

SEMI 3D3-0613 (Reapproved 1218) GUIDE FOR MULTIWAFAER TRANSPORT AND STORAGE CONTAINERS FOR 300 mm, THIN SILICON WAFERS ON TAPE FRAMES

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1 Purpose

1.1 This Guide is intended to address the needs for choosing a method for shipping thin wafers on tape frames in such a way that they arrive undamaged at their final destination. It describes various methods of shipping thin wafers on tape frames.

1.2 Shipping thin wafers without damage requires the use of appropriate transport and storage containers because of several interacting factors, the most important of which are listed here.

1.2.1 Although the thicknesses of standard wafers have increased with increasing diameter due to increased fragility with dimension, process flows for three-dimensional stacked ICs (3DS-ICs) reverse that trend, using thinned, and hence much more fragile, wafers to allow for shorter through-wafer interconnects and lower total volume of the stack.

1.2.2 Stacking processes, especially for heterogeneous integration, will necessitate the use of wafers from multiple sources, which means that the wafers must be shipped from location to location.

1.2.3 A package dropped from a height of approximately 1 m will experience an impact on the order of 100 g. Such an event is easily capable of breaking a wafer that is not properly protected.

2 Scope

2.1 This Guide provides the user with information about containers needed to ship thin wafers that are mounted on dicing tape to tape frames conforming to either SEMI G74 or SEMI G87.

2.2 This Guide covers the shipping of 300 mm nominally diameter silicon wafers. The actual diameter of a 300 mm (nominal) silicon wafer may be less than 300 mm due to material removal via edge trim; the diameter of 300 mm silicon wafers fabricated specifically for use as carrier wafers may be greater than 300 mm.

2.2.1 The maximum diameter of a nominal 300 mm wafer is 301 mm.

2.2.2 There is not a fixed minimum diameter for nominal 300 mm wafers; edge trim and other processes are not yet standardized; thus, the actual diameter of nominal 300 mm wafers may millimeters smaller.

2.3 This Guide may be useful for materials other than silicon, but that is beyond the scope of this Document.

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 Limitations

3.1 This Guide does not purport to describe methods for shipping thinned wafers that are mounted or held in any manner other than on dicing tape, on tape frames.

3.2 This Guide does not purport to describe methods for shipping wafers of diameter other than 300 mm (nominal), for example 200 mm or 450 mm.

3.3 The laboratory experimental results described in this Document (refer to Appendix 1) were performed on wafers 50 μ m and 100 μ m thick. The methodology can be applied to other thicknesses, but use of these shipping methods on wafers with other thicknesses is outside to scope of this Guide and at the discretion of the user.

3.4 The laboratory experimental results described in this Document (see Appendix 1) were obtained on unpatterned wafers without bumps. The presence of patterns or bumps may induce stresses that will lead to failure at lower force levels than observed in this experiment.

4 Referenced Standards or Documents

4.1 SEMI Standards and Safety Guidelines

SEMI G74 — Specification for Tape Frame for 300 mm Wafers

SEMI G87 — Specification for Plastic Tape Frame for 300 mm Wafer

SEMI G94 — Specification for Coin-Stack Type Tape Frame Shipping Container for 300 mm Wafer

SEMI M31 — Specification for Mechanical Features for Front-Opening Shipping Box Used to Transport and Ship 300 mm Wafers

4.2 ISO Standards¹

ISO 2248 — Packaging – Complete, Filled Transport Packages – Vertical Impact Test by Dropping

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *3DS-IC* — three-dimensional stacked integrated circuit

5.1.2 *TSV* — through silicon via

5.2 Definitions

5.2.1 *base, of a wafer shipping box* — the open-top container into which dicing frames carrying wafers are placed, either in cassettes or into integrally molded pockets.

5.2.2 *clamshell wafer shipping container* — a type of stackable wafer shipping container that consists of a base and connected lid that holds a single wafer on a dicing frame.

5.2.3 *coin-stack type shipping container* — a container in which dicing frames carrying wafers are placed horizontally.

5.2.4 *cover, of a wafer shipping box* — the portion of the box which closes at the top of the base.

5.2.5 *cushions* — materials placed between the wafer shipping box and secondary container in order to absorb shock during shipping and to stabilize the wafer shipping box within the secondary container.

5.2.6 *horizontal wafer shipping box* — a wafer shipping box that, when placed upright on its base, holds the wafers such that the front and back surfaces are oriented parallel to the base.

5.2.7 *outer box* — a container part of a shipping box, surrounding the whole objects so as to protect a shipping cassette, except gasket and clamps.

5.2.8 *plastic tape frame* — as described by SEMI G87, a ring-shaped plastic frame to fix a wafer to itself using wafer tape. It is used between the dicing process and the die bonding process, and for the handling and shipping of wafers.

5.2.9 *shipping box* — a protective portable container for a carrier and/or wafer(s) that is used to ship wafers from the wafer suppliers to their customers.

5.2.10 *shipping container* — a carton used to transport wafer boxes; it is typically constructed of corrugated cardboard.

5.2.11 *shipping pack* — a package or shipping container/final container that is of sufficient strength to be used in commerce for packing, storing, and transporting products.

¹ International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, <http://www.iso.org>

5.2.12 *stackable wafer shipping container* — a wafer shipping box or tray that holds a single wafer on a dicing frame and is designed such that multiple shipping containers may be stacked in small volume.

5.2.13 *tape frame* — the frame that the wafer tape is attached to, as described in SEMI G74 and SEMI G87. The frame supports the tape, which retains the wafer. It is used between the dicing process and the die-bonding process and also used for shipping, handling, and storage of wafers.

5.2.14 *thin silicon wafer* — any silicon wafer which has been fabricated, or mechanically and/or chemically processed, such that its thickness is less than the minimum thickness allowed in a wafer material standard.

5.2.15 *vertical wafer shipping box* — a wafer shipping box that, when stood on its base, holds the wafers such that the front and back surfaces are oriented perpendicular to the base.

5.2.16 *wafer shipping box* — a box that directly holds the wafers. In SEMI M45, this box is specified by SEMI M31.

5.2.17 *wafer shipping tray* — an open-top stackable wafer shipping container where the base of one tray holding a wafer serves as the cover for the next wafer. The cover to the top tray occupied by a wafer is an additional tray which is not holding a wafer.

5.2.18 *wafer tape* — adhesive plastic tape to hold the wafer or cut die.

6 Methods for Shipping Thin Wafers on Dicing Frames

6.1 A number of options are available for shipping thin wafers mounted on dicing tape (Figure 1). These methods are generally based on commercially available methods for shipping full thickness wafers mounted on dicing tape. In the list below the terms ‘horizontal’ and ‘vertical’ refer to the way wafers are oriented in the wafer shipping box when the wafer shipping box is placed in the feet down position. In each case, access to the wafer(s) is from the top of the wafer shipping box.

6.1.1 *Horizontal Multiwafer Shipping Box (see Figure 2)* — A box into which multiple tape frames are stacked. Each tape frame contains exactly one wafer which is attached to the frame using dicing tape. The wafers are prevented from contacting one another using spacers and cushioning material. An example of a horizontal multiwafer shipping box is the SEMI G94, Specification for Coin-Stack Type Tape Frame Shipping Container for 300 mm Wafer.

6.1.2 *Horizontal, Stackable, Single-Wafer Clamshell (see Figure 3)* — A horizontal shipping box with integrated cover tray which holds exactly one wafer mounted on a tape frame using dicing tape. From below, the clamshell contacts the tape directly below the wafer as well the tape directly below tape frame; from above the clamshell contacts the upper surface of the tape frame. Thus, the clamshell holds the tape frame firmly in place during shipment and constrains the wafer from moving relative to the tray without directly contacting the exposed surface of the wafer. Clamshell wafer shipping boxes are typically designed to be stacked during shipment with minimum wasted space.

6.1.3 *Horizontal, Stackable, Single-Wafer Tray (see Figure 4)* — A tray which holds exactly one wafer mounted on a tape frame using dicing tape. The wafer is held firmly against the bottom of the tray with the tape in tension. Any number of these trays may be stacked with the bottom of the upper tray held at a distance above the wafer. From below, the tray contacts the tape directly below the wafer as well the tape directly below the tape frame; the upper tray contacts only the top surface of the tape frame. This combination holds the tape frame firmly in place during shipment and constrains the wafer from moving relative to the tray without directly contacting the exposed surface of the wafer. The top tray is covered with an additional tray that does not hold a wafer and therefore serves as a cover, thus requiring $n + 1$ trays to ship n wafers.

6.1.4 *Vertical Multiwafer Shipping Box (see Figure 5)* — A box into which multiple standard tape frames are loaded into guides formed in the shipping box. Each tape frame contains exactly one wafer which is attached to the frame using dicing tape. The guides mechanically prevent the wafers from contact. The mechanical guides may be fabricated in such a way as to hold frames of a specific thickness. Shipping boxes compliant with standard frames are:

6.1.4.1 *Vertical Multiwafer Shipping Box for SEMI G74 Compliant Metal Frame* — Thickness of the guides are set to securely hold tape frames of thickness 1.2 mm to 1.5 mm.

6.1.4.2 *Vertical Multiwafer Shipping Box for SEMI G87 Compliant Plastic Frame* — Thickness of the guides are set to securely hold tape frames of thickness 2.5 mm.

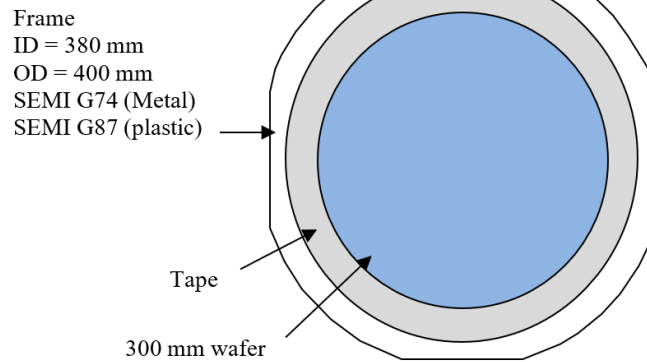


Figure 1
Tape Frame with Attached 300 mm Wafer

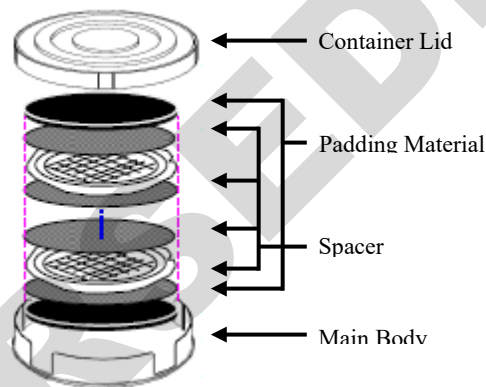


Figure 2
Horizontal Shipping Container (Multiwafer)

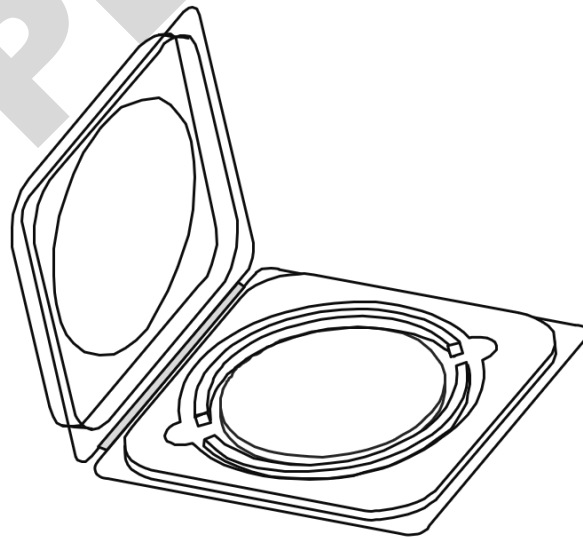


Figure 3
Horizontal Single Wafer Clamshell Container