




# Memorandum

U.S. Department  
of Transportation

**Federal Aviation  
Administration**

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Subject: **INFORMATION:** Engineering Brief No.67D  
Light Sources Other Than Incandescent and Xenon  
For Airport and Obstruction Lighting Fixtures  
Date: March 6,  
2012

From:  Manager, Airport Engineering Division, AAS-100  
Reply to  
Attn. of:

To: All Regions  
Attn: Manager, Airports Division

Engineering Brief No.67D provides additional requirements for light sources other than incandescent and xenon technologies subject to certification under Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program*, and other applicable documents as required. It includes the required specific test and design requirements for alternative light sources that will be used in certified airfield lighting fixtures. This Engineering Brief ensures these new lighting technologies are seamlessly integrated with existing lighting technologies on the airfield.

Airfield Lighting Equipment Manufacturers employing alternative light sources in equipment certified under AC 150/5345-53 must meet the requirements contained in each applicable AC. The third party certification activity must verify the airfield lighting manufacturers' equipment meets the design and operational provisions as dictated by changing illuminating technology.



John R. Dermody

Attachment

# ENGINEERING BRIEF NO. 67D

## LIGHT SOURCES OTHER THAN INCANDESCENT AND XENON FOR AIRPORT AND OBSTRUCTION LIGHTING FIXTURES

### I. PURPOSE

This engineering brief provides additional requirements for "Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures" subject to certification under AC 150/5345-53, *Airport Lighting Equipment Certification Program*, and/or other applicable documents.

### II. DESCRIPTION

This document includes specific test and design requirements for alternative light sources used in certified equipment.

### III. BACKGROUND

Manufacturers utilizing alternative light sources, such as Cold Cathode, Light Emitting Diodes (LED), fiber optics, etc. in equipment certified under the U.S. Department of Transportation, Federal Aviation Administration, Advisory Circular No. 150/5345-53, must meet the requirements contained in each applicable equipment Advisory Circular. Additionally, the third party certification body must verify that the manufacturer's equipment meets the following design and operational provisions as dictated by changing illumination technology.

### IV. CANCELLATION

Engineering Brief 67C, *Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures*, dated December 29, 2010, is canceled.

### V. EFFECTIVE DATE

This Engineering Brief is effective 9 months from the date of signature except for the requirements specified in paragraph 1.0 "Intensity Ratios", Table I (white light) and Appendix I, Table 3 (continuous curve for white light) that are effective immediately.

### VI. APPLICATION

The Federal Aviation Administration (FAA) recommends the guidelines and standards in this Engineering Brief (EB) for light sources other than incandescent and xenon for use in airport and obstruction lighting fixtures. In general, use of this EB is not mandatory. However, use of this EB is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assurance No. 34, "Policies, Standards, and Specifications," and PFC Assurance No. 9, "Standard and Specifications."

## **VII. APPLICABLE DOCUMENTS**

### FAA Advisory Circulars:

AC 150/5340-30	Design and Installation Details for Airports Visual Aids
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-53	Airport Lighting Equipment Certification Program
AC 150/5345-43	Specification for Obstruction Lighting Equipment
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities

### Other Documents:

Journal of the Optical Society, vol. 23, page 359, October 1933 (commonly known as CIE 1931)

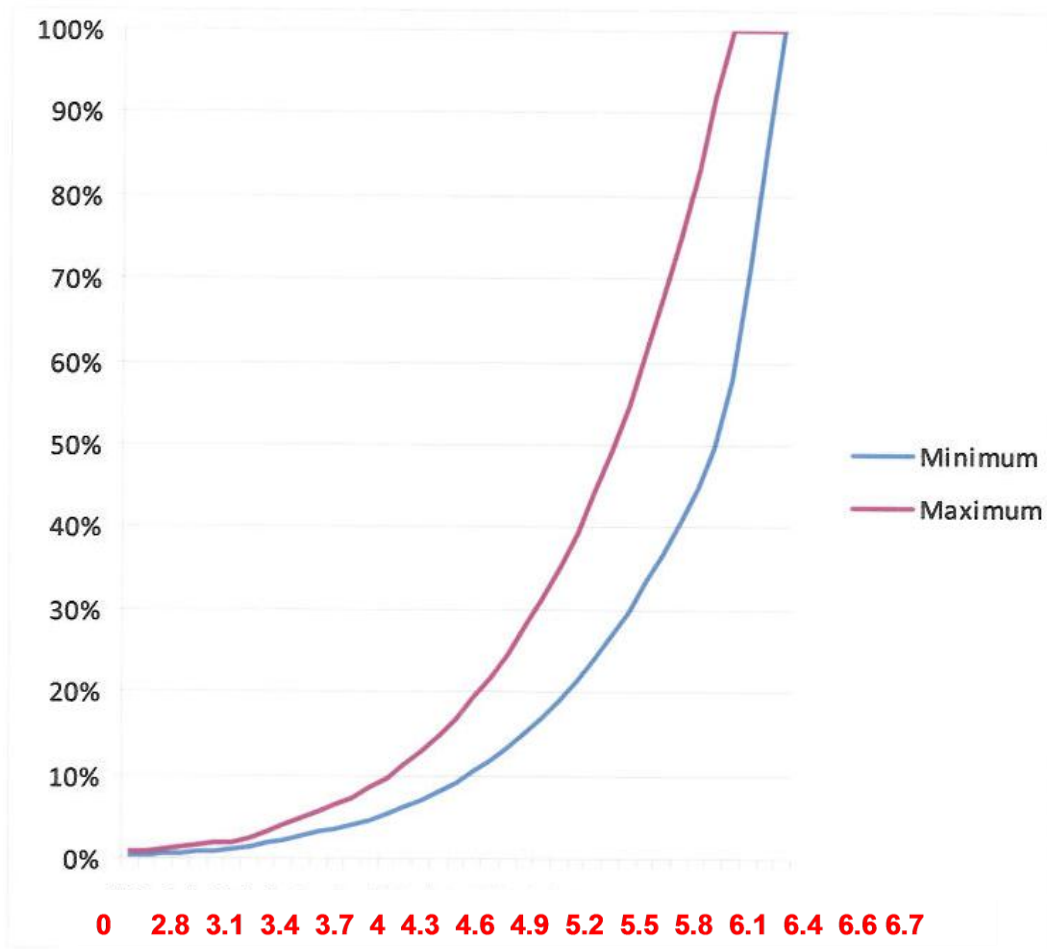
## **VIII. PRINCIPAL CHANGES**

The following principal change(s) are incorporated:

1. Figure 1 x-axis current scale is updated.
2. Table 2 5.2A % minimum and maximum intensity is updated.
3. Paragraph 2.5.1 is updated to measure power factor at the isolation transformer primary leads.
4. Paragraph 4.1 is updated to include a reference to AC 150/5340-26.
5. Paragraph 5.0 is added to introduce an LED Type designation.
6. Paragraph 6.0 Owner Option is added.

**1.0 Intensity Ratios** — The intensity of a fixture with an alternative light source intended to operate on a 3 or 5 step Constant Current Regulator must vary in accordance with characteristics of an incandescent lamp as described in AC 150/5340-30, *Design and Installation Details for Airport Visual Aids*. Light output must increase with increasing CCR output current and decrease with decreasing CCR output current per Tables 1 (white light) and Table 2 (colored light). The tolerance for the curve as shown below will be added to AC 150/5340-30 at a later date. See Appendix 1 for detailed versions of Tables 1 and 2.

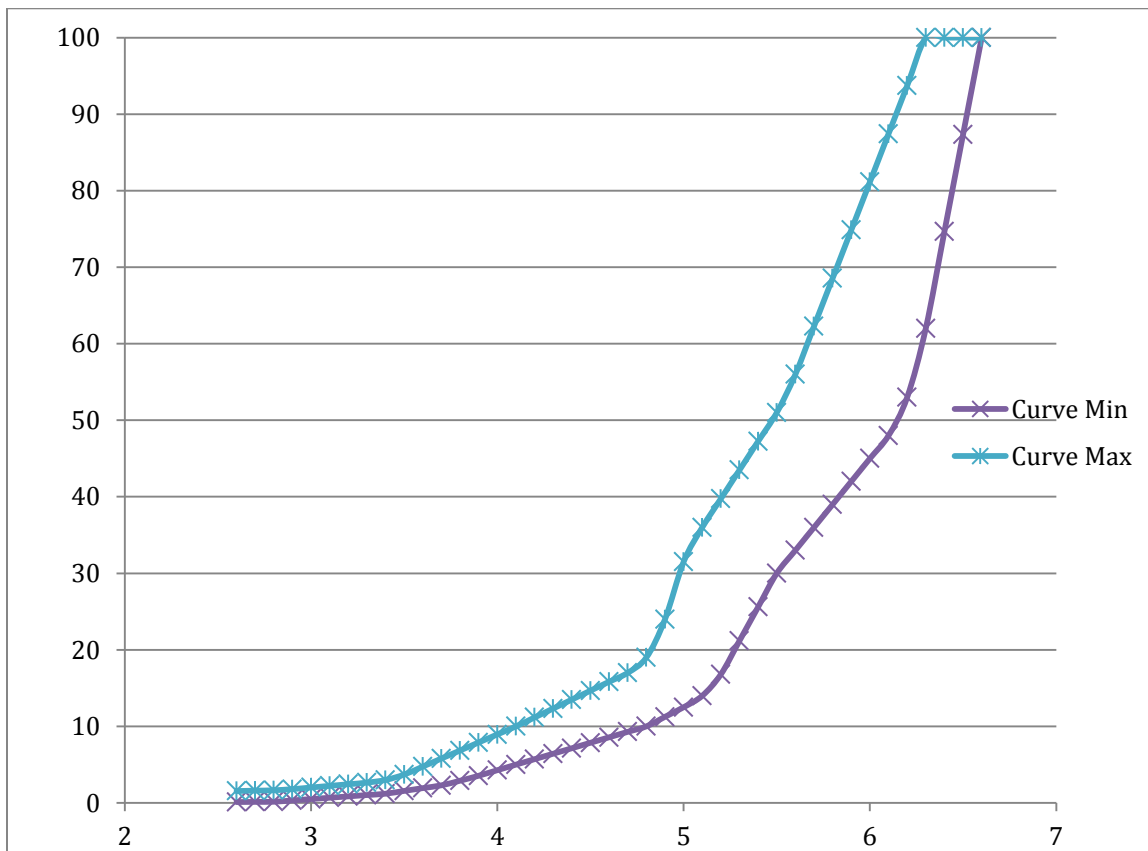
For series circuit applications, the fixture's light intensity shall be based on a continuous curve and shall not use discrete step intensity changes.



**Figure 1: Dimming Curve (Applies To White Light Only)**

LAMP CURRENT	% MINIMUM INTENSITY	% MAXIMUM INTENSITY
6.6	100	n/a
5.5	23.9	44.1
5.2	16.9	31.3
4.8	10.4	19.2
4.1	3.9	7.3
3.4	1.0	2.0
2.8	0.15	0.7

**Table 1 (Applies To White Light Only)**



**Figure 2. Detailed Current/intensity Graph of Figure 2 for LED Light Colors Blue, Red, Green, and Yellow**

LAMP CURRENT	% MINIMUM INTENSITY	% MAXIMUM INTENSITY
6.6	100	n/a
5.5	30.0	51.0
5.2	16.8	39.75
4.8	10.0	19.0
4.1	5.0	10.0
3.4	1.2	3.0
2.8	0.15	1.65

**Table 2. Applies To Colored Light Only (see Appendix 1 for detailed table)**

When testing intensity ratios, the current must be measured at the primary of the isolation transformer.

## **2.0 Additional Qualification Requirements/Testing**

2.1 Chromaticity — All fixtures must meet the chromaticity requirements per this paragraph for color of light emitted. Testing must be done using a spectroradiometer in increments of 2nm or less. Testing must be conducted after the applicable photometric test warm-up time specified in the applicable AC, or after stabilization if warm-up time is not specified.

**NOTE:** This section does not apply to runway and taxiway signs. See AC 150/5345-44 for ALD sign requirements.

2.1.1 Aviation White LED Chromaticity Boundaries — All white LED light fixtures must meet the following chromaticity boundaries for aviation white:

- Yellow boundary:  $x = 0.440$
- Blue boundary:  $x = 0.320$
- Green boundary:  $y = 0.150 + 0.643x$
- Purple boundary:  $y = 0.050 + 0.757x$

Boundary Intersection Points for Aviation White:

$x = 0.320, y = 0.356$   
 $x = 0.440, y = 0.433$   
 $x = 0.440, y = 0.383$   
 $x = 0.320, y = 0.292$

**NOTE:** See AC 150/5345-43 for white obstruction light chromaticity.

2.1.2 LED light fixtures that emit aviation green, blue, yellow or red light color must meet the following boundary equations and boundary intersection points:

a. Green (ICAO Modified)

Blue boundary:  $y = 0.768 - 1.306x$

White boundary:  $y = 0.600$

Yellow boundary:  $y = 3.470 - 9.200x$

Green boundary intersection points:

$x = 0.014, y = 0.750$

$x = 0.129, y = 0.600$

$x = 0.312, y = 0.600$

$x = 0.302, y = 0.692$

b. Blue (ICAO)

Green boundary:  $y = 0.805x + 0.065$

White boundary:  $y = 0.400 - x$

Purple boundary:  $y = 1.668x - 0.222$

Blue boundary intersection points:

$x = 0.090, y = 0.137$

$x = 0.186, y = 0.214$

$x = 0.233, y = 0.167$

$x = 0.148, y = 0.025$

c. Yellow (CIE S 0004/E2001):

Green boundary:  $y = 0.727x + 0.054$

White boundary:  $y = 0.980 - x$

Red boundary:  $y = 0.387$

Yellow boundary intersection points:

$x = 0.547, y = 0.452$

$x = 0.536, y = 0.444$

$x = 0.593, y = 0.387$

$x = 0.613, y = 0.387$

d. Restricted Red (CIE S 0004/E-2001 restricted region)

Yellow boundary:  $y = 0.320$   
White boundary:  $y = 0.980 - x$   
Purple boundary:  $y = 0.290$

Red boundary intersection points:

$x = 0.680, y = 0.320$   
 $x = 0.660, y = 0.320$   
 $x = 0.690, y = 0.290$   
 $x = 0.710, y = 0.290$

**NOTE:** See AC 150/5345-43 for red obstruction light chromaticity.

2.2 High Temperature Test — Unless specified in other Advisory Circulars, alternative light source fixtures must meet the following requirements. Manufacturers must ensure that the light output of the fixture does not drop more than 30% of the photometric requirement of the applicable AC when operated at high temperature. The photometric measurement must be done after 15 minutes of operation (for products covered under AC 150/5345-46) or stabilization (for all other products) at 25C, and again after 4 hours of continuous operation at 55C.

2.3 Fixtures must be designed to operate and interface with all existing airport lighting equipment systems contained in Advisory Circular 150/5345-53.

2.4 Accelerated Fixture Life Test - Alternative light sources must be subjected to the accelerated life test per AC 150/5345-46D, Specification for Runway and Taxiway Light Fixtures, paragraph 4.5.4, Accelerated Life Test, with the following exceptions and additions:

- a. The accelerated life test duration shall be 500 hours at 131 degrees Fahrenheit (55 degrees Celsius). A light system shall be operated at highest fixture manufacturer rated voltage or current using approved regulators or a current supply having one percent regulation. The duty cycle shall consist of 20 hours fixture operating time and 4 hours de-energized. A voltage controlled system shall be operated from a supply having three percent regulation. This test may be run in parallel with other accelerated life tests.
- b. The manufacturer must report to the 3rd party certifier the LED junction temperature as measured with a pre-approved procedure in the “as-installed” condition for that light fixture. This information will be compared with the LED manufacturer's ratings.

2.5 Light Fixture Performance Criteria - Manufacturers are required to publish the performance criteria for all light generating devices. This performance criteria is defined as worst-case wattage and VA at both the input leads of the fixture and, for fixtures powered from a series circuit, across the primary winding of an appropriately sized isolation transformer. The fixture lead length shall not exceed 24 inches for this test. This information shall be listed on the manufacturer's datasheets and verified by third party certification body. The manufacturer shall also state the operational current range, for series circuit powered fixtures, or input voltage



range, for voltage powered fixtures, on their datasheets and verified by the third party certification body test laboratory.

2.5.1 Light Fixture Power Factor - The true power factor for all fixtures powered by a Constant Current Regulator must not be less than 0.7 when measured at the isolation transformer primary input power leads of the fixture on all constant current regulator current steps. The true power factor measurement must be done over the frequency bandwidth range of at least 100 kHz. The power factor measurement must not be displacement power factor ( $\cos \phi$ ). Testing will be conducted using a pure sine wave source.

2.6 Fixtures Using Multiple Light Devices - If multiple light devices to produce a single source are used, the design must ensure the fixture meets the light output specification while it is on, and it must turn off if more than 25% of the light devices fail. Additionally, all light devices must be connected in a manner to ensure that there will be no failures of entire rows or columns when there is no method of detecting failures of entire rows or columns.

2.7 Fixture Monitoring - Fixtures that have the capability to be electronically monitored must provide that capability at the top two intensity steps on a 3-step constant current regulator and the top three intensity steps on a 5-step constant current regulator. The fixture in any failure condition must have the ability to provide an open circuit (fail-open) at the secondary of the isolation transformer, or draw zero current on a constant voltage circuit. Other appropriate monitoring methods may be used if the fixtures can retrofit into existing monitoring systems.

2.8 Fixture Daytime Viewing - Means must be provided on all L-860E, L-861T, L-861E, L861SE and L-862E elevated airport to indicate specified light color during daytime viewing. The minimum colored surface area must be a minimum of 2 1/2 sq. in. from any direction when using a horizontal viewing angle of 0° to +45°. The color must comply with the aviation colors as defined in the Society of Automotive Engineers (SAE) AS-25050, *Colors, Aeronautical Lights and Lighting Equipment, General Requirements for*, specification corresponding to the fixture energized color and may be accomplished with appropriate means such as reflective material (not retro-reflective), painting, or coloring of the fixture components. The upper portion of the fixture body may also be painted to achieve the desired amount of colored surface area. For surfaces below the optical or daytime visibility area surface on elevated lights, the exterior finish must match color No. 13538, Aviation Yellow, Table V of FED-STD-595B unless otherwise specified. The finish of a fixture heat sink or cooling element may be a natural finish or black.

2.9 Flashing Lights - Flashing lights with alternate lighting sources subject to certification under AC 150/5345-53 and/or other applicable documents must have all testing conducted in the flashing mode.

2.10 Detector Calibration - To verify proper photometric testing conducted on alternate light source fixtures, the test equipment must have an up to date calibration including correction for spectral response of the detector.

2.11 Electromagnetic Emissions - The alternate light source fixture and associated on-board circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15, "Unintentional Radiators", regulations concerning the emission of electronic noise. Both conducted and radiated emission limits must be tested.

2.12 Surge Protection - The interface circuitry (if any) and solid state devices shall be designed to withstand and/or include separate surge protection devices which have been tested against defined waveforms detailed in Table 4, Location Category C2 of ANSI/IEEE C62.41-1991 "Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits", Standard 1.2/50 microsecond ( $\mu$ S) — 8/20  $\mu$ S Combination Wave. Peak voltage is 10 kilovolts, peak current is 5 kilo amps with a nominal ratio of peak open circuit voltage to peak short circuit current of 2 ohms. Obstruction Lights per FAA Advisory Circular 150/5345-43, "Specification for Obstruction Lighting Equipment" are excluded from this requirement.

2.13 Optional Arctic Kits - Any fixture (includes in-pavement fixtures), may have an optional arctic kit and/or an appropriate addressing of potential icing conditions to no less extent than present fixtures. An arctic kit may be an optional feature and may be specified by the customer at the time of purchase. The arctic kit, if present, must be self-activating.

2.13.1 Arctic Kit Testing Requirements. The arctic kit must be tested as follows:

- a. With light source and arctic kit off, the light fixture must be stabilized for 4 hours at - 20°C.
- b. Then, in still air and with the light source activated at the highest intensity setting, the main beam light emitting surface temperature must rise a minimum of 15°C after 30 minutes operation.
- c. For elevated fixtures, this test is run in open-air conditions.

2.14 In-Pavement Light Fixture Testing - All light fixtures with alternative light source electronics at or below grade level must be subjected to the in-pavement light tests described in Advisory Circular 150/5345-46, *Specification for Runway and Taxiway Light Fixtures*.

2.15 Light Fixture Flicker - All light fixtures that use pulse width modulation (PWM) to facilitate LED brightness changes must not cause perceptible flicker to a moving human observer (example: pilot in an aircraft) throughout the range of brightness steps.

### **3.0 Additional Production Testing**

3.1 Burn-In Production Test — Alternative light sources must be energized for a minimum of 4 hours, at 100 percent intensity at standard ambient temperature before shipment. Any failure of an alternative light source during burn-in or testing after burn-in will be cause for rejection.

### **4.0 Minimum Warranties**

4.1 All LED light fixtures with the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all

electronics. The replacement criterion for light fixtures is per AC 150/5340-26.

## **5.0 LED Type Designation**

5.1 LED lighting fixtures shall be identified by using an additional character when specifying the type of fixture as specified in AC 150/5345-46.

Example: An incandescent taxiway edge light type is "L-861T".

The LED version of the taxiway edge light type will be specified as "L-861T(L)".

This will apply to all LED "L-XXX" type fixtures.

## **6.0 Owner Option**

6.1 Where a light fixture type is available as both incandescent (L-XXX) or LED (L-XXX(L)), the owner must select the fixture type to be used, or must specify that either incandescent or LED are acceptable.

## Appendix I – Additional Information

**Table 3. Detailed Version of Table 1 (White Light Only)**

<b>Current</b>	<b>Minimum</b>	<b>Maximum</b>
2.7	0.15%	0.70%
2.8	0.15%	0.70%
2.9	0.28%	0.92%
3	0.41%	1.14%
3.1	0.54%	1.35%
3.2	0.67%	1.57%
3.3	0.80%	1.78%
3.4	1.00%	2.10%
3.5	1.36%	2.75%
3.6	1.79%	3.50%
3.7	2.22%	4.25%
3.8	2.65%	5.00%
3.9	3.08%	5.75%
4	3.51%	6.50%
4.1	3.94%	7.35%
4.2	4.57%	8.45%
4.3	5.28%	9.76%
4.4	6.08%	11.23%
4.5	6.98%	12.89%
4.6	7.99%	14.75%
4.7	9.11%	16.83%
4.8	10.37%	19.15%
4.9	11.76%	21.73%
5	13.31%	24.59%
5.1	15.03%	27.76%
5.2	16.93%	31.27%
5.3	19.03%	35.15%
5.4	21.34%	39.41%
5.5	23.88%	44.11%
5.6	26.67%	49.26%
5.7	29.73%	54.90%
5.8	33.07%	61.08%
5.9	36.73%	67.83%
6	40.71%	75.19%
6.1	45.05%	83.21%
6.2	49.77%	91.93%
6.3	58.13%	100.00%
6.4	71.58%	100.00%
6.5	85.18%	100.00%
6.6	100.00%	100.00%
6.7	100.00%	100.00%

**Table 4. Detailed current/intensity for color LEDs**

Step	I(A)	Curves	
		Dmin(%)	Dmax(%)
	2.7	0.13	1.6
B1	2.8	<b>0.15</b>	<b>1.65</b>
	2.9	0.33	1.8
	3	0.5	2.01
	3.1	0.68	2.23
	3.2	0.85	2.44
	3.3	1.03	2.65
B2	3.4	<b>1.2</b>	<b>3</b>
	3.5	1.57	3.7
	3.6	1.93	4.75
	3.7	2.3	5.8
	3.8	2.9	6.85
	3.9	3.55	7.9
	4	4.28	8.95
B3	4.1	<b>5</b>	<b>10</b>
	4.2	5.71	11.17
	4.3	6.43	12.33
	4.4	7.14	13.5
	4.5	7.86	14.67
	4.6	8.57	15.83
	4.7	9.29	17
B10	4.8	<b>10</b>	<b>19</b>
	4.9	11.25	24
	5	12.5	31.5
	5.1	14	36
B4	5.2	<b>16.8</b>	<b>39.75</b>
	5.3	21.2	43.5
	5.4	25.6	47.25
B30	5.5	<b>30</b>	<b>51</b>
	5.6	33	56
	5.7	36	62.29
	5.8	39	68.57
	5.9	42	74.86
	6	45	81.14
	6.1	48	87.43
	6.2	53	93.71
	6.3	62	<b>100</b>
	6.4	74.67	<b>100</b>
	6.5	87.33	<b>100</b>

B5	6.6	<b>100</b>	<b>100</b>
	6.7	<b>100</b>	<b>100</b>