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	<p>Subsystem/Office GLAST Tracker Tray</p>	
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Process Cleanliness

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Change History Log

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1	Sept. 13, 2004	Initial Release

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1 Introduction

The present document describes the preparation of the bonding surface on the Tungsten Tiles

2 Scope

The goal is to increase the bond adhesion, avoid contamination during the process and to maintain the tile flat.

3 Acronyms and Definitions

EM – Engineering Model

GLAST – Gamma-Ray Large Array Telescope

Plyform – Trays Manufacturing

MEK – Methyl Ethil Kethone

TKR – Tracker

TVAC – Thermo vacuum Test

W - Tungsten

4 Applicable Documents

Documents relevant to the development of this procedure include:

- [1] ASTM D2240-91, Standard Test Method for Rubber Property - Durometer Hardness or Barcol Hardness as for ASTM 2583
- [2] Bell test, Plyform Modified, picture Showed in Appendix D
- [3] LAT-PS-01584, Mid Tray Assembly Procedure
- [4] FED-STD-209
- [5] INFN-LAT-MECH-006-01
- [6] INFN-LAT-MECH-008-01
- [7] INFN-LAT-MECH-009-01
- [8] INFN-LAT-MECH-010-01
- [9] Tart Report, Pisa 09/02/2004

5 Process Cleanliness

As for The Tart Report [9] all the following manufacturing guidelines and process controls listed below shall be implemented in the Bonding Area.

5.1 General Manufacturing Guidelines

All the guidelines listed below are briefly summarized in the Appendix A, any deviation from this should be communicated to INFN and Approved.

1. Smocks and hairnets should be worn in all flight manufacturing activities. The bonding area should be clean, temperature and humidity controlled, free of particulate generating material (eg. cardboard boxes), and an area dedicated to bonding or lay-up operations. No silicone processing, mold release applications, eating, drinking, use of aerosol sprays, and operation of polluting-generating machinery should be permitted there. Personnel access should be limited to as few as necessary. The area should receive routine housekeeping. Laminar flow in the bonding area is desirable. As a minimum, the area should have adequate ventilation for the venting of solvent vapors that may contaminate the bonding materials. Control of particulates in Plyform tray bonding is required.

Consider use of clean tent.

2. All handling of flight materials should be performed with appropriate gloves to avoid surface contamination. In most cases for general handling and personnel protection nitrile gloves are acceptable. However, when using strong solvents, eg. MEK or acetone, polyethylene gloves should be used. MEK and acetone attack nitrile and surfaces being cleaned could be contaminated with nitrile.

3. Procedure for Solvent Wiping (Appendix B).

Wearing appropriate gloves, wipe with successive wiping cloths (Tex Wipe 609 or equivalent), each saturated with solvent, one pass in one direction for each cloth. Repeat until no visible residue remains on the wiping cloth. Be careful not to drag contaminants into bond area from any surrounding area. To minimize solvent evaporation and waste, small cloths are recommended. On the last wipe, remove the solvent with a second clean dry cloth before the solvent evaporates. Wait 30 minutes for the solvent to evaporate before bonding.

4. Adhesive preparation and bonding operations should be performed in clean temperature- and humidity-controlled environment. Temp 23+/-2 deg. Humidity less than 60%. Temperature and humidity of the tray bonding area should be recorded.
5. All abrading operations should be done in a separate room well away from adhesive preparation and bonding activities.

5.2 Process Controls

1. Bell-Peel test [2] for tungsten samples to verify primer and surface prep. Samples should be co-etched with tile material. Lot sample (minimum of three) for each lot (Appendix D).
2. Adhesive mix sample, for hardness check – correct mix and curing. Aluminum dish, filled uniformly to a depth of ¼ inch minimum. Keep bottom flat during cure. Cure condition/duration should be same as flight sample – 7Day/Room Temp. Do Shore D hardness test per ASTM D2240-91 (or Barcoll ASTM 2583, Appendix E). 3M2216 specified hardness is 50 – 65. Record and preserve data.
3. Each process step is given on a process work sheet or log. Quality control inspection are included for critical steps as listed in Appendix C.

Appendix A
BONDING AREA GENERAL REQUIREMENTS

ID	Features required in the BONDING AREA	NOTES
TO USE		
A	Smocks	
B	Hairnets	
C	Polyethylene Gloves when strong Solvents are used as MEK, ACETONE	
D	Only Tex Wipe 609 or equivalent as Wiping cloths	
TO AVOID		
E	Particulate generating Material (CARDOXES)	
F	Silicone Processing, handling	
G	Mold Release Applications	
H	Eating, Drinking	
I	Use of Aerosol Sprays	
L	Operation of Polluting generating machinery	
M	Abrading Operation	
TEMPERATURE AND HUMIDITY		
N	Adhesive Preparation and Bonding Operations are performed in Temperature and Humidity Controlled Environment. Temperature: 23°C ± 2°, Humidity<60%. Temperature and Humidity recording is needed	
REQUIREMENT		
O	Temperature and Humidity recording	
P	Limited Personnel Access	
Q	Ventilation for the Venting of the Solvent Vapors	
R	Laminar flow	
S	Routine housekeeping	
T	Controls of particulates (clean tent)	

Appendix B
PROCEDURE FOR SOLVENT WIPING

ID	PROCEDURE FOR SOLVENT WIPING	NOTES
A	Wear polyethylene Gloves	
B	Use "Tex wipe 609" wipes	
C	Use small clothes to minimize Solvent evaporation	
D	During the wiping don't drag contaminants into bond area from any surrounding area	
E	Saturate the wiping cloth, then pass it only one time in one direction	
F	Use another wiping cloth, pass it only one time in one direction	
G	Repeat step F until no visible residue remains on the wiping cloth	
H	On the last wipe, remove the Solvent with a second clean dry cloth before the solvent evaporates	
I	Wait 30 minutes for the solvent to evaporate before bonding	

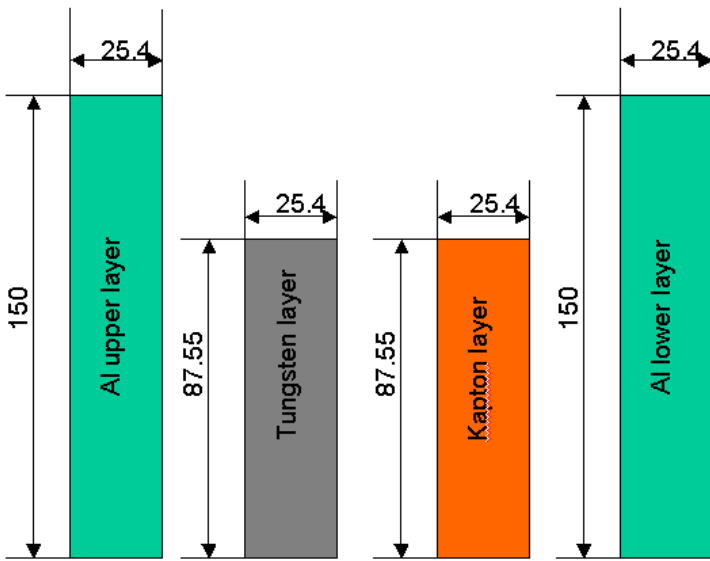
Appendix C
LIST OF THE MANDATORY INSPECTION POINTS

ID	MANDATORY INSPECTION POINTS
A	BIAS CIRCUIT PREPARATION WITH SCOTCH BRITE
B	*GLUE MIXING AND DEGASSING
C	*ADHESIVE APPLICATION
D	*CLEANING SURFACE PROCESS
F	TILES INSPECTION (WATER BREAK TEST)
G	COUPON TEST FABBRICATION

* Only on periodic base

Appendix D

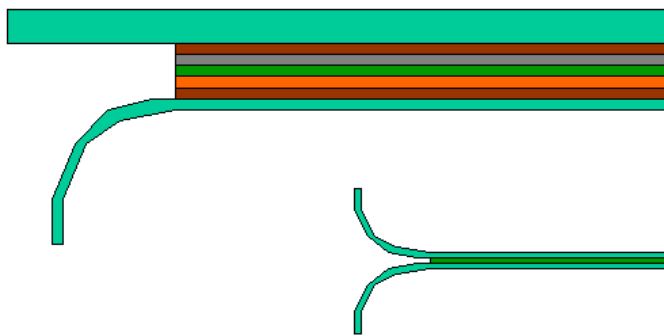
BELL PELL TEST, PLYFORM MODIFIED



Bell peel test configuration used by Plyform for GLAST

The samples are cured at RT for 24 hours at least in vacuum bag

material	Thickness (mm)
Al	1.6
Hvsol 934A	~0.1
W	0.1
3M2216	~0.1
Kapton	0.1
Hvsol 934A	~0.1
Al	0.6



← T peel test configuration

Appendix E

ASTM 2583 – 95 , Barcol Impressor



Designation: D 2583 – 95 (Reapproved 2001)^{e1}

Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor¹

This standard is issued under the fixed designation D 2583; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

^{e1} Note—Editorial changes were made throughout in November 2001.

1. Scope

1.1 This test method covers the determination of indentation hardness of both reinforced and nonreinforced rigid plastics using a Barcol Impressor, Model No. 934-1 and Model No. 935.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

Note 1—There is currently no ISO standard that duplicates this test method.

2. Referenced Documents

2.1 ASTM Standards²

- D 618 Practice for Conditioning Plastics for Testing³
- D 883 Terminology Relating to Plastics³
- D 4000 Classification System for Specifying Plastic Materials³
- D 4805 Terminology for Plastics Standards³
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

3. Terminology

3.1 **Definitions**—For definitions of technical terms pertaining to plastics used in this test method, see Terminology D 883 or Terminology D 4805.

¹ This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.10 on Mechanical Properties. Current edition approved October 10, 1995. Published December 1995. Originally published as D 2583 – 67. Last previous edition D 2583 – 93.

² Annual Book of ASTM Standards, Vol. 08.01.

³ Annual Book of ASTM Standards, Vol. 08.03.

⁴ Annual Book of ASTM Standards, Vol. 14.02.

4. Summary of Test Method

4.1 A material's surface hardness is determined through the use of a Barcol Impressor. The relative depth of penetration of the Impressor's indenter provides a comparative measure of the material's hardness. The Model No. 934-1 and Model No. 935 Barcol Impressors are designated for use. Within the range of hardness measured by these Impressors the Model No. 934-1 is used for measuring harder materials and the Model No. 935 is used for measuring softer materials.

5. Significance and Use

5.1 The Barcol Impressor is portable and therefore suitable for testing the hardness of fabricated parts and individual test specimens for production control purposes.

5.2 Before proceeding with this test method, reference should be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters or combination thereof covered in the relevant ASTM materials specification shall take precedence over those mentioned in this test method. If there are no relevant ASTM material specifications, then the default conditions apply. Table 1 of Classification System D 4000 lists the ASTM materials standards that currently exist.

6. Apparatus (Fig. 1 and Fig. 2)

6.1 **Indenter**⁵—The indenter shall consist of a hardened steel truncated cone having an angle of 26° with a flat tip of 0.157 mm (0.0062 in.) in diameter. It shall fit into a hollow spindle and be held down by a spring-loaded plunger. See Fig. 2.

6.2 **Indicating Device**—The indicating dial shall have 100 divisions, each representing a depth of 0.0076-mm (0.0003-in.) penetration. The higher the reading the harder the material.

6.3 **Calibration Standards**—"Hard" and "soft" aluminum alloy disks supplied by the manufacturer of the instrument.

⁵ Apparatus is available from Eurotherm/Barber-Colman, 741-F Miller Drive, Leesburg, VA 20175-8993.

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TABLE 1 Recommended Sample Sizes to Equalize the Variance of the Average for Model No. 934-1

Homogeneous Material				
Hardness M-934 Scale	Reading Variance	Coefficient of Variation, %	Variance of Average	Minimum Number of Readings
20	2.47	2.6	0.27	9
30	2.20	1.7	0.28	8
40	1.93	1.3	0.27	7
50	1.66	1.1	0.28	6
60	1.39	0.9	0.28	5
70	1.12	0.8	0.28	4
80	0.85	0.7	0.28	3
Nonhomogeneous Material (Reinforced Plastics)				
30	22.4	2.9	0.77	29
40	17.2	2.2	0.78	22
50	12.0	1.7	0.75	16
60	7.8	1.5	0.78	10
70	3.6	1.2	0.75	5

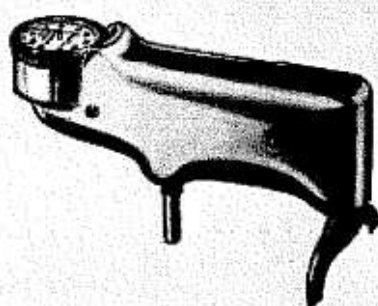


FIG. 1 Barcol Impressor

Other disks should not be used, even if they are of the same alloy and temper as the manufacturer's disks, as the hardness of aluminum may vary within any given alloy-temper parameter.

6.4 A smooth glass plate is also needed.

7. Test Specimens

7.1 The testing area shall be smooth and free from mechanical defects.

7.2 *Dimensions*—Test specimens shall be at least 1.5 mm (1/16 in.) thick and large enough to ensure a minimum distance of 3 mm (1/4 in.) in any direction from the indenter point to the edge of the specimen, as well as from test point to test point.

8. Preparation and Operation of Apparatus

8.1 The preparation and operation of Models 934-1 and 935 are identical. Place the Impressor and the material to be tested (or the calibration disk) on a solidly supported, flat, hard, firm surface such as stone, metal, or ceramic. If softer supporting surfaces are used, a falsely low instrument reading may occur.

8.2 Set the point sleeve on the surface to be tested. Set the legs on the same surface or on solid material of the same

thickness, so that the indenter is perpendicular to the surface being tested. Grasp the instrument firmly between the legs and point sleeve. Apply a uniform downward force quickly, by hand, increasing the force on the case until the dial indication reaches a maximum (Note 3). Take care to avoid sliding or scraping while the indenter is in contact with the surface being tested. Record the maximum reading.

Note 2—It is recommended that measurements be made with the Model 934-1 Impressor when values above 90 are obtained with the Model 935 Impressor and that measurements be made with the Model 935 Impressor when values less than 20 are obtained with the Model No. 934-1 Impressor. Values below 10 using the Model 935 Impressor are inexact and should not be reported.

Note 3—Drift in readings from the maximum may occur in some materials and can be nonlinear with time.

9. Calibration

9.1 With the plunger upper guide backed out until it just engages the spring, place the Impressor on a glass surface and press down until the point is forced all the way back into the lower plunger guide. The indicator should now read 100. If it does not, loosen the lock-nut and turn the lower plunger guide in or out to obtain a 100 reading. Next, read the "hard" aluminum alloy disk supplied by the manufacturer of the Impressor and, if necessary, adjust so that the reading is within the range marked on the disk. Then do the same with the "soft" disk. If these readings cannot be obtained, subsequent measurements are not valid.

10. Conditioning

10.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5% relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, unless otherwise specified by the contract or relevant ASTM material specification. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2% relative humidity.

10.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5% relative humidity, unless otherwise specified by the contract or relevant ASTM material specification. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2% relative humidity.

11. Procedure

11.1 Observing the precautions of Section 8, make measurements on the specimens to be tested (Note 4). Impressions should not be made within 3 mm (1/8 in.) of the edge of the specimen or of other impressions.

Note 4—Curved surfaces may be more difficult to support. When the load is applied, bending and spring action in the specimen should be avoided.

12. Number of Readings

12.1 Application of the Barcol Impressor to reinforced plastic (nonhomogeneous) materials will produce greater variation in hardness readings than on nonreinforced (homogeneous) materials. This greater variation may be caused mainly by the difference in hardness between resin and filler materials.

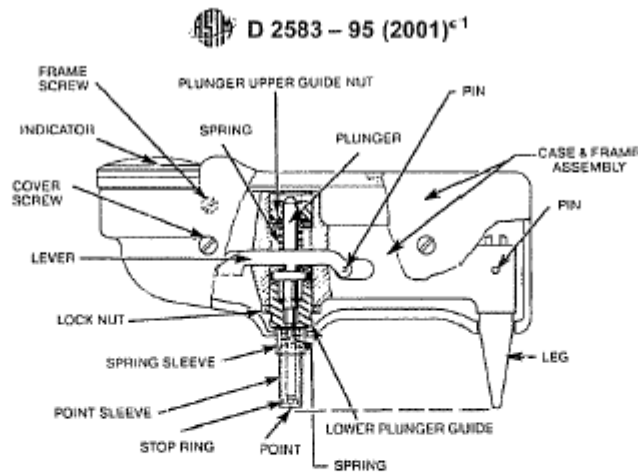


FIG. 2 Diagram of Barcol Impressor

in contact with the small diameter indenter. There is less variation in hardness readings on harder materials in the range of 50 Barcol and higher and considerably more variation in the readings of softer materials. On homogeneous materials, five readings are needed to maintain a variance-of-average of 0.28 at a 60 Barcol reading; for the same variance-of-average at 30 Barcol, eight readings are needed. On reinforced plastics, in order to maintain a variance-of-average of 0.78 at 60 Barcol, ten readings are needed; and 29 readings are needed for the same variance at the 30 Barcol level (Table 1).

NOTE 5—These findings were obtained with a round robin conducted in a workshop with all participants present. Eight plastic materials of different hardness were evaluated with six different Barcol (934-1) Impressors.

13. Report

- 13.1 Report the following information:
 - 13.1.1 Identification of material tested,
 - 13.1.2 Conditioning of specimen,
 - 13.1.3 Model number of Impressor,
 - 13.1.4 Number of readings taken,
 - 13.1.5 Average of hardness values rounded to the nearest whole scale reading,
 - 13.1.6 Date of test, and
 - 13.1.7 Test method number and published/revision date

14. Precision and Bias⁶

- 14.1 No precision statement using Model 935 can be offered at this time.
- 14.2 Table 2 is based on a round robin conducted in 1981, in accordance with Practice E 691, involving five materials tested by nine laboratories using Model No. 934-1. For each material, all the samples were prepared at one source. Each laboratory obtained three test results for each material. For the materials shown, the indicated number of individual determinations were averaged to calculate each test result as follows:

TABLE 2 Precision Data for Model No. 934-1

Material	Values in Units of Barcol Hardness				
	Average	S_x^a	S_R^b	I_x^c	I_R^d
SAN	35	1.04	2.93	3	8
BMC	39	0.95	3.75	3	11
Reinforced SAN	44	1.11	2.25	3	6
Polyester laminate	55	1.45	1.93	4	5
SMC	61	1.14	2.15	3	6

^a S_x = within-laboratory standard deviation of the average
^b S_R = between-laboratories standard deviation of the average
^c $I_x = 2.83 S_x$
^d $I_R = 2.83 S_R$

Material	No. of Determinations using Model No. 934-1
SAN	8
BMC	22
SAN reinforced with 20% glass	22
Polyester Mat Laminate (thermoset)	16
SMC (sheet molding compound)	16


NOTE 6—Caution: The following explanations of I_x and I_R (14.3-14.3.3) are only intended to present a meaningful way of considering the approximate precision of this test method. The data in Table 2 should not be rigorously applied to acceptance or rejection of material, as those data are specific to the round robin and may not be representative of other lots, materials, or laboratories. Users of this test method should apply the principles outlined in Practice E 691 to generate data specific to their laboratory and materials, or between specific laboratories. The principles of 14.3-14.3.3 would then be valid for such data.

14.3 Concept of I_x and I_R —If S_x and S_R were calculated from a large enough body of data, and for test results that were averages from the numbers of determinations stated in 14.2:

14.3.1 Repeatability, I_x (Comparing two test results for the same material, obtained by the same operator using the same Barcol Impressor on the same day)—The samples represented by the two test results should be regarded as not having equivalent hardness if the test results differed by more than the I_x value for that material and condition.

14.3.2 Reproducibility, I_R (Comparing two test results for the same material, obtained by different operators using different Barcol Impressors on different days)—The samples represented by the two test results should be regarded as not having

⁶ Supporting data are available from ASTM Headquarters. Request RR: D20-1087.

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equivalent hardness if the test results differed by more than the I_R value for that material and condition.

14.3.3 Any judgment in accordance with 14.3.1 and 14.3.2 would have an approximate 95 % (0.95) probability of being correct.

14.4 *Bias*—There are no recognized standards on which to base an estimate of bias for this test method.

15. Keywords

15.1 Barcol Hardness Impressor; Models 934-1 and 935; hardness; indentation hardness; rigid plastics

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