

DIN EN 12405-1:2007-08 (E)

Gas meters - Conversion devices - Part 1: Volume conversion (includes Amendment A1:2006)

| Contents | | Page |
|-----------------|---|-------------|
| 1 | Scope | 9 |
| 2 | Normative references | 10 |
| 3 | Terms, definitions and symbols | 11 |
| 3.1 | Terms and definitions | 11 |
| 3.2 | Symbols | 15 |
| 3.3 | Classification | 17 |
| 3.3.1 | Mechanical classes | 17 |
| 3.3.2 | Electromagnetic Environmental classes | 17 |
| 4 | Principle of measurement | 17 |
| 4.1 | Conversion as a function of temperature | 17 |
| 4.2 | Conversion as a function of pressure and temperature | 18 |
| 4.3 | Conversion as a function of pressure, temperature and deviation from the ideal gas law .. | 18 |
| 4.4 | Correction of the volume at measurement conditions | 19 |
| 5 | Rated operating conditions | 19 |
| 5.1 | Specified field of measurement | 19 |
| 5.1.1 | Specified measurement range for gas pressure | 19 |
| 5.1.2 | Specified measurement range for gas temperature | 20 |
| 5.1.3 | Gas characteristics | 20 |
| 5.1.4 | Base conditions | 20 |
| 5.2 | Environmental conditons | 20 |
| 5.2.1 | Ambient temperature range | 20 |
| 5.2.2 | Humidity range | 20 |
| 5.2.3 | Mechanical environment | 20 |
| 5.2.4 | Electromagnetic environment | 20 |
| 5.3 | Power supply | 20 |
| 6 | Construction requirements | 21 |
| 6.1 | General | 21 |
| 6.2 | Casings | 22 |
| 6.3 | Indications | 22 |
| 6.3.1 | General | 22 |
| 6.3.2 | Electronic indicating device | 24 |
| 6.4 | Inputs for volume conversion | 24 |
| 6.5 | Battery powered conversion device | 24 |
| 6.6 | Security devices and alarms | 25 |
| 7 | Installation requirements | 26 |
| 7.1 | General | 26 |
| 7.2 | Temperature transducer | 26 |
| 7.3 | Pressure transducer | 26 |
| 8 | Performance | 26 |
| 8.1 | Reference conditions | 26 |
| 8.2 | Rated operating conditions | 27 |
| 8.3 | Maximum permissible errors | 27 |
| 8.3.1 | General | 27 |
| 8.3.2 | Error of conversion | 28 |

| | | |
|-------------------------------------|---|----|
| 8.3.3 | Specific errors for a gas-volume conversion device, type 2 | 28 |
| 8.4 | Conditions of matching the constituent elements of a conversion device type 2 | 29 |
| 8.5 | Influence factors | 29 |
| 8.6 | Disturbances | 29 |
| 8.7 | Durability | 30 |
| 8.8 | Repeatability | 30 |
| 8.9 | Reliability | 30 |
| 9 | Tests of conformity | 30 |
| 9.1 | Verification of the construction requirements | 30 |
| 9.2 | Verification of the performance requirements | 30 |
| 9.2.1 | Test conditions | 30 |
| 9.2.3 | Samples of gas volume conversion device type 1 required for testing | 31 |
| 9.2.4 | Samples of gas volume conversion devices type 2 required for testing | 34 |
| 9.3 | Test report | 34 |
| 10 | Marking | 34 |
| 11 | Installation and operating instructions | 35 |
| Annex A (normative) Type test | | 36 |
| A.1 | General conditions | 36 |
| A.1.1 | General | 36 |
| A.1.2 | Additional conditions specific to gas volume conversion devices type 1 | 36 |
| A.1.3 | Additional conditions specific to gas-volume conversion devices type 2 | 36 |
| A.1.4 | Test procedures | 37 |
| A.1.5 | Verification of the construction requirements | 39 |
| A.2 | Accuracy tests under reference conditions | 39 |
| A.2.1 | Objective | 39 |
| A.2.2 | Reference to documents | 39 |
| A.2.3 | Procedure | 39 |
| A.2.4 | Acceptance criteria | 39 |
| A.3 | Effect of ambient temperature | 39 |
| A.3.1 | Objective | 39 |
| A.3.2 | Reference to documents | 39 |
| A.3.3 | Procedure | 39 |
| A.3.4 | Acceptance criteria | 40 |
| A.4 | Effect of damp heat, steady state test | 40 |
| A.4.1 | Objective | 40 |
| A.4.2 | Reference to documents | 40 |
| A.4.3 | Procedure | 40 |
| A.4.4 | Acceptance criteria | 40 |
| A.5 | Effect of damp heat, cyclic test | 40 |
| A.5.1 | Objective | 40 |
| A.5.2 | Reference to documents | 41 |
| A.5.3 | Procedure | 41 |
| A.5.4 | Acceptance criteria | 41 |
| A.6 | Electrical power variation | 41 |
| A.6.1 | Objective | 41 |
| A.6.2 | Reference to documents | 41 |
| A.6.3 | Procedure | 41 |
| A.6.4 | Acceptance criteria | 42 |
| A.7 | Short time power reductions | 42 |
| A.7.1 | Objective | 42 |
| A.7.2 | Reference to documents | 42 |
| A.7.3 | Procedure | 42 |
| A.7.4 | Acceptance criteria | 42 |
| A.8 | Electrical bursts | 43 |
| A.8.1 | Objective | 43 |
| A.8.2 | Reference to documents | 43 |
| A.8.3 | Procedure | 43 |

| | | |
|---|---|-----------|
| A.8.4 | Acceptance criteria | 43 |
| A.9 | Electromagnetic susceptibility | 43 |
| A.9.1 | Objective | 43 |
| A.9.2 | Reference to documents | 43 |
| A.9.3 | Procedure | 43 |
| A.9.4 | Acceptance criteria | 43 |
| A.10 | Electrostatic discharges | 44 |
| A.10.1 | Objective | 44 |
| A.10.2 | Reference to documents | 44 |
| A.10.3 | Procedure | 44 |
| A.10.4 | Acceptance criteria | 44 |
| A.11 | Overload of pressure (only for type 1 and pressure transducers) | 44 |
| A.11.1 | Objective | 44 |
| A.11.2 | Reference to documents | 44 |
| A.11.3 | Procedure | 44 |
| A.11.4 | Acceptance criteria | 45 |
| A.12 | Effect of vibrations | 45 |
| A.12.1 | Objective | 45 |
| A.12.2 | Reference to documents | 45 |
| A.12.3 | Procedure | 45 |
| A.12.4 | Acceptance criteria | 45 |
| A.13 | Effect of shocks | 45 |
| A.13.1 | Objective | 45 |
| A.13.2 | Reference to documents | 46 |
| A.13.3 | Procedure | 46 |
| A.13.4 | Acceptance criteria | 46 |
| A.14 | Overload of pressure (mechanical) | 46 |
| A.14.1 | Objective | 46 |
| A.14.2 | Reference to documents | 46 |
| A.14.3 | Procedure | 46 |
| 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 | 47 |
| A.15.4 | Acceptance criteria | 47 |
| A.16 | Alarms operation | 47 |
| A.16.1 | Objective | 47 |
| A.16.2 | Reference to documents | 48 |
| A.16.3 | Procedure | 48 |
| A.16.4 | Acceptance criteria | 48 |
| A.17 | Repeatability | 48 |
| A.17.1 | Objective | 48 |
| A.17.2 | Reference to standards | 48 |
| A.17.3 | Procedure | 48 |
| A.17.4 | Acceptance criteria | 48 |
| Annex B (normative) Pressure transducers | | 49 |
| B.1 | Scope | 49 |
| B.2 | Rated operating conditions | 49 |
| B.2.1 | Specified measurement range for pressure | 49 |
| B.2.2 | Environmental class | 49 |
| B.2.3 | Power supply | 49 |
| B.3 | Construction requirements | 49 |
| B.3.1 | General | 49 |
| B.3.2 | Casings | 49 |
| B.3.3 | Indications | 50 |
| B.4 | Performances | 50 |
| B.4.1 | Reference conditions | 50 |
| B.4.2 | Rated operating conditions | 50 |
| B.4.3 | Maximum permissible errors | 50 |

| | | |
|--|--|-----------|
| B.4.4 | Influence factors | 50 |
| B.4.5 | Disturbances | 50 |
| B.4.6 | Durability | 51 |
| B.5 | Tests of conformity | 51 |
| B.5.1 | Test conditions | 51 |
| B.5.2 | Tests | 51 |
| B.5.3 | Sample of pressure transducers required for testing | 51 |
| B.6 | Marking | 51 |
| Annex C (normative) Platinum resistance thermometer sensors | | 53 |
| C.1 | Scope | 53 |
| C.2 | Operating rated conditions | 53 |
| C.2.1 | Specified measurement range for temperature | 53 |
| C.2.2 | Environmental class | 53 |
| C.3 | Construction requirements | 53 |
| C.4 | Performances | 53 |
| C.5 | Marking | 54 |
| C.5.1 | Required markings | 54 |
| C.5.2 | Verification mark | 54 |
| C.6 | Metrological verifications | 54 |
| C.6.1 | Type approval | 54 |
| C.6.2 | Initial verification | 55 |
| C.7 | Verification procedure | 55 |
| C.7.1 | Visual inspection | 55 |
| C.7.2 | Type testing (type approval) | 55 |
| C.7.3 | Samples of PRT required for testing | 56 |
| C.7.4 | Initial verification | 56 |
| Annex D (normative) Temperature transducers | | 57 |
| D.1 | Scope | 57 |
| D.2 | Rated operating conditions | 57 |
| D.2.1 | Specified measurement range for temperature | 57 |
| D.2.2 | Environmental class | 57 |
| D.2.3 | Power supply | 57 |
| D.3 | Construction requirements | 57 |
| D.3.1 | General | 57 |
| D.3.2 | Casings | 57 |
| D.3.3 | Indications | 58 |
| D.4 | Performances | 58 |
| D.4.1 | Reference conditions | 58 |
| D.4.2 | Rated operating conditions | 58 |
| D.4.3 | Maximum permissible errors | 58 |
| D.4.4 | Influence factors | 58 |
| D.4.5 | Disturbances | 58 |
| D.4.6 | Durability | 59 |
| D.5 | Tests of conformity | 59 |
| D.5.1 | Test conditions | 59 |
| D.5.2 | Tests | 59 |
| D.5.3 | Sample of temperature transducers required for testing | 59 |
| D.6 | Marking | 59 |
| Annex E (informative) Model type test report for conversion devices | | 61 |
| 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 | 62 |

| | | |
|--|--|-----------|
| E.2.1 | Ambient temperature during the test | 62 |
| 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 | 66 |
| E.4.1 | Ambient temperature during the test | 66 |
| E.4.2 | Test equipment used | 66 |
| 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 | 69 |
| E.6.1 | AC power supply | 69 |
| E.6.2 | DC power supply or battery supply | 71 |
| E.7 | Short time power reductions | 72 |
| E.7.1 | Test equipment used | 72 |
| E.7.2 | Test results | 72 |
| E.8 | Electrical bursts | 73 |
| E.8.1 | Test equipment used | 73 |
| E.8.2 | Test results | 73 |
| E.9 | Electromagnetic immunity | 75 |
| E.9.1 | Test equipment used | 75 |
| E.9.2 | Test results | 75 |
| E.10 | Electrostatic discharges | 75 |
| E.10.1 | Test equipment used | 75 |
| E.10.2 | Test results | 76 |
| E.11 | Effect of an overload of static pressure | 76 |
| E.11.1 | Ambient temperature during the test | 76 |
| E.11.2 | Test equipment used | 76 |
| E.11.3 | Test results | 77 |
| E.12 | Effect of vibrations | 78 |
| E.12.1 | Ambient temperature during the test | 78 |
| E.12.2 | Test equipment used | 78 |
| E.12.3 | Test results | 78 |
| E.13 | Effect of shocks | 79 |
| E.13.1 | Ambient temperature during the test | 79 |
| E.13.2 | Test equipment used | 79 |
| E.13.3 | Test results | 79 |
| E.14 | Mechanical resistance to overload of static pressure | 80 |
| E.14.1 | Ambient temperature during the test | 80 |
| E.14.2 | Test equipment used | 80 |
| E.14.3 | Test results | 80 |
| E.15 | Durability | 80 |
| E.15.1 | Ambient temperature during the test | 80 |
| E.15.2 | Test equipment used | 80 |
| E.15.3 | Test equipment used | 81 |
| E.16 | Alarms operation | 84 |
| E.16.1 | Ambient temperature during the test | 84 |
| E.16.2 | Test equipment used | 84 |
| E.16.3 | Test results | 84 |
| E.17 | Repeatability | 84 |
| Annex F (informative) Model type test report for associated transducers | | 85 |
| F.1 | General | 85 |
| F.1.1 | General remarks | 85 |
| F.1.2 | Number of pages | 85 |
| F.1.3 | Laboratory's identification | 85 |
| F.1.4 | Applicant | 85 |

| | | |
|--------|--|-----|
| F.1.5 | Identification of device(s) submitted for testing | 85 |
| F.2 | Accuracy tests under reference conditions | 86 |
| F.2.1 | Ambient temperature during the test | 86 |
| F.2.2 | Test equipment used | 86 |
| F.2.3 | Test results | 86 |
| F.3 | Ambient temperature | 86 |
| F.3.1 | Effect of dry heat | 86 |
| F.3.2 | Effect of cold | 87 |
| F.4 | Effect of damp heat, steady state test | 88 |
| F.4.1 | Ambient temperature during the test | 88 |
| F.4.2 | Test equipment used | 88 |
| F.4.3 | Test results | 88 |
| F.5 | Effect of damp heat, cyclic test | 89 |
| F.5.1 | Ambient temperature during the test | 89 |
| F.5.2 | Test equipment used | 89 |
| F.5.3 | Test results | 90 |
| F.6 | Electrical power variation | 90 |
| F.6.1 | AC power supply | 90 |
| 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 | 92 |
| 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 | 96 |
| F.11 | Effect of an overload of static pressure | 96 |
| F.11.1 | Ambient temperature during the test | 96 |
| F.11.2 | Test equipment used | 96 |
| F.11.3 | Test results | 97 |
| F.12 | Effect of vibrations | 98 |
| F.12.1 | Ambient temperature during the test | 98 |
| F.12.2 | Test equipment used | 98 |
| F.12.3 | Test results | 98 |
| F.13 | Effect of shocks | 98 |
| F.13.1 | Ambient temperature during the test | 98 |
| F.13.2 | Test equipment used | 98 |
| F.13.3 | Test results | 99 |
| F.14 | Mechanical resistance to overload of static pressure | 99 |
| F.14.1 | Ambient temperature during the test | 99 |
| F.14.2 | Test equipment used | 99 |
| F.14.3 | Test results | 99 |
| F.15 | Durability | 100 |
| F.15.1 | Ambient temperature during the test | 100 |
| F.15.2 | Test equipment used | 100 |
| F.15.3 | Test results | 100 |
| F.16 | Repeatability | 102 |

| | |
|--|------------|
| Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2004/22 Measuring Instruments Directive | 103 |
|--|------------|

| | |
|---------------------------|------------|
| Bibliography | 107 |
|---------------------------|------------|