ultra-trace mercury analysis

Tekran Inc.

Series 2600

The most sensitive mercury system available today.

The **Tekran® Series 2600** offers unparalleled performance and flexibility for those who require truly sensitive total mercury analysis. The system can implement a wide range of different analytical techniques, depending on the requirements of your particular application. Unlike conventional systems, the **Series 2600** is available in a wide range of configurations, with options to suit your budget. The system can perform virtually any type of ultra-trace total mercury analysis. The **Series 2600** allows easy migration from a starter system to a fully automated, high throughput configuration.

Highlights

- Sensitivity measured in *parts per quadrillion.* Typical MDL: *< 0.05 ppt* [1]
- Atomic Fluorescence based: Greater sensitivity, selectivity and dynamic range than AA based systems
- Unprecedented modularity and flexibility

Typical Applications

Total Mercury in Liquids
- Automated analysis of aqueous samples
  - *Dual stage gold preconcentration*
  - *Single stage gold preconcentration*
  - *Direct reading*
- May be used with stannous chloride or sodium borohydride reductant
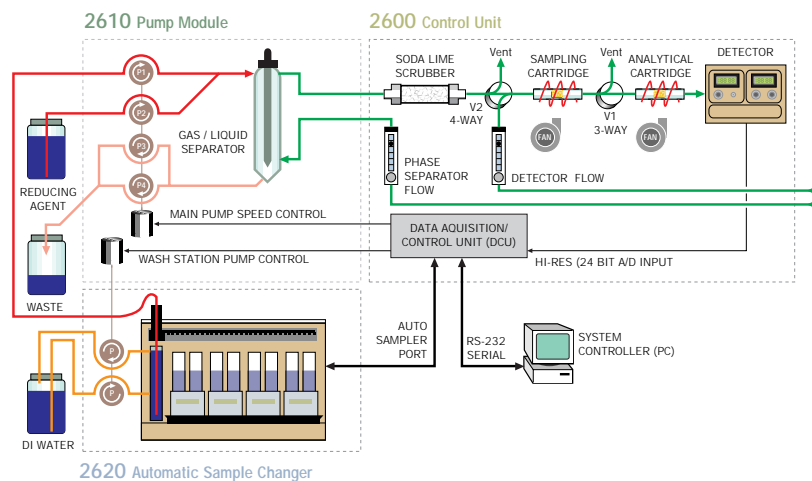
Mercury in Gases
- Automated analysis of adsorbent sample cartridges using dual stage preconcentration with thermal desorption

2610 Pump Module   **2600** Control Unit   **2620** Automatic Sample Changer

Typical Full Flow Diagram

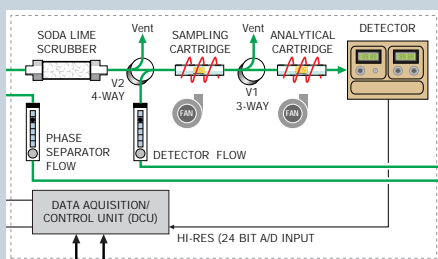Automated liquid analysis using dual stage gold preconcentration.
(US EPA Method 1631)

[1] Dual stage preconcentration. Analysis conducted in clean room with controlled blanks. Sample aliquot: 30 ml.

Liquid Analysis via
Dual Stage Gold Preconcentration
US EPA Method 1631

SODA LIME SCRUBBER
Vent
SAMPLING CARTRIDGE
Vent
ANALYTICAL CARTRIDGE
DETECTOR
V2 4-WAY
V1 3-WAY
FAN
FAN
PHASE SEPARATOR FLOW
DETECTOR FLOW
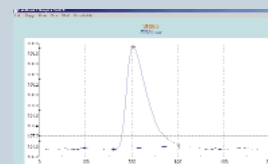DATA AQUISITION/ CONTROL UNIT (DCU)
HI-RES (24 BIT A/D INPUT)

The combination of dual stage preconcentration and atomic fluorescence detection provides the most sensitive, selective and resilient mercury analysis available today. After passing through the gas/liquid phase separator, the carrier gas is passed through a desiccant dryer and on to a gold coated sample collection cartridge.

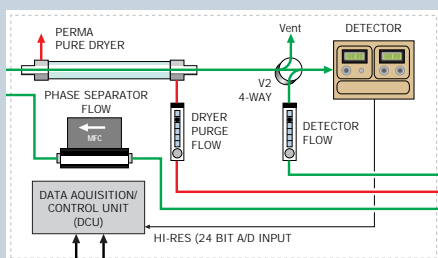This cartridge is then thermally desorbed onto an analytical gold trap. This dual stage preconcentration method eliminates virtually all interfering compounds, ensuring excellent analytical results.

The solenoid valve **V2** ensures precise loading of the first cartridge. Valve **V1** vents effluent during loading, eliminating contamination of downstream components.

Peak obtained from 0.5 ppt standard using gold preconcentration

Liquid Analysis via
Direct Atomic Fluorescence
US EPA Method 245.7

PERMA PURE DRYER
Vent
DETECTOR
PHASE SEPARATOR FLOW
V2 4-WAY
MFC
DRYER PURGE FLOW
DETECTOR FLOW
DATA AQUISITION/ CONTROL UNIT (DCU)
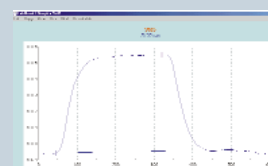HI-RES (24 BIT A/D INPUT)

The direct measurement technique provides good performance for many applications and allows for a faster analytical cycle. Carrier gas from the gas/liquid phase separator is passed through a Perma Pure® diffusion dryer and sent directly to the AF detector.

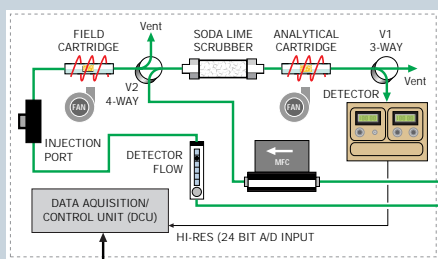Valve **V2** provides precise introduction of the loaded carrier gas into the detector and eliminates the need to use solenoids for switching liquid sample.

Systems equipped for dual stage preconcentration can be converted to and from the direct method in only minutes!

Five ppt standard using direct method

Dual Stage
Gas Phase
Analysis

FIELD CARTRIDGE
Vent
SODA LIME SCRUBBER
ANALYTICAL CARTRIDGE
V1 3-WAY
V2 4-WAY
FAN
FAN
DETECTOR
Vent
INJECTION PORT
DETECTOR FLOW
MFC
DATA AQUISITION/ CONTROL UNIT (DCU)
HI-RES (24 BIT A/D INPUT)

The **Model 2600**, without any of the liquid handling components, can be used for gas analysis. Sample cartridges are inserted and the entire thermal desorption process is performed automatically.

The arrangement shown is optimized for gas analysis and allows the field cartridge to be changed while the analytical trap is still being analysed.

The solenoids vent cartridge effluent during preheating to eliminate downstream contamination.

Peak from gas sample with 1.7 ng/m^3 of mercury (50 L integrated sample)
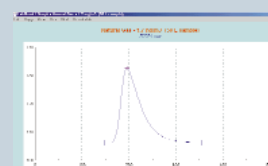
MODEL 2600

Preconcentrator / Detector

The Tekran® Model 2600 is the most sensitive and flexible atomic fluorescence mercury analytical unit available today. The wide range of options available allows a system to be configured to suit virtually any application and budget.

ULTRA-SENSITIVE ATOMIC FLUORESCENCE DETECTOR
- Based on the Tekran tried and proven Cold Vapor Atomic Fluorescence Spectrophotometer (CVAFS) elemental mercury detector
- Very high sensitivity, (MDL < 0.1 pg)
- Wide dynamic range (>10^5)
- Inherently linear
- Superior selectivity

FULL FEATURED DUAL STAGE PRECONCENTRATOR
- Individual cooling fans for rapid cycle times
- Continuously variable heater power prevents condensation and allows precleaning of cartridges
- Heating stations can be populated with virtually any type of preconcentration cartridge:
  - Pure gold, gold coated sand, coated silica-gel, coated glass beads, etc.

MULTIPLE SCRUBBER / DRYER OPTIONS
- Desiccant dryer/acid gas scrubber cartridge (eg: sodalime)
- Perma Pure® diffusion dryer

FLOW CONTROL SOLENOID VALVES
- Multi-function all Teflon solenoid valves:
  - Provide precise analytical loadings
  - Ensure clean sample is sent to the detector by venting flows during preclean operations
  - Separate flow paths to allow overlapped adsorption and desorption operations
- Only the gas phase is switched by the solenoids
  - Eliminates contamination and carry over problems inherent in switching liquid sample streams
  - Prevents valve damage caused by crystallization of reductant within valve body

HI-RESOLUTION DATA CAPTURE
- 24 bit A/D convertor ensures accurate measurement of both large and small peaks

FLEXIBLE FLOW PATH CONFIGURATION
- All flow path components are made of Teflon®.
- Convenient push-on fittings allow easy component replacement and flow path changes.

MASS FLOW CONTROLLER
- Optional precision mass flow controller may be used to set critical analytical flows
- Flow rates may be automatically programmed over the course of each analysis

BALL FLOW CONTROLLERS
- Up to three ball flowmeters with manual adjustment valves may be configured on the front panel
- Interchangeable tube sets allow full scale flows of 50, 100, 200, or 500 ml/min, 1, 2 or 5 l/min

COMMUNICATIONS
- All system functions (including the autosampler) are performed through a single serial port
- A notebook PC may serve as the controller for portable applications

EXTERNAL EVENT CONTROL
- Two opto-isolated external outputs can control external equipment

HIGH EFFICIENCY PHASE SEPARATOR
- Removable center rod for easy cleaning
- Low dead volume
- High efficiency

Full configuration with internal AF detector, mass flow controller, and two ball flowmeters

Version with internal detector and two ball flowmeters. (no MFC)

Low cost version for use with external Model 2500 detector

Automatic Sample Changer

The Model 2620 Automatic Sample Changer (Auto Sampler), is a practical, cost effective solution for laboratories with large numbers of samples to run. The addition of our Tekran-MDS data handling system creates a fully automated, high throughput mercury analysis system. For the first time, users have the ability to accurately perform ultra-trace mercury analysis in the parts per quadrillion range, without user intervention.

EASY INTEGRATION
- Connects directly to the Model 2600
- Does not require a second serial port on your PC

WASH STATION
- Glass recirculating wash station provides continuous rinsing of sample probe
- Provides clean deionized water for system flushing between samples
- May be operated in either recirculating or single pass mode

RACKS
- Auto sampler holds up to four individual rack modules
- Usable with a wide range of industry standard rack types
- Different rack types may be mixed within a single run
- Two typical rack types are shown below.

Rack code	Positions per rack	Total positions	Volume (ml)	Material
22	44	176	30	Borosilicate glass
112	12	48	60	Teflon

Peristaltic Pump Module

The addition of the Model 2610 Pump Module creates a complete atomic fluorescence analyzer for mercury in aqueous samples. This combination allows you to analyze background levels in virtually any type of liquid sample. The Pump Module fits directly beneath the Model 2600 and the two together require only 9″ of bench space.

WASH PUMP
- Provides continuous source of DI water for the wash station on the Automatic Sample Changer
- Two channel peristaltic, fixed speed
- Automatic shutoff after run is complete

MAIN PUMP
- Five channel variable speed precision peristaltic pump
- Precise flow delivery and long term stability is ensured by using closed loop optical speed controller
- Pump speed may be set either manually or automatically under program control
- Variable speed control minimizes use of reagents and sample while allowing quick analysis times

Control Software

The Tekran Mercury Data System (Tekran-MDS) is a full featured Windows® based application that provides all control, display and data reduction functions for the system.

SIMPLE DATA ENTRY
- Samples and standards are entered into a run worksheet. Detailed information for each sample is available in a single sample spreadsheet.
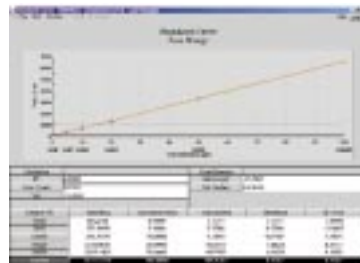
FULLY PROGRAMMABLE SAMPLE CYCLE
- Convenient editor allows full user control of analytical cycle, including:
  - Pump speed, carrier flow rate, wash pump, solenoid activations, heater power levels, cooling fans, peak acquisition, autosampler operations

PEAK INTEGRATION
- Detector output for each run is automatically captured and integrated
- Manual reintegration is possible using graphical user interface

CALIBRATION
- Multi-point least squares fit
- Variety of curve fitting options
- Export of analytical results to your own QA/QC packages or LIMS

REPORTING
- Report formats may be user configured
- Easy export to other applications

MODEL 2600	Control Unit	MODEL 2610	Pump Module	MODEL 2620	Automatic Sampler

MODEL 2600 — Control Unit

DETECTOR
Type: Atomic fluorescence, 253.7 nm
Sensitivity: < 0.1 pg
Warm up Time: < 10 min

PRECONCENTRATOR
Stages: 2 max.

FLOW REGULATION
Mass Flow Meter: 1 max.
Ball Flow Meter: 3 max.

DIMENSIONS
Width: 9″   (230 mm)
Height: 12″ (300 mm)
Depth: 17″ (430 mm)

WEIGHT
Instrument: 30 lb (14 kg)
Shipping: 45 lb (20 kg)

POWER REQUIREMENTS
100-120, 220-240 VAC,
50-60 Hz., 200 VA max.

MODEL 2610 — Pump Module

MAIN PUMP
Type: 5 channel peristaltic
Speed: 0 - 200 rpm
Regulation: closed loop optical tachometer
Control: local or computer (continuously variable)

WASH PUMP
Type: 2 channel peristaltic
Speed: 100 rpm, fixed
Control: local or computer

DIMENSIONS
Width: 9″   (230 mm)
Height: 5″   (130 mm)
Depth: 17″ (430 mm)

WEIGHT
Instrument: 14 lb (7 kg)
Shipping: 24 lb (11 kg)

POWER REQUIREMENTS
100-120, 220-240 VAC,
50-60 Hz., 100 VA max.

MODEL 2620 — Automatic Sampler

SAMPLER UNIT
Type: XYZ 3 axis with four stationary rack modules
Capacity: Code 112 - 48 positions (60 ml)
             Code 22 - 176 positions (30 ml)
             (Other rack and tube types available)
Control: Serial RS-232.
Probe Rinse: Dedicated recirculating DI water rinse station.
Arm Speed: X: 25.15 cm/sec;
             Y: 25.25 cm/sec;
             Z: 2.0, 3.0, 6.2, 12.7, or 24.7 cm/sec

POSITIONING
Accuracy: +/- 1 mm in XYZ dimensions
Repeatability: +/- 0.25 mm in XYZ dimensions

WORKING AREA
X: 13″ (33 cm); Y: 9.5″ (24.1 cm)

DIMENSIONS
Width: 21″   (535 mm)
Depth: 17″   (430 mm)
Height: 14.6″ (371 mm)
Height with arm: 22″   (560 mm)

WEIGHT
Instrument:: 38 lb (17 kg)
Shipping: 49 lb (22 kg)

POWER REQUIREMENTS
100-120, 220-240 VAC,
50-60 Hz., 75 VA max.

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