Tips for Improving Repeatability of Air Leakage Tests to EN and ISO Standards

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ABSTRACT

Numerous tests are being performed throughout Europe. While most are or appear to be successful others have high calculated uncertainty values and others don't correlate well when repeated by the same tester with the same equipment or where someone else does the repeated test. Some feel that equipment calibration is the key to consistent results but in most cases that it could be one of the smallest causes for lack of repeatability. We will take a look at how much different factors affect results and how to get the best results.

Repeating the same test on the same building with the same equipment and operators over time has yielded results at 50 Pa that are within +/-2% of each other while results at 4 Pa are within +/-15%. We can assume those errors are all due to wind which was light in all cases of the experiment so far. Since this precludes any building set up error, operator error or equipment error, it is useful to take a look at how EN and ISO Standards should be used to first to reduce the effects of wind and secondly to look at the combined effects of gauge and fan calibration as well as set up.

Building set up accounted for a 15% variation in results at 75 Pa on a large building. The tests were performed by 6 teams of experts on the same building but at different times. Each team was instructed on how to set up the building and all teams took results in the same manner.

Retrotec has performed several rounds of air leakage tests on a fixed enclosure to determine what the variation due to wind. Some were done at the minimum number of 5 points while another set was done at 12 Points. Most often the results were closer to the mean of all tests than the calculated uncertainty indicated but 12% of the tests had uncertainties that were 4 times greater than the calculated value. More testing is being performed to arrive at suitable recommendations.

EN and ISO both require gauge accuracy of +/- 2 Pa from 10 to 100 Pa. when this accuracy range is introduced to results, the potential errors increase by 3% at 50 Pa and 22 % at 4 Pa. Clearly most gauges in current use are typically within 0.2 Pa which eliminates 90% of this error but this is an area that must be controlled if repeated tests after retrofit are to be correlated.

EN and ISO both require flow measurement accuracy of +/- 7% which can realistically be reduced to say 5% but not much lower. Combining gauge and fan accuracy could give a variation of 9% at 50 Pa and 37% at 4 Pa.

Adding up all these error is usually done as the sum of squares. Currently the situation looks like this:

Reference	gauge	fan	wind	set up	sum of squares
4	0.22	0.07	0.15	0.15	0.31
50	0.03	0.07	0.02	0.15	0.17

With some tweaking our potential is:

Reference	gauge	fan	wind	set up	sum of squares
4	0.05	0.05	0.05	0	0.09
50	0.01	0.05	0.02	0	0.05

To accomplish this goal, careful guidelines must be established for performing the test which will be proposed. The Set Up variable must be controlled by local committees who are enforcing their standards. Currently, tests are being performed to the absolute minimum of the Standards will start to cause problems in future when results from one test group and another do not coincide.

Recommendations using the current version of EN and ISO Standards:

1. Perform a field calibration check of your gauge and tubes before each test. Simply connect the yellow tube between Channel A and B. The results should be within 2% and should not fall rapidly indicating a tube leak. A large difference will identify a tube blockage. Check the other color tubes in the same fashion.
2. After the building has been set up and before any automated test is attempted, run the fan up to full speed to ensure you can reach at least 60 Pa on the existing range. If you reach 100 Pa, change to a lower flow range. If you cannot achieve 50 Pa, change to a higher flow range. Then, see how low you can go on that range, let's say 22 Pa. Then set the pressure range in your software to run the fan from just under the maximum to 25 Pa. Before starting your automated test, you must ensure you can reach the maximum and minimum pressures and still get flow readings. Ensure your gauge is set to the range your fan is on and that the gauge will display a flow reading.
3. Although the Standards say the Minimum Test Pressure must be 10 Pa, I believe it really means it must not be lower than 10 Pa. If your Bias pressure is 2 Pa initially and your test pressure is set to 10 Pa on the gauge, later this Baseline will be subtracted so your actual test pressure will be only 8 Pa.
4. Test from the maximum to minimum test pressure to decrease the likelihood that a door or some building feature will open during the test and spoil the result. If you do it the other way around and your arrival criteria is +/- 1 Pa then you system could start taking readings at only 9 Pa if you had set your lowest test pressure to 10 Pa. With a 2 Pa Bias pressure, your true test point may only be 7 Pa which will fall below the Minimum Allowable Test Pressure.
5. The above steps will reduce the chances that you'll have to change ranges in mid test. This slows the test down and will always produce a small notch because calibrations from one range to another are not exact. This notch, if it appears at the top or bottom of your test will cause the result at 4 Pa in particular to vary a lot.