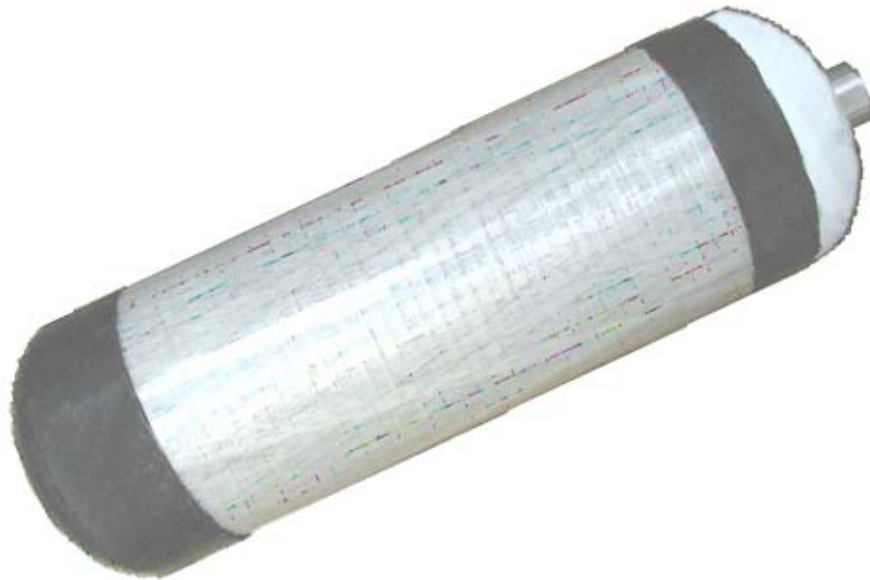


# *END CAP INSPECTION GUIDE*



*A guide for the Inspection and/or Replacement of  
End Caps on SCI Non Limited Life Composite Cylinders*

**TP-902.08/A**



**Structural Composites Industries, LLC**

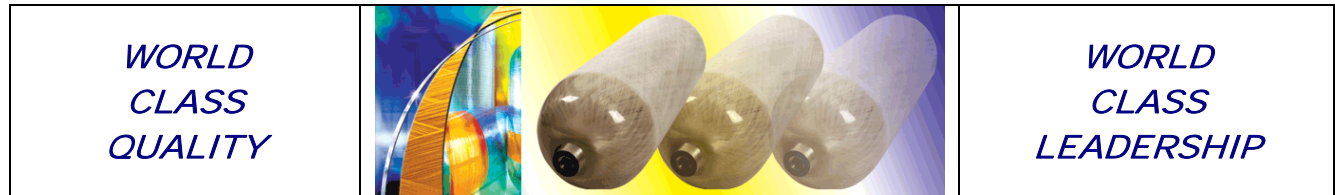
325 Enterprise Pl - Pomona, CA 91768-3245

Tel: 909.594.7777 - Fax: 909.594.3939

Website: [www.scicomposites.com](http://www.scicomposites.com)



**Quality System Registered to AS9100 Rev B / ISO 9001:2000**



## GUIDELINES

### NOTICE:

The information contained in this document was obtained from sources believed to be reliable and is based on technical information, experience, and regulations currently available from Structural Composites Industries, LLC (SCI) and other sources.

The guidelines provided herein are not intended to be comprehensive and are intended to assist suitably trained personnel in the safe operation and inspection of end caps used on some SCI composite cylinder designs. The use of these guidelines shall not create or give rise to any liability to SCI.

There may be situations, however, which may be outside the company's current experience and so are not included in this document. SCI, the national approval authority, or a government approved retest agency should be contacted for guidance if there is any doubt as to the cylinder's condition and/or integrity. If such consultation is not possible, the cylinder should be condemned.

It should be noted that these guidelines should not be used for inspecting caps on composite cylinders from any other manufacturer.

SCI can be contacted at the following addresses:

#### North America:

Structural Composites Industries, LLC  
325 Enterprise Place  
Pomona CA 91768-3268  
USA  
Tel: (909) 594-7777  
Fax: (909) 594-3939  
Website: <http://www.scicomposites.com>

#### Europe:

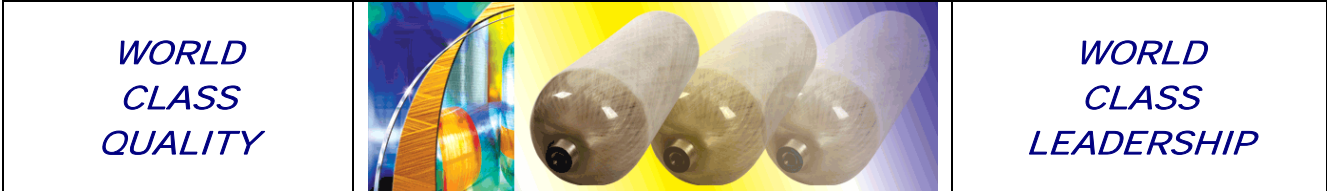
Structural Composites Industries, LLC  
DBH House Carlton Square  
Nottingham NG4 3BP  
UK  
Tel: (44) 115-940-8521  
Fax: (44) 115-954-1032  
eMail: [esands@scicomposites.com](mailto:esands@scicomposites.com)

September 2008  
Document No: TP-902.08, Rev. A

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**TABLE OF CONTENTS**

Notice ..... i

Table of Contents ..... ii

Issue Sheet ..... iii

Scope ..... 1

Introduction ..... 1

Definitions ..... 1

Cap Inspection ..... 1

Exterior Inspection ..... 2

    Preparation For Inspection ..... 2

Types of Damage ..... 2

    Abrasion/Scuff Damage ..... 2

    Cut/Tear Damage ..... 3

    Impact Damage ..... 4

    Structural Damage ..... 4

    Heat or Fire Damage ..... 4

Damage Level Classifications ..... 5

    Level 1 ..... 5

    Level 2 ..... 5

Acceptance Criteria ..... 5

    Abrasion/Scuff Damage ..... 5

    Cut/Tear Damage ..... 5

    Impact Damage ..... 5

    Structural Damage ..... 6

    Heat or Fire Damage ..... 6

Rework or Replacement ..... 6

    Cap Removal ..... 6

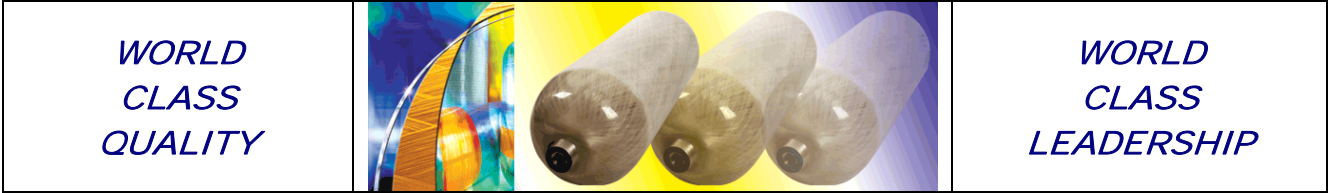
    Preliminary Cap Fitting ..... 7

    Cap Fitting ..... 7

Materials and Equipment ..... 8

Appendix A ..... 9

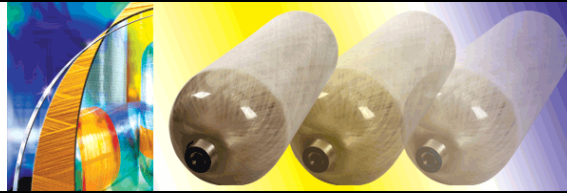
Appendix A ..... 11



**ISSUE SHEET**

Issue	Description / Changes	Date
1	Initial Release of Document for SCI Cylinder Designs ALT 1068C & ALT 990C.	December 2006
TP-902.08/A	Complete Reformat, Update, & Renumber of Document.	September 2008

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## SCOPE

These guidelines are intended for suitably trained personnel, to assist them in carrying out the safe operation and inspection of end caps used on SCI's range of Non Limited Life composite cylinder designs manufactured to approved specifications, standards, and national approvals.

These end caps are an integral part of the individual designs and should not be removed during normal service, or at periodic inspections.

These guidelines are specific in scope, and, no attempt will be made to reiterate all of the requirements of normal cylinder inspection which are covered in a separate publication. Instead, they highlight those items that are essential for an accurate appraisal of the end caps.

## INTRODUCTION

Composite cylinders, with integral end caps, have been used commercially in Europe since the late 1990s. The addition of end caps, to composite cylinder designs, provides additional protection to the cylinder ends and so enabled the design to be optimized for weight. The caps that SCI has incorporated into their design of high pressure cylinders are primarily used for additional impact protection.

The caps, in these guidelines, are specific to SCI's Non Limited Life range of cylinders which are approved and CE certified in Europe for Breathing Apparatus applications.

At this time, these guidelines cover the integral caps used on cylinder designs for a 6.8 litre 300 bar cylinder, SCI Model ALT 1068C and a 9.0 litre 300 bar cylinder, SCI Model ALT 990C.

## DEFINITIONS

The following definitions are applicable to the guidelines contained in this document:

**Abrasion** - Damage resulting from wear, friction, or intense rubbing of the end cap surface.

**Cut** - Damage resulting from a sharp object in contact with the end cap.

**Heat/Fire Damage** - Damage caused by exposure to excessive heat and/or flames from a fire.

**Impact Damage** - Damage caused by dropping or by a blow from another object. Impact damage may be at the surface, internal to the structure, or both.

**Structural Damage** - Damage caused by a severe blow or impact by another object resulting in damage to the end cap, composite, and liner.

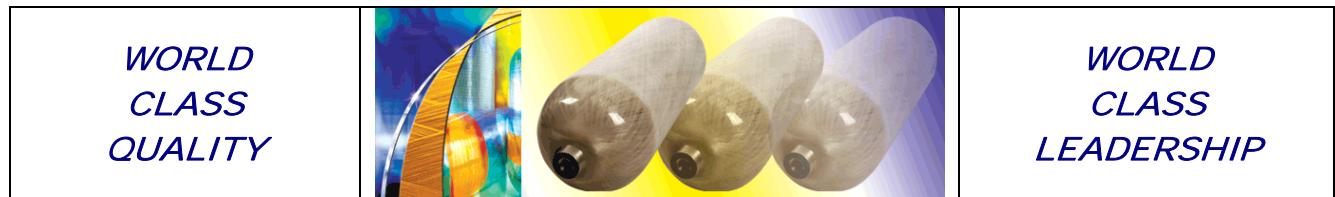
## CAP INSPECTION

The cylinder and end caps should only be inspected by trained personnel who are knowledgeable in the care, maintenance, and safe handling of gas cylinders.

The caps need to be inspected:

- Prior to the cylinder being filled





- As part of the periodic retest procedure

The exterior surface of the dome cap does not look or feel the same as that of the composite cylinder. The foam dome cap will protrude like a cap over the dome ends, depending on the thickness of the dome cap. It will feel slightly spongy when pressed hard with the finger. However, the visual inspection procedure for dome caps is similar, in much respect, to composite cylinders.

## EXTERIOR INSPECTION

The caps have a generally 'smooth' surface and will typically remain in this condition under normal circumstances. However, they do provide protection for the cylinder and so will become dirty, scuffed, and scratched in service. This is considered normal wear and tear, and, the caps can safely remain in service.

Where the caps have been exposed to severe damage, which is detailed in the following section, there will be need for additional work to be carried out.

### Preparation For Inspection

Where the caps are very dirty and require cleaning, they may be wiped clean with mild soap and water solution.

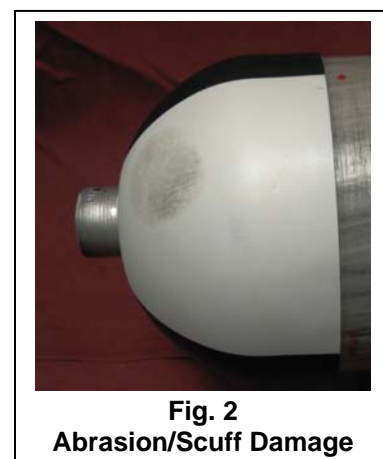
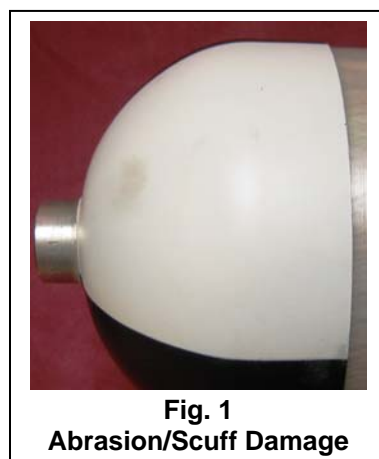
## TYPES OF DAMAGE

These caps will withstand the normal wear and tear that BA cylinders will experience in their day to day use, but, in some extreme environments, they may become damaged at which point they may need to be replaced. The typical types of damage that will be encountered in service are:

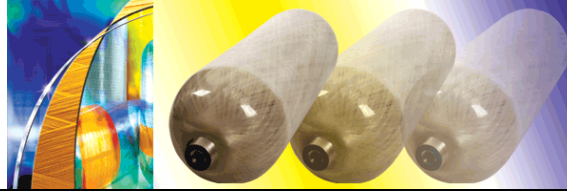
### Abrasion/Scuff Damage

This type of damage is caused by wearing, grinding or rubbing away by friction.

- Scuffs are minor abrasion damage to the protective coating (i.e. paint). Examples are shown in Fig. 1 and Fig. 2 below.



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- Abrasion involves a greater loss of surface than scuffs with more raw foam showing. These can be caused by sliding contact with a rough surface. Excessive rough spots and flat spots on the surface are evident of excessive loss of foam thickness. An example is shown in Fig. 3 below.



**Fig. 3  
Abrasion Damage**

### **Cut/Tear Damage**

This type of damage is usually caused by a sharp object, or by being caught on a projection. Sometimes tears are caused by material degrading or breakdown, due to age and other external exposures.

- Tears are usually separations caused by excessive force by pulling or ripping. Examples of cuts and tears are shown in Fig. 4, Fig. 5, and Fig. 6 below.



**Fig. 4  
Cut Damage**

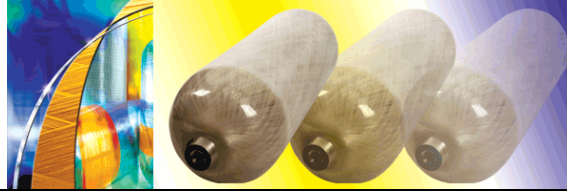


**Fig. 5  
Cut Damage**



**Fig. 6  
Tear Damage**

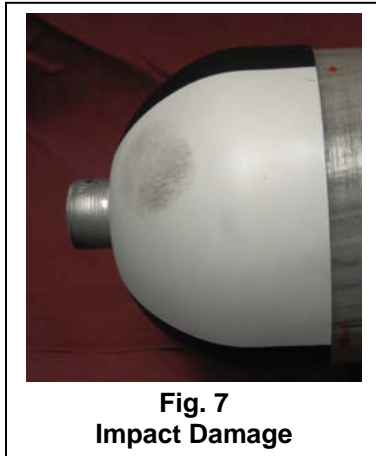
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### **Impact Damage**

This type of damage is caused by dropping or by a blow from a blunt instrument and may appear as crazing, permanent dent, or deformation and sometimes a tear. Examples are shown in Fig. 7 and Fig. 8 below.

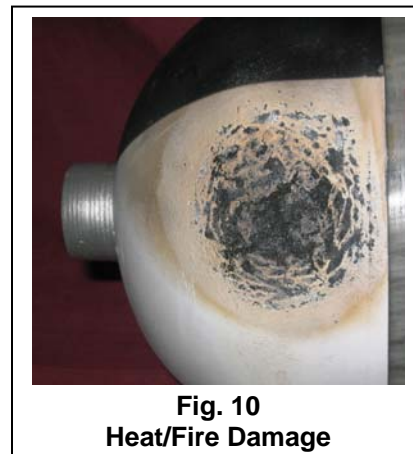
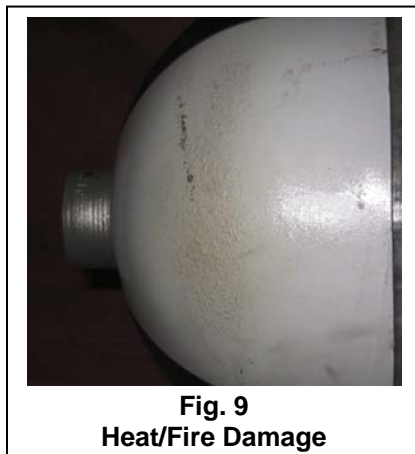


### **Structural Damage**

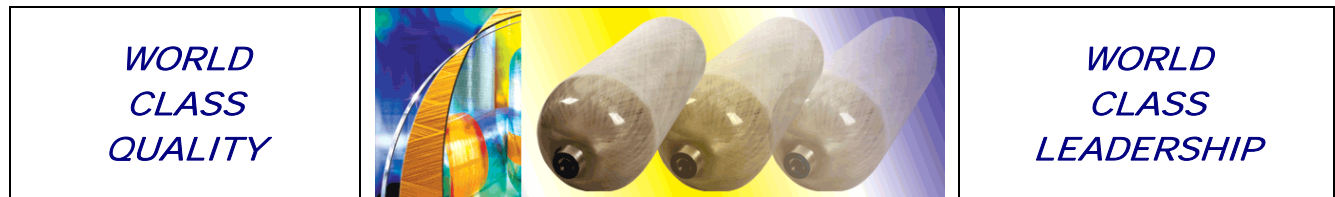
This is a general inclusive term for severe damage. Such damage is extreme and may involve damage to the composite as well as the liner. If structural damage is found under the cap, or by drop light or borescope inspection, the cylinder shall be condemned.

### **Heat or Fire Damage**

Heat or fire damage is evident by discoloration, charring, or melting of the foam. Examples are shown in Fig. 9 and Fig. 10 below.







## DAMAGE LEVEL CLASSIFICATION

Damage has been classified at two levels: Acceptable (Level 1) and Unacceptable (Level 2).

### Level 1 Damage (Acceptable)

Level 1 damage is minor and would be considered normal. Such damage should have no adverse effects on the integrity of the cylinder and its continued use. Such items as scratches, nicks, minor cuts and discoloration are considered in this category.

### Level 2 Damage (Unacceptable)

Level 2 damage is such that the dome cap has been rendered unfit for continued service and cannot be reworked. In this case, the dome cap shall be removed and the cylinder dome inspected for damage. If no damage is found, replace the cap. If damage exists, remove the cylinder from service.

## ACCEPTANCE CRITERIA

### Abrasion/Scuff Damage

**Level 1** - Minor abrasions in the shoulder area such as scuffs less than 0.12 in (3 mm) deep are acceptable. Where painted areas are scuffed, touch up or rework is allowed. Refer back to Fig. 1 and Fig. 2 for examples of acceptable Level 1 abrasion damage.

**Level 2** - Abrasions and flat spots in the shoulder area exceeding a depth of 0.12 in (3 mm) are unacceptable. Caps with this level of damage shall be replaced. Refer back to Fig. 3 for an example of unacceptable Level 2 abrasion damage.

### Cut/Tear Damage

**Level 1** - Cuts or scratches in the shoulder area less than 0.20 in (5 mm) deep are acceptable. The number of scratches with depths of 0.20 in (5 mm) shall not exceed 3 per quadrant, regardless of direction, with a maximum length of 1.50 in (38 mm). Refer back to Fig. 4 and Fig. 5 for examples of acceptable Level 1 cut damage.

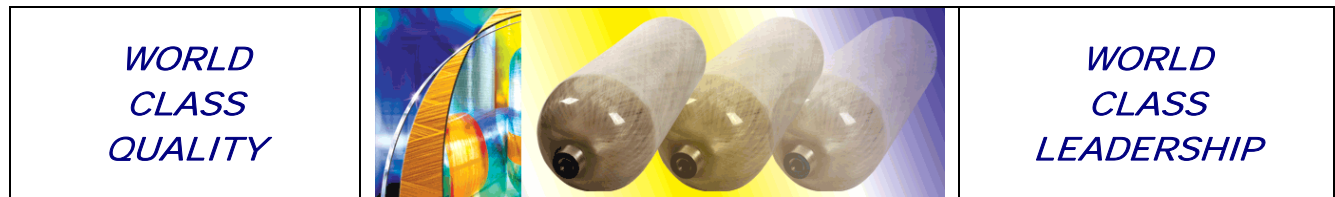
Torn caps are acceptable provided tears are not in the shoulder area. Refer back to Fig. 6 for an example of acceptable Level 1 tear damage.

**Level 2** - Cuts in the shoulder area greater than 0.20 in (5 mm) deep and with a length greater than 1.50 in (38 mm) are unacceptable and the caps must be replaced. Tears in the shoulder area are unacceptable and the caps must be replaced.

### Impact Damage

**Level 1** - The foam dome caps are very resistant to this type of damage and a significant impact is required to cause damage sufficient to warrant replacement. Damage which is relatively slight, from normal use, will show nothing or a very light scuff mark in the impact area and the cylinder may be returned to service. Refer back to Fig. 7 for an example of acceptable impact damage.





**Level 2** - Damage is severe if structural damage is present. Refer back to Fig. 8 for an example of unacceptable impact damage.

### Structural Damage

**Level 2** - Visual evidence of structural damage to dome caps would be a significant change from the original configuration. The dome cap must be replaced, but the cylinder dome must first be inspected for damage. If there is any doubt, about the cylinder's integrity, then the cylinder should be retested.

### Heat/Fire Damage

**Level 1** - Smoke, staining, or discoloration of the dome cap is to be expected over time, and, paint can be touched up, if required.

**Level 2** - Caps with signs of heat or fire damage (charring, melting, or bubbling) are considered to be unacceptable and must be replaced. If the cylinder is thought to have been exposed to excessive temperatures, then it should be taken out of service and retested. Refer back to Fig. 9 and Fig. 10 for examples of unacceptable heat/fire damage

## REWORK OR REPLACEMENT

Any rework or replacement of dome caps must be conducted by suitably trained operators. Where the cylinder shoulder, under the cap, has been damaged, or there is any concern about the cylinder's integrity, the cylinder should be removed from service.

### Cap Removal

- Secure the composite cylinder body using an appropriate fixture, as it very important not to damage the cylinder.
- Remove the end cap by forcibly peeling back the foam cap with both hands (see Fig. 11 below). A careful cut with a sharp hook razor blade may be used for ease of removal, taking care not to cut the composite.

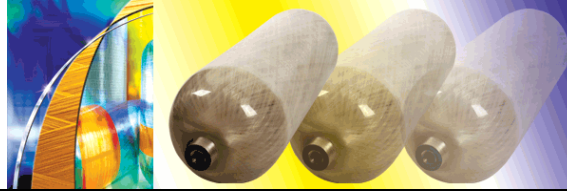


**Fig. 11**  
**Cap Removal**



**Fig. 12**  
**Cap Removed**

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- After end cap removal, wipe dome with acetone or alcohol. Do not attempt to remove the remaining adhesive that adhered to the dome (see Fig. 12 on previous page).

### **Preliminary Cap Fitting**

- Place cylinder in an upright or vertical position.
- Take a new replacement end cap and dry fit it over the dome, making sure it is positioned straight.
- Mask along the edge of the end cap and cylinder, using 2 in (50 mm) wide masking tape.
- Remove the end cap and prepare for bonding.

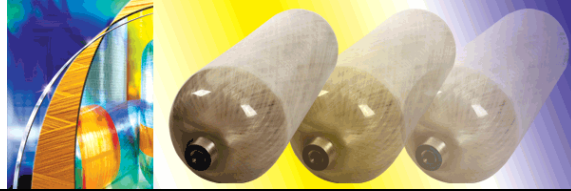
### **Cap Fitting**

- Mix a small equal amount of part A and part B adhesive (see Materials and Equipment section) in a clean container. Mix quickly and thoroughly; until the blue and white colors turn a uniform light blue color (see Fig. 13 below). The adhesive sets very quickly (approximately 5 to 6 minutes), so it is important that everything is prepared.



- Quickly apply a thin coat of the mixed adhesive to the inside surface of the new end cap (see Fig. 14 on the following page).
- Carefully and quickly hold the outside of the end cap the place over the dome (see Fig. 15 on the following page).
- Position the end cap in line with the edge of the 2 in (50 mm) masking tape.
- Press firmly with both hands.
- Remove as much trapped air pockets as possible.
- Remove masking tape and excess flash.
- Allow end cap to dry for a minimum of 2 hours before placing the cylinder back in service.

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**Fig. 14**  
**Adhesive Applied**



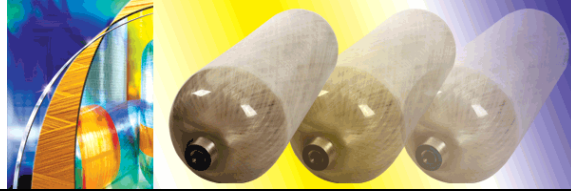
**Fig. 15**  
**End Cap Placement**

### **Materials and Equipment**

The following materials and equipment are needed in order to remove and replace the end cap of a cylinder:

- Tongue depressor, or similar, for mixing adhesive
- Hook razor blade
- 2 in (50 mm) wide masking tape
- Mixing container
- Cylinder holding fixture or strap
- Two part resin adhesive (Resin Lab, P/N: EP1167-8 Blue)

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## **APPENDIX A**

### **FWD DOME END CAP DRAWING**

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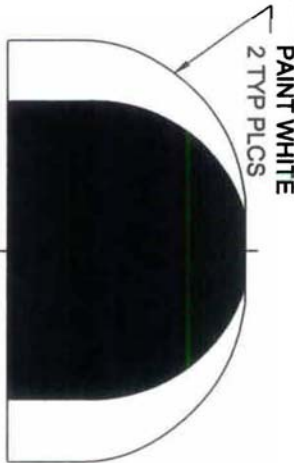
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2. IDENTIFICATION OF THE APPROVED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING
3. MATERIAL:
  - A. POLYURETHANE, CLOSED-CELL FOAM, WT. 1.80, BLACK, FIRE RETARDANT
4. THE BOOT MUST BE PAINTED WHITE IN QUARTERS USING SEMI GLOSS POLYURETHANE PAINT

APPROVED SOURCE(S) OF SUPPLY	
DASH/ VENDOR PART NO.	NAME AND ADDRESS
-1 FMS 74001-10FR#1	FOAM MOLDERS & SPECIALTIES 20004 STATE RD. CERRITOS, CA. 90703-6456

**FOR REFERENCE ONLY**

FWD DOME INSIDE CONTOUR	
X	Y
3.075	0
3.075	0.200
3.071	0.550
3.049	0.926
2.989	1.272
2.895	1.638
2.763	1.998
2.578	2.288
2.360	2.572
2.095	2.834
1.800	3.070
1.479	3.293
1.152	3.465
0.750	3.665

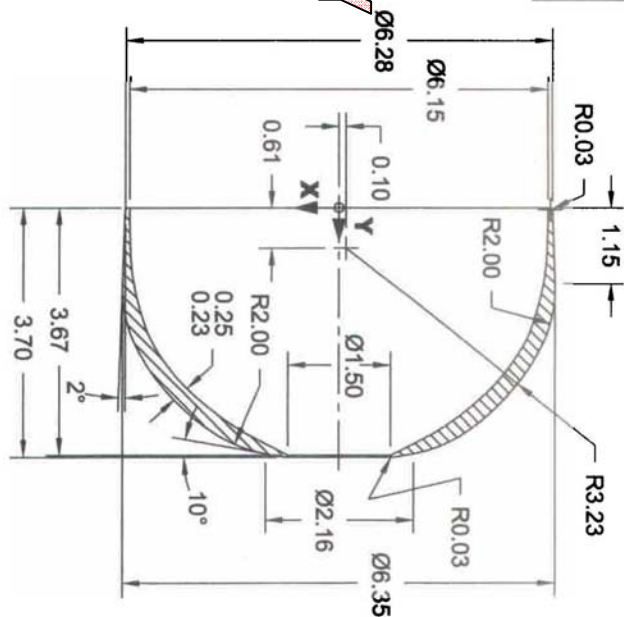


**PAINT SCHEME DETAIL**

PART NO.	QTY.	RECD.	PER ASSY.	FINAL	APPLICATION
-1	1	1	1	1	ALT 1088C USED ON

REVISIONS (CAD CONTROLLED DO NOT MANUALLY REVISE)

LTR	DCN	DESCRIPTION	DATE	APPROVED
A	5294B	MULTIPLE CHANGES.	2/1/06	[Signature]



**SOURCE CONTROL DRAWING**

QTY/REQD	PART NO.	DESCRIPTION	MATERIAL/SPECIFICATION
-1		BOOT, FWD DOME	POLYURETHANE

APPROVALS	DATE
DRAWN: CUONG LE	11-15-05
CHECK: R. ALMAGRO	11-18-05
ENGR: E. SCHINDLER	11-18-05
MFR: R. CAUDILL	11-21-05
D.A.: R.L. BECK	11-18-05

LIST OF MATERIAL	
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN [ ] ARE IN INCHES DIMENSIONS IN ( ) ARE IN MILLIMETERS TOLERANCE ON DECIMALS ANGULAR XXS 0.03 XXKX 0.10 50.5°	
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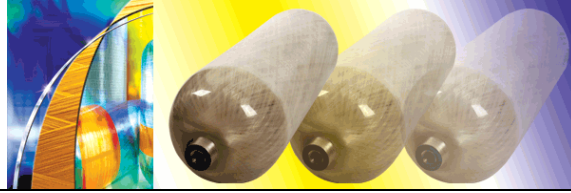
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<b>BOOT, FWD DOME PROTECTION</b>	58943	1274274

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NONE	11-23-05	



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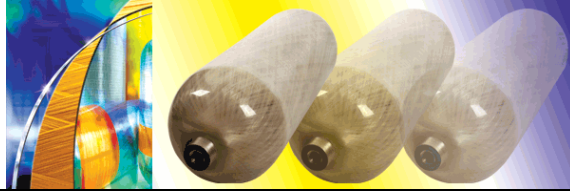


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## **APPENDIX B**

### **AFT DOME END CAP DRAWING**

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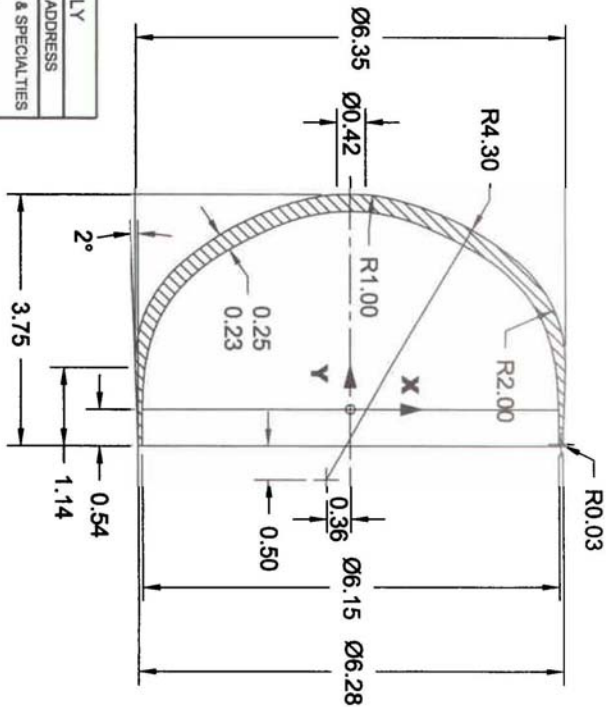
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**NOTES:**

1. ONLY THE ITEM DESCRIBED ON THIS DRAWING WHEN PROCURED FROM THE VENDOR(S) LISTED HEREON IS APPROVED BY STRUCTURAL COMPOSITES INDUSTRIES FOR USE IN THE APPLICATION(S) SPECIFIED HEREON. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR APPROVAL BY STRUCTURAL COMPOSITES INDUSTRIES.
2. IDENTIFICATION OF THE APPROVED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING
3. MATERIAL:  
A. POLYURETHANE, CLOSED-CELL FOAM,  
WT. TBD GRMS., BLACK, FIRE RETARDANT

**FOR REFERENCE ONLY**

REVISIONS (CAD CONTROLLED DO NOT MANUALLY REVISE)				
LTR	DCN	DESCRIPTION	DATE	APPROVED
A	5294	MULTIPLE CHANGES.	02-06-06	GB



APPROVED SOURCE(S) OF SUPPLY			
DASH NO.	VENDOR PART NO.	NAME AND ADDRESS	
-1	FMS 74001-10FR#1	FOAM MOLDERS & SPECIALTIES 20004 STATE RD. CERRITOS, CA. 90703-6456	

AFT DOME INSIDE CONTOUR	X	Y
3.075	0	
3.066	0.486	
2.977	0.962	
2.798	1.429	
2.515	1.826	
2.141	2.176	
1.725	2.435	
1.305	2.652	
0.880	2.829	
0.580	2.910	
0.250	2.965	
0	2.965	

PART NO.	QTY.	RECD.	PER ASSY.	NEXT ASSY.	USED ON
-1	1	1		AL11088C	

APPROVALS	DATE
DRWEN CUONG LE	11-18-05
CHEK R. ALMAGRO	11-18-05
ENGRG E. SCHINDLER	11-18-05
MFG. R. CAUDILL	11-21-05
QA R.L. BECK	11-18-05

LIST OF MATERIAL			
QTY/RECD	PART NO.	DESCRIPTION	MATERIAL/SPECIFICATION
	-1	BOOT, AFT DOME	POLYURETHANE

**SOURCE CONTROL DRAWING**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSIONS IN [ ] ARE IN MILLIMETERS TOLERANCE ON DECIMALS XX± 0.03 XXX± 0.10 ANGULAR ±0.5°

**DO NOT SCALE DRAWING**

**SCIENCE MODEL INDUSTRIES**  
Structural Composites Industries  
Hercules

**SCI MODEL 1088C**

**6.8L MIL SCBA CYLINDER**

GAGE CODE **58943** DWG. NO. **1274277**

SCALE: NONE REL. DATE: 11-22-05 SHT 1 OF 1

