Appendix E1-5
LAX SPECIFIC PLAN AMENDMENT STUDY REPORT

Los Angeles International Airport Takeoff Length Analysis for Runway 6R/24L

June 2010

Prepared for:

Los Angeles World Airports
One World Way
Los Angeles, California 90045

Prepared by:

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Carlsbad, CA 92008

RICONDO & ASSOCIATES

MEMORANDUM **VIA E-MAIL**

Date: June 15, 2010

To: Joe Huy, Joe Birge, Steve Smith, and Phil Hogg
Ricondo & Associates

From: Joshua Jones [ORIGINAL SIGNED]

Subject: LOS ANGELES INTERNATIONAL AIRPORT
TAKEOFF LENGTH ANALYSIS FOR RUNWAY 6R-24L

In order to determine the most appropriate future runway length to accommodate departures on Runway 6R-24L, a takeoff length analysis was done utilizing the 2020 LAX No Yellow Light Project (NYLP) Scenario Schedule. The 2020 LAX NYLP Scenario Schedule was used to determine the type and volume of aircraft forecasted to use the airport in the year 2020.

FAA Advisory Circular (AC) 150/5325-4B *Runway Length Requirements for Airport Design* states that the airplane manufacturers' airport planning manuals (APMs) be used to determine takeoff length for airplanes with a maximum certificated takeoff weight (MTOW) of 60,000 pounds or more or regional jets. An excerpt from FAA AC 150/5325-4B is attached. Using the APMs from the various airplane manufacturers takeoff distances were calculated at MTOW for the aircraft included in the schedule. For the purposes of this analysis only heavy aircraft, defined by the FAA as those having a MTOW of 255,000 pounds or more, were used.

Table 1A gives the required runway takeoff length for heavy aircraft at MTOW and International Standard Atmosphere (ISA) temperature. At sea level the ISA temperature is 15°C (59°F). For reference the existing Runway 6R-24L length, existing Runway 7L-25R length, RSA Study Refinement #2 Accelerate-Stop Distance Available (ASDA), and Master Plan Future ASDA length are included along with the percentage of heavy departure operations accommodated by the various lengths. Peak Month Average Day (PMAD) departures are shown for each individual aircraft. Similarly, **Table 1B** gives the required runway takeoff length for heavy aircraft at MTOW and ISA + 15°C temperature. At sea level the ISA + 15°C temperature is 30°C (86°F).

The attached tables should assist in determining an appropriate takeoff length for Runway 6R-24L.

Enclosures:
Tables 1A & 1B, FAA AC 150/5325-4B, Takeoff Length Spreadsheet, APM Takeoff Charts

cc: 08-14-0466 341
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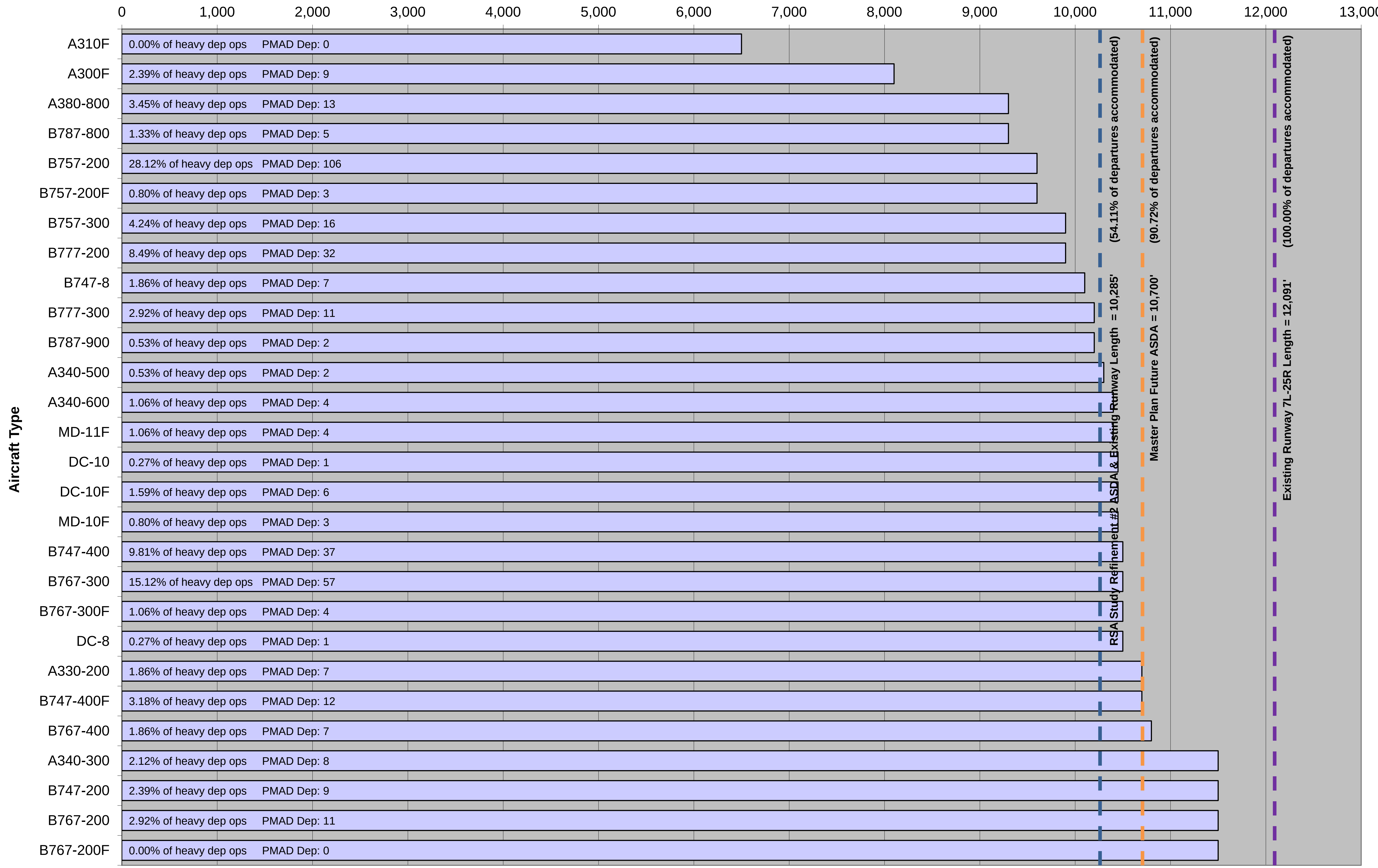
20 NORTH CLARK STREET, SUITE 1500, CHICAGO, IL 60602
TEL (312) 606-0611 • FAX (312) 606-0706

Runway 6R-24L Required Takeoff Runway Length for Heavy Aircraft at MTOW (feet) and ISA



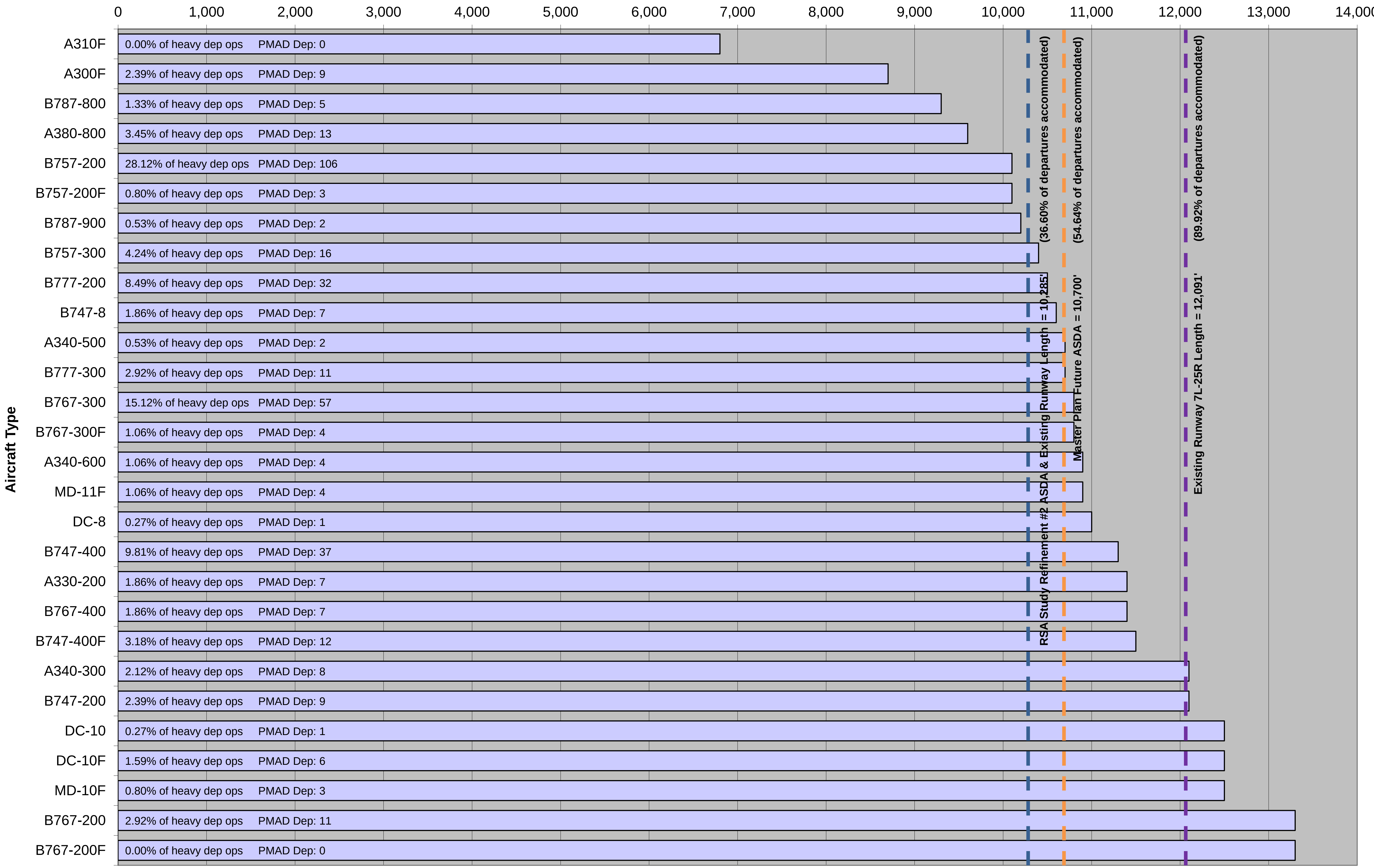
Note: A heavy aircraft is definied by the FAA of having a MTOW greater than 255,000lbs

Source: Aircraft Manufacturers' Manuals, 2020 LAX No Yellow Light Project (NYLP) Scenario Schedule, February 2010; Ricondo & Associates, Inc., April 2010.

Prepared by: Ricondo & Associates, Inc., May 2010.

June 15, 2010

Runway 6R-24L Required Takeoff Runway Length for Heavy Aircraft at MTOW (feet) and ISA + 15°C



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Source: Aircraft Manufacturers' Manuals, 2020 LAX No Yellow Light Project (NYLP) Scenario Schedule, February 2010; Ricondo & Associates, Inc., April 2010.
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Aircraft Name	Aircraft ID	Departure Ops	Arrival Ops	Total Airport Ops	% of Total Ops (incl. GA)	MTOW	Takeoff Distance	Temp	Engines
Airbus A310 Freighter	A310F	0	1	1	0.04%	313,056	6,500	ISA	Model 200 GE-CF6-80A3
Airbus A300-600 Freighter	A300F	9	6	15	0.66%	375,890	8,100	ISA	GE-CF6-80C2
Airbus A380-800	A380-800	13	14	27	1.18%	1,234,588	9,300	ISA	GP 7270
Boeing 787-800	B787-800	5	6	11	0.48%	484,000	9,300	ISA + 15°C	---
Boeing 757-200	B757-200	106	109	215	9.41%	255,500	9,600	ISA	PW2037
Boeing 757-200 Freighter	B757-200F	3	3	6	0.26%	255,500	9,600	ISA	PW2037
Boeing 757-300	B757-300	16	18	34	1.49%	270,000	9,900	ISA	PW2040
Boeing 777-200	B777-200	32	34	66	2.89%	766,000	9,900	ISA	GE90-110B1
Boeing 747-8	B747-8	7	7	14	0.61%	975,000	10,100	ISA	GEnx-2B67
Boeing 777-300	B777-300	11	10	21	0.92%	775,000	10,200	ISA	GE90-115B
Boeing 787-900	B787-900	2	2	4	0.18%	540,000	10,200	ISA + 15°C	---
Airbus A340-500	A340-500	2	2	4	0.18%	811,301	10,300	ISA	RB211 Trent 553
Airbus A340-600	A340-600	4	4	8	0.35%	811,301	10,400	ISA	RB211 Trent 556
McDonnell Douglas MD-11 Freighter	MD-11F	4	1	5	0.22%	618,000	10,400	ISA	PW4460
McDonnell Douglas DC-10-30	DC-10	1	1	2	0.09%	555,000	10,450	ISA	CF6-50C
McDonnell Douglas DC-10-30 Freighter	DC-10F	6	6	12	0.53%	580,000	10,450	ISA	CF6-50C
McDonnell Douglas MD-10 Freighter	MD-10F	3	6	9	0.39%	580,000	10,450	ISA	CF6-50C
Boeing 747-400	B747-400	37	37	74	3.24%	875,000	10,500	ISA	CF6-80C2B1
Boeing 767-300	B767-300	57	61	118	5.16%	350,000	10,500	ISA	JT9D-7R4D/7R4E
Boeing 767-300 Freighter	B767-300F	4	0	4	0.18%	350,000	10,500	ISA	JT9D-7R4D/7R4E
McDonnell Douglas DC-8	DC-8	1	1	2	0.09%	355,000	10,500	ISA	JT3D-7
Airbus A330-200	A330-200	7	7	14	0.61%	513,675	10,700	ISA	CF6-80E1
Boeing 747-400 Freighter	B747-400F	12	8	20	0.88%	875,000	10,700	ISA	CF6-80C2B1
Boeing 767-400	B767-400	7	9	16	0.70%	450,000	10,800	ISA	PW4062
Airbus A340-300	A340-300	8	7	15	0.66%	606,270	11,500	ISA	CFM56-5C2
Boeing 747-200/200F/300	B747-200	9	9	18	0.79%	833,000	11,500	ISA	RB211-524B2
Boeing 767-200	B767-200	11	12	23	1.01%	380,000	11,500	ISA	CF6-80C2B2, PW4052
Boeing 767-200 Freighter	B767-200F	0	4	4	0.18%	395,000	11,500	ISA	CF6-80C2B2, PW4052

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(9) Itinerant Operation. Takeoff or landing operations of airplanes going from one airport to another airport that involves a trip of at least 20 miles. Local operations are excluded.

(10) Effective Runway Gradient. The difference between the highest and lowest elevations of the runway centerline divided by the runway length.

b. Procedure and Rationale for Determining Recommended Runway Lengths. This AC uses a five-step procedure to determine recommended runway lengths for a selected list of critical design airplanes. As previously stated, the information derived from this five-step procedure is for airport design and is not to be used for flight operations. Flight operations must be conducted per the applicable flight manual. The five steps and their rationale are as follows:

(1) Step #1. Identify the list of critical design airplanes that will make regular use of the proposed runway for an established planning period of at least five years. For Federally funded projects, the definition of the term "*substantial use*" quantifies the term "regular use" (see paragraph 102a(8).)

(2) Step #2. Identify the airplanes that will require the longest runway lengths at maximum certificated takeoff weight (MTOW). This will be used to determine the method for establishing the recommended runway length. Except for regional jets, when the MTOW of listed airplanes is 60,000 pounds (27,200 kg) or less, the recommended runway length is determined according to a *family grouping of airplanes* having similar performance characteristics and operating weights. Although a number of regional jets have an MTOW less than 60,000 pounds (27,200 kg), the exception acknowledges the long range capability of the regional jets and the necessity to offer regional jet operators the flexibility to interchange regional jet models according to passenger demand without suffering operating weight restrictions. When the MTOW of listed airplanes is over 60,000 pounds (27,200 kg), the recommended runway length is determined according to *individual airplanes*. The recommended runway length in the latter case is a function of the most critical individual airplane's takeoff and landing operating weights, which depend on wing flap settings, airport elevation and temperature, runway surface conditions (dry or wet), and effective runway gradient. The procedure assumes that there are no obstructions that would preclude the use of the full length of the runway.

(3) Step #3. Use table 1-1 and the airplanes identified in step #2 to determine the method that will be used for establishing the recommended runway length. Table 1-1 categorizes *potential design airplanes* according to their MTOWs. MTOW is used because of the significant role played by airplane operating weights in determining runway lengths. As seen from table 1-1, the first column separates the various airplanes into one of three weight categories. Small airplanes, defined as airplanes with MTOW of 12,500 pounds (5,670 kg) or less, are further subdivided according to approach speeds and passenger seating as explained in chapter 2. Regional jets are assigned to the same category as airplanes with a MTOW over 60,000 pounds (27,200 kg). The second column identifies the applicable airport design approach (by airplane family group or by individual airplanes) as noted previously in step #2. The third column directs the airport designer to the appropriate chapter for design guidelines and whether to use the referenced tables contained in the AC or to obtain airplane manufacturers' airport planning manuals (APM) for each individual airplane under evaluation. In the later case, APMs provide the takeoff and landing runway lengths that an airport designer will in turn apply to the associated guidelines set forth by this AC to obtain runway lengths. The airport designer should be aware that APMs go by a variety of names. For example, Airbus, the Boeing Company, and Bombardier respectively title their APMs as "Airplane Characteristics for Airport Planning," "Airplane Characteristics for Airport Planning," and "Airport Planning Manuals." For the purpose of this AC, the variously titled documents will be referred to as APM. Appendix 1 lists the websites of the various airplane manufacturers to provide individuals a starting point to retrieve an APM or a point of contact for further consultation.

(4) Step #4. Select the recommended runway length from among the various runway lengths generated by step #3 per the process identified in chapters 2, 3, or 4, as applicable.

(5) Step #5. Apply any necessary adjustment to the obtained runway length, when instructed by the applicable chapter of this AC, to the runway length generated by step #4 to obtain a final recommended runway length. For instance, an adjustment to the length may be necessary for runways with non-zero effective gradients. Chapter 5 provides the rationale for these length adjustments.

Table 1-1. Airplane Weight Categorization for Runway Length Requirements

<table>
<tr><th colspan="3">Airplane Weight Category
Maximum Certificated Takeoff Weight (MTOW)</th><th>Design Approach</th><th>Location of Design Guidelines</th></tr>
<tr><td rowspan="4">12,500 pounds (5,670 kg) or less</td><td colspan="2">Approach Speeds less than 30 knots</td><td>Family grouping of small airplanes</td><td>Chapter 2;
Paragraph 203</td></tr>
<tr><td colspan="2">Approach Speeds of at least 30 knots but less than 50 knots</td><td>Family grouping of small airplanes</td><td>Chapter 2;
Paragraph 204</td></tr>
<tr><td rowspan="2">Approach Speeds of 50 knots or more</td><td>With Less than 10 Passengers</td><td>Family grouping of small airplanes</td><td>Chapter 2;
Paragraph 205
Figure 2-1</td></tr>
<tr><td>With 10 or more Passengers</td><td>Family grouping of small airplanes</td><td>Chapter 2;
Paragraph 205
Figure 2-2</td></tr>
<tr><td colspan="3">Over 12,500 pounds (5,670 kg) but less than 60,000 pounds (27,200 kg)</td><td>Family grouping of large airplanes</td><td>Chapter 3;
Figures 3-1 or 3-2 [1]
and Tables 3-1 or 3-2</td></tr>
<tr><td colspan="3">60,000 pounds (27,200 kg) or more or Regional Jets [2]</td><td>Individual large airplane</td><td>Chapter 4; Airplane Manufacturer Websites (Appendix 1)</td></tr>
</table>

Note [1]: When the design airplane's APM shows a longer runway length than what is shown in figure 3-2, use the airplane manufacturer's APM. However, users of an APM are to adhere to the design guidelines found in Chapter 4.

Note [2]: All regional jets regardless of their MTOW are assigned to the 60,000 pounds (27,200 kg) or more weight category.

103. PRIMARY RUNWAYS. The majority of airports provide a single primary runway. Airport authorities, in certain cases, require two or more primary runways as a means of achieving specific airport operational objectives. The most common operational objectives are to (1) better manage the existing traffic volume that exceed the capacity capabilities of the existing primary runway, (2) accommodate forecasted growth that will exceed the current capacity capabilities of the existing primary runway, and (3) mitigate noise impacts associated with the existing primary runway. Additional primary runways for capacity justification are parallel to and equal in length to the existing primary runway, unless they are intended for smaller airplanes. Refer to AC 150/5060-5, *Airport Capacity and Delay*, for additional discussion on runway usage for capacity gains. Another common practice is to assign individual primary runways to different airplane classes, such as, separating general aviation from non-general aviation customers, as a means to increase the airport's efficiency. The design objective for the main primary runway is to provide a runway length for all airplanes that will regularly use it without causing operational weight restrictions. For Federally funded projects, the criterion for substantial use applies (see paragraph 102a(8).) The design objective for additional primary runways is shown in table 1-2. The table takes into account the separation of airplane classes into distinct airplane groups to achieve greater airport utilization. Procedurally, follow the guidelines found in subparagraph 102(b) for determining recommended runway lengths for primary runways, and, for additional primary runways, apply table 1-2.

104. CROSSWIND RUNWAYS. The design objective to orient primary runways to capture 95 percent of the crosswind component perpendicular to the runway centerline for any airplane forecast to use the airport is not always achievable. In cases where this cannot be done, a crosswind runway is recommended to achieve the design standard provided in AC 150/5300-13, *Airport Design*, for allowable crosswind components according to airplane design groups. Even when the 95-percentage crosswind coverage standard is achieved for the design airplane or airplane design group, cases arise where certain airplanes with lower crosswind capabilities are unable to utilize the primary runway. For airplanes with lesser crosswind capabilities, a crosswind runway may be built, provided there is regular usage. For Federally funded projects, the criterion for substantial use applies to the airplane used as the design airplane needing the crosswind runway (see paragraph 102a(8).) The design objective for the length of crosswind runways is shown in table 1-3. Procedurally, follow the guidelines found in subparagraph 102(b) for determining recommended runway lengths for crosswind runways, and, for additional crosswind runways, apply table 1-3.