



Further Preventing Runway Overrun

The Airbus Runway Overrun Prevention System (ROPS), initially introduced on the A380 in 2009, has since been progressively implemented and enhanced across the A320 family, A330, and A350 aircraft.

In alignment with ICAO recommendations, several mandates have been issued requiring the installation of a Runway Overrun Awareness and Alerting System (ROAAS) on aircraft delivered from 2026.

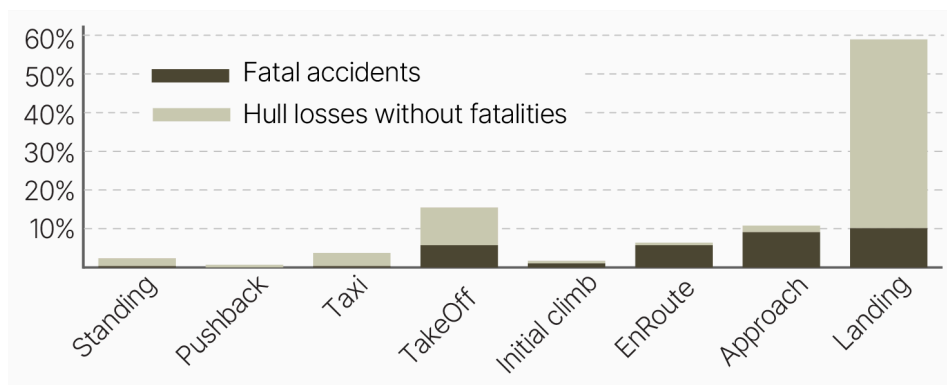
This article provides a status of the various standards of ROPS, and a description of the ROAAS solution for the A220. It also addresses operational considerations for managing fleets with mixed ROPS standards and outlines the possibility of retrofitting in-service aircraft with one of the ROPS standards.

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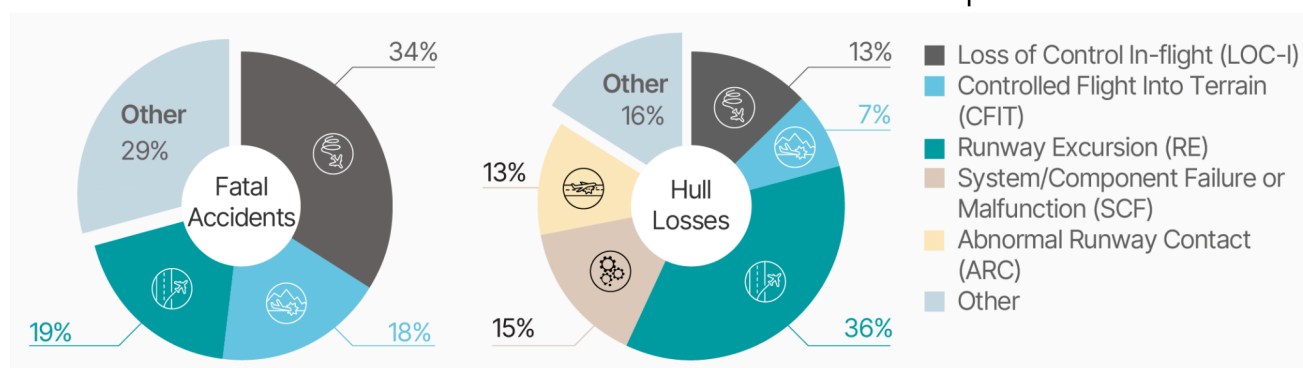
RUNWAY EXCURSION: ONE OF THE MAIN CAUSES OF ACCIDENTS

The graph showing the accident distribution by flight phase from the "[Statistical Analysis of Commercial Aircraft Accidents 1958-2024](#)" website clearly indicates that the majority of commercial aircraft accidents in the last twenty years (59 %) occurred during the landing phase (**fig.1**).



(fig.1) Commercial jet aircraft accidents distribution per flight phase 2004-2024

The website also highlights that runway excursion was the third main cause of commercial jet fatal accidents and the first main cause of hull losses in the last twenty years (**fig.2**).



(fig.2) Accident distribution per category 2004-2024

Innovating for Safety

In the early 2000s, Airbus initiated the development of a new technology to mitigate the risk of runway excursion: The **Runway Overrun Prevention System (ROPS)**. ■

ROPS CONCEPT AND EVOLUTION

ROPS Concept

ROPS has two subfunctions that are activated one after the other, during the final approach and landing phases.

Runway Overrun Warning (ROW)

ROW is active **during the final approach until touchdown. This is called the air phase**. The system continuously computes the landing distance of the aircraft in real-time, comparing it with either the Landing Distance Available (LDA) of the runway or the remaining runway length, if the aircraft has already crossed the runway threshold.

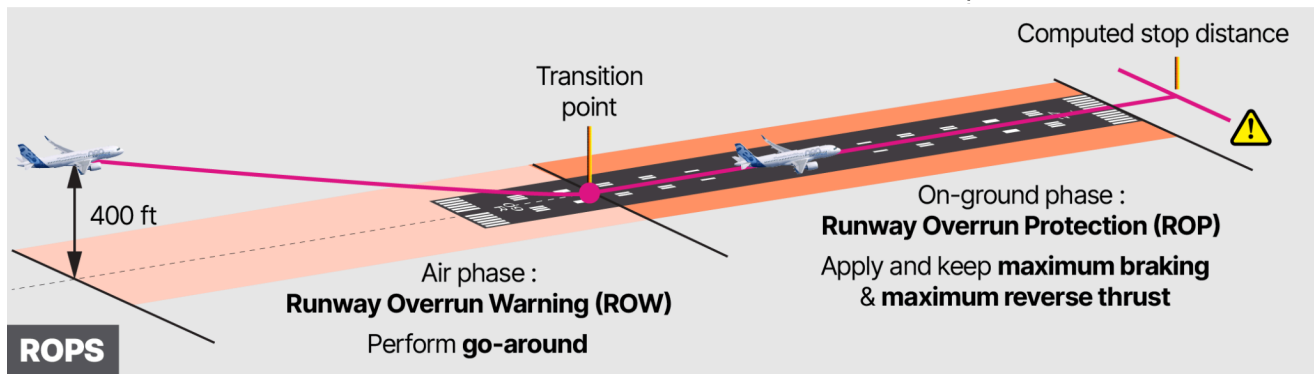
Below 400 ft, if a runway overrun risk is detected, ROW alerts the flight crew, enabling them to decide to either continue the landing or perform a go-around.

Runway Overrun Protection (ROP)

After touchdown, during the on-ground phase, ROP monitors the position of the aircraft relative to the remaining runway length and continuously computes the stopping distance needed by the aircraft based on current aircraft speed and deceleration.

If a runway overrun risk is identified, ROP alerts the flight crew asking them to **apply and keep all available deceleration means** i.e. maximum braking and maximum reverse thrust. **ROP remains active until 30 kt** (taxi speed) is reached.

(fig.3) ROPS concept

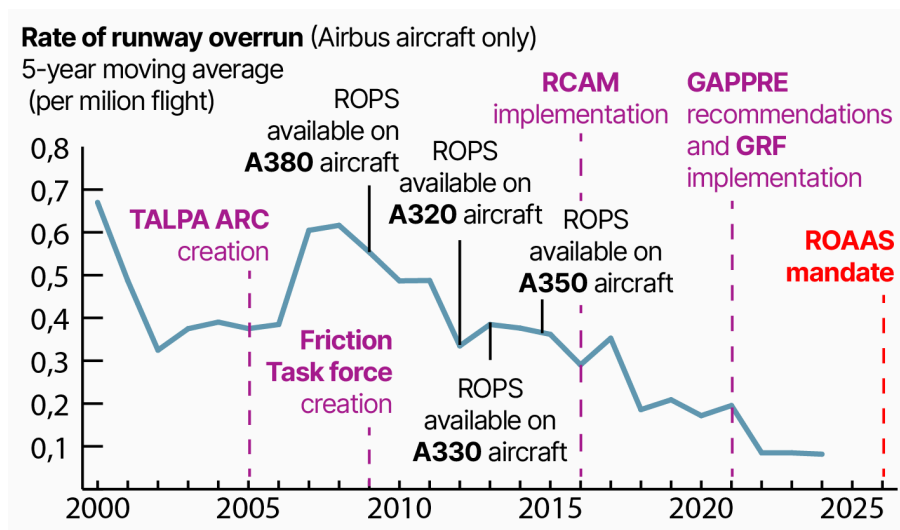


Continuous enhancement

Airbus continuously enhanced the ROPS concept taking into account in-service feedback from the operators. It evolved from Step 1 on the A380 only, to Step 2 and Step2+ also available on A320 family and A330 aircraft, to now reach Step 3, available on A350 aircraft, and progressively made available for the A320 family aircraft.

Positive trend

The reduction in runway overruns encountered by Airbus aircraft in the last 20 years shows a positive trend. The combination of several industry initiatives to prevent runway overrun combined with the progressive implementation of ROPS on the Airbus fleet undoubtedly contributed to these encouraging results.



(fig.4) Implementation of ROPS combined with industry initiatives helped in reducing the rate of runway overrun of Airbus aircraft

TALPA ARC: Takeoff/Landing Performance Assessment Aviation Rulemaking Committee led by the FAA
RCAM: Runway Condition Assessment Matrix from the TALPA ARC
GAPPRE: Global Action Plan for the Prevention of Runway Excursions led by Eurocontrol
GRF: Global Reporting Format from ICAO
ROAAS: Runway Overrun Awareness and Alerting System

Runway Overrun Awareness and Alerting System (ROAAS) Mandate

In 2022, Amendment 47 of **ICAO Annex 6** introduced a new paragraph in Chapter 6 (Airplane instruments, equipment and flight documents) stating the following:

"6.26.1 All turbine-engined aeroplanes of a maximum certificated take-off mass in excess of 5 700 kg, for which the individual certificate of airworthiness is first issued on or **after 1 January 2026**, shall be **equipped with a runway overrun awareness and alerting system (ROAAS).**"

Compliance with this requirement can be demonstrated by showing **compliance with Eurocae ED-250** "Minimum Operation Performance Specification (MOPS) for Runway Overrun Awareness and Alerting System (ROAAS)"

Based on these ICAO recommendations, some national airworthiness authorities have already mandated the installation of a ROAAS on aircraft registered from 1 January 2026. EASA also mandated ROAAS on all aircraft registered from 1 July 2026.

Airbus demonstrated **compliance of ROPS Step 2+ and Step 3 to the ROAAS mandate.**

ROPS Step 1: The Origin

The initial concept (ROPS step 1) was **introduced on A380 aircraft in 2009**. ROPS Step 1 was only available when an autobrake mode was selected (LO, 2, 3, HI or BTv) and was available only for dry and wet runways. **ROPS Step 1 is no longer available** since all A380 aircraft were upgraded to Step 2.

ROPS Step 2: DRY and WET Runway Conditions

ROPS Step 2 has the same functionalities as Step 1, but is available both in autobrake and manual braking modes. ROPS Step 2 was **introduced in 2011 on A380 aircraft**. It also became certified for **A320 family and A330 aircraft, respectively, in 2012 and 2013**.

Step 2 ROW alerts

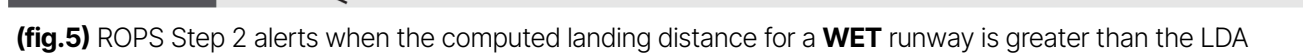
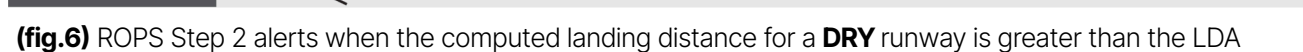
ROPS Step 2 continuously computes and compares the landing distance for **both dry and wet runway states**:

- If the computed landing distance for a **WET runway** is greater than the LDA (**fig.5**), the PFD displays an **IF WET : RUNWAY TOO SHORT** alert.
- If the computed landing distance for a **DRY runway** is greater than the LDA (**fig.6**):
 - **Between 400 ft and 200 ft**, the PFD displays a **RUNWAY TOO SHORT** alert.
 - **Below 200 ft**, the PFD still displays a **RUNWAY TOO SHORT** alert and adds a **"RUNWAY TOO SHORT!"** audio alert.

Step 2 ROP alerts

Step 2 uses the WET stopping distance to trigger ROP alerts. If a risk of runway overrun is detected, the following occurs:

- The PFD displays **MAX BRAKING MAX REVERSE** red messages.
- Simultaneously, a **"BRAKE! MAX BRAKING! MAX BRAKING!"** audio alert is triggered and is repeated until full pedal braking is detected.
- Then, if full pedal braking is detected but thrust levers are not detected in the MAX reverse position, a **"SET MAX REVERSE!"** audio alert is triggered and is repeated until MAX reverse is detected.
- **At 80 kt**, if the risk of overrun is still detected, a **"KEEP MAX REVERSE"** audio message is triggered to prevent the flight crew from selecting REV IDLE at 70 kt.



(fig.7) Step 2+ runway condition selector and indication on ND

- **Below 400 ft**, if the computed landing distance of the selected runway condition is greater than the LDA, then the PFD and HUD (if installed) display an amber **"RUNWAY TOO SHORT"** message.
- **Below 200ft**, if the computed landing distance of the selected runway condition is greater than the LDA, then the PFD and HUD (if installed) display a red **"RUNWAY TOO SHORT"** message combined with a **"RUNWAY TOO SHORT!"** audio alert

Step 2+ ROP alerts

Step 2+ ROP offers similar but enhanced alerts compared with Step 1 and Step 2 alerts. This enhancement comes from Step 2+ using the specific stopping distance for the runway state chosen on the runway condition selector, rather than the more conservative WET value used by ROPS Step 1 and Step 2 (**fig.9**).

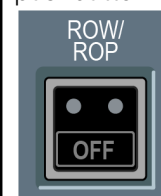
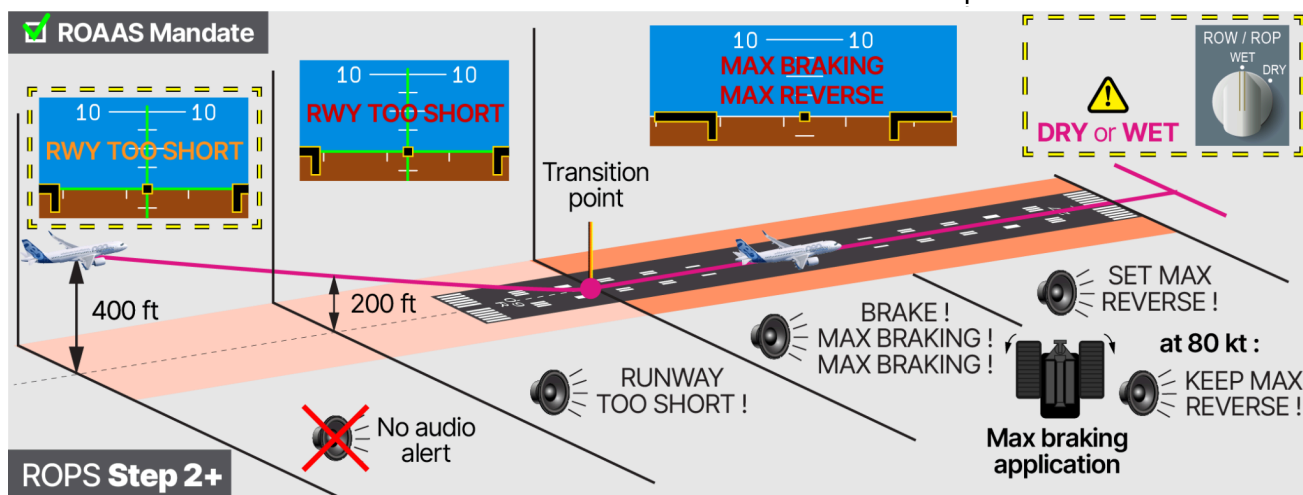
ROW/ROP pushbutton-switch

ROPS Step2+ also introduces a dedicated ROW/ROP pushbutton-switch on the overhead panel to manually inhibit the ROPS function (**fig.8**).

Compliance with the ROAAS mandate

Airbus demonstrated that the **ROPS Step2+ is compliant with the ROAAS mandate**.

(fig.8) ROW/ROP pushbutton-switch



ROPS Step 3: All Runway Conditions

ROPS Step 3 was first introduced on the A350 in 2016, and is progressively being certified for the different aircraft models of the A320 family, starting with the A321XLR in 2024. It is **available for all runway conditions**. ROPS Step 3 represents a significant safety benefit for airlines operating on airports subjected to snow, icing, or heavy precipitation conditions or airports with shorter runways.

Selection of the runway condition

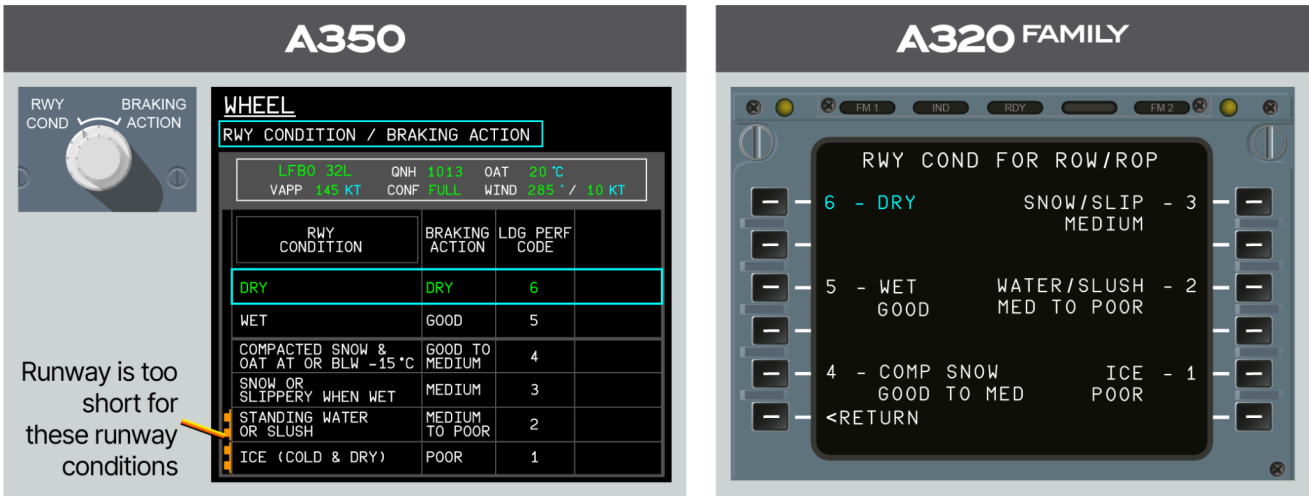
ROPS Step 3 requests the flight crew to select the runway conditions or reporting braking action among the 6 levels defined in accordance with the Global Reporting Format (GRF) from ICAO.

On A350 aircraft, the flight crew can select the runway condition using the **RWY COND / BRAKING ACTION selector** on the brake panel (**fig.10**). The selected value is displayed in the **RWY CONDITION / BRAKING ACTION** matrix displayed on the SD. A barber pole indicates the runway conditions where a risk of overrun is detected.

(fig.9) ROPS Step 2+ alerts

On A320 family aircraft, the flight crew can select the runway condition on the **RWY COND FOR ROW/ROP** page accessible from the **PERF APPR** page of the MCDU.

(fig.10) Selection of the runway state for ROPS Step 3



Step 3 ROW and ROP alerts

Step 3 provides similar ROW and ROP alerts to the Step 2+ alerts, but for the selected runway condition, with some enhancements.

On A350 aircraft, if an autobrake mode is engaged, ROP automatically applies maximum braking if a risk of overrun is detected. In that case, the **MAX BRAKING** message is not displayed on the PFD and its audio alert is inhibited.

Pre-ROP message

A pre-ROP function provides the crew with a **single ‘SET MAX REVERSE’ audio message**, acting as a Standard Operating Procedure (SOP) reminder to select maximum reverser thrust in the following conditions:

- The selected runway condition is different from DRY
- MAX REV is not selected after touchdown
- The computed stop distance is still on the runway but near the end of the runway.

Runway Condition Downgrading Function (RCDF)

On the ground, if the braking efficiency is lower than anticipated for the selected runway condition, ROP can automatically downgrade the runway condition to the current one.

The RCDF provides awareness of the downgrading via a message on the FMA (fig.11), as well as an update of the runway condition indication on the ND.



(fig.11) Indication of the runway condition degradation on the FMA

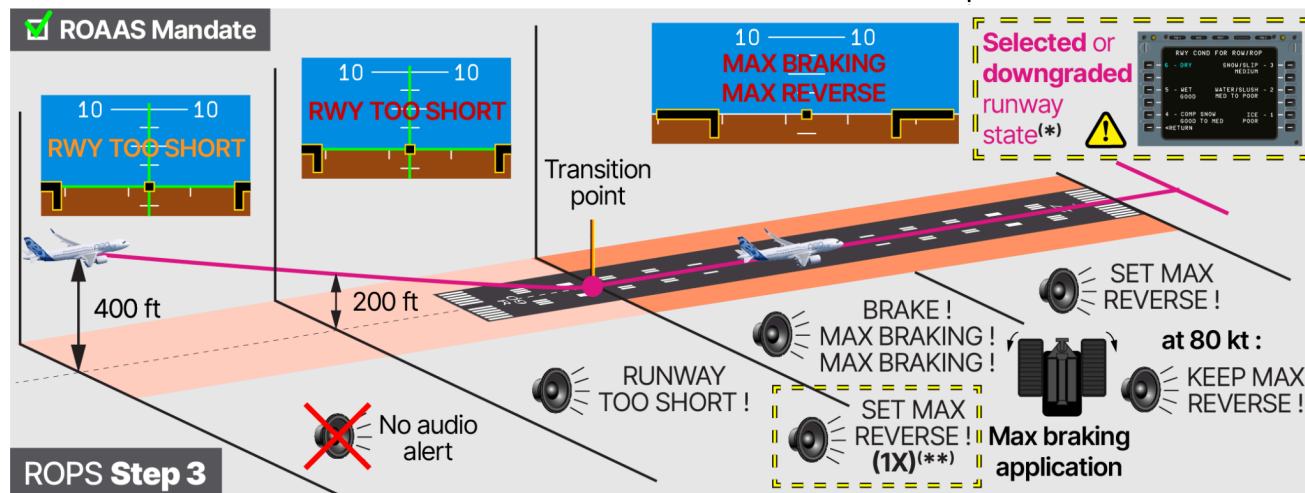
ROPS manual deactivation

On A320 family aircraft, ROPS Step 3 is not equipped with a ROW/ROP deactivation pushbutton-switch. It can be manually deactivated via the MCDU **SURV CONTROLS** page, accessible via the **DATA INDEX** page.

Compliance with the ROAAS mandate

Airbus demonstrated that **ROPS Step 3 is compliant with the ROAAS mandate.**

(fig.12) ROPS Step 3 alerts



(*) The **Runway Condition Downgrading Function (RCDF)** can downgrade the runway condition based on real time deceleration measurements.

(**) **Pre-ROP** triggers a single "SET MAX REVERSE !" audio alert if REV MAX is not selected after touchdown for runway conditions different than DRY, and if the computed stopping distance is close to the runway end.

A220 Runway Overrun Awareness and Alerting System (ROAAS)

A ROAAS function is also being developed for A220 aircraft. It is not yet certified at the time of publication of this article.

The A220 ROAAS slightly differs from the ROPS installed on the other Airbus aircraft, but the same principle applies.

Selection of the runway condition

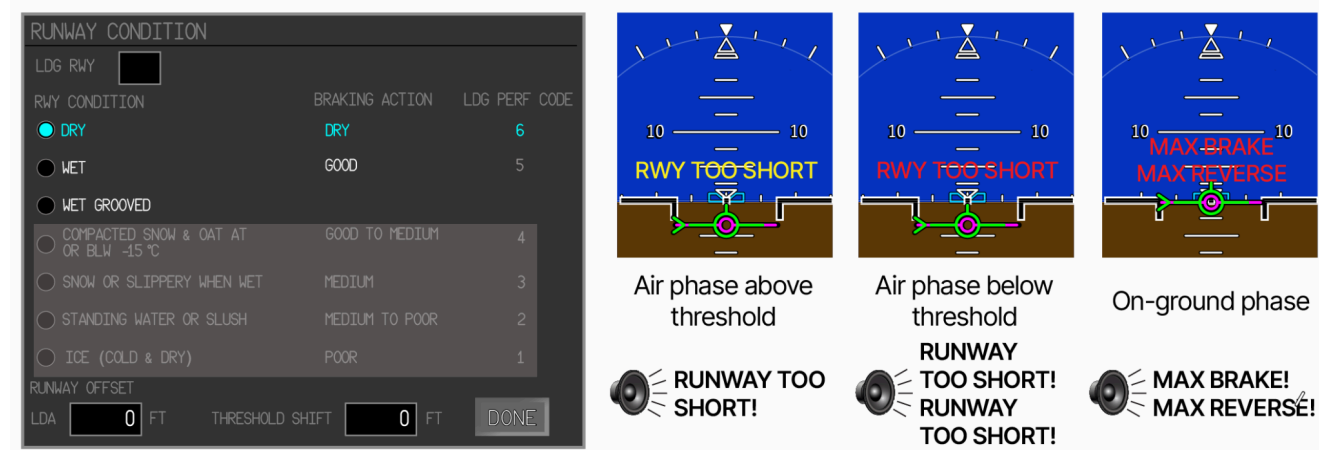
The flight crew can select the runway condition from the **MFD PERF page**.

The DRY, WET, and WET GROOVED will be available at the introduction of the ROAAS. The other runway conditions will be available after additional certification.

A220 ROAAS alerts

As for ROPS, the A220 ROAAS is composed of an air phase divided into two parts by an altitude threshold and an on-ground phase requesting the use of all the deceleration means in the case of a risk of overrun. ■

(fig.13) A220 ROAAS function



OPERATIONAL CONSIDERATIONS

Mixed Fleet Is Not an Issue

All A380 aircraft are equipped with ROPS Step 2 and all A350 aircraft are fitted with ROPS Step 3.

On A320 family and A330 aircraft, various ROPS standards are currently in service. This can lead to operators having fleets with mixed ROPS standards. However, this is manageable as the operational differences between standards are minor and easily recognizable.

Cockpit preparation - Is ROPS installed on my aircraft?

During the cockpit preparation, the flight crew can check if ROPS is installed on their aircraft using the Aircraft Configuration Summary table of the QRH.

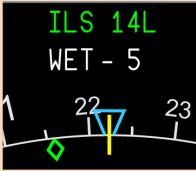
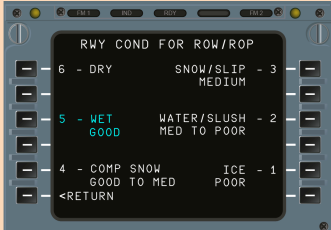
Descent Preparation - Selection of the Runway Condition (if available)

No action related to ROPS is required for aircraft equipped with Step 2.

On aircraft equipped with ROPS Step 2+, the flight crew should use the ROW/ROP runway condition selector to select the DRY or WET condition depending on the reported conditions.

On A320 aircraft with ROPS Step 3, during the FMS preparation, the flight crew will see a **ROW/ROP >** prompt at the bottom of the **PERF APPR** page. This leads to the **RWY COND FOR ROW/ROP** page (A320 family) where the flight crew can select the appropriate runway condition.

(table 1) ROPS actions during descent preparation

ROPS Step 2	ROPS step 2+	ROPS step 3
No action	Select DRY or WET  	Select Runway condition  

Final Approach

Regardless of the ROPS standard, during final approach,

- If an amber message appears on the PFD, the flight crew must quickly analyze the situation: If **IF WET : RUNWAY TOO SHORT** appears (step2), they must perform a go-around if the runway is not dry or contaminated, and can continue the approach if the runway is dry. If **RUNWAY TOO SHORT** appears (Step2+ or Step 3), the flight crew should consider a go-around depending on the situation.
- If a red **RUNWAY TOO SHORT** message appears, the flight crew must immediately perform a go-around.

Altitude threshold	PFD alert	Audio alert	ROPS step 2	ROPS step 2+ and Step 3
Between 400 ft and 200 ft	IF WET : RUNWAY TOO SHORT		<ul style="list-style-type: none"> If runway is wet: Go-around If runway is dry: Approach can be continued 	Not applicable
	RUNWAY TOO SHORT		Not applicable	Consider Go-around
	RUNWAY TOO SHORT		Go-around	Not applicable
Below 200 ft	RUNWAY TOO SHORT	 RUNWAY TOO SHORT!	Go-around	

(table 2) ROPS actions during final approach

Landing Roll

During the landing roll, there is no difference between the ROPS standards. The handling of alerts is identical. ■

PFD Alert	Audio alert	Crew action (all ROPS standards)
MAX BRAKING MAX REVERSE	 BRAKE! MAX BRAKING! MAX BRAKING!	Apply full manual braking
	 SET MAX REVERSE!	Set thrust lever to MAX REV
	 KEEP MAX REVERSE!	Maintain thrust levers to MAX REV

(table 3) ROPS actions during landing roll

TRAINING CONSIDERATIONS

Level B training

Level B (aided instruction) training is needed for the use of ROPS. Computer Based Training (CBT) is available, free of charge, and covers the following topics:

- ROW/ROP objectives
- Operating domain
- ROW/ROP function overview ■

(table 4) Simulator package for A320 family and A330 aircraft

	Step 2	Step 2+	Step3
A320	1.9	2.1 (*)	3.0 (A321) 2.3 (A320)
A330	2.6	3.1(*)	Under study

(*) hardware modification to add the ROW/ROP runway condition selector

ROPS/ROAAS STANDARDS AVAILABILITY

Compliance of Newly Delivered Aircraft with the ROAAS Mandate

The below table provides the date of availability of each ROPS standard **(table1)**. The year of application of the current default standard installed in the production line (linefit) for each aircraft type is **highlighted in green**.

Today, **all newly delivered A320 family, A330, and A350 aircraft are equipped with a ROPS standard compliant with the ROAAS mandate.**

The introduction of the ROAAS on A220 aircraft is expected in 2027. An exemption period of the ROAAS mandate is expected pending the availability of the function.

(table 5) Date of availability of each ROPS standard

Aircraft		ROPS step 2	ROPS step 2+	ROPS step 3
A320ceo family		2012	2020	Retrofit expected in 2029
A320neo family (except A321 XLR)	CFM engines	2015	2020	Retrofit from Nov. 2025 Linefit expected in 2026
	PW engines	2016	2020	Under development
A321 XLR	CFM engines			2024
	PW engines			2025
A330		2013	2020	Under study
A350			2014	2016
A380		2011	Retrofit expected in 2027	Under study
A220		ROAAS		
		Linefit expected in 2027		

20XX Year of application of the current default standard installed in the production line (linefit)

Retrofit of ROPS standards on in-service A320 family and A330 aircraft

Operators with A320 family or A330 aircraft that are not equipped with ROPS can retrofit one of the ROPS standards, provided that the necessary system prerequisites are installed.

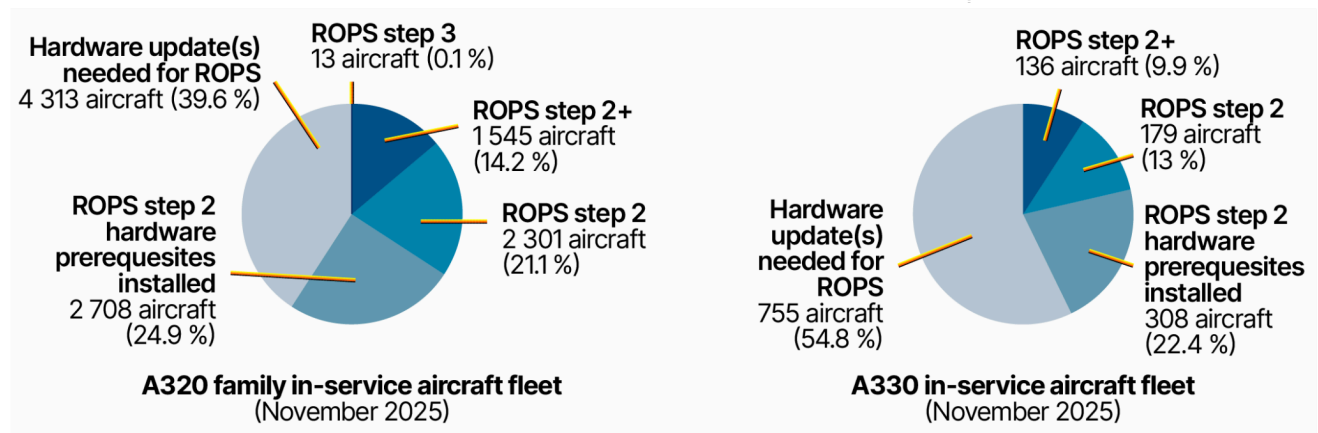
Fleet status

In November 2025, the in-service fleet status concerning the ROPS function shows that **35.4 %** of the A320 family in-service fleet is equipped with ROPS, representing 3 859 aircraft. It also highlights that **2 708 additional A320 family aircraft could easily activate ROPS since they have all the system hardware prerequisites already installed.**

Similarly, **22.9 %** of the A330 in-service aircraft fleet is equipped with ROPS and **308 A330 aircraft have all the hardware prerequisites to activate ROPS.**

Operators wishing to retrofit ROPS on their aircraft can contact Navblue via <https://www.navblue.aero/contact/>.

(fig.14) ROPS in-service fleet status



Minimum computer standards for ROPS retrofit on A320 family aircraft

Minimum computer standards	Step 2	Step 2+	Step 3 (*)
DMC	EIS1 V70 or EIS2 S10	EIS2 S16	EIS2 S18.1
FWC	H2F7 (ceo) H2F8 or H2-F9C or H2-F9E or H2-F12 (neo)	H2F7 (ceo) H2F9E (neo)	H2F13
FAC	CAA09 or B624/625	CAA11	CAA14
FMGC	PC13 or C13 or PI12 or I12	PI17 or PC20	PI19 or PC21
BSCU	No minimum BSCU standard	No minimum BSCU standard	L4.11
HUD(**)	L5	L7	L8C

(*) Retrofit of Step 3 on aircraft equipped with Step 2+ requires the removal of the ROW/ROP runway condition selector. The ROW/ROP deactivation pushbutton-switch may be kept as it is compatible with Step 3.

(**) Minimum Head Up Display (HUD) standard for ROPS compatibility. HUD is not a prerequisite for ROPS.

Minimum computer standards for ROPS retrofit on A330 aircraft

Minimum computer standards for A330 aircraft	Step 2	Step 2+
DMC	EIS1 V513	EIS2 L13
SDAC	C10	C12
FWC	T5	T9-1
MMR	GLU-920	GLU-920 or iMMR L2
FMGEC	HJ2	H6A
HUD(*)	L7	L7

(*) Minimum HUD standard for ROPS compatibility. HUD is not a prerequisite for ROPS

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The Airbus Runway Overrun Prevention System (ROPS) is a safety innovation that addresses the risk of runway excursions, which account for a significant portion of commercial aircraft accidents.

ROPS has two subfunctions: Runway Overrun Warning (ROW) during the final approach to request a go-around, and Runway Overrun Protection (ROP) after touchdown to request the selection of all deceleration means.

ROPS has undergone continuous improvement, progressing from Step 1 to the current Step 2+ and Step 3 standards. These latest standards are compliant with the new Runway Overrun Awareness and Alerting System (ROAAS) mandate (effective from 2026 for new aircraft).

Today, all newly delivered A320 family, A330, and A350 aircraft are equipped with a ROAAS-compliant ROPS standard. A ROAAS function is also in the final development stage for A220 aircraft.

Furthermore, operational flexibility for airlines is ensured, as fleets with mixed ROPS standards are manageable, and a retrofit path is available for in-service A320 family and A330 aircraft to upgrade to one of the ROPS standards. This continuous commitment to prevention contributes to further increasing the level of safety by mitigating the risk of runway overrun across the Airbus fleet.

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