APPLICATION		REVISIONS				
NEXT ASSY	USED ON	SYM	DESCRIPTION	CN	DATE	APVD
NUMEROUS	NUMEROUS	-	RELEASED PER A/R 4167.	-----	08/15/12	S. MYERS
		A	REVISED SHEET 4 AS MARKED.	12311	10/31/13	S. MYERS
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		C	ADDED PARAGRAPH 5.18.	202035	03/05/18	S. MYERS
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APPROVED P. PERDAN	07/27/12	MANUFACTURING QUALITY, STANDARD FOR
CONTRACT NO.		
APPROVAL		

SIZE	CAGE CODE	
A	**72429**	**ST437003**
REVISION LEVEL **D**		SHEET **1 OF 11**

1. PURPOSE AND SCOPE

The purpose of this Manufacturing Quality Standard is to define the minimum requirements and acceptable quality for parts and assemblies manufactured by or for SFI when the engineering drawing or applicable documents (including contractual or specification requirements) do not otherwise prescribe specific requirements. In case of uncertain or conflicting requirements, the Engineering Department of SFI shall be consulted for interpretation or drawing revision before proceeding with any manufacture. In cases where this standard is more restrictive than the applicable government or military specifications, the requirements of this document shall prevail. SFI, as used herein, refers to Sargent Fletcher Inc. doing business as Cobham Mission Systems. CLSS, as used herein, refers to Carleton Life Support Systems Inc. doing business as Cobham Mission Systems.

2. APPLICABLE DOCUMENTS

The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bid or request for proposals shall apply. When a specific document issue is indicated below, references to the document in subsequent sections of this standard shall consist of the basic document number without repetition of the pertinent issue designations.

2.1 Hierarchy of information. The following is the hierarchy in order of control, highest to lowest:

a) Engineering Document: Drawing, Model or BOM
b) Customer Supplied Document, Contract (e.g., a PO)
c) Specific Shop or QA Instruction
d) Specified Company Shop Practice (e.g., this or similar document)
e) Standard Industry Practice (e.g., Machinery Handbook)

2.2 Government documents.

SPECIFICATIONS

Federal

FED-STD-H28	Screw–Thread Standards for Federal Services

Military

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-DTL-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys

2.3 Non-Government documents.

OTHER PUBLICATIONS

American National Standards Institute Engineering Drawings and Related Documentation Practices

ECA (IPC) J-STD-001	Requirements for Soldered Electrical and Electronic Assemblies

American Society for Testing of Materials

ASTM A967	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

American Society of Mechanical Engineers Engineering Drawings and Related Documentation Practices

ASME B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASME Y14.5	Dimensions and Tolerancing

American Welding Society

AWS A2.4	Standard Symbol for Welding, Brazing and Nondestructive Examination

SFI

PD1635250	Materials List
PD434001	Solid Rivets, Installation of
PD434004	Non-Aqueous Penetrant, Inspection Procedure for
PD434006	Fusion Welding of Aluminum Fuel Tanks Procedure, Requirements, Qualification, Inspection of
PD434011	Wet Installation of Fasteners
PS428	Finishing & Coating F-16 Fuel Tank F-16 Pylon Assembly

Society of Automotive Engineers

AS478	Identification Marking Methods

(Copies of specifications, standards, drawings, and publications required by suppliers should be obtained by the supplier, except SFI-controlled documents, which will be furnished by SFI. If a supplier in unable to obtain any document listed herein, he should immediately contact SFI for assistance.)

3. DEFINITIONS

3.1 Finished surfaces. A finished surface is a surface produced by bringing a tool in contact with a work piece and then moving or removing material on the work piece by motion either of the work piece or the tool or both. All surfaces shown on drawings will be considered as finished surfaces unless evidence to the contrary is contained on the drawing; e.g., by specification or reference to a process or by symbology which differentiates finished and unfinished surfaces.

3.2 Arithmetic average (Ra). The definition of arithmetic average (Ra) in Paragraph 1-4.1.1 of ASME B46.1 shall apply where applicable.

3.3 Drawing format tolerance standards. These are the tolerance standards, which are listed on drawings as a part of the engineering drawing format.

3.4 General dimensioning. All definitions listed in ASME Y14.5 or all historical-related standards, as applicable, issue noted on the face of the drawing, apply to this document.

4. GENERAL REQUIREMENTS

4.1 Temperature. All dimensions and tolerance stated herein apply at 68 $\pm$8°F. Measurements can be made at other temperatures if proper compensation is made for differences in temperature of the part and measuring tools.

4.2 Reference dimensions. Drawing dimensions and notes identified as "reference" (REF) are intended as information for processing and manufacturing and do not require verification for acceptance of the part or assembly.

5. DETAILED REQUIREMENTS

5.1 Surface roughness quality.

5.1.1 Surface roughness is related to size tolerances according to table I:

Table I.

Size Tolerance	Maximum Surface Roughness in Microinches Ra
To and including 0.001 inch	32
Greater than 0.001 inch, but not greater than 0.002 inch	63
Greater than 0.002 inch on any surface	125

Any surface with a surface roughness greater than RA125 shall be identified and called out in the engineering document.

5.1.2 The surface roughness of areas of transition such as fillets, chamfers, etc., shall conform to the roughest adjacent area.

When the roughness of a surface does not exceed 1/2 of the maximum allowable roughness specified on the print, any lay direction is acceptable, regardless of any specific direction callout on the print. For example:

If $\sqrt[32]{c}$ is specified on the drawing, $\sqrt[20]{}$ is not acceptable.

If $\sqrt[32]{c}$ is specified on the drawing, $\sqrt[16]{}$, $\sqrt[16]{m}$, and $\sqrt[16]{\perp}$ are all acceptable.

5.1.3 Roughness word descriptions.

5.1.3.1 Burnish. Where the note "burnish" is shown, the surface must be produced by a burnishing process and have a surface roughness of 8 Ra (microinches) maximum.

5.1.3.2 Smooth finish. This requires a maximum surface roughness of 16 Ra (microinches). The manufacturing process is optional.

5.1.3.3 Polish. Where the word "polish" is specified, the operation or process is optional, but the surface produced must have a surface roughness of 6 Ra (microinches) or better and must be reflective when viewed with the unaided eye.

5.1.3.4 Tumble to polish. This note requires the roughness to be produced by the tumbling process. A surface roughness of 4 Ra (microinches) or better is required.

5.2 Surface coating.

5.2.1 Effect on dimensions and finish. All dimensional limits and surface roughness specifications apply after plating or surface conversion treatments and before finishes such as primer, paint, or drylube. Therefore the dimensional changes resulting from conversion coat, anodizing, electroplating and similar operations must be accounted for during the machining process.

The thickness of paint, primer, and other surface coatings does not affect the machining requirements. Internal and external threads shall not be painted unless specifically required by the drawing.

5.2.2 Anodic coating. The following restrictions apply to all aluminum parts which are anodized per MIL-A-8625 and supersede any conflicting allowances in that document:

NOTE

Section 7 of this document outlines acceptable touchup procedures for anodized parts.

a) The preferred location for racking is in holes with a tolerance greater than 0.002 inch and no surface finish requirement.
b) Racking is not permissible on any internal or external surface that has a surface finish callout or a tolerance of 0.002 inch or less.
c) Racking is not permissible on any exterior surface of parts that are dyed.
d) Small contact marks from the racks are permissible on the allowable racking surfaces. Scratches caused by dragging the part off the rack are not permissible on any surface and care shall be used to prevent them.

5.3 Parallelism. When a parallelism condition exists between two surfaces less than 12 inches in length, a tolerance of 0.006 inch per linear inch of length will be allowed, not to exceed a total of 0.030 inches or the tolerance of the locating dimension, whichever is less. Surfaces greater than 12 inches in length are required to be produced within the prescribed dimensional boundaries.

5.4 Perpendicularity. When a perpendicular condition exists between two surfaces less than 12 inches in length, a tolerance of 0.006 inch per linear inch will be allowed, not to exceed a total of 0.030 inch or the tolerance of the locating dimension, whichever is less. Surfaces greater than 12 inches in length are required to be produced within the prescribed dimensional boundaries.

5.5 Flatness. All machined flat surfaces less than 12 inches in length (or diameter) must be flat within 0.006 inch per linear inch, not to exceed 0.030 inch total, or the tolerance of the locating dimension, whichever is less. This applies with the part unrestrained. Surfaces greater than 12 inches in length (or diameter) are required to be produced within the prescribed dimensional boundaries.

5.6 True position. All machined circular features shown about a common axis, and not subject to feature position control by the drawing, shall be produced with a mutual true position of not more than 0.010 inch, regardless of feature size (RFS).

5.7 Die break. When die break is permitted by the applicable drawing, a maximum of 80 percent of the thickness (T) of the die finished (i.e. sheared or punched) surfaces may exceed the tolerance of the locating or size dimension up to a maximum of 10 percent of the thickness. (See figure 1.)

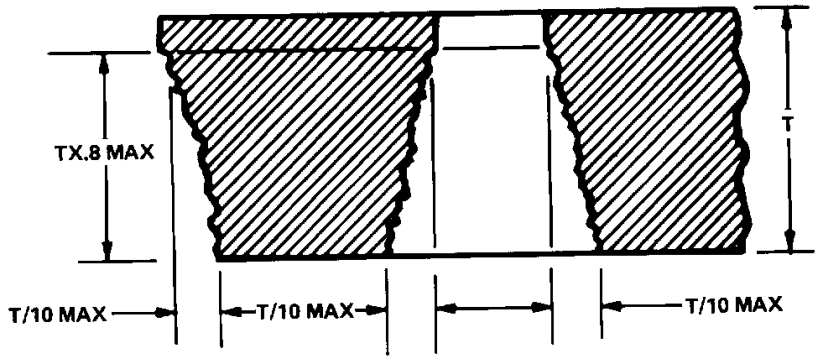


Figure 1.

5.8 Corner breaks, chamfers, countersinks, and radii.

5.8.1 All chamfers and countersinks of less than 0.040 inch width are allowed a tolerance on the angle of $\pm 5°$.

5.8.2 Unless otherwise specified on the drawing, all outside corners must be broken with a chamfer or radius of 0.001 inch minimum to 0.010 inch maximum. On thin flanges, short hubs, shallow counterbores, or other applicable situations, the corner break cannot reduce the length or width of the remaining surface to less than 1/2 of the minimum allowable dimension.

5.8.3 Unless otherwise specified on the drawing, all inside corners shall have a radius of 0.010 inch maximum. On short hubs, shallow counterbores, or other applicable situations, the inside corner radius cannot reduce the length or width of the remaining surface to less than 3/4 of the minimum allowable dimension.

5.9 Hole locations.

5.9.1 Undimensioned centerlines. When a hole is shown on a drawing as located on the intersection of two centerlines, but is dimensioned on only one of the centerlines, the tolerance on the location of the undimensioned centerline shall be the same as the tolerance on the location of the dimensioned centerline.

5.9.2 Bolt circles. When holes are specified as being equally spaced on a bolt circle diameter, the spacing shall be within a true position diameter equal to the total (diametral) tolerance of the bolt circle.

5.10 Threads.

5.10.1 Threads may be accepted if all complete threads can enter in or be entered by the "not go" gauge, provided that a definite drag results from metal to metal contact on or before the third turn of entry.

5.10.2 Where material thickness or length will not allow more than four full threads, the "not go" gauge shall not enter the threads more than 1/3 the total thread length.

5.10.3 Gauging of unified (UNF and UNC) threads shall be accomplished in accordance with FED-STD-H28.

5.10.4 Gauging of unified (UNJ) threads shall be accomplished in accordance with FED-STD-H28.

5.11 Tapped hole chamfers. When a tapped hole must be chamfered and no size is specified, the maximum diameter chamfer shown in table II shall apply:

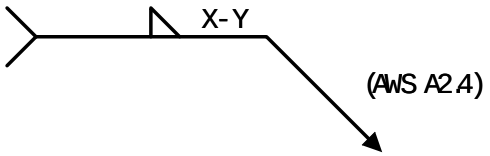
Table II.

Thread size	Maximum Chamfer Diameter (inches)	Thread size	Maximum Chamfer Diameter (inches)
00	0.067	8	0.184
0	0.080	10	0.210
1	0.093	12	0.236
2	0.106	1/4	0.270
3	0.119	5/16	0.333
4	0.132	3/8	0.395
5	0.145	over 3/8	0.030 larger than O.D. of thread
6	0.158		

5.12 Fusion welding of aluminum fuel tanks. Fusion weld per PD434006.

5.13 Intermittent welds. Edges of surfaces to be welded should be free of chemical film and primer (No finish) prior to welding for a length up to 3" – example skins and rings. Post welding these areas should be finished same as rest of the part.

5.13.1 Definitions. An intermittent weld is a weld wherein the continuity of the weld is broken by recurring unwelded spaces. This type weld is designated on the weld symbol as illustrated here.



"X" is the length of the weld, and "Y" is the centerline dimension of the intermittent welds. (Weld symbols other than fillet welds are allowed.)

5.13.2 Acceptance criteria.

a) Intermittent welds which have more than required by the drawing ("Y" centerline dimension less than specified) will be accepted as exceeding the requirements of the drawing with regard to the "Y" dimension.

b) Intermittent welds which have fewer welds than required by the drawing ("Y" centerline dimension greater than specified) are not acceptable.
c) Weld lengths which are shorter than required by the drawing ("X" dimension less than specified) are acceptable if the total length of weld is greater than or equal to the total weld length specified on the drawing (i.e. only if the number of welds is proportionally increased via a smaller "Y" dimension).
d) Weld lengths which are longer than those required by the drawing ("X" dimension greater than specified) will be acceptable as exceeding the drawing requirements with regard to the "X" dimension.

In general, if there are at least as many welds as specified, and if the total weld length is as long or longer than specified on the drawing, the welds will be accepted with regard to the "X" and "Y" dimensions (since the weld strength is greater than drawing requirements).

5.14 Default torque requirements. Unless otherwise specified, ensure cross-pattern is utilized when applying appropriate torques.

All threaded fasteners and B-nuts used on production hardware are to be assembled to the specified torque values. The following values shall be used when the drawing does not specify torque requirements for a fastener or B-nut. These values are applicable for all steel fasteners and aluminum-alloy or steel B-nuts, regardless of whether a locking compound is being used. For locking fasteners and B-nuts, the torque in table III or table IV shall be applied in addition to the running torque.

Table III.

Fastener Size	Required Torque	Dash Number (Ref)
4-40	5.0-6.0 in-lb	04
4-48	6.4-7.4 in-lb	
5-40	7.6-8.6 in-lb	05
5-44	9.3-10.3 in-lb	
6-32	9.6-10.6 in-lb	06
6-40	12.2-13.2 in-lb	
8-32	19.7-21.7 in-lb	08
8-36	22.0-24.0 in-lb	
10-24	22.8-24.8 in-lb	
10-32	32.1-34.1 in-lb	3
1/4-20	75.8-81.8 in-lb	
1/4-28	96.0-102.0 in-lb	4
5/16-24	100.0-140.0 in-lb	5
3/8-24	160.0-190.0 in-lb	6
7/16-20	450.0-500.0 in-lb	7

Table IV

Dash Number (Ref)	Tubing OD	Aluminum-Alloy Required Torque	Steel Tubing Required Torque
-2	.125	20-30	75-85
-3	.188	25-35	95-105
-4	.250	50-65	135-150
-5	.313	70-90	170-200
-6	.375	110-130	270-300
-8	.500	230-260	450-500
-10	.625	330-360	650-700
-12	.750	460-500	900-1000
-16	1.000	500-700	1200-1400
-20	1.250	800-900	1520-1680
-24	1.500	800-900	1900-2100
-28	1.750	---------	----------
-32	2.000	1800-2000	2660-2940

5.15 Part mark. Mark parts per AS478-30.

5.15 Installation of solid rivets. Install solid rivets per PD434001.

5.16 Wet installation of fasteners. Wet install fasteners per PD434011.

5.17 Inspection of non-aqueous penetrant.

a) Penetrant inspect welds per PD434004.
b) Acceptance criteria for any Penetrant-inspected feature require no cracks visible with the naked eye.

5.18 Seating of shear fasteners. Shear fasteners do not normally have large axial clamp-up loadings and as a result need to have some control of fastener clamp-up. For shear fastener installations (including Hi-Loks) not covered by other specifications, the fastener head shall be seated on the base metal after final collar installation and/or nut torque up. “Seated” is defined as:

a) A seated fastener has some portion of the head perimeter in contact with the base metal. This contact can be measured by either a 30 to 50 lumen light behind the fastener head (examine shadows for indications of light or shadow gaps), or by the use of a 0.0015” piece of shim stock. This contact shall be a minimum of a single point under the fastener head near the perimeter of the head. A suggested method to check for contact is to use a flashlight to identify light or shadows that are unusual, then use a feeler gauge to specifically measure the size of that gap.
b) If no portion of the fastener head is within 0.0015” of the base metal, the installation is non-conforming and shall be either repaired (re-seated) and checked again, or handled by normal NC processes.
c) The fastener installation drawing, or Customer specification will control the maximum gap allowed. Note that this max gap measurement is a fastener angularity indication.

6. MATERIAL USAGE

6.1 Identification of materials and processes. The Engineering document defines the acceptable materials for production of any part. Any acceptable alternate material and/or process of fabrication shall also be identified by the Engineering document.

6.2 Changes to material and processes. Any change in material, temper, or manufacturing process not identified by the Engineering document is not acceptable and shall not be used unless documented by MRB (non-conformance) or ECN and approved by the Structural Engineering Department and incorporated into the Engineering document.

7. SURFACE TOUCH-UP PROCEDURES

7.1 The following paragraphs pertain to the surface rework required to ensure corrosion protection and piece-part aesthetics.

7.2 Surface preparation. All surfaces requiring touch-up shall be wiped with isopropyl alcohol, methyl ethyl keotone (MEK), or Ardrox and wiped dry.

7.3 Anodic coatings. Anodic coatings shall not be reworked, except by replating, on any surface which is exposed to oxygen at a pressure of 100 psi or greater.

7.3.1 Clear anodize (MIL-A-8625, Type I or Type II, Class 1 Water Seal). Using an applicator, apply iridite (conversion coat per MIL-DTL-5541) to aluminum surfaces. Remove excess iridite and wipe surfaces clean with distilled water. Anodic coatings shall not be reworked, except by replating, on any surface which is exposed to oxygen at a pressure of 100 psi or greater.

7.3.2 Black anodize (MIL-A-8625, Type I or Type II, Class 2, Dyed Black). Using an applicator, apply chemical blackening process, such as Aluma Black A-14 from Birchwood Casey, to aluminum surfaces and allow to dry for at least 10 minutes. Wipe surfaces clean with distilled water. Anodic coatings shall not be reworked, except by replating, on any surface which is exposed to oxygen at a pressure of 100 psi or greater.

> Alternate method: For black anodized surfaces requiring touch-up to an area smaller than 0.30 inches wide, iridite may be applied and allowed to dry. Permanent black marking ink may then be applied and allowed to dry.

7.3.3 Obliterate part mark. When the drawing says to "obliterate part mark" on a vendor part, the preferred method of obliteration is to stamp the letter "X" over the existing characters per AS478-2, making them unreadable. Remove burrs and maintain surface roughness per section 5.1.

7.3.3.1 Meaningless numbers. Meaningless numbers do not have to be removed. If there is an MS, AN, or AS with no number after it, the MS, AN, or AS does not have to be removed.

7.3.3.2 Plastic or electronic components. For plastic parts or electronic components that could be damaged by the “X”-ing method above, a vibrating engraver may be used to only scratch out enough to make the markings unreadable per AS478-3.

7.3.3.3 Vendor markings. When the print says “obliterate the vendor markings,” part marks and any other markings that identify the vendor must be removed as per paragraph 7.3.3 or 7.3.3.2. Meaningless numbers do not have to be removed.

7.3.3.4 Bare metal. Bare metal created by the operations mentioned above shall be touched up per paragraph 7.3.1, regardless of the color of the anodize.

7.4 Painted surfaces. Touch-up of manufacturing discrepancies shall be such that the total thickness of coating shall not exceed that obtained by one additional coat of primer or coating in the touch-up area.

7.4.1 Touch-up or refinish of bare area. The edges of the finish adjacent to the bare spot shall be tapered or faired by sanding with #320 grit or finer, wet or dry abrasive paper. Prior to application of finish, clean damaged and sanded areas with clean cloth dampened with isopropyl alcohol or toluene or ARDROX 5564 and wipe dry with clean cloth. The primer shall then be spotted in by spraying over the bare area and feathered slightly over the old finish to as small a distance as possible. Allow primer to dry completely. Remove the dried primer form the old finish top coat by lightly sanding with #320 grit or finer, wet or dry abrasive paper. Apply top cat and feather slightly over the finished coat.

7.4.2 Touch-up of top coat damage. The edges of the damaged area shall be tapered by sanding with #320 grit or finer, dry or wet abrasive paper. Prior to application of finish, clean damaged and sanded areas with clean cloth dampened with isopropyl alcohol, toluene, or ADROX 5564 and wipe dry with clean cloth. Apply top coat by spraying over the damaged area and feathered slightly over the old finish to as small a distance as possible. Allow top coat to dry completely.

8. ELECTRICAL AND ELECTRONIC ASSEMBLIES

8.1 Soldering. Unless otherwise specified on the drawing, soldered electrical and electronic assemblies shall meet the requirements of ECA J-STD-001, Class 3 (High Performance Electronic Products).

9. REPORTS

Formal reports shall be in accordance with contractual requirements.

10. NOTES

Changes to this document shall be made using the applicable procedures described in ST1637815. Changes shall be reviewed and approved in accordance with Section 9.0 of ST1637815.