Selecting a Certified Air Handling Unit

By Alok Bhardwaj Vice President, Systemair India, Greater NOIDA

Introduction

The Air Handling Unit (AHU) industry in India is the similitude of our dear tailor master across the street who had been stitching our clothes for ages, giving us the comfort of a perfect fit. Today, clothing trends have changed to wearing standardized branded clothes, but the AHU industry is still running on cut-and-stitch mode. The AHU manufacturing sector is being considered as a cottage industry – where a few profiles and double skin panels make the outer box of an AHU and other components like fan, motor, filter and coils can be bought from the open market. But the fact is far away from this myth.

About the Author

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What is an AHU?

An AHU is a fully engineered product, designed to maintain the desired ventilation, temperature, humidity and pressure in a conditioned space. These conditions can easily be maintained by designing oversized AHUs – resulting in more airflow, deeper coils, etc. but at the cost of wastage of energy throughout its useful life.

In the current context of net zero energy buildings and the green building movement, AHUs should be designed to maintain the perfect desired inside conditions in conjunction with being energy efficient and cost effective.

Key Points to Consider while Designing a Perfect AHU

The points to remember while designing an Air Handling Unit are:

- Correct input design parameters: for component selection.
- Energy saving components: energy efficient motors, plug/EC fans for step-less modulation, PM motors, heat recovery products, filters having low pressure drop, etc.
- Good manufacturing practices.
- Design basis for each component: raw material specifications, interference details for tube expansion, PUF density, etc.

continued on page 76

continued from page 74

and their monitoring during manufacturing.

- Component reliability tests: salt spray test, UV test, etc. to see how the condition of AHU would be after years of operation in different climatic conditions.

Certifications and Standards

When a purchaser specifies the parameters of an AHU while releasing the order, he expects that the product received should meet the specified requirement. One has to believe the software outputs of the unit or individual component or assurance by the manufacturer. Can we ensure the same performance even after installation at site?

There are different standards available for components used in AHUs, which have a common acceptance criteria, viz. AMCA certified fans, AHRI certified coils, casing as per EN 1886, filters as per EN 779, motor energy classification, etc. But putting all these individually certified components does not guarantee the desired performance when it works as a system. So it becomes important to follow a standard that talks about certification of Air Handling Units as a complete product and also guarantees the performance after installation. It is only possible if the products undergo third party certification by an independent body.

For AHUs, the third party certification bodies are:

- Eurovent Certita Certification (ECC)
- Air-conditioning, Heating, & Refrigeration Institute (AHRI)

Role of Third Party Certification

The independent body certifies the performance that the manufacturer claims in the data sheets.

- The selection software used for selection is analyzed and certified.
- Factory audit is carried out to ensure manufacturing standards and quality.
- Sample boxes are selected and sent for testing of mechanical characteristics of casing.
- Real unit is selected from the selection software for testing.
- Unit is sent to the designated laboratory of the third party certification body.
- All the parameters are tested and captured in the laboratory.
- Tested parameters are compared with the selection output.
- If results are within the specified tolerance of the standard, the unit and software are certified.
- Annual factory audits are carried out to ensure consistency of selections, design and production vis-a-vis the approved software and the declared components used for manufacturing.
- Model boxes and the real unit are tested after a specified interval during the pendency of the certification agreement.

Importance of Certification

Every certified unit and its selection output should bear the mark of the certifying body. By opting for a certified product, the customer is assured of getting performance results in line with the design parameters and as specified in the selection sheet. The units should not be oversized for possible fear of underperformance. This will ensure,

- Honest and fair competition,
- Correctly rated equipment on the market,
- Accurate energy comparison calculations,
- Enforceable, specifiable and available for all manufacturers, and
- Energy efficiency class of the unit as a whole will be displayed on the name plate.

Photo 1: A certified AHU

Awareness of Certification

(Reference Eurovent Certita Certification)

The certification follows mainly two standards:

1. EN 1886: 2007 – Ventilation of buildings – Air Handling Units – Mechanical Performance.
2. EN 13053: 2006 + A1: 2011 – Ventilation of buildings – Air Handling Units – Rating and performance for units, components and sections.

Mechanical Performance – EN 1886: 2007

Various tests, as detailed below, are carried out on a model box that is manufactured using the profiles, panels and components proposed to be used for certified units. The certified mechanical performance and its validity are listed on ECC website and can be accessed by anyone.

Mechanical Strength of Casing

The casing strength classification of an AHU defines various casing classes corresponding to maximum relative deflection (mm/m) at a test pressure of +1000 Pa. Lower the deflection value, better the casing class.

As a rider to all the classes, the casing should have no permanent deflection (maximum permanent deflection +2.0 mm/m of frame/panel span) of the structural parts or any damage to the casing, when a maximum fan pressure of +2500 Pa is applied.

Table 1: Classes of casing

Casing Class	Maximum Relative Deflection (mm/m)
D1	4
D2	10
D3	Exceeding 10
Note: The leakage test is done after the strength test	

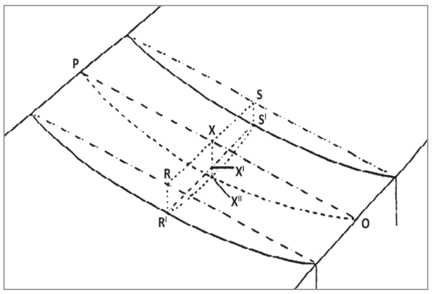

Figure 1: Casing deflection

continued on page 78

continued from page 76

Casing Air Leakage

Lower the leakage rate (L/sec/sq m) of the casing, lesser wastage of energy and reduced chances of condensation. Air leakage from the casing is tested at both negative and positive test pressures. A negative pressure of 400 Pa is created in the model box and air leakage into the casing is measured. A similar test is repeated for positive pressure and outward leakage of the air at 700 Pa is measured.

Table 2: Air leakage classes of AHUs

Casing air leakage classes of AHUs, 400 Pa negative test pressure		
Leakage class of casing	Maximum leakage rate (f400) l/sec/sq. mt.	Filter class (EN 779)
L1	0.15	Superior to F9
L2	0.44	F8 to F9
L3	1.32	G1 to F7
Note: The maximal leakage rates given in this table are according to the ductwork leakage classes specified in EN 1507 and EN 12237, (e.g. L2 = B), but the test pressures are different.		

Casing air leakage classes of AHUs, 700 Pa positive test pressure	
Leakage class of casing	Maximum leakage rate (f700) l/sec/sq. mt.
L1	0.22
L2	0.63
L3	1.90
Note: Class L1 is for units for special application, e.g. cleanrooms.	

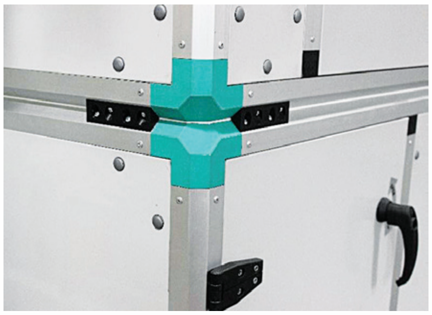

Photo 2: Casing air leakage

Filter Bypass Leakage

Air bypass around filter cells will decrease the effective efficiency of the filter, especially a high efficiency one, because the bypass air will not be filtered. The factors contributing to filter bypass leakage rate when the filters are located upstream of the fan, are air leakage from filter frame and leakage from the area of casing between the filter and the fan. In case of downstream filters the leakage considered is for the bypass around the filter only. These leakages are measured by applying 400 Pa test pressure and filter face velocity as 2.5 m/s.

Table 3: Maximum leakage for various filter classes

Filter Class	G1 to F5	F6	F7	F8	F9
Maximum filter bypass leakage rate k (% of volume flow rate)	6	4	2	1	0.5

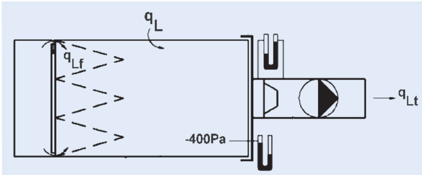

Figure 2: Testing filter bypass leakage

Thermal Performance of Casing

In order to test the thermal performance of a casing, a steady state temperature difference of 20K is maintained between inside and outside of the model box. No radiant heat should be present in the test environment. Inside steady state temperature is maintained with the help of heaters and circulating fans. The test unit is kept in an environment chamber where a steady state temperature is maintained.

i. Thermal Transmission

A lower thermal transmittance value means low heat transfer which results in energy saving. After achieving steady state temperate difference, thermal transmittance U (W/m²/K) is calculated. Power consumed (W) by the heaters and fans to maintain inside steady state temperature is measured. Mean inside temperature and mean surface temperature are measured to find the temperature difference K.

Table 4: Thermal transmittance of casings

Class	Thermal Transmittance (W/m²/K)
T1	$U \leq 0.5$
T2	$0.5 < U \leq 1.0$
T3	$1.0 < U \leq 1.4$
T4	$1.4 < U \leq 2.0$
T5	No requirements

Photo 3: Thermal transmittance

ii. Thermal Bridging

Higher the thermal bridging factor, higher the energy efficiency and reduction in possibility of condensation. Under test conditions, when mean temperature difference between internal and external temperatures is stabilized at 20K, the lowest value of temperature difference between any point on the external surface and the mean internal air temperature is established. The ratio between the lowest temperature difference and the mean air-to-air temperature difference determines the thermal bridging factor K_b.

K_b = (Inside temperature – Maximum surface temperature) / (Inside air temperature – Outside air temperature)

Table 5: Thermal bridging factor

Class	Thermal Bridging Factor K_b
TB1	$0.75 < K_b < 1.0$
TB2	$0.60 \leq K_b < 0.75$
TB3	$0.45 \leq K_b < 0.60$
TB4	$0.30 \leq K_b < 0.45$
TB5	No requirements

continued on page 80

continued from page 78

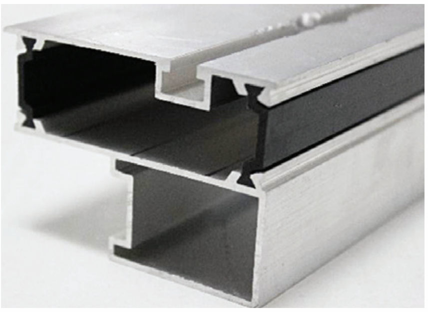

Photo 4: Thermal bridging

Acoustic Insulation of Casing

This test provides a way of determining approximate sound insertion loss value D_p of a test enclosure. The sound pressure insulation performance (casing insertion loss) is calculated in accordance with EN ISO 11546 – 2 and is reported for octave bands 125 Hz to 8000 Hz.

Rating and Performance for Units, Components and Sections – EN 13053: 2006 + A1: 2011

The performance of the entire AHU cannot be defined as the sum of individual components and sections. Hence, the performance parameters of a complete AHU are tested. A real unit is selected with the help of certified software and its performance is selected on various variable parameters.

This real unit is tested at the certified laboratory for following parameters.

- Air flow: static pressure data, power consumption
- Octave bands for conducted sound power emission
- Heat recovery
- Cooling duty
- Heating duty
- Air-side and water-side pressure drop

The tested parameters are then compared with the selected parameters and should be strictly within the close tolerances set by the standard.

The test standards referred to measure the performance of various components are:

- EN 308, heat exchangers: test procedures for establishing performance of air-to-air and flue gas heat recovery devices.

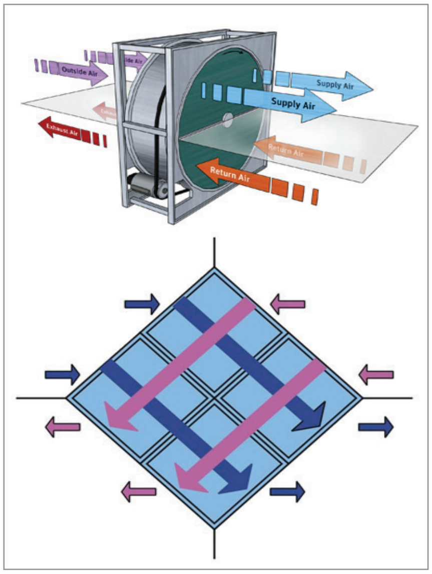

Figure 3: Air to air and flue gas recovery devices

- EN 779, particulate air filters for general ventilation: determination of filtration performance.

Photo 5: Particulate air flters

- EN 1216, heat exchangers: forced circulation air cooling/heating coils – test procedures for establishing performance.

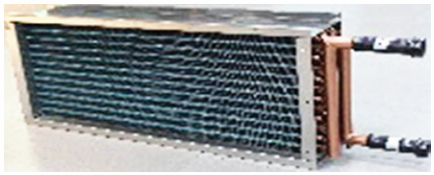

Photo 6: Heat exchanger

- EN 1751, ventilation for buildings: air terminal devices: aerodynamic testing of dampers and valves.

Photo 7: Dampers and valves

- EN ISO 3741, 3744 and 3746, acoustics: determination of sound power levels of noise sources using sound pressure.
- EN ISO 5136, acoustics: determination of sound power radiated into a duct by fans and other air moving devices – in-duct method.
- EN ISO 5167-1, measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full.
- ISO 5801, industrial fans: performance testing using standardized airways.

What End User Should Expect from a Certified Manufacturer

Basic

All technical selections should be from a selection software version that is enlisted on the certifying body website. If a manufacturer submits separate selection sheets for different components, it means that the components are not included in the certification process. The complete AHU selection shall contain all components, which should carry Eurovent logo on each page with the software version.

continued on page 82

continued from page 80

Table 6: Prerequisites for energy efficiency classes

CLASS	All Units	Units for full or partial outdoor air at design winter temperature ≤9°C		Fan Efficiency Grade $NG_{ref\text{-}class}$ (–)
	Velocity V_{class} (m/s)	Heat recovery system		
		η_{class} (%)	Δp_{class} (Pa)	
A+ / A+↪ / A+↑	1.4	83	250	64
A / A↪ / A↑	1.6	78	230	62
B / B↪ / B↑	1.8	73	210	60
C / C↪ / C↑	2.0	68	190	57
D / D↪ / D↑	2.2	63	170	52
E / E↪ / E↑	No calculation required			No requirements
The lowest classes E, E↪ and E↑ have no requirements				

Energy Class

The impact of various factors is weighted together to establish the final energy class for a complete Air Handling Unit. Energy consumption of AHUs can be divided into two main groups: thermal energy (for heating and cooling) and electrical energy for fans. Different levels of thermal energy consumption for heating are covered by the consideration of the Heat Recovery System (HRS) efficiency. The climate dependency of the thermal energy consumption is considered and the difference in primary energy between thermal energy and electrical energy is taken into account for evaluation.

The major influencing factors are velocity, HRS pressure drop, overall static efficiency of the supply and/or the extract air fan and efficiency of the electric motor(s), which will give a good estimate of the energy used for fans. AHUs are divided into three subgroups for this purpose:

- Units for full or partial outdoor air at design winter temperature ≤ 9°C. The class signs are A+, A, B, C, D, E
- Recirculation units or units with design inlet temperatures always > 9°C. The class signs are A+, A, B, C, D, E with sign as suffix.
- Stand-alone extract air units. The class signs are A+, A, B, C, D, E with sign as suffix.

The prerequisites for different energy efficiency classes are detailed in *Table 6*.

Photo 8: The class is mentioned on the AHU name plate

Challenges

The biggest challenge is to create awareness of the advantages of a certified AHU and the process followed to get it certified amongst end users and specifiers. For example, the European standard EN 1886 is often misunderstood as a Eurovent standard. The fact is that Eurovent performs tests for mechanical performance based on EN 1886. Testing the AHU for mechanical performance from a third party laboratory does not qualify it as 'Eurovent Certified Unit'. One must remember that Eurovent certification includes the performance and witnessing of tests by authorized representatives of Eurovent in their approved laboratories as per EN 1886 (mechanical performance) and EN 13053 (rating and performance for units, components and sections). The Eurovent certification mark should appear both on the selection submittal and the unit.

Conclusion

This article takes us through the advantages and importance of a certified Air Handling Unit. Not only the performance of the AHU as a whole (as against individual components) is certified, but also its mechanical characteristics play a major role in ensuring a better product. One can be sure of energy savings, low air leakages, better strength and acoustic properties of the selected units. So, there is no need to oversize the unit for possible fear of its underperformance – as long as the input parameters are correct. The user or specifier should ask for the following parameters while specifying an Air Handling Unit along with other design parameters:

Thermal Bridging Class TB	TB1, TB2, TB3
Thermal transmittance	T1, T2, T3
Casing Air Leakage	L1, L2, L3
Casing Strength	D1, D2

References

1. EN 1886: 2007 – Ventilation of Buildings – Air Handling Units – Mechanical Performance.
2. EN 13053: 2006 + A1: 2011 – Ventilation of Buildings – Air Handling Units – Rating and performance for units, components and sections.