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FAST Launch Site Contamination Control Implementation Plan

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SPACECRAFT CONTAMINATION ENGINEERING SECTION
CODE 724.4

FAST AURORAL SNAPSHOT EXPLORER (FAST)
LAUNCH SITE CONTAMINATION CONTROL IMPLEMENTATION PLAN

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SECTION 1.0 INTRODUCTION

The Fast Auroral Snapshot Explorer (FAST) is the second spacecraft developed by NASA's Small Explorer Project. It will measure magnetic and electric fields and electron and ion accelerations in the earth's auroral regions. The measurements will be made from a 350 km. x 4200 km. orbit with 83° inclination. Launch of the spacecraft will be done on a Pegasus XL launch vehicle from Vandenberg Air Force Base (VAFB) in August, 1994.

To accomplish its on-orbit objectives, the FAST spacecraft must meet established surface contamination requirements. The instruments responsible for taking scientific measurements feature several components that can be degraded by exposure to contaminants or water vapor. Additionally, elements of the attitude control, thermal, and power subsystems can suffer degradation or failure from excessive contamination.

During launch site operations, steps must be taken to ensure that the surface contamination requirements are met. For most operations, FAST will be kept in clean areas that have filtered air supplies and restrictions on contaminant generation. Highly sensitive instrument components will be further protected by non-flight covers and a nitrogen purge. When the spacecraft must be moved from a clean area, or when contaminant-generating procedures must be done in a clean area, the spacecraft will be covered with bagging. During transport, the bagged spacecraft will also be enclosed by a shipping container. These basic steps, which are detailed for specific launch site situations in the following pages, will ensure that FAST cleanliness levels remain within allowable levels.

1.1 PURPOSE

This document defines the contamination control requirements for launch site processing of the Fast Auroral Snapshot Explorer. Launch site processing includes all spacecraft operations from arrival at the launch site through release from the Pegasus carrier aircraft.

1.2 RESPONSIBILITY

Each organization supporting and servicing FAST flight hardware will implement the requirements of this plan and the applicable documents cited herein. Any questions regarding this document should be addressed to the SMEX Contamination Control Manager, Code 724.4, through the SMEX project office.

SECTION 2.0 APPLICABLE DOCUMENTATION

2.1 SMEX DOCUMENTS

SMEX-QA-002	Small Class Explorer (SMEX) Program Performance Assurance Requirements, Revision B (July 1990)
FAST-MGMT-014	FAST Subsystems Bakeout Plan (September 1993)
FAST-PROC-002	FAST Cleaning and Verification Procedure (February 1994)
FAST-PROC-003	FAST Clean Area Operation Procedure (November 1993)
FAST-SPEC-005	Requirements Document for SMEX, FAST Mission, Revision B (April 1993)
FAST-SPEC-008	Fast Auroral Snapshot (FAST) Explorer Contamination Requirements and Control Plan (October 1992)
FAST-SPEC-023	SMEX FAST I&T Magnetic Cleanliness Requirements (June 1993)
UCB Space Sciences Laboratory Document	Contamination Control Plan for the Fast Auroral Snapshot Instrument (March, 1992)

2.2 OSC AND LAUNCH SITE DOCUMENTS

OSC SSD-TD-0024	Contamination Control Procedure
OSC Document	Pegasus Launch System Payload User's Guide
SP-VSTS-81-1	WTR Operations Handbook

2.3 REFERENCE DOCUMENTS

FED-STD-209E	Federal Standard, Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones
MIL-STD-1246B	Product Cleanliness Levels and Contamination Control Program
MIL-P-27401C	Military Specification, Propellant Pressurizing Agent, Nitrogen
NASA-JSC-SP-R-0022A	Vacuum Stability Requirements of Polymeric Material for Spacecraft Application
NASA-JSC-SN-C-005	Contamination Control Requirements for the Space Shuttle Program, Revision C

NASA-RP-1124-87	Outgassing Data for Selected Spacecraft Materials
GSFC-TLS-PR-7324-01	Contamination Control Procedure for the Tape Lift Sampling of Surfaces

SECTION 3.0 ACRONYMS, TERMINOLOGY, AND STANDARDS

3.1 ACRONYMS

AACS	Airborne Air Conditioning System
AIT	Assembly and Integration Trailer
CCM	Contamination Control Manager
CE	Contamination Engineer
ECS	Environmental Control System
ESD	Electrostatic Discharge
FAST	Fast Auroral Snapshot Explorer
FED-STD	Federal Standard
GN_2	Gaseous Nitrogen
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HEPA	High Efficiency Particulate Air
IPA	Isopropyl Alcohol
JSC	Johnson Space Center
KSC	Kennedy Space Center
LN_2	Liquid Nitrogen
MIL-STD	Military Standard
MLI	Multi-Layer Insulation
NASA	National Aeronautics and Space Administration
NVR	Non-Volatile Residue

OSC	Orbital Sciences Corporation
SAI	Swales and Associates, Inc.
UCB	University of California at Berkeley
UV	Ultraviolet
VAFB	Vandenberg Air Force Base
WTR	Western Test Range

3.2 TERMINOLOGY

Clean Area	Area where airborne particle levels are strictly controlled by air filtration and regulation of particle sources. Cleanrooms, clean tents, and clean benches are the most common types of clean areas.
Contamination	Unwanted material that degrades the desired function of an instrument or flight hardware. Contamination is usually divided into two categories, particulate and non-volatile residue (NVR).
Contamination Control	Organized action to control contamination levels.
Extracted Wipe/Swab	Cleanroom wipe/swab repeatedly soaked in solvent and baked out in a vacuum or oven until particulate and NVR levels are negligible.
Fiber	Particle with a length-to-width ratio exceeding 10:1 and a minimum length of 100 microns.
Gross Cleaning	Cleaning hardware surfaces in a normal work environment to visual inspection standards. This step precedes precision cleaning.
Nitrogen Purge	Pressurized flow of clean, dry nitrogen through a system to displace impurities and reactive species.
Non-Volatile Residue	Soluble material that causes functional degradation in flight hardware.
Particle	Small quantity of solid or liquid material with definable shape and mass.
Particle Size	Maximum linear dimension or diameter of a particle.
Precision Cleaning	Cleaning procedure done in a clean area to attain a specific, quantitative level of cleanliness.

Sensitive Surfaces	Flight hardware surfaces requiring a specific cleanliness level to meet minimum performance requirements.
Solvent Flushing	Pressurized stream of filtered solvent directed against a surface to dislodge and rinse away contaminants.
Solvent Washes	Quantitative method of verifying MIL-STD-1246B levels by measuring molecular contamination in a solvent washed over a surface.
Surface Cleanliness Level	Established maximum allowable particle and NVR contamination ranging from visibly clean to specific MIL-STD-1246B levels.
Swab Sample	Qualitative method of identifying contaminants by analyzing residue on a solvent soaked swab that was wiped over a surface.
Tape Lifts	Quantitative method of verifying MIL-STD-1246B particle cleanliness levels by measuring particle contamination on a tape sample that has contacted a surface.
Vapor Degrease	Item to be cleaned is exposed to heated solvent vapors that condense on the part and wash away contaminants. (NOTE: Halogenated solvents used to vapor degrease plastics are often outgassed or leached out later. Therefore, plastics vapor degreased with halogenated solvents must be baked out.)
Visibly Clean	Clean surface as seen without optical aids (except corrected vision) when measured by a specific method.

3.3 STANDARDS

FAST contamination control requirements are expressed in accordance with the following standards:

MIL-STD-1246B, "Product Cleanliness Levels and Contamination Control Program", establishes quantitative methods for describing surface particle and NVR levels. Particle levels are denoted by a number (100, 250, 480, etc.), while NVR levels are represented by a letter (A, B, C, etc.). The number describing the particle level reflects a distribution of particle size and number that can be expressed by a $\log^2$-log relationship. This relationship is illustrated by the graph in Figure 1 and summarized in Table 1a for several different particle levels. The letter used to represent NVR levels signifies a concentration of NVR (mg/ft^2) within defined limits. The limits for different NVR levels are listed in Table 1b.

NASA-JSC-SN-C-0005, Revision C, "Contamination Control Requirements for the Space Shuttle Program", establishes methods for qualitative evaluation of surface contamination levels. The evaluation method requires surface examination from a prescribed distance with an inspection lamp that meets or exceeds a specified intensity. When no contamination is visible on a surface undergoing inspection in this manner, the surface is deemed "visibly clean". There are three types of visibly clean surfaces, standard, sensitive, and highly sensitive, which are distinguished by different requirements for inspection lamp luminous intensity and inspection distance. A summary of the requirements for different visibly clean levels is included in Table 2.

FED-STD-209E, "Federal Standard, Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones", governs the measurement of airborne particulate contamination in clean areas. It defines a term, the clean area *class*, which serves as a rating for clean area airborne particle levels. This term is approximately equivalent to the base 10 logarithm of the number of particles greater than 0.5 microns per cubic meter of air. The number of particles larger than a certain size allowed by different clean area classes is listed in Table 3.

Figure 1. Particle Contamination Levels (Per MIL-STD-1246B)

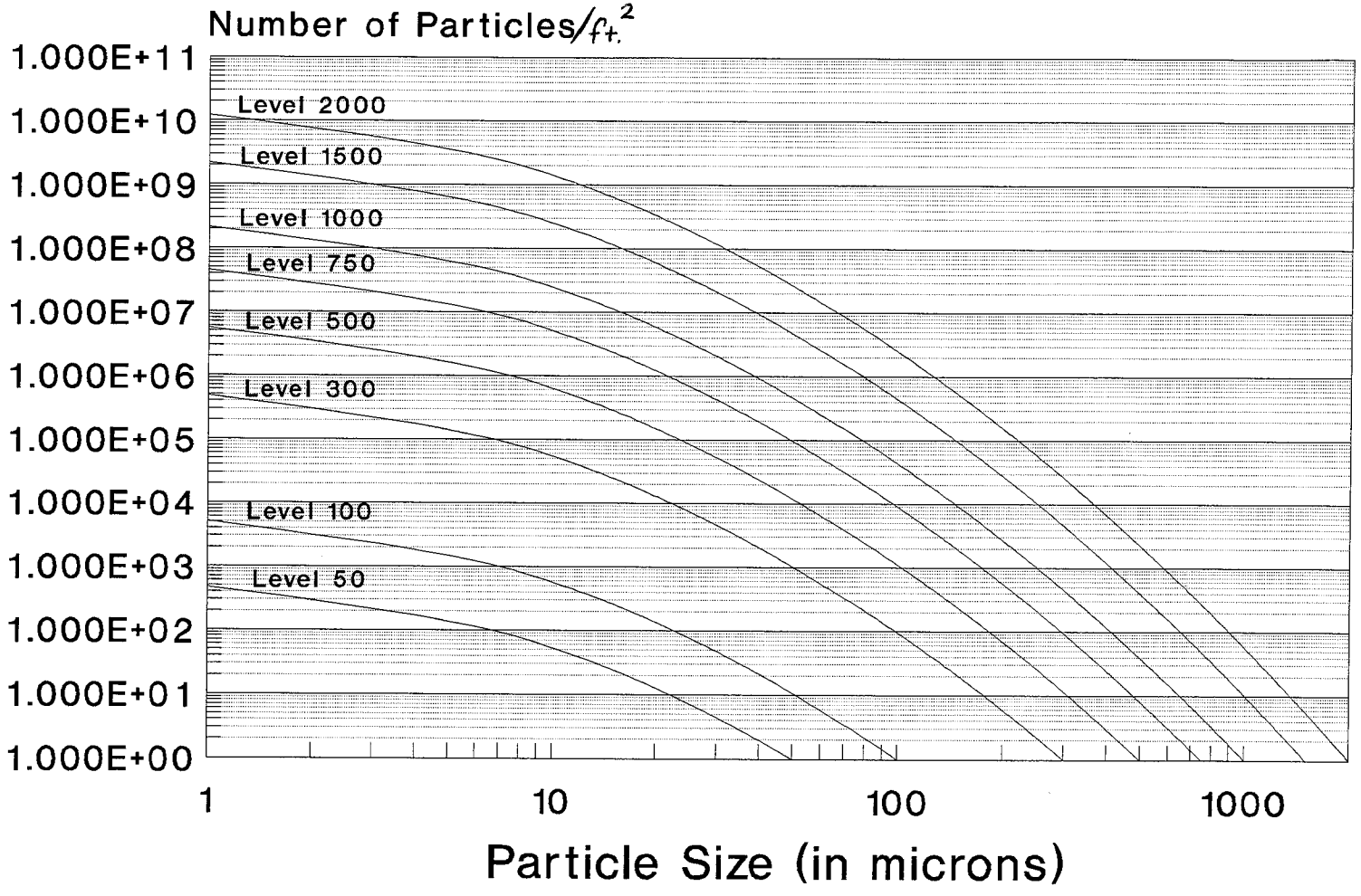

Table 1. Classification of Product Cleanliness Levels (from MIL-STD-1246B)

Table 1a. Particle Limits

Cleanliness Level	Particle Size (in μm)	Quantity of Particulates (/ft^2)
1	1	1
5	1 2 5	3 2 1
10	5	3
25	5 15 25	23 3 1
50	5 15 25 50	165 25 7 1
100	15 25 50 100	265 78 11 1
200	15 25 50 100	4190 1240 170 16
300	25 50 200 250	7450 1020 95 2
500	50 100 250 500	11800 1100 26 1
750	100 250 500 750	8900 210 7 1
1000	250 500 750 1000	1020 40 5 1

Table 1b. NVR Limits

Level	Quantity NVR (/ft^2)
A	$\leq$ 1.0 mg
B	1.0 mg to 2.0 mg
C	2.0 mg to 3.0 mg
D	3.0 mg to 4.0 mg
E	4.0 mg to 5.0 mg
F	5.0 mg to 7.0 mg
G	7.0 mg to 10.0 mg
H	10.0 mg to 15.0 mg
J	15.0 mg to 25.0 mg

Table 2. Visibly Clean Levels (from NASA-JSC-SN-C-0005)

VC Level	Incident Light Level (1)	Observation Distance	Remarks
Standard	≥ 50 foot-candles	5 to 10 feet	(2) (3) (5)
Sensitive	≥ 50 foot-candles	2 to 4 feet	(2) (3) (5)
Highly Sensitive	≥ 100 foot-candles	6 to 18 inches	(3) (4)

NOTES:
(1) One foot-candle (lumens per square foot) is equivalent to 10.76 lumens per square meter.
(2) Cleaning is required if the surface in question does not meet VC under the specified incident light and observation distance conditions.
(3) Exposed and accessible surfaces only.
(4) Initial cleaning is mandatory; Note (2) applies thereafter.
(5) Areas of suspected contamination may be examined at distances closer than specified for final verification.

Table 3. Class Limits (from FED-STD-209E)

Class Name		Class Limits									
		0.1 μm		0.2 μm		0.3 μm		0.5 μm		5 μm	
		Volume Units		Volume Units		Volume Units		Volume Units		Volume Units	
SI	English	(m^{-3})	(ft^{-3})	(m^{-3})	(ft^{-3})	(m^{-3})	(ft^{-3})	(m^{-3})	(ft^{-3})	(m^{-3})	(ft^{-3})
M 1		350	9.91	75.7	2.14	30.9	0.875	10.0	0.283	-	-
M 1.5	1	1240	35.0	265	7.50	106	3.00	35.3	1.00	-	-
M 2		3500	99.1	757	21.4	309	8.75	100	2.83	-	-
M 2.5	10	12400	350	2650	75.0	1060	30.0	353	10.0	-	-
M 3		35000	991	7570	214	3090	87.5	1000	28.3	-	-
M 3.5	100	-	-	26500	750	10600	300	3530	100	-	-
M 4		-	-	75700	2140	30900	875	10000	283	-	-
M 4.5	1000	-	-	-	-	-	-	35300	1000	247	7.00
M 5		-	-	-	-	-	-	100000	2830	618	17.5
M 5.5	10000	-	-	-	-	-	-	353000	10000	2470	70.0
M 6		-	-	-	-	-	-	1000000	28300	6180	175
M 6.5	100000	-	-	-	-	-	-	3530000	100000	24700	700
M 7		-	-	-	-	-	-	10000000	283000	61800	1750

SECTION 4.0 FAST CONTAMINATION REQUIREMENTS

4.1 INSTRUMENT

The FAST instrument is designed to measure magnetic and electric fields and ion and electron accelerations in the earth's auroral regions. The ion and electron measurements will be conducted by four electrostatic analyzer (ESA) stacks and the time-of-flight energy angle mass spectrograph (TEAMS). The FAST electric and magnetic field measurements will be made with radial electric field booms, axial electric field booms, a flux gate magnetometer, and a search coil magnetometer.

The contamination sensitivity of the FAST instrument is driven by the ESA and TEAMS detectors. The TEAMS detector operates with a 25 kV potential, while the ESA detectors utilize 1000 V. If particles penetrate the detectors, or if material outgassing elevates the detector pressure, damaging corona could result. In addition, if contaminants accumulate on the microchannel plates in the detectors, plate operation could be severely degraded. Significant microchannel plate degradation can also occur if the plates are exposed to water vapor.

During most launch site operations, instrument detectors will be protected by non-flight covers and purged with Ultra Pure Carrier Grade (Air Products, 99.999%) or better gaseous nitrogen (GN_2). Before the non-flight covers are removed for the final time during spacecraft closeout, the covers will only be removed for the post-shipment inspection and at the request of the instrumenter. The detector purge will be used until the spacecraft umbilical is removed on the flight line. Up to its removal, the purge will be operative at all possible times and will not be interrupted for more than four consecutive hours.

Besides the ESA and TEAMS detectors, other contamination-sensitive instrument components include the spherical electric field boom probes. The probes are coated with a conductive film that cannot be effectively cleaned. During most launch site operations, the radial boom probes will be enclosed by the boom housings and the axial boom probes will be shielded by red tag covers. The red tag covers will be removed for flight during the Building 1555 spacecraft closeout. Before closeout, the red tag covers will only be removed for the post-shipment inspection and when requested by the instrumenter.

In addition to the non-flight covers and nitrogen purge, the instrument will be protected by keeping the spacecraft in controlled environments at all times. Specific requirements for the spacecraft environment are summarized in Section 4.2 and detailed in Section 5 and Section 6.

The surface contamination requirements for exterior instrument surfaces were established by the FAST Contamination Requirements and Control Plan, FAST-SPEC-008. These requirements dictate that external surfaces of sensitive instrument components (the ESAs, TEAMS, and spherical probes) will be delivered to VAFB at MIL-STD-1246B Level 500A and remain at that level throughout launch site operations. The external surfaces of other instrument components will be delivered at a visibly clean-highly sensitive level per NASA-JSC-SN-C-0005 and verified to MIL-STD-1246B Level 500A during spacecraft closeout.

FAST instrument external surface cleanliness levels will be inspected twice during launch site operations. The first inspection will be done after FAST arrives at Building 836 and the second inspection will be done during spacecraft closeout in Building 1555. Both inspections will be done in FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) clean areas. During each inspection, clean area personnel levels will be minimized and no major contamination-generating procedures (soldering, abrading, blanket fitting, etc.) will be performed. With these precautions in place, the instrument non-flight covers will be removed and all external instrument surfaces will be examined with UV and/or visible wavelength inspection lamps.

If contaminants are observed, cleaning will be done per instrumenter procedures until no contaminants remain visible. Following any necessary cleaning, tape lifts and a solvent wash will be taken to certify the cleanliness of surfaces that must meet MIL-STD-1246B Level 500A.

Internal instrument surface cleanliness requirements have been established by the instrument supplier and will be verified for the final time before the instrument is delivered to the launch site. The cleanliness of sensitive internal instrument surfaces will be preserved during launch site operations by purging the surfaces with Ultra Pure Carrier Grade GN_2.

4.2 FAST SUBSYSTEMS

The contamination requirements for FAST subsystems are designed to prevent instrument exposure to redistributed contaminants and to preserve functions in the thermal, power, and attitude control subsystems. The thermal subsystem utilizes thermal control coatings that must remain clean to retain the required absorptance and emittance. Meanwhile, the solar cells used in the power subsystem and the spinning sun sensor and horizon crossing indicator employed by the attitude control subsystem can be obscured by excessive contaminant accumulation.

The subsystems contamination levels necessary to preserve instrument and subsystem functions were established in FAST-SPEC-008. These requirements dictate that subsystem surfaces be delivered to VAFB at a visibly clean-highly sensitive level per NASA-JSC-SN-C-0005 and be verified to MIL-STD-1246B Level 500A during spacecraft closeout.

During launch site operations, subsystem cleanliness levels will be maintained by keeping the spacecraft in controlled environments at all times. In Building 836 and Building 1555, FAST will be kept in a FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) or better clean area and all operations in the clean areas will conform to the regulations in Section 7. When FAST is moved from Building 836 to Building 1555, it will be sealed in approved bagging and the bagged spacecraft will be enclosed by the spacecraft shipping container. During transport to the L-1011, L-1011 flight line operations, and L-1011 captive carry, FAST will be enclosed by the Pegasus fairing and the fairing air supply will be filtered with activated carbon and HEPA filters. Particle levels in the fairing air will be FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) or better, while airborne hydrocarbons in the fairing air will be less than 15 ppm during transport to the L-1011 and less than TBD on the flight line and during captive carry. Also, during L-1011 flight line operations and captive carry, a nitrogen purge will be used to dissipate heat from the FAST battery radiator plate. Nitrogen for the battery purge will be MIL-P-27401C Grade B or better.

FAST subsystems will undergo cleanliness inspections upon delivery to VAFB Building 836 and during spacecraft closeout in Building 1555. Both inspections will be done in FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) clean areas. During the inspections, subsystems surfaces will be examined with UV and/or visible wavelength inspection lamps. If the lamps reveal contaminants, cleaning will be done per FAST-PROC-002 until no contaminants remain visible. In addition, during the second inspection, tape lift and solvent wash samples will be taken after any necessary cleaning to verify that external subsystem surfaces meet MIL-STD-1246B Level 500A.

The instrument non-flight covers will be installed and the detector purge will be operative throughout the subsystems inspections. After the subsystems inspection is completed, external instrument surfaces will be inspected and cleaned.

SECTION 5.0 MATERIAL RESTRICTIONS

5.1 CLEANING MATERIALS

When required, FAST flight hardware will be cleaned by vacuuming and solvent wiping. To prevent the cleaning process from acting as a contamination source, only HEPA-filtered cleanroom vacuums or house vacuum systems will be used, and all solvent wiping will be done with ACS grade or better isopropyl alcohol or acetone. Only extracted polyester cleanroom wipes and swabs will be used to solvent wipe flight hardware. Unextracted polyester cleanroom wipes and swabs are sufficient for cleaning support items and surfaces near exposed spacecraft surfaces.

5.2 PURGE MATERIALS

The FAST instrument detectors will be purged with nitrogen from launch site delivery through the removal of the spacecraft umbilical on the flight line. The detector purge will not be interrupted for more than four consecutive hours. Also, a separate nitrogen purge will be used during launch site operations to cool flight hardware with stringent thermal requirements.

For the detector purge, Ultra Pure Carrier Grade (Air Products, 99.999%) or better GN_2 will be used. For nitrogen purges of other flight hardware, the purge gas will be MIL-P-27401C Grade B or better. The tubing for all purges will be teflon, viton, or stainless steel and it will be solvent rinsed, dried, and capped before use. All incidental purge line items (connectors, regulators) will be made from teflon, tefzel, delrin, or stainless steel. No lubricants or sealants will be used in the purge lines unless approved by the CCM or a designated representative.

5.3 BAGGING

Only the following bagging materials will be used during launch site operations:

- National Metallizing NMD-FR 100 PA 1 N
- National Metallizing NMD-FR 190 PA 1 NN
- Courtalds Intrex Llumalloy HSC

All of these materials can be heat sealed, but if a heat sealer is not available, K-102 kapton tape or 3M #425 aluminum tape will be used to seal the bagging.

5.4 CLEAN TENT CONSTRUCTION/FILTERING MATERIALS

The clean tents used to house FAST in Buildings 836 and 1555 will not use vinyl as a clean tent walling material unless the NVR fallout is demonstrated to be less than 1 mg/ft^2/month under operating conditions. In addition, the filters used in the Building 836 clean tent, Building 1555 clean tent, Pegasus ground air conditioning cart, and L-1011 airborne air conditioning system (AACS) will be inspected for blockages and leaks before being used for FAST. No filters that have been leak tested with dioctyl phthalate will be used in the aforementioned units.

5.5 SILICONES

During Pegasus preparations, FAST-Pegasus integration, and flight line operations, silicones will be applied to many launch vehicle surfaces with direct contaminant redistribution paths to the spacecraft. Silicones applied to such areas could significantly contaminate payload surfaces by releasing acetic acid during curing or by generating outgassing during flight line operations, captive carry, or ascent to orbit. The latter threat could be particularly significant for silicones applied to fairing surfaces that experience high temperatures while the vehicle is on the flight line or during ascent to orbit.

Due to the payload contamination concerns associated with launch vehicle silicone use, only space flight qualified silicone grades will be used on fairing surfaces. In addition, space flight qualified grades are required for all cases where silicones are applied to surfaces in the fairing volume within seven days of FAST-Pegasus integration. Space flight qualified silicone grades include Dow Corning 6-1104 and General Electric RTV 566 and RTV 142.

SECTION 6.0 CONTAMINATION CONTROL IMPLEMENTATION

6.1 TRANSPORT TO BUILDING 836

Before FAST leaves the integration area at GSFC, it will be covered with bagging and the bagging will be taped down to the spacecraft support stand or dolly. The support stand and dolly will be cleaned to a visibly clean-standard level before the bagging is placed over the spacecraft. While the spacecraft is being bagged, tubing for the instrument nitrogen purge will be fed through the spacecraft bag. Once the bagging and purge line are in place, FAST will be installed in a shipping container. Interior surfaces of the container will be cleaned to a visibly clean-standard level before the spacecraft is installed.

FAST will be moved from GSFC to VAFB by truck. During transport the spacecraft will be protected from the truck bay environment by the shipping container and the spacecraft bag. Inside the bag, sensitive instrument detectors will be further protected with red tag covers and a GN_2 purge per Section 5.2. The temperature and humidity inside the container will be controlled by the truck bay's thermal control system to 55°F-66°F and 35-50% RH, respectively. Both the temperature and humidity levels inside the container will be continuously recorded during shipment.

Upon arrival at VAFB Building 836, the shipping container will be unloaded from the truck and delivered to a point just outside the clean tent. During transport from the truck to the clean tent, the instrument detectors will continue to be purged with clean GN_2 per Section 5.2. Upon delivery to a point outside the clean tent, the shipping container will be disassembled and exterior surfaces of the spacecraft dolly and bag will be inspected and cleaned to a visibly clean-standard level. Once cleaned, the spacecraft will be moved into the clean tent.

6.2 BUILDING 836 CLEAN AREA OPERATIONS

Before FAST is delivered to VAFB, the Building 836 clean tent will be cleaned and certified to FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) or better. Following spacecraft arrival, all operations in the tent will conform to the cleanroom procedures detailed in Section 7.

After FAST is moved into the clean tent, the spacecraft bag will be removed and test operations will commence. Following testing, representatives from the solar array contractor will inspect and clean external solar array surfaces to a visibly clean-highly sensitive level per NASA-JSC-SN-C-0005. Concurrently, GSFC will inspect external surfaces of other exposed subsystems with UV and/or visible wavelength lamps. If contaminants are observed during the inspection, cleaning will be done per FAST-PROC-002 until the surfaces are at a visibly clean-highly sensitive level per NASA-JSC-SN-C-0005.

Following the subsystems inspection, instrument surfaces will be inspected and cleaned. Personnel levels in the clean tent will be minimized and contaminant-generating procedures will not be performed while the instrument is inspected. During the inspection, non-flight instrument covers will be removed and external instrument surfaces will be examined with UV and/or visible wavelength inspection lamps. Contaminants observed under the inspection lamps will be removed by cleaning per instrumenter procedures. After any necessary cleaning, tape lift and solvent wash samples will be taken from surfaces that must be verified to MIL-STD-1246B Level 500A. The nitrogen purge for the instrument detectors will be operative at all times during the subsystems and instrument post-shipment inspections. After the instruments have been inspected and cleaned, the instrument non-flight covers will be reinstalled.

6.3 TRANSPORT TO BUILDING 1555

Before FAST leaves the Building 836 clean tent, it will be bagged and installed in the shipping container per the same procedure described in Section 6.1. After the spacecraft is installed in the shipping container, the container will be installed in a transport truck and moved to VAFB Building 1555. During the trip, the instrument GN_2 detector purge will be operational and purge gas exiting the instrument detectors will pressurize the spacecraft bag.

6.4 BUILDING 1555 PROCEDURES

FAST will be delivered to a point just outside the payload clean tent in Building 1555. Upon reaching that point, the shipping container will be dismantled. The instrument GN_2 purge may have to be temporarily disabled to dismantle the container, but the spacecraft bag and instrument non-flight covers will remain in place. The spacecraft lift points will then be prepared.

As FAST is readied for lifting, the Building 1555 high bay crane and the spacecraft lifting cage, turnover fixture, and mating table will be inspected for lubricant leaks or flaking. After any leaks or flaking areas are detected and corrected, the lifting cage, turnover fixture and mating table will be inspected and cleaned. General surfaces will be cleaned to a visibly clean-standard level, while surfaces that will directly contact flight hardware will be cleaned to a visibly clean-highly sensitive level.

Once all preparations are completed, the crane will be used to lower the lifting cage over the spacecraft. The cage will then be attached to the lifting points of the spacecraft and the spacecraft will be lifted and placed on the turnover fixture. After the spacecraft is attached to the turnover fixture, it will be rotated

and the lifting cage/spacecraft assembly will be fastened to the mating table. Once the lifting cage and spacecraft are fastened to the mating table, the spacecraft will be separated from the turnover fixture and the spacecraft/mating table assembly will be moved into the clean tent. The spacecraft will remain bagged throughout this process and the bag will only be accessed to install the spacecraft lifting blocks.

6.4.1 BUILDING 1555 CLEAN AREA OPERATIONS

6.4.1.1 FAST - PEGASUS INTEGRATION

FAST-Pegasus integration hardware will include a 23" payload attach ring, guide pins, and fasteners. Prior to integration, the integration hardware, mating surfaces and external surfaces of the third stage and interstage will be cleaned by the vehicle supplier to Level 700A. The integration hardware will also be inspected by a FAST spacecraft representative under UV and/or visible wavelength inspection lamps. If contaminants are observed during the inspection, the launch vehicle supplier will spot clean the integration hardware until it is visibly clean under the inspection lamps.

During FAST-Pegasus integration preparations and operations, the spacecraft will still be covered with approved bagging material and the separate instrument non-flight covers and detector purge will remain in place. Contamination generated by installation of the guide pins and fasteners or other integration procedures will be removed with a HEPA filtered vacuum as-generated. After integration, additional vacuuming and solvent wiping with IPA and cleanroom wipes will be done to remove visible contaminants from work surfaces. Once cleaning is completed, the spacecraft lifting cage and mating table will be removed from the integration area. The spacecraft bag will then be removed.

6.4.1.2 SPACECRAFT CLOSEOUT

After the spacecraft has been mated to the launch vehicle and all interfaces have been verified, the spacecraft will undergo final closeout. During closeout, subsystem non-flight covers (e.g. ACS sensor covers, solar array covers) will be removed and all external subsystem surfaces will be examined with UV and/or visible wavelength inspection lamps. If contaminants are found, subsystems surfaces will be cleaned per FAST-SPEC-002 with a HEPA-filtered vacuum, extracted cleanroom wipes or swabs, and IPA. Solar array cleaning will only be done by or under the direct supervision of the solar array lead engineer or a designated representative. Cleaning will continue until no contaminants are visible when the surfaces are examined with UV and/or visible wavelength inspection lamps. After cleaning is completed, tape lifts and a solvent wash will be taken to verify that pre-launch cleanliness levels are Level 500A or better.

After subsystems surfaces are inspected, cleaned and sampled, the instrument non-flight covers will be removed and external instrument surfaces will be inspected for visible contamination. During the inspection, personnel levels in the clean tent will be minimized and no contaminant-generating procedures will be performed. If contaminants are detected during the inspection, cleaning will be done per the instrumenter's direction. Following cleaning, contamination measurements will be taken to verify that pre-launch surface contamination meets Level 500A. The instrument non-flight covers will not be reinstalled after the instrument is inspected. The FAST instrument detector GN_2 purge will remain operational throughout spacecraft closeout.

6.4.1.3 FAIRING INSTALLATION

The Pegasus fairing halves will be delivered to the clean tent after spacecraft closeout is completed. The fairing will be delivered by the vehicle supplier with internal surfaces cleaned to MIL-STD-1246B Level 700A and covered with approved bagging (see Section 5.3). The outer fairing surfaces will be verified to a visibly clean-standard level before the fairing halves are admitted to the clean tent.

Once the fairing has been admitted to the clean tent, the protective bagging will be removed from one of the fairing halves and the fairing half will be inspected by a FAST spacecraft representative with visible wavelength and/or UV inspection lamps. If contaminants are observed during the inspection, spot cleaning will be done by the launch vehicle supplier until the fairing surfaces are visibly clean under the lamps. Following inspection, the fairing half will be installed. The other fairing half will then be uncovered, inspected, and cleaned in the same manner as the first fairing half. After the inspection and any necessary cleaning, the second half will be installed.

As the Pegasus fairing halves are installed, the FAST instrument detector purge may be temporarily disconnected. If the purge line must be disconnected, the exposed lines will be capped. Once the Pegasus fairing is positioned such that the spacecraft umbilical can be connected, the instrument detector purge will be reactivated.

During fairing installation assembly processes, contamination will be removed as-generated by a HEPA filtered vacuum. Surfaces in close proximity to the assembly process will also be cleaned following assembly by vacuuming with a HEPA-filtered vacuum and solvent wiping with IPA and cleanroom wipes.

6.4.2 BUILDING 1555 CLEAN AREA REQUIREMENTS

The clean tent used for payload processing in Building 1555 will be operated at FED-STD-209E Class M 6.5 (FED-STD-209D Class 100,000) or better. To preserve this airborne cleanliness class, all operations in the clean tent must conform to the clean tent requirements detailed in Section 7.

6.5 TRANSPORT FROM BUILDING 1555 TO THE L-1011

The integrated Pegasus launch vehicle will be transported to the L-1011 carrier aircraft on an OSC provided assembly and integration trailer (AIT). Throughout transport, conditioned air will be delivered to the launch vehicle fairing by a ground air conditioning cart with activated carbon and HEPA filters. This system will filter fairing airborne particle levels to Class M 6.5 (FED-STD-209D Class 100,000) or better and fairing airborne hydrocarbon levels to 15 ppm or less. The dew point created by the fairing supply air temperature and relative humidity will always remain at least 5°C less than the lowest surface temperature in the fairing. These performance specifications will be verified by the launch vehicle supplier no more than one week before system use with FAST. In addition, between the performance verification and system use with FAST, the launch vehicle supplier will keep all air conditioning output ducting sealed with approved bagging and tape or with a cover made from non-shedding, low outgassing materials.

6.6 VEHICLE INSTALLATION ON THE L-1011

Upon arrival at the L-1011, the integrated launch vehicle will be raised into position for installation and the Pegasus/L-1011 interfaces, including the L-1011 airborne air conditioning system (AACS) ducting, will be connected. The Pegasus ground air conditioning unit will continue to operate per Section 6.5 as the vehicle is integrated with the L-1011.

Shortly before carrier aircraft takeoff, the instrument detector purge line and other GSE running into the fairing will be disconnected and the fairing access doors will be sealed shut with a low outgassing silicone per Section 5.5. The aircraft's jet engines will then be started and the fairing air supply will be switched from the ground support air conditioning unit to the aircraft AACS. The air supplied by the AACS will be treated with activated carbon and HEPA filters. Particle levels in the air delivered to the fairing by the AACS will be Class M 6.5 (FED-STD-209D Class 100,000) or better and hydrocarbon levels in the fairing air will be TBD or less. The dew point created by the fairing supply air temperature and relative humidity will always remain at least 5°C less than the lowest surface temperature in the fairing. These performance characteristics will be verified by the launch vehicle supplier no more than one week before vehicle installation on the L-1011. Between the performance verification and system use with FAST, the launch vehicle supplier will keep all air conditioning output ducting sealed with approved bagging and tape or with a cover made from non-shedding, low outgassing materials.

In addition to the AACS, the fairing will be supplied with GN_2 for cooling of vehicle avionics and purging of the FAST battery radiator. The GN_2 will be supplied by tanks in the L-1011 aircraft and carried by tubing that enters the fairing with the AACS ducting. The purge lines will then extend down the inner surface of the fairing, with the spacecraft purge terminating at a point even with the battery radiator. At its termination, the spacecraft purge will direct a laminar flow of GN_2 over the radiator.

The fairing purge system will use separate GN_2 supplies and purge lines for the vehicle avionics purge and the spacecraft purge. Both purge lines will be teflon or viton and the payload purge gas will be MIL-P-27401C Grade B or better. Additionally, the payload nitrogen purge system cleanliness must be verified and the system outputs must be sealed no more than one week prior to its use for FAST.

After the fairing air supply has been switched from the ground support air conditioner to the AACS, the ground support air conditioner ducting will be disconnected from the fairing and a door will be sealed in the air conditioner access port. The door will be sealed with low outgassing silicone per Section 5.5.

6.7 CAPTIVE CARRY

After ground preparations are completed, the L-1011 will take off and carry the vehicle to an altitude of approximately 40,000 feet. The aircraft will then release the vehicle and the vehicle will ascend to the FAST orbital insertion point.

During captive carry, the Pegasus fairing will be supplied with the GN_2 purge and air treated by the AACS. The GN_2 purge and AACS-supplied air will meet the same requirements specified in Section 6.6. When the vehicle is released, the AACS ducting will be released from the fairing and the duct access port will be covered by a retractable door.

6.8 LAUNCH ABORT OR DELAY

In the event of a launch abort or delay, the L-1011 carrier aircraft will return to VAFB with the launch vehicle. During the descent to VAFB, the fairing will still be supplied with GN_2 and air treated by the AACS. The air treated by the AACS will meet the same specifications listed in Section 6.6. Throughout the descent, the dew point created by the fairing supply air temperature and relative humidity will always remain at least 5°C less than the lowest surface temperature in the fairing.

After the L-1011 returns to VAFB, the Pegasus ground support air conditioning unit will be connected to the fairing and the AACS will be disabled. The air supplied by the ground support unit will meet the same specifications listed in Section 6.5.

If necessary, the launch vehicle may be removed from the L-1011 and returned to Building 1555. If this is done, the ground support air conditioning unit will continue to treat the air per the specifications in Section 6.5 during transport. The Building 1555 clean tent will be re-certified per Section 7.5 before the vehicle returns. Once the vehicle has returned, all clean tent operations will be done according to the procedures specified in Section 7.

SECTION 7.0 FAST CLEAN AREA REQUIREMENTS

7.1 ADMISSION REQUIREMENTS

Personnel

Prior to the start of spacecraft operations in the Building 836 and Building 1555 clean tents, the FAST project and the launch vehicle supplier will prepare a personnel access list and submit it to VAFB. Only individuals named on the personnel access list will be permitted in the clean tents. All personnel on the access list must have received training on proper cleanroom procedures (including those listed in Sections 7.2 through 7.5) before working in the clean tents.

Hardware

All flight hardware and GSE must be cleaned and inspected before being admitted to the Building 836 or Building 1555 clean tent. Flight hardware entering either clean tent before final spacecraft closeout must be cleaned and inspected to a visibly clean-highly sensitive level before being admitted. If flight hardware enters the Building 1555 clean tent during or after final spacecraft closeout, it must be cleaned to Level 500A before it is admitted. Tape lift and solvent wash measurements will be used to verify surfaces to Level 500A.

GSE entering the Building 836 or Building 1555 clean tent must be cleaned and inspected to a visibly clean-highly sensitive level if it will directly contact flight hardware. If the GSE will not directly contact flight hardware, it must be cleaned and inspected to a visibly clean-standard level before it is admitted.

All FAST subsystem and GSE cleaning will be done per the FAST Cleaning and Verification Procedure, FAST-PROC-002. Instrument cleaning will be done per instrumenter procedures. Launch vehicle hardware cleaning will be done per OSC procedures.

Flight hardware and GSE cleaning will be done in a clean area or clean bench. The garments required for clean area or clean bench operations (see Section 7.2) will be followed during cleaning. After cleaning, the GSE or flight hardware may be passed directly into the clean tent if it will not travel through uncontrolled areas. If the GSE or flight hardware must travel through uncontrolled areas to reach the clean tent, however, it must be double bagged in approved materials before leaving the cleaning area.

Hardware that is double bagged when delivered to the clean tent will be admitted per the following procedure:

1. The double bagged hardware is brought into the gowning area and the outer bag is opened with scissors or a razor. The inner bag, which contains the hardware, is then removed from the outer bag and the outer bag is discarded. Only personnel wearing the required cleanroom garments will handle the inner bag.

2. The hardware, still wrapped in the inner bag, is taken into the clean tent.

3. If the hardware is required for immediate use in the clean tent, the hardware should be unbagged at a designated location away from the spacecraft. The bagging must only be opened with scissors or a razor. Once the hardware has been removed from the bagging, it must be inspected for visible contamination. Any surfaces appearing contaminated must be cleaned.

4. If the hardware will not be used immediately, it should remain bagged and placed in a designated storage area of the clean tent. Once ready for use, the item should be removed from the bag and inspected according to the procedure in (3).

If the hardware is being taken into the clean tent in a shipping container, the outer surfaces of the container must be at a visibly-clean standard level before it is admitted. After cleaning, the container will be manually transported into the gowning area. The container will then be taken into the clean tent by personnel wearing the required cleanroom garments. Once in the clean tent, the container should be opened in a designated area away from the spacecraft. The hardware should then be inspected and cleaned if necessary. The empty shipping container should be removed from the clean tent for storage.

7.2 GOWNING REQUIREMENTS

Clean Tent Operations

Personnel working in the Building 836 and Building 1555 clean tents must wear cleanroom garments to keep the facilities within the airborne particle limit. The nominal garment requirements for both facilities will include hoods, smocks, shoe covers, and latex gloves. Face masks will also be worn by personnel with beards or mustaches. Wrist straps will be used for personnel grounding in Building 836, while leg stats will be used to ground personnel in Building 1555. For both facilities, polyethylene gloves will be worn over the latex gloves when solvents are handled.

Cleanroom garments will be donned according to the following "top-down" procedure:

1. Remove any lab coat, loose jacket, sweater, etc., and leave it outside the gowning area. Empty shirt and pants pockets of loose change, pens, pencils, and other objects that may fall out when working. Also remove and store beepers, watches, and other items that are magnetic or could tear garments or gloves.

NOTE: All items that are potential sources of magnetic fields must be screened per FAST-SPEC-023.

2. Clean soles of street shoes with the shoe cleaner. Step on the tacky mat and enter the gowning area.

3. For Building 1555 operations, place the leg stat over bare skin on the lower part of the leg and connect the grounding cord to the leg stat.

4. Get clean bagged garments from the storage shelf. Use a razor blade or scissors to open the garment bags. Do not tear the bag. Place the open bags on a shelf.

5. Put on the hood, making sure all hair is tucked inside. Snap for a snug fit.

6. Put on smock, keeping the lower portion of the hood tucked inside the collar. Snap to close around neck and wrist. Do not drag the garment on the floor. Make sure the sleeves leave no uncovered areas. If the sleeves are too short, remove the garment and try a larger size.

7. Put on shoe covers. Minimize contact between street shoes and external surfaces of shoe covers.

8. For Building 1555 operations, install the heel strap part of the leg stat over the shoe cover. After the heel strap is installed, connect the unattached end of the grounding cord to the heel strap.

9. Cover beard or mustache with a face mask or beard cover. Make sure nose, mouth, and all facial hair are covered.

10. For Building 836 operations, install the wrist strap, tucking it under the sleeve of the coveralls or smock. Make sure the wrist strap fully contacts the skin. Check the monitoring system to make sure the wrist strap is working properly.

11. Put on gloves, pulling them down over the smock sleeves and the wrist strap.

12. Discard empty plastic bags.

13. Inspect clothing for a proper fit. Verify that the grounding system (leg stat or wrist strap) is working properly.

14. Step on the tacky mat and enter the clean tent.

Follow the procedure below to ungown:

1. Enter the gowning area.

2. Remove gloves and face mask or beard cover and discard.

3. For Building 836, remove ESD wrist strap and grounding wire. For Building 1555, remove heel strap and disconnect grounding cord.

4. Remove shoe covers, smock, and hood - in that order. Do not remove the hood before removing the smock. After removal, do not drag garments on the floor.

5. For Building 1555, remove the leg stat.

6. If the person wearing the garments will re-enter the clean tent the same day, the garments may be hung on a labeled hanger or bagged and placed on a shelf to be worn again. If the wearer will not re-enter the clean tent that day, or the garments are soiled, then the garments must be cleaned. All used garments must be cleaned at least once per week in a facility dedicated to laundering cleanroom garments.

7. Exit the gowning area.

Clean Bench

If a clean bench is used to handle flight hardware or GSE, cleanroom gloves must be worn. When solvents are used, the flight hardware or GSE must be handled with polyethylene gloves. If solvents will not be used, flight hardware may be handled with latex cleanroom gloves. An ESD wrist strap must also be worn during any clean bench operations that involve handling electronic components.

7.3 CLEAN AREA PERSONNEL PROCEDURES

Standard cleanroom personnel procedures are listed below. These procedures apply to all activities in the Building 836 and Building 1555 clean tents.

a. Loose personal items, such as pens, pencils, notebooks, calculators, etc., must not be taken into the clean tent.

b. Valuable personal items such as wallets may be brought into the clean tent if they are secured in street clothing and are not sources of excessive magnetic fields. Rings and other jewelry are permitted in the clean tent only if they fit securely under cleanroom garments, do not tear the

garments, and do not generate excessive magnetic fields. Specifications for the magnetic field limits are included in FAST-SPEC-023.

c. Personnel will move at a normal pace and avoid quick, sporadic movements that tend to stir up settled particulate matter.

d. In a clean tent utilizing a horizontal air flow, avoid walking or working between the filter bank and the hardware whenever possible to avoid having personnel-generated contamination carried by the air flow to the hardware.

e. Personnel must wear cleanroom garments at all times in the clean tent. Do not unzip or unbutton the garments in the clean tent. Do not begin removing the garments until fully inside the gowning area.

f. Cleanroom garments must not be worn outside of the clean tent and gowning area.

g. Combing or brushing hair and removing eyeglasses must not be done in the clean tent and the garment changing area. Do not scratch head, eyebrows, or exposed skin areas. If exposed skin areas are touched, return to the garment changing area and replace gloves with a clean pair.

h. Smoking, eating, drinking beverages, and chewing gum or tobacco are forbidden in the clean tent and the garment changing area. Personnel who have engaged in any of these activities in the previous 30 minutes should drink water before entering the clean tent.

i. No cosmetics or aerosols (aftershave lotion or perfume) shall be worn in the clean tent.

j. Personnel experiencing severe sunburn, a bad cold, or excessive coughing or sneezing should not be allowed in the clean tent. Any such conditions that arise will be evaluated by the CCM and I&T manager on a case-by-case basis.

k. Situations not described here should be referred to the CCM for resolution.

7.4 CLEAN AREA OPERATING PROCEDURES

Personnel will follow these procedures to minimize the contamination generated while working in the Building 836 and Building 1555 clean tents. A copy of these procedures should be readily available near each clean tent.

a. If there is visible contamination on flight hardware, GSE, or work surfaces, a description of the contamination and affected surfaces must be recorded in the problem record log by the Floor Manager and reported to QA and the CCE. The contaminated surfaces must then be cleaned to the required level per the applicable procedure (see (b) below).

b. All flight hardware and GSE must be cleaned and inspected before entering the clean tent. Subsystem flight hardware and GSE will be cleaned per FAST-PROC-002, while instrument and launch vehicle items will be cleaned per procedures developed by the instrumenter and OSC, respectively.

c. Only use cleanroom approved, non-retractable ball point pens for writing in the clean tent. Do not use markers, pencils or erasers. Writing will only be done on low shedding, cleanroom approved paper. If ordinary looseleaf paper, notebooks, or engineering drawings must be brought in the clean tent, it must remain sealed in approved bagging.

d. Do not allow cleanroom garments to contact the floor. If work requires personnel to sit or kneel on the floor, clean bagging material should be placed on the floor to act as a barrier. Personnel must not stand on bagging, however, since doing so would constitute a safety hazard.

e. Latex gloves will be worn in the clean tent. When working with solvents, polyethylene gloves will be worn over the latex gloves to prevent extractable compounds from leaching out of the latex. If the gloves become soiled or torn, return to the gowning area and change gloves.

f. Do not pick up and reuse an item that has dropped to the floor. The item must be vacuumed and solvent wiped to the required cleanliness level before subsequent use.

g. Keep flight hardware covered with approved bagging material (see Section 5.3) during periods of inactivity or during contamination generating activities. Only use a heat sealer or approved tapes (see Section 5.3) with the bagging.

h. Bagging material and cleanroom paper must not be torn and will only be cut with scissors or a razor.

i. Do not allow waste or surplus materials to accumulate in the clean tent. If clean bags will be reused, keep the bags in a clean storage area instead of the work area.

j. Personnel will be electrically grounded with ESD wrist straps or leg stats and grounding cords before touching flight hardware. The wrist strap or leg stat must remain in contact with bare skin when worn.

k. Minimize activity that obstructs the air flow from the HEPA filters to flight hardware. Work "downwind" or below the flight hardware when possible to minimize the effects of contamination generated by movement.

l. When not being used, clean tent GSE must be kept in a designated area that is away from flight hardware.

m. GSE that utilizes an exhaust fan must filter the exhaust or vent the exhaust out of the clean tent.

n. Any tool requiring compressed air or nitrogen must be connected to a filtered compressed air source in the clean tent. All air lines and extension cords must be visibly clean before being admitted to the clean tent.

o. Solvents needed in the clean tent will be stored in polyethylene or teflon bottles that will not leach molecular contaminants into the solvent.

p. Cleanroom wipes/swabs will not be dipped into a solvent container. This practice contaminates the solvent. When wipes and swabs must be dampened with solvent, the solvent will be applied from a polyethylene or teflon squirt bottle.

q. No abrasives such as files, crocus cloth, etc., and shedding or masking tapes should be taken into the clean tent. If a non-cleanroom procedure such as abrading, drilling, soldering, or MLI fitting *must* be done in the clean tent, notify the CCM or CCE. During the procedure, follow these guidelines:

- Work downwind from unaffected spacecraft hardware.
- Cover the immediate floor area and as much of the flight hardware as possible with approved bagging material.
- Vacuum contamination with a HEPA filtered vacuum as-generated during the procedure.
- Discard used bagging material from the scaffolding/floor.
- Vacuum the floor and spacecraft bagging. Wipe the surfaces clean with solvent dampened cleanroom wipes or swabs.
- Remove the spacecraft bag. Inspect and clean, if necessary.

r. The CCM should be consulted for special cases that are not covered above.

7.5 CLEAN AREA CERTIFICATION AND MAINTENANCE

The Building 836 and Building 1555 Class M 6.5 clean tents will be cleaned before FAST arrives at each facility. Building 836 clean tent cleaning will be performed by VAFB, while Building 1555 clean tent cleaning will be done by OSC per SSD-TD-0024. Upon spacecraft arrival, surfaces inside the clean tent will be visibly clean and free of materials that could flake or transfer residue. Airborne particle levels in the facility will be verified to within Class M 6.5 and temperature and humidity in the tent will be continuously maintained at 70 ± 5°F and 35-50% RH, respectively.

Following spacecraft arrival, the Building 836 and Building 1555 clean tents will be recleaned by VAFB (Building 836) or OSC (Building 1555) when requested by a payload representative. In addition, airborne particle counts in the Building 836 and Building 1555 clean tents will be continuously monitored. If the particle counter produces a reading above the cleanliness requirement, non-essential personnel must leave the clean tent. If the reduction of clean tent personnel does not correct the problem, the CCM will determine what additional corrective actions must be taken.

APPENDIX. CLEANROOM SUPPLY ORGANIZATION

Operations in VAFB Buildings 836 and 1555 will require the cleanroom supplies listed in the following table. The supplies will be provided by the organization designated in the table.

Item	Supplying Organization	
	Building 836	Building 1555
Bagging Material	GSFC	GSFC
Bags, Anti-Stat, Cleanroom Approved	GSFC	GSFC
Beard Covers or Face Masks	GSFC	OSC
Bottles, Polyethylene or Teflon	GSFC	GSFC
Cleanroom Garments Polyester with ESD Grid (smocks, hoods)	GSFC	OSC
Deionized Water	GSFC	GSFC
ESD Protection · Wrist Straps · Leg Stats and Heel Straps · Grounding Cords · Test System	 GSFC N/A GSFC GSFC	 N/A OSC OSC OSC
Gloves · Latex · Polyethylene	GSFC	OSC
Isopropyl Alcohol, Reagent Grade or Better	GSFC	OSC
Lamp, UV Inspection (100 Watt, 365 nm)	GSFC	GSFC
Lamp, Visible Light Inspection (TBD Watt)	GSFC	GSFC
Mop, With Cleanroom Compatible Sponge and Stainless Steel or Epoxy Coated Handle	VAFB	OSC
Paper, Non-shedding Cleanroom	GSFC	GSFC
Particle Counter	VAFB	OSC
Pens, Non-retractable Ball Point	GSFC	GSFC
Shoe Cleaner	VAFB	OSC
Shoe Covers, Cleanroom	GSFC	OSC
Tacky Mats	VAFB	OSC
Tape, K102 Kapton	GSFC	GSFC

Item	Supplying Organization	
	Building 836	Building 1555
Tape, Mylar	GSFC	GSFC
Tape, 3M #425 aluminum foil	GSFC	GSFC
Vacuum, HEPA filtered	GSFC	GSFC
Wipes and Swabs, Unextracted Polyester	GSFC	GSFC
Wipes and Swabs, Extracted Polyester	GSFC	GSFC

N/A = not applicable

SMALL EXPLORER (SMEX) DOCUMENTATION CONTROL FORM

ACTION CODE	NAME	MAIL CODE
	M. ADAMS	741
X	R. ALEMAN	740.4
	M. ANDERSON	745.2
	J. ARRISON	740.4
	M. BAXTER/STX	740.4
	D. BERRY	512.1
	D. BETZ	740.4
	M. BLAU	743.3
	T. BUDNEY	745
	J. BURT	740.4
	J. BYRD	740.4
	J. CATENA	740.4
	G. CHIN	693.1
	C. CLAGETT	745.1
	SMEX CM	740.4
X	G. COOPER	743.1
	T. CORRELL	745.2
	B. DEDALIS	302
	T. DOD/SWALES	737
	D. EVERETT	743.1
	B. FAFAUL	311.1
	L. FANTANO	724.1
	O. FIGUEROA	740.4
	J. FIORA	740.4
	K. FROST	600.0
	J. GALLEHER/HEI	740.4
X	D. GATES/ATSC	740.4
X	T. GEHRINGER	740.4
	D. GILMAN/NASA HQ	SZD

ACTION CODE	NAME	MAIL CODE
	T. GRUNER	745.2
	K. HERSEY	737.1
	L. HILLIARD	740.4
	T. HUBER	700
	F. HUEGEL	743.3
	T. JACOBS	743.2
	D. JUNG	734.5
	K. KEADLE-CALVERT	743.2
	J. KELLOGG	741.1
X	R. KOLECKI	740.4
	T. LAFOURCADE	743.1
	J. LYONS	734.4
	H. MALDONADO	737.3
	S. MANNING/UNISYS	740.4
	R. MENCIA/SWALES	724
	S. MEYERS	741
	T. MICHAELIS	745.1
	P. MULE	750.2
	Y. NGAN	737.3
	D. NGUYEN	724
	Q. NGUYEN	743.2
	D. OLNEY	745.1
	K. PARRISH	724.1
	R. PATSCHKE	743.1
	S. PATTON	741.1
	C. PETRUZZO	745
	R. PFAFF	696
	W. POWELL	822
	G. RAKOW	743.3

ACTION CODE	NAME	MAIL CODE
	M. REID	512.2
X	M. RODRIQUEZ/SWAL	724.4
	G. ROSANOVA	741.3
	P. SALERNO	743.1
	R. SCHNURR	745.2
	B. SETTLES	743.3
	A. SHERMAN	700
	D. SHREWSBERRY	740
X	D. SILVA	470
	SMEXFOT/ATSC	740.4
	G. SNEIDERMAN	741.3
	T. SPITZER	734.1
	M. STEINER	743.1
	R. STONE	743
X	S. STRAKA	724.4
	T. TRENKLE/MMS	743.1
	B. VERNIER	470
	M. WALKER	745.1
	J. WATZIN	740.4
	R. WEAVER	740
	J. ZEMBOWER/INTER	740.4
X	S. Hoeksema OSC	
X	T. Oglesby	

NUMBER OF ENCLOSURES OR ATTACHMENTS INCLUDED 1

SUBJECT: Fast Launch Site Contamination Control Implementation Plan
CM #: FAST-MGMT-013

COMMENTS: Please review the attached document. Redline if necessary and/or return to the Smex CM Office w/comments. Thank you

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