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<i>Standard Number:</i>	WS-003
<i>Standard Title:</i>	Part Cleanliness & De-burring Standards

SIGNATURES OF APPROVAL

Department:	Signature:	Date:
President		
VP of Eng & Operations		
Quality Assurance Manager		
Design Engineering Manager- Industrial		
Design Engineering Manager - Aerospace		
Production Engineering Manager		
Materials Manager		
Manufacturing Manager		



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REVISION HISTORY

Date:	Revision:	Description:	By:
10/24/05	NONE	INITIAL RELEASE	T. BUKOWSKI
8/31/09	A	Added definition of "Break Edges "	P. Kowalewski

Part Cleanliness & de-burring Standards**1. Scope****1.1. Purpose**

This specification establishes the Production Engineering and inspection criteria for deburring and part cleanliness as well as the cleanliness of part packaging.

1.2. Conflict Statement

In the event of a conflict between the requirements of this specification and the requirements of other documents, the order of precedence is as follows:

1.2.1. Purchase Order

1.2.2. Engineering Drawing

1.2.3. Assembly Manual

1.2.4. Procedures and Standards

1.2.5. All other documents

**** **Note:** This precedence is for the manufacturing process only to allow for in-process dimensions and requirements. All parts will be inspected to the requirements of the engineering drawing at final inspection (after all processing).

2. Engineering

2.1. Drawings will conform to the requirements set forth by this specification.

2.2. Parts will be deburred to conform to the requirements set forth in this specification.

2.3. Parts will be accepted / rejected based on the requirements set forth in this specification.

2.4. In areas where further machining, at a subsequent part number, will remove any burrs that may be generated, a note stating "BURRS ALLOWED IN THIS AREA" will be added to the drawing. This area will be outlined with phantom lines to control its boundaries, or specific edges will be flagged.

2.5. If the default inspection classes as stated in 5.1 are not acceptable, the engineering drawing shall also state the acceptable class of inspection.

3. Definitions**3.1. Burr**

Non-functional material extending from the parent surface of a part.



3.1.1. **Extruded Burr** – readily seen raised material generally caused by the drilling of a malleable material. This type of burr does **NOT** exhibit evidence of material that can break away. See Figure 1 for pictorial example.

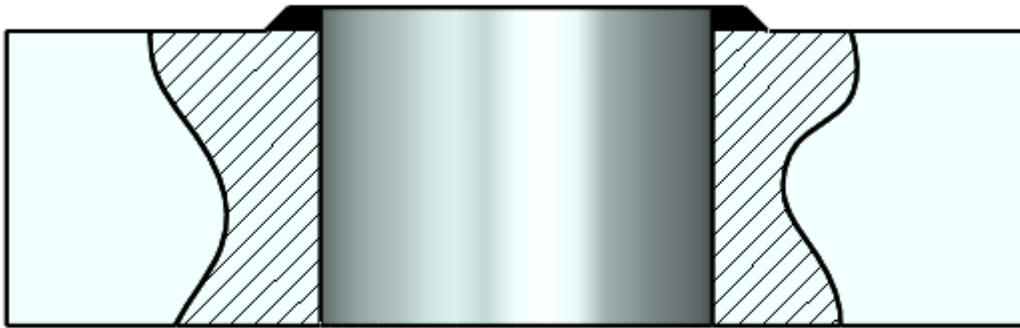


Figure 1 - Extruded Burr

3.1.2. **Feathered Burr** – loose burr generally found on an edge where two dissimilar surface finishes meet. See Figure 2 for pictorial example.

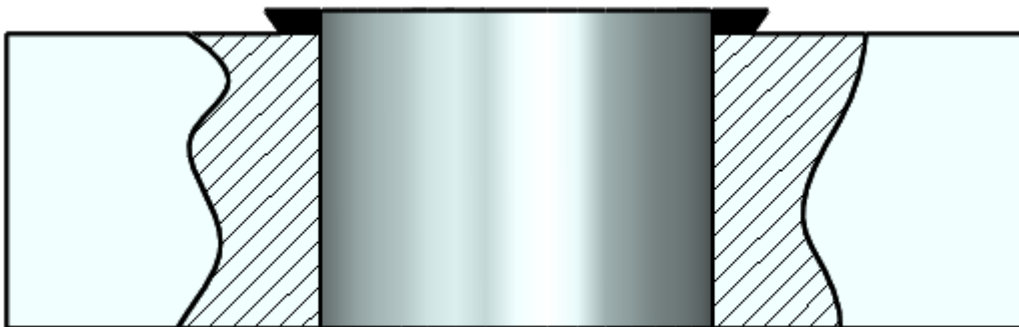


Figure 2 - Feathered Burr



3.1.3. **Doughnut Burr**- loose piece of rolled material that tends to flatten and blend itself into the adjacent material. See Figure 3 for pictorial example.



Figure 3 - Doughnut Burr

3.1.4. **Sliver Burr** – loose sliver of material attached to the edge of a feature. This type of burr generally forms on edges adjacent to a milled or turned surface. See Figure 4 for pictorial example.



Figure 4 - Sliver Burr



3.1.5. **Hinged Burr** – loose material typically formed in holes and features located on surfaces that have been milled. See Figure 5 for pictorial example.

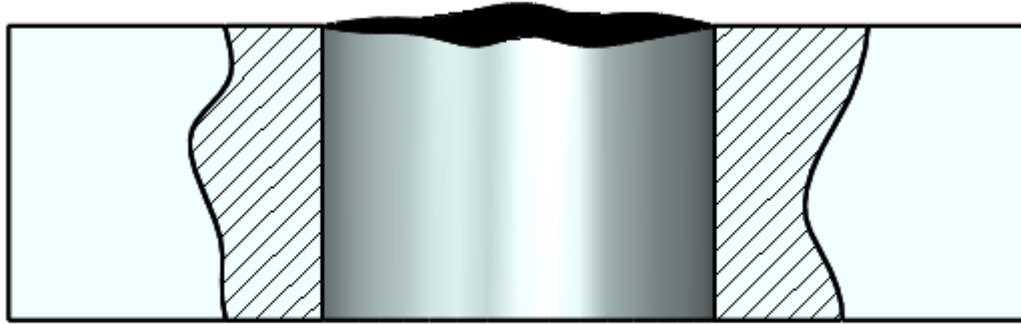


Figure 5 - Hinged Burr

3.1.6. **Crowned Burr** – loosely attached material typically formed around a hole that has been countersunk. See Figure 6 for pictorial example.

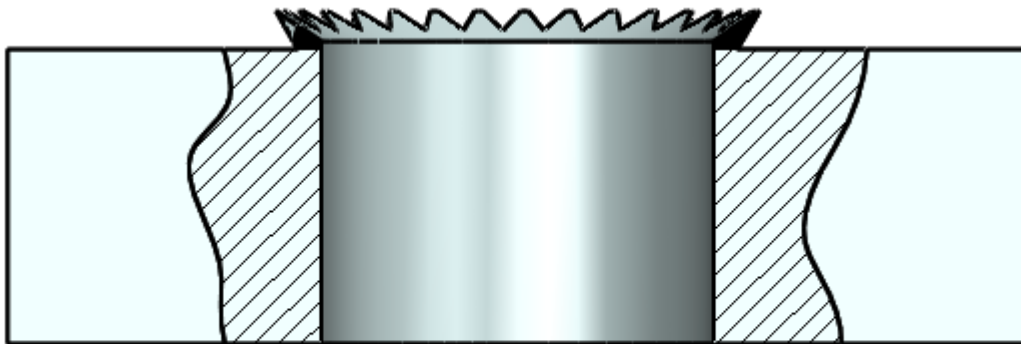


Figure 6 - Crowned Burr



3.1.7. Rolled Burr – Similar to a hinged burr, this type of burr forms in holes and features that are located on surfaces that have been milled or turned. See Figure 7 for pictorial example.



Figure 7 - Rolled Burr

3.1.8. Secondary Burr – Often after a primary deburring operation such as countersinking or chamfering, a small burr will be generated at the intersection of the countersink or chamfer surfaces and the original part surfaces. These burrs are known as secondary burrs and their disposition is described in Paragraph 4.

3.2. Sharp Edge

Edge with .001" or less radius. Edge must be free of any flaws such as nicks, scratches, chips, etc.

3.2.1 Break Edges

Defined as any combination of angles and radii as specified on the drawing with no Sharp edges.



3.3. R.XXX Max.

Any combination of angles and radii that fall between a .000" radius and the specified maximum radius.

Example: R .030 Max – Any combination of angles and radii that fall within the shaded area shown in Figure 8.

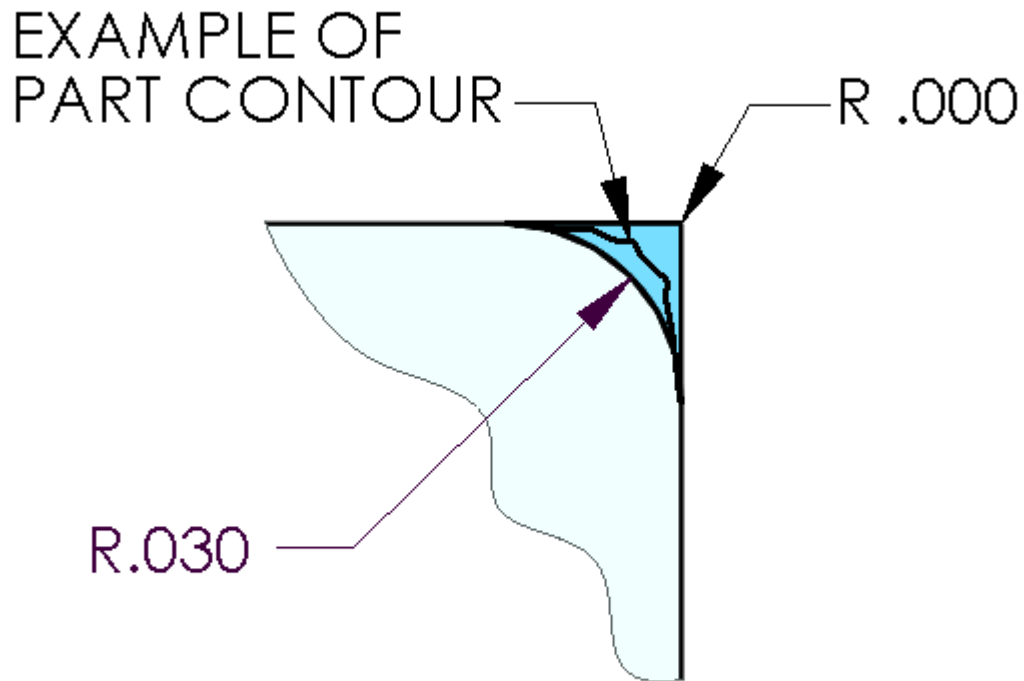


Figure 8



3.4. R .XXX ± .XXX

Any combination of angles and radii that fall between the smallest and largest radius allowed by the stated tolerance.

Example: R .025 ± .010 – Any combination of angles and radii that fall within the shaded area shown in Figure 9.

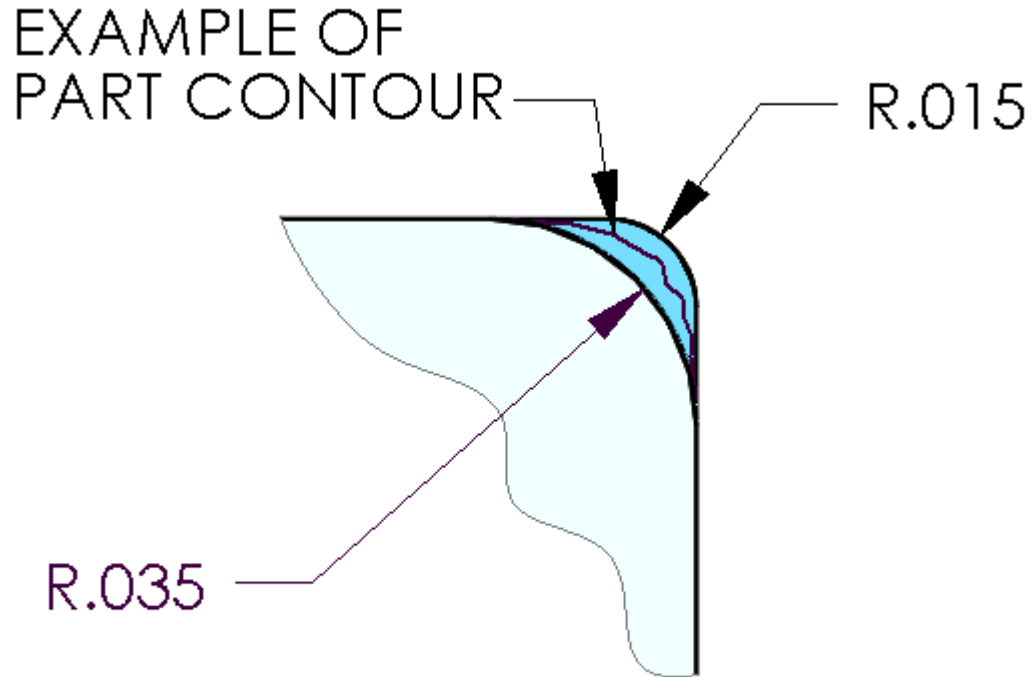


Figure 9



3.5. CR.XXX (Controlled radius)

Any size radius that falls between the smallest and largest radius allowed by the stated tolerance.

Note: the part contour must be a fair curve with no reversals. Additionally, radii taken at all points on the part contour shall neither be smaller than the specified minimum limit nor larger than the maximum limit. Radius must be tangent to the adjacent surfaces.

Example: CR .025 ± .010 – A fair curve with no reversals that lies within the shaded region as shown in Figure 10.

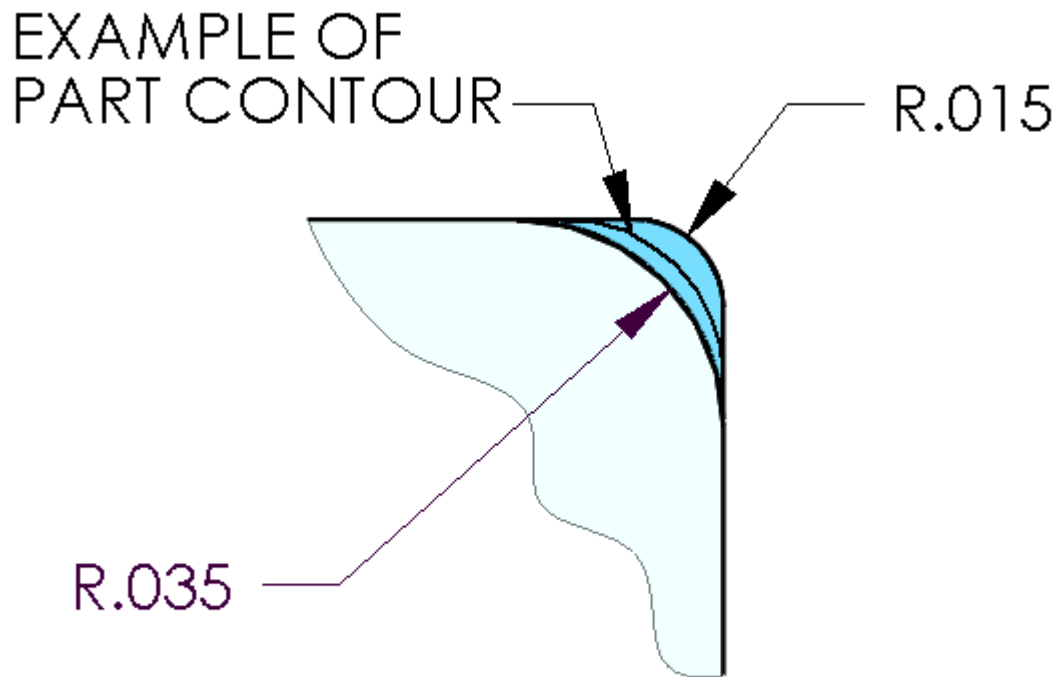


Figure 10



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3.6. C/R (Chamfer/Radius)

Any combination of angles and radii that fall inside an area formed by the largest chamfer and the smallest radii allowed by the stated tolerance.

Example: C/R .015 Max. – Any combination of angles and radii that fall within the shaded area shown in Figure 11. (Note that a sharp edge is permitted.)

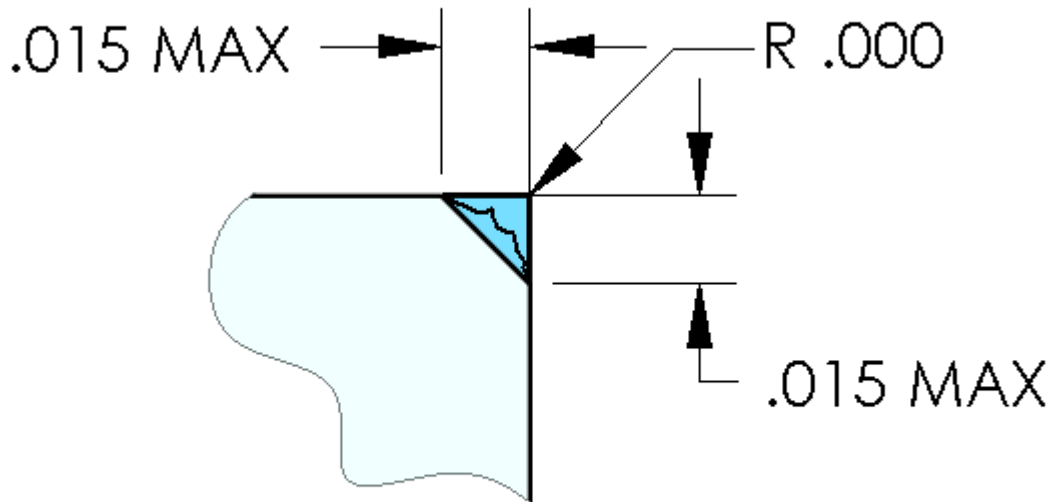


Figure 11



Example: C/R .010 ± .005 – Any combination of angles and radii that fall within the shaded area shown in Figure 12.

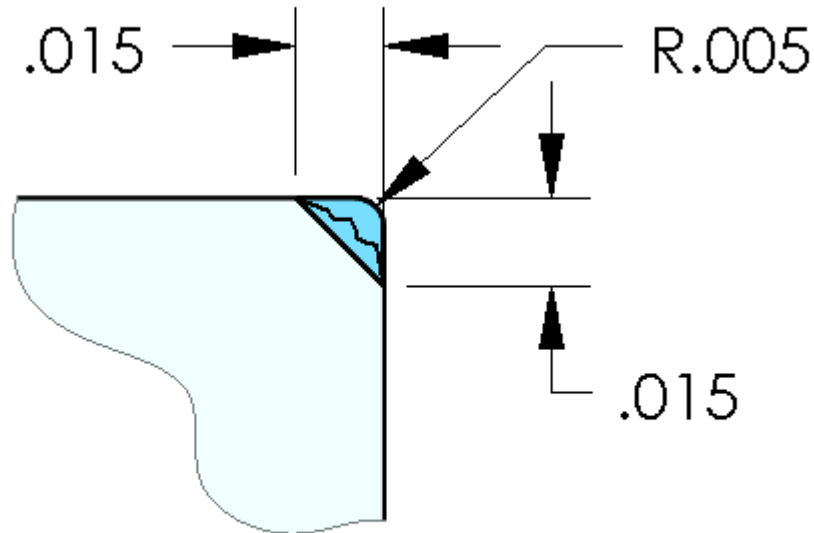


Figure 12

4. Deburring Requirements

- 4.1. All burrs including feathered, doughnut, sliver, hinged, crowned, secondary and rolled burrs (except extruded burrs as stated in 4.3) shall be removed to a C/R .005 max. unless otherwise specified on the engineering drawing.
- 4.2. Any external sharp edges will be removed to a C/R .015" max. unless otherwise specified on the engineering drawing.
- 4.3. Extruded burrs are accepted as long as no print tolerances are deviated (i.e. flatness, parallelism, size, surface finish, etc.).
- 4.4. All print tolerances, finishes and requirements must be maintained AFTER deburring is completed.
- 4.5. Blind tapped holes will be acceptable with rolled cups generated from the tapping operation at the crest or minor diameter of the thread so long as this material is firmly enough attached so that a compressed air blast from a nozzle small enough to enter the blind hole to its bottom will not dislodge this material. Likewise, a slight raised appearance where the first thread intersects the countersink at the entrance to the hole will be acceptable if it cannot be dislodged by air blast or contact with a nylon bristle brush. In all cases, the tapped hole must gage properly with the appropriate plug gages.



5. Inspection Requirements

5.1. Inspection Classes

5.1.1. **Class I** – Inspect part with the naked eye

5.1.2. **Class II** - Inspect part using 4X magnification.

5.1.3. **Class III** – Inspect part using 10X magnification

5.1.4. **Class IV** – Inspect part using 30X magnification

Note 1: If, for any of the Classes I, II or III above, a defect is visible, but not identifiable, then an increase in magnification to the next higher Class is permissible. If a possible defect is discovered at this higher magnification, an MRB qualified member of the appropriate Product Team shall be consulted before the generation of a rejection. For a Class IV criteria, no higher magnification is allowed.

Note 2: All inspection shall be performed using lighting appropriate for inspection method. Instruments used for Class II, III, and IV inspections shall include dedicated light sources for illumination of the inspection area. See appendix 1 for recommended inspection instrument types.

5.2. Unless otherwise specified on the engineering drawing or assembly manual, the default inspection classes will be Class 1 for external edges and features and Class II for internal passages and features. An external feature or edge is defined as any outside profile that can be seen by holding the part in front of a light source. An internal feature is defined as anything that is not an external feature. All through, blind or intersecting pockets of removed material are considered to be internal features, where an internal feature intersects an external surface, the edge formed is considered external.

6. Cleanliness of Parts and Packaging

6.1. Prior to stocking and/or prior to returning parts to Enidine, all parts are to be free of process related material (i.e. chips, coolant, bead blast material, deburring media, etc.) Aqueous cleaning, utilizing ultrasonics, induced aeration or agitation, in conjunction with direct compressed air blasts administered to blind areas with a small diameter air nozzle are proven methods for achieving the desired contamination free result. Inspect for cleanliness, unless otherwise specified using Class I criteria (refer to Section 5.1 Inspection Classes).

6.2. Handling, storage, packaging, preservation and delivery practices shall be established to prevent handling damage and where appropriate to provide special storage and usage requirements (limited life, etc.) and to assure that material arrives at Enidine clean, dry and undamaged. This packaging shall be free of process related material (i.e. chips, coolant, bead blast material, deburring media, etc.). Inspect for cleanliness, unless otherwise specified using Class I criteria (refer to Section 5.1 Inspection Classes).



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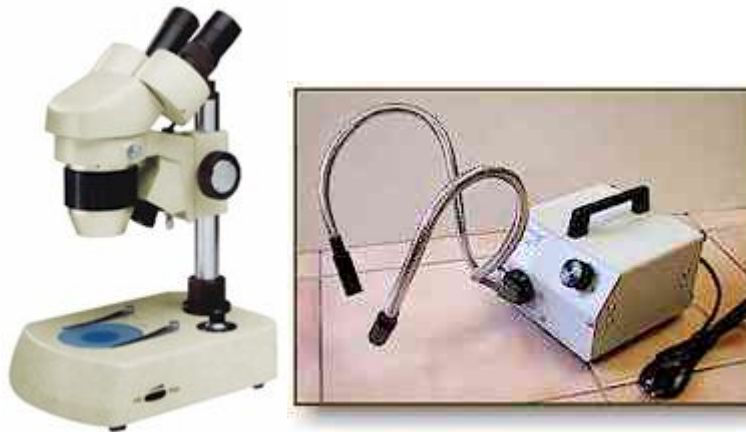
Appendix 1

Recommended instruments for Inspection Classes II, III and IV

Class II: 4x power OTOSCOPE



Class III 10x power BINOCULAR MICROSCOPE & dual pipe light source



Class IV 30x power BINOCULAR MICROSCOPE & dual pipe light source