LXRD®

Laboratory Residual Stress & Retained Austenite Measurement

TECHNOLOGY THAT DELIVERS ACCURATE RESULTS™

X-ray Diffraction
Systems & Services

PROTO

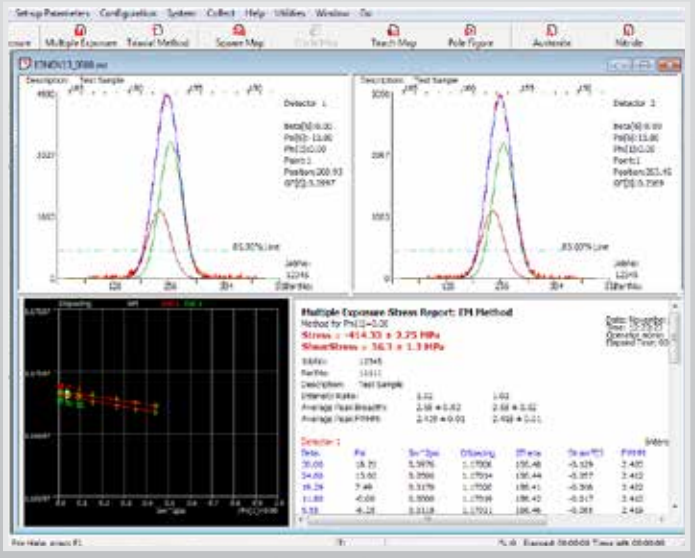
LXRD OVERVIEW

The LXRD laboratory system is designed to ensure accurate results on complex part geometries and all materials. Safety and life-critical engineered parts need accurate residual stress determination. The LXRD system ensures you have the dependable results you need.

The LXRD is available with standard or oversized enclosures for large part capacity. Flexible instrument options and available residual stress mapping, make the LXRD a proven leader in high-powered residual stress and retained austenite measurement systems.

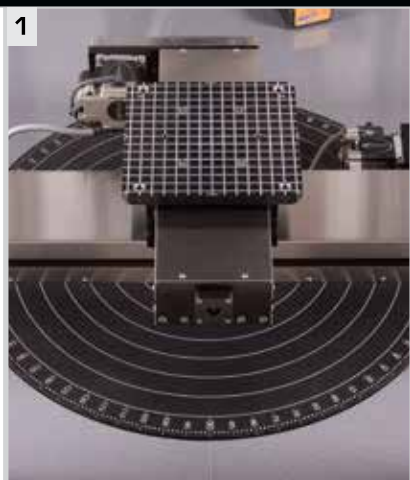
ACCURACY WHEN IT MATTERS MOST

At the core of every LXRD system is the powerful yet easy to use PROTO XRDWIN software. A comprehensive Windows®-based data collection and stress analysis package with features such as: linear and elliptical regression, Dolle-Hauk, and triaxial methods. Advanced peak fitting functions: parabolic, gaussian, pearson VII, cauchy, centroid, centered centroid, and mid-chord. Graphical display of peak intensity, breadth, FWHM, and $\sin^2\psi$ plots provides informative easy to read results. Software utilities for XEC determination, principle stress, material removal, depth of penetration, retained austenite, pole figures, and single crystal stress make a complete package.



ADVANCED FEATURES

1. **RESIDUAL STRESS MAPPING** is available on all LXRD models, providing a comprehensive picture of the residual stress state of the part. As the originators of residual stress mapping, PROTO is a leader in the field.
2. **AUTOMATED RETAINED AUSTENITE** ASTM E975 4 peak %RA analysis. R value calculator. Low concentration 1% detection limit. No changeover required between stress and austenite. Optional nitride layer analysis.
3. **X-RAY ELASTIC CONSTANT DETERMINATION (XEC)** Fully automated residual stress measurement material calibration as per ASTM E1426.
4. **POLE FIGURES** created using LXRD rotary stages can be used for preferred orientation analysis, single crystal orientation, and single crystal stress measurement.

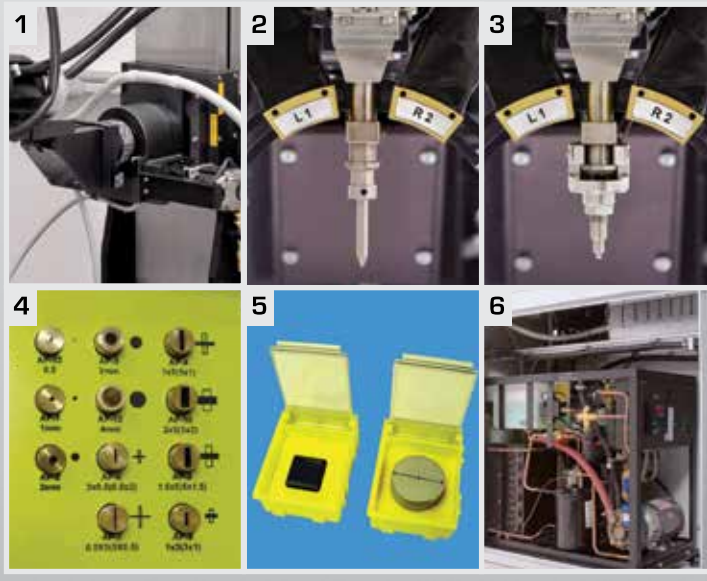


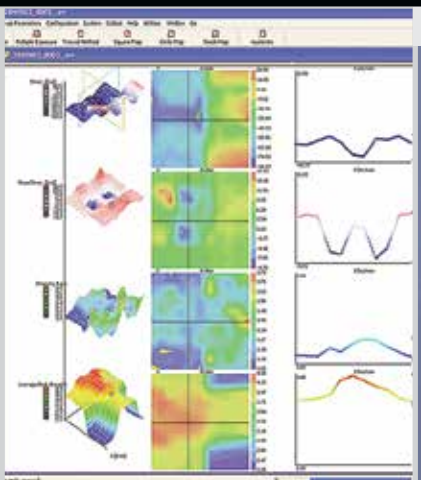
SAFETY & PROTECTION

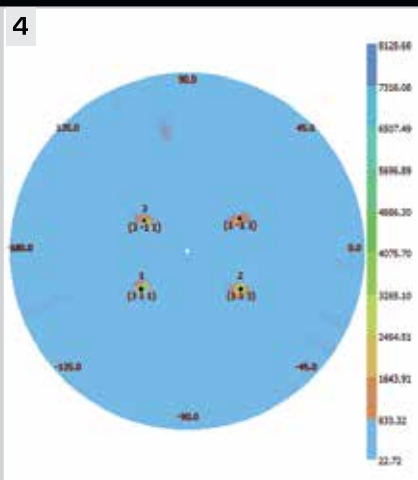
All of PROTO'S LXRD models are built with both your safety and the long term protection of your instrument in mind. Our instruments are compliant with ANSI N43.2 regulations providing full radiation protection. An informative safety interlock panel directly linked to the flow sensor, x-ray tube, high voltage power supply and door interlocks provides thermal and operational status diagnostics. X-ray and shutter beacons conveniently notify the operator of the status of the x-ray beam.

EASY AND CONVENIENT TO USE

1. **HIGH PERFORMANCE GONIOMETER** maintains ASTM E915 accuracy in a low maintenance design.
2. **MANUAL FOCUS** pointer enables accurate positioning of the goniometer in complex geometries.
3. **AUTOMATED FOCUS** pointer for convenient automated focusing, and fast focusing of large residual stress maps.
4. **X-RAY BEAM APERTURES** round 0.2, 0.5, 1.0, 2.0, 3.0, 4.0 mm; rectangular 0.5x3, 1x3, 0.5x5, 1x5, 2x5 mm
5. **HIGH STRESS STANDARDS, ZERO STRESS POWDERS, %RA STANDARDS** ensure accurate system results.
6. **INTEGRATED COOLING SYSTEMS** make the LXRD a convenient self-contained instrument.







LXRD STANDARD

The LXRD STANDARD small enclosure system has been designed to fit through a single door and is perfect for measuring smaller parts and samples up to 30 cm. This state-of-the-art instrument is available in a cost effective bare enclosure configuration, or upgraded with numerous options including: a manual XY positioning stage, phi rotation stage (automated triaxial measurement), fully automated 300 x 200 mm travel XY residual stress mapping stage and % retained austenite measurement capabilities.

The radiation proof enclosure, automated 400mm Z-axis, MG2000 1200W high-power goniometer, fully integrated chiller, and levelling pads with wheels provide performance and flexibility in a compact package.

LXRD WIDEBODY

The LXRD WIDEBODY comes with all of the features of the standard model, but with increased enclosure capacity for measuring larger parts up to 50 cm.

With a 500 mm Z-axis and an increased travel of 300 mm for the Y stage, the WIDEBODY provides one of the largest measurement envelopes of a stand-alone cabinet system.

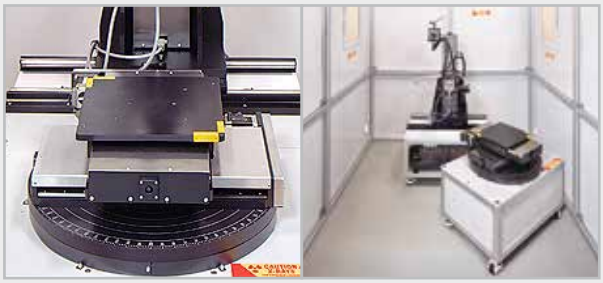
MG2000 Goniometer

Bare Enclosure

LXRD

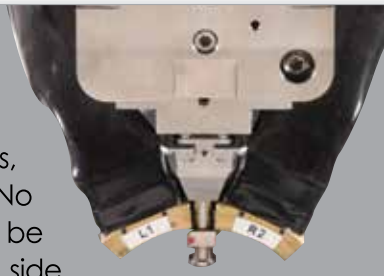
LXRD MODULAR MAPPING

The LXRD MODULAR MAPPING system introduces high-powered residual stress mapping on large components. Oversized parts composed of difficult to measure materials such as titanium, are no longer restricted to low-power portable systems. With over 2 meters of measurement space, heavy-duty XY mapping stages, and a removable mapping stage, it has the flexibility to meet all of your complex measurement needs.



Heavy-Duty XY Stages | Removable Mapping

PROTO'S STATE-OF-THE-ART X-RAY DETECTORS



PROTO's proprietary position sensitive scintillation detectors (PSSD) provide unsurpassed speed, stability and a wide 2θ range. Unlike other x-ray detectors, they do not deteriorate with exposure to x-rays. No expensive replacements required. The detectors can be quickly positioned between iso (omega) or modified side inclination (psi) geometry. Two detectors for accurate shear stress determination. Available in standard and extended 2θ range.

THE FASTEST FULL SIZE RESIDUAL STRESS MEASUREMENT SYSTEM IN THE WORLD TODAY

LXRD GANTRY

The LXRD GANTRY system is PROTO's largest enclosure system, with a 3.5 meter walk-in enclosure, and long travel overhead XYZ slides. The LXRD GANTRY simplifies measurement of large heavy components by moving the goniometer instead of the sample. Outfitted with a GR2000 goniometer, it adds the flexibility of built-in phi rotation for triaxial measurements.

Stand-Alone Power Unit

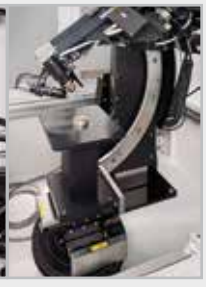
GR2000 Goniometer

LXRD MICROAREA

The LXRD MICROAREA is PROTO's full-featured research grade instrument for residual stress measurement. A secondary chi rotation stage enables measurement in true side inclination (in addition to omega and modified side inclination). An XY mapping stage, phi rotation stage, video microscope, and x-ray beam aperture sizes down to 30 microns provide advanced tools for your microarea residual stress measurement needs.

Video Microscope

Chi Axis



XY Phi Mapping

PROTO'S HIGH QUALITY X-RAY TUBES

Our ceramic/metal x-ray tubes are produced in-house to provide you with the best quality, performance, warranty and support. These durable, stable and high flux tubes provide years of accurate measurements . For optimal results we utilize a wide range of anodes to ensure the best possible x-ray diffraction peaks on your materials.

Available anodes: Ti, V, Cr, Mn, Fe, Co, Cu

	STANDARD MODEL	WIDEBODY MODEL	MODULAR MAPPING	GANTRY	MICROAREA
Dimensions (L x W x H)	1.1 x 0.7 x 1.9 m 43 x 28 x 75 in	1.1 x 1.1 x 1.9 m 43 x 43 x 75 in	2.5 x 1.9 x 2.0 m 98 x 75 x 79 in	3.8 x 3.6 x 4.0 m 150 x 142 x 158 in	1.1 x 1.1x 1.9 m 43 x 43 x 75 in
Recommended Maximum Part Size	300 mm 12 in	500 mm 20 in	1000 mm 40 in	2000 mm 80 in	300 mm 12 in
Focusing Axis (Z)	400 mm 16 in	500 mm 20 in	400 mm 16 in	800 mm 32 in	300 mm 12 in
Optional Mapping Stages (X,Y)	300 x 200 mm 12 x 8 in	300 x 300 mm 12 x 12 in	200 x 200 mm 8 x 8 in	2500 x 2500 mm 98 x 98 in	100 x 100 mm 4 x 4 in
Manual Stages (X,Y)	100 x 100 mm 4 x 4 in		n/a		
Phi Rotation Stage	500 mm (20 in) rotation stage (0-360°)			integrated into goniometer (0-360°)	300 mm (12 in) rotation stage (0-360°)
Sample Table	180 mm (7 in)		300 mm (12 in)	n/a	180 mm (7 in)
HV Power	1200 W (optional 3000 W)			3000 W	
Goniometers	MG2000			GR2000	MG2000 + chi axis
Geometry	iso (omega), modified side inclination (psi)				iso, modified side, side inclination
X-ray Tubes	long fine focus 60 mm diameter metal ceramic				
X-ray Tube Cooling	integrated recirculating liquid-to-air heat exchanger		recirculating external water chiller		
X-ray Beam Apertures	round: 0.2, 0.5, 1.0, 2.0 mm rectangular: 0.5x3, 3x0.5, 1x3, 3x1, 0.5x5, 5x 0.5, 1x5, 5x1, 1.5x5, 5x1.5 mm				
	optional: 0.2, 0.2x2, 0.2x5 mm				optional: 30, 50, 100, 150, 300 microns
X-ray Detectors	proprietary dual position sensitive scintillation detectors (PSSD)				
Detector Width (2θ)	standard 18.4°, wide 29.5°				standard 19.3°
2θ Range	residual stress: 123°-171°, retained austenite: 70°-171°				
Focusing	manual, automated, laser (optional)				
X-ray Filters	diffracted beam Kβ filters				
Safety	independent warning light beacons for "x-ray on" and "shutter open", emergency stop with lockout key, x-ray protective glass for zero x-ray emission from enclosure				
Computer	latest generation brand name desktop or laptop computer with each LXRD				
Software	powerful yet easy to use XRDWin 2.0				
Enclosure Features	enclosure light, fully interlocked, clear view windows, hand-held motion control pendant				
Operating Temperature Range	0°C to 35°C non-condensing humidity				
Power Requirements	200-240 VAC, 50/60 Hz, single phase				
System Compliance	ASTM E915, ANSI N43.2, CE				

Proto Manufacturing engages in continuous research and development, therefore specifications in this publication are subject to change. Please call for details.
Various items and methods in this brochure are covered by patents or patents pending.

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