

# SEMI P22-0699

## GUIDELINE FOR PHOTOMASK DEFECT CLASSIFICATION AND SIZE DEFINITION

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### 1 Purpose

1.1 The purpose of this guideline is to establish standard nomenclature for photomask defect classifications, and to define defect sizing methods.

### 2 Scope

2.1 It is desirable to follow this guideline when discussing classification, nomenclature, and size of the photomask defects.

**NOTICE:** SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

### 3 References

#### 3.1 SEMI Standards

SEMI P33 — Provisional Specification For Developmental 230 mm Square Hard Surface Photomask Substrates

**NOTICE:** Unless otherwise indicated, all documents cited shall be the latest published versions.

### 4 Terminology

4.1 *design pattern* — pattern of intended design data.

4.2 *photomask pattern* — pattern on photomask surface.

4.3 Many terms relating to photomask technology can be found in SEMI P33.

### 5 Classification of the Mask Defect

#### 5.1 Mask Pattern Defects

5.1.1 *Shape Defect* — A photomask pattern whose shape is different from its intended design pattern.

5.1.1.1 *Isolated Defect* — Shape defects which are isolated from pattern.

1. Dot (See Figures 1, 23)

2. Hole (See Figure 2)

5.1.1.2 *Edge Defect* — Shape defects which are adjacent to straight pattern edge.

1. Edge Extension (See Figures 3, 24)

2. Edge Intrusion (See Figure 4)

5.1.1.3 *Corner Defect* — Shape defects which are adjacent to corners.

1. Corner Extension (See Figures 5, 27, 29)

2. Corner Intrusion (see Figures 6, 28, 30)

5.1.1.4 *Bridge* — Shape defects which are adjacent to more than two edges.

1. Opaque Bridge (See Figures 7, 26)

2. Clear Bridge (See Figure 8)

5.1.2 *Size Defect* — A photomask pattern whose size is different from its intended design pattern.

1. Oversize (on opaque pattern) (See Figure 9)
2. Oversize (on clear pattern) (See Figure 10)
3. Undersize (on opaque pattern) (See Figure 11)
4. Undersize (on clear pattern) (See Figure 12)
5. Elongation (on opaque pattern) (See Figure 13)
6. Elongation (on clear pattern) (See Figure 14)
7. Truncation (on opaque pattern) (See Figure 15)
8. Truncation (on clear pattern) (See Figure 16)

5.1.3 *Misplacement Defect* — A photomask pattern whose placement is different from its intended design. (See Figures 17, 18, 25)

5.1.4 *Transmission Defect* — A photomask pattern whose transmission is different from its intended design.

1. Transmission Defect (on clear pattern) (See Figure 19)
2. Transmission Defect (on opaque pattern) (See Figure 20)

5.1.5 *Missing Pattern Defect* — A photomask pattern which is absent.

1. Missing opaque pattern (See Figure 21)
2. Missing clear pattern (See Figure 22)

5.2 *Glass Defect* — Unwanted defect in (or on) a glass created by various undefined causes (e.g., sleek, pit, scratch, chip, striation, polishing mark, discolor, bubbles, etc.).

5.3 *Miscellaneous Defect* — Unwanted clear or opaque spot created by various undefined causes (e.g., crystal growth, electrostatic damage, organic material deposit, phase shift defect).

## 6 Definition of Size for Photomask Defects

6.1 The tools and conditions used to measure defect size should be clearly specified.

### 6.2 Pattern Defects

#### 6.2.1 Shape Defects

6.2.1.1 *Isolated Defect* — Defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the defect. (See Figures 1, 2, 23)

6.2.1.2 *Edge Defect* — defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the defect. (See Figures 3, 4, 24)

6.2.1.3 *Corner Defect* — defect size is expressed as the distance (S1) between the intersection point, formed by the bisection of the corner angle and the pattern, and the point designed. (See Figures 5, 6)

6.2.1.4 *Bridge* — defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the defect. (See Figures 7, 8, 26)

#### 6.2.2 Size Defects

6.2.2.1 *Oversize and Undersize* — Defect size is expressed as two dimensions (S1 and S2) representing the absolute value of the deviation from the intended design pattern.

$$S1 = |b - a|$$

$$S2 = |d - c|$$

“a” and “c” are intended value; “b” and “d” are actual measured value. (See Figures 9, 10, 11, 12)

6.2.2.2 *Elongation and Truncation* — Defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the deviation from the intended design pattern. (See Figures 13, 14, 15, 16)

6.2.3 *Misplacement Defect* — Defect size is expressed as the absolute value of X and Y displacement from its intended position. (See Figures 17, 18, 25)

6.2.4 *Transmission Defect* — Transmission defects are evaluated by their transmissivity in addition to the size. The wavelength used for measurement should be clearly specified, as well as the transmissivity error (Te). Defect dimensions should be consistent with other definitions. (See Figures 19, 20)

$$T_e = T_d - T_i$$

where

Td = transmissivity of defect

Ti = intended transmissivity of design

6.2.5 *Missing Pattern Defect* — Defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the intended design pattern. (See Figures 21, 22)

6.3 *Randomly Shaped Defects* — For the defects which all of above sizing method cannot be applied, defect size is expressed as two dimensions (S1 and S2) of the smallest rectangle that encloses the defect. (See Figures 23, 24, 27, 28, 29, 30)

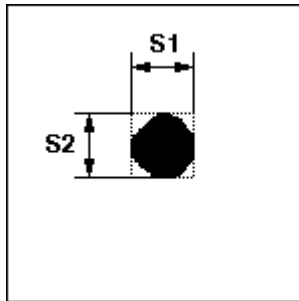


**Figure 1**  
**Dot**

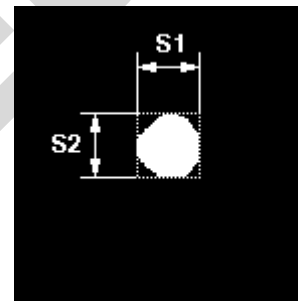


**Figure 2**  
**Hole**

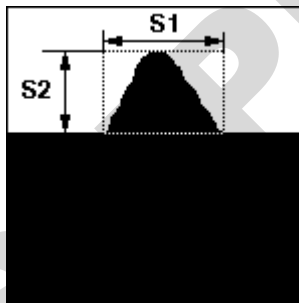


**Figure 3**  
**Edge Extension**

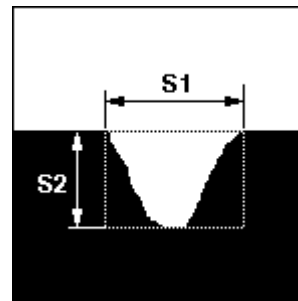


**Figure 4**  
**Edge Intrusion**