FlowCon Fabric Air Diffusers

Design Manual

Air Distribution Concepts

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Air Distribution Concepts designs and fabricates FlowCon Fabric Air Diffusers for a wide variety of air systems. All of our fabric ducts are custom made.We fabricate fabric diffuser systems for heating, air conditioning, evaporative cooling, ventilation, dehumidification, and makeup air. Our fabric diffusers along with being tailor made for your application are cost effective, good for the environment, and aesthetically pleasing. This design manual should assist through the design process for FlowCon Fabric Duct Ventilation Systems. The process involves considerations that include layout, sizing, air dispersion, appearance, durability and installation.

The Four Steps of Fabric Duct System Design:

1 Design Layout
determine duct layout and sizing - selecting location, diameter, lengths and required fittings.

2 Air Dispersion Style
determine type, location and size of air jets for Powerflow or Softflow dispersion or calculate required porosity for Microflow and Linearflow Series based on available airflow and static pressure.

3 Fabric
select fabric based on product quality, colors and/or required air dispersion type.

4 Suspension
select Tension Cable, Suspended HD-Rail, Flush Mount Rail.

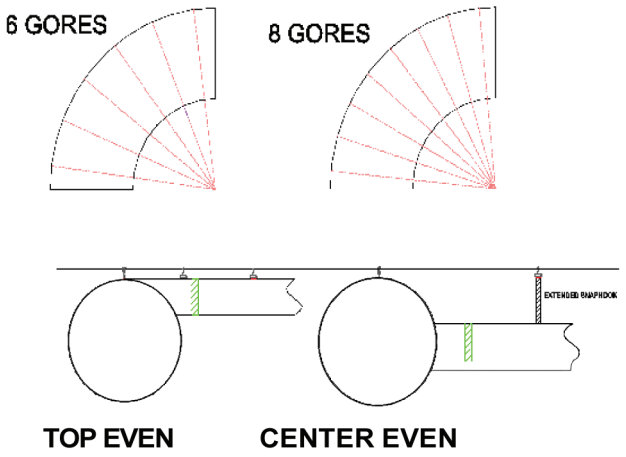
1. Design Layout

Diameter
Diameter is based on airflow volume. Lower inlet velocities (1500 FPM and less) reduce stress, noise and yield a better balanced system. (See Chart next page)
1,700 FPM Maximum: Powerflow systems.
1,500 FPM Maximum: Softflow , LinearFlow and Micro flow systems.
If the required diameter is to large for the available area consider dividing the system into two diffusers.

Length
Length is another consideration when designing a system. Friction loss can be calculated in a similar fashion as sheet metal duct. Caculate friction loss and use a correction factor of .85 to correct due to the lack of connections.

Fittings
Fittings used in a fabric duct system are similar to fittings used with sheet metal systems. The Key difference in fabric duct design is any turbulence existing internally may be seen externally in appearance and will affect the fabric longevity. Therefore when designing a system fittings play an important part.

Radius Elbows
The standard centerline radius of an elbow is 2-2.5 x dia. With a 2-2.5 x radius friction loss and turbulence are kept to a minimum. Number of gores and sizes depend on angle and radius of elbow. Zippers are recommended before and after elbow for ease of installation.



Take-Off
When designing systems, takeoff fittings direct air to areas perpendicular to the main run. The branch duct will require a zipper for attachment. For better airflow management, branch ducts diameter should be sized with the internal velocity in mind. The internal velocity should be less in the branch runs than the main trunk. This will prevent the branches from bouncing. Take offs should be positioned at 3 to 4 ft. from end caps.

Transitions
Reducing transitions are available in Concentric, Top Flat or Bottom Flat configurations. Length is an important factor when designing a transition. The minimum length can be calculated by taking half the difference of the two diameters and multiplying by 14. (Example: A 30” to 24” transition; 1/2*(30”—24”)* 14 = 42” long.)

Zippers
Straight lengths and/or fittings are connected together using a zipper connection. The zipper is sewn with the zipper head located at top center - and each includes a 2” fabric overlap to conceal the zipper.

Diameter Selection

Diameter sizing is based on airflow entering the fabric diffuser. Low inlet velocities put less stress on fabric diffuser system which can also extend the longenevity of the diffuser. Velocities below 1200 fpm will also reduce noise. Use the chart to the right to size the diameter of the diffuser. General rule of thumb is to size all diffuser designs to 1500 fpm. But unfortunally that does not always work so we recommend:

1200 fpm max. Noise
1500 fpm max. Softflow
1700 fpm max. Powerflow

If required diameter is too large for the area the diffuser must occupy break the system down to multiple runs.

			POWER FLOW SOFTFLOW,		
		LINEARFLOW, MICROFLOW			
		INTERNAL VELOCITIES			
CFM	**1000**	**1250**	**1500**	**1750**	**2000**
200	6	5	5	5	4
400	9	8	7	6	6
600	10	9	9	8	7
800	12	11	10	9	9
1000	14	12	11	10	10
2000	19	17	16	14	14
3000	23	21	19	18	17
4000	27	24	22	20	19
5000	30	27	25	23	21
6000	33	30	27	25	23
7000	36	32	29	27	25
8000	38	34	31	29	27
9000	41	36	33	31	29
10000	43	38	35	32	30
11000	45	40	37	34	32
12000	47	42	38	35	33
13000	49	44	40	37	35
14000	51	45	41	38	36
15000	52	47	43	40	37
16000	54	48	44	41	38
17000	56	50	46	42	39
18000	57	51	47	43	41
19000	59	53	48	45	42
20000	61	54	49	46	43
22000	64	57	52	48	45
24000	66	59	54	50	47
26000	69	62	56	52	49
28000	72	64	59	54	51
30000	74	66	61	56	52
32000	77	69	63	58	54
34000	79	71	64	60	56
36000	81	73	66	61	57
38000	83	75	68	63	59
40000	86	77	70	65	61
42000	88	79	72	66	62
44000	90	80	73	68	64
46000	92	82	75	69	65
48000	94	84	77	71	66
50000	96	86	78	72	68
52000	98	87	80	74	69
54000	100	89	81	75	70
56000	101	91	83	77	72
58000	103	92	84	78	73
60000	105	94	86	79	74
62000	107	95	87	81	75
64000	108	97	88	82	77
66000	110	98	90	83	78
68000	112	100	91	84	79
70000	113	101	93	86	80

2. Dispersion Style

There are five styles of FlowCon diffusers that determine the diffusion of air.

PowerFlow
Air is delivered through large orifices providing extended distance and jet-type air flow. They are very efficient at entrapping and mixing air. The long throw of the air jets can effectively propel heated or cooled air. The mass and velocity of the jets can cause air circulation 10'-40' beyond the diffuser. PowerFlow air jets range from 1" to 6" in diameter. Application recommendations include; industrial, warehousing, and manufacturing areas, gyms, pools, retail, grocery stores, and temporary structures.

SoftFlow
Air is delivered through small orifices. SOFTFLOW air jets have less mass then POWERFLOW jets, so they diffuse quickly. The area of noticeable air movement typically ranges from 2-10' beyond the diffuser. These smaller jets are also very efficient at entrapping air, and SOFTFLOW diffusers mix air efficiently over broad areas with little noticeable air movement. SoftFlow air jets range from 0.25" to 0.75" in diameter. Application recommendations include; Office space, telecommunications, restaurant, food processing, auditorium, pools, church, and classroom.

LinearFlow
Air is delivered through linear vents providing a gentle air flow. The exact linear vent size and location will be determined in the design phase to optimize air delivery. LinearFlow air diffusers have an aesthetically pleasing look to a design. Linear vents deliver air through a mesh vent located down the entire length of the diffuser and diffuse the air with the area of noticeable movement ranges from 5'-20' from the diffuser. Linear vents do not perform the same as our Powerflow diffusers. Because of the continuous vent a laminar effect may develop. Keep this in mind when designing a system. Application recommendations include; Office space, restaurant, retail, and grocery stores.

MicroFlow
Air is delivered through permeable fabric engineered to specific levels of porosity. Typically, MICROFLOW diffusers are used to displace rather than mix air. MICROFLOW air diffusers are used primarily for special applications. Since they displace rather than mix air, they are very efficient at removing contaminated air. Application recommendations include; Office space, telecommunications, food processing, classroom, clean rooms, and test labs.

Seasonflow
Seasonflow air diffusers enable the user to quickly change the direction of the air flow. There is an "up" position for cold weather and a "down" position for warm weather. The user simply zips open an access panel and zips the divider panel into a different position for the desired directional diffusion.

3. Fabric

Premium Fabric: Polyester- Coated / Uncoated Antimicrobial Treated Fabric, Machine washable variety of colors.
Possible diffusion: PowerFlow,Softflow, LinearFlow, and MicroFlow.

Commercial/Industrial Fabric: Vinyl coated polyester, Polyethylene ,variety of colors.
Possible diffusion: PowerFlow, Softflow, and LinearFlow

Economy Fabric: Polyethylene, 5 colors High-Throw airflow at lower cost.
Possible diffusion: PowerFlow, and Softflow.

Specialty Fabric: Fiberglass / Xstatic unique solutions for critical environments. Fiberglass for high temperature application and Xstatic for highly sensitive electronic assembly facilities'.
Possible diffusion: PowerFlow, and Softflow.

Temporary: Extruded Polyethylene, White, Clear Only, High-Throw airflow at low cost.

Possible diffusion: PowerFlow

4. Suspension System

TensionCable
The tension cable option - allows simple installation from wall to wall or between supports using a 1/8" cable and tensioning hardware. Components include: turnbuckle, cable clamps, eyebolts and intermediate supports and are available in galvanized, stainless steel.

HD-Track
Great for applications where the system is not mounted directly against the ceiling. "HD-Track" is an anodized aluminum track suspension system that includes 10 ft sections of track, cable support drops with vertical quick connections (2 per 10 ft section), couplers, radius track sections.

SurfaceMount
Designed to be mounted directly to a surface - this suspension option is most commonly used for surface mount systems - or low ceiling areas.

Halo
New Halo Tension suspension system (HTS) gives the appearance of your FlowCon diffuser system to be inflated when the air handling system is off. This option can be used with a simple one row cable suspension or single HD rail to keep the FlowCon diffuser looking inflated without airflow. Limited from 10" to 36" diameter, this option is perfect for applications where deflated diffuser hang down is a problem. Sections can easily be taken down and washed with no extra labor. Components include standard one row tension cable or our HD single rail system.

Design Recommendations

Application	Diffusion Style	Fabric Options	Suspension Type
Industrial,Manufacturing, Warehouse	PowerFlow, SoftFlow	Polyester, Polyethylene, Vinyl coated polyester, Fiberglass	Tension Cable, HD Track
Pools	PowerFlow, SoftFlow, LinearFlow	Polyester, Polyethylene, Vinyl coated polyester	Tension Cable, HD Track
Gymnasiums	PowerFlow	Polyester, Polyethylene, Vinyl coated polyester	Tension Cable, HD Track, Halo
Retail	SoftFlow, LinearFlow, MicroFlow	Polyester	Tension Cable, HD Track, Flush Mount
Tent, Temporary Structure	PowerFlow, SoftFlow	Polyduct	Tension Cable
Office, Telemarketing	SoftFlow, MicroFlow	Polyester, Xstatic	Tension Cable, HD Track, Flush Mount, Halo
Telecommunication	SoftFlow	Xstatic	Tension Cable, HD Track, Flush Mount, Halo
Food Processing	MicroFlow	Polyester	Tension Cable, HD Track, Flush Mount
Auditorium, Church	PowerFlow, SoftFlow	Polyester, Polyethylene	Tension Cable, HD Track, Halo
Library, School Classroom	SoftFlow, MicroFlow	Polyester, Polyethylene, Vinyl coated polyester	Tension Cable, HD Track, Flush Mount, Halo
Restaurant, Bar, Cafeteria	SoftFlow	Polyester, Polyethylene, Vinyl coated polyester	Tension Cable, HD Track, Halo
Clean Room, Test Lab	SoftFlow, MicroFlow	Polyester, Xstatic	Tension Cable, HD Track, Flush Mount

Fabric	Weight	Colors
Coated Polyester	7.1 oz.	White, Black, Gray, Blue, Green, Tan, Red
Antimicobable Polyester	5.3 oz.	White, Black, Gray, Blue, Green, Tan, Red
Xstatic Polyester	3.2oz.	White, Blue, Gray
Polyethlene	7 oz.	White, Natural, Gray, Blue, Dk. Green
Extruded Polyethlene	4 mil.	White, Clear
Vinyl Coated Polyester	10 oz.	White, Black, Gray, Blue, Green, Tan, Red, Yellow,
Fiberglass	17.3 oz.	Gray

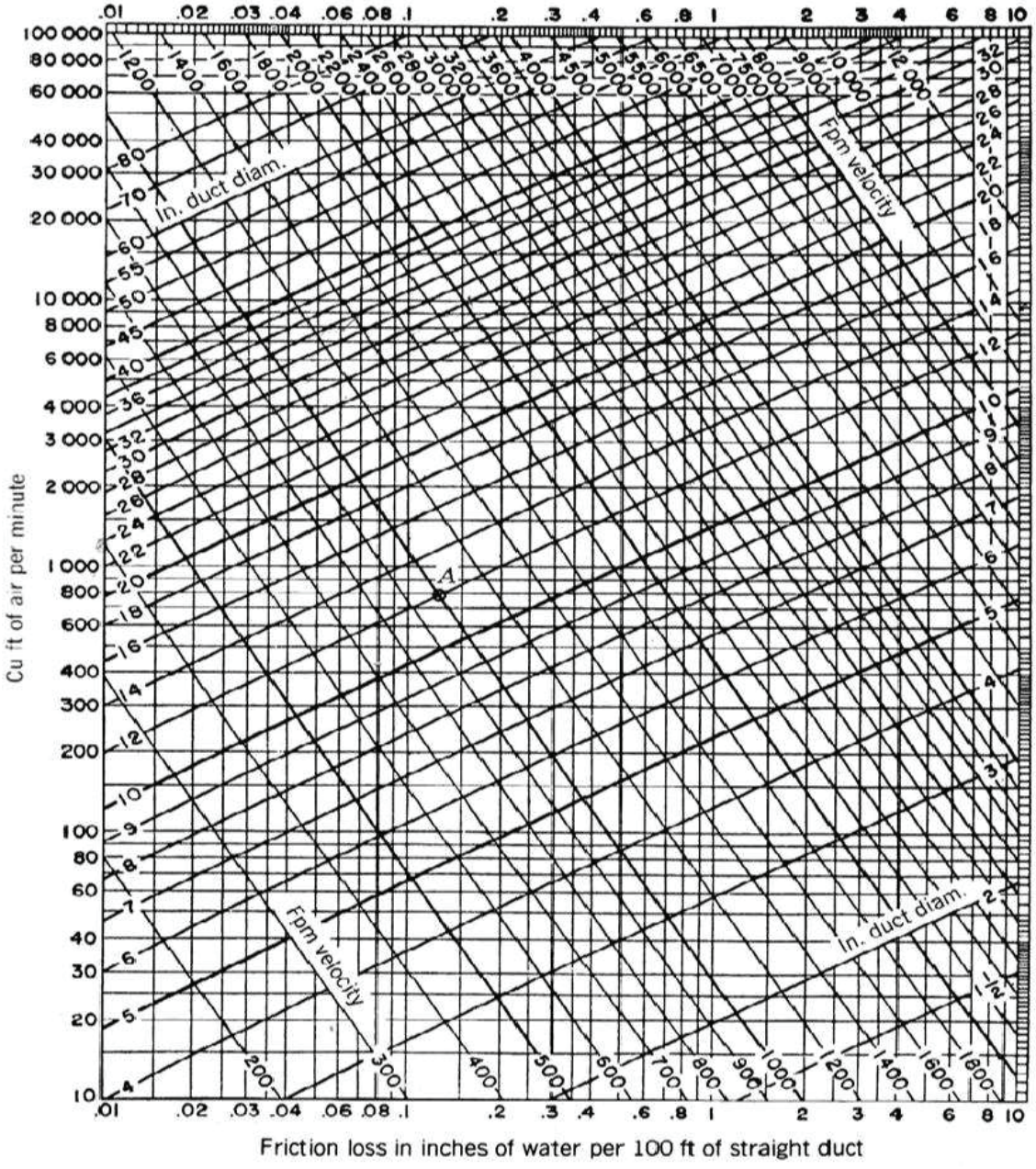
Airflow: Design & Pressure

Metal ducts are commonly designed with either the equal friction method, static regain method, or the T-method. Fabric duct design is best served by the static regain method. Which consists of consistent diameters and evenly dispersed airflow. The use a constant duct diameter assists in installation and manufacturing processes. Also the lack of reducing fittings reduces noise and frictional loss. (Reducing fittings can be used when clearances are a factor). The total pressure can be calculated by breaking it down into the three components: Static Pressure, Velocity Pressure, and Friction Losses. The largest and most critical component to the operating pressure of a system is the Static Pressure. This is the static pressure available at the inlet of the fabric duct (may be the external static of the fan). The inflation and operation is dependant on the static pressure within the fabric duct system.

Based on our experience observed, the majority of static pressure available is approximately .5 w.g. and the remaining is between 1/4”to 1-1/2”.

Similar to metal ducts, fabric duct systems have friction losses along straight sections of duct and fittings. The losses, however, are much less than an alternate traditional metal layout. This is because of the absents of duct connectors and the smoothness of the fabric. The friction loss is 15% less then that of metal designs. The Friction losses are directly related to the duct diameter and cross-sectional velocity.

The chart below determines the friction loss per 100 ft. of metal duct. Find the frictions loss in the chart below and multiply .85 to obtain the correct friction loss for the fabric system.



Throw

FlowCon diffusers are custom designed for application so there is no limit in designing the system. The number and locations of the orifices or vents is totally dependent on the application. Some of the possible and most popular locations when designing outlet orientation are:

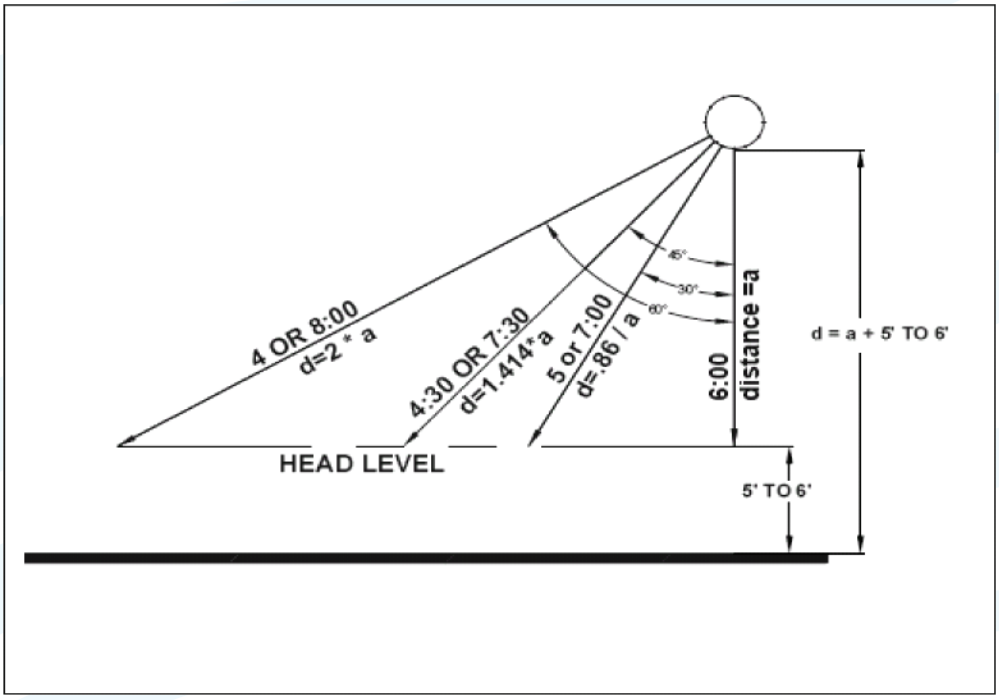
For cooling or Ventilation: 11 & 1, 10 & 2, 3 & 9
For Heating: 4 & 8, 4:30 & 7:30, 5 & 7 and 6 o'clock

Throw design can be the most critical part of a design. Tempered air is directed towards the occupied space in most cases.

To calculate the throw of the orifice or vent first find the height off the flo or. The distance of the throw can be calculated as a function of the height. Using the following equations:

4 & 8 o'clock: (Height - 6' or 5') x 2.00 = Throw required
4:30 & 7:30 (Height - 6' or 5') x 1.414 = Throw required
5 & 7 o'clock: (Height - 6' or 5') / .86 = Throw required
6 o'clock: (Height - 6' or 5') x 1 = Throw required

Other Throw Consideration
Throw location can be altered throughout the diffuser. Throw location can be a combination of any or all of the above possibilities. Since FlowCon diffuser offer countless designs the possibilities can be as simple or as complex as desired. FlowCon diffusers with double suspension, (3 & 9 or 6 & 12), can also be flipped for summer and winter use. A combination of different diffusion type or location can satisfy winter and summer use by means of just flipping the diffuser upside down.Logo's Also may play an important part of a diffusion design. The area where the logo is located may or may not have diffusion.



Airjets

Depending on the diffuser type, air jets can be classified as follows:

Compact
Air jets are formed by cylindrical tubes, nozzles, square or rectangular openings. The Maximum velocity in the cross section of the compact jet is on the axis.

Linear
Air jets are formed by slots or rectangular openings with a large aspect ratio. Air velocity is symmetric in the plane at which air velocities in the cross section are maximum. The shape of the jets at a given distance from the face is very similar. The jet discharged from a round opening forms an expanding cone; jets from rectangular outlets rapidly pass from a rectangular to an elliptical cross-sectional shape and then to a circular shape.

FlowCon PowerFlow and SoftFlow diffusers are designed with compact air jets spaced along the entire length of the diffuser. The first four foot and the last one foot of the diffuser will not have any air jets unless specified. The first four foot with not air jets is to allow the airflow to even out before the first air jet. The last one foot is in order to develop static in the diffuser. Once the total pressure is calculated select the air jet that best fits the desired throw. Divide the total cfm by the cfm of the air jet selected. This will be the total number of air jets to diffuse the total cfm. Depending on the number of air jets needed and the length of the diffuser multiple rows may be needed. FlowCon diffusers use a standard of 5 time the diameter of the air jet minimum spacing. Staggered patterns are sometime used when multiple patterns are desired.

Example: If 100 1” air jets are needed, 50 per row, we would need a minimum of 245”.
All are isothermal throws as a free air jet. Actual throw velocities will vary.

Linear Vents
FlowCon LinearFlow diffusers are designed with a continuous mesh slot spaced along the entire length of the diffuser. The first four foot and the last one foot of the diffuser will not have any air mesh. Vent design similar to air jet design. Consult factory because mesh vents are not recommended for all applications.

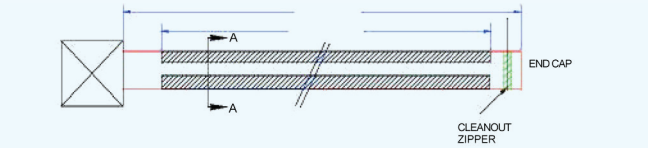
Air Jet Performance					
ORIFICE	AP	Airflow	Distance (ft)to Velocity (FPM)		
SIZE	(INW.G.)	(CFM/ea.)	150	100	50
1/4”	0.25	0.41	1	1.5	3
	0.5	0.58	1	2	4
	0.75	0.71	1.6	2.5	5
	1	0.82	2	3	6
	1.25	0.92	2.2	3.2	6.4
1/2”	0.25	1.64	3	4	8
	0.5	2.32	3	4	8
	0.75	28.4	3	4.5	9
	1	3.28	4	5.5	11
	1.25	3.67	4	6	12
1”	0.25	6.56	4	6	12
	0.5	9.28	5	8	16
	0.75	11.37	6	9	19
	1	13.12	7	11	22
	1.25	14.67	8	12	24
2”	0.25	26.25	7	11	22
	0.5	37.12	10	15	30
	0.75	45.46	13	19	38
	1	52.49	15	22	44
	1.25	58.69	17	15	
2.5”	0.25	41.01	13	19	38
	0.5	58	14	21	42
	0.75	71.02	16	24	48
	1	82.02	19	28	
	1.25	91.07	21	31	
3”	0.25	59.06	10	15	30
	0.5	83.25	15	23	46
	0.75	102.29	19	29	
	1	118.11	22	33	
	1.25	132.06	25	37	
4”	0.25	104.99	14	21	42
	0.5	148.48	21	31	
	0.75	181.85	25	38	
	1	209.98	29	44	
	1.25	234.76	33		
5”	0.25	164.05	18	27	
	0.5	232	25	37	
	0.75	284.14	32	48	
	1	328.09	37		
	1.25	366.82	41		
6”	0.25	164.05	22	33	
	0.5	232	32	47	
	0.75	284.14	39		
	1	328.09	45		
	1.25	366.82			

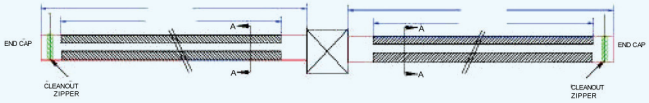
Mesh Vents					
Vent	AP	Airflow	Distance (ft.) to Velocity (fpm)		
Size	in w.g.	cfm/ft.	150	100	50
1/4”	0.25	16	8	12	22
	0.375	20	10	14	25
	0.5	22	12	18	27
	0.6	25	14	20	28
3/8”	0.25	24	10	18	24
	0.375	29	14	20	26
	0.5	34	16	22	28
	0.6	38	18	24	29
1/2”	0.25	32	13	19	26
	0.375	38	16	22	28
	0.5	45	18	24	30
	0.6	50	20	26	32

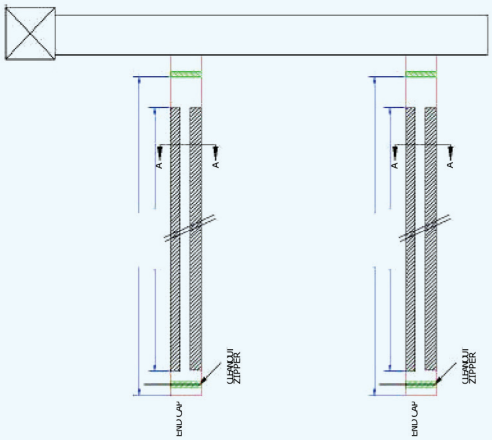
Design Layout

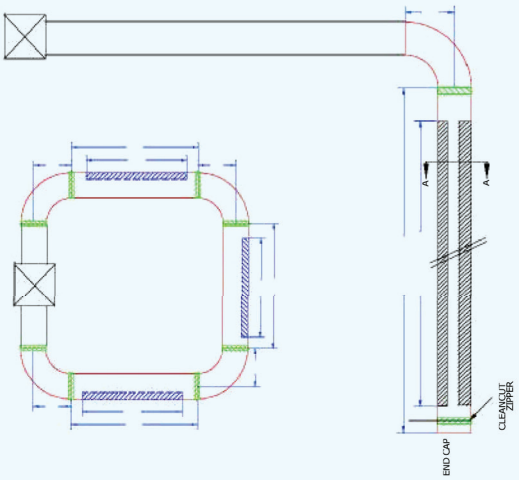
The Design layout is should target the desired dispersion. The design should not only contain the general layout but also include the specific details of type of airflow and location, suspension type, and fitting locations. ADC Inc. can supply specific design layouts for your application. Also suspension details and diffuser blanks can be downloaded from our website www.adctubes.com

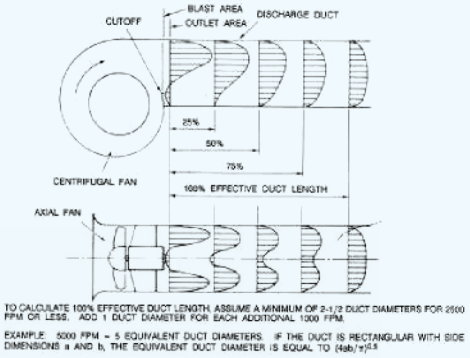
Some systems might require a straight length of sheet metal to insure an even velocity profile inside the fabric diffuser. Any excessive turbulence may effect the longenevity of the diffuser. Refer to the drawing at the right for the effective duct length.

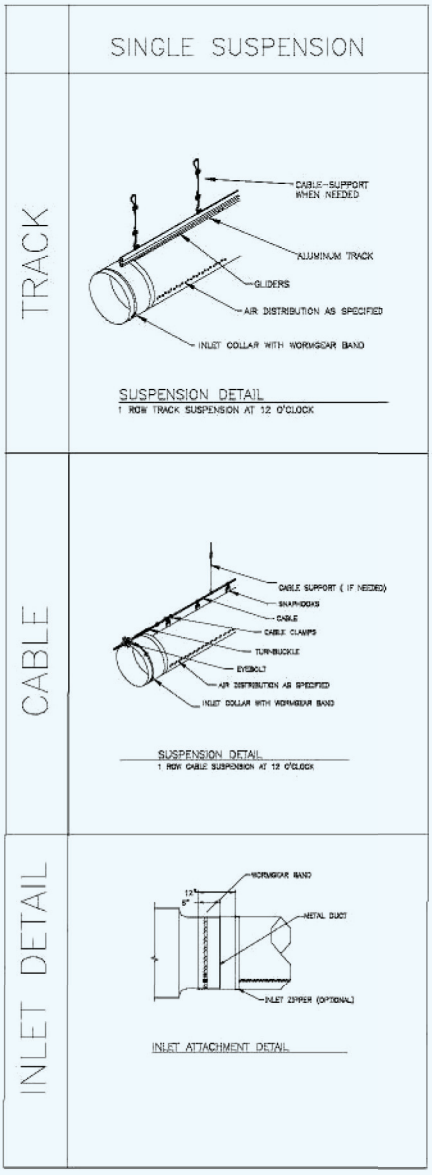








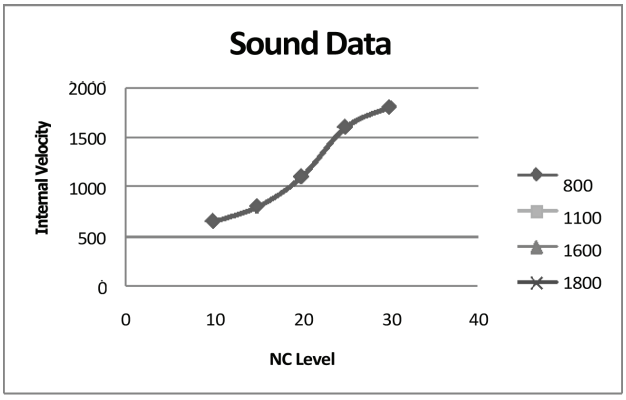




Duct Noise Considerations

The major source of noise in a duct system is the fan. The selected operating point of a fan has a major effect on the acoustic output level or noise generated; the point of maximum efficiency produces the best acoustical effect. However, during system operation when dampening occurs, the operating point moves up into a less efficient region, adding low-frequency rumble. Selecting a fan operating point at a lower total pressure than the maximum for clean filters will also avoid or reduce noise problems. Undersized fans operating at higher shaft speeds produce more noise, and oversized fans operating at lower shaft speeds create more low-frequency noise than fans operating at maximum efficiencies. Most straight ductwork naturally attenuates noise. Fittings such as elbows, dampers, and branch take offs either create or attenuate noise, depending on their geometry and air velocity. Higher air velocity in fittings creates higher noise levels. Duct velocities of (1000 fpm) or less generate no audible noise.

- Reduce air velocities.
- Avoid abrupt changes in duct cross sections.
- Provide smooth transitional duct branches, take offs.
- Duct velocities 1000 fpm or less generate no audible noise. NC rating <20 db.
- Higher air velocity in ducts creates higher noise levels.
- See chart below for recommended NC ratings.



The Noise Rating level for different uses should not exceed the Noise Ratings indicated in the table below.

Noise rating curve	Application
NC <20	Concert halls, broadcasting and recording studios, churches
NC <25	Private dwellings, hospitals, theatres, cinemas, conference rooms
NC <25	Libraries, museums, court rooms, schools, hospital operating theaters and wards, flats, hotels, executive offices
NC <30	Halls, corridors, cloakrooms, restaurants, night clubs, offices, shops
NC <35	Department stores, supermarkets, canteens, general offices
NC <40	Typing pools, offices with business machines
NC< 50	Light engineering works
NC <60	Foundries, heavy engineering works

FlowCon Fabric Air Diffusers have been tested to meet the highest quality standards. Product testing is an ongoing process. Please check our website for up-to-date information.

UNDERWRITER'S LABORATORIES (UL)

UL Classified/UL2518
Antimicrobial Polyester, Fiberglass High Temp
Requirements to certify are to pass the 25/50 Flame Spread/Smoke Developed requirements of ASTM E-84 (Tunnel Test). UL Classification ensures continued compliance for all products manufactured.

CAN/ULC Listed (Canada only)

Polyethylene
Products meet the minimum requirements to pass the 25/50 Flame Spread/Smoke Developed requirements of ULC test method S102.2 "Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies".

ICC EVALUATION Evaluation Service Inc. (ICC-ES)

AC 167 – ESR-2646/Compliance with 2018 International Mechanical Code
Compliance with UL 2518 - 2016
Polyethylene, Coated Polyester
Requirements to certify are to pass the 25/50 Flame Spread/Smoke Developed requirements of ASTM E-84 (Tunnel Test). These requirements additionally include weight, air permeability, mold growth and humidity, high temperature, low temperature, erosion and pressure. Additional requirements include an acceptable production quality program, comprehensive public design manual/support and continued compliance for all components.

SGS U.S. Testing Company Inc.

XStatic, MicroFlow Polyester
Requirements to certify are to pass the 25/50 Flame Spread/Smoke Developed requirements of ASTM E-84 Standard Test Method for Surface Burning Characteristics of Building Materials.

USDA

Accepted for Meat and Poultry Facilities
Polyethylene, Polyester
Evaluated and approved for use in Meat and Poultry Facilities by the USDA (1996).

WARRANTY

FlowCon diffusers now include a 10-year non-prorated warranty program for our Premium polyester and fiberglass systems and 5 year non-prorated warranty program for our polyethylene, vinyl and X- static systems. The FlowCon warranty is for replacement credit, based on the original amount of system cost excluding suspension system. The warranty is not available in the form of a cash payment.

The warranty covers materials, fabrication, and workmanship of the fabric portion of the system only. Warranty coverage begins at the time of shipment. This warranty also requires that the original system be designed within requirement design guidelines – including inlet velocity of maximum of 1500 FPM for Powerflow and 1200 FPM for Softflow, Microflow and Linearflow diffusers. Two row suspension systems for 30" diameter and larger and 3 row suspension system for diameters larger than 52" must be installed. For warranty to be valid all installation and maintenance instructions must be followed, in addition to regular maintenance of the supply air units and filters. Fabric diffuser maintence schedule must be submitted at time of warranty clam. Warranty excludes damage to fabric from improper installation, poor maintenance, abuse, abrasion, caustic chemicals, exposure to high temperature, failure to specify all system requirements, or any unauthorized modification to system. Warranty does not cover any labor, equipment rental, or freight charges incurred as a result of executing warranty.

Contact Sales with warranty questions

Phone 262-728-6860 Fax 262-728-6840