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Investigation on impedance chip muffler performance

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Abstract

Nowadays it is quite significant to control the noise generated from the fan, air conditioning and air flow, as well as to reduce the noise pressure level. The chip mufflers have been widely used for its advantages of large air volume and high amount of noise elimination. The method adopted in our study is comparison. Before determining the muffler insertion loss, we should do the controlled experiment without the muffler, then we use the muffler to replace the duct for the experiment. So we can obtain the insertion loss by measuring the noise level in the two different conditions. Attention should be paid to the noise conditions and the main duct speed which should remain the same in the whole experiment process. By measuring, calculating and analyzing the insertion loss of the chip mufflers with different silencing cotton density under different main duct speed, verifying that the muffler have a very good silencing effectiveness for the high and intermediate frequency noise, reaching the quadratic relationship between noise elimination and silencing cotton density which is beneficial to optimize the chip muffler performance in the future.

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Keywords: Noise; Chip muffler; Insertion loss; Silencing cotton density

1. Introduction

Impedance chip muffler [1] is a kind of absorptive muffler, using the arrangement of the sound-absorbing material on the inner wall of the duct or the sound-absorbing effect of the sound-absorbing structure to make the noise reduce rapidly with distance along the duct so as to achieve the aim of noise elimination. Impedance muffler's effective frequency band is wide and it has a good silencing effectiveness for the high and intermediate frequency noise, but its service life is short in the high temperature erosion gas and its silencing effectiveness of the low frequency noise is poor, the actual noise elimination is related with the frequency. We can draw the relationship among the quantity of

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muffler noise elimination, frequency and silencing cotton density through the study of the impedance chip muffler's insertion loss, which provides certain theoretical guidance and reference for the further study.

Nomenclature

D	the insertion loss of each frequency band [dB]
ΔL_P	insertion loss (same as the amount of noise elimination) [dB]
ρ	density of the silencing cotton [kg/m^3]
α	the modified value of different main wind speed
β	the modified value of different silencing cotton density

2. The muffler's acoustic performance

The noise elimination of the muffler is an important index of its acoustic performance. Our research adopts the insertion loss [2, 3] as the acoustic performance of muffler evaluation index. Insertion loss is calculated according to the results of the test of monitoring system, actually we measure the noise pressure level before and after the measuring system which connected muffler, the difference of them is insertion loss which directly reflect the muffler's noise elimination effect. We use direct method to measure the insertion loss, as we keep the reference and the noise position as the same, the equivalence of the test results are good.

3. Methods

3.1. The design principle and installation drawing of muffler test bench

According to the laboratory conditions, we set different wind speed, and we control the air volume entered the system by different nozzle combinations. The fan rotation speed controlled by frequency converter so as to achieve the required air volume. In the drawing, noise goes through the straight duct, muffler is connected in the straight duct with two microphones (GRAS Type 40AE) connecting before and after the chip muffler. The collected signals will go into the modal analysis device through microphones, the modal analytical device used as a voice signal acquisition device connected to the computer, then analyze the signals through the software (DEWEsoft) on the computer to output the spectrum. The system structure [4] is as follows: