

# Changing Shop Floor Metrology From a Cost to a Benefit

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**A WHITE PAPER**

# Table of Contents

- What is 4D InSpec? . . . . . 2
- Executive Summary . . . . . 3
- Sources of ROI for 4D InSpec . . . . . 3
- Reducing Cost. . . . . 3
- Better, Faster Quality Assurance. . . . . 6
- Accelerating Delivery . . . . . 7
- Trusted Results to Review . . . . . 8
- Calculating Your Projected ROI . . . . . 8

## What is 4D InSpec?

A handheld, 3D surface measuring gauge. It takes a measurement in about 1-2 seconds, in-situ. It's highly accurate, with micron-level precision.

The instrument was first used for measuring defects on precision machined parts. It quickly assesses scratches, pits, nicks, corrosion and other defects, and assures the quality of features like peening, scribe marks, edge blending and rivets.

Its analysis software measures and quantifies edge break, radius of curvature with high precision. It's easily set up for pass-fail analysis.

4D InSpec improves profitability in repair and new-make manufacturing processes in the aviation, automotive, nuclear and general precision machining sectors.

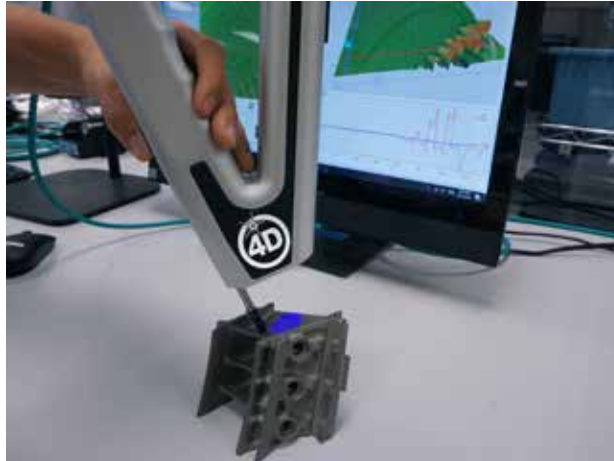
More details: <https://www.4dinspec.com>



Download the 4D InSpec data sheet:

**Click here** for the  
4D InSpec gauge  
**Data Sheet**

***What if part inspection wasn't just an expense, but could increase productivity, profit, and safety?***



## Making metrology pay for itself

By Edgar Schrock

### Executive Summary

**WHY:** Consider your highest-value part. If you could reduce the number of those that are scrapped or reworked via inaccurate inspection by 40%, how much money would that save you?

**WHAT:** The 4D InSpec surface measuring gauge produces fast, numerical, objective surface information needed to assess components. By quantifying quickly and easily, customers have reported a 20-40% increase in yield.

**WHO & WHERE:** The instrument instantly reports defect statistics on precision machined parts, and is transforming throughput in the MRO process for the aviation, automotive and nuclear energy industries. It is also used in industries as diverse as furniture, cutting tools, saw blade, and solar tile manufacturing.

**BENEFITS:**

- High precision, quantified measurements increase yield by saving more parts
- Return on investment is normally days to weeks
- Records reliable, repeatable results you can share to prove your outcomes
- Reduces labor by saving on dismantling and part transportation
- Improves turnaround time by eliminating waiting, increasing throughput

### Sources of ROI for 4D InSpec

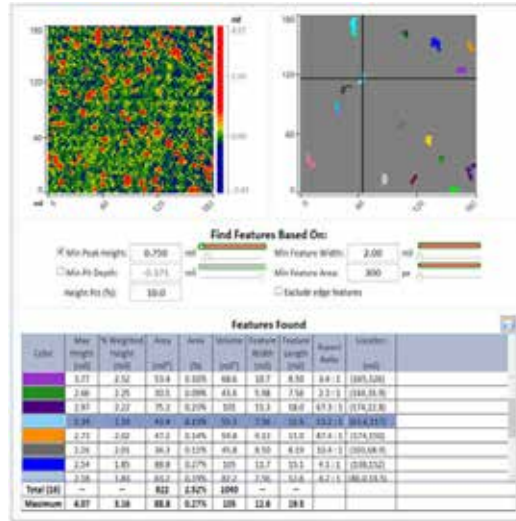
Customers who have used 4D InSpec have reported a number of **improvements in Cost, Quality, and Delivery**—removing non-value-added activities in both new-make manufacturing as well as maintenance, repair, and overhaul (MRO) settings.

### Reducing Cost

#### Saving parts from scrap

Studies have found that visual/tactile inspection techniques—widely used in assessing aircraft engine parts—results in discarding parts, 40-80% of which are not actually defective. Moving from visual/tactile inspection to quantifiable metrology increases yield. **Typical aviation MRO customers report a 20-40% increase in yield.**

One commercial US airline service center performed maintenance on a blisk assembly. The part cost \$950,000. The part had a visible defect. Other instruments couldn't reach the location, and inspectors feared that the defect would rule the part scrap. Then a measurement by 4D InSpec proved that the defect was merely cosmetic, not deep enough to affect perfor-



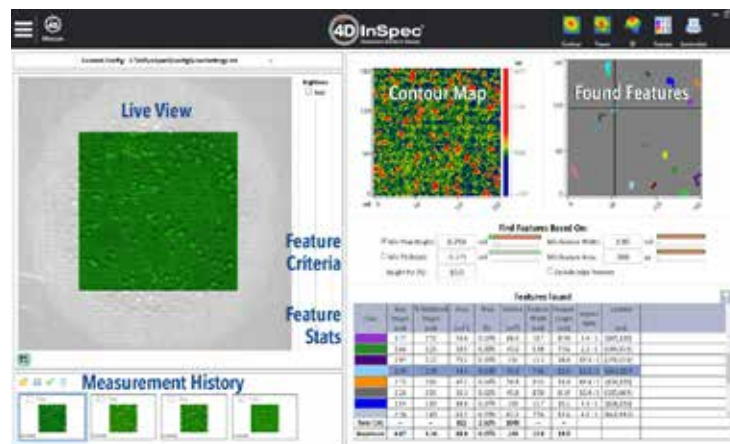
“Increased yield by 20% after quantifying visually ID’d defects as merely cosmetic.”  
 —A New-Make Parts Manufacturer

mance of the part—saving the part from scrap, and gaining a **19X return on investment** in the first week of ownership of the new gauge.

**Reducing the costs of metrology**

Objective measurements determine a part’s status. Quantitative, repeatable results are required.

- Alternatives cost more: 3D optical profilometers can measure some features that 4D InSpec can measure, but cost 50% to 150% more to purchase. They can take up to 20 minutes to measure a single location, and require transport of the part to a noise-free controlled environment.
- Eliminating consumables:
  - By reducing the use of replication gels, 4D InSpec eliminates a recurring cost. **One customer reported that replication gels costs were \$250,000 per year.** 4D InSpec is a fraction of that expense. When they started using the 4D InSpec, it dramatically reduced the need for gels.
  - Without a stylus to replace, customers who switched from a pocket stylus system



After pointing and clicking to take a measurement, operators easily verify the area they are measuring (left, live view area).

They see the 3D contour data plot (center). And the intelligent Feature Analysis (right and bottom) finds the features that are present.

Imagine trying to evaluate—in a few seconds—the peaks in this 0.3” (8mm) field of view with a stylus, a roughness comparator, or a shadowgraph!



*“The 4D InSpec addresses a compelling need in precision machined surface measurement: to bring affordable, easy-to-use, quantitative metrology to where samples are located.”*

—Kevin Harding  
Principal Engineer  
GE Global Research

have reported **savings up to \$10,000 per year** in consumable cost reduction for each 4D InSpec purchased.

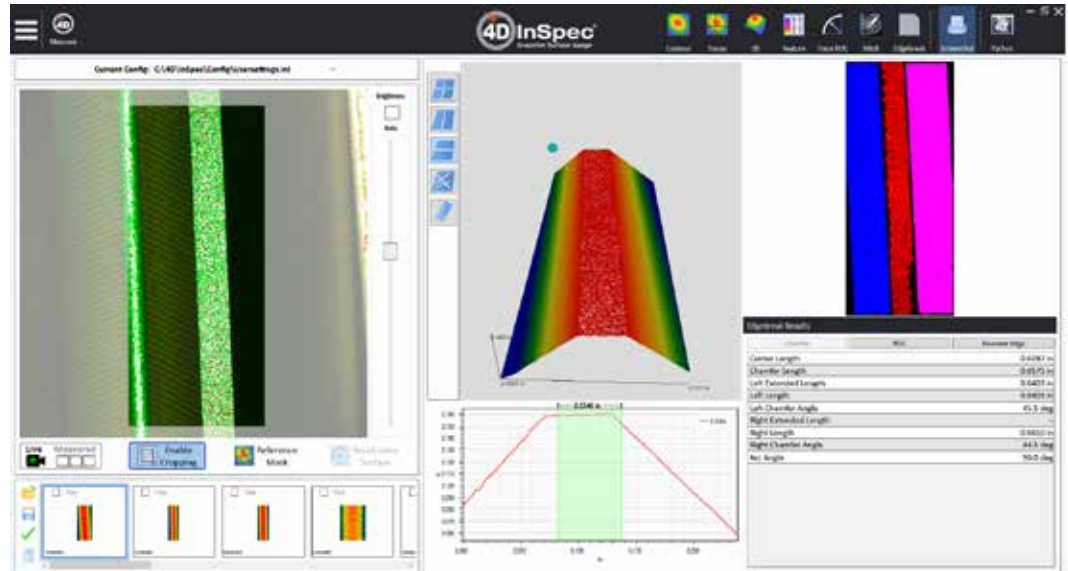
## Measure the part where it is

4D InSpec’s hand-held portability provides some great benefits. If the part can’t come to the measurement station, the measurement station must go to the part. In the LEAN waste categories of motion, transportation, and waiting, a portable metrology system generates gains in value-added activities:

- **Reducing Motion:** less labor is wasted because the measurement to accept or discard a part can often be made without as much disassembly (and subsequent reassembly) to get the part into a measureable state. One customer reported that in one instance they **reduced labor by 40 hours per week through elimination of disassembly** prior to inspection of a critical component.
- **Reducing Transportation:** The 4D InSpec workstation works in the parts receiving area, or can be carried to the inspection site using the backpack option. Going directly to a part and measuring—on the floor, the aircraft wing, or beside the machining tool—means less transportation of materials into and out of inspection and metrology areas.
- **Reducing Waiting:** taking measurements with instant pass-fail results, instead of waiting for reports on parts transported to and from a metrology center, means the parts get the assessment they need now, not later—and can immediately enter the next step in your process. At a USAF repair facility, we were told that inspecting



*4D InSpec’s many accessory options include a fold mirror kit, to help you measure sidewalls, inside grooves and holes—or deep inside a fir tree.*



One of the difficulties of measuring edge break is the challenge of lining up the gauge system perpendicular to the edge. With 4D InSpec's area measurements, even if the 4D InSpec is cocked to the edge, the software calculates the surface planes from the data, and then measures the edge break surface (chamfer, rounding or radius). The improved time savings could amount to hours per shift, while the data is numerical and precise.

multiple parts on engines, hydraulics and fuselages was, **“Really easy for an inspector to walk over and snap a picture when they need a measurement.”**

## Better, Faster Quality Assurance

### Parts processing

During engine overhaul a great number of parts must be dispositioned, for example: Use as is, Rework or Replace. Having a precise, reliable measurement tool means these decisions are based on data and parts are not reworked or replaced out of an excess of caution. In addition, when rework is required, knowing when to stop—eliminates the waste of over-processing. Being able to identify a part that is within specification means that rework does not need to occur. Having a precise, reliable measurement means these decisions are more concrete and parts are not reworked out of an excess of caution.

Quality is retained and delivery improves if the end user's expectation is met, but the part is not overworked. For example, when grinding an area of corrosion, there's a need to quickly assess when the required amount of materials have been removed. Stopping immediately results in a more robust part. Since 4D InSpec measures grinding areas with the ease that it takes to shoot a cell phone picture, measurements swiftly tell the operators when to stop.

4D InSpec “reduced rework rate by 30% on a critical engine component with ability to correctly quantify defects.”

—Top-3 Turbine Manufacturer

### Making edge break measurements easy

Edge rounding, chamfers and edge break of manufactured parts are top safety and part longevity priorities in manufacturing. But the measurement of rounding and chamfers is difficult without 4D InSpec.

These part features, done correctly, help prevent wear and fretting, and protect users from dangerous burrs. Being able to measure edge break quantitatively and quickly can permit process control improvements—and you can offer safer, more reliable parts.

## Accelerating Delivery

### Turning parts around more quickly

Turnaround time (TAT) is a key performance metric for many repair and overhaul facilities, because part shortages are common—reportedly, they are the biggest challenge today in the aviation MRO industry.

4D InSpec has a substantial impact on TAT for our customers, because:

- Increased yield: the largest benefit is an increased acceptance of parts being inspected that would otherwise have been scrapped
- Process parts instead of waiting: much faster inspection through portability, access to hard-to-reach spots that save disassembly time, and very fast acquisition times
- Faster rework: more rapid throughput by reducing rework time because measurements are fast and precise

### Higher sampling rates

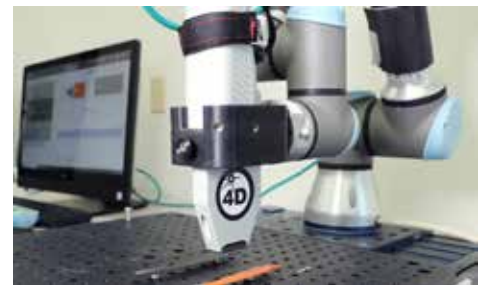
With the opportunity to increase sampling, more accurate failure analysis becomes possible, potentially improving parts, products and systems overall. 4D InSpec's point-and-click ease means more parts get measured, and quality can improve accordingly. Upgrading to a robot arm that makes tens of measurements per minute makes production measurements a viable opportunity to transform your product quality and customer satisfaction.

### Automation

There's a button right on the inspection gauge that the operator can press when the target area is in focus, to take a measurement. But the touch screen has a button, and we offer a foot pedal trigger as well, for customers that mount the gauge in position and take repetitive "hands off" measurements quickly and easily. The logical step up from this is interfacing the handheld gauge with a robot arm that can quickly and precisely make repetitive measurements, faster than humanly possible.

4D InSpec's software supports a generic robot interface, and natively supports UR Robots in particular. Customers in parts production have used 4D InSpec with UR Robots to measure such things as rivet and fasteners, saw blade teeth, and even to measure automotive part edge break—and experienced a quicker setup time, with reduced part jiggling requirements, versus their attempts to measure the parts with other gauge types.

*The automation interface is built into every 4D InSpec software package, meaning you can have reliable measurements now, and add a robot option when you need it.*



### Trusted Results to Review

In industries like aviation maintenance and nuclear power generation, the risk of being wrong in an assessment and retaining a part that should be discarded poses an unacceptably high safety risk. By eliminating uncertainty, parts measured by 4D InSpec are approved or discarded with improved peace of mind.

One significant benefit of 4D InSpec to these industries is that measurements are numerically quantified and data can be saved in a database, providing an historical reference to review part condition and perhaps even analyze trends.

### Estimating Your Projected ROI

As we've mentioned, an investment in improved metrology can be recouped through: reduced scrapping or over-processing of good parts; reduced handling/disassembly/measurement time; elimination of consumables used in the measurement process.

The table below provides an estimate of the potential return on investment in these categories. To assess your potential savings, enter your 1-month, 1-quarter or 1-year expenses in the "Current" column. Then multiply those costs by the "Potential Change" to calculate the "Projected ROI" for each category. Add the rows to calculate the total projected ROI.

Lastly, enter the cost of the metrology investment you are considering. Divide the Total Potential ROI by the Cost of Metrology Investment to see how many months/quarters/years will be required to recoup the cost.

Expense	Current Cost for 1 Month/Quarter/Year	Multiply by potential change	Projected ROI per Month/Quarter/Year
Total value of parts being measured		x0.2 to x0.4 (20%-40% increase in yield)	
Costs associated with queuing, transportation, and handling and disassembly for measurement		x0.3 (30% reduction in cost)	
Cost of replication materials and time		x0.8 (80% reduction in cost)	
Stylii replacement costs		x1.0 (100% reduction in cost)	
		<b>Total Potential ROI:</b>	
		<b>Cost of metrology investment:</b>	
		<b>Periods to recoup investment: (Total Potential ROI divided by Investment)</b>	

Results reported in customer stories within this document are verified by records on file at 4D Technology. 4D Technology believes these results to be typical, but results vary. The examples and quotes were obtained without payment for the information, but should not be construed as an explicit endorsement by any of the companies or users that have provided them.





# 4D InSpec turns inspection into yield



*Portability is a big part of getting the measurement you need, when you need it. On a robot or in a belt holster, 4D InSpec is convenient.*

Download the data sheet:

**Check out**  
4D InSpec gauge  
**today**

By measuring right up to the specification, on demand, you can turn out more in-spec parts, faster.

Determine the depth breadth and height of peen marks, corrosion, wear, scratches, edge break, chamfers, edge blend, rivet height... the 4D InSpec gauge measures nearly any material, and hundreds of physical features.

Quantify your results. Make judgements repeatable. Save the records. All while increasing yield. Find out more today.

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