G.W. Lisk Co., Inc.
Workmanship Manual
DOC 09-09
Revision 4

Final Approval: Ron Panek **Date:** 07Jul17

PURPOSE:

This documentation establishes the G.W. Lisk definitions, requirements, and inspection criteria for workmanship of components and assemblies. This standard is intended to serve as a consistent guide for determination of questionable flaws that arise during the course of visual examination. Standards within this document are applied to G.W. Lisk and its suppliers.

SCOPE:

This document applies to all purchased and manufactured, components and assemblies which are supplied to G.W. Lisk customers.

1.0 Definitions:

This section defines terms used in this document.

Flaw: a mark, blemish or other imperfection which mars a surface. May include the following:

Burr: A rough edge or a sharp protrusion on the edge of surface of the parent material. Reference EPS-805-STD for further definition and acceptance criteria. (Figure 1.2.1 and 1.2.2)

Chatter/Chatter Marks: A pattern of undulations introduced on a machined surface by intermittent loading as a result of vibration on the work piece, cutting tool, grinding wheel, etc. (Figure 1.4)

Crack: A linear defect as a narrow break /fissure resulting in a partial/complete parting of material. (Figure 1.1)

Ding/Dent: A completely smooth surface depression caused by pressure or impact from another object. The parent material is displaced, but usually none is separated. (Figure 1.3 and 1.5)

Flash: excess material which has flowed out of the mold at the parting line and is still attached to a molded part.

Flow Line: linear or circular grooving on the surface of a part from the flow of material within the mold.

FOD: (foreign object debris) may be fluid, metallic, fibrous etc.

Gouge: A wide, rough scratch or group of scratches, usually with one or more sharply impressed corners, and frequently accompanied by deformation or removal of parent material.

Nick: A surface impression with sharp corners or bottom, usually caused by pressure or impact from a sharp-edged foreign body. The parent material is displaced, but usually none is separated.

Pinched: Distortion of one or more surfaces of the parent material, caused by pressure.

Pitting: Small crater looking appearance typically caused by oxidation of the base material. (Figure 1.8.3)

Raised Material: Any material that protrudes above the parent surface or pad.

Scratch: A long, narrow, sharp cornered impression caused by the movement of a sharp object across the surface of the parent material. (Figure 1.5)

Short Shot: Incomplete fill of mold for molded plastic or rubber which results in an incomplete/deformed part.

Thread Damage: Threads shall be free from flaws that would affect run-on torque with a free running mating thread. Flaws which result in incomplete thread are acceptable providing they are not so deep as to cross the pitch line of the thread. There should be no more than three flaws per unit length equal to thread O.D.

Void: A gap or air bubble in a molded material resulting in loss of structural integrity.

External Features: Feature on the part being delivered to a Lisk customer which is visible without disassembly.

Internal Feature: A feature on the part that is not visible to the customer without disassembly.

Sealing Surface: Features generally with 63 Ra or better surface texture are used for sealing purposes (Exception: 63 Ra used for reamed holes). Therefore, FLAWS (chatter, dings/dents, nicks, scratches, etc.) that would cause a leak path or shear an O-ring, are not allowed on features with 63 Ra surface texture or better.

2.0 Requirements (Acceptance Instructions)

The following is an overview of the defects which may or may not be acceptable based on the requirements of G.W. Lisk and their customers.

2.1 Unacceptable Workmanship Defects (internal and external)

The following defects are unacceptable in any case unless specified on the print. Please refer to any process documentation on the print for further instructions on certain processes.

- **Cracks**
- **Pitting/Pits**
- **Short shot**
- **Flow lines**
- **Flash**
- **Voids**
- **Raised Material:** which affects the dimension or is a result of the other listed defects within this document.
- **FOD:** Debris free parts are critical to the function of the assemblies at G.W. Lisk. FOD is not acceptable for assemblies or their components. (see definition)
- **Burrs:** burrs in general will not be acceptable and hanging burrs are not acceptable due to the creation of FOD. Reference EPS-805-S.
- **General:** Any workmanship defect that violates surface finish requirements, dimensions, or creates a sharp condition.

2.2 Internal Feature (not visible to G.W. Lisk customer):

- **Chatter/Chatter Marks, Ding/Dent, Gouge, Nick, Scratch** are acceptable as long as:
  - The flaw does not violate dimensional requirements
  - The flaw is not on a sealing surface
  - There is no raised material
  - The flaw does not impact other features
  - The flaw does not create a thin wall condition
  - The surface continues to meet surface finish requirement
- **All other flaws listed in section 2.1 are** NOT ACCEPTABLE.

2.3 External Feature (Visible to G.W. Lisk Customer):

The following specifications apply:

- **Chatter/Chatter Marks, Ding/Dent, Gouge, Nick, Scratch** acceptable as long as:
  - The flaw does not violate dimensional requirements
  - The flaw is not on a sealing surface
  - There is no raised material
  - The flaw does not impact other features
  - The flaw does not create a thin wall condition
  - The surface continues to meet surface finish requirement
- **Thread Damage:** Reference EPS-805-S for burrs on threads. Threads shall be free from flaws that would affect run-on torque with a free running mating thread. Nicks and other flaws which result in incomplete thread are acceptable providing they are not so deep as to cross the pitch line of the thread, and providing there are no more than three flaws per unit length equal to thread O.D.
- **Shrink Sleeve Damage:** There shall be no splits, cracks in the sleeving which would expose the lead wires.
- **Wire Damage:** An area on the insulation of a wire that has been reduced by either a gouge or dent is unacceptable as gouges or dents can affect the insulating properties of the wire. Damage to lead wires is unacceptable. (Figure 1.9.4)
- **Molding Defects:** (voids, short shot, flow lines, flash) are not acceptable on rubber or plastic parts. (Figure 1.9.2 and 1.9.3)
- **All other flaws listed in section 2.1 are** NOT ACCEPTABLE.

2.4 Additional Defect Information for Special Processes

- **Connectors:** The connector marking shall remain in the same condition as received from the supplier. There shall be no loss of marking information or circular (red/blue) stripe around the circumference of the connector. (Figure 1.9.3)
- **Lockwiring:** The lockwiring shall have positive pull, correct twists per inch, pulled tight, and correct pigtail length. The lockwiring shall conform to the requirements of AS567 and NASM 33540.
- **Plating:** The plating shall be uniform in appearance and shall be free of pits, roughness, cracks, and nodules and show no signs of lack of adhesion such as; flaking peeling or blistering. The coating shall not be stained or discolored. However, staining as a result of rinsing or slight discoloration as a result of drying or baking is not cause for rejection. Refer to the specific EPS-500 series document called out on the drawing for workmanship criteria. (Figure 1.7.1 and 1.7.2)
- **Screws:** Screws shall be flush to the surface and must have no gap between the head of the screw and mating part. Use of a feeler gauge is required if there is a visible gap between the head of the screw and surface of the part. There shall be no gap greater than .003". (Figure 1.9.6)
- **Epoxy Workmanship:** There shall be no excess epoxy exposed from the assembly. This is considered FOD and is not acceptable. (Figure 1.9.7)

Please see section 5.0 picture examples for representation of the defined defects. Additional undefined and unacceptable defects are provided in the examples or can be requested from a quality engineer.

3.0 Exception and Further Requirements

Components and assemblies which go into products may have specific workmanship requirements based on the customer flow downs. Below is a matrix for categories of products as workmanship applies.

The required measurement method for scratches, dings, dents, etc. is to first use a comparator under reflection for length and width. If both are acceptable and the defect is still questionable, a profilometer with the appropriate stylus for the required surface finish should be used to evaluate the depth as required by ASTM standards.

The requirement is listed on the purchase order or route as a labeled workmanship class. If the requirement is not listed, workmanship should default to category C. Specific drawing requirements supersede workmanship requirements

If you are unsure of the requirements or level of requirement for the component or assembly, please contact your SQE, Quality Engineer or Buyer.

3.1 Category A – includes most stringent requirements and should meet the requirements of section 2.0 of this document as well as the requirements listed below. The chart includes dimensions for acceptability, unless the surface is a functional or sealing surface. Cracks and pits are not acceptable under any circumstances in category A.

Acceptable Flaws Non-Sealing and Non-Functional Surfaces			
Finish Requirement	**Max Depth**	**Max Width**	**Max Length**
00-32 Ra (visual inspection is not acceptable)			
Scratch	0.002	0.001	Any
Nicks / Dents	0.002	0.002	0.004
33-63 Ra			
Scratch	0.003	0.002	Any
Nicks / Dents	0.003	0.003	0.008
64-125 Ra			
Scratch	0.004	0.004	Any
Nicks / Dents	0.004	0.004	0.012
126-250 Ra			
Scratch	0.006	0.005	Any
Nicks / Dents	0.006	0.005	0.018
251 or higher			
Scratch	0.007	0.007	Any
Nicks / Dents	0.007	0.007	0.025

3.2 Category B – not currently in use

3.3 Category C – includes general requirements (see section2.0) and exceptions may be approved by a Customer Quality Engineer.

- Workmanship may not violate print or standard requirements contained in this document
- Workmanship may not violate the intended purpose of the component or assembly
- Workmanship may not violate the intended purpose of the product
- Reference applicable process documents as called out on the print

4.0 Packaging Notification

- External Suppliers are responsible for packaging material in order to best protect parts from these defects. Packaging is a requirement of the PPAP documentation. If there are questions or concerns regarding appropriate packaging, suppliers should contact their SQE.
- Internal operations are responsible for appropriately packaging materials to move between operations. If there are questions or concerns regarding operation to operation packaging, the QE should be contacted.
- Please reference DOC 09-02 for initial requirements for packaging.

5.0 Picture Examples of Defined Defects

Figure 1.1 - Example of Cracked Material

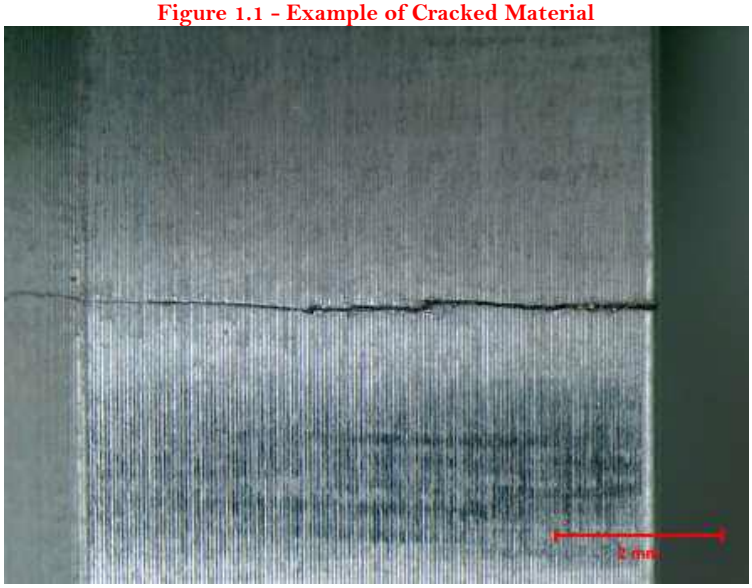
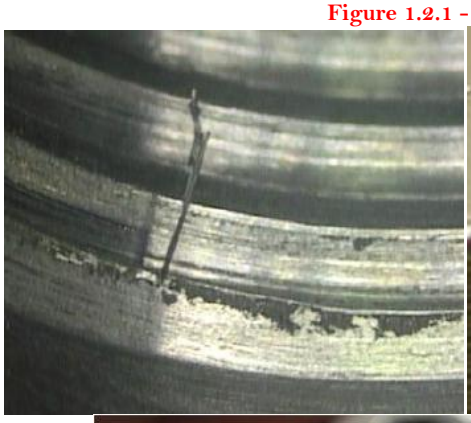
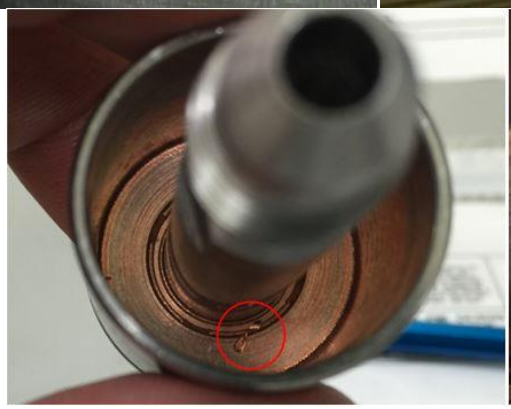


Figure 1.2.1 - Examples of Unacceptable Burrs





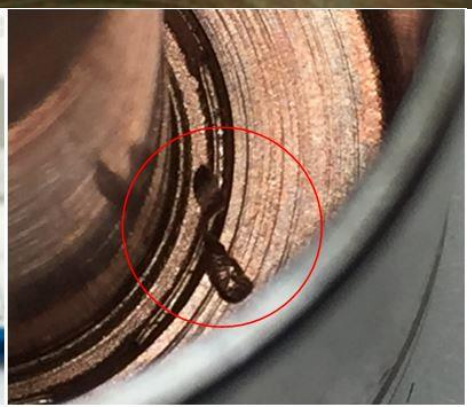
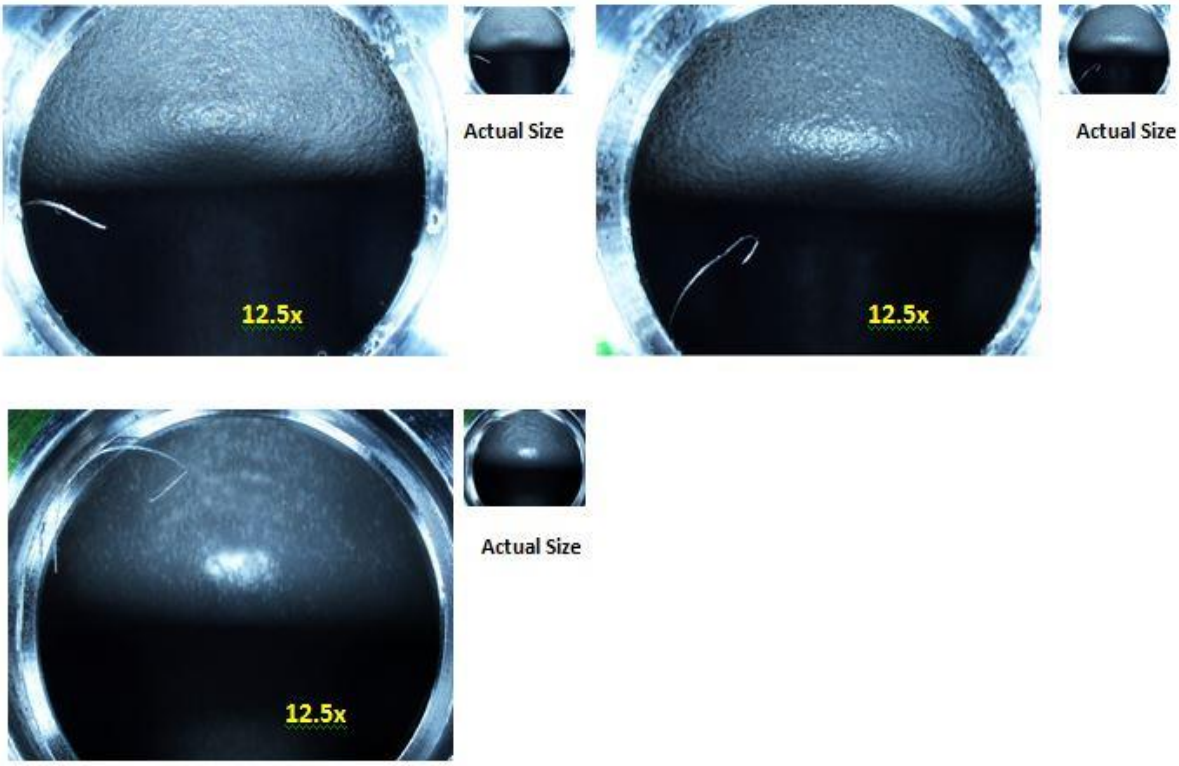


Figure 1.2.2 - Examples of Unacceptable Burrs



Below are digital images of "Unacceptable Burr" conditions.

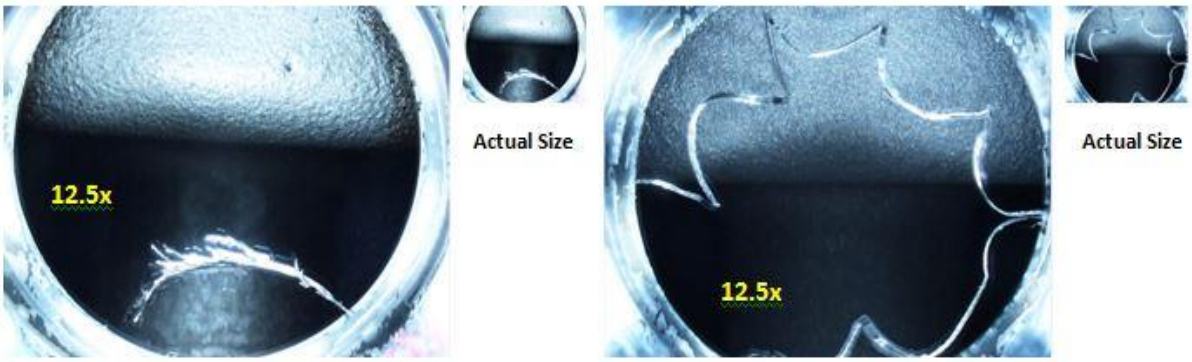
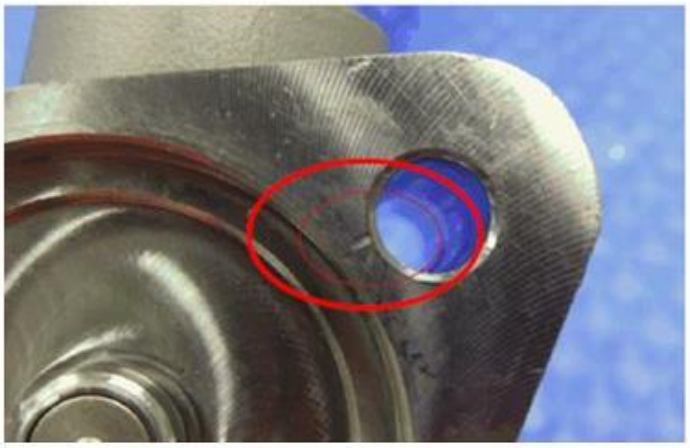


Figure 1.3 - Examples of Dings/Dents

Figure 1.4 - Example of Unacceptable Chatter

Figure 1.5 - Damage, Dings, and Scratches



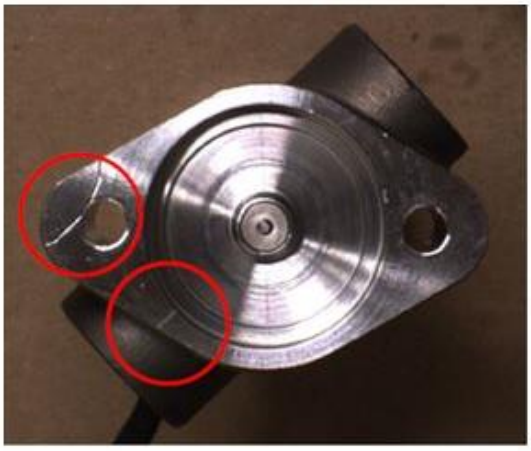


Figure 1.6.1

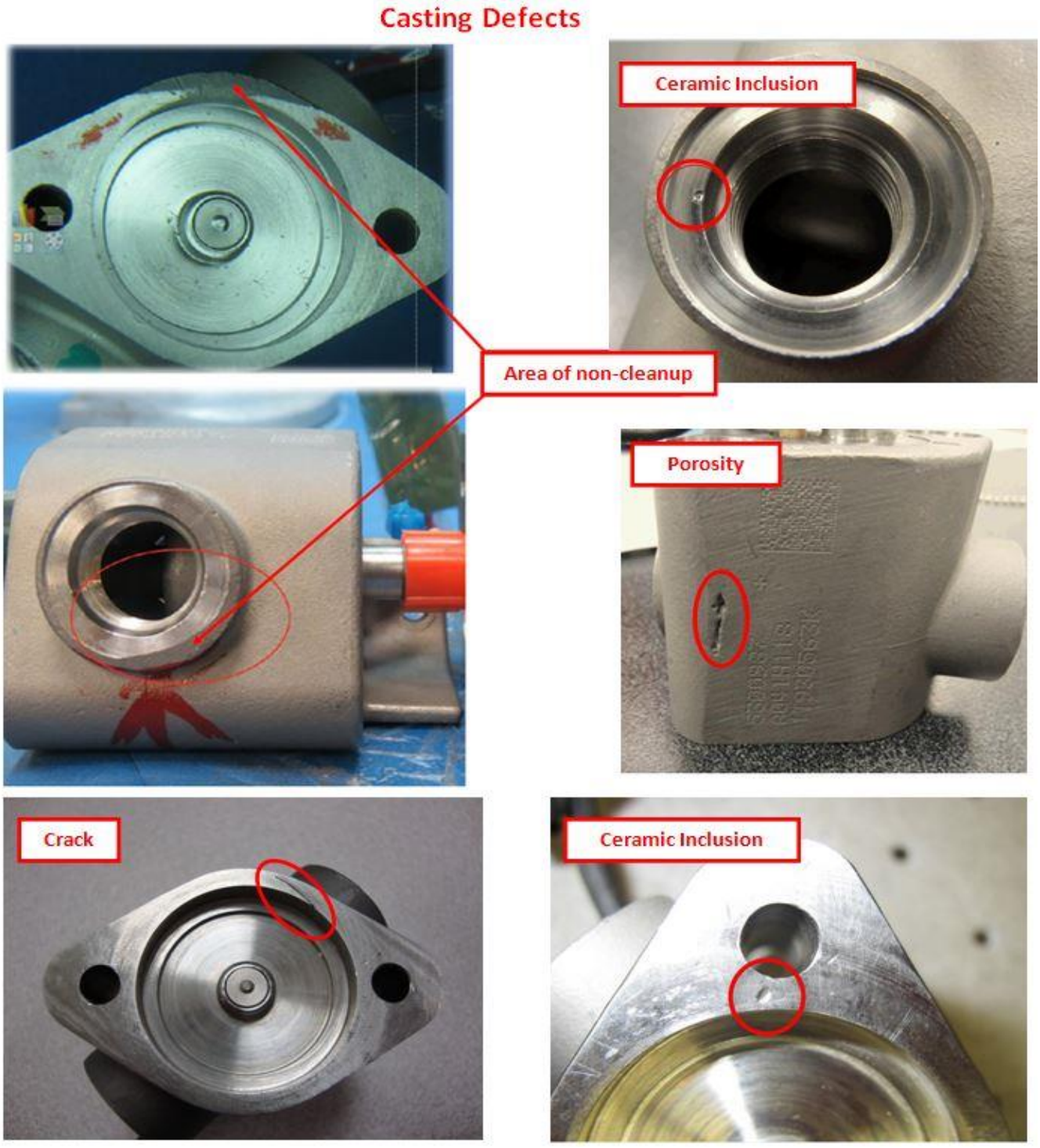


Figure 1.6.2 – Casting Defects

Figure 1.6.3 – Example of unacceptable casting sand

Figure 1.6.4 – Example of unacceptable casting voids

Figure 1.7.1 – Damage to Plating

Figure 1.7.2 - Examples of Unacceptable Plating Adhesion from Tape Test

Figure 1.8.1

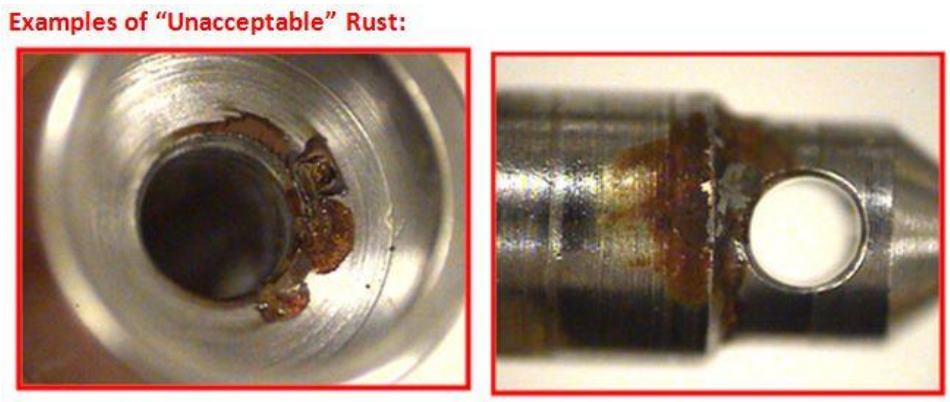


Figure 1.8.2 – Example of Unacceptable Surface

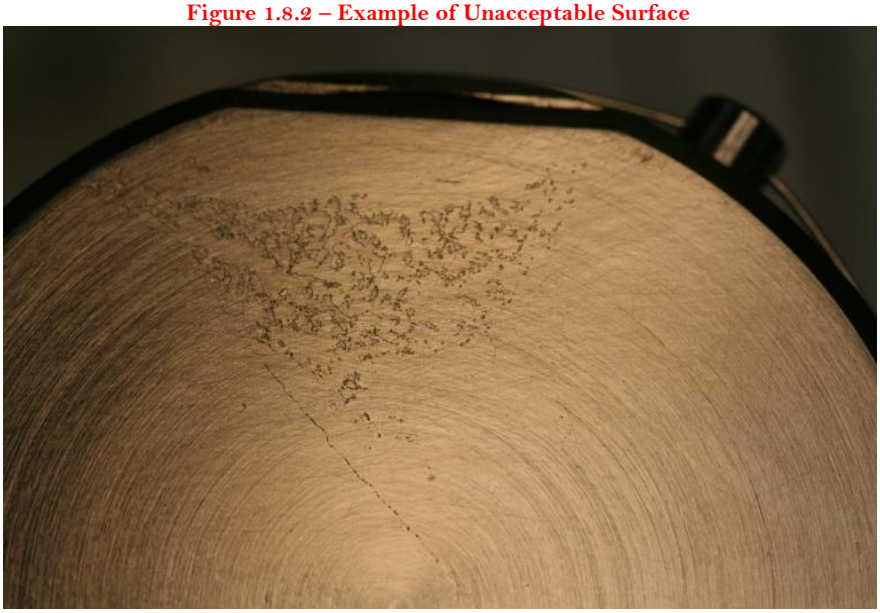


Figure 1.8.3 – Examples of Pitting

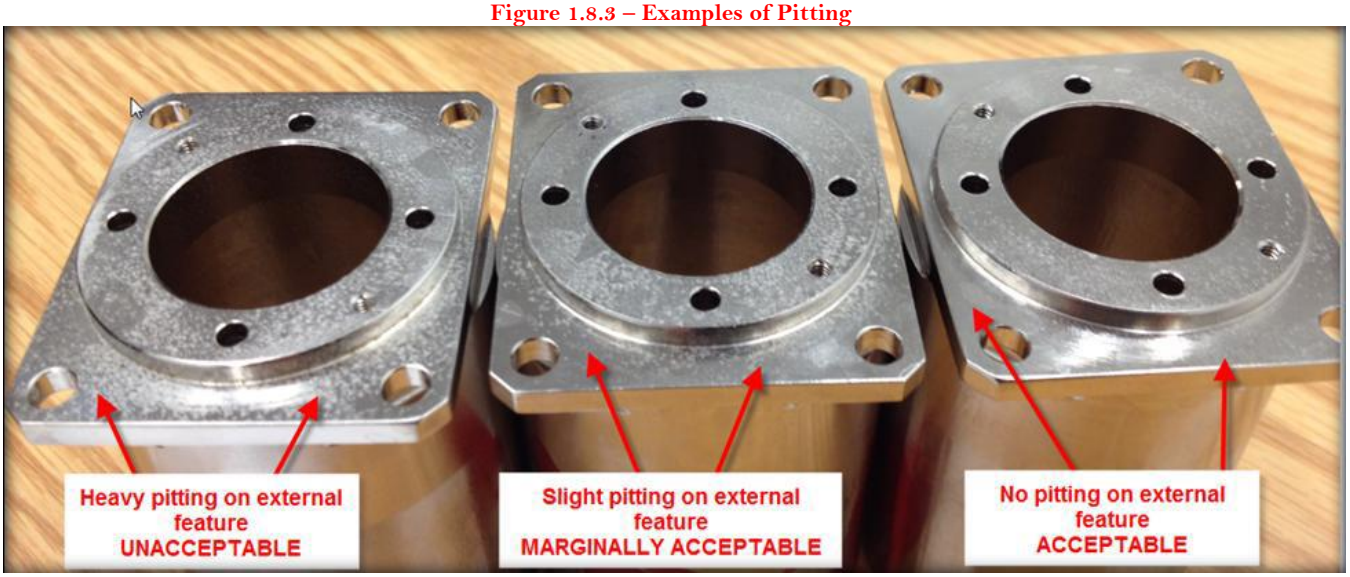


Figure 1.9.1 – Example of a Flow Line

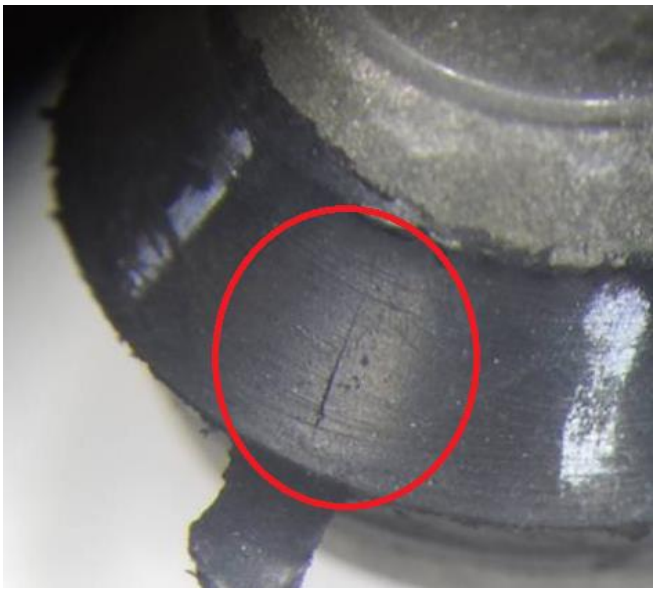


Figure 1.9.2 – Examples of Voids

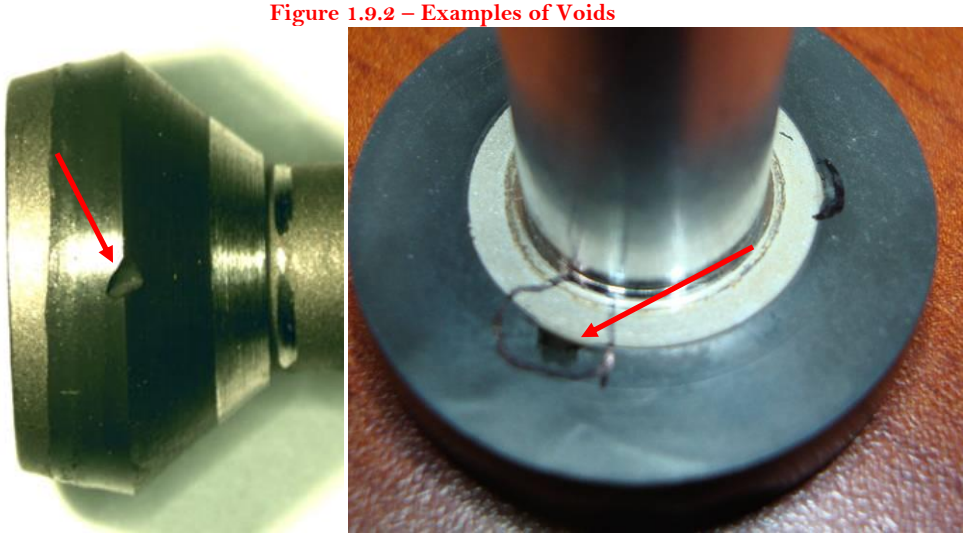


Figure 1.9.3 - Examples of Process Defects

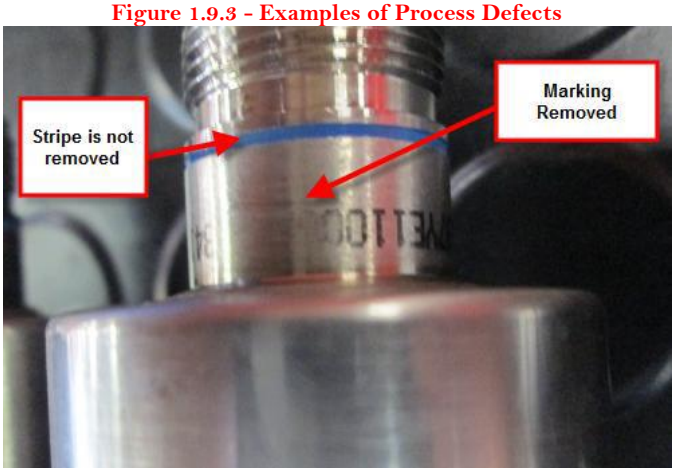


Figure 1.9.4 - Unacceptable Wire Damage

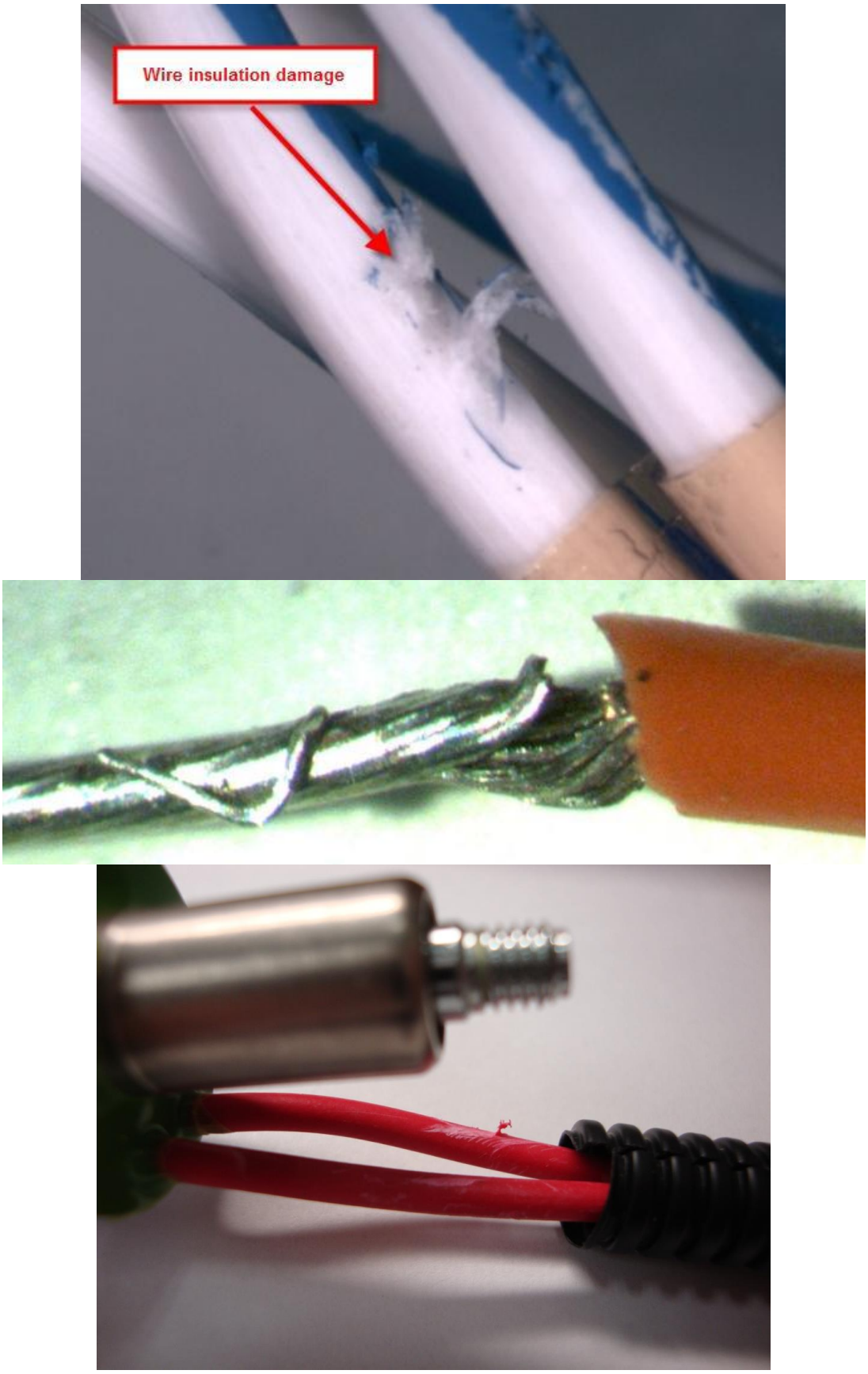


Figure 1.9.5 - Internal, Assembly Only

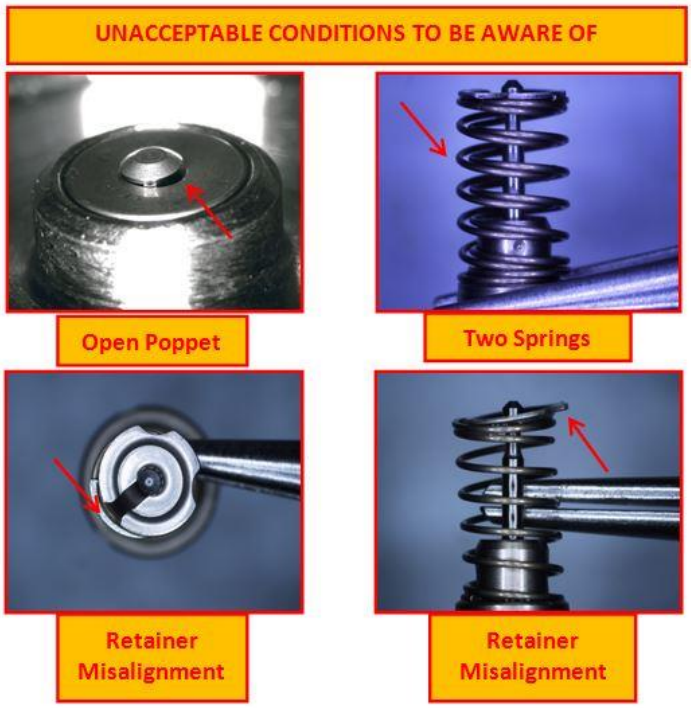


Figure 1.9.6 - Unacceptable Screw Condition

Figure 1.9.7 – Unacceptable Epoxy

Revision History:

CR#95, Rev4, 20Jun17: • Addition of section three

- Formatting edits general
- Addition of pictures 1.6.3 and 1.6.4
- Increased detail in section 2.2 and 2.3 for clarification