# APPENDIX G

Tisch Brushless VFC High Volume Air Sampler SOP

# Standard Operating Procedure
# For a
# Tisch Brushless VFC High Volume Air Sampler

## 1.0 INTRODUCTION

This procedure applies to the Tisch Environmental, Inc single filter brushless VFC High Volume (Hi-Vol) air samplers, which will be used to monitor the preoperational and operational airborne radionuclides. The sampling will take place at five sites in the vicinity of the proposed Energy Fuels Resources Corporation (EFR) Uranium Mill. The Monitoring Sites were chosen according to guidance outlined in Nuclear Regulatory Commission (NRC) Regulatory Guides 3.63 Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reporting (NRC 3.63); 4.14 Radiological Effluent and Environmental Monitoring at Uranium Mills (NRC 4.14); and Environmental Protection Agency (EPA) Meteorological Monitoring Guidance for Regulatory Modeling Applications (MMGRMA) (EPA-454/R-99-005).

Data from the samplers will be collected at five air monitoring sites in order to obtain a representative set of data for the assessment. Three sites were selected near the boundaries of the proposed Energy Fuels Piñon Ridge Uranium Mill site, one site was selected as a background site to the northwest, and one site was selected at the nearest residence which is located to the southeast. Samples will be collected at all five sites with continuous sampling on a 14 day filter change out schedule during preoperational sampling and will continue when the mill becomes operational. The filter change out schedule may be adjusted for more frequent filter changes, depending on filter loading. Filters for sample collection will be prepared by the contract laboratory according to laboratory procedures.

## 2.0 SAMPLER INSTALLATION

### 2.1 Sampler Assembly

Samplers will be assembled and prepared for operation with assistance from Inter-Mountain Laboratories (IML) according to the procedure in the manufacturer's operating manual. IML will also carryout the initial calibration of the instruments.

## 3.0 SAMPLER OPERATIONS

Please enter date, time, technician name, name of any visitors, and purpose of visit in Site Notebook for any visit to the site.

It is also important to note in the Site Notebook and on the Tisch Hi-Vol Field Form any unusual events that could influence particulate matter levels. These include forest fire smoke, high winds, local construction activity, etc.

**Note:** Do not turn sampler off unless absolutely necessary.

## 3.1 Filter Setup Procedure

### 3.1.1 Necessary Equipment

Sample Filter
Clean Filter Holder Frame
Clean Snap Cover Lid for Filter Holder Frame
Clean Filters Box
Filter Envelope and Zip Bag
Blank Transducer Chart
Field Container
Tisch Hi-Vol Field Form
ACZ Chain of Custody Form
Checklist for Tisch Hi-Vol Sampler
Writing Instrument

### 3.1.2 Filter Setup Procedure - In the Office

1. While performing this procedure please record requested information on the Checklist for Tisch Hi-Vol Sampler (Figure 1).

   **Note:** Bi-weekly is once every two weeks, corresponding to the 14-day filter exchange schedule.

2. Prepare a clean work surface for filter setup procedure. Wash hands prior to handling filters.

3. Prepare a clean empty Filter Holder Frame for the next filter.

4. Remove a zip bag with a clean filter from the “clean filters” box.

5. Remove the Filter Envelope from the zip bag and remove the clean Filter from the Filter Envelope.

6. Carefully center the new filter, rougher/filter number side up, on the supporting screen. **Be sure to only touch the ends, not the corners or center of the filter.**

7. Write the filter number, filter holder frame number, and sample start date on the Tisch Hi-Vol Field Form (Figure 2) in the row associated with the site number located on the filter holder frame.

8. Properly align the filter on the screen so that when the frame is in position the gasket will form an airtight seal on the outer edges of the filter.

9. Tighten two brass washer bolts on the top of the filter holder frame.

10. Attach snap cover to the top of the filter holder frame. The filter is prepared for the next run.

11. Write required information on the ACZ Chain of Custody Form (Figure 3).

12. Write the filter number, site name, sampler ID number, and sample start date on empty filter envelope and on a blank transducer chart (Figure 4).

13. Place empty filter envelope in its accompanying plastic zip bag.

14. Place prepared filter and transducer chart in the field container for transporting to site for next filter change out. Be sure to have one loaded filter holder frame for each site.

**Checklist for Tisch Hi-Vol Sampler**

Site Name: _____ Filter #: _____

Sampler ID #: _____ Sample Start Date: _____

Sampler Serial #: _____ Sample End Date: _____

**Daily Instrument Checks**

**Sampler Operation**

| | Sample Setup | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Time | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Technician Name | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Is sampler running? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| If No, the sampler is not running, see Section 5.3 in SOP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Is filter loading heavy? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| If Yes, filter loading is heavy check $P_{stag}$ reading using 0-40" $H_2O$ manometer. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Is the $P_{stag}$ below 30" H2O? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| If No, $P_{stag}$ reading is above 30" $H_2O$, contact appropriate personnel, see contact list in site binder. Immediate filter exchange may be necessary. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Is elapsed time meter operating correctly? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Current Elapsed Time | Set to zero | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| If No, the elapsed timer is not operating correctly, contact appropriate personnel, see contact list in site binder. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Visual Check of Sampler**

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Is sampler level and securely mounted? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Any visible damage to sampler? | | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| If Yes, the sampler is damaged, contact appropriate personnel, see contact list. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Bi-Weekly Instrument Checks and Filter Exchange**

**Please Note: Bi-Weekly is once every two weeks, corresponding to the 14-day filter exchange schedule.**

Date: _____ Time: _____ Technician Name: _____

| Perform Daily Check Procedure | |
|---|---|
| Is flow recorder (Transducer Chart) operating correctly? | Yes / No |

**Filter Retrieval**

| | |
|---|---|
| Take Pstag reading from pressure port | |
| Turn Sampler off | |
| Snap cover on filter holder frame | |
| Remove sample filter holder frame | |
| Place sample in field container | |
| Record requested information on Tisch Field Form & Transducer Chart | |

**Bi-Weekly Instrument Checks**

| | |
|---|---|
| Inspect filter holder frame gaskets for airtight seal. | |
| Do gaskets need to be replaced? If Yes, contact appropriate personnel, see contact list. | Yes / No |
| Is motor mount ring tight? | Yes / No |

**Before placing clean sample filter**

| | |
|---|---|
| Is a Monthly Check scheduled? | Yes / No |
| If Yes - Perform Monthly Check Procedure | |
| If No - Continue with filter exchange procedure | |

**Filter Setup**

| | | |
|---|---|---|
| Prepare for next run -- | Remove new sample filter holder frame from field container | |
| | Secure filter holder frame to sampler | |
| | Remove snap cover from filter holder frame | |
| | Prepare & Install continuous flow recorder (Transducer Chart) | |
| | Reset elapsed time meter & Turn Sampler On & Warm Motor | |
| | Take Pstag reading from pressure port | |
| | Record requested information on Tisch Field Form and Blank Tisch Hi-Vol Checklist | |

**Monthly Instrument Checks**

**Perform Daily and Weekly Check Procedures**

Date: _____ Time: _____ Technician Name: _____ Inspect sampler tubing & conenctions

Inspect & clean filter screen Inspect power cords & all connections **Caution:** Do not allow power cord or outlets to be immersed in water!

Notes: Please note any unusual events that could influence particulate matter levels. These include forest fire smoke, high winds, local construction activity, etc.

**Figure 1:** Example Checklist for Tisch Hi-Vol Sampler.

## Field Form for Tisch Hi-Vol Sampler

Filter Setup Technician: _____

Filter Retrieval Technician: _____

| Site Name & Number & Sampler ID # | Filter Number | Filter Holder Frame Number | Start Date & Time | End Date & Time | Elapsed Time Indicator at Stop | Set-up $P_{stag}$ | Retrieval $P_{stag}$ | Flow Rate* |
|---|---|---|---|---|---|---|---|---|
| Site # 1: (North): 10 m Tower Sampler ID: 1-1 | | | | | | | | |
| Site #2 (East): 30 m Tower Sampler ID: 2-1 | | | | | | | | |
| Site #3: West: Sampler ID: 3-1 | | | | | | | | |
| Site #4 (Northwest): Cooper Sampler ID: 4-1 | | | | | | | | |
| Site #5 (Southeast): Carver Sampler ID: 5-1 | | | | | | | | |
| **Trip Blank** | | N/A | | | N/A | N/A | N/A | N/A |

* Flow Rate will be calculated using an Excel spreadsheet provided by Inter-Mountain Laboratories. Please contact the appropriate Kleinfelder personnel at the end of each sampling cycle (14-days per cycle) to obtain the Average Temperature and Pressure required to calculate the Flow Rate for each sample collected during the sample cycle.

Calculation Performed By: _____ Date: _____

**Site # 3 (West): Generator Maintenance**

| Date | Sampler Shut Off Time | Generator Shut Off Time | Generator Restart Time | Sampler Restart Time | Is Sampler Motor Mount Ring Tight? | Reason for Generator Shut down |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Notes: _____

**Figure 2:** Example Tisch Hi-Vol Field Form

ACZ LABORATORIES, INC.
Total Suspended Particulates in Air
EPA 40CFR Part 50

Analyst: as
Date: 11/26/2007

Approved:

Client: KLEINFELDER 11-20-07
P:\DEPARTMENT\SOILS\TSP-

Project: Air Monitoring Filters

| | Equilbration | | |
|---|---|---|---|
| | Start | Finish | Temp C |
| Initial Weighing: | see blank | see blank | ROOM |
| Final Weighing: | see blank | see blank | ROOM |

| # | Lab No. (ACZ's Used Only) | Sample ID | Sample Date (Start) | Hi-Vol Filter # | Initial Weight g | Final Weight g | TSP Weight mg | Air Flow cfm | Sampling Time minutes | TSP Conc. ug/m3 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | 6804367 | 4.2700 | | | | | | |
| 2 | | | | 6804368 | 4.2910 | | | | | | |
| 3 | | | | 6804369 | 4.3673 | | | | | | |
| 4 | | | | 6804370 | 4.4063 | | | | | | |
| 5 | | | | 6804371 | 4.3794 | | | | | | |
| 6 | | | | 6804372 | 4.3947 | | | | | | |
| 7 | | | | 6804373 | 4.3223 | | | | | | |
| 8 | | | | 6804374 | 4.3373 | | | | | | |
| 9 | | | | 6804375 | 4.3472 | | | | | | |
| 10 | | | | 6804376 | 4.3454 | | | | | | |
| 11 | | | | 6804377 | 4.2787 | | | | | | |
| 12 | | | | 6804378 | 4.3076 | | | | | | |
| 13 | | | | 6804379 | 4.3070 | | | | | | |
| 14 | | | | 6804380 | 4.4026 | | | | | | |
| 15 | | | | 6804381 | 4.4073 | | | | | | |
| 16 | | | | 6804382 | 4.3467 | | | | | | |
| 17 | | | | 6804383 | 4.3991 | | | | | | |
| 18 | | | | 6804384 | 4.3878 | | | | | | |
| 19 | | | | 6804385 | 4.3602 | | | | | | |
| 20 | | | | 6804386 | 4.3495 | | | | | | |
| 21 | | | | 6804387 | 4.3639 | | | | | | |
| 22 | | | | 6804388 | 4.4147 | | | | | | |
| 23 | | | | 6804389 | 4.4054 | | | | | | |
| 24 | | | | 6804390 | 4.3681 | | | | | | |
| 25 | | | | 6804391 | 4.4310 | | | | | | |
| 26 | | | | 6804392 | 4.4022 | | | | | | |
| 27 | | | | 6804393 | 4.4007 | | | | | | |
| 28 | | | | 6804394 | 4.4260 | | | | | | |
| 29 | | | | 6804395 | 4.4359 | | | | | | |
| 30 | | | | 6804396 | 4.4129 | | | | | | |
| 31 | | | | 6804397 | 4.3915 | | | | | | |
| 32 | | | | 6804398 | 4.4100 | | | | | | |
| 33 | | | | 6804399 | 4.4325 | | | | | | |

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**Figure 3:** Example ACZ Chain of Custody Form

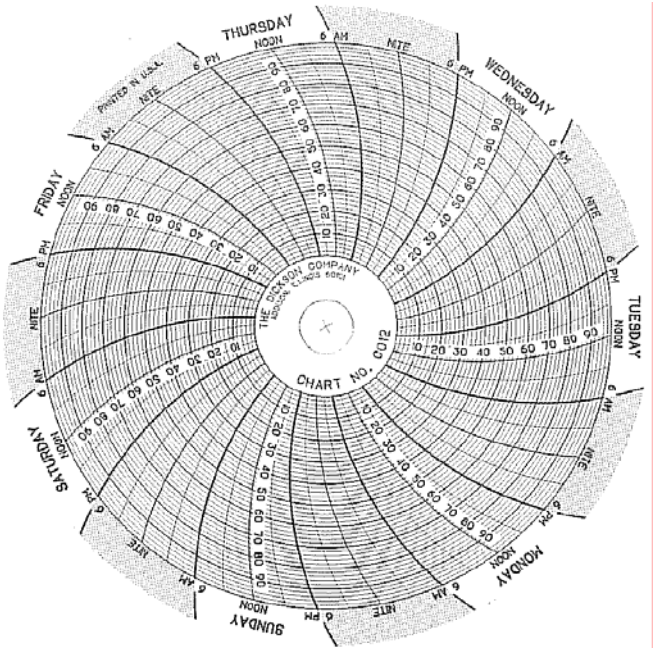


**Figure 4:** Example Transducer Chart

## 3.2 Filter Exchange Procedure – In the Field

### 3.2.1 Necessary Equipment

Field Container
Snap Lid for Each Filter Holder Frame
Clean Filter for Next Sample Cycle in its Filter Holder Frame
Previously Filled Out Transducer Chart for New Filter
Timepiece
Manometer for stagnation port (typically 0-40"$H_2O$) and Tubing
Clean Cloth
Tisch Hi-Vol Field Form
Checklist for Tisch Hi-Vol Sampler
Site Notebook
Writing Instrument

### 3.2.2 Filter Retrieval Procedure - In the Field

1. While performing this procedure please follow steps for the daily and bi-weekly checks and record requested information on the Checklist for Tisch Hi-Vol Sampler (Figure 1).

2. Allow sampler to continue operating. Remove covers, turn on and Zero the designated manometer (0-40 in $H_20$ pressure range). Connect one side of the manometer to the stagnation port on the side of the sampler with the designated rubber vacuum tube (clip end to sampler port). Leave the opposite side of the manometer open to the atmosphere.

3. Record the pressure reading in the "Retrieval $P_{stag}$" column on the Tisch Hi-Vol Field Form (Figure 2). Stagnation pressure readings will typically be between 18 and 28 inches $H_2O$. Remove and turn off the manometer. Remove and turn off the manometer and replace protective caps on manometer ports.

4. Turn the sampler off.

5. Note date and time the sampler was turned off (End Date and End Time), the elapsed time from the elapsed time indicator on the sampler, and the technician name on Tisch Hi-Vol Field Form (Figure 2).

   **Note:** All times should be recorded using 24 hour format and should be recorded in Mountain Standard Time as apposed to Mountain Daylight Time to avoid daylight savings adjustments. The Tisch Hi-Vol samplers have clocks (Digital Timer on inside door of sampler) that should be set to Mountain Standard Time. See Section 3.4 for instructions if the time on the sampler needs to be reset.

6. Open lid of sampler and secure with S-hook.

7. Attach snap cover to the top of the filter holder frame.

8. Remove filter holder frame by loosening the four plastic nuts allowing the plastic nuts and washers to swing down out of the way (do not loosen the brass nuts at this time).

**Note:** While removing the filter holder frame incrementally loosen each wing nut. That is, do not loosen one wing nut entirely before loosening all wing nuts.

9. Shift frame to one side and remove.

10. Carefully place in field container in a flat position for transportation back to office (avoid shaking or vibrating the filter).

    **Note:** The field container should be a hard plastic container/box with a secure lid that can be used for safely transporting filters to/from site.

11. Open transducer box mounted on inside door of the sampler by unscrewing securing bolt. Depress pen arm lifter to raise pen point from transducer chart. Remove Transducer Chart from the Continuous Flow Recorder. Record the End Date, End Time, Elapsed Time, Pstag reading from the manometer, and name of technician on the back of the Transducer Chart and place in Field Container for transportation back to office. Close transducer box (make sure securing bolt is snug to seal out moisture).

    **Note:** In inclement weather information can be written on the Tisch Hi-Vol Field Form and transferred to the Transducer Chart in the office.

12. Record the requested information associated with the filter in the site notebook.

13. Perform any scheduled daily, bi-weekly, or monthly checks, and maintenance or calibration procedures before setting up for the next run cycle.

### 3.2.3 Filter Setup Procedure - In the Field

1. Wipe any dirt accumulation from the filter holder frame area of the sampler with a clean cloth.

2. Remove the designated filter holder frame (noted with the sampler identification number) for the next run from the field container. Be careful in windy conditions that the filter is not damaged from wind passing through the bottom of the filter holder frame (you may need to place a notebook or similar item under the holder while transitioning from the field container to the sampler). The filter holder frame number is also noted on the Tisch Hi-Vol Field Form for reference.

3. Secure the filter holder frame to the sampler with plastic bolts and washers with sufficient pressure to avoid air leakage at the edges (make sure that the plastic washers are on top of the frame). Recheck the brass filter cover screws to ensure they did not loosen.

   **Note:** While securing the filter holder frame incrementally tighten each wing nut. That is, do not tighten one wing nut entirely before tightening all wing nuts. This is important so that the pressure is equal around the entire filter holder frame. Do not over tighten the frame as it can over-compress the seal causing it to degrade over time or cause the attaching screws to break.

4. Carefully remove the snap cover.

5. Record the requested information associated with the new sample filter on the Checklist for Tisch Hi-Vol Sampler (Figure 1) and on the Tisch Hi-Vol Field Form (Figure 2).

6. Check that the sampler time is correct. The sampler time should be in Mountain Standard Time year round, not Mountain Daylight Savings Time to avoid daylight savings adjustments.

7. Press and hold the Elapsed Time indicator button until it resets to zero.

8. Close shelter lid carefully and secure with the "S" hook.

9. Make sure all cords are plugged into their appropriate receptacles and the rubber tubing between the blower motor pressure tap and the TE-5009 continuous flow recorder is connected (be careful not to pinch tubing when closing door).

10. Prepare the Continuous Flow Recorder with Transducer Chart previously prepared in the office (Section 3.4).

11. Turn the Sampler On.

12. Allow sampler motor to warm up. Remove protective caps from manometer ports, turn on and zero the designated manometer (0-40 in. $H_20$ pressure range) and connect one side of the manometer to the stagnation port on the side of the sampler with the designated rubber vacuum tube (clip end to sampler port). Leave the opposite side of the manometer open to the atmosphere.

13. Record the pressure reading in the "Set-up $P_{stag}$" (also referred to as Pstag – On or Pstag - Start) column on the Tisch Hi-Vol Field Form (Figure 2). Set-up $P_{stag}$ will typically read between 15 and 20 inches $H_20$. If it is out of this range, check the seal and gasket condition on the filter holder and the motor mount ring. Remove and turn off the manometer and replace protective caps on manometer ports.

### 3.3 Filter Retrieval Procedure - In the Office

#### 3.3.1 Necessary Equipment

Field Container
Sample Filter in Filter Holder Frame with Snap Cover Lid in Place
Filter Envelope Corresponding to Filter Number
Transducer Chart from Field Container Corresponding to Filter Number
Tisch Hi-Vol Field Form
ACZ Chain of Custody Form
Exposed Filters Box
Writing Instrument

#### 3.3.2 Filter Retrieval Procedure – In the Office

1. When back in the office, prepare a clean work surface for filter exchange procedures. Wash hands prior to handling filters.

2. Carefully remove filter holder frame with sample from field container. Maintain in a flat position and avoid shaking or vibrating.

3. Remove snap cover from the filter holder frame.

4. Loosen two brass washer bolts on the top of the filter holder frame, and lift frame off of filter.

5. Make note of the Filter Number and retrieve the appropriate sample filter envelope, prepared before sampling.

6. Prior to returning the filter to the Filter Envelope, record the Sample Start Time, End Date, End Time, and the Set-up and Retrieval $P_{stag}$ from the Tisch Hi-Vol Field Form on the transducer chart and on the Filter Envelope.

   **Note:** Prior to placing the exposed Filter in the filter envelope, the Filter Envelope and the back of the Transducer Chart should be labeled with the Filter Number, Site Name, Sampler ID Number, Sample Start Date and Time, Set-up $P_{stag}$, Sample End Date and Time, Retrieval $P_{stag}$, and the Elapsed Time.

7. Check the filter for signs of leakage. Leakage may result from a worn filter holder frame gasket or from an improperly installed gasket. Generally, a gasket deteriorates slowly, and the operator can determine in advance by the increased fuzziness of the sample outline that the gasket must be changed before total failure occurs.

   If it appears that leakage has occurred:
   - Void the sample. Write Void on the ACZ Chain of Custody Form and on the line of the Tisch Hi-Vol Field Form in the fields associated with that filter. Also write Void on the Filter Envelope associated with the voided filter.
   - Take corrective actions by installing a new gasket prior to starting a new sampling period.

8. Inspect the filter holder frame gasket to see if glass fibers from the filter are being left behind due to over-tightening of the filter holder frame wing nuts and to check for consequent cutting of the filter along the gasket interface.

9. Check the exposed filter for physical damage that may have occurred during or after sampling. Physical damage after sampling would not invalidate the sample if all pieces of the filter were put in the envelope; however, sample losses due to leakage during sampling would invalidate the sample so mark such samples “VOID” before forwarding them to the laboratory. VOID should be written on the ACZ Chain of Custody (only on the line for the voided filter), the Tisch Hi-Vol Field Form and on the Filter Envelope. Notation of the reason the filter is being voided should also be included.

10. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners).

11. Fold the filter widthwise so that sample touches sample. **Be sure to only touch the ends, not the corners or center of the filter.**

12. Place folded filter in the appropriate Filter Envelope and place the envelope in its associated zip bag.

    Note again that the Filter Envelopes should be labeled, while empty, with the Filter Number, Site Name, Sampler ID Number, Sample Start Date and Time, Sample End Date and Time, Set-up $P_{stag}$, Retrieval $P_{stag}$, and Elapsed Time. Avoid writing on the envelopes after the filter is in the envelope as that can damage the sample.

13. Place the zip bag with the exposed filter in the “exposed filters” box for temporary storage prior to shipment to the laboratory. Include any voided filters.

14. Record the requested information associated with the filter on the ACZ Chain of Custody Form (Figure 2).

15. Wipe any dirt accumulation from around the filter holder frame and snap cover lid with a clean cloth.

16. Call the appropriate Kleinfelder personnel to calculate the Flow Rate and Volume for each sample filter and record on Tisch Hi-Vol Field Form.

### 3.4 Prepare TE-5009 Continuous Flow Recorder – Transducer Chart

1. Inspect and clean any excess ink and moisture on the inside of recorder by wiping with a clean cloth.

2. Remove the transducer chart prepared for the next sample cycle from the field container.

3. Verify the Site Name, Filter Number, Sampler ID Number, and sample Start Date and Start Time on the back of the transducer chart.

4. Open transducer box mounted to inside door of sampler by unscrewing securing bolt. Depress pen arm lifter to raise pen point and carefully insert the transducer chart. Carefully align the tab of the transducer chart to the drive hub of the recorder and press gently with thumb to lower chart center onto hub. Make sure transducer chart is placed under the two chart guide clips and the time index clip so it will rotate freely without binding.

5. Use flathead screwdriver to turn the transducer chart and align the pointer with the appropriate day and approximate time. Lower the pen lifter arm.

6. Be sure the transducer pen is on the zero line. If it is not gently tap on the side of the transducer box to return pen to operating position. Do not directly adjust the pen to zero line as that may affect the sampler calibration and may void the samples. If pin does not return to the zero mark, contact appropriate personnel for further assistance. Close the transducer box (make sure securing bolt is snug to seal out moisture).

7. Make sure the pen point rests on the transducer chart with sufficient pressure to make a visible trace.

### 3.5 Setting the Sampler Clock

Please see Figure 5 for reference.

1. Flip the Set/Run switch to the “Set” position.

2. Press and hold the “clear” button and then depress the “Reset” button using a pen or small pointed device. Hold both of these buttons until the Screen on the timer says “Reset”. Release the “Reset” button and then release the “clear” button.

3. Press the SET UP Button.

4. Using the number pad enter the date mmddyy format. For example: March 28, 2008 would be entered as 032808.

5. Then enter the time in hhmm then press the AM or PM button. This time is not entered in a 24 hr format and thus the operator will convert this time to the 24 hour format for recording purposes. Time should be entered in Mountain Standard Time, not Mountain Daylight Savings Time to avoid daylight savings adjustments.

6. Press the Prog button.

7. Flip the Set/Run switch to the Run position.

8. Be sure that the Enable/Disable switch is in the "**Disable**" position.

9. Return to the Filter Setup Procedure – In the Field.

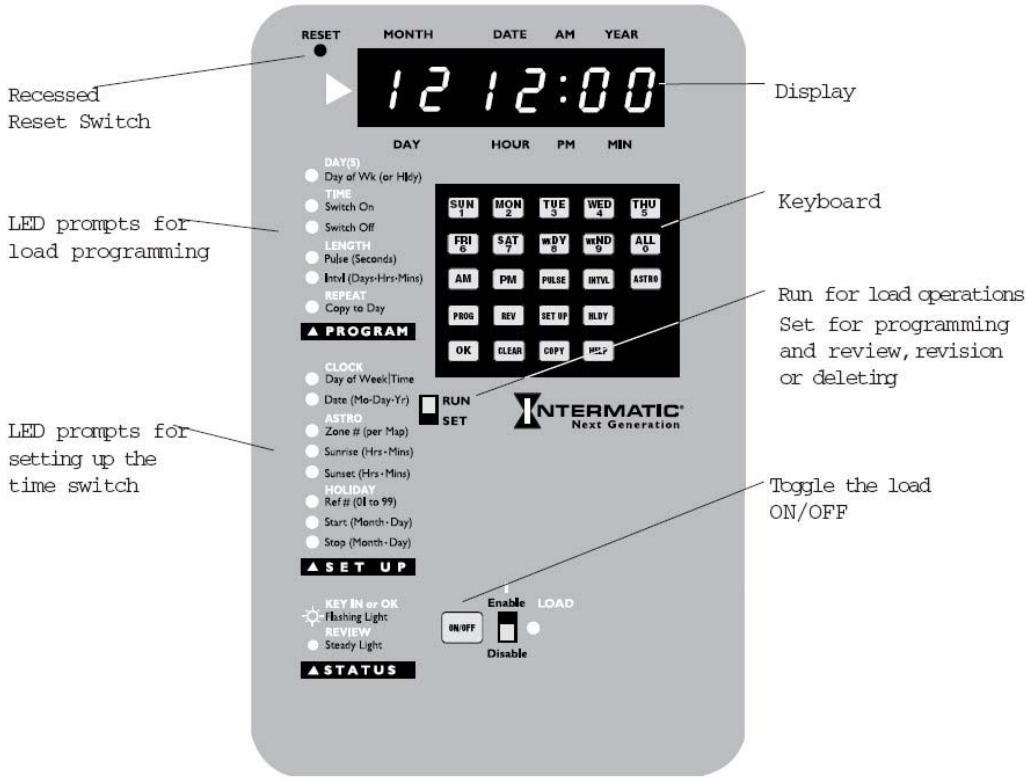


**Figure 5:** Digital Timer

## 4.0 TRIP BLANK

### 4.1 Necessary Equipment

Clean Filter
Clean Filters Box
Filter Envelope and Zip Bag
ACZ Chain of Custody Form
Tisch Hi-Vol Field Form
Writing Instrument

### 4.2 Frequency

The contract laboratory will send three extra filters for each quarter to be used as Trip Blanks for quality control purposes, which will allow for one Trip Blank per month.

### 4.3 Trip Blank Procedure

1. When a new shipment of samples is received from ACZ Laboratories, prepare a clean work surface for filter exchange procedures. Wash hands prior to handling filters.

2. Remove a clean filter from the “clean filters” box.
3. Remove the Filter Envelope from the zip bag.

4. Using a clean filter holder frame with clean screen, place the clean filter on the clean screen just long enough to record the necessary Trip Blank information on the Filter Envelope.

   **Be sure to only touch the ends, not the corners or center of the filter.**

5. Plainly write “Trip Blank” on the Filter Envelope. Also record the start date of the first sample run cycle associated with the trip blank on the Filter Envelope.

6. Record requested information on Tisch Hi-Vol Field Form.

7. Fold the Trip Blank and place in the Trip Blank envelope. **Be sure to only touch the ends, not the corners or center of the filter.**

8. Do not take this filter into the field. Place this filter envelope in storage during the period that corresponding samples are being exposed in the field. This filter will be shipped with a monthly shipment of samples.

9. Prior to placing the Trip Blank into the shipping container, carefully remove the filter from the filter envelope and place the Trip Blank on a clean filter holder frame with clean screen.

10. Write the End Date of the last sample cycle on the Filter Envelope and on all Tisch Hi-Vol Field Forms that will be included in the shipment with this Trip Blank.

11. Carefully return the filter to the Filter Envelope and the zip bag, and place in shipping container with other exposed filters.

12. Return the Trip Blank to the laboratory following the same procedure as used for sample filters.

## 5.0 DAILY/BI-WEEKLY INSTRUMENT CHECKS

### 5.1 Necessary Equipment

Timepiece
Checklist for Tisch Hi-Vol Sampler
Manometer for stagnation port (typically 0-40”$H_2O$) and Tubing
Site Notebook
Writing Instrument

### 5.2 Daily Check Procedure

1. Complete the Checklist for Tisch Sampler (Figure 1) while performing the daily check procedure.

2. Ensure that the sampler is operating.

   If the sampler is not operating, the cause should be determined (go to Section 5.3).

3. Verify that the Elapsed Time Indicator is operating correctly by confirming the hours are accurate for the time interval the sampler should have run based on when it was set up. For example, if the sampler ran for two full weeks, the elapsed time indicator will show 336 hours (24hrs/day x 14 days of operation).

4. Open sampler lid: if filter loading appears heavy, check the $P_{stag}$ reading.

   **Note:** If filter loading is heavy contact appropriate personnel as soon as possible. (see contact list in site binder). Filter exchange may need to be more frequent to avoid motor burnout and sample invalidation.

   - To check the $P_{stag}$ reading: Remove covers, turn on and zero the designated manometer (0-40 inches $H_20$ pressure range). Connect one side of the manometer to the stagnation port on the side of the sampler with the designated rubber vacuum tube (clip end to sampler port). Leave the opposite side of the manometer open to the atmosphere.

   - If the manometer reading is at or above 30 inches $H_2O$ note the date, time and pressure reading in the site notebook.

     - Turn the sampler off and note the time the sampler was turned off and the elapsed time in the site notebook.

     - Check the seal and gasket condition on the filter holder, and the motor mount ring. If the seal and gasket are in working order and the motor mount ring is tight. Particulate matter loading on the filter may be such that immediate filter exchange may be necessary. Contact appropriate personnel for next steps.

     - Remove and turn off the manometer and replace protective caps on manometer ports.

5. Ensure that the sampler is securely mounted and level. A level is not necessary for this task; simply check that the instrument has not been displaced and is upright.

6. Inspect the sampler for malfunction, damage, etc. Specifically, check for abnormal motor noises that could indicate motor bearing failure, malfunctioning flow controller, electrical cord damage, power outages, unreasonable elapsed time indications, audible and/or visual leaks in or around filter papers, deteriorated gaskets, signs of physical damage, lightning strike damage or vandalism.

7. Perform a visual inspection of the instrument, and note any damage that may affect sampler operation. If needed contact appropriate personnel for next steps.

If Maintenance is required:

- Please contact the appropriate personnel for next steps.
- Note any problems that could affect data recovery.
- Note all work done in the Site Notebook.

**Note:** Do not turn sampler off unless necessary.

### 5.3 Sampler Malfunction Noted During Check

1. Determine if electrical power is available to the sampler motor by verifying that the controller switches are "ON" and electrical connections are complete.

2. If electrical power is available, but motor is not running:

   - Replace sampler motor.
   - Initiate sampler calibration using the Tisch Calibration Form.

3. If electrical power is not available, notify appropriate personnel and take proper steps to determine the problem and have power restored as soon as possible. Inform appropriate personnel of the sampler malfunction as soon as possible.

### 5.4 Bi-Weekly Check Procedure

This procedure should be performed **once every two weeks**, coinciding with Filter Exchanges.

1. Complete the Checklist for Tisch Hi-Vol Sampler (Figure 1) while performing the bi-weekly check procedure.

2. Perform Daily Check Procedure (Section 5.2).

3. Verify flow recorder (Transducer Chart) is operating correctly. The pen should be recording on the current day of the week and approximate time.

4. Perform Filter Retrieval Procedure – In the Field (Section 3.2.2).

5. Inspect filter holder frame gaskets. If any gaskets need to be replaced, contact the appropriate Kleinfelder personnel using the contact list located in the site binders or in the office.

6. Check to ensure that motor mount ring is tight.

If Maintenance is required:

- Please contact the appropriate personnel for next steps.
- Note any problems that could affect data recovery.
- Note all work done in the Site Notebook.

### 5.5 Routine Inspection and Maintenance

A regular maintenance schedule will allow a monitoring network to operate for longer periods of time without system failure. Adjustments in routine maintenance frequencies may be necessary due to the operational demands of the samplers. Tisch Environmental, Inc. recommends that the following cleaning and maintenance activities be observed until a stable operating history of the sampler has been established.

### 5.5.1 Necessary Equipment

Timepiece
Paper Towels or Wipes
VFC Flow Rate Calibration Form
Checklist for Tisch Hi-Vol Sampler
Site Notebook
Writing Instrument

### 5.5.2 Monthly Sampler Inspection and Maintenance Procedure

1. Please complete the Checklist for Tisch Hi-Vol Sampler (Figure 1) while performing the following checks including sampler ID, date and time, technician name, etc.

2. Perform Daily and Bi-Weekly Checks before proceeding. However, do not perform filter exchange procedure prior to finishing the Monthly Inspection.

   If the sampler is not operating, the cause should be determined (go to Section 5.3).

3. Inspect and clean the filter screen.

4. The power cords should be checked for good connections and for cracks (replace if necessary).

   **CAUTION:** Do not allow power cord or outlets to be immersed in water!

5. Perform a visual inspection of the instrument, and note any damages that may affect sampler operation. If needed contact appropriate personnel for next steps.

   If Maintenance is required:
   - Please contact the appropriate personnel for next steps, unless trained or qualified to perform maintenance.
   - Note any problems that could affect data recovery.
   - Note all work done in the Site Notebook.

6. The sampler tubing should be checked for good connections and for cracks. Note any damages that may affect sampler operation. If needed contact appropriate personnel for next steps.

7. Reload with new sample filter for next run cycle (Filter Exchange Procedure in the Field Section 3.2.3).

## 6.0 CALIBRATION PROCEDURES

The Tisch samplers will be calibrated quarterly, or as needed by qualified personnel.

### 6.1 Necessary Equipment

Calibration Orifice and Top Loading Adaptor Plate
Manometer for Orifice Transfer Standard (OTS) (measures between 0-20”$H_2O$)
Manometer for stagnation port (measures between 0-40”$H_2O$)
Manometer Tubing
Calculator
Barometer

NIST traceable thermometer, accurate to ±1°C
VFC Flow Rate Calibration Form
Site Notebook
Writing Instrument

### 6.2 Sampler Calibration Procedure

1. Follow the Filter Retrieval Procedure – In the Field (Section 3.2.2) for removing the sample filter, but do not place sample filter for next run. Open transducer box mounted to inside door of sampler by unscrewing securing bolt. Depress pen arm lifter to raise pen point off transducer chart.

2. Record requested information on VFC Flow Rate Calibration Form (Figure 6).

3. Mount the calibrator orifice and top loading adapter plate to the sampler. A sampling filter is generally **not** used during this procedure. Tighten the top loading adapter; hold down nuts securely for this procedure to assure that no air leaks are present. Make sure the TE-5028A orifice is all the way open (turn the black knob counter clockwise).

4. Turn on the sampler and allow it to warm up for 10 minutes in order to reach its normal operating temperature.

5. Conduct a leak test by covering the holes on top of the orifice and pressure tap on the orifice with your hands.

   **Note:** Listen for a high-pitched squealing sound made by escaping air. If this sound is heard, a leak is present and the top loading adapter hold-down nuts need to be re-tightened.

   **Note: Avoid running the sampler for longer than 30 seconds at a time with the orifice blocked.** This will reduce the chance of the motor overheating.

6. Remove manometer inlet covers, turn on and zero the low-range manometer (0-20 inches $H_20$ pressure range). Connect one side of the manometer to the pressure tap on the side of the orifice with a rubber vacuum tube. Leave the opposite side of the manometer open to the atmosphere.

7. Remove manometer inlet covers, turn on, and zero the high-range manometer (0-40 inches of $H_20$ pressure range) and connect one side of the manometer to the stagnation port on the side of the sampler with the designated rubber vacuum tube (clip end to sampler port). Leave the opposite side of the manometer open to the atmosphere.

8. Record the manometer reading from the orifice (typically below 10 inches $H_20$) and the stagnation pressure (typically below 40 inches $H_20$) readings on the sampler VFC Flow Rate Calibration Form.

9. Repeat this procedure by turning the orifice (TE-5028A) knob a little bit (this will cause more resistance) and taking the manometer and continuous flow recorder

readings. Repeat this procedure until you have 5 sets of readings, ten numbers in all.

**Note:** During adjustments the orifice should remain open. Do not completely close orifice.

10. Record the ambient air temperature, the ambient barometric pressure, the sampler serial number, the orifice serial number, the orifice $Q_{standard}$ slope and intercept with date last certified, today's date, site location and technician name on the VFS Flow Rate Calibration Form.

11. Turn the sampler off.

12. Calculate difference between each of the measured Orifice Transfer Standard (OTS) flow rates and the corresponding values calculated by the new calibration equation and the stagnation pressure. These values should not differ by more than ±2%. If this is not the case, rerun the calibration. If a fit still cannot be reached, recheck the system to verify there are no leaks. Correct any problems and rerun the calibration. (See Appendix for an example of a Sampler Calibration Data Sheet.)

13. Return the sampler to normal operating condition, and install new sample filter per procedures (Sec. 3.2.3).

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**VFC Flow Rate Calibration**
High Volume Particulate Sampler

Network: _____ Calibrated by: _____
Date: _____ Ta: _____
Sampler ID: _____ Pa: _____
Sampler Type: _____ OTS ID: _____

OTS Relationship / Cal. Date: _____

| ΔP OTS | ΔPstg |
|---|---|
| | |
| | |
| | |
| | |
| | |

_____ Pen replaced
_____ Inlet Serviced
_____ % diff. < 2.0%
_____ 1.02 < 3 Qa < 1.24

_____ Motor Cushion
_____ Gaskets (explain)
_____ Motor
_____ Transducer Hose
_____ Transducer Recorder
_____ Electrical cord
_____ Other (explain)

**m =** _____
**b =** _____
**r =** _____

Comments: _____

**Figure 6:** Example VFC Flow Rate Calibration Form

## 7.0 AUDIT SCHEDULE

Independent auditing will be performed on a quarterly basis by VSI Environmental Monitoring Service. A plan outlining audit procedures and instruments to be used for auditing is provided in the appendices of the Energy Fuels Resources Corporation Uranium Mill Licensing Support Ambient Air Monitoring Plan for the Piñon Ridge Mill Site.

## 8.0 SHIPPING AND RECEIVING

Follow these steps for shipping and receiving of filters for the sampler:

### 8.1 Receiving

1. Check the ACZ Chain of Custody Form included with the shipment to be sure that the appropriate filters have been received and shipment is intact. In each monthly shipment there should be either 11 or 16 total filters: 2 or 3 Sample Filters per site and 1 Trip Blank per shipment.

2. Place shipping container in a secure location until filters are needed for field deployment. This shipping container should be designated the “clean filters” box.

### 8.2 Field Sheet Tracking

Copies of Field Sheets for Kleinfelder may be scanned and saved as pdf documents, and e-mailed to the appropriate Kleinfelder personnel instead of creating a hard copy.

1. **Tisch Hi-Vol Field Form:** Two copies should be made of the Tisch Hi-Vol Field Form associated with the filters to be shipped. One copy should be shipped with the filters, and one copy sent to the appropriate Kleinfelder personnel. The originals should be filed at the EFR site office.

2. **Chain of Custody Form** Two copies should be made of the Chain of Custody Form. One copy should be filed at the EFR site office, and one copy should be sent to the appropriate Kleinfelder personnel. The original Chain of Custody Form should be shipped to ACZ with the filters.

3. **Checklists and Calibration Forms:** One copy should be made of all Checklists and Calibration Forms. These copies should be sent to the appropriate Kleinfelder personnel. The originals should be filed at the EFR site office

4. **Transducer Charts:** Two copies should be made of the front and back of ALL transducer charts. One copy of each chart should be sent to the laboratory with the filters, and the other should be sent to the appropriate Kleinfelder personnel. The originals should be filed at the EFR site office. Personnel responsible for copying the Transducer Charts may fit as many transducer charts onto one page as possible, while not deterring from the quality of the copy.

### 8.3 Shipping

1. Shipments should be made by EFR to ACZ monthly.

2. Check all Filter Envelopes in the “exposed filters” box for proper labeling. This box will become the shipping container for shipping samples back to the contract laboratory.

3. Be sure that the ACZ Chain of Custody Form is filled out with necessary information.

4. Check shipping container to be sure all filters that are on the ACZ Chain of Custody Form, are in the shipping container, including any voided filters.

5. Prior to shipping, follow the Field Sheet Tracking procedure (Section 8.2).

6. Place a copy of the Transducer Charts in the appropriate filter zip bag.

7. Place the original ACZ Chain of Custody Form and copies of the Tisch Hi-Vol Field Form in shipping container.

8. Seal shipping container.

9. Complete shipping label and affix to shipping container.

10. Contact appropriate shipping company for pick up.

## References:


1. Quality Assurance Handbook for Air Pollution Measurements Systems, Vol. II, Part 2, USEPA, Environmental Monitoring Systems Laboratory.
2. Operations Manual: Tisch Environmental, Inc. TE-5170-DV-BL Total Suspended Particulate Brushless VFC High Volume Air Sampler
3. Energy Fuels Resources Corporation Uranium Mill Licensing Support Ambient Air Monitoring Plan Piñon Ridge Mill Site, 2008.

## Appendix:

The five orifice manometer readings taken during the calibration have been recorded in the column on the calibration worksheet titled ΔP OTS.

The five sampler stagnation pressure readings taken during the calibration have been recorded under the column titled ΔP stg.

For each flow rate, convert each stagnation pressure reading ($P_{stag}$) from (inches $H_20$) to (inches Hg) by dividing by 13.6. Calculate and record the absolute stagnation pressure ($P_1$), in inches Hg with the following equation: $P_1 = P_a - P_{stag}$, where $P_a$ is the atmospheric pressure.

For each flow rate, calculate and record the stagnation pressure ratio:

$$\text{pressure ratio} = \left( \frac{P_1}{P_a} \right)$$

Convert the orifice readings to the standard air flows they represent using the following equation:

$$\overline{Q}_a = \frac{\left( \left( \frac{\overline{P}_1}{P_a} \right) - b \right) \left( \sqrt{\overline{T}_a} \right)}{m}$$

Where:
$Q_a$=average actual flow rate, $m^3$/min
$P_1/P_a$=average stagnation pressure ratio
$T_a$=average temperature for the sample period, K
b=intercept of orifice calibration relationship
m=slope of orifice calibration relationship

EPA guidelines state that at least three of the calibrator flow rates that go into the average should be between 1.017 and 1.243 $m^3$/min. This is the acceptable operating flow rate range of the sampler. If this condition is not met, the sampler should be recalibrated.

**Note:** An air leak in the calibration system may be the source of this problem. In some cases, a filter may have to be in place during the calibration to meet this condition.

- Using $P_1/P_a$ (y-axis), versus $Q_{a(OTS)}/ \sqrt{T_a}$ (x axis). A slope, intercept, and correlation coefficient can be calculated using the least squares regression method.

  **Note:** The correlation coefficient should never be less than 0.990 after a five point calibration. A correlation coefficient below 0.990 indicates a calibration that is not

linear and the calibration should be performed again. If this occurs, it is most likely the result of an air leak during the calibration.

- The equations for determining the slope (m) and intercept (b) are as follows:

$$m = \frac{\sum xy - \frac{\left(\sum x\right)\left(\sum y\right)}{n}}{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}$$

$$b = \bar{y} - m\bar{x}$$

where: n=number of observations

$\bar{y} = \frac{\sum y}{n}$ $\bar{x} = \frac{\sum x}{n}$ $\sum$ = sum of

- The equation for the correlation coefficient (r) is as follows:

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]\left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

Where: n=number of observations

$\sum$ = sum of