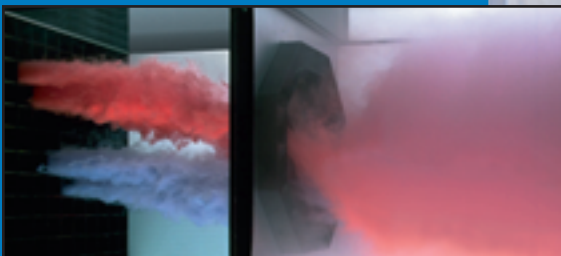
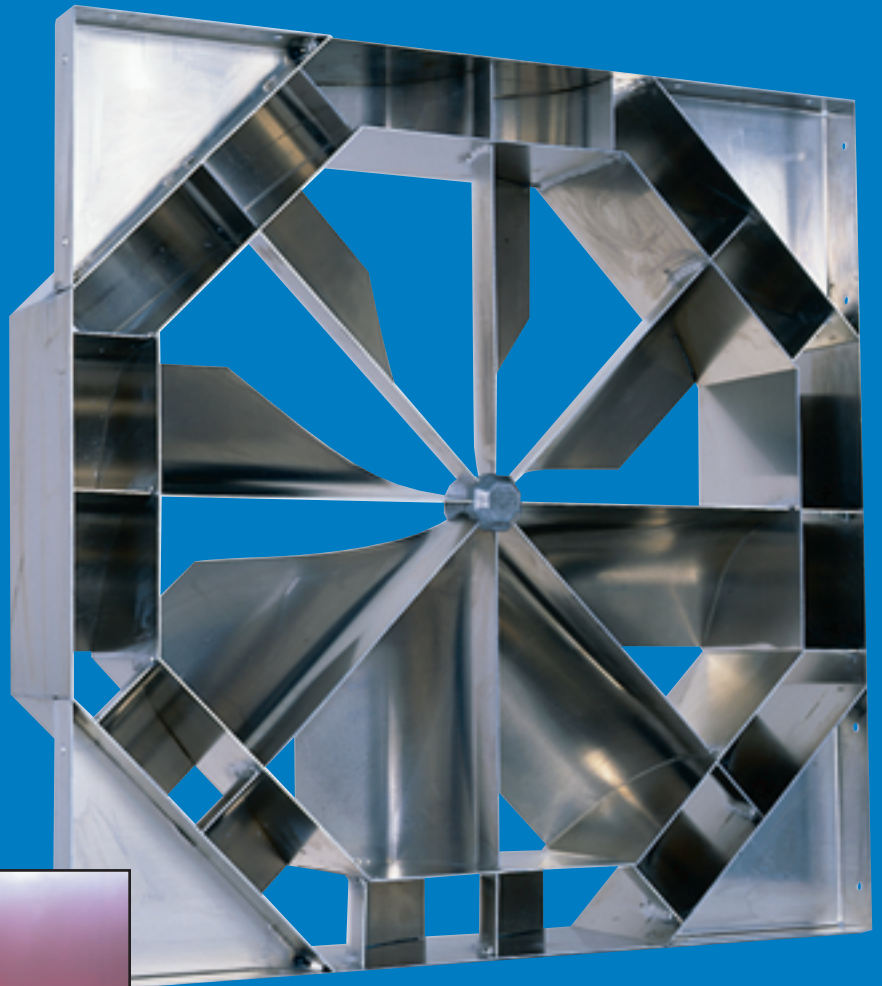


SERIES IV AIR BLENDER®

Static Air Mixer Designed to Mix Stratified Air Streams

BENEFITS:

- Mix to Even Temperature and Consistency
- Improve Freeze Coil Protection
- Reduce sensor error
- Improve Outside Air Dilution
- Meet IAQ Requirements



Blender Products, Inc.

Engineered Air Mixing Systems and Equipment

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Toll-free: 800-523-5705
E-mail: INFO@airblender.com
Internet: www.airblender.com

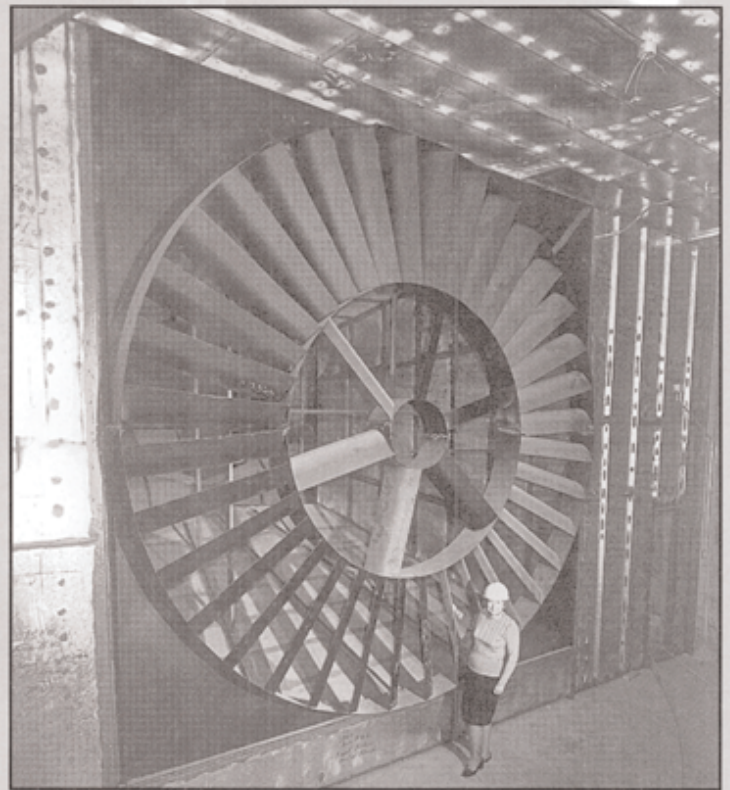
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S-IV 11/01

THE ORIGINAL *Series I* AIR BLENDER® mixing device was developed in 1962 to provide a means of providing a pre-manufactured product to help eliminate the nuisance tripping of Freeze stats and the inevitable frozen coil. Many of these units sold in the early 60's are still on the job providing the needed frozen coil protection. With every cold morning startup the AIR BLENDER® mixer is there doing its duty. The *Series II* mixer was a minor redesign of the original AIR BLENDER® unit.

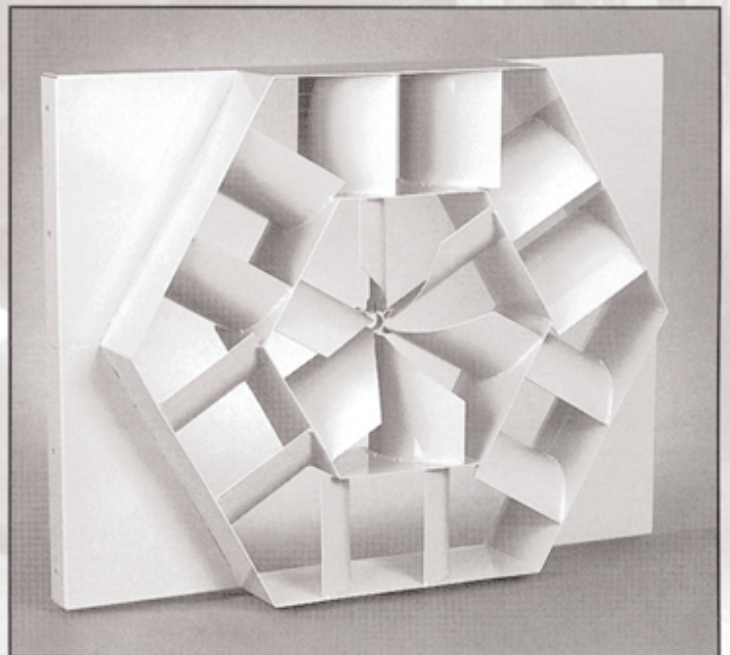
The *Series III* AIR BLENDER® static mixer was developed in 1984 after a renewed research and development program to introduce a new static mixer. About this same time a controls revolution started in the HVAC industry known as DDC. This new system of control required much higher precision of sensor reading and required the AIR BLENDER® device to provide a higher level of mixing to enhance the control system operation.

Shortly after the *Series III* unit was introduced a line of mixing systems were introduced to provide ease of application for the HVAC industry. The Blender Box® mixing box provided the first complete mixing system incorporating a damper section with the AIR BLENDER® device. Next, a Blender Section® flanged mixing housing around an AIR BLENDER® mixing device was developed. Both products were designed to fit up to standard air handler equipment.

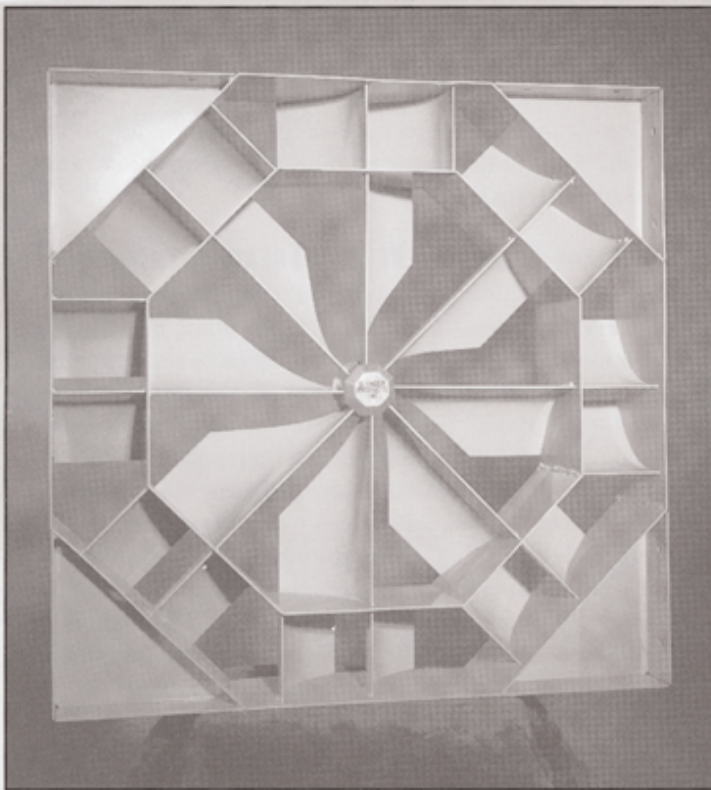
Soon thereafter The Blendercone® fan diffuser was introduced to mix and diffuse air flow at the fan discharge before blowing through filters and coils.



SERIES I



SERIES III



SERIES IV

N

OW IN RESPONSE to the need for greater mixing and with the increased interest in good mixing for indoor air quality Blender Products announces the *Series IV AIR BLENDER*® static mixing device. The *Series IV* static mixing device is designed to meet the needs of today's HVAC mixing systems.

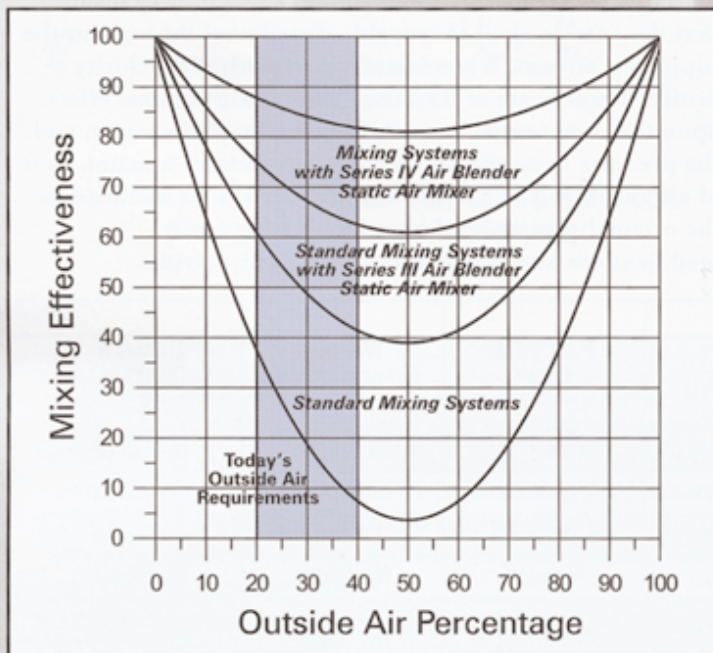
The *Series IV* has been redesigned to incorporate geometric, dynamic, and kinematic scaling, the same factors which govern the design of fans. By using proper scaling a designer can be assured that the performance of a smaller mixer is consistent with the full range of mixer sizes. No other static mixer manufactured in the HVAC industry can say this today.

The new model is also symmetrical in shape to provide the same performance for either orientation and to facilitate layout and installation. A new center was designed to provide greater strength and three methods of mounting the mixers are available.

However, the greatest features of the *Series IV* are not in the new design but in the application and performance characteristics.

A new selection procedure ensures that the mixer selected is the right unit for the job by accurately predicting the mixing effectiveness and pressure drop. Furthermore, when using the *Mixing Effectiveness Design Guide* the required mixing effectiveness can be determined to eliminate nuisance freeze stat trips, prevent possible frozen coils, reduce sensor error, and to enhance the mixing of outdoor air with the supply air stream to help meet IAQ requirements.

The performance of the new improved AIR BLENDER® Static mixing device provides by about 25% better mixing in most applications. This new level of performance allows more flexibility to reduce the mixing distance required downstream or to provide greater mixing at the same distance as before.



THE NEED FOR MIXING

Stratification in an air handling unit is the result of the momentum inherent in a stream of moving air. This stratification is apparent when two air streams of different temperatures are introduced into the same duct or plenum and the temperature across the duct or plenum varies. This situation occurs many times in the typical HVAC air handling system. The common places where this occurs is in the air handling unit mixing box and after face and bypass coil units.

TEMPERATURE CONCERNS

During the winter months, stratification results in a variety of problems. The most widely recognized problems are frozen coils and low temperature limit controller (freezestat) trips. In many cases, air handling units are unable to operate when the outside air temperature falls below 25°–30° F. Unfortunately, the solution to this problem has often been to close outside air dampers. Other problems associated with winter stratification are poor mixed air temperature control, and excessive energy use due to heating and cooling the mixed air.

Stratification has traditionally been thought to be limited to winter time, but it does exist during summer months as well, although the effects are different. During the winter months, stratification can result in damage to the system (frozen coils), inability to operate (nuisance Freezestat trips), and inefficient system operation (control sensor error). During the summer months, the effects of stratification are usually poor mixed air temperature control and increased energy usage.

INDOOR AIR QUALITY CONCERNS

The importance of stratification has also increased as a result of the new concerns over Indoor Air Quality. IAQ standards such as ASHRAE Standard 62 require more outside air than previously required in systems. As the amount of outside air is increased, the amount of mixing which must take place between the two air streams increases. In systems with inadequate mixing, systems may be unable to operate during the winter months due to freezestat trips. In other systems, the control systems may be unable to properly control the amount of outside air or the cooling or heating required to maintain comfort in the building.

Perhaps the biggest effect stratification has upon the system is the resulting uncertainty of how well the outside air

is distributed throughout the building. Without good mixing of the recirculated and outside air, it is difficult to ensure that all areas of a building are receiving the correct amount of outside air and it may be necessary to bring in additional outside air to meet the required minimum ventilation rates dictated by ASHRAE 62-89.

MASKING THE PROBLEMS VERSUS TREATING THE CAUSE

Many solutions have been proposed for the stratification found in HVAC systems. For winter stratification, many people decide to use some type of antifreeze solution to prevent frozen coils. While this solution does prevent frozen coils, it does not address the question of control inaccuracy, coil efficiency, or outside air distribution throughout the return air stream. Other people have used very small dampers and high velocity jets to mix the air streams. This solution may provide mixing, but there is no way to predict how much mixing will be achieved and the small dampers may not provide the correct control for the system or may increase the pressure drop of the mixing box to unacceptable levels. Other people suggest the use of baffles to help mix. This method may provide mixing, but there is no way to know how much mixing will be achieved or the pressure requirements of the arrangement. In addition, the rapid changes in velocity will result in uneven velocity profiles and will affect the performance of any components located downstream of the baffle plates. Recently, heat recovery has been proposed as a solution to stratification. Like the other methods, this solution can help prevent frozen coils, but it does not address such issues as outside air distribution. The chart below summarizes the various approaches to solving stratification problems and their affect on several different aspects of stratification.

The SERIES IV AIR BLENDER® static air mixer and its related mixing systems address all of the areas affected by stratification and mixing. The mixing provided by the static mixer helps eliminate the freeze potential and control inaccuracies created by stratification and will help insure that the outside air is thoroughly distributed throughout the supply air stream. When installed correctly, the velocity profile downstream of the mixer will have a minimal effect upon the components located downstream of the mixer, and the pressure drop will be a known, predictable amount. Best of all, the AIR BLENDER® static mixer can be included in the original equipment design, eliminating costly modifications and complaints after system startup.

METHOD	FREEZE PROTECTION	SENSOR ERROR AND CONTROL ACCURACY	VELOCITY PROFILE	PRESSURE DROP	MIXING EFFECTIVENESS	DAMPER CONTROL
Glycol	Known	No Effect	No Effect	No Effect	No Effect	No Effect
Baffles	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Dampers	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Heat Recovery	Known	Known	No Effect	Known	No Effect	No Effect
Averaging Bulb T-Stat	No Effect	Known	No Effect	No Effect	No Effect	Unknown
Series IV	Known	Known	Known	Known	Known	No Effect

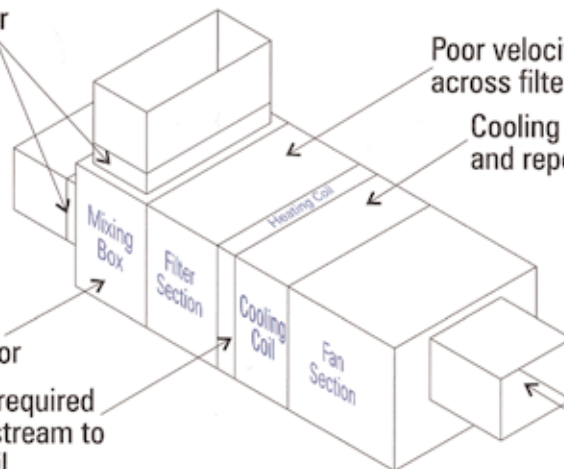
Without Series IV AIR BLENDER® static air mixer:

Control dampers must be selected for mixing, not for proper control of airstreams

Poor control due to large mixed air temperature error
Excessive energy required to heat mixed air stream to protect cooling coil

Poor velocity distribution across filter bank and coil
Cooling coil freezeups and repeated Freeze-Stat trips

Unknown distribution of Outside Air within supply ducts requires increased outside air



With Series IV AIR BLENDER® static air mixer:

Control dampers may be selected for proper control not for mixing

Improved control due to reduced mixed air temperature error

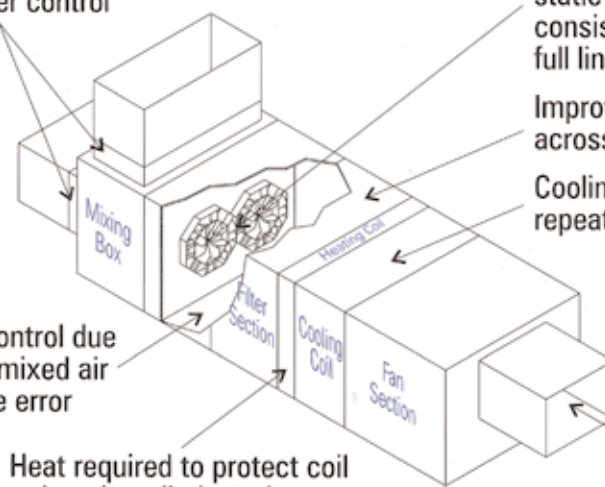
Heat required to protect coil reduced or eliminated

Geometrically similar Series IV Air Blender static mixers provide consistent performance across the full line of mixer sizes

Improved velocity distribution across filter bank and coil

Cooling coil freezeups and repeated Freeze-Stat trips eliminated

Known distribution of Outside Air within supply duct



THE SERIES IV AIR BLENDER® static air mixer applied using the new selection procedure also provides the designer and building owner with the following features and benefits.

- Each model is carefully scaled to provide consistent performance across the full line of mixer sizes.
- Square symmetrical shape and new mounting methods make layout and installation easier.
- The new improved selection procedure ensures you that the AIR BLENDER® model selected is the right unit for the job by accurately predicting the mixing effectiveness and pressure drop based on the mixer-to-plenum area ratio and plenum approach velocity.
- The *Mixing Effectiveness Design Guide* can be used to determine the mixing effectiveness required to eliminate nuisance freeze stat trips and frozen coils, reduce sensor error, and to enhance the mixing of outdoor air into the supply air stream to help meet IAQ requirements.

MIXING EFFECTIVENESS

The performance of mixing devices such as mixing boxes and static air mixers is rated using the concept of mixing effectiveness. This rating system, which was first developed by the National Bureau of Standards (now the NIST), compares the spread of a temperatures downstream of a mixing device to the spread of temperatures upstream of a mixing device in order to provide a convenient method for determining the amount of mixing performed by a mixing device. The mixing effectiveness of a mixing box and a static mixer may be determined using the following equation:

$$E = 1 - \frac{\text{Range}_{\text{Downstream}}}{\text{Range}_{\text{Upstream}}}$$

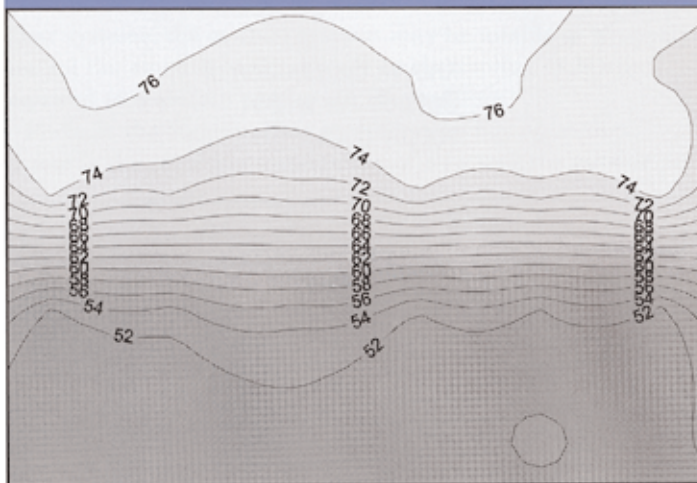
WHERE — $\text{Range}_{\text{Downstream}}$ = Temperature Range downstream of mixing device

$\text{Range}_{\text{Upstream}}$ = Temperature Range upstream of mixing device

The mixing effectiveness for the AIR BLENDER® static air mixer has been determined from a large number of tests, both in actual installations and in the laboratory. The stated values for mixing effectiveness have been determined using a fully stratified air handling unit in order to prevent overestimating the performance of the static mixer. Figures 1 & 2 show typical temperature patterns for the system used to determine the performance of the AIR BLENDER® static mixer. These figures clearly indicate that the mixing in the system is solely due to the static mixer and not to the mixing box. Because the mixing box provides negligible mixing, the mixing effectiveness of the static mixer may be calculated using the following equation:

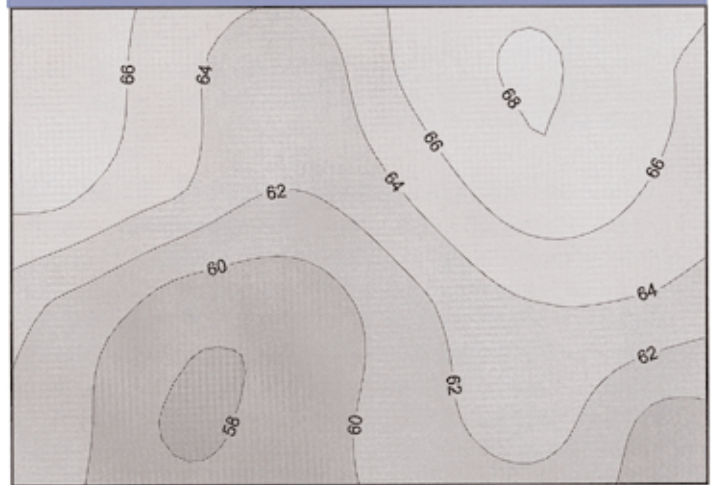
$$E = 1 - \frac{\text{Range}_{\text{Downstream}}}{t_{\text{RA}} - t_{\text{OA}}}$$

Figure 1 – Without Series IV AIR BLENDER® static air mixer.



t_{Mix} : 63.2°F t_{Max} : 76.0°F $t_{\text{RA}} - t_{\text{OA}}$: 26.8°F
 %OA: 53% t_{Min} : 50.7°F E_{RDT} : 6%
 %RA: 47% Range: 25.3°F

Figure 2 – With Series IV AIR BLENDER® static air mixer.



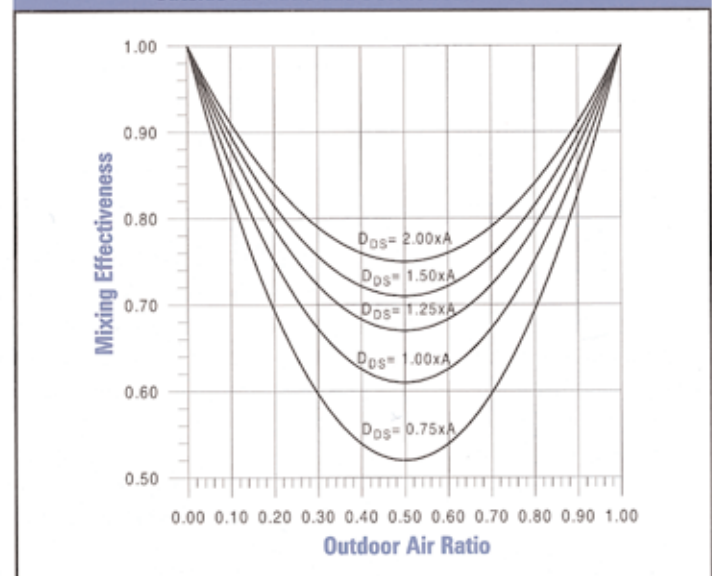
t_{Mix} : 63.2°F t_{Max} : 68.3°F $t_{\text{RA}} - t_{\text{OA}}$: 26.8°F
 %OA: 53% t_{Min} : 57.5°F E_{RDT} : 60%
 %RA: 47% Range: 10.8°F

DISTANCE

The amount of mixing provided by a static mixer is largely determined by how much distance is downstream of the static mixer and the amount of outside air being introduced into the system. By changing the amount of distance between the static mixer and the nearest downstream component, the amount of mixing can be altered to fit the mixing requirements of any system. Chart 1 shows the mixing effectiveness for several different downstream distances.

Many designers choose to use a downstream distance equal to the "A" dimension of the selected static mixer. This distance provides sufficient mixing in many applications. However, the mixing provided by the static mixer should be checked using the information contained in booklet *Mixing Effectiveness Design Guide* in order to insure that the mixing system provides the required level of mixing for each particular system.

Chart 1 – Mixing Effectiveness vs. Outside Air Ratio and Downstream Distance



PRESSURE DROP

The pressure drop across a static mixer is a function of the velocity of the air upstream of the mixer and the ratio of the area of the mixer to the area of the plenum or duct in which it is mounted. This ratio, the Mixer Area Ratio (β), is determined using the following equation:

$$\beta = \frac{\text{Area}_{\text{Mixer}}}{\text{Area}_{\text{Plenum}}}$$

This ratio should be used with the calculated approach velocity and Chart 2 in order to determine the pressure drop across a static mixer when it is installed in a system. Table 1 presents the recommended values of β for applications which require short distance, low pressure drop, or the best combination of distance and pressure drop.

For VAV systems, the pressure drop should be determined for the full flow condition. The turndown ratio for the system should be calculated and located on Chart 2. The operating point at the full flow condition should lie above the correct turndown line in Chart 2 in order to insure that the velocity through the mixers is at least 400 FPM at the minimum supply flow rate.

Table 1 – Recommended Area Ratios

PRIMARY CONSTRAINT	RECOMMENDED AREA RATIO (β)
Shortest Distance	0.36
Best Selection	0.43
Lowest ΔP	0.50

Chart 3 – Pressure Loss Coefficient for Series IV AIR BLENDER® static mixer for plenum/duct velocities



AREA RATIO (β)	LOSS COEFFICIENT (C_{MIXER})
0.3	29.1
0.4	13.7
0.5	7.6
0.6	4.7
0.7	3.1
0.8	2.2

$$\Delta P_{\text{Mixer}} = C_{\text{Mixer}} \times P_{\text{Vel}}$$

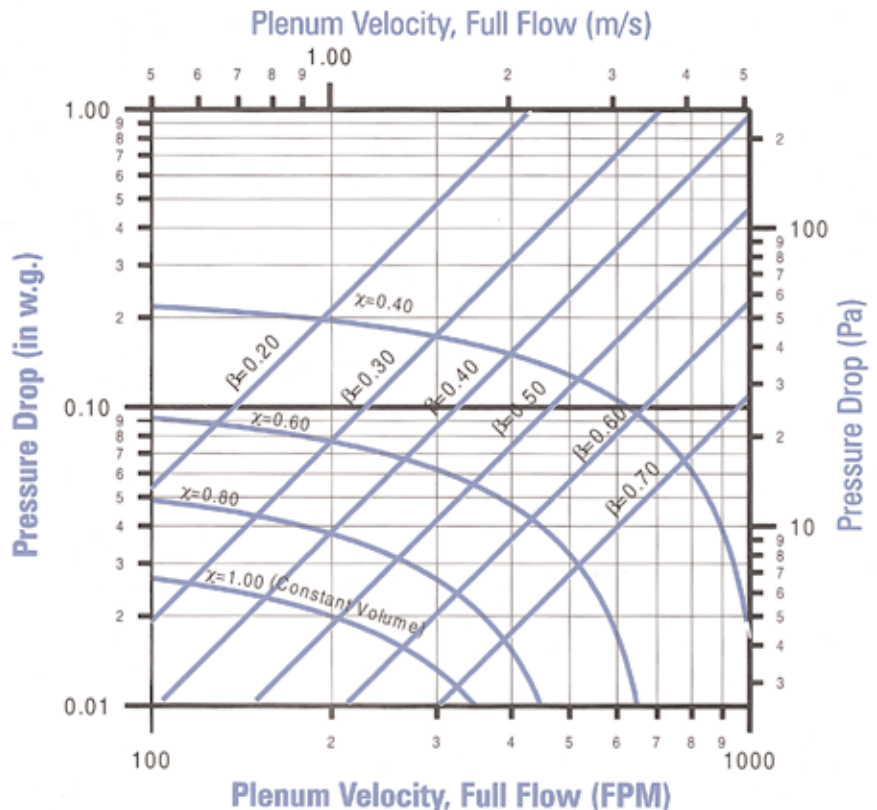
(P_{Vel} = Duct velocity pressure)

Chart 2 – Pressure Drop for Series IV AIR BLENDER® static mixer mounted in air handling unit

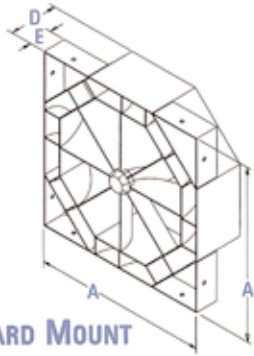
NOTES:

- Recommended Area Ratios:
Shortest Distance: 0.36
Best Selection: 0.43
Lowest Pressure Loss: 0.50
- Operating point should lie above the turndown ratio line for the system.
- Area ratios below 0.35 should not be used unless absolutely necessary.
- The turndown ratio (χ) is the minimum flow rate divided by the maximum flow rate of the system. For constant volume systems, the turndown ratio is 1.00.

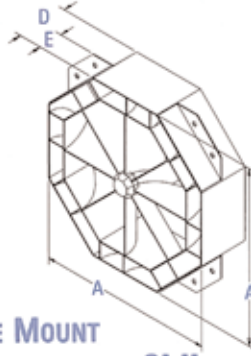
$$\chi = \frac{\text{Supply}_{\text{Minimum}}}{\text{Supply}_{\text{Maximum}}}$$



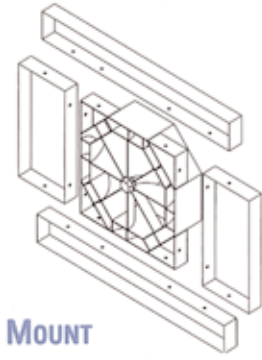
Series IV AIR BLENDER® static air mixer Product Data Sheet



STANDARD MOUNT
I-P UNITS



FLANGE MOUNT



PANEL MOUNT

SI UNITS

MODEL	A Inches	D Inches	E Inches	AREA Sq. Ft.	WEIGHT Lbs.
8	8	1.94	1.5	0.4	2
9	9	2.30	1.5	0.5	2
10	10	2.30	1.5	0.6	2
11	11	2.48	1.5	0.7	3
12	12	2.48	1.5	0.8	3
13	13	2.88	2	1.0	4
14	14	2.88	2	1.1	4
15	15	3.38	2	1.3	6
16	16	3.38	2	1.5	7
18	18	3.94	2	1.9	8
20	20	3.94	2	2.3	9
22	22	4.81	2	2.8	11
24	24	4.81	2	3.3	12
26	26	5.56	2	3.9	15
28	28	5.56	2	4.5	16
30	30	5.56	2	5.2	18
32	32	6.56	2	5.9	22
34	34	6.56	2	6.7	23
36	36	6.56	2	7.5	25
38	38	6.56	2	8.3	30
40	40	8.00	2	9.2	32
42	42	8.00	2	10.14	34
44	44	8.00	2	11.1	36
46	46	8.00	2	12.14	38
48	48	8.00	2	13.25	40
52	52	9.31	2.5	15.6	61
56	56	10.39	2.5	18.0	73
60	60	10.75	2.5	20.7	81
66	66	11.65	2.5	25.1	97
72	72	12.55	2.5	29.8	114
78	78	13.63	2.5	35.0	134
84	84	14.89	2.5	40.6	157
90	90	15.79	2.5	46.6	184
96	96	16.88	4	53.0	252
102	102	17.75	4	59.9	262
108	108	19.00	4	67.1	324
114	114	20.13	4	74.8	360
120	120	21.00	4	82.8	391
132	132	22.81	4	100.2	477
144	144	25.13	4	119.3	569
156	156	26.94	4	140.0	660
168	168	28.75	4	162.4	766

MODEL	A Millimeters	D Millimeters	E Millimeters	AREA Sq. M.	WEIGHT Kg
8	203	49	38	0.04	0.8
9	229	58	38	0.05	0.9
10	254	58	38	0.06	1.0
11	279	63	38	0.07	1.4
12	305	63	38	0.08	1.5
13	330	73	51	0.09	1.8
14	356	73	51	0.10	1.8
15	381	86	51	0.12	2.7
16	406	86	51	0.14	3.2
18	457	100	51	0.18	3.6
20	508	100	51	0.21	4.1
22	559	122	51	0.26	5.0
24	610	122	51	0.31	5.4
26	660	141	51	0.36	6.8
28	711	141	51	0.42	7.3
30	762	141	51	0.48	8.2
32	813	167	51	0.55	10.0
34	864	167	51	0.62	10.4
36	914	167	51	0.67	11.3
38	965	167	51	0.77	13.6
40	1016	203	51	0.85	14.5
42	1067	203	51	0.94	15.4
44	1118	203	51	1.03	16.3
46	1168	203	51	1.13	17.2
48	1219	203	51	1.23	18.1
52	1321	236	64	1.45	27.7
56	1422	264	64	1.67	33.1
60	1524	273	64	1.92	36.7
66	1676	296	64	2.33	44.0
72	1829	319	64	2.77	51.7
78	1981	346	64	3.25	60.8
84	2134	378	64	3.77	71.2
90	2286	401	64	4.33	83.5
96	2438	429	102	4.92	114.3
102	2591	451	102	5.56	118.8
108	2743	483	102	6.23	147.0
114	2896	511	102	6.95	163.3
120	3048	533	102	7.69	177.4
132	3353	579	102	9.31	216.4
144	3658	638	102	11.08	258.1
156	3962	684	102	13.01	299.4
168	4267	730	102	15.09	347.5

NOTES:

1. Mixers may be supplied with either standard, flange or panel mounting systems.
2. Standard construction of models 96-168 is split into 2 pieces.
3. Standard construction is 5052-H34 aluminum. Other materials available. Consult local representative for other materials.

APPLICATION NOTES

In order to properly select and properly apply an AIR BLENDER® static mixer in an air handling unit, several factors need to be considered:

1. The quantity of mixers to use depends on how the return and outside air streams enter the static mixer. The safest way to use a static mixer is to use a single mixer. However, if relatively equal amounts of both air streams enters each mixer, multiple mixers may be used. This condition is generally satisfied if both air inlets are the same width and extend the full width of the air handling unit. Any time multiple mixers are used, they should be arranged in a single line, not as an array.

(Note: There are a few exceptions to this rule. Contact factory or representative if you have questions about the use of multiple mixers.)

2. The size of mixer to use depends on the quantity of mixers to be used and the size of the plenum or duct in which the mixer is to be mounted. Once the applicability of using multiple mixers has been determined, the Quick Selection chart on the next two pages may be used to select the correct size and quantity of mixer to use. If desired, the models shown in this table may be changed to achieve a better selection. If the models are changed, the new area ratio, required distances and pressure drop should be determined. If a plenum size is not listed on the Quick

Selection chart, the recommended area ratios in Table 1 on page 7 should be used to determine the mixer area required.

3. The distance required upstream of the mixer depends upon the mixer(s) selected and the size of the plenum in which the mixer is to be mounted. The distance required upstream of a mixer is based on how much the air streams have to contract in the process of entering the static mixer. This entrance angle should be kept in the range of 90°–120° to avoid creating excessive pressure drop (*Application Detail 1 on page 12*).
4. The distance downstream of the mixer depends on the amount of mixing desired. The Quick Selection chart assumes a downstream distance equal to the “A” dimension of the mixer. If more mixing is required, the downstream distance should be increased. If necessary, this downstream distance may be shortened, but it should never be less than 0.75 times the “A” dimension of the mixer. Chart 1 on page 6 may be used to determine the relationship between downstream distance and mixing effectiveness. *The Mixing Effectiveness Design Guide (MEDG 3/00)* should be consulted to determine the amount of mixing required for each system.

Following the procedure outlined above will help insure that the mixers selected will provide the correct amount of mixing without an excessive pressure drop.

How Many Mixers?

Determining the Proper Quantity and Layout of Mixers to Use Based on Air Stream Entrance Conditions.

The use of multiple mixers depends upon the pattern of stratification which is present in the system. In order for multiple mixers to be used, it is necessary for portions of both the hot and cold air streams to pass through each mixer. Ideally, the relative amounts of hot and cold air passing through each mixer will be equal. If these relative amounts vary through each mixer, there will be a different mixed air temperature downstream of each mixer, resulting in a higher level of stratification. The figure below shows the proper use of multiple air mixers in a system.

Incorrect

Single or Multiple mixers may be used. (Mixers must be in horizontal line and damper blades should extend full width of unit. Recommended inlet arrangement.)

Correct

Use Single Mixer (This inlet condition Not Recommended.)

The pattern of stratification is largely dependent upon the inlet arrangement of the air streams. The figure below shows typical stratification patterns developed by common inlet arrangements.

Single or Multiple mixers may be used. (Multiple mixers must be in vertical line and damper blades should extend full height of unit. Usually results in higher pressure drop and longer distances.)

NOTES:

1. Any time a minimum outside air damper is used with multiple mixers, it should extend the full width of the mixers being used.
2. Any time multiple static mixers are used, care should be taken to insure that the flow rate is uniformly distributed in each inlet. For example, if a duct approaches the mixing box the side and an elbow is used to introduce the air into the top of the unit, turning vanes should be used to insure even flow across the inlet.

Quick Selection Guide for the Series IV Air Blender® Static Air Mixer

Plenum Width

42

NOTES:

- Dimensions shown are inside dimensions of plenum or duct in which mixers are to be mounted.
- Stated downstream distance is equal to the "A" dimension of the mixer used. See Chart 1 on page 6 to determine the effect of changing this downstream distance has upon the mixing effectiveness.
- Pressure drop shown is for a plenum velocity of 500FPM. If design plenum velocity is different, the pressure drop may be calculated using the following equation:

$$\Delta P_{Actual} = \Delta P_{Chart} \times \left(\frac{V_{Actual}}{500}\right)^2 = \Delta P_{Chart} \times \left(\frac{CFM_{Actual}}{CFM_{Chart}}\right)^2$$

Plenum Height

42

48

54

60

66

72

78

84

90

96

24.50 1 AB40 15/40 0.25
12250 2 AB30 8/30 0.18
3 AB24 6/24 0.21
4 AB20 8/20 0.25

28.00 1 AB44 14/44 0.22
14000 2 AB32 7/32 0.19
3 AB26 8/26 0.19
4 AB20 10/20 0.36

31.50 1 AB48 12/48 0.18
15750 2 AB34 7/34 0.18
3 AB28 9/28 0.18
4 AB20 12/20 0.49

35.00 1 AB48 12/48 0.24
17500 2 AB36 8/36 0.18
3 AB28 11/28 0.23

38.50 1 AB52 11/52 0.21
19250 2 AB38 10/38 0.23
3 AB28 13/28 0.30

42.00 1 AB56 10/56 0.18
21000 2 AB36 12/36 0.29
3 AB28 15/28 0.38

45.50 1 AB56 10/56 0.22
22750 2 AB40 13/40 0.21
3 AB28 17/28 0.47

49.00 1 AB60 18/60 0.18
24500 2 AB40 15/40 0.25
3 AB30 18/30 0.47

52.50 1 AB60 10/60 0.22
26250 2 AB44 14/44 0.18
3 AB30 18/30 0.47

56.00 1 AB60 12/60 0.22
28000 2 AB40 19/40 0.36

30.00 1 AB44 16/44 0.26
15000 2 AB32 9/32 0.22
3 AB26 8/26 0.23
4 AB22 9/22 0.26

33.75 1 AB48 14/48 0.22
16875 2 AB34 8/34 0.22
3 AB28 9/28 0.21
4 AB22 11/22 0.35

40.00 1 AB52 15/52 0.23
20000 2 AB36 8/36 0.25
3 AB30 10/30 0.23
4 AB24 12/24 0.35

44.00 1 AB56 14/56 0.20
22000 2 AB40 9/40 0.19
3 AB32 12/32 0.21
4 AB24 14/24 0.45

48.00 1 AB56 14/56 0.25
24000 2 AB40 11/40 0.24
3 AB32 14/32 0.26

52.00 1 AB60 12/60 0.22
26000 2 AB44 12/44 0.18
3 AB32 16/32 0.33

56.00 1 AB60 12/60 0.26
28000 2 AB44 14/44 0.22
3 AB32 18/32 0.40

60.00 1 AB66 10/66 0.19
30000 2 AB44 16/44 0.26
3 AB32 20/32 0.47

64.00 1 AB66 10/66 0.22
32000 2 AB48 16/48 0.19

40.50 1 AB52 19/52 0.24
20250 2 AB36 12/36 0.26
3 AB30 8/30 0.24
4 AB26 10/26 0.24

45.00 1 AB56 18/56 0.21
22500 2 AB40 10/40 0.23
3 AB34 9/34 0.21
4 AB28 11/28 0.25

49.50 1 AB60 18/60 0.22
24750 2 AB40 10/40 0.26
3 AB34 11/34 0.18
4 AB28 14/28 0.40

54.00 1 AB60 16/60 0.24
27000 2 AB44 10/44 0.20
3 AB36 12/36 0.19
4 AB26 16/26 0.50

58.50 1 AB66 14/66 0.18
29250 2 AB44 12/44 0.24
3 AB36 14/36 0.24

63.00 1 AB66 14/66 0.22
31500 2 AB48 12/48 0.18
3 AB36 16/36 0.29

67.50 1 AB66 14/66 0.26
33750 2 AB48 14/48 0.22
3 AB36 18/36 0.34

72.00 1 AB72 12/72 0.19
36000 2 AB48 16/48 0.26
3 AB36 20/36 0.41

50.00 1 AB60 20/60 0.19
25000 2 AB40 14/40 0.27
3 AB34 9/34 0.21
4 AB30 10/30 0.19

55.00 1 AB66 18/66 0.22
27500 2 AB44 11/44 0.21
3 AB36 10/36 0.20
4 AB30 12/30 0.25

60.00 1 AB66 18/66 0.19
30000 2 AB44 11/44 0.26
3 AB36 12/36 0.25
4 AB30 14/30 0.31

66.00 1 AB66 18/66 0.27
33000 2 AB48 12/48 0.26
3 AB40 11/40 0.19
4 AB32 14/32 0.29

71.50 1 AB72 20/72 0.19
35750 2 AB48 12/48 0.26
3 AB40 13/40 0.18
4 AB32 16/32 0.35

77.00 1 AB72 20/72 0.23
38500 2 AB52 11/52 0.21
3 AB40 15/40 0.28
4 AB32 18/32 0.43

82.50 1 AB78 18/78 0.18
41250 2 AB52 13/52 0.25
3 AB44 16/44 0.21
4 AB36 18/36 0.34

88.00 1 AB78 18/78 0.22
44000 2 AB52 15/52 0.23
3 AB40 19/40 0.31

96.00 1 AB78 22/78 0.23
48000 2 AB56 14/56 0.25
3 AB44 18/44 0.25
4 AB36 20/36 0.41

84

90

96

102

108

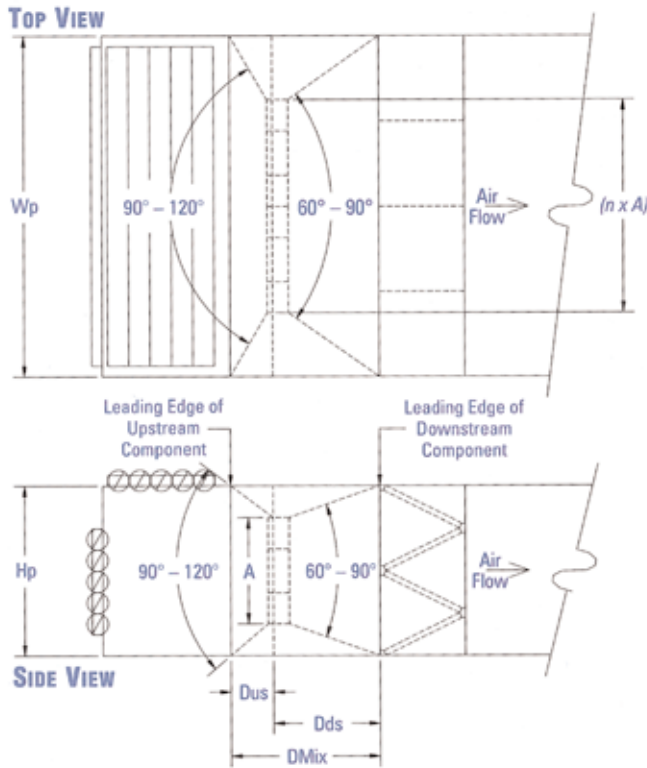
114

120

132

144

Application Detail 1



The distance upstream of a static mixer should be great enough that the angle at which the air stream must contract is between $90^\circ - 120^\circ$. If the contraction angle is greater than 120° , the pressure drop of the mixer will be greater than shown in the catalog. In addition, the pressure drop of any component located immediately upstream of the mixer will increase and the efficiency of that component will decrease.

The distance downstream of a mixer is usually governed by the required mixing. However, the downstream distance should be large enough so that the discharge angle is between $60^\circ - 90^\circ$. If the discharge angle is more than 90° , the velocity profile across the component located immediately downstream of the mixer will be affected. Typically, this results in decreased performance and increased pressure drop for the downstream component. ($n = \text{number of mixers}$)

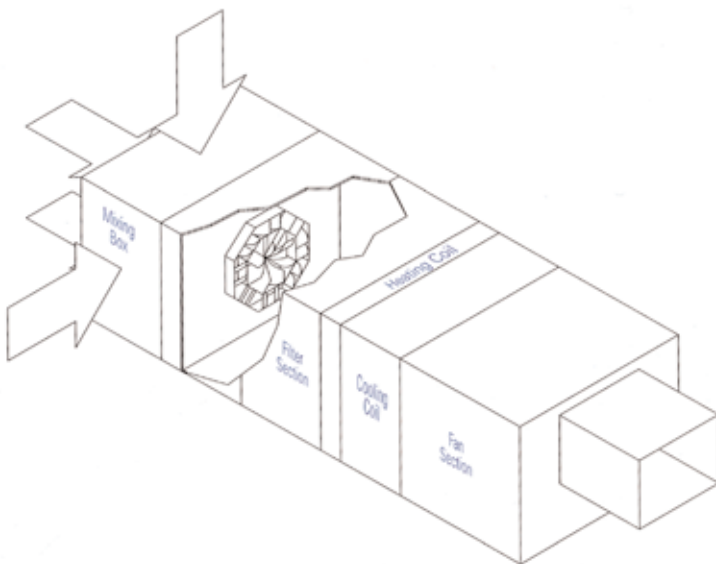
$D_{US} = \text{the greater of}$

$$\frac{W_{Plenum} - (n \times A)}{3}$$

or

$$\frac{H_{Plenum} - A}{3}$$

Application Detail 2

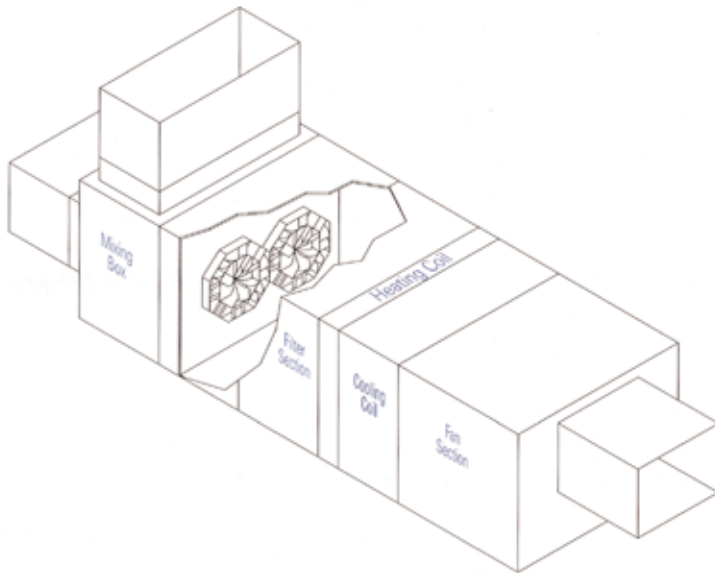


The use of a single AIR BLENDER® static mixer is the safest way to apply a static mixer and provides the system designer with an almost unlimited variety of inlet arrangements.

If the required upstream and downstream distances are too great with a single mixer, the use of multiple mixers may be considered. However, if multiple mixers are used, it is necessary that the same relative amounts of outside and return air pass through each mixer. In most cases, this means that the air inlets and control damper blades should extend the full width of the air handling unit.

If there is a question whether or not the use of multiple mixers is advisable, please contact the factory or your local sales representative.

Application Detail 3

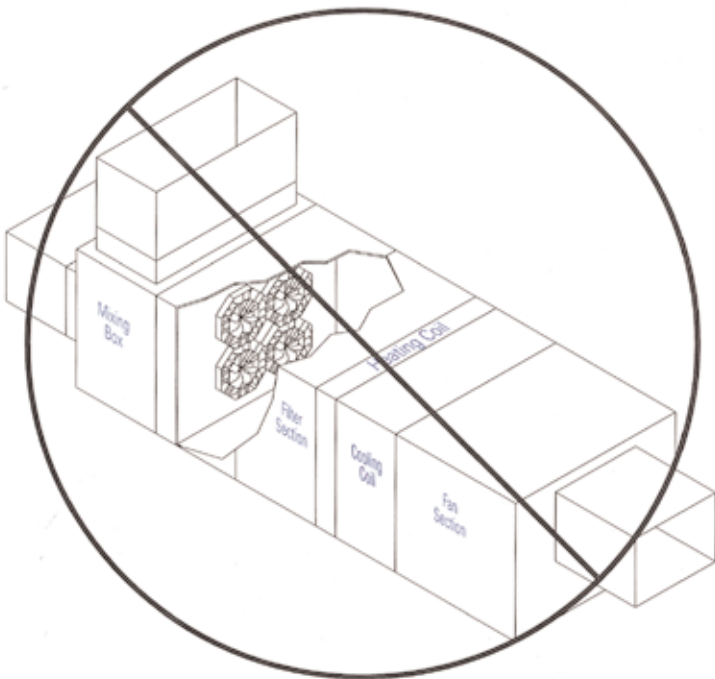


The use of multiple static mixers can provide a substantial savings in mixing distance and pressure drop. However, when using multiple static mixers, the inlet arrangement of the two air streams is critical. There must be the same relative amounts of outside and return air passing through each mixer in order for the system to work correctly. If this condition is not true, the mixers may not reduce the stratification. This condition is generally satisfied when both the return and outside air inlets and control damper blades extend the full width of the air handling unit.

If there is an elbow located just before the inlet and the ducts enter from the side of the unit, turning vanes should be used to insure that the air is evenly distributed across the entire inlet.

If both inlets and damper blades extend the full height of the unit, it may be possible to stack the static mixers in a vertical line. As previously mentioned, all mixers must have the same relative amounts of air passing through them to be effective.

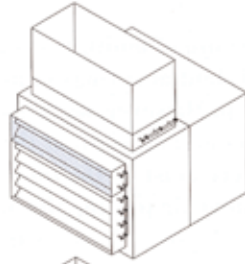
Application Detail 4



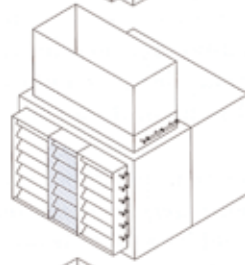
The desire to save space may lead to the decision to use an array of mixers rather than a single line. This practice is rarely acceptable due to the uneven amount of return and outside air which pass through each mixer. Please contact factory before designing a system using an array of static mixers.

Application Detail 5

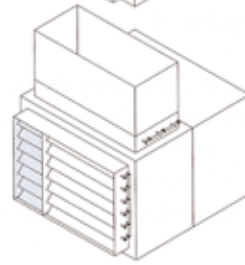
BEST ARRANGEMENT
Full Width Min. OA
Damper; Multiple Mixers



O.K. ARRANGEMENT
Centered, Partial Width
Min. OA Damper,
Max. of 2 Mixers



POOR ARRANGEMENT
Offset, Partial Width
Min. OA Damper
Use Single Mixer



The performance of multiple static mixers depends upon how the air enters the air handling unit.

The safest arrangement for the minimum outside air damper is to extend the damper the full width of the unit. If a partial width min. OA damper is used, it should be centered and a maximum of two mixers should be used. If the min. OA damper is not centered, a single static mixer should be used.

The best arrangement for control dampers is for the damper blades to extend the full width of the unit. This arrangement allows a horizontal line of multiple mixers to be used. If necessary, the damper may extend the full height of the unit. This arrangement allows a vertical line of multiple mixers to be used. But in many cases, this results in longer mixing distances and higher pressure drops.

In general, the use of a side inlet should be avoided unless a specially designed mixing box is used.

Sample Selection Using Quick Selection Chart

Series IV AIR BLENDER® static mixers are to be installed in an air handling unit with inside dimensions of 90" wide and 56" high. The system is to use a standard mixing box with inlets which extend the full width of the air handling unit. The plenum velocity will be 450 FPM. What mixers should be used and how much distance and pressure drop is required for these mixers?

SOLUTION:

Since the inlets extend the full width of the unit, we may use multiple mixers. The Quick Selection chart suggests the following mixers:

		$W_p = 90$					
$H_p = 54$	33.75	.....	1 AB48	.....	14/48	.....	0.22
	16875	.....	2 AB34	.....	8/34	.....	0.22
			3 AB28	.....	9/28	.....	0.21
			4 AB22	.....	11/22	.....	0.35

If pressure drop is more important than distance, two AB34 mixers may be used with 8" upstream and 34" downstream. The pressure drop for this selection will be:

$$\Delta P_{\text{Mixer}} = 0.22 \left(\frac{450}{500} \right)^2 = 0.18 \text{ in. w.g.}$$

If pressure drop is not as important as distance, four AB22 mixers may be used with 11" upstream and 22" downstream of the mixers. The plenum velocity is approximately 450 FPM, so the pressure drop will be:

$$\Delta P_{\text{Mixer}} = 0.35 \left(\frac{450}{500} \right)^2 = 0.28 \text{ in. w.g.}$$

Selection Procedure without Using Quick Selection Chart

A 120" x 120" air handling unit is to have AIR BLENDER static mixers installed after the mixing box. The system is to have a maximum flow rate of 50000 CFM and a minimum flow rate of 30000 CFM. What mixers should be used in this system?

SOLUTION:

The first step is to determine the area of the plenum. In this case, it is $120" \times 120"/144 = 100 \text{ ft}^2$. The plenum velocity at maximum flow is 500 FPM and 300 FPM at minimum flow. The next step is to select an area ratio from Table 1 on page 7. For most applications, an area ratio of 0.43 will provide the best selection. Calculate the mixer area required to achieve the desired area ratio:

$$\begin{aligned} \text{Area}_{\text{Mixer}} &= \beta \times \text{Area}_{\text{Plenum}} \\ &= .43 \times 100 = 43 \text{ ft}^2 \end{aligned}$$

Use the Product data sheet on page 8 to select the possible mixers based on area.

QUANTITY	MODEL	AREA	ACTUAL β	WIDTH	HEIGHT
1	AB84	40.6	0.41	84.0"	84.0"
2	AB60	41.4	0.41	120.0"	60.0"
3	AB48	39.9	0.39	144.0"*	48.0"
4	AB40	27.6	0.28**	120.0"	40.0"

Note: *Selection too wide to fit within unit. **Area ratio below recommended minimum of 0.35.

From this chart, the best selection will be two AB60 static mixers. If distance is at a premium, the next smaller size mixer (two AB56) may be used instead. The upstream distance and pressure drop will increase with the use of these smaller mixers.

The distance upstream of the mixer needs to be great enough to keep the contraction angle between 90–120° (see application detail 1 on page 12). The difference in the horizontal and vertical directions:

$$\Delta \text{Width} = 120 - (60 \times 2) = 0 \quad \Delta \text{Height} = 120 - 60 = 60$$

The upstream distance can be determined from the larger of the ΔHeight and ΔWidth using the following equation:

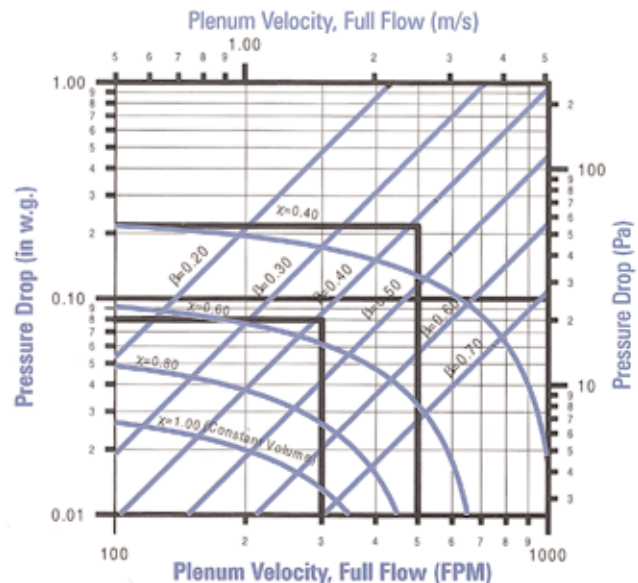
$$D_{US} = \frac{\Delta \text{Height}}{3} = \frac{60}{3} = 20$$

The downstream distance is 60". The total distance required for mixing is: $20" + 60" = 80"$

The turndown ratio (χ) for the system is

$$\chi = \frac{30000}{50000} = 0.60$$

Plotting the actual area ratio and the maximum plenum velocity on pressure drop chart 2, page 7 yields a pressure drop of approximately 0.21" w.g. at the maximum flow and 0.08" w.g. at the minimum flow rate. Since the plotted point lies above the 0.60 turndown line, the selection will provide mixing throughout the operating range of the system.



Static Air Mixer Specifications

The air mixer will be a Series IV Air Blender® mixing device. The air mixer or mixers shall be constructed of a minimum .030" thick aluminum. Mixer shall be welded construction with a mechanically fastened center. The mixing device shall impart a counter rotational mixing of entering air streams. Each mixer model shall be geometrically scaled to ensure proper performance across the full range of sizes. Mixers that do not use counter rotational mixing or are not geometrically scaled are not acceptable.

The performance of the mixing equipment shall be stated in terms of Range Mixing Effectiveness. Mixing Effectiveness calculated using the standard deviation is not acceptable. Mixing equipment shall be geometrically similar for all sizes.

The pressure drop of mixers shall include mixer area ratio so that the "orifice effect" is included. If not geometrically similar, then each different size must be tested for mixing performance and pressure drop. Detailed documentation of performance testing shall be made available

Air Handling Unit mixing equipment shall have a Range Mixing Effectiveness as shown in the AHU schedule when the system is operating under the conditions in the AHU schedule.

Acceptable Manufactures and Products: Blender Products, Inc., Series IV Air Blender® static mixer or approved equal prior to bidding.

STATIC AIR MIXER SCHEDULE

UNIT I.D.	SYSTEM SERVED	AIRFLOW CFM	MAXIMUM PRESSURE DROP (IN. WG)	PLENUM WIDTH IN.	PLENUM HEIGHT IN.	DISTANCE UPSTREAM OF MIXER IN.	DISTANCE DOWNSTREAM OF MIXER IN.	MODEL NUMBER	OUTSIDE AIR PERCENTAGE	MIXING EFFECTIVENESS REQUIRED



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