CREAFORM SURFACE INSPECTOR 2.0 SOLUTION

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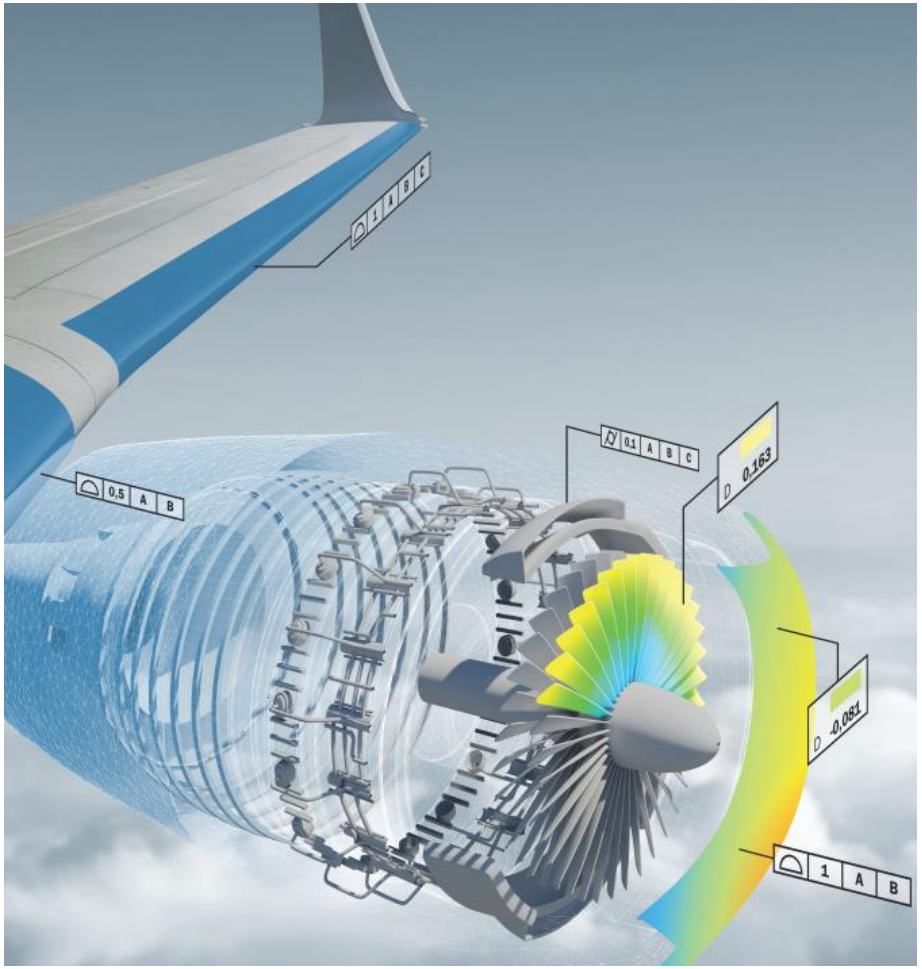
Mark Maizonnasse, Creaform
September 27th, 2016

CREAFORM

AMETEK®
ULTRA PRECISION TECHNOLOGIES

AGENDA

- Creaform
- HandySCAN:
  - How it works
  - Applications
- Surface inspector 2.0
- Case Studies
- Questions / Demo



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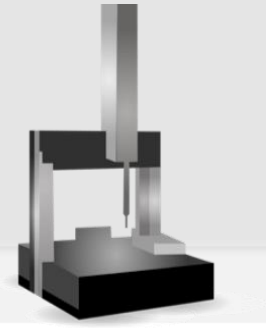
CREAFORM:
MANUFACTURER OF PORTABLE 3D MEASUREMENT SOLUTIONS

HISTORY OF 3D MEASUREMENTS

1st GENERATION



Cost $$$$

Accuracy on shop floor

Portability

Ease of use

2nd GENERATION

Cost $$$

Accuracy on shop floor

Portability

Ease of use

3rd GENERATION

CREAFORM

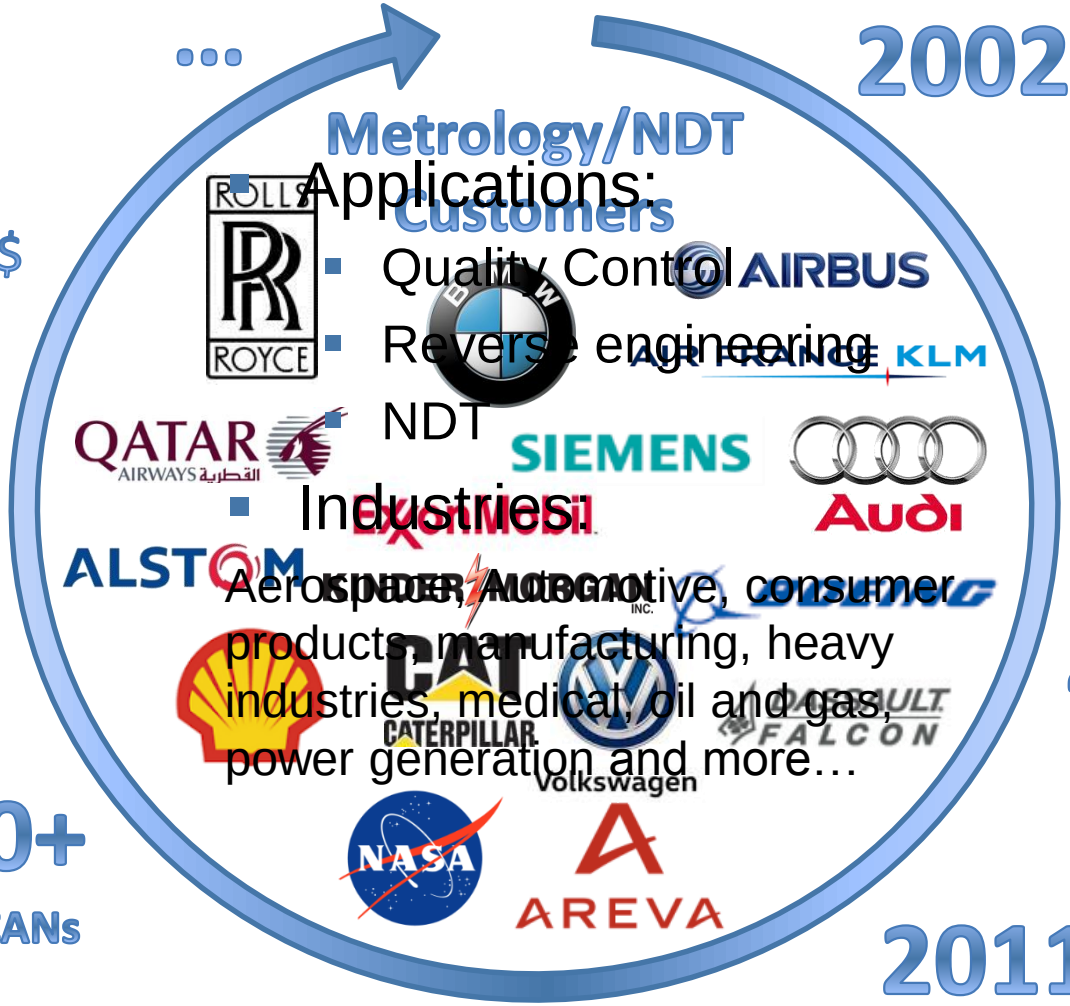
Cost $$

Accuracy on shop floor

Portability

Ease of use

A WORLD-CLASS METROLOGY LEADER



2002 Founded in Quebec

100 M$

200 CAD and metrology experts

25% growth/year

450 Employees worldwide

7000+ HandySCANs

2011 NDT Division

2013 Part of Ametek Group

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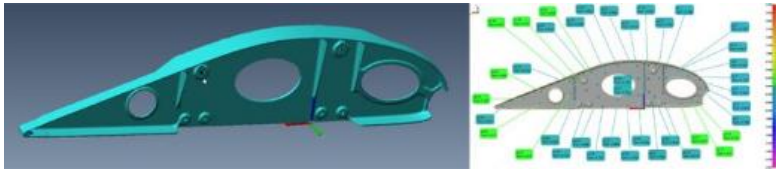
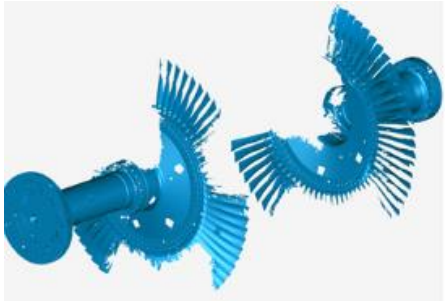
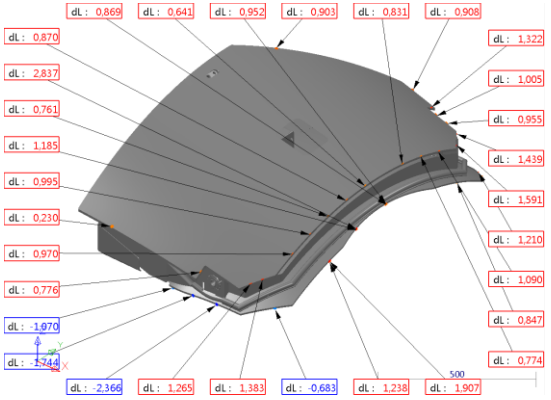
QUALITY CONTROL / REVERSE

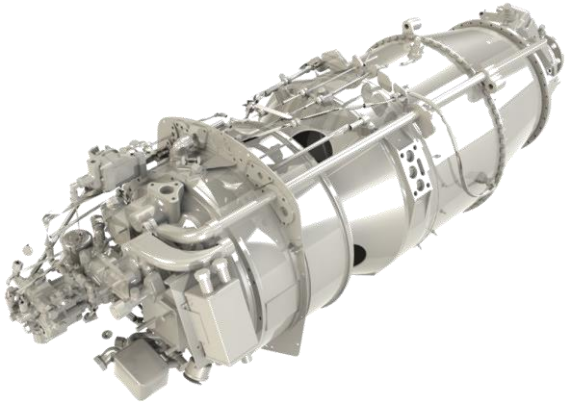
- Quality Control:







- Reverse engineering:



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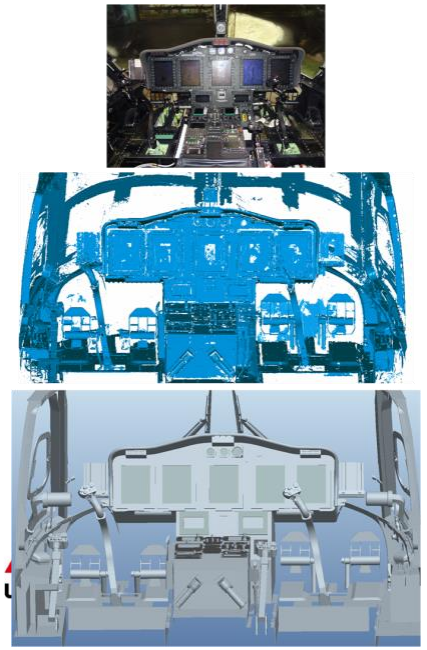
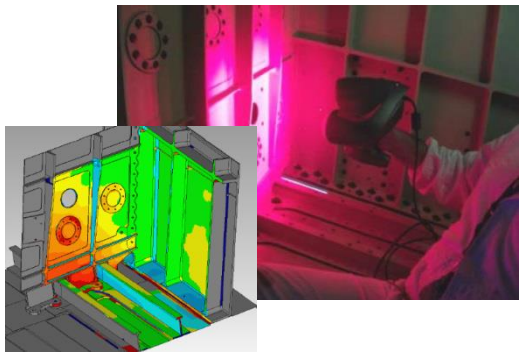
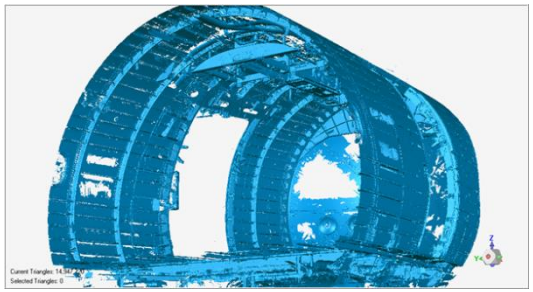
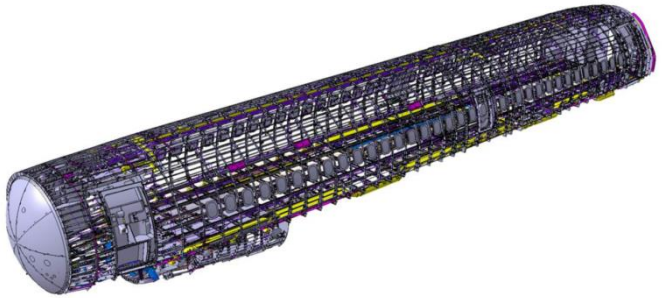


LARGE AREA SCANNING







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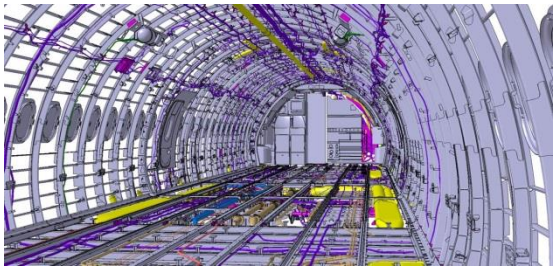
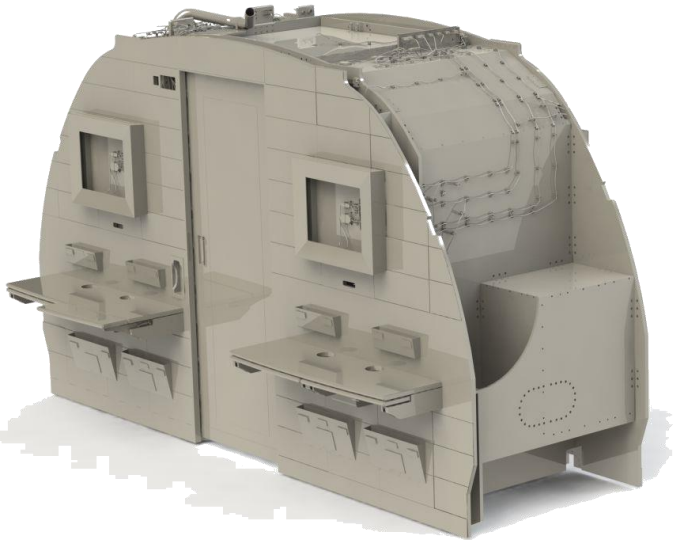
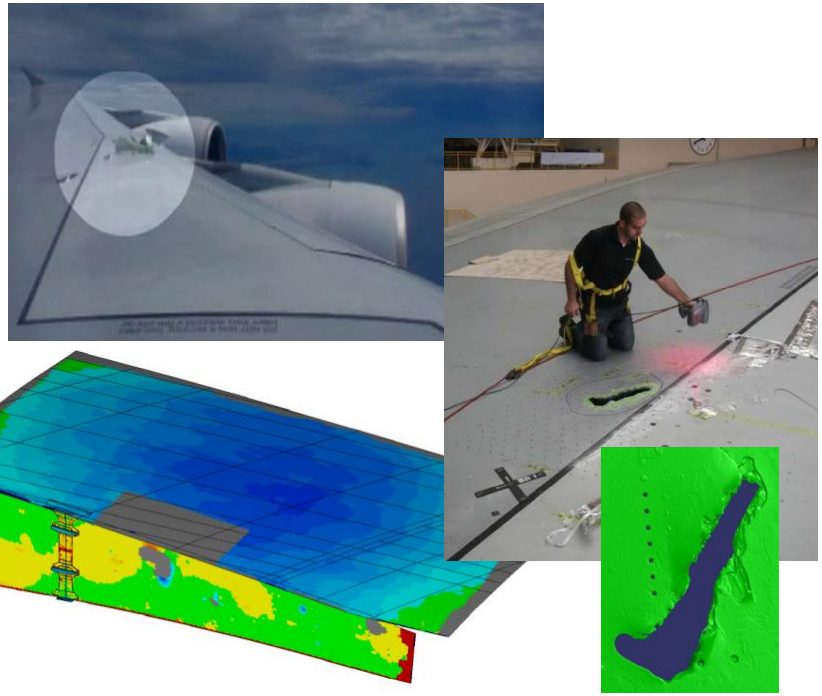


PORTABILITY ANYWHERE

- Anywhere around the aircraft
- Inside, outside (daylight)
- Alignment with UT data





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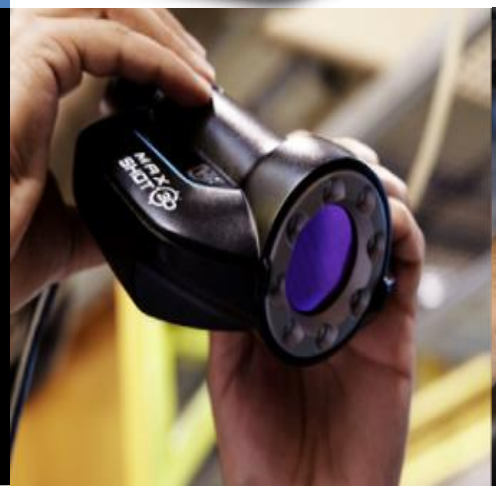
ULTRA PRECISION TECHNOLOGIES

PORTABLE
3D SCANNERS

REVERSE
ENGINERING &
INSPECTION
SOFTWARE

ROBOT-
MOUNTED 3D
SCANNING CELLS

OPTICAL
COORDINATE
MEASURING
SYSTEM
PHOTOGRAMMETRY

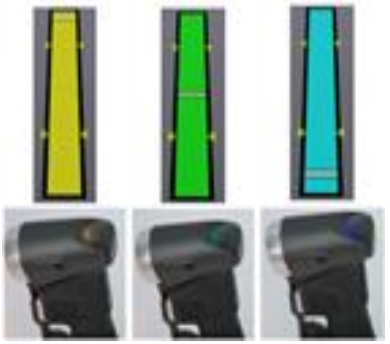


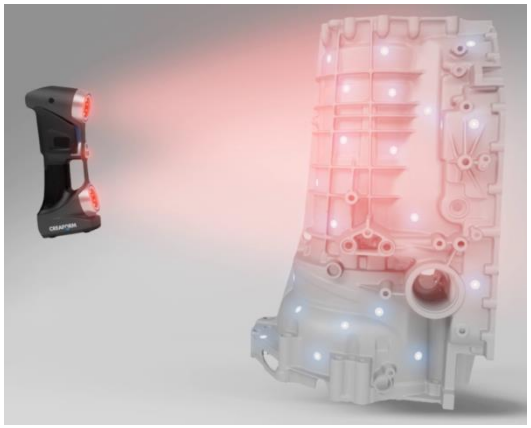
PORTABLE
OPTICAL CMM

HANDYSCAN

TRUPORTABILITY: SELF-POSITIONING DEVICE

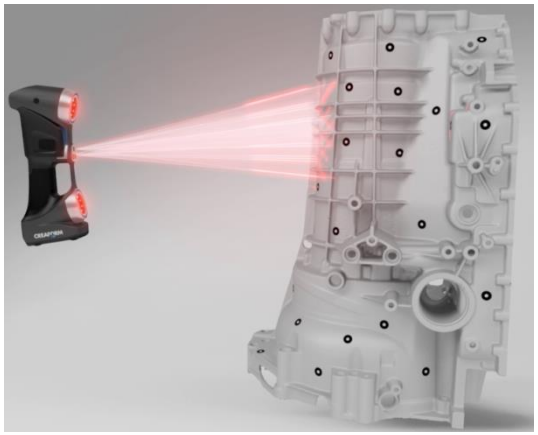
- **Human factor controlled**
- Optimal Stand-off distance / Live feedback
- **<u>Intelligent acquisition method</u>**





Self positioning 3D Scanner

+



Real Time Surface Rendering

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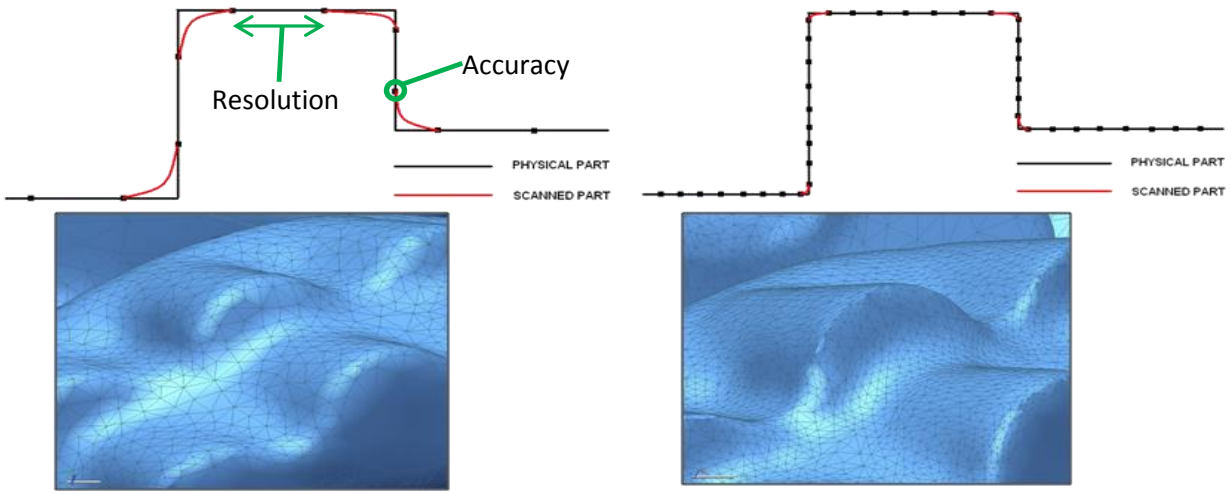
TRUACCURACY: HIGH QUALITY RESULTS

- HandySCAN's accuracy is independent of the user (30µm = 1.2 thou)

- HandySCAN's resolution (up to 50µm = 2 thou) refers to the level of details that the sensor can acquire:
  - Set by inspector
  - Organized mesh output (.stl)



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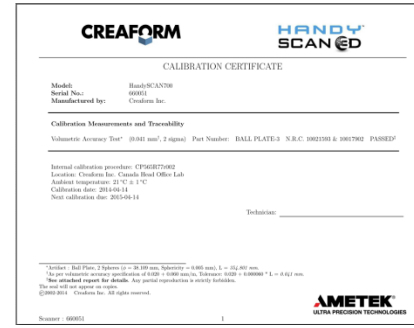
TRUACCURACY: HIGH QUALITY RESULTS

- On site calibration
- Extra fast calibration +/- 30 secs
- Traceability of calibration plate
- Similar to calibration block with UT devices


CREAFORM — HANDY SCAN 3D

CALIBRATION CERTIFICATE

Model: HandySCAN700
Serial No.: 660051
Manufactured by: Creaform Inc.

Calibration Measurements and Traceability

Volumetric Accuracy Test* (0.041 mm[1], 2 sigma) Part Number: BALL PLATE-3 N.R.C. 10021593 & 10017902 PASSED[2]

Internal calibration procedure: CP565R77r002
Location: Creaform Inc. Canada Head Office Lab
Ambient temperature: 21 °C ± 1 °C
Calibration date: 2014-04-14
Next calibration due: 2015-04-14

Technician: ____________

*Artifact : Ball Plate, 2 Spheres (ϕ = 38.109 mm, Sphericity = 0.005 mm), L = 354.801 mm.
[1]As per volumetric accuracy specification of 0.020 + 0.060 mm/m. Tolerance: 0.020 + 0.000060 * L = 0.041 mm.
[2]**See attached report for details.** Any partial reproduction is strictly forbidden.
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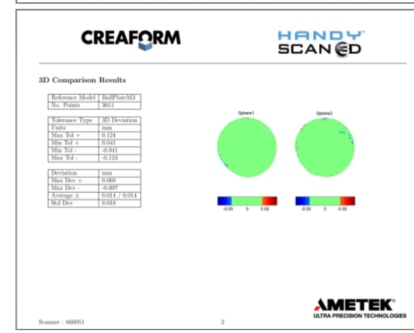
Scanner : 660051 1


CREAFORM — HANDY SCAN 3D

3D Comparison Results

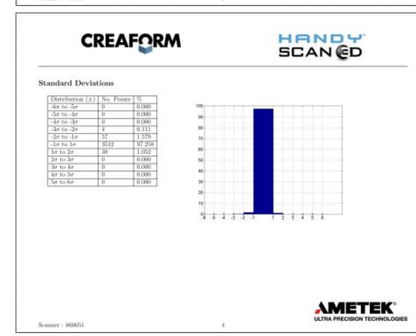
Reference Model	BallPlateM3
No. Points	3611

Tolerance Type	3D Deviation
Units	mm
Max Tol +	0.124
Min Tol +	0.041
Min Tol -	-0.041
Max Tol -	-0.124

Deviation	mm
Max Dev +	0.068
Max Dev -	-0.097
Average ±	0.014 / 0.014
Std Dev	0.018

AMETEK ULTRA PRECISION TECHNOLOGIES

Scanner : 660051 2


CREAFORM — HANDY SCAN 3D

Standard Deviations

Distribution (±)	No. Points	%
-6σ to -5σ	0	0.000
-5σ to -4σ	0	0.000
-4σ to -3σ	0	0.000
-3σ to -2σ	4	0.111
-2σ to -1σ	57	1.579
-1σ to 1σ	3512	97.258
1σ to 2σ	38	1.052
2σ to 3σ	0	0.000
3σ to 4σ	0	0.000
4σ to 5σ	0	0.000
5σ to 6σ	0	0.000

AMETEK ULTRA PRECISION TECHNOLOGIES

Scanner : 660051 4

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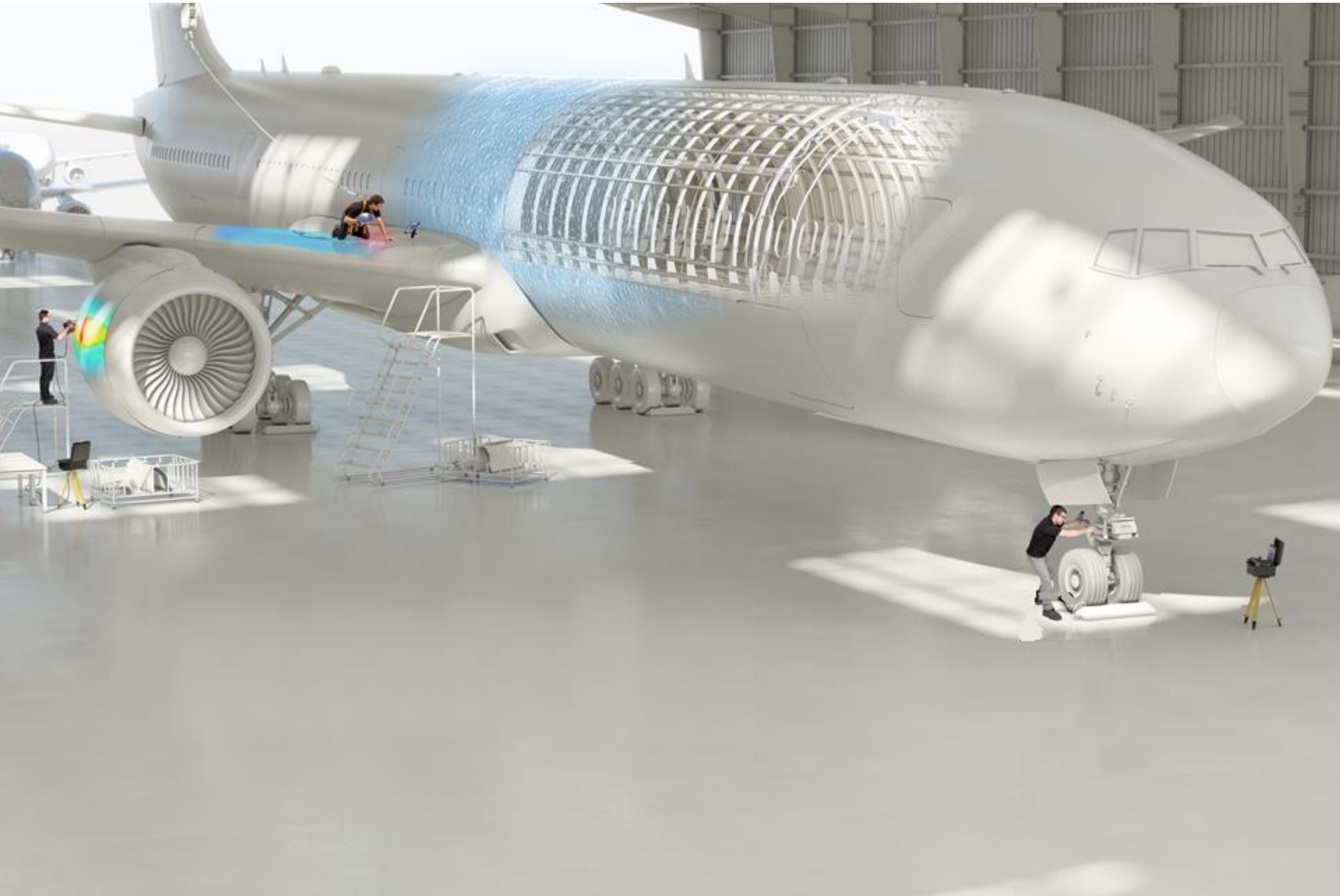
SURFACE INSPECTOR SOLUTION

SURFACE INSPECTOR OVERVIEW

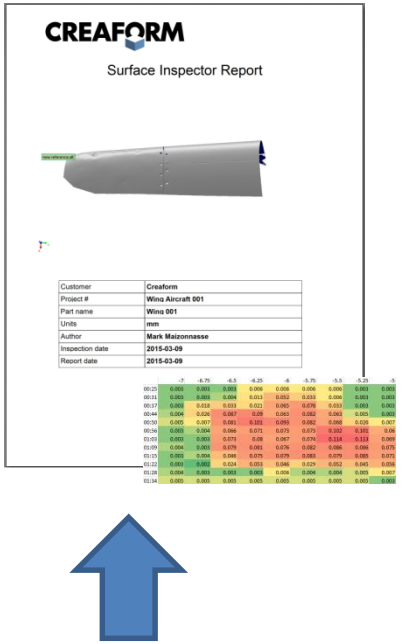


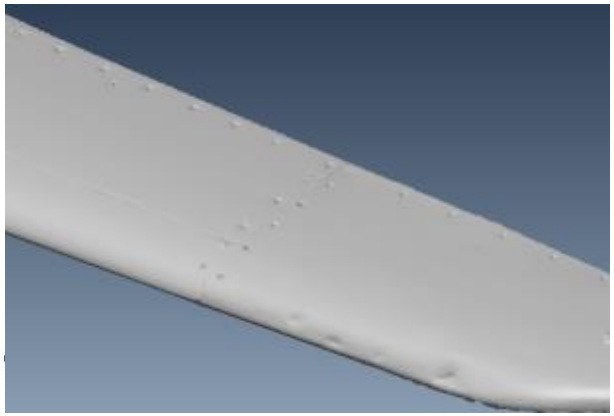
SIMPLEST POSSIBLE WORKFLOW

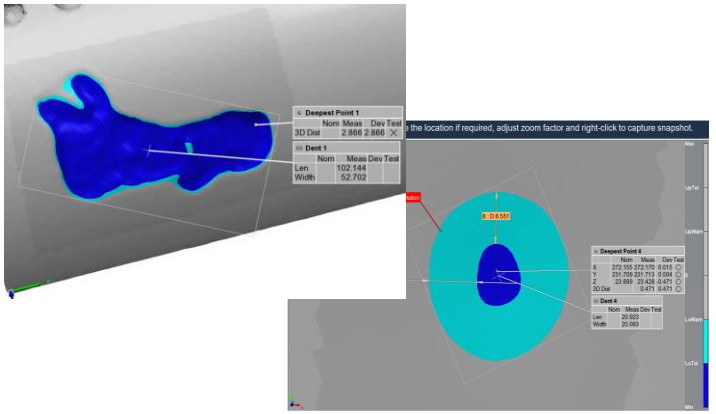
1. Surface acquisition (30 secs/m²)

2. Surface reconstruction/extraction of inspection data (1 min)

3. Reporting (seconds):
   - PDF or spreadsheets, editable
   - Damage characterization
   - Skin waviness (2D depth mapping)



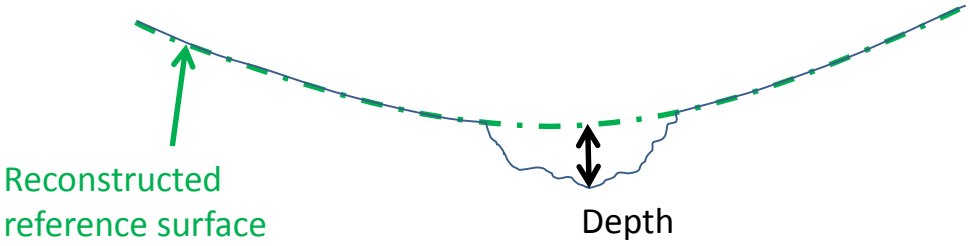


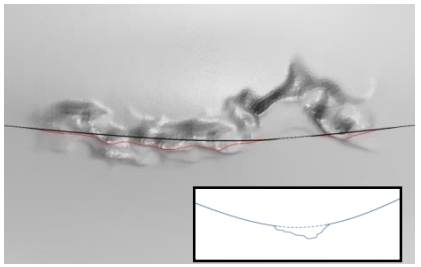


HOW IT IS MEASURED?

- **Reference surface reconstruction** based on the curvature around the damaged area (**only good material is used as reference**)
- The reference surface is then compared to the measured data
- This allows **versatile** measurements on **any kind of surface** (convex, concave, **free form**…)

- **No limitations/error** compared to pit gauge measurements
- Results are **not user dependent**





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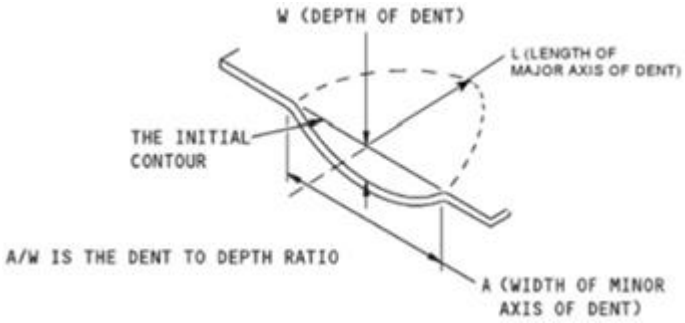
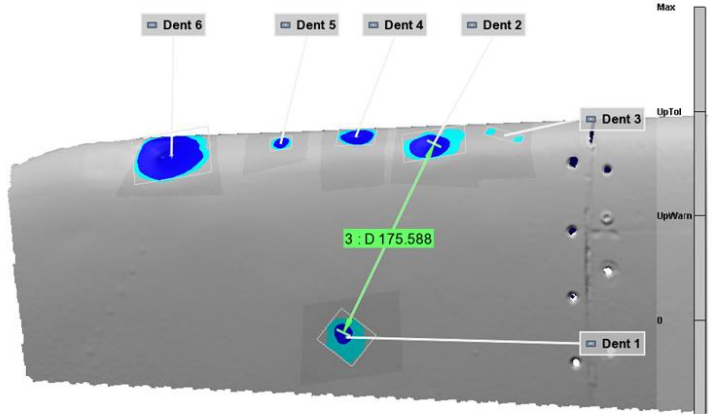
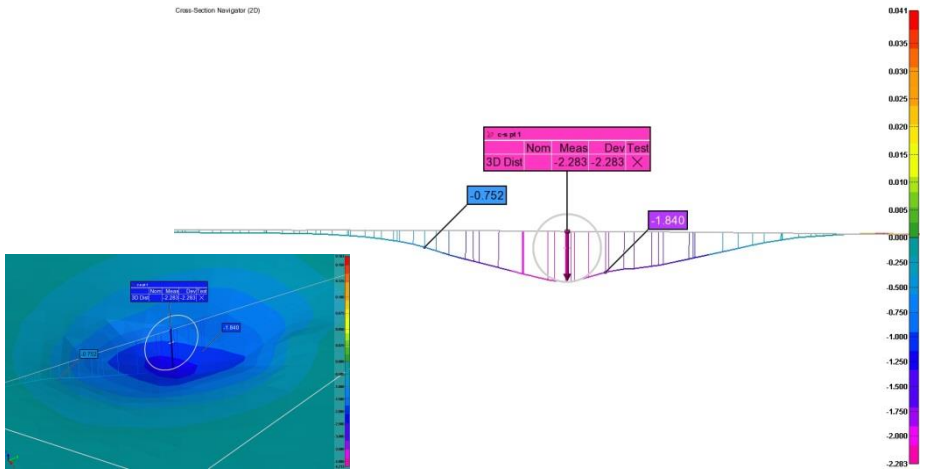
WHAT IS MEASURED?



- **Specific damaged area dimensions** (length, width, depth, A/W ratio)
- Localization of **deepest point over a specified area**
- **Position** of the damaged area
- 2D **depth mapping**
- **Replaces pit gages, calipers, measuring tape, etc.**



	-7	-6.75	-6.5	-6.25	-6	-5.75	-5.5	-5.25	-5
00:25	0.003	0.003	0.003	0.006	0.006	0.006	0.006	0.003	0.003
00:31	0.003	0.003	0.004	0.013	0.052	0.033	0.006	0.003	0.003
00:37	0.003	0.018	0.033	0.021	0.065	0.076	0.033	0.003	0.003
00:44	0.004	0.026	0.087	0.09	0.063	0.082	0.063	0.005	0.003
00:50	0.005	0.007	0.081	0.101	0.093	0.082	0.068	0.026	0.007
00:56	0.003	0.004	0.066	0.071	0.073	0.073	0.102	0.101	0.06
01:03	0.003	0.003	0.073	0.08	0.067	0.074	0.114	0.113	0.069
01:09	0.004	0.003	0.079	0.081	0.076	0.082	0.086	0.086	0.075
01:15	0.003	0.004	0.046	0.075	0.079	0.083	0.079	0.085	0.071
01:22	0.003	0.002	0.024	0.053	0.046	0.029	0.052	0.045	0.056
01:28	0.004	0.003	0.003	0.003	0.006	0.004	0.004	0.005	0.007
01:34	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.003



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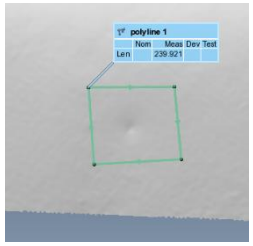
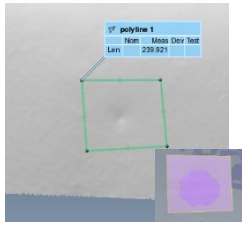
TRUSIMPLICITY: SIMPLEST POSSIBLE WORKFLOW

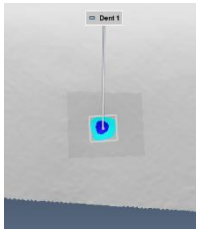
- 4 clicks around the area of interest (single or multiple defects)
- Automatic surface reconstruction and measurement extraction
- Automatic report generation

- Report personalization on the fly
- Possibility of adding annotations and distances

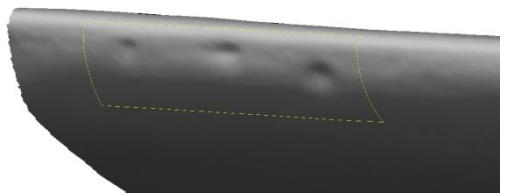
Single Dent

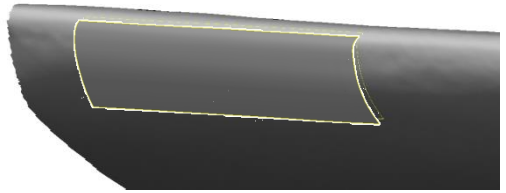


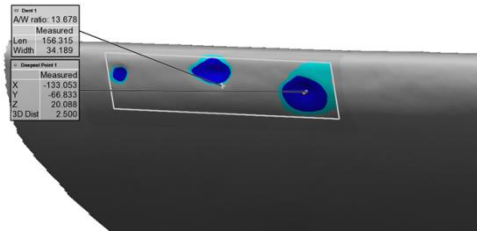




Surface inspection







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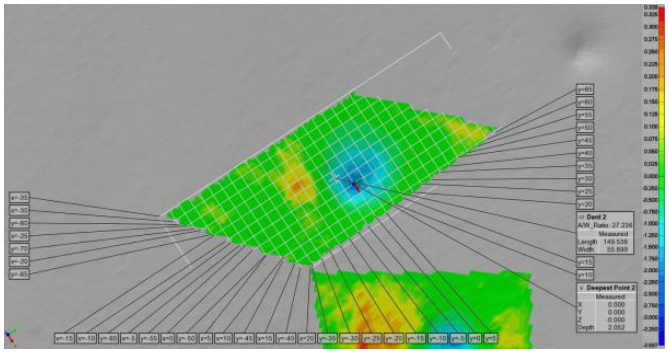
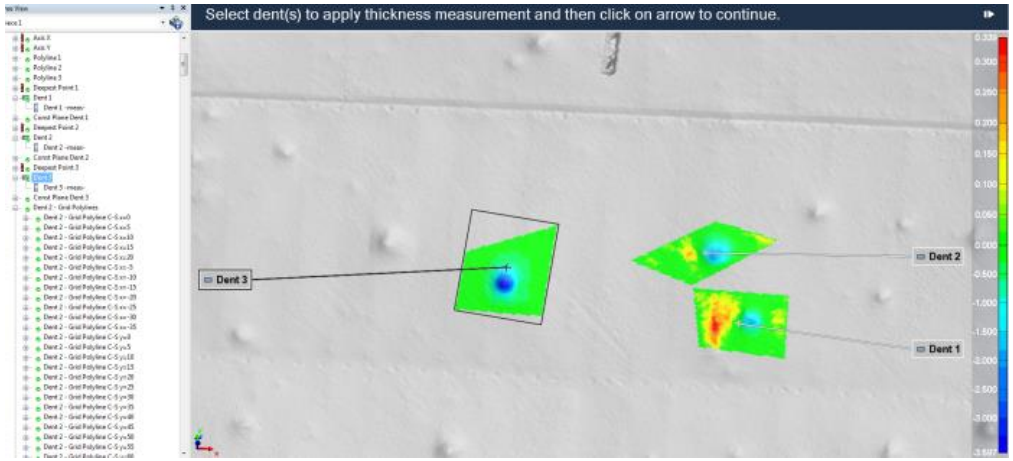
SURFACE INSPECTOR 2.0

- Add automatically
  - Measurements
  - Dents
  - Snapshots/images
  - Grids with deepest point
- Set thickness
- Auto rebuild report



Grid Points

Name	X	Y	Dist
Dent 2 - Grid Point 108	-5	-5	2.052
Dent 2 - Grid Point 121	0	0	1.976
Dent 2 - Grid Point 120	-5	0	1.969
Dent 2 - Grid Point 109	0	-5	1.954
Dent 2 - Grid Point 131	-5	5	1.693
Dent 2 - Grid Point 119	-10	0	1.680
Dent 2 - Grid Point 132	0	5	1.560
Dent 2 - Grid Point 107	-10	-5	1.534
Dent 2 - Grid Point 142	-5	10	1.504
Dent 2 - Grid Point 130	-10	5	1.460
Dent 2 - Grid Point 143	0	10	1.443
Dent 2 - Grid Point 122	5	0	1.441
Dent 2 - Grid Point 110	5	-5	1.348
Dent 2 - Grid Point 97	-5	-10	1.319
Dent 2 - Grid Point 133	5	5	1.318
Dent 2 - Grid Point 141	-10	10	1.260
Dent 2 - Grid Point 96	-10	-10	1.256
Dent 2 - Grid Point 98	0	-10	1.256
Dent 2 - Grid Point 118	-15	0	1.171
Dent 2 - Grid Point 106	-15	-5	1.118



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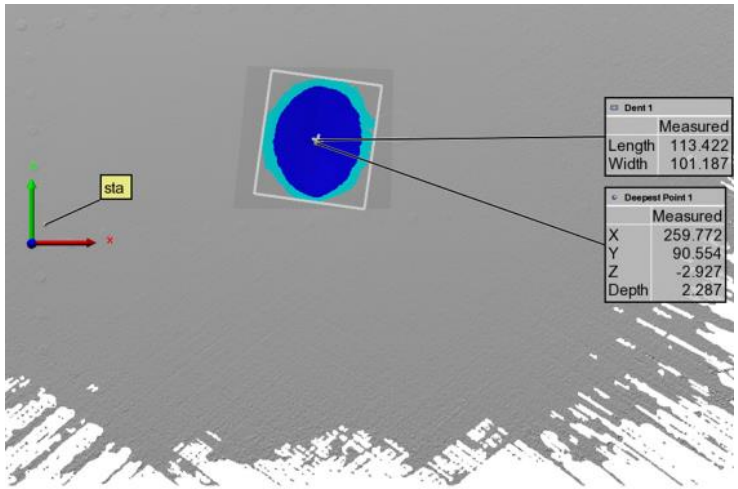
SURFACE INSPECTOR 2.0

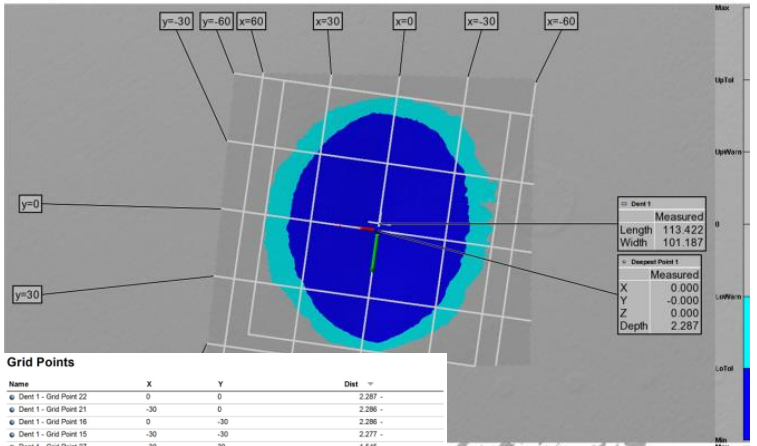


Deepest Point 1

Control	Meas
X	259.772
Y	90.554
Z	-2.927
Depth	2.287

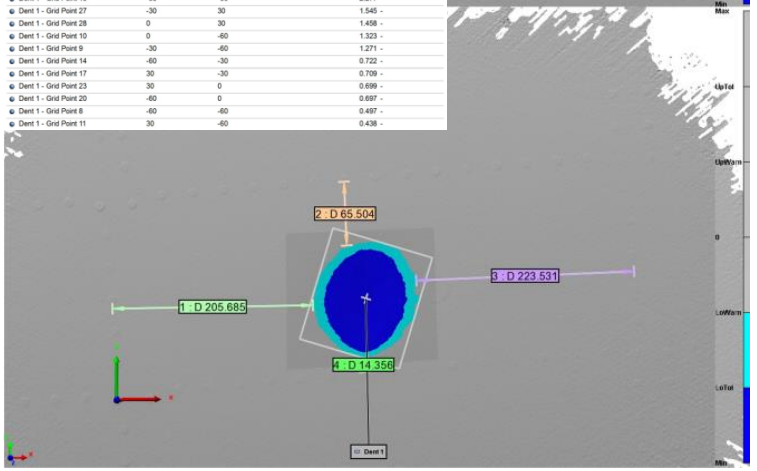
Dent 1 A/W_Ratio: 44.249

Control	Meas
Length	113.422
Width	101.187



Grid Points

Name	X	Y	Dist
Dent 1 - Grid Point 22	0	0	2.287
Dent 1 - Grid Point 21	-30	0	2.286
Dent 1 - Grid Point 16	0	-30	2.286
Dent 1 - Grid Point 15	-30	-30	2.277
Dent 1 - Grid Point 27	-30	30	1.545
Dent 1 - Grid Point 28	0	30	1.458
Dent 1 - Grid Point 10	0	-60	1.323
Dent 1 - Grid Point 9	-30	-60	1.271
Dent 1 - Grid Point 14	-60	-30	0.722
Dent 1 - Grid Point 17	30	-30	0.709
Dent 1 - Grid Point 23	30	0	0.699
Dent 1 - Grid Point 20	-60	0	0.697
Dent 1 - Grid Point 8	-60	-60	0.497
Dent 1 - Grid Point 11	30	-60	0.438



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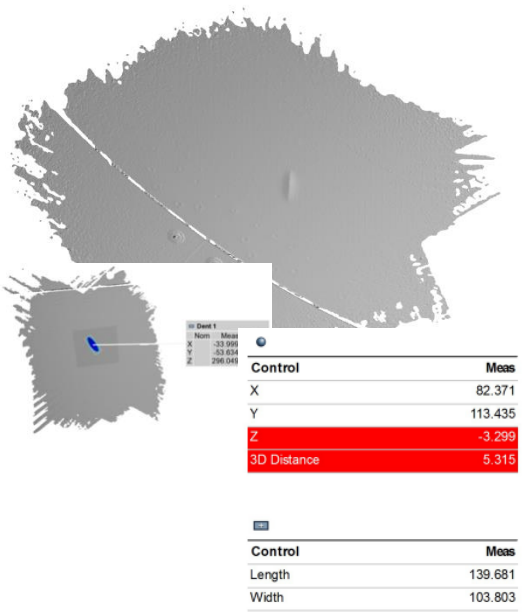
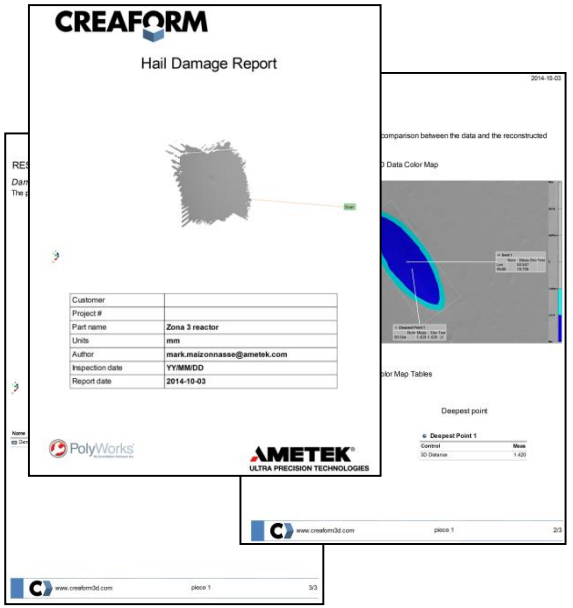
AMETEK®
ULTRA PRECISION TECHNOLOGIES

CASE STUDY AND EXAMPLES

CASE STUDY: DENT IN ENGINE AREA

- **Simple setup:** scanner, laptop, battery
- **Human factor controlled**
- Benefits: **high analytical accuracy, repeatability**, traceability, portability and ease of use





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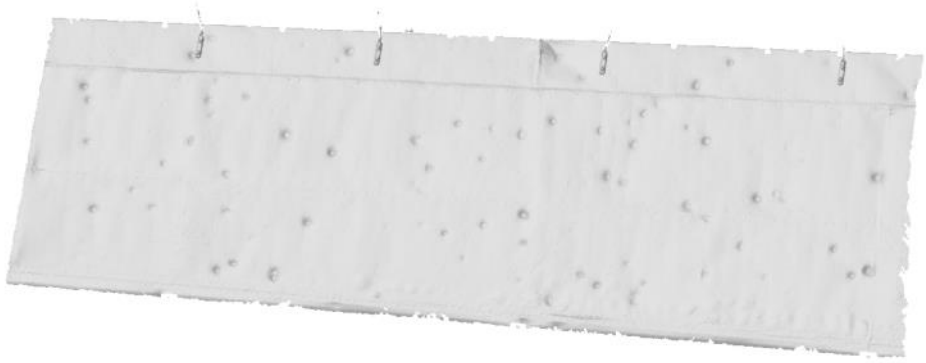
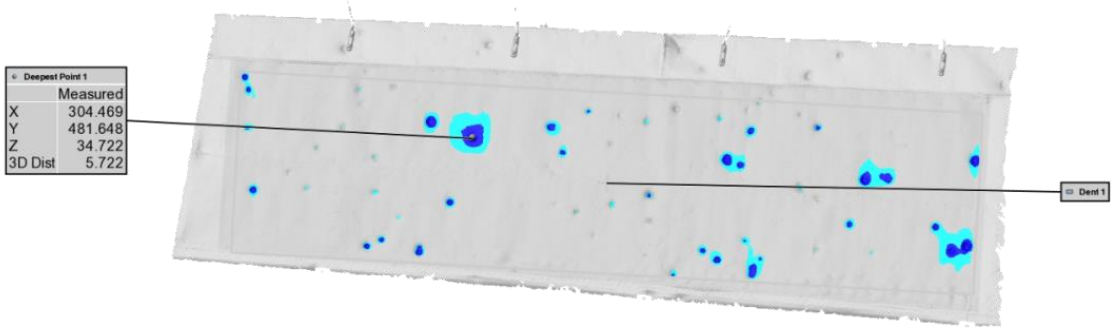
CASE STUDY: FIND DEEPEST POINT ON PART

- Scan whole fin which suffered mechanical damage
- Reconstruct surface
- Deepest point coordinates and value calculated
- 80% reduction in time compared traditional method
  4-5hr/m² ➔ 15 min/m²
- **<u>Completely automated process</u>**





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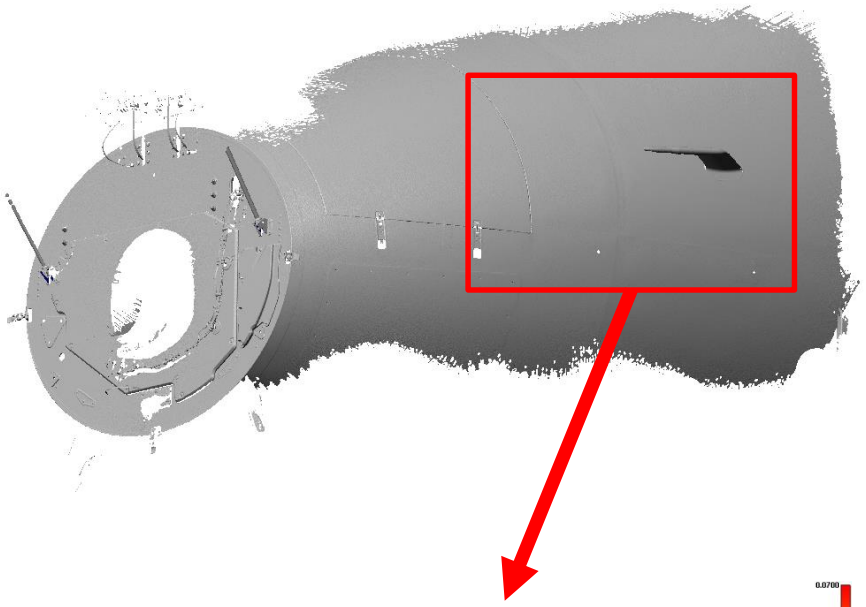
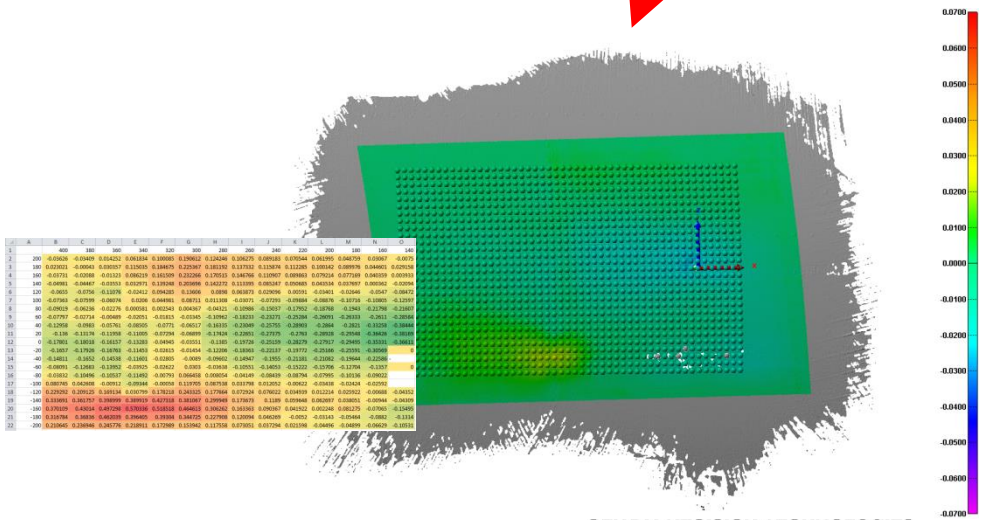
ULTRA PRECISION TECHNOLOGIES

CASE STUDY: SKIN WAVINESS

- No operator error
- Insured repeatability, accuracy and speed
- Automatic depth mapping measurement (any grid size)
- Digital record available
- **Applications:** RVSM certification, doublers, patch repair measurements…





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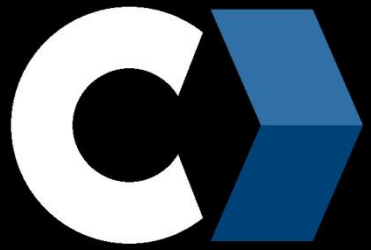
QUESTIONS? / DEMO



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