

# Carl Zeiss CMM

## GUIDES ANDREW TOOL WITH COMPLEX MARS ROVER PROJECT

When Andrew Tool got the call to quote on a MSL (Mars Science Laboratory) project, they were determined to succeed by taking advantage of their expertise. At Andrew Tool, CMMs have been an integral part of their manufacturing processes for years, but they had never faced a project with such intricate measurements, tight tolerances, heat treatments and a very short time frame requirement. Carl Zeiss had proven to be a great resource at Superior Tool (Andrew's sister company).

"Our PRISMO CMM at Superior Tool is the backbone of our quality department, and my goal was to replicate and build on this capability at Andrew," says Bruce Hanson, president and CEO. This goal and initial project discussions with the MSL top-tier contractor pointed Andrew Tool toward a Zeiss CMM as the best option.

Andrew Tool is a unique machine shop with more than 30 years of experience handling five-axis milling, EDM, grinding and more. Their success is dependent upon fostering good relationships between the tool designer or engineer and the machinist.

"They need each other, and our employees understand that it's a team effort that links us to our customers," Hanson says. The majority of Andrew Tool's customers are found in the aerospace, defense, medical and micro electronic industries, all having parts that often require extremely tight tolerances.



**Andrew Tool is utilizing the Zeiss ACCURA with VAST technology for the Mars rover Curiosity (courtesy of Carl Zeiss).**

This new, complex project from MSL required Andrew Tool to manufacture actuators (gearboxes) for the next Mars rover Curiosity. This new rover will weigh more than 10,000 lbs., five times the weight of the current rovers, and carry more than ten times the weight in scientific instruments compared to the current Spirit or Opportunity rovers.

Therefore, the propulsion system's power and torque will be more robust, and the unit's wheels considerably larger than previous designs. NASA engineers believe these changes will help prevent the problem that Spirit is encountering now: it's stuck in a sand pile. There were many parameters that Andrew Tool had to adhere to in order to help NASA make their new actuator design a success. Many of the parts had very deep pockets (almost a 20:1 ratio), and small radii added to the challenge, along with extremely tight tolerances, many of which are tied to different gear pitch diameters. The parts are very labor intensive with thousands of points of data measured on individual parts. The VascoMax material used for the actuator parts changes size slightly during heat treatment and, as a result, many of the part

features were machined and inspected to process dimensions that allowed for this size change if the feature was not going to be final finished post heat treat. Additionally, position tolerances of .0002", geometric control of .00008" and size control within .0001", even on relatively large (5" range) dimensions added to the challenge. All of these factors, coupled with a demanding 18-month timeline and AS9100 certification requirements, made it critical that Andrew Tool bolster its CMM capabilities for precision and speed.

Andrew Tool decided to purchase the Zeiss ACCURA with the VAST XT gold active scanning sensor. The Zeiss ACCURA was an affordable solution with the range they needed while the VAST technology and automatic stylus rack system increased flexibility and productivity when determining size, form and position. The VAST XT gold is suitable for the complex and heavy stylus configurations required in measuring MSL's actuators.

Of course with any new machine being added to the production process, there's always a learning curve. The first surprise they had was seeing

how seemingly benign parameter setting changes could dramatically affect measurement results. The discipline of always verifying critical measurements with another method was crucial to the learning curve. Brent Helgeson, metrology applications manager at Concept Machine, was very responsive in efficiently diagnosing the correlation problems, enabling Andrew to quickly get up to speed with their new CMM. Additionally, probing strategy for some of the features and proper alignment sequences to achieve correct results were developed and refined to achieve consistency.

“The Zeiss ACCURA helped us orchestrate the project by providing timely, accurate and understandable in-process reporting. It can’t be overstated how critical good inspection is for process development and setup,” says Bryant Broderick, quality control engineer at Andrew Tool. The project included 14 different part numbers with quantities ranging from four to 12 plus setup parts. Throughout all of the

different processes including milling, gear cutting, heat treatment and stabilization, each part was successfully measured up to 60 times by the Zeiss CMM to ensure accuracy every step of the way. The temperature compensation feature was especially helpful because they were able to check parts

right off the machine tool and relay the results to the toolmaker instead of having to wait for the part temperature to stabilize before measurement. With a coefficient of expansion of five and one half millionths of an inch per degree, a few degrees could mean the

**continued**



WHEN YOU NEED IT RIGHT  
THE FIRST TIME

# The Broach MASTERS

**& Universal Gear**

**Much More Than Just a Broach Company!**

The quality and precision of our Broaches, Shaper Cutters and Gears have won customers world-wide - from the smallest gear shop to NASA and the Mars Rover.

- Broach & Shaper Cutter manufacturing & repair
- Gear & Spline—prototype to production
- Master Gears & Gages
- Small & fine pitch

**Precision. Performance. Perfection. The First time and every time.**

**The Broach Masters, Inc.**  
 QUALITY TOOLS & SERVICE  
 "DEDICATED TO EXCELLENCE"

1605 Industrial Drive  
 Auburn, CA 95603  
 Phone: (530) 885-1939  
 Fax: (530) 885-8157  
 Web: www.broachmasters.com  
 Email: info@broachmasters.com

**U.G.C.**  
 MADE IN U.S.A.

Made in USA

difference between pass or fail. “We were amazed by how effortless the ACCURA made this whole process.”

The robust reporting capability in CALYPSO is a great asset for the AS9100 certification process required by NASA. This certification involved

a lot of time on the program management side of things ensuring there was documentation for all of the critical paths of each part throughout the whole manufacturing process. All of this information was contained in a spreadsheet with all of the serialized

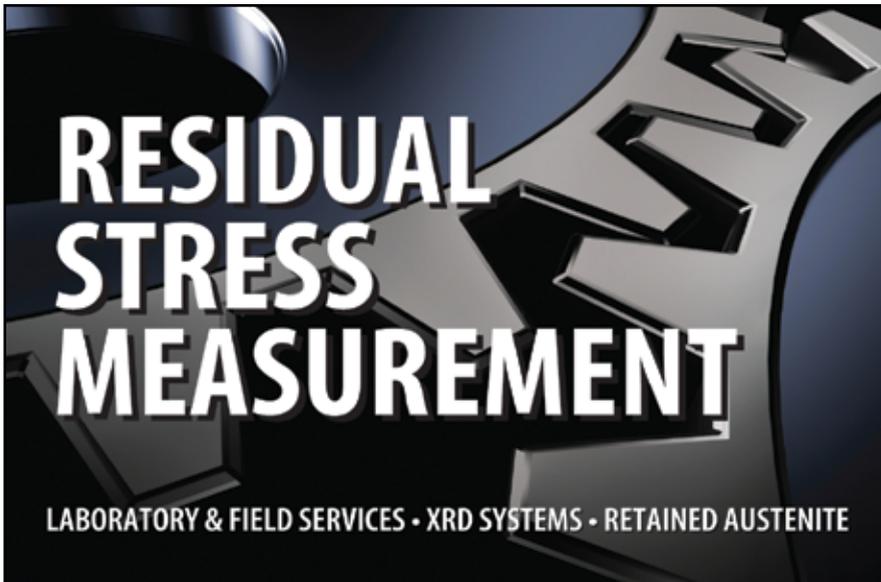
parts to clarify where each part was at any point. The CALYPSO software easily documented the information electronically each time the part was measured.

“Verbal information of part details means nothing; documented data is everything,” states Don Felix, director of sales and marketing. “We couldn’t have been successful without Carl Zeiss. The benefits Zeiss brings have been enormous, and we see positive results every time we use the CMM.” Ongoing training continues to drive Andrew toward the goal of using the ACCURA to its full capacity.

Andrew Tool even acquired a new customer after another NASA supplier saw several of the MSL actuator parts. They were so impressed with the precision and complexity of the parts that they were instantly sold on Andrew Tool’s capabilities. This supplier also required AS9100 certification and fortunately, Andrew Tool was well on their way to attaining this certification and ready to take on this new opportunity with enhanced confidence in data from their Zeiss CMM.

**For more information:**  
 Andrew Tool & Machining, Inc.  
 15300 28th Avenue North  
 Plymouth, MN 55447  
 Phone: (763) 559-0402  
[www.andrewtool.com](http://www.andrewtool.com)

Carl Zeiss Industrial Metrology  
 6250 Sycamore Lane North  
 Maple Grove, MN 55369  
 Phone: (800) 327-9735  
[www.zeiss.com](http://www.zeiss.com)



LABORATORY & FIELD SERVICES • XRD SYSTEMS • RETAINED AUSTENITE

## Reduce costs and improve quality.

Residual stress plays such a critical role in the fatigue life, cracking and distortion of components, that its characterization is more important than ever. In today’s tough economic times, X-ray Diffraction (XRD) residual stress measurement can both improve quality and help lower component cost by reducing scrap rates, shortening design cycles and ensuring full component life.



Our comprehensive line of XRD residual stress measurement systems and full service laboratories have the accuracy, speed, technology and knowledge to keep your product perfect right from the start.

LABORATORY SERVICES



FIELD SERVICES



PORTABLE XRD SYSTEMS



LABORATORY XRD SYSTEMS



[www.protoxrd.com](http://www.protoxrd.com)

1 (800) 965-8378

USA  
 Proto Manufacturing Inc  
 313-965-2900  
[xrldlab@proxrd.com](mailto:xrldlab@proxrd.com)

Canada  
 Proto Manufacturing Ltd  
 519-737-6330  
[proto@proxrd.com](mailto:proto@proxrd.com)

Japan  
 Proto Manufacturing KK  
 047-402-2703  
[info@proxrd.jp](mailto:info@proxrd.jp)