



Machine Tool Calibration

XD Laser



SwivelCheck



Ballbar



What is Machine Tool Calibration? And Why Do I Need it?

Every manufacturing plant is rooted in Machine Tool production. CNCs, Lathes, Gantries, and more are used in projects that require tight tolerances, often to within a just a few microns. So, the machine tools used in these productions must be accurate to these same standards. In addition to environmental effects, like foundation, mounting, alignment, and temperature, there are up to 21 error parameters for a simple three-axis machine tool. The Linear Positioning; Vertical and Lateral Straightness; and Pitch, Roll, and Yaw all have possibility for error in their X, Y, and Z coordinates. Additionally, machine tools can produce errors if they are not perfectly square at the XY, YZ, and XZ junctions.

If they are not caught and corrected, these errors can diminish the quality of casting, tooling, assembly, and composites for a given project, and they can lead to costly rework or parts being scrapped. Fortunately, these errors can be found and compensated for before they create project delays and scrapped parts. The most common form of Machine Tool Calibration (MTC) is through the use of a laser interferometer, but there are other methods, including Ballbars and SwivelChecks or the use of a Laser Tracker for full Volumetric Error Compensation (VEC). Each of these methods has their own benefits for different machine types and setups, but all are useful for the necessary work of preventing or eliminating machine tool error.

The 7 most important reasons to have your machine tool calibrated today

- 1) Acceptance Testing
- 2) Preventative Maintenance
- 3) Certify a Machine that Has Probing Capabilities
- 4) Know Your Machine's Accuracy Limitations
- 5) Improve Accuracies on Older Machines
- 6) Reduce Machine Waste
- 7) More Accurate Parts



HEAR THE
REASONS
EXPLAINED HERE

Regular, scheduled machine tool calibration is essential to ensure the accuracy of the tool, the part, and the project as a whole. Many machine shops elect to purchase MTC equipment (like API's XD Laser and Wireless Ballbar) and training so their teams can perform the work in house, but for many that is not the most cost-effective solution. For training or contract calibration, API Services has decades of experience with our state-of-the-art MTC equipment and with more than 20 kinds of machine tool controllers.

API's comprehensive MTC product line and contract Services reduce downtime and maximize quality by offering the fastest and most accurate calibration results with the expertise to perform the fewest measurement setups at the most affordable prices.

XD Laser

CNC Machine Measurement System

API's XD Laser is a multi-dimensional interferometer offering a high level of flexibility for machine-tool calibration. The 6DoF XD laser is the only tool that provides 6DoF measurement data for all axis errors in a single setup. XD provides rapid machine-tool error assessment by evaluating velocity, acceleration, parallelism, squareness, flatness, straightness as well as linear, angular, and roll errors with a single set-up. XD is wireless and available in 1, 3, 5, and 6 Degree of Freedom (6DoF) configurations.

XD Laser is compact and provides easy setup and operation. The control box is integrated into the laser head for portability; the environmental station compensates in real time with software for control, data acquisition, and reporting all included as standard. Available options include linear and volumetric error compensation.



SEE IT IN
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XD Laser Features and Benefits

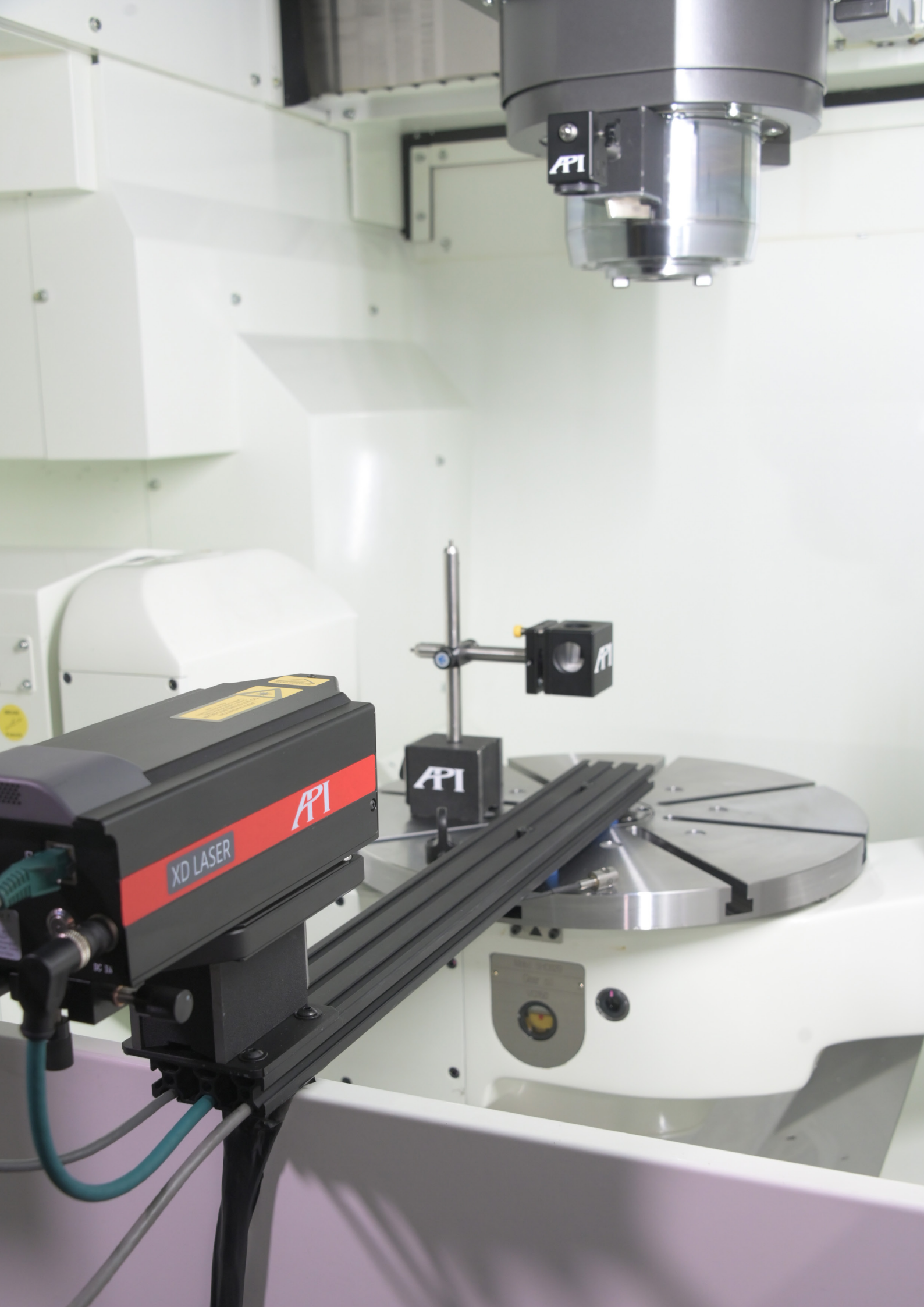
- **Rapid Measurement** - The XD Laser's fast, accurate measurement of machine positioning and axial capability makes complete machine assessment possible with up to 80% less machine downtime compared to conventional interferometers.
- **6 Degrees of Freedom Measurement** - XD Laser is the only assessment system that can collect all 6 error parameters simultaneously in a single set-up.
- **Measurement Flexibility** - XD Laser evaluates velocity, acceleration, parallelism, squareness, and flatness error of a machine.
- **Compact Design** - XD Laser system contains minimal parts and compact sensors for ease of setup and maximization of the machine measurement volume.
- **Software** - Includes XD Laser software for control, data acquisition and reporting. Linear and volumetric error compensation options are also available.
- **Service and Support** - The API global team provides consistent support anywhere in the world.





XD Compared to Other Laser Interferometer Systems

	API XD6 System	Conventional Interferometer	Conventional Precision Interferometer
Linear	Included	Included	Included
H-Straightness	Included	Option sold seperately	Included
V-Straightness	Included	Option sold seperately	Included
YAW	Included	Option sold seperately	Included
PITCH	Included	Option sold seperately	Included
ROLL	Included	Option sold seperately	Included
Squareness Kit	Included	Option sold seperately	Option sold seperately
Flatness Kit	Option sold seperately	Option sold seperately	Option sold seperately
Parallelism Kit	Option sold seperately	Option sold seperately	Option sold seperately
Measurement Range	25m	80m	4m
Magnetic Base	Included	Not Available	Not Available
Cost	\$	\$\$	\$\$\$\$
Measurement Time	🕒	🕒🕒🕒🕒	🕒🕒



XD Laser Technical Specifications

Precision System

6DoF Features	Accuracy	Resolution	Operating Range
Linear	0.2µm/m 0.2 parts per million (ppm)	0.02 µm	0-40m (80m optional)
Straightness	± (0.5µm + 0.1µm/m) or 1% of max measured error	0.1 µm	0-25m (±0.3mm)
Angular Yaw & Pitch	± (0.5 arcsec + 0.05 arcsec/m)	0.1 arcsec	0-25m (±400 arcsec)
Roll	± 0.5 arcsec or 1% of max measured error traveled	± 0.5 arcsec (within ±50 arcsec calibrated range)	0-25m (±400 arcsec)

Additional Features	Accuracy	Range
Squareness	± (1.0 arcsec + 0.2 arcsec/m)	0-25 m
Parrallelism	± (1.0 arcsec + 0.2 arcsec/m)	0-25 m
Velocity	> 3 meters/sec	0-40 m

Standard System

6DoF Features	Accuracy	Resolution	Operating Range
Linear	0.5µm/m 0.5 parts per million (ppm)	0.02 µm	0-40m (80m optional)
Straightness	± (1.0µm + 0.2µm/m) or 1% of max measured error	0.1 µm	0-25m (±0.5mm)
Angular Yaw & Pitch	± (1.0 arcsec + 0.05 arcsec/m)	0.1 arcsec	0-25m (±800 arcsec)
Roll	± 1.0 arcsec or 1% of max measured error traveled	± 1.0 arcsec (within ±100 arcsec calibrated range)	0-25m (±800 arcsec)

Additional Features	Accuracy	Range
Squareness	± (1.0 arcsec + 0.4 arcsec/m)	0-25 m
Parrallelism	± (1.0 arcsec + 0.4 arcsec/m)	0-25 m
Velocity	> 3 meters/sec	0-40 m

After 25m measurement range may decrease by up to 50%. The reported accuracy values, calculated with a 95% confidence level (k=2), do not account for errors associated with normalizing the readings to a material temperature of 20°C. API has made considerable efforts to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. API excludes liability, however arising from any inaccuracies in this document.

API SwivelCheck

CNC Rotary Axis Calibrator

API's SwivelCheck measures and calibrates machine tool rotary axes, swivel axes, tilt tables, and pendulum axes. It is the only tool that can be mounted off-center of the rotating axis to measure swivel axes and trunnions without disassembling critical machine-tool components. SwivelCheck utilizes a servo-driven motor in conjunction with an electronic level and precision rotary encoder to measure multiple parameters in a single setup.

SwivelCheck can operate in automated or manual modes and includes software for control, data acquisition, and reporting. Used in conjunction with the API XD Laser, SwivelCheck can also measure table wobble on horizontal rotary tables.



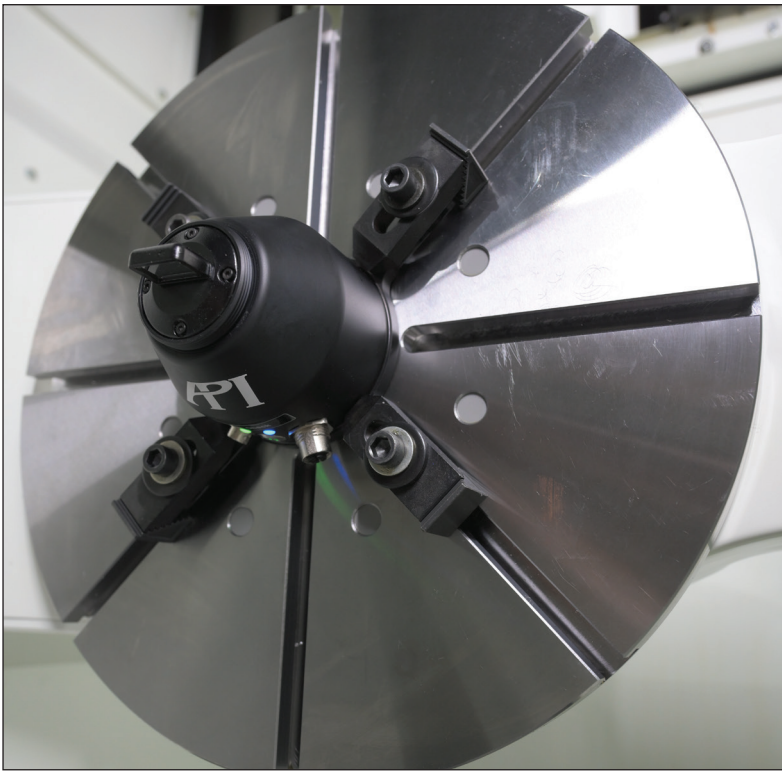
SEE IT IN
ACTION HERE!



SwivelCheck Features and Benefits

- **Smaller Size** - SwivelCheck is now 70% smaller and lighter than previous versions of the device, weighing just 1.88 lbs.
- **Controller** - SwivelCheck now features an Embedded Controller in the Gimbal, allowing for more streamlined operation directly from the software.
- **Battery Powered** - Battery operation is capable of 8-10 hours of continuous use meaning a full day's measurement and calibration without interruption.
- **Wired & Wireless Compatibility** - The system is Wi-Fi enabled for rapid data transmission.
- **Simple Operation** - Measure rotary axes, swivel axes, vertical axes and tables with a single set-up – just install and measure.
- **Off-rotating Axis Mounting** - SwivelCheck is the only tool that can be mounted off rotating axis center to measure swivel axes and trunnions without disassembling critical machine components.
- **Flexible Capability** - Paired with the XD Laser, Swivelcheck extends the operation to measure table wobble on horizontal rotary tables.
- **Portability** - Swivelcheck is fully portable and designed with ease of use, efficiency and accuracy in mind.
- **Software** - Includes new software for control, data acquisition and reporting.
- **Service and Support** - The Automated Precision global team provides consistent support anywhere in the world.





SwivelCheck Technical Specifications

Range	No limit
Minimum Test Increment	0.0002 °
Resolution	0.03 arc-seconds
Accuracy	± 2 arc-seconds
Dimensions	101.6 x 101.6 x 127.0 mm (4 x 4 x 5 inches)
Weight	0.85kg (1.88 lbs)
Battery Life	6-8 hours
Connectivity	WiFi
Warm-up Time	± 10 minutes



Ballbar

Rapid Machine Tool Performance Check

API's wireless Ballbar easily measures CNC machine performance to predict and diagnose servo errors and path deviations. Ballbar is a simple, cost-effective solution that is designed to improve overall machining quality and reduce costs to all end users.



SEE IT IN
ACTION HERE!



Ballbar Features and Benefits

- **Wireless Operation** - Connect wirelessly to the API VeriComp Software with Bluetooth connectivity.
- **Extended Battery** - 8 hour rechargeable battery.
- **Powerful Diagnostic Tool** - Capable of measuring lathes or CNC machines at any sweep angle within the 360° circular path to identify and diagnose servo and mechanical errors.
- **Early Detection Tool & Maintenance** - Add Ballbar Performance Verification to your regular maintenance cycle to identify and predict machine errors, reducing scrap, setup times, and production costs.
- **Easy-to-Use Software** - Perform multiple measurements in a single, simple setup to identify all machine servo errors with an intuitive analysis.
- **Complete Diagnostic Package** - Complement your API suite of products with the XD Laser and Spindle Analyzer for a complete CNC solution.

Ballbar Technical Specifications

Communication	Bluetooth
Battery Life	8 hours/charge cycle
Resolution	0.075 μm (.003 μin)
Accuracy	$\pm (0.5+0.1\%L)$ μm ($\pm 0.02+0.1\%L$)
Range	± 1.5 mm (0.06 in)
Sample Rate	1,000 Hz
Dimensions	102.6 mm x 37.3mm x 37.3 mm (4.0 in x 1.5 in x 1.5 in)



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Regional Contact Information

API HEADQUARTERS

+1 (240) 268-0400

Info@apimetrology.com

15000 Johns Hopkins Drive, Rockville,
MD 20850

API DETROIT

+1 (734) 667-1586

Info@apimetrology.com

47522 Galleon Court, Plymouth,
MI 48170

API SERVICES

+1 (757) 223-4157

Service.us@apimetrology.com

750 City Center Blvd. Newport News,
VA 23606

API EUROPE

+49 (0) 6221-729-805-0

Info.EU@apimetrology.com

Im Breitspiel 17, 69126 Heidelberg,
Germany

API CHINA - BEIJING

+86 10-59796858

Marketing@apimetrology.com

A2118 International Center of Times,
No.101 Shaoyaoju Beili, North 4th Ring
Road East, Chaoyang District, 100029
Beijing, P.R.China

API CHINA – CHENGDU

+86 (0) 28 - 84644048-56

Service@apizc.com

(API-ZC) Economic & Technological
Development Zone Longquan,
Chengdu, China 610101

API HONG KONG

+852 2151 9978

Fax: +852 2151 1825

2 Science Park West Avenue,
Bio-Information Centre, Unit 212
Hong Kong Science Park, Shatin, N.T.,
Hong Kong Sichuan (610101)

API CHINA – SHANGHAI

+86 (0) 21-6164-5601, 86-21-5896-7392

Room 701, Bldg 4, 258, Jinzhang Rd,
Pudong New district, Shanghai 201206

API INDIA

+91 9998732225

India@apimetrology.com

1st Floor, Heaven Hills commercial complex,
Kondhwa, Pune, India 411048

API SOUTH AMERICA

+12 3209-0675

Contato@apimetrology.com

Av. Doutor Altino Bondensan, 500,
Centro Comercial IV- Sala 2101,
Eugênio de Melo, São José dos
Campos- SP, Brasil

API KOREA

+82-26949-2740

Info@apimetrology.com

RM1203 A bldg, Songpa Teratower2,
#201 Songpadaero Songpagu,
Seoul Korea 05854

API MEXICO

+1 909 438 5408

Info@apimetrology.com

Edificio CS9800

Lic. Manuel Gomez Morin 9800 Piso 8,
Col. Centro Sur, Queretaro, Queretaro, 76090