GlobalGauge CORPORATION

Perfecta - 200

X-Ray Profilometer Gauge
Lab / Offline - Hot Mill

Global Gauge Mission

We will consistently deliver the most advanced, Perfectate and reliable measurement systems to flat product producers throughout the world. We will continue to succeed because of our hard work, our innovative solutions and our intense commitment to solving our customers' problems.

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Phone: 937.254.3500 ● www.globalgauge.com

1.0 Customer Application

1.1 Application Information

Application

Application Type: Offline Profilometer
Measurement Type: Cross-Width Profile Scanning
Internal Scanning X-ray and Laser Sensors
Thickness: to be provided
Mill Speed: to be provided
Strip width: to be provided
Strip temperature: to be provided

Utilities

Water:

Closed loop cooling system required for c-frame, power supply, and detectors: to be specified depending on installation environment

Air:

1.5 SCM @ 60 PSI, clean dry air

Power (or local equivalent):

EPC:	120 VAC, Single-Phase, 60 Hz, 20 Amps
Chiller:	to be specified depending on installation environment

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2.0 Global Gauge Recommended System

Global Gauge Corporation recommends the Perfecta-200 X-Series, a PLC-based X-ray offline profilometer system designed for high-precision strip and sample profile measurements. The system operates on a Windows operating system. The Perfecta-200 X-Series features a modern human–machine interface (HMI) and comprehensive diagnostic tools that simplify operation, maintenance, and troubleshooting.

The proposed system utilizes a GHF X-ray generator, providing excellent stability and accuracy across a wide range of materials and thicknesses. The system is based on an O-frame mechanical configuration designed for offline measurement applications. Samples are positioned within the O-frame, and profile measurements are performed with the frame fixed in place. Internal scanning X-ray sensors traverse across the sample width to generate high-resolution thickness profiles.

The Global Gauge solution is built upon the GHF X-Ray Generator, an integrated X-Ray generator/tube, which is designed and manufactured at our engineering facility. Our exclusive positioning allows us to provide industry-specific support through in-house critical sensor manufacturing and non-proprietary design. Incorporating off-the-shelf independent customer support. We source metal components from U.S.-based suppliers, ensuring reliability.

Situated in Dayton, Ohio, our headquarters uniquely position us to serve USA-based customers. Our solutions offer unparalleled reliability, supportability, and cost effectiveness on a global scale.

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3.0 System Description

The Perfecta gauging system consists of the following major components: Electronics Power Cabinet Assemblies (EPC), O-frame Assembly, and Sensors. A basic block diagram of the layout of the proposed Gauging System is shown below along with an example of a system at staging for gauge check-out.

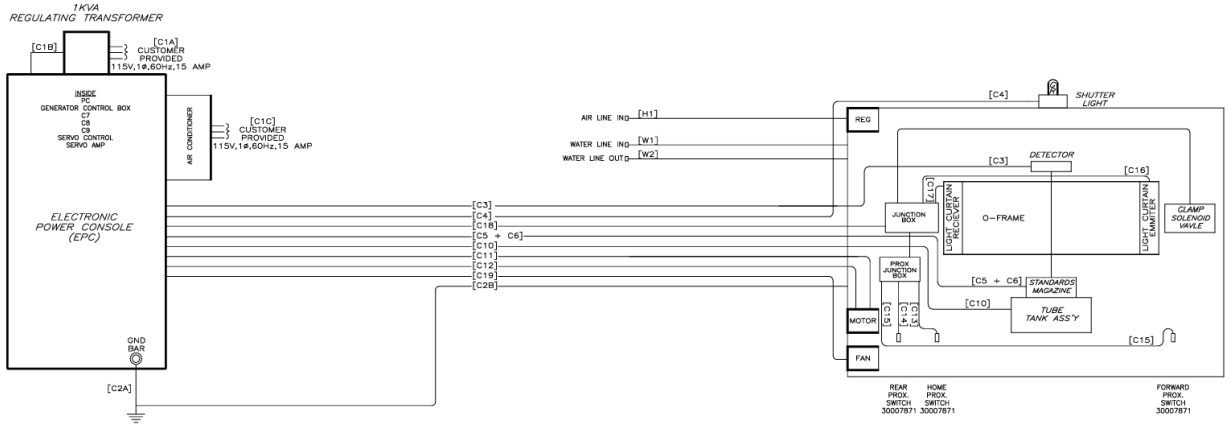

Figure - Typical Perfecta Profilometer System Diagram

Figure - Typical Perfecta Profilometer System at Check-out

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3.1 Electronics Power Cabinet (EPC)

The Perfecta EPC is built around an industrial Rittal cabinet and contains all process-control and data-acquisition components required to operate the gauge system. These include, but are not limited to: Industrial PC, Remote I/O subassembly, GHF X-ray generator control and power supply, critical system power supplies, circuit breakers and terminal strips. The majority of EPC components are off-the-shelf industrial hardware, readily available through local suppliers.

The cabinet is designed for operator convenience and safety, featuring externally mounted control switches and indicators, a large HMI display, a fold-down panel supporting a full-size keyboard and mouse, and a main power disconnect with full lock-out/tag-out capability. The EPC back panel houses the Remote I/O subassembly, which serves as the primary interface between the industrial PC and all gauge analog and digital I/O points.

Figure – Typical Perfecta EPC, Exterior

Figure – Typical Perfecta EPC, Interior

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3.2 HMI Screens and Diagnostics

The gauge operator and maintenance screens are available at the HMI in the EPC, and at the Operator's Remote Console or KVM extender (if required). Several screen shots are provided below to provide an indication of the type of data that is available.

The main operator's screen is shown below in the Figure below. This screen provides the operator with all basic information to determine the overall status of the gauge system, and the particular state of the gauge's most critical components. For example, at this screen the state of the X-ray generator, X-ray shutter, and overall fault status can be determined. When the gauge is in the gauging mode, the set thickness value, the measured value, and the deviation from the set thickness are all displayed continuously. The screen refresh rate is approximately 100ms. The simulated strip chart in the center of the screen shows a scrolling thickness deviation during the gauging time.

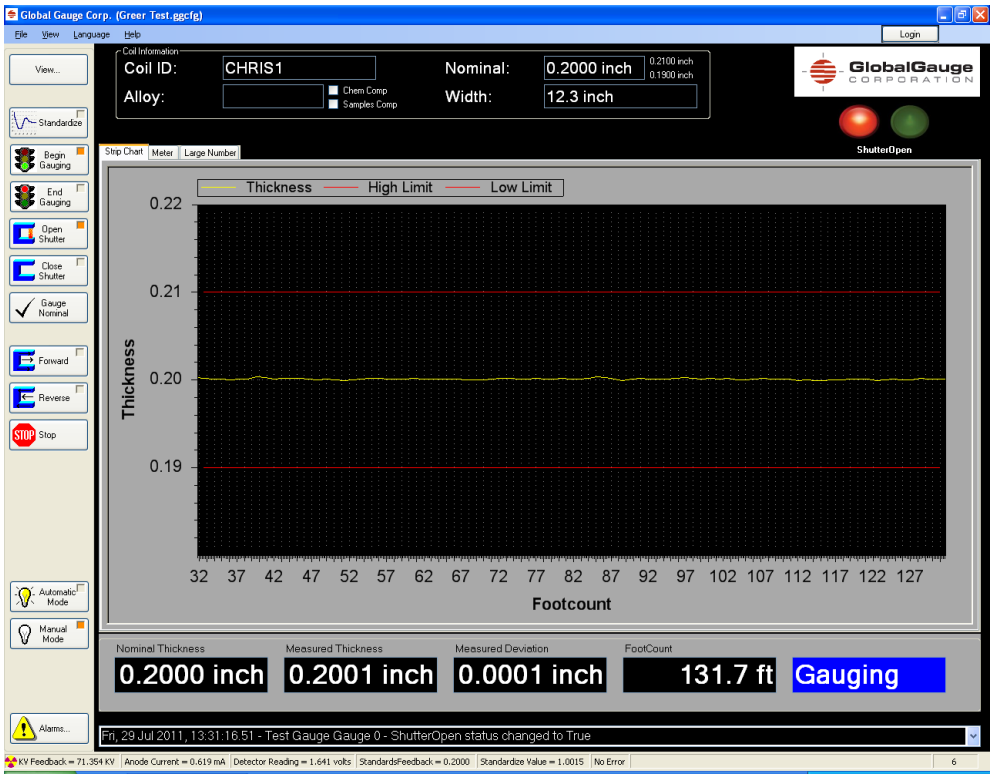

Figure – HMI Screen

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The Figure below shows the settings related to motion control for the sensors. The scanning sensors will scan in unison on the same track. Some of the information displayed includes the locations for home, edge, and centerline. It also includes settings such as the acceleration & deceleration and scan speed of the sensor assemblies.

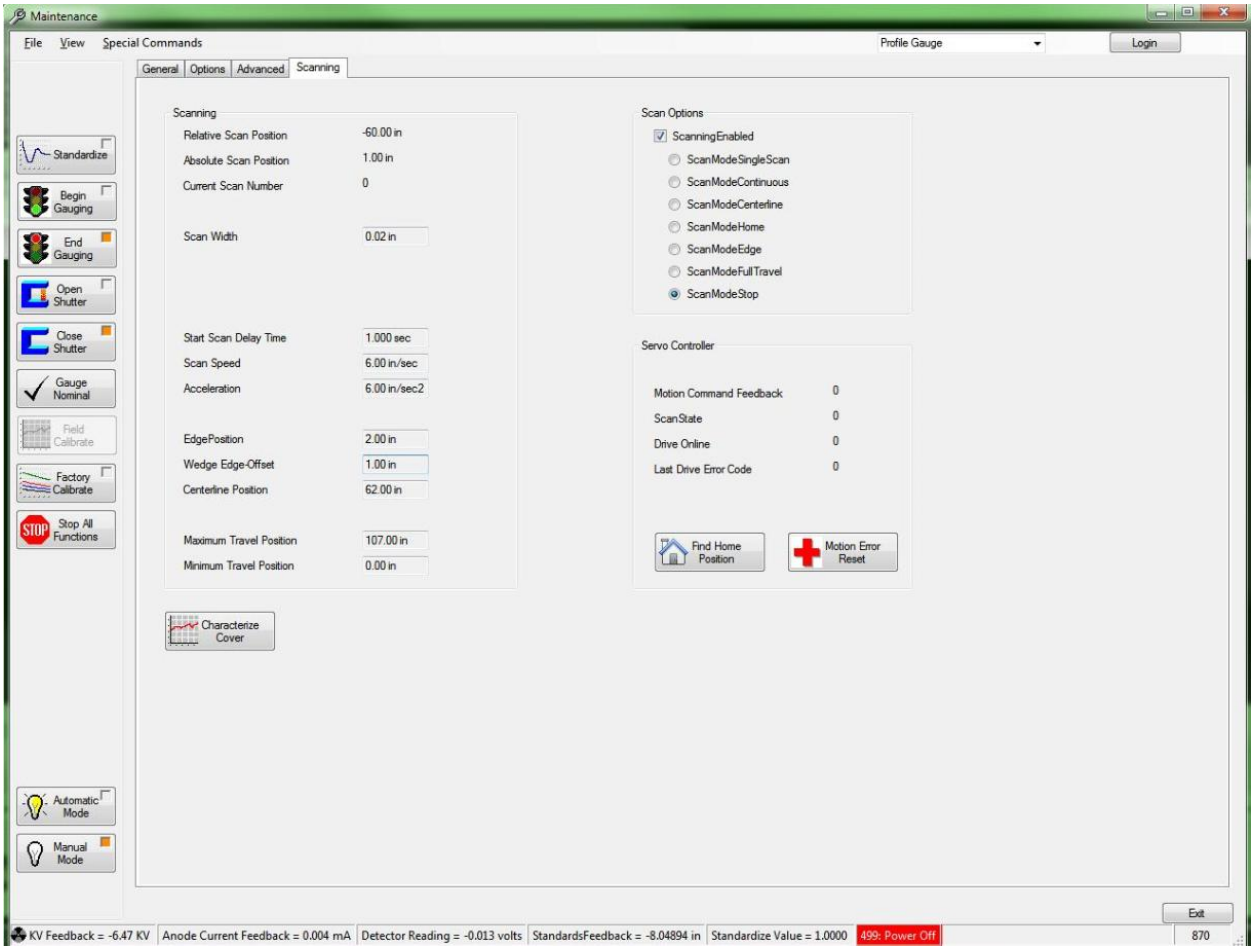

Figure – Sensor Setup Screen

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The Gauge Setup screens are shown in the Figures below. These screens are typically used by engineering to configure basic elements of the gauge for the particular application. Other gauge functions can be enabled via this screen, including logging functions and compensation functions.

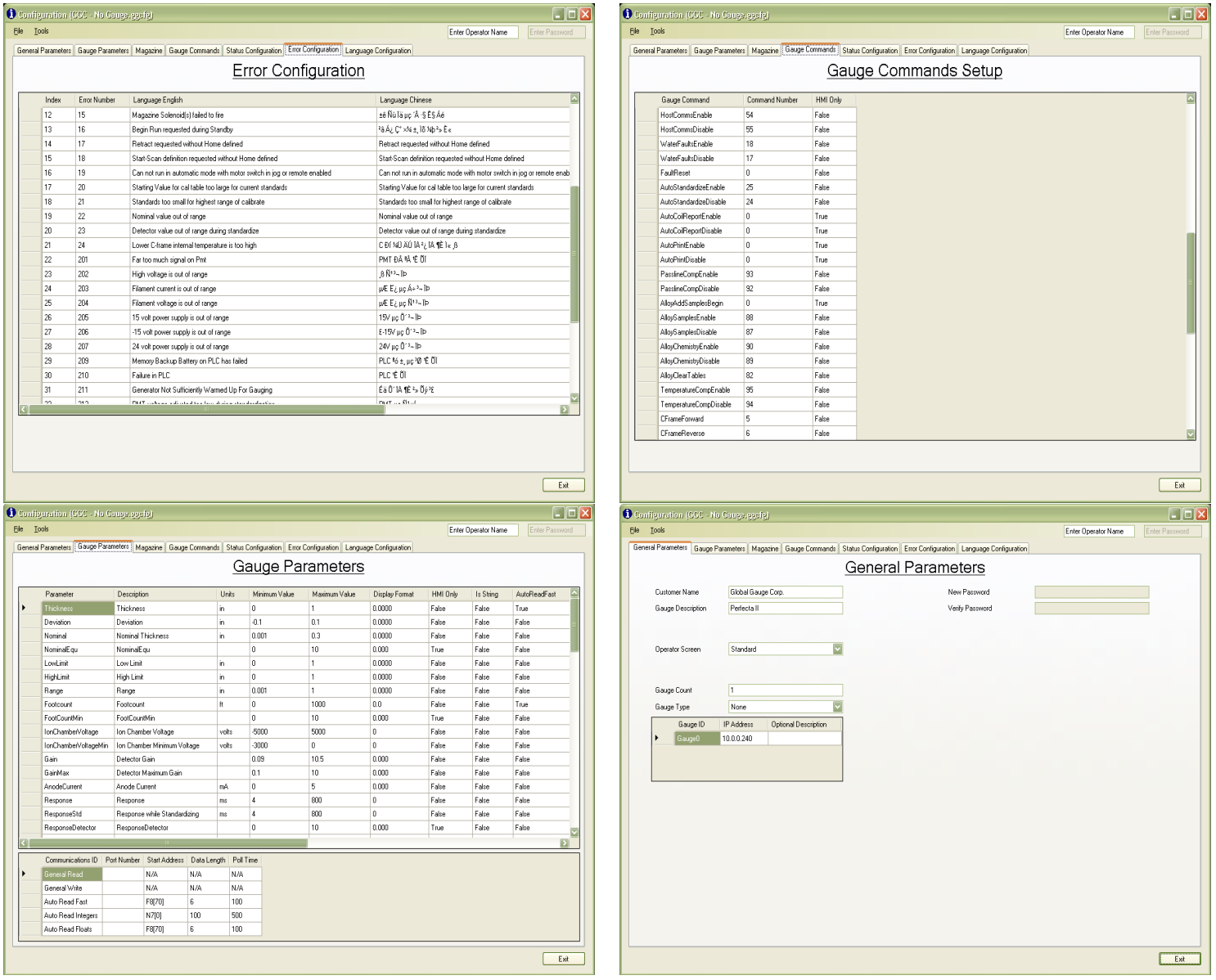

Figure - Gauge Setup Screens

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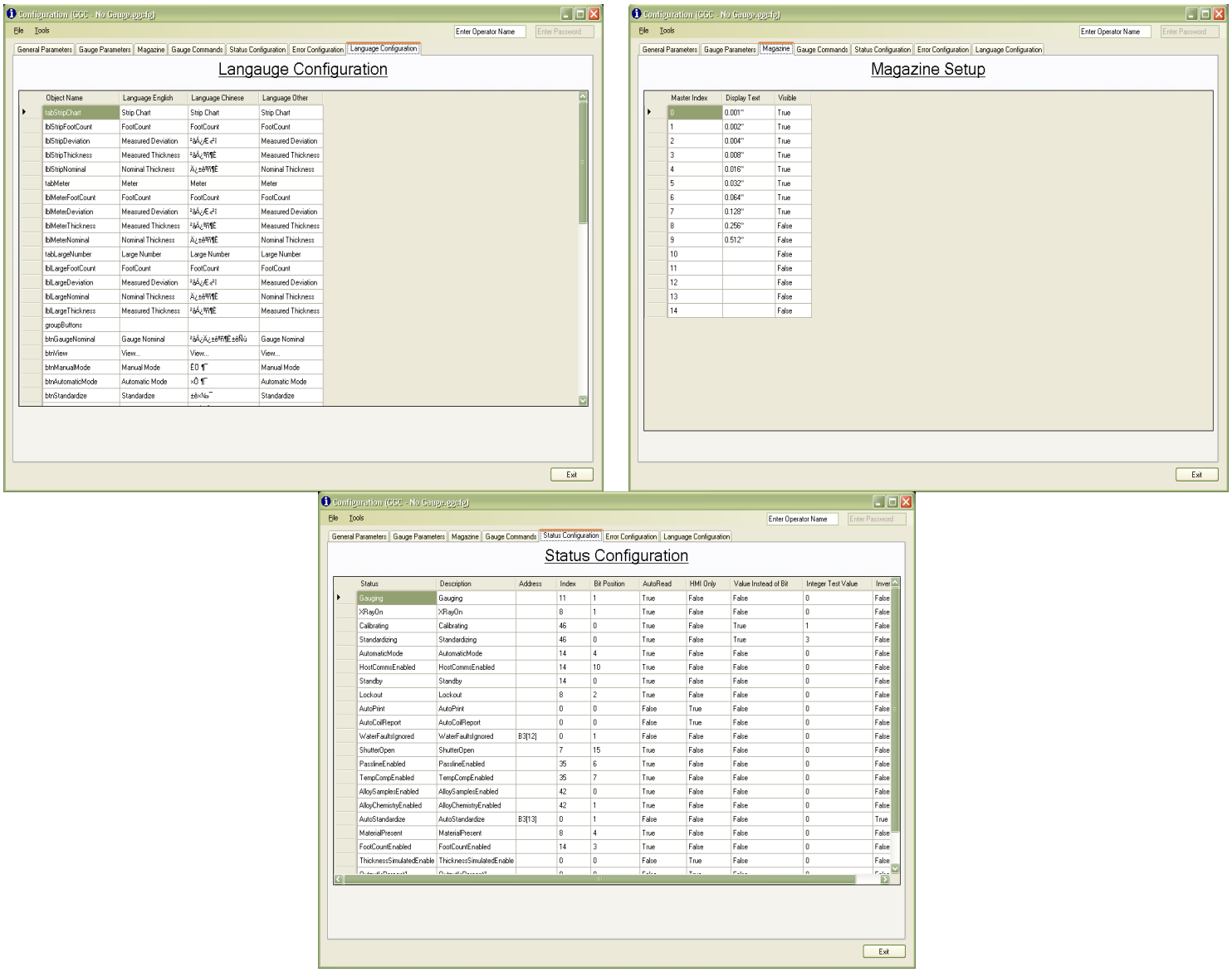

Figure - Gauge Setup Screens

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The gauge Maintenance Screen is shown below in the Figure below. From this screen all critical states/values are shown. The trained maintenance technician will be able to use this screen to debug any gauge problems with the generator, detector, or shutter box.

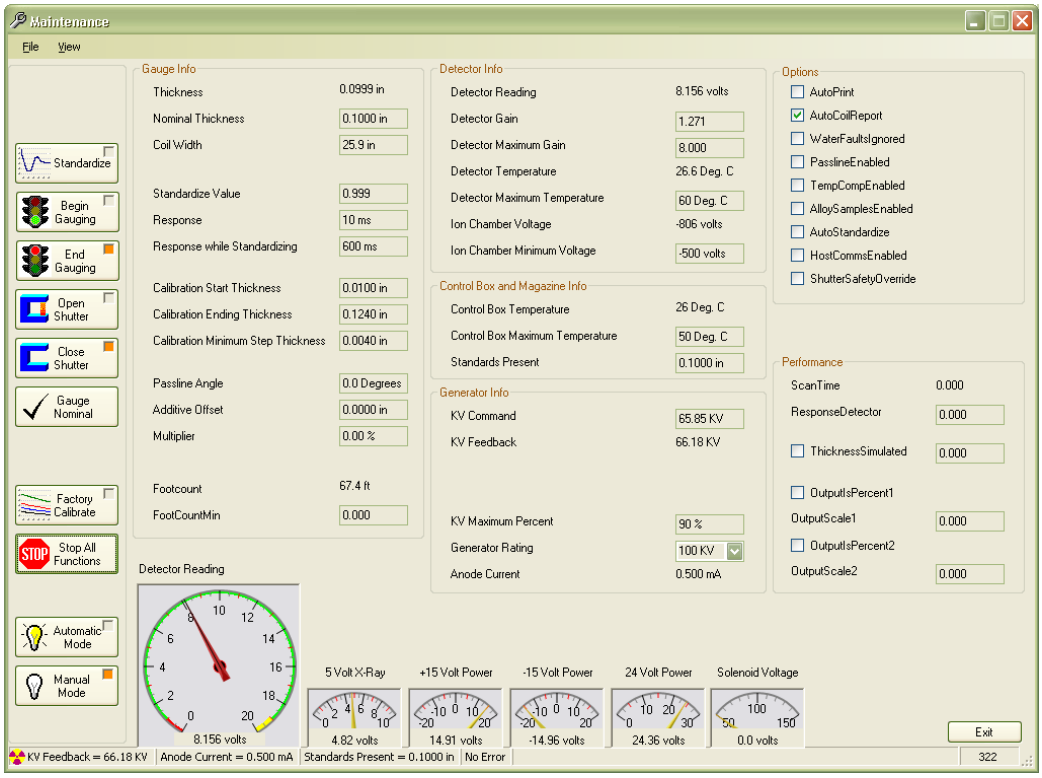

Figure - Maintenance Screen

3.3 Communications

GGC system architecture is as open and off-the-shelf as possible. We allow for maximum supportability for our customers, so that our systems can often be maintained by in-plant personnel and reduce the need for assistance by GGC engineers. This is a key differentiator between Global Gauge and our competitors in the gauging industry.

Global Gauge will provide communications interfaces to accept all setup data from the host computer via means requested by customer personnel. This can be done either manually or by a standard ethernet-based communications protocol with the L1 or L2 Systems (i.e. Generic TCP/IP, Modbus TCP, EtherNet/IP, ProfiNET).

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Moraine, Ohio 45439 USA ●
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3.4 Compensation Factors

All GGC gauges include complete compensation functionality as a standard feature. These features enhance the gauge's ability to provide Perfectate thickness information in all conditions. These utilities are enabled via software when the application-specific design of a gauge identifies it is required:

Passline Height Compensation ensures Accuracy when gauging material anywhere in the air gap of the Gauge C-frame. GGC personnel will customize the Passline information during manufacturing of the gauge, confirming during installation that the compensation is working properly. Typically, GGC designs the C-frame so that Passline Height Compensation is not necessary.

Passline Angle Compensation ensures Accuracy when gauging on material that is passing through the Gauge C-frame at an angle (i.e. when the surface of the material is not perpendicular to the x-ray beam). This compensation uses the geometrical formula to calculate the necessary compensation. An input from the customer indicating the value of the passline angle is required for this compensation. For most cold mill applications Passline Angle Compensation is not necessary.

Temperature Compensation ensures Accuracy when gauging on material that is hot, typically in excess of 400 degrees F. On a radiation-based gauge, hot material will not gauge the same as cold material. Customers are usually only interested in knowing the cold thickness. The gauge has the ability to compensate for these temperature related effects. The Temperature Compensation function requires an input signal representing the strip temperature.

Alloy Compensation ensures Accuracy when gauging on material that is chemically different from the material used to calibrate the gauge. The radiation from X-ray based gauges is affected by the chemical make-up of the material being gauged, and the gauge includes two methods for addressing this. One method uses the chemistry of the gauged material to correct the difference. The other method uses samples of these other alloys to correct the difference. Based on our experience, we use a combination of these two methods to obtain the best results. We will work with customer personnel to fully implement this Alloy Compensation functionality.

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Moraine, Ohio 45439 USA ●
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3.5 O-frame Assembly

The O-frame assembly is custom-designed and manufactured to meet the specific requirements of each application. For the Perfecta-200-X Series Offline Profilometer, the O-frame includes: Precision linear slides and servo-drive system for sensor scanning across the sample width, integrated cable and hose routing with an internal cable-handling system, access panels for ease of inspection and maintenance, and visual indicator lights to show X-ray and shutter status.

All sensors are fully accessible and designed for easy installation or removal. The internal scanning configuration allows the X-ray and laser sensors to traverse the sample while the material remains stationary, ensuring highly repeatable profile measurements.

Cooling for the X-ray generator is provided by the end user, if required, based on ambient temperature conditions at the installation location. Global Gauge will define the cooling requirements during the engineering phase and will coordinate integration of any required cooling systems into the final system design.

The Figure below shows a typical O-frame assembly during staging at GGC.

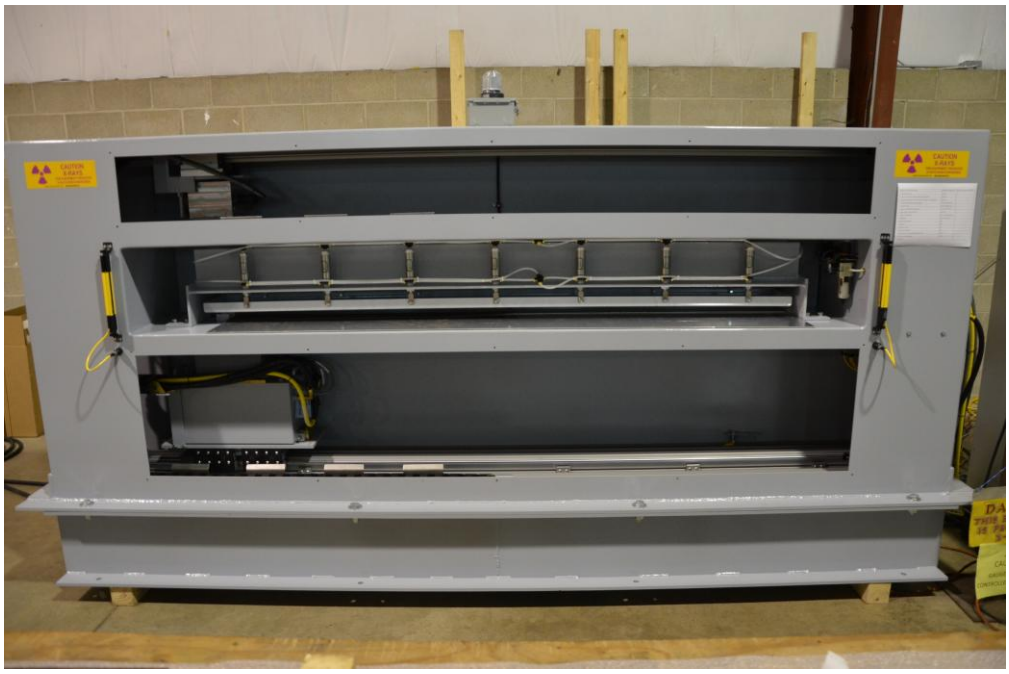

Figure - Typical O-Frame for Offline Profilometer Application

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Moraine, Ohio 45439 USA ●
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3.6 X-ray Generators

The GHF X-ray Generator supplied with this system is an integrated X-Ray generator/tube, which is designed and manufactured at our engineering facility. The GHF series of generators was developed by experts in the gauging field specifically for thickness gauge applications in rolling mill environments. This is a proven design with several hundred installations around the world.

Global Gauge is uniquely positioned to support USA-based customers in our industry with in-house generator manufacturing and non-proprietary design (off-the-shelf components used as often as possible), and headquarters based in Dayton, Ohio.

The key components of the GHF Generator are the Control Box and Generator Tank. The Control Box is the subassembly which contains the power and control components for controlling and monitoring the Generator Tank. A photo of the interior of the Control Box is shown below. Notice that the box contains a single control board and a single power supply.

Figure – GHF Control Box

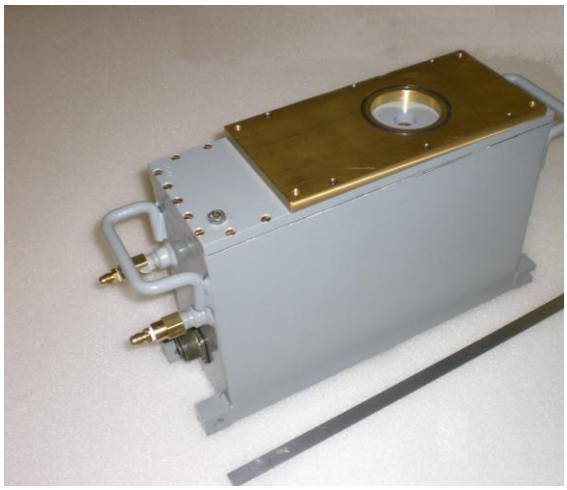

Figure – GHF Generator Tank

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3.7 Standards Magazine

The GGC standards magazine includes a normally closed lead shutter, which blocks the X-ray beam from exiting the assembly when appropriate. GGC can also add precision standards to this scope item. The standards are affixed to short arms, which are in-turn mounted to rotary solenoids. When the rotary solenoids are actuated, the thickness standards are rotated into the X-ray beam. When solenoids are de-activated, a built-in spring returns the standard to the out of beam position. Each solenoid also includes a feedback switch that provides an indication of the solenoid position.

The GGC design includes O-Rings on the Top and Bottom of the device and includes a redesigned window with O-Rings as well. The performance of these magazines and shutterboxes has been exceptional, and several hundred are installed throughout the world.

Figure – Typical GGC Standards Magazine

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3.8 Ion Chamber Detector

The Ion Chamber Detector was designed by GGC engineers to provide millisecond level response to changes in material thickness. The sealed, heavy duty detector housing is constructed of stainless steel. The unit contains a Xenon filled (4 atm.) ion chamber and a variable gain detector amplifier board. The variable gain feature allows the gauge system to operate at fewer kV ranges (possibly one), resulting in fewer alloy compensation issues. The Ion Chamber Detector has better longevity and less temperature sensitivity than PMT technology.

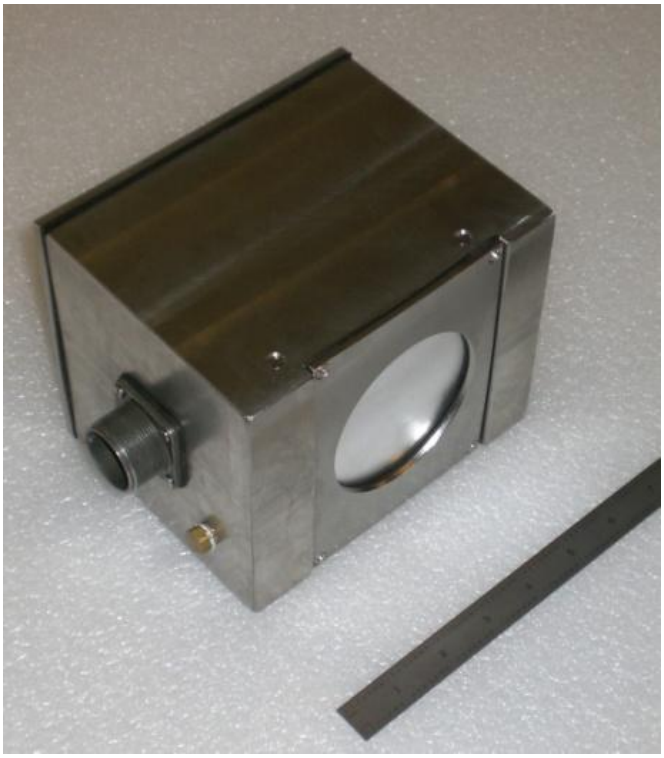

Figure – Ion Chamber Detector

3.9 Cooling

The customer will supply a water/glycol cooling system to provide cooling for the gauge or purchase this item as outlined in the proposal. Global Gauge will outline the cooling requirements for the new gauge equipment and work with the customer to integrate the cooling systems into the design. This cooling will be used to cool the generator tank and the detector chamber housing.

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3.10 Data Acquisition and Storage

The Perfecta gauge software includes comprehensive data logging and archiving functions to support diagnostics, maintenance, and long-term performance monitoring.

- Event Log: Records operator actions, system events, and fault conditions to aid in troubleshooting and root-cause analysis.
- Diagnostics Log: Captures sensor configuration data, environmental parameters, feedback signals, and performance metrics over time.

In addition, the system records measurement data for individual samples, including sample ID, thickness, deviation, and timestamp information. All archived profile data can be reviewed and analyzed using the GGC-supplied Profile Grapher software.

Profile Grapher allows users to display and report:

- Sample or Coil ID
- Target thickness and width
- Material grade
- Calculated profile metrics, including Crown, Wedge, Edge Drop, and Average Thickness

Reports can be customized to meet specific customer documentation and quality-control requirements.

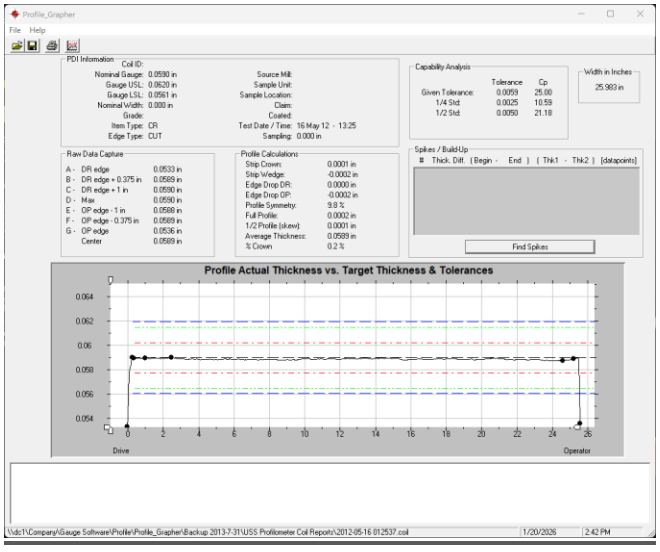

Figure – Example of Profile Grapher Coil Report

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4.0 GAUGE PERFORMANCE SPECIFICATIONS

The Global Gauge Perfecta Gauge will operate under the following specifications for this application:

4.1 Gauge Response: at or better than 10 milliseconds (adjustable)

- The time required for the output signal to register 63% of a 10% step-change in thickness at 0.100", to within the Accuracy specification.

4.2 Noise (2σ or 95.5%) = ±0.10%

- The 2σ (or 95.5%) value of the random variation of the gauge output signal while gauging on a static sample with a gauge filter setting of 25ms. Expressed as a percentage of the nominal set-point thickness the gauge is set up on.

4.3 Measurement Accuracy = ±0.10%

- The Accuracy of the gauge is ±0.10% of the set thickness of the precision master on which the gauge has been standardized.

4.4 Drift = ±0.15%

- The drift of the gauge signal as recorded on a chart recorder during an eight hour period will not range more than 0.15% from the set thickness on which the gauge, with cooling, was standardized.

4.5 Repeatability (2σ) = ±0.10%

- Closeness of agreement among a number of consecutive measurements of the gauge output signal for the same input and under the same operating conditions.

These standard specifications are valid if the installation is in compliance with Global Gauge installation specifications as will be provided in Engineering Approval Drawings. Variations on these specifications to meet the customer's specific requirements can be accommodated. Please contact Global Gauge Corporation for further details.

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5.0 Scope of Supply

5.1 Electronic Power Cabinet (EPC)

- PLC for gauge control (Allen-Bradley or Siemens, user preference)
- Rittal free-standing style enclosures with air conditioner or pagoda fan
- Remote I/O modules, system power supplies, relays and circuit breakers
- Industrial Windows PC with Global Gauge HMI Software including integrated diagnostics
- Industrial Ethernet interface for communications

5.2 O-frame Assembly

- Steel O-frame supporting X-ray generator, detector, and shutter assembly
- X-ray warning signage and shutter indication lights
- Precision linear slides for moving the profile sensors
- Internal Catrac style cable handling system for the profile sensors
- Internal cooling hoses
- Access panels in O-frame for accessing the sensors

5.3 Sensors

- GHF X-Ray Generator
- GHF Control Box
- Standards Magazine
- Ion Chamber Detector Assembly

5.4 Interconnect Cables and Hoses

- Generator Source Cable
- Standards Magazine Solenoid Cable
- Standards Magazine Feedback Cable
- Ion Chamber Detector Cable
- Additional cables as required to operate the auxiliary hardware as necessary

*Interconnect cables from the EPC to the sensors located in the Frame, up to 100 ft. Actual lengths will be determined during detailed design phase.

5.5 Drawings and Manuals

- Three Sets of system drawings, provided on standard GGC borders
- Check out test certificates
- Operator's & Maintenance manuals

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5.6 Field Services

Installation Supervision

- Supervision of gauge installation including but not limited to:
  - Removal of old equipment
  - Pulling cables
  - Setting of O-frame
  - EPC placements

Start-Up & Commissioning

- Complete start-up and commissioning of the gauge system after installation is completed

On-site Training

- On-site operator and maintenance training after commissioning is completed

Post-Commissioning Maintenance Support for One (1) Year

- Weekly Remote Stand-up Meeting
  - 30-minute remote web-meeting for communication & task tracking

- Quarterly System Review (Recommended, not required)
  - Half-day on-site or remote service visit to
    - Review system
    - Address any outstanding tasks

5.7 Operator's Remote (Optional)

- Touch screen monitor
- KVM extender

5.8 Calibration Samples (Optional)

- Complete set of Hand Held Calibration Samples
  - Manual off-line thickness verification
  - Samples will cover the full measuring range, BCD, 0.001" – 0.400"
  - Certified and Traceable to NIST

Note that all designs meet or exceed all applicable Codes and Standards.

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6.0 HOT MILL GAUGE REFERENCE LIST

Please see the attached reference list for Hot Mill Gauge Installations reference list from 2005-2021 below.

Please note that the list below is limited only to Hot Mill applications.

In addition to the list below, Global Gauge has built more than 300 gauging and measurement systems since Y2000, the majority of which are still fully functional and operational. Many of the 300+ systems are with repeat customers, which we are proud to reference as an indication of our high customer satisfaction.

End User/OEM	Location	Gauge Type	Made By	Qty	Application	Measured Range	Materials	Year Installed
Novelis - Richmond	Richmond, VA	Perfecta, Internal Scanning Profile Gauge	GGC	1	Hot Strip Casting Mill	up to 0.150"	Aluminum	2021
Novelis - Davenport	Davenport, IA	Perfecta, 2 Pt. Profile Gauge	GGC	1	Hot Strip Mill	up to 0.250"	Aluminum	2021
Novelis - Davenport	Davenport, IA	Hot Mill Profilometer Lab Gauge	GGC	1	Hot Strip Mill	up to 0.250"	Aluminum	2021
AK Steel - Mansfield Plant	Mansfield, OH	Perfecta Profile Gauge	GGC	1	Hot Strip Mill	up to 0.50"	Steel	2019
AK Steel - Mansfield Plant	Mansfield, OH	Perfecta C/L Gauge	GGC	1	Hot Strip Mill	up to 0.50"	Steel	2019
Danieli/ALCOA	Kunshan, PRC	3-Point, Perfecta 125	GGC	1	Hot Reversing Mill	3.5 mm - 100 mm	Aluminum	2016
Novelis - Milan	Italy	D3-100	LGE	3	Casting	up to 10 mm	Aluminum	2015
Aleris-Lewisport	USA	Perfecta 40	GGC	1	Hot Rolling Mill	0.090" - 0.313"	Aluminum	2014
Aleris - Uhrichsville	USA	Perfecta Profile Gauge	GGC	1	Hot Rolling Mill	0.050" - 0.250"	Aluminum	2013
Aleris - Uhrichsville	USA	Perfecta C/L Gauge	GGC	1	Hot Rolling Mill	0.050" - 0.250"	Aluminum	2013
NLMK Indiana (formerly Beta Steel)	USA	Perfecta 200	GGC	1	Hot Mill-Steckel	2 mm - 25 mm	Steel	2014
NLMK Pennsylvania Corp	USA	Perfecta 200	GGC	1	Hot Mill-Roughing	0.75" - 1.50"	Steel	2013
Aritime/Hang Zhou Steel	China	Perfecta 150	GGC-ASIA	1	Hot Mill	0.8 mm - 12 mm	Steel	2013
NLMK Pennsylvania Corp	USA	Perfecta 200	GGC	1	Hot Mill	0.055" - 1.00"	Steel	2012
Yezi Oubo	China	Perfecta 150	GGC-ASIA	2	Hot Mill	0.8 mm - 12.0 mm	Steel	2012
BRG Group, Kolkata India	India	Perfecta 150	GGC	1	Hot Strip Mill	2.0 mm - 25 mm	Steel	2011
North Star Bluescope Steel	USA	Perfecta Dual Profile Gauge	GGC	1	Hot Strip Mill	1.0 mm - 13.0 mm	Steel	2011
North Star Bluescope Steel	USA	Perfecta C/L Gauge	GGC	1	Hot Strip Mill	1.0 mm - 13.0 mm	Steel	2011
Algoma Steel	Canada	Perfecta 150 Dual Profile Gauge	GGC	1	Hot Strip Mill	0050" to 1.000"	Steel	2008
Algoma Steel	Canada	Perfecta 150 C/L Gauge	GGC	1	Hot Strip Mill	0050" to 1.000"	Steel	2008
Stomana (Danieli)	Bulgaria	Accura 250	GGC-Europe	1	Hot Plate Mill	5 - 40mm	Steel	2008
Tanjin Hongri/Tianjin Qifeng	China	Accura 8600/75KV/C	GGC-ASIA	1	Hot Mill - Strip	0.1~5mm	Steel	2007
JSPL - Raigarh	India	Perfecta 150	GGC	1	Hot Mill - Steckel	up to 25mm	Steel	2007
JSW Mingo Junction (formerly Severstal - Wheeling)	USA	Perfecta Dual Profile Gauge	GGC	1	Hot Mill - Strip 80"	up to 0.625"	Steel	2007
JSW Mingo Junction (formerly Severstal - Wheeling)	USA	Perfecta C/L Gauge	GGC	1	Hot Mill - Strip 80"	up to 0.625"	Steel	2007
Bokaro Steel	India	Perfecta 150	GGC	1	Hot Mill - Strip	23 mm	Steel	2006
Aritime Metallurgical	China	Perfecta 150	GGC	1	Hot Mill	1.0 - 18.0 mm	Steel	2006
Beijing Aritime Co.,Ltd /Tangshan Ganglu Iron and Steel Co.,Ltd.	China	Perfecta-9600/150KV	GGC-ASIA	1	Hot Mill - Tandem 5 Stand	1.0 - 18.0mm	Steel	2006
Beijing Adler Co., Ltd./Jinan Steel Co. Ltd.	China	Perfecta 9600/150KV/C	GGC-ASIA	1	Hot Mill - Plate	5 - 22mm	Steel	2005

3200 Kettering Blvd.
Moraine, Ohio 45439 USA ●
Phone: 937.254.3500 ● www.globalgauge.com

7.0 Global Gauge Corporation – Key Contacts

Tim Quackenbush
Vice President, Operations
O: +1 (937) 254-3500
C: +1 (513) 604-6896
t.quackenbush@globalgauge.com

David Kober
Vice President, Sales & Marketing
O: +1 (937) 254-3500
C: +1 (334) 475-1611
d.kober@globalgauge.com

Bill McCormick
President
O: +1 (937) 254-3500
C: +1 (347) 882-5827
b.mccormick@globalgauge.com

Robert Day
Quality Assurance and Health & Safety Manager
O: +1 (937) 254-3500 x260
b.day@globalgauge.com

Tracy Evans
Director of Finance
O: +1 (937) 254-3500 x229
t.evans@globalgauge.com

3200 Kettering Blvd.
Moraine, Ohio 45439 USA ●
Phone: 937.254.3500 ● www.globalgauge.com