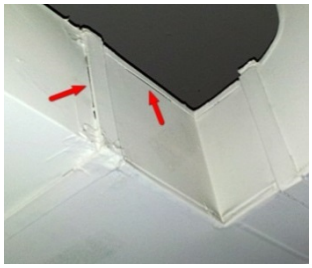
DUCT LEAKAGE AND LEAKAGE TESTING

INTRODUCTION

The leakage of air out of and into air handling supply, return and exhaust ducts can have a significant effect on energy usage and greenhouse gas emissions. AS 4254.2 [1] mandates leakage testing of all duct systems, this is contrary to recommendations in earlier editions of the standard. AS 4254.2 is incorporated by reference into the NCC (National Construction Code).

Improved duct sealing and leakage testing has the potential to provide substantial reductions in operating cost and greenhouse gas emission, as well as improving the quality of the service delivered. This TECHnote examines the impact of duct leakage, statutory testing requirements and NATSPEC provisions for leakage testing.

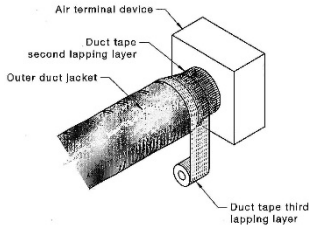


Some common jointing methods, like drive slip, have considerable potential for leaks.

DUCT LEAKAGE

Recent research [2] has shown that even a small leakage rate of 5% (a common value used in calculating total required fan air quantities) not only wastes up to 5% of the cooling and heating effect but increases fan power consumption by 17%. At 10% leakage, the extra fan energy consumption increases by 37%.

This research also demonstrates that leakage into outside air ducts is particularly wasteful. Using a typical comfort air conditioning plant in Perth as an example, and assuming a design value of 15% outside air, it shows that a 5% leakage into the return duct of an average typical (i.e. not in every case) cooling plant increases the outside air-cooling load by 28% [2].



AS 4254.1 contains extensive details of sealing for flexible ducts

In summary, a modest 5% leakage rate implies:

- A 17% increase in fan power and fan energy consumption on the supply side plus;
- 5% additional cooling and heating energy consumption, if the leakage is to the outside of the conditioned space plus.

This would be bad enough if leakage was only 5%, but American research [3] found duct leakage rates in existing buildings of 0% to 30%, with most between 10% and 20%. Since these American systems would most likely have been constructed to the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) HVAC duct construction standards [8] which are very similar to the AS 4254 series, similar results are likely in Australia. Unfortunately, leakage testing has been rare in Australia, so no corresponding data is available.

Testing requirements to AS 4254.2

AS 4254.2 clause 2.2.4 requires that all duct systems (not only air conditioning ducting) with a capacity of 3000 L/s or greater be tested to at least 1.25 times its operating pressure and not leak more than 5% of the design air quantity of the duct system. In a typical system, this would result in a leakage rate in operation of around 3%, significantly better than the 5% commonly assumed for calculations.

AS 4254.2 recommends testing using the UK Building and Engineering Services Association procedure [4], formally the Heating and Ventilating Contractors Association. As leakage testing has been rare in Australia, it is likely that Australian contractors do not know if their sealing methods will produce systems that pass the AS 4254.2test.

Builders work risers are a frequent cause of excessive air leaks.

Some points to note:

AS 4254.2 testing applies to rigid ducts and so arguably does require testing of flexible ducts and components such as VAV terminals and air handling plant. AS 4254.1 [5] covers sealing of flexible ducts in considerable detail but does not include leakage testing. American research[3] found that leakage rates at diffusers and grilles are much higher than in the connecting ducts.

Relevant worksection

0741 Ductwork

DUCT LEAKAGE AND LEAKAGE TESTING

Unlike US and European leakage criteria [6, 7], the AS 4254.2 test method ignores the surface area of the ducts being tested. This means that Australian duct systems with large surface areas require much tighter sealing than small systems to achieve the same leakage rate. There is no guarantee for contractors that, even if AS 4254.2 sealing procedures are followed, a large system will pass the leakage test.

AS 4254.2 requires that only 10% of the duct system be tested (type-test) but, unlike other standards, it does not specify what should happen if this type-test fails.

- Leakage testing can be disruptive of the sequence of work on site and may involve interaction with some building works and other works to be completed out of normal sequence. Since it is a type-test, it should be done early in the construction sequence so if additional sealing methods are required, they can be applied to the whole of the system as the rest of the work proceeds, and not attempted as a retrofit.

NATSPEC PROVISIONS

NATSPEC specifies requirements for sealing and leakage testing in *0741 Ductwork*.

Sealing

Because of the importance of reducing leaks and the uncertainties about whether AS 4254.2 sealing is sufficient to pass the leakage test, NATSPEC documents additional sealing over that in the standard. For example, AS 4254.2 only requires that longitudinal joints in ducts operating at less than 500 Pa (most duct systems) be sealed for 50 mm from each end but NATSPEC requires the whole of the joint to be sealed. It also extends the sealing regime to all parts of the system, not just rigid ducts covered by AS 4254.2.

Leakage testing

NATSPEC retains the basic criteria in AS 4254.2 regarding leakage rates under test and 10% of the system to be tested but clarifies and extends some of the AS 4254.2 provisions:

- It requires a representative section of duct to be tested, including riser, plant room and floor distribution ducts, flexible ducts, diffusers and grilles, air handling plant and plenums.
- It requires that builders work risers and plenums be subjected to the same level of leakage testing.
- It adopts the Eurovent 2/2 requirement that if the test section fails to meet the leakage test, it must not only be rectified but re-tests must be carried out on a larger area of duct.

REFERENCES

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