Verifying ACCA Manual D® Procedures

Why are duct design calculations important?

Achieving occupant satisfaction is the principal goal of any HVAC design. For residential air duct designs ACCA's Manual D is the procedure recognized by the American National Standards Institute (ANSI) and specifically required by residential building codes. Air is the first word in air conditioning. If the network of ducts carrying the air is not properly designed then the health and safety of the occupant are at risk, the equipment could fail more quickly, the energy costs could rise, and occupant comfort might be sacrificed.

What problems come from wrong sized ducts?

In order for home owners to be comfortable a duct system must be designed to carry the right amount of air, at the right speed, into the right room. If the ducts are the wrong size then the wrong amount of air will enter the room and may cause:

- The room to be too warm or too cool
- The air to be too drafty and disturb people while they sleep, eat, read, etc...
- The air to be too noisy and drown out conversations, TV or radio programs, etc...
- The air to be too slow – the conditioned air will not circulate or mix well in the room.
- The fan to work harder, possibly fail sooner, and use more energy to move air
- The furnace or air conditioner safety devices to stop equipment operation
- Pressure differentials that may increase energy costs by pushing out conditioned air or drawing in unwanted air

For a more detailed analysis on the design process

or visit

www.acca.org/tech/articles/

To order ACCA Manual D

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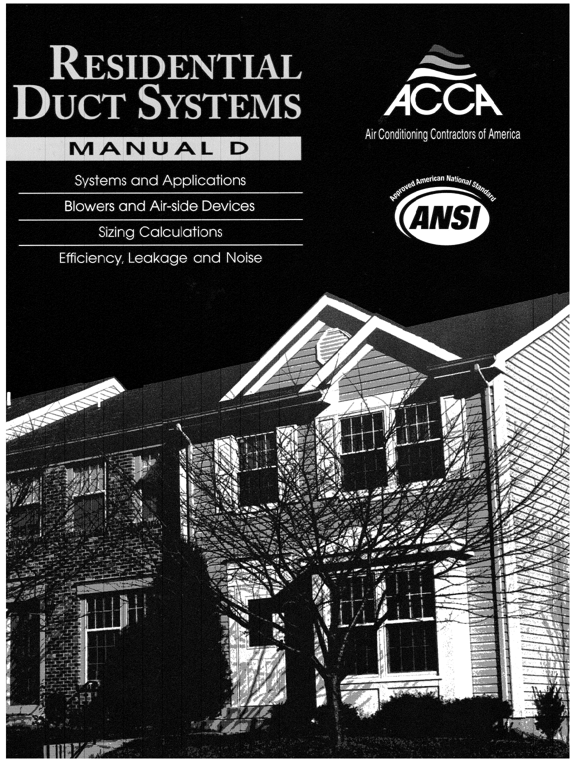

Includes Duct Inspection Checklist

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ACCA's Manual D Residential Duct Design Checklist

Key Item	Check	Questions to Ask
Information from load calculation	CFM for each room	Does each room have a heating and cooling CFM assigned? (Proportioned air supply based on Manual J8 room-by-room load calculations) (F)
Manufacturer's Data	Manufacturer's External Static Pressure (ESP)	According to the manufacturer's data will the fan produce the specified airflow at the specified static pressure? (Manufacturers produce a graph that relates air flow and static pressure) (A) (B)
	Accessory and device pressure losses	Did the contractor submit the manufacturer's data specifying the pressure drop for any item in the air stream like a high efficiency filter or a hot water coil? (C)
Manual D Friction Worksheet	Available Static Pressure (ASP)	Are supply outlets, return grilles, and balancing dampers listed at a standard 0.03?
		Are the pressure drops listed for other external devices: filters, coils, etc...? (C)
	Total Effective Length (TEL)	Did the contractor calculate the TEL by adding the longest Supply Total Effective Length and the longest Return Total Effective Length? (Total Effective Length = the length of the duct from outlet back to unit + the effective length for all fittings, i.e., elbows, reducers, take-offs, etc…) (D)
	Friction Rate design value	Did the contractor use the Friction Rate Chart or calculate Friction Rate [FR = ASP x 100 / TEL] (E)
Air Distribution System Design	Branch Lead Size	Did the contractor size the ducts based on the design CFM, friction rate, and the duct material used? (G)
	Trunk Size	Did the contractor select a supply trunk duct large enough to accommodate all the supply branch leads?
	Return Trunk Duct Velocities	Did the contractor select the return trunk duct large enough to meet the lower return air velocity requirements? (H)
	Return air path	Verify each occupied room has an open air path (ACCA recommends a ducted return for each bedroom, den, library, etc…)
Manual T	Register and Grille Face Velocities	Does the air velocity across the register or grille exceed the Recommended Velocity Chart? (Grille manufacturers list the face velocity for grilles and registers at a given CFM, e.g., 12 x 4 - Model XYZ, 500fpm at 120cfm (I)

Friction Rate Worksheet

Step 1) Manufacturer's Blower Data

External Static Pressure (ESP) = 0.70 IWC   CFM= 1200 CFM

Step 2) Device Pressure Losses (DPL)

Device	Loss
Direct expansion refrigerant coil	0.23 IWC
Electric heat resistance coil	
Hot water coil	
Filter	0.18 IWC
Humidifier	
Supply outlet	0.03 IWC
Return grille	0.03 IWC
Balancing dampers	0.03 IWC
Other device	
Total device losses	0.50 IWC

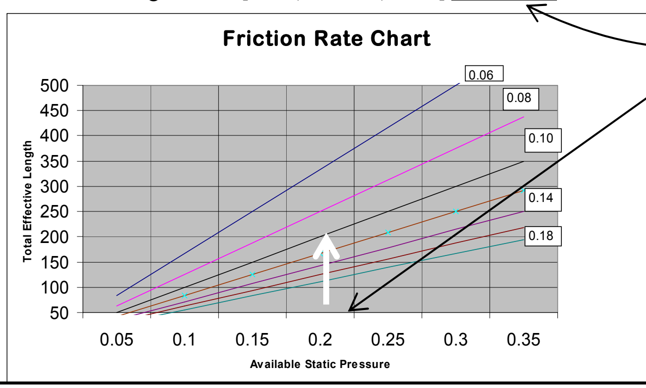
Step 3) Available Static Pressure (ASP)

ASP = ESP – DPL (Step 1 – Step 2)   0.20 IWC

Step 4) Total Effective Length (TEL)

Supply side TEL + Return side TEL =   200 ft TEL

Step 5) **Friction Rate** Design Value [FR= (ASPx100)÷TEL] 0.10 IWC from chart below



A From manufacturer's data—equipment CFM at rated capacity

B From Manufacture's Blower Performance Data corresponding to the CFM

C From Manufacturer's Performance Data

D **Total Effective Length** ≈ loss from duct lengths, reducers, elbows and other fittings

E **Friction Rate** is found by reading bottom scale to 0.20 and up the side scale to 200 feet the intersecting line is the 0.10. That is the design friction rate. This example, 0.10, is within the acceptable friction rate range.

F The **Design CFM** for each room is based on the larger of the Cooling or Heating CFM. Those heat and cool CFM come from the allocation of the system's capacity based on each room's heating and cooling needs.

G The **Friction Rate** is used to determine the duct size.

H The **return duct size** is based on the friction rate and then may be adjusted to a larger size to meet recommended velocity.

I **Grille and register sizes** should be selected to ensure the velocities are acceptable.

Recommended Velocity (FPM) (Manual D, Table 3-1)

	Supply				Return			
	Recommended		Maximum		Recommended		Maximum	
	Rigid	Flex	Rigid	Flex	Rigid	Flex	Rigid	Flex
Trunk Ducts	700	600	900	700	600	600	700	700
Branch Ducts	600	600	900	700	400	400	700	700
Supply Outlet Face Velocity	Size for Throw		700					
Return Grille Face Velocity							500	
Filter Grille Face Velocity							300	

Table of Useful Air Distribution System Design Information

Zone:	One	Design Friction Rate	0.10	Type of System:	Trunk and Branch
Construction Material	Supply Air Trunk	Metal	Supply Air Branch	Flex	
Construction Material	Return Air Trunk	Duct board	Return Air Branch	Flex	
R-Value of Insulation	Supply	R6	Return	R6	

Room	Design CFM	Supply Duct Size(s)	Supply Grille(s) Size, and Velocity	Return Duct Size(s)	Return Grille Size and Velocity
Bedroom 1	150	1 - 8"	1 - 14x6, 600fpm	(9")- 12"	14x14, 300fpm
Walk-in-Closet	15	1 - 4"	1 - 8x4, 450fpm		
Bedroom 2	100	2 - 6"	2 - 10x4, 600fpm	(7") - 8"	14x8, 275fpm
Bedroom 3	100	1 - 7"	1 - 12x4, 600fpm	(7") - 8"	14x8, 275fpm
Living Room	275	2 - 8"	2 - 14x6, 575fpm	(16")- 18"	24x24, 350fpm
Den	125	1 - 8"	1 - 14x6, 600fpm		
Dining	125	2 - 6"	2 - 10x4, 600fpm		
Foyer	80	1 - 6"	1 - 10x4, 600fpm		
Kitchen	125	2 - 6"	2 - 10x4, 625fpm	ACCA does not recommend installing return ducts in kitchens, baths, laundry, or utility rooms	
Bath 1	65	1 - 6"	1 - 10x4, 600fpm		
Bath 2	40	1 - 5"	1 - 8x4, 500fpm		
Bath 3					
TOTALS	1200				

Notes:

Types of Supply System: Trunk and Branch, Perimeter Loop, Radial

Construction Materials: Sheet metal, Fiberglass Ductboard, Rigid Round Fiberglass, Flexible Vinyl Duct, Fiberglass Duct Liner w/ Facing, Flexible Metal Duct