One Touch 300 mm wafer probing

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Synopsis

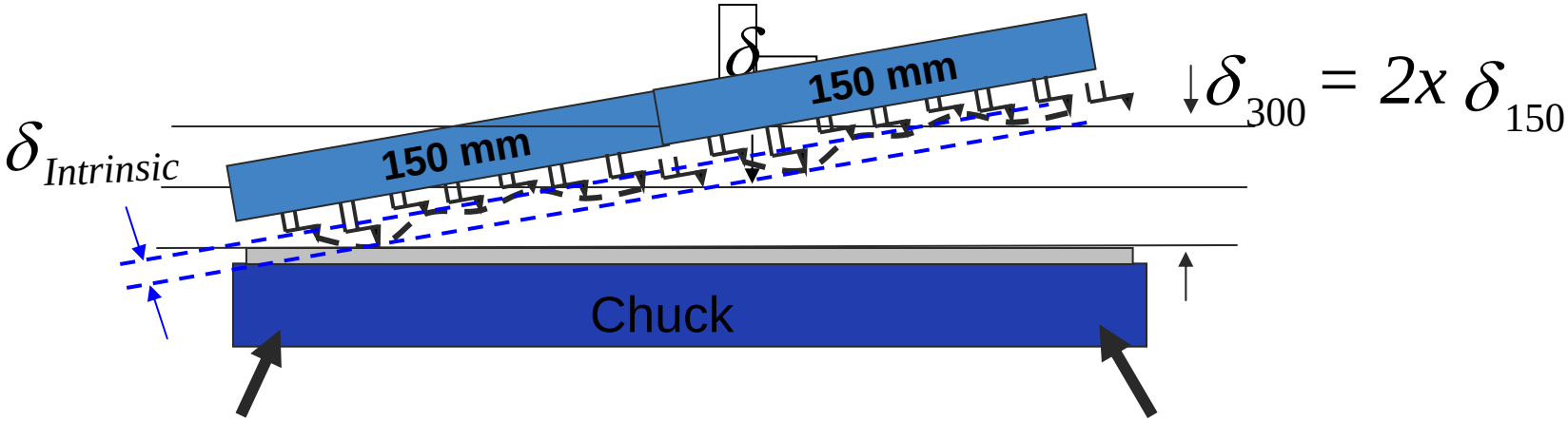
The problems encountered with 1 TD 300 mm wafer probing are unique enough that an approach that simply scales up traditional probe card architecture and industry practice is not sufficient.

To resolve the specific setup and throughput issues associated with 1 TD requires a systems level approach where probe card, prober and tester vendors work collaboratively to solve customer problems.

1TD Probing Process Challenges

1TD Challenges	Impact on Probing
Co-Planarity across wide area	More Adjustments or Yield Loss Setup issues (x/y alignment) More maintenance (cleaning change out) More planarity adjusts risk opens/ Cres
High probing forces	
Testcell Productivity and Xput Setup times, thermal behavior Maintenance, debug and repair	Back-up testers and probecards

300mm 1TD challenges – Planarity & Tilt



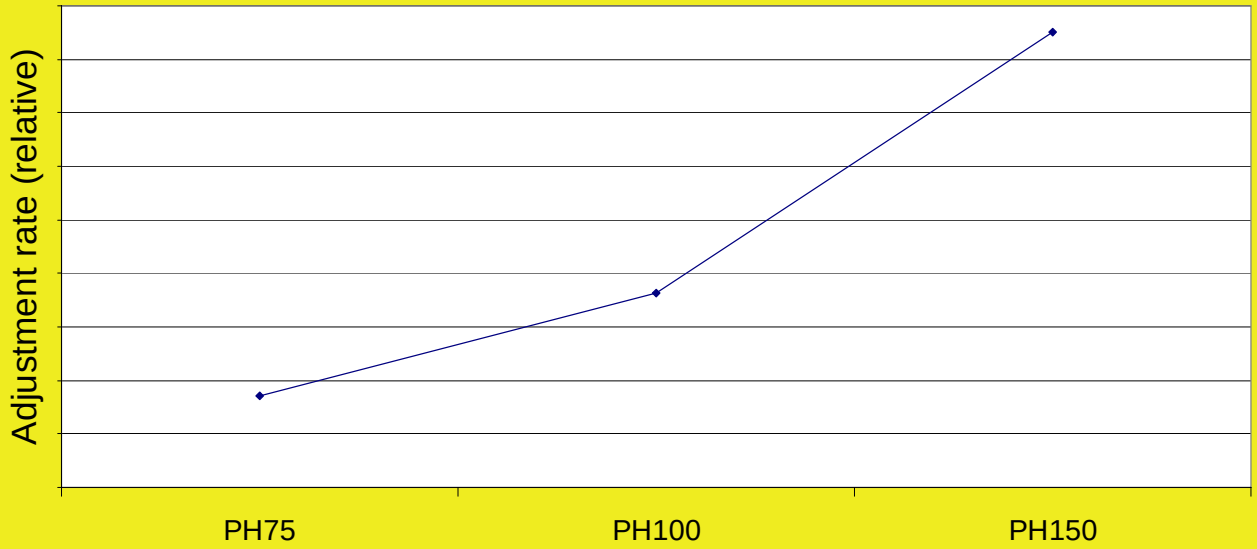
Long Scrubs (more damage)
Low Cres, Higher Probing Force

Short Scrubs (less damage)
High Cres, Lower Probing Force

To maintain spec, we have to be 2 x better than we have been before

Problems impacted by planarity and tilt

Planarity correlation between customer and supplier.
Test floor to test floor correlation – cards are shipped between sites.
Test system to test system correlation – on a single test floor



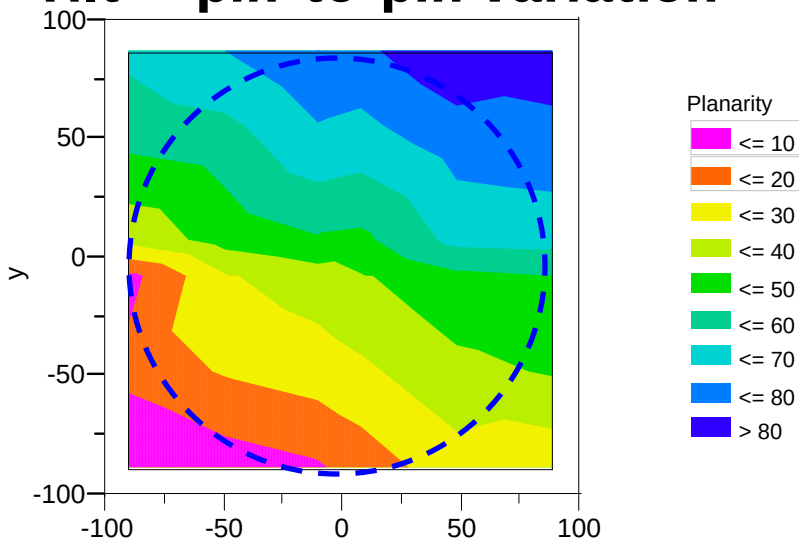
300 mm 1 TD predicted to be at least 2 x adjustment rate of PH150

How to address planarity and tilt

- **System to system correlation**
  - Usually carried out using a “standard” that is measured across the floor.
    - Glass mask
    - Golden probe card.
    - Ceramic probe card.
  - Issues with correlation
    - Extensive Time and work required.
    - System downtime.
    - Repeatability and accuracy.
- **In-situ tilt control**
  - Issues with this method
    - Automation has not traditionally been available
    - Card often has to be pulled out of the prober to adjust, while measurement is done inside the prober.

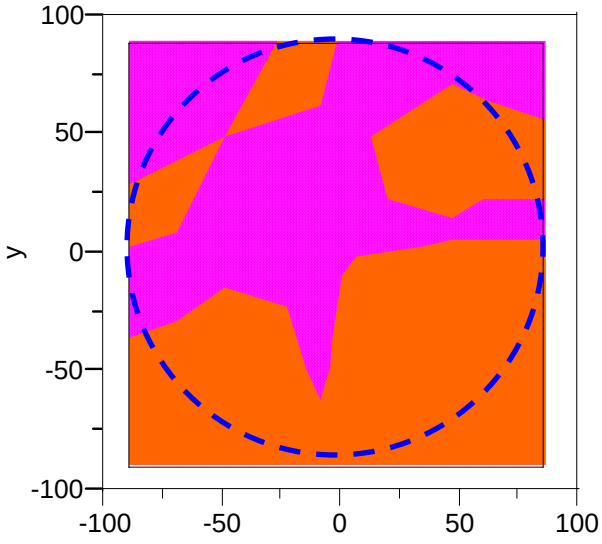
Results of System Level tilt control on a 1 TD card

Tilt + pin-to-pin variation



First to last = 90 um at user

Pin-to-pin variation



First to last = 18 um

Card left factory with 20 um planarity

Adjusted at customer using one leveling point

Will be automated in the future

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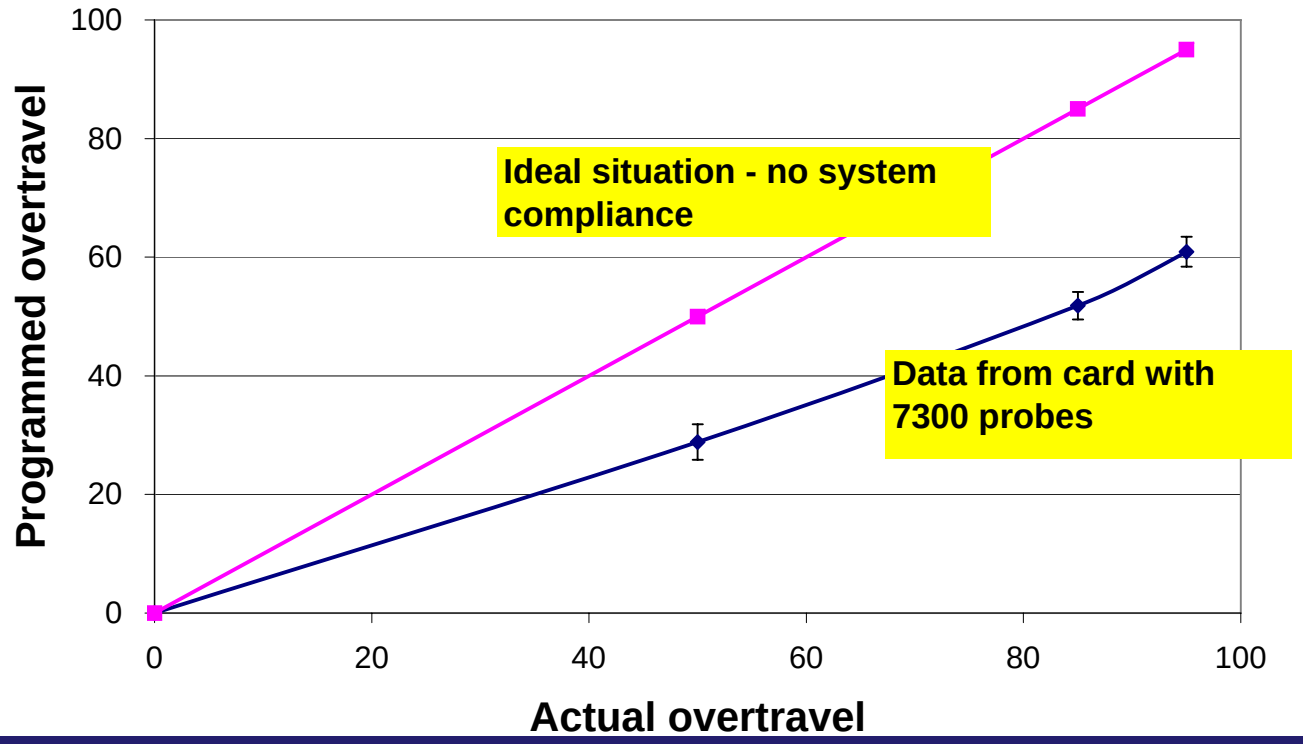
300mm 1TD challenges – High Probe Force

This is a big jump in force over current products

Product Type	Springs /DUT	# of DUTs	Springs	Low Force Spring Kg	High Force Spring Kg
Nand Flash	25	500	12,500	63	125
NOR Flash	40	800	32,000	160	320
DRAM #1	75	500	37,500	188	375
DRAM #2	75	1000	75,000	375	750

* Low spring force is 5 grams per contact

300mm 1TD challenges – High Probe Force

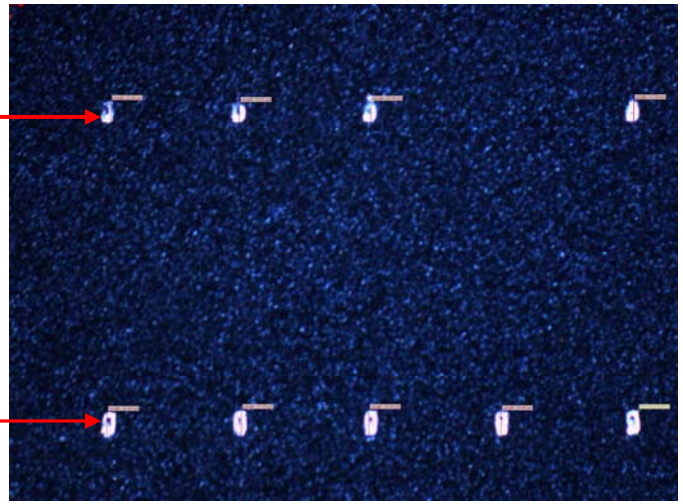


System deflection results in 35 % loss of effective spring compression

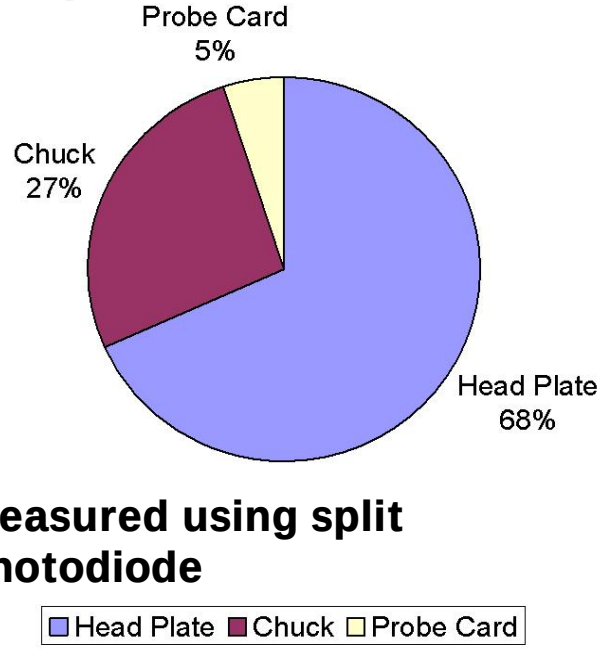
300mm 1TD challenges – High Probe Force

Short scrub

Long scrub



Compliance Contributions



Measured using split photodiode

Unbalanced loading leads to horizontal system compliance

Methods for adjusting for system z compliance

Engineering studies on cards with different probe counts

- **Platform dependent**
- **Issues with resolution, accuracy**

Add stiffeners to the probe cards

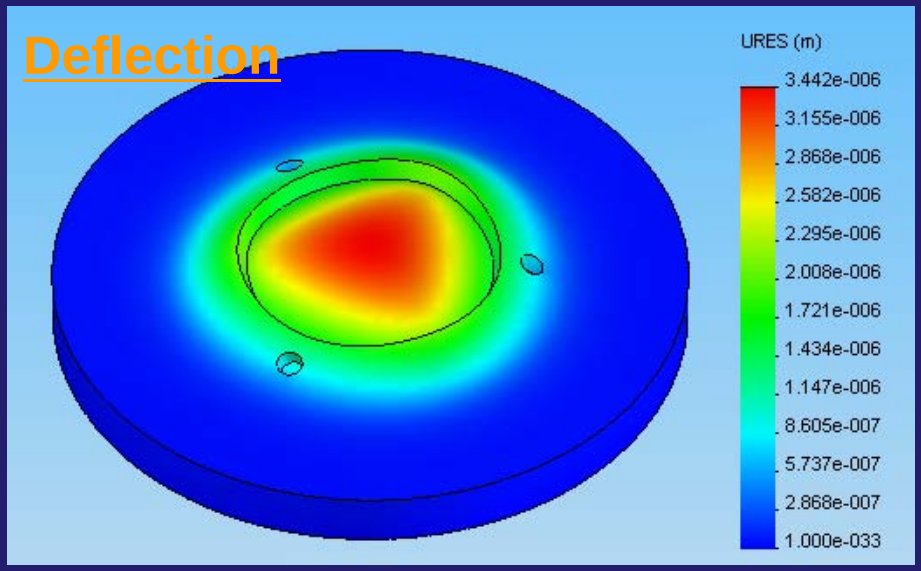
- Adds mass (approaching ergonomic limits)
- The high CTE of the stiffener can cause thermal bending.
- Adds thermal mass, which increases setup times.
- May not fit in space allocated for probe card.
- Adds cost

The most effective approach is to look at the structural rigidity of the system

Results of minimizing system compliance

Rigid element attached to tester motherboard

Force = 200 kgms



Max Deflection = 3.4 um

Vertical Z Deflection

No Tilt

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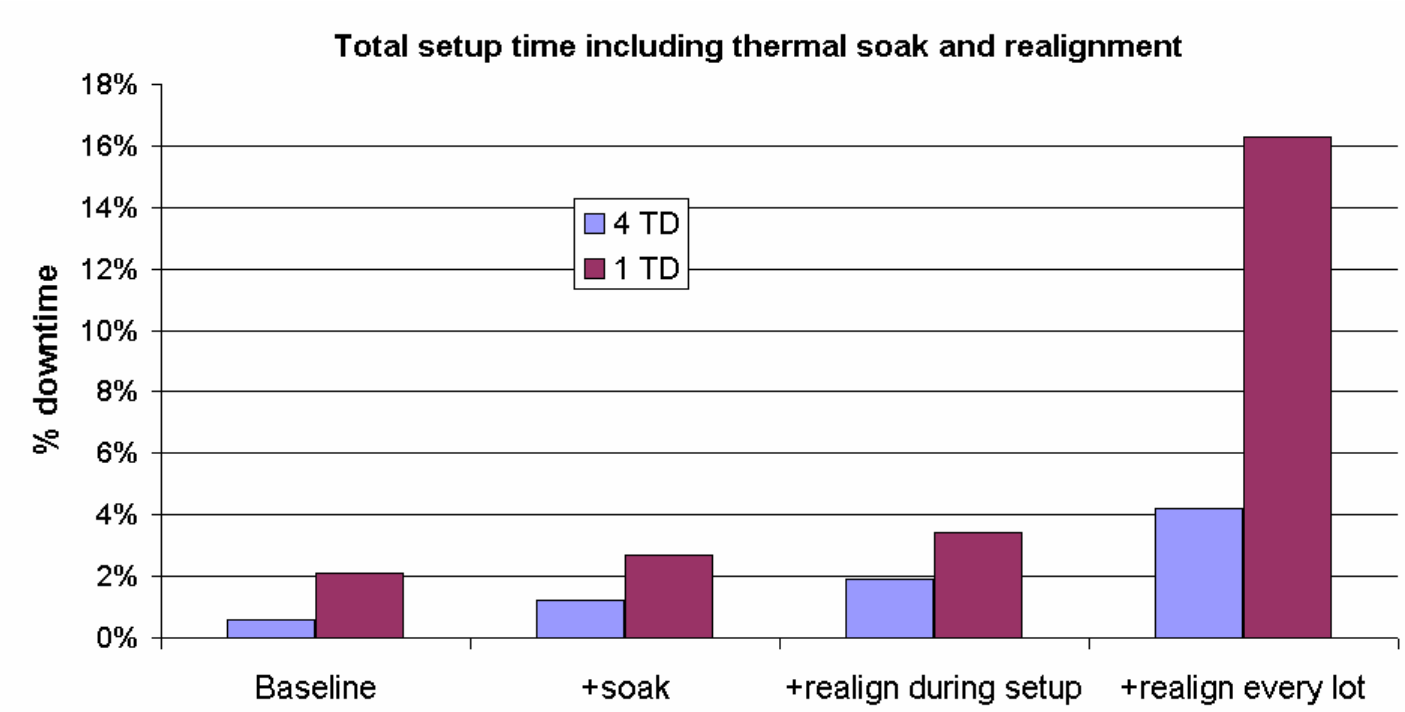
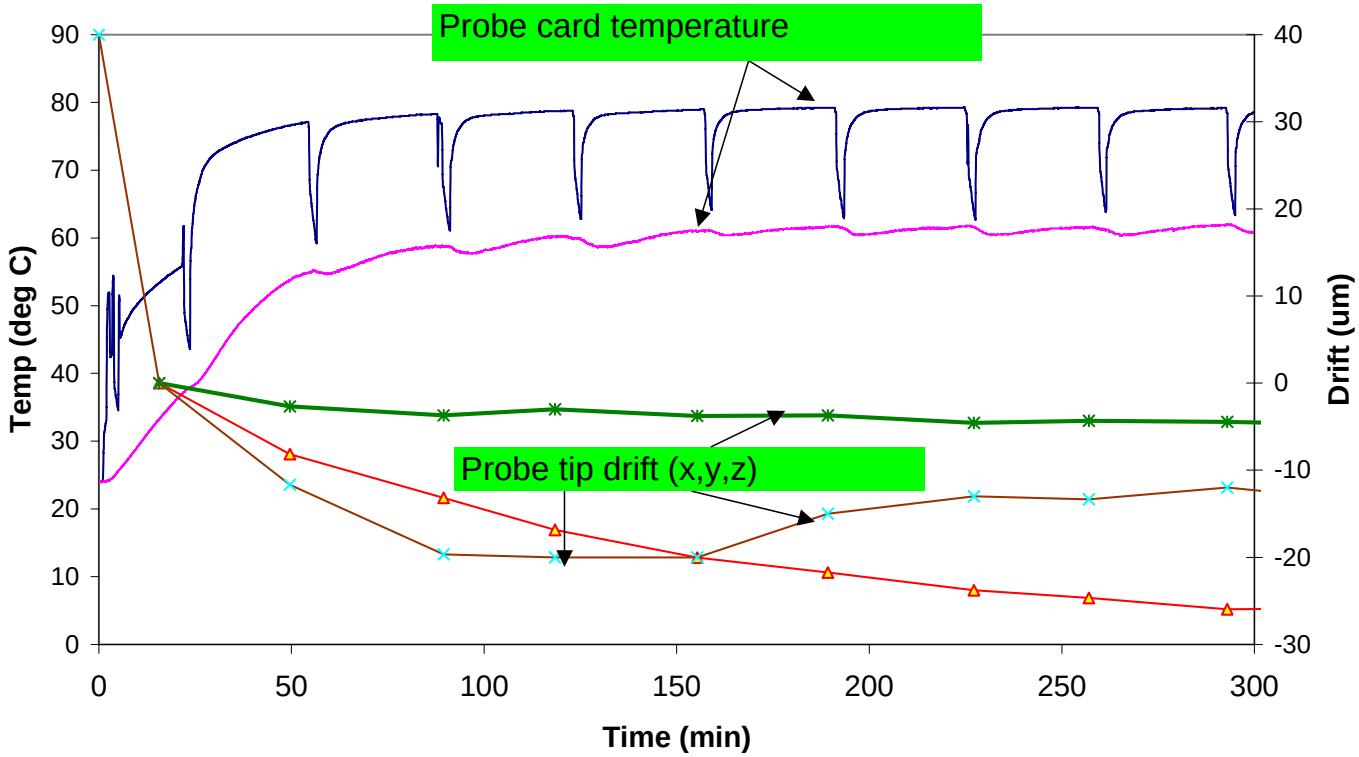
300mm 1TD challenges – Uptime

- Baseline – no thermal soak (5 minutes for lot change).
- 30 minute thermal soak
- Realign every 10 minutes for 4 hours – setup only
- Realign every 10 minutes for 4 hours – every lot

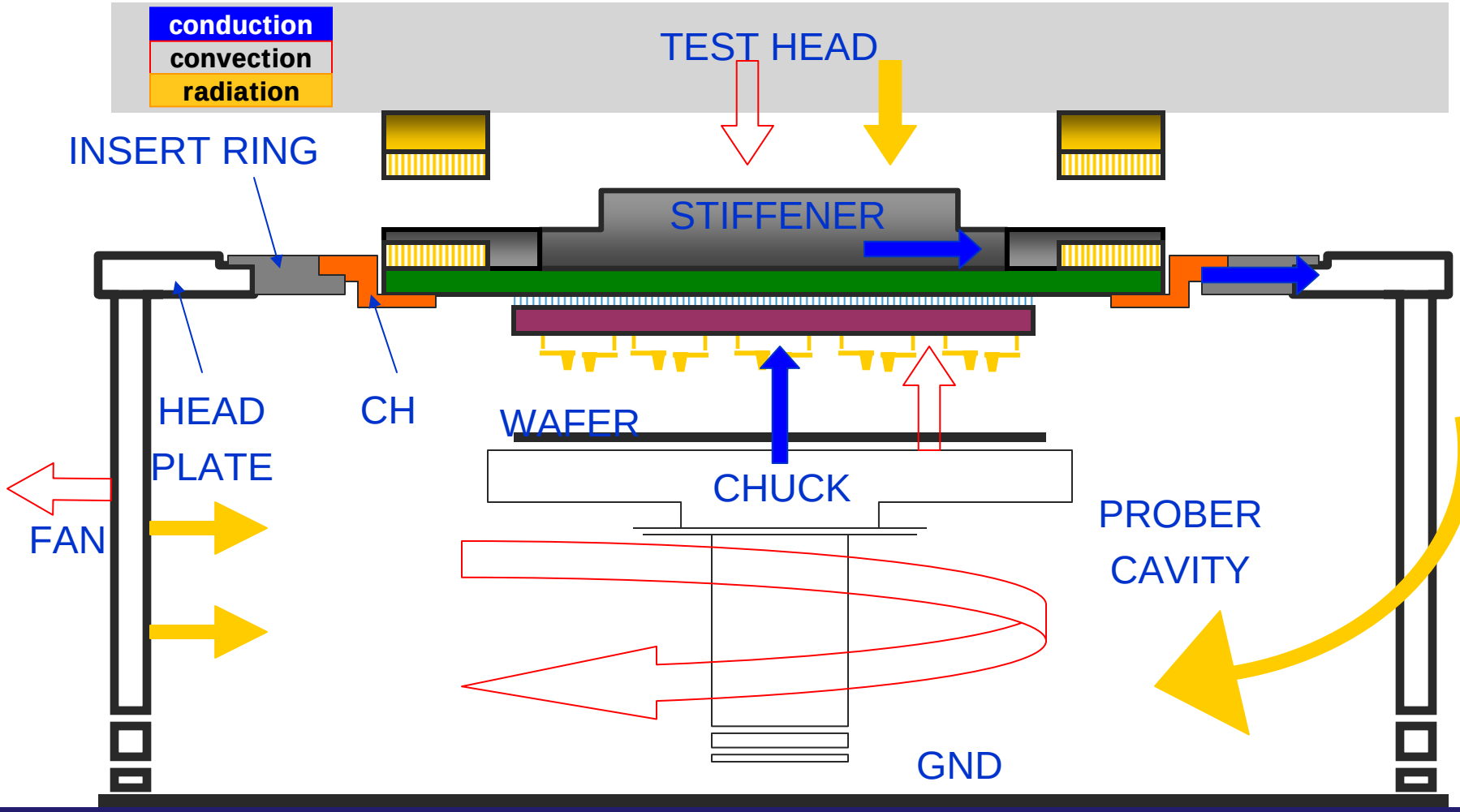


Slow system thermal response impacts probe position



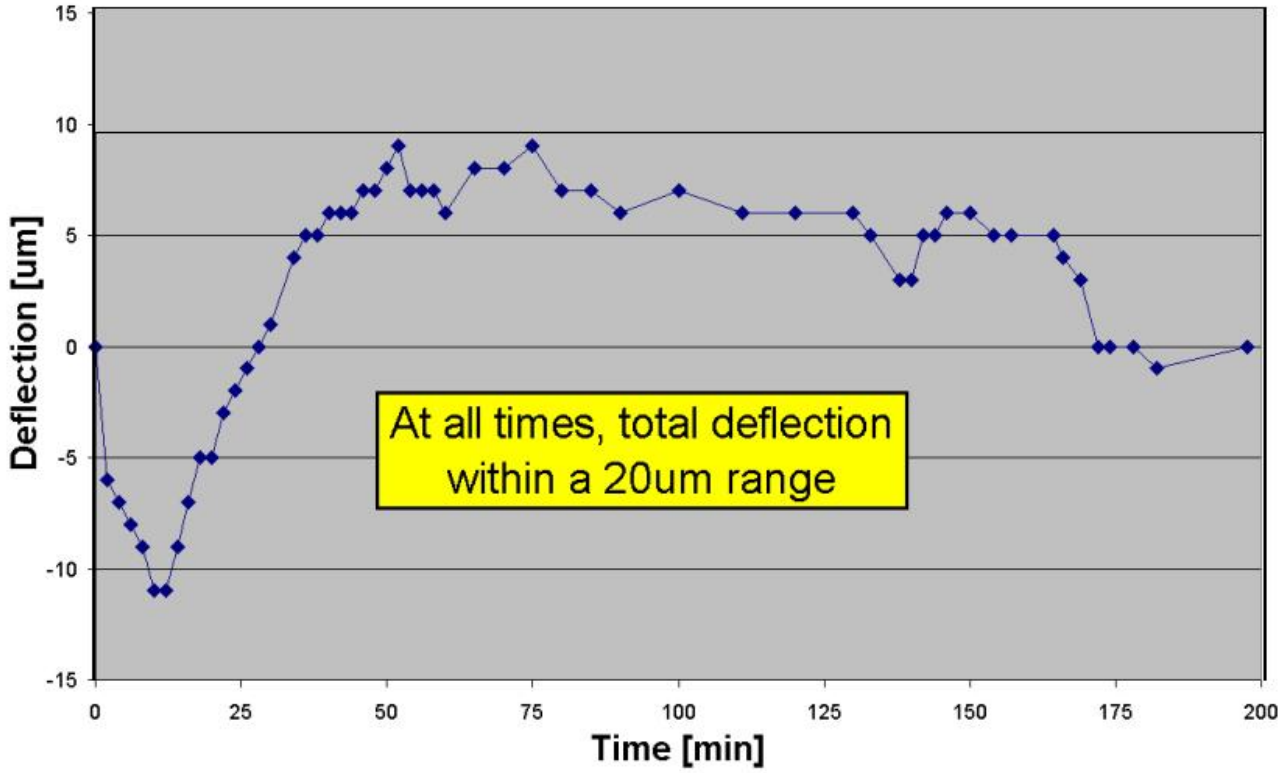
System continues drifting after probe card reaches thermal equilibrium

Tester – Probe Card – Prober Thermal Loop



Thermal Stability Results

One TD card designed to minimize system thermal response



This card carries the potential to remove thermal soak and realignment times

Other elements of uptime

Alignment failures

- Special alignment features.
- Minimize thermal realignment.

Cleaning /PM

- Process improvements discussed earlier are all designed to provide a consistent probing process which minimizes cleaning.

Repair

- Minimize repair through improved contactor design.
- Service close to customer (fast turn times)

Conclusion

1 TD probing is more than a scale up of previous technologies

System Level approaches are needed to overcome key probing process and throughput issues.