Fans | Air Handling Units | Air Distribution Products | Fire Safety | Air Curtains and heating Products | Tunnel Fans

Centrifugal Fans

ASP (Single Width Single Inlet)

General information

ASP SINGLE INLET CENTRIFUGAL FAN

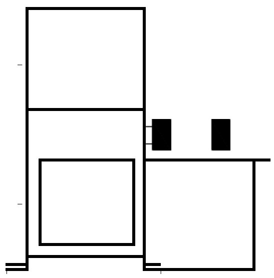
Systemair's range of centrifugal fans offer the engineers the flexibility to choose the most suitable sizes and configurations to suit any site condition. With over 2000 variations of diameter, width and length type, specifications are virtually tailor-made to individual needs.

Casings are made of mild steel, welded and many are of semi-universal construction allowing the discharge angle to be modified to suit customer's requirements. Many additional features and ancillaries can be supplied on request, example; split casings, carbon steel and stainless steel impellers.

BACKWARD INCLINED BLADES :
Non-overloading power characteristic suitable for very light dust applications (e.g. clean side of dust collector) where a good efficiency is required. Used for high pressure ventilation systems or where the system resistance could fluctuate. Normal discharge velocities 1800-3000 feet per minu

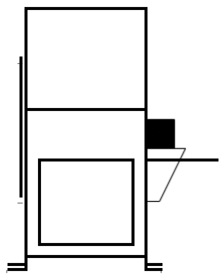
Centrifugal fan arrangements

Arrangement 1
Single inlet pedestal



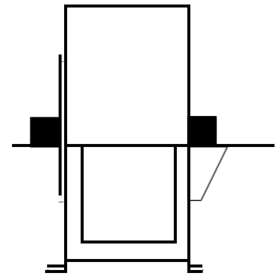
For belt drive. Impeller overhung. Two bearings on full-depth pedestal.

Arrangement 2
Single inlet overhung



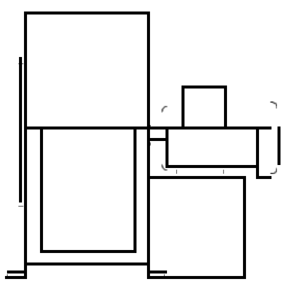
For belt drive. Impeller overhung. Bearings on bracket, supported by fan housing.

Arrangement 3
Single inlet bearer bar



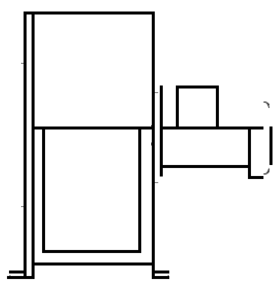
For belt drive. One bearing on each side of casing, supported by bearer bars.

Arrangement 4
Single inlet direct drive and stool



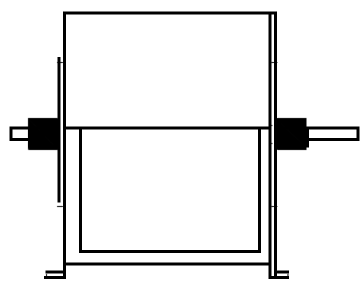
For direct drive. Impeller overhung on motor shaft. No bearings on fan. Motor feet supported by full depth-pedestal.

Arrangement 5
Single inlet direct drive, no stool



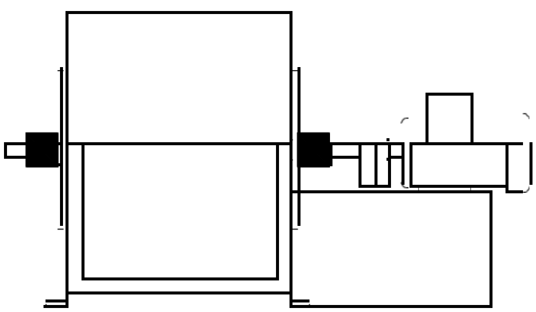
For direct drive. Impeller overhung motor shaft. No bearings on fan. Motor bolted to fan casing by its flanged end shield.

Arrangement 6
Double inlet bearer bar



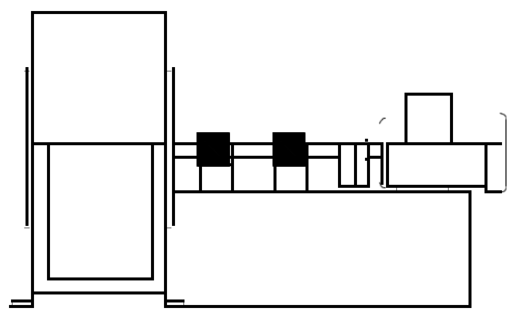
Double inlet, double width fan for belt drive. One bearing in each inlet, supported by bearer bars.

Arrangement 7
Double inlet coupling



Double inlet, double width fan for coupling drive. Generally as arrangement 6, plus pedestal for the motor.

Arrangement 8
Single inlet coupling



For coupling drive. Generally as arrangement 1 but pedestal extended to receive motor.

Designation of direction of rotation and positions of fan parts

The following conventions have been established for the designation of direction of rotation of the fan and the positions of some of its parts, in accordance with Eurovent Document 1/1

Direction of rotation

The direction of rotation is designated clockwise (right hand, symbol RD) or counter-clockwise (left hand, symbol LG) according to the direction seen when viewed along the axis of the fan from the side opposite to the inlet. By this convention the direction of rotation is determined according to the airflow into the inlet and regardless of motor position.

Note : For a double-inlet centrifugal fan the direction of the rotation is determined when viewed from the drive side.

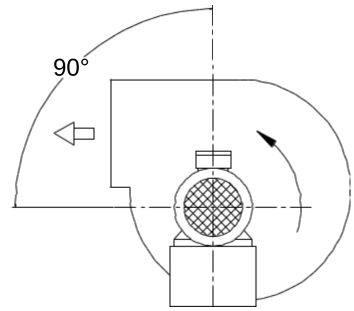
Angular position of parts of the fan assembly

The angular positions of parts of a fan are defined in relation to an origin taken as a straight line perpendicular to the mounting base towards the axis of rotation.

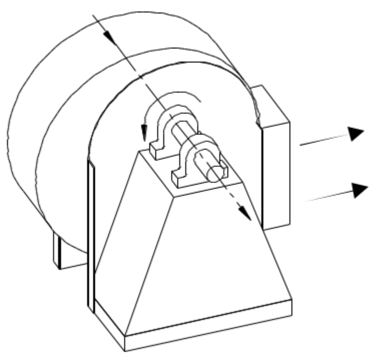
Outlet position of a centrifugal fan

The outlet position of a centrifugal fan is designated by the symbol for the direction of rotation (i.e. LG or RD) followed by the angle in degrees between the origin and the axis of the discharge measured in the direction of rotation e.g. LG135 or RD 90.

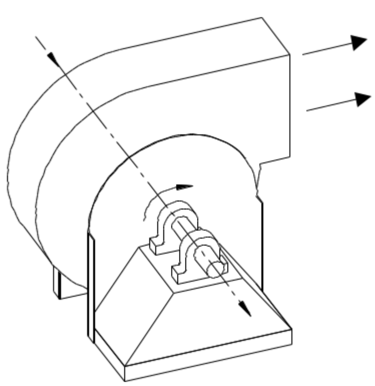
Example
LG 90



VIEW FROM THE DRIVE SIDE

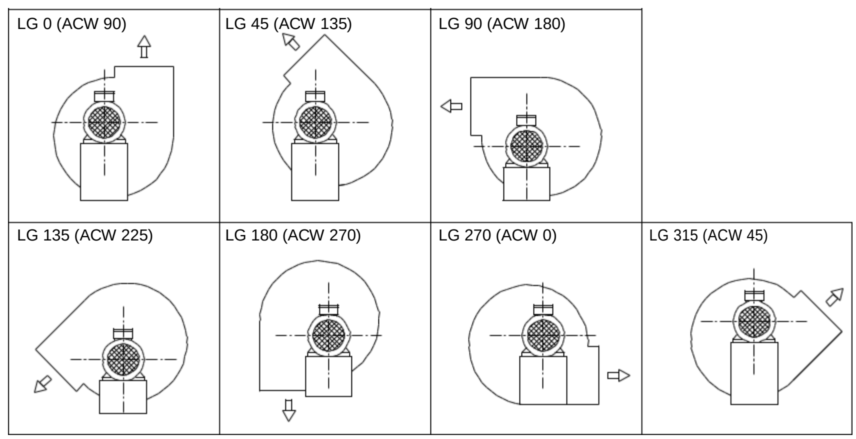


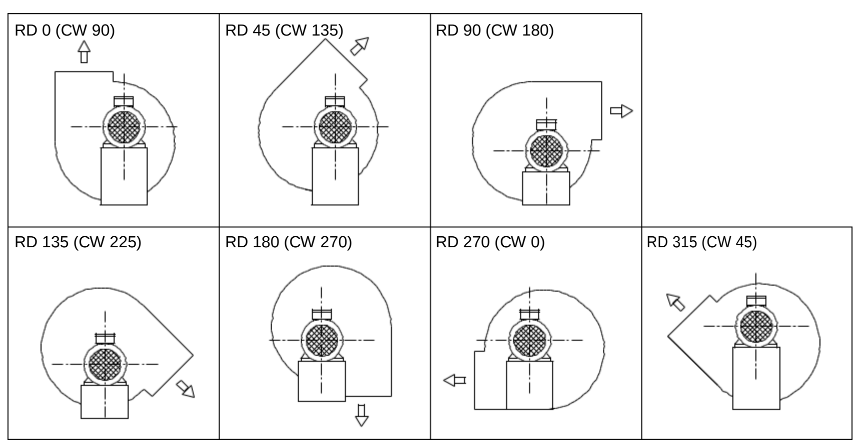
LG : counter-clockwise rotation



RD : clockwise rotation

Direction of rotation of centrifugal fans





Standard discharge positions for centrifugal fans

Position of component parts of a centrifugal fan with volute casing

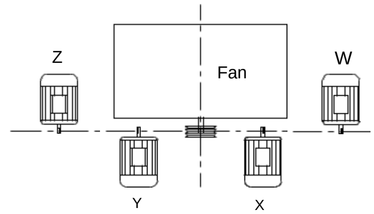
The angular position of a motor, inlet box or bend, inspection door or other component, is designated by the symbol for the direction of rotation (i.e. LG or RD) followed by the angle in degrees between the origin and the axis of the component part measured in the direction of rotation.

Note : Where the fan casing is not provided with feet the outlet position will be taken as 0° .

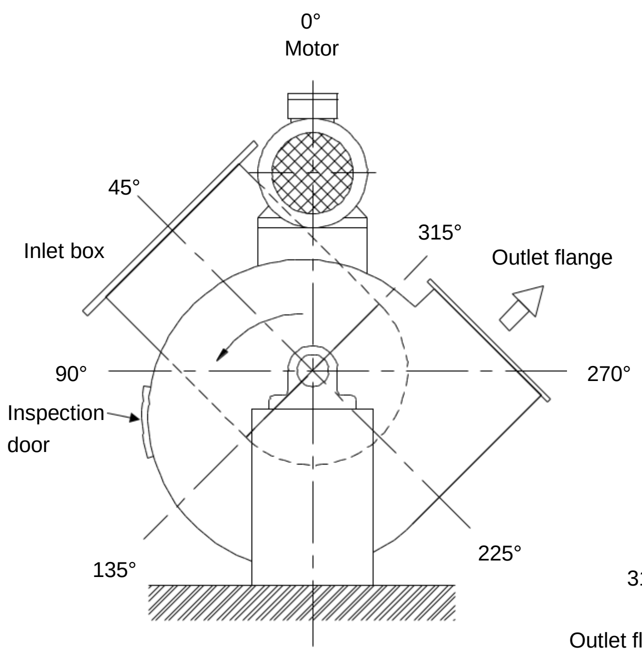
Plan view position of motor for belt or chain drive

The position of a motor when viewed perpendicular to the mounting base is denoted by letters W, X, Y, Z, as shown below and it has to be specified whether the drive is on the inlet side or on the side opposite to the inlet.

Note : The angular position of a motor may be indicated as explained on the right.



Method of designation of the alternative positions in plan view of a motor for belt or chain drive. Positions W and Z are standard, positions X and Y are only available to special order.

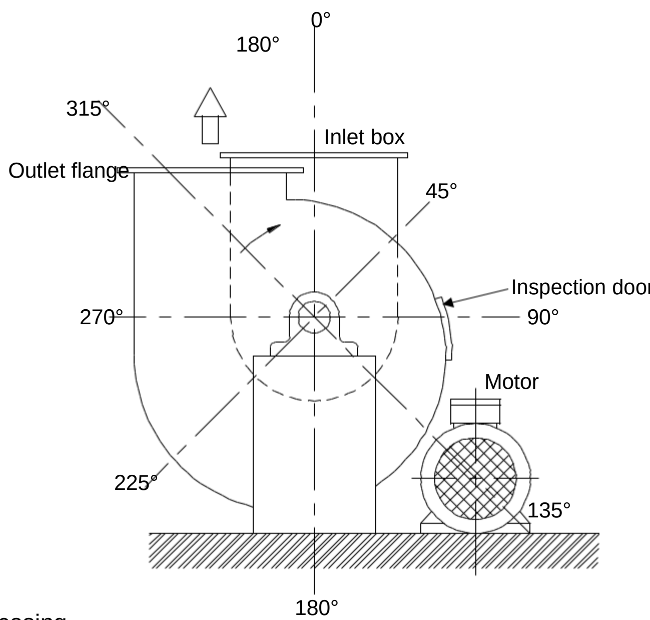


Example I

Outlet Flange	: LG 315
Inspection Door	: LG 135
Inlet Box	: LG45
Motor	: LG0

Example II

Outlet Flange	: RD0
Inspection Door	: RD45
Inlet Box	: RD0
Motor	: RD 135



Position of components of a centrifugal fan with volute casing

TEMPERATURE AND ALTITUDE DERATION

All performance date given in this catalogue are for standard inlet conditions. These assume a gas density of 1.2 kg/m^3, dry air at a temperature of 20º C and a barometric pressure of 101.325 kPa

It is advisable for the user to ascertain the conditions under which the fan is to be subjected i.e. to enable necessary deration for a more precise fan selection.

Operating temperature effects the fan pressure and also the power. Thus the fan static pressure must be corrected accordingly.

An example how this is done is as follows :

A customer required a fan for duty of 7.39 m^3/s @ 101.6mm w.g. at 150 m above sea level and at an elevated temperature of 90º C. From table 1 at a temperature of 90º C and altitude of 150 m we have a factor at 1.25. With this factor the new static pressure is 101.6 x 1.25 = 127 mm w.g.

With 7.39 m^3 / s at 127mm w.g. we now select the fan from the performance tables.

An AS 100 SWSI running at 906 rpm requiring 11.73 kw would be a suitable choice.
Now we have to correct the brake kw.

11.73 ÷ 1.25 = 9.38 kw.

This would then be the required power at the operating condition.

Table 1

Temp 0º C	ALTITUDE IN METRES ABOVE SEA LEVEL										
	0	150	300	450	600	750	900	1050	1200	1350	1500
20	0.97	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.14	1.16	1.18
30	1.04	1.05	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22
40	1.07	1.08	1.10	1.12	1.14	1.16	1.18	1.20	2.22	2.24	2.26
50	1.11	1.12	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.30
60	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.32	1.33
70	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.31	1.33	1.35	1.37
80	1.19	1.22	1.24	1.26	1.28	1.30	1.32	1.35	1.38	1.40	1.42
90	1.22	1.25	1.27	1.30	1.32	1.34	1.36	1.38	1.41	1.43	1.45
100	1.25	1.29	1.31	1.33	1.35	1.38	1.40	1.42	1.45	1.48	1.51
125	1.34	1.38	1.40	1.42	1.45	1.47	1.50	1.53	1.56	1.58	1.60
150	1.43	1.46	1.48	1.51	1.53	1.56	1.59	1.62	1.65	1.68	1.71
175	1.52	1.55	1.57	1.60	1.62	1.66	1.69	1.72	1.75	1.78	1.81
200	1.60	1.64	1.66	1.69	1.72	1.75	1.79	1.82	1.85	1.88	1.91
225	1.69	1.72	1.74	1.77	1.80	1.84	1.88	1.92	1.95	1.99	2.05
250	1.78	1.81	1.83	1.86	1.89	1.93	1.97	2.00	2.04	2.08	2.12
275	1.86	1.90	1.92	1.95	1.99	2.03	2.07	2.10	2.14	2.18	2.22
300	1.95	1.98	2.00	2.04	2.08	2.12	2.16	2.20	2.24	2.28	2.32
325	2.03	2.07	2.10	2.14	2.18	2.22	2.26	2.30	2.34	2.38	2.42
350	2.12	2.16	2.18	2.22	2.26	2.30	2.34	2.38	2.43	2.47	2.51
375	2.20	2.24	2.27	2.31	2.35	2.40	2.44	2.48	2.52	2.56	2.60
400	2.29	2.33	2.35	2.41	2.45	2.49	2.53	2.57	2.62	2.67	2.72
425	2.37	2.42	2.46	2.50	2.54	2.59	2.63	2.67	2.72	2.77	2.82
450	2.45	2.50	2.54	2.58	2.63	2.68	2.72	2.77	2.82	2.87	2.92

SYSTEM EFFECTS

Despite the need to establish good inlet and outlet conditions, it has to be recognised that there will be many installations where lack of space or site geometry will preclude the fitting of ideal duct connections. The information which follows is intended to assist the designer in assessing the likely effects of less than ideal ducting. As an alternative, it also indicates the preferred amounts of straight ducting necessary on fan inlet and outlet.

Normally the system designer will have access to information giving the pressure loss in fittings expressed as some fraction of the local velocity pressure. These losses always assume a fully developed and symmetrical velocity profile. Where fittings are adjacent to the fan inlet or outlet, an additional effect may be anticipated as the profile may be far from this ideal. The additional loss is given in the ‘approximate’ information in this section.

Inlet connections

Swirl and non-uniform flow can be corrected by straightening or guide vanes. Restricted fan inlets located too close to walls or obstructions or restrictions caused by fans inside a cabinet, will decrease the usable performance of a fan. The clearance effects is considered a component part of the entire system and the pressure losses through the cabinet must be considered a system effect when determining system characteristics.

Fig 3. shows the variations in inlet flow which will occur. A ducted inlet condition is as (i), the unducted conditions as (ii), and the effect of a bellmouth inlet as (vi). Flow into a sharp edged duct as shown in (iii) or into an inlet without a smooth entry as shown in (iv) is similar to flow through a sharp edged orifice in that vena contracta is formed. The reduction in flow area caused by the vena contracta and the following rapid expansion causes a loss which should be considered a system effect.

Wherever possible fans with open inlet should be fitted with ‘bell-mouths’ as (vi). If it is not practical to include such a smooth entry, a converging taper will substantially diminish the loss of energy and even a simple flat flange on the end of a duct will reduce the loss to about one half of the loss through an unflanged entry. The slope of transition elements should be limited to an included angle 30º when converging or 15º when diverging.

Non-uniform flow into the inlet is the most common cause of deficient fan performance. An elbow or a 90º duct turn located at the fan inlet will not allow the air to enter uniformly and will result in turbulent and uneven flow distribution at the fan impeller. Air has weight and a moving air stream has momentum and the air stream therefore resists a change in direction within an elbow as illustrated.

The system effects for elbows of given radius diameter ratios are given in Fig 4 – 6. These losses only apply when the connection is adjacent to the fan inlet and are additional to the normal loss.

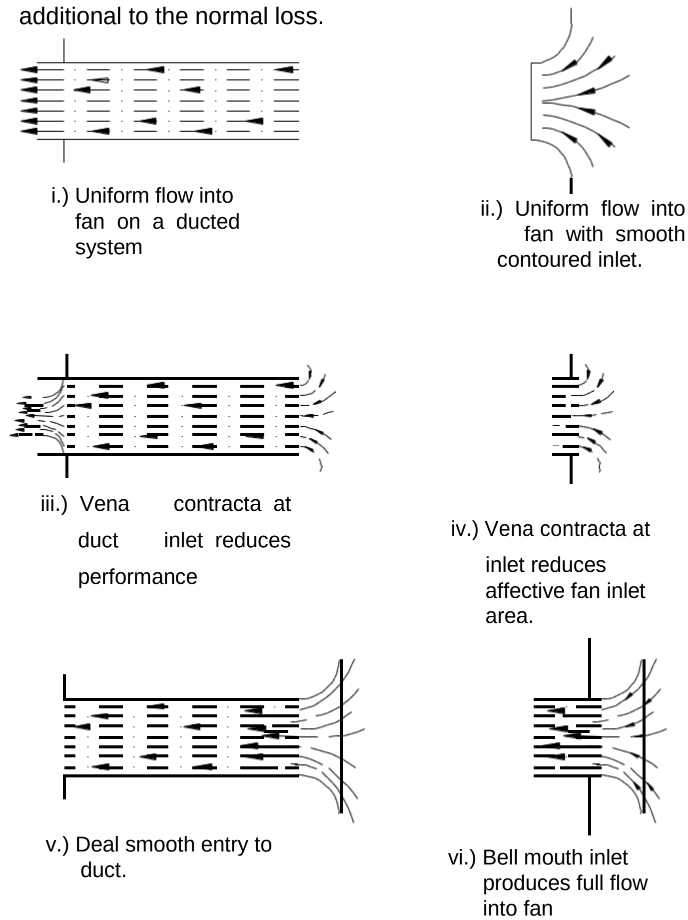
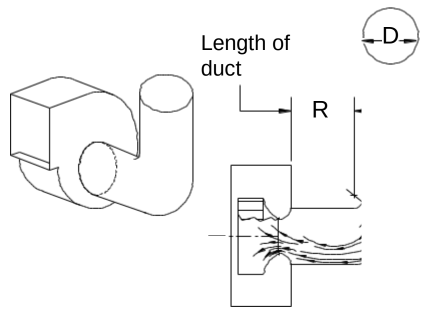


Fig 3. Typical inlet connections for centrifugal fans.



R/H	No duct	2D duct	5D duct
0.75	1.5	0.8	0.4
1.0	1.2	0.7	0.3
2.0	1.0	0.6	0.2
3.0	0.7	0.4	0.2

Fig. 4

Fig. 4 System effects expressed as velocity pressures. Non-uniform flow into a fan from a 90º round section elbow, no turning vanes.

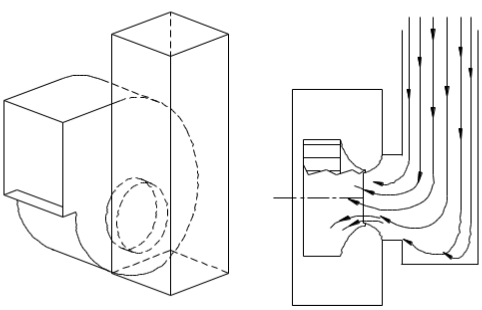
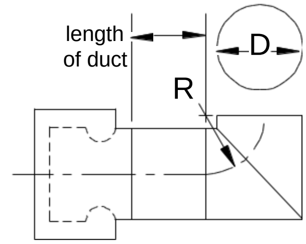


Fig. 5

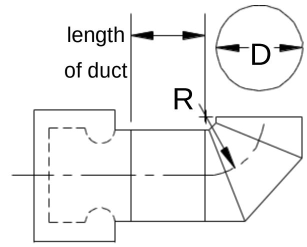
Fig. 5 System effects expressed as velocity pressures. Non-uniform flow into a fan from a rectangular inlet duct. The reduction in capacity and pressure for this type of inlet condition are difficult to tabulate. The many differences in width and depth of duct influence the reduction in performance to varying degrees. Such inlets should therefore be avoided. Capacity losses of 45% have been observed. Existing installations can be improved with guide vanes or the conversion to square or mitred elbows with guide vanes.

Fig. 6 System effects of ducts of given radius/diameter ratios expressed as velocity pressures. Note : the inside area of the square duct (H x H) is equal to the inside area circumscribed by the inlet fan spigot. The maximum included angle of any converging element of the transition should be 30º, and for diverging element 15º



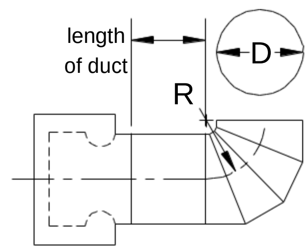
R/H	No duct	2D duct	5D duct
-	3.0	3.0	1.0

a) Two piece mitred 90º round section elbows – no vanes



R/H	No duct	2D duct	5D duct
0.5	2.5	1.5	0.8
0.75	1.5	1.0	0.5
1.0	1.2	0.7	0.3
2.0	1.0	0.5	0.3
3.0	0.8	0.5	0.3

b) Three piece mitred 90º round section elbow – no vanes



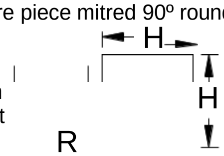
R/H	No duct	2D duct	5D duct
0.5	1.8	1.0	0.5
0.75	1.5	0.8	0.4
1.0	1.3	0.7	0.3
2.0	1.0	0.5	0.3
3.0	0.7	0.4	0.2

c) Four or more piece mitred 90º round section elbow – no vanes

$D = \frac{2H}{\pi}$

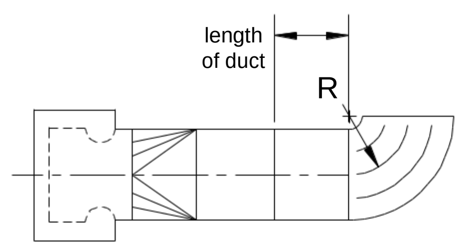
length of duct

R



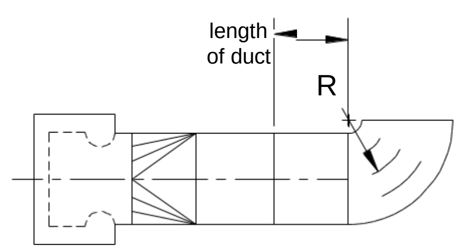
R/H	No duct	2D duct	5D duct
0.5	2.5	1.6	0.8
0.75	2.0	1.5	0.7
1.0	1.5	0.7	0.3
2.0	0.8	0.5	0.2

a) Square elbow with inlet transition – no turning vanes



R/H	No duct	2D duct	5D duct
0.5	0.8	0.5	0.3
1.0	0.5	0.3	0.2
2.0	0.3	0.3	0.1

b) Square elbow with inlet transition – three long turning vanes



R/H	No duct	2D duct	5D duct
0.5	0.8	0.5	0.3
1.0	0.5	0.6	0.2
2.0	0.3	0.3	0.1

c) Square elbow with inlet transition – short turning vanes

Fig. 6

Inlet swirl Another cause of reduced performance is an inlet duct which produces a vortex in the air stream entering a fan inlet. An example of this condition is shown.

The ideal inlet duct is one which allows the air to enter axially and uniformly without swirl in either direction. Swirl in the same direction as the impeller rotation reduces the pressure-volume curve by an amount dependent upon the intensity of the vortex. The effect is similar to the change in the pressure volume curve achieved by inlet vanes installed in a fan inlet which induce a controlled swirl and so vary the volume flow. Contra-swirl at the inlet will result in a slight increase in the pressure-volume curve but the horsepower will increase substantially.

Inlet swirl may arise from a variety of conditions and the cause is not always obvious. Some common duct connections which cause inlet swirl are illustrated.

Inlet turning vanes Where space limitations prevent the use of optimum fan inlet connections, more uniform flow can be achieved by the use of turning vanes in the inlet elbow. Many types are available from a single curved sheet metal vane to multi bladed aerofoils.

The pressure drop through the vanes must be added to the system pressure losses. These are published by the manufacturer, but the catalogued pressure loss will be based upon uniform air flow at entry. If the air flow approaching the elbow is none-uniform because of a disturbance further up the system, the pressure loss will be higher than published and the effectiveness of the vanes will be reduced.

Straighteners Air flow straighteners (egg crates) are often used to eliminate or reduce swirl in a duct. An example of an egg-crate straightener is shown in Fig 10.

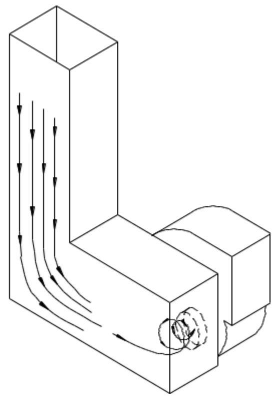


Fig. 7 Loss of performance due to inlet swirl

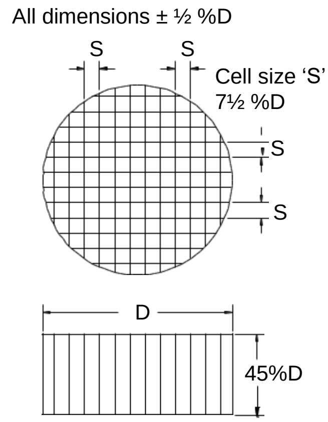


Fig. 10 Example of ‘egg crate’ air flow straighteners.

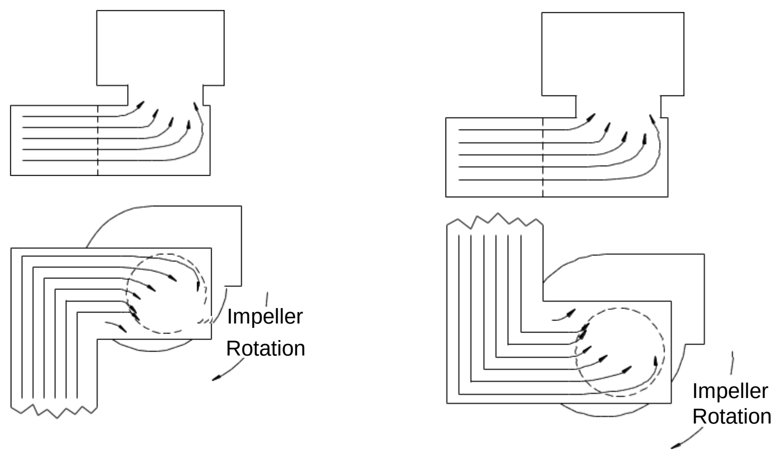


Fig. 8 Examples of duct arrangements which cause inlet swirl

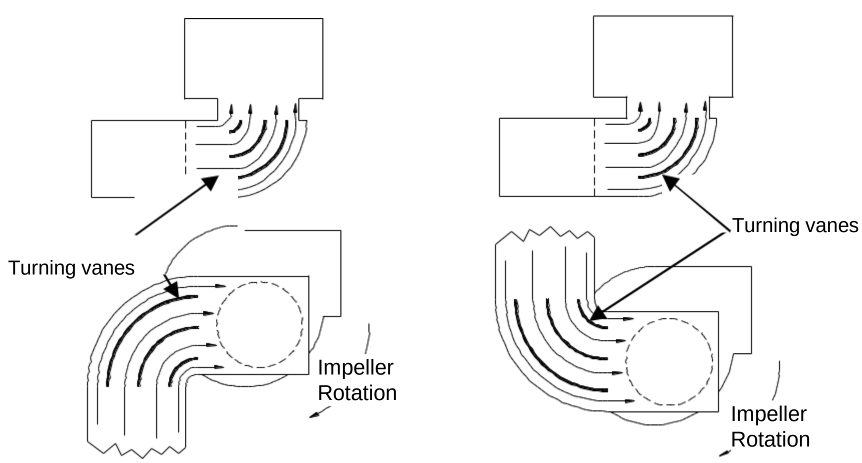


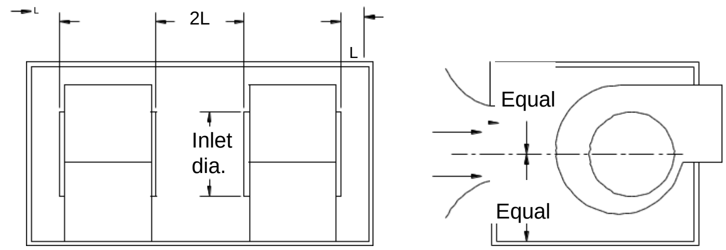
Fig. 9 Pre-swirl (left) and contra-swirl (right) corrected by use of turning vanes.

Enclosures
(plenum and cabinet effects)

Fans within air handling units, plenums, or next to walls should be located so that air flows unobstructed into the inlets. Performance is reduced if the distance between the fan inlet and the enclosure is too restrictive. It is usual to allow one-half of the inlet diameter between enclosure wall and the fan inlet.

Multiple D.I.D.W. fans within a common enclosure should be at least one impeller diameter apart for optimum performance. Fig. 11 shows fans located in an enclosure and lists the system effects as additional unmeasurable velocity pressure.

The way the air stream enters an enclosure relative to the fan also effects performance. Plenum or enclosure inlets of walls which are not symmetrical to the fan inlets will cause uneven flow and swirl. This must be avoided to achieve maximum performance but if not possible, inlet conditions can usually be improved with a splitter sheet to break up the swirl as illustrated.



L Distance Inlet to wall	System effect additional fraction of Velocity pressure at inlet
0.75 x dia. of inlet	0.2
0.5 x dia. of inlet	0.4
0.4 x dia. of inlet	0.5
0.3 x dia. of inlet	0.8
0.2 x dia. of inlet	1.2

Fig. 11 System effects of fans located in common enclosure

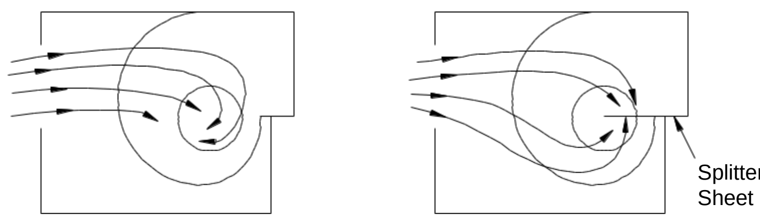


Fig. 12 Use of splitter sheet to break up swirl. Left, enclosure inlet not symmetrical with fan inlet: pre-swirl induced. Right, flow condition improved with a splitter sheet: substantial improvement would be gained by repositioning inlet symmetrically.

Outlet Connections

The velocity profile at the outlet of a fan is not uniform, but is shown in Fig 13. The section of straight ducting on the fan outlet should control the diffusion of the velocity profile, making this more uniform before discharging into a plenum chamber or to the atmosphere. Alternatively, where there is a ducting system on the fan outlet, the straight ducting is necessary to minimise the effects of bends, etc.

The full effective duct length is dependent on duct velocity and may be obtained from Fig. 14

If the duct is rectangular with side dimensions a and b, the equivalent duct diameter equals

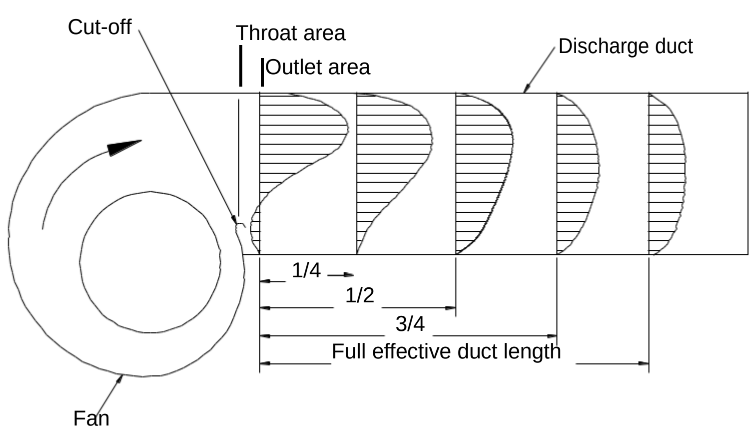


Fig. 13 Velocity profile at fan outlet (see also Fig. 14)

The use of an opposed blade damper is recommended when volume control is required at the fan outlet and there are other system components, such as coils or branch takeoffs downstream of the fan. When the fan discharges into a large plenum or to free space a parallel blade damper may be satisfactory.

For a centrifugal fan, best air performance will be achieved by installing the dampers with its blades perpendicular to the fan shaft; however, other considerations may require installation of the damper with its blades parallel to the fan shaft. Published pressure losses for control dampers are based upon uniform approach velocity profiles. When a damper is installed close to the outlet of a fan the approach velocity profile is non-uniform and much higher pressure losses through the damper can result. The multipliers in Table 3 should be applied to the damper manufacturer's catalogued pressure loss when the damper is installed at the outlet of a centrifugal fan.

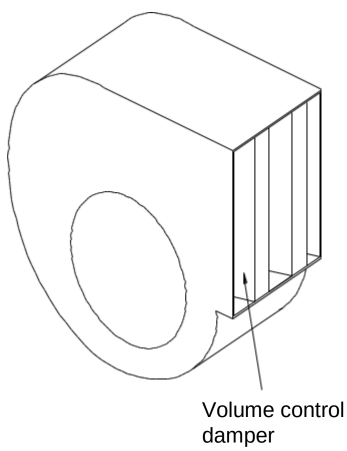


Fig. 16 Volume control damper
installed at fan outlet

* The performance of volume dampers with the pressure loos multipliers are not licensed by AMCA International.

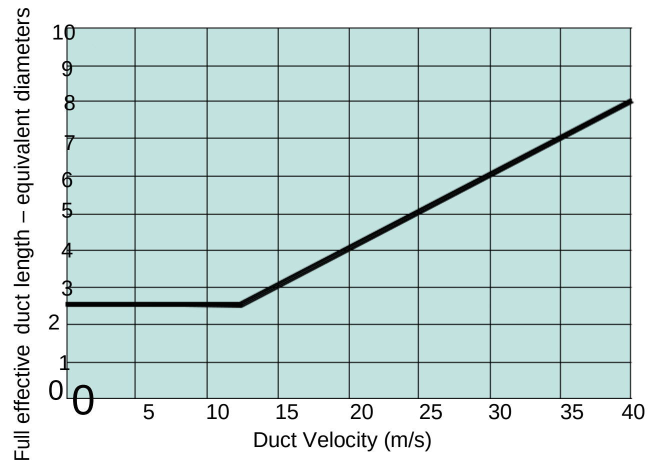


Fig. 14 Full effective duct length expressed in equivalent duct diameters

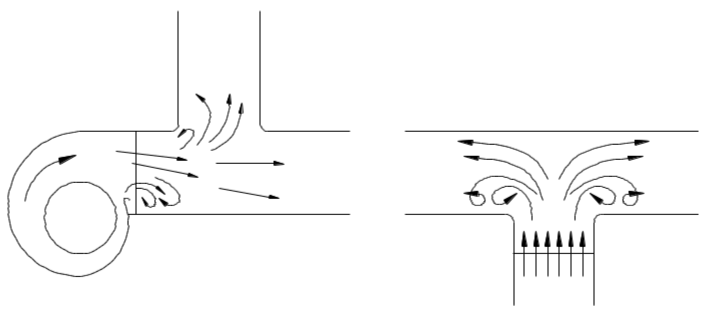


Fig.15 Branches located too close to fan. Split or duct branches should not be located close to the fan discharge: a straight section of duct will allow for air diffusion.

Throat area Outlet area	Sp multiplier
0.40	7.5
0.50	4.8
0.63	3.3
0.67	2.4
0.80	1.9
0.88 0.89	1.5
1.00	1.5

Table 2 Pressure loss multipliers for volume control dampers

ACCESSORIES / ANCILLARIES

In addition to the variations of diameter and impeller type, Systemair's centrifugal fans can be tailored specifically to individual needs by adding ancillary items shown in the drawing.

Customers are requested to specify at the time of ordering the ancillaries required.

Flexible Inlet Connection	Prevents transmission of vibration from fan to inlet ducting.
Flexible Outlet Connection	Prevents transmission of vibration from fan to outlet ducting.
Inlet Guard	For use when fan is not ducted on inlet
Outlet Guard	For use when fan is not ducted on outlet.
Drive Guard	Essential for proper guarding of drives.
Inspection Door	Permits examination of fan impeller for material build-up, etc.
Drain Point	Necessary where fan is handling air contaminated with liquids or vapours. The drain point is screwed to accept piping and fitted with a closing plug.
Base Frame	A rigid fabricated base which allows the fan motor and drive to be transported and installed as a complete unit. Necessary where anti-vibration mountings are required.
Anti-Vibration Mountings	Fitted to fan base to prevent transmission of vibration to adjacent structure.
Inlet / Outlet Mating Flanges	For fitting to customer's ducting or system to ensure accurate mating with fan flanges.
Spark Minimising Feature	A non-ferrous rubbing ring on inlet venturi and a non-ferrous shaft washer minimise possibility of incendiary sparks being produced. Essential where explosive of inflammable gas or vapours are being handled.
Cooling fan	Protects the fan bearings from heat conducted along shaft. Must be used for fans handling temperature above 75ºC.