

SEMI P22-93

GUIDELINE FOR PHOTOMASK DEFECT CLASSIFICATION AND SIZE DEFINITION

This Standard was technically approved by the Mask & Mask Equipment Global Technical Committee.

1 Purpose

1.1 The purpose of this guideline is to establish standard nomenclature for photomask defect classifications, and to define defect sizing methods. It is desirable to follow this guideline when discussing photomask defects.

2 Background

2.1 Confusion concerning definitions of classification, nomenclature, and size of the photomask defects has often occurred in the past.

3 References

3.1 SEMI Standards

SEMI P23 — Guideline for Programmed Defect Masks and Benchmark Procedures for Sensitivity Analysis of Mask Defect Inspection Systems

3.2 General Services Administrator¹

MIL-STD-209D — Required Items for a Cleanroom and Work Station with a Controlled Environment

4 Classification of the Mask Defect

4.1 *Mask Pattern Defect* — Figures of each defect classified in this section are shown in SEMI P23.

4.1.1 *Shape Defect*

4.1.1.1 *Opaque Defect*

1. Dot
2. Bridge
3. Protrusion (on opaque pattern)
4. Extension (on opaque pattern)
5. Oversize (on opaque pattern)
6. Intrusion (on clear pattern)
7. Truncation (on clear pattern)
8. Undersize (on clear pattern)

4.1.1.2 *Clear Defect*

1. Hole
2. Space
3. Intrusion (on opaque pattern)
4. Truncation (on opaque pattern)
5. Undersize (on opaque pattern)
6. Protrusion (on clear pattern)

¹ General Services Administrator, 4th and D Street, SW, Room 6039, Washington, D.C. 20407, USA.

7. Extension (on clear pattern)

8. Oversize (on clear pattern)

4.1.2 *Misplacement Error*

4.1.2.1 *Butting Error*

4.1.2.2 *Registration Error*

4.1.3 *Tone Defect*

4.1.3.1 *Pattern Half Tone*

4.1.3.2 *Opaque Defect Half Tone*

4.1.3.3 *Clear Defect Half Tone*

4.1.4 *Disappearance*

4.1.4.1 *Opaque Pattern Disappearance*

4.1.4.2 *Clear Pattern Disappearance*

4.1.5 *Edge Roughness*

4.2 *Glass Defect*

4.2.1 *Sleek, Pit, Scratch, Chip, Striation, Polishing Mark, Discolor, and Bubbles*

4.3 *Miscellaneous Defect*

4.3.1 Unwanted clear or opaque spot created by various undefined causes (e.g., crystal growth, electrostatic damage, organic material deposit).

5 **Definition of Size for Photomask Defect**

5.1 *Isolated Defect, Edge Defect* — Shape defects, in which defects are isolated from the pattern, are called isolated defects. For these types of defects, dot or hole is suitable for a definition. Size of isolated defect is expressed as “width” and “height”. “Width” of the isolated defect is expressed with dimension of X direction, and “height” dimension of Y direction. Defects adjacent to pattern are called edge defects. However, the edge defect which is positioned at corner section of contact (island) pattern, etc. is called a corner defect, and definition of size should follow item 5.2. Also, definition of oversize and undersize should follow item 5.3. Size of edge defect is expressed as “width” and “height”. “Width” of the edge defect is expressed with dimension which is parallel to the side of the pattern, “height”, dimension which is normal to it.

Note: Shape defects to which the above mentioned definition are applicable are as follows:

1. Dot
2. Protrusion
3. Extension
4. Bridge
5. Hole
6. Intrusion
7. Truncation
8. Space

5.2 *Corner Defect* — Size of a corner defect in a contact (island) pattern, etc. is defined as follows:

This is expressed as “width” and “depth”.

Depth: Distance between the intersection point formed by the bisection of the corner angle and the pattern, and the point designed (see Figure 1).