

Annex B: Procedures for sound insulation testing

B1 Introduction

$D_{nT,w}$ and spectrum adaptation term, C_{w} , in accordance with ISO 717-1:1997.

E PRE-COMPLETION TESTING

Section 1: Pre-completion testing

Introduction

1.1 This section provides guidance on an appropriate programme of sound insulation testing for a sample of properties, in Regulation 20A of the Building Regulations and Regulation 12A of the Approved Inspectors Regulations.

1.2 Sound insulation testing to demonstrate compliance with Requirement E1 shall be carried out on site as part of the construction process, and in this Approved Document referred to as pre-completion testing. Regulation 20A and Regulation 12A, ensuring that appropriate sound insulation testing is carried out falls on the person carrying out the building work, who is also responsible for the cost of the testing. Therefore, guidance in this section is addressed to persons carrying out the work (testing bodies employed by them). It also addresses to building control by the Secretary of State expects building control bodies to determine, for each new development, the properties selected for testing.

1.3 Testing should be carried out in the following circumstances:

- (a) purpose built dwelling-houses;
- (b) dwelling-houses and flats in material change of use;
- (c) purpose built rooms for residential purposes;
- (d) rooms for residential purposes in material change of use.

1.4 The normal programme of tests described in paragraphs 1.29 to 1.32.

1.5 The testing procedure formally approved by the Secretary of State is described in Section 6: Procedures for sound insulation.

1.6 The performance standards to be demonstrated by pre-completion testing are set out in Section 6: Performance - and 1b. The sound insulation value tables have a built-in allowance for measurement uncertainty, so if any one of these values not to have been met by any margin, the test has been failed.

1.7 The person carrying out the testing should ensure that the guidance on construction given in this Approved Document or in another suitable source, is followed properly to minimize the chances of test failure. Where additional guidance is required, specialist advice on the building design should be sought at an early stage.

1.8 Testing should not be carried out between living spaces, corridors, or hallways.

single sound source
position, the average
the source and
sured in one-third-
octave band
fixed microphones
of these values on an
stationary microphone.



OFFICE OF THE
SECRETARY OF STATE

The Building Regulations 2000
The Building (Approved Inspectors etc) Regulations 2000

Resistance to the passage of sound



APPROVED DOCUMENT

- E1** Protection against sound from other parts of the building and adjoining buildings
- E2** Protection against sound within a dwelling-house etc
- E3** Reverberation in the common internal parts of buildings containing flats or rooms for residential purposes
- E4** Acoustic conditions in schools

Regulation 20A The Building Regulations 2000 (as amended)
Regulation 12A The Building (Approved Inspectors etc) Regulations 2000 (as amended)

Coming into effect 1 July 2003

2003 EDITION

APPROVED DOCUMENT



2003 EDITION

CONTENT

- INTRODUCTION
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 - Why 2003 ADE was brought in
 - Compliance routes
- Pre –Completion Testing
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 - Who should do the test?
 - What tests are required?
 - What if it fails?
- ROBUST DETAILS

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- LAB REQUIREMENTS
- POTENTIAL PROBLEMS
 - Conducting the test
 - Results
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- QUESTIONS

THE BTC

- The Building Test Centre is owned by British Gypsum which is part of Saint Gobain.
- The principle products of British Gypsum are plaster and plasterboard systems.
- The BTC is the company's British centre of excellence for fire, acoustic and structural testing.
- The BTC has UKAS accreditation enabling a quality impartial service to be provided to all customers
- See our test schedule via the website:
www.btconline.co.uk

THE BTC

•What is UKAS?

- United Kingdom Accreditation Service
- The sole UK national accreditation body covering certification, testing and calibration

•Why do we have it?

- UKAS monitors the performance of the laboratory annually.
 - Laboratory impartiality
 - Technical competence
 - Measurement Traceability
 - Appropriate resources and facilities
 - Actual laboratory performance to the required standard
 - Capability to sustain the required level of performance
 - Commitment to sustained continuous improvement

THE BTC

The test centre operates five distinct test areas from our Leicestershire site:

ACOUSTICS

Laboratory Testing

On Site Pre-completion Testing – anywhere in Britain / Ireland

STRUCTURES

BS 5234 Duty Grading

Racking Stiffness

Uniformly Distributed Load

PHYSICAL

EN520 Testing

FIRE RESISTANCE

REACTION TO FIRE

THE BTC

- The BTC has:
 - Over 40 years of acoustic lab test experience and
 - Over 30 years of acoustic site test experience
- Dedicated testing team
- The latest equipment and technology for fast efficient testing and reporting
- BTC is an Approved Measurement Contractor for the Robust Details Scheme

Approved Document E

- Why was a new Approved Document E brought in?
 - The 1996 English House Condition Survey - indicated that 4.7 million householders were still bothered by noise
 - In a study by BRE, 25% of occupants living in dwellings which met the standards still rated privacy as poor
 - Constructions capable of delivering reasonable sound insulation, were not doing so.
 - PPG3 and urbanisation will increase potential noise problems
 - Consumer demand for greater acoustic privacy within the home

Compliance Routes

New build dwelling houses and flats

- **Pre Completion Testing** Sampling approach to testing for compliance
- **Robust Details** Similar to 'deemed to satisfy' constructions

Properties formed by material change of use and rooms for residential purpose

- **Pre-Completion Testing**

Laboratory Requirements

- Internal floors and walls
- Doors leading onto corridors

Communal Areas - Flats or rooms for residential purpose

- Reverberations in common areas to be controlled through use of materials of required absorption class

TESTING



Source Room



Receiving Room

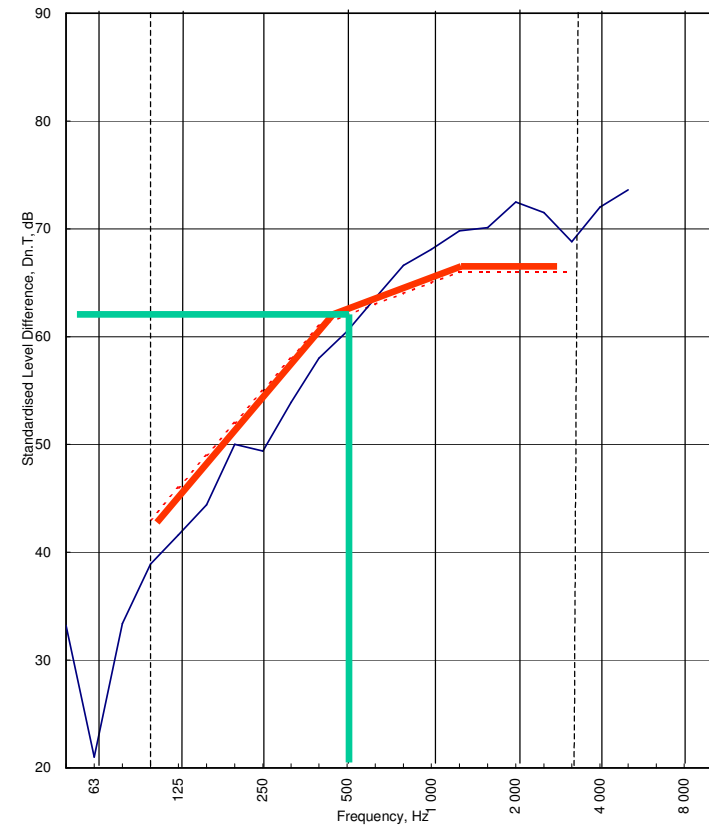


TESTING

Test Code:
F12104A
Test Date:
27/05/02

- Level difference values
 - Plot D_{nT} values
- Rating Curve
- Area under reference curve
 - Unfavourable deviations ≤ 32
- Take value off reference curve at 500Hz

Freq. Hz	D_{nT} dB
50	33.2
63	21.0
80	33.4
100	38.9
125	41.6
160	44.4
200	50.0
250	49.4
315	53.9
400	58.0
500	60.5
630	63.6
800	66.6
1 000	68.1
1 250	69.8
1 600	70.1
2 000	72.5
2 500	71.5
3 150	68.8
4 000	72.0
5 000	73.6
6 300	
8 000	
10 000	



Single figure $D_{nT,w}$ 62dB

Spectrum adaptation Ctr

$$D_{nT,w} + Ctr = 54$$

----- Curve of reference values (ISO 717-1)

Rating according to BS EN ISO 717-1:1997	$D_{nT,w}$ (C;Ctr) = 62 (-2;-8) dB		
	Max dev. 5.6 dB at 250 Hz		
Evaluation based on laboratory measurement results obtained by an engineering method:	$C_{50-3150} = -7$ dB	$C_{50-5000} = -6$ dB	$C_{100-5000} = -1$ dB
	$C_{tr,50-3150} = -19$ dB	$C_{tr,50-5000} = -19$ dB	$C_{tr,100-5000} = -8$ dB

TESTING

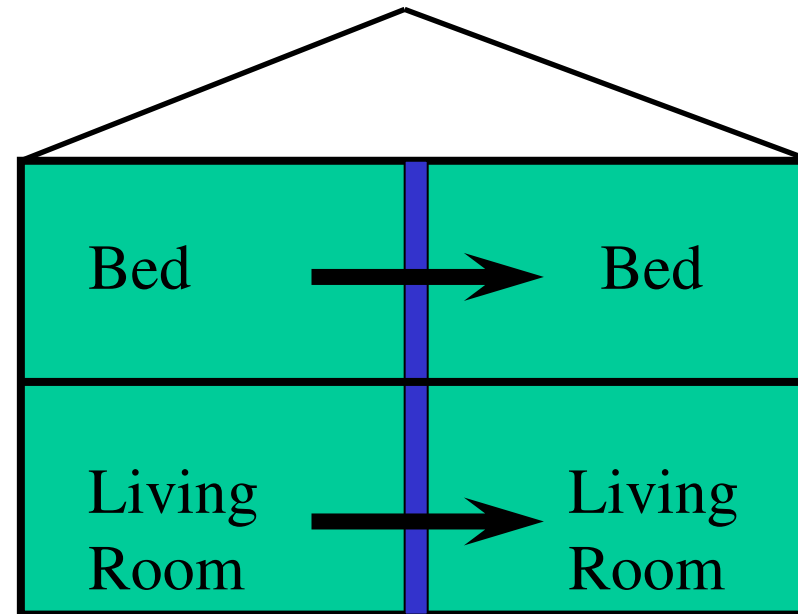
- Where to test
 - Separating walls, separating floors and stairs having separating function
- Where not to test
 - Between living spaces of the same plot, corridors, stairwells or hallways
- Rooms must be
 - Complete except for decoration
 - Volume at least 25m³
 - Floors normally tested excluding soft coverings

TESTING

- First completed unit in each sub-group to be tested
- 10% of each individual sub-group to undergo a SET of Pre-Completion Tests, assuming no failures
- Testing more frequently at the beginning of a series of completions
- Testing throughout the construction period
- ALL results in a SET must meet the criteria

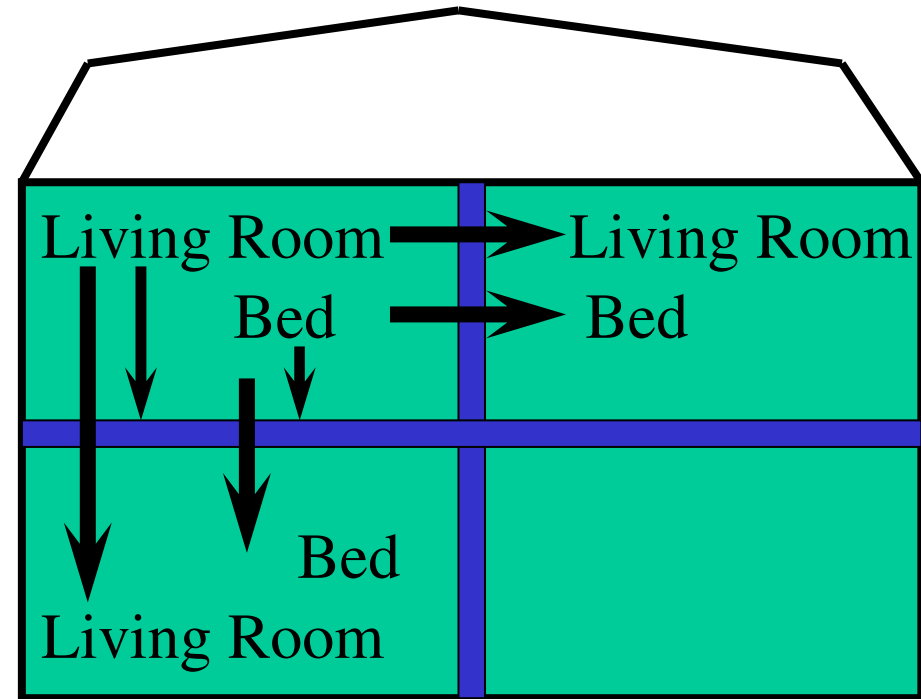
TESTING

- Dwelling House
- 1 SET of tests
 - Bedroom to bedroom
 - Living room to living room
- Access required to both houses



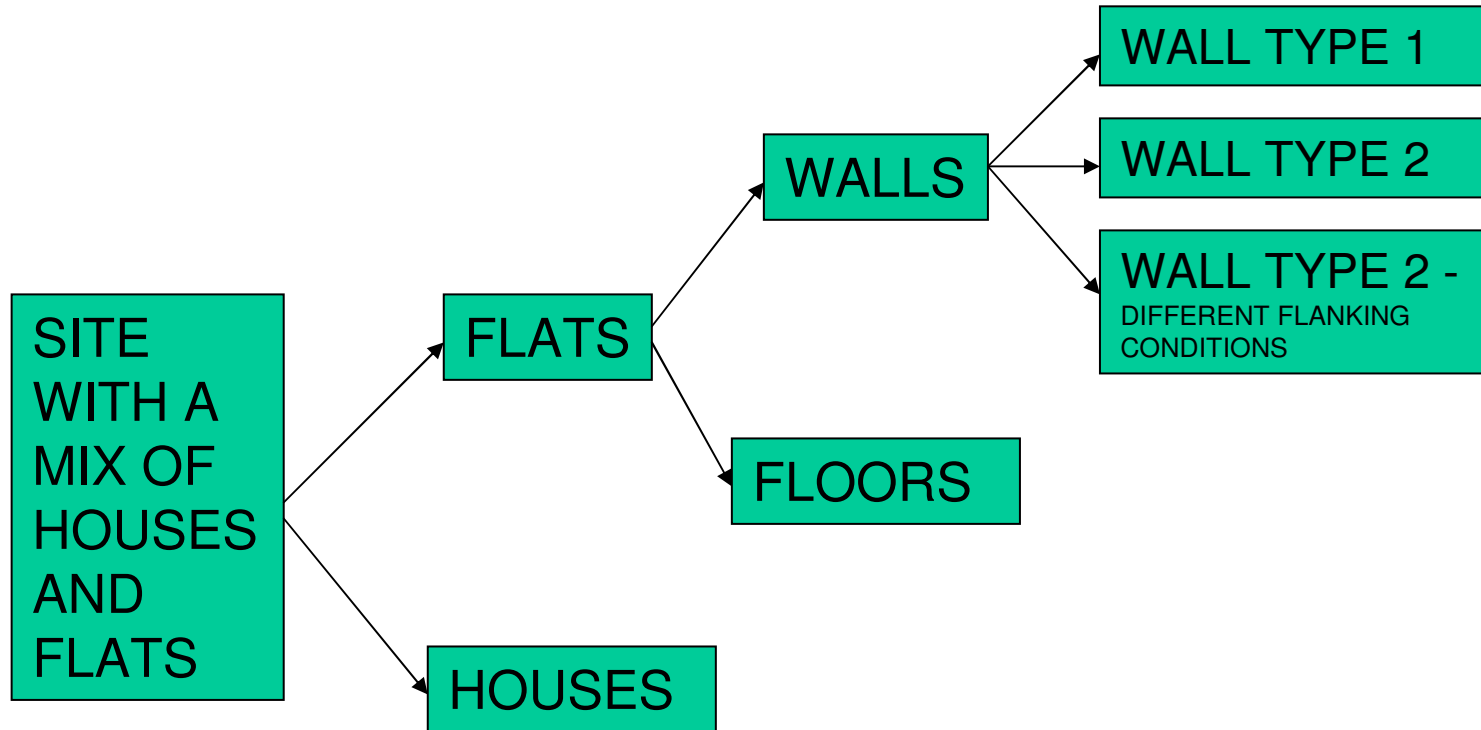
TESTING

- Flats
- 1 SET of tests
 - Wall
 - Bedroom to bedroom (air)
 - Living room to living room (air)
 - Floor
 - Bedroom to bedroom (air + impact)
 - Living room to living room (air + impact)



- **Access required to 3 flats**

Grouping/sub-grouping



- BUILDING CONTROL BODIES TO EXERCISE JUDGEMENT WHEN SETTING UP SUB-GROUPS



Real World



- In The Real World....
- It's not always possible to test living room to living room and/or bedroom to bedroom
 - One of the rooms in one of the pairs should be a bedroom
 - One of the rooms in the other pair should be a living room
- Number of tests in a set to be reduced only if there's 1 pair of rooms on opposite sides of the entire area of the separation
 - e.g. open plan flats
 - Stairways
 - It may not be possible to test a plot if the adjacent plot has a stairway against the separating wall

Acoustic Criteria

	PCT criteria for Purpose Built Buildings		PCT criteria for Buildings Formed by Conversion	
	Dntw + Ctr (minimum)	Lntw (maximum)	Dntw + Ctr (minimum)	Lntw (maximum)
Separating Wall	45 dB (43 dB)	-	43 dB	-
Separating Floor	45 dB	62 dB	43 dB	64 dB

Test Report

 The Building Test Centre Fire Acoustics Structures	The Building Test Centre British Gypsum Limited East Leake Loughborough Leics. LE12 6NP Tel (0115) 945 1564 Fax (0115) 945 1562 email btc.testing@bpb.com																			
	Report Number BTC testPCTA																			
ACOUSTIC TEST REPORT COVERING A SITE AIRBORNE SOUND INSULATION TEST TO BS EN ISO 140-4: 1998 ON A PURPOSE BUILT SEPARATING WALL OF TWO DWELLING HOUSES. TEST CONDUCTED ON 26 th AUGUST 2004.																				
SITE ADDRESS: Not East Leake Some where In the U.K.	CUSTOMER ADDRESS: Building Test Centre East Leake Loughborough LE12 6NP																			
TEST RESULTS																				
<table border="1"> <thead> <tr> <th>Test Code</th> <th>Test Description</th> <th>Source Room Volume (m³)</th> <th>Receiving Room Volume (m³)</th> <th>Common Area (m²)</th> <th>Dntw (C,Ctr) dB</th> <th>Pass/ Fail</th> </tr> </thead> <tbody> <tr> <td>FtestPCTAA</td> <td>Plot 9 Bedroom to Plot 10</td> <td>30.00</td> <td>30.00</td> <td>5.00</td> <td>33(-1;-2)</td> <td>FAIL</td> </tr> </tbody> </table>	Test Code	Test Description	Source Room Volume (m ³)	Receiving Room Volume (m ³)	Common Area (m ²)	Dntw (C,Ctr) dB	Pass/ Fail	FtestPCTAA	Plot 9 Bedroom to Plot 10	30.00	30.00	5.00	33(-1;-2)	FAIL						
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FtestPCTAA	Plot 9 Bedroom to Plot 10	30.00	30.00	5.00	33(-1;-2)	FAIL														
REQUIRED SOUND INSULATION VALUES For purpose built buildings :																				
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	Dwelling houses & flats		Rooms for residential purpose																	
	Walls	Floors	Walls	Floors																
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Customer: PCT Testing BTC testPCTA: Page 1 of 1	 0296																			

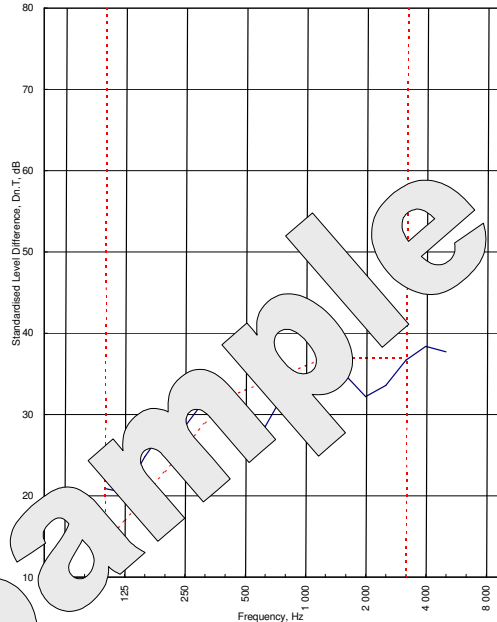
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D _{nt,w} +C _{tr} dB (min)	43	43	43	43																
L _{nt,w} dB (max)	-	64	-	64																
For full test data see Appendix A.																				
The tests were conducted in accordance with BS EN ISO 140-4: 1998 except that description and identification of building construction and test arrangement details were not supplied.																				
The measurements were rated in accordance with BS EN ISO 717-1: 1997.																				
TEST PROCEDURE																				
An omni-directional loudspeaker was placed in the source room and a stationary loudspeaker was placed in the receiving room. Broadband white noise was used to measure the level differences in each 1/3 octave band using rotating microphone booms and a dual channel real time analyser. The correction term for the receiving room was calculated from six reverberation times, measured using broadband pink noise.																				
The accuracy of the test method conforms to BS EN 20140-2:1993, the test procedure used was ISO 140/4 Issue 7 (airborne). Contact The Building Test Centre for further information.																				
Test Co-ordinator was Miss Sarah Wood																				
REPORT AUTHORISATION																				
Report Author James Stonell Technologist	Authorised by Dan Patterson BSc. (Hons.), MIOA Technical Manager																			
Customer: PCT Testing BTC testPCTA: Page 2 of 4	 0296																			

Test Report

APPENDIX A – TEST DATA

Test Code:
FtestPCTAA
Test Date:
26/08/04

Freq. Hz	D _{nT} dB
50	20.9
63	20.4
80	24.8
100	20.9
125	20.4
160	24.8
200	28.3
250	28.5
315	31.8
400	30.8
500	30.1
630	28.5
800	32.9
1 000	34.9
1 250	34.5
1 600	34.8
2 000	32.2
2 500	33.6
3 150	37.7
4 000	
5 000	
6 300	
8 000	
10 000	



Rating according to BS EN ISO 717-1:1997
D_{nT,w} (C;Ctr) = 33 (-1;-2) dB
 Max dev. 5.5 dB at 630 Hz
 Evaluation based on laboratory measurement results obtained by an engineering method:
 C₁₀₀₋₅₀₀₀ = 0 dB
 C₁₀₋₁₀₀₋₅₀₀₀ = -2 dB

Customer: PCT Testing
 BTC testPCTA: Page 3 of 4



SITE AIRBORNE SOUND INSULATION TEST - BS EN ISO 140-4:1998

Test Code: **FtestPCTAA** Test Date: **26/08/04**

Common Area = **5.0** m² Room Volume, m³: Room 1 **30** Room 2 **30**

Freq. Hz	Test Room 1 to Test Room 2							D _{nT} dB	U.Dev. dB	D _{nT} 1/1Oct dB
	Bgnd1 dB	Source dB	Rec. (uc) dB	Bgnd2 dB	Rec. (corr) dB	Rev.time Sec	Corr. dB			
100	44.2	84.5	64.8	37.9	64.8	0.66	20.9			
125	38.7	88.7	67.6	35.9	67.6	0.43	20.4			
160	40.7	91.6	67.3	35.8	67.3	0.56	24.8			
200	36.6	93.3	65.1	33.4	65.1	0.51	28.3			
250	38.1	89.5	58.2	35.2	58.2	0.27	28.5			
315	37.9	88.5	55.5	34.7	55.5	0.1	31.8		29.3	
400	41.4	87.7	55.2	33.2	55.2	-1.1	30.8	1.2		
500	42.2	88.2	56.3	33.2	56.3	-1.1	30.1	2.9	29.7	
630	42.4	88.1	55.8	35.1	55.8	0.2	28.5	5.5		
800	37.7	88.3	52.7	33.7	52.7	0.2	32.9	2.1		
1 000	34.5	89.4	51.1	34.1	51.1	0.23	34.9	1.1	34.0	
1 250	29.5	92.3	54.0	27.3	54.0	0	34.5	2.5		
1 600	30.5	93.2	55.9	27.7	55.9	0	34.8	2.2		
2 000	28.9	93.6	57.2	27.7	57.2	-0.9	32.2	4.8	33.4	
2 500	28.7	96.4	60.1	27.7	60.1	0.27	33.6	3.4		
3 150	26.1	99.3	59.4	22.6	59.4	0.24	36.7	0.3	37.5	
4 000	27.7	103.3	61.7	22.6	61.7	0.24	38.4			
5 000	27.2	97.9	60.1	22.6	60.1	0.25	37.7			
6 300										
8 000										
10 000										
Single BS EN Background Background limited Source levels > 6dB apart	33	-1	-2	0	-2					
RT's > factor 1.5 apart								Total U. Dev., dB	26.0	
Procedure: 140/4/Issue 7 - Rotating; B/Issue 6 - Stationary								Worksheet: 140_4.XLS		

Customer: PCT Testing
 BTC testPCTA: Page 3 of 4



What If It Fails?

- Failed rooms must have remedial treatment
- Other rooms with the same separating element in the same dwelling
 - additional testing
 - apply remedial treatment to other room
 - demonstrate that cause of failure does not occur in other rooms.
- Between dwellings where tests have not yet been conducted
 - developer must satisfy building control body that such properties meet the requirements
- After a failed set the rate of testing should be increased until building control bodies are satisfied there is no longer a problem

Robust Details

- Guidance constructions in Approved Document E still have to undergo PCT
- Some are concerned about:
 - Cost of testing
 - Lateness of test in development cycle
- Robust Details are:
 - Constructions designed to consistently perform better than required by Approved Document E
 - Practical to construct on site
 - Reasonably tolerant to workmanship
 - Not required to undergo PCT**

Robust Details

- Arguably, all RD constructions should meet the requirements rather than just 10%
- Key concerns
 - Flanking Conditions
 - Details of joints and flanking conditions essential part of an RD specification
 - Workmanship
 - Included in RD specification is advice on how to build and a sitework checklist

Robust Details

- Non-profit company 'Robust Details Limited'

- approve new robust details
- manage the use of robust details
- monitor the performance of robust details
- promote the use of robust details.

- Robust Details Handbook

- Generic and Propriety System Specifications
- Constantly updated as new systems are approved and systems are withdrawn
- Full handbook available to buy
- Sitework checklist available to download for all

Robust Details

- Monitoring

- Auditing of Robust Details, 3%

- Sound testing, 2%

- Visual inspection, 1 %

- Sound testing not to be carried out on inspected constructions

- Plot Registrations

- register each plot with Robust Details Limited – There is a fee per plot

- robust details purchase statement (unique reference no.)

- **give to building control body before work starts**

- Compliance certificate signed for each home as soon as the robust detail work is completed and passed the building control body.

Robust Details

- Approval of new robust details
 - 3 stage assessment process
- Register for 'Proposed Robust Detail' Status
 - Application fee
 - Evidence demonstrating that the proposed robust detail is likely to meet the required performance criteria (sound tests)
- Additional Testing
 - Testing fee
 - 30 field tests in total
 - Variety of different sites, house builders and measurement contractors required.
- Approval
 - Design detail fee
 - Inclusion in Robust Detail Handbook

Robust Details

	PCT standards required in 2003 regs		Individual Values Required for RD		Mean Values Required for RD	
	Dntw + Ctr (minimum)	Lntw (maximum)	Dntw + Ctr (minimum)	Lntw (maximum)	Dntw + Ctr (minimum)	Lntw (maximum)
Separating Wall	45 dB	-	47 dB	-	50 dB	-
Separating Floor	45 dB	62 dB	47 dB	60 dB	50 dB	57 dB

Robust Details

- Benchmarking
 - If test data for a Robust Detail is in public domain
 - Test new product against it in the lab.
 - If comparable, this indicates that the new product would be equivalent on site.
i.e.. As good as a RD
- Main examples are:
 - - show that there is no significant downgrade in performance from downlighters
 - - show that resilient bars provide the min. acoustic improvement
 - - show that floor treatment provides the min. acoustic improvement

Eco Homes / Code for Sustainable Homes

- Credits can be gained by conducting additional testing or by building to an appropriate Robust Detail
- The amount of credits earned is dependent on:
 - How much additional testing is conducted and the results obtained
 - Which particular Robust Detail has been used

Lab Requirements

- Lab Testing:

- Internal Floor/Wall

Criteria - R_w (min) 40dB

- Doors leading onto a corridor

Criteria - R_w (min) 29dB

Potential problems

- Kitchen / Furnished properties
 - Test possibly affected with resonance effects if there are wall units on separating wall – overall result potentially downgraded by Ctr
- Student Accommodation
 - Building Control to confirm if they view the plots as flats or rooms for residential purpose
- Carpet / Internal doors
 - Internal doors are required for the test, but tend to be fitted after carpet
 - Floor tests should only be conducted before carpet is installed
 - Additional delay / disruption to take up carpet or wait for doors to be fitted
- Room layouts
 - Actual layouts may change the number of tests / visits required if different from expected

Potential problems

- Access

- Access is required to both sides of the separation under test at the same time
- Locked plots, waiting for others to vacate the plots and high background noise makes it more difficult to cause the smallest amount of disruption

- High Background noise

- Could result in either the test result being an underestimation of actual performance; or extend the time required to conduct the test

- Occupied Plots

- Potential for access complications
- Carpet is normally already installed and difficult to take up
- Lots of surrounding furniture (to be moved / affect test)

- Understanding of number of tests in a SET

- Potential for misunderstanding whether just 1 test is required or 1 SET of tests having impacts on total cost and time required

Potential problems

- Screwing directly through isolation treatment (eg resilient bar)
- Have socket boxes etc. been staggered?
- Has the resilient flanking strip been installed correctly around the walking surface and continued underneath the wall cladding?
- Has there been mortar build up in the cavity on wall ties or Damp Course Membrane?
- Have there been any substitutions or omissions in the materials used to that which was specified?

Potential problems

- Have the correct wall ties been used throughout?
- Have the deflection heads been installed correctly and considered at design stage?
- Has a Sacrificial Lining been used for services to prevent penetration of the separation? Does it have insulation within it?
- Are the flanking walls of lightweight block and so providing a weaker path for sound transmission?
- Are there any penetrations or gaps in the partition?
- Is the mass of the products correct?

Confusion over lab/site result

- Laboratory Testing
 - Controlled environment
 - No flanking conditions
 - Sound Reduction Index R_w
- Site Testing
 - Test carried out on whole environment including flanking conditions
 - Weighted Standardized Level Difference D_{nTw}
 - Spectrum Adaptation Term C_{tr}
 - Weighted Standardized Impact Sound Pressure Level L_{ntw}
- **RULE OF THUMB**
 - D_{nTw} value could be as much as 6 dB below R_w result
 - $D_{nTw} + C_{tr}$ value could be as much as 10-12 dB below R_w result

SUMMARY

- Sound Insulation is going to continue being a concern as we develop more dense populations and consumers become more aware of privacy
- ADE has two routes of compliance for site (PCT & RD)
- ADE has additional requirements for internal separations, doors and control of reverberation in communal areas
- Testing must be conducted by accredited companies
- Credits for CSH can be earned by testing or by using appropriate Robust Detail
- Many of the potential problems can be overcome by consideration at an early stage & good, clear communication and organisation at all stages

www.btconline.co.uk

More Information

Building Regulations (Office of the Deputy Prime minister) - www.communities.gov.uk

House Builders Federation - www.hbf.co.uk

Robust Details Limited – www.robustdetails.com

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