



## **USER MANUAL**

# **JEROME<sup>®</sup> 411 MERCURY VAPOR ANALYZER OPERATION MANUAL**

Revision D1  
July 1997

### **ARIZONA INSTRUMENT LLC**

3375 N Delaware Street | Chandler, AZ 85225 USA  
800.528.7411 | 602.470.1414 | f 602.281.1745

[www.azic.com](http://www.azic.com)

Email:

General - [azi@azic.com](mailto:azi@azic.com)

International - [intl@azic.com](mailto:intl@azic.com)

Customer Service - [support@azic.com](mailto:support@azic.com)

ARIZONA INSTRUMENT LLC  
3375 N Delaware St | Chandler, AZ 85225  
800.528.7411 | [sales@azic.com](mailto:sales@azic.com) | [www.azic.com](http://www.azic.com)  
MADE IN THE USA

**AZI P/N SS-101**  
Last update July 1997



**JEROME 411**

**MERCURY VAPOR ANALYZER**

**OPERATION MANUAL**

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# THE JEROME 411 GOLD FILM MERCURY VAPOR ANALYZER

The Jerome 411 Gold Film Mercury Vapor Analyzer is designed for the easy and accurate analysis of mercury vapor in the workplace environment and for the location of mercury spills. This portable instrument will operate five hours on fully charged batteries. The 10-second SAMPLE mode provides an integrated, direct reading of mercury vapor concentration in  $\text{mg}/\text{m}^3$ . The 1-second SURVEY mode allows quick checks to locate high concentration areas.

The microprocessor automatically zeroes the digital meter at the start of each sample cycle and freezes the meter reading until the next sample cycle is activated, thus eliminating drift between samples.

## **PRINCIPLE OF OPERATION**

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A thin gold film, in the presence of mercury vapor, will undergo an increase in electrical resistance proportional to the mass of mercury in the sample.

Activating either the 10-second SAMPLE or 1-second SURVEY mode starts an internal pump which draws a precise volume of air over the Gold Film Sensor. The Gold Film Sensor adsorbs and integrates the mercury vapor, and the resulting signal is displayed on the digital meter.

As mercury adsorbs on the sensor, the percentage of saturation is indicated on the digital meter by pressing the SENSOR STATUS button. Approximately forty 10-second samples containing  $0.1 \text{ mg}/\text{m}^3$  Hg may be taken before the sensor reaches saturation. At this point, a 15 minute heat cycle is manually activated to desorb the accumulated mercury from the sensor. An internal charcoal filter prevents contamination from the desorbed mercury.

# INSTRUMENT OPERATION

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## DIRECTORY OF DIGITAL METER DISPLAY CODES

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Meter Display	Explanation
.000	Ready to sample
.H.H.H	Film heat in progress (.H.H.H flashes)
LO BAT	Recharge batteries (see page 8)
.L.L.L	Bridge balance is below 0 (see page 4)
.8.8.8	Press SENSOR STATUS  <i>If the digital meter displays 100, the Gold Film Sensor is saturated. No further operation is possible until a film heat is performed. Refer to page 3 for film heat procedure.</i>  <i>If the digital meter does not read 100, the sample was over range. Further operation is possible with samples of lower concentration, or with the use of a Dilution Module. For dilution module information call Customer Service at (800) 235-3360.</i>

### Sensor Status Button Pressed

.10	10% sensor saturation
.50	50% sensor saturation
.100	100% sensor saturation - film heat required

## OPERATIONAL TEST

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Before each day's use of the Jerome 411, perform the following 4 steps to verify the instrument is operational.

### Procedure:

1. Press power ON.  
*The digital meter displays .0.0.0 (Disregard the digital meter's initial momentary readings.). Recharge or replace the battery pack if the LO BAT indicator **remains on**. Refer to page 8 for the procedure.*



2. Perform a film heat.  
*Refer to page 3 for the procedure.*
3. Press SENSOR STATUS.  
*The digital meter displays the percent of mercury saturation of the sensor. The SENSOR STATUS must be between 01 and 99 for the instrument to operate. Refer to page 4, step 6 for the adjustment procedure.*
4. Press SAMPLE (10-second).  
*The digital meter counts up 9 seconds, as indicated by EO1 through EO9. At the end of the 10-second cycle, the digital meter displays the level of mercury present in the air.*

## **FILM HEAT PROCEDURE**

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Line voltage must be between 115 and 120 VAC for the films to clean properly. (For 230 VAC models, line voltage must be between 230 and 240 VAC.)

**CAUTION: Once a FILM HEAT is initiated, DO NOT interrupt the cycle.**

### **Procedure:**

1. Insert a zero air filter in the instrument's intake and tighten the intake tube nut to ensure an airtight seal.  
*This filter prevents mercury in the atmosphere from entering the Jerome 411.*
2. Attach the line cord to the 411 and plug into a VAC outlet.  
*The line cord is used during a FILM HEAT to provide line voltage to the films.*
3. Connect the battery charger to the 411 and plug into a VAC outlet.  
*This ensures completion of the FILM HEAT cycle. The battery charger supplies operating voltage to the instrument.*
4. Press power ON.  
**NOTE: If LO BAT is ON, turn unit OFF and charge the batteries at least one hour before activating a film heat.**
5. Press FILM HEAT.  
*The digital meter flashes .H.H.H for the duration of the 15-minute cycle.*

**DO NOT INTERRUPT THIS CYCLE.**

*Wait a minimum of 30 minutes after the cycle is complete before continuing with the next step.*

6. Press SENSOR STATUS and hold down. Adjust the BRIDGE BALANCE using the trimmer tool until the digital meter reads greater than 02 and less than 06.  
*If the meter reads less than 02, turn the BRIDGE BALANCE counter-clockwise; if greater than 06, turn the BRIDGE BALANCE clockwise.*

**IMPORTANT: The BRIDGE BALANCE should be adjusted only after a FILM HEAT cycle.**

7. Press power OFF.
8. Disconnect the battery charger.
9. Disconnect the line cord.
10. Remove the zero air filter.
11. The Jerome 411 is ready for sampling.

**NOTE: If FILM HEAT is activated with the line cord unplugged, there is no voltage applied to the film chamber. Under these circumstances, the cycle may be discontinued by pressing the power OFF.**

## **SAMPLING FOR MERCURY**

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### **SAMPLE 10-SECOND**

#### **Procedure:**

1. Press SAMPLE (10-second).
2. Read the digital meter.  
*The number displayed at the end of the count is the mercury concentration in  $\text{mg}/\text{m}^3$ . This value remains displayed until the next sample is taken. The digital meter automatically zeroes at the start of each sample.*
3. Occasionally check SENSOR STATUS.
4. Press power OFF when not in use.  
*The Jerome 411 will operate 5 hours on a fully charged battery.*

## **SURVEY 1-SECOND**

The SURVEY 1-second mode DOES NOT provide for accurate analysis of mercury concentrations. This mode is used to assess areas of potentially high mercury concentrations. If sampling unknown mercury levels or locating spills, use this 1-second mode first.

### **Procedure:**

1. Press SURVEY (1-second).
2. Read digital meter.
3. Occasionally check SENSOR STATUS.

The probe may be used for locating mercury vapor in hard to reach places. Plug the probe directly into the instrument's intake.

**CAUTION: The Jerome 411 is intended for vapor use only. DO NOT allow the probe or the instrument's intake to come in contact with liquids, dust or other foreign material.**

**NOTE:** Plug the Zero Air Filter in the instrument's intake when not in use.

## **OPERATING ON BATTERY POWER**

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Battery power enables you to use the Jerome 411 as a portable instrument. If battery power is necessary for your use, please be aware of the following:

- A fully charge battery pack provides power for five (5) hours of operation
- For operation longer than five (5) hours, an extra fully-charged battery pack is needed. Refer to NOTE on page 8.
- 20 minutes of sampling remains after LO BAT is indicated.
- Complete battery recharging takes 14 hours. Refer to page 8 for the procedure. Refer to page 7 for battery maintenance.

## OPERATING ON POWER SUPPLY

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For stationary use, the optional Continuous Operation Power Supply Kit (COPS) is available for the Jerome 411. The COPS kit eliminates the need for the battery pack and its necessary maintenance. Installation steps follow:

### Procedure:

1. Unplug the line cord.
2. Remove the two (2) side screws from the digital meter end of the instrument and open the case lid.
3. Locate the battery jacks and disconnect them.
4. Remove the battery pack from the instrument.
5. Plug the jumper assembly into the instrument battery jack.  
*The jumper assembly is included in the COPS kit.*
6. Close the case and replace the side screws.
7. Plug the power supply into the battery charger receptacle on the rear of the Jerome 411.  
*When the power supply line cord is plugged into 115 VAC (or 230 VAC), the instrument is ready for use.*

### **WARNING!!!**

**With the COPS jumper assembly installed in the Jerome 411, the battery charger should NOT be plugged into the charging jack. The battery charger does not supply adequate current to operate the instrument, and damage to the instrument and/or the battery charger will result.**

## MAINTENANCE

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### PREVENTIVE MAINTENANCE CALENDAR

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To keep the Jerome 411 operating at peak performance, follow this maintenance schedule.

Charge batteries	After 1 month storage or at the end of a day of use	page 8
Change intake filter disc	After 20 hours of use, or as needed	page 10
Change internal filter system	After 6 months of use, or as needed	page 11
Change scrubber filter	Annually	page 11
Check instrument's calibration	After 20 hours of use, every 3 months, or as needed	page 14

Replace zero air filter\* Annually

**NOTE: Plug the zero air filter in the instrument's intake during storage.**

\* The zero air filter contains Resisorb mercury vapor absorbent. For safety information, see the Resisorb Material Safety Data Sheet included in this manual.

### OBTAINING MAXIMUM BATTERY LIFE

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There are certain inherent limitations to NiCd batteries. A major limitation is a "memory" effect that occurs if the batteries are partially discharged and then recharged repeatedly. This "memory" leads to a drastic reduction of usable battery capacity. To prevent this, periodically allow the battery pack to discharge until LO BAT appears on the digital meter. Then recharge battery pack. To obtain maximum battery life, follow these 3 steps.

1. At least once a month wait until LO BAT appears on the digital meter before recharging the battery pack.
2. Charge the battery pack when the LO BAT indicator comes on. Excessive discharge can damage the battery pack.

3. Use the plastic button guard on the power ON/OFF switch when packing the instrument in the carrying case. This will prevent the power being turned on and running down the batteries. Before storing the instrument, verify the power is OFF.
4. When batteries fail to hold a charge, the battery pack should be replaced. Battery life under normal usage is approximately 1 year depending on the number of charge and discharge cycles.

**NOTE:** Instead of recharging the batteries with the Jerome 411, a spare battery pack may be recharged with the battery charging adapter and battery charger, outside the instrument.

5. When the instrument indicates LO BAT, simply exchange the discharged pack with a fully charged spare for continued operation.
6. The discharged pack may then be connected to the adapter and charger, then recharged for the full 14 hours without putting the instrument out of service.

## **CHARGING BATTERIES**

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### **Procedure:**

1. Press power OFF.
2. Connect the battery charger to the Jerome 411.
3. Plug the charger into a VAC outlet.  
*Complete battery recharging takes 14 hours.*

## **REPLACING BATTERY PACK**

---

### **Procedure:**

1. Press power OFF.
2. Unplug the line cord.
3. Ensure the battery charger is disconnected from the Jerome 411.
4. Remove the two (2) side screws from the digital meter end of the instrument.
5. Open the Jerome 411 case lid.
6. Disconnect battery jacks.
7. Loosen the two (2) captive screws holding the battery pack bracket and remove the bracket.

8. Remove the old battery pack and replace with a new battery pack.
9. Replace the battery pack bracket and tighten the captive screws.
10. Reconnect the battery jacks.
11. Close the case and replace the screws.

## FLOW SYSTEM

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The Jerome 411's flow system is the crucial link between the sensor and the sample. For the instrument to perform correctly, the flow system must be properly maintained. This system consists of the intake assembly, internal filter system and scrubber filter.

See the following section for information on when to change filter disc and filters:

Change intake filter disc	After 20 hours of use, or as needed	page 10
Change internal filter system	After 6 months of use, or as needed	page 11
Change scrubber filter	Annually	page 11

For proper flow, the Tygon™ tubing on the filter systems must be free of crimps.

## INTAKE FILTER DISC

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Replace the intake filter disc after twenty (20) hours of sampling. In dusty environments the filter disc may need replacement as often as once a day. Replacement .25 diameter intake filter discs are available from Arizona Instrument LLC (p/n 2600-3039).

### Procedure:

1. Unscrew the intake from the Jerome 411.
2. Remove the old filter disc using a trimmer tool.
3. Use tweezers to insert the new filter disc. Avoid touching the new filter disc with your fingers.
4. Using your trimmer tool, seat the disc firmly against the inner ledge of the intake.
5. Screw the intake back on the Jerome 411.



## INTERNAL FILTER SYSTEM

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Replace the internal filter system after 6 months of use, or as needed.

### Procedure:

1. Unplug the line cord.
2. Remove the two (2) side screws on the digital meter end of the instrument and open the case.
3. Carefully disconnect the Tygon tubing from the intake and from the gold film sensor (to the left side of the sensor).
4. Remove the old internal filter system\* and discard using proper disposal methods.
5. Attach the new internal filter system.  
*Ensure the arrow on the filter is pointing in the direction of the air flow.*
6. Push the filter into the mounting clips.
7. Remove any crimps in the tubing and check that tubing connections are secure.
8. Close the case and replace the screws.

\* The internal filter contains Mallcosorb. For safety information, see the Mallcosorb Material Safety Data Sheet included in this manual.

## SCRUBBER FILTER

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The scrubber filter traps mercury released during film heat. Change this filter once a year.

**CAUTION: Old filters contain mercury. For safety information, see the Mercury Material Safety Data Sheet included in this manual. Use proper disposal methods.**

### Procedure:

1. Unplug the line cord.
2. Remove the two (2) side screws on the digital meter end of the instrument and open the case.
3. Carefully disconnect the Tygon tubing from the gold film sensor (right side) and slide the scrubber filter\* out of the mounting clip.

4. Remove the Tygon tubing from the scrubber filter.  
*Do not remove the Tygon tubing from the pump.*
5. Discard the old scrubber filter using proper disposal methods.
6. Connect the Tygon tubing from the pump to the new scrubber filter.  
*Ensure the arrow on the scrubber filter is pointing in the direction of the air pump.*
7. Connect the remaining Tygon tubing to the new scrubber filter and connect the other end to the gold film sensor.
8. Slide the scrubber filter into the mounting clip.
9. Remove any crimps in the tubing and check that the tubing connections are secure.
10. Close the case and replace the screws.

**\* The scrubber filter contains Resisorb mercury vapor absorbent. For safety information, see the Resisorb Material Safety Data Sheet included in this manual.**

## FUNCTIONAL TEST

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If your application requires frequent verification of instrument functionality, this test will benefit you. If the test results fall within the expected range, you may assume the instrument is functioning properly. This test does not calibrate the instrument.

**NOTE:** The functional test should only be performed after a film heat.

### 011 FUNCTIONAL TEST KIT

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The accessories necessary to perform this test are contained in the 011 Functional Test Kit:

- Vacuum Bottle (1)
- Stopper/thermometer assembly (1)
- Vial of Hg (1)
- Syringe assembly (1)
- Syringe needles (5)
- Septum holder assembly (1)
- Septa (20)

**CAUTION:** The vial and thermometer contain liquid mercury and are possible sources of mercury contamination. Follow the instructions carefully.

### VACUUM BOTTLE SET-UP

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#### Procedure:

1. Unwrap the thermometer assembly carefully.
2. Remove the cap from the vacuum bottle.
3. Remove the cap from the vial containing mercury (labeled CAUTION: MERCURY) and carefully pour the liquid mercury into the vacuum bottle.  
*Pour over a lipped container to trap any spilled mercury.*
4. Install the thermometer assembly securely in the mouth of the vacuum bottle.
5. Place the vacuum bottle in a location with a stable ambient temperature.  
*The temperature range for the test is 18-22°C. Avoid temperature fluctuations.*

**CAUTION:** Do not use the vacuum bottle as a portable container. If the vacuum bottle is upset or greatly agitated, mercury droplets will cling to the thermometer stem, the rubber stopper, the mouth of the vacuum bottle and the needle guide.

## FUNCTIONAL TEST PROCEDURE

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**NOTE: The functional test should only be performed after a film heat.**

1. Leave the vacuum bottle at stable room temperature for at least 2 hours.  
*The temperature range for the test is 18-22°C. Temperature fluctuations during the test procedure will produce erratic results.*
2. Unplug the line cord and battery charger.
3. Replace the intake filter disc.
4. Replace the septum.
5. Plug the septum assembly into the instrument's intake and tighten the intake tube nut to ensure an airtight seal.
6. Attach a zero air filter to the septum assembly.
7. Press power ON.
8. Note the temperature of the vacuum bottle.
9. Inject 1cc of mercury vapor according to the syringe technique described on page 19.

**NOTE: To minimize error, it is important to carefully follow this procedure.**

10. Record the meter reading.
11. Repeat step 9 and 10 three times.  
*The last three 1cc injections should be within  $\pm 5\%$  of each other. If not, refer to page 19 for proper syringe technique and repeat the procedure.*
12. Refer to the Temperature Conversion Chart, page 16, for the acceptable range.  
*The average of the last three digital meter readings should fall within the range indicated in the chart.*

*IT THE AVERAGE IS WITHIN RANGE, THE JEROME 411 IS FUNCTIONING PROPERLY.*

*If the average is not within range, proceed to the next step.*

13. Perform a film heat.  
*Refer to page 3. Wait 1 hour before proceeding to step 14.*

14. Using the trimmer tool, adjust the BRIDGE BALANCE until the digital meter reads not less than 02 and not greater than 06.

*Refer to page 4, step 6.*

15. Repeat steps 5-12 of this test procedure.

*If the average of the digital meter readings is still not within range, refer to page 17, Functional Test Troubleshooting.*

## 411 TEMPERATURE CONVERSION CHART

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TEMP °C	DIGITAL METER RESPONSE
16	.064 to .086
17	.070 to .094
18	.076 to .094
19	.082 to .112
20	.090 to .122
21	.097 to .131
22	.105 to .143
23	.115 to .155
24	.124 to .168

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## FUNCTIONAL TEST TROUBLESHOOTING

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If the proper results were not achieved during the test procedure, review the following to discover the cause:

- Ensure the battery charger and line cord are unplugged.
- Ensure the vacuum bottle temperature is stable.
- Ensure the mercury drop in the vacuum bottle is not oxidized.
- Replace a clogged, bent or contaminated syringe needle.
- If the internal tubing is crimped or blocked, straighten or replace the affected tubing.
- Ensure the instrument's intake is not blocked with foreign matter.

If none of the above conditions exist, follow these steps to determine if the flow system is contaminated:

1. Insert your zero air filter in the instrument's intake and tighten the intake tube nut to ensure an airtight seal.
2. Take 3 samples.  
*If the average meter reading is less than .005, there is no mercury contamination. If the average meter reading is greater than .005, proceed to step 3.*
3. Remove and replace the zero air filter.
4. Take 3 samples.  
*If the average reading is less than .005, the old zero air filter was contaminated. If still greater than .005, proceed to step 5.*
5. Change the internal filter system.  
*Refer to page 11.*
6. Take 3 more samples.  
  
*If the average meter reading is less than .005, the internal filters were contaminated. If the average is still greater than .005, please call Customer Service at (800) 235-3360 or (602) 470-1414.*

## REPLACING MERCURY

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An oxide coating will form on the drop of mercury and will cause lower readings in your testing. Replace your mercury on a yearly basis or when a filmy coating is evident on the surface of your mercury drop.

### **Procedure :**

1. Carefully remove the stopper assembly from the vacuum bottle.

BE SURE THE NEEDLE GUIDE IS FREE OF LIQUID MERCURY.

2. Replace the oxidized mercury with approximately  $\frac{1}{2}$  cc fresh mercury.

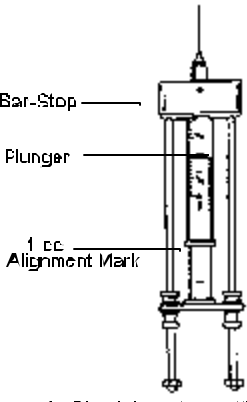
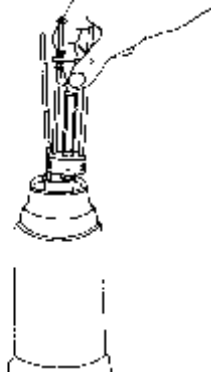
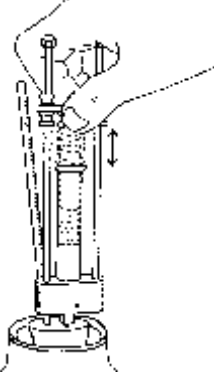
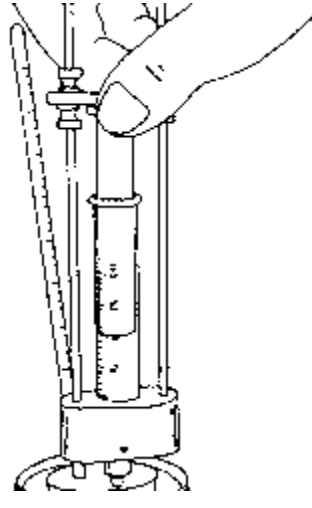
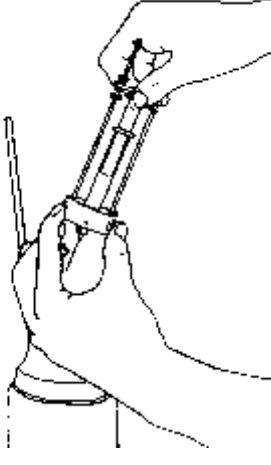
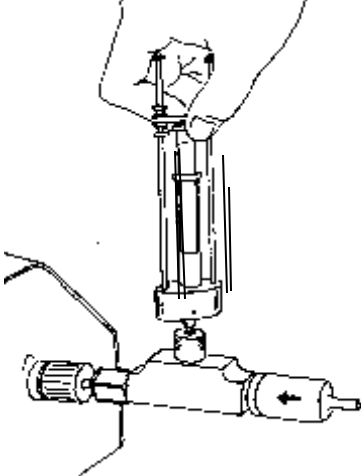
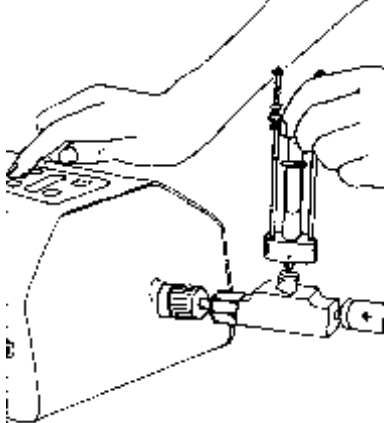
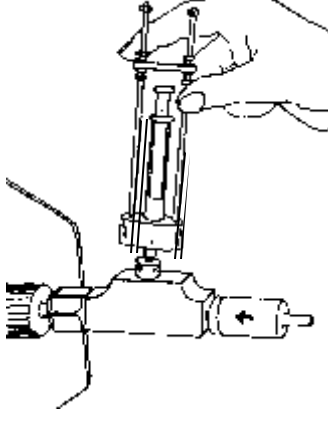
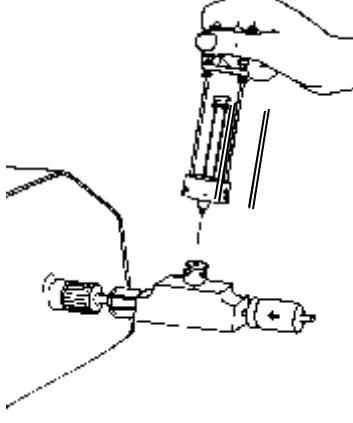
*Do NOT use the syringe for measuring liquid mercury. Dispose of oxidized mercury properly.*

3. Reinstall the stopper assembly.



# SYRINGE TECHNIQUE

## TECHNICAL SPECIFICATIONS

 <p>1. Check bar-stop setting (1cc)</p>	 <p>2. Insert needle into calibration vessel</p>	 <p>3. Pump plunger 2 times</p>
 <p>4. Pull plunger quickly and smoothly to bar stop.</p>	 <p>5. Hold plunger firmly against bar-stop and remove syringe from vessel</p>	 <p>6. Insert syringe needle into septum</p>
 <p>7. Press SAMPLE</p>	 <p>8. Release plunger so that gravity feeds Hg into 411 airstream. If necessary, push plunger completely closed.</p>	 <p>9. Remove syringe needle from septum</p>

Sensitivity	0.003 mg/m <sup>3</sup> Hg
Precision	5% Relative Standard Deviation @ 0.107 mg/m <sup>3</sup> Hg
Accuracy	±5% @ 0.107 mg/m <sup>3</sup> Hg
Range	0.000 to 1.999 mg/m <sup>3</sup> Hg
Response Time SAMPLE Mode SURVEY Mode	10 seconds 1 second
Flow Rate	750 cc/min 0.75 Liters/min = 750 CC/min
Power Requirements	115 VAC or 230 VAC 115 watts maximum
Batteries	Rechargeable nickel-cadmium
Construction	Aluminum alloy
Dimensions	6" W X 13" L X4" H
Weight	5 pounds
Digital Meter	Liquid Crystal Display
Operating Environmental Range	0 - 40°C, non-condensing, non-explosive
Data Output	Digital, serial; Voltage levels: Logi 0 = +5V, Logic 1 = 0V Transfer rate: 150 bits/second Data string: 1 start bit (+5V) 7 data bits (ASCII format) LSB 1st 1 parity bit (always 0) 2 stop bits (0V)

## ACCESSORIES & MAINTENANCE PARTS

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### PART #      ITEM DISCRIPTION

#### 411 Flow System

2600-3901	Internal Filter
Z2600-3930	Scrubber Filter
Z2600-3905	Zero Air filter
Z2600-3907	411 Internal Filter System (Includes Acrodisc, internal filter & Tygon tubing-assembled)
1400-3010	Tubing Adapter
2600-3039	.25 Diameter Intake Filter Disc
2500-3001	Tygon Tubing - 1/8" I.D.
2600-3015	Acrodisc - 5 micron

#### Calibration Equipment

2600-0030	Vacuum bottle
A2600-0902	Stopper Assembly (Includes: rubber stopper, thermometer & needle guide)
A2600-0903	Calibration Syringe Assembly (Includes: syringe, syringe holder & needle)
2600-0022	Syringe Needle
Z2600-3914	411 Septum Holder Assembly - Standard
3200-0011	Septum
A2600-0904	Vial with Hg

#### Replacement Parts

Z4000-0901	Battery Pack Assembly - 411
Z4000-0902	Battery Charging Adapter Assembly
1400-2002	Probe - 411
2300-0001	Trimmer Tool
4000-1003	Battery Charger - 115 VAC
6000-4003	Line Cord (411) - 115 VAC
Y411-0901	411 Accessory Kit Includes: battery charger (1), zero air filter (1), .25 dia. Intake filter discs (20), trimmer tool (1), probe (1) & tubing adapter (1)
Y411-0902	011 Functional Test Kit Includes: vacuum bottle (1), stopper assembly (1), vial of Hg (1), syringe assembly (1), syringe needles (2), 411 septum holder assembly (1) & septums (20)
Y411-0903	Maintenance Kit Includes: .25 dia. Intake filter discs (20), battery pack assembly (1), charging adapter (1), 411 internal filter system (1), scrubber filter (1), zero air filter (1) & 1' Tygon tubing - 1/8" I.D.

- Y411-0904 411 Carrying Case Assembly  
Includes: case & die cut foam rubber. Holds: Jerome 411, 412 Dosimeter Controller,  
Personal Mercury Dosimeters & accessories
- Z2600-3911 10:1 Dilution Module Assembly
- X412-0901 Personal Mercury Dosimeter
- Y411-0905 Continuous Operation Power Supply Kit (COPS) - 115 VAC

**FACTORY CALIBRATION & MAINTENANCE SERVICE**

Service includes instrument reconditioning & recalibration to bring to manufacturer's specifications.  
Call AZI Customer Service Department for authorization and scheduling.

**FACTORY CALIBRATION SERVICE**

Service includes checking and adjusting instrument calibration.  
Call AZI Customer Service Department for authorization and scheduling.

**(800) 235-3360 or (602) 470-1414**

## WARRANTY

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Arizona Instrument LLC (seller) warrants to buyer that Jerome products delivered pursuant to this Agreement shall, at the time of delivery, and for a period of one (1) year thereafter (the Internal Battery Pack, where applicable, is warranted for a period of ninety [90] days only), be free from defects in material or workmanship and shall conform to seller's specifications or such other specifications as seller has agreed to in writing. Seller's obligations with respect to claims under this warranty shall be limited, at seller's option, either to the replacement of defective or non-conforming product or to an appropriate credit for the purchase price thereof subject to the provisions of seller's Warranty Policy as amended from time to time, said Policy being incorporated herein by reference.

Return products under warranty claims will be shipped to seller's plant by buyer at buyer's expense and shall be accompanied by a statement or the reason for the return and an approved Return Material Authorization Number issued by seller. Buyer remains responsible for payment for products not accepted for warranty adjustment and freight and handling costs associated therewith.

Notwithstanding the foregoing, no warranty shall be enforceable in the event that product has been subjected to environmental or stress testing by buyer or any third party without written approval of seller prior to such testing. Further, no warranty shall be enforceable if the alleged defect is found to have occurred as a result of misuse, neglect, improper installation, repair, alteration, accident, or improper return handling procedure by the buyer.

Discontinued product is warranted only for a credit or replacement at seller's option.

THE EXPRESS WARRANTIES GRANTED ABOVE SHALL EXTEND DIRECTLY TO BUYER AND NOT TO BUYER'S CUSTOMERS, AGENTS, OR REPRESENTATIVES AND, EXCEPT FOR WARRANTY OF TITLE, IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, SUCH OTHER WARRANTIES BEING SPECIFICALLY DISCLAIMED BY SELLER. IN NO EVENT SHALL EITHER PARTY'S LIABILITY FOR ANY BREACH OR ALLEGED BREACH OF THIS AGREEMENT EXCEED THE TOTAL EXTENDED PRICE OR PRICES SHOWN ON UNFILLED ORDERS, NOR SHALL EITHER PARTY BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OR ALLEGED BREACH.

Notwithstanding the foregoing, if any product covered by order(s) placed hereunder is designated as "developmental," "prototype" or "experimental," no warranty whatsoever except a warranty of title to component materials will be applicable thereto and buyer shall indemnify seller for any claims for liability asserted seller in connection therewith.

Medical Applications: Seller's products are not designed for use in medical appliances, devices, or systems where malfunction of buyer's product can result in personal injury. Buyer's customers using or selling buyer's products for use in medical applications do so at their own risk and agree to fully indemnify buyer.

The foregoing state the entire liability of seller in connection with products supplied hereunder.

# MATERIAL SAFETY DATA SHEET

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Date of Issue 04/95

## MALLCOSORB

Arizona Instrument LLC  
3375 N Delaware St  
Chandler, AZ 85225  
INFORMATION HOTLINE (800) 235-3360

### Product Identification

SYNONYMS: Soda lime solid; sodium hydroxide mixed with lime  
FORMULA CAS NO.: 8006-28-28  
MOLECULAR WEIGHT: N/A  
HAZARDOUS INGREDIENTS: N/A  
CHEMICAL FORMULA: N/A

### Section 1 - Physical Data

---

APPEARANCE: White deliquescent pellets  
ODOR: Odorless  
BOILING POINT: No information found  
MELTING POINT: No information found  
VAPOR PRESSURE @ 20°C: Essentially zero  
SPECIFIC GRAVITY: No information found

### Section 2 - Fire and Explosion Data

---

FIRE: Not combustible, contact with moisture may generate heat to ignite combustibles.  
EXPLOSION: Possible when in contact with incompatible materials.  
FIRE HAZARD: Full protective clothing & NIOSH approved self-contained breathing apparatus.

### Section 3 - Reactivity Data

---

STABILITY: Causes no hazardous decomposition or hazardous polymerization  
INCOMPATIBILITIES: Water, steam, acids, fluorine & many organics; contact with nitro compounds cause formation of flammable hydrogen gas.

### Section 4 - Leak/Spill Disposal Information

---

PRODUCT CLEAN-UP: Protective clothing & respiratory protection, scoop up spilled material, avoid dusting, neutralize traces with dilute acid.  
DISPOSAL: Transfer to closed metal container & dispose of according to local, state & federal regulations. DO NOT CONTACT WITH WATER.

### Section 5 - Health Hazard Information

---

OSHA PERMISSIBLE EXPOSURE LIMIT(PEL):  
Calcium Oxide 5 mg/m<sup>3</sup> (TWA)

Sodium Hydroxide 2 mg/m<sup>3</sup> (TWA)  
ACGIH THRESHOLD LIMIT VALUE (TLV):  
Sodium Hydroxide 2 mg/m<sup>3</sup> (TWA)  
Calcium Oxide 2 mg/m<sup>3</sup> (TWA)

### EXPOSURE/HEALTH EFFECTS:

INHALATION - Upper respiratory tract damage, pneumonitis;  
INGESTION - Severe mouth, throat & stomach burns, severe tissue scarring & death may result;  
SKIN & EYES - Irritation or severe burns, possible blindness resulting

### FIRST AID:

INHALATION - Remove to fresh air; if not breathing, give artificial respiration; if breathing is difficult, give oxygen; get medical attention immediately.  
INGESTION - DO NOT INDUCE VOMITING!  
give large quantities of water or milk; get medical attention immediately.  
SKIN & EYES - Immediately flush with water for 15 minute minimum; remove contaminated clothing.

### Section 6 - Special Protection Information

---

Ventilation must be sufficient to meet TLV. Wear rubber gloves & eye protection.

### Section 7 - Storage and Special Information

---

Keep in tightly closed container, in cool, dry ventilated area, away from incompatible substances.

The information and recommendations set forth herein are presented in good faith and believed to be correct as of the date hereof. Arizona Instrument LLC, however makes no representations as to the completeness or accuracy thereof and information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Arizona Instrument LLC be responsible for damages of any nature whatsoever resulting from the use of or reliance upon this information.

# MALLCOSORB

## Addendum to Material Safety Data Sheet

ARIZONA INSTRUMENT LLC  
 3375 N Delaware St  
 Chandler, AZ 85225  
 INFORMATION HOTLINE (800) 235-3360

### Hazard Categories for SARA Section 311/312 Reporting

**Acute   Chronic   Fire   Pressure   Reactive**

X

Product or Components of Product	SARA EHS Sect. 302		SARA Sect. 313 Chemicals		CERCLA Sec103 RQ (lbs)	RCRA Sec. 261.33
	RQ (lbs)	TPQ (lbs)	Name List	Chemical Category		
MALLCOSORB™ Sodium hydroxide (1310-73-2) 1-10%	No	No	Yes	No	1000	No
Calcium chloride (10043-52-4)	No	No	No	No	No	No
Ethyl violet (2390-59-2)	No	No	No	No	No	No
Calcium hydroxide (1305-62-0)	No	No	No	No	No	No
Actual concentrations proprietary						

**SARA Section 302 EHS RQ:** Reportable quantity of extremely hazardous substance, listed at 40 CFR 355.

**SARA Section 302 EHS TPQ:** Threshold-Planning Quantity of extremely hazardous substance. An asterisk (\*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 lbs.

**Section 313 Chemicals:** Toxic substances subject to annual release reporting requirements listed at 40 CFR 372.65.

**CERCLA Sec. 103:** Comprehensive Environmental Response Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center (800) 414-8802; listed at 40 CFR 302.4.

**RCRA:** Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

# MATERIAL SAFETY DATA SHEET

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Date of Issue 04/95

## MERCURY

ARIZONA INSTRUMENT LLC  
3375 N Delaware St  
Chandler, AZ 85225  
INFORMATION HOTLINE (800) 235-3360

### Product Identification:

CHEMICAL NAME: Mercury metal  
TRADE NAME & SYNONYMS: Quick Silver  
CHEMICAL FAMILY: Metals  
FORMULA: Hg  
FORMULA WEIGHT: 200.59

### Section 1 - Physical Data

---

ODOR: Odorless  
SPECIFIC GRAVITY (H<sub>2</sub>O = 1): 13.54  
VAPOR PRESSURE AT 20°C (mmHg): 0.0012  
BOILING POINT, 760 mm Hg (°C): 356.9  
MELTING POINT (°C): -38.9

### Section 2 - Fire and Explosion Data

---

FIRE HAZARD: Nonflammable  
UNUSUAL HAZARDS: Extremely toxic vapors upon exposure to high temperatures.

### Section 3 - Reactivity Data

---

STABILITY: Stable at room temperature  
INCOMPATIBILITIES AND REACTIVITIES:  
Acetylene, ammonia, chlorine dioxide, azides, calcium (amalgam formation), sodium carbide, lithium, rubidium, copper, nitric acid

### Section 4 - Leak/Spill Disposal Information

---

PRODUCT CLEAN-UP: Recover with suction cup equipped with a capillary tube.  
DISPOSAL METHOD: Perform in compliance with all current local, state and federal regulations.

### Section 5 - Health Hazard Information

---

EXPOSURE LIMIT  
0.05mg/m<sup>3</sup> (NIOSH/TWA)  
0.100mg/m<sup>3</sup> Ceiling (OSHA)

**EXPOSURE/HEALTH EFFECTS:** Coughing, bronchitis, pneumonia, tremor, insomnia, irritability, headache, fatigue, weakness, stomatitis, weight loss, GI disorder  
**SKIN & EYES:** Can irritate skin and eyes

### FIRST AID:

**SKIN:** Wash with water, get medical assistance.  
**EYES:** Wash with water, get medical assistance.  
**INHALATION:** Remove to fresh air, get medical assistance.  
**INGESTION:** Get medical assistance.

### Section 6 - Special Protection Information

---

Ventilation must be sufficient to meet TLV. Wear rubber gloves and eye protection.

### Section 7 - Special Handling and Storing Precautions

---

Do NOT heat mercury unless appropriate safety precautions for highly toxic vapors have been taken. Store in sealed container.

### Section 8 - Hazardous Ingredients

---

Mercury and Mercury vapor

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# MATERIAL SAFETY DATA SHEET

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Date of Issue 04/95

## RESISORB

ARIZONA INSTRUMENT LLC  
3375 N Delaware St  
Chandler, AZ 85225  
INFORMATION HOTLINE (800) 235-3360

### Product Identification:

PRODUCT NAME: Resisorb - Mercury Vapor  
Absorbent  
FORMULA CAS NO.: 00000-00-0  
MOLECULAR WEIGHT: .00  
CHEMICAL FORMULA: Proprietary mixture

### Section 1 - Physical Data

---

APPEARANCE & ODOR: Black solid with halogen-like odor  
BOILING POINT: N/A  
MELTING POINT: N/A  
VAPOR PRESSURE: N/A  
SPECIFIC GRAVITY: N/A

### Section 2 - Fire and Explosion Hazard Data

---

FIRE: Combustible, keep away from heat, sparks, flame.  
EXPLOSION: Contact with strong oxidizers may cause explosion.  
FIRE HAZARD: Use water spray to soak, class A extinguisher, gull protective clothing & NIOSH approved self-contained breathing apparatus, move exposed containers from fire area if it can be done without risk, if not, use water to keep fire-exposed containers cool.

### Section 3 - Reactivity Data

---

STABILITY: Stable, no hazardous polymerization  
CONDITIONS TO AVOID: Heat, flame, sources of ignition  
INCOMPATIBILITIES: Strong oxidizing agents, nitric acid, ammonia, alkali metals, strong reducing agents

### Section 4 - Leak/Spill Disposal Information

---

PRODUCT CLEAN-UP: Protective clothing & respiratory protection, scoop up spilled material, avoid dusting, flush spill area with water.  
DISPOSAL: Transfer to clean, dry container & dispose of in accordance with local, state & federal environmental regulations.

### Section 5 - Health Hazard Information

---

#### EXPOSURE/HEALTH EFFECTS:

INHALATION: May cause tightness & chest pain, coughing & difficulty in breathing.  
INGESTION: May cause nausea, vomiting, headaches.  
SKIN AND EYES: Dust may irritate skin and/or eyes.

#### FIRST AID:

INGESTION: get medical attention, if conscious, immediately induce vomiting.  
SKIN AND EYES: Immediately flush with water for 15 minute minimum; remove contaminated clothing.

### Section 6 - Special Protection Information

---

Use adequate general or local ventilation to keep fume or dust levels as low as possible. If airborne concentration is high, use respirator or dust mask. Wear rubber gloves & eye protection.

### Section 7 - Storage and Special Information

---

Keep in tightly closed container, in cool, dry ventilated area, away from heat, sparks or flame; isolate from incompatible substances.

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# MATERIAL SAFETY DATA SHEET

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## NICKEL CADMIUM BATTERY

MATSUSHITA BATTERY INDUSTRIAL  
CO  
1 Matsushita-Cho  
Moriguchi Osaka 570 JAPAN  
EMERGENCY TELEPHONE 201-392-6703  
INFORMATION TELEPHONE 714-373-7538

### Product Identification:

PRODUCT NAME: Nickel Cadmium Battery  
HAZARDOUS INGREDIENTS: Ni(OH)<sup>2</sup>, NiOOH, Cd,  
Cd(OH)<sup>2</sup>, KOH or NaOH, LiOH  
CHEMICAL FORMULA: NiCd

### Section 1 - Physical Data

---

APPEARANCE & ODOR: None  
BOILING POINT: Approximately 170°C  
MELTING POINT: N/A  
VAPOR PRESSURE: N/A  
SPECIFIC GRAVITY: 2.6

### Section 2 - Fire and Explosion Data

---

FIRE HAZARD: Under normal charging and  
discharging, no fire hazard exists.  
EXPLOSION: Under normal charging and  
discharging, no explosion hazard exists.

### Section 3 - Reactivity Data

---

STABILITY: Extremely stable  
INCOMPATIBILITIES: N/A

### Section 4 - Leak/Spill Disposal Information

---

PRODUCT CLEAN-UP: Non-toxic in normal use  
DISPOSAL METHOD: DO NOT incinerate. Dispose  
of in discharged state to avoid shorting.

### Section 5 - Health Hazard Information

---

#### EXPOSURE/HEALTH EFFECTS:

INHALATION: N/A  
INGESTION: N/A  
SKIN AND EYES: May irritate if contact is made with  
the electrolyte (alkaline).

#### FIRST AID:

INHALATION: N/A  
INGESTION: N/A  
SKIN AND EYES: Immediately flush affected area  
with cool water. If contact is made with the eyes or  
mucous membranes, immediately flush with water and  
get medical assistance.

### Section 6 - Special Protection Information

---

No special protection required in normal usage.

### Section 7 - Storing and Special Information

---

No special precautions required for storing.

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**Arizona Instrument LLC**  
**Jerome 411 Mercury Vapor Analyzer Manual**  
**Part Number: SS-101**  
**Revision D1**  
**July 1997**

If you have any questions regarding the operation of this instrument, please call our toll free number (800) 235-3360. Internationally, call (602) 470-1414 or fax (602) 470-1888.

Arizona Instrument LLC  
3375 N Delaware St  
Chandler, Arizona 85225 USA

<http://www.azic.com>  
email:  
[azi@azic.com](mailto:azi@azic.com) - General  
[intl@azic.com](mailto:intl@azic.com) - International  
[support@azic.com](mailto:support@azic.com) - Customer Support