



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002**

---

### **WORKMANSHIP STANDARDS FOR MACHINED PARTS & ASSOCIATED SPECIAL PROCESSES**

#### **1.0 PURPOSE**

##### **1.1 SCOPE & INTENT**

- 1.1.1 EMNOR continually strives to deliver the highest quality products that meet performance, cost and on-time delivery goals. However, many visible irregularities, although not aesthetically perfect, conform to the drawing requirements and do not adversely affect the design intent. This document will assist in the judgment of whether a machined part for EMNOR is deemed Non-Conforming. The standards, guidelines and instructions within this document are intended to apply to machined parts and assemblies and associated special processes. This document supplements engineering drawings and purchase order requirements for make-to-print machined parts. In all cases, reference must be made to the order of precedence presented below:

Emnor Drawing

Emnor PO (including Standard Clauses)

**This Workmanship Standard**

Other referenced documents

- 1.1.2 Given the order of precedence, nothing in this standard can override a requirement or specification called out on the drawing or PO. The primary intent of this document is to align suppliers and EMNOR as to criteria and methods for judging whether parts are non-conforming. It is therefore expected that both suppliers' and EMNOR Quality & Product Engineers will use this document as the basis for process optimization, control plans, inspection plans, and accept/reject criteria when dispositioning parts with visual irregularities.

##### **1.2 GENERAL GUIDELINE NOTES**

- 1.2.1 Suppliers must supply inspection records with all machined parts.
- 1.2.2 Applicable dimensions within this workmanship standard are presented in U.S. inches. Metric equivalents are presented in parentheses for general guidance to those organizations using these units of measure; e.g., .25" (6.3mm), .0003" (0.008mm), etc.
- 1.2.3 All parts are to be free from foreign objects, debris and damage.
- 1.2.4 Packaging shall be adequate to protect the components during transportation, handling, and storage at all stages including provisions for the protection of corrosion sensitive materials. Packaging containers shall be appropriate for the size, weight, and fragility of the components being packed.

##### **1.3 MAGNIFICATION REQUIREMENTS**

- 1.3.1 The table below summarizes the magnification needed to inspect and verify each type of irregularity. Where a higher magnification level is deemed necessary, based on criticality of parts or tolerances specified on the drawing for example, this is specified in the appropriate Appendix of this document.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

<b>Irregularity Type</b>	<b>Magnification Requirement</b>
Surface Corrosion and Pitting	Visual check (1X); if Non-Conforming, inspect at up to 10X to validate
Cosmetic Irregularities	Visual check only (1X)
Burrs	No burrs visible at 10X (maximum)
External Contouring	Visual check only (1X)
Special Processes	Visual check only (1X); up to 10X in certain limited cases



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

## **2.0 DEFINITIONS**

<b>Part-to-Print</b>	A Part-to-Print irregularity indicates that the part meets the requirements of the drawing. When this applies to images within this document, images will be bordered in green
<b>Non-Conforming</b>	A Non-Conforming irregularity indicates that the part does not meet the requirements of the drawing. When this applies to images within this document, images will be bordered in red. Non-Conforming parts will be dispositioned by EMNOR, i.e. Use, Return to Vendor etc..
<b>Irregularity</b>	Any area that is visibly different from the surrounding surface of the same material, verified at 1X
<b>Smooth</b>	Meeting the drawing surface finish requirement and any drawing mismatch allowance or, when there is no mismatch allowance, exhibiting no surface discontinuity detectable with a plastic pick
<b>Rework</b>	Localized area on a surface where an irregularity has been removed or touched up. Reworked areas can show evidence of mechanical blending. A Part-to-Print rework must conform to all GD&T callouts on the drawing. Surface Finish, Flatness, Perpendicularity, Parallelism etc.
<b>Shall</b>	<i>Shall</i> denotes an intended mandatory requirement. Each <i>shall</i> hereafter requires a verification process. Each use of the term <i>shall</i> is listed in the verification matrix. Where not already indication in the matrix, the supplier is required to state how the requirement of each <i>shall</i> is to be verified.
<b>Will</b>	<i>Will</i> denotes an intended mandatory requirement. It is synonymous with <i>shall</i> but does not require verification
<b>Should &amp; May</b>	Should & May both denote non-mandatory provisions and are used to show guidelines

## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

---

### 3.0 ABBREVIATIONS

<b>MRB</b>	<b>Management/Materials Review Board</b>	A group and process in which deviating parts are dispositioned.
<b>GD&amp;T</b>	<b>Geometric Dimensioning &amp; Tolerancing</b>	A system for defining and communicating engineering tolerances. It uses a symbolic language on engineering drawings and computer-generated three-dimensional solid models that explicitly describes nominal geometry and its allowable variation.
<b>FOD</b>	<b>Foreign Object Debris/Damage</b>	Any substance, debris, or article alien to a part or system which could potentially cause damage or improper function. The acronym FOD is used to describe both the foreign objects themselves, and any foreign object damage attributed to them.
<b>PO</b>	<b>Purchase Order</b>	A defined contract for purchase of goods between EMNOR and a supplier.
<b>Ra</b>	<b>Roughness Average</b>	The roughness average or mean roughness is the arithmetic average of the absolute values of the roughness profile ordinates. Ra is one of the most effective surface roughness measures commonly adopted in general engineering practice. It gives a good general description of the height variations in the surface.
<b>Rt</b>	<b>Total Profile Height</b>	The distance from the highest peak to the deepest valley within the evaluation length.
<b>DWG</b>	<b>Drawing</b>	A representation of EMNOR's part manufacturing requirements -Interchangeable terms include print, blueprint or part technical drawing.
<b>IPA</b>	<b>Isopropyl Alcohol</b>	A colorless, flammable hydrocarbon liquid which can be used for cleaning parts.
<b>IVD</b>	<b>Ion Vapor Deposit</b>	Ion Vapor Deposition, known as IVD or Ivdizing, is a physical Vacuum deposition process which is used to apply a pure aluminum coating to various substrates, to improve the resistance to atmospheric and bi-metallic corrosion.
<b>OD</b>	<b>Outer Diameter</b>	The length of a line that bisects a circle which begins and ends on the outer surface of a feature or part.
<b>ID</b>	<b>Inner Diameter</b>	The length of a line that bisects a circle which begins and ends on the inner surface of a feature or part.
<b>NC</b>	<b>Non-Conformance</b>	A part or assembly which deviates from the specification of its part technical drawing or any standards applicable to it. This includes dimensioning and aesthetic appearances.
<b>TLO</b>	<b>Tool Length Offset</b>	An offset used to account for variations in tool length.
<b>CAD</b>	<b>Computer Aided Design</b>	Using computer software, 3D models of parts can be made. This can help with product design and visualization.
<b>CAM</b>	<b>Computer Aided Manufacture</b>	Using software to manufacture parts from data, using it to program instructions into manufacturing tools such as CNC.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

## **4.0 REFERENCE DOCUMENTS:**

SQR-1/1A	EMNOR Supplier Quality Requirements.
AS 9146	Foreign Object Damage/Foreign Object Debris (FOD) Prevention.
ASME Y14.5-2009	Dimensioning & Tolerancing.
MIL-DTL-83488	Aluminum Coatings.
MIL-DTL-5541	Chemical conversions and coatings.
MIL-A-8625	Anodizing.
SAE-AS5272 MIL-PRF-46010	Lubricant, solid film, heat cure and corrosion inhibition.
AMS QQ-P-416AMS-C-8837	Cadmium plating. Cadmium coating.

This is not a complete list of documents and specifications referenced on EMNOR drawings. As stated above, this workmanship standard does not supersede requirements referenced on EMNOR drawings.



Emnor Mechanical Inc.  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

---

### APPENDIX A:

#### 1.0 SURFACE CORROSION AND PITTING

- 1.1 This Appendix defines what constitutes a non-conformance or otherwise against EMNOR requirements in the area of surface pitting and corrosion.

#### 2.0 DEFINITIONS

- 2.1 **Corrosion** Gradual destruction of a metal surface caused by electrochemical interaction with the environment resulting in oxidation where the passive layer is compromised (by inclusion, scratches, dents, etc.).
- 2.2 **Pitting** Formation of small areas of deep material removal, indicating localized surface attack where the passive layer is compromised (by inclusion, scratch, dent, etc.). Usually such pitting is caused by a chemical attack comprised of zones with anode, cathode and electrolyte(oxidation) properties. For instance, Chlorine dissolved in water can interact with a weak Chrome-Oxide layer on a 440C part. Increased temperature or increased PH can accelerate pitting. Pits, wide or narrow, deep or shallow (with many shapes) usually are covered with corrosion by-products that hide the hole. More resistance materials with Chromium, Molybdenum or Nickel or polished surfaces or environmental control can reduce and even prevent pitting.
- 2.3 **Passive Layer** Spontaneous thin (< 10 nanometer) film created on a part surface that acts as a barrier to oxidation (corrosion pitting).

#### 3.0 BACKGROUND

Pitting corrosion results in weakened material properties for both wear and fatigue, therefore such conditions **are Non-Conforming**. Materials with low amounts of Chrome, Molybdenum and Nickel with rougher surfaces are more susceptible.

##### 3.1 Detection Method

###### 3.1.1 Visual Detection

Corrosion is usually detectable with normal unaided 1X vision. However, magnification up to 10X may be required to differentiate corrosion from watermarks, FOD, heat tint, scale or some other discoloration. Corrosion of steels is usually due to free iron from an improperly controlled process where spots (freckles) exist on the surface with rings around them and a pit in the middle. For steel, the spot color is brownish red due to iron oxide formation, but the spots may appear black if very small. Residue that wipes off with a damp cloth, IPA or another appropriate solvent is not considered corrosion unless there are pits visible at 10X. Corrosion of aluminum involves the generation of a uniform protective aluminum oxide layer that is usually dull gray to powdery white, but chlorine induced corrosion results in black spots with pitting. Note that other noncorrosive stain types (colors and shapes) exist without pitting that may result from material or electro-chemical process variation or impurities.

- 3.2 **Definition of Part-to-Print and Non-Conforming** Refer to [Section 2.0](#) of the main body for definitions on Part-to-Print and Non-Conforming.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

#### **4.0 PITTING CORROSION DETERMINATION**

##### **4.1 Decision Matrix**

- 4.1.1**     **If the Answer No then the part is to Print**
- 4.1.2**     Are Brown or Black Spots Visible at 1X, if yes then
- 4.1.3**     Clean the part with IPA or the like to confirm that other contaminants (i.e. not corrosion) have been removed, then
- 4.1.4**     Can a Pit be seen at 10X in the middle of the discoloration? If yes then
- 4.1.5**     Issue a Non Conformance report for disposition by EMNOR

## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

---

# APPENDIX B:

## COSMETIC IRREGULARITIES

### 1.0 INTRODUCTION

This Appendix defines what constitutes a non-conformance or otherwise against EMNOR requirements in the area of cosmetic irregularities.

### 2.0 DEFINITIONS

<b>Cracks:</b>	A tear or fracture in the material surface or edge.
<b>Dent:</b>	Depression in a part surface. <a href="#">Smooth</a> transition with surrounding areas and free from creases, folds, gouges or cracks.
<b>Discontinuity</b>	An irregularity with a sharp edge that is detectable with a pick specifically providing resistance to motion when the pick is run across the irregularity.
<b>Scratches, Gouges, Abrasions, Grooves or Scrapes:</b>	Irregularities resulting from material removal by a sharp object. Typically with elongated shape and not following the normal machining marks of the surrounding surface.
<b>Nicks and Dings:</b>	Surface impressions having sharp edges or corners caused by impact of a sharp object.
<b>Raised Material</b>	Displaced base material extending above the object surface plane as a result of a scratch, gouge, nick, ding or dent.
<b>Chatter (machining tool mark)</b>	Recurring irregularities on the surface that the result from vibration or jumping of a machining cutting tool.
<b>Rifling (Machining tool mark)</b>	Helical grooves or scratches on a bore that are typically caused after machining when the machining tool is removed.
<b>Machining Tool Mark</b>	Visible mark left in the machined surface of a part by the machining process. The use of this term in this document applies to marks that are irregular (visibly different from the surrounding surface of the same material) and not a normally expected surface

### 3.0 BACKGROUND

Visible irregularities on surfaces, edges of parts and assemblies may be caused by inherent material geometry, processing operations, rework performed and mishandling of the part.

#### 3.1 Detection Method

**3.1.1 Tactile Detection:** Irregularities that have a discontinuity or change in profile detectable with a plastic pick are considered to be tactile. In some cases (refer [Table B2](#)), tactile irregularities may already be [Smooth](#) or may be reworked until [Smooth](#), allowing the part to conform to the requirements of the drawing and this workmanship standard.

**3.1.2 Visual Detection:** Irregularities that are not tactile but still detectable by visual inspection are considered to be visual only. In some cases (refer [Table B2](#)) visual only irregularities will already conform to the requirements of the drawing and this workmanship



## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

standard. In other cases, e.g. sealing surfaces, these visual only irregularities violate the requirements of this workmanship standard and will not be Part-to-Print.

- 3.1.3 **Measuring the Depth of Irregularities:** It may be necessary to measure the depth of an irregularity to determine whether the part is conforming to the GD&T requirements on the drawing. This section defines the method for using Roughness Average requirements to define the allowable limits for the depth of an irregularity. A surface roughness tester or profilometer can be used to provide a trace of the surface profile of a part. Most surface roughness testers will provide a Roughness Average (Ra) and Total Profile Height (Rt) value with the trace. [Table B1](#) below shows the maximum allowable Total Profile Height (Rt) for irregularities on surfaces for typical Roughness Average requirements.

**Table B-1 - Maximum Allowable Irregularity Depths for Different Surface Finish Requirements.**

Drawing Surface Finish Requirement	(Ra)Multiple of Ra Allowed	Maximum Allowable Irregularity Depth (Rt)
≤ 8Ra Max.	3 times	≤ 24µin (.000024")
≤ 16Ra Max.	3 times	≤ 48µin (.000048")
≤ 32Ra Max.	3 times	≤ 96µin (.000096")
≤ 63Ra Max.	4 times	≤ 252µin (.000252")
≤ 125Ra Max.	4 times	≤ 500µin (.000500")

[Table B2](#) below shows the maximum allowable Total Profile Height (Rt) for regular machined surfaces (i.e. free of irregularities) with typical Roughness Average requirements.

**Table B2 – Maximum Allowable Machining Mark Depths for Different Surface Finish Requirements.**

Drawing Surface Finish Requirement	(Ra)Multiple of Ra Allowed Maximum Allowable	Total Profile Height (Rt)
≤ 8Ra Max.	4 times	≤ 32µin (.000032")
≤ 16Ra Max.	4 times	≤ 64µin (.000048")
≤ 32Ra Max.	4 times	≤ 128µin (.000128")
≤ 63Ra Max.	4 times	≤ 252µin (.000252")
≤ 125Ra Max.	4 times	≤ 500µin (.000500")

In summary:

A surface with an irregularity must:

- Have a Roughness Average (Ra) that is equal to or less than the requirement on the drawing AND
- Have a Total Profile Height (Rt) that is equal to or less than the limits defined in Table B1 above when the profile of the surface in the area of the irregularity is evaluated

A surface with no visible irregularities at 1X must:

- Have a Roughness Average (Ra) that is equal to or less than the requirement on the drawing AND
- Have a Total Profile Height (Rt) that is equal to or less than the limits defined in Table B2.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

**Note:** Even if the irregularity meets the above Ra and Rt requirements, EMNOR may still reject the part if the irregularity is on a seal groove or similarly important functional surface. Suppliers are not assumed to have such knowledge of critical part features, but such cases will likely be rare as most if not all irregularities rejected by EMNOR would fail to meet the above requirements.

**Note:** Machining steps/mismatch are not allowed. [Table B1](#) and [Table B2](#) shall not be used as a rationale to accept such features.

## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

### 4.0 COSMETIC IRREGULARITIES

#### 4.1 Part-to-Print Decision for Cosmetic Irregularities

**Table B3** below defines the Part-to-Print decision of surface irregularities against surface types.

Y = Yes (Part-to-Print)

N = No (Non-Conforming)

**Table B3 - Part-to-Print Decision by Irregularity Type**

Surface Irregularity	Machined Surface***	
	Irregularity does NOT meet all drawing GD&T requirements including Ra/Rt per Table B1	Irregularity meets all drawing GD&T requirements including Ra/Rt per TableB1
Crack	N	N
Dent	<b>Visual Only: N</b> <b>Tactile, not Smooth: N</b> <b>Tactile, Smooth: N</b>	<b>Visual Only: Y*</b> <b>Tactile, not Smooth: N</b> <b>Tactile, Smooth: Y*</b>
Discontinuity		
Nick/Ding		
Scratch		
Machining Tool Marks		
Raised Materia	N	N

\*Additional Requirements:

- Irregularity must not cover more than 5% of the part feature surface. Even if the irregularity satisfies the less than 5% of the surface allowance, it may still be unacceptable for cosmetic/aesthetic reasons, such as with an externally visible or larger surface. EMNOR may reject any visual irregularities based on quality expectations and aesthetic requirements flowed down by customers.
- Irregularities must conform to all GD&T callouts on the drawing. This includes Surface Finish per TableB1 and Table B2, Flatness, Perpendicularity, Parallelism, Edge-break dimensions etc. Even if an irregularity meets the drawing GD&T requirements and meets the definition of Smooth, EMNOR may still reject the part if the irregularity is on a seal groove or similarly important functional surface.

\*\*Additional Requirements:

- All rework must generate a Smooth surface. Where doubt exists over the interpretation of an irregularity, including whether rework-to-print is allowable, it should be considered non-conforming and additional advice sought from EMNOR engineering via a Non Conformance Report.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

- Whenever an irregularity is caused by an event that may cause an over-stress condition, such as dents caused by dropping a part, it shall be considered non-conforming and advice sought from EMNOR engineering via a Non Conformance Report.

\*\*\*Additional requirements: For as-forged and as-cast surfaces, refer to the drawing requirements for acceptability of any irregularities.



Emnor Mechanical Inc.  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS Specification 1002

---

# APPENDIX C:

## BURRS

### 1.0 INTRODUCTION

This Appendix defines EMNOR's deburr criteria for inspecting and deburring edge breaks, cross holes, wire-ways, intersecting passages, threads, profiles and general knowledge of burr removal.

### 2.0 DEFINITIONS

**Burr** - A burr is a raised edge or small piece of residual material attached to a workpiece after a machining process. Unless otherwise specified, required to be removed with a tool in a process called 'deburring'.

### 3.0 BACKGROUND

Edges should comply with drawing edge break requirements and be free of burrs. When dislodged, burrs may cause product failures, adversely affect subsequent machining and dimensional inspections, and damage other parts. While ultimate acceptance criteria depends upon factors including product application, burrs that are visible at 10X magnification are **considered non-conforming**.

#### 3.1 Detection Method

Consideration for the following may simplify the burr detection process:

**Part cleanliness** - Cleanliness may be essential for efficiently detecting burrs. Confused with dirt or other contaminants, burrs may be overlooked.

**Viewing angle** - Frequently, easily detectable burrs are overlooked when viewing a part from a single direction. It is good practice to view from varying directions and angles. In general, parts should be viewed with the line of sight between 30° to 60° to the edge or surface being inspected.

#### 3.2 Deburring / Over Deburr

##### **Deburring:**

This is a critical post-machining operation for ensuring the functionality and safe handling of the part. Edges should comply with drawing edge break requirements and be free of burrs. Care must be taken not to damage the part or introduce new defects or contamination during the deburring operation.

**Over-Deburring:** Functional surfaces such as sealing surfaces on EMNOR parts will have carefully specified land lengths and surface finish requirements, and so all specified drawing tolerances for edge conditions must be adhered to and special care must be taken not to over-deburr these features. Over-deburring of the ends of spline teeth, especially on internal splines, is also a common cause for non-conformances and rejection – care to be taken while deburring such features.

### 4.0 FLOW HOLES

#### 4.1 Feature Description



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

These features are hydraulic passages. Burr free conditions are required on these areas. Edge break requirements are to drawing specifications. Dependent upon the material, machining process, and dimensions, difficult to detect burrs and other imperfections may be created.

#### **5.0 SCALLOPPED RECESSES**

##### **5.1 Feature Description**

These features are bore intersections that play a vital role in assemblies. Burrs and contaminants may be hidden from view. Burr free conditions are required. Top edges of scallops are to be **Smooth** while still meeting drawing specifications.

**Note: For proper inspection use mirror, bore scope and/or endoscope**

#### **6.0 INTERSECTING PASSAGES**

##### **6.1 Feature Description**

Form essential flow paths that must be free of restrictions and debris. Intersections should be verified, and passages should be free of chips and burrs.

#### **7.0 INTERNAL AND EXTERNAL THREADS**

##### **7.1 Feature Description**

These features are high stress areas and are critical to the assembly of the part. Deburr first and last thread and blend all chamfers that are present on bores. Burr free conditions are essential on these features.

#### **8.0 BLIND TAPPED HOLES**

##### **8.1 Feature Description**

Generally low stress areas. Be sure to remove any FOD such as packed chips and other debris. No extruded material is allowed on mating surfaces. Deburr the first thread and make sure last thread is clean without hanging material.

#### **9.0 SPLINES AND SERRATIONS**

##### **9.1 Feature Description**

Ridges or teeth on a drive shaft that mesh with grooves in a mating piece and transfer torque to it, maintaining the angular correspondence between them. Burrs are usually large on one side of spline. Remove all burrs while maintaining drawing requirements.

#### **10.0 WIREWAYS**

##### **10.1 Feature Description**

These features are generally low stress, dry areas. Edges must be blended and **Smooth** to prevent damage to wires during installation. Edge break requirements are to drawing specification.

#### **11.0 TIE WIRE HOLES**

##### **11.1 Feature Description**

These features are non-stress diameters used to lock a part in place in the assembly. Burr free condition is essential on these features to ensure no cross-contamination at assembly.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

## **EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**

### **Specification 1002**

---

## **APPENDIX D:**

## **EXTERNAL CONTOURING**

### **1.0 INTRODUCTION**

This Appendix defines what constitutes a non-conformance or otherwise against EMNOR requirements in the area of external contouring. Specifically, this includes fillets and radii created during machining operations.

### **2.0 DEFINITIONS**

- 2.1 Drawing Border Tolerance  
The tolerances called out on the drawing border, which state “unless otherwise specified...”
- 2.2 Edge radius  
A corner radius between the junction of 2 surfaces where the material is on the inside of the radius, lying on and external corner
- 2.3 Fillet  
A corner radius between the junction of 2 surfaces where the material is on the outside of the radius, lying on an internal corner

### **3.0 External Contouring**

The following requirements are applicable to all fillets and radii created during external part contouring. These features are typically defined on the drawing with a note similar to “Unless otherwise specified, Contour fillets are to be R.250” or “Unless otherwise specified, Contour fillets are to be R.375”.

- The radii must fall within the criteria established in Section 3.4.
- Fillets not defined or shown on the drawing shall be compliant to the drawing note. They must be uniform in shape and can be generated via milling or turning but must be [Smooth](#).
- Radii should be tangential to adjacent surfaces and bisect corners that they cannot be tangent to due to space constraints. These radii commonly create contour bridging between the bosses and features.
- Surfaces between faces should not be created in an attempt to fill in the solid model. They should have a fillet radius between the faces and bisecting the corners of the adjacent faces, but not necessarily tangential to the adjacent faces (i.e. not necessarily a full radius). Imagine a ball with a radius matching the fillet radius note rolling around the part. Any place it will not fit gets a radius from the ball while contacting the two adjacent surfaces or edges. The remaining material is referred to as contour bridging and is acceptable.



**Emnor Mechanical Inc.**  
20 Depew Street  
Hamilton, Ontario  
L8L 7H8

**EMNOR WORKMANSHIP STANDARDS FOR MACHINED PARTS**  
**Specification 1002**

---