

# DELTA Test Report



**DANAK**  
TEST Reg. no. 100

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## Measurement of Sound Absorption Coefficient for Gyptone Sixto 11 mm, Suspended 58 mm without Mineral Wool

**Client: Gyproc A/S**

AV 1182/06  
DANAK 100/993  
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10 May 2006

**DELTA**

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**Title**

Measurement of Sound Absorption Coefficient for Gyptone Sixto 11 mm, Suspended 58 mm without Mineral Wool

**Journal no.**

AV 1182/06  
DANAK 100/993

**Project no.**

A580213

**Our ref.**

DH/JV/lm

**Date of test**

27 April 2006

**Client**

Gyproc A/S  
Hareskovvej 12  
4400 Kalundborg

**Client ref.**

Kim Byberg

**Summary**

Laboratory measurements of the sound absorption coefficient were carried out in a reverberation room according to the test method of EN ISO 354:2003.

Product: Gyptone Sixto 11 mm, suspended 58 mm without mineral wool  
Thickness: 13 mm  
Mounting depth: 58 mm

The tiles were placed on the concrete floor of the reverberation room.

The test results per one-third octave and per octave are shown in tabular form and graphically on the graph sheets together with the weighted sound absorption coefficient  $\alpha_w$  and the absorption class according to EN ISO 11654:1997.

Descriptions of reverberation room and test procedure are found in the Appendix.

**Remark**

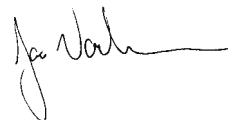
The test results apply only to the objects tested.

DELTA, 10 May 2006



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Dan Hoffmeyer  
Acoustics



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Jan Voetmann  
Head of Department, Acoustics

## 1. Introduction

At the request of Gyproc A/S measurements of the sound absorption coefficient in a reverberation room were carried out for a ceiling product.

## 2. Description of the Test Specimen Based on the Client's Specifications

Product: Gyptone Sixto 11 mm, suspended 58 mm without mineral wool  
Thickness: 13 mm  
Module size: 600 mm × 600 mm

## 3. Mounting in the Laboratory

The tiles were placed as a plane on a concrete floor in a frame with the size 3.00 m × 3.60 m.

Mounting depth: 58 mm (Type E-60 mounting).

Both the air gap and the edges of the test specimen were enclosed by a 22 mm wooden frame.

All joints between the test specimen and the frame as well as between the frame and the concrete floor were sealed with tape.

The test specimen was placed so that no part of it was closer than 1 m to any edge of the boundary of the room.

## 4. Test Method

The measurements were carried out according to the test method of EN ISO 354:2003: "Measurement of Sound Absorption in a Reverberation Room".

The sound absorption coefficient was calculated from the reverberation times measured with and without the test specimen.

The measurements were performed in Room 005, Building 355 at the Technical University of Denmark. Brief descriptions of the reverberation room and test procedure are found in the Appendix.

## 5. Instrumentation

The following instruments were used for the test:

Instrument	Type	A&V No.
Real-Time Frequency Analyser	B&K 2144	1025L
Measuring Microphone	B&K 4144	859L
Measuring Microphone	B&K 4144	1256L
Microphone Preamplifier	B&K 2619	853L
Microphone Preamplifier	B&K 2619	857L
Microphone Power Supply	B&K 2807	722L
Sensor for Temperature and Humidity	Elpro Ecolog TH1	1216L

The instruments used have been tested according to procedures approved by the Danish accreditation scheme DANAK.

## 6. Measurement Conditions

The reverberation time was recorded in 6 microphone positions, each placed in the range 1.55 m to 2.85 m above the floor. The number of sound source positions was two.

The reverberation time per octave of the room without test specimen:

Frequency f [Hz]	Reverberation time $T_1$ [sec]
125	7.9
250	7.9
500	6.8
1000	5.7
2000	4.5
4000	2.7

Temperature and relative humidity in the reverberation room during measurements:

Room without test specimen: 18.3°C, 59% RH. Date of test: 24 April 2006

Room with test specimen: 18.6°C, 61% RH. Date of test: 27 April 2006

The correction of the absorption coefficient due to differences in temperature and relative humidity during measurements of  $T_1$  (the reverberation time of the empty room) and  $T_2$  (the reverberation time of the room with test specimen) was 0.01 at 2500 Hz, 0.01 at 3150 Hz, 0.02 at 4000 Hz, 0.03 at 5000 Hz, and 0 at all other frequencies.

## 7. Test Results

The test result  $\alpha_s$  per one-third octave from 100 Hz to 5000 Hz is shown in tabular form and graphically on Graph Sheet 1.

The calculated, practical sound absorption coefficient  $\alpha_p$  per octave from 125 Hz to 4000 Hz is shown on Graph Sheet 2 together with the weighted sound absorption coefficient  $\alpha_w$  as well as the absorption class. These values are calculated in accordance with EN ISO 11654:1997.

## 8. Measurement Uncertainty

Measurement uncertainty (90% confidence interval) estimated from a Nordic intercomparison (Nordtest Project No. 1023-92) for the practical absorption coefficient  $\alpha_p$  per octave:

Frequency [Hz]	Uncertainty
125	$\pm 0.15$
250	$\pm 0.10$
500	$\pm 0.05$
1000	$\pm 0.10$
2000	$\pm 0.10$
4000	$\pm 0.10$

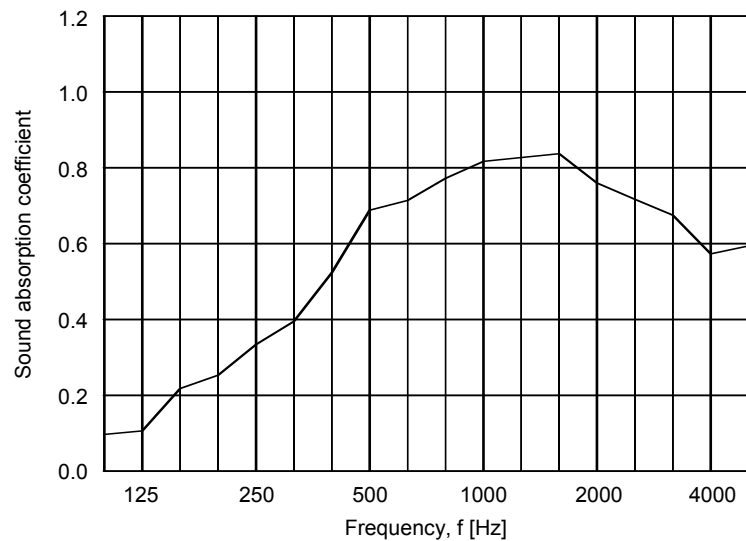
## Laboratory Measurement of Sound Absorption Coefficient according to EN ISO 354:2003

Client: Gyproc A/S, Hareskovvej 12, 4400 Kalundborg  
Date of test: 27 April 2006

Test specimen: Gyptone Sixto 11 mm, suspended 58 mm without mineral wool  
Thickness: 13 mm  
Module size: 600 mm × 600 mm  
Mounting depth: 58 mm (Type E-60 mounting)

Test area: 10.8 m<sup>2</sup>  
Room volume: 215 m<sup>3</sup>  
Room surface: 305 m<sup>2</sup>

Frequency f [Hz]	$\alpha_s$
100	0.10
125	0.11
160	0.22
200	0.25
250	0.33
315	0.39
400	0.52
500	0.69
630	0.71
800	0.77
1000	0.82
1250	0.83
1600	0.84
2000	0.76
2500	0.72
3150	0.68
4000	0.57
5000	0.59



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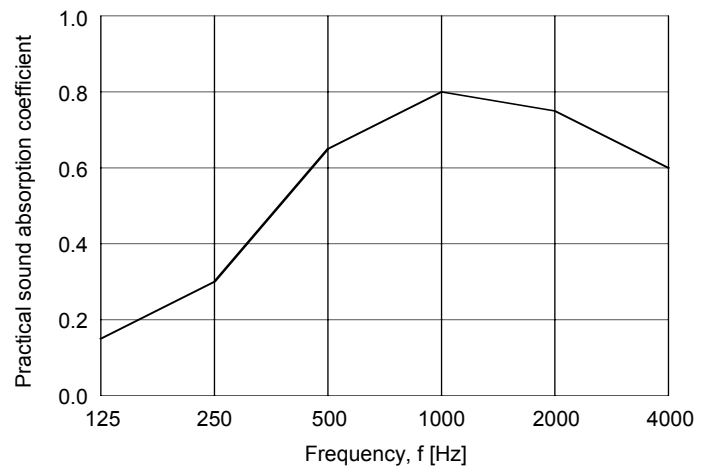
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Room volume: 215 m<sup>3</sup>  
Room surface: 305 m<sup>2</sup>

Frequency f [Hz]	$\alpha_p$
125	0.15
250	0.30
500	0.65
1000	0.80
2000	0.75
4000	0.60



Practical sound absorption coefficient, weighted sound absorption coefficient, and absorption class according to EN ISO 11654:1997:  
 $\alpha_w = 0.60$       Absorption class: C

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## Description of Reverberation Room

The measurements are performed in a reverberation room (Room 005, Building 355 at the Technical University of Denmark) with walls, ceiling, and floor of 300 mm in situ cast concrete. Length, width, and height of the room are 7.85 m, 6.25 m, and 4.95 m, respectively. The volume of the room is approx. 215 m<sup>3</sup>, and the total surface area is approx. 305 m<sup>2</sup>. Sound diffusion elements of concrete, of damped steel plate, and of acrylic sheets are placed in the room.

## Test Procedure

Measurement of sound absorption according to EN ISO 354:2003 is carried out in a reverberation room. The reverberation time is measured with and without the test specimen, and the sound absorption coefficient is evaluated using Sabine's formula.

The test signal used is broad band pink noise emitted successively by two loudspeakers located in two opposite corners of the room. The reverberation time is measured in six microphone positions for each loudspeaker. For each microphone/loudspeaker position three repeated excitations are used. One-third octave filters (100-5000 Hz) are included in the receiving equipment.

The reverberation time is evaluated from the averaged slope of the decay curve over a range from 5 dB to 25 dB below the steady state level.

The sound absorption coefficient  $\alpha_s$  is calculated using the following formula:

$$\alpha_s = \frac{55.3 \cdot V}{c \cdot S} \cdot \left( \frac{1}{T_2} - \frac{1}{T_1} \right) - \frac{4V}{S} \cdot (m_2 - m_1)$$

where  $V$  = Volume of the empty reverberation room [m<sup>3</sup>]

$c$  = Velocity of sound in air [m/s]

$S$  = Area of the test specimen [m<sup>2</sup>]

$T_1$  = Reverberation time of the empty reverberation room [s]

$T_2$  = Reverberation time of the reverberation room after the test specimen has been introduced [s]

$m_1$  = Attenuation coefficients due to air absorption during measurement of  $T_1$  (m<sup>-1</sup>)

$m_2$  = Attenuation coefficients due to air absorption during measurement of  $T_2$  (m<sup>-1</sup>)

The attenuation coefficient of sound in air varies with relative humidity, temperature, and frequency. During a series of measurements of reverberation times  $T_1$  and  $T_2$ , the relative humidity and the temperature are held as constant as possible. A correction term as given in the formula above is applied. The correction is based on data from ISO 9613-1:1993.