SW Test Workshop
Semiconductor Wafer Test Workshop

"SMART" Laser Drilling for Advanced Vertical Probe Card Manufacturing

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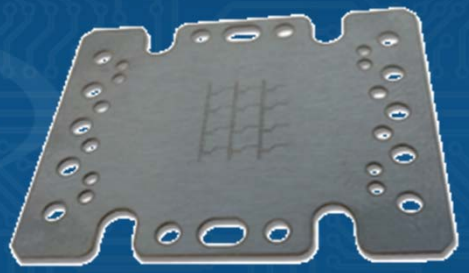
Overview

- Introduction
- Advanced Vertical Probe Cards
- Historical Review
- “SMART” Program
- Results
- Future R & D Targets
- Summary

Introduction

- **Guide Plates**
  - Are an essential component in Vertical probe cards.
  - Consist of 1000's micro-holes through which probes are fitted, ensuring accurate location of each probe.
  - Typical probe card uses several guide plates.



- **Guide Plate Features**
  - Accurately locate probe pins.
  - Pin size and pitch to match DUT.
  - Appropriate current capacity, impedance, contact resistance etc.
  - Appropriate guiding/sliding of pins, scrub, wear, cleaning etc.
  - Mechanically stable substrate.
  - Match CTe to DUT.

Advanced Vertical Probe Cards

- **Advanced Vertical Probe Card Types**
  - Cobra
  - Micro-pogo
  - MEMs
- **Minimum Probe Pitch**
  - Reducing from 120um to <50um.
  - Driven by transition from solder bump to copper pillar.
- **Materials**
  - Ceramics (SiN, Alumina, Macerite, Photoveel).
  - Polymers: Polyimides, (Kapton, Vespel, Cirlex), PEEK.

Historical Review

2015

2014

2008

2005

Historical Review

What we have shown and presented :

Demonstrated the use of Lasers in Probe Card Drilling (2005)
Demonstrated Practical and Economic Drill Speeds (2008)
Demonstrated the Over Coming of Challenges in the Industry (2014)
Demonstrated a variety of drilling methods and materials (2015)

Now to the next Level :

Project SMART

Innovate UK
Technology Strategy Board

Smart

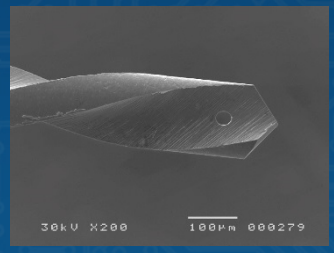
Smart is a UK Government fund to help companies, to engage in R&D projects in the strategically important areas of science, engineering and technology.

Started December 2015

Innovate UK Smart – Non Round Holes

Why Square or Rectangular Holes ?

More and more requests for rectangular / square micro holes
Probes can achieve softer touchdowns
Probes are of lower cost

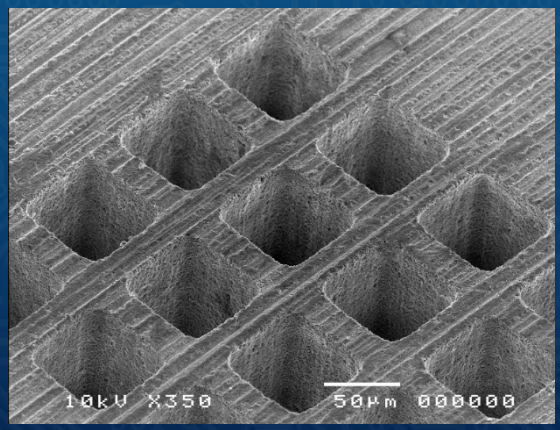


Why Laser Drilling ?

Can't make a square hole with a round mechanical drill bit.

What are the Issues ?

Rounded / Square corners
Hole Taper
Stability
Speed



Goals of the Project

a) Decrease the corner radius for square holes

b) Maintain taper at under 2µm for all holes

c) Improve the positional accuracy of microholes

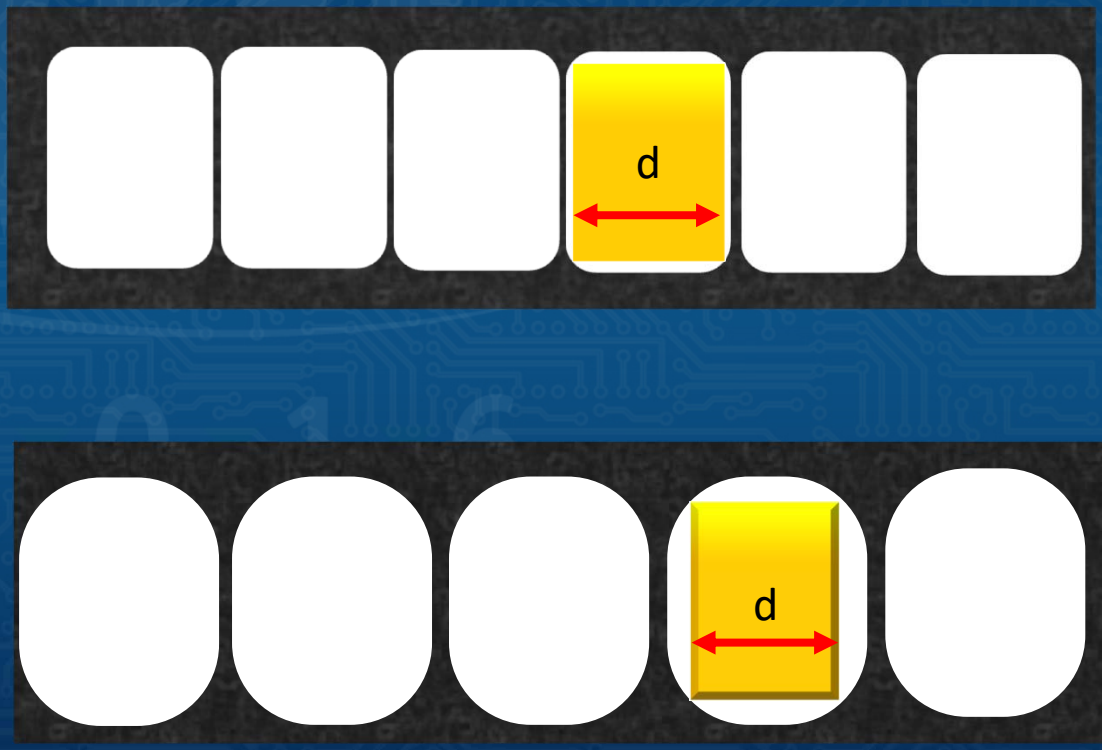
d) Improve the roundness of round holes

e) Improve / Reduce hole size variation

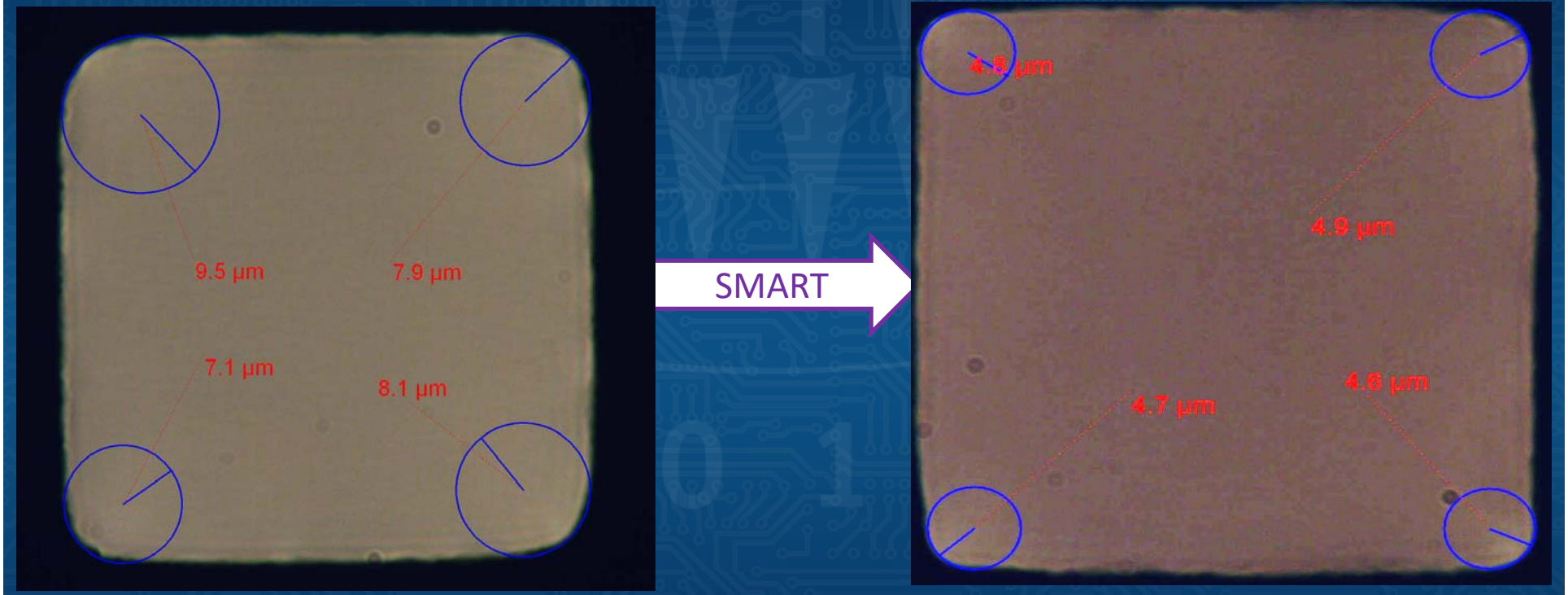
f) Increase the drill speed for all holes

Importance of Reduced Corner Radius

While the pin size "d" is the same, the larger corner radii reduces the possible minimum pitch of holes

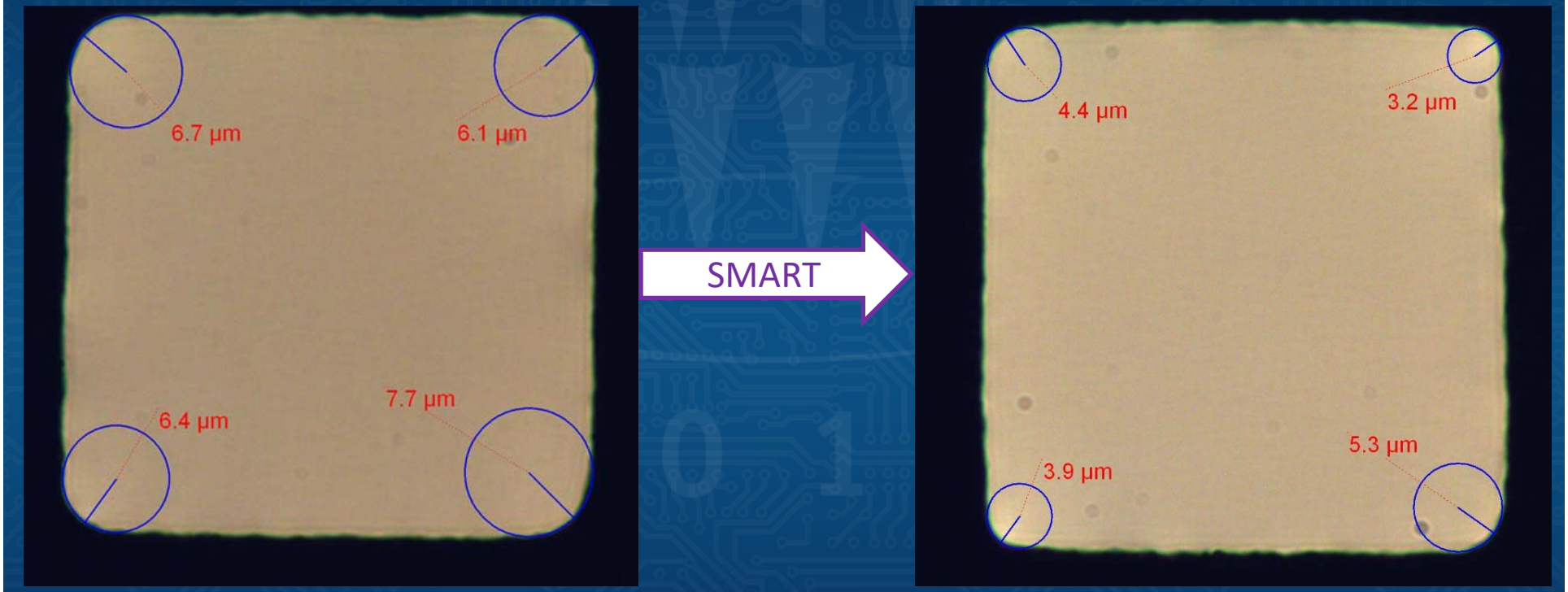


Preliminary Results



380um thick Silicon Nitride

Preliminary Results



250um thick Silicon Nitride

Preliminary Results

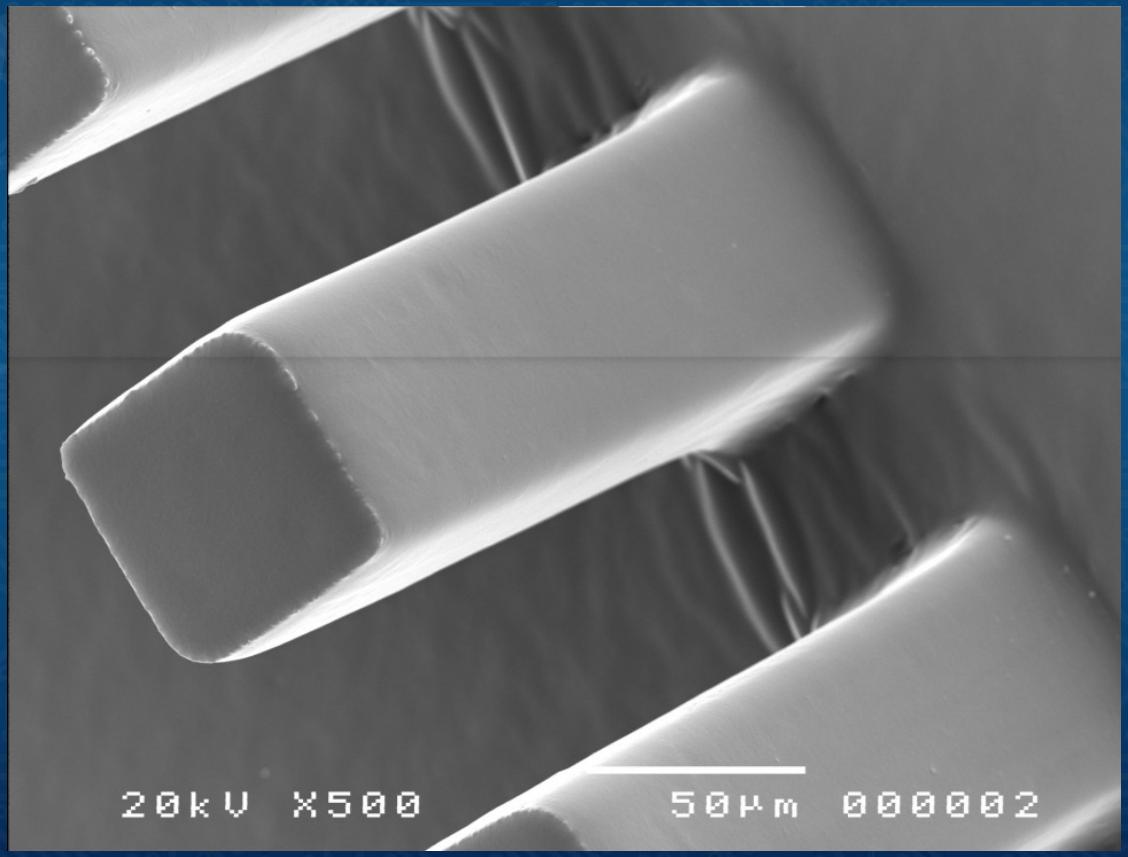
Material Thickness Si_3N_4	250µm	380µm
Old Method Range of Radii	6-8µm	7-10µm
New Method Range of Radii	4-5µm	4.5-5.5

Preliminary Results

Cast of Square Hole

Smooth Hole Profile

Low Hole Taper



What's Next

Next Production Steps :

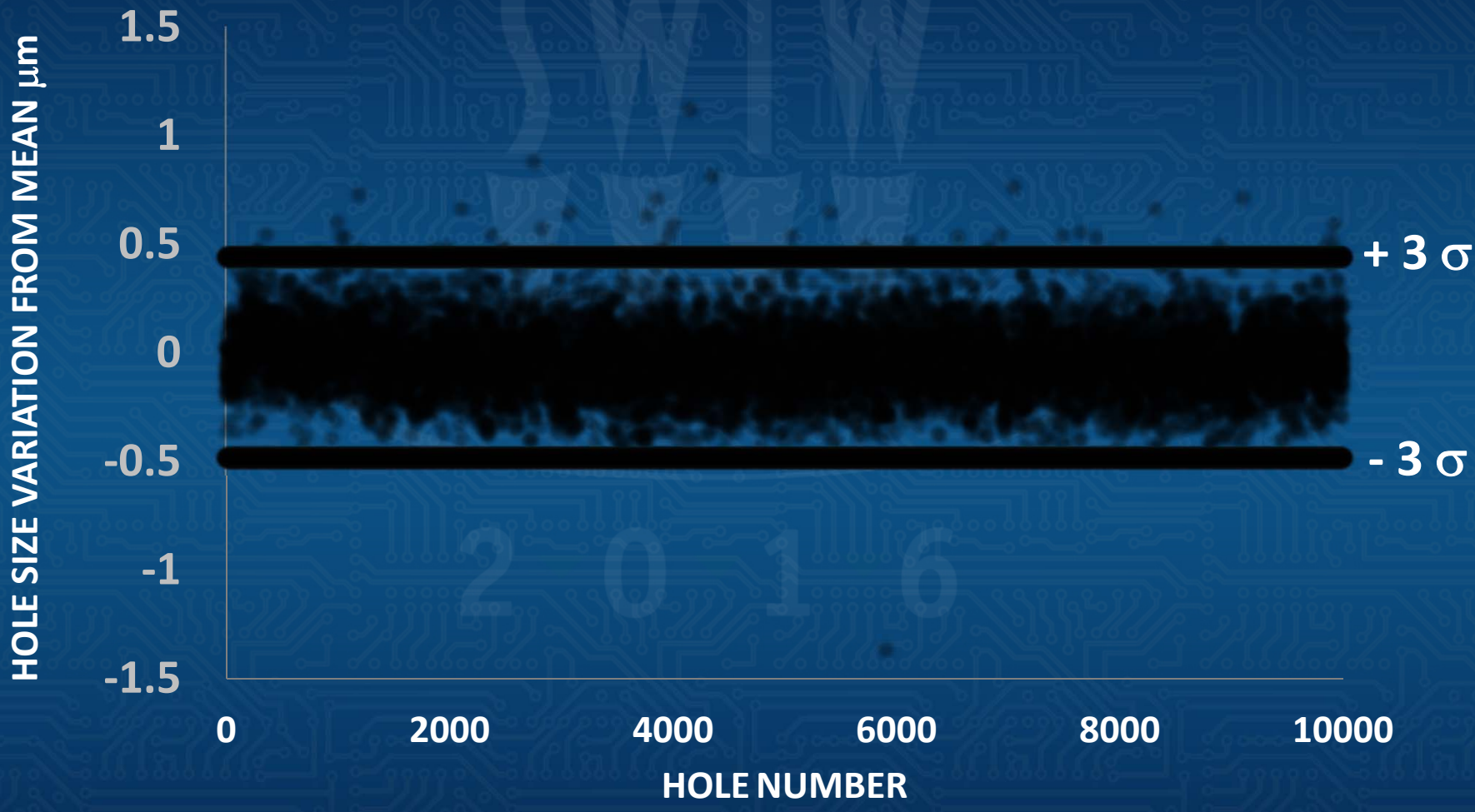
A.) Vigorously test and productionise Corner Radius Method

Next R&D Smart Steps :

A.) Reduce Hole Size Variation

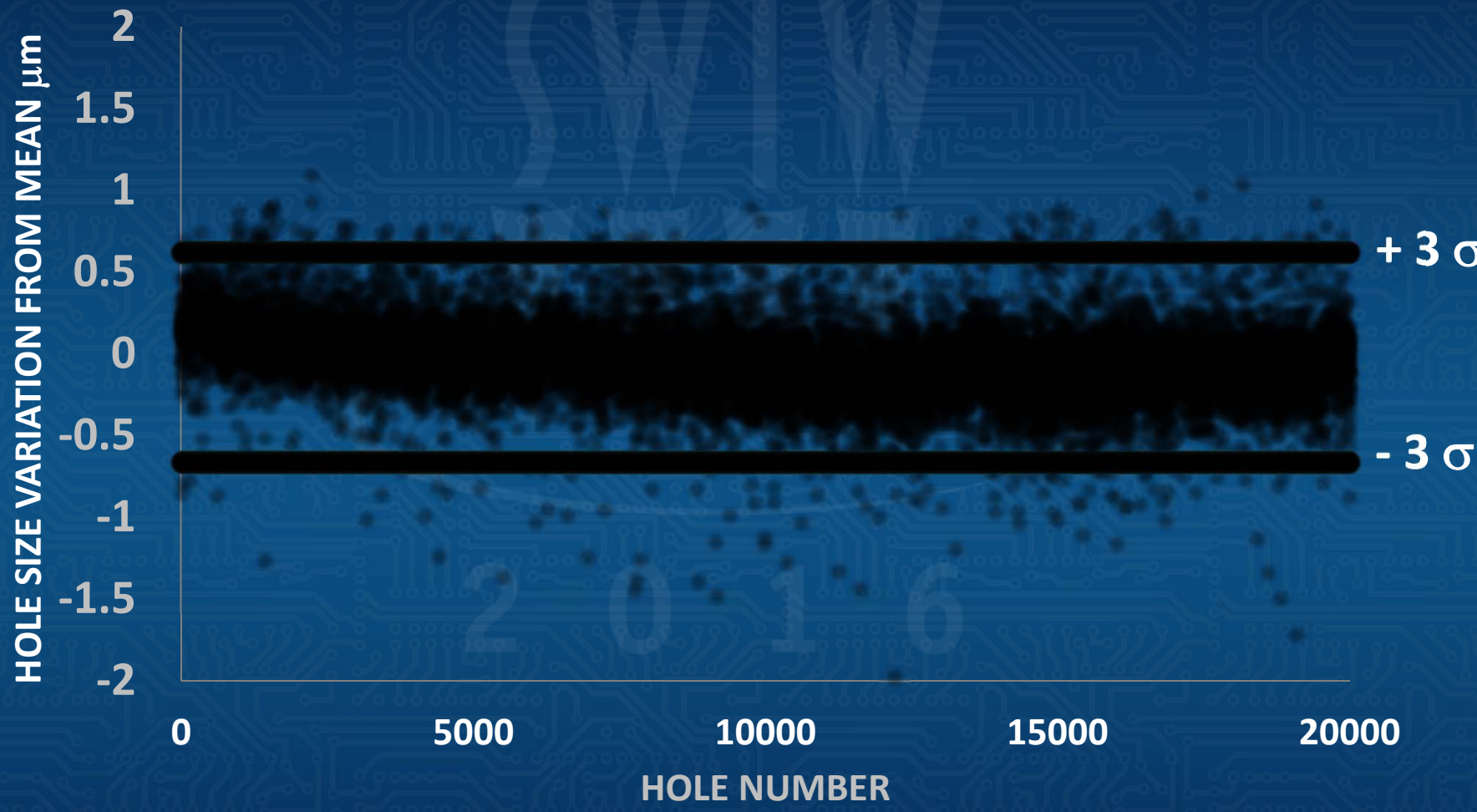
B.) Reduce Hole Taper

Hole Size Variation for 10,000 Holes



60 um by 60 um. 100-200um thick Silicon Nitride

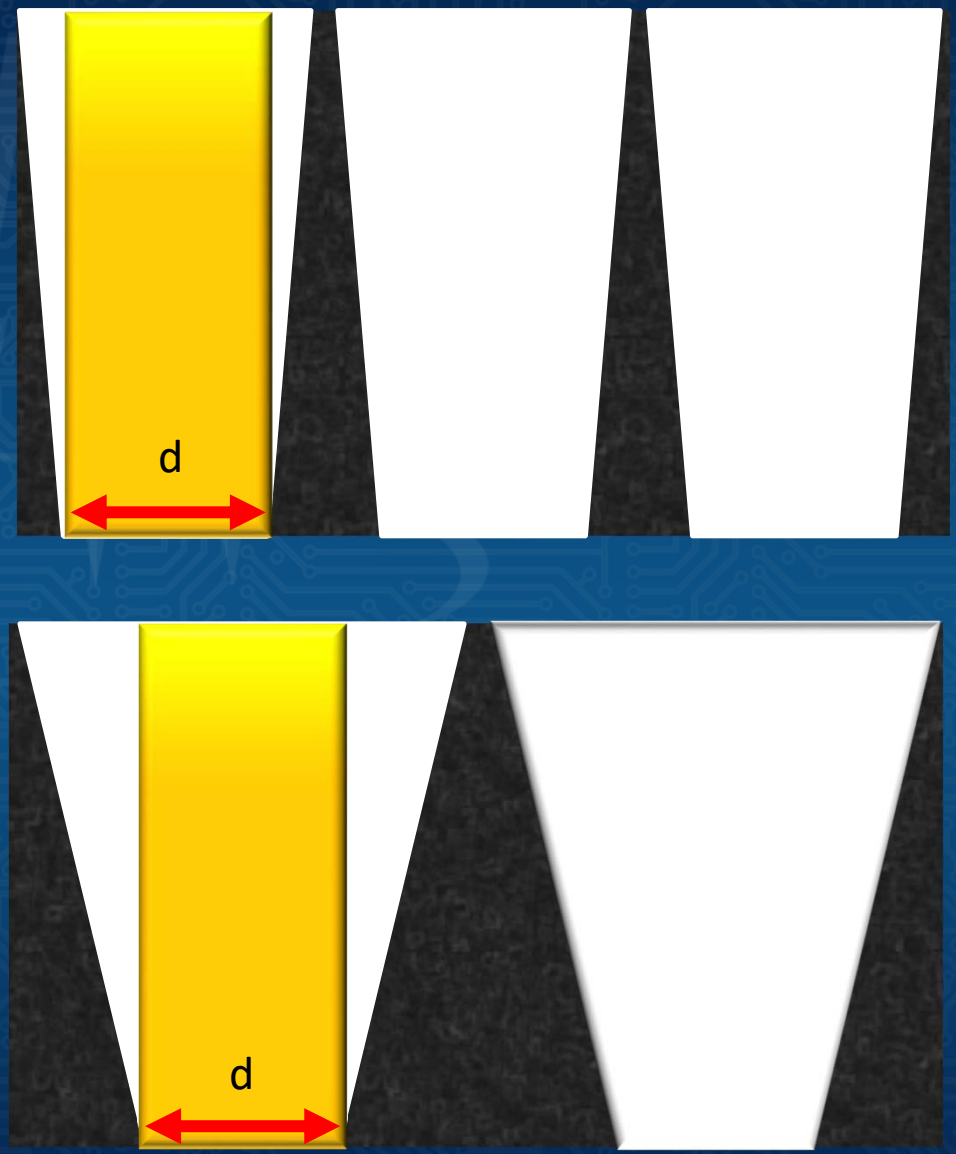
Hole Size Variation For 20,000 Holes



60 um by 60 um. 200-300 um thick Silicon Nitride

Importance of Hole Taper

While the pin dimension "d" is the same, if we reduce the entrance diameter, then this reduces the minimum pitch of the holes



Summary

- Smart Progress
- Tighter Corner Radius possible
- Research and Development is never complete there are always further improvements to be made