INTERNATIONAL STANDARD

ISO 27327-1

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Fans — Air curtain units —

Part 1:
Laboratory methods of testing for aerodynamic performance rating

Ventilateurs — Rideaux d'air —

Partie 1: Méthodes d'essai en laboratoire des caractéristiques de performance aérodynamique

Reference number
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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 27327-1 was prepared by Technical Committee ISO/TC 117, *Fans*.

ISO 27327 consists of the following parts, under the general title *Fans — Air curtain units*:

— *Part 1: Laboratory methods of testing for aerodynamic performance rating*

Introduction

This part of ISO 27327 is the first developed by ISO/TC 117 and is intended to determine the aerodynamic performance rating of an air curtain. The principal aerodynamic attributes determined by this part of ISO 27327 are airflow rate, power consumption, velocity uniformity near the exit plane and average air curtain core velocities at specified distances from the exit plane.

While a fan energy efficiency calculation is included in this part of ISO 27327, it is generally recognized by the developers of this part of ISO 27327 that a different measure of energy effectiveness is more important and meaningful than fan efficiency because the energy savings that can be obtained by a properly selected, installed and controlled air curtain are significantly higher than the energy needed to drive the motor(s) of an air curtain. This part of ISO 27327 is developed with the understanding that another test standard can be developed at a later stage, which can define a test method for energy effectiveness.

This part of ISO 27327 is not intended as an *in situ* test International Standard and neither is it applicable to thermodynamic performance.

Fans — Air curtain units —

Part 1: Laboratory methods of testing for aerodynamic performance rating

1 Scope

This part of ISO 27327 establishes uniform methods for laboratory testing of air curtain units to determine aerodynamic performance in terms of airflow rate, outlet air velocity uniformity, power consumption and air velocity projection, for rating or guarantee purposes.

This part of ISO 27327 is not applicable to the specification of test procedures to be used for design, production or field testing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5801:2007, *Industrial fans — Performance testing using standardized airways*

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1
air curtain airstream
directionally-controlled airstream, moving across the entire height and width of an opening, which can reduce the infiltration or transfer of air from one side of the opening to the other and/or inhibit the passage of insects, dust and debris

3.1.2
air curtain depth
airstream dimension perpendicular to both the direction of airflow and the airstream width

NOTE This is the short dimension of the airstream.

3.1.3
air curtain width
airstream dimension perpendicular to both the direction of airflow and the airstream depth

NOTE This is the long dimension of the airstream.

3.1.4
air curtain unit
ACU
air-moving device which produces an air curtain

3.1.5
air discharge nozzle
component or an assembly in the ACU which directs and controls the airstream

NOTE This may include adjustable vanes.

3.1.6
air discharge nozzle depth
h_n
inside dimension perpendicular to both the direction of airflow and the airstream width

NOTE This depth is expressed in millimetres.

3.1.7
air discharge nozzle width
b_n
inside dimension perpendicular to both the direction of airflow and the nozzle depth

NOTE This width is expressed in millimetres.

3.1.8
air discharge angle
θ
angle between the plane of the protected opening and the direction in which the air curtain leaves the discharge

3.1.9
dry-bulb temperature
T_d
air temperature measured by a dry temperature sensor in the test enclosure, near the ACU inlet or airway inlet

NOTE This temperature is expressed in degrees Celsius.

3.1.10
wet-bulb temperature
T_w
air temperature measured by a temperature sensor covered by a water-moistened wick and exposed to air in motion

NOTE 1 When properly measured, it is a close approximation to the temperature of adiabatic saturation.

NOTE 2 This temperature is expressed in degrees Celsius.

3.1.11
air density
ρ_a
mass per unit volume of air

NOTE Air density is expressed in kilograms per cubic metre.

3.1.12
pressure
force per unit area

3.1.13
absolute pressure
p
value of a pressure when the datum pressure is absolute zero

NOTE This is always positive.

3.1.14
atmospheric pressure
p_a
absolute pressure of the free atmosphere at the mean altitude of the ACU

NOTE This pressure is normally expressed in pascals.

3.1.15
gauge pressure
p_e
value of the pressure when the datum pressure is the atmospheric pressure at the point of measurement

NOTE 1 Gauge pressure can be negative or positive.

NOTE 2 Gauge pressure is determined using Equation (1):

$$p_e = p - p_a \tag{1}$$

NOTE 3 This pressure is normally expressed in pascals.

3.1.16
dynamic pressure at a point
p_d
pressure calculated from the velocity and the density, ρ_a, of the air at a point

NOTE 1 The point is determined using Equation (2):

$$p_d = \rho_a \left(\frac{v^2}{2} \right) \tag{2}$$

NOTE 2 This pressure is normally expressed in pascals.

3.1.17
gauge stagnation pressure at a point
p_{esg}
difference between the absolute stagnation pressure, p_{sg}, and the atmospheric pressure, p_a

NOTE 1 This pressure is calculated using Equation (3):

$$p_{esg} = p_{sg} - p_a \tag{3}$$

NOTE 2 This pressure is normally expressed in pascals.

3.1.18
ACU airflow rate
q
airflow volume which leaves the discharge nozzle, at standard air conditions, as measured in accordance with ISO 5801

NOTE 1 This is given by Equation (4):

$$q = q_{Vsg1} \tag{4}$$

NOTE 2 This rate is expressed in cubic metres per second.

3.1.19
inlet stagnation volume flow rate
q_{Vsg1}
mass flow rate divided by the inlet stagnation density

NOTE 1 This is determined using Equation (5):

$$q_{Vsg1} = \frac{q_m}{\rho_{sg1}} \tag{5}$$

NOTE 2 Inlet stagnation volume flow rate is expressed in cubic metres per second.

3.1.20
ACU pressure
p_{ACU}
difference between the stagnation pressure at the ACU outlet and the stagnation pressure at the ACU inlet

NOTE 1 This is determined using Equation (6):

$$p_{ACU} = p_{sg2} - p_{sg1} \tag{6}$$

NOTE 2 When the Mach number is less than 0,15, it is possible to use the relationship given in Equation (7):

$$p_{ACU} = p_{t2} - p_{t1} \tag{7}$$

NOTE 3 ACU pressure is expressed in pascals.

3.1.21
ACU static pressure
p_{sACU}
conventional quantity defined as the ACU pressure minus the ACU dynamic pressure corrected by the Mach factor

NOTE 1 This is determined using Equation (8):

$$p_{sACU} = -p_{sg1} \tag{8}$$

NOTE 2 ACU static pressure is expressed in pascals.

3.1.22
average outlet air velocity
v_a
airflow rate produced by the ACU divided by the cross-sectional area of the discharge nozzle plane at free-air delivery

NOTE See 4.4.3 for calculation of the value.

3.1.23
outlet air velocity uniformity
u_{ACU}
indicator of the consistency of air velocities across the air curtain width

NOTE 1 See 5.4.4 for calculation of the value. See Figure 7.

NOTE 2 The outlet air velocity uniformity is expressed as a percentage.

3.1.24
air curtain core velocity
v_{cx}
maximum air velocity of the air curtain at point x as measured across both the air curtain depth and width at specified distances from the discharge nozzle

NOTE See 5.1.1 and 5.3.4.

3.1.25
air curtain average core velocity
v_{ca}
average of air curtain core velocities measured along the air curtain width at specified distances from the discharge nozzle

NOTE See 6.4.3.

3.1.26
air curtain velocity projection
set of average air curtain core velocities measured along the air curtain width at specified distances from the discharge nozzle

NOTE 1 See 6.3.2.5.

NOTE 2 Velocity is expressed in metres per second.

3.1.27
motor input power
P_e
electrical power supplied at the terminals of an electric motor drive

NOTE Motor input power is expressed in watts.

3.1.28
ACU energy effectiveness
E_{ACU}
ratio described by the difference in energy loss through an opening without and with the use of an air curtain divided by the energy loss without the air curtain

NOTE The energy loss with the use of the air curtain includes the energy consumption of the air curtain

3.1.29
ACU fan efficiency
η_{fan}
ratio of the air power of the ACU to the motor input power of the ACU

3.1.30
ACU target distance
l_t
distance perpendicular to the discharge nozzle depth in metres, determined by the sponsor of the test, for the purpose of setting up the test

3.1.31
air power of ACU
P_{ACU}
conventional output power which is the product of the inlet volume flow rate, q_{Vsg1}, and the ACU pressure, p_{ACU}

NOTE 1 This is determined using Equation (9):

$$P_{ACU} = q_{Vsg1} \times p_{ACU} \quad (9)$$

NOTE 2 The air power of the ACU is expressed in watts when q_{Vsg1} is in cubic metres per second and p_{ACU} is in pascals.

3.1.32
point of operation
relative position on the air curtain performance curve corresponding to a particular airflow rate, pressure, power and efficiency

3.1.33
free-air delivery
that point of operation where the ACU operates against zero static pressure

3.1.34
determination
complete set of measurements for a particular point of operation for the parameter being determined

3.1.35
test
series of determinations of various characteristics at a single point of operation of an ACU

3.2 Symbols

Symbol	Term	Unit
A_n	Nozzle cross-sectional area	m^2
b_n	Air discharge nozzle width	mm
C_d	The calculated test line spacing	mm
E_{ACU}	ACU energy effectiveness	1
h_n	air discharge nozzle depth	mm
l_t	ACU target distance	m
η_{fan}	ACU fan efficiency	per unit
n	Number of data points	1

