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**Title: SWEDISH DUCT LEAKAGE STATUS**

**Author: JOHNNY V. ANDERSSON**

**Affiliation: SCANDIACONSULT, STOCKHOLM, SWEDEN**

## Swedish Duct Leakage Status

Johnny V. Andersson, Scandiaconsult, Stockholm, Sweden

### The first fifty years

With very few exceptions all buildings in Sweden and their installations are performed in accordance with the quality requirements specified in the 'AMA-system'. AMA standing for 'Allmän Material- och Arbetsbeskrivning', i.e. General Requirements for Material and Workmanship, and was launched already 1950 and has since been extended to cover all areas within the building and infrastructure fields.

The first ventilation duct tightness requirements were stipulated in the HVAC part of the 1960 edition of AMA. In the 1966 edition the requirements were strengthened to comprise two 'tightness norms', A and B. The fulfilment of these requirements were to be spot checked by the contractor but supervised by the owner. Each spot test should cover systems with a minimum of 10 m<sup>2</sup> duct surface.

In the 1972 edition the requirements were transformed into two 'tightness classes' A and B (in accordance with the A and B classes used today), with B being three times tighter than A. A was then the standard requirement for the 'complete duct system in the air handling installation', i.e. including 'dampers, filters, humidifiers and heat exchangers'.

The following advises were given to the designer:

'The choice of tightness class should be based on economic decisions. An analysis of duct systems according to economic factors thus shows that:

- duct systems with an air flow less than 3 m<sup>3</sup>/s should be built according to class A,
- systems with no treatment of the air or only air heating should also be built according to class A but, if the system was operated for more than 8 hours/day, class B should be considered,
- all extract air systems should be built according to class A,
- the tightness requirements should be increased parallel to the degree of used air treatment. Thus cooling, high class filters, humidification and dehumidification of the air could motivate the use of class B.'

The 1983 AMA edition, still in use today, was influenced by the rising energy costs after the first oil crisis 1972/73 and the higher tightness being possible by the use of spiral wound round ducts. Tightness class C was now added, being three times tighter than B and thus nine times tighter than A. The standard AMA requirement thus became class C for round ductwork larger than 50 m<sup>2</sup> duct surface, class B for smaller round duct systems as well as for all rectangular ductwork and A for visible supply and extract ducts within the ventilated room. The introduction of class C was first met with resistance from the contractors who considered class C to be too high a demand. After the first year in use it was however found that the AMA requirements were easier to fulfil than first thought, the opposition died and the demands were accepted.

### The status today

AMA requires all ventilation and air conditioning systems to be carefully commissioned. The procedures include:

- measurement and adjustment of all supplied or extracted air flows in the building. The result should be within  $\pm 15\%$  including the measurement error. The result is to be presented on standard AMA protocols,
- the duct system leakage has to be controlled, normally by the contractor as part of the contract. This is done as a spot check where the parts to be checked are chosen by the owner's consultant. For round duct systems 10% and for rectangular ducts 20% of the total duct surface has to be controlled. In case the system is found to be more leaky than required the tested system shall be tightened and another equally sized part of the system shall be controlled in the same manner. Should also this part be found to leak more than accepted the complete installation has to be leak tested and tightened until the requirements are fulfilled.

### **Time for tightness class D?**

Today we are working with the next AMA generation, AMA 98, to be published during 1988. We now think that it is time to raise the tightness requirements once more by introducing tightness class D as the standard requirement for larger spiroduct systems. There are several reasons for this step:

- the today available technology permits it.  
The quality of modern round duct system available on the market today, with double rubber seals connections, are that tight when installed properly. (One of the main AMA principles is to raise the quality requirements if and when the technology makes it possible),
- the duct systems installed today will probably be used for at least the next twenty years. An eventual higher investment cost for a higher quality duct system should be considered on an Life Cycle Cost (LCC) basis and not just on the first cost,
- the energy prices will be higher and the demand for low energy use will increase during this period - the green house effect and the ozone layer are among the factors to be considered,
- air leaking out of or into duct systems between the fans and the ventilated rooms in the building has to be compensated by higher fan air flows (which is an old AMA requirement - the air flow considered necessary to ventilate a room should also be delivered there. Another AMA requirement is that the air flows are to be adjusted, controlled and listed for each room),
- the leakage air is of little or no use to the building but leads not only to higher operating costs but often also to disadvantages such as noise and draught complaints.

### **Compulsory authority requirements**

The AMA requirements are made valid when they are referred to in the contract between the owner and the contractor - which is practically always the case in Sweden.

The concern about an increasing part of the Swedish population becoming allergic and asthmatic, often due to 'sick buildings' and inadequate dilution of indoor emissions by inferior ventilation systems, lead the Swedish Parliament and Government to decide on compulsory inspection of ventilation systems (Government Bill 1990/91:145 and Ordinance, SFS 1991:1273, about the performance checks on ventilation systems).

The rules for the inspection were issued by the Swedish National Board of Housing, Building and Planning (General Guidelines 1992:3 'Checking the performance of ventilation systems' based on BFS 1992:15 'Regulations about performance checks on ventilation systems').

The intervals between the checks depend on how sensitive the building occupants are and how complicated the ventilation system is. They vary from 2 years inspection intervals for day-care centres, schools, health care centres, etc. up to 9 years for one- and two-dwelling houses with balanced ventilation.

The performance checks are to be carried out by an inspector who is authorised either nationally by the Swedish National Board of Housing, Building and Planning or locally by the municipal committee(s) responsible for planning and building matters.

The inspector qualifications differ between these different buildings and systems and whether the authorisation is local or national.