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PROCEDURE

FOR

IN PLACE TESTING OF HEPA FILTERS

AND IODINE ADSORBERS

NCS-375

MARCH 11, 1975

NUCLEAR CONTAINMENT SYSTEMS, INC. COLUMBUS, OHIO 43219	
REVIEWED BY Fred D. Leslie	IN-PLACE TESTING
APPROVED BY Fred D. Leslie	EFFECTIVE DATE 3/21/75 REVISION NO.1 8/22/75

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SCOPE

1.0 This procedure covers the in-placing testing of the High Efficiency Particulate Air (HEPA) filters and Iodine Adsorber filters.

STANDARD

2.0 This procedure complies with ORNL-NSIC-65, "Design, Construction, and Testing of High-Efficiency Air Filtration Systems for Nuclear Applications" and ANSI N510, "Testing of Nuclear Air Cleaning Systems", and in accord with ANSI 101/1 and Regulatory Guide 1.52.

VISUAL INSPECTION

3.1 A visual inspection of the components or subsystems to be tested, their holding devices, gaskets, housing, and all components shall be made before any leak test.

3.2 Complete a visual report, NCS Form No. 1 attached to this NCS-375 procedure, page 6.

EQUIPMENT & SYSTEM TESTS

4.1 Testing of HEPA Filter Banks.

Perform the following steps on the high efficiency filter systems listed below and attach a completed test report for each filter system to this procedure.

4.1.1 Establish air flow through the filter being tested. Measure and record the resistance across the filter bank.

4.1.2 Connect the penetrometer sampling line to upstream sampling port and calibrate it against its built-in standard in accordance with the manufacturer's instruction.

4.1.3 For an acceptance test of a new system, check the background dust concentration upstream and downstream of the filters; the background dust concentration shall be less than 25% of the expected aerosol concentration during the test.

4.1.4 Connect the DOP generator to the injection port. Start the injection and adjust the generator as necessary.

4.1.5 Connect the penetrometer to the upstream sample point, allow it to stabilize, and adjust it to read 50% or higher on the lowest sensitivity scale, readjusting the DOP generator as necessary. Record the upstream reading. It may prove in larger systems a lower or different scale reading is necessary to establish an upstream reading.

4.1.6 Connect the sampling line to the downstream sample point, allow the photometer to stabilize, and record the downstream reading.

4.1.7 Repeat steps 5 and 6 and record the new readings if different. If significant differences occur, recheck until the readings remain constant within about +5%. Use the final constant readings for calculating the leakage.

4.1.8 Calculate the leakage from the equation:

% Leakage where $L = 100 \frac{C_d}{C_u}$

with L = percent leakage

C_d = downstream concentration; from photometer reading

C_u = upstream concentration; from photometer reading

4.1.9 If the leakage is greater than the specified value of Section 5.0, scan the downstream face of the bank as follows:

a. Connect a sample line to downstream sample port and adjust the penetrometer to zero when set to the most sensitive scale.

b. Disconnect the sample line from the downstream sample port and attach a scanning probe. Traverse the downstream side of bank at a rate of about 10ft/min. with the probe held about 1 to 1 1/2

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.

c. A leak is indicated by a sustained and reporducible deflection of the meter needle when the probe is held at the point in question on one scale division or more.

d. Mark the indicated leaks. After necessary repairs or filter replacement, retest the system in accordance with Steps 1 thru 8.

4.1.10 If the HEPA filter system contains more that one bank of filters, each bank must be tested individually. Complete a separate test report for each bank.

4.1.11 Close system after testing.

a. Disconnect all sample lines.

b. Seal all injection and sample ports.

c. Notify designated plant personnel that test is completed and system may be put in normal operation.

4.1.12 Complete a test report, for each HEPA bank on NCS Form No. 2, attached to this procedure page 7.

4.2 Testing of Iodine Adsorber Banks

Perform the following steps on each iodine adsorber bank listed below and attach a completed test report for each bank to this procedure.

4.2.1 Each iodine adsorber shall be inspected individually for any visible damage prior to testing.

4.2.2 Establish air flow through the bank.

4.2.3 Connect the sample lines to upstream and downstream sample points, establish detector operating conditions used in their calibration, establish upstream dilution-air ratio to produce an upstream concentration at the tracer gas detector which is within the linear response range.

4.2.4 Take upstream background samples and downstream background samples (5 minimum for noncontinuous detectors). If these show no background contaminants that might interfere with the test results, continue with the test. If downstream interference is too great to obtain a base line, purge the bank at rated system air flow for 8 to 12 hours, or change tracer gas.

4.2.5 Estimate the tracer gas transit time from the generator on through the injection port and system to the detector. Start the injection and after the estimated transit time, monitor the upstream concentration. The time when the initial tracer gas is detected is designated as time zero tracer gas R-11.

4.2.6 Calculate the leakage for each time interval from the equation:

% Leakage with L = % leakage

Where $L = 100 \frac{C_d}{C_u}$

C_d = Downstream concentration

C_u = Upstream concentration

Plot penetration vs. time and extrapolate curve to time zero.

4.2.7 If the leakage obtained from step 6 is greater than the value specified in section 5.0 of this procedure, locate and repair any leaks, then retest.

4.2.8 Close system after testing.

a. Disconnect all sample lines.

b. Seal all injection and sample ports.

c. Notify designated plant personnel that test is completed and system may be put in normal operation.

4.2.9 Complete a test report for each adsorber bank, on NCS Form No. 3, attached to this procedure, page 8.

ACCEPTANCE CRITERIA

5.1 Each HEPA filter bank, except for those specified in step 5.3, shall have a mixiumum leakage of 0.05% (efficiency of 99.95%) or as specified by the Contractor, based on the actual number of particules that penetrate the filter when using the polydisperse aerosol, generated from a liquid DOP having a particle diameter of 0.75 $\pm$ 0.50 micron.

5.2 Each iodine adsorber bank shall have an in-place maximum leakage of 1.0% (efficiency of 99.0%), or as specified by the Contractor, based on the differential zero time concentration of the upstream and downstream samples. It is understood that the test shows only mechanical leak and does not represent actual elemental iodine of methyl iodide removal efficiency.

5.3 The Sample Rack filters and Fume Hood filters shall have a maximum leakage of 5% (efficiency of 95%) as specified by the DOP test in Step 4.1.

NCS FORM NO. 1
Rev. 0

VISUAL INSPECTION OF FILTER SYSTEM

CUSTOMER _____ Purchase Order No. _____

_____

_____

LOCATION _____

SYSTEM _____

NUMBER OF FILTERS _____

FLOW _____

FILTER TYPE _____

DATE OF INSPECTION _____

INSPECTED BY _____

NUCLEAR CONTAINMENT SYSTEMS, INCORPORATED

DATE _____

CHECK LIST FOR VISUAL INSPECTION

Mounting Frames

/ / a. Continuous seal weld between members of frame and between frame and housing.

/ / b. Structural rigidity.

/ / c. Squareness of members, flatness and condition of component seating surfaces.

/ / d. Damage to frames.

Filter Clamping Devices or Bolts

/ / a. Proper adjustment (50 to 80% gasket compression all around) (tighten if less).

/ / b. Sufficient number of adequate size to produce 50 to 80% gasket compression.

/ / c. Individual clamping of filter (adsorber) cells.

/ / d. Proper condition of clamping devices (eg., all nuts in place and tightened).

/ / e. Adequate clearances between filter (adsorber) elements to tighten clamping devices on all sides.

/ / f. Full penetration and freedom from cracks in welds of clamping devices.

HEPA Filters

/ / a. Damage to filter media (tears, cracks etc. - some damage to separators is permissible), case, case corners, on both faces of filters.

/ / b. Damage to or improper seating of gaskets.

/ / c. Burns of media or case from cutting or welding on both faces of filters.

/ / d. Excessive dirt loading (check gage showing pressure drop across filters).

Prefilters

/ / a. Damage to media, case, or gaskets.

/ / b. Excessive dirt loading.

Adsorbers

/ / a. Damage to cells, including burns from welding or cutting operations in housing.

/ / b. Individual clamping.

/ / c. Condition of clamping devices.

/ / d. Condition of gaskets.

Lighting

/ / a. Adequate for visual inspection of housing and components.

/ / b. All lights lit (replace if out).

/ / c. Penetration of mounting frame by power or control conduits.

/ / d. Vapor-tight globe, guard to protect globe from physical damage.

Housing

/ / a. Adequate space for personnel and equipment for maintenance, testing.

/ / b. Reasonable access to housing.

/ / c. Space adjacent to housing amenable to isolation as a contamination zone, adequate space for temporary storage of clean and contaminated filters during filter change.

/ / d. Doors of rigid construction with adequate seal between door and casing; doors opening outward on negative-pressure housings.

/ / e. Adequate latches on doors, with provision for opening from inside and outside of housing and provision for locking. Adequate sills.

/ / f. Adequate structural rigidity to resist undue flexure - reinforcing members on outside, preferably.

/ / g. Access to upper tiers with permanent service platform at approximately the 6-foot level - adequate, permanently installed ladders.

/ / h. Adequate clearances between banks of components, with door on each side of each bank.

/ / i. No back-to-back banks of components.

/ / j. Proper location of tracer injection and sample ports.

/ / k. Adequate guards on fans located inside of housing.

/ / l. Housekeeping in and around housing.

/ / m. Condition of flexible connection between housing and fan external to housing.

/ / n. Fan-shaft seal.

/ / o. Adequate dampers to prevent intake of air from adjacent housing or plenum during test, and to prevent bypassing of system.

/ / p. Freedom from corridors, plenums, conduits, electrical, connections, plumbing, drains or other conditions that could result in bypassing of the system, many of which are not immediately apparent.

Dampers

/ / a. Damage to or distortion of frame or blades.

/ / b. Bent pivot pins, operator.

/ / c. Missing seats or blade edging.

/ / d. Condition of resilient seats or edging.

Drains

/ / a. Each section has a drain.

/ / b. Shut-off valves for each drain.

/ / c. No two sections with common pipe connection.

/ / d. All drains closed during in-place testing of filter banks.

REMARKS _____

NCS FORM NO. 2
Rev. 1

PARTICULATE FILTER IN-PLACE LEAK TEST REPORT

CUSTOMER _____ Purchase Order No _____

_____

_____

LOCATION _____

SYSTEM _____

NUMBER OF FILTERS _____

FLOW _____

ΔP HEPA FILTERS _____

FILTER TYPE _____

DATE OF TEST _____

TEST RESULT _____ % LEAKAGE _____ % EFFICIENCY (DOP AEROSOL)

REMARKS _____

_____

_____

_____

_____

_____

_____

_____

_____

TEST PERFORMED BY _____

NUCLEAR CONTAINMENT SYSTEMS, INCORPORATED

DATE _____

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NCS FORM NO. 3
REV. 1

IN-PLACE
CHARCOAL ADSORBER FILTER LEAK TEST REPORT

CUSTOMER _____ Purchase Order No _____

_____

_____

LOCATION _____

SYSTEM _____

NUMBER OF FILTERS _____

FLOW _____

ΔP CHARCOAL ADSORBERS _____

FILTER TYPE _____

DATE OF TEST _____

TEST RESULT _____ % LEAKAGE _____ % EFFICIENCY

REMARKS _____

_____

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TEST PERFORMED BY _____

NUCLEAR CONTAINMENT SYSTEMS, INCORPORATED

DATE _____

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