

ICS 13.100

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Reference No.: 18894-2006

中华人民共和国安全生产行业标准

Chinese Industrial Standard for Safety in Production

AQ 6206-2006

煤矿用高低浓度甲烷传感器

Coalmine High-Low Concentration Methane Transducers

Issued on November 2, 2006

Implemented on December 1, 2006

Issued on State Administration of Production Safety Supervision of China

Contents

Foreword

Coalmine carrier catalysis and heat conduction combined high-low concentration methane transducers are instruments to monitor methane gas in high gas and coal and gas burst mines in Chinese coalmine safety monitoring systems. This standard is hereby set up according to related state laws and standards in order to meet production safety requirements.

This standard is proposed by State Administration of Production Safety Supervision of China.

This standard is under the jurisdiction of Sub Technical Committee for Coalmine Safety under National Technical Committee for Production Safety Standardization.

This standard is responsibly drafted by Chongqing Branch under Coal Science Academy and Chongqing Mining Production Safety Equipment Test Center.

This standard is specifically drafted by Huang Qiang, Fan Rong, Wang Tao, Yu Qing, Du Wenjun, Chen Fumin and Shi Faqiang.

Coalmine High-Low Concentration Methane Transducers

1 Scope

This standard specifies technical requirements, testing methods, rules for inspection, marking, packing, operating instruction, transport and storage of coalmine carrier catalysis and heat conduction combined high-low concentration methane transducers.

This standard applies to carrier catalysis and heat conduction combined high-low concentration methane transducers with measuring ranges (0-40)% CH₄ and (0-100)% CH₄ used in underground coalmine environment monitoring (known as transducers for short hereafter).

2 Normative references

The following normative documents contain provisions which, through reference in the text, constitute provisions of this standard. For dated reference, subsequent amendments to, or revisions of, any of these publications (excluding contents of corrigenda) do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. For undated references, the latest edition of the normative document referred to applies.

GB 191-2000 Packaging—Pictorial marking for handling of goods

GB/T 2423.1-2001 Environmental testing for electric and electronic and electronic products--Part 2: Test methods--Tests A: Cold

GB/T 2423.2-2001 Environmental testing for electric and electronic products--Part 2: Test methods--Tests B: Dry heat

GB/T 2423.4-93 Basic environmental testing procedures for electric and electronic products—Test Db: Damp heat, cyclic

GB/T 2423.5-1995 Environmental testing for electric and electronic products Part 2: Test methods Test Ea and guidance: Shock

GB/T 2423.8-1995 Environmental testing for electric and electronic products Part 2: Test methods Test Ed: Free fall

GB/T 2423.10-1995 Environmental testing for electric and electronic products—Part 2: Test methods Test Fc and guidance: Vibration (Sinusoidal)

GB 3836.1-2000 Electrical apparatus for explosive gas atmospheres--Part 1: General requirements

GB 3836.2-2000 Electrical apparatus for explosive gas atmospheres--Part 2: Flameproof enclosure

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GB 3836.4-2000 Electrical apparatus for explosive gas atmospheres--Part 4: Intrinsic safety

GB 4208-93 Degrees of protection provided by enclosure (IP code)

GB9969.1-1998 General principles for preparation of instructions for use of industrial products

GB 10111-88 Methods for and sampling by utilizing dices of random number

AQ 6202-2006 Coal mina carrier catalytic element for methane detection

MT 210-90 Basic test methods for electric and electronic products for coal mine communication, testing and control

MT/T 772-1998 Measuring methods for the primary performances of coal mine supervision systems

3 Terms and Definitions

3.1 Displayed value

Measured numerical value displayed on transducer.

3.2 Zero point

Value displayed on transducer which operates normally in clean air.

3.3 Calibration point

Standard gas sample value selected for transducer to meet measuring accuracy.

3.4 Alarm point

Alarm actuation value preset for transducer according to application requirement.

3.5 Basic error

Transducer measurement error value determined under normal test conditions.

3.6 Stability

Performances of transducer to maintain its zero point, calibration point and alarm point within allowed variation ranges within specified operating conditions and time.

3.7 response time T_{90}

Time required for transducer output to reach 90% stabilized value when methane concentration shows step change.

4 Technical Requirements

4.1 General Requirements

4.1.1 Transducers shall meet requirements provided herein and be manufactured according to specified procedure and drawings and technical documents approved by a state-authorized inspection agency.

4.1.2 Transducer outfitting with associated equipment shall be qualified by an anti-explosion inspection agency authorized by a competent authority. Equipment associated with transducers shall carry mining product safety certificate with validity.

4.1.3 Transducer anti-explosion type shall be mining intrinsic safety and explosion suppression type, marked with “Exibdl”.

4.2 Operating Conditions

Temperature: (0-40) °C;

Relative humidity: ≤98%;

Atmospheric pressure: (80-116) kPa;

Wind speed: not more than 8 m/s.

4.3 Storage Temperature: (-40-60) °C.

4.4 Output Signal Types

Following signal types should be used:

a) current type: DC (1-5) mA, (4-20) mA;

b) frequency type: (200-1,000) Hz (pulse width more than 0.3ms), (200-2,000) Hz;

c) digital signal type: transmission rate 1,200bps, 2,400 bps, 4,800 bps, 9,600 bps, not lower than 3V.

4.5 Requirements for Transducer Appearance and Structure

4.5.1 Transducer display window shall have good light transparence, numbers and symbols shall be legible and complete.

4.5.2 Transducer surface, plating or coating shall be free of air bubble, crack, obvious flake-off or stain.

4.5.3 Transducers shall be structure-reasonable, firm and durable, with suspension or support structure suitable for underground mine installation.

4.5.4 Transducer enclosure, connectors and parts shall take anti-corrosion measures, coating shall be uniform, firm, color-consistent; printed circuit board shall be painted with at least 2 passes of corrosion-proof, mould-proof and moisture-proof paint.

4.6 Transducers shall take disperse sampling mode, and sampling probe shall be provided with protective cover to avoid dust and wind impact.

4.7 Transducer measurement value shall be indicated in % volume concentration, displayed digitally, with resolution not lower than 0.01% CH₄ in low concentration range and with resolution not lower than 0.1% CH₄ in high concentration range, and positive value and negative value can be displayed.

4.8 In transducers, carrier catalysis element and heat conduction element operating switchover point setting ranges within (2.00-4.00)%CH₄, where different switchover points can be set for switchover from low concentration to high concentration and switchover from high concentration to low concentration respectively. Transducers shall have function to protect carrier catalysis element.

4.9 Transducers should have remote-adjusted and calibrated function.

4.10 Basic Error

4.10.1 Stability of Displayed Value

Within range (0.00-4.00)% CH₄, when methane concentration is constant, variation of transducer's displayed value or output signal value (converted to methane concentration value)shall not exceed 0.04%CH₄.

Within range (4.00-100)% CH₄, when methane concentration is constant, variation of transducer's displayed value or output signal value (converted to methane concentration value)shall not exceed 0.4%CH₄.

4.10.2 Basic errors of transducer shall meet values specified below.

Basic error of transducer at carrier catalysis element detection shall meet values specified in Table 1.

Table 1 Basic Errors (at Carrier Catalysis Element Detection)

Measuring Range(% CH ₄)	Basic Error
0.00-1.00	±0.10%CH ₄
1.00-3.00	±10% true value
3.00-4.00	±0.30%CH ₄

Basic errors of transducer at heat conduction element detection and with measuring range (4.00-40.0) %CH₄ shall meet values specified in Table 2.

Table 2 Basic Errors (measuring range 4.00% CH₄-40% CH₄)

Measuring Range(% CH ₄)	Basic Error
4.00-40.0	±10%true value

Basic errors of transducer at heat conduction element detection and with measuring range (4.00-100) %CH₄ shall meet values specified in Table 3.

Table 3 Basic Errors (measuring range (4.00 % CH₄-100% CH₄)

Measuring Range(% CH ₄)	Basic Error
4.00-40.0	±10%true value
>40.00	±10% measuring upper limit

4.10.3 Additional error of transducer at switchover point shall not exceed 1.00%CH₄.

4.11 Transducers shall be able to operate normally within input voltage range 9V-24V, while their basic errors shall not exceed values specified in 4.10.2.

4.12 When cross section area of single core of transducer cable is 1.5mm², transducer and associated equipment transmission distance shall not be less than 2 km, displayed value or output signal value of associated equipment (converted to methane concentration value) shall meet specifications given in 4.10.2.

4.13 Operating Stability

Basic error of transducer continuously operating for 15 days shall not exceed values specified in 4.10.2.

4.14 Response Time T₉₀

Transducer response time shall be no more than 20 seconds.

4.15 Alarm Function

4.15.1 For transducers with alarm function, alarm point shall be able to preset arbitrarily within

range (0-4)%CH₄, and difference between displayed alarm value and preset value shall not exceed $\pm 0.05\%$ CH₄.

4.15.2 Pressure level of sound signal at 1m away from alarm transducer shall be no less than 80dB (A); light signal shall be seen clearly at 20m away.

4.16 Insulation resistance between transducer intrinsic safety end and enclosure shall be no lower than 50M Ω under normal condition, and no lower than 1.5 M Ω after withstanding alternative humid and hot test.

4.17 transducer intrinsic safety end and enclosure shall be able to withstand 500V 50Hz 1min dielectric test without breakdown or flickering, with leak current not more than 5 mA.

4.18 With transducer tested at 8m/s wind, when displaying carrier catalysis element indication value, its indication value drift shall not exceed $\pm 0.01\%$ CH₄; when displaying heat conduction element indication value, its indication value drift shall not exceed $\pm 0.1\%$ CH₄.

4.19 When tested at operating temperature, transducers shall satisfy requirements specified in 4.10.2.

4.20 After tested at storage temperature, transducers shall satisfy requirements specified in 4.10.2.

4.21 After tested at alternative humid and hot condition, transducers shall satisfy requirements specified in 4.10.2.

4.22 After transducers have experienced vibration test, their connectors and parts shall not loose or fall down, and satisfy requirements specified in 4.10.2.

4.23 After transducers have experienced impact test, they shall not show any damage, their connectors and parts shall not loose or fall down, and satisfy requirements specified in 4.10.2.

4.24 After transducers have experienced falling test, their connectors and parts shall not loose or fall down, and satisfy requirements specified in 4.10.2.

4.25 Anti-Explosion Requirements

4.25.1 Transducers shall be of mining intrinsic safety and explosion suppression structure and meet GB3836.1-2000, GB3836.2-2000 and GB3836.4-2000.

4.25.2 In transducers, any elements associated with intrinsic safety performance shall meet requirements given in 7 in GB3836.4-2000, under normal operating and fault states, shall not operate under more than max current, voltage and 2/3 of power rating value specified for element installation condition and temperature range.

4.25.3 Transducer enclosure protection performance shall meet protection class IP54 specified in GB 4208-93.

4.25.4 If transducer enclosure is plastic, enclosure surface insulation resistance shall not exceed 1GΩ.

4.25.5 If transducer enclosure is plastic, enclosure fire retardation performance shall meet 7.4 in GB3836.1-2000.

4.25.6 Transducers shall be able to pass spark ignition test specified in 10.1-10.4 of GB3836.4-2000. Transducer and associated equipment, after connected via cable not lower than 2km (cross section area of single core is 1.5mm²), shall be able to pass spark ignition test specified in 10.1-10.4 of GB3836.4-2000.

4.25.7 Max surface temperature of transducer at both normal and faulty states shall not be higher than 150°C.

4.25.8 Transducer enclosure structure, electrical gap and creepage distance shall meet requirements given in 6 in GB3836.4-2000.

4.25.9 Carrier catalysis elements used in transducers shall meet requirements specified in AQ 6202-2006 Carrier Catalysis Elements for Coalmine Methane Detection, and shall carry valid mining product safety certificate.

5 Testing Methods

5.1 Testing Conditions

5.1.1 Environmental Conditions

Unless otherwise specified in environmental test or related standards, tests shall be carried out under following conditions:

- a) Temperature: (15-35) °C;
- b) Relative humidity: 45%-75%;
- c) Atmospheric pressure: (80-116) kPa.

5.1.2 Gas Sample for Test

Methane standard sample taken from air (known as standard gas sample for short) shall be one provided by a unit certified by a national metering authority, whose uncertainty shall not be larger than 3%. Gas sample application shall meet requirements described in Table 4.

Table 4 Test Gas Samples

Test Item	Required Gas Sample and Value Range(%CH ₄)
Basic error test	0.50, 1.50, 2.00, 3.50, 20.0, 35.0, 75.0
Response time test	2.00, 20.00
Alarm error test	1.20

Note: Deviation of standard gas sample value from nominal value of standard gas sample shall not exceed ±10%.

5.1.3 Major Test Instruments

5.1.3.1 Gas flowmeter

Measuring range: (30-300)mL/min; accuracy: Class 2.5.

5.1.3.2 Stop watch

Resolution 0.01s.

5.1.3.3 Frequency meter

(0-2,000)Hz; stability: $\leq 1 \times 10^{-6}$.

5.1.3.4 Regulated DC power supply

Output voltage: (0-30)V; output current: 2A.

5.1.3.5 Voltmeter and ammeter

4-1/2-digit digital avometer, with accuracy not worse than Class 0.5.

5.2 Appearance and Structure Inspection

Transducer appearance and structure shall be checked visually and meet requirements given in 4.5 hereof.

5.3 Stability of Displayed Value and Basic Error

All following tests required for transducer adjustment and calibration shall be conducted by using remote control associated with transducer, where remote control shall be used by observing its operating instruction book.

In following tests requiring gas supply, except alarm error test and test of additional error at switchover point, gas flow rate for other tests shall be kept at gas flow rate for transducer calibration specified in enterprise product standard (known as specified flow rate for short).

Connect transducer to regulated power supply, respectively adjust regulated power supply output to max and min operating voltage specified in enterprise product standard, and determine stability of displayed value on transducer and basic error.

5.3.1 Stability of Displayed Value

5.3.1.1 Low Concentration Range

After transducer zero point is stabilized in clean air, supply specified flow rate of 2.0%CH₄ standard gas sample for 3 minutes, adjust transducer displayed value to accord with standard gas sample value, continue to supply gas, observe for 1 minute more, record difference between max transducer displayed value and min transducer display value, repeat the tests for 3 times and take the max difference.

5.3.1.2 High Concentration Range

After transducer zero point is stabilized in clean air, supply specified flow rate of 20%CH₄ standard gas sample for 3 minutes, adjust transducer display value to accord with standard gas sample value, continue to supply gas, observe for 1 minute more, record difference between max transducer display value and min transducer display value, repeat the tests for 3 times and take the max difference.

5.3.2 Basic Error

5.3.2.1 Low Concentration Range

Calibrate transducer 3 times by using specified flow rate, clean air and 2.0%CH₄ standard sample (known as instrument calibration). No re-calibration is allowed in subsequent tests.

After transducer zero point is stabilized in clean air, supply specified flow rate of 0.5%CH₄, 1.5%CH₄ and 3.5%CH₄ standard gas sample in turn respectively for 3 minutes, and record transducer display value or output signal value (converted to methane concentration value). Repeat measurement for 4 times and take the difference between arithmetic mean value of the last 3 measurements and standard gas sample, which is known as basic error in low concentration range.

5.3.2.2 High Concentration Range

Calibrate transducer 3 times by using specified flow rate, clean air and 20%CH₄ standard sample (known as instrument calibration). No re-calibration is allowed in subsequent tests.

After transducer zero point is stabilized in clean air, supply specified flow rate of 35%CH₄ and 75%CH₄ standard gas sample respectively for 3 minutes, and record transducer display value or output signal value (converted to methane concentration value). Repeat measurement for 4 times and take the difference between arithmetic mean value of the last 3 measurements and standard gas sample, which is known as basic error in high concentration range.

5.4 Additional Error at Switchover Point

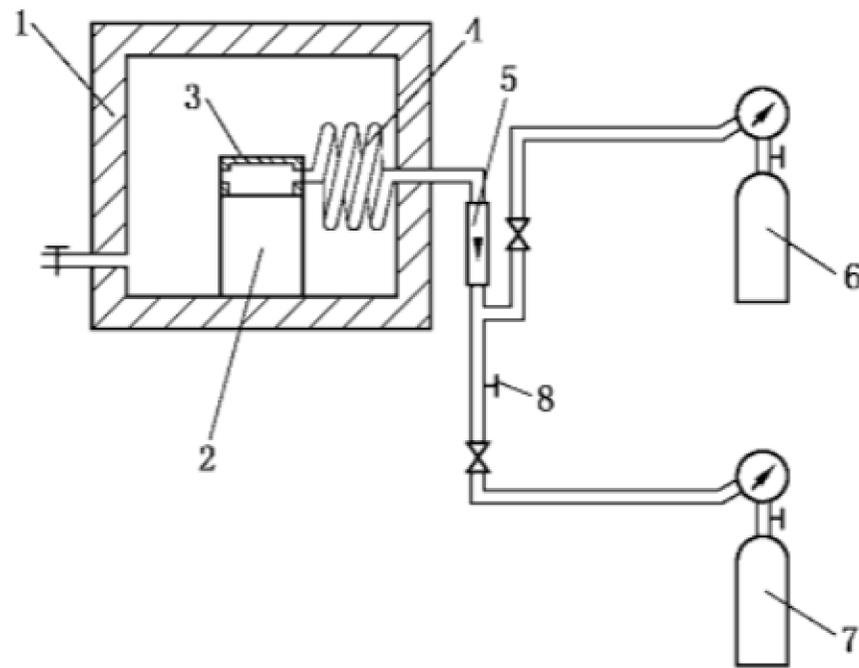
After transducer zero point is stabilized in clean air, supply 20.0%CH₄ standard methane gas to transducer, record transducer displayed value or output signal value at the moment when low concentration state switches to high concentration state (converted to methane concentration). Then supply 1.5%CH₄ standard methane gas, again record transducer displayed value or output signal value at the moment when high concentration state switches to low concentration state(converted to methane concentration), compute difference from switchover point specified in enterprise product standard, repeat measurement 4 times and take arithmetic mean value of the last 3 measurements.

5.5 Transmission Distance

Connect transducer with associated equipment via a simulation cable parameter not lower than 2km (or cable with cross section area of single core is 1.5mm²; but manufacturer and model of said cable shall be indicated in list of equipment associated with the transducer), and the associated equipment shall provide power required by transducer. Test method with gas supply shall be conducted as per 5.3.2. Record displayed value or output signal value of associated equipment (converted to methane concentration value). Basic error shall be computed according to 5.3.2. Simulation cable shall follow Annex A Simulation of MT/T 772-1998, cable simulation parameter shall be computed based upon R=12.8Ω/km single core, L=0.8mH/km single core and C=0.06μF/km.

5.6 Determination of Operating Stability

Mount well-adjusted transducer on device shown in Fig. 1. Continuously supply 0.5% CH₄ gas (standard gas sample is used in type test; for delivery test, gas sample value is controlled within 0.3% CH₄ and 0.8% CH₄). After operating 12 hours, supply in turn specified flow rate of clean air, 1.5%CH₄ and 20%CH₄ standard gas samples respectively for 3 minutes, record displayed value or output signal value. After operating continuously in air for 12 hours again, supply in turn specified flow rate of clean air, 1.5%CH₄ and 20%CH₄ standard gas sample respectively for 3 minutes, record displayed value or output signal value. Test time shall last for 15 days, during which transducer shall not be adjusted.



- 1- test box;
- 2- transducer;
- 3- gas injector;
- 4- preheater;
- 5- flowmeter;
- 6- clean air bottle;
- 7- test gas sample bottle;
- 8- regulator valve.

Fig. 1 Schematic Diagram of Stability Determination

5.7 Response Time Determination

5.7.1 Test of Response Time to Low Concentration

Connect disperse sampling gas injector provided by manufacturer with transducer gas inlet, supply specified flow rate of clean air. After transducer zero point is stable, supply the same flow rate of 2.0%CH₄ standard gas sample for 3 minutes and record displayed value. Then supply clean air. Waiting for transducer zero point to be stable, rapidly switch 2.0%CH₄ standard gas sample injector of the same flow rate to sampling probe, and start to record time required for transducer displayed value to reach 90% of originally displayed measured value. Measure 3 times and take their arithmetic mean value.

5.7.2 Test of Response Time to High Concentration

Connect disperse sampling gas injector provided by manufacturer with transducer gas inlet, supply specified flow rate of clean air. After transducer zero point is stable, supply the same flow rate of 20.0%CH₄ standard gas sample for 3 minutes and record displayed value. Then supply clean air. Waiting for transducer zero point to be stable, rapidly switch 20.0%CH₄ standard gas sample injector of the same flow rate to sampling probe, and start to record time required for transducer displayed value to reach 90% of originally displayed measured value. Measure 3 times and take

their arithmetic mean value.

5.8 Alarm Function Test

5.8.1 Determination of Difference between Alarm Value and Set Value

Set transducer alarm point at 1.0%CH₄, wait for transducer zero point to be stable, slowly supply gas with methane concentration specified in Table 4, record transducer displayed value at the moment when sound or light signal occurs, and compute difference between set methane concentration value at alarm point and displayed value.

5.8.2 Alarm Sound Level Measurement

Alarm sound level shall be measured with a sound level meter, with ambient noise less than 50dB (A). Place sound level meter at 1m in right front of transducer alarm axle center. Measure 3 times and take their mean value.

5.8.3 Alarm Light Signal

Observe at 20m away from transducer in a dark environment.

5.9 Insulation Resistance Test

Conducted according to method specified in 7 in MT 210-90.

5.10 Dielectric Strength Test

Conducted according to method specified in 10.6 in GB 3836.4-2006.

5.11 Wind Speed Impact Test

Transducer is switched over to display carrier catalysis element indication value, and put into wind test device. Adjust properly transducer reference point at zero wind current, record displayed value. Start wind blower, adjust wind speed to $8^{+0.5}_0$ m/s. Artificially make transducer rotate around suspending axle to find wind speed impact position. Fix this position, record indicated value once every other 30 seconds, record 3 times and take difference between their arithmetic mean value and reference point as drift value.

Transducer is switched over to display heat conduction element indication value, and put into wind test device. Adjust properly transducer reference point at zero wind current, record display value. Start wind blower, adjust wind speed to $8^{+0.5}_0$ m/s. Artificially make transducer rotate around suspending axle to find wind speed impact position. Fix this position, record indicated value once every other 30 seconds, record 3 times and take difference between their arithmetic mean value and reference point as drift value.

5.12 Operating Temperature Test

During test, temperature of standard gas sample supplied to transducer shall be same as that required by test.

5.12.1 Low Temperature Operating Test

Conducted according to method specified in Test Ab of GB/T 2423.1-2001. At temperature $(0\pm 3)^{\circ}\text{C}$ condition, supply power to transducer, stabilize for 2 hours, measure basic error, later on measure basic error once every other hour, measure 3 times, take their arithmetic mean value as determined value and check its appearance.

5.12.2 High Temperature Operating Test

Conducted according to method specified in Test Bb of GB/T 2423.2-2001. At temperature $(40\pm 2)^{\circ}\text{C}$ condition, supply power to transducer, stabilize for 2 hours, measure basic error, later on measure basic error once every other hour, measure 3 times, take their arithmetic mean value as determined value and check its appearance.

5.13 Storage Temperature Test

5.13.1 Low Temperature Storage Test

Conducted according to method specified in Test Ab of GB/T 2423.1-2001. At temperature $(-40\pm 2)^{\circ}\text{C}$ condition, test lasts for 16 hours. Transducer is unpacked, powered off, not tested intermediately. After tested, transducer is recovered in test box to condition specified in 4.2 and kept for 2 hours, then determine basic error and check its appearance.

5.13.2 High Temperature Storage Test

Conducted according to method specified in Test Bb of GB/T 2423.2-2001. At temperature $(60\pm 2)^{\circ}\text{C}$ condition, test lasts for 16 hours. Transducer is unpacked, powered off, not tested intermediately. After tested, transducer is recovered in test box to condition specified in 4.2 and kept for 2 hours, then determine basic error and check its appearance.

5.14 Alternative Humid and Hot Test

Conducted according to method specified in Test Db of GB/T 2423.4-93. At temperature $(40\pm 2)^{\circ}\text{C}$ and relative humidity (93 ± 3) condition, test lasts for 12 days, where transducer is unpacked, powered off and not tested intermediately. After tested, transducer is kept at condition specified in 4.2 for 2 hours. Conduct insulation resistance and power frequency voltage withstanding test, determine basic error and inspect its appearance.

5.15 Vibration Test

Vibration test shall be performed according to method specified in Test Fc of GB/T 2423.10-1995, with severe class, sweep frequency range $(10-150)\text{Hz}$, acceleration amplitude 50m/s^2 , 5 sweeping cycles, where transducer is unpacked, transducer fixed in application is powered off, not tested

intermediately, transducer machine-borne mobile in application is powered on, tested intermediately. After test, perform appearance check and determine basic error.

5.16 Impact Test

Impact test shall be performed according to method specified in Test Ea of GB/T 2423.5-1995, with severe class, peak acceleration 500m/s^2 , pulse duration (11 ± 1) ms, continuous 3 impacts in each direction of 3 axes (18 impacts in total), where transducer is unpacked, transducer which is fixed in application is powered off, not tested intermediately, transducer which is machine-borne mobile in application is powered on, tested intermediately. After test, perform appearance check and determine basic error.

5.17 Falling Test

Falling test shall be performed according to method specified in Test Ed of GB/T 2423.8-1995, with severe class, falling height 0.5m, freely falling in normal application direction to smooth and hard concrete surface twice; transducer unpacked, not tested intermediately. After test, perform appearance check and determine basic error.

5.18 After each test in 5.13-5.17 and before performance test, transducer re-calibration is allowed.

5.19 Anti-Explosion Test

5.19.1 Transducer anti-explosion performance shall be tested by a state-authorized anti-explosion inspection agency according to methods described in GB 3836.1-2000, GB 3836.2-2000 and GB 3836.4-2000.

5.19.2 Elements related to intrinsic safety performance shall be inspected according to method described in 7 of GB 3836.4-2000.

5.19.3 Enclosure protection performance shall be tested according to method described in GB 4208-93.

5.19.4 Plastic enclosure surface insulation resistance shall be tested according to method described in 23.4.7.8 of GB 3836.1-2000.

5.19.5 Plastic enclosure flame retardation performance shall be tested according to method described in Annex E to GB 3836.1-2000.

5.19.6 Transducer spark ignition test shall be conducted according to method described in 10.1-10.4 of GB 3836.4-2000. Connect transducer with associated equipment via a simulation cable parameter not lower than 2km (or cable with cross section area of single core is 1.5mm^2 ; but manufacturer and model of said cable shall be indicated in list of equipment associated with the transducer). Integration spark ignition test shall be conducted according to method described in 10.1-10.4 of GB 3836.4-2000. Simulation cable shall follow Annex A Simulation to MT/T 772-1998, cable simulation parameter shall be computed based upon $R=12.8\Omega/\text{km}$ single core,

$L=0.8\text{mH/km}$ single core and $C=0.06\mu\text{F/km}$.

5.19.7 Max surface temperature shall be tested according to method described in 10.5 of GB 3836.4-2000.

5.19.8 Electrical gap and creepage distance shall be measured by using vernier calipers.

6 Rules for Inspection

6.1 Inspection Classification

Inspection includes factory inspection and type test (refer to Table 5 for inspection items).

Table 5 Inspection Items

No.	Inspection Item	Test Requirement in Clause	Test Item in Clause	Factory Inspection	Type Test
1	Appearance and structure inspection	4.5	5.2	O	O
2	Remote adjustment and calibration function test	4.9	5.3	O	O
3	Determination of stability of displayed value	4.10.1	5.3.1	O	O
4	Determination of basic error	4.10.2	5.3.2	O	O
5	Test of additional error at switchover point	4.10.3	5.4	O	O
6	Operating voltage range test	4.11	5.3	O	O
7	Transmission distance test	4.12	5.5	O	O
8	Operating stability determination	4.13	5.6	O	O

9	Response time determination	4.14	5.7	O	O
10	Alarm function test	4.15	5.8	O	O
11	Insulation resistance test	4.16	5.9	※	O
12	Dielectric strength test	4.17	5.10	*	O
13	Wind impact test	4.18	5.11	-	O
14	Operating temperature test	4.19	5.12	-	O
15	Storage temperature test	4.20	5.13	-	O
16	Alternative humid and hot test	4.21	5.14	-	O
17	Vibration test	4.22	5.15	-	O
18	Impact test	4.23	5.16	-	O
19	Falling test	4.24	5.17	-	O
20	Element intrinsic safety performance inspection	4.25.2	5.19.2	-	O
21	Enclosure protection performance	4.25.3	5.19.3	-	O
22	Surface insulation resistance test	4.25.4	5.19.4	-	O
23	Enclosure flame retardation performance test	4.25.5	5.19.5	-	O
24	Spark ignition test	4.25.6	5.19.6	-	O
25	Max surface temperature test	4.25.7	5.19.7	-	O

26	Electrical gap and creepage distance test	4.58.8	5.19.8	-	O
Note: In the table, “O” stands for item to be inspected; “-” stands for item not to be inspected; “※” stands for factory inspection of insulation resistance in normal condition only; “*” stands for item to be spot-inspected.					

6.2 Exworks inspection

Manufacturer’s quality department shall inspect every transducer, issue certificate and then deliver.

6.3 Type Test

6.3.1

Type test shall be carried out in any one of the following cases:

- a) when new product is produced or old product is produced at another manufacturer;
- b) if larger changes in structure, material or process after official production may impact product performance;
- c) during normal production, type test of product shall be carried out once every other 3 years;
- d) when production resumes after shut down for 2 years or more;
- e) when there is larger discrepancy between exworks inspection results and previous type test results;
- f) when type test is required by State Administration of Quality Supervision.

6.3.2 Type test shall be carried out responsibly by a state-authorized inspection agency.

6.3.3 Sampling

Not less than 3 samples shall be drawn from sample base of not less than 10 transducers which have passed factory inspection according to method described in GB 10111.

6.3.4 Rules for Judgment

3 transducers shall be inspected. During inspection, the product lot is disqualified if 1 set-item fails to pass 4.9, 4.10.1, 4.10.2, 4.10.3, 4.11, 4.12, 4.13, 4.14, 4.15, 4.25.3, 4.25.6, 4.25.7 or 2 set-items fail to pass other clauses. If 1 set-item fails to pass other clauses than 4.9, 4.10.1, 4.10.2, 4.10.3, 4.11, 4.12, 4.13, 4.14, 4.15, 4.25.3, 4.25.6, 4.25.7, all items of double samples shall be re-checked; if any set-item is still disqualified, the product lot is disqualified.

7 Markings, Package, Operating Instruction Manual, Transport and Storage

7.1 Markings

7.1.1 “Ex”, “MA” and metering tool marks shall be provided at a obvious place on transducer enclosure.

7.1.2 Transducer nameplate shall show the following data:

- a) product model and name;
- b) “Ex” mark at the up-right corner;
- c) anti-explosion mark;
- d) anti-explosion certificate No.;
- e) coalmine safety mark No.;
- f) metering tool manufacture license No.;
- g) model of associated equipment;
- h) major technical parameters;
- i) protection class;
- j) manufacturer’s name;
- k) exworks No. and date.

7.1.3 Package Marks:

- a) Shipment marks shall meet related transportation rules;
- b) Handling marks shall meet GB 191 requirements.

7.2 Package

7.2.1 Package shall be of composite protection type, rain-prof, moist-proof, dust-proof and vibration-proof.

7.2.2 Following documents shall be put into packing boxes:

- a) product certificate;
- b) product operating instruction book;
- c) packing list.

7.3 Operating Instruction Book

Operating instruction book shall be written according to GB 9969.1-1998.

7.4 Transportation

Well-packed products shall be suitable for highway, railway, and waterway and airway transportation.

7.5 Storage

Products shall be stored in a storehouse well-ventilated and free of corrosive gas.