Transport Canada Transports Canada

Advisory Circular

Subject: **Airport Pavement Management System**

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1.0 INTRODUCTION

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

1.1 Purpose

(1) The purpose of this document is to outline the Airport Pavement Management System concept, its components and how it can be used to make decisions regarding pavement maintenance and rehabilitation.

1.2 Applicability

(1) This document applies to Canadian airport operators and is also available to the aviation industry and aerodrome community for information purposes.

1.3 Description of Changes

(1) The principal revisions in Issue 03 of this AC include:

a) Update of references to TP 312 5th Edition – *Aerodrome Standards and Recommended Practices.*

b) Update of references to new Advisory Circulars.

c) Revisions to Section 2.3 *Definitions and Abbreviations*.

d) Revision to Section 3.0 *BACKGROUND*, part (2).

e) Revisions to Section 7.0 *Pavement Structural Condition Survey*, part (2) and (6).

f) Revisions to Section 9.3 *Pavement Management System Software*.

g) Other changes of an editorial nature.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

(1) It is intended that the following reference materials be used in conjunction with this document:

(a) Part III, Subpart 2 of the *Canadian Aviation Regulations* (CARs) — *Airports*;

(b) Transport Canada Publication (TP) 312 5th Edition — *Aerodrome Standards and Recommended Practices*;

(c) Advisory Circular (AC) 300-004 — *Unpaved Runway Surfaces*;

(d) AC 300-008 — *Runway Grooving*;

(e) AC 302-011 — *Airport Pavement Bearing Strength Reporting*;

(f) AC 302-017 — *Runway Friction Measurement*;

(g) AC 302-023 — *Measurement and Evaluation of Runway Roughness*;

(h) TP 1849 (Historical Reference Document AK-68-32) — *Airport Pavement Structural Condition Surveys.* (A newer version of this document was published as Engineering Reference Document (ERD) 121, January 2004 — *Guidelines Respecting Airport Pavement Structural Condition Surveys*;

(i) FAA AC 150/5380-6C, 2014-10-10 — *Guidelines and Procedures for Maintenance of Airport Pavements;*

(j) *FAA AC 150/5380-7B, 2014-10*-10 — *Airport Pavement Management Program (PMP)*;

(k) *International Civil Aviation Organization (ICAO) Annex 14 to* the *Convention on International Civil Aviation—International Standards and Recommended Practices: Aerodromes* (Sixth Edition, July 2013); and

(l) ASTM D5340, 2012 — *Standard Test Method for Airport Pavement Condition Index Surveys*.

2.2 Cancelled Documents

(1) Not applicable.

(2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

2.3 Definitions and Abbreviations

(1) The following **definition**s are used in this document:

(a) **Airport Pavement Management System**: a set of defined procedures for collecting, analyzing, maintaining and reporting pavement data to assist airport operators in finding optimum strategies for maintaining pavements in a serviceable condition for the least cost.

(b) **California Bearing Ratio (CBR)**: a measure of the load bearing capacity of a given sample of soil expressed as a ratio relative to the load bearing capacity of crushed limestone.

Note: The load bearing capacity of crushed limestone is expressed as a CBR of 100.

(c) **Pavement Classification Number (PCN):** a number expressing the bearing strength of a pavement for unrestricted operations.

(d) **Pavement Load Rating (PLR):** a number expressing the bearing strength of a pavement for unrestricted operations (historical Transport Canada pavement strength reporting format).

(2) The following **abbreviations** are used in this document:

(a) **AC**: Advisory Circular

(b) **APMS**: Airport Pavement Management System

(c) **CBR**: California Bearing Ratio

(d) **FAA**: Federal Aviation Administration

(e) **FOD**: Foreign Object Debris/Damage

(f) **ICAO**: International Civil Aviation Organization

(g) **PMS:** Pavement Management System

(h) **PCI**: Pavement Condition Index

(i) **PCN**: Pavement Classification Number

(j) **PLR**: Pavement Load Rating

(k) **TP:** Transport Canada Publication

3.0 BACKGROUND

(1) TP 312 5th Edition - *Aerodrome Standards and Recommended Practices* gives the following standard with respect to maintenance:

9.1.1.1 A maintenance program is established to maintain the aerodrome components in a condition of compliance with standards.

Note: *Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities and systems.*

(2) The role of on Airport Pavement Management System (APMS) is to improve the quality and performance of airside pavements and minimize costs through good management practices. The implementation of an APMS is not mandatory but provides a means of demonstrating compliance with 9.1.1.1 by giving a procedure to assist with the planning and scheduling of maintenance and rehabilitation of airside pavements.

(3) In general, a pavement performs well for most of its service life after which it reaches a “critical condition” and starts to deteriorate quickly. Studies have shown that it is much less expensive to maintain a pavement in good condition over time rather than periodically rehabilitating a pavement that is in poor condition.

(4) The best time for major rehabilitation is just as the rate of deterioration of the pavement begins to increase. The length of time a pavement stays in good condition before deteriorating depends on several factors such as construction type and quality, type and frequency of aircraft loading, climate and maintenance. However, it is difficult to identify the point at which the pavement’s rate of deterioration begins to increase. An APMS helps to identify the optimal time to rehabilitate a pavement by using data from a pavement condition rating system that can predict future conditions.

4.0 PAVEMENT QUALITY CHARACATERSTICS

(1) Pavement maintenance and restoration decisions are normally made in consideration of the following pavement quality characteristics:

(a) structural integrity;

(b) roughness;

(c) surface friction;

(d) surface drainage; and

(e) strength.

4.1 Structural Integrity

(1) Pavement structural integrity refers to the intactness or integrity of the pavement surface. The pavement surface should be in good structural condition i.e. structurally intact (no loose pieces) and free of deposits of broken materials lying on the surface which could pose a Foreign Object Debris/Damage (FOD) hazard.

(2) The structural integrity of the pavement surface is the quality attribute that most commonly results in the requirement for restoration. As a pavement ages, the surfacing material is weakened by processes such as stripping or oxidation of the asphalt, frost effects or alkali reactions in concrete. Cracking of one type or another usually develops. These effects ultimately weaken the pavement surface to the point where breakdown begins, with the rate of breakdown depending on the magnitude and frequency of traffic loads. The breakdown leads to spalling and the presence of loose chunks of surfacing material that can damage aircraft bodies and engines. FOD potential is therefore not only a safety hazard but a major consideration in the majority of restoration decisions.

4.2 Roughness

(1) The pavement surface of a runway should not have any irregularities which create roughness that could adversely interfere with operation of aircraft, result in loss of friction, cause structural damage to the aircraft itself or cause discomfort/alarm to passengers. Pilot complaints of pavement roughness are often the first indication that there may be something wrong with the pavement profile and that further investigation (roughness measurements) may be required. Guidance on runway roughness is given in AC 302-023 – *Measurement and Evaluation of Runway Roughness*.

4.3 Surface Friction

(1) The runway surface should provide adequate surface friction and texture necessary for the safe braking of aircraft. Variables that affect the skid resistance of wet runway pavements include texture depth, rubber deposits, paint markings, and pavement abnormalities such as rutting, ravelling and depressions. Guidance on the measurement, evaluation and maintenance of airport pavement surface friction is given in AC 302-017 – *Runway Friction Measurement*.

4.4 Surface Drainage

(1) Surface transverse and longitudinal slopes should provide for the adequate drainage/runoff of water during rainstorms to ensure the minimization of water depths and standing pools of water. Guidance on visual inspections to evaluate surface water drainage is given in AC 302-017 – *Runway Friction Measurement.* Guidance on the grooving of runway pavements is given in AC 300-008 — *Runway Grooving*.

4.5 Strength

(1) The pavement should be strong enough to support the aircraft loads it is intended to serve. Guidance on methodologies for determining and reporting airside pavement bearing strengths is given in Advisory Circular (AC) 302-011 — *Airport Pavement Bearing Strength Reporting.* Guidance on methodologies for the measurement and reporting of surface shear strength for unpaved runways such as gravel is given in AC 300-004 — *Unpaved Runway Surfaces*.

5.0 BASIC COMPONENTS OF AN AIRPORT PAVEMENT MANAGEMENT SYSTEM

(1) The basic components of an Airport Pavement Management System include the following:

- (a) technical inventory of airside pavement operational surfaces;
- (b) pavement structural condition survey; and
- (c) pavement management plan.

6.0 TECHNICAL INVENTORY OF AIRSIDE PAVEMENT OPERATIONAL SURFACES

6.1 Application

(1) A technical inventory of all airside pavement operational surfaces at an airport should be maintained (reference Figures 1 and 2).

(2) The airside pavement operational surfaces that should be included in the inventory are the runway, taxiway, apron and de-icing pad areas. Paved areas associated with and/or adjacent to the operational surfaces, such as paved shoulders and blastpads, should also be included in the inventory.

(3) The inventory should be updated when pavement construction and/or restoration projects are completed to reflect changes in the dimensional, structural composition and/or strength properties of the pavement(s).

6.2 Data Components

(1) For reporting purposes, each operational surface should be divided into sections of uniform pavement construction. Each section of uniform construction should be assigned a numerical identifier termed a “Plan Code”.

(2) The following data where applicable and available should be reported separately for each pavement section of uniform construction (Plan Code):

(a) Pavement Dimensions – start and end chainages (metres), width (metres), and area of the section (square metres);

(b) Construction History – thickness (cm) of the individual pavement layers including the surface, base and subbase courses, construction contract reference number*, and year of construction;

(c) Pavement Strength – historical Transport Canada Pavement Load Rating (PLR) and tire pressure limit (both the evaluated and reported values), historical Transport Canada pavement strength code or alternative subgrade strength value, and the ICAO Pavement Classification Number (PCN) reporting code;

(d) Notes – should be included for each pavement section as appropriate to identify surfaces constructed with gravel, turf or other materials and to indicate unique construction features.

Note: *The construction contract or project number is useful for identification and reference purposes. The contract number provides a link to project related design and construction data including as-built records, engineering job reports and results of material quality control tests and acceptances. The contract number also facilitates interpretation of the construction history information by clearly identifying all pavement sections that were built under the same contract.*

6.3 Reporting Format

(1) For reporting purposes, the technical inventory of airside pavement operational surfaces should be comprised of two (2) parts:

(a) A site plan consisting of a scaled drawing of the airside pavement operational surfaces at the airport. The sections of uniform construction should be shown along with their numerical identifier (Plan Code). An example airside pavement inventory site plan is given in Figure 1;

(b) An airside pavement inventory table containing the data specified in section 6.2 (2) above. An example airside pavement inventory table is given in Figure 2. The “Pavement Strength” column of Figure 2 provides for the entry of strength values on the basis of a technical evaluation (left column) and reported values (right column):

(i) Evaluated PLR/Code Column

(A) The first line of the “Evaluated PLR/Code” column contains the evaluated PLR value (and tire pressure limit if applicable) for the pavement section;

(B) The second line of the “Evaluated PLR/Code” column contains the Transport Canada pavement strength code (or alternative subgrade strength value such as the CBR) for the pavement section;

(C) If a technical analysis was not used to determine the PLR value, then “Not Evaluated” is entered. A “Not Evaluated” entry is also used when

the pavement section is abandoned, the surface is composed of turf or the surface is non-operational such as a shoulder or blastpad area.

(ii) Reported PLR/PCN Column

(A) The first line of the “Reported PLR/PCN” column contains the reported PLR value (and tire pressure limit if applicable);

(B) The second line of the “Reported PLR/PCN” column contains the reported ICAO PCN code.

Figure 1 – Example Airside Inventory Plan

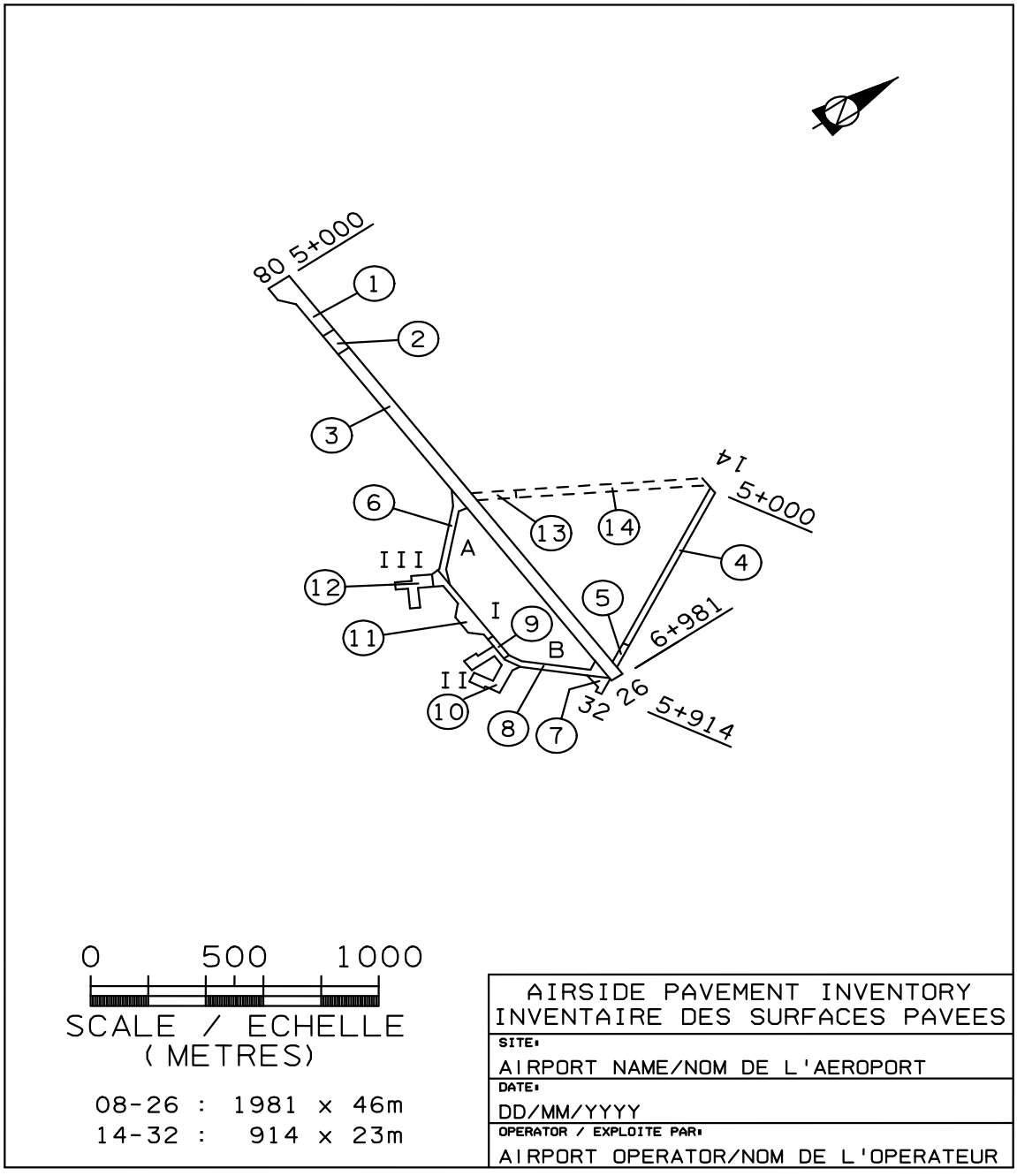

Figure 2 – Example Format of Airside Pavement Inventory Table

Page: 1 — AIRSIDE PAVEMENT INVENTORY — Printed: dd/mm/yyyy
Airport: Airport Name — Operator: Name of Operating Authority — Revised: dd/mm/yyyy

Pavement Facility	Plan Code	Chainage (m)	Width (m)	Area (m² x 1000)	Layer Thickness (cm) PCC	AC	B	SB	Contract Number	Year Built	Evaluated PLR/Code	Reported PLR/PCN
PAVEMENT DIMENSIONS					CONSTRUCTION HISTORY						PAVEMENT STRENGTH	
RUNWAY 01-19	13	5000 5154	30	4.62		5.0 5.0	23.0		12345 39456	1951 1965	Not Evaluated	Not Evaluated
Note: Abandoned.												
RUNWAY 01-19	14	5154 5765	30	18.33		5.0 5.0	30.0		12345 39456	1951 1965	Not Evaluated	Not Evaluated
Note: Abandoned.												
RUNWAY 08-26	1	5000 5247	46	11.36		10.0	30.0	60.0	TW8506	1995	10 S60t110	10 64/F/D/W/T
RUNWAY 08-26	2	5247 5338	46	4.19	30.5		15.0	59.0	TW8506	1995	10 k80h30.5	10 46/R/B/W/T
RUNWAY 08-26	3	5338 6981	46	75.58		10.0 -10.0 10.0	30.0	75.0	48632 TW8506* TW8506*	1967 1995 1995	10 S60t125	10 64/F/D/W/T
Note: * 10 cm of 1967 AC removed and replaced.												
RUNWAY 14-32	4	5000 5695	23	16.00		5.0	23.0	30.0	32531	1962	7(0.5) S60t63	7(0.5) 27/F/D/0.5MPa/T
RUNWAY 14-32	5	5695 5778	23	1.91		5.0	30.0	40.0	89573	1975	8(0.5) S60t80	7(0.5) 27/F/D/0.5MPa/T
RUNWAY 14-32	7	5830 5914	23	3.71		5.0	30.0	40.0	89573	1975	8(0.5) S60t80	7(0.5) 27/F/D/0.5MPA/T
TAXI A	6	1000 1326	23	7.50		5.0 5.0	33.0	40.0	89573 TW7212	1975 1992	9 S60t93	9 50/F/D/W/T
TAXI B	8	1000 1326	23	7.50		10.0 5.0 6.5	23.0	60.0	48632 TW5790 TW8506	1967 1978 1995	10 S60t126	10 64/F/D/W/T
APRON I	9			3.48		5.0 5.0	33.0	40.0	89573 TW7212	1975 1992	9 S60t93	9 50/F/D/W/T
APRON I	11			12.80	23.0 -23.0 30.5		23.0 10.0	60.0	48632 TW8506 * TW8506 *	1967 1995 1995	11 k104h30.5	11 62/R/B/W/T
Note: * 23 cm of 1967 PCC removed. Replaced with an additional 10 cm of base and 30.5 cm PCC in 1995.												
APRON II	10			8.39					*	1971	Not Evaluated	5(0.5) 13/F/D/0.5MPa/U
Note: * Construction not known; surface is AC.												
APRON III	12			8.21		5.0	23.0	50.0	TW7212	1992	8(0.5) S60t83	8(0.5) 37/F/D/0.5MPa/T

Notes:

1) *The above "Example Format of Airside Pavement Inventory Table" illustrates the data entry format to be used for typical pavement surfaces, construction types, and situations.*
2) *The data in the above table is fictitious and does not correspond to an actual airport site. The pavement plan codes are intended to match the sections as designated in Figure 1.*
3) *PCC = Portland Cement Concrete, AC = Asphaltic Concrete, B = Base, and SB = Subbase*

7.0 PAVEMENT STRUCTURAL CONDITION SURVEY

(1) An airport pavement structural condition survey consists of a visual inspection of the pavement surfaces to identify the types of defects present and to record the extent and severity of those defects.

(2) A detailed engineering pavement structural condition survey should be carried out for all airside movement area surfaces on a regular basis by trained/experienced engineers, technicians, or maintenance personnel. It is recommended that a condition survey be carried out once per year in particular for pavements exhibiting load related distress and for pavements with overload operations. If a pavement condition survey is performed using the PCI index as set forth in ASTM D5340, the frequency of condition surveys by PCI Index may be extended to three years. The purpose of the survey should be to record, report on and assess the various types of distress observed in the pavement(s) and to evaluate the impact of the distress on future pavement performance. The survey report should also identify and make recommendations for both immediate and future pavement maintenance and restoration work.

(3) It is also recommended that drive-by inspections be performed once per month to detect unexpected changes in pavement condition. These monthly pavement inspections are in addition to the normal daily inspections for operations.

(4) Historical guidance material on performing airside pavement structural condition surveys and interpreting their results is given in ERD-121 “Guidelines Respecting Airport Pavement Structural Condition Surveys”. The practices described are based on those followed by Transport Canada as the owner/operator of Canadian airports from the early 1960's to the mid-1990's. This document is available upon request.

(5) Another method for conducting pavement condition surveys is given in ASTM D5340 *Standard Test Method for Airport Pavement Condition Index Surveys.* This standard employs the pavement distress identification and rating system known as the Pavement Condition Index (PCI).

(6) The FAA AC 150/5380-7B – *Airport Pavement Management Program (PMP)* provides web links in Appendix C of the document to the PAVER™ Distress Identification Manuals developed by the U.S. Army Corps of Engineers Army Engineering Research and Development Center – Construction Engineering Research Laboratory (USACE ERDC-CERL). The Asphalt Surfaced Airfields PAVER™ Distress Identification Manual includes descriptions of distress types, severity levels and measurement methods for asphalt surfaced airfield pavements. The Concrete Surfaced Airfields Paver™ Distress Identification Manual includes descriptions of distress types, severity levels and measurement methods for concrete surfaced airfield pavements. The information contained in these manuals can be used to determine the PCI of airfield pavements.

8.0 PAVEMENT MANAGEMENT PLAN

(1) The airport operating authority should have a “Pavement Management Plan” in place that identifies the future maintenance and restoration work required to keep all airside movement areas surface in safe operational condition. The plan should be maintained and updated annually to reflect the results and recommendations of the pavement structural condition survey identified in section 7.0 above and other pavement evaluation programs for surface friction, roughness and bearing strength.

(2) The “Pavement Management Plan” need not be complicated and the format can be adapted to suit the administrative and financial requirements of the airport operating authority and its governing body. As a minimum, the plan should identify:

(a) the work that needs to be done (e.g. overlay a runway, remove rubber deposits, crack sealing, joint resealing, etc.)

(b) when the work has to be done (in what fiscal/financial year), and

(c) the funding levels that must be budgeted to perform each work item.

(3) The plan should cover annual maintenance work as well as major restoration projects. For the upcoming 5-year period, the plan should be fairly specific, identifying the work items and funding required in each year. Beyond the next 5 years, the plan may be less definitive by showing only the general scheduling of work items into 5-year time periods and lower level project cost estimates may be used.

9.0 SOFTWARE APPLICATIONS

(1) Specialized Pavement Management System (PMS) software applications are available which provide for more sophisticated pavement management capabilities than the basic components outlined in Section 5.0. The software allows for storage of construction history information, maintenance history and costs, pavement condition history, strength information, traffic data and non-destructive test data. The pavement inventory format may be different format from the one outlined in Section 6.0. Additional capabilities of PMS software include modelling to predict future conditions, inspection scheduling, and identification of maintenance and repair requirements.

9.1 System Capabilities of Pavement Management System Software

(1) Software programs for PMS typically have the capability to:

(a) Develop and organize the pavement inventory in a database (pavement construction history and dimensions, pavement strength, maintenance history and costs, traffic data, and pavement condition data);

(b) Assess the current condition of the pavement;

(c) Develop models to predict pavement life cycle curves and future conditions;

(d) Report on past and future pavement performance;

(e) Develop scenarios for pavement maintenance and rehabilitation based on budget or operational requirements; and

(f) Plan projects.

9.2 Reporting Capabilities of Pavement Management System Software

(1) The following types of reporting capabilities are typically included in PMS software :

(a) Inventory Report (surface type, location, area, etc.);

(b) Inspection Schedule (a plan outlining when each pavement section should be re-inspected);

(c) Pavement Condition Report (a pavement condition report for current or future years by single pavement section or group of sections);

(d) Maintenance and Repair Report (based on the user specified maintenance strategy, the type and cost of maintenance to repair distresses identified in specific pavement sections; and

(e) Budget Planning Report (projects the budget required to maintain a pavement above a user specified condition level).

9.3 Pavement Management System Software

(1) The FAA has developed a web-based airport PMS software application called “FAA PAVEAIR” which provides the capability to store information on airport pavement construction, maintenance and management. The program also has a planning tool capable of modeling airport pavement surface degradation due to external effects such as traffic and the environment. The “FAA PAVEAIR” software is accessible on the FAA website.

(2) Other pavement management system software applications are also available. The PMS software application should have the capabilities as outlined in sections 9.1 and 9.2 above.

10.0 INFORMATION MANAGEMENT

(1) Not applicable.

11.0 DOCUMENT HISTORY

(1) Advisory Circular (AC) 302-016 Issue 01, RDIMS 9107851 (E), 9133925 (F), dated 2014-07-30 – *Airfield Pavement Management System*.

(2) Advisory Circular (AC) 302-016 Issue 02, RDIMS 9919136 (E), 9919661 (F), dated 2014-10-10 – *Airfield Pavement Management System*.

12.0 CONTACT OFFICE

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