

Inspection Standard: Sheet Metal, Machined, and Carbon Fiber Parts Quality

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Revision: D

Revision History:

Rev	Change Order	Description	Date	Prepared By	Approved By
A	C3-01057	Initial Release.	2/27/2020	Sara Liddi	Mack Huntress, Terry Crandell, Kari Niebell, Danen Butler
B	C3-02025	Update per C3-02025	7/21/2021	Sara Liddi	Mack Huntress, Kari Niebell, Paul Han
C	C3-04077	Change Title to Inspection Standard: Sheet Metal, Machined, and Carbon Fiber Parts Update to include information that was present in 24-01553 that was missing from Rev B of this document. Add Section 6.2 Laser Engraving/Laser Etch Add Section 6.3 Durability Test for Laser Etching & Silkscreen Clarify Appendix A to better define types of scratches.	10/22/2024	Kari Niebell	Michael Watkins Josh Bollinger
D	C3-04937	Updated part number to include the -W suffix.	4/17/2026	Kari Niebell	Michael Watkins Josh Bollinger

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1 Purpose

This document provides cosmetic appearance guidelines and acceptance criteria for ZMicro's sheet metal, machined, and carbon fiber parts. It is intended to be used as a reference by ZMicro's manufacturers/suppliers of these commodities as well as internally by ZMicro when inspecting or otherwise evaluating this material.

2 Scope

This standard applies to ZMicro sheet metal, machined, and carbon fiber parts that enter and exit ZMicro. It establishes quality requirements for the cosmetic acceptance of purchased custom ZMicro sheet metal, machined, and carbon fiber parts. This standard shall be used to ensure parts manufactured for ZMicro comply with ZMicro requirements.

3 Definitions

N/A

4 Responsibilities

- ZMicro Quality:
 - o Establish and enforce the requirements as defined in this document.
 - o Use the criteria defined in this document when performing inspection on applicable components and ZMicro products.
 - o Apply the criteria defined in this document when generating new inspection procedures.
- ZMicro Engineering:
 - o Identify the surface class assignment on part drawings. This assignment will be made per 24-01574, Surface Class Definitions.
- Supplier
 - o Provide all parts and services as outlined in the corresponding Purchase Orders, drawings, specifications, and this inspection standard.
- ZMicro Employees:
 - o Use the criteria defined in this document when working with ZMicro products and process any non-conformances in accordance with 22-0034P, Non-Conforming Material.

4.1 Communication

All product-quality related communication between ZMicro and its suppliers, including questions or requests for additional information, should include ZMicro's Supplier Quality representative.

4.2 Compliance

Full compliance from all organizations within scope is expected at the time of issuance of this document. Any exceptions to the specification referenced herein must be submitted by the supplier and approved by the appropriate ZMicro representative and documented accordingly.

5 Cosmetic Quality Requirements

5.1 Surface Classes

All part surfaces are classified into distinct areas based on their visibility and significance on the finished product. These classifications, known as surface classes, help define the cosmetic quality requirements for each area. ZMicro utilizes four surface classes, labeled A, B, C, D. The specific surface class for each part is indicated on the part drawing, and further details on these classifications are outlined in document 24-01574, *Surface Class Definitions*.

If a drawing does not specify a surface class, the requirements for surface class A shall be applied by default.

5.2 Viewing Distance and Time

- Unless otherwise stated, viewing distance and duration shall be based on part classification, which will be defined on part drawings.
- Visual inspection of ZMicro parts shall use the Time and Distance method of inspection described in this document.

Viewing Surface	Class A	Class B	Class C	Class D
Viewing Distance	18 inches	24 inches	30 inches	N/A
Viewing Time	10 seconds	8 seconds	6 seconds	N/A

5.3 Viewing Conditions

- Viewing tools: Inspection conducted using the unaided eye. Magnification may be used as an aid to evaluate an observed condition.
- Viewing angle: $45^\circ \pm 15^\circ$ to the surface, unless otherwise specified.
- Light source: Cool white fluorescent light; the light source will be positioned and distanced to provide optimal viewing and minimized glare and shadowing of the component under inspection.

5.4 General Acceptance Criteria

- Products must meet requirements specified in this document, in conjunction with the chart in Appendix A, and the drawing.
- Note: When a discrepancy exists between this document and the drawing, the drawing takes priority.
- Defects that affect the fit, form, or function of the product will not be accepted. Exceptions may apply provided written authorization from our customer.
- Cleanliness of parts:
 - o Product should be free of dirt, grease, oils, contaminants, touch-up paint/ink, and any removable foreign material. The exception to this is mylar/protective film used to protect carbon fiber parts during the manufacturing/handling/shipping process.
 - o ZMicro may clean or reject material for unacceptable cleanliness. Powder coat, silkscreen, and finish should not become faded when cleaned with isopropyl alcohol.

6 Acceptance Criteria: Sheet Metal and Machined Parts

6.1 Silkscreen

- Must match the color as specified on the drawing.
- Must be permanent as verified by 8.3, Durability Test for Laser Etching and Silkscreen.
- Defects in the lettering or surface are not permitted.
- The following shall NOT be permitted when viewed from the distances outlined in 7.2, Viewing Distance and Time:
 - o Smearred/smudged ink.
 - o Spreading/bleeding of ink.
 - o Fading of ink.
 - o FOD within ink.
 - o Peeling/flaking of ink.
 - o Unfilled apertures in letters.
 - o Missing ink in the body of symbol/lettering (voids).

6.2 Laser Engraving/Laser Etch

- Must be legible.
- Must be permanent as verified by 8.3, Durability Test for Laser Etching and Silkscreen.
- No visible defects in the engraving/etch are permitted.
- The laser engraved/etched area shall NOT contain any of the following anomalies:
 - o Smearing/Smudges
 - o Spreading/bleeding
 - o Fading
 - o FOD
 - o Peeling/flaking
 - o Unfilled apertures
 - o Voids

6.3 Durability Test for Laser Etching & Silkscreen

Apply isopropyl alcohol to a lint-free cloth.

Rub the laser-etched/silkscreened area with consistent pressure for 3 passes.

Evidence of fading, smearing, or wear will result in rejection.

6.4 Powder Coat

- Must match the color as specified on the drawing.
- Powder coat must be uniform with no bare metal showing through.
- Texture must be consistent throughout the entire part.
- Any debris on the painted surface must comply with the measurement limits outlined in Appendix A Cosmetic Reference Standard Table and should be fully covered by paint. There must be 3 inches separating individual debris.
- Scratches must conform to the width and length restrictions referenced Appendix A Cosmetic Reference Standard Table. No bare metal may be visible through any scratch or blemish.
- Follow the ZMicro part drawing for masked areas and allowable overspray.

6.5 Chem film

There are two types of chemical (chem) film used by ZMicro. 1. Gold which contains Hexavalent Chromate and 2. Clear which does not contain Hexavalent Chromate.

- Chem film coverage should be full, leaving no bare metal exposed.
- Chem film should be as even in finish as the chem film application process allows, avoiding darker/lighter patches/stains caused by masking residue, oversaturation, or incomplete cleaning.
- Chem film should be set/cleaned enough so that application and subsequent removal of adhesives such as painter's tape or QA stickers does not cause fading/visually apparent removal of chem film (except surface class D).
- Scratches may be permissible provided they fall within the dimensional criteria of the Appendix A Cosmetic Reference Standard Table, and they are covered by chem film.

6.6 Anodize

- Finish shall not cause dimensions to exceed the drawing tolerances.
- Finish shall be even and fully adhered, with no bare metal exposed and no flaking.
- Masking/plugging shall be used to prevent overspray in areas referred to on the drawing, such as threaded holes.

6.7 Staining and Discoloration

- For powder coated and uncoated parts, staining and discoloration must not be visible from the viewing distances/surface classes outlined in Appendix A Cosmetic Reference Standard Table.
- Standard mill finish applies unless more stringent criteria are defined on the drawing.

6.8 Scratches, Tooling Marks, Bend Lines

- Scratches:
 - o Acceptance criteria per guidelines in Appendix A Cosmetic Reference Standard Table.
- Tool Marks:
 - o Acceptance criteria per guidelines in Appendix A Cosmetic Reference Standard Table.
- Bend Lines
 - o Shall be allowed permitting they are straight, consistent lines as referenced per the guidelines in Appendix A Cosmetic Reference Standard Table. Bend lines shall remain as shallow as the manufacturing process reasonably permits.
- Chem Film parts:
 - o Scratches, tool marks, and bend lines must remain covered by chem film, regardless of surface class.

6.9 Welding

- Excess welds may be permitted provided it does not affect form, fit, function, and it is internal (Surface Class D).
- Welded areas must not be cracked, incomplete, or have voids.

6.10 Hardware

- Hardware shall be securely installed per specific hardware requirements.
- PEMs/self-locking clinch nuts shall be installed flush, neither protruding or depressed, so that teeth are sufficiently gripping metal.

7 Acceptance Criteria: Carbon Fiber Parts

7.1 Panel thickness

- Panel shall be the thickness stated in the materials callout on the drawing. It is critical that it does not exceed the maximum tolerance stated.

7.2 A1/A2 Finish Requirements

- Must match the color as specified on the drawing.
- Weave, finish, texture, and color shall have full, consistent coverage and match ZMicro's sample coupon TM-00054.
- Scratches/tool marks must conform to the width and length restrictions referenced in Appendix A Cosmetic Reference Standard Table.
- It is not acceptable for finish on surfaces to cause dimensions to exceed the allowable drawing dimensions.

7.3 B1/B2 Finish Requirements

- Any debris in the copper conductive coated surface which falls within the measurement restrictions referenced Appendix A Cosmetic Reference Standard Table should be fully covered by copper finish.
- All scratches and tool marks must remain covered by copper finish. Touch-up is permitted.
- provided they pass visual evaluation in accordance with the distance and time for the corresponding zone and provided they do not cause dimensional issues.
- Pocket depths must be consistent to the entire pocket and shall not have tooling "steps" or gradients (results of machining process) that interfere with these pocket depth measurements.

7.4 Staining and Discoloration

- Staining and discoloration on the top of the part must not be visible from the viewing distances/surface classes outlined below.

7.5 Countersinks

- Countersinks should be clean with no fibers protruding from the circumference.
- Countersinks should be correctly dimensioned so that hardware (provided by ZMicro to aid inspection at supplier's site) lies completely flush, with no protrusion.

7.6 Packaging

- Parts shall be individually wrapped and protected using bubble wrap, plastic bags, or other similar packaging to protect each panel from damage caused during stacking/shipping.
- Part number and revision shall be labeled on the exterior of the lot packaging.

8 Record Retention

Records required by this procedure are maintained per 30-0007P, Control of Records.

9 Related Documents

30-0007P - Control of Records

24-01574 - Surface Class Definitions

10 Appendix A: Cosmetic Reference Standard Table

CLASS	A1	A2	B1	B2	C1	C2	D1	D2
APPLICATION	SMALL EXTERNAL	LARGE EXTERNAL	SMALL EXTERNAL	LARGE EXTERNAL	SMALL EXTERNAL	LARGE EXTERNAL	SMALL INTERNAL	LARGE INTERNAL
FOD in powder coat (There must be 3" separating individual FOD)	None	QTY 2: .025" DIA x .015" H	QTY 2: .030" DIA x .015" H	QTY 4: .050" DIA x .015" H	N/A	N/A	Acceptable	Acceptable
Phantom Scratch (light surface marring, may only be visible at certain angles through manipulation)	None	QTY 2: 0.25" L x .010 W	QTY 2: 0.25" L x .010" W	QTY 4: 0.50" L x .010" W	QTY 4: 3.0" L x .020W	QTY 8: 4.0" L x .020W	Acceptable	SEE NOTE 1
Scratch that does not catch fingernail	None	None	QTY 1: 0.15" L x 0.005" W	QTY 4: 0.25" L x 0.005" W	QTY 4: 2.0" L x .010 W	Qty 4: 4.0" L x .010 W	Acceptable	SEE NOTE 1
Scratch that catches fingernail	None	None	None	None	None	None	Acceptable	SEE NOTE 1
Exposed metal from scratch, bend-lines, dents, dings, or fractures	None	None	None	None	None	None	None	None
Tooling Marks (process marks consistent on all parts, doesn't catch fingernail)	None	QTY 2: .025" L x .015" W	QTY 2: 0.25" L x .015" W	QTY 4: .050" L x .015" W	QTY 2: 0.5" L x .015 W	QTY 4: 1.0" L x .015" W	Acceptable	Acceptable
Bend lines- straight, consistent, shallow lines.	None	None	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Dent, Ding, Nick 0.05" depth max	None	None	QTY 1: 0.15" DIA	QTY 2: 0.15" DIA	QTY 1: 0.25" DIA	Qty 2: 0.25" DIA	SEE NOTE 1	SEE NOTE 1
Fracture, split, crack	Defect not allowed							

Incomplete fill/ cold shot in cast metals	Defect not allowed
Corrosion, oxidation, rust	Defect not allowed
Burrs and sharp edges	Defect not allowed
Protruding fasteners (PEMs, hardware, rivets, etc)	Defect not allowed

NOTE 1: Flaws exceeding those allowed under Class C2 are permitted; however, the flaws must not be so severe as to affect form, fit or function.