

Thermo's India Operations

Thermo established its wholly owned subsidiary in India to provide world-class sales and service to the Indian community. Thermo's India organization includes nine offices and is staffed with a healthy mix of process, application and product specialists. In November 2005, Thermo opened its new customer demonstration laboratory in Mumbai, India. This new state-of-the-art customer demonstration and training facility offers customers in this region hands-on experience with Thermo's laboratory and manufacturing process solutions.

About Thermo Electron Corporation

Thermo Electron Corporation is the world leader in analytical instruments. Our instrument solutions enable our customers to make the world a healthier, cleaner and safer place. Thermo's Life and Laboratory Sciences segment provides analytical instruments, scientific equipment, services and software solutions for life science, drug discovery, clinical, environmental and industrial laboratories. Thermo's Measurement and Control segment is dedicated to providing analytical instruments used in a variety of manufacturing processes and in-the-field applications, including those associated with safety and homeland security. For more information, visit www.thermo.com.



Mumbai Demonstration Laboratory

For more information about Thermo's solutions for the steel industry, visit our website at www.thermo.com/metals or contact our office in Pune:

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Thermo
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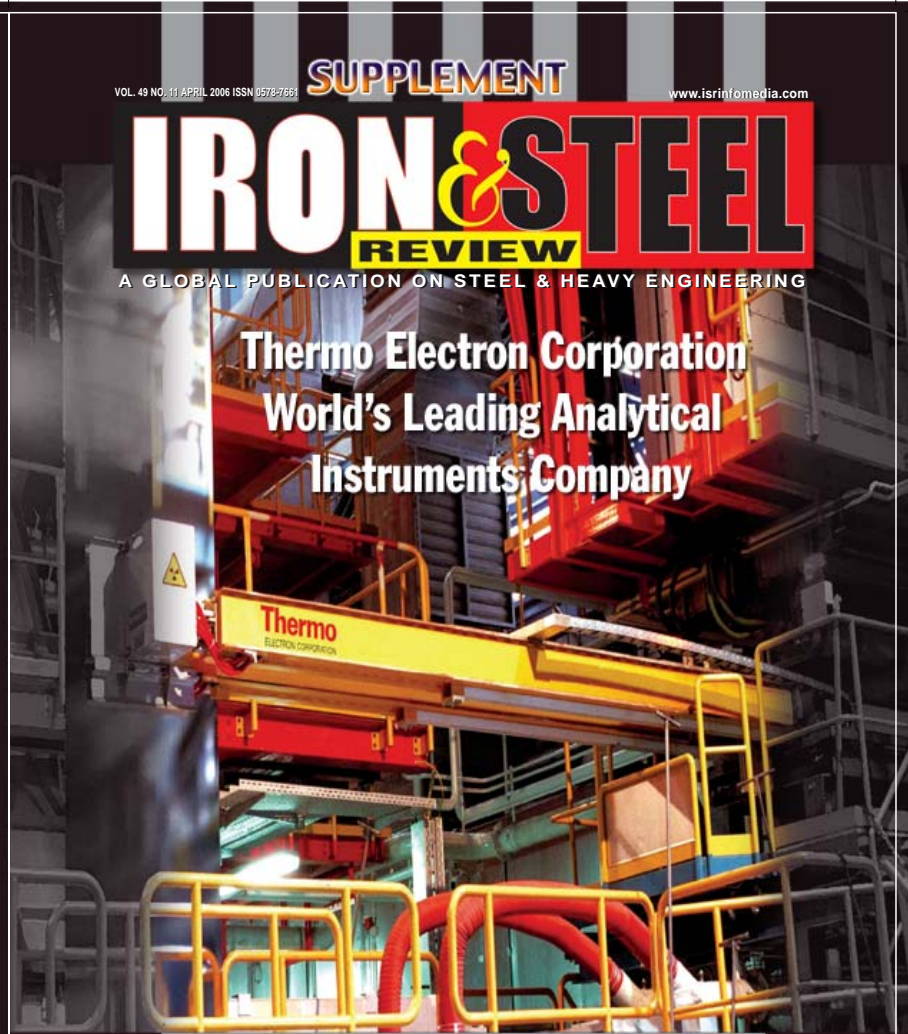
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REVIEW

A GLOBAL PUBLICATION ON STEEL & HEAVY ENGINEERING

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World's Leading Analytical
Instruments Company



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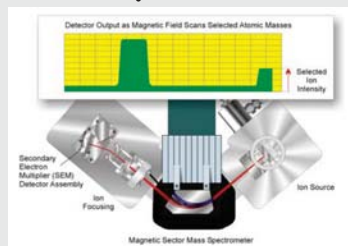
Tapered Element Oscillating Microbalance (TEOM)®

This technology has emerged as a new approach for real-time mass monitoring. The technique is based on a tapered element oscillating microbalance (TEOM)®. This technology measures particle mass inertially as the mass deposits on a filter. As such, it is a direct mass measurement and eliminates the mass uncertainties inherent in indirect methods represented by optical or beta adsorption instrumentation. Mass determination is made with a resolution of 10 nanograms (0.01 micrograms).

The TEOM® system for ambient air monitoring utilizes an exchangeable filter cartridge on the end of a hollow tapered tube. The wider end of the tube is fixed. Air is passed through the filter, on which particulate deposit, and the filtered air passes through the tapered tube to a flow controller. The tapered tube with the filter on its end is maintained in oscillation in a clamped-free mode. The frequency of oscillation is dependent upon the physical characteristics of the tapered tube and the mass on its free end. As particulate land on the filter, the filter mass change is detected as a frequency change in the oscillation of the tube. The mass of the particulate is then determined directly and inertially. When this mass change is combined with the flow rate through the system, the device yields an accurate measurement of the particulate concentration in real time.

Mass Spectrometry

Our process gas analyzer uses mass spectrometry technology which has been proven over many years in a wide range of iron and steel applications including blast furnace, gas mixing stations, VOD, AOD, coke oven gas analysis and direct reduction processes. The method of analysis is achieved using the components depicted in the following figure.



Thermo Electron
corporate headquarters
Waltham, Massachusetts, USA

Thermo Electron Corporation: Analyze . Detect . Measure . Control

Thermo is the world leader in analytical laboratory and process instrumentation. For laboratories, Thermo offers a complete range of analytical instruments, scientific equipment, software and service solutions for sample preparation, sample analysis and data interpretation.

For industrial markets, Thermo takes its world-class analytical technology to the line with rugged and reliable instruments that provide real-time analysis, measurement and control of processes, helping manufacturers improve quality and productivity in the food and beverage, pharmaceutical, petrochemical, steel, cement and mining industries.

In the 2005 issue of *Fortune* magazine's annual survey of "America's Most Admired Companies," Thermo was rated as one of the top three companies in the precision equipment category. And *Instrument Business Outlook* newsletter rated Thermo as its 2005 Company of the Year.

Thermo is a multinational company with over 10,000 employees and operations in more than 30 countries. Thermo has nine sales and service offices throughout India in Pune, Mumbai, New Delhi, Kolkata, Mohali, Lucknow, Chennai, Hyderabad, and Bangalore, with 135 employees. We have 11 customer demo centers around the world, including our most recent demo center in Mumbai, which opened in November of 2005.

Our customers use our instrument solutions to analyze, detect, measure and control their processes, enabling them to ultimately make the world a healthier, cleaner and safer place.

Thermo's contribution to India's industrial processes

Thermo has helped many industrial producers all across India to optimize their production processes by meeting their need for accurate and reliable instruments to increase throughput and quality.

Thickness Measurement and Metal & Paint Coating

Thermo is the Indian steel industry's premier supplier of thickness measurement gauges, capturing a major share of this market. One such partnership is with a leading manufacturer of cold rolled products in Mumbai who uses Thermo's gauges to improve quality and operational efficiency.



Thermo has sold its first plate thickness gauge to be installed in 2006 at Bhilai Steel in Bhilai, Chhattisgarh to optimize mill production due to its highly sophisticated sensor technology and unparalleled measurement accuracy. Thermo's plate thickness gauge has more than 40 installations worldwide.

With the sale of the first online (paint) coating measurement gauge in India, Thermo is well positioned to be a pioneer and trendsetter for India's paint coating industry. Our gauge was selected due to its ability to ensure uniform coating quality and to reduce waste.

Ambient Monitoring

Approximately one quarter of India's ambient monitoring stations use Thermo technology. Thermo's monitoring instruments deliver unsurpassed sensitivity, accuracy and reliability and our wide range of sampling systems provide you the best solution for your application.



Process Mass Spectrometry

The first VG Prima dB process mass spectrometer from Thermo was sold to a leading Indian steel manufacturer last year's for its Direct Reduced Iron (DRI) process.



Laboratory Automation and Elemental Analysis

A substantial percentage of metal is produced using laboratory analyzers from Thermo. One of India's leading steel makers uses our XRF and XRD system for its iron sinter project, and has purchased three of Thermo's OES systems due to the excellent service Thermo provides its customers.



Thermo's CCD-based OES metals analyzers were launched in the spring of 2005 and are well perceived by the growing foundry sector due to their flexibility, compact size and the ability to suit customer new requirements without the need for expensive hardware modifications.

Online Elemental Analysis

Utilization of Thermo's online analyzers in zinc and iron ore slurry analysis has proven to be a key success in India's metals industry. Thermo's online X-ray fluorescence and Prompt Gamma Neutron Activation Analysis (PGNAA) analyzers are able to monitor feed, concentrate, and tailings streams either in dedicated or multiplexed fashion. Minute-by-minute analysis results are used to optimize the flotation process. Thermo also offers slurry sampling products either to feed the analyzer or to produce a metallurgical sample for subsequent laboratory analysis.

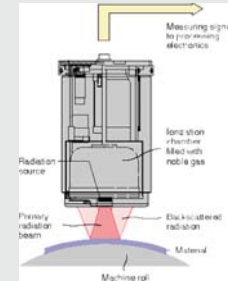


The PGNAA technology is also used by Thermo in its online coal analyzers. These products analyze ash, sulfur, moisture, and heating value and are frequently used in conjunction with prep plant control. Tata Steel uses Thermo's coal analyzers at its West Bokaro cleaning facility.

Thermo is proud of the reputation we have earned in the Indian community. It's all part of the Thermo solution – quality, performance and our commitment to serve you – today and in the future.

Beta Backscatter Technology

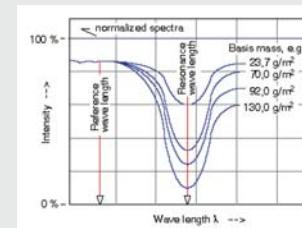
The beta-backscatter method is also used in measuring coatings on steel, but is uniquely capable of measuring paint, varnish and other organic coatings. A low-energy beta emitter is the ideal source for providing a signal that is sensitive to the smallest changes in paint coating, see diagram. Using this technology to control the paint application to a tight tolerance results in raw materials savings that lower overall production costs.



Design of beta-backscattering measuring head

Infrared Attenuation

Principle: Many hydrocarbon based materials exhibit a rich spectrum of discrete absorption lines in the near infrared region (NIR) of the electromagnetic spectrum (0.8 - 2.5 micrometer radiation wavelength). These absorption lines are narrow bands of frequencies (energies) in which the material exhibits more or less absorption relative to the other wavelengths of infrared light, see diagram.



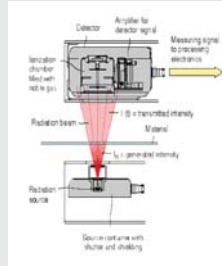
Typical Infrared Absorption Spectrum

By comparing relative intensities of the resonant wavelength and reference wavelength, the thickness of hydrocarbon material can be determined. This technology has been successfully applied in measuring the thickness of thin oil films on sheet steel.

Attenuation Technology

Attenuation technologies are found in one of the basic principles of radiated energies. As energy is transmitted through a medium, it loses intensity. The rate of the energy loss depends on the physical properties of the medium and the type of energy itself. By using a fixed energy source placed a distance from a radiation detector, the signal from the detector will reveal information on material placed between the two.

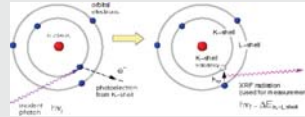
Transmission method: A radiation source and detector are mounted on opposite sides of the material as shown in the diagram.



Design of a transmission measuring head

X-ray Fluorescence Measurement

This technology is similar to the X-ray Fluorescence Analysis listed earlier, but instead of using the fluorescence signals to determine the concentration of multiple elements, one or two signals are isolated to determine metallic coating weight and/or composition. The X-ray fluorescence sensors are mounted online and provide real-time measurement of coating thickness. Using this technology coupled with Thermo's adaptive coating weight auto-control software, galvanizing lines are able to optimize their coating process with the most economical use of raw zinc.



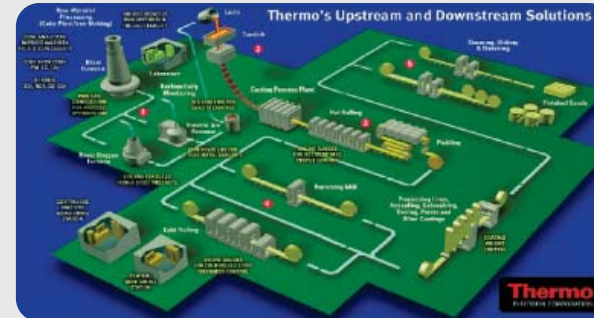
Generation of XRF radiation by photoelectric effect

Principle: Generation of X-ray fluorescence radiation is achieved by utilizing the photoelectric effect – see diagram.

For steel production, Thermo offers a variety of attenuation technologies that are ideal for thickness measurements at specific points in the sheet steel production process.

Radiation type	Steel making process	Thickness measuring range	Number of installations in India
X-ray	Hot Mill, Cold Mill, Process lines	0.05 mm to 75 mm	Over 75
Gamma	Roughing mill, Hot mill, Process lines	0.10 mm to 150 mm	Over 100
Beta	Process lines	0.02 mm to 0.90 mm	Approx 10

Upstream and downstream solutions for steel making



Thermo optimizes your metal production process by offering you the very best solutions. In looking at the metals process map, you can see where Thermo's products are being used in the upstream and downstream phases. Our combination of product breadth and wide-ranging process expertise means that we can tailor systems to your exact requirements, even if they cover several analytical techniques or production stages.

Thermo's broad range of products

With over 50 years of experience, Thermo is ideally suited to meet the needs of the Indian steel and aluminium industries. Through innovative process optimization technologies, we offer improved solutions for our customers' analysis and measurement needs.

Whether your equipment is upstream or downstream, Thermo's products will deliver reliable performance and analysis and measurement accuracy, thereby reducing production cycle delays and ensuring product consistency.

Bulk Material Handling

Thermo's bulk material handling product line offers industrial in-motion weighing and inspection and monitoring equipment used for process and production control in a wide array of industries. Products include belt scales, weighbelt feeders, sampling systems, level indicators, conveyor safety switches, constituent analyzers and more.



Ramsay Belt Scale System

Elemental Analysis

Thermo's elemental analyzers provide full elemental analysis of raw materials for quality control, which leads to increased productivity and reduced operating costs. Optical emission spectroscopy continues to be the reference technique for direct analysis of solid metallic samples. Using state-of-the-art X-ray collection techniques, Thermo's X-ray fluorescence and X-ray diffraction products provide elemental composition and structural information from a variety of materials.

Gas Analysis

The gas analyzers offered by Thermo provide flexible configuration and intuitive operation for effective monitoring and control of manufacturing plants. Fast and precise analysis provides tighter process control in a steel mill environment. Field proven systems are available to measure pollutants in the most severe sampling environments and our air quality instruments are used for environmental compliance and process monitoring offering unsurpassed sensitivity, stability and selectivity.

Thickness Measurement

Thermo offers a wide array of thickness measurement gauges for a variety of applications including hot plate rolling mill, cold rolling mill, tandem mills and processing lines. Our gauging systems generate continuous strip profiles, including temperature, thickness, position and other physical parameters. These critical measurements are needed to optimize rolling conditions resulting in improved operations, mill set-up time and operational efficiency.

Coating Weight Measurement

Thermo's family of coating weight gauges provides you with the highest level of precise, non-contact coating weight cross-profile measurement of metal coatings applied to steel strip. This series of gauges reduces the dead time between the measurement and the actuator, resulting in raw material savings and a reduction in scrap. Thermo is the world's only supplier of hot coating weight gauges for hot dip galvanizing lines.

Commitment to service

Thermo supports its instruments with its award-winning service staff. Our application and field-service representatives offer decades of experience providing our customers with in-depth process expertise and knowledge. Thermo's qualified application engineers will work closely with you to understand and evaluate your specific production parameters. Our experts will help you choose the right instruments for your application, then keep them performing to spec. Thermo's goal is to optimize your process today, and also lay the foundation for easy upgrades in the future.



ARL 9900 Series Integrated XRF/XRD Spectrometers



VG Prima B Process Mass Spectrometer



Radiometric RM 200 EG Hot Steel Plate Thickness Gauge



Radiometric RM 300 EH Hot Metal Coating Weight Gauge

Word leader in technology

When you partner with Thermo, you benefit from a global leader that delivers customized solutions backed by a research team bringing you advanced technologies in the steel industry. Here are a few examples of the technologies used in our analysis and measurement systems in the Indian community.

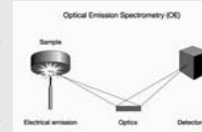
Prompt Gamma Neutron Activation Analysis (PGNAA)

PGNAA technology uses very low levels of radiation to determine the elemental composition of materials on a conveyor belt, in a coal sample stream, or in a mineral slurry. The technology is able to generate a complete elemental analysis every minute, permitting the user to take timely process control action to improve process efficiency, reduce operating costs, and ensure more consistent quality. The users include coal-fired power plants, coal mines, cement plants, iron ore producers, along with phosphate producers. India is second among all countries, trailing only the US, in its use of PGNAA analyzers.

Applications vary widely. In cement, PGNAA analyzers are used to control stockpile chemistry and to optimize raw mix proportions. In coal mines, the analyzers are used for prep plant ash control, sorting and blending, while power plants use them for improved boiler efficiency. In minerals applications the PGNAA analyzers can be used for sorting, blending, or flotation control.

Optical Emission Spectroscopy

Optical emission spectroscopy continues to be the reference technique for direct analysis of solid metallic samples. The unmatched combination of accuracy, high speed, precision, stability and reliability have made it an indispensable tool for production of quality metallurgical products.

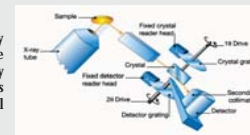


The rapid simultaneous analysis of up to sixty elements fits the requirements of many facets of the metals industry, from production control to R&D or from incoming material inspection to scrap sorting. Typical applications involve determination of the metallurgical content of iron and steel, aluminum, copper, nickel, zinc, lead and many other metals and alloys.

The optical emission technique utilizes a high energy spark created across an argon-filled gap between an electrode and a sample of the material to be analyzed. The spark creates an emission of radiation from the excited sample surface with wavelengths characteristic of the elemental composition. The spectrum of radiation is separated into the distinct element lines and the intensity of each line is measured. Finally, these are accurately converted into concentration values for each element present.

X-ray Fluorescence Analysis

The XRF technique offers elemental analysis of a wide variety of materials in a highly precise and generally non-destructive way. Particular strengths of this analytical method include easy sample preparation, analysis of non-conducting materials (notably oxides, glasses, ceramics and plastics) and exceptional precision, especially for high concentration levels.



Process control and R&D tasks can be undertaken, and precision inside $\pm 0.1\%$ relative is routinely achieved whilst limits of detection are often at ppm or sub ppm levels. The XRF technique is also widely used in the metals industry alongside OE spectrometers. This combination brings the optimum configuration for rapid and accurate elemental analysis of both metals and the oxides associated with metal production such as ores and slags.

XRF spectrometers operate by irradiating a sample with a beam of high energy X-rays and exciting characteristic X-rays from those elements present in the sample (known as X-ray Fluorescence). The individual X-ray wavelengths are sorted via a system of crystals and detectors, and specific intensities are accumulated for each element. When required, chemical concentrations of individual elements are then established by reference to stored calibration data.



Through thick and thin, Thermo delivers.

The only true measure of a gauge is how well it performs when the going gets tough — when you're under pressure to meet your customer's specifications without compromising on quality or throughput.

Thermo non-contact, non-destructive thickness and coating weight gauges measure quality at the earliest point in the production process — and at every step along the way. So you can rapidly identify and correct problems to maintain mill uptime, ensure product uniformity, and provide higher value to your customers.

It's all part of the complete Thermo solution — a complete line of gauging equipment and services designed to keep your mill rolling.

Take a closer look at Thermo metals solutions at www.thermo.com/metals or call +44 (1452) 337-800 (United Kingdom), +49 (9131) 998-0 (Germany), +91 (20) 56011245 (India) or +1 (858) 450-9811 (USA).

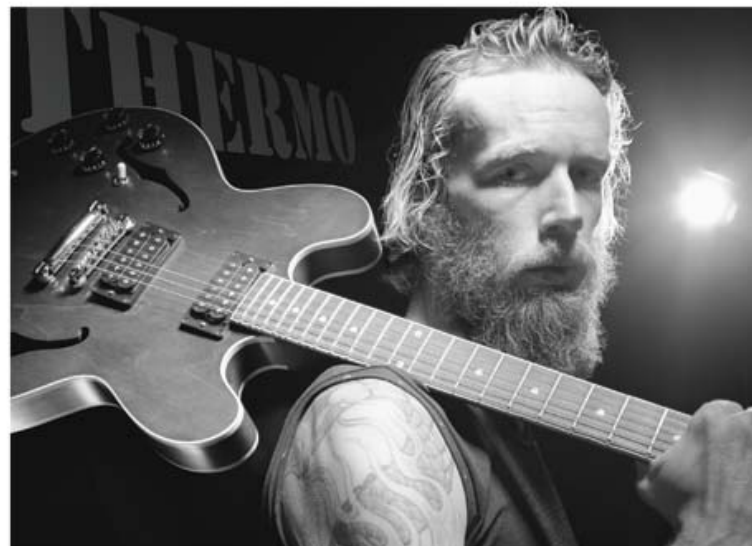
Look closer for answers.

Thermo gauges deliver the performance, accuracy, and uptime to ensure consistency in rolled and coated products.

Analyze • Detect • Measure • Control™

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Discover the hottest name in heavy metal gas analysis.

The faster you analyze gases coming off hot metal, the sooner you can reduce energy consumption and increase throughput—to lower costs and keep your plant rocking.

Thermo's VG Prima Δ B process mass spectrometers give you the power to measure a wide range of gases on a single analyzer—in a fraction of the time it takes using individual analyzers. So you have the detailed online measurements you need to make rapid control decisions to optimize your process, minimize costs, and maximize productivity.

It's no wonder so many modernized plants in Europe and Asia have replaced their conventional analyzers with Thermo's VG Prima Δ B. Why not join the band?

Take a closer look at Thermo solutions for iron and steel plants at www.thermo.com/metals.

Look closer for answers.

Analyze • Detect • Measure • Control™



VG Prima Δ B — the leading process mass spectrometer for gas analysis in hot metal manufacturing.

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