

MMC 2015
Chap 6, Section 603
Duct Systems

1 Credit Specialty

ACCA MANUAL D DUCT DESIGN

3 Basic components of airflow:

Volume: Standard air is air that is 70F with 50% Relative Humidity (RH) at sea level. Air volume is measured in Cubic Feet per Minute (CFM)

Velocity: The system must deliver the volume (CFM) at a proper velocity. Velocity is measured in Feet per Minute (FPM).

You want to keep your main trunk at 700 – 900 FPM and the Branch duct runs between 400 – 600 FPM.

Note: Velocities less than these recommendations can produce poor air flow and velocities greater than these will always produce noise.

ACCA MANUAL D DUCT DESIGN

PRESSURE: You can measure pressure in a duct in Inches of Water column (IWC) with a Magnehelic gauge or a Digital Manometer

There are two primary pressures in a duct system:

Velocity pressure: The faster the air moves the greater the velocity pressure.

Static Pressure: Is resistance to airflow in a heating and cooling system's components and ductwork. The push of air must be greater than the resistance to the flow of air or no air will circulate through the duct work.

Duct Systems Quiz Question One

1. The purpose of ACCA Manual D is for Residential HVAC Duct sizing:
A. True
B. False

ACCA MANUAL D DUCT DESIGN

An inflated balloon contains 100% **Static Pressure**.

When you release the air from the balloon the **Static Pressure** converts to **Velocity pressure**.

Total Pressure is **Static Pressure** plus **Velocity Pressure**.

Most of our residential duct systems are designed to operate in a range from 0.5 to 1.0 IWC

RESIDENTIAL DUCT DESIGN(12 STEP PROCEDURE)

- **Calculate a Manual J Heat Loss and/or Heat Gain calculation.**
- House is 29' x 51' = 1479 Square Feet. 8' Ceilings.
- Assign the Volume (CFM) per room or area.
- Locate all outlets and inlets.
- Locate the furnace or air handler.
- Draw the trunk lines.
- Connect the branch lines.
- Locate the trunk reductions.
- **Trunk Reduction rule: Reduce the main trunk every 20' – 24' using a transition on Supply and Return ducts or when the Velocity in the previous trunk halves.**

Duct Systems Quiz Question Two

2. Basic components of airflow are:

A. Volume

B. Velocity

C. Pressure

D. All of the above

Residential Duct Design (12 Step Procedure Continued)

Calculate the TEL (Total Equivalent Length) of the longest run.

Choose a furnace or air handler blower.

Calculate the friction rate.

Size the trunk ducts.

Size the branch ducts.

RECOMMENDED AND MAXIMUM DUCT VELOCITIES

- **Residences:**
- Fan Outlets: 1000-1600 FPM (Feet per Minute)
- Main Ducts: 700-900 FPM
- Branch Ducts: 400-600 FPM
- Branch Risers: 500 FPM
- Heating coils: 450 FPM
- Cooling coils: 450 FPM
- Filters: 250 FPM

Duct Systems Quiz Question Three

3. Air Pressure can be measured with:

- A. Megnehelic gauge
- B. Digital Manometer
- C. Both A and B
- D. None of the above

AIR FILTER VELOCITIES

- Fiberglass air filters: 450 FPM
- Hog Hair air filters: 375 FPM
- Electronic Air Cleaners: 400 FPM
- HEPA Air Filters: 225 FPM
- Electrostatic air cleaners: 250 FPM
- 90% Media air Filters: 175 FPM

CALCULATE THE LONGEST TOTAL EQUIVALENT LENGTH OF THE LONGEST SUPPLY DUCT RUN

SUPPLY DUCT (EQUIVALENT LENGTH OF DUCT, PIPE OR FITTING(S))

Supply Plenum takeoff (Trunk): 35'

Supply Trunk reduction: 5'

Supply Trunk length: 50'

Supply branch takeoff: 55'

Supply branch 90 degree ell (Elbow): 30'

Supply floor boot 90 degree: 80'

Supply branch length: 15'

Total Equivalent length of Supply Duct = 270'

Duct Systems Quiz Question Four

4. There is one Primary pressure in a duct system:
- A. True
 - B. False

CALCULATE THE LONGEST TOTAL EQUIVALENT LENGTH OF THE LONGEST RETURN DUCT RUN

RETURN DUCT (EQUIVALENT LENGTH OF DUCT, PIPE OR FITTING(S))

Return boot (Drop): 30'

Return drop into boot: 55'

Return flat 90 degree ell (Elbow): 80'

Return trunk reduction: 20'

Return takeoff of trunk: 110'

Return boot: 15'

Return trunk length: 45'

Return branch length: 15'

Total Equivalent Length of Return = 370'

CALCULATE THE LONGEST LENGTH OF THE LONGEST DUCT RUN (SUPPLY AND RETURN)

SUPPLY DUCT (EQUIVALENT LENGTH) = 270'

RETURN DUCT (EQUIVALENT LENGTH) = 370'

TOTAL EQUIVALENT LENGTH (SUPPLY & RETURN DUCT) = 640'

Duct Systems Quiz Question Five

5. Total Pressure is Static Pressure plus Velocity Pressure:
- A. True
 - B. False

CALCULATE THE LONGEST TOTAL EQUIVALENT LENGTH OF THE LONGEST DUCT RUN (SUPPLY & RETURN)

- **Supply Duct**

- Supply Plenum takeoff (trunk): 35
- Supply trunk reduction: 5
- Supply trunk length: 50
- Supply branch takeoff: 55
- Supply branch 90 degree ell: 30
- Supply floor boot 90 degree: 80
- Supply branch length: 15

- **Return Duct**

- Return boot (drop): 30
- Return drop into boot: 55
- Return flat 90 degree ell: 80
- Return trunk reduction: 20
- Return takeoff of trunk: 110
- Return boot: 15
- Return trunk length: 45
- Return branch length: 15

- **Total Equivalent Length = 640'**

CALCULATE THE FRICTION RATE

- Acceptable friction rate range is from .06" to .18" w.c. (inches of water column)
- **FR = ASP (Available Static Pressure) x 100' (feet)**
- **TEL (Total Equivalent Length)**
- TEL (Total Equivalent length) = 640'
- **Choose an air handler or blower:**
- External static pressures:
- Evaporator coil .28" w.c.
- Registers: .03" w.c.
- Grilles: .03" w.c.
- Volume dampers: .03" w.c.
- Media air filter: .20" w.c.
- External static pressure = .57" w.c. (less the duct system)
- Therefore, we need a blower that will deliver 1225 CFM against .57" w.c. external static pressure and still have enough power left over to overcome the resistance of the duct system that we have designed.

Duct Systems Quiz Question Six

6. Most Residential duct systems are designed to operate in a range from 0.5 to 1.0 Inches of Water Column (IWC):

A. True

B. False

CALCULATE THE FRICTION RATE

- Friction rate = ASP (Available Static Pressure) x 100'
- TEL (Total Equivalent Length)
- TEL = 640'
- From the manufacturer's blower performance chart we determined that there are four blowers that are capable of delivering this volume (1225 CFM) and can overcome external static pressure of 0.70", 0.80", 0.90" and 1.0" w.c.
- .70 - .57 = .13" w.c. .13 x 100/640 = .02 (this blower is too small)
- .80 - .57 = .23" w.c. .23 x 100/640 = .036 (this blower is too small)
- .90 - .57 = .33" w.c. .33 x 100/640 = .05 (this blower is too small)
- 1.0 - .57 = .43" w.c. .43 x 100/640 = .067 (this blower is acceptable)
- **Use .07" w.c. as the design static pressure for this duct system and use it to enter the Duct Sizing Calculator to size all of the trunk and branch runs.**

SIZE THE BRANCH DUCTS

- **Total CFM (Cubic Feet Per Minute) for this house = 1225 CFM**
- **How are the CFM per room assignments made?**
- By applying the CF (Cooling Factor = Blower CFM/Manual J Sensible Heat Gain) and/or HF (Heating Factor = Blower CFM/ Manual J Heat Loss) calculations.
- Examples:
- Bathroom needs 66 CFM, use a 6" round supply branch at 340 FPM (Feet per Minute)
- Bedroom 1 needs 169 CFM, $169/2 = 84.5$ CFM, use 2 6" round supply branches at 340 FPM.
- Bedroom 2 needs 141 CFM, $141/2 = 71$ CFM each, use 2 6" round supply branches at 340 FPM.
- Bedroom 3 needs 113 CFM, use a 7" round supply branch at 420 FPM velocity.

Duct Systems Quiz Question Seven

7. Recommended Duct Velocities are:
- A. Fan Outlets: 1000-1660 Feet per Minute (FPM)
 - B. Main Ducts: 700-900 Feet per Minute (FPM)
 - C. Branch Ducts: 400-600 Feet per Minute (FPM)
 - D. All of the above

ALL BRANCH DUCT TOTAL

- Living room: 288 CFM (Cubic Feet Per Minute) (2: 8" round duct or 3:7" round ducts)
- Bedroom 1: 169 CFM (2: 6" round duct)
- Bedroom 2: 141 CFM (2: 6" round duct)
- Bedroom 3: 113 CFM (1: 7" round duct)
- Bathroom 1: 66 CFM (1: 6" round duct)
- Bathroom 2: 30 CFM (1: 4" round duct)
- Kitchen: 128 CFM (2: 6" round ducts)
- Dining Room: 123 CFM (2: 6" round ducts)
- Hallway: 85 CFM (1: 6" round duct)
- Laundry room: 82 CFM (1: 6" round duct)

- **Total CFM: 1225**

MAIN DUCT SIZE

- 1225 Total CFM:
- Look at a 24" x 8" duct = 1200 CFM @ .07" w.c. = 900 FPM
- Look at a 24" x 10" duct = 1320 CFM @ .07" w.c. = 900 FPM
- Look at a 32" x 8" duct = 1300 CFM @ .07" w.c. = 900 FPM
- Trunk Reduction Rule: Reduce the main trunk every 20'-24' with a transition on Supply and Return ducts or when the Velocity in the previous trunk halves.
- Try to maintain 700 -900 FPM on the Main trunk.
- Try to maintain 400-600 FPM on the branch trunk.

Duct Systems Quiz Question Eight

8. To calculate the Longest Total Equivalent Length of a Duct system you need to:
- A. Figure out the Total length of the Supply Duct longest run.
 - B. Figure out the Total Equivalent length of the Return Air Duct longest run.
 - C. Add both A and B together.
 - D. None of the above.

CAPACITY OF TRUNK DUCTWORK 2" RULE

- This method will allow you to check the sizing of the supply and return ductwork.
- Use 8" trunk with a Friction Rate of 0.10" w.c. per 100 feet of equivalent duct length.
- Count the number of 6" round duct runs from the main ductwork.
- Multiply the number of branch runs by 2 then add 2". The number you get is the minimum width of the main rectangular duct required.
- 15, 6" round ducts $\times 2 + 2 = 32$ " width
- The main trunk in this example would be a 32" x 8" supply duct @ .07" w.c. at 900 FPM

TYPICAL STATIC PRESSURE DROPS

- **Note: It is always best to use the OEM (Original Equipment Manufacturers) Product Data static pressure charts to be the most accurate in your system design and testing.**
- If it is not available these are some average static pressure drops:
- Supply duct system: .10" w.c.
- Return duct systems: .10" w.c.
- Evaporator coil .20" w.c.
- Air cleaner: .20" w.c.
- Supply registers: .03" w.c.
- Return grilles: .03" w.c.
- Volume dampers: .03" w.c.
- **Total External Static Pressure: .69" w.c.**
- **The furnace blower must be able to deliver the required volume of air (1225 CFM) against an external static pressure of .69" w.c. @ 700-900 FPM into the supply duct.**

Duct Systems Quiz Question Nine

9. What does FR mean:

- A. Fan Rate
- B. Friction Rate
- C. Furnace Rate
- D. Flue Rating

Duct Systems Quiz Question Ten

10. To do a proper Duct Load Calculation you should use:
- A. ACCA Manual D.
 - B. An ACCA Manual D Sizing form.
 - C. An ACCA Duct sizing Calculator.
 - D. All of the above.

ACCA MANUAL D DUCT DESIGN

- For more Duct Sizing information please refer to:
- ACCA Manual D.
- ACCA Manual D Residential Duct Sizing Calculation form.
- ACCA Duct Sizing Calculator and the ACCA Duct Slide Rule Users Manual.
- ACCA Manual D, ACCA Manual D Residential Duct Sizing Calculation form and the ACCA Duct Sizing Calculator with the ACCA Duct Slide Rule Users Manual can be purchased from ACCA by calling them at (703)-575-4477 or www.acca.org