



Mercury Analyzers
For a Cleaner Tomorrow

Hydra II



TELEDYNE LEEMAN LABS
A Teledyne Technologies Company

The *Hydra II* Family of Mercury Analyzers

At Teledyne Leeman Labs, atomic spectroscopy is our business – our only business. We are industry leading innovators with a proven track record providing systems that deliver outstanding performance, robustness and operational simplicity.

Teledyne Leeman Labs Hydra series mercury analyzers were the first to offer 'turnkey' operation for the Hg analysis techniques:

- (1) reduction with cold vapor atomic absorption (CVAA) detection,
- (2) reduction with cold vapor atomic fluorescence (CVAF) detection and
- (3) thermal decomposition with cold vapor atomic absorption detection.

The *Hydra II* 'family' advances the state-of-the-art with improved performance, greater analysis throughput and more simplified operation. Furthermore, the *Hydra II* family is built around an innovative 'integrated modular' design so systems can be easily reconfigured in the lab to perform other Hg analysis techniques as your analysis requirements change.



*Hydra II*_{AA} Atomic Absorption Detection – Liquid Samples

Provides fully automated analysis for digested samples

- High sampler capacity (up to 270 sample locations)
- Large reservoirs for recurring QCs
- Handles difficult sample matrices
- Automatic over-range protection



*Hydra II*_{AF} Atomic Fluorescence Detection without Pre-concentration – Liquid Samples

- Sub ng/L detection limits
- Over-range protection
- Short analysis cycle (~1-2 min.)
- Very low gas consumption



Hydra II_C Atomic Absorption Detection – Direct Analysis of Solid and Semi Solids

Provides results in about 5 minutes without any sample digestion

- 70 position autosampler
- “On-the-fly” sample programming
- Easy to maintain
- Reduction option for low concentration liquids



Hydra II_{AF Gold} Atomic Fluorescence Detection with pre-concentration – Liquid Samples

- For the ultimate in sensitivity
- Short analysis cycle (~ 3min.)
- Pre-screen option to minimize contamination
- Modular detector option for CVAAS methods



Innovative Integrated Modular design enables one system technique to be reconfigured to another in your lab should your analysis needs change saving money, time and bench space.

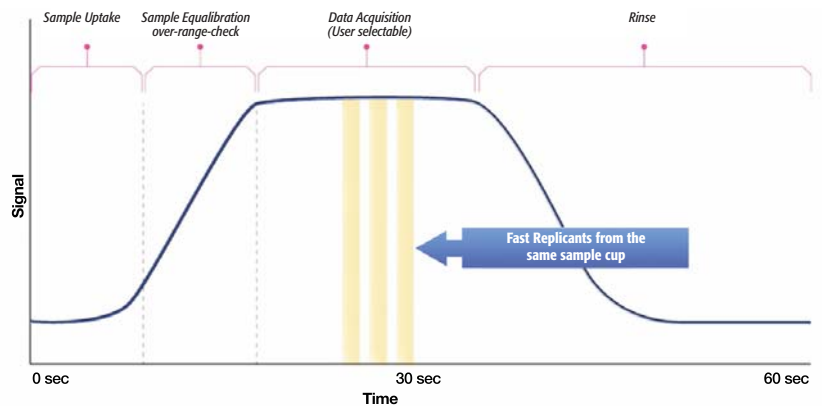


Sample Digestion Cold Vapor Atomic Absorption (CVAA) *The Hydra II_{AA}*

The *Hydra II_{AA}* employs the most widely used mercury analysis technique: sample digestion followed by cold vapor atomic absorption (CVAA). This technique's popularity is in its ability to deliver both sensitivity and selectivity needed to meet or exceed the requirements of many US and European standard methods. With its ppt detection capability, exceptional stability and powerful over-range protection system, the most stringent QCs can be satisfied while its high capacity autosampler assures a long period of unattended operation.

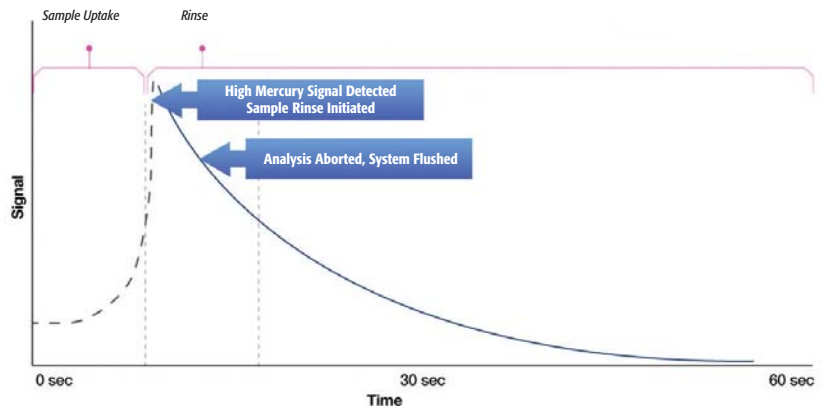
Fast Results, Better Decisions

The *Hydra II_{AA}* provides fast analysis cycle times; less than 1 minute. Unlike other systems that consume the full sample, it is able to conduct multiple analyses from the same sample cup in the same amount of time or less. This approach ensures better analysis results and samples can be re-analyzed if needed. For example, if intelligent quality control is utilized.



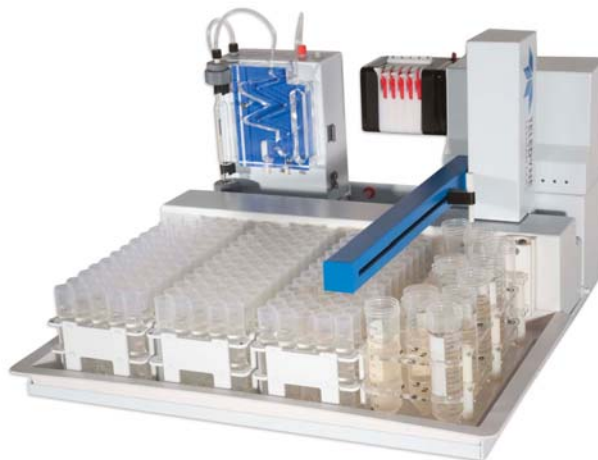
Built-in Safety Net

Systems can become contaminated if a sample with an unexpectedly high concentration of mercury is encountered forcing unanticipated shutdown and cleaning. This is easily avoided with the *Hydra II_{AA}*'s unique **over-range protection** by which samples with high mercury concentration are automatically detected BEFORE contamination can occur. Analysis is automatically aborted and the system flushed so the next sample can be analyzed correctly. Unplanned downtime is avoided saving time and money.



Analyzing Many Samples is Easy

The *Hydra II* autosampler is designed for the flexibility needed to take advantage of the system's fast analysis speed as well as to accommodate the use of a wide variety of low cost sample cups. It has two large reservoirs for recurring QCs, including CCVs and CCBs, with enough capacity for a complete automated run without operator intervention.



A wide variety of commercially available sample cups are supported to achieve maximum productivity and to ensure compatibility with your lab's digestion vessels

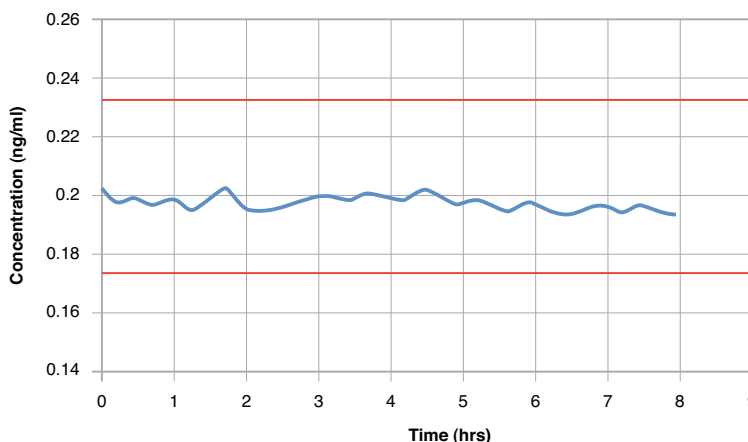
Difficult Samples Made Simple

The novel gas/liquid separator ensures that samples prone to foaming such as municipal wastewater and industrial effluent do not enter the gas phase and contaminate the system.



Stability You Can Depend On

In EPA Method 245.1 a laboratory fortified blank (LFB) with a mercury concentration >10 times the method detection limit must be run every 20 samples. The chart at right shows the LFB consistently passes the $\pm 15\%$ accuracy limits (depicted in red).





Sample Digestion Cold Vapor Atomic Fluorescence *The Hydra II_{AF}* and *AF Gold*

With the drive to routinely achieve sub ppt detection of mercury, analysts are increasingly turning to cold vapor atomic fluorescence (CVAF) which is inherently a more sensitive technique than CVAA. To meet that challenge, Teledyne Leeman Labs developed the *Hydra II_{AF}* and *Hydra II_{AF Gold}* systems. The *Hydra II_{AF}* uses cold vapor atomic fluorescence detection for the measurement of mercury to 0.1 ppt or lower. The *Hydra II_{AF Gold}* adds a pre-concentration stage using gold amalgamation prior to detection yielding detection levels down to 0.05 ppt or even lower; for the *ultimate in trace level mercury detection*.

Ultimate Sensitivity via Gold Amalgamation

To achieve ultra-trace detection levels the *Hydra II_{AF Gold}* employs a gold amalgamator that traps all of the free mercury resulting in a 10X or more increase in sensitivity compared to the *Hydra II_{AF}*.

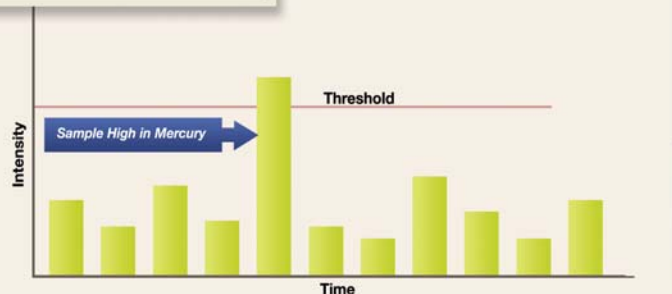


Hassle Free Operation

Although the level of mercury is predictable most of the time, occasionally it's not. Because high amounts of mercury can contaminate the system, the *Hydra II_{AF Gold}* has a special **pre-screen function**. If enabled, a small aliquot of the sample is taken and the gold amalgamator by-passed. If the measured value is < the threshold value, the sample will be analyzed and the sequence continued. If the measured value is > the threshold value, the sample will not be analyzed and it will be flagged for dilution and re-analysis.

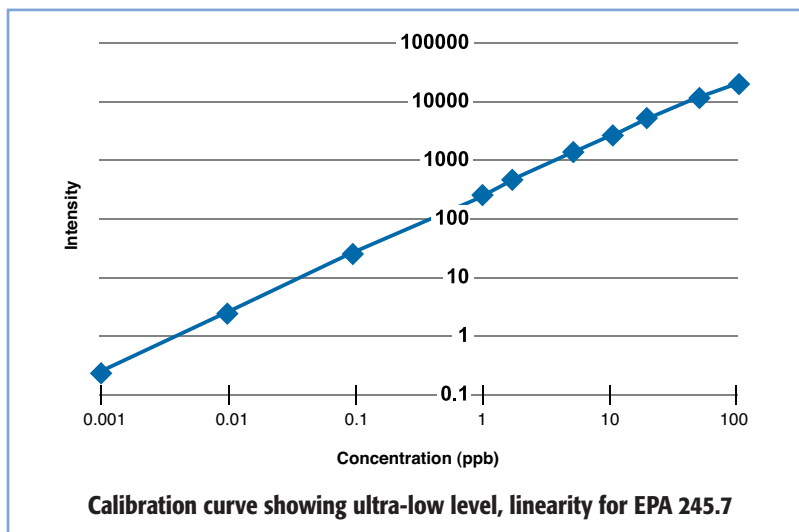
Sample	
Intgration Time:	45 sec
Estimated Run Time: 180 sec.	
Scan Data Fts: 450	Number of Sample Replicates: 1
<input checked="" type="checkbox"/> Use Prescreen	

Pre-Screen Function



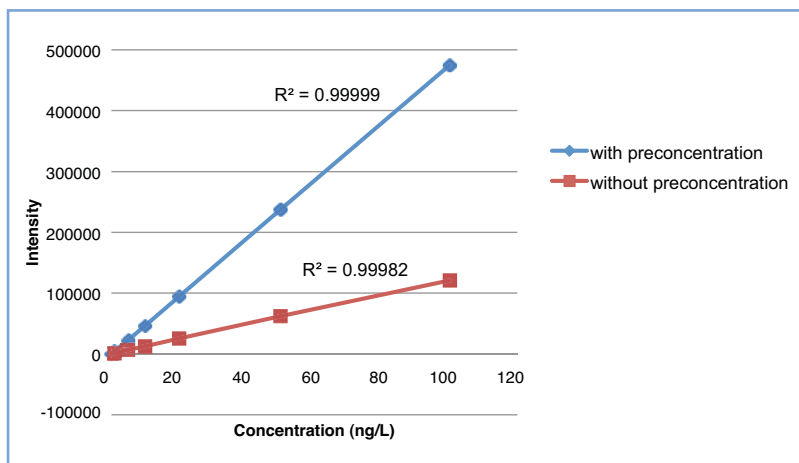
Exceptional Linearity

An attractive characteristic of atomic fluorescence is its linear range. The chart to the right shows a linear response for the **Hydra II_{AF}** that extends to 5 orders of magnitude. The benefit to the analyst is that samples with higher concentrations can be measured without additional dilution.



Sensitivity for the Most Demanding Methods

This chart shows signal enhancement using the **Hydra II_{AF Gold}** to pre-concentrate 12mL of sample prior to analysis. If more sample is pre-concentrated the enhancement increases. EPA Method 1631 employs pre-concentration while EPA Method 245.7 and EN 17582 do not.





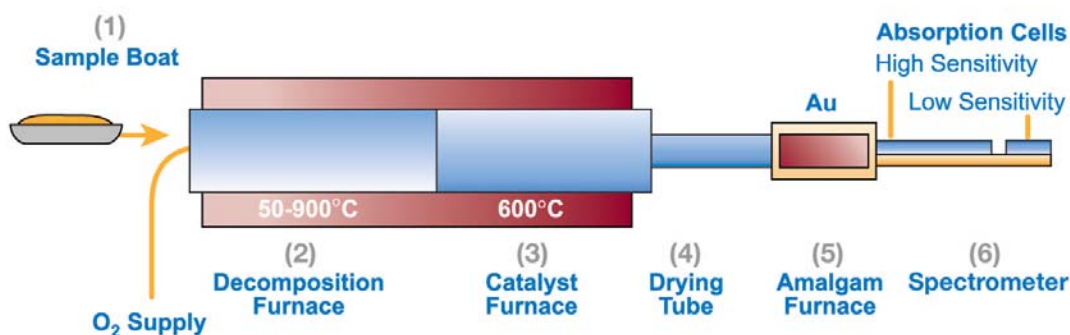
Direct Analysis of Solids and Semi Solids

The Hydra II_c

The **Hydra II_c** is a fully automated analyzer that measures mercury in solid and semi-solid sample matrices directly without any acid digestion (sample preparation). It employs the technique of sample combustion (thermal decomposition), mercury concentration via gold amalgamation and detection by cold vapor atomic absorption.

The biggest advantage of the **Hydra II_c** is that no sample preparation is required. And, because no sample prep is required, no hazardous waste is generated that would have to be disposed of safely and with high cost.

Principle of Operation



A weighed sample is deposited into a sample boat (1) and then introduced into the **Hydra II_c** where oxygen begins to flow over the sample. The decomposition furnace (2) temperature is then increased in two stages; first to dry the sample, then to decompose it. The evolved gases are carried through a heated catalyst (3) to produce free mercury while removing halogens, nitrogen oxides, and sulfur oxides.

The remaining combustion products including elemental mercury (Hg^0) are swept through a drying tube (4) and a gold amalgamation trap (5) where elemental Hg is trapped and concentrated. After the amalgamation step, the trap is heated to release the mercury into a carrier gas which transports it into an atomic absorption spectrometer (6).

Typical Applications

- Beverages
- Blood
- Coal
- Effluent
- Fertilizer
- Feed
- Fly Ash
- Foods
- Hair
- Minerals
- Ore
- Petrochemical
- Sediment
- Sludge
- Soil
- Urine
- Wastewater
- Water

Matrix Independent Calibration

A key benefit of the thermal decomposition process is its ability to report accurate results regardless of differences in sample matrix, Figure 1. Figure 2 shows the system accuracy

for a diverse variety of sample types all obtained from a single aqueous calibration curve. Alternatively, certified reference materials may be used as standards to calibrate the system.

Figure 1

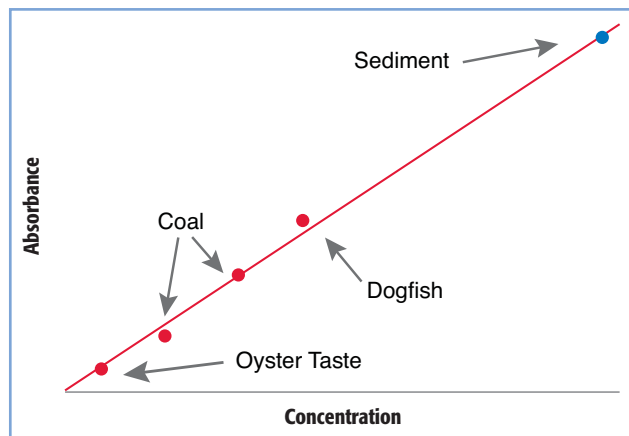


Figure 2

SAMPLE	NO.	CERTIFICATE (ppm)	MEASURED (ppm)	RECOVERY (%)
Bovine Liver	1577	0.016	0.0178	111.7
Blood	Lypho 1	0.0096	0.0091	94.8
Dogfish	Dorm-2	4.64	4.34	93.5
Oyster	1566	0.057	0.061	107.0
Soil	8406	0.06	0.061	101.7
Coal	HC-35150	0.176	0.177	100.6

Eliminates Transcription Errors



Weigh Sample

Sample Wt (g)	% Moisture	Dry Temp	Dry Time	Dcrmp Temp
0.357000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800
0.000000	0.00	300	1	800

Automatic Weight Transfer

Building sample sequences can take considerable effort. The *Hydra II*, enables sample weights to be automatically transferred directly into the sample table saving time and eliminating transcription error.

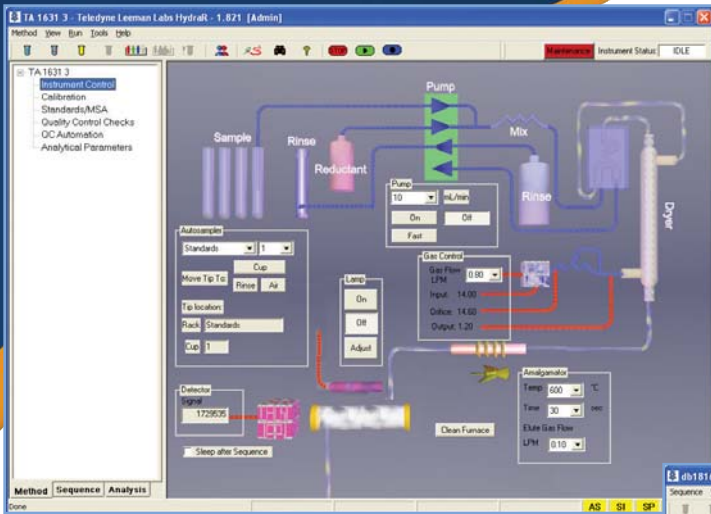
Elegant Yet Simple Design



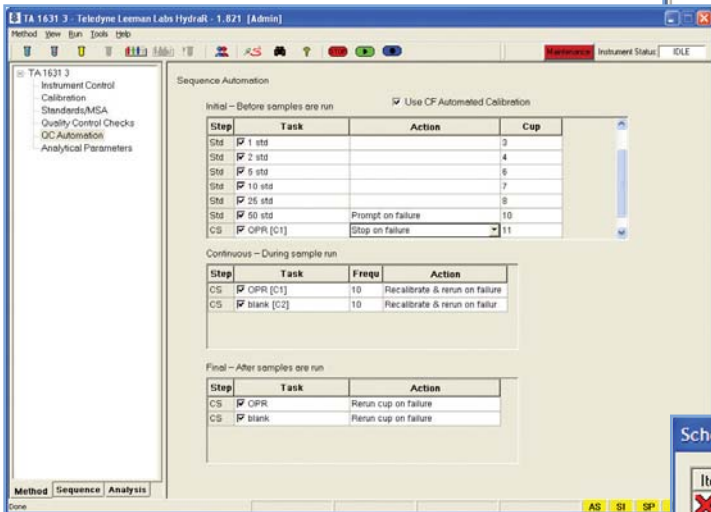
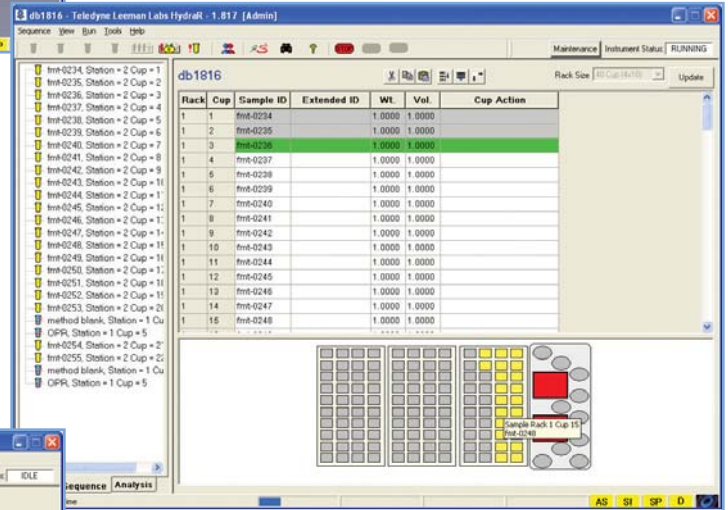
At the heart of the system is the catalyst tube which can be easily replaced without tools in as little as a minute.

Software – Powerful Yet Easy-to-Use

Instrument Control is fully automated and appears on a single screen. The graphical display helps operators to understand how the system functions. System parameters are automatically stored and can be recalled at any time to satisfy audit requirements. On start-up, simply clicking the start button returns all system conditions to the last setting saved with the method.

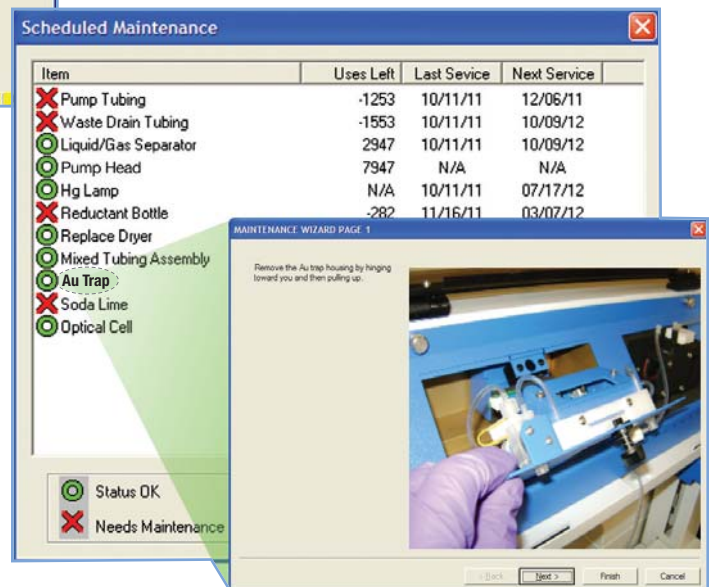


'On-the-fly' Sample Programming saves valuable time by allowing the operator to start a sample sequence even if individual sample entries are not yet complete. Samples can be easily located, added and positioned using the convenient rack map display.



Intelligent Quality Control enables the analyst to define acceptance limits for his quality control checks and choose from a variety of corrective actions when the limits are not met. Each QC sample can be programmed as an initial, recurring, and/or final QC with unique corrective actions.

Preventive Maintenance. The software keeps a record of routine maintenance and notifies the analyst when maintenance is required. When a maintenance procedure is required, the *Hydra II* provides the analyst with step-by-step instructions, including audio/visual support. In this case, the gold trap was highlighted on the preventive maintenance screen and the Maintenance button was clicked to start the detailed instructions.



Hydra II Mercury Family – ‘At-a-Glance’ Capabilities Summary

Sample	Hydra II _{AA}	Hydra II _{AF}	Hydra II _{AF Gold}	Hydra II _C
Analytical Method Used	Chemical reduction followed by cold vapor atomic absorption (CVAA)	Chemical reduction followed by cold vapor atomic fluorescence (CVAF)	Chemical reduction and Hg pre-concentration followed by cold vapor atomic fluorescence (CVAF)	Thermal decomposition followed by amalgamation and atomic absorption
Recommended for:	<ul style="list-style-type: none"> Liquid samples Hg measured from low ppt to ppm levels 	<ul style="list-style-type: none"> Liquid samples Hg measured from sub ppt to high ppb levels 	<ul style="list-style-type: none"> Liquid samples When the lowest detection levels are required 	<ul style="list-style-type: none"> Solid, semi-solid matrices Analysis without sample preparation
Detection Limit	1 ppt	0.1 ppt	0.05 ppt	0.001 ng
Usable Range	1 ppt – 1 ppm	0.1 ppt – 250 ppb	<0.05 ppt – 250 ppb	0.001 ng – 1500 ng; <25,000 ng with extended range option

Key Capabilities	Hydra II _{AA}	Hydra II _{AF}	Hydra II _{AF Gold}	Hydra II _C
High Performance Gas/Liquid separator	Y	Y	Y	NA
Easy access ‘on the fly’ sample introduction system	Y	Y	Y	Y
Dual cell detection system for wide dynamic range	Y	N	N	Y
Built in high concentration protection system	Y	Y	Y	NA
Flow through rinse to minimize carryover even at ultra-low levels	Y	Y	Y	NA
Counter-flow Nafion® membrane dryer to minimize vapor formation in detector cells	Y	Y	Y	Y
Can be reconfigured to liquids analysis	NA	NA	NA	Y
Can be reconfigured to solids analysis	Y	N	N	NA
Ultra-trace analysis mode with gold amalgamation for lower detection levels	NA	N	Y	Y

Regulatory and/or ‘Standard’ Methods – System Selection Guide	Hydra II _{AA}	Hydra II _{AF}	Hydra II _{AF Gold}	Hydra II _C
(US) EPA 245.1	X			
(US) EPA 245.5	X			
(US) EPA 245.6	X			
(US) EPA 245.7		X	X	
(US) EPA 7470A	X			
(US) EPA 7471B	X			
(US) EPA 7473				X
(US) EPA 1631E			X	
ASTM D6722-01				X
EN 1483	X			
EN 13806	X			
EN 13506		X	X	
EN 12338			X	
EN 17582		X		



ICP Spectrometers



DC Arc Spectrometers



ICP Standards & Mercury Reagents



After Sales Support

When you buy from Teledyne Leeman Labs you get much more than a quality instrument

Every order we receive gives us an opportunity to develop a lasting relationship with our customers. Our customers are not numbers to us. We know that your ability to succeed depends on your ability to get the help you need when you need it. And when you reach out to Teledyne Leeman Labs for assistance you'll encounter no complicated phone menus or call center hassles. Rather, you will speak to a very knowledgeable member of our team who is ready and able to answer your question or identify the nature of your problem and then work with you to solve it.

We offer all of the 'after sales' support services you need, including:

- Telephone support
- Remote diagnostics capabilities
- Onsite diagnostic and repair services
- Operator training at our facility or yours
- A range of service maintenance agreements
- Custom support agreements for special circumstances
- Readily available consumables/supplies and parts
- NIST traceable calibration standards
- Mercury reagents

As a leading innovator in atomic spectroscopy, we offer other powerful systems for inorganic, metal analysis including:

- Inductively Coupled Plasma – Optical Emission Spectrometers (ICP-OES) – for low to trace level analysis of metals, metallic components in a very wide variety of sample matrices
- DC Arc Spectrometers – for the analysis of inorganic components in solids without sample preparation

For more information, please contact Teledyne Leeman Labs.

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