

Sac City Municipal Airport

Pavement Classification Number Report

USING AIRCRAFT METHOD



PREPARED BY

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SAC CITY MUNICIPAL AIRPORT PAVEMENT CLASSIFICATION NUMBER REPORT USING AIRCRAFT METHOD

PREPARED FOR:

**IOWA DEPARTMENT OF TRANSPORTATION
AVIATION BUREAU**

PREPARED BY:

APPLIED PAVEMENT TECHNOLOGY, INC.

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INTRODUCTION

As part of the Airport Pavement Management System (APMS) update for the Iowa Department of Transportation, Aviation Bureau (Iowa DOT), Applied Pavement Technology, Inc. (APTech) determined Pavement Classification Numbers (PCNs) for Runways 14/32 and 18/36 at Sac City Municipal Airport.

PCNs can be calculated using the Technical Evaluation Method or the Using Aircraft Method. The Technical Evaluation Method requires information on pavement cross-section and subgrade strength as well as aircraft data, whereas the Using Aircraft Method is based only on aircraft traffic data. The Iowa DOT and the Federal Aviation Administration (FAA) chose to use the Using Aircraft Method for this phase of the project.

Through a review of publicly available data (specifically from FAA's Traffic Flow Management System Counts [TFMSC] obtained from aspm.faa.gov and overall operational volumes from airnav.com) and input from Airport Managers, APTech compiled representative traffic data for use in determining the associated PCN. Each aircraft type using a pavement has an associated Aircraft Classification Number (ACN), with the ACNs determined using the FAA's COMFAA 3.0 software. The largest ACN associated with an aircraft regularly using the facility was reported as the PCN. Additional considerations are presented under the PCN Determination heading in this report.

This report includes a general overview of the Aircraft Classification Number–Pavement Classification Number (ACN–PCN) system; relevant information regarding the Pavement Condition Index (PCI) results, especially regarding load-related distress; inputs for determining PCNs; and the resulting PCNs.

PAVEMENT CONDITION SUMMARY

As part of the Iowa DOT’s statewide APMS project, APTech visually assessed the pavement using the PCI procedure. This procedure is described in FAA Advisory Circular 150/5380-6C, *Guidelines and Procedures for Maintenance of Airport Pavements*, FAA Advisory Circular 150/5380-7B, *Airport Pavement Management Program (PMP)*, and ASTM D5340-12(2018), *Standard Test Method for Airport Pavement Condition Index Surveys*, and is supported by the PAVER pavement management software. Detailed information regarding the PCI procedure and results can be found in the 2019 Individual Airport Pavement Management Report for this airport.

Pavement condition data are not directly used in the structural analysis; however, the results should be considered when determining the PCN to publish. For example, a pavement exhibiting a significant amount of load-related distress provides a strong indication that the past traffic has exceeded the limits the structure can support. The following distresses are considered load-related:

- Hot-mix asphalt (HMA)-surfaced pavement:
 - Alligator (fatigue) cracking.
 - Rutting.
- Portland cement concrete (PCC) pavement:
 - Corner break.
 - Longitudinal, transverse, and diagonal (LTD) cracking.
 - Shattered slab.

For reference, the percent of the PCI deduct caused by load-related distress and the specific load-related distress(es) recorded during the most recent pavement inspection at Sac City Municipal Airport are summarized in Table 1.

Table 1. PCI results.

Branch	Section	Surface Type	Last Construction Date	2019 PCI	Deduct due to Load-Related Distress, %	Load-Related Distress Observed
R14SC	01	PCC	6/1/2004	92	34	LTD Cracking
R18SC	01	PCC	5/1/1977	94	32	LTD Cracking
R18SC	02	PCC	5/1/1993	94	0	None
R18SC	03	PCC	5/1/1993	92	15	LTD Cracking
R18SC	04	PCC	5/2/1963	81	0	None
R18SC	05	PCC	5/1/1993	82	32	LTD Cracking
R18SC	06	PCC	5/1/1993	85	13	LTD Cracking

Table Notes:

1. See Figure A-1 located in Appendix A for the location of the branch and section.
2. Surface Type: AC = asphalt cement concrete; AAC = asphalt overlay on AC; PCC = portland cement concrete; APC = asphalt overlay on PCC.
3. Distress types are defined by ASTM D5340-12(2018).

Runway 14/32 was reconstructed with PCC pavement in 2004. Runway 18/36 is defined by six sections. Section 01 consists of the majority of the runway and was constructed with PCC pavement in 1977. Sections 02, 03, 05, and 06 are widening on either side of the runway and were constructed with PCC pavement in 1993. Section 04 is an extension at Runway 36 Approach and was constructed with PCC pavement in 1963. Runway 14/32 and multiple sections of Runway 18/36 (Sections 01, 03, 05, and 06) contain load related distress. Available work history information for Runways 14/32 and 18/36 is entered in the APMS PAVER database. A summary of available construction information is presented in Table 2.

Table 2. Pavement cross section information.

Branch	Section	Construction Date	Layer Thickness, in	Material Type
R14SC	01	6/1/2004	Unknown	PCC*
R18SC	01	5/1/1977	Unknown	PCC*
R18SC	02	5/1/1993	Unknown	PCC*
R18SC	03	5/1/1993	Unknown	PCC*
R18SC	04	5/2/1963	6	Aggregate (P-154)
R18SC	04	5/1/1963	6	PCC (P-501)
R18SC	05	5/1/1993	Unknown	PCC*
R18SC	06	5/1/1993	Unknown	PCC*

Table Notes:

1. See Figure A-1 located in Appendix A for the location of the branch and section.
- * In addition to the PCC layer, information regarding any underlying base layers is unknown.

ACN–PCN OVERVIEW

The ACN–PCN system of reporting pavement strength was developed by the International Civil Aviation Organization (ICAO). Because the United States is a member of this organization, the FAA is obligated to adhere to this system and provides guidance to comply with the ICAO standards.

The ACN–PCN procedure is structured so that a pavement with a given PCN can support an aircraft that has an ACN equal to or less than the PCN. Likewise, the pavement cannot, according to the procedure, handle frequent loadings from an aircraft with an ACN exceeding the PCN. Some infrequent overloads are allowed in accordance with the general overload guidance, which is presented within this report. Aircraft operators are required to obtain permission to use a facility when their aircraft’s ACN exceeds the published PCN.

ACNs

According to FAA Advisory Circular 150/5335-5C, the ACN is defined as a number that expresses the relative effect of an aircraft at a given weight on a pavement structure for a specified standard subgrade strength. The ACN can be calculated for any operating weight. Higher ACNs indicate an aircraft has a more severe effect on the pavement, while lower values indicate a less severe effect. ACNs are reported by pavement type for each subgrade strength category. Stronger subgrade support conditions (e.g., granular subgrade soils with higher *k*-values or California Bearing Ratios [CBRs]) correspond to lower ACNs as compared to weaker subgrade support conditions. The ACN has a minimum value of 0 and no upper limit.

A list of ACNs for common aircraft is shown in Table 3 to assist decision-makers with determining whether the analyzed pavements can realistically support aircraft that might not be in the traffic mix. The listed ACNs were determined using the FAA’s COMFAA software and are presented for each subgrade strength category for both flexible and rigid pavement types; the presented ACNs are for the specified aircraft weight and tire pressure. For a given aircraft, the ACNs will decrease as aircraft weight decreases. It is also worth noting that tire pressure influences ACNs for specific aircraft. For example, given two aircraft with similar weights and gear configurations (for a specific pavement type and subgrade strength category), the aircraft with the lower tire pressure will have a lower ACN, indicating that its demand on a pavement is less than a similar aircraft with a higher tire pressure.

Table 3. ACNs for common aircraft by pavement type and subgrade category (not specific to this airport).

Aircraft	Weight, lbs	Tire Pressure, psi	Gear Type	ACN: Flexible Pavement, Subgrade Category A	ACN: Flexible Pavement, Subgrade Category B	ACN: Flexible Pavement, Subgrade Category C	ACN: Flexible Pavement, Subgrade Category D	ACN: Rigid Pavement, Subgrade Category A	ACN: Rigid Pavement, Subgrade Category B	ACN: Rigid Pavement, Subgrade Category C	ACN: Rigid Pavement, Subgrade Category D
Chk.Six-PA-32	3,400	50	S	1	1	1	1	1	1	1	1
Aztec-D	5,200	46	S	1	1	2	2	1	2	2	1
Baron-E-55	5,424	56	S	1	1	2	2	2	2	2	2
Navajo-C	6,536	66	S	2	2	2	3	2	2	2	2
GrnCaravanCE208B	8,750	75	S	2	3	3	3	3	3	3	3
Air Tractor 502	9,000	62	S	2	3	3	4	3	3	3	3
Citation 525	10,500	98	S	4	4	4	4	4	4	4	4
Air Tractor 802	14,200	62	S	3	5	5	6	4	4	5	5
Citation-550B	15,000	130	S	6	6	6	6	6	6	6	6
Citation-V	16,500	130	S	6	7	7	7	6	7	7	7
Sabreliner-60	20,372	214	S	9	9	9	9	9	9	9	9
Shorts 360	27,200	78	S	7	9	10	11	9	9	9	9
King Air B-100	11,500	52	D	1	2	2	3	2	2	2	3
Super King Air-B200	12,590	98	D	2	3	3	4	3	3	3	4
Super King Air-300	14,100	92	D	3	3	4	4	3	4	4	4
Super King Air-350	15,100	92	D	3	3	4	5	4	4	4	4
Learjet-55	21,500	201	D	6	6	7	7	7	7	8	8
Hawker-800	27,520	135	D	7	7	8	9	8	8	9	9
Falcon-2000	35,000	197	D	9	10	11	11	11	11	12	12
Falcon-50	38,800	208	D	10	11	12	13	13	13	13	14
Falcon-900	45,500	145	D	12	13	14	15	14	15	15	16
Challenger-CL-604	48,200	145	D	12	12	14	16	14	14	15	15
Gulfstream-G-II	66,000	160	D	18	20	21	22	21	22	23	23
Gulfstream-G-IV	75,000	185	D	22	24	25	25	26	26	27	28

Table Notes:

- Configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

PCNs

The PCN is assigned to a pavement and expresses the relative load-carrying capacity of that pavement. Ideally, the PCN will be determined based on aircraft departures (frequency and weight) along with any pavement and subgrade layer properties. If these data become available, APTech recommends a technical evaluation be completed to determine the PCN.

FAA Advisory Circular 150/5335-5C states the following regarding the Using Aircraft Method of reporting PCNs:

The accuracy of this method is greatly improved when aircraft traffic information is available. Significant over-estimation of the pavement capacity can result if an excessively damaging aircraft, which uses the pavement on a very infrequent basis, is used to determine the PCN. Likewise, significant under-estimation of the pavement capacity can lead to uneconomic use of the pavement by preventing acceptable traffic from operating. Use of the Using Aircraft Method is discouraged on a long-term basis due to the concerns listed above.

As with the ACN, the PCN has a minimum value of 0 and has no upper limit. In addition to the numerical value, the PCN is reported with four codes, which represent the following categories:

- Pavement Type
 - R = Rigid
 - F = Flexible
- Subgrade Strength Category
 - A = High (k-value ≥ 442 psi/in or CBR ≥ 13)
 - B = Medium (221 psi/in $<$ k-value < 442 psi/in or $8 <$ CBR < 13)
 - C = Low (92 psi/in $<$ k-value ≤ 221 psi/in or $4 <$ CBR ≤ 8)
 - D = Ultra Low (k-value ≤ 92 psi/in or CBR ≤ 4)
- Maximum Allowable Tire Pressure
 - W = Unlimited (no pressure limit)
 - X = High (pressure limited to 254 psi)
 - Y = Medium (pressure limited to 181 psi)
 - Z = Low (pressure limited to 73 psi)
- Pavement Evaluation Method
 - T = Technical Evaluation
 - U = Using Aircraft Evaluation

General Overload Guidance

For aircraft with an ACN that exceeds the PCN, ICAO overload guidance can be referenced. Alternatively, aircraft with ACNs greater than the PCNs for analyzed facilities may be able to safely use these pavements (following the ACN–PCN procedure) by operating at a reduced weight. Appendix D of FAA Advisory Circular 150/5335-5C presents the following guidance for pavement overloads (ICAO 1983):

- For flexible pavements, occasional traffic cycles by aircraft with an ACN not exceeding 10 percent above the reported PCN should not adversely affect the pavement.

- For rigid or composite pavements, occasional traffic cycles by aircraft with an ACN not exceeding 5 percent above the reported PCN should not adversely affect the pavement.
- The annual number of overload traffic cycles should not exceed approximately 5 percent of the total annual aircraft traffic cycles. [As additional guidance, the FAA recommends limiting the overload cycles to 500 coverages; the corresponding number of annual departures depends on the aircraft and its typical pass-to-coverage ratio.]
- Overloads should not normally be permitted on pavements exhibiting signs of load-related distress, during periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water.
- When overload operations are conducted, the airport owner should regularly inspect the pavement condition. The airport owner should periodically review the criteria for overload operations. Excessive repetition of overloads can cause a significant reduction in pavement life or accelerate when a pavement will require a major rehabilitation.

In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

PCN DETERMINATION—USING AIRCRAFT METHOD

Aircraft traffic is the primary consideration when reporting a PCN following the Using Aircraft Method. The PCN is reported based on the pavement type (rigid or flexible) corresponding to a given subgrade category. For the Using Aircraft Method, the specific strength is not required, but a subgrade category should be specified so the corresponding ACN can be referenced. The subgrade support conditions are unknown for this airport, and a subgrade strength category C was assumed based on typical conditions throughout Iowa.

APTech compiled traffic data to provide a representation of the aircraft using Runways 14/32 and 18/36 based on publicly available information. This information was provided to the Airport Manager for review, who noted that the traffic was representative of the aircraft using Runways 14/32 and 18/36. Representative traffic information is presented in Tables 4 and 5 along with the corresponding ACNs (as determined using COMFAA) for the pavement types and subgrade strength categories associated with Sac City Municipal Airport.

Table 4. Runway 14/32 traffic data.

Representative Aircraft	Weight, lbs	Gear Type	Tire Pressure, psi	ACN: Rigid Pavement, Subgrade Category C
Skyhawk 172	2,558	S	50	1
Beech Bonanza 36	3,600	S	52	1
Navajo PA-31	6,536	S	66	2
Air Tractor 502	9,000	S	62	3
Pilatus PC-12	10,450	S	98	4
Cheyenne 3	11,200	S	100	4

Table Notes:

1. Defined by the configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

Table 5. Runway 18/36 traffic data.

Representative Aircraft	Weight, lbs	Gear Type	Tire Pressure, psi	ACN: Rigid Pavement, Subgrade Category C
Skyhawk 172	2,558	S	50	1
Beech Bonanza 36	3,600	S	52	1
Navajo PA-31	6,536	S	66	2
Air Tractor 502	9,000	S	62	3
Pilatus PC-12	10,450	S	98	4
Cheyenne 3	11,200	S	100	4
Air Tractor 802	14,200	S	62	5

Table Notes:

1. Defined by the configuration of the main gear: S = single wheel and D = dual wheel (as defined in FAA Order 5300.7, *Standard Naming Convention for Aircraft Landing Gear Configurations*).

Based on the representative aircraft using Runways 14/32 and 18/36 the PCNs and corresponding allowable aircraft weights are presented in Table 6. The most demanding representative aircraft for the given pavement type and subgrade category is the Cheyenne 3 with an ACN of 4 on Runway 14/32 and Air Tractor 802 with an ACN of 5 on Runway 18/36. The corresponding allowable aircraft weight was determined using the FAA’s COMFAA Support Spreadsheet, which is approximation and is not specific for any particular aircraft model. The PCNs can be reported to the FAA’s regional office using the results from this report.

Table 6. PCN results and corresponding allowable aircraft weights.

Branch	PCN	Single Wheel Allowable Aircraft Weight, lbs
Runway 14/32	4/R/C/W/U	13,500
Runway 18/36	5/R/C/W/U	16,500

Table Notes:

1. Single wheel allowable aircraft weight refers to the aircraft’s main gear type.

Load-related distresses were observed during the 2019 PCI inspection on Runways 14/32 and 18/36, which indicates that some aircraft may be overloading the pavements. Therefore, additional investigation is recommended to determine a more accurate assessment of the capacity of the runways. Furthermore, the overall pavement condition and progression of distress should continue to be monitored.

The ICAO overload guidance, included in the ACN–PCN Overview chapter of this report, can be referenced for aircraft with an ACN that exceeds the PCN for a specified pavement, although this information is more applicable for PCNs determined from a Technical Evaluation Method. Alternatively, aircraft with ACNs greater than the documented PCN may be able to use the facility, following the ACN–PCN procedure, by operating at a reduced weight. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

SUMMARY

This report presents an overview of the ACN–PCN procedure and documents the representative traffic considered when determining the PCN following the FAA’s Using Aircraft Method, as described in FAA Advisory Circular 150/5335-5C. The PCN recommended for publication for Runway 14/32 is 4/R/C/W/U and for Runway 18/36 is 5/R/C/W/U. Load-related distresses were observed during the 2019 PCI inspection on both runways, which indicates that some aircraft may be overloading the pavements.

ACNs of common aircraft are provided, and overload guidance is presented. In general, pavement overloads are expected to decrease pavement life but do not often cause immediate or catastrophic failures unless they are excessive.

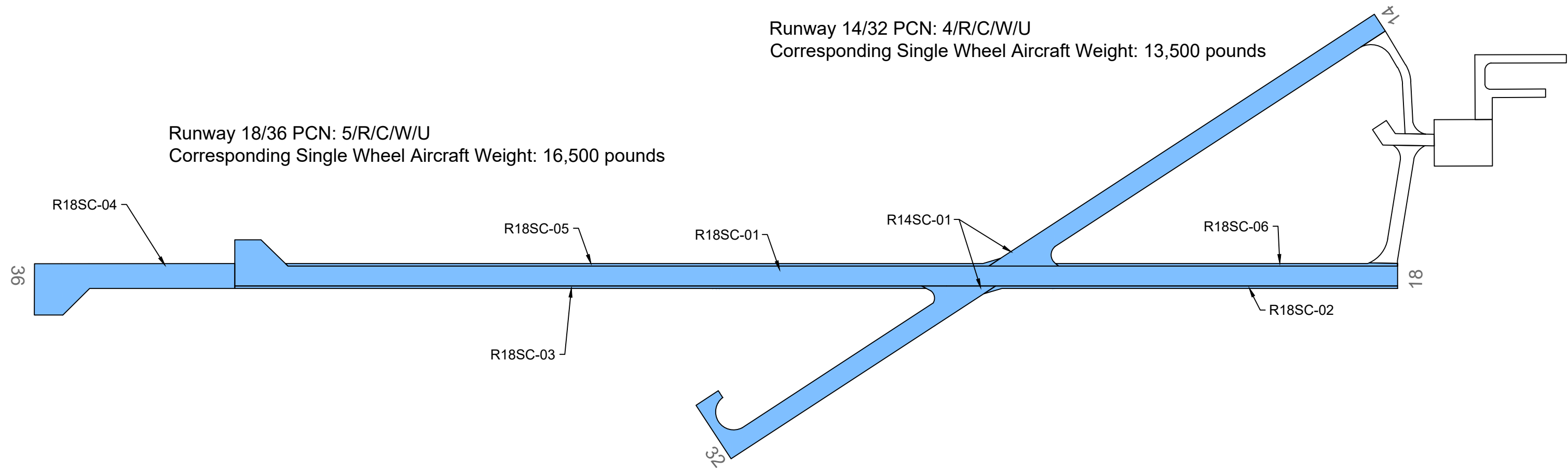
REFERENCES

- AirNav, LLC. 2018. “Airport Information.” www.airnav.com.
- ASTM International. 2018. “Standard Test Method for Airport Pavement Condition Index Surveys.” ASTM Designation D5340-12(2018). *Annual Book of ASTM Standards, Volume 12*. ASTM International, West Conshohocken, PA.
- Federal Aviation Administration (FAA). 1995. *Airport Pavement Design and Evaluation*. Advisory Circular 150/5320-6D. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2005. *Standard Naming Convention for Aircraft Landing Gear Configurations*. Order 5300.7. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2014. *Airport Pavement Management Program (PMP)*. Advisory Circular 150/5380-7B. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2014. *Guidelines and Procedures for Maintenance of Airport Pavements*. Advisory Circular 150/5380-6C. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2014. *Standardized Method of Reporting Airport Pavement Strength—PCN*. Advisory Circular 150/5335-5C. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2016. *Airport Pavement Design and Evaluation*. Advisory Circular 150/5320-6F. U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.
- FAA. 2018. “Traffic Flow Management System Counts (TFMSC).” aspm.faa.gov.
- International Civil Aviation Organization (ICAO). 1983. *Aerodrome Design Manual: Pavements*. ICAO 9157-AN/901 Part 3, Second Edition. International Civil Aviation Organization, Montreal, Quebec, Canada.
- ICAO. 1999. *International Standards and Recommended Practices: Aerodromes—Annex 14 to the Convention on International Civil Aviation*. Third Edition. International Civil Aviation Organization, Montreal, Quebec, Canada.


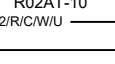
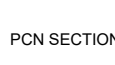
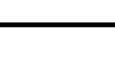

APPENDIX A



PCN SECTION IDENTIFICATION MAP

FIGURE A-1. PCN SECTION IDENTIFICATION MAP.



LEGEND

 BRANCH IDENTIFIER
 SECTION IDENTIFIER
 PCN VALUE
 SECTION BREAK LINE
 PCN SECTION

		115 W. Main Street, Suite 400 Urbana, IL 61801 Tel: (217) 398-3977 Fax: (217) 398-4027	
		322 First Street East Independence, Iowa 50644 319-334-7211	
AGENCY: Iowa Department of Transportation Office of Aviation			
LOCATION: Sac City Municipal Airport Sac City, Iowa			
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APPENDIX B

FAA FORM 5010 DATA ELEMENTS



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