

**TEST REPORT ON DETERMINATION OF
VIBRATION DAMPING LOSS FACTOR OF MELT SHEET
ACP ALUMINIUM COMPOSITE PANEL-AL 45**

NO. NVH/11265/2016-17/590(V-4)-1

29th March 2017

1.0 CUSTOMER NAME : Aludecor Lamination Pvt. Ltd.
1, R. N. Mukherjee Road,
Martin Burn Building,
Suit No. 52, 5th Floor
Kolkata – 700 001
West Bengal

2.0 LETTER REF. : E-mail dated 15th March 2017

3.0 TEST COMPONENT :

ACP Aluminium composite panel AL 45 with following details given by customer

Overall ACP Thickness : 4.00 mm
Top Coil Thickness : 0.50 mm
Bottom Coil Thickness : 0.50 mm
Core Thickness : 3.00 mm
Alloy : AA3105
Top Coil density : 2.72 kg/m²
Core weight : 0.93 gram/m²
ACP density : 5.51 kg/m²
Sample Size : 225 mm (L) x 12.7 mm(W) x 4mm (thick)

4.0 TEST REQUIREMENTS :

Measurement of vibration damping loss factor of ACP Aluminium composite panel AL 45 of 4 mm as mentioned above as per ASTM E 756.

5.0 TEST PROCEDURE :

The vibration damping loss factor measurement was carried out on ACP Aluminium composite panel AL 45 of 4 mm using Oberst bar test rig as per ASTM E 756. The damping loss factor measurement was carried out at 24±1⁰C and 55% humidity. While testing 25 mm sample was clamped in the test rig and 200 mm was kept as a free length.

6.0 DATE OF EVALUATION :

The vibration damping loss factor measurement was carried out on ACP Aluminium composite panel AL 45 of 4 mm on 30th March 2017.

NO. NVH/11265/2016-17/590(V-4)-1

29th March 2017

6.0 INSTRUMENTATION :

Sr. No	Instrument Name	Type / Model No	Make
1	Multi-channel Data Acquisition System	3560 D	Brueel & Kjaer, Denmark
2	Power Amplifier	2716	Brueel & Kjaer, Denmark
3	Capacitance probe (receiver),	MM0004	Brueel & Kjaer, Denmark
4	Magnetic (exciter) sensor	MM0002	Brueel & Kjaer, Denmark
5	Oberst bar test rig	-	ARAI

8.0 TEST RESULTS :

The composite damping loss factor was measured using half power bandwidth technique at resonance frequencies in 2nd, 3rd and 4th modes.

- 8.1 Table 1 shows the average values of composite damping loss factor at resonance frequencies of ACP Aluminium composite panel AL 45 of 4 mm.
- 8.2 Figure 1 show the plot of composite damping loss factor Vs resonance frequencies of ACP Aluminium composite panel AL 45 of 4 mm.

Report Prepared By:

Reviewed By:

Approved By:


Ms. M. P. Joshi
Manager


S. K. Jain
Dy. General Manager


N. V. Karanth
Sr. Deputy Director & HoD

This test report pertains only to the melt sheet samples actually tested at ARAI in the presented condition. The issuing of this test report does not indicate any measure of approval, certification, supervision, control of quality surveillance by ARAI of any product. No extract, abridgement or abstraction from this test report be published or used to advertise the product without the written consent of the Director, ARAI, who reserves the absolute right to agree or reject all or any of the details of any items of publicity for which consent may be sought.

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29th March 2017

Table 1: Values of Composite damping loss factor of ACP Aluminium composite panel AL 45 of 4 mm at resonance frequencies

Resonance modes	Resonance frequency, Hz	Composite damping loss factor, η_c
2 nd	464.0	0.015
3 rd	1211.3	0.025
4 th	2171.2	0.034

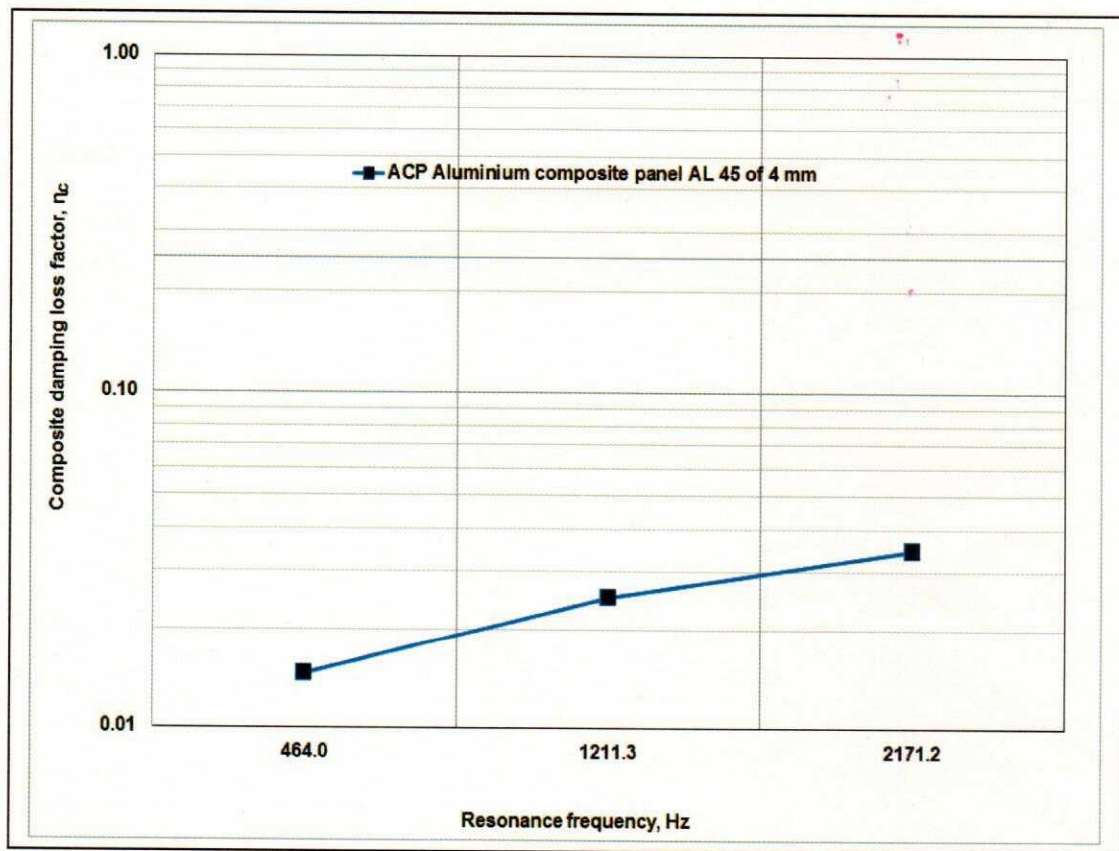


Figure 1: Plot of composite damping loss factor of ACP Aluminium composite panel AL 45 at resonance frequencies

**TEST REPORT ON
DETERMINATION OF SOUND TRANSMISSION LOSS OF
ACP ALUMINIUM COMPOSITE PANEL – AL 45**

NO. NVH/11265/2016-17/590(V-4)-2**29th March 2017**

1.0 CUSTOMER NAME : Aludecor Lamination Pvt.Ltd..
1, R. N. Mukherjee Road,
Martin Burn Building,
Suit No. 52, 5th Floor
Kolkata – 700 001
West Bengal

2.0 LETTER REF. : E-mail dated 15th March 2017

3.0 TEST COMPONENT DETAILS :

ACP Aluminium composite panel AL 45 with following details given by customer

Overall ACP Thickness	:	4.00 mm
Top Coil Thickness	:	0.50 mm
Bottom Coil Thickness	:	0.50 mm
Core Thickness	:	3.00 mm
Alloy	:	AA3105
Top Coil density	:	2.72 kg/m ²
Core weight	:	0.93 gram/m ²
ACP density	:	5.51 kg/m ²

4.0 TEST REQUIREMENTS :

Measurement of sound transmission loss of ACP Aluminium composite panel AL 45 of 4 mm thick as per ISO 10140-2 / ASTM E-90 and determination of sound transmission class (STC) as per ASTM E- 413 and weighted sound reduction index R_w (C; Ctr) with spectrum adaptation terms as per ISO 717-1.

5.0 TEST PROCEDURE :

The above mentioned ACP Aluminium composite panel AL 45 of 4 mm thick was mounted in between two reverberation chambers of size 2.4 m x 2.4 m. Please refer figure 1 for test set up and mounting of system. The airborne sound transmission loss test was carried out as per ISO 10140-2 / ASTM E-90 standard at temperature 25°C ± 1°C and humidity 51%.

6.0 DATE OF EVALUATION :

The sound transmission loss test was carried out on ACP Aluminium composite panel AL 45 of 4 mm thick on 29th March 2017.

7.0 INSTRUMENTATION :

Sr. No	Instrument Name	Type / Model No	Make	Calibrated on	Calibration due on
1	Multi-channel Data Acquisition System	3560 D	Bruel & Kjaer, Denmark	14-Jun-16	14-Jun-17
2	½" Random Incidence Microphone	378B20 (Sr. No. 109016 and Sr. No. 109018)	PCB, USA	16-Jun-16	16-Jun-17
3	Power Amplifier	2716	Bruel & Kjaer, Denmark	-	-
4	Omni directionnel sound source	Omni power 4296	Bruel & Kjaer, Denmark	-	-
5	Reverberation Chambers	80 m ³ and 110 m ³	-	-	-

8.0 TEST RESULTS :

- 8.1 Table 1 and figure 2 show the values and plot of airborne sound transmission loss of ACP Aluminium composite panel AL 45 of 4 mm thick in the one-third octave frequency bands of 100 Hz to 8000 Hz, STC (sound transmission class), and R_w ($C_{100-5000}$; $C_{tr100-5000}$) (weighted sound reduction index and spectrum adaptation terms).

9.0 CONCLUSIONS :

The sound transmission class (STC) is calculated as per ASTM E- 413 and weighted sound reduction index with spectrum adaptation terms R_w ($C_{100-5000}$; $C_{tr100-5000}$) is calculated as per ISO 717-1 for ACP Aluminium composite panel AL 45 of 4 mm thick	
Sound transmission class (STC)	29 dB
Weighted sound reduction index with spectrum adaptation terms R_w ($C_{100-5000}$; $C_{tr100-5000}$)	29 (-1; -4) dB

Report Prepared By:

Reviewed By:

Approved By:


M. P. Joshi

Manager


S. K. Jain

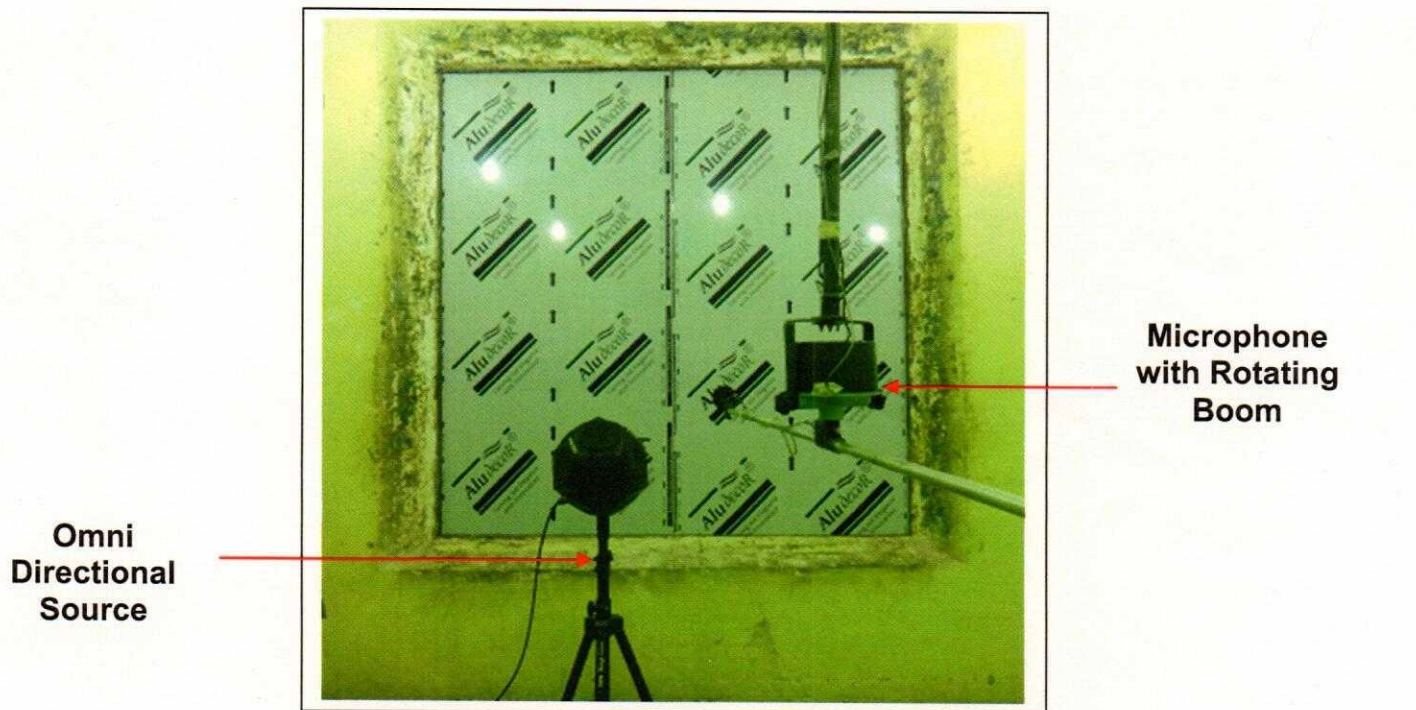
Dy. General Manager



N. V. Karanth
Sr. Deputy Director & HoD

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Source Room

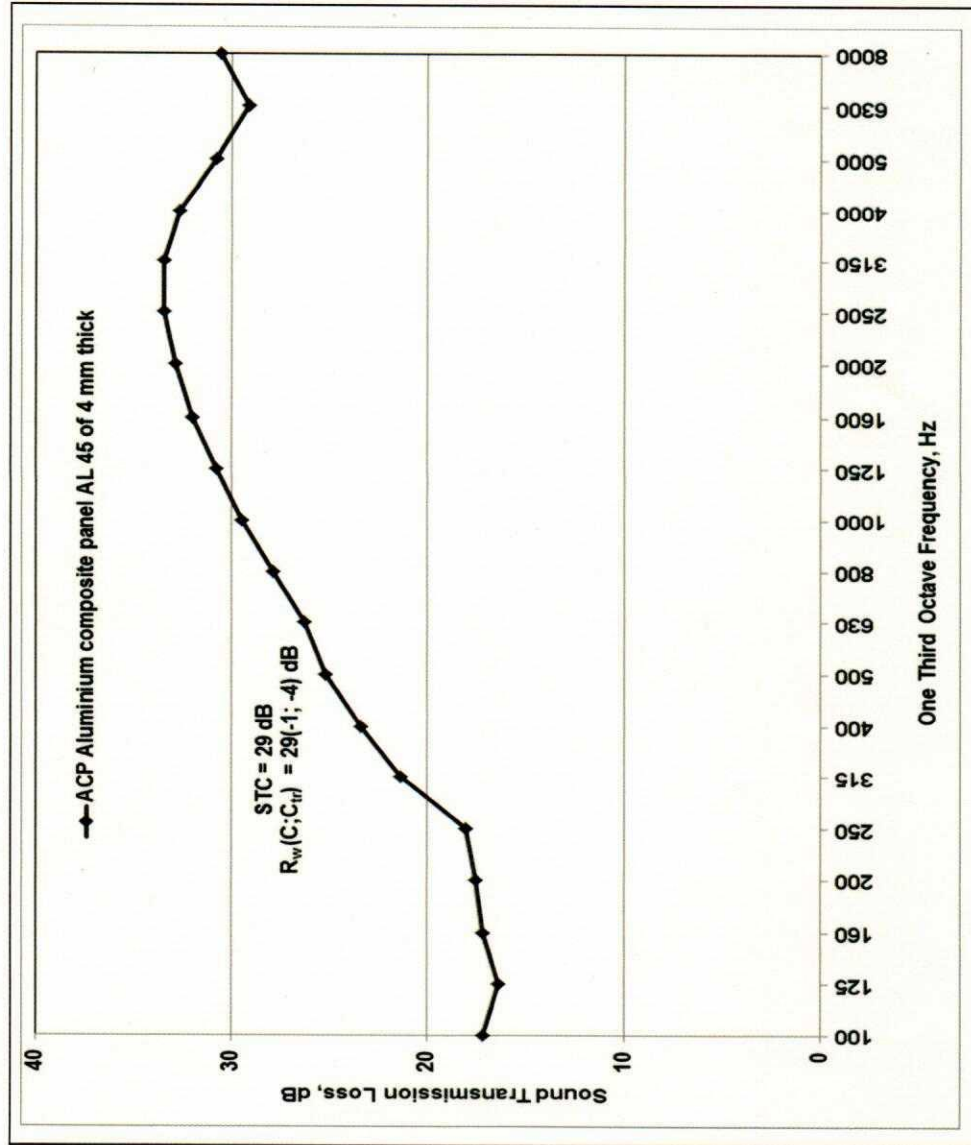


Receiver Room

Figure 1: Test set up for mounting of ACP Aluminium composite panel AL 45 of 4 mm thick between two reverberation chambers

Table 1 and Figure 2: Values and plot for sound transmission loss of ACP Aluminium composite panel AL 45 of 4 mm thick at one third octave frequencies

One Third Octave Frequency, Hz	Sound Transmission Loss, dB	STDV
100	17.2	0.63
125	16.4	2.16
160	17.2	1.35
200	17.6	0.29
250	18.1	0.45
315	21.4	0.12
400	23.4	0.36
500	25.2	0.30
630	26.3	0.45
800	27.9	0.43
1000	29.5	0.36
1250	30.8	0.26
1600	32.0	0.13
2000	32.9	0.19
2500	33.5	0.20
3150	33.5	0.17
4000	32.7	0.47
5000	30.8	0.34
6300	29.1	0.53
8000	30.6	0.48
STC	29 dB	
$R_w(C;C_{tr})$	29(-1;-4) dB	



The Measurement Uncertainty in sound transmission loss evaluation is ± 3 dB from 125 Hz to 630 Hz and ± 1.5 dB above 630 Hz with 95.45 % confidence level and $K=2$.
 The measurement uncertainty has been computed at one third octave frequency band from 125 Hz to 8000 Hz.

**TEST REPORT ON DETERMINATION OF
RANDOM INCIDENCE SOUND ABSORPTION COEFFICIENT OF
ACP ALUMINIUM COMPOSITE PANEL-AL 45**

NO. NVH/11265/2016-17/590(V-4)-1

29th March 2017

1.0 CUSTOMER NAME : Aludecor Lamination Pvt.Ltd..
1, R. N. Mukherjee Road,
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Suit No. 52, 5th Floor
Kolkata – 700 001
West Bengal

2.0 LETTER REF. : E-mail dated 15th March 2017

3.0 TEST COMPONENT DETAILS :

ACP Aluminium composite panel AL 45 with following details given by customer

Overall ACP Thickness	:	4.00 mm
Top Coil Thickness	:	0.50 mm
Bottom Coil Thickness	:	0.50 mm
Core Thickness	:	3.00 mm
Alloy	:	AA3105
Top Coil density	:	2.72 kg/m ²
Core weight	:	0.93 gram/m ²
ACP density	:	5.51 kg/m ²

4.0 TEST REQUIREMENTS :

Measurement of Random incidence sound absorption coefficient on above mentioned ACP Aluminium composite panel AL 45 of 4 mm as per ISO 354 / ASTM C423 and determination of noise reduction coefficient.

5.0 TEST PROCEDURE :

The Random incidence sound absorption coefficient measurement was carried out on ACP Aluminium composite panel AL 45 of 4 mm as per ISO 354 / ASTM C423 in reverberation chamber. The test sample was mounted on the floor with Type A mounting. Please refer figure 1 for test set up and test component details. The measurement was carried out at temperature 25°C ± 1°C and humidity 72%.

6.0 DATE OF EVALUATION :

The Random incidence sound absorption coefficient measurement was carried out on above mentioned ACP Aluminium composite panel AL 45 of 4 mm on 27th March 2017.

7.0 INSTRUMENTATION :

Sr. No	Instrument Name	Type / Model No	Make	Calibrated on	Calibration due on
1	Multi-channel Data Acquisition System	3560 D	Bruel & Kjaer, Denmark	14-Jun-16	14-Jun-17
2	½" Random Incidence Microphone	378B20 (Sr. No. 109015)	PCB, USA	16-Jun-16	16-Jun-17
3	Power Amplifier	2716	Bruel & Kjaer, Denmark	-	-
4	Omni directionnel sound source	Omni power 4296	Bruel & Kjaer, Denmark	-	-
5	Reverberation room	80 and 110 m ³	-	-	-

8.0 TEST RESULTS :

Table 1 and figure 2 shows the average values for random incidence sound absorption coefficient of ACP Aluminium composite panel AL 45 of 4 mm in the one third octave frequency between 125 Hz to 8000 Hz.

9.0 CONCLUSIONS :

The Noise Reduction Coefficient (NRC) is given by the average value of sound absorption coefficient at 250 Hz, 500 Hz, 1000 Hz and 2000 Hz is calculated as per ASTM C- 423.

ACP Aluminium composite panel AL 45 of 4 mm	
Noise Reduction Coefficient (NRC)	0.06

Report Prepared By:



M. P. Joshi
Manager

Reviewed By:



S. K. Jain
Dy. General Manager

Approved By:



N. V. Karanth
Sr. Deputy Director & HoD

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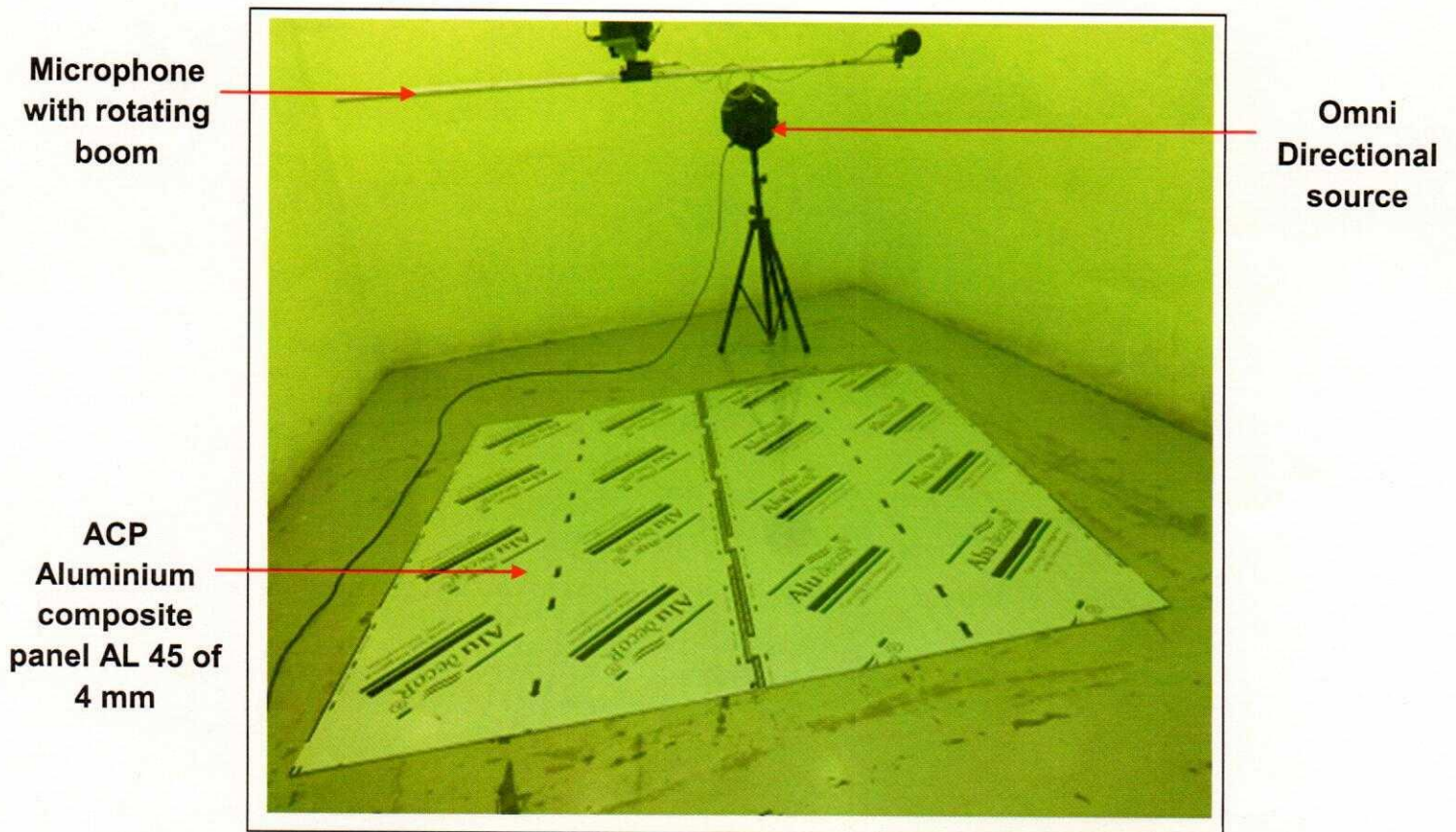
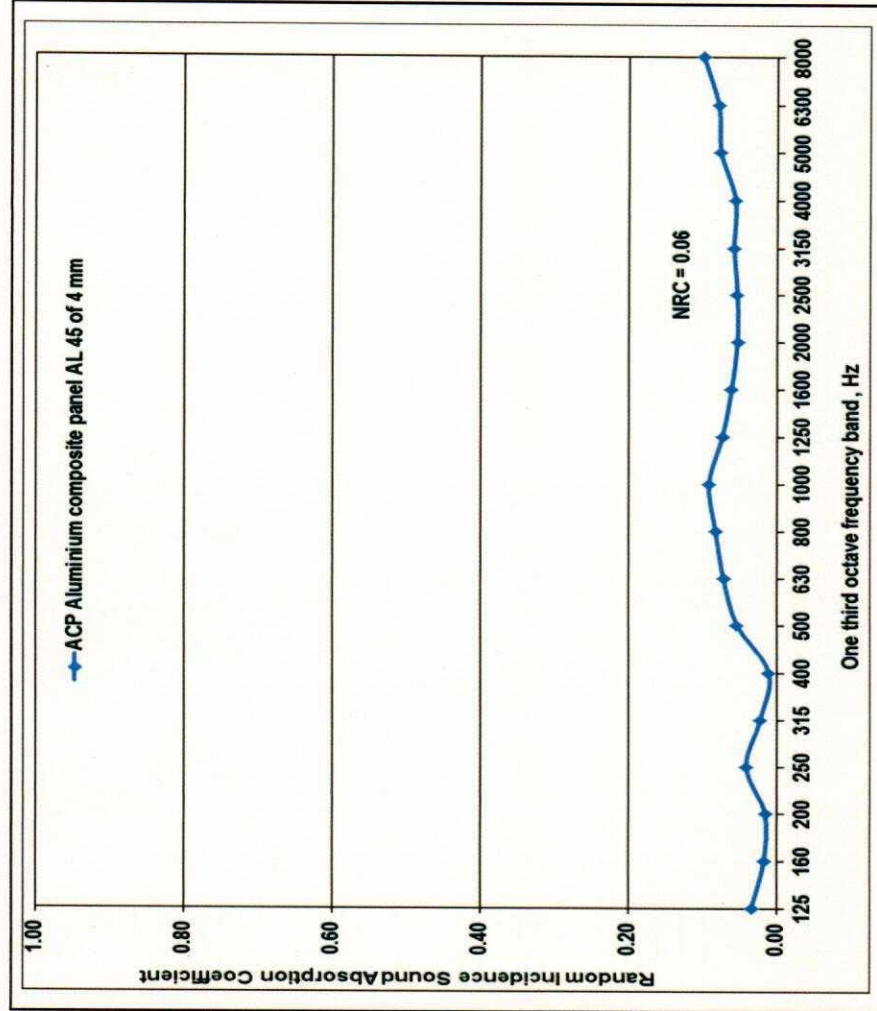


Figure 1: Test set up for mounting and testing of ACP Aluminium composite panel AL 45 of 4 mm in reverberation chamber

Table 1 and Figure 2: Values and Plot for Random incidence sound absorption coefficient of ACP Aluminium composite panel AL 45 of 4 mm at one third octave frequencies

One third octave frequency, Hz	Random Incidence Sound Absorption Coefficient	Standard Deviation
125	0.03	0.00
160	0.02	0.00
200	0.01	0.00
250	0.04	0.01
315	0.02	0.00
400	0.01	0.01
500	0.05	0.00
630	0.07	0.01
800	0.08	0.00
1000	0.09	0.00
1250	0.07	0.00
1600	0.06	0.00
2000	0.05	0.00
2500	0.05	0.01
3150	0.06	0.01
4000	0.06	0.00
5000	0.08	0.01
6300	0.08	0.01
8000	0.10	0.02
NRC		0.06



Note: (*Measurement uncertainty for Random incidence sound absorption coefficient evaluation is $\pm 4.23\%$ at 95.45% confidence level and $k = 2$ in the frequency range 125 Hz to 5000 Hz)