
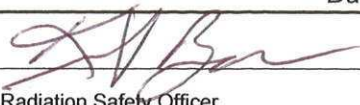


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|--------------|---|--|
| Approved by: |  |  |
|              | General Manager   | Radiation Safety Officer   |

## STANDARD OPERATING PROCEDURE

### 15.OPS.15

## AIR MONITORING FOR RADIOACTIVE MATERIALS

### 1.0 OBJECTIVE

To define the methods and requirements for conducting air particulate and radon monitoring at the Clean Harbors Deer Trail (CHDT) facility or other job sites

### 2.0 SCOPE

This standard operating procedure (SOP) applies to the performance of general area and breathing zone air monitoring for airborne radioactive materials, and to radon monitoring during normal operations at the CHDT facility.

### 3.0 POLICY

Air monitoring will be performed to assess potential environmental impacts from site operations, to verify the effectiveness of engineered contamination control or containment systems, and to evaluate worker and public exposures from site operations. All worker and public exposures will be maintained as low as reasonably achievable (ALARA).

### 4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

### 5.0 AIR MONITORING PROCEDURES

#### 5.1 General Area Air Monitoring

##### 5.1.1 Monitoring Locations and Equipment

Continuous particulate air monitoring will be performed at three general locations at the CHDT facility. Location A is the north air sampling station, located to the northeast of Disposal Cell 3, the active disposal cell. Location B is the south air sampling station, located south of the Disposal Cell 3. Locations C and D are side by side locations along the north rim of Disposal Cell 3.

The airborne sampling system consists of a Hi-Q model VS23-1023CV ¾ HP oil-less rotary vane pump, flow rate rotometer and calibration knob, elapsed timer, 47 mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house.

Flow rates on the air samplers are recorded from the rotometer. Flow rates are checked against the data shown by a Hi-Q Air Flow Calibrator (AFC) Complete-6. The AFC measures the true

flow rate in actual and in standard temperature and pressure (STP) units. Flow calibration will be performed a minimum of once per month, per Section 5.1.5.

#### 5.1.2 Sample Collection

Pumps will be run 24 hours a day, 7 days a week during sample collection. Samples will be collected from each location a minimum of 300 hours per calendar month. This time allows for approximately one to two weeks of downtime per month to allow for maintenance on the pumps as necessary. The CHDT RSO or designee may require more sample time, as needed.

Results from samples collected for durations less than 300 hours may be qualified by the CHDT RSO, or alternate estimates (such as the average of the previous and subsequent months) may be used.

The pumps will be inspected a minimum of weekly during the sample collection to verify that the pump is still in working order. The date and time of the pump inspection and pump flow rate will be recorded in the air monitoring logbook or attached example form (Attachment 1) to document the inspection.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps. The final flow rate, elapsed time, and filter collection date and time will be recorded in a dedicated log book or on the example form included as Attachment 2.

#### 5.1.3 On-Site Sample Analysis

Sample filters will be collected after 300 hours of sampling time, or more frequently as directed by the CHDT RSO. Following a minimum decay period of 21 days, the filters will be counted onsite using the Ludlum 3030 Alpha Beta sample counter. The air activity concentration is calculated using the following equation from NUREG-1400, *Air Sampling in the Workplace* (NRC 1993).

$$C = \frac{R_n}{EFKT_s}$$

Where  $C$  = concentration of radioactive material in the air in  $\mu\text{Ci}/\text{cm}^3$  (or  $\mu\text{Ci}/\text{ml}$ )

$R_n$  = net count rate in counts per minute (cpm)

$E$  = fractional filter efficiency (% efficiency/100)

$F$  = airflow rate through the sampler in ml/min

$K$  = counting efficiency in cpm/ $\mu\text{Ci}$

$T_s$  = duration of sample collection, in minutes

As the 3030 accounts for detection efficiency and background and reports measurements in units of dpm, the gross alpha and beta measurements will be converted from the dpm displayed by the 3030 to a concentration of  $\mu\text{Ci}/\text{ml}$  using the following equation.

$$C = \frac{M}{EF_{CFM} \left( \frac{ml}{3.53 \times 10^{-5} ft^3} \right) T_s \left( 2.22 \times 10^6 \frac{dpm}{\mu Ci} \right)}$$

Where  $M$  is the 3030 measurement in dpm. The airflow rate also requires conversion from the rotometer units of cubic feet per minute (CFM) to milliliters, as shown in the equation.

When on-site measurements are conducted, the date and time of the analysis, the counting time, and the instrument and serial number are to be recorded in a dedicated logbook or on the example form included as Attachment 3.

#### 5.1.4 Off-Site Sample Analysis

Filters will then be sent to an offsite analytical laboratory for the following analyses:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

If multiple filters are collected from a single location over a month, the filters will be composited for offsite analysis.

#### 5.1.5 Pump Calibration and Maintenance

Flow rates on the pumps will be checked once a month during the filter changeout, using the AFC-Complete-6. During calibration, the following procedure will be followed:

- Screw the sample holder with a filter into the calibration connector, connect via the hose to the AFC and the sampler inlet
- Prior to starting the flow, turn on the AFC and turn the knob to allow it to zero itself with no flow
- Plug in the pump and start the airflow
- Record the following information:
  - Date/time
  - Flow measured by the rotometer on the pump (CFM)
  - Flow measured by AFC (CFM) for both STP and actual settings
- Stop the flow and disconnect the calibrator

As necessary, the pump rotometer may be adjusted to match the AFC measurement for STP. Alternatively, values recorded from the AFC unit may be used to calculate the correct flow rate on the pump.

Maintenance will be performed as necessary on the pumps. Rebuild kits will be kept on hand at the facility. Pump maintenance will be documented in the air monitoring log book.

## 5.2 Breathing Zone Air Monitoring

### 5.2.1 Monitoring Procedures and Equipment

Breathing zone monitoring will be performed as directed by the CHDT RSO or designee to determine exposures of specific personnel to airborne radioactivity. Monitoring will be performed with portable lapel air samplers and 37 mm filters with cartridges placed near the breathing zone of the air monitoring subject. The samplers may also be placed in specific areas, or in cabs of equipment, in order to obtain a longer sample.

### 5.2.2 Sample Collection

Samples will be collected over the course of a single work day. At a minimum, the following information will be collected in the air monitoring logbook or form:

- Sampled individual/activity/area
- Start date/time, and starting flow rate (including units)
- Stop date/time, and ending flow rate (including units)
- Total sampling time
- Calibration information, including pre- and post- sampling flow rate check, if performed.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps.

### 5.2.3 On-Site Sample Analysis

Air filters may be counted on-site using the 3030 counter, and converted to an activity concentration in  $\mu\text{Ci}/\text{ml}$  using the following equation from Section 5.1.3:

$$C = \frac{M}{EF_{lpm} \left( 1000 \frac{\text{ml}}{\text{l}} \right) T_s \left( 2.22 \times 10^6 \frac{\text{dpm}}{\mu\text{Ci}} \right)}$$

Where  $M$  is the 3030 measurement in dpm. The airflow rate also requires conversion from the standard lapel sampler units of liters per minute (lpm) to milliliters, as shown in the equation.

### 5.2.4 Off-Site Sample Analysis

Personal air samples will be sent off-site for radiochemical analysis when determined to be required by the CHDT RSO or designee. If off-site analytical is required one or more of the following analyses may be performed:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample

- Radium-226 by wet chemistry method E903.0, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

#### 5.2.5 Pump Calibration and Maintenance

Pump calibration and maintenance will be performed in accordance with manufacturer's recommendations and the user's manual for the equipment. Where possible, the air sampler will be calibrated on-site, but calibration by a rental vendor is acceptable. In addition, battery life will be extended by following the user manual recommendations for charging.

### 5.3 Radon Monitoring

#### 5.3.1 Monitoring Equipment

Radon monitoring will be performed at the CHDT facility using Landauer Radtrak alpha-track radon monitors. The Radtrak is a passive radon gas monitor that records the alpha tracks from radon gas decay. The tracks are counted and correlated with a known air concentration of radon, which is averaged over the sampling time.

#### 5.3.2 Deployment Procedure

The radon monitors will be deployed at the following locations:

|    |  |
|----|--|
| 1  | Cell #3 – South                        |
| 2  | Cell # 3 – East                        |
| 3  | Cell # 3 – North                       |
| 4  | Cell # 3 – West                        |
| 5  | South Air Sampler (Sampler B)          |
| 6  | Central Air Sampler – East (Sampler D) |
| 7  | Central Air Sampler – West (Sampler C) |
| 8  | North Air Sampler (Sampler A)          |
| 9  | Treatment Building                     |
| 10 | Lunch Room                             |

The Radtrak detectors will be positioned upside down inside the plastic cup. The serial numbers of the outgoing and incoming detectors will be recorded, as will the deployment date and time.

Detectors will be changed out at the start of each quarter, or as close as possible – January 1, April 1, July 1, and October 1. When removed, the foil stickers provided by Landauer will be placed over the openings on the detector face.

Locations 5 through 8, coinciding with the stationary air samplers, are considered to be background radon locations.

### 5.3.3 Off-Site Analysis

Detectors will be sent to Landauer for analysis. The manufacturers report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in picocuries per liter (pCi/l)-days, and the average radon concentration in pCi/l.

## 6.0 STANDARDS AND CRITERIA

### 6.1 Ambient Air Sampling

Analytical results from the monthly ambient air samples will be used to estimate the committed effective dose equivalent (CEDE) estimates for site workers, per 15.RPP.05, *Estimation of Inhalation Dose*.

### 6.2 Breathing Zone Air Sampling

Results from breathing zone air sampling will be compared with the derived air concentration (DAC) or air effluent limits from 10 CFR 20 to determine potential worker exposure and dose.

### 6.3 Radon Sampling

The quarterly analytical report of measured radon concentrations will be evaluated by the CHDT RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels at the edge of the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents.

## 7.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation*. Current Version.

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

ANSI/HPS 1999. *Surface and Volume Radioactivity Standards for Clearance*.

NRC 1993. *Air Sampling in the Workplace*. NUREG-1400. September.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

## 8.0 ATTACHMENTS

|              |   |
|--------------|---|
| Attachment 1 | Air Monitor Weekly Inspection Checklist |
| Attachment 2 | Air Monitor Filter Collection Checklist |
| Attachment 3 | Air Filter Counting Checklist           |



**15.OPS.15 ATTACHMENT 1**  
**AIR MONITOR WEEKLY INSPECTION CHECKLIST**

The following inspections shall be conducted on a weekly basis. Inspectors are required to date and sign their names on the Inspection Checklist that they complete. All items shall be responded to by indicating that an item is either a problem or is not a problem. If an item is not inspected, the Inspector shall respond by writing "NI" in the Problem column with an explanation of why it was not inspected. In the event the Inspector cannot complete a checklist, the new Inspector shall continue with the same inspection and shall date and sign his/her name to that checklist.

Deficiencies noted during inspections will be noted on the form. If the deficiency can be corrected in the same day the correction will be noted on the form. If the deficiency cannot be corrected within the same day then an Inspection Corrective Action Report shall be initiated and distributed by the Inspector. The remediator will retain the original copy until the item has been corrected. A second copy will be given to management and the third copy will remain with the Inspector. The signed original will then be filed with the originating checklist upon completion.

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|--|--------------|
| <i>Reviewed by Compliance Manager or General Manager</i> | <i>Date:</i> |
|--|--------------|

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection:

**1) Location A**

Inspection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**2) Location B**

Inspection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**3) Location C**

Inspection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**4) Location D**

Inspection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection:



**15.OPS.15 ATTACHMENT 2**  
**AIR MONITOR FILTER COLLECTION CHECKLIST**

The following inspections shall be conducted on a weekly basis. Inspectors are required to date and sign their names on the Inspection Checklist that they complete. All items shall be responded to by indicating that an item is either a problem or is not a problem. If an item is not inspected, the Inspector shall respond by writing "NI" in the Problem column with an explanation of why it was not inspected. In the event the Inspector cannot complete a checklist, the new Inspector shall continue with the same inspection and shall date and sign his/her name to that checklist.

Deficiencies noted during inspections will be noted on the form. If the deficiency can be corrected in the same day the correction will be noted on the form. If the deficiency cannot be corrected within the same day then an Inspection Corrective Action Report shall be initiated and distributed by the Inspector. The remediator will retain the original copy until the item has been corrected. A second copy will be given to management and the third copy will remain with the Inspector. The signed original will then be filed with the originating checklist upon completion.

|  |              |
|--|--------------|
| <i>Reviewed by Compliance Manager or General Manager</i> | <i>Date:</i> |
|--|--------------|

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection:

**1) Location A**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed End Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed End Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Air Flow Calibration

Observed Flow Rate, Flow Meter: \_\_\_\_\_

Observed Flow Rate, AFC – STP: \_\_\_\_\_

Observed Flow Rate, AFC – Actual: \_\_\_\_\_

Filter Start Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Start Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Was timer reset to zero? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**2) Location B**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed End Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed End Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Air Flow Calibration

Observed Flow Rate, Flow Meter: \_\_\_\_\_

Observed Flow Rate, AFC – STP: \_\_\_\_\_

Observed Flow Rate, AFC – Actual: \_\_\_\_\_

Filter Start Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Start Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Was timer reset to zero? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**3) Location C**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed End Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed End Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Air Flow Calibration

Observed Flow Rate, Flow Meter: \_\_\_\_\_

Observed Flow Rate, AFC – STP: \_\_\_\_\_

Observed Flow Rate, AFC – Actual: \_\_\_\_\_

Filter Start Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Start Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Was timer reset to zero? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**4) Location D**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed End Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Observed End Elapsed Time: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Air Flow Calibration

Observed Flow Rate, Flow Meter: \_\_\_\_\_

Observed Flow Rate, AFC – STP: \_\_\_\_\_

Observed Flow Rate, AFC – Actual: \_\_\_\_\_

Filter Start Date: \_\_\_\_\_ Time: \_\_\_\_\_

Observed Start Flow Rate: \_\_\_\_\_ Within Expected Values? Yes ☐ No ☐

Was timer reset to zero? Yes ☐ No ☐

Comments: \_\_\_\_\_  
\_\_\_\_\_

**15.OPS.15 ATTACHMENT 3  
MONTHLY AIR FILTER COUNTING CHECKLIST**

The following will be used to count ambient air filters on a monthly basis. Inspectors are required to date and sign their names on the Inspection Checklist that they complete. All items shall be responded to by indicating that an item is either a problem or is not a problem. If an item is not inspected, the Inspector shall respond by writing "NI" in the Problem column with an explanation of why it was not inspected. In the event the Inspector cannot complete a checklist, the new Inspector shall continue with the same inspection and shall date and sign his/her name to that checklist.

Deficiencies noted during inspections will be noted on the form. If the deficiency can be corrected in the same day the correction will be noted on the form. If the deficiency cannot be corrected within the same day then an Inspection Corrective Action Report shall be initiated and distributed by the Inspector. The remediator will retain the original copy until the item has been corrected. A second copy will be given to management and the third copy will remain with the Inspector. The signed original will then be filed with the originating checklist upon completion.

A dedicated logbook may be substituted for this form provided that approval is granted by the CHDT RSO and all required information below is included.

|  |              |
|--|--------------|
| <i>Reviewed by Compliance Manager or General Manager</i> | <i>Date:</i> |
|--|--------------|

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection:

**1) Location A**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Filter Count Date: \_\_\_\_\_ Time: \_\_\_\_\_

Decay Period of 21 Days? Yes ☐ No ☐

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

**2) Location B**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Filter Count Date: \_\_\_\_\_ Time: \_\_\_\_\_

Decay Period of 21 Days? Yes ☐ No ☐

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

**3) Location C**

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Filter Count Date: \_\_\_\_\_ Time: \_\_\_\_\_

Decay Period of 21 Days? Yes ☐ No ☐

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection:

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

#### 4) Location D

Filter Collection Date: \_\_\_\_\_ Time: \_\_\_\_\_

Filter Count Date: \_\_\_\_\_ Time: \_\_\_\_\_

Decay Period of 21 Days? Yes ☐ No ☐

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

#### 5) Field Blank

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

#### 6) Lab Duplicate

Counter Used: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

Using a count time of **5 minutes**: Alpha: \_\_\_\_\_ dpm Beta \_\_\_\_\_ dpm

Sent to Lab? Yes ☐ No ☐ Date Shipped: \_\_\_\_\_ Date Analytical Received: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

If any of the above items are checked "No" and are part of an ongoing corrective action, circle the item and write the originating date beside the item.

Inspector's Signature:

Date of Inspection: