Best practices in the use of Non-Contact Capacitive "Smart" Displacement, Gap & Hole Sensors for Aircraft & Aircraft Engines

Presented at AeroTest America

by

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Commercial Director-Europe

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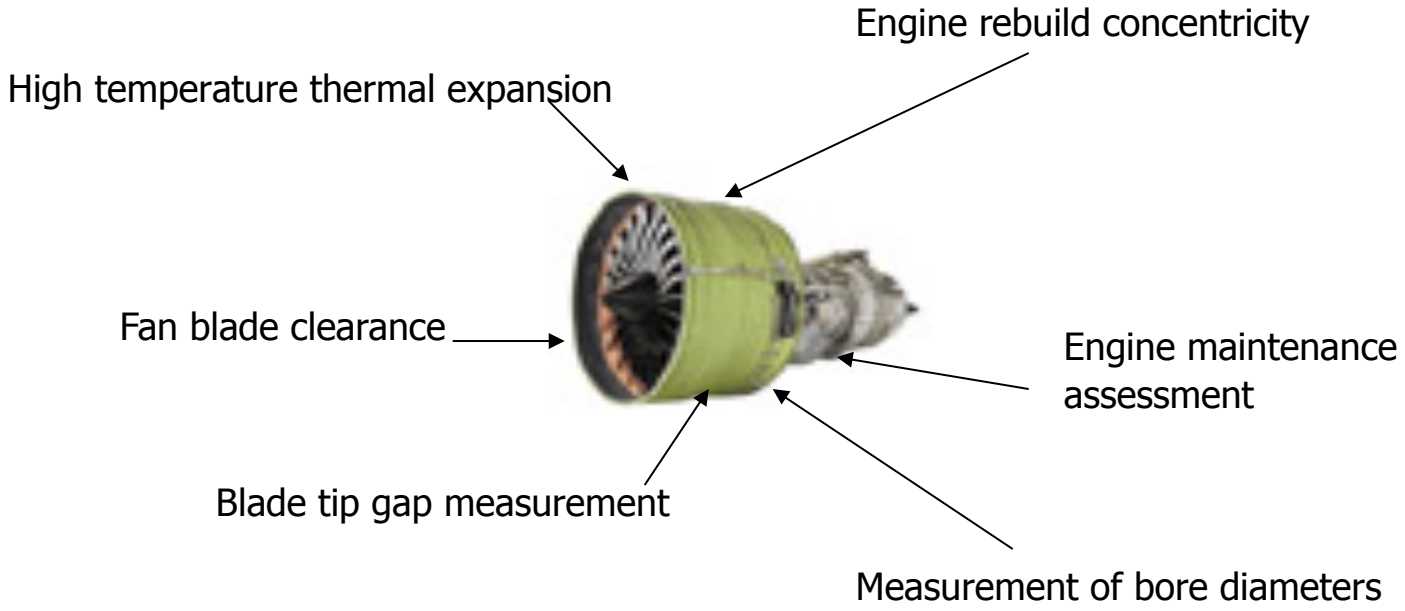
www.capacitec.com

Capacitec Background

- Over 25 years of Aerospace Market Experience in the US, Europe and Japan.
- Customers include: Lockheed Martin, Boeing, Northrop Grumman, Delta IV, GE, P&W, Rolls Royce, Snecma, MTU, Airbus, Lufthansa, Air France...
- Unique leading technology in non-contact capacitive displacement, gap and hole "mapping" sensors and systems.
- Introduction of:
  - Displacement sensors used on fuselage alignment jigs and step gaps.
  - New Gapman® wands and start of Gapman 2 development
  - Next Generation Hole Diameter Mapping System

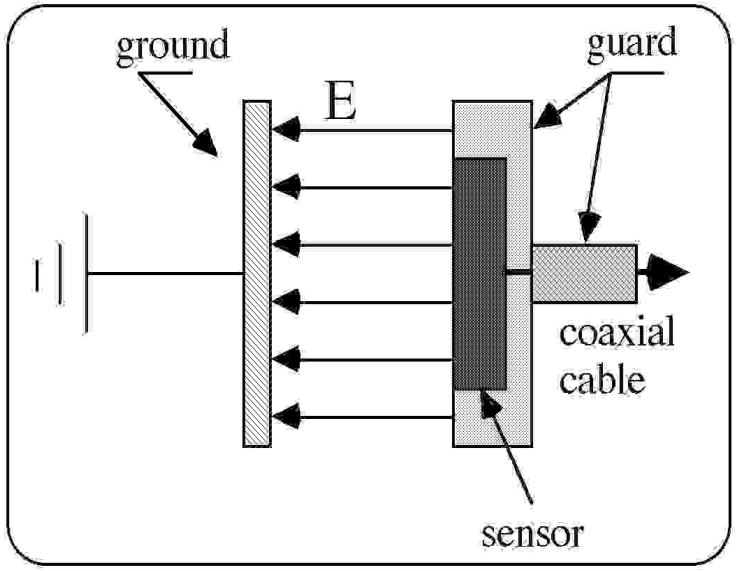
Aircraft Applications

Aircraft Engine Applications

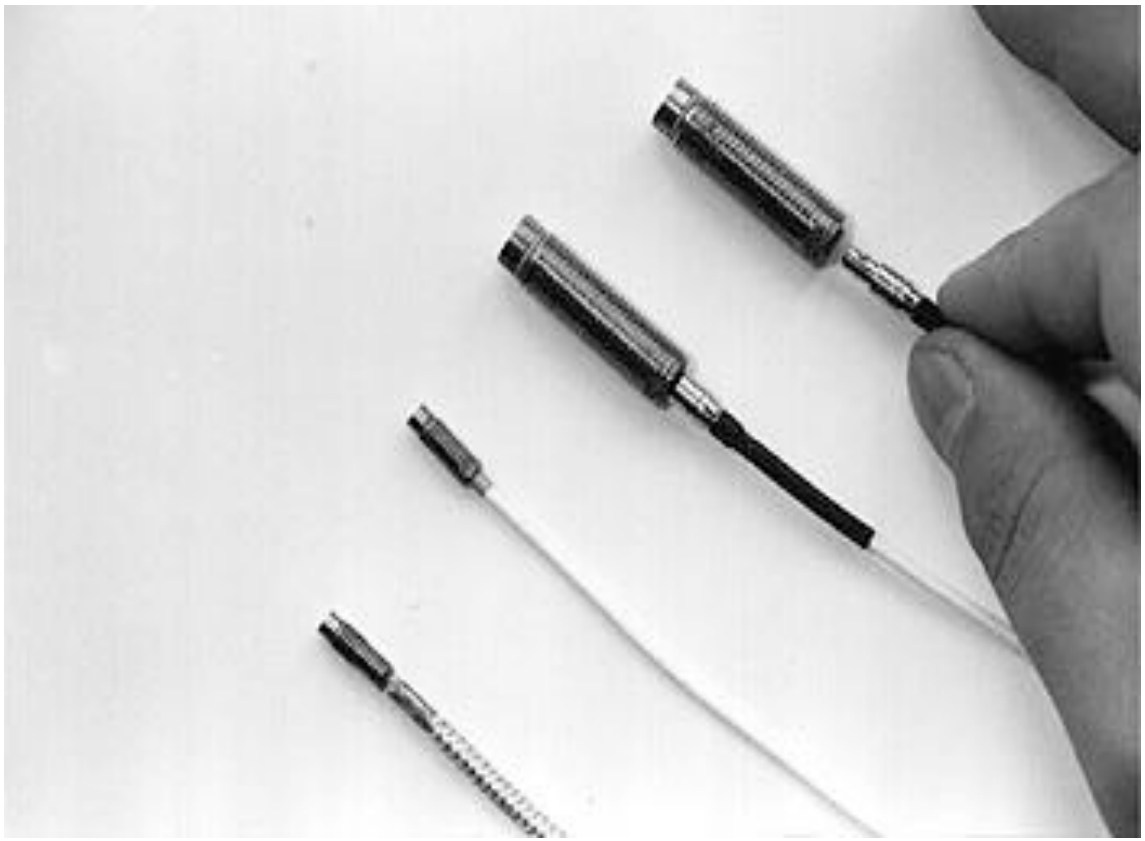


Principle of non contact capacitive measurement

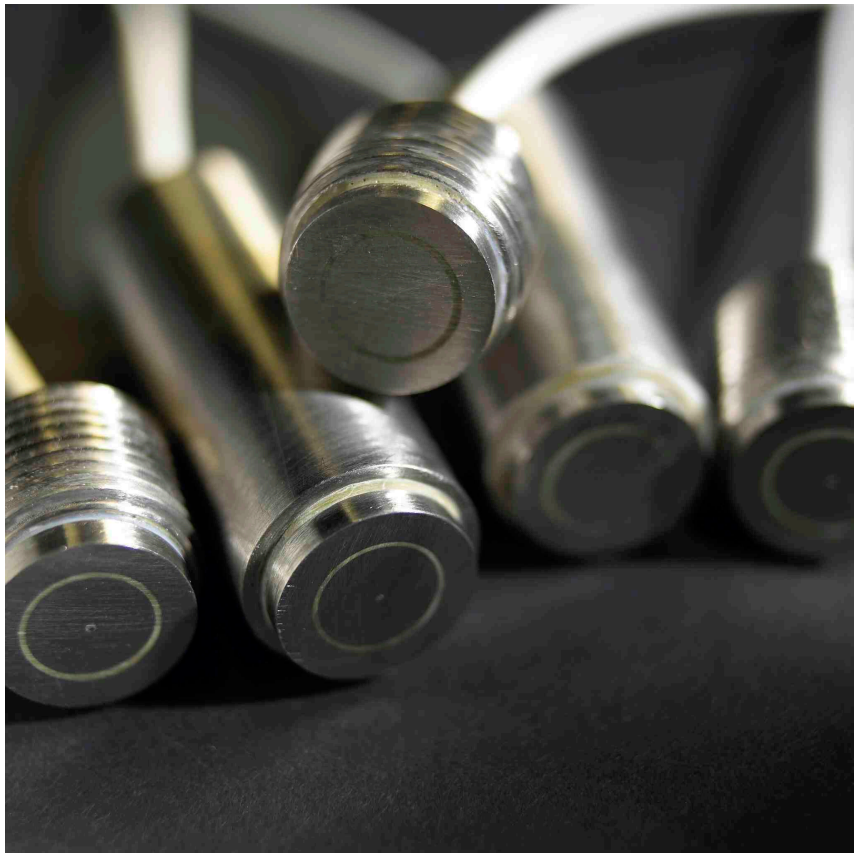
- Capacitive reactance is proportional to the distance between the sensor and the target



Typical displacement sensors



Typical displacement sensors



Displacement measurement

- High resolution combined with very small probe sizes (2 mm OD)
- High precision with linearity to 0.1% FS and repeatability to 0.01% FS
- Extreme temperature: Cryogenic (-272°C) to 1000°C
- High frequency response for high temperature and fatigue testing
- Blade length balance testing

Displacement measurement
Aircraft Applications

Subassembly Alignment jig sensor:

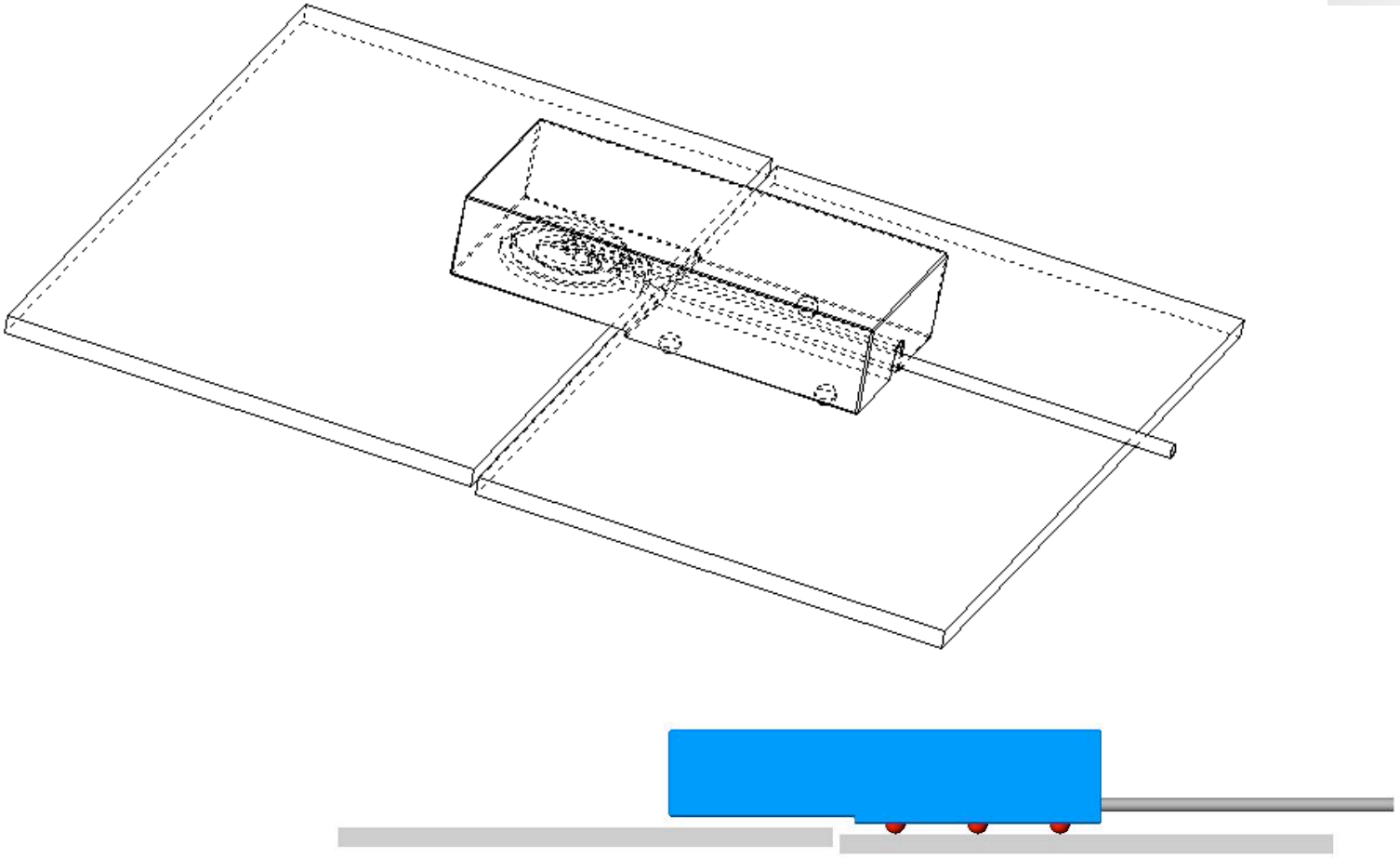
- Some aircraft assemblers use XYZ plane alignment jigs to hold various sections (e.g. fuselage, wing flaps etc.) during assembly.
- There are typically several tooling hole pins to correctly fix the alignment of joining stages.
- Laser tracker systems are often used but are costly and slow (1 hour + set up time requiring 2 to 3 specialized employees)
- ***Capacitec offers a non-contact displacement sensors to measure this alignment with a lower cost and more efficient solution.***

Displacement measurement
Aircraft Applications

Steps & Gap Measurement:

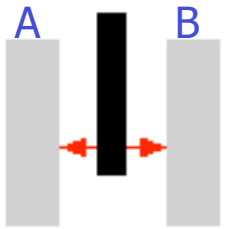
- When large composite skins are laid down on a fuselage or wings, they need to be leveled
- The process could be compared to laying ordinary floor tiles. When a tile is too low or high, shims are used for leveling.
- There are typically hundreds to thousands of steps & gaps per aircraft.
- ***Capacitec offers a simple Step and Gap Tool using non contact displacement sensors***

Step Gage

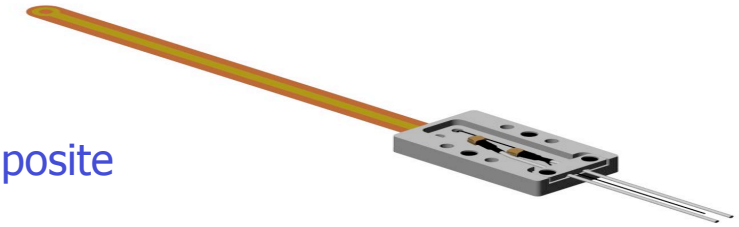


Gap measurement

- Gap measurement range from 0.008” to 0.240”
- Handheld portable instrumentation: Gapman®/ Gapmaster3
- Complete line of standard and custom wand sizes
- Complete solutions: sensor wand, electronics, data acquisition and display software



A, B = metal or composite



Typical gap sensors

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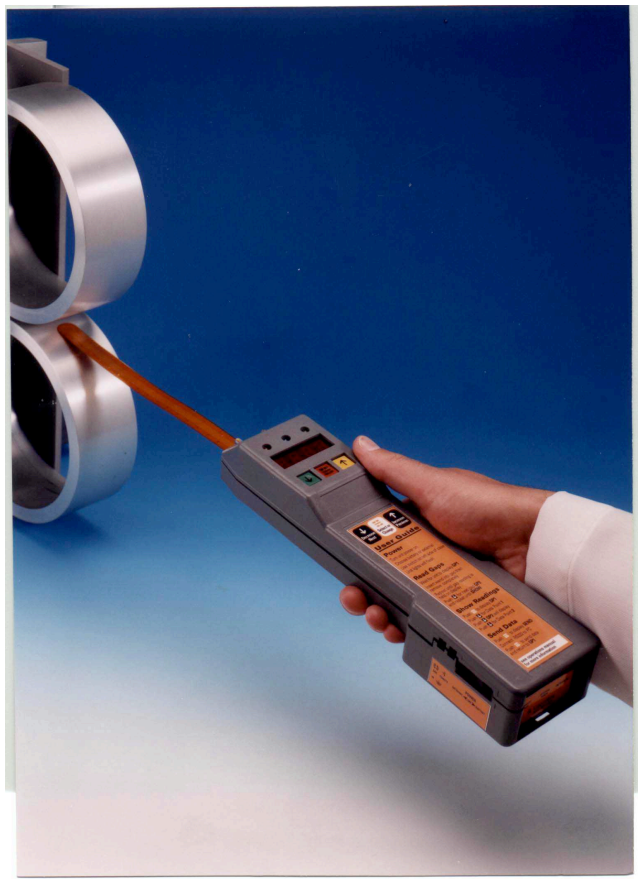
Portable "Electronic Feeler Gage"



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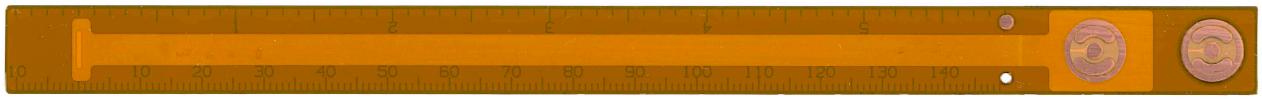
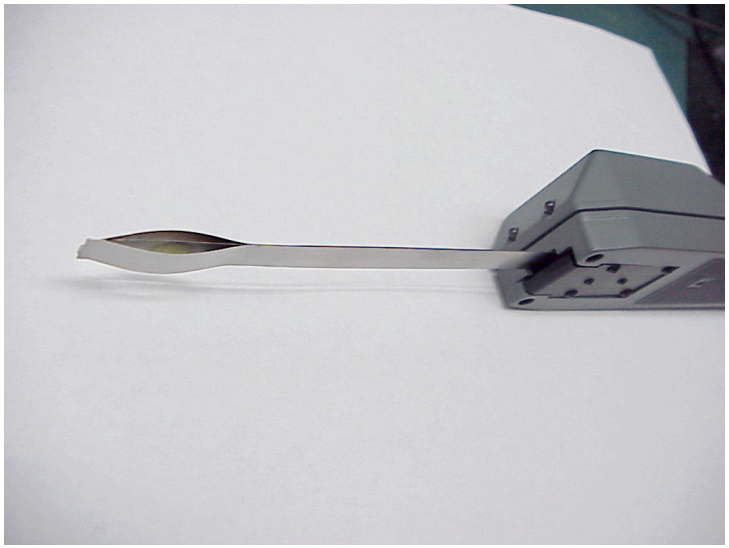
New Gapman® Wands



New 0.008” (200 micron) wand

New contact wand ➽



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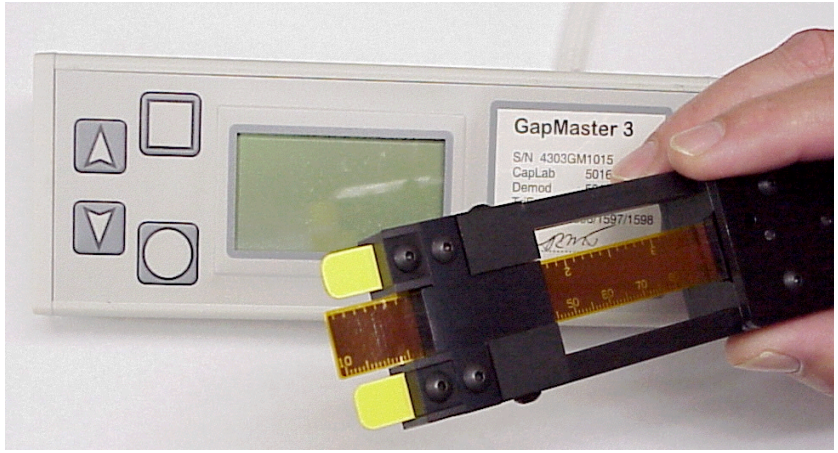
Gapmaster 3

- Semi-portable non-contact thin gap sensor system
- Flash memory data logger, real time LCD display
- Easy to use: menu driven software
- Critical gap control: flat to flat, flat to radius, composite materials
- Excellent stability even in production maintenance shop

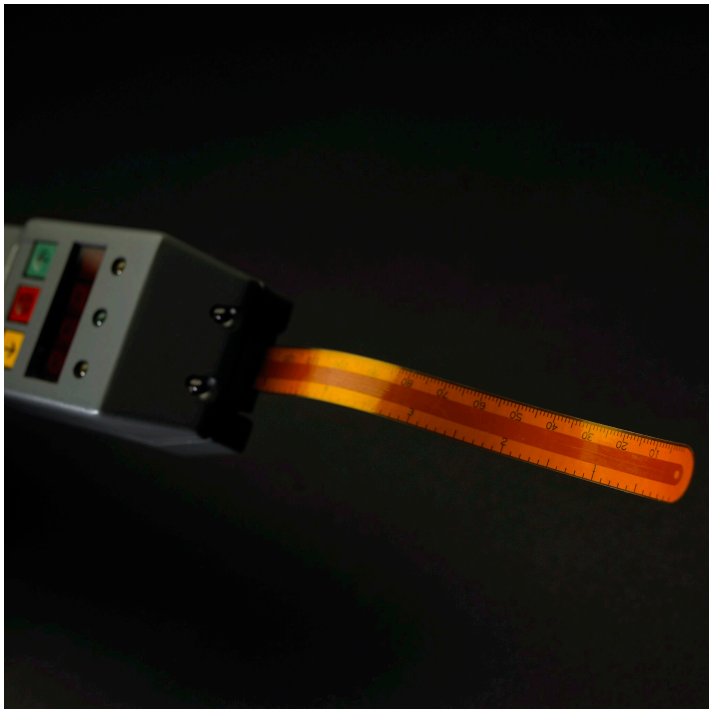


Portable/Precise Gapping System

"Gapman 2" VOC Underway

The objective is to modernize the electronics as well as enhance the device with enhanced features such as:

- Flash memory for handling more data
- Smaller size
- Longer battery life
- USB interface
- Enhanced display



Hole/Bore/Taper measurement

Easy to use in all aircraft environments.

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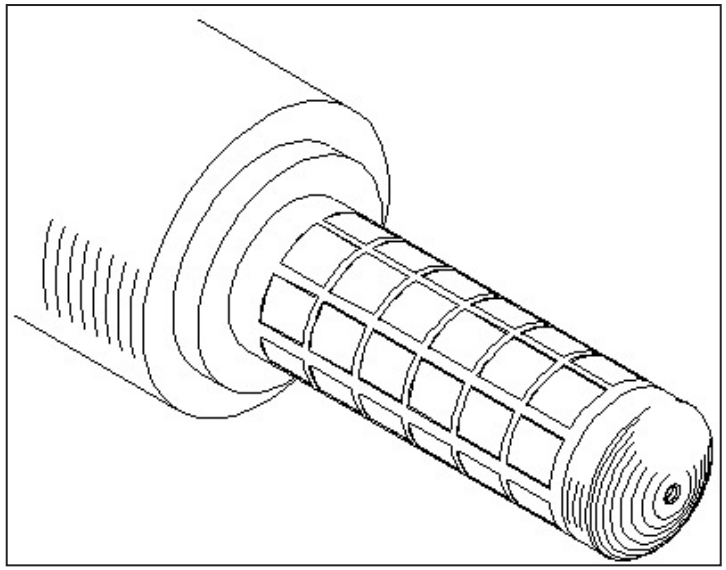
CMS Hole Diameter Mapping System

- The non-contact displacement sensor probe contains **48 sensors**
- that allow the system to inspect **24 inside diameter locations** of a fastener hole,
- in **one insertion**,
- in **less than 3 seconds**.

Capacitec Hole Probes

- Typical configuration:
  6 levels with 8 sensors



- Variety of handle configurations available

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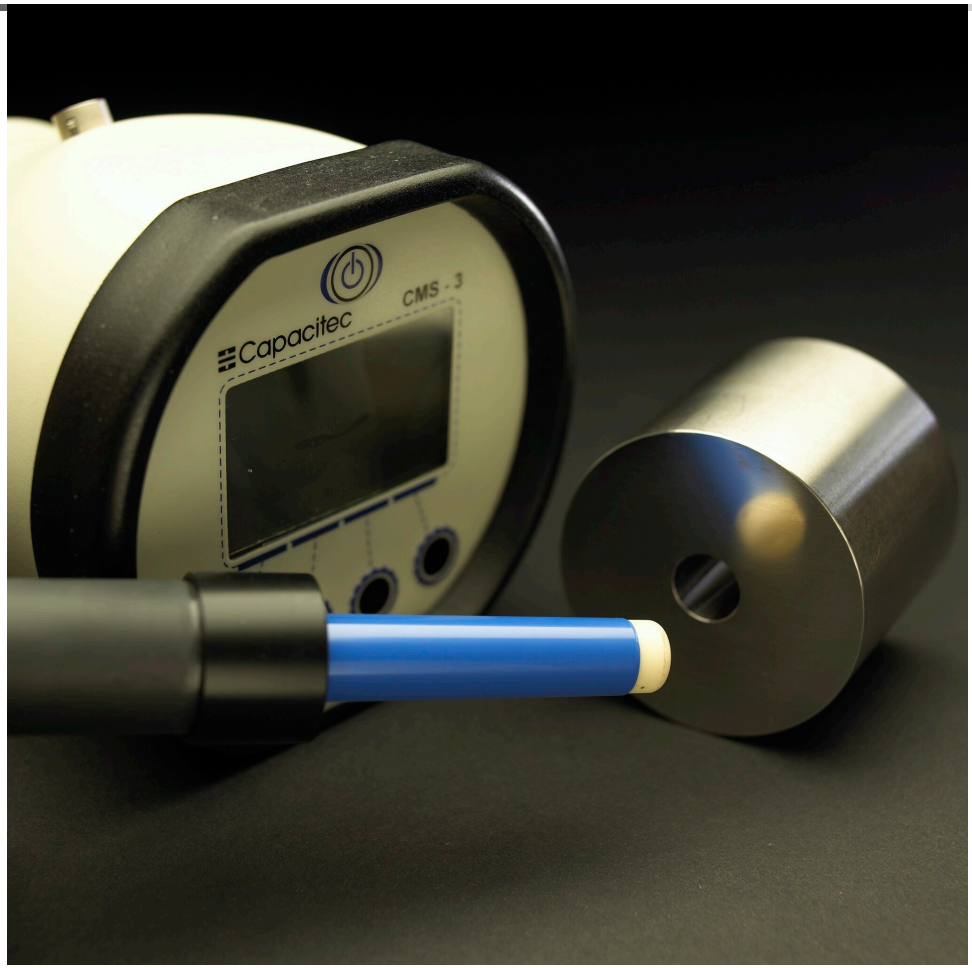
CMS Hole Diameter Mapping System

Additional features:

- *±0.0001" (15 micron) precision* measurement of straight, tapered or countersink holes
- *Min, Max and Average* hole diameter displayed with optional *Pass/Fail* limits.
- Interfaces with industry standard data collectors for *in-process trend analysis*.
- Dramatically increases *measurement throughput* while *minimizing* operator induced *errors*
- Rigid probe design provides a unique *centerline data reference.*

Hole/Bore/Taper measurement



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Hole/Bore/Taper measurement

Bore diameters from 0.150” to 1.00”

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Introducing "Next Generation" Hole Diameter Mapping System

- Designed in response to the increasing demand for fully automated robotic drilling and diameter/ countersink measurement.
- The next generation system incorporates advantages of CMS style non-contact displacement sensor probe with Capacitec standard signal conditioning electronics and Bargrafx® software

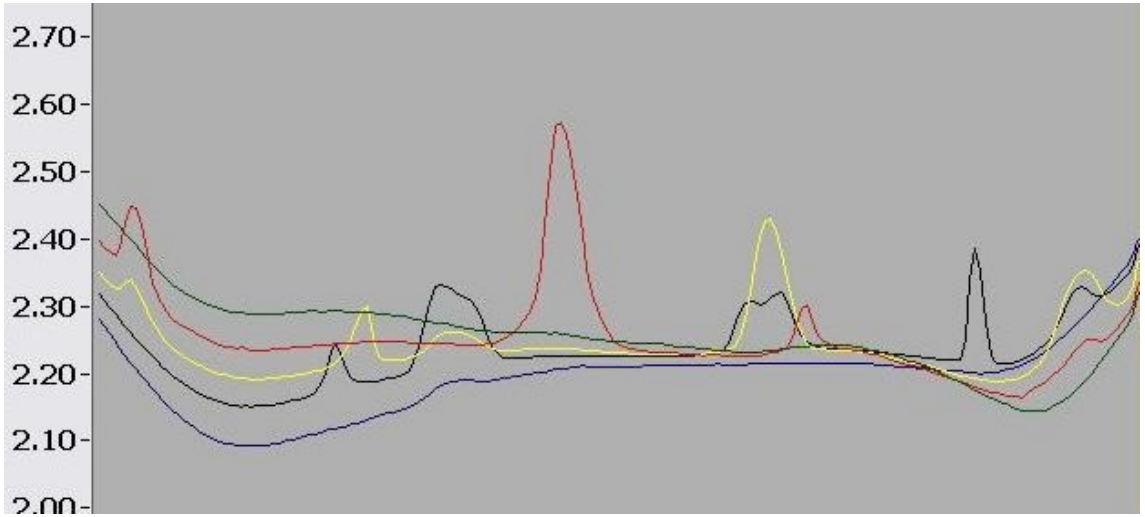
New features/benefits:

- Incorporates multiple sensors on one level to measure several diameters by using existing drilling robotics.

Real-time Mapping of bore diameters

Shows change in diameter over bore length

Δ Diameter



Depth →

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Introducing "Next Generation" Hole Diameter Mapping System

Additional new features/benefits:

- The same probe can measure interference fit and clearance fit holes.
- ***4X improvement*** in range and potential for better than ***2X improvement*** in accuracy
- Could be mounted next to drilling fixture to perform in-process measurement
- Combined with drilling robotics offers dramatic improvements in measurement throughput versus contact methods

Diameter + countersink measurement

Dramatic throughput improvement with SPC

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Thank You!

Come see a free demo at Stand 818

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