

**Fermilab**

**Particle Physics Division  
Mechanical Department Engineering Note**

Number: MD-ENG-031

Date: January 12, 2004

Project Reference: Air Cooling System, WBS 1.1.2.1.8.5, UID 74239

Project: NuMI

Title: Filter and Housing Specification

Author: Andy Stefanik *AMS*

Reviewer:

Key Words: air cooling system, target pile shielding, beam heating

Abstract Summary: Technical requirements for the air cooling system filters and the housing for them are specified. Kamran Vaziri provided radiation safety requirements: bag-in/bag-out housing, HEPA filter minimum particle removal efficiency (5.5), and HEPA filter removal efficiency certification (5.6).

Applicable Codes:



**NuMI Air Cooling System  
Filter & Housing Specification  
#MD-ENG-031**

January 12, 2004 Andy Stefanik PPD Mechanical Department

**1.0 Scope**

This specification is for a standard bag-in/bag-out housing, prefilters and HEPA filters. Vendor technical and cost-saving suggestions are welcome.

**2.0 Operating Conditions**

- 2.1 Fluid Air and water vapor
- 2.2 Altitude 600 feet above mean sea level
- 2.3 Barometric pressure 14.4 psia
- 2.4 Operating temperature range 50 F to 80 F
- 2.5 Relative humidity range 50 to 90%
- 2.6 Dry airflow rate – normal 26,000 scfm normal
- 2.7 Dry airflow rate - maximum 28,000 scfm maximum
- 2.8 Volume of air & moisture – max. 29,700 acfm maximum
- 2.9 The air stream will contain radioactive particulates.
- 2.10 The filter bank will be installed in a closed loop cooling system.

**3.0 Housing**

- 3.1 Quantity of 1.
- 3.2 Configuration: 4 filters high by 3 filters wide with filter access from one side.
- 3.3 Single welded unit. No field welding.
- 3.4 4 HEPA filter access doors.
- 3.5 4 prefilter access doors.
- 3.6 Airflow direction is from left to right when looking at the filter access doors.
- 3.7 Individual HEPA filter clamping mechanism: Vendor standard.
- 3.8 Swivel latches on access doors.
- 3.9 Filter removal rods.



- 3.10 Filter removal tray.
- 3.11 Lifting lugs for lifting the housing vertically.
- 3.12 Static pressure taps:
  - 3.12.1. Three (3) threaded taps on each 1 high by 3 wide tier to measure static pressure differential across the group of three prefilters and also across the group of three HEPA filters in the tier.
  - 3.12.2. All static pressure taps installed on access door side of the housing. (The backside of the housing is installed against a wall).
- 3.13 Fermilab will weld the inlet and outlet transitions to the housing in the field.
- 3.14 Vendor standard mounting feet or mounting base shall be provided on the underside of the housing. Mounting feet or base shall not interfere with welding the transitions to the housing. Mounting feet or base shall raise the bottom of the housing about 4" above the floor.
- 3.15 Height restrictions:
  - 3.15.1. Installation tunnel: 10 feet
  - 3.15.2. Final installation area: None
- 3.16 Housing design pressure: +/- 10" Water Gauge
- 3.17 Housing and access doors shall be leak tight.
- 3.18 Material of construction: 304L stainless steel and compatible electrode such as 308L. Parts that are not welded can be straight grade 304 stainless steel.
- 3.19 Vendor's standard tests for housing operating pressure, operating vacuum, and leakage shall be performed with access doors on. Test results shall be submitted to Fermilab.
- 3.20 Vendor's standard tests for filter fit, filter seal, HEPA filter sealing surface alignment, and HEPA filter clamping mechanism operation shall be performed. Test results shall be submitted to Fermilab.



#### **4.0 Prefilters**

- 4.1 Quantity of 24.
- 4.2 Size: 24" by 24".
- 4.3 Depth: 4".
- 4.4 Clean static pressure drop at 2,500 cfm: 0.28" Water Gage.
- 4.5 Change-out static pressure drop: 1" Water Gage.
- 4.6 ASHRAE average efficiency up to maximum flow rate: 25 to 30%.
- 4.7 Vendor shall specify the maximum flow and pressure drop that will damage the filter or cause unloading.

#### **5.0 HEPA filters**

- 5.1 Quantity of 12.
- 5.2 Face size: 24" x 24".
- 5.3 Depth: 12" nominal.
- 5.4 Gasket sealed.
- 5.5 Minimum removal efficiency of 99.97% with 0.3-micron size particles.
- 5.6 Removal efficiency certified by submitting vendor standard QA test records to Fermilab.
- 5.7 Stainless steel frame.
- 5.8 Clean static pressure drop
  - 5.8.1. At 2,000 cfm - 1.45" Water Gage maximum.
  - 5.8.2. At 2,560 cfm – 1.9" Water Gage maximum.
- 5.9 Vendor shall specify the maximum flow and pressure drop that will damage the filter or cause unloading.

#### **6.0 Bags/Security straps/Cinching straps**

- 6.1 Vendor shall provide one set for 12 prefilters and 12 HEPA filters.

#### **7.0 Banding kit**

- 7.1 Vendor shall provide one banding kit with at least 25 steel bands.



## **8.0 Transitions**

- 8.1 Quantity of one inlet transition.
- 8.2 Quantity of one outlet transition.
- 8.3 Design pressure: +/- 10" Water Gauge
- 8.4 Material of construction: 304L stainless steel and compatible electrode such as 308L.
- 8.5 Each housing-transition joint shall be fitted with full length backing strips around the perimeter of the joint. Backing strips shall be tack welded either to the transition or to the housing.
- 8.6 Fermilab will weld the transitions to the housing and ducting in the field.
- 8.7 The transitions shall be trial fitted to the housing at the fabricator's shop to make sure they fit.
- 8.8 Dimensions for the inlet transition are specified in Figure 1.
- 8.9 Dimensions for the outlet transition are specified in Figure 2.
- 8.10 Two lifting lugs shall be provided on each transition. The lugs shall be located on the vertical centerline of the transition and spaced approximately as shown in Figures 1 and 2. The lifting lugs shall not interfere with welding the transition to the housing.

## **9.0 Fabrication Approval Drawings**

- 9.1 Vendor shall submit fabrication approval drawings for the housing and transitions within 3 weeks after receiving an order.

## **10.0 Shipping**

- 10.1 Housing shall be completely closed to keep debris out.
- 10.2 Filters shall ship loose.
- 10.3 Transitions shall ship loose.
- 10.4 Ends of the transitions shall be protected from damage.
- 10.5 Threaded plugs shall be installed in the pressure taps.

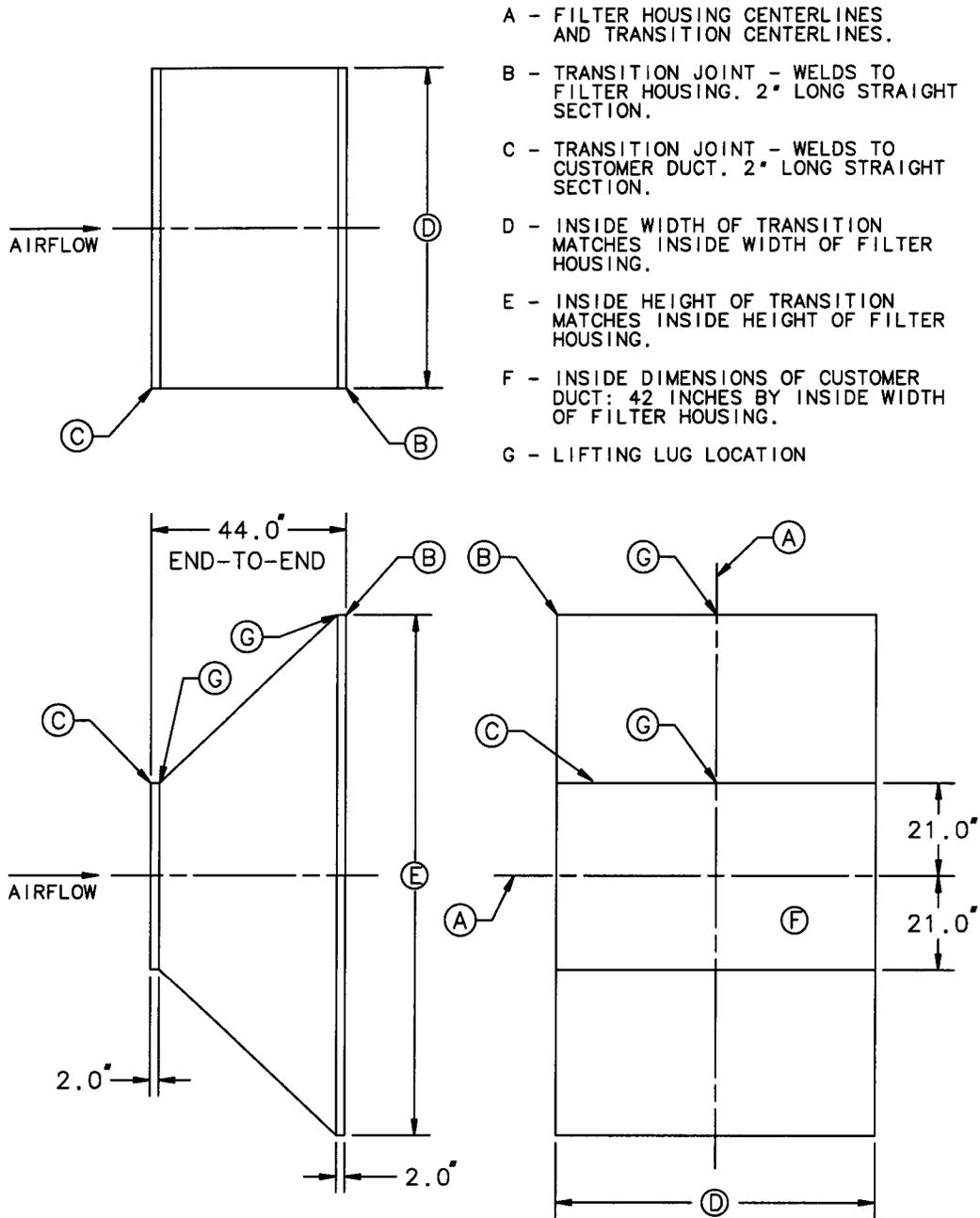


Figure 1. Filter housing welded inlet transition.

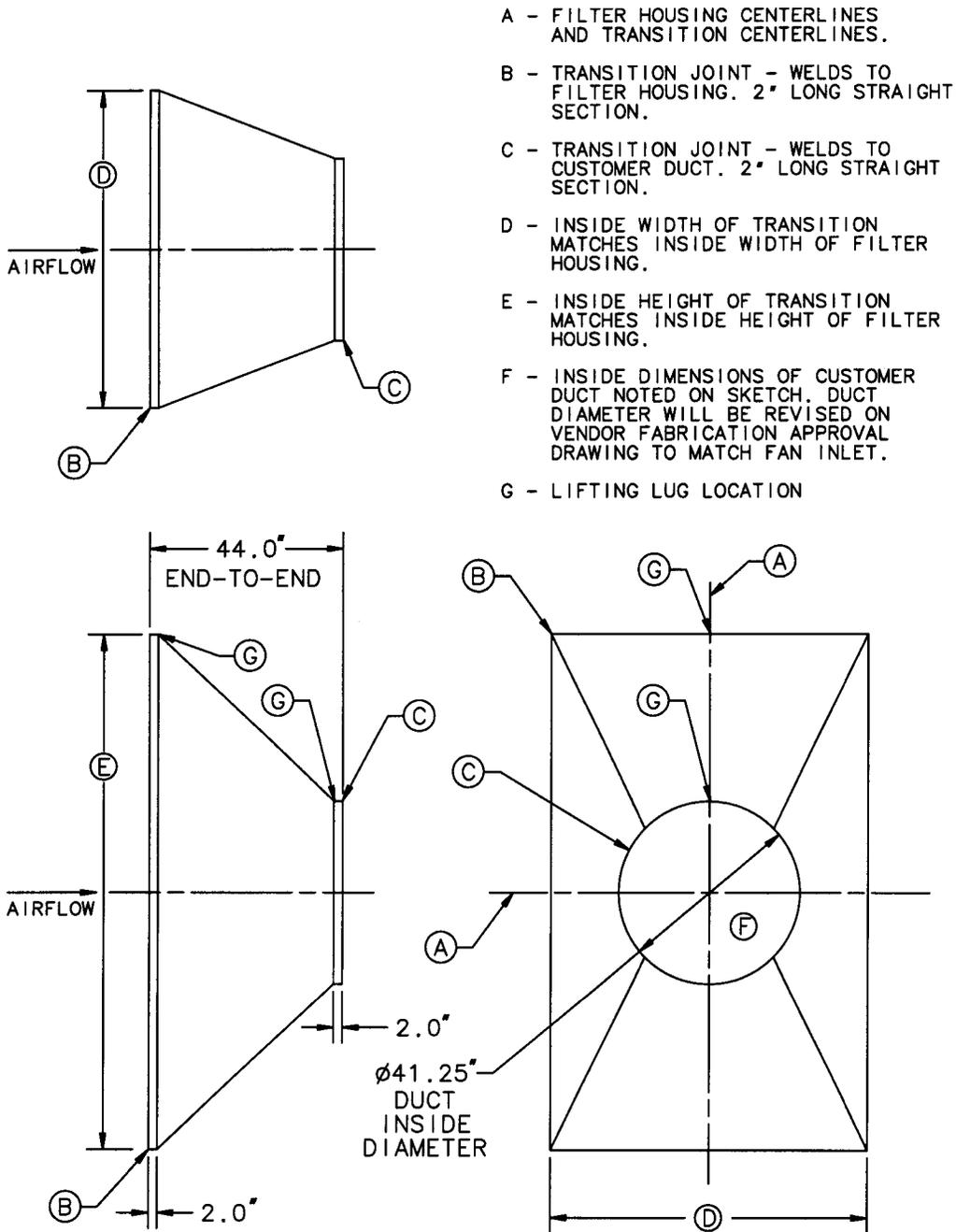


Figure 2. Filter housing welded outlet transition.

**Andy Stefanik**

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**From:** "Andy Stefanik" <stefanik@fnal.gov>  
**To:** <myeoward@fnal.gov>  
**Cc:** "Jim Hysten" <hysten@fnal.gov>  
**Sent:** Tuesday, March 23, 2004 9:10 AM  
**Subject:** Fw: NuMI Air Cooling System Filter Bank

Mike,

I have two more items for this summary:

13) Figure 2. Filter housing welded outlet transition The inside diameter for the outlet duct on the outlet transition (Item "F" in Figure 2) increases from 41.25 inches to 52 inches.

14) para 8.5 Vendor proposed 1.5" wide, turned-out flanges for the welded joint between the housing and each of the transitions. The backing strips specified in para 8.5 are not included in the proposal as they are not needed with this joint. OK.

Andy

----- Original Message -----

**From:** Andy Stefanik  
**To:** myeoward@fnal.gov  
**Cc:** Jim Hysten  
**Sent:** Friday, March 19, 2004 2:06 PM  
**Subject:** NuMI Air Cooling System Filter Bank

Mike,

We have completed reviewing dp systems, LLC's quotation for the NuMI air cooling system filter bank. We conclude that it meets or exceeds our specification. We approve it for purchase.

Here is a summary of the details included in their proposal. I learned these details during my meeting with Greg Hall. These details are not included in their bid paperwork and I am writing them down to clarify what we are buying from them.

Their proposal is in accordance with spec #MD-ENG-031 except for:

- 1) para 3.16 Housing design pressure is +/- 15" Water Gauge. Exceeds requirement of +/- 10" Water Gauge. Please have them record the design pressure rating on the housing approval drawing. OK.
- 2) para 4.4 Farr 30/30 filters are provided. Filter thickness is 4". Clean static pressure drop for this filter is 0.4" Water Gauge at 2,500 cfm. This is higher than the 0.28" Water Gauge requirement. OK.
- 3) para 4.7 Replace the Farr 30/30 filter when the pressure drop is 1" Water Gauge. OK.
- 4) section 5.0 Their quotation included xh absolute HEPA filters. They proposed the filtra 2000 HEPA filter as an alternative. We decided to purchase the filtra 2000 HEPA filters. They quoted you a cost adder to go with the alternative HEPA filters. Please revise the order to purchase the filtra 2000 HEPA filters, Model number FA 1560-01-01. OK.
- 5) para 5.5 Minimum removal efficiency of a filtra 2000 HEPA filter, Model number FA 1560-01-01, is 99.99% with 0.3-micron size particles. This efficiency exceeds the requirement of 99.97% with 0.3-micron size particles. OK.

- 6) para 5.6 Vendor will certify HEPA filter removal efficiency by submitting their standard QA test records as required. We need to use their terminology so we need to ask the vendor for a Certificate of Compliance for each HEPA filter. OK.
- 7) para 5.7 A stainless steel HEPA filter frame was specified. The filtra 2000 HEPA filter, Model number FA 1560-01-01, has an aluminum frame. We accept aluminum in lieu of the specified stainless steel material. OK.
- 8) para 5.8 Pressure drop for the filtra 2000 HEPA filter, Model number FA 1560-01-01, is 1" Water Gauge at 2,400 cfm. This pressure drop is less than the requirement. OK.
- 9) para 5.9 Replace the filtra 2000 HEPA filter, Model number FA 1560-01-01, when the pressure drop is double the initial, clean pressure drop. OK.
- 10) para 7.1 They listed this exception in their bid paperwork: Nylon bands are provided instead of the steel bands specified. OK.
- 11) para 7.1 They listed this exception in their bid paperwork: The banding kit has 10 banding ties instead of the 25 requested. We need to order two packages of banding ties. Then we'll have a total of 30 banding ties.
- 12) para 8.3 Design pressure for the transitions is specified to be +/- 10" Water Gauge. Greg said he thought it might be the same as the filter housing, +/- 15" Water Gauge. Please have them record the design pressure rating on the transition approval drawing. OK.
- 13) Figure 2. Filter housing welded outlet transition The note on this figure states that the outlet duct diameter will be revised on the vendor fabrication approval drawing. Greg checked with the factory and told me this was ok. He quoted you a "no charge" for increasing this diameter. Let me know if you need to specify the diameter when placing the order. Otherwise, I'll note it on the fabrication approval drawing.

That's it. Please call if we need to discuss anything about this order.

Andy