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 and FAA Design Method

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 Design 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 chart in Section 7.4 is 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, and as modified according to the methods described in FAA Advisory Circular AC 150/5320-6C Change 2, "Airport Pavement Design and Evaluation," dated September 14, 1988. 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 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 Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077-1083. 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 rigid pavement design curves (Section 7.9) have been developed based on methods used in the FAA Advisory Circular AC 150/5320-6C, September 14, 1988. The following procedure is used to develop the curves, such as shown in Section 7.9:

1. Having established the scale for pavement flexure strength on the left and temporary scale for pavement thickness on the right, an arbitrary load line is drawn representing the main landing gear maximum weight to be shown at 5,000 coverages.

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

3. Additional load lines for the incremental values of weight are then drawn on the basis of the subgrade modulus curves already established.

4. The permanent scale for the rigid-pavement thickness is then placed. Lines for other than 5,000 coverages are established based on the aircraft pass-to-coverage ratio.
The ACN/PCN system (Section 7.10) as referenced in ICAO document 9157-AN/901, Aerodrome Design Manual, Part 3, Pavements, Second Edition 1983, 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 = Rigid</td>
<td>A = High</td>
<td>W = No Limit</td>
<td>T = Technical</td>
<td></td>
</tr>
<tr>
<td>F = Flexible</td>
<td>B = Medium</td>
<td>X = To 217 psi (1.5 MPa)</td>
<td>U = Using Aircraft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C = Low</td>
<td>Y = To 145 psi (1.0 MPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D = Ultra Low</td>
<td>Z = To 73 psi (0.5 MPa)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 7.10.1 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 7.10.2 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

<table>
<thead>
<tr>
<th>MAXIMUM DESIGN TAXI WEIGHT</th>
<th>747-400D</th>
<th>747-400, 747-400COMBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>LB</td>
<td>603,000 TO 613,500</td>
<td>803,000 TO 853,000</td>
</tr>
<tr>
<td>KG</td>
<td>273,517 TO 278,279</td>
<td>364,235 TO 386,915</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERCENT OF WEIGHT ON MAIN GEAR</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEE SECTION 7.4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOSE GEAR TIRE SIZE</th>
<th>IN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>49X17, 32 PR (1)</td>
<td>49X17, 32 PR (2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOSE GEAR TIRE PRESSURE</th>
<th>PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>10.55 (1)</td>
<td>14.06 (2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAIN GEAR TIRE SIZE</th>
<th>IN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>H49 X 19.0 - 22, 24 PR</td>
<td>H49 X 19.0 - 22, 32 PR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAIN GEAR TIRE PRESSURE (3)</th>
<th>PSI</th>
<th>KG/CM²</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>10.55</td>
<td>13.36</td>
</tr>
<tr>
<td>190</td>
<td>13.71</td>
<td></td>
</tr>
<tr>
<td>195</td>
<td>14.06</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) OPTION: 49X19.0-20 32PR OR 34PR AT 150 PSI (10.55 KG/CM²) OR H49X19.0-22, 24PR AT 150 PSI (10.55 KG/CM²).

(2) OPTION: 49X19.0-20, 32PR OR 34PR AT 185 PSI (13.01 KG/CM²) OR H49X19.0-22, 32PR AT 175 PSI (12.30 KG/CM²)

(3) COLD, LOADED PRESSURES SHOWN. TOLERANCE = +5/-0 PSI.

### 7.2.1 LANDING GEAR FOOTPRINT

*Model 747-400, -400 COMBI, -400 DOMESTIC*

D6-58326-1
### UNITS

**MAXIMUM DESIGN TAXI WEIGHT**

- **LB**
  - 803,000
  - 836,000 TO 853,000
  - 873,000 TO 877,000

- **KG**
  - 364,235
  - 379,204 TO 386,915
  - 375,987 TO 397,801

**PERCENT OF WEIGHT ON MAIN GEAR**

- **%**
  - SEE SECTION 7.4

**NOSE GEAR TIRE SIZE**

- **IN.**
  - H49 X 19.0 - 22 32PR

**NOSE GEAR TIRE PRESSURE**

- **PSI**
  - 175

- **KG/CM²**
  - 12.30

**MAIN GEAR TIRE SIZE**

- **IN.**
  - H49 X 19.0 - 22, 32 PR

**MAIN GEAR TIRE PRESSURE (1)**

- **PSI**
  - 190
  - 195
  - 200

- **KG/CM²**
  - 13.36
  - 13.71
  - 14.06

(1) COLD, LOADED PRESSURES SHOWN. TOLERANCE = +5/-0 PSI.

---

### 7.2.2 LANDING GEAR FOOTPRINT

**MODEL 747-400 FREIGHTER**

- **D6-58326-1**

DECEMBER 2002  157
### Units

<table>
<thead>
<tr>
<th>Units</th>
<th>747-400ER</th>
<th>747-400ER Freighter</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAXIMUM DESIGN TAXI WEIGHT</td>
<td>LB 913,000 KG 414,130</td>
<td>LB 913,000 KG 414,130</td>
</tr>
<tr>
<td>PERCENT OF WEIGHT ON MAIN GEAR</td>
<td>% SEE SECTION 7.4</td>
<td>SEE SECTION 7.4</td>
</tr>
<tr>
<td>NOSE GEAR TIRE SIZE</td>
<td>IN. 50 X 20.0 R 22, 34 PR</td>
<td>50 X 20.0 R 22, 34 PR</td>
</tr>
<tr>
<td>NOSE GEAR TIRE PRESSURE</td>
<td>PSI 190 KG/CM² 13.36</td>
<td>PSI 190 KG/CM² 13.36</td>
</tr>
<tr>
<td>MAIN GEAR TIRE SIZE</td>
<td>IN. 50 X 20.0 R 22, 34 PR</td>
<td>50 X 20.0 R, 34 PR</td>
</tr>
<tr>
<td>MAIN GEAR TIRE PRESSURE</td>
<td>PSI 230 KG/CM² 16.17</td>
<td>PSI 230 KG/CM² 16.17</td>
</tr>
</tbody>
</table>

### 7.2.3 LANDING GEAR FOOTPRINT

*MODEL 747-400ER, -400ER FREIGHTER*

D6-58326-1

DECEMBER 2002
\[ V_{NG} = \text{MAXIMUM VERTICAL NOSE GEAR GROUND LOAD AT MOST FORWARD CENTER OF GRAVITY} \]
\[ V_{MG} = \text{MAXIMUM VERTICAL MAIN GEAR GROUND LOAD AT MOST AFT CENTER OF GRAVITY} \]
\[ H = \text{MAXIMUM HORIZONTAL GROUND LOAD FROM BRAKING} \]

**NOTES:**
1. ALL LOADS CALCULATED USING AIRPLANE MAXIMUM DESIGN TAXI WEIGHT
2. ALL CALCULATED VALUES AND CONVERSIONS ROUNDED TO NEAREST 100 LB AND 50 KG.

<table>
<thead>
<tr>
<th>AIRPLANE MODEL</th>
<th>UNITS</th>
<th>MAX DESIGN TAXI WEIGHT</th>
<th>( V_{NG} )</th>
<th>( V_{MG} ) PER STRUT (4)</th>
<th>( H ) PER STRUT (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>747-400</td>
<td>LB</td>
<td>803,000</td>
<td>93,300</td>
<td>138,200</td>
<td>191,500</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>364,250</td>
<td>42,350</td>
<td>62,700</td>
<td>86,850</td>
</tr>
<tr>
<td>747-400*</td>
<td>LB</td>
<td>803,000</td>
<td>65,900</td>
<td>110,800</td>
<td>191,500</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>364,250</td>
<td>29,900</td>
<td>50,250</td>
<td>86,850</td>
</tr>
<tr>
<td>747-400</td>
<td>LB</td>
<td>836,000</td>
<td>93,000</td>
<td>139,900</td>
<td>197,300</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>379,200</td>
<td>42,200</td>
<td>63,450</td>
<td>89,500</td>
</tr>
<tr>
<td>747-400*</td>
<td>LB</td>
<td>836,000</td>
<td>68,100</td>
<td>114,800</td>
<td>197,300</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>379,200</td>
<td>30,850</td>
<td>52,150</td>
<td>89,500</td>
</tr>
<tr>
<td>747-400</td>
<td>LB</td>
<td>853,000</td>
<td>92,200</td>
<td>139,900</td>
<td>200,300</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>386,900</td>
<td>41,800</td>
<td>63,450</td>
<td>90,850</td>
</tr>
<tr>
<td>747-400*</td>
<td>LB</td>
<td>853,000</td>
<td>66,600</td>
<td>116,300</td>
<td>200,300</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>386,900</td>
<td>31,100</td>
<td>52,750</td>
<td>90,850</td>
</tr>
<tr>
<td>747-400</td>
<td>LB</td>
<td>873,000</td>
<td>68,800</td>
<td>117,700</td>
<td>204,500</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>396,000</td>
<td>32,100</td>
<td>53,400</td>
<td>92,750</td>
</tr>
<tr>
<td>747-400</td>
<td>LB</td>
<td>877,000</td>
<td>64,000</td>
<td>114,000</td>
<td>204,600</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>397,800</td>
<td>29,000</td>
<td>51,700</td>
<td>92,600</td>
</tr>
<tr>
<td>747-400F</td>
<td>LB</td>
<td>873,000</td>
<td>80,100</td>
<td>116,200</td>
<td>204,500</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>396,000</td>
<td>36,350</td>
<td>52,700</td>
<td>92,750</td>
</tr>
<tr>
<td>747-400F*</td>
<td>LB</td>
<td>873,000</td>
<td>67,400</td>
<td>116,200</td>
<td>204,500</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>396,000</td>
<td>30,550</td>
<td>52,700</td>
<td>92,750</td>
</tr>
<tr>
<td>747-400F</td>
<td>LB</td>
<td>877,000</td>
<td>76,500</td>
<td>127,900</td>
<td>204,600</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>397,800</td>
<td>34,700</td>
<td>58,000</td>
<td>92,800</td>
</tr>
<tr>
<td>747-400F*</td>
<td>LB</td>
<td>877,000</td>
<td>67,400</td>
<td>118,800</td>
<td>204,600</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>397,800</td>
<td>30,550</td>
<td>53,900</td>
<td>92,800</td>
</tr>
<tr>
<td>747-400D</td>
<td>LB</td>
<td>603,000</td>
<td>70,100</td>
<td>103,800</td>
<td>145,200</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>273,500</td>
<td>31,800</td>
<td>47,100</td>
<td>65,900</td>
</tr>
<tr>
<td>747-400D</td>
<td>LB</td>
<td>613,500</td>
<td>71,300</td>
<td>105,600</td>
<td>147,800</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>278,300</td>
<td>32,350</td>
<td>47,900</td>
<td>67,050</td>
</tr>
<tr>
<td>747-400ER</td>
<td>LB</td>
<td>913,000</td>
<td>71,950</td>
<td>122,400</td>
<td>213,600</td>
</tr>
<tr>
<td></td>
<td>KG</td>
<td>414,150</td>
<td>32,650</td>
<td>55,550</td>
<td>96,900</td>
</tr>
<tr>
<td>747-400ER</td>
<td>LB</td>
<td>913,000</td>
<td>73,300</td>
<td>130,950</td>
<td>213,600</td>
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<td></td>
<td>KG</td>
<td>414,150</td>
<td>35,050</td>
<td>59,400</td>
<td>96,900</td>
</tr>
</tbody>
</table>

* AIRPLANE WITH TAIL TANK FUEL

### 7.3. MAXIMUM PAVEMENT LOADS

**MODEL 747-400**

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7.4.1 LANDING GEAR LOADING ON PAVEMENT
MODEL 747-400, -400 COMBI, -400 DOMESTIC
7.4.2 LANDING GEAR LOADING ON PAVEMENT
MODEL 747-400 FREIGHTER

NOTE: UNSHADED AREAS REPRESENT OPERATIONAL LIMITS
7.4.3 LANDING GEAR LOADING ON PAVEMENT

Model 747-400ER
7.4.4 LANDING GEAR LOADING ON PAVEMENT
MODEL 747-400ER FREIGHTER
7.5 Flexible Pavement Requirements - U.S. Army Corps of Engineers Method (S-77-1) and FAA Design Method

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 35.5 and an annual departure level of 6,000, the required flexible pavement thickness for a 747-400 airplane with a main gear loading of 818,400 pounds is 13.1 inches. In Section 7.5.2, for the same CBR and departure levels, the required flexible pavement thickness for a 747-400ER airplane with a main gear loading of 854,408 pounds is 14.2 inches.

The line showing 10,000 coverages is used for ACN calculations (see Section 7.10).

The FAA design method uses a similar procedure using total airplane weight instead of weight on the main landing gears. The equivalent main gear loads for a given airplane weight could be calculated from Section 7.4.
7.5.1 FLEXIBLE PAVEMENT REQUIREMENTS - U.S. ARMY CORPS OF ENGINEERS DESIGN METHOD (S-77-1) AND FAA DESIGN METHOD

MODEL 747-400, -400 COMBI, -400 DOMESTIC, - 400 FREIGHTER
7.5.2 FLEXIBLE PAVEMENT REQUIREMENTS - U.S. ARMY CORPS OF ENGINEERS DESIGN METHOD (S-77-1)

MODEL 747-400ER, -400ER FREIGHTER
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 21 inches with an LCN of 63. For these conditions, the apparent maximum allowable weight permissible on the main landing gear is 500,000 pounds for a 747-400 airplane with 200-psi main gear tires. In Section 7.6.2, for a flexible pavement thickness of 30 inches with an LCN of 95, the apparent maximum allowable weight permissible on the main landing gear is 600,000 pounds for a 747-400ER airplane with 230-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 Design Manual, Part 3, "Pavements," First Edition dated 1977.)
7.6.1 FLEXIBLE PAVEMENT REQUIREMENTS - LCN METHOD

MODEL 747-400, -400 COMBI, -400 DOMESTIC, -400 FREIGHTER

LOAD CLASSIFICATION NUMBER (LCN)

INCHES

CENTIMETERS

FLEXIBLE PAVEMENT THICKNESS, h

EQUIVALENT SINGLE-WHEEL LOAD

WEIGHT ON MAIN LANDING GEAR

MAXIMUM POSSIBLE MAIN GEAR LOAD AT MAXIMUM DESIGN TAXI WEIGHT (877,000 LB) AND AFT CG

TIRE PRESSURE

WEIGHT (1,000 KG) AND AFT CG

NOTES:

* TIRES - H49x19.0-22, 24PR AT 150 PSI (10.55 KGF/CM²)
* TIRES - H49x19.0-22, 32PR AT 200 PSI (14.06 KGF/CM²)
* EQUIVALENT SINGLE-WHEEL LOADS ARE DERIVED

ICAO AERODROME MANUAL, PART 2 PAR. 4.1.3, DATED 1965.

SEE SEC 7.4

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7.6.2 FLEXIBLE PAVEMENT REQUIREMENTS - LCN METHOD
MODEL 747-400ER, -400ER FREIGHTER
7.7 Rigid Pavement Requirements - Portland Cement Association Design Method

The Portland Cement Association method of calculating rigid pavement requirements is based on the computerized version of "Design of Concrete Airport Pavement" (Portland Cement Association, 1965) as described in XP6705-2, "Computer Program for Airport Pavement Design" by Robert G. Packard, Portland Cement Association, 1968.

The rigid pavement design charts in Section 7.7.1 and Section 7.7.2 present 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, a main gear load on a 747-400 airplane of 700,000 pounds, and a subgrade strength (k) of 300, the required rigid pavement thickness is 9.6 inches. In Section 7.7.2, for an allowable working stress of 550 psi, a main gear load on a 747-400ER airplane of 800,000 pounds, and a subgrade strength (k) of 300, the required rigid pavement thickness is 10.8 inches.
7.7.1 RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION DESIGN METHOD

MODEL 747-400, -400 COMBI, -400 DOMESTIC, - 400 FREIGHTER

D6-58326-1

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7.7.2 RIGID PAVEMENT REQUIREMENTS - PORTLAND CEMENT ASSOCIATION DESIGN METHOD
MODEL 747-400ER, -400ER FREIGHTER
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 ($R$) 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 48 with an LCN of 58, the apparent maximum allowable weight permissible on the main landing gear is 400,000 pounds for a 747-400 airplane with 200-psi main tires. In Section 7.8.3, for a rigid pavement with a radius of relative stiffness of 47 with an LCN of 91, the apparent maximum allowable weight permissible on the main landing gear is 600,000 pounds for a 747-400ER airplane with 230-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 Design Manual, Part 3, "Pavements," First Edition dated 1977).
\[ t = \sqrt[4]{\frac{E d^3}{12(1-\mu^2)k}} = 4.1652 \sqrt[4]{\frac{d^3}{k}} \]

Where:
- \( E \) = Young's Modulus of Elasticity = 4 x 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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### 7.8.1 RADIUS OF RELATIVE STIFFNESS

(Reference: Portland Cement Association)
7.8.2 RIGID PAVEMENT REQUIREMENTS - LCN CONVERSION
MODEL 747-400, -400 COMBI, -400 DOMESTIC, -400 FREIGHTER

D6-S8326-1

NOTES:
* TIRES - H49x19.0-22, 24PR AT 150 PSI (10.55 KG/SQ CM)
* TIRES - H49x19.0-22, 32PR AT 200 PSI (14.06 KG/SQ CM)
* EQUIVALENT SINGLE-WHEEL LOADS ARE DERIVED FROM
ICAO AERODROME MANUAL, PART 2 PAR 4.1.3, DATED 1965.

LOAD CLASSIFICATION NUMBER (LCN)

EQUIVALENT SINGLE-WHEEL LOAD
1,000 KILOGRAMS

1,000 POUNDS

MAX POSSIBLE MAIN GEAR LOAD
AT MAX DESIGN TAXI WEIGHT
(877,000 LB MW)
AND AFT CG

WEIGHT ON MAIN
Landing Gear
(See Sec 7.9.1)

784,000 (35.56)
700,000 (27.45)
600,000 (22.85)
500,000 (20.22)
300,000 (12.04)
200,000 (8.32)

LOAD PRESSURE
(PSI)

150 10.55
200 14.06

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

NOTES:
* TIRES - 50 x 20 R22, 34PR AT 230 PSI (16.17 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 TAKE-OFF WEIGHT
AND AFT CG (973,000 LB MTW)
WEIGHT ON MAIN LANDING GEAR
(SEE SEC 7.4)

- 854,408 (387,553)
- 800,000 (362,874)
- 700,000 (317,515)
- 600,000 (272,156)
- 500,000 (226,796)
- 400,000 (181,437)
7.9 Rigid Pavement Requirements - FAA Design Method

The rigid pavement design charts shown in Section 7.9.1 and Section 7.9.2 present data on six incremental main gear loads at the minimum tire pressure required at the maximum design taxi weight.

In the example shown in Section 7.9.1, for a pavement flexure strength of 725 psi, a subgrade strength of \( k = 300 \), and an annual departure level of 6,000, the required rigid pavement thickness for a 747-400 airplane with a main gear load of 600,000 pounds is 10.4 inches. In Section 7.9.2, for a pavement flexure strength of 700 psi, a subgrade strength of \( k = 300 \), and an annual departure level of 3,000, the required rigid pavement thickness for a 747-40ER airplane with a main gear load of 600,000 pounds is 10.4 inches.
7.9.1 RIGID PAVEMENT REQUIREMENTS - FAA DESIGN METHOD
MODEL 747-400, -400 COMBI, -400 DOMESTIC, - 400 FREIGHTER
7.9.2 RIGID PAVEMENT REQUIREMENTS - FAA DESIGN METHOD

MODEL 747-400ER, -400ER FREIGHTER
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. In the example in Section 7.10.1, for a 747-400 aircraft with a gross weight of 675,000 pounds and medium subgrade strength, the flexible pavement ACN is 45. In Section 7.10.3, for the same aircraft and subgrade strength, the rigid pavement ACN is 43.8. In Section 7.10.2, for a 747-400ER aircraft with a gross weight of 900,000 pounds and medium subgrade strength, the flexible pavement ACN is 60.5. In Section 7.10.4, for the same aircraft and subgrade strength, the rigid pavement ACN is 57.8.

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.

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<th>ALL-UP MASS/OPERATING MASS EMPTY LB (KG)</th>
<th>LOAD ON ONE MAIN GEAR LEG (%)</th>
<th>TIRE PRESSURE PSI (MPa)</th>
<th>HIGH 150</th>
<th>MEDIUM 80</th>
<th>LOW 40</th>
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D6-58326-1

180 DECEMBER 2002
7.10.1 AIRCRAFT CLASSIFICATION NUMBER - FLEXIBLE PAVEMENT
MODEL 747-400, -400 COMBI, -400 DOMESTIC, - 400 FREIGHTER
7.10.2 AIRCRAFT CLASSIFICATION NUMBER - FLEXIBLE PAVEMENT

MODEL 747-400ER, -400ER FREIGHTER
D6-58326-1

NOTES:
- 50x 20 R22, 34 PR
- PRESSURE = 230PSI (16.17 KG/CM SQ)

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

1. ACN WAS DETERMINED AS REFERENCED IN AMENDMENT 38 TO ICAO ANNEX 14 “AERODROMES”, 8TH EDITION, MARCH 1983
2. TO DETERMINE MAIN LANDING GEAR LOADING, SEE SECTION 7.4.
3. PERCENT WEIGHT ON MAIN LANDING GEAR: 93.6
NOTES:
- Tires - 49 x 19.0 - 22, 32PR
- Pressure - Constant at 200 psi (14.06 kg/sq cm)

CODE D - K = 75 (Ultra Low)
CODE C - K = 150 (Low)
CODE B - K = 300 (Medium)
CODE A - K = 550 (High)

2. To determine main landing gear loading, see Section 7.4.
3. Percent weight on main landing gear: 93.32.
7.10.4 AIRCRAFT CLASSIFICATION NUMBER - RIGID PAVEMENT
MODEL 747-400ER, -400ER FREIGHTER

D6-58326-1

NOTES:
* 50x 20 R22, 34 PR
* PRESSURE = 230PSI (16.17 KG/CM SQ)

CODE D - k=75 (ULTRA LOW)
CODE C - k=150 (LOW)
CODE B - k=300 (MEDIUM)
CODE A - k=550 (HIGH)

NOTES:
1. ACN WAS DETERMINED AS REFERENCED IN AMENDMENT 38 TO ICAO ANNEX 14 "AERODROMES", 8TH EDITION, MARCH 1983
2. TO DETERMINE MAIN LANDING GEAR LOADNG, SEE SECTION 7.4.
3. PERCENT WEIGHT ON MAIN LANDING GEAR: 93.6