Revised Approach FI, Metal HEPA Filters

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ASME FI Standard 7-06
Overview

- HEPA standards from the 1950’s
- Metal filters cannot meet low pressure drop
  - AG-1, Section FC
- Draft FI may have been dated at conception
- Metal filtration materials have vastly improved
  - 99.999% efficiency with robust design
- Advantages and needs for metal filter
- A need exists for Metal Filter Standards
- Path forward for FI
FC Section Impacts on Draft FI

- **HEPA standards are from 1950’s**
  - Pressure drop 1” w.c. @ 1000 cfm air flow, new filter
  - 99.97% efficiency when challenged with 0.3 μm DOP

- **Existing draft FI may have been dated at conception**
  - Written around direct HEPA replacement mentality
  - dP 1” w.c. @ 1000 cfm air flow
FC Section Impacts on Draft FI - continued

- Metal filters would replace existing 2’x’2x1’ HEPA’s
  - Use existing conventional HEPA filter housing
  - No system design modification required
  - No changes in system requirements (dP, flowrates, etc.)

- Industry unable to provide a metal filter
  - 1” w.c. dP per AG-1, FC
  - Direct replacement “foot print”
  - Cost effectiveness vs. risk reduction (1000 cfm or larger)
  - Filter media surface area

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Concept to Replace a Conventional HEPA

Original concept of metal filters replacing a conventional HEPA

Many small metal filters were used in a 2’x2x1’ configuration to obtain a large surface area.

64 filters ~150 ft$^2$ surface area

50 ft$^2$ less than a glass fiber filters
2’ x 2’x1’ Metal HEPA Filter Assembly

- Concept never implemented in facility process
- Tested at ORNL in 1990’s
Changes in Filtration Media Technology

- Metal filtration materials have vastly improved
  - Greater than 99.97% efficiency (can be >99.999999999)
  - Robust design
  - High differential pressure and pressure surges
  - Not damaged by water
  - High temperature resistant
- Metal filters are being used in small processes within nuclear facilities
- Metal filter cannot meet the low pressure drop requirement
- Existing standards (FC) will need to differ for metal filters (FI)
  - Higher dP
  - Efficiency testing material (DOP or PAO not ideal)
- Equipment Improvements
- Blower design to support the higher dP
High Grade Alternative HEPA Filters

Industry is manufacturing high grade HEPA filters that are being used in many commercial and government applications but not direct replacement of conventional HEPA systems.
Sintered Metal Full-scale Filter Element

- Full Size Filter Characteristics
- Material: 200 Nickel
- Diameter: 3.0 in.
- Length: 24 in.
- Surface Area: 1.8 ft²
- 90” wc dP @ 30 cfm
- Excellent particle retention
  - 99.999% Tested at Oak Ridge FTF
- Cleans well insitu
- Robust filter media
Metal Filter Application, HLW Tank H&V System

- Exhaust Stack
- Pre-Filter & HEPA
- Exhaust Blower
- Filter Housing
- Preheater
- Condenser
- Demister
- Inlet HEPA Filter

(1.0 million gallon waste tank held at 1.0” w.c. vacuum)

SUPERNATE (Liquid)

SLUDGE (Semi-solid)

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Single Metal HEPA System, 800 cfm
Filter Vessel, Sintered Metal Filter Elements

SECTION SHOWING FILTER INTERNALS

ASME FI Standard 7-06
Point-of-Use Metal Filters

- Developed for Semiconductor Industry over past 15 years
- Used for all process gases
  - Includes highly toxic
  - Helium leak tested
- Efficiency: > 99.999999999%
- Material: 316L stainless steel, Nickel, Hastelloy C-22
- Flow rates: Range for 1 to >10,000 SLPM (<0.1 to >300 SCFM)
- Pressure drop (max rated flow): 5 - 10 psid (130 - 250” wc)

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Advantages and Needs for Metal Filter

- Ideal for small hostile type systems
- Minimizes risk of catastrophic failure
- Not damaged by water exposure
- Fire and temperature resistant
- Great potential for in-situ cleaning
Conclusion

- A need exists for Metal Filter Standards
  - Small systems, less than 1,000 cfm
  - Hostile environment
- Metal filters are in used in nuclear facilities
- Contact metal manufacturers to support standard development (Vested interest)
  - Mott Corporation, Pall Corporation, Fairey Microfiltrex Inc., Purolator Corporation, Etc.
- Team members/companies to prepare a plan for rewriting FI
- Withdraw the existing ballot of FI