ISO 16911-2:2013-03 (E)

Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts - Part 2: Automated measuring systems

Contents

Page

Foreword v

Introduction vi

1 Scope 1

2 Normative references 1

3 Terms and definitions 1

4 Symbols and abbreviations 4
4.1 Symbols 4
4.2 Abbreviations 5

5 Principle 6
5.1 General 6
5.2 Importance of minimizing systematic errors 6
5.3 Relationship to EN 14181 7

6 Type testing, quality assurance level 1 data 7
6.1 Introduction 7
6.2 Performance criteria 8
6.3 Flow reference material or procedure 8
6.4 Quality assurance level 1 calculation 9
6.5 Velocity check points and quality assurance level 3 9

7 Selection of automated measuring system location 10
7.1 General 10
7.2 Selection based upon pre-investigation 10
7.3 Selection based upon a predictable flow profile 10
7.4 Qualifying the automated measuring system calibration through a type 2 quality assurance level 2 procedure 11
7.5 Ports and working platforms 11

8 Pre-investigation of flow profile 11
8.1 General 11
8.2 Pre-investigation by measurement 12
8.3 Pre-investigation by computational fluid dynamics (CFD) 13
8.4 Automated measuring system selection guide 14
8.5 Quality assurance level 2 requirements 14

9 Calibration and validation of the automated measuring system (quality assurance level 2 and annual surveillance test) 14
9.1 Selection of calibration method 14
9.2 Selection of calibration method, if calculation methods are used 15
9.3 Calibration procedure 15
9.4 Functional tests 15
9.5 Parallel measurements with a standard reference method 15
9.6 Wall effects 16
9.7 Automated measuring system flow calibration procedure with transit time tracer 17
9.8 Data evaluation 17

9.9 Calibration function of the automated measuring system and its validity 17
9.10 Calculation of variability 18
9.11 Test of variability and annual surveillance test of validity of the calibration function 18
9.12 Test of R2 18
9.13 Quality assurance level 2 and annual surveillance test report 18

10 Commissioning documentation 19

11 On-going quality assurance during operation (quality assurance level 3) 19

12 Assessment of uncertainty in volume flow rate 19

Annex A (informative) Example of calculation of the calibration function (data from tests in Copenhagen and Wilhelmshaven) 20

Annex B (informative) Flow profile characteristics 32

Annex C (informative) Determination of measuring points and/or paths 37

Annex D (normative) Treatment of a polynomial calibration function 41

Annex E (normative) Values of kv(N) and t0,95(N - 1) 42

Annex F (informative) Example of a pre-investigation measurement 43

Annex G (informative) Computational fluid dynamics issues 50

Annex H (informative) The use of time of flight measurement instruments based on modulated laser light 54

Annex I (informative) Relationship between this International Standard and the essential requirements of EU Directives 55

Bibliography 56