LXRD®
Laboratory Residual Stress & Retained Austenite Measurement

TECHNOLOGY THAT DELIVERS ACCURATE RESULTS™

X-ray Diffraction Systems & Services
The LXR D 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 LXR D system ensures you have the dependable results you need.

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

**ACCURACY WHEN IT MATTERS MOST**

At the core of every LXR D 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 V11, cauchy, centroid, centered centroid, and mid-chord. Graphical display of peak intensity, breadth, FWHM, and sin²θ 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 LXR D 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 LXR D 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.
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.

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.
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.

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 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.

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.
STANDARD MODEL WIDEBODY MODEL MODULAR MAPPING GANTRY MICROAREA

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

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.

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