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CLEAN AIR ACT COMPLIANCE FMPC RESPONSE TO ITEM G OF CLEAN AIR ACT SECTION - FFCA FEDERAL FACILITIES COMPLIANCE AGREEMENT

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REPORT

FMPC

Clean Air Act Compliance

FMPC Response to Item G of
Clean Air Act Section - FFCA

FEDERAL FACILITIES COMPLIANCE AGREEMENT

90-Day Deliverable

October 16, 1986

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INTRODUCTION

Item G for the Clean Air Act section of the compliance agreement specifies that the operation and maintenance (O&M) programs be furnished for air pollution control devices. Therefore, five such programs have been assembled and are herewith included. The programs are as follows:

A- Plan for Dust Collectors

B- Plan for Boiler Plant Electrostatic Precipitators

C- Plan for Plant 6 and 9 Precipitators

D- Plan for Air Scrubbers

E- Guidelines for Exhaust System Filtration Components

FEED MATERIALS PRODUCTION CENTER

OPERATION AND MAINTENANCE PLAN

FOR

DUST COLLECTORS

SEPTEMBER, 1986

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INTRODUCTION

The FMPC is a large scale production facility operating in excess of 400 air emission sources* which have the potential to emit air pollutants to the atmosphere. The FMPC utilizes high efficiency dust collection and scrubber systems to control particulates and gaseous emissions. Emissions from the facility are limited to quantities of listed criteria pollutants, radionuclides and trace amounts of hydrogen fluoride (HF) and kerosene fumes.

Overview of Current Air Pollution Control Programs

A comprehensive Air Pollution Control Program is in effect at the FMPC to minimize the emission of air pollutants to the atmosphere and ensure continued regulatory compliance. The program's objective is to effectively reduce air pollutant discharges from plant emission points in order to reduce worker and public exposure and minimize associated environmental impacts due to plant operations.

All particulate emission points with the potential to emit radionuclides to the atmosphere (there are a total of 59 at the FMPC) are equipped with stack samplers. These samplers draw a continuous sample from a fixed point within the stack across a pleated filter paper at an isokinetic rate. The filter papers are inspected at least once per week and changed if they show soiling. If no soiling is evident, filters are changed monthly, at a minimum. Critical dust collector samplers are inspected twice weekly. Upon removal, all filter papers are analyzed to determine both particulate and radionuclide emission levels.

Isokinetic flow rate for each sampler is based upon velocity traverse data obtained in the stack. Traverse data is collected from each stack annually, and the sample flow rate that gives a representative sample is determined. The sample flow is adjusted using a sampler rotameter, and the calibration of sampler rotameters is checked weekly. Plant personnel check rotameter settings hourly to ensure that the sample flow is present.

Twenty-two FMPC emission stacks are currently equipped with Ludlum breakthrough monitors. These monitors are designed to give operators an immediate alarm in the event of failure (breakthrough) of the filter system by continuously monitoring the sampler filter paper for radioactivity. All monitors are tied into control panel boards with audible alarms to alert operating personnel. The fifteen most recently installed monitors are linked to the FMPC central alarm system which sounds in the Guardhouse Communications Center. A data base of monitor count rate records has been established to statistically define optimum monitor action level settings. Panel board alarms are checked every two weeks to assure they are functioning properly. Monitors are calibrated electronically and checked with a check source semiannually.

*An emission "source" is defined as each individual piece of equipment that generates a potential pollutant. An emission "point" is a stack, or other device, where emission actually takes place. Thus, many "sources" may be involved in a single emission point.

Under the provisions of DOE Order 5480.14 and the Comprehensive Environmental Response Compensation and Liability Act (CERLA) of 1980, the release of one pound of radionuclides above normal operating losses from a source to the atmosphere mandates the shutdown of processes involved and the implementation of specific response and reporting procedures. Normal operating losses are those levels established by the source operating permits. The FMPC operates in compliance with these regulatory requirements.

The Production Operations Department is responsible for operations of emission control equipment, exclusive of sampling/monitoring instrumentation. This department also has responsibility for preventative and routine maintenance. Operational procedures involving emission control systems are reviewed and approved by the Environmental Compliance Group prior to implementation.

REASONS FOR OPERATION AND MAINTENANCE

This Operation and Maintenance Plan has been prepared to explain dust collector activities necessary to keep the units operating at peak efficiency and to satisfy the 90 day FFCA requirement.

This plan addresses three types of dust collectors--Manual Shaker, Pulse Jet, and Blowring--and was written to be of a general nature and not specific to a particular collector.

Similar type collectors may differ slightly in their operation and associated maintenance. Standard Operating Procedures have been prepared for each dust collector at the FMPC and should be consulted should specific information on an individual collector be sought.

DESCRIPTION OF OPERATION AND EQUIPMENT

Uranium and uranium contaminated dust are routed through the collectors where the dust is removed from the air stream and filtered air exhausted to the atmosphere.

Exhaust fans direct the flow of dust-laden air from equipment enclosures, bins, hoppers, dumping and drumming stations, and processing equipment to the dust collectors. Dust removed from the collectors is placed in drums.

Baghouses

*Bag or fabric filters, typically enclosed in a metal housing called baghouses, remove particulates from a gas or air stream by filtering the airborne particulates (by impaction or diffusion) through a porous flexible fabric made of a woven or felted material. These collected particles form a structure of their own, supported by the filter, and have the ability to intercept and retain other particles. The increase in retention efficiency is accompanied by an increase in pressure drop through the filter. The baghouses are equipped with one of several automatic cleaning mechanisms for periodically dislodging collected material from filter components to prevent excessive resistance to the flow (i.e., excessive pressure drop) that would otherwise develop. The dislodged material settles in storage hoppers before the filter components are placed back on stream. The automatic cleaning cycle can be initiated by either a differential pressure switch or a timer, which may be interlocked with the main fan motor for the baghouse.

*USNRC Regulatory Guide, May 1986

The cleaning mechanisms employed in baghouses are based on either mechanical shaking of the filter components or pneumatic vibration of these components by high-pressure air applied in reverse flow, reverse jet, or reverse pulse modes. The effectiveness of these compressed air systems depends on maintaining a sufficient reservoir of compressed air at the pressure specified by the baghouse manufacturer. Higher pressures than specified could cause failure of the filter fabric, while lower pressures can result in poor filter cleaning. These problems are minimized by pressure-regulating devices used in the compressed air systems.

The most critical parameter to be observed during baghouse operation is the pressure drop. Proper operation of the baghouse requires, at a minimum, maintaining the differential pressure of this device in the correct range specified by the manufacturer. A manometer or a differential-pressure gauge and transmitter are usually provided for this purpose. This instrumentation is often supplemented by an audible alarm system designed to signal and alert mill operators when prescribed differential-pressure ranges are exceeded. Lower differential pressures indicate potential deficiencies such as damaged filters or other air bypass channels that should be corrected. Higher differential pressures indicate that cleaning operations are inadequate. This can be corrected by increasing the frequency of the automatic cleaning cycle through adjustment of the differential-pressure switch or timer of the baghouse installation.

Blowring

Blowring type collectors contain vertically positioned cylindrical bags which are formed of fabric. The dust-laden air is routed through the interior of the bags, and the filtered air exits through the bag exterior. In time, a layer of dust accumulates on the interior surface. Blowrings, which encircle the bags, are mechanically driven up and down the length of the bags when the pressure difference between the inside and outside of the bags attains a preset magnitude. High pressure cleaning air, supplied to the blowrings by positive displacement air pumps, causes the dust accumulations on the inner surfaces of the bags to fall into the bins or hoppers. This dust is discharged directly to drums through a drumming station.

Mechanical Shaker

The Shaker type dust collector contains vertically positioned cylindrical bags that operate similar to the blowring type dust collector except the bags are cleaned by means of a motor shaker.

Pulse Jet

The Pulse Jet type dust collector has vertically positioned cylindrical bags which are cleaned by pulses of air emitted from fixed high pressure air jets.

INDUSTRIAL SAFETY AND HEALTH REQUIREMENTS

Observe all nuclear safety requirements for dust collector material per Manufacturing Specification 4-BN/E-410-1 and 4-BN-480-1.

A dust-type respirator fitted with cartridges approved for radionuclides shall be worn when there is possible contact with dust.

Leather-palm gloves shall be worn when handling drums or when working with dust collector equipment.

Move and store dust collector material per Standard Operating Procedure 20-C-101.

When working in dust conditions, vacuum excessive nuclear material from the exterior of clothing before removing the respirator.

Respirators must be worn anytime a dust collector is entered. A dust-type air-purifying respirator may be worn when exposure periods inside a dust collector do not exceed five minutes. An airline respirator shall be worn for exposure periods inside a dust collector which exceed five minutes.

Disposable outer coveralls will be worn by anyone entering a dust collector for cleaning or bag removal. Upon exiting the collector, the disposable garments will be discarded in a properly labeled drum.

Safety glasses shall be worn at all times.

Dust spills shall be immediately vacuumed.

Exhausters shall remain on while the equipment served is in use, except in an emergency, or during the inspection of the units. If the dust collector must be shut down, follow the procedure in Table 2, "Operator Emergency Shutdown." The shutdown procedure shall be posted on each dust collector control panel.

Process clothing shall be worn and be completely buttoned when working inside the dust collector.

Before entering the filter housing enclosure, check that a "Work Permit" Form FMPC-EH&S-973 has been issued and is posted outside the collector.

Before entering the baghouse enclosure, lock and tag "Out Of Service" the power equipment to the collector and the associated unit including the main exhaust motor, blowring blower motor, and blower motor per FMPC "Lock and Tag Procedure," Section 8.3, FMPC Environmental Safety and Health Manual.

Any circumstance which could have resulted in a significant intake of radioactive materials by inhalation, ingestion, or absorption will be immediately reported to a supervisor. The involved employees, wage or salary, will report to the Medical Department at the end of their shift to submit a urine sample and again report at the start of their next shift to submit another urine sample. The supervisor will inform the Industrial Hygiene Technician of the circumstance and file a minor event report before the end of the shift during which the circumstance happened.

Use care when handling dirty bags to minimize spillage of dust. Spillage shall be vacuumed as soon as possible in order to minimize the spread of possibly contaminated material to clothing and to areas outside the dust collector enclosure.

OPERATING PROCEDURES

Mechanical Shaker Type

Turn off the main power disconnect.

Start the differential pressure recorder-controller.

Set the differential pressure recorder-controller at settings as indicated in collector Standard Operating Procedure. Open the air inlet valves and close the bypass and drain valves. Alarm points are preset by maintenance.

Starting the dust collector:

Press the "START" button for the main exhauster blower, ring blower, and drive motor.

Shutting down the dust collector:

Press the "STOP" button for the exhauster motor.

Note: The blowring drive and high pressure blower motors are interlocked with the exhauster motor switch.

Empty the dust collector after the drums are dumped into a hopper and before the material is removed from loading stations. Discharage the dust from the collector into the hopper as follows:

Perform a scale check of the scale in use per applicable SOP.

Tare weigh a 30 or 50-gallon drum, record the weight on a "Residue Production - Transfer and Identification" Form FMPC-AC-1945 and attach the ticket to the drum.

Premark the drum with the 15-digit lot number and place the drum under the dust hopper inlet.

Open the discharge valve.

Start the automatic bag shaker.

To prevent overfilling while discharging the dust, frequently check the drum by tapping or by visual inspection.

Close the discharge valve.

Remove the full drum and replace with a pretared, premarked empty drum.

When the shaker cycle is complete, push the shaker "STOP" button.

When the hopper is empty, restart the main blower.

Gross weigh the filled drum(s). Enter the lot number, drum number, gross, tare, and net weights on Form FMPC-AC-1945. Stencil the date on each drum.

Record on Form FMPC-PRO-1127 that the dust collector was emptied.

Forward the Form FMPC-AC-1945 to the Production Recording office.

Send the filled drums to Plant 1.

Blowring Type

Turn on the main power disconnect.

Open the exhaust blast gate to atmosphere.

Start the differential pressure recorder-controller.

Set the differential pressure-recorder at settings indicated in collector SOP. Open the air inlet valves, and close the bypass and drain valves. Alarm points are preset by maintenance.

Starting the dust collector:

Press the "START" button for the main exhaust blower, ring blower, and drive motor.

Set the selector switch on "AUTO."

Shut down the dust collector as follows:

Press the "STOP" button for the exhauster motor.

Close the blast gate.

Empty the dust collector as follows:

Attach the vacuum hoses to the drum hood.

Perform a scale check of the scale in use per SOP 4-C-901.

Tare weigh a 30 or 50-gallon drum, record the weight on a "Residue Production - Transfer and Identification," Form FMPC-AC-1945 and attach the ticket to the drum.

Premark the drum with the 15-digit lot number and place the drum under the dust hopper outlet.

Shut down the main blower and turn on the rotary valve.

To prevent overfilling while discharging the dust, frequently check the drum by tapping or by visual inspection.

Remove the full drum and replace with a pretared, premarked empty drum.

When the hopper is empty, turn off the rotary valve and restart the main blower.

Gross weigh the filled drum(s). Enter the lot number, drum number, gross, tare, and net weights on Form FMPC-AC-1945. Stencil the data on each drum.

Record on Form FMPC-PRO-1127 that the dust collector was emptied.

Forward the Form FMPC-AC-1945 to the Production Recording office.

Send the filled drums to Plant 1.

Pulse Jet Type

Turn on the main power disconnect.

Start the differential pressure recorder-controller.

After startup and once each hour, check that the manometer is registering the readings as listed in the SOP for the particular collector. Record the readings on Form FMPC-PRO-2617.

Note: If reading exceeds listed limit, activate reverse air to clean bags.

Turn on main exhauster blower.

Turn on the air supply to the bag cleaning mechanism.

Set the selector switch on "AUTO."

Shut down the dust collector as follows:

Press the "STOP" button for the exhauster blower.

Empty the dust collector as follows:

Place all empty drums under the discharge valve.

Open the discharge valve.

Fill the drum. Check the drum frequently to prevent overfilling.

When the drum is full, close the discharge valve.

Remove the filled drum and replace it with an empty drum.

Record on Form FMPC-PRO-1127 that the dust collector was emptied.

Send the filled drum to the appropriate facility for disposal.

INSPECTION AND FREQUENCY

Every Service Hour

Every hour of operation perform the following for all collectors:

Check the differential pressure and record on Form FMPC-PRO-2623, "Dust Collector Differential Pressure Check Sheet."

If the pressure reading or manometer reading is above the upper limit as listed in the collector SOP. "Dust Collector Differential Pressure Recorder-Controller Settings and Manometer Readings," check that the instruments are functioning properly and clean the bags or operate the blowrings as required.

If the pressure reading or manometer is below the lower limit as listed in the collector SOP, turn off the dust collector and check for leaking bags.

Notify the supervisor if the trouble cannot be corrected.

Note on the differential pressure recorder chart that the dust collector was down.

If the collector is equipped with a temperature gauge, check for a sudden rise in temperature. If there is a sudden rise, notify the supervisor.

Check the radiation stack monitor and record the readings on Form FMPC-PRO-2608, "Dust Collector Stack Monitor Readings." If the reading increases more than 10 percent of any scale in one hour, notify the supervisor and the Industrial Hygiene Technician.

Check the stack sampler rotameter for proper flow and record the reading on Form FMPC-PRO-2612, "Stack Sampler Check Sheet." If necessary, adjust the flow and record the adjusted flow on Form FMPC-PRO-2612.

Every Eight Service Hours

Each shift of operation perform the following for all collectors:

Check the high and low differential pressure alarms. Record that the check has been completed on Form FMPC-PRO-1127, "Daily Check of Dust Collectors." Date and replace the recorder chart if less than eight hours remain on the chart. Charts may be used for three days at the rate of one shift per day.

Change and initial the differential pressure recorder chart. Forward the completed chart to the office of the supervisor.

At a time specified by the supervisor shut down the collector and inspect the collector per items on Form FMPC-PRO-2609, "Dust Collector Inspection Check Sheet."

WARNING: WEAR A DUST-TYPE RESPIRATOR DURING INSPECTION. If the collector is equipped with a shaker mechanism, shake down the bags. Manually operate the blowring mechanism on collectors equipped with blowrings.

If problems exist after inspection per items on Form FMPC-PRO-2609, "Dust Collector Inspection Check Sheet," the supervisor is to correct the problems per Table 4, "Inspection Troubleshooting Guide." If damaged bags are found, notify the Maintenance Department.

OPERATOR EMERGENCY SHUTDOWN

Notify appropriate area operators to shut down operations.

Shut down the dust collector by pushing the exhauster "STOP" button.

DIFFERENTIAL PRESSURE ALARM

Sounding of a Differential Pressure Alarm or Indications of High or Low Differential Pressure on the Recorder--Operator and Supervisor Responsibility

Operator Responsibility

Note: If the supervisor cannot be located immediately, shut down the dust collector per "Operator Emergency Shutdown." Emergency information is listed by number for each dust collector. Notify the supervisor of the dust collector shutdown.

Note: Information contained in "Operator Emergency Shutdown" is posted on each dust collector control panel.

Supervisor Responsibility

If the dust collector is not shut down, shut it down per "Operator Emergency Shutdown." Lock and tag "Out Of Service" the dust collector main exhaust motor per Lock and Tag Procedure (Section 8.3, "FMPC Environmental Safety and Health Manual."

Notify an Industrial Hygiene (IH) Technician.

Industrial Hygiene Technician Responsibility

Check monitor for proper operation. If the monitor is operating properly, check for a soiled sample filter and if the filter is changed, submit the soiled filter for normal analysis.

Notify the supervisor of filter condition.

Notify the supervisor of soiled filter analysis.

If the Industrial Hygiene Technician reports the filter is not soiled and if the cause of low or high differential pressure cannot be determined, notify the Instrument Shop to service the differential pressure gauge.

WARNING: THE CAUSE OF HIGH OR LOW DIFFERENTIAL PRESSURE MUST BE DETERMINED BEFORE CONSIDERATION CAN BE GIVEN TO RESTARTING THE COLLECTOR AND OPERATIONS SERVED BY THE COLLECTOR.

Notify the Plant Manager of condition of the soiled filter being analyzed, or if the filter was not soiled, what action has been taken.

Inspect the collector for evidence of dust, and if dust is present, determine the source.

If there is no visual evidence of a dust collector problem, initiate a fluorescein dye test. Report the results of the dye test to the Plant Manager.

Obtain the filter analysis and notify the Plant Manager.

Note: Do not restart the dust collector or operation(s) served by the dust collector until an analysis of the stack loss has been reported and approval to restart has been granted by the Plant Manager.

If the Plant Manager determines from the filter analysis that there has been a dust loss, and the leak has not been located, run a dye test to find the leak.

If a leak source has been located, clean the collector and notify the Maintenance Department to make repairs.

After repairs are complete, clean the collector and run a dye test.

At completion of the dye test, complete Form FMPC-PRO-2610.

Notify the Plant Manager of the results of the dye test.

Note: The Plant Manager shall make the determination to restart the collector.

Check for the specified differential readings and record them once each hour.

A "Minor Event" report is to be completed by the supervisor prior to the completion of the shift.

STACK MONITOR ALARM - OPERATOR AND SUPERVISOR RESPONSIBILITY

Operator Responsibility

Notify the supervisor.

Note: If the supervisor cannot be located immediately, shut down the dust collector per "Operator Emergency Shutdown." Emergency information is listed for each dust collector by number. Notify the supervisor of the dust collector shut down.

Note: Information relevant to "Operator Emergency Shutdown" is posted on each dust collector control panel.

Supervisor Responsibility

If the dust collector is not shut down, shut the collector down per "Operator Emergency Shutdown." Lock and tag "Out Of Service" the main exhauster motor per Section 8.3, FMPC Environmental Safety and Health Manual.

Notify an Industrial Hygiene Technician.

Industrial Hygiene Technician Responsibility

Check the monitor for proper operation. If the monitor is operating properly, check it for a soiled filter. If the filter is changed, submit the soiled one for normal analysis.

Notify the supervisor of the filter condition.

Notify the supervisor of the soiled filter analysis.

Notify the Plant Manager of the condition of the soiled filter being analyzed.

Inspect the collector for evidence of dust, and if dust is present, determine the source.

Obtain the filter analysis and notify the Plant Manager.

Note: Do not restart the dust collector or operation(s) served by the dust collector until an analysis of the stack loss has been reported and approval to restart has been granted by the Plant Manager.

If the Plant Manager determines from filter analysis that there has been a dust loss, and the leak has not been located, initiate a fluorescein dye test to find the leak.

FLUORESCEIN DYE TEST

Check that all dust collector bags are in place inside the baghouse.

If repairs have been completed, "Post-Maintenance Check Sheet," Form FMPC-PRO-2610 must be completed before proceeding with dye test.

Turn on the exhaust blower of the dust collector.

Note: High vacuum and blowring units must be turned off during the dye test.

Add fluorescein dye to the dust collector system at the closest possible inlet to the baghouse so that the dye is routed through the baghouse.

Note: The amount of dye added to the system is determined by the amount of filtering area in the baghouse. Specifications require that 1 lb. dye/1000 sq. ft. of filter area be added to the system.

Allow the dust collector to run for 30 seconds after all of the fluorescein dye has been added to the system.

Lock and Tag "Out Of Service" the main exhaust blower and electrical controls prior to entering the baghouse per Section 8.3, FMPC Environmental Safety and Health Manual.

Obtain all necessary equipment including required safety items as specified in "Industrial Health and Safety Requirements." Enter the baghouse with an ultraviolet light to check the bags.

Note: Do not enter the baghouse unless another operator is on standby outside of the baghouse enclosure.

Using the ultraviolet light, check the bags for fluorescein dye particles. Detailed inspection should be on the bag/flange connections, seams and flange/baghouse wall interfaces, and all surfaces of the bags.

Have the Industrial Hygiene Technician remove the stack sampler filter for ultraviolet light inspection.

If the leak source has been located, clean the collector and notify the Maintenance Supervisor to make repairs.

After repairs are completed, clean the collector and run a dye test.

At completion of the dye test, complete the Form FMPC-PRO-2610.

Notify the Plant Manager of the results of the dye test.

Note: The Plant Manager shall make the determination to restart the collector.

INSPECTION TROUBLE SHOOTING GUIDE

Item No.	Problem	Condition And/Or Cause	Corrective Action
1	Dust on the floor of the baghouse.	Broken bag/ Loose bag connection	Notify the Maintenance Department to replace bag or repair connection.
2	Dust on the blowrings	Broken bag/ Blowring binding/ Loose bag	Notify the Maintenance Department to replace bag/repair blowring/ tighten connection.

3	Misalignment of the blowrings	Broken blowring/ Loose bag	Notify the Maintenance Department to repair blowring or bag connection.
4	Blowring chain drive or cable malfunction	Chain/ Cable broken	Notify the Maintenance Department to repair chain or cable.
5	Reversing motor malfunction	Electrical problems	Notify the Maintenance Department to repair broken or loose hose.
6	Blower hose leaking	Broken hose or loose connection	Notify the Maintenance Department.
7	Damaged or broken bags	Bag installation/ Connection loose	Replace bag.
8	Bag loose at the flange connections, top and bottom	Improper installation	Notify the Maintenance Department to tighten connections.
9	Dye check - Leak indications	Bag installation/ Hose connections/ Bag damage	Check bag condition and connections/ hose connections. Inspect dust collector.
10	Dust inside the Hoffman unit	Bag connections/ Bag damage	Notify the Maintenance Department to repair or replace bags. Inspect bag conditions and connections.
11	Dust leaking around the bags	Bag connection/ Improper installation or bag damage	Notify the Maintenance Department to repair.
12	High differential pressure	Blowring drive "OFF"/reverse air "OFF"/blowring or drive malfunction/air solenoid or bag shaker malfunction/ defective blowring hoses or connections.	Notify the Maintenance Department to repair.
13	Low differential pressure	Defective connections/ bags	Notify the Maintenance Department to repair.

UNUSUAL CIRCUMSTANCE

Any Unusual Circumstance Shall Be Considered As A Possible Failure Until Determined Otherwise and the Supervisor Shall Proceed as Follows:

Shut down the collector per "Operator Emergency Shutdown." Lock and tag "Out Of Service" the main exhaust motor per Lock and Tag Procedure (Section 8.3, FMPC Environmental Safety & Health Manual.)

Notify the Plant Manager.

Request an Industrial Hygiene Technician to check the sampler filter.

Visually check the collector.

Initiate a fluorescein dye test.

A "Minor Event" report is to be completed by the supervisor prior to the completion of the shift.

FILTER CHANGE AND INSPECTION

Production Operations

Stack Sampler Filter - Inspection and/or Change

Stack sampler filters are checked once each week and changed at least once per month by an Industrial Hygiene Technician.

Industrial Hygiene Technician Responsibility

Notify the supervisor of the filter inspection and/or change.

Notify the supervisor of the condition (soiled or unsoiled) of the filter.

If the filter is changed, submit the filter for normal analysis.

Notify the supervisor of the filter analysis.

Supervisor Responsibility

If the filter is changed but is not soiled, resume normal operation of the dust collector.

If the filter is soiled, shut down the dust collector per "Operator Emergency Shutdown." Lock and tag "Out Of Service" the main exhaust motor per Lock and Tag Procedure (Section 8.3, FMPC Environmental Safety & Health Manual.

Notify the Plant Manager of the condition of the soiled filter being analyzed.

Inspect the dust collector for evidence of dust, and if dust is present, determine the source.

Obtain the filter analysis and notify the Plant Manager.

Note: Do not restart the dust collector or operation(s) served by the dust collector until an analysis of the stack loss has been reported and approval to restart has been granted by the Plant Manager.

If the Plant Manager determines from the filter analysis that there has been a dust loss, and the leak has not been located, run a dye test to find the leak.

If the leak source has been located, clean the collector and notify the Maintenance Supervisor to make repairs.

After repairs are complete, clean the collector and run a dye test.

At completion of the dye test, complete a Form FMPC-PRO-2610.

Notify the Plant Manager of the results of the dye test.

Note: The Plant Manager shall make a determination to restart collector.

A "Minor Event" report is to be completed by the supervisor prior to the completion of his shift.

Environmental Safety & Health

Definitions

Stack Sampler - A device mounted on the exhaust stack, consists of a single-point sample extraction tube and a filter holder. A controlled volume of air is pulled from the exhaust stack by a vacuum pump. This air passes through a pleated filter located inside the filter holder. Any particulate material is collected on the pleated filter.

Pleated Filter - Staplex TFA "S" pleated cellulose paper filter, four inches in diameter, designed for high flowrates.

Rotameter - An airflow measuring device that consists of a graduated glass tube containing a free floating metal ball. The rotameter is used at the stack sampler to measure the airflow being drawn through the stack sampler. The rotameter is placed between the stack sampler and the vacuum line by use of quick disconnect fittings that are present on the stack sampler and the rotameter.

Sampling Rate - The volume of air being drawn through the stack by a vacuum pump. Each stack's velocity has been measured, and the sampling rate is set so the flowrate through the stack sampler is equal to the flowrate in the stack at the sampler location.

Ludlum Stack Monitor - A beta-gamma radiation detection instrument consisting of a control/meter box, a section of coaxial cable, and a Geiger-Muller (GM) pancake probe. The GM probe is located beneath the filter in the stack sampler assembly, as material collects on the filter, a signal is delivered to the control box which is located at the dust collector panelboard (or any

location convenient to Production Operations). The stack monitor has an alarm mechanism that can be set to alarm at the panelboard if any material collects on the stack filter.

Required Equipment

Rotameter, 0 to 60 Lpm, with Schrader or Swagelok fittings.

Pre-numbered type "S" pleated filters.

Polyethylene bags.

Screwdriver and pliers.

Stack Sampler Inspection Report (FMPC-ES&H-2239 through 2242) (hereinafter called the "Inspection Report").

Dust Collector Log Book.

Final Stack Sampler Results Form (FMPC-ES&H-1510).

Stack Discharge Report (FMPC-ES&H-2563).

Procedure for Filter Inspection and Change

All stack samplers shall be inspected once each week and all filters will be changed at least once per month.

Fifteen critical dust collectors (identified by Production) will have their filters changed twice per week.

Obtain required equipment at ES&H Decontamination room. Obtain numbers of installed filters and prescribed flow from the Stack Log Book and fill in on Inspection Report.

At the control panel of the dust collector being inspected, observe the differential pressure chart.

Log the high and low pressure on the Inspection Report. Also, see that there is no unusual pattern on the chart and that the collector cleaning mechanism is operating in the correct differential pressure range.

Any unusual or incorrect operation should be noted in the "Remarks"section of the Inspection Report.

At the control panel of the dust collector being inspected, observe the Ludlum stack monitor.

Record the reading from the stack monitor on the Inspection Report.

Record the stack alarm set point on the Inspection Report.

At the stack sampler, check to see that the stack sampler, vacuum tubing, and other sampling equipment is operating properly. If any defects are found, note them in the "Remarks" section.

Determine the existing sampling rate by inserting the rotameter between the vacuum line and the filter holder.

Record this reading under "Rate-actual" on the Inspection Report and adjust to prescribed rate, if necessary.

If the prescribed rate is not obtainable, this should be noted on the Inspection Report sheet.

Strike the cone section of the filter holder several times around the periphery of it with the handle of the screwdriver to dislodge any material that might be clinging to the inside of the cone.

Using the screwdriver, loosen the three 1/4" bolts and carefully lower the bottom section of the filter holder.

If the filter shows evidence of any accumulation of material, remove the pleated filter and place it in a plastic sample bag. Care must be taken to assure that none of the material falls from or is blown off of the filter while it is being removed and placed in the bag.

If a filter change is necessary, insert a new pleated filter (prenumbered) in the filter holder.

Using the three 1/4" bolts, secure the filter holder tightly to the cone using pliers and screwdriver.

If no change is made, check that the filter number is correct before closing the filter holder.

Recheck the sampling rate of the stack sampling assembly. Adjust to the prescribed rate, if necessary.

Remove the rotameter and reconnect the vacuum line to the sampler.

If the prescribed rate could not be obtained, note this on the Inspection Report sheet.

If the filter has been changed and it is clean, go to the next dust collector and continue the inspection by repeating the above steps until all dust collectors in the plant are inspected.

If any fiters were changed or if there is any deficiency in a sampler or dust collector operation, advise the plant supervisor or his representative of the facts before leaving the plant and make suggestions for correcting any deficiencies. Note the plant supervisor's name or his representative's name and the time and date he was notified on the Inspection Report sheet.

If the filter has been changed and there is an accumulation of material on the filter, immediately inform the plant supervisor or his representative of this finding and take the soiled filter to the Sample, Receiving Laboratory, Room W-34. Fill out a Report of Chemical Analyses form (FMPC T-200) with all required information for the analysis of the filter removed for the stack sampler.

Under "Sample Description" write the date the filter was put into the sampler and the date it was taken for analysis.

Request analysis for total uranium and total particulates.

The Environmental Radiation Monitoring (ERM) Technician or Technologist shall ask the Technical Laboratory to perform the analysis immediately and to telephone the results as soon as they are available.

Any irregularities noted on the Inspection Report shall be brought to the attention of an ERM or IH Technologist on returning to the Decontamination Room after the inspection is completed.

Record Keeping

During the actual inspection of the stacks, a rough copy of the Inspection Report is carried in a pocket because it is unsafe to climb ladders with a clipboard. This copy is prepared before the inspection by copying the filter identification number and the prescribed sampling rate from the Stack Sampling Log Book.

During the inspection the actual rate in the L/m column is filled in for each sampler. The flow measurement is the rate of sampling in L/m. The differential pressure reading minimum and maximum are the high and low readings on the differential pressure chart. The Ludlum (CPM) is the reading taken from the stack monitor before the filter is inspected, and after the filter is changed. The Alarm Set Point is recorded from the Ludlum stack monitor.

After the inspection is complete, all information that has been recorded on the rough copy of the Inspection Report must be transferred to the permanent record copy of the Inspection Report.

Copies of the Inspection Report shall be prepared and distributed as directed on each Stack Sampler Inspection Report:

- Original routed to the Environmental Compliance Subsection Engineer for review. On return, it will be filed in the Stack Log Book and shall be the record copy.
- Copy to Vice-President & Manager, Production Operations
- Copy to Chemical Area/Metal Area Manager
- Copy to General Supervisor
- Copy to Area Supervisor
- Copy to Production Supervisor

Each filter change must also be recorded in the Dust Collector Log Book.

The filter number of the new filter and the date it was put into service is logged on the line below the old filter number. The date the old filter was taken out of service is logged in the line starting with the old filter number.

The old filter number, stack number, and the dates the filter was in the sampler should be recorded on an Analytical Data Sheet and on a Final Sampler Result form.

As soon as the Technical Division reports the results of the analysis of the stack filter samples to the ERM Department, the ERM Technician will immediately calculate the losses and record them in the Dust Collector Log Book and on the Final Stack Sampler Result Form.

The ERM Technician will than notify the plant supervisor of the amount of the calculated loss.

Record the supervisor's name and the time of notification on the Final Stack Sampler Results form.

The ERM Technician will then take the completed Stack Sampling Report form to the Environmental Compliance Subsection Engineer.

The Analytical Data Sheet should be taken to the Dosimetry Subsection for filing.

During the last working week of each month, the Stack Discharge Report will be submitted to the Environmental Compliance Subsection Engineer.

The record copy of the analytical results shall be kept in the Dosimetry Subsection files.

The completed Final Stack Sampler Results form shall be distributed as follows:

Original - routed to Environmental Compliance Subsection Engineer
Record Copy
Copy to Manager of Regulator Compliance
Copy to Manager of Environmental & Radiological Safety
Copy to Vice-President & Manager of Production Operations
Copy to Chemical Area/Metals Area Manager
Copy to Production Supervisor
Copy to Supervisor of Health Physics

Forms Used

Stack Sampler Inspection Report

Plant 1 (FMPC ES&H 2239-1)
Refinery (FMPC ES&H 2239-2
Plant 4 (FMPC ES&H 2240)
Plant 5 (FMPC ES&H 2240-1)
Plants 6 & 9 (FMPC ES&H 2242)
Plant 8 (FMPC ES&H 2241)
Pilot Plant (FMPC ES&H 2239-3)

Final Stack Sampler Results (FMPC ES&H 1510)

Dust Collector Stack Sampling Log (FMPC ES&H 1536)

Report of Chemical Analysis (FMPC T-20C)

Quality Control

During the last week of each month an ERM Technologist will compare the Stack Discharge Report, the Dust Collector Log Book and the Stack Log Book to determine that all entries have been properly made each month. Any differences between log books and report will be discussed with the inspector and corrected.

BAG RENEWAL

Removal

Notify the production supervisor of the work to be accomplished on the dust collector.

Post approved work permit on the outside of dust collector bag house.

Assemble required tools and safety equipment (See work permit for required respiratory equipment).

Lock and tag "Out Of Service" the dust collector blower and the associated vacuum unit.

Open doors as required. Take care to catch any material that may have collected inside the access doors. Plastic bags and/or a portable vacuum cleaner may be used.

Inspect the clean side for dust accumulation. The work area should be reasonably clean to minimize contamination of clothing. If not clean, notify the Maintenance Department Supervisor so that production personnel may be requested to further clean the area.

Tape plastic over the opening to the exhauster on the clean side of the collector to prevent dust from entering the duct during bag removal.

> Note: Ensure proper respiratory equipment is obtained prior to entering the bag house. Refer to "Industrial Health and Safety Requirements" for proper equipment.

Disconnect and remove dust collector bags in accordance with procedures outlined for each type system as follows:

> Manual Shaker
>
> Carefully slide the top of the bag off the shaker mechanism hook and lower the bag into a plastic bag with the assistance of the assigned production operator.
>
> Tape the bottom of the dust collector bag as close to the tube sheet as possible.
>
> Remove the bag from the tube sheet.
>
> Place the bottom end of the dust collector bag into the plastic bag.
>
> Vacuum loose material from clothing and the bottom tube sheet.

Repeat above steps for the remaining dust bags.

Blowring

Position the blowrings so that they may be used as a platform for working on the top of the bag house. Lock and tag "Out Of Service" the blowring drive motor(s).

Loosen the hose clamp and carefully remove the bag from the lower thimble. Tape off bag to prevent spillage of material from inside the bag. With the assistance of the assigned production operator, place the bottom of the bag inside a plastic bag provided by Production.

Carefully loosen the clamp and remove the bag from the top thimble. Tape off the bag just below the top and carefully lower into the plastic bag. A rope is required to lower the bag to the bottom of the bag house.

Vacuum loose material from the bottom tube sheet, the blowring platform, and clothing.

Repeat above steps for the remaining dust bags.

Pulse Jet

Remove any pulse jet air supply manifolds, if necessary.

Remove all cages from each of the bags, allowing the bags to hang inside the dust collector. The cages are wedged in and may require rapping with a rubber mallet. Take care not to crack the aluminum casting. Check for loose material on the cages, remove the cage and store until ready for installation of new bags.

Caution: USE EXTREME CARE WHEN REMOVING CAGES TO AVOID DAMAGE OR PRODUCING BURRS WHICH MAY PUNCTURE BAGS DURING BAG INSTALLATION

Carefully remove the bags from the tube sheet by prying loose the rubber sealant. Lower the bags to the bottom of the dirty side of the collector. Scrape excess sealant from the tube sheet.

Ask for the assistance of the production operator(s) to remove the bags through the access doors.

The production operator will seal the plastic bags and place into drums for disposition.

Upon completion of bag removal, remove the plastic and tape installed over the opening to the exhauster.

Vacuum loose material from clothing, the plastic bags, and the general areas.

Note: Ensure contamination is vacuumed from clothing before removing respirator.

Notify the Production Supervisor the dust collector is ready for cleaning.

After the Production Supervisor has been notified that the dust collector is ready for cleaning, check that Production personnel have thoroughly cleaned all surfaces on the clean side of the bag house. This includes the outlet transition piece to the exhauster. The plenum at the top (dirty side) must also be cleaned to prevent material from falling into the clean side during bag installation. Thorough cleaning is necessary to ensure that contaminated material is not discharged to the environment when the dust collector is restarted following rebagging. In addition, false indications of a leaking bag may result if the bag house is not thoroughly cleaned prior to rebagging.

Inspection

Inspect access doors for proper operation and closure. Replace door seals as required to assure a proper seal. Repair or replace worn or broken door closure hardware. Adjust door closure mechanism as required to assure proper operation and a tight seal.

Inspect dust collector interior in accordance with procedures outlined in each type system as follows:

Manual Shaker

Inspect the shaker mechanism for wear and proper lubrication. Lubricate as required. Repair or replace worn, broken, or missing parts.

Blowring

Inspect the upper and lower tube sheet and thimbles for cracks and deterioration. Repair defects. File sharp edges that might cut the bag during installation or operation.

Inspect the blowring assembly for damage and/or excessive wear, especially at the point where the bags contact the blowring.

Inspect the blowring air supply hoses for excessive wear and/or deterioration. Replace all defective hoses.

Inspect the blowring drive mechanism for wear and proper lubrication. Lubricate as required. Notify the supervisor of excessive wear.

Note: Sprockets, chains, bearings, seals, roller guides, lifting arm assemblies, and counterweights shall be included in this inspection.

Pulse Jet

Inspect the tube sheet, thimbles, and cages for cracks and deterioration. Repair as required.

Remove sharp edges from the tube sheet that might cut the bags during installation.

Installation

Ensure that the entire clean side of the bag house has been thoroughly cleaned prior to installing new bags.

During installation, inspect the bags for tears, holes, or abrasions which may affect bag performance.

Note: All dust collector bag receipts are inspected by the Quality Assurance/Quality Control Department for size, construction, and material defects.

Install new bags in accordance with procedures outlined for each type system as follows.

Manual Shaker

Install new bags, one at a time, as follows:

Install the bottom of the bag into the tube sheet by compressing the spring hoop and inserting the hoop into the hole in the tube sheet. Distribute excess material evenly around the circumference of the bag/hoop.

Pull up sharply on the bag two or three times to ensure the bag is tightly seated in the tube sheet.

Hook the top of the bag over the shaker hook.

Without bending the shaker hook, tighten or loosen the shaker hook to ensure the bags are tight.

Remove the safety lock and tag from the shaker drive motor.

Run the shaker for several minutes while inspecting for proper operation. Ensure that bags were not pulled loose during operation of the shaker mechanism.

Blowring

Remove lock wire from the blowring drive chains and unlock and remove the tag from the blowring drive motor.

Level the blowring platform in both directions by adjusting the drive chain.

Position the blowrings for use as a platform during bag installation.

Lock and tag "Out Of Service" the blowring drive motor and wire the drive chains.

Position bag over top thimble approximately 1 inch to 1-1/2 inches above the bead or as specified in individual SOP's. Install a hose clamp just above the bead ensuring bag material is evenly distributed around the circumference of the thimble. Folds or puckers in the material are not acceptable.

Note: When installing bags in a "split ring" blowring collector, the bag seam must be in line with the split between the two halves of blowring opening.

Drop the bag through the corresponding hole in the blowring platform.

Ensuring that the seam is straight, place the bag over the lower thimble and install a hose clamp approximately one quarter of an inch below the top of the thimble. Distribute any excess material evenly around the circumference of the thimble. There shall be no folds or puckers in the bag.

Remove the safety wire from the blowring drive chains and remove the safety lock and tag from the drive motor.

Run the blowring drive through at least two complete cycles while inspecting for proper travel and smooth operation. Ensure that no bags were pulled loose during operation of the blowrings.

Pulse Jet

Install new bags, one at a time, as follows:

Apply approximately 1/4 inch bead of rubber sealant (RTV) between the two plastic tubes at the top of the bag, if required.

Drop the bag through the tube sheet. Press out around the entire circumference to seat the bag into the tube sheet.

Lower the cage into the bag. Push the thimble down until the thimble contacts the tapered area. Tap the thimble with a rubber mallet until the thimble secures the upper plastic tube against the tube sheet. Distribute excess caulking evenly around perimeter of bag, if required.

Caution: THE THIMBLE IS A CAST ALUMINUM MATERIAL AND MAY BE CRACKED BY EXCESSIVE FORCE OR TAPPING

When all bags are installed, remove all tools and debris from the bag house.

The Maintenance Supervisor and Production Supervisor will inspect the dust collector following completion of work in accordance with the Dust Collector Post-Maintenance Check Sheet (FMPC-PRO-2610) found in SOP 1-C-701, 4-C-701, 5-C-701, or 8-C-701. Both supervisors will sign the check sheet (FMPC-PRO-2610) indicating the dust collector is approved for operation.

Following inspection by Maintenance and Production Supervisors, close the bag house and advise Production that work on the dust collector is complete. Remove locks and tags from the dust collector and the associated vacuum units.

Sign the preventive maintenance (PM) record card indicating that the bag change has been completed in accordance with the SOP.

Note: Production personnel will conduct a dye check for bag leakage prior to putting the dust collector in service following a bag change.

PREVENTIVE MAINTENANCE

The following procedures will be followed by Maintenance Department personnel twice each year.

1. Notify the supervisor in the building of the dust collector inspection.
2. Instrument check and calibration.
3. Check housing platform and ladders for any deformation, corrosion and cracks.
4. Check dust bags for holes, ripped seams, dust build-up, bag tension and fasteners.
5. Check blowring assembly, alignment, sprockets, rollers, chains, guides, sheaves and drive.
6. Check hose and clamps, piping and fittings for deterioration and leaks.
7. Check limit switches, blower motor, vacuum motor belt tension, electrical timers and safety devices.
8. List corrective action required.
9. Notify supervisor of corrective action required.
10. Complete scheduled PM record card.
11. Review and return PM Check Sheets to the PM Activity Clerk.

ASSIGNMENT OF RESPONSIBILITY

Operating personnel are responsible for performing checks and operations according to Standard Operating Procedures.

The Production Supervisor assigned to each area which contains dust collectors is responsible for ascertaining that each one is operating satisfactorily and that operators have performed checks and operations according to Standard Operating Procedures.

The Plant Manager, General Supervisor and Area Supervisor are responsible for satisfactory operation of dust collectors in their areas.

The Maintenance Manager, Assistant Maintenance Manager and the Area Maintenance Sueprvisor are responsible for responding to the needs of Production personnel in providing equipment maintenance and are responsible for implementing the Preventive Maintenance Program.

Checks on operations are performed at scheduled intervals and reported monthly by Environmental Safety and Health to ascertain stack losses. Copies of the sampling reports (FMPC-ES&H-2239, 2242, 2241, 2241) are reviewed by Production supervision and action taken as necessary. Monitoring stations around the site also determine if air or water has exceeded specified limits of radioactivity. Readings are reported.

EMERGENCY REPORTING

If inspection of an air pollution control device indicates the potential for the emission above acceptable limits of radioactive materials, the Emergency Duty Officer will be immediately contacted. The Emergency Duty Officer will then initiate the appropriate procedures mandated in the FMPC Emergency Plan.

QUALITY ASSURANCE

All quality related activities are conducted per the requirements of the FMPC Quality Assurance (QA) program. The QA program will be conducted in accordance with the Environmental Compliance QA Plan as submitted under item B4 of the 30 day submittal. This program includes but is not limited to:

- work being conducted to approved Standard Operating Procedures (SOP)
- the alarm systems will be checked to ascertain that all collector alarm systems are in operating condition
- scheduled inspection being performed by trained personnel with calibrated instrumentation
- selection and purchase of the bags will be done according to established specification
- maintenance procedures designed to assure proper installation and operations of bags, blowring carriages, and other critical components will be done
- PM procedures to assure replacement before life of bag has been exceeded will be performed
- maintenance procedures and check lists will be developed to assure proper installation of clamps, bands, holders or other fasteners
- PM procedures to assure replacement of fasteners before deterioration will be performed
- PM procedures to anticipate and prevent leaks in connecting duct work, fans, blowers, etc. will be performed
- PM procedures to anticipate and prevent the failure of instrument monitors and controllers will be performed
- complete documentation of all inspections and associated corrective action
- complete documentation of all training of personnel

- complete documentation of all calibrations

- QA surveillances conducted on stack sampler, breakthrough alarms, etc. for compliance with air contaminant source permit status

RECORDS

1. The preventive maintenance program provides check lists and monthly printouts (Report 308-03) of the inspection record on each collector. These data are obtained from the form (FMPC-PRO-2234) by Maintenance personnel.

2. Several forms are used by Production to request Maintenance to repair collectors and associated controls:

   a) Minor Work Request (FMPC-PRO-2532)
   b) Job Order Request (FMPC-PRO-183-1)

   The following PMP records are also maintained:

   a) Dust Collector Sheet (FMPC-PRO-2234) (Mech-PMP-20A)
   b) PMP Check Sheet - Foxboro Differential
      Bell meter with Rotex controller - (FMPC-PRO-2400)
      (FMPC-PRO-PMP-13K)
   c) PMP Checksheet - Manometer (FMPC-PRO-2399) (FMPC-PRO-PMP-13K)

3. The Environmental Safety & Health Department maintains a log on dust collector sampling (FMPC-IHS-1536).

4. The Environmental Safety & Health Dosimetry Laboratory prepares a data sheet (FMPC-ESH-736) which is used to summarize and prepare the annual report on Environmental Monitoring.

5. Records are kept of the Environmental Safety & Health Stack Sampler Reports (FMPC-ESH-2239, 2240, 2241, 2242).

6. The Production Operations Department maintains records of dust collector operation on the following daily check sheets:

   a) FMPC-PRO-333, 1186, 1127, 1187, 1245, 1706 and
   b) FMPC-PRO-333-1, 1186-2, 2608, 2609, 2610, 2611, 2612

REFERENCE DOCUMENTS

Manufacturing Standards

1. SOP 1-C-701, "Dust Collector Systems," Plant 1

2. SOP 2-C-701, "Refinery Dust Collector Systems,"

3. SOP 4-C-701, "Dust Collector Systems," Plant 4

4. SOP 5-C-701, "Dust Collectors," Plant 5

5. SOP 6-C-701, Dust Collectors," Plant 6

6. SOP 8-C-701, "Dust Collectors," Plant 8

7. SOP 9-C-701, "Dust Collectors," Plant 9

8. SOP 11-C-238, "Dust Collectors," Pilot Plant

Preventive Maintenance Program and Maintenance Standards

1. SOP 43-C-7701, "Changing Bags in Pulverizing Machine Co. (Mikro Pulverizer) Type Dust Collectors"

2. SOP 43-C-7702, "Changing Bags in American Air Filter (Amerjet) Type Dust Collectors"

3. SOP 43-C-7703, "Changing Bags in Day-Type Dust Collectors"

4. SOP 43-C-7704, "Changing Bags in General Resources Company Dust Collectors"

5. SOP 43-C-7705, "Changing Bags in Turner-Haws 'Aeroturn' Type Dust Collectors"

6. SOP 43-C-7706, "Changing Bags in Hoffman High Vacuum Units"

7. SOP 43-C-7707, "Changing Bags in Spencer Portable Vacuum Units"

8. SOP 43-C-7708, "Changing Bags in Wheelabrator Type Dust Collectors"

9. SOP 43-C-7709, "Changing Bags in Hoffman Portable Vacuum Units (Mikro Pulverizer) Type Collectors"

10. SOP 43-C-7710, "Changing Bags in Pangborne Model CM-1 Dust Collectors"

11. SOP 43-C-7711, "Changing Bags in Mikro Pulverizer Dust Collectors"

12. SOP 43-C-7712, "Changing Bags in Dracco Dust Collectors"

13. SOP 43-C-7713, "Changing Bags in EVO Corporation G2-95 (Incinerator Building)"

14. DC-4, "Periodic Inspection of Dust Collectors"

Health and Safety Manual - Section 16.1.2

Job Order Procedure by Maintenance Department

DOE Order 5480.1 Chapter XI, "Standards for Radiation Protection"

Industrial Hygiene and Radiation 1.4, "Stack Sample Inspection and Filter Change Procedure"

QAA PROD-OG-5, "Dust Collector Systems in Production Plants"

QAA PROD-OG-8, "Dust Collector Bags"

QAP PROD-OG-8, "Dust Collector Bags"

Specifications for Procurement of Dust Collector Bags

1. SOP 15-C-701, "Incoming Materials Inspection - Dust Collection Bags"

2. PSS 20-PS-400-2, "Vendor Specification and Certification Requirements for Wool Felt Dust Collector Bags - American Air Amerjet Collector"

3. PSS 20-PS-400-4, "Vendor Specification and Certification Requirements for Wool Felt Dust Filter Bags - Mikro Pulverizer Collectors"

4. PSS-20-PS-400-5, "Vendor Specification and Certification Requirements for Canton Flannel Dust Filter Bags - Hoffman Dust Collectors"

5. PSS-20-PS-400-6, "Vendor Specification and Certification Requirements for Wool Felt Dust Filter Bags - Turner-Haws 'Aeroturn' Collectors"

6. PSS-20-PS-400-7, "Vendor Specification and Certification Requirements for PTFE Membrane Laminated Polyester Felt Dust Bags - Koppers and Day Collectors"

7. PSS-20-PS-400-8, "Vendor Specification and Certification Requirements for Wool Felt Dust Filter Bags - Day Collectors"

8. PSS-20-PS-400-9, "Vendor Specification and Certification Requirements for Sateen Weave Cotton Dust Filter Bags - Wheelabrator Dust Collectors"

9. PSS-20-PS-400-11, "Vendor Specification and Certification Requirements for PTFE Membrane Laminated to Polyester Felt Dust Bags - Mikro Pulverizer Collectors"

10. PSS-20-PS-400-12, "Vendor Specification and Certification Requirements for PTFE Membrane Laminated to Felt Dust Bags - Turner-Haws Collectors"

11. PSS-20-PS-400-13, "Vendor Specification and Certification Requirements for Polyester Sateen Dust Filter Bags - Pangborne Dust Collectors

12. PSS-20-PS-400-141, "Vendor Specification and Certification Requirements for Cotton Sateen Dust Filter Bags - Dracco Dust Collectors"

13. PSS-20-PS-400-15, "Vendor Specification and Certification Requirements for Polyester (Needled Felt) Dust Filter Bags - Buffalo Forge Collectors"

14. PSS-20-PS-400-18, "Vendor Specification and Certification Requirements for Fiberglass Dust Filter Bags - EVO Corporation Collector"

15. PSS-20-PS-400-22, "Vendor Specification and Certification Requirements for PTFE Membrane Laminated Polyester Flat Dust Filter Bags - Dracco Collector"

FEED MATERIALS PRODUCTION CENTER

OPERATION AND MAINTENANCE PLAN

FOR

BOILER PLANT ELECTROSTATIC PRECIPITATORS

SEPTEMBER, 1986

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INTRODUCTION

The FMPC currently has two operating Riley Traveling Grate Stokers for coal fired boilers with a maximum capacity of 75,000 pounds of steam per hour each at a pressure of 150 psi. The boilers of the power plant provide steam for heat and operations of all aspects of the WMCO uranium processing plant. The boiler fuel is stoker coal, which must exceed the following specifications:

BTU	12,500 minimum
Ash	12% maximum
Sulfur	1% maximum
Moisture	8% maximum

The coal is fed at typical rates of 40-120 tons per day.

Both boilers 1 and 3 are equipped with United McGill 250 x 2 electrostatic precipitators which use electrical forces to contain particulates from a flue gas system. The process consists of charging dust particles which pass through an electric field where they are attracted to the surfaces of opposite polarity.

REASON FOR OPERATION AND MAINTENANCE PLAN

This Operation and Maintenance Plan has been prepared to explain the operation of the FMPC Power Plant Electrostatic Precipitators and to satisfy the 90 day FFCA requirement.

The Plan addresses the operation, maintenance, and control procedures necessary to keep the United McGill systems operating at peak efficiency.

SAFETY DEVICES

Key interlock system	Withdrawal of key to obtain access to high voltage areas - shuts off breaker feeding power
Transformer/Rectifier (T/R) disconnects	Locking of disconnects prevents T/R's from being energized
T/R grounding switch	Use of grounding switch insures that residual charges on field are discharged

INDUSTRIAL SAFETY REQUIREMENTS

All employees will wear such protective equipment as is suitable for the particular operation, such as gloves, eye protection and respiratory protection.

Access to the Electrostatic Precipitator will require eye and respiratory protection noted in Section E of the Work Permit (FMPC-ES&H-973) and consistent with the provision of the Environmental Safety & Health Manual Sections 7.1.3.1 and 7.3.3.

As required by the State of Ohio, operating personnel will include a Stationary Engineer, who has been licensed by the State of Ohio.

DESCRIPTION OF EQUIPMENT

Effluent gases from Boilers 1 and 3 are routed through Electrostatic Precipitator (EP) Units 1 and 2 respectively. Gasses enter the south sides of the units and exit from the north sides to the stacks. Draft is supplied by the boiler induced draft fans.

Particulate matter is removed from the products of combustion by exploiting a well-known phenomenon of nature: objects of opposite electrical charge attract each other. Since the particles in the exhaust gases are for the most part neutral in electrical charge, the smoke is passed through an electrical field generated around special, needle-tipped plates, called discharge plates, where the particles are "artifically" charged. The electrical field results from the application of a high voltage direct current source to the discharge plates. After the particles are charged, they are attracted to oppositely charged (grounded) plates, where they are held by the electrically binding force. When enough particles accumulate on the plates, the weight of the dust begins to overcome that force, making removal of the dust easier. This is done by mechanically shaking (rapping) the plates. After the dust is shaken off, it falls into hoppers from which it can be removed by a conveyor system for disposal.

Location and Functions of Major EP Components

Major Component	No.	Location	Function
Transformer/rectifier units	4	EP Penthouses	DC current source
EP Penthouses	2	Top of units	Support for plates and isolating insulators
EP Mainbodies	2	Above hoppers	Enclosure for plates
Rapping Mechanisms	8	At base of enclosure upper and lower sections	Cleaning of plates by shaking
Gas Distribution Plates	2	Inlet end of units	Spreads dust particles more evenly over fields
Hoppers	4	Bottom of units	Dust storage

EP Control Panel

The control panel in the Boiler Plant contains the following control devices for the EP units.

Transformer/rectifier control (automatic or manual)

Transformer/rectifier alarms

Rapping system control

Insulator heaters

Insulator heater alarms

Purge air system

Purge air alarms

High hopper level alarms (high and high-high dust alarms)

Power Distribution Panels

These panels, located under the EP units, are the source of power for T/R sets, vibrators, and heaters and contain the automatic voltage control unit.

OPERATING PROCEDURES

Inspection Prior to Start Up

After an extended shutdown of either EP unit, all the devices on it should be inspected and tested to make sure they are operational.

Make certain that current to plates is off as follows:

Obtain keys for access doors at power distribution panels by withdrawal of key in interlock system.

Verify that T/R disconnects are in the "OFF" position and that the grounding switch on the T/R set is in the "GROUND" position.

Inspect the EP units:

Using keys, open unit doors.

Examine the interior for foreign objects (tools, loose metal, etc.).

Check the plates and needles for alignment.

Inspect the hoppers' interior for foreign objects, dust buildup, etc.

Check the action of the rapping systems for each field, making certain there is no binding or sticking of the mechanism.

Close and lock all the access doors on the EP units.

Ready the penthouse for startup:

Using key, open doors at penthouse(s).

Clean the accumulated dust from all the insulators in the penthouse.

Inspect the insulators for damage (chipping, cracking) and call for repairs if necessary.

Inspect the penthouse for foreign objects (tools, debris, construction materials, etc.).

Close and lock the penthouse door(s).

Prepare the transformer/rectifiers (T/R's) for operation:

Inspect and clean the T/R insulators.

Inspect the T/R platform for foreign objects and remove any.

Reset the oil temperature meter indicators.

Turn T/R grounding switches to the H.V. (high voltage) position.

Unlock the T/R disconnects and place them in the "ON" position.

Reconnect EP unit to power at the distribution panel (located under the EP unit):

Replace key in the key interlock breaker.

Turn key interlock breaker to "ON" position.

Turn on all of the breakers inside the EP power distribution panel.

Turn on the main breaker on the EP power distribution panel.

Make the "cold test;" verify that all foreign objects have been removed from the EP interiors and penthouses by turning on the voltage to each field:

Press "MAN" pushbutton at the voltage control selector switch for the unit.

Turn on the voltage to field by depressing its power "ON" pushbutton.

Note: The KV meter should indicate about 10 KV.

Increase the voltage control slowly until arcing occurs.

Note: If all foreign objects are removed and the plates are in adjustment, arcing should occur between 29 and 36 KV.

Turn off the voltage to each field by depressing the power "OFF" pushbutton.

Record in the Boiler Plant operating log, data and time Electrostatic Precipitator was checked and any discrepancies noted.

Warming and Drying the EP System

Warm the EP system at a uniform rate not exceeding 100°F per hour temperature rise to allow the entire structure to expand uniformly.

Allow a dry-out period to rid the structure of any condensate which may have accumulated on cold steel during the previous shutdown.

Empty the hoppers continuously to run out condensate during the warm-up and dry-out times.

CAUTION: DO NOT APPLY VOLTAGE TO THE FIELDS BEFORE THE EP IS COMPLETELY DRY.

Wet dust inside the EP will affect EP performance and necessitate cleaning the interior.

Visually inspect the hopper outlets for condensate before turning the fields on.

Starting the EP Unit

Turning on an EP Field

In the automatic mode:

The T/R set may be energized in the automatic mode provided the circuit breaker and disconnect switch for each T/R set have been placed in the automatic position.

Set the manual/automatic selector switch for the field in the "AVC" (automatic voltage control) position.

Press the "ON" rectangular button for power.

Note: "POWER ON" light should come on. Voltage will increase after a 10-second delay until the sparking level is reached, will then drop to set back level, and begin to ramp up again.

In the manual mode:

Turn the field voltage adjustment dial to zero.

Press the "MAN" pushbutton on the manual/automatic selector switch.

Press the "ON" rectangular button for power.

Note: The "POWER ON" light should come on and the KV meter should read approximately 10 KV.

Slowly turn the voltage adjustment dial clockwise in small increments until excessive arcing (more than one arc every five minutes) occurs.

Note: Arcing can be observed by rapid fluctuations on the KV and milliamp meters within a short time span.

Reduce the KV meter reading by about 1/2 KV or until the arcing stops.

Set the lower alarm setpoint on the KV meter to about 10 KV.

Set the upper alarm setpoint to about 35 KV.

Turn on the air purge system by pressing the "START" buttons for top and side purge.

Turn on the rapping system by setting the selector switch on "AUTO."

Note: Frequency of rapping periods and their duration are controlled by timer. Manual rapping may be accomplished by setting the selector switch on "MAN" and pressing the "MAN-TEST" button.

When the weather is at freezing or below, turn on heaters for insulator and rapping boxes.

Note: Thermostats for heaters should be set at 150°F.

Empty the EP hoppers daily or more frequently if required.

Shutting Down the EP Unit (Extended Shutdown)

Turn each field of the EP off by pressing the power "OFF" pushbutton just before the boiler draft fans are shut down.

Turn off the air purge fans after the smoke (gas flow) has stopped.

Turn the key interlock circuit breaker in the EP power distribution panel to the "OFF" position.

Place each T/R grounding switch in the "GROUND" position.

Turn on the heaters and leave them operating while the unit is down.

Allow the rapping system to run several days so that most of the dust is removed from the plates.

Empty the EP hoppers so that there is no accumulated dust to solidify.

ASH EMPTYING

Transfer of Ash from Hoppers to Silo

Check level of ash in silo to see if sufficient room is available to receive ashes.

Check position and cleanliness of swing gates on the bottom of the primary and secondary receivers.

Note: Gates should be in closed position with no holes in them.

Remove any accumulation of small particles or wet ash before turning on the system.

Open stop valves in water and steam lines located just inside the service door on east side of Boiler Plant.

Close the drain valves on the water and steam supply lines located in the trench that runs from the Boiler Plant to the ash silo.

Note: When the pressure and flow of water inside the line is sufficient, the mercoid switch attached to the water valve will close the circuit feeding the steam valve timer.

The minimum operating water pressure is 15 psig at the air washer nozzles, giving a flow of 240 gallons per hour through four 1/2-inch nozzles.

Turn the panel selector switch to the ON position.

PANEL ON (Amber) - light comes on

AIR ON (White) - light comes on

STEAM ON (White) - light comes on

LINE CLEAR (White) - light comes on

Push SYSTEM START button.

SYSTEM ON (White) - light comes on

STEAM VALVE OPEN (White) - light comes on

Push AUTOMATIC CIRCUIT ON button.

AUTOMATIC CIRCUIT ON (Amber) - light comes on

AUTOMATIC SEQUENCE READY (Green) - light comes on

Push SEQUENCE START button.

IN SEQUENCE (Green) - light comes on

AUTOMATIC SEQUENCE READY (Green) - light goes out

VALVE SG_4 CLOSED (White) - light comes on

VALVE SG_3 OPEN (White) - light comes on

Note: The automatic system will run through cycles to clean all hoppers on the EP system and shut off everything in the automatic system. The system will pull an extra cycle after SG_3 valve closes and SG_4 valve opens to clean the Boiler Plant ash line.

Shut off the automatic system's START and STOP panel manually as follows:

Turn the panel selector switch to the OFF position while STEAM VALVE OPEN light is off.

Note: The system must be shut off when STEAM VALVE is in the OFF position. If this is not done, steam valve will not shut off and the system will pull continuously until the manual steam valve is closed.

Shut off steam at STOP valve just inside east personnel door.

Close water valve to the air washer.

Open drain valves in the steam line and water line.

PREVENTIVE MAINTENANCE SCHEDULE

	Frequency
Inspect vibrators for proper operation.	Once each week.
Test all control panel pilot light bulbs and replace as necessary.	Once each week.
Record all control panel meter readings.	Every 4 hours.
Insure hoppers are emptied of dust.	Every 8 hours.
Inspect and clean all insulators and insulator compartments. Inspect all rapper air cylinder linkages.*	Yearly
Open access doors on the EP chamber and inspect plates and needles for cleanliness. Also inspect hoppers for bridging.*	Yearly
Check insulator compartment heater resistance and insure that open or short circuit conditions do not exist.	Yearly
Inspect all motors and bearings for overheating and excessive vibration. Lubricate as necessary. Note: Motors must be operating at steady state during check.	Every 8 hours.
Inspect and clean purge air filters if necessary.	Once per month.
Blow down drip legs in air lines.	Once each day.
Inspect all air line lubricators and fill with Union Carbide HFT 500 Poli Alkaline Glycol Oil or equivalent.	Once per month.
Inspect all air line filters for water accumulation, drain if necessary. Note: If excessive water is observed, check air drying system for proper operation.	Once per month.
Manually operate rapping cylinders using solenoid valve override and inspect for proper operation (not necessary to open rapping boxes to do this).	Once each month.

*Caution: Must be done with fields de-energized. Insure T/R disconnects at "off" and T/R grounding switch is in ground position.

Read and record temperature gauge on T/R set.	Once each week.
Inspect high voltage bushing on T/R set and clean as necessary.*	Once each year.
Remove oil sample from T/R set and analyze for dielectric strength and presence of acids.	Once each year.
Check Rotary Valve Torque Limiter for over heating due to excessive slippage.	Once each week

*Caution: Must be done with fields de-energized. Insure T/R disconnects at "off" and T/R grounding switch is in ground position.

YEARLY PREVENTIVE MAINTENANCE INSPECTION

- With the boiler out of service, set both fields to rap at timed intervals for two days.
- Shut off electrical power to the fields.
- Lock and tag "Out Of Service" the power equipment to the unit.
- Turn the key interlock circuit breaker in the EP power panel to "Off." The key can now be removed.
- Place T/R grounding switch to GROUND position.
- Key from the interlock circuit breaker can be used to gain access to extra keys to unlock penthouse at access doors.
- Ground high voltage lines in penthouse with GROUNDING STRAPS BEFORE ENTERING UNIT.
- Clean complete interior of both fields checking all plates for damage.
- Vacuum penthouse, insulators, and insulator compartments.
- Check insulator compartment heater resistance and insure that open or short circuit conditions do not exist.
- Check for tightness on all insulators.
- Inspect high voltage bushings on T/R set and clean.
- Remove oil sample from T/R set and analyze for dielectric strength.

PROBLEM TROUBLESHOOTING GUIDE

Problem	Possible Cause	Correction Steps
1. Field will not energize after the "POWER ON" button is pushed.	a) T/R disconnect not on.	a) Turn disconnect on.
	b) Control power not on.	b) Turn control power on.
	c) Manual - AVC selector switch is in the "OFF" position.	c) Turn to either "MAN" or "AVC."
	d) Alarms not reset.	d) Reset the alarms.
	e) Breakers in power distribution panel not on.	e) Turn all breakers in panel on.
2. "POWER ON" light indicates field power is on, but KV meter reading is zero, and MA meter reading is high.	Short circuits on high voltage side of the T/R caused by:	
	a) Shorted high voltage wiring.	a) Check the high voltage wiring for foreign objects.
	b) Dust build-up between the plates.	b) Turn power to field off. Manually rap the field to dislodge dust or foreign object. Turn power on and again check for short.
	c) A foreign object falling between the plates.	c) Turn power to field off. Manually rap the field to dislodge dust or foreign object. Turn power on and again check for short.
	d) An insulator failure.	d) Visually inspect all insulators for crack or electrical puncture. Replace as necessary. Check for groundings of secondary T/R.
	e) The breakdown of the T/R insulating oil.	e) Have T/R oil tested by an oil testing service.

3. Over/under voltage alarm sounds.	a) Voltage limits on KV meter not set properly due to a change in operating conditions.	a) Set limits at proper set point.
	b) Voltage is high, but current is zero. Possible open circuit on secondary side of T/R.	b) Check all high voltage wiring connections. All should be tight and clean.
	c) Voltage is low and current is high due to conduction across a dirty, damaged or cracked insulator.	c) Check all insulators on high voltage side of T/R for dirt or damage. Clean or replace as necessary.
	d) See Item 2 above.	
4. T/R high oil temperature alarm sounds.	Overheating of T/R insulating oil caused by:	
	a) Short circuit on secondary side of T/R.	a) See 2 (a), (b), (c).
	b) Oil deterioration (moisture, acids, etc.)	b) Have T/R oil tested by an oil testing service.
5. T/R overload alarm sounds.	Excessive primary T/R current being drawn due to:	
	a) Continual arcing between plates.	a) Readjust voltage manually so that arcing stops. AVC may need to be retuned. See AVC manual/automatic. Call electrical maintenance to reset overloads.
	b) Short circuit on high voltage secondary or T/R.	b) See No. 2.

MAINTAINING RECORDS

Log a set of meter readings for each operating field every four hours.

File the data sheet in the Boiler Plant office for future reference.

Continuous opacity and oxygen readings are recorded on strip charts located in the main operating panel of the firing aisle.

SPARE PARTS LIST

Material Removal (Rappers)

Air Cylinder
Air Press Regulator
Lubricator
Solenoid Valve

Material Handling (Hoppers and Screws)

Unitop Conveyor Vibrator
Rotary Valve Sprocket (drive)
Rotary Valve Sprocket (driven)

Material Removal

Insulators (Top and Side)
Insulator (Through)
Temperature Switch
Heaters

Duct System

Thermocouple (type J)
Thermocouple Transmitter

Control Panels

Switch Contact Block, 1 NO, Inc.
EP Inlet Temperature Meter
KV Meter
MA Meter
Volttrap
Variable Time Delay
Fixed Time Delay
Relay
Rapping Pulse Timer
Rapping Duration Timer
Rapping Cycle Timer
Solid State Relay
Auto Voltage Controller
Auto Voltage Circuit
Surge Arrestors

QUALITY ASSURANCE

All quality related activities are conducted per the requirements of the FMPC Quality Assurance (QA) program. The QA Program will be conducted in accordance with the Environmental Compliance QA Plan as submitted under item B4 of the 30 day submittal. This program includes but it is not limited to:

- work being conducted to approved Standard Operating Procedures (SOP)

- the alarm systems will be checked to ascertain that all systems are in operating condition
- scheduled inspections will be performed by trained personnel with calibrated instrumentation
- selection and purchase of associated equipment done according to established specification
- maintenance procedures designed to assure proper installation and of critical components will be done
- preventive maintenance (PM) procedures to assure replacement before life of bag has been exceeded will be performed
- maintenance procedures and check lists will be developed to assure proper and timely maintenance
- PM procedures to anticipate and prevent the failure of instrument monitors and controllers will be performed
- complete documentation of all calibrations
- complete documentation of all inspections and associated corrective action
- complete documentation of all training of personnel

REFERENCE DOCUMENTS

Manufacturing Standards

1. SOP 43-C-402, "Steam Generating Equipment"
2. SOP 43-C-406, "Ash Handling System"
3. SOP 43-C-411, "Power Plant Electrostatic Precipitator"

FEED MATERIALS PRODUCTION CENTER

OPERATION AND MAINTENANCE PLAN

FOR

PLANT 6 AND 9 PRECIPITATORS

SEPTEMBER, 1986

TABLE OF CONTENTS

INTRODUCTION

The FMPC is a large scale production facility operating in excess of 400 air emission sources* which have the potential to emit air pollutants to the atmosphere. The FMPC utilizes high efficiency dust collection and scrubber systems to control particulates and gaseous emissions. Emissions from the facility are limited to quantities of listed criteria pollutants, radionuclides and trace amounts of hydrogen fluoride (HF) and kerosene fumes.

Overview of Current Air Pollution Control Programs

A comprehensive Air Pollution Control Program is in effect at the FMPC to minimize the emission of air pollutants to the atmosphere and ensure continued regulatory compliance. The program's objective is to effectively reduce air pollutant discharges from plant emission points in order to reduce worker and public exposure and minimize associated environmental impacts due to plant operations.

All particulate emission points with the potential to emit radionuclides to the atmosphere (there are a total of 59 at the FMPC) are equipped with stack samplers. These samplers draw a continuous sample from a fixed point within the stack across a pleated filter paper at an isokinetic rate. The filter papers are inspected at least once per week and changed if they show soiling. If no soiling is evident, filters are changed monthly, at a minimum. Critical dust collector samplers are inspected twice weekly. Upon removal, all filter papers are analyzed to determine both particulate and radionuclide emission levels.

Isokinetic flow rate for each sampler is based upon velocity traverse data obtained in the stack. Traverse data is collected from each stack annually, and the sample flow rate that gives a representative sample is determined. The sample flow is adjusted using a sampler rotameter, and the calibration of sampler rotameters is checked weekly. Plant personnel check rotameter settings hourly to ensure that the sample flow is present.

Twenty-two FMPC emission stacks are currently equipped with Ludlum breakthrough monitors. These monitors are designed to give operators an immediate alarm in the event of failure (breakthrough) of the filter system by continuously monitoring the sampler filter paper for radioactivity. All monitors are tied into control panel boards with audible alarms to alert operating personnel. The fifteen most recently installed monitors are linked to the FMPC central alarm system which sounds in the Communications Center. A data base of monitor count rate records has been established to statistically define optimum monitor action level settings. Panel board alarms are checked every two weeks to assure they are functioning properly. Monitors are calibrated electronically and checked with a check source semiannually.

*An emission "source" is defined as each individual piece of equipment that generates a potential pollutant. An emission "point" is a stack, or other device, where emission actually takes place. Thus, many "sources" may be involved in a single emission point.

Under the provisions of DOE Order 5480.14 and the Comprehensive Environmental Response Compensation and Liability Act (CERLA) of 1980, the release of one pound of radionuclides above normal operating losses from a source to the atmosphere mandates the shutdown of processes involved and the implementation of specific response and reporting procedures. Normal operating losses are those levels established by the source operating permits. The FMPC operates in compliance with these regulatory requirements.

The Production Operations Department is responsible for operations of emission control equipment, exclusive of sampling/monitoring instrumentation. This department also has responsibility for preventative and routine maintenance. Operational procedures involving emission control systems are reviewed and approved by the Environmental Compliance Group prior to implementation.

REASONS FOR OPERATION AND MAINTENANCE PLAN

This Operation and Maintenance Plan has been prepared to explain the activities necessary to keep the Precipitator associated equipment operating at peak efficiency and to satisfy the 90 day FFCA requirement.

This plan addresses the emission control equipment which augments the three electronic precipitators. The units servicing the precipitators are filter blanket dust collectors and a cyclone separator.

DESCRIPTION OF OPERATION AND EQUIPMENT

The FMPC has in Plants 6 and 9 three electronic precipitators. Though none of these is currently operated, each has a dust collector as associated equipment. Two precipitators in Plant 6 and one precipitator in Plant 9 are augmented by American Air Filter, filter blanket type dust collectors. One precipitator in Plant 6 is equipped with a Kirk and Blum Cyclone. All of these units service machining operations in the two production plants. Descriptions of these air pollution control devices are as follows.

Kirk and Blum Cyclone

The cyclone is a large round cylinder. The air travelling in a horizontal direction enters the cylinder body of the cycle tangentially. Since the cylinder body is much larger than the inlet air duct, this greatly decreases the air velocity causing the dust particles in the air flow to fall out. The bottom of the cylinder body funnels the dust particles to residue disposal. The air entering the cyclone will be funnelled in a circular motion initially. It then exhausts out an opening in the top of the cylinder body.

The Kirk and Blum cyclone serves the three Sunstrand lathes, one Herbinger lathe, and the Tocco furnaces. The lathes are almost never used and the Tocco furnaces have not operated in years.

American Air Filters

The north and south American Air Filters (AAF) in Plant 6 filter uranium contaminated dust from the exhaust air streams for the various lathes and mills used in the Plant 6 machining processes. The dust is filtered through a roll filter media prior to being exhausted to the atmosphere. The electronic precipitators for these units are not operational. The exhaust air is sampled by a single point isokinetic air sampler. When the filter roll has been

expended, it is removed by the Maintenance Department, placed in drums by the Production Department and sent to Plant 1 for disposal.

The north AAF services the two Bardons & Oliver cutoff lathes, the six Acme Bar and Drill machines, the three Heald lathes, and two J&L turret lathes.

The south AAF services the Cross Transfermatic, the four vertical Cincinnati mills, and the two Kearney and Trecker horizontal mills.

The American Air Filter in Plant 9 filters the particulates through a roll filter media prior to exhausting to the atmosphere. The electronic precipitators for this unit is not operational. The air is exhausted out a stack that is equipped with a single point isokinetic air sampler to monitor emissions. When the filter roll has been expended it is removed by maintenance, placed in drums by production and then sent to Plant 1 for disposal. Dust Collector 69E-2400 services all mills, lathes, and boring machines used in the Plant 9 machining process.

INDUSTRIAL SAFETY AND HEALTH REQUIREMENTS

Observe all nuclear safety requirements for dust collector material per Manufacturing Specification 4-BN/E-410-1 and 4-BN-480-1.

A dust-type respirator fitted with cartridges approved for radionuclides shall be worn when there is possible contact with dust.

Leather-palm gloves shall be worn when handling drums or when working with dust collector equipment.

Move and store dust collector material per Standard Operating Procedure 20-C-101.

When working in dust conditions, vacuum excessive nuclear material from the exterior of clothing before removing the respirator.

Respirators must be worn anytime a dust collector is entered. A dust-type air-purifying respirator may be worn when exposure periods inside a dust collector do not exceed five minutes. An airline respirator shall be worn for exposure periods inside a dust collector which exceed five minutes.

Disposable outer coveralls will be worn by anyone entering a dust collector for cleaning or filtering media removal. Upon exiting the collector, the disposable garments will be discarded in a properly labeled drum.

Safety glasses shall be worn at all times.

Dust spills shall be immediately vacuumed.

Exhausters shall remain on while the equipment served is in use, except in an emergency, or during the inspection of the units. If the dust collector must be shut down, follow the procedure in "Operator Emergency Shutdown." The shutdown procedure shall be posted on each dust collector control panel.

Process clothing shall be worn and be completely buttoned when working inside the dust collector.

Before entering the filter housing enclosure, check that a "Work Permit" Form FMPC-EH&S-973 has been issued and is posted outside the collector.

Before entering the collector enclosure, lock and tag "Out Of Service" the power equipment to the collector and the associated unit including the main exhaust motor and blower motor per FMPC "Lock and Tag Procedure," Section 8.3, FMPC Environmental Safety and Health Manual.

Any circumstance which could have resulted in a significant intake of radioactive materials by inhalation, ingestion, or absorption will be immediately reported to a supervisor. The involved employees, wage or salary, will report to the Medical Department at the end of their shift to submit a urine sample and again report at the start of their next shift to submit another urine sample. The supervisor will inform the Industrial Hygiene Technician of the circumstance and file a minor event report before the end of the shift during which the circumstance happened.

Use care when handling dirty bags to minimize spillage of dust. Spillage shall be vacuumed as soon as possible in order to minimize the spread of possibly contaminated material to clothing and to areas outside the dust collector enclosure.

OPERATING PROCEDURES

Cyclone

These units have no filter media, differential pressure controls instrumentation, or alarms.

Turn on the main power disconnect.

Starting the dust collectors:

Start the collector by pushing the "START" button on the controller.

Inspect the dust collector hourly for:

Visual and audible characteristics. Record on Form FMPC-PRO-334 "Dust Collector Inspection" that the unit was inspected. If the dust collector is obviously malfunctioning or emitting unusual sounds, shut down the unit. Notify the supervisor.

A sudden rise (100^{0} +/- 25^{0} F) in temperature (if equipped with a temperature gauge). Shut down the dust collector. Notify the supervisor.

Radiation stack monitor readings (if equipped with a stack monitor). Record the readings on Form FMPC-PRO-2608-1 "Dust Collector Radiation Stack Monitor Readings." If the readings increase more than 10 percent of any scale in one hour, notify the supervisor and the Industrial Hygiene Technician.

Stack sampler rotameter flow (if equipped with a stack sampler rotameter). Record the reading on Form FMPC-PRO-2612 "Stack Sampler Check Sheet." Adjust the flow if necessary and record the adjusted flow on Form FMPC-PRO-2612.

Perform the following each shift of operation:

At a time specified by the supervisor shut down and inspect the dust collector per items on "Dust Collector Inspection Sheet," Form FMPC-PRO-2609.

WARNING: WEAR A DUST-TYPE RESPIRATOR DURING INSPECTION.

If problems exist after inspection per Form FMPC-PRO-2609 the supervisor is to correct the problems per Table 1. If damage is found notify the Maintenance Department.

Shutting down the dust collector:

Insure that all equipment served is out of operation.

Press the "STOP" button on the controller.

Empty the collector as follows:

The collector empties to a sump and is pumped to the Plant 6 water treatment area.

TABLE 1
INSPECTION TROUBLESHOOTING GUIDE

Item No.	Problem	Condition And/Or Cause	Corrective Action
1.	High rotameter flowrate	Damaged filter blanket	Check the filter blanket. Advance or replace as required.
2.	Soiled stack sampler filter	Damaged filter blanket	Check the filter blanket. Advance or replace as required.
3.	Filter blanket will not advance	Advance mechanism faulty	Notify the Maintenance Dept.

American Air Filters

Note: The Westinghouse electronic precipitators on these units are not operational. There are no differential pressure controls.

Turn on the main power disconnect.

Starting the dust collectors:

Start the unit by pressing the "ON" button on the controller in the filter house.

On unit 3579, advance the filter media as required by pressing the manual operating button on the advance mechanism until sufficient clean filter is exposed. On unit 3978, the manual operating button actuates a timer which rolls the soiled filter up until the timer has expired.

Turn on the stack sample control unit.

After startup and once each hour, check that the manometers are indicating in the green area as indicated by the mark on the manometer tube. Record the readings on Form FMPC-PRO-2617 "Dust Collector Manometer Readings." (These units have no differential pressure alarms.)

Inspect the dust collector hourly for:

Visual and audible characteristics. Record on Form FMPC-PRO-2617 "Dust Collector Inspection" that the unit was inspected. If the dust collector is obviously malfunctioning or emitting unusual sounds, shut down the unit. Notify the supervisor.

A sudden rise (100^{0} +/- 25^{0}F) in temperature (if equipped with a temperature gauge). Shut down the dust collector. Notify the supervisor.

Radiation stack monitor readings (if equipped with a stack monitor). record the readings on Form FMPC-PRO-2608-1 "Dust Collector Radiation Stack Monitor Readings." If the readings increase more than 10 percent of any scale in one hour, notify the supervisor and the Industrial Hygiene Technician.

Stack sampler rotameter flow (if equipped with a stack sampler rotameter). Record the reading on Form FMPC-PRO-2612. Adjust the flow if necessary and record the adjusted flow on Form FMPC-PRO-2612.

Cubic feet/hour meter (if equipped with a cubic feet/hour meter). Record the flow reading on Form FMPC-PRO-2612. Adjust the flow if necessary and record the adjusted flow on Form FMPC-PRO-2612.

Perform the following each shift of operation:

At a time specified by the supervisor shut down and inspect the dust collector per items on Form FMPC-PRO-1706 "Precipitron Inspection."

WARNING: WEAR A DUST-TYPE RESPIRATOR DURING INSPECTION.

If problems exist after inspection per Form FMPC-PRO-1706 the supervisor is to correct the problems per "Inspection Troubleshooting Guide." If a damaged filter blanket is found notify the Maintenance Department.

Shutting down the dust collectors:

Insure that all equipment served is out of operation.

Press the "STOP" button on the controller.

Empty the collector as follows:

When the filter media is expended, notify the Maintenance Department to install a replacement.

Mark a drum with the following code numbers: 600-N003-7--- (current month).

Place the soiled filter in a plastic liner and then a drum. Invert another drum over the top of the marked drum. Band the two drums together and place them on a skid. Enter the required information on Form FMPC-AC-1945.

Send the filled drums to Plant 1 for disposal.

OPERATOR EMERGENCY SHUTDOWN

Notify appropriate area operators to shut down operations. Shut down the dust collector by pushing the exhauster "STOP" button.

UNUSUAL CIRCUMSTANCE

Any Unusual Circumstance Shall Be Considered As A Possible Failure Until Determined Otherwise and the Supervisor Shall Proceed as Follows:

Shut down the collector per "Operator Emergency Shutdown." Lock and tag "Out of Service: the main exhaust motor per Lock and Tag Procedure (Section 8.3, FMPC Environmental Safety & Health Manual.)

Notify the Plant Manager.

Request an Industrial Hygiene (IH) Technician to check the sampler filter.

Visually check the collector.

A "Minor Event" report is to be completed by the supervisor prior to the completion of the shift.

FILTER CHANGE AND INSPECTION

Production Operations

Stack Sampler Filter - Inspection and/or Change

Stack sampler filters are checked once each week and changed at least once per month by an Industrial Hygiene Technician.

Industrial Hygiene Technician Responsibility

Notify the supervisor of the filter inspection and/or change.

Notify the supervisor of the condition (soiled or unsoiled) of the filter.

If the filter is changed, submit the filter for normal analysis.

Notify the supervisor of the filter analysis.

Supervisor Responsibility

If the filter is changed but is not soiled, resume normal operation of the dust collector.

If the filter is soiled, shut down the dust collector per "Operator Emergency Shutdown." Lock and tag "Out Of Service" the main exhaust motor per Lock and Tag Procedure (Section 8.3, FMPC Environmental Safety & Health Manual.

Notify the Plant Manager of the condition of the soiled filter being analyzed.

Inspect the dust collector for evidence of dust, and if dust is present, determine the source.

Obtain the filter analysis and notify the Plant Manager.

Note: Do not restart the dust collector or operation(s) served by the dust collector until an analyses of the stack loss has been reported and approval to restart has been granted by the Plant Manager.

If the leak source has been located, clean the collector and notify the Maintenance Supervisor to make repairs.

After repairs are complete, clean the collector.

Note: The Plant Manager shall make a determination to restart collector.

A "Minor Event" report is to be completed by the supervisor prior to the completion of his shift.

Environmental Safety & Health

Definitions

Stack Sampler - A device mounted on the exhaust stack, consists of a single-point sample extraction tube and a filter holder. A controlled volume of air is pulled from the exhaust stack by a vacuum pump. This air passes through a pleated filter located inside the filter holder. Any particulate material is collected on the pleated filter.

Pleated Filter - Staplex TFA "S" pleated cellulose paper filter, four inches in diameter, designed for high flowrates.

Rotameter - An airflow measuring device that consists of a graduated glass tube containing a free floating metal ball. The rotameter is used at the stack sampler to measure the airflow being drawn through the stack sampler. The rotameter is placed between the stack sampler and the vacuum line by use of quick disconnect fittings that are present on the stack sampler and the rotameter.

Sampling Rate - The volume of air being drawn through the stack by a vacuum pump. Each stack velocity has been measured, and the sampling rate is set so the flowrate through the stack sampler is equal to the flowrate in the stack at the sampler location.

Ludlum Stack Monitor - A beta-gamma radiation detection instrument consisting of a control/meter box, a section of coaxial cable, and a Geiger-Muller (GM) pancake probe. The GM probe is located beneath the filter in the stack sampler assembly. As material collects on the filter, a signal is delivered to the control box which is located at the dust collector panelboard (or any location convenient to Production Operations). The stack monitor has an alarm mechanism that can be set to alarm at the panelboard if any material collects on the stack filter.

Required Equipment

Rotameter, 0 to 60 Lpm, with Schrader or Swagelok fittings.

Pre-numbered type "S" pleated filters.

Polyethylene bags.

Screwdriver and pliers.

Stack Sampler Inspection Report (FMPC-ES&H-2239 through 2242) (hereinafter called the "Inspection Report").

Dust Collector Log Book.

Final Stack Sampler Results Form (FMPC-ES&H-1510).

Stack Discharge Report (FMPC-ES&H-2563).

Procedure for Filter Inspection and Change

All stack samplers shall be inspected once each week and all filters will be changed at least once per month.

Fifteen critical dust collectors (identified by Production) will have their filters changed twice per week.

Obtain required equipment at ES&H Decontamination Room. Obtain numbers of installed filters and prescribed flow from the Stack Log Book and fill in on Inspection Report.

At the control panel of the dust collector being inspected, observe the Ludlum stack monitor.

Record the reading from the stack monitor on the Inspection Report.

Record the stack alarm set point on the Inspection Report.

At the stack sampler, check to see that the stack sampler, vacuum tubing, and other sampling equipment is operating properly. If any defects are found, note them in the "Remarks" section.

Determine the existing sampling rate by inserting the rotameter between the vacuum line and the filter holder.

Record this reading under "Rate-actual" on the Inspection Report and adjust to prescribed rate, if necessary.

If the prescribed rate is not obtainable, this should be noted on the Inspection Report sheet.

Strike the cone section of the filter holder several times around the periphery of it with the handle of the screwdriver to dislodge any material that might be clinging to the inside of the cone.

Using the screwdriver, loosen the three 1/4" bolts and carefully lower the bottom section of the filter holder.

If the filter shows evidence of any accumulation of material, remove the pleated filter and place it in a plastic sample bag. Care must be taken to assure that none of the material falls from or is blown off of the filter while it is being removed and placed in the bag.

If a filter change is necessary, insert a new pleated filter (pre-numbered) in the filter holder.

Using the three 1/4" bolts, secure the filter holder tightly to the cone using pliers and screwdriver.

If no change is made, check that the filter number is correct before closing the filter holder.

Recheck the sampling rate of the stack sampling assembly. Adjust to the prescribed rate, if necessary.

Remove the rotameter and reconnect the vacuum line to the sampler.

If the prescribed rate could not be obtained, note this on the Inspection Report sheet.

If the filter has been changed and it is clean, go to the next dust collector and continue the inspection by repeating the above steps until all dust collectors in the plant are inspected.

If any filters were changed or if there is any deficiency in a sampler or dust collector operation, advise the plant supervisor or his representative of the facts before leaving the plant and make suggestions for correcting any deficiencies. Note the plant supervisor's name or his representative's name and the time and date he was notified on the Inspection Report sheet.

If the filter has been changed and there is an accumulation of material on the filter, immediately inform the plant supervisor or his representative of this finding and take the soiled filter to the Sample Receiving Laboratory, Room W-34. Fill out a Report of Chemical Analyses form (FMPC-T-200) with all required information for the analysis of the filter removed for the stack sampler.

Under "Sample Description" write the date the filter was put into the sampler and the date it was taken for analysis.

Request analysis for total uranium and total particulates.

The Environmental Radiation Monitoring (ERM) Technician or Industrial Hygiene Technologist shall ask the Technical Laboratory to perform the analysis immediately and to telephone the results as soon as they are available.

Any irregularities noted on the Inspection Report shall be brought to the attention of an ERM Technologist on returning to the Decontamination Room after the inspection is completed.

Record Keeping

During the actual inspection of the stacks, a rough copy of the Inspection Report is carried in a pocket because it is unsafe to climb ladders with a clipboard. This copy is prepared before the inspection by copying the filter identification number and the prescribed sampling rate from the Stack Sampling Log Book.

During the inspection the actual rate in the L/m column is filled in for each sampler. The flow measurement is the rate of sampling in L/m. The Ludlum (CPM) is the reading taken from the stack monitor before the filter is inspected, and after the filter is changed. The Alarm Set Point is recorded from the Ludlum stack monitor.

After the inspection is complete, all information that has been recorded on the rough copy of the Inspection Report must be transferred to the permanent record copy of the Inspection Report.

Copies of the Inspection Report shall be prepared and distributed as directed on each Stack Sampler Inspection Report:

- Original routed to the Engineer in the Environmental Compliance Subsection responsible for review. On return, it will be filed in the Stack Log Book and shall be the record copy.
- Copy to Vide-President & Manager, Production Operations.
- Copy to Chemical Area/Metal Area Manager.
- Copy to General Supervisor.
- Copy to Area Supervisor.
- Copy to Production Supervisor.

Each filter change must also be recorded in the Dust Collector Log Book.

The filter number of the new filter and the date it was put into service is logged on the line below the old filter number. The date the old filter was taken out of service is logged in the line starting with the old filter number.

The old filter number, stack number, and the dates the filter was in the sampler should be recorded on an Analytical Data Sheet and on a Final Sampler Result form.

As soon as the Technical Division reports the results of the analysis of the stack filter samples to the ERM Department, the ERM Technician will immediately calculate the losses and record them in the Dust Collector Log Book and on the Final Stack Sampler Result form.

The ERM Technician will then notify the plant supervisor of the amount of the calculated loss.

Record the supervisor's name and the time of notification on the Final Stack Sampler Results form.

The ERM Technician will then take the completed Stack Sampling Report form to the Environmental Compliance Engineer resposible for reviewing these reports.

The Analytical Data Sheet should be taken to the Dosimetry Subsection for filing.

During the last working week of each month, the Stack Discharge Report will be submitted to the Environmental Compliance Engineer.

The record copy of the analytical results shall be kept in the Dosimetry Subsection files.

The completed Final Stack Sampler Results form shall be distributed as follows:

Original - routed to Environmental Compliance Engineer responsible for program
Record Copy
Copy to Manager of Environmental & Radiological Safety
Copy to Vice-President & Manager of Production Operations
Copy to Chemical Area/Metals Area Manager
Copy to Production Supervisor
Copy to Supervisor of Health Physics

Forms Used

Stack Sampler Inspection Report

Final Stack Sampler Results (FMPC-ES&H-1510)

Dust Collector Stack Sampling Log (FMPC-ES&H-1536)

Report of Chemical Analysis (FMPC-T-20-C)

FILTER MEDIA RENEWAL

1. Notify the Production Supervisor of the work to be accomplished on the dust collector.

2. Post approved work permit on the outside of dust collector enclosure.

3. Assemble required tools and safety equipment (see work permit for required respiratory equipment).

4. Lock and tag "Out Of Service" the dust collector blower and associated vacuum unit.

   Note: Ensure proper respiratory equipment is obtained prior to entering the collector enclosure. Refer to "Industrial Health and Safety Requirements" for proper equipment.

5. Make sure the spent filter blanket is wrapped completely around the bottom role.

6. Remove cotter pins from each end of the bottom roll.

7. Lift the spent blanket roll out of its housing and place it on plastic on the floor.

8. Remove the retainment pins from the blanket roll.

9. Deposit the soiled filter blanket in a plastic 55-gallon drum liner and put both in a coded drum.

10. Install the retainment pins from the new filter blanket.

11. Install the new blanket roll on the top rack of the collector.

12. Remove tape from the blanket and unroll.

13. Cut the leading edge of the roll on an angle and feed the roll through the bottom roll brackets.

14. Advance the roll by jogging the drive motor to ensure it is even.

15. Set the motor switch to "Automatic."

Inspection

Inspect access doors for proper operation and closure. Replace door seals as required to assure a proper seal. Repair or replace worn or broken door closure hardware. Adjust door closure mechanism as required to assure proper operation and a tight seal.

The Maintenance Supervisor and Production Supervisor will inspect the dust collector following completion of work in accordance with the Dust Collector Post Maintenance Check Sheet (FMPC-PRO-2610) found in SOP 6-C-701 and 9-C-701. Both supervisors will sign the check sheet indicating the dust collector is approved for operation.

Following inspection by Maintenance and Production Supervisors, close the collector door and advise Production that work on the dust collector is complete. Remove locks and tags from the dust collector and the associated vacuum units.

PREVENTIVE MAINTENANCE

The following procedures will be followed by Maintenance Department personnel twice each year.

1. Notify supervisor in the building of the dust collector inspection.
2. Instrument check and calibration.
3. Check housing platform and ladders for any deformation, corrosion and cracks.
4. Check dust bags for holes, ripped seams, dust build-up, bag tension and fasteners.
5. Check blowring assembly, alignment, sprockets, rollers, chains, guides, sheaves and drive.
6. Check hose and clamps, piping and fittings for deterioration and leaks.
7. Check limit switches, blower motor, vacuum motor belt tension, electrical timers and safety devices.
8. List corrective action requried.
9. Notify supervisor of corrective action required.
10. Complete scheduled preventive maintenance (PM) card.
11. Review and return PM Check Sheets to the PM Activity Clerk.

ASSIGNMENT OF RESPONSIBILITY

Operating personnel are responsible for performing checks and operations according to Standard Operating Procedures.

The Production Supervisor assigned to each area which contains dust collectors is responsible for ascertaining that each one is operating satisfactorily and that operators have performed checks and operations according to Standard Operating Procedures.

The Plant Manager, General Supervisor and Area Supervisor are responsible for satisfactory operation of dust collectors in their areas.

The Maintenance Manager, Assistant Maintenance Manager and the Area Maintenance Supervisor are responsible for responding to the needs of Production personnel in providing equipment maintenance and are responsible for implementing the Preventive Maintenance Program.

Checks on operations are performed at scheduled intervals and reported monthly by Environmental Safety and Health to ascertain stack losses. Copies of the sampling reports (FMPC-ES&H-2239, 2242, 2241) are reviewed by Production supervision and action taken as necessary. Monitoring stations around site also determine if air or water has exceeded specified limits of radioactivity. Readings are reported.

EMERGENCY REPORTING

If inspection of an air pollution control device indicates the potential for the emission above acceptable limits of radioactive materials, the Emergency Duty Officer will be immediately contacted. The Emergency Duty Officer will then initiate the appropriate procedures mandated in the FMPC Emergency Plan.

QUALITY ASSURANCE

All quality related activities are conducted per the requirements of the FMPC Quality Assurance (QA) program. The QA Program will be conducted in accordance with the Environmental Compliance QA Plan as submitted under item B4 of the 30 day submittal. This program includes but it is not limited to:

- work being conducted to approved Standard Operating Procedures (SOP)
- the alarm systems will be checked to ascertain that all collector alarm systems are in operating condition
- Complete documentation of all training of personnel
- selection and purchase of the filtering media will be done according to established specification
- maintenance procedures designed to assure proper installation and operations of critical components will be done
- PM procedures to assure replacement before life of filter media has been exceeded will be performed
- maintenance procedures and check lists will be developed to assure proper installation of clamps, bands, holders or other fasteners
- PM procedures to assure replacement of fasteners before deterioration will be performed
- PM procedures to anticipate and prevent leaks in connecting duct work, fans, blowers, etc. will be performed
- PM procedures to anticipate and prevent the failure of instrument monitors and controllers will be performed
- scheduled inspection being performed by trained personnel with calibrated instrumentation
- complete documentation of all inspections and associated corrective action
- complete documentation of all calibrations

RECORDS

1. The preventive maintenance program provides check lists and monthly printouts (Report 308-03) of the inspection record on each collector. These data are obtained from the form (FMPC-PRO-2234) by Maintenance personnel.

2. Several forms are used by Production to request Maintenance to repair collectors and associated controls:

   a) Minor Work Request (FMPC-PRO-2532)
   b) Job Order Request (FMPC-PRO-183-1)

   The following PMP records are also maintained:

   a) Dust Collector Sheet (FMPC-PRO-2234) (FMPC-PRO-PMP-20A)
   b) PMP Check Sheet - Foxboro Differential Bell meter with Rotex controller - (FMPC-PRO-2400) (FMPC-PRO-PMP-13K)
   c) PMP Checksheet - Manometer (FMPC-PRO-2399) (FMPC-PRO-PMP-13K)

3. The Environmental Safety & Health Department maintains a log on dust collector sampling (FMPC-ESH-1536).

4. The Environmental Safety & Health Bio-Assay Laboratory prepares a data sheet (FMPC-ESH-736) which is used to summarize and prepare the annual report on Environmental Monitoring.

5. Records are kept of the Environmental Safety & Health Stack Sampler Reports (FMPC-ESH-2239, 2240, 2241, 2241).

6. The Production Operations Department maintains records of dust collector operation on the following daily check sheets:

   a) FMPC-PRO-333, 1186, 1127, 1187, 1245, 1706 and
   b) FMPC-PRO-333-1, 1186-2, 2608, 2609, 2610, 2611, 2612

REFERENCE DOCUMENTS

Manufacturing Standards

1. SOP 6-C-701, "Dust Collectors," Plant 6

2. SOP 9-C-701, "Dust Collectors," Plant 9

3. SOP 6-C-301, "Water Treatment," Plant 6

FEED MATERIALS PRODUCTION CENTER

OPERATION AND MAINTENANCE PLAN

FOR

AIR SCRUBBERS

SEPTEMBER, 1986

TABLE OF CONTENTS

INTRODUCTION

Wet Scrubbers*

Wet scrubbers remove particulates from a gas stream by effecting intimate contact between the gas stream and a scrubbing liquor, usually water. The basic operations that take place within a wet scrubber are (1) saturation of the incoming gas, (2) contacting and capture of the particulates in the scrubbing liquor, and (3) separating the entrained particulate-laden liquid from the gas stream. The basic types of wet scrubbers are distinguished by the mechanisms used for transfer of particulates from the gas stream to the liquid stream. Most scrubber systems require some type of treatment and disposal of the particulate-laden scrubbing liquor.

REASONS FOR OPERATION AND MAINTENANCE PLAN

This Operation and Maintenance Plan has been prepared to explain the operation of Wet Scrubber systems, the activities necessary to keep the units operating at peak efficiency, and to satisfy the 90 day FFCA requirement.

This plan addresses the Venturi-type scrubber system and the up flow Absorber Tower system in use at the FMPC.

Wet Venturi scrubber systems employed at the FMPC may differ slightly in their operation and in their scrubber liquor composition. Standard Operating Procedures have been prepared for each system and should be consulted should specific information on an individual system be sought.

DESCRIPTION OF OPERATION AND EQUIPMENT

Nitric Acid Recovery System

See Attachment 1.

Venturi Scrubber

In a venturi scrubber the gas stream flows through a throatlike passage where the gas is accelerated in velocity. The scrubbing liquor is added at or ahead of the venturi throat and is sheared into fine droplets by the high-velocity gas stream, resulting in liquid-particulate interaction.

Prior to exiting from the scrubber, the gas stream passes through an entrainment separator to remove entrained liquid droplets.

Scrubber Liquor

The scrubber operation and the particulates in the gas stream determine the type of scrubber liquor to be used. Most scrubbers at FMPC employ the use of water as the scrubber liquor. There are operations, however, that require the use of basic solutions such as a mixture of Sodium Hydroxide or Potassium Hydroxide and water.

*USNRC Regulatory Guide, May 1986

As the liquor circulates through the scrubber system it concentrates the particulates removed from the gas stream. Once each operating shift (8 hours) the liquor is sampled and analyzed. When tests indicate, the liquor is removed from the recirculating tank and processed for removal and reclamation of the scrubbed particulates or, as in the acid recovery system, used in the manufacturing process digestion operation.

INDUSTRIAL HEALTH AND SAFETY REQUIREMENTS

Avoid skin contact with nitric acid (HNO_3) by proper use of the protective equipment provided.

Avoid breathing or exposure of the skin to fumes containing nitrogen oxides (brown or yellow-colored gases).

Black chemical resistant gloves will be worn when taking samples or when exposure to acidic liquid or gases is possible.

Chemical goggles will be worn at all times within the designated areas, as indicated by posted notices.

Self-contained breathing equipment or air-supplied respirator and protective clothing will be worn if entry to a fume-release area is required. This equipment is to be used by trained personnel only.

Personnel working in the area should be familiar with the location and use of safety showers, eye bubblers, self-contained breathing equipment, etc.

OPERATING PROCEDURES

Nitric Acid Recovery System

See Attachment 1.

Venturi Scrubber System

Startup

1. Check liquid level in the scrubber system recirculating hold tank. Add scrubber liquid to desired operation.

2. Start scrubber tank agitator if applicable.

3. Align the valves to the selected scrubber recirculating pump. Open seal water supply to the pump and start the pump.

   Note: To assure continuous operation, most scrubber pumps are equipped with a redundant system.

4. Verify that sufficient draft exists to achieve minimum draft requirements.

5. Start associated process equipment.

Shutdown

1. Secure associated process equipment.

2. Stop the scrubber exhaust blower, if applicable.

3. Stop the scrubber recirculating pump and shut off the seal water.

4. Close discharge and suction valves.

SAFETY FEATURES

On gas fired furnaces equipped with wet scrubbers, failure of the scrubber to provide sufficient draft for the furnace will result in the automatic cessation of the gas burner supply. A purge timer is activated which locks out the pilot light for a set period after which the gas burners and scrubber may be put in operation.

INSPECTION AND FREQUENCY

1. Ensure that recirculating tank liquid is maintained at desired level.

2. Ensure that scrubber liquor does not exceed pre-determined chemical concentration parameters. Depending on the specific scrubber system, these could be but are not necessarily limited to acidity, alkalinity, total solids, uranium.

3. Every two operating hours, record scrubber draft.

4. Every four operating hours, record recirculating tank level.

5. The Nitric Acid Recovery System DuPont Analyzer and Multipoint Recorder are inspected daily by the Instrument Shop personnel.

PREVENTIVE MAINTENANCE

Each week, the wet scrubber recirculating pumps are inspected by a maintenance department representative who initiates appropriate repairs.

ASSIGNMENT OF RESPONSIBILITY

Operating personnel are responsible for performing checks and operations according to Standard Operating Procedures.

The Production Supervisor assigned to each area which contains scrubber systems is responsible for ascertaining that each one is operating satisfactorily and that operators have performed checks and operations according to Standard Operating Procedures.

The Plant Manager, General Supervisor and Area Supervisor are responsible for satisfactory operation of scrubber systems in their areas.

The Maintenance Manager, Assistant Maintenance Manager and the Area Maintenance Supervisor are responsible for responding to the needs of Production personnel in providing equipment maintenance and are responsible for implementing the Preventive Maintenance Program.

EMERGENCY REPORTING

If inspection of an air pollution device indicates the potential for the emission above acceptable limits of radioactive materials, the Emergency Duty Officer will be immediately contacted. The Emergency Duty Officer will then initiate the applicable procedures mandated in the FMPC Emergency Plan.

QUALITY ASSURANCE

All quality related activities are conducted per the requirements of the FMPC QA program. The QA program will be conducted in accordance with the Environmental Compliance QA Plan as submitted under item B4 of the 30 day submittal. This program includes but it is not limited to:

- work being conducted to approved Standard Operating Procedures (SOP)
- selection and purchase of associated equipment done according to established specification
- maintenance procedures designed to assure proper installation and operations of critical components will be done
- preventive maintenance procedures to anticipate and prevent the failure of instrument monitors and controllers will be performed
- scheduled inspection being performed by trained personnel with calibrated instrumentation
- complete documentation of all inspections and associated corrective action
- complete documentation of all training of personnel
- complete documentation of all calibrations
- QA surveillance(s) conducted for compliance with air contaminant source permit status

REFERENCE DOCUMENTS

Manufacturing Standards

1. SOP 11-C-245, "Reduction of UF_6 to UF_4 DCS Controlled Process," Pilot Plant
2. SOP 9-C-406, "Denitration Fume Scrubbing," Plants 2 and 3
3. SOP 2-C-501, "Nitric Acid Recovery System," Plant 2
4. SOP 4-C-301, "KOH Scrubbing System," Plant 4

5. SOP 6-C-202, "Briquetting," Plant 6

6. SOP 8-C-203, "Box Furnace," Plant 8
   SOP 8-C-205, "Oxidation Furnace No. 2," Plant 8
   SOP 8-C-207, "Oxidation Furnace No. 1," Plant 8
   SOP 8-C-208, "Rotary Kiln," Plant 8
   SOP 8-C-212, "Conversion of Uranium Tetrafluoride to Calcium Uranate and Calcium Fluoride Using Calcium Hydroxide (Lime) in the No. 2 Oxidation Furnace," Plant 8

NLO - FMPC MANUFACTURING STANDARDS

TITLE			INDEX NUMBER
SOP - NITRIC ACID RECOVERY SYSTEM			2-C-501
DIVISION & PLANT	SUPERSEDES	PREPARED BY	DATE ISSUED
Prod. - 2	2-C-501 4/18/73	J. B. Patton Revised by L. A. Tilney	11/06/81 10/24/84

R Page 1 Revision Date: 10-24-84

REFERENCES: None

R DESCRIPTION OF OPERATION AND EQUIPMENT

The nitric acid recovery system collects nitrogen oxide fumes from the uranium metal dissolver, ore concentrate and residue digesters, and denitration pots.

In the normal mode of operation, these fumes together with ventilation air in leakage are drawn by a Roots-Connersville (RC) blower into the bottom of and through Absorber Tower D3-12 (east), and then into the bottom of and through Absorber Tower D3-13 (west). (See flow diagram.) The gases flow upward through 27 bubble-cap trays in each absorber tower where they are contacted by a downward flow of water (west tower) and weak nitric acid (east tower). A major portion of the nitrogen oxide is absorbed in the liquid phase, and the final tail gas from the west absorber is mixed in a ventilation stack with a large volume of air which is discharged into the atmosphere. A DuPont nitrogen oxide analyzer continuously samples and analyzes the gas stream at the following points:

1. Upstream from the RC blower (east absorber feed gas).

2. East absorber tail gas (west absorber feed gas).

3 West absorber tail gas.

4. Diluted gases in the ventilation stack (to atmosphere).

The liquid is recirculated from the bottom to the top of the west absorber column and then downward through the column counter-current to the gas flow which is rising there. When the liquid acidity reaches the target normality, the liquid is pumped from the bottom of the tower to Tank F3-23, and the tower is refilled with water.

The east column with its associated tank is charged with a supply from the west column acid product when it is available in Tank F3-23. This acid is then recycled down through the column, through Tank F3-24 or F3-25, whichever is the in-process tank, back to the top of the column. When the acid attains its target normality, it is held for transfer to Tank F1-23 or F1-24.

Tanks F3-24 and F3-25 will be used in alternating functions as part of the east column recycle system. This is described in the following paragraphs.

R - MATERIAL REVISED, ADDED, OR DELETED.

DESCRIPTION OF OPERATION AND EQUIPMENT (cont.)

Assuming that F3-24 has been selected to be actively in the recycle circuit first, weak product acid is pumped from Tank F3-23 to the top of the column, from which eventually it is received in Tank F3-24.

When the system is fully charged, the pumping of acid from Tank F3-23 is stopped and recycling of the weak acid from the tank, to the top of the column, and back to the tank is begun. Tank F3-25 is at this time empty. The attaining of the target

R - MATERIAL REVISED, ADDED, OR DELETED.

normality for this acid is the signal to stop recycling the acid from F3-24 and to begin replacing column acid with acid from F3-23. After 2500 gallons has been fed into the column, the product acid has been displaced from it to tank F3-24, and the flow from the column's bottom is redirected to F3-25.

At this time F3-25 becomes the receiving tank and F3-24 becomes an acid product holding tank. Charging of the system from F3-23 is terminated upon supervision's decision and recycling from F3-25 is immediately begun. F3-25 is now fully part of cycling system, while F3-24 remains an acid product hold tank until its contents are pumped to F1-23 or F1-24.

Each of the two tanks then goes through a cycle of functions:

Tank A	Weak Acid Receiving	Acid Recycling	Tower Acid Exchange	Product Acid Hold
Tank B	Empty	Empty	Empty	Weak Acid Receiving
Tank A	Product Acid Hold	Empty	Weak Acid Receiving	Acid Recycling Etc.
Tank B	Acid Recycle	Tower Acid Exchange	Product Acid Hold	Product Acid Hold

R INDUSTRIAL HEALTH AND SAFETY REQUIREMENTS

1. Avoid skin contact with nitric acid (HNO_3) by proper use of the protective equipment provided.

2. Avoid breathing or exposure of the skin to fumes containing nitrogen oxides (brown or yellow-colored gases).

R 3. Black chemical resistant gloves will be worn when taking samples or when exposure to acidic liquid or gases is possible.

4. Chemical goggles will be worn at all times within the designated areas, as indicated by posted notices.

5. Self-contained breathing equipment or air-supplied respirator and protective clothing will be worn if entry to a fume-release area is required. This equipment is to be used by trained personnel only.

6. Personnel working in the area should be familiar with the location and use of safety showers, eye bubblers, self-contained breathing equipment, etc.

PROCEDURE

1. Startup of Absorber Columns

NOTE: See attached "Nitric Acid - General Flow Diagram" and "Liquid Flow Diagram - Absorbers".

(R) MATERIAL REVISED, ADDED, OR DELETED.

1.01 Open bottom outlet valve for the east absorber tower to discharge pump and set the downstream valves to deliver weak acid to storage tanks F3-24 or F3-25. (Tank F3-22 can be equalized through bottom lines with any of the other three storage tanks when authorized.)

1.02 Align valves as instructed by the supervisor to supply weak acid from storage tank to the top tray of the east column. Turn on pump G3-18 or G3-19.

1.03 Set pump G3-33 on automatic control.

NOTE: Pump G3-34, the middle pump in the set of three, operates only on manual control and is a spare for G3-33.

1.04 Align valves for the recycling of weak acid to the top of the west column and turn on pump G3-35 (continuous manual operation).

1.05 Open valves to bypass the magnetic flowmeters and the automatic control valves (top platform level) in the liquid feed control systems to raise the tray liquid levels to operational state for both columns. (This will require two hours.)

1.06 Close bypass valves and align valves for flow through the magnetic and visual (Fischer-Porter) flowmeters and the automatic control valves after sufficient liquid has been added to the column.

1.07 Adjust the automatic liquid feed recorder-controller (main panelboard) to deliver a minimum of 1 gpm to each absorber tower.

NOTE: Flows greater than 1 gpm may be specified by supervision if NO_x fume load in the gas feed stream is expected to be high (e. g., greater than 2.1 v/o). See Manufacturing Specification 2-B-450-1.

1.08 Check that DuPont analyzer and the multipoint recorder are operating and if they are not, notify Instrument Shop.

1.09 Open valves from the east absorber tower bottom to feed the RC blower seal liquid pump.

1.10 Start pump to deliver seal liquid to the RC blower and adjust the flow (visual rotameter) to 4 - 6 gpm.

1.11 Open water valves to each lobe bearing to "wide open" position. Check to see that cooling water is flowing to bearings.

1.12 Start RC blower and check to see that oil pump is delivering oil to all six main bearings (sight glasses).

1.12 (cont.)

NOTE: There are two blowers (east and west) available for use. Changing from one to the other requires removal and reinstallation of isolating blanks on suction and discharge of blowers. Also, a change in valving of the lobe seal acid to supply the blower in service and a change in the belt drive sheaves is required.

R NOTE: An oil pressure supply confirmation switch is interlocked
R with the RC blower "START" lever. If the blower should
R fail to continue operating, after the start lever is
R released, it may be an indication of insufficient oil
R pressure. Do not bypass this interlock mechanism by
R wiring or blocking the start lever in the "ON" (start)
R position.

1.13 Start Stack Fan G3-20.

NOTE: Stack fan must be operating whenever the absorber towers are receiving NO_x-containing gases. Check to see that the drip valves are open under the stack (D3-5) and stack fan housing (G3-20).

1.14 Check the sumps at the ground floor level to determine that the pumps are on automatic level-control operation and that the sump pump inlet is not plugged with foreign material. These pumps can be manually tripped and will shut off at the preset low level.

2. Maintaining Operation

The flow rate of water or weak nitric acid to the absorption towers depends on several factors. The factors are primarily the concentration of nitrogen oxides in the feed gas, the quantity and concentration of weak acid in the storage tanks, atmospheric pollution restrictions, and seasonal temperatures. The objectives are to maximize the recovery of nitrogen oxides, minimize the volume of weak acid produced, and minimize the amount of nitrogen oxides released to the atmosphere. The supervisor will advise operating personnel as to mode of operation consistent with these objectives.

2.01 Maintain the designated liquid flow at the desired rate (automatic record-controller, main panelboard).

2.02 (Supervisor) Monitor the DuPont analyzer at least once per shift to make certin that the NO_x fumes are not exceeding 100 ppm in the incoming air stream.

NOTE: Chart paper will be removed daily from the DuPont analyzer by personnel of the Instrument Shop and taken to the Production Clerk who prepares a monthly report.

R - MATERIAL REVISED, ADDED, OR DELETED.

2. Maintaining Operation (cont.)

2.03 Check the RC blower lobe seal liquid flow rate, bearing cooling water, and lubricating oil flow at least twice each shift.

2.04 Check for liquid or gas (nitrogen oxide) leaks at flanges, valves, pumps, etc. in the area at least once each shift. Advise supervisor on items requiring maintenance.

2.05 Check ground floor sumps at least once each shift for proper operation. Pump collected water in catch basin just north of and adjacent to the NAR pad daily to the NAR pad sump.

2.06 Enter readings of flows and tank volumes on Form No. NLO-PRO-747 (Acid Recovery Data). Record samples on Form No. NLO-PRO-522 (Sample Log Sheet).

R - MATERIAL REVISED, ADDED, OR DELETED

2.07 Check the DuPont NO_x recorder twice each shift to determine conformance to environmental considerations. (See Manufacturing Specification 2-B-450-1.) To correct high fume levels, increase the reflux rate or replace the reflux liquor if it is of high acid normality. If these fail, reduce the load to nitric acid recovery by curtailing operations.

2.08 Take liquid samples per Manufacturing Specification 2-B-450-1.

3. Withdrawing Recycled Acid from Columns

3.01 Withdraw weak acid product from the west tower as follows:

3.01.01 Set valves in line from pump G3-35 to tank F3-23.

3.01.02 Close recycle valve

3.01.03 Switch pump from manual to automatic operation.

3.01.04 Set valves to provide water flow to the top of the west column.

3.01.05 After transfer of approximately 2500 gallons (pumping time dependent on gpm rate), shut off water and return to recycling water (weak acid) in the west column. See items 1.05, 1.07, and following:

3.02 Withdraw east column product acid and replace with west column product from tank F3-23 as follows:

3.02.01 Close outlet from tank F3-24 or F3-25 and open outlet from tank F3-23.

3.02.02 After transfer of 2500 gallons (pumping time dependent on gpm rate), reset valves to receive in the alternate tank.

NOTE: Accumulate a quantity in the alternate tank as directed by supervision. When the desired level has been reached in the alternate tank, F3-23 will be shut off, and the alternate tank will become the source of recycle material of the east tower system.

4. Extended Shutdown of Absorber Tower System

NOTE: If shutdown is planned during or extending into a subfreezing weather period, the liquid shutoffs noted below should be revised to include complete drainage of tanks, absorber towers, lines (including steam-tracing drainage), pumps, etc. to prevent damage due to freezing.

4.01 Turn off RC blower.

4.02 Turn off stack fan.

4.03 Shut off liquid flow (water or recycle acid) to the top of the absorber towers.

4.04 Close all main valves at the bottom of the weak acid storage tanks.

(R) MATERIAL REVISED, ADDED, OR DELETED.

4.05 Turn off liquid feed pumps (G3-18 and/or G3-19).

4.06 Turn off RC blower lobe seal liquid pump.

4.07 Turn off the RC blower bearing cooling water if instructed by the supervisor.

4.08 Turn off cooling water to east absorber tower's internal coils (if on) and drain vertical headers.

4.09 Leave acid product pumps (G3-33 and G3-35) on for at least eight hours after liquid feed to the top of the absorber towers has been stopped.

NOTE: The absorber towers will require several hours for drainage of liquid from the trays. Final shutdown conditions which are dependent on the anticipated length of the shutdown will be determined by Refinery supervision.

4.10 When the desired liquid drainage from the towers has been achieved, close the main valves in the liquid lines at the bottoms of the absorber towers.

The above SOP has been approved by the Chemical Plants Superintendent, General Superintendent, Health and Safety Division, and the Quality Control and Production Technology Departments.

AUTHORIZED BY:

Assistant Manager — Date 10/8/81

NITRIC ACID - GENERAL FLOW DIAGRAM

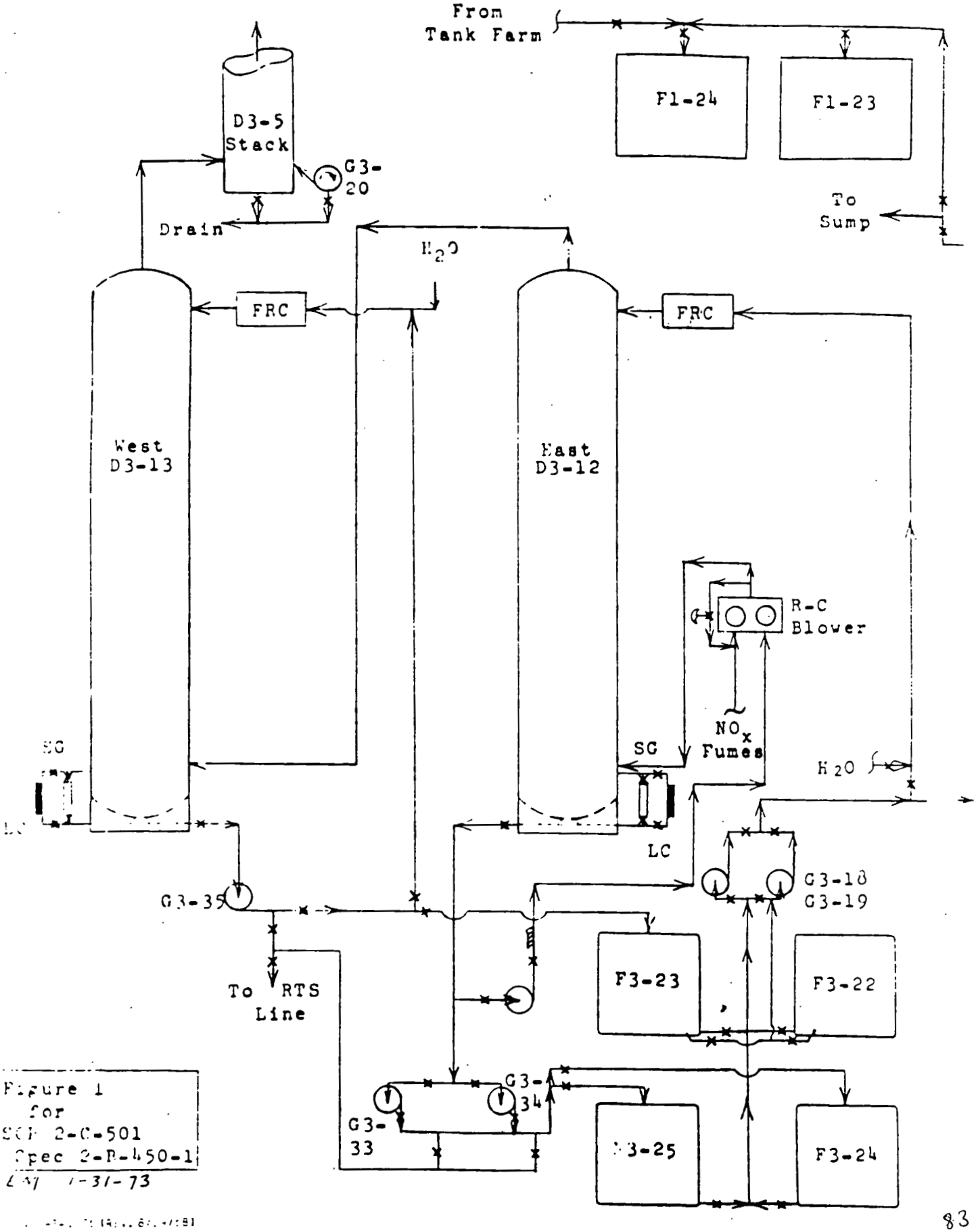

Figure 1
for
SOP 2-C-501
Proc Spec 2-P-450-1
EAJ 7-31-73

LIQUID FLOW DIAGRAM - ABSORBERS

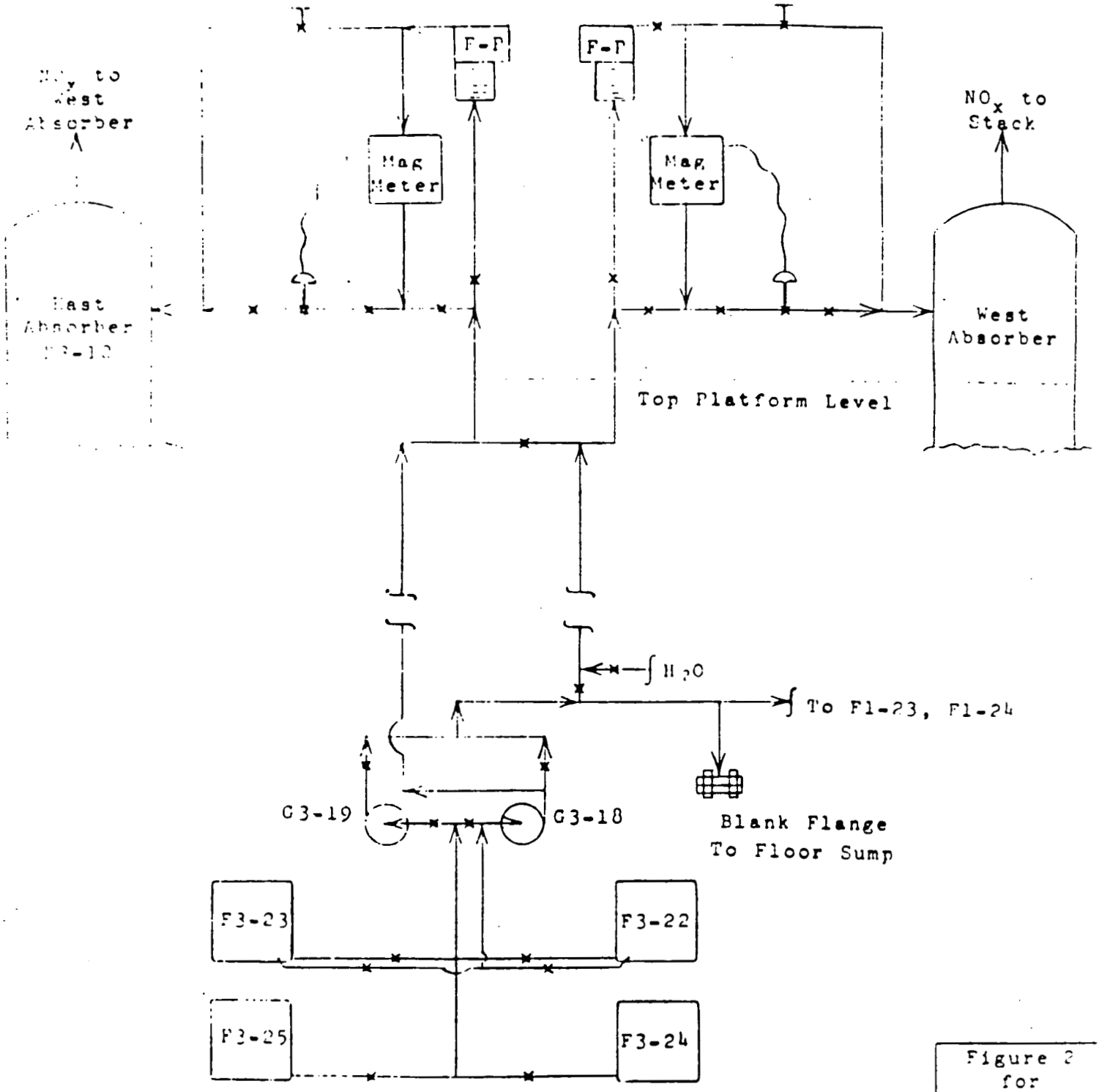

Figure 3
for
SOP 2-C-501

EM 1-31-73

RECORD OF REVISIONS

Page	Date	Description and Authority
3	3-19-76	Information concerning cooling water to blower bearings inserted. Require merits for changeover from one blower to the other included. Revision per Change in SOP No. 134, initiated by E. M. Nutter.
All	11-06-81	Entire SOP revised to provide for independent operation of towers per Change in SOP No. 632, initiated by D. L. Dunaway.
2, 4 5, 9	9-01-83	Chemical resistant gloves added to Industrial Health and Safety Requirements. Data recording and sample form numbers, and names added. Corrective action added for high levels of NO_x. All items added per Change Request No. 846, initiated by D. L. Dunaway.
1 thru 1A 4 thru 4A 9	10-24-84	Note added to item 1.12 for reference to oil pressure supply switch interlocked with R C Blower "START" lever per Change Request No. 928, initiated by R. L. Gardner.

LIST OF EFFECTIVE PAGES

Page	Date
1 thru 1A	10-24-84
2	9-01-83
3	11-06-81
4 thru 4A	10-24-84
5	9-01-83
6 thru 8	11-06-81
9	10-24-84

R - MATERIAL REVISED, ADDED, OR DELETED.

FEED MATERIALS PRODUCTION CENTER

OPERATIONAL GUIDELINES

EXHAUST SYSTEM FILTRATION

COMPONENTS

JUNE, 1986

OPERATIONAL GUIDELINES FOR EXHAUST SYSTEM FILTRATION COMPONENTS

Contents

June 1986

Operational Requirements for Filtration Components

1. Qualified personnel must be selected (and/or acquired) to handle (manage) all operations related to exhaust filtration, and logically the operation of the exhaust ventilation system(s). One person must be in responsible charge of all such activities.

2. Materials must be acquired that meet the specifications for their use. Filters must be requisitioned, purchased, received, inspected, and properly stored ready for use. A stock level of replacement filters should be maintained that would service at least two (2) complete changeouts or one (1) year's usage.

   A. HEPA filters must be purchased according to Specification Data Sheet DS-H-121.

   Note that when HEPA filters are purchased according to DS-H-121, the manufacturer ships them to the QA test station in Oak Ridge. Then after successful QA inspection/testing the filters are repackaged and shipped to FMPC for storage and/or use. The time required from requisitioning to delivery at FMPC can be 60 days or more. Hence, the need to maintain a minimum storage level that will provide replacement filters for all occasions, within reason.

   Several sources of nuclear grade (Type B) HEPA filters are:

   1. Flanders Filters, Inc.
      P.O. Box 1708
      Washington, NC 27889-9990
      (919)946-8081 TWX: 510-924-1898

   2. Mine Safety Appliance Company
      Filter Products Division
      Evans City, PA 16033
      (412)538-3510

3. American Air Filter
   Environmental Control Division
   P.O. Box 35530
   Louisville, KY 40232-5530

4. Cambridge Filter Corporation
   P.O. Box 4906
   7645 Seventh North Road
   Syracuse, NY 13221

B. Prefilters must be purchased according to Specification Data Sheet DS-H-120.

Note that prefilters are not QA tested in Oak Ridge like HEPA filters. Prefilters are shipped directly to users (FMPC) from the manufacturer. Therefore, inspection and evaluation after delivery are wholly the function of the user (FMPC) before being added to storage stock and subsequent use. Substitution of materials and features of prefilters must be closely evaluated to ensure they will fit and serve equally for the item identified by the data sheet. DS-H-120 does not identify a generic prefilter item that is common to many manufacturing sources.

The most available source is:

Mine Safety Appliance Company
Filter Products Division
Evans City, PA 16033
(412)538-3510

C. Disposal Bag (A) for filters must be purchased for prefilter and HEPA filter changeout use. Data Sheet DS-H-123 is prepared for polyethylene bags to fit 24"x24"x11-1/2" filters (either prefilters or HEPA filters). Data sheet requirements include accessories for bag use, e.g. security strap, bag cinching straps, marked carton for storage and handling prior to use. The apparatus for sealing the bag and cutting the bag to separate the bagged filter from the remaining

stub should remain uniform for all bags used. Therefore, variations in bag features from different bag sources should not be allowed to compromise requirements for uniform methods adapted for the bag-in/bag-out procedure.

Sources for Disposal Bag (A) can be the same as sources of nuclear grade (Type B) HEPA filters (see above).

D. Cartridge filter elements for the dust collector are specified by Data Sheet DS-H-122. A minimum of one complete set of replacement cartridge filters should be maintained in stores.

A primary source for these filter elements would be the same manufacturer as the dust collector. However, DS-H-122 should be used for replacement items and not the manufacturer's "standard" item.

E. Disposal Bag (B) for cartridge filters must be purchased for the changeout of cylindrical cartridge filters used in dust collectors. Data Sheet DS-H-124 is prepared for this type disposal bag. Specified length of 120" is sized to allow one bag to bag-out both filter elements separately from one sleeve and leave a stub that will allow safe handling of the sleeve sealing plug. Specified accessories are to account for the two filters being bagged separately.

Sources for Disposal Bag (B) can be the same as the source(s) for the cartridge filters.

F. Portable HEPA Filtered Exhaust Unit is needed to maintain a small suction (negative pressure) on the filter housing and dust collector module during the time of filter changeout. A negative pressure condition of 0.3 to 0.5" WG is the desirable range. It is necessary to use portable suction hose (Flexaust), or ducts, to temporarily connect the filtered exhaust unit to the filter housing (or DC module) during filter changeout periods. This type of arrangement can be "homemade" or bought from limited sources. An airflow capacity of approximately 250 CFM, using a single HEPA filter (24"x24"x11-1/2") is

suggested. Bag-out handling of the filter on this unit is not a mandatory feature. One source for such equipment is American Air Filter, Louisville, KY.

G. DOP Test Equipment, and qualified personnel, are required to perform in-place DOP leak testing of installed HEPA filters. Such testing is performed after HEPA filter installation (prior to service) to ensure the integrity of the filters and their mounting (filter bank) framing. If testing is to be performed by in-house personnel, it is necessary that select person(s) be trained in the proper use of testing apparatus. Because testing (to be creditable) must be done in accordance with the requirements of the procedures contained in ANSI Standard N510 (Sections 9 & 10). No other test method is considered fully acceptable. Required equipment includes: portable DOP aerosol generator, photometer (forward-light-scattering type), vacuum pump, flexible tubing, DOP (Dioctyl-phthalate) supply. Electric power is required at the test site, and a compressed air supply is needed also if compressed air DOP generators are used in lieu of gas-thermal type. The choice of gas-thermal type DOP generators is recommended.

Two commercial sources for DOP test instruments and thermal generators are:

a. Air Techniques, Inc.

b. Frontier Enterprises, Inc.

Operational Guidelines for Exhaust System Filtration Components

Bag-In/Bag-Out Filtration System Maintenance/Operation Procedures

1.0 Introduction/Purpose

The purpose of these instructions is to make clear those activities proven as necessary to insure the filter installation will function as designed to provide maximum safety (minimum risk) and function at minimum maintenance costs. Where radioactive contamination is to be encountered it is essential that proper safeguards be adopted and practiced by all participants: operating, maintenance and testing.

The surest way to meet established rules and regulations intended as a goal to achieve safety is to preplan and train. Preplan activities in full detail and train personnel under realistic conditions. Preplanned activities must include all detailed steps in their correct sequence. Trainees must work with real or mock up equipment and materials that reflect correct weights, dimensions and the actual time relationship for doing specific tasks. To develop needed skills and techniques, crew personnel training must involve rote learning methods that reflect efficient handling, the correct sequential order, and not compromise safety with "short cuts".

2.0 Filter Acquisition

All exhaust filter units (HEPA and prefilters) must always be acquired to conform to a performance specification and never to a manufacturer's number only. HEPA filter construction and performance can vary widely within the same size configuration from a single manufacturing source. To safeguard against unacceptable filters being acquired and used, "system specific" specifications must be carefully adopted and used without compromise until actual operating experience dictates change. As an aid in accomplishing this, the DOE has a Filter Test Program (NE F 3-42; 3/85) that applies to HEPA filters used for radionuclide environmental protection purposes. Nuclear Standard NE F 3-45T; "Specifications for HEPA Filters Used by DOE Contractors", 3/85, provides standard requirements for HEPA filters, which can be a basis for designating a "system specific" filter specification.

3.0 Care and Handling of HEPA Filters

Publication USAEC Report TID-7023' has long served as a direct guide for the care and handling of HEPA filters. An updated version, as published in the Nuclear Air Cleaning Handbook (ERDA 76-21), is reprinted here as continued guidance on this subject.

Care and Handling of HEPA Filters[1]

High reliance can be placed on the HEPA filter if precautions are taken in handling, storage, and installation. Inspection upon delivery, upon withdrawal from stock, and before and after installation is important. A filter unit should be inspected each time it is handled to guard against installation of a damaged item.

The precautions and recommendations in this handbook are based upon field experience and current development.

Packaging and Shipping

Packaging practice varies among the filter unit manufacturers. Normally, units are packaged in cardboard cartons with various means of providing internal strengthening and impact resistance of the carton. A carton will usually contain one of the larger units, such as the 1000-cfm, 24x24x11-1/2 in. unit; or it may have two 500-cfm 24x24x5-7/8 in. units. The smaller sizes, the 50-cfm, 8x8x5-7/8 in., and the 25-cfm, 8x8x3-1/16 in. units, frequently are packaged in multiple.

When a filter is placed in the carton, it is inserted so that the pleated folds are vertical to prevent damage in shipment. To prevent sagging of the pleats, vertical positioning of the pleats must be maintained during subsequent handling and storage. Moreover, filter units should also be installed vertically for operation.

The shipping carton is marked with a vertical arrow and the notation "this side up" to indicate positioning of the carton in the transport vehicle. Other markings, "handle with care,""use no hooks," etc. may be found on some containers.

When a filter unit is shipped with pleats in the horizontal position, the vibration that occurs during transportation and the jarring that usually accompanies handling often cause the filter medium to split or break at the adhesive line, which will appear as a hairline crack.

Occasionally a filter unit is positioned improperly in the container by the manufacturer. Cartons frequently are not placed in railroad cars or trucks according to the vertical arrow, and they are not handled consistently with the care designated. Consequently,inspection to verify that filters have been packed properly is necessary upon delivery at destination.

Inspection and Test

Inspection starts when delivery of filter units reaches the purchaser, even while the load is still aboard the carrier. As the shipment is being unloaded, each carton should be inspected for external damage and improper positioning in the cargo space (carton placed with arrow directed horizontally). Damaged cartons, including those with corners dented and those improperly oriented in the truck, should be set aside for particularly careful inspection of their contents. Damage will be more prevalent when filter units are loaded with mixed cargoes or are shipped in a partially loaded carrier.

The filter unit must be removed carefully from its carton. The acceptable method for removal is to open the top flaps of the container after removing the sealing tape. With flaps folded back, the carton should be inverted or upended gently to place the exposed end of the filter unit on a flat surface, preferably the floor. The surface must be clear of nuts, bolts, and similar protrusions. Then withdraw the carton from the filter unit. Attempts to remove the filter unit from the carton by grasping below the exposed filter case can result in irreparable damage if fingers puncture the delicate filter medium attached immediately below the case.

When visual inspection is made, a strong lamp should be used to examine the exposed areas of both faces to ensure that no breaks, cracks, or pinholes are evident. In addition, a less intense light, such as a flashlight, can be used in a darkened room. The inspector should look for visible defects with the light projected along the full length of each channel created by the separators.

Translucent spots will likely prove to be variations in thickness of the filter medium which occur during manufacture. Breaks or cracks in the medium usually show up on the surface edges of the filter pleats but often are not readily detected. Minor cracks can be of major importance. If the filter unit is installed with this pleat-edge damage, the cracks can be extended by air movement through the unit. After examining each channel, the inspector should examine the adhesive seal around the filter unit face to be sure that the seal is complete and unbroken. When one face of the filter unit has been inspected, the other face should be examined in the same manner and with the same care. After the inspector has completed a thorough scrutiny of both faces, he should check the corner joints of the frame for adhesive sealing and tightness. Gasketing about the edge of the frame should be inspected for tight mating of gasket strips and good physical condition. Gasket strips should also be examined for full adhesion to the frame.

Cartons showing damage or dented corners and those that are found loaded in improper position upon delivery and that were set aside after being unloaded from the carrier,require careful inspection. The filter unit should be examined at all corners and particularly at the point of carton impact for damage to separators and medium. Exterior damage to several protruding separator edges in a small area will not influence filter unit efficiency if the medium is not mashed, punctured, or broken. Even though the medium may not be broken on one face, damage may occur at the opposite edge of the pleat on the other face. Large areas of mashed separator edges, even though the medium is not damaged, will obstruct the passage of air through the filter unit and thus reduce its life. Improperly stowed filter units should be inspected particularly for cracks alongside the adhesive seal, for extreme sags in pleats and separators, and for slits or breaks in the medium. The procedures outlined above, including examination with lamp and flashlight, should be used for routine inspections.

Repair of a damaged filter unit, particularly the medium, should not be attempted by the user. Any repaired unit must be retested by DOP penetrometer to ensure that hidden damage does not exist which

will reduce filtering efficiency. Repair and retest thus become uneconomical for most users.

Materials used in construction of the filter unit must comply with the purchase specification, if any. Compliance, so far as practicable, should be determined at the time of inspection. Filter units that have been inspected and found damaged, defective, or not in conformance with the purchase order should be separated from acceptable units; identified; and, accompainied by necessary records, referred to the purchasing, receiving, or other appropriate department for proper disposal.

Visual inspection of the filter unit to detect physical damage is necessary. Inspection, however, is not a substitute for DOP testing with a penetrometer.

Prior to delivery, efficiency testing of the filter unit by an ERDA Quality Assurance Station is advisable. Such testing will readily disclose a defective filter unit, even when faults in the unit cannot be found by visual inspection. High penetration due to faults results in an excessive release of particles to the atmosphere. The penetrometer also measures the pressure drop, or resistance of the filter unit to the rated airstream. Excessive resistance will shorten the period that the filter unit can be used. Resistance, like penetration, must not exceed a predetermined level.

Standard practice for manufacture of HEPA filters requires that the manufacturer's test results of airflow, penetration, and resistance be marked on the case of the filter unit. These will be found in a stamp that bears the manufacturer's name, or vendor's name, together with the model number and serial number of the filter unit. Penetration and resistance should not be greater than specified by the purchase order. If not specified, penetration should not exceed 0.03% and resistance should not be more that 1.0 in. wg at rated airflow.

Shipping

HEPA filters should be shipped under controlled conditions insofar as practicable. Too often, after the cartons have been carefully arranged in a truck-trailer body, the shipper removes them at an interchange station, stacks them temporarily in the terminal (under completely uncontrolled conditions), and then stacks them into another truck-trailer. Handling under such conditions is usually careless, and attention to proper orientation of the cartons may be nonexistent. As a minimum, it is recommended that cartons be steel-banded to a skid or pallet, no more that 6-1/2 ft high, in the specified vertical orientation. Skids (pallets) must not be stacked one above the other unless bracing is provided in the truck-trailer body or railroad car to prevent the weight of the upper load from resting on the lower. This will force the shipper to keep the cartons in their proper orientation and prevent him from throwing or dropping them indiscriminately.

Another control is to require that the filters be packed properly in a sealed truck-trailer body or in a sealed containerized-freight unit, not to be opened until arrival at the specified delivery point. The trailer or containerized-freight unit should be unloaded by personnel employed at the delivery site who have been thoroughly instructed in the proper care and handling of HEPA filters. Mixed-load shipments should be avoided.

Storage

Following receipt and inspection, the filter unit should be repacked carefully in the carton in which it was shipped and received. All packing material for internal strengthening of the carton and for protection of the filter unit should be replaced properly. Pleats of the filter unit should be positioned to conform to the orientation marking on the carton; this should be done routinely whether the filter unit will be installed at an early date or whether it will be stored.

Cartons of filter units should be positioned in storage to conform to the vertical arrow, and manufacturer's recommendations for storage heights should be followed. When recommendations are not available, filter units 24x24x11-1/2 in. and 24x24x5-7/8 in. should be stacked not more that three filter units high.

Mixing other items and materials with filter units in storage should be avoided to prevent damage to the filter units. Recommended aisle widths consistent with good warehousing practice should be provided to reduce damage of filter units from materials-handling equipment and other traffic. Filter units should not be stored in locations where they will be exposed to dampness, excessive heat or cold, or rapidly changing temperatures.

Handling

Mechanical warehousing equipment is recommended for handling large quantities of filter units. Skids and pallets should be used to provide a flat bed for movement of the units. Chains, slings, and hooks obviously must not be used. The cartons should be placed on the pallet so that the arrow on the carton points vertically.

In physically handling a packaged filter unit, a person must make certain that the carton is picked up at opposite corners and deposited carefully on the floor or other surface. The carton should not be dropped or jarred. Any filter unit dropped, whether or not in the carton, should be reexamined for damage as prescribed in Sect. C.2.

When a filter unit is lifted, it must be grasped only along the outer surface of the case. Even slight contact of fingers at almost any point within the case can puncture the filter medium.

A handle or grip is sometimes attached permanently to the wood filter frame for ease of installation and removal of the filter unit. In such instances, care must be taken in attaching the handle. Screws should not be pounded for starting, and nails should never be used. The recommended method is to drill starting screw holes, making certain that the drill and the length of screws do not penetrate through the frame and pierce the filter medium attached (screws must not be longer than 3/4 in.). Pounding may crack the filter medium and possibly loosen the adhesive seal that bonds the filter pack within the frame. Attachment of a handle to a metal-frame filter unit is not recommended.

Filter units should be kept in shipping cartons when moved from one location to another. When transferred for installation, the units should be unloaded at a point which, so far as practicable, will reduce physical handling. Filter units should remain in cartons until ready for installation and

then should be unpacked as prescribed in Sect. C.2.

If for any reason an unpackaged filter unit must be placed with its face on the floor or other surface, the surface must be cleared of every object or irregularity that might damage the filter pack.

Installation

Craftsmen responsible for installation of the filter unit must be carefully instructed in proper handling technique. They should know that the filter pack within the frame is delicate and must not be damaged during installation. Equally important is that the filter unit must be installed so that unfiltered air will not leak past the unit. The following installation procedure should be used:

1. Carefully remove filter unit from shipping carton, following the procedure described under Sect. C.2.
2. Carefully inspect both faces of the filter unit for cracks in the filter medium, for damage of separators, and for separation of the filter pack at the frame.
3. Ensure that the gasket is cemented firmly to the frame and that the gasket pieces are butted or mated at the joints.
4. The gasket must be compressed firmly. Compression should be applied evenly and equally at all points in increments of 5ft-lb or less, with the filter frame completely covering the opening.
5. Install the filter with pleats and separators in the vertical position. This will eliminate sagging of pleats from accumulated weight of materials stopped by the filter unit.

[1]Updated from H. Gilbert and J.H. Palmer, High Efficiency Particulate Air Filter Units, USAEC Report TID-7023, August 1961

4.0 Personnel

4.1 Each phase of care and handling, including the application of filters during changeout activities, must be performed by trained personnel under the responsible supervision of a designated person.

4.2 All participants in HEPA filter care, handling, application (changeout activities), testing and disposal (packaging and incineration) must be trained before actual work participation starts. "On-the-job training" or "learning-on-the-job" are not acceptable options for untrained personnel, regardless of the level of supervision, when radioactive contamination may be encountered. Training should be accomplished under simulated conditions until worker proficiency clearly indicates it is safe to encounter the real environment that is subject to actual contamination.

4.3 Only persons who meet several requirements should be selected as trainees for filter changeout and testing work crews:

4.3.1 Persons of average or higher intelligence
4.3.2 Good physical/mental dexterity
4.3.3 Physically capable of routine lifting of filter units in cartons (40 lbs. approx.) with dimensions approx. 28"x 28"x 14" and no handles. Lifters must exercise extraordinary care in all handling operations under adverse conditions.

4.4 Training of personnel should be started in a formal manner, where a classroom type environment is provided away from unrelated activities. Training aids must present a realistic simulation, but be clear of contamination until persons can be individually judged as proficient in the techniques and methods being taught. Worker safety is taught only to workers who recognize that unsafe conditions may be part of a task.

5.0 Necessary Equipment & Tools for Filter Changeout

5.1 Equipment and tools used for filter changeout activities are subject to surface contamination, and therefore should be dedicated to filter changeout uses only. Missing tools or faulty pieces of equipment will cause loss of valuable work time during subsequent changeout periods, when work in progress must be delayed until the item is recovered or replaced.

Checks of tool/equipment inventories are a necessity before work in the contamination zone is started to ensure all items are ready.

5.2 The following basic items are needed by a crew for filter changeout (replacement) activities:

5.2.1 Access platform with tray (for upper level filter units)

5.2.2 Utility cart(s) (for filter transport)

5.2.3 Castered work table, 30"W x 72"L with storage shelf under work level

5.2.4 Banding kit for sealing bagging complete with stainless steel bands and plastic ties (e.g. Flanders Banding Kit No. 1A)

5.2.5 Hand tools, comprising at least: 2 - 10" crescent wrenches, 2 screw drivers (flat blade), pliers, 12 ft. tape measure, 2" wide white or tan plastic tape in hand dispenser, 2 black felt markers, 6 volt hand lantern

5.2.6 Safety items conforming to local Health and Safety Rules for work in a contamination zone. The minimum for each worker should include, but not be limited to: safety gloves, individually-fit facial respirator, hand gloves and outer clothing that is full-body covering (coveralls), shoe covers, personal dosimeter.

5.2.7 Portable HEPA filter/fan equipment arrangement with adaption (hose and fittings) for use in maintaining negative pressure

conditions in the filter housing(s) during changeout activities. Unit must be adaptable to the upstream (dirty) side of the housing and be allowed local discharge.

5.2.8 Platform scales for filter weighing (before installation); scale capacity to 25 kilograms. Scales required only where material accountability is necessary.

5.2.9 Cartoned filters, prefilter and/or HEPA filters (number as required for particular system). Include at least one additional unit/system as spare in the event of handling damage (spare unit(s) should be held in readiness outside contamination zone and returned to stores when unused).

5.2.10 Polyethylene bagging for filters, plus two spares/system in event of spoilage (number as required for particular system(s)).

5.2.11 Container of quality silicone grease (Dow Corning), with applicator (for wiping exposed face of filter gasket before bag-in operation).

5.2.12 Precoat feeder with attachment accessories, and precoat material. Precoating is a consideration for dust collector cartridge filter elements only. Requirements for precoating must be established by design.

5.3 After use in a contamination zone, all items of tools and equipment must be surveyed according to local regulations to determine they are free of contamination. Instruments too delicate to clean up may require that they be dedicated to one contamination zone and kept there for subsequent uses.

6.0 System Specific Requirements

6.1 Related Work

6.1.1 Planners must realize that other activities related to filter changeout must be preplanned and coordinated with filter changes. Namely these include:

6.1.1.2 In-place DOP leak testing of HEPA filters after their installation and before the newly installed filters are placed in service.

6.1.1.3 Securing all penetrations used during filter changeout activities. Resetting system dampers to establish system airflow as required for continuation of activities being served.

6.1.1.4 Recording data, such as clean filter information and initial airflow resistance. Before installation, individual filter unit recorded data must include: clean weight, labeled serial number, penetration/

pressure drop values (per filter manufacturer), installation position in housing. The early follow-up work of inputting these data in the record file is important to the correlation of system operation and on-going emission monitoring.

6.1.2 It is essential that system operation not be needlessly interrupted for filter changeout activities. The need for filter changeout must be anticipated through routine monitoring of system limits (filters and fan) and required airflow rates to preserve pre-established control velocities at work stations, hoods, etc.

6.1.3 Preplanning must include the acquisition of necessary materials, equipment and personnel for system maintenance, such as filters, bags and experienced workers. Material substitutions must be avoided; personnel substitutions require a judgment be made that could concern safety.

6.2 Sequential Steps in Prefilter Changeout Procedure For Housings (without DOP Test Section) While System is Not In Operation

6.2.1 Before any system alterations begin and system is in normal operating mode, read and record the airflow rate for the total system. Read and record the airflow resistance (pressure drop) of each filter stage (bank) in the housing to be changed.

6.2.2 The idle filter housing should be isolated by dampers (or closures) insofar as possible. After isolation, the portable HEPA filter/fan equipment is adapted to the upstream (dirty) side of the housing; then a differential pressure gage (Dwyer Model 4302 with A-339 adapter, or equivalent) shall be adapted (3/16" plastic tubing) vertically to the housing where the gage can remain in clear view during changeout activities.

6.2.3 With the portable HEPA filter/fan equipment operating, a negative pressure (relative to surrounding space) is applied to the housing and a pressure range of -0.3" to -0.5" WG pressure maintained, using a connection on the dirty side of the housing. The negative pressure range shall be maintained by cracking open the downstream (clean side) damper on the housing, or removing part of the closure device(s), with pressure indicated by the differential pressure gage.

6.2.4 Starting with the top tier prefilter, adjust and set the access platform in position to receive the filter when withdrawn from the housing opening.

6.2.5 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

6.2.6 Remove the filter opening cover. Set aside in a clear position. Unfold the plastic bag sealing the opening and extend bagging (drape over platform tray). Protect bagging from local traffic and sharp edges (protrusions) that could cause puncture or snagging. Prevent strain on the bagging connection at the housing opening (port).

6.2.7 Unclamp the gasket sealing mechanism for the filter; then, using the removal lever (where furnished as a housing feature), withdraw the filter from the housing after carefully extending the plastic bagging to clear the filter. Position the old bag stub (already in the bag) into the heel of the bag, then position the dirty filter into the same end of the bag (against the stub) by carefully sliding the bagging over the filter. Keep plastic bagging free of sharp edges that can tear or abrate the plastic. Housing suction will be collapsing the bagging to the filter casing, so care must be exercised to prevent punctures that can spread contamination. Rest the filter on the access platform tray.

6.2.8 With plastic bagging fully deflated and clear of unnecessary folds, group the bagging so the dirty filter and old bag stub are contained in the bag end without strain or unused volume on the bagging. Place a strong plastic locking tie at the grouped point. Place a second tie on the grouped bagging 3" closer to the housing. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

Preplanned filter changeout schedules dictate whether or not the HEPA filters are to be replaced (changed out) in addition to prefilters. If yes, then the installation of new prefilters must be delayed until the HEPA filters are changed out and DOP tested, so refer to .7.0 Changeout of HEPA Filters, herein. This delay in prefilter installation is necessary until the DOP in-place testing of the newly installed HEPA filters is completed. After test completion, the continuance of this procedure (6.2.9) can be followed to install replacement prefilters.

6.2.9 Select a new replacement filter unit (in carton) from the supply at hand. Confirm it to be the correct filter (i.e. prefilter type). Carefully remove the new replacement filter from its cardboard carton while on the work table. Inspect all filter sides and exposed faces to ensure there is no visual damage. (Damaged filters should be returned to the carton and set aside for later examination and disposition, but not for use until proven in good condition). Keep new cartoned filter units at floor (cart) level or on work table.

For housings having a two filter wide arrangement with one side access, it is necessary to next remove the filter from the inner position. Therefore, the next step is to connect a new bag to the opening port and repeat steps 6.2.7 and 6.2.8 (above).

6.2.10 Remove the bagged filter from the platform tray and place on the work table with the same side down as when installed. Place the empty cardboard carton (with bottom filler in place) over the bagged filter without straining the bag. Carefully rotate the carton (with filter inside) 90 degrees to the next side (never over on its face) and push (slide) the filter into the bottom of the carton. Next, rotate the carton (with filter inside) another 90 degrees to rest on the next side, which is the carton's bottom. Insert the remaining carton filler(s) and close carton flaps and seal all top edges with 2" wide plastic tape. With felt marker, clearly identify the sealed top side with: housing number, filter position and removal date. Store the cartoned filter upright (taped and marked side up) on the utility cart for eventual removal. Strap down loaded cartons before transport from the changeout area.

6.2.11 Using inspection light (6 volt lantern) view the gasket sealing surface through the bagging stub to determine it is clean and clear of debris such as gasket pieces. If dirty, the surface must be cleaned or repaired remotely (using a work bag and extension hand tools) before and new filter is bagged into position.

6.2.12 Position new replacement filter on work table, remove from carton and set carton aside. With care, wipe a very thin complete coat of silicone grease on the exposed gasket face of the new filter to prevent sticking to the seal face while in service. Position filter on scale and weigh. Record serial number, accurate weight (grams), intended housing number and filter position in housing. Group and collect new (clean) plastic bagging and install filter inside bag (pleats always remaining vertical). Be certain direction of airflow through filter corresponds to required airflow direction through housing.

For the housings having a two filter wide arrangement with one side access it is necssary to prepare a second replacement filter at this point in the procedure. Each new filter shall be separately bagged. Two filters in the same bag are too awkward and too heavy to handle, and therefore would be an unsafe maneuver.

6.2.13 Position new filter (in bag) on tray of access platform and align to housing opening with open end of bag facing housing.

6.2.14 Carefully remove security strap from bag stub presently sealing opening and set aside. Extend the open end of the new bag over the existing bag stub that is closing the port opening. Group the new bag to the inner sealing sleeve ring (beyond the elastic cord of the stub), and secure with elastic cord and security strap. Then, with access thru the new bag, remove the existing bag stub. Position stub in the heel of the new bag, behind the new filter. The new filter is now within the confinement limits of the housing and hereafter must be considered as contaminated.

6.2.15 Confirm again that the pleats of the new filter media are vertical and the gasketed edge and airflow through the filter is correct. Carefully lift, align to the opening, and slide the new filter into the housing and into position of alignment to the sealing face. When properly aligned, clamp the filter into position.

For housings having a two filter wide arrangement with one side access it is necessary to bag-in the second replacement filter by repeating steps 6.2.13 through 6.2.15. Clamping the initial filter in position is withheld until the second filter also is properly positioned.

6.2.16 While keeping the old bag stub in the bag heel, roll (in loose form) the bag sealing the opening and position against the installed filter case. Inspect the cover gasket to determine condition and completeness. If the gasket is fully intact, replace the opening cover and clamp closed. Again, inspect the cover gasket to ensure it to be in a sealed position (clear of bagging) with good contact all around. Deteriorated cover gaskets must be replaced when worn or torn to ensure sealing that prevents strain and extension of the seal bagging due to the negative pressure maintained on the housing during normal system operation.

6.2.17 After completion of Step 16, the procedure is repeated for other filters in the prefilter bank, in order, from top tier to bottom. Repetition includes the continuance of Steps 6.2.2 and 6.2.3, and the repeat of Steps 6.2.6 thru 6.2.16 for each filter in order. Opposite sides of the same filter housing can be changed out simultaneously, i.e. either prefilter and/or HEPA filter bank. However, separate crews working in the same aisle between housings will be limiting spatially because of the need for withdrawal depths for filters and the nearness of banks, access platform(s) and work table(s).

7.0 Changeout of HEPA Filters
System Specific Requirements

7.1 Planning HEPA Filter Changeout

7.1.1 It is planned, and intended, that prefilters will be changed out at the same time as HEPA filters. This is to allow prefilters to be out of the housing at the time new HEPA

filters are DOP tested in-place (See 6.2.8). For effective DOP testing per procedures in ANSI N510 (Chapter 10) it is necessary to have prefilters removed and DOP smoke injected upstream of the housing to ensure sufficient aerosol-air mixing and acceptable upstream aerosol concentration for the test instrumentation used.

It is mandatory that newly installed HEPA filters are successfully DOP tested in-place before the filter system is returned to service. The frequency for periodic retesting HEPA filter installations during their service life must be determined through operating experience, with the usual maximum frequency limit being once each year (12 months max.), or when system operation becomes suspect. Otherwise the changeout frequency is determined by the limit of airflow resistance the system and the filter(s) can safely withstand. As initial criteria use 3.5" WG as maximum HEPA filter resistance. Initially, allow a maximum airflow resistance of 0.80" WG for prefilters.

7.2 Sequential Steps in HEPA Filter Changeout Procedure for Housings While System is Not in Operation

7.2.1 The changeout of HEPA filters in a housing will normally be scheduled in coordination with the changeout of the prefilters in the same housing (see 6.2.8), and be worked by the same crew. When done in this order the HEPA filter changeout is just a continuation of work started with the prefilter changeout. Preparatory work has been done, the slight negative pressure on the housing is continued by using the portable HEPA filter/fan arrangement and pressure monitored (see 6.2.2) using the pressure gage temporarily installed for the purpose, and all housing penetrations are secured (closed) except for the inleakage through the downstream (clean) damper.

7.2.2 Similar to prefilter changeout procedures, start with the top tier HEPA filter by setting access platform in position to receive the dirty HEPA filter when withdrawn from the housing opening.

7.2.3 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

7.2.4 Remove the HEPA filter opening cover. Set cover aside in a clear position. Unfold the plastic bag sealing the opening and extend bagging (drape over platform tray). Protect bagging from local traffic and sharp edges (protrusions) that could cause puncture. Prevent strain on the bagging connection at the housing opening (port).

7.2.5 Through the bagging, if necessary, unclamp the gasket sealing mechanism for the filter; then, using the removal lever (where furnished as a housing feature), withdraw the

filter from the housing after carefully extending the plastic bagging to clear the filter. If present, keep the old bag stub in the heel of the bag, then position the dirty filter into the same end of the bag (against the stub) by carefully sliding the bagging over the filter. Keep plastic bagging free of sharp edges that can tear or abrate the plastic material. Housing suction will be collapsing the bagging to the filter casing, so care must be exercised to prevent punctures that can spread contamination. Rest the filter on the platform tray.

7.2.6 With plastic bagging fully deflated and clear of unnecessary folds, group the bagging so the dirty filter and old bag stub are contained in the bag end without strain or unused volume on the bagging. Place a strong plastic locking tie at the grouped point. Place a second tie on the grouped bagging 3" closer to the housing. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

7.2.7 Select a new replacement HEPA filter unit (in carton) from the supply at hand. Confirm it to be the correct filter (by label markings). Carefully open the top of the carton and remove the new replacement filter from its cardboard carton while on the work table. Do this by opening top flaps then carefully rotate carton to a side (never to its face), then holding flaps aside, rotate so carton bottom is up, remove carton vertically. Keeping the filter pleats vertical, inspect all filter sides and exposed faces to ensure there is no visual damage. (Damaged filters should be returned to the carton and set aside for later careful examination and disposition, but not for use until proven in good condition). Keep new cartoned filter units at floor (cart) level or on work table. Always keep cartons upright with top up and never stack HEPA filters over three (3) cartons high. Filters dropped (in carton or out), from even a height of a few inches, must be set aside and not used until retested as good.

For housings having a two filter wide arrangement with one side access, it is necessary to next remove the spent filter from the inner position. Therefore, the next step is to remove the bagged filter from the platform tray and place it on the work table. Then, with a new bag, connect its open end over the bag stub sealing the opening. Secure it with a security strap and stow the stub in the heel of the bag. Now, repeat steps 7.2.5 through 7.2.7.

7.2.8 Remove the bagged filter from the platform tray and place on the work table, maintaining pleats vertical, with the same side down as when installed. Place an empty cardboard carton (with bottom filler in place) over each bagged filter

without straining the bag. Handling one spent filter at a time, carefully rotate the carton (with filter inside) 90 degrees to the next side (never over on its face) and push (slide) the filter into the bottom of the carton. Next, rotate the carton (with filter inside) another 90 degrees in the same direction to rest on the next side, which is the carton's bottom (i.e. the open top is now up and open). Insert the remaining carton filler(s) and close carton top flaps and seal all top edges with 2" wide plastic tape. With felt marker, clearly identify the sealed top side with: housing number, filter position, filter serial number and removal date. Store the cartoned filter upright (taped and marked side up) on the utility cart for eventual removal. Strap down loaded cartons before transport from the changeout area.

For housings having two filter wide, with one side access, it is necessary to secure both bagged filters in cartons and store on the cart out of the way. The work area must be kept free of bagged items that are contaminated and subject to accidental puncture.

7.2.9 Using inspection light (6 volt lantern or equivalent) view the gasket sealing surface and clamping mechanism through the bagging stub to determine surfaces are clean and clear of debris such as gasket pieces. If dirty or in need of repair, the surface must be cleaned or repaired remotely (using a work bag and extension hand tools) before a new filter is bagged into position.

7.2.10 Position new replacement HEPA filter (in carton) on work table. Open filter carton at top and rotate carton on side; then rotate open top to table surface (with flaps clear); lift empty carton vertically to clear filter (set carton aside for later reuse). Inspect both open faces and determine each to be clear of visible damage. If damaged return to carton, mark exterior and set aside for later inspection and testing before any use. With care, position new replacement filter on work table (carton removed) and wipe a very thin complete coat of silicone grease on the exposed gasket face of the new filter to prevent sticking to the seal face while in service. Place filter on scales (pleats vertical) and weigh. Do not bump, jar or drop filters during any handling operation. Record serial number, accurate weight (grams), intended housing number and filter position in housing. Group and collect new (clean) plastic bagging and install filter inside bag (pleats always remaining vertical). Be certain direction of airflow through filter corresponds to required airflow direction through housing. This dictates which side of the filter must be inserted into the bag first.

For housings having a two filter wide arrangement, with one side access, it is necessary to prepare a second replacement HEPA filter at this point. So, repeat step 7.2.10 for the

second HEPA filter. Each new HEPA filter shall be separately bagged. Two filters in the same bag are too awkward and too heavy to handle, therefore would be an unsafe maneuver.

7.2.11 Position new HEPA filter (in bag with pleats vertical) on the platform tray, matching airflow directions and align to housing opening with open end of bag facing housing.

7.2.12 Carefully remove security strap from bag stub presently sealing opening and set aside. Extend the open end of the new bag over the existing bag stub that is closing the opening. Group the new bag to the inner sealing sleeve ring, and secure with elastic cord and security strap. Then, with access through the new bag, remove the existing bag stub. Position stub in the heel of the new bag, behind the new filter. The new filter is now within the confinement limits of the housing and hereafter must be considered as contaminated.

7.2.13 Confirm again that the pleats of the new filter media are vertical and the gasketed edge and airflow direction through the filter is correct. Carefully lift, align to the opening, and slide the new filter into the housing and into position of alignment to the sealing face. When properly aligned, clamp the filter into position.

For housings having a two filter wide arrangement, with one side access, the next step is to bag-in the second filter by repeating steps 7.2.11 through 7.2.13. If the two filter wide housing has a common clamping mechanism for both filters, it is necessary to delay clamping the first filter until both filters are in position and properly aligned.

7.2.14 While keeping the old bag stub in the bag heel, roll (in loose form) the bag sealing the opening, and position against the installed filter case. Inspect the cover gasket to determine condition and completeness. If the gasket is fully intact, replace the opening cover and clamp closed. Again, inspect the cover gasket to ensure it to be in a sealed position (clear of bagging) with good contact all around. Deteriorated cover gaskets must be replaced promptly when worn or torn to ensure sealing that prevents strain and extension of the seal bagging due to the negative pressure maintained on the housing during normal system operation.

7.2.15 After completion of Step 14, the procedure is repeated for other filters in the HEPA filter bank, in order, from top tier to bottom (each side of the housing if required). Repetitive work must include the continuance of negative pressure on the housing as well as other preparatory steps concerning system safety. Opposite sides of the same filter housing can be changed out simultaneously, i.e. either prefilter and/or HEPA filter bank. However, separate crews working in the same aisle between housings will be limited

spatially because of the need for withdrawal depths for filters and the nearness of filter banks, access platform(s) and work table(s).

7.2.16 When the HEPA filters have been changed out and before prefilters are reinstalled, the housing must be prepared for DOP testing of the newly installed HEPA filters. For more accurate correlation of filter performance to total system performance, DOP testing should be done at 100% nominal flow. Periods of airflow through the untested HEPA filters must be limited to test periods only, until penetration through the HEPA filter bank has been proven within established limits. Maximum penetration through the HEPA filter bank (including filters and framing) shall not exceed 0.03% when DOP tested per procedures in ANSI N510 (Section 10).

7.2.17 To prepare the housing for DOP testing status the following specific conditions must be set: 1) The DOP test crew must be on-hand and have set up their test apparatus and be ready to test (immediately) the particular HEPA filter bank in question. 2) The HEPA filter changeout records must be consulted to determine the new clean HEPA filter airflow resistance (for the total bank) that corresponds with nominal airflow (i.e. 1000 CFM per HEPA filter) through the bank. This can be done with sufficient accuracy by averaging the resistances of all individual filters in the bank (when clean only).

CAUTION: After the HEPA filters have been in service the airflow rate through the filter bank cannot be accurately correlated to airflow resistance (pressure drop across the filters). It is necessary to measure the airstream that will (or has) pass(ed) through the particular filter bank in order to establish nominal airflow for DOP testing and to prevent excessive airflow that deteriorates the filters.

With clean filter conditions established the changeout crew adjusts system dampers to provide nominal airflow through the HEPA filter bank by using the differential pressure gage (local) at the specific housing. After this is set, the HEPA filter bank is ready to be DOP tested. The DOP test crew then is in charge of DOP testing while the changeout crew makes any necessary filter replacement and/or adjustment required by testing. To alter filters in the housing the airflow must first be stopped by closing dampers (and/or stopping fan unit) and a slight negative pressure (range: -0.3" to -0.5" WG) set on the housing (using the portable HEPA filter/fan arrangement on the upstream (dirty) side of the housing and slightly opening the downstream housing damper for needed inleakage to regulate housing pressure). Retest after filter adjustment/replacement requires that nominal airflow be re-established again through the housing under test and the DOP test crew repeats the test sequence. Retesting (including probing) is

repeated until leaks are corrected and performance is within established DOP smoke penetration limits. It is more than obvious that careful handling and positioning of HEPA filters in the initial changeout procedure will be rewarded with much less retesting requirement of time and materials. In-place DOP leak testing of HEPA filters is described in separate procedures/documents (ANSI Standard N510, Chapter 10).

7.2.18 After the HEPA filters have been successfully DOP tested the housing shall be either placed in service by the adjustment of dampers or be put in standby status (if the system is so arranged) by leaving the inlet and outlet dampers in the same position as for filter changeout work. In the event the HEPA filters fail to pass the penetration test, even after repeated retesting, the test airflow through the housing must be stopped and kept stopped until faults are corrected and DOP testing proves the smoke penetration is within the established penetration limit.

7.2.19 Following final disposition of the completed housing the HEPA filter/fan arrangement shall be removed and the connecting penetration closed. Also, the pressure gage indicating housing differential pressure relative to surrounding work space shall be removed and the connection secured. If a temporary pitot tube with pressure gage has been used to judge airflow through the housing they too shall be removed and penetration secured.

7.2.20 Tools and equipment shall be cleaned and secured, followed by the removal of cartoned spent filters; all of which shall be surveyed for excessive surface contamination before withdrawl from the contamination zone.

8.0 Sequential Steps in Cartridge Filter Changeout Procedure for Dust Collector Module While System is Not in Operation

8.1 Before any system alterations begin, read and record the airflow rate for the total system. Read and record the airflow resistance of the dust collector module where cartridge filters are to be changed. These values should include both the high and low differential pressure (range) being experienced by the module. Turn off electrical power to the controls for the module under service. If the dust collector module cannot be fully isolated by dampers, it is necessary to stop the system fan(s) during the filter changeout period. Close the compressed air supply valve and bleed down the compressed air manifold on the module. These module services must be deactivated before module dampers are closed and/or any covers are removed. This is a requirement to enhance safety, i.e. to prevent the accidental pressurization of the module while dampers are closed and bagging is not fully secured with sleeves covered (capped).

8.2 Adapt a pressure gage to the module cabinet to indicate the negative pressure in the cabinet relative to the surrounding space.

Using a connection on the clean (downstream) side of the module, temporarily connect the pressure gage (equal to Dwyer model No. 4302, with A-339 adapter) using 3/16" plastic tubing. Position the gage for clear viewing by the crew during filter changeout.

8.3 Close inlet and outlet dampers on the module to isolate it from other sections of the system insofar as possible. As a minimum, inleakage from ducted sources must be restricted so a negative pressure can be maintained on the cabinet with a "reasonable" exhaust rate (i.e. within the capacity of portable HEPA filter/fan equipment).

8.4 Adapt the HEPA filter/fan arrangement to the upstream side of the module. Then with open filtered exhaust path, adjust the downstream (clean side) module damper to achieve and maintain a slight negative pressure (range: -0.3" to -0.5" WG) on the module, relative to the surrounding space. The module is ready for cartridge filter changeout to begin. The pressure gage indicating module negative pressure must be checked periodically and the upstream damper adjusted, if necessary, to maintain the module pressure within range.

8.5 Starting with the top tier, left side sleeve, adjust and set the access platform in position to receive the used (spent) filter cartridge when withdrawn from the module sleeve.

8.6 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

8.7 Remove the sleeve cover/cap and set aside clear of the receiving area (tray) on the platform.

8.8 Extend the grouped bagging from the sleeve and unseal the sleeve plug (through bagging) and remove the plug to the outer section of the bagging, positioning clear of the sleeve alignment where its weight can be securely supported.

8.9 Through the plastic bagging, grasp the end of the (first) mounted filter cartridge and extract it a few inches, rotate it 180 degrees to dump any top dust, then continue to extract the filter from the sleeve to the heel of the bag being careful to work the collapsed bagging around the cartridge filter and past the sleeve sealing plug without straining the plastic. Rest the cartridge on the support tray on the platform. Group the bagging on the module side of the spent cartridge (not including sleeve plug), reducing all unnecessary bag volume and unneeded bag folds (i.e. deflate the bagging). Secure the bag near the module with a strong plastic locking tie. Replace the sleeve plug and reseal. Install a second plastic locking tie on the grouped bag approximately 3" closer to the module from the first tie. Between these ties install <u>two</u> 3/8" wide stainless steel bands 2" apart, and cinch each <u>to</u> full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

8.10 Read and record the serial number of the cartridge filter that is bagged out.

8.11 Place the bagged spent cartridge filter into an empty carton and carefully close the carton flaps; then seal all edges with 2" wide (brown or white) plastic tape. Mark the carton top with the cartridge filter serial number, the removal date, module number and filter position. Set the closed filter aside on the utility cart (top up).

8.12 Continuing with the remaining part of the bag attached to the cartridge sleeve, carefully extract the second filter a few inches, rotate 180 degrees to dump dust, then extract the upper (second) spent filter from the sleeve and work it to the end of the bag (past the sleeve sealing plug). Rest the bagged cartridge filter on the support tray.

8.13 Group the bagging on the module side of the spent cartridge (not including sleeve plug), reducing all unnecessary bag volume and unneeded folds (i.e. deflate the bagging). Secure the bag near the module with a strong plastic locking tie. Replace the sleeve plug and reseal. Install a second plastic locking tie on the grouped bag approximately 3" closer to the module from the first tie. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

8.14 Read and record the serial number of the cartridge filter that is bagged out.

8.15 Place the bagged spent cartridge filter into an empty carton and carefully close the carton flap; then seal all edges with 2" wide (brown or white) plastic tape. Mark the carton top with the cartridge filter serial number, the removal date, module number and filter position. Set the closed filter aside on the utility cart (top up).

8.16 Fold the bag stub within the sleeve and replace the sleeve cap until time to install new cartridge filter elements. The normal procedure would be to continue with loading new cartridges into the same sleeve that had just been emptied. This continuation saves repositioning the access platform and allows a repetitive sequence to be followed requiring the minimum number of equipment setups to accomplish a full filter changeout of a module.

8.17 Prepare two (2) new cartridges for loading. Remove elements from carton (top up), set cartons aside. Carefully wipe the exposed face of the cartridge ring gasket with a very thin complete coat of silicone grease to prevent sticking to the mating surface (seal face). If material accountability is required, weigh and record each filter element weight (in grams), record element serial number, manufacturer, and installation date. If material accountability is not required, dispense with weighing, but record other data.

8.18 Fit the new cartridge filters (2) into one new plastic bag, one filter at a time, so the gasketed end can enter the sleeve first, once the bag is attached to the module sleeve. Position the bagged filters on the platform tray in an upright position, then align the tray to the sleeve to be loaded.

8.19 Remove the security strap from the bag stub and attach the new bag to the module sleeve to be loaded (starting at the top tier, left), install security strap. Detach old bag stub and position in the bag, clear of the first new cartridge filter. Unseal the sleeve plug and remove to the bag, clear of sleeve alignment, and beyond the first cartridge filter.

8.20 Using the 6 volt lantern (viewing through the bagging), inspect the support yoke and the gasket sealing face (up the sleeve). Determine the yoke to be fully intact and the sealing face and yoke to be clear of debris, including gasket pieces.

8.21 Through the bagging, carefully align the first new cartridge filter to the sleeve (gasket end first); thread the filter on the yoke and slide the gasket end to the sealing face.

8.22 Carefully thread the second cartridge filter through the deflated bag, past the old bag stub and the sleeve sealing plug, to align with the sleeve. Thread the filter on the yoke (gasket end first) and slide up the sleeve to contact the sole end of the first cartridge filter.

8.23 Replace the seal plug to the yoke end in the sleeve. Work the old bag stub to the heel of the bag. Carefully fold the deflated bag to near the sleeve end. Complete the sealing of the plug and arrange the deflated/folded bag in the end of the sleeve. Restore the sleeve cover (cap) over the end of the sleeve.

8.24 Filter element changeout of the top tier left sleeve is completed. Progress to the top tier right sleeve and repeat steps 8.6 through 8.23.

8.25 Cartridge filter changeout should then progress in a uniform sequence that will minimize the needed equipment changes and repositioning of access platform. Following a set sequence will help prevent skipping filters and help eliminate duplication in case of personnel changes or lapsed time during changeout (e.g. end of shift).

8.26 Following the completion of filter cartridge changeout, it is necessary to remove the portable HEPA filter/fan arrangement and reset the system dampers. It must be recognized that the dampers must be positioned differently than during previous operation to account for clean filters. Excessive airflow can damage filters, particularly HEPA type with corrugated separators.

8.27 If initial precoating is to be practiced, the new cartridge filter elements in the reworked module are ready to be precoated. The purpose of precoating is to extend cartridge filter life and reduce

power costs by preventing very fine particles from permanently loading the cartridge media. Choosing a precoat material requires that it be compatible with other ingredients, possess the qualities required to coat effectively and be of reasonable cost. The decision to precoat should be borne out of experience with a particular dust collecting operation.

A measured amount of the precoat material shall be introduced into the airstream entering the reworked module. Generally, the procedure shall be: The outlet damper shall be opened followed by the opening of the inlet damper. The precoat feeder shall then be started and the premeasured amount of material introduced into the airstream at a rate that allows all particles to be kept airborne and be carried into the module to be coated (not reversed to the common inlet header serving other dust collector modules). The precoat feeder shall adapt to a 3" screwed half coupling in the inlet duct to the module.

8.28 Electrical power and compressed air service to the reworked module must remain off until the inlet damper is in an open position. This is a requirement to enhance safety, i.e. to prevent the accidental pressurization of the module while dampers are closed and bagging is not fully secured with sleeves covered (capped).

8.29 Tools and equipment shall be cleaned and secured, followed by the removal of cartoned spent cartridge filter elements; all of which shall be surveyed for excessive surface contamination before withdrawal from the contamination zone.

8.30 Personnel monitoring shall comply with local regulations.

9.0 Sequential Steps in Prefilter Changeout Procedure for Housings (Without DOP Test Section) While System is in Normal Operation

9.1 Before any system alterations begin and system is in normal operating mode, read and record the airflow rate for the total system. Read and record the airflow resistance (pressure drop) of each filter stage (bank) in the housing to be changed.

9.2 Adapt a differential pressure gage (Dwyer Model 4302 with A-339 adapter, or equivalent) to the housing to be serviced using 3/16" plastic tubing as a temporary connection. Position the gage vertically at the housing face where it can remain in clear view of crew members during changeout activities.

Then the filter housing to be serviced must be isolated from the operating system by closing the inlet and outlet dampers serving the housing. To prevent filter damage in the remaining (operating) housings, it is necessary to determine that airflow is not excessive (an indeterminable condition beyond rated airflow for filter components that usually reflects careless operation). Where standby housings exist as system equipment, they should be used to alleviate overflow through operating housings.

9.3 A portable breather-filter unit must be adapted to the clean side of the housing using a temporary suction hose; and carefully

dampered open to accept inflow. By slightly opening the housing inlet damper (if necessary) inleakage through the breather filter path is allowed to adjust the negative pressure in the housing to be within the range of -0.3" WG to -0.5" WG, as indicated by the differential pressure gage. The housing is now ready for filter changeout to begin.

9.4 Starting with the top tier prefilter, adjust and set the access platform in position to receive the filter when withdrawn from the housing opening.

9.5 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

9.6 Remove the filter opening cover. Set aside in a clear position. Unfold the plastic bag sealing the opening and extend bagging (drape over platform tray). Protect bagging from local traffic and sharp edges (protrusions) that could cause puncture or snagging. Prevent strain on the bagging connection at the housing opening (port).

9.7 Unclamp the gasket sealing mechanism for the filter; then, using the removal lever (where furnished as a housing feature), withdraw the filter from the housing after carefully extending the plastic bagging to clear the filter. Position the old bag stub (already in the bag) into the heel of the bag, then position the dirty filter into the same end of the bag (against the stub) by carefully sliding the bagging over the filter. Keep plastic bagging free of sharp edges that can tear or abrate the plastic. Housing suction will be collapsing the bagging to the filter casing, so care must be exercised to prevent punctures that can spread contamination. Rest the filter on the access platform tray.

9.8 With plastic bagging fully deflated and clear of unnecessary folds, group the bagging so the dirty filter and old bag stub are contained in the bag end without strain or unused volume on the bagging. Place a strong plastic locking tie at the grouped point. Place a second tie on the grouped bagging 3" closer to the housing. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

Preplanned filter changeout schedules dictate whether or not the HEPA filters are to be replaced (changed out) in addition to prefilters. If yes, then the installation of new prefilters must be delayed until the HEPA filters are changed out and DOP tested, so refer to 10.0 Changeout of HEPA Filters, herein. This delay in prefilter installation is necessary until the DOP in-place testing of the newly installed HEPA filters is completed. After test completion, the continuance of this procedure (9.9) can be followed to install replacement prefilters.

9.9 Select a new replacement filter unit (in carton) from the supply at hand. Confirm it to be the correct filter (i.e. prefilter type.

Carefully remove the new replacement filter from its cardboard carton while on the work table. Inspect all filter sides and exposed faces to ensure there is no visual damage. (Damaged filters should be returned to the carton and set aside for later examination and disposition, but not for use until proven in good condition). Keep new cartoned filter units at floor (cart) level or on work table.

For housings having a two filter wide arrangement with one side access, it is necessary to next remove the filter from the inner position. Therefore, the next step is to connect a new bag to the opening port and repeat steps 9.7 and 9.8 (above).

9.10 Remove the bagged filter from the platform tray and place on the work table with the same side down as when installed. Place the empty cardboard carton (with bottom filler in place) over the bagged filter without straining the bag. Carefully rotate the carton (with filter inside) 90 degrees to the next side (never over on its face) and push (slide) the filter into the bottom of the carton. Next, rotate the carton (with filter inside) another 90 degrees to rest on the next side, which is the carton's bottom. Insert the remaining carton filler(s) and close carton flaps and seal all top edges with 2" wide plastic tape. With felt marker, clearly identify the sealed top side with: housing number, filter position and removal date. Store the cartoned filter upright (taped and marked side up) on the utility cart for eventual removal. Strap down loaded cartons before transport from the changeout area.

9.11 Using inspection light (6 volt lantern) view the gasket sealing surface through the bagging stub to determine it is clean and clear of debris such as gasket pieces. If dirty, the surface must be cleaned or repaired remotely (using a work bag and extension hand tools) before a new filter is bagged into position.

9.12 Position new replacement filter on work table, remove from carton and set carton aside. With care, wipe a very thin complete coat of silicone grease on the exposed gasket face of the new filter to prevent sticking to the seal face while in service. Position filter on scale and weigh. Record serial number, accurate weight (grams), intended housing number and filter position in housing. Group and collect new (clean) plastic bagging and install filter inside bag (pleats always remaining vertical). Be certain direction of airflow through filter corresponds to required airflow direction through housing.

For the housings having a two filter wide arrangement with one side access, it is necessary to prepare a second replacement filter at this point in the procedure. Each new filter shall be separately bagged. Two filters in the same bag are too awkward and too heavy to handle, and therefore would be an unsafe maneuver.

9.13 Position new filter (in bag) on tray of access platform and align to housing opening with open end of bag facing housing.

9.14 Carefully remove security strap from bag stub presently sealing opening and set aside. Extend the open end of the new bag over the existing bag stub that is closing the port opening. Group the new bag to the inner sealing sleeve ring (beyond the elastic cord of the stub), and secure with elastic cord and security strap. Then, with access through the new bag, remove the existing bag stub. Position stub in the heel of the new bag, behind the new filter. The new filter is now within the confinement limits of the housing and hereafter must be considered as contaminated.

9.15 Confirm again that the pleats of the new filter media are vertical and the gasketed edge and airflow through the filter is correct. Carefully lift, align to the opening, and slide the new filter into the housing and into position of alignment to the sealing face. When properly aligned, clamp the filter into position.

For housings having a two filter wide arrangement with one side access it is necessary to bag-in the second replacement filter by repeating steps 9.13 through 9.15. Clamping the initial filter in position is withheld until the second filter also is properly positioned.

9.16 While keeping the old bag stub in the bag heel, roll (in loose form) the bag sealing the opening and position against the installed filter case. Inspect the cover gasket to determine condition and completeness. If the gasket is fully intact, replace the opening cover and clamp closed. Again, inspect the cover gasket to ensure it to be in a sealed position (clear of bagging) with good contact all around. Deteriorated cover gaskets must be replaced when worn or torn to ensure sealing that prevents strain and extension of the seal bagging due to the negative pressure maintained on the housing during normal system operation.

9.17 After completion of Step 16, the procedure is repeated for other filters in the prefilter bank, in order, from top tier to bottom. Repetition includes the continuance of Steps 9.2 and 9.3, and the repeat of Steps 9.6 through 9.16 for each filter in order. Opposite sides of the same filter housing can be changed out simultaneously, i.e. either prefilter and/or HEPA filter bank. However, separate crews working in the same aisle between housings will be limiting spatially because of the need for withdrawal depths for filters and the nearness of banks, access platform(s) and work table(s).

10.0 Changeout of HEPA Filters
System Specific Requirements

10.1 Planning HEPA Filter Changeout

10.1.1 It is planned, and intended, that prefilters will be changed out at the same time as HEPA filters. This is to allow prefilters to be out of the housing at the time new HEPA filters are DOP tested in-place (See 9.8). For effective DOP testing per procedures in ANSI N510, Chapter 10, it is necessary to have prefilters removed and DOP smoke injected upstream of the housing to ensure sufficient aerosol-air mixing and acceptable upstream aerosol concentration for the test instrumentation used.

It is mandatory that newly installed HEPA filters are successfully DOP tested in-place before the filter system is returned to service. The frequency for periodic retesting HEPA filter installations during their service life must be determined through operating experience, with the usual maximum frequency limit being once each year (12 months max.), or when system operation becomes suspect. Otherwise the changeout frequency is determined by the limit of airflow resistance the system and the filter(s) can safely withstand. As initial criteria use 3.5" WG as maximum HEPA filter resistance. Initially, allow a maximum airflow resistance of 0.80" WG for prefilters.

10.2 Sequential Steps in HEPA Filter Changeout Procedure for Housings (Without DOP Test Section) While System is in Operation

10.2.1 The changeout of HEPA filters in a housing will normally be scheduled in coordination with the changeout of the prefilters in the same housing (see 9.8), and be worked by the same crew. When done in this order the HEPA filter changeout is just a continuation of work started with the prefilter changeout. Preparatory work has been done, the slight negative pressure on the housing is continued, and pressure monitored (see 9.2) using the pressure gage temporarily installed for the purpose, and all housing penetrations are secured (closed).

10.2.2 Similar to prefilter changeout procedures, start with the top tier HEPA filter by setting access platform in position to receive the dirty HEPA filter when withdrawn from the housing opening.

10.2.3 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

10.2.4 Remove the HEPA filter opening cover. Set cover aside in a clear position. Unfold the plastic bag sealing the opening and extend bagging (drape over platform tray). Protect bagging from local traffic and sharp edges (protrusions) that could cause puncture. Prevent strain on the bagging connection at the housing opening (port).

10.2.5 Through the bagging, if necessary, unclamp the gasket sealing mechanism for the filter; then, using the removal lever (where furnished as a housing feature), withdraw the filter from the housing after carefully extending the plastic bagging to clear the filter. Keep the old bag stub in the heel of the bag, then position the dirty filter into the same end of the bag (against to stub) by carefully sliding the bagging over the filter. Keep plastic bagging free of sharp edges that can tear or

abrate the plastic material. Housing suction will be collapsing the bagging to the filter casing, so care must be exercised to prevent punctures that can spread contamination. Rest the filter on the platform tray.

10.2.6 With plastic bagging fully deflated and clear of unnecessary folds, group the bagging so the dirty filter and old bag stub are contained in the bag end without strain or unused volume on the bagging. Place a strong plastic locking tie at the grouped point. Place a second tie on the grouped bagging 3" closer to the housing. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

10.2.7 Select a new replacement HEPA filter unit (in carton) from the supply at hand. Confirm it to be the correct filter (by label markings). Carefully open the top of the carton and remove the new replacement filter from its cardboard carton while on the work table. Do this by opening top flaps then carefully rotate carton to a side (never to its face), then holding flaps aside, rotate so carton bottom is up, remove carton vertically. Keeping the filter pleats vertical, inspect all filter sides and exposed faces to ensure there is no visual damage. (Damaged filters should be returned to the carton and set aside for later careful examination and disposition, but not for use until proven in good condition). Keep new cartoned filter units at floor (cart) level or on work table. Always keep cartons upright with top up and never stack HEPA filters over three (3) cartons high. Filters dropped (in carton or out), from even a height of a few inches, must be set aside and not used until retested as good.

For housings having a two filter wide arrangement with one side access, it is necessary to next remove the spent filter from the inner position. Therefore, the next step is to remove the bagged filter from the platform tray and place it on the work table. Then, with a new bag, connect its open end over the bag stub sealing the opening. Secure it with a security strap and stow the stub in the heel of the bag. Now, repeat steps 10.2.5 through 10.2.7.

10.2.8 Remove the bagged filter from the platform tray and place on the work table, maintaining pleats vertical, with the same side down as when installed. Place an empty cardboard carton (with bottom filler in place) over each bagged filter without straining the bag. Handling one spent filter at a time, carefully rotate the carton (with filter inside) 90 degrees to the next side (never

over on its face) and push (slide) the filter into the bottom of the carton. Next, rotate the carton (with filter inside) another 90 degrees in the same direction to rest on the next side, which is the carton's bottom (i.e. the open top is now up and open). Insert the remaining carton filler(s) and close carton top flaps and seal all top edges with 2" wide plastic tape. With felt marker, clearly identify the sealed top side with: housing number, filter position, filter serial number and removal date. Store the cartoned filter upright (taped and marked side up) on the utility cart for eventual removal. Strap down loaded cartons before transport from the changeout area.

For housings having two filter wide, with one side access, it is necessary to secure both bagged filters in cartons and store on the cart out of the way. The work area must be kept free of bagged items that are contaminated and subject to accidental puncture.

10.2.9 Using inspection light (6 volt lantern or equivalent) view the gasket sealing surface and clamping mechanism through the bagging stub to determine surfaces are clean and clear of debris such as gasket pieces. If dirty or in need of repair, the surface must be cleaned or repaired remotely (using a work bag and extension hand tools) before a new filter is bagged into position.

10.2.10 Position new replacement HEPA filter (in carton) on work table. Open filter carton at top and rotate carton on side; then rotate open top to table surface (with flaps clear); lift empty carton vertically to clear filter; set carton aside for later reuse. Inspect both open faces and determine each to be clear of visible damage. If damaged return to carton, mark exterior and set aside for later inspection and testing before any use. With care, position new replacement filter on work table (carton removed) and wipe a very thin complete coat of silicone grease on the exposed gasket face of the new filter to prevent sticking to the seal face while in service. Place filter on scales (pleats vertical) and weigh. Do not bump, jar or drop filters during any handling operation. Record serial number, accurate weight (grams), intended housing number and filter position in housing. Group and collect new (clean) plastic bagging and install filter inside bag (pleats always remaining vertical). Be certain direction of airflow through filter corresponds to required airflow direction through housing. This dictates which side of the filter must be inserted into the bag first.

For housings having a two filter wide arrangement, with one side access, it is necessary to prepare a second replacement HEPA filter at this point. So, repeat step

10.2.10 for the second HEPA filter. Each new HEPA filter shall be separately bagged. Two filters in the same bag are too awkward and too heavy to handle, therefore would be an unsafe maneuver.

10.2.11 Position new HEPA filter (in bag with pleats vertical) on the platform tray, matching airflow direction, and align to housing opening with open end of bag facing housing.

10.2.12 Carefully remove security strap from bag stub presently sealing opening and set aside. Extend the open end of the new bag over the existing bag stub that is closing the opening. Group the new bag to the inner sealing sleeve ring, and secure with elastic cord and security strap. Then, with access through the new bag, remove the existing bag stub. Position stub in the heel of the new bag, behind the new filter. The new filter is now within the confinement limits of the housing and hereafter must be considered as contaminated.

10.2.13 Confirm again that the pleats of the new filter media are vertical and the gasketed edge and airflow direction through the filter is correct. Carefully lift, align to the opening, and slide the new filter into the housing and into position of alignment to the sealing face. When properly aligned, clamp the filter into position.

For housings having a two filter wide arrangement, with one side access, the next step is to bag-in the second filter by repeating steps 10.2.11 through 10.2.13. If the two filter wide housing has a clamping mechanism for both filters, it is necessary to delay clamping the first filter until both filters are in position and properly aligned.

10.2.14 While keeping the old bag stub in the bag heel, roll (in loose form) the bag sealing the opening, and position against the installed filter case. Inspect the cover gasket to determine condition and completeness. If the gasket is fully intact, replace the opening cover and clamp closed. Again, inspect the cover gasket to ensure it to be in a sealed position (clear of bagging) with good contact all around. Deteriorated cover gaskets must be replaced promptly when worn or torn to ensure sealing that prevents strain and extension of the seal bagging due to the negative pressure maintained on the housing during normal system operation.

10.2.15 After completion of Step 14, the procedure is repeated for other filters in the HEPA filter bank, in order, from top tier to bottom (each side of the housing if required). Repetitive work must include the continuance of negative pressure on the housing as well as otner preparatory steps concerning system safety. Opposite sides of the same filter housing can be changed out

simultaneously, i.e. either prefilter and/or HEPA filter bank. However, separate crews working in the same aisle between housings will be limited spatially because of the need for withdrawal depths for filters and the nearness of filter banks, access platform(s) and work table(s).

10.2.16 When the HEPA filters have been changed out, and before prefilters are reinstalled, the housing must be prepared for DOP testing of the newly installed HEPA filters. For more accurate correlation of filter performance to total system performance to total system performance, DOP testing should be done at 100% nominal flow. Periods of airflow through the untested HEPA filters must be limited to test periods only, until penetration through the HEPA filter bank has been proven within established limits. Maximum penetration through the HEPA filter bank (including filters and framing) shall not exceed 0.03% when DOP tested per procedures in ANSI N510, Section 10.

10.2.17 To prepare the housing for DOP testing status, the following specific conditions must be set: 1) The DOP test crew must be on-hand and have set up their test apparatus and be ready to test (immediately) the particular HEPA filter bank in question. 2) The HEPA filter changeout records must be consulted to determine the new clean HEPA filter airflow resistance (for the total bank) that corresponds with nominal airflow (i.e. 1000 CFM per HEPA filter) through the bank. This can be done with sufficient accuracy by averaging the resistances of all individual filters in the bank (when clean only).

CAUTION: After the HEPA filters have been in service the airflow rate through the filter bank cannot be accurately correlated to airflow resistance (pressure drop across the filters). It is necessary to measure the airstream that will (or has) pass(ed) through the particular filter bank in order to establish nominal airflow for DOP testing and to prevent excessive airflow that deteriorates the filters.

With clean filter conditions established, the changeout crew adjusts system dampers to provide nominal airflow through the HEPA filter bank by using the differential pressure gage (local) at the specific housing. After this is set, the crew then is in charge of DOP testing while the changeout crew makes any necessary filter replacement and/or adjustment required by testing. To alter filters in the housing the airflow must first be stopped by closing dampers and a slight negative pressure (range: -0.3" to -0.5" WG) set on the housing by slightly opening the upstream housing damper for needed inleakage to regulate housing pressure. The filter breather should remain in position to allow inleakage into the clean (downstream) side of the housing. Retesting after filter

adjustment/replacement requires that nominal airflow be re-established again through the housing under test and the DOP test crew repeats the test sequence. Retesting (including probing) is repeated until leaks are corrected and performance is within established DOP smoke penetration limits. It is more than obvious that careful handling and positioning of HEPA filters in the initial changeout procedure will be rewarded with much less retesting requirement of time and materials. In-place DOP leak testing of HEPA filters is described in separate procedures/documents (ANSI Standard N510, Chapter 10).

10.2.18 After the HEPA filters have been successfully DOP tested the housing shall be either placed in service by the adjustment of dampers or be put in standby status (if the system is so arranged) by leaving the inlet and outlet dampers in the same position as for filter changeout work. In the event the HEPA filters fail to pass the penetration test, even after repeated retesting, the test airflow through the housing must be stopped and kept stopped until faults are corrected and DOP testing proves the smoke penetration is within the established penetration limit.

10.2.19 Following final disposition of the completed housing the portable filter breather unit and adapting hose shall be removed and the connecting penetration closed. Also, the pressure gage indicating housing differential pressure relative to surrounding work space shall be removed and the connection secured. If a temporary pitot tube with pressure gage has been used to judge airflow through the housing they too shall be removed and penetration secured.

10.2.20 Tools and equipment shall be cleaned and secured, followed by the removal of cartoned spent filters; all of which shall be surveyed for excessive surface contamination before withdrawl from the contamination zone.

11.0 Sequential Steps in Cartridge Filter Changeout Procedure for Dust Collector Module While System is in Operation

11.1 Before any system alterations begin, read and record the airflow rate for the total system. Read and record the airflow resistance of the dust collector module where cartridge filters are to be changed. These values should include both the high and low differential pressure (range) being experienced by the module. Turn off electrical power to the controls for the module under service. Close the compressed air supply valve and bleed down the compressed air manifold on the module. These module services must be deactivated before module dampers are closed and/or any covers are removed. This is a requirement to enhance safety, i.e. to prevent the accidental pressurization of the module while dampers are closed and bagging is not fully secured with sleeves covered (capped).

11.2 Adapt a pressure gage to the module cabinet to indicate the negative pressure in the cabinet relative to the surrounding space. Using a connection on the clean (downstream) side of the module, temproarily connect the pressure gage (equal to Dwyer Model No. 4302, with A-339 adapter) using 3/16" plastic tubing. Position the gage for clear viewing by the crew during filter changeout.

11.3 Isolate the module by closing the damper on the downstream and upstream paths. Adapt a portable filter breather on the clean side of the module to allow inleakage necessary to regulate negative pressure.

11.4 Then, with open filter breather path, adjust the upstream (dirty side) module damper to achieve and maintain a slight negative pressure (range: -0.3" to -0.5" WG) on the module, relative to the surrounding space. The module is ready for cartridge filter changeout to begin. The pressure gage indicating module negative pressure must be checked periodically and the upstream damper adjusted, if necessary, to maintain the module pressure within range.

11.5 Starting with the top tier, left side sleeve, adjust and set the access platform in position to receive the used (spent) filter cartridge when withdrawn from the module sleeve.

11.6 Inventory all needed tools and equipment, including filters, bags and banding kit with accessories, to be certain all items are immediately at hand and in good order for use.

11.7 Remove the sleeve cover/cap and set aside clear of the receiving area (tray) on the platform.

11.8 Extend the grouped bagging from the sleeve and unseal the sleeve plug (through bagging) and remove the plug to the outer section of the bagging, positioning clear of the sleeve alignment where its weight can be securely supported.

11.9 Through the plastic bagging, grasp the end of the (first) mounted filter cartridge and extract it a few inches, rotate it 180 degrees to dump any top dust, then continue to extract the filter from the sleeve to the heel of the bag being careful to work the collapsed bagging around the cartridge filter and past the sleeve sealing plug without straining the plastic. Rest the cartridge on the support tray on the platform. Group the bagging on the module side of the spent cartridge (not including sleeve plug), reducing all unnecessary bag volume and unneeded bag folds (i.e. deflate the bagging). Secure the bag near the module with a strong plastic locking tie. Replace the sleeve plug and reseal. Install a second plastic locking tie on the grouped bag approximately 3" closer to the module from the first tie. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

11.10 Read and record the serial number of the cartridge filter that is bagged out.

11.11 Place the bagged spent cartridge filter into an empty carton and carefully close the carton flaps; then seal all edges with 2" wide (brown or white) plastic tape. Mark the carton top with the cartridge filter serial number, the removal date, module number and filter position. Set the closed filter aside on the utility cart (top up).

11.12 Continuing with the remaining part of the bag attached to the cartridge sleeve, carefully extract the second filter a few inches, rotate 180 degrees to dump dust, then extract the upper (second) spent filter from the sleeve and work it to the end of the bag past the sleeve sealing plug). Rest the bagged cartridge filter on the support tray.

11.13 Group the bagging on the module side of the spent cartridge (not including sleeve plug), reducing all unnecessary bag volume and unneeded folds (i.e. deflate the bagging). Secure the bag near the module with a strong plastic locking tie. Replace the sleeve plug and reseal. Install a second plastic locking tie on the grouped bag approximately 3" closer to the module from the first tie. Between these ties install two 3/8" wide stainless steel bands 2" apart, and cinch each to full tightness. Using the plier-shears from the kit, cut the grouped plastic bagging midway between the steel bands. Leave all bands and ties intact.

11.14 Read and record the serial number of the cartridge filter that is bagged out.

11.15 Place the bagged spent cartridge filter into an empty carton and carefully close the carton flap; then seal all edges with 2" wide (brown or white) plastic tape. Mark the carton top with the cartridge filter serial number, the removal date, module number and filter position. Set the closed filter aside on the utility cart (top up).

11.16 Fold the bag stub within the sleeve and replace the sleeve cap until time to install new cartridge filter elements. The normal procedure would be to continue with loading new cartridges into the same sleeve that had just been emptied. This continuation saves repositioning the access platform and allows a repetitive sequence to be followed requiring the minimum number of equipment setups to accomplish a full filter changeout of a module.

11.17 Prepare two (2) new cartridges for loading. Remove elements from carton (top up). Carefully wipe the exposed face of the cartridge ring gasket with a very thin complete coat of silicone grease to prevent sticking to the mating surface (seal face). If material accountability is required, weigh and record each filter element weight (in grams), record element serial number , manufacturer, and installation date. If material accountability is not required, dispense with weighing, but record other data.

11.18 Fit the new cartridge filters (2) into one new plastic bag, one filter at a time, so the gasketed end can enter the sleeve first, once the bag is attached to the module sleeve. Position the bagged filters on the platform tray in an upright position, then align the tray to the sleeve to be loaded.

11.19 Remove the security strap from the bag stub and attach the new bag to the module sleeve to be loaded (starting at the top tier, left), install security strap. Detach old bag stub and position in the bag clear of the first new cartridge filter. Unseal the sleeve plug and remove to the bag clear of the sleeve alignment, and beyond the first cartridge filter.

11.20 Using the 6 volt lantern (viewing through the bagging) inspect the support yoke and the gasket sealing face (up the sleeve). Determine the yoke to be fully intact and the sealing face and yoke to be clear of debris, including gasket pieces.

11.21 Through the bagging carefully align the first new cartridge filter to the sleeve (gasket end first); thread the filter on the yoke and slide the gasket end to the sealing face.

11.22 Carefully thread the second cartridge filter through the deflated bag, past the old bag stub and the sleeve sealing plug, to align with the sleeve. Thread the filter on the yoke (gasket end first) and slide up the sleeve to contact the sole end of the first cartridge filter.

11.23 Replace the seal plug to the yoke end in the sleeve. Work the old bag stub to the heel of the bag. Carefully fold the deflated bag to near the sleeve end. Complete the sealing of the plug and arrange the deflated/folded bag in the end of the sleeve. Restore the sleeve cover (cap) over the end of the sleeve.

11.24 Filter element changeout of the top tier left sleeve is completed. Progress to the top tier right sleeve and repeat steps 11.6 through 11.23.

11.25 Cartridge filter changeout should then progress in a uniform sequence that will minimize the needed equipment changes and repositioning of access platform. Following a set sequence will help prevent skipping filters and help eliminate duplication in case of personnel changes or lapsed time during changeout (e.g. end of shift).

11.26 Following the completion of cartridge filter changeout it is necessary that airflow through the module be restored by opening the dampers (inlet and outlet). Also, the filter breather unit must be disconnected and the penetration closed. Initially, airflow through the module will be heavy, compared to other system modules, because of the filter element cleanliness. However, airflow should be restricted until precoating is accomplished to protect the filters from embedded fines (if precoating is practiced).

11.27 If initial precoating is practiced, the new cartridge filter elements in the reworked module are ready to be precoated. The purpose of precoating is to extend cartridge filter life and reduce power costs by preventing very fine particles from permanently loading the cartridge media. Choosing a precoat material requires that it be compatible with other ingredients, possess the qualities required to coat effectively and be of reasonable cost. The decision to precoat should be borne out of experience with a particular dust collection operation.

A measured amount of the precoat material shall be introduced into the airstream entering the reworked module. Generally, the procedure shall be; The outlet damper shall be opened followed by the opening of the inlet damper. The precoat feeder shall then be started and the premeasured amount of material introduced into the airstream at a rate that allows all particles to be kept airborne and be carried into the module to be coated (not reversed to the common inlet header serving other dust collector modules). The precoat feeder shall adapt to an inlet connection in the inlet duct to the module.

11.28 Electrical power and compressed air service to the reworked module must remain off until the inlet damper is in an open position. This is a requirement to enhance safety, i.e. to prevent the accidental pressurization of the module while dampers are closed and bagging is not fully secured with sleeves covered (capped).

11.29 Tools and equipment shall be cleaned and secured, followed by the removal of cartoned spent cartridge filter elements; all of which shall be surveyed for excessive surface contamination before withdrawal from the contamination zone.

11.30 Personnel monitoring shall comply with local regulations.

LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Oak Ridge, Tennessee

Equipment: **AIR FILTER**
(95% EFF, - ASHRAE 52-76)

Data Sheet No.: DS-H-120
Project No.:
Sheet No.: 1 of 2
Reference Spec. Section:
Rev. By Date

Client: DOE-FMPC
Qty. Required: Item: Area:
Designed by: R.H.F. Checked by: R. H. Forde Approved by: K. A. Wilson
Date: 6/20/86 Date: Date:

TOTAL QUANTITY REQUIRED	
SELECTION: Manufacturer	Mine Safety Appliances Co.
Model No.	B-2000 (See Note 3)
Item, Type or Mark	SM-86979
PERFORMANCE:	
Air Volume, scfm	1000
Initial Resistance, in. w.g., max.	0.23
Efficiency, ASHRAE 52-76, min/average	90/95
Dust Holding Capacity, grams, (Note 1)	3000
At Resistance, in. w.g.	0.8
Dust Type	NBS Cottrell Precipitate
Velocity through Media, fpm, max.	6.3
Air Temperature, °F max. continuous	300
Relative Humidity max. continuous, Ambient	90%
Fire Classification (NFPA)	Class 1
DOP Efficiency, min. (Note 2)	60%
PHYSICAL:	
Frame Size: Width, in.	24 (Note 3)
Height, in.	24 (Note 3)
Depth, in.	11-5/8
Media Depth in Frame, in.	10-3/4
Media Area, sq. ft.	160
Media Thickness, in.	.03
Gasket Size, in.	3/4 x 1/4
Divider Thickness, in.	.0015
MATERIAL:	
Media	Fiberglass
Frame	Hardboard
Dividers	Corrugated Aluminum
Adhesive	Rubber Base
Gasket (On Air Out Side)	Neoprene (ASTM-D1056, SCE-43)
FINISH:	
Mfg. Standard	Yes

1. National Bureau of Standards (NBS) dust, minimum holding capacity, or ASHRAE 52-76.
2. Hot DOP Penetration of media (per MIL-282).
3. Full size to fit in a bag-in/bag-out filter housing.

Data Sheet No.: DS-H-120
Project No.:
Sheet No.: 2 of 2

ACCESSORIES:

Reinforcement -- (Both Faces - Face Guards) Hardware Cloth	4X4 MESH Gal (ASTM A740)
Label	Units to be serially numbered

MANUFACTURER'S DATA QUANTITIES INDICATED	NUMBER OF COPIES w/Bids	Certified
1. Outline dimension drawings	3	6
2. Weight of equipment	3	6
3. Performance curves or tables	3	6
4. Installation instructions		6
5. Descriptive literature	3	6

LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Oak Ridge, Tennessee

Data Sheet No.: DS-H-121
Project No.:
Sheet No.: 1 of 2
Reference Spec. Section:

Equipment: **AIR FILTER - HEPA (WOOD FRAMED)**

Rev.	By	Date

Client: DOE-FMPC
Qty. Required: Item: Area:
Designed by: R.H.F. Checked by: R. H. Forde Approved by: K. A. Wilson
Date: 6/20/86 Date: Date:

TOTAL QUANTITY REQUIRED	
SELECTION: Manufacturer	MSA
Model No.	Sm 72920 (XBAAA)
PERFORMANCE:	
Air Volume, scfm	1000
Initial Resistance, in. w.g., max. (Note 1)	1.0
Efficiency, % DOP, min. (Note 1)	99.97
Particle size, micrometer	0.3
At 100% Airflow Test Resistance, in. w.g.	1.0
Dust Type	DOP
Velocity through Media, fpm, max.	4.2
Air Temperature, °F	80
Moisture Content of Air, % RH	50
Fire Resistant-Label	Underwriters Laboratories,
Test	UL-586
PHYSICAL:	
Frame Size: Width, in.	24
Height, in.	24
Depth, in.	11 1/2
Media Depth in Frame, in. (Pack depth, nominal)	11
Media Area, Sq. ft. (min.)	240
Air in side	Open
Gasket Size, in. (On Air Out Side)	3/4 x 1/4
Air out side	Open
MATERIAL:	
Media	MIL-F-51079 (7% Max. Organic Content)
Frame	3/4" Exterior Grade Plywood
Dividers (Separators)	Aluminum
Adhesive	Epoxy
Gaskets (ASTM-D1056, SCE-43)	Neoprene
FACE GUARDS:	Yes, both faces; 4x4 mesh galvanized hardware cloth (ASTM A740)

1. In accordance with MIL-STD-282; 100% and 20% airflow rate (MIL-F-51068).

Data Sheet No.: DS-H-121
Project No.:
Sheet No.: 2 of 2

FINISH:	
Mfg. Standard	Yes
APPLICABLE STANDARD	
Nuclear Standard	NE F 3-45T
SHIPPING	Filter cartons shall be palletized (6 1/2 ft. max. height) to minimize unit handling

MANUFACTURER'S DATA QUANTITIES INDICATED	NUMBER OF COPIES		
	W/Bids	Approval	Certified
1. Outline dimension drawings	3		6
2. Weight of equipment	3		6
3. Performance curves or tables	3		6
4. Installation instructions			6
5. Descriptive literature	3		6

Ship To:

Martin Marietta Energy Systems Inc.
K-25 Plant, Building K-1024
Oak Ridge, Tennessee 37831
Attention: Filter Test Facility

The Filter Test Facility (FTF) will repack filters and forward them to:

Westinghouse Materials Company of Ohio
Feed Materials Production Center
7400 Wiley Road
Fernald, Ohio 45030

Rejected filters shall be disposed of by the FTF in accordance with current written instructions on file from the manufacturer. In the absence of such instructions the FTF will repack rejected filters and return them to the manufacturer, by public carrier (FOB).

ACCEPTABLE SUPPLIERS

The following list of firms are the only ones known to provide filters that will meet the requirements of this specification. Other suppliers may be added as they are approved by the installations.

American Air Filter Company, Inc.
215 Central Avenue
Louisville, Kentucky 40277

Cambridge Filter Corporation
P.O. Box 4906
7645 Seventh North Road
Syracuse, New York 13221

Flanders Filters, Inc.
P.O. Box 1708
Washington, N.C. 27889

Mine Safety Appliances Company
Filter Products Division
Evans City, Pennsylvania 16033

LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Oak Ridge, Tennessee
Equipment: **CARTRIDGE FILTER ELEMENT**

Data Sheet No.: DS-H-122
Project No.:
Sheet No.: 1 of 5
Rev. By Date

Client: DOE-FMPC
Qty. Required: Item: Area: Plant
Designed by: A.B.F. Checked by: R.H. Forde Approved by: K.A. Wilson
Date: 6/20/86 Date: Date:

1.0 GENERAL DESCRIPTION

1.1 The purpose of the cartridge type filter element is to serve as the air filtering element in the cartridge type dust collectors.

1.2 Filter elements are intended for service with reverse flow pulse-jet cleaning using compressed air as the motive force for reverse flow. After extended use the element will be replaced with a new element by manual bag-out/bag-in procedures. The spent element is to be incinerated to reduce waste volume and recover residual dust. Minimum amount of metal shall be used.

1.3 The fluid to be filtered by the element is air which is ladened with dust containing uranium and other contaminating particles.

1.4 Filter element shall be furnished complete with required accessories for element mounting. The accessories shall be disposable.

2.0 PERFORMANCE

2.1 An element shall have a nominal airflow capacity of 270 SCFM with a maximum clean airflow resistance of 1.10 inch W.G. Initial (clean) medium velocity shall not exceed 1.20 fpm through the effective medium area.

2.2 The penetration of the filter medium by DOP (dioctylphthalate) smoke of 0.3 micrometer average particle size shall not exceed 65%, as determined by comparing downstream with upstream smoke concentration with the air and smoke mixture having the flow rate specified in paragraph 2.1.

2.3 The filter media shall show no tears, breaks, cracks or fiber separation after it is drawn back and forth, five times, around a 3/16 inch diameter mandrel and moving through an arc of at least 180°, when tested as specified in paragraph 4.3.

2.4 The filter elements shall be capable of operating at nominal airflow at a continuous temperature of 150°F.

2.5 The filter elements and accessories shall function without performance penalty in an atmosphere of 90% relative humidity (water in air) within the range 50°F to 150°F.

2.6 The maximum weight of a filter element (clean) as specified herein shall be less than 22 pounds, exclusive of accessories.

3.0 CONSTRUCTION

3.1 Media shall be a non-woven cellulose sheet formed in uniform pleats with ends sealed. The configuration of media shall be constrained by reinforcement material, in addition to the media itself, forming a cylindrical body. The media shall be combustible.

3.2 Combustible reinforcement parts are preferred. The minimum amount of metal reinforcement parts and fasteners shall be used. The metal parts shall be easily compacted after incineration. Polyvinyl chloride (PVC) shall not be used as any part of the filter element.

3.3 Gaskets to seal the ends of filter elements to the abutting flat seal face (tube sheet) or adjoining filter element shall be closed cell neoprene (ASTM D1056 SCE-43 B1) in circular form (ring) without joint. The percent of set shall not be more than 45% after 24 hours.

3.4 The filter element shall be cylindrical with ends normal to the cylinder's centerline. Airflow shall be from the exterior to the inner core.

3.5 The size of filter element shall be as shown on Sheet 5 of 5.

3.6 All surfaces shall be free of sharp edges and burrs that will snag or abrate sheet plastic.

3.7 A ring gasket shall be attached to the head plate that will seal the filter element end to an adjoining flat seal face (tube sheet) or adjoining sole plate of another filter element aligned on the same centerline. The ring gasket shall be 1/2 in. height by 3/8 in. minimum width in cross-section.

4.0 TESTING

4.1 Tests shall be performed on clean filter elements to confirm compliance with the performance requirements of this specification. Tests shall be performed by an independent laboratory with performance results certified and furnished for each composite of filter element construction.

Subsequent testing from the same manufacturer for elements of certified equal construction will not be required except where separately specified. Manufacturer will supply certified test data from the independent testing source as part of bid submission.

4.2 Three filter medium test specimens shall be tested for airflow resistance (resistance as defined in paragraph 2.1) and DOP smoke penetration at a velocity of 1.2 feet per minute (fpm) using the Q 127 DOP Filter Testing Penetrometer (Draving D136-42-102-5B, Reference MIL-F-51079C, Military Specification, Filter Medium, Fire-Resistant, High Efficiency, Revised March 4, 1980). The exposed test area of the specimens is 15.5 square inches.

4.3 Eight filter medium test specimens, cut 12 inches long in the machine direction and 6 inches wide shall be bent perpendicular to the machine direction over a 3/16 inch wide mandrel and drawn back and forth so that 10 inches of filter media is drawn five times through an arc of 180°. Four specimens with the outside of the filter media roll against the mandrel and four specimens with the inside of the filter media roll against the mandrel shall be flexed. The filter media shall meet the performance indicated in paragraph 2.3 as well as below.

After examination as specified in paragraph above, the center of each test specimen shall be tested for DOP penetration in accordance with the procedure in paragraph 4.2.

5.0 QUALITY ASSURANCE

5.1 All test reports shall be approved prior to shipment.

5.2 All review and record drawings shall be approved prior to construction.

6.0 PACKAGING

6.1 Filter shall be individual packaged in 6 mil. polyethylene bags (unsealed) with heavy (100 psi test) corrugated cardboard carton that is sealed on all edges. The exterior shall be stenciled on one side and on the end to be opened with 1 in. high letters that clearly indentify the contents, including manufacturer's reference number. Carton length shall allow space for end filter treatment that will protect the element from damage in handling and opening. The carton is to be considered for reuse in handling spent (bagged-out) filter elements of equal size.

7.0 SHIPPING

7.1 Cartoned filter elements shall be palletized for shipping with stencil markings visible from one side and top side. Cartons shall be strapped to the pallet with any and all stacking/handling precautions made clearly visible on the top face of the pallet unit. Stated precautions shall be uniformly stenciled with 2 in. high letters in a conspicuous manner.

8.0 SUBMITTALS

8.1 The manufacturer shall provide the material and quantites as specified below.

8.2 MANUFACTURER'S DATA

	NUMBER OF COPIES W/BIDS	Certified
1. Outline dimension drawings	3	6
2. Weight of equipment	3	6
3. Performance curves or tables	3	6
4. Installation instructions		6
5. Descriptive literature	3	6

8.3 All descriptive literature shall indicate specific equipment to be supplied.

8.4 Review/record drawings shall include: all performance data, equipment weight, purchases order number, material sizes, material thicknesses, and material types.

9.0 SKETCH

9.1 Dimensional requirements and other features are illustrated on Sheet 5 of 5. Any deviation from the data given via the sketch shall be cited and defined by the manufacturer as part of bid submitted information.

10.0 SUGGESTED VENDORS

10.1 Torit Division of Donaldson Co. Inc., Minneapolis, MN.

10.2 Fabric Max by TS Industries. Inc., Anaheim, CA.

10.3 Farr Co., Los Angeles, CA.

10.4 Pneumafil Corp., Charlotte, NC.

10.5 Successful Vendor shall provide the Company an opportunity to witness construction methods and review quality controls procedures prior to delivery.

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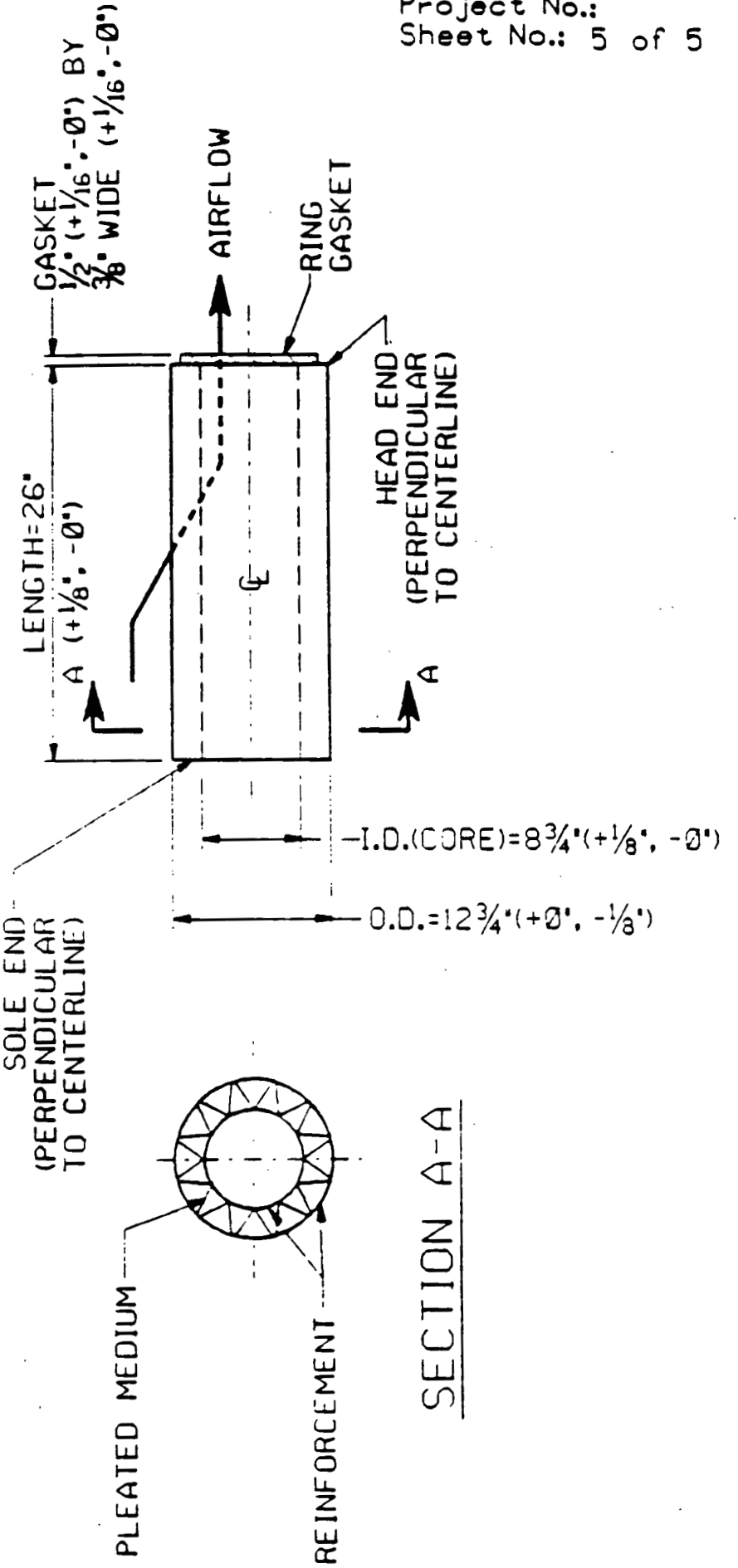
Project No.:
Sheet No.: 5 of 5



LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Oak Ridge, Tennessee
Equipment: **DISPOSAL BAG (A) FOR 24X24X11 1/2 HEPA FILTER UNIT**

Data Sheet No.: DS-H-123
Project No.:
Sheet No.: 1 of 1

Rev.	By	Date

Client: DOE-FMPC
Qty. Required:
Designed by: A.B.F.
Date: 6/20/86

Item:
Checked by: R. H. Forde
Date:

Area:
Approved by: K. A. Wilson
Date:

TOTAL QUANTITY REQUIRED:

SELECTION: Manufacturer (See Note 1)

Flanders Filters, Inc.
P. O. Box 1708
Washington, NC 27889-1708
919/946-8081

Bag Size Designator: 90Cx108

REQUIREMENTS:

Material	Polyethylene (PE), 8 mil thickness, transparent.
Bag Size	Opening: 90" circumference; length (flat): 108".
Features	a) Continuous elastic cord hemmed in opening circumference, with stretch to 90". b) Two (2) hand sleeves (mittens) approx. 36" from opening. c) Bag shall be airtight (free of all visible penetrations, pin holes, etc.) and capable of withstanding 10" w.g. pressure without tearing or fracturing seams.
Accessories	a) Security strap to fit bag sleeve on housing (approximately 86" circumference). b) Cinching strap (bands), SST, 3/8" wide x 24 ga. x 12" long (effective). Two (2) required per bag. c) Sealed rectangular carton to contain folded bag and accessories, with external identification of contents.

DESCRIPTION

PE bag (with accessories) for use in containing filter units (24x24x11 1/2 size) in changeout operations (bag-in/bag-out) for filter housings. Bag opening to be equipped with elastic binder hemmed into bag opening to grip housing port sleeve; and security strap to prevent slippage of hemmed binder from port sleeve. All disposable accessories (as listed above) for bag use shall be furnished. folded bag (and accessories for one bag use) shall be contained in an individual cardboard carton (sealed) and identified on the exterior surface (edge) with generic name, bag size and Manufacturers' name and number.

1. Alternate manufacturers or suppliers: Charcoal Services Corp., P.O. Box 3, Bath, NC 919/923-2911. ASCO Inc. P.O Box 3036, Knoxville, TN 615/522-2113.

LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Oak Ridge, Tennessee
Equipment: **DISPOSAL BAG (B) FOR 12 3/4" O.D. X 26" LONG CARTRIDGE FILTER**

Data Sheet No.: DS-H-124
Project No.:
Sheet No.: 1 of 1

Rev.	By	Date

Client: DOE-FMPC
Qty. Required:
Item:
Area:
Designed by: A.B.F.
Checked by: R. H. Forde
Approved by: K. A. Wilson
Date: 6/20/86
Date:
Date:

TOTAL QUANTITY REQUIRED:
SELECTION:

REQUIREMENTS:

Material	Polyethylene (PE), 8 mil thickness, transparent.
Bag Size	Opening: 63" circumference; length (flat): 120.
Features	a) Continuous elastic cord hemmed in opening circumference, with stretch to 60" min. b) No girth seams allowed except within 12" of either end of bag. c) Bag shall be airtight (free of all visible penetrations, pinholes, etc.) and capable of withstanding 10" w.g. pressure without tearing or fracturing seams.
Accessories	a) Security strap to fit bag sleeve on dust collector. b) Cinching strap (bands), SST, 3/8" wide x 24 ga x 12" long (effective) four (4) required per bag. c) Sealed rectangular carton to contain folded bag and accessories, with external identification of contents.

DESCRIPTION

PE bag (with accessories) for use in containing cylindrical cartridge filters (each 12"3/4" o.d. x 26" long) in changeout operations (bag-in/bag-out) for cartridge type dust collectors. Bag opening to be equipped with elastic binder hemmed into bag opening to grip the port sleeve; and security strap to prevent slippage of hemmed binders from the port sleeve. All disposable accessories (as listed above) for bag use shall be furnished. Folded bag (and accessories for one bag use) shall be contained in and individual cardboard carton (sealed) and identified on the exterior surface (edge) with generic name, bag size and Manufacturer's name and number.

PROSPECTIVE SUPPLIERS

Donaldson Company, Inc.
Torit Division
P.O. Box 1299
Minneapolis, MN 55440
612/887-3900

Charcoal Services Corp.
P.O. Box 3
Bath, NC 27808
919/923-2911

ASCO Inc.
P.O. Box 3036
Knoxville, TN 37917
615/522-2113

AN AMERICAN NATIONAL STANDARD

Testing of Nuclear Air-Cleaning Systems

ANSI/ASME N510-1980

(REVISION OF N510 - 1975)

SECRETARIAT

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United Engineering Center 345 East 47th Street New York, N.Y. 10017

when making serial measurements. In such cases even the substantial airflow resistance of filters and adsorbers may be inadequate to redistribute airflow across their faces when they are in close proximity to such flow disturbances. Carefully placed flow straightening baffles may be required to meet the flow distribution acceptance criterion of paragraph 8.3.2(4).

1. *Through HEPA Filter Banks.* For filter banks containing ten or more filters, the minimum number of velocity measurements will be one in the center of each filter. For systems containing fewer than 10 HEPA filters in a single bank, the minimum number of velocity measurements will be ten and will include one reading in the center of every filter in the bank. Velocity measurements are preferably made downstream of the filters to take advantage of the flow straightening characteristics of the HEPA filter.

2. *Through Adsorber Banks.* For banks containing pleated bed adsorber cells (Type I), the air distribution test will follow the same procedures specified for HEPA filter banks in paragraph 1. For banks containing adsorber modular trays (Type II) the air distribution test will follow the same procedures specified for filter banks in paragraph 1 except that all velocity measurements will be made precisely in the plane of the face of the air channels and in the center of every open channel. For single unit adsorbers of the deep bed or gasketless design (Type III), velocity measurements for the air distribution test will be made in the centers of equal areas that cover the entire open face and are not in excess of 12 inches on a side.

3. *Through Prefilter and Moisture Separator Banks.* Whenever air distribution tests are required for these air cleaning devices, the test procedures specified for HEPA filter banks will be followed.

4. *Acceptance Criteria.* All readings shall be within ± 20% of the average velocities measured per 8.3.2.

8.4 Report

A written report shall be furnished to all persons specified in the test procedures. The report shall include as a minimum:

1. Title or identification of test series.

2. Job number or Purchase Order.

3. Test instruments employed.

4. Location and cross-sectional dimensions of each duct of plenum where tests were made.

5. Instrument reading at each test point with identification of location, calculated velocity, and calculated average velocity.

6. Total airflow through system.

7. Airflow distribution test results.

8. Nonconformances discovered during test and name of parties to whom reported.

9. Instrument calibration data.

10. Signature(s) of test personnel.

11. Date of test.

12. Distribution of report.

9. AIR-AEROSOL MIXING UNIFORMITY TEST

9.1 Purpose

This test is prerequisite to the tests of Sections 10 and 12, in-place leak tests of HEPA filter and adsorber banks, respectively. The purpose of the test is to verify that tracer (DOP or refrigerant gas) injection and sample ports are located so as to provide proper mixing of the tracer in the air approaching the component stage (HEPA filter bank or adsorber stage) to be tested, or the sample plane. The test is made only upon completion of initial system installation, modification, or major repair, and is not required each time an in-place test of the filters or adsorbers is made. A valid in-place test is not possible without a uniform tracer-air mixture.

9.2 Summary of Method

DOP aerosol is introduced into the air stream at a previously selected injection point. Aerosol concentration readings are taken across a plane parallel to, and a short distance upstream of the HEPA filter bank; the uniformity of these readings establishes the acceptability of the injection port location.

NOTE 1

If the system has more than one HEPA filter bank or more than one adsorber stage, a separate tracer-injection port is required for each bank and therefore a separate air-aerosol mixing test is required for each injection port and filter bank. If air-aerosol mixing is adequate for the first bank of HEPA filters, it can be assumed to be adequate for the first adsorber stage downstream. If the system contains a second bank of HEPA filters, the DOP must be injected at a point between the two HEPA banks in order to introduce sufficient aerosol to the second bank for a valid test.

NOTE 2

In some systems it may be necessary to inject DOP upstream of a bank of adsorbers in order to challenge the HEPA filters downstream, or to inject a refrigerant (fluorocarbon) gas upstream of a bank of HEPA filters in order to test a bank of adsorbers. It has been shown that DOP has no adverse affect on activated carbon, and that refrigerant gases have no adverse affect on HEPA filters.

9.3 Apparatus

1. DOP generator (See Par. 10.4.1);

2. Penetrometer (See Par. 10.4.2);

3. System fan or auxiliary blower capable of producing the airflow and suction pressure specified in the test procedure.

9.4 Procedure

1. Connect DOP generator to injection port, start system fan or auxiliary blower.

2. Connect penetrometer to upstream sample port.

3. Start DOP injection, adjust generator as necessary.

4. Make concentration readings in a sample plane parallel to and approximately one foot upstream of the filters. Allow instrument to stabilize before taking readings. Record readings. For system of less than 10 filters, divide the sample plane into ten equal areas and take one reading at the center of each area. This test is not required for systems containing a single HEPA filter.

For systems with ten or more filters, take one reading opposite the center of each filter.

5. Calculate average concentration from the equation:

$$\overline{C} = \frac{\Sigma_1^n C_i}{n}$$

where $\overline{C}$ = average concentration reading;

C_i = individual concentration readings;

n = number of readings taken.

6. If the maximum and minimum readings differ by more than ± 20% of the average reading, relocate the injection port, or provide means for additonal mixing between the injection port and the sample point, or specify multiple sampling in the procedures for the tests of Sections 10 and 12.

9.5 Report

A written report shall be furnished to all persons specified in the test procedure. The report shall include, as a minimum:

1. Title or identification of test.

2. Job number or Purchase Order.

3. Identification of system and unit tested.

4. Test apparatus.

5. Test data.

6. Size (number and airflow capacity of cells) of each bank.

7. Volumetric flow rate.

8. Location of ports for injection and sampling.

9. Concentration reading at each sample point and average concentration.

10. Relocation of injection or sample port, or means provided for additional mixing if required.

11. Concentration readings and average concentration after system modification.

12. Conclusions or recommendations.

13. Signature(s) of test personnel.

14. Date of test.

15. Distribution of report.

10. IN-PLACE LEAK TEST, HEPA FILTER BANKS

10.1 Purpose

The in-place test is a leak test of the installed system and should not be confused with the efficiency test of individual filters. This test is used during acceptance testing of the air cleaning system, after any filter replacement, or after any maintenance activity in the filter housing to verify (1) that the filters have not been damaged, (2) that they have been installed properly, (3) that there are no leaks in the mounting frame or between the mounting frame and the housing, and (4) that the system contains no bypassing (e.g., through defective or inefficient bypass dampers, through adjacent plenums, or through penetrations, such as electrical conduits, which penetrate the mounting frame) which would compromise the function of the filters. The test is also made periodically in both operating and standby systems to check on possible degradation of the filters or the filter installation (e.g., development of cracks in the mounting frame or

mounting-frame-to-housing seal). This standard covers only the gross test (see Par. 3.15) but can be used as a basis for the development of procedures for a shrouded test. The shrouded test is sometimes used when extensive scanning of the bank (and therefore extended release of challenge aerosol or gas) is expected. The shrouded test is valid ONLY if a satisfactory pressure-leak test of the mounting frame has previously been completed.

10.2 Summary of Method

With the system fan or an auxiliary blower operating, DOP aerosol is injected upstream of the filters. Concentration measurements are made upstream and downstream of the filters and percent penetration is calculated from the ratio of DOP concentrations in the filtered air (downstream reading) and the unfiltered air (upstream reading). If penetration is greater than the value specified in the test procedure, the test is stopped and the system re-inspected for leaks or bypasses. If leaks or bypasses cannot be located visually, the fan and DOP generator are turned on again and the downstream face of the mounting-frame-to-housing seal, the peripheries of the individual filters, and finally the faces of the filters, in that recommended order, are scanned. After location and correction of leaks and bypasses or, if necessary, replacement of defective filters, the in-place test is repeated for record. The test may be at the air flow measured in Section 8.3.1 (which is used to establish the uniformity of air-aerosol mixing in Section 9) or at some other specified airflow.

10.3 Prerequisites for Test

Sections 8 and 9 are prerequisites for this test. The downstream sample point should be located, if possible, at a point where a single-point sample, representative of the downstream concentration, can be taken; this may be a point downstream of the fan or auxiliary blower, or a point downstream of a flow disturbance which will provide adequate mixing of the DOP-air mixture emitting from the filters in the bank. Where it is impossible to obtain an adequate single-point downstream sample, a multiple sampling technique, in accordance with Section 11, is required. There must be adequate room and safe working conditions for test personnel and equipment. Verify that DOP shall be injected at a point far enough upstream to disclose any possible system bypasses.

10.4 Apparatus

10.4.1 Dop Generator. An air-operated generator or gas-thermal generator certified by the manufacturer to be capable of producing the droplet-size distribution of Par 3.9. The generator output and/or penetrometer adjustment as specified in the test procedure shall ensure penetrometer sensitivity high enough to permit detection of leaks at least two times smaller than the maximum leak allowed by project specifications. The DOP concentration shall not exceed the linear response capability of the detector.

10.4.2 Penetrometer. An instrument with a linear read-out, near-forward light-scattering aerosol photometer having the following characteristics is recommended:

1. Threshold sensitivity to permit detection of test aerosol in concentrations of at least as low as 10^{-3} µg per liter of air and having a minimum reading at this concentration of 1.0% when set on the most sensitive scale.

2. Capability of measuring concentrations of DOP in air of at least 10^5 times the threshold sensitivity of the instrument used for the test.

3. For testing of systems larger than 1000 cfm installed capacity, a sampling rate of at least 1 cfm.

4. Linear response from minimum detectable aerosol concentration to maximum upstream concentration.

10.4.3 System fan or auxiliary blower capable of producing the airflow and pressure specified in the test procedure.

10.5 Procedure

1. Ensure ductwork and plenum are free from dust and debris which may damage filter elements.

2. Establish air flow. Measure and record resistance across bank, using system instrument or temporary manometers.

3. Connect penetrometer sampling line to upstream sampling port.

4. Check the background dust concentration upstream and downstream of the HEPA filters. The background dust concentration should not interfere with the penetrometer's capability to detect leaks at least two times smaller than the maximum leak allowed by project specifications. If the background dust concentration is too high and/or unstable, reduce it to an acceptable level.

5. Connect DOP generator to injection port, start injection, and adjust generator as necessary.

6. Connect penetrometer to upstream sample point, allow to stabilize. Record upstream reading, and disconnect sample line.

7. Transfer sampling line to downstream sample point, allow photometer to stabilize, and record downstream reading.

8. Repeat steps 10.5.6 and 10.5.7 until readings are within ±5%. Use final readings for calculating leakage.

9. Calculate percent penetration from the equation:

$$P = 100 \frac{C_d}{C_u} \quad (7)$$

where P = percentage penetration;

C_d = downstream concentration, from photometer readings;

C_u = upstream concentration, from photometer reading.

10. If penetration is greater than the specified value, scan the downstream face of the bank as follows:

a. Connect sample line to downstream sample port, adjust penetrometer to zero when set to the most sensitive scale.

b. Disconnect sample line from downstream sample port, attach scanning probe, traverse downstream side of bank with the probe held about 1 to 1½ inches from the section to be checked. It is recommended that the seal between the mounting frame and the housing be scanned first, then the peripheries of the individual filters, and finally the cores of the individual filters. In some cases, shrouding individual filters (or groups of filters) and subjecting only that portion of the bank to the DOP test may facilitate leak isolation in large systems.

c. A leak is indicated by a sustained and reproducible deflection of the meter reading (when the probe is held at the point in question).

d. Mark indicated leaks; after repairs or filter replacement, as necessary, retest system in accordance with steps 1 to 9.

11. If the HEPA filter system contains more than one bank of filters, in series, each bank must be tested individually.

10.6 Report

A written report shall be furnished to all persons specified in the test procedure. The report shall include, as a minimum:

1. Title or identification of test.
2. Job number or Purchase Order.
3. Identification of system, unit, and bank tested.
4. Test apparatus and method of test (gross or shroud).
5. Percent penetration.
6. Test data (including readings and calculations for multiple sampling, if used).
7. Location(s) of excessive leakage, if discovered, and method of repairing or alleviating leaks.
8. Signature(s) of test personnel.
9. Date of test.
10. Distribution of report.

11. MULTIPLE SAMPLING TECHNIQUE

11.1 Purpose

This technique is used for establishing a representative value of DOP penetration for in-place tests of HEPA filter banks when single-point samples representative of the tracer-air concentration cannot be obtained (see Section 9).

11.2 Apparatus

DOP generator and penetrometer as specified in Section 10.

11.3 Prerequisites for Test

1. Scan perimeter of mounting frame(s) noting leaks.

2. Scan filter gaskets noting leaks. After leaks, if any, are repaired, repeat step 1, above.

3. When no further leaks are found proceed to 11.4.

11.4 Procedure

1. Subdivide a sampling plane through the selected sample point and perpendicular to the duct (or housing) into a traverse pattern in accordance with Fig. 9.3 or 9.4 (whichever is applicable) of ACGIH *Industrial Ventilation*.

2. Scan each traverse area for maximum reading. The maximum reading shall be taken as the reading-for-record for that traverse point. Identify each reading-for-record as X_1, X_2 ... X_n. (See Tables 9-1 through 9-3 of ACGIH Industrial Ventilation for selection of traverse points).

3. Take concentration samples at each traverse location and identify them as X_1, X_2, ... X_n. (See Tables 9-1 through 9-3 of ACGIH *Industrial Ventilation* (eleventh edition) for traverse points for round duct).

4. Calculate average concentration in the sample plane from the equation:

$$\bar{X} = \frac{\Sigma_1^n X_i}{n} \qquad (8)$$

where $\bar{X}$ = average concentration, percent; full scale penetrometer range
X_i = individual concentrations, percent; full scale penetrometer range
n = number of readings in traverse.

5. Calculate the standard error of $\bar{X}$ from the equation:

$$S_{\bar{x}} = \left[\frac{\Sigma_1^n (X_i - \bar{X})^2}{n(n-1)}\right]^{1/2} \qquad (9)$$

where $S_{\bar{x}}$ = the standard error of $\bar{X}$, where $\bar{X}$, X_i, and n have the same meaning as in equation (8).

6. Calculate the 95% confidence level of concentration from the equation:

$$P_{95} = \bar{X} \pm t\, S_{\bar{x}}$$

where P_{95} gives the 95% confidence level of $\bar{X}$; $\bar{X}$ and $S_{\bar{x}}$ have the same meaning as in equation (9).

t = a value found from:

n	t
10-15	2.2
16-20	2.1
over 20	2.0

7. Report both average concentration and the 95% confidence level of the concentration.

12. IN-PLACE LEAK TEST, ADSORBER STAGE

12.1 Purpose

This test is used for both acceptance and surveillance leak-testing of the installed adsorber stage. If samples of adsorbent are to be taken for laboratory testing (see Section 13), remove such samples prior to this test, and restore stage to operating condition.

12.2 Summary of Method

A refrigerant tracer gas is injected into the air stream upstream of the adsorber bank, tracer concentrations are determined downstream and upstream of the bank, and penetration (percent leakage) is determined from the ratio of downstream to upstream concentration at time zero.

12.3 Prerequisites for Test

Sections 8 and 9 are prerequisites for this test. The downstream sample point should be located at a point where a single point sample, representative of the downstream concentration, can be taken; this may be a point downstream of the fan or auxiliary blower, or a point downstream of a flow disturbance which will provide adequate mixing of the tracer-air mixture emitting from the adsorber stage. There must be adequate room and safe working conditions for test personnel and equipment. Verify that tracer gas will be injected at a point far enough upstream to disclose any possible system bypasses in accordance with Section 9.

12.4 Apparatus

12.4.1 Tracer Gas. R-11 is preferred; R-112 (or R-112A) is an acceptable alternate.

12.4.2 Tracer Gas Detector. The tracer-gas detector shall have demonstrable capability to distinguish the tracer gas from background.

12.4.3 Tracer Gas Generator. The tracer gas output shall be at least 4 times the Minimum Workable Threshold Sensitivity (MWTS) of the tracer gas detector divided by the maximum acceptable leak rate, expressed as a fraction of total system airflow. The MWTS is the concentration of tracer gas which will produce response on the readout of the tracer gas detector. The generator output shall be held within ±20% of the pre-set value.

12.4.4 System Fan or Auxiliary Blower.

APPENDIX A

SIGNIFICANCE OF IN-PLACE LEAK TESTS

A-1 General

It is one purpose of this standard to verify that there is no significant leakage through the air cleaning system.

A-2 HEPA Filters

Tests of an individual HEPA (high efficiency particulate air) filter are of two types. The test by the factory or quality assurance station is an efficiency determination using a monodisperse challenge aerosol of 0.3 ± 0.03 μm diameter droplets. The minimum specification value for HEPA filter efficiency is 99.97% efficiency (where efficiency equals 100 minus percent penetration). Most filters today run about 99.97% efficiency. In the efficiency test, the total filter is challenged at one time and a single reading of penetration is obtained.

In-place field tests of installed HEPA filters are made with a polydisperse DOP aerosol, and do not show the efficiency of the filters but only reveal the presence of leaks in the system—scanning may be used if necessary to locate the leaks. If the penetration observed in the test is equivalent to the penetration established during factory testing, however, it can be inferred that the particle-removal efficiency of the system is equivalent to that of the individual filters. This is the basis for many persons identifying the in-place test as an efficiency test. The in-place test is not an efficiency test and should not be so considered.

A-3 Adsorber System

Efficiency, in the usual sense, cannot be measured for adsorption systems. Adsorption is time dependent and therefore instantaneous contaminant-removal efficiency is meaningless. True efficiency tests are run on small, representative samples of the adsorbent using a radioactively tagged tracer having similar properties and composition of those of the contaminant of interest (e.g., radioactive elemental iodine or methyl iodide). The tagged challenge gas is mixed with air and flowed through a sample bed of the same thickness as the beds in the system, at the same airflow rate as the airflow through the beds in the system. The amount of challenge gas retained over a specified period of time (usually 2 hours), compared to the quantity in the unfiltered air establishes the efficiency of the adsorbent for that particular contaminant gas (adsorbate). Because of the difficulty of handling radioactive materials, this type of test is generally not made in the field.

Factory tests of full size cells and in-place field tests of installed systems, using a refrigerant-gas, are leak tests only. The tests are designed to determine only the amount of leakage through or around the adsorbent in the cell (factory test) or through or around the installed bank of cells (field tests). Poor-performance adsorbent is not detected by these tests.

Penetration values shown on individual cells by the manufacturer, unlike the penetration values shown on HEPA filters, do not indicate contaminant-removal efficiency, but only leak-tightness. Therefore, the contaminant removal efficiency of an installed adsorber system cannot be inferred from the penetration values shown on the individual cells, as can be done with HEPA filters.

The efficiency of the individual cells and of the installed system can be assumed to have a given value only on the basis of the tests made on representative samples of the adsorbent used in those cells and systems. An installed system can be assumed to have an efficiency equivalent to that of the sample only if:

1. The sample is actually representative of all of the adsorbent in all of the cells in the system.
2. All of the cells are filled properly in accordance with a qualified filling procedure which will ensure a "tight pack".
3. There are no leaks or bypasses in either the individual cells (factory tests) or the installed system (field tests).

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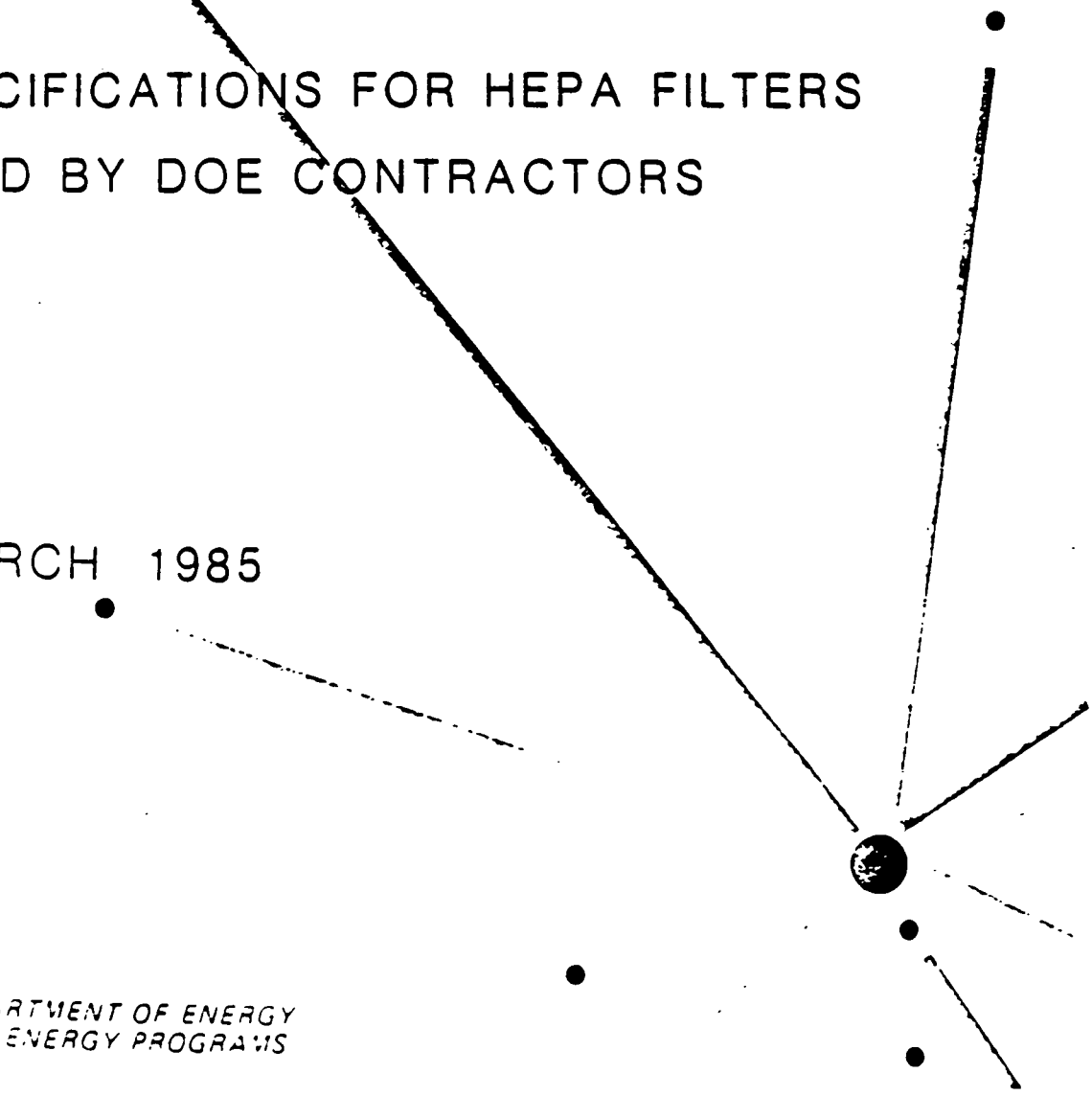
SPECIFICATIONS FOR HEPA FILTERS USED BY DOE CONTRACTORS

MARCH 1985



U.S. DEPARTMENT OF ENERGY
NUCLEAR ENERGY PROGRAMS

FOREWORD

This standard was developed primarily for application in U.S. Department of Energy programs. It is one of a series of program standards developed under a "limited coordination" procedure designed to achieve a technical coordination among individuals of recognized authority from affected DOE programs in a relatively short period of time and, where appropriate, from suppliers, purchasers, users, and technical experts. The procedure utilizes a writing group to prepare the standard and a technical review committee to provide formal review and comment. Participants in the writing and review of this standard are listed below.

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SPECIFICATIONS FOR HEPA FILTERS USED BY DOE CONTRACTORS

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SPECIFICATIONS FOR HEPA FILTERS USED BY DOE CONTRACTORS

1. SCOPE

This standard establishes minimum specification requirements for high efficiency particulate air (HEPA) filters to be used in DOE environmental protection applications. The standard specifies the minimum requirements to be included in contractor specifications.

2. POLICY

HEPA filters to be used for environmental protection in DOE facilities shall be purchased to definitive specifications and not simply to a filter manufacturer's model number. Contractor procurement specifications shall meet the requirements of this standard.

3. APPLICABLE DOCUMENTS

The following documents are a part of this standard to the extent indicated in the text. The issue current at the time of the invitation to bid shall apply.

3.1 Department of Energy (DOE) Documents.

NE F 3-42 Operating Policy of DOE Filter Test Program

NE F 3-43 Quality Assurance Testing of HEPA Filters and Respirator Canisters

NE F 3-44 DOE Filter Test Facility Quality Program Plan

3.2 Department of Defense Military Specifications (MIL).

MIL-F-51068 Filter, Particulate, High-Efficiency, Fire-Resistant

MIL-F-51079 Filter Medium, Fire Resistant, High-Efficiency

3.3 The Aluminum Association | E

Aluminum Standards and Data

3.4 American National Standards Institute (ANSI). | E

ANSI/ASME NQA-1 Quality Assurance Program Requirements for Nuclear Power Plants

ANSI A208.1 Mat-Formed Wood Particleboard

ANSI PS-1 — ANSI Voluntary Product Standard, Construction and Industrial Plywood (A199.1)

ANSI/UL-586 — Test Performance of High Efficiency Particulate Air Filter Units (B 132.1)

3.5 American Society for Testing and Materials (ASTM). E

ASTM A165 — Specification for Electrodeposited Coatings of Cadmium on Steel

ASTM A176 — Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

ASTM A366 — Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality

ASTM A740 — Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric)

ASTM B209 — Specification for Aluminum and Alluminum-Alloy Sheet and Strip

ASTM D1056 — Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D2986 — Evaluation of Air Assay Media by the Monodisperse DOP (Dioctyl Phthalate) Smoke Test

ASTM D3359 — Standard Method Measuring Adhesion by Tape Test

4. TERMS AND DEFINITIONS

4.1 Acceptance Test. Inspection and test of a qualified filter to verify certain characteristics or properties, the results of which determine the acceptance or rejection of that filter.

4.2 Approved Test Aerosol. The test agent currently approved by the DOE is di-octyl phthalate (DOP) also known as DEHP. Test aerosol certification and characteristics are described in Annex E of NE F 3-43.

4.3 High Efficiency Particulate Air (HEPA) Filter. A throwaway, extended-pleated medium, dry type filter with (1) a rigid casing enclosing the full depth of the pleats; (2) a minimum particle removal efficiency of 99.97% when tested with DOE approved aerosol and test method; and (3) a maximum pressure drop (airflow resistance) in accordance with those listed in NE F 3-45 (Paragraph 6.2.3, Table 1).

4.4 Penetration. The amount of leakage through, or bypassing a filter, expressed as a percentage of the upstream concentration of a approved test aerosol, when the filter is encapsulated in a test chamber (chuck) and operated under specified conditions.

4.5 Qualification Test. A test, often destructive, of a prototype or randomly selected production filter to establish its capability to meet certain functional and specification requirements, the results of which are considered to typify subsequent items or lots of items of the same design and manufactured by the same process.

5. GENERAL REQUIREMENTS

All HEPA filters to be used for environmental protection purposes in DOE facilities shall be purchased according to the following general requirements and those of Section 6 below.

5.1 The filters shall be manufactured and delivered under a quality assurance (QA) program which meets the requirements of Section 6 of this standard, and applicable provisions of NE F 3-42, F 3-43, and F 3-44.

5.2 Prior to use in DOE facilities, the filters shall be delivered to one of the DOE Filter Test Facilities (FTF) for acceptance testing in accordance with provisions of DOE standards NE F 3-42, F 3-43, and F 3-44.

5.3 Each filter shall be tested by both the manufacturer and the FTF operator for penetration and airflow resistance at 100% of the manufacturer's rated airflow capacity. Size 3 filters (125 CFM) and above shall also be tested for penetration at 20% manufacturer's rated airflow.

5.4 All unencapsulated filters shall be tested for airflow resistance at manufacturer's rated airflow capacity. (Maximum acceptable resistances for several standard filters appear in Sec. 6.2.3, Table I). Size 4 filters (500 CFM) and above shall have a maximum airflow resistance of 1 in. water gage [1.0 in.wg (250 Pa)]. If the measured airflow resistance at the manufacturer's rated airflow exceeds 1.0 in.wg, the measured airflow at 1.0 in.wg shall be considered to be the rated airflow.

5.5 A HEPA filter which appears on the Military Qualified Products Lists (QPL) associated with MIL-F-51068 and MIL-F-51079 automatically meets all the requirements of Section 6 of this standard, unless tests performed by qualified persons as part of DOE's ongoing quality program provides evidence to the contrary.

5.6 A HEPA filter containing filter medium listed on the QPL associated with MIL-F-51079 meets the filter medium requirements only, subject to provisions of 5.5 above. Other components of the filter

subject to provisions of 5.5 above. Other components of the filter must be qualified as required by Section 6 of this standard.

5.7 HEPA filters carrying the UL label will be accepted as evidence of compliance with the heated air or spot flame test requirements described in Sec. 7.3.2. All other tests specified in Section 6 of this standard must be peformed.

5.8 HEPA filters which do not appear on the above mentioned QPL or UL lists shall be tested for all the requirements of Sec. 6 of this standard. These quality tests shall be performed under acceptably controlled conditions, either by the filter manufacturer or a qualified agent. For filter media, documented tests performed by the medium manufacturer or a testing lab, can be used to demonstrate compliance with filter medium requirements. Records shall be prepared and maintained which show evidence that the filter medium tests are performed in an acceptably controlled manner.

5.9 The filter purchaser shall ensure that special requirements either (1) do not result in a deviation or modification of Section 6 requirements; or (2) if deviations do occur, said deviations do not compromise the ability of the filter to meet operating requirements. Deviations from DOE specifications shall be subject to review by DOE HEPA filter purchasers.

6. DOE OR DOE CONTRACTOR HEPA FILTER PROCUREMENT

6.1 General. HEPA filters to be used at DOE owned facilities shall be purchased under specifications which address, as a minimum, those specifications in MIL-F-51068 and MIL-F-51079. The specifications shall be submitted to the local DOE office for review and comment; a copy of the specifications shall be retained by DOE, and any DOE comments on the specifications shall be resolved before the specification is used for procurement.

6.2 Performance Requirements. Performance requirements (penetration; airflow resistance and airflow capacity) are set out below.

6.2.1 Penetration. Permissible penetration at test airflows shall be no greater than 0.03% (NE F 3-43, par. 3.10). If efficiency is specified, it shall be not less than 99.97%.

6.2.2 Resistance. In no case shall a resistance of greater than 1.0 in.wg across the filter pack be specified or permitted for new open face HEPA filters, Size 4 (500 CFM) and above, regardless of filter pack construction.

6.2.3 Airflow Capacity. Airflow capacity is established by the filter manufacturer and is a function of pack configuration, specific resistance of the filter medium, and the net area of medium

in the pack. Claimed airflow capacities are not always consistent with the specified maximum resistance of 1.0 in.wg when the filter is operated at that capacity; this is particularly true for some of the "high capacity" filters. It has also been found that some of the smaller HEPA filters, rated at 25, 50, and 125 cfm cannot achieve these capacities at a maximum resistance of 1.0 in.wg. Refer to Table I for nominal airflow capacity and maximum authorized resistance for standard sized HEPA filters.

Table I. Dimensions, Nominal Airflow Ratings, and Maximum Resistance for Type B HEPA Filter [a]

Size	Dimension		Nominal Airflow Rating		Maximum Resistance	
	Inches	(millimeters)	cfm	(m^3/hr.)	in.wg	(Pa)
1	8x8x3-1/16	(200x200x80)	25	(42)	1.3	(325)
2	8x8x5-7/8	(200x200x150)	50	(85)	1.3	(325)
3	12x12x5-7/8	(305x305x150)	125	(212)	1.3	(325)
4	24x24x5-7/8	(610x610x150)	500	(850)	1.0	(250)
5	24x24x11-1/2	(610x610x290)	1000	(1700)	1.0	(250)
6[b]	24x24x11-1/2	(610x610x290)	1250	(2125)	1.0	(250)
7[c]	24x24x11-1/2	(610x610x290)	1500	(2550)	1.0	(250)
8[d]	24x24x11-1/2	(610x610x290)	2000	(3400)	1.0	(250)

[a]Unencapsulated.

[b]Constructed with corrugated separators identical to size 5.

[c]Constructed without separators.

[d]Mini-pleat design.

6.3 Materials Requirements.

6.3.1 Filter Medium. MIL-F-51079 is the basic standard for HEPA filter media and must be specified in the purchaser's specification. As a minimum, the purchaser's specification (if MIL-F-51079 is not specified) must include all materials and test requirements of MIL-F-51079 which can rationally apply to the grade of material under consideration. Certain acid-resistant filter media now becoming available employ carbonaceous fibers (e.g., duPont Nomex or Kevlar®) in addition to glass fibers; the percent-by-weight of these fibers (usually 5%) must be added to the permissible organic content (7%) of MIL-F-51079 when specifying these media.

6.3.2 Case Material. Following are specifications for various materials which have been used successfully for filter cases.

a. Carbon steel (cold-rolled steel sheet), 14 gage (2 mm) minimum thickness conforming to ASTM A366. Prior to frame construction, the formed metal sections shall be cadmium plated in accordance with ASTM A165, Type OS, minimum.

b. Stainless steel, ASTM A176, Type 409, 14 gage minimum.

Note: This is a "muffler grade" ferritic stainless steel.

c. Plywood, ANSI PS-1 (A199.1) Structural I or II, Exterior, Grade A-A, A-B, or A-C, 3/4 in. (19 mm) thick, minimum, fire retardant treated.

d. Wood particleboard, ANSI A208.1, exterior grade phenolic-resin-bonded, density 45 lb/ft^3 (722 Kg/m^3) minimum, filled both faces, 3/4 in. (19 mm) thick, minimum, fire-retardant treated before mat forming, with flame spread classification of 25 or less.

6.3.3 Separator Material. Solution hardening aluminum alloys with high tempers have proven to be successful separator materials. Asbestos papers are no longer approved. The requirements for aluminum separators shall include the following information:

a. Aluminum separators: ASTM B209, Alloy 1145-H19, Alloy 3003-H-19, or Alloy 5052-H39, 0.0015 in. (38 m) thick, minimum.

Note: ASTM B 209 generally applies to sheet and plate, however, aluminum classified as "foil" can be procured to this specification. Alloy 1145, heat treatment designation H-19 (Alloy 1145 and 3003) and H-39 (Alloy 5052) are valid designations. The Aluminum Association, "Aluminum Standards and Data," includes the information on the "foil" classifications. E

6. Acid-resistant separators: teflon, epoxy resin, thermoset vinyl, or other acid resistant treatment on aluminum separators. The coating shall be colored (to permit defects in the coating to be discerned); shall be tightly adherent and not crack or delaminate when the material is corrugated; and shall be at least 0.0001 to 0.0002 in. (2.5 to 5 m) thick (dry film). After corrugation and subsequent flattening, the coating shall exhibit an adhesive peel resistance of 3A or greater when tested in accordance with Method A of ASTM D3359.

6.3.4 Adhesives. Adhesives used to seal the filter pack into the case and to glue gaskets to the case shall be either nonflammable or self-extinguishing. When the dried film is exposed to an open flame, it shall either not burn or not continue to support combustion when the source of ignition is removed.

6.3.5 Gaskets and Seals. Two methods are currently employed for sealing the filter to its mounting frame, flat gaskets and "fluid"

seal. The two methods are not interchangeable on the same mounting frame, and the "fluid" seal requires a specially designed mounting frame that is not compatible with flat-gasket-sealed filters.

a. Gasket. Gaskets shall be oil and ozone-resistant synthetic rubber, closed cell sponge, Grade SCE-43 ~~or Grade SE-43 (high temperature)~~ in accordance with ASTM D 1056; and shall be 1/4 in. (6 mm). thick by 3/4 in. (19 mm) wide with split or cut surfaces (i.e., no mold skin).

b. Fluid Seal. The sealant shall be a non-flammable or self-extinguishing non-Newtonian fluid.

6.3.6 Face Guards. Face guards on open-face filters are recommended to protect the filter pack from inadvertent damage during handling. Face guards should be made of corrosion resistant material and have an opening size large enough so as to not affect pressure drop, but small enough to keep out the fingers of workmen. Expanded, flattened, and smoothed 1/2 x 1 in. (12.7mm x 25.4mm), 24 gage expanded aluminum or 4-mesh (4-openings to the inch) galvanized hardware cloth meeting the requirements of ASTM A740 is recommended.

6.4 Filter Construction.

6.4.1 Configuration. HEPA filters are available in four basic configurations: square open face (the most commonly used); rectangular enclosed (case extended with end closure and nipple on one or both faces); cylindrical open face, with or without flanges; and cylindrical enclosed (case extended with end closure and either flanged or plain nipple on one or both ends). Rectangular open-face filters are generally furnished with a 3/4 in. (19 mm) wide gasket sealing surface on each face; some special designs may require no flange or flange on one face only.

Filters may be designed for gasket seal (most commonly used) or fluid seal between the filter and its mounting frame (see 7.3.5). The fluid seal is a proprietary design but, when specified, shall require that the dimensions of the sealant channel and matching sealing blade ensure proper fit upon installation.

Appendix X1 discusses filter pack descriptions.

Note: Fluid seal filters are not interchangeable with the more standard flat gasket seal design and therefore could present logistical problems on resupply. This should be considered by the designer when specifying this design.

6.4.2 Dimensions. The configuration and dimensions of open face rectangular HEPA filters have been standardized (Table I). All other configurations are "specials" and dimensions and tolerances must be specified in the specification or procurement documents. It is

be specified in the specification or procurement documents. It is recommended that tolerances of "special" HEPA filters be based on the tolerances specified in Table II, par. 6.4.4.

6.4.3 Filter Pack Construction. The filter pack of a pleat-and-separator or separatorless filter and each individual panel (a mini-pack) of a mini-pleat filter shall be made from a continuous sheet of filter medium and shall be pleated evenly to form a pack or panel of equal depth throughout. The filter pack shall be tight. A single splice or patch is permitted in the core of a Size 4 or 5 pleat-and-separator filter; no splices are permitted in other sizes or configurations of filter. The splice shall have an overlap of at least 1-1/2 in. (38 mm) wide and shall extend the full width of the sheet. Repair of pin holes and other defects with adhesive or patch is not permitted.

a. Pleat and Separator Filters. Separators shall extend at least 1/8 in. (3 mm) beyond the pleats of medium, and the plane formed by the edges of the separators shall be at least 1/4 in. (6 mm) in from the plane of the filter frame (less gasket). The pleats shall be straight, and shall not deviate more than 1/2 in. (13 mm) from a line drawn from one end of the pleat to the other and perpendicular to the case.

b. Mini-pleat filters. Filter medium panels shall be sealed into a reservoir which is at least 1/8 in. (3 mm) deep. The panels shall not vary more than 1/2 in. (13 mm) from a line drawn from the top to the bottom of the panel and perpendicular to the case. Filter medium support (ribbons, strings, etc.) shall not vary more than 1/2 in. (13 mm) from a straight line drawn from top to bottom of the line formed by the supports, and perpendicular to the case. The panels on the left and right sides of the filter shall be sealed to the case with adhesive No splicing of the filter medium within any single panel is permitted.

c. Separatorless Filters. The filter element shall be firm to the touch and, when the flat of the hand is applied with pressure to the face of the pack, shall not evidence lateral or horizontal movement (greater than 1/16 in.). Dividers shall be provided as appropriate, for additional support. The vertical plane formed by the ends of the convolutions shall not deviate more than 3/4 in. from the top to bottom of the pleat, and shall be recessed at least 1/16 in. from the plane formed by the four sides of the filter frame. Where convolutions do not have crest-to-crest contact, spacing shall not be less than 1/16 in. Abrupt kinks or deviations in the folds of the medium are not permitted. The trimmed edges of the filter element shall be firmly potted (fixed) into the sealant. The two flap edges have sufficient sealant to secure them to the frame sides.

6.4.4 Filter Case. The case shall be fabricated from one of the materials listed in 6.3.2. The completed case, less gaskets, shall conform to the dimensions listed in Table I, unless alternative dimensions are specified in procurement documents. Table II presents the acceptable tolerances.

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Table II. Tolerances for Filter Cases

a.	Face Dimensions;	
	i. less than 18 in.	+0, - 1/16 in. (1.6 mm)
	ii. greater than 18 in.	+0, - 1/8 in. (3 mm)
b.	Depth	1/16 in. (1.6 mm), -0
c.	Width of gasket surface	3/4 in. (19 mm) ±1/16 in. (1.6 mm)
d.	Squareness (face diagonals shall be equal within the following total tolerances)	
	i. less than 18 in.	1/16 in. (1.6 mm)
	ii. greater than 18 in.	1/8 in. (3 mm)
e.	Gasket seating surfaces - Square (with sides of frame within ±3°) and flat and parallel (within 1/16 in. [1.6 mm]) total allowance when measured with one face of the filter resting on a certified flat surface.	

6.4.4.1 Wooden Cases. Case panels shall be joined with rabbeted joints, assembled by gluing with an adhesive meeting the requirements of 6.3.4 and double nailing or double screwing with coated box nails or corrosion resistant plated screw-nails or flat-head wood screws. The points of fasteners shall not penetrate the inside or outside surfaces of the case. Edges and inner surfaces of the case shall be thoroughly coated with sealant to minimize permeability. There shall be no splinters or rough edges that might penetrate or cut workers' gloves, or injure the fingers of personnel handling the filters.

6.4.4.2 Metal Cases. The case shall have a double-turned, 3/4 in. (19 mm) wide flange on each face or a fluid-seal socket or sleeve, as specified in the procurement documents. Panels shall be assembled into the frame by riveting or bolting the corners; or by potting a subassembly consisting of the filter pack and side panels into the top and bottom panels, using an adhesive meeting the requirements of 6.3.4. For mechanically joined panels, the space between abutting panels shall be sealed with an adhesive meeting the requirements of 6.3.4. For carbon steel frames cadmium plating shall be applied after all shearing, forming, and welding operations have been completed.

6.4.5 Gaskets. Gaskets, when specified, shall be glued firmly and continuously to the case on one or both faces, as specified

(gasket on one face only is recommended); loose, peeling, or distorted gaskets shall be cause for rejection. The gasket shall not extend more than 1/16 in. (1.6 mm) over either side of the seating surface at any point. Gaskets may be one-piece, or made up of strips, joined at the corners by keyhole, keystone, or other interlocking type joints; edges of the joint area shall be thoroughly coated with adhesive (sealant meeting requirement of 6.3.4) before assembly.

6.4.6 Faceguards. Faceguards meeting the requirements of 6.3.6 are recommended on open-face filters. The faceguard edges shall be firmly imbedded in adhesive meeting the requirements of 6.3.4, and shall be installed so that projecting wires or edges do not form a puncture hazard to personnel handling the filter, and do not project onto or beyond the gasket mounting surface. Wire edges formed when slitting or shearing expanded-metal faceguards shall be smoothed on both surfaces of the material before installation.

7. QUALITY ASSURANCE

7.1 Quality Assurance Program, Procedures, and Documentation. Filters shall be manufactured and shipped under a quality assurance program directly derived from the requirements of ANSI/ASME NQA-1. Materials procurement, storage, cutting, and utilization procedures, and filter fabrication and assembly procedures shall be designed to permit positive identification of the grades of materials used, and to permit positive identification of the roll (or production run, for separatorless filters) of filter medium used in the completed filter. All test and inspections shall be conducted in accordance with documented procedures, and the results shall be documented and identified to the lot of completed filters. The results of penetration and resistance tests specified in 7.3 shall be documented and identified, by serial number, with the individual filter unit. Nonconformances with the above items and documentation of problems and their resolution, shall be addressed in the QA Plan.

7.2 Qualification. (See also general requirements of Sec. 5). Filter manufacturers shall be required to show evidence that Type B (nuclear) filters meet, or can be reasonably expected to meet the test requirements of 7.3.1-7.3.4. Tests can be conducted at the manufacturer's facility, Edgewood Arsenal, at the DOE Rocky Flats Plant, or other facilities judged acceptable by DOE. Manufacturers may choose to list filters in QPL F-51068, by arranging for tests at either Edgewood or at Rocky Flats. The manufacturer may choose to present written arguments to show filters should be considered for QPL listing based on testing of similar filters. For DOE filters, QPL listing is desirable, but not mandatory.

DOE intends to periodically select stocked filters from DOE facilities on a random basis, and perform the tests defined in 7.3.1-7.3.4. When failures are noted, the manufacturer and the DOE test facilities and field offices will be notified that the failed filter model is not acceptable for use at DOE facilities until the manufacturer can get the filters requalified (7.3.4).

7.3 Qualification Testing. Qualification tests shall be conducted in accordance with and meet the requirements of the applicable paragraphs of MIL-F-51068, or equivalent procedures that have been approved by the DOE. Listing of a manufacturer's model of filter in MIL-F-51068 shall be satisfactory evidence of having met the qualification requirements of this standard. Filters for qualification shall be either prototypes of the proposed design or production filters of the specific design randomly selected from the manufacturer's stock. The number of filter units required for qualification testing shall be as specified in MIL-F-51068. Modification of these requirements shall be only as specified below.

7.3.1 Overpressure Resistance. The new, unused filters, when preconditioned according to MIL-F-51068, 3.4.4.2a Table II, shall withstand a pressure differential of 10 ±0.2 in.wg (2500 ±50 Pa) for 60 minutes without visible evidence of damage; within 15 minutes, while still wet, the filter shall meet the penetration requirement of 7.4 at 20% of rated airflow (size 5 filter).

7.3.2 Resistance to Fire and Heated Air. The new, unused filter shall withstand exposure to air heated to 700°F ±50°F (370° ±28°C) for 5 minutes. After exposure, the penetration, when tested at rated airflow capacity in accordance with 6.2.3, shall not exceed 3.0%. When subjected to open flame at any point of the filter except the gasket, there shall be no evidence of sustained burning. Labeling or certification (by Underwriters Laboratories) in accordance with ANSI/-UL-586 shall be evidence of satisfactory compliance with this requirement.

7.3.3 Resistance to Rough Handling. The filter shall withstand shaking for 15 minutes at 3/4-in. (19 mm) amplitude and 200 cycles per minute (3.33 Hz) without evidence of filter damage. After the test, the filter shall meet the penetration requirement of 7.4 at 100% (all filters) and 20% (size 3 and larger filters) of rated airflow capacity.

7.3.4 Recertification and Qualification. The DOE may make or have made, qualification tests, or verifications of materials, on any filters furnished to them. Failure of filters submitted for qualification testing to meet any requirement shall be cause for withdrawal of qualification and removal of the design from applicable QPL until the problem is resolved.

7.4 Production Testing and Marking. Each filter unit shall be tested for penetration by a DOE-approved aerosol by the method outlined in ASTM D2986 and NE F 3-43 at the following air flows.

Size 1 and 2 (up to 125 cfm) filter units: 100% of rated airflow.

Size 3 (125 cfm) and larger filter units: 100% and 20% of rated airflow.

Penetration shall not exceed 0.03% at any airflow unless specified as a special more restrictive case in procurement documents and agreed to by the manufacturers. Size 4 and larger units shall exhibit maximum resistance at 100% of the manufacturer's rated airflow capacity of 1.0 in.wg (250 Pa), or the rated airflow capacity shall be reduced to achieve 1 in.wg. The penetration at each specified airflow and the resistance at rated airflow capacity shall be marked clearly and indelibly on the case of the filter unit tested. Arrows showing the direction of airflow during the test shall be shown adjacent to the data marking. The filters shall be marked to show proper orientation (pleats vertical) when installed.

7.5 Acceptance Inspection and Testing. Acceptance shall be confirmed at a DOE FTF, contingent on satisfactory completion of inspections and tests specified in NE F 3-43. Filters will be inspected for physical damage to the packaging and filter, and for compliance with specification requirements which can be checked visually. Each filter shall be tested and the test results displayed on the filter case. At the discretion of the FTF, the customer may be advised to request the manufacturer to supply evidence of compliance with qualification and materials requirements of the specification. Failure to meet inspection, test, or verification requirements shall be cause for rejection. After the testing and inspection is completed, each filter will bear a FTF test label indicating acceptance or rejection.

7.6 Rejection. Rejected filters shall be disposed of according to the provisions of Section 8.4.

8. PACKAGING AND SHIPPING

8.1 Packing and Packaging.

8.1.1 Packing. Filters shall be packed in durable corrugated paperboard or wood cartons which meet shipping regulations.

8.1.2 Preparation for Delivery. It is recommended that the contractor's shipping instructions specify that cartons be crated or palletized to minimize unit handling, particularly at public carrier interchange points. For large shipments, it is recommended that the entire shipment be shipped in a sealed, dedicated trailer or rail car. At all times the filters must be handled with care and orientated properly (pleats vertical) (NE F 3-43, Annex C).

8.2 Shipping. Filters shall be shipped to one of the addresses below, as agreed to by the contractor and manufacturer, for acceptance inspection and tests (7.5).

1. Martin Marietta Energy Systems, Inc.
   K-25 Plant, Bldg. K-1024
   Oak Ridge, Tennessee 37831
   Attention: Filter Test Facility

2. Rockwell International
   Energy Systems Group
   Rocky Flats Plant
   Highway 92
   Golden, Colorado 80401
   Attention: Filter Test Facility, Bldg. 442

3. Hanford Environmental Health Foundation
   Hanford Filter Test Facility
   c/o 1100 Area
   Richland, Washington 99352

8.3 Reshipment. Following satisfactory completion of inspection and tests specified in 7.5, the FTF will repack the filters as agreed to by the customer and manufacturer and forward them to the address specified by the customer.

8.4 Rejected Filters. Rejected filters will be disposed of by the FTF's in accordance with written instructions on file from the manufacturer, or in accordance with written instructions from the purchaser.

APPENDIX X1 - NONMANDATORY

FILTER PACK DESCRIPTIONS

X1.1 Scope. Appendix A provides descriptive information on filter pack construction and configuration.

X2.1 Filter Pack. A number of configurations, in addition to the conventional pleat-and-separator construction, have become available, including separatorless and mini-pleat configurations. Other factors being equal (i.e., resistance to overpressure, radiation, fire and hot air, chemicals, moisture, etc.), the various designs are interchangeable and stipulation of particular construction in the contractor's specifications or procurement documents is a matter of choice, provided that filter meets these specifications and performance requirements. However, the requirement of objective evidence to demonstrate the ability of the filter to meet these qualification requirements is essential. The following descriptions are furnished for information only and should not be included in the contractor's specification.

The pack of the pleat-and-separator filter is made by pleating a continuous web of filter medium and placing a corrugated separator between each pleat. The separators support the fragile filter medium and provide air passages. The pack of the currently available separatorless filter is formed from a continuous web of filter medium which is corrugated (parallel to the long dimension of the web) and pleated (perpendicular to the web) while still wet, as it comes off the paper-making machine. The corrugations, when pleated back on themselves, provide self-support to the filter pack, and provide air passages between pleats. The corrugations are formed so that no nesting of adjacent pleats occurs.

The mini-pleat filter pack is built up of a number of approximately 3/4 in. wide flat panels of shallow-pleated (approximately 3/4 in.) filter medium, in which ribbons of fabric or filter medium separate and support the individual pleats. The panels are arranged in the filter pack in zig-zag fashion, and the ends of the panels are sealed into adhesive-filled reservoirs or end caps which extend the height of the filter pack. Each panel is made from a continuous web of filter medium.

A phenomenon characteristic of separatorless filters is that they sometimes "nest" at one or more places; e.g., contiguous layers of the corrugated material do not always have crest-to-crest contact at the peaks of the corrugations. Instead, the peaks on one fold become misaligned and fit into the troughs of the adjacent fold. If this occurs frequently throughout the pack with complete closure the consequence will be high initial resistance and the filter will be disqualified when tested. Nesting is not esthetically pleasing, but unless it occurs frequently, does not substantially effect performance or filter life.