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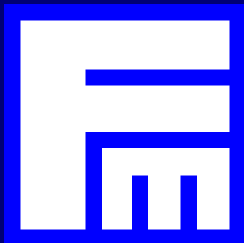
Feinmetall GmbH

# Hot-Spot: High Temperature Probing

## Challenges of wafer probing beyond 150°C



**FEINMETALL**

Contact technologies for electronics

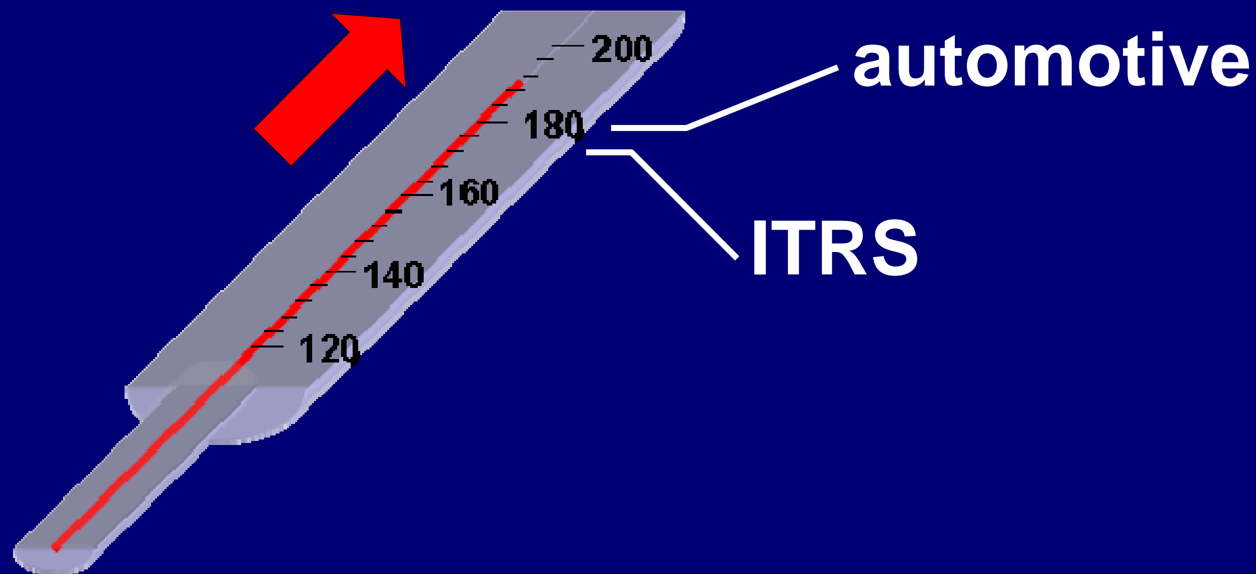
**June 7-10, 2009**
**San Diego, CA USA**

# Demand on High Temperature Probe Cards

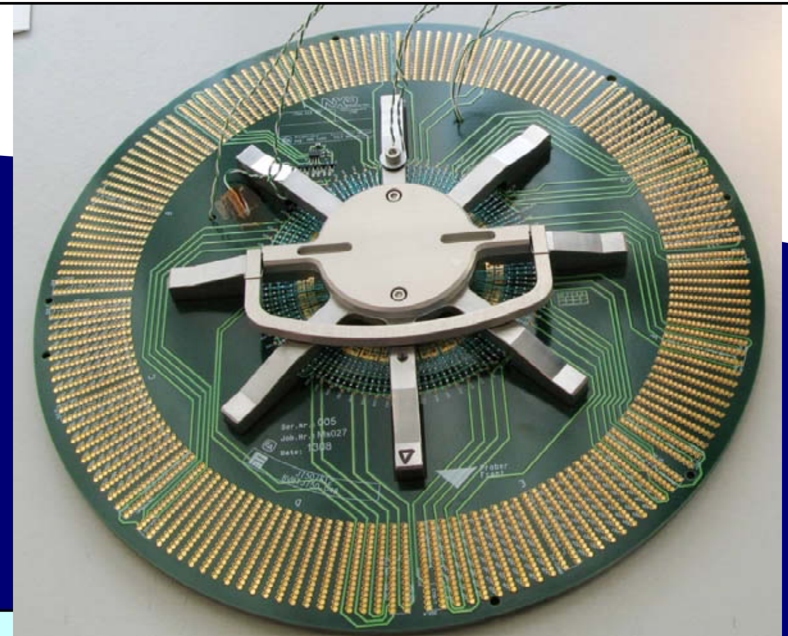
- ITRS-Roadmap max. test temperature demand: -55°C ➔ +175°C

- automotive industrie requests higher test temperatures: -40°C ➔ +180°C

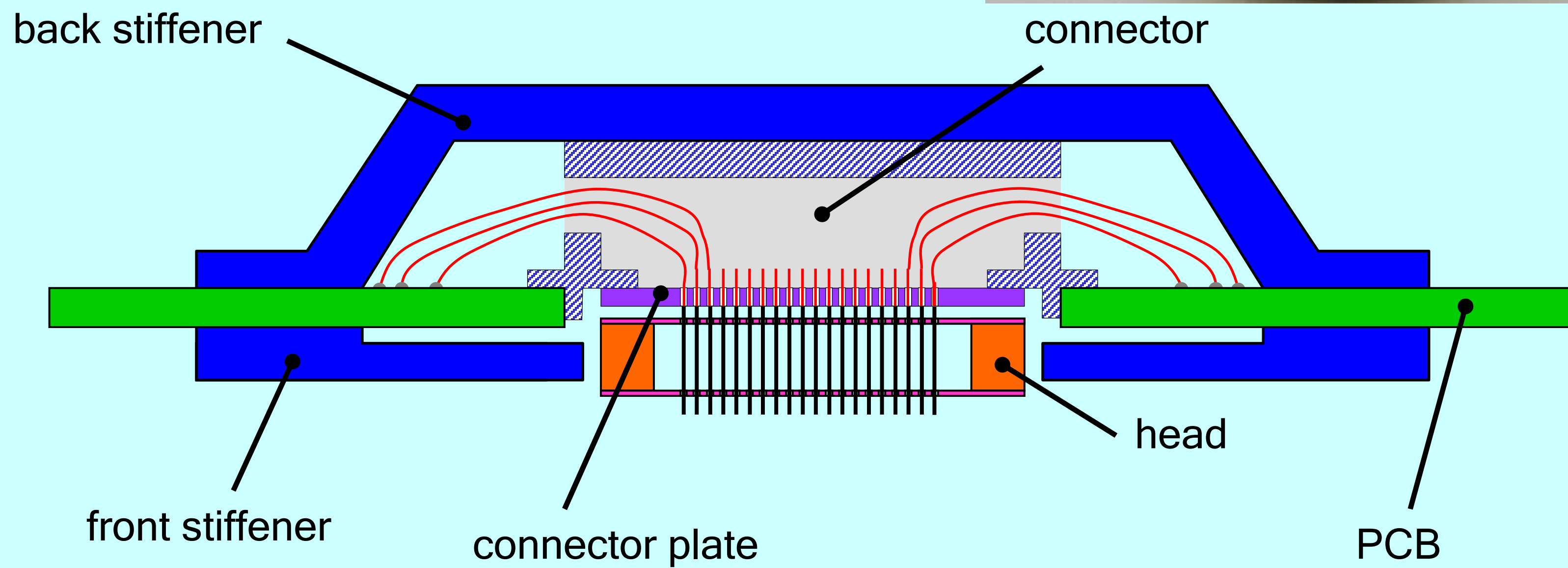
- trend to large footprint multi DUT testing at high temperatures



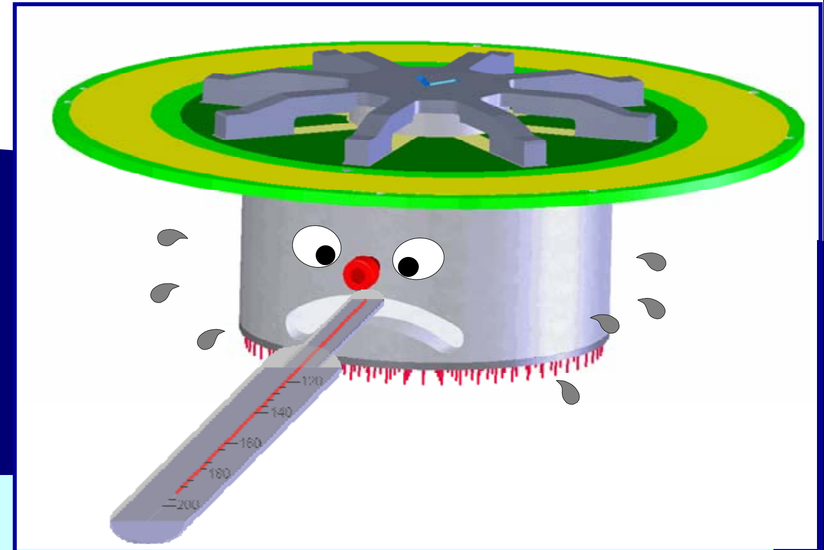
# Wired Connector



**wired card:**



# Probing Challenges at 180°C wafer temperature



2. temperature of electronics

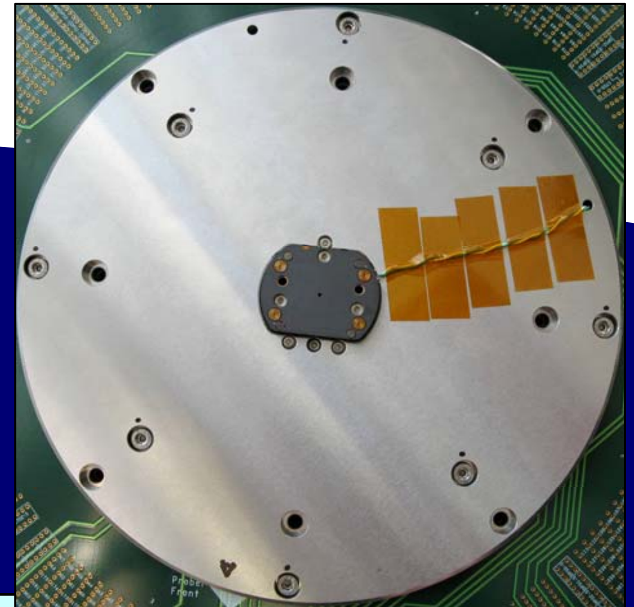
1. temperature distribution

3. dimensional stability

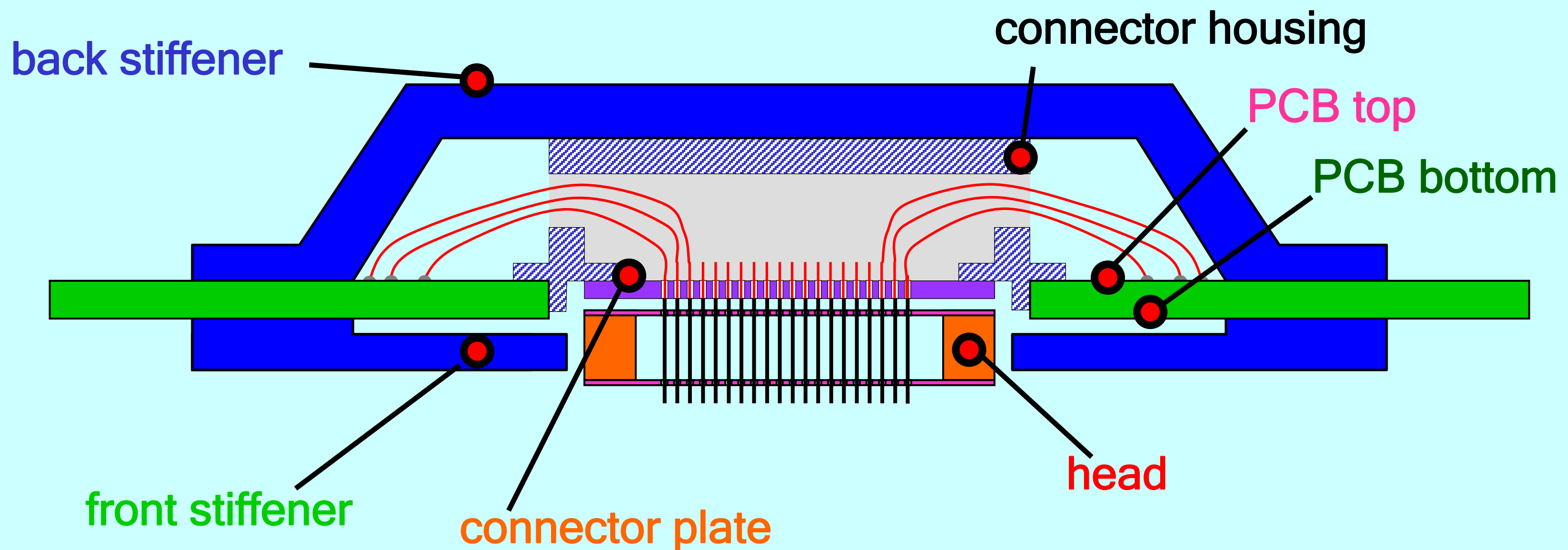
4. alignment

5. contact performance

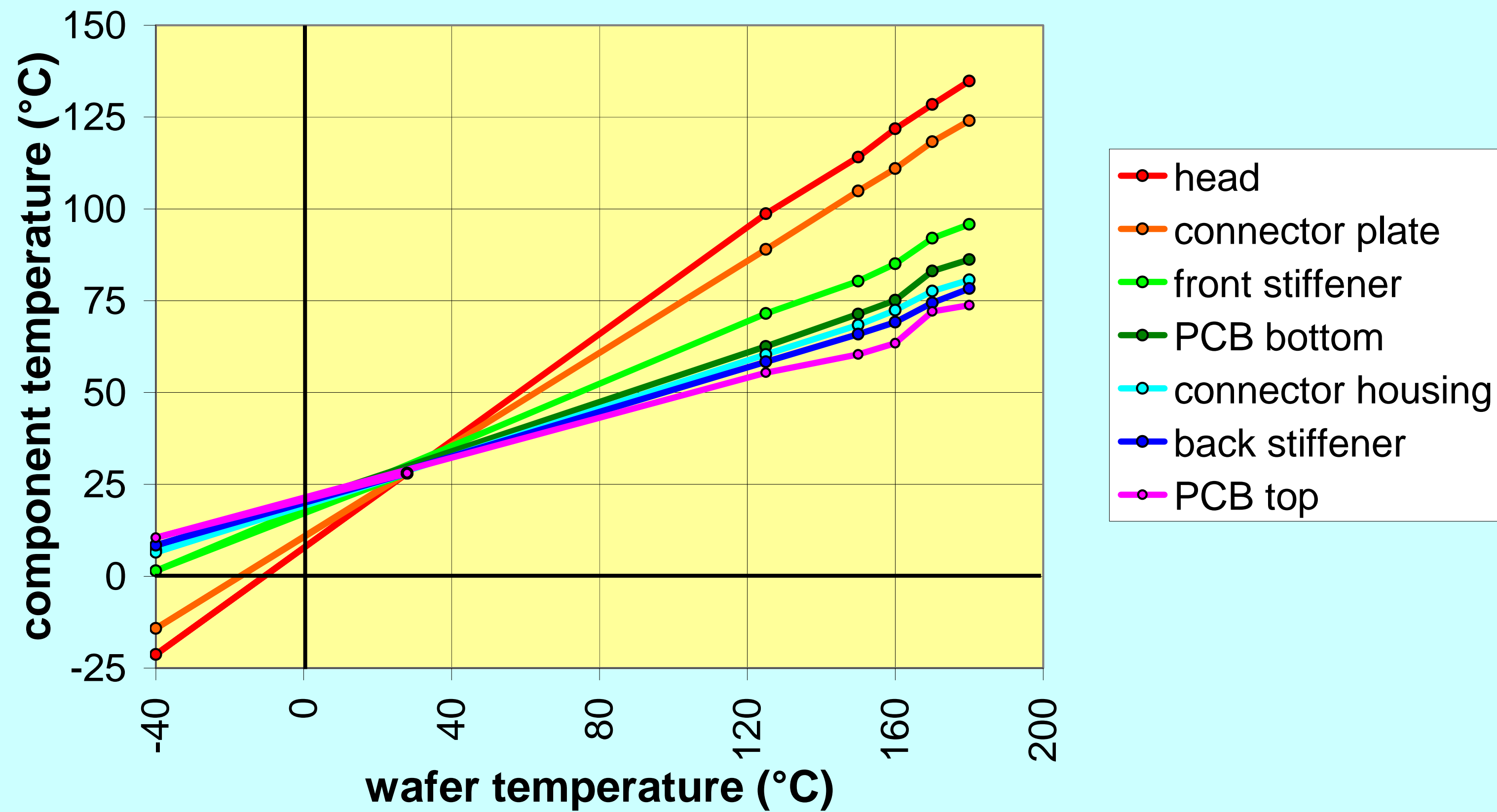
# 1. Temperature Measurements within the Probecard



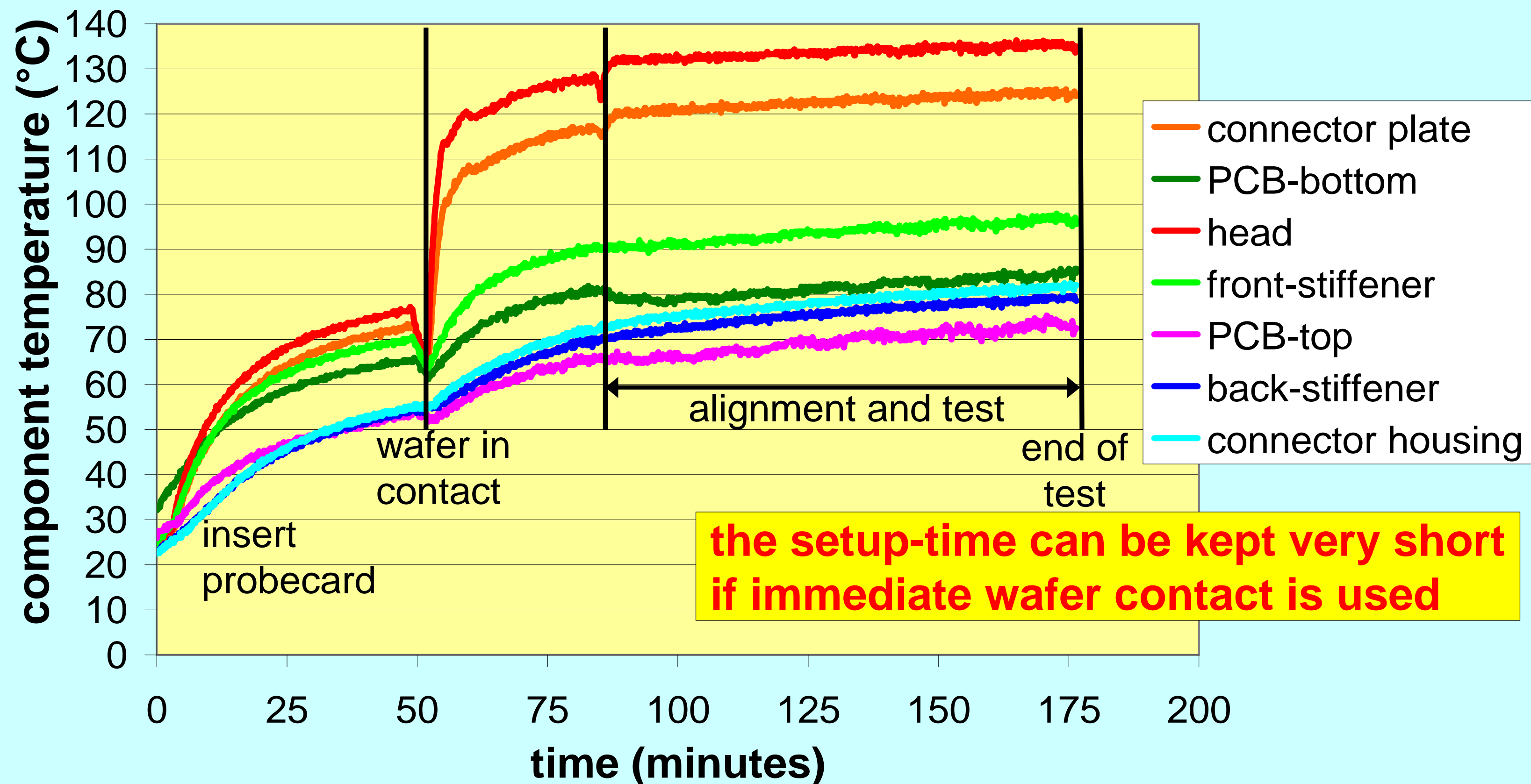
**temperature sensor locations:**



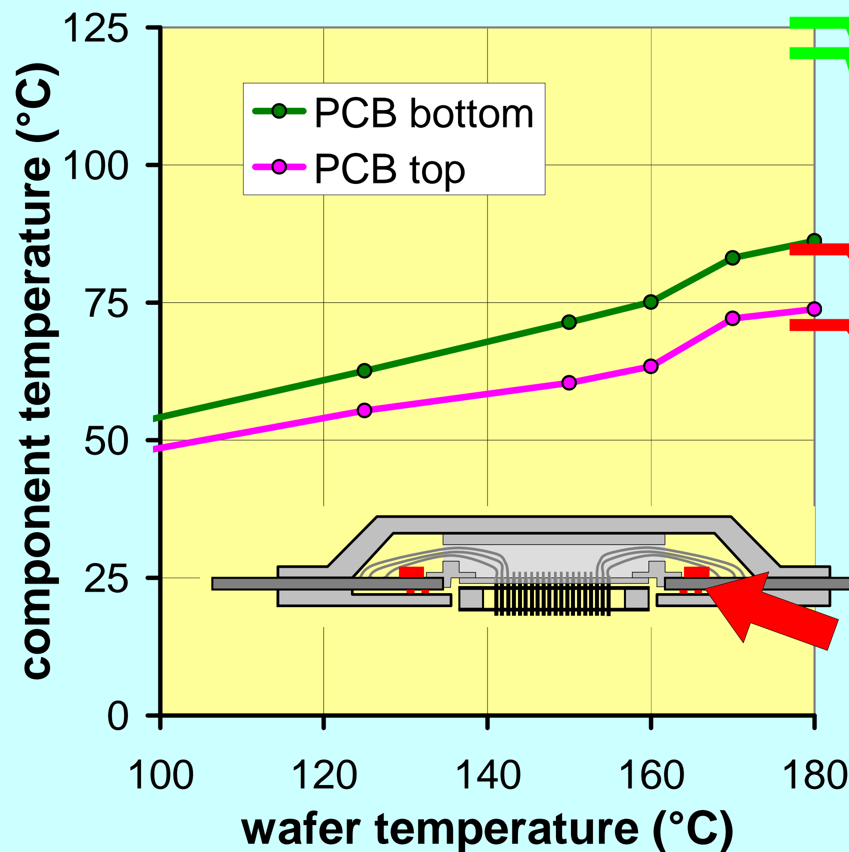
# 1. Temperature Measurements within the Probecard



# 1. Temperature Rise within the Probecard



# 2. Probecard Electronics Temperature Limit

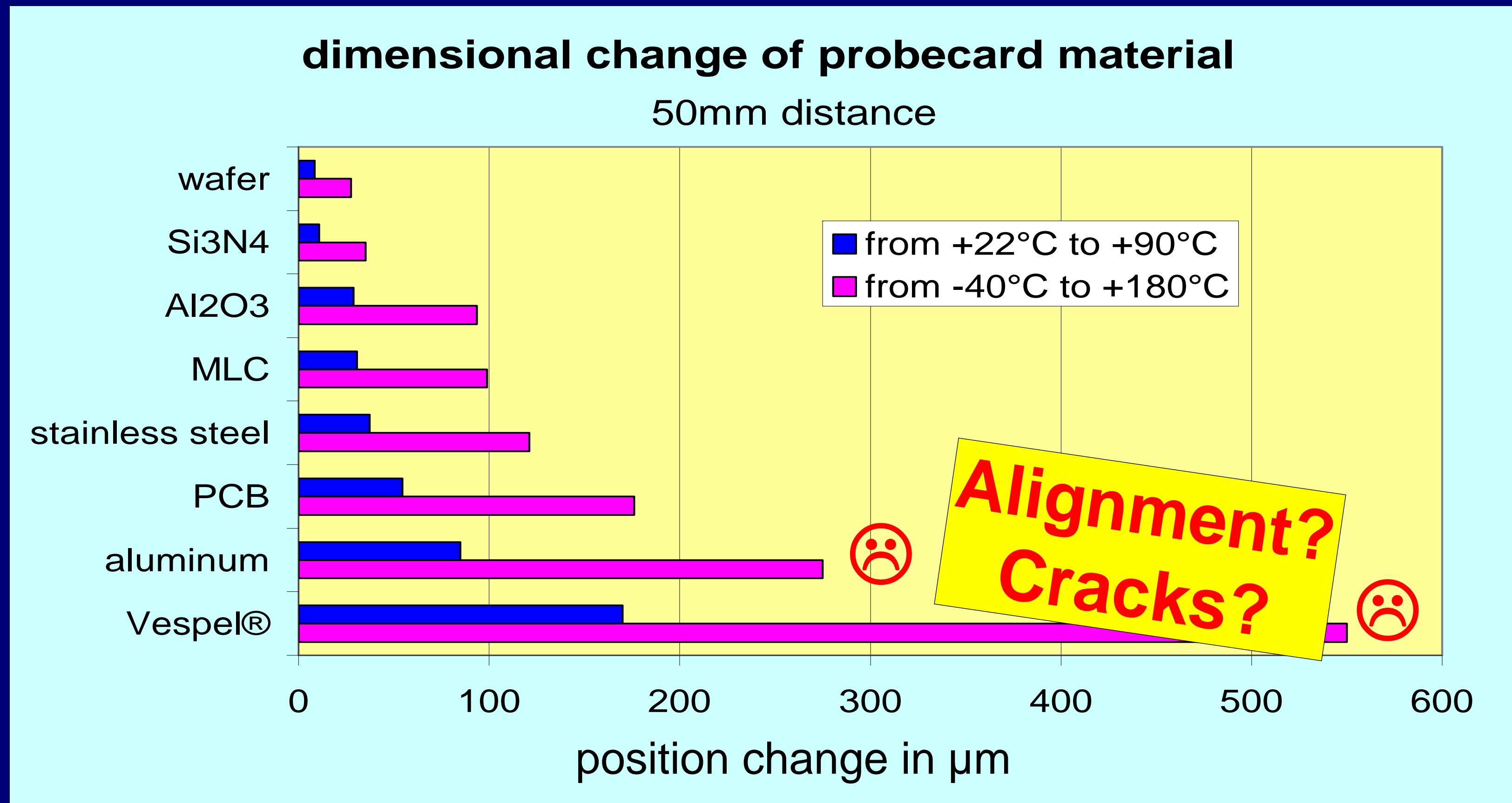



| component type | max. temp. |
|---|---|
| semi conductor resistor | >125°C |
| ceramic capacitor | 125°C |
| relay | 85°C |
| clock | <85°C |

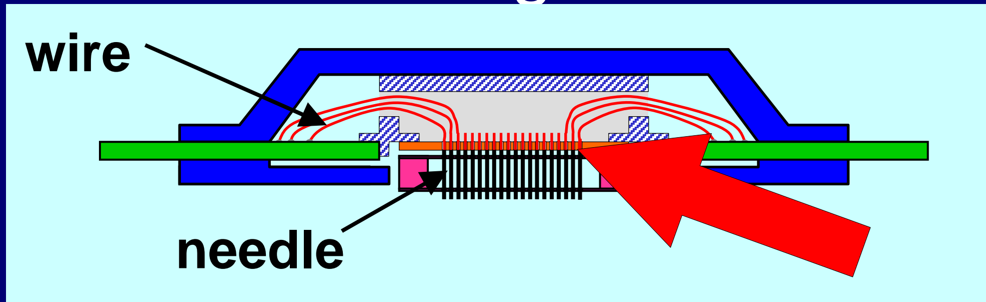
**selection and location of electronic components on the probecard with respect to their max. temperature limit**

# 3. Dimensional Changes of Wafer and Probecard

Many traditional probecard materials are unsufficient for high temperature probing.

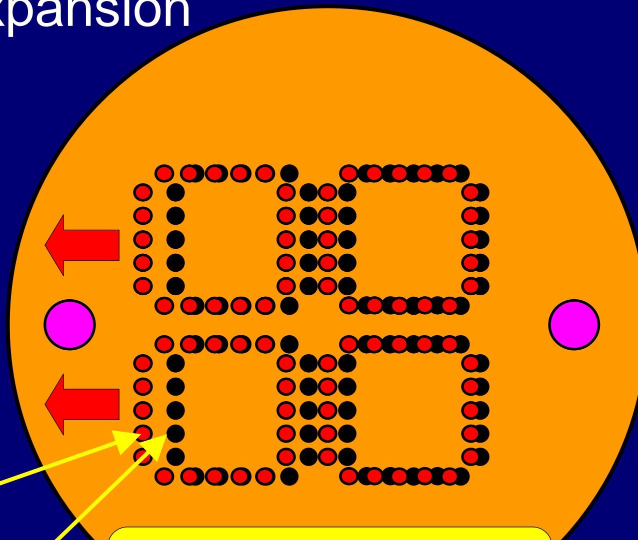


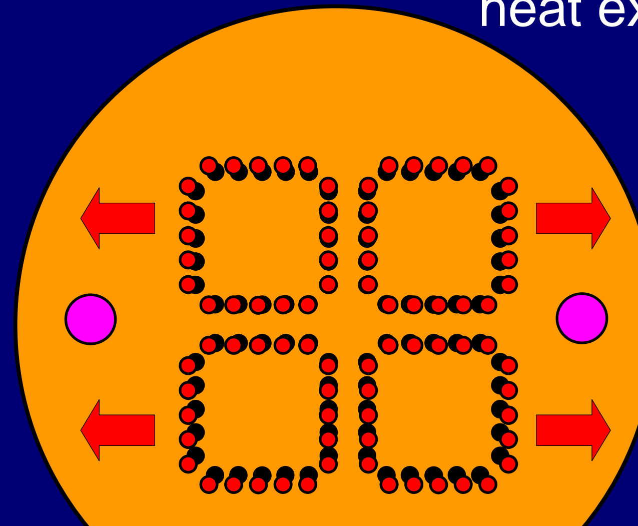
# 3. Needle – Connector Alignment




**old style**
heat expansion

**new design**
heat expansion

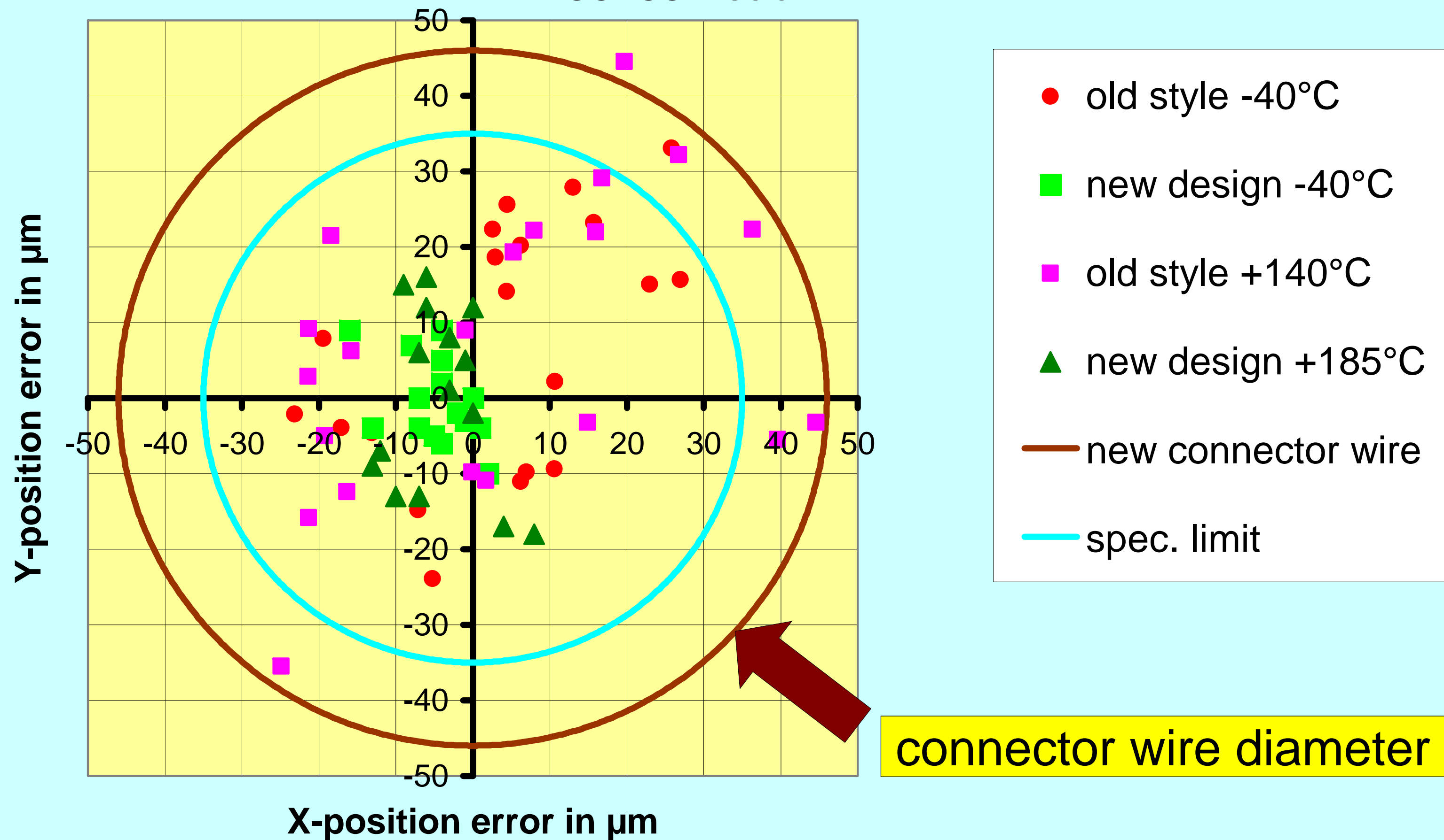


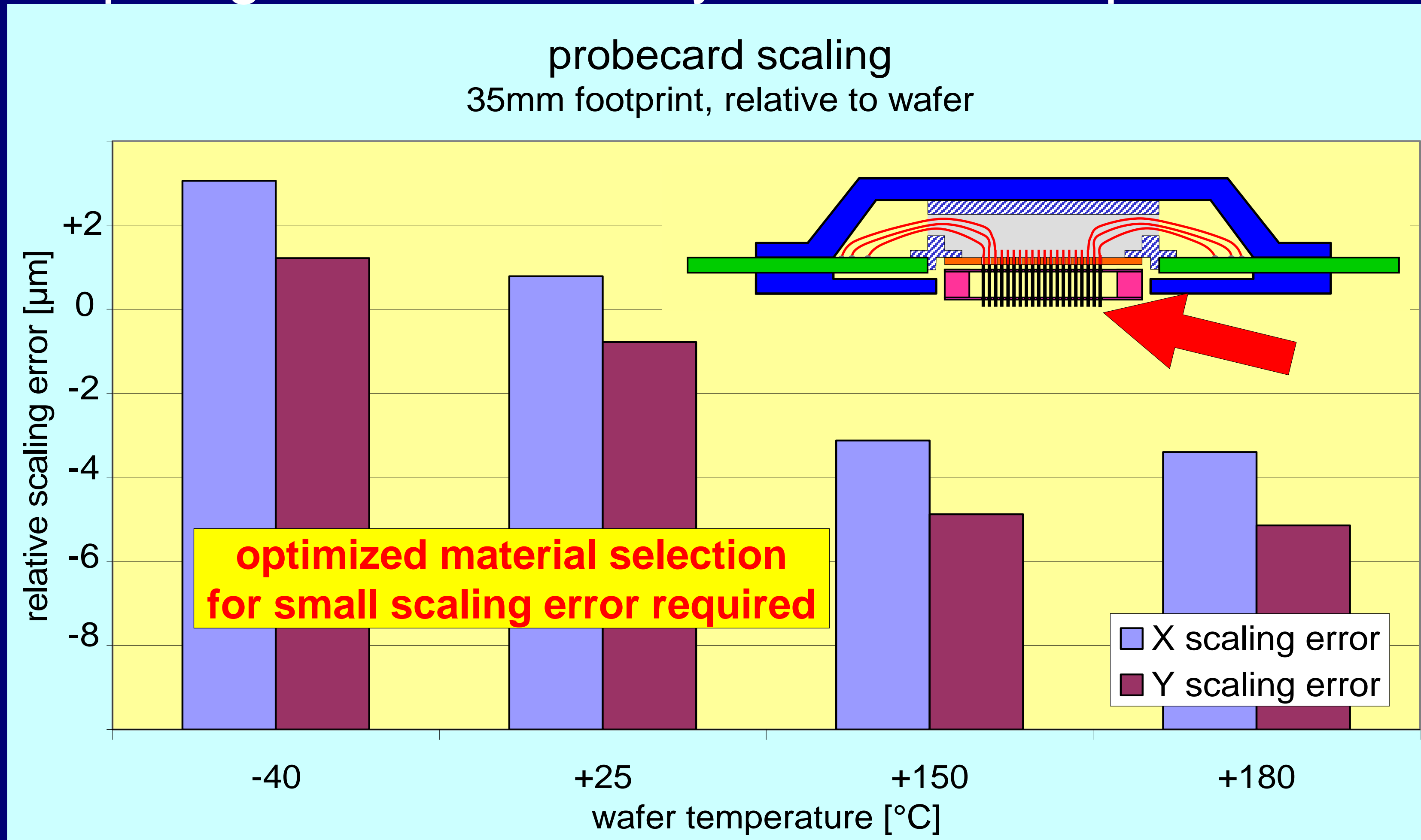

**needle**

**wire**

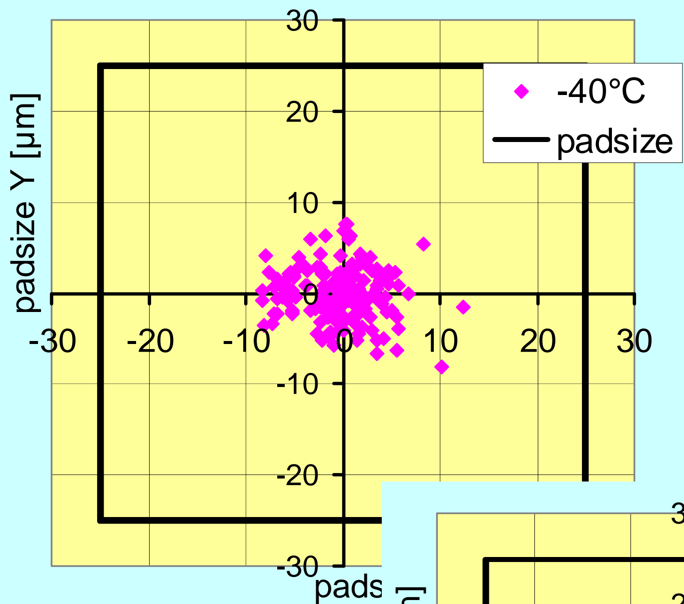
# 3. Needle – Connector Alignment

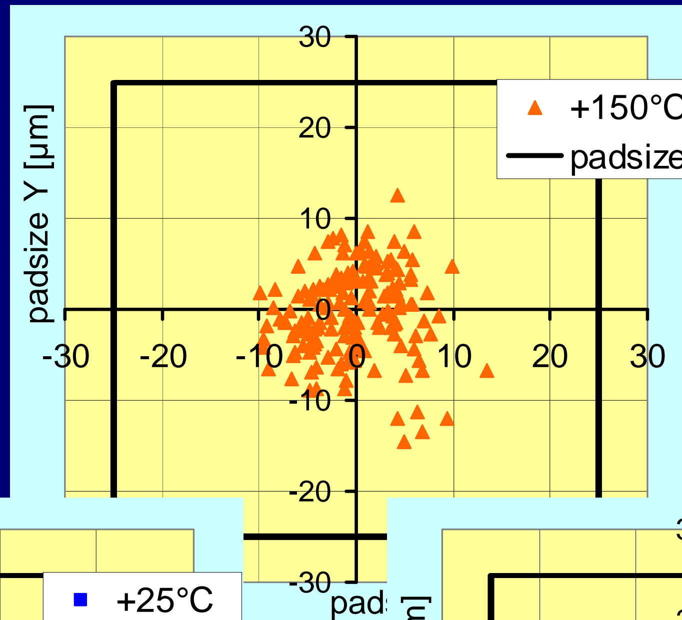


# 4. Tip Alignment Accuracy at Wide Temperature Range



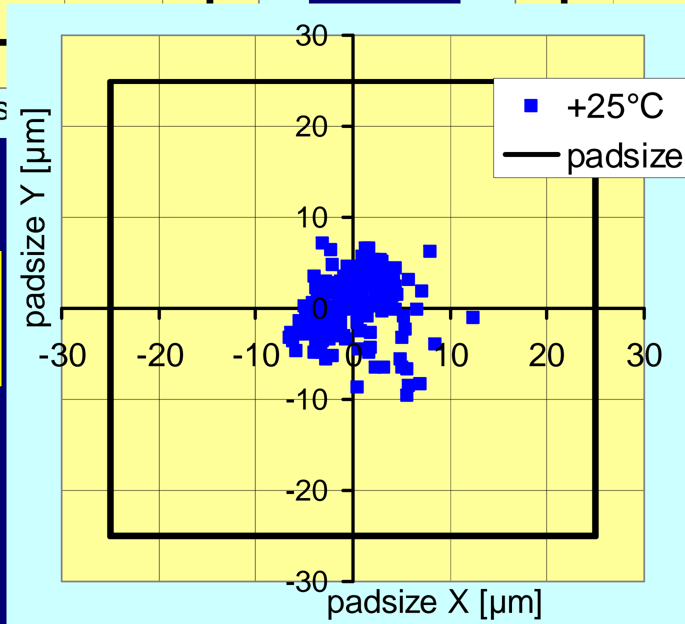
# 4. Tip Alignment Accuracy at Wide Temperature Range

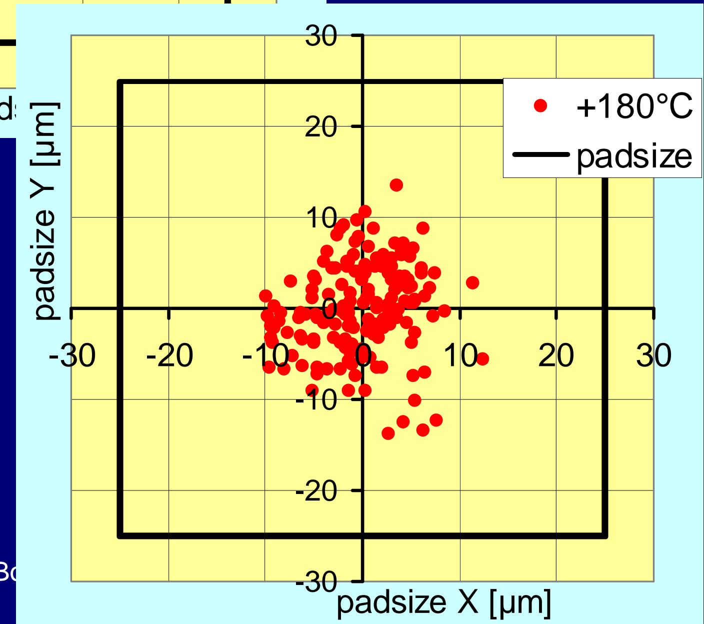



probemark inspection data

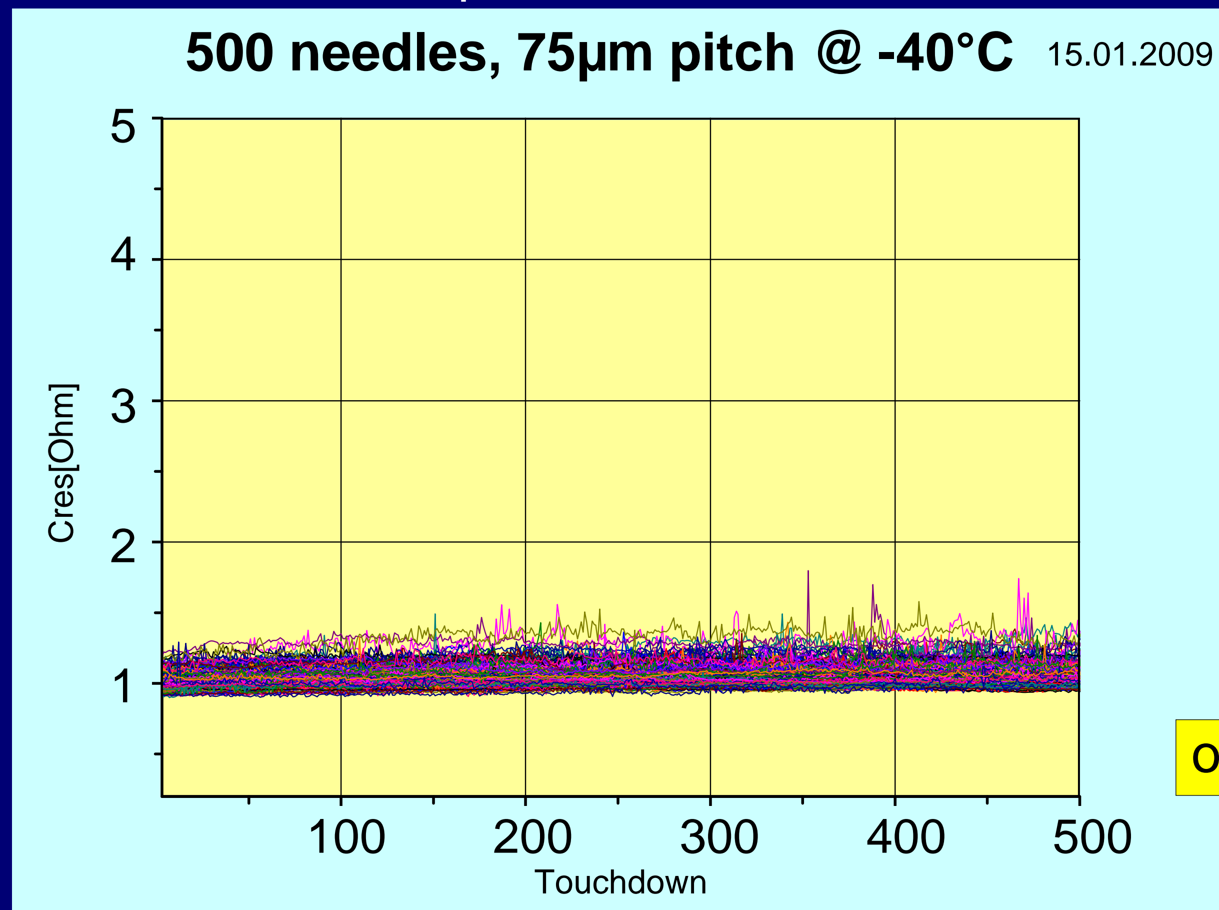
CTE matched guide plates



# 5. Contact Resistance Measurement

Typical test result from the prober:




on $AlCu_{0,5\%}$

# 5. Contact Resistance Measurement

**Ratio of measurements greater than specified CRes in ppm**

ratio of contacts above a specific Cres

data from 250.000 contacts

discontinuing X-scale

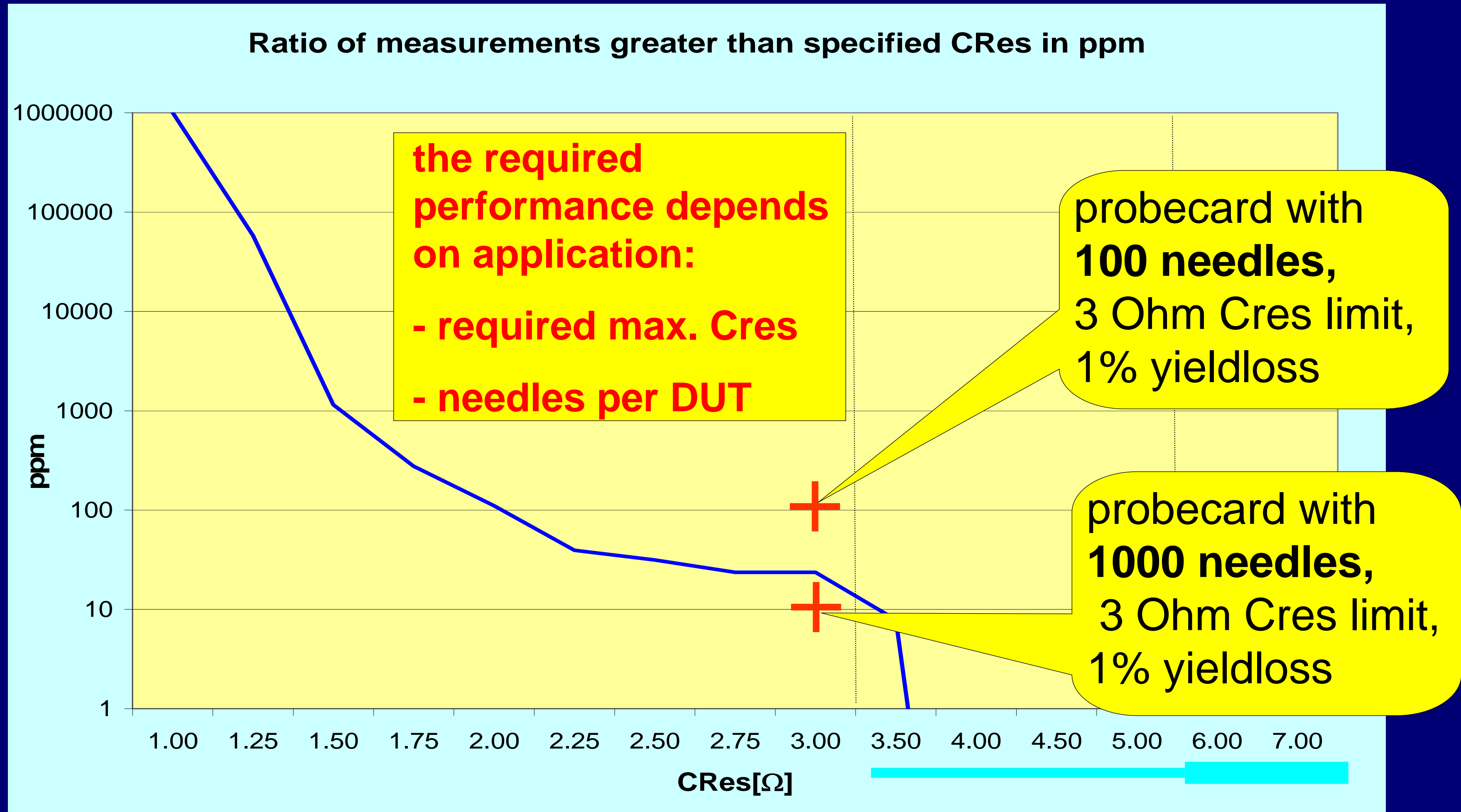
ppm

1000000
100000
10000
1000
100
10
1

1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.50 4.00 4.50 5.00 6.00 7.00

**CRes[Ω]**

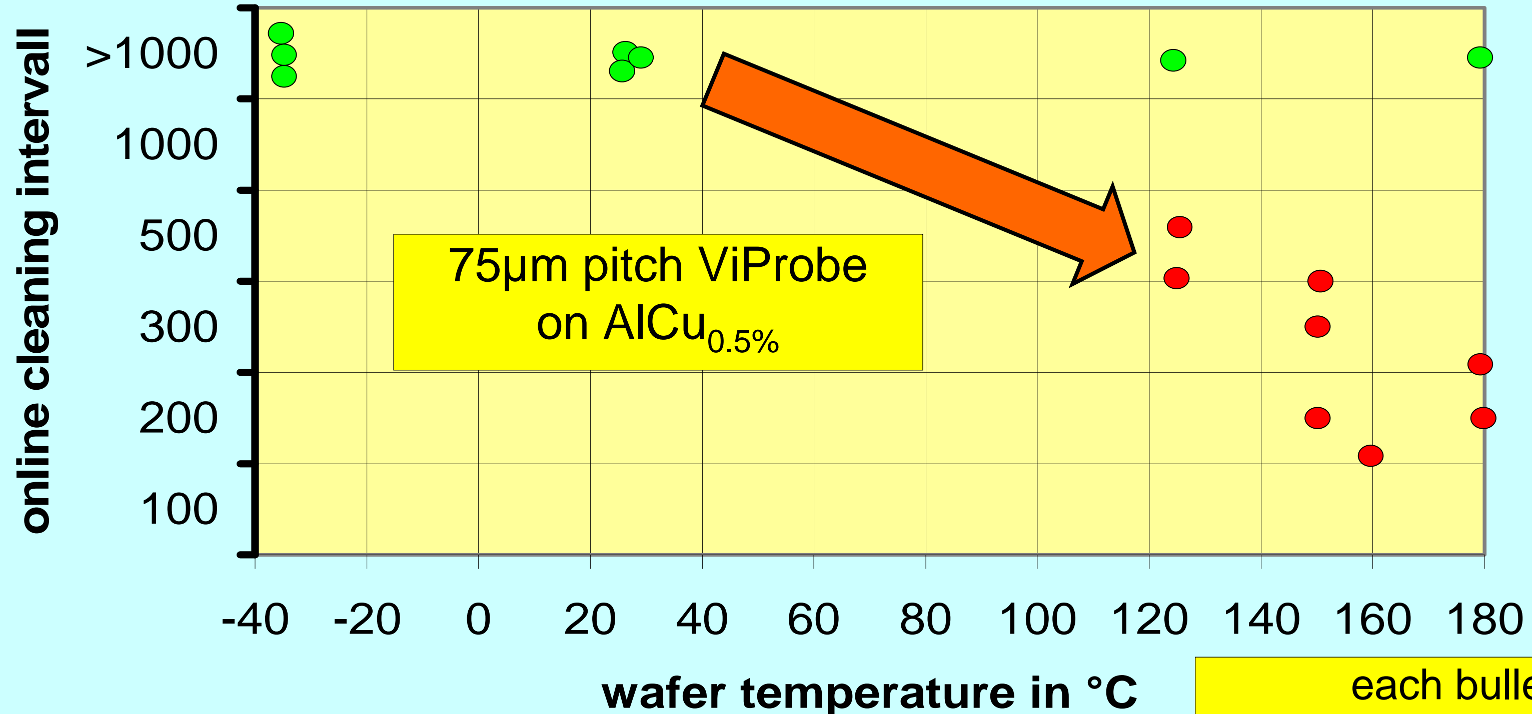
# 5. Contact Resistance Measurement



# 5. Contact Resistance at High Temperature Range

**Ratio of measurements greater than specified CRes in ppm**

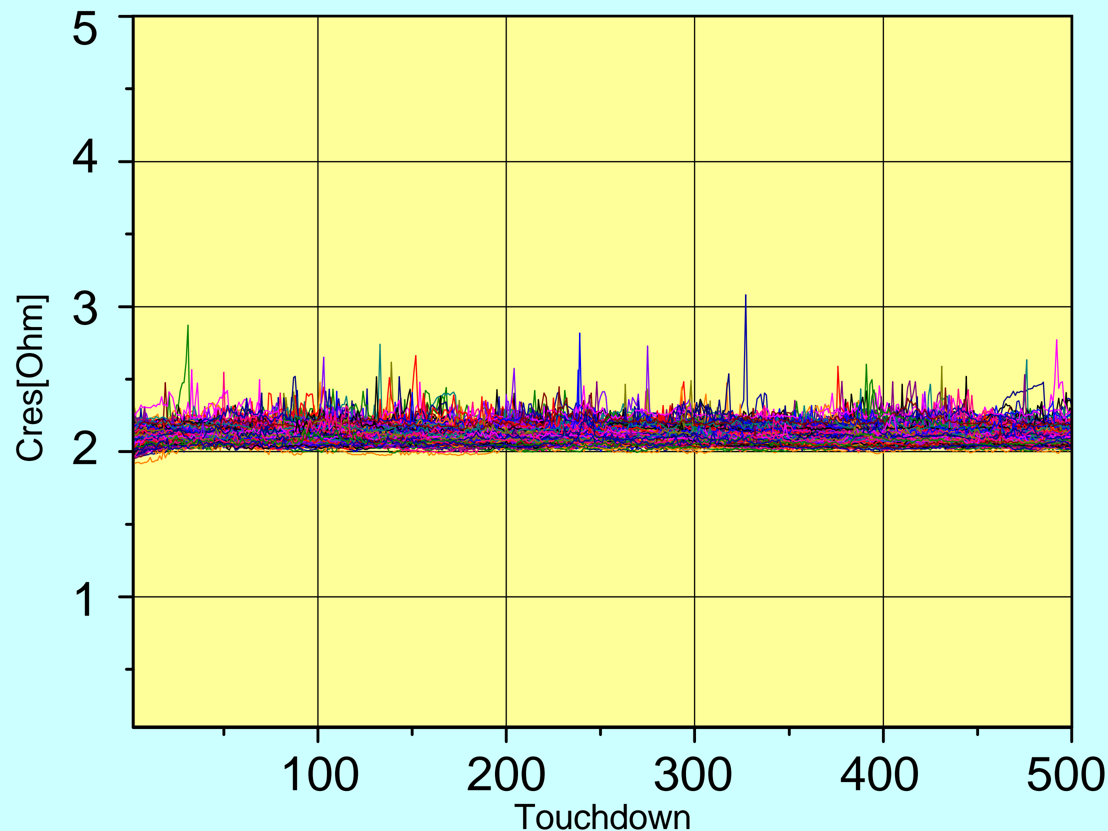
# 5. Online Cleaning at Elevated Temperatures




each bullet:
one test with 500 needles/
500 touchdowns

# 5. Contact Resistance Measurement

Typical testresult from the prober: online cleaning not required




500 needles on $AlCu_{0,5\%}$

# 5. Scrubmarks at Elevated Wafer Temperatures

| | -40°C | 25°C | 125°C | 150°C | 180°C |
|---|---|---|---|---|---|

width

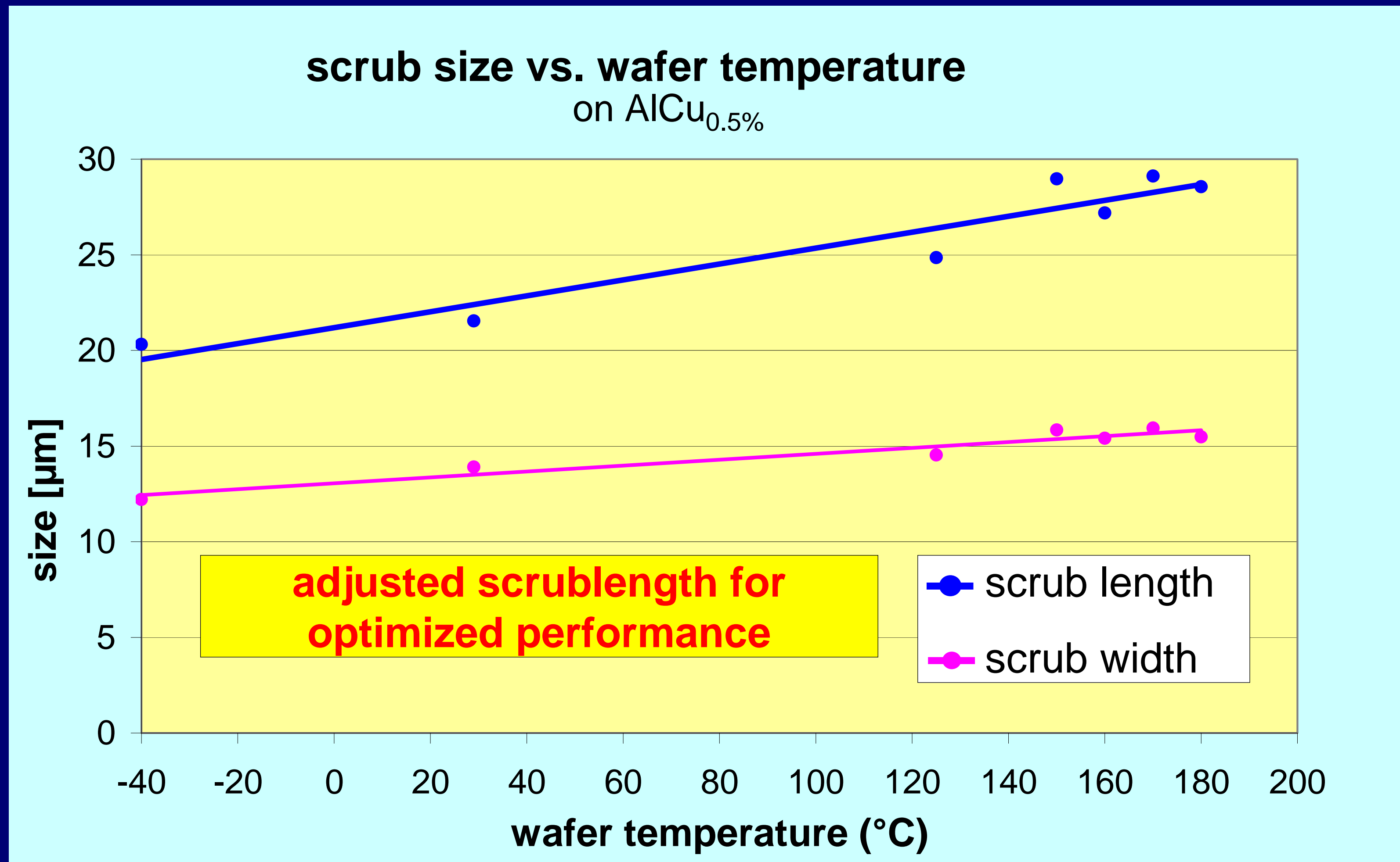
length

Total_Scrub :

| | | | | | |
|---|---|---|---|---|---|
| Length | 20µm | 22µm | 25µm | 29µm | 29µm |
| Width | 12µm | 14µm | 15µm | 16µm | 16µm |

(Average, count : 90)

# 5. Scrubmarks at Elevated Wafer Temperatures



# High Temperature Probing Recommendations

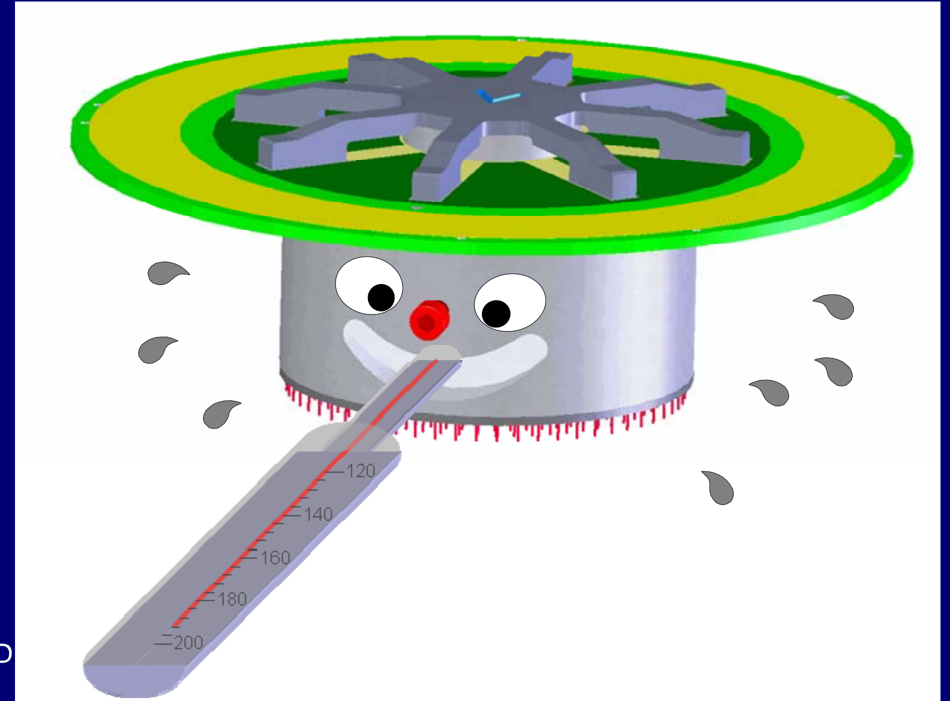
| challenge | solution |
|---|---|
| 1. temperature distribution | adequate warmup setting with the needles in contact with the wafer |
| 2. temperature of electronics | selection and location of electronic components on the probecard with respect to their max. temperature limit |
| 3. dimensional stability | - CTE matched materials<br>- design to consider temperature gradients |
| 4. alignment | CTE matched guide plates |
| 5. contact performance | - adjusted scrub length<br>- adjusted online cleaning |

# Summary

- probing from -40°C to +180°C with one probecard is ready for industrial applications

- space transformer or wired probecards are both possible

- application specific optimization can reduce cleaning frequency



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