The home of
JEROME®
by Arizona Instrument LLC

ABLE
Instruments & Controls

Jerome® J505

Portable Atomic Fluorescence
Spectroscopy Mercury Vapour Analyser

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Introduction

Whether it is fluorescent lighting, dental fillings, antique switches, gold mining or thermometers, the element mercury (Hg) is present in the world we live. Many of the mercury containing products give us comfort, are used to provide us with information, and even allow us to control our environment. While these products are safe, they could potentially expose people to a plethora of toxic compounds if an accident should occur. Symptoms of mercury exposure include seizures, memory loss, and in some cases, death. Because of these risks, several guidelines and regulations have been developed that limit the amount of mercury people can be exposed to, and special methods are required for cleaning up mercury if an accident should occur. Currently the time weighted average limit for mercury varies depending on the regulating agency. The EU Indicative Occupational Exposure Limit Valve (IOELV) for mercury and its organic compounds is set at 0.02mg/m^3 (8-hour Time Weighted Average (TWA). OSHA and NIOSH have set an exposure limit of 0.01mg/m^3 (TWA) and the ACGIH has a limit of 0.025mg/m^3*. Since mercury vapour is not something people can see, how do they determine their amount of exposure? Arizona Instrument, LLC manufactures the J505 Atomic Fluorescence Analyser; a hand-held atomic fluorescence spectrophotometer that measures the concentration of mercury in air. The lower detection limit of this instrument is 50ng/m^3 (0.000050mg/m^3), and it can detect as high as 0.5mg/m^3. These detection limits exceed the current industrial exposure limits, as well as clean-up levels for public facilities.

Atomic Fluorescence Spectroscopy (AFS)

When an atom is excited by an input of energy, one of its electrons transitions from a stable ground state to an unstable excited state. Once the source of energy is removed, the electron returns to its ground state and the absorbed energy is emitted as a photon (light). This process is called fluorescence. Often the amount of energy given off is not the same as the energy going in. This is not the case for mercury, which makes it special. When the energy required to excite an electron is the same energy as the photon it gives off when it returns to its ground state, it is called resonance fluorescence, and is easily detectable using AFS. The J505 instrument uses a mercury lamp to excite the mercury atoms at the 254nm wavelength, and then uses a detector to measure the emission of the photons, at the same wavelength, as the electrons return to their stable ground states. Because AFS measures the emission of photons, this technique does not have interferences, such as hydrocarbons, hydrogen sulphide, and ammonia, which are often problematic for traditional detection methods. The specifications for the J505 Atomic Fluorescence are below.

Atomic Fluorescence Spectroscopy should not be confused with Atomic Absorption Spectroscopy (AAS). In AAS, a light source of known wavelength and intensity is passed through a sample of interest. Some of the energy of the source light is absorbed by the sample as it energizes electrons in the material from the ground state to an excited state. A detector is placed at the end of the pathway to determine how much of the energy passed through. The difference between the energy of the source light and the energy of the light that arrives at the detector is directly proportional to the concentration of analyte in the sample. One of the drawbacks of this technique is that there are a number of other common molecules that can absorb energy at the same wavelength as mercury. To compensate for these unwanted absorptions, manufacturers use a variety of filtering techniques to limit background interference. While these filtration principles are sound, they come at the cost of a more complicated and bulkier instrument. Further, AAS can also have physical limitations that may limit low level sensitivity. At very low concentrations, the amount of absorbed light, when compared to the intensity of the incident light source, can become indistinguishable from electronic noise, making detection at these levels more challenging.

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J505 Specifications

Test Mode (Units)	ng/m^3	µg/m^3	mg/m^3
Standard Range	50 to 500,000	0.05 to 500	0.00005 to 0.50000
	(0.05 µg/m^3 ± 0.033 µg/m^3 to 500 µg/m^3 ± 40 µg/m^3)		
Resolution	10	0.01	0.00001
Quick Range	100 to 500,000	0.1 to 500	0.0001 to 0.500
Resolution	100	0.1	0.0001
Search Range	100 to 500,000	0.1 to 500	0.0001 to 0.500
Resolution	100	0.1	0.0001
Typical Test Time			
Standard	28 seconds		
Quick	16 seconds		
Search	8 seconds for first reading then continuous 1 second updates		
Power Requirements	Internal battery (NiMH) with 10+ hours of operation 12VDC power adapter runs on 100-240VAC, 0.8A, 50-60Hz Battery charges in 3 hours or less (Note: Battery will not charge if battery temperature > 40°C)		
Operating Environment	5 to 45°C, non-condensing, non-explosive		
Dimensions	12in L x 6.2in W x 8.4in H (30.5cm L x 15.7cm W x 21.3cm H)		
Weight	6.5 pounds (3.0 kilograms)		
Display	3.5 inch (9 cm) colour LCD display. High brightness backlight		
Unattended Auto Sample	Available in intervals of 1, 2, 5, 10, 15, 20, 30, 45, 60, 90 or 120 minutes		
Data Storage Capacity	Up to 10,000 test results 100 test sites		
USB	USB port located on rear of instrument Test results and calculations saved to USB flash drive Menu navigation, text entry, and softkey operation with optional USB Keyboard		
Certifications	Power adapter marked with UL and TUV		

Accuracy and Precision (Standard mode):

Gas Level	Accuracy	Precision (RSD)
0.3 µg/m3	± 15%	15%
1 µg/m3	± 10%	7%
25 µg/m3	± 10%	5%
100 µg/m3	± 10%	3%

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