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**Report on**

**Determination of Sound Transmission Class (STC) of Door Assembly (64mm FIREBAN Core with Solid Wooden Frame)**

**Report No: TPWR-170415/046SN1/1 C2-2**

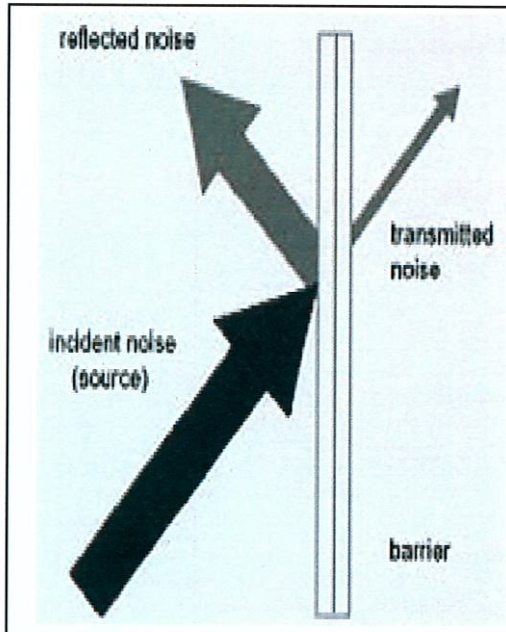
**Lab Project No: P-3239**

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## 1) INTRODUCTION

This report gives the results of Sound Transmission Loss tests and determination of Sound Transmission Class / acoustic performance on the following door assembly, produced by **Khansaheb Joinery**:

- 1) 90 Minutes Fire Rated Wooden Door Assembly with 64mm thick FIREBAN Core, Solid Hard Wood Frame of dimensions (2453 x 1194 x 150) mm, 3 Nos. of acoustic, smoke & fire seal with acoustic fins (LP2504DS), Acoustic Bulb Seal (LAS1005) & Acoustic Bottom Seal (NOR810)

## 2) TESTING METHOD

The specimen were tested in accordance with the American Society for Testing and Materials designation ASTM E 90 - 2004, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions", ASTM E - 1408, "Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems", and classified in accordance with the American Society for Testing and Materials designation ASTM E 413 - 2004, "Classification for Rating Sound Insulation" and ASTM Standard E 1332 - 90 (Re-Approved 2003) entitled, "Standard Classification for Determination of Outdoor-Indoor Transmission Class".

## 3) SOUND TRANSMISSION CLASS

### 3.1: General:

Sound Transmission Class, or STC for short, is a measure in dB of the extent or ability for a building material to absorb sound. This is the most common rating used to determine airborne sound transmission loss between frequency ranges of 100Hz to 5000Hz. This range covers majority of noises and annoyances easily audible to humans, which include musical instruments, television, speech and many more. The STC can be used to measure sound absorption for both, external or internal building walls in a single or multi layered structure.

### 3.2: Principle of STC testing:

The STC is measured by placing a site representative sample in the middle of an acoustical chamber dividing the chamber into two rooms. One chamber acts as the source room where sound of a specific level is generated. In the opposite chamber sound receiving equipment measures the level of sound transmitted through the specimen allowing for the calculation of the level of noise reduced by the specimen placed in between.

For example, if a sound level of 100dB was generated in the source room and the level of sound measured in receiving room was 60dB, then the specimen placed in between has reduced noise level transmitted to the receiving room by 40dB and thus has a STC rating of 40dB.

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#### 4) TERMS & DEFINITIONS

**4.1: Sound:** sound is a vibration that travels as mechanical wave having pressure and displacement. Sound is indicated in two ways, frequency and intensity.

**4.2: Frequency:** frequency is the high or low pitch of a sound and is expressed as the number of vibrations per second. The S.I unit of frequency is Hertz, donated by Hz, and 1 Hz is defined as one vibration per second.

**4.3: Decibels:** as per the definition of sound in 4.1, sound is a vibration that creates air pressure which is detected by the human ear. Greater the air pressure of the vibration, greater is the intensity or loudness of the sound. Intensity or loudness of sound is measured in decibels, donated by dB.

**4.4: STC:** is an integer that donates how well a building wall, roof or ceiling attenuates airborne sound. It is widely used in the USA to rate and compare interior or exterior wall configurations, ceilings and roof configurations, doors and windows.

**4.5: Octave Band:** is a frequency band where the highest frequency is twice the lowest frequency. The numerical value of the frequency interval in octaves is given by  $lb(f_2 / f_1)$ , ( $f_2 \geq f_1$ )

**4.6: Sound Absorption:** is the process in which a construction material takes in or absorbs sound energy decreasing the intensity or loudness of sound. This phenomenon only absorbs sound energy and does not reflect sound waves.

**4.7: Transmission Loss:** TL in room acoustics indicates the amount of reduction, in decibels, of sound intensity by a partitioned interior or exterior wall, roof, ceiling, window or door. It is described by ten times the logarithm of the ratio of power of an incoming wave towards the partition to the power of the same wave that has passed through the partition.







## 6) TEST SPECIMEN DETAILS

### 6.1: Description:

Test was conducted on the following sample:

- 1) Specimen -90 Minutes Fire Rated Wooden Door Assembly with 64mm thick FIREBAN Core, Solid Hard Wood Frame of dimensions (2453 x 1194 x 150) mm, 3 Nos. of acoustic, smoke & fire seal with acoustic fins (LP2504DS), Acoustic Bulb Seal (LAS1005) & Acoustic Bottom Seal (NOR810) in 'Operable Condition'. (Average of three determinations)

Test was carried out in the one-third octave band of frequencies ranging from 100 Hz - 5000 Hz. For each test three set of readings were taken from lowest to highest frequency.

### 6.2: Items used for Door Assembly:

Name	Manufacturer/Supplier	Physical Properties	Additional Details (provided by client)
90 Minutes Fire Rated Door Leaf	FireBAN (Core Manufacturer) Khansaheb Joinery (Leaf Manufacturer)	Overall Thickness: 65 mm	64mm FireBAN Core having stated minimum density of 600 kg/m <sup>3</sup> with 0.6mm SAPELE veneer on both sides and 3mm thick solid SAPELE hard wood lipping on all sides having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 %
Door Frame for 90 Minutes Fire Rated Door	Khansaheb Joinery (Manufacturer)	Jamb Thickness: 150 mm	65mm thick solid SAPELE hard wood door frame having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 %
Door Architraves for 90 Minutes Fire Rated Door	Khansaheb Joinery (Manufacturer)	Overall Thickness: 18mm	18mm thick solid SAPELE hard wood door architraves having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 %
Double Bearing Door Butt Hinges for 90 Minutes Fire Rated Doors	SIMPLEX (Supplier)	Overall Dimension: (102 x 76 x 3)mm	Model No.: HSSBS-SIM-FR, 304 Grade stainless steel, double ball bearing door hinges
Mortise Sash Lock Body for 90 Minutes Fire Rated Door	SIMPLEX (Supplier)	Overall Dimension: (235 x 85 x 24) mm	Model No.: 885572-SSS, mortise lock with 2mm intumescent protection sheet around the lock body
Euro Profile Double Cylinder Lock with Escutcheon for 90 Minutes Fire Rated Door	SIMPLEX (Supplier)	Dimension: 80mm length	Model No.: 1910-40/40-AB, Complying with German Standard DIN 18252/EN 1303, double cylinder 80mm in length fixed with M5 screws
Lever Handle for 90 Minutes Fire Rated Door	SIMPLEX (Supplier)	-	Model No.: MS0101
Three Nos. of Fire Strip with Acoustic fins for 90 Minutes Doors	LORIENT (Supplier)	Dimension: 2 Nos. of (25x4) mm only on door frame 1 Nos. of (25x4) mm only on door leaf except bottom	Model No.: LP2504DS
Acoustic Automatic Door Bottom Seal for 90 Minutes Fire Rated Door	NORSOUND (Supplier)	Overall Dimension: (35 x 14) mm	Model No.: NOR810, aluminum holder with silicone gasket
Acoustic Bulb Seal for 90 Minutes Fire Rated Door	LORIENT (Supplier)	Overall Length: 10 mm	Model No.: LAS1005, flexible silicone rubber

Table 2.1: Items used for design of 90 min Fire Rated Door

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### 6.3: Details of Door Leaf, Frame Ironmongery & Seals Used:

90 min Fire Rated Door Frame	
Overall Dimension of Frame	Height x Width: (2453x 1120) mm
Overall Thickness of Jamb	150 mm
Frame Type	65mm solid SAPELE hard wood frame
Frame Constituents	65mm solid SAPELE hard wood frame having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 %
	2 Nos. of (25 x 4) mm acoustic, smoke & fire seal on three sides of frame rebate and fixed 8mm inwards from frame edge at receiving room end and 10mm apart (60 x 18) mm solid SAPELE hard wood architraves having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 %
	1 Nos. of 10 mm acoustic single bulb seal on three sides of frame and fixed in gap between door stop and door leaf
	2mm thick mortar applied on 10mm polyurethane foam in between frame, architraves and supporting construction gaps
Frame Details and Dimensions	Rebate Face: 32 mm
	Frame Stop: 13 mm
	Rebate: 58 mm
	Soffit: 92 mm

Table 2.2: 60 min Door Frame Details

90 min Fire Rated Door Leaf	
Overall Dimension of Leaf	Height x Width: (2400 x 1100) mm
Overall Thickness of Leaf	65 mm
Core	FireBAN FD90
Leaf Constituents	64mm thick FireBAN Core- having stated minimum density of 600 kg/m <sup>3</sup>
	0.6mm SAPELE veneer on both front and back sides
	1 Nos. of (25 x 4) mm acoustic, smoke & fire seal on three sides of leaf except bottom and fixed centrally on leaf
	1 Nos. of (35 x 14) mm acoustic automatic bottom seal on bottom of leaf and fixed centrally on bottom
	3mm thick solid SAPELE hard wood Lipping on all sides having stated minimum density of 650 kg/m <sup>3</sup> and moisture content of 10±2 % fixed using Fevicol 1K PUR

Table 2.3: 90 min Door Leaf Details










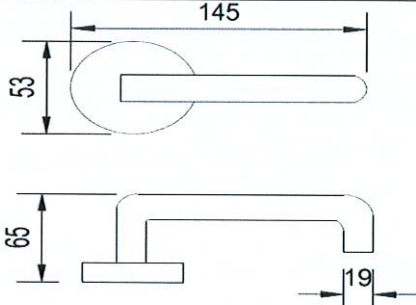
Lever Handle for 90 min Fire Rated Door	
Supplier (Model No.)	SIMPLEX (MS0101)
Door Handle Figure	
Door Handle Dimension	

Table 2.6: Door Handle Details


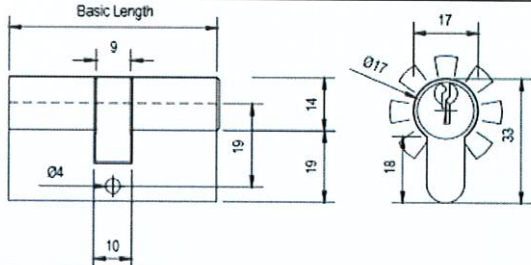
Double Cylinder Lock for 90min Fire Rated Door	
Supplier (Model No.)	SIMPLEX (1910-40/40-AB)
Additional Details	Length: 80mm
Cylinder Lock Figure	
Cylinder Lock Dimension	

Table 2.7: Cylinder Lock Details

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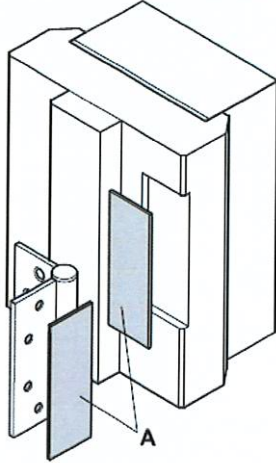
Intumescent Kit for Fire Rated Door Butt Hinge	
Manufacturer (Model No.)	LORIENT (Interdens)
Thickness	2mm
Location	Under each hinge blade screwed to door frame
Application of Protection Kit on Door Butt Hinge	 <p>A = hinge protection kit</p>

Table 2.8: Intumescent Kit for Door Butt Hinge Details

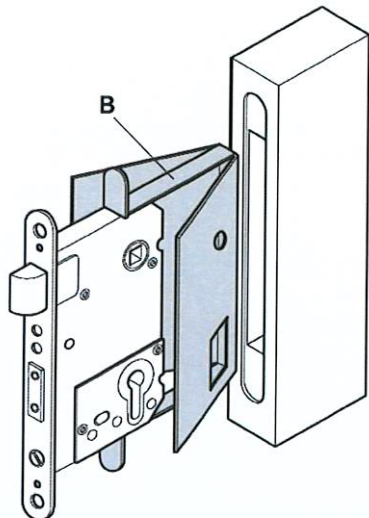
Intumescent Kit for Fire Rated Door Mortise Lock	
Manufacturer (Model No.)	LORIENT (Interdens)
Thickness	2mm
Location	Around mortise lock case
Application of Protection Kit on Mortise Lock	 <p>B = mortise lock protection kit</p>

Table 2.9: Intumescent Kit for Mortise Lock Case Details


Acoustic, Smoke & Fire Seal for 90 min Fire Rated Door	
Manufacturer (Model No.)	LORIENT (LP2504DS)
Thickness	2mm & 4mm
Material	Sodium Silicate Compound Encapsulated in PVC with acoustic fins
Other properties	Self-Adhesive Combined Acoustic, Fire and Smoke Seal
Location on 90 min door	<ol style="list-style-type: none"> <li>2 Nos. of (25 x 4) mm acoustic, smoke &amp; fire seal on all sides of frame rebate and fixed 8mm inwards on frame edge at receiving room end and 10mm apart</li> <li>1 Nos. of (25 x 4) mm acoustic, smoke &amp; fire seal on all sides of leaf except bottom and fixed centrally on leaf</li> </ol>
Acoustic Fire Seal Figure	

Table 2.10: Acoustic Fire Seal Details

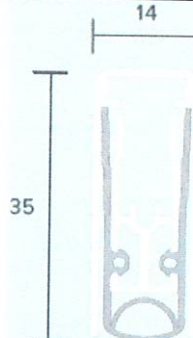
Acoustic Automatic Door Bottom Seal for 90 minutes Fire Rated Door	
Supplier (Model No.)	NORSOUND (NOR810)
Overall Dimensions	Height x Thickness: (35 x 14) mm
Material	Aluminum carrier with silicone gasket
Door Bottom Acoustic Seal Dimension	

Table 2.11: Acoustic Automatic Door Bottom Seal Details

Acoustic Bulb Seal for 90 minutes Fire Rated Door	
Supplier (Model No.)	LORIENT (LAS1005)
Overall Dimensions	Length: 10 mm
Material	Flexible Silicone Rubber
Acoustic Bulb Seal Dimension	<p style="text-align: center;"><b>LAS1005</b></p> 

Table 2.12: Bulb Seal Details

Installation of FD 90 Door:

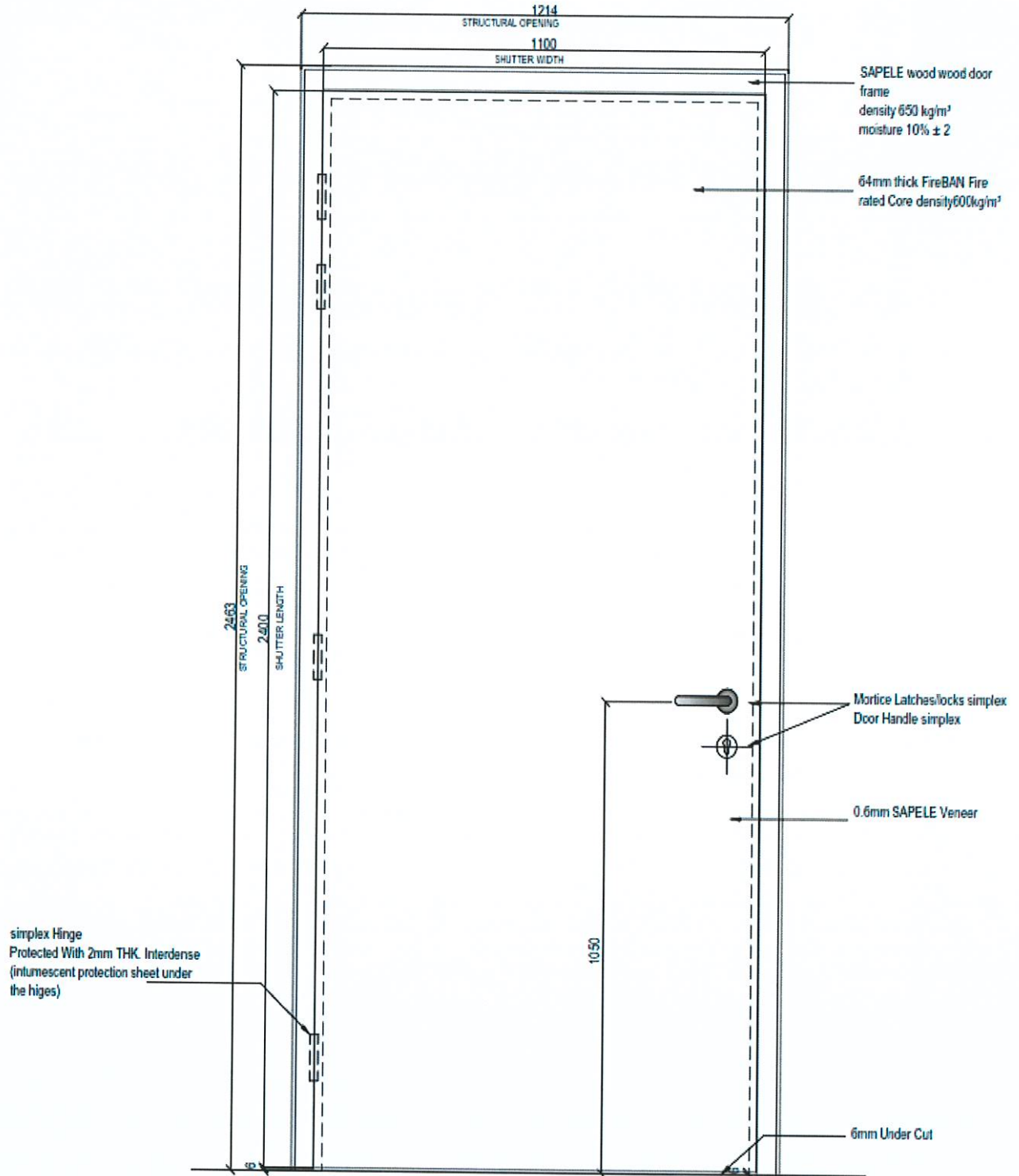


Figure 1.1: Front view of the assembled FD90 door set

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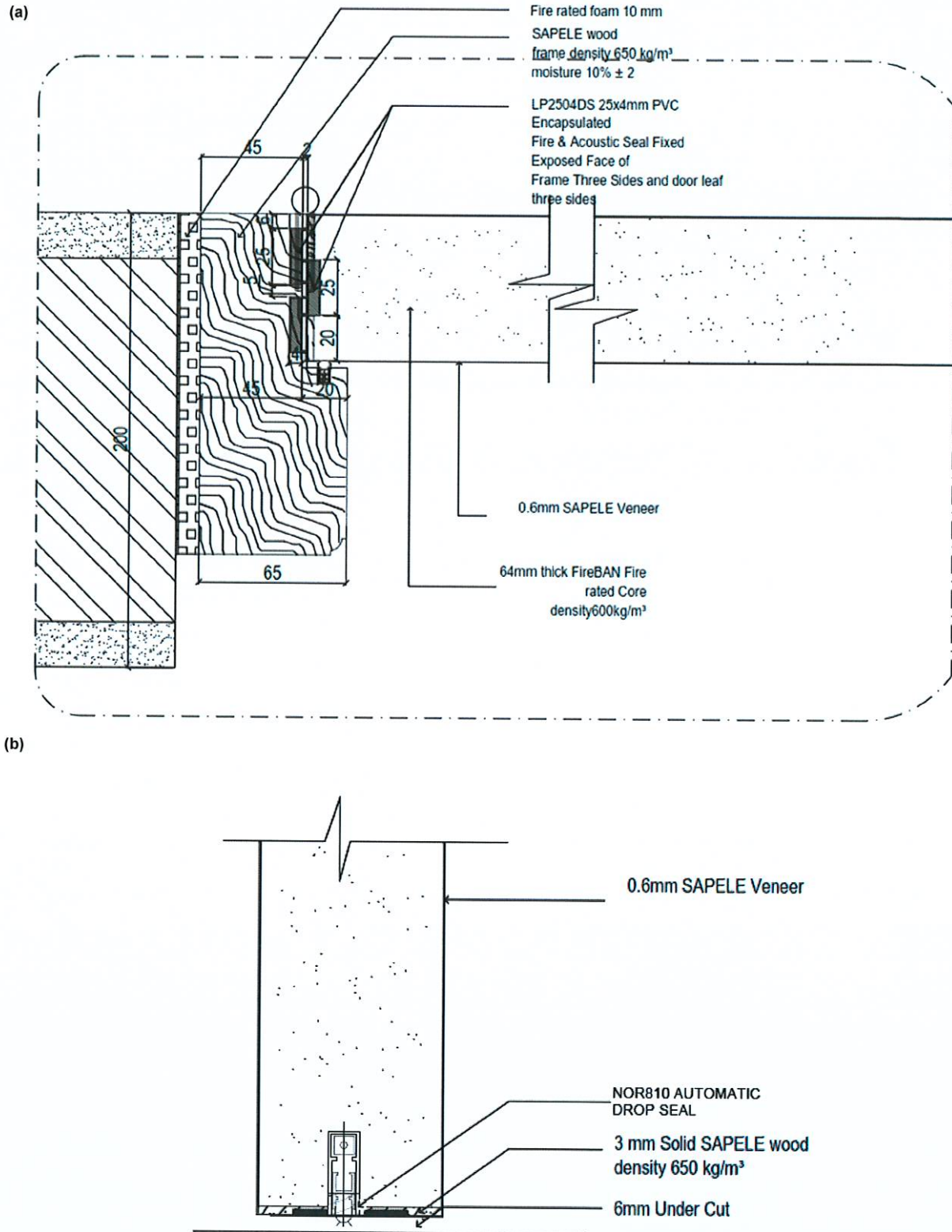


Figure 1.3: (a) Top view of hinge side fixing details of FD90 door frame and leaf (b) Side view of bottom section FD90 door leaf

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## 8) TEST DATA & DETAILED RESULTS

### 8.1: Determination of Average Decay Rate in Receiving Room for All Test Trials:

Octave Band Center Frequency (Hz)	Decay Rate dB/sec				
	Mic-6	Mic-7	Mic-8	Mic-9	Mic-10
100	5,64	6,10	4,61	4,90	5,10
125	5,96	6,19	6,28	6,46	4,95
160	6,75	6,77	6,89	6,44	7,44
200	6,89	6,97	6,93	6,88	7,75
250	6,74	5,53	6,53	5,59	5,88
315	5,16	4,79	5,31	5,22	5,46
400	5,40	5,11	5,35	5,37	5,18
500	4,95	4,84	4,79	4,80	5,00
630	4,35	4,50	4,45	4,52	4,51
800	3,93	4,02	3,94	3,92	3,96
1000	3,69	3,64	3,67	3,65	3,71
1250	3,41	3,48	3,42	3,45	3,37
1600	3,40	3,44	3,45	3,39	3,40
2000	3,33	3,21	3,22	3,28	3,29
2500	3,07	3,09	3,02	3,12	3,17
3150	2,85	2,85	2,83	2,88	2,92
4000	2,68	2,68	2,76	2,77	2,70
5000	2,61	2,55	2,56	2,56	2,60

Table 4: Average Decay rate obtained after all test trials

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8.2: Determination of Average Sound Absorption in Receiving Room for All Test Trials:

Octave Band Center Frequency (Hz)	Sound Absorption dB.m <sup>2</sup>				
	Mic-6	Mic-7	Mic-8	Mic-9	Mic-10
100	0,80	0,86	0,65	0,69	0,72
125	0,84	0,87	0,89	0,91	0,70
160	0,95	0,96	0,97	0,91	1,05
200	0,97	0,98	0,98	0,97	1,09
250	0,95	0,78	0,92	0,79	0,83
315	0,73	0,68	0,75	0,74	0,77
400	0,76	0,72	0,75	0,76	0,73
500	0,70	0,68	0,68	0,68	0,71
630	0,61	0,63	0,63	0,64	0,64
800	0,55	0,57	0,56	0,55	0,56
1000	0,52	0,51	0,52	0,51	0,52
1250	0,48	0,49	0,48	0,49	0,48
1600	0,48	0,49	0,49	0,48	0,48
2000	0,47	0,45	0,45	0,46	0,46
2500	0,43	0,44	0,43	0,44	0,45
3150	0,40	0,40	0,40	0,41	0,41
4000	0,38	0,38	0,39	0,39	0,38
5000	0,37	0,36	0,36	0,36	0,37

Table 5: Average Sound absorption obtained after all test trials





8.3: STC Rating for Wooden Door Assembly, 64 mm thick FIREBAN Core & Solid Hard Wood Frame:  
(TPWR-170415/046)

1/3 Octave Band Center Frequency (Hz)	Sound Transmission Loss Data		
	Test 1	Test 2	Test 3
100	28	29	27
125	30	30	29
160	33	31	31
200	34	33	32
250	34	34	33
315	33	33	33
400	35	34	34
500	36	35	34
630	36	36	35
800	35	36	35
1000	37	37	36
1250	38	38	37
1600	39	38	37
2000	38	38	37
2500	35	36	35
3150	36	36	35
4000	38	38	37
5000	44	44	43
<b>Sound Transmission Loss</b>	<b><u>36</u></b>	<b><u>36</u></b>	<b><u>35</u></b>

Table 6: STC obtained for each individual test

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8.4: Sound Transmission Class Graph for Test #1:

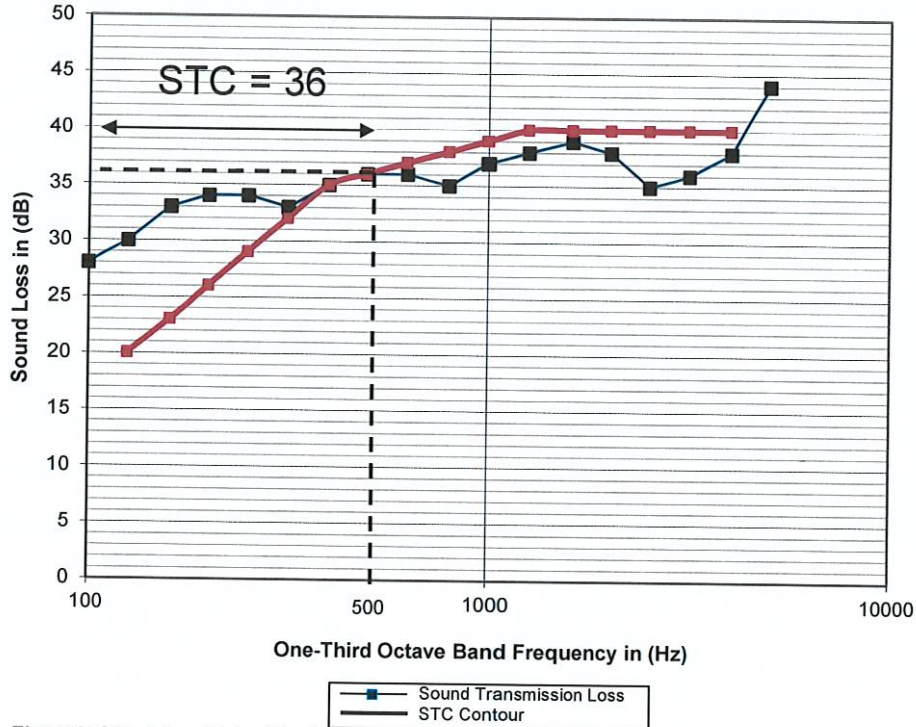


Figure2: STL data obtained for test 1 and adjustment of contour to obtain STC value at 500 Hz

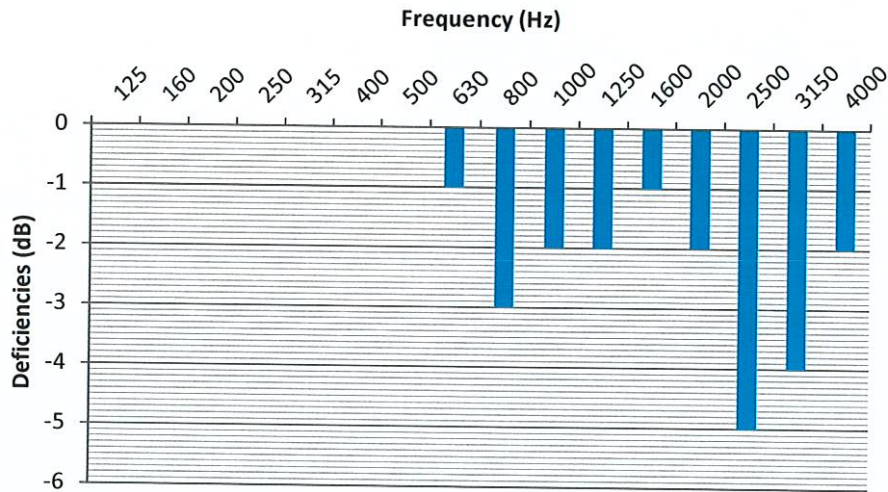


Figure3: Negative deficiency for test 1 between contour and STL raw data for each frequency. The sum of all deficiencies does not exceed 32 dB and the value of an individual deficiency does not exceed 8 dB.

8.5: Sound Transmission Class Graph for Test #2:

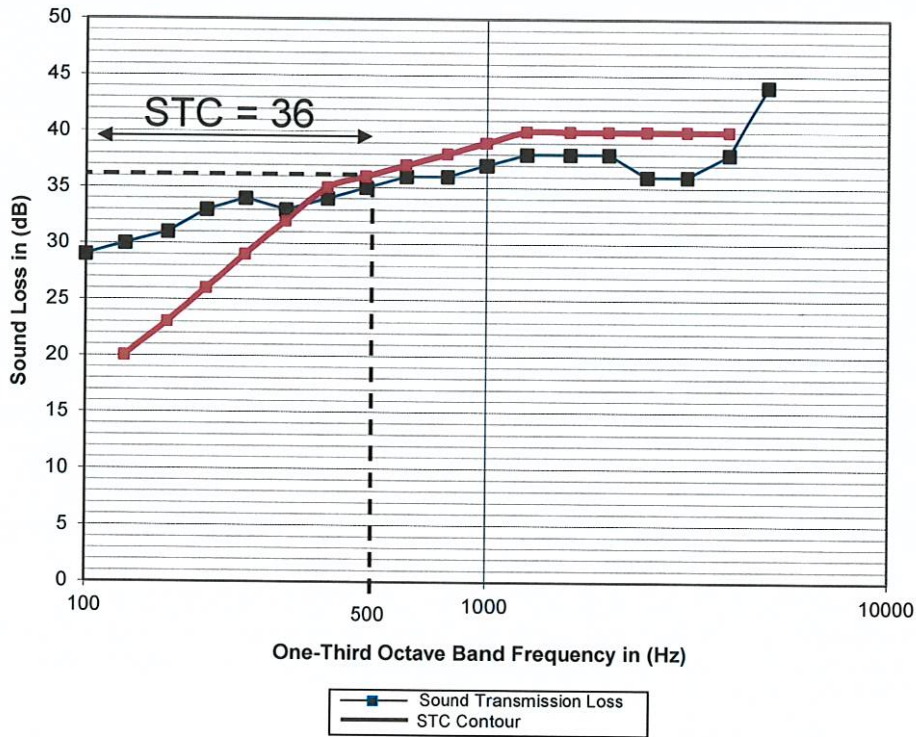


Figure4: STL data obtained for test 2 and adjustment of contour to obtain STC value at 500 Hz

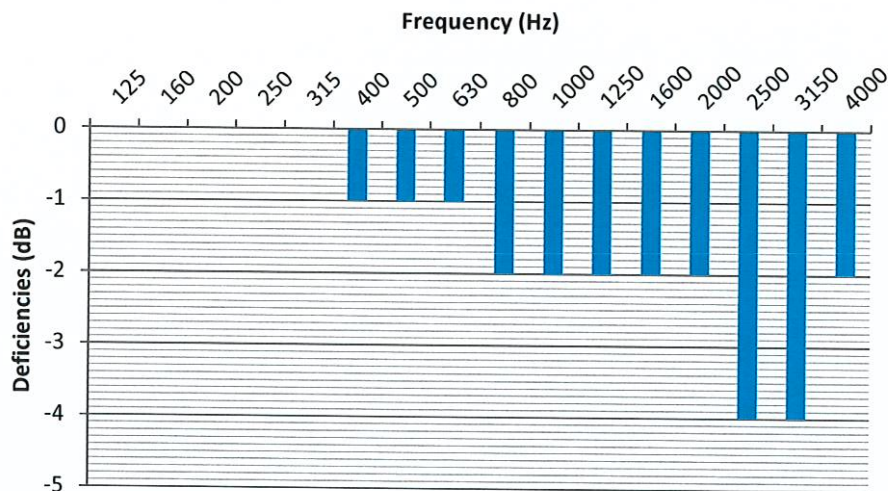


Figure5: Negative deficiency for test 2 between contour and STL raw data for each frequency. The sum of all deficiencies does not exceed 32 dB and the value of an individual deficiency does not exceed 8 dB.








## 9) REMARKS

1. Room temperature during testing was  $24^{\circ}\text{C} \pm 2^{\circ}\text{C}$
2. Relative Humidity: 50%
3. The test specimen supporting construction was cured for ten days before testing.

## 10) CONCLUSION & LIMITATIONS

The test method employed for this test has no pass-fail criteria; therefore, the evaluation of the test results is left to the discretion of the client / consultant as per their specific contract specification requirement.

- Supporting construction was cured for ten days only in accordance with instructions from the client.
- The door assembly was tested in operable condition.
- Polyurethane foam with Mortar overlap was used as sealant for gaps.
- The torque value of the door closer was not determined.
- This report is related to the door assembly tested only.
- This report relates only to the items (ironmongery and seals) used in assembly of the tested door.
- Test results given in this report are valid only for the conditions under which the test was performed.
- This test report represents the results of the door in operable condition only.
- This report cannot be reproduced except in full and without written approval of the laboratory.
- Upon the request of the test sponsor two separate reports have been issued, one for Khansaheb Joinery with Lab Report No. TPWR-170415/046 SN1/1 C1-2 and TPWR-170415/046 SN1/1 C2-2 for Gulf Trade Link. Management ensures that there are no changes in test data and the only changes are in the names of the test sponsor.

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Determination of Sound transmission Class (STC) of Wooden Door Assembly



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