Outsourcing

4.5. Braze Tape

5. QUALITY PROVISIONS

5.1 Acceptability limits

5.2 Rework procedures

5.3 Finished dimensions and tolerances

5.4 Document Priority

6. PACKAGING AND MARKING

6.1 Marking

1. SCOPE

The purpose of this specification is to establish configuration and acceptability limits for welded metallic honeycomb primarily for turbine engine seal applications.

2. APPLICABLE DOCUMENTS

Honeycomb manufactured to this specification shall meet requirements of Purchase Agreement or Contract, Engineering Drawing, Material Specification or other applicable documents.

Aerospace Specifications:

AMS 5850 – Honeycomb Specification

AMS 5536 – Hastelloy-X

AMS 5878 – Haynes 230

AMS 5513 – Stainless Steel Gr. 304

AMS 5524 – Stainless Steel Gr. 316

AMS 5507 – Stainless Steel Gr. 316L

AMS 5510 – Stainless Steel Gr. 321

AMS 4777 – Braze filler material

AMS 4778 – Braze filler material

AMS 4782 – Braze filler material

3. DEFINITIONS

Burr – flattened edge of the foil, normally produced by machining or sanding operation.

Border cell – See Windage Strip

Cell – A single enclosed opening in the honeycomb core formed by attaching sections of corrugated ribbons at their nodes.

Cell Depth – see Honeycomb Height

Cell Size – The inside distance between the two opposite and parallel sides of a cell. Node flats shall not be considered cell sides for purposes of determining cell size.

Consecutive Separated Nodes – A series of un-welded nodes separated by less than three connected nodes.

Foil – Metal strip used for honeycomb construction

Honeycomb Core – A pattern of metal ribbons formed and joined to result in multiple open adjacent cells.

Honeycomb Core Depth – see Honeycomb Height

Honeycomb Core Splice – Any area in which two edges of honeycomb core are joined.

Honeycomb Height – Distance between faces of honeycomb i.e. width of the ribbon in honeycomb core. A.k.a. Honeycomb Core Depth and Cell Depth

Node – The surface of a corrugated ribbon which contacts an adjacent ribbon.

Node Gap – Distance between adjacent nodes

Node Bond – The permanent connection of two formed ribbons at the nodes

Open Cell – A cell which is not completely enclosed as the result of a machining operation.

Partial Cell – A cell which is not completely enclosed by the honeycomb ribbon by the virtue of its position at the outer edge of the structure as formed.

Pitch – The distance from the centerline of one node to the centerline of an adjacent node measured in the direction parallel to the nodes.

Ribbon – A single strip of corrugated metal foil which forms the cell walls of honeycomb core.

Ribbon Direction – The direction parallel to the nodes on one ribbon as assembled into honeycomb core.

Traceability – positive identification of materials and performed operations by means of documentation.

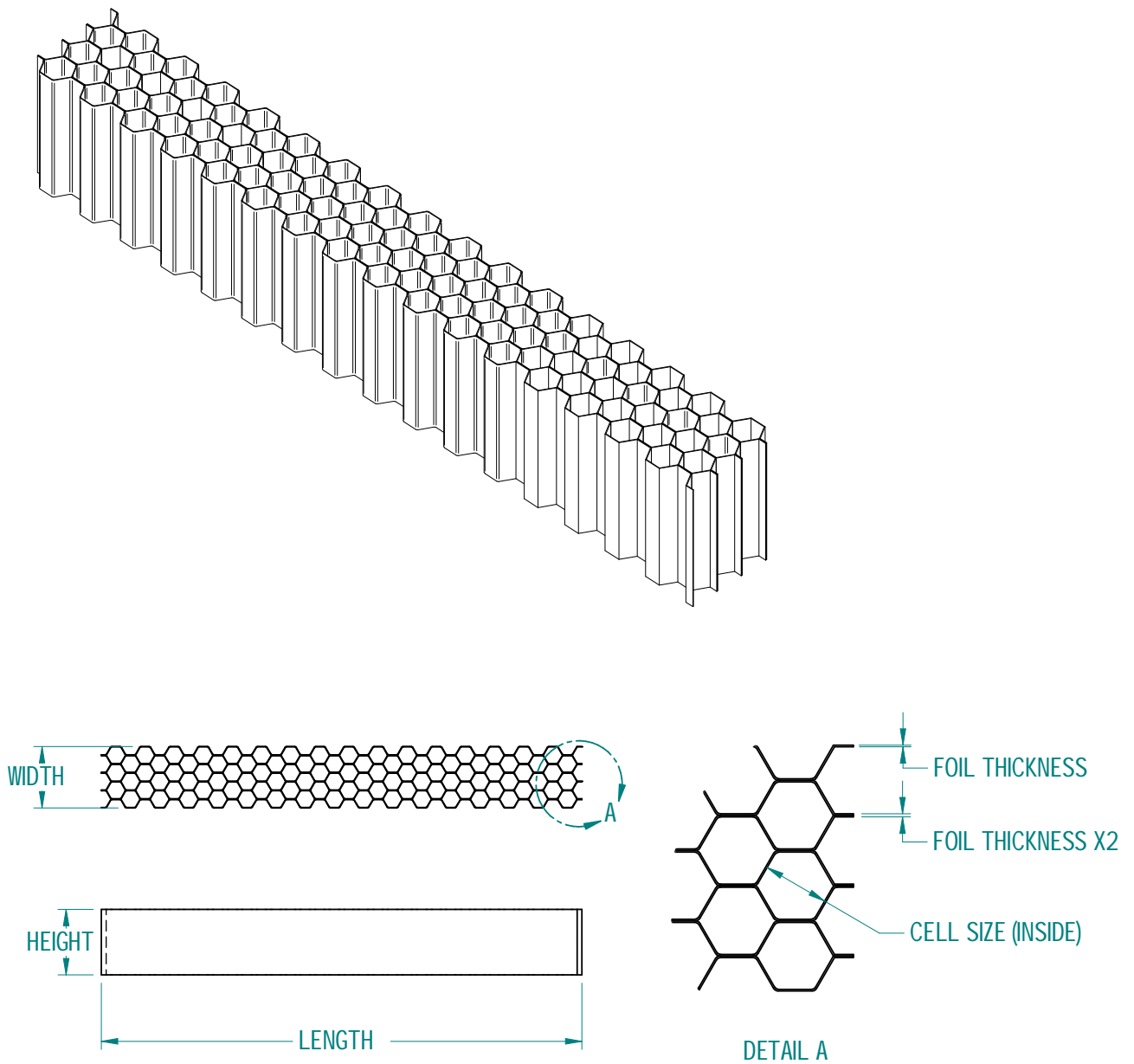
Transverse Direction – The direction perpendicular to and in the same plane as ribbon direction.

Un-welded Area – The area of a cell or cells that have completely separated nodes.

Windage Strip – Single ribbon with cell size different from honeycomb core, welded to outer edge of honeycomb structure.

4. REQUIREMENTS

Typical honeycomb construction and key characteristics are shown in Pic. 1



Pic. 1. Honeycomb Construction

4.1 Cell Size

Cell size is to be measured with the raw honeycomb in the flat state, before forming.

Following nominal cell sizes are covered by this specification:

Cell Size	Range	
1/64" (.016")	available only as windage strip	
1/32" (.031")	0.029	0.033
1/16" (.063")	0.059	0.066
3/32" (.094")	0.088	0.099
1/10" (.100")	0.094	0.106
1/8" (.125")	0.118	0.133
5/32" (.156")	0.147	0.166
3/16" (.188")	0.176	0.199
1/4" (.250")	0.235	0.265

Average cell size may vary from nominal by +/-6%. No single cell shall vary from the nominal cell size by more than +/-12%.

4.1.2 Cell modifications

Cells dimensions different from ones listed above as defined by engineering drawing.

4.2 Welding

Node Bonds shall be achieved by means of laser or resistance spot welding at the nodes.

4.3 Configurations

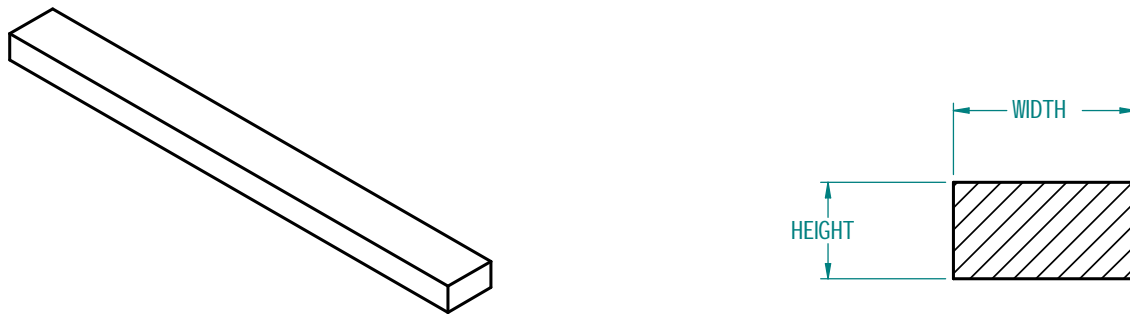
Honeycomb manufactured in a form of segment or ring with various features.

Segments manufactured flat or rolled to approximately conform to brazing surface.

4.3.1 Segments

4.3.1.1 Simple Segments

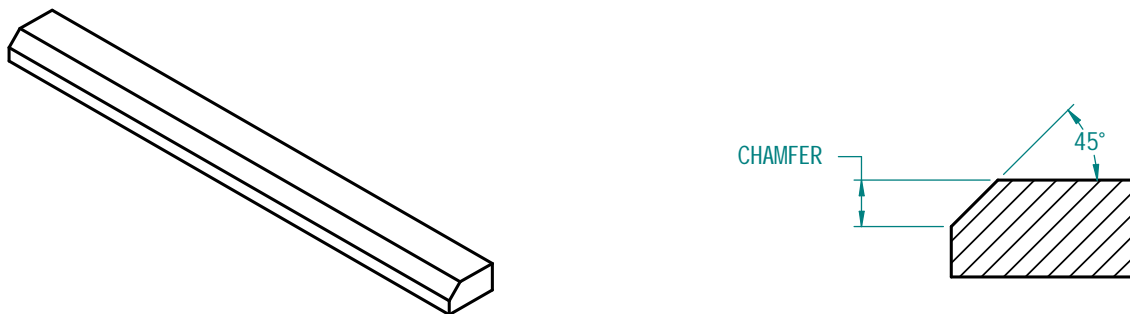
Honeycomb strips without machined features



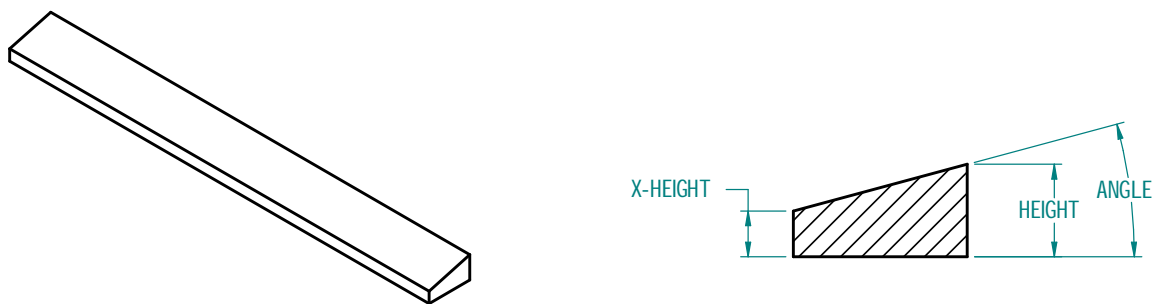
Pic.2 Simple Honeycomb Segment

4.3.1.2 Chamfer/Contour Segments

Honeycomb with features machined features produced by means of conventional or non-conventional machining.



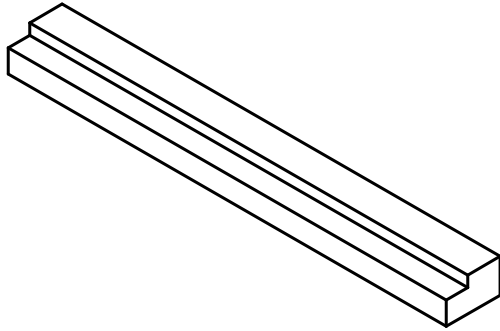
Pic.3 Chamfered Honeycomb Segment



Pic.4 Contoured Honeycomb Segment

4.3.1.3 Stepped Segments

Honeycomb segment that contain two or more sections of different Height

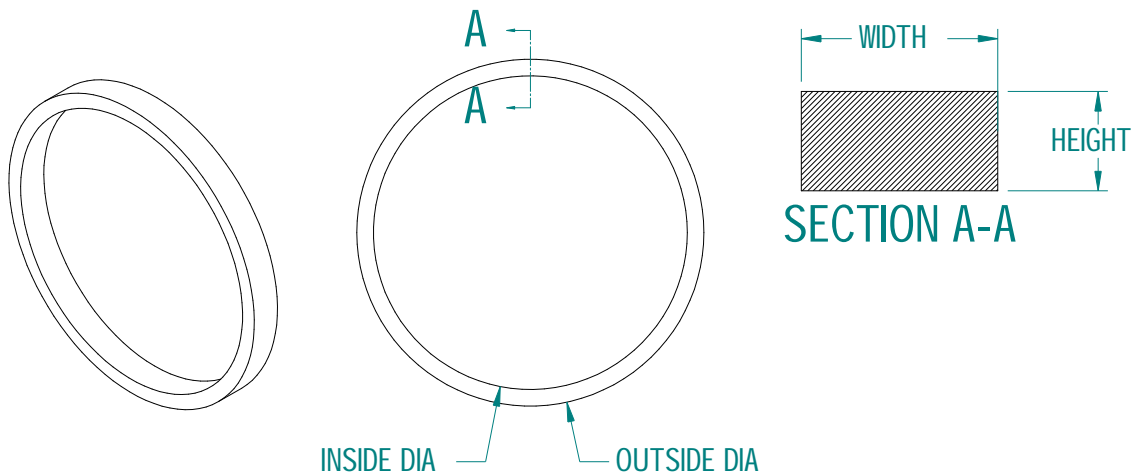


Pic.4 Stepped Honeycomb Segment

4.3.2 Rings

4.3.2.1. Simple Rings

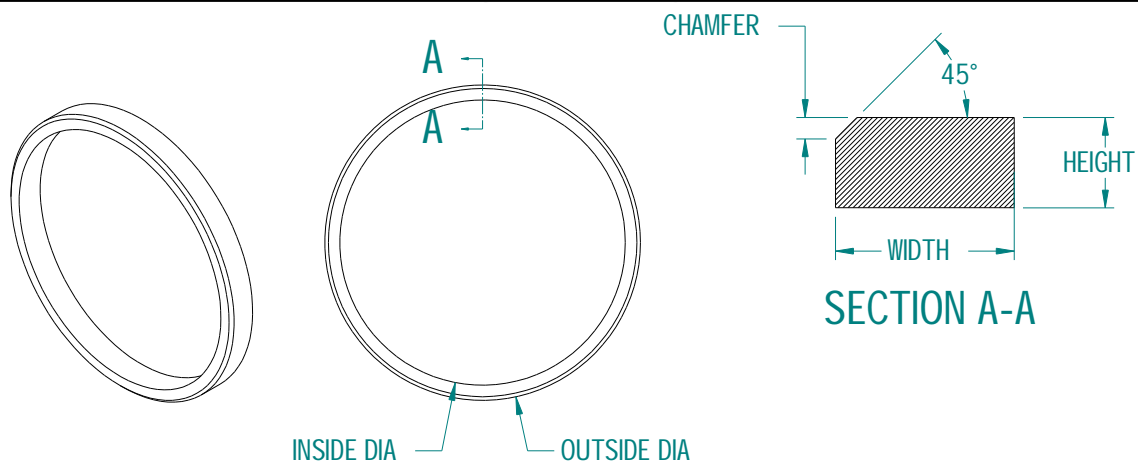
Honeycomb ring without machined features



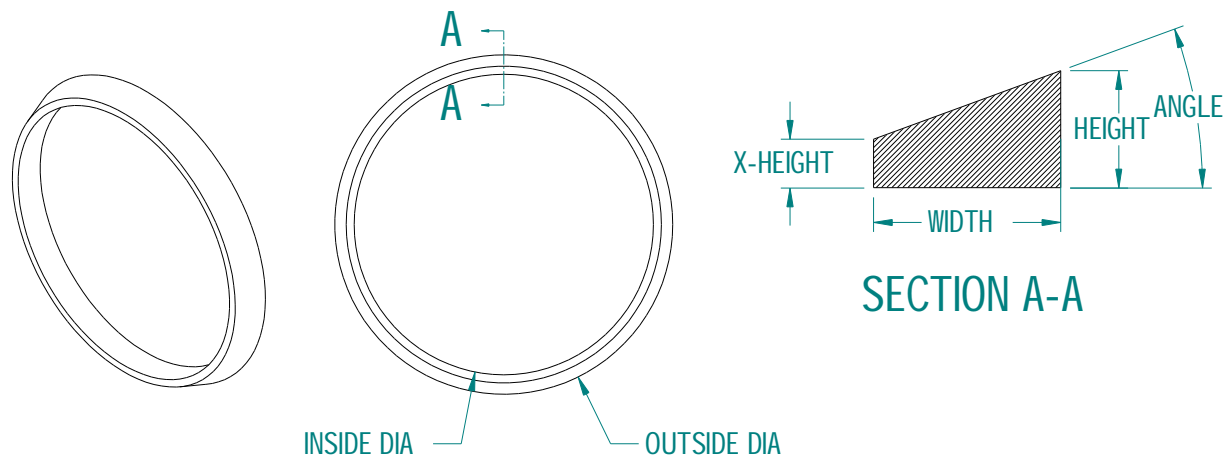
Pic.5 Simple Honeycomb Ring

4.3.1.2. Chamfer/Contour Rings

Honeycomb ring with features machined features produced by means of conventional or non-conventional machining.



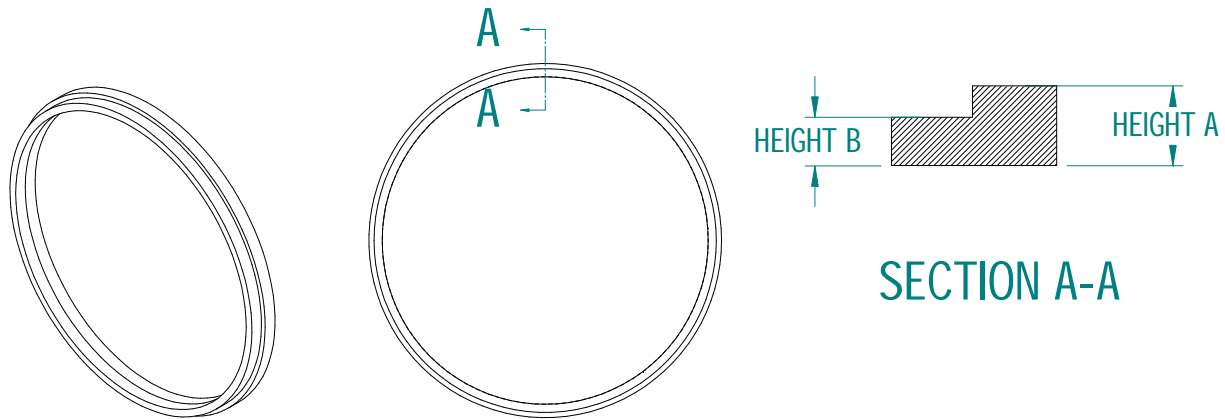
Pic.6 Chamfered Honeycomb Ring



Pic.7 Contoured Honeycomb Ring

4.3.1.3 Stepped Rings

Honeycomb ring that contain two or more sections of different Height



Pic.8 Stepped Honeycomb Ring

4.4 Machining

Honeycomb Material can be removed in order to produce chamfer, contour or other features.

4.4.1 Conventional Machining

Conventional machining can be defined as removing of material using mechanical (motion) energy. Typical methods used to machine honeycomb are grinding or sanding.

4.4.2 Non-Conventional Machining

Non-conventional machining can be defined as removing of material using electrical, thermal or chemical energy. Typical non-conventional methods used to machine honeycomb are Electro-discharge Machining (EDM) and Spark Erosion Grinding (SEG)

Non-Conventional machining of the honeycomb core is permitted provided the surfaces meet the following requirements:

1. Average recast not to exceed .002".
2. Maximum recast not to exceed .004".
3. Micro cracks allowed in recast layer only.
4. Maximum intergranular attack not to exceed .0015"
5. Surface finish requirements of non-conventional machined surfaces do not apply.

4.5. Braze Tape

Honeycomb preloaded with braze material (braze tape) applied to brazing surface. Type and overall thickness of braze tape shall be defined in Purchase Order or other applicable document. Tape must be fully pressed inside honeycomb cells. Warming process can be used to increase pliability of the tape during application, temperature of the tape not to exceed 170°F. Required thickness can be achieved by stacking of multiple tape layers. Excess tape must be removed from honeycomb so the ribbon edges (honeycomb pattern) are visible and clean. Honeycomb part must meet dimensional requirements after tape application.

Honeycomb preloaded with Braze Tape shall be stored in conditions that minimize vibration and contact with air.

5. QUALITY PROVISIONS

5.1 Acceptability limits

1. No more than 2 consecutive nodes shall be un-welded
2. Minimum 80% of all nodes shall contain at least one weld
3. Holes through node or cell wall shall not exceed .015"
4. No more than 10% of all cells shall contain hole.
5. Welds shall be located at least .080" away from honeycomb faces.
6. Minimum distance between welds shall be .080", unless required in order to maintain structural integrity of the part (e.g. contoured or chamfered honeycomb).
7. Vertical mismatch shall not exceed .002"
8. Horizontal mismatch shall not to exceed 20% of the node width. Cell size requirement shall apply.
9. Honeycomb ring shall contain only one diagonal (scarf) or butt splice
10. Burr width shall not exceed .004"+F (where F is Foil Thickness)
11. Node nesting is not allowed except when single nodes overlapped as required by splicing or rework procedure.
12. Perpendicularity/Lean/Squareness +/- 3°
13. Partial cells are not acceptable
14. Node Gap shall not exceed .003"
15. If braze tape applied, all completely enclosed cells must have braze tape pressed in to them.

5.2 Rework procedures

Honeycomb areas that do not meet requirement of Para. 5.1 can be reworked. As follows:

1. Open cells can be reworked by means of resistance or laser tacking.
2. Damaged or partial cells can be replaced by conforming honeycomb produced from same material type and thickness.
3. Weld quantity location and requirements do not apply to reworked cells.
4. Cell with missing Braze Tape can be reworked by application of the smallest possible tape patch of same type and thickness.
5. Traceability requirements shall apply.

5.3 Finished dimensions and tolerances

Unless specified by Purchase Order or Contract or Engineering Drawing following tolerances shall apply:

1. Average Cell Size: +/-6%
2. Honeycomb Height: +/- .010"
3. Honeycomb Width: +/- .010"
4. Contour/Chamfer Profile: +/- .015"

5. Honeycomb length for segments equal or less than 24.000": $+.200"/-0$
6. Honeycomb length for segments more than 24.000": Minimum
7. Radius/Curvature: Reference only
8. Outside Diameter: $\pm .010"$
9. Inside Diameter: Reference only
10. Step Width: $\pm 1/2 * C$ (where C is nominal Cell Size)
11. Width for honeycomb ring with Diameter-to-Height ratio less than 20: $\pm .030"$
12. Foil thickness for foils less than .002: $\pm .00025"$
13. Foil thickness for foils equal or greater than .002: $\pm 10\%$
14. Braze Tape Thickness: $\pm .005"$

5.4 Outsourcing

Machining operations can be outsourced to approved vendors. Flow Down and Traceability requirements shall apply.

5.5 Document Priority

In event of the conflict or insufficiency of requirements documents shall take precedence in following order:

1. Latest revision of Purchase Order or Contract
2. Latest revision of Engineering Drawing incorporated in Purchase Order or Contract
3. Honeycomb Specification identified by Customer
4. This Specification
5. Industry Standard Specifications
6. Quotation issued by Indy Honeycomb

6. PACKAGING AND MARKING

Honeycomb shall be packaged using adequate material and methods to provide protection under normal shipping conditions

Special care shall be taken when packaging honeycomb containing Braze Tape to minimize vibration exposure to air during transport and storage e.g. sealed bag, foam padding etc.

6.1 Marking

Interior packages and exterior shipping containers shall be durable and legibly marked. Unless specified by Purchase Order or Contract or Engineering Drawing the following information shall be placed on each interior package so that the markings will not be damaged when the packages are opened:

- Purchase Order Number
- Honeycomb Part Identification and/or configuration
- Alloy traceability information