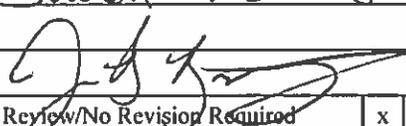


7 - FUME HOOD 2 – MERCURY TRANSFER

Title: Hood 2 – Mercury Transfer

Doc. No. 2015-MMTS-7

Approval Signatures and Date

Prepared/Reviewed by:		Date: 10/29/15
Approved by:	Burton Packard	Date: 10/29/15
Approved by:		Date:
Approved by:		Date: 10/29/15
<input type="checkbox"/> Initial Release	<input type="checkbox"/> Annual Review/No Revision Required	<input checked="" type="checkbox"/> Annual Review/Update (see history below)

NOTE: This document will be reviewed at least annually to ensure its suitability.

Revision History

Rev. No.	Change description	Author
2	Refer to “Accommodate Lessons Learned – Following the IPR and August 24 th Operations July 10, 2015-Review Completed August 6, 2015”, “MMTS Operating Changes from Initial Operations Conducted in September 2015- October 13, 2015” and “MMTS Operating Changes from Initial Operations Conducted in June and August 2015- September 24, 2015”.	Burton Packard and Renee Rodriguez
1	Change description Crosswalk Between NDEP CAPP Review Comments (dated 2014-12-09, 2015-01-30 and 2015-02-26) and Mercury Storage and Transfer Program Document Contents March 10, 2015	Burton Packard and Renee Rodriguez

NOTE: Hard copies of this document may not be the current version. Refer to the “IAmTheKey” to verify the current version.

Reference Documents

Document number	Document title
Procedure 2015-MMTS-2	Metric Ton Container Set Up
Procedure 2015-MMTS-6	Fume Hood 1 – Mercury Access
Procedure 2015-MMTS-12	Emergency Response and Spill Cleanup
Procedure 2015-MMTS-15	Inspection, Testing and Maintenance
Procedure 2015-MMTS-20	Mercury Medical Surveillance

7.1 PURPOSE

This procedure describes operations under Fume Hood 2 for pumping mercury from 76-lb flasks into MT containers.

NOTE: Other flask handling operations under a fume hood that interface with Mercury Transfer Operations are covered in Procedure 2015-MMTS-6, "Fume Hood 1 – Mercury Access."

7.2 SCOPE

This procedure covers Fume Hood 2 activities for the worker in the Flask Handling Area. These activities include:

- Set up and operation of the peristaltic pump.
- Inserting and removing the stainless steel siphon tube into and out of 76-lb storage flasks.
- Using the Adjustable Flask Holding Fixture, if needed, to minimize mercury retained in a flask
- Placing emptied flasks, inverted, into the shaker tray.
- Siphoning mercury that was collected in the shaker tray.
- Plugging, bagging, and placing emptied flasks into the nonhazardous waste drum.

7.3 FLOWCHARTS

Section 9.10, Attachment 1 shows work locations in the fume hood, related equipment and movement of conveyer trays.

7.4 OPERATIONS

7.4.1 Required Equipment and Supplies (PPE as specified on page XI of the Executive Summary under General Safety and Health)

The workers need the following supplies for operations described in this procedure:

- Rubber plugs (to substitute for a steel plug that cannot be inserted into a flask)
- Tube clamps
- Hand-held mirror

7.4.2 System Startup

At the start of the workday, the Flask Handling Area worker shall:

- Follow the startup instructions in Section 6.3.2.
- Verify that there are sufficient trays with filled flasks available to begin operations.

- Visually inspect the work area within the fume hood, and ensure that the flexible tubing connections inside and outside the fume hood, and at the quick disconnect (QD) transfer fitting are snug and leak free.
- Verify that the QD transfer fitting is properly connected to a metric ton (MT) container.
- Verify that non-hazardous waste drums are available for accumulation of emptied flasks.
- Verify that a hazardous waste drum is available (in the Drum Handling Area) for disposing of personal protective equipment.
- Place the flexible tubing into the pump head at a location approximately 2-inches away from the markings made the previous workday; replace the Plexiglas® cover over the peristaltic pump and flexible tubing. Test the operation of the peristaltic pump.
- Ensure that PCDAS and MMS-16 are functioning correctly. If not, consult the operating manuals.
- Remove loosened plugs from a tray of flasks if that task has not already been done. Place the plugs in the available container where they are ready to be replaced into the flasks.
- Power on the peristaltic pump using the switch at the left-side rear of the pump.

NOTE: The Facility Manager shall be notified if any of the above checks are not satisfactorily met, and cannot be corrected by the worker.

7.4.3 Mercury Transfer Operations

The Flask Handling Area worker shall:

- Using a clipboard, a pen and form ORNL/MMTS/FHR-1 (see §7.6, Attachment 7.3), record the designated weights and times for the tare weight and the MT container into which mercury is pumped. Retain the filled-out form in the MMTS Computer Room as a record of daily activities.

NOTE: A scanned electronic record copy of form ORNLMMTSFHR-1 should be retained by the Facility Manager.

NOTE: The gross weight recorded for the MT container should be taken from the PCDAS display after the filled MT container has been lifted, the scale has been re-zeroed, and the MT container has been placed back on the scale.

- Move one or more six-pack trays into Fume Hood 2 (refer to Section 7.6, Attachment 7.1) and lock the tray using the down-lock fittings.
- Enter information for this MT container, pallet, drum, and flask six pack tray into the FILLING INFORMATION screen of the wireless handheld data input unit (see description in Section 13.8, pages 13-7,13-11 and 13-12). This action should be performed by an operator who is working outside Fume Hood 2 and is wearing a clean pair of gloves.

NOTE: The six-pack tray is called a carrier in the description in Section 13.8.

- The Facility Manager enters the originating warehouse information on the FILLING INFORMATION screen using either the PCDAS computer or a wireless handheld data input unit.
- Remove the loosened plugs from a tray of flasks; place the plugs in the available storage container where they will be ready for reinstallation into the flasks before disposal.
- Insert the stainless steel siphon tube into the bottom of flask no. 1, holding the siphon tube with a gauze wipe wrapped around the neck of the flask.
- Activate the pump using the foot-operated switch.

NOTE: After suction has been "lost" and mercury is no longer being siphoned, the operator is expected typically to consider the flask to be "empty." If the operator has reason to believe that the mercury dregs in the flask may not be minimized, the Adjustable Flask Holding Fixture may be used to assist with achieving an "empty" flask (see the following steps for using the adjustable Flask Holding Fixture).

- Using the Adjustable Flask Holding Fixture
 - Move the currently used six-pack tray to the back of Fume Hood 2
 - Position and lock the Adjustable Flask Holding Fixture at the location vacated by the sixpack tray
 - Using caution to ensure the siphon tube remains in the flask, move the flask from the six-pack tray to the Adjustable Flask Holding Fixture
 - Adjust the Adjustable Flask Holding Fixture to maximize access to the mercury.
 - Activate the pump using the foot-operated switch.
 - After suction has been "lost" and mercury is no longer being siphoned, the operator is to consider the flask to be "empty." The operator follows the directions for removing the siphon tube.
 - After placing the "empty" flask in the vibration tray, the positions of the Adjustable Flask Holding Fixture and the six-pack tray are swapped and normal operations are resumed.

Continue pumping while the siphon tube is removed slowly from the flask. Pull the siphon tube through the gauze wipe to capture small beads of mercury adhered to the siphon tube. As the tube is raised, the mercury in the flexible tubing loop will pass through the pump rollers thereby minimizing the amount of mercury that would fall back into the flask. Move the siphon tube into flask no. 2 with the gauze held over the siphon tube end and repeat the pumping process. Repeat until all flasks have been emptied. Turn off the pump after the mercury in the tube loop has passed through the pump head. Place the gauze wipe into a sealable polyethylene bag and into the small hazardous waste accumulation receptacle within the fume hood. The bag is to be disposed of as hazardous waste at the end of each day.

NOTE: Each “emptied” flask may contain up to 10 ml of mercury, most of which is expected to be collected at the shaker tray.

- Using a clipboard and pen, record the scale weight (ending weight) after the mercury in all the flasks in the flask six pack tray has been transferred. Compare the difference between the ending weight and the beginning weight with the table of acceptable weights and weight differences. Move the siphon tube into the next flask with the gauze, cheesecloth or equivalent held over the siphon tube end.

NOTE: The typical weight difference will be 456 lbs. (6 flasks at 76 lbs. of mercury per flask). The final tray will contain only five flasks (29 flasks per MT container). The typical weight difference for the final tray will be 380 lb. (5 flasks at 76 lbs. of mercury per flask). If at any time the weight difference is not within 6 lbs. of the typical value (within 5 lbs. for the final tray that only contains 5 flasks), notify the Facility Manager. Do not proceed without the approval of the Facility Manager.

- The worker who is operating the shaker tray should wear hearing protection. With care, manually invert the six (6) emptied flasks into the shaker tray. (See Section 7.6, Attachment 7.1, for a diagram of the work positions and other pertinent equipment arrangements). Activate the shaker tray and vibrate the emptied flasks while the next tray is being emptied of mercury; 30-60 seconds of shaking will be sufficient.
- Release the down-lock fittings of the now empty six-pack tray and move that tray to an open space under the fume hood and move the next six-pack tray of flasks containing mercury to the pumping station.

7.4.4 Dispose of Emptied Flasks

After the emptied flasks have been inverted and “shaken” under the fume hood to remove small quantities of remaining mercury a Flask Handling Area worker removes each flask one at a time from the shaker tray and

- Reinstalls an appropriately sized steel plug to contain residual vapors.

NOTE: Two workers are required for bagging and disposing of empty flasks.

- A worker with clean gloves places a 3-mil re-closable slider zip polyethylene bag, 18-in. wide × 20-in. tall into the “single flask” bagging station so that placing the flask into the bag, and sealing the bag is simplified.
- A different worker (the one who has removed the flask from the shaker tray and reinstalled a steel plug) places each flask into the re-closable slider zip polyethylene bag. This worker is wearing gloves that may have contacted microdroplets of mercury.
- The worker with clean gloves closes the bag, seals it, carries the bagged flask to the 30-gallon non-hazardous waste drum and places it in the drum.

NOTE: With assistance of MMTS supervisor, a Flask Handling Area worker arranges for a pallet of empty waste drums when needed.

7.4.5 Resume Mercury Transfers

- Before resuming mercury transfers from the next tray, inspect the shaker tray for an accumulation of mercury/crud using a hand held mirror. Siphon the accumulated material if necessary.
- Move the next six-pack tray of full flasks to the pumping station and repeat the transfer process for the second tray. Operator with clean gloves updates drum and six-pack tray data in the wireless handheld data input unit.
- After flasks from the second tray are placed in the shaker tray, position both empty trays so that they can be moved out of the fume hood and bring in two (2) full trays for mercury transfer.
- Following the actions in Sections 7.4.4 and 7.4.5, repeat the entire mercury transfer and flask disposal process until the MT container is filled with the contents of 29 flasks.

NOTE: Prior to leaving the MMTS for work breaks and lunch, ensure that the ventilation system is operating, the peristaltic pump is turned off, compression on the flexible tubing is released from the peristaltic pump head, loops in the flexible tubing are emptied of mercury, the doors to the fume hoods are closed and operating snorkels left in use for venting are positioned to not pose safety hazards to returning workers.

NOTE: Before all breaks, including lunch, and at the end of each workday, the Flask Handling Area operator transferring mercury ensures that there is no mercury in the tubing loops, turns off the peristaltic pump power switch located at the left-side rear of the motor-controller, and opens the pump head to release the roller compression on the flexible tubing. Ensure the Plexiglas® cover is over the peristaltic pump and flexible tubing before pumping resumes.

Shutdown operations at the close of each workday are specified for the Drum Handling Room in Procedure §§6.3.2 and 7.4.9 and for the Flask Handling Room in Procedure §§2.3.3, 4.3.6 and 5.3.4.

NOTE: If the “high mercury vapor alarm” is set off while pumping operations are under way, the worker shall immediately shut down the pump operation, close the fume hood, and await instructions from the Facility Manager. Pumping may resume upon direction by the Facility Manager.

NOTE: Additional snorkel venting is available using the cart-mounted portable snorkel (Airfiltronix® or equivalent) that contains replaceable sulfur-impregnated charcoal filters.

7.4.6 Off Normal Event – Burst Flexible Tubing

If the flexible tubing should burst (a very unlikely event), the Flask Handling Area worker

- Immediately shuts off the peristaltic pump.
- Closes the fume hood sash.
- Notifies the Facility Manager

- Follows the instructions in Procedure 2015-MMTS-14, “Emergency Response and Spill Cleanup.”
- After the cleanup activities, follows the instructions in 2015-MMTS-15, “Inspection, Testing and Maintenance” for replacing the flexible tubing and disposing of the burst tubing as hazardous waste.

7.4.7 Off Normal Event – Clogged Flexible Tubing

If the Tygon® becomes clogged (a very unlikely event), the Flask Handling Area worker

- Immediately shuts off the peristaltic pump.
- Closes the fume hood sash.
- Notifies the Facility Manager
- Follows the instructions in 2015-MMTS-15, “Inspection, Testing and Maintenance” for replacing the flexible tubing and disposing of the clogged tubing as hazardous waste.

7.4.8 Off Normal Event – Pump Damaged

- If the peristaltic pump breaks and damages the flexible tubing such that there is a breach, the Flask Handling Area worker:
 - Immediately shuts off the peristaltic pump.
 - Close the fume hood sash.
 - Notifies the Facility Manager
 - Follows the instructions in Procedure 2015-MMTS-12, “Emergency Response and Spill Cleanup.”
 - After the cleanup activities, follows the instructions in 2015-MMTS-15, “Inspection, Testing and Maintenance” for replacing the flexible tubing.
 - Installs spare pump and tubing to resume operation.
- If the peristaltic pump should break such that it does not damage the flexible tubing, the Flask Handling Area worker:
 - Immediately shuts off the peristaltic pump.
 - Notifies the Facility Manager
 - Installs spare pump to resume operations.
 - Disposes of the pump and parts by packaging in a large zip lock or twist tie polyethylene bag. Sends the waste back through the Fume Hood 2 door to Fume Hood 1, and then to the conveyor table for placement in the hazardous waste drum.

7.4.9 System Shutdown

- At the conclusion of workday operations, the Flask Handling Area worker (operator) checks for any equipment operations issues and inspects equipment for mercury contamination/sludge, reporting results to the Supervisor.
- For final shutdown for the day, the operator:
 - Places the siphon tube into the collection port on the shaker tray to siphon mercury that has been collected from “emptied” flasks.
 - Verifies that the peristaltic pump is turned off after pumping operations are completed using the power switch located at the left-side rear of the peristaltic pump motor-controller, and that the siphon tube is secured upside down in its storage position.
 - Marks both ends of the flexible tubing, where the tube exits the pump head, with a permanent marker and opens the pump head. (At the start of the next workday the operator places the tube into the pump head at a location approximately 1-inch away from the markings.)
 - Cleans up any residual sludge in the shaker tray, packages it in a slider zip polyethylene bag along with any contaminated cleaning supplies and PPE (all the hazardous waste accumulated during the workday), and moves that bag in an empty tray back through Fume Hood 2, Fume Hood 1, and the conveyor table to the hazardous waste drum in the pallet/drum handling area.
 - Verifies that the quick disconnect fitting remains properly installed in a MT container or is securely placed into its storage holder at the end wall of Fume Hood 2 (for location of the storage holder see Section 7.6, Attachment 7.2).
- All fume hood doors should be closed prior to leaving the fume hood unattended.

7.5 RECORDS

- Database entry for the number of flasks emptied during a workday.
- Operating log of equipment problems and resolution.
- Up-to-date inventory tracking spreadsheets showing all mercury moves from the beginning to the end of the workday. Daily tracking spreadsheet information should include the original warehouse, pallet and drum numbers associated with the mercury pumped into each MT container.

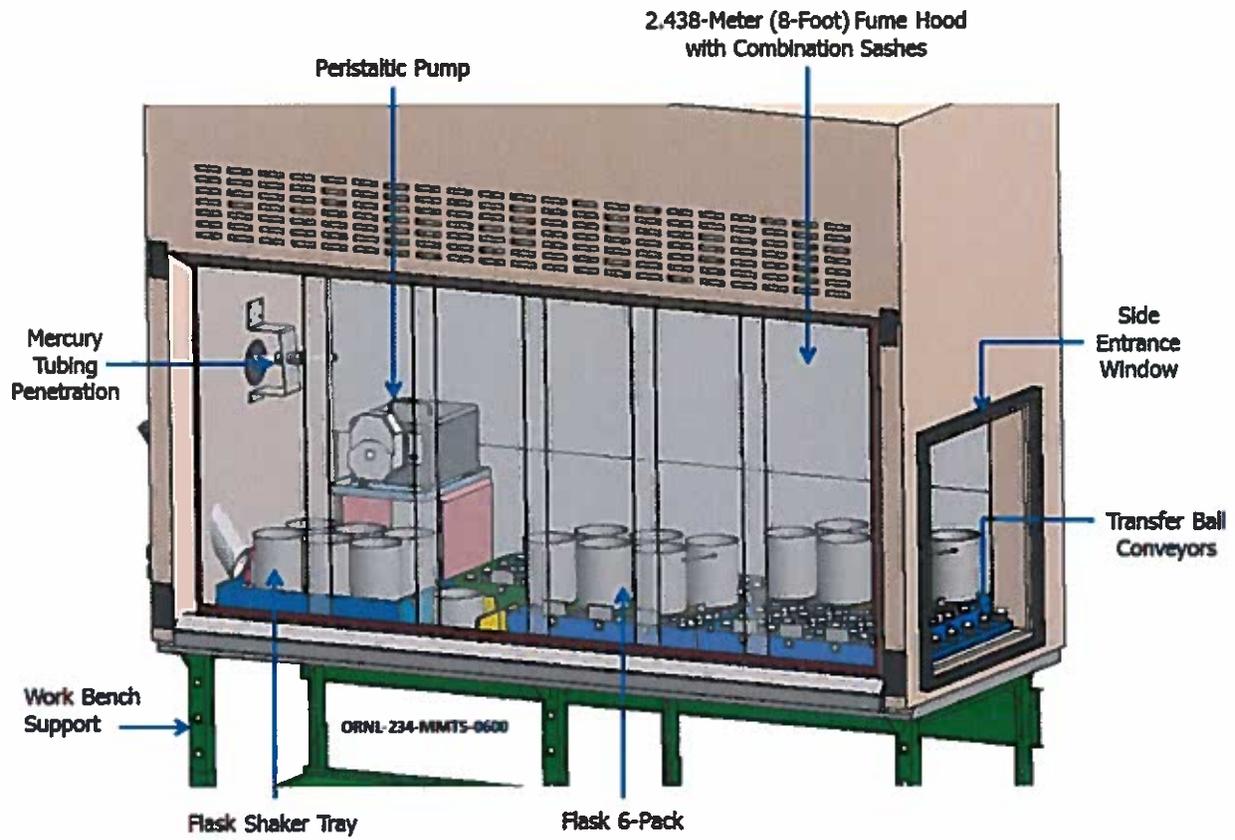
7.6 ATTACHMENTS

Ball Conveyor Table and Fume Hood Work Stations (Attachment 7.1)

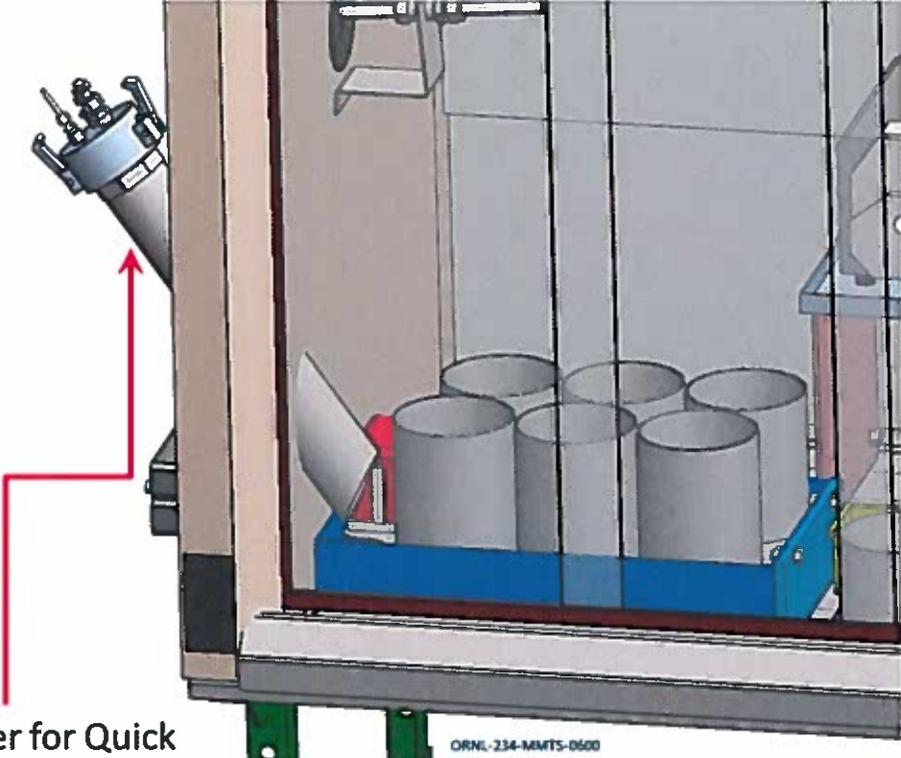
Storage of the Quick Disconnect Transfer Fitting (Attachment 7.2)

Metric Ton Container and Weight Tracking – Flask Handling Room [Form ORNL/MMTS/FHR-1] (Attachment 7.3)

ATTACHMENT 7.1 Fume Hood 2



ATTACHMENT 7.2 Storage of the Quick Disconnect Transfer Fitting



Holder for Quick Disconnect Fitting

ATTACHMENT 7.3 Metric Ton Container and Weight Tracking – Flask Handling Room [Form ORNL/MMTS/FHR-1]

Metric Ton Container and Weight Tracking - Flask Handling Room

MT Serial Number _____
 MT initial warehouse & location _____ MT final warehouse & location _____
 Date fill starts _____ Date fill ends _____
 Employee Name(s): _____

Scale used (A/B)	Test weight start (time)	Test weight (lb.)	Lift test weight off scale and re-zero (time)	MT tare weight (lb.)	Begin fill (time)	Stop fill – for multi-day filling (time)	Finish fill (time)	Lift MT off scale and re-zero (time)	MT stopped fill gross weight – for multi-day filling (lb)	MT gross weight (lb)

NET weight of elemental mercury = (gross weight – tare weight) = _____ lb.

1. Note AM or PM with each time entry
2. MT tare weight and gross weight measurements are made with end cap on only and no other loads
3. When finishing an MT container, press the *FINISH MT* button on the PCDAS display after the scale is re-zeroed and the MT container is set back on the scale to measure the gross weight. Record the MT gross weight displayed by PCDAS.

Employee signature: _____ Date: _____

Supervisor signature: _____ Date: _____

The purpose of this form is to track the weight and storage location of MT containers. Filling an MT container may take more than one day. Each row in this form is for a single workday, e.g., two rows should be used for an MT container for which filling began on one workday and finished on the following workday.

For MT containers designated for long-term storage in 110-66 the *MT initial warehouse and location* is the same as the *MT final warehouse and location*. For MT containers that will be stored for the long term in building 110-XX, the *MT initial warehouse and location* is the interim storage location in 110-66, and the *MT final warehouse and location* is the designated location in 110-XX.

Retain this form and update it with the *MT final warehouse and location* after the MT container is placed in its long-term storage location.