

RSI

GaugeMaster Plus
Measurement Systems

50kV, 100kV, 160kV and 250kV DC X-ray Sources

Suitable for
Carbon and Stainless Steels, Aluminum, Copper & Brass, Nickel,
Titanium, Zirconium, Coated Steels and Aluminum

Our Mission Statement...

Quality

RSI products are designed using the highest quality components and workmanship. Equipment arrives fully tested for fast, efficient installation and startup.

Reliability

RSI believes reliability is the key to customer satisfaction. Everything we manufacture is built with this in mind.

Service and Support

RSI will respond quickly and courteously when problems occur.

Science Behind the Measurement

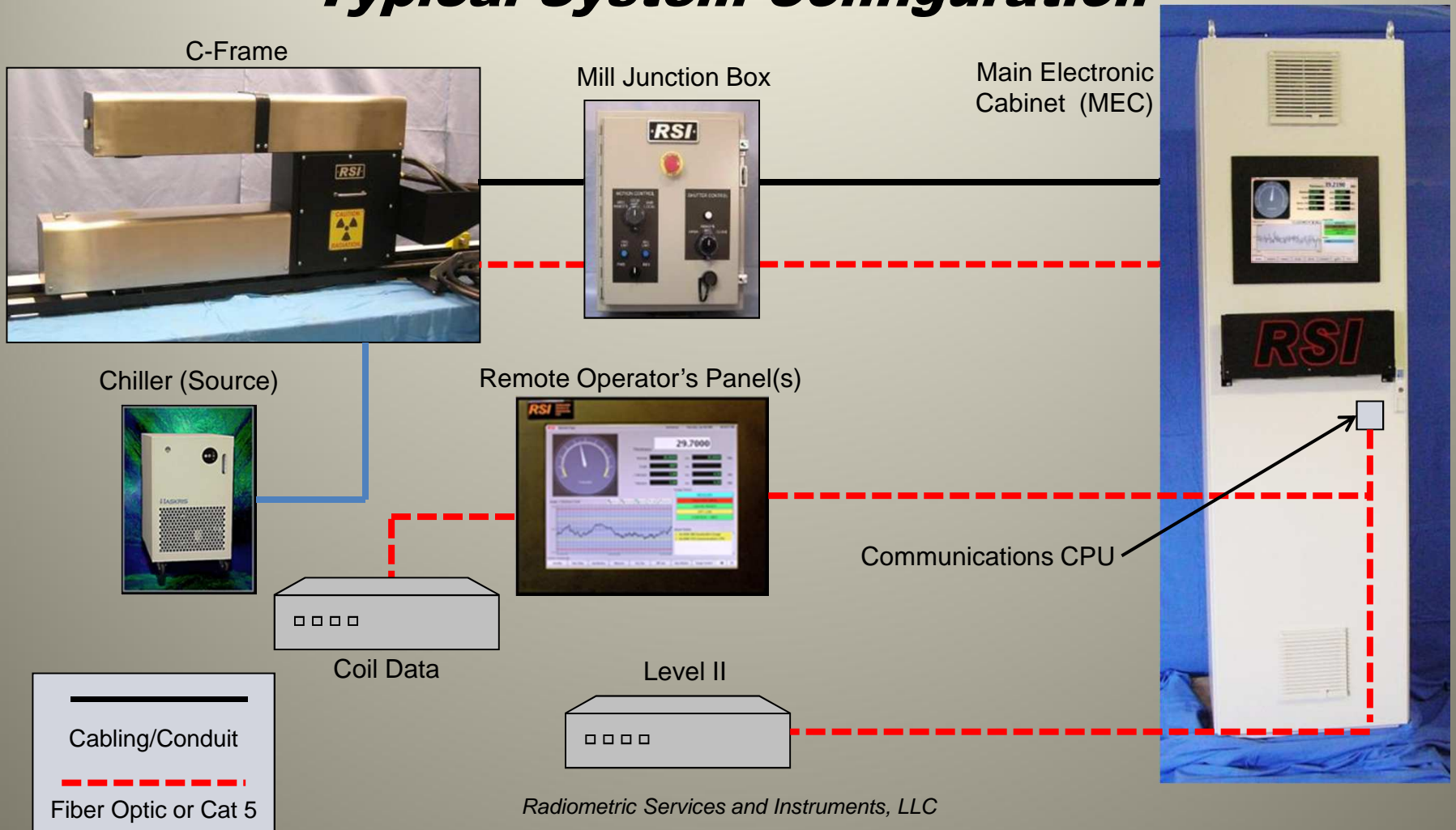
RSI utilizes the most advanced scientific principles to simplify gauge operation. This translates to better performance and reliability, creating better value for the customer.

Applications

| Source Model (Kilovolts; kV) | Steel Thickness (Max.) | Pure Aluminum Thickness * (Max.) |
|---|-----------------------------------|---|
| 50kV | Not used | 40.0 mm |
| 80kV | 6.25 mm | 65 mm |
| 100kV | 10.0 mm | 90 mm |
| 160kV | 25.0 mm | 125 mm |
| 250kV | 60.0 mm | 150 mm |

** Thickness reduced by 50% for 2000 and 7000 Series Aluminum Alloys*

Typical System Configuration



RSI High powered X-ray Sources provide high stability and the best noise-to-signal ratio

- Long life liquid-cooled X-ray sources for hot mill and cold mill applications
 - 50kV, 100kV, 160kV and 250kV
- Fixed energy operation
- Faster, less frequent standardization maximizes availability for increased production
- Machined housing provides superior x-ray absorption, minimizing radiation exposure to nearby personnel. Integral cooling channels provide excellent thermal transfer ensuring reliable, trouble-free operation for many years. Lifetime of 4-5 years is typical.
- Reliability is enhanced by minimizing the number of components inside the source housing. X-ray drive and control circuitry is housed in the Main Electronic Cabinet for ease of access.



The *RSI* Difference

While other gauge manufacturers provide x-ray sources with regulated beam intensity, RSI also tightly regulates beam energy. This insures not only excellent stability (“long term drift”) of the gauge, but maintains long term accuracy without the use of large numbers of internal samples.

Additional benefits of Beam Energy Regulation:

- Simplifies alloy compensation
- Eliminates the need for large number of alloy samples
- Guarantees alloy correction factors do not change over time, as is the case in x-ray gauges from other manufacturers

Ion Chamber Detectors (75 mm and 125 mm) are utilized for their superior physical and performance attributes. They are rugged, thermally stable, shock resistant and lack “dark current”, providing virtually zero “hysteresis”, allowing for a quick recovery from excessive x-ray exposure (“blinding”).

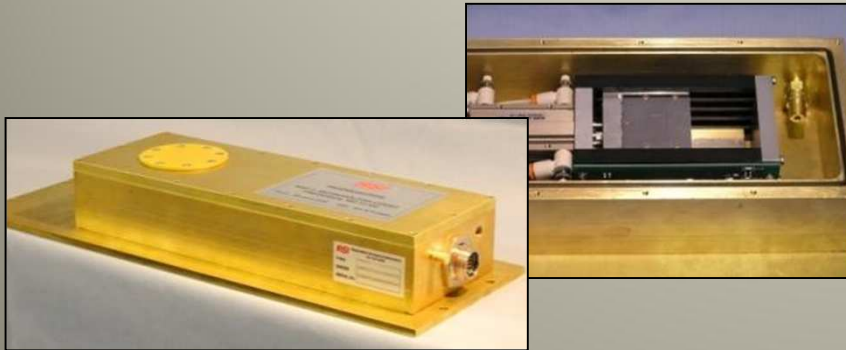


- Optimum stability in severe environments
- Superior shock and vibration resistance
- Adjustable variable gain amplifiers
- Fast Response, typically 2-3 milliseconds
- Ultra Fast, 0.5 millisecond ion chambers available for cold mill chatter detection and other high speed applications
- High pressure, low noise, Xenon gas filled Ion chamber (125HP) is available for critical hot mill applications

Quad Standard Magazines ... Two Models

Pneumatic

- High reliability
- Temperature monitored
- TCP/IP Interface
- Excellent sample positioning accuracy
- Recommended for “new” applications



Electric

- Preferred by some customers
- Occasionally used in upgrades



X-ray Spectrum Correction requires only 2 to 4 samples plus a safety shutter.
A sealed, solid brass housing ensures longevity, high reliability and zero contamination.

Typical System Performance

Performance Values: 2 Sigma (95.45% confidence Level)

Accuracy: Better than or equal to ± 0.1 % of the thickness (for samples of the same chemical composition and density as the calibration samples)

Reproducibility (Repeatability): Better than or equal to ± 0.05 % of the thickness

Long Term Drift (Stability): Better than or equal to 0.2% or better over 8 hours

Noise (Overall Radiometric Instability): Better than or equal to $\pm 0.1\%$ of the thickness at 10 millisecond response time

Performance Enhancing Features:

Standardization: (4 seconds or less, typically) maintains accuracy short term.

X-ray Spectrum Correction (XSC): Compensates for "Aging" affect. Adjusts X-ray beam energy until the V1 / V2 ratio is restored to the original values, maintaining accuracy over the life of the gauge.

DynaComp and DynaCompPlus: Industry Leading Alloy Correction Software. Accurately measures Carbon, Stainless Steel, Aluminum alloys and Exotic Metals.

Technical data per Standards for Thickness Measurement as defined in the IEC 1336
"Thickness measurement systems utilizing ionizing radiation - Definitions and test methods"

GaugeMaster Plus Cabinet



Rail Mounted Power Supplies

Touchscreen Technician's Panel

X-ray Driver Chassis

Keyboard

Communications CPU s

Gauge Processor – 0.25 ms Update

Inputs/Outputs

Power, etc.

Optional Side Mounted Air Conditioning Unit for ambient temperatures higher than 35°C / 95°F



Gauge Processor Configuration ... Added Reliability !!!

- Industry Standard "Computer-On-Module", ETX (Embedded Technology eXtended) modules minimize long term "hardware obsolescence" issues
- Compact Flash Drives for enhanced reliability
- Separate Processors for system measurement and communications. "Core" measurement software continues to run even if display application software crashes.
- 16 bit - A/D Channels
- Four Independent Analog Output Channels
- Up to 48 Channels of Digital I/O, configurable
- Network Conductivity for remote monitoring and troubleshooting
- Linux Real Time O/S with "C++" language modularized

Diagnostic Features

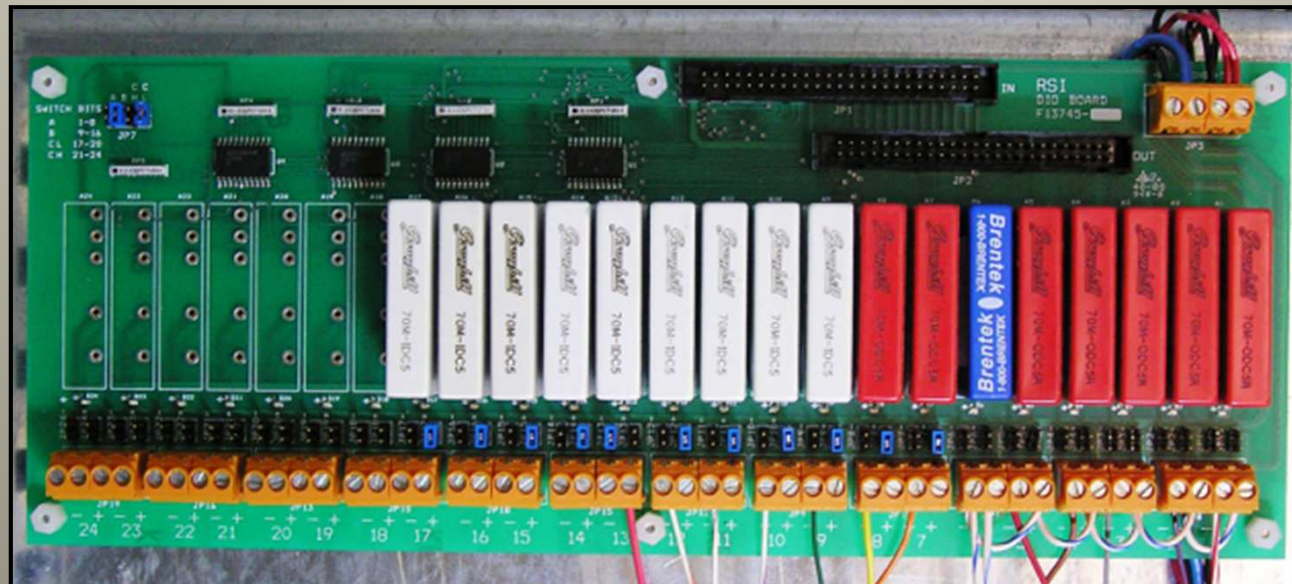
- Cabinet temperature, x-ray driver temperature, standard magazine temperature and x-ray source temperature monitoring with alarms
- Full diagnostics with multiple screens
- Calibration curve building capabilities built in; includes curve order selection, display of coefficients and curve error display
- Remote troubleshooting via modem / internet / network capability (Optional)
- Alarm and event logging by time and date
- Analog input and output scaling
- Digital I/O checks

A highly stable **Digital X-ray Control System** drives the x-ray source(s). A Pentium class CPU is used to regulate the high voltage and current through the x-ray tube. Capable of driving most DMC, MX/DMC and Thermo Radiometrie X-ray sources.

- Backwards Compatible with existing DMC, MX/DMC and Thermo Radiometrie X-ray Driver Chassis and PCB's
- Ethernet Connectivity: X-ray source high voltage and current are regulated via Ethernet link to the Main CPU
- Temperature Monitoring of x-ray power driver and x-ray source. Overheating problems are quickly recognized and averted, minimizing production delays.
- Increased Accessibility for ease of maintenance



Industry Standard **I/O Modules** are mounted on a circuit board. Terminal strips provide a convenient and easy connection point for the customer's wiring. Each module has a LED status indicator for ease of identification.



System Interfaces

- TCP/IP, Profibus or OPC interface to Level II computer
 - Download nominal thickness, tolerances, alloy name, alloy chemistry, etc.
 - FTP coil data and reports for remote storage and Achieving
- RS232C serial links available for older systems
- Four scalable analog outputs (standard)...additional outputs are optional
- Isolation amplifiers available for Control Interfaces
 - ± 10 VDC or 4 – 20 mA current loop, 1000 vdc isolation
- Digital Inputs and Outputs (Solid State or Relay) for system status
 - Gauge healthy, measuring, calibrating, on/off-line, etc.

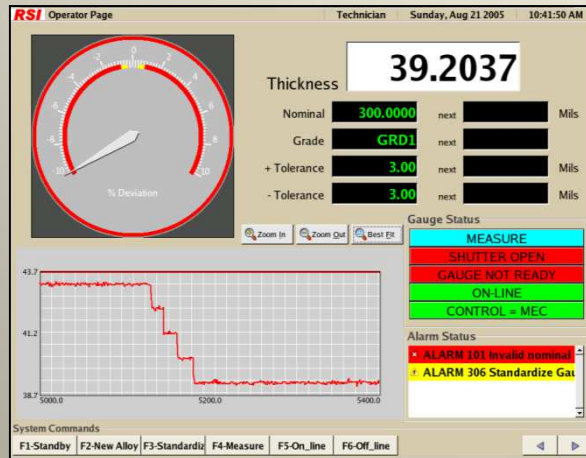
The **Remote Operator's Panel** permits the viewing and entry of measurement values and parameters. Multi-level password control allows access to system extensive diagnostic and configuration tools.



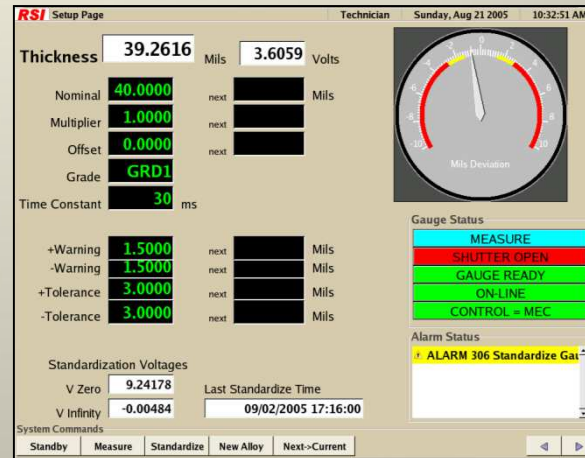
- Touchscreen LCD color display
- Rugged, industrial quality for tough environments
- Display of thickness, deviation from set point together with present and next nominal values
- Manual entry of thickness, alloy/grade
- Gauge status and alarms
- Mounting options...Surface, Desktop, or Rack
- Chassis mounted CPU simplifies installation
- Ethernet fiber-optic interface
- Optional keyboard, trackball and mouse operation

Typical Gauge Displays

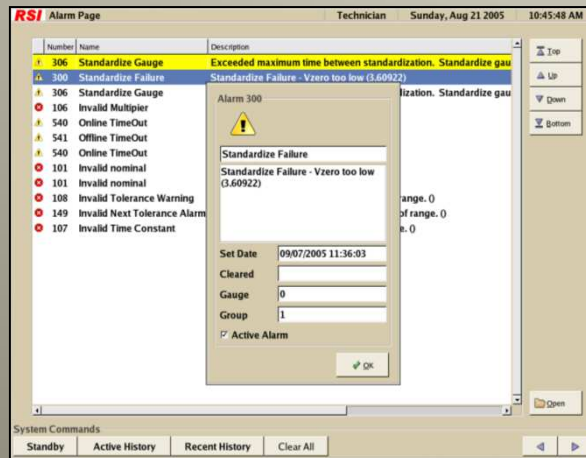
Measurement Page



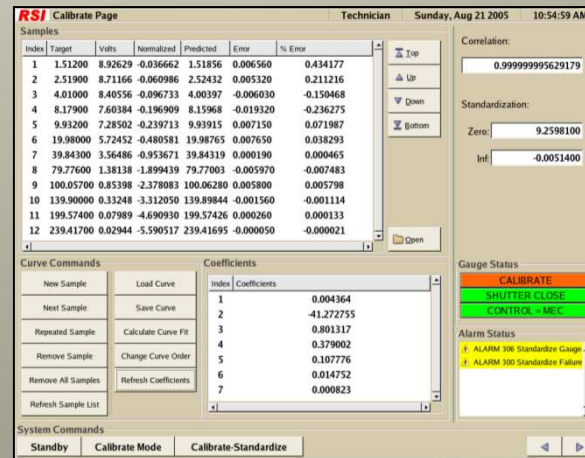
Setup Page



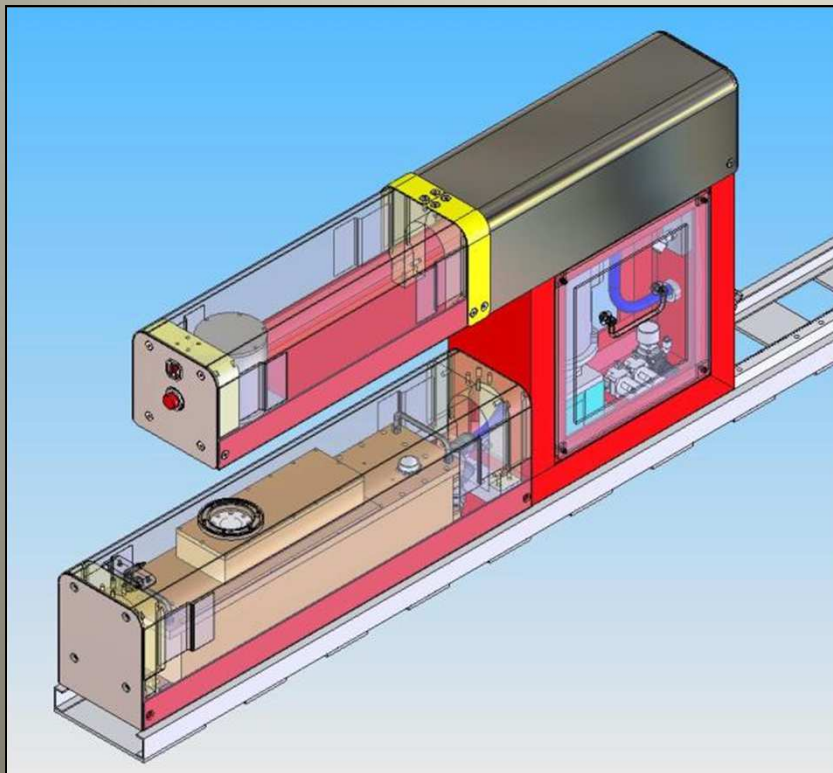
Alarm Page



Calibration Page

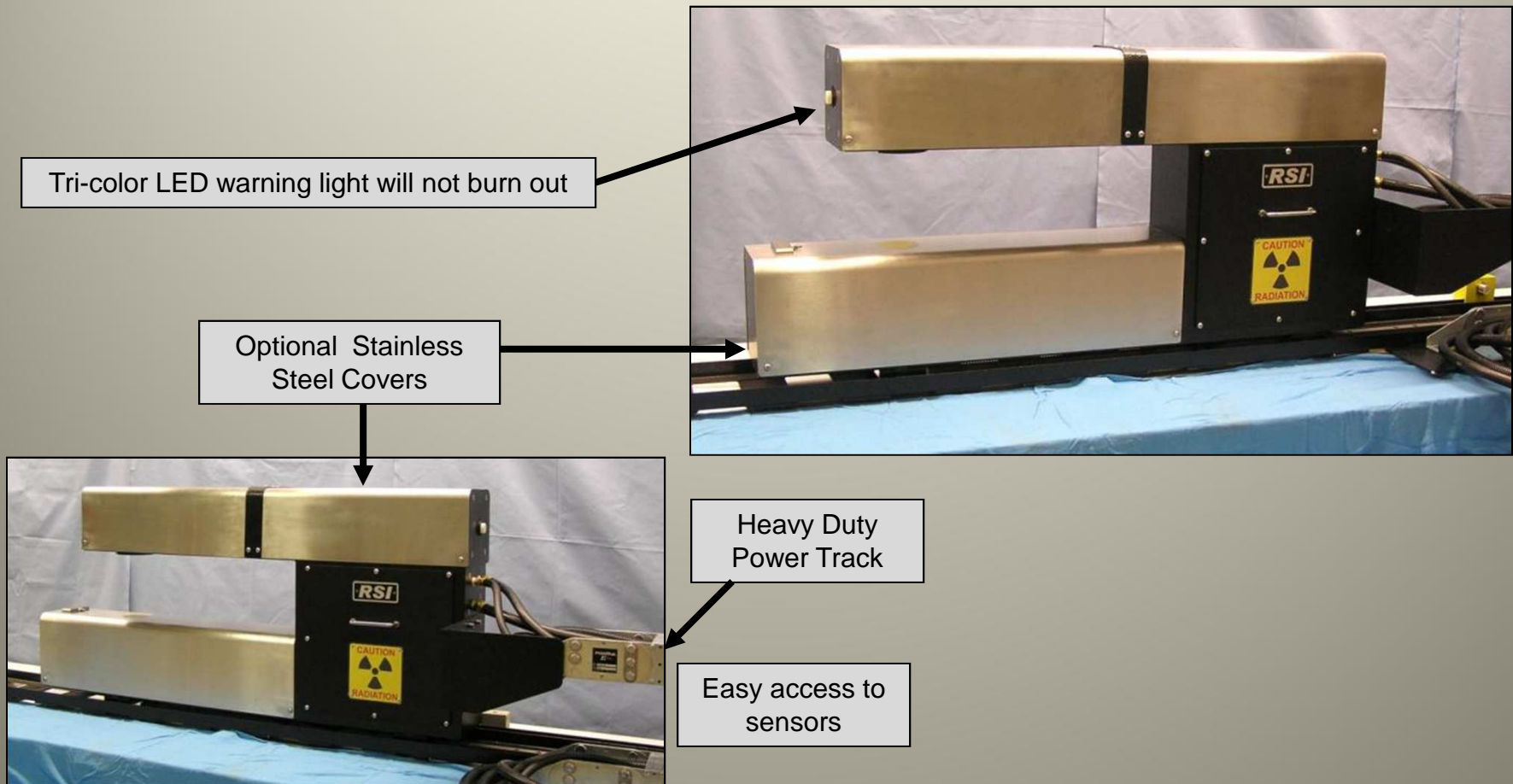


C-frame designs for all applications. Custom designed for your hot mill, cold mill or process line.

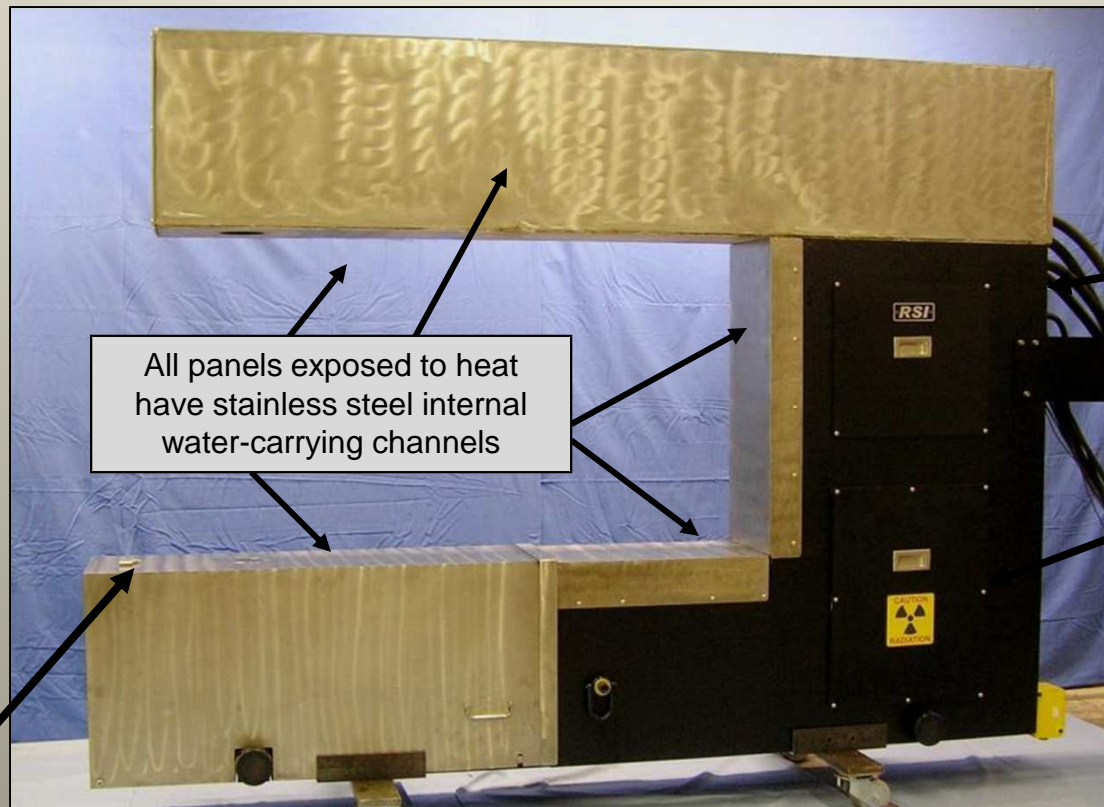


- Easy access for maintenance
- Rugged design protects key sensor components
- Drive options include positive drive by rack and pinion gear
- LED safety warning lights for long life
- Air wipes on source and detector windows
- C-frame designs undergo Finite Element Analysis (FEA) analyst
- Suspended C-frame designs available

Better Cold Mill C-frames



Better Hot Mill C-frames



High intensity LED Warning Light at rear of C-frame

All panels exposed to heat have stainless steel internal water-carrying channels

Removable covers provide access to drive motor

Powerful Air-wipe removes debris from Beam

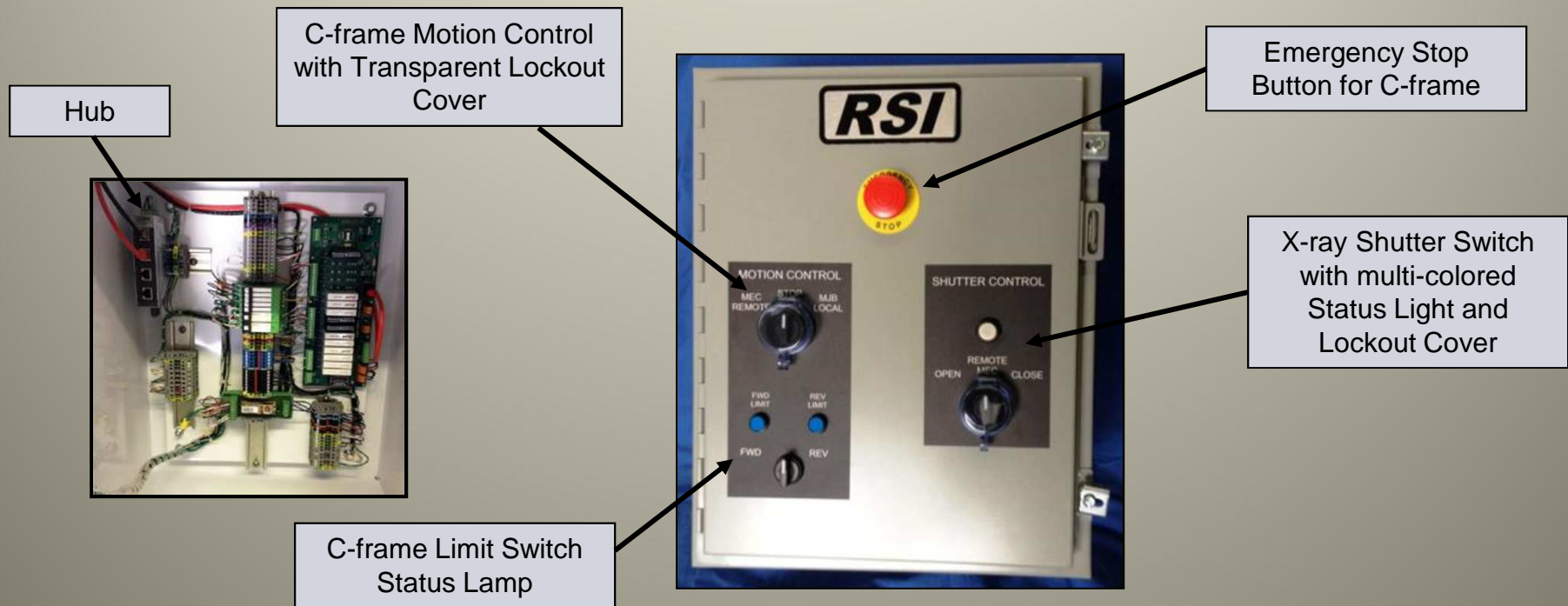
Engineered for extreme rigidity and stability for high accuracy measurements under all conditions

Special Features for Steel Hot Mill Applications

- Rugged C-frame design uses water-cooled panels on surfaces exposed to direct heat. Stainless steel water-carrying components ensure long life and protection of sensors.
- Corrosion-resistant stainless steel cooling panels are standard supply
- Cables from C-frame to Mill Junction Box enclosed in coolant resistant hoses
- Hot strip temperature correction based on temperature and alloy
- Optional pyrometer mounted in C-frame for automatic temperature correction
- Alloy Correction via download of alloy chemistry and dynamic alloy correction with x-ray beam hardening model for precise measurements of difficult alloys
- Dual Profile models available for hot mills and plate mills
- Scanning gauges utilize rack and pinion motor drive system for highly accurate C-frame positioning

Mill Junction Box incorporates a DIO module and a multi-port Ethernet Hub.

Sensor signals (limits switches, flow switch, etc.) are converted to digital and transmitted via fiber optic cable to the Main Electronics Cabinet. The conversion minimizes the number of interconnect cables between the two units.



Coil Report Package* (Summary Report)

- Coil Data stored in .pdf format
- May be printed (printer optional)
- Store up to 2000 reports
- Up to 12,000 data points per coil
- Report includes
 - Coil Summary
 - Statistics
 - Out-of-tolerance report
 - Coil length calculation

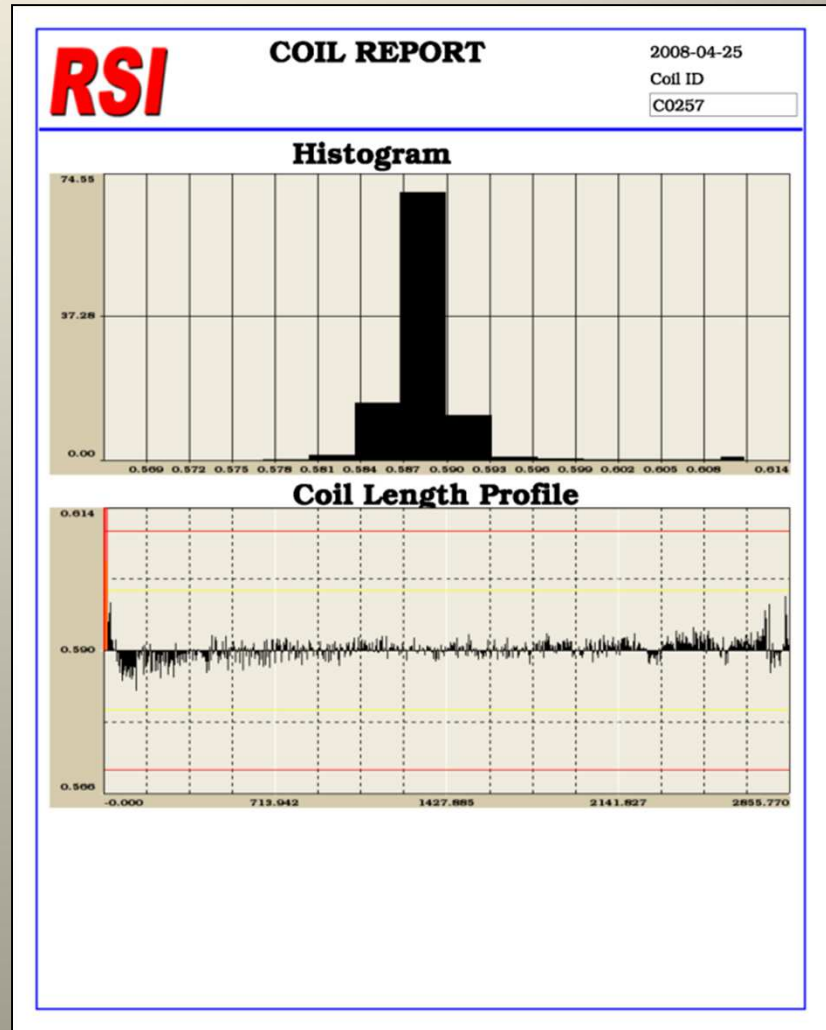
* Requires Remote Operator's Station

| RSI | | COIL REPORT | | 2008-04-25 | |
|---------------------------|--------------|--------------------|-----------------------------------|---------------------|--------|
| | | | | Coil ID | |
| | | | | C0257 | |
| SETUP INFORMATION | | | COIL INFORMATION | | |
| Target | 0.5900 | mm | Start Time | 2008-04-25 14:14:50 | |
| + Tolerance | 0.0200 | mm | End Time | 2008-04-25 15:52:45 | |
| - Tolerance | -0.0200 | mm | Run Time | 01:37:55 | |
| Alloy Name | 301 | | Coil Length | 2503.09 | meters |
| STATISTICAL DATA | | | STANDARD DEVIATION (SIGMA) | | |
| Mean (X Bar) | 0.5907 | mm | 1 Sigma | 0.0102 | mm |
| Maximum | 0.8595 | mm | 2 Sigma | 0.0204 | mm |
| Minimum | 0.5807 | mm | 3 Sigma | 0.0307 | mm |
| Range (R) | 0.2788 | mm | % Out of Tolerance 0.8547 | | |
| Variance | 0.0001 | | | | |
| VIOLATION SEGMENTS | | | | | |
| Count | Type | Max Deviation | Start | End | |
| 1 | Over | 0.2495 | 0.4892 | 10.6241 | |
| 2 | Over | 0.0188 | 16.4149 | 21.3566 | |
| 3 | No Violation | | | | |
| 4 | No Violation | | | | |
| 5 | No Violation | | | | |
| 6 | No Violation | | | | |
| 7 | No Violation | | | | |
| 8 | No Violation | | | | |
| 9 | No Violation | | | | |
| 10 | No Violation | | | | |
| 11 | No Violation | | | | |
| 12 | No Violation | | | | |
| 13 | No Violation | | | | |
| 14 | No Violation | | | | |
| 15 | No Violation | | | | |
| 16 | No Violation | | | | |
| 17 | No Violation | | | | |
| 18 | No Violation | | | | |
| 19 | No Violation | | | | |
| 20 | No Violation | | | | |

Coil Report Package (Continued)

Report also includes

- Coil Histogram
- Coil Length Profile



Coil Report Package (Continued)

Optional Pass Report for Reversing Mills

| RSI | | COIL REPORT | | | | | 2008-04-25 | | |
|--------------------|----------|--------------------|--------|-------|-------|--------|------------------------------------|------|------|
| | | | | | | | Coil ID | | |
| | | | | | | | <input type="text" value="C0257"/> | | |
| PASS REPORT | | | | | | | | | |
| Pass | Run Time | Target | | Speed | | Length | Percent Distribution | | |
| | | Entry | Exit | Avg | Max | | Under | In | Over |
| 1 | 00:05:05 | 3.0000 | 2.3800 | 187.8 | 207.5 | 749 | 99.7 | 0.0 | 0.3 |
| 2 | 00:09:10 | 2.3800 | 2.0200 | 232.2 | 254.0 | 878 | 99.7 | 0.0 | 0.3 |
| 3 | 00:04:21 | 2.0200 | 1.7400 | 283.0 | 303.0 | 984 | 66.3 | 33.5 | 0.3 |
| 4 | 00:05:22 | 1.7400 | 1.5200 | 221.5 | 303.3 | 1119 | 0.5 | 96.7 | 2.8 |
| 5 | 00:05:28 | 1.5200 | 1.3400 | 258.5 | 318.0 | 1260 | 0.1 | 98.5 | 1.4 |
| 6 | 00:06:01 | 1.3400 | 1.1900 | 243.3 | 339.6 | 1429.0 | 0.2 | 99.3 | 0.5 |
| 7 | 00:06:23 | 1.1900 | 1.0600 | 236.9 | 307.2 | 1421.8 | 0.1 | 99.4 | 0.5 |
| 8 | 00:07:32 | 1.0600 | 0.9450 | 265.8 | 340.2 | 1795.5 | 0.0 | 99.3 | 0.7 |
| 9 | 00:09:52 | 0.9450 | 0.8450 | 251.5 | 295.6 | 1788.1 | 0.0 | 99.4 | 0.6 |
| 10 | 00:09:58 | 0.8450 | 0.7500 | 250.1 | 331.8 | 2253.9 | 0.0 | 99.2 | 0.8 |
| 11 | 00:15:10 | 0.7500 | 0.6650 | 225.8 | 271.8 | 2243.8 | 0.0 | 99.4 | 0.6 |
| 12 | 00:13:33 | 0.6650 | 0.5900 | 243.1 | 281.2 | 2855.8 | 0.0 | 99.5 | 0.5 |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |

Coil Review Package **(Requires Coil Report Package)**

- The Coil Review Package stores ALL collected data for each coil in a system hard drive (Coil Report Package only saves a condensed summary of the coil data)
- A technician may use this feature to perform a detailed analysis of any selected portion of a coil
- Up to 200 coils may be saved using this format

Upgrade Packages Available for DMC Model 420, 510, 800, 480 and Radiometrie RM216 / 218 X-ray Gauges

- The most cost-effective solution to gauge obsolescence. Roughly half the cost of a new gauge.
- No need to purchase expensive, new gauges to benefit from newer technologies. Existing measurement sensors are often retrofitted with the latest technology as part of the upgrade.
- Reusing the existing measuring frames, sensors and cabling minimizes installation costs and down-time to a minimum. Most upgrades can be completed in just a few days.
- Reusing existing measurement sensors negates the need to purchase expensive new sensors to support the system.

RSI...now #1 in Service Support!

RSI now provides more service support than any other North American supplier, using experienced test and service personnel

- Free emergency service Hot Line (+1) 717-476-9012
- North American Service from Frederick, MD, Wheeling, WV and Detroit, MI
- European Service from the UK and Italy
- Service in Asia from Beijing, China
- Maintenance contracts designed to meet your requirements
- Discounts on spare parts
- Wipe tests
- Competitive rates
- Visit our website; www.rsi-xray.com

Why Work with RSI ?

- Our thickness gauges and coating gauges are proudly made in the USA
- Field service and technical support are always available
- Free hot line for customer emergencies
- Affordable preventive maintenance contracts and call-out service
- Fast turn-around on fully tested repairs – large inventory of spare parts
- Our x-ray sources and detectors are mechanically and electrically backwards compatible with those used in many older gauges
- An experienced technical staff with a proven track record
- We have more than 200 years of combined gauging experience

At RSI, the Customer is #1