CIVIL AVIATION PUBLICATION

AGA 13

USE OF PAVEMENT WITH ACN HIGHER THAN PCN

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1.0 PURPOSE

This Advisory Circular is intended to provide guidance and limitations for use of a pavement by an aircraft with an Aircraft Classification Number (ACN) higher than the reported Pavement Classification Number (PCN) as a means of complying with Civil Aviation Regulations CAR AGA 1 and Annex 14 Volume 1 and to explain the regulatory requirements of Aerodrome Operators.

2.0 REFERENCES

Civil Aviation Regulations CAR AGA 1

ICAO Annex 14 Volume 1 (Aerodromes)

ICAO Document 9157 Aerodrome Design Manual, Part 3 Pavements

3.0 DEFINITIONS AND TERMS

Term	Definition/Description
ACN-PCN Method	A method to assign a pavement with a particular PCN value with an aircraft that has an ACN value equal to or less than the associated PCN.
Aircraft Classification Number (ACN)	A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.
Flexible Pavement	A pavement structure that maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.
Pavement Classification Number (PCN)	A number expressing the bearing strength of a pavement for unrestricted operations.
Rigid Pavement	The combination of sub-base, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the subgrade.

4.0 GENERAL

The ACN/PCN method has been developed by the International Civil Aviation Organization (ICAO) in 1981 as an international method of reporting the bearing strength of a pavement intended for aircraft of mass greater than 5 700 kg (12,566 lbs.). This method is meant only for the publication of pavement strength data in the Aeronautical Information Publications (AIPs). It is not intended for design or evaluation of pavements, nor does it contemplate the use of a specific method by the airport authority either for the design or evaluation of pavements.

In addition, mandatory requirements to regulate pavement strength and overload operations are specified in ICAO Annex 14 Volume 1 and The Civil Aviation Authority Bahamas (CAAB), CAR AGA 1. The principles in this document are to provide guidance and limitations on overload operations to ensure all runway, taxiway and apron pavement surfaces are maintained at high quality so as not to damage aircraft or personnel in the vicinity of pavement, by an aircraft with an Aircraft Classification Number (ACN) higher than the Pavement Classification Number (PCN) since excessive repetition of overloads can shorten pavement life or require major rehabilitation.

Where overload operations are conducted, the appropriate authority should review the criteria for overload operations and the relevant pavement condition regularly.

5.0 OVERLOAD OPERATIONS

Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behaviour are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behaviour is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration.

For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

1) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 % above the reported PCN should not adversely affect the pavement;

2) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 % above the reported PCN should not adversely affect the pavement;

3) if the pavement structure is unknown, the 5 % limitation should apply; and

4) the annual number of overload movements should not exceed approximately 5 % of the total annual aircraft movements.

Such overload movements should not normally be permitted on pavements exhibiting signs of loading distress or failure. Furthermore, overloading should be avoided when the strength of the pavement or its subgrade could be weakened by water.

6.0 PRACTICES IN THE UNITED KINGDOM

ICAO has provided practices from the United Kingdom regarding overload operations in ICAO Document 9157 Aerodrome Design Manual, Part 3 Pavements. These methods are acceptable for use by aerodrome operators within The Commonwealth of the Bahamas under the following conditions:

a) Where there is a 10 % difference in ACN over PCN:
   1) The pavement is more than 12 months old;
   2) The pavement is not already showing signs of loading distress; and

Overload operations do not exceed 5% of the annual departures and are spread throughout the year;

b) Overload operations representing a difference in ACN over PCN of from 10% to 25% justify regular inspections of the pavement by a competent person in addition to satisfying the above criteria. There should be an immediate curtailment of such overload operations as soon as distress becomes evident, and the higher loading should not be re-imposed until appropriate pavement strengthening work has been completed;
c) Overload operations representing a difference in ACN over PCN of from 25% to 50% may be undertaken under special circumstances. They call for scrutiny of available pavement construction records as test data by a qualified pavement engineer and a thorough inspection by a pavement engineer before and on completion of the movement to assess any signs of pavement distress; and
d) Overload operations in excess of an ACN over PCN of 50% should only be undertaken in an emergency.

6.1 Flexible Pavement Operations

The U.S. Corps of Engineers method is used to calculate the pavement thickness required for 10,000 coverages for single wheel loads having 1250 Kpa (18 psi) tire pressure on four standard bearing strengths.

The four standards subgrades used are based on California Bearing Ratio (CBR):

Subgrade Code A	High strength	CBR 15
Subgrade Code B	Medium strength	CBR 10
Subgrade Code C	Low strength	CBR 6
Subgrade Code D	Ultra low strength	CBR 3

7.1 ACN FOR SEVERAL AIRCRAFT TYPES

For convenience tabulation from ICAO Document 9157 Aerodrome Design Manual, Part 3, have been provided with ACN for several aircraft types based on the (4) four types of subgrade strength for rigid and flexible pavements. The tabulation for the ACN and the criteria for the subgrade strength are listed.

To assist with general use, ACN values for various aircraft types operating on flexible and rigid pavements are provided in the table below:

The ACN values have been determined for operations on flexible and rigid pavements overlying the four standards subgrade strengths by aircraft operating at MTOW, OWE and a given operating tyre pressure (TP).

Units of weight (mass) are kilograms and units of tyre pressure are kilopascals.

Specific ACN values for a particular aircraft should be obtained from the aircraft manufacturer.

Table of ACNs for Several Aircraft Types

AIRCRAFT TYPE	MTOW(KG) OWE (KG) TP (Kpa)	Flexible Pavement Subgrade CBR%				Rigid Pavement Subgrade K in MN/m3			
		A 15	B 10	C 6	D 3	A K150	B K80	C K40	D K20
A319-100	75865 38952	39 18	40 18	44 20	50 22	44 20	46 21	48 22	50 23

	1380								
A320-100	68013 39768 1210	35 19	36 19	40 21	46 24	38 20	41 22	43 23	45 24
A320-200	77395 44968 1440	41 22	42 22	47 24	53 28	46 24	49 26	51 27	53 58
A321-100	78414 47000 1280	42 23	44 24	49 25	55 30	47 25	50 27	52 29	54 30
A330-300	212000 121870 580	55 29	60 30	69 33	94 41	47 28	54 27	64 31	75 36
A340-300	271000 129300 1380	59 24	64 25	74 28	100 34	50 25	58 24	69 26	80 30
A340- 500,600	366072 178448 1420	70 29	76 31	90 34	121 42	60 29	70 28	83 32	97 37
A380-800	562262 281233 1470	56 23	62 25	75 28	106 36	55 26	67 27	88 31	110 38
Antonov AN-124-100	391972 203940 1030	51 20	60 23	77 27	107 40	35 17	48 18	73 23	100 32
Antonov AN-225	600000 458865 1130	63 41	75 48	95 62	132 88	45 30	61 39	89 55	125 75
ATR 42-200	18559 11217 720	9 5	10 5	11 6	13 7	10 6	11 6	12 7	12 7
ATR 72	21516 12746 790	11 6	12 6	14 7	15 8	13 7	14 7	14 8	15 8
B707-320C	152407 67495 1240	44 16	50 17	60 19	76 25	41 15	49 16	58 19	66 22
B717- 100,200,300	54885 32110 1048	31 16	33 17	37 19	40 22	35 18	37 19	38 20	40 21
B737-BBJ	77826 42942 1470	46 21	45 22	50 24	55 28	50 24	52 26	54 27	56 28

AIRCRAFT TYPE	MTOW(KG) OWE (KG) TP (Kpa)	Flexible Pavement Subgrade CBR%				Rigid Pavement Subgrade K in MN/m3			
B727-200	78517 45887 1150	42 23	44 25	50 25	55 30	47 24	50 26	52 28	54 29
B737-300	63527 33140 1400	35 16	37 17	41 18	45 21	40 19	42 20	44 21	46 22
B737-400	68320 35689 1280	38 18	40 18	45 20	49 23	43 20	45 21	47 22	49 23
B737-500	60774 32630 1340	33 16	35 16	39 18	43 21	38 18	40 19	42 20	43 21
B737-600	65770 36400 1300	35 18	36 18	40 19	45 22	39 19	41 21	44 22	45 23
B737-700	70359 37728 1390	38 18	40 19	44 20	49 23	43 21	46 22	48 23	50 24
B737-800	79230 41400 1470	44 21	46 21	51 23	56 26	51 23	53 25	55 26	57 27
B737-900	79230 41400 1470	44 21	46 22	51 24	56 28	51 24	53 25	55 27	57 28
B747-200B	364200 173320 1400	51 20	57 22	69 24	91 31	47 19	56 21	66 24	76 28
B747-300	379100 174820 1296	53 20	60 22	74 24	95 31	48 18	57 20	68 24	79 28
B747-400	398192 183546 1380	59 23	66 24	82 27	105 35	54 20	65 23	77 27	88 31
B757-200	115634 58123 1240	34 14	38 15	47 17	60 23	32 13	38 15	45 18	52 20
B767-200	141520 80890 1172	37 18.7	40 19	48 22	66 28	32 16	38 18	45 21	53 25
B767-200 ER	157400 80890	42 19	46 20	55 22	75 28	37 17	44 19	53 22	61 25

	1260								
B767-300	159685 87694 1380	44 21	49 22	59 25	79 33	40 19	48 22	57 25	65 29
B767-300 ER	172820 88000 1260	48 21	53 22	65 25	86 32	41 18	50 20	60 24	70 28

AIRCRAFT TYPE	**MTOW(KG) OWE (KG) TP (Kpa)**	**Flexible Pavement Subgrade CBR%**				**Rigid Pavement Subgrade K in MN/m3**			
		A 15	**B 10**	**C 6**	**D 3**	**A K150**	**B K80**	**C K40**	**D K20**
B777-200ER	287861 136945 1480	49 19	54 20	67 23	93 30	50 22	63 22	82 26	100 33
B777-300	300300 159277 1480	53 23	59 25	73 28	101 38	54 20	69 27	89 33	108 42
B777-300ER	352441 167830 1550	64 24	71 25	89 29	120 40	66 27	86 28	110 35	132 43
B787-9	245847 115350 1470	67 27	73 28	87 31	119 38	60 26	70 27	82 30	95 35
BAE 125-800	12483 6858 1007	6.6 3.2	7.0 3.4	8 3.8	8.7 4.4	7.9 3.9	8.2 4.1	8.6 4.3	8.8 4.5
BAE 146-200	42419 23962 970	22 11	23 12	26 13	29 15	24 12	26 13	27 14	29 15
Beech 1900	7750 5710 670	3 2	4 3	4 3	5 4	4 3	4 3	5 3	5 4
Beech king Air 300	6832 5710 730	3 2	3 3	4 3	4 4	4 3	4 3	4 3	4 3
Bombardier Challenger 800	24166 15397 1120	13 8	14 8	16 9	17 10	16 9	16 10	17 10	18 11
Bombardier CRJ 900	38442 21617 1060	21 10	21 11	24 12	27 14	23 12	24 12	26 13	27 14

Bombardier Dash 8-300	19578 11828 670	8 4	9 5	11 6	13 7	10 5	11 6	11 6	12 7
Bombardier Dash 8-400	29265 17130 670	14 7	16 8	18 9	20 11	16 8	17 9	18 10	19 10
Canadair CL-600	19590 10000 1316	10.6 4.8	11.4 4.9	12.5 5.4	13 6.3	12.8 5.8	13.3 6.1	13.7 6.3	14.1 6.6
Cessna 525B Citation Jet 3	6396 5700 910	6	7	7	7	7	7	7	7
Cessna 550S2	6940 4146 830	5.3 3.2	5.8 3.4	5.8 3.5	6.1 3.6	5.5 3.3	5.6 3.3	5.6 3.4	5.7 3.4
Cessna 560 Citation V	7650 5712 1000	7 4	7 5	7 5	7 5	7 4	7 5	7 5	7 5

AIRCRAFT TYPE	**MTOW(KG) OWE (KG) TP (Kpa)**	**Flexible Pavement Subgrade CBR%**				**Rigid Pavement Subgrade K in MN/m3**			
		A 15	**B 10**	**C 6**	**D 3**	**A K150**	**B K80**	**C K40**	**D K20**
Cessna 560 XL	9180 5916 1500	9 6	9 6	9 6	9 6	9 6	9 6	9 6	9 6
Cessna 650 III/VI	10098 5712 1160	6 3	7 3	7 3	8 4	7 3	8 4	8 4	8 4
Cessna 650 VII	10608 6324 1160	7 3	7 3	8 4	8 4	8 4	8 4	8 4	8 5
Cessna 750 X	16320 9792 1310	10 5	11 6	12 6	12 7	12 6	12 7	13 7	13 7
Cessna Citation 3	9525 5670 1013	5.5 2.8	5.9 3.0	6.3 3.4	6.6 3.8	6.5 3.5	6.7 3.6	6.9 3.8	7 3.9
C141B Starlifter	158359 61182 1310	52 15	60 16	73 18	88 24	51 14	61 16	70 19	78 22
C 5 Galaxy	379634	31	33	40	51	28	31	37	45

	169780 770	11	12	14	17	12	13	13	15
Dassault Falcon 10	8565 5710 930	5 3	5 3	6 4	6 4	6 4	6 4	6 4	6 4
Dassault Falcon 2000	16728 9486 1360	9	10	11	12	11	12	12	13
Dassault Falcon 50	17600 9600 1400	9.6 4.6	9.9 4.8	11 5.1	12 6	11.4 5.6	11.8 5.8	12.2 6.1	12.5 6.3
Dassault Falcon 900	20598 10503 1300	11 5	12 5	14 6	15 7	14 6	14 7	15 7	15 7
Fairchild Metro 227	7545 5710 730	3 2	4 3	4 3	5 4	4 3	5 3	5 3	5 4
Brasilia Embraer 120	11600 7150 830	5.4 3.1	5.9 3.5	6.7 3.8	7.8 4.6	7.2 4.1	7.5 4.5	7.8 4.7	8.1 4.9
Embraer 170	37525 21210 1040	20 10	21 11	24 12	26 14	22 11	24 12	25 13	26 14
Embraer 190	49048 26104 1100	28 14	30 14	33 16	35 18	31 15	33 16	35 17	36 18
Embraer ERJ 145	24167 12542 900	14 6	15 6	16 7	17 8	16 7	16 8	17 8	18 8
AIRCRAFT TYPE	**MTOW(KG) OWE (KG) TP (Kpa)**	**Flexible Pavement Subgrade CBR%**				**Rigid Pavement Subgrade K in MN/m3**			
		A 15	**B 10**	**C 6**	**D 3**	**A K150**	**B K80**	**C K40**	**D K20**
F/A-18 S	23542 10523 1723	22.5 10	21.6 9.7	21.5 9.6	21 9.5	23.4 10.4	23.2 10.3	23 10.2	22.8 10.2
Fokker 100	46090 24779 940	25 12	27 13	31 14	33 16	28 13	30 14	31 15	33 16
Fokker 50	20904 12746	9 5	11 6	13 7	14 8	11 6	12 7	13 7	13 8

	590								
Fokker F27-500	20904 12236 570	9 5	11 5	13 6	14 8	11 6	12 6	13 7	13 7
Fokker F28-1000	33140 17845 530	14 6	17 8	20 9	23 11	16 8	18 9	20 9	21 10
GG II	28100 16000 930	15.4 7.7	16.6 8	18.3 9.3	19 10.5	17.6 9.0	18.4 9.5	19 10	19.7 10.4
GG III	31824 17340 1210	19 9	20 9	22 10	23 12	22 11	23 11	23 12	24 12
GG IV	34068 19278 1210	20 10	22 11	24 12	25 13	24 12	25 13	25 13	26 14
GG V	41310 21930 1370	26 12	28 13	30 14	31 15	31 14	32 15	32 16	33 16
Hercules C130	79333 36709 670	29 12	34 14	37 15	43 17	33 14	36 15	39 16	42 18
HS-748	20183 11786 550	7.7 4	9.5 4.8	11.1 5.6	13 7	9.6 5	10.5 5.5	11.3 6	12 6.4
HS/BAe 125	11420 6220 830	6 3	6 3	7 3	8 4	7 3	7 4	8 4	8 4
Ilyushin IL	171000 83819 640	24 9	27 10	34 12	45 16	29 11	33 13	30 14	34 14
Jetstream 31,32	7036 5710 390	3 3	4 3	5 4	6 5	4 4	5 4	5 4	5 4
Jetstream 41	10910 6424 830	5 3	5 3	6 3	7 4	6 3	6 3	7 4	7 4
Learjet 24F	6322 5710 790	3 3	3 3	4 3	4 4	4 3	4 4	4 4	4 4
AIRCRAFT TYPE	**MTOW(KG) OWE (KG) TP (Kpa)**	**Flexible Pavement Subgrade CBR%**				**Rigid Pavement Subgrade K in MN/m3**			

		A 15	B 10	C 6	D 3	A K150	B K80	C K40	D K20
Lear 35A	7824 4132 1080	3.9 1.9	4 1.9	4.6 2.1	5.1 2.4	4.7 2.2	4.9 2.3	5.1 2.5	5.3 2.6
Learjet 40,45	9996 6222 790	5 3	6 3	7 4	7 4	6 4	7 4	7 4	7 4
Learjet 55B,C	9891 5914 1240	6 3	6 3	7 3	7 4	7 4	7 4	7 4	7 4
Learjet 60	10812 6426 1480	6 3	7 4	7 4	8 4	8 4	8 4	8 5	8 5
Lockheed C130-H	70300 35000 550	23 10	28 13	32 15	37 16	26 13	29 14	32 15	35 16
Lockheed C130-JH	70300 35000 725	27 12	30 14	33 15	38 17	30 14	33 15	35 16	38 17
MD-81	64037 35690 1140	36 18	38 19	43 21	46 24	41 20	43 21	45 23	46 24
MD-90-30	71277 39972 1140	41 20	43 21	48 24	52 27	46 23	48 24	50 26	52 27
Orion P3A	61235 27000 1310	35 13	38 14	42 15	44 17	41 15	43 16	44 17	46 18
SAAB 340 A,B	13358 8259 820	6 4	6 4	8 4	9 5	7 4	8 4	8 5	9 5
Shorts 330	10400 6730 550	6 4	8 5	9 6	9 6	7 5	8 5	8 5	8 5
Shorts 360	12338 7851 540	7 5	9 6	10 7	11 7	9 6	9 6	9 6	9 6
Westwind I	10660 6066 1050	9 5.1	9.3 5.3	9.2 5.3	9.4 5.4	9.1 5.2	9.1 5.2	9.2 5.2	9.2 5.3

7.1 Subgrade Strength per CAR AGA 1 and ICAO Annex 14 Volume 1

- High strength: characterized by K = 150 MN/m3 and representing all K values above 120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.
- Medium strength: characterized by K = 80 MN/m3 and representing a range in K of 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.
- Low strength: characterized by K = 40 MN/m3 and representing a range in K of 25 to 60 MN/m3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.
- Ultra-low strength: characterized by K = 20 MN/m3 and representing all K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.