No Kinks or Sharp Bends in Flex Duct Installation

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Scope

Install flex ducts without kinks or sharp bends.

- Do not bend ducts across sharp corners such as framing members.
- Ensure that all bends are gradual rather than tight. The radius of each bend should be greater than the diameter of the flexible duct.
- Coordinate with the framer to plan for the shortest, most direct duct layout. Webbed trusses between floors allow for ducts to freely pass through the floor joists rather than being routed over them.
- Coordinate with the plumber and the electrician to avoid crushing ducts when other services are installed.
- Design ducts in compliance with Manual D.
- Use proper sized ducts or balancing dampers rather than loops in flex ducts to control air flow. For metal ducts, butterfly dampers may be used to control air flow.
- To prevent kinks at the duct and boot connections, consider using metal duct elbows instead of flex duct.
- Avoid installing excessive lengths of flex duct; flex duct should be stretched taut when installed correctly.

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

Flexible ductwork, known as flex duct, is very convenient ducting for attaching supply air outlets to rigid trunk ductwork. In many cases, flex duct comprises the complete duct system. Flex duct made for HVAC applications is typically constructed of a plastic inner liner attached to a metal wire helix (or coil) to make round, flex duct. The duct comes with a layer of fiberglass blanket insulation already attached around the duct. The insulation is covered and protected by a polyethylene or foil vapor barrier. Flex duct is typically available in insulation values of R-4, R-6, and R-8. For residential HVAC systems, insulated flex duct typically comes in diameters of 4 inches through 10 inches; above 10 inches, it comes in even sizes of 12, 14, 16, etc., up to 22 inches measured at the radius of the metal helix.

![Diagram of flex duct components]

Figure 1 - Flex duct consists of a plastic inner liner attached to a metal coil, covered by a layer of fiberglass blanket insulation, which is covered by a foil or plastic vapor barrier.

![Image of flex duct in use]

Figure 2 - Because flex duct is so flexible, contractors are sometimes tempted to bend it too much or squeeze it through areas that are too narrow. These compressions can greatly restrict air flow, hindering HVAC system performance and leading to comfort complaints from homeowners.

Insulated flex duct, if installed to the standards described in Manual D Residential Duct Systems (Air Conditioning Contractors of America [ACCA] 2009), can be a cost-effective air duct product. Flex duct bends easily to accommodate turns around slight obstructions. This flexibility is flex duct’s greatest asset and its greatest liability. Because it bends so easily, there is a temptation to ignore HVAC layout in framing designs. Then, when HVAC is installed after framing, the ducting may be bent or compressed excessively to fit around obstructions. Compressions restrict air flow to affected rooms and increase pressure on the system fan, causing premature wear and excessive energy use. For a better understanding of HVAC fan static pressure and pressure drop in HVAC systems, see Supply Return Static Pressure.
The routing of flex duct, the number of bends, the degree of the bends, and the amount of sag between supports will negatively affect the overall pressure drop across the duct system because of the increased resistance. When a bend or turn has to be made in the flex duct, avoid bending across sharp corners and do not exceed 90-degree turns. Use gradual curves instead. Avoid incidental contact with metal fixtures, pipes, or conduits, especially in humid climates where compressed insulation can create condensation issues.

The best way to avoid conflict between the HVAC duct system and other services like plumbing and wiring is to plan for HVAC system layout in the initial design stage. Figure 4 shows a compact duct design with short runs and minimal turns.

The Manual D friction rate method requires estimating the equivalent length of the duct system. The equivalent length of duct is
based on the design velocity. Bends and junction boxes increase friction in the duct. To account for this friction, ACCA has determined numerical values in feet of equivalent length that can be added when estimating the length of ducting in the distribution system. For example, a 90-degree bend in a flex duct adds an additional 15 feet of equivalent length to the duct system at a velocity of 700 feet per minute. (See Manual D, Third Edition, Appendix 3, Group 11, "Flexible Duct Junction Boxes and Radius Bends," [ACCA 2009].)


For more on flex duct installation, see No Excessive Coiled or Looped Flex Ducts, Sufficient Cavity Space for Flex Ducts, Support at Intervals for Flex Ducts, and Sealed and Insulated Flex Ducts.

How to Install Flex Duct without Kinks and Bends:

1. During the design phase, perform a room-by-room Manual J HVAC load calculation to identify the required airflow for each room.
2. Using preliminary construction documents, lay out or sketch possible duct routing on floor plans. Lay out the ducts so that runs are as short and straight as possible. Review sectional drawings for possible obstructions.
3. Perform a Manual D calculation on the proposed sketch. Make the Manual D duct design part of the construction documents. If flex duct is run through manufactured trusses, there will be bends and they should be calculated as elbows.
4. At the duct-to-boot connection, consider using a metal duct elbow or a plastic duct bend support product to reduce the risk of a kink at the duct-boot connection. When installing, pull ducting taut to avoid sagging as described in No Excessive Coiled or Looped Flex Ducts.
5. Before the framing stage, consult the design team, discuss duct routing, and determine the work flow to minimize conflict with other trades. If HVAC ducts are installed before plumbing and electrical, discuss expectations about avoiding compression of ducts with those trades.
Ensuring Success

Make sure that duct chases are considered early in the home design phase. Use ACCA Manual D procedures for designing flexible duct systems (See Manual D, Section 11, Sizing Flexible Constant Volume Duct Systems). Inspect installed ductwork during the thermal bypass inspection to ensure there are no sharp bends or kinks.
Climate

No climate specific information applies.
Training

Right and Wrong Images

Display Image: ES_HVAC_QIRC_2.1_PG24_2b_102811.jpg
CAD

None Available
Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which 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, Version 3/3.1 (Rev. 09)**

National Rater Field Checklist

HVAC System.
6.1 Ductwork installed without kinks, sharp bends, compressions, or excessive coiled flexible ductwork.

Footnote 33) Kinks are to be avoided and are caused when ducts are bent across sharp corners such as framing members. Sharp bends are to be avoided and occur when the radius of the turn in the duct is less than one duct diameter. Compression is to be avoided and occurs when flexible ducts in unconditioned space are installed in cavities smaller than the outer duct diameter and ducts in conditioned space are installed in cavities smaller than inner duct diameter. Ducts shall not include coils or loops except to the extent needed for acoustical control.

Please see the [ENERGY STAR Certified Homes Implementation Timeline](#) for the program version and revision currently applicable in your state.

**DOE Zero Energy Ready Home (Revision 07)**

Exhibit 1 Mandatory Requirements.
Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.

**2009, 2012, 2015, and 2018 IECC**

Flex duct installation is not specifically addressed in the IECC.
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 (Rev. 07)**
   - **Author(s):** U.S. Department of Energy
   - **Organization(s):** DOE
   - **Publication Date:** May, 2019
   - Standard requirements for DOE's Zero Energy Ready Home national program certification.

3. **ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09) National Program Requirements**
   - **Author(s):** U.S. Environmental Protection Agency
   - **Organization(s):** EPA
   - **Publication Date:** September, 2018
   - Webpage with links to documents providing the program requirements and checklists for ENERGY STAR Certified Homes (Ver. 3/3.1, Rev. 09).

4. **Flexible Duct Performance and Installation Standards**
   - **Author(s):** Air Diffusion Council
   - **Organization(s):** Air Diffusion Council
   - **Publication Date:** January, 2010
   - Standard providing a comprehensive approach to evaluating, selecting, specifying and installing flexible duct in HVAC systems.

5. **Recommended Practices for Properly Installing Flexible Duct**
   - **Author(s):** ACTO Rubber Products Inc., Air Diffusion Council
   - **Organization(s):** Air Diffusion Council
   - **Publication Date:** March, 2011
   - Presentation about proper installation of flexible ducts.

*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.

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