

# DIN EN 12405-1:2018-12 (E)

## Gas meters - Conversion devices - Part 1: Volume conversion

---

<b>Contents</b>		<b>Page</b>
European foreword .....		10
<b>1</b>	<b>Scope .....</b>	<b>11</b>
<b>2</b>	<b>Normative references .....</b>	<b>11</b>
<b>3</b>	<b>Terms, definitions, symbols and classification .....</b>	<b>13</b>
3.1	Terms and definitions .....	13
3.2	Symbols .....	17
3.3	Classification .....	18
3.3.1	Mechanical classes .....	18
3.3.2	Electromagnetic environmental classes .....	18
<b>4</b>	<b>Principle of measurement .....</b>	<b>19</b>
4.1	Conversion as a function of temperature .....	19
4.2	Conversion as a function of pressure and temperature .....	19
4.3	Conversion as a function of pressure, temperature and deviation from the ideal gas law .....	20
4.4	Correction of the volume at measurement conditions .....	20
<b>5</b>	<b>Rated operating conditions .....</b>	<b>21</b>
5.1	Specified field of measurement .....	21
5.1.1	General .....	21
5.1.2	Specified measurement range for gas pressure .....	21
5.1.3	Specified measurement range for gas temperature .....	21
5.1.4	Gas characteristics .....	21
5.1.5	Base conditions .....	21
5.2	Environmental conditions .....	21
5.2.1	Ambient temperature range .....	21
5.2.2	Humidity range .....	21
5.2.3	Mechanical environment .....	22
5.2.4	Electromagnetic environment .....	22
5.3	Power supply .....	22
<b>6</b>	<b>Construction requirements .....</b>	<b>22</b>
6.1	General .....	22
6.2	Casings .....	23
6.3	Indications .....	23
6.3.1	General .....	23
6.3.2	Electronic indicating device .....	25
6.4	Inputs for volume conversion .....	25
6.5	Battery powered conversion device .....	25
6.6	Security devices and alarms .....	26
<b>7</b>	<b>Installation requirements .....</b>	<b>27</b>
7.1	General .....	27
7.2	Temperature transducer .....	27
7.3	Pressure transducer .....	27
<b>8</b>	<b>Performance .....</b>	<b>28</b>
8.1	Reference conditions .....	28
8.2	Rated operating conditions .....	28
8.3	Maximum permissible errors .....	28

8.3.1	Conversion devices type 1 .....	28
8.3.2	Conversion devices type 2 .....	29
8.3.3	Error of conversion .....	29
8.3.4	Specific errors for a gas-volume conversion device, type 2 .....	29
8.4	Conditions of matching the constituent elements of a conversion device type 2 .....	30
8.5	Influence factors .....	30
8.6	Disturbances .....	31
8.7	Durability .....	31
8.8	Repeatability .....	31
8.9	Reliability .....	31
9	Tests of conformity .....	31
9.1	Verification of the construction requirements .....	31
9.2	Verification of the performance requirements .....	31
9.2.1	Test conditions .....	31
9.2.2	Samples of gas volume conversion device type 1 required for testing .....	32
9.2.3	Samples of gas volume conversion devices type 2 required for testing .....	35
9.3	Test report .....	36
10	Marking .....	36
11	Installation and operating instructions .....	37
Annex A (normative) Type test .....		38
A.1	General conditions .....	38
A.1.1	General .....	38
A.1.2	Additional conditions specific to gas volume conversion devices type 1 .....	38
A.1.3	Additional conditions specific to gas-volume conversion devices type 2 .....	38
A.1.4	Test procedures .....	39
A.1.5	Verification of the construction requirements .....	40
A.2	Accuracy tests under reference conditions .....	40
A.2.1	Objective .....	40
A.2.2	Reference to documents .....	41
A.2.3	Procedure .....	41
A.2.4	Acceptance criteria .....	41
A.3	Effect of ambient temperature .....	41
A.3.1	Objective .....	41
A.3.2	Reference to documents .....	41
A.3.3	Procedure .....	41
A.3.4	Acceptance criteria .....	41
A.4	Effect of damp heat, steady-state test .....	41
A.4.1	Objective .....	41
A.4.2	Reference to documents .....	41
A.4.3	Procedure .....	42
A.4.4	Acceptance criteria .....	42
A.5	Effect of damp heat, cyclic test .....	42
A.5.1	Objective .....	42
A.5.2	Reference to documents .....	42
A.5.3	Procedure .....	42
A.5.4	Acceptance criteria .....	42
A.6	Electrical power variation .....	43
A.6.1	Objective .....	43
A.6.2	Reference to documents .....	43
A.6.3	Procedure .....	43
A.6.4	Acceptance criteria .....	43
A.7	Short time power reductions .....	43
A.7.1	Objective .....	43
A.7.2	Reference to documents .....	43
A.7.3	Procedure .....	43
A.7.4	Acceptance criteria .....	44
A.8	Electrical bursts .....	44

A.8.1	Objective .....	44
A.8.2	Reference to documents .....	44
A.8.3	Procedure .....	44
A.8.4	Acceptance criteria .....	44
A.9	Electromagnetic susceptibility .....	44
A.9.1	Objective .....	44
A.9.2	Reference to documents .....	44
A.9.3	Procedure .....	44
A.9.4	Acceptance criteria .....	45
A.10	Electrostatic discharges .....	45
A.10.1	Objective .....	45
A.10.2	Reference to documents .....	45
A.10.3	Procedure .....	45
A.10.4	Acceptance criteria .....	45
A.11	Overload of pressure (only for type 1 and pressure transducers) .....	45
A.11.1	Objective .....	45
A.11.2	Reference to documents .....	45
A.11.3	Procedure .....	45
A.11.4	Acceptance criteria .....	46
A.12	Effect of vibrations .....	46
A.12.1	Objective .....	46
A.12.2	Reference to documents .....	46
A.12.3	Procedure .....	46
A.12.4	Acceptance criteria .....	46
A.13	Effect of shocks .....	46
A.13.1	Objective .....	46
A.13.2	Reference to documents .....	46
A.13.3	Procedure .....	46
A.13.4	Acceptance criteria .....	47
A.14	Overload of pressure (mechanical) .....	47
A.14.1	Objective .....	47
A.14.2	Reference to documents .....	47
A.14.3	Procedure .....	47
A.14.4	Acceptance criteria .....	47
A.15	Durability .....	47
A.15.1	Objective .....	47
A.15.2	Reference to documents .....	47
A.15.3	Procedure .....	48
A.15.4	Acceptance criteria .....	48
A.16	Alarms operation .....	48
A.16.1	Objective .....	48
A.16.2	Reference to documents .....	48
A.16.3	Procedure .....	48
A.16.4	Acceptance criteria .....	48
A.17	Repeatability .....	49
A.17.1	Objective .....	49
A.17.2	Reference to standards .....	49
A.17.3	Procedure .....	49
A.17.4	Acceptance criteria .....	49
A.18	Short time DC power variations .....	49
A.18.1	Objective .....	49
A.18.2	Reference to standards .....	49
A.18.3	Procedure .....	49
A.18.4	Acceptance criteria .....	49
A.19	Surges on supply lines and/or signal lines .....	50
A.19.1	Objective .....	50
A.19.2	Reference to standards .....	50
A.19.3	Procedure .....	50
A.19.4	Acceptance criteria .....	50
A.20	Power frequency magnetic field .....	50
A.20.1	Objective .....	50
A.20.2	Reference to standards .....	50

A.20.3	Procedure .....	50
A.20.4	Acceptance criteria .....	50
<b>Annex B (normative) Pressure transducers .....</b>		<b>51</b>
B.1	Scope .....	51
B.2	Rated operating conditions .....	51
B.2.1	Specified measurement range for pressure .....	51
B.2.2	Environmental class .....	51
B.2.3	Power supply .....	51
B.3	Construction requirements .....	51
B.3.1	General .....	51
B.3.2	Casings .....	51
B.3.3	Indications .....	51
B.4	Performances .....	52
B.4.1	Reference conditions .....	52
B.4.2	Rated operating conditions .....	52
B.4.3	Maximum permissible errors .....	52
B.4.4	Influence factors .....	52
B.4.5	Disturbances .....	52
B.4.6	Durability .....	52
B.5	Tests of conformity .....	53
B.5.1	Test conditions .....	53
B.5.2	Tests .....	53
B.5.3	Sample of pressure transducers required for testing .....	53
B.6	Marking .....	53
<b>Annex C (normative) Platinum resistance thermometer sensors .....</b>		<b>54</b>
C.1	Scope .....	54
C.2	Operating rated conditions .....	54
C.2.1	Specified measurement range for temperature .....	54
C.2.2	Environmental class .....	54
C.3	Construction requirements .....	54
C.4	Performances .....	54
C.5	Marking .....	55
C.5.1	Required markings .....	55
C.5.2	Verification mark .....	55
C.6	Metrological verifications .....	55
C.6.1	Type approval .....	55
C.6.2	Initial verification .....	56
C.7	Verification procedure .....	56
C.7.1	Visual inspection .....	56
C.7.2	Type testing (type approval) .....	56
C.7.3	Samples of PRT required for testing .....	56
C.7.4	Initial verification .....	56
<b>Annex D (normative) Temperature transducers .....</b>		<b>58</b>
D.1	Scope .....	58
D.2	Rated operating conditions .....	58
D.2.1	Specified measurement range for temperature .....	58
D.2.2	Environmental class .....	58
D.2.3	Power supply .....	58
D.3	Construction requirements .....	58
D.3.1	General .....	58
D.3.2	Casings .....	58
D.3.3	Indications .....	58
D.4	Performances .....	59
D.4.1	Reference conditions .....	59
D.4.2	Rated operating conditions .....	59
D.4.3	Maximum permissible errors .....	59

D.4.4	Influence factors .....	59
D.4.5	Disturbances .....	59
D.4.6	Durability .....	59
D.5	Tests of conformity .....	60
D.5.1	Test conditions .....	60
D.5.2	Tests .....	60
D.5.3	Sample of temperature transducers required for testing .....	60
D.6	Marking .....	60
<b>Annex E (informative) Model type test report for conversion devices .....</b>		<b>61</b>
E.1	General .....	61
E.1.1	General remarks .....	61
E.1.2	Number of pages .....	61
E.1.3	Laboratory's identification .....	61
E.1.4	Applicant .....	61
E.1.5	Identification of device(s) submitted for testing .....	61
E.2	Accuracy tests under reference conditions .....	61
E.2.1	Ambient temperature during the test .....	61
E.2.2	Test equipment used .....	62
E.2.3	Test results .....	62
E.3	Ambient temperature .....	63
E.3.1	Effect of dry heat .....	63
E.3.2	Effect of cold .....	64
E.4	Effect of damp heat, steady-state test .....	65
E.4.1	Ambient temperature during the test .....	65
E.4.2	Test equipment used .....	65
E.4.3	Test results .....	66
E.5	Effect of damp heat, cyclic test .....	67
E.5.1	Ambient temperature during the test .....	67
E.5.2	Test equipment used .....	67
E.5.3	Test results .....	68
E.6	Electrical power variation .....	68
E.6.1	AC power supply .....	68
E.6.2	DC power supply or battery supply .....	70
E.7	Short time power reductions .....	71
E.7.1	Test equipment used .....	71
E.7.2	Test results .....	72
E.8	Electrical bursts .....	72
E.8.1	Test equipment used .....	72
E.8.2	Test results .....	72
E.9	Electromagnetic immunity .....	73
E.9.1	Test equipment used .....	73
E.9.2	Test results .....	74
E.10	Electrostatic discharges .....	74
E.10.1	Test equipment used .....	74
E.10.2	Test results .....	75
E.11	Effect of an overload of static pressure .....	75
E.11.1	Ambient temperature during the test .....	75
E.11.2	Test equipment used .....	75
E.11.3	Test results .....	76
E.12	Effect of vibrations .....	76
E.12.1	Ambient temperature during the test .....	76
E.12.2	Test equipment used .....	77
E.12.3	Test results .....	77
E.13	Effect of shocks .....	78
E.13.1	Ambient temperature during the test .....	78
E.13.2	Test equipment used .....	78
E.13.3	Test results .....	78
E.14	Mechanical resistance to overload of static pressure .....	78
E.14.1	Ambient temperature during the test .....	78
E.14.2	Test equipment used .....	78

E.14.3	Test results .....	79
E.15	Durability .....	79
E.15.1	Ambient temperature during the test .....	79
E.15.2	Test equipment used .....	79
E.15.3	Test equipment used .....	79
E.16	Alarms operation .....	82
E.16.1	Ambient temperature during the test .....	82
E.16.2	Test equipment used .....	82
E.16.3	Test results .....	82
E.17	Repeatability .....	82
E.18	Short time DC power variations .....	83
E.18.1	Test equipment used .....	83
E.18.2	Test results .....	83
E.19	Surges on supply lines and/or signal lines .....	83
E.19.1	Test equipment used .....	83
E.19.2	Test results .....	84
E.20	Power frequency magnetic field .....	84
E.20.1	Test equipment used .....	84
E.20.2	Test results .....	84
<b>Annex F (informative) Model type test report for associated transducers .....</b>		<b>86</b>
F.1	General .....	86
F.1.1	General remarks .....	86
F.1.2	Number of pages .....	86
F.1.3	Laboratory's identification .....	86
F.1.4	Applicant .....	86
F.1.5	Identification of device(s) submitted for testing .....	86
F.2	Accuracy tests under reference conditions .....	86
F.2.1	Ambient temperature during the test .....	86
F.2.2	Test equipment used .....	87
F.2.3	Test results .....	87
F.3	Ambient temperature .....	87
F.3.1	Effect of dry heat .....	87
F.3.2	Effect of cold .....	88
F.4	Effect of damp heat, steady-state test .....	89
F.4.1	Ambient temperature during the test .....	89
F.4.2	Test equipment used .....	89
F.4.3	Test results .....	89
F.5	Effect of damp heat, cyclic test .....	90
F.5.1	Ambient temperature during the test .....	90
F.5.2	Test equipment used .....	90
F.5.3	Test results .....	90
F.6	Electrical power variation .....	91
F.6.1	AC power supply .....	91
F.6.2	DC power supply or battery supply .....	92
F.7	Short time power reductions .....	92
F.7.1	Ambient temperature during the test .....	92
F.7.2	Test equipment used .....	93
F.7.3	Test results .....	93
F.8	Electrical bursts .....	93
F.8.1	Ambient temperature during the test .....	93
F.8.2	Test equipment used .....	93
F.8.3	Test results .....	93
F.9	Electromagnetic immunity .....	94
F.9.1	Ambient temperature during the test .....	94
F.9.2	Test equipment used .....	94
F.9.3	Test results .....	95
F.10	Electrostatic discharges .....	95
F.10.1	Ambient temperature during the test .....	95
F.10.2	Test equipment used .....	95
F.10.3	Test results .....	95

<b>F.11</b>	<b>Effect of an overload of static pressure .....</b>	<b>96</b>
<b>F.11.1</b>	<b>General .....</b>	<b>96</b>
<b>F.11.2</b>	<b>Ambient temperature during the test .....</b>	<b>96</b>
<b>F.11.3</b>	<b>Test equipment used .....</b>	<b>96</b>
<b>F.11.4</b>	<b>Test results .....</b>	<b>96</b>
<b>F.12</b>	<b>Effect of vibrations .....</b>	<b>97</b>
<b>F.12.1</b>	<b>Ambient temperature during the test .....</b>	<b>97</b>
<b>F.12.2</b>	<b>Test equipment used .....</b>	<b>97</b>
<b>F.12.3</b>	<b>Test results .....</b>	<b>97</b>
<b>F.13</b>	<b>Effect of shocks .....</b>	<b>98</b>
<b>F.13.1</b>	<b>Ambient temperature during the test .....</b>	<b>98</b>
<b>F.13.2</b>	<b>Test equipment used .....</b>	<b>98</b>
<b>F.13.3</b>	<b>Test results .....</b>	<b>98</b>
<b>F.14</b>	<b>Mechanical resistance to overload of static pressure .....</b>	<b>98</b>
<b>F.14.1</b>	<b>General .....</b>	<b>98</b>
<b>F.14.2</b>	<b>Ambient temperature during the test .....</b>	<b>98</b>
<b>F.14.3</b>	<b>Test equipment used .....</b>	<b>98</b>
<b>F.14.4</b>	<b>Test results .....</b>	<b>99</b>
<b>F.15</b>	<b>Durability .....</b>	<b>99</b>
<b>F.15.1</b>	<b>Ambient temperature during the test .....</b>	<b>99</b>
<b>F.15.2</b>	<b>Test equipment used .....</b>	<b>99</b>
<b>F.15.3</b>	<b>Test results .....</b>	<b>99</b>
<b>F.16</b>	<b>Repeatability .....</b>	<b>100</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2014/32/EU Measuring Instruments Directive .....</b>		<b>101</b>
<b>Bibliography .....</b>		<b>106</b>