Known-Good-Die (KGD)
Wafer-Level Packaging (WLP)
Inspection Tutorial
Wafer inspection process starts with detecting defects and ends with making a decision on what to do with both the wafers as well as the inspection data.

Examples of inspection strategies and associated decision
- **Gate:**
  - Decision on Lot: Go / No Go.
  - Decision on Data: Inspection data passed down stream to aid pick and place equipment.
- **Process Excursion Monitor:**
  - Decision on Lot: Go / No Go / Re-work.
  - Decision on Data: Inspection data used to improve any one of the preceding process steps.

Understanding of the different process points for which inspection provides value.

Value-added of inspection is the information on the lot and the insight of improvements to the preceding process steps.
Typical Inspection points - Post-Passivation

Non-Bumped Die

- Incoming defect inspection
- (Outgoing Fab QC)
- Wafer Edge Inspection
- Wafer Back side Inspection
- Probe Mark Metrology
- Post-test Inspection
- Post-back-grind Inspection
- Post-saw Inspection

Note: Representative process steps. Actual process sequence may vary and may not include all of the above steps.
Typical Inspection points - Post-Passivation
WLP / Bumped Die

- Incoming defect inspection
- (Outgoing Fab QC)
- Wafer Edge Inspection
- Wafer Back side Inspection

- Metal metrology
- Thin film metrology
- 100% defect inspection

- Plating metrology inspection
- Post-Develop Inspection
- Resist/thin film Metrology
- Pre-reflow inspection
- (Possibility of Re-work)

- 100% defect inspection
- 100% bump metrology

- Post-back-grind Inspection
- Probe Mark Metrology
- Post-test Inspection

Note: Representative process steps. Actual process sequence may vary and may not include all of the above steps.
Defect examples include:

- Over/incomplete etch
- Mechanical damage
- Lifting metal
- Bond pad
- Mask/Photoresist defects
- Residue
- Ink splatter
- Scratches
- Passivation holes
- Probe defects
- Bridged and missing metal
- Particle contamination
- And more…

Typical 2D Inspection criteria
Non-Bumped Die
Typical Bumped Die Inspection criteria (Includes 2d Inspection criteria for non-bumped die)

Bump Inspection & Metrology

- Bridged Bumps
- Bump Height
- Missing Bumps
- Bump Size
- Bump Location
- Satellite Bumps

Advanced Packaging Inspection & Metrology

- Metrology
- Intermediate Interconnect
- Film/Layer
- Thickness
- VIA and Redistribution
Wafer inspection process starts with detecting defects and ends with making a decision on what to do with both the wafers as well as the inspection data.
Defect Detection Tool Requirements

Throughput
- High-speed, production volume, Low Cost of Ownership

Accuracy
- Highly repeatable. High actual defect capture rate, High false defect filtering.

Flexibility
- Wide variety of applications & variations
  - Solder, gold, copper, micro springs, others
  - Nodules, surface reflectivity, pitch & height
  - Varying chemistries, polymers & other thick films
- All surface – wafer front-side, back-side and wafer edge

Modularity
- Available as stand-alone inspection, integrated to process tools or embedded within process tools.

Scalability
- To meet the future requirements of evolving technologies
Defect Analysis Requirements
Defect classification

Throughput
- As fast as Defect Detection, faster than manual classification. If classified manually, ergonomics allows speedy review.

Accuracy
- Meaningful defect clustering and false defect filtering.
- Highly repeatable, as good as manual inspection, minimize mis-classification.

Flexibility
- Wide variety of process applications & variations

Accessibility
- Allows on-tool and off-line analysis
- Allows remote access (from office desk)

Maintainable
- Preferred that classification is a by-product of inspection. Example: Bump too tall is a direct result of 3d bump metrology.
- Does not require re-teach of classification database for minor process variation

Data Capture
- Capture Images into Defect Management Systems for defect sourcing
Decision-support Data Requirements

- **Accuracy**
  - User-programmable tolerance criteria allows go/no go decision.
  - User-selectable algorithms – Ex: least square fit, 3 point plane for coplanarity.
  - Die count, defect count tallies accurately.

- **Flexibility**
  - Wide variety of file formats for different customers.
  - Updating of wafer maps.
  - Output data for down-stream process tools.
  - Compatible with Yield Enhancement / Defect Management systems.
  - Wide variety of analysis, by wafer, by lot, by trends.

- **Through Statistics Package**
  - Allow analysis of data statistically.
  - Provide Statistic Process Control or data format for other SPC packages.
Inspection & Metrology Tools

Automating Inspection

NSX Series

2D & 3D bump inspection & metrology

Automated wafer, die & bump defect inspection

3Di Series

- High-speed & accurate 3D metrology & defect inspection
- 2D vision
  - High-speed & accurate 2D metrology & defect inspection
  - All surface inspection – Wafer front, edge and back-side
- YieldPilot for Data Analysis
- Versascope for manual inspection and review

E20, B20