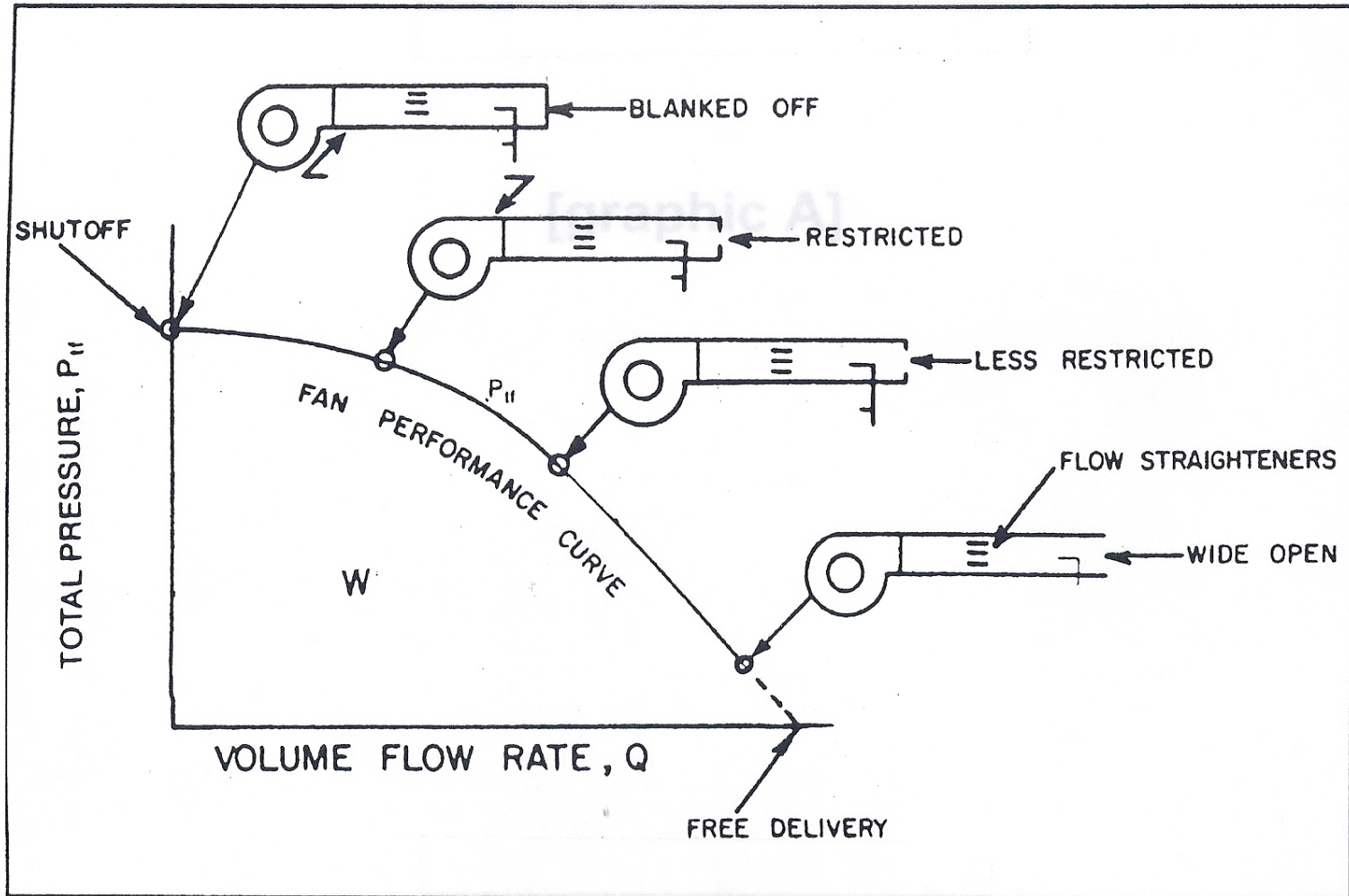


Fundamentals – Fans and Ducts

- Air flow in a ducted fan system is a results of
 - Fan characteristics
 - Type of fan: axial or centrifugal
 - Size of fan and motor
 - Fan enclosure
 - Duct characteristics
 - Type of duct: smooth or flex
 - Size and shape
 - Length, corners, fittings
 - Room/house characteristics
 - Tightness
 - Other exhaust or supply devices

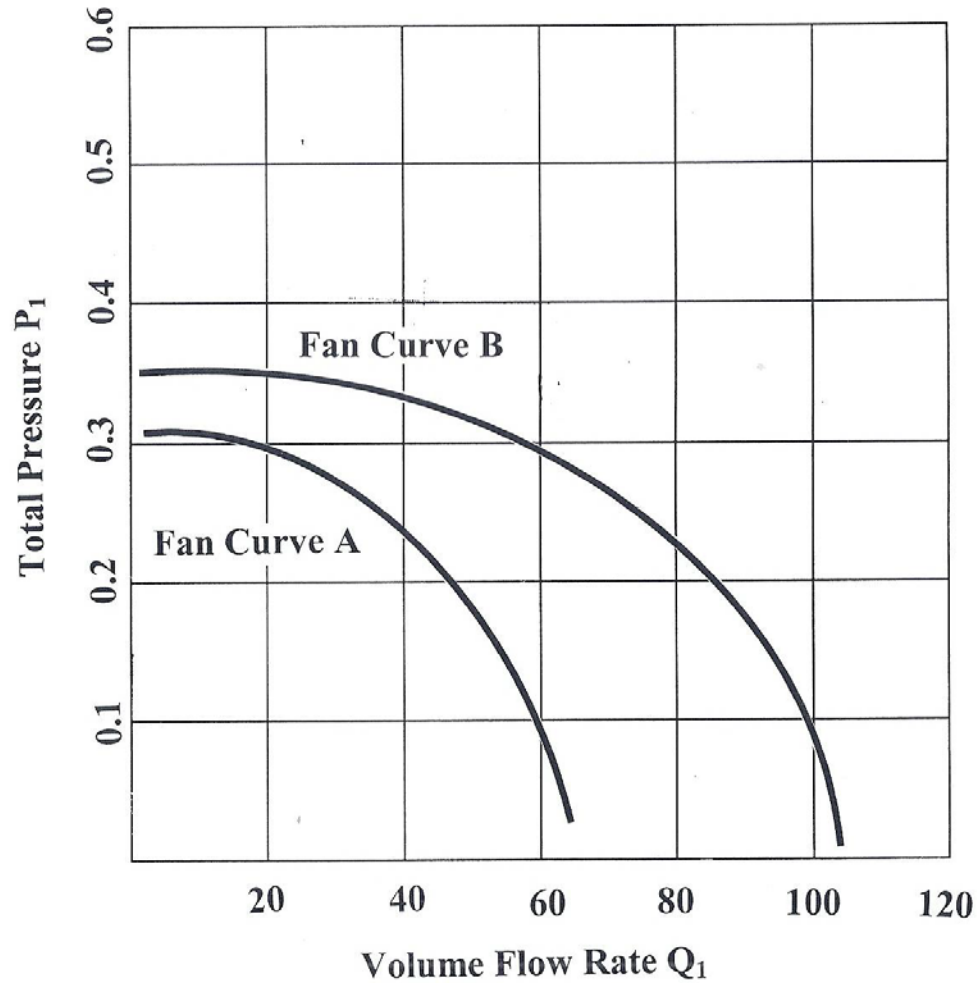
Fan Curve



Fans

- Fan flow
 - Each fan has a characteristic flow response at varying static pressure conditions
 - As the static pressure that the fan experiences increases the flow generally decreases

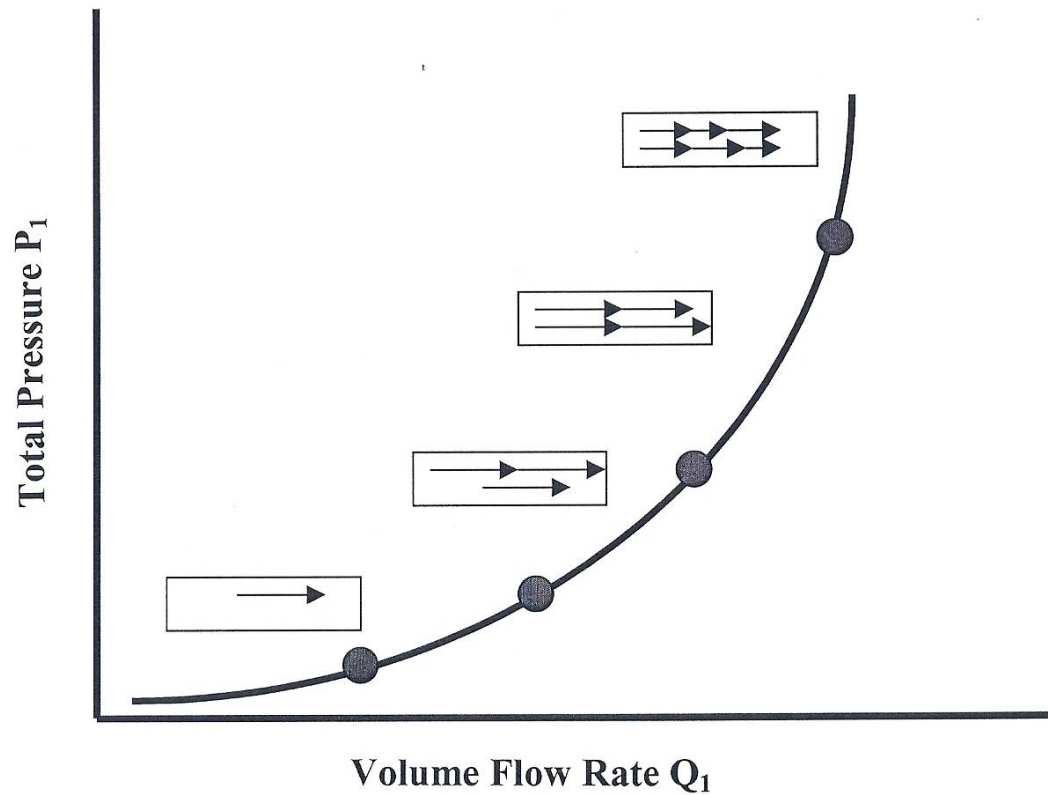
Fan Curves



Duct Resistance

- Each duct system has a characteristic static pressure response at varying flow conditions
- As the flow that the duct experiences increases the static pressure generally decreases

Duct Resistance Curve



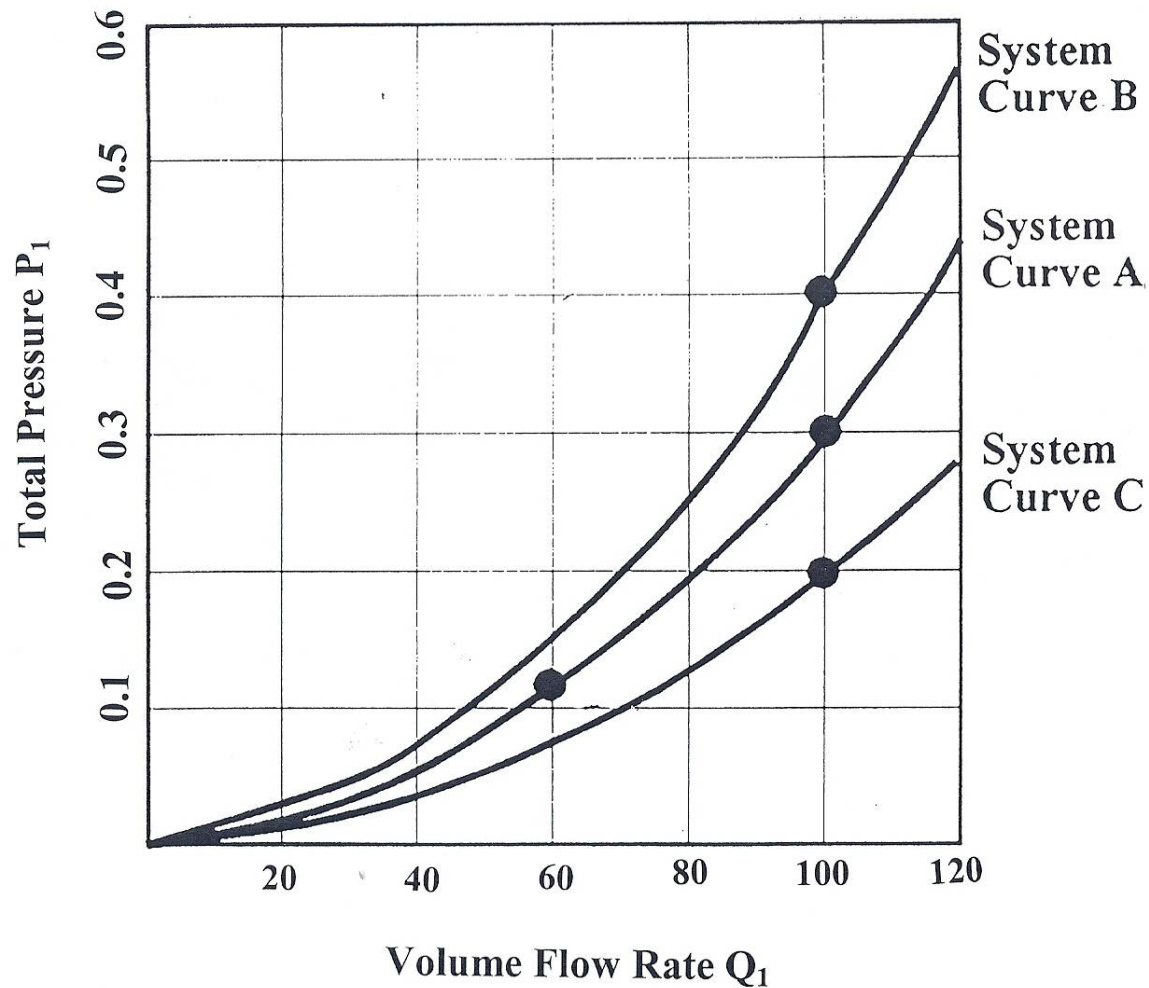
Duct Resistance for Straight and Smooth Ducts

- In general duct resistance is a function of velocity which will determine
 - Friction losses at the duct surface
 - Turbulent losses throughout the system
- So, duct diameter (cross-sectional area) is critical
 - Increasing cross-sectional area greatly reduces velocity
 - For a given air flow, if you double the duct size the velocity is reduced by four
- Minimizing the perimeter is important
 - Reducing the perimeter for a given cross-sectional area reduces frictional losses

Duct System Resistance

- Length
 - Determines total frictional losses
- Fittings
 - Restriction and changes in direction cause additional losses
- Duct type and surface characteristics
 - Determines losses due to friction and turbulence
- Exit and entrance conditions
 - Generally referred to as “system affects”

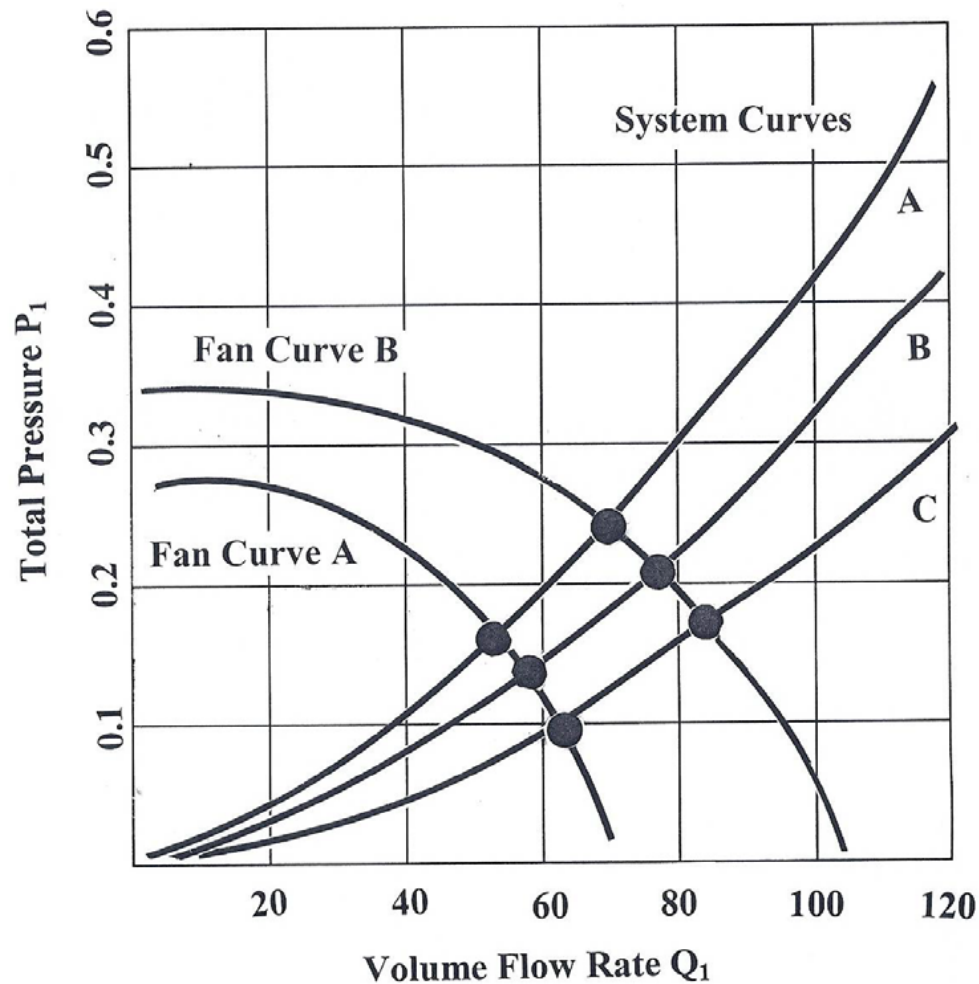
Duct Systems Curves



Fan Duct Diagrams

- The actual air flow rate will be a function of both the fan and duct characteristics
- The exact flow rate for the fan-duct system is found at the intersection of the fan curve and the duct resistance curve

Predicting Flow



Room or House Resistance

- Fan flow may be significantly reduced due to resistance caused by trying to exhaust from
 - A room with poor communication to the rest of the house
 - A very tight house with no make-up air
 - A room or house with other exhaust equipment operating

Equivalent Length Method

- A method to approximate the resistance for a duct system is
 - Based on the resistance of a straight duct the resistance for each fitting is converted to a straight length equivalent
 - By adding the length of straight duct and the equivalent length for each fitting, a total length can be determined
- This can be used to predict air flow for a given fan
 - However, system affects caused by fitting location, orientation, etc. may cause the actual flow to vary

Simplified Duct Guide

Calculating Equivalent Length

	Equiv. Feet		Number	Equiv. Length
smooth duct	1'	x	_____ ft. =	_____
flex duct	2'	x	_____ ft. =	_____
45° elbows / turns	5'	x	_____ =	_____
90° elbows / turns	10'	x	_____ =	_____
Y - branch	30'	x	_____ =	_____
T - take-off	50'	x	_____ =	_____
wall boot & grille	30'	x	_____ =	_____
wall cap & damper	40'	x	_____ =	_____
roof cap & damper	50'	x	_____ =	_____
Total Equivalent Length =				_____

Note: Add the equivalent lengths for the fittings to the length of straight ducts to calculate a total equivalent length.

Equivalent Lengths for Typical Systems

– Single point exhaust

- short = 100'
- medium = 150'
- long = 200'

– Multi-point exhaust

- short = 200'
- medium = 300'
- long = 400'

Simplified Duct Guide

Equivalent length up to 50 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	4"	5"	5"	5"	6"	6"	7"
0.25" w.g.	4"	4"	4"	5"	5"	5"	6"
0.40" w.g.	3"	4"	4"	4"	5"	5"	5"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.

Simplified Duct Guide

- Equivalent length up to 100 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	5"	5"	6"	6"	7"	7"	8"
0.25" w.g.	4"	4"	5"	5"	6"	6"	7"
0.40" w.g.	4"	4"	4"	5"	5"	6"	6"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.

Simplified Duct Guide

Equivalent length up to 150 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	5"	6"	6"	7"	7"	8"	9"
0.25" w.g.	5"	5"	5"	6"	6"	7"	8"
0.40" w.g.	4"	4"	5"	5"	6"	6"	7"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.

Simplified Duct Guide

Equivalent length up to 200 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	6"	6"	6"	7"	8"	8"	9"
0.25" w.g.	5"	5"	5"	6"	6"	7"	8"
0.40" w.g.	4"	5"	5"	5"	6"	6"	7"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.

Simplified Duct Guide

Equivalent length up to 300 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	6"	6"	7"	7"	8"	9"	10"
0.25" w.g.	5"	5"	6"	6"	7"	8"	8"
0.40" w.g.	5"	5"	5"	6"	6"	7"	8"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.

Simplified Duct Guide

Equivalent length up to 400 feet

Fan Rating	Desired Flow in Cubic Feet Per Minute (cfm)						
	50	60	75	90	120	150	200
0.10" w.g.	6"	7"	7"	8"	9"	9"	10"
0.25" w.g.	5"	6"	6"	7"	7"	8"	9"
0.40" w.g.	5"	5"	6"	6"	7"	7"	8"

This table is for round ductwork. Because other factors affect air flow in fan-duct systems, this is a guide only.