ACOUSTIC CONSULTING

BCA / NCC Evidence of Suitability
Acoustic Performance

Company Description
AFS Systems Pty Ltd, 2/34-38 Anzac Ave, Smeaton Grange

Product
AFS Logic Wall AFS162

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1 CLIENT

AFS Systems Pty Ltd, 2/34-38 Anzac Ave Smeaton Grange NSW 2567, Australia

2 PRODUCT FOR CERTIFICATION

AFS Logic Wall AFS162

3 PRODUCT DESCRIPTION

The AFS Logic Wall consists of lightweight sandwich panels created by bonding hard wearing fibre cement sheets to galvanized steel stud frames. The panels are quickly and simply hand erected on site and then core filled with concrete. The joints between the panels are then set, leaving the wall ready for applied finishes. The Logic Wall system is an advancement on the previous AFS wall system. The improvements include:

- Reinforced Fibre Cement Board – stronger, lighter, more durable and water resistant
- Polyurethane Adhesive System – universally renowned for product reliability
- Large oval holes in the steel studs enabling excellent concrete flow & compaction
- Glueless Site Joiner System creating a faster and cleaner site installation process

The AFS162 system comprises - 6mm fibre cement facing
- 150mm core-filled concrete
- 6mm fibre cement facing
-

The sandwich panel is shown below.

4 INVESTIGATION AND EVIDENCE SUPPORTING THE SUITABILITY STATEMENT IN SECTION 7 OF PART A

AFS Systems had commissioned CSIRO Acoustic Laboratories, Highett, Victoria to carry out Sound Transmission Loss Testing of the AFS162 Wall initially was in its bare form, then with a plasterboard layer using furring channels and resilient supports together with insulation. A further wall system comprising the AFS162 Wall with a separate steel stud plasterboard wall including insulation in the cavity. The standard AFS162 Wall achieved the following:

Results	**Rw 52**
	Ctr -5
	Rw + Ctr 47

The results were somewhat disappointing for the standard AFS162 Wall as the system contained the equivalent of 150mm of concrete which in itself complied with the BCA's Part 5 Deemed-to-Satisfy Provisions – Acceptable Forms of Construction for Walls. The measured acoustic performance is shown in Graph 06 which is attached to this document.

There was the feeling that perhaps the wall may not have been fully filled with cement or it was some form of installation problem within the laboratory.

On that basis the field tests of the wall should be of the order of DnT,w 47 and a Ctr of -5. It could be expected that actual field measurements of DnT,w + Ctr could be in the range of 42 to 45.

Previous field testing of the 150mm AFS and Ritek walls had produced results in the order of DnT,w + Ctr of 45 to 47 which indicated that the AFS162 Wall may have been capable of a better performance than that achieved by the laboratory or that the standard of installation in the field was of a very high order.

The problem with testing concrete panel walls is that there were only two laboratories in Australia where this can be carried out. One is CSIRO Highett, the other was CSIRO North Ryde which was closed at that stage due to acoustic performance issues. One of these issues was the testing of heavy walls which resulted in lower than expected outcomes. The mechanics of what caused this problem were discovered in the investigation carried out in 1992 in which the author of this document was involved, this left CSIRO Highett as the only acoustic laboratory in Australia to measure a heavy concrete panel.

Further field testing of the AFS162 Wall by the following acoustical consultants –

Acoustic Logic Consulting – Reference 2k3161/0311A/MC of 14/3/2003
PKA Acoustic Consulting
SRL Acoustic Consulting
Vipac Scientists – Reference 50B-04-5464-TRP-239671-0 of 18/6/2007

showed typical field results of DnT,w + Ctr = 45 to 49 (SLR achieved 51) which provided full compliance with Verification Methods FV5.1 (a) of the BCA / NCC.

This seemed to indicate that the test results of the single AFS162 Wall as tested by CSIRO, Highett, appeared to be on the low side. The initial thought was the actual installation in the laboratory may not have been to the standard required.

Investigation was carried out by PKA Acoustic Consulting over a period of time to resolve what appeared to be an inconsistency. PKA Acoustic Consulting had data on an Ultrafloor system (Report No HAS081) that was tested at the new CSIRO Acoustic Laboratory, North Ryde. The floor panel was effectively only 92mm thick, however this can be corrected to indicate the acoustic performance of the panel if it was 150mm thick. This gave a performance of Rw 56 with a CTR -5. These results are shown on Graph 05.

Sometime after the testing of the AFS162 Wall, CSIRO provided PKA Acoustic Consulting with the results of two 150mm concrete panels that they tested in the Highett laboratories. Full details of the test were not supplied by CSIRO as they were protecting the interests of other sponsors. The best performance of the 150mm concrete panel is shown in Graph 01. The rating was Rw 52 with a Ctr -5. The performance of the 150mm concrete panel is shown compared to the AFS162 Wall on Graph 06. It can be seen that the results are close to identical over the critical frequencies of 100 Hz to 2000 Hz.

This clearly demonstrated that the installation of the AFS162 Wall panel had been properly carried out as the results were identical to a 150mm concrete panel.

A search for acoustic data of 150mm concrete slab or panel proved to be more difficult than anticipated. The first step was to use a prediction software called Insul to determine the potential performance of a 150mm concrete wall. Insul predicted Rw 55 with a Ctr of -5 making Rw + Ctr = 50. The Insul prediction and the measured performance of 150mm concrete slab at Highett is shown in Graph 08. The results from 250 Hz up to 2500 Hz are close to identical however there is a significant difference between 100 and 200 Hz.

An important next step in our investigation was the discovery of an acoustic test from the Portland Cement Association of the United States of America which showed that the acoustic performance of a 152mm concrete panel achieved Rw 57 with a Ctr -5 making a Rw + Ctr of 52. The results are shown on Graph 02. These results are compared to the 150mm concrete panel measured at CSIRO, Highett again the significant difference being between 100 to 200 Hz and is shown together with the varying difference from 250 Hz up to approximately 1000 Hz. This is shown on Graph 07.

The measured and predicted performance of the various 150mm concrete slab equivalents were added together and then averaged. This includes a test of the Portland Cement Association, the Insul prediction, the 92mm thick Ultrafloor corrected to 150mm. This is shown on Graph 11, the average of the results was Rw 56 with a Ctr -5 making Rw + Ctr 51.

An important breakthrough occurred when a field test carried out by Vipac in 2007 was supplied to PKA Acoustic Consulting in late 2014. Whilst it is only a field test and should not be compared to a laboratory test, the results were very informative. The performances between 500 and 1250 Hz were almost identical to the laboratory results measured at the CSIRO Highett. However below 500 Hz the field results were significantly better than the laboratory results. This is shown on Graph 11. The trend is very similar and generally follows the pattern of the average results shown on Graph 13.

Field tests of 152mm concrete walls carried out in Canada are included and shown on Graph 14. Again it clearly demonstrates that the acoustic performance is in the range of DnT,w 54 to 57 (DnT,w + Ctr 49 to 50). This further confirms that the original test of the AFS 162 wall was influenced by the unique characteristics of the CSIRO Highett Laboratory.

5 CONCLUSION DERIVED FROM THE INVESTIGATION OF ACOUSTIC PERFORMANCE OF 150mm CONCRETE SLAB / AFS162 WALL AS MEASURED AT CSIRO HIGHETT

In my opinion it is clear that the acoustic measurements of the AFS162 Wall carried out at the CSIRO laboratories, Highett, Victoria have indicated a lower performance from 100 Hz to 630 Hz than is typical of a concrete panel of 150mm thickness. The evidence is clearly shown by the Vipac acoustic test on an actual field installation. In broad principle, comparison to the 152mm concrete wall carried out for Portland Cement Association (USA), the Ultrafloor concrete floor corrected from 92mm to 150mm thick all show the same trend from 100 Hz to 630 Hz.

It is therefore feasible that the actual performance of an AFS162 Wall panel would be between Rw55 to 56 with Ctr -5 if tested at another acoustic laboratory. At this stage there are no other laboratories in Australia that can be recommended. It may be feasible to use the Acoustic Laboratory at Auckland University.

The CSIRO Victoria are currently building a new laboratory which should be completed at the end of this year. The design of the new laboratory is based on some of the experiences from the investigation of the acoustic performance of the North Ryde CSIRO laboratory.

In my opinion a re-test of the AFS162 Wall is not required because field verification testing has shown that it consistently complies with the verification requirements of the BCA. In some cases, where the performance has been slightly lower, sound flanking paths or bad workmanship have been identified and satisfactorily corrected.

From our research of the typical performance of a 150mm concrete wall together with the significant amount of field testing and in particular the test by Vipac Scientists, it is clear that the acoustic testing carried out at CSIRO Highett gave a very low performance in the low frequency range and therefore penalised the AFS 162 Wall panel. We have determined the likely performance of the AFS 162 Wall panel. This is the order of performance had the AFS162 Wall been tested at the National Acoustic Laboratory, Lindfield or RMIT Melbourne. Of course it is impossible to get a wall of this type into those laboratories however we are familiar with the performance parameters of both laboratories.

6 CONCLUSION

Reference to Tests of concrete walls at other laboratories clearly shows that the AFS162 Wall would have achieved at least Rw 55 with a Ctr of -5 which would result in a Rw + Ctr 50 and therefore compliance with Part F5 of the BCA / NCC.

7 THE ACOUSTIC CHARACTERISTICS OF CSIRO HIGHETT ACOUSTIC LABORATORIES

All acoustic laboratories have interesting acoustic properties which cause slight variations when compared to other laboratories. It is recommended to read the references attached to this Part B of the Evidence of Suitability. There have been a number of round robin tests of acoustic laboratories conducted in Europe. In the case of the lightweight partitions, the material came from the same factory, the installation was carried out by the same installation team in all laboratories. The results varied from Rw 47 to Rw 52 with a mean value of Rw 49.5. This was over a total of 24 acoustic laboratories.

Similarly an inter-laboratory test of sound insulation was carried out of heavy walls with a face density of 440 kgs/m^2 (which compares with the AFS162 Wall at approximately 390 kgs/m^2). In this case there were 12 laboratories where the Rw value results varied from Rw 54 to Rw 61 for identically the same wall system. When corrections were applied for what is called the "Reference Loss Factor" the result was closer to Rw 58.

Our experience with all the major acoustic laboratories in Australia and in particular the research work that we carried out on the new CSIRO laboratory North Ryde, has clearly shown that the sample holder for the wall system has a strong influence on the performance depending upon its construction and how it diverts the energy contained within the wall under test. In the case of CSIRO Highett the performance of the wall is influenced by the frequency range of its coincidence dip. In the case of CSIRO, Highett a coincidence dip of around 160 to 250 Hz results in a lower tested performance would occur at say National Acoustic Laboratory, Lindfield or RMIT, Melbourne. On the other hand the National Acoustic Laboratory, Lindfield gave very low results when the coincidence dip was around 2000 to 2500 Hz.

The lower acoustic performance measured by CSIRO Highett would be within the ISO 140 tolerance and therefore would be considered acceptable. It was unfortunate in this case that it excluded the AFS162 Wall panel achieving an Rw + Ctr rating of 50 and therefore compliance with the BCA Part F5. Field testing has clearly shown that the AFS162 Wall when properly installed easily satisfies the verification criteria in FV5.1(a).

8 REFERENCES

An Intercomparison of Laboratory Measurements of Airborne Sound Insulation of Lightweight Plasterboard Walls

by Patrizio Fausti, Roberto Pompoli and R Sean Smith
Dept of Engineering, University of Ferrara, Via Saragat 1, Ferrara 44100, Italy
Dept of Acoustics, Istituto Elettrotecnico Nazionale, Galileo Ferraris, Strada Delle Cacce 91, Torino 10135, Italy

Inter-Laboratory Test of Sound Insulation Measurements on Heavy Walls:
Part 1 – Preliminary Test

by A Schmitz, A Meier and G Raabe
Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig, Germany

Part II – Results of Main Test

by A Schmitz, A Meier and G Raabe
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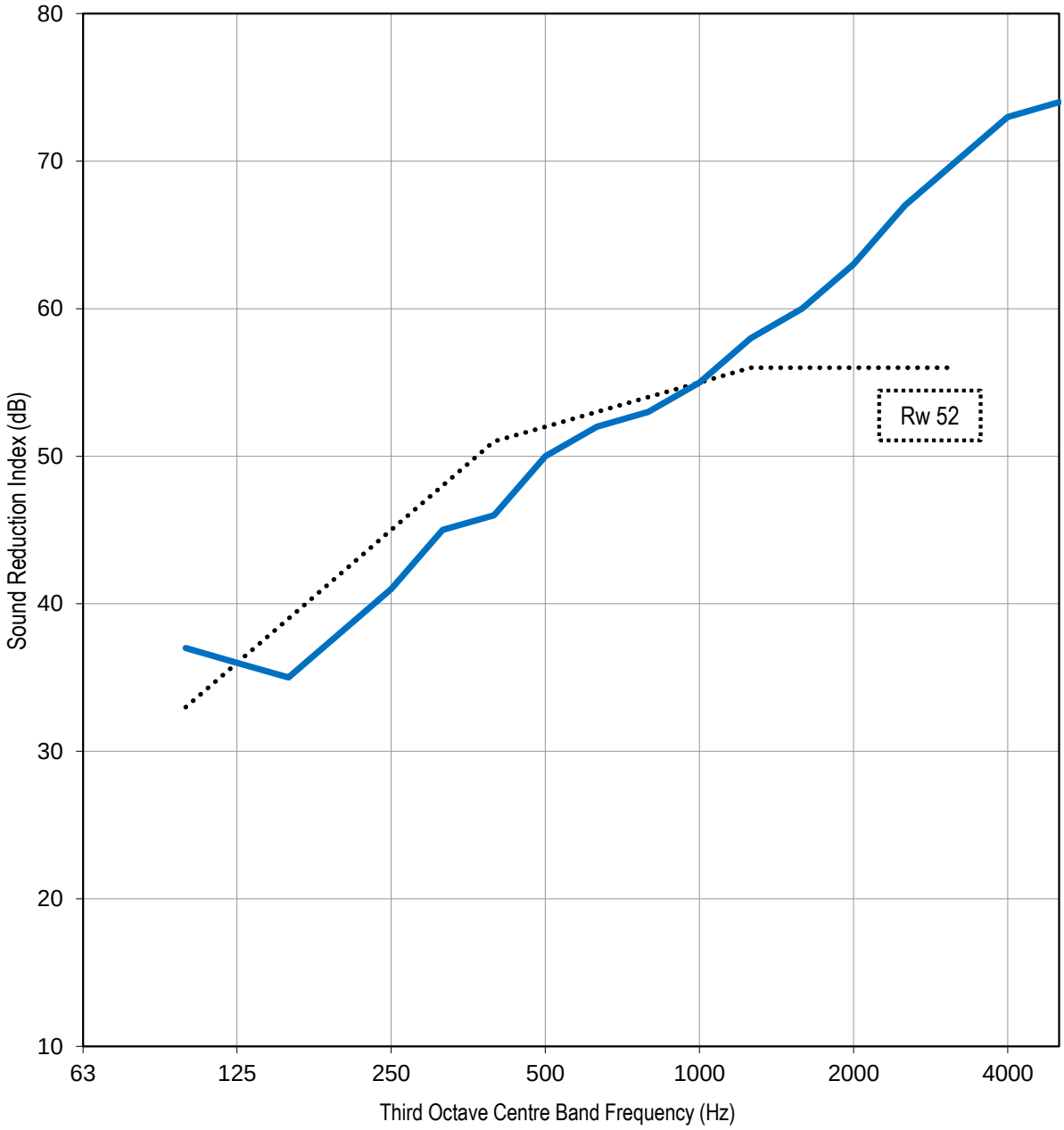
PKA Comparison: 26th February 2015 PKA215012

Graph 01

Laboratory	Description	Rw(Ctr)
CSIRO Highett	**150mm Concrete**	**52 (-5)**



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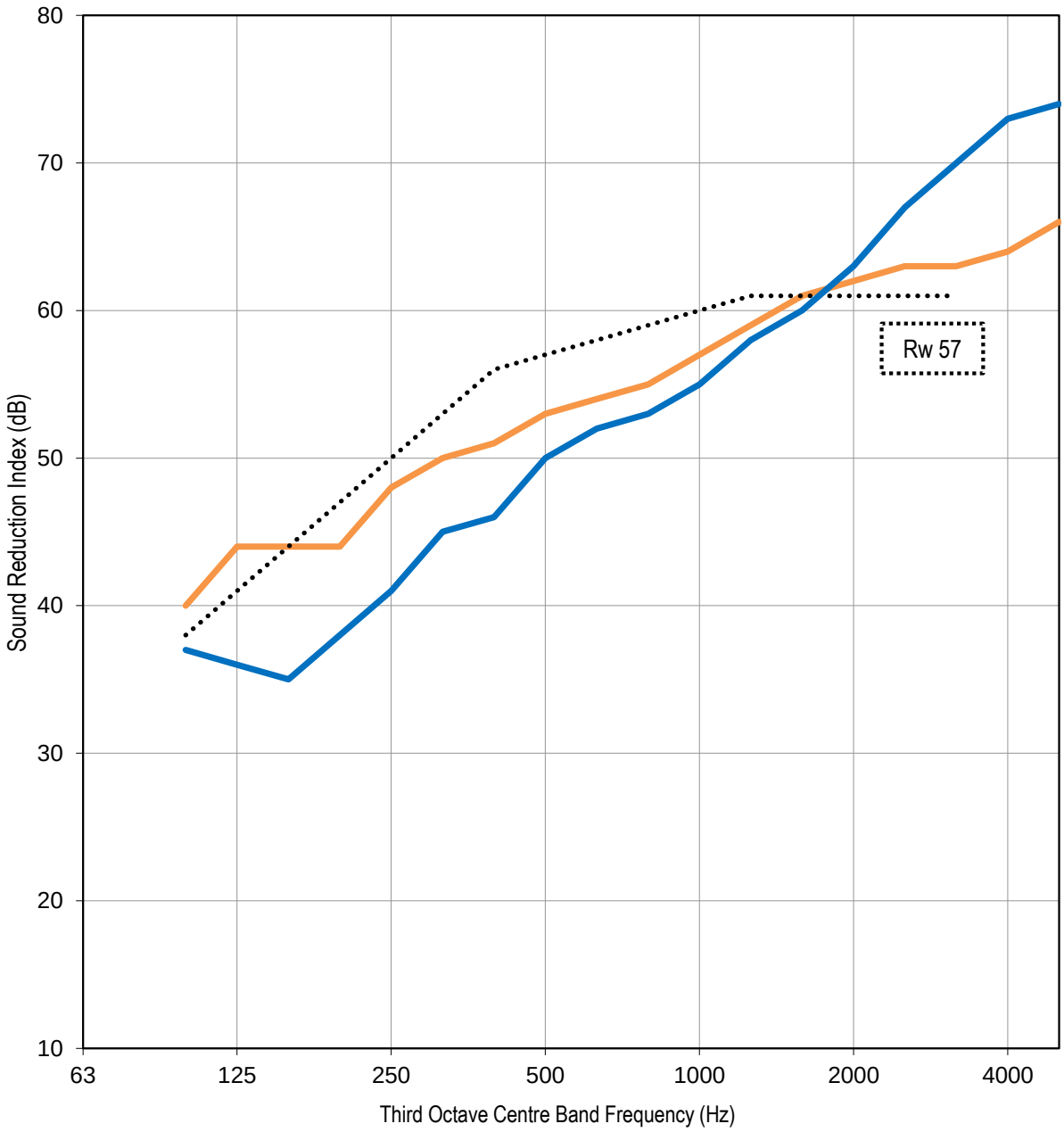
Graph 02

Laboratory	Description	Rw(Ctr)
CSIRO Highett	150mm Concrete	52 (-5)
PCA (U.S.A)	152mm Concrete	57 (-5)



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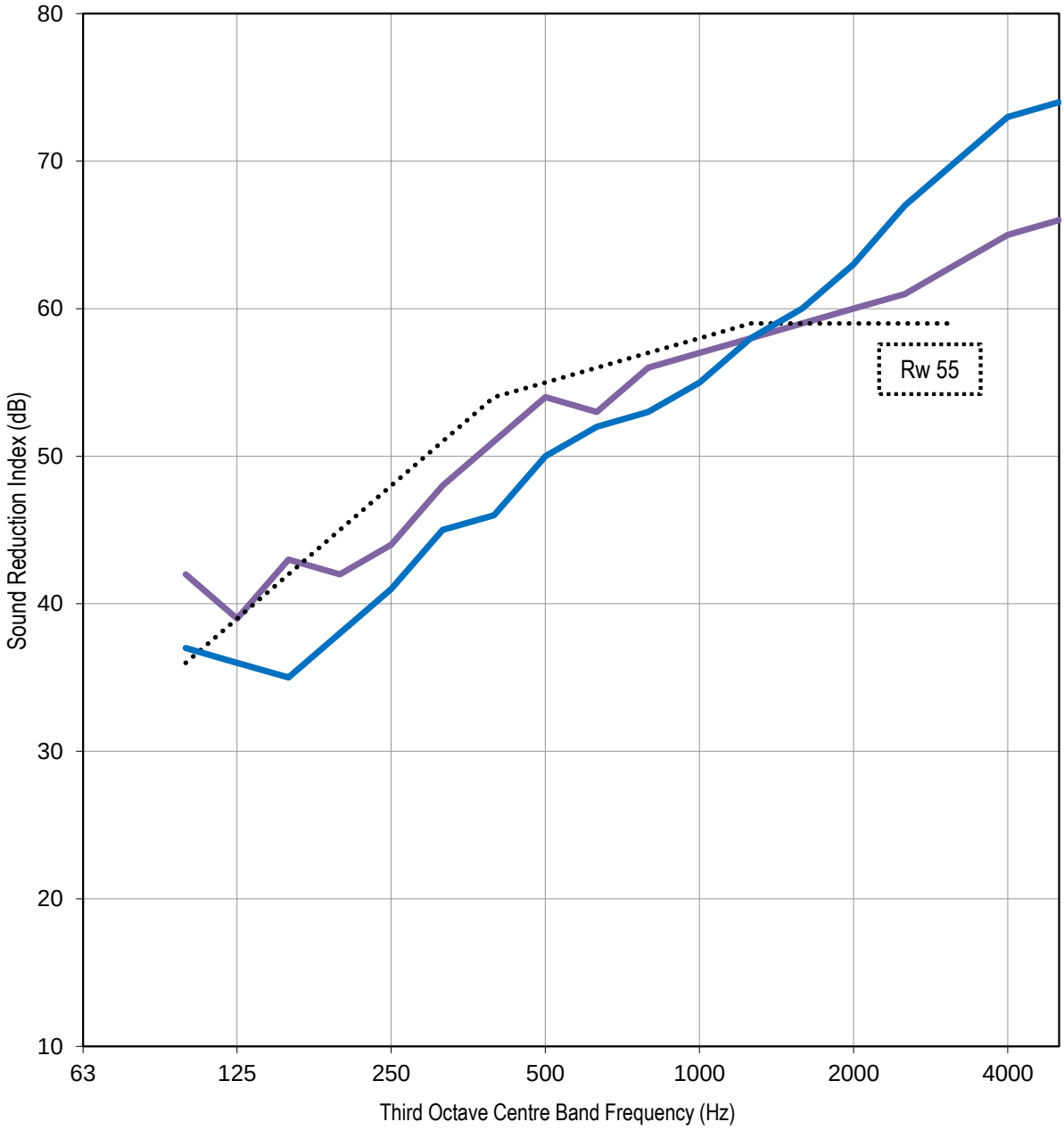
Graph 05

Laboratory	Description	Rw(Ctr)
CSIRO Highett	150mm Concrete	52 (-5)
CSIRO Nth Ryde	UltraFloor Concrete Floor (Corrected to150mm)	56 (-5)



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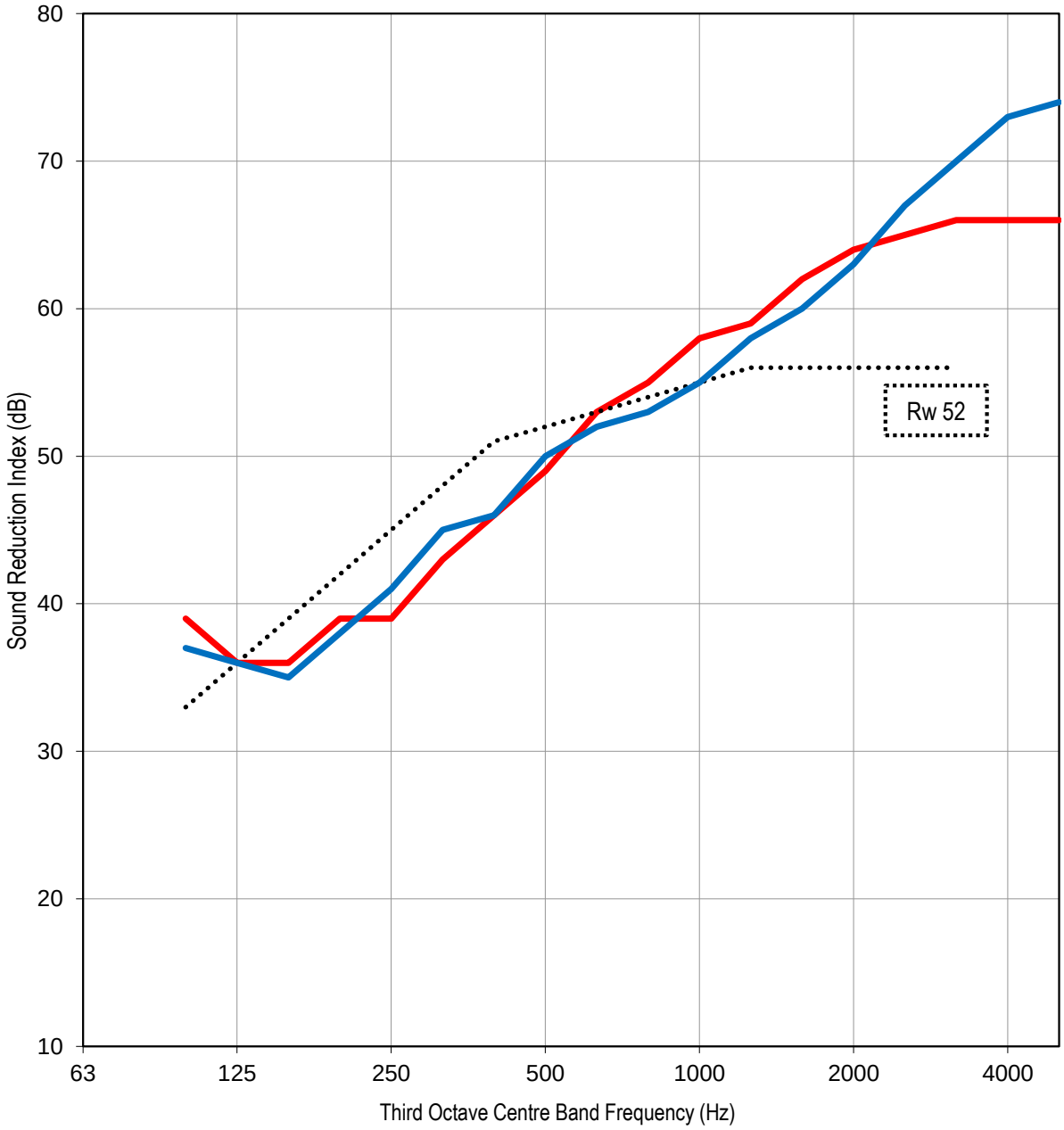
Graph 06

Laboratory	Description	Rw(Ctr)
CSIRO Highett	150mm Concrete	52 (-5)
CSIRO Highett	AFS 162mm LogicWall	52 (-5)



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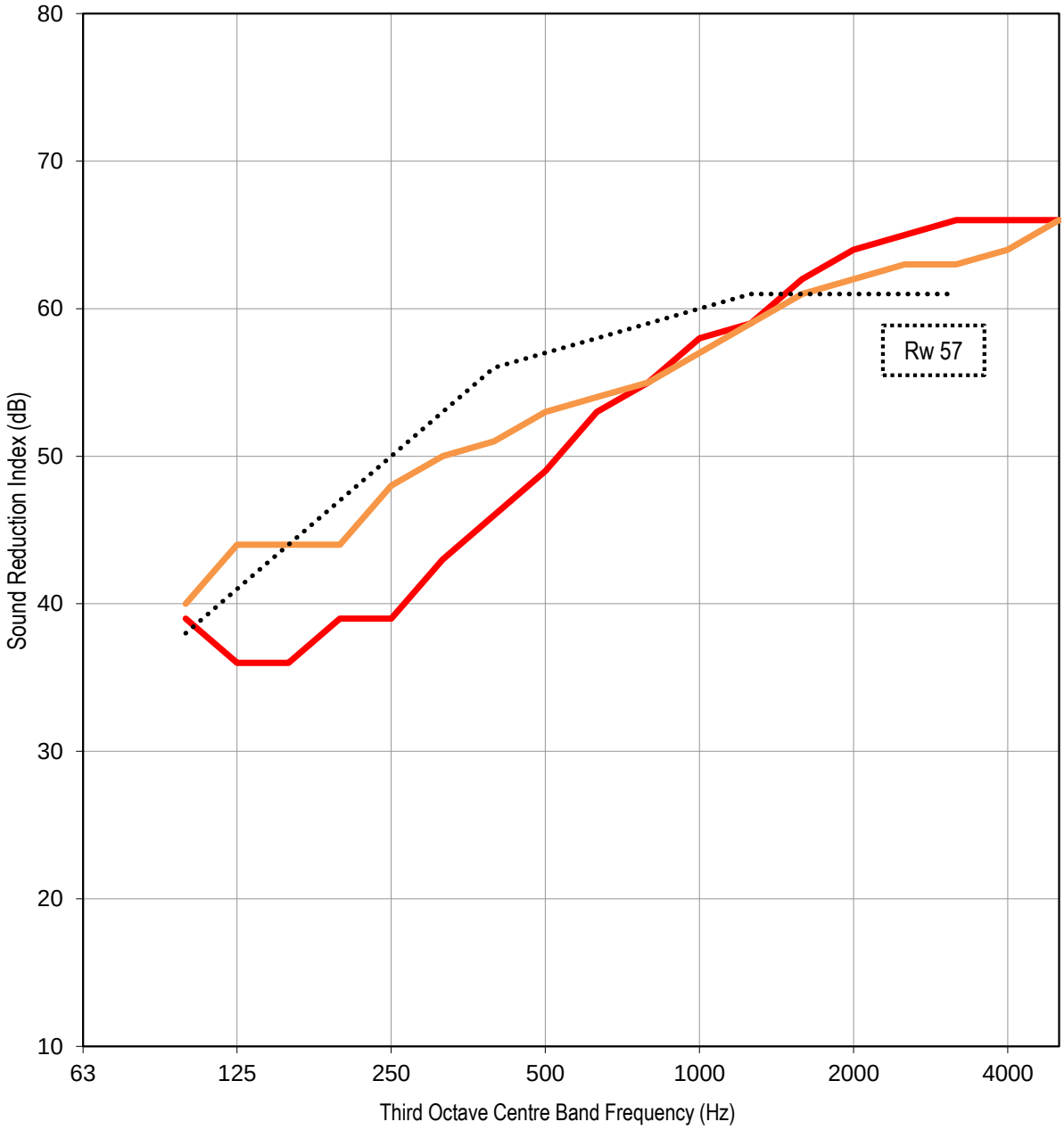
PKA Comparison: 26th February 2015 PKA215012

Graph 07

Laboratory	Description	Rw(Ctr)
CSIRO Highett	**AFS 162mm LogicWall**	**52 (-5)**
PCA (U.S.A)	152mm Concrete	57 (-5)



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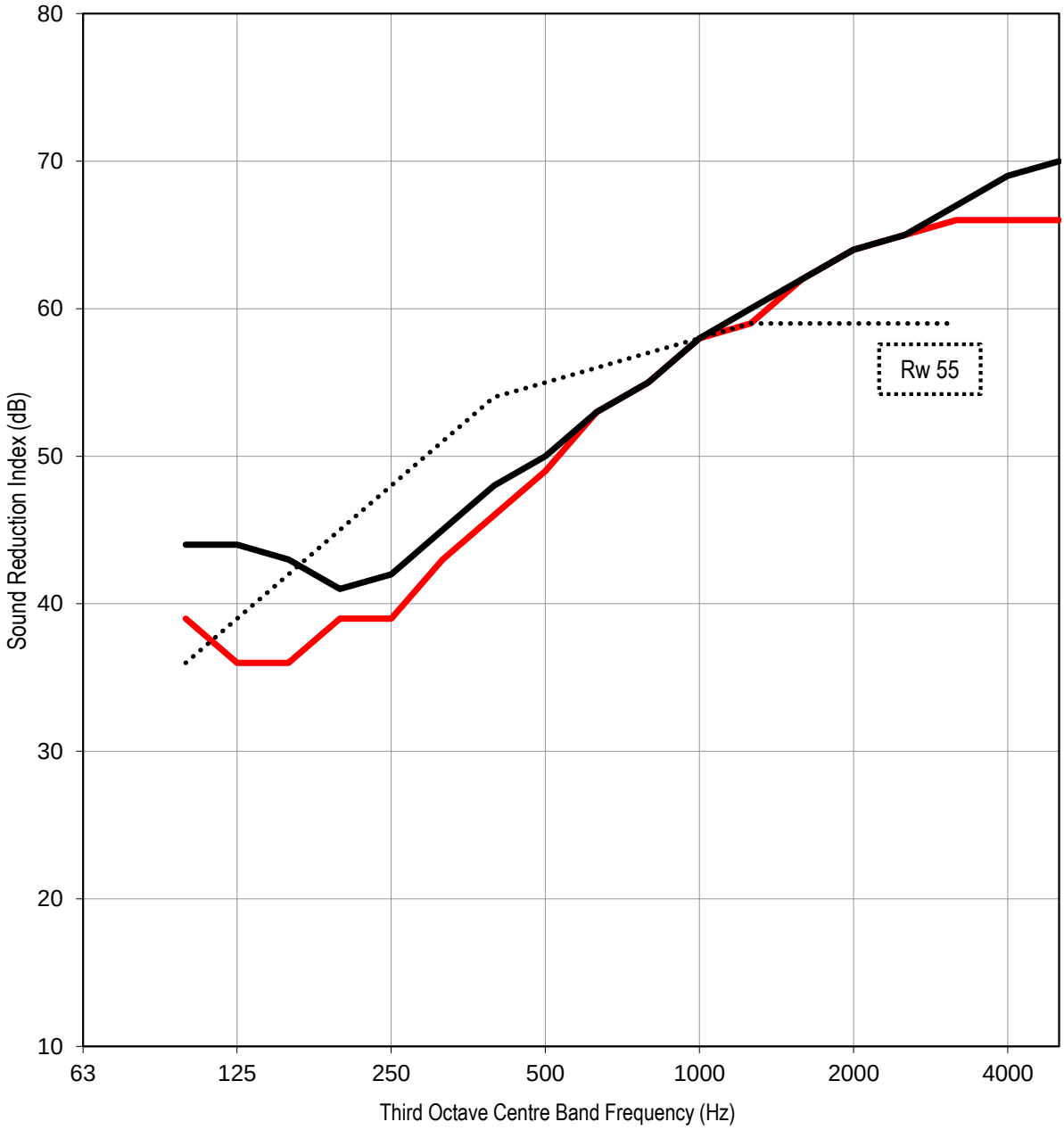
PKA Comparison: 26th February 2015 PKA215012

Graph 08

Laboratory	Description	Rw(Ctr)
CSIRO Highett	**AFS 162mm LogicWall**	**52 (-5)**
Insul Prediction	**150mm Concrete**	**55 (-5)**



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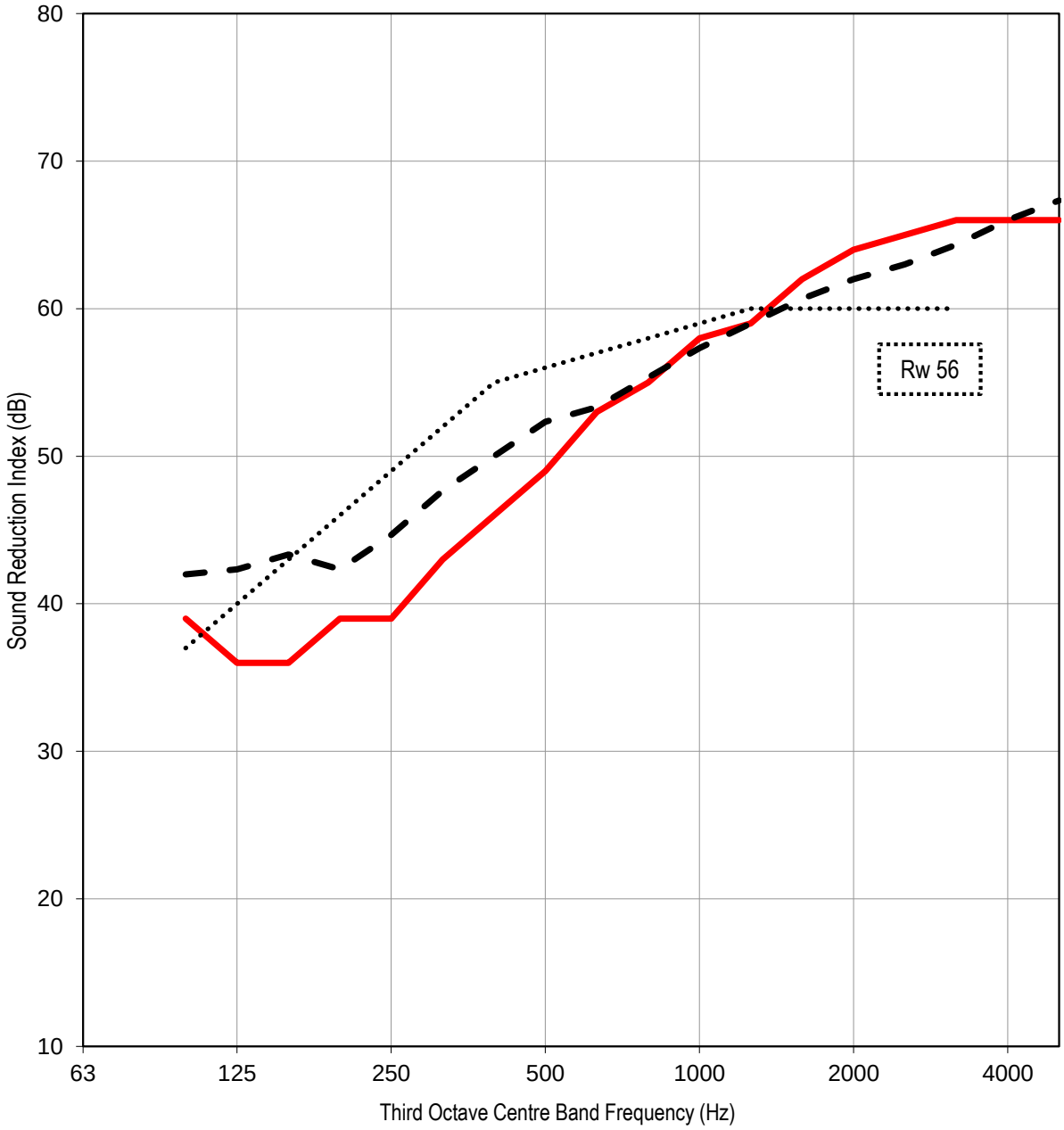
PKA Comparison: 15th April 2015 PKA215012

Graph 11

Laboratory	Description	Rw(Ctr)
CSIRO Highett	**AFS 162mm LogicWall**	**52 (-5)**
PKA Calculation	**Average of All Other Results**	**56 (-5)**



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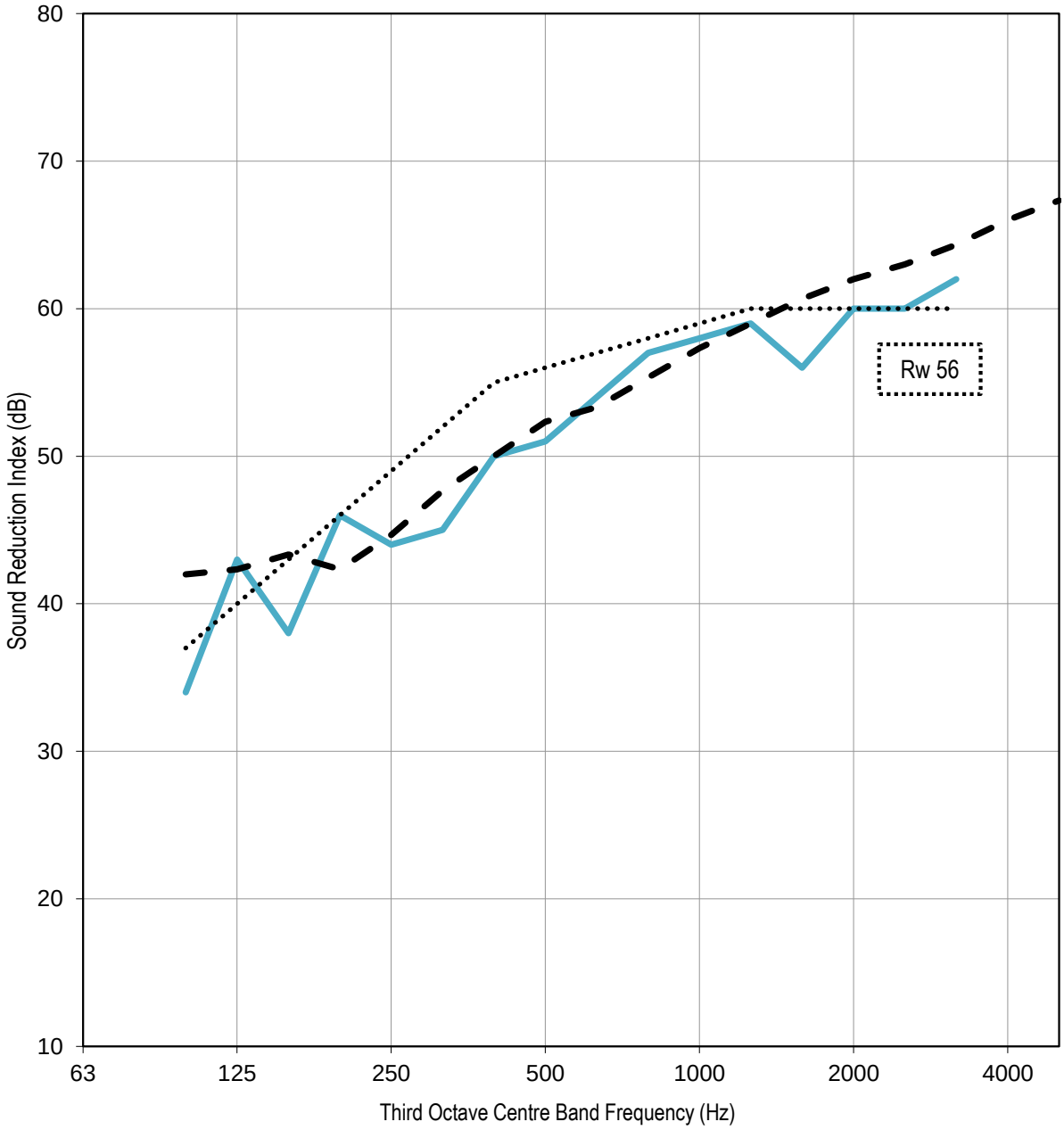
PKA Comparison: 15th April 2015 PKA215012

Graph 13

Laboratory	Description		Result
Vipac (Field Test 2007)	AFS 162mm LogicWall	$D_{nT,w}$ (C_{tr})	54 (-5)
PKA Calculation	**Average of All Other Results**	**R_w (C_{tr})**	**56 (-5)**



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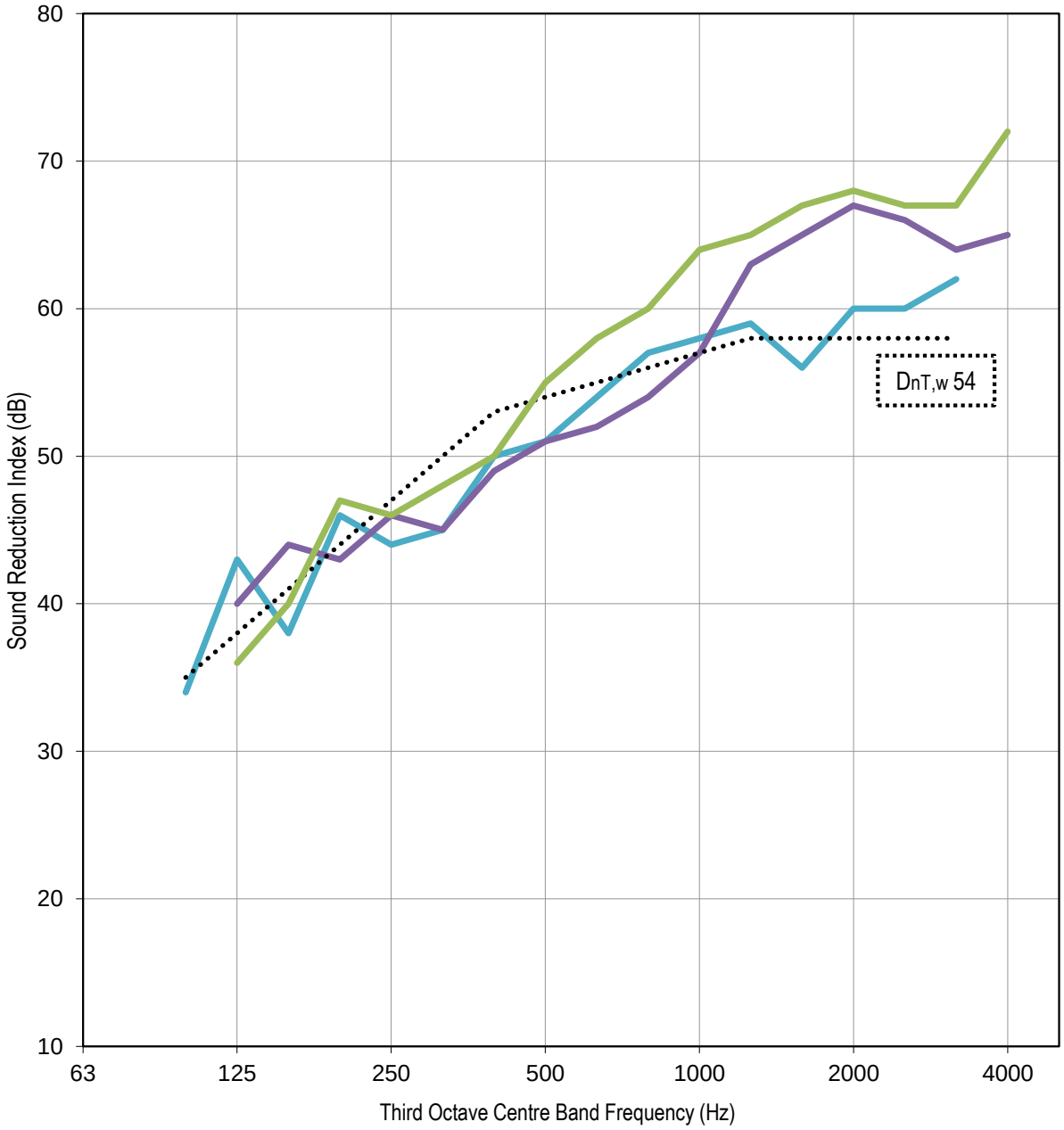
Graph 14

Laboratory	Description	$D_{nT,w}$ (Ctr)
Vipac (Field Test 2007)	AFS 162mm LogicWall	54 (-5)
Canada Field Test A	150mm Reinforced Concrete	55 (-5)
Canada Field Test B	150mm Reinforced Concrete	57 (-8)



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