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ACOUSTICS—MEASUREMENT PROCEDURES FOR DUCTED SILENCERS

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PREFACE

This standard was prepared by the Association's Committee on Architectural Acoustics.

It deals with the objective measurement and determination of the performance of unit silencers and silencing elements for ducted ventilating and airconditioning systems. It sets out measurement procedures for the following aspects of ducted silencers:

(a) The attenuation of broad—band airborne sound, i.e. the insertion loss.

(b) The generation of aerodynamic sound by air flowing through the silencer, i.e. the generated noise level.

(c) The change in pressure of air flowing through the silencer, expressed as a total pressure loss.

In the preparation of this standard, account was taken of the following:

BS 4718 Methods of Test for Silencers for Air Distribution Systems

ISO Draft Proposal 7235 Acoustics—Measurement Procedures for Ducted Silencers (Doc ISO/TC 43/SC 1/N 441).

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
ACOUSTICS—MEASUREMENT PROCEDURES FOR DUCTED SILENCERS

FOREWORD

This standard contains two methods for the determination of the insertion loss of ducted silencers, viz the direct method and the substitution method.

The test arrangement and test method ensure that the measured data are determined only by the silencer under test and not by elements to which the silencer is connected.

With the substitution method, the sound pressure level of the transmitted sound is first determined with the silencer installed between the sections of the test ducts and then when it is replaced by the substitution duct (a hard-duct element). The sound pressure level of the transmitted sound can be measured either in the test duct after the silencer or in a reverberation room connected to this test duct via a transition element. The latter method must be used where the noise from airflow over the microphone in the test duct cannot be sufficiently suppressed. With the substitution method, the determination of the sound power level of the incident sound is not necessary. This method does, however, create the problem of maintaining an unchanged power and sound pressure distribution in the incident sound when the silencer is replaced by the substitution duct.

With the direct method, the sound pressure level is measured in the test duct in front of and after the silencer. As the silencer normally reflects part of the incident sound, and as anechoic terminations are not perfectly free of reflections, standing waves are set up in the test duct in front of and after the silencer. With the procedures of this standard, these standing waves are minimized and the results are equivalent to the results of the substitution method within the frequency limits determined by the anechoic termination.

The insertion loss of a silencer is not significantly affected by the airflow provided that the flow velocity in the silencer airway does not exceed approximately 10 m/s. The exact value of this limiting velocity depends on the design of the silencer.

If the velocity reaches higher values the insertion loss may be changed and the insertion loss should then be measured with superimposed airflow. This measurement requires an additional air-moving device with its own silencer. The same arrangement is necessary for measuring the flow noise and pressure drop.

Airflow through a silencer produces noise. This flow noise establishes the lowest sound pressure level which can be achieved after the silencer. It is necessary to know the sound power level of the flow noise after the silencer. This is preferably determined in a reverberation room connected to the test duct by means of a transition element.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard sets out measurements procedures in ducted silencers for—

(a) the broad-band insertion loss with and without airflow;

(b) the generated noise level by air flowing through the silencer; and

(c) the change in pressure of air flowing through the silencer.

NOTES:

1. The term 'silencer' is used to describe either a unit silencer or an arrangement of silencing elements within a duct.
2. It is normal practice in the assessing of the pressure loss of an air distribution system to consider the total pressure loss of the components forming that system. The silencer is rated in terms of total pressure loss.

1.2 APPLICATION. This standard applies to the objective measurement of performance of silencers for ducted ventilating and air-conditioning systems of two types as follows:

Type A: Silencers having the same dimensions as those of the test duct and the same direction for the inlet and outlet connections.

Type B: Silencers having different dimensions from those of the test duct and/or different directions between the axis of the inlet and outlet connections.

This standard does not apply to the objective measurement and determination of performance of silencers providing selective attenuation over narrow frequency bands, i.e. less than one-third octave.

The results obtained from tests carried out using the standard do not apply to the determination of the performance of the following:

(a) Silencers which are designed for direct coupling to a fan. Such combinations are considered as a single unit and the performance should be obtained by one of the methods appropriate for testing of fans.

(b) Silencers designed to increase the sound insulation of a partition having a ventilation opening.

1.3 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 1217	Methods of Measurement of Airborne Sound Emitted by Machines
AS 1259	Sound Level Meters
AS 1633	Glossary of Acoustic Terms
AS 2460	Acoustics—Measurement of Reverberation Time in Enclosures
AS Z1	Octave, Half Octave and One-third Octave Band Pass Filters Intended for the Analysis of Sound and Vibrations
ISO 5167	Measurement of Fluid Flow by Means of Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-section Conduits Running Full
BS 848	Methods of Testing Fans for General Purposes, Including Mine Fans Part 1—Performance.

1.4 DEFINITIONS. For the purpose of this standard, the following definitions apply:

NOTE: For definitions of acoustic terms, see also AS 1633.

1.4.1 Generated noise level—the sound power level that is radiated through either the inlet or outlet duct connection of a silencer and which arises from airflow within the silencer.

1.4.2 Insertion loss—the difference between the output sound power levels of the duct before and after substitution of the silencer for an equivalent length of hard wall duct.

1.4.3 Mean sound pressure level—the calculated mean sound pressure level obtained by the procedure in Appendix A or measured with instrumentation that provides continuous space averaging.

1.4.4 Sound pressure reflection coefficient—the ratio of the reflected sound pressure amplitude to the pressure amplitude of the sound wave incident on the reflecting object.

NOTE: The maximum values of the sound pressure reflection coefficients of the anechoic terminations and of the transmission element are subject to specified limitations which are a compromise between the possibilities of realization and the accuracy of the final results.

1.4.5 Silencer airway velocity—the mean air velocity, at the minimum airway section, between silencing elements.

1.4.6 Silencer face velocity—the mean air velocity at the silencer inlet connection.

1.4.7 Silencer in test—the test carried out with the unit silencer inserted into the test installation.

1.4.8 Silencer-out test—the test carried out with a plain substitution duct replacing the unit silencer in the test installation.

1.4.9 Silencing element—an element designed to be introduced within a passageway in an air distribution system to provide an attenuation of sound.

1.4.10 Static pressure loss—the difference between the mean static pressure at the silencer inlet and the mean static pressure at the silencer outlet.

1.4.11 Total pressure loss—the difference between the mean total pressure at the silencer inlet and the mean total pressure at the silencer outlet. The pressure loss is specified for air of standard density 1.2 kg/m^3.

1.4.12 Unit silencer—a device to carry air as part of an air distribution system to provide an attenuation of sound.

1.5 SYMBOLS. For the purpose of this standard, the following symbols apply:

Symbol	Quantity	Unit symbol
P	Sound pressure	μPa
P_o	Reference sound pressure	20 μPa
L_p	Sound pressure level	dB
	$= 20 \log_{10} \frac{P}{P_o}$	
$\bar{L}_p$	Mean band pressure level	dB
P	Sound power	W
P_o	Reference sound power	1 pW
L_w	Sound power level	dB
	$= 10 \log_{10} \frac{P}{P_o}$	
IL	Insertion loss	dB
Δp_t	Total pressure loss	Pa