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GUIDE TO THE ISO 5801 « INDUSTRIAL FANS - PERFORMANCE TESTING USING STANDARDISED AIRWAYS »

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« INDUSTRIAL FANS - PERFORMANCE
TESTING USING STANDARDISED AIRWAYS »

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GUIDE TO THE ISO 5801

CONTENTS

1 - INTRODUCTION

This document has been prepared in order to assist in the understanding and correct use of ISO 5801. This standard deals with the aerodynamic performance testing of fans with a work per unit mass less than 25000 J/Kg. Fans designed solely for air circulation are excluded.

The standard has been developed over a long period of time and has been prepared as a reference document for the laboratory testing of fans. It is based essentially on the following national standards :

AFNOR X 10-200 ; 1983 (France)
ANSI/AMCA 210-85 ; 1985 (USA)
BS 848-1 : 1980 (UK)
DIN 24163-2 ; 1985 (Germany)

Careful attention has been taken to ensure, wherever possible, national standards to coexist with this new international standard.

2 - STRUCTURE OF THE STANDARD

Although consisting of 230 pages the ISO 5801 is in fact, not very difficult to use.

The standard may be divided into four parts :

Part 1 - General principles

- Scope and application range (clause 1)
- Symbols, units, definitions and general (clauses 3, 4 and 5)

- Determination and instrumentation for the measurement of :

    - pressure (clauses 6 and 7)

    - temperature (clause 8)

    - rotational speed (clause 9)

    - power input (clause 10)

    - dimensions and determination of areas (clause 11)

    - air density, humid gas constant and viscosity (clause 12)

    - flow rate (clause 13)

- Calculation of the results of a test (clause 14)

- Conversion rules and fan characteristics (clauses 15 and 16)

- Uncertainty of measurement (clause 17)

Part 2 - Test setup : laboratory and measurement systems

- Selection of test method (clause 18)

- Installation of fan and test airways (clause 19)

- Operation of test (clause 20)

- Determination of flow rate (clauses 21 to 27)

- Installation categories and setups (clause 28)

- Component parts, common airways sections and standardized test chambers
   (clauses 29 to 31)

Part 3 - Standardized test chambers and ducts (clause 31 to 35)

Part 4 - Annexes (Annex A to E)

3 - HOW TO USE THE STANDARD

For each installation category block diagrammes given in Annex 1 show how to proceed.

All quantities with the same sequence as in point 3 of ISO 5801 are listed in the Annex 2 with the indication where to find the relevant definition.

4 - CALCULATION OF THE RESULT OF A TEST

General instructions for the determination of fan performances from the measurements at a single test point are given in chapter 14 of ISO 5801.

Two simplified methods that can be used under certain conditions are presented in 14.9.

Sub-clause 14.9.1 deals with a simplified calculation method to be used when Ma_{ref} is less than 0.15 and fan pressure ratio p_r greater than 2.000 Pa.

Sub-clause 14.9.2 deals with a simplified calculation method to be used when Ma_{ref} is less than 0.15 and fan pressure ratio p_r lower than 2.000 Pa.

For each standardized test installation specific procedures (general or simplified) are given.

An important work concerning differences obtained using the general or simplified methods has been carried out by Mr CYFFERS and presented in Annex 3.

ANNEX 1

BLOCK DIAGRAMS

OPERATION OF TEST

IN ACCORDANCE TO THE CATEGORY SETUP

INSTALLATION CATEGORY : TYPE A

free inlet, free outlet

28.1, from 32 to 32.1 incl.

Inlet side test chamber 32.2

Flow rate determination and measurements taken during the test from 32.2.1 to 32.2.2 incl.

- Simplified procedure $Ma_{2ref} < 0.15$ pressure ratio < 1.02 from 32.2.4.2 to 32.2.4.2.5 incl
- Simplified procedure $Ma_{2ref} < 0.15$ pressure ratio > 1.02 from 32.2.4.1 to 32.2.4.1.5 incl.
- Procedure for general compressible flow from 32.2.3 to 32.2.3.5 incl.

Outlet size test chamber 32.3

Flow rate determination and measurements taken during the test from 32.3.1 to 32.3.2 incl.

Procedure for general compressible flow from 32.3.3 to 32.3.5 incl.

- Simplified procedure $Ma_{2ref} < 0.15$ pressure ratio < 1.02 from 32.3.4.2 to 32.3.4.2.5 incl.
- Simplified procedure $Ma_{2ref} < 0.15$ pressure ratio > 1.02 from 32.3.4.1 to 32.3.4.1.5 incl.

INSTALLATION CATEGORY : TYPE B

free inlet, ducted outlet

28.2, from 33 to 33.1 incl.

Outlet duct of the short type in which no measurements are taken followed by an outlet chamber and a flowmeter
33.3

Flow rate determination and measurements taken during the test
from 33.3.1 to 33.3.2 incl.

Procedure for general compressible flow
from 33.3.3 to 33.3.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio > 1.02

from 33.3.4.1 to 33.3.4.1.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio < 1.02

from 33.3.4.2 to 33.3.4.2.5 incl.

Outlet side test ducts with antiswirl device the pressure being measured downstream the antiswirl device
33.2

Flow rate determination and measurements taken during the test
from 33.2,1 to 33.2.2 incl.

Procedure for general compressible flow
from 33.2.3 to 33.2.3.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio > 1.02

from 33.2.4.1 to 33.2.4.1.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio < 1.02

from 33.2.4.2 to 33.2.4.2.5 incl.

INSTALLATION CATEGORY : TYPE C

ducted inlet, free outlet

28.3, from 34 to 34.1 incl.

Inlet duct, the pressure is measured the test duct
34.2

Flow rate determination and measurements taken during the test
from 34.2.1 to 34.2.2 incl.

Procedure for general compressible flow
from 34.2.3 to 34.2.3.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio > 1.02
from 34.2.4.1 to 34.2.4.1.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio < 1.02
from 34.2.4.2 to 34.2.4.2.5 incl.

Inlet chamber with, at the end of the chamber inlet duct simulation.
The inlet pressure is measured in the chamber
34.3

Flow rate determination and measurements taken during the test
from 34.3.1 to 34.3.2 incl.

Procedure for general compressible flow
from 34.3.3 to 34.3.3.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio > 1.02
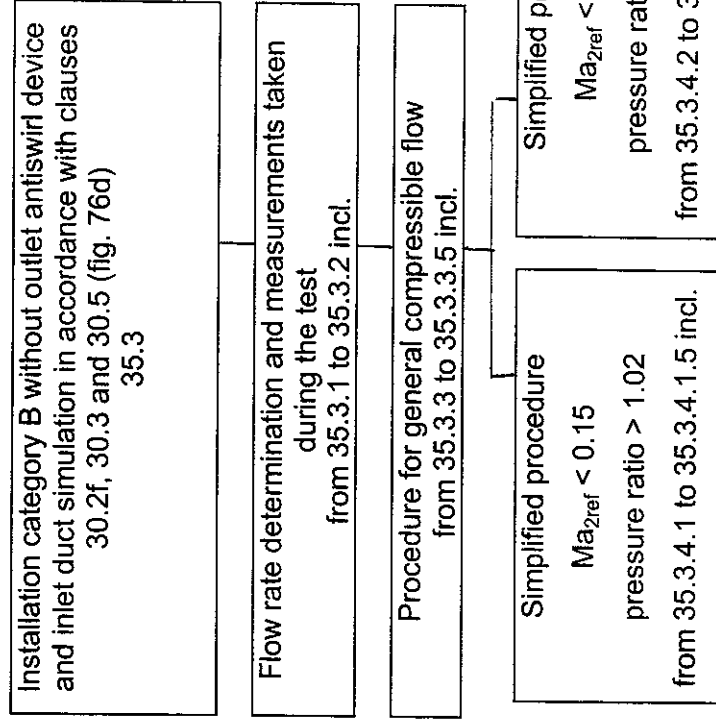from 34.3.4.1 to 34.3.4.1.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio < 1.02
from 34.3.4.2 to 34.3.4.2.5 incl.

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INSTALLATION CATEGORY : TYPE D

ducted inlet, ducted outlet

TABLE I/II

28.4, from 35 to 35.1 incl.

RECOMMENDED
Installation category B with outlet duct and antiswirl device and with inlet duct simulation in accordance with clauses 30.2, 30.3 and 30.5 (fig. 76a and 76b)
35.2

Flow rate determination and measurements taken during the test
from 35.2.1 to 35.2.2 incl.

Procedure for general compressible flow
from 35.2.3 to 35.2.3.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio < 1.02
from 35.2.4.2 to 35.2.4.2.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio > 1.02
from 35.2.4.1 to 35.2.4.1.5 incl.

Installation category B without outlet antiswirl device and inlet duct simulation in accordance with clauses 30.2f, 30.3 and 30.5 (fig. 76d)
35.3

Flow rate determination and measurements taken during the test
from 35.3.1 to 35.3.2 incl.

Procedure for general compressible flow
from 35.3.3 to 35.3.3.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio > 1.02
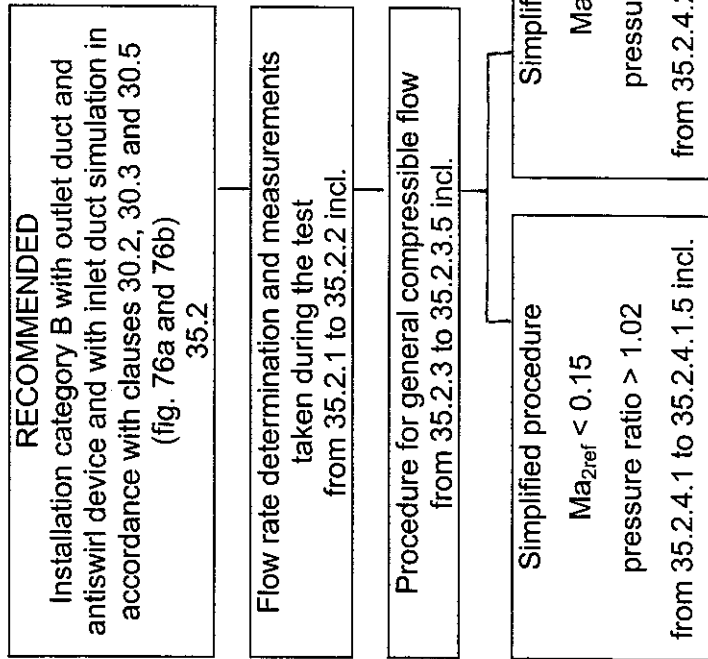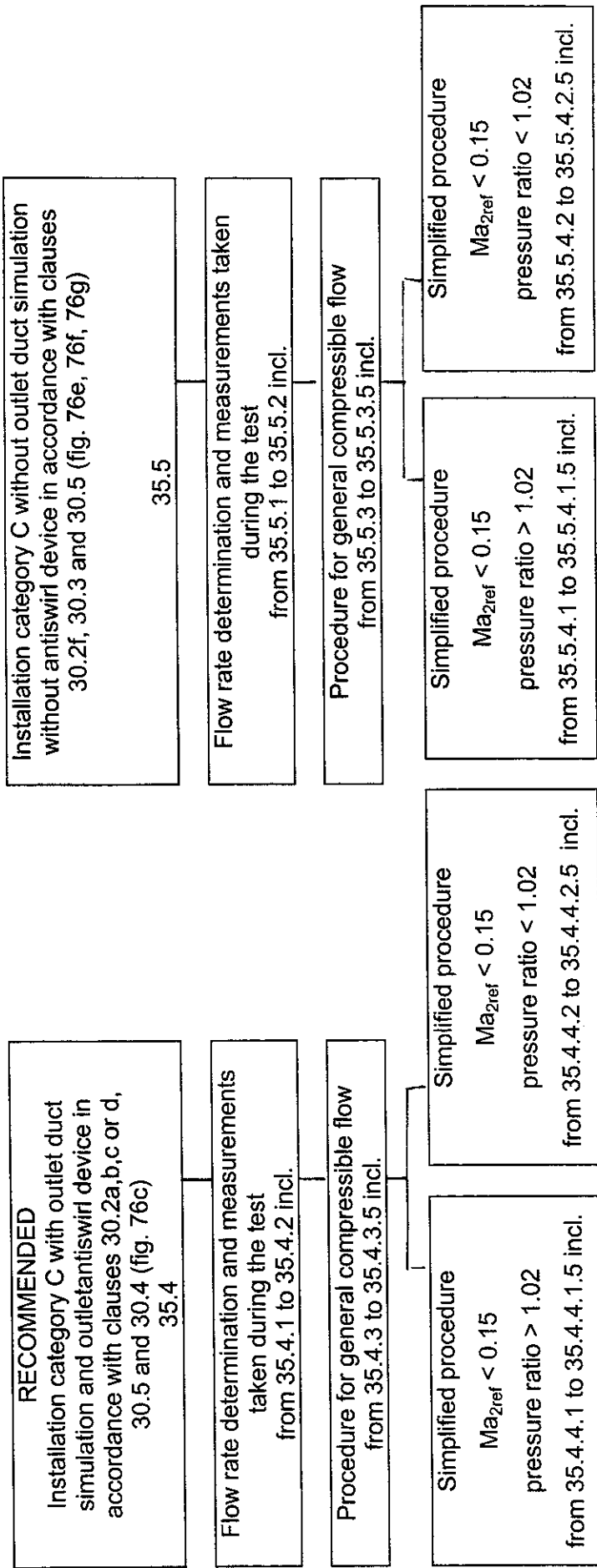from 35.3.4.1 to 35.3.4.1.5 incl.

Simplified procedure
$Ma_{2ref} < 0.15$
pressure ratio < 1.02
from 35.3.4.2 to 35.3.4.2.5 incl.

INSTALLATION CATEGORY : TYPE D

ducted inlet, ducted outlet

TABLE II/II

28.4, from 35 to 35.1 incl.

Installation category C without outlet duct simulation without antiswirl device in accordance with clauses 30.2f, 30.3 and 30.5 (fig. 76e, 76f, 76g)

35.5

Flow rate determination and measurements taken during the test
from 35.5.1 to 35.5.2 incl.

Procedure for general compressible flow
from 35.5.3 to 35.5.3.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio > 1.02

from 35.5.4.1 to 35.5.4.1.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio < 1.02

from 35.5.4.2 to 35.5.4.2.5 incl.

RECOMMENDED

Installation category C with outlet duct simulation and outletantiswirl device in accordance with clauses 30.2a,b,c or d, 30.5 and 30.4 (fig. 76c)
35.4

Flow rate determination and measurements taken during the test
from 35.4.1 to 35.4.2 incl.

Procedure for general compressible flow
from 35.4.3 to 35.4.3.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio > 1.02

from 35.4.4.1 to 35.4.4.1.5 incl.

Simplified procedure

$Ma_{2ref} < 0.15$

pressure ratio < 1.02

from 35.4.4.2 to 35.4.4.2.5 incl.

ANNEX 2

SUBJECT INDEX

Term	Reference	Symbol	Unit
area of the conduit at section x	3.1	A_x	m²
hole diameter of wall pressure tappings	7.3	a	mm
width of the rectangular section of a duct	29	b	m
velocity of sound	14.4	c	m/s
discharge coefficient	23.4.2	C	-
specific heat at constant pressure	4.8	c_p	J/(kg K)
specific heat at constant volume	4.9	c_v	J/(kg K)
diameter of orifice or nozzle throat	23.2 - 24.2	d	m
diameter of stagnation pressure hole in Pitot-static tube	27	d_i	mm
internal diameter of a circular conduit upstream an in-line flow meter	7.3 - 29 - 30	D	mm
hydraulic diameter =(4x area of cross section)/(perimeter of cross section)	30.2	D_h	m
internal diameter of a circular conduit in the x plane	3.65 - 29 - 30	D_x	m
diameter of the impeller	15.1.1.2 - 15.2 (3.55)	D_r	m
Mach factor for correction of dynamic pressure at section x	3.21	F_{mx}	-
gravitational acceleration	6.1	g	m/s²
height of the rectangular section of a duct	29	h	m
relative humidity ($h_u = p_v/p_{sat}$)		h_u	-
kinetic index at section x	3.64	i_{kx}	-
isentropic exponent for an ideal gas ($k = c_p/c_v$) see greek letters	3.7	k	-
resulting coefficient used in the conversion of test results	15.2.	k_c	-
fan density ratio	3.62	k_ρ	-

Term	Reference	Symbol	Unit
compressibility coefficient for the calculation of fan power P_u	3.46	k_p	-
compressibility coefficient for the calculation of fan static pressure	3.46	k_{ps}	-
Mach number (for shock waves see 14.1.1.3)	3.23	Ma	-
Mach number at section x	3.32	Ma_x	-
reference Mach number at section x inlet stagnation conditions	14.4.3.2	Ma_{sgx}	-
peripheral Mach number of impeller	3.56	Ma_u	-
area ratio of an orifice plate $(d/D)^2$	26	m	-
rotational frequency of impeller	3.54	n	rev/s
rotational speed of impeller	3.53	N	rev/min
absolute pressure of the fluid = absolute static pressure ·	3.17	p	Pa
atmospheric pressure at the mean altitude of the fan	3.18	p_a	Pa
gauge pressure $(p_e = p - p_a)$	3.19	p_e	Pa
absolute stagnation pressure	3.20	p_{sg}	Pa
dynamic pressure	3.22	p_d	Pa
downstream pressure	21-22-23-24 25-26-27	p_d	Pa
gauge stagnation pressure	3.24	p_{esg}	Pa
upstream pressure	21-22-23-24 25-26-27	p_u	Pa
mean or average absolute pressure in space and time of the fluid at section x	3.27	p_x	Pa
mean or average gauge pressure in space and time at section x	3.26	p_{ex}	Pa
mean or average absolute stagnation pressure in space and time at section x	3.33	p_{sgx}	Pa
conventional dynamic pressure at section x	3.31	p_{dx}	Pa
saturation vapour pressure	12.2	p_{sat}	Pa
mean or average total pressure at section x $(p_{tx} = p_{ex}+p_{dx})$	3.34	p_{tx}	Pa
partial pressure of water vapour	12.2	p_v	Pa

Term	Reference	Symbol	Unit
fan pressure ($p_F = p_{sg2} - p_{sg1}$)	3.38	p_F	Pa
fan static pressure ($p_{sF} = p_2 - p_{sg1}$)	3.40	p_{sF}	Pa
fan dynamic pressure	3.39	p_{d2}	Pa
upstream pressure (see r_d)		p_u	Pa
downstream pressure (see r_d)		p_{do}	Pa
fan shaft power or mechanical power supplied to the fan output shaft	3.50	P_a	W
motor input power	3.52	P_e	W
motor output power or power available at the shaft of the drive	3.51	P_o	W
impeller power or mechanical power supplied to the impeller of the fan	3.49	P_r	W
fan air power ($P_u = q_m\, y$, or $= q_{vsg1}\, p_F\, k_p$)	3.47	P_u	W
fan static power ($P_{us} = q_m\, y_s$ or $q_{vsg1}\, P_F\, k_{ps}$)	3.48	P_{us}	W
mass flow rate	3.25	q_m	kg/s
volume flow rate	3.29	q_v	m³/s
inlet volume flow or volume flow rate at the stagnation conditions upstream of the inlet corresponding to the standard conditions of use	3.37	q_{vsg1}	m³/s
volume flow rate at section x	3.29	q_{vx}	m³/s
pressure ratio	3.45	r	-
pressure ratio for a flowmeter ($r_d = p_d / p_u$)	22.3.3 - 22.3.5. 23.4.3 - 26.7	r_d	-
$\Delta p/p_u$ for a flowmeter (see r_d)		$r_{\Delta p}$	-
gas constant of dry air	3.6	R	J/(kg K)
Reynolds number at section x	26.6 - 27.6	Re_{Dx}	-
peripheral Reynolds number	15.1.1.2	Re_u	-
throat Reynolds number	22.3.2 - 26.6	Re_d	-
gas constant of water vapour	12.1	R_V	J/(kg K)
gas constant of humid gas	12.1	R_W	J/(kg K)

Term	Reference	Symbol	Unit
ambient temperature	3.4	t_a	°C
barometer temperature	3.4	t_b	°C
dry-bulb temperature	3.13	t_d	°C
wet-bulb temperature	3.14	t_w	°C
static temperature at section x	(see 3.16)	t_x	°C
stagnation temperature at section x	(see 3.15)	t_{sgx}	°C
peripheral velocity of impeller	3.55	u	m/s
absolute uncertainty of x	17.	U_x	as x
relative uncertainty of x	17.	u_x	%
velocity of gas at a point		v	m/s
average velocity of the gas at a section x	3.30	v_{mx}	m/s
fan work per unit mass	3.43	y	J/kg
fan static work per unit mass	3.44	y_s	J/kg
mean altitude of section x	6.1	z_x	m
compressibility coefficient in state equation $Z= 1$ for ideal gas		Z	-
coefficient used for the calculation of the compressibility coefficient (first method)	14.8.2.1	Z_k	-
coefficient used for the calculation of the compressibility coefficient (second method)	14.8.2.1	Z_p -	
flow coefficient of an in-line flowmeter	21 - 22.3.2 23.4.2-27.6	α	-
coefficient of kinetic energy of the flow in the section x of area A α_{Ax} is assumed = 1	3.63 - 21	α_{Ax}	-
compound coefficient	22.3.4 - 26	$\alpha\varepsilon$	-

Term	Reference	Symbol	Unit
ratio of the internal diameter of an orifice or nozzle to the upstream diameter of the duct d/D	22 - 23 - 24 25 - 26	β	-
differential pressure		Δp	Pa
difference of altitude between the barometer and the mean altitude of the fan		ΔZ_b	m
expansibility factor	22 - 23 - 24 25 - 26 - 27	ε	-
conventional loss coefficient between sections x and y calculated for section y	3.66	$(\xi_{x-y})_y$	-
efficiency		η	-
static efficiency	(see 3.58)	η_s	-
fan shaft efficiency ($\eta_a = P_u/P_a$)	3.59	η_a	-
overall efficiency ($\eta_e = P_u/P_e$)	3.61	η_e	-
motor efficiency ($\eta_m = P_u/P_m$)	3.60	η_m	-
fan efficiency ($\eta_r = P_u/P_r$)	3.57	η_r	-
fan static efficiency ($\eta_{sr} = P_{us}/P_r$)	3.58	η_{sr}	-
absolute temperature	3.5	Θ	K
absolute ambient temperature	(see 3.4 - 3.5)	Θ_a	K
absolute static temperature at section x	3.12 - 3.16	Θ_x	K
absolute stagnation temperature at section x	3.11 - 3.15	Θ_{sgx}	K
absolute temperature upstream of an in-line flowmeter	(see 3.16)	Θ_u	K
isentropic exponent for an ideal gas ($k = c_p/c_v$)	3.7	k	-
fan power coefficient		λ	-
specific friction loss coefficient for a lenght of one diameter of a straight duct	30.6	Λ	-
dynamic viscosity	12.3	μ	Pa.s
density of gas	(see 3.36)	ρ	kg/m³

Term	Reference	Symbol	Unit
mean density of gas at section x	3.28	ρ_x	kg/m^3
mean density of gas in the fan	3.41 (3.42)	ρ_m	kg/m^3
flow coefficient ($\Phi = (q_m/(\rho D_r^2 u))$		Φ	-
fan work per unit mass coefficient ($\Psi = y/u^2$)		Ψ	-
angular velocity ($\omega = 2\pi n$)		ω	rad/s
kinetic viscosity ($\nu = \mu/\rho$)		ν	m^2/s

ANNEX 3

CALCULATION EXAMPLES OF FAN PERFORMANCES

This annex contains the detailed calculations of fan performances using four calculation methods. A summary of 23 examples is presented in Table 1. The test airways utilised are presented on the attached diagrams.

Symbols from ISO 5801 have been used. However, due to printing reasons some small modifications were needed.

Table 2 gives the equivalence between the symbols used and ISO symbols with the definition of the considered parameter.

The following fan calculating methods have been considered.

1 - Method taking in account the compressibility of air

- difference between stagnation temperatures and absolute static temperature of air flow
- Mach number influence on the difference between stagnation pressure and absolute static pressure : correction factor F_m

This method is applicable to all cases but must be applied for :

$M_a > 0.15$

$p_F > 2000$ Pa

(see ISO 5801 13.4 to 13.8)

2 - Simplified method based on the equality between the stagnation temperature and the absolute static temperature

- The absolute static temperature is equal to the stagnation temperature
- The influence of flow Mach number on the difference between the stagnation pressure and the absolute static pressure is neglected
- The variation of air density with pressure is taken in account

This simplified method is applicable when :

$M_a < 0.15$

$p_F > 2000$ Pa

(see ISO 5801 14.9.1.)

3 - Simplified method based on the assumption of incompressibility of air

The air density at the fan outlet is equal to the density at the fan inlet.

This simplified method is applicable when :

$M_a < 0.15$

$p_F < 2000$ Pa

(see ISO 5801 14.9.2.)

4 - Method based on the Document ISO TC 117/SC1 n° 101 January 82. (Annex 7 to ISO Standard 5801)

This method is the result of the work of the ad hoc group «Compressibility effect on industrial fans» created by ISO TC 117/SC1, slightly modified by the Resolution 1994-6 on 6 May 1994 of ISO TC 117.

This method may be applied to all values of Mach number or fan pressure within the range corresponding to the definition.

Based on the equation governing compressible fluid flows, this method gives more accurate results in the range of Mach numbers lower than 0.25-0.3.

Remarks

a) The values of parameters used in the different examples are not the result of real fan tests, but calculated values selected in order to put into evidence the influence of Mach number and fan pressure on the results obtained by different calculating methods.

Consequently these results are not exactly representative of real performances of fans.

b) The methods of flow measurement are those described in ISO 5801 :

- ISO 5167-1 - Orifice plate pressure taps at D, D/2

        - ISO Venturi nozzle

        - ISA 1932 Nozzle

- DIN 24163 Quadrant inlet nozzle
- BS 848 Conical inlet
- AMCA 210-85 AMCA Nozzle in duct or chamber (in this last case only one nozzle is used)
- AFNOR X 10-200 « Caisson reduit »
- BSI DIN VDI Inlet or outlet orifice plate which will be introduce in the software.

The method of determination of flow rate by Pitot static tube traverse is not used.

c) Fan work per unit mass and efficiency :

For $P_F > 2$ kPa (Ma > 0,15, Ma < 0,15, Annex 7)

$$y = \frac{p_2 - p_1}{\rho m} + \frac{v_2^2}{2} - \frac{v^2}{2}$$

$$y_s = \frac{p_2 - p_1}{\rho m} - \frac{v^2}{2}$$

For $P_F < 2$ kPa

$y = q_{vsg1} * P_F / qm = P_F / \rho_{sg1}$

$ys = q_{vsg1} * P_{SF} / qm = P_{SF} / \rho_{sg1}$

etar : $\eta_r = y * qm / Pr$

etasr = η_{sr} ys * qm/Pr

The polytropic fan work per unit mass y_p y_{sp} is always calculated from :

$$y_p = q_{vsg1} * P_F * K_p$$
$$y_{sp} = q_{vsg1} * P_{SF} * K_{ps}$$

d) For a given test point the values of the required parameters and detailed calculations corresponding to the four calculating methods are displayed on one page in order to facilitate a comparison.

e) The number of decimal places is obviously much higher than the number of decimal places corresponding to the accuracy of real tests or calculation. However, this number of decimal places may be useful in some cases, for example for the verification of software used for performance calculation.

CONCLUSION

As may be seen from the enclosed examples, the three basic calculation methods produce very similar results. Even the simplified method normally only applicable for Mach numbers lower than 0.15, shows very little deviation from the exact values even with very high Mach numbers (Example 23 with Ma = 0.35 shows a deviation of only 2.5 % for fan work and 1.6 points for efficiency).

The situation is completely different with the simplified method based on the assumption of the incompressibility of air. Deviations from exact values, when using this calculation method, may reach several percent on mass flow rate, fan work or efficiency. Depending on the flow rate measuring method the sens and magnitude of any deviations are unpredictable. Even for relatively low Mach numbers, as in Example 8 (Ma = 0.07) the deviation for flow rate is - 5 % and for fan work + 6 %. Only when both conditions specified for using this method (Ma < 0.15 and p_F < 2000 Pa) are satisfied, is the deviation from the exact value acceptably low.

TABLE 1

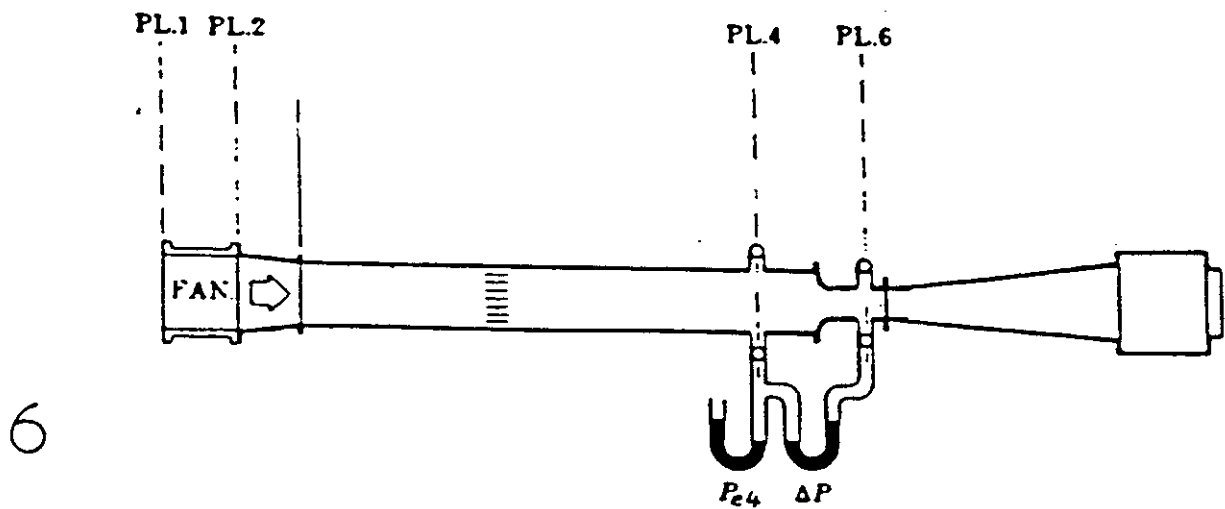|		Fig 5801	Pressure measurement	Flow measurement	y	Ma₁	Ma₂
1	A	70 a	Inlet chamber	conical inlet	1626	0.03	0.07
2	A	70 c	Inlet chamber	ISO 5167-1	1603	0.03	0.07
3	A	71 b	Outlet chamber	AMCA nozzle in chamber	1608	0.04	0.07
4	A	75 a	inlet chamber	Quadrant inlet nozzle DIN	1605	0.037	0.07
5	B	72 b	Outlet duct	X 10-200 Caisson reduit	1630	0.037	0.07
6	B	72 f	Outlet duct	AMCA nozzle in duct	1686	0.038	0.077
7	B	73 b	Outlet chamber	AMCA nozzle in chamber	1608	0.04	0.07
8	B	72 c	Outlet duct	ISO 5167-1 Orifice D D/2	15012	0.08	0.16
9	B	72 c	Outlet duct	ISO 5167-1 Orifice D D/2	25034	0.10	0.23
10	B	72 c	Outlet duct	ISO 5167-1 Orifice D D/2	25018	0.18	0.3
11	B	72 c	Outlet duct	ISO 5167-1 Orifice D D/2	25099	0.2	0.35
12	C	74 e	Inlet duct	ISO 5167-1 Orifice D D/2	1649	0.07	0.07
13	C	74 a	Inlet duct	Conical inlet	1628		0.07
14	C	74 c	Inlet duct	ISO nozzle ISA 32 DIN	1930	0.077	0.077
15	C	75 d	Inlet chamber	AMCA nozzle in chamber	1605	0.035	0.07
16	C	74 a	Inlet duct	Conical inlet	14998	0.16	0.17
17	C	74 e	Inlet duct	ISO 5167-1 Orifice D D/2	25043	0.13	0.23
18	C	74 e	Inlet duct	ISO 5167-1 Orifice D D/2	25124	0.3	0.15
19	C	74 e	Inlet duct	ISO 5167-1 Orifice D D/2	24623	0.35	0.17
20	D	76 c	Inlet duct Outlet duct	X 10-200 Caisson reduit	1865	0.07	0.07
21	D	76 c	Inlet duct Outlet duct	X 10-200 Caisson reduit	25039	0.12	0.24
22	D	76 c	Inlet duct Outlet duct	ISO 5167-1 Orifice D D/2	25095	0.3	0.3
23	D	76 c	Inlet duct Outlet duct	ISO 5167-1 Orifice D D/2	25127	0.35	0.35

TABLE 2

Used symbol   **ISO Symbol**

Used symbol	ISO Symbol	
A1	A_1	Fan inlet area
A2	A_2	Fan outlet area
A3	A_3	Inlet pressure measurement area
A4	A_4	Outlet
A5	A_5	Section 5 area
A6	A_6	Section 6 area
A7	A_7	Section 7 area
A8	A_8	Section 8 area
A0		Orifice plate or nozzle area
p	p_{e3}	Inlet pressure section 3
pe4	p_{e4}	Outlet pressure section 4
pe5	p_{e5}	Pressure in section 5
pe6	p_{e6}	Pressure in section 6
pe7	p_{e7}	Pressure in section 7
pe8	p_{e8}	Pressure in section 8
pr	p_r	Impeller power
etam	η_m	Motor efficiency
		= 1 when the motor is out of the flow
		= when the motor is in the flow
P_x	P_{rx} or P_{ex}	Auxiliary fan power :
		electric power when it is in the flow
		shaft power when it is out of the flow
N	N	
pa	p_a	Atmospheric pressure
Ta	θ_a	Absolute temperature in the test enclosure
t_d	t_d	Dry
t_w	t_w	Wet bulb temperature
p satW	p_{sat}	Saturation vapor pressure at wet bulb temperature
R_W	R_W	M gas constant of humid gas
pu	p_u	Upstream pressure

dp	Δp	Differential pressure
Tsgu	θ_{sgu}	Upstream stagnation temperature
Tu	θ_u	Upstream absolute temperature
rou	ρ_u	Upstream density
Red u, Red o		Upstream duct or orifice Reynolds number
alfa	α	Flow coefficient
epsi	ε	Expansion coefficient
al feps	$\alpha\varepsilon$	Product $\alpha.\varepsilon$
qm	q_m	Mass flow
p4	p_4	Absolute pressure in section 4
Tsg4	θ_{sg4}	Stagnation temperature in section 4
T4	θ_4	Absolute temperature in section 4
ro4	ρ_4	Air density in section 4
Red4	Red_4	Reynolds number in section 4
Z 2-4/4	$(\zeta 2\text{-}4)_4$	Friction loss coefficient between section 2 and 4 calculated for section 4
Ma4	M_{a4}	Mach factor in section 4
Fm4	F_{m4}	Mach number in section 4
psg2	p_{sg2}	Stagnation pressure in section 2
p2	P_2	Absolute pressure in section 2
Tsg2	θ_{sg2}	Stagnation temperature in section 2
T2	θ_2	Absolute pressure in section 2
ro2	ρ_2	Air density in section 2
Ma2	M_{a2}	Mach number in section 2

Same quantities for sections 3 and 1, excepted p3 which is p_3 or p_{sg3} for AMCA inlet chamber)

qm	q_m	Mass flow
qvsg1	q_{vsg1}	Volume flow
pF	p_F	Fan pressure
psf	p_{sf}	Fan static pressure
y	y	Fan work per unit mass
ys	y_s	Fan static work per unit mass
eta r	η_r	Fan efficiency
eta s r	η_{sr}	Fan static efficiency
yp	y_p	Polytropic fan work per unit mass
ysp	y_{sp}	Polytropic fan static work per unit mass
ik1	i_{k1}	Kinetic index section 1
ik2	i_{k2}	Kinetic index section 2

1

2

3

4

PL5   PL3   PL1   PL2

t_3

D_3

Δp

P_{e3}

5

V

①②

④

⑥

7°

P_{e4}

Δp

6

PL.1   PL.2   PL.4   PL.6

FAN

P_{e4} ΔP

13 16

14

15

PL.1 PL.2   PL.4   PL.6

FAN

7

P_{eu} P_{e6} ΔP

8 9

10

11

V

P_{e4} P_{e6} Δp

12 17

18

19

V

Δp P_{s3}

20 21

Pe6

6

Pe4

4

1 2

3

Pe3

22 23

Pe4

4

1 2

3

Pe3

5

ΔP

7

Pe7
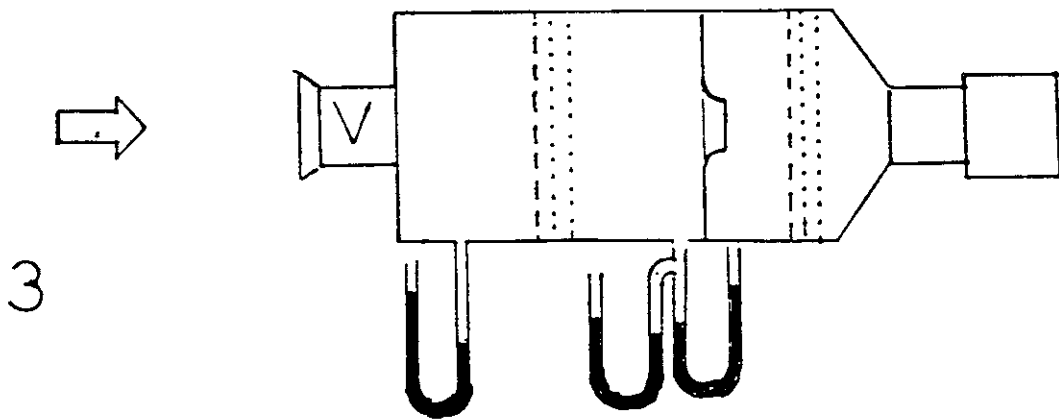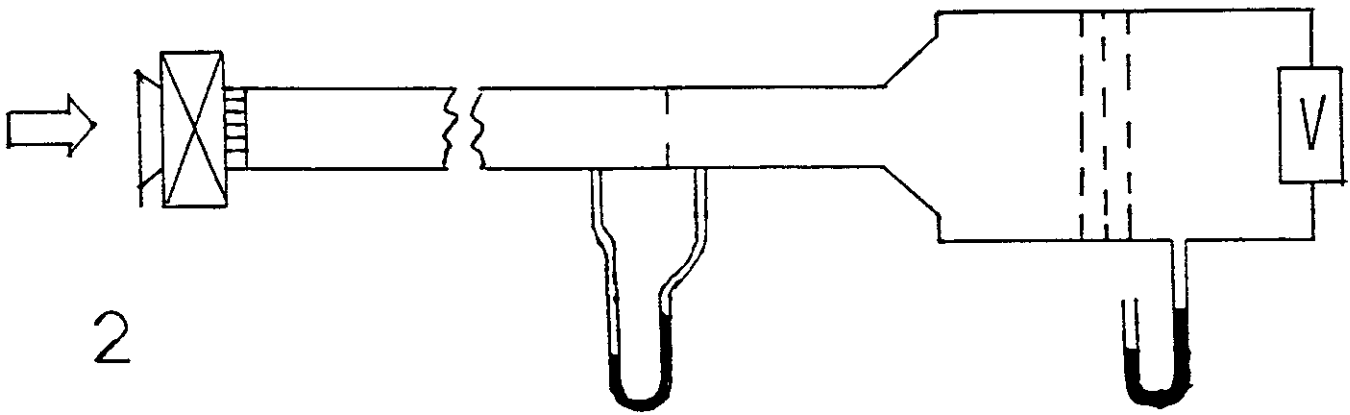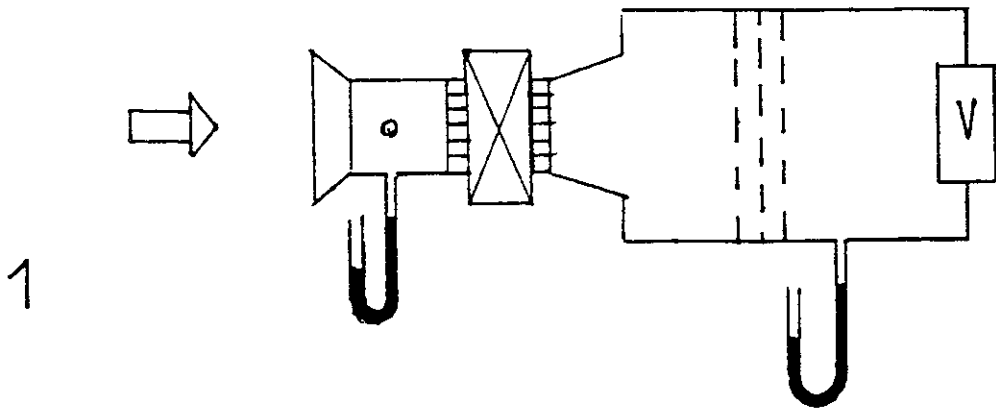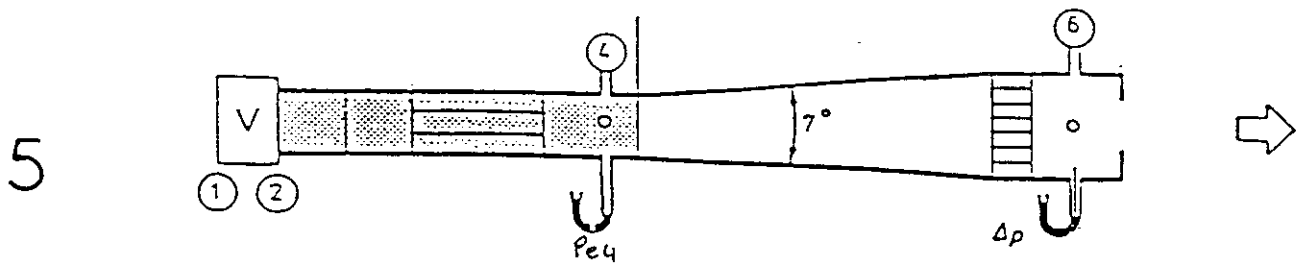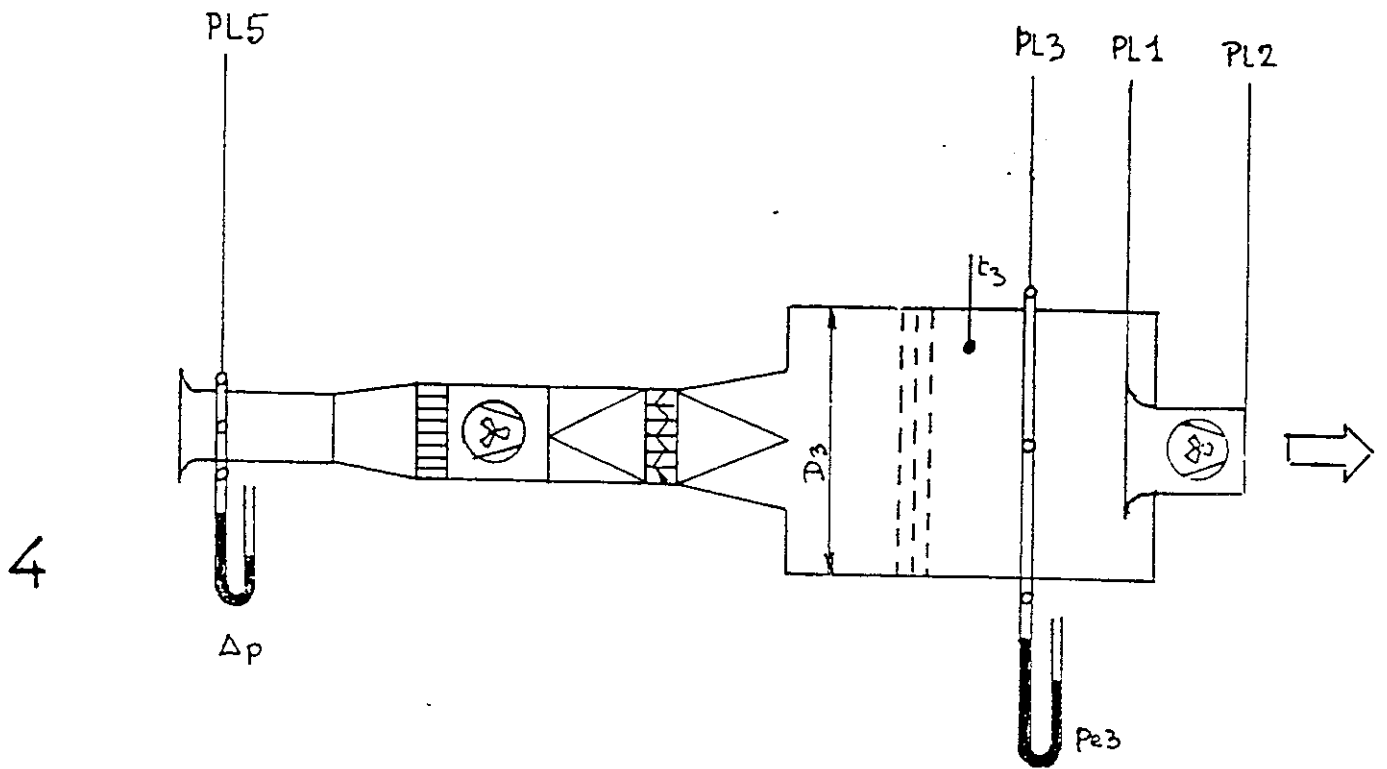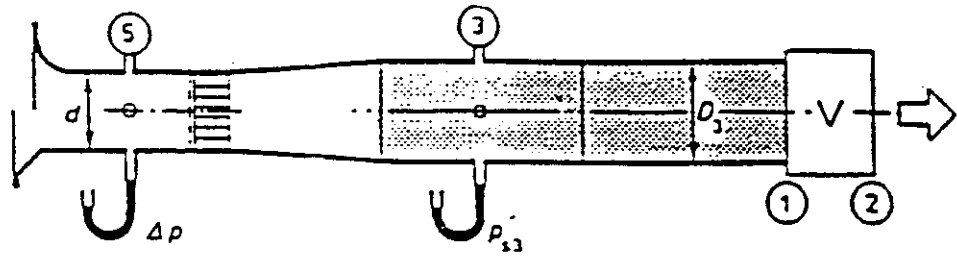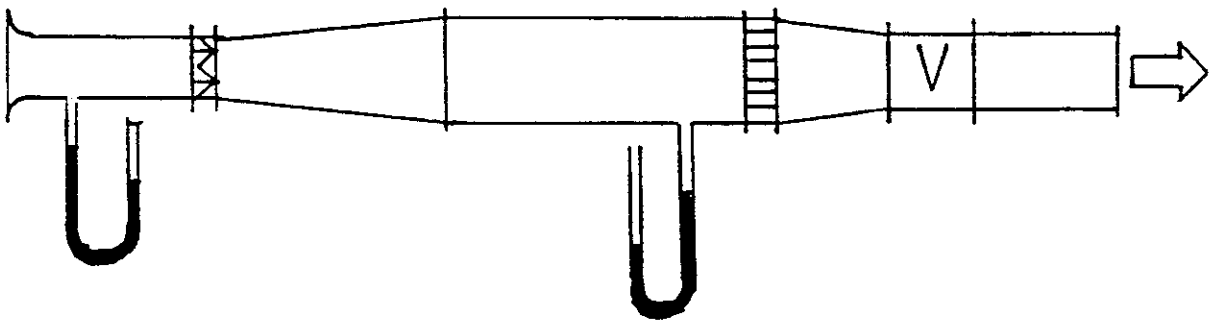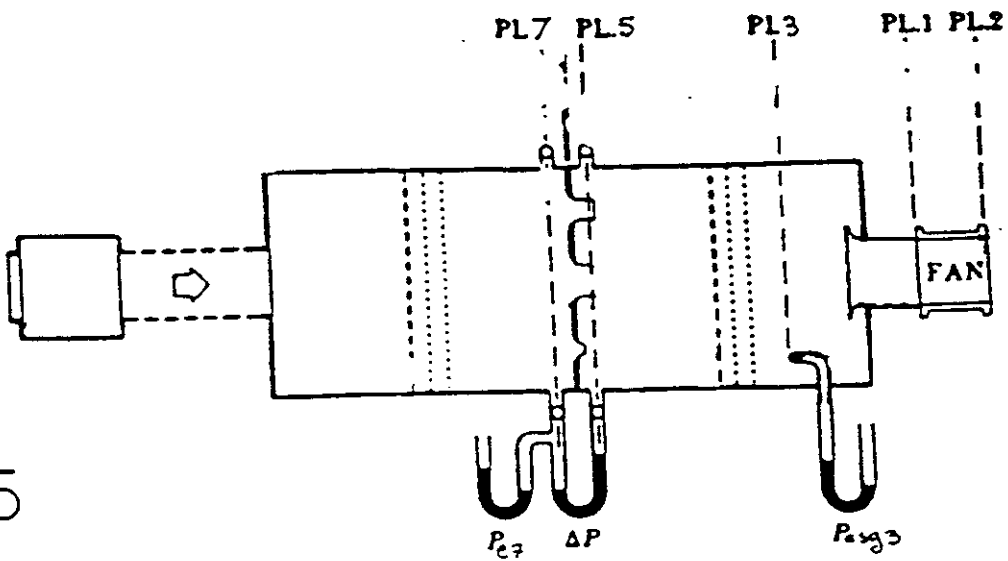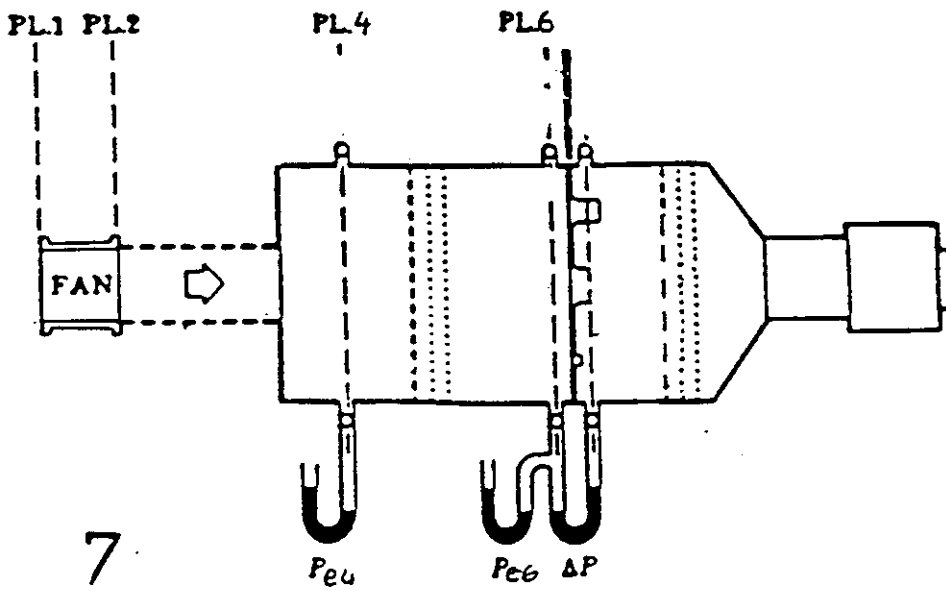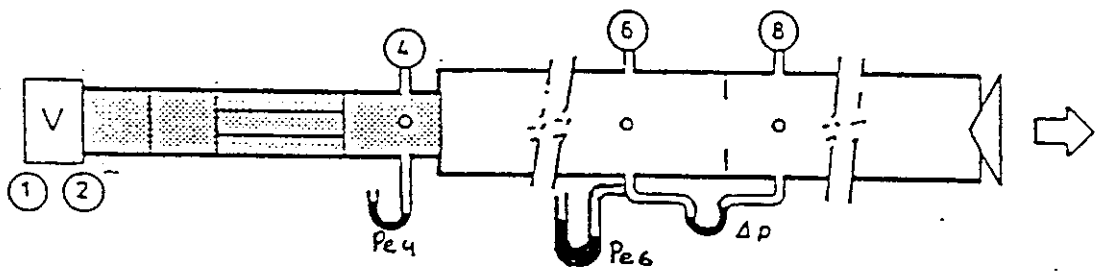
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                    installation category :A              Test Nr  01
        measurement of flow rate          conical inlet
            position of flow measurement fan inlet
                pressure measurement  inlet chamber
                auxiliary fan    downstream flow measurement
A1 m^2= 1.57049640          A2 m^2= 0.78539820          A3 m^2= 7.06853500
A4 m^2= 0.00000000          A5 m^2= 0.50265480          A6 m^2= 0.00000000
A7 m^2= 0.00000000          A8 m^2= 0.00000000          Ao m^2= 0.50265480
pe3 Pa=  -1605.200         pe5 Pa=  -1015.500          pe7 Pa=     +0.000
pe4 Pa=      0.00          pe6 Pa=      0.00            pe8 Pa=      0.00
Pr W=    45320.00       etam=0.89      Px=  121747.0     N  rpm=   1780.
----------------------------------------------------------------------------
                    iso Ma>0.15    iso Ma<0.15    iso pf<2kPa    iso annex 7
----------------------------------------------------------------------------
    pa      Pa      100500.000     100500.000     100500.000     100500.000
    Ta      K       278.150000     278.150000     278.150000     278.150000
    td      C       5.000          5.000          5.000          5.000
    tw      C       2.000          2.000          2.000          2.000
    psatw   Pa      705.0          705.0          705.0          705.0
    Rw      J/kg/K  287.546765     287.546765     287.546765     287.546765
    pu      Pa      100500.000     100500.000     100500.000     100500.000
    dp      Pa      1015.5000      1015.5000      1015.5000      1015.5000
    Tsgu    K       278.150000     278.150000     278.150000     278.150000
    Tu      K       278.150000     278.150000     278.150000     278.150000
    rou     kg/m^3  1.25654635     1.25654635     1.25654635     1.25654635
    Redo    --      2220943.43     2220943.43     2220943.43     2220943.43
    alfa    --      0.00000000     0.00000000     0.00000000     0.00000000
    epsi    --      0.00000000     0.00000000     0.00000000     0.00000000
    alfeps  --      0.95291120     0.95291120     0.95291120     0.95291120
    qm      kg/s    24.197277      24.197277      24.197277      24.197277
    p4      Pa      0.000          0.000          0.000          0.000
    Tsg4    K       0.000000       0.000000       0.000000       0.000000
    T4      K       0.000000       0.000000       0.000000       0.000000
    ro4     kg/m^3  0.00000000     0.00000000     0.00000000     0.00000000
    Red4    --      0.00           0.00           0.00           0.00
Z  2-4/4   --      +0.00000000    +0.00000000    +0.00000000    +0.00000000
    Ma4     --      0.00000000     0.00000000     0.00000000     0.00000000
    Fm4     --      0.00000000     0.00000000     0.00000000     0.00000000
    psg2    Pa      100887.433     100887.326     100890.727     100887.415
    p2      Pa      100500.000     100500.000     100500.000     100500.000
    Tsg2    K       285.240383     285.240383     283.149369     285.240383
    T2      K       284.926979     285.240383     283.149369     284.926979
    ro2     kg/m^3  1.22665943     1.22531166     1.21464502     1.22665943
    v2      m/s     25.116122      25.143749      25.364553      25.116122
    Ma2     --      0.07416011     0.07420040     0.00000000     0.07416011
    p3      Pa      98894.800      98894.800      98894.800      98894.800
    Tsg3    K       283.149369     283.149369     283.149369     283.149369
    T3      K       283.145420     283.149369     283.149369     283.145420
    ro3     kg/m^3  1.21466196     1.21464502     1.21464502     1.21466196
    Red3    --      0.00           0.00           0.00           0.00
Z  3-1/3   --      +0.00000000    +0.00000000    +0.00000000    +0.00000000
    Ma3     --      0.00835089     0.00834760     0.00000000     0.00835089
    Fm3     --      1.00001740     1.00000000     1.00000000     1.00000000
    psg1    Pa      98899.624      98899.624      98899.624      98899.586
    p1      Pa      98801.842      98801.812      98801.905      98801.804
    Tsg1    K       283.149369     283.149369     283.149369     283.149369
    T1      K       283.069324     283.149369     283.149369     283.069323
    ro1     kg/m^3  1.21384644     1.21350292     1.21464502     1.21384598
    v1      m/s     12.693044      12.696638      12.684699      12.693049
    Ma1     --      0.03760159     0.03760648     0.00000000     0.03760117

    qm      kg/s    24.197277      24.197277      24.197277      24.197277
    qvsg1   m^3/s   19.920303      19.920303      19.921275      19.920311
    pf      Pa      1987.8088      1987.7021      1991.1035      1987.8285
    psf     Pa      1600.3761      1600.3761      1600.3761      1600.4139
    y       J/kg/K  1626.4973      1628.1358      1639.2473      1626.5285
    ys      J/kg/K  1311.0875      1312.0317      1317.5670      1311.1186
    etar    --      0.86842025     0.86929507     0.87522771     0.86843689
    etasr   --      0.70001648     0.70052063     0.70347600     0.70003312
    yp      J/kg/K  1625.5571      1625.4693      1639.2473      1625.5807
    ysp     J/kg/K  1311.2526      1311.2526      1317.5670      1311.2830
    ik1     --      0.04952771     0.04950588     0.04907789     0.04952680
    ik2     --      0.19391967     0.19415092     0.19623659     0.19391595
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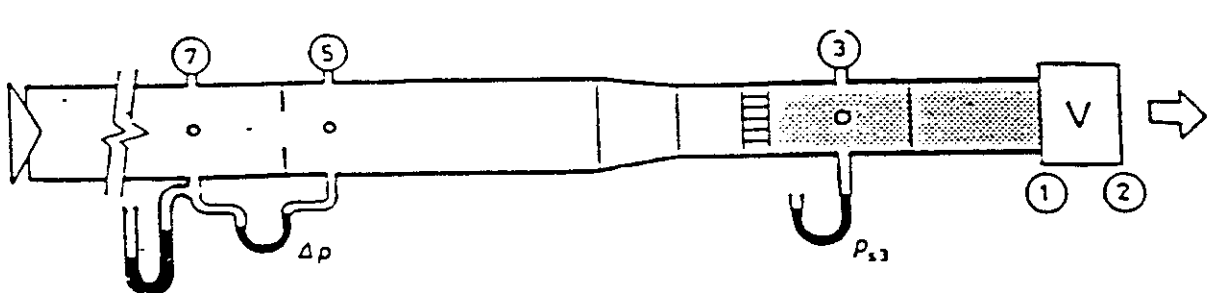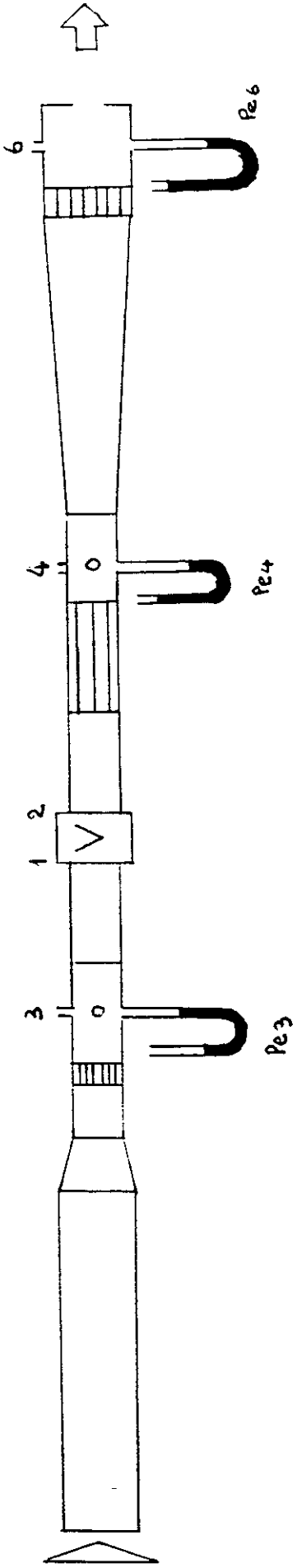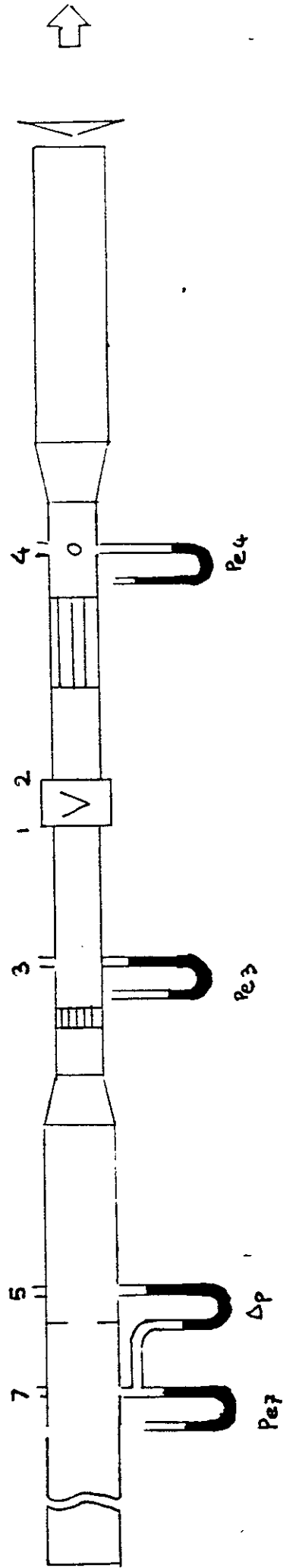
measurement of flow rate   iso 5167-1 pressure taps D-D/2
position of flow measurement fan inlet
pressure measurement   inlet chamber
auxiliary fan   upstream flow measurement

A1 m^2= 0.56548700		A2 m^2= 0.28274340		A3 m^2= 4.00000000
A4 m^2= 0.00000000		A5 m^2= 0.45364600		A6 m^2= 0.00000000
A7 m^2= 0.45364600		A8 m^2= 0.00000000		Ao m^2= 0.22228653
pe3 Pa= -1561.000		pe5 Pa= +0.000		pe7 Pa= +1031.000
pe4 Pa= 0.00		pe6 Pa= 0.00		pe8 Pa= 0.00
Pr W= 16321.70	etam=0.89	Px= 26196.0	N rpm= 2980.	

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	102390.000	102390.000	102390.000	102390.000
Ta	K	287.150000	287.150000	287.150000	287.150000
td	C	14.000	14.000	14.000	14.000
tw	C	10.000	10.000	10.000	10.000
psatw	Pa	1227.0	1227.0	1227.0	1227.0
Rw	J/kg/K	288.013925	288.013925	288.013925	288.013925
pu	Pa	103421.000	103421.000	103421.000	103421.000
dp	Pa	1270.0000	1270.0000	1270.0000	1270.0000
Tsgu	K	290.150380	290.150990	290.150990	290.150380
Tu	K	290.032426	290.150990	290.150990	290.032426
rou	kg/m^3	1.23807996	1.23757404	1.23757404	1.23807996
Redu	--	810157.53	809735.40	809735.40	810157.53
alfa	--	0.69784491	0.69784554	0.69784554	0.69784491
epsi	--	0.99566664	0.99566664	0.99566664	0.99566664
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	8.661183	8.659421	8.659421	8.661183
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	102775.805	102775.546	102778.700	102775.827
p2	Pa	102390.000	102390.000	102390.000	102390.000
Tsg2	K	292.250850	292.251888	290.150990	292.250850
T2	K	291.936975	292.251888	290.150990	291.936975
ro2	kg/m^3	1.21774107	1.21642891	1.20655721	1.21774107
v2	m/s	25.155317	25.177329	25.383323	25.155317
Ma2	--	0.07331946	0.07334326	0.00000000	0.07331946
p3	Pa	100829.000	100829.000	100829.000	100829.000
Tsg3	K	290.150380	290.150990	290.150990	290.150380
T3	K	290.148789	290.150990	290.150990	290.148789
ro3	kg/m^3	1.20656636	1.20655721	1.20655721	1.20656636
Red3	--	0.00	0.00	0.00	0.00
Z 3-1/3	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma3	--	0.00523623	0.00524564	0.00000000	0.00523623
Fm3	--	1.00000691	1.00000000	1.00000000	1.00000000
psg1	Pa	100830.943	100830.942	100830.942	100830.938
p1	Pa	100733.639	100733.674	100733.767	100733.634
Tsg1	K	290.150380	290.150990	290.150990	290.150380
T1	K	290.070342	290.150990	290.150990	290.070351
ro1	kg/m^3	1.20575122	1.20541650	1.20655721	1.20575113
v1	m/s	12.702725	12.703667	12.691657	12.702726
Ma1	--	0.03714320	0.03714038	0.00000000	0.03714279
qm	kg/s	8.661183	8.659421	8.659421	8.661183
qvsg1	m^3/s	7.178274	7.176829	7.176967	7.178274
pf	Pa	1944.8623	1944.6037	1947.7581	1944.8888
psf	Pa	1559.0571	1559.0579	1559.0579	1559.0622
y	J/kg/K	1602.6362	1604.0786	1614.3106	1602.6405
ys	J/kg/K	1286.2412	1287.1297	1292.1541	1286.2455
etar	--	0.85044608	0.85103831	0.85646688	0.85044835
etasr	--	0.68254966	0.68288217	0.68554787	0.68255193
yp	J/kg/K	1601.6711	1601.4596	1614.3106	1601.7162
ysp	J/kg/K	1286.3684	1286.3570	1292.1541	1286.3822
ik1	--	0.05034181	0.05030400	0.04989069	0.05034169
ik2	--	0.19742159	0.19758939	0.19956289	0.19742107

measurement of flow rate   amca nozzle in chamber
position of flow measurement fan outlet
pressure measurement outlet chamber
auxiliary fan   downstream outlet

A1 m^2= 0.50893800		A2 m^2= 0.28274300		A3 m^2= 0.00000000
A4 m^2= 4.90873800		A5 m^2= 0.00000000		A6 m^2= 4.90873800
A7 m^2= 0.00000000		A8 m^2= 4.90873800		Ao m^2= 0.12450690
pe3 Pa= +0.000		pe5 Pa= +0.000		pe7 Pa= +0.000
pe4 Pa= 1573.00		pe6 Pa= 401.50		pe8 Pa= 0.00
Pr W= 15540.50	etam=0.88	Px= 0.0	N rpm= 2980.

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	100520.000	100520.000	100520.000	100520.000
Ta	K	291.150000	291.150000	291.150000	291.150000
td	C	18.000	18.000	18.000	18.000
tw	C	16.000	16.000	16.000	16.000
psatw	Pa	1817.0	1817.0	1817.0	1817.0
Rw	J/kg/K	288.826710	288.826710	288.826710	288.826710
pu	Pa	100921.500	100921.500	100520.000	100921.500
dp	Pa	1946.5000	1946.5000	1946.5000	1946.5000
Tsgu	K	293.245869	293.245873	291.150000	293.245869
Tu	K	293.244865	293.245873	291.150000	293.244865
rou	kg/m^3	1.19156003	1.19155594	1.19535893	1.19156003
Redo	--	1475515.38	1475508.77	1486101.43	1475515.38
alfa	--	0.99324317	0.99324316	0.99326311	0.99324317
epsi	--	0.98960865	0.98960865	0.98956448	0.98960865
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	8.335136	8.335121	8.348207	8.335136
p4	Pa	102093.000	102093.000	102093.000	102093.000
Tsg4	K	293.245869	293.245873	291.150000	293.245869
T4	K	292.950635	293.245873	291.150000	292.950635
ro4	kg/m^3	1.20660235	1.20538755	1.19535893	1.20660235
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.07098575	0.07102229	0.00000000	0.07098575
Fm4	--	1.00126040	1.00000000	1.00000000	1.00000000
psg2	Pa	102453.574	102453.482	102457.648	102453.537
p2	Pa	102092.976	102093.003	102093.000	102093.000
Tsg2	K	293.245869	293.245873	291.150000	293.245869
T2	K	292.950607	293.245873	291.150000	292.950635
ro2	kg/m^3	1.20660219	1.20538759	1.19535893	1.20660235
v2	m/s	24.431870	24.456444	24.700344	24.431866
Ma2	--	0.07098909	0.07102229	0.00000000	0.07098666
p3	Pa	0.000	0.000	0.000	0.000
Tsg3	K	0.000000	0.000000	0.000000	0.000000
T3	K	0.000000	0.000000	0.000000	0.000000
ro3	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red3	--	0.00	0.00	0.00	0.00
Z 3-1/3	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma3	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm3	--	0.00000000	0.00000000	0.00000000	0.00000000
psg1	Pa	100520.000	100520.000	100520.000	100520.000
p1	Pa	100407.702	100407.684	100407.454	100407.702
Tsg1	K	291.150000	291.150000	291.150000	291.150000
T1	K	291.057003	291.150000	291.150000	291.057006
ro1	kg/m^3	1.19440502	1.19402330	1.19535893	1.19440501
v1	m/s	13.711854	13.716213	13.722397	13.711854
Ma1	--	0.03996963	0.03997543	0.00000000	0.03996911
qm	kg/s	8.335136	8.335121	8.348207	8.335136
qvsg1	m^3/s	6.972914	6.972902	6.983849	6.972914
pf	Pa	1933.5741	1933.4818	1937.6484	1933.5369
psf	Pa	1572.9764	1573.0026	1573.0000	1573.0000
y	J/kg/K	1608.2569	1609.7689	1620.9762	1608.2764
ys	J/kg/K	1309.7988	1310.7101	1315.9227	1309.8184
etar	--	0.86258742	0.86339680	0.87077281	0.86259788
etasr	--	0.70250962	0.70299712	0.70690100	0.70252013
yp	J/kg/K	1607.2754	1607.2016	1620.9762	1607.2511
ysp	J/kg/K	1309.8413	1309.8611	1315.9227	1309.8587
ik1	--	0.05845302	0.05843524	0.05808357	0.05845231
ik2	--	0.18557864	0.18577748	0.18819122	0.18557633

measurement of flow rate   quadrant inlet nozzle
position of flow measurement fan inlet
pressure measurement   inlet chamber
auxiliary fan   downstream flow measurement

A1 m^2= 0.56548700	A2 m^2= 0.28274340	A3 m^2= 4.00000000	
A4 m^2= 0.00000000	A5 m^2= 0.15904310	A6 m^2= 0.00000000	
A7 m^2= 0.00000000	A8 m^2= 0.00000000	Ao m^2= 0.15904310	
pe3 Pa= -1561.000	pe5 Pa= -1235.000	pe7 Pa= +0.000	
pe4 Pa= 0.00	pe6 Pa= 0.00	pe8 Pa= 0.00	
Pr W= 16321.70	etam=0.89 Px= 26196.0	N rpm= 2980.	

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	102390.000	102390.000	102390.000	102390.000
Ta	K	287.150000	287.150000	287.150000	287.150000
td	C	14.000	14.000	14.000	14.000
tw	C	10.000	10.000	10.000	10.000
psatw	Pa	1227.0	1227.0	1227.0	1227.0
Rw	J/kg/K	288.013925	288.013925	288.013925	288.013925
pu	Pa	102390.000	102390.000	102390.000	102390.000
dp	Pa	1235.0000	1235.0000	1235.0000	1235.0000
Tsgu	K	287.150000	287.150000	287.150000	287.150000
Tu	K	287.150000	287.150000	287.150000	287.150000
rou	kg/m^3	1.23804160	1.23804160	1.23804160	1.23804160
Redo	--	1386192.42	1386192.42	1386192.42	1386192.42
alfa	--	0.99660254	0.99660254	0.99660254	0.99660254
epsi	--	0.99336605	0.99336605	0.99336605	0.99336605
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	8.706873	8.706873	8.706873	8.706873
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	102779.852	102779.746	102782.950	102779.879
p2	Pa	102390.000	102390.000	102390.000	102390.000
Tsg2	K	292.224083	292.224083	290.134635	292.224083
T2	K	291.906934	292.224083	290.134635	291.906934
ro2	kg/m^3	1.21786639	1.21654465	1.20662522	1.21786639
v2	m/s	25.285415	25.312887	25.520979	25.285415
Ma2	--	0.07370460	0.07374166	0.00000000	0.07370460
p3	Pa	100829.000	100829.000	100829.000	100829.000
Tsg3	K	290.134635	290.134635	290.134635	290.134635
T3	K	290.133044	290.134635	290.134635	290.133044
ro3	kg/m^3	1.20663184	1.20662522	1.20662522	1.20663184
Red3	--	0.00	0.00	0.00	0.00
Z 3-1/3	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma3	--	0.00523623	0.00527423	0.00000000	0.00523623
Fm3	--	1.00000691	1.00000000	1.00000000	1.00000000
psg1	Pa	100830.963	100830.963	100830.963	100830.922
p1	Pa	100732.664	100732.630	100732.726	100732.622
Tsg1	K	290.134635	290.134635	290.134635	290.134635
T1	K	290.053759	290.134635	290.134635	290.053784
ro1	kg/m^3	1.20580848	1.20547196	1.20662522	1.20580788
v1	m/s	12.769128	12.772693	12.760485	12.769135
Ma1	--	0.03733845	0.03734323	0.00000000	0.03733803
qm	kg/s	8.706873	8.706873	8.706873	8.706873
qvsg1	m^3/s	7.215748	7.215748	7.215888	7.215751
pf	Pa	1948.8885	1948.7824	1951.9864	1948.9570
psf	Pa	1559.0366	1559.0366	1559.0366	1559.0781
y	J/kg/K	1605.7734	1607.3870	1617.7239	1605.8079
ys	J/kg/K	1286.0973	1287.0159	1292.0637	1286.1317
etar	--	0.85660596	0.85746672	0.86298096	0.85662432
etasr	--	0.68607352	0.68656352	0.68925629	0.68609188
yp	J/kg/K	1604.8333	1604.7468	1617.7239	1604.8924
ysp	J/kg/K	1286.2593	1286.2593	1292.0637	1286.2835
ik1	--	0.05077012	0.05074748	0.05032688	0.05076909
ik2	--	0.19907921	0.19931176	0.20130765	0.19907495

```
                    installation category :B
        measurement of flow rate        afnor x10-200
          position of flow measurement fan outlet
             pressure measurement  outlet duct
                auxiliary fan              without
```

A1 m^2= 1.57079600   A2 m^2= 0.78539820   A3 m^2= 0.00000000
A4 m^2= 0.78539820   A5 m^2= 0.00000000   A6 m^2= 7.06858300
A7 m^2= 0.00000000   A8 m^2= 0.00000000   Ao m^2= 0.59320000
pe3 Pa=   +0.000   pe5 Pa=   +0.000   pe7 Pa=   +0.000
pe4 Pa=   1552.10   pe6 Pa=   1866.70   pe8 Pa=   0.00
Pr W=   46085.00   etam=0.89   Px=   0.0   N rpm=   1780.

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	101300.000	101300.000	101300.000	101300.000
Ta	K	285.150000	285.150000	285.150000	285.150000
td	C	12.000	12.000	12.000	12.000
tw	C	8.000	8.000	8.000	8.000
psatw	Pa	1072.0	1072.0	1072.0	1072.0
Rw	J/kg/K	287.861586	287.861586	287.861586	287.861586
pu	Pa	103166.700	103166.700	101300.000	103166.700
dp	Pa	1866.7000	1866.7000	1866.7000	1866.7000
Tsgu	K	287.241890	287.241904	285.150000	287.241890
Tu	K	287.238039	287.241904	285.150000	287.238039
rou	kg/m^3	1.24771062	1.24769383	1.23410569	1.24771062
Redo	--	2024854.43	2024819.71	2025203.20	2024854.43
alfa	--	0.00000000	0.00000000	0.00000000	0.00000000
epsi	--	0.00000000	0.00000000	0.00000000	0.00000000
alfeps	--	0.60683214	0.60683214	0.60683214	0.60683214
qm	kg/s	24.568516	24.568351	24.434202	24.568516
p4	Pa	102852.100	102852.100	102852.100	102852.100
Tsg4	K	287.241890	287.241904	285.150000	287.241890
T4	K	286.928713	287.241904	285.150000	286.928713
ro4	kg/m^3	1.24524681	1.24388907	1.23410569	1.24524681
Red4	--	1761214.89	1759713.66	1760046.93	1761214.89
Z 2-4/4	--	+0.20098320	+0.20100480	+0.20100003	+0.20098320
Ma4	--	0.07387423	0.07391365	0.00000000	0.07387423
Fm4	--	1.00136507	1.00000000	1.00000000	1.00000000
psg2	Pa	103324.622	103324.495	103323.053	103324.861
p2	Pa	102931.467	102931.462	102930.919	102931.704
Tsg2	K	287.241890	287.241904	285.150000	287.241890
T2	K	286.929175	287.241904	285.150000	286.929196
ro2	kg/m^3	1.24620571	1.24484888	1.23410569	1.24620850
v2	m/s	25.101478	25.128669	25.209016	25.101422
Ma2	--	0.07381962	0.07385667	0.00000000	0.07381678
p3	Pa	0.000	0.000	0.000	0.000
Tsg3	K	0.000000	0.000000	0.000000	0.000000
T3	K	0.000000	0.000000	0.000000	0.000000
ro3	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red3	--	0.00	0.00	0.00	0.00
Z 3-1/3	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma3	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm3	--	0.00000000	0.00000000	0.00000000	0.00000000
psg1	Pa	101300.000	101300.000	101300.000	101300.000
p1	Pa	101200.773	101200.793	101201.967	101200.773
Tsg1	K	285.150000	285.150000	285.150000	285.150000
T1	K	285.070173	285.150000	285.150000	285.070175
ro1	kg/m^3	1.23324208	1.23289708	1.23410569	1.23324208
v1	m/s	12.682673	12.686137	12.604511	12.682673
Ma1	--	0.03741828	0.03742285	0.00000000	0.03741787
qm	kg/s	24.568516	24.568351	24.434202	24.568516
qvsg1	m^3/s	19.907951	19.907818	19.799116	19.907951
pf	Pa	2024.6220	2024.4950	2023.0525	2024.8607
psf	Pa	1631.4665	1631.4623	1630.9189	1631.7043
y	J/kg/K	1630.6484	1632.2267	1639.2863	1630.8372
ys	J/kg/K	1315.6063	1316.5018	1321.5391	1315.7965
etar	--	0.86932000	0.87015558	0.86914728	0.86942065
etasr	--	0.70136693	0.70183960	0.70067815	0.70146834
yp	J/kg/K	1629.7115	1629.5790	1639.2863	1629.9123
ysp	J/kg/K	1315.7601	1315.7355	1321.5391	1315.9540
ik1	--	0.04932093	0.04930016	0.04845819	0.04931522
ik2	--	0.19320051	0.19343206	0.19383268	0.19317727
```

measurement of flow rate        amca nozzle in duct
position of flow measurement fan outlet
pressure measurement  outlet duct
auxiliary fan              downstream outlet

| | | | | |
|---|---|---|---|---|
| A1 m^2= 0.56548670 | | A2 m^2= 0.28274340 | | A3 m^2= 0.00000000 |
| A4 m^2= 0.29417000 | | A5 m^2= 0.00000000 | | A6 m^2= 0.29417000 |
| A7 m^2= 0.00000000 | | A8 m^2= 0.08107955 | | Ao m^2= 0.08107955 |
| pe3 Pa=    +0.000 | | pe5 Pa=    +0.000 | | pe7 Pa=    +0.000 |
| pe4 Pa=   1486.00 | | pe6 Pa=   1486.00 | | pe8 Pa=      0.00 |
| Pr W=  18039.00 | etam=0.88 | Px= | 0.0 | N rpm=  2980. |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 102300.000 | 102300.000 | 102300.000 | 102300.000 |
| Ta | K | 297.150000 | 297.150000 | 297.150000 | 297.150000 |
| td | C | 24.000 | 24.000 | 24.000 | 24.000 |
| tw | C | 17.000 | 17.000 | 17.000 | 17.000 |
| psatw | Pa | 1937.0 | 1937.0 | 1937.0 | 1937.0 |
| Rw | J/kg/K | 288.551467 | 288.551467 | 288.551467 | 288.551467 |
| pu | Pa | 103786.000 | 103786.000 | 102300.000 | 103786.000 |
| dp | Pa | 5189.0000 | 5189.0000 | 5189.0000 | 5189.0000 |
| Tsgu | K | 299.380647 | 299.381880 | 297.150000 | 299.380647 |
| Tu | K | 299.053183 | 299.381880 | 297.150000 | 299.053183 |
| rou | kg/m^3 | 1.20272699 | 1.20140650 | 1.19309936 | 1.20272699 |
| Redo | -- | 1965749.95 | 1962975.34 | 1966776.84 | 1965749.95 |
| alfa | -- | 1.03554307 | 1.03553949 | 1.03554439 | 1.03554307 |
| epsi | -- | 0.97003579 | 0.97003579 | 0.96959639 | 0.97003579 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 9.099292 | 9.094264 | 9.058706 | 9.099292 |
| p4 | Pa | 103786.000 | 103786.000 | 103786.000 | 103786.000 |
| Tsg4 | K | 299.380647 | 299.381880 | 297.150000 | 299.380647 |
| T4 | K | 299.053167 | 299.381880 | 297.150000 | 299.053167 |
| ro4 | kg/m^3 | 1.20272706 | 1.20140650 | 1.19309936 | 1.20272706 |
| Red4 | -- | 1032011.95 | 1030555.25 | 1032551.03 | 1032011.95 |
| Z 2-4/4 | -- | +0.34977600 | +0.34985988 | +0.34974487 | +0.34977600 |
| Ma4 | -- | 0.07399516 | 0.07399303 | 0.00000000 | 0.07399516 |
| Fm4 | -- | 1.00136960 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 104323.623 | 104322.917 | 104322.390 | 104324.072 |
| p2 | Pa | 103892.909 | 103892.802 | 103892.219 | 103893.357 |
| Tsg2 | K | 299.380647 | 299.381880 | 297.150000 | 299.380647 |
| T2 | K | 299.026944 | 299.381880 | 297.150000 | 299.026958 |
| ro2 | kg/m^3 | 1.20407156 | 1.20264282 | 1.19309936 | 1.20407669 |
| v2 | m/s | 26.727777 | 26.744743 | 26.853264 | 26.727663 |
| Ma2 | -- | 0.07690398 | 0.07690419 | 0.00000000 | 0.07690068 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 102300.000 | 102300.000 | 102300.000 | 102300.000 |
| p1 | Pa | 102191.408 | 102191.496 | 102192.457 | 102191.408 |
| Tsg1 | K | 297.150000 | 297.150000 | 297.150000 | 297.150000 |
| T1 | K | 297.059808 | 297.150000 | 297.150000 | 297.059811 |
| ro1 | kg/m^3 | 1.19219474 | 1.19183391 | 1.19309936 | 1.19219473 |
| v1 | m/s | 13.497024 | 13.493650 | 13.426634 | 13.497024 |
| Ma1 | -- | 0.03896242 | 0.03894627 | 0.00000000 | 0.03896192 |
| qm | kg/s | 9.099292 | 9.094264 | 9.058706 | 9.099292 |
| qvsg1 | m^3/s | 7.626601 | 7.622386 | 7.592583 | 7.626601 |
| pf | Pa | 2023.6226 | 2022.9169 | 2022.3900 | 2024.0719 |
| psf | Pa | 1592.9095 | 1592.8022 | 1592.2193 | 1593.3570 |
| y | J/kg/K | 1686.2293 | 1687.6268 | 1695.0725 | 1686.5966 |
| ys | J/kg/K | 1329.0422 | 1329.9861 | 1334.5237 | 1329.4127 |
| etar | -- | 0.85057336 | 0.85080791 | 0.85122037 | 0.85075868 |
| etasr | -- | 0.67039989 | 0.67050531 | 0.67016230 | 0.67058675 |
| yp | J/kg/K | 1685.0932 | 1684.5150 | 1695.0725 | 1685.4662 |
| ysp | J/kg/K | 1329.1997 | 1329.1118 | 1334.5237 | 1329.5551 |
| ik1 | -- | 0.05401687 | 0.05394516 | 0.05317605 | 0.05400511 |
| ik2 | -- | 0.21182591 | 0.21191928 | 0.21270411 | 0.21177796 |

measurement of flow rate      amca nozzle in chamber
position of flow measurement  fan outlet
pressure measurement   outlet chamber
auxiliary fan          downstream outlet

| | | | |
|---|---|---|---|
| A1 m^2= 0.50893800 | A2 m^2= 0.28274330 | | A3 m^2= 0.00000000 |
| A4 m^2= 4.90873800 | A5 m^2= 0.00000000 | | A6 m^2= 4.90873800 |
| A7 m^2= 0.00000000 | A8 m^2= 4.90873800 | | Ao m^2= 0.12450687 |
| pe3 Pa=      +0.000 | pe5 Pa=      +0.000 | | pe7 Pa=      +0.000 |
| pe4 Pa=     1573.00 | pe6 Pa=      401.50 | | pe8 Pa=        0.00 |
| Pr W=    15540.00 | etam=0.88      Px=        0.0 | | N  rpm=    2980. |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 100520.000 | 100520.000 | 100520.000 | 100520.000 |
| Ta | K | 291.150000 | 291.150000 | 291.150000 | 291.150000 |
| td | C | 18.000 | 18.000 | 18.000 | 18.000 |
| tw | C | 16.000 | 16.000 | 16.000 | 16.000 |
| psatw | Pa | 1817.0 | 1817.0 | 1817.0 | 1817.0 |
| Rw | J/kg/K | 288.826710 | 288.826710 | 288.826710 | 288.826710 |
| pu | Pa | 100921.500 | 100921.500 | 100520.000 | 100921.500 |
| dp | Pa | 1947.0000 | 1947.0000 | 1947.0000 | 1947.0000 |
| Tsgu | K | 293.245538 | 293.245542 | 291.150000 | 293.245538 |
| Tu | K | 293.244533 | 293.245542 | 291.150000 | 293.244533 |
| rou | kg/m^3 | 1.19156138 | 1.19155728 | 1.19535893 | 1.19156138 |
| Redo | -- | 1475702.70 | 1475696.24 | 1486286.97 | 1475702.70 |
| alfa | -- | 0.99324353 | 0.99324352 | 0.99326346 | 0.99324353 |
| epsi | -- | 0.98960555 | 0.98960555 | 0.98956072 | 0.98960555 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 8.336185 | 8.336171 | 8.349248 | 8.336185 |
| p4 | Pa | 102093.000 | 102093.000 | 102093.000 | 102093.000 |
| Tsg4 | K | 293.245538 | 293.245542 | 291.150000 | 293.245538 |
| T4 | K | 292.950234 | 293.245542 | 291.150000 | 292.950234 |
| ro4 | kg/m^3 | 1.20660400 | 1.20538892 | 1.19535893 | 1.20660400 |
| Red4 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 2-4/4 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma4 | -- | 0.07099415 | 0.07103113 | 0.00000000 | 0.07099415 |
| Fm4 | -- | 1.00126064 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 102453.664 | 102453.571 | 102457.739 | 102453.659 |
| p2 | Pa | 102093.005 | 102093.001 | 102093.000 | 102093.000 |
| Tsg2 | K | 293.245538 | 293.245542 | 291.150000 | 293.245538 |
| T2 | K | 292.950203 | 293.245542 | 291.150000 | 292.950234 |
| ro2 | kg/m^3 | 1.20660419 | 1.20538892 | 1.19535893 | 1.20660400 |
| v2 | m/s | 24.434879 | 24.459473 | 24.703398 | 24.434883 |
| Ma2 | -- | 0.07099791 | 0.07103113 | 0.00000000 | 0.07099547 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 100520.000 | 100520.000 | 100520.000 | 100520.000 |
| p1 | Pa | 100407.642 | 100407.656 | 100407.426 | 100407.642 |
| Tsg1 | K | 291.150000 | 291.150000 | 291.150000 | 291.150000 |
| T1 | K | 291.056980 | 291.150000 | 291.150000 | 291.056982 |
| ro1 | kg/m^3 | 1.19440441 | 1.19402297 | 1.19535893 | 1.19440440 |
| v1 | m/s | 13.713587 | 13.717945 | 13.724108 | 13.713587 |
| Ma1 | -- | 0.03997467 | 0.03998048 | 0.00000000 | 0.03997416 |
| | | | | | |
| qm | kg/s | 8.336185 | 8.336171 | 8.349248 | 8.336185 |
| qvsg1 | m^3/s | 6.973793 | 6.973781 | 6.984720 | 6.973793 |
| pf | Pa | 1933.6637 | 1933.5715 | 1937.7386 | 1933.6586 |
| psf | Pa | 1573.0050 | 1573.0006 | 1573.0000 | 1573.0000 |
| y | J/kg/K | 1608.3796 | 1609.8397 | 1621.0517 | 1608.3756 |
| ys | J/kg/K | 1309.8479 | 1310.7068 | 1315.9227 | 1309.8438 |
| etar | -- | 0.86278957 | 0.86357140 | 0.87094995 | 0.86278742 |
| etasr | -- | 0.70264702 | 0.70310659 | 0.70701191 | 0.70264483 |
| yp | J/kg/K | 1607.3644 | 1607.2764 | 1621.0517 | 1607.3644 |
| ysp | J/kg/K | 1309.8884 | 1309.8596 | 1315.9227 | 1309.8744 |
| ik1 | -- | 0.05846334 | 0.05844744 | 0.05809536 | 0.05846349 |
| ik2 | -- | 0.18561021 | 0.18581533 | 0.18822900 | 0.18561071 |

measurement of flow rate    iso 5167-1 pressure taps D-D/2
position of flow measurement fan outlet
pressure measurement  outlet duct
auxiliary fan          without

A1 m^2= 0.55000000      A2 m^2= 0.25000000      A3 m^2= 0.00000000
A4 m^2= 0.25510200      A5 m^2= 0.00000000      A6 m^2= 0.38484510
A7 m^2= 0.00000000      A8 m^2= 0.38484510      Ao m^2= 0.16763853
pe3 Pa=      +0.000     pe5 Pa=      +0.000     pe7 Pa=      +0.000
pe4 Pa=   17268.10      pe6 Pa=   17387.70      pe8 Pa=        0.00
Pr W=   335058.40       etam=1.00    Px=        0.0      N  rpm=    2990.

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 101300.000 | 101300.000 | 101300.000 | 101300.000 |
| Ta | K | 285.150000 | 285.150000 | 285.150000 | 285.150000 |
| td | C | 12.000 | 12.000 | 12.000 | 12.000 |
| tw | C | 8.000 | 8.000 | 8.000 | 8.000 |
| psatw | Pa | 1072.0 | 1072.0 | 1072.0 | 1072.0 |
| Rw | J/kg/K | 287.861586 | 287.861586 | 287.861586 | 287.861586 |
| pu | Pa | 118687.700 | 118687.700 | 101300.000 | 118687.700 |
| dp | Pa | 10829.0000 | 10829.0000 | 10829.0000 | 10829.0000 |
| Tsgu | K | 302.795125 | 302.814298 | 285.150000 | 302.795125 |
| Tu | K | 302.155901 | 302.814298 | 285.150000 | 302.155901 |
| rou | kg/m^3 | 1.36455460 | 1.36158771 | 1.23410569 | 1.36455460 |
| Redu | -- | 1853811.16 | 1848639.68 | 1844397.63 | 1853811.16 |
| alfa | -- | 0.67493723 | 0.67493874 | 0.67493998 | 0.67493723 |
| epsi | -- | 0.96895176 | 0.96895176 | 0.96895176 | 0.96895176 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 18.847077 | 18.826620 | 17.923653 | 18.847077 |
| p4 | Pa | 118568.100 | 118568.100 | 118568.100 | 118568.100 |
| Tsg4 | K | 302.795125 | 302.814298 | 285.150000 | 302.795125 |
| T4 | K | 301.345194 | 302.814298 | 285.150000 | 301.345194 |
| ro4 | kg/m^3 | 1.36684691 | 1.36021566 | 1.23410569 | 1.36684691 |
| Red4 | -- | 2281741.50 | 2270588.09 | 2265377.81 | 2281741.50 |
| Z 2-4/4 | -- | +0.19454920 | +0.19466864 | +0.19472460 | +0.19454920 |
| Ma4 | -- | 0.15510522 | 0.15531259 | 0.00000000 | 0.15510522 |
| Fm4 | -- | 1.00602889 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 120967.623 | 120959.910 | 120957.620 | 120972.503 |
| p2 | Pa | 118881.299 | 118880.771 | 118875.093 | 118886.500 |
| Tsg2 | K | 302.795125 | 302.814298 | 285.150000 | 302.795125 |
| T2 | K | 301.293755 | 302.814298 | 285.150000 | 301.293997 |
| ro2 | kg/m^3 | 1.37069144 | 1.36380263 | 1.23410569 | 1.37075029 |
| v2 | m/s | 55.000204 | 55.218019 | 58.094385 | 54.997842 |
| Ma2 | -- | 0.15784606 | 0.15806538 | 0.00000000 | 0.15783182 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 101300.000 | 101300.000 | 101300.000 | 101300.000 |
| p1 | Pa | 100821.780 | 100823.035 | 100869.726 | 100821.840 |
| Tsg1 | K | 285.150000 | 285.150000 | 285.150000 | 285.150000 |
| T1 | K | 284.764745 | 285.150000 | 285.150000 | 284.764778 |
| ro1 | kg/m^3 | 1.22994142 | 1.22829498 | 1.23410569 | 1.22994201 |
| v1 | m/s | 27.861012 | 27.868076 | 26.406539 | 27.860999 |
| Ma1 | -- | 0.08224627 | 0.08220807 | 0.00000000 | 0.08224276 |
| qm | kg/s | 18.847077 | 18.826620 | 17.923653 | 18.847077 |
| qvsg1 | m^3/s | 15.271850 | 15.255273 | 14.523596 | 15.271850 |
| pf | Pa | 19667.6227 | 19659.9099 | 19657.6204 | 19672.5033 |
| psf | Pa | 17581.2994 | 17580.7714 | 17575.0933 | 17586.4998 |
| y | J/kg/K | 15012.9503 | 15069.1137 | 15928.6360 | 15016.4566 |
| ys | J/kg/K | 13500.4392 | 13544.5989 | 14241.1573 | 13504.0754 |
| etar | -- | 0.84448034 | 0.84671948 | 0.85208830 | 0.84467757 |
| etasr | -- | 0.75940140 | 0.76105841 | 0.76181812 | 0.75960593 |
| yp | J/kg/K | 15010.7956 | 15005.8778 | 15928.6360 | 15014.2030 |
| ysp | J/kg/K | 13539.0028 | 13539.0685 | 14241.1573 | 13542.7039 |
| ik1 | -- | 0.02585221 | 0.02576892 | 0.02188842 | 0.02584615 |
| ik2 | -- | 0.10074709 | 0.10116818 | 0.10593995 | 0.10071492 |

measurement of flow rate    iso 5167-1 pressure taps D-D/2
position of flow measurement fan outlet
pressure measurement  outlet duct
auxiliary fan            without

| | | | |
|---|---|---|---|
| A1 m^2= 0.50260000 | A2 m^2= 0.18000000 | A3 m^2= 0.00000000 |
| A4 m^2= 0.18947368 | A5 m^2= 0.00000000 | A6 m^2= 0.38484510 |
| A7 m^2= 0.00000000 | A8 m^2= 0.38484510 | Ao m^2= 0.16763853 |
| pe3 Pa=     +0.000 | pe5 Pa=     +0.000 | pe7 Pa=     +0.000 |
| pe4 Pa=   27497.10 | pe6 Pa=   30293.00 | pe8 Pa=       0.00 |
| Pr W=  698000.00   | etam=1.00    Px=        0.0   | N rpm=   3940. |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| Ta | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| td | C | 20.000 | 20.000 | 20.000 | 20.000 |
| tw | C | 12.500 | 12.500 | 12.500 | 12.500 |
| psatw | Pa | 1448.0 | 1448.0 | 1448.0 | 1448.0 |
| Rw | J/kg/K | 288.009146 | 288.009146 | 288.009146 | 288.009146 |
| pu | Pa | 131618.000 | 131618.000 | 101325.000 | 131618.000 |
| dp | Pa | 13066.0000 | 13066.0000 | 13066.0000 | 13066.0000 |
| Tsgu | K | 326.217456 | 326.257213 | 293.150000 | 326.217456 |
| Tu | K | 325.472561 | 326.257213 | 293.150000 | 325.472561 |
| rou | kg/m^3 | 1.40408896 | 1.40071212 | 1.20010829 | 1.40408896 |
| Redu | -- | 1942146.03 | 1936095.58 | 1949782.39 | 1942146.03 |
| alfa | -- | 0.67491261 | 0.67491423 | 0.67491057 | 0.67491261 |
| epsi | -- | 0.96621829 | 0.96621829 | 0.96621829 | 0.96621829 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 20.940174 | 20.915028 | 19.359399 | 20.940174 |
| p4 | Pa | 128822.100 | 128822.100 | 128822.100 | 128822.100 |
| Tsg4 | K | 326.217456 | 326.257213 | 293.150000 | 326.217456 |
| T4 | K | 323.057019 | 326.257213 | 293.150000 | 323.057019 |
| ro4 | kg/m^3 | 1.38453811 | 1.37095744 | 1.20010829 | 1.38453811 |
| Red4 | -- | 2784361.82 | 2759277.30 | 2778783.41 | 2784361.82 |
| Z 2-4/4 | -- | +0.18977484 | +0.18998875 | +0.18982221 | +0.18977484 |
| Ma4 | -- | 0.22116636 | 0.22199254 | 0.00000000 | 0.22116636 |
| Fm4 | -- | 1.01228857 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 134134.577 | 134110.302 | 133997.186 | 134156.537 |
| p2 | Pa | 129201.035 | 129200.729 | 129177.838 | 129223.167 |
| Tsg2 | K | 326.217456 | 326.257213 | 293.150000 | 326.217456 |
| T2 | K | 322.743302 | 326.257213 | 293.150000 | 322.744029 |
| ro2 | kg/m^3 | 1.38996055 | 1.37498691 | 1.20010829 | 1.39019552 |
| v2 | m/s | 83.696117 | 84.505969 | 89.618759 | 83.681971 |
| Ma2 | -- | 0.23199624 | 0.23299156 | 0.00000000 | 0.23197203 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| p1 | Pa | 100596.115 | 100598.309 | 100706.858 | 100596.222 |
| Tsg1 | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| T1 | K | 292.545918 | 293.150000 | 293.150000 | 292.545983 |
| ro1 | kg/m^3 | 1.19393556 | 1.19150125 | 1.20010829 | 1.19393656 |
| v1 · | m/s | 34.896102 | 34.925406 | 32.095855 | 34.896073 |
| Ma1 | -- | 0.10160991 | 0.10158495 | 0.00000000 | 0.10160436 |
| qm | kg/s | 20.940174 | 20.915028 | 19.359399 | 20.940174 |
| qvsg1 | m^3/s | 17.448571 | 17.427617 | 16.131377 | 17.448571 |
| pf | Pa | 32809.5767 | 32785.3021 | 32672.1863 | 32831.5367 |
| psf | Pa | 27876.0351 | 27875.7292 | 27852.8385 | 27898.1668 |
| y | J/kg/K | 25034.5722 | 25249.8878 | 27224.3652 | 25048.4136 |
| ys | J/kg/K | 21532.0524 | 21679.2587 | 23208.6044 | 21547.0777 |
| etar | -- | 0.75104341 | 0.75659329 | 0.75508215 | 0.75145866 |
| etasr | -- | 0.64596694 | 0.64960216 | 0.64370290 | 0.64641771 |
| yp | J/kg/K | 24995.4254 | 24980.8252 | 27224.3652 | 25010.0125 |
| ysp | J/kg/K | 21656.2386 | 21657.3450 | 23208.6044 | 21671.4977 |
| ik1 | -- | 0.02432113 | 0.02415425 | 0.01891952 | 0.02430764 |
| ik2 | -- | 0.13990732 | 0.14141168 | 0.14750614 | 0.13978274 |

     measurement of flow rate      iso 5167-1 pressure taps D-D/2
          position of flow measurement fan outlet
             pressure measurement  outlet duct
             auxiliary fan          without

| | | | | |
|---|---|---|---|---|
| A1 m^2= 0.36000000 | A2 m^2= 0.18000000 | | A3 m^2= 0.00000000 | |
| A4 m^2= 0.18000000 | A5 m^2= 0.00000000 | | A6 m^2= 0.38484510 | |
| A7 m^2= 0.00000000 | A8 m^2= 0.38484510 | | Ao m^2= 0.16763853 | |
| pe3 Pa=    +0.000 | pe5 Pa=    +0.000 | | pe7 Pa=    +0.000 | |
| pe4 Pa=  22946.50 | pe6 Pa=  28355.00 | | pe8 Pa=      0.00 | |
| Pr W=  881608.00 | etam=1.00    Px=      0.0 | | N  rpm=   4000. | |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| Ta | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| td | C | 20.000 | 20.000 | 20.000 | 20.000 |
| tw | C | 17.000 | 17.000 | 17.000 | 17.000 |
| psatw | Pa | 1937.0 | 1937.0 | 1937.0 | 1937.0 |
| Rw | J/kg/K | 288.866959 | 288.866959 | 288.866959 | 288.866959 |
| pu | Pa | 129680.000 | 129680.000 | 101325.000 | 129680.000 |
| dp | Pa | 22370.0000 | 22370.0000 | 22370.0000 | 22370.0000 |
| Tsgu | K | 326.084000 | 326.149267 | 293.150000 | 326.084000 |
| Tu | K | 324.858256 | 326.149267 | 293.150000 | 324.858256 |
| rou | kg/m^3 | 1.38191466 | 1.37644456 | 1.19654447 | 1.38191466 |
| Redu | -- | 2459349.06 | 2446741.97 | 2481308.06 | 2459349.06 |
| alfa | -- | 0.67480014 | 0.67480239 | 0.67479629 | 0.67480014 |
| epsi | -- | 0.94129876 | 0.94129876 | 0.94129876 | 0.94129876 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 26.476777 | 26.424410 | 24.636920 | 26.476777 |
| p4 | Pa | 124271.500 | 124271.500 | 124271.500 | 124271.500 |
| Tsg4 | K | 326.084000 | 326.149267 | 293.150000 | 326.084000 |
| T4 | K | 320.157883 | 326.149267 | 293.150000 | 320.157883 |
| ro4 | kg/m^3 | 1.34372214 | 1.31903787 | 1.19654447 | 1.34372214 |
| Red4 | -- | 3637975.58 | 3577625.84 | 3628168.37 | 3637975.58 |
| Z 2-4/4 | -- | +0.18358710 | +0.18396683 | +0.18364830 | +0.18358710 |
| Ma4 | -- | 0.30422020 | 0.30644630 | 0.00000000 | 0.30422020 |
| Fm4 | -- | 1.02335203 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 134022.991 | 133943.535 | 133537.487 | 134095.541 |
| p2 | Pa | 125893.386 | 125878.654 | 125709.159 | 125968.631 |
| Tsg2 | K | 326.084000 | 326.149267 | 293.150000 | 326.084000 |
| T2 | K | 320.305766 | 326.149267 | 293.150000 | 320.310971 |
| ro2 | kg/m^3 | 1.36063077 | 1.33609647 | 1.19654447 | 1.36142188 |
| v2 | m/s | 108.106627 | 109.874010 | 114.389210 | 108.043807 |
| Ma2 | -- | 0.30033103 | 0.30253375 | 0.00000000 | 0.30019332 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| p1 | Pa | 99007.844 | 99021.250 | 99367.918 | 99007.948 |
| Tsg1 | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| T1 | K | 291.218735 | 293.150000 | 293.150000 | 291.218815 |
| ro1 | kg/m^3 | 1.17693485 | 1.16933954 | 1.19654447 | 1.17693576 |
| v1 · | m/s | 62.489952 | 62.771450 | 57.194605 | 62.489903 |
| Ma1 | -- | 0.18209428 | 0.18230738 | 0.00000000 | 0.18209046 |
| qm | kg/s | 26.476777 | 26.424410 | 24.636920 | 26.476777 |
| qvsg1 | m^3/s | 22.127700 | 22.083935 | 20.590058 | 22.127700 |
| pf | Pa | 32697.9909 | 32618.5354 | 32212.4870 | 32770.5414 |
| psf | Pa | 24568.3860 | 24553.6544 | 24384.1591 | 24643.6308 |
| y | J/kg/K | 25081.0516 | 25505.3273 | 26921.2618 | 25126.8584 |
| ys | J/kg/K | 19237.5301 | 19469.1784 | 20378.8156 | 19290.1260 |
| etar | -- | 0.75324339 | 0.76447040 | 0.75232639 | 0.75461908 |
| etasr | -- | 0.57774860 | 0.58354909 | 0.56949488 | 0.57932818 |
| yp | J/kg/K | 24990.3034 | 24939.8491 | 26921.2618 | 25038.6652 |
| ysp | J/kg/K | 19398.9140 | 19390.4227 | 20378.8156 | 19452.3022 |
| ik1 | -- | 0.07784750 | 0.07724376 | 0.06075537 | 0.07770545 |
| ik2 | -- | 0.23298551 | 0.23666228 | 0.24302150 | 0.23229058 |

measurement of flow rate      iso 5167-1 pressure taps D-D/2
position of flow measurement fan outlet
pressure measurement  outlet duct
auxiliary fan            without

| | | | | |
|---|---|---|---|---|
| A1 m^2= 0.36000000 | A2 m^2= 0.18000000 | | A3 m^2= 0.00000000 | |
| A4 m^2= 0.18000000 | A5 m^2= 0.00000000 | | A6 m^2= 0.38484510 | |
| A7 m^2= 0.00000000 | A8 m^2= 0.38484510 | | Ao m^2= 0.18857410 | |
| pe3 Pa=      +0.000 | pe5 Pa=      +0.000 | | pe7 Pa=      +0.000 | |
| pe4 Pa=   19556.80 | pe6 Pa=   26915.00 | | pe8 Pa=       0.00 | |
| Pr W= 1009100.00 | etam=1.00    Px=      0.0 | | N  rpm=    4100. | |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| Ta | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| td | C | 20.000 | 20.000 | 20.000 | 20.000 |
| tw | C | 17.000 | 17.000 | 17.000 | 17.000 |
| psatw | Pa | 1937.0 | 1937.0 | 1937.0 | 1937.0 |
| Rw | J/kg/K | 288.866959 | 288.866959 | 288.866959 | 288.866959 |
| pu | Pa | 128240.000 | 128240.000 | 101325.000 | 128240.000 |
| dp | Pa | 22000.0000 | 22000.0000 | 22000.0000 | 22000.0000 |
| Tsgu | K | 326.099226 | 326.186488 | 293.150000 | 326.099226 |
| Tu | K | 324.462575 | 326.186488 | 293.150000 | 324.462575 |
| rou | kg/m^3 | 1.36823605 | 1.36100485 | 1.19654447 | 1.36823605 |
| Redu | -- | 2816433.78 | 2797163.04 | 2852971.94 | 2816433.78 |
| alfa | -- | 0.69687519 | 0.69687842 | 0.69686915 | 0.69687519 |
| epsi | -- | 0.93946189 | 0.93946189 | 0.93946189 | 0.93946189 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 30.291659 | 30.211647 | 28.327172 | 30.291659 |
| p4 | Pa | 120881.800 | 120881.800 | 120881.800 | 120881.800 |
| Tsg4 | K | 326.099226 | 326.186488 | 293.150000 | 326.099226 |
| T4 | K | 318.010820 | 326.186488 | 293.150000 | 318.010820 |
| ro4 | kg/m^3 | 1.31589474 | 1.28291263 | 1.19654447 | 1.31589474 |
| Red4 | -- | 4184429.08 | 4090011.48 | 4171615.24 | 4184429.08 |
| Z 2-4/4 | -- | +0.18044806 | +0.18095544 | +0.18051615 | +0.18044806 |
| Ma4 | -- | 0.35661167 | 0.36021259 | 0.00000000 | 0.35661167 |
| Fm4 | -- | 1.03219867 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg2 | Pa | 133993.535 | 133847.925 | 133099.081 | 134125.659 |
| p2 | Pa | 123088.774 | 123063.185 | 122749.980 | 123232.857 |
| Tsg2 | K | 326.099226 | 326.186488 | 293.150000 | 326.099226 |
| T2 | K | 318.285455 | 326.186488 | 293.150000 | 318.302230 |
| ro2 | kg/m^3 | 1.33876325 | 1.30606357 | 1.19654447 | 1.34025973 |
| v2 | m/s | 125.703325 | 128.510194 | 131.523050 | 125.562970 |
| Ma2 | -- | 0.35035390 | 0.35382756 | 0.00000000 | 0.34996836 |
| p3 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T3 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro3 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red3 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 3-1/3 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm3 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg1 | Pa | 101325.000 | 101325.000 | 101325.000 | 101325.000 |
| p1 | Pa | 98267.791 | 98291.195 | 98737.725 | 98267.609 |
| Tsg1 | K | 293.150000 | 293.150000 | 293.150000 | 293.150000 |
| T1 | K | 290.595101 | 293.150000 | 293.150000 | 290.594969 |
| ro1 | kg/m^3 | 1.17064451 | 1.16071834 | 1.19654447 | 1.17064288 |
| v1 | m/s | 71.877923 | 72.301124 | 65.761525 | 71.878023 |
| Ma1 | -- | 0.20966586 | 0.20998445 | 0.00000000 | 0.20967137 |
| qm | kg/s | 30.291659 | 30.211647 | 28.327172 | 30.291659 |
| qvsg1 | m^3/s | 25.315949 | 25.249080 | 23.674149 | 25.315949 |
| pf | Pa | 32668.5347 | 32522.9252 | 31774.0805 | 32800.6585 |
| psf | Pa | 21763.7742 | 21738.1852 | 21424.9798 | 21907.8574 |
| y | J/kg/K | 25099.7886 | 25728.1671 | 26554.8680 | 25185.2829 |
| ys | J/kg/K | 17199.1260 | 17470.7326 | 17905.7113 | 17302.2526 |
| etar | -- | 0.75345776 | 0.77028074 | 0.74544081 | 0.75602417 |
| etasr | -- | 0.51629180 | 0.52305976 | 0.50264410 | 0.51938750 |
| yp | J/kg/K | 24971.2454 | 24877.4636 | 26554.8680 | 25059.3139 |
| ysp | J/kg/K | 17386.2078 | 17369.9933 | 17905.7113 | 17490.7430 |
| ik1 | -- | 0.10291791 | 0.10159007 | 0.08142723 | 0.10256882 |
| ik2 | -- | 0.31477008 | 0.32094920 | 0.32570891 | 0.31300146 |

measurement of flow rate      iso 5167-1 pressure taps D-D/2
position of flow measurement fan inlet
pressure measurement   inlet duct
auxiliary fan          without

| | | | |
|---|---|---|---|
| A1 m^2= 0.28274300 | A2 m^2= 0.28274300 | A3 m^2= 0.28274300 |
| A4 m^2= 0.00000000 | A5 m^2= 0.45364598 | A6 m^2= 0.00000000 |
| A7 m^2= 0.45364598 | A8 m^2= 0.00000000 | Ao m^2= 0.22228653 |
| pe3 Pa=  -2042.000 | pe5 Pa=    +0.000 | pe7 Pa=  -1227.000 |
| pe4 Pa=     0.00 | pe6 Pa=      0.00 | pe8 Pa=      0.00 |
| Pr W=   16714.50 | etam=0.88    Px=      0.0 | N  rpm=   2980. |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 100500.000 | 100500.000 | 100500.000 | 100500.000 |
| Ta | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| td | C | 5.000 | 5.000 | 5.000 | 5.000 |
| tw | C | 2.000 | 2.000 | 2.000 | 2.000 |
| psatw | Pa | 705.0 | 705.0 | 705.0 | 705.0 |
| Rw | J/kg/K | 287.546765 | 287.546765 | 287.546765 | 287.546765 |
| pu | Pa | 99273.000 | 99273.000 | 100500.000 | 99273.000 |
| dp | Pa | 1330.0000 | 1330.0000 | 1330.0000 | 1330.0000 |
| Tsgu | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| Tu | K | 278.026760 | 278.150000 | 278.150000 | 278.026760 |
| rou | kg/m^3 | 1.24175541 | 1.24120523 | 1.25654635 | 1.24175541 |
| Redu | -- | 857485.91 | 857004.26 | 862275.57 | 857485.91 |
| alfa | -- | 0.69777840 | 0.69777905 | 0.69777202 | 0.69777840 |
| epsi | -- | 0.99527230 | 0.99527230 | 0.99527230 | 0.99527230 |
| alfeps | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| qm | kg/s | 8.872202 | 8.870245 | 8.924804 | 8.872202 |
| p4 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg4 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T4 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro4 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red4 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 2-4/4 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma4 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm4 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg2 | Pa | 100894.913 | 100894.628 | 100896.465 | 100894.866 |
| p2 | Pa | 100500.000 | 100500.000 | 100500.000 | 100500.000 |
| Tsg2 | K | 280.277173 | 280.277642 | 278.150000 | 280.277173 |
| T2 | K | 279.963321 | 280.277642 | 278.150000 | 279.963321 |
| ro2 | kg/m^3 | 1.24840770 | 1.24700766 | 1.25654635 | 1.24840770 |
| v2 | m/s | 25.135246 | 25.157914 | 25.120503 | 25.135246 |
| Ma2 | -- | 0.07486802 | 0.07489661 | 0.00000000 | 0.07486802 |
| p3 | Pa | 98458.000 | 98458.000 | 98458.000 | 98458.000 |
| Tsg3 | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| T3 | K | 277.827944 | 278.150000 | 278.150000 | 277.827944 |
| ro3 | kg/m^3 | 1.23244231 | 1.23101533 | 1.25654635 | 1.23244231 |
| Red3 | -- | 1086747.83 | 1085539.43 | 1092216.42 | 1086747.83 |
| Z 3-1/3 | -- | -0.03447744 | -0.03448394 | -0.03444814 | -0.03447744 |
| Ma3 | -- | 0.07613118 | 0.07615922 | 0.00000000 | 0.07613118 |
| Fm3 | -- | 1.00144982 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg1 | Pa | 98844.255 | 98843.970 | 98840.808 | 98844.212 |
| p1 | Pa | 98444.135 | 98444.161 | 98444.343 | 98444.115 |
| Tsg1 | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| T1 | K | 277.827823 | 278.150000 | 278.150000 | 277.827854 |
| ro1 | kg/m^3 | 1.23226929 | 1.23084230 | 1.25654635 | 1.23226890 |
| v1 | m/s | 25.464429 | 25.488327 | 25.120503 | 25.464437 |
| Ma1 | -- | 0.07614551 | 0.07616993 | 0.00000000 | 0.07614264 |
| qm | kg/s | 8.872202 | 8.870245 | 8.924804 | 8.872202 |
| qvsg1 | m^3/s | 7.179059 | 7.177496 | 7.102646 | 7.179063 |
| pf | Pa | 2050.6578 | 2050.6584 | 2055.6575 | 2050.6548 |
| psf | Pa | 1655.7450 | 1656.0300 | 1659.1922 | 1655.7884 |
| y | J/kg/K | 1649.1751 | 1651.0064 | 1635.9583 | 1649.1912 |
| ys | J/kg/K | 1333.2848 | 1334.5461 | 1320.4385 | 1333.3009 |
| etar | -- | 0.87539653 | 0.87617521 | 0.87352946 | 0.87540507 |
| etasr | -- | 0.70771922 | 0.70823239 | 0.70505581 | 0.70772775 |
| yp | J/kg/K | 1647.8792 | 1647.8604 | 1635.9583 | 1647.8792 |
| ysp | J/kg/K | 1333.1524 | 1333.3651 | 1320.4385 | 1333.1923 |
| ik1 | -- | 0.19659440 | 0.19674509 | 0.19286545 | 0.19659260 |
| ik2 | -- | 0.19154442 | 0.19167721 | 0.19286545 | 0.19154255 |

measurement of flow rate          conical inlet
position of flow measurement fan inlet
pressure measurement   inlet duct
auxiliary fan          without

| | | | |
|---|---|---|---|
| A1 m^2= 0.78539800 | A2 m^2= 0.78539800 | A3 m^2= 1.13097335 |
| A4 m^2= 0.00000000 | A5 m^2= 0.50265480 | A6 m^2= 0.00000000 |
| A7 m^2= 0.00000000 | A8 m^2= 0.00000000 | Ao m^2= 0.50265480 |
| pe3 Pa= -1815.000 | pe5 Pa= -1063.000 | pe7 Pa= +0.000 |
| pe4 Pa= 0.00 | pe6 Pa= 0.00 | pe8 Pa= 0.00 |
| Pr W= 46362.60 | etam=0.89   Px= 0.0 | N rpm= 1780. |

| | | iso Ma>0.15 | iso Ma<0.15 | iso pf<2kPa | iso annex 7 |
|---|---|---|---|---|---|
| pa | Pa | 100500.000 | 100500.000 | 100500.000 | 100500.000 |
| Ta | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| td | C | 5.000 | 5.000 | 5.000 | 5.000 |
| tw | C | 2.000 | 2.000 | 2.000 | 2.000 |
| psatw | Pa | 705.0 | 705.0 | 705.0 | 705.0 |
| Rw | J/kg/K | 287.546765 | 287.546765 | 287.546765 | 287.546765 |
| pu | Pa | 100500.000 | 100500.000 | 100500.000 | 100500.000 |
| dp | Pa | 1063.0000 | 1063.0000 | 1063.0000 | 1063.0000 |
| Tsgu | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| Tu | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| rou | kg/m^3 | 1.25654635 | 1.25654635 | 1.25654635 | 1.25654635 |
| Redo | -- | 2272292.05 | 2272292.05 | 2272292.05 | 2272292.05 |
| alfa | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| epsi | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| alfeps | -- | 0.95291120 | 0.95291120 | 0.95291120 | 0.95291120 |
| qm | kg/s | 24.756722 | 24.756722 | 24.756722 | 24.756722 |
| p4 | Pa | 0.000 | 0.000 | 0.000 | 0.000 |
| Tsg4 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| T4 | K | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| ro4 | kg/m^3 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Red4 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Z 2-4/4 | -- | +0.00000000 | +0.00000000 | +0.00000000 | +0.00000000 |
| Ma4 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| Fm4 | -- | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 |
| psg2 | Pa | 100898.450 | 100898.337 | 100895.365 | 100898.437 |
| p2 | Pa | 100500.000 | 100500.000 | 100500.000 | 100500.000 |
| Tsg2 | K | 280.240779 | 280.240779 | 278.150000 | 280.240779 |
| T2 | K | 279.924135 | 280.240779 | 278.150000 | 279.924135 |
| ro2 | kg/m^3 | 1.24858247 | 1.24717169 | 1.25654635 | 1.24858247 |
| v2 | m/s | 25.245625 | 25.274182 | 25.085620 | 25.245625 |
| Ma2 | -- | 0.07520562 | 0.07524769 | 0.00000000 | 0.07520562 |
| p3 | Pa | 98685.000 | 98685.000 | 98685.000 | 98685.000 |
| Tsg3 | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| T3 | K | 277.993814 | 278.150000 | 278.150000 | 277.993814 |
| ro3 | kg/m^3 | 1.23454672 | 1.23385350 | 1.25654635 | 1.23454672 |
| Red3 | -- | 1515516.60 | 1514861.36 | 1514861.36 | 1515516.60 |
| Z 3-1/3 | -- | -0.03262797 | -0.03263025 | -0.03263025 | -0.03262797 |
| Ma3 | -- | 0.05300158 | 0.05301752 | 0.00000000 | 0.05300158 |
| Fm3 | -- | 1.00070250 | 1.00000000 | 1.00000000 | 1.00000000 |
| psg1 | Pa | 98872.864 | 98872.837 | 98869.444 | 98872.785 |
| p1 | Pa | 98469.237 | 98469.317 | 98474.079 | 98469.218 |
| Tsg1 | K | 278.150000 | 278.150000 | 278.150000 | 278.150000 |
| T1 | K | 277.825068 | 278.150000 | 278.150000 | 277.825099 |
| ro1 | kg/m^3 | 1.23259573 | 1.23115682 | 1.25654635 | 1.23259535 |
| v1 | m/s | 25.573060 | 25.602948 | 25.085620 | 25.573068 |
| Ma1 | -- | 0.07647076 | 0.07651246 | 0.00000000 | 0.07646784 |
| qm | kg/s | 24.756722 | 24.756722 | 24.756722 | 24.756722 |
| qvsg1 | m^3/s | 20.026432 | 20.026438 | 19.702196 | 20.026448 |
| pf | Pa | 2025.5861 | 2025.5001 | 2025.9206 | 2025.6511 |
| psf | Pa | 1627.1364 | 1627.1633 | 1630.5556 | 1627.2145 |
| y | J/kg/K | 1628.6145 | 1630.3889 | 1612.2928 | 1628.6301 |
| ys | J/kg/K | 1309.9437 | 1310.9968 | 1297.6486 | 1309.9593 |
| etar | -- | 0.86964832 | 0.87059580 | 0.86093282 | 0.86965664 |
| etasr | -- | 0.69948435 | 0.70004665 | 0.69291897 | 0.69949268 |
| yp | J/kg/K | 1627.4353 | 1627.3525 | 1612.2928 | 1627.4750 |
| ysp | J/kg/K | 1309.8922 | 1309.9154 | 1297.6486 | 1309.9617 |
| ik1 | -- | 0.20077843 | 0.20102903 | 0.19515327 | 0.20077666 |
| ik2 | -- | 0.19566986 | 0.19589935 | 0.19515327 | 0.19566799 |

measurement of flow rate          iso nozzle isa 32 DIN 1952
position of flow measurement fan inlet
pressure measurement  inlet duct
auxiliary fan              without

```
A1 m^2= 0.38484510        A2 m^2= 0.38484510        A3 m^2= 0.50265480
A4 m^2= 0.00000000        A5 m^2= 0.28274333        A6 m^2= 0.00000000
A7 m^2= 0.00000000        A8 m^2= 0.00000000        Ao m^2= 0.28274333
pe3 Pa=  -2065.000        pe5 Pa=   -783.800        pe7 Pa=    +0.000
pe4 Pa=      0.00         pe6 Pa=      0.00         pe8 Pa=      0.00
Pr W=   31885.00      etam=0.87      Px=      0.0      N rpm=   2944.
```

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	101050.000	101050.000	101050.000	101050.000
Ta	K	296.050000	296.050000	296.050000	296.050000
td	C	22.900	22.900	22.900	22.900
tw	C	14.800	14.800	14.800	14.800
psatw	Pa	1683.0	1683.0	1683.0	1683.0
Rw	J/kg/K	288.222193	288.222193	288.222193	288.222193
pu	Pa	101050.000	101050.000	101050.000	101050.000
dp	Pa	783.8000	783.8000	783.8000	783.8000
Tsgu	K	296.050000	296.050000	296.050000	296.050000
Tu	K	296.050000	296.050000	296.050000	296.050000
rou	kg/m^3	1.18425120	1.18425120	1.18425120	1.18425120
Redo	--	1400422.19	1400422.19	1400422.19	1400422.19
alfa	--	0.99000001	0.99000001	0.99000001	0.99000001
epsi	--	0.99583030	0.99583030	0.99583030	0.99583030
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	12.010261	12.010261	12.010261	12.010261
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	101465.529	101465.407	101461.206	101465.494
p2	Pa	101050.000	101050.000	101050.000	101050.000
Tsg2	K	299.074957	299.074957	296.050000	299.074957
T2	K	298.724512	299.074957	296.050000	298.724512
ro2	kg/m^3	1.17364848	1.17227324	1.18425120	1.17364848
v2	m/s	26.590619	26.621814	26.352550	26.590619
Ma2	--	0.07658782	0.07663372	0.00000000	0.07658782
p3	Pa	98985.000	98985.000	98985.000	98985.000
Tsg3	K	296.050000	296.050000	296.050000	296.050000
T3	K	295.840021	296.050000	296.050000	295.840021
ro3	kg/m^3	1.16087389	1.16005052	1.18425120	1.16087389
Red3	--	1050898.65	1050316.64	1050316.64	1050898.65
Z 3-1/3	--	-0.09000000	-0.09000000	-0.09000000	-0.09000000
Ma3	--	0.05957232	0.05959303	0.00000000	0.05957232
Fm3	--	1.00088763	1.00000000	1.00000000	1.00000000
psg1	Pa	99208.963	99208.924	99204.348	99208.888
p1	Pa	98788.237	98788.302	98793.142	98788.174
Tsg1	K	296.050000	296.050000	296.050000	296.050000
T1	K	295.690696	296.050000	296.050000	295.690721
ro1	kg/m^3	1.15915138	1.15774532	1.18425120	1.15915054
v1	m/s	26.923179	26.955876	26.352550	26.923198
Ma1	--	0.07794657	0.07799077	0.00000000	0.07794353
qm	kg/s	12.010261	12.010261	12.010261	12.010261
qvsg1	m^3/s	10.329850	10.329854	10.141650	10.329858
pf	Pa	2256.5660	2256.4838	2256.8582	2256.6056
psf	Pa	1841.0367	1841.0765	1845.6525	1841.1116
y	J/kg/K	1930.1991	1932.4074	1905.7259	1930.2531
ys	J/kg/K	1576.6686	1578.0469	1558.4974	1576.7226
etar	--	0.72705647	0.72788828	0.71783803	0.72707680
etasr	--	0.59389061	0.59440978	0.58704598	0.59391094
yp	J/kg/K	1927.6151	1927.5407	1905.7259	1927.6505
ysp	J/kg/K	1575.9083	1575.9330	1558.4974	1575.9578
ik1	--	0.18776754	0.18800880	0.18220273	0.18776259
ik2	--	0.18315752	0.18337772	0.18220273	0.18315240

measurement of flow rate   amca nozzle in chamber
position of flow measurement fan inlet
pressure measurement   inlet chamber
auxiliary fan   upstream flow measurement

A1 m^2= 1.57079600   A2 m^2= 0.78539820   A3 m^2=10.00000000
A4 m^2= 0.00000000   A5 m^2=10.00000000   A6 m^2= 0.00000000
A7 m^2=10.00000000   A8 m^2= 0.00000000   Ao m^2= 0.32090000
pe3 Pa= -1464.000   pe5 Pa=   +0.000   pe7 Pa= +2567.000
pe4 Pa=   0.00   pe6 Pa=   0.00   pe8 Pa=   0.00
Pr W=   39600.00   etam=0.89   Px= 185210.0   N rpm=   1780.

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	101325.000	101325.000	101325.000	101325.000
Ta	K	301.150000	301.150000	301.150000	301.150000
td	C	28.000	28.000	28.000	28.000
tw	C	22.500	22.500	22.500	22.500
psatw	Pa	2725.0	2725.0	2725.0	2725.0
Rw	J/kg/K	289.535801	289.535801	289.535801	289.535801
pu	Pa	103892.000	103892.000	103892.000	103892.000
dp	Pa	2000.0000	2000.0000	2000.0000	2000.0000
Tsgu	K	309.649727	309.649751	309.649751	309.649727
Tu	K	309.648028	309.649751	309.649751	309.648028
rou	kg/m^3	1.15880809	1.15880164	1.15880164	1.15880809
Redo	--	2271977.41	2271961.03	2271961.03	2271977.41
alfa	--	0.99452348	0.99452347	0.99452347	0.99452348
epsi	--	0.98962027	0.98962027	0.98962027	0.98962027
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	21.502507	21.502447	21.502447	21.502507
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	101658.873	101658.793	101661.467	101658.812
p2	Pa	101325.000	101325.000	101325.000	101325.000
Tsg2	K	311.691680	311.691710	309.649751	311.691680
T2	K	311.398865	311.691710	309.649751	311.398865
ro2	kg/m^3	1.12382145	1.12276558	1.11384024	1.12382145
v2	m/s	24.361380	24.384221	24.579615	24.361380
Ma2	--	0.06856832	0.06860110	0.00000000	0.06856832
psg3	Pa	99861.000	99861.000	99861.000	99861.000
Tsg3	K	309.649727	309.649751	309.649751	309.649727
T3	K	309.575113	309.649751	309.649751	309.575114
ro3	kg/m^3	1.11316993	1.11290122	1.11384024	1.11316993
Red3	--	0.00	0.00	0.00	0.00
Z 3-1/3	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma3	--	0.06856832	0.00000000	0.00000000	0.00000000
Fm3	--	1.00117600	1.00000000	1.00000000	1.00000000
psg1	Pa	99861.000	99861.000	99861.000	99861.000
p1	Pa	99776.848	99776.813	99776.883	99776.848
Tsg1	K	309.649727	309.649751	309.649751	309.649727
T1	K	309.575113	309.649751	309.649751	309.575114
ro1	kg/m^3	1.11316993	1.11290122	1.11384024	1.11316993
v1	m/s	12.297246	12.300180	12.289811	12.297246
Ma1	--	0.03471475	0.03471850	0.00000000	0.03471440
qm	kg/s	21.502507	21.502447	21.502447	21.502507
qvsg1	m^3/s	19.304838	19.304785	19.304785	19.304838
pf	Pa	1797.8732	1797.7927	1800.4675	1797.8120
psf	Pa	1464.0000	1464.0000	1464.0000	1464.0000
y	J/kg/K	1605.2653	1606.6374	1616.4504	1605.2653
ys	J/kg/K	1308.5268	1309.3423	1314.3716	1308.5269
etar	--	0.87164717	0.87238978	0.87771813	0.87164717
etasr	--	0.71052041	0.71096117	0.71369207	0.71052041
yp	J/kg/K	1604.4579	1604.4030	1616.4504	1604.4058
ysp	J/kg/K	1308.6646	1308.6683	1314.3716	1308.6646
ik1	--	0.04710195	0.04708419	0.04671948	0.04710195
ik2	--	0.18485319	0.18504184	0.18687783	0.1848C

measurement of flow rate   conical inlet
position of flow measurement fan inlet
pressure measurement   inlet duct
auxiliary fan   without

A1 m^2= 0.30000000   A2 m^2= 0.25000000   A3 m^2= 0.30000000
A4 m^2= 0.00000000   A5 m^2= 0.28274340   A6 m^2= 0.00000000
A7 m^2= 0.00000000   A8 m^2= 0.00000000   Ao m^2= 0.28274340
pe3 Pa= -15636.000   pe5 Pa= -1679.000   pe7 Pa=   +0.000
pe4 Pa=   0.00   pe6 Pa=   0.00   pe8 Pa=   0.00
Pr W= 300392.60   etam=1.00   Px=   0.0   N rpm=   3000.

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	102120.000	102120.000	102120.000	102120.000
Ta	K	299.150000	299.150000	299.150000	299.150000
td	C	26.000	26.000	26.000	26.000
tw	C	20.000	20.000	20.000	20.000
psatw	Pa	2337.0	2337.0	2337.0	2337.0
Rw	J/kg/K	289.057850	289.057850	289.057850	289.057850
pu	Pa	102120.000	102120.000	102120.000	102120.000
dp	Pa	1679.0000	1679.0000	1679.0000	1679.0000
Tsgu	K	299.150000	299.150000	299.150000	299.150000
Tu	K	299.150000	299.150000	299.150000	299.150000
rou	kg/m^3	1.18096501	1.18096501	1.18096501	1.18096501
Redo	--	1945714.48	1945714.48	1945714.48	1945714.48
alfa	--	0.00000000	0.00000000	0.00000000	0.00000000
epsi	--	0.00000000	0.00000000	0.00000000	0.00000000
alfeps	--	0.94483881	0.94483881	0.94483881	0.94483881
qm	kg/s	16.823217	16.823217	16.823217	16.823217
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	104153.220	104150.328	104037.216	104153.243
p2	Pa	102120.000	102120.000	102120.000	102120.000
Tsg2	K	316.799294	316.799294	299.150000	316.799294
T2	K	315.019869	316.799294	299.150000	315.019869
ro2	kg/m^3	1.12147111	1.11517194	1.18096501	1.12147111
v2	m/s	60.004103	60.343043	56.981255	60.004103
Ma2	--	0.16805674	0.16853057	0.00000000	0.16805674
p3	Pa	86484.000	86484.000	86484.000	86484.000
Tsg3	K	299.150000	299.150000	299.150000	299.150000
T3	K	297.612235	299.150000	299.150000	297.612235
ro3	kg/m^3	1.00531050	1.00014276	1.18096501	1.00531050
Red3	--	1896554.63	1888924.92	1888924.92	1896554.63
Z 3-1/3	--	-0.03148090	-0.03150085	-0.03150085	-0.03148090
Ma3	--	0.16073282	0.16114800	0.00000000	0.16073282
Fm3	--	1.00647545	1.00000000	1.00000000	1.00000000
psg1	Pa	88008.603	88006.589	87773.460	88007.992
p1	Pa	86433.420	86433.556	86442.060	86432.951
Tsg1	K	299.150000	299.150000	299.150000	299.150000
T1	K	297.610308	299.150000	299.150000	297.610437
ro1	kg/m^3	1.00472905	0.99955940	1.18096501	1.00472317
v1	m/s	55.813446	56.102109	47.484379	55.813773
Ma1	--	0.16083403	0.16124204	0.00000000	0.16082772
qm	kg/s	16.823217	16.823217	16.823217	16.823217
qvsg1	m^3/s	16.529423	16.529801	14.245314	16.529538
pf	Pa	16144.6165	16143.7388	16263.7562	16145.2514
psf	Pa	14111.3969	14113.4105	14346.5402	14112.0080
y	J/kg/K	14998.1826	15082.3190	13771.5817	14998.6459
ys	J/kg/K	13197.9363	13261.6776	12148.1501	13198.3995
etar	--	0.83995972	0.84467170	0.77126504	0.83998566
etasr	--	0.73913854	0.74270831	0.68034621	0.73916448
yp	J/kg/K	14989.8467	14989.4091	13771.5817	14990.4833
ysp	J/kg/K	13235.2920	13237.3264	12148.1501	13235.9060
ik1	--	0.10385060	0.10434226	0.08186300	0.10384862
ik2	--	0.12003097	0.12071363	0.11788273	0.12002726

measurement of flow rate   iso 5167-1 pressure taps D-D/2
position of flow measurement fan inlet
pressure measurement   inlet duct
auxiliary fan   without

A1 m^2= 0.39600000	A2 m^2= 0.18000000	A3 m^2= 0.39600000
A4 m^2= 0.00000000	A5 m^2= 0.45364598	A6 m^2= 0.00000000
A7 m^2= 0.45364598	A8 m^2= 0.00000000	Ao m^2= 0.14226338
pe3 Pa= -23105.400	pe5 Pa= +0.000	pe7 Pa= -10615.000
pe4 Pa= 0.00	pe6 Pa= 0.00	pe8 Pa= 0.00
Pr W= 556609.00	etam=1.00 Px= 0.0	N rpm= 3940.

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	99720.000	99720.000	99720.000	99720.000
Ta	K	283.150000	283.150000	283.150000	283.150000
td	C	10.000	10.000	10.000	10.000
tw	C	4.500	4.500	4.500	4.500
psatw	Pa	843.0	843.0	843.0	843.0
Rw	J/kg/K	287.522211	287.522211	287.522211	287.522211
pu	Pa	89105.000	89105.000	99720.000	89105.000
dp	Pa	17594.0000	17594.0000	17594.0000	17594.0000
Tsgu	K	283.150000	283.150000	283.150000	283.150000
Tu	K	282.590257	283.150000	283.150000	282.590257
rou	kg/m^3	1.09666375	1.09449582	1.22488215	1.09666375
Redu	--	1593717.37	1589710.45	1681682.07	1593717.37
alfa	--	0.63746219	0.63746314	0.63744223	0.63746219
epsi	--	0.93732003	0.93732003	0.93732003	0.93732003
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	16.698192	16.681705	17.646813	16.698192
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	103654.973	103636.546	103643.406	103654.922
p2	Pa	99720.000	99720.000	99720.000	99720.000
Tsg2	K	316.273887	316.306626	283.150000	316.273887
T2	K	312.795944	316.306626	283.150000	312.795944
ro2	kg/m^3	1.10879117	1.09648471	1.22488215	1.10879117
v2	m/s	83.665652	84.521140	80.038600	83.665652
Ma2	--	0.23578475	0.23687079	0.00000000	0.23578475
p3	Pa	76614.600	76614.600	76614.600	76614.600
Tsg3	K	283.150000	283.150000	283.150000	283.150000
T3	K	282.159419	283.150000	283.150000	282.159419
ro3	kg/m^3	0.94437740	0.94107356	1.22488215	0.94437740
Red3	--	1707789.06	1701488.37	1799926.82	1707789.06
Z 3-1/3	--	-0.03200750	-0.03202636	-0.03174148	-0.03200750
Ma3	--	0.13248989	0.13259089	0.00000000	0.13248989
Fm3	--	1.00439620	1.00000000	1.00000000	1.00000000
psg1	Pa	77529.872	77527.242	77399.491	77529.665
p1	Pa	76583.845	76584.027	76588.870	76583.722
Tsg1	K	283.150000	283.150000	283.150000	283.150000
T1	K	282.158517	283.150000	283.150000	282.158626
ro1	kg/m^3	0.94400132	0.94069803	1.22488215	0.94399944
v1	m/s	44.668531	44.781126	36.381182	44.668620
Ma1	--	0.13255040	0.13264382	0.00000000	0.13254281
qm	kg/s	16.698192	16.681705	17.646813	16.698192
qvsg1	m^3/s	17.534297	17.517578	14.406948	17.534344
pf	Pa	26125.1018	26109.3045	26243.9150	26125.2571
psf	Pa	22190.1284	22192.7580	22320.5092	22190.3353
y	J/kg/K	25043.4850	25282.9310	21425.6654	25043.6218
ys	J/kg/K	21543.5146	21711.0194	18222.5770	21543.6513
etar	--	0.75130106	0.75773548	0.67928244	0.75130516
etasr	--	0.64630244	0.65068444	0.57773125	0.64630654
yp	J/kg/K	24999.7774	24988.7133	21425.6654	24999.9724
ysp	J/kg/K	21668.1118	21672.1735	18222.5770	21668.3453
ik1	--	0.03983626	0.03965817	0.03088797	0.03983620
ik2	--	0.13975573	0.14127759	0.14949773	0.13975496

measurement of flow rate   iso 5167-1 pressure taps D-D/2
position of flow measurement fan inlet
pressure measurement   inlet duct
auxiliary fan   without

```
A1 m^2= 0.22522100        A2 m^2= 0.34500000        A3 m^2= 0.22522100
A4 m^2= 0.00000000        A5 m^2= 0.38484510        A6 m^2= 0.00000000
A7 m^2= 0.38484510        A8 m^2= 0.00000000        Ao m^2= 0.18857410
pe3 Pa= -28145.700        pe5 Pa=      +0.000       pe7 Pa= -16939.000
pe4 Pa=       0.00        pe6 Pa=       0.00        pe8 Pa=       0.00
Pr W=  675210.00      etam=1.00      Px=        0.0      N  rpm=   3940.
```

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	101325.000	101325.000	101325.000	101325.000
Ta	K	293.150000	293.150000	293.150000	293.150000
td	C	20.000	20.000	20.000	20.000
tw	C	17.000	17.000	17.000	17.000
psatw	Pa	1937.0	1937.0	1937.0	1937.0
Rw	J/kg/K	288.866959	288.866959	288.866959	288.866959
pu	Pa	84386.000	84386.000	101325.000	84386.000
dp	Pa	13300.0000	13300.0000	13300.0000	13300.0000
Tsgu	K	293.150000	293.150000	293.150000	293.150000
Tu	K	291.782957	293.150000	293.150000	291.782957
rou	kg/m^3	1.00118103	0.99651223	1.19654447	1.00118103
Redu	--	2047683.31	2035491.12	2230279.46	2047683.31
alfa	--	0.69704461	0.69704818	0.69699517	0.69704461
epsi	--	0.94438257	0.94438257	0.94438257	0.94438257
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	20.257586	20.210401	22.144456	20.257586
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	102929.553	102920.657	103046.603	102929.534
p2	Pa	101325.000	101325.000	101325.000	101325.000
Tsg2	K	326.117441	326.194410	293.150000	326.117441
T2	K	324.656746	326.194410	293.150000	324.656746
ro2	kg/m^3	1.08042422	1.07533115	1.19654447	1.08042422
v2	m/s	54.346839	54.477053	53.643495	54.346839
Ma2	--	0.14998662	0.14999003	0.00000000	0.14998662
p3	Pa	73179.300	73179.300	73179.300	73179.300
Tsg3	K	293.150000	293.150000	293.150000	293.150000
T3	K	287.979852	293.150000	293.150000	287.979852
ro3	kg/m^3	0.87968721	0.86417258	1.19654447	0.87968721
Red3	--	2704143.14	2660772.71	2915398.00	2704143.14
Z 3-1/3	--	-0.02981705	-0.02988909	-0.02948642	-0.02981705
Ma3	--	0.29960939	0.30158356	0.00000000	0.29960939
Fm3	--	1.02264333	1.00000000	1.00000000	1.00000000
psg1	Pa	77741.530	77699.139	77099.923	77735.945
p1	Pa	73030.687	73030.554	73060.183	73023.380
Tsg1	K	293.150000	293.150000	293.150000	293.150000
T1	K	287.960809	293.150000	293.150000	287.958519
ro1	kg/m^3	0.87795879	0.86241604	1.19654447	0.87787792
v1	m/s	102.448283	104.051711	82.172648	102.457721
Ma1	--	0.30017060	0.30219781	0.00000000	0.30023878
qm	kg/s	20.257586	20.210401	22.144456	20.257586
qvsg1	m^3/s	22.065937	22.026551	18.507006	22.067523
pf	Pa	25188.0228	25221.5175	25946.6803	25193.5895
psf	Pa	23583.4699	23625.8608	24225.0775	23589.0551
y	J/kg/K	25124.5510	25273.9395	21684.6770	25132.2406
ys	J/kg/K	23647.7615	23790.0647	20245.8647	23655.4510
etar	--	0.75378440	0.75650013	0.71117929	0.75401510
etasr	--	0.70947790	0.71208476	0.66399143	0.70970860
yp	J/kg/K	25078.9103	25122.9517	21684.6770	25085.3097
ysp	J/kg/K	23674.9350	23726.5337	20245.8647	23681.3637
ik1	--	0.20887240	0.21418819	0.15569390	0.20884696
ik2	--	0.05877874	0.05871165	0.06635157	0.05876076

```
                    installation category :C          Test Nr  19
       measurement of flow rate    iso 5167-1 pressure taps D-D/2
              position of flow measurement fan inlet
              pressure measurement  inlet duct
              auxiliary fan        without
```

A1 m^2= 0.22522100		A2 m^2= 0.34500000		A3 m^2= 0.22522100
A4 m^2= 0.00000000		A5 m^2= 0.38484510		A6 m^2= 0.00000000
A7 m^2= 0.38484510		A8 m^2= 0.00000000		Ao m^2= 0.18857410
pe3 Pa= -28865.000		pe5 Pa= +0.000		pe7 Pa= -14697.000
pe4 Pa= 0.00		pe6 Pa= 0.00		pe8 Pa= 0.00
Pr W= 766741.00		etam=1.00 Px= 0.0 N rpm= 3940.		

		iso Ma>0.15	iso Ma<0.15	iso pf<2kPa	iso annex 7
pa	Pa	101325.000	101325.000	101325.000	101325.000
Ta	K	293.150000	293.150000	293.150000	293.150000
td	C	20.000	20.000	20.000	20.000
tw	C	17.000	17.000	17.000	17.000
psatw	Pa	1937.0	1937.0	1937.0	1937.0
Rw	J/kg/K	288.866959	288.866959	288.866959	288.866959
pu	Pa	86628.000	86628.000	101325.000	86628.000
dp	Pa	17789.0000	17789.0000	17789.0000	17789.0000
Tsgu	K	293.150000	293.150000	293.150000	293.150000
Tu	K	291.434304	293.150000	293.150000	291.434304
rou	kg/m^3	1.02901036	1.02298795	1.19654447	1.02901036
Redu	--	2359951.25	2342318.99	2533084.01	2359951.25
alfa	--	0.69696415	0.69696819	0.69692711	0.69696415
epsi	--	0.92753589	0.92753589	0.92753589	0.92753589
alfeps	--	0.00000000	0.00000000	0.00000000	0.00000000
qm	kg/s	23.325118	23.256897	25.151003	23.325118
p4	Pa	0.000	0.000	0.000	0.000
Tsg4	K	0.000000	0.000000	0.000000	0.000000
T4	K	0.000000	0.000000	0.000000	0.000000
ro4	kg/m^3	0.00000000	0.00000000	0.00000000	0.00000000
Red4	--	0.00	0.00	0.00	0.00
Z 2-4/4	--	+0.00000000	+0.00000000	+0.00000000	+0.00000000
Ma4	--	0.00000000	0.00000000	0.00000000	0.00000000
Fm4	--	0.00000000	0.00000000	0.00000000	0.00000000
psg2	Pa	103450.105	103435.145	103545.821	103450.098
p2	Pa	101325.000	101325.000	101325.000	101325.000
Tsg2	K	325.663140	325.758513	293.150000	325.663140
T2	K	323.737566	325.758513	293.150000	323.737566
ro2	kg/m^3	1.08349184	1.07677005	1.19654447	1.08349184
v2	m/s	62.399212	62.605098	60.926661	62.399212
Ma2	--	0.17245214	0.17248402	0.00000000	0.17245214
p3	Pa	72460.000	72460.000	72460.000	72460.000
Tsg3	K	293.150000	293.150000	293.150000	293.150000
T3	K	286.242795	293.150000	293.150000	286.242795
ro3	kg/m^3	0.87632640	0.85567838	1.19654447	0.87632640
Red3	--	3128265.22	3061854.89	3311220.94	3128265.22
Z 3-1/3	--	-0.02918337	-0.02927497	-0.02894358	-0.02918337
Ma3	--	0.34735128	0.35048901	0.00000000	0.34735128
Fm3	--	1.03052831	1.00000000	1.00000000	1.00000000
psg1	Pa	78582.533	78508.413	77520.326	78572.656
p1	Pa	72258.812	72260.382	72309.171	72247.282
Tsg1	K	293.150000	293.150000	293.150000	293.150000
T1	K	286.206704	293.150000	293.150000	286.203947
ro1	kg/m^3	0.87400345	0.85332110	1.19654447	0.87387241
v1	m/s	118.495489	121.012544	93.329210	118.513257
Ma1	--	0.34827954	0.35145723	0.00000000	0.34835028
qm	kg/s	23.325118	23.256897	25.151003	23.325118
qvsg1	m^3/s	25.135388	25.085533	21.019698	25.138548
pf	Pa	24867.5716	24926.7327	26025.4956	24877.4422
psf	Pa	22742.4667	22816.5873	23804.6743	22752.3442
y	J/kg/K	24623.5658	24755.0342	21750.5460	24635.2295
ys	J/kg/K	22676.7350	22795.3349	19894.5170	22688.3986
etar	--	0.74907638	0.75087320	0.71347177	0.74943120
etasr	--	0.68985161	0.69143133	0.65258942	0.69020643
yp	J/kg/K	24550.7831	24625.7992	21750.5460	24561.9948
ysp	J/kg/K	22697.3476	22785.0094	19894.5170	22708.5779
ik1	--	0.28511674	0.29577893	0.20023269	0.28506722
ik2	--	0.07906372	0.07916366	0.08533253	0.07902629

LIST OF THE MEMBER ASSOCIATIONS

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