



Dispelling the Myths for Light-Commercial Duct Systems

Air Duct Council

Most light-commercial HVAC systems use ducts to convey supply and return air to and from the conditioning unit to outlets throughout the building. The three most common types of ducting used in light commercial systems are round snap-lock sheet metal pipe (typically post-insulated), rectangular fiberglass duct board and insulated UL-181 labeled flexible duct. The model building codes and their referenced standards govern the construction and performance of each of these duct types.

There can be a misconception that light-commercial duct systems using flexible duct are inherently less efficient at moving air than duct systems that are assembled with metal duct and metal elbow transitions. The myth is a wire helix core of flexible duct exhibits greater pressure drop than the same diameter sheet-metal duct and overall efficiency of the system will suffer. Example - ASHRAE Handbook of Fundamentals recommends that flexible duct be limited to six feet length for commercial applications. One model building code (IAPMO - UMC) actually limits the length of flexible duct in commercial applications to maximum five feet because of this same myth.

The Air Duct Council believes that making this assumption without taking into account all other aspects of the duct system is incorrect and a disservice to one duct type. To validate that light-commercial HVAC systems perform comparatively regardless of selection of either of these two duct type, ADC commissioned a third-party laboratory to conduct pressure loss measurements of multi-branch duct systems utilizing various lengths of both sheet metal and flexible duct. The testing program evaluated a system compliant with the model code limitation for flexible duct length and compared it with two additional system configurations that incorporated progressively longer lengths of flexible duct. The test program demonstrated that light-commercial duct systems using significantly longer lengths of flexible duct perform comparative to systems with flexible duct length limited as per the referenced code requirement.

Three similar multi-branch systems (Systems A, B, & C) were evaluated during the performance of this testing program. Each system consisted of a twelve inch diameter by thirty feet long metal trunk line containing three take-offs spaced ten feet apart. The end of the trunk line was capped. Branch lines extended perpendicular to the trunk line from each of the take-offs for a total distance of sixteen feet and included a 90-degree bend. Each branch line terminated at a 24 inch square T-Bar Diffuser after the 90-degree flex bend. All metal trunk and branch lines were connected using self-tapping screws, sealed with approved mastic, and supported at the required five feet maximum spacing per SMACNA HVAC Duct Construction Standard - Metal and Flexible. All flexible ducts were sealed using approved tape and fasteners and supported at the required four feet maximum spacing per the ADC Flexible Duct Performance and Installation Standard. Prior to installation, the flex duct was fully stretched and allowed to retract to its relaxed state. Bends for the flexible duct maintained the minimum one duct diameter bend radius (reference Images 1, 2, & 3 for the test set-ups).

Figure 1- For System A, each branch run consisted of an eight inch diameter metal take-off, ten lineal feet of eight inch diameter sheet metal duct, six lineal feet of eight inch diameter flexible duct, a 90-degree flex bend, and the T-Bar Diffuser. This set-up most resembles the length limitation for flex as described above (see Figure 1).

Figure 1- System A

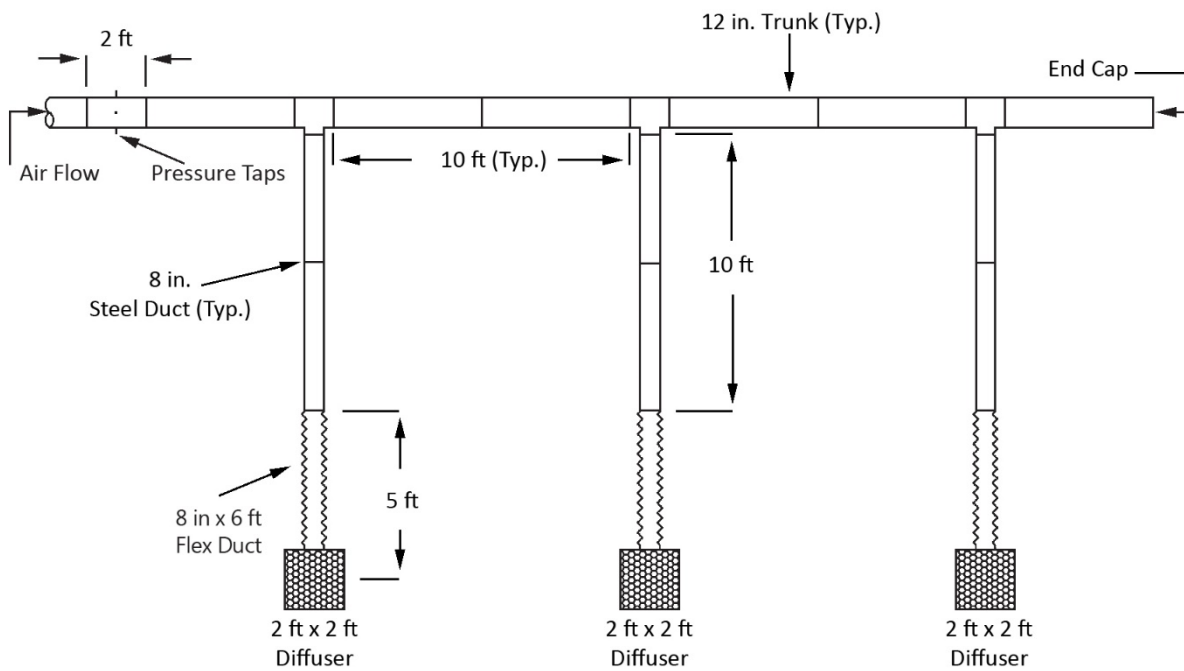


Figure 2- System B, The branch runs consisted of an eight inch diameter metal take-off, five lineal feet of eight inch diameter sheet metal duct, eleven lineal feet of eight inch diameter flexible duct, a 90-degree flex bend, and the T-Bar Diffuser. This set-up effectively doubles the length of flex duct before the bend and exceeds the code limitation by a hundred percent (see Figure 2).

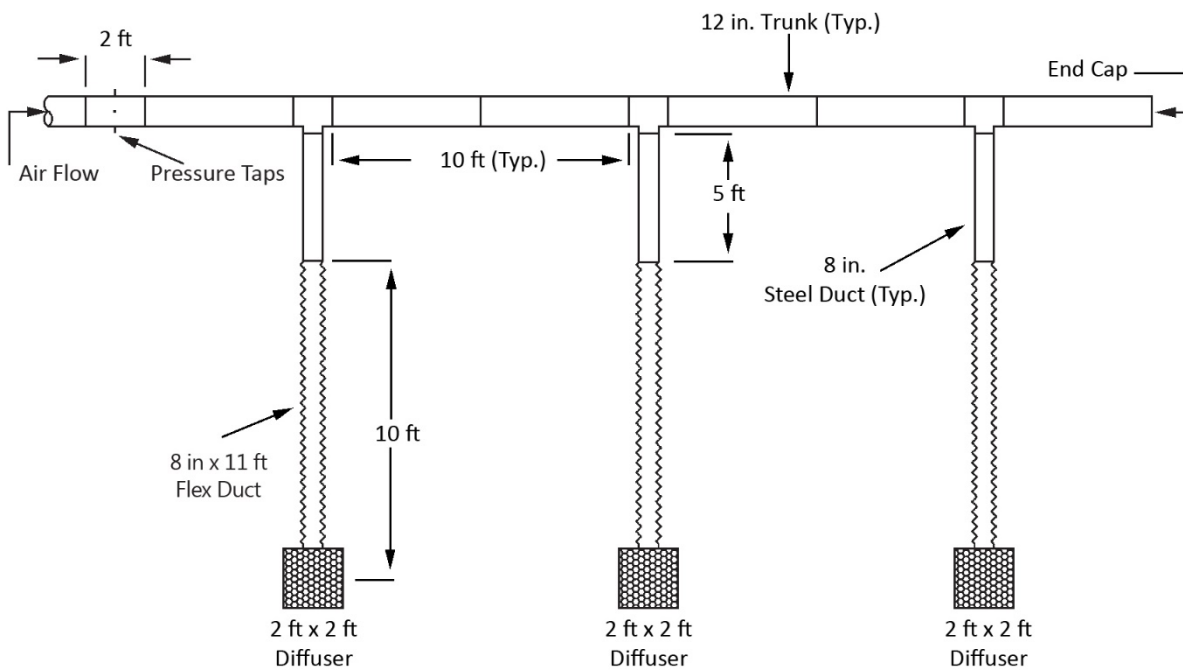


Figure 2- System B

Figure 3- For System C, the eight inch diameter metal take-offs in the trunk line were replaced with nine inch take-offs and the branch lines consisted of sixteen lineal feet of nine-inch diameter flexible duct with a 90-degree flex bend before the T-Bar Diffuser. This size change is appropriate when taking into account the pressure loss characteristic of the flex duct and to maintain the design airflow measured from the diffusers. Length of flex duct for System C now exceeds the 5- foot limit in the code and 6- feet recommendation for commercial applications by more than a factor of three (see Figure 3).

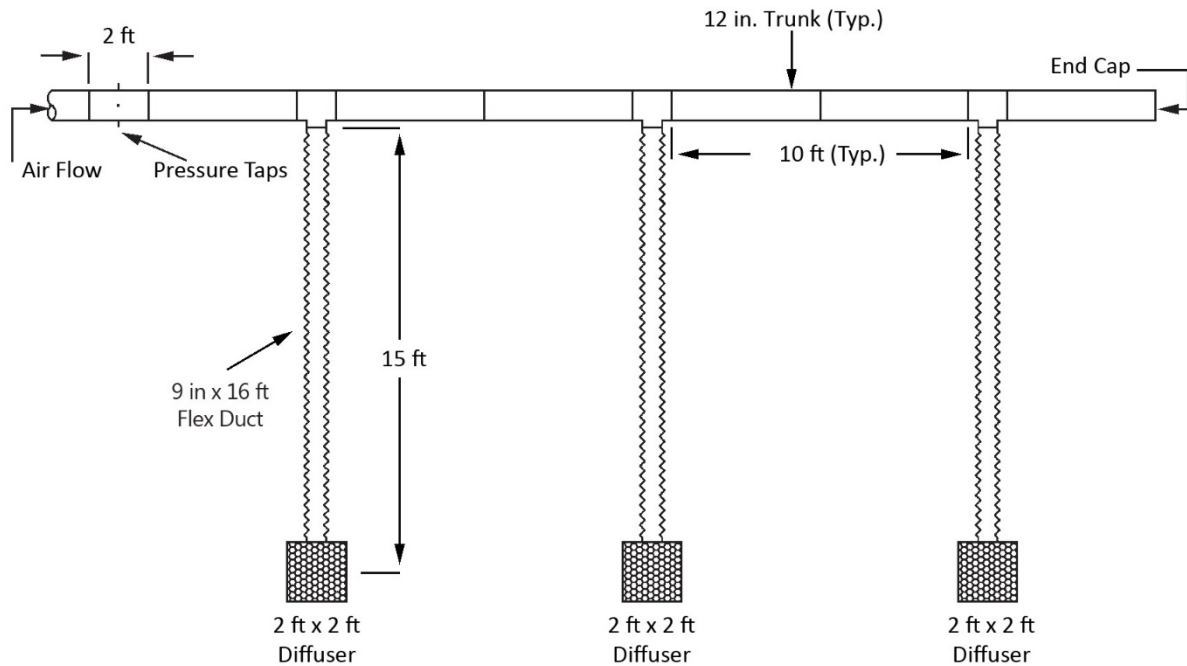


Figure 3- System C

For each test set-up, a centrifugal fan and multiple-nozzle chamber was used to develop a range of airflow through the duct system. The system static pressure was measured at a prescribed location upstream of the test section using pressure taps configured as a piezometer ring connected to a micro manometer. Airflow determination and static pressure measurement was conducted following the principles in ASHRAE Standard 120-2017, “*Method of Testing to Determine Flow Resistance of HVAC Ducts and Fittings*”. A calibrated airflow capture hood was used to measure the flow rates at each of the three diffusers following the device manufacturer’s recommendations for measurement.

Total system pressure loss was measured as a function of velocity pressure upstream of the test sections. Total pressure loss and the velocity pressure data were corrected to standard conditions of air density. Figure 4 demonstrates the comparison of pressure loss curves for each test set-up.

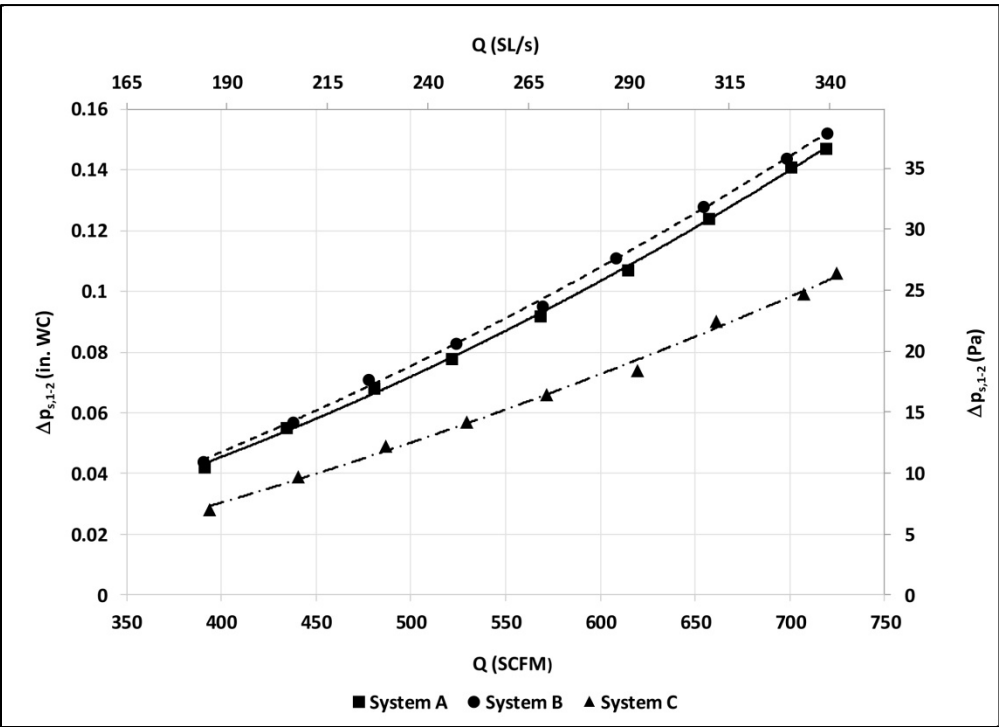


Figure 4

Figure 5 indicates the loss coefficients (C_o) for each test set-up.

Loss Coefficient Data for Systems A, B, and C			
System	C	δC	Loss Coefficient Factor
A	3.829	0.078	1.00
B	3.937	0.112	1.03
C	2.981	0.128	0.78

Figure 5

The comparison of data for System B versus A shows only an approximate 3% penalty when the flexible duct installation is twice the length of the current code limitation. This small increase in pressure drop does not appear to justify the limitation of flexible duct length in the referenced building code.

Furthermore, when comparing System C to System A, there is a 22% advantage even though the flexible duct installation is more than three times the length of the code limitation. By appropriately sizing the flexible duct for the desired flow rate, comparable (and potentially better) results can be obtained due to the overall reduction in pressure loss associated with the increased diameter of the duct and the fittings.

The results from this 3rd party laboratory study clearly demonstrates that flexible air ducts exhibit satisfactory air flow performance, even when the flex length exceeds the limitations prescribed in the referenced code and handbook. When properly sized and installed, flexible air ducts provide a suitable choice for duct installation in light-commercial applications.



Image 1 (System A)



Image 2 (System B)



Image 3 (System C)