



National Aeronautics and  
Space Administration

**SN-C-0005**  
**REVISION D**  
**JULY 20, 1998**

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**Lyndon B. Johnson Space Center**  
Houston, Texas 77058

REPLACES  
SN-C-0005  
REVISION C

## **SPACE SHUTTLE**

# **CONTAMINATION CONTROL REQUIREMENTS**

## REVISION LOG

REV LTR	CHANGE NO	DESCRIPTION	DATE
		BASELINE ISSUE	03/74
A	1	REVISION A (Reference: Level II PRCBD S15722A, dated 3/7/82) also includes PRCBDs S15492A and S15722.	03/82
B	2	REVISION B (Reference: Level II PRCBD S40129, dated 7/23/86). NOTE: Published as/with Revision C.	9/86
C	3	REVISION C (Reference: Level II PRCBD S15492E, dated 1/6/89).	2/15/89
D	6	REVISION D (Reference: Space Shuttle PRCBD S015492F, dated 6/20/98) also includes CAR S041880B, dated 4/2/93; SSP DOC-271 and Changes 4 and 5.	07/20/98

CHANGE SHEET

FOR

SN-C-0005 - Space Shuttle  
Contamination Control Requirements

REVISION D - CHANGE NO. 6

Program Requirements Control Board Directive No. S015492F/(1-1), dated 6/20/98; CAR S041880B, dated 4/2/93 and SSP DOC-271.(1)

July 20, 1998

Robert H. Heselmeyer  
Secretary, Program Requirements  
Control Board

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CHANGE INSTRUCTIONS

1. This is Revision D to SN-C-0005 dated July 20, 1998, which replaces Revision C dated February 15, 1989. Please discard Revision C to SN-C-0005 and utilize this Revision D in its place.
2. This Revision D includes the contents of SN-C-0005, Revision C as amended by this Change 6.
3. Subsequent changes to SN-C-0005 will be processed against this Revision D.

\_\_\_\_\_  
Signature of person incorporating changes

\_\_\_\_\_  
Date

SN-C-0005 - Space Shuttle  
Contamination Control Requirements

\*Revision D (Reference PRCBD No. S015492F, dated 6/20/98; CAR S041880B, dated 4/2/93 and SSP DOC-271)

LIST OF EFFECTIVE PAGES

July 20, 1998

The current status of all pages in this document is as shown below:

<u>Page No.</u>	<u>Change No.</u>	<u>PRCBD No.</u>	<u>Date</u>
(i) - (ii)	Rev. D	*	July 20, 1998
(1) - (2)	Rev. D	*	July 20, 1998
i - viii	Rev. D	*	July 20, 1998
1-1 - 1-4	Rev. D	*	July 20, 1998
2-1 - 2-8	Rev. D	*	July 20, 1998
A-1 - A-6	Rev. D	*	July 20, 1998

**INDEX OF DEVIATIONS/WAIVERS AUTHORIZED FOR REQUIREMENTS  
CONTAINED IN THIS DOCUMENT**

<b><u>Number</u></b>	<b><u>Title</u></b>	<b><u>Para. No.</u></b>	<b><u>Page</u></b>
1.	Definitions	1.4	(1)
	Precision Cleaning (Reference Level II PRCBD S41427B, dated 2/2/89)	2.10	

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**DEVIATIONS/WAIVERS AUTHORIZED FOR REQUIREMENTS  
CONTAINED IN THIS DOCUMENT**

**1. REQUIREMENT:** Paragraph 1.4 DEFINITIONS, specifies that to promote mutual understanding, the following definitions are provided:

GC (Generally Clean) - Freedom from manufacturing residue, dirt, oil, grease, processing debris or other extraneous contamination. This level can be achieved by washing, wiping, blowing, vacuuming, brushing, or rinsing. This level shall not be designated for hardware that is sensitive to contamination.

VC (Visibly Clean) - The absence of all particulate and non-particulate matter visible to the normal unaided (except corrected vision) eye. Particulate is identified as matter of miniature size with observable length, width, and thickness. Nonparticulate is a film matter without definite dimension. This level, with the exception of the Orbiter payload (cargo) bay, payload canister and payloads, requires precision cleaning methods, but no particle count.

VC + UV (Visibly Clean Plus Ultraviolet) - VC (visibly clean) and inspected with the aid of an ultraviolet light (black light) of 3200 to 3800 Angstroms wavelength ( $3.2 \times 10^{-7}$  to  $3.8 \times 10^{-7}$  meters). This level requires precision cleaning methods, but no particle count.

Visual Cleanliness Levels - A category which includes VC, VC + UV, and GC cleanliness levels.

Paragraph 2.10 PRECISION CLEANING, specifies that when precision cleanliness levels are required, the precision cleaning processes shall be performed in a controlled environment, and shall be controlled to documented procedures. The level of precision cleanliness achieved shall be verified, and evidence of inspection and acceptance documented. The precision cleaned article shall be packaged in accordance with the requirements of the Product Packaging section of this specification. Packaging shall be conducted immediately after verification of cleanliness and prior to leaving the controlled environment.

**WAIVER:** This waiver allows pre-shipment cleaning of the following EMU hardware to the specified visual cleanliness level without utilization of a "controlled environment" facility for STS-26 and subsequent.

**DEVIATIONS/WAIVERS AUTHORIZED FOR REQUIREMENTS  
CONTAINED IN THIS DOCUMENT - Concluded**

<u>Nomenclature</u>	<u>Drawing Number</u>
Comm. Carrier Assy (CCA)	0101-10001
Gloves	0106-10006
Hard Upper Torso (HUT)	0102-10002
Arms	0103-10003
Lower Torso Assy (LTA)	0104-10004
Helmet	0105-10005
Liquid Cooling Ventilation Garment (LCVG)	0107-10007
Extravehicular Visor Assy (EVVA)	0108-10008
Insuit Drink Bag (IDB)	0110-10010

**EFFECTIVITY:** STS-26 thru STS-999.

**AUTHORITY:** Level II PRCBD S41427B, dated 2/2/89.

**SN-C-0005**

**SPACE SHUTTLE**

**CONTAMINATION CONTROL REQUIREMENTS**

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## FOREWORD

Efficient management of the Space Shuttle Program (SSP) dictates that effective control of program activities be established. Requirements, directives, procedures, interface agreements, and system capabilities shall be documented, baselined, and subsequently controlled by SSP management.

Program requirements controlled by the Manager, Space Shuttle Program, are documented in, attached to, or referenced from Volume I through XVIII of NSTS 07700.

This specification has been approved by the Space Shuttle Program Office and is available for use by NASA and associated contractors. The Safety, Reliability, and Quality Assurance Office, NASA-JSC, is the Office of Primary Responsibility for this document.

All elements of the SSP must adhere to these baselined requirements. When it is considered by the Space Shuttle Program element/project managers to be in the best interest of the SSP to change, waive or deviate from these requirements, an SSP Change Request (CR) shall be submitted to the Program Requirements Control Board (PRCB) Secretary. The CR must include a complete description of the change, waiver or deviation and the rationale to justify its consideration. All such requests will be processed in accordance with NSTS 07700, Volume IV - Book 1 and dispositioned by the Manager, Space Shuttle Program, on a Space Shuttle PRCB Directive (PRCBD).

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Tommy W. Holloway  
Manager, Space Shuttle Program

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## 1.0 INTRODUCTION

### 1.1 PURPOSE

The purpose of this specification is to establish common, definitive responsibilities and requirements for contamination control on the Space Shuttle Program (SSP).

### 1.2 SCOPE

This specification contains contamination control requirements applicable to space vehicles and Ground Support Equipment (GSE) from design concept through procurement, fabrication, assembly, test, storage, delivery, launch/ground operations, and maintenance for the SSP.

### 1.3 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein:

- a. NASA SP-5076, Contamination Control Handbook
- b. JSCM 5322, Contamination Control Program Requirements Manual
- c. SE-S-0073, Specification, Fluid Procurement and Use Control
- d. FED-STD-209B, Clean Room and Work Station Requirements Controlled Environment
- e. K-STSM-14.2.1, KSC Cargo Facilities Contamination Control Plan
- f. VCP-85-485, Cargo Operations Contamination Control Plan

### 1.4 DEFINITIONS

To promote mutual understanding, the following definitions are provided:

Airborne Particulate Matter - Particulate matter suspended in the ambient atmosphere.

Clean Room - A clean room is an enclosed area employing control over the particulate matter in air with temperature, humidity, and pressure control, as required.

Clean Work Station - A clean work station is a work bench or similar working enclosure characterized by having its own filtered air or gas supply.

Cleanliness Level - An established maximum of allowable contaminants based on size distribution or quantity on a given area or in a specific volume.

Contaminant - Any unwanted matter which could be detrimental to the required operation, reliability, or performance of a part, component, subsystem, or system.

Critical and/or Significant Surface - A surface which requires precision cleanliness.

Fiber - A particle whose length-to-width ratio is in excess of 10 to 1 (minimum length of 100 micrometers).

Fluid - A liquid or gaseous material.

Flush - A rinsing of a part, component, subsystem, or system, using a liquid as the rinsing medium.

GC (Generally Clean) - Freedom from manufacturing residue, dirt, oil, grease, processing debris or other extraneous contamination. This level can be achieved by washing, wiping, blowing, vacuuming, brushing, or rinsing. This level shall not be designated for hardware that is sensitive to contamination.

Micron/Micrometer - A unit of measurement equal to  $1 \times 10^{-6}$  meters ( $3.93 \times 10^{-5}$  inches), 25 microns being equal to approximately one-thousandth of an inch.

NVR (Non Volatile Residue) - Soluble (or suspended) material and insoluble particulate matter remaining after controlled evaporation of a filtered volatile liquid, usually measured in milligrams. Filtration is normally through a 0.45-micrometer or 0.8-micrometer membrane filter prior to evaporation.

Particle - Matter with observable length, width, and thickness usually measured in micrometers. This definition includes fibers.

Particle Counters - Automatic electronic devices designed to electronically separate, size, and count individual particles.

Particulate Matter - The general term applied to matter with observable length, width, and thickness, as contrasted to nonparticulate film matter without definite dimension.

Precision Cleaning - Final or fine cleaning accomplished in a controlled environment to achieve precision cleanliness.

Precision Cleanliness - The degree of freedom from contaminants that cannot normally be detected by visual means. Detection and measurement of precision cleanliness require special equipment and techniques.

Precision Clean Packaging - Packaging or protection used to preserve precision cleanliness for a specific period and condition.

Purge - To flow gas through a system (or line, tank, etc.) for the purpose of removing a residual fluid, or for providing a positive flow of gas from some opening in the system.

Silting - An accumulation of minute particles in the size range normally not counted but of sufficient quantity to interfere with sample analysis.

Total Solids - The residue from a known volume of liquid which has been evaporated to dryness in an oven.

VC (Visibly Clean) - The absence of all particulate and nonparticulate matter visible to the normal unaided (except corrected vision) eye. Particulate is identified as matter of miniature size with observable length, width, and thickness. Nonparticulate is a film matter without definite dimension. This level, with the exception of the Orbiter payload (cargo) bay, payload canister and payloads, requires precision cleaning methods, but no particle count.

VC Levels STANDARD, SENSITIVE, and HIGHLY SENSITIVE - VC (visibly clean) with specified inspection criteria in accordance with Table A.2. Table A.2 options are applicable for the Orbiter payload (cargo) bay, payload canister, and payloads during Space Shuttle Orbiter/payload integrated operations at launch and landing sites.

VC + UV (Visibly Clean Plus Ultraviolet) - VC (visibly clean) and inspected with the aid of an ultraviolet light (black light) of 3200 to 3800 Angstroms wavelength ( $3.2 \times 10^{-7}$  to  $3.8 \times 10^{-7}$  meters). This level requires precision cleaning methods, but no particle count.

Visual Cleanliness Levels - A category which includes VC, VC + UV, and GC cleanliness levels.

Deviation/Waiver 1 is applicable to Paragraph 1.4.  
Refer to the Deviations/Waivers Section in front of the document.

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## **2.0 REQUIREMENTS**

### **2.1 CONTAMINATION CONTROL ACTIVITIES**

The contractor shall develop a contamination control activity which implements all contamination control requirements of the contract and the requirements of this specification as applicable to the end product being procured. The contractor shall select and assign specific personnel the responsibility of implementation and management of the contamination control activity. The contractor-developed contamination control activity is subject to review by the procuring agency in accordance with the terms of the contract.

### **2.2 CONTAMINATION CONTROL PLAN**

When specified by contract, the contractor shall develop a contamination control plan to describe the manner in which the contamination control requirements of this specification and of the contract are to be implemented and achieved. The plan shall define the type of facilities to be utilized, the specific cleanliness level to be achieved, and the method of certifying the cleanliness levels. The contamination control plan will be subject to review in accordance with the terms of the contract.

### **2.3 DESIGN**

The consideration of contamination control during the design phase is of the utmost importance. To prevent unnecessarily stringent and costly cleanliness requirements, the design's sensitivity to contamination must be limited to the maximum extent possible.

To assure the most effective contamination control at minimum cost, the designer shall provide for:

- a. Reduction of design sensitivity to contamination
- b. Incorporation of features which will minimize or eliminate self-generation of contamination
- c. Materials compatibility for contamination and corrosion control
- d. Incorporation of filtration and/or other design features for contamination control during system operation
- e. Maintainability features to facilitate contamination removal and monitoring during maintenance

Upon selection of the design, the contractor shall establish:

- a. The cleanliness levels required by the design
- b. Manufacturing and processing environmental requirements
- c. Assembly, processing, and test requirements pertaining to contamination control
- d. Cleanliness preservation and storage requirements

Lubricants, sealing and staking compounds, nonmetallic materials, etc., shall be selected, tested, and controlled to ensure preservation of the required cleanliness levels. Selection and evaluation of these materials shall include consideration of out-gassing and degradation resulting from all environmental conditions expected during the life and use of the end product.

NOTE: Contamination control guidelines for designers may be obtained from NASA SP-5076, Contamination Control Handbook.

## **2.4 CLEANLINESS LEVELS**

The contractor shall, unless otherwise specified by contract, establish, document, and adhere to the cleanliness levels for each part, component, subsystem, and system of the end product. The contractor-established cleanliness levels shall provide the cleanliness required for the most contamination sensitive design features of the product. Cleanliness levels shall be selected from Table A.1, Surface Cleanliness Levels, unless otherwise specified or approved by the procuring agency.

NOTE: With respect to the Orbiter payload (cargo) bay, payload canister and payload, the VC baseline as referred to in contractual documents is, unless otherwise stated, "visibly clean level STANDARD" as defined in Table A.2. VC levels SENSITIVE and HIGHLY SENSITIVE are at extra cost and added ground operations time.

VC levels STANDARD, SENSITIVE, and HIGHLY SENSITIVE are to be documented by Operations and Maintenance Requirements and Specifications Documentation (OMRSD) and OMIs (Operations and Maintenance Instructions) with established costs and ground processing schedule impact. Special cleanliness requirements will be evaluated on an individual basis. This is responsive to Paragraph 2.25 of this document. When approved by the procuring agency, appropriate OMRSD and OMI documentation will be generated and maintained.

Analysis methods for NVR fallout from LLS (Launch and Landing Site) facility environments can be found in KSC document K-STSM-14.2.1, and USAF document VCP-85-485.

## **2.5 MINIMUM INTERNAL CLEANLINESS**

Where precision cleanliness or visual cleanliness levels have not been stipulated by the contract and are not required by the design, internal areas shall, as a minimum, be subjected to a cleanliness inspection. This inspection shall verify the absence of loose hardware, soils, and all other extraneous materials, such as excessive lubricant or sealing compound, solder, etc. The presence of such materials shall require appropriate corrective cleaning action(s).

## **2.6 PROCUREMENT AND SUBCONTRACTING**

The contractor shall assure that the applicable contamination control requirements of this specification and of the contract are included in its subcontracts. Cleanliness levels stipulated for subcontract item(s) shall be compatible with the cleanliness requirements of the end product.

## **2.7 OPERATIONAL, TESTING, AND SYSTEM CLEANING FLUIDS**

Fluids used for the operation, testing, and cleaning of Space Shuttle fluid systems shall conform to SE-S-0073, where applicable.

## **2.8 MANUFACTURING**

The contractor shall have procedures which shall establish and maintain the cleanliness requirements for the article being manufactured. The procedures shall give consideration for their potential applicability for use during the operational life of the end product.

## **2.9 CLEANING METHODS AND MATERIALS**

The contractor shall implement detailed methods and procedures for attaining the cleanliness levels required for the product. The cleaning methods selected shall be compatible with the design configuration. The cleaning methods must not be detrimental to the materials of construction and/or to the design requirements of the part or component.

## **2.10 PRECISION CLEANING**

When precision cleanliness levels are required, the precision cleaning processes shall be performed in a controlled environment, and shall be controlled to documented procedures. The level of precision cleanliness achieved shall be verified, and evidence of inspection and acceptance documented. The precision cleaned article shall be packaged in accordance with the requirements of the Product Packaging section of this

specification. Packaging shall be conducted immediately after verification of cleanliness and prior to leaving the controlled environment.

Deviation/Waiver 1 is applicable to Paragraph 2.10.  
Refer to the Deviations/Waivers Section in front of the document.

### **2.11 CLEANING FLUIDS CONTROL**

The contractor shall establish and implement requirements for all cleaning fluids. All cleaning fluids utilized shall be controlled by documented requirements. The contractor shall procure cleaning fluids in accordance with SE-S-0073, where applicable.

Unless otherwise specified in the contract, the contractor shall select from existing specifications, or shall establish composition requirements for cleaning fluids. All cleaning fluids used shall comply with the specified requirements.

The cleaning fluids selected for use as precleaning solutions shall be controlled during use by analysis, solution replacement, or adjustment, to maintain cleaning effectiveness and compatibility with the type of material being cleaned.

Final flush and verification fluids for precision cleanliness shall be analyzed prior to use to determine compliance with the stipulated specification requirements.

The contractor shall maintain fluid control records. The records shall indicate the scheduled analysis results and any solution replacement or adjustments.

### **2.12 CLEAN ROOMS, CLEAN WORK STATIONS, AND OTHER WORK ENCLOSURES**

Assembly, processing, and functionally testing of the product shall be conducted in facilities which provide airborne contamination levels compatible with the product cleanliness required.

Clean rooms and clean work stations required for product processing shall be classified as described in FED-STD-209B. The operation of all clean rooms, clean work stations, or other environmentally controlled work enclosures shall be controlled by approved documented procedures. These operating procedures for monitoring shall be selected from requirements contained in FED-STD-209B, as applicable for the product. Examples of clean room monitoring and apparel requirements are found in JSCM 5322.

The contractor shall establish and implement the requirements for the periodic certification of clean rooms, clean work stations, and other environmentally controlled work enclosures. The certification process shall be controlled by contractor-established documented procedures.

### **2.13 CALIBRATION PROCEDURES**

The contractor shall establish the requirements and documented procedures for the calibration of facilities and equipment used for the contamination control activity.

NOTE: Automatic liquid-borne particle counters cannot be utilized for final verification of cleanliness of the end product unless the individual counters have demonstrated accuracy and repeatability, and their use is approved by the procuring agency.

## **2.14 PRODUCT PACKAGING**

The contractor shall establish and implement requirements and processes for packaging the cleaned article, interim and final, as necessary to preserve the required cleanliness level. The packaging processes shall be controlled by documented procedures.

Packaging materials selected for cleaning items shall possess:

- a. Qualities which allow for visual inspection and ready identification of the cleaned item.
- b. Flexibility and strength adequate to assure normal handling without rupture.
- c. Compatibility with the cleanliness level required for the item.
- d. Resistance to particle sloughing that is compatible with the required cleanliness levels.
- e. A coefficient of heat sealability that assures the formation of an effective and strong seal.
- f. Low water-vapor-transmission rate to reduce or eliminate corrosion of the item.
- g. Antistatic properties compatible with the item.
- h. Characteristics that, through normal storage periods, will not adversely affect or contaminate the item.

NOTE: NASA SP-5076 contains information on the characteristics of various packaging materials. Examples of acceptable packaging procedures are found in JSCM 5322.

### **2.14.1 Precision Cleanliness Packaging**

Precision cleaned items shall be double-bagged during the packaging process to assure:

- a. The preservation of item cleanliness in the event of damage to one bag.
- b. Both slough resistance and moisture barrier qualities.
- c. The ability to remove the outer bag during transfer of item(s) into a clean room in order to maintain the cleanliness of the packaged items and the clean room environment.

Caps and plugs used to protect internal areas of fluid system components shall be compatible with the system fluid. When caps or plugs are not used, the inner bag material shall be compatible with the system fluid.

### **2.14.2 Visual Cleanliness Packaging**

#### **2.14.2.1 GC Packaging**

GC items are not required to be packaged.

#### **2.14.2.2 VC Packaging**

VC items shall be packaged with one bag (disposable or reusable) or equivalently protected in a suitable container. VC items that are moisture sensitive shall be packaged with one bag as a minimum (disposable or reusable). All VC packaging materials shall be in accordance with Paragraphs 2.14a through 2.14h; Paragraphs 2.14a and 2.14e are not applicable for VC containers.

#### **2.14.2.3 VC + UV Packaging**

VC + UV items shall be packaged in accordance with Paragraph 2.14.1.

## **2.15 INSPECTION**

The contractor shall assure compliance to the contamination control requirements and procedures by performing verification inspections, and shall retain inspection records.

## **2.16 RECEIVING INSPECTION**

The contractor shall establish procedures and appropriate environmental controls for receiving inspection of procured items. The inspection of procured items shall assure

that storage, transit, and handling of the packaged items have not violated the required cleanliness.

#### **2.17 IN-PROCESS INSPECTION**

During manufacturing and assembly of the product and/or operational use, inspections shall be performed to assure the achieved cleanliness has not been degraded or jeopardized.

#### **2.18 MINIMUM CLEANLINESS INSPECTION**

The inspection required by Paragraph 2.5 shall be performed prior to such assembly processes as potting, foaming, final closure, and the incorporation of subassemblies into higher order assemblies.

#### **2.19 CONTAMINATION CONTROL INSPECTION RECORDS**

The contractor shall maintain records of contamination control processing which are traceable to the articles processed. Traceable records shall also be maintained for contamination control facility tests and certification of flush or test fluids. Certification of cleanliness shall accompany the product upon delivery of the procuring agency.

#### **2.20 PRODUCT TESTING**

Testing requirements and procedures shall include contamination controls. The testing controls shall assure that testing equipment, techniques, and materials do not degrade the previously achieved product cleanliness.

#### **2.21 ENVIRONMENT**

The test environment shall be established and controlled as required for product cleanliness. Whenever critical surfaces of the item are exposed (for example, when connecting or disconnecting equipment), either the entire test environment shall be controlled or effective localized environmental controls shall be implemented.

#### **2.22 TEST EQUIPMENT**

Test equipment used shall have contamination controls compatible with the cleanliness required for the product. Particular attention shall be given to cleanliness of interfacing components. Liquids, gases, and other materials used in the test equipment systems which interface with the product shall meet the purity, cleanliness, and physical properties required for the product.

### **2.23 STORAGE AND SHIPPING**

The contractor shall establish and utilize a storage and shipping procedure which maintains the required cleanliness of the product(s).

### **2.24 TRAINING**

The contractor shall select, assign, and train personnel in all areas required to satisfactorily meet the requirements of the contamination control activity.

The contractor training shall assure that all personnel responsible for contamination control functions shall be trained as required to assure proficiency within their assigned task. Manufacturing and support personnel shall be trained or indoctrinated to the extent necessary to prevent compromise of contamination control. Retraining of all personnel shall be accomplished, as required. The contractor shall establish personnel certification with traceable documentation.

### **2.25 SPECIAL REQUIREMENTS**

The contractor shall determine if special requirements (for example, radiation, microbial, total organics, etc.) are required by the product design or application. As applicable, these requirements shall be established and implemented when approved by the procuring agency.

**APPENDIX A**  
**CLEANLINESS LEVELS**

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**TABLE A.1**  
**SURFACE CLEANLINESS LEVELS**

VISUAL CLEANLINESS LEVELS

GC        (Generally Clean) (1) Freedom from manufacturing residue, dirt, oil, grease, processing debris or other extraneous contamination. This level can be achieved by washing, wiping, blowing, vacuuming, brushing, or rinsing. The GC level shall not be designated for hardware that is sensitive to contamination.

VC        (Visibly Clean) (2) The absence of all particulate and nonparticulate matter visible to the normal unaided (except corrected vision) eye. Particulate is identified as matter of miniature size with observable length, width, and thickness. Nonparticulate is film matter without definite dimension. This level, with the exception of the Orbiter payload (cargo) bay, payload canister and payloads, requires precision cleaning methods, but no particle count.

VC + UV    (Visible Clean Plus Ultraviolet) (2) Visibly clean (as defined above) and inspected with the aid of an ultraviolet light (black light) of 3200 to 3800 Angstroms wavelength ( $3.2 \times 10^{-7}$  TO  $3.8 \times 10^{-7}$  meters).

NOTE: Any evidence of fluorescence shall be cause for recleaning. If recleaning does not reduce the fluorescence, an investigation shall be made to determine whether the fluorescing material is contamination or the basic materials. This level requires precision cleaning methods, but no particle count.

**TABLE A.1**  
**SURFACE CLEANLINESS LEVELS - Continued**

<u>PRECISION PARTICULATE LEVELS</u>			<u>PRECISION PARTICULATE LEVELS</u>		
<u>Level</u>	<u>Particle Size Micrometers</u>	<u>Range (3) (4)</u>	<u>Level</u>	<u>Particle Size Micrometers</u>	<u>Range (3) (4)</u>
1000	<500	Unlimited (5)	25	<5	Unlimited (5)
	500 thru 750	34		5 thru 15	19
	>750 thru 1000	5		>15 thru 25	4
	>1000	0		>25	0
750	<250	Unlimited (5)	Example: Level 300 would be particulate level 300. Level 300 C would be particulate level 300 plus NVR level C.		
	250 thru 500	205			
	>500 thru 750	9			
	>750	0			
500	<100	Unlimited (5)	<u>NVR (NONVOLATILE RESIDUE) LEVELS</u>		
	100 thru 250	1073	Maximum Quantity NVR Per 0.1 Square Meters		
	>250 thru 500	27	<u>Level</u>	<u>(1 Sq. Ft.) (3)</u>	
	>500	0	A	1 mg.	
300	<100	Unlimited (5)	B	2 mg.	
	100 thru 250	93	C	3 mg.	
	>250 thru 300	3	D	4 mg.	
	300	0			
250	<100	Unlimited (5)			
	100 thru 200	39			
	>200 thru 250	3			
	>250	0			
200	<50	Unlimited (5)			
	50 thru 100	154			
	>100 thru 200	16			
	>200	0			
150	<50	Unlimited (5)			
	50 thru 100	47			
	>100 thru 150	5			
	>150	0			
100	<25	Unlimited (5)			
	25 thru 50	68			
	>50 thru 100	11			
	>100	0			
50	<15	Unlimited (5)			
	15 thru 25	17			
	>25 thru 50	8			
	>50	0			

## TABLE A.1

### **SURFACE CLEANLINESS LEVELS - Concluded**

- NOTES: (1) Inspection criteria shall be specified at the discretion of the procuring agency. In the event that cleaning is necessary to achieve the GC level, evidence that cleaning was performed will constitute verification of the GC level.
- (2) Inspection criteria shall be specified at the discretion of the procuring agency. Refer to Table A.2 for inspection criteria options that are applicable for the Orbiter payload (cargo) bay, payload canister, and payloads during Space Shuttle Orbiter/payload integrated operations at launch and landing sites.
- (3) Particulate and NVR allowables are based on 0.1 square meters (1 square foot) of surface area. Flush fluid quantity for sampling shall be 100 milliliters per 0.1 square meters (1 square foot) of surface area. Small parts should be grouped together to obtain 0.1 square meters (1 square foot) of surface area. For determination of NVR fallout in environmentally controlled areas, see Paragraph 2.4.
- (4) Maximum quantity per 1.0 standard cubic meters (35 standard cubic feet) of effluent gas when systems are being evaluated by purging. If feasible, the sampling must be accomplished at maximum system operational flow rate.
- (5) Unlimited means particulate in this size range is not counted; however, if the accumulation of this silt is sufficient to interfere with the analysis, the sample shall be rejected.

**TABLE A.2**

**VC (VISIBLY CLEAN) LEVELS AND INSPECTION CRITERIA  
FOR THE ORBITER PAYLOAD (CARGO) BAY,  
PAYLOAD CANISTER, AND PAYLOADS**

Three levels of VC requirements are available for the Orbiter payload (cargo) bay, payload canister and payloads during Space Shuttle Orbiter/payload integrated operations at launch and landing sites. VC STANDARD is baseline as referred to in contractual documentation. The VC definition in Table A.1 is applicable to this table with the understanding that incident light levels and inspection distances are specified herein:

VC Level	Incident Light Level (1)	Observation Distance	Remarks
Standard	$\geq 50$ foot-candles	5 to 10 feet	(2) (3) (5)
Sensitive	$\geq 50$ foot-candles	2 to 4 feet	(2) (3) (5)
Highly Sensitive	$\geq 100$ 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.