



ENGINEERING SPECIFICATION

Part #: 010-100594
Revision: 04

Revision #	Date Prepared	Change
01	11/08/05	Initial Release
02	5/16/06	Update salt spray hours & add note regarding paint in threads
03	4/10/14	Update RoHS directive to 2011/65/EU
04	10/10/14	Update entire finishes Section 5 for magnesium, salt spray requirements, and coating verification

DESCRIPTION: Part RoHS, Finish, Handling, Defect, and Other Requirements

FAMILY: General

1. Scope

This specification is intended to convey Christie Digital Systems requirements for parts and assemblies, to the Vendor. This specification covers all standard processes used for manufacturing, including deburring, finishing, coating, marking, handling, defects & inspection, and especially RoHS (Restriction of Hazardous Substances) requirements for materials and processes.

Unless otherwise stated, every section of this specification shall apply to all parts or assemblies for which it is called up on the drawing.

2. RoHS Requirements

European Union Directive 2011/65/EU, which came into effect 2 January 2013 and repealed Directive 2002/95/EC, places strict limits on hazardous substances used in the manufacture of electrical and electronic equipment. There are 6 regulated substances, as listed below, along with their defined limits.

- Lead
- Hexavalent Chromium
- Cadmium
- Mercury
- Polybrominated biphenyl (PBB) flame retardants
- Polybrominated diphenyl ether (PBDE) flame retardants

These substances are limited to very low levels, less than 0.1% by weight (1000ppm) for all elements but cadmium and 0.01% by weight (100 ppm) for cadmium.

There are also some specific exemptions that that apply to metals.

Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminum



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containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.

2.1. Part / Assembly Requirements

The following requirements shall be met by all products purchased by Christie Digital Systems Inc.

- 2.1.1. No RoHS restricted substance shall be present in quantities greater than the defined limits for said substance, per 2011/65/EU. This includes in any finishes, coatings, stickers or any other secondary process.
- 2.1.2. No RoHS restricted substance shall be used in the manufacturing of any parts or assemblies.
- 2.1.3. No washes, cleaners, cutting fluids or other chemicals that do not meet the RoHS requirements are to be used in the manufacture of these products.
- 2.1.4. All hardware used in the assembly of these parts/assemblies must be RoHS compliant (ie: screws, nuts, pems, rivets, standoffs, etc)
- 2.1.5. If there is a discrepancy between a material or process called up on the drawing and this specification, then this specification shall take precedence.

3. Deburring Requirements

Unless otherwise specified, all parts shall be deburred to ensure that they are safe for handling. This includes removing any sharp edges, burrs, hanging or loose material and breaking any sharp corners or other features which could cause injury to a person handling the parts with bare hands. Note that any specific deburring requirements called up on a drawing will supersede those described in this document.

4. Marking Requirements

Unless otherwise specified, all components shall, at a minimum, have their part number and drawing revision clearly marked on the packaging or shipping material in which they are shipped to Christie. If individual marking of part numbers and revisions on a part is required, then it shall be called up on the part drawing.

A drawing calling up part marking should specify the exact location in which the part is to be



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marked on the drawing. This will preferably be shown by a hexagonal balloon containing the number of the note which specifies the marking. If no location is explicitly indicated, the vendor may choose a location which is suitable, based on the design and manufacture of the part.

Parts may be engraved or marked by other permanent, indelible means. All marking must be clear and legible. If part marking is engraved or stamped, there shall be no raised areas on the marked surface caused by the marking.

5. Finish Requirements

5.1. Conversion Coatings for Aluminum Alloys

- 5.1.1. Alodine 5200 or any other coating which has specifically been approved by the manager of Mechanical Engineering at Christie (in writing) are acceptable for use, providing they meet the other requirements of this specification. (Note: Alodine T 5900 or SurTec 650 are also acceptable for use, but Alodine 5200 is the preferred coating).
- 5.1.2. The above mentioned conversion coatings must meet a minimum salt spray resistance test of 8 hours with $\leq 0.1\%$ corrosion, per fog chamber test practice per ASTM B117 and evaluated per ASM D 1654 Method B.
- 5.1.3. The supplier must ensure robust, durable coating. This may be accomplished through periodic testing of finished parts or coupons, by verifying the integrity of processes and plating tanks, or by a combination of each. Verification testing shall be done by testing representative physical parts or samples (coupons) against the salt spray test requirements above. To verify process integrity, suppliers shall monitor the condition of baths regularly and ensure critical parameters are within manufacturer guidelines, as well as follow (and audit) process instructions in place.
- 5.1.4. The use of a hexavalent chromate wash in the manufacturing process is not acceptable.

5.2. Zinc Plating for Ferrous and Copper Alloy Parts

- 5.2.1. Clear, yellow, or black zinc plating using a trivalent chromate coating are acceptable provided they meet the other requirements of this specification. In particular, trivalent zinc chromate applied per GMW 3044 specification is acceptable.
- 5.2.2. The above mentioned conversion coatings must meet a minimum salt spray resistance test of 8 hours, per fog chamber test practice per ASTM B117 and evaluated per ASM D 1654 Method B.
- 5.2.3. The supplier must ensure robust, durable coating. This may be accomplished through

periodic testing of finished parts or coupons, by verifying the integrity of processes and plating tanks, or by a combination of each. Verification testing shall be done by testing representative physical parts or samples (coupons) against the salt spray test requirements above. To verify process integrity, suppliers shall monitor the condition of baths regularly and ensure critical parameters are within manufacturer guidelines, as well as follow (and audit) process instructions in place.

5.2.4. Zinc plating with a hexavalent chromate coating or using a hexavalent chromate wash are not acceptable.

5.3. Nickel Plating for Ferrous and Copper Alloy Parts

5.3.1. Electrolytic or electroless nickel plating are acceptable provided they meet the other requirements of this specification.

5.3.2. Nickel plating may be used either bare (medium corrosion resistance) or with a trivalent chromate coating for maximum corrosion resistance.

5.3.3. Nickel plating with a hexavalent chromate coating or using a hexavalent chromate wash are not acceptable.

5.4. Conversion Coatings for Magnesium Alloys

5.4.1. Hexavalent chromium-free conversion coatings, such as SurTec 650 trivalent chromium process (TCP) with full acid etch/activation, are approved. It is understood that full acid etching may remove up to 0.0075mm of material for two sides combined. Manganese phosphate, calcium phosphate, Alodine 5200, Alodine T 5900, or any other conversion coating must be specifically approved by Christie (in writing) to be acceptable for use, providing they also meet the other requirements of this specification.

5.4.2. The above mentioned conversion coatings must meet a minimum salt spray resistance test of 8 hours with $\leq 0.1\%$ corrosion, per fog chamber test practice per ASTM B117 and evaluated per ASM D 1654 Method B.

5.4.3. The supplier must ensure robust, durable coating. This may be accomplished through periodic testing of finished parts or coupons, by verifying the integrity of processes and plating tanks, or by a combination of each. Verification testing shall be done by testing representative physical parts or samples (coupons) against the salt spray test requirements above. To verify process integrity, suppliers shall monitor the condition of baths regularly and ensure critical parameters are within manufacturer guidelines, as well as follow (and audit) process instructions in place.

5.4.4. The use of a hexavalent chromate wash in the manufacturing process is not acceptable.



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5.5. Other Platings and Coatings

5.5.1. No hexavalent chromate wash is to be used in the processing of any platings.

5.5.2. None of the restricted substances are to be introduced in the processing or application of the platings.

6. Coatings

6.1. Samples

Prior to production, the Vendor shall submit a finish samples (on the same substrate as the part) per the print specifications for:

- Color – Paint type and Manufacturer if required.
- Gloss – In Degrees
- Spatter (If Applicable) – as Light, Medium or Heavy

From these samples Christie Digital will select and approve four sets of samples that reflect the required finish appearance of the part, one set of each sample set shall be retained by the Vendor for reference. A log will be kept with sequential numbering for each paint sample. Samples of the same paint on different materials (plastic, metal) are to be maintained. Alpha suffix to be used for same paint, but different gloss levels and spatters.

6.1.1. Samples at Christie shall be at three locations:

- Receiving Inspection
- In Supplier Quality Department
- In Engineering

6.1.2. Samples shall be signed by Engineering and/or Sales and Marketing as determined by the Program Manager.

6.2. Paint

6.2.1. Paint Type, Manufacturers Reference, Gloss Limits and Spatter Definition shall be added and referenced on the individual component print referencing this document. Also, reference is to be made indicating the sample log number.

6.2.2. All parts shall be cleaned and prepared for paint to reduce any contamination and effect adhesion

to the basic part.

7. Handling and Packaging, Masking, Screening

7.1. The finish of the parts shall not be compromised by handling during the Manufacturing (Painters) process.

7.2. Masking

7.2.1. Specific masking requirements shall be noted on the respective component drawings. General tolerance will be $\pm 1/16$ " unless otherwise noted on the part drawing. All flakes and loose paint shall be removed. No tape residue or data dots are allowed after painters process, clean up and inspection.

- Overspray is allowed in non-masked areas unless otherwise specified.

7.2.2. Unless otherwise specified, all threads or threaded items in a part, shall be masked by default to prevent paint getting into the threads. This includes pem nuts, inserts, installed studs, tapped holes and any other threaded feature.

7.3. Screening

7.3.1. Screening requirements, if required will be reflected on the component drawings. The artwork number listed shall be the specification for screen manufacture. Colors of ink and location on components shall be under notes on the component drawing or artwork. The screening shall:

- Not Smeared
- Legible
- Have No Missing Details
- Screening to be viewed in the "Inspection Environment" outlined in Table 8.1.1.

7.4. Packaging

7.4.1. Packaging of the finished part shall not precede adequate curing of the part to a durable surface. If there is any specialized packaging specified on the print, the vendor must ensure that it meets those requirements.

7.4.2. If no packaging is specified on the print, paper wrap interleaved to prevent damage to adjacent parts shall be used. Weight restrictions have to be met for safe handling.

7.4.3. Packaging needs to be sufficient to meet the ASTM D4169-96 "Standard Practice for Performance Testing of Shipping Containers and Systems". It also should meet the similar ISTA "International Safe Transit Association" standard for shipping containers. The containers

must be able to meet the specified drop tests and vibration requirements. It is not necessary to test all packages to this standard however if there is any damage during shipping, this standard will be used to determine if the packaging was sufficient.

7.4.4. Packaging used in shipping / storing of the parts/assemblies is not required to meet RoHS guidelines, except as noted below. This includes shipping fixtures, containers, shipping hardware and any other items that are not part of the defined part / assembly.

7.4.5. Any packaging, including shipping fixtures, hardware, containers, etc., used with the parts/assemblies shall not cause contamination of the parts/assemblies with any of the restricted substances. For example, if a zinc trivalent chromate plated part is held on to a shipping fixture with a hexavalent chromate plated screw, the hexavalent chromate could leach onto the part, thereby contaminating it and causing it not to meet the requirements of this specification. Although the shipping screw is not necessarily required by this specification to meet RoHS requirements, in this case it could cause the final part to be out of specification and so must be of a material which meets RoHS requirements.

7.4.6. Any packaging including shipping fixtures, hardware, containers, etc., used with the parts/assemblies shall not cause any failures in part defects or other damage to the parts during shipping to Christie.

7.5. Adhesion

7.5.1. Adhesion tests shall be performed on a sample piece on a basis determined by Christie material quality personnel. The sample shall be of the same substrate as the parts provided.

7.5.2. 72 hours after the part has been baked, a grid with lines spaced 1.5mm apart, shall be scribed down to the substrate over an area 1cm X 1cm. A strip of $\frac{3}{4}$ " wide masking tape (3M #202) is applied over the area for one minute. When the tape is removed the results shall meet A.S.T.M. Spec D3359-97, Class 4B. 4B indicates equal or less than 5% tearing at the crosshatched area and loss of finish.

8. Part Defects and Inspection Environment

8.1. General

8.1.1. All parts shall be inspected by the vendor prior to shipping to Christie and shall be inspected under the conditions of the inspection environment as defined in 8.1.1. There are two methods of identifying defects that are described in section 8.3 and 8.4. The method chosen depends on the requirements of the project as well as the vendors process. The methods can be easily identified on the drawing, as Method 1, indicates the part as grade A, B, C where Method 2 indicates specific surfaces as zones.

8.1.2. Table 8.1.1. - Inspection Environment

Viewing Area	Minimum 4 X 4 feet
Light Source	48" cool white fluorescent tubes (typically 4), prism diffused
Light Intensity	100 Foot Candles (at surface of part)
Viewing Distance	20 to 24 inches from surface of part to observer
Viewing Angle	20° to 80° to give maximum base/spatter contrast
Viewing Duration	10 seconds per surface

8.2. Part Process and Curing Conditions

8.2.1. Part Vendors shall supply Christie Digital Supply Management with general curing dwell time and temperatures to be suitable with various paint finishes and substrates of metal and plastic components. This is to prevent warping, burns, blistering of finished coatings and damage to substrate material.

8.3. Method 1 – Classification of Grades

8.3.1. Procedure

Defects are grouped according to their main dimensional characteristic: Linear (scratches, streaks) or Area (nicks, flecks). During the inspection process, look for visual contrasts in color or texture, single defects and groupings of defects. If a defect appears to be objectionable, at the specified viewing distance, closer inspection is required. All parts shall meet the requirements for defects as specified in



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Tables 8.3.1 and 8.3.2.

8.3.2. Grades of Finish

- **Grade A** parts are those parts which are primarily of a decorative nature for enhancing the appeal of the product on which it is used.
- **Grade B** parts are those primarily used on the outside of the product and are in full view when the product is on display or in use.
- **Grade C** parts are those not normally exposed when the product is on display or in use.

Note: All parts that have been painted to obtain an even surface finish will default to grade C unless otherwise specified on the component drawings. All parts shall have complete coating of base material. Any base material exposed in any grade is considered not acceptable and shall be rejected.

Table 8.3.1. – Linear Defects

Grade	Size
A	.25 x .003"
B	.50 x .003"
C	.50 x .005"

Maximum Per Viewing Surface
1
1
3

Table 8.3.2. – Area Defects

Grade	Size
A	.020"
B	.040"
C	.040"

Maximum Per Viewing Surface
2
2
6

Note: Area and Linear defects alone or grouped are to be at least 6" apart.

8.4. Method 2 – Classification of Zones

8.4.1. Procedure

The various surfaces of the part is identified according to zone that reflect how the surface will be viewed by the customer. These zones will be identified on the print. The defects are then identified

and the length and width of the defect is measured using the overlay in Appendix A. The defect size is then checked according to the allowable size limits shown in table 8.4.1 for the type of defect it is. The distance between two defects/deviations on zones 1-5 must be greater than 40 mm (see figure 8.4.2). Any parts with defects greater than this must be rejected.

8.4.2. Classification of zones

- **Zone 1:** Part of the surface, which **always** will be seen by the customer (short distance)
- **Zone 2:** Part of the surface, which **sometimes** will be seen by the customer (long distance)
- **Zone 3:** Part of the surface, which **rarely** will be seen by the customer in normal use.
- **Zone 4:** Part of the surface, which **seldom** will be seen by the customer in normal use.
- **Zone 5:** Part of the surface, which **never** will be seen by the customer **in normal use**.
- **Zone 6:** Part of the surface, which after mounting **never will be seen by the customer.**

Table 8.4.1. – Accept Criteria on Visual Defects

Zone	1		2		3		4		5	
	B	L	B	L	B	L	B	L	B	L
Deviations										
Knot, hole, marks etc. (same colour as part)	0.7	0.7	1.0	1.0	1.5	1.5	2.0	2.0	3.0	3.0
Knot, hole, marks etc. (different colour as part)	0.4	0.4	0.4	0.4	0.7	0.7	1.0	1.0	1.5	1.5
Scratches, threads, material convergence. (same colour as part)	0.10	10	0.10	10	0.15	10	0.15	10	0.15	15
Scratches, threads, material convergence. (different colour as part)	0.05	10	0.05	10	0.10	10	0.10	10	0.10	15

B=width in mm

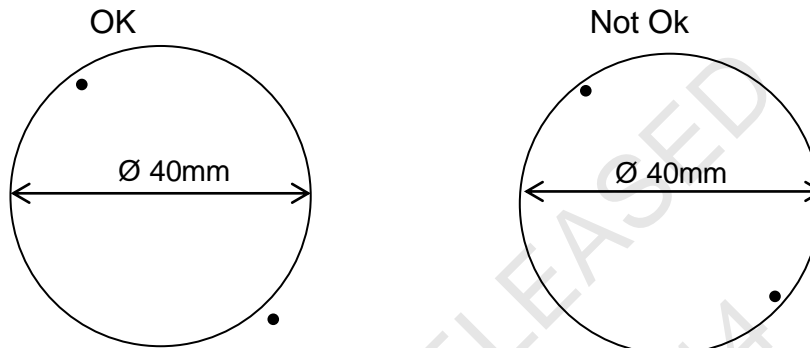
L=Length in mm

Zone 6: No requirements on accept criteria

Figure 8.4.2. – Distance Between Deviations

The distance between two deviations on the zones 1-5 must be greater than 40 mm:

Example:



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Appendix A: - Size of Defect Template

