GPM Compression Molded Solar Array Cup/Cones
Statement of Work

September 23, 2009

Background

Spacecraft solar arrays commonly use titanium cup/cones attached to honeycomb panels made with graphite fiber composite facesheets. Occasionally aluminum cup/cones are used, such as in the current Global Precipitation Measurement (GPM) spacecraft. Relative to these metal main-stays, graphite fiber composite cup/cones offer spacecraft significant mass advantages and reduce thermal mismatch issues typical of metal-to-composite interfaces.

GPM solar array cup/cones using continuous resin reinforced graphite fiber material have been developed and test-verified in a previous effort. The validated design reduces GPM solar array mass by 15%, decreases interface stresses, and improves system reliability compared to the aluminum design.

In order to also be competitive with the Aluminum design on cost, it is desirable to make the composite parts using a compression molding technique. This high volume manufacturing process promises to lower unit costs by significantly reducing the amount of labor that usually goes into laying-up each composite part by hand. As a result, the purpose of this procurement is to produce compression molded cup/cones in order to demonstrate materials and manufacturing techniques for the GPM solar array cup cone application.

Description of Tasks to be Performed

The contractor shall:

1. Review a GSFC-supplied design of the compression-molded cup/cones (Figure 1) as specified in drawings 2131586 (cup 1) through 2131589 (cup 4) and provide GSFC feedback to ensure the design is manufacturable using the compression molding technique.

2. Design / build the tooling and, jointly with GSFC, develop the manufacturing process necessary to produce cups 1 and 3.

    - Process development will involve an iterative process of manufacturing 1 or 2 samples at a time, evaluating the resulting microstructure, and altering the molding procedure until a consistent random 2D distribution of fibers is obtained.

    - Process development may include on-site visits by GSFC engineers.

    - All process development data and hardware, including but not limited to sectioned parts, micrographs, fiber volume measurements, cure

temperatures and durations, dimensional measurements, etc., shall be forwarded to GSFC for review.

3. Ship quantity 11 of cup 3 for mechanical and environmental testing at GSFC. In addition, ship a quantity of 2 of cup 1.

4. Work with GSFC to address any issues identified in the testing process.

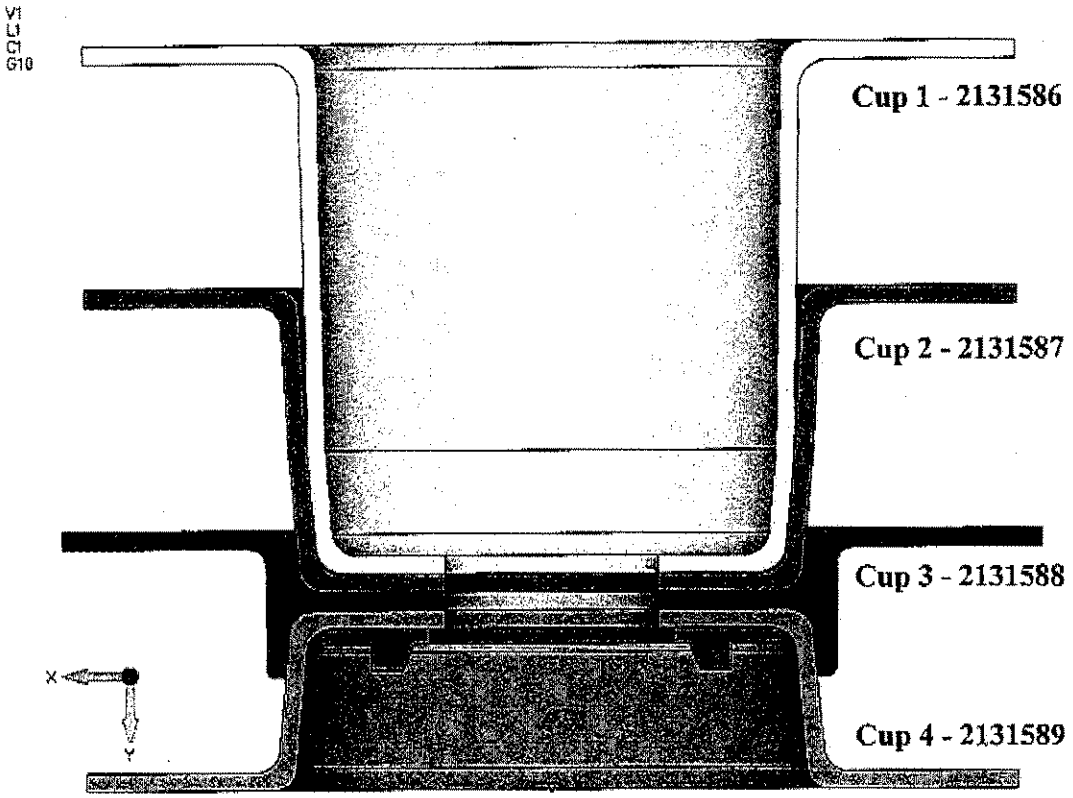


Figure 1 – GPM Compression-Molded Cup-Cone Stack

Requirements

1. The desired fiber distribution shall be consistently random two-dimensional. The preferential direction for fiber orientation, if any, shall be radial, outward from the center of the part and flowing along the sides. Bulk fiber orientation shall be the same within any sector of the part.

2. Fiber flow along the corners of the part shall be continuous without kinking or folding.

3. Parts shall be produced using the MS-4A material.

4. Parts shall conform to drawings 2131586 and 2131588.

5. The vendor shall provide status updates (telecon or e-mail is acceptable) to GSFC at least every two weeks and shall immediately notify GSFC of any significant issues such as those that may affect part delivery schedule.

6. The vendor shall support a kick-off telecon no later than one week after contract award.

Deliverables

1. Iterative process development parts and data as defined above.

2. After the iterative process development portion of the effort is complete, the contractor shall ship to GSFC:

   - 2 cup/cones 1 (2131586)
   - 11 cup/cones 3 (2131588)
   - Final tooling for cup/cones 1 and 3

Period of Performance

All materials shall be delivered to GSFC 10 weeks after contract award.

Options

The contractor shall cost Options for later execution

Option1

The contractor shall perform the following:

1. Use lessons learned in the development of cups 1 and 3 to build the tooling and manufacture cups 2 and 4.

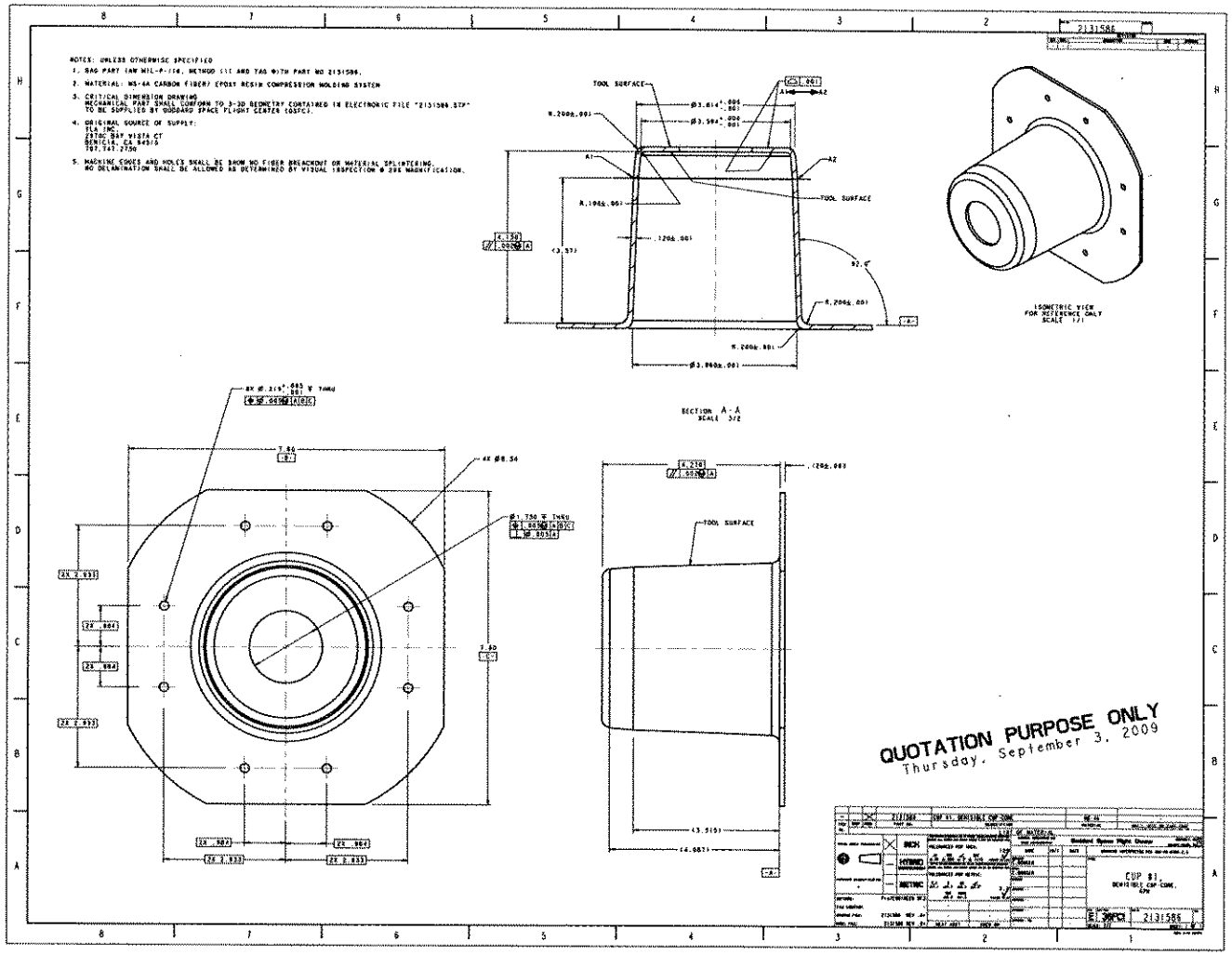
2. Deliver 2 each of cups 2 and 4 to GSFC.

3. Deliver tooling for cups 2 and 4 to GSFC.

Option 2

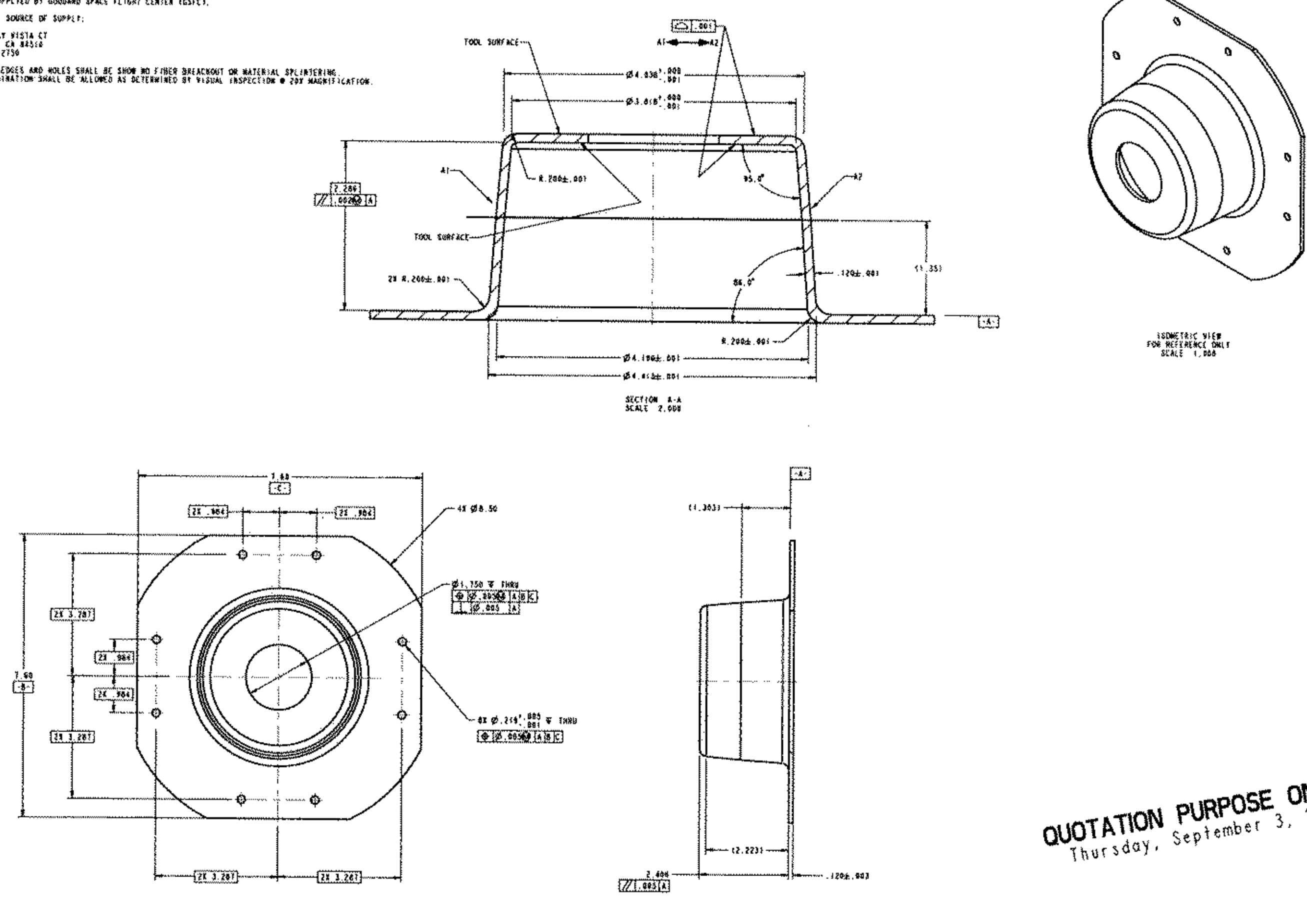
The contractor shall perform the following:

1. Build and deliver to GSFC flight sets of 14 each of cups 1, 2, 3 and 4 (56 cups total) for use on the GPM spacecraft.


NOTES: UNLESS OTHERWISE SPECIFIED
1. BAG PART IAW MIL-P-116, METHOD C1C AND TAG WITH PART NO 2131586.
2. MATERIAL: MS-6A CARBON FIBER/ EPOXY RESIN COMPRESSION MOLDING SYSTEM
3. CRITICAL DIMENSION DRAWING
MECHANICAL PART SHALL CONFORM TO 3-3D GEOMETRY CONTAINED IN ELECTRONIC FILE "2131586.STP"
TO BE SUPPLIED BY GODDARD SPACE FLIGHT CENTER (GSFC).
4. ORIGINAL SOURCE OF SUPPLY:
TLA, INC.
28TAC BAY VISTA CT
BENICIA, CA 94510
707.747.2750
5. MARKING, EDGES AND HOLES SHALL BE SHOW NO FIBER BREAKOUT OR MATERIAL SPLINTERING.
NO DELAMINATION SHALL BE ALLOWED AS DETERMINED BY VISUAL INSPECTION @ 20X MAGNIFICATION.
TOOL SURFACE
TOOL SURFACE
SECTION A-A
SCALE 3/2
ISOMETRIC VIEW
FOR REFERENCE ONLY
SCALE 1/1
TOOL SURFACE
QUOTATION PURPOSE ONLY
Thursday, September 3, 2009
CUP 81,
2131586

NOTES: UNLESS OTHERWISE SPECIFIED

1. BAG PART IAW MIL-P-116, METHOD III AND TAG WITH PART NO 2131587.
2. MATERIAL: MS-4A CARBON FIBER/ EPOXY RESIN COMPRESSION MOLDING SYSTEM
3. CRITICAL DIMENSION DRAWING
   MECHANICAL PART SHALL CONFORM TO 3-3D GEOMETRY CONTAINED IN ELECTRONIC FILE "2131587.STP"
   TO BE SUPPLIED BY GODDARD SPACE FLIGHT CENTER (GSFC).
4. ORIGINAL SOURCE OF SUPPLY:
   YLA INC.
   2970C BAY VISTA CT
   BENICIA, CA 94510
   707.747.2750
5. MACHINE EDGES AND HOLES SHALL BE SHOW NO FIBER BREAKOUT OR MATERIAL SPLINTERING.
   NO DELAMINATION SHALL BE ALLOWED AS DETERMINED BY VISUAL INSPECTION @ 20X MAGNIFICATION.



QUOTATION PURPOSE ONLY
Thursday, September 3, 2009

2131587	CUP #2, DENISIBLE CUP CONE			
PART NO.	DESCRIPTION		MATERIAL	
LIST OF MATERIAL				

INCH / HYBRID / METRIC

TOLERANCES FOR INCH:

TOLERANCES FOR METRIC:

Goddard Space Flight Center

CUP #2,
DENISIBLE CUP-CONE,
GPM

E 38FC1 2131587

SCALE: 1.000

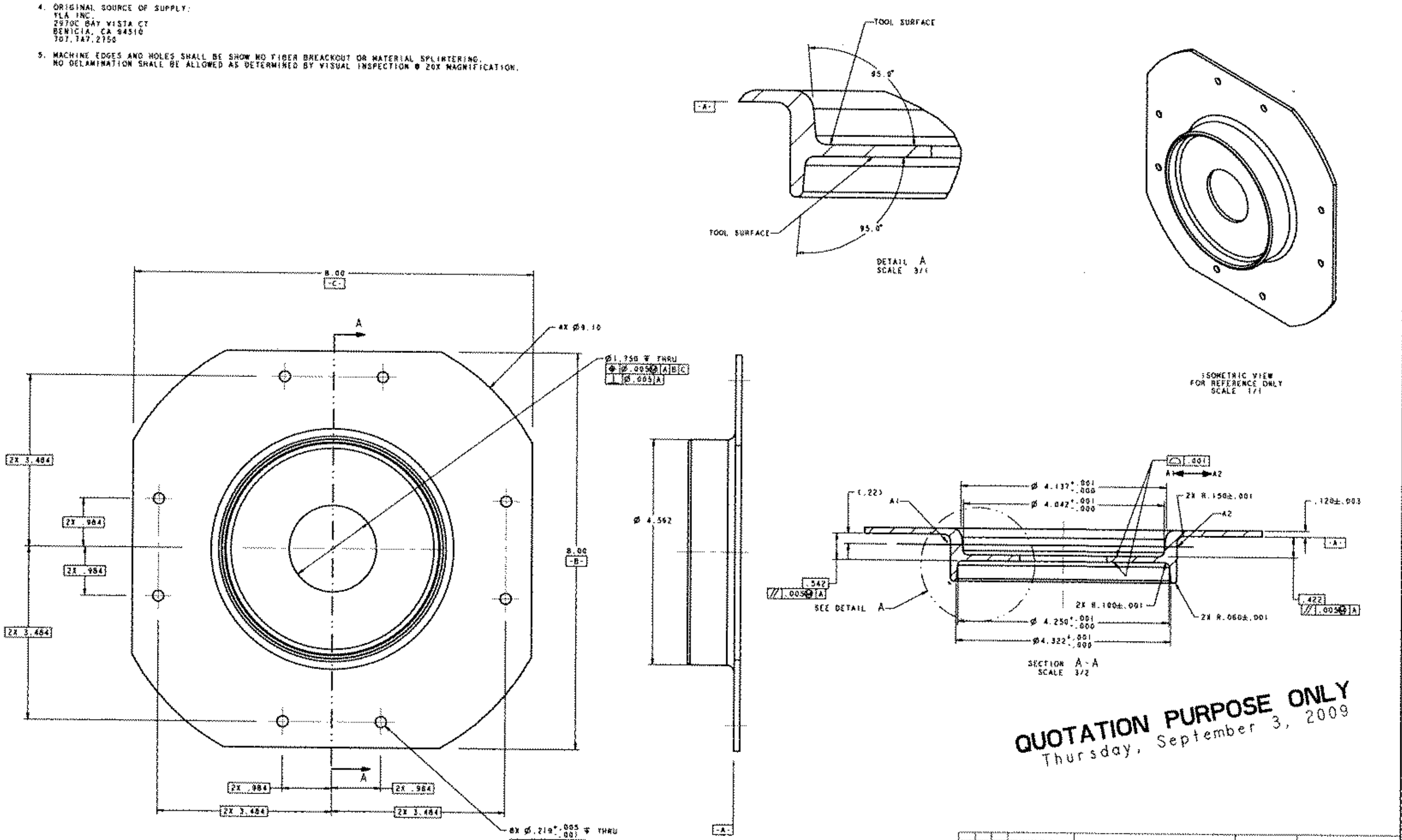
SHEET 1 OF 1

NEXT ASSY · USED ON

DRAWING FILE: 2131587 REV .0

NOTES: UNLESS OTHERWISE SPECIFIED

1. BAG PART IAW MIL-P-116, METHOD III AND TAG WITH PART NO 2131588.
2. MATERIAL: MS-4A CARBON FIBER/ EPOXY RESIN COMPRESSION MOLDING SYSTEM
3. CRITICAL DIMENSION DRAWING
   MECHANICAL PART SHALL CONFORM TO 3-3D GEOMETRY CONTAINED IN ELECTRONIC FILE "2131586.STP"
   TO BE SUPPLIED BY GODDARD SPACE FLIGHT CENTER (GSFC).
4. ORIGINAL SOURCE OF SUPPLY:
   YLA INC.
   2970C BAY VISTA CT
   BENICIA, CA 94510
   707.747.2750
5. MACHINE EDGES AND HOLES SHALL BE SHOW NO FIBER BREACKOUT OR MATERIAL SPLINTERING.
   NO DELAMINATION SHALL BE ALLOWED AS DETERMINED BY VISUAL INSPECTION @ 20X MAGNIFICATION.

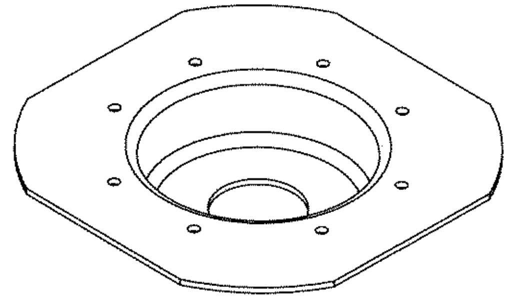


QUOTATION PURPOSE ONLY
Thursday, September 3, 2009

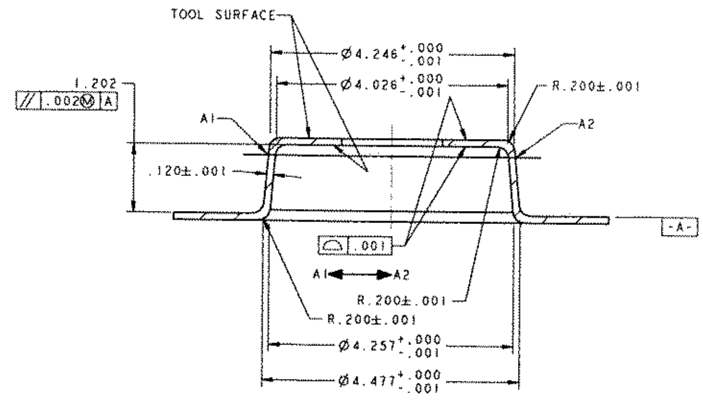
2131588	CUP #3, DENSIBLE CUP-CONE	SEE NOTE 2	
PART NO.	DESCRIPTION	MATERIAL	
LIST OF MATERIAL			
INCH / HYBRID / METRIC		Goddard Space Flight Center	
Pro/ENGINEER		CUP #3, DENSIBLE CUP-CONE, GPM	
2131588 REV 0		E 36FC1	2131588
		SCALE 3/2	SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

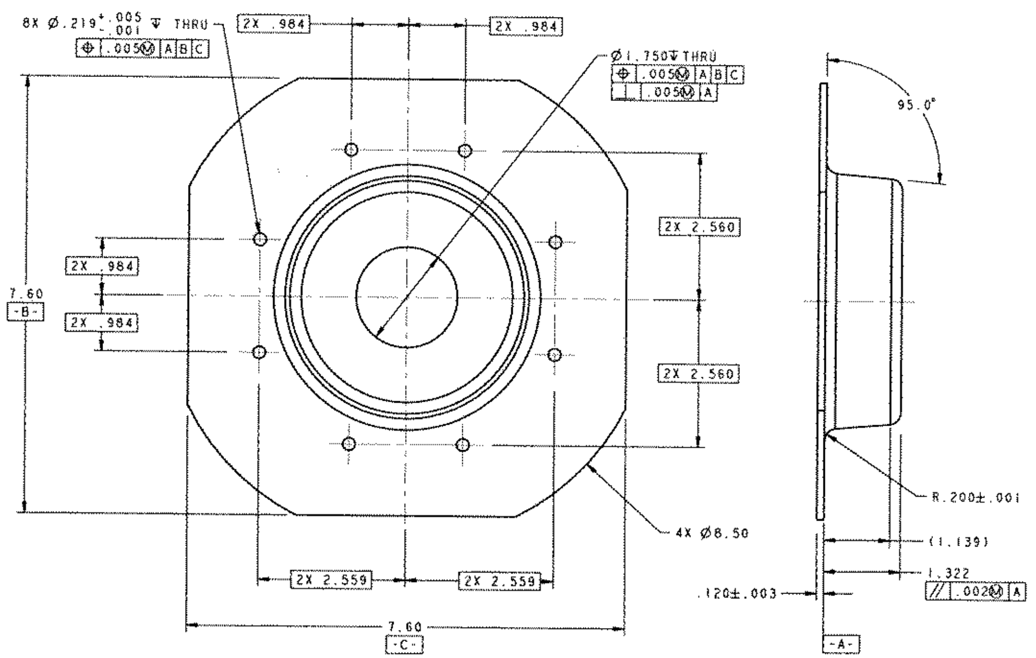
1. BAG PART IAW MIL-P-116, METHOD III AND TAG WITH PART NO 2131589.
2. MATERIAL: MS-4A CARBON FIBER/ EPOXY RESIN COMPRESSION MOLDING SYSTEM
3. CRITICAL DIMENSION DRAWING
   MECHANICAL PART SHALL CONFORM TO 3-3D GEOMETRY CONTAINED IN ELECTRONIC FILE "2131589.STP"
   TO BE SUPPLIED BY GODDARD SPACE FLIGHT CENTER (GSFC).
4. ORIGINAL SOURCE OF SUPPLY:
   YLA INC.
   2970C BAY VISTA CT
   BENICIA, CA 94510
   707.747.2750
5. MACHINE EDGES AND HOLES SHALL BE SHOW NO FIBER BREAKOUT OR MATERIAL SPLINTERING.
   NO DELAMINATION SHALL BE ALLOWED AS DETERMINED BY VISUAL INSPECTION @ 20X MAGNIFICATION.



ISOMETRIC VIEW
FOR REFERENCE ONLY
SCALE 1/1



SECTION A-A



QUOTATION PURPOSE ONLY
Thursday, September 3, 2009

ITEM NO.	REQD	REQD	PART NO.	DESCRIPTION	MATERIAL	MAT'L SPEC OR CAGE CODE
-			2131589	CUP #4, DEMISIBLE CUP-CONE		

LIST OF MATERIAL

THIRD ANGLE PROJECTION — INCH / HYBRID METRIC/INCH / METRIC

TOLERANCES FOR INCH: .XX ±.02, .XXX ±.005, ±.5°, ± 1/16

TOLERANCES FOR METRIC: X.X ±0.1, X ±0.2, XX ±0.3, ±0.5°

HARDWARE CLASSIFICATION: -

SOFTWARE: Pro/ENGINEER WF3

FILE LOCATION:

DRAWING FILE: 2131589 REV .0

MODEL FILE: 2131589 REV .0

NEXT ASSY | USED ON

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION — Goddard Space Flight Center, GREENBELT, MD / WALLOPS ISLAND, VA

DRAWING INTERPRETED PER 500-PG-8700.2.5

DESIGNER: C.BOWSER

DRAWN: C.BOWSER

TITLE: CUP #4, DEMISIBLE CUP-CONE, GPM

SIZE: D | CAGE CODE: 36FC1 | DWG NO.: 2131589

SCALE: 1/1 | SHEET: 1 OF 1

GSFC 4-40 (8/07)

2131589