AMC2 ADR.OPS.C.007(c) Maintenance of vehicles

ED Decision 2021/003/R

MAINTENANCE OF VEHICLES — OTHER ORGANISATIONS

(a) The maintenance programme should be individual for each vehicle, depending on its function and characteristics. The maintenance programme should take into account the following:

(1) applicable regulatory requirements;

(2) the manufacturer's maintenance recommendations;

(3) local environmental conditions (e.g. heat versus cold winters);

(4) the need to ensure the serviceability of the equipment installed on the vehicle (e.g. radio, transponders); and

(5) regular performance test results, if appropriate.

(b) With regard to maintenance procedures, they should include at least specify:

(1) the frequency of the maintenance services;

(2) activities to be undertaken at each type of maintenance service (e.g. visual check, inspections, etc.); and

(3) environmental procedures, including appropriate disposal procedures for old parts and other material.

(c) With regard to preventive maintenance, AMC1 ADR.OPS.C.007(a)(1) applies.

(d) With regard to record-keeping, AMC1 ADR.OPS.C.007(b)(3) applies.

GM1 ADR.OPS.C.007(d) Maintenance of vehicles

ED Decision 2021/003/R

UNINTENDED USE OF UNSERVICEABLE VEHICLES

Apart from the obligation to ensure that an unserviceable vehicle is removed from operations, measures also need to be taken to avoid the unintended use of an unserviceable vehicle. The latter may include the placing of a warning placard inside the vehicle to inform about the unserviceability of the vehicle, and the establishment of a method for the provision of such information to the relevant personnel, especially those of the next shift.

ADR.OPS.C.010 Maintenance of pavements, other ground surfaces and drainage

Delegated Regulation (EU) 2020/2148

(a) The aerodrome operator shall inspect the surfaces of all movement areas including pavements (runways, taxiways and aprons), adjacent areas and drainage to regularly assess their condition as part of an aerodrome preventive and corrective maintenance programme.

(b) The aerodrome operator shall:

(1) maintain the surfaces of all movement areas with the objective of avoiding and eliminating any FOD that might cause damage to aircraft or impair the operation of aircraft systems;

(2) maintain the surface of runways, taxiways and aprons in order to prevent the formation of harmful irregularities;

(3) maintain the runway in a condition so as to provide surface friction characteristics at or above the minimum standards;

(4) periodically inspect and document the runway surface friction characteristics for maintenance purposes. The frequency of those inspections shall be sufficient to determine the trend of the surface friction characteristics of the runway;

(5) take corrective maintenance action to prevent the runway surface friction characteristics for either the entire runway or a portion thereof, when uncontaminated, from falling below the minimum standards.

AMC1 ADR.OPS.C.010 Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

GENERAL

(a) Mud, dust, sand, oil, rubber deposits, and other pollutants should be removed, as rapidly and completely as possible, to minimise accumulation.

(b) Taxiways and aprons should be kept clear of pollutants to the extent necessary to enable aircraft to be taxied to and from an operational runway.

(c) Drainage systems and storm water collection systems should be periodically checked and, if necessary cleaned or maintained, to ensure efficient water run-off.

(d) The surface of a paved runway should be evaluated when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives.

GM1 ADR.OPS.C.010(b)(1) Pavements, other ground surfaces, and drainage

ED Decision 2021/003/R

OVERLOAD OPERATIONS

(a) Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behaviour are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behaviour is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy, and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

(1) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 % above the reported PCN should not adversely affect the pavement;

(2) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 % above the reported PCN should not adversely affect the pavement;

(3) if the pavement structure is unknown, the 5 % limitation should apply; and

(4) the annual number of overload movements should not exceed approximately 5 % of the total annual aircraft movements.

(b) Such overload movements should not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading should be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water. Where overload operations are conducted, the aerodrome operator should review the relevant pavement condition regularly, and should also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life, or require major rehabilitation of pavement.

GM1 ADR.OPS.C.010(b)(2) Pavements, other ground surfaces and drainage

ED Decision 2021/003/R

RUNWAY SURFACE EVENNESS

(a) The operation of aircraft and differential settlement of surface foundations will eventually lead to increases in surface irregularities. Small deviations in the above tolerances will not seriously hamper aircraft operations. In general, isolated irregularities of the order of 2.5 cm to 3 cm over a 45 m-distance are acceptable, as shown in Figure 1. Although maximum acceptable deviations vary with the type and speed of an aircraft, the limits of acceptable surface irregularities can be estimated to a reasonable extent. The following table describes acceptable, tolerable and excessive limits:

Surface Irregularity	Length of irregularity (m)								
	3	6	9	12	15	20	30	45	60
Acceptable surface irregularity height (cm)	2.9	3.8	4.5	5	5.4	5.9	6.5	8.5	10
Tolerable surface irregularity height (cm)	3.9	5.5	6.8	7.8	8.6	9.6	11	13.6	16
Excessive surface irregularity height (cm)	5.8	7.6	9.1	10	10.8	11.9	13.9	17	20

Table 1

(1) If the surface irregularities exceed the heights defined by the acceptable limit curve but are less than the heights defined by the tolerable limit curve, at the specified minimum acceptable length, herein noted by the tolerable region, then maintenance action should be planned. The runway may remain in service. This region is the start of possible passenger and pilot discomfort.

(2) If the surface irregularities exceed the heights defined by the tolerable limit curve, but are less than the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the excessive region, the maintenance corrective action is mandatory to restore the condition to the acceptable region. The runway may remain in service but should be repaired within a reasonable period. This region could lead to the risk of possible aircraft structural damage due to a single event or fatigue failure over time.

(3) If the surface irregularities exceed the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the unacceptable region, then the

area of the runway where the roughness has been identified warrants closure. Repairs are required to restore the condition within the acceptable limit region and the aircraft operators may be advised accordingly. This region runs the extreme risk of a structural failure and must be addressed immediately.

(b) The term ‘surface irregularity’ is defined herein to mean isolated surface elevation deviations that do not lie along a uniform slope through any given section of a runway. For the purposes of this concern, a ‘section of a runway’ is defined herein to mean a segment of a runway throughout which a continuing general uphill, downhill, or flat slope is prevalent. The length of this section is generally between 30 and 60 m, and can be greater, depending on the longitudinal profile and the condition of the pavement.

(c) The maximum tolerable step-type bump, such as that which could exist between adjacent slabs, is simply the bump height corresponding to zero bump length at the upper end of the tolerable region of the roughness criteria of Figure 1.

(d) Deformation of the runway with time may also increase the possibility of the formation of water pools. Pools as shallow as approximately 3 mm in depth, particularly if they are located where they are likely to be encountered at high speed by landing aeroplanes, can induce aquaplaning which can then be sustained on a wet runway by a much shallower depth of water. Improved guidance regarding the significant length and depth of pools relative to aquaplaning is the subject of further research. It is, of course, especially necessary to prevent pools from forming whenever there is a possibility that they might become frozen.

(e) Macrotexture and microtexture are taken into consideration in order to provide the required surface friction characteristics. This normally requires some form of special surface treatment.

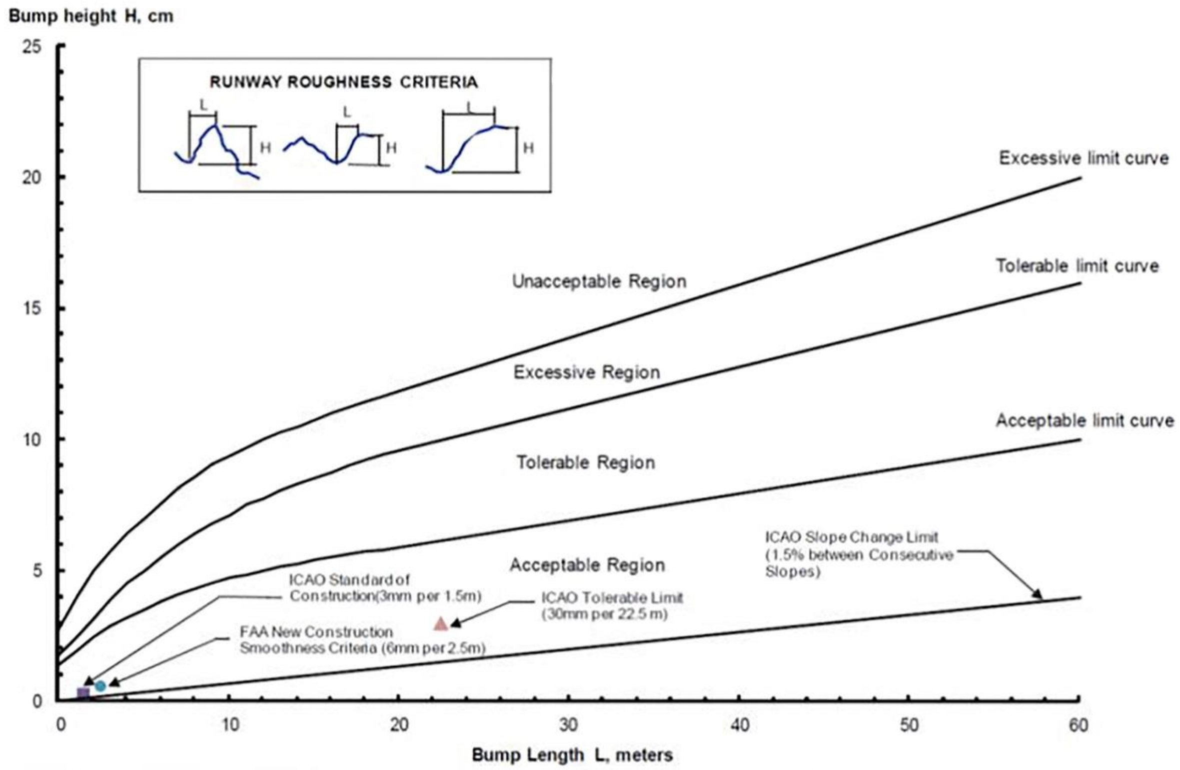

Figure 1

AMC1 ADR.OPS.C.010(b)(3) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

MAINTENANCE PLANNING AND MINIMUM STANDARDS

(a) When friction measuring devices are used in order to evaluate the condition of the runway surface for maintenance purposes, the maintenance planning and minimum friction levels should be according to the following table:

	65 km/h		95 km/h	
	Minimum	Maintenance planning	Minimum	Maintenance planning
Airport Surface Friction Tester	0.50	0.60	0.34	0.47
Dynatest Consulting Inc. Dynatest Runway Friction Tester	0.50	0.60	0.41	0.54
Findlay, Irvine, Ltd Griptester Friction Meter	0.43	0.53	0.24	0.36
Halliday Technologies RT3	0.45	0.55	0.42	0.52
Moventor Oy Inc. BV-11 Skiddometer	0.50	0.60	0.34	0.47
Mu Meter	0.42	0.52	0.26	0.38
NAC Dynamic Friction Tester	0.42	0.52	0.28	0.38
Norsemeter RUNAR (operated at fixed 16 % slip)	0.45	0.52	0.32	0.42
Automatic Friction Measuring Device (Instrument de Mesure Automatique de Glissance) – IMAG	0.30	0.40	0.20	0.30

Table 1

(b) Other friction measuring devices can be used, provided they have been correlated with, at least, one test equipment mentioned in the table above.

(c) Measurements at or below the maintenance planning level trigger a complete survey of the texture, contaminant and drainage state of the affected runway third.

(d) A complete survey should ensure that the runway surface is able to create enough grip by the aeroplane tyre to ensure adequate aeroplane stopping and crosswind capability for the desired operation on a wet runway. This is achieved by ensuring that:

(1) exposed texture can indent the tyre rubber; and

(2) water drains from the runway pavement.

(e) In order to achieve the objectives of point (d), an inspection of the surface friction characteristics should, as a minimum, ensure:

(1) the presence of exposed microtexture by touching the aggregates, if the polished or rubber coated extends to 100 m in the zone used by aeroplanes;

(2) the presence of macrotexture;

(3) that grooves, if present, are open and within set limits according to their design;

(4) that porous friction course, if present, drains according to its design; and

(5) that slopes are above minimum design specifications.

GM1 ADR.OPS.C.010(b)(3) Pavements, other ground surfaces and drainage

ED Decision 2021/003/R

MONITORING OF PHYSICAL PARAMETERS

The following table describes how the physical parameters of the runway surface are monitored.

Physical parameter	How to monitor
Microtexture	Presence of microtexture is ensured by touching the pavement surface. If it feels smooth, there is a lack of microtexture, most commonly due to rubber deposits which normally should be visually detectable or by polishing. In either case, the amount of free exposed microtexture should be assessed.
Macrotexture	Can be measured using volumetric or profile measurement method and expressed by ESDU classification. ESDU 15002 groups runways into five classifications labelled A through E with A being the smoothest and E the most heavily textured. The classification can be used to compare the runway texture relevant to the recommended texture depth which is 1.0 mm.
Drainage	Slopes are within the certification specifications. If the slope falls below the minimum values, then the runway becomes more susceptible to standing water during heavy rainfalls.
Ponding	Visually, during and after rain storm events as the runway dries up.
Rutting	Visually, during and after rain storm events. The degree of rutting can be measured using a straight edge.
Sand and vegetation	Visually during and after rain storm events. Normally, ordinary maintenance activities should prevent sand to accumulate and vegetation to form alongside the runway to such a degree that it becomes a hazard.

AMC1 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

PERIODIC ASSESSMENTS OF RUNWAY SURFACE FRICTION CHARACTERISTICS

The aerodrome operator when establishing a plan of periodic assessments of runway surface friction characteristics, should take into consideration the number of jet aircraft movements per runway end, the weight of the aircraft, the type and age of the surface of the runway as well as climatic conditions.

AMC2 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

TREND MONITORING OF RUNWAY SURFACE FRICTION CHARACTERISTICS

The aerodrome operator should monitor the trend of degradation of runway surface friction characteristics that is caused by:

(a) rubber deposits;

(b) surface polishing; and

(c) poor drainage.

AMC3 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

FUNCTIONAL FRICTION EVALUATIONS WITH CONTINUOUS FRICTION MEASURING DEVICES

The aerodrome operator when conducting functional friction evaluations with continuous friction measuring device, should:

(a) for friction evaluations on runways at 65 km/h, begin recording the data 150 m from the threshold end to allow for adequate acceleration distance and terminate approximately 150 m from the opposite end of the runway to allow for adequate distance to safely decelerate the vehicle;

(b) for friction evaluations on runways at 95 km/h, begin recording the data 300 m from the threshold end to allow for adequate acceleration distance and terminate approximately 300 m from the opposite end of the runway to allow for adequate distance to safely decelerate the vehicle; and

(c) conduct the surveys at a distance from the runway centre line that is representative of the wheel span of the aeroplanes operating on the runway.

The aerodrome layout or other circumstances may dictate other distances in order to ensure the personal safety of the operator of the friction measuring device.

AMC4 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

RUNWAY SURFACE FRICTION CHARACTERISTICS EVALUATION WITHOUT FRICTION MEASURING DEVICES

(a) The evaluation should be conducted for the full width and length of the pavement and should focus on:

  (1) slopes;

  (2) texture; and

  (3) drainage.

(b) The area symmetrical from the centre line representative of the wheel span of the aeroplanes operating on the runway should be inspected with special focus on:

(1) rubber deposits;

(2) polishing of aggregates; and

(3) amount of exposed texture.

GM1 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

TREND MONITORING PROGRAMME

(a) The objective of the trend monitoring programme is to ensure that the surface friction characteristics for the entire runway remain at or above the minimum standards, to avoid the runway becoming slippery wet.

(b) Degradation is typically caused by rubber deposits, surface polishing or poor drainage. These can be mitigated as follows:

(1) Accumulation trend of rubber can be managed through a rubber removal programme.

(2) Polishing trend of the surface can be managed by monitoring loss of sharpness and retexturing/resurfacing programme.

(3) Drainage trend can be managed by monitoring changes in geometry and blocking of drainage channels and reshaping programme.

(c) In the construction of new runways or the resurfacing of existing runways, the construction of surfaces with adequate slopes and aggregate of angular fragments from crushed gravel or stone so as to provide a sharp texture will help to ensure surface friction characteristics providing good braking action in wet conditions. The surface friction characteristics of a new constructed or resurfaced runway surface establish the normal starting point for trend monitoring; however, trend monitoring can also start at any given time through the lifespan of a pavement.

(d) The determination that a runway or portion thereof is slippery wet stems from various methods used by themselves or in combination. Additionally, substandard runways or portion thereof can be identified through repeated reports by aeroplane operators based upon flight crew experience or through analysis of aeroplane stopping performance. When such reports are received, it is an indication that the surface friction characteristics are likely to be severely degraded and immediate remedial action is necessary.

GM2 ADR.OPS.C.010(b)(4) Maintenance of pavements, other ground surfaces and drainage

ED Decision 2021/003/R

FRICTION EVALUATIONS WITH CONTINUOUS FRICTION MEASURING DEVICES

(a) The lateral location on the runway for performing friction measurements is based on the type and/or mix of aircraft operating on the runway:

(1) For runways serving only narrow-body aircraft, friction measurements are conducted 3 m to 5 m from the runway centre line.

(2) For runways serving narrow-body and wide-body aircraft, friction measurements are conducted 3 m and 6 m from the runway centre line to determine the worst-case condition. If the worst-case condition is found to be consistently to one track, future

measurements may be limited to this track. Care needs to be exercised, however, to account for any future and/or seasonal changes in aircraft mix.

(b) The measurements are performed using a self-wetting continuous friction measuring device on a dry runway surface.

(c) Interpretation of comparative self-wetting friction measurements

(1) The texture of the tyre pavement contact patch area in direct contact with aircraft tyre penetrates the rubber of the aircraft tyre and creates horizontal forces in the aircraft tyre and creates grip. Grip is a micro-movement of the rubber over the texture indenting the rubber. This micro-movement is called slippage. On a free-rolling aircraft tyre, there is no relative movement between the aircraft tyre and the pavement regardless of the rolling speed. The amount of exposed texture, and the quality thereof, both micro and macrotexture, defines the ability of the pavement surface to create wet grip performance of the aircraft tyre.

(2) If the aircraft wheel is braked and the horizontal forces applied on the aircraft tyre are higher than those produced by the grip, the aircraft tyre starts to skid.

(3) The friction coefficient that can be calculated is a dynamic friction coefficient. The dynamic friction coefficient is lower than the static friction coefficient (maximum tyre grip that can be achieved). Related to stopping performance of the aircraft, the operation has become friction-limited when a tyre starts skidding.

(4) The basic assumption for the using a self-wetting continuous friction measuring device with a forced skid is to mirror a braked skidding aircraft tyre on a wet pavement surface. This is an oversimplification since the aircraft tyres are controlled by an anti-skid system and the friction measuring devices operate at a fixed slip.

(5) It is noted that friction measuring device values are not used to determine and report surface conditions. Joint industry and multi-national government tests have not established a reliable correlation between runway friction values and the relationship to aeroplane braking performance. However, the measured values can be used in a comparative way to support other survey information collected.

(6) The measured friction coefficient is a dynamic friction coefficient where the surfaces are forced to be in relative motion regardless of the measuring speed. The degree of relative motion is friction measuring device-specific.

(7) A complete survey is, as a minimum, performed at speeds of 65 km/h and 95 km/h.

(8) The measured value is an indication of the overall texture, contaminant and drainage capability of the pavement surface in the tyre pavement contact patch area of a skidding tyre. No single capability can be extracted but certain qualities can be deduced from comparative measurements using the same friction measurement device on the same surface.

(9) The measured values are to be compared with measured values from previous surveys in order to monitor the trend of the texture, contaminant and drainage characteristics of the runway pavement.

(i) Texture

(A) At low speed, the microtexture of the aggregates in the tyre pavement contact patch area penetrates the residual water film between the pavement and the rubber. These are qualities associated with 65 km/h.

Lower comparative values at low speed indicate reduced exposed microtexture and are indicative of microtexture cover-up (rubber) and polishing of aggregates.

(B) At higher speed,the microtexture may not penetrate the residual water film. As speed increases, the residual water film may become thicker and reduce the amount of microtexture that penetrates the water film. If no microtexture penetrates the water film, there is no effect of the microtexture on the performance of the aircraft tyre. The tyre then goes into an aquaplaning mode with no stopping and directional control capability. These are qualities associated with 95 km/h, and lower comparative values are indicative of the combined rubber build-up and reduced drainage capability.

(C) Macrotexture creates escape channels for bulk water and reduces the susceptibility of the pavement surface to build up water films under the aircraft tyre. Lower comparative values at high speed indicate reduced macrotexture.

(ii) Contaminant

(A) The most common contaminant to consider is the build-up of rubber. Build–up of rubber reduces the amount of exposed microtexture and the fill-up of the macrotexture, and thereby reduces the drainage capability of the pavement in the tyre pavement contact patch area. Affected areas can readily be identified by the eye.

(B) If the aerodrome operator suspects that the runway has a microtexture problem, this can be identified by the touch; pavement surface does feel 'sandpapery'. This applies to both rubber build-up, where the aggregates get covered, and the polishing of aggregates.

(C) For interpretation of comparative measurements on rubber built-up areas, see *(i) Texture* above.

(10) Drainage

(i) The aircraft tyres' contribution to drainage is the drainage through the longitudinal grooves. The pavements' contribution is the drainage through their macrotexture. This drainage can be in all directions, and in the case of porous friction course drainage downwards, through the porous friction course layer itself. If the pavement is transverse grooved, the drainage in the transverse direction of travel is enhanced. Lower comparative values at high speed indicate reduced drainage capability under the aircraft tyre and reduced macrotexture.

(ii) It should be noted that the effects of drainage defects, such as ponding and rutting, will not be detected by comparative measurements by self-wetting continuous friction measuring devices. As the self-wetting continuous friction measurements are performed on a dry runway, there will be no ponding, nor any water stream in any rutting if the runway has such defects.