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Determination method of separation machinery noise

分离机械噪声测试方法

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Table of Contents

Foreword	4
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
4 Test environment	9
4.1 General	9
4.2 Background noise requirements	10
4.3 Wind speed	10
5 Test instruments	11
5.1 General	11
5.2 Calibration	11
6 Installation and operation of separation machinery	11
6.1 Installation	11
6.2 Operation	11
7 Determination of microphone position	12
7.1 Determination of reference box	12
7.2 Selection of measurement surface	12
7.3 Microphone position	14
8 Sound pressure level measurement	15
8.1 Quantity to be measured	15
8.2 Uncertainty of measurement	15
8.3 Operation of sound level meter	15
8.4 Correction of background noise	16
8.5 Correction of measurement environment	16
9 Determination of sound power level	17
9.1 Calculation of the time-average sound pressure level of the measurement surface	17
9.2 Calculation of sound power level	17
10 Record content	18
10.1 General	18
10.2 Separation machinery under test	18
10.3 Test environment	18
10.4 Test instruments	18
10.5 Test data	19
10.6 Others	19
11 Test report	19
Appendix A (Normative) Determination method for sound pressure level of noise emitted by separation machinery	20

Determination method of separation machinery noise

1 Scope

This document describes the engineering method for determining the noise source sound power level of separation machinery using the sound pressure method under free sound field conditions on a reflecting plane, as well as the measurement method for the sound pressure level of noise emitted by separation machinery.

This document applies to the measurement of noise from various types of industrial centrifuges, separators, filters and filter assemblies.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 3102.7, Quantities and units of acoustics

GB/T 3241-2010, Electroacoustics - Octave-band and fractional-octave-band filters

GB/T 3767-2016, Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane

GB/T 3768, Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane

GB/T 3785.1-2010, Electroacoustics - Sound level meters - Part 1: Specifications

GB/T 3947, Acoustical terminology

GB/T 4774, Terminology of filtration and separation

GB/T 15173-2010, Electroacoustics - Sound calibrators

GB/T 17248.2, Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other

4.1.2 The adverse effects of environmental conditions (such as strong electric or magnetic fields, wind, airflow shock caused by the air emission of the noise source being measured, high or low temperatures) on the microphone to be measured should be eliminated, and the requirements provided by the test instrument manufacturer regarding the effects of adverse environments on the measuring instrument should be followed.

4.1.3 In outdoor areas, the effects of adverse meteorological conditions (such as temperature, humidity, wind, precipitation, etc.) on sound propagation and sound generation within the measurement frequency range, as well as the effects of background noise during the measurement process should be reduced.

4.1.4 For outdoor areas, there shall be no reflective objects within 10 m from the reference box.

Note: If the width of an object (such as the diameter of a pole or support column) near the sound source being measured exceeds one tenth of its distance to the reference box, the reflective object is considered to have sound reflection.

4.1.5 The accuracy of the noise sound pressure level measured in the test environment specified in this document shall comply with the Level 2 accuracy specified in GB/T 19052, and the measurement of the separation machinery noise sound pressure level shall comply with the test environment specified in Appendix A.

4.2 Background noise requirements

The measurement shall be carried out in a quiet environment. In the entire measurement environment, the difference between the sound pressure level measured at each measure point when the separation machinery is working and the background noise sound pressure level shall not be less than 6 dB, and should be greater than 15 dB. If the difference between the sound pressure level of the background noise and the sound source noise being measured is less than 6 dB and greater than 3 dB, the test method of GB/T 3768 shall be used.

4.3 Wind speed

During measurement, the wind speed near the measure point shall be less than 6 m/s (equivalent to level 3 to 4 wind). When the wind speed is greater than 1 m/s, the microphone shall be provided with a wind shield.

5 Test instruments

5.1 General

The instrument system, including microphone, sound level meter, cable and wind shield, shall meet the requirements of Level 1 in GB/T 3785.1-2010. The filter shall comply with the requirements of Level 1 in GB/T 3241-2010.

5.2 Calibration

5.2.1 Before and after each measurement, the entire test instrument system shall be calibrated at one or more frequencies using a sound calibrator that meets the Level 1 accuracy requirements of GB/T 15173-2010. If the difference between the calibration values before and after the measurement exceeds 0.5 dB, the measurement is invalid.

5.2.2 Sound calibrators shall be calibrated regularly in accordance with JJG 176, and sound level meters and other test instruments shall be calibrated regularly in accordance with JJG 188 to ensure the accuracy of the test instruments.

6 Installation and operation of separation machinery

6.1 Installation

6.1.1 The installation of separation machinery shall comply with the relevant product standards and technical requirements. All accessories shall be installed completely, but no additional sound insulation and sound absorption components shall be added.

6.1.2 Generally, the separation machinery shall be placed directly on the ground or on a test platform for noise measurement. It can also be measured according to the actual installation position, which shall be stated in the test report.

6.2 Operation

6.2.1 The separation machinery shall be started and operated under the operating conditions specified in the relevant product standards or technical documents, and the noise measurement shall be carried out after the operation is stable.

6.2.2 Under no-load operation, for fully enclosed separation machinery, the inlet and outlet can be closed to prevent the noise generated by the airflow at the inlet and outlet from affecting the test; when measuring open-type separation machinery (such as filter centrifuge), if necessary, it is allowed to attach hard paper or filter media to the inner wall of the drum to prevent the additional noise caused by the rotation of the holes.

7 Determination of microphone position

7.1 Determination of reference box

7.1.1 In order to facilitate the selection of the shape and size of the measurement surface and determine the position of the microphone, a minimum parallelepiped that just surrounds the separation machinery to be measured shall be taken as the reference box. When determining the reference box, small protruding parts on the separation machinery that do not radiate obvious sound (such as handles, connecting pipes, etc.) can be ignored.

7.1.2 If necessary, in order to measure the emission sound pressure level next to the noise source in accordance with GB/T 17248.2, a test bench as small as possible should be used.

7.1.3 This document only specifies the determination of the reference box on one reflecting plane. This document is not applicable to the measurement environment with two or three reflecting planes.

7.2 Selection of measurement surface

7.2.1 General

The schematic diagrams of the hemispherical measurement surface and the parallelepiped measurement surface shall comply with the provisions of Appendix B. When measuring, the appropriate measurement surface shall be selected according to the overall dimensions of the separation machinery in accordance with Appendix B. Hemispherical measurement surface is preferred.

7.2.2 Hemispherical measurement surface

7.2.2.1 The center of the hemispherical measurement surface is the projection of the geometric center of the reference box on the reflecting plane (which shall comply with the provisions of Appendix B). The measurement radius r shall be equal to or greater than $2d_0$ (d_0 is the characteristic source dimension), and $1\text{m} \leq r \leq 16\text{m}$.

Calculate the characteristic source dimension according to Formula (1):

$$d_0 = \sqrt{(0.5l_1)^2 + (0.5l_2)^2 + l_3^2} \dots\dots\dots (1)$$

Where:

d_0 – characteristic source dimension, in meters (m);

l_1, l_2, l_3 – length, width and height of the reference box, in meters (m).

l_3 – height of the reference box, in meters (m).

7.3 Microphone position

7.3.1 All microphones shall be located on the measurement surface determined in 7.2 and the microphones shall point to the geometric center of the reference box during measurement.

7.3.2 The microphone position and coordinates – divided into basic position and additional position – on the hemispherical measurement surface shall comply with the provisions of B.1. Under the following situations, there shall be additional positions:

- a) The variation range (i.e., the difference between the highest sound level and the lowest sound level) of the A-weighted sound pressure level measured at the basic position exceeds 10 dB;
- b) The A-weighted apparent directivity index of the separation machinery noise measured exceeds 5 dB in any direction. The determination of the apparent directivity index shall comply with the provisions of 3.24 of GB/T 3767-2016.

The coordinates of the additional microphone positions can be measured, by rotating 180° from the coordinates of the basic positions, at the original basic microphone positions (these measurement positions are microphone positions 11 ~ 20). Alternatively, lift the separation machinery to be tested; keep the projection geometric center position of the reference box on the reflecting plane unchanged; rotate it 180°; keep the original microphone positions unchanged, which are the microphone positions 11 ~ 20.

For larger separation machinery, the noise source only comes from small areas of the machinery, such as the opening of the closed machinery. The measurement of additional microphone positions shall be carried out in accordance with the provisions of 8.1.1 of GB/T 3767-2016.

7.3.3 The microphone positions on the parallelepiped measuring surface are divided into basic positions and additional positions. There are 9 basic positions and 8 additional positions. The microphone positions and coordinates shall comply with the provisions of B.2. Under the following situations, there shall be additional positions:

- a) The variation range (i.e., the difference between the highest sound level and the lowest sound level) of the A-weighted sound pressure level measured at the basic position exceeds the number of measure points;
- b) The A-weighted apparent directivity index of the separation machinery noise measured exceeds 5 dB in any direction. The determination of the apparent directivity index shall comply with the provisions of 3.24 of GB/T 3767-2016;
- c) The dimension of any side of the reference box is greater than 2 m.

Appendix A

(Normative)

Determination method for sound pressure level of noise emitted by separation machinery

A.1 Measurement conditions

A.1.1 Overview

The accuracy of the sound pressure level of noise emitted by the separation machinery determined according to the method given in this Appendix is Class 3.

A.1.2 Measurement environment

Measure the sound pressure level of noise emitted by separation machinery, where the measurement environment shall meet the following points:

- a) The separation machinery shall be measured in a free sound field on a reflecting plane (that is, when the measurement distance is doubled, the measured A sound level shall be reduced by more than 5 dB). Unsatisfactory measurement environment shall be recorded and explained;
- b) When measuring, there shall be no reflective objects within 1 m around the microphone under any circumstances; when reading, the distance between the operator and the microphone shall be greater than 0.5 m;
- c) During measurement, environmental and meteorological conditions shall comply with the provisions of 4.1.2 and 4.1.3, and wind speed shall comply with the provisions of 4.3.

A.1.3 Background noise

The measurement shall be carried out in a quiet environment. In the entire measurement environment, the difference between the sound pressure level measured at each measure point when the separation machinery is working and the background noise sound pressure level shall not be less than 3 dB, and should be greater than 10 dB. When the difference is 3 dB ~ 10 dB, make corrections according to Table A.1.

Appendix C

(Normative)

Determination of environmental correction K_2

C.1 Environmental correction

C.1.1 Overview

This Appendix specifies the use of the absolute comparison test method (reference sound source method) to determine the environmental correction. This method can be used both indoors and outdoors. It is the preferred method for characterizing the test environment, especially when frequency band data is required and the noise source being measured can be moved away from the test site.

C.1.2 Correction method

Place the reference sound source certified according to JJG 277 in the test environment at the same location as the separation machinery under test; measure and calculate the sound power level of the reference sound source according to the methods in Chapters 8 and 9 (set the environmental correction term to zero). When the reference sound source is placed in multiple positions, measure the average surface sound pressure level $\overline{L}_p$, and calculate according to Formula (C.1):

$$\overline{L}_p = 10 \lg \left(\frac{1}{NM} \sum_{i=1}^N \sum_{j=1}^M 10^{0.1L_{pij}} \right) \dots\dots\dots (C.1)$$

Where:

$\overline{L}_p$ – average sound pressure level on the measurement surface, in decibels (dB);

N – total number of measure points;

M – reference sound source placement points;

L_{pij} – the sound pressure level at the j^{th} reference sound source placement point at the i^{th} measure point, in decibels (dB).

Calculate the environmental correction K according to Formula (C.2):

$$K = L_w - L_{wr} \dots\dots\dots (C.2)$$

Where:

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