STEREO CONFIGURATION CHANGE REQUEST

For Office Use Only	TITLE: Request use of cork as the brake pad material of the flyweight brakes for both IMPACT and S/WAVES deployment mechanisms.	CLASS:	I / II	NUMBER: / DATE:

CONFIGURED ITEM:

STS Number:

Payload: STEREO

Component :

Experiments: IMPACT / WAVES

Component Part #:

Serial #:

ORIGINATOR:

Name: Dave Curtis / Keith Goetz

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PRIORITY:

√	Routine
	Urgent
	Emergency

TYPE OF REQUEST:

	Configuration	
	Deviation	#
√	Waiver	#
	Other:	

RESPONSIBLE ORGANIZATION / INDIVIDUAL:

Space Sciences Lab, UC Berkeley

Robert Ullrich (510)642-0245

rullrich@ssl.berkeley.edu

IMPACTS: (If yes attach additional pages)

COST:		Yes	√	No
SCHEDULE:		Yes	√	No

REASONS FOR CHANGE:

	Improvement		Test / Payload Failure		New Document:
√	Reliability	√	Specification Requirements	√	Other: Left off Impact mat'l list On Waves list from inception

RETEST REQUIRED:

√	No
	Yes

PROPOSED CHANGE (Attach additional pages as required): See attached sheet,

IMPACT request that a waiver of outgassing requirements be granted for the use of 0.16 g of cork for each boom mechanism. Approx volume per boom mechanism: 0.19 cc.

S/WAVES request that a waiver of outgassing requirements be granted for the use of 0.49 g of cork for each assembly (3 antenna elements). Approx volume per assembly: 0.58 cc.

RATIONALE (Attach additional pages as required):

See attached sheet.

DOCUMENTS / DRAWINGS AFFECTED (Document No. / Title / Section) :

APL Contamination Control Document 7381-9006 .

UCB fab drawings:

SWAVES-122 Brake pad-R0, Higher assemblies

IMP-122-brakepad-R0; Higher assemblies

AFFECTED (Check all that apply):

FLIGHT SYSTEMS:

	Avionics		Electrical and Cables				
√	Experiment		Software / Firmware				
	Structures and Mechanical		Other:				Other:

GROUND SYSTEMS:

REQUIRED APPROVAL DATE: _____1 June 2003_____

REQUIRED JUSTIFICATION:

STEREO CONFIGURATION CHANGE REQUEST

For Office Use Only	TITLE:	CLASS:		NUMBER:
			I	
			II	DATE:

CONTRACT / AGREEMENT NUMBER EFFECTIVITY:

	STEREO NAS5-97271	√	IMPACT S-13635Y		PLASTIC NAS5-00132		SECCHI S-13631Y

DOCUMENTS / DRAWINGS TO BE REVISED:

Document / Drawing Number:	Document / Drawing Title:	Section(s) No.	EO No.:	Date Completed:

PROCESSING APPROVAL:

	CCB		
	Out of Board		
	Emergency	Systems Engineer	Date

CCB APPROVAL:

CCB ACTION DATE:		CCB ACTION ITEMS / CONDITIONS:
	Approved	
	Denied	
	Withdrawn	
	Hold	

CLOSEOUT COMMENTS:	DATE OF CLOSEOUT:
	CMO

Rationale for Waiver Approval:

There has been some testing performed on cork material at GSFC, the compositions are similar to the proposed brake pads: ground cork in a natural polymer binder (nitrile rubber, same as flight o-rings)

From the NASA GSFC Outgassing website: http://outgassing.nasa.gov:

MATERIAL	% TML	% CVCM	CURE TIME	CURE AT-TEMP	MOS	% WVR	DATA REF	APPLICATION	MFR CODE
ARMSTRONG NC-733 RUBBER/GROUND CORK	5.97	0.94				0.56	GSC17094	FRICTION PAD	ACL
CORK/DC100 SHEET ACL	5.05	1.58				1.03	GSC12670	DAMPER	

This test was performed on a 1/32" thk sample, in 1982. It was not cleaned or processed prior to testing. The sample was "stacked in boats" and baked at 125 ^{0}C. See scanned sheet at end of waiver package.

Applicability of Data to Swaves / Impact Boom Case

The 5% TML and 1.6% CVCM values for cork exceed "preferred Material" specifications of 1% TML and 0.1% CVCM. The amount of material used for both Swaves and Impact Boom for each spacecraft is 0.49 + 0.16 = 0.65 grams. From the data in the report, this gives a mass loss of 0.033 gr, of which 0.006 gr is water. The CVCM for each spacecraft is 0.010 gr. The test temperatures are far above the flight values: the expected amounts of materials outgassing can be expected to be proportionally lower.

An 'engineering intuition' comment is that the amounts here are very small, compared to the volume they would need to fill to reach the sensitive instruments.

Outgassing Issues

The material has been shown to outgass significant amounts (5-6%) at high temperatures (125^0C) in a short (24 hr) period of time. However, the amount of material that is being proposed here is minute. For comparison, a material that meets the outgassing specification of 1% & 0.1%, but masses 6 times the cork will provide the same amount of volatiles; for example: an epoxy or uralane. Using this comparison, taking 6 times the cork mass (3.9 grams) of epoxy will give the same contamination quantity. There are many 10s or 100s of grams of these type materials throughout the spacecraft.

The specific path for the outgassed mass is of concern. Internal to the spacecraft, all boxes have filtered vents to keep the particles inside and help reduce the volatile redistribution. For these deployables, they are on the exterior of the spacecraft, and not able to be filtered, as they cannot be closed out.

1. To ensure that there is not a contamination path from the Swaves antennas to the Impact Boom mounted instruments, esp SWEA, the cover should be kept closed until a TBD (similar to the bake out) period of time has passed. As there is a delay between the 2 activities already in the commissioning plan, the delay value could be adjusted to accommodate this with minimal effect on the program. The STE is closed during this time. Swaves has no sensitivity to these contaminants.
2. The bake out requirement will remove most of the volatiles. Despite this waiver, the bake-out sequence will be completed, and meet the specified TQCM values.

<u>Mitigating facts:</u>

1) Both Swaves and Impact Boom are currently scheduled to deploy within the first 2 weeks after launch. This allows the spacecraft to move away from any contaminants that may be generated by any commissioning activities; as there

will be several delta v maneuvers required to reach helio-centric orbit. The instruments sensitive to contamination are scheduled to be commissioned later in the program. Specific commissioning activities are planned to minimize any contamination from the spacecraft or its instruments prior to exposing sensitive openings and surfaces eg. running heaters in the telescopes to drive off any condensed gases

2) These deployments are '1-shot' activities. Once they are deployed, there will be no further disturbance of the cork material.

3) The cork is attached to the brake shoe using Loctite / Hysol 0151 2 part epoxy (on the 'Approved' list). ½ of the surface area is potted by this epoxy, decreasing the available outgassing surfaces.

4) This material has long flight heritage, and is not easily substituted. Other brake pad regimes have been tried with lesser results, including unpredictable friction, unreliable friction, and no friction.

5) Impact Boom Mechanical

   a) The cork is sealed in a brake housing. The exit path for any particles is blocked.

   b) Vapors will 'plate out' on the cold internal surfaces of the brake itself. Expected high temperature: $+13^0$C. Expected low temperature: -45^0C.

   c) This housing resides in the bobbin assembly, inside the thermal blankets. Due to the need for clear aperture for deployment of the boom, it is not possible to cover the opening in the boom. This aperture is aimed away from the Sun (and thus the entire spacecraft).

   d) A contamination survey was performed including the use of the brake mechanism, which did not contribute any noticeable particulate.

6) Swaves Antenna Mechanical

a) The cork is again located inside the rear of the antenna housing, and a labyrinth path prevents any direct line for particulate to dissipate.

b) The volatiles would also 'plate out' on the cold portions of the inside of the antenna housing. Expected high temperature: $+35^0$C. Expected low temperature: -23^0C.

c) Due to the requirements for minimum capacitance from the antenna element to the ground plane, and also the need for a clear deployment aperture, it is not possible to cover the opening from which the antenna deploys. These apertures are aimed away from the Sun (and thus the entire spacecraft).

d) A contamination survey was performed including the use of the brake mechanism, which did not contribute any noticeable particulate.

7) Mechanisms will be deployed after thermal vacuum, to verify no degradation of brake pad material.

Summary

1. Total amount of outgassed material: .06 (TML) X 0.65grams (cork mass) X ½ (lower temp derate) X ½ (encapsulation in epoxy) X ¾ (encapsulation in nitrile rubber) = 0.007 grams TML per spacecraft.
2. CVCM derated similarly: 0.016 X 0.65 X ½ X ½ X ¾ = 0.002 grams condensed mass.
3. Both 1 & 2 can be further reduced by taking into account the labyrinthine exchaust path.
4. Volume to be affected (Impact deployed, HI, SECCHI not counted as they are screened by spacecraft): sphere of 4m radius = 4/3Pi r^3 = 268 m^3 .

5. Bake out monitored by TQCM will be performed to APL 7381-9006 specification.
6. Alternative materials do not provide required functionality.