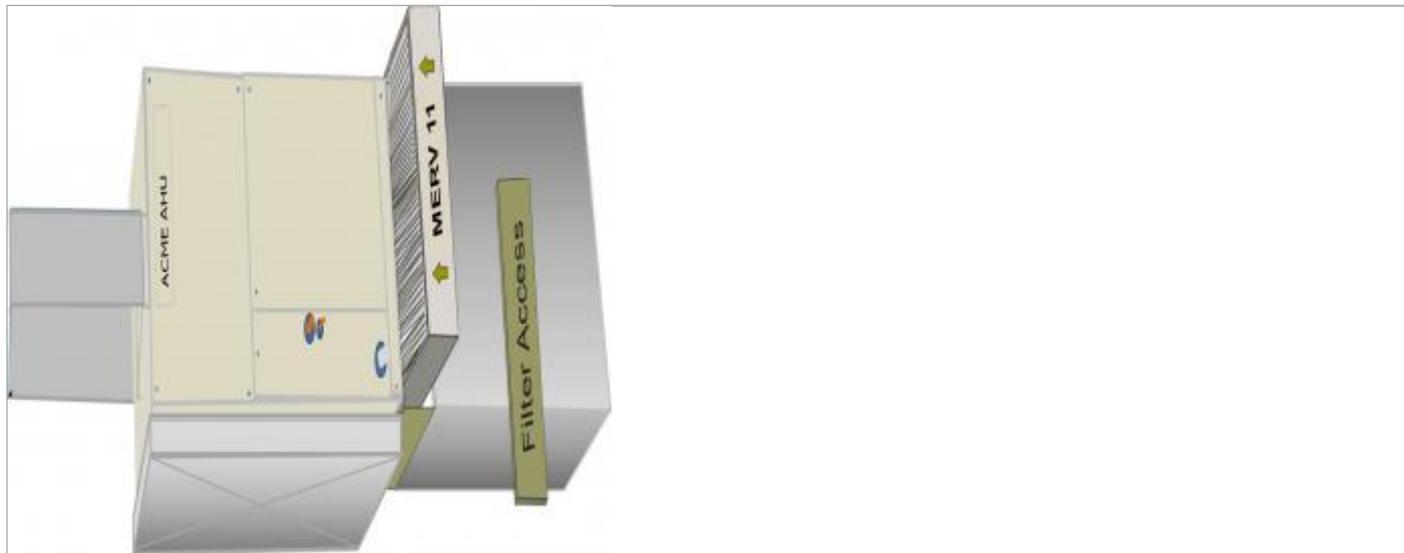


# Proper Installation of Filter

Last Updated: 03/14/2016

## Scope



Size the filter box for the appropriate filter, according to ACCA Manual D, taking into account pressure drop across the system.

Install air filters on any ducted heating and cooling systems to filter air passing through the return air duct and outdoor air that is mechanically supplied to the air handler.

- Locate the filter where it can be easily accessed by the homeowner for replacement or cleaning.
- If the filter is installed in a filter media box attached to the air handler, the access panel for the filter should be fitted with a flexible, air-tight gasket to prevent air leakage.

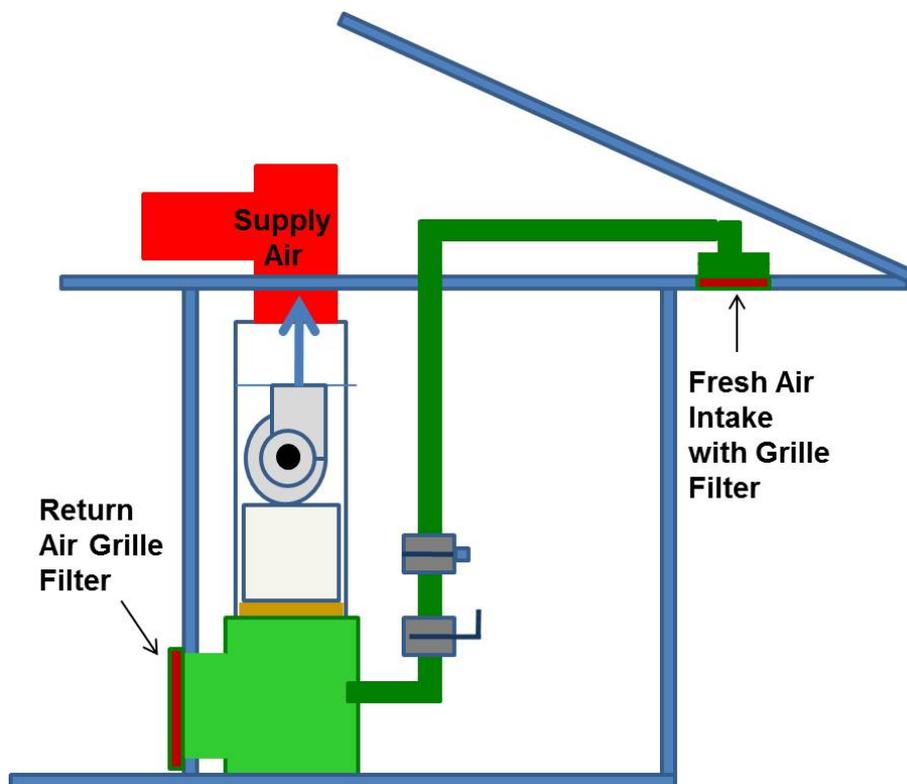
See the [Compliance Tab](#) for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

## Description

Air filters are an important component of forced air HVAC systems. Filters are installed on the return side of the HVAC air handler to clean the air to protect the HVAC motor and to improve indoor air quality. Filters should also be installed in fresh air intakes to clean outside air that is brought into the home. Filters with higher MERV (Minimum Efficiency Reporting Value) ratings of MERV 6 or above can trap pollutants like pollen, dust mites, and mold spores. However, a dirty, clogged filter can dramatically reduce air flow, increasing furnace run time and increasing both wear on the motor and energy consumption. For optimum operation of both the filter and the HVAC equipment, the filters should be replaced or cleaned frequently. Therefore, the filters should be located in a place that is easily accessible for the home owner.

If the furnace air handler is in an accessible location (such as a utility room, a basement, or an attic with a pull-down staircase), the filter can be installed in the air handler at the return plenum. The air handler box should be equipped with a filter media box that has a removable access panel cover that has a gasket for an air-tight seal when closed. The filter box might be prefabricated by the manufacturer or could be fabricated on site. The filter media frame should be appropriate for the size and type of filter desired. The filter dimensions and filter depth both influence filter capacity and air flow velocity. Filter sizing must be taken into account when designing the HVAC system to ensure that the HVAC system can handle the associated pressure drop, especially with high MERV filters. Increasing the filter surface area will decrease pressure drop; options for increasing surface area could include using more deeply pleated filters or larger dimensioned filters. Filters must be sized using the Air Conditioning Contractors of America (ACCA) Manual D ([ANSI/ACCA 2009](#)). For more on furnace filter MERV ratings and sizing, see [High MERV Filter](#).

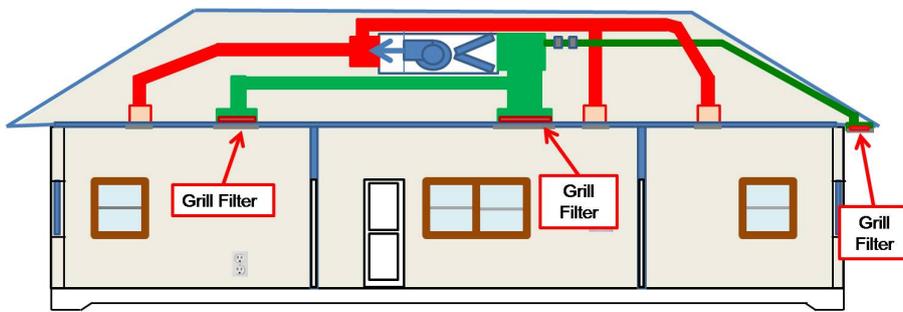
If the furnace is in the attic, in addition to a staircase or pull-down stairs, there should be a permanently installed walkway for the homeowner or service technician to use to get to the furnace.



**Figure 1** - If the furnace is easy to access, for example in a utility room in the house, the filter can be located in a filter media frame between the return air plenum and the air handler box. [i](#)

If the furnace air handler is located in an inaccessible location such as a crawlspace or attic without a staircase, then the furnace filters should be located in the return grilles, with a filter located in each return grille.

If the home is equipped with a fresh air intake that is ducted to the air handler, a filter should be installed at the fresh air intake and the fresh air intake should be located where it is accessible so the filter can be replaced or cleaned as needed.

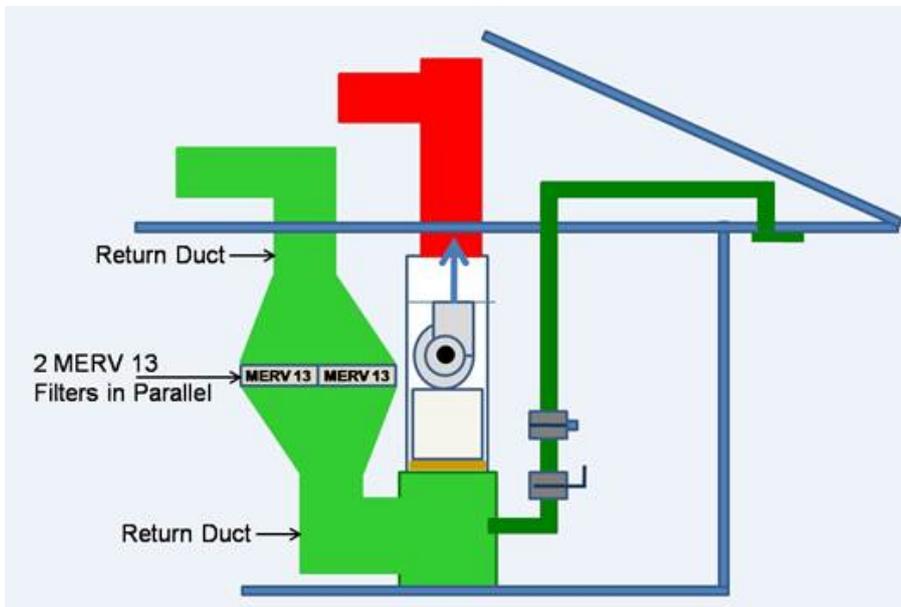


**Figure 2** - If the furnace is hard to access, locate the filters at each return air grille. If there is a fresh air intake, locate a filter there as well. 

### One Option for Increasing Filter Surface Area

If the furnace is in a location where it can be accessed by the homeowner for filter replacement and where the furnace location permits an increase in the width of the return duct, the following option may enable the installation of higher MERV filters.

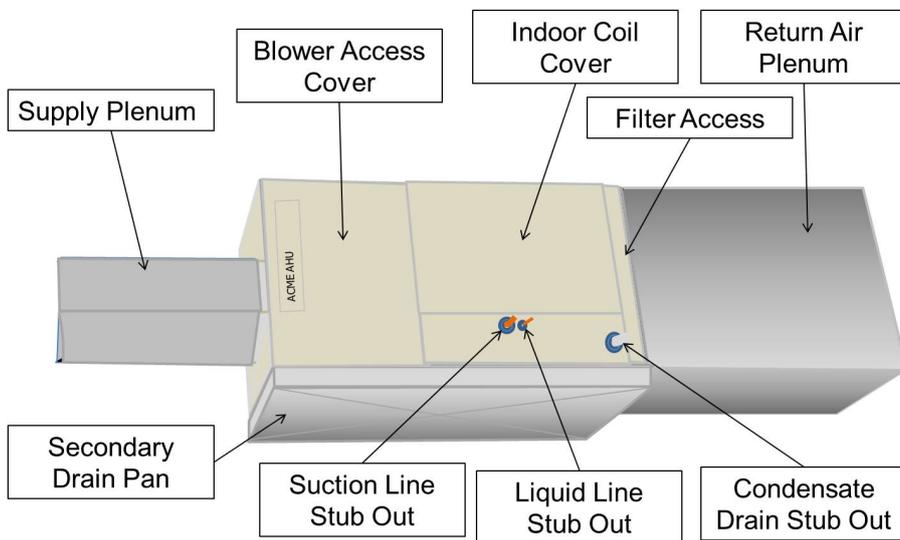
1. Calculate pressure drop and airflow requirements for the desired filter MERV and dimensions in accord with Manual D (ANSI/ACCA 2009). Construct a box to hold two filters side-by-side in the return duct above the 90 degree turn into the return air plenum. Increase the duct width to accommodate the filter dimensions above and below this filter box. If possible, install the filter box at shoulder height for easier servicing. See the figure below.



**Figure 3** - To increase surface area and reduce pressure drop for high MERV filters, the return duct can be constructed to permit the installation of two furnace filters side by side, if space at the HVAC installation permits and if the HVAC location makes filter replacement practical. 

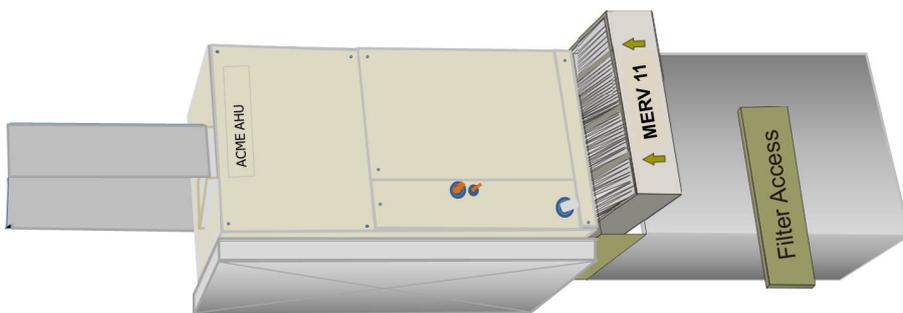
### How to Install a Filter in a Furnace Air Handler

1. Fabricate and install a filter media box on site. Install the filter media box between the return air plenum and the air handler box. Or, purchase an air handler that includes a pre-fabricated filter box. Ensure that the box is the right size for the filter to be installed. Filters must be sized using ACCA Manual D ([ANSI/ACCA 2009](https://www.acca.org/Manual-D)). Improperly sized filters can cause mechanical failure.

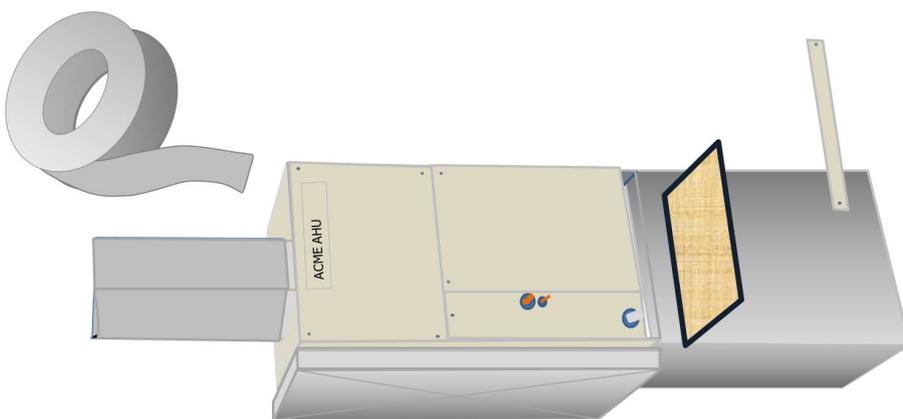


**Figure 4** - Install the filter media box between the return air plenum and the air handler box. 

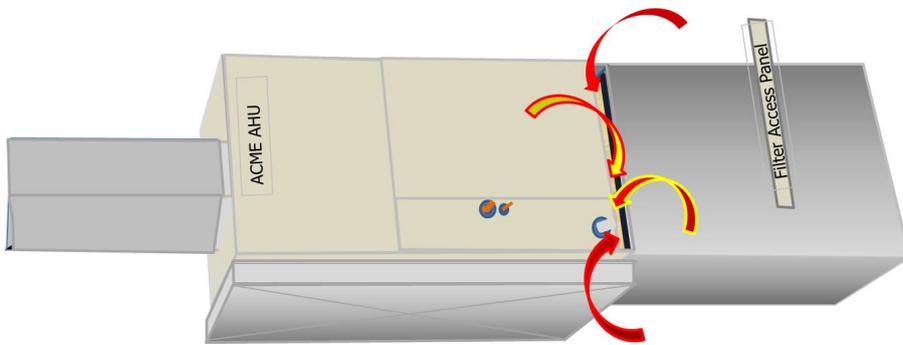
2. Slide the filter into place and place the filter access panel cover over the opening. The panel cover should have a gasket to ensure an air-tight seal. The cover can be duct taped at the edges, which provides additional air sealing and can be easily removed when the filter is checked for cleaning or replacement. If the filter cover is left off or unsealed, the air handler can pull unconditioned and/or unwanted air into the home. Leakage at the filter cover can be an indoor air quality problem if the air handler is located in a garage or other areas where the air quality is not desirable.



**Figure 5** - Size the filter box for the appropriate filter, according to ACCA Manual D, taking into account pressure drop across the system. 

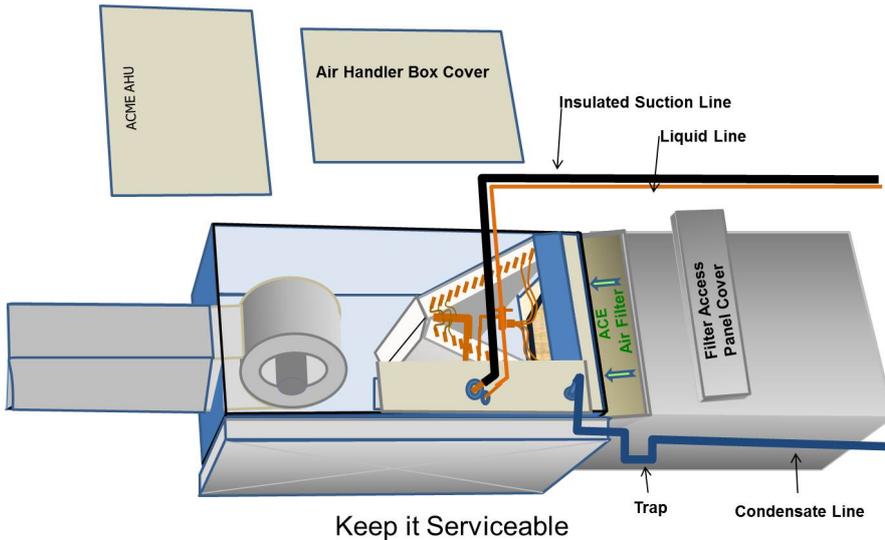


**Figure 6** - If the system is designed to use a thinner filter, the filter box should be sized appropriately. Install an access panel cover with a gasket and duct tape the edges. 



**Figure 7** - Leaks at the air filter cover panel can draw in unconditioned or undesirable air. 

3. Complete air handler installation by installing wiring and condensate piping. Ensure that piping and wiring do not block access to the filter.



**Figure 8** - When installing piping and wiring, do not block access to the filter. 

**How to Install a Filter at the Return Grille**

1. If the furnace is in a location that is difficult for the homeowner to access (for example, a crawlspace or an attic that does not have stairway or drop-down stairway access), then install filters inside the return grilles in the home.
2. Ensure that grilles can be opened from within the home. Install grilles that can be removed safely, for example, grilles that are attached by a hinge along one side to minimize the risk that they will accidentally fall down while being opened.



**Figure 9** - If the furnace is hard to access, locate filters at return registers covered by hinged grilles that are easy to open from inside the home. 

3. Install MERV 6 or higher filters that match the sizing designation specified by the HVAC designer in accord with Manual D ([ANSI/ACCA 2009](https://www.ansi.org/standards/acc2009)). Do not install filters with MERV ratings higher than that for which the HVAC system was designed. Higher-

than-specified MERV filters will increase air resistance, increasing energy usage and possibly contributing to equipment failure. For more about filter sizing, see [High MERV Filter](#).

### How to Install a Filter at the Fresh Air Intake

1. Choose a location to install the outside air intake, such as a porch ceiling or eave, that is away from polluting sources and easily accessible to the home owner to facilitate filter replacement (see Figures 2 and 9). For more on outside air intake locations, see [Ventilation Air Inlet Locations](#).
2. Cut a hole for the air intake with dimensions similar to the grille and the filter to be installed. When selecting a filter size and MERV rating, consider air flow resistance because the pressure drop of this outdoor air intake duct and filter must be included in the Manual D calculations when designing the entire HVAC duct system. A MERV 6 filter should be adequate.
3. Install a register box (boot) to which the duct will be attached. Most register boxes are at least 4 inches deep. This space will keep the duct terminus from touching the filter. Allowing several inches of distance between the filter and the duct terminus helps to decrease the velocity of the air flow through the filter and also ensures that the full surface area of the filter is used, which will improve filter performance and increase filter life.
4. Install a hinged grille at the exterior of the fresh air intake opening (see Figure 8).
5. Cover the grill with wire mesh insect and bird screen.
6. Place the filter on the interior side of the grille and close the grille.
7. Include instructions informing the homeowner to check this filter periodically for replacement with a similar MERV-rated filter.
8. If the outside air intake must be located in an inaccessible location, construct and install a filter media frame in a filter box that is positioned in an accessible place at the duct connection to the air handler return air plenum or somewhere along the fresh air intake duct that is accessible to the home owner.



**Figure 10** - Locate the fresh air intake away from pollution sources and in an easily accessible location, such as a porch ceiling, to encourage frequent filter replacement. 

## Ensuring Success

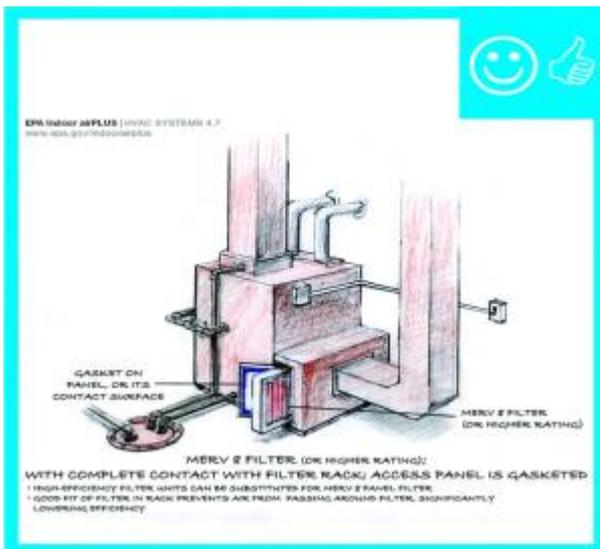
In homes with ducted HVAC equipment, the designer/ HVAC contractor should specify and install furnace filters at the return plenum of the air handler or at all return grilles and on any outdoor air intakes. The HERS rater should inspect to make sure that the filters are installed correctly; if the filter is installed at the furnace, inspect that a filter media box has been installed to house the filter and that this box has an access panel with a gasket to prevent air leakage.

## Climate

No climate specific information applies.

# Training

## Right and Wrong Images



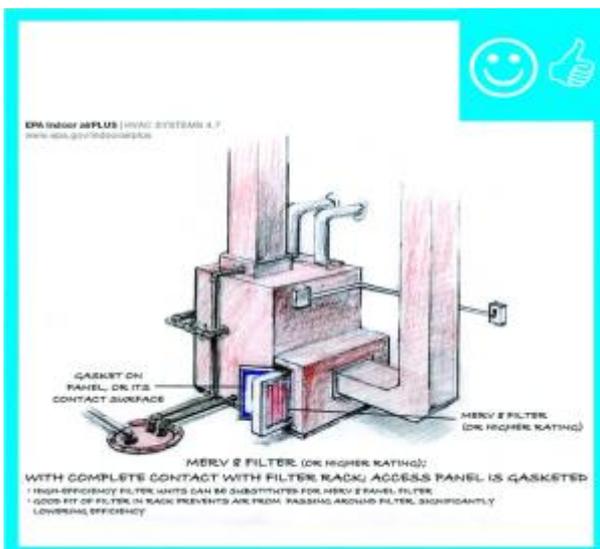
Display Image: [HVAC42PropInstallFilter-R\\_EPA2014.jpg](#)

Reference: [Technical Guidance to the Indoor airPLUS Specifications](#)

Author(s): EPA

Organization(s): EPA

Website providing technical guidance to help home builders and their subcontractors, architects, and other housing professionals understand the intent and implementation of the specification requirements of the IAQ labeling program.



Display Image: [HVAC42PropInstallFilter-R\\_EPA2014.jpg](#)

Reference: [Technical Guidance to the Indoor airPLUS Specifications](#)

Author(s): EPA

Organization(s): EPA

Website providing technical guidance to help home builders and their subcontractors, architects, and other housing professionals understand the intent and implementation of the specification requirements of the IAQ labeling program.

# CAD

None Available

# Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

## [ENERGY STAR Certified Homes](#)

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Rater Field Checklist

### 9. Filtration

9.1 At least one MERV 6 or higher filter installed in each ducted mechanical system in a location that facilitates access and regular service by the owner.<sup>52</sup>

9.2 Filter access panel includes gasket or comparable sealing mechanism and fits snugly against the exposed edge of filter when closed to prevent bypass.<sup>53</sup>

9.3 All return air and mechanically supplied outdoor air passes through filter prior to conditioning.

### Footnotes:

(52) Per ASHRAE 62.2-2010, ducted mechanical systems are those that supply air to an occupiable space through ductwork exceeding 10 ft. in length and through a thermal conditioning component, except for evaporative coolers. Systems that do not meet this definition are exempt from this requirement. Also, mini-split systems typically do not have MERV-rated filters available for use and are, therefore, also exempted under this version of the requirements. HVAC filters located in the attic shall be considered accessible to the owner if drop-down stairs provide access to attic and a permanently installed walkway has been provided between the attic access location and the filter.

(53) The filter media box (i.e., the component in the HVAC system that houses the filter) may be either site-fabricated by the installer or prefabricated by the manufacturer to meet this requirement. These requirements only apply when the filter is installed in a filter media box located in the HVAC system, not when the filter is installed flush with the return grill.

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

## [DOE Zero Energy Ready Home](#)

Exhibit 1: Mandatory Requirements, 6. Indoor Air Quality. Certified under EPA Indoor airPLUS.

Advisory: Filters perform best when the filter rack design includes the following features, which are also included in some manufacturers' filter media boxes: Flexible, air-tight (e.g., closed-cell foam) gasket material on the surface that contacts the air-leaving (downstream) side of the filter; and friction fit or spring clips installed on the upstream side of the filter to hold it firmly in place.

Do not install any air-cleaning equipment designed to produce ozone (i.e., ozone generators).

## More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

### Case Studies

None Available

### References and Resources\*

1. [ACCA Manual D - Residential Duct Systems](#)  
**Author(s):** Air Conditioning Contractors of America  
**Organization(s):** Air Conditioning Contractors of America  
**Publication Date:** December, 2013  
*Standard outlining industry procedure for sizing residential duct systems.*
2. [DOE Zero Energy Ready Home National Program Requirements](#)  
**Author(s):** DOE  
**Organization(s):** DOE  
**Publication Date:** August, 2015  
*Standard requirements for DOE's Zero Energy Ready Home national program certification.*
3. [ENERGY STAR Certified Homes, Version 3 \(Rev. 08\) National Program Requirements](#)  
**Author(s):** EPA  
**Organization(s):** EPA  
**Publication Date:** September, 2015  
*Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).*
4. [Indoor airPLUS Construction Specifications Version 1 \(Rev. 03\)](#)  
**Author(s):** EPA  
**Organization(s):** EPA  
**Publication Date:** October, 2015  
*Document outlining specifications that were developed by the U.S. Environmental Protection Agency (EPA) to recognize new homes equipped with a comprehensive set of indoor air quality (IAQ) features.*
5. [Is There a Downside to High-MERV Filters?](#)  
**Author(s):** Springer  
**Organization(s):** Home Energy Magazine  
**Publication Date:** November, 2009  
*Information sheet about efficiency and health benefits of MERV filters.*
6. [The Best Furnace Filters to Buy](#)  
**Author(s):** The Family Handyman  
**Organization(s):** The Family Handyman  
**Publication Date:** January, 2012  
*Brochure describing HVAC filter options for efficiency and IAQ.*

\*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

### Contributors to this Guide

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