Spencer Municipal Airport

Pavement Classification Number Report

USING AIRCRAFT METHOD

PREPARED BY

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applied pavement TECHNOLOGY

SPENCER MUNICIPAL AIRPORT
PAVEMENT CLASSIFICATION NUMBER REPORT USING AIRCRAFT METHOD

PREPARED FOR:

IOWA DEPARTMENT OF TRANSPORTATION
AVIATION BUREAU

PREPARED BY:

APPLIED PAVEMENT TECHNOLOGY, INC.

October 2020

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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 Runway 12/30 and Runway 18/36 at Spencer 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 Spencer 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
R12SP	01	PCC	11/2/1992	86	25	Corner Break, LTD Cracking
R18SP	01	PCC	6/1/1994	98	25	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 12/30 was initially constructed in 1958 with HMA pavement and overlaid (whitetopping) and extended with PCC pavement in 1992. Runway 18/36 was initially constructed with HMA pavement in 1985 and overlaid (whitetopping) and extended with PCC pavement in 1994. Even though both runways were rehabilitated within 2 years of each other, Runway 12/30 has a much lower PCI. Both runways contain load-related distress. Available work history information for Runways 12/30 and 18/36 is entered in the APMS PAVER database. A summary of available construction information is presented in Table 2. The cross section presented in the table provides the cross section for the majority of the runway; the extension has a different cross section.

Table 2. Pavement cross section information.

Branch	Section	Construction Date	Layer Thickness, in	Material Type
R12SP	01	11/2/1992	6	PCC (P-501)
R12SP	01	11/1/1992	1	HMA (P-401)
R12SP	01	6/2/1958	2	HMA (P-401)
R12SP	01	6/1/1958	8	Aggregate (P-208)
R18SP	01	6/1/1994	6	PCC (P-501)
R18SP	01	6/2/1985	2	HMA (P-401)
R18SP	01	6/1/1985	4	Aggregate

Table Notes:

1. See Figure A-1 located in Appendix A for the location of the branch and section.

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:

1. 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 strength category B was chosen for Runways 18/36 and 12/30 based on Runway 18/36 design documentation that corresponds with what was used for a previous PCN evaluation (discussed in more detail later in this chapter). Historic design documentation indicates that the subgrade support for Runway 12/30 may be greater; however, this information is not critical to a non-technical evaluation.

APTech compiled traffic data to provide a representation of the aircraft using Runways 12/30 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 the airport and provided additional input regarding traffic data and other results from a previous PCN evaluation. Representative traffic information is presented in Table 4 along with the corresponding ACNs (as determined using COMFAA) for the pavement types and subgrade strength categories associated with Spencer Municipal Airport.

Table 4. Runways 12/30 and 18/36 traffic data.

Representative Aircraft	Weight, lbs	Gear Type	Tire Pressure, psi	ACN: Rigid Pavement, Subgrade Category B
Taylorcraft Seabird	2,750	S	50	1
Diamond Twin Star	4,407	S	55	1
Citation Mustang	8,645	S	75	3
Air Tractor 502	9,000	S	62	3
Citation CJ3	13,870	S	130	6
Air Tractor 802	14,200	S	162	4
Phenom 300	17,968	S	185	8
Cessna Excel/XLS	20,200	S	214	9
Beech Super King Air 350	15,100	D	92	4
Hawker 800	27,520	D	135	8
Citation X	36,000	D	189	12
Challenger 300	38,850	D	208	13
Challenger 604	48,200	D	145	14
Dassault Falcon F7X	70,000	D	175	24
Gulfstream G500	73,000	D	188	24

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 12/30 and 18/36, of which the most demanding aircraft is the Gulfstream G500 with an ACN of 24 for the given pavement type and subgrade category, the PCN and corresponding allowable aircraft weights based on the Using Aircraft Method are presented in Table 5. The corresponding allowable aircraft weights were determined using the FAA's COMFAA Support Spreadsheet, which are approximations and are not specific for any particular aircraft model.

Table 5. PCN results and corresponding allowable aircraft weights.

Branch	PCN	Single Wheel Allowable Aircraft Weight, lbs	Dual Wheel Allowable Aircraft Weight, lbs
Runway 12/30	24/R/B/W/U	68,000	87,000
Runway 18/36	24/R/B/W/U	68,000	87,000

Table Notes:

1. Single or dual wheel allowable aircraft weight refers to the aircraft's main gear type.

Based on the aircraft using Runways 12/30 and 18/36, the resulting PCNs for these facilities per the Using Aircraft Method correspond with higher allowable aircraft weights when compared to currently published data. This PCN assessment is non-technical and is not a guarantee that the pavement is structurally adequate for this traffic. Load-related distresses were observed during the 2019 PCI inspection on both runways, which further indicates that some aircraft may be overloading the pavements.

As previously mentioned, a separate PCN study was completed in 2018 by Kruse, Cate & Nelson, P.C. That assessment appears to be based on a technical approach and concluded that the PCN of both runways was 18 with a corresponding single wheel allowable aircraft loading of 54,350 pounds. It is APTech's interpretation that the complete PCN would be 18/R/B/W/T and that the results of that analysis suggest the runways are both overloaded by the analyzed traffic. While the PCNs have been determined based on the Using Aircraft Method, herein, greater consideration should be given to the results of the previously completed evaluation.

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 PCNs determined following this methodology for both Runways 12/30 and 18/36 is 24/R/B/W/U. However; load-related distresses were observed during the 2019 PCI inspection on both runways, which indicates that some aircraft may be overloading the pavements. Furthermore, through the process of gathering traffic data, results of a previous evaluation were provided that suggest a PCN of 18/R/B/W/T is more appropriate for reporting.

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.

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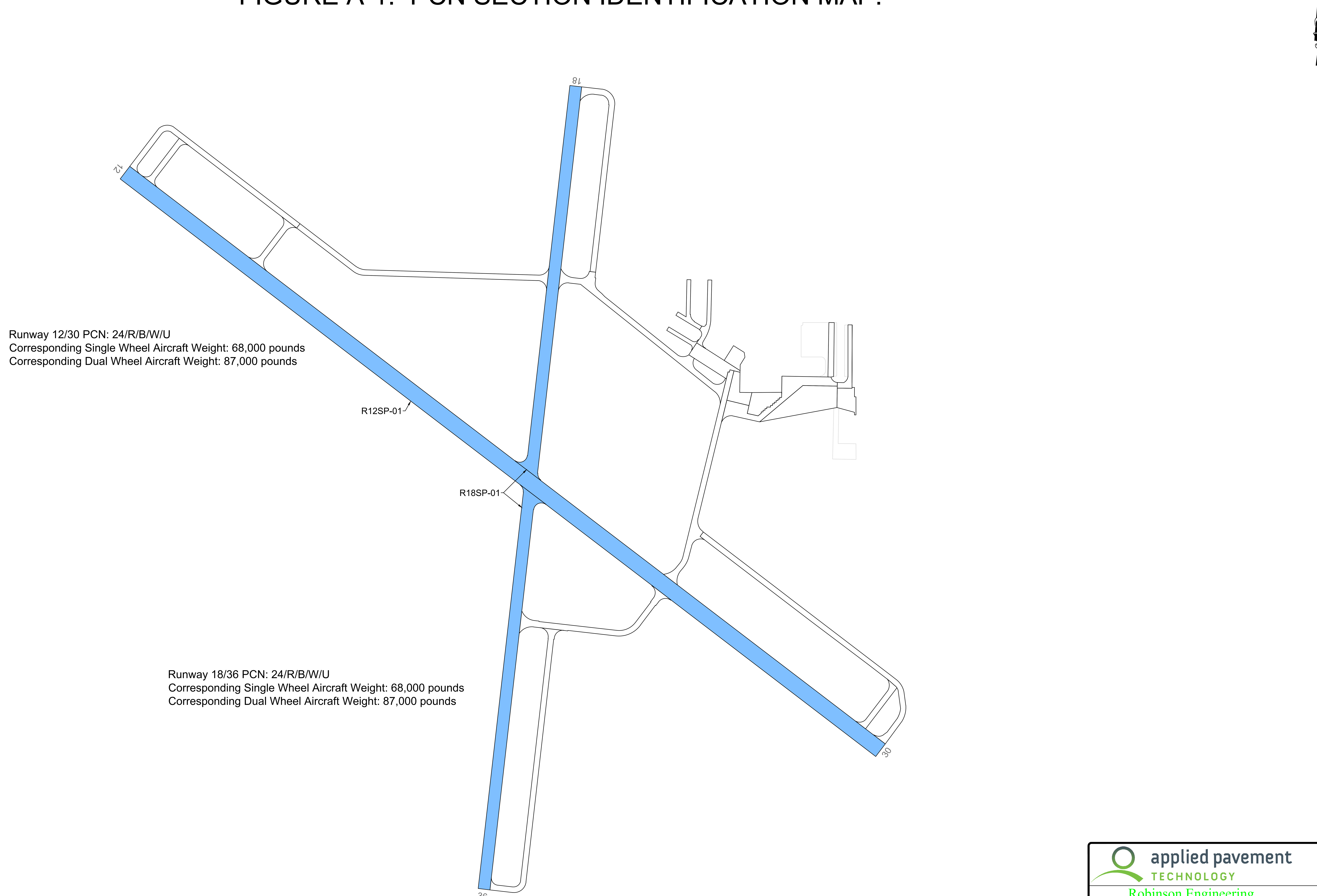
APPENDIX A

PCN SECTION IDENTIFICATION MAP

FIGURE A-1. PCN SECTION IDENTIFICATION MAP.



LEGEND

R02AT-10 — BRANCH IDENTIFIER / SECTION IDENTIFIER
32/R/C/W/U — PCN VALUE
SECTION BREAK LINE
PCN SECTION

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Office of Aviation

LOCATION: Spencer Municipal Airport
Spencer, Iowa

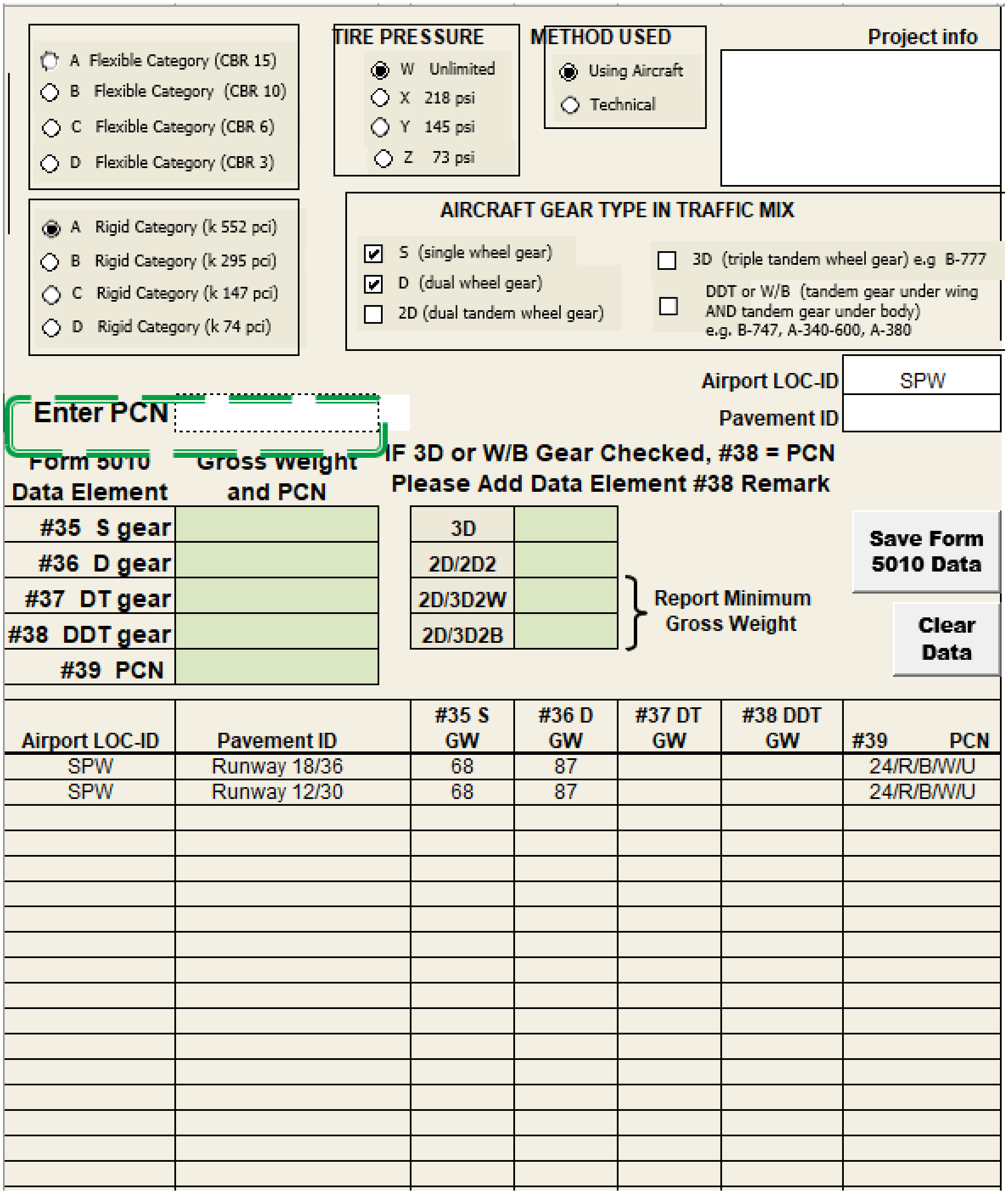
PAGE TITLE: PCN Section Identification Map

PROJECT DATE:	CREATION DATE:	PROJECT MANAGER:	JOB NUMBER:
OCT. 2019	OCT. 2019	LJR	2017-020-AM03
DRAWING SCALE:	LAST MODIFIED DATE:	REVISED BY:	DRAWN BY:
1"=300'	OCT. 2020	KEW	KEW
FILENAME:		LAYOUT NAME/NUMBER:	PAGE NUMBER:
Spencer.dwg		PCN	A-1

APPENDIX B

FAA FORM 5010 DATA ELEMENTS

Figure B-1. Form 5010 Data Elements
(Standard Form from the FAA's Support Spreadsheet for COMFAA 3.0).



A Flexible Category (CBR 15)
B Flexible Category (CBR 10)
C Flexible Category (CBR 6)
D Flexible Category (CBR 3)

A Rigid Category (k 552 pci)
B Rigid Category (k 295 pci)
C Rigid Category (k 147 pci)
D Rigid Category (k 74 pci)

TIRE PRESSURE
W Unlimited
X 218 psi
Y 145 psi
Z 73 psi

METHOD USED
Using Aircraft
Technical

Project info

AIRCRAFT GEAR TYPE IN TRAFFIC MIX
S (single wheel gear)
D (dual wheel gear)
2D (dual tandem wheel gear)
3D (triple tandem wheel gear) e.g B-777
DDT or W/B (tandem gear under wing AND tandem gear under body) e.g. B-747, A-340-600, A-380

Airport LOC-ID: SPW
Pavement ID:

Enter PCN

IF 3D or W/B Gear Checked, #38 = PCN
Please Add Data Element #38 Remark

Form 5010 Data Element	Gross Weight and PCN
#35 S gear	
#36 D gear	
#37 DT gear	
#38 DDT gear	
#39 PCN	

3D	
2D/2D2	
2D/3D2W	
2D/3D2B	

Report Minimum Gross Weight

Save Form 5010 Data

Clear Data

Airport LOC-ID	Pavement ID	#35 S GW	#36 D GW	#37 DT GW	#38 DDT GW	#39 PCN
SPW	Runway 18/36	68	87			24/R/B/W/U
SPW	Runway 12/30	68	87			24/R/B/W/U

PREPARED FOR

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