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Standard

Laboratory Measurement of Aerodynamic Noise Generated by Control Valves

ISA-S75.07 —Laboratory Measurement of Aerodynamic Noise Generated by Control Valves

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1 Scope

This standard defines equipment, methods, and procedures for the laboratory testing and measurement of airborne sound radiated by a compressible fluid flowing through a control valve and its associated piping, including fixed-flow restrictions. The test may be conducted under any conditions mutually agreed upon by the user and the manufacturer. Although this standard is designed for measurement of the noise radiated from the piping downstream of the valve, other test variations are optional, including the use of insulation and nonstandard piping. (See 4.3.) Applications of this standard to control valves discharging directly to atmosphere are excluded from this standard.

2 Purpose

The purpose of this standard is to provide a procedure for testing, measuring, and reporting the aerodynamic noise-generating characteristics of a control valve and its associated piping.

3 Test system

The test system is shown in Figures 1, 2, and 3. The various parts are described below.

3.1 Throttling valves

The upstream and/or downstream throttling valves (optional) are used to regulate the test pressures. Caution should be taken to avoid pressure drops which will create significant stream-borne noise. If such pressure drops are unavoidable, then silencers must be used.

3.2 Test specimen

The test specimen is any valve, combination of valves, fixed restrictions, and associated piping components for which data are required. The test specimen and test section shall not be insulated, although optional tests may be conducted to determine the effect of insulation. (See 4.3.)

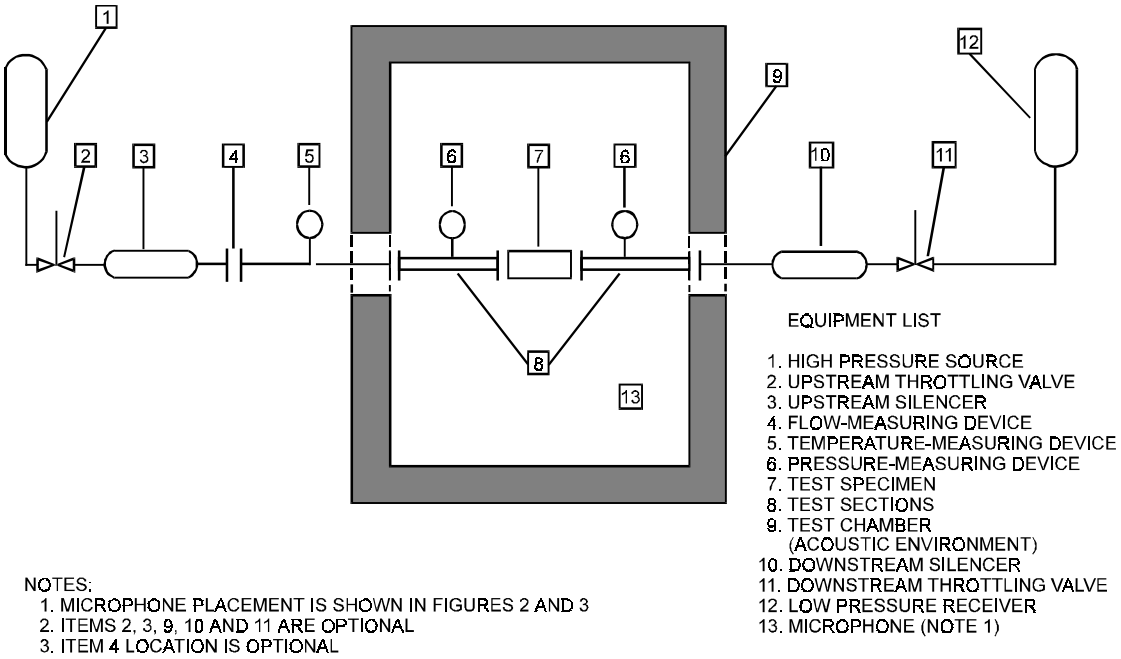
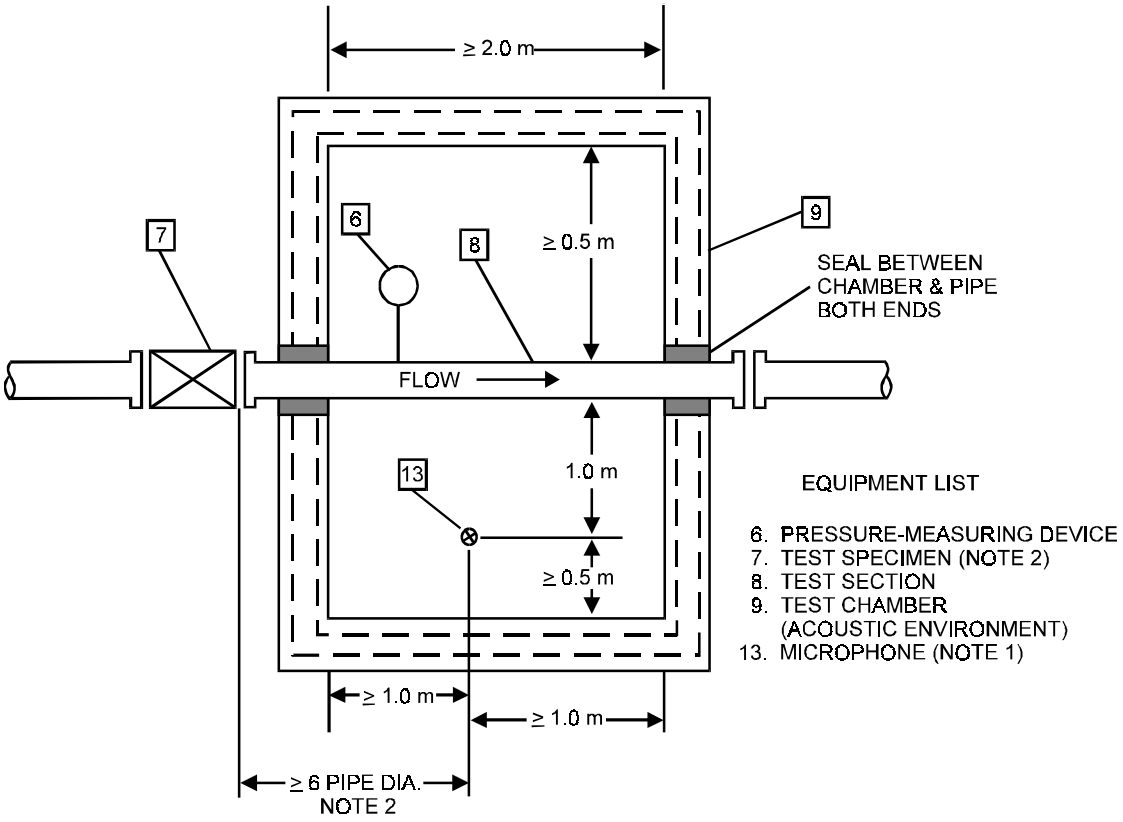


Figure 1 — Control valve noise test — system components



NOTES:

1. THE MICROPHONE SHALL BE LOCATED AT A DISTANCE OF 1.0 m FROM THE OUTER SURFACE OF THE PIPE AND SHALL BE NO CLOSER THAN 0.5 m FROM THE NEAREST CHAMBER SURFACE.
2. SEE 4.2. THE TEST SECTION AND TEST SPECIMEN SHOULD BE AS CLOSELY COUPLED AS PHYSICALLY POSSIBLE.

Figure 2 — Test arrangement for test specimen outside test chamber

3.3 Test section piping

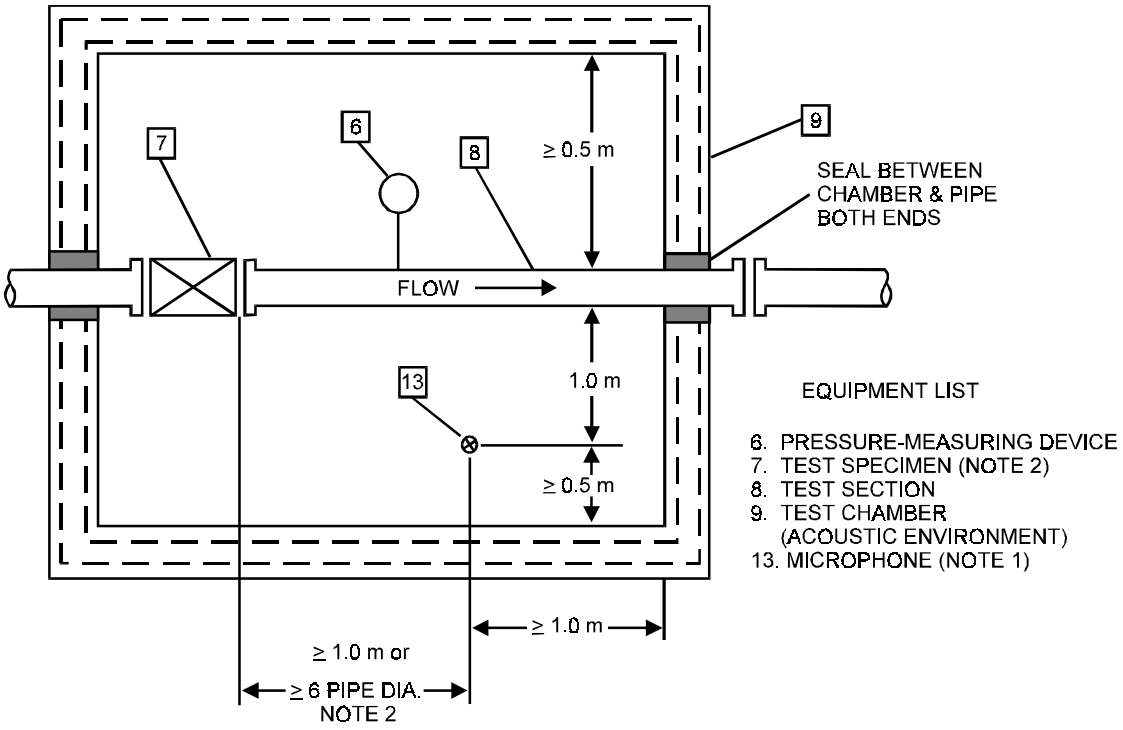
There is no limitation concerning the maximum length of upstream and downstream piping connected to the test specimen. The exposed pipe within the acoustic environment shall be a minimum of 2.0 meters (m) in length, free of mechanical joints except for the connections between the test specimen and test section (upstream or downstream pipe, depending upon the test conducted). Piping for each side of the test section shall be ANSI Schedule 40 steel pipe for valves through 10 inches (250 mm) body size, having pressure ratings up to ANSI Class 600. Pipe having 0.375 inches (10 mm) wall thickness shall be used for sizes ranging from 12 inches (300 mm) through 24 inches (600 mm).

An effort should be made to match the test specimen inlet and outlet inside diameters with those of the adjacent piping for valve sizes exceeding the above-mentioned limits. Un-insulated pipe

shall be used. Other pipe schedules, pipe materials, or insulated piping may be used for optional tests. (See 4.3.)

3.4 Pressure taps

Pressure taps shall be provided for the measurement of pressures, and the taps shall conform to ANSI/ISA-S75.02-1996, *Control Valve Capacity Test Procedures*, 3.6.



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2. SEE 4.2. THE TEST SECTION AND TEST SPECIMEN SHOULD BE AS CLOSELY COUPLED AS PHYSICALLY POSSIBLE.

Figure 3 — Test arrangement for test specimen inside test chamber

3.5 Acoustic environment

The test environment shall be controlled such that background noise, reflected noise, and other extraneous noise sources are at a minimum of 10 dB lower than the noise radiated by the test section. Depending upon the test system and the acoustic environment, upstream and/or downstream silencers may be necessary. General recommendations for the acoustic

environment can be found in ANSI -S1.13-1971(R1986), *Methods for the Measurement of Sound Pressure Levels*. No sound-level correction shall be made for excessive sound levels caused by the test system, the acoustic environment, or other reasons.

3.6 Instrumentation

The instrumentation for sound-level measurements shall conform to ANSI-S1.13-1971(R 1986), Section 5, entitled *Instrumentation for Noise Measurements.* Specifications for sound-level meters shall conform to ANSI-S1.4-1983, *Specification for Sound Level Meters.* Calibration and sensitivity checks shall be corrected for atmospheric pressure to sea level conditions. Accuracy of flow, pressure, and temperature measurements shall conform to ANSI/ISA-S75.02-1996, *Control Valve Capacity Test Procedures.*

4 Testing procedures

4.1 Fluid

Air is the preferred test fluid to be used, but other compressible fluids may be substituted where need and availability dictate. The fluid shall be sufficiently dry to ensure that any icing which may take place does not significantly affect the test results. Saturated vapors are not acceptable as test fluids unless data are required for application to the particular saturated vapor.

4.2 Microphone position

The microphone shall be located 1.0 m away from the nearest pipe surface and oriented per the manufacturer's specifications to measure the noise coming from the pipe. Downstream location shall be 1.0 m from the beginning of the exposed part of the test section, or six nominal pipe diameters downstream of the test specimen outlet, whichever is greater. For test specimens having multiple flow passages, the six pipe diameters may be changed to ten hydraulic diameters of the largest single-flow passage of the test specimen. (For any cross section, Hydraulic Diameter D = 4 X Hydraulic Radius, or 4 X Area/Wetted Perimeter.)

4.3 Optional tests

Additional tests may be conducted to evaluate nonstandard factors. These tests shall be conducted to otherwise concur with the parameters of this standard. Any exceptions shall be noted in the test data.

4.4 Blowdown test limitation

Blowdown test results are intended to simulate steady-state test results. As a guideline, the difference between the blowdown test results and the steady-state test results should not exceed 2 dB, for equivalent flow conditions. Such assurance of accuracy could be established mathematically, or through a small-scale demonstration test. The blowdown rate shall be limited to conform with ANSI-S1.13-1971(R1986), *Methods for the Measurement of Sound Pressure Levels*, Section 2, Definitions, and shall not exceed the transducer response and data acquisition capabilities of the instrumentation system. In the blowdown method of testing, the inlet pressure to the test specimen decays during the test period. The blowdown rate is the rate at which the inlet pressure to the test specimen changes.

5 Test data

The minimum data to be recorded and reported are as follows:

1) upstream pressure;

2) pressure drop (ΔP) and/or downstream pressure;

3) upstream fluid temperature;

4) flow rate;

5) valve travel (percent of full travel ±2%);

6) valve C_v at the test travel positions(s);

7) acoustic data consisting of the "A-weighted" source level and either a 1/3-octave or full-octave band analysis which shall be recorded over the frequency range of 180 Hz (250 Hz for full-octave band, or 200 Hz for 1/3-octave band center frequency) to 22 400 Hz (16 000 Hz for full-octave band, or 20 000 Hz for 1/3-octave band center frequency). Narrowband data may be obtained when further frequency resolution is desired.

8) description of the complete test specimen;

9) description of the test facility, including:

   a) piping and instrumentation schematic, including the pipe size, material, and wall thickness;

   b) description of the environmental chamber (if used); and

c) dimension sketch of the test facility.

10) test fluid and its molecular weight or specific gravity;

11) instruments used (manufacturer, model number, span, accuracy specification);

12) microphone position; and

13) any deviations from this standard.

Annex A — References

AMERICAN NATIONAL STANDARDS INSITITUTE (ANSI)

ANSI-S1.13-1971 (R1986)	Methods for the Measurement of Sound Pressure Levels
ANSI-S1.4-1983	Specification for Sound Level Meters

Available from: **American National Standards Institute**
11 West 42nd Street
New York, NY 10036 Tel: (212) 642-4900

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ANSI/ISA S75.02	Control Valve Capacity Test Procedures, 1996

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ANSI/(NFPA) T3.5.28 R1-1997	Hydraulic Fluid Power — Valves — Pressure Differential Flow Characteristic — Method of Measuring and Reporting

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