European Union Aviation Safety Agency

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RWYMT (RUNWAY MICRO TEXTURE) [EASA.2022.C06]

Manual for the use of the method D-4.4

An Agency of the European Union

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SUMMARY

As part of the EASA Runway Micro Texture project a method is being developed to identify when a runway surface could be defined as slippery wet. This method uses high resolution surface scans to analyse the micro texture characteristics of the runway surface. The current report describes the work done as part of work package 4.4. Minimum specifications and operational procedures for a high-resolution laser scanner are presented based on the working experience gained with the scanner used in the research project.

CONTENTS

ABBREVIATIONS

ACRONYM	DESCRIPTION
ASTM	American Society for Testing and Materials
EASA	European Union Aviation Safety Agency
ESDU	Engineering Sciences Data Unit
NLR	Nationaal Lucht- en Ruimtevaartlaboratorium (National Aerospace Center)

1. Introduction

1.1 Background

NLR, and its partners DLR and ESDU conducted a research project for EASA, called the EASA Runway Micro Texture Project, to develop a new method to determine when a runway maybe slippery when it is wet. This project was funded from the European Union's Horizon Europe research and innovation programme. As part of the EASA Runway Micro Texture Project several tests have been conducted. These tests encompassed braked tests with different aircraft on wetted runway sections and surface pavement measurements using different devices. Friction data derived from the flight tests and results from British Pendulum tests have been converted into a micro texture sharpness parameter. Results obtained with high resolution surface lasers scanners have been used to derive several micro texture parameters that have been correlated with the micro texture sharpness parameter. These results can be used to develop a methodology to assess slippery wet runways.

The present report is deliverable D-4.4 of work package 4. It discusses the use of the proposed method in the form of a short manual. This manual can be used by aerodrome operators, national aviation authorities and accident investigation bodies.

1.2 Objectives

This report is deliverable D-4.4 of the EASA Runway Micro Texture Project (EASA.2022.C06). The work presented here is the output from work package 4. The objective is to develop a manual that describes how to apply the proposed method. The manual contains the working procedures of a high-resolution laser surfaces scanner (or similar device) and discusses the interpretation of the results. The manual is written based on the experience gained during the execution of the project.

2. Basic specifics for assessing micro texture characteristics of a runway surface

2.1 Introduction

The World Road Association has established standard categories of texture, classified by wavelength. These categories include micro texture (wavelengths up to 0.5 mm), macro texture (0.5 to 50 mm), mega texture (50 to 500 mm), and roughness (wavelengths larger than 500 mm). Texture wavelength is a quantity describing the horizontal dimension of the irregularities of a texture profile (ISO/DIS 13473-1). The wavelengths and the amplitude for micro texture determine the requirements for a surface scanner or any other device that measures surfaces profiles.

2.2 Scan area

Surface laser scanners that use a laser sensor normally scan the surface coordinates of parallel straight lines. The length of one line should be at least 100 mm. An area with a width of at least 70 mm should be scanned. It is recommended to use 15 scanlines as a minimum over a width of 70 mm. More lines could improve the results however at the cost of more time to performed one spot measurement. For other types of surface scanners an equal area is recommended.

2.3 Operational conditions

The surface scan measurements should not be made during rain or snow fall or on surfaces that are covered by water, snow, ice etc. This will give incorrect results regarding the surface texture. Measurements should not be conducted at temperatures outside the specified range set by the manufacturer because the internal mechanism of the surface scanner can be affected by air temperature. Direct sunlight will cause spikes to occur in the data. When sunlight is directly striking the surface that is to be scanned, a shield to block direct sunlight on the scanning surface should be used. Alternatively, the surface scanner could be covered by lighttight box. For very dark coloured surfaces, or for scanning outside in the sunlight it is best to use the full power setting of the scanning device.

3. Assessment of the runway micro texture

3.1 Location and amount of spot measurements

Current high resolution surface scanners cannot be used in a continues way due to the scanning frequency limitations of those devices. Therefore, spot measurements have to be taken along the runway. These spots should be appropriately distributed on the runway. For newly constructed runways, the surface pavement texture would be homogeneous along the runway. However, the texture of the runway pavement that has been in service for some time can vary due to normal wear. This wear is mostly caused by aircraft wheels running over the surface. In this case the transverse location of the measurements should be determined by the expected location of the main gear tires of the aircraft that frequently use the runway. Along the runway, differences could also exist in the texture due e.g. rubber buildup and wear. Uniform test sections along the runway should therefore be identified. For a uniform test section, it is sufficient to obtain 16 evenly spaced profiles regardless of test section length following the guidelines given in ASTM E1845 – 09[1]. When characterising a long section with relatively short sample lengths, it is important to ensure that the texture is sufficiently homogeneous to provide a representative measure. To characterise a nonhomogeneous pavement sound judgement is necessary from the user. Aerial surveys using a drone could be of assistance to identify differences in the surface and also to the areas with rubber deposits.

For example, consider a runway that is 3,000 m long which has a reasonable homogeneous pavement. With 16 evenly spaced profiles, spot measurements should be taken every 150 m along the runway, left and right of the runway centreline. The lateral position of each spot should be based on the expected location of the main gear tires of the aircraft that frequently use the runway. Assume in this example that B737, A320 and EMB175 are the most common aircraft that operate on the runway. These aircraft have main gear wheel bases varying between 5 and 8 meters (see the airport planning manual). Based on the location of the main gear wheels and accounting for some lateral deviation during the ground roll, the wheels are roughly expected to be anywhere between 2 and 5 meters from the runway centreline. These values can be used to select the lateral location of the spots. Table 1 gives the locations for the spot measurements in this example. Should the pavement of the runway be nonhomogeneous, more spots should be selected either in longitudinal direction and or lateral location. This will be up to expert judgement.

[1] ASTM E1845-09, Standard Practice for Calculating Pavement Macrotexture Mean Profile Depth, Jun 12, 2015.

Table1: example of locations for spot measurements

Distance from threshold (m)	Distance left from CL (m)	Distance right from CL (m)
150	2	2
300	5	5
450	2	2
600	5	5
750	2	2
900	5	5
1050	2	2
1200	5	5
1350	2	2
1500	5	5
1650	2	2
1800	5	5
1950	2	2
2100	5	5
2250	2	2
2400	5	5
2550	2	2
2700	5	5
2850	2	2

Care should be taken when measuring on painted sections on the runway for instance on the touchdown zone markers. These will have different macro and micro texture characteristics. They may not be representative of the overall braking performance of a runway surface. Spots that show high buildup of rubber deposits should be selected carefully. They should not be excluded from the data sample as rubber deposits can significantly affect the micro texture of a runway. The amount of buildup could vary significantly on the runway where most will be found in the touchdown zone area. This makes the runway pavement to be less homogeneous and more spots should be selected in those areas. The actual number of additional spots is difficult to state and should be based on the sound judgement from the user (e.g. aerodrome inspector).

3.2 Time needed to assess a runway

The time needed to completely assess a runway depends on the length and on the homogeneity of the pavement surface (which defines the number of spots). Also the settings and characteristics of the scanner will affect the required time. For the example in table 1, using a high-resolution surface laser scanner with 15 scan lines selected, it will take about 2 minutes per spot to complete a scan. In the example 38 spots are scanned so it will take one person at least 76 minutes to complete the survey. This excludes the time to go to each spots and locate the position.

3.3 Output of the laser surface scanner

The device should be able to export the results to text files which can be processed by the user with dedicated software as developed in deliverable D-4.5. Alternatively, the manufacturer of the device could implement the algorithms into the memory of the device to process the results immediately after the spot measurements. This last option would be preferred. The results of each spot can then be recorded by the user from a display or from the data stored in the memory.

3.4 Analysis and use of the results

The results of the surface scans are the micro texture characteristics for each spot on the runway that has been scanned. The exact micro texture parameter to be used and the associated threshold for a slippery wet runway condition is still to be determined. Deliverable D-4.5 explores several parameters that can be used to characterise the micro texture.

For now it is assumed that a micro texture parameter is selected from D-4.5. For the overall analysis of the result it is not relevant which parameter will be selected. The micro texture parameter will vary for the different locations selected in the runway survey. The first step of the analysis is to determine whether the derived micro texture parameter for each spot exceeds the threshold for a slippery wet runway condition or not. Table 2 shows a notional example of different spots measured on the runway taken from the example in Table 1. The measured data have to be converted into information representative for a runway third to be compatible with the Global Reporting Format (GRF). In the example there are several spots identified mostly in the middle of the runway section that would classify the spot as slippery wet. This would justify in this example that the airport declares the second part of the runway as slippery wet whenever the runway is wet in this part of the runway. The assigned RWYCC 3 is reported in the RCR. The exact working procedures related to this could still be refined or changed as the method is formalised.

Table 2: example of slippery wet spots located on the runway

Distance from threshold (m)	Distance left from CL (m)	Distance right from CL (m)	Distance left from CL slippery wet?	Distance right from CL slippery wet?
150	2	2	No	No
300	5	5	No	No
450	2	2	No	No
600	5	5	No	No
750	2	2	No	No
900	5	5	No	No
1050	2	2	No	No
1200	5	5	No	Yes
1350	2	2	Yes	Yes
1500	5	5	Yes	Yes
1650	2	2	Yes	No
1800	5	5	Yes	Yes
1950	2	2	No	Yes
2100	5	5	Yes	No
2250	2	2	No	No
2400	5	5	No	No
2550	2	2	No	No
2700	5	5	No	No
2850	2	2	No	No

EASA

European Union Aviation Safety Agency

European Union Aviation Safety Agency

Konrad-Adenauer-Ufer 3
50668 Cologne
Germany

Runway microtecture | EASA Europa.eu

Mail EASA.research@easa.europa.eu
Web www.easa.europa.eu

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