JJG

National Metrological Verification Regulation

of the People's Republic of China

JJG 1107-2015

Automatic Standard Pressure Generators

自动标准压力发生器

Issued on: February 9, 2015 **Implemented on: May 9, 2015**

Issued by: General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China.

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Verification Regulation of Automatic Standard Pressure Generators

1 Scope

This Regulation applies to the initial verification, subsequent verification, and in-service inspection of -0.1 ~ 250MPa automatic standard pressure generators (hereinafter referred to as “pressure generators”).

2 Normative references

This Regulation references the following documents:

JJG 875-2005 Verification Regulation of Digital Pressure Gauges

JJF 1001-2011 General Terms in Metrology and Their Definitions

JJF 1008-2008 Pressure Metrological Terms and Their Definitions

For dated references, only the versions with the dates indicated are applicable to this Regulation. For undated references, the latest versions (including all the amendments) are applicable to this Regulation.

3 Terms and units of measurement

3.1 Terms

3.1.1 Automatic standard pressure generator

It refers to the digital pressure gauge that can realize automatic control and display output target pressure.

3.1.2 Control stability

It refers to the ability of pressure generators whose output pressure can maintain within the limited boundary within a certain time limit.

3.1.3 Overshoot of pressure control

It refers to the maximum level for the pressure generators to exceed the target pressure value in the process of controlling the pressure-increase.

3.1.4 Undershoot of pressure control

It refers to the maximum level for the pressure generators to be lower than the target pressure value in the process of controlling the pressure-decrease.

3.1.5 Stable duration of target pressure

It refers to the time for the pressure generators to maintain the stable output target

7 Control of metrological instruments

The control of metrological instruments includes initial verification, subsequent verification, and in-service inspection.

7.1 Verification conditions

7.1.1 Standard pressure gauge

7.1.1.1 Selection of the standard pressure gauges with measurement function

SELECT the standard pressure gauge with measurement function for verifying the pressure generators from the following instruments:

a) Piston gauges (including single and double piston type pressure vacuum gauges, and gas piston gauges);

b) Float-type manometers;

c) Liquid manometers;

d) Automatic standard pressure generators;

e) Digital pressure gauges.

The measuring range of the selected standard pressure gauge shall be greater than or equal to that of the pressure generators. The absolute value of the maximum permissible error of standard gauges shall be less than 1/3 of the absolute value of the maximum permissible error of the indicating values of the under-verification pressure generators. For those pressure generators with above class-0.05 (including 0.05), when the piston gauge is selected to be standard gauge, the absolute value of the maximum permissible error of standard gauges shall be less than 1/2 of the absolute value of the maximum permissible error of the indicating values of pressure generators.

7.1.1.2 Selection of the standard gauges with control function

Respectively SELECT the standard pressure gauge with control function and the test system with control function (hereinafter referred to as “test system”) for verifying the pressure generators from the following instruments and systems:

a) Digital pressure gauges with high resolution;

b) The system composed of measuring transducer, acquisition system, and display.

The measuring range of the selected test system shall be greater than or equal to that of the pressure generators. The absolute value of the maximum permissible error of test systems shall not be greater than that of the indicating values of pressure generators, while the resolution shall be greater than 1/10 of the absolute value of the maximum permissible error of the indicating values of the under-verification pressure generators. For those above class-0.01, the sampling frequency of the test system shall not be lower than 10Hz. For those below class-0.02 (including 0.02), the sampling frequency of the test system shall not be lower than 20Hz.

7.1.2 Auxiliary equipment

7.1.2.1 Insulation resistance tester: DC 100V, DC 500V, 10 levels.

7.1.2.2 Withstand voltage tester: The output voltage shall be AC 0~1.5kV. The frequency is 45~55Hz. The output power shall not be lower than 0.25kW.

7.1.2.3 Pressure source: cylinders, manual pressure (vacuum) pumps, air compressors, vacuum pumps, booster pumps, etc.

7.1.2.4 Other equipment: stopwatch, etc.

7.1.3 Conditions of verification environment

7.1.3.1 Ambient temperature:

For the pressure generators with above class-0.1 (including 0.1): (20 ± 2) °C; For the pressure generators with below class-0.2 (including 0.2): (20 ± 5) °C.

7.1.3.2 Relative humidity: not greater than 85%.

7.1.3.3 No obvious mechanical vibration or external magnetic field (excluding the geomagnetic field) shall exist near the standard gauges and the under-verification pressure generators.

7.2 Verification items

See Table 4 for the verification items of pressure generators.

Table 4 Table for Verification Items

Verification Items	Initial Verificatio	Subsequent Verification	In-service Verification
6.1 Appearance	+	+	+
6.2 Insulation resistance	+	+	-
6.3 Insulating strength	+	-	-
6.4 Tightness	+	-	-
5.2.1 Indication error	+	+	+
5.2.2 Return error	+	+	+
5.2.3 Zero drift	+	+	-
5.2.4 Periodic stability	-	+	-
5.3.1 Control stability	+	+	+
5.3.2 Overshoot (Undershoot) of pressure control	+	+	-
5.3.3 Stable duration of target pressure	+	+	-
5.3.4 Response time of control	+	+	-

on the same horizontal plane. When the two reference positions are not on the same horizontal plane, the absolute value of the additional error of verification caused by the altitude difference of reference positions shall not be greater than 1/10 of the absolute value of the maximum permissible error of the indicating values of pressure generators. Otherwise, it shall conduct the correction to the additional error. See Annex E for the correction methods.

7.3.1.5 Selection of verification points and verification cycle times

During the verification of the measurement function of pressure generators, for accuracy class that is class-0.05 and above, the verification points shall not be less than 10 (including 0); for class-0.1 and below, the verification points shall not be less than 5 (including 0); the verification points shall not be less than 5 (including 0). The selected verification points shall be evenly distributed within the entire measuring range. The verification cycle of the pressure-increase and pressure-decrease of the pressure generators with different indicating values and accuracy class shall be twice.

During the verification of the control stability and the overshoot (undershoot) of pressure generators, SELECT at least 6 points of the pressure generators with different accuracy class as the points of target pressure value. The selected control points shall be evenly distributed within the entire measuring range. For the pressure generators with positive gauge pressure, the verification points shall include the pressure points that is not higher than 10% of the range of the measurement lower-limit. For the composite-ranged pressure generators with positive and negative gauge pressure, the selected verification points on the negative pressure section shall not be less than 2, and shall be evenly distributed within the range of negative pressure section as possible. The verification cycle of the pressure-increase and pressure-decrease shall be twice.

During the verification of the stable duration of target pressure, SELECT at least 3 points of the pressure generators with different accuracy class as the control points. The selected control points shall be evenly distributed within the entire measuring range. For the pressure generators with positive gauge pressure, the verification points shall include the pressure points that is not higher than 10% of the range of the measurement lower-limit. For the composite-ranged pressure generators with positive and negative gauge pressure, the selected verification points on the negative pressure section shall not be less than 1, and shall be evenly distributed within the range of negative pressure section as possible. During the verification of the response time of control, SELECT the verification points that can complete 20% step-value within the measuring range as the starting and finishing points of control. At least COMPLETE the control of three-sections 20% step-value that includes the measurement upper-limit (or lower-limit) as the pressure verification points; the three-sections 20% step-value shall be evenly distributed within the entire measuring range. The verification cycle of the pressure-increase and pressure-decrease shall be once.

7.3.1.6 Before verifying the measurement function of pressure generators, CONDUCT the pre-pressure (evacuation) test once or twice. During the verification, the pressure-increase (evacuation) and the pressure-decrease (pressurization) shall be steady, so as to avoid shock and overpressure. READ the numerical values on various verification points after the pressure values become stable. MAKE the records. During the verification, it is prohibited to knock or vibrate the pressure generators.

During the verification of control stability, RECORD down the pressure value of the test system when the pressure generator controls the pressure-increase (pressure-decrease) until the pressure value on the next verification point becomes stable. In the process of pressure-increase (pressure-decrease), the absolute value of the difference between the maximum (minimum) indicating value of the test system and the indicating value of the test system after the pressure value on the verification point becomes stable is the overshoot (undershoot) of pressure control. CALCULATE according to the Formula (5). The overshoot (undershoot) shall meet the requirements of Article 5.3.2.

$$\Delta p_{Ck} = | p_{Bk} - p_k | \qquad (5)$$

Where:

Δp_{Ck} – The overshoot (undershoot) of pressure control on the k^{th} verification point;

p_{Bk} – The maximum (minimum) indicating value of the test system in the process of pressure-increase (decrease) on the k^{th} verification point;

p_k – The indicating value of the test system after the pressure value on the k^{th} verification point becomes stable.

7.3.7.3 Stable duration of target pressure

At a predetermined verification point, control pressure of pressure generator shall not exceed the duration that is allowed by the control stability; if it is more than 2min, then RECORD it as 2min; the recording time shall meet the requirements of 5.3.3.

7.3.7.4 Control response time

RECORD the pressure generator's pressure-increase and pressure-decrease measurement-range 20% step-value; RECORD the time that is needed from the control starting point to the control finishing point of selected pressure verification-point; the recording time shall meet the requirements of 5.3.4.

7.3.8 Verification of additional functions

Verification of additional functions of pressure generators shall be executed according to corresponding metrological verification regulations.

7.4 Processing of verification results

After verification of the pressure generator, if the metrological performance and general technical requirements comply with the provisions of this Regulation, then it is deemed as qualified, Verification Certificate (see Appendix C for the format) is issued; if any specific item does not comply with the provisions of this regulation, then it is deemed as unqualified, Verification Result Notice (see Appendix D for the format) is issued, and it indicates the failed item(s) and content; for pressure generator of which the periodic stability is not qualified, and, after the commissioning, the verification of indication value is qualified, then Verification Certificate is issued, and it indicates "this pressure generator can not be used as a standard tester to conduct metrology". For initial-verification pressure generator, it shall indicate "the first-time verification-submission, verification of

Appendix B

Verification recording format of control functions of automatic standard pressure generator

Recording serial number: Verification / calibration date: YY MM DD

Application organization		
Type / Instrument information	Device under-verification	Standard device
Instrument name		
Model specifications		
Manufacturing organization		
Instrument serial number		
Measurement range		
Accuracy class		
Verification personnel:		Confirmation personnel:

Verification point ()	Within 30s, measurement system's indication value ()								Control stability ()
	1st cycle				2nd cycle				
	Positive-stroke		Reverse-stroke		Positive-stroke		Reverse-stroke		
	Maximum value	Minimum value	Maximum value	Minimum value	Maximum value	Minimum value	Maximum value	Minimum value	

Verification point ()	Measurement system's indication value, during pressure-increase / pressure-decrease				Control overshoot / undershoot ()
	Positive-stroke		Reverse-stroke		
	Maximum value	Average of indication value	Maximum value	Average of indication value	

Permissible error of control stability:	Maximum value of control stability:
Permissible error of pressure control overshoot (undershoot):	Maximum value of pressure control overshoot (undershoot):
Maximum value of control response time:	Duration of target pressure stability:
Conclusion:	

Appendix D

Format of verification result notice (inner pages)

Verification Result

1. Appearance inspection:
2. Zero drift:
3. Indication value error:
4. Return error:
5. Periodic stability:
6. Control stability:
7. Pressure control overshoot (undershoot):
8. Duration of target pressure stability:
9. Control response time:
10. Verification data:

Indication value of standard device ()	Average of indication value of pressure generator ()

Note: The non-qualified item(s) and the contents are:

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