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1.0 Scope

This procedure is written to provide instructions for measuring Silicon Witness Samples(SWS) used for monitoring contamination, from particulate and Non-Volatile Residue(NVR) fall out during various processes, throughout the ACIS Project. This procedure also describes the materials and equipment used to determine particle counts and NVR thickness. The SWSs are also to be used when direct sampling can not be efficiently or effectively performed per MIL-STD-1246, Product Cleanliness Levels and Contamination Control Program.

1.1 Introduction

Monitoring particulate and molecular levels for various processes is required per MSFC-SPEC 1238, Thermal Vacuum Bakeout Specification for Contamination Sensitive Hardware and 36-01207, ACIS Contamination Control Plan. This procedure is developed to provide the instructions necessary to measure contamination on SWSs. This procedure is applicable to the Contamination Control Engineer (CCE) .

1.1.1 Material

2 or 4 inch Silicon Prime Wafers
VLSI Standard Oxide Thickness Wafer 124 +/- 10 Angstrom
VLSI Standard Particle Count
Two or Four inch Fluoroware wafer holders, cleaned to level 100A per Mil-Std-1246

1.1.2 Special Equipment

Ellipsometer
Wafer Inspection Scanner(WIS)

1.2 Responsibilities

The CCE, or his appointee, is responsible for measuring and analyzing SWSs and determining contamination levels upon completion of individual processes.

2.0 Applicable Documents

<u>Military Standards</u>

MIL-STD-1246 Product Cleanliness Levels and Contamination Control Program

<u>MIT Specifications</u>

36-01316 Cleantent Dressing, Behavior, and Material Handling

<u>Marshall Space Flight Center Specifications</u>

MSFC-SPEC 1238 Thermal Vacuum Bakeout Specification for Contamination Sensitive Hardware

3.0 Method

Standard cleanroom practices per 36-01316, Cleantent Dressing, Behavior, and Material Handling are to be followed during this procedure. All tools and fixtures are to be clean so as not to contaminate the SWS. Motion is to be minimized during exposed SWS handling and measuring. Samples are to be stored in clean wafer carriers and transported in a way so as not to risk contamination.

3.0.1 New SWS- Baseline

New SWSs are delivered in cartridges containing 25 wafers. Each cartridge shall be measured, using an ellipsometer, for a baseline Oxide thickness using a 20 % sample and an average assigned to the entire cartridge. An Alpha serial number shall be assigned to the cartridge. Form A of this procedure is to be completed to baseline new SWSs. After the NVR baseline has been determined each wafer shall be measured for particulates using the WIS. Each SWS shall be put into a clean wafer holder. Each wafer holder shall be serialized with the alpha prefix and numbers 1 through 25. Write the initial NVR, serial number, name of operator, and date on a label attached to the wafer holder cover.

(As an option each SWS can be measured individually for an NVR test which requires more precise measurements.)

3.0.2 Post process measurements

When samples are ready for post process analysis, the particle count is to be performed first, then the NVR . On the label, write name of the operator if different from initial measurement, post- NVR thickness, and date of measurement. Form B of this procedure is to be completed for NVR post-measurements.

3.1 Procedure

3.1.1 Measuring NVR

Place VLSI Oxide Standard on the ellipsometer platform. Locate beam in the center ring on the VLSI Oxide Standard. Align cross hairs in the alignment port until the cross hairs meet the center lines. Set computer to measure Oxide thickness. Repeat these steps in five locations approximately as shown in figure 1. Document each measurement on appropriate form A or B, and determine the average. Ensure the readings fall within tolerances, before continuing.

Remove VLSI Oxide Standard and place the Silicon Witness Sample on ellipsometer platform. Locate beam on the SWS. Align cross hairs in the alignment port until the cross hairs meet the center lines. Set computer to measure Oxide thickness. Repeat these steps in five locations approximately where shown in Figure 1. Document each measurement on appropriate form A or B, and determine the average .

Determine the average of the five samples taken;

$$\bar{\bar{X}}=(\bar{x}1+\bar{x}2+\bar{x}3+\bar{x}4+\bar{x}5)/5$$

For the new cartriges determine the Standard Deviation using

$$S = \left[(1/n-1) \left[\sum_{i=1}^{N} \bar{x}_i^2 - \left(\sum_{i=1}^{N} \bar{x}_i\right)^2/n \right] \right]^{1/2}$$

3.1.2 Measuring Particulates

Measure Particles using the Wafer Inspection Scanner(WIS).
Open each door of the WIS conveyor. Install dummy wafer. Set heading to specify date and edge exclusion of 5 for four inch wafers and 50 for 2 inch wafers. Run dark and light calibration programs.

Place VLSI Standard on conveyor and measure single scan. Print out results of all flaws. Ensure total count of flaw type A is within VLSI Standard.
Replace VLSI Standard and place SWS on conveyor and measure single scan. Print out results of all flaws. Replace SWS in suitable container.
Identify the following information on the printout

- serial number
- before or after measurement
- Location represented by SWS

Copies of particle post-printouts shall be attached to their original baseline printout and analyzed by the CCE.

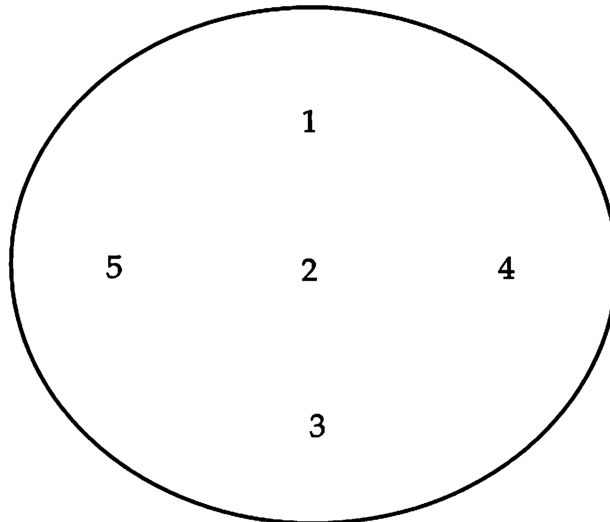

Figure 1.
NVR Meassuring Locations

Non-Volatile Residue Baseline Measurements on Silicon Witness Samples

ALPHA SERIAL NUMBER CODE:

Operator Name ____________

Date

Calibration Sample

Measure calibrated sample 5 places:

1	
2	
3	
4	
5	
Must be 124 +/- 10 Angstroms AVG	

5 Sample Wafers

Measure Wafer # 1, 5 places:

1	
2	
3	
4	
5	
$\bar{X}1$ AVERAGE	

Measure Wafer # 2, 5 places:

1	
2	
3	
4	
5	
$\bar{X}2$ AVERAGE	

Measure Wafer # 3, 5 places:

1	
2	
3	
4	
5	
$\bar{X}3$ AVERAGE	

average $\bar{\bar{X}}$=

standard deviation S=

Measure Wafer # 4, 5 places:

1	
2	
3	
4	
5	
$\bar{X}4$ AVERAGE	

Measure Wafer # 5, 5 places:

1	
2	
3	
4	
5	
$\bar{X}5$ AVERAGE	

Non-Volatile Residue
Post-Measurements of
Silicon Witness Samples

Witness Wafer Serial Number: ____________________
Operator Name ____________________
Date ____________________

Measure calibrated sample 5 places:

1	
2	
3	
4	
5	

Must be 124 +/- 10 Angstroms AVG [ ]

POST-MEASUREMENT

Measure SWS Wafer 5 places:

1	
2	
3	
4	
5	

	POST-MEASUREMENT	Baseline pre-Cartridge measurement	DELTA
AVERAGE			

QC Signature ____________________
Date ____________________