### 777-200LR/-300ER Airplane Characteristics

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1.0 SCOPE AND INTRODUCTION

1.1 Scope

1.2 Introduction

1.3 A Brief Description of the 777 Family of Airplanes
1.0 SCOPE AND INTRODUCTION

1.1 Scope

This document provides, in a standardized format, airplane characteristics data for general airport planning. Since operational practices vary among airlines, specific data should be coordinated with the using airlines prior to facility design. Boeing Commercial Airplanes should be contacted for any additional information required.

Content of the document reflects the results of a coordinated effort by representatives from the following organizations:

● Aerospace Industries Association

● Airports Council International - North America

● Air Transport Association of America

● International Air Transport Association

The airport planner may also want to consider the information presented by the International Industry Working Group, in the "Commercial Aircraft Design Characteristics – Trends and Growth Projections," available from the US AIA, 1250 Eye St., Washington DC 20005, or at www.boeing.com/airports for long-range planning needs. This document is updated periodically and represents the coordinated efforts of the following organizations regarding future aircraft growth trends:

● International Coordinating Council of Aerospace Industries Associations

● Airports Council International - North American and World Organizations

● Air Transport Association of America

● International Air Transport Association
1.2 Introduction

This document conforms to NAS 3601. It provides characteristics of the Boeing Model 777-200LR and 777-300ER airplanes for airport planners and operators, airlines, architectural and engineering consultant organizations, and other interested industry agencies. Airplane changes and available options may alter model characteristics; the data presented herein reflect typical airplanes in each model category.

For additional information contact:

Boeing Commercial Airplanes
P.O. Box 3707
Seattle, Washington 98124-2207
U.S.A.

Attention: Manager, Airport Technology
Mail Code 67-KR
1.3 A Brief Description of the 777 Family of Airplanes

777-200/-200ER Airplane

The 777-200/-200ER is a twin-engine airplane designed for medium to long range flights. It is powered by advanced high bypass ratio engines. Characteristics unique to the 777 include:

- Two-crew cockpit with digital avionics
- Circular cross-section
- Lightweight aluminum and composite alloys
- Structural carbon brakes
- Six-wheel main landing gears
- Main gear aft axle steering
- High bypass ratio engines
- Fly-by-wire system

777-200LR Airplane

The 777-200LR is a derivative of the 777-200 airplane and is equipped with raked wingtips to provide additional cruise altitude and range. It is powered by high bypass ratio engines that develop higher thrusts than those used in the 777-200/-200ER airplanes. The 777-200LR has an identical fuselage as the 777-200/-200ER but has a wider wingspan due to raked wingtips.

777-300 Airplane

The 777-300 is a second-generation derivative of the 777-200. Two body sections are added to the fuselage to provide additional passenger seating and cargo capacity.

777-300ER Airplane

The 777-300ER is a derivative of the 777-300 airplane and is equipped with raked wingtips for additional cruise altitude and range. It is powered by high bypass ratio engines that develop higher thrusts than those used in the 777-200/-200ER/-300 airplanes. The 777-300ER has an identical fuselage as the 777-300, but has a wider wingspan due to the raked wingtips.
Main Gear Aft Axle Steering

The main gear axle steering is automatically engaged based on the nose gear steering angle. This allows for less tire scrubbing and easier maneuvering into gates with limited parking clearances.

High Bypass Ratio Engines

The 777 airplane is powered by two high bypass ratio engines. The following table shows the available engine options.

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Document Applicability

This document contains data pertinent to the 777-200LR and 777-300ER.

Data for the 777-200, 777-200ER, and 777-300 airplanes are contained in document D6-58329.
2.0 AIRPLANE DESCRIPTION

2.1 General Characteristics

2.2 General Dimensions

2.3 Ground Clearances

2.4 Interior Arrangements

2.5 Cabin Cross Sections

2.6 Lower Cargo Compartments

2.7 Door Clearances
2.0 AIRPLANE DESCRIPTION

2.1 General Characteristics

Maximum Design Taxi Weight (MTW). Maximum weight for ground maneuver as limited by aircraft strength and airworthiness requirements. (It includes weight of taxi and run-up fuel.)

Maximum Design Takeoff Weight (MTOW). Maximum weight for takeoff as limited by aircraft strength and airworthiness requirements. (This is the maximum weight at start of the takeoff run.)

Maximum Design Landing Weight (MLW). Maximum weight for landing as limited by aircraft strength and airworthiness requirements.

Maximum Design Zero Fuel Weight (MZFW). Maximum weight allowed before usable fuel and other specified usable agents must be loaded in defined sections of the aircraft as limited by strength and airworthiness requirements.

Operating Empty Weight (OEW). Weight of structure, powerplant, furnishing systems, unusable fuel and other unusable propulsion agents, and other items of equipment that are considered an integral part of a particular airplane configuration. Also included are certain standard items, personnel, equipment, and supplies necessary for full operations, excluding usable fuel and payload.

Maximum Structural Payload. Maximum design zero fuel weight minus operational empty weight.

Maximum Seating Capacity. The maximum number of passengers specifically certificated or anticipated for certification.

Maximum Cargo Volume. The maximum space available for cargo.

Usable Fuel. Fuel available for aircraft propulsion.
### PRELIMINARY INFORMATION

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>UNITS</th>
<th>777-200LR</th>
</tr>
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<td>320,863</td>
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<td></td>
<td>KILOGRAMS</td>
<td>145,541</td>
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NOTES: (1) APPROXIMATE SPEC OPERATING WEIGHT FOR A TYPICAL THREE-CLASS CONFIGURATION. CONSULT WITH AIRLINE FOR SPECIFIC WEIGHTS AND CONFIGURATIONS.

(2) FWD CARGO = 18 LD3’S AT 158 CU FT EACH.
AFT CARGO = 14 LD3’S AT 158 CU FT EACH.
BULK CARGO = 600 CU FT

(3) INCLUDES OPTIONAL 3 X 1,850-US GAL BODY TANKS IN AFT CARGO COMPARTMENT.
AFT CARGO COMPARTMENT CAPACITY REDUCED TO 8 LD3’S AT 158 CU FT EACH.

### 2.1.1 GENERAL CHARACTERISTICS

*MODEL 777-200LR*
<table>
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<th>777-300ER</th>
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<td></td>
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NOTES: (1) APPROXIMATE SPEC OPERATING WEIGHT FOR A TYPICAL THREE-CLASS CONFIGURATION. CONSULT WITH AIRLINE FOR SPECIFIC WEIGHTS AND CONFIGURATIONS.

(2) FWD CARGO = 24 LD3'S AT 158 CU FT EACH.
AFT CARGO = 20 LD3'S AT 158 CU FT EACH.
BULK CARGO = 600 CU FT

2.1.2 GENERAL CHARACTERISTICS
MODEL 777-300ER

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10 JUNE 2004
2.2.1 GENERAL DIMENSIONS

MODEL 777-200LR
2.2.2 GENERAL DIMENSIONS

MODEL 777-300ER

D6-58329-2

12 JUNE 2004
NOTES: VERTICAL CLEARANCES SHOWN OCCUR DURING MAXIMUM VARIATIONS OF AIRPLANE ATTITUDE. COMBINATIONS OF AIRPLANE LOADING AND UNLOADING ACTIVITIES THAT PRODUCE THE GREATEST POSSIBLE VARIATIONS IN ATTITUDE WERE USED TO ESTABLISH THE VARIATIONS SHOWN.

DURING ROUTINE SERVICING, THE AIRPLANE REMAINS RELATIVELY STABLE, PITCH AND ELEVATION CHANGES OCCURRING SLOWLY.

* NOMINAL DIMENSIONS ROUNDED TO NEAREST INCH AND NEAREST CENTIMETER
** 777-200ER DATA SHOWN. 777-200LR DATA TO BE PROVIDED AT A LATER DATE

### 2.3.1 GROUND CLEARANCES

MODEL 777-200LR.
### MINIMUM* vs MAXIMUM*

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<td>16 - 9</td>
<td>5.11</td>
<td>17 - 5</td>
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<td>G(LARGE DOOR)</td>
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<td>3.19</td>
<td>11 - 9</td>
<td>3.58</td>
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<tr>
<td>G(SMALL DOOR)</td>
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<td>3.19</td>
<td>11 - 9</td>
<td>3.58</td>
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<tr>
<td>H</td>
<td>10 - 11</td>
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<td>12 - 4</td>
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<td>59 - 10</td>
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<td>M</td>
<td>25 – 7</td>
<td>7.79</td>
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**NOTES:** VERTICAL CLEARANCES SHOWN OCCUR DURING MAXIMUM VARIATIONS OF AIRPLANE ATTITUDE. COMBINATIONS OF AIRPLANE LOADING AND UNLOADING ACTIVITIES THAT PRODUCE THE GREATEST POSSIBLE VARIATIONS IN ATTITUDE WERE USED TO ESTABLISH THE VARIATIONS SHOWN.

DURING ROUTINE SERVICING, THE AIRPLANE REMAINS RELATIVELY STABLE, PITCH AND ELEVATION CHANGES OCCURRING SLOWLY.

* NOMINAL DIMENSIONS ROUNDED TO NEAREST INCH AND NEAREST CENTIMETER

### 2.3.2 GROUND CLEARANCES

*MODEL 777-300ER.*

D6-58329-2

JUNE 2004
2.4.1 INTERIOR ARRANGEMENTS – TYPICAL TWO-CLASS CONFIGURATIONS

MODEL 777-200LR

OVERHEAD PILOT CREW REST
ACCESS TO OVERHEAD PILOT CREW REST

279 PASSENGERS
42 FIRST CLASS AT 60-IN PITCH
237 ECONOMY CLASS AT 34-IN PITCH

ATTENDANT'S SEAT
CLOSET
GALLEY
LAVATORY
WARDROBE
PURSER STATION

OVERHEAD PILOT CREW REST
ACCESS TO OVERHEAD PILOT CREW REST

268 PASSENGERS
40 PREMIUM BUSINESS CLASS AT 82-IN PITCH
228 ECONOMY CLASS AT 32-IN PITCH
2.4.2 INTERIOR ARRANGEMENTS – TYPICAL THREE-CLASS CONFIGURATIONS

MODEL 777-200LR

296 PASSENGERS
6 FIRST CLASS AT 87-IN PITCH
42 BUSINESS CLASS AT 50-IN PITCH
248 ECONOMY CLASS AT 32-IN PITCH

301 PASSENGERS
16 FIRST CLASS AT 61-IN PITCH
58 BUSINESS CLASS AT 39-IN PITCH
227 ECONOMY CLASS AT 32-IN PITCH
2.4.3 INTERIOR ARRANGEMENTS – TYPICAL TWO-CLASS CONFIGURATIONS

MODEL 777-300ER

D6-S8329-2

JUNE 2004  17

OVERHEAD PILOT CREW REST

ACCESS TO OVERHEAD PILOT CREW REST

A ATTENDANT’S SEAT
C CLOSET
G GALLEY
L LAVATORY
W WARDROBE
S/W STOWAGE/WARDROBE

339 PASSENGERS
56 FIRST CLASS SEATS AT 60-IN PITCH
283 ECONOMY SEATS AT 32-IN PITCH

OVERHEAD PILOT CREW REST

ACCESS TO OVERHEAD PILOT CREW REST

378 PASSENGERS
28 FIRST CLASS SEATS AT 62-IN PITCH
350 ECONOMY SEATS AT 31-IN PITCH
2.4.4 INTERIOR ARRANGEMENTS – TYPICAL THREE-CLASS CONFIGURATIONS

**MODEL 777-300ER**

**D6-56329-2**

**18 JUNE 2004**

**368 PASSENGERS**
- 22 FIRST CLASS SEATS AT 61-IN PITCH
- 70 BUSINESS CLASS SEATS AT 39-IN PITCH
- 276 ECONOMY SEATS AT 32-IN PITCH

**370 PASSENGERS**
- 12 FIRST CLASS SEATS AT 87-IN PITCH
- 42 BUSINESS CLASS SEATS AT 50-IN PITCH
- 316 ECONOMY CLASS SEATS AT 32-IN PITCH

A ATTENDANT’S SEAT
C CLOSET
G CALLEY
L LAVATORY
W WARDROBE
S/W STOWAGE/WARDROBE

ACCESS TO OVERHEAD PILOT CREW REST

OPTIONAL LOWER HOLD ENHANCED LAVATORIES AND CREW CLOSET

ACCESS TO OVERHEAD PILOT CREW REST

ACCESS TO LOWER HOLD LAVATORIES

OVERHEAD PILOT CREW REST

OPTIONAL OVERHEAD ATTENDANT CREW REST

ACCESS TO OVERHEAD ATTENDANT CREW REST
2.5.1 CABIN CROSS-SECTIONS - FIRST AND BUSINESS CLASS SEATS

MODEL 777-200LR, -300ER
2.5.2 CABIN CROSS-SECTIONS - BUSINESS AND ECONOMY CLASS SEATS

MODEL 777-200LR,-300ER

D6-58329-2
2.6.1 LOWER CARGO COMPARTMENTS - CONTAINERS AND BULK CARGO
MODEL 777-200LR, -300ER
2.6.2 LOWER CARGO COMPARTMENTS - OPTIONAL AFT LARGE CARGO DOOR

MODEL 777-200LR

D6-58329-2
2.6.3 LOWER CARGO COMPARTMENTS - OPTIONAL AFT LARGE CARGO DOOR

MODEL 777-300ER

D6-58329-2

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2.7.1 DOOR CLEARANCES - MAIN ENTRY DOOR LOCATIONS
MODEL 777-200LR, -300ER

NOTES:

1. MODEL 777-200LR - EIGHT PASSENGER DOORS, 4 ON EACH SIDE
   DOOR OPENING SIZE = 42 BY 74 IN (1.07 BY 1.88 M)
   DOOR SIZE = 42 BY 74 IN (1.07 BY 1.88 M)

2. MODEL 777-300ER - TEN PASSENGER DOORS, 5 ON EACH SIDE
   DOOR OPENING AND SIZE SAME AS IN 777-200LR

3. DOORS ARE TRANSLATING TYPE A DOORS.

4. SEE SECTION 2.3 FOR DOOR SILL HEIGHTS
NOTES:

(1) DOOR MOVES UPWARD 2 IN. AND INWARD 0.4 IN. TO CLEAR STOPS BEFORE OPENING OUTWARD

(2) DOOR CAPABLE OF MOVING AN ADDITIONAL 3 IN VERTICALLY (OVERLIFT) TO PRECLUDE DAMAGE FROM CONTACT WITH LOADING BRIDGE

2.7.2 DOOR CLEARANCES - MAIN ENTRY DOOR NO 1
MODEL 777-200LR, -300ER
2.7.3 DOOR CLEARANCES - MAIN ENTRY DOOR NO 2, NO 3, AND NO 4

MODEL 777-200LR, -300ER

NOTES:
(1) DOOR MOVES UPWARD 2 IN. AND INWARD 0.4 IN TO CLEAR STOPS BEFORE OPENING OUTWARD
(2) DOOR CAPABLE OF MOVING AN ADDITIONAL 3 IN VERTICALLY (OVERLIFT) TO PRECLUDE DAMAGE FROM CONTACT WITH LOADING BRIDGE
2.7.4 DOOR CLEARANCES - MAIN ENTRY DOOR NO 4 OR NO 5

MODEL 777-200LR, -300ER

NOTES:
(1) DOOR MOVES UPWARD 2 IN. AND INWARD 0.4 IN. TO CLEAR STOPS BEFORE OPENING OUTWARD
(2) DOOR CAPABLE OF MOVING AN ADDITIONAL 3 IN VERTICALLY (OVERLIFT) TO PRECLUDE
    DAMAGE FROM CONTACT WITH LOADING BRIDGE
(3) DOOR NO 4 ON 777-200LR, DOOR NO 5 ON 777-300ER

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2.7.5 DOOR CLEARANCES - CARGO DOOR LOCATIONS

MODEL 777-200LR

(DIMENSIONS ARE TO CENTER OF DOOR)

151 FT 11.5 IN (46.32 M)

136 FT 9.5 IN (41.69 M)

135 FT 4 IN (41.25 M)

38 FT 8.5 IN (11.80 M)

AFT CARGO DOOR CLEAR OPENING
70 BY 67 IN (1.78 BY 1.70 M)

OPTIONAL AFT CARGO DOOR CLEAR OPENING
106 BY 67 IN (2.69 BY 1.70 M)

BULK CARGO DOOR CLEAR OPENING
36 BY 45 IN (0.91 BY 1.14 M)

MODEL 777-300ER

(DIMENSIONS ARE TO CENTER OF DOOR)

185 FT 2.5 IN (56.45 M)

170 FT 0.5 IN (51.83 M)

168 FT 7 IN (51.38 M)

38 FT 8.5 IN (11.80 M)

(NOTE: DOOR DIMENSIONS SAME AS FOR 777-200LR)

PRELIMINARY FOR 777-200LR

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28 JUNE 2004
2.7.6 DOOR CLEARANCES - FORWARD CARGO DOOR

MODEL 777-200LR, -300ER

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2.7.7 DOOR CLEARANCES – SMALL AFT CARGO DOOR
MODEL 777-200LR, -300ER
2.7.8 DOOR CLEARANCES - BULK CARGO DOOR
MODEL 777-200LR, -300ER
3.0 AIRPLANE PERFORMANCE

3.1 General Information

3.2 Payload/Range for 0.84 Mach Cruise

3.3 F.A.R. Takeoff Runway Length Requirements

3.4 F.A.R. Landing Runway Length Requirements
3.0 AIRPLANE PERFORMANCE

3.1 General Information

The graphs in Section 3.2 provide information on operational empty weight (OEW) and payload, trip range, brake release gross weight, and fuel limits for airplane models with the different engine options. To use these graphs, if the trip range and zero fuel weight (OEW + payload) are known, the approximate brake release weight can be found.

The graphs in Section 3.3 provide information on F.A.R. takeoff runway length requirements with the different engines at different pressure altitudes. Maximum takeoff weights shown on the graphs are the heaviest for the particular airplane models with the corresponding engines. Standard day temperatures for pressure altitudes shown on the F.A.R. takeoff graphs are given below:

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<td>4,000</td>
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<td>6,000</td>
<td>1,829</td>
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The graphs in Section 3.4 provide information on landing runway length requirements for different airplane weights and airport altitudes. The maximum landing weights shown are the heaviest for the particular airplane model.
3.2.1 PAYLOAD/RANGE FOR 0.84 MACH CRUISE

MODEL 777-200LR
3.2.2 PAYLOAD/RANGE FOR 0.84 MACH CRUISE

NOTE:
- STANDARD DAY, ZERO WIND
- 0.84 MACH STEP CRUISE
- TYPICAL MISSION RULES
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEED
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN

MODEL 777-300ER

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3.3.1 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

MODEL 777-200LR (GE90-110B1 ENGINES)

NOTES:
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING
  PROCEDURE PRIOR TO FACILITY DESIGN
* AIR CONDITIONING OFF
* ZERO RUNWAY GRADIENT
* ZERO WIND

![Graph showing F.A.R. takeoff runway length requirements for a standard day. The graph includes axes for brake-release gross weight and takeoff runway length. Notations are made for different tire speed limits and takeoff weights.](image-url)
3.3.2 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS
STANDARD DAY +33°F (STD + 20°C)
MODEL 777-200LR (GE90-110B1 ENGINES)

NOTES:
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN
* AIR CONDITIONING OFF
* ZERO RUNWAY GRADIENT
* ZERO WIND

<table>
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<tr>
<th>PRESSURE ALTITUDE</th>
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<tr>
<td>8,800 (2,683)</td>
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<td>6,000 (1,829)</td>
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</tr>
<tr>
<td>4,000 (1,219)</td>
<td>235 MPH TIRE SPEED LIMIT</td>
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<td>2,000 (610)</td>
<td>235 MPH TIRE SPEED LIMIT</td>
</tr>
</tbody>
</table>

MAXIMUM TAKEOFF WEIGHT 766,800 LB (347,814 KG)
NOTES:
• CONSULT USING AIRLINE FOR SPECIFIC OPERATING
  PROCEDURE PRIOR TO FACILITY DESIGN
• AIR CONDITIONING OFF
• ZERO RUNWAY GRADIENT
• ZERO WIND
3.3.4 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY +27°F (STD + 15°C)

MODEL 777-200LR (GE90-110B ENGINES)

NOTES:
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING
  PROCEDURE PRIOR TO FACILITY DESIGN
* AIR CONDITIONING OFF
* ZERO RUNWAY GRADIENT
* ZERO WIND

MAXIMUM TAKEOFF WEIGHT
766,800 LB (347,814 KG)

PRELIMINARY INFORMATION
3.3.5 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS - STANDARD DAY

MODEL 777-200LR (GE90-115B ENGINES)

NOTES:
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN
* AIR CONDITIONING OFF
* ZERO RUNWAY GRADIENT
* ZERO WIND

MAXIMUM TAKEOFF WEIGHT
766,800 LB (347,814 KG)

PRESSURE ALTITUDE
8,800 (2,683)
6,000 (1,829)
4,000 (1,219)
3,000 (910)
SEA LEVEL

STANDARD DAY
235 MPH TIRE SPEED LIMIT

1,000 POUNDS
(1,000 KILOGRAMS)

BRAKE-RELEASE GROSS WEIGHT
1,000 FEET (1,000 METERS)

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PRELIMINARY INFORMATION
3.3.6 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS

STANDARD DAY +33°F (STD + 20°C)

MODEL 777-200LR (GE90-115B1 ENGINES)
NOTES:
* CONSULT USING AIRLINE FOR SPECIFIC OPERATING
  PROCEDURE PRIOR TO FACILITY DESIGN
* AIR CONDITIONING OFF
* ZERO RUNWAY GRADIENT
* ZERO WIND

MAXIMUM TAKEOFF WEIGHT
775,000 LB (351,533 KG)

REFERENCES:
44 JUNE 2004
3.3.8 F.A.R. TAKEOFF RUNWAY LENGTH REQUIREMENTS
STANDARD DAY +27°F (STD + 15°C)
MODEL 777-300ER (GE90-115B1 ENGINES)

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3.4.1 F.A.R. LANDING RUNWAY LENGTH REQUIREMENTS – FLAPS 25

NOTES:
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN
- ZERO RUNWAY GRADIENT
- ZERO WIND

MODEL 777-200LR

FLAPS 25

PRESSURE ALTITUDE
- 10,000 FT (3,049 M)
- 8,000 FT (2,439 M)
- 6,000 FT (1,829 M)
- 4,000 FT (1,219 M)
- 2,000 FT (610 M)
- SEA LEVEL

DRI RUNWAY
- 6,000 FT
- 4,000 FT
- 2,000 FT
- SEA LEVEL

WET RUNWAY
- MAX LANDING WEIGHT
  - 487,000 LB (220,900 KG)
  - 492,000 LB (223,168 KG)

LONGEST RUNWAY LENGTH (1,000 METERS)

1,000 POUNDS

OPERATIONAL LANDING WEIGHT (1,000 KILOGRAMS)
3.4.2 F.A.R. LANDING RUNWAY LENGTH REQUIREMENTS – FLAPS 30

MODEL 777-200LR

PRELIMINARY INFORMATION
3.4.3 FAR LANDING RUNWAY LENGTH REQUIREMENTS – FLAPS 25

NOTES:
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE PRIOR TO FACILITY DESIGN
- ZERO RUNWAY GRADIENT
- ZERO WIND

MODEL 777-300ER

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4.0 GROUND MANEUVERING

4.1 General Information
4.2 Turning Radii
4.3 Clearance Radii
4.4 Visibility From Cockpit in Static Position
4.5 Runway and Taxiway Turn Paths
4.6 Runway Holding Bay
4.0 GROUND MANEUVERING

4.1 General Information

The 777 main landing gear consists of two main struts, each strut with six wheels. The steering system incorporates aft axle steering of the main landing gear in addition to the nose gear steering. The aft axle steering system is hydraulically actuated and programmed to provide steering ratios proportionate to the nose gear steering angles. During takeoff and landing, the aft axle steering system is centered, mechanically locked, and depressurized.

The turning radii and turning curves shown in this section are derived from airplane geometry. Other factors that could influence the geometry of the turn include:

1. Engine power settings
2. Center of gravity location
3. Airplane weight
4. Pavement surface conditions
5. Amount of differential braking
6. Ground speed
NOTES:
DATA SHOWN FOR AIRPLANE WITH AFT AXLE STEERING
ACTUAL OPERATING TURNING RADIi MAY BE GREATER THAN SHOWN
CONSULT WITH AIRLINE FOR SPECIFIC OPERATING PROCEDURE
DIMENSIONS ROUNDED TO NEAREST 0.1 FOOT AND 0.1 METER

<table>
<thead>
<tr>
<th>STEERING ANGLE (DEG)</th>
<th>R1 INNER GEAR</th>
<th>R2 OUTER GEAR</th>
<th>R3 NOSE GEAR</th>
<th>R4 WING TIP</th>
<th>R5 NOSE</th>
<th>R6 TAIL</th>
</tr>
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<tbody>
<tr>
<td>30</td>
<td>122.4</td>
<td>164.8</td>
<td>168.8</td>
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<td>177.4</td>
<td>207.4</td>
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<td>35</td>
<td>97.2</td>
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<td>147.7</td>
<td>228.1</td>
<td>157.7</td>
<td>186.1</td>
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<td>40</td>
<td>77.6</td>
<td>120.0</td>
<td>132.3</td>
<td>208.8</td>
<td>143.6</td>
<td>170.3</td>
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<tr>
<td>45</td>
<td>61.7</td>
<td>104.1</td>
<td>120.7</td>
<td>193.3</td>
<td>133.2</td>
<td>158.0</td>
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<tr>
<td>50</td>
<td>48.4</td>
<td>90.8</td>
<td>111.8</td>
<td>180.2</td>
<td>125.3</td>
<td>148.3</td>
</tr>
<tr>
<td>55</td>
<td>36.8</td>
<td>79.2</td>
<td>104.8</td>
<td>169.0</td>
<td>119.3</td>
<td>140.4</td>
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<tr>
<td>60</td>
<td>26.7</td>
<td>69.1</td>
<td>99.5</td>
<td>159.1</td>
<td>114.7</td>
<td>133.9</td>
</tr>
<tr>
<td>65</td>
<td>17.5</td>
<td>59.9</td>
<td>95.3</td>
<td>150.2</td>
<td>111.1</td>
<td>128.3</td>
</tr>
<tr>
<td>70 (MAX)</td>
<td>9.0</td>
<td>51.4</td>
<td>92.1</td>
<td>142.0</td>
<td>108.5</td>
<td>123.7</td>
</tr>
</tbody>
</table>

4.2.1 TURNING RADIi - NO SLIP ANGLE
MODEL 777-200LR
NOTES: DATA SHOWN FOR AIRPLANE WITH AFT AXLE STEERING
ACTUAL OPERATING TURNING RADII MAY BE GREATER THAN SHOWN
CONSULT WITH AIRLINE FOR SPECIFIC OPERATING PROCEDURE
DIMENSIONS ROUNDED TO NEAREST 0.1 FOOT AND 0.1 METER

<table>
<thead>
<tr>
<th>STEERING ANGLE (DEG)</th>
<th>R1 INNER GEAR</th>
<th>R2 OUTER GEAR</th>
<th>R3 NOSE GEAR</th>
<th>R4 WING TIP</th>
<th>R5 NOSE</th>
<th>R6 TAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>152.7 FT 46.5 M</td>
<td>195.1 FT 59.5 M</td>
<td>203.8 FT 62.1 M</td>
<td>283.3 FT 86.4 M</td>
<td>212.3 FT 64.7 M</td>
<td>241.5 FT 73.6 M</td>
</tr>
<tr>
<td>35</td>
<td>122.2 FT 37.2 M</td>
<td>164.6 FT 50.2 M</td>
<td>178.2 FT 54.3 M</td>
<td>252.8 FT 77.1 M</td>
<td>188.1 FT 57.3 M</td>
<td>215.6 FT 65.7 M</td>
</tr>
<tr>
<td>40</td>
<td>98.5 FT 30.0 M</td>
<td>140.9 FT 42.9 M</td>
<td>159.5 FT 48.6 M</td>
<td>229.4 FT 69.9 M</td>
<td>170.7 FT 52.0 M</td>
<td>196.4 FT 59.9 M</td>
</tr>
<tr>
<td>45</td>
<td>79.2 FT 24.1 M</td>
<td>121.6 FT 37.1 M</td>
<td>145.4 FT 44.3 M</td>
<td>210.4 FT 64.1 M</td>
<td>157.8 FT 48.1 M</td>
<td>181.5 FT 55.3 M</td>
</tr>
<tr>
<td>50</td>
<td>63.0 FT 19.2 M</td>
<td>106.5 FT 32.4 M</td>
<td>134.6 FT 41.0 M</td>
<td>194.6 FT 59.3 M</td>
<td>148.0 FT 45.1 M</td>
<td>169.4 FT 51.6 M</td>
</tr>
<tr>
<td>55</td>
<td>49.1 FT 15.0 M</td>
<td>91.5 FT 27.9 M</td>
<td>126.2 FT 38.5 M</td>
<td>180.9 FT 55.1 M</td>
<td>140.5 FT 42.8 M</td>
<td>160.3 FT 48.9 M</td>
</tr>
<tr>
<td>60</td>
<td>36.8 FT 11.2 M</td>
<td>79.2 FT 24.1 M</td>
<td>119.7 FT 36.5 M</td>
<td>168.9 FT 51.5 M</td>
<td>134.8 FT 41.1 M</td>
<td>152.5 FT 46.5 M</td>
</tr>
<tr>
<td>65</td>
<td>25.6 FT 7.8 M</td>
<td>68.0 FT 20.7 M</td>
<td>114.6 FT 34.9 M</td>
<td>158.1 FT 48.2 M</td>
<td>130.4 FT 39.7 M</td>
<td>145.9 FT 44.5 M</td>
</tr>
<tr>
<td>70 (MAX)</td>
<td>15.3 FT 4.7 M</td>
<td>57.7 FT 17.6 M</td>
<td>110.7 FT 33.7 M</td>
<td>148.2 FT 45.2 M</td>
<td>124.6 FT 38.0 M</td>
<td>140.4 FT 42.8 M</td>
</tr>
</tbody>
</table>

4.2.2 TURNING RADI - NO SLIP ANGLE
MODEL 777-300ER
**PRELIMINARY FOR 777-200LR**

**NOTES:**
1. 6° TIRE SLIP ANGLE APPROXIMATE FOR 54° TURN ANGLE.
2. CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE.
3. DIMENSIONS ARE ROUNDED TO THE NEAREST 0.1 FOOT AND 0.1 METER.

**4.3 CLEARANCE RADI**

**MODEL 777-200LR, -300ER**

<table>
<thead>
<tr>
<th>AIRPLANE MODEL</th>
<th>EFFECTIVE STEERING ANGLE (DEG)</th>
<th>X</th>
<th>Y</th>
<th>A</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
</tr>
</thead>
<tbody>
<tr>
<td>777-200LR</td>
<td>64</td>
<td>82.9</td>
<td>25.3</td>
<td>40.4</td>
<td>12.3</td>
<td>155.8</td>
<td>47.5</td>
<td>94.3</td>
</tr>
<tr>
<td>777-300ER</td>
<td>64</td>
<td>100.4</td>
<td>30.6</td>
<td>49.0</td>
<td>14.9</td>
<td>183.9</td>
<td>56.1</td>
<td>113.7</td>
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</tbody>
</table>
4.4 VISIBILITY FROM COCKPIT IN STATIC POSITION

NOTES:

MODEL 777-200LR, -300ER

NOTES:
4.5.1 RUNWAY AND TAXIWAY TURNPATHS - RUNWAY-TO-TAXIWAY, MORE THAN 90 DEGREES
MODEL 777-200LR, -300ER

- BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THEY ARE EXPECTED TO USE AT THE AIRPORT
- 777-300ER DATA SHOWN. 777-200LR DATA WOULD BE LESS STRINGENT.
NOTES:

• BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THEY ARE EXPECTED TO USE AT THE AIRPORT

• 777-300ER DATA SHOWN. CALCULATED EDGE MARGIN FOR THE 777-200LR WOULD BE APPROXIMATELY 20 FT (6.1 M) INSTEAD OF 14 FT (4.3 M) AS SHOWN.
NOTES:

- BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THEY ARE EXPECTED TO USE AT THE AIRPORT
- 777-300ER DATA SHOWN. CALCULATED EDGE MARGIN FOR THE 777-200LR WOULD BE APPROXIMATELY 22 FT (6.7 M) INSTEAD OF 14 FT (4.3 M) AS SHOWN.

4.5.3 RUNWAY AND TAXIWAY TURNPATHS - TAXIWAY-TO-TAXIWAY, 90 DEGREES, NOSE GEAR TRACKS CENTERLINE
MODEL 777-200LR, -300ER
NOTES:

- BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THEY ARE EXPECTED TO USE AT THE AIRPORT
- 777-300ER DATA SHOWN. CALCULATED EDGE MARGIN FOR THE 777-200LR WOULD BE APPROXIMATELY 17 FT (5.2 M) INSTEAD OF 4 FT (1.2 M) AS SHOWN.
NOTES:
- BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THEY ARE EXPECTED TO USE AT THE AIRPORT
- 777-300ER DATA SHOWN. 777-200LR DATA WOULD BE LESS STRINGENT

4.5.5 RUNWAY AND TAXIWAY TURNPATHS - TAXIWAY-TO-TAXIWAY, 90 DEGREES, JUDGMENTAL OVERSTEERING
MODEL 777-200LR, -300ER

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4.6 RUNWAY HOLDING BAY
MODEL 777-200LR, -300ER

NOTE
BEFORE DETERMINING THE SIZE OF THE INTERSECTION FILLET, CHECK WITH THE AIRLINES REGARDING THE OPERATING PROCEDURES THAT THEY USE AND THE AIRCRAFT TYPES THAT ARE EXPECTED TO SERVE THE AIRPORT.
5.0 TERMINAL SERVICING

5.1 Airplane Servicing Arrangement - Typical Turnaround
5.2 Terminal Operations - Turnaround Station
5.3 Terminal Operations - En Route Station
5.4 Ground Servicing Connections
5.5 Engine Starting Pneumatic Requirements
5.6 Ground Pneumatic Power Requirements
5.7 Conditioned Air Requirements
5.8 Ground Towing Requirements
5.0 TERMINAL SERVICING

During turnaround at the terminal, certain services must be performed on the aircraft, usually within a given time, to meet flight schedules. This section shows service vehicle arrangements, schedules, locations of service points, and typical service requirements. The data presented in this section reflect ideal conditions for a single airplane. Service requirements may vary according to airplane condition and airline procedure.

Section 5.1 shows typical arrangements of ground support equipment during turnaround. As noted, if the auxiliary power unit (APU) is used, the electrical, air start, and air-conditioning service vehicles would not be required. Passenger loading bridges or portable passenger stairs could be used to load or unload passengers.

Sections 5.2 and 5.3 show typical service times at the terminal. These charts give typical schedules for performing service on the airplane within a given time. Service times could be rearranged to suit availability of personnel, airplane configuration, and degree of service required.

Section 5.4 shows the locations of ground service connections in graphic and in tabular forms. Typical capacities and service requirements are shown in the tables. Services with requirements that vary with conditions are described in subsequent sections.

Section 5.5 shows typical sea level air pressure and flow requirements for starting different engines. The curves are based on an engine start time of 90 seconds.

Section 5.6 shows air conditioning requirements for heating and cooling (pull-down and pull-up) using ground conditioned air. The curves show airflow requirements to heat or cool the airplane within a given time at ambient conditions.

Section 5.7 shows air conditioning requirements for heating and cooling to maintain a constant cabin air temperature using low pressure conditioned air. This conditioned air is supplied through an 8-in ground air connection (GAC) directly to the passenger cabin, bypassing the air cycle machines.

Section 5.8 shows ground towing requirements for various ground surface conditions.
5.1.1 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND
MODEL 777-200LR
5.1.2 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND

MODEL 777-300ER

NOTE: IF THE APU IS USED, ELECTRICAL PNEUMATIC AND AIR CONDITIONING TRUCKS ARE NOT REQUIRED
### 5.2.1 TERMINAL OPERATIONS - TURNAROUND STATION

**MODEL 777-200LR**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position Passenger Bridges or Stairs</td>
<td>1.0</td>
</tr>
<tr>
<td>Deplane Passengers</td>
<td>7.5</td>
</tr>
<tr>
<td>Service Cabin - Aft LH Door</td>
<td>26.5</td>
</tr>
<tr>
<td>Service Galley - Two Trucks</td>
<td>29.5</td>
</tr>
<tr>
<td></td>
<td>27.0</td>
</tr>
<tr>
<td>Board Passengers</td>
<td>12.5</td>
</tr>
<tr>
<td>Remove Passenger Bridges</td>
<td>1.0</td>
</tr>
<tr>
<td>Unload Fwd Compartment</td>
<td>18.0</td>
</tr>
<tr>
<td>Unload Aft Compartment</td>
<td>14.0</td>
</tr>
<tr>
<td>Unload &amp; Load Bulk Compartment</td>
<td>41.0</td>
</tr>
<tr>
<td>Load Aft Compartment</td>
<td>14.0</td>
</tr>
<tr>
<td>Load Fwd Compartment</td>
<td>18.0</td>
</tr>
<tr>
<td>Fuel Airplane</td>
<td>23.0</td>
</tr>
<tr>
<td>Service Toilets</td>
<td>15.0</td>
</tr>
<tr>
<td>Service Potable Water</td>
<td>17.0</td>
</tr>
<tr>
<td>Push Back</td>
<td></td>
</tr>
</tbody>
</table>
5.2.2. TERMINAL OPERATIONS - TURNAROUND STATION

MODEL 777-300ER

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NOTES:

POSITION/REMOVE EQUIPMENT

1. WITH EIGHT PALLETS, LOAD OR UNLOAD TIME IS ESTIMATED TO BE 16 MINUTES
2. LOWER LOSE: 20 L/D3 CONTAINERS AFT AND 24 FWD
3. 451 PASSENGERS DEPLAN AND BOARD VIA LEFT DOORS NO 1 AND NO 2
4. 100% PASSENGER EXCHANGE
5. DEPLAN AND BOARDING TIMES BASED ON RATES OF:
   50 AND 30 PASSENGERS PER MINUTE RESPECTIVELY

FUELING WITH FOUR NOZZLES AT 50 PSIG
TOTAL AIRCRAFT FUEL = 45,220 U.S. GAL (171,170 L)
REFUELING FROM RESERVE LEVEL OF 3,700 FUEL IN MAIN TANKS
### 5.3.1 TERMINAL OPERATIONS - EN ROUTE STATION

#### MODEL 777-200LR

<table>
<thead>
<tr>
<th>Service</th>
<th>Time (Minutes)</th>
</tr>
</thead>
<tbody>
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<td><strong>Passenger Services</strong></td>
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<tr>
<td>Service Cabin - Aft LH Door</td>
<td>10.5</td>
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<tr>
<td>Service Galley - Additional Meals</td>
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<tr>
<td>Board Passengers</td>
<td>7.5</td>
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<tr>
<td>Remove Passenger Bridges</td>
<td>1.0</td>
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<tr>
<td><strong>Cargo/Baggage Handling</strong></td>
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</tr>
<tr>
<td>Unload Aft Compartment</td>
<td>8.0</td>
</tr>
<tr>
<td>Unload &amp; Load Bulk Compartment</td>
<td>21.0</td>
</tr>
<tr>
<td>Load Aft Compartment</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Airplane Servicing</strong></td>
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</tr>
<tr>
<td>Fuel Airplane</td>
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</tr>
<tr>
<td>Service Toilets</td>
<td>0.0</td>
</tr>
<tr>
<td>Service Potable Water</td>
<td>0.0</td>
</tr>
<tr>
<td>Push Back</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- **Position/Remove Equipment**
- **No Potable or Water Service**

50% Passenger Exchange - 188 Passengers
Passengers Board via Left Door No 1

Deplane and Boarding times based on rates of 40 and 25 passengers per minute respectively.

Fueling with two nozzles at 50 psig
Approximately 14,000 U.S. Gal (53,000 L) added

Lower Lobe 8 LD3's Aft
### 5.3.2 TERMINAL OPERATIONS - EN ROUTE STATION

**MODEL 777-300ER**

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TIME (MINUTES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position Passenger Bridges or Stairs</td>
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</tr>
<tr>
<td>Deplane Passengers</td>
<td>6.0</td>
</tr>
<tr>
<td>Service Cabin - Aft LH Door</td>
<td>18.0</td>
</tr>
<tr>
<td>Service Galleys - Additional Meals</td>
<td>18.0</td>
</tr>
<tr>
<td>Board Passengers</td>
<td>9.0</td>
</tr>
<tr>
<td>Remove Passenger Bridges</td>
<td>1.0</td>
</tr>
<tr>
<td>Unload Aft Compartment</td>
<td>9.0</td>
</tr>
<tr>
<td>Unload &amp; Load Bulk Compartment</td>
<td>29.0</td>
</tr>
<tr>
<td>Load Aft Compartment</td>
<td>9.0</td>
</tr>
<tr>
<td>Fuel Airplane</td>
<td>29.0</td>
</tr>
<tr>
<td>Service Toilets</td>
<td>0.0</td>
</tr>
<tr>
<td>Service Potable Water</td>
<td>0.0</td>
</tr>
<tr>
<td>Push Back</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### Diagram

- **Available Time**
- **Last Baggage**

### Notes:
- **Position/Remove Equipment**
- **No Potable Water or Lavatory Service**
- 50% Passenger Exchange - 226 Passengers
- Passengers Board via Left Door No 1
- Deplane and Boarding Times Based on Rates of 40 and 25 Passengers per Minute Respectively

Fueling with Four Nozzles at 50 PSIG
Approximately 17,000 U.S. Gal (64,350 L) Added
Lower Lobe 9 LD3's Aft
5.4.1 GROUND SERVICING CONNECTIONS

MODEL 777-200LR
5.4.2 GROUND SERVICING CONNECTIONS

MODEL 777-300ER

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<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>MODEL</th>
<th>DISTANCE AFT OF NOSE</th>
<th>DISTANCE FROM AIRPLANE CENTERLINE</th>
<th>MAX HEIGHT ABOVE GROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FT  M</td>
<td>FT  M</td>
<td>FT  M</td>
</tr>
<tr>
<td>CONDITIONED AIR</td>
<td>777-200LR</td>
<td>80  24.4</td>
<td>3  1.1</td>
<td>3  1.1</td>
</tr>
<tr>
<td>TWO 8-IN (20.3 CM) PORTS</td>
<td>777-300ER</td>
<td>97  29.6</td>
<td>3  1.1</td>
<td>3-6 1.1</td>
</tr>
<tr>
<td>ELECTRICAL</td>
<td>777-200LR</td>
<td>23  7.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TWO CONNECTIONS</td>
<td>777-300ER</td>
<td>23  7.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>90 KVA, 200/115 V AC 400 HZ, 3-PHASE EACH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUEL</td>
<td></td>
<td>777-200LR</td>
<td>92  28.1</td>
<td>39  11.9</td>
</tr>
<tr>
<td>TWO UNDERWING PRESSURE</td>
<td></td>
<td>777-300ER</td>
<td>94  28.5</td>
<td>41  12.5</td>
</tr>
<tr>
<td>CONNECTORS ON EACH WING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUEL VENTS</td>
<td>777-200LR</td>
<td>110 33.5</td>
<td>39  11.9</td>
<td>39  11.9</td>
</tr>
<tr>
<td></td>
<td>777-300ER</td>
<td>111 33.9</td>
<td>41  12.5</td>
<td>41  12.5</td>
</tr>
<tr>
<td>TANK CAPACITIES</td>
<td></td>
<td>777-200LR</td>
<td>125 38.1</td>
<td>80  24.4</td>
</tr>
<tr>
<td>STANDARD = 47,890 GAL (181,260 L)</td>
<td></td>
<td>777-300ER</td>
<td>142 43.3</td>
<td>80  24.4</td>
</tr>
<tr>
<td>THREE OPTIONAL BODY TANKS</td>
<td></td>
<td>= 5,550 GAL (21,000 L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POTABLE WATER</td>
<td>777-200LR</td>
<td>29  8.8</td>
<td>4  1.3</td>
<td>-</td>
</tr>
<tr>
<td>ONE SERVICE CONNECTION</td>
<td></td>
<td>777-300ER</td>
<td>147 44.9</td>
<td>-</td>
</tr>
<tr>
<td>AFT LOCATION (BASIC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FWD LOCATION (OPTIONAL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: DISTANCES ROUNDED TO THE NEAREST FOOT AND 0.1 METER.

5.4.3 GROUND SERVICING CONNECTIONS AND CAPACITIES
MODEL 777-200LR, -300ER
5.5 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL

MODEL 777-200LR, -300ER

NOTES:
1. ALTITUDE = SEA LEVEL
2. 90 SECONDS TO IDLE
3. 2 GROUND CONNECTIONS USED
5.6.1 GROUND CONDITIONED AIR REQUIREMENTS - HEATING, PULL-UP

MODEL 777-200LR

NOTE: THIS GRAPH SHOWS THE TIME REQUIRED TO HEAT THE CABIN TO 75°F (24°C) AS A FUNCTION OF AIRFLOW WHEN USING A CONDITIONED AIR GROUND SOURCE.
PRELIMINARY INFORMATION

CONDITIONS:
ALL EXTERIOR DOORS AND WINDOWS CLOSED
OUTSIDE TEMPERATURE 103°F (39°C)
INITIAL CABIN TEMPERATURE 115°F (46°C)
FULL SOLAR LOAD
RECRYCLATION FANS OFF
CHILLERS ON
MINIMUM LIGHTING
NO OCCUPANTS

NOTE: THIS GRAPH SHOWS THE TIME REQUIRED TO COOL THE CABIN TO 75°F (24°C)
AS A FUNCTION OF AIRFLOW WHEN USING A CONDITIONED AIR GROUND SOURCE.

5.6.2 GROUND CONDITIONED AIR REQUIREMENTS - COOLING, PULL-DOWN
MODEL 777-200LR

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5.6.3 GROUND CONDITIONED AIR REQUIREMENTS - HEATING, PULL-UP

MODEL 777-300ER

CONDITIONS:
ALL EXTERIOR DOORS AND WINDOWS CLOSED
OUTSIDE TEMPERATURE -40°F (-40°C)
INITIAL CABIN TEMPERATURE -20°F (-32°C)
NO SOLAR HEAT LOAD
REcirculation fans OFF
CHILLERS OFF
MINIMUM LIGHTING
NO OCCUPANTS

NOTE: THIS GRAPH SHOWS THE TIME REQUIRED TO HEAT THE CABIN TO 75°F (24°C) AS A FUNCTION OF AIRFLOW WHEN USING A CONDITIONED AIR GROUND SOURCE.
5.6.4 GROUND CONDITIONED AIR REQUIREMENTS - COOLING, PULL-DOWN

MODEL 777-300ER

CONDITIONS:
ALL EXTERIOR DOORS AND WINDOWS CLOSED
OUTSIDE TEMPERATURE 103°F (39°C)
INITIAL CABIN TEMPERATURE 115°F (46°C)
FULL SOLAR LOAD

RECIIRCULATION FANS OFF
CHILLERS ON
MINIMUM LIGHTING
NO OCCUPANTS

NOTE: THIS GRAPH SHOWS THE TIME REQUIRED TO COOL THE CABIN TO 75°F (24°C) AS A FUNCTION OF AIRFLOW WHEN USING A CONDITIONED AIR GROUND SOURCE.
5.7.1 CONDITIONED AIR FLOW REQUIREMENTS - STEADY STATE AIRFLOW

MODEL 777-200LR, -300ER

NOTE:
THIS GRAPH SHOWS REQUIRED AIR TEMPERATURES AT THE GROUND AIR CONNECTION IN ORDER TO MAINTAIN CABIN TEMPERATURE AT 75°F (24°C)
5.7.2 AIR CONDITIONING GAUGE PRESSURE REQUIREMENTS - STEADY STATE AIRFLOW

MODEL 777-200LR, -300ER
5.7.3 CONDITIONED AIR FLOW REQUIREMENTS - STEADY STATE BTU'S

MODEL 777-200LR, -300ER

NOTE: THIS GRAPH SHOWS REQUIRED COOLING AND HEATING BTU'S AS A FUNCTION OF AMBIENT TEMPERATURE TO MAINTAIN CABIN TEMPERATURE AT 75°F (24°C).
5.8.1 GROUND TOWING REQUIREMENTS - ENGLISH UNITS

MODEL 777-200LR, -300ER

NOTES:

1. EXAMPLE SHOWS A 777 WEIGHING 557,000 LB BEING PULLED UP A 2.5° SLOPE ON A SANDED ICEWAY.
2. USUAL BREAKAWAY CONDITIONS NOT SHOWN.
3. COEFFICIENTS OF FRICTION (+) ARE ESTIMATED FOR RUBBER-TIRED VEHICLES.
4. ENGINE THRUST NOT SHOWN.
5.8.2 GROUND TOWING REQUIREMENTS - METRIC UNITS

MODEL 777-200LR, -300ER

NOTES:
1. EXAMPLE SHOWS A 777 WEIGHING 243,500 KG, BEING PUSHED UP A 2.5% SLOPE ON SANDED ICE AT 0°C BACKING AGAINST ONE ENGINE AT IDLE THRUST.
2. UNUSUAL BREAKAWAY CONDITIONS NOT SHOWN
3. STRAIGHT-LINE TOW
4. COEFFICIENTS OF FRICTION (μ) ARE ESTIMATED FOR RUBBER-TIRED VEHICLES

ENGINE THRUST RESISTANCE (NUMBER OF ENGINES BACKING AGAINST IDLE THRUST)

AIRPLANE GROSS WEIGHT - 1,000 KILOGRAMS

DRAWBAR PULL/PUSH - 1,000 KILOGRAMS

TOTAL TRACTION WHEEL LOAD - 1,000 KILOGRAMS

ENGINE THRUST RESISTANCE (NUMBER OF ENGINES BACKING AGAINST IDLE THRUST)
6.0  JET ENGINE WAKE AND NOISE DATA

6.1  Jet Engine Exhaust Velocities and Temperatures

6.2  Airport and Community Noise
6.0 JET ENGINE WAKE AND NOISE DATA

6.1 Jet Engine Exhaust Velocities and Temperatures

This section shows exhaust velocity and temperature contours aft of the 777-200LR and 777-300ER. The contours were calculated from a standard computer analysis using three-dimensional viscous flow equations with mixing of primary, fan, and free-stream flow. The presence of the ground plane is included in the calculations as well as engine tilt and toe-in. Mixing of flows from the engines is also calculated. The analysis does not include thermal buoyancy effects which tend to elevate the jet wake above the ground plane. The buoyancy effects are considered to be small relative to the exhaust velocity and therefore are not included.

The graphs show jet wake velocity and temperature contours for a representative engine. The results are valid for sea level, static, standard day conditions. The effect of wind on jet wakes was not included. There is evidence to show that a downwind or an upwind component does not simply add or subtract from the jet wake velocity, but rather carries the whole envelope in the direction of the wind. Crosswinds may carry the jet wake contour far to the side at large distances behind the airplane.
6.1.1 PREDICTED JET ENGINE EXHAUST VELOCITY CONTOURS - IDLE THRUST

MODEL 777-200LR,-300ER
6.1.2 PREDICTED JET ENGINE EXHAUST VELOCITY CONTOURS - BREAKAWAY THRUST

**NOTES:**
- ENGINE THROTTLE AT BREAKAWAY SETTING
- CONTOURS CALCULATED FROM COMPUTER DATA
- STANDARD DAY  
- STATIC AIRPLANE AT MAX TAXI WT
- NO WIND  
- SEA LEVEL
- BOTH ENGINES RUNNING
- 1° PAVEMENT UPSLOPE

**777-300ER TAIL**

- 50 MPH (80 KMPH)
- 35 MPH (56 KMPH)

**GROUND PLANE**

- 17 FT (5 M)

**FEET 0 50 100 150 200 250 300 350 400 450**

**METERS 0 25 50 75 100 150**

**AXIAL DISTANCE FROM AFT OF AIRPLANE**

**AIRPLANE CENTERLINE**

- 50 MPH
- 35 MPH
6.1.3 PREDICTED JET ENGINE EXHAUST VELOCITY CONTOURS - TAKEOFF THRUST
MODEL 777-200LR, -300ER
6.1.4 PREDICTED JET ENGINE EXHAUST TEMPERATURE CONTOURS - IDLE THRUST

MODEL 777-200LR, -300ER

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6.1.5 PREDICTED JET ENGINE EXHAUST TEMPERATURE CONTOURS - BREAKAWAY THRUST
MODEL 777-200LR, -300ER
6.1.6  PREDICTED JET ENGINE EXHAUST TEMPERATURE CONTOURS - TAKEOFF THRUST MODEL 777-200LR, -300ER

NOTES:
* ENGINE THRUST AT TAKEOFF SETTING (110,000 TO 115,000 LB)
* CONTOURS CALCULATED FROM COMPUTER DATA
* STANDARD DAY
* SEA LEVEL
* NO WIND
* BOTH ENGINES RUNNING

777-300ER TAIL
100 °F (38 °C)
17 FT (5 M)
GROUND PLANE

FEET 0 50 100 150 200 250 300 350 400 450
METERS 0 25 50 75 100 150

AXIAL DISTANCE FROM AFT OF AIRPLANE

DISTANCE FROM AIRPLANE 0 20 40 60 80 100
METERS 0 10 20 30

AIRPLANE CENTERLINE
6.2 Airport and Community Noise

Airport noise is of major concern to the airport and community planner. The airport is a major element in the community's transportation system and, as such, is vital to its growth. However, the airport must also be a good neighbor, and this can be accomplished only with proper planning. Since aircraft noise extends beyond the boundaries of the airport, it is vital to consider the impact on surrounding communities. Many means have been devised to provide the planner with a tool to estimate the impact of airport operations. Too often they oversimplify noise to the point where the results become erroneous. Noise is not a simple subject; therefore, there are no simple answers.

The cumulative noise contour is an effective tool. However, care must be exercised to ensure that the contours, used correctly, estimate the noise resulting from aircraft operations conducted at an airport.

The size and shape of the single-event contours, which are inputs into the cumulative noise contours, are dependent upon numerous factors. They include the following:

1. Operational Factors

   (a) **Aircraft Weight**-Aircraft weight is dependent on distance to be traveled, en route winds, payload, and anticipated aircraft delay upon reaching the destination.

   (b) **Engine Power Settings**-The rates of ascent and descent and the noise levels emitted at the source are influenced by the power setting used.

   (c) **Airport Altitude**-Higher airport altitude will affect engine performance and thus can influence noise.
PRELIMINARY FOR 777-200LR

2. Atmospheric Conditions-Sound Propagation

   (a) **Wind**-With stronger headwinds, the aircraft can take off and climb more rapidly relative to the ground. Also, winds can influence the distribution of noise in surrounding communities.

   (b) **Temperature and Relative Humidity**-The absorption of noise in the atmosphere along the transmission path between the aircraft and the ground observer varies with both temperature and relative humidity.

3. Surface Condition-Shielding, Extra Ground Attenuation (EGA)

   (a) **Terrain**-If the ground slopes down after takeoff or before landing, noise will be reduced since the aircraft will be at a higher altitude above ground. Additionally, hills, shrubs, trees, and large buildings can act as sound buffers.
All these factors can alter the shape and size of the contours appreciably. To demonstrate the effect of some of these factors, estimated noise level contours for two different operating conditions are shown below. These contours reflect a given noise level upon a ground level plane at runway elevation.

**Condition 1**

<table>
<thead>
<tr>
<th>Landing</th>
<th>Takeoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Structural Landing Weight</td>
<td>Maximum Gross Takeoff Weight</td>
</tr>
<tr>
<td>10-knot Headwind</td>
<td>Zero Wind</td>
</tr>
<tr>
<td>3° Approach</td>
<td>84 °F</td>
</tr>
<tr>
<td>84 °F</td>
<td>Humidity 15%</td>
</tr>
<tr>
<td>Humidity 15%</td>
<td></td>
</tr>
</tbody>
</table>

**Condition 2**

<table>
<thead>
<tr>
<th>Landing</th>
<th>Takeoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% of Maximum Structural Landing Weight</td>
<td>80% of Maximum Gross Takeoff Weight</td>
</tr>
<tr>
<td>10-knot Headwind</td>
<td>10-knot Headwind</td>
</tr>
<tr>
<td>3° Approach</td>
<td>59 °F</td>
</tr>
<tr>
<td>59 °F</td>
<td>Humidity 70%</td>
</tr>
<tr>
<td>Humidity 70%</td>
<td></td>
</tr>
</tbody>
</table>
As indicated from these data, the contour size varies substantially with operating and atmospheric conditions. Most aircraft operations are, of course, conducted at less than maximum gross weights because average flight distances are much shorter than maximum aircraft range capability and average load factors are less than 100%. Therefore, in developing cumulative contours for planning purposes, it is recommended that the airlines serving a particular city be contacted to provide operational information.

In addition, there are no universally accepted methods for developing aircraft noise contours or for relating the acceptability of specific zones to specific land uses. It is therefore expected that noise contour data for particular aircraft and the impact assessment methodology will be changing. To ensure that the best currently available information of this type is used in any planning study, it is recommended that it be obtained directly from the Office of Environmental Quality in the Federal Aviation Administration in Washington, D.C.

It should be noted that the contours shown herein are only for illustrating the impact of operating and atmospheric conditions and do not represent the single-event contour of the family of aircraft described in this document. It is expected that the cumulative contours will be developed as required by planners using the data and methodology applicable to their specific study.
7.0 PAVEMENT DATA

7.1 General Information

7.2 Landing Gear Footprint

7.3 Maximum Pavement Loads

7.4 Landing Gear Loading on Pavement

7.5 Flexible Pavement Requirements - U.S. Army Corps of Engineers Method S-77-1

7.6 Flexible Pavement Requirements - LCN Conversion

7.7 Rigid Pavement Requirements - Portland Cement Association Design Method

7.8 Rigid Pavement Requirements - LCN Conversion

7.9 Rigid Pavement Requirements - FAA Method

7.10 ACN/PCN Reporting System - Flexible and Rigid Pavements
7.0 PAVEMENT DATA

7.1 General Information

A brief description of the pavement charts that follow will help in their use for airport planning. Each airplane configuration is depicted with a minimum range of six loads imposed on the main landing gear to aid in interpolation between the discrete values shown. All curves for any single chart represent data based on rated loads and tire pressures considered normal and acceptable by current aircraft tire manufacturer's standards. Tire pressures, where specifically designated on tables and charts, are at values obtained under loaded conditions as certificated for commercial use.

Section 7.2 presents basic data on the landing gear footprint configuration, maximum design taxi loads, and tire sizes and pressures.

Maximum pavement loads for certain critical conditions at the tire-to-ground interface are shown in Section 7.3, with the tires having equal loads on the struts.

Pavement requirements for commercial airplanes are customarily derived from the static analysis of loads imposed on the main landing gear struts. The charts in Section 7.4 are provided in order to determine these loads throughout the stability limits of the airplane at rest on the pavement. These main landing gear loads are used as the point of entry to the pavement design charts, interpolating load values where necessary.

The flexible pavement design curves (Section 7.5) are based on procedures set forth in Instruction Report No. S-77-1, "Procedures for Development of CBR Design Curves," dated June 1977. Instruction Report No. S-77-1 was prepared by the U.S. Army Corps of Engineers Waterways Experiment Station, Soils and Pavements Laboratory, Vicksburg, Mississippi. The line showing 10,000 coverages is used to calculate the Aircraft Classification Number (ACN).
The following procedure is used to develop the curves, such as shown in Section 7.5:

1. Having established the scale for pavement depth at the bottom and the scale for CBR at the top, an arbitrary line is drawn representing 6,000 annual departures.

2. Values of the aircraft gross weight are then plotted.

3. Additional annual departure lines are drawn based on the load lines of the aircraft gross weights already established.

4. An additional line representing 10,000 coverages (used to calculate the flexible pavement Aircraft Classification Number) is also placed.

All Load Classification Number (LCN) curves (Sections 7.6 and 7.8) have been developed from a computer program based on data provided in International Civil Aviation Organization (ICAO) document 9157-AN/901, Aerodrome Design Manual, Part 3, “Pavements”, First Edition, 1977. LCN values are shown directly for parameters of weight on main landing gear, tire pressure, and radius of relative stiffness (i) for rigid pavement or pavement thickness or depth factor (h) for flexible pavement.

Rigid pavement design curves (Section 7.7) have been prepared with the Westergaard equation in general accordance with the procedures outlined in the Design of Concrete Airport Pavement (1955 edition) by Robert G. Packard, published by the American Concrete Pavement Association, 3800 North Wilke Road, Arlington Heights, Illinois 60004-1268. These curves are modified to the format described in the Portland Cement Association publication XP6705-2, Computer Program for Airport Pavement Design (Program PDILB), 1968, by Robert G. Packard.

The following procedure is used to develop the rigid pavement design curves shown in Section 7.7:

1. Having established the scale for pavement thickness to the left and the scale for allowable working stress to the right, an arbitrary load line is drawn representing the main landing gear maximum weight to be shown.

2. Values of the subgrade modulus (k) are then plotted.

3. Additional load lines for the incremental values of weight on the main landing gear are drawn on the basis of the curve for k = 300, already established.
The ACN/PCN system (Section 7.9) as referenced in ICAO Annex 14, "Aerodromes," First Edition, July 1990, provides a standardized international airplane/pavement rating system replacing the various S, T, TT, LCN, AUW, ISWL, etc., rating systems used throughout the world. ACN is the Aircraft Classification Number and PCN is the Pavement Classification Number. An aircraft having an ACN equal to or less than the PCN can operate on the pavement subject to any limitation on the tire pressure. Numerically, the ACN is two times the derived single-wheel load expressed in thousands of kilograms, where the derived single wheel load is defined as the load on a single tire inflated to 181 psi (1.25 MPa) that would have the same pavement requirements as the aircraft. Computationally, the ACN/PCN system uses the PCA program PDILB for rigid pavements and S-77-1 for flexible pavements to calculate ACN values. The method of pavement evaluation is left up to the airport with the results of their evaluation presented as follows:

<table>
<thead>
<tr>
<th>PCN</th>
<th>PAVEMENT TYPE</th>
<th>SUBGRADE CATEGORY</th>
<th>TIRE PRESSURE CATEGORY</th>
<th>EVALUATION METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Rigid</td>
<td>A = High</td>
<td>W = No Limit</td>
<td>T = Technical</td>
</tr>
<tr>
<td>F</td>
<td>Flexible</td>
<td>B = Medium</td>
<td>X = To 217 psi (1.5 MPa)</td>
<td>U = Using Aircraft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C = Low</td>
<td>Y = To 145 psi (1.0 MPa)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D = Ultra Low</td>
<td>Z = To 73 psi (0.5 MPa)</td>
<td></td>
</tr>
</tbody>
</table>

Section 7.9.1 shows the aircraft ACN values for flexible pavements. The four subgrade categories are:

- Code A - High Strength - CBR 15
- Code B - Medium Strength - CBR 10
- Code C - Low Strength - CBR 6
- Code D - Ultra Low Strength - CBR 3

Section 7.9.2 shows the aircraft ACN values for rigid pavements. The four subgrade categories are:

- Code A - High Strength, k = 550 pci (150 MN/m³)
- Code B - Medium Strength, k = 300 pci (80 MN/m³)
- Code C - Low Strength, k = 150 pci (40 MN/m³)
- Code D - Ultra Low Strength, k = 75 pci (20 MN/m³)
UNITS  777-200LR  777-300ER

<table>
<thead>
<tr>
<th>MAXIMUM DESIGN TAXI WEIGHT</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>LB</td>
<td>768,800</td>
<td>762,700</td>
</tr>
<tr>
<td>KG</td>
<td>348,721</td>
<td>345,954</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERCENT OF WT ON MAIN GEAR</th>
<th>SEE SECTION 7.4</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NOSE GEAR TIRE SIZE</th>
<th>IN.</th>
<th>43 X 17.5 R 17, 32 PR</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NOSE GEAR TIRE PRESSURE</th>
<th>PSI</th>
<th>218</th>
<th>218</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG/CM²</td>
<td>15.3</td>
<td>15.3</td>
<td>15.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAIN GEAR TIRE SIZE</th>
<th>IN.</th>
<th>52 X 21 R 22, 36 PR</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>MAIN GEAR TIRE PRESSURE</th>
<th>PSI</th>
<th>218</th>
<th>218</th>
<th>221</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG/CM²</td>
<td>15.3</td>
<td>15.3</td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>

7.2 LANDING GEAR FOOTPRINT
MODEL 777-200LR/-300ER
PRELIMINARY FOR 777-200LR

\[ V_{(NG)} = \text{MAXIMUM VERTICAL NOSE GEAR GROUND LOAD AT MOST FORWARD CENTER OF GRAVITY} \]
\[ V_{(MG)} = \text{MAXIMUM VERTICAL MAIN GEAR GROUND LOAD AT MOST AFT CENTER OF GRAVITY} \]
\[ H = \text{MAXIMUM HORIZONTAL GROUND LOAD FROM BRAKING} \]

NOTE: ALL LOADS CALCULATED USING AIRPLANE MAXIMUM DESIGN TAXI WEIGHT

<table>
<thead>
<tr>
<th>MODEL</th>
<th>UNITS</th>
<th>MAXIMUM DESIGN TAXI WEIGHT</th>
<th>( V_{(NG)} )</th>
<th>( V_{(MG)} ) PER STRUT</th>
<th>( H ) PER STRUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>777-200LR</td>
<td>LB</td>
<td>768,800</td>
<td>67,500</td>
<td>114,597</td>
<td>352,436</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>348,721</td>
<td>30,617</td>
<td>51,980</td>
<td>159,862</td>
</tr>
<tr>
<td>777-300ER</td>
<td>LB</td>
<td>762,700</td>
<td>60,525</td>
<td>99,259</td>
<td>352,211</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>345,954</td>
<td>27,454</td>
<td>45,023</td>
<td>159,760</td>
</tr>
<tr>
<td>777-300ER</td>
<td>LB</td>
<td>777,000</td>
<td>59,019</td>
<td>98,480</td>
<td>359,166</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>352,441</td>
<td>26,771</td>
<td>44,670</td>
<td>162,915</td>
</tr>
</tbody>
</table>

7.3 MAXIMUM PAVEMENT LOADS

MODEL 777-200LR,-300ER
7.4.1 LANDING GEAR LOADING ON PAVEMENT
MODEL 777-200LR
7.4.2 LANDING GEAR LOADING ON PAVEMENT

MODEL 777-300ER

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7.5 Flexible Pavement Requirements - U.S. Army Corps of Engineers Method
(S-77-1)

The following flexible-pavement design chart presents the data of six incremental main-gear loads at the minimum tire pressure required at the maximum design taxi weight.

In the example shown in Section 7.5.1, for a CBR of 25 and an annual departure level of 6,000, the required flexible pavement thickness for a 777-200LR airplane with a main gear loading of 550,000 pounds is 13.8 inches. Likewise, the required flexible pavement thickness for the 777-300ER under the same conditions, is 13.9 inches as shown in Section 7.5.2.

The line showing 10,000 coverages is used for ACN calculations (see Section 7.9).

The FAA does not officially recognize the validity of the S77-1 flexible pavement design calculation for individual six-wheel gear aircraft. At the time this document (D6-58329-2) was printed, the FAA was recommending a multi-layer elastic system pavement thickness design method for the 777 airplane when considered as a component of the traffic mix. Consequently, the charts presented on the following two pages are provided as an estimate of the design thickness for general guidance purposes only.
THIS CHART IS AN ESTIMATE OF PAVEMENT REQUIREMENTS BASED ON THE S77-1 METHOD. THICKNESSES DETERMINED HEREIN ARE NOT APPROVED BY THE FAA FOR PAVEMENT DESIGN.

7.5.1 FLEXIBLE PAVEMENT REQUIREMENTS - U.S. ARMY CORPS OF ENGINEERS DESIGN METHOD (S-77-1)
MODEL 777-200LR

NOTE: TIRES - 52 x 21 R22.36 PR AT 218 PSI (15.33 KG/CM SQ)
CALIFORNIA BEARING RATIO, CBR
7.5.2 FLEXIBLE PAVEMENT REQUIREMENTS - U.S. ARMY CORPS OF ENGINEERS DESIGN METHOD (S-77-1)

MODEL 777-300ER

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7.6 Flexible Pavement Requirements - LCN Method

To determine the airplane weight that can be accommodated on a particular flexible pavement, both the Load Classification Number (LCN) of the pavement and the thickness must be known.

In the example shown in Section 7.6.1, flexible pavement thickness is shown at 30 inches with an LCN of 90. For these conditions, the maximum allowable weight on the main landing gear is 500,000 lb for a 777-200LR airplane with 218 psi main gear tires. Likewise, in the example shown in Section 7.6.2, the flexible pavement thickness is shown at 24 inches and the LCN is 85. For these conditions, the maximum allowable weight on the main landing gear is 550,000 lb for a 777-300ER airplane with 218 psi main gear tires.

Note: If the resultant aircraft LCN is not more that 10% above the published pavement LCN, the bearing strength of the pavement can be considered sufficient for unlimited use by the airplane. The figure 10% has been chosen as representing the lowest degree of variation in LCN that is significant (reference: ICAO Aerodrome Manual, Part 2, "Aerodrome Physical Characteristics," Chapter 4, Paragraph 4.1.5.7v, 2nd Edition dated 1965).
7.6.1 FLEXIBLE PAVEMENT REQUIREMENTS - LCN METHOD

MODEL 777-200LR
7.6.2 FLEXIBLE PAVEMENT REQUIREMENTS - LCN METHOD

MODEL 777-300ER

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7.7 Rigid Pavement Requirements - Portland Cement Association Design Method


The following rigid pavement design chart presents the data for six incremental main gear loads at the minimum tire pressure required at the maximum design taxi weight.

In the example shown in Section 7.7.1, for an allowable working stress of 550 psi, and a subgrade strength (k) of 300, the required rigid pavement thickness is 11.1 inches for a 777-200LR airplane with a main gear load of 650,000 lb. Likewise, for the same pavement conditions, the required pavement thickness for a 777-300ER airplane with a main gear load of 650,000 lb is 11.0 inches as shown in Section 7.7.2.
7.7.1 RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION DESIGN METHOD
MODEL 777-200LR

NOTE: TIRES - 52 x 21 R22 36 PR AT 218 PSI (15.33 KG/CM SQ)

NOTE: THE VALUES OBTAINED BY USING THE MAXIMUM LOAD REFERENCE LINE AND ANY VALUE OF k ARE EXACT. FOR LOADS LESS THAN MAXIMUM, THE CURVES ARE EXACT FOR k = 300 BUT DEVIATE SLIGHTLY FOR OTHER VALUES OF k.

REFERENCES: "DESIGN OF CONCRETE AIRPORT PAVEMENT" AND "COMPUTER PROGRAM FOR AIRPORT PAVEMENT DESIGN - PROGRAM PDLM" PORTLAND CEMENT ASSOCIATION.

PRELIMINARY INFORMATION
7.7.2 RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION DESIGN METHOD

MODEL 777-300ER
7.8 Rigid Pavement Requirements - LCN Conversion

To determine the airplane weight that can be accommodated on a particular rigid pavement, both the LCN of the pavement and the radius of relative stiffness ($i$) of the pavement must be known.

In the example shown in Section 7.8.2, for a rigid pavement with a radius of relative stiffness of 39 with an LCN of 87, the maximum allowable weight permissible on the main landing gear for a 777-200LR airplane is 550,000 lb for an airplane with 218 psi main tires. Similarly, in Section 7.8.3, for the same pavement characteristics, the maximum allowable weight permissible on the main landing gear for a 777-300ER airplane is 550,000 lb for an airplane with 218 psi main tires.

Note: If the resultant aircraft LCN is not more that 10% above the published pavement LCN, the bearing strength of the pavement can be considered sufficient for unlimited use by the airplane. The figure 10% has been chosen as representing the lowest degree of variation in LCN that is significant (reference: ICAO Aerodrome Manual, Part 2, "Aerodrome Physical Characteristics," Chapter 4, Paragraph 4.1.5.7v, 2nd Edition dated 1965).
### 7.8.1 RADIUS OF RELATIVE STIFFNESS

**VALUES IN INCHES**

\[ t = \sqrt[3]{\frac{4Ed^3}{12(1-\mu^2)k}} = 24.1652 \sqrt[3]{\frac{d^3}{k}} \]

**WHERE:**
- \( E \) = YOUNG'S MODULUS OF ELASTICITY = \( 4 \times 10^6 \) psi
- \( k \) = SUBGRADE MODULUS, LB PER CU IN
- \( d \) = RIGID PAVEMENT THICKNESS, IN
- \( \mu \) = POISSON'S RATIO = 0.15

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7.8.2 RIGID PAVEMENT REQUIREMENTS - LCN CONVERSION

MODEL 777-200LR

NOTES:
* TIRES - 52 x 21 R22 36PR AT 218 PSI (15.33 KG/CM SQ)
* EQUIVALENT SINGLE-WHEEL LOADS ARE DERIVED FROM
  ICAO AERODROME MANUAL, PART 2 PAR 4.1.3, DATED 1965.

MAXIMUM POSSIBLE MAIN GEAR LOAD
AT MAXIMUM DESIGN TAXI WEIGHT
AND AT CG (768,800 LB MTW)
WEIGHT ON MAIN
LANDING GEAR
(SEE SEC 7.4)
LB KG
704,872 319,724
650,000 294,834
600,000 272,115
550,000 249,475
500,000 226,798
450,000 204,116

LOAD CLASSIFICATION NUMBER (LCN)

RADIUS OF RELATIVE STIFFNESS, $r$
7.8.3 RIGID PAVEMENT REQUIREMENTS - LCN CONVERSION

MODEL 777-300ER
7.9 Rigid Pavement Requirements - FAA Design Method

The FAA does not officially recognize the validity of rigid pavement thickness design calculations for individual six-wheel gear aircraft. At the time this document (D6-58329-2) was printed, the FAA was recommending a multi-layer pavement thickness design method for the 777 airplane when considered as a component of the traffic mix. Consequently, the chart shown in Section 7.9.1 is provided as an estimate of the design thickness for general guidance purposes only. In the example shown, for a pavement flexural strength of 700 psi, a subgrade strength of k = 300, and an annual departure level of 3,000, the required pavement thickness for a 777-200LR or 777-300ER airplane with a main gear load of 650,00 lb is 10.8 inches.
7.9.1 RIGID PAVEMENT REQUIREMENTS
MODEL 777-200LR, -300ER

NOTE: ALL TIRES - ALL CONTACT AREA CONSTANT
AT 270.8 SQ IN (0.175 SQ M)

WEIGHT ON MAIN
LANDING GEAR
(SEE SEC 7.4)
LB (KG)
718,332 (325,829)

FLEXURAL STRENGTH
(PSI/CM²)
550,000
(249,475)
500,000
(226,796)
450,000
(204,116)
350,000
(159,014)
300,000
(133,330)
250,000
(109,870)
200,000
(94,290)
150,000
(68,710)
100,000
(43,130)
50,000
(21,560)

ANNUAL
DEPARTURES
1,200
3,000
6,000
13,000
25,000

NOTE: 30-YR
PAVEMENT LIFE

INCHES
6 8 10 12 14 16 18 20 22 24 26 28

CENTIMETERS
20 30 40 50 60 70

PAVEMENT THICKNESS
7.10 ACN/PCN Reporting System: Flexible and Rigid Pavements

To determine the ACN of an aircraft on flexible or rigid pavement, both the aircraft gross weight and the subgrade strength category must be known. The chart in Section 7.10.1 shows that for 777-200LR aircraft with gross weight of 700,000 lb on a medium strength subgrade (Code B), the flexible pavement ACN is 62. In Section 7.10.3, for the same aircraft weight and medium subgrade strength (Code B), the rigid pavement ACN is 73.

Similarly, for a 777-300ER aircraft with gross weight of 700,000 lb on a medium strength subgrade (Code B), the flexible pavement ACN is 62 (Section 7.10.2) and the rigid pavement ACN is 73 (Section 7.10.4).

Notes: 1. An aircraft with an ACN equal to or less that the reported PCN can operate on that pavement subject to any limitations on the tire pressure. (Ref: ICAO Annex 14 Aerodromes, First Edition, July 1990.)

2. The ACN values on the Flexible Pavement charts were calculated using alpha factors proposed by the ICAO ACN Study Group.

The following table provides ACN data in tabular format similar to the one used by ICAO in the “Aerodrome Design Manual Part 3, Pavements.” If the ACN for an intermediate weight between taxi weight and empty fuel weight of the aircraft is required, Figures 7.10.1 through 7.10.4 should be consulted.
7.10.1 AIRCRAFT CLASSIFICATION NUMBER - FLEXIBLE PAVEMENT

NOTES:

1. ACN was calculated using ICAO ACN study group alpha factors.
2. To determine main landing gear loading, see Section 7.4.
3. Percent weight on main landing gear: 91.7%

MODEL 777-200LR

AIRCRAFT CLASSIFICATION NUMBER (ACN) VS. AIRCRAFT CROSS-SECTION WEIGHT

CODE A - CBR 15 (HIGH)
CODE B - CBR 10 (MEDIUM)
CODE C - CBR 6 (LOW)
CODE D - CBR 3 (ULTRA LOW)
7.10.2 AIRCRAFT CLASSIFICATION NUMBER - FLEXIBLE PAVEMENT

MODEL 777-300ER

NOTES:
1. ACN WAS CALCULATED USING ALPHA FACTORS PROPOSED BY THE ICAO ACN STUDY GROUP
2. TO DETERMINE MAIN LANDING GEAR LOADING, SEE SECTION 7.4.
3. PERCENT WEIGHT ON MAIN LANDING GEAR: 92.4

- CODE D - CBR 3 (ULTRA LOW)
- CODE C - CBR 6 (LOW)
- CODE B - CBR 10 (MEDIUM)
- CODE A - CBR 15 (HIGH)

- 52x 21 R22 36 PR
- PRESSURE = 221PSI (15.54 KG/CM SQ)

AIRCRAFT CLASSIFICATION NUMBER (ACN)

(1,000 LB) (1,000 KG)

1,000 LB
200 250 300 350

AIRCRAFT GROSS WEIGHT

60 650 700 750 800

CODE A
CODE B
CODE C
CODE D

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7.10.3 AIRCRAFT CLASSIFICATION NUMBER - RIGID PAVEMENT

MODEL 777-200LR
7.10.4 AIRCRAFT CLASSIFICATION NUMBER - RIGID PAVEMENT

MODEL 777-300ER

NOTES:
1. TO DETERMINE MAIN LANDING GEAR LOADING, SEE SECTION 7.4.
2. PERCENT WEIGH ON MAIN LANDING GEAR: 97.4

CODE A = \( k = 550 \) (HIGH)
CODE B = \( k = 500 \) (MEDIUM)
CODE C = \( k = 150 \) (LOW)
CODE D = \( k = 75 \) (ULTRA LOW)

* PRESSURE = 221 PSI (15.54 KG/CM SQ)
8.0 FUTURE 777 DERIVATIVE AIRPLANES
8.0 FUTURE 777 DERIVATIVE AIRPLANES

Several derivatives are being studied to provide additional capabilities of the 777 family of airplanes. Future growth versions could require additional passenger capacity or increased range or both. Whether these growth versions could be built would depend entirely on airline requirements. In any event, impact on airport facilities will be a consideration in the configuration and design.
9.0 SCALED 777 DRAWINGS

9.1 - 9.5 Scaled Drawings, 777-200LR

9.6 - 9.10 Scaled Drawings, 777-300ER
9.0 SCALED DRAWINGS

The drawings in the following pages show airplane plan view drawings, drawn to approximate scale as noted. The drawings may not come out to exact scale when printed or copied from this document. Printing scale should be adjusted when attempting to reproduce these drawings. Three-view drawing files of the 777-200LR and 777-300ER, along with other Boeing airplane models, can be downloaded from the following website:

http://www.boeing.com/airports
9.2.1 SCALED DRAWING - 1 IN. = 50 FT
MODEL 777-200LR

NOTE: ADJUST SCALE WHEN PRINTING THIS PAGE

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LEGEND

A  AIR CONDITIONING
B  BULK CARGO DOOR
C  CONTAINER CARGO DOOR
E  ELECTRICAL (2)
F  FUEL (2 CONNECTORS)
L  LAVATORY
MG  MAIN GEAR
NG  NOSE GEAR
P  PNEUMATIC PORT (3)
V  FUEL VENT
W  POTABLE WATER
X  PASSENGER DOOR

NOTE: ADJUST SCALE WHEN PRINTING THIS PAGE

9.3.1 SCALED DRAWING - 1 IN = 100 FT

MODEL 777-200LR
PRELIMINARY INFORMATION

9.3.2 SCALED DRAWING - 1 IN = 100 FT
MODEL 777-200LR

NOTE: ADJUST SCALE WHEN PRINTING THIS PAGE

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9.4.1 SCALED DRAWING - 1:500
MODEL 777-200LR

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NOTE: ADJUST SCALE WHEN PRINTING THIS PAGE

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PRELIMINARY INFORMATION

9.4.2 SCALED DRAWING - 1:500
MODEL 777-200LR

NOTE: ADJUST SCALE WHEN PRINTING THIS PAGE

D6-58329-2

136 NOVEMBER 2002
9.5.1 SCALED DRAWING - 1:1000
MODEL 777-200LR

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PRELIMINARY INFORMATION

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9.5.2 SCALED DRAWING - 1:1000
MODEL 777-200LR

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138 NOVEMBER 2002
9.6.2 SCALED DRAWING - 1 IN. = 32 FT
MODEL 777-300ER
9.7.1 SCALED DRAWING - 1 IN. = 50 FT

MODEL 777-300ER

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9.7.2 SCALED DRAWING - 1 IN. = 50 FT

MODEL 777-300ER

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LEGEND

A  AIR CONDITIONING
B  BULK CARGO DOOR
C  CONTAINER CARGO DOOR
E  ELECTRICAL (2)
F  FUEL (2 CONNECTORS)
L  LAVATORY
MG MAIN GEAR
NG NOSE GEAR
P  PNEUMATIC PORT (3)
V  FUEL VENT
W  POTABLE WATER
X  PASSENGER DOOR
9.9.1 SCALED DRAWING - 1:500

MODEL 777-300ER

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9.10.2  SCALED DRAWING - 1:1000

MODEL 777-300ER

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