



## Airborne Mercury Monitoring: Drone-Based Sampling & XRF Analysis with the Scentroid DR2000

*How an airborne sampling platform and a ground-based X-ray fluorescence analyzer combine to deliver defensible, geolocated mercury data from hazardous and hard-to-reach sites.*

## EXECUTIVE SUMMARY

## THE CHALLENGE OF MERCURY MONITORING

Mercury (Hg) is one of the most persistent and toxic heavy metal pollutants released into the atmosphere. It enters the air through coal combustion, non-ferrous metal smelting, cement production, chlor-alkali processes, artisanal and small-scale gold mining, and legacy contaminated sites. Even trace airborne concentrations carry serious health and environmental consequences, and the very locations that most need monitoring, flare stacks, tailings ponds, smelter stacks, remediation zones, and active mining faces, are frequently hazardous, elevated, or physically difficult for field crews to reach.

Conventional airborne mercury monitoring typically relies on fixed ambient stations or manual sampling campaigns. Both approaches require personnel to work in proximity to the source, exposing field teams to the very contaminant being measured, and both introduce a lag between sample collection and laboratory reporting that can delay critical decisions.

Scentroid closes this gap with a two-stage workflow that keeps both people and analytical hardware out of the hazard zone. The proven DR2000 drone-based air sampler flies into the source area and draws ambient air through a dedicated filter at its sample inlet, capturing airborne mercury directly onto the filter media. Once the drone returns, that filter is analyzed on the ground with Scentroid's Airborne Lead Analyzer, an X-ray fluorescence (XRF) instrument, delivering a rapid, non-destructive mercury reading tied to the exact GPS location, altitude, and time the sample was taken.



*A Scentroid operator launches a DR2000-equipped drone at an active industrial site, maintaining a safe standoff distance from the sampling zone.*

## TECHNOLOGY OVERVIEW

### HOW IT WORKS: AIRBORNE SAMPLING WITH GROUND-BASED XRF ANALYSIS

#### 1. THE DR2000 AIRBORNE SAMPLING PLATFORM

Our solution is the Scentroid DR2000, a self-contained, lightweight payload (520–640 g) that mounts to a wide range of commercial drone airframes and does not draw on the aircraft's own battery or communication systems. The drone simply serves as the vehicle. A patented sampling design draws only undisturbed ambient air into the inlet, avoiding contamination from propeller downwash. The DR2000 can sample up to 150 metres vertically or horizontally from the operator, reaches confined or elevated areas ground crews cannot, and its fast-charge battery supports continuous operation for up to three hours between charges. The platform is flexible by design: it can carry its full complement of gas and particulate sensors alongside the mercury sampling filter, or it can be configured to run as a dedicated, sampling-only unit when the job calls for nothing but a clean air sample.

#### 2. FILTER-BASED MERCURY CAPTURE

A dedicated filter sits at the DR2000's sample inlet. As the onboard pump draws ambient air across it during flight or at a stationary hover point, airborne mercury is captured directly onto the filter media. Because the capture happens in the air rather than on the ground, the drone can reach directly into a flare plume, a stack path, or a contaminated area that would otherwise put a sampling technician at risk, while every sample point is automatically stamped with GPS position, altitude, time, date, temperature, and relative humidity.

#### 3. GROUND-BASED XRF ANALYSIS

Once the drone returns, the filter cartridge is removed and read using Scentroid's Airborne Lead Analyzer, an X-ray fluorescence (XRF) instrument, the Scentroid metal analyzer. High-energy X-rays directed at the filter displace inner-shell electrons in the captured particulate; as outer electrons fall in to fill the gaps, each element releases fluorescent X-ray energy at a signature wavelength. Because mercury's signature is distinct from other elements, the analyzer identifies and quantifies it directly, alongside up to 30 other metals such as lead, arsenic, cadmium, chromium, manganese, and nickel, if required, in minutes, with no off-site laboratory turnaround. Because the analyzer stays on the ground, it never adds weight, power draw, or vibration exposure to the flight itself.

## FLIGHT-TO-DATA WORKFLOW

1. Plan the flight path and sampling points in the DRIMS2 ground station software.
2. Launch and fly to the target zone, vertically up to 150 m or across long horizontal transects.
3. The onboard pump draws air through the inlet filter, capturing mercury; other onboard sensors, if installed, log gas and particulate data at the same time, or the flight can be dedicated entirely to sampling.
4. Every sample point is geo-tagged with GPS position, altitude, temperature, and relative humidity, streamed live via encrypted LoRa radio to the 9" ground station tablet.
5. After landing, the filter is retrieved and read on the Scentroid Airborne Lead Analyzer to quantify mercury concentration.
6. Analyzer results are matched to the geo-tagged flight data and reviewed as a hotspot map in SIMS3, on-site or remotely via the secure cloud portal.



*SIMS3 view of a DR2000 flight*

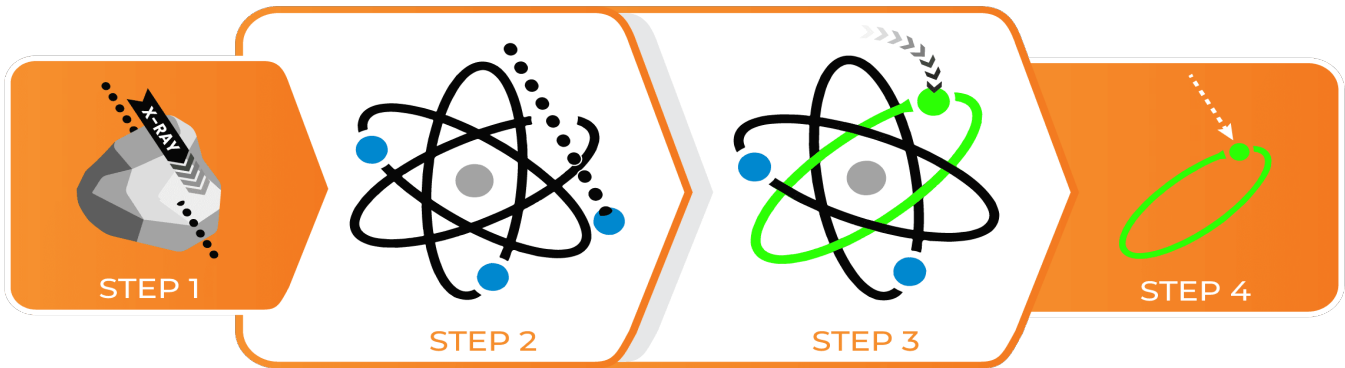
THE ANALYSIS INSTRUMENT

THE SCENTROID AIRBORNE METAL ANALYZER: GROUND-BASED MERCURY ANALYSIS

The second half of the workflow happens entirely on the ground. Scentroid's Airborne Metal Analyzer, the same XRF platform Scentroid for continuous ambient metal monitoring, serves as the analytical endpoint for every DR2000 flight. In its standard deployments, the analyzer draws its own ambient air sample through a port, filters it onto a membrane filter, and reads that filter with an onboard X-ray fluorescence (XRF) sensor. In the DR2000 configuration, that same XRF measurement engine is used to read the filter the drone brings back, turning an airborne sample into a quantified mercury result without ever putting the analyzer itself in the air.

HOW THE ANALYZER READS A SAMPLE

X-ray fluorescence works by directing high-energy X-rays at the filter media. This energy displaces inner-shell electrons within the atoms present; as outer electrons fall in to fill the resulting gaps, each element releases fluorescent X-ray energy at a signature wavelength. Because mercury's signature is distinct from that of other elements, the analyzer identifies and quantifies it directly. The technique is non-destructive and proven across Scentroid's lead and metal analyzer product line, and results are typically available within about seven minutes of loading a sample.



| X-Ray Excitation                                | Electron Displacement                                                | Energy Emission                                                                                                          | Element Identification                                                                                                                 |
|-------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| High-energy X-rays are directed at the material | The X-rays knock out inner electrons from the atoms in the material. | The atom becomes unstable, and outer electrons jump to fill the gaps, emitting energy in the form of X-ray fluorescence. | The emitted X-rays have unique energies depending on the element, allowing the instrument to detect and identify the elements present. |

## KEY CAPABILITIES

- Rapid turnaround: concentration results are typically available within about 7 minutes of loading a sample
- Multi-metal capable: primarily configured for mercury (Hg), with the option to simultaneously quantify up to 30–40 other elements such as lead, arsenic, cadmium, chromium, manganese, and nickel
- Autocalibration: built-in autocalibration and daily sensor health checks reduce manual maintenance
- Touch-screen interface: an on-unit display shows concentration results directly; all data also flows to SIMS3 for logging, trending, and alarms
- Cost-effective compliance: typical sampling-and-analysis cost runs under \$2 per sample, avoiding the turnaround and expense of sending filters to an off-site laboratory method such as NIOSH 7082

## ANALYZER SPECIFICATIONS

| Category                 | Specification                                                                   |
|--------------------------|---------------------------------------------------------------------------------|
| Primary target compound  | Mercury (Hg); other elements available as an optional configuration             |
| Measurement method       | X-ray fluorescence (XRF), non-destructive                                       |
| Sample type              | Airborne (continuous) or threshold (batch) sample                               |
| Sampling intervals       | Every 10 min / 1 hr / 8 hr / 12 hr / 24 hr (continuous deployments)             |
| Analysis time            | Results typically available within approximately 7 minutes per sample           |
| Reported detection limit | 0.89 µg/m <sup>3</sup> (1-hour sampling, standard lead reference configuration) |
| Power                    | 110–240V, 2.5A                                                                  |
| Weight                   | Approx. 20 kg                                                                   |
| Dimensions               | 460 mm x 400 mm x 590 mm                                                        |
| On-board storage         | 64 GB                                                                           |
| Communications           | Wi-Fi, MODBUS                                                                   |
| Software                 | SIMS3 — data logging, trend analysis, alarms, and remote management             |
| Calibration              | Autocalibration option; daily sensor health checks                              |
| Warranty                 | 24 months, full coverage including sensors                                      |

*Note: published detection limits above reference the analyzer's standard lead configuration; Scentroid's engineering team can confirm limits for the mercury-specific configuration. Paired with the DR2000, this analyzer becomes the mercury-quantification endpoint for every flight — turning a safely collected airborne sample into a defensible concentration figure without exposing people, or analytical hardware, to the hazard itself.*

## APPLICATIONS & BENEFITS

### WHERE IT DELIVERS THE MOST VALUE

Because the DR2000 removes the need to physically enter a hazardous or hard-to-reach sampling zone, it opens mercury monitoring to sites and scenarios that were previously impractical, slow, or unsafe to survey on foot.

### TARGET APPLICATIONS

- Mining and smelting operations, including tailings ponds and stack emissions
- Oil & gas facilities: flare stacks, tank farms, and pipeline corridors
- Coal-fired power plants and other industrial combustion stacks
- Contaminated sites, landfills, and active remediation projects
- Artisanal and small-scale gold mining (ASGM) regions
- Emergency response and spill or release assessment
- Regulatory compliance and fenceline / perimeter monitoring programs

### KEY BENEFITS

- Operator safety: crews stay at a safe standoff distance from hazardous plumes, stacks, or contaminated ground
- Speed: the ground-based XRF analyzer delivers a mercury reading within minutes of landing, with no off-site laboratory turnaround
- Access: vertical reach up to 150 m and long horizontal transects that ground-based equipment cannot cover
- Flexible payload: run the mercury sampling filter alongside other gas and particulate sensors, or dedicate the DR2000 entirely to sample collection
- Defensible data: every filter is tied to precise GPS, altitude, and time stamps captured during the flight
- Cost efficiency: a single flight can replace a multi-day, multi-person ground survey
- Data management: the DRIMS2 cloud platform provides heat-maps, historical trending, and multi-drone fleet oversight



*The DR2000's standoff sampling capability allows safe data collection near active combustion or flare sources and other hazardous plumes.*

## TECHNICAL SPECIFICATIONS

## SPECIFICATIONS &amp; GETTING STARTED

| Category                      | Specification                                                                                                                                                   |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Payload weight</b>         | 520 – 640 g (self-contained; excludes drone)                                                                                                                    |
| <b>Payload size</b>           | 230 mm × 108 mm × 103 mm                                                                                                                                        |
| <b>Sampling reach</b>         | Up to 150 m vertical or horizontal from operator                                                                                                                |
| <b>Probe length</b>           | 44 cm or 88 cm (switchable)                                                                                                                                     |
| <b>Flight endurance</b>       | Up to 3 hours per charge (fast-charge battery); drone-dependent                                                                                                 |
| <b>Sampling rate</b>          | Approx. 1 reading/second across onboard sensors                                                                                                                 |
| <b>Mercury sample capture</b> | Dedicated filter at the sample inlet; onboard pump draws ambient air across it in flight or at hover                                                            |
| <b>Mercury analysis</b>       | Performed post-flight, on the ground, with the Scentroid Airborne Lead Analyzer — quantifies Hg plus up to 30 other elements (Pb, As, Cd, Cr, Mn, Ni, and more) |
| <b>Concurrent sensing</b>     | Filter sampling can run alongside the DR2000's other gas/PM sensors, or as a dedicated sampling-only configuration                                              |
| <b>On-board storage</b>       | 16 GB SD card; on-board server included by default                                                                                                              |
| <b>Communications</b>         | LoRa (encrypted) to ground station; GSM/Wi-Fi for cloud sync                                                                                                    |
| <b>Ground station</b>         | 9" tablet with DRIMS2 software and high-gain antenna                                                                                                            |
| <b>Data tagging</b>           | GPS location, altitude, time/date, temperature, and relative humidity on every sample                                                                           |
| <b>Operating range</b>        | 5°C to 40°C; 10–90% relative humidity                                                                                                                           |
| <b>Calibration</b>            | Auto-zero before each flight; full sensor and XRF analyzer calibration recommended annually                                                                     |
| <b>Warranty</b>               | 24 months, full coverage including sensors                                                                                                                      |

## WHAT'S INCLUDED

- DR2000 drone-based air sampler with mercury-capture inlet filter
- Scentroid Airborne Lead Analyzer for ground-based mercury (and multi-metal) analysis
- Ground station receiver and 9" tablet with software
- Air sampling probe, charge adapter, and zeroing filter
- Replacement filter cartridges and safety mounting hardware
- Option to add additional air quality sensors

*Note: the drone airframe is not included. Scentroid can manufacture a custom mounting plate for virtually any drone capable of carrying the payload, simply advise the make and model at time of order.*

## WHY SCENTROID

Scentroid designs and manufactures its instruments to ISO 9001:2015 quality standards and backs every DR2000 with a 24-month full warranty, including sensors. Clients gain access to a trained, authorized service network and a global support team throughout the life of the equipment.

**Ready to bring airborne mercury monitoring to your site?**

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# DR2000 FLYING LAB

## Mercury (Hg) Sampling Module



The DR2000 Flying Lab carries an integrated air sampling pump and a dedicated filter at its sample inlet, allowing it to collect airborne mercury (Hg) samples from a safe standoff distance for analysis on the ground.

It mounts to virtually any drone and reaches spaces impossible for ground crews, both horizontally and vertically, for applications such as emergency response, hazardous waste sites, stack and flare emissions, mining and smelting operations, and contaminated site assessment.

Note: Mercury analysis requires the companion Scentroid Airborne Metal Analyzer: see separate spec sheet.

### Included with DR2000:

- DR2000 Analyzer
- Mercury Sampling Pump & Filter Kit
- Ground Station Receiver
- 9" Tablet with Built-In Interface
- Air Sampling Probe
- Charge Adapter
- Zeroing Filter
- Replacement Filter Cartridges
- Safety Ties

*\*Does not include drone*



The DR2000 uses its brand-new patented sampling system to draw only undisturbed ambient air, completely avoiding propeller downwash, before capturing it on the mercury sampling filter.

The onboard pump draws air through a replaceable filter at the sample inlet, capturing airborne mercury directly onto the filter media during flight or at hover.

Flight and sampling data are sent back to the ground station using long range radio transmission (LoRa protocol), providing secure & encrypted data transmission.

Every sample point is automatically stamped with GPS position, latitude, time, date, relative humidity, and temperature.

After landing, the filter is retrieved and analyzed with the companion Scentroid Airborne Lead Analyzer; results are matched to the geo-tagged flight data in DRIMS2.



### General Capabilities

DR2000 can travel any distance above ground level, up to 150 meters, while sampling for mercury in flight..



### Lightweight, Modular Design

The sampling pump and filter integrate into the existing lightweight payload, preserving flight time across a diverse drone portfolio.



### Battery Life

The DR2000 ships with a fast-charge battery for continuous operation of up to 3 hours before recharging.



### Cloud Access

Flight and sampling data can be accessed on location or remotely using encrypted cloud-based hosting.



### Ground Station

9" tablet equipped with LoRa communication and customized DRIMS2 mobile software for real-time flight and sample tracking.

|                               |                                                                             |
|-------------------------------|-----------------------------------------------------------------------------|
| <b>Mercury Sample Capture</b> | filter at the sample inlet; onboard pump draws ambient air across it        |
| <b>Max. # of Sensors</b>      | 11 (4xEC, 1xC02, 1xPID, 1xCH4, 1xPM, T, RH, Barometer) + XRF module         |
| <b>Type of sensors</b>        | PID, NDIR, EC, Laser PM Counter, XRF, Temp. and RH, & pressure              |
| <b>Sampling rate</b>          | Approximately 1/s (onboard sensors); XRF screening on filter retrieval      |
| <b>Probe Length</b>           | 44 cm or 88 cm (switchable)                                                 |
| <b>Time in flight / Reach</b> | Up to 3h; up to 150 m vertical or horizontal from operator, drone dependent |
| <b>Communication</b>          | LoRa, GSM/WiFi                                                              |
| <b>On-board data storage</b>  | 16GB SD card                                                                |
| <b>Additional</b>             | Cloud Server, On-Board Server/Storage                                       |
| <b>Temp/Humid Range</b>       | 5°C to 40 °C(Temperature), 10 - 90% (RH)                                    |
| <b>Calibration</b>            | Auto-zero before flight. Full sensor calibration recommended once annually  |
| <b>Mounting hardware</b>      | Customizable mounting lid. Triple mounting safety redundancy to the drone   |
| <b>Location and Altitude</b>  | GPS Based with barometric pressure augmentation                             |
| <b>Sample Analysis</b>        | Performed post-flight by the companion Scentroid Airborne Metal Analyzer    |



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**SCENTROID**  
Future of Sensory Technology

# Airborne METAL ANALYZER

Quantify the Concentration of Metals in the Air



An ambient air sample is taken through a port into the Airborne Metal Analyzer. The sample is then filtered using a special membrane filter paper. Our X-Ray Fluorescence (XRF) sensor, which is a proven measurement principle and non-destructive analytical technique, scans the sample on the filter and measures the concentration of lead in the air.



## Lead Standard Compliance

Complies with General Industry Standard for Lead (29CF1910.1025)



## Low Total Costs

Significantly lowers regulatory costs for compliance compared to XRF or lab methods such as NIOSH 7082



## Your Regulatory Assistant

Assists you with following occupational and environmental regulations



## Low Maintenance Requirement

Periodic replacement of only the membrane filter depending on usage for continuously lead air testing



## Less Than \$2 Per Sample

Total sampling and analysis costs less than \$2.00 per sample

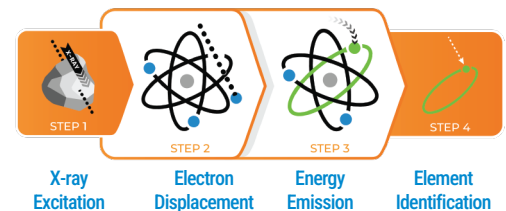


## Wide Variety of Industries

Mining Operations, Shooting Ranges, Automotive Supply Chains, Lead-acid Battery Manufacturing, Construction, and more...

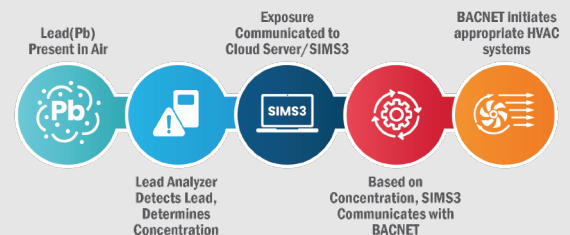
## X-ray Fluorescence

X-ray fluorescence (XRF) is a non-destructive analytical technique used to determine the elemental composition of materials.



## HVAC Automation

The Scentroid Lead Analyzer integrates seamlessly with HVAC systems through BACNET (Building Automation and Control Networks), ensuring real-time response to elevated lead levels.



|                                    |                                                                                   |
|------------------------------------|-----------------------------------------------------------------------------------|
| <b>Sensors</b>                     | Lead (Detectable Compound), Heavy Metals (Optional)                               |
| <b>Max. # of Sensors</b>           | Lead, and up to 40 Optional Airborne Metals                                       |
| <b>Detection Method</b>            | X-Ray Fluorescence (XRF)                                                          |
| <b>Sample Methods</b>              | Airborne, Threshold                                                               |
| <b>Sampling Rate</b>               | Every 10 minutes/ 1 hour/ 8 hour/ 12 hour/ 24 hour                                |
| <b>Minimum Detection Threshold</b> | Air Sample: 0.89 ug/m <sup>3</sup> (1 hour sampling)<br>Physical Sample: 2 ppm    |
| <b>Mount Type</b>                  | Wall Mount, NEMA 4X Cabinet, Wall mounting hardware Included                      |
| <b>Weight/Dimensions</b>           | 28 kg / 620mm x 510mm x 230mm                                                     |
| <b>Power Requirements</b>          | 110-220V 7A                                                                       |
| <b>Communication</b>               | WiFi (Default), Optional Ethernet                                                 |
| <b>Cloud Server</b>                | SIMS3 Data Logging, Analysis, Alarms, Remote Management                           |
| <b>On-Board Data Storage</b>       | 64 GB SD Card                                                                     |
| <b>User Interface</b>              | Touchscreen on panel door and remote access to SIMS3                              |
| <b>Optional Outputs</b>            | BACnet over IP (UDP), Building BAS - 4-20 mA, ModBus, Customizable Binary Outputs |
| <b>Device Health</b>               | Daily Sensor Health & Replacement Check and Reminders                             |
| <b>Warranty</b>                    | 24 Months Full Warranty (Parts, Including Sensors)                                |



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