Impact Sound Testing of Floor Covering on a Heavyweight Standard Floor

Report INR171/R1
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SUMMARY

The impact sound characteristics $L_{n,w}$, C_I and IIC, ΔL_w and ΔL_{lin} of two vinyl floor coverings on a 150 mm concrete slab have been measured.

The floor systems consisted of a 150mm concrete slab covered with the floor coverings under test, loose laid directly on top of the slab with no underlay or adhesive materials.

The ΔL values reported are the decibel reductions in normalized impact sound pressure level (L_n) measured in a reverberant room beneath the test floor, achieved by each floor covering material compared to the bare test floor. The ΔL_w and ΔL_{lin} are single number ratings for the improvement in impact sound levels between the bare reference floor and the same floor with the floor covering material. ΔL_w is the difference between $L_{n,w}$ for the bare reference floor and $L_{n,w}$ for the reference floor plus the floor covering, as defined in AS ISO 717.2-2004. ΔL_{lin} is the difference between $L_{n,sum}$ for the bare reference floor and $L_{n,sum}$ for the reference floor plus the floor covering combination, as defined in AS ISO 717.2-2004. IIC (ASTM E989-89), $L_{n,w}$ and C_I (AS ISO 717.2-2004) apply to the combination of the floor covering and the 150mm thick concrete test slab.

1. TEST SPECIMENS

1.1 Materials

The test specimens were vinyl-based floor covering materials as described below, supplied by the client.

Test ‘a’

Trade Name:	Texline HQR
Description:	Sheet vinyl with textile backing, supplied in the form of a single roll, 4 m wide
Thickness:	3.1 mm (0.35 mm wear layer)
Mass per unit area:	2370 g/m^2

Test ‘b’

Trade Name:	Creation Clic
Description:	Vinyl planks, 17.6 x 100 cm, interlocking by means of mating edge profiles
Thickness:	6 mm (0.7 mm wear layer)
Mass per unit area:	9895 g/m^2

Test ‘c’

Trade Name:	Texline Comfort
Description:	PVC Surface with polyester textile backing, supplied in the form of a single roll, 4 m wide
Thickness:	4.2 mm (0.3 mm wear layer)
Mass per unit area:	2440 g/m^2

1.2 Installation

- The specimen materials were laid over a standard concrete test slab measuring 3.68 m x 3.22 m x 150 mm thick
- The specimen floor covering materials covered the entire 3.68 x 3.22 m area of the slab
- All test materials were installed by the test laboratory’s staff
- No adhesives or other materials were used in the laying of the test material

2. METHOD OF TEST

2.1 General

The test-material is installed onto a standard test-floor, this being a 150mm reinforced concrete slab satisfying the requirements of ISO 140-8. A standard tapping-machine is operated on the test-material, and again on the bare-floor. The reduction in the sound pressure levels produced in a chamber beneath the floor is reported. Measurements for the floor covering are made at several different tapping machine positions on the standard test-floor and the average results reported.

2.2 Specific

The measurement complies with the requirements of ISO 140-8:1997(E) *"Measurement of sound insulation in buildings and building elements – Part 8: Laboratory measurement of the reduction in transmitted impact noise by floor coverings on a standard floor"*. It also complies with ISO 140-6 *"Measurement of sound insulation in buildings and building elements – Part 6: Laboratory measurement of sound insulation of floors"*.

3. TEST LABORATORY

3.1 Description Of Test Floor And Test Facility

The standard floor used was a reinforced concrete floor with dimensions 3.66 x 3.22 x 0.15 m - this is in accordance with the requirements of ISO 140-8.

The tests were conducted with the standard floor-slab placed in an aperture between two purpose-built concrete rooms, all the bounding surfaces of which are 305 mm in thickness. The rooms were designed and built to minimise any structure-borne noise (induced by test signals) from outflanking sound passing through the test specimen.

The "sending" and the "receiving" rooms are both pentagonal in shape; the receiving room has a volume of 105 m^3 and a floor area of 32 m^2.

The underside of the concrete test slab forms part of the ceiling of the receiving chamber; no intermediate ceiling was present beneath the test slab.

3.2 Environmental Conditions

Table 1 gives the environmental conditions in the measuring chamber when the tests were carried out.

Table 1, Environmental Conditions

28 May 2011, Laboratory Conditions	
Dry Bulb Temp, °C	15
Relative Humidity, %	73
Barometer, hPa	1022

4. INSTRUMENTATION AND EQUIPMENT

4.1 Tapping Machine

The tapping-machine employed was a Brüel & Kjær type 3204. (A rotating cam allows five, 500 g, steel hammer-heads to be raised, then dropped under gravity through 40 mm, at a rate of 10 impacts/s). The tapping machine meets the requirements of ISO 140.

4.2 Microphone

The microphone used was a Brüel & Kjær type 4166 mounted on a Brüel & Kjær type 2619 preamplifier and was mounted at end of a rotating boom of radius 1.35 m which had a rotation period of 32 s.

4.3 Calibration of Microphone Sensitivity

Sensitivity of the microphone and measuring system was calibrated prior to commencement of measurements by using a Brüel & Kjær type 4220 pistonphone to give absolute dB re 20 μPa. The pistonphone was calibrated by a NATA registered laboratory in April 2011.

4.4 Analysis Equipment

Microphone signals were analysed using a Norwegian Electronics type 830 Real-Time-Analyser (RTA). This enables measurements in each of the standard 1/3-octave bands simultaneously, and also can perform internal averaging of repeated measurements. The measured levels reported below are each the result of internally averaging 9 x 32 s integrals in the 100 Hz to 5000 Hz bands.

The reverberation times in the receiving room were measured by overlaying 60 decays using the internal program of the RTA.

5. MEASUREMENT DETAILS

5.1 Measured Impact Sound Pressure Levels

Table 2 presents the impact sound pressure level (L_i), corrected for background levels, for the Bare Floor (L_{io}) and the test specimens averaged over nine different tapping machine positions as measured in the receiving room.

5.2 Correction for Background Sound Pressure Level

ISO 140-6 & 8 both require the measured impact sound pressure level to be corrected if it is close to the background sound pressure level. In this series of tests, background corrections were required for some sound levels. All of the 1/3-octave impact sound levels and background correction details are presented in Table 2.

Table 2, Impact sound levels (L_i), and background corrections.

Freq (Hz)	L_{io} (dB)	L_i (dB) Test 'a'	L_i (dB) Test 'b'	L_i (dB) Test 'c'
	Bare Floor	with Gerflor Texline HQR floor covering	with Gerflor 'Creation Clic' floor covering	with Gerflor 'Texline Comfort' floor covering
100	67.6 -	65.9 -	66.7 -	65.7 -
125	71.3 -	69.3 -	69.4 -	68.5 -
160	70.3 -	68.7 -	68.6 -	67.8 -
200	74.4 -	72.5 -	72.3 -	71.0 -
250	75.9 -	73.8 -	74.0 -	71.6 -
315	77.7 -	75.5 -	75.2 -	72.5 -
400	77.8 -	75.4 -	75.6 -	70.5 -
500	76.5 -	73.2 -	73.0 -	66.4 -
630	77.4 -	73.4 -	71.7 -	63.5 -
800	77.3 -	71.6 -	70.6 -	59.0 -
1000	77.3 -	68.5 -	71.1 -	57.1 -
1250	78.1 -	67.4 -	71.9 -	52.9 -
1600	78.5 -	67.2 -	72.0 -	46.4 -
2000	77.4 -	62.6 -	70.5 -	35.8 -
2500	75.8 -	56.1 -	68.5 -	23.8 -
3150	74.4 -	46.4 -	65.6 -	16.1 0.4
4000	71.9 -	33.4 -	60.5 -	13.4 0.7
5000	68.6 -	24.1 -	52.9 -	13.6 0.8
	⇧	⇧	⇧	⇧

Size of background corrections (dB).

L_i data in this table includes corrections made for background level.

5.3 Normalized Impact Sound Pressure Levels

ISO 140-6 & 8 both require the reporting of the normalized impact sound pressure level for the bare floor, L_{no}. The normalized impact sound pressure levels are the levels that would be measured if exactly 10 m^2 of sound absorption was present in the receiving room at each frequency. Accordingly, this information is presented in Table 3, together with the normalized impact sound pressure level for the test floors.

Table 3, Normalized impact sound pressure levels (dB) for the test floors.

Freq (Hz)	L_{no} (dB)	L_n (dB) Test 'a'	L_n (dB) Test 'b'	L_n (dB) Test 'c'
	Bare Floor	with Gerflor Texline HQR floor covering	with Gerflor 'Creation Clic' floor covering	with Gerflor 'Texline Comfort' floor covering
100	57.8	56.1	56.9	55.9
125	61.5	59.5	59.6	58.7
160	61.3	59.7	59.6	58.8
200	65.7	63.9	63.7	62.4
250	67.9	65.9	66.1	63.6
315	70.5	68.2	67.9	65.2
400	71.4	68.9	69.1	64.0
500	70.2	66.9	66.7	60.2
630	71.3	67.4	65.6	57.5
800	71.5	65.8	64.8	53.2
1000	72.0	63.1	65.7	51.7
1250	73.2	62.5	67.0	48.0
1600	74.2	62.9	67.7	42.1
2000	73.8	59.0	67.0	32.3
2500	73.0	53.3	65.7	21.0
3150	72.3	44.3	63.5	14.0
4000	70.4	31.9	59.1	12.0
5000	68.0	23.5	52.3	13.0

6. TEST RESULTS

Impact Sound Pressure Level for the Bare Slab, Reduction (ΔL), and Performance Index Numbers for the Test Floors

The reduction of impact sound pressure level (ΔL), (i.e. the improvement in impact sound insulation) is given by the simple difference between the sound pressure level (L_{io}) measured for the bare floor, and the (L_i) measured for each test floor, corrected where appropriate for background levels. The impact isolation class (IIC) on the 150mm thick test slab, as defined in ASTM E989-89, the weighted reduction in impact

sound pressure level ΔL_w, and ΔL_{lin}, as defined in AS ISO 717.2-2004, has also been determined for the test floors.

Table 4 presents the impact sound pressure levels, and the reduction (ΔL) with each test floor, calculated for each measured 1/3-octave frequency band. The last six rows of the table give ΔL_w, ΔL_{lin}, IIC, $L_{n,w}$, C_I and ($L_{n,w}$ + C_i) respectively for the test floors.

Table 4. Impact sound levels, reduction (ΔL), and performance index numbers for the test floors.

Freq (Hz)	Bare 150mm Concrete Slab	Test 'a' 150mm slab with Gerflor 'Texline HQR' continuous roll vinyl floor covering		Test 'b' 150mm slab with Gerflor 'Creation Clic' interlocking vinyl plank floor covering		Test 'b' 150mm slab with Gerflor 'Texline Comfort' continuous roll vinyl floor covering	
	Normalized Impact Level, L_{no} (dB)	Normalized Impact Level, L_n (dB)	Reduction with floor covering, ΔL (dB)	Normalized Impact Level, L_n (dB)	Reduction with floor covering, ΔL (dB)	Normalized Impact Level, L_n (dB)	Reduction with floor covering, ΔL (dB)
100	57.8	56.1	1.8	56.9	0.9	55.9	1.9
125	61.5	59.5	2.0	59.6	1.9	58.7	2.8
160	61.3	59.7	1.6	59.6	1.7	58.8	2.5
200	65.7	63.9	1.8	63.7	2.0	62.4	3.3
250	67.9	65.9	2.1	66.1	1.9	63.6	4.3
315	70.5	68.2	2.2	67.9	2.6	65.2	5.2
400	71.4	68.9	2.5	69.1	2.2	64.0	7.4
500	70.2	66.9	3.3	66.7	3.5	60.2	10.0
630	71.3	67.4	3.9	65.6	5.7	57.5	13.9
800	71.5	65.8	5.7	64.8	6.7	53.2	18.3
1000	72.0	63.1	8.8	65.7	6.2	51.7	20.3
1250	73.2	62.5	10.8	67.0	6.2	48.0	25.3
1600	74.2	62.9	11.3	67.7	6.5	42.1	32.1
2000	73.8	59.0	14.8	67.0	6.8	32.3	41.5
2500	73.0	53.3	19.7	65.7	7.3	21.0	52.0
3150	72.3	44.3	28.0	63.5	8.8	14.0	58.3
4000	70.4	31.9	38.5	59.1	11.3	12.0	58.4
5000	68.0	23.5	44.5	52.3	15.6	13.0	54.9
ΔL_w	-	-	13	-	7	-	19
ΔL_{lin}	-	-	5	-	4	-	8
IIC	28	45	-	37	-	54	-
$L_{n,w}$	79	66	-	72	-	57	-
C_I	-11	-5	-	-9	-	-1	-
$L_{n,w}$ + C_I	68	61	-	63	-	56	-

Officer conducting measurement: Mr. David Truett

Report reviewed by: Dr. Christopher Preston

Date report issued: 16 June 2011

Results of Floor-Impact Acoustic Testing

Floor Materials Tested: "Gerflor Texline HQR"

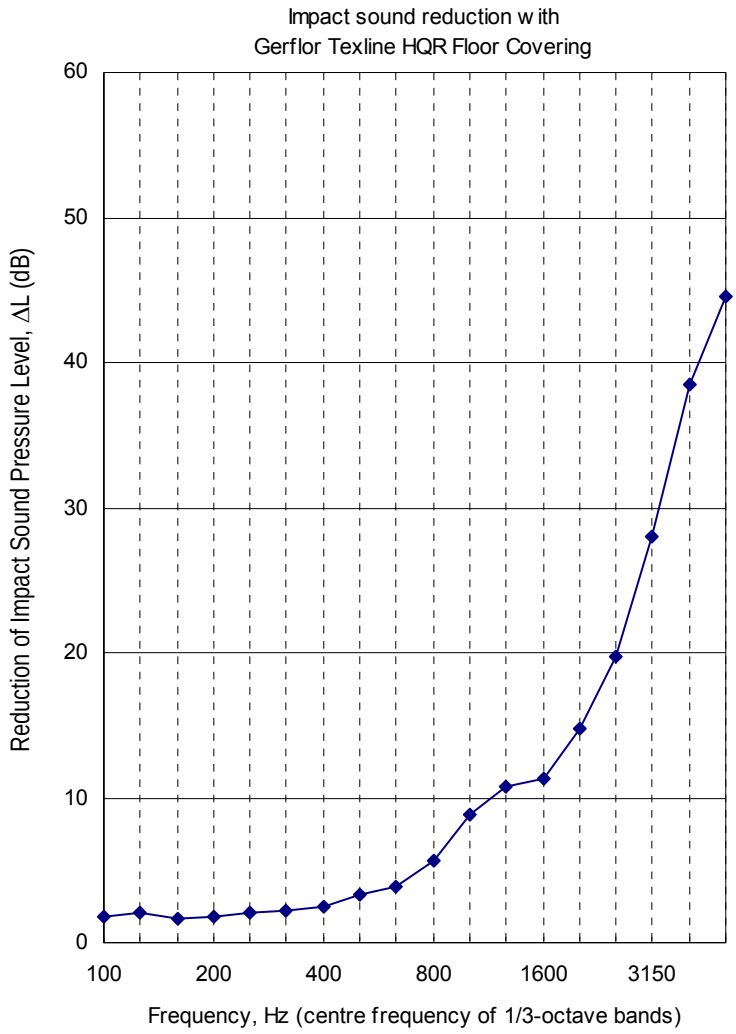
Type of Material: Sheet vinyl (woodgrain appearance) with textile backing
Form: Continuous roll, 4 m wide
Thickness: 3.1 mm (0.35 mm wear layer)
Mass per unit area: 2370 g/m^2
Underlying floor: Reinforced concrete slab, 3.68 m (l) x 3.22 m (w) x 150 mm (thick)

Test Conditions

Date of Test: 28 May 2011
Barometric Pressure: 1022 hPa
Temperature: 15 °C
Relative Humidity: 73%

Results

Freq (Hz)	Normalized Impact SPL		Improvement ΔL
	Bare Floor	With Floor Covering	
100	57.8	56.1	1.8
125	61.5	59.5	2.0
160	61.3	59.7	1.6
200	65.7	63.9	1.8
250	67.9	65.9	2.1
315	70.5	68.2	2.2
400	71.4	68.9	2.5
500	70.2	66.9	3.3
630	71.3	67.4	3.9
800	71.5	65.8	5.7
1000	72.0	63.1	8.8
1250	73.2	62.5	10.8
1600	74.2	62.9	11.3
2000	73.8	59.0	14.8
2500	73.0	53.3	19.7
3150	72.3	44.3	28.0
4000	70.4	31.9	38.5
5000	68.0	23.5	44.5
ΔL_w	-	-	13
ΔL_{lin}	-	-	5
IIC	28	45	-
$L_{n,w}$	79	66	-
C_l	-11	-5	-
$L_{n,w} + C_i$	68	61	-



These are the results of testing carried out at CSIRO Acoustic Laboratories, 37 Graham Rd, Highett, Australia 3190 in accordance with the Australian and ISO standards AS ISO 140.6-2006 and AS ISO 140.8-2006. Calculations have been carried out in accordance with AS ISO 717.2-2004 and ASTM E989-89. This appendix may serve as a statement of results for the particular floor materials described; full details are contained in CSIRO Report INR171/R1.

Results of Floor-Impact Acoustic Testing

Floor Materials Tested: "Gerflor Creation Clic"

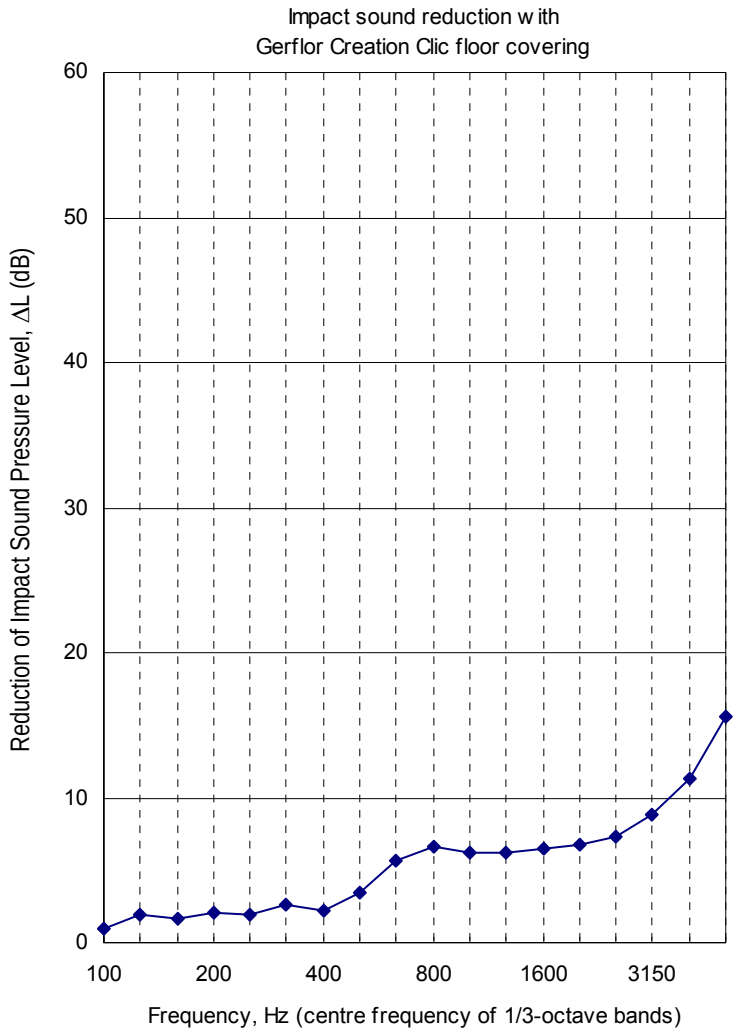
Type of Material: Vinyl (woodgrain appearance)
Form: Interlocking Planks, 17.6 cm x 100 cm
Thickness: 6 mm (0.7 mm wear layer)
Mass per unit area: 9895 g/m^2
Underlying floor: Reinforced concrete slab, 3.68 m (l) x 3.22 m (w) x 150 mm (thick)

Test Conditions

Date of Test: 28 May 2011
Barometric Pressure: 1022 hPa
Temperature: 15 °C
Relative Humidity: 73%

Results

Freq (Hz)	Normalized Impact SPL		Improvement ΔL
	Bare Floor	With Floor Covering	
100	57.8	56.9	0.9
125	61.5	59.6	1.9
160	61.3	59.6	1.7
200	65.7	63.7	2.0
250	67.9	66.1	1.9
315	70.5	67.9	2.6
400	71.4	69.1	2.2
500	70.2	66.7	3.5
630	71.3	65.6	5.7
800	71.5	64.8	6.7
1000	72.0	65.7	6.2
1250	73.2	67.0	6.2
1600	74.2	67.7	6.5
2000	73.8	67.0	6.8
2500	73.0	65.7	7.3
3150	72.3	63.5	8.8
4000	70.4	59.1	11.3
5000	68.0	52.3	15.6
ΔL_w	-	-	7
ΔL_{lin}	-	-	4
IIC	28	37	-
$L_{n,w}$	79	72	-
C_I	-11	-9	-
$L_{n,w} + C_i$	68	63	-



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Results of Floor-Impact Acoustic Testing

Floor Materials Tested: "Gerflor Texline Comfort"

Type of Material: Sheet vinyl (woodgrain appearance) with polyester textile backing
Form: Continuous roll, 4 m wide
Thickness: 4.2 mm (0.3 mm wear layer)
Mass per unit area: 2440 g/m^2
Underlying floor: Reinforced concrete slab, 3.68 m (l) x 3.22 m (w) x 150 mm (thick)

Test Conditions

Date of Test: 28 May 2011
Barometric Pressure: 1022 hPa
Temperature: 15 °C
Relative Humidity: 73%

Results

Freq (Hz)	Normalized Impact SPL		Improvement ΔL
	Bare Floor	With Floor Covering	
100	57.8	55.9	1.9
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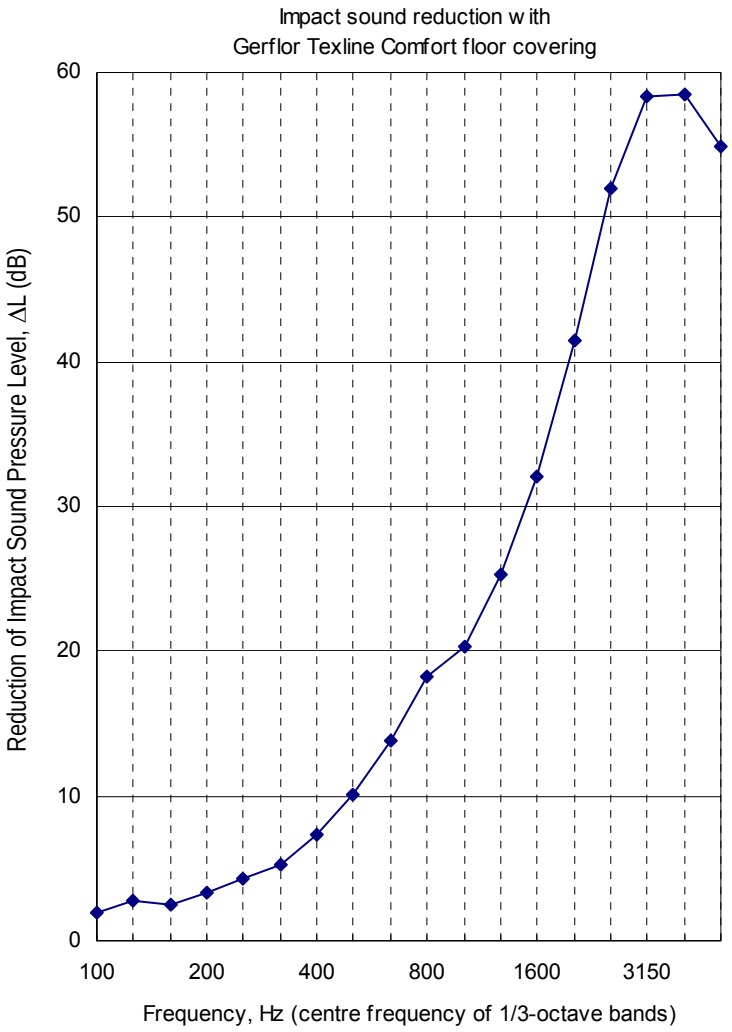
250	67.9	63.6	4.3
315	70.5	65.2	5.2
400	71.4	64.0	7.4
500	70.2	60.2	10.0
630	71.3	57.5	13.9
800	71.5	53.2	18.3
1000	72.0	51.7	20.3
1250	73.2	48.0	25.3
1600	74.2	42.1	32.1
2000	73.8	32.3	41.5
2500	73.0	21.0	52.0
3150	72.3	14.0	58.3
4000	70.4	12.0	58.4
5000	68.0	13.0	54.9
ΔL_w	-	-	19
ΔL_{lin}	-	-	8
IIC	28	54	-
$L_{n,w}$	79	57	-
C_l	-11	-1	-
$L_{n,w} + C_i$	68	56	-



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