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JB/T 9249-1999

Replacing ZB N12 008-89

Vortex shedding flow transducer

涡街流量传感器

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Foreword

This Standard is the revision of ZB N12 008-89 "Vortex shedding flow transducer".

There is no main technical differences between this Standard and ZB N12 008-89. Only editorial changes are made on the basis of the previous standard.

From the implementation date of this Standard, ZB N12 008-89 is replaced by this Standard.

This Standard was proposed by and shall be centralized by National Industrial Process Measurement and Control Standardization Technical Committee.

The drafting organization of this Standard: Shanghai Institute of Process Automation Instrumentation.

Vortex shedding flow transducer

1 Scope

This Standard specifies the definition, product category, technical requirements, test methods and inspection rules of vortex shedding flow transducer.

This Standard is applicable to liquid and gas vortex shedding flow transducers with pulse signal output (hereinafter referred to as the transducer). It is also applicable to the transducer of vortex shedding flow transmitter with standardized signal output as well as the transducer of vortex shedding flowmeter with flow display.

2 Normative references

The following standards contain the provisions which, through reference in this Standard, constitute the provisions of this Standard. At the publication of this Standard, the editions indicated are valid. All standards shall be revised. The parties who use this Standard shall explore the possibility of using the latest version of the following standards.

GB 191-1990 Packaging - Pictorial marking for handling of goods

GB/T 2555-1981 Pipe flange connectors for ordinary use - Mounting dimensions

GB/T 2556-1981 Pipe flanges for ordinary use - Sealing surfaces - Forms and dimensions

GB 3836.1-1983 Electrical apparatus for explosive atmosphere - General requirements

GB 3836.2-1983 Electrical apparatus for explosive atmosphere - Flameproof electrical apparatus "d"

GB 3836.3-1983 Electrical apparatus for explosive atmosphere - Increased safety electrical apparatus "e"

GB 3836.4-1983 Electrical apparatus for explosive atmospheres - Intrinsically safe circuits and electrical apparatus "i"

GB/T 9248-1988 Methods of evaluating the performance of flowmeters for

incompressible fluids

GB/T 15464-1995 General-purpose specification for the packaging instrumentation products

JB/T 9329-1999 Basic environmental conditions and testing methods for instruments transportation and storage in the transportation

3 Definitions

This Standard uses the following definitions.

3.1 Vortex shedding flow transducer

Flow transducer that adopts placing an un-streamlined vortex body in fluid. The fluid alternatively separates and releases two strings of vortex on both sides of the vortex body, which are regularly and crisscross lined. Within a certain range, vortex's separation frequency is proportional to the flow. And the vortex frequency can be detected by various types of detectors.

It comprises of housing, vortex body, detecting element and amplifier.

3.2 Amplifier

The device that amplifies and reforms the signal output by detecting element.

3.3 Meter factor

The number of pulses output from per unit volume of fluid through the sensor.

3.4 Mean meter factor

The arithmetic mean value of the maximum value and the minimum value among meter factors of each measurement point, within the predetermined flow range, represented by $\overline{K}$.

3.5 Resistance factor

Factor relating to pressure loss when the fluid goes through the transducer, represented by C_d .

3.6 Linearity

The degree of consistency between calibration curve and stipulated line, i.e., the ratio BETWEEN the half value of the maximum value and the minimum value AND the average meter factor, represented by percentage.

Gas: air under 20°C and 101325Pa.

4.2.5 Range

The transducer's range shall be selected from the following numeral systems.

6, 7, 8, 10, 11, 12, 15, 20, 25, 30.

4.2.6 Measured mediums

The measured mediums shall comply with the requirements in Table 2.

Table 2

Measured medium	Gas-liquid universal	Liquid	Gas
Mark number	1	2	3

4.2.7 Temperature range

The transducer's range of working temperature shall be selected among the following numeral systems of upper temperature limit and lower temperature limit.

Upper temperature limit: 50, 80, 120, 200, 250, 300, 400°C;

Lower temperature limit: 0, -10, -20, -40, -80, -120, -200°C.

Thermal vortex shedding flow transducer's absolute value of the difference between the upper limit and the lower limit temperature shall be greater than 50°C.

4.2.8 Power supply

The transducer's power supply shall use AC power supply of which the frequency is 50 HZ; the root-mean-square voltage is 220 V. It may also use DC power supply.

DC power supply voltage shall be selected from the following numeral systems.

12, 24, (36) V.

Note: Values in brackets are not recommended to use.

4.2.9 Output signal

The transducer's output signal is pulse signal, in which:

Voltage pulse: low level 2V; high level 6V.

Current pulse: low level is 4mA±0.25mA; high level is 20mA±1mA.

resistance coefficient shall not be greater than 2.4.

5.6 Compressive strength

The transducer shall be able to withstand the compressive strength test of 1.5 times nominal pressure and 5 min. There shall be no damage nor leakage.

5.7 Power supply voltage variation

When power supply voltage varies between -15% ~ +10% of nominal value, the deviation BETWEEN meter factors of the transducer's all measurements points AND the original calibrated average meter factor of this transducer shall be within the permissible basic error limit range, and comply with the requirements of 5.2, 5.3 and 5.4.

5.8 Power supply frequency variation

When power supply frequency varies between -5% ~ +5% of rated value, the deviation BETWEEN meter factors of the transducer's all measurements points AND the original calibrated average meter factor of this transducer shall be within the permissible basic error limit range, and comply with the requirements of 5.2, 5.3 and 5.4. (This article is only applicable to AC power supply transducer.)

5.9 Output signal

When the transducer's loading resistance varies within the range specified by the manufacturer, the level value of pulse signal shall comply with the requirements of 4.2.9.

5.10 Insulation resistance

The insulation resistance among the transducer's power supply terminal, output terminal and housing shall not be less than 20MΩ.

5.11 Insulation strength

5.11.1 DC power supply transducer

Between the transducer's power supply terminal and housing, between output terminal and housing, it shall withstand the insulation strength test of which the frequency is 50Hz, the voltage is 500V and the time is 1min. There shall be no breakdown or arcing.

5.11.2 AC power supply transducer

Between the transducer's power supply terminal and housing, between output terminal and housing, it shall withstand the insulation strength test of which the

frequency is 50Hz, the voltage is respectively 1500V and 500V, and the time is 1min. There shall be no breakdown or arcing.

5.12 Effect of external magnetic field

Under the effect of external magnetic field of which the frequency is 50Hz, and the magnetic field intensity is 400A/m, the deviation BETWEEN meter factors of the transducer's all measurements points AND the original calibrated average meter factor of this transducer shall be within the permissible basic error limit range, and comply with the requirements of 5.2, 5.3 and 5.4.

5.13 Appearance

The outer surface of the transducer shall be well treated. There shall be no peeling, flaking or other defects on the outer surface coating; no damage on the sealing surface; no loosening fasteners. All visible writings and symbols shall be clear.

5.14 Anti-transport environmental performance

The transducer shall comply with the requirements in JB/T 9329 under the conditions of transport packaging. After the test, the deviation BETWEEN meter factors of the transducer's all measurements points AND the original calibrated average meter factor of this transducer shall be within the permissible basic error limit range, and comply with the requirements of 5.2, 5.3, 5.4 and 5.6. The high temperature uses +55°C, the low temperature uses -40°C, falling shall be free fall and its height shall be 100mm.

5.15 Explosion-proof performance

Explosion-proof performance of the explosion-proof transducer shall comply with relevant requirements in GB 3836.1 ~ 3836.4.

6 Test methods

6.1 Test equipment and test conditions

6.1.1 Test equipment

- a) The transducer's linearity and repeatability tests shall use volumetric method, weighing method or standard meter method. Three methods have same effect.
- b) The basic error limit of flow calibration device must be less or equal to $\frac{1}{2}$ of the basic error limit of the transducer to be calibrated. When it is greater than $\frac{1}{3}$, the basic error of the calibration device must be taken into

Ripple voltage: less than 1.0% of nominal value (DC power supply).

d) Other environmental conditions

External magnetic field: it shall make other magnetic fields negligible except the Earth's magnetic field;

Mechanical vibration: negligible.

e) Test mediums

Liquid: water;

Gas: air.

6.2 Basic error and repeatability tests

The transducer's basic error and repeatability tests shall be conducted according to methods and steps specified in 6.2.1.

6.2.1 Test methods and steps

a) Horizontally install the transducer on the flow calibration device according to the requirements in 5.1 and 6.1.2b. Conduct the test after running in the upstream flow for 5min.

b) According to the transducer's flow range, select Q_{min} , $0.15Q_{max}$, $0.25Q_{max}$, $0.4Q_{max}$, $0.7Q_{max}$ and Q_{max} , 6 flow points in all (Q_{min} and Q_{max} respectively represent the minimum flow value and the maximum flow value). The actual flow value of each flow point shall not exceed $\pm 5\%$ of the predetermined value. When $Q_{min} > 0.15Q_{max}$, it shall be allowed to select five flow points.

Note: Under the premise of quality assurance, it allows to reduce or choose flow points to conduct factory inspection.

c) Conduct single stroke calibration according to the specified flow points. Continuous measurement of each point shall not be less than three times.

6.2.2 Calculation of average meter factor $\overline{K}$

a) Calculate the meter factor of each measurement of each flow point, according to equation (2):

$$K_i = \frac{N_i}{V_i} \dots\dots\dots (2)$$

frequency is 50Hz and the voltage is the value stipulated in 5.11, to conduct the insulation strength test between the transducer's power supply terminal and housing, output terminal and housing. When conducting the test, set the voltage of test equipment as 50% of the test voltage, then connect to the transducer, so as to make the test voltage smoothly raised to a predetermined value for 1min. There shall be no breakdown or arcing.

6.10 Test of external magnetic field effect

Place the transducer on the equipment of external magnetic field test, so as to make magnetic field strength reach a predetermined value. Change magnetic phase to make the transducer under the most unfavorable conditions. Conduct the basic error, linearity and repeatability tests according to the method in 6.2.

6.11 Appearance inspection

Adopt self-test inspection.

6.12 Transport environmental performance test

Conduct transport environmental performance test according to the test method in JB/T 9329.

6.13 Explosion-proof performance test

Conduct the test according to the provisions in 5.15 by explosion test institutes authorized by national authorities.

7 Inspection rules

The transducer's inspection is divided into factory-exit inspection and type inspection.

7.1 Factory-exit inspection

7.1.1 The transducer can leave the factory only when it is inspected as qualified with product certificate by relevant department of the manufacturer.

7.1.2 The transducer's factory inspection items are 5.2, 5.3, 5.4, 5.6, 5.9, 5.10, 5.11 and 5.13.

7.2 Type inspection

7.2.1 In case one of the following situations, type inspection shall be conducted for the transducer, according to all technical requirements and corresponding test methods of this Standard.

- a) Test type identification of new products or old product for transferring production;
- b) When there are significant changes in structure, material and process that may affect the product performance after formal production;
- c) Periodic inspection of batch production;
- d) When production is resumed after it is stopped for a long time;
- e) When there is significant difference between factory inspection result and the previous type inspection result;
- f) When state administration of quality supervision agency requires for type inspection.

8 Mark, packaging and storage

8.1 Product mark

8.1.1 There shall be permanent marks of representing fluid flow on significant parts of the transducer housing.

8.1.2 There shall be a nameplate on an appropriate place of the transducer. The nameplate shall be indicated by:

- a) Manufacturer's name;
- b) Product name and model;
- c) Manufacturing date (or number) or production batch number;
- d) Average meter factor, $\overline{K}$;
- e) Accuracy grade;
- f) Nominal pressure;
- g) Power supply;
- f) Explosion-proof grade and "explosion-proof certificate" number.

These items can be added or deleted according to the actual situation. However, a), b), c) and e) must be marked. Item h) must be added for explosion-proof product.

8.1.3 Packaging mark

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