

# Large Building Air Leakage Testing



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Although the test is relatively quick to perform, testing large building differs from testing residential houses in that but the building setup can easily take ten times longer. Additionally, the tester must understand the mechanical systems in order to ensure that they have been properly set up for the test. Learning how to use Retrotec's specialized door fan equipment is the easy part and takes a very small amount of time compared to understanding the dynamics of the buildings involved. Companies that normally do mechanical engineering jobs on large buildings are best suited for this type of test.

## Examples of testing costs for various sized buildings

Enclosure area facing outdoors (ft <sup>2</sup> )	32,000	64,000	128,000	192,000
Number of Buildings tested together	3	3	3	3
Number of floors	1	2	4	6
Number of door fans (Model 3000)	1	2	4	6
Staff used	2	2	2	2
Days of testing	2	3	4	4
Preparation prior to test	\$2100	\$2400	\$2475	\$2550
Travel cost from out of town by air	\$7,600	\$8,100	\$8,600	\$8,600
On site testing for leakage and infrared	\$4,650	\$6,750	\$8,400	\$9,675
Reporting for leakage and infrared	\$5,175	\$6,975	\$6,975	\$8,775
Door fan and IR equipment rental and shipping	\$1,500	\$2,300	\$3,910	\$5,920
<b>Total cost of test all inclusive</b>	<b>\$21,025</b>	<b>\$26,525</b>	<b>\$30,360</b>	<b>\$35,520</b>

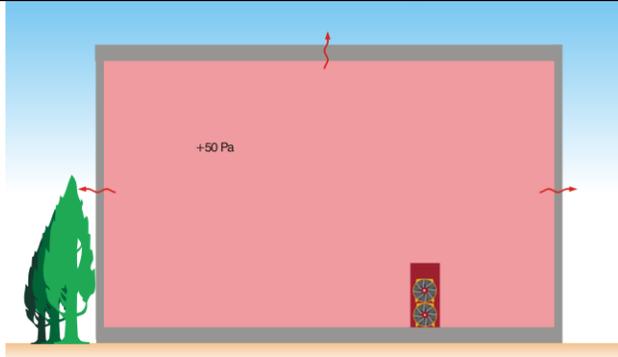
## Maximum envelope area that can be tested for various door fans

Size of buildings to be tested is based on 0.25 CFM at 75 Pa/ft<sup>2</sup> (per square foot) of envelope area.

Energy efficient buildings would be 0.1 CFM at 75 Pa/ft<sup>2</sup>, good buildings would be 0.25, average buildings would be 0.5 and poor buildings would be 1.0. The figures in the table below can be scaled up or down for the expected leakage rate. Eg. If 0.5 CFM at 75 Pa/ft<sup>2</sup> is expected, divide all the areas by 2.

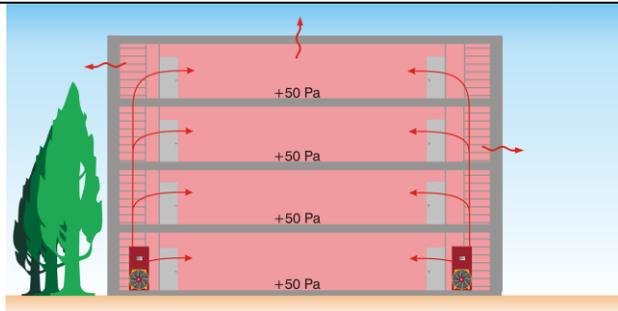
Systems (See models: <b>US3101</b> or <b>US3121</b> )	1	2	3	4	6
<b>Open warehouse style buildings</b>					
Enclosure area facing outdoors (ft <sup>2</sup> )	32,000	64,000	96,000	128,000	192,000
Building footprint (ft <sup>2</sup> ) of one floor, 12 ft high	13,000	24,000	48,000	60,000	89,000
<b>1 to 4 story buildings</b>					
Enclosure area facing outdoors (ft <sup>2</sup> )	32,000	64,000	96,000	128,000	192,000
Building footprint (ft <sup>2</sup> ) of one floor	13,200	28,000	43,000	58,200	89,000
Total floor area (ft <sup>2</sup> ) of all floors	52,800	112,000	172,000	232,800	356,000
<b>High-Rise buildings - any height</b>					
Enclosure area facing outdoors (ft <sup>2</sup> )	No	No limit	No limit	No limit	No limit
Building footprint (ft <sup>2</sup> ) of one floor	No	23,000	28,000	46,000	69,000
Total floor area (ft <sup>2</sup> ) of all floors	No	No limit	No limit	No limit	No limit

## Open warehouse style buildings



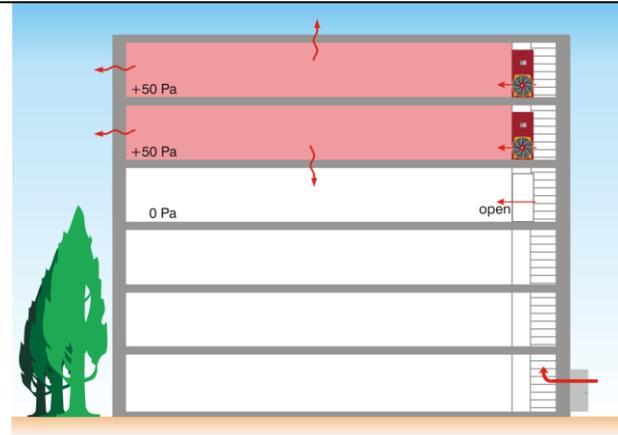
This is the only style building where any number of fans can be put into one or more doorways. In other buildings with interior doorways there is a limit of 200 CFM per square foot of doorway opening which limits the maximum number of fans that can be used to access floors above.

## 1 to 4 story buildings open to outdoors

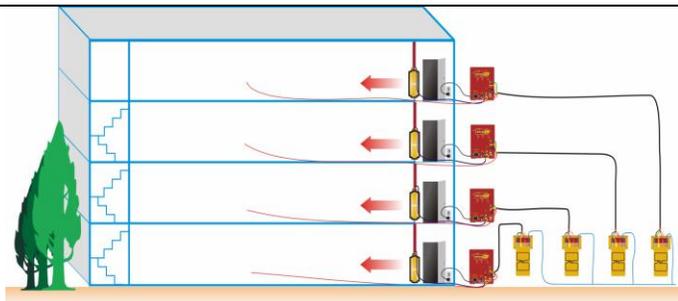


The practical limit for this style of test is usually reached with two fans of 8000 CFM each. Assuming 1/3 of the leakage is out the ground floor then 6000 CFM per fan will reach the upper floors through the available doorways. Two 3' x 7' doorways to the stairs, provides 42 ft<sup>2</sup> of area, through which 12,000 CFM must flow. This will cause a pressure drop of about 2.7 Pa. still acceptably under the 5 Pa limit. Only if 4 doorways were available could 4 fans be used to test this building.

## High-Rise buildings



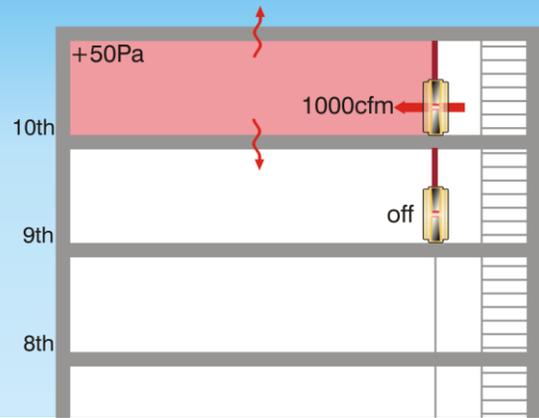
High rise buildings with any number of floors can be tested as long as the building footprint area does not go above the limit specified in the table above. This test method has the added advantage in that leakage from each floor to the outdoors is measured as well as the leakage between floors. Leakage to the outdoors will affect the energy efficiency of the building as well as the indoor air quality and the amount of stack effect and wind effect in the building. The leakage between floors will affect the amount of pressure due to stack effect.



If each floor in the high-rise is open to the outdoors, another testing option is to have one fan running on each floor.

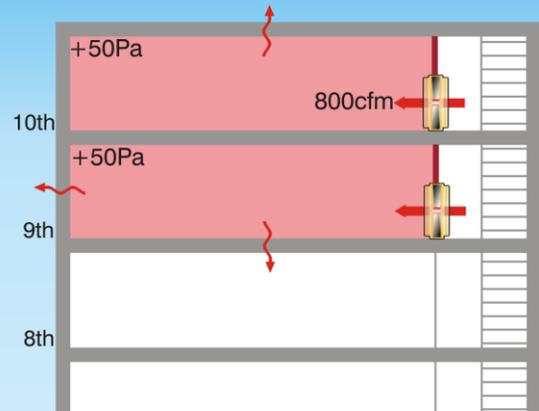
## Floor-at-a-time Testing Procedure with 2 door fans

The fan on the 10th floor is measuring 1000 CFM which is the leakage from the 10th floor to outdoors plus the leakage to the floor below.

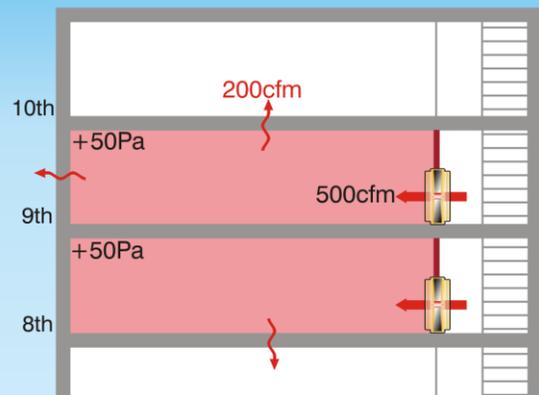


When the 9th floor is pressurized to the same pressure as the 10th floor, leakage between the floors is neutralized.

The 10th floor flow drops to 800 CFM, which is a measure of the leakage from the 10th floor to outdoors. The 200 CFM decrease in the 10th floor fan indicates that the leakage between the 10th and 9th floors is 200 CFM.

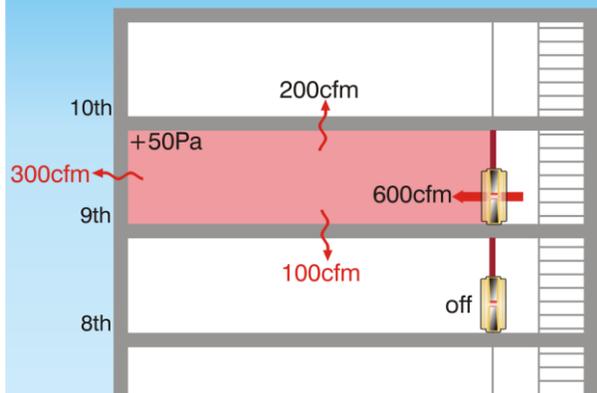


The 10th floor fan is now moved to the 8th floor to neutralize the flow between the 8th and 9th floors. The fan on the 9th floor is now measuring leakage from the 9th floor to outdoors and to the floor above. Since it is known that the leakage to the floor above is 200 CFM, by subtraction the leakage from the 9th floor to outdoors must be  $500 - 200 = 300$  CFM.

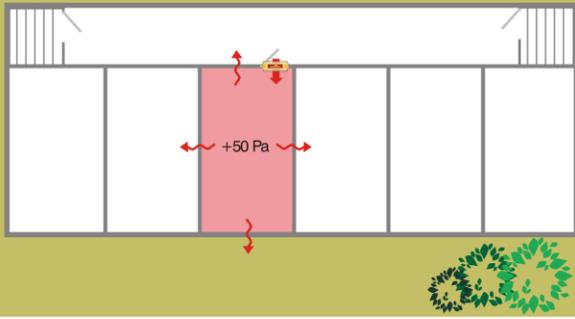


Now when the 8th floor fan is turned off, the flow on the 9th floor fan increases to 600 CFM. The increase of 100 CFM from the previous step indicates that the leakage between the eighth of the ninth floors is 100 CFM.

By continuing this process down the building, the leakage of each floor to outdoors, and the leakage between each floor, can be quickly and easily measured.

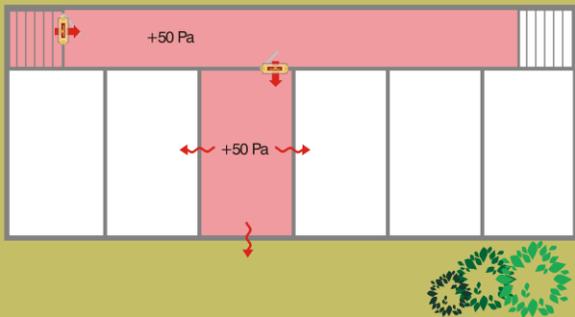


## Apartment testing on all sides with 2 door fans



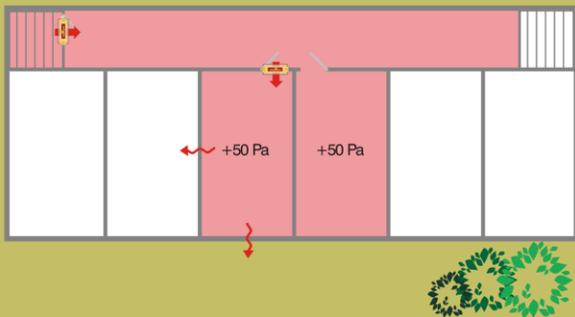
Leakage from all sides can be tested, with one system, by pressurizing a single apartment.

Assume this apartment is on the 3rd floor of a four story apartment building.

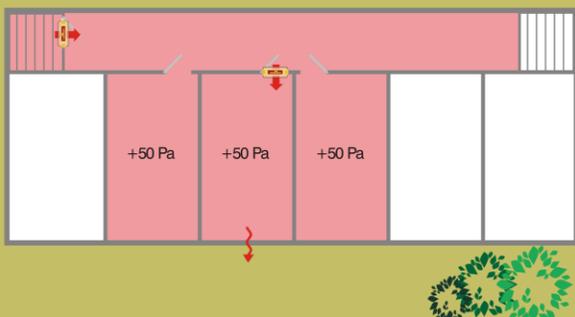


A second door fan is set up, sucking air out of the stairwell which is open to outdoors and into the hallway. Both fans are set to pressurize to the same set pressure of +50 Pa, and in automatic mode will balance themselves to achieve the same pressure.

By pressuring the hallway to the same pressure as the apartment, the leakage across the hallway wall to the apartment is neutralized. The drop in flow rate, on the fan pressurizing the apartment, indicates how much the hallway wall is leaking.



Next, the door is opened to the adjacent apartment. The hallway fan now neutralizes the flow across both the hallway wall, and the adjacent apartment wall. The change in flow, on the apartment fan, indicates the leakage across the adjacent apartment wall.



Next, the door to the other apartment is opened, and the hallway fan now neutralizes the flow across the both apartment wall. The incremental drop in flow, from the previous test, measures the air leakage across the second apartment wall.

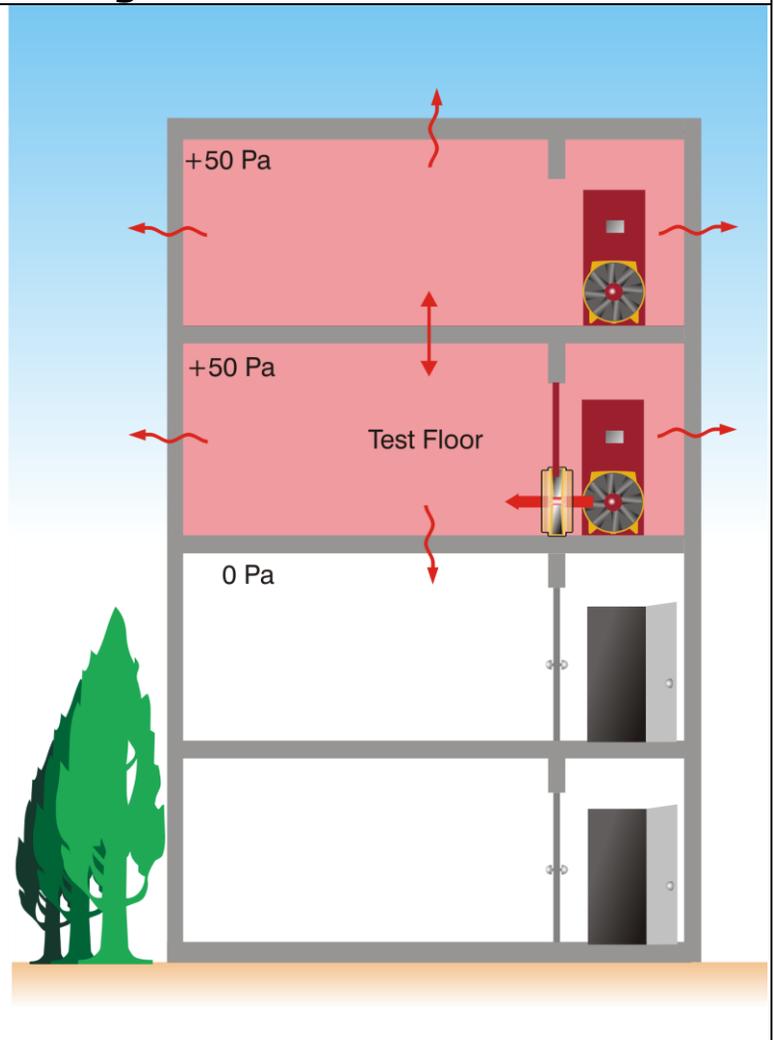
The leakage of the three interior sides of the apartment has now been measured, plus the total leakage.

## Apartment floor leakage measurement

Leakage from the apartment on the previous page to the **floor above** is measured by establishing the same pressure on the floor above using another door fan. The drop in fan flow from the tested apartment is an indication of the leakage from the apartment to the floor above.

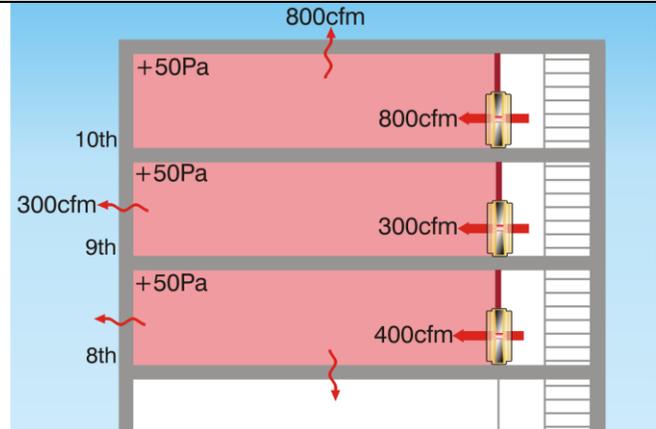
The same test, with a door fan moved to the **floor below**, indicates the leakage through the floor below.

Now the leakage of the apartment from five sides has been measured and the remaining leakage is the leakage from the apartment to outdoors.

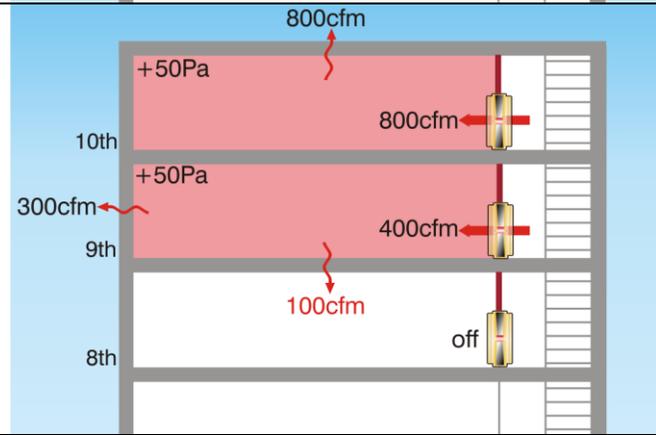


## Floor-at-a-time Testing Procedure with 3 door fans

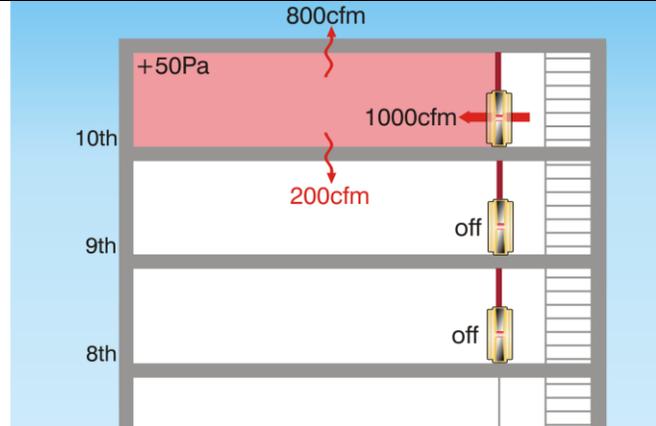
The fans on the top three floors are run simultaneously to establish the same pressure on each floor. The 10<sup>th</sup> and 9<sup>th</sup> floor door fans measure the leakage of their respective floors to outdoors directly, because the leakage of the 10<sup>th</sup> and 9<sup>th</sup> floor slabs is neutralized.



The 8<sup>th</sup> floor fan is now turned off and the measured flow on the 9<sup>th</sup> floor fan goes up from 300 to 400 CFM. The increase of 100 CFM is the leakage between the 8<sup>th</sup> and 9<sup>th</sup> floors.



The 9<sup>th</sup> floor fan is now turned off and the measured flow on the 10<sup>th</sup> floor fan goes up from 800 to 1000 CFM. The increase of 200 CFM is the leakage between the 9<sup>th</sup> and 10<sup>th</sup> floors.



Fans from the 10<sup>th</sup> and 9<sup>th</sup> floors are moved to the 7<sup>th</sup> and 6<sup>th</sup> floors and the process is repeated all the way down the building.

Using 3 fans to test a large building is significantly faster than using 2 fans.

