

ED-292

MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD (MASPS) FOR RUNWAY WEATHER INFORMATION SYSTEMS

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CHAPTER 1

GENERAL

1.1 INTRODUCTION

The minimum performance requirements specified herein have the scope to support airports implement the relevant ICAO Standards and Recommended Practices and EASA regulation related to the Global Reporting Format (GRF).

The working group aligned this standard with the provisions of EASA regulation in terms of approach and definitions. Thus, differences to ICAO SARPS could be noted in several parts of this document.

To enhance comprehension and clarity, requirements and recommendations are listed as follows:

- The term “shall” is used to indicate a provision is mandatory. Such requirements are sequentially listed as “**REQ X.X**”.
- The terms “should” or “may” are used to indicate a provision is optional. Such recommendations are sequentially listed as “**REC X.X**”.

Please, note that the compliance with the regulation on GRF is the result of activities conducted by an organisation’s management system and cannot solely rely on a technical system. It has to be kept in mind that today’s technologies do not offer the possibility to fully comply with the regulation without the involvement of human factors. This document does not address the way airports should organise their operations.

Runway Weather Information System (RWIS) means a system composed by at least one sensor, embedded and/or mobile, aiming at airport operators to have information about runway surface descriptors and/or present weather meteorological information. Airport operators use these systems as supporting tools. They are composed of:

- Environmental sensors (embedded or mobile)
- Models to develop forecast and customise information
- Dissemination software to present the information

RWIS could provide information about:

- Runway surface condition and/or
- Runway surface descriptors and/or
- Outside or runway temperature and/or
- Meteorological data and/or
- De-icing products

“Runway weather” refers to information that is linked with:

- Outside or runway temperature and/or
- Meteorological data.

“RWIS” and “Runway weather” are not defined in any ICAO, EASA and World Meteorological Organisation (WMO) documentation but they are manufacturers’ terminology commonly used by airport operators that is why the working group decided to use this terminology in the document. There is no official definition of this type of product.

Moreover, experts in meteorology have not participated in the drafting of this document. Thus, meteorological terms used in this standard should be understood in their usual/common sense. The working group made an effort to align the standards with WMO terms but was not in position to use only such terminology.

1.2 DEFINITIONS

1.2.1 Runway surface descriptors

Compacted snow: snow that has been compacted into a solid mass such that aeroplane tyres, at operating pressures and loadings, will run on the surface without significant further compaction or rutting of the surface.

Dry snow: snow from which a snowball cannot readily be made.

Frost: ice crystals formed from airborne moisture on a surface which temperature is at or below freezing; frost differs from ice in the fact that frost crystals grow independently and therefore, have a more granular texture.

Ice: water that has frozen or compacted snow that has transitioned into ice in cold and dry conditions.

Slush: snow that is so water-saturated that water will drain from it when a handful is picked up or will splatter if stepped on forcefully.

Standing water: water of depth greater than 3 mm.

Wet ice: ice with water on top of it or ice that is melting.

Wet snow: snow that contains enough water to be able to make a well-compacted, solid snowball, but water will not squeeze out.

1.2.2

Other definitions

Accuracy: closeness of agreement between a measured quantity value and a true quantity value of a measurand.

Contaminated runway: means a runway of which a significant portion of the runway surface area (whether in isolated areas or not) within the length and width being used is covered by one or more of the substances listed in part 1.2.1.

Embedded sensors: defines one element or several elements of a measuring system, or an entire measuring system, which is installed on the runway. These elements give a locally information of the contamination which is not only meteorological (e.g., chemicals) on the top of the sensors. Components can be at the same level with the surface or placed deeper into the road surface depending on the data to be measured.

Measurand: quantity intended to be measured.

Measurement uncertainty: non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.

Mobile sensors: defines one element or several elements of a measuring system, or an entire measuring system, which is installed to a vehicle or an aeroplane. These elements give information about runway surface contaminants on the line where the vehicle passes. They can also detect if a paved runway is free of any of these contaminants.

Physical contaminant depth: the depth of a specific contaminant as measured by physical means from the top of the aggregates to the top of the contaminant. The relationship between the water-equivalent and physical contaminant depths can be obtained by taking contaminant density into account.

Precision: closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects under specified conditions.

Reference measurement procedure: measurement procedure accepted as providing measurement results fit for their intended use in assessing measurement trueness of measured quantity values obtained from other measurement procedures for quantities of the same kind, in calibration, or in characterizing reference materials.

Repeatability: measurement precision under a set of repeatability conditions of measurement.

Repeatability condition: condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time.

Reproducibility: measurement precision under reproducibility conditions of measurement.

Reproducibility condition: condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects.

Runway Condition Report (RCR): means a comprehensive standardized report relating to runway surface condition and its effect on the aeroplane landing and take-off performance.

Sensors: element of a measuring system of, at least, one physical/chemical quantity.

Slippery wet runway: means a wet runway whose surface friction characteristics for a significant portion of it have been determined to be degraded. A portion of runway in the order of 100m long may be considered significant.

Specially prepared winter runway: means a runway with a dry frozen surface of compacted snow and/or ice which has been treated with sand or grit or has been mechanically treated to improve runway friction.

Trueness: closeness of agreement between the average of an infinite number of replicates measured quantity values and a reference quantity value.

Units: The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

Water-equivalent depth: the depth of the water film that would form over the given area if the specific contaminant from this area was completely melted and evenly distributed over the same area. The water-equivalent depth contaminant depth is defined from the smooth surface bottom to the top of the contaminant layer. Mobile and embedded sensors are able to measure the water-equivalent depth of these contaminants on the surface which is not the physical depth specified in the ICAO and other regulations used in the aviation industry.

Wet runway: means a runway whose surface is covered by any visible dampness or water up to including 3mm deep within the area intended to be used.

1.3

RUNWAY WEATHER INFORMATION SYSTEMS

1.3.1

Overall concept

Operation of aeroplanes on contaminated surfaces may pose a safety hazard and increase the risk of runway excursions. Following a runway excursion at Chicago Midway International Airport in 2005, FAA initiated the TALPA ARC in order to improve runway condition assessment and reporting and correlate with aeroplane performance calculations. This was taken over later by ICAO Friction Task Force which developed the 'Global Reporting Format (GRF)'. The new method is based on the assessment of the type, depth and coverage of the contaminants and the information is used by the flight crews to take-off and landing performance calculations. The new requirements apply by November 2021 (EASA implementation date is August 2021).

The implementation of the new GRF places new demands on Runway Condition Reporting, which consists of measuring, evaluating and communicating surface conditions of the runway system, as well as supporting the execution and planning of winter maintenance measures. Today's runway condition assessment and reporting is mainly based on visual inspections and ruler measurements. Despite the poor quality and discontinuous measurements, those inspections always require time intensive runway closures. To facilitate the implementation of the new GRF and improve Runway Condition Reporting overall, a system-based and partially automated evaluation and visualisation of meteorological conditions as well as contamination is required. Corresponding systems can be referred to as Runway Weather Information Systems (RWIS).

Runway Weather Information Systems (RWIS) are designed to support the Runway Condition Reporting by providing airport staff with critical information about the surface condition (type, depth, and coverage of the contamination) as well as present weather information. The information from a RWIS supplements the knowledge gained from runway inspections and AIREP and results in a valid overall view that is essential for using the RCAM and meeting the requirements of the GRF.

RWIS thus serve as an important additional source of information, but do not fully automate runway condition reporting. The information is used to support decision making on treating, cleaning and maintaining the surface and to report the condition to air traffic controllers (ATC) and flight crews. The information submitted shall be continuously reviewed for currency and compared to the AIREP.

The description of RWIS and the development of MASPS serves to present minimum requirements for such a system. Furthermore, optional requirements or

recommendations are also presented. Ultimately, however, it is the responsibility of the respective airport operators to capture the local requirements.

RWIS can consist of embedded or remote sensors, mobile systems and can use aeroplane (see categories) to collect data on the surface state and the atmosphere to provide reliable information to the airport staff. A RWIS can also use a combination of different sensor types and mobile systems. Sensor outputs should be clear enough to be used by runway inspectors to determine the Runway Condition Report (RCR).

Most systems typically refer to the following present weather information (among others):

- Surface state and contaminants (classification and depth)
- Freezing point temperature
- Surface temperature
- Additional present weather parameters

Data can be achieved from other/external systems/sources.

Specific software and models are used to process observations and measurements, to develop nowcasts and forecasts and to display the information in a format that can be easily interpreted. The outcome can be used in reports on the runway condition.

Sensors' use impact will depend on the size of the airport. For airports with huge traffic, airlines and airports should be the first beneficiaries. Indeed, sensors should reduce or avoid runway closures for inspection to assess runway surface conditions year-round; since the regulations also require year-round information on the surface condition.

This is an advantage especially for highly frequented airports. In general, it increases the situational awareness and may support runway maintenance planning. For airports with small traffic, airports should be the first beneficiaries. Indeed, runway closure may have small impact on the traffic. The benefits would be done on operational costs.

Depending on the climate, an airport should be more or less inclined to invest in information systems since the climate has an impact on the surface condition regarding meteorological contaminants and therefore on the number of closure hours.

1.3.2 Categories

1.3.2.1 Embedded sensor measurements

Embedded sensors are built into the runway pavement and provide continuous measurements at specific relevant locations at a runway (e.g., at each third of the runway). Once installed at the runway, embedded sensors monitor surface conditions at a frequency consistent with landings/takes off frequency without any manual interaction with airport staff and so without any traffic disruption. This is the most advantageous feature of embedded sensors.

There are several types of embedded sensors measuring various parameters. In general, active sensors automatically cool down until freezing to measure current freezing point temperature. This type of freezing temperature measurement is independent from the type of chemicals used for runway treatment. Passive sensors usually contain temperature probe for runway surface temperature measurement. Some sensors have more than one temperature probe, which enable also sub-surface temperature measurement. This type of embedded sensors is capable to identify contaminant type (e.g., dry, wet, snow, ice) and depth of the contaminant (in most cases water-equivalent depth of the contaminant). Based on electrical properties of solution layer at the sensor, it estimates concentration of some predefined chemicals (for indirect estimation of freezing point temperature, assuming the surface contaminant does not only contain water and some pre-defined chemicals).

Embedded sensors may need supplementary present weather information to provide accurate estimate of the runway state.

1.3.2.2 Remote sensor measurements

Remote sensors are located close to the runway, providing real time continuous runway monitoring, assessing, and measuring of the runway surface contaminants (type, depth and runway coverage). Remote stationary sensors use non-contact processing data technology as the primary means to provide a real time accurate measuring and

reporting of the runway contaminant's type, depth and runway coverage (e.g., at each third of the runway).

Moreover, they provide real-time runway surface condition data being processed and automatically produce a draft report to airport operators, in line with the format and terminology in use.

Remote sensors continuously assess the runway surface condition and perform measurements under changing present weather conditions without any manual interaction and without affecting the air traffic. Remote sensors are enabling airports with automation of runway practices and full visibility of the entire runway.

These remote sensors may provide full runway coverage for air temperature trends, optimized timing for chemicals deployment, and other weather conditions.

1.3.2.3

Mobile sensor measurements

Mobile systems are vehicle mounted systems that measure and classify the type of runway surface condition descriptors on paved surfaces, or whether the paved surface is free of any of such weather-based contaminants. These measured and classified weather-based contaminants include at least liquid water, slush, snow and ice.

The mobile system does the actual measurement without any physical contact to the surface, also when the vehicle is moving on the runway. The collected data samples are provided both with time stamp and associated geographical location, typically based on utilizing GNSS (GPS, Galileo, or other appropriate positioning system) with suitable accuracy. As a result, the mobile systems can provide representative picture of overall runway conditions for each runway third when the observations are accumulated.

Moreover, the mobile systems are able to measure the water-equivalent depth of snow, which does not necessarily directly match with the physical contaminant depth definitions of ICAO and other regulations used in the aviation industry. The data from mobile systems may need to be converted or interpreted in order to derive the contaminant depth values according to applicable regulations, potentially requiring further data input and processing, or also human input, depending on the type of contaminant or a combination of multiple contaminants on the surface.

The mobile system components are ideally compact, easily and securely mountable on the outside of typically used operational vehicles such as patrol vehicles, anti- and de-icing trucks, friction testers, plows, or multifunction vehicles, and they tolerate the normal height of any of these typical vehicles. The systems components outside the vehicle cabin are to be tolerant to vibration, weather hardened (thunderstorm, strong wind...) and can operate in both extreme winter and summer conditions.

1.3.2.4

Aeroplane as a sensor

Aeroplanes are not part of airport RWIS. However, as presented below, aeroplanes can be a source of information for RWIS.

Aeroplanes are embedding many sensors (air pressure & temperature, 3-axes accelerometers & gyrometers, wheels tachometers...) for their own use. In addition to aeroplane piloting, all the data provided by these on-board sensors can be also used during aeroplane landing to assess some characteristics of the aeroplane's braking on the runway. Among those characteristics, it is possible to assess if the braking is friction limited or not (anti-skid active or not) and to compute some Tire-to-Runway friction dependent parameters. It is then possible to make a correlation between those parameters and the GRF RCAM levels to provide an aeroplane computed Braking Action information on parts of the runway where the aeroplane has braked. The aeroplane computed Braking Action is a direct aeroplane performance related objective information.

GRF application requires Flight Crew to provide (AIREP) to air traffic controller an estimated Braking Action when he detects, during landing, a degraded runway condition when compared to the one provided by ATS. This information has then to be transmitted to the airport. This flight crew assessment is by nature subjective, linked to pilots' assessment experience and skills.

The broadcasting of the aeroplane computed Braking Action information to airspace users (e.g. Flight Crew to assist them in their AIREP) and Airports (as a traffic non-

intrusive mean to get additional runway condition information) strongly enhances global runway condition awareness.

This MASPS contains the requirements or recommendations to enable the use of aeroplane computed Braking Action by airports as an RWIS input data.

If aeroplane uses software to automatically determine the AIREP, the competent regional authority must certify this software for safe on-board implementation and use.

At the time of the edition of this MASPS, no specific standard is applicable to specify requirements to ensure an acceptable minimum level of quality for an aeroplane computed Braking Action information. Thus, unless a standard becomes applicable, in order to ensure a sufficient quality level for aeroplane computed Braking Action, this MASPS also contains the information, requirements or recommendations to consider generating an aeroplane computed Braking Action. Those information, requirements or recommendation are identified using “[Aeroplane computed Braking Action quality related, superseded by applicable standard if any]” tag.

1.3.3

Use Cases for RWIS

Runway Condition Report

The RCR is mandatory to report the runway surface condition in presence of one or more contaminants. It allows pilots to calculating aeroplane performances for take-off and landing.

A RWIS supports the observation and reporting of the runway surface condition.

Winter operations

Airport operators need to assess the type, depth and coverage of winter contaminants present on a runway to optimize interventions such as de-icing or snow-clearing. A RWIS can support the observation. The aim is to reduce the time of these interventions in order not to interrupt traffic. RWIS could also enable to optimize (reduce) the use of anti-icing/de-icing chemicals.

Year-round operations

Since it will be mandatory to report the runway surface condition, RWIS can support the observation throughout the whole year. In case of heavy rainfall, a system can increase the situational awareness and can help to decrease the number of inspections and their duration.

Runway inspections

Inspections often require runway closures. That is why it is necessary to reduce their number and duration. A precise assessment of the runway surface condition by using Runway Weather Information Systems will allow to reduce the runway's closure time, in the case of mobile sensors, or to reduce the number of human's intervention, in the case of stationary sensors. To achieve both advantages, some RWIS contain of different sensor categories.

Runway management

Using an information system will allow to collect and save data of contaminated runway surface periods in order to analyse them and to improve operational processes during contamination periods, for maintenance needs or for costs/benefits analysis.

CHAPTER 2

SPECIFIC PERFORMANCE REQUIREMENTS

2.1 INFORMATION GENERATION REQUIREMENTS

2.1.1 Mandatory and optional information

2.1.1.1 Mandatory information

As a result of the assessment, the system shall be capable to provide reports containing at least the following information in order to enable the completion of the 'Aeroplane Performance Calculation Section' of the SNOWTAM Format (ref. ICAO Doc 9981 & Annex to EASA Regulations 2017/373 and 139/2014 + related draft AMC/GM).

REQ 2.1: System shall assess following runway condition description (type of contaminant):

- DRY RUNWAY
- SNOW (including DRY SNOW / WET SNOW / COMPACTED SNOW)
- FROST
- ICE (including WET ICE)
- SLUSH
- WATER (this includes 'WET' and 'STANDING WATER').

REQ 2.2: System shall assess depth of 'loose contaminants': water, slush, (dry/wet) snow.

REQ 2.3: System shall measure outside air temperature (OAT)

REQ 2.4: System shall assess runway coverage %

REQ 2.5: System shall assign a time stamp to the data

Note: The airport operators and manufacturer should agree on the acceptable time lag between sensor's measurement and availability of information for airport operator.

REQ 2.6: System shall include the airport ICAO location indicator (Doc 7910) approved and published by the ICAO.

REQ 2.7: System shall identify the runway third concerned by the measurement.

REQ 2.8: System shall assess if a sensor is not able to provide one or more data listed before (REQ 2.1 to 2.7), manufacturers should precise it.

REQ 2.9: System shall provide the lower runway designation number. The aim is to enable airports with several runway to identify the one concerned by the measures.

2.1.1.2 Optional information

Additionally, as an optional information, the equipment may also provide the following parameters, useful for a comprehensive assessment of the runway surface conditions.

REC 2.1: System should measure weather and runway parameters other than OAT.

In addition to the OAT, as indicated in para. 2.1.1.1, the system features may include the capability of measuring and/or calculating:

- ground (pavement) temperature in one or at least three multiple depths within a 1m depth-range.
- wind speed / direction
- humidity,
- precipitation rate, type
- freezing point,
- dew point
- radiation flux
- visibility
- air pressure

REC2.2: System should assess runway condition descriptors other than those provided in 2.2.1.1.

In addition to the runway condition descriptors listed in para. 2.1.1.1, the system features may include the capability of detecting:

layered contaminants (DRY SNOW ON TOP OF COMPACTED SNOW; DRY SNOW ON TOP OF ICE; WATER ON TOP OF COMPACTED SNOW; WET SNOW ON TOP OF COMPACTED SNOW; WET SNOW ON TOP OF ICE)

REC 2.3: System should assess friction measurements.

The system may include a 'built-in' friction measurement device, capable of performing friction measurements, to be used as part of the overall runway surface assessment for compacted snow- or ice-covered surfaces; the friction measuring device shall meet the standard set or agreed by the State (see ICAO Circular 355, 1.22 and 4.37, Table 4-3 and EASA Draft GM1 ADR.OPS. A.065(d)).

REC 2.4: System should assess 'SLIPPERY WET' Warning

The system features should include the capability of issuing a warning whenever the runway is found to be wet and the available friction data (routine measurements taken periodically on the dry runway for maintenance purposes) indicate that the runway surface condition is below the Minimum Friction Level (MFL). To this end, the system shall be capable of storing and processing the friction figures (measured by means of the equipment itself, if including a 'built-in' friction measuring device, or by means of other equipment).

REC 2.5: System should be able to assign a RWYCC based on the type and the depth of the contaminant.

The system features should include the capability of determining the Runway Condition Code (RWYCC) as per ICAO definition (see Annex 14 Vol. I Ch. 1 - 1.1 Definitions) and procedures (see ICAO Doc 9981 - PANS-Aerodromes).

REC 2.6: System should assess presence and concentration of chemicals.

The system features may include the capability of detecting the presence and amount of chemicals in water / slush / snow may be useful in order to:

- help establish the available 'protection time' when de-icing fluids are used for the purpose of runway anti-icing.
- enable the aerodrome operator to report the presence of residual chemicals (e.g., from aeroplane de / anti-icing fluids or runway treatment) in the 'Situational awareness' section of the SNOWTAM format, as per ICAO / EASA provisions.

REC 2.7: System should be able to generate a RCR

The system features should include the capability of issuing a Runway Condition Report (RCR) as per ICAO definition (see Annex 14 Vol. I Ch. 1 - 1.1 Definitions) and procedures (see ICAO Doc 9981 - PANS-Aerodromes).

REC 2.8: System should assess aeroplane computed Braking Action.

The system feature should include the capability of displaying the computed Braking Action received from just landed aeroplane.

Items from 1 to 5 have to be provided for each runway third, starting from the lower runway designation number, as per the relevant ICAO / EASA provisions.

Remark: The Runway Designation Number shall be expressed as a two- or three-character number identifying the runway as per the relevant ICAO / EASA provisions.

REC 2.9: The system features should include the runway width for which the RWYCC assessment applies.

2.1.2 Detailed specifications

2.1.2.1 Mandatory information

REQ 2.10: System shall assess runway surface condition description shall be expressed in terms of type of contaminant as per ICAO definitions (see Annex 14 Vol. I Ch. 1 - 1.1 Definitions 2.9.5, 2.9.11 of Annex 14, Volume I as follows:

- DRY RWY
- SNOW (this includes DRY SNOW, WET SNOW and COMPACTED SNOW)
- FROST
- ICE (including WET ICE)
- SLUSH
- WATER