

Wafer Products Handling and Operating Manual

This manual describes notes on using Epson Wafer products. It is the responsibility of the customer to optimize the process and the mounting parameters to obtain the optimum results.

The content of this document is subject to change without notice.

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Notice using this document:

This document is not intended to define “specifications” or “recommendations” but to introduce something to note while using the product.

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1. Outline of Wafer and Bare Die Products

Wafer products and Bare Die products are shipped as wafers or diced (singulated) dies according to the customer's request in order to realize the mounting on the substrate in the bare die stated by the customer.

Wafer products are subjected to the process from our wafer production process's probe inspection process (electrical characteristics test) and are shipped to customers in wafer state (after back grinding or no back grinding).

Bare die products which shipped in die state are subjected to back grinding, dicing, placing in the tray and visual inspection.

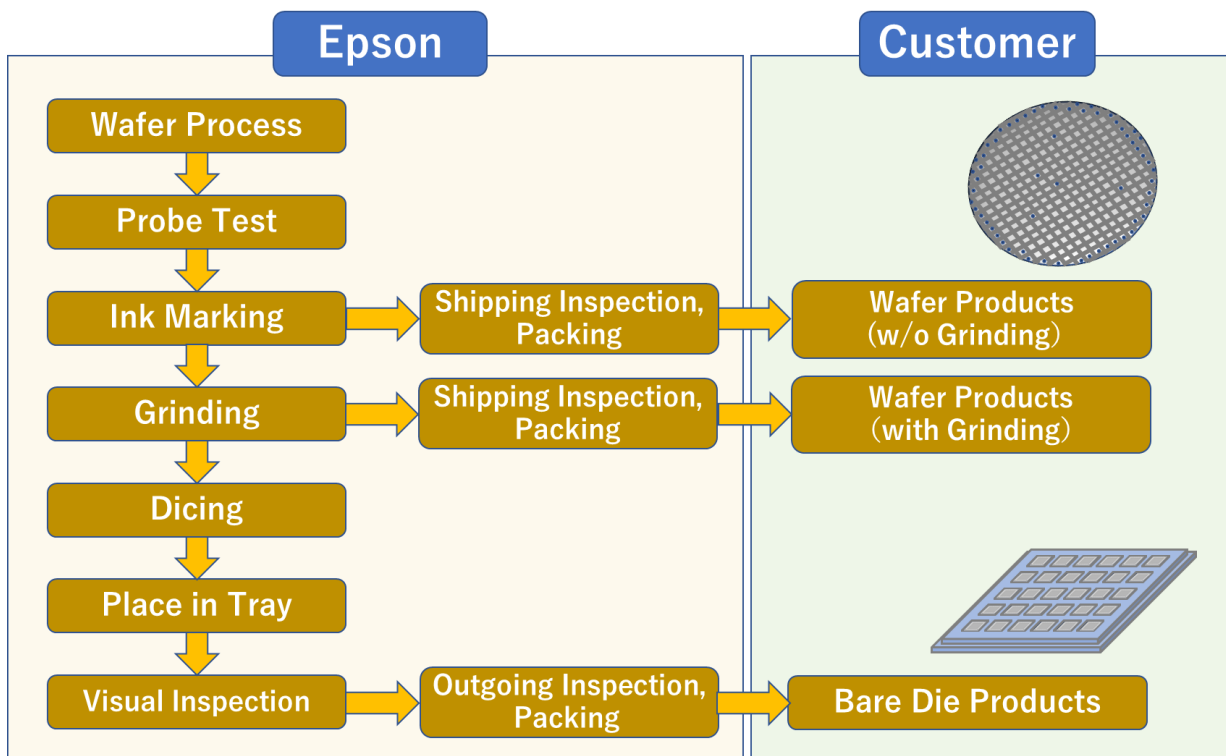


Fig. 1.1 Sample Flow: Wafer/Bare Die Products.

Wafer products and bare die products are stored and shipped in shipping containers as shown.



Fig. 1.2
Wafer Shipping Box
(Wafer Vertical Type)



Fig. 1.3
Wafer Canister
(Wafer Horizontal Type)



Fig. 1.4
Die Tray

1.1 Wafer Products Structure

The specification of the wafer product's dimension is shown as follows. The wafer thickness specification is for no back grinded wafer.

1.1.1 The Specifications of 6-Inch Wafer Products Dimension

Table 1.1 Dimension of 6-Inch Wafer

Item	Specification
Wafer Diameter (a)	150±0.3mm
Thickness (b) (w/o Grinding)	625±25um
Orientation Flat Length (C)	47.5±2.5mm
Edge Shape	Round Edge

Table 1.2 Wafer ID of 6-Inch Wafer

Wafer ID XXXXX-YYYY-ZZ##		
X	5-digit	Products Identification Code
Y	4-digit	Lot Numbers
Z	2-digit	Wafer Numbers
#	2-digit	Checksum
Location	Opposite Side of Orientation Flat	

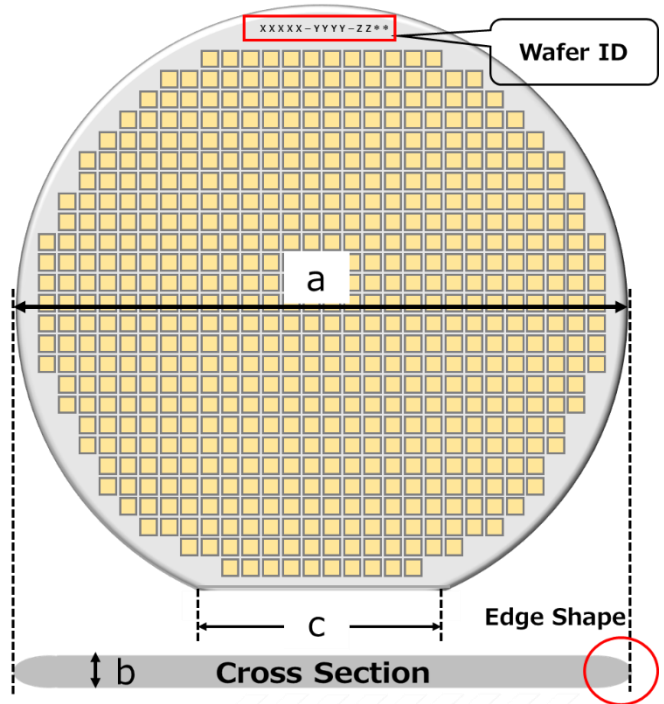


Fig. 1.5 Outline of the 6-Inch Wafer Product

1.1.2 The specifications of 8-Inch Wafer Products Dimension

Table 1.3 Dimension of 8-Inch Wafer

Item	Specification
Wafer Diameter (a)	200±0.3mm
Thickness (b) (w/o Grinded)	725±25um
Notch Size (d)	1.00 ^{+0.25} _{-0.00} mm
Edge Shape	Round Edge

Table 1.4 Wafer ID of 8-Inch Wafer

Wafer I D XXXX-YYYYZZ##		
X	4-digit	Products Identification Code
Y	4-digit	Lot Numbers
Z	2-digit	Wafer Numbers
#	2-digit	Checksum
Location	Notch Side or Opposite Side	

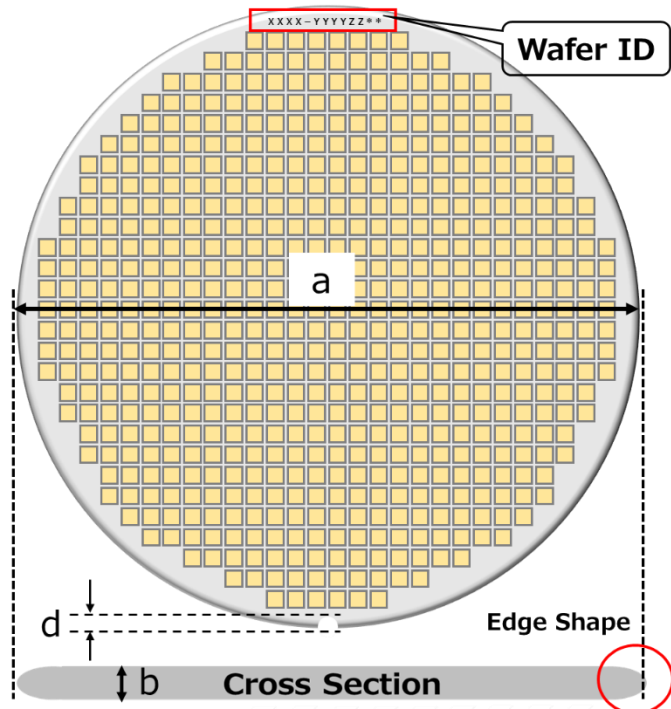


Fig. 1.6 Outline of the 8-Inch Wafer Product

1.2 Identifications of the Defective Dies in the Wafer Products

The defective dies in the wafer products are identified by ink-marking on the die in the Probe Test Process (Electrical Characteristics Test).

Ink-marks are marked with black color ink. The specifications of the Ink-mark size is shown in Table 1.5.

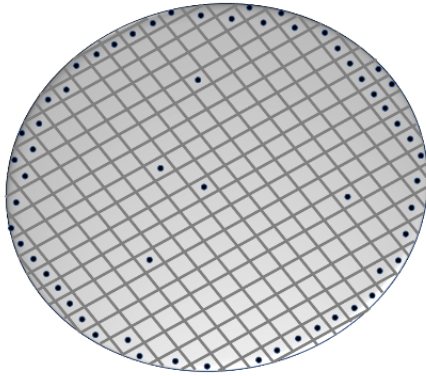


Table 1.5 Ink-Mark Specifications

Short Side Size of Die	Ink-Mark Diameter
1.0mm less	200um or more
From 1.0mm to 3.0mm less	350um or more
3.0mm or more	400um or more

Fig. 1.7 Example: Ink-marks on Wafer products

Epson will provide wafer map information using electronic data (SEMI standard: xml format) depending on customer requests. We need to define the specification (e.g. data format, data transfer methods, etc.) before applying the electronic data, so please contact our sales representative.

1.3 Color Unevenness on Wafer Products Back Side

In the wafer manufacturing process, an uneven film is formed on the back of the wafer. The color unevenness may differ from wafer to wafer or within each wafer due to variations of film thickness, and this does not affect the product functionality and quality.



Fig. 1.8 Color Unevenness on Wafer Back Side (Macro Visual)



Fig. 1.9 Color Unevenness on Wafer Back Side (Micro Visual)

1.4 Bare Die Structure

An example of a general structure of our bare die is shown as follows.

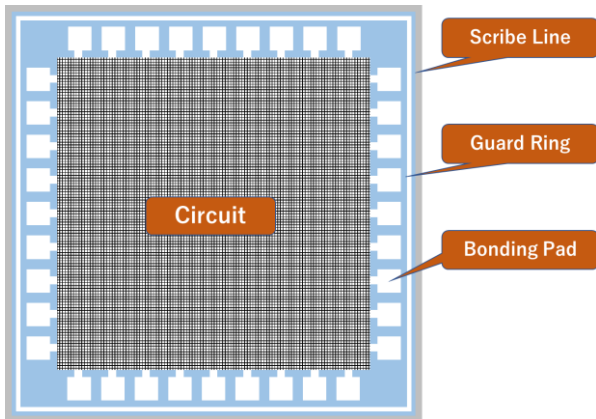


Fig. 1.10 Example Bare Die Structure

Table 1.6 Die Structure and Feature

Each Parts Name	Function Description
Scribe Line	Cutting area for dicing from the wafer.
Guard Ring	Arranged for the improving the moisture resistance from the bare die cross section direction (each interlayer). (Depends on the device. Prepare as needed.)
Bonding Pad	Terminals to connect to external circuit.
Circuit	Electrical circuit area.
Passivation	Passivation applied on wafer and bare die products surface are not design to protect the die from external impact.

1.5 Examples of Structure by Pad Type

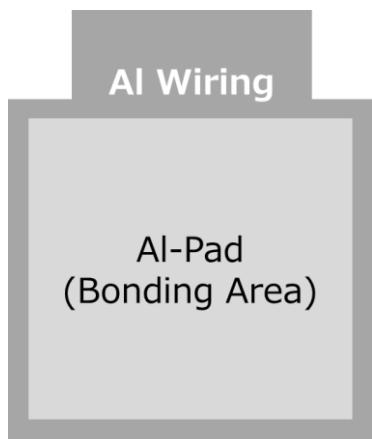


Fig. 1.11 Al-Pad (Top View)

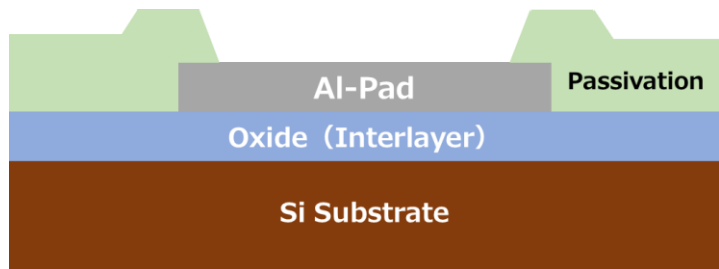


Fig 1.12 Al-Pad (Section View)

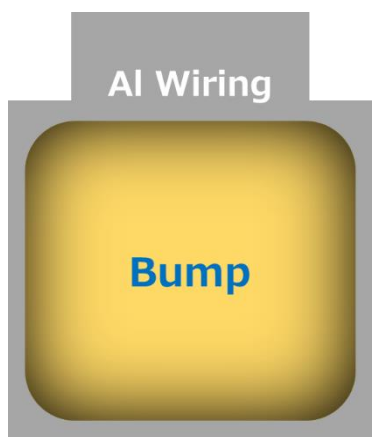


Fig. 1.13 Au-Bump (Top View)

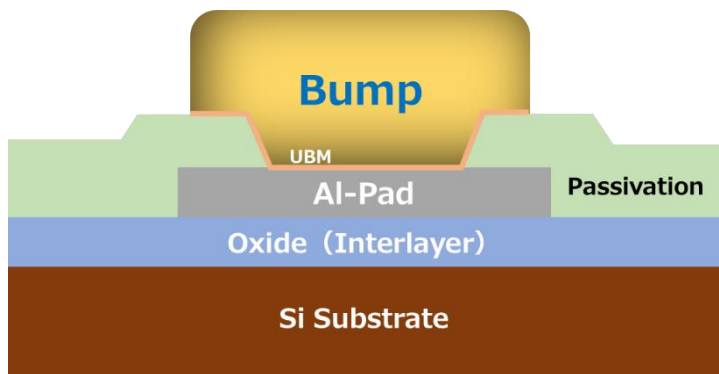


Fig. 1.14 Au-Bump (Section View)

2. Handling Precaution for Wafer and Bare Die Products

2.1 Introduction

Our semiconductor products are designed and manufactured to assure problem-free operation when used under normal operating conditions. All products are subject to stringent electrical and mechanical testing to ensure reliability, but users are strongly recommended to observe the following precautions when designing systems, handling and storing products to minimize the chance of failure.

- Wafer and Bare Die products have a higher risk of quality and reliability degrading depending on the handling method than general products.
- The passivation film applied on wafer and bare die products surface are not design to protect the die from external impact.
- Moisture and dust in the air and careless handling during assembly can cause defective products, so please take care adequately.
- Please perform sufficient evaluations for quality and reliability by the customer: such as testing and screening to detect failures.

2.2 Storage

- Do not induce impact, vibration, or contact with water to prevent damages of bare die.
- Do not store or use the products under conditions where moisture condensation may be formed due to rapid changes in temperature. Also, do not put on load to the product during storage
- When storing, avoid dusty conditions or locations with corrosive gases.

2.2.1 Packing Type for Wafer Products

- Wafer products are shipped in Wafer Shipping Box or Wafer Case depending on wafer diameter and thickness.

Table 2.1 Packing type of wafer products

Packing Type by Wafer Products		
Wafer Size	Wafer Shipping Box (Wafer Vertical Installation)	Wafer Canister (Wafer Horizontal Installation)
6 inch	Wafer Thickness \geq 300um	Wafer Thickness < 300um
8 inch	Wafer Thickness > 300um	Wafer Thickness \leq 300um

- When wafer products are shipped, they are stored in wafer shipping box or wafer canister to prevent damage during transportation. Then the boxes or canisters are packed in antistatic bags. Do not open the bags more frequent than necessary to prevent foreign material. And do not leave trays open for prolonged time.

2.2.2 Storage Periods of Wafer Products

Table 2.2 Storage Periods of Wafer Products

Status	Storage Periods	Storage Conditions
Before Opening	6 months	$T_a \leq 35^\circ\text{C}$, $RH \leq 80\%$
After Opening	30 days	$T_a \leq 30^\circ\text{C}$, $RH \leq 80\%$
	6 months	Dew Point -30°C or less in Dry N_2

(Maximum allowable storage periods, including before and after opening the packing, are twelve months under the conditions mentioned.)



Fig. 2.1 Example of Opening the Packing (Before and After Opening) of Wafer Products

- After the bags are opened, assemble the products immediately in order to prevent the bonding degradation caused by the quality change on the bonding pad surfaces.
- If products are to store for long period of time, sufficient mounting evaluations (e.g. bondability evaluation) by the customer is needed.

2.3 Precautions for Handling operations of Wafer Product

- Without back grinding, the cross section of the wafer edge is round shape. However, the cross section edge of the back grinded wafer is sharp like a knife tip. The edge of the wafers is extremely fragile. Take care when handling, storing in containers, and the transportation inside the machine.

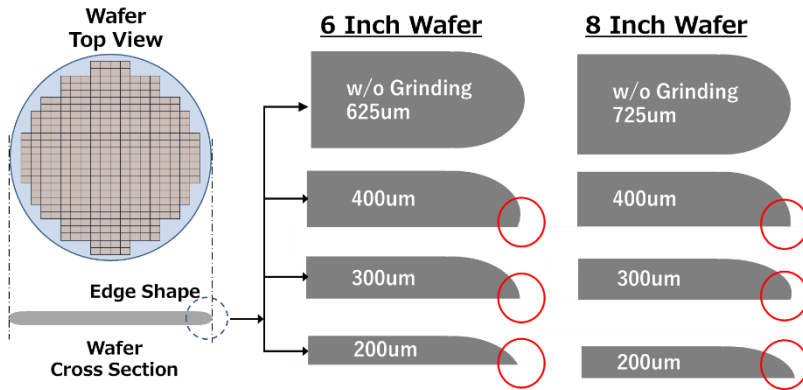


Fig. 2.2 Example: Wafer Edge Shape of Wafer Products

- Open, store, process, and mount bare wafer products in a clean environment where the wafer surface is not exposed to contaminated atmospheres or substances. Examples of recommended environment conditions are show as follows.

In case of storing after the opening packing ~ISO 6

In case of processing / mounting ~ISO 8

Table 2.3 ISO14644-1 Cleanroom Classifications

Fed.std.209E	Maximum Particles/ft ³					JIS B9920 ISO 14644-1
	0.1μm	0.2μm	0.3μm	0.5μm	5μm	
Class 1	35	7.5	3	1	-	ISO 3
Class 10	350	75	30	10	-	ISO 4
Class 100	3,500	750	300	100	-	ISO 5
Class 1,000	35,000	7,500	3,000	1,000	7	ISO 6
Class 10,000	-	-	-	10,000	70	ISO 7
Class 100,000	-	-	-	100,000	700	ISO 8

- When handling wafer products manually, do not touch the wafer surface to prevent contamination or scratches on the wafer surface. The following figures are the recommendation for handling.

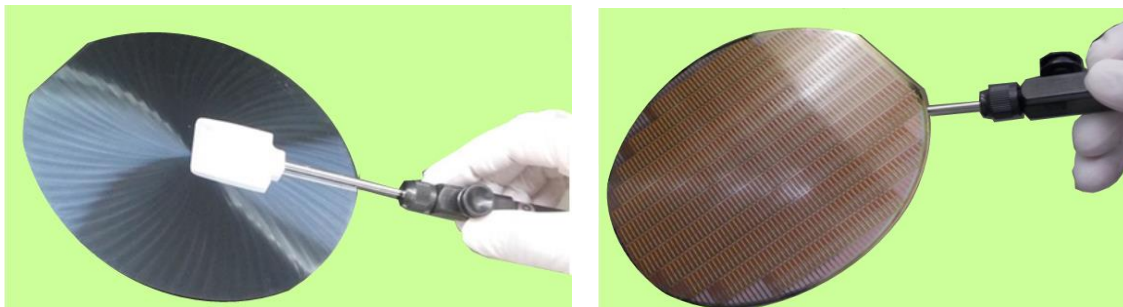


Fig. 2.3 Example of manually Handling of Wafer Products

2.4 Precautions for Processing and Mounting Wafer Product

- When processing and mounting wafer products, perform in a clean environment where it is not exposed to contaminated atmospheres or substances.
- When dicing a wafer, the wafer may be charged up during dicing. Take sufficient countermeasures against static electricity in the processing.

2.5 Precautions for Mounting Bare Die

- When mounting bare die, perform in a clean environment where it is not exposed to contaminated atmospheres or substances.
- Please use the bare die collet for pickup and die bonding. If foreign material adheres to the collet, process defects such as scratches on the bare die surface may occur. When using a collet with a surface that comes into contact with the bare die surface, periodic cleaning should be carried out.
- Do not clean bare dies. If bare dies have to be cleaned, extreme precaution must be carried out to ensure no residue remain on die surface.
- When mounting bare die, take sufficient countermeasure against static electricity.
- For mold resins, use "semiconductor grade" material. This is recommended to prevent corrosion in bonding pads due to moisture absorption, and reduce internal stress due to temperature changes. Similar precautions must be taken for other materials to be used.

2.6 Precautions Against the Light Irradiation

Exposing semiconductor products to the light may cause malfunction, as the light affects the device characteristics. To prevent products from malfunction, please take into account the following points regarding semiconductor mounted substrates and products.

- During product design and assembly, please consider the product structure so that the bare die is shielded from light in actual use.
- In the testing process, please provide the light-shielded environment for the bare die under test.
- Please consider shielding light from the surface, back, and sides of the bare die, as bare die should be shielded from light entirely.

3. Countermeasures Against Static Electricity in Handling Semiconductor Products

Although all terminals are equipped with an anti-electrostatic circuit, exceeding the electrostatic capacity may cause malfunction. So please take sufficient countermeasures when handling products.

This document introduces examples of basic countermeasures. Please refer to below guidelines.

3.1 Working Environment

- It is recommended that the working environment be maintained at a relative humidity of at least 45%. If the relative humidity is low, the charge diffusivity decreases, and it becomes easier to charge up.
- Lay a conductive layer (conductive mat / conductive sheet) on the floor and connect it with ground potential. Also, always keep the surface clean as contamination on the surface of the conductive layer will degrade its conductivity.
 - e.g. "Conductive floor surface resistance" to "between surface and Ground": $1\text{M}\Omega$ to $1000\text{M}\Omega$
- Ensure that the workbench has a conductive mat to remove static electricity and connect it with ground potential. Do not use a metal workbench because it can cause a rapid electrostatic discharge.
 - e.g. "Workbench conductive mat etc. surface resistance"
to "between surface and Ground": $1\text{M}\Omega$ to $1000\text{M}\Omega$
- Cover the work chair with a conductive cover and ground it to a conductive floor with a grounding chain.

3.2 Storage Environment

- Containers and bags used for transporting and storing semiconductor products should be made of materials that dissipate static electricity.
 - e.g. Surface resistance value of static dissipative material: $1 \times 10^5\Omega$ to $1 \times 10^{11}\Omega$
- Lay the storage shelf with a conductive mat on the surface and connect it with ground potential. Dust on the surface of the conductive mat etc. will reduce the conductivity, so always keep the surface clean.
 - e.g. "Worktable conductive mat etc.'s surface resistance"
to "resistance between surface and Ground": $1\text{M}\Omega$ to $1000\text{M}\Omega$
- Use a conductive mat on the cart carrier and ground it to the conductive floor using a grounding chain or conductive caster.

3.3 Handling

- Persons who handle the products should be connected to ground potential by a wrist strap, antistatic clothing, conductive shoes, etc.
 - Place a high resistance resistor (e.g., one meg ohm) in the wrist strap to prevent electric shock to human body.
 - e.g. Resistance of Antistatic clothing + conductive shoes: $1M\Omega$ to $100M\Omega$

3.4 Equipment and Jig

- In order to prevent accumulation and induction of static electricity, connect the manufacturing equipment, inspection and test equipment, conveyors and other transport mechanisms, and tools with ground potential.

Appendix- 1 Opening Procedure for Wafer Products (Wafer Shipping Box)

Packing style upon arrival

- Cut the tape on the top of the cardboard box and open it.



Cardboard box opening

- Remove top cushioning cardboards
- Remove buffer material for fixing wafer shipping box.



After removing the packing

- Take out the wafer shipping box.
Capacity (8 inches): Max 2 boxes
Capacity (6 inches): Max 6 boxes



Take out wafer shipping box

- Open antistatic bag and take out wafer shipping box.



Wafer shipping box opening

- Detach the snap-fit of the wafer shipping box lid and open.
The number of storing: Max 25

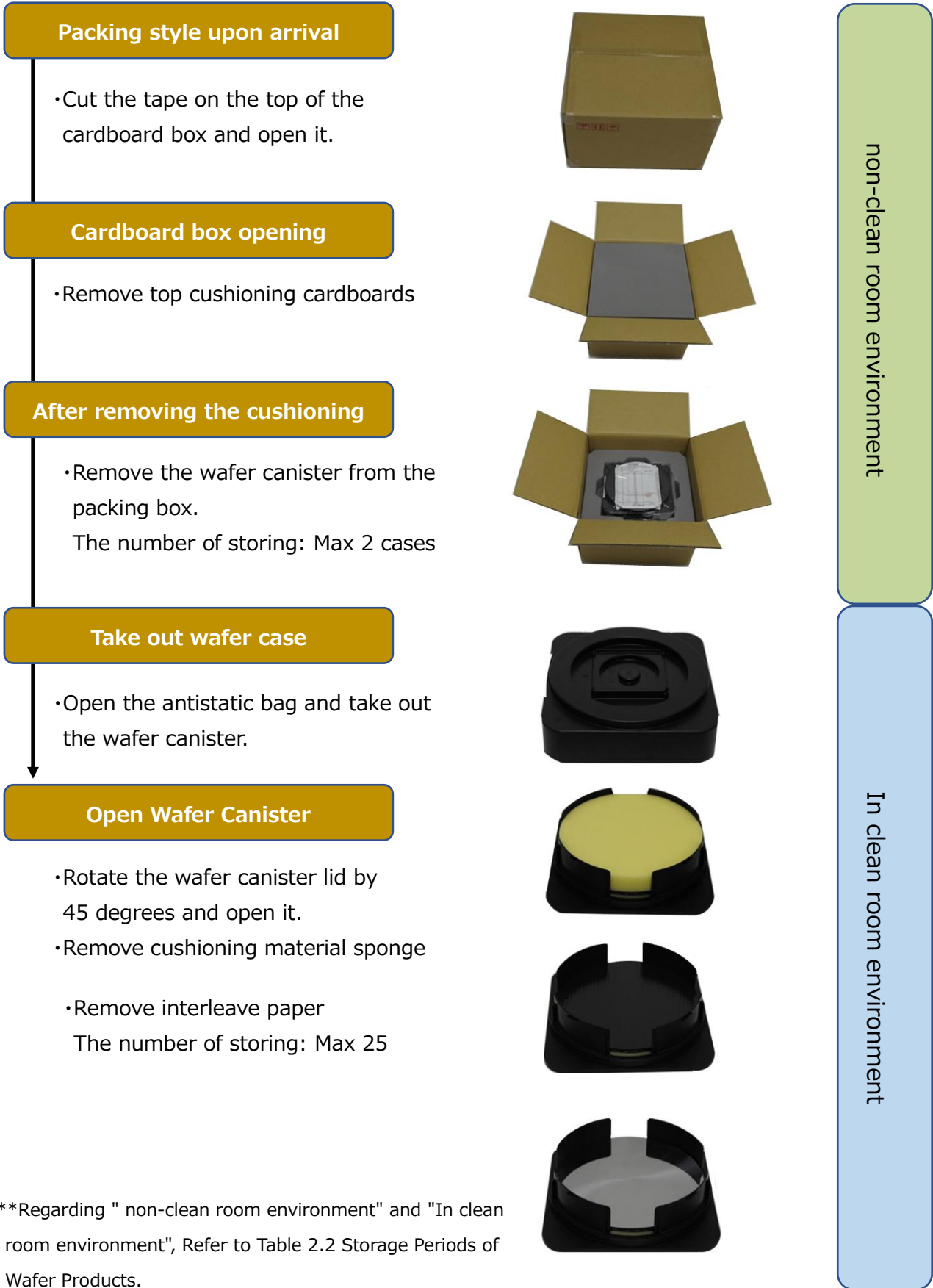


non-clean room environment

In clean room environment

**Regarding " non-clean room environment" and "In clean room environment", Refer to Table 2.2 Storage Periods of Wafer Products.

Appendix-2 Opening Procedure for Wafer Products (Wafer Canister)



**Regarding " non-clean room environment" and "In clean room environment", Refer to Table 2.2 Storage Periods of Wafer Products.

Revision history

Rev. No	Date	Page	Type	Revision contents (including old contents) And reason for revision
Rev.1.0	2020/01/16	All	New	New regulations