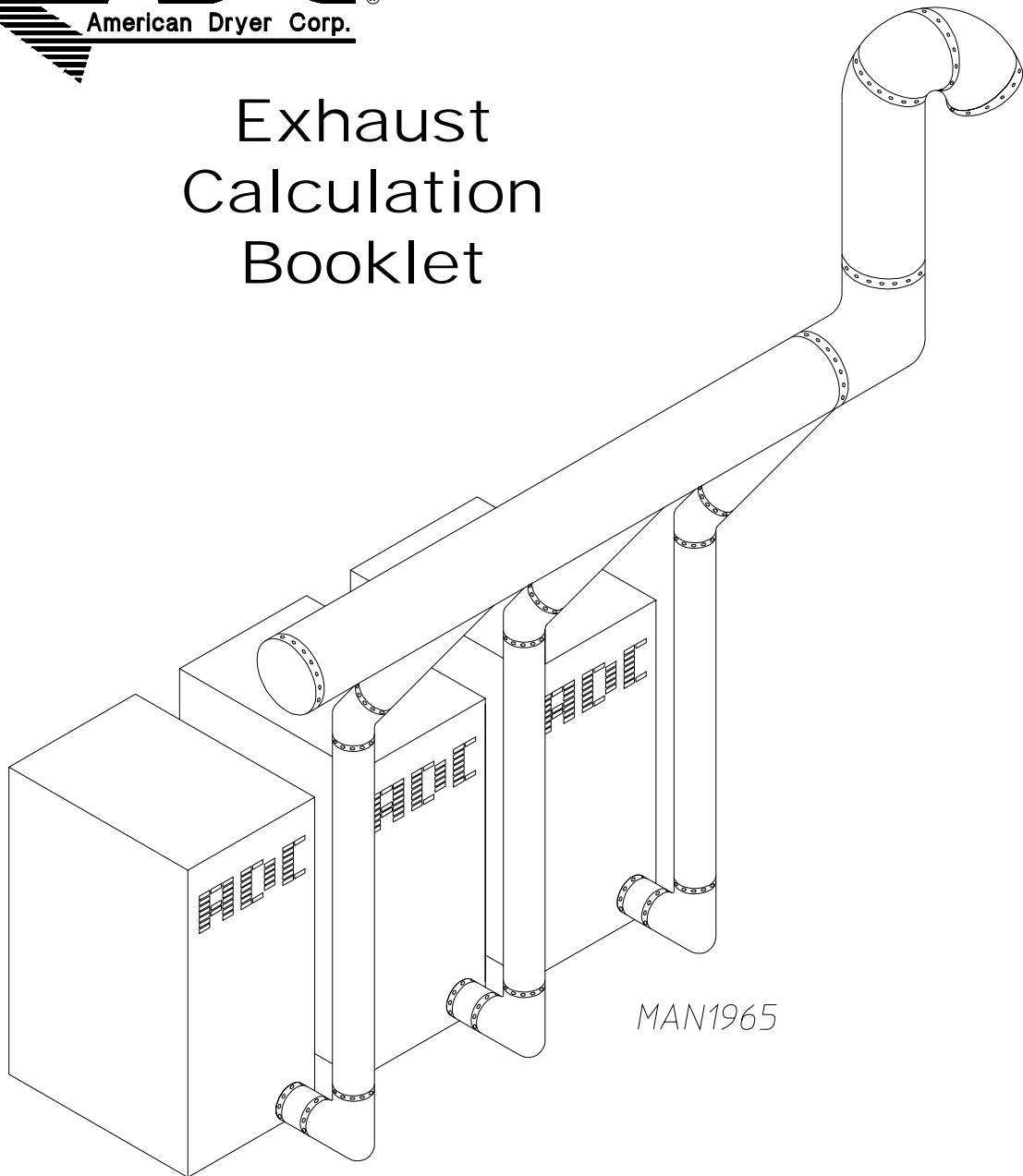




# Exhaust Calculation Booklet



MAN1965

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**ADC Part No. 450450**

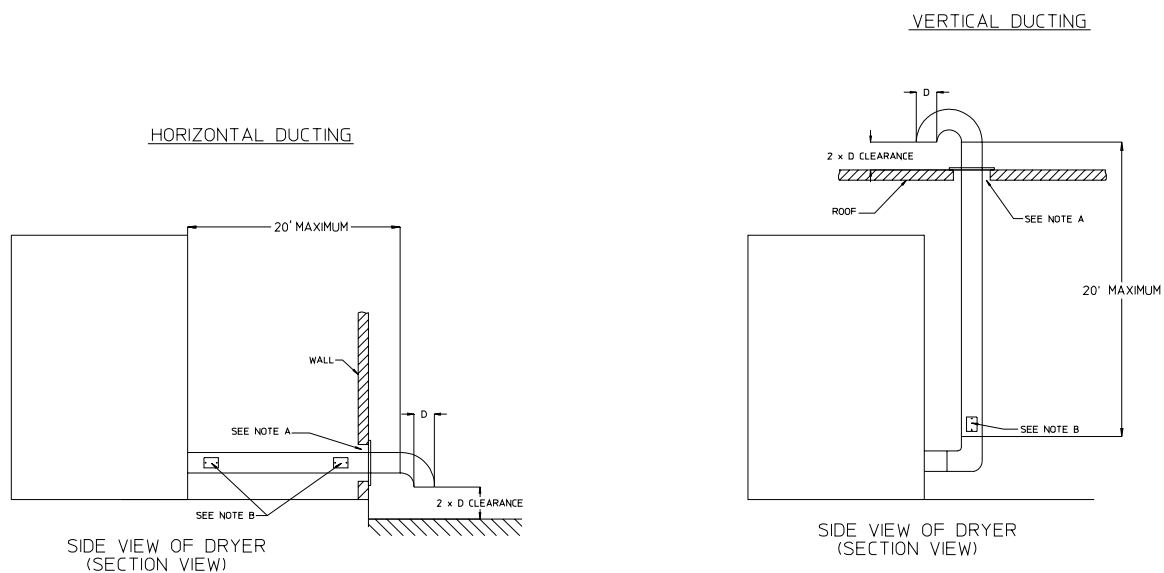
Exhaust duct work should be designed and installed by a qualified professional. Properly sized duct work is imperative for the dryer(s) to operate efficiently and safely. Improperly sized duct work will create conditions which result in slow drying, increased use of energy, shutdown of the burner by the air flow (sail) switch, burner hi-limit, or basket (tumbler) hi-heat thermostats. A potential fire hazard may be created if the duct work is improperly sized or installed.

The dryer must be exhausted to the outdoors. The exhaust duct work should be designed and installed in such a way that it travels as directly as possible to the outdoors with as few elbows as possible. Wherever the duct passes through a wall, ceiling, or roof made of combustible materials, the opening must be two (2) inches larger, all the way around, than the duct. The duct must be centered within this opening. The use of sheet metal screws should be avoided as the projections within the duct work trap lint and cause an increase in friction loss. All duct work connections should be taped to prevent lint and moisture from escaping into the building. Doors should be installed throughout strategic points in the duct work for periodic inspection and cleaning.

Where possible, it is suggested to provide a separate (independent) exhaust duct for each dryer. When a dryer is exhausted separately, it is recommended that a back draft damper be installed, if not provided with the dryer. If it is not feasible or possible to provide separate exhaust ducts for each dryer, ducts from individual dryers may be channeled into a "common main duct". The individual ducts should enter the bottom or side of the main duct at an angle of not more than 45 degrees, in the direction of the air flow and should be spaced apart the width of the dryer. When exhausting individual dryers into a main common duct, each dryer must have a back draft damper.

To protect the outside end of horizontal duct work from the weather, a 90 degree elbow bent downward should be installed where the exhaust exits the building. If the exhaust duct work travels vertically up through the roof, it should be protected from the weather by using a 180 degree turn to point the opening downward. In both instances, a distance equal to twice the diameter of the exhaust duct must be allowed between the duct opening and the nearest obstruction. Do not use screens, louvers, or caps on the outside opening of the exhaust duct. The following are examples of single and multiple dryer exhaust ducting.

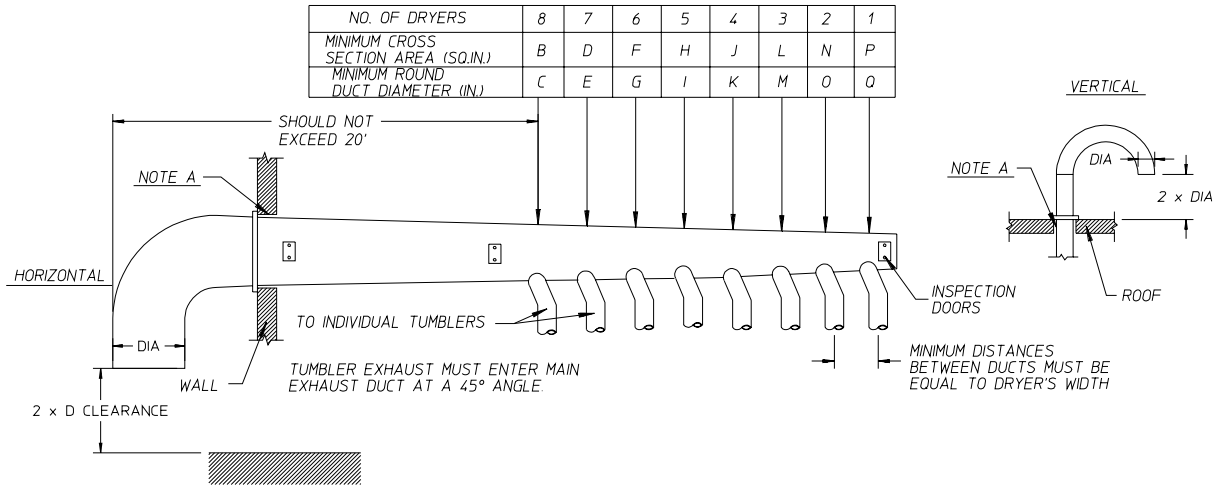
### SINGLE DRYER VENTING



NOTE: "A"- OPENING MUST BE TWO (2) INCHES LARGER THAN DUCT (ALL THE WAY AROUND). THE DUCT MUST BE CENTERED WITHIN THIS OPENING.  
 "B"- INSPECTION DOORS SHOULD BE INSTALLED AT STRATEGIC POINTS FOR PERIODIC INSPECTION AND CLEANING

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MULTIPLE DRYER VENTING  
WITH AN "A" DIAMETER EXHAUST CONNECTIONS AT COMMON DUCT



IMPORTANT: NO MORE THAN 8 DRYERS CAN BE CONNECTED TO ONE COMMON DUCT ( VENT ) WITH A HORIZONTAL RUN AND NO MORE THAN 6 DRYERS CAN BE CONNECTED WITH A VERTICAL RUN.

NOTE A: OPENING MUST BE TWO (2) INCHES LARGER THAN DUCT (ALL THE WAY AROUND). THE DUCT MUST BE CENTERED WITHIN THIS OPENING.

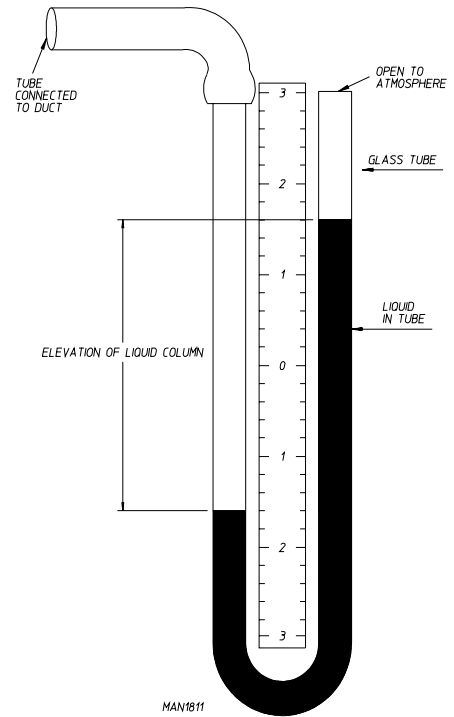
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The pressure of the air in sheet metal ducts is of great importance for safe and efficient operation of the dryer. The air pressures, as small as they are, have a large influence upon the performance of the dryer. There are three pressures present within a duct. The velocity pressure which is the pressure due to the moving stream of air, the static pressure which is the outward push of the air against the walls of the duct, and the total pressure which is the sum of the static and velocity pressures. Only the total and static pressures can be measured. The velocity pressure is then calculated from the difference between the two. The static pressure is the most influential and determining factor in the design of a dryer duct system. American Dryer Corp. recommends that the dryer exhaust duct static pressure not exceed the maximum listed in the dryer installation manual.

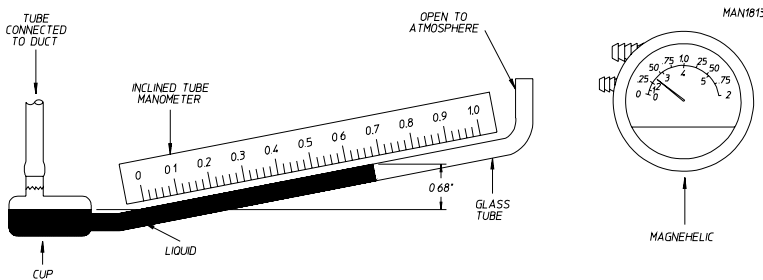
Gages used to measure such small air pressures utilize the elevation of a column of water. This form of gage is called a manometer. One form of this gage is known as a U-tube and is shown in Illustration #1. When one end of the tube is connected to the duct, the static (outward) pressure within the duct forces the water column to be depressed in one leg of the U-tube and up in the other. The elevation of the water column in Illustration #1 is 3.2 inches.

**Illus. # 1**



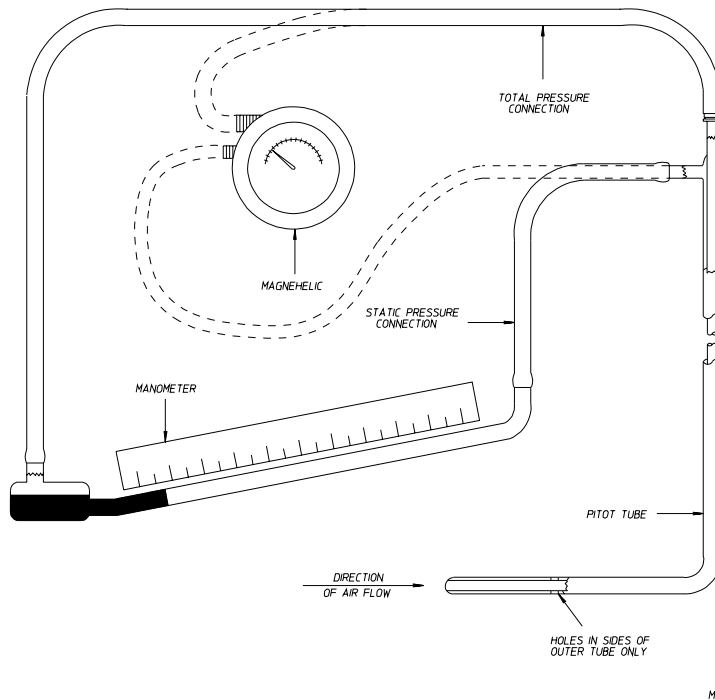
When measuring such small air pressures the U-tube is often not accurate enough. Such small differences in pressure are most often measured by an inclined tube manometer or a Magnehelic pressure gage as shown in Illustration # 2.

**Illus. # 2**



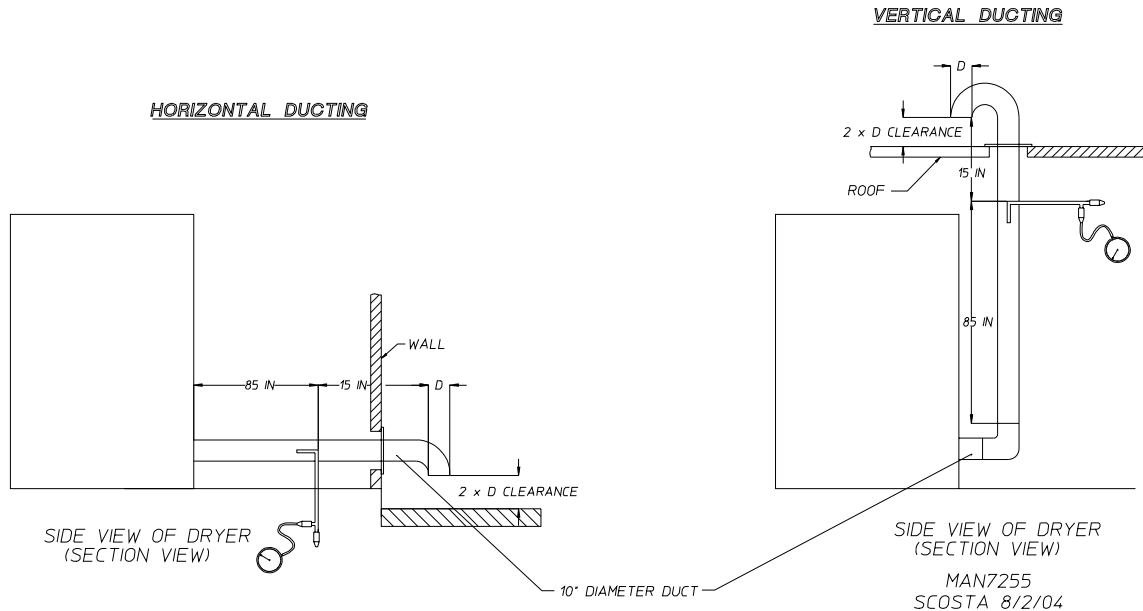
For convenience and accuracy an instrument known as a Pitot tube is used with the gage. The Pitot tube, as shown in Illustration #3, consists of two tubes - one within the other. The inner tube measures the total pressure alone while the outer tube measures the static pressure alone.

**Illus. # 3**



To obtain the most accurate static pressure readings of a dryer, the following guidelines should be conformed to. The reading should be taken in a straight section of duct, a minimum of ten (10) times the diameter of the duct (i.e. 10" diameter duct, a straight section 100" in length). The reading should be taken a minimum of 8-1/2 times the diameter upstream of the dryer or nearest elbow, and 1-1/2 times the diameter downstream of the Pitot tube. The following is an example showing the proper location to take a static pressure reading.

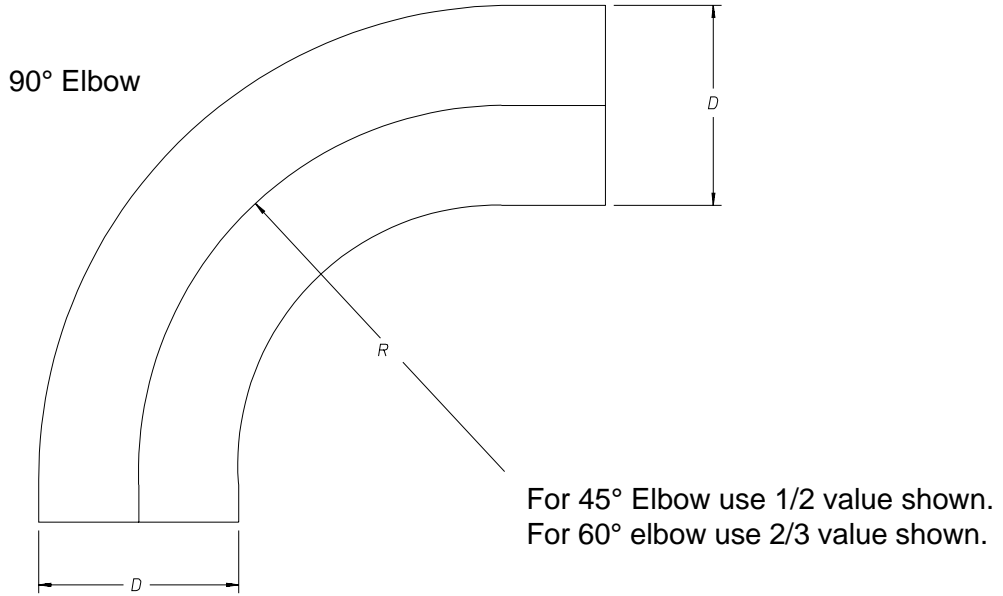
### SINGLE DRYER VENTING



In designing a dryer exhaust duct system it is not necessary to compute the friction loss of the duct work. American Dryer Corp. recommends that the dryer exhaust duct static pressure not exceed the maximum listed in the dryer installation manual. This maximum allowable static pressure is calculated to provide maximum dryer efficiency. It is necessary to determine the total equivalent length of the duct system. The total equivalent length of the duct system is the actual length of the duct added to the equivalent length of all of the fittings. The equivalent length of a fitting is the length of straight duct of the same size as the fitting in which the friction losses are equal. Equivalent lengths must be determined for all elbows, as well as, any entries which may be incorporated into a common duct system for multiple dryers. The total equivalent length is then used with the total cfm (cubic feet per minute) exhaust rating of the dryer(s) to calculate the minimum round duct diameter. Values of the equivalent length of specific diameter elbows can be determined from Table #1. When designing a single common duct system for multiple dryers, each individual dryer exhaust duct enters the main common duct. The equivalent length of the entry losses for each dryer can be determined from the values listed in Table #2.

Table # 1  
**Equivalent Resistance of Round Elbows**  
 Expressed in Feet of Straight Pipe

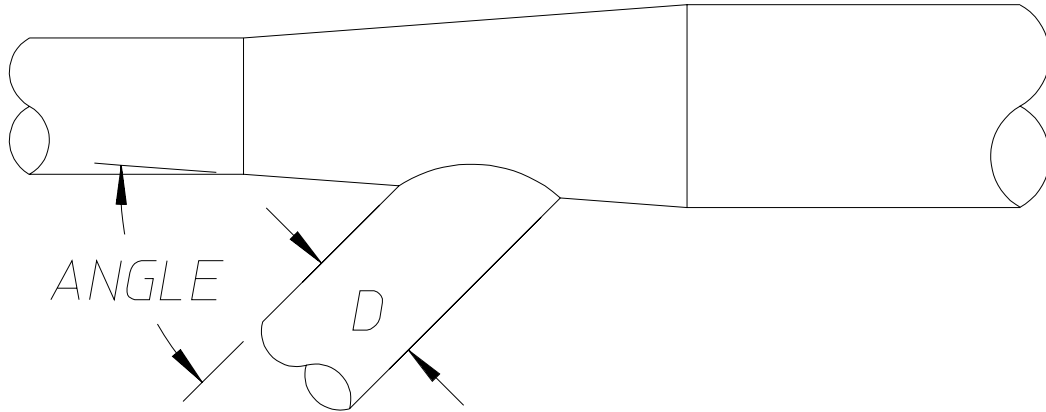
MAN1739



D	$\frac{R}{D} = 1.5$
4"	6'
6"	12'
8"	15'
10"	20'
12"	25'
14"	30'
16"	36'
18"	41'
20"	46'
24"	57'
28"	68'
30"	74'
32"	80'
36"	93'
40"	105'
42"	111'
44"	118'
48"	130'

Table # 2  
**Equivalent Entry Losses**  
 Expressed in Feet of Straight Pipe

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Dia of Pipe	30°	45°
4"	3'	5'
6"	5'	7'
8"	7'	11'
10"	9'	14'
12"	11'	17'
14"	13'	21'
16"	16'	25'
18"	18'	28'
20"	20'	32'
24"	24'	37'
28"	28'	46'
30"	31'	49'
32"	33'	53'

TABLE # 3

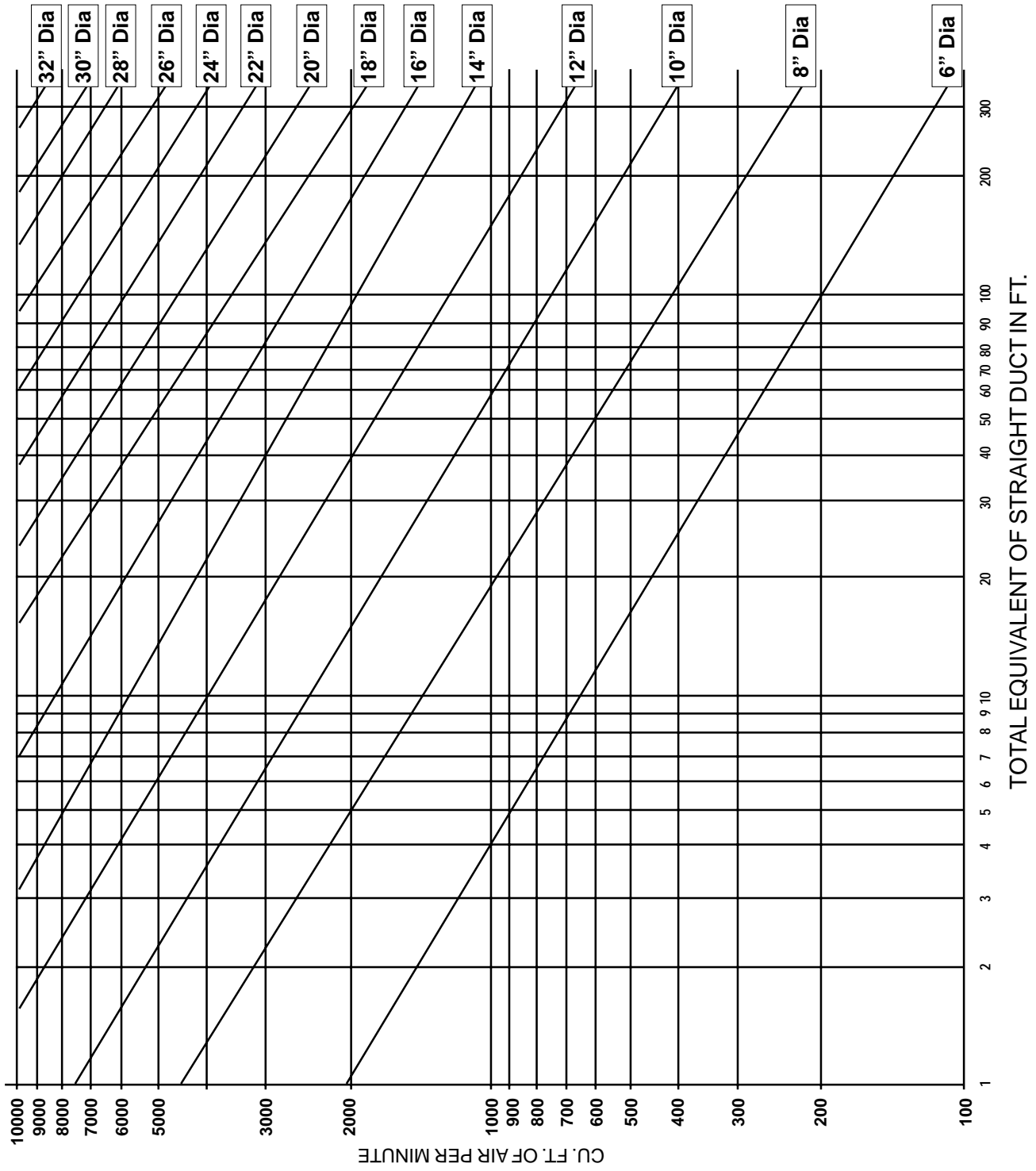
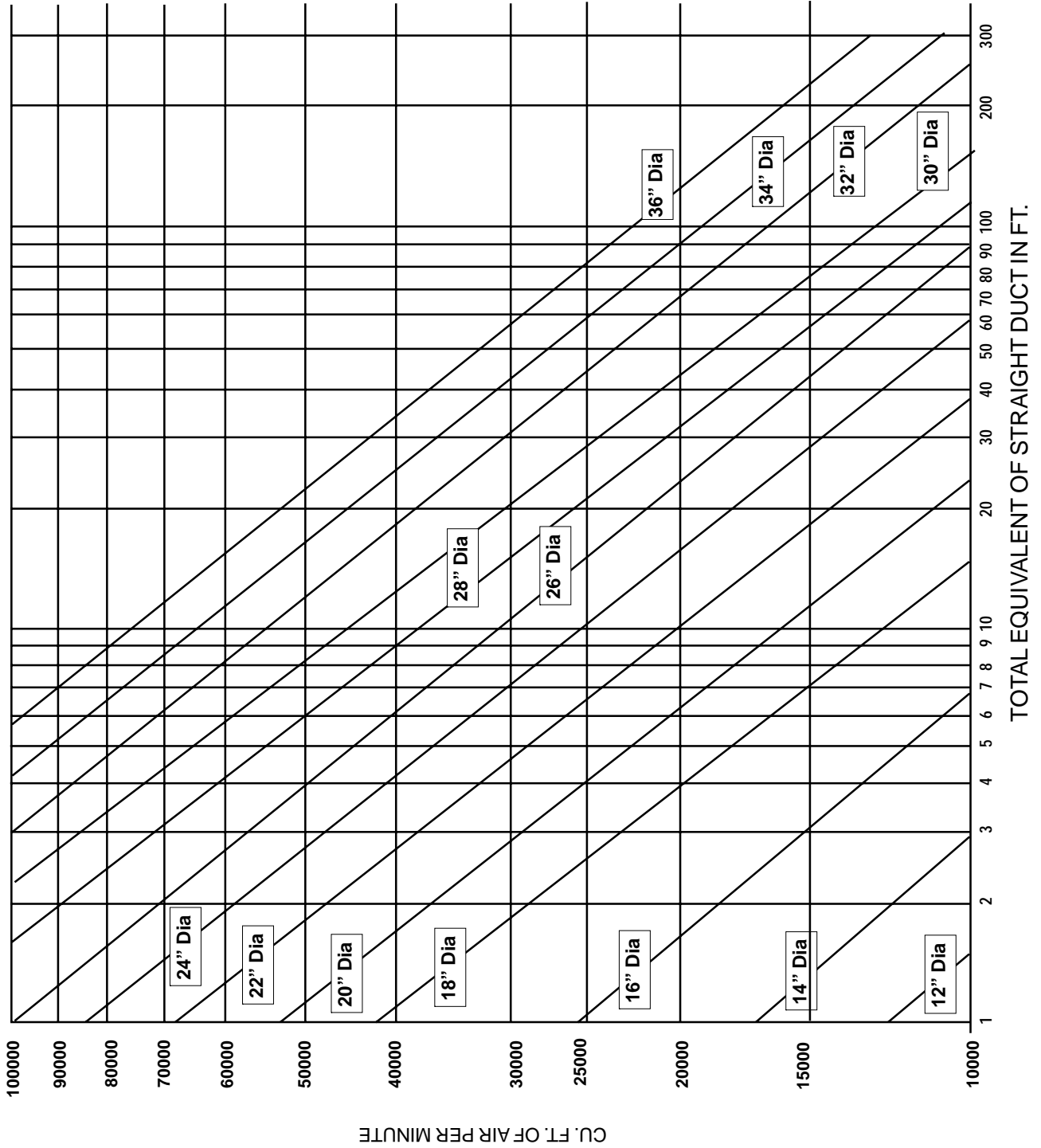


TABLE # 4



Once the total equivalent length of duct is determined, Tables #3 and #4 are used to determine the minimum diameter round duct to be used. The dryer(s) cfm is read on the left hand side of the chart. The total equivalent length of duct is read across the bottom. The minimum diameter round duct to be used is read at the intersection of the two.

Each round duct diameter line on the graph represents the maximum limit for each size shown. When making calculations, if the intersection is in the middle of two diameters, the larger size is chosen (I.E. 600 cfm at 30' use 8" diameter).

The following are examples of the procedures to calculate the duct size for a single dryer.

**Example 1:**

A dryer has an air flow of 600 cfm (cubic feet per minute) and an 8-inch diameter dryer exhaust connection. The duct run will travel 20 feet and has two (2) - 90 degree elbows. What is the total equivalent length of the duct system? What will be the minimum diameter round duct to be used?

Solution:

Straight length of duct:	20 Feet
From Table #1	
Equivalent length of each 90 degree elbow:	15 Feet x 2 = 30 Feet
Total equivalent length of the duct system:	50 Feet

From Table #3  
The minimum diameter round duct to be used is 8-inches.

**Example 2:**

A dryer has an air flow of 1,700 cfm with a 12-inch dryer exhaust connection. The exhaust duct will travel 50 feet with six (6) 90 degree elbows. What is the total equivalent length of the duct system? What will be the minimum diameter round duct to be used?

Solution:

The initial total equivalent length of the duct system must first be calculated using the dryer exhaust connection size.

Straight length of duct:	50 Feet
From Table 1	
Equivalent length of each 12" 90 degree elbow:	25 Feet x 6 = 150 Feet
Total equivalent length of the duct system:	200 Feet

From Table 3  
The minimum diameter round duct to be used is 16-inches.

Because the minimum diameter round duct to be used calculates to a size which is larger than the dryer exhaust connection, the total equivalent length of the duct system must be recalculated using the 16" diameter equivalent lengths. This new total length is then used with the dryer(s) cfm to verify that it still falls within the 16" diameter minimum round duct area.

Straight length of duct:	50 Feet
From Table 1	
Equivalent length of each 16" 90 degree elbow:	36 Feet x 6 = 216 Feet
Total equivalent length of the duct system:	266 Feet

From Table 3

The minimum diameter round duct to be used is 16-inches.

When calculating and sizing a common exhaust duct for two (2) or more dryers, several steps are required. First, the main common duct size is calculated using the total cfm of all of the dryers and the total equivalent length of the duct system. Second, the individual dryer exhaust ducts, which travel to the common duct, are calculated.

Tables 5 and 6 are used to determine the initial common duct size to use in the calculation of the total equivalent length of the duct system. The total cfm of all of the dryers are added and found on the left side of the chart. The friction loss (static pressure) is listed at the bottom of the chart. The value of .3" water column is used at the bottom of the chart. This is the maximum recommended static pressure for the dryer exhaust. The initial minimum diameter round duct is then read at the intersection of the total cfm and the .3" water column value. This initial duct size is then used to calculate the total equivalent length of the duct system.

TABLE # 5

**AIRFLOW**

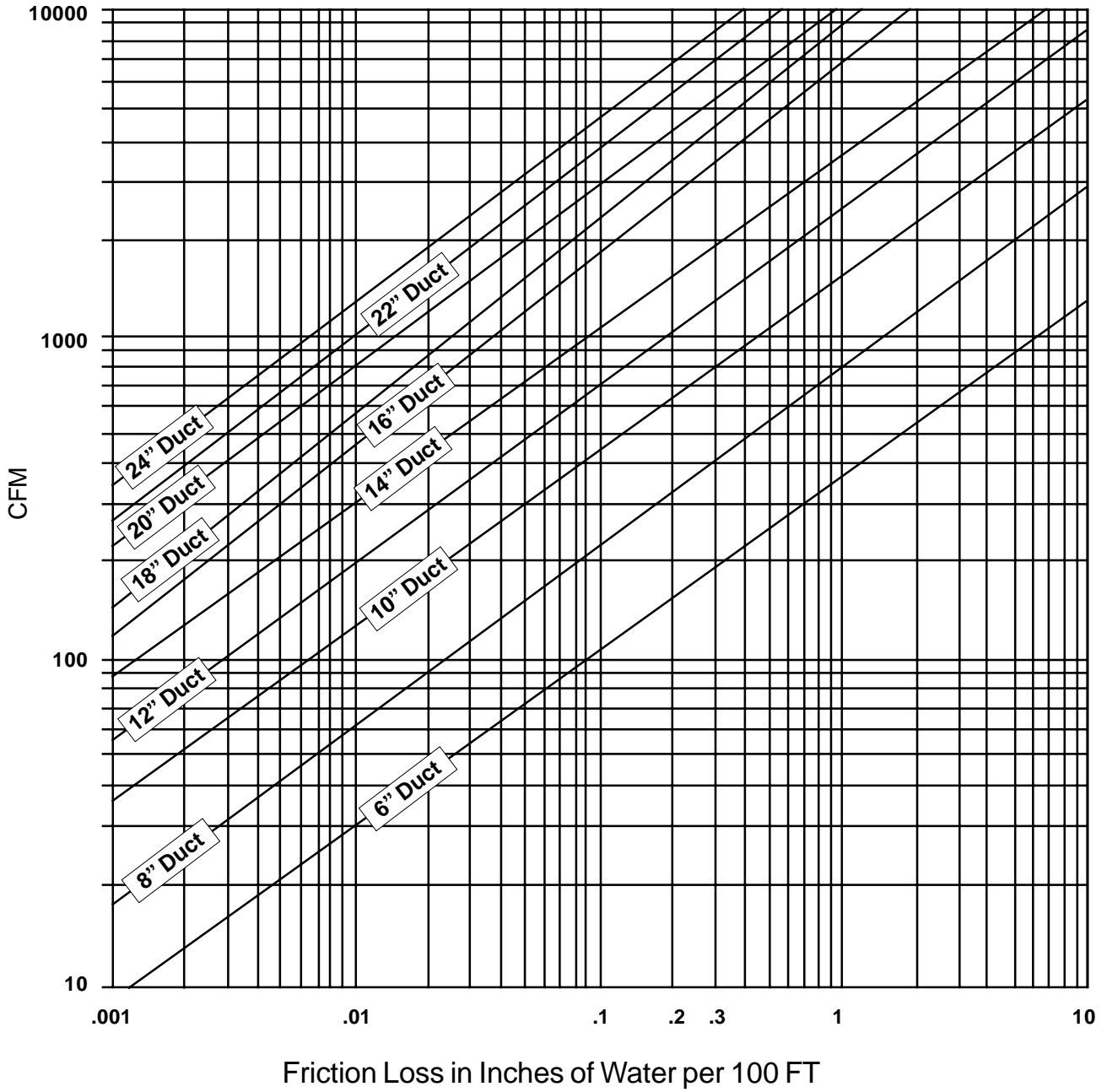
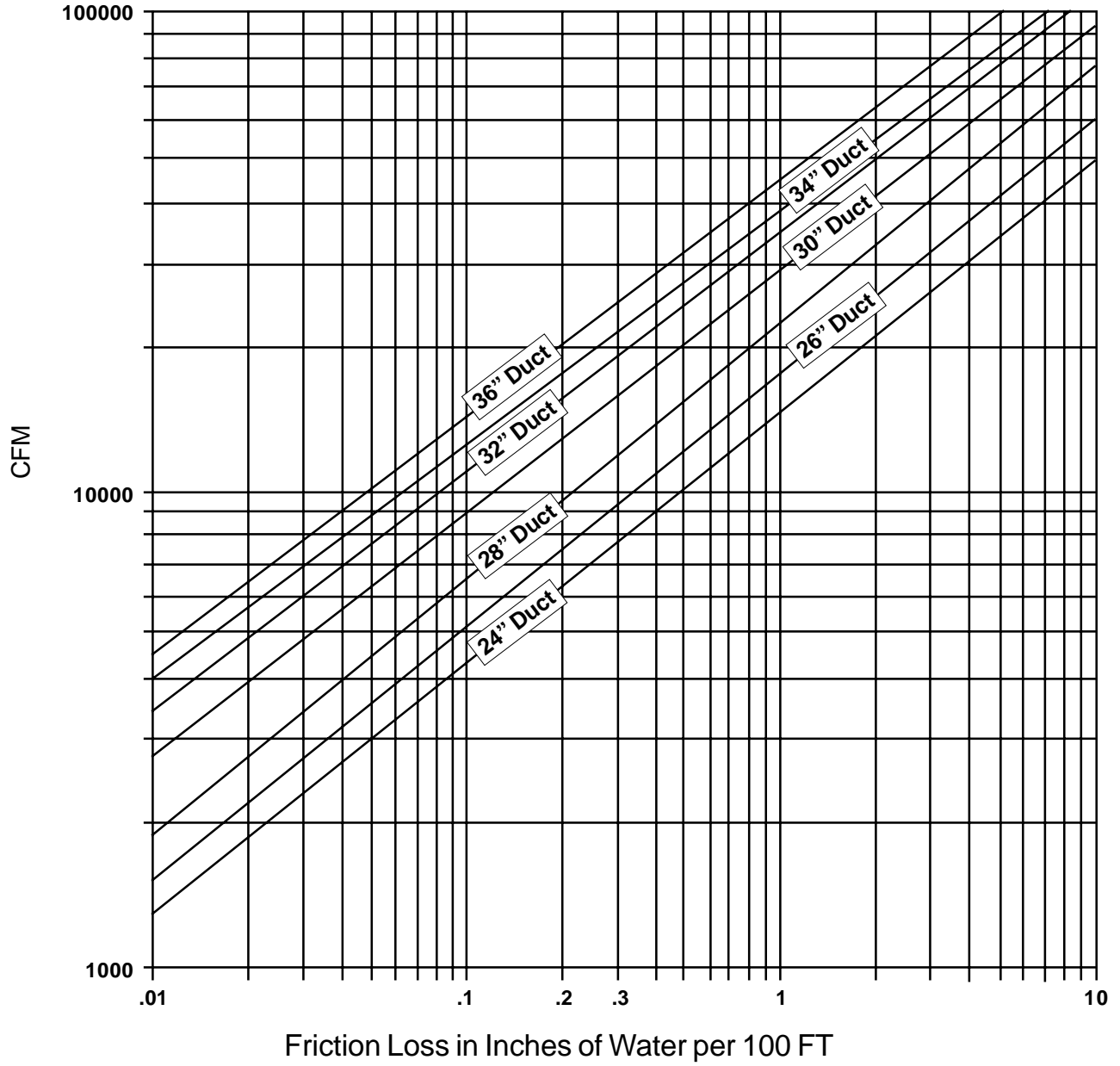


TABLE # 6

**AIRFLOW**



The following examples show how a single common duct for multiple dryers is calculated.

**Example 1:**

There are three (3) dryers with 600 cfm each which will be connected to one (1) common exhaust duct. The dryers have an 8" diameter exhaust connection. The main duct will have a total run of 70 feet and include three (3) 90 degree elbows and two (2) 45 degree elbows. Each individual dryer duct will travel ten (10) feet and have one (1) 90 degree elbow, one (1) 45 degree elbow, and enter the common duct at a 45 degree angle. What is the total equivalent length of the common duct system? What is the minimum diameter of the main common duct? What is the total equivalent length of the individual dryer ducts? What is the minimum diameter of the individual dryer ducts?

Solution:

To determine the total equivalent length and minimum diameter round duct of the main common duct.

From Table 5

The intersection of 1,800 cfm (total of 3 dryers at 600 cfm each) and the static pressure of .3" water column is 14" diameter duct. This is the initial size used in calculations.

Straight length of duct:	70 Feet
From Table 1	
Equivalent length of each 14" 90 degree elbow:	30 Feet x 3 = 90 Feet
Equivalent length of each 14" 45 degree elbow:	15 Feet x 2 = 30 Feet
Total equivalent length of the common duct:	190 Feet

From Table 3

The minimum diameter round duct for the common duct is 16-inches.

The total equivalent length must be recalculated using 16" diameter equivalent lengths to determine the total equivalent length. This is necessary because the minimum size shown on Table 3 exceeded the initial size obtained in Table 5. This recalculation is required because the initial size obtained in Table 5 is calculated on a total equivalent length of duct of 100 feet.

When the calculated total equivalent length exceeds 100 feet, the minimum diameter , in most cases, increases.

Straight length of duct:	70 Feet
From Table 1	
Equivalent length of each 16" 90 degree elbow:	36 Feet x 3 = 108 Feet
Equivalent length of each 16" 45 degree elbow:	18 Feet x 2 = 36 Feet
Total equivalent length of the common duct:	214 Feet

From Table 3

The minimum diameter round duct for the common duct is 16-inches.

To determine the total equivalent length and minimum diameter round ducts for the individual dryer exhausts.

When calculating and sizing the individual dryer exhaust ducts, the dryer's exhaust connection size is initially used to determine the total equivalent length.

Straight length of duct:	10 Feet
From Table 1	
Equivalent length of each 8" 90 degree elbow:	15 Feet x 1 = 15 Feet
Equivalent length of each 8" 45 degree elbow:	7-1/2 Feet x 1 = 7-1/2 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 8":	11 Feet
Total equivalent length of each individual dryer duct:	43-1/2 Feet

From Table 3

The minimum diameter round duct for each individual dryer duct is 8-inches.

**NOTE:** The dryer exhaust duct must never be decreased from the dryer's exhaust connection size.

### Example 2:

There are four (4) dryers which will be connected into a main common duct. The common duct will travel 45 feet and include four (4) 90 degree elbows. There are two (2) dryers with 2,000 cfm each which have a 12" exhaust connection, one (1) dryer with 1,500 cfm which has a 10" exhaust connection, and one (1) dryer with 800 cfm which has an 8" exhaust connection. Each individual dryer exhaust duct will travel 15 feet and include one (1) 90 degree elbow, one (1) 45 degree elbow, and will enter the common duct at a 45 degree angle. What is the total equivalent length of the common duct? What is the minimum diameter round duct to be used for the common duct? What is the total equivalent length and minimum diameter round duct for each of the individual dryer ducts?

Solution:

To determine the total equivalent length of the main common duct.

From Table 5

The intersection of 6,300 cfm (total cfm of 4 dryers) and the static pressure of .3" water column is 22" diameter duct. This is the initial size used in calculations.

Straight length of duct:	45 Feet
From Table 1	
Equivalent length of each 22" 90 degree elbow:	1 Feet x 4 = 204 Feet
Total equivalent length of the common duct:	249 Feet

From Table 3

The minimum diameter round duct for the common duct is 28-inches.

The total equivalent length must be recalculated using 28" diameter equivalent lengths to determine the total equivalent length. This is necessary because the minimum size shown in Table 3 exceeded the initial size obtained from Table 5.

Straight length of duct:	45 Feet
From Table 1	
Equivalent length of each 28" 90 degree elbow:	68 Feet x 4 = 272 Feet
Total equivalent length of the common duct:	317 Feet

From Table 3

The minimum diameter round duct for the common duct is 28-inches.

To determine the total equivalent length and minimum diameter round duct for the individual dryer ducts.

For the dryers with 2,000 cfm each with a 12" diameter exhaust connection.

Straight length of duct:	15 Feet
From Table 1	
Equivalent length of each 12" 90 degree elbow:	25 Feet x 1 = 25 Feet
Equivalent length of each 12" 45 degree elbow:	12-1/2 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 12":	17 Feet
Total equivalent length of each individual dryer duct:	69-1/2 Feet

From Table 3

The minimum diameter round duct for each individual dryer duct is 14-inches.

The total equivalent length must be recalculated using 14" diameter equivalent lengths to determine the total equivalent length. This is necessary because the minimum size shown in Table 3 exceeds the dryer exhaust connection size used initially.

Straight length of duct:	15 Feet
From Table 1	
Equivalent length of each 14" 90 degree elbow:	30 Feet
Equivalent length of each 14" 45 degree elbow:	15 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 14":	21 Feet
Total equivalent length of the individual dryer duct:	81 Feet

From Table 3

The minimum diameter round duct for the individual dryer duct is 14-inches.

For the dryer with 1,500 cfm with a 10" diameter exhaust connection.

Straight length of duct:	15 Feet
From Table 1	
Equivalent length of each 10" 90 degree elbow:	20 Feet
Equivalent length of each 10" 45 degree elbow:	10 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 10":	14 Feet
Total equivalent length of the individual dryer duct:	59 Feet

From Table 3

The minimum diameter round duct for the individual dryer duct is 12-inches.

The total equivalent length must be recalculated using 12" diameter equivalent lengths to determine the total equivalent length. This is necessary because the minimum size shown in Table 3 exceeds the dryer exhaust connection size used initially.

Straight length of duct:	15 Feet
From Table 1	
Equivalent length of each 12" 90 degree elbow:	25 Feet x 1 = 25 Feet
Equivalent length of each 12" 45 degree elbow:	12-1/2 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 12":	17 Feet
Total equivalent length of each individual dryer duct:	69-1/2 Feet

From Table 3

The minimum diameter round duct for each individual dryer duct is 12-inches.

For the dryer with 800 cfm with an 8" diameter exhaust connection.

Straight length of duct:	15 Feet
From Table 1	
Equivalent length of each 8" 90 degree elbow:	15 Feet
Equivalent length of each 8" 45 degree elbow:	7-1/2 Feet
From Table 2	
Equivalent length of entry loss at 45 degree angle for 8":	11 Feet
Total equivalent length of the individual dryer duct:	48-1/2 Feet

From Table 3

The minimum diameter round duct for the individual dryer duct is 10-inches.

The total equivalent length must be recalculated using 10" diameter equivalent lengths to determine the total equivalent length. This is necessary because the minimum size shown in Table 3 exceeds the dryer exhaust connection size used initially.

Straight length of duct: From Table 1	15 Feet
Equivalent length of each 10" 90 degree elbow:	20 Feet
Equivalent length of each 10" 45 degree elbow: From Table 2	10 Feet
Equivalent length of entry loss at 45 degree angle for 10":	14 Feet
Total equivalent length of the individual dryer duct:	59 Feet

From Table 3

The minimum diameter round duct for the individual dryer duct is 10-inches.

Notice that, at times, it is necessary to connect a larger duct than what the dryer has for an exhaust connection. This is required in order to keep the static pressure within the maximum allowable of .3" water column.

It is often necessary to use either square or rectangular duct instead of round. This may be required due to constricted passageways. In these instances, it is necessary to use a size which has the same friction loss as the round duct. Table 7 lists the minimum cross sectional area equivalents of the round ducts. When using rectangular ducts, the length to width ratio must not exceed 3-1/2 to 1.

In some cases it is impossible to meet the minimum size requirements. This may be due to exhaust duct size limitations. In these cases, a booster fan is required in order to meet the recommended static pressure requirements. In an exhaust duct system with individual dryer vents, a booster fan is added to each individual duct. It is more difficult when installing a booster fan into a common duct for multiple dryers. In this case, each dryer should be fitted with a barometric damper to compensate for the increased airflow created by the fan. In either case, a HVAC (heating, ventilating, air-conditioning) engineering firm should be consulted.

Should any value exceed the limitations in the tables provided, please consult a HVAC engineering firm. The information given is to assist in the calculation of an exhaust duct system. It may also be used to check the sizing of an existing exhaust duct system to verify whether it is within the recommended guidelines.

TABLE # 7

Round Duct Diameter (Inches)	Minimum Equivalent Cross Sectional Area (Square Inches)
6	30
8	54
10	80
12	120
14	164
16	210
18	256
20	324
22	400
24	464
26	540
28	650
30	730
32	840
34	960
36	1,056

- Problem 1: Three dryers are to be installed into a laundromat. Each dryer has an air flow of 400 cfm and a six (6) inch exhaust connection. Each dryer will be vented separately. Each dryer exhaust will travel 35 feet and have three (3) 90 degree elbows and one (1) 45 degree elbow. What is the total equivalent length and minimum diameter round duct to be used for each dryer duct?
- Problem 2: A nursing home is installing a new dryer which has an air flow of 2,500 cfm and a 14" diameter exhaust connection. The exhaust duct will travel 60 feet and have two (2) 90 degree elbows and three (3) 45 degree elbows in the run. What is the total equivalent length and minimum diameter round duct to be used?
- Problem 3: A laundromat owner plans to expand his business. He wants to install eight (8) new dryers which have an air flow of 600 cfm each and an eight (8) inch dryer exhaust connection. He plans to separate the dryers so that there will be two (2) common exhaust ducts with four (4) dryers into each one. Each of the two ducts will travel 43 feet and have three (3) 90 degree elbows. Each individual dryer duct will travel 10 feet and have one (1) 90 degree elbow, one (1) 45 degree elbow, and enter the main common duct at a 45 degree angle. What is the total equivalent length and minimum diameter round duct for each common duct? What is the total equivalent length and minimum round duct diameter for each individual dryer exhaust duct?
- Problem 4: An institutional laundry is planning on opening in several months. They are currently installing three (3) dryers. One dryer has an air flow of 2,100 cfm with a 12" diameter exhaust connection. One dryer has an air flow of 1,700 cfm with a 12" diameter exhaust connection. One dryer has an air flow of 900 cfm with a 8" diameter exhaust connection. The three (3) dryers are to be vented into one (1) common duct. The common duct will travel 55 feet and have two (2) 90 degree elbows. Each of the individual dryer ducts will travel 10 feet and have one (1) 90 degree elbow, one (1) 45 degree elbow, and enter the common duct at a 45 degree angle. What is the total equivalent length and minimum diameter round duct for the common duct? What are the total equivalent lengths and minimum round duct diameters for each individual dryer duct?

***ANSWERS FOUND ON PAGE 21***

Answers: #1 - The total equivalent length is 87-1/2 feet and the minimum round diameter duct is 8-inches.

#2 - The total equivalent length is 203-1/2 feet and the minimum round diameter duct is 18-inches.

#3 - The total equivalent length of the common duct is 166 feet and has a minimum diameter of 18-inches.

Each of the individual dryer ducts has a total equivalent length of 43-1/2 feet and a the minimum round diameter duct is 8-inches.

#4 - The total equivalent length of the common duct is 157 feet and has a minimum diameter of 22-inches.

The dryer with 2,100 cfm has a total equivalent length of 76 feet and a minimum round diameter duct of 14-inches.

The dryer with 1,700 cfm has a total equivalent length of 64-1/2 feet and a minimum round diameter duct of 14-inches.

The dryer with 900 cfm has a total equivalent length of 54 feet and a minimum round diameter duct of 10-inches.

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