

SEMI D44-0706^E

SPECIFICATION FOR REFERENCE POSITION OF SINGLE SUBSTRATE FOR HANDING OFF ON TOOL

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^E This standard was editorially modified in February 2007 to correct an error. Changes were made to ¶ 6.2.2.4.

1 Purpose

1.1 This standard defines the datum line that specifies the position of the FPD manufacturing equipment, the position of the substrate, and the mutual positional relationship required to describe each position when AMHS loads and unloads the substrate to or from the manufacturing equipment.

2 Scope

2.1 This standard is used to clarify the positional relationship when a substrate is loaded to or unloaded from manufacturing equipment by AMHS.

2.2 For the purpose above, this standard shall define a datum line of the AMHS and the manufacturing equipment that clarifies the positional relationship between substrate and equipments.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard does not define the tolerance of the substrate itself nor the tolerance specific to the equipment.

3.2 The datum point specified in this standard does not increase the accuracy of the substrate positioning nor evaluate any results related to the FPD manufacturing.

3.3 Though tolerances to the datum line may differ depending on installation regulations by equipment suppliers, operations purposes, and transportation methods of the substrates, this standard does not apply those tolerances.

3.4 It may sometimes be necessary in fab operation to assess the tolerances of the substrates themselves. Depending on equipment used, it may demand specific tolerances. Tolerances also differ among substrate suppliers and generation of substrates. Based on these two points, tolerances shall be out of the scope of standardization for the substrate datum line.

4 Background

4.1 As the substrate size increases, higher accuracy is required during FPD production including positioning of the substrate. Positioning accuracy of the substrate during loading to and unloading from manufacturing equipment by AMHS is the most critical, and equipment suppliers and users have discussed it with strong interest. If a substrate is to be positioned within the tolerance required by a manufacturing equipment item through aligning the substrate center line to the equipment center line, following issues become critical.

- Substrate itself is neither square nor rectangular.
- Datum that specifies positional relationship between the equipment and the substrate is not clear.
- Naming of datum lines and others that confirm substrate positioning during load/unload is not unified.

4.2 This standard defines the datum line required to align the center lines of a substrate and equipment when AMHS loads or unloads the substrate to or from the manufacturing equipment.

4.3 When standardization of datum lines is to be implemented under these circumstances, characteristics of feature sizes of the current substrates should be understood first. If the datum line of the substrate is standardized as a guideline based on the characteristics of substrate feature size, it would be very beneficial for both equipment suppliers and users since two parties can share this datum line for positioning when equipment is set up. Also, it is applicable regardless of generations of FPD substrates.

5 Referenced Standards and Documents

5.1 SEMI Standards

SEMI D9 — Terminology for FPD Substrates

SEMI D24 — Specification for Glass Substrates used to Manufacture Flat Panel Displays

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

6 Terminology

6.1 Abbreviations and Acronyms

6.1.1 *AMHS* — Automated Material Handling Systems

6.1.2 *FPD* — Flat Panel Display

6.1.3 *LRE* — Long Reference Edge

6.1.4 *SRE* — Short Reference Edge

6.2 Definitions

6.2.1 Substrate Definition (see SEMI D9 and SEMI D24)

6.2.1.1 *Orientation Corner* — as defined by SEMI D9. Due to the nature of the substrate manufacturing process, a substrate has an Orientation Corner (also called Orientation Flat) at a specific location. Opposite edges of the substrate are parallel.

6.2.1.2 *Pattern Surface* — a surface defined as the orientation corner, where device patterns are mainly formed.

6.2.1.3 Definition of Substrate Datum Line (see Figure 1)

6.2.1.3.1 *Length (L)* — datum line for a long edge of a substrate.

6.2.1.3.1.1 *Long Reference Edge (LRE)* — two long edges of a substrate and their extension lines.

6.2.1.3.1.1.1 *LRE1* — extension line of LRE on the orientation corner.

6.2.1.3.1.1.2 *LRE2* — extension line of LRE on the opposite side of the orientation corner.

6.2.1.3.2 *Width (W)* — base line for short edge of a substrate.

6.2.1.3.2.1 *Short Reference Edge (SRE)* — two short edges of a substrate and their extension lines.

6.2.1.3.2.1.1 *SRE1* — extension line of SRE on the orientation corner side.

6.2.1.3.2.1.2 *SRE2* — extension line of SRE on the opposite side of the orientation corner.

6.2.1.4 *Definition of Substrate Center Line* — the bisection line of LRE1 and LRE2, or the bisection line of SRE1 and SRE2 (see Figure 2).

6.2.1.5 Definition of Substrate Datum Point

6.2.1.5.1 *Datum Point 1* — intersection of LRE1 and SRE1 on the orientation corner side.

6.2.1.5.2 *Datum Point 2* — intersection of the Substrate Center Line and either SRE1 or LRE1.

6.2.1.5.3 *Datum Point 2A* — intersection of the Substrate Center Line and either SRE2 or LRE2 (located on the opposite side of the datum point 2).

6.2.1.6 Vertical (Z-direction) dimension (see Figure 5)

6.2.1.6.1 *Z1* — height of datum point 1 from the floor.

6.2.1.6.2 *Z2* — height of datum point 2 from the floor.

6.2.2 Equipment Definition

6.2.2.1 *Equipment Opening Plane* — an opening through which AMHS loads/unloads substrates (see Figure 1).

6.2.2.2 *Datum Line of an Equipment Opening plane; Y-Axis* — a line parallel to a front of the opening plane and tangent to the bottom of the opening plane (see Figure 1).

6.2.2.3 *X1* — an extended line tangent to either side of the bottom of the equipment opening plane and orthogonal to the Y-axis (see Figure 1 and 2).

6.2.2.4 *X2* — an extension of a line tangent to other side of the bottom of the equipment opening plane (on the opposite side and parallel to X1), and orthogonal to Y-axis (see Figure 1 and 2).

6.2.2.5 *Equipment Opening Width* — length of an equipment opening plane through which AMHS loads or unloads substrates (see Figure 1).

6.2.2.6 *Equipment Center Line* — it shall be the center of the width of an equipment opening plane (center line of the equipment opening plane). In other words, it shall be a center line of two extension lines X1 and X2 orthogonal to Y-axis which is the datum line of the equipment opening plane.

6.2.2.7 *Virtual Center Line (Virtual Datum Line)* — the center line of a substrate placed in a loader/unloader (with no openings) shall be the virtual center line (virtual datum line), (see Figure 8).

6.2.2.8 *Substrate Stop Position in an Manufacturing Equipment* — substrate location in the equipment where it halts when loaded to or unloaded from the equipment (see Figure 4).

6.2.2.9 *Stop Line* — it shall be the line orthogonal to the vertical plane along X1 and X2, and passing the datum point 2A on the substrate center line, of which substrate is halted at the substrate stop position.

7 Requirement

7.1 A datum line required to align the center lines of a substrate and equipment when the substrate is loaded to and unloaded from AMHS shall be defined. The datum line shall be a standard on the positioning for all users and equipment suppliers during the equipment setup. However, it is not aimed to apply this standard to the tolerances of the substrate itself nor to the specific tolerances required by the equipment.

7.1.1 *Positional Relationship of the Equipment and the Substrate* — The substrate center line shall be positioned along the extension of the equipment center line, and perpendicular to the equipment opening plane (refer to the Y-axis in Figure 2). Furthermore, the equipment opening plane and the substrate transport direction shall be orthogonal.

7.1.1.1 *Horizontal Line in X Direction* — Datum point 2 and datum point 2A shall be the same distance from the floor in Z direction.

7.1.1.2 *Horizontal Line in Y Direction* — Datum point 1 and datum point 2 shall be the same distance from the floor in Z direction.

7.1.1.2.1 A substrate will be horizontally loaded to or unloaded from the equipment when $Z1 = Z2$. When $Z1 > Z2$ or $Z1 < Z2$, the substrate is loaded or unloaded with a certain angle to the equipment along the Y-axis (see Figure 5 and 6).

NOTE 1: *Substrate Loading Pattern* — There are two patterns associated with the position of the orientation flat and load/unload direction of the substrate toward the equipment. ‘Loading/unloading along the LRE’ keeps LRE1 and LRE2 parallel to the center line of the equipment, while ‘loading/unloading along the SRE’ keeps

NOTE 2: SRE1 and SRE1 parallel to the center line.

7.1.2 AMHS and manufacturing equipment inline and adjacent to each other shall share the extension line of the equipment center line and the substrate center line (on the AMHS), i.e., share the virtual center line (see Figure 7). The load angle of the substrate to the equipment shall be defined in accordance with 7.1.1.1 and 7.1.1.2 (see Figure 5 and 6).

NOTE 3: Loader/unloader — as shown by Figure 7 (See SEMI D43)

8 Related Documents

8.1 SEMI Standards

SEMI D32 — Specification for Improved Information Management for Glass FPD Substrates through Orientation Corner Unification

SEMI D43 — Test Method for Mechanical Vibration in AMHS for FPD Manufacturing