

234100 AIR CLEANING DEVICES & FILTERS

Cornell's Design and Construction Standards provide mandatory design constraints and acceptable or required products for all construction at Cornell University. These standards are provided to aid the design professional in the development of contract documents and are not intended to be used verbatim as a contract specification nor replace the work and best judgement of the design professional. Any deviation from the Design and Construction standards shall only be permitted with approval of the University Engineer.

PART 1 GENERAL**1.01 RELATED SECTIONS**

- A. Section 237300 – Air Handling
- B. Section 233100 – Air Distribution

1.02 RESOURCES

- A. ANSI/ASHRAE Standard 52.1 – Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (Withdrawn)
- B. ANSI/ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

1.03 SUMMARY COMMENTS

- A. Poorly selected air handling filtration will increase energy consumption and maintenance requirements. Therefore, it is the responsibility of the Consultant to properly select filters which will provide a reasonable balance between particulate capture efficiency, filter pressure drop, moisture (snow/water) resistance, and filter service life. At the discretion of Facilities Engineering, a Life Cycle Cost Analysis (LCCA) may need to be performed. This analysis shall be provided to Facilities Engineering for review and approval.

1.04 STANDARDIZATION OF FILTER SIZES

- A. The Consultant shall make every effort to ensure all HVAC units utilize standard filter types and sizes whenever possible.
 - 1. All air handling units shall utilize filters with a 24"x24" or 12"x24" face size.

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2. Where smaller air handlers, blower coils, etc., cannot accommodate the 24"x24" or 12"x24" filters, the Consultant shall pick from the following sizes, which are listed in order of preference:
 - a. 16" x 16"
 - b. 16" x 20"
 - c. 16" x 24" (See Note 1)
 - d. 16" x 25" (See Note 1)
 - e. 18" x 24" (See Note 1)
 - f. 18" x 25" (See Note 1)
 - g. 20" x 20"
 - h. 20" x 24"
 - i. 20" x 25"

Note 1: These filters have longer lead times, so try to avoid selecting these whenever possible.

3. This above list reflects filters already utilized on campus and is ranked by the number of filters ordered annually, where the first item has the highest order count.
4. Consult with Facilities Engineering if the equipment being considered is unable to utilize any of the standard .
5. Standardization does not apply to equipment utilizing Commercial & industrial (C&I) filters.

1.05GENERAL REQUIREMENTS

- A. The Consultant shall specify that the air handler manufacturer must install the filter manufacturer's filter rack in the air handler. The filter manufacturer's racks provide a better fit and are less prone to filter bypass than those provided by air handling unit manufacturers.
- B. All air handling applications require separate pre-filter and primary-filter racks.
 1. The minimum depth pre-filter shall be 2" deep.
 2. Primary filters shall be 12" deep.
 3. An air gap shall be provided between the pre-filter and primary filter racks. Filters butted up together induce excessive pressure drops.
- C. Pre-Filters: Cornell's successful pre-filter applications have been achieved with Camfill-Farr 30/30 2" pleated filters or with Viledon F-50 and F-50S pocket filters (if space permits). The pocket's loading potential equates to a useful life roughly six times longer than that of a standard 2" or 4" pleated pre-filter. The minimum pre-

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filter rating shall be a Minimum Efficacy Reporting Value (MERV) of 8 when tested in accordance with ASHRAE 52.2.

D. Primary Filters:

1. The campus standard is a 12" deep, high-performance V-Bank Cassette filter with (4) v-banks. Filter media shall be 100% synthetic media for indoor air quality, energy consumption, and life cycle cost reasons.
2. Pocket Filters are a viable alternative to the 12" cassette; please consult with Facilities Engineering for applications warranting the use of this type of filter. Pocket filters shall be self-supporting 18" or 26" deep which stay rigid at low (and zero) airflow, with heat welded spacers to stabilize and maintain pocket shape, and heat welded seams to ensure leak proof performance. Pockets shall be imbedded in a polyurethane header.
4. Four inch (4") mini-pleat filters for air handlers should only be utilized if 12" filters cannot fit inside the air handler; these are generally unacceptable for use on campus due to their high relative pressure drop and short service life when compared to the 12" v-bank filter.
5. Use of bag filters is not allowed.

E. Minimum Filtration Dust Spot Efficiency ratings (per ASHRAE 52.1) and MERV ratings (per ASHRAE 52.2):

PRIMARY FILTER OPTIONS				
	LOCATION	DUST SPOT	MERV	TYPE
a.	Animal facilities	95%	14	Rigid Pocket or V-Cell
b.	Laboratory facilities	85%	13	Rigid Pocket or V-Cell
c.	Classroom/Offices/Other	85%	13	Rigid Pocket or V-Cell
d.	Clean room	- CASE BY CASE BASIS -		

For other specific applications, contact Facilities Engineering for recommendations.

- F. For filters not listed on the acceptable manufacturers list, a simple payback analysis, filter sample, and test report shall be submitted to Cornell Facilities Engineering for review and approval. Alternative filters may be subjected to a 12-30 month field evaluation before approval.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Camfil-Farr
- B. Filtration Group
- C. Freudenberg Filter Division / Brand: Viledon
- D. Tri-Dim Corporation

2.02 ACCEPTABLE FILTER TYPES

A. Medium capacity pleated air filter

1. Filters shall be medium capacity extended surface pleated air filters.
2. Filters shall be available in standard nominal depths of 1", 2", and 4".
3. Filter shall be the Camfil-Farr 30/30, or an approved equal.
4. This type of filter is employed as a pre-filter in dry environments.
5. Media shall be 100% synthetic or polyester/cotton blend, mechanical media which does not support microbial growth.
6. Frame shall be a heavy duty, high strength, moisture resistant paperboard with a cross member design that increases filter rigidity and prevents breaching. Frame shall be made with 100% recycled paperboard with an average of 35% post-consumer content. Frame shall be recyclable.
7. Filters shall have a paperboard or expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Paperboard and metal support grid shall be recyclable and contain a significant amount of post-consumer and pre-consumer content.
8. Filters shall be MERV 8 in a medium capacity configuration when fully tested in accordance with the current version of the ASHRAE 52.2 Test Standard.
9. Filter initial pressure drop shall not exceed the initial pressure drop as indicated in the following table, based on face velocity:

Filter Depth	Airflow Velocity	Initial Pressure Drop
1"	375 fpm	0.23" w.g.
2"	500 fpm	0.31" w.g.
4"	500 fpm	0.27" w.g.

10. Filters shall have a recommended maximum final resistance of 1.0" w.g.

B. Three-ply depth loading wire-ring-frame air filter

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1. Filters shall be high-capacity depth-loading wire ring panel or link filter.
2. Filters shall be available in standard nominal depths of 2".
3. Filter shall be the Tri-Dim Tri-Dek 15/40, or an approved equal.
4. This type of filter is used in pre-filtration applications where high moisture resistance is desired and where the lack of room in the existing air handler limits the use of deeper, more efficient filters.
5. The filter shall have a MERV 8 rating when fully tested in accordance with the current version of the ASHRAE 52.2 Test Standard.
6. Filter initial pressure drop shall not exceed the initial pressure drop as indicated in the following table, based on face velocity:

Filter Depth	Airflow Velocity	Initial Pressure Drop
2"	500 fpm	0.48" w.g.

7. Filters shall have a recommended maximum final resistance of 1.0" w.g.

C. Depth loading cube filter

1. Filters shall be high-capacity depth-loading cube filter.
2. Filters shall be available in standard nominal depths of 20".
3. Filter shall be the Tri-Dek 4-Ply XL Cube filter, or an approved equal.
4. This type of filter is employed in pre-filter applications where high snow loading is present.
5. The filter shall have a MERV 11 rating when fully tested in accordance with the current version of the ASHRAE 52.2 Test Standard.
6. Filter initial pressure drop shall not exceed the initial pressure drop as indicated in the following table, based on face velocity:

Filter Depth	Airflow Velocity	Initial Pressure Drop
20"	500 fpm	0.16" w.g.

7. Filters shall have a recommended maximum final resistance of 1.0" w.g.

D. High performance rigid-pocket pre-filter

1. Filters shall be high-capacity depth-loading rigid pocket filters.
2. Filters shall be available in 18" and 26" pocket depth.
3. Filter shall be the Viledon F 50, or an approved equal.

4. This type of filter is employed as pre-filtration.
5. Filter frame shall be high-impact plastic.
6. The filter media shall be manufactured from three distinct layers of organic synthetic fibers and microfibers. The pre-filter layer shall be thermally bonded to prevent fiber shedding and break-off. The micro-fiber layer shall be constructed from synthetic microfibers. Filters containing either urea-extended phenolformaldehyde binders, air-laid microfiberglass, or cotton fibers are not acceptable. The filter media shall be progressively structured to enhance depth loading and to provide lower average static resistance and longer life.
7. The filter media shall be hydrophobic and operate unaffected at relative humidity up to 100% and completely impervious to mechanical (handling) damage.
8. The filter pockets shall be injection molded into a hard polyurethane header to ensure a leak-proof seal. Pockets that are crimped into metal headers are not acceptable.
9. Filter must be supplied with factory-applied closed-cell neoprene gasketing as required for each application (either side-load gasket or down-stream gasket) to prevent air leakage and bypass. Open-cell foam is unacceptable.
10. Pockets shall be self-supporting.
11. The filter shall be fully tested in accordance with the current version of the ASHRAE 52.2 Test Standard, and have a MERV rating and initial pressure drop as indicated in the following table:

Filter Efficiency	Airflow Velocity	Initial Pressure Drop
MERV 8	500 fpm	0.14" w.g.

12. The filter shall have a documented wet burst strength of no less than 12" w.g.

E. High performance rigid-pocket primary-filter

1. Filters shall be high-capacity depth-loading rigid pocket filters.
2. Filters shall be available in 16" and 26" pocket depth.
3. Filters shall be the Viledon MF 70 products, or approved equals.
4. This type of filter is employed as primary filtration.
5. Filter frame shall be high-impact plastic.
6. The filter media shall be manufactured from three distinct layers of organic synthetic fibers and microfibers. The pre-filter layer shall be thermally bonded to prevent fiber shedding and break-off. The micro-fiber layer shall be constructed from synthetic microfibers. Filters containing either urea-extended

phenolformaldehyde binders, air-laid microfiberglass, or cotton fibers are not acceptable. The filter media shall be progressively structured to enhance depth loading and to provide lower average static resistance and longer life.

7. The filter media shall be hydrophobic and operate unaffected at relative humidity up to 100% and completely impervious to mechanical (handling) damage.
8. The filter pockets shall be injection molded into a hard polyurethane header to ensure a leak-proof seal. Pockets that are crimped into metal headers are not acceptable.
9. Filter must be supplied with factory-applied closed-cell neoprene gasketing as required for each application (either side-load gasket or down-stream gasket) to prevent air leakage and bypass. Open-cell foam is unacceptable.
10. Pockets shall be self-supporting.
11. The filter shall be fully tested in accordance with the current version of the ASHRAE 52.2 Test Standard, and have a MERV rating and initial pressure drop as indicated in the following table:

Filter Efficiency	Airflow Velocity	Initial Pressure Drop
MERV 13	500 fpm	0.20" w.g.

12. The filter shall have a documented wet burst strength of no less than 12" w.g.

F. High performance extended surface rigid cassette primary-filter

1. Filters shall be high-capacity eight-panel "V" bank air filters.
2. Filters shall be available in 12.5" depth.
3. Filter shall be the Viledon MV-Series, or an approved equal.
4. This type of filter is employed as primary filtration for office/classroom and lab applications.
5. Frame shall be high-impact plastic and shall contain no metal parts.
6. The filter media shall be 100% synthetic and manufactured from two distinct layers of polyester and polypropylene microfibers. The integral pre-filter layer shall be a spunbond polyester which allows the product to operate without pre-filtration. Filter medias of wet-laid fiberglass, air-laid fiberglass, or single-layer synthetics shall be deemed unacceptable.
7. The filter media shall be hydrophobic and operate unaffected at relative humidity up to 100% and completely impervious to mechanical (handling) damage.

8. The filter media packs shall be potted within the top and bottom horizontal end caps, while the media packs shall be sealed to nonwoven vertical support stabilizers with hot melt glue that creates a molecular bond to the nonwoven vertical supports, eliminating any possibility of internal air filter bypass.
9. The filter shall incorporate a 1" offset to improve air intake performance.
10. The filter shall be independently tested in accordance with the current version of the ASHRAE 52.2 Test Standard and have a MERV rating and initial pressure drop as indicated in the following table, based on face velocity:

Filter Efficiency	Airflow Velocity	Initial Pressure Drop
MERV 13	500 fpm	0.22" w.g.
MERV 14	500 fpm	0.36" w.g.

11. The filter shall have a documented wet burst strength of no less than 12" w.g.