FREE AREA CHARACTERISTICS

Free Area is the area within an aperture unobstructed by the components of a damper or air transfer grille product when in the normal or open position through which air is free to flow.

Its size can be given in square metres, square centimetres, square millimetres, square feet or square inches.

The sketch shows a typical air transfer grille fitted in a door where the aperture size is indicated by the heavy line i.e. W x H. The shaded area represents the components of the grille and the non-shaded area within the aperture is the **free area**.

As can be seen the free area equals the aperture area minus the shaded area and is often expressed as a percentage of the area of the aperture.

i.e FREE AREA =

$$\frac{\text{unshaded area}}{\text{width x height of aperture}}$$

Example

If the overall dimensions of the grille are 0.298 metre by 0.298 metre this gives an area of 0.08804 square metres. If the components of the grille are each 6mm thick then the free area (un-shaded) will be found from:

$$\frac{(298 - (16 \times 6))}{1000} \times \frac{(298 - (4 \times 6))}{1000}$$

= 0.0553 sq.meters

Divide the shaded area by the aperture area to give the percentage of free area:

0.0553/0.298 x 0.298 x 100

= 62.33%

Air Velocity

Is the speed of passage of air and is usually measured in metres per second or in imperial terms in feet per second.

An indication of velocities can be gauged by noting that 2 metres per second is approximately equivalent to 7.2 kilometres per hour or 4.5 miles per hour (a brisk walking pace).

Volumetric Flow

Is the volume of air movement in a specific time and is usually given in cubic metres per hour or litres per second. Volumetric flow through a damper is calculated by multiplying the free area of the product by the velocity of the air passing through it.

Example

The free area 0.0553 sq. metres from the previous example shown in figure one multiplied by preferred velocity of **2.0 metres per second** gives a **volumetric flow** of:

0.0553 x 2.0 = 0.1106 cubic metres per second or 398.16 cubic metres per hour.

Pressure Differential

In order to create air movement through any ventilation system it is necessary to create a pressure differential from one end of the system to the other. Though this can be achieved by natural phenomena in the building such as "stack effect" it is more usual to incorporate motor driven fans.

The pressure differential created reduces as the distance from the fan increases due to frictional losses along the route, e.g. Duct walls. The differential will be further reduced when the air stream meets a partial obstruction such as a damper.

Loss of pressure differential means that the volumetric airflow will also be reduced. It is therefore important to make allowances for the pressure losses that will be encountered when dampers or any other products that cause a degree of obstruction to the airflow are incorporated in the system.

To assist in these calculations each Lorient air transfer product has been tested to measure the pressure losses incurred through a range of pressure differentials and velocities. Values can be selected from the differential pressure charts provided in this publication.

Air pressure differentials in the UK and Europe are usually given in Pascals (Pa).

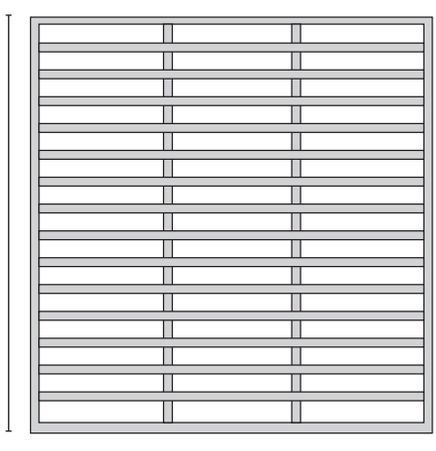


Fig. 1

FREE AREA CHARACTERISTICS

Air Changes

The number of air changes that are required within a room in a given period so that the air quality can be maintained at an acceptable level when the room is used for its intended purpose.

The following are general recommendations to maintain satisfactory air quality within certain locations:

- Boiler house or plant room: **15 - 30**
- Hospital operating theatres: **15 - 17**
- Canteens: **8 - 12**
- Lavatories and toilets: **6 - 7**
- Hospital general rooms and wards: **6**
- Offices: **4 - 6**
- Factories and Laundries (subject to special regulations): **more than 4.**

Example of Air Volume Calculation:

In order to establish the volume of air required per hour for a particular room the room volume should be multiplied by the number of changes needed per hour.

A hospital ward measuring 10 metres x 6 metres x 3.2 metres high and needing 6 air changes per hour requires:

10 x 6 x 3.2 x 6 = 1152 cubic metres of air supply per hour.

It is worth noting that if the air change is induced by extraction at the above rate "make up" air must

be introduced into the room at the same rate. In most cases it is necessary to provide fire and smoke protection along both the "supply air" and the "extract air" routes.

Example of Calculation of Air Transfer Grille Requirements:

It has been decided that air will be extracted from the above ward through ducting and the supply air will be introduced through air transfer grilles mounted in the 2 doors that give access to the ward. If one grille is to be used per door then the volumetric flow needed will be: 1152/2 = 576 cubic metres per hour. Given that the free area of the relevant grille type is 62% and the velocity is 2.0 metres per second, then the area of the grille can be calculated:

$$\frac{52 \times 100}{2.0 \times 60 \times 60 \times 62} = 0.129 m^2$$

This gives a theoretical grille size of 0.36 x 0.36 metres.

Selection of Appropriate Air Transfer Grille

Having calculated the theoretical grille size, select the next standard size above (i.e. from the example 400mm x 400mm) then check the acoustic and pressure drop charts to confirm acceptable performance values.

Useful Conversion Data

Pressure:

1 Pascal (Pa) = 1 Newton / per m^2

1 Bar = 105 N/ m^2 = 0.1 mega Pascals = 14.7 pounds per square inch

Note: A Newton is that force which, applied to a mass of one kilogram, gives it an acceleration of one metre per second per second.

1 N = 1 kg m/s2

Length:

One foot = 305 mm or 30.5 cm

Area:

One square foot = 930 cm^2

Volume:

1 $metre^3$ = 1000 litres or 1000 000 cm^3 = 35 $feet^3$ or 60700 $inch^3$.

Images: LVH44 air transfer grille

AIR TRANSFER GRILLES

FREE AREAS

LVV40	MM	CM	M	% FREE AREA
100 X 100	4,650mm²	46.5cm²	0.0046m²	46.50%
150 X 150	12,555mm²	125.7cm²	0.0125m²	55.80%
200 X 200	23,280mm²	233cm²	0.0233m²	58.20%
250 X 250	38,250mm²	383cm²	0.0383m²	61.20%
300 X 200	35,900mm²	359cm²	0.0359m²	59.80%
300 X 300	54,180mm²	542cm²	0.0542m²	60.20%
350 X 350	75,636mm²	756cm²	0.0756m²	61.74%
400 X 200	48,200mm²	482cm²	0.0482m²	60.25%
400 X 400	97,600mm²	977cm²	0.0976m²	61%
450 X 450	128,790mm²	1,288cm²	0.128m²	63.60%
500 X 500	155,500mm²	1,554cm²	0.155m²	62.20%
600 X 150	53,998mm²	539cm²	0.0539m²	59.90%
600 X 500	189,400mm²	1,894cm²	0.189m²	63.13%
600 X 600	227,520mm²	2,278cm²	0.227m²	63.20%

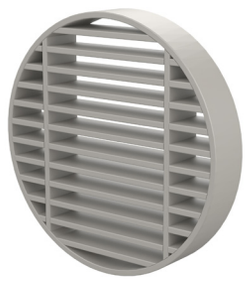
LVH44	MM	CM	M	% FREE AREA
100 X 100	4,240mm²	42.4cm²	0.0042m²	42.40%
150 X 150	10,800mm²	108cm²	0.0108m²	48%
200 X 200	22,520mm²	225.5cm²	0.0225m²	56.30%
250 X 250	35,438mm²	354cm²	0.0354m²	56.70%
300 X 300	54,900mm²	549.8cm²	0.0549m²	61%
400 X 400	98,240mm²	982.3cm²	0.0982m²	61.40%
400 X 150	33,158mm²	331.5cm²	0.0331m²	55.26%
450 X 150	36,538mm²	365.3cm²	0.0365m²	54.10%
450 X 450	121,095mm²	1,211cm²	0.121m²	59.80%
500 X 500	157,750mm²	1,578cm²	0.157m²	63.10%
600 X 600	231,660mm²	2,316cm²	0.231m²	64.35%

COVER GRILLES	MM	CM	M	% FREE AREA
100 X 100	6,300mm²	63cm²	0.0063m²	63%
150 X 150	15,187mm²	152cm²	0.0152m²	67.50%
200 X 200	26,200mm²	262cm²	0.0262m²	65.50%
250 X 250	42,375mm²	424cm²	0.0424m²	67.80%
300 X 200	-	-	-	-
300 X 300	62,550mm²	626cm²	0.0625m²	69.50%
400 X 200	-	-	-	-
400 X 400	103,040mm²	1,031cm²	0.103m²	64.4%
450 X 450	142,155mm²	1,422cm²	0.142m²	70.20%
500 X 500	172,500mm²	1,726cm²	0.172m²	69%
600 X 600	253,800mm²	2,539cm²	0.254m²	70.50%

AIR TRANSFER GRILLES

FREE AREAS

LVC SIZE	MM	CM	M	% FREE AREA
LVC 100Ø	2,868mm²	28.7cm²	0.0028m²	38.03%
LVC 200Ø	15,550mm²	155.5cm²	0.0155m²	55.25%
LVC 300Ø	41,765mm²	417.6cm²	0.0417m²	59.88%
LVC 400Ø	75,241mm²	752.4cm²	0.0752m²	60.47%
LVC 500Ø	107,054mm²	1070.5cm²	0.1070m²	54.96%
LVC 600Ø	147,671mm²	1476.7cm²	0.1476m²	64.5%



LVHC SIZE	MM	CM	M	% FREE AREA
LVHC 98Ø	2,967mm²	29.6cm²	0.0029m²	39.34%
LVHC 123Ø	5,380mm²	53.8cm²	0.0053m²	45.28%
LVHC 125Ø	5,555mm²	55.5cm²	0.0055m²	45.27%
LVHC 148Ø	8,527mm²	85.2cm²	0.0085m²	52.36%
LVHC 248Ø	27,532mm²	275.3cm²	0.0275m²	56.9%
LVHC 498Ø	97,876mm²	978.7cm²	0.0978m²	50.25%

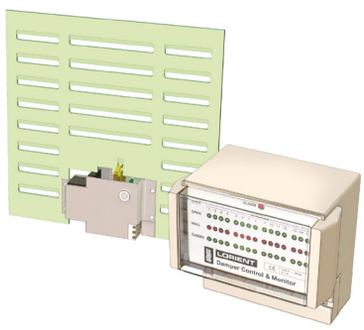
LVN20 SIZE	MM	CM	M	% FREE AREA
200 x 200	10,666mm²	106.6cm²	0.0106m²	27.2%
300 x 300	26,446mm²	264.4cm²	0.2644m²	29.78%
400 x 400	50,911mm²	509.1cm²	0.0509m²	32.14%
500 x 500	8,527mm²	769.5cm²	0.0769m²	31.02%

LVN25 SIZE	MM	CM	M	% FREE AREA
200 x 200	12,512mm²	125.1cm²	0.0125m²	31.9%
300 x 300	31,013mm²	310.1cm²	0.0310m²	34.92%
600 x 600	130,416mm²	1,304.1cm²	0.1304m²	36.46%

AIR TRANSFER GRILLES

FREE AREAS

TALKBACK F+S DAMPERS	MM	CM	M	% FREE AREA
200 X 200	8,240mm²	82.4cm²	0.0082m²	20.6%
250 X 250	15,437mm²	154.3cm²	0.0154m²	24.7%
300 X 300	26,640mm²	266.4cm²	0.0266m²	29.6%
350 X 350	37,975mm²	379.7cm²	0.0379m²	31.0%
400 X 400	50,880mm²	508.8cm²	0.0508m²	31.8%
450 X 450	69,862mm²	692.5cm²	0.0692m²	34.2%
500 X 500	86,250mm²	862.5cm²	0.0862m²	34.5%
600 X 600	133,200mm²	1,332cm²	0.1332m²	37.0%



LVV40S	MM	CM	M	% FREE AREA
200 X 150	5,550mm²	55.5cm²	0.0055m²	18.94%
250 X 200	10,739mm²	107.4cm²	0.0107m²	21.87%
300 X 200	14,597mm²	145.9cm²	0.0145m²	24.73%
400 X 300	35,992mm²	359.9cm²	0.3599m²	30.34%

LVH44S	MM	CM	M	% FREE AREA
200 X 150	5,550mm²	55.5cm²	0.0055m²	18.94%
250 X 200	10,739mm²	107.4cm²	0.0107m²	21.87%
300 X 200	14,597mm²	145.9cm²	0.0145m²	24.73%
400 X 300	35,992mm²	359.9cm²	0.3599m²	30.34%