AIRCRAFT PERFORMANCE & GRF REPORTING

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REQUIREMENTS on AIRCRAFT RUNWAY PERFORMANCE

TAKEOFF:

Maximum allowed runway limited takeoff weight is determined taking into account the following critical events:

1) Acceleration with all engines
2) One engine failure
3) Continued takeoff with one engine inoperative
   OR
   Rejected takeoff and deceleration to zero speed

When the A/C is in the runway length limited takeoff weight, the continued takeoff and/or the rejected takeoff will take all of the available runway length.

- Aircraft acceleration capability (one engine failed) is critical for continued takeoff
- Tyre to ground friction is critical for rejected takeoff

LANDING:

Performance determination in landing is divided into two separate cases:

1) Preflight assesment done before the flight departs
2) Inflight assesment done in an in-flight situation

These cases have different regulatory basis, and either one can be more limiting than the other.
The aircraft must be able to stop within the available runway length with the regulatory margins included.

- Tyre to ground friction is critical for stopping the aircraft

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PERFORMANCE COMPUTATION

The mandatory performance computations before the flight are done by the pilots in the cockpit with the EFB device and it´s dedicated performance software.

Among other input parameters, the crew selects the runway condition.

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RUNWAY CONDITIONS AVAILABLE in A/C PERFORMACE SOFTWARE

TAKEOFF:

Dry
Wet (eq. damp or max 3mm of any cont)
Slippery wet
Compacted snow
Dry snow 10mm, 100mm
Wet snow 5mm, 15mm, 30mm
Slush 6mm, 13mm
Water 6mm, 13mm
Ice cold & dry
Reported friction coefficient

LANDING PREFLIGHT:

Dry
Wet (eq. damp or max 3mm of any cont)
Slippery wet
Compacted snow
Dry snow
Wet snow
Slush
Standing Water
Ice cold & dry
Reported friction coefficient

LANDING INFLIGHT:

6 – Dry
5 – Good
4 – Good to medium
3 – Medium
2 – Medium to poor
1 – Poor
Reported friction coefficient

These are the options the crew has available when selecting the runway condition in the performance software in the cockpit.

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RUNWAY CONTAMINANT CATEGORIES

THIN/HARD CONTAMINANTS:
- Only friction effects
- No effect on A/C acceleration

Types:
Wet (eq. damp or max 3mm water or slush)
Slippery wet
Compacted snow
Dry snow max 10mm
Wet snow max 5mm
Ice cold & dry
Reported friction coefficient

THICK CONTAMINANTS:
- Effect on A/C acceleration is accounted for
- Also contain friction effects and hydroplaning effects

Types:
Slush > 3mm
Water > 3mm
Dry snow > 10mm
Wet snow > 5mm

The effect on A/C acceleration in takeoff can be substantial and must be accounted for in the T/O performance computations.

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FINNAIR´s current method for selecting the runway condition:

TAKEOFF:
Depending on the contaminant and it´s thickness, the calculation is performed either with a contaminant input or with a friction input, if it is below a certain limit.

With thick contaminants the computation is always performed with the contaminant input, not with friction input.

A321 (-211 and -231)

Contamination description for T/O

Finnair	LPC-NG
Wet MIN reported friction 0.54 Damp Frost Max 3 mm water Max 3 mm slush Max 3 mm wet snow Max 3 mm dry snow	WET
Slippery when wet	Calculate with friction input, converted from ESF/BA if needed. If ESF/BA not available, use rwy cond "DRY SNOW 10mm"
Compacted Snow MIN reported friction 0.36	COMPACTED SNOW
Standing Water 4-6 mm Do not use reported friction	STANDING WATER ¼ INCH
Standing Water 7-13 mm Do not use reported friction	STANDING WATER ½ INCH
Slush 4-6 mm Do not use reported friction	SLUSH ¼ INCH
Slush 7-13 mm Do not use reported friction	SLUSH ½ INCH
Dry Snow 4-10 mm Do not use reported friction	DRY SNOW 2/5 INCH (10mm)
Dry Snow 11-100 mm Do not use reported friction	DRY SNOW 4 INCH (100mm)

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FINNAIR´s current method for selecting the runway condition:

TAKEOFF:
Depending on the contaminant and it´s thickness, the calculation is performed either with a contaminant input or with a friction input, if it is below a certain limit.

With thick contaminants the computation is always performed with the contaminant input, not with friction input.

LANDING PREFLIGHT:
If both the contaminant and the friction is know, two computations are performed and the more limiting result is selected for operations.

A350/A330/A321/A320/A319
Contamination description for landing for
Pre-Flight Planning Computations

If both Friction Coefficient and contaminant type are reported, calculate LDG-performance with both conditions separately and choose the more limiting result. For an ICY runway (cold ice & wet ice) it is allowed to calculate only using the Reported Friction Coefficient, which can be converted from ESF/BA if needed.

Finnair	LPC-NG
Wet -Damp -Frost -Max 3 mm water -Max 3 mm slush -Max 3 mm wet snow -Max 3 mm dry snow	WET
Slippery when wet	Calculate with friction input, converted from ESF/BA if needed. If friction coeff is not available: **A319/320/321**: assume friction 0,23 **A330**: assume friction 0,35 **A350**: assume friction 0,36
Compacted Snow	COMPACTED SNOW
Standing Water 4-13 mm A350: 4-15mm	STANDING WATER
Slush 4-13 mm A350: 4-15mm	SLUSH
Dry Snow 4-100mm	DRY SNOW
Wet Snow 4-30	WET SNOW

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FINNAIR´s current method for selecting the runway condition:

TAKEOFF:
Depending on the contaminant and it´s thickness, the calculation is performed either with a contaminant input or with a friction input, if it is below a certain limit.

With thick contaminants the computation is always performed with the contaminant input, not with friction input.

LANDING PREFLIGHT:
If both the contaminant and the friction is know, two computations are performed and the more limiting result is selected for operations.

LANDING INFLIGHT:
Runway condition is selected according to the RCAM. If a numeric friction is also know in addition to the ESF and contaminant, two computations are performed and the more limitig result is selected for operations.

A319/A320/A321

Runway Condition Assessment Matrix for landing

(In-Flight computations)

Runway Surface Conditions		Observations on Deceleration and Directional Control	Related Landing Performance		Maximum Crosswind for Landing (Gust included)
Runway State or / and Runway Contaminant	ESF(1) or PIREP(2)		Code	Level	
Dry	-	-	**6**	**DRY**	38 kt
Damp **Wet** Up to 3 mm (1/8") of water **Slush** Up to 3 mm (1/8") **Dry snow** Up to 3 mm (1/8") **Wet snow** Up to 3 mm (1/8") **Frost**	**Good**	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	**5**	**GOOD**	38 kt
Compacted snow OAT at or below -15 °C	**Good to Medium**	Braking deceleration and controllability is between Good and Medium.	**4**	**GOOD TO MEDIUM**	29 kt
Dry snow More than 3 mm (1/8"), up to 100 mm (4") **Wet snow** More than 3 mm (1/8"), up to 30 mm (6/5") **Compacted snow** OAT above -15 °C **Dry snow over compacted snow** **Wet snow over compacted snow** **Slippery when wet**	**Medium**	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be reduced.	**3**	**MEDIUM**	25 kt
Water More than 3 mm (1/8"), up to 13 mm (1/2") **Slush** More than 3 mm (1/8"), up to 13 mm	**Medium to Poor**	Braking deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	**2**	**MEDIUM TO POOR**	20 kt

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GRF REPORTING

-Runway contaminant, thickness (if applicable) and runway condition code RWYCC are reported

-Numeric friction values are not reported (prohibited at EASA level)

-Upgrade / downgrade: if the measured friction or other runway condition aspects reflect a different runway condition than the nominal RCAM code for that contaminant, a downgrade or an upgrade can be performed via the RWYCC reporting. An upgrade is possible only from RWYCC codes 0 or 1 to max code 3.

-Thin/hard contaminants (no acceleration effect) with an upgrade or downgrade: the crew should use a calculation input with the correct upgraded/downgraded friction effect instead of the reported contaminant status input

➡ A correlation between a reported RWYCC + contaminant and an available input in performance software must be created for takeoff and landing preflight computations

-Thick contaminants affecting acceleration: the computation has to be performed with the contaminant type and thickness

➡ Should we account for a downgraded RWYCC with thick contaminants? How do we do that?

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TAKEOFF CONTAMINANT SELECTION with GRF IN FORCE

A table is consulted to find the correct software input, which depends on the reported contamination and RWYCC

➡ The selection could be different than the reported runway contaminant. This is not intuitive for the crew

RWY CONTAMINATION	RWYCC	FLYSMART T/O INPUT
DRY or **NR (Not Reported)**	6	Dry
	5	Wet
	4	Compacted snow
	3	Slippery wet
	2	Water 1/4" (6mm)
	1	Ice cold & dry
WET Damp Frost max 3mm of Water, Wet Snow, Dry snow or Slush	5	Wet
	4	Compacted snow
	3	Slippery wet
	2	Water 1/4" (6mm)
	1	Ice cold & dry
COMPACTED SNOW	4	Compacted Snow
	3	Dry Snow 2/5" (10mm)
	2	Water 1/4" (6mm)
	1	Ice cold & dry
SLIPPERY WET RWY is Wet and a Notam states it is slippery when wet	3	Slippery wet
	2	Water 1/4" (6mm)
	1	Ice cold & dry
WATER 4-6mm	2	Water 1/4" (6mm)
	1	Water 1/4" (6mm), no rolling T/O, use full rwy length
WATER 7-13mm	2	Water 1/2" (13mm)
	1	Water 1/2" (13mm), no rolling T/O, use full rwy length
DRY SNOW OVER COMPACTED SNOW	3	Snow depth <= 10mm: Dry Snow 2/5" (10mm) Snow depth > 10mm: Input according to snow depth
	2	Snow depth <= 10mm: Water 1/4" (6mm) Snow depth > 10mm: Input according to snow depth **OR NO T/O?**
	1	Snow depth <= 10mm: Ice cold & dry Snow depth > 10mm: Input according to snow depth **OR NO T/O?**

➡ What about layered contaminants with a thick top layer and a downgrade via RWYCC?

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LANDING CONTAMINANT SELECTION with GRF IN FORCE

For landing performance computations, only the RWYCC code is of interest. However, preflight landing input options are not RWYCC code based. So again a table must be consulted to find the correct software input for preflight landing computations.
The contaminant selection could be different than the reported contaminant status of the runway.

For In-Flight landing computations, the input options are in line with RWYCC reporting, and the selection in performance software will be according to the RWYCC code only.

RWYCC	FLYSMART LDG DISPATCH INPUT	FLYSMART LDG IN-FLIGHT INPUT
6	Dry	6-Dry
5	Wet	5-Good
4	Compacted snow	4-Good to Medium
3	Slippery wet	3-Medium
2	Standing water	2-Medium to poor
1	Ice cold & dry	1-Poor

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PERFORMANCE LIMITED WEIGHTS WITHOUT A NUMERIC FRICTION AVAILABLE

TAKEOFF:

Example calculation at EFIV for an A321-231.

BEFORE GRF
Runway condition ICE, reported friction coeff. 0,24.
In this case calculation would be performed with the friction input, because the contaminant does not cause drag, and only the braking capability is affected.

⇒ MTOW= 88300 kg

AFTER GRF:
Runway condition ICE, RWYCC=1
Since friction is not allowed to be reported anymore, RWYCC=1 is reported (no upgrade), which would result in computation made with an input ”ICE COLD & DRY”

⇒ MTOW = 82800 kg

DELTA MTOW = 5500 kg

LANDING:

Example calculation at EFIV for an A321-231.

BEFORE GRF
Runway condition ICE, reported friction coeff. 0,24.
Current guidance for an icy rwunway with a friction value availble allows calculation with friction only.

⇒ MLW = 77800 kg (limited by max structural LW)

AFTER GRF:
Runway condition ICE, RWYCC=1
Since friction is not allowed to be reported anymore, RWYCC=1 is reported (no upgrade), which would result in computation made with an input ”1-Poor”

⇒ MLW = 75800 kg

DELTA MLW = 2000 kg

QUESTIONS or COMMENTS?

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