MERX™

AUTOMATED MODULAR MERCURY SYSTEM
Mercury Analysis

Mercury has long been known to be a dangerous element, but only in the last few decades and after much research has the toxicity and biogeochemistry of mercury become better understood. Researching the harmful impacts of mercury has been challenging due to the vast differences in toxicity of various mercury compounds or species and the complexity of the local and global mercury cycling in the environment.

The advancement of analytical technology to measure mercury at extremely low levels and to speciate mercury has greatly assisted this research, but until recently this analytical technology required significant time, expense, and expertise to operate effectively. Now with MERX, the automated modular mercury system from Brooks Rand, fast and accurate results for mercury and mercury species can be easily obtained to greatly accelerate our understanding of mercury.

The automated MERX system can be configured for total mercury analysis, methyl mercury analysis, and other mercury speciation, eliminating the need for multiple complete systems. By simply switching the purge and trap modules, the MERX system is transformed from a total mercury system to a mercury speciation system in a matter of minutes.

**MERX™ Autosampler**

Using inert and corrosion resistant septum piercing needles, the MERX autosampler, in connection with the purge and trap modules, provides robust pump-free liquid handling that greatly reduces carryover contamination.

**Model III CVAFS Mercury Detector**

**Mercury Guru™ Software**

- Peak Integration & Calculations
  - automatic peak selection & integration with manual override
  - multiple calculation & correction algorithms

- Quality Assurance
  - user defined QA criteria & auto accept/reject
  - flags user modified peaks for validation

- System Control
  - controls all Brooks Rand manufactured systems

- Reporting
  - multiple report options & data export formats

**The MERX Advantage**

- interchangeable modules for total mercury, methylmercury, & other mercury species
- switch from total mercury to mercury speciation configuration in minutes
- the unique modular approach provides significant cost savings & requires less bench space, compared with buying two completely separate systems for total mercury & methylmercury analysis
- patent-pending liquid handling technology reduces carryover contamination
- fast, stable, sensitive, easy-to-use, & low operating costs
- sealed vial system eliminates contamination from lab air & reduces the need for clean room analytical lab space
- incredible sensitivity from the Brooks Rand Model III CVAFS detector with patented optics (U.S. patent No. 57318473)

**About Brooks Rand**

Founded in 1982, Brooks Rand has a long history of developing innovative analytical technology and methodology for ultra-trace mercury analysis and mercury speciation. Brooks Rand was the first commercial lab to offer trace level mercury analysis and mercury speciation by cold vapor atomic fluorescence spectrophotometry (CVAFS). In 1989, Brooks Rand was the first company in North America to sell CVAFS mercury detectors.

In 2007, Brooks Rand introduced the world's first commercial automated system for methylmercury analysis by U.S. EPA Method 1630 (GC-CVAFS). Brooks Rand’s unique experience of providing both commercial analytical services and instrumentation for mercury analysis gives us unparalleled expertise in the development of new instrumentation and the technical support that we provide to our customers.
TOTAL MERCURY METHODOLOGY

Sample Preparation
Samples are prepared by standard total mercury methodology (U.S. EPA Method 1631) to oxidize all mercury to Hg(II).

Vial Loading
Prepared samples are added to 40 mL vials with Teflon® lined septa caps. Samples are pre-reduced with the addition of hydroxylamine hydrochloride, and then reduced with stannous chloride, capped, and loaded into the autosampler.

Software Setup
Sample information is entered into Mercury Guru™ software, settings are selected, and then sample analysis begins.

Purging
Samples are purged directly in the autosampler vials using N₂ gas to volatilize elemental mercury to the gold amalgamation traps.

Multi-Trap Processing
The first collection trap is ballistically heated to release and transfer the mercury to the analytical trap, which is in turn heated to release the mercury to the detector. Simultaneously, the second vial is purged onto the other collection trap to provide near continuous sample purging for rapid throughput.

CVAFS Detection
Mercury is detected using the Brooks Rand Model III cold vapor atomic fluorescence spectrophotometer (CVAFS) with patented optics for enhanced sensitivity.

Data Processing
Mercury Guru™ software integrates the detector signal and calculates results based on calibration and sample volume information. QC results are automatically flagged based on user defined criteria.

U.S. EPA Method 1631 Summary
- oxidation, reduction, purge, gold amalgamation, desorption, & CVAFS detection
- detection at 0.2 ng/L & quantitation at 0.5 ng/L or less
- improved sensitivity, linearity, accuracy, & precision at low levels relative to CVAA
- supports measurement at ambient water quality criteria levels
- virtually free of interferences from any matrix

Key Benefits and Features
At Brooks Rand, we firmly believe that obtaining the highest quality data is essential, but also recognize the necessity of operational efficiency. Our decades of trace level mercury analysis experience have enabled us to develop a system that achieves both of these critical goals.

- Ultra-low level – instrument detection limit of <0.03 ng/L
- Wide linear range – quantifiable range of 5,000x (0.08-400 ng/L)
- Reduced contamination – The biggest challenge to performing quality ultra-low level mercury analysis is avoiding contamination. MERX greatly reduces sample contamination in two key areas:
  1. Carryover contamination – By purging samples in the vials, only gaseous elemental mercury is transferred from the vial through an inert transfer line to the amalgamation trap, vastly reducing carryover contamination. Most other systems struggle with carryover contamination due to the use of a common pump, transfer line and gas-liquid separator.
  2. Atmospheric contamination – Utilizing sealed sample containers on the autosampler prevents atmospheric mercury from contacting the sample. Other systems have open vials therefore requiring operation in a clean room type atmosphere.
- Reduced reagent consumption – Rather than requiring a continuous flow of reagents common to most other systems, MERX only uses the necessary amount of reagents to effectively reduce the sample, minimizing reagent and waste disposal costs.
- Less maintenance – In addition to syringe and peristaltic pumps being a huge source of cross contamination, these pumps generally require constant maintenance and tubing replacement. With the pump-free MERX system, these issues simply don’t exist.
METHYLMERCURY METHODOLOGY

Sample Preparation
Prior to analysis, samples are prepared as per normal methylmercury methodology, typically distillation for water (US EPA 1630), extraction for sediment or digestion for tissue.

Vial Loading
Prepared samples are added to 40 mL vials with Teflon® lined septa caps. Samples are buffered to pH 4.9, ethylated with the addition of NaBEt₄, topped off with DI water, capped, shaken and loaded into the autosampler.

Software Setup
Sample information is entered into Mercury Guru™ software, settings are selected, and then sample analysis begins.

MERX does the rest!

Liquid Handling
As each vial is pierced, the liquid is automatically transferred via gas pressure to a purge vessel where N₂ gas volatilizes ethylated Hg species to a Tenax® trap.

Trap Processing
The first trap is dried while another trap collects ethylated Hg species from the next vial. After drying, another vial is purged onto a third trap, while the second is dried, and the first trap, now dry, is-ballistically heated to thermally release the Hg species in an argon carrier gas stream.

GC Separation
The released Hg species are separated on a GC column and then thermally reduced to elemental mercury.

CVAFS Detection
Mercury is detected using the Brooks Rand Model III cold vapor atomic fluorescence spectrophotometer (CVAFS) with patented optics for enhanced sensitivity.

Data Processing
Mercury Guru™ software integrates the detector signal and calculates results based on calibration and sample volume information. QC results are automatically flagged based on user defined criteria.

U.S. EPA Method 1630 Summary
- ethylation, purge & trap, desorption, GC separation, pyrolytic reduction, & CVAFS detection
- detection at 0.02 ng/L & quantitation at 0.06 ng/L or less
- lower detection limits often required to measure at ambient levels in water
- method written for water only but easily adapted to sediments & tissue

Key Benefits and Features
In use at Brooks Rand Labs since 2006 and introduced commercially in 2007, MERX is the world’s first commercial automated analytical system based on US EPA Method 1630 for methylmercury analysis. Around the world, numerous national environmental agencies and leading universities have quickly embraced MERX as an easy-to-use, robust, and reliable system that delivers high quality data.

- Ultra-low level – All MERX systems undergo rigorous QC testing to ensure they achieve an instrument detection limit of <0.002 ng/L. That’s less than 2 parts-per-quadrillion!
- Wide linear range – quantifiable range of 5000x (0.005 ng/L - 25 ng/L)
- Reduced carryover contamination – With the patent pending gas-pressurized liquid handling system, the purge gas not only transfers the ethylated sample to the purge vessel, but also continues to flow through the sample vial and transfer line to remove any residual volatile mercury compounds, thus allowing the next sample to be processed immediately without a rinse cycle.
- Sharper peaks – The patent pending ballistic trap heating releases the ethylated mercury species instantly, resulting in sharper peaks and improved GC separation.
- Fast – MERX utilizes a multiple trap configuration, such that all three traps are in use simultaneously at different stages in the analytical process, resulting in runs every 6.5 minutes or less.
- Less maintenance – With the “pump-free” MERX system, there is no pump maintenance or constant requirements for tubing replacement. MERX has only a few replacement parts, which are all easily accessible and designed for longevity. Trap sets average over 4000 runs and most other replacement parts last much longer.
Technical Specifications

subject to change without notice

MERX System

- Dimensions: 21 in/54 cm (H) x 44 in/112 cm (W) x 23.25 in/59 cm (D)
- Weight: 75 lbs/34 kg (total mercury configuration); 82 lbs/37.2 kg (methylmercury configuration)
- Power: 115 VAC (+/-10%), 47-63 Hz, 7.4A; or 230 VAC (+/-10%), 47-63 Hz, 5.4A
- Purge Gas: nitrogen, general grade, maximum 20 PSI. 300-600 mL/min flow rate
- Carrier Gas: argon, 5.0 grade (high purity 99.999%), maximum 20 PSI. 50 mL/min flow rate
- Autosampler Capacity: 3 racks of 24 x 40 mL (72 vials total)
- PC Interface: 1 or more PC USB port, v1.x/v2.x
- Environmental: operating temperature 10-25° C; altitude 0-10,000 ft.; relative humidity 20–90%, non-condensing

Total Mercury Configuration

- Instrument Detection Limit: <0.8 pg; <0.03 ng/L based on 25 mL sample
- Precision: <3% at 100 pg (4 ng/L); <10% at 5 pg (0.2 ng/L)
- Working Range: 0-10,000 pg
- Time per run: 4.5 minutes
- Application: US EPA Method 1631 for water, sediment, and tissue

Methylmercury Configuration

- Instrument Detection Limit: <0.08 pg; 0.002 ng/L based on 40 mL sample
- Precision: <5% at 25 pg (0.625 ng/L); <10% at 0.5 pg (0.0125 ng/L)
- Working Range: 0-1,000 pg
- Time per run: 6.5 minutes
- Application: US EPA Method 1630 for water, sediment, and tissue

Mercury Guru Software (v 4.0) minimum requirements

- Pentium® III 400 MHz processor
- Microsoft® Windows 98/2000/XP
- 256MB RAM; 90MB Free Hard Drive Space
- CD-Rom Drive (for installation media)
- Windows compatible graphics printer

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