JJG

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OF THE PEOPLE'S REPUBLIC OF CHINA

JJG 882-2004

Pressure Transmitter

压力变送器

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Verification Regulation of the Pressure Transmitter

JJG 882-2004

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Administration organization:

National Pressure Metrological Technology Committee.

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Shanghai Institute of Measurement and Testing Technology.

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Verification Regulation of the Pressure Transmitter

1 Scope

This Regulation applies to the stereotyped identification (or prototype test), initial verification, subsequent verification and in-service inspection of the pressure (including positive and negative gauge pressures, differential pressure and absolute pressure) transmitter.

2 Normative references

This Regulation references the following literature:

JJF 1015-2002 *General norm for pattern evaluation and pattern approval of measuring instruments*

JJF 1016-2002 *The rules for drafting program of pattern evaluation of measuring instruments*

JJG 875-1994 *Verification regulation of digital pressure gauges*

GB/T 17614.1-1998 *Transmitters for use in industrial-process control systems - Part 1: Methods of evaluating the performance*

GB/T 17626.3-1998 *Electromagnetic compatibility - Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*

When using this procedure, care should be taken to use the current valid version of the cited literature.

3 Overview

A pressure transmitter is a meter that converts a pressure variable into a transferable standardized output signal, and has a given continuous function relationship (usually a linear function) between the output signal and the pressure variable, which is mainly used for pressure parameter measurement and control in the industrial process. A differential pressure transmitter is often used for flow measurement.

Pressure transmitters can be divided into electric and pneumatic pressure transmitters. Electric standardized output signals are mainly 0mA to 10mA and 4mA to 20mA (or 1V to 5V) DC electric signals. Pneumatic standardized output

6.2.1 Verification conditions

6.2.1.1 Verification equipment

The standard instrument and ancillary equipment required for the verification can be selected and combined into a set according to the specifications of the pressure transmitter to be verified and by reference to Table 5. A complete set of standard equipment includes the entire verification equipment. During verification, the uncertainty U_{95} of the introduced expansion shall not exceed 1/4 of the absolute value of the maximum allowable error of the pressure transmitter to be verified. For the Level 0.1 and Level 0.05 pressure transmitters to be verified, the introduced U_{95} shall not exceed 1/3 of the absolute value of the maximum allowable error of the pressure transmitter to be verified. Refer to Appendix D for analysis.

6.2.1.2 Ambient conditions

a) Ambient temperature: 20°C ± 5°C, and the change every 10min shall not be greater than 1°C; relative humidity: 45% to 75%.

b) The pressure transmitter should have no effect on the output of the stable mechanical vibration.

c) In addition to the geomagnetic field, there shall be no external magnetic fields affecting its normal working around the electric pressure transmitter.

6.2.1.3 Other conditions

a) Power supply: For the AC power supply pressure transmitters, the voltage change shall not exceed ±1% of the rated value, and the frequency change shall not exceed ±1% of the rated value; for the DC power supply pressure transmitters, the voltage change shall not exceed ±1% of the rated value.

b) Gas source: The gas source pressure of the pneumatic pressure transmitter is 140kPa. The change shall not exceed ±1%. The gas source shall be free of oil and dust. The dew point shall be stable and 10°C below the pressure transmitter shell.

Note: If the pressure transmitter is to be verified on site and the environmental conditions and power conditions on the site do not meet the above requirements, it must be determined by uncertainty assessment. After analysis in the new conditions, only when the uncertainty U_{95} of the introduced expansion of the standard instrument and ancillary equipment still does not exceed 1/3 to 1/4 of the absolute value of the allowable error of the pressure transmitter to be verified can perform the on-site verification.

6.2.2 Verification items

			ammeter as the measurement standard of the output current signals of the electric transmitter.
5	Pressure gauge	Not lower than Level 1.6	Leakage test
6	Insulation resistance meter	Output voltage: DC 500V, 100V Level 10	Insulation resistance verification
7	Withstand voltage tester	Output voltage: AC 0V to 1,500V Frequency: 45Hz to 55Hz Output power: Not lower than 0.25kW	Insulation strength verification
8	Vacuum unit	The vacuum degree of the mechanical and diffusion pumps shall comply with the requirements	Pressure sources of the absolute pressure transmitter and negative pressure transmitter
9	AC voltage regulator	220V, 50Hz, stability of 1%, power of not less than 1kW	AC power supply of the transmitter
10	DC voltage regulator	24V, allowable error of ±1%	DC power supply of the transmitter
11	Air supply device and valuator	Stable output pressure: 126kPa to 154kPa, allowable error of ±1%, free of oil and dust, and the dew point is stable and 10°C below the transmitter shell.	Gas source of the pneumatic pressure transmitter

6.2.3 Verification method

6.2.3.1 Appearance inspection

USE visual observation and power-on inspection, which shall meet the

For the transmitters with adjustable input range, the input range of the pressure transmitter under initial verification shall be respectively adjusted to largest and smallest for verification. For the pressure transmitters under subsequent verification and in-service inspection, they can only be conducted with the verifications of common range or the range specified by the submitting personnel.

d) Adjustment before verification

Before verification, USE the method of changing the input pressure to adjust the output upper and lower limits, so as to be consistent with the theoretical upper and lower limits, which can be generally realized by adjusting the “zero point” and “full range”. For the pressure transmitter with the fieldbus, the “zero point” and “full range” of the input and output sections must be adjusted respectively, and the damping value of the pressure transmitter must be adjusted to zero.

The zero absolute pressure of absolute pressure transmitter shall be as small as possible. The resulting error shall not exceed 1/10 to 1/20 of the allowable error.

e) Verification method

PERFORM smooth input of the pressure signals to each verification point from the lower limits. READ and RECORD the output value until up to the upper limit. Then steadily CHANGE the pressure signals to each verification point in a reverse direction. READ and RECORD the output value until up to the lower limit. The above procedures are one cycle. CONDUCT the verification in such two cycles.

The pressure transmitter under forced verification shall be verified in the above-mentioned cycle for three times.

In the process of verification, it is not allowed to adjust the zero point and range. Do NOT allow to tap and vibrate the transmitter. When getting close to the verification point, the input pressure signals shall be slow enough to avoid overshoot.

f) Measurement error calculation

The measurement error of the pressure transmitter shall be calculated according to the Formula (2).

$$\Delta_A = A_d - A_s \qquad (2)$$

Where:

chamber so that the pressure difference of high and low pressure chambers equals to the upper limit of the differential pressure. MEASURE the output upper limit at the same time. CALCULATE the output range in working pressure status (difference between upper and lower limits). COMPARE with the output range in atmospheric pressure status. CALCULATE the changes in range.

c) Considering the difficulty in measuring the changes in output range under high static pressure, the differential pressure transmitters under subsequent verification and in-service inspection can only be verified the changes in lower limit, while the differential pressure transmitters under stereotyped identification (or prototype test) initial verification shall be verified the changes in lower limit and range. When the pressure in static process of the differential pressure transmitter is greater than 4MPa, and when there are difficulties in testing the changes in output range due to the test device, it is allowed to reduce pressure, but not lower than 4MPa.

6.2.3.6 Verification of insulation resistance

DISCONNECT the power supply from the pressure transmitter. Respectively short CONNECT the power supply terminal with the output terminal. USE an insulation resistance meter to measure the insulation resistance between the power supply terminal and the ground terminal (housing), the power supply terminal and the output terminal, the output terminal and the ground terminal (housing), respectively. During measurement, READ the values after stabilizing for 5s.

Note: When testing the capacitive pressure transmitter, USE an insulation resistance meter with an output voltage of 100V.

6.2.3.7 Verification of insulation strength

DISCONNECT the power supply from the pressure transmitter. Respectively short CONNECT the power supply terminal with the output terminal. According to the requirements of Section 5.4, respectively MEASURE the insulation resistance between the power supply terminal and the ground terminal (housing), the power supply terminal and the output terminal, the output terminal and the ground terminal (housing) on a withstand voltage tester. During measurement, the test voltage shall be increased from zero. Within 5s to 10s, INCREASE to specified value (with an error of not greater than 10%) smoothly and evenly. KEEP for 1min. DECREASE the voltage to zero smoothly. CUT off the test voltage as well.

Note: When testing the pressure transmitter, a withstand voltage tester with alarm current settings can be used. The setting value is generally 10mA. When using this instrument, CONSIDER whether the alarm is given as the basis for determining whether the insulation strength is qualified.

Appendix B

Test items and methods for stereotyped identification (or prototype test)

CONDUCT the stereotyped identification test (or prototype test) according to relevant clauses in GB/T 17614.1-1998 *Transmitters for use in industrial-process control systems - Part 1: Methods of evaluating the performance*. According to the characteristics of the pressure transmitter, the following items shall be selected for the test. The technical indicators shall consider the transmitter manufacturing plant's technical specifications. For some test items that need to simplify the procedures due to the test device and other reasons, CONSULT with the manufacturing plant, and INDICATE in the test report.

B.1 Appearance

According to the requirements of Section 5.1 in this Regulation, USE visual observation method. For the transmitters with display units, INSPECT the display function during electrification.

B.2 Tightness

In accordance with the methods in Section 6.2.3.2 of this Regulation.

B.3 Measurement error

CONDUCT the test according to the verification method in Section 6.2.3.3 of this Regulation under the verification conditions in Section 6.2.1 of this Regulation.

B.4 End-based consistency

End-based consistency refers to the maximum deviation between the actual error curve (mean value of the up and down stroke readings) and this straight line, when the actual error curve of the transmitter output coincides with the straight line in the range of the upper and lower limits.

End-based consistency results can be obtained by the following method: DRAW a straight line on the basis of measurement error test so that the upper and lower limits within the measurement range coincide with the actual error curve. CALCULATE the maximum deviation between the average error curve of the up and down strokes and the straight line.

B.5 Hysteresis

In accordance with the Section 6.2.3.4 of this Regulation.

decreases to below 25°C within not less than 1h. KEEP the test chamber closed so as to achieve saturation within this period of time. DETERMINE and RECORD the maximum change in range lower limit and range due to this condition.

After the end of the test, CONDUCT visual measurement to check whether there are jump spark marks, condensate accumulation, element damages, etc.

After 24h under the environmental conditions, DETERMINE the transmitter's error with an interval of about 20% of the range of the rise and fall signals. Furthermore, COMPARE with the error measured under previous environmental conditions. RECORD the error variation.

B.11 Installation position effects

The changes in range lower limit and range due to ±10° tilt from the position specified by the manufacturing plant shall be measured and recorded. A total of four tilt measurements shall be made on the two planes at right angles to each other.

B.12 Dumping

It is allowed to implement according to the method of surface dumping. The procedures are as follows.

The transmitter is placed in a flat, solid cement or steel rigid plane and tilts along a bottom edge according to its normal use position so that the distance from its opposite edge to the test plane is 25mm, 50mm or 100mm (its value is selected by the manufacturing plant or users), or MAKE an angle of 30° between the transmitter bottom and the test plane. SELECT a less demanding condition, and then let it fall to the test plane free.

Each of the four bottom edges of the transmitter shall undergo dumping once.

After this test, CHECK whether the transmitter is damaged. RECORD any changes in range lower limit and range. VERIFY whether the transmitter can be readjusted to previous performance.

B.13 Vibration effects

The purpose of this test is to measure the changes in lower limit and range caused by the mechanical vibration that may be encountered in the work, followed by ensuring the strength of the transmitter to meet the requirements.

Unless otherwise provided by the manufacturing plant, this test shall be conducted according to the following rules.

1) The vibration test shall be carried out when the transmitter has a normal

For some types of transmitters, the test procedures shall be determined jointly with the manufacturing plant.

Note: If over range generates significant thermal effects, the duration of the applied range shall increase sequentially.

B.15 Stability

B.15.1 Initial drift

This test is performed by measuring the change in output that occurs over a period of time after the transmitter is connected with the energy (power or gas source). Before the test, the transmitter shall be placed under atmospheric conditions or the conditions put forward by the manufacturing plant for 24h, without connecting with the energy.

APPLY 10% of the input signal to the transmitter. CONNECT with the energy. RECORD the output value after 5min, 1h and 4h. The energy of the transmitter is then disconnected. The test is repeated at 90% of the input signal after placing the transmitter under the atmospheric conditions for at least 24h. The measurement results are recorded to show the short-term drift characteristics of the transmitter.

B.15.2 Long-term drift

The transmitter operates at steady input signals equivalent to 90% of the range for 30 days. MEASURE the input and output on a daily basis. Output drift is determined and corrected by calculating any small input changes. It is important to note that, in addition to time, changes due to ambient conditions do not obscure the effects of long-term drift. MEASURE and RECORD the range lower limit and range in time before and after the 30-day test period.

B.15.3 Accelerated operating life test

Transmitters consisting of mechanical or electrical-mechanical components shall be connected in a normal operating condition. APPLY an initial alternating input signal having a peak-to-peak amplitude equal to 1/2 of the range and centered at the mean value of the upper and lower limits of the range. The frequency shall ensure that the gain is not reduced below 0.8. Unless otherwise agreed with the manufacturing plant, the transmitter shall withstand 10^5 measurement cycles. Before and after the test, MEASURE the lower limit of the range as well as the hysteresis between the range and the range midpoint. RECORD any changes.

B.16 Power distortion effects (not applicable to pneumatic pressure transmitters)

The output of the transmitter is set to the upper limit of the range. The supply voltage is reduced to 75% of the nominal value for 5s. RECORD the output changes, transient amplitude and duration.

B.16.4 Instantaneous overvoltage of mains supply

The spike voltage shall be superimposed on the mains supply. The peak energy shall be 0.1J. The peak amplitude shall be 100%, 200% or 500% of the overvoltage (percentage of the nominal mains supply's root-mean-square voltage). The spike voltage can be generated either by capacitor discharge or by any device that can give an equivalent waveform.

The power cord shall be protected with a suitable suppression filter, and shall contain at least a 500μH choke that can carry the line power supply.

Two pulses of the same amplitude as the mains supply peak voltage or at least 10 pulses of random phase relative to the mains supply shall be applied. Any transient or DC output changes present on the transmitter output shall be recorded.

B.17 RF interference effects (not applicable to pneumatic pressure transmitters)

The transmitter is tested with a steady input signal equivalent to 90% of the range. CONDUCT the test as specified in GB/T 17626.3-1998. SELECT the severity level, usually Level 2 (with a frequency of 80MHz to 1GHz, an electric field strength of 3V/m). OBSERVE and RECORD the effect of RF interference on output.

B.18 Magnetic interference effects (not applicable to pneumatic pressure transmitters)

The objective of this test is to determine the effect of alternating magnetic fields at the mains frequency on the transmitter output.

The transmitter shall be exposed to a 400 A/m (RMS) magnetic field aligned to the main axis of the transmitter. DETERMINE the effect of the magnetic field on the DC level and output ripple content, when the output signal is 10% and 90% of the range. This test shall also be repeated in the other two axial directions where the magnetic field alignment is perpendicular to the first axial direction.

Note: A magnetic field of approximately 400 A/m is obtained at or near the center of a toroidal coil having a diameter of 1m and carrying 5A current and 80 turns.

B.19 Output open and short circuit effects (not applicable to pneumatic pressure transmitters)

B.22 Step response

A series of step changes shall be applied to the input of the transmitter as described below. The rise time of the step input shall be relatively smaller than the response time of the transmitter. The following time shall be recorded.

a) APPLY a step signal corresponding to 80% of the output range, from 10% to 90%, then from 90% to 10%.

b) APPLY a step signal corresponding to 10% of the output range. RISE and FALL in the following order: 5% to 15%, 45% to 55% and 85% to 95%.

For each test condition, the time to reach and maintain the steady-state value within 1% of the range shall be measured.

If there is time delay and overshoot, LIST them in the report.

Note: In the case of an exponential response, the time equivalent to 63% and 95% of the input step can also be used.

B.23 Frequency response

When the peak-to-peak amplitude of the sinusoidal signal applied to the input is remained at a relatively low value (up to 20% of the range), it should be sufficient to allow efficient measurements. The frequency of the input signal shall be incrementally increased to a higher frequency from a sufficiently low initial value close to the zero frequency condition (no more than 0.005Hz) at which the output approximately attenuates to half of its original amplitude.

At least one complete input and output cycle shall be recorded at each frequency step.

These test results are plotted on logarithmic coordinates.

a) Amplitude-frequency characteristics. The curve of the gain with respect to the zero frequency gain versus frequency.

b) Phase-frequency characteristics. The curve of the phase lag between input and output versus frequency.

B.24 Insulation resistance (not applicable to pneumatic pressure transmitters)

In accordance with the Section 6.2.3.6 of this Regulation.

B.25 Insulation strength (not applicable to pneumatic pressure transmitters)

Appendix E

Format of verification certificate and verification result notice (inner pages)

E.1 Format of verification certificate (inner pages)

1. Model specifications

   Measuring range:

   Output range:

2. Verification environment

   Temperature: °C

   Relative humidity: %RH

3. Verification location

4. Verification results

Verification item	Allowable error	Conclusion (or actual maximum error)
Appearance		
Tightness		
Insulation resistance		
Insulation strength		
Measurement error		
Hysteresis		
Static pressure effects		

E.2 Format of verification result notice (inner pages)

The format is the same as above. Unqualified items are required to be indicated.

END

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