SPACING TABLES FOR EMERGENCY LUMINAIRES AT 0.5 AND 1 LUX

Introduction

Lighting Council Australia and Lighting Council New Zealand are the peak bodies for the lighting industries of their respective countries. The Councils represent manufacturers and suppliers of luminaires, control gear, lamps and associated technologies.

This report provides tables with the correct spacing between emergency luminaires for each classification shown in the Australian and New Zealand standard AS/NZS 2293 using a minimum lighting level of 0.5 lux and 1 lux.

Lighting Council Australia and Lighting Council New Zealand, in conjunction with the emergency lighting equipment manufacturer members of both Councils as sponsors and LightLab International, have cooperated in preparing this report.

LightLab International is a NATA-accredited laboratory for photometric testing and carries out a range of testing associated with emergency lighting products and projects. LightLab was commissioned to calculate the maximum luminaire spacing, based on a minimum horizontal illumination level of 0.5 lux and 1 lux.

The methodology and tables are presented in this report.

The contributing emergency lighting equipment manufacturers are shown by their logos at the end of the report.

Methodology

The joint Australian and New Zealand AS/NZS 2293 suite of standards “Emergency escape lighting and exit signs for buildings” provides requirements for system design, installation and operation (part 1), inspection and maintenance (part 2) and emergency escape luminaires and exit signs - design and test requirements (part 3).

AS/NZS 2293.1 “Emergency escape lighting and exit signs for buildings” contains tables of maximum spacing for the five standard intensity classifications based on a minimum horizontal illumination level of 0.2 lux. These spacing-to-mounting height tables allow the maximum spacing between appropriately classified emergency luminaires or exit signs to be determined for each mounting height. The tables simplify both the design of emergency lighting installations and the assessment of compliance by allocating a maximum spacing-to-mounting height characteristic to each luminaire type.

This report shows the calculated maximum spacing based on a minimum horizontal illumination level of 0.5 and 1 lux. The methodology employed is the same as that shown in AS/NZS 2293.3 and the tables are presented in a similar format to those shown in AS/NZS 2293.1.

The tables in this report are for use in applications where spacing needs to be in accordance with jurisdiction requirements based on a minimum horizontal illumination level of 0.5 or 1 lux.

Users of this report are assumed to have a working knowledge of the AS/NZS 2293 suite of standards.

Classification of emergency luminaires

Each emergency luminaire or exit sign has a C_0/C_{90} (transverse/ longitudinal) classification determined. This is used in conjunction with the tables shown in AS/NZS 2293.1 for 0.2 lux or with the tables shown in this report for 0.5 and 1 lux to determine the maximum spacing for 0.2, 0.5 or 1 lux illumination levels.

The classification system used in this report is in accordance with and fully described in AS/NZS 2293.3 Appendix C.

Deriving the luminaire classification

The classification is based on a luminaire's photometric (lighting) performance – emitted luminous intensity measured in both the C_0 and C_{90} planes at maximum 5° intervals from the downward vertical, up to the horizontal. The values are measured while the luminaire operates in the emergency mode at the conditions determined during the tests in AS/NZS 2293.3 Appendix D.
The classification assigned to an emergency luminaire consists of a combination of an alphabetic and a numerical designation:

- The alphanumeric classification is based on the general shape of the intensity distribution curves in the transverse (C_0) and longitudinal (C_{90}) vertical planes through the luminaire. (Each plane is considered separately.)The numeric classification based on a number from a series equal to or less than the actual luminous intensity in the downward vertical direction. (This intensity is used for convenience, but is related to the intensities at other angles by the lighting distribution shape.)

The relationship between the alpha and numeric parts of the classification is determined by calculation. The luminous intensity at each measured angle is calculated and must not be less than the values determined from the formulas specified in AS/NZS 2293.3:1995 C3.2.2 and shown below.

Different classifications may be assigned in the C_0 and C_{90} planes (see AS/NZS 2293.1 Figure C1) provided that each classification is specifically related to the relevant plane.

Example

Where a luminaire is assigned a C classification in the C_0 plane and a B classification in the C_{90} plane, the luminaire would be marked:

C_0/C...
C_{90}/B...

A single classification, corresponding to the lowest classification afforded by any one of the measurement planes, may be adopted. Multiple classifications – that is, a C_0/C_{90} classification for each alphabetic component – are allowed.

Alphabetic component of the classification
The alphabetic component of the classification, in the form of the letters A, B, C, D or E, is assigned based on the general shape of the luminous intensity distribution and the formulas below.

Numerical component of the classification

The numerical component of the classification is assigned according to any value in the following series which is equal to or less than the actual luminous intensity in the downward vertical direction:

1, 1.25, 1.6, 2, 2.5, 3.2, 4, 5, 6.3, 8, 10, 12.5, 16, 20, 25, 32, 40, 50 . . .

Marking of information relating to the luminaire classification

Emergency luminaires shall be clearly and durably marked with their classification(s).

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AS/NZS 2293 Spacing Table Re-calculation

Intensity values were derived using the formulas specified within AS/NZS2293.3:1995 C3.2.2.

These formulas were extended past the implied cut off limits stated (next to the formula) except for the case of class E (see notes and formula below).

A cut off of 70 degrees was used for class E (values become negative beyond this point).

All spacing values of less than 1m were discarded, as instructed by the client.

Notes

As part of the initial testing of the program, calculations were produced based on a minimum of 0.2 lux and compared to the original tables.

In evaluating these tables, it became apparent that:

a) The original table calculations appear to have been mainly concerned with mid-point values and, in at least some cases, the levels directly below the luminaires do not meet the minimum level. The new table calculations take into account the level below the luminaire.

b) The cut-off angles for A, B, C and D are not implemented in the original tables (except for E, which appears to cut off at <70, not the 65 included in the standard).

c) The AS/NZS2293.3:1995 edition, clause C3.2.2 appears to contain an error in the Class E formula.

Basis of calculations

Assumptions include:

- Horizontal illuminance
- Direct illumination only
- No inter-reflected component
- Luminaires are treated as point sources
- Calculations are for two luminaires only
- Calculation points are directly beneath a luminaire and at the midpoint between the two.

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AS/NZS 2293 Spacing Table Re-calculation

Formulas used

Classification A

Ip = I0 * Cos(angle) ^ 4

Classification B

Ip = I0 * Cos(angle) ^ 3

Classification C

Ip = I0 * Cos(angle) ^ 1.5

Classification D

Ip = I0 *((2+ Cos(angle))/3)

Classification E

angle >= 70	Ip =0
angle <= 30	Ip = I0 *(1+ (0.04* (angle/30)))
angle >30 and <70	Ip = I0 * 1.07 *(Cos((2.6*(angle-35))))

Tables

The resulting spacing tables for 0.5 lux and 1 lux follow this page. The tables follow the same basic format as those included in the AS/NZS 2293.1 standard.

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
A 1																
A 1.25																
A 1.6	1.1															
A 2	1.8	1.2														
A 2.5	2.1	1.9	1.3													
A 3.2	2.5	2.4	2.2	1.6	1.0											
A 4	2.8	2.7	2.7	2.5	1.9	1.3										
A 5	3.0	3.1	3.1	3.0	2.8	2.3	1.5									
A 6.3	3.3	3.4	3.5	3.5	3.4	3.2	2.6	1.7								
A 8	3.6	3.8	3.9	3.9	3.9	3.9	3.7	3.0	2.1							
A 10	3.9	4.1	4.2	4.3	4.4	4.4	4.3	4.1	3.4	1.5						
A 12.5	4.2	4.4	4.6	4.7	4.8	4.9	4.9	4.8	4.6	3.0						
A 16	4.4	4.7	5.0	5.2	5.3	5.4	5.5	5.6	5.5	5.0	3.1					
A 20	4.7	5.0	5.3	5.5	5.7	5.9	6.1	6.2	6.2	6.0	5.1	3.1				
A 25	5.0	5.3	5.6	5.9	6.2	6.4	6.6	6.8	6.9	6.9	6.6	5.2	3.4			
A 32	5.3	5.7	6.0	6.3	6.6	6.9	7.2	7.4	7.7	7.9	7.8	7.4	6.1	4.2		
A 40	5.6	6.0	6.4	6.7	7.0	7.3	7.7	8.0	8.3	8.7	8.8	8.7	8.3	6.9		
A 50	5.9	6.3	6.7	7.1	7.5	7.8	8.2	8.6	9.0	9.5	9.8	9.9	9.7	9.3		
A 63	6.1	6.6	7.1	7.5	7.9	8.3	8.7	9.2	9.6	10.3	10.8	11.0	11.1	10.9	4.0	
A 80	6.5	7.0	7.5	7.9	8.4	8.8	9.3	9.8	10.3	11.1	11.7	12.2	12.4	12.5	8.1	
A 100	6.8	7.3	7.8	8.3	8.8	9.2	9.8	10.4	10.9	11.9	12.6	13.2	13.6	13.9	12.6	
A 125	7.1	7.7	8.2	8.8	9.2	9.7	10.3	11.0	11.6	12.7	13.5	14.3	14.8	15.2	15.1	7.9
A 160	7.4	8.0	8.6	9.2	9.7	10.3	10.9	11.6	12.3	13.5	14.5	15.4	16.1	16.7	17.6	13.9
A 200	7.7	8.4	9.0	9.6	10.2	10.7	11.4	12.2	13.0	14.3	15.4	16.4	17.3	18.0	19.8	18.7
A 250	8.0	8.8	9.4	10.1	10.7	11.2	12.0	12.8	13.6	15.1	16.3	17.4	18.4	19.2	21.8	21.8
A 320	8.4	9.2	9.9	10.6	11.2	11.8	12.6	13.5	14.4	15.9	17.3	18.6	19.7	20.7	24.0	25.1
A 400	8.7	9.5	10.3	11.0	11.7	12.3	13.2	14.1	15.1	16.7	18.2	19.6	20.8	21.9	26.0	27.8
A 500	9.1	9.9	10.7	11.5	12.2	12.9	13.7	14.8	15.8	17.6	19.2	20.6	22.0	23.2	27.9	30.5
A 630	9.5	10.3	11.2	12.0	12.7	13.4	14.4	15.5	16.5	18.4	20.2	21.7	23.2	24.6	29.9	33.2
A 800	9.9	10.8	11.6	12.5	13.3	14.0	15.0	16.2	17.3	19.3	21.2	22.9	24.5	26.0	31.9	36.0

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B 1																
B 1.25																
B 1.6	1.2															
B 2	1.9	1.3														
B 2.5	2.3	2.1	1.4													
B 3.2	2.7	2.6	2.4	1.7	1.1											
B 4	3.0	3.0	2.9	2.7	2.0	1.4										
B 5	3.3	3.4	3.4	3.3	3.1	2.5	1.7									
B 6.3	3.7	3.8	3.8	3.8	3.7	3.5	2.9	1.9								
B 8	4.0	4.2	4.3	4.3	4.3	4.2	4.0	3.3	2.2							
B 10	4.3	4.5	4.7	4.8	4.8	4.8	4.7	4.5	3.8	1.6						
B 12.5	4.6	4.9	5.1	5.2	5.3	5.4	5.4	5.3	5.0	3.3						
B 16	5.0	5.3	5.5	5.7	5.9	6.0	6.1	6.1	6.0	5.5	3.3					
B 20	5.3	5.6	5.9	6.2	6.4	6.5	6.7	6.8	6.8	6.6	5.6	3.4				
B 25	5.6	6.0	6.3	6.6	6.9	7.1	7.3	7.5	7.6	7.6	7.2	5.8	3.7			
B 32	6.0	6.4	6.8	7.1	7.4	7.7	8.0	8.2	8.5	8.7	8.5	8.1	6.7	4.5		
B 40	6.3	6.8	7.2	7.6	7.9	8.2	8.5	8.9	9.2	9.6	9.7	9.5	9.0	7.6		
B 50	6.7	7.2	7.6	8.0	8.4	8.7	9.1	9.6	10.0	10.5	10.8	10.8	10.6	10.1		
B 63	7.0	7.6	8.1	8.5	8.9	9.3	9.8	10.3	10.7	11.4	11.9	12.1	12.2	12.0	4.3	
B 80	7.4	8.0	8.5	9.0	9.5	9.9	10.4	11.0	11.5	12.4	13.0	13.4	13.7	13.7	8.8	
B 100	7.8	8.4	9.0	9.5	10.0	10.5	11.0	11.7	12.3	13.3	14.0	14.6	15.0	15.3	13.7	
B 125	8.2	8.8	9.4	10.0	10.6	11.1	11.7	12.4	13.0	14.2	15.1	15.8	16.4	16.8	16.5	8.6
B 160	8.6	9.3	10.0	10.6	11.2	11.7	12.4	13.2	13.9	15.2	16.2	17.1	17.9	18.5	19.3	15.3
B 200	9.0	9.8	10.5	11.1	11.7	12.3	13.1	13.9	14.7	16.1	17.3	18.3	19.2	19.9	21.7	20.3
B 250	9.4	10.2	11.0	11.7	12.3	12.9	13.7	14.7	15.5	17.0	18.4	19.5	20.6	21.4	24.0	23.9
B 320	9.9	10.7	11.5	12.3	13.0	13.7	14.5	15.5	16.4	18.1	19.6	20.9	22.1	23.1	26.5	27.5
B 400	10.4	11.2	12.1	12.9	13.6	14.3	15.2	16.3	17.3	19.1	20.7	22.1	23.4	24.6	28.8	30.6
B 500	10.8	11.7	12.6	13.4	14.2	15.0	16.0	17.1	18.1	20.1	21.8	23.4	24.8	26.1	31.0	33.7
B 630	11.3	12.3	13.2	14.1	14.9	15.7	16.7	17.9	19.1	21.2	23.0	24.7	26.3	27.7	33.3	36.8
B 800	11.8	12.8	13.8	14.7	15.6	16.5	17.6	18.8	20.0	22.3	24.3	26.2	27.9	29.4	35.7	39.9

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C 1																
C 1.25																
C 1.6	1.5															
C 2	2.3	1.5														
C 2.5	2.7	2.5	1.7													
C 3.2	3.2	3.1	2.8	2.1	1.3											
C 4	3.6	3.6	3.4	3.2	2.4	1.7										
C 5	4.1	4.1	4.0	3.9	3.6	3.0	2.0									
C 6.3	4.5	4.6	4.6	4.5	4.4	4.2	3.5	2.2								
C 8	4.9	5.1	5.2	5.2	5.1	5.0	4.8	4.0	2.6							
C 10	5.4	5.6	5.7	5.8	5.8	5.8	5.6	5.3	4.6	1.9						
C 12.5	5.8	6.0	6.2	6.4	6.4	6.5	6.4	6.3	6.0	3.9						
C 16	6.3	6.6	6.8	7.0	7.2	7.3	7.3	7.3	7.2	6.4	3.9					
C 20	6.8	7.1	7.4	7.6	7.8	8.0	8.1	8.2	8.2	7.8	6.7	4.0				
C 25	7.2	7.6	8.0	8.3	8.5	8.7	8.9	9.1	9.2	9.0	8.5	6.9	4.3			
C 32	7.8	8.2	8.6	9.0	9.3	9.5	9.8	10.1	10.3	10.4	10.2	9.6	8.0	5.3		
C 40	8.3	8.8	9.2	9.6	10.0	10.3	10.6	11.0	11.3	11.6	11.6	11.3	10.6	9.2		
C 50	8.8	9.4	9.8	10.3	10.7	11.0	11.5	11.9	12.3	12.8	13.0	12.9	12.6	12.0		
C 63	9.4	10.0	10.5	11.0	11.5	11.9	12.4	12.9	13.3	14.0	14.4	14.6	14.5	14.2	5.0	
C 80	10.0	10.6	11.2	11.8	12.3	12.7	13.3	13.9	14.5	15.3	15.9	16.3	16.5	16.4	10.5	
C 100	10.6	11.3	11.9	12.5	13.1	13.6	14.2	14.9	15.5	16.6	17.3	17.9	18.2	18.4	16.1	
C 125	11.2	12.0	12.7	13.3	13.9	14.5	15.2	15.9	16.6	17.8	18.8	19.5	20.0	20.4	19.5	10.0
C 160	11.9	12.8	13.5	14.2	14.9	15.5	16.3	17.1	17.9	19.3	20.4	21.3	22.0	22.6	23.0	18.4
C 200	12.6	13.5	14.3	15.1	15.8	16.4	17.3	18.2	19.1	20.6	21.9	23.0	23.9	24.6	26.1	24.0
C 250	13.3	14.3	15.1	16.0	16.7	17.4	18.3	19.4	20.3	22.0	23.5	24.7	25.8	26.7	29.0	28.3
C 320	14.2	15.2	16.1	17.0	17.8	18.6	19.6	20.7	21.7	23.6	25.2	26.7	27.9	29.0	32.3	32.9
C 400	14.9	16.0	17.0	17.9	18.8	19.7	20.7	21.9	23.1	25.1	26.9	28.5	29.9	31.1	35.3	36.9
C 500	15.8	16.9	18.0	19.0	19.9	20.8	21.9	23.2	24.5	26.7	28.6	30.4	31.9	33.3	38.4	40.8
C 630	16.6	17.9	19.0	20.1	21.1	22.0	23.2	24.7	26.0	28.4	30.5	32.4	34.1	35.7	41.6	45.0
C 800	17.6	18.9	20.1	21.3	22.3	23.4	24.7	26.2	27.6	30.2	32.5	34.6	36.5	38.2	45.0	49.3

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D 2.5	3.3	3.0	2.0	1.1												
D 3.2	4.0	3.7	3.4	2.5	1.6											
D 4	4.5	4.4	4.2	3.8	3.0	2.0										
D 5	5.1	5.1	4.9	4.7	4.3	3.7	2.4									
D 6.3	5.7	5.7	5.7	5.5	5.3	5.0	4.4	2.6								
D 8	6.4	6.5	6.5	6.4	6.3	6.1	5.7	5.0	3.2							
D 10	7.1	7.2	7.2	7.2	7.2	7.1	6.8	6.4	5.7	2.2						
D 12.5	7.7	7.9	8.0	8.1	8.1	8.1	7.9	7.6	7.2	4.8	1.1					
D 16	8.5	8.8	9.0	9.1	9.2	9.2	9.2	9.0	8.7	7.7	4.7					
D 20	9.3	9.6	9.8	10.0	10.1	10.2	10.3	10.2	10.1	9.4	8.2	4.8				
D 25	10.1	10.5	10.8	11.0	11.2	11.3	11.4	11.5	11.5	11.1	10.2	8.6	5.2			
D 32	11.1	11.5	11.8	12.1	12.4	12.6	12.8	12.9	13.0	12.9	12.4	11.5	10.0	6.4		
D 40	12.0	12.5	12.9	13.2	13.5	13.8	14.0	14.3	14.5	14.5	14.3	13.7	12.8	11.4		
D 50	13.0	13.5	14.0	14.4	14.7	15.0	15.4	15.7	16.0	16.3	16.2	15.9	15.3	14.4		
D 63	14.1	14.7	15.2	15.7	16.1	16.4	16.8	17.3	17.6	18.1	18.3	18.2	17.9	17.3	5.9	
D 80	15.3	16.0	16.6	17.1	17.5	17.9	18.4	19.0	19.4	20.1	20.5	20.6	20.5	20.2	12.7	
D 100	16.6	17.3	17.9	18.5	19.0	19.5	20.0	20.7	21.2	22.0	22.6	22.9	23.0	23.0	19.3	
D 125	17.9	18.6	19.3	20.0	20.6	21.1	21.7	22.4	23.1	24.1	24.8	25.3	25.6	25.8	23.6	12.0
D 160	19.4	20.3	21.1	21.8	22.4	23.0	23.7	24.6	25.3	26.5	27.4	28.1	28.7	29.0	28.2	22.8
D 200	21.0	21.9	22.7	23.5	24.2	24.9	25.7	26.6	27.4	28.8	29.9	30.8	31.5	32.0	32.3	28.8
D 250	22.6	23.6	24.5	25.4	26.2	26.9	27.8	28.8	29.7	31.3	32.6	33.6	34.5	35.2	36.4	34.4
D 320	24.5	25.7	26.7	27.6	28.5	29.3	30.3	31.4	32.4	34.2	35.7	36.9	38.0	38.9	41.2	40.5
D 400	26.5	27.7	28.8	29.8	30.7	31.6	32.7	33.9	35.0	37.0	38.7	40.1	41.4	42.4	45.6	46.0
D 500	28.5	29.8	31.0	32.1	33.1	34.1	35.2	36.6	37.8	40.0	41.9	43.5	44.9	46.2	50.3	51.6
D 630	30.8	32.2	33.5	34.7	35.8	36.8	38.1	39.6	41.0	43.4	45.5	47.3	48.9	50.3	55.3	57.6
D 800	33.3	34.9	36.3	37.6	38.8	39.9	41.3	42.9	44.4	47.1	49.4	51.4	53.3	54.9	60.8	64.1

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
E 1																
E 1.25																
E 1.6	1.9	1.0														
E 2	3.1	2.0	1.0													
E 2.5	3.6	3.2	2.2	1.2												
E 3.2	4.1	4.1	3.7	2.7	1.8											
E 4	4.6	4.6	4.6	4.2	3.2	2.3										
E 5	5.0	5.1	5.2	5.1	4.9	3.8	2.7									
E 6.3	5.4	5.6	5.7	5.8	5.8	5.6	4.4	3.0								
E 8	5.8	6.1	6.3	6.5	6.5	6.5	6.4	5.0	3.6							
E 10	6.1	6.5	6.8	7.1	7.2	7.3	7.3	7.1	5.6	2.5						
E 12.5	6.5	7.0	7.3	7.6	7.9	8.0	8.2	8.2	8.0	5.2	1.3					
E 16	6.9	7.4	7.8	8.2	8.5	8.8	9.1	9.3	9.3	8.5	5.3					
E 20	7.3	7.8	8.3	8.8	9.1	9.5	9.8	10.1	10.3	10.3	8.2	5.4				
E 25	7.6	8.2	8.8	9.3	9.7	10.1	10.6	11.0	11.3	11.6	11.4	8.7	5.9			
E 32	8.0	8.7	9.3	9.9	10.4	10.8	11.4	11.9	12.4	13.0	13.2	12.8	10.0	7.3		
E 40	8.3	9.0	9.7	10.4	10.9	11.4	12.1	12.7	13.3	14.2	14.6	14.7	14.3	11.3		
E 50	8.6	9.4	10.2	10.8	11.5	12.1	12.8	13.5	14.2	15.3	16.0	16.4	16.4	16.0		
E 63	8.9	9.8	10.6	11.3	12.0	12.7	13.5	14.3	15.1	16.4	17.4	18.1	18.4	18.5	6.6	
E 80	9.2	10.1	11.0	11.8	12.6	13.3	14.2	15.2	16.0	17.6	18.8	19.7	20.3	20.7	13.7	
E 100	9.5	10.5	11.4	12.3	13.1	13.9	14.8	15.9	16.9	18.6	20.0	21.2	22.1	22.7	21.3	1.0
E 125	9.7	10.8	11.8	12.7	13.6	14.4	15.4	16.6	17.7	19.6	21.3	22.6	23.7	24.6	25.8	13.7
E 160	9.9	11.1	12.1	13.1	14.1	15.0	16.1	17.4	18.6	20.8	22.6	24.2	25.5	26.7	29.5	22.7
E 200	10.1	11.3	12.4	13.5	14.5	15.5	16.7	18.1	19.4	21.7	23.8	25.6	27.1	28.5	32.5	32.1
E 250	10.3	11.5	12.7	13.8	14.9	15.9	17.2	18.7	20.1	22.7	24.9	26.9	28.7	30.2	35.5	36.8
E 320	10.5	11.8	13.0	14.2	15.3	16.4	17.8	19.4	20.9	23.7	26.2	28.4	30.4	32.1	38.6	41.5
E 400	10.6	11.9	13.2	14.5	15.7	16.8	18.3	20.0	21.6	24.6	27.3	29.7	31.9	33.8	41.3	45.5
E 500	10.7	12.1	13.4	14.7	16.0	17.2	18.7	20.5	22.2	25.4	28.3	30.9	33.3	35.5	44.0	49.3
E 630	10.8	12.2	13.6	14.9	16.2	17.5	19.1	21.0	22.9	26.3	29.3	32.2	34.8	37.2	46.7	53.1
E 800	10.9	12.3	13.8	15.1	16.5	17.8	19.5	21.5	23.4	27.0	30.4	33.4	36.2	38.8	49.5	57.0

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
A 1																
A 1.25																
A 1.6																
A 2																
A 2.5																
A 3.2	1.1															
A 4	1.8	1.2														
A 5	2.1	1.9	1.3													
A 6.3	2.4	2.4	2.2	1.5	1.0											
A 8	2.8	2.7	2.7	2.5	1.9	1.3										
A 10	3.0	3.1	3.1	3.0	2.8	2.3	1.5									
A 12.5	3.3	3.4	3.5	3.4	3.4	3.2	2.6	1.7								
A 16	3.6	3.8	3.9	3.9	3.9	3.9	3.7	3.0	2.1							
A 20	3.9	4.1	4.2	4.3	4.4	4.4	4.3	4.1	3.4	1.5						
A 25	4.2	4.4	4.6	4.7	4.8	4.9	4.9	4.8	4.6	3.0						
A 32	4.4	4.7	5.0	5.2	5.3	5.4	5.5	5.6	5.5	5.0	3.1					
A 40	4.7	5.0	5.3	5.5	5.7	5.9	6.1	6.2	6.2	6.0	5.1	3.1				
A 50	5.0	5.3	5.6	5.9	6.2	6.4	6.6	6.8	6.9	6.9	6.6	5.2	3.4			
A 63	5.3	5.7	6.0	6.3	6.6	6.8	7.1	7.4	7.6	7.8	7.7	7.3	5.9	4.0		
A 80	5.6	6.0	6.4	6.7	7.0	7.3	7.7	8.0	8.3	8.7	8.8	8.7	8.3	6.9		
A 100	5.9	6.3	6.7	7.1	7.5	7.8	8.2	8.6	9.0	9.5	9.8	9.9	9.7	9.3		
A 125	6.1	6.6	7.1	7.5	7.9	8.3	8.7	9.2	9.6	10.3	10.7	11.0	11.0	10.9	3.8	
A 160	6.5	7.0	7.5	7.9	8.4	8.8	9.3	9.8	10.3	11.1	11.7	12.2	12.4	12.5	8.1	
A 200	6.8	7.3	7.8	8.3	8.8	9.2	9.8	10.4	10.9	11.9	12.6	13.2	13.6	13.9	12.6	
A 250	7.1	7.7	8.2	8.8	9.2	9.7	10.3	11.0	11.6	12.7	13.5	14.3	14.8	15.2	15.1	7.9
A 320	7.4	8.0	8.6	9.2	9.7	10.3	10.9	11.6	12.3	13.5	14.5	15.4	16.1	16.7	17.6	13.9
A 400	7.7	8.4	9.0	9.6	10.2	10.7	11.4	12.2	13.0	14.3	15.4	16.4	17.3	18.0	19.8	18.7
A 500	8.0	8.8	9.4	10.1	10.7	11.2	12.0	12.8	13.6	15.1	16.3	17.4	18.4	19.2	21.8	21.8
A 630	8.4	9.1	9.8	10.5	11.2	11.8	12.6	13.5	14.3	15.9	17.3	18.5	19.6	20.6	23.9	24.9
A 800	8.7	9.5	10.3	11.0	11.7	12.3	13.2	14.1	15.1	16.7	18.2	19.6	20.8	21.9	26.0	27.8

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
B 1																
B 1.25																
B 1.6																
B 2																
B 2.5																
B 3.2	1.2															
B 4	1.9	1.3														
B 5	2.3	2.1	1.4													
B 6.3	2.7	2.6	2.4	1.7	1.1											
B 8	3.0	3.0	2.9	2.7	2.0	1.4										
B 10	3.3	3.4	3.4	3.3	3.1	2.5	1.7									
B 12.5	3.7	3.8	3.8	3.8	3.7	3.5	2.9	1.8								
B 16	4.0	4.2	4.3	4.3	4.3	4.2	4.0	3.3	2.2							
B 20	4.3	4.5	4.7	4.8	4.8	4.8	4.7	4.5	3.8	1.6						
B 25	4.6	4.9	5.1	5.2	5.3	5.4	5.4	5.3	5.0	3.3						
B 32	5.0	5.3	5.5	5.7	5.9	6.0	6.1	6.1	6.0	5.5	3.3					
B 40	5.3	5.6	5.9	6.2	6.4	6.5	6.7	6.8	6.8	6.6	5.6	3.4				
B 50	5.6	6.0	6.3	6.6	6.9	7.1	7.3	7.5	7.6	7.6	7.2	5.8	3.7			
B 63	6.0	6.4	6.7	7.1	7.4	7.6	7.9	8.2	8.4	8.6	8.5	8.0	6.4	4.4		
B 80	6.3	6.8	7.2	7.6	7.9	8.2	8.5	8.9	9.2	9.6	9.7	9.5	9.0	7.6		
B 100	6.7	7.2	7.6	8.0	8.4	8.7	9.1	9.6	10.0	10.5	10.8	10.8	10.6	10.1		
B 125	7.0	7.6	8.0	8.5	8.9	9.3	9.7	10.3	10.7	11.4	11.8	12.1	12.1	11.9	4.1	
B 160	7.4	8.0	8.5	9.0	9.5	9.9	10.4	11.0	11.5	12.4	13.0	13.4	13.7	13.7	8.8	
B 200	7.8	8.4	9.0	9.5	10.0	10.5	11.0	11.7	12.3	13.3	14.0	14.6	15.0	15.3	13.7	
B 250	8.2	8.8	9.4	10.0	10.6	11.1	11.7	12.4	13.0	14.2	15.1	15.8	16.4	16.8	16.5	8.6
B 320	8.6	9.3	10.0	10.6	11.2	11.7	12.4	13.2	13.9	15.2	16.2	17.1	17.9	18.5	19.3	15.3
B 400	9.0	9.8	10.5	11.1	11.7	12.3	13.1	13.9	14.7	16.1	17.3	18.3	19.2	19.9	21.7	20.3
B 500	9.4	10.2	11.0	11.7	12.3	12.9	13.7	14.7	15.5	17.0	18.4	19.5	20.6	21.4	24.0	23.9
B 630	9.9	10.7	11.5	12.2	12.9	13.6	14.5	15.4	16.4	18.0	19.5	20.8	22.0	23.0	26.4	27.3
B 800	10.4	11.2	12.1	12.9	13.6	14.3	15.2	16.3	17.3	19.1	20.7	22.1	23.4	24.6	28.8	30.6

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
C 1																
C 1.25																
C 1.6																
C 2																
C 2.5																
C 3.2	1.5															
C 4	2.3	1.5														
C 5	2.7	2.5	1.7													
C 6.3	3.2	3.0	2.8	2.0	1.2											
C 8	3.6	3.6	3.4	3.2	2.4	1.7										
C 10	4.1	4.1	4.0	3.9	3.6	3.0	2.0									
C 12.5	4.5	4.6	4.6	4.5	4.4	4.1	3.4	2.1								
C 16	4.9	5.1	5.2	5.2	5.1	5.0	4.8	4.0	2.6							
C 20	5.4	5.6	5.7	5.8	5.8	5.8	5.6	5.3	4.6	1.9						
C 25	5.8	6.0	6.2	6.4	6.4	6.5	6.4	6.3	6.0	3.9	.9					
C 32	6.3	6.6	6.8	7.0	7.2	7.3	7.3	7.3	7.2	6.4	3.9					
C 40	6.8	7.1	7.4	7.6	7.8	8.0	8.1	8.2	8.2	7.8	6.7	4.0				
C 50	7.2	7.6	8.0	8.3	8.5	8.7	8.9	9.1	9.2	9.0	8.5	6.9	4.3			
C 63	7.7	8.2	8.6	8.9	9.2	9.5	9.8	10.0	10.2	10.3	10.1	9.4	7.7	5.1		
C 80	8.3	8.8	9.2	9.6	10.0	10.3	10.6	11.0	11.3	11.6	11.6	11.3	10.6	9.2		
C 100	8.8	9.4	9.8	10.3	10.7	11.0	11.5	11.9	12.3	12.8	13.0	12.9	12.6	12.0		
C 125	9.4	10.0	10.5	11.0	11.4	11.8	12.3	12.9	13.3	14.0	14.4	14.5	14.5	14.1	4.8	
C 160	10.0	10.6	11.2	11.8	12.3	12.7	13.3	13.9	14.5	15.3	15.9	16.3	16.5	16.4	10.5	
C 200	10.6	11.3	11.9	12.5	13.1	13.6	14.2	14.9	15.5	16.6	17.3	17.9	18.2	18.4	16.1	
C 250	11.2	12.0	12.7	13.3	13.9	14.5	15.2	15.9	16.6	17.8	18.8	19.5	20.0	20.4	19.5	10.0
C 320	11.9	12.8	13.5	14.2	14.9	15.5	16.3	17.1	17.9	19.3	20.4	21.3	22.0	22.6	23.0	18.4
C 400	12.6	13.5	14.3	15.1	15.8	16.4	17.3	18.2	19.1	20.6	21.9	23.0	23.9	24.6	26.1	24.0
C 500	13.3	14.3	15.1	16.0	16.7	17.4	18.3	19.4	20.3	22.0	23.5	24.7	25.8	26.7	29.0	28.3
C 630	14.1	15.1	16.0	16.9	17.7	18.5	19.5	20.6	21.7	23.5	25.1	26.5	27.8	28.8	32.1	32.6
C 800	14.9	16.0	17.0	17.9	18.8	19.7	20.7	21.9	23.1	25.1	26.9	28.5	29.9	31.1	35.3	36.9

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	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	15.0	20.0
D 1																
D 1.25																
D 1.6																
D 2																
D 2.5																
D 3.2	1.8															
D 4	2.7	1.9														
D 5	3.3	3.0	2.0	1.1												
D 6.3	3.9	3.7	3.3	2.4	1.5											
D 8	4.5	4.4	4.2	3.8	3.0	2.0										
D 10	5.1	5.1	4.9	4.7	4.3	3.7	2.4									
D 12.5	5.7	5.7	5.6	5.5	5.3	5.0	4.3	2.6								
D 16	6.4	6.5	6.5	6.4	6.3	6.1	5.7	5.0	3.2							
D 20	7.1	7.2	7.2	7.2	7.2	7.1	6.8	6.4	5.7	2.2						
D 25	7.7	7.9	8.0	8.1	8.1	8.1	7.9	7.6	7.2	4.8	1.1					
D 32	8.5	8.8	9.0	9.1	9.2	9.2	9.2	9.0	8.7	7.7	4.7					
D 40	9.3	9.6	9.8	10.0	10.1	10.2	10.3	10.2	10.1	9.4	8.2	4.8				
D 50	10.1	10.5	10.8	11.0	11.2	11.3	11.4	11.5	11.5	11.1	10.2	8.6	5.2			
D 63	11.0	11.4	11.8	12.1	12.3	12.5	12.7	12.8	12.9	12.8	12.2	11.3	9.6	6.1		
D 80	12.0	12.5	12.9	13.2	13.5	13.8	14.0	14.3	14.5	14.5	14.3	13.7	12.8	11.4		
D 100	13.0	13.5	14.0	14.4	14.7	15.0	15.4	15.7	16.0	16.3	16.2	15.9	15.3	14.4		
D 125	14.1	14.6	15.2	15.6	16.0	16.4	16.8	17.2	17.6	18.0	18.2	18.1	17.8	17.2	5.6	
D 160	15.3	16.0	16.6	17.1	17.5	17.9	18.4	19.0	19.4	20.1	20.5	20.6	20.5	20.2	12.7	
D 200	16.6	17.3	17.9	18.5	19.0	19.5	20.0	20.7	21.2	22.0	22.6	22.9	23.0	23.0	19.3	
D 250	17.9	18.6	19.3	20.0	20.6	21.1	21.7	22.4	23.1	24.1	24.8	25.3	25.6	25.8	23.6	12.0
D 320	19.4	20.3	21.1	21.8	22.4	23.0	23.7	24.6	25.3	26.5	27.4	28.1	28.7	29.0	28.2	22.8
D 400	21.0	21.9	22.7	23.5	24.2	24.9	25.7	26.6	27.4	28.8	29.9	30.8	31.5	32.0	32.3	28.8
D 500	22.6	23.6	24.5	25.4	26.2	26.9	27.8	28.8	29.7	31.3	32.6	33.6	34.5	35.2	36.4	34.4
D 630	24.4	25.5	26.5	27.5	28.3	29.1	30.1	31.2	32.2	34.0	35.5	36.7	37.8	38.6	40.9	40.1
D 800	26.5	27.7	28.8	29.8	30.7	31.6	32.7	33.9	35.0	37.0	38.7	40.1	41.4	42.4	45.6	46.0

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E 1																
E 1.25																
E 1.6																
E 2																
E 2.5																
E 3.2	1.9	1.0														
E 4	3.1	2.0	1.0													
E 5	3.6	3.2	2.2	1.2												
E 6.3	4.1	4.0	3.6	2.6	1.6											
E 8	4.6	4.6	4.6	4.2	3.2	2.3										
E 10	5.0	5.1	5.2	5.1	4.9	3.8	2.7									
E 12.5	5.4	5.6	5.7	5.8	5.7	5.6	4.3	2.9								
E 16	5.8	6.1	6.3	6.5	6.5	6.5	6.4	5.0	3.6							
E 20	6.1	6.5	6.8	7.1	7.2	7.3	7.3	7.1	5.6	2.5						
E 25	6.5	7.0	7.3	7.6	7.9	8.0	8.2	8.2	8.0	5.2	1.3					
E 32	6.9	7.4	7.8	8.2	8.5	8.8	9.1	9.3	9.3	8.5	5.3					
E 40	7.3	7.8	8.3	8.8	9.1	9.5	9.8	10.1	10.3	10.3	8.2	5.4				
E 50	7.6	8.2	8.8	9.3	9.7	10.1	10.6	11.0	11.3	11.6	11.4	8.7	5.9			
E 63	8.0	8.6	9.3	9.8	10.3	10.8	11.3	11.9	12.3	12.9	13.0	12.6	9.7	7.0		
E 80	8.3	9.0	9.7	10.4	10.9	11.4	12.1	12.7	13.3	14.2	14.6	14.7	14.3	11.3		
E 100	8.6	9.4	10.2	10.8	11.5	12.1	12.8	13.5	14.2	15.3	16.0	16.4	16.4	16.0		
E 125	8.9	9.8	10.6	11.3	12.0	12.7	13.4	14.3	15.1	16.4	17.3	18.0	18.4	18.4	6.4	
E 160	9.2	10.1	11.0	11.8	12.6	13.3	14.2	15.2	16.0	17.6	18.8	19.7	20.3	20.7	13.7	
E 200	9.5	10.5	11.4	12.3	13.1	13.9	14.8	15.9	16.9	18.6	20.0	21.2	22.1	22.7	21.3	1.0
E 250	9.7	10.8	11.8	12.7	13.6	14.4	15.4	16.6	17.7	19.6	21.3	22.6	23.7	24.6	25.8	13.7
E 320	9.9	11.1	12.1	13.1	14.1	15.0	16.1	17.4	18.6	20.8	22.6	24.2	25.5	26.7	29.5	22.7
E 400	10.1	11.3	12.4	13.5	14.5	15.5	16.7	18.1	19.4	21.7	23.8	25.6	27.1	28.5	32.5	32.1
E 500	10.3	11.5	12.7	13.8	14.9	15.9	17.2	18.7	20.1	22.7	24.9	26.9	28.7	30.2	35.5	36.8
E 630	10.5	11.7	13.0	14.2	15.3	16.4	17.8	19.4	20.9	23.6	26.1	28.3	30.3	32.0	38.4	41.2
E 800	10.6	11.9	13.2	14.5	15.7	16.8	18.3	20.0	21.6	24.6	27.3	29.7	31.9	33.8	41.3	45.5

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