PROBLEM REPORT
PR-3012
Walpole
4/25/05

STEREO IMPACT

PR Numbers: 1xxx=UCB, 2xxx=Caltech/JPL, 3xxx=UMd, 4xxx=GSFC/SEP, 5xxx=GSFC/Mag, 6xxx=CESR, 7xxx=Keil, 8xxx=ESTEC, 9xxx=MPAe

Assembly : SIT Instrument	**SubAssembly : telescope**
Component/Part Number:	**Serial Number: 01**
Originator: Walpole	**Organization: UMd**
Phone : 301-405-6217	**Email : Walpole@umd.edu**

Failure Occurred During (Check one √)

x Functional test □ Qualification test □ S/C Integration □ Launch operations

Environment when failure occurred:

x Ambient □ Vibration □ Shock □ Acoustic
□ Thermal □ Vacuum □ Thermal-Vacuum □ EMI/EMC

Problem Description

A cracked ceramic piece, drawing S11a, was found in the FM1 telescope STOP MCP stack.
During disassembly of the FM1 telescope to inspect for something that might have caused the large signal (or HV breakdown) that damaged the FM1 ATOF STOP channel during thermal balance testing, we found that a thick (.070") ceramic was broken into two pieces. The piece is essentially picture frame shaped. The break occurred at one end of the frame where the sides meet the end. Both sides were broken at the same spot. The break looks clean and there is no evidence of blackening from HV breakdown. The piece had about 1kv across it (2200 v – 3200v) and acted as the holder for the rear MCP in the stack. No other ceramic pieces in the stack were broken but some microscopic cracks were evident in the thinnest pieces. Examination of unused spare parts of the same design showed some of the same small cracks, but not as many.

Analyses Performed to Determine Cause

The part was sent to the materials branch, Len Wang. The analysis is attached but indicates that the ceramic piece was made before recent advancements in ceramic technology that have made ceramics tougher and stronger. The Belleville washers were fully compressed and therefore the compressive load was indeterminate.

Corrective Action/ Resolution

x Rework □ Repair □ Use As Is □ Scrap

MRB recommendations:

1) Reassembled STOP stack replacing all of the ceramic pieces for which spares exist.
2) Reassembled the STOP stack using 2 Belleville washers and compressing the Belleville pair half way. No action was taken on the START stack nor the stacks in FM2 because the ceramic parts are captured and in compression, and there was no indication of any electrical degradation found in the stack with the cracked ceramic piece.

Date Action Taken:___4/29/2005_____**Retest Results**:_5/2/05 Functional test successful.

Corrective Action Required/Performed on other Units □ Serial Number(s): ____n/a_____

Closure Approvals

Subsystem Lead: _____ Date:_____
IMPACT Project Manager: _____ Date _____
IMPACT QA: _____ Date:_____

STEREO IMPACT

NASA IMPACT Instrument Manager: _____ Date:_____

From: Len Wang <lwang@mscmail.gsfc.nasa.gov>
Date: Tue, 03 May 2005 10:32:07 -0400
To: Michael D Jones <mijones@pop700.gsfc.nasa.gov>,
<swasserzug@swales.com>
Cc: <Charles.C.He.1@GSFC.NASA.GOV>
Subject: Stereo-Impact, MCP alumina holder fracture

I did not see any indication of electric discharge. The cause of the failure is apparently mechanical over load, likely local bending over load due to over clamping. The microstructure of the material can be seen at the fracture surfaces -- attached images. Very large grains (tens of microns) are mixed with small grains (1 to 2 microns). This is not a desirable structure. Charles He is our ceramic expert. He pointed out that such microstructure indicates the material experienced a secondary grain growth during the sintering, which will substantially drop the strength of the material. The material was made during the time when secondary grain growth control technique was not widely available, probably in the 70's, as Steve told us. We had similar problem with HST gyro rotors and thruster plates that were made of the alumina during the 70's with large grains and showed poor mechanical performance.

Alumina with such microstructure can only be used under compressive load, It can only sustain very limited bending or tensile load if there should be any. Extreme care must be taken during the assembly. Over clamping, as Steve told us, will cause local bending and tensile stress that could fail the part. Mis-alignment, hard contact, or particle contaminants will also cause local bending or indentation and could potentially fail the part.

Len

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