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Ventilation for buildings - Ductwork - Cleanliness of ventilation systems

Lüftung von Gebäuden - Luftleitungen - Sauberkeit von Lüftungsanlagen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 156.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (prEN 15780:2008) has been prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

1 Scope

This Standard applies to ventilation and air conditioning systems and defines the initial assessment criteria of cleanliness, cleaning procedures of these systems, and the validation of the effectiveness of cleaning applies also to products, which conform to EN 1505, EN 1506, EN 13053, EN 13180 and EN 13403, used in air conditioning and ventilation systems defined in the scope of CEN/TC 156.

This standard specifies requirements and procedures necessary in assessing and maintaining the cleanliness of ventilation, including:

— how to assess the need for cleaning (visual, measurements);

— assessment frequency (general guidance);

— selection of cleaning method;

— how to assess the result of cleaning.

This standard is a parallel standard to EN 12097, which specifies requirements for dimension, shape and location for access panels for cleaning and service in ductwork systems

This standard is made as an umbrella standard with informative annexes that can be added over time with the following topics:

Air Handling Units (AHU)

Filter

Humidifiers

Ductwork

Terminal devices

The main target groups of this standard are building owners, services companies, maintenance companies, end users and consultancy and control companies.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1505, *Ventilation for buildings — Rectangular sheet metal air ducts and duct fittings — Dimensions*

EN 1506, *Ventilation for buildings — Circular sheet metal air ducts and duct fittings — Dimensions*

EN 12097, *Ventilation for buildings — Requirements for ductwork components to facilitate maintenance of ductwork systems*

EN 12792, *Ventilation for buildings — Symbols and terminology*

EN 13053, *Ventilation for buildings — Air handling units — Ratings and performance for components and sections*

EN 13180, *Ventilation for buildings — Ductwork — Dimensions and mechanical requirements for flexible ducts*

EN 13403, *Ventilation for buildings Non metallic ducts — Ductwork made from insulation ductboards*

EN 13779, *Ventilation for non-residential buildings — performance requirements for ventilation and room-conditioning systems*

EN 14239, *Ventilation for buildings —- Measurement of ductwork surface area*

3 Definitions

For the purposes of this European Standard, the definitions given in EN 12792 and the following apply.

3.1
acceptable cleaning level
the amount of dust and other impurities shall not exceed the given limit values

3.2
acceptable cleaning result visually
no loosened dust is detected visually on the duct surface after cleaning

3.3
acceptable dust accumulation
limit value of dust accumulated in an air duct, defined by one of the methods defined in this standard

3.4
cleanliness
cleanliness of the ventilation system and/or its components: the state of the ventilation system and/or the components, in which the amount or concentration of contaminants is below a specified level

3.5
cleanliness level
in the scope of this standard, there are three cleanliness levels: basic (A), intermediate (B) and advanced (C). For each level, this standard specifies certain characteristics as default values in an informative way

3.6
ductwork surface area
the surface area (m^2) of the ductwork determined according to EN 14239

3.7
total joint length
the length (m) of joints resulting from the installation of the ductwork

3.8
visually clean
no loosened dust is detected on surfaces visually

3.9
visual inspection
a subjective method to evaluate cleanliness level of surfaces

4 Symbols and units

For the purpose of this standard, the symbols and units given in EN 12792 apply.

5 Criteria for cleanliness and assessment

5.1 General

NOTE REHVA Guidebook "Criteria for the cleanliness of ventilation systems and components" specifies in detail the items mentioned in this chapter. Cleanliness classes and their applications are introduced in Annex A

The key issue is to design and build the whole ventilation system so that it can be kept clean enough during the whole lifetime of the installation. The following requirements, as well as the methodology described in Clause 5, can be also applied to air handling units (according to EN 13053) and entire systems (see EN 13779, Annex A)

Therefore it is necessary to specify the cleanliness criteria from the beginning and include in the specification both design and installation issues and means to maintain a sufficiently clean ventilation system for its whole lifetime. The design and installation aspects include (as a minimum):

Production of the system components

Delivery to site

Site storage

Installation

Protection of components after installation

NOTE Annex A presents, as a common classification, criteria of three levels of cleanliness, and application example for ductwork.

5.2 Assessment of the need for cleaning

Inspection of functionality and cleanliness of ventilation system is a part of proper maintenance of the ventilation systems. Mostly the inspection of the cleanliness may arise from two purposes:

— to check if ventilation system is dirty and need to be cleaned (exceeding of a "target level");

— to evaluate cleanliness after the cleaning work (to control cleaning work).

The assessment methodology is presented in 6.2.

NOTE Annex A gives further recommendations on assessment frequency.

5.3 Selection of cleaning method

In the handing-over documents the cleaning methods shall be specified, and guidelines for reaching the points to be cleaned shall also be given.

The cleaning method may vary according to the air distribution system. Normally dry methods are enough in supply air systems and general extract air systems. Wet methods (or a combination of dry and wet methods) may be needed for exhaust air ducts from professional kitchens and similar installations where extract air contains smoke, grease and/or other similar impurities.

The instructions of all wet methods shall include a warning of conditions and restrictions of use, for example that the method is only applicable only for ducts with high requirements of tightness and smooth duct surfaces, and that the ducts need to be sloping to prevent retention of cleaning fluids in the ducts.

A sufficient number of access doors shall be provided in the ductwork. Additionally special care shall be taken during cleaning obstacles, such as dampers, sound attenuators etc., which are mounted in the ducts. In many cases additional access doors are needed after or before such obstacle, which then can be cleaned carefully. Requirements for location of and distance between access doors are presented in EN 12097 and EN 13779.

5.4 Determination of cleaning interval

The cleaning interval shall be defined in the system documentation.

NOTE Further guidance can be found from REHVA and EVHA Guidelines and also from national guidelines, e.g. VDI 6022 or HVCA.

5.5 Assessment of the result of cleaning

Methods for assessment of the need for cleaning can be also applied for assessment of the result of cleaning.

6 Methodology

6.1 General methodology

Figure 1 presents a procedure to control and maintain cleanliness of ventilation system. It does not include the design stages or selection and specification of the system, or any of its components.

The system shall be first checked visually, both in assessing the need for cleaning and in verification of the result of cleaning. Objective measurements are needed if the visual inspection results in disagreement or uncertainty about cleanliness or need for cleaning.

NOTE REHVA Guideline and some national guidelines like VDI 6022 and FiSIAQ Guideline give more detailed guidance on product selection and specification from the hygienic point of view.

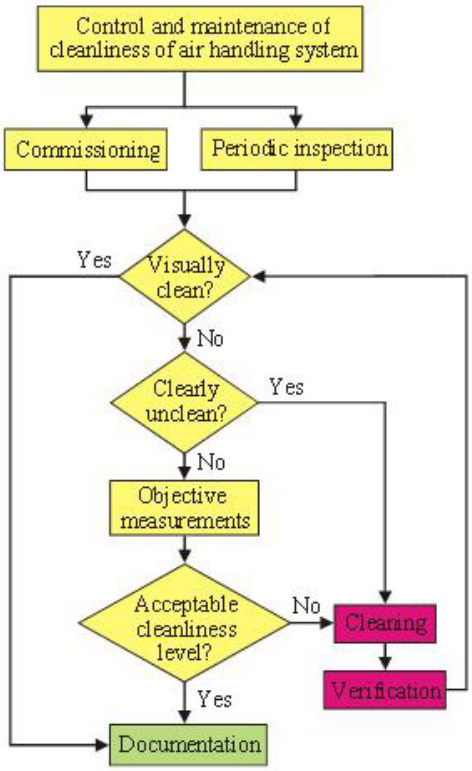


Figure 1 — Schematic flow chart for procedures to maintain cleanliness of ventilation system

If the components are certified for cleanliness or the cleanliness after production is otherwise verified, and if the cleanliness instructions are properly documented, the commissioning may be reduced to checking the documentation and spot checking of the system cleanliness (compliance with the documentation).

The methods applied for objective measurements and verification needs to be consistent so that the result of inspection is acceptable and gives reliable grounds for decision making to order cleaning work of the system when needed. Verification after cleaning is needed for quality control of the cleaning work, and to verify the cleaning result.

Objective methods are needed if any guidelines or demands on cleanliness are set in official or in voluntary documents. The methods to evaluate the cleanliness vary, and thus target values given for the cleaning action are not easy to compare. Certain visible signs like visible microbial growth are enough to reveal the need for cleaning. For systems consisting dust with less potential health risks the visible signs are not so clear and evaluation of the need by measurement may be needed to find out whether the ventilation system should be cleaned or not.

6.2 Assessment of the need for cleaning

6.2.1 General

The assessment of cleanliness level of the system is important in order to define the cleaning method to be used.

System components are considered to be polluted when visual inspection and analytic verification give evidence of dust or microbial growth inside. Assessment will be carried out through inspection. Dust accumulation, different types of pollutants, as well as “bacterial amplification”, should determine the cleaning methods to be used and the environmental required controls.

Elements to be inspected for cleaning go from outdoor air intake and should be, at least, the following:

— Air handling units (AHU’s). AHU’s assessment should include all their components and sections: fan section, filters, plenums, heating and cooling coils, condensate trays, sound attenuators, heat recovery section, and humidifier section including droplet eliminators.

— Supply air ductwork, including all types of terminal devices and terminal units, sound attenuators, duct-mounted heating and cooling coils, dampers and valves.

— Extract air ductwork, including all types of components.

6.2.2 Inspection plan

The inspection plan consists of the following information:

— review plan and reports;

— determining which systems will be inspected;

— determining where to inspect and sample (see note);

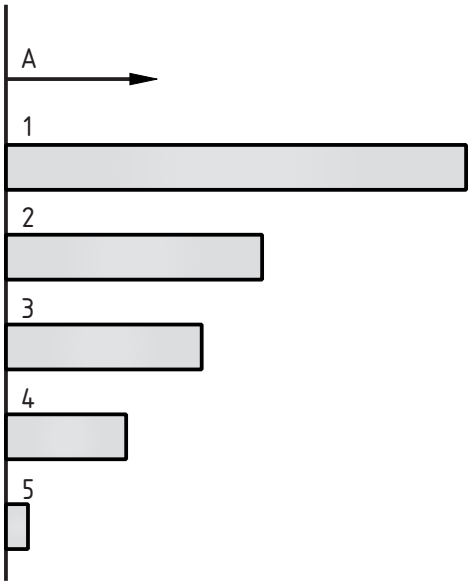
— choosing equipment and tools.

Additionally, the inspection plan describes the requirements of the specific qualification and experience for inspectors before they are authorised to inspection work. The assessment frequency shall be specified.

NOTE Recommendations for assessment frequency are given in Annex A. To obtain objective results a representative number of samples from representative parts and sites in the ventilation system should be selected for evaluation of the cleanliness of the whole system. A good rule of thumb for choosing sites or taking samples is to select areas where the dust deposits are obvious, or liable to cause reduced IAQ. For inspecting and sampling, the ventilation system can be divided in two parts, the ductwork and the rest of the system. Before inspection or sampling, the sites should be selected at random with the aid of the design documents. The sampling sites in the ductwork should be selected from the main duct starting from the AHU, main ducts, risers and side branch ducts. The sampling sites should contain direct ducts and ducts with changes of direction or terminations.

6.2.3 Evaluation methods of dust accumulation

Different methods to evaluate cleanliness of ventilation systems are applied. The simplest methods are based on more or less subjective visual observation of the cleanliness of ventilation system combined with use of some special instrumentation. The advanced techniques are able to give relatively accurate results that are comparable to given limit values. In Figure 2 the methods are presented in sequence of the reliability level of their results.



Key

A Reliability
1 Vacuum sampling on filter, or wiping the dust with a cloth
2 Gravimetric tape method
3 Evaluation with optical gel tape
4 Visual evaluation with reference scale
5 Visual survey without reference scale

Figure 2 — The reliability level of the results by different evaluations methods for dust

6.2.3.1 Visual inspection

Visual inspection method is a basic method to evaluate the cleanliness of ventilation system. Although it is subjective as such it gives a very good estimate of the condition on ventilation system surfaces. It is usually good enough to detect e.g. microbial growth on water reservoirs, and deposits from major malfunction of filtration, and to reveal lack of maintenance. The visual inspection may be assisted with technical devices such as cameras, endoscopes, and robotic cameras with video footages. In some references, the visual inspection is developed more repeatable by using special forms and notebooks that make the inspection more systematic. To make visual inspection more objective, besides the list with dirtiness scales the inspectors should have experience from many ventilation systems. Visual inspection need not to refer any mass values, preferably objective of the inspection (with the aid of scale) should be the need of cleaning and other action for repairs. In clear cases visual inspection by a trained person is also a useful method to evaluate cleanliness after the cleaning.

NOTE For new installations the visual inspection may be aided with a scale based on reference material consisting photographs of newly installed ductworks. The scale presents the amount of dust accumulation on the photographs so that the inspector is enabled to give a numeric value for evaluation.

6.2.3.2 Methods of verifying deposited solid dust and micro-organisms

Most of the methods to verify cleanliness of ventilation systems are based on the measurement of mass of the dust and debris deposited on a known surface area. In the filter sampling method dust is vacuumed on a weighed filter either without or with a filter housing. In the latter method, the dust fastened on the walls of the filter housing is easily counted to the sample. Several methods are developed for to loose the dust from the surface.

The sample is also possible to be taken without vacuuming by wiping method on the filter or non-woven cloth. Solvent may strengthen the loosening of the dust from the surface, which makes the method very effective especially for greasy solids.

A sticky tape is also used to collect deposited dust particles from the surface. The tape is weighed before and after collection of the dust and the difference of the mass is used in calculation of the dust density on the surface. The shape and dimensions of the tape restricts the sampling area constant. On very dusty surfaces, the collection capacity of tape on surfaces with dusty surfaces rejects also the usefulness of the method to obtain objective value.

A gel tape method is applicable for verification of the cleanliness of indoor surfaces. The sample is collected on a transparent tape that contains gelatine gel as glue. The transparency of the tape is measured with a special analyser before and after the sampling. The analyser gives a percentage value (%) which is related to the density of dust particles on the gel surface. The optical method with gelatine tapes or with semi-transparent engineering adhesive tapes may be also used to evaluate the cleanliness of air ducts, especially after duct cleaning.

Another method is partly based on the deposit thickness test method. The thickness of dust layer is measured with the aid of a special device. The measuring procedure applies an instrument that bases on electromagnetic induction sensor.

The amount of microbial contamination is usually determined by the cultivation method which also enables the identification of the genera and species of micro-organisms. Determining the fungal spore and bacteria counts can be done from the dust sample collected using the filter sampling method. Direct counting of spores or microbial cells with aid of microscopy is usually impossible because of the high density of dust particle with various light reflectance properties in the samples.

6.2.3.3 Summary of methods for evaluation of cleanliness

A list of the evaluation methods is expressed in the Table 1.

Table 1 — Summary of the methods used for evaluation of cleanliness of ventilation systems

Evaluation method		
Visual inspection		
Non-systematic inspection	No scaling for the cleanliness, subjective	
Systematic	Grades for the cleanliness, semi-objective optical and electrical devices may be used to store the views and records	
Quantitative methods for dust		
Method	Units	Note
Filter sampling	(g/m^2)	most common, repeatable
Cloth wiping	(g/m^2)	effective when used with solvent
Tape sampling	(g/m^2)	suitable for low levels (<~4 g/m^2)
Gel tape sampling	(%)	need special device
Deposit thickness test (D.T.T)	(µm)	need special device
Comb method	(µm)	need a simple instrument
Quantitative methods for micro-organisms		
cultivation of dust sample	(CFU/g)	identification of the cultivable species
cultivation of liquid sample	(CFU/ml)	
cultivation of swab sample	(CFU/m^2)	
counting of spores in dust sample	(spores/g)	gives total spore count, needs a specific separation technique
Quantitative analysis of oil residues (usually not performed in the field)		
Filter contact method	mg/m^2	analysis by gas chromatograph of by IR-spectroscopy

6.3 Cleaning plan

If, as assessed according to 6.2, cleaning is needed, a cleaning plan shall be provided. The cleaning plan shall include.

— a summary of the assessment including the list of the systems and parts that has to be cleaned;

— detailed time schedule of cleaning;

— cleaning methods to be applied;

— access and routes to equipment not visible in the rooms (ducts, air handling units);

— list of components to be removed for cleaning, and components to be replaced (when relevant);

— protection of the rooms in which the cleaning equipment is used;

— how and when the occupants are informed (including protection and safety considerations);

— microbiological considerations when relevant, including considerations for the use of disinfection – criteria to assess the need for involvement of a specialist on microbiological issues;

— technical data, including an estimate of the present level of dust and impurities, and target levels for cleanliness after cleaning;

— evaluation methods for cleanliness after cleaning.

One example of technical cleaning plan is presented in Annex C.

6.4 Cleaning methods

Examples of cleaning methods are:

Dry cleaning

— vacuum cleaning;

— compressed air;

— brush cleaning.

Wet cleaning

— steam blasting;

— chemical cleaning;

— disinfecting.

These methods may also be used for periodical cleaning during the operation, according to the handing-over documentation.

The manufacturer's instructions for cleaning of special components, e.g. fire dampers and sound attenuators, shall be followed carefully.

NOTE Ductwork is normally cleaned the same direction as airflow into ducts during operation of ventilation system. The branch ducts of small diameter are cleaned by using a smaller brushing machine and the main ducts using a larger brushing machine or robot. The components of ductwork, such as bends and dampers, are cleaned from both directions, according to EN 12097, to ensure a good cleaning result and without causing damage to the components.

6.5 Assessment of the result of cleaning

Checking the result of cleaning (normally visual inspection is enough) shall be combined with checking of functions of the system after cleaning, and readjustment whenever needed. If, however, visual methods are not sufficient, the assessment may include objective measurements according to 6.2.

7 Evaluation and reporting

7.1 Evaluation of cleaning

The final evaluation of cleaning shall be made after all parts of the ductwork or system subject to cleaning has been assessed as visually clean.

7.2 Cleaning report

A report shall be prepared and signed. This should include at least the following details:

Details of the object (building, ventilation system, etc…):

— The address, name, or other unique identifier of the property.

— The owner or manager of the building.

— The date of the inspection, cleaning and evaluation.

List of the documents provided, including documentation of the product certificates and manufacturer's or supplier's instructions, whenever available.

Details of the systems inspected:

— Physical descriptions of the systems subject to inspection and cleaning.

— The inventory of equipment.

Methods and equipment used for cleaning, and assessment before and after cleaning (visual, measured) Details:

— Results of assessment before cleaning.

— Object for cleaning (entire system/ part of system).

— Results of assessment after cleaning.

— Documentation of the methods and equipment.

— Recommendations (incl. recommended time for next assessment and cleaning.

Annex A
(informative)

Cleanliness classes

A.1 General

This Annex gives a summary of three cleanliness levels. This issue was originally presented as Annex C of ENV 12097, but appears no more in EN 12097. In this revised form this classification is presented in the REHVA draft. It is a key issue to pay attention to cleanliness in design of systems and especially in component selection and specification and therefore repeated here. It may be modified to take better into account some existing national guidance such as FiSIAQ guideline and VDI 6022. Application examples are presented in A.2, and more specific applications in Annexes C and D.

The following three major contaminants from all components may deteriorate IAQ and should be limited:

— residues of lubricant oils from duct manufacture;

— dust accumulated during manufacture and installation or debris from construction;

— deposited micro organisms, particularly when toxigenic species are present and conditions are favourable for their survival and growth during installation and storing.

A.2 Application in general

These levels of cleanliness should be generally applied as follows:

Level	Typical examples
Basic	rooms with only intermittent occupancy
Intermediate	offices, hotels, schools, theatres, sales rooms, residential homes, exhibition buildings, sport buildings, hospitals.
Advanced	Pharmaceutical industry, semiconductor industry, food industry, laboratories, clean rooms, high security hospitals.

A.3 Assessment frequency recommendation

Assessment frequency described on Table A.3 should be considered as the minimum recommendations and the necessity of increasing them will depend on the environment conditions, on the activity and on mechanical and human conditions in both building and its surroundings.

	AHU	Filters	Humidifiers	Ducts	Terminals
Basic	2	1	1	4	4
Intermediate	1	1	6 months	2	2
Advanced	1	1	6 months	1	1

Air handling units equipped with humidification or adiabatic cooling systems, or located in mild and wet weather conditions should be assessed at least twice a year, whatever the use of the building.

Annex B
(informative)

Example of cleaning plan

This Annex presents one example (according to UNE 100012) of cleaning plan. The cleaning plan is needed in case the assessment reveals a need for cleaning. The tasks listed in the right column are always optional, and also other tasks may be included in the cleaning plan.

CLEANING PLAN (example)		
WORK	**TARGET**	**TASKS** (examples; the list of tasks is drawn up case by case as the result of assessment)
1 Cleaning of coils	Achieving a higher air volume and thermal exchange	1 Brushing and vacuum to dry 2 Detergent application 3 Brushing 4 Rinse with pressurized water
2 Drainage/ condensate tray cleaning	Removing the focus of infection and nutrients that support the microbial pollution	1 Brushing and vacuum to dry 2 Detergent application- Disinfection product. 3 Brushing 4 Rinse and dry
3 Fan cleaning	Achieving a higher air volume and a reduction of the dirtiness on ductwork	1 Brushing and vacuum to dry 2 Detergent application - Disinfection product. 3 Brushing 4 Rinse and dry For all blades and casing
4 Panels cleaning	Avoiding airborne particles to go into the ductwork	***Metallic:** 1 Brushing and vacuum to dry 2 Detergent application- Disinfection product. 3 Brushing 4 Rinse and dry ***Lined with porous insulators** 1 Brushing and vacuum to dry 2 Sealer product application for fibre sealing
5 Anti corrosion treatment	Avoiding corrosion or corrosion increasing	1 Manual brushing 2 Mechanical brushing 3 Vacuum suction of the total oxide dust 4 Anti corrosion product application

6 System disinfection	Stamping out the microbial pollution	1 Disinfection product spray 2 Keep the system motionless for a safety timing (manufacturer's instructions)

AIR CONDITIONING SYSTEMS CLEANING PROTOCOL		
WORK	**TARGET**	**TASKS**
1 Cleaning of the extract air ducts	Removing physiochemical and microbial pollutants Always to begin from the end of the air duct	1 If not is possible to access through the extract air grilles, then hatches on ducts should to be performed 2 Brushing 3 Shaking or brushing accompanied with negative vacuum cleaning 4 Disinfection of the duct in the case of being required. 5 Sealing of duct in the case of being porous.
2 Cleaning of extract air terminals	Removing physiochemical and microbial pollutants	1 Disassembling 2 Detergent – disinfection product application 3 Brushing 4 Rinse and dry 5 Assembling
3 AHU cleaning	Removing physiochemical and microbial pollutants and get a higher air volume and a thermal exchange	1 Apply the air conditioning system cleaning protocol
4 Diffusers cleaning	Removing physiochemical and microbial pollutants	1 Diffusers disassembling 2 Detergent – disinfection product application 3 Diffusers brushing 4 Rinse 5 Diffusers assembling
5 Supply air duct cleaning	Removing physiochemical and microbial pollutants Always to be begin from the end of the air duct	1 If not is possible to access through diffusers, hatches on ducts should to be performed 2 Conduct cleaning: - Brushing and pressurized air 3 Shaking or brushing accompanied with negative vacuum cleaning 4 Disinfection of duct in the case of being required 5 Sealing of duct in the case of being porous.

Annex C
(informative)

Air handling units – specific guidance

C.1 General

In manufacturing and construction, special attention has to be paid on the following aspects:

— complete cleaning before shipment;

— during transportation and storage, sealing of the AHU in such a way that contamination is avoided;

— inspection and cleaning after installation.

The following examples of material, access and installation requirements, based on EN 13053, are for normal (e.g. residential, office) and high hygiene level (e.g. hospitals) applications. For each criterion they can be applied independently of each other.

C.2 Recommendations for normal applications

C.2.1 Casing, including accessibility/access doors

EN 13053, subclause 6.2 gives requirements and recommendations for AHU casing, taking also into account hygiene and cleanliness aspects, including the following aspects:

— construction and materials;

— accessibility to all components for cleaning and maintenance;

— protection of components from the weather.

The ingress of unfiltered air through casing leakage can cause hygiene problems. The following tightness classes are therefore recommended as a minimum (classes according to EN 1886):

Level	Recommended minimum tightness class
Basic	L3 (A)
Intermediate	L3 (A)
Advanced	L2 (B)

C.2.2 Filters

The recommendations given in Annex D apply also for filters and filter sections in air handling units.

C.2.3 Humidifiers

The recommendations given in Annex E apply also for humidifiers and humidification sections in air handling units.

C.2.4 Coils

EN 13053, subclause 6.4 gives requirements and recommendations for heating and cooling coils in AHU's, including:

— construction of the coils, including maximum recommended fin depth and minimum distance between fins;

— special requirements for cooling coils that are designed to dehumidify, including location, materials, accessibility etc.

If the inspection reveals a need for cleaning, the coil surfaces are cleaned according to the instructions. If no instructions are available, use dry methods, preferably vacuum cleaning or pressurized air. The result of cleaning can be assessed either by visual inspection or, if feasible, checking the coil pressure drop at the operating air flow.

For cooling coil sections, the same requirements for drainage, cleaning, materials and disinfection apply as for humidifiers, see Annex E.

C.2.5 Sound attenuators

See EN 13053, subclause 6.10.

C.2.6 Fan position and cleaning, including fan motors

The position of the fans in the air-handling unit is important so that proper pressure conditions are maintained to avoid any risks of leakage of contaminated air. This is especially important for units where transfer of particles and gases are possible within the heat recovery section.

The fans and fan motors are cleaned by dry methods: brushing, vacuum or compressed air.

C.2.7 Drainage and prevention of condensation

Penetration of rain or snow into the unit should be prevented by protecting the outdoor air openings against rain and snow and having low air speed into outdoor air openings. In cold climates it can be necessary to have a water-tight plenum section between the outdoor opening and the unit (or the first section) which guides the water immediately out of the building and/or is connected to drain.

NOTE Cold bridges in cabinets introduce a risk of condensation on the inner or outer surfaces, depending on which side of the unit is colder. The bridging factor class, as defined in clause 7 of EN 1886, should therefore be selected to take into account the climatic conditions in which the unit is expected to operate.

C.3 Units for special applications

Clause 7 of EN 13053 gives extended hygiene requirements for air handling units for special applications, including:

— accessibility for cleaning purposes;

— smoothness of surfaces;

— inspection windows and lights;

— drainage and prevention of condensation.

C.4 Inspection aspects

The condition of the filters and the filter section is generally a good indicator of need for cleaning, so it is recommended to start inspection from these components. After cleaning, all these components shall be inspected to ensure that no damage has occurred and that the cleanliness and functioning are as intended.

Annex D
(informative)

Filters – Specific guidance

The side wall on the service side of the filter section should be equipped with an inspection door. The width and height of the door should be greater than the external dimensions of the replaceable filter elements. There should be sufficient free space to the side of the access door, and immediately upstream of front access filters, to allow unrestricted access for filter removal and replacement.

The condition of the filters and the filter section is generally a good indicator of need for cleaning, so it is recommended to start inspection from these components. After cleaning, all these components shall be inspected to ensure that no damage has occurred and that the cleanliness and functioning are as intended.

Annex E
(informative)

Humidifiers – specific guidance

E.1 General

The condition of the humidifiers is a good indicator of need for cleaning, so inspection may also be started from the humidifiers.

E.2 Humidifiers for normal applications

For humidifiers for normal applications, the requirements and recommendations presented in EN 13053, subclause 6.8 apply. These include:

— selection of materials;

— air filtering upstream and downstream;

— limit values for bacteria content;

— water treatment;

— overflow;

— use of disinfectants;

— arrangements to avoid droplet impingement;

— surface finishing of the humidifier casing;

— inspection and maintenance, including recording.

E.3 constructional details Humidifiers for special applications, additional aspects

For additional aspects for humidifiers for special applications, subclause 7.5 of EN 13053 will apply.

Annex F
(informative)

Ductwork – specific guidance

F.1 Application of cleanliness levels for installation

Level	Factory seal	Protection during transit	Protection during site storage	Site clean	Cap off on site
Basic	No	No	No	No	Risers only
Intermediate	No	No	Yes	Yes	Yes
Advanced	Yes	Yes	Yes	Yes	Yes

Basic level

Condition of ducts ex works: Ductwork leaving the premises of the manufacturer may include some or all of the following:

— internal and/or external self-adhesive labels or marking for part(s) identification;

— exposed mastic sealant;

— light zinc oxide coating on the metal surface;

— a light coating of oil an machine formed parts;

— minor protrusions into the airway of rivets;

— screws, bolts and other jointing devices;

— internal insulation and associated fixings;

— discoloration marks from plasma cutting process.

The ductwork is not generally wiped down or specially cleaned at this level unless specified.

Delivery to site: Unless otherwise specified, ductwork delivered from the premises of the manufacturer is not protected.

Installation: Before the installation of individual duct sections they should be inspected to ensure that they are free from all debris but not be wiped or specially cleaned.

Protection of ductwork risers: All risers should be covered to prevent the entry of debris into the duct. In respect of the safety of personnel, full regard should be given to requirements of health and safety at work. Downward facing and horizontal duct openings: These are not covered.

Intermediate level

The intermediate level includes the following requirements in addition to the provisions of the basic level.

Site storage: The area provided for storage should be permanently clean, dry and dust free and this may require a boarded floor and water resistant covering.

Installation: The working area should be clean and dry and protected from the elements. The internal surfaces of the ductwork should be wiped to remove excess dust immediately prior to installation. Open ends on complete ductwork and overnight work-in-progress should be sealed. Prior to the installation of air terminal devices, any remaining protective end covers should be removed before installing the terminal device with the damper in closed position.

Advanced level

Advanced level includes the following requirements in addition to the provisions of the intermediate level.

Production and site delivery: All self-adhesive labels for part identification should be applied to external surfaces only. To maintain cleanliness during transportation, all ductwork should be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping.

Site storage: A clean, dry and dust free environment should be provided for the storage of ductwork prior to installation. All sealed ends should be visually examined and if damaged resealed with polythene or another appropriate material.

Installation: The working area should be clean, dry and dust free. Protective coverings should only be removed immediately before installation.

Unprotected and uncleaned ducts and fittings, leaving the factory, may include residues of lubricant oil from manufacture, dirt accumulation during manufacture and storage. Also, the level of dust accumulation before the initial operation of the system should be related to these quality-levels:

Level	Dust accumulation level	System shall be cleaned
Basic	None	None
Intermediate	1,5 g/m^2*	≥ 3 g/m^2 *
Advanced	0,75 g/m^2*	≥ 1,5 g/m^2 *

*Vacuum/Brush method; 1,5 g/m^2 corresponds 10 g/m^2 wiping with cloth. All other methods than the dust level are too complex for real use, especially the quantitative methods for micro-organism and the quantitative analysis of oil residues)

The oil-residues may be only mentioned as a recommendation, because at this time no practicable test method for the use in field is available. An agreement about allowed micro organism should be recommended for special uses of the advanced level, for other levels clean installation is normally enough to keep the level of micro-organism negligible.)

F.2 Application of cleanliness levels - airtightness

The airtightness of the ductwork is also important for cleanliness. Leakages in unclean hollow spaces or suspended ceilings can have a big influence to the indoor air quality, especially for the advanced level. The minimum tightness class related to these Cleanliness levels can be expressed as follows, corresponding with the technical recommendations of EN 13779, A.8.2,

Level	Recommended minimum tightness class
Basic	B
Intermediate	C
Advanced	D

Annex G
(informative)

Terminal devices and units – specific guidance

Diffusers and other supply and exhaust air units, as well as fan coils, cooling beams and cooling ceilings, should be easy to clean.

Visual inspection is usually sufficient in assessment of need for cleaning and for the result of cleaning, but verification should also include checking of the proper functioning of the terminals and, if the air flows are not according to the specification, readjustment or even balancing of the whole system may be needed.

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