ELEMENTARY EQUIPMENT SOUND-LEVEL VERIFICATION TEST

1 Instrumentation

Use a Type-I or Type-II integrating sound-level meter including microphone, as specified in *ANSI S1.4*. If octave-band readings are desired, a Type I meter is required along with a Type E, Class II octave-band analyzer, as specified in *ANSI Sl.11*.

> NOTE - A Type II sound-level meter has acceptable accuracy (±2-3 dB). If available, a Type I sound level meter (± I dB) is preferred. Type III meters are not acceptable because their accuracy is not sufficient for acceptance testing.

Instruments shall be calibrated before and after the test by means of an acoustical coupler type calibrator *(ANSI S1.4*) and as recommended by the instrument manufacturer.

2 Loading and Operation

The equipment shall be operated under the loading and operational conditions specified to the Contractor.

Where multiple, identical units have been purchased, test one at a time.

3 Measurement Locations

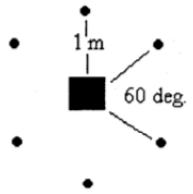
Use the measurement location(s) specified in the submittal documents.

If none were explicitly specified choose a default configuration based on the type of noise source from Table I below. Manually search at a radius of 1m from the equipment to locate the point of maximum sound level. Lay out the default microphone configuration as shown in Figure 1 beginning at that point.

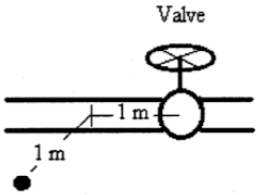
Table 1: Default Measurement Configuration by Equipment Type

Type of Noise Source	Recommended Measurement Configuration
Valves, Throttles, and Orifice Plates	2
Piping and Ductwork	3
Fan, Blower and Duct Outlets, Relief Vents, Blowdowns	4
Cooling Towers	5
Everything Else	1

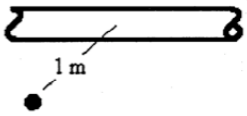
Configuration 1: 1 meter from equipment, at half the equipment height or 1.5 meters above ground level (AGL), whichever is greater, at six points at 60 degree increments in plan.



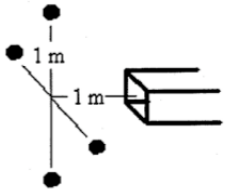
Configuration 2: At one location 1 meter downstream from valve or orifice, one meter perpendicular distance from piping, at elevation of pipe or 1.5 meters AGL, whichever is greater.



Configuration 3: At one location, 1 meter perpendicular distance from piping or ductwork, at elevation of pipe or 1.5 meters AGL, whichever is greater.



Configuration 4: One meter downstream from opening, 1 meter perpendicular to flow, four points at 90 degree increments circumferential around axis of flow



Configuration 5: One meter from each face of cooling tower serving as air inlet, at two positions 1/3 of cell width from each edge of cell, 1.5 meters AGL.

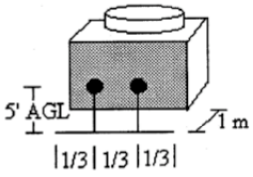


Figure 1: Measurement Configuration Layouts

4 Microphone

Place the microphone so that it is protected from air currents (by means of a wind screen), vibrations, electric or magnetic fields, and other influences that might affect the readings. Use the same microphone location and orientation when measuring with the source "on" and "off". Microphone location and position should be repeatable to within 12 mm and 10 degrees.

NOTE - Microphone sensitivity is dependent on the direction of sound incidence. Each microphone type has a preferred direction which produces the best approximation to flat frequency response. The preferred direction is documented in the user's manual. For example, the microphone of a Quest Model 1400 sound level meter should be pointed directly at the source of sound being measured.

5 Duration

For equipment that operates continuously, measure for no less than 1 minute at each location unless the duration of operation is shorter (e.g., a pressure relief vent). For cyclic or intermittent operation, measure for no fewer than three cycles of operation at each location.

6 Data to be Recorded

Record the measured sound level (A-weighted sound pressure level) as equivalent sound level, $L_{A,eq}$, and the maximum sound pressure levels $L_{A,max,FAST}$ for each location.

7 Adjustment for Background Noise

Background sound levels without the unit operating (Source off) should be at least 10 dB below the total level with the unit operating (Source on).

If the sound level does not increase by at least 10 dBA when the unit is turned on, an adjustment K_1 for background noise is applied (see Table 2).

If the sound level does not increase by at least 3 dBA, the location is unacceptable for testing according to this method. If background noise levels cannot be further reduced, you'll need the services of an acoustical consultant.

Table 2: Background Noise Corrections K_1

Difference between "Source on" and "Source off" Levels (dBA)	Correction to be added to measured L_{PA} (dBA)
Less than 3	Too Noisy
3	-3
4-5	-2
6-9	-1
10 or more	0

8 Averaging over Measurement Locations

Use arithmetic averaging to average values across space and time if required.

9 Adjustment for Sound Reflections

An ideal test environment is typically large and/or highly sound-absorptive. The lack of sound reflections tends to yield lower measured noise emission values. Vendor's noise emission tests are usually performed in such an environment for obvious reasons.

The installed environment, on the other hand, often contains significant numbers of sound reflecting surfaces. Recorded levels should be adjusted based on the host room volume.

Table 3: Corrections for Installed Host Room Volume K_2

Installed Host Space Volume [ft^3]	Correction to be added to measured L_{PA} (dBA)
2,000 – 5,000	-7
5,000 – 25,000	-5
25,000 – 250,000	-2
250,000 or more	-1
Outdoors	0

10 Report

If the difference between $L_{A,eq}$ and $L_{A,max,FAST}$ is less than 3 dBA, report the $L_{A,eq}$ value less the adjustments for background noise and host room volume. If greater, report the $L_{A,max,FAST}$ value less the adjustments.

$$L_{PA,FV} = L_{PA} + K_1 + K_2$$

Compare $L_{PA,FV}$ to the L_{PA} promised by the vendor. The measured field-verification level should be less.

If an A-weighted sound power level (L_{WA}) was promised by the vendor, you must first convert the L_{WA} to an average L_{PA} according to the method of ANSI S12.16 as embodied in this spreadsheet. The average measured field-verification level should be less.