

DIN EN 12405-1:2022-02 (E)

Gas meters - Conversion devices - Part 1: Volume conversion

Contents	Page
European foreword.....	16
1 Scope.....	18
2 Normative references.....	18
3 Terms, definitions and symbols.....	21
3.1 Terms and definitions.....	21
3.2 Symbols.....	25
3.3 Classification.....	27
3.3.1 Mechanical classes.....	27
3.3.2 Electromagnetic environmental classes.....	27
4 Principle of measurement.....	27
4.1 Conversion as a function of temperature.....	27
4.2 Conversion as a function of pressure and temperature.....	27
4.3 Conversion as a function of pressure, temperature and deviation from the ideal gas law.....	28
4.4 Correction of the volume at measurement conditions.....	28
5 Rated operating conditions.....	29
5.1 Specified field of measurement.....	29
5.1.1 General.....	29
5.1.2 Specified measurement range for gas pressure.....	29
5.1.3 Specified measurement range for gas temperature.....	29
5.1.4 Gas characteristics.....	29
5.1.5 Base conditions.....	30
5.2 Environmental conditions.....	30
5.2.1 Ambient temperature range.....	30
5.2.2 Humidity range.....	30
5.2.3 Mechanical environment.....	30
5.2.4 Electromagnetic environment.....	30
5.3 Power supply.....	30
6 Construction requirements.....	30
6.1 General.....	30
6.2 Casings.....	32
6.3 Indications.....	32
6.3.1 General.....	32
6.3.2 Electronic indicating device.....	34
6.4 Inputs for volume conversion.....	34
6.5 Battery powered conversion device.....	34
6.6 Security devices and alarms.....	35
7 Installation requirements.....	36
7.1 General.....	36
7.2 Temperature transducer.....	37
7.3 Pressure transducer.....	37
8 Performance.....	37
8.1 Reference conditions.....	37

8.2	Rated operating conditions.....	38
8.3	Maximum permissible errors	38
8.3.1	General	38
8.3.2	Error of conversion.....	39
8.3.3	Specific errors for a gas-volume conversion device, type 2	39
8.4	Conditions of matching the constituent elements of a conversion device type 2	40
8.5	Influence factors	40
8.6	Disturbances.....	40
8.7	Durability	41
8.8	Repeatability	41
8.9	Reliability	41
9	Tests of conformity	41
9.1	Verification of the construction requirements.....	41
9.2	Verification of the performance requirements (type tests).....	41
9.2.1	Test conditions	41
9.2.2	Samples of gas volume conversion device type 1 required for testing	42
9.2.3	Samples of gas volume conversion devices type 2 required for testing	46
9.2.4	Test report	46
10	Marking	46
11	Installation and operating instructions	47
Annex A	(normative) Type test.....	48
A.1	General conditions	48
A.1.1	General	48
A.1.2	Additional conditions specific to gas volume conversion devices type 1	48
A.1.3	Additional conditions specific to gas-volume conversion devices type 2	48
A.1.4	Test procedures	49
A.1.4.1	Test procedure 1 (PR1)	49
A.1.4.1.1	Test conditions.....	49
A.1.4.1.2	Performance of the test.....	49
A.1.4.1.2.1	T conversion.....	49
A.1.4.1.2.2	PT and PTZ conversion.....	49
A.1.4.2	Test procedure 2 (PR2)	50
A.1.4.3	Test procedure 3 (PR3)	50
A.1.4.4	Test procedure 4 (PR4)	50
A.1.4.5	Test procedure 5 (PR5)	50
A.1.5	Verification of the construction requirements.....	50
A.2	Accuracy tests under reference conditions.....	50
A.2.1	Objective	50
A.2.2	Reference to documents.....	51
A.2.3	Procedure	51
A.2.4	Acceptance criteria	51
A.3	Effect of ambient temperature.....	51

- A.3.1 Objective.....51
- A.3.2 Reference to documents51
- A.3.3 Procedure.....51
- A.3.4 Acceptance criteria.....51
- A.4 Effect of damp heat, steady-state test51
- A.4.1 Objective.....51
- A.4.2 Reference to documents51
- A.4.3 Procedure.....51
- A.4.4 Acceptance criteria.....52
- A.5 Effect of damp heat, cyclic test.....52
- A.5.1 Objective.....52
- A.5.2 Reference to documents52
- A.5.3 Procedure.....52
- A.5.4 Acceptance criteria.....52
- A.6 Electrical power variation53
- A.6.1 Objective.....53
- A.6.2 Reference to documents53
- A.6.3 Procedure.....53
- A.6.4 Acceptance criteria.....53
- A.7 Short time power reductions.....53
- A.7.1 Objective.....53
- A.7.2 Reference to documents53
- A.7.3 Procedure.....53
- A.7.4 Acceptance criteria.....54
- A.8 Electrical bursts.....54
- A.8.1 Objective.....54
- A.8.2 Reference to documents54
- A.8.3 Procedure.....54
- A.8.4 Acceptance criteria.....54
- A.9 Electromagnetic susceptibility.....54
- A.9.1 Objective.....54
- A.9.2 Reference to documents54
- A.9.3 Procedure.....54
- A.9.4 Acceptance criteria.....55
- A.10 Electrostatic discharges.....55
- A.10.1 Objective.....55

A.10.2 Reference to documents.....	55
A.10.3 Procedure.....	55
A.10.4 Acceptance criteria	55
A.11 Overload of pressure (only for type 1 and pressure transducers).....	55
A.11.1 Objective	55
A.11.2 Reference to documents.....	55
A.11.3 Procedure	55
A.11.4 Acceptance criteria	56
A.12 Effect of vibrations	56
A.12.1 Objective	56
A.12.2 Reference to documents.....	56
A.12.3 Procedure	56
A.12.4 Acceptance criteria	56
A.13 Effect of shocks	56
A.13.1 Objective	56
A.13.2 Reference to documents.....	56
A.13.3 Procedure	56
A.13.4 Acceptance criteria	57
A.14 Overload of pressure (mechanical)	57
A.14.1 Objective	57
A.14.2 Reference to documents.....	57
A.14.3 Procedure	57
A.14.4 Acceptance criteria	57
A.15 Durability	57
A.15.1 Objective	57
A.15.2 Reference to documents.....	57
A.15.3 Procedure	58
A.15.4 Acceptance criteria	58
A.16 Alarms operation.....	58
A.16.1 Objective	58
A.16.2 Reference to documents.....	58
A.16.3 Procedure	58
A.16.4 Acceptance criteria	58
A.17 Repeatability	59
A.17.1 Objective	59
A.17.2 Reference to standards.....	59

A.17.3 Procedure.....	59
A.17.4 Acceptance criteria.....	59
A.18 Short time DC power variations.....	59
A.18.1 Objective.....	59
A.18.2 Reference to standards.....	59
A.18.3 Procedure.....	59
A.18.4 Acceptance criteria.....	59
A.19 Surges on supply lines and/or signal lines.....	60
A.19.1 Objective.....	60
A.19.2 Reference to standards.....	60
A.19.3 Procedure.....	60
A.19.4 Acceptance criteria.....	60
A.20 Power frequency magnetic field.....	60
A.20.1 Objective.....	60
A.20.2 Reference to standards.....	60
A.20.3 Procedure.....	60
A.20.4 Acceptance criteria.....	60
A.21 Functionality “Error curve correction” of a gas meter (optional).....	61
A.21.1 Objective.....	61
A.21.2 Reference to documents.....	61
A.21.3 Procedure.....	61
A.21.4 Acceptance criteria.....	61
Annex B (normative) Pressure transducers.....	62
B.1 Scope.....	62
B.2 Rated operating conditions.....	62
B.2.1 Specified measurement range for pressure.....	62
B.2.2 Environmental class.....	62
B.2.3 Power supply.....	62
B.3 Construction requirements.....	62
B.3.1 General.....	62
B.3.2 Casings.....	62
B.3.3 Indications.....	62
B.3.3.1 General.....	62
B.3.3.2 Electronic indicating device.....	63
B.4 Performances.....	63
B.4.1 Reference conditions.....	63

B.4.2	Rated operating conditions.....	63
B.4.3	Maximum permissible errors	63
B.4.4	Influence factors	63
B.4.5	Disturbances.....	63
B.4.6	Durability	63
B.5	Tests of conformity	64
B.5.1	Test conditions	64
B.5.2	Tests	64
B.5.3	Sample of pressure transducers required for testing.....	64
B.6	Marking	64
Annex C	(normative) Platinum resistance thermometer sensors	65
C.1	Scope	65
C.2	Operating rated conditions.....	65
C.2.1	Specified measurement range for temperature.....	65
C.2.2	Environmental class	65
C.3	Construction requirements	65
C.4	Performances.....	65
C.5	Marking	66
C.5.1	Required markings	66
C.5.2	Verification mark.....	66
C.6	Metrological verifications.....	66
C.6.1	Type approval	66
C.6.2	Initial verification.....	66
C.7	Verification procedure	67
C.7.1	Visual inspection.....	67
C.7.2	Type testing (type approval).....	67
C.7.3	Samples of PRT required for testing.....	67
C.7.4	Initial verification.....	67
Annex D	(normative) Temperature transducers	69
D.1	Scope	69
D.2	Rated operating conditions.....	69
D.2.1	Specified measurement range for temperature.....	69
D.2.2	Environmental class	69
D.2.3	Power supply.....	69
D.3	Construction requirements	69
D.3.1	General	69

D.3.2	Casings	69
D.3.3	Indications.....	69
D.3.3.1	General.....	69
D.3.3.2	Electronic indicating device	70
D.4	Performances	70
D.4.1	Reference conditions	70
D.4.2	Rated operating conditions	70
D.4.3	Maximum permissible errors	70
D.4.4	Influence factors	70
D.4.5	Disturbances	70
D.4.6	Durability	70
D.5	Tests of conformity.....	71
D.5.1	Test conditions.....	71
D.5.2	Tests.....	71
D.5.3	Sample of temperature transducers required for testing.....	71
D.6	Marking.....	71
Annex E	(informative) Model type test report for conversion devices.....	72
E.1	General.....	72
E.1.1	General remarks.....	72
E.1.2	Number of pages.....	72
E.1.3	Laboratory's identification.....	72
E.1.4	Applicant	72
E.1.5	Identification of device(s) submitted for testing.....	72
E.2	Accuracy tests under reference conditions	72
E.2.1	Ambient temperature during the test	72
E.2.2	Test equipment used.....	73
E.2.3	Test results	73
E.3	Ambient temperature.....	74
E.3.1	Effect of dry heat.....	74
E.3.1.1	Ambient temperature during the test	74
E.3.1.2	Test equipment used.....	74
E.3.1.3	Test results	74
E.3.2	Effect of cold.....	75
E.3.2.1	Ambient temperature during the test	75
E.3.2.2	Test equipment used.....	75
E.3.2.3	Test results	75

E.4	Effect of damp heat, steady-state test.....	76
E.4.1	Ambient temperature during the test.....	76
E.4.2	Test equipment used.....	76
E.4.3	Test results.....	77
E.4.3.1	Before the application of the test.....	77
E.4.3.2	During the application of the test.....	77
E.4.3.3	After the application of the test.....	78
E.5	Effect of damp heat, cyclic test.....	78
E.5.1	Ambient temperature during the test.....	78
E.5.2	Test equipment used.....	78
E.5.3	Test results.....	78
E.5.3.1	Before the cyclic test.....	78
E.5.3.2	After the cyclic test.....	79
E.6	Electrical power variation.....	79
E.6.1	AC power supply.....	79
E.6.1.1	Test equipment used.....	79
E.6.1.2	Test results.....	79
E.6.1.2.1	Variation in voltage.....	79
E.6.1.2.2	Variation in frequency.....	80
E.6.2	DC power supply or battery supply.....	81
E.6.2.1	Test equipment used.....	81
E.6.2.2	Test results.....	81
E.7	Short time power reductions.....	82
E.7.1	Test equipment used.....	82
E.7.2	Test results.....	82
E.7.2.1	Before the application of the perturbation.....	82
E.7.2.2	During the application of the perturbation.....	83
E.7.2.3	Error shift calculation.....	83
E.8	Electrical bursts.....	83
E.8.1	Test equipment used.....	83
E.8.2	Test results.....	83
E.8.2.1	Mains power.....	83
E.8.2.1.1	Before the application of the perturbation.....	83
E.8.2.1.2	During the application of the perturbation.....	84
E.8.2.1.3	Error shift calculation.....	84
E.8.2.2	In/out connections.....	84

E.8.2.2.1	Before the application of the perturbation	84
E.8.2.2.2	During the application of the perturbation.....	84
E.8.2.2.3	Error shift calculation	84
E.9	Electromagnetic immunity	85
E.9.1	Test equipment used.....	85
E.9.2	Test results	85
E.9.2.1	Before the application of the perturbation.....	85
E.9.2.2	During the application of the perturbation	85
E.9.2.3	Error shift calculation	85
E.10	Electrostatic discharges.....	85
E.10.1	Test equipment used.....	85
E.10.2	Test results.....	86
E.10.2.1	Before the application of the perturbation	86
E.10.2.2	During the application of the perturbation.....	86
E.10.2.3	Error shift calculation	86
E.11	Effect of an overload of static pressure	86
E.11.1	Ambient temperature during the test	86
E.11.2	Test equipment used.....	86
E.11.3	Test results.....	86
E.11.3.1	Before the application of the perturbation	86
E.11.3.2	After the application of the perturbation	87
E.11.3.3	Error shift calculation	87
E.12	Effect of vibrations.....	87
E.12.1	Ambient temperature during the test	87
E.12.2	Test equipment used.....	87
E.12.3	Test results.....	88
E.12.3.1	Before the application of the test.....	88
E.12.3.2	After the application of the test	88
E.13	Effect of shocks.....	88
E.13.1	Ambient temperature during the test	88
E.13.2	Test equipment used.....	89
E.13.3	Test results.....	89
E.13.3.1	Before shocks	89
E.13.3.2	After the application of the perturbation	89
E.13.3.3	Error shift calculation	89
E.14	Mechanical resistance to overload of static pressure.....	89

E.14.1	Ambient temperature during the test.....	89
E.14.2	Test equipment used	89
E.14.3	Test results.....	90
E.15	Durability	90
E.15.1	Ambient temperature during the test.....	90
E.15.2	Test equipment used	90
E.15.3	Test equipment used	90
E.15.3.1	Before durability	90
E.15.3.2	After durability	91
E.15.3.3	Error shift calculation.....	92
E.16	Alarms operation.....	93
E.16.1	Ambient temperature during the test.....	93
E.16.2	Test equipment used	93
E.16.3	Test results.....	93
E.17	Repeatability	93
E.18	Short time DC power variations	93
E.18.1	Test equipment used	93
E.18.2	Test results.....	94
E.18.2.1	Before the application of the perturbation.....	94
E.18.2.2	During the application of the perturbation	94
E.18.2.3	Error shift calculation.....	94
E.19	Surges on supply lines and/or signal lines.....	94
E.19.1	Test equipment used	94
E.19.2	Test results.....	95
E.19.2.1	Before the application of the perturbation.....	95
E.19.2.2	After the application of the perturbation	95
E.19.2.3	Error shift calculation.....	95
E.20	Power frequency magnetic field	95
E.20.1	Test equipment used	95
E.20.2	Test results.....	96
E.20.2.1	Before the application of the perturbation.....	96
E.20.2.2	During the application of the perturbation	96
E.20.2.3	Error shift calculation.....	96
Annex F (informative) Model type test report for associated transducers		97
F.1	General	97
F.1.1	General remarks	97

F.1.2	Number of pages.....	97
F.1.3	Laboratory's identification.....	97
F.1.4	Applicant.....	97
F.1.5	Identification of device(s) submitted for testing.....	97
F.2	Accuracy tests under reference conditions	97
F.2.1	Ambient temperature during the test	97
F.2.2	Test equipment used.....	97
F.2.3	Test results.....	98
F.3	Ambient temperature.....	98
F.3.1	Effect of dry heat.....	98
F.3.1.1	Ambient temperature during the test	98
F.3.1.2	Test equipment used.....	99
F.3.1.3	Test results.....	99
F.3.2	Effect of cold.....	99
F.3.2.1	Ambient temperature during the test	99
F.3.2.2	Test equipment used.....	99
F.3.2.3	Test results.....	100
F.4	Effect of damp heat, steady-state test	100
F.4.1	Ambient temperature during the test	100
F.4.2	Test equipment used.....	100
F.4.3	Test results.....	100
F.4.3.1	Before the application of the test	100
F.4.3.2	During the application of the test.....	101
F.4.3.3	After the application of the test	101
F.5	Effect of damp heat, cyclic test.....	101
F.5.1	Ambient temperature during the test	101
F.5.2	Test equipment used.....	101
F.5.3	Test results.....	102
F.5.3.1	Before the application of the test	102
F.5.3.2	After the cyclic test	102
F.6	Electrical power variation	102
F.6.1	AC power supply.....	102
F.6.1.1	Test equipment used.....	102
F.6.1.2	Test results.....	102
F.6.1.2.1	Variation in voltage.....	102
F.6.1.2.2	Variation in frequency	103

F.6.2	DC power supply or battery supply.....	103
F.6.2.1	Test equipment used.....	103
F.6.2.2	Test results.....	104
F.7	Short time power reductions.....	104
F.7.1	Ambient temperature during the test.....	104
F.7.2	Test equipment used.....	104
F.7.3	Test results.....	104
F.7.3.1	Before the application of the perturbation.....	104
F.7.3.2	During the application of the perturbation.....	104
F.7.3.3	Error shift calculation.....	105
F.8	Electrical bursts.....	105
F.8.1	Ambient temperature during the test.....	105
F.8.2	Test equipment used.....	105
F.8.3	Test results.....	105
F.8.3.1	Mains power.....	105
F.8.3.1.1	Before the application of the perturbation.....	105
F.8.3.1.2	During the application of the perturbation.....	105
F.8.3.1.3	Error shift calculation.....	105
F.8.3.2	In/out connections.....	106
F.8.3.2.1	Before the application of the perturbation.....	106
F.8.3.2.2	During the application of the perturbation.....	106
F.8.3.2.3	Error shift calculation.....	106
F.9	Electromagnetic immunity.....	106
F.9.1	Ambient temperature during the test.....	106
F.9.2	Test equipment used.....	106
F.9.3	Test results.....	106
F.9.3.1	Before the application of the perturbation.....	106
F.9.3.2	During the application of the perturbation.....	107
F.9.3.3	Error shift calculation.....	107
F.10	Electrostatic discharges.....	107
F.10.1	Ambient temperature during the test.....	107
F.10.2	Test equipment used.....	107
F.10.3	Test results.....	107
F.10.3.1	Before the application of the perturbation.....	107
F.10.3.2	During the application of the perturbation.....	107
F.10.3.3	Error shift calculation.....	108

- F.11 Effect of an overload of static pressure 108**
- F.11.1 General..... 108**
- F.11.2 Ambient temperature during the test 108**
- F.11.3 Test equipment used..... 108**
- F.11.4 Test results 108**
- F.11.4.1 Before the application of the perturbation 108**
- F.11.4.2 After the application of the perturbation 109**
- F.11.4.3 Error shift calculation 109**
- F.12 Effect of vibrations..... 109**
- F.12.1 Ambient temperature during the test 109**
- F.12.2 Test equipment used..... 109**
- F.12.3 Test results 110**
- F.12.3.1 Before the application of the test..... 110**
- F.12.3.2 After the application of the test 110**
- F.13 Effect of shocks..... 110**
- F.13.1 Ambient temperature during the test 110**
- F.13.2 Test equipment used..... 110**
- F.13.3 Test results 111**
- F.13.3.1 Before shocks 111**
- F.13.3.2 After shocks 111**
- F.13.3.3 Error shift calculation 111**
- F.14 Mechanical resistance to overload of static pressure..... 111**
- F.14.1 General..... 111**
- F.14.2 Ambient temperature during the test 111**
- F.14.3 Test equipment used..... 111**
- F.14.4 Test results 111**
- F.15 Durability 112**
- F.15.1 Ambient temperature during the test 112**
- F.15.2 Test equipment used..... 112**
- F.15.3 Test results 112**
- F.15.3.1 Before durability..... 112**
- F.15.3.2 After durability 113**
- F.15.3.3 Error shift calculation 113**
- F.16 Repeatability..... 114**
- Annex G (normative) Individual testing before putting into service 115**
- G.1 Objective..... 115**

G.2	Reference to documents.....	115
G.3	Procedure	115
G.4	Acceptance criteria	115
Annex ZA (informative)	Relationship between this European Standard and the Essential Requirements of EU Directive 2014/32/EU Measuring Instruments Directive	117
Bibliography		122