DIN EN ISO 5801:2018-04 (E)

Fans - Performance testing using standardized airways (ISO 5801:2017)

Contents

Page

European foreword **6**
Foreword **7**
Introduction **8**
1 Scope **9**
2 Normative references **9**
3 Terms and definitions **9**
4 Symbols, abbreviated terms and subscripts **18**
4.1 Symbols and abbreviated terms 18
4.2 Subscripts 20
5 General **21**
6 Test configurations **22**
6.1 General 22
6.2 Category A configuration 23
6.3 Category B configuration 23
6.4 Category C configuration 23
6.5 Category D configuration 23
6.6 Inlets and outlets 23
6.7 Fans with significant swirl 23
6.8 Airways 23
6.9 Test space 24
6.10 Leakage 24
6.11 Test report 24
7 Carrying out the test **24**
7.1 Working fluid 24
7.2 Rotational speed 24
7.3 Steady operation 24
7.4 Ambient conditions 24
7.5 Pressure readings 25
7.6 Test for a specified duty 25
7.7 Test for a fan characteristic curve 25
7.8 Operating range 25
8 Airways for duct simulations **25**
8.1 General 25
8.2 Common segments at fan inlet (iCS) 25
8.3 Inlet duct simulation (iDS) 27
8.4 Common segment at fan outlet (oCS) 28
8.5 Outlet duct simulation (oDS) 29
8.6 Long duct (LD) 30
8.7 Loss allowances for standardized airways 31
8.7.1 Loss allowances for an inlet common segment (iCS) 31
8.7.2 Loss allowances for inlet duct simulation (iDS) 32
8.7.3 Loss allowances for outlet common segments (oCS) 32
8.7.4 Loss allowances for duct simulation at outlet (oDS) 33
8.7.5 Loss allowances for long duct (LD) 33
9 Standardized test chambers **33**
9.1 General 33
9.2 Pressure tappings 33

9.3 Flow-settling means ... 33
9.3.1 General ... 33
9.3.2 Piezometer ring check ... 34
9.3.3 Blow through verification test ... 34
9.3.4 Outlet chamber reverse flow verification test ... 34
9.4 Standardized inlet test chambers (iTC) ... 34
9.4.1 Test chambers ... 34
9.4.2 Fan under test ... 37
9.5 Standardized outlet test chambers (oTC) ... 38
9.5.1 Test chambers ... 38
9.5.2 Fan under test ... 38

10 Various component parts for a laboratory setup ... 39
10.1 General ... 39
10.2 Variable supply system ... 39
10.2.1 General ... 39
10.2.2 Throttling device ... 39
10.2.3 Auxiliary fan ... 39
10.3 Straightener ... 39
10.3.1 General ... 39
10.3.2 Cell straightener ... 39
10.3.3 Star straightener ... 40
10.4 Transition parts ... 41
10.4.1 General ... 41
10.4.2 Rectangular/circular transition ... 42
10.4.3 Circular/circular transition ... 42
10.4.4 Connection for double-inlet fans ... 43

11 Standard test configurations ... 43
11.1 Units ... 43
11.2 Measuring flow rate ... 48
11.3 Standard test configurations A ... 49
11.4 Standard test configurations B ... 50
11.5 Standard test configurations C ... 50
11.6 Standard test configurations D ... 50

12 Measurements ... 51
12.1 Calibration ... 51
12.2 Dimensions and cross-sectional areas ... 51
12.2.1 Tolerance on dimensions ... 51
12.2.2 Cross-sectional area ... 51
12.3 Rotational speed ... 52
12.4 Power input ... 52
12.4.1 General ... 25
12.4.2 Motor input power ... 52
12.4.3 Fan shaft power ... 53
12.4.4 Impeller power ... 54
12.4.5 Transmission systems ... 54
12.5 Mass flow rate ... 54
12.6 Temperature ... 55
12.6.1 General ... 55
12.6.2 Accuracy of temperature measurement ... 55
12.6.3 Correction for high velocities ... 55
12.7 Humidity ... 56
12.8 Pressure ... 56
12.8.1 Barometers ... 56
12.8.2 Manometers ... 57
12.8.3 Damping of manometers ... 57
12.8.4 Checking of manometers ... 57
12.8.5 Position of manometers ... 57
12.8.6 Average pressure in an airway ... 58
12.8.7 Construction of tappings ... 58
12.8.8 Position and connections ... 59
12.8.9 Methods of measurement ... 59
12.8.10 Checks for compliance ... 59

12.8.11 Use of Pitot-static tube ... 59
12.9 Air properties ... 60
12.9.1 General ... 60
12.9.2 Density of air at section *x* ... 60
12.9.3 Air viscosity ... 61
12.9.4 Standard air ... 61

13 Reference conditions ... 61

14 General rules for conversion of test results ... 62
14.1 General ... 62
14.2 Laws on fan similarity ... 62
14.2.1 General ... 62
14.2.2 Geometrical similarity ... 62
14.2.3 Reynolds number similarity ... 63
14.2.4 Mach number and similarity of the velocity triangles ... 63

15 Calculations ... 63
15.1 Test results ... 63
15.1.1 General ... 63
15.1.2 Temperature ... 64
15.1.3 Pressure ... 66
15.1.4 Set of formulae ... 66
15.1.5 Simplified sets of formulae, which can be used for $v_{2.ref} \leq 65 m/s$ ... 68
15.1.6 Fan pressure ... 69
15.1.7 Fan static pressure ... 70
15.1.8 Volume flow rate of the fan ... 70
15.1.9 Fan air power and efficiency ... 70
15.2 Efficiencies ... 73
15.2.1 General ... 73
15.2.2 Fan static air power and static efficiency ... 74
15.3 Conversion rules ... 74
15.3.1 General ... 74
15.3.2 Shaft power and impeller power ... 74

16 Fan characteristic curves ... 75
16.1 Methods of plotting ... 75
16.2 Characteristic curves at constant speed ... 75
16.3 Characteristic curves at inherent speed ... 76
16.4 Complete fan characteristic curve ... 76
16.5 Test for a specified duty ... 77
16.6 Specific fan types ... 77

17 Uncertainty analysis ... 78
17.1 Principle ... 78
17.2 Pre-test and post-test analysis ... 78
17.3 Analysis procedure ... 78
17.4 Propagation of uncertainties ... 78
17.5 Reporting uncertainties ... 79
17.6 Maximum allowable uncertainties for measurements ... 79
17.7 Maximum allowable uncertainty of results ... 80

Annex A (normative) **Determination of air flow rate ... 81**

Annex B (informative) **Fan-powered roof exhaust ventilators ... 98**

Annex C (informative) **Chamber leakage test procedure ... 99**

Annex D (informative) **Fan outlet elbow in the case of a non-horizontal discharge axis ... 105**

Annex E (informative) **Input power calculation for driven fans at design point ... 108**

Annex F (informative) **Motor fed from a variable frequency speed device ... 117**

Annex G (informative) **Axial fans without outlet guide vanes** **118**
Annex H (informative) **Vapour pressure, p_v** **120**
Annex I (informative) **Clearances** **121**
Annex J (normative) **Polytropic approach for the calculation of p_{fC} from p_{fTe}** **123**
Annex K (informative) **Examples for test setups** **125**
Annex L (informative) **Measurement of plenum fans and plug fans** **133**
Annex M (informative) **Comparison of NEMA methodology for calculation motor efficiency with IEC** **135**
Annex N (informative) **Report and results of test** **136**
Bibliography **144**