

This is a preview of "ISO 5801:2017". [Click here to purchase the full version from the ANSI store.](#)

Third edition  
2017-09

---

---

## Fans — Performance testing using standardized airways

*Ventilateurs — Essais aérauliques sur circuits normalisés*



Reference number  
ISO 5801:2017(E)

© ISO 2017

This is a preview of "ISO 5801:2017". Click here to purchase the full version from the ANSI store.



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

This is a preview of "ISO 5801:2017". Click here to purchase the full version from the ANSI store.

## Contents

	Page
<b>Foreword</b> .....	<b>vii</b>
<b>Introduction</b> .....	<b>viii</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols, abbreviated terms and subscripts</b> .....	<b>10</b>
4.1 Symbols and abbreviated terms.....	10
4.2 Subscripts.....	12
<b>5 General</b> .....	<b>13</b>
<b>6 Test configurations</b> .....	<b>14</b>
6.1 General.....	14
6.2 Category A configuration.....	15
6.3 Category B configuration.....	15
6.4 Category C configuration.....	15
6.5 Category D configuration.....	15
6.6 Inlets and outlets.....	15
6.7 Fans with significant swirl.....	15
6.8 Airways.....	15
6.9 Test space.....	16
6.10 Leakage.....	16
6.11 Test report.....	16
<b>7 Carrying out the test</b> .....	<b>16</b>
7.1 Working fluid.....	16
7.2 Rotational speed.....	16
7.3 Steady operation.....	16
7.4 Ambient conditions.....	16
7.5 Pressure readings.....	17
7.6 Test for a specified duty.....	17
7.7 Test for a fan characteristic curve.....	17
7.8 Operating range.....	17
<b>8 Airways for duct simulations</b> .....	<b>17</b>
8.1 General.....	17
8.2 Common segments at fan inlet (iCS).....	17
8.3 Inlet duct simulation (iDS).....	19
8.4 Common segment at fan outlet (oCS).....	20
8.5 Outlet duct simulation (oDS).....	21
8.6 Long duct (LD).....	22
8.7 Loss allowances for standardized airways.....	23
8.7.1 Loss allowances for an inlet common segment (iCS).....	23
8.7.2 Loss allowances for inlet duct simulation (iDS).....	24
8.7.3 Loss allowances for outlet common segments (oCS).....	24
8.7.4 Loss allowances for duct simulation at outlet (oDS).....	25
8.7.5 Loss allowances for long duct (LD).....	25
<b>9 Standardized test chambers</b> .....	<b>25</b>
9.1 General.....	25
9.2 Pressure tappings.....	25
9.3 Flow-settling means.....	25
9.3.1 General.....	25
9.3.2 Piezometer ring check.....	26
9.3.3 Blow through verification test.....	26
9.3.4 Outlet chamber reverse flow verification test.....	26

9.4	Standardized inlet test chambers (ITC).....	26
9.4.1	Test chambers.....	26
9.4.2	Fan under test.....	29
9.5	Standardized outlet test chambers (oTC).....	30
9.5.1	Test chambers.....	30
9.5.2	Fan under test.....	30
<b>10</b>	<b>Various component parts for a laboratory setup.....</b>	<b>31</b>
10.1	General.....	31
10.2	Variable supply system.....	31
10.2.1	General.....	31
10.2.2	Throttling device.....	31
10.2.3	Auxiliary fan.....	31
10.3	Straightener.....	31
10.3.1	General.....	31
10.3.2	Cell straightener.....	31
10.3.3	Star straightener.....	32
10.4	Transition parts.....	33
10.4.1	General.....	33
10.4.2	Rectangular/circular transition.....	34
10.4.3	Circular/circular transition.....	34
10.4.4	Connection for double-inlet fans.....	35
<b>11</b>	<b>Standard test configurations.....</b>	<b>35</b>
11.1	Units.....	35
11.2	Measuring flow rate.....	40
11.3	Standard test configurations A.....	41
11.4	Standard test configurations B.....	42
11.5	Standard test configurations C.....	42
11.6	Standard test configurations D.....	42
<b>12</b>	<b>Measurements.....</b>	<b>43</b>
12.1	Calibration.....	43
12.2	Dimensions and cross-sectional areas.....	43
12.2.1	Tolerance on dimensions.....	43
12.2.2	Cross-sectional area.....	43
12.3	Rotational speed.....	44
12.4	Power input.....	44
12.4.1	General.....	44
12.4.2	Motor input power.....	44
12.4.3	Fan shaft power.....	45
12.4.4	Impeller power.....	46
12.4.5	Transmission systems.....	46
12.5	Mass flow rate.....	46
12.6	Temperature.....	47
12.6.1	General.....	47
12.6.2	Accuracy of temperature measurement.....	47
12.6.3	Correction for high velocities.....	47
12.7	Humidity.....	48
12.8	Pressure.....	48
12.8.1	Barometers.....	48
12.8.2	Manometers.....	49
12.8.3	Damping of manometers.....	49
12.8.4	Checking of manometers.....	49
12.8.5	Position of manometers.....	49
12.8.6	Average pressure in an airway.....	50
12.8.7	Construction of tappings.....	50
12.8.8	Position and connections.....	51
12.8.9	Methods of measurement.....	51
12.8.10	Checks for compliance.....	51

This is a preview of "ISO 5801:2017". Click here to purchase the full version from the ANSI store.

12.8.11	Use of Pitot-static tube.....	51
12.9	Air properties.....	52
12.9.1	General.....	52
12.9.2	Density of air at section x.....	52
12.9.3	Air viscosity.....	53
12.9.4	Standard air.....	53
<b>13</b>	<b>Reference conditions.....</b>	<b>53</b>
<b>14</b>	<b>General rules for conversion of test results.....</b>	<b>54</b>
14.1	General.....	54
14.2	Laws on fan similarity.....	54
14.2.1	General.....	54
14.2.2	Geometrical similarity.....	54
14.2.3	Reynolds number similarity.....	55
14.2.4	Mach number and similarity of the velocity triangles.....	55
<b>15</b>	<b>Calculations.....</b>	<b>55</b>
15.1	Test results.....	55
15.1.1	General.....	55
15.1.2	Temperature.....	56
15.1.3	Pressure.....	58
15.1.4	Set of formulae.....	58
15.1.5	Simplified sets of formulae, which can be used for $v_{2,ref} \leq 65\text{m/s}$ .....	60
15.1.6	Fan pressure.....	61
15.1.7	Fan static pressure.....	62
15.1.8	Volume flow rate of the fan.....	62
15.1.9	Fan air power and efficiency.....	62
15.2	Efficiencies.....	65
15.2.1	General.....	65
15.2.2	Fan static air power and static efficiency.....	66
15.3	Conversion rules.....	66
15.3.1	General.....	66
15.3.2	Shaft power and impeller power.....	66
<b>16</b>	<b>Fan characteristic curves.....</b>	<b>67</b>
16.1	Methods of plotting.....	67
16.2	Characteristic curves at constant speed.....	67
16.3	Characteristic curves at inherent speed.....	68
16.4	Complete fan characteristic curve.....	68
16.5	Test for a specified duty.....	69
16.6	Specific fan types.....	69
<b>17</b>	<b>Uncertainty analysis.....</b>	<b>70</b>
17.1	Principle.....	70
17.2	Pre-test and post-test analysis.....	70
17.3	Analysis procedure.....	70
17.4	Propagation of uncertainties.....	70
17.5	Reporting uncertainties.....	71
17.6	Maximum allowable uncertainties for measurements.....	71
17.7	Maximum allowable uncertainty of results.....	72
<b>Annex A</b>	<b>(normative) Determination of air flow rate.....</b>	<b>73</b>
<b>Annex B</b>	<b>(informative) Fan-powered roof exhaust ventilators.....</b>	<b>90</b>
<b>Annex C</b>	<b>(informative) Chamber leakage test procedure.....</b>	<b>91</b>
<b>Annex D</b>	<b>(informative) Fan outlet elbow in the case of a non-horizontal discharge axis.....</b>	<b>97</b>
<b>Annex E</b>	<b>(informative) Input power calculation for driven fans at design point.....</b>	<b>100</b>
<b>Annex F</b>	<b>(informative) Motor fed from a variable frequency speed device.....</b>	<b>109</b>

This is a preview of "ISO 5801:2017". [Click here to purchase the full version from the ANSI store.](#)

<b>Annex G</b> (informative) <b>Axial fans without outlet guide vanes</b> .....	<b>110</b>
<b>Annex H</b> (informative) <b>Vapour pressure, <math>p_v</math></b> .....	<b>112</b>
<b>Annex I</b> (informative) <b>Clearances</b> .....	<b>113</b>
<b>Annex J</b> (normative) <b>Polytropic approach for the calculation of <math>p_{fC}</math> from <math>p_{fTe}</math></b> .....	<b>115</b>
<b>Annex K</b> (informative) <b>Examples for test setups</b> .....	<b>117</b>
<b>Annex L</b> (informative) <b>Measurement of plenum fans and plug fans</b> .....	<b>125</b>
<b>Annex M</b> (informative) <b>Comparison of NEMA methodology for calculation motor efficiency with IEC</b> .....	<b>127</b>
<b>Annex N</b> (informative) <b>Report and results of test</b> .....	<b>128</b>
<b>Bibliography</b> .....	<b>136</b>

This is a preview of "ISO 5801:2017". [Click here to purchase the full version from the ANSI store.](#)

## Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 117, *Fans*.

This third edition cancels and replaces the second edition (ISO 5801:2007), which has been technically revised. It also incorporates the Technical Corrigendum ISO 5801:2007/Cor.1:2008.

## Introduction

This document is the result of almost 50 years of discussion, comparative testing and detailed analyses by leading specialists from the fan industry and research organizations throughout the world.

It was demonstrated many years ago that the codes for fan performance testing established in different countries do not always lead to the same results.

The need for an International Standard has been evident for some time and Technical Committee ISO/TC 117 started its work in 1963. Important progress has been achieved over the years and, although the International Standard itself was not yet published, the successive revisions of various national standards led to much better agreement among them.

It has become possible since 1997 to complete this document by agreement on certain essential points. It is to be borne in mind that the test equipment, especially for large fans, is very expensive and it was necessary to include in this document many setups from various national codes in order to authorize their future use. This explains the sheer volume of the first edition (ISO 5801:1997).

The second edition (ISO 5801:2007) of this document was the result of a survey of ISO members, deleting those methods that were the least frequently used. A significant reduction in the number of pages had been achieved.

For the third edition, the contents were reorganized to define and allow all possible configurations of defined component parts as standardized test setups. A further significant reduction of volume has been achieved by streamlining the content.

Essential features of this document are as follows.

— **Installation categories and test configurations** (see [Clause 5](#) and [Clause 6](#)).

Since the connections of a duct to a fan inlet and/or outlet affect the fan's performance, a number of installation categories and test configurations need to be recognized.

— **Common segments** (see [Clause 8](#)).

It is essential that all standardized test airways to be used with fans need to have portions in common adjacent to the fan inlet and/or outlet sufficient to ensure consistent determination of fan pressure.

Geometric variations of these common segments are strictly limited.

— **Flow rate measurement** (see [12.5](#) and [Annex A](#)).

Determination of flow rate has been separated from the determination of fan pressure. A number of standardized methods may be used.

— **Test results** (see [Clause 15](#)).

Methods of measurement and calculation for the flow rate, for the fan pressure and for the fan efficiencies are established taking into account all compressibility effects of the air. For fan pressure less than 2 000 Pa, the change of density between fan inlet and fan outlet is allowed to be neglected. Other compressibility effects are allowed to be neglected for reference velocity values not higher than 65 m/s (see [Clause 13](#)).