### Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 PURPOSE AND SCOPE</td>
<td>3</td>
</tr>
<tr>
<td>1.1 Purpose</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Scope</td>
<td>3</td>
</tr>
<tr>
<td>2.0 INFORMATION</td>
<td>3</td>
</tr>
<tr>
<td>2.1 Terms and Definitions</td>
<td>3</td>
</tr>
<tr>
<td>2.2 General Information</td>
<td>4</td>
</tr>
<tr>
<td>3.0 PRECAUTIONS AND LIMITATIONS</td>
<td>4</td>
</tr>
<tr>
<td>3.1 Personnel Safety</td>
<td>4</td>
</tr>
<tr>
<td>3.2 Equipment Safety</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Document No.</th>
<th>Rev/Mod</th>
<th>Release Date</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROUTINE</td>
<td>TF-OPS-IHT-023</td>
<td>B-4</td>
<td>08/06/2018</td>
<td>1 of 19</td>
</tr>
</tbody>
</table>

### CHANGE HISTORY (≤ LAST 5 REV-MODS)

<table>
<thead>
<tr>
<th>Rev-Mod</th>
<th>Release Date</th>
<th>Justification</th>
<th>Summary of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-4</td>
<td>08/06/2018</td>
<td>Industrial Hygiene Request</td>
<td>Added additional instrument information in 2.2. Changed warnings in 3.1 to WARNINGS rather than steps. Incorporated warnings and safety concerns from previous Attachment 1 into document. Amended radiation control section to remove mention of sampling. Added Software Installation procedure to 4.1. Amended steps discussing %D to clarify &quot;the absolute value of %D&quot;. Incorporated information from DRI procedure TF-OPS-IHT-007 regarding alarm response and use of tubing. Updated records section. Provided general corrections to improve flow of document, accurately reflect work being performed in field, and eliminate any loopholes/traps/redundancies. Addressed comment to generalize location in NOTE above 5.1.28. Added statement in 2.2 General Information to direct IHTs on what to do if operating outside instrument parameters</td>
</tr>
<tr>
<td>B-3</td>
<td>03/20/2018</td>
<td>Industrial Hygiene Request</td>
<td>Modified “Radiological and Contamination Control” section to update correct usage and size of radiation contamination filters for this instrument. Added a “Figure” to procedure that displays picture of filter housing orientation for this instrument.</td>
</tr>
<tr>
<td>B-2</td>
<td>10/10/2017</td>
<td>Industrial Hygiene Request</td>
<td>Modified “Radiological and Contamination Control” section to current standard.</td>
</tr>
<tr>
<td>B-1</td>
<td>10/12/2016</td>
<td>Records Management request</td>
<td>Updated records section</td>
</tr>
<tr>
<td>B-0</td>
<td>07/14/2016</td>
<td>Periodic Review</td>
<td>Changed Section 2.2- T90 sensor response time switched to 20 seconds from 10 seconds.</td>
</tr>
</tbody>
</table>
3.3 Radiation and Contamination Control .................................................. 5

4.0 PREREQUISITES ....................................................................................... 7
4.1 Performance Documents ....................................................................... 7
4.2 Field Preparation .................................................................................. 7

5.0 PROCEDURE .......................................................................................... 8
5.1 Operation of the Lumex RA-915M ....................................................... 8
5.2 Records .................................................................................................. 16

Attachment 1 – Screen Definitions ............................................................. 17

Figure 1 Filter House Orientation ............................................................... 19
1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this procedure is to ensure the proper use of the Lumex RA-915M inorganic mercury vapor analyzer in support of field monitoring performed in accordance with TF-OPS-IHT-007 and an industrial hygiene sampling plan.

1.2 Scope

The scope includes function testing, use and data logging.

2.0 INFORMATION

2.1 Terms and Definitions

Zeeman correction – named after Nobel laureate Pieter Zeeman, a Dutch physicist who experimented with the use of magnetism to produce polarized light that is now applied to minimize absorption interferences in the detection of chemical contaminants.

“On Stream” mode – using the Lumex for general industrial hygiene surveys for inorganic mercury in air.

“Monitoring” mode - using the Lumex for measuring inorganic mercury in air using the multi-path cell with periodic zero checks and data logging the results.

“Protocol” mode – this mode is useful if measurements are recorded manually without data logging.

Zero correction time – time it takes in seconds to zero the Lumex.

Frame time – time it takes in seconds to take an average reading.

“Test” mode – using the Lumex to function test it.

Analyzer performance – function test.

NOTE – See Attachment 1 for an explanation of additional terms.
2.2 General Information

The Lumex RA-915M analyzer should be operated within the following parameters:

- Temperature: 34 to 104 °F
- Relative humidity: ≤ 95 % at 95 °F, non-condensing
- Accuracy: ± 20 %
- Concentration range: 2 – 200,000 ng/m³ (multi-path cell)
- T 90 sensor response time: 20 sec. (max)
- Power: 8 hrs. of continuous operation, 5 hrs. charge time
- Warm-up time: 20 min.
- Data log capacity: 121 hours with 10 second averaging.

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Personnel Safety

WARNING - The analyzer generates ultraviolet light and disassembling the instrument may result in exposure to unprotected eyes and skin.

WARNING - Care should be used in carrying and using the instrument with the hose probe attached since it can present an eye hazard.

WARNING - Instrument weighs 7 kg (15.43 lbs) and can be unwieldy. Exercise care when lifting or carrying the instrument

3.2 Equipment Safety

NOTE - The following cautions are applicable throughout the entire procedure.

CAUTION - Failure to use care when handling, carrying and transporting this instrument may damage the optical mirrors in the analyzer.

CAUTION - Failure to maintain this instrument a minimum distance of 1 meter from heating devices and heat sources may result in damage to the instrument.

CAUTION - Using this instrument without absorption and dust filters in place and working in dusty ambient air may result in damage to the instrument.
3.3 Radiation and Contamination Control

3.3.1 Planned work in radiological areas must be approved by Radiological Control personnel per the Radiological Risk Screening procedure TFC-ESHQ-RP-RWP-C-01.

3.3.1.1 When performed without a formal work package or approved procedure (i.e., Level 3 or 4 work), this procedure is limited to radiological areas and work activities permitted by a low risk Radiological Work Permit (RWP).

3.3.2 Filtration requirements for air monitoring equipment.

- The filter membrane is bonded to a polyethylene backing layer, thus keeping the orientation as taken off the stack of filters is important. The filter membrane should be maintained at the same direction. The Teflon side has a slightly frosted appearance, with the polyethylene backing having a “weave” or paper-like grain.
- Two 47mm filter housings with a 2-3 micron 47mm radiological particulate filter membrane. When monitoring in a Contamination Area (CA), High Contamination Area (HCA), or Airborne Radioactivity Area (ARA) or unfiltered tank systems. Not required, but encouraged in posted Radiological Buffer Areas (RBA). See Figure 1 Filter House Orientation for display of two-filter orientation.
- The use of parallel, sacrificial sorbent tubes or sample media, or multiple filters may be necessary depending on intended use and equipment parameters. A specific radiological Release Survey Plan (RSP) would need to address this allowance.

3.3.3 Before conducting sampling or monitoring, contact the responsible Radiological Control personnel for the facility or area to determine any specific survey or monitoring requirements.

- Pre, during, and post contamination survey requirements.
- Any applicable RSP’s for your specific equipment or task.
- Alternative survey or monitoring needs to support the radiological release survey process.
3.3 Radiation and Contamination Control (Cont.)

3.3.4 Comply with the requirements set forth by the RWP, HPT coverage, Release Survey Plan (RSP), and any other applicable procedures as determined above.

3.3.5 When exiting radiological areas where no HPT coverage was provided, inform the radiological control personnel of the use/history for the equipment being presented (e.g., only sampled air in the Contamination Area, No known history of contamination based on use, etc.) to aid them in properly evaluating the radiological release criteria needed.
4.0 PREREQUISITES

4.1 Performance Documents

The following documents may be needed to perform this procedure:

- Lumex “Operation Manual” for model RA-915M
- TFC-BSM-IRM_DC-C-02, “Records Management”
- TFC-ESHQ-S_IH-C-46, “Industrial Hygiene Reporting and Records Management”
- TFC-ESHQ-RP_RWP-C-03, “ALARA Work Planning”
- TF-OPS-IHT-007, “Using Direct Reading Instruments.”
- TFC-BSM-IRM_HS-C-09, “Software Administrative Installation.”

4.2 Field Preparation

4.2.1 PERFORM a review of the applicable industrial hygiene sampling plan prior to execution of this procedure.

4.2.2 PERFORM a review of Attachment 1 prior to operating the Lumex.
5.0 PROCEDURE

5.1 Operation of the Lumex RA-915M

NOTE - Steps in this section can be performed in any logical order. Sections may be performed sequentially, concurrently or any logical order.

5.1.1 CHECK maintenance calibration date on sticker is current.

5.1.1.1 IF calibration is past due, RETURN applicable instrument to equipment custodian with a completed green tag, i.e., “IH Instrument Service Tag” (BT-6004-019) indicating “Scheduled Maintenance Calibration” is needed.

5.1.2 PERFORM daily visual inspection to verify that there is no physical damage of the analyzer housing and its parts, e.g., inlet/outlet ports, display.

5.1.3 CHECK that hose and inlet/outlet ports are undamaged and securely fastened.

5.1.4 IF there is any physical damage to the analyzer housing, hose, inlet/outlet ports, or display, RETURN the equipment to the custodian with a completed green tag, i.e., “IH Instrument Service Tag” (BT-6004-019) indicating Broken Part.”
5.1 Operation of the Lumex RA-915M (Cont.)

5.1.5 ATTACH the air intake hose to the base unit as follows:

5.1.5.1 PRESS down on the quick disconnect AND

INSERT the yellow banded hose onto the upper yellow banded inlet (labeled with an up arrow).

5.1.5.2 RELEASE the quick disconnect AND

GENTLY TUG on it to check tightness.

5.1.6 TURN the instrument ON by pressing the ON/OFF button on the control panel for 1 to 2 seconds.

5.1.6.1 VERIFY that the model number, serial number, software version, time/date, battery charge level, and manufacturer’s name appear on the screen when the instrument is turned on.

NOTE - Battery life is indicated in the 20% increments of shading. The battery icon is in the upper right-hand corner of the display.

5.1.7 CHECK battery life is sufficient for the duration of the survey.

5.1.7.1 IF battery life is not sufficient, CHARGE the instrument by connecting charger to the charging jack, located on the lower left corner on the back of the meter to an A/C outlet.

5.1.8 PRESS the “ENT” button to make the “Main Menu” window appear.

5.1.9 USE arrow cursor on the “Main Menu” window to highlight “On Stream” command.

5.1.10 ALLOW the analyzer to warm up for 20 minutes.

Verify Instrument Settings

NOTE - Attachment 1 contains a description of the operating parameters and “Main Menu” commands.

5.1.11 WHILE the instrument is warming up, CHECK the settings as follows:

5.1.11.1 USE the UP control button to select the “Settings” command under the “Main Menu” AND

PRESS “ENT”.

5.1 Operation of the Lumex RA-915M (Cont.)

5.1.11.2 IF data logging, SELECT “Time/Date”, by using the down control button AND

PRESS “ENT”.

5.1.11.3 PRESS “ENT” button to select the digit to be changed.

5.1.11.4 SET time/date by pressing the up UP/DOWN control buttons to the correct value.

5.1.11.5 SAVE the changes by pressing the "ESC" key.

5.1.12 IF required by the IH sampling plan, SET "Parameters" as follows:

5.1.12.1 USE the UP/DOWN keys AND

SELECT “Parameters”.

5.1.12.2 PRESS “ENT”.

5.1.12.3 CHOOSE the parameter to change using the UP/DOWN control buttons AND

PRESS “ENT”.

5.1.12.4 USE the UP/DOWN control buttons to change the value AND

PRESS “ENT”.

OR

USE the "ENT" key to select the digit to be changed AND

USE the UP/DOWN control buttons to change the value.

5.1.12.5 WHEN changes are completed, PRESS “ENT” to save the value.

5.1.12.6 USE the UP/DOWN keys to choose the next parameter to change.

5.1.12.7 REPEAT Steps 5.1.12.3 through 5.1.12.6 to make additional changes.

5.1.13 AFTER setting all the parameters, PRESS the “ESC” button once.
5.1 Operation of the Lumex RA-915M (Cont.)

5.1.14 USE the UP/DOWN control buttons AND

SELECT the necessary command:
- “Save”: Saves all of the changes made
- “Cancel”: Does not save changes in the parameter menu
- “Default”: Set the default parameters for the current session.

5.1.15 PRESS “ENT” to select command.

5.1.16 PRESS "ESC" key to access the “Main Menu”.

**Perform Function Test**

NOTE - The “Test” command is used for function testing.

5.1.17 SELECT “Test” in the Main Menu by using the UP/DOWN control buttons AND

PRESS “ENT”.

NOTE - The turbo pump will turn on and a zero check will occur for 40 seconds (default value). Then the screen will display "Zero Check Please wait remaining ____". At the end of the pre-set time, the screen will display test mode i.e. “TM” in the upper left corner of the display.

5.1.18 ALLOW the analyzer to run for about 45 seconds, noting the “D” value in the lower left corner.

5.1.19 IF the absolute value of the relative deviation value (“D”) is less than 25% (-25% ≤ D ≤ 25%), USE the instrument.

5.1.20 IF the absolute value of the relative deviation value (“D”) is more than 25% (D < -25% or D > 25%), TROUBLESHOOT AND

REPEAT the function test.
5.1 Operation of the Lumex RA-915M (Cont.)

5.1.21 IF the instrument does not obtain an absolute value of less than 25% after another attempt, CHECK ambient temperature is within 59 to 77°F.

5.1.21.1 IF the instrument is not located in a location where the ambient temperature is within 59 to 77°F, either MOVE the instrument to a location within the temperature range

OR

EXTEND the relative deviation value by ± 0.5 (20%) for each 18°F change.

5.1.22 IF relative deviation value is within tolerance, RECORD reading in the Site Wide Industrial Hygiene Database (SWIHD).

5.1.22.1 IF instrument is within temperature range and still does not obtain an absolute value less than 25%, RETURN the equipment to the custodian with a completed green tag “IH Instrument Service Tag” (BT-6004-019) indicating “Function Check Failure” AND

OBTAIN another instrument.

5.1.23 PRESS “ESC” to access the “Main Menu” AND

RETURN to the “Main Menu”.
5.1 Operation of the Lumex RA-915M (Cont.)

NOTE - Steps 5.1.24 through 5.1.40 in this section can be performed in any logical order. Sections may be performed sequentially, concurrently or any logical order.

Conduct the “On Stream” zero baseline initialization outside the Tank Farm, if applicable, to minimize potential mercury exposures from emission points connected to the headspace of the tanks.

5.1.24 **SELECT** the “On Stream” command using the UP/DOWN control buttons.

5.1.25 **PRESS** the “ENT” button.

NOTE - “Zero Check Please wait remaining ___” will be displayed on the screen and a zero check will occur for 40 seconds (default value). On the completion of the zero signal measurement, the window of operation in the “On Stream” mode, i.e., “SM”, will appear in the upper left corner of the display.

- Readings will commence with an update every second (“S”) or every 10 seconds (“S”), depending on how the parameters were previously set.

- The battery life may be extended by using the down arrow to switch off the pump during pauses in a work activity and the up arrow to restart the pump to perform sampling.

- The “A” warning may appear during the operation in the “SM” mode. This means that the mercury vapor concentration in the air exceeds the preset alarm limit.

- The low radiation warning “●” may indicate a faulty UV lamp. In this case, the measurement is assumed to be invalid and it should be repeated.

5.1.26 **ENSURE** that the meter has a minimum flow rate of 1 Lpm by **CHECKING** with a primary flow calibrator at the inlet ahead of any filters installed.

5.1.27 **WHEN** performing remote monitoring, **USE** Teflon™-coated Tygon® tubing because some gases/vapors can be absorbed by uncoated plastic tubing and result in less accurate readings.

5.1.28 **PERFORM** monitoring in accordance with industrial hygiene sampling plan, work package, and/or IH direction.
5.1 Operation of the Lumex RA-915M (Cont.)

NOTE - If temperature of sampling location will be < 34°F, a bag sample may be taken and analyzed at a location > 34°F (such as change trailer, lab, etc.). The sample should be allowed 10 minutes to equilibrate to ambient temperature before taking a reading.

5.1.29 RECORD the “S” value for your reading unless otherwise directed by IH.

5.1.30 RECORD all field data in accordance with TFC-ESHQ-S_IH-C-46.

5.1.31 IF performing source monitoring and an action level is reached, SWITCH to breathing zone monitoring instead of immediately going to alarm response contained in 5.1.32.

5.1.32 IF an action level is still exceeded, proceed to alarm response steps contained in 5.1.33.

5.1.33 IF an instrument reading exceeds action limits as contained within the IHSP or as directed by IH:

5.1.33.1 STOP and PLACE work in safe configuration.

5.1.33.2 NOTIFY workers to move upwind AND CONTACT FWS and cognizant IH.

5.1.33.3 EVALUATE the source of the alarm.

5.1.33.4 FOLLOW corrective actions given by IH or contained within Industrial Hygiene Sample Plan

5.1.33.5 CLEAR AND RESET alarms before allowing workers to resume work.

5.1.33.6 IF additional information is needed, REFER to instrument-specific procedures and operation manuals.
5.1 Operation of the Lumex RA-915M (Cont.)

5.1.34 WHEN monitoring activities are complete, PERFORM a post-function test by following the instructions in Steps 5.1.7 through 5.1.18.

5.1.35 IF the analyzer does not indicate a relative deviation value $D$ (%) with an absolute value of less than 25%, INFORM the equipment custodian and the Project Industrial Hygienist.

5.1.36 RECORD readings and post function check results in the Site Wide Industrial Hygiene Database (SWIHD).

5.1.37 PRESS “ESC” button.

5.1.38 PRESS the ON/OFF button on the top panel for at least 4 to 5 seconds to turn off the instrument.

NOTE - A unit with a discharged battery should not be stored for more than 10 days to avoid permanent damage. The battery is charged when the analyzer is connected with the transformer. If it is only necessary to charge the battery without making measurements, the power should be left in the off position. It takes 5 hours to charge a dead battery but longer charging time does not cause damage to the battery. The fully charged battery provides continuous operation of the analyzer for approximately 8 hours. The battery may be charged while the Lumex is in use using line power. In the display, the battery icon will indicate it is being charged by “filling up”.

5.1.39 CHARGE the monitor by plugging the AC cord into the charging jack located in the lower left-hand corner of the back panel.

5.1.40 PROVIDE completed field documentation to the Project Industrial Hygienist within 2 working days.
5.2 Records

Data and attachments are entered into the Site-Wide Industrial Hygiene Database and when reviewed and completed by the Industrial Hygienist, are uploaded to IDMS via an automated interface.

The record custodian identified in the Company Level Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Attachment 1 – Screen Definitions

1. **“Settings” mode**: The “Settings” command is intended for setting the operation parameters.

   A. Select the “Parameters” command if you want to change the measurement variables. The “Parameters” window will appear with the following window selections:

   1) **“Zero Corr. Time” (sec)**: The zero correction time is a period of time during which the level corresponding to the zero mercury vapor concentration in the analytical cell is measured over a range of 40 to 255 sec. The default value is 40 sec.

   2) **“Frame Time” (sec)**: The frame time is a period of time during which an analytical signal is averaged over a range of 1 - 600 sec. The default value is 10 sec.

   3) **”Monit. Duration”**: The time of measurement in the monitoring mode and ranges from 3 minutes to 99 hours and 59 minutes. Default value is 30 minutes.

   4) **“Zero check in”**: In the monitoring mode, the period of time between 2 consecutive checks of the zero signal. Range is 5 to 30 minutes and default value is 10 minutes.

   5) **“Alarm Limit” (ng/m³)**: The alarm limit is the value of the mercury vapor concentration in the analytical cell above which the blinking "A" warning symbol appears on the screen and a sound alert is produced. The range is 1 – 50,000 ng/m³ and the default value is 100 ng/m³.

   B. **“Sound”**: When activated, Lumex will produce a sound when any button on the control panel is pressed, preset alarm level is exceeded, or battery is discharged.

   C. **“STP normal.”**: Enables recalculation of the mercury vapor concentration for standard temperature and pressure; i.e. 20° C and 760 mm mercury.
2. **“On Stream” mode:** The “On Stream” command is used for measuring the mercury vapor concentration in the air.

<table>
<thead>
<tr>
<th>SM</th>
<th>Name of the measurement mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td><strong>Current value</strong> of the mercury vapor concentration in the air sample. It is displayed at a repetition rate of once per second and is measured in ng/m$^3$.</td>
</tr>
<tr>
<td>Si</td>
<td><strong>Mean value</strong> is the average mercury vapor concentration determined during the frame or averaging time. It is displayed once per the averaging time and is measured in ng/m$^3$.</td>
</tr>
<tr>
<td>A</td>
<td>The mercury vapor concentration in the air exceeds the preset alarm limit.</td>
</tr>
</tbody>
</table>

3. **“Test” mode:** The “Test” command is intended for checking the analyzer performance, i.e. function check.

<table>
<thead>
<tr>
<th>TM</th>
<th>Name of the measurement mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td><strong>Current value</strong> of the mercury vapor concentration in the test cell. It is displayed at a rate of once per second.</td>
</tr>
<tr>
<td>Sk</td>
<td><strong>Calculated value</strong> is the computed mercury vapor concentration in the test cell, which depends on the temperature of the test cell.</td>
</tr>
<tr>
<td>Si</td>
<td><strong>Mean value</strong> is the average mercury vapor concentration determined during the frame or averaging time.</td>
</tr>
<tr>
<td>D (%)</td>
<td><strong>Deviation</strong> is the relative deviation of the measured value of the mercury vapor concentration in the test cell from the calculated value.</td>
</tr>
</tbody>
</table>

4. **“High Conc.” (HC) mode:** High concentrations measurement mode. This command is intended for determination of the mercury content in atmospheric air if the mercury concentration is between 10 to 2,000 ug/m$^3$. In this case, the mercury vapor concentration is measured in the single-path cell compartment with the air pump off. In this mode, the air is exchanged by convection only. When this mode is selected, a window similar to that for the “On Stream” mode appears with the same designations, except for the name of the operation mode, i.e., “HC.” The zero signal can be measured outdoors in the open air and away from any mercury source $\geq 0.5$ ug/m$^3$. 
Figure 1 Filter House Orientation