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AIRPORT PLANNING MANUAL

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DATED 19 NOVEMBER 1985, REVISION 2 - 22 MAY 1987

A.P. – 120/731
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REVISION 1 - 27 SEPTEMBER 2019

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TO: HOLDERS OF PUBLICATION No. A.P. 120/731 - “AIRPORT PLANNING MANUAL”, APPLICABLE TO EMB-120 “BRASILIA” AIRCRAFT.

REVISION No. 1 DATED SEPTEMBER 27/19

HIGHLIGHTS

Pages which have been added, revised or deleted by the current revision are indicated by an asterisk, on the List of Effective Pages. This issue incorporates all preceding Temporary Revisions (if any).
### LIST OF EFFECTIVE PAGES

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* Asterisk indicates pages changed, added/deleted (del) by the current revision.
Section I - Introduction

Section II - General Airplane Characteristics

Section III - Airplane Performance

Section IV - Ground Maneuvering

Section V - Terminal Servicing

Section VI - Operating Conditions

Section VII - Pavement Data

Section VIII - Hangar and Shop Arrangements

Section IX - Scale Drawings
CURRENT STATUS OF EFFECTIVE TEMPORARY REVISIONS

AP-120/731
Revision 1 - September 27/2019

Currently there is no effective Temporary Revision intended for this manual. The latest revision to it has incorporated any and all preceding Temporary Revisions issued (if any).

Latest update: Sep 27/19
1.1 PURPOSE

This document provides 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. EMBRAER should be contacted for any additional information required.

1.2 SCOPE

This document provides characteristics of the EMB-120 airplane 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.

For additional information on and revisions to this document, contact:

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e-mail: distrib@embraer.com.br
http://www.embraer.com
### Units Conversion Table

**Figure 1-1**

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**Note:**
- To convert liters to U.S. gal: multiply by 0.264.
- To convert liters to imp. gal: multiply by 0.220.
- To convert millibars to inches of mercury: multiply by 0.025.
- To convert kilograms to pounds: multiply by 2.205.
- To convert pounds to kilograms: multiply by 0.454.
- To convert kilometers to statute miles: multiply by 0.621.
- To convert kilometers to nautical miles: multiply by 0.540.
- To convert mega newton per cubic meter to pounds per cubic inch: multiply by 3.604.
- To convert mega pascal to pounds per square inch: multiply by 145.038.
2.1. GENERAL DESCRIPTION

The EMB-120 Brasilia has been basically conceived for passenger and/or cargo transportation in typical commercial aviation operations. It is an all-metal, pressurized, low-wing, T-tail, monoplane airplane. Fully retractable, tricycle-type landing gear with dual wheels, anti-skid braking system, and steerable nose gear are utilized. Power is provided by two turboprop, axial-flow, PW118-series engines. Fuel is stored in two integral wing tanks. As an option, the airplane may be provided with an auxiliary power unit (APU).

2.2. DEFINITIONS

2.2.1. Maximum Zero Fuel Weight (MZFW)
Is the maximum approved weight for the airplane with only unusable fuel in tanks.

2.2.2. Equipped Empty Weight (EEW TOLERANCE = ± 1%)
Is the total weight of the airplane structure plus power plant, instruments, control, hydraulic, electronic, electrical, air conditioning, anemometric, oxygen, de-icing and anti-icing, pressurization systems, plus interior furnishings, etc.

2.2.3. Basic Empty Weight (BEW)
Is the equipped empty weight plus unusable fuel, total engine oil, total hydraulic fluid and, when existing, removable ballast weights.

2.2.4. Maximum Payload
Is the difference between maximum zero fuel weight and operating weight.
2.2.5. Operating Weight (OW)
Is the basic empty weight plus weights of movable items which do not alter significantly along a mission. Such items include toilet water, crew, attendant material, extra and emergency equipment possibly needed.

2.2.6. Useful Load
Is the difference between takeoff weight and equipped empty weight.

2.2.7. Maximum Taxi Weight (MTW)
Is the maximum weight for ground maneuver as limited by aircraft strength and airworthiness requirements. (It includes weight for taxiing and runup fuel).

2.2.8. Maximum Landing Weight (MLW)
Is the maximum weight for landing as limited by aircraft strength and airworthiness requirements.

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

![Image](EMB120_Logo.png)

**Figure 2-1**

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*Design Weights for Standard Configuration*
NOTE: Assumed fuel density is 0.785 kg/l (6500 lb/U.S. GAL).

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<tr>
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<td>Kilograms</td>
<td>22</td>
</tr>
</tbody>
</table>

NOTE: Assumed fuel density is 0.785 kg/l (6500 lb/U.S. GAL).

Usable and Unusable Fuel

Figure 2-2
Overhead Bins: Max allowable weight is 40 lb (18 kg) in each module.

Rear BAGGAGE COMPARTMENT:

- For passenger luggage:

  Sections I + II (Max. allowable weight: 1213 lb (550 kg)).

- For cargo Transportation:

  Section I (Max. allowable weight: 1213 lb (550 kg)).

  Section II (Max. allowable weight: 570 lb (258 kg)).

The amount of sections I and II should not exceed the maximum allowable weight of 1213 lb (550 kg).
Airplane General Dimensions

Figure 2-4
### Vertical Clearances

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meters</td>
<td>In</td>
</tr>
<tr>
<td>A</td>
<td>3.43</td>
<td>135.0</td>
</tr>
<tr>
<td>B</td>
<td>1.46</td>
<td>57.5</td>
</tr>
<tr>
<td>C</td>
<td>1.13</td>
<td>44.5</td>
</tr>
<tr>
<td>D</td>
<td>1.58</td>
<td>62.2</td>
</tr>
<tr>
<td>E</td>
<td>1.76</td>
<td>69.3</td>
</tr>
<tr>
<td>F</td>
<td>1.88</td>
<td>74.0</td>
</tr>
<tr>
<td>G</td>
<td>6.53</td>
<td>257.1</td>
</tr>
<tr>
<td>H</td>
<td>0.58</td>
<td>22.8</td>
</tr>
<tr>
<td>I</td>
<td>2.36</td>
<td>92.9</td>
</tr>
<tr>
<td>J</td>
<td>0.43</td>
<td>16.9</td>
</tr>
</tbody>
</table>

*Ground Clearances*

*Figure 2-5*
Interior Arrangements (30 PAX)

Figure 2-6 (Sheet 1)
Interior Arrangements (28 PAX)
Figure 2-6 (Sheet 2)
Interior Arrangements (Cargo)
Figure 2-6 (Sheet 4)
Door Clearances
Figure 2-7
Passenger Cabin Cross Section - Typical

Figure 2-8
Main Door Operation (Inside Cabin)

Figure 2-9
Main Door Operation (Outside Cabin)
Figure 2-10
Cargo Door Operation

Figure 2-11
CENTER OF GRAVITY LIMITS
AIRPLANES MODEL EMB-120RT

TAKEOFF AND LANDING LIMITS

IN-FLIGHT LIMITS (FLAPS AND GEAR UP)

WEIGHT - kg

WEIGHT - lb

% MAC

MTOW = 25383 lb (11500 kg)
MLW = 24802 lb (11250 kg)
MZFW = 23148 lb (10500 kg)
MOW = 14330 lb (8500 kg)
MTW = 25529 lb (11580 kg)

22707 lb (10300 kg)
18297 lb (8300 kg)
15873 lb (7200 kg)

Weight x C.G. Envelope

Figure 2-12 (Sheet 1)
CENTER OF GRAVITY LIMITS
AIRPLANES MODEL EMB–120ER

- TAKEOFF AND LANDING LIMITS
- IN-FLIGHT LIMITS (FLAPS AND GEAR UP)

Weight x C.G. Envelope
Figure 2-12 (Sheet 2)
3.1. GENERAL INFORMATION

This section contains conversion tables and charts with information on payload, range, fuel limits, and take-off and landing runway length requirements for different weights and pressure altitudes for the standard configuration of EMB-120 BRASILIA equipped with PW 118, PW 118A, or PW 118B engines.
<table>
<thead>
<tr>
<th>PRESSURE ALTITUDE</th>
<th>STANDARD DAY TEMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEET</td>
<td>METERS</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>610</td>
</tr>
<tr>
<td>4000</td>
<td>1220</td>
</tr>
<tr>
<td>6000</td>
<td>1830</td>
</tr>
<tr>
<td>8000</td>
<td>2440</td>
</tr>
</tbody>
</table>

Standard Day Temperatures for Pressure Altitudes
Figure 3-1
ISA CONVERSION

Isa Conversion Chart
Figure 3-2
PAYLOAD x RANGE
ISA

NOTES:
FLIGHT LEVEL............................. 250
RESERVE...................................... 100 NM ALTERNATE + 45 min HOLDING
MAX. TAKEOFF WEIGHT................. 11500 kg
MAX. ZERO FUEL WEIGHT............. 10300 kg
BASIC OPERATING WEIGHT........... 7230 kg (standard configuration)
MAX. USABLE FUEL......................... 2600 kg

Payload x Range - (PW 118 Engines)
Figure 3.3 (Sheet 1)
Payload x Range - (PW 118 Engines)

Figure 3-3 (Sheet 2)
Payload x Range - (PW 118 Engines)

NOTES:
- FLIGHT LEVEL: 250
- RESERVE: 100 NM ALTERNATE + 45 min HOLDING
- MAX. TAKEOFF WEIGHT: 11990 kg
- MAX. ZERO FUEL WEIGHT: 10900 kg
- BASIC OPERATING WEIGHT: 7150 kg (standard configuration)
- MAX. USABLE FUEL: 2800 kg

Payload x Range - (PW 118 Engines)
Figure 3.3 (Sheet 3)
Payload x Range - (PW 118A Engines)

Figure 3.3 (Sheet 5)
Payload x Range - (PW 118A Engines)

Figure 3-3 (Sheet 6)

NOTES:
- FLIGHT LEVEL: 250
- RESERVE: 100 NM
- MAX. TAKEOFF WEIGHT: 11990 kg
- MAX. ZERO FUEL WEIGHT: 10900 kg
- BASIC OPERATING WEIGHT: 7650 kg (standard configuration)
- MAX. USABLE FUEL: 2600 kg
F.A.R. TAKEOFF WEIGHT CLimb LIMITED
Bleed Off, EEC On
Flaps 15°

ENGINE: PW 118

WEIGHT - lb
12500
27000
26000
25000
24000
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11500
11000
10500
10000
9500
9000
8500
8000
-5 0 5 10 15 20 25 30 35 40 45 50 55

STATIC AIR TEMPERATURE - °C

WEIGHT - kg

AIRPORT PRESSURE ALTITUDE (ft)

ISA
ISA + 5°C
ISA + 10°C
ISA + 15°C
ISA + 20°C
ISA + 25°C
ISA + 30°C
ISA + 35°C

2000 ft
4000 ft
6000 ft
8000 ft

FAR Takeoff Weight Requirements - (PW 118 Engines)
Figure 3-4 (Sheet 1)
F.A.R. TAKEOFF WEIGHT CLIMB LIMITED
Bleed Off, EEC On
Flaps 15°

ENGINE: PW 118A

WEIGHT - lb

WEIGHT - kg

STATIC AIR TEMPERATURE - °C

AIRPORT PRESSURE ALTITUDE (ft)

ISA
ISA + 5°C
ISA + 10°C
ISA + 15°C
ISA + 20°C
ISA + 25°C
ISA + 30°C
ISA + 35°C

2000 ft
4000 ft
6000 ft
8000 ft

9000
9500
10000
10500
11000
11500
12000
12500
13000
13500
14000
14500
15000
15500
16000
16500
17000
17500
18000
18500
19000
19500
20000
20500
21000
21500
22000
22500
23000
23500
24000
24500
25000
25500
26000
26500
27000
27500
28000

90°
95°
100°
105°
110°
115°
120°
125°
130°
135°
140°
145°
150°
155°
160°
165°
170°
175°
180°
185°
190°
195°
200°
205°
210°
215°
220°
225°
230°
235°
240°
245°
250°
255°
260°
265°
270°
275°
280°
285°
290°
295°
300°
305°
310°
315°
320°
325°
330°
335°
340°
345°
350°
355°
360°
365°
370°
375°
380°
385°
390°
395°
400°
405°
410°
415°
420°
425°
430°
435°
440°
445°
450°
455°
460°
465°
470°
475°
480°
485°
490°
495°
500°
505°
510°
515°
520°
525°
530°
535°
540°
545°
550°

FAR Takeoff Weight Requirements - (PW 118A Engines)
Figure 3-4 (Sheet 2)
F.A.R. TAKEOFF RUNWAY LENGTH
Dry, Paved
Bleed Off, EEC On
Flaps 15°
ISA

ENGINE: PW 118

AIRPORT PRESSURE ALTITUDE (ft)

Max. design TOW
RT = 11500 kg
ER = 11990 kg

WEIGHT - kg

FAR Takeoff Runway Length Requirements - ISA Conditions
Figure 3-5 (Sheet 1)
F.A.R. TAKEOFF RUNWAY LENGTH
Dry, Paved
Bleed Off, EEC On
Flaps 15°
ISA

ENGINE: PW 118A

8000 ft
6000 ft
4000 ft
2000 ft
SL

Max. design TOW
RT = 11500 kg
ER = 11990 kg

FAR Takeoff Runway Length Requirements - ISA Conditions
Figure 3-5 (Sheet 2)
F.A.R. TAKEOFF RUNWAY LENGTH
Dry, Paved
Bleed Off, EEC On
Flaps 15°
ISA + 15°C

ENGINE: PW 118

Max. design TOW
RT = 11500 kg
ER = 11990 kg

FAR Takeoff Runway Length Requirements - ISA + 15°C Conditions
Figure 3-6 (Sheet 1)
FAR Takeoff Runway Length Requirements - ISA + 15°C Conditions

Figure 3-6 (Sheet 2)
MAXIMUM LANDING WEIGHT - RUNWAY LENGTH LIMITED
FLAPS 45°
ISA - DRY,
LEVELED AND PAVED RUNWAY - ZERO

FAR Landing Runway Length Requirements - Flaps 45°
Figure 3-7
4.1. GENERAL INFORMATION

This section provides airplane turning capability and maneuvering characteristics.

For ease of presentation, these data have been determined from the theoretical limits imposed by the geometry of the aircraft.

As such, they reflect the turning capability of the aircraft in favorable operating circumstances. These data should be used only as guidelines for the method of determination of such parameters and for the maneuvering characteristics of this airplane.

In the ground operating mode, varying airline practices may demand that more conservative turning procedures be adopted to avoid excessive tire wear and reduce possible maintenance problems.

Airline operating techniques will vary, as far as the performance is concerned, over a wide range of operating circumstances throughout the world.

Variations from standard aircraft operating patterns may be necessary to satisfy physical constraints within the maneuvering area, such as adverse grades, limited area or high risk of prop blast and exhaust smoke damage. For these reasons, ground maneuvering requirements should be coordinated with the using airlines prior to layout planning.

This section provides the following information:

- Turning radii for various nose-gear steering angles.
- Data on minimum width pavement for 180° turn.
- Pilot's visibility from the cockpit and the limits of ambinocular vision through the windows. Ambinocular vision is defined as the total field of vision encompassed by both eyes at the same time.
- Performance of the EMB-120 on runway-to-taxiway, and taxiway-to-taxiway turn paths.
- Runway holding bay configuration (illustration).
4.2. **TURNING RADII - NO-SLIP ANGLE**

![Diagram of aircraft with turning radii](120APM040001.MCE)

<table>
<thead>
<tr>
<th>STEERING ANGLE (IN DEGREES)</th>
<th>NOSE R1 (m)</th>
<th>NOSE GEAR R2 (m)</th>
<th>OUTBOARD GEAR R3 (m)</th>
<th>INBOARD GEAR R4 (m)</th>
<th>LH WING TIP R5 (m)</th>
<th>RH WING TIP R6 (m)</th>
<th>TAIL TIP R7 (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
</tr>
<tr>
<td>30°</td>
<td>15.24</td>
<td>50.0</td>
<td>14.16</td>
<td>45.5</td>
<td>8.52</td>
<td>28.0</td>
<td>21.99</td>
</tr>
<tr>
<td>35°</td>
<td>13.59</td>
<td>44.6</td>
<td>12.37</td>
<td>40.6</td>
<td>7.59</td>
<td>21.0</td>
<td>19.87</td>
</tr>
<tr>
<td>40°</td>
<td>12.42</td>
<td>40.7</td>
<td>11.06</td>
<td>36.3</td>
<td>6.39</td>
<td>15.6</td>
<td>18.22</td>
</tr>
<tr>
<td>45°</td>
<td>11.55</td>
<td>37.9</td>
<td>10.08</td>
<td>33.1</td>
<td>5.73</td>
<td>12.1</td>
<td>16.08</td>
</tr>
<tr>
<td>50°</td>
<td>10.90</td>
<td>35.8</td>
<td>9.32</td>
<td>30.6</td>
<td>4.73</td>
<td>7.5</td>
<td>15.43</td>
</tr>
</tbody>
</table>

*Turning Radii - No-Slip Angle*

*Figure 4-1*
4.3. MINIMUM TURNING RADI I

Minimum Turning Radii - No-Slip Angle

Figure 4-2

NOTE: THE CORRECT OPERATING DATA WILL BE HIGHER THAN THE VALUES SHOWN BECAUSE TIRE SLIPAGE IS NOT INCLUDED IN THIS CALCULATION.
4.4. VISIBILITY FROM COCKPIT IN STATIC POSITION

Visibility From Cockpit in Static Position

Figure 4-3
4.5. RUNWAY AND TAXIWAY TURN PATHS

NOTE
NOSE GEAR STEERING ANGLE IS 20° or less
CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE

Figure 4-4

Runway and Taxiway Turn Paths - More Than 90° Turn, Runway to Taxiway

Figure 4-4
Runway and Taxiway Turn Paths - 90° Turn, Runway to Taxiway

Figure 4-5

NOTE
NOSE GEAR STEERING
ANGLE IS 20° or less

CONSULT USING AIRLINE
FOR SPECIFIC OPERATING
PROCEDURE
Runway and Taxiway Turn Paths - 90° Turn, Taxiway to Taxiway

Figure 4-6
4.6. RUNWAY HOLDING BAY

Runway Holding Bay (Apron)

Figure 4-7
5.1 GENERAL INFORMATION

During turnaround at the terminal, certain services must be performed on 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 herein reflect ideal conditions for a single airplane. Service requirements may vary according to airplane condition and airline procedure.

This section provides the following information:

- Typical arrangements of ground support equipment during turnaround.

- Typical turnaround and enroute servicing times at an air terminal. These charts give typical schedules for performing servicing on the airplane within a given time. Servicing times could be rearranged to suit availability of personnel, airplane configuration, and degree of servicing required.

- The locations of ground servicing connections in graphic and tabular forms. Typical capacities and servicing requirements are shown in the figures. Services with requirements that vary with conditions are described in subsequent figures.

- Air conditioning requirements for heating and cooling the airplane, using low-pressure conditioned air. This conditioned air is supplied through an 8-inch GAC directly to the air distribution system, bypassing the air-cycle machines. Normally, a 36000-Bh/hr source would be sufficient to meet air conditioning requirements.
Ground towing requirements for various towing conditions. Drawbar pull and total traction wheel load may be determined by considering airplane weight, pavement slope, coefficient of friction and engine idle thrust.

An example is included with an airplane gross weight of 10000 kg (22046 lb) and two engines with flight idle thrust. When the pavement is assumed to be wet asphalt with a 2% slope, the required total traction wheel load would be 1800 kg (3968 lb) and the drawbar pull would be 1340 kg (2954 lb) (Example A of figure 5-8). When the airplane is backed without idle thrust or with ground idle thrust, these numbers would change to 675 kg (1488 lb) and 500 kg (1102 lb), respectively (Example B of figure 5-8).
5.2. AIRPLANE SERVICING ARRANGEMENT

Airplane Servicing Arrangement (Typical Turnaround)
Figure 5-1 (Sheet 1)
Airplane Servicing Arrangement (Typical Turnaround)
Figure 5-1 (Sheet 2)
### 5.3. AIR TERMINAL OPERATION - TURNAROUND STATION

**Figure 5-2**

<table>
<thead>
<tr>
<th>SHUTDOWN ENGINES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPLANING PASSENGERS</td>
<td>2</td>
</tr>
<tr>
<td>CLEAN CABIN/SERVICE</td>
<td>5</td>
</tr>
<tr>
<td>SERVICE GALLEY</td>
<td>5</td>
</tr>
<tr>
<td>BOARD PASSENGERS</td>
<td>2</td>
</tr>
<tr>
<td>CARGO SERVICE</td>
<td></td>
</tr>
<tr>
<td>UNLOAD CARGO/BAGGAGE</td>
<td>3</td>
</tr>
<tr>
<td>LOAD CARGO/BAGGAGE</td>
<td>3</td>
</tr>
<tr>
<td>AIRPLANE SERVICE</td>
<td></td>
</tr>
<tr>
<td>FUEL AIRPLANE</td>
<td>4</td>
</tr>
<tr>
<td>SERVICE TOILET</td>
<td>6</td>
</tr>
<tr>
<td>START ENGINES</td>
<td></td>
</tr>
<tr>
<td>ELAPSED TIME (MINUTES)</td>
<td>SET CHOCKS</td>
</tr>
</tbody>
</table>

**NOTE:** THESE DATA ARE PROVIDED TO ILLUSTRATE THE GENERAL SCOPE AND TYPES OF TASKS INVOLVED IN TERMINAL OPERATIONS. VARYING AIRLINE PRACTICES AND OPERATING CIRCUMSTANCES THROUGHOUT THE WORLD WILL RESULT IN DIFFERENT SEQUENCES AND TIME INTERVALS TO ACCOMPLISH THE TASKS SHOWN. BECAUSE OF THIS, GROUND OPERATION REQUIREMENTS SHOULD BE COORDINATED WITH THE USING AIRLINES PRIOR TO RAMP PLANNING.
5.4. AIR TERMINAL OPERATIONS - EN-ROUTE STATION

### Figure 5-3

<table>
<thead>
<tr>
<th>SHUTDOWN ENGINES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPLAN PASSENGERS</td>
<td>1</td>
</tr>
<tr>
<td>SERVICE GALLEY</td>
<td>3</td>
</tr>
<tr>
<td>BOARD PASSENGERS</td>
<td>1</td>
</tr>
<tr>
<td>UNLOAD CARGO/BAGGAGE</td>
<td>2</td>
</tr>
<tr>
<td>LOAD CARGO/BAGGAGE</td>
<td>2</td>
</tr>
<tr>
<td>FUEL AIRPLANE</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELAPSED TIME (MINUTES)</th>
<th>SET CHOCKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

**NOTE:**

These data are provided to illustrate the general scope and types of tasks involved in terminal operations, varying airline practices and operating circumstances throughout the world. Different sequences and time intervals to accomplish the tasks shown. Because of this, ground operation requirements should be coordinated with the using airlines prior to ramp planning. Galley service through baggage door entry.

---

Air Terminal Operations - En-route Station

*Figure 5-3*
5.5. GROUND SERVICING CONNECTIONS

Ground Servicing Connections
Figure 5-4
### External Electrical Power
- An external electrical power receptacle accessible through an access door.
- Nominal voltage: 28 V DC. During ground operations, the electrical power may be supplied by the APU generator (if applicable) or by an external electrical power supply with 28 V DC, 300A thru 1500A, as required.

<table>
<thead>
<tr>
<th>Servicing Point</th>
<th>RH Side</th>
<th>LH Side</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Electrical Power</strong></td>
<td>2.3 m</td>
<td>7.4 ft</td>
<td>1.0 m</td>
</tr>
<tr>
<td></td>
<td>1.0 m</td>
<td>3.3 ft</td>
<td>1.6 m</td>
</tr>
<tr>
<td></td>
<td>1.6 m</td>
<td>5.4 ft</td>
<td></td>
</tr>
</tbody>
</table>

### Oxygen System
- A panel with a pressure gage and a valve for recharging. System charging pressure is 1275 Kpa (1850 psig) at a temperature of 21°C (70°F).

<table>
<thead>
<tr>
<th>Servicing Point</th>
<th>RH Side</th>
<th>LH Side</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oxygen System</strong></td>
<td>4.0 m</td>
<td>12.8 ft</td>
<td>0.8 m</td>
</tr>
<tr>
<td></td>
<td>2.6 m</td>
<td>1.5 ft</td>
<td>4.9 ft</td>
</tr>
</tbody>
</table>

### Air Conditioning System
- An air conditioning service connection of 8.0 in (20.3 cm) GAC (MS33562). See figures 5-6 and 5-7.
- Maximum Flow: 90 lb/min (40.8 kg/min)
- Maximum Pressure: 254 mm H2O (10 in H2O)

<table>
<thead>
<tr>
<th>Servicing Point</th>
<th>RH Side</th>
<th>LH Side</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Conditioning System</strong></td>
<td>10.8 m</td>
<td>35.2 ft</td>
<td>0.3 m</td>
</tr>
<tr>
<td></td>
<td>1.0 m</td>
<td>1.1 ft</td>
<td>3.6 ft</td>
</tr>
<tr>
<td>SERVICING POINTS</td>
<td>NOSE DISTANCE</td>
<td>DISTANCE FROM CENTER LINE</td>
<td>HEIGHT</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------</td>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>m</td>
<td>ft</td>
<td>m</td>
</tr>
<tr>
<td>Aft toilet position</td>
<td>12.7</td>
<td>41.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Forward toilet position</td>
<td>4.6</td>
<td>15.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Toilet - A 4.0 in (10.16 cm) servicing connection and a 1.0 in (2.54 cm) connection for waste water and toilet bowl refilling. Pre-charge of toilet bowl - 6.5 l (17 US Gal)</td>
<td>6.9</td>
<td>22.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Engine Oil Refilling</td>
<td>8.4</td>
<td>27.6</td>
<td>4.3</td>
</tr>
<tr>
<td>- Accessible through an access door installed at the engine left upper cowl.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System total capacity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6 US Gal (25.0 l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil tank total capacity - 8.9 l (2.4 US Gal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual (non-drainable) quantity - 1.1 l (0.3 US Gal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pressure Refueling Adapter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The adapter inlet port is provided with a flange which allows connections with standard MS29520 type fueling nozzle. It is located on the right wing leading edge underside.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refueling pressure - 241.3 thru 344.7 Kpa (35 thru 50 (psig)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ground Servicing Connection Data
Figure 5-5 (Sheet 2)
### Gravity Refueling Filler Caps
- A filler cap installed on each wing upper surface. Total fuel capacity - 882 US Gal (3340 l).
- Usable fuel 33121 (874 US Gal)
- Left wing outboard and inboard tanks - 1670 l (441 US Gal)
- Right wing outboard and inboard tanks - 1670 l (441 US Gal)

<table>
<thead>
<tr>
<th>SERVICING POINTS</th>
<th>NOSE DISTANCE</th>
<th>DISTANCE FROM CENTER LINE</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m ft</td>
<td>m ft</td>
<td>m ft</td>
</tr>
<tr>
<td>Gravity Refueling Filler Caps</td>
<td>8.6 28.4</td>
<td>8.4 27.6</td>
<td>8.4 27.6</td>
</tr>
</tbody>
</table>

### Hydraulic Fluid Refilling
- Two systems (two reservoir), one service panel with two couplings
- Capacity of each reservoir - 4.3 l (1.1 US Gal)

<table>
<thead>
<tr>
<th>SERVICING POINTS</th>
<th>NOSE DISTANCE</th>
<th>DISTANCE FROM CENTER LINE</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m ft</td>
<td>m ft</td>
<td>m ft</td>
</tr>
<tr>
<td>Hydraulic Fluid Refilling</td>
<td>9.5 31.2</td>
<td>3.4 11.2</td>
<td>1.1 3.6</td>
</tr>
</tbody>
</table>

### A.P.U. Oil Refilling
- Accessible through an access door installed on the left side of tail cone.
- Capacity - 4.2 l (0.6 US Gal)

<table>
<thead>
<tr>
<th>SERVICING POINTS</th>
<th>NOSE DISTANCE</th>
<th>DISTANCE FROM CENTER LINE</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m ft</td>
<td>m ft</td>
<td>m ft</td>
</tr>
<tr>
<td>A.P.U. Oil Refilling</td>
<td>17.1 56.0</td>
<td>0.2 0.6</td>
<td>2.4 7.9</td>
</tr>
</tbody>
</table>

Ground Servicing Connection Data
Figure 5-5 (Sheet 3)
### 5.6. CONDITIONED AIR REQUIREMENTS

<table>
<thead>
<tr>
<th>CONDITIONS</th>
<th>AMBIENT TEMP</th>
<th>SOLAR LOAD (BTU/H)</th>
<th>ELECTRICAL LOAD (BTU/H)</th>
<th>OCCUPANTS</th>
<th>CABIN TEMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(°C)</td>
<td>(°F)</td>
<td></td>
<td>(°C)</td>
<td>(°F)</td>
</tr>
<tr>
<td>1</td>
<td>39</td>
<td>103</td>
<td>7034</td>
<td>8799</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>39</td>
<td>103</td>
<td>7034</td>
<td>8799</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>39</td>
<td>103</td>
<td>0</td>
<td>8799</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>-40</td>
<td>-40</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>-29</td>
<td>-20</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>-18</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

---

**Pre-Conditioned Airflow Requirements**

*Figure 5-6*
5.7. CABIN PULLUP/PULLDOWN TIME

Cabin Pullup/Pulldown Time - APU Bleed Source

Figure 5.7
5.8. GROUND TOWING REQUIREMENTS

Ground Towing Requirements
Figure 5-8
6.1. PROPELLER AND ENGINE WAKE AND DANGER AREAS

6.1.1. General Information

This section provides information on prop blast and engine exhaust velocities and temperatures for different engine power conditions. In addition, data of engine propeller and APU areas are presented.

NOTE: In engine power settings above FLIGHT IDLE/FEATHER (Fl/FEA), the prop slipstream cools the exhaust gases, thus rendering the temperature data insignificant.
6.1.2. Propeller Blast Velocities

NOTES:
- ENGINE LEVER SETTING: REV/MIN RPM
- OAT: 18 °C (64.4°F)
- PRESSURE ALTITUDE: 640 m (2100 ft)

DISTANCE - m (ft) | SPEED - m/s (kt)
---|---
20 (66.6) | 4.0 (7.8)
15 (49.2) | 4.5 (8.7)
10 (32.8) | 5.5 (10.7)
5 (16.4) | 10.5 (20)

Propeller Blast Velocities
Figure 6.1
6.1.3. Propeller Blast/Engine Exhaust Velocities

**Engine Lever Setting**

**Ground Idle/Min RPM**

<table>
<thead>
<tr>
<th>Distance (ft)</th>
<th>Temperature (°C)</th>
<th>Speed (m/s) (KT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (16.4)</td>
<td>21 (69.8)</td>
<td>1.5 (2.9)</td>
</tr>
</tbody>
</table>

**Engine Lever Setting**

**Ground Idle/Max RPM**

<table>
<thead>
<tr>
<th>Distance (ft)</th>
<th>Temperature (°C)</th>
<th>Speed (m/s) (KT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (16.4)</td>
<td>54 (129.2)</td>
<td>6.5 (12.6)</td>
</tr>
<tr>
<td>10 (32.8)</td>
<td>39 (102.2)</td>
<td>6.0 (11.6)</td>
</tr>
<tr>
<td>15 (49.2)</td>
<td>31 (67.8)</td>
<td>4.8 (9.3)</td>
</tr>
<tr>
<td>20 (65.6)</td>
<td>21 (69.8)</td>
<td>3.0 (5.8)</td>
</tr>
</tbody>
</table>

**Engine Lever Setting**

**Ground Idle/Feather**

<table>
<thead>
<tr>
<th>Distance (ft)</th>
<th>Temperature (°C)</th>
<th>Speed (m/s) (KT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (16.4)</td>
<td>50 (122)</td>
<td>6.5 (12.6)</td>
</tr>
<tr>
<td>10 (32.8)</td>
<td>38 (96)</td>
<td>5.5 (10.7)</td>
</tr>
<tr>
<td>15 (49.2)</td>
<td>25 (77)</td>
<td>4.0 (7.8)</td>
</tr>
</tbody>
</table>

**Notes:**
- OAT: 18°C (64.4°F)
- Pressure Altitude: 640 m (2100 ft)
### Propeller Blast/Engine Exhaust Velocities

**Figure 6-2 (Sheet 2)**

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>Speed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10.4</td>
</tr>
<tr>
<td>10</td>
<td>12.6</td>
</tr>
<tr>
<td>15</td>
<td>14.5</td>
</tr>
<tr>
<td>20</td>
<td>17.6</td>
</tr>
<tr>
<td>25</td>
<td>20.0</td>
</tr>
<tr>
<td>30</td>
<td>25.0</td>
</tr>
<tr>
<td>35</td>
<td>31.2</td>
</tr>
<tr>
<td>40</td>
<td>37.0</td>
</tr>
<tr>
<td>45</td>
<td>43.8</td>
</tr>
<tr>
<td>50</td>
<td>50.5</td>
</tr>
</tbody>
</table>

**Notes:**
- OAT: 10°C (50°F)
- Pressure Altitude: 640 m (2100 ft)

**Engine Lever Setting**
- FLT Idle Feather
NOTES:  
- ENGINE POWER, TAKEOFF  
- OAT: 18 °C (64.4 °F)  
- PRESSURE ALTITUDE: 640 m (2100 ft)
6.1.4. Danger Areas

Figure 6-3

Danger Areas
6.2. AIRPORT AND COMMUNITY NOISE

Aircraft 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 local 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 noise 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 matter; 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:

6.2.1. 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.
6.2.2. Atmospheric Conditions - Sound Propagation

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

6.2.3. Surface Condition - shielding, Extra Ground Attenuation (EGA)

(a) Terrain - If the ground slopes down after takeoff or up before landing, noise will be reduced since the aircraft will be at a higher altitude above the ground. Additionally, hills, shrubs, trees, and large buildings can act as sound buffers.

All of 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 for EPNL and SEL scales, at the following conditions:

**Condition 1**

| ISA + 10°C | No wind |
| Sea level | No runway slope |
| Humidity 70% | Without noise |

**LANDING**

Maximum design landing weight

1.3 \( V_s \) + 10 knots

ILS standard approach angle - 3°

**TAKEOFF**

Maximum design takeoff weight

\( V_2 \) + 10 knots
Condition 2

ISA + 10°C  
Sea level  
Humidity 70%  
No wind  
No runway slope  
Without noise abatement procedure

LANDING
90% of maximum design landing weight  
1.3 Vs + 10 knots  
ILS standard approach angle - 3°

TAKEOFF
90% of maximum design takeoff weight  
V2 + 10 knots

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 the average load factors are less than 100 percent. Therefore, in developing cumulative contours for planning purposes, it is recommended that the airlines servicing a particular city be contacted to provide operational information.

In addition, there are no universally accepted methods for developing aircraft noise contours for relating the acceptability of specific noise zones to specific land uses. It is therefore expected that the noise contour data for a particular aircraft and the impact assessment methodology change. To ensure that currently available information of this type is used in any planning study, it is recommended that it be obtained directly from the local Environmental Quality agency.

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 EMB-120 BRASILIA. It is expected that the cumulative contours be developed as required by planners using the data and methodology applicable to their specific study.
DISTANCE FROM START OF TAKE-OFF ROLL (km)

CONDITION 1

ISA +10°C
SEA LEVEL
HUMIDITY 70%
NO WIND
NO RUNWAY SLOPE
WITHOUT NOISE ABATEMENT PROCEDURE

LANDING
100% OF MLW: 11700 kg (25794 lb )
1.3Vs + 10 knots
ILS STANDARD APPROACH ANGLE 3°

TAKEOFF
100% OF MTOW: 11990 kg (26433 lb)
V2 + 10 knots
FLAP 15°

EMB-120 EPNL Noise Contours
Condition 1
Figure 6-4
DISTANCE FROM START OF TAKE-OFF ROLL (km)

CONDITION 1

ISA+10°C
SEA LEVEL
HUMIDITY 70%
NO WIND
NO RUNWAY SLOPE
WITHOUT NOISE ABATEMENT PROCEDURE

LANDING
100% OF MLW: 11700 kg (25794 lb)
1.3Vs+10 knots
ILS STANDARD APPROACH ANGLE 3°

TAKEOFF
100% OF MTOW: 11990 kg (26433 lb)
V2+10 knots
FLAP 15°

EMB-120 SEL Noise Contours
Condition 1
Figure 6-5
DISTANCE FROM START OF TAKE-OFF ROLL (km)

CONDITION 2

ISA + 10°C
SEA LEVEL
HUMIDITY 70%
NO WIND
NO RUNWAY SLOPE
WITHOUT NOISE ABATEMENT PROCEDURE

LANDING
90% OF MLW: 10530 kg (23215 lb)
1.3Vs + 10 knots
ILS STANDARD APPROACH ANGLE 3°

TAKEOFF
90% OF MTOW: 10791 kg (23790 lb)
V2 + 10 knots
FLAP 15°

EMB-120 EPNL Noise Contours
Condition 2
Figure 6-6
CONDITION 2

ISA +10°C
SEA LEVEL
HUMIDITY 70%
NO WIND
NO RUNWAY SLOPE
WITHOUT NOISE ABATEMENT PROCEDURE

LANDING
90% OF MLW: 10530 kg (23215 lb)
1.3Vs+10 knots
ILS STANDARD APPROACH ANGLE 3°

TAKEOFF
90% OF MTOW: 10791 kg (23790 lb)
V2+10 knots
FLAP 15°

EMB-120 SEL Noise Contours
Condition 2
Figure 6-7
7.1. GENERAL INFORMATION

Pavement or Pavement Structure is defined as a structure consisting of one or more layers of processed materials.

The primary function of a pavement is to distribute concentrated loads so that the supporting capacity of the subgrade soil is not exceeded. The subgrade soil is defined as the material on which the pavement rests, whether embankment or excavation.

Several methods for design of airport pavements have been developed that differ considerably in their approach. Generally speaking, the design methods are derived from observation of pavements in service or experimental pavements. Thus, the reliability of any method is proportional to the amount of experience or experimental verification behind the method, and all methods require a considerable amount of common sense and judgment on the part of the engineer who applies them.

Each airplane configuration is depicted with a minimum range of five loads imposed on the main landing gear to aid in the interpolation between the discrete values shown. The tire pressure used for the 120 model charts will produce the recommended tire deflection with the airplane loaded to its maximum taxi weight and with center of gravity position. The tire pressure where specifically designated on table and charts are values obtained under loaded conditions as certificated for commercial use.

This section presents EMB-120 basic data on landing gear footprint configuration, maximum design taxi loads, and tire sizes and pressures. The tire pressures shown are given for optimum flotation at the condition of maximum design taxi weight. In addition, maximum pavement loads for certain critical conditions at the tire-ground interface are presented.

Pavement requirements for commercial airplanes are customarily derived from the static analysis of loads imposed on the main landing gear struts. Figures 7-3 are provided in order to determine these loads throughout the stability limits of the airplane at rest on pavement. These main landing gear
loads are used to center the pavement design charts which follow, interpolating load values where necessary.

### 7.2. LANDING GEAR FOOTPRINT

<table>
<thead>
<tr>
<th></th>
<th>EMB-120 MODEL</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>RT</strong></td>
<td><strong>ER</strong></td>
<td></td>
</tr>
<tr>
<td>MAXIMUM DESIGN TAXI WEIGHT</td>
<td>11580 kg</td>
<td>12070 kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22529 lb</td>
<td>26610 lb</td>
<td></td>
</tr>
<tr>
<td>NOSE TIRE SIZE</td>
<td>18 x 5.5 (10 PR)</td>
<td>18 x 5.5 (10 PR)</td>
<td></td>
</tr>
<tr>
<td>NOSE TIRE PRESSURE</td>
<td>483-552 kPa</td>
<td>538-565 kPa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70-80 psi</td>
<td>78-82 psi</td>
<td></td>
</tr>
<tr>
<td>MAIN GEAR TIRE SIZE</td>
<td>24 x 7.25-12 (10 PR)</td>
<td>24 x 7.25-12 (12 PR)</td>
<td></td>
</tr>
<tr>
<td>MAIN GEAR TIRE PRESSURE</td>
<td>759-828 kPa</td>
<td>910-938 kPa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110-120 psi</td>
<td>132-136 psi</td>
<td></td>
</tr>
</tbody>
</table>

Landing Gear Footprint

Figure 7-1
7.3. MAXIMUM PAVEMENT LOADS

VNG = Maximum vertical nose gear ground load at most forward center of gravity
VMG = Maximum vertical main gear ground load at most aft center of gravity
H = Maximum horizontal ground load from braking

**NOTE:** All loads calculated using airplane maximum design taxi weight.

<table>
<thead>
<tr>
<th></th>
<th>MAXIMUM DESIGN TAXI WEIGHT</th>
<th>EMB-120 MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg (lb)</td>
<td>RT</td>
</tr>
<tr>
<td><strong>MAXIMUM DESIGN TAXI WEIGHT</strong></td>
<td></td>
<td>11580 (25529)</td>
</tr>
<tr>
<td>VNG Static at most forward center of gravity</td>
<td>kg (lb)</td>
<td>1335 (2943)</td>
</tr>
<tr>
<td>VNG Steady braking with deceleration of 3m/s²</td>
<td>kg (lb)</td>
<td>2200 (4850)</td>
</tr>
<tr>
<td>VMG PER STRUT Static at most aft center of gravity</td>
<td>kg (lb)</td>
<td>5490 (12103)</td>
</tr>
<tr>
<td>VMG PER STRUT Steady braking with deceleration of 3m/s²</td>
<td>kg (lb)</td>
<td>1555 (3428)</td>
</tr>
<tr>
<td>H PER STRUT Instantaneous braking (coefficient of friction -0.8)</td>
<td>kg (lb)</td>
<td>3535 (7793)</td>
</tr>
</tbody>
</table>

Maximum Pavement Loads
Figure 7-2
7.4. LANDING GEAR LOADING ON PAVEMENT

Main Landing Gear Loading on Pavement
Figure 7-3 (Sheet 1)
Main Landing Gear Loading Pavement
Figure 7-3 (Sheet 2)
Runway Types and Nomenclature

Figure 7-4
7.5. ACN-PCN METHOD

The ACN/PCN METHOD as referenced in Annex 14, "Aerodromes", 8th Edition, March 1983, provides a standardized international airplane/pavement rating system. ACN is the Aircraft Classification Number and PCN is the corresponding Pavement Classification Number. To determine the ACN of an aircraft on flexible or rigid pavement, both the aircraft gross weight and the subgrade strength must be known. An aircraft having an ACN equal to or less than the PCN can operate without restriction on the pavement. Numerically, the ACN is two times 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 1.25 MPa (181 psi) that would have the same pavement requirements as the aircraft. Computationally, the ACN/PCN METHOD 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:

- **PCN NUMERICAL VALUE**
- **EVALUATION METHOD**
  - T - TECHNICAL STUDY
  - U - AIRCRAFT EXPERIENCE
- **PAVEMENT TYPE**
  - R - RIGID
  - F - FLEXIBLE
- **TIRE PRESSURE CATEGORY**
  - W - NO LIMIT
  - X - TO 1.75 MPa (254 psi)
  - Y - TO 1.25 MPa (181 psi)
  - Z - TO 0.5 MPa (73 psi)
- **SUBGRADE CATEGORY**
  - A - HIGH
  - B - MEDIUM
  - C - LOW
  - D - ULTRA LOW
The following table shows the ACN values for flexible and rigid pavements:

**EMB-120RT and EMB-120ER Aircraft Classification Number (ACN)**

<table>
<thead>
<tr>
<th>SUBGRADE STRENGTH</th>
<th>RIGID PAVEMENT</th>
<th>FLEXIBLE PAVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMB-120 RT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Taxi Weight</td>
<td>6.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Operational Empty Weight</td>
<td>2.8</td>
<td>2.4</td>
</tr>
<tr>
<td>EMB-120 ER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Taxi Weight</td>
<td>6.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Operational Empty Weight</td>
<td>2.9</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**NOTE:** The value used for Operational Empty Weight (6500 kg) in the ACN charts (Figures 7-5 and 7-6) is the minimum value for both versions of EMB-120 (RT and ER).

The four subgrade categories for flexible pavements are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Strength</th>
<th>CBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High</td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td>Medium</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>Low</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>Ultra Low</td>
<td>3</td>
</tr>
</tbody>
</table>
The four subgrade categories for rigid pavements are.

<table>
<thead>
<tr>
<th>Code</th>
<th>Strength Description</th>
<th>K Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High Strength</td>
<td>$K = 150 \text{ MN/m}^3 \ (550 \text{ lb/in}^3)$</td>
</tr>
<tr>
<td>B</td>
<td>Medium Strength</td>
<td>$K = 80 \text{ MN/m}^3 \ (300 \text{ lb/in}^3)$</td>
</tr>
<tr>
<td>C</td>
<td>Low Strength</td>
<td>$K = 40 \text{ MN/m}^3 \ (150 \text{ lb/in}^3)$</td>
</tr>
<tr>
<td>D</td>
<td>Ultra Low Strength</td>
<td>$K = 20 \text{ MN/m}^3 \ (75 \text{ lb/in}^3)$</td>
</tr>
</tbody>
</table>
7.5.1. AIRCRAFT CLASSIFICATION NUMBER FLEXIBLE PAVEMENT EMB-120RT

FLEXIBLE PAVEMENT SUBGRADES - MODEL EMB-120RT

NOTE: TIRE PRESSURE 122.5 psi (LOADED)
FLEXIBLE PAVEMENT SUBGRADES - MODEL EMB-120ER

NOTE: TIRE PRESSURE 134 psi (LOADED)

AIRCRAFT CLASSIFICATION NUMBER - ACN

AIRCRAFT GROSS WEIGHT - kg

AIRCRAFT GROSS WEIGHT - lb

Aircraft Classification Number - Flexible Pavement
Figure 7-5 (Sheet 2)
7.5.2. Aircraft Classification Number - Rigid Pavement EMB-120RT

**Rigid Pavement Subgrades - Model EMB-120RT**

NOTE: Tire Pressure 122.5 psi (Loaded)

![Graph showing aircraft classification number vs. aircraft gross weight](image)

**Figure 7-6** (Sheet 1)
RIGID PAVEMENT SUBGRADES - MODEL EMB-120ER

NOTE: TIRE PRESSURE 134 psi (LOADED)

Aircraft Classification Number - Rigid Pavement

Figure 7-6 (Sheet 2)
7.6. FLEXIBLE PAVEMENT REQUIREMENTS

The flexible pavement design curves (Figure 7-7 Sheets 1 and 2) are based on procedures set forth in Instruction Report No. S-77-1, "Procedures for Development of CBR Design Curves", dated June 1977, and as modified according to the methods described in FAA Advisory Circular 150/5320-6D, "Airport Pavement Design and Evaluation", dated July 7, 1995. 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 Aircraft Classification Number (ACN).

The design criteria involve the use of several significant parameters, including load, load distribution, load repetitions, strength and thickness. The first three are concerned with the loading delivered to the pavement, whereas strength and thickness are concerned with the pavement and the materials of which it is constructed.

The design curves presented treat load in terms of gross aircraft weight.

In working with the design criteria, load repetitions were dealt with in terms of annual departures. The criteria are for a 20-year life.

Strength considerations include the ability of the pavement to resist shear deformation and densification. The strength of soil in regard to its resistance to shear deformation is assessed by use of the California Bearing Ratio (CBR).

Thickness of overlying construction is the parameter which determines the protection of a layer of given strength from the load applied to the pavement surface above it.

In the example shown in Figure 7-7 Sheet 1, for a CBR of 5 and an annual departure level of 1.200, the required flexible pavement thickness for a gross weight of 11,580 kg (25,530 lb) is 31 cm (12.2 in).

The LCN Method curves for flexible pavements (Figure 7-8 Sheets 1 and 2) have been built using procedures and curves in the International Civil Aviation Organization (ICAO) Aerodrome Design Manual, Part 3 - Pavements, Document 9157-AN/901, 1983.

The same chart includes the data of equivalent single-wheel load versus pavement thickness.
Flexible Pavement Requirements - US Army Corps of Engineers Design Method

Figure 7-7 (Sheet 1)
Flexible Pavement Requirements - US Army Corps of Engineers Design Method

Figure 7-7 (Sheet 2)

EMB - 120ER
SUBGRADE STRENGTH - CBR

WEIGHT ON MAIN LANDING GEAR (lb) (kg)
- 26610 12062
- 25794 11692
- 24030 10890
- 18298 8294
- 14330 6496

MAXIMUM POSSIBLE MAIN GEAR LOAD AT MAXIMUM DESIGN TAXI WEIGHT AND AFT CG

10000 COVERAGE (USED FOR ACN CALCULATIONS)

ANNUAL DEPARTURES
- 1200
- 3000
- 6000
- 15000
- 25000

FLEXIBLE PAVEMENT THICKNESS (in)

FLEXIBLE PAVEMENT THICKNESS (cm)
7.6.2. FLEXIBLE PAVEMENT REQUIREMENT - LCN METHOD

TIRE PRESSURE 122.5psi (8.61 kg/cm²)

NOTE: EQUIVALENT SINGLE WHEEL LOADS ARE DERIVED BY METHODS SHOWN IN ICAO AERODROME MANUAL, PART 2, PAR. 4.1.3

Flexible Pavement Requirements - LCN Method
Figure 7-8 (Sheet 1)
Flexible Pavement Requirements - LCN Method

Figure 7-8 (Sheet 2)

TIRE PRESSURE 134 psi (9.42 kgf/cm²) (LOADED)

NOTE: EQUIVALENT SINGLE WHEEL LOADS ARE DERIVED BY METHODS SHOWN IN ICAO AERODROME MANUAL, PART 2, PAR. 4.1.3
7.7. RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION (PCA) DESIGN METHOD

Rigid pavement design curves (Figure 7-9 Sheets 1 and 2) have been prepared with the use of the Westergaard Equation in general accordance with the procedures outlined in the 1955 edition of "Design of Concrete Airport Pavement" published by the Portland Cement Association, 33 W. Grand Ave., Chicago 10, Illinois, but modified to the new format described in the 1968 Portland Cement Association publication, "Computer Program for Concrete Airport Pavement Design" (Program PDILB) by Robert G. Packard. The following procedure is used to develop rigid pavement design curves such as that shown in the Figures 7-9.

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

2. All values of the subgrade modulus (k-values) are then plotted.

3. Additional load lines for the incremental values of weight on the main landing gear are then established on the basis of the curve for k = 300, already established.

Strength considerations include resisting stresses applied to the foundation by the loaded slab. Stress can be controlled by increasing the strength of the soil layer supporting the pavement slab or by increasing the thickness of the slab.

The design of rigid pavements is based upon the critical tensile stresses produced by the aircraft loads. The ability of the pavement to withstand these stresses is, in turn determined by the strength of the concrete.
NOTE: TIRE PRESSURE 122.5 psi (LOADED)

WEIGHT ON MAIN LANDING GEAR
(kg) (lb)
(SEE SECTION 7 - 4)

MAXIMUM DESIGN
POSSIBLE MAIN
AXIAL LOAD AND
AP PROXIMATE
OVERALL (K=300)
OVERALL (K=550)
OVERALL (K=800)
OVERALL (K=1000)
OVERALL (K=1200)
OVERALL (K=1400)
OVERALL (K=1600)

ALLOWABLE WORKING STRESS - Kgf/cm²
ALLOWABLE WORKING STRESS - psi

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".

REFERENCE: PORTLAND CEMENT ASSOCIATION METHOD.

Rigid Pavement Requirements - Portland Cement Association Design Method
Figure 7-9 (Sheet 1)
NOTE: TIRE PRESSURE 134 psi (LOADED)

WEIGHT ON MAIN LANDING GEAR
kg (lb)
(SEE SECTION 7 - 4)

Maximum
Maximum
Possible Main Gear Load At CG
K = 75 lbs/ft²
K = 150 lbs/ft²
K = 300 lbs/ft²
K = 550 lbs/ft²

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".

REFERENCE: PORTLAND CEMENT ASSOCIATION METHOD.

Rigid Pavement Requirements - Portland Cement Association Design Method
Figure 7-9 (Sheet 2)
7.8. RIGID PAVEMENT REQUIREMENTS - LCN METHOD

The LCN conversion curves for rigid pavements (Figure 12 - Sheets 1 and 2) have been built using procedures and curves in (ICAO) Aerodrome Design Manual, Part 3 - Pavements, document 9157-AN/901, 1983. The same chart includes the data of equivalent single-wheel load versus radius of relative stiffness. Radius of relative stiffness values are obtained from Subsections 7.8.1. and 7.8.2.

To determine the airplane weight that can be accommodated on a particular rigid airport pavement, both the LCN of the pavement and the radius of relative stiffness must be known.
### 7.8.1. Radius of Relative Stiffness

The radius of relative stiffness is given by the equation:

\[ r = \frac{\sqrt{\frac{Ea^2}{12(1-\nu^2)}}}{4\sqrt{\frac{d^3}{k}}} \]

where:
- \( E \) = Young's Modulus = \( 4 \times 10^6 \) psi
- \( k \) = Subgrade Modulus, lb/in^2
- \( d \) = Rigid-Pavement Thickness, in.
- \( \nu \) = Poisson's Ratio = 0.15

| \( d \) (in) | 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | 9.0 | 9.5 | 10.0 | 10.5 | 11.0 | 11.5 | 12.0 | 12.5 | 13.0 | 13.5 | 14.0 | 14.5 | 15.0 | 15.5 | 16.0 | 16.5 | 17.0 | 17.5 | 18.0 | 18.5 | 19.0 | 19.5 | 20.0 | 20.5 | 21.0 | 21.5 | 22.0 | 22.5 | 23.0 | 23.5 | 24.0 | 24.5 | 25.0 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| \( k = 75 \) | 31.48 | 29.30 | 26.47 | 24.63 | 23.30 | 22.26 | 21.42 | 20.72 | 19.59 | 19.13 | 18.68 | 18.26 | 17.92 | 17.65 | 17.46 | 17.33 | 17.25 | 17.20 | 17.17 | 17.15 | 17.13 | 17.12 | 17.11 | 17.10 | 17.09 | 17.08 | 17.07 | 17.06 | 17.05 | 17.04 | 17.03 | 17.02 | 17.01 | 17.00 | 16.99 | 16.98 |
| \( k = 100 \) | 33.43 | 31.11 | 28.11 | 26.16 | 24.74 | 23.64 | 22.74 | 22.00 | 20.80 | 20.31 | 19.84 | 19.43 | 19.09 | 18.82 | 18.60 | 18.43 | 18.30 | 18.22 | 18.16 | 18.12 | 18.09 | 18.07 | 18.05 | 18.03 | 18.01 | 17.99 | 17.97 | 17.95 | 17.93 | 17.91 | 17.89 | 17.87 | 17.85 | 17.83 | 17.81 |
| \( k = 150 \) | 36.34 | 32.89 | 29.72 | 27.65 | 25.16 | 24.04 | 23.25 | 22.19 | 21.14 | 20.41 | 19.77 | 19.28 | 18.88 | 18.56 | 18.30 | 18.13 | 18.00 | 17.90 | 17.82 | 17.76 | 17.71 | 17.68 | 17.66 | 17.64 | 17.62 | 17.60 | 17.58 | 17.56 | 17.54 | 17.52 | 17.50 | 17.48 | 17.46 | 17.44 | 17.42 |

**Radius of Relative Stiffness**

*Figure 7-10*
7.8.2. RADIUS OF RELATIVE STIFFNESS (OTHER VALUES)

The table of section 7.8.1. (Figure 7-10) presents the (RRS) Radius of Relative Stiffness values based on Young's modulus (E) of 4,000,000 psi and Poisson's ratio (µ) of 0.15.

For convenience in finding this Radius based on other values of E and µ, the curves of section 7.8.2. are included.

For example, to find a RRS value based on an E of 3,000,000 psi, the “E” factor of 0.931 is multiplied by the RRS value found in figure 7-11. The effect of the variations of µ on the RRS value is treated in a similar manner.
Radius of Relative Stiffness (Other Values)

Figure 7-11
TIRE PRESSURE: 122.5 psi (8.61 kgf/cm²)

NOTE: EQUIVALENT SINGLE WHEEL LOADS ARE DERIVED BY METHODS SHOWN IN ICAO AERODROME MANUAL, PART 2, PAR. 41,3
Tires pressure 134 psi (9.42 kg/cm²) (Loaded)

**NOTE:** Equivalent single wheel loads are derived by methods shown in ICAO Aerodrome Manual, Part 2, Par. 4.1.3

Rigid Pavement Requirements - LCN Method

Figure 7-12 (Sheet 2)
7.9. UNSURFACED SOIL AREAS REQUIREMENTS

Unsurfaced soil areas may be used by aircraft where the strength is sufficient.

There are instances when the natural subgrade do not have sufficient strength to support a particular load, so that a soil or aggregate strengthening layer is required on top of the subgrade.

The CBR is the soil strength parameter used in unsurfaced soil strength determinations.

A thickness of higher strength soil is at times needed above the subgrade to upgrade the capacity of an unsurfaced soil area, when the in situ soil does not have the strength needed to support the anticipated traffic.

To illustrate the use of the soil strength criteria, assume that an unsurfaced airfield is to be designed for 12,000 departures of EMB-120 (BRASILIA), having a gross weight of 11,580 kg (25,530 lb). Enter the curves in Figure 7-13, with the 12,000 aircraft departures, move vertically to the 11,580 kg line, then horizontally to the CBR scale and read a value of 7.8. This indicates that a soil having a CBR of 7.8 or greater will support 12,000 departures of EMB-120 with a gross weight of 11,580 kg (25,530 lb).

The above example illustrating the soil strength criteria indicated that a CBR of 7.8 was required in order to support 12,000 departures of EMB-120 having a gross weight of 11,580 kg (25,530 lb). Assume that an airfield is to be provided for EMB-120 at a location where the in-place CBR is 5. This will require some thickness of soil to be placed over the 5 CBR in order to support the EMB-120. The traffic level of 12,000 departures represents 600 annual departures for a 20-year life. From Figure 7-14, the thickness requirement for a 5 CBR, 600 annual departures and 11,580 kg (25,530 lb) gross weight is 23.4 cm (9.2 in). This thickness of soil must have a strength equal to the soil strength requirement of 7.8 CBR.
CBR Required for Supporting EMB-120 Brasilia on Unsurfaced Soils

Figure 7-13
Unsurfaced Soil Thickness Design for EMB-120 Brasilia

Figure 7-14
8.1. GENERAL INFORMATION

This section provides concepts of hangar and workstands for preliminary planning purposes. These concepts are not the result of detailed studies but are included to show the approximate area.

A maintenance hangar should provide a weather safe space where aircraft maintenance and repair may be accomplished. It may include space for aircraft shops, support equipment, and administration functions.

Plans for a maintenance facility should include the following considerations:

(a) Level of maintenance to be performed.

(b) Clearances - (i.e., hangar door height and ability to jack airplane to swing landing gear).

(c) Tug drive-through capability.

(d) Structural Materials/Design.

(e) Security.

(f) Local union working requirements.

(g) Environmental controls - prevailing winds and temperatures.

(h) Airplane capacity and storage space.

(i) Local building codes.

(j) Site location - with respect to taxiways, runways, and electronic requirements.
(k) Expansion.

(l) Special features:

- Cranes
- Landing gear pits
- Workstands
- Cleaning and painting
- Fire protection
- Drainage
- Pneumatic, electrical, and hydraulic connections
Single-bay Hangar and Supporting Area

Figure 8-1
Hangar and Supporting Equipment
Figure 8-2
9.1. GENERAL INFORMATION

This section provides EMB-120 plan views to the following scales:

- **English**
  1 inch = 32 feet  
  1 inch = 50 feet  
  1 inch = 100 feet

- **Metric**
  1:500  
  1:1000
LEGEND:
A  AIR CONDITIONING CONNECTION
B  BAGGAGE DOOR
E  ELECTRICAL POWER DC RECEPTACLE
EO  ENGINE OIL SUPPLY PANEL
F  GRAVITY FUEL FILLER
J  RAMP INTERPHONE JACKS
MLG  MAIN LANDING GEAR
NLG  NOSE LANDING GEAR
R  PRESSURE REFUELING AND DEFUELING CONNECTION
SO  OXYGEN SUPPLY RECEPTACLE
T  TOILET SERVICE
X  PASSENGER DOOR
+  TURNING RADIUS POINTS:
   50°, 45°, 40°, 36°, 30°
LEGEND:
A  AIR CONDITIONING CONNECTION
B  BAGGAGE DOOR
E  ELECTRICAL POWER DC RECEPTACLE
EO  ENGINE OIL SUPPLY PANEL
F  GRAVITY FUEL FILLER
J  RAMP INTERPHONE JACKS
MLG  MAIN LANDING GEAR
NLG  NOSE LANDING GEAR
R  PRESSURE REFUELLING AND DEFUELING CONNECTION
SO  OXYGEN SUPPLY RECEPTACLE
T  TOILET SERVICE
X  PASSENGER DOOR
+  TURNING RADIUS POINTS:
   50°, 45°, 40°, 35°, 30°
LEGEND:

A  AIR CONDITIONING CONNECTION
B  BAGGAGE DOOR
E  ELECTRICAL POWER DC RECEPTACLE
EO ENGINE OIL SUPPLY PANEL
F  GRAVITY FUEL FILLER
J  RAMP INTERPHONE JACKS
MLG MAIN LANDING GEAR
NLG NOSE LANDING GEAR
R  PRESSURE REFUELING AND DEFUELING CONNECTION
SO OXYGEN SUPPLY RECEPTACLE
T  TOILET SERVICE
X  PASSENGER DOOR
+  TURNING RADIUS POINTS:
   50°, 45°, 40°, 35°, 30°
LEGEND:

A  AIR CONDITIONING CONNECTION
B  BAGGAGE DOOR
E  ELECTRICAL POWER DC RECEPTACLE
EO  ENGINE OIL SUPPLY PANEL
F  GRAVITY FUEL FILLER
J  RAMP INTERPHONE JACKS
MLG  MAIN LANDING GEAR
NLG  NOSE LANDING GEAR
R  PRESSURE REFUELING AND DEFUELING CONNECTION
SO  OXYGEN SUPPLY RECEPTACLE
T  TOILET SERVICE
X  PASSENGER DOOR
+  TURNING RADIUS POINTS:
    50°, 45°, 40°, 35°, 30°
LEGEND:

A  AIR CONDITIONING CONNECTION  
B  BAGGAGE DOOR  
E  ELECTRICAL POWER DC RECEPTACLE  
EO  ENGINE OIL SUPPLY PANEL  
F  GRAVITY FUEL FILLER  
J  RAMP INTERPHONE JACKS  
MLG  MAIN LANDING GEAR  
NLG  NOSE LANDING GEAR  
R  PRESSURE REFueling AND DEFueling CONNECTION  
SO  OXYGEN SUPPLY RECEPTACLE  
T  TOILET SERVICE  
X  PASSENGER DOOR  
+  TURNING RADIUS POINTS:  
50°, 45°, 40°, 35°, 30°  

EMB-120 Scale: 1 to 1000  
Figure 9-2 (Sheet 2)