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A Home Inspectors' Guide to Flexible HVAC Duct Installation

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Whether it's a freezing winter morning in Minneapolis or a torrid summer afternoon in Phoenix, air leaking from ducts and air handlers can bring a little welcome relief to a home inspector braving the elements in an unconditioned attic. For clients, however, the leak that brings relief to the home inspector can represent a costly defect. Poorly installed HVAC ducts cost our clients money and reduce their comfort every minute the HVAC system runs. Installation errors can also contribute to moisture problems and related fungal growth.

This article focuses on flexible HVAC duct (flex duct), the most common material used in modern residential HVAC duct systems. While other materials such as sheet metal and duct board are still used, the cost advantages of flex duct make it a popular choice for many builders. Unfortunately, the factors that give it a cost advantage--mainly less skilled and less expensive labor--also make installation errors more likely when compared to other materials.

Costs of poorly installed ducts

In a low-pressure, forced-air HVAC system, the goal is to move the air effectively and efficiently.

- Effectiveness is measured by occupant comfort and by maintaining reasonably consistent temperature, humidity and pressure throughout the house.
- Efficiency is measured by total operating cost, which includes costs for utilities, maintenance and replacement at the end of the equipment's design life.

Estimates of efficiency reductions caused by poorly installed ductwork range from 10 percent for good systems up to 40 percent in poor systems. Assuming a modest annual household heating and cooling bill of \$1,200 (\$100/month), between \$100 and \$480 in utility costs alone could be wasted each year. This excludes costs for increased system maintenance and reduced system useful life, and excludes the environmental costs of pollution caused by generating the power to run inefficient systems. Adding these costs together defines a problem that deserves attention.

Like any other listed construction product, flex duct should be installed according to the terms of its listing and according to manufacturer's instructions. The following guidelines apply to most flexible duct systems.



Duct constricted by bend over truss web.

1. Avoid bending flex duct across or around framing members, pipes and other objects. Such bends can decrease the size of the duct at the bend point, restricting airflow and increasing air friction. Over time, the duct inner core can continue to collapse at the bend point further restricting airflow. This is a common installation error.

2. Avoid bending flex duct so that the radius at the centerline is less than one duct diameter.

Such bends also restrict airflow and increase air friction. This is another common installation error.



Radius of bend less than duct diameter



Duct constricted by two bends leaving plenum

3. Run flex duct through spaces at least as large as the diameter of



Ducts compressed into small space

the duct inner core. While this might seem a statement of the obvious, compressing flex ducts is a common installation error. The ducts are often compressed to fit into small spaces, such as chases running between floors and the area between truss webs and truss braces in floors and attics. This installation error is also frequently found when ducts are run between different areas, such as between a garage attic and the attic over the conditioned area. Minor compression of the duct is acceptable so long as the inner core is not compressed.



Improper duct support and excess duct sag

4. Support flex duct horizontally at intervals of not more than 5 feet and vertically at intervals of not more than 6 feet. The maximum amount of sag between supports is 1/2 inch per foot of horizontal run. Support plenums and distribution junctions independently of the flex duct. Support straps or other support material should be at least 1 1/2 inches wide. Support by lumber is usually acceptable.



Duct compressed by wires

5. Avoid using flex duct to support other flex duct or construction materials such as wires or coolant lines. Over time, the weight of these materials can constrict the duct inner core.

6. Extend flex duct to its full length. Excess duct material in a run should be less than 5 percent. Excess material increases air friction.

7. Run flex duct out of plenums, distribution junctions and boots at least 12 inches before making a bend in the duct. Tight bends near plenums also increase air friction and decrease duct size.



Duct constricted by bend into boot



Duct constricted by bend leaving plenum

8. Provide air space on all sides of flex duct when the duct runs through unconditioned spaces such as attics and crawlspaces. Avoid fully or partially covering flex duct with insulation. This is more important in humid climates than in dryer climates. Moisture can condense on flex duct that does not have adequate airflow around it. This moisture can damage surrounding materials and can contribute to fungal growth.

9. Provide clearance between flex duct and furnace or water heater vent flues as required by the flue type. Flex duct is considered to be combustible material in terms of clearance to

combustion appliances flues.

10. Avoid running flex duct over steam pipes and similar heat sources.

11. Install flex duct at least 4 inches above ground level and above the design flood elevation. Do not install flex duct in tile, metal pipe or within masonry or concrete.

12. Avoid installing flex duct where it will be subjected to direct sunlight, such as under turbine vents. Sunlight can degrade the vapor barrier.

13. Attach flex ducts at plenums and distribution junctions to sheet metal collars that are at least 2 inches long. Use metal sleeves at least 4 inches long to splice two lengths of flex duct. Make joints substantially airtight. Use at least two wraps of approved metal tape to attach the duct inner core at collars and distribution junctions. A clamp is recommended, though not always required. Use both tape and clamps to splice two lengths of flex duct.

14. Repair tears in the vapor barrier using recommended material.

15. Install fireblocking where flex duct penetrates floor and ceiling assemblies, and where it penetrates concealed connections between vertical and horizontal spaces such as soffits and other dropped ceilings. Unfaced batt mineral wool or fiberglass insulation is usually acceptable fireblocking material.

16. Avoid installing flex duct that penetrates a fire-rated assembly unless approved by the authority

having jurisdiction. This includes flex duct connected to boots located in a garage.

17. Protect flex duct from damage by sharp objects such as truss gusset plates, attic furnace support straps and nails. These objects can puncture the duct.

18. Protect flex duct from moisture during and after construction. Once it becomes wet, flex duct insulation can remain wet for years, providing a breeding ground for fungal growth.

19. Protect duct boots, particularly floor ducts, from contamination during and after construction.

Finding and describing installation errors

How does an inspector decide what warrants being reported as an installation error in need of repair or evaluation by an expert? In the absence of a measurable guideline (such as the one-duct diameter bend guideline), each inspector must make a common sense determination based on the HVAC system(s) in the home. Here are some common installation errors, and some suggestions for when to call for expert evaluation and/or repair.

Evaluate and/or repair:

1. Trunk supply ducts (those that serve more than one branch duct) and central return ducts that bend across an obstruction or a support at more than a 45-degree angle. These ducts are often constricted, and those that make a vertical bend over an obstruction may become more constricted over time.
2. Trunk supply ducts and central return ducts whose inner core is constricted in size by more than about 20 percent. Somewhat more constriction may be reasonable for a duct serving a single boot because only one boot is affected.
3. Duct bends that do not comply with the one duct diameter bend guideline.
4. Ducts that run horizontally out of a plenum or into a boot.
5. Ducts that are loose at a collar or do not have a metal sleeve at a splice.
6. Ducts with a punctured inner core.
7. Ducts in direct contact with a heat-generating appliance vent.
8. Ducts that leak a "significant" amount of conditioned air at a plenum collar or at a splice or junction.
9. Ducts that touch the ground and ducts buried in insulation if there is evidence of condensation on or near the duct.
10. Ducts that breach a fire-rated assembly unless the local authority having jurisdiction accepts the practice.
11. Ducts that have wet insulation from sources such as rain or plumbing leaks.

Flex your knowledge

If you're inspecting flex duct in a newer HVAC system, there's a good chance you'll find installation errors. Armed with knowledge of recommended installation techniques and your own common sense, you can save your clients money and help the environment as well.

To view flexible duct installation guidelines online, visit www.flexduct.org.