


HCB Mass Properties Measurement Procedure

 GLAST LAT PROCEDURE	Document # LAT-PS-07373-01	Date effective 10/22/05
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Document Title HCB Mass Properties Measurement Procedure		

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	10/22/05	Initial Release

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1. SCOPE

This document describes the procedure required to measure the mass properties (weight and center of gravity) of the LAT HCB assembly as shown in figure 1.

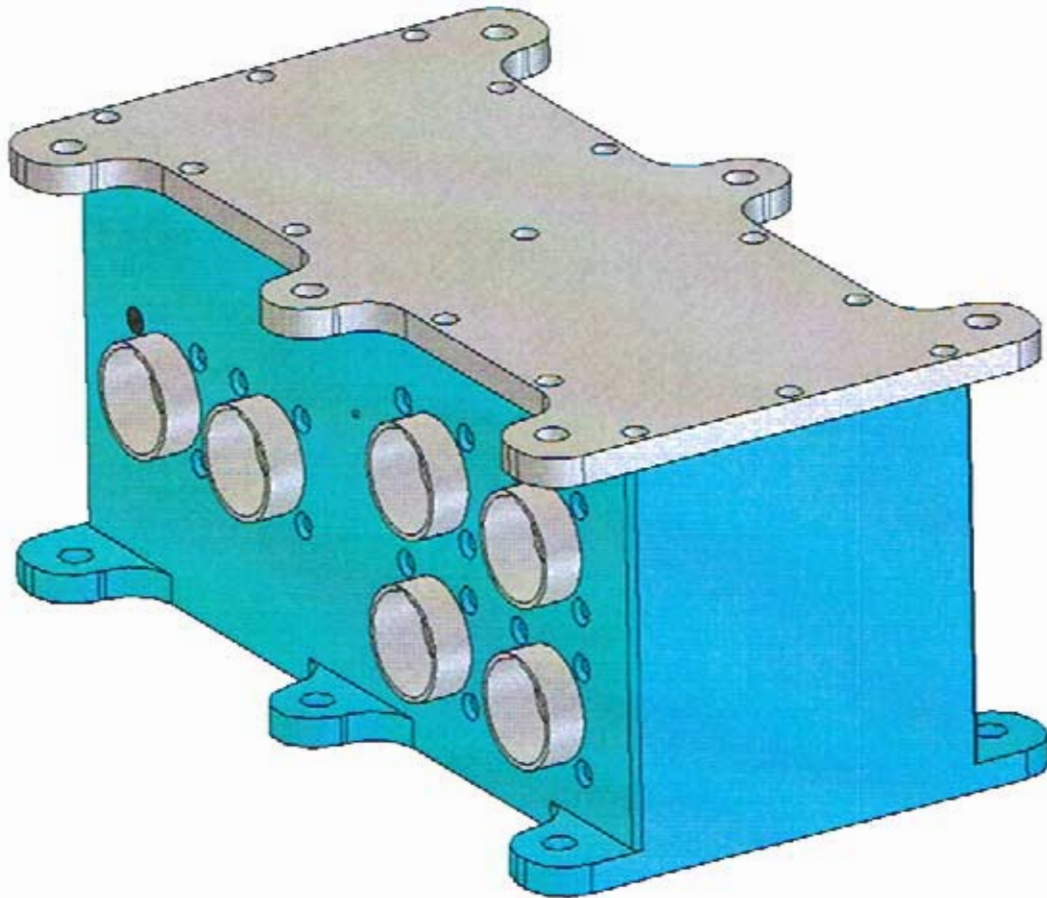


Figure 1 HCB ASSEMBLY LAT-DS-02137

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2. DEFINITIONS AND ACRONYMS

The following terms, abbreviations, and acronyms are used in this document.

2.1 Definitions and Acronyms

GLAST Gamma-Ray Large Area Space Telescope

LAT Large Area Telescope

HCB Heater Control Box

CG	Center of Gravity
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CMM Coordinate Measuring Machine

3. REFERENCES

The list below provides documents that are to be used as references for this procedure.

3.1 Applicable Documents

Document Number	Description
LAT-DS-02137	HCB Assembly

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4. GENERAL REQUIREMENTS

4.1 MASS PROPERTIES

4.1.1 Mass

The maximum HCB assembly mass allocation is 1.6 kg/3.52 lbs.

4.2 ENVIRONMENT

Weighing and CG operations shall be performed in the following environmental condition:

- Temperature: 20°C to 25°C

4.3 EQUIPMENT AND SUPPLIES

The following equipment and supplies are required for the procedure.

Test Equipment Description/Manufacturer	Model Number
Load Cell- 5lb capacity	Interface sm5 Load Cells
Load Cell Reader	Interface model 9820 Indicators
Weight Scale	AccuWeight CA27125
Mounting hardware	WITTE 21360
Miscellaneous Hand Tools	
Coordinate Measuring Machine CMM	LEITZ PMM 12 10 6

4.4 PARTS LIST

This following assembly is required for the procedure.

Drawing Number	Part Description	Quantity
LAT-DS-02137	HCB Assembly	1

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4.5 WEIGHING OPERATION

All assemblies—qualification/protoflight and acceptance units—will be weighed per this section.

1. Verify that all connector savers have been removed from the boxes prior to weighing.
2. Setup and secure weight scale on a level surface. Slowly lower HCB assembly on to scale. Record weight and unit GLAT #.

4.6 MEASURING CENTER OF GRAVITY

Unit center of gravity will be measured for qualification and protoflight boxes, only. Follow-on unites do not need to be measured for center of gravity

1. Verify that all connector savers have been removed from the boxes prior to weighing.
2. Setup and secure three load cells on the load plate (see figure 2). Measure and record the location of each load cell in the plate coordinate system (X, Y, Z), as shown in figure 2.
3. Slowly place the HCB assembly onto the load cells (see figure 3). Set the unit down on the load cells in any orientation, keeping the geometric center of the box within the triangle defined by the 3 load cells.
4. Measure the location of the box in its as-mounted position by measuring the location of the auxiliary coordinate system (U,V,W) with the CMM using the U and V edges of the box and bottom surface, as defined in figure 2 and 3. Note that the UVW-Coordinate system is fixed with respect to the unit, and must be defined as shown in Figures 2 and 3.

Since the unit will be measured in a static bag, take care to make sure the static bag is flat (no wrinkles) against the box when measurements are taken by the CMM.

Record the rotation angle of the U-axis of the box coordinate system with respect to the X-axis of the plate coordinate system. Record in the Data Table.

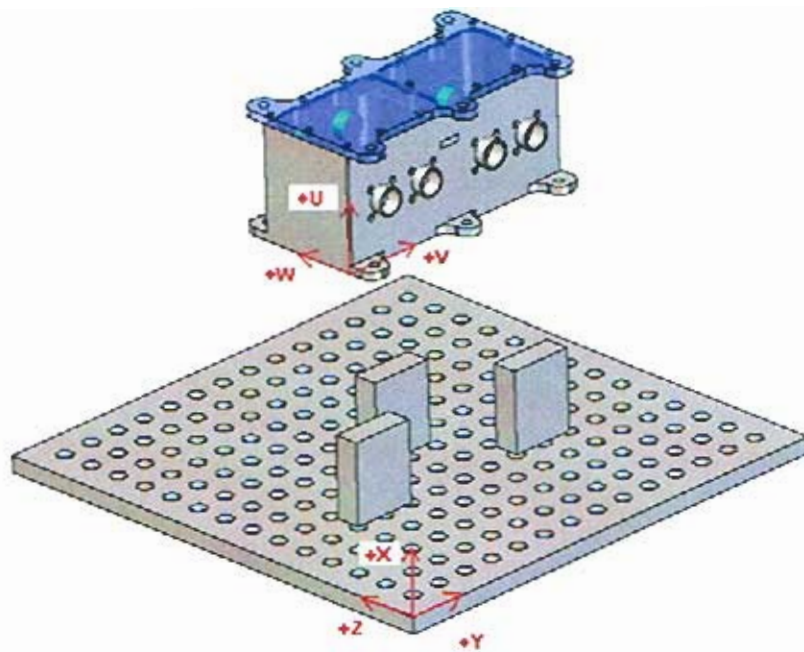


Figure 2 HCB, LOAD CELLS, LOAD PLATE, COORDINATE SYSTEMS

5. In the CMM, transform the location of the load cells from the plate (X, Y, Z) to the box (U, V, W) coordinate system.
Record the (U, V, W) location of all 3 loadcells in the Data Table.
Record the load reading for all 3 load cells in the Data Table.
6. Repeat steps 3-5 with the unit rotated 90 +/- 20 degrees from its initial orientation. Note that the UVW-Coordinate system is fixed with respect to the box, so it too rotates with respect to the XYZ-Coordinate system.
7. Repeat steps 3-5 with the unit rotated 180 +/- 20 degrees from its initial orientation.

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8. Calculate the center of gravity and total weight for all 3 measurement orientations. Record results in the Data Table.

Verify that the center of gravity spread between the 3 measurements is less than 2 mm.

Verify that the weight spread between the 3 measurements is less than 40 grams.

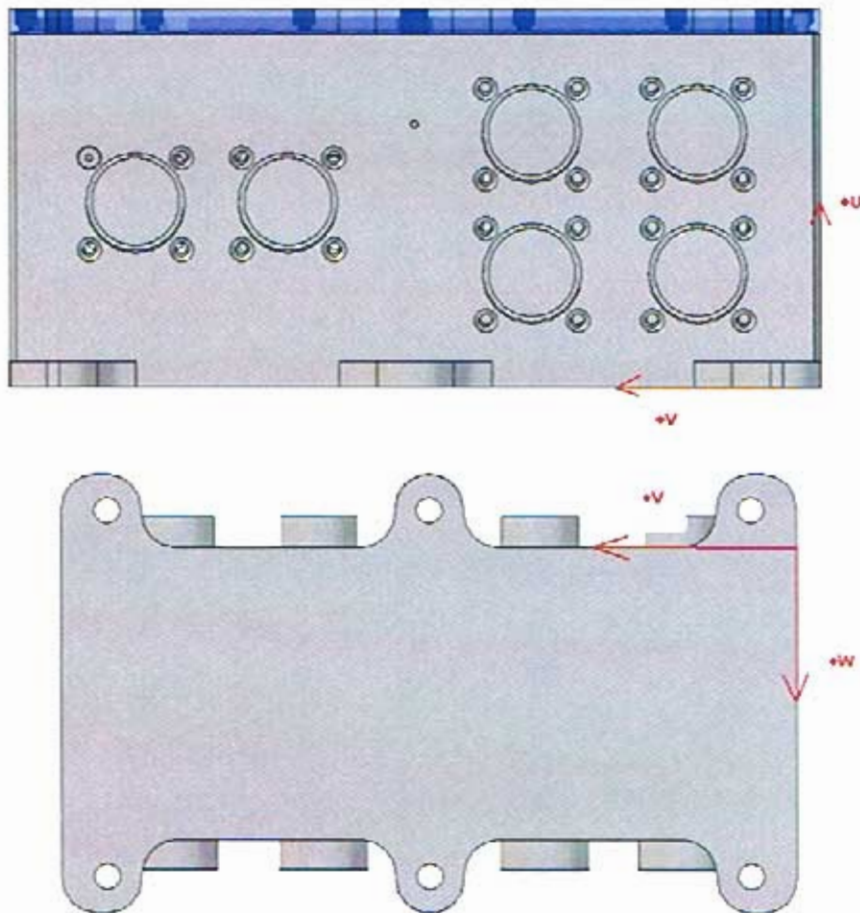


Figure 3. HCB Box Coordinates

4.7 CALCULATION OF HCB CENTER OF GRAVITY

There are four values associated with each of the load cells 1, 2, and 3:

L1 = Load read by that load cell.

(U1, V1, W1) = the location of the load cell in box coordinates

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Using the definitions listed above, find the box center of gravity (U_{cg} , V_{cg}) with the following formulae:

$$U_{cg} = (L1*U1 + L2*U2 + L3*U3) / (L1 + L2 + L3)$$

$$V_{cg} = (L1*V1 + L2*V2 + L3*V3) / (L1 + L2 + L3)$$

HCB Mass Properties Measurement Data Sheet

Procedure No. LAT-PS-07373-01

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Part Number: LAT-DS-02137

Test Type: HCB Mass Measurement

Test Operator (s):

Name: Keith Caban

Phone Number: x 4022

Calibration Record

Description	Serial #	Date of Last Calibration	Calibration Due Date
Weight Scale	CA27125	12/02/05	Calibrate Prior to use

Procedure

Step/ Description: Section 4.1	Performed by/date:	Q.A.	Notes:
1. Verify that connector savers are all removed	<i>[Signature]</i> 12/5/05		
2. Weigh unit on scale	KC 12/02/05 <i>[Signature]</i> 12/2/05	<i>[Signature]</i>	
Unit Serial # <u>GAT 2436</u>	KC 12/02/05		
Mass: <u> 1.36</u> kg	<i>[Signature]</i> 12/2/05	<i>[Signature]</i>	

Test Data Review and Approval:

Test Operator/Engineer: Keith Caban *[Signature]* Date: 12/02/05 12/2/05
 Responsible Engineer: *[Signature]* Date: 12/5/05
 Quality Engineer: *[Signature]* Date: 12/02/05

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HCB Mass Properties Measurement Data Sheet

Procedure No. LAT-PS-07373-01

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Part Number: LAT-DS-02137

Test Type: HCB CG Measurement

Test Operator (s):

Name: Keith Caban

Phone Number: x 4022

Calibration Record

Description	Serial #	Date of Last Calibration	Calibration Due Date
Load Cell1	163135	12/01/05	Calibrate Prior to Use
Load Cell 2	157003	12/01/05	Calibrate Prior to Use
Load Cell 3	157009	12/01/05	Calibrate Prior to Use

Procedure

Step/ Description: Section 4.1	Performed by/date:	Q.A.	Notes:
1. Verify that connector savers are all removed	<i>[Signature]</i> 12/1/05		
2. Set up load cells and define plate coordinate system. Measure load cell location in plate coordinate system.	KC 12/02/05	Y✓	
Measurement #1 3. Set box on load cells	KC 12/02/05	Y✓	
4. Define box (U, V, W) coordinate system. Record offset of the box U-axis with respect to the plate X-axis in Data Table.	KC 12/02/05	Y✓	
5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record load cell locations and loads in the Data Table	KC 12/02/05	Y✓	

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Measurement #2 3. Set box on load cells rotated 90 +/- 20 degrees from original orientation 4. Define box (U, V, W) coord. system. Record offset of the box U-axis with respect to the plate X-axis in Data Table. 5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record locations, loads in the Data Table	KC		
	12/02/05	✓	
	KC		
Measurement #3 3. Set box on load cells rotated 180 +/- 20 degrees from original orientation 4. Define box (U, V, W) coord. system. Record offset of the box U-axis with respect to the plate X-axis in Data Table. 5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record locations, loads in the Data Table	KC		
	12/02/05	✓	
	KC		
8. Calculate center of gravity and total weight for all 3 measurements. Record results in Data Table Verify that spread is within allowables	KC		
	12/02/05	✓	
	KC		

Data Table

#	Load Cell	U offset (degrees)	Load Cell Location/Reading				Box CG/Weight		
			U (mm)	V (mm)	W (mm)	Load (kg)	U (mm)	V (mm)	Weight (kg)
1	L1	89.93522	24.614	48.006	96.602	0.330	42.294	99.333	1.360
	L2		24.585	149.729	95.934	0.340			
	L3		59.476	99.048	96.055	0.690			
2	L1	179.07871	93.191	96.869	96.640	0.640	42.351	99.581	1.360
	L2		-8.523	98.190	95.910	0.640			
	L3		42.616	132.405	96.057	0.080			
3	L1	269.12925	57.582	151.164	97.399	0.360	42.281	99.589	1.360
	L2		59.272	49.456	96.683	0.370			
	L3		23.558	99.560	96.842	0.630			
Average:						42.308	99.501	1.360	
Spread:						0.070	0.256	0.000	

Test Data Review and Approval:

Test Operator/Engineer: Keith Caban  Date: 12/02/05 12/2/05

Responsible Engineer:  Date: 12/2/05

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Quality Engineer: 11275  Date: 12/2/08

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