EVALUATION OF AIR TERMINAL UNITS TEST METHODS : INFLUENCE OF INLET PARAMETERS ON PERFORMANCE

A.-M. Bernard[1], N. Van Oosten[2]

AIVC 12,401

[1] CETIAT, Villeurbanne (69), FRANCE
[2] KOOLAIR, Mostoles (Ma), SPAIN

ABSTRACT

This study focuses on the way to apply CEN test methods to a full range of air diffusers and is dedicated to the improvement of these methods proposed by the CEN TC 156/WG4 of which both authors are members. Air terminals of different sizes have been tested on aerodynamic and acoustic aspects both in a Spanish and a French laboratory. The tests were made according to pr EN 12238 *"Air Terminal devices - Aerodynamic testing and rating for mixed flow applications"* and to EN 25135 (ISO 5135) :
"Determination of sound power levels from air terminal devices, high / low velocity / pressure assemblies, dampers and valves by measurement in a reverberation room".

The influence of the flow stabilisation inside the plenum is very important on the results in throw, effective area determination and sound power level measurements. Perforations on the plates as well as the presence of the steel flow straightener recommended by the pr EN inside the plenum affect strongly the tests results. Other parameters could also induce strong differences in the results although the CEN project pr EN 12238 doesn't determine them precisely. Once difficulties due to these parameters have been solved, the intercomparison between both labs has been tempted.

KEYWORDS

Air flow pattern
Air terminal units
Jets
Mixing ventilation
Standards

SYMBOLS

Qv	volume airflow rate
A	Internal cross-section
Ps	absolute value of required pressure
ρ	density of the air
vk	effective velocity
Ak	effective area

INTRODUCTION

This study, which began in 1996, focuses on the way to apply CEN test methods to a full range of air diffusers, to compare results between two different test labs and to determine the influence of plenum

geometrical parameters on the ATD's acoustics and aerodynamics performances.

METHODS

A range of standard grilles from 300 x 300 to 600 x 300 were tested according to :

- pr EN 12238 *"Air terminal devices - Aerodynamic testing and rating for mixed flow applications"* for aerodynamic tests;
- EN 25135 (ISO 5135) *"Determination of sound power levels from Air terminal devices, high/low velocity/ pressure assemblies, dampers and valves by measurement in a reverberation room"* for acoustics measurements.

For both series of test, we have used the plenum described in pr EN 12238 as indicated.

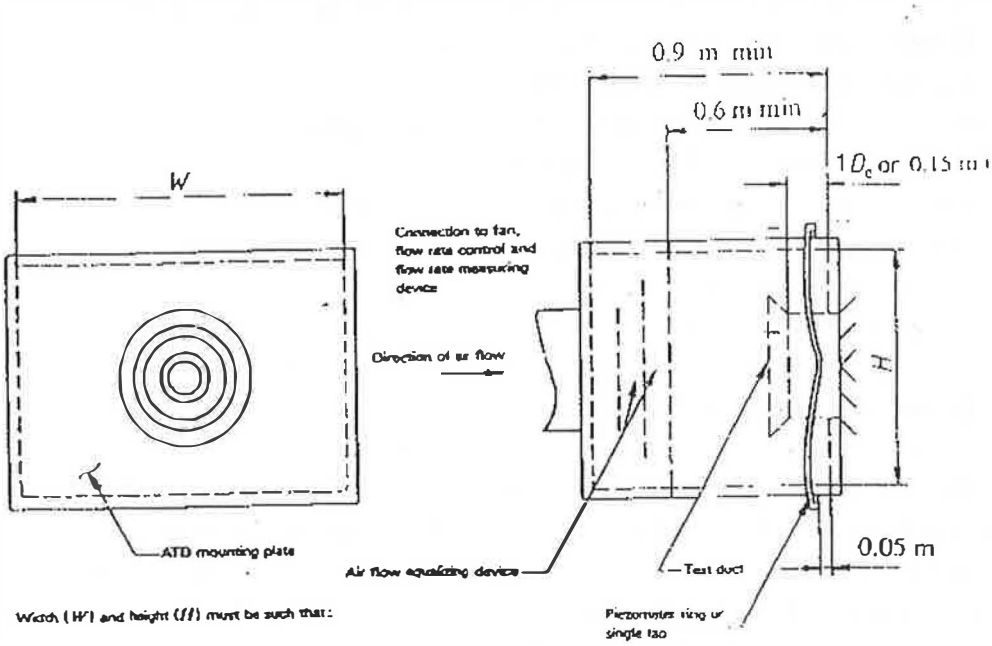

Figure 1 : Test installation for supply ATD

The mounting plenum includes several devices :

- the inlet take-off whose diameter is not described
- an airflow equalising device
- a flow straightener (i.e. a test duct)
- a piezometer ring for static pressure measurements.

The plenum area must respect the following condition :

$$\frac{Qv}{A} < \sqrt{\frac{Ps}{5\rho}} \qquad (1)$$

which induces that the dynamic pressure inside the plenum is lower than 20 % of the static.

The airflow equalising device, perforated plates or grills, must guarantee an uniform flow without swirl.

The plenum used for these experimentations were of big dimensions 1500 x 700 x 1000 to fulfill the prescriptions of the standard for the whole range of grills and airflows. Yet, in one lab, for geometrical reason, the inlet was on the top of the plenum and both diameters were slightly different (∅ 200 and ∅ 250).

As the plenum did respect the conditions of the draft, we considered, at first, that the change in position would not induce strong differences.

Both lab had standard room dimension according to pr EN 12238.

RESULTS

A lot of experimentations have allowed to see the importance of each device on test results.

1. Flow straightener

Although its presence is compulsory according to pr EN 12238, we have tested with and without straightener to be able to determine its effect on final results. As shown in Figure 1 and 2, the velocity profile and the throw of the jet change significantly when inserting the flow straightener.

On the acoustic side, Figure 3 shows the difference with and without straightener on a 600 x 300 grill : it could reach 5 dB(A) in total sound power level.

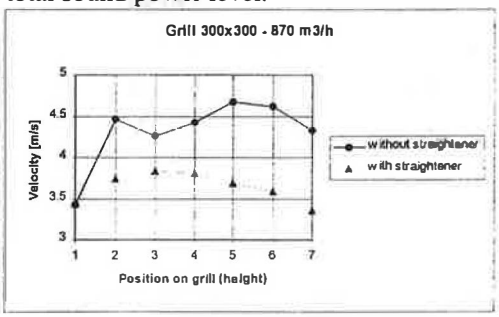

Figure 1 : Effect of the flow straightener on the velocity profile

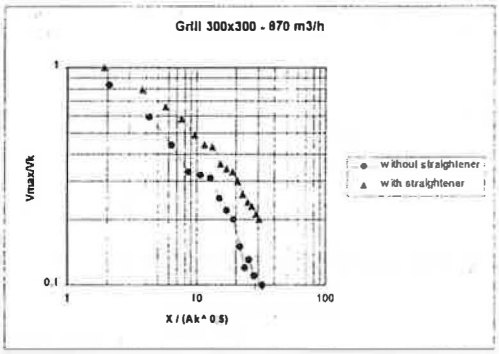

Figure 2 : Effect of the flow straightener on the throw

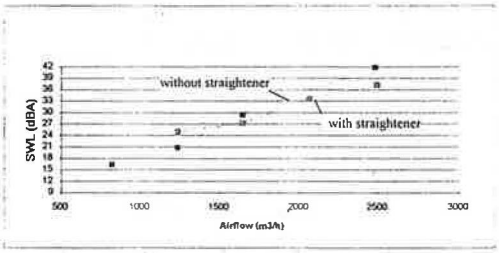

Figure 3 : SWL comparison on grille 600x300 with and without straightener

2. Plenum inlet size and position

Figures 4 to 5 show differences between the two plenum tests on throw.

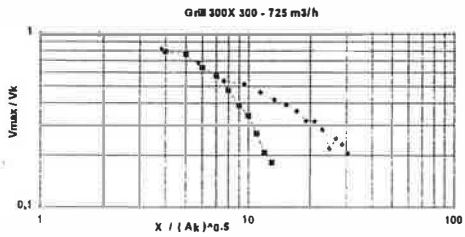

Figure 4 : Throw comparison on 300x300 grille at 725 m3/h

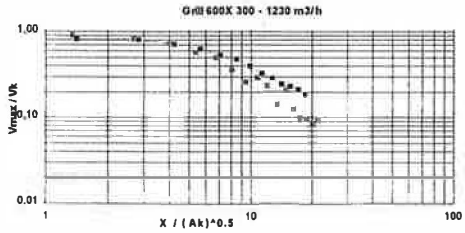

Figure 5 : Throw comparison on 600x300 grille at 1250 m3/h

Although tests were not made in the same lab, we think that the differences in velocity distribution (average Vk and Ak were equal) might be due to the plenum inlet differences, as all others devices were the same.

3. Other parameters

We have also noticed strong differences due to the perforated plates used to stabilize the flow. Perforation rate as well as the number and the position of plates induce differences in the results.

CONCLUSION

We have noticed a strong influence of the perforated plates, the flow straightener and the geometrical parameters. To reproduce results from one lab to another, it is most important to describe precisely the perforated plates (perforation rate, number and position) as well as the plenum geometry.

Moreover, we must consider that we chose in this study the same plenum area, quite large, while on-site plenums are often smaller, without straightener, with or without perforated plate. We can imagine that on-site conditions may influence strongly the results (in throw and sound power level). This is the reason why we are continuing this study in 1998 to show the influence of real on-site plenum on results.