# Measurement of Noise from Air-Cooled Heat Exchangers

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**Refining Department**

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## FOREWORD

This recommended practice is based on the accumulated knowledge and experience of petroleum refiners, air-cooled heat exchanger manufacturers, and engineering contractors. The objective of this publication is to provide a standard test procedure for measurement of noise emanating from air-cooled heat exchangers. Separate procedures for testing of an isolated single bay and for testing of a single bay of an installed unit are given. Testing the isolated single bay is considered a more accurate procedure.

The test procedure for installed air-cooled heat exchangers is similar to the procedure given in CONCAWEE Report Number 5/78, "Method for Determining the Sound-Power Levels of Air-Cooled (air-fin) Heat Exchangers." Comparative tests have shown that the two procedures yield similar results within $\pm 2$ decibels.

Although it is recognized that the purchaser may desire to modify, delete, or amplify sections of the practice, it is strongly recommended that all such changes be made by supplementing this practice rather than by rewriting or by incorporating sections into another complete practice.

Suggested revisions are invited and should be submitted to the director of the Refining Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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# Measurement of Noise from Air-Cooled Heat Exchangers

## SECTION 1—GENERAL

### 1.1 Purpose

This recommended practice establishes standard procedures for measuring and reporting sound-pressure levels (*SPL*) and sound-power levels (*PWL*) of air-cooled heat exchangers.

### 1.2 Scope

This procedure applies to air-cooled exchangers used for general refinery service, including both forced- and induced-draft type units. The procedures are based on testing complete air-cooled exchangers and are not intended for testing individual components such as fans, motors, gears, and so forth. Separate procedures are given for the following types of tests:

1. Test of an isolated single-bay air-cooled exchanger for determining sound-power levels and sound-pressure levels (Section 2).
2. Test procedures for conducting noise tests on a single bay of installed air-cooled exchangers (normally multibay installations) (Section 3).

### 1.3 Instrumentation

The following are the required instrumentation and applicable specifications to be used to perform the measurements required.

| Instrument | Specification |
|---|---|
| Sound level meter, including microphone, Type I, precision | ANSI S1.4-1971 (R1976) |
| Octave band filter, Type E, Class II | ANSI S1.11-1966 (R1975) |
| Acoustic calibrator of coupler type | ANSI S1.4-1971 (R1976) |
| Wind screen | ANSI S1.4-1971 (R1976) |

### 1.4 Nomenclature and Definitions

#### 1.4.1 NOMENCLATURE

The following abbreviations are used in this recommended practice.

| Abbreviation | Definition | Unit |
|---|---|---|
| *B* | Measuring distance from surface | meter |
| *D* | Fan diameter | meter |
| *dB* | Unit of measure for sound level | decibel |
| *dB(A)* | Decibel weighted to correspond to standard "A" scale | decibel |
| *H* | Height of geometric center | meter |
| *hp* | Horsepower | — |
| *Hz* | Hertz, sound frequency | cycle/second |
| *L* | Length of bay | meter |
| *N* | Number of fans per bay | — |
| *n* | Number of measurement positions per source | — |
| *PWL* | Sound-power level | decibel |
| *R* | Radius of hemisphere and cyclinder | meter |
| *S* | Surface area (measuring surface) | square meter |
| $S_o$ | Reference area of 1 square meter | square meter |
| *SPL* | Sound-pressure level | decibel |
| $\overline{SPL}$ | Mean sound-pressure level | decibel |
| *W* | Width of one bay | meter |

#### 1.4.2 DEFINITIONS

A *bay* is one or more tube bundles served by two or more fans complete with structure, plenum, and attendent equipment.

The *geometric center* is located at the center of a bay on a plane midway between the air inlet and the air outlet for both forced-draft and induced-draft units. The geometric center is also considered the acoustic center of a bay for calculations.

*Octave bands* are the preferred frequency bands.

The *sound level* is the sound-pressure level when frequency is weighted according to the standardized A, B, or C weighting used in sound-level meters. Only A weighted readings [dB(A)] are referenced in this procedure.

The *sound-power level* is ten times the logarithm to base 10 of the ratio of the total acoustic power radiated by a sound source to the reference power of $10^{-12}$ watt.

The *sound-pressure level* is twenty times the logarithm to base 10 of the ratio of the root mean square sound pressure to the reference sound pressure of $2 \times 10^{-5}$ newtons per square meter.

A *unit* is one or more tube bundles in one or more bays for an individual service.

NOTE: For additional definitions see API Publication EA 7301, *Guidelines on Noise*.