Pilot's Best Practices for the Prevention of Runway Excursions

ECA
European Cockpit Association

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Introduction

Runway excursions pose one of the highest risks to commercial aviation. Despite a decline of overall accident rates, the rate and number of runway excursions worldwide remained steady in the last decade. The International Air Transport Association (IATA) reported that between 2005 and the first half of 2019, 23 percent (283) of accidents in IATA’s global accident database involved a runway excursion. This was the most frequent end state.

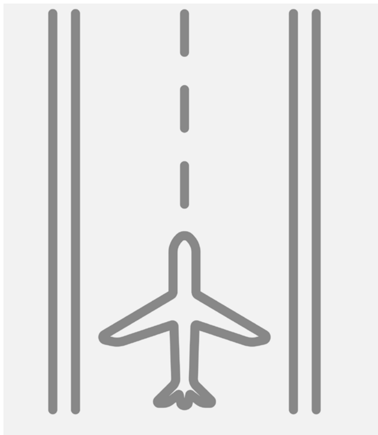
Managing the runway excursion risk is one of the best examples of how different aviation segments cannot achieve success alone. Runway excursion risk and resilience management rely on a system of tightly coupled factors for success. That system depends on a joint and coordinated effort of all the aviation players. The jointly owned risk requires joint solutions. This is why the industry came together, within a dedicated working group, to discuss and agree on the most important actions to address the runway excursion risk. The result is a list of recommendations and guidance material that represent the industry consensus on the best practices and intervention beyond simple regulatory compliance – the Global Action Plan on the Prevention of Runway Excursions (GAPPRE).

Subject matter experts from the European Cockpit Association participated in the development of the GAPPRE, which addresses organisations such as aerodrome operators, air navigation service providers, aircraft operators or manufacturers. From a pilot's perspective, the recommendations and guidance material for aircraft operators should further improve procedures and investments in safety enhancing technologies. However, many best practices are generic enough to be already applied by flight crew even before specific operator guidance has been implemented. Therefore, this best practices document intends to enable flight crew's contribution in the combined efforts to reduce runway excursion risks.

As the GAPPRE aircraft operator's guidance material comprises 60 pages alone, the following summarises all GAPPRE recommendations and guidance, which can be implemented by flight crew in their daily routines.

Caution:
In case of a conflicting SOP or operating manual provision, flight crew should not apply a respective recommendation or guidance. Operator documentation remains primarily binding!

General Considerations



Within the scope of threat and error management (TEM), flight crew should aim to gain complete awareness of threats to their operation. This avoids surprises, creates a common perspective of all crew members and allows to prepare alternatives. Be aware of and brief factors including psychological pressures (efficiency, punctuality, profitability) and physiological influences (tiredness, fatigue, dietary deficiencies). **Flight crew should always apply risk-averse decision-making!** This means to always plan and act defensively (conservatively), e.g. in departure or approach planning, even if this leads to delay. GAPPRE 2.2

Flight crew should report any SOP or operational pressure which contradict risk-averse decisions to their flight safety department. GAPPRE 4.1

Commanders should encourage and accept the pilot monitoring (PM) duties of the first officer and all qualified crew members on the flight deck. These involve speaking up and intervening in the commander's aircraft handling and safety relevant decision-making at any time. GAPPRE 4.5

Flight crew should ask for opportunities to train demanding and complex take-off and landing situations in simulator training, e.g. gusty crosswind, contaminated or slippery runways, poor visibility etc. This allows to practice TEM regarding runway excursion prevention as well as the handling of such challenges. GAPPRE 2.3

Instructors should be role models in terms of defensive decision-making and creating an atmosphere which fosters PM's assertiveness. They should create situations in simulators which require flight crew to react to changing environmental situations and to practice intervention techniques. GAPPRE 4.1

Flight crew should not accept Air Traffic Control (ATC) procedures and clearances which have the potential to decrease safety margins to an unacceptable level, increasing the risk of runway excursions. This could include factors such as the following: GAPPRE 2.4

- Requests for immediate/rolling take-off or to expedite vacating the runway
- A late runway change, on both take-off or landing
- A late descent clearance, a tight base-turn or an instruction to keep the speed up
- Late handing over from approach to tower GAPPRE 2.4

Pilots should report any such risks or hazardous situation, as well as any experiences which could have resulted in an unstable approach or runway excursion and how this was successfully avoided, to their safety departments. Such reports allow flight safety departments to analyse trends, exchange information and discuss areas of improvement with other stakeholders, e.g. ATC. It is important to always have in mind that ATC is responsible for the safe and orderly flow of traffic, but flight crew are ultimately responsible for the safe operation of their aircraft. GAPPRE 2.1

Flight crew should not conduct take-off or approach following any runway change until the appropriate set-up, planning, performance calculations (for multi-pilot operations this includes independent calculations and cross-checks by at least two pilots) and re-briefings are completed. Runway-excursion related TEM should be addressed in the briefing every time a runway change is expected, probable or actually occurs. The following universal checklist for (late) changes may serve as a supportive tool for pilots in such situations: GAPPRE 2.5

(Late) Change - Checklist

DEPARTURE		APPROACH	
FMS	Performance	FMS	Performance
FMS RWY/SID change?	OPTIMYM FLAPS? (tora?)	FMS RWY/APP change?	OPTIMUM FLAPS? (reverse/a/b?)
FMS vs IAC WYPT x-check?	V-SPEEDS change?	FMS vs IAC WYPT x-check?	V-REF SPEED change?
SID PDG change (able?)	T/O N1? (correct bleed setting?)	FMS STAR/TRANS. change (able?)	A/B CHANGE? (optimym rwy exit?)
New ALT / SPD constraints	EOSID special? (e/o holding?)	New ALT / SPD constraints	EO-G/A special? (eosid/vis.escape?)
Setup	Briefing	Setup	Briefing
SID/RTN NAV-SET change?	New CHART X-CHECK required?	APPG/A NAV-SET change?	New CHART X-CHECK required?
MCP CRS SELECTORS change?	New SID/EOSID Briefing?	MCP CRS SELECTORS change?	New APP/G/A Briefing?
RWY HDG change?	New TAXI Route?	RWY HDG change?	New TAXI Route?
1. STOP ALT change?	New Threats/Hazards?	G/A ALT change?	New Threats/Hazards?
MEOAA change? (eosid?)		MDA/DA change? (vdp/callouts?)	

Flight crew should request a more favourable runway for take-off or landing for any reason, that may affect the safety of the flight and advise ATC accordingly. Safety considerations which might reduce safety margins for flight crew’s departure or arrival procedures may include, amongst others:

- Wind considerations, e.g. tailwind, crosswind or known turbulence
- Reduced visibility through rain shower, fog or sun blinding
- Runway condition status, e.g. during winter operation necessitating snow removal
- Available type of approach
- Engine-out or go-around climb considerations GAPPRE 2.6

Pilots should always feel free to reduce cross- and tail wind limitations based on the actual situation, e.g. weather, runway conditions, flight crew member’s state of alertness or experience. Manufacturer’s wind speed limits are demonstrated values flown by experienced test pilots and not to be regarded as normative goals. Equally, company limitations cannot always be achieved under certain local conditions or an individual’s abilities and experiences. The safest course of action should always be followed instead of pushing for published limits. GAPPRE 2.7

Flight crew should be aware of and brief the availability and utilisation of aircraft arresting systems such as engineered materials arresting systems (EMAS). Such areas should only be used in abnormal situations to safely slow down the aircraft, e.g. when a runway overrun is inevitable. However, it may not be used during routine operation, e.g. for take-off, as an additional stopway or any taxi manoeuvre. GAPPRE 2.3 Case-Study

Take-off Performance Calculations

Pilots should report any wrong calculations, potentials for erroneous data insertions or ambiguous presentations related to performance calculation programs/tables to allow for a continuous improvement of applications and procedures. GAPPRE 3.1 Case Study

To allow flight crew to perform an effective briefing and conduct TEM, they should calculate preliminary take-off performance data based on expected values before the briefing. If such preliminary data is already inserted, cues should be used to remind flight crew that this is not the correct result of the final calculation. GAPPRE 3.1

Flight crew should ensure not being disturbed while performing load sheet crosschecks, performance calculations, data insertions or briefings. Allocate sufficient time and do not rush these tasks, even if this leads to delay. GAPPRE 3.1

All relevant information on the final load and trim sheet, plausibility of this data as well as the correct insertion in flight management systems (FMS) should be checked by all flight crew members in the cockpit. Data insertion should be done in a concerted manner as given per SOP, e.g. one pilot states the value and the other one enters it into the FMS. GAPPRE 3.1

Before doors closure pilots should always verify the correct final load numbers (passenger, baggage or cargo) and its agreed distribution with the responsible ground staff. GAPPRE 3.1

If possible, performance calculations should be performed individually by each crew member and crosschecked prior insertion. Suitable crosschecks with values calculated by independent sources should be performed (e.g. characteristic speeds such as the minimum clean speed calculated by the FMS versus the performance calculation tool). Additional references are provided in the IATA FMS Data Entry Error Prevention Best Practices. GAPPRE 3.1

Flight crew should have a comprehensive knowledge of the safety factors used and assumptions made by performance calculation programs/tables. They should always make conservative calculations based on their experience and local knowledge:

- In headwind situations, flight crew may consider performance calculations based on zero wind
- In calm or variable wind situations, flight crew may use a minimum of 5 kts tailwind for their calculations
- If a variable range of wind direction is given (e.g. 330/5 300V360), flight crew should use the least favourable value for the given runway direction (for runway 28 => 360/5)
- In tail wind situations, flight crew should consider effects causing increasing tail winds (e.g. by incoming weather or land/sea wind effects) and keep in mind the maximum tailwind limits GAPPRE 2.12

Gross weight and temperature values used for calculation should reflect actual or realistic numbers at the time of break-release (e.g. actual take-off weight higher than load-sheet value due to short taxi-out. GAPPRE 2.12

When approaching the runway for take-off or nearing the final approach, flight crew should mention any relevant changes in the actual versus planned environmental conditions and consider if a recalculation is required. GAPPRE 2.12

Departure

Flight crew should include TEM principles in their departure briefing. The expected departure runway and a possible take-off intersection should be anticipated, briefed and calculated according to the most recent information available. The following checklist may help to identify threats affecting a flight. GAPPRE 2.2

Departure Threat/Hazard Awareness Checklist

DEP AIRPORT CAT: A B C	GROUND OPS & TIME	WEATHER Δ p / LARGE SCALE WX?
FACILITIES	GND HANDLING	WIND
☐ NCF / OPS HRS RESTRICTED	☐ T/A < 50min / LATE CREW ARR	☐ VARIABLE / CALM WINDS
☐ NO ILS / RNP APP (lighting?)	☐ SECURITY SEARCH required	☐ CWC / TWC (act. limit? trend?)
☐ NO D-ATIS / NO MRC	☐ STAFF / EQPMT. missing (shift?)	☐ WIND >15kt (ops restrictions?)
☐ RCFF < 7 / PCN restricted	☐ PUSHBACK DELAY probable	☐ GUSTS (orography or roll cloud?)
☐ LOWEST T/O MINIMA > 400m	☐ RAMP / TWY CONGESTION	☐ WIND-SHEAR / LLWS (safe t/o?)
☐ AOI / CCI RELEVANT	☐ DE-/ANTI-ICING required	☐ LAND / SEA WIND EFFECTS
☐ NOTAM RELEVANT	☐ APU-LIM: ☐ N/A min (gnd air?)	☐ W.-CHANGE ALOFT (twc? wca?)
ATC / NOISE	TAXI-OUT	CLOUDS / VISIBILITY
☐ CHALLENGING / DIFFICULT ATC	☐ SHORT / LONG TAXI-ROUTE	☐ DARKNESS SR/SS: ☐ n/a
☐ HIRO / MROT / RRSM	☐ BACKTRACK required	☐ SUN POSITION (sid turns?)
☐ PARALLEL / X-ING RWYs	☐ RWY CROSSING required	☐ VISIBILITY < 5000m (trend?)
☐ SINGLE RWY / CONGEST. OPS	☐ SLIPPERY POS / APN / TWY	☐ LOW SPREAD (mist / fog?)
☐ SINGLE / REMOTE / NO ATC	☐ MARKINGS / LIGHTING / LOVIS	☐ LOW CLOUDS (<1000'? / rtn app?)
☐ HIGH TA / LATE HANDOVER	☐ HOTSPOTS / WIP / VEHICLE TFC	☐ PRECIPITATION (wiper? contam.?)
☐ NADP / COMFAIL special	☐ INBOUND TFC / T/O QUEUE	☐ CB / TCU / THERM. (t/o / sid / clb?)
ENVIRONMENT	RESTRICTIONS	ADVERSE WX
☐ TERRAIN critical (high. obstacle?)	☐ DELAY / EET ≥ PL.BT / ACSCHED.	☐ INCOMING WX (remain. time?)
☐ HIGH ELEVATION (toperf?)	☐ HOT BRAKES / SHORT T/A	☐ WX TREND DETERIORATING
☐ LOCAL WIND / WX PHENOM.	☐ DEP-NCF / RTD (outbound tfc?)	☐ TURBULENCE ON SID / CLB
☐ WATER IN VC (ponds / sea?)	☐ DEST-NCF / RTA / DBC-DLY	☐ THUNDERSTORM (vc? embd?)
☐ BIRDS (flocks? migration time?)	☐ FDT / RT MARGIN < 2h	☐ ICING / HAIL / +SN / VA / SA
☐ VFR / DRONE TFC (controlled?)	☐ SNOW REMOVAL probable	☐ OAT <10° (cold wx ops?)
☐ PEAK / HUB TFC (wk/time of day?)	☐ H.O.T LIMITED (precipitat. trend?)	☐ OAT >30° / TEMP INVERSION
VL L M H	VL L M H	VL L M H

TOPERF / SID & HUMAN FACTORS RWY / SID / TOPERF CHANGE?		EO / EMERGENCY RETURN
RWY: INT: ☐ N/A	MATOW: ☐ MTOW	EOSID
☐ INTSCT. T/O (line-up / tora / view?)	☐ HEAVY / LOW GW (rotation / eo?)	☐ EOSID - SID DEV. PRIOR 400’
☐ RWY - TORA<2500m (oppos. tdz?)	☐ A/C - SYS. MALF. / MEL-OPS	☐ EOSID - COMPLEX (wca? navs?)
☐ RWY - WET / DAMP (realist.ba?)	☐ A/C - DIFFERENCES (1FMC? CBN?)	☐ EOSID - EARLY TURN (mrva?)
☐ RWY - SLIPPERY / CONTAMIN.	☐ BLEED / FLAP SETTING special	☐ EOSID - OPPOSITE TO SID
☐ RWY - SLOPE (uneven rwy? birds?)	☐ NADP 1 OR SPEC. / Δ V1/R > 4 kts	☐ EOSID - LATE ACCEL. (msa? turn?)
☐ RWY - WIDTH <40m (cwc? load?)	☐ STOP MARGIN < 200m (line-up?)	☐ EOSID - WX / TFC / TERR critical
☐ W/S TOPERF REQ. (wx / rwy / gw?)	☐ CWC / TWC LIM: ☐ 25 / 0	☐ EOSID - EO ON SID CRITICAL
SID:	RNAV: B P RNP: 1 2	EMERGENCY RETURN
☐ RTE 2 REQ (rwy / sid / sfx change?)	☐ SID-COMPLEX (early a/p? exp. wca?)	☐ RTN - RWY ≠ DEP RWY
☐ NO IMM. T/O (atc-unable info!)	☐ SID-EARLY TURN (sun pos.? mrva?)	☐ RTN - NO VIS RTN / OPP. LDG
☐ T/O NEAR MINTOF (t/o queue?)	☐ SID-EARLY LVL-OFF (early a/p?)	☐ RTN - OVERWT (max t/d v/s? ldr?)
☐ UNEVEN RWY / NO RCLL	☐ SID-PDG > 3,3% (able? nadp?)	☐ RTN - LDA < 2500m
☐ SPACING / WAKES / LLTURB.	☐ SID-OPPOS. TFC (early a/p / v/s?)	☐ RTN - WX / TFC / TERR critical
☐ BIRDS / VFR / DRONE (360°view?)	☐ SID-WX critical (cb, tcu ts, w/s, ice?)	☐ RTN - NO ILS/RNP (exp. app?)
☐ F/D OFF / R. DATA / M.THR.	☐ WX-RADAR / WIPER REQ.	☐ RTN - APP: EO G/A special
HUMAN FACTORS		T/O ALTERNATE ☐ N/A
☐ FATIGUE / FITNESS (crew?)	☐ NEAR LIMIT OPERATION	☐ ALT - NO ILS/RNP (exp. app?)
☐ AWAKE > 10h (time in wocl?)	☐ UNFAMILIAR AIRPORT / VARIANT	☐ ALT - LDA < 2500m
☐ EMOTIONAL / STRESSED	☐ WORK-ERROR(S) > 2	☐ ALT - WX / TFC / TERR critical
☐ PERCEIVED TIME PRESSURE	☐ WORK ATMOSPHERE	☐ ALT - NOTAM relevant
☐ PROFICIENCY (self or crew)	☐ SPORTY / SLOPPY ATTITUDE	☐ DIV - RTE WX / ICE / TERR (mfa?)
☐ COMPLACENCY / ROUTINE	☐ LOW ROLE / TYPE EXPERIENCE	☐ DIV - RTE TFC / VFR / SUA
☐ IDLE TIME / DISTRACTION	☐ TRAINING / CHECK / OBS FLT	☐ DIV - EET > 30min
VL L	M H	VL L M H

Once the taxi clearance is received, the take-off position provided by ATC should be compared with the position used for calculation. Confirm that environmental conditions still reflect the calculated values (e.g. runway surface condition, wind or anti-ice requirements). GAPPRE 3.3

When approaching the take-off position, flight crew should always search for visual cues to verify (and possibly call out) that it matches the intended and cleared runway including correct intersection if applicable. Make sure to apply the line-up procedure (e.g. 90 degree) used during performance calculations. GAPPRE 3.3 Case Study

Flight crew should only report ready for departure, when all required tasks have been accomplished and the cabin crew report was received. GAPPRE 3.3

Prior line-up, ATC should be informed of any requirements influencing the time spent on the runway to allow for appropriate traffic spacing and avoiding any pressure. This may include scanning the departure sector for weather or traffic, required engine run-up or other reasons as deemed necessary by the flight crew. GAPPRE 3.3

Extra caution and situational awareness are required during long backtracks. Such situations are connected with time pressure due to incoming traffic and can pose additional threats, e.g. forgetting procedural items due to distraction or even missing turning bays or the runway beginning. Backtracks should be prepared with TEM principles during briefing. GAPPRE 3.3

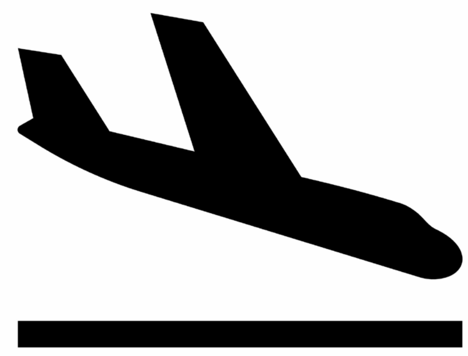
Especially during cross-wind take-offs on slippery runways, a smooth symmetrical thrust application is important. Both engines should be allowed to spool up evenly before applying full take-off thrust. In line with SOPs, it may be advisable to conduct a rolling take-off procedure to avoid engine surge in certain crosswind or tail wind conditions. GAPPRE 3.2

Close attention is essential during transfer of control, especially during rolling take-offs. If one engine fails at take-off thrust with a low aircraft speed, the rudder has no effectiveness to counteract the huge jawing moments. In such situation, the thrust immediately needs to be retarded to idle. GAPPRE 3.2

Forward pressure on the elevator control might be recommended on some aircraft types to increase nosewheel steering effectiveness. GAPPRE 2.8

During take-off roll, whenever doubts arise about the validity of the inserted take-off parameters, the take-off should be rejected or full thrust applied depending on the take-off roll's progress. GAPPRE 3.2 Case Study

Landing Performance Calculations



Flight crew should verify in the preplanning stage that the dispatch landing performance calculations used realistic but conservative values, even at the price of reducing traffic loads. GAPPRE 4.1

Landing performance calculations should be performed during the approach preparation prior top of descent. Nevertheless, whenever more recent information with deteriorating conditions become available, calculations have to be updated accordingly. GAPPRE 4.2

Flight crew should have a comprehensive knowledge of the safety factors used and assumptions made by performance calculation programs/tables. They should always make conservative calculations based on their experience and local knowledge:

- In headwind situations, flight crew may consider performance calculations based on zero wind
- In calm or variable wind situations, flight crew may use a minimum of 5 kts tailwind for their calculations
- If a variable range of wind direction is given (e.g. 330/5 300V360), flight crew should use the least favourable value for the given runway direction (for runway 28 => 360/5)
- In tail wind situations, flight crew should consider effects causing increasing tail winds (e.g. by incoming weather or land/sea wind effects) and keep in mind the maximum tailwind limits
- Anticipate weather changes and associated runway surface conditions upon landing
- Use a conservative landing weight and recalculate, if necessary, when changes occur, e.g. due to shortcuts on approach GAPPRE 2.12/4.2

Using "canned decisions": calculating with deteriorating conditions to obtain limiting factors, until which a landing can be performed safely, e.g. maximum tailwind or a minimum runway condition code (RWYCC). GAPPRE 4.2

Go-around considerations should be included in performance calculations (e.g. engine out climb gradient) GAPPRE 4.2

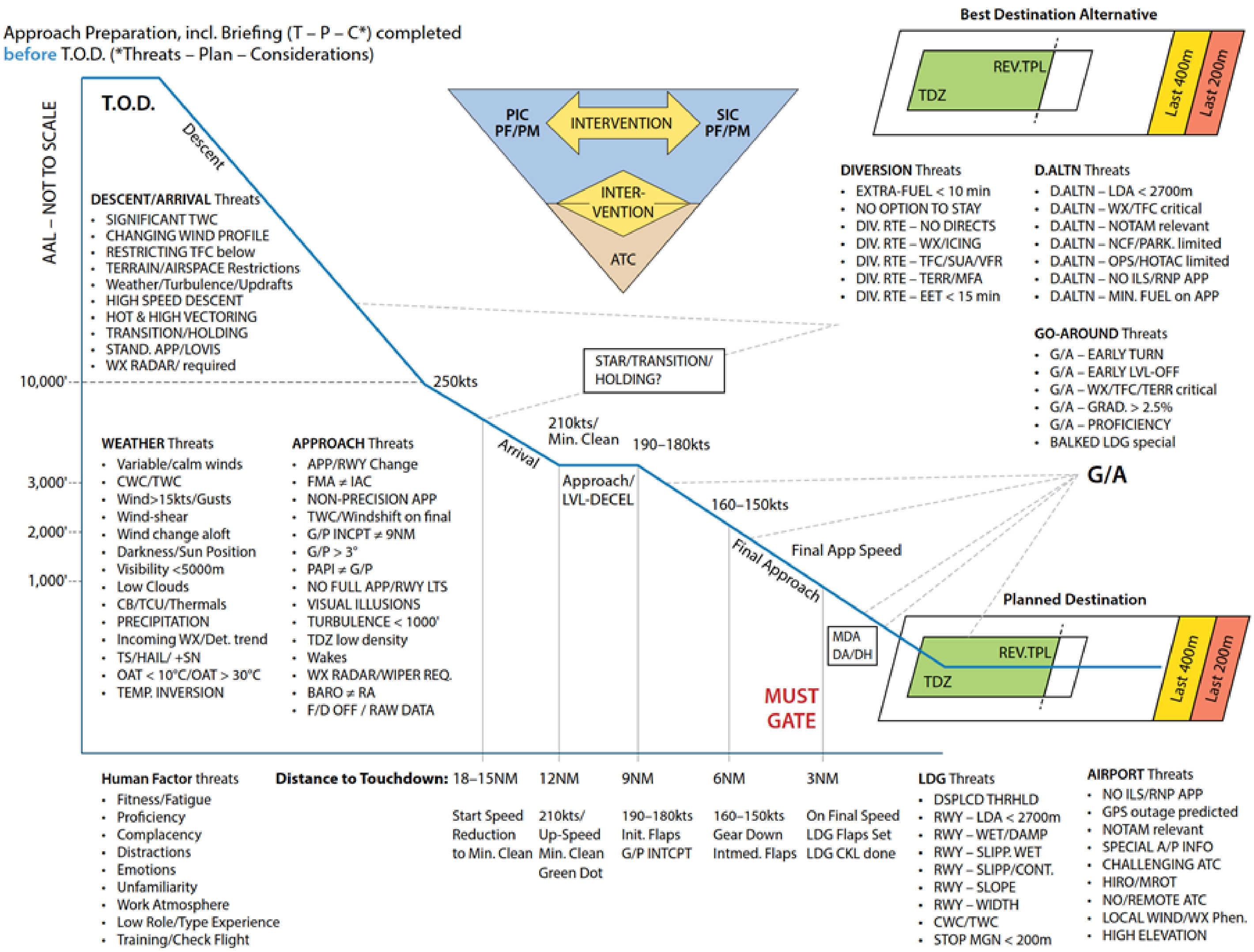
As runway performance decreases, so do margins calculated by programs/tables. Flight crew should be aware that calculations do not always have precise input values. This necessitates to calculate and act accordingly. GAPPRE 4.2

Arrival

To reduce landing pressures and extend options, flight crew should consider possible threats at destination in their fuel planning and carry extra fuel accordingly. These include, but are not limited to performance limited runways, unfavourable weather, no available 3D approaches, unreliable ATC, known tailwind ops or frequent runway changes. GAPPRE 4.1

The same thorough TEM preparation should always be performed, even when flying to an airfield frequently visited. Human factors and available type of approaches need to be considered. Flight crew should specifically prepare for 2D approaches and be aware that they are non-standard. The following graphic may help to identify threats affecting a flight: GAPPRE 4.1

Example of a safe arrival planning based on medium to large turbofan aircraft (e.g. A320/B737), adaptions for different aircraft types may be needed



Approach briefings should be finished before top of descent, whenever feasible. On very short flights, it might be useful to already complete parts of the approach briefing on the ground. Approaches should be delayed if not being fully prepared. Approach preparations should include the following:

- A thorough threat analysis
- Separate performance calculations using the latest available data
- A safe descent planning and briefing of the arrival procedure
- Type of approach, flying strategy and go-around
- Canned decisions for marginal conditions
- Latest touchdown position and deceleration strategy (e.g. autobrake setting)
- Intended runway exit including corresponding speed, any handover of controls if required and expected taxi-route GAPPRE 4.1

Flight crew should always choose the type of approach and landing runway which provide the highest level of safety and operational assurances. The flight crew’s status in relation to fitness, proficiency, airport and aircraft/variant familiarity as well as the individual work atmosphere in the cockpit should be considered. 3D approaches should be preferred over 2D approaches. Automation and workload should be managed based on any given situation. There are situations to practice manual flight and times when it is advisable to use maximum automation. GAPPRE 4.3

Flight crew should not conduct auto-land approach manoeuvres at airports when low visibility procedures (LVP) are not in force, unless:

- the Instrument Landing System (ILS) critical and sensitive areas are protected, ATC has been informed and reassurance of ILS sensitive area protection has been received

or

- specific precautions have been taken and risk analysis has been performed by the airline

or

- the aircraft is demonstrated as robust to non-protection of ILS sensitive area.

GAPPRE 4.4 Case Study

Auto-land approaches and associated procedures should be thoroughly briefed. Pilots need to be ready to react to unexpected influences causing unsatisfactory aircraft behaviour, e.g. beam disruptions. GAPPRE 4.4

Successful approaches are a collaborative effort between the pilot flying (PF), PM and ATC. Flight crew can achieve stable approaches by applying a conservative strategy in their energy management. This may include considering expected a lower descent speed, less headwind or tailwind at lower levels or anticipating anti-ice selection. Flying high speed below 10.000ft should not be planned. GAPPRE 4.1/4.5

Any qualified flight crew member on the flight deck should be allowed to address concerns and call for a go-around irrespective of rank or experience. The role of the PM (and supernumerary crew members) is crucial as the PF may become task-saturated or target-fixated more easily. GAPPRE 4.1/4.5

The PM should intervene early enough in the descend before an unstabilised situation arises. Soft intervention techniques such as the following may be used: GAPPRE 4.5

Nudges between the PM and PF	Nudges between the flight crew and ATC
Asking/advising the PF on the use of speed brakes;	Pilot: asking ATC for the planned track miles to go;
Asking/advising the PF on the estimated shortest distance to go (even at regular intervals);	Pilot: advising ATC on the required track miles to go;
Stating out loud actual wind or gross weight and its influence on the descent path; and,	ATCO: stating the planned track miles to flight crews on initial contact or asking for the required track miles; and,
Calling out anticipation of an unstable approach.	ATCO: asking/challenging flight crews if their approach path or approach speed appear higher than usual.

The later in the approach, the more direct interventions must be used. Towards ATC: "Unable" and towards the other crew member: "I feel uncomfortable/concerned". Whenever hard interventions are required, the published callouts must be used such as "Speed", "Glideslope", etc. and ultimately "Go-around" or "I have control". GAPPRE 4.5

A go-around is always the favoured option instead of taking over control (e.g. by the pilot-in-command) to force a landing. GAPPRE 2.8 Case Study

Go-around execution should neither be delayed nor discussed and any go-around should be applied immediately. Once initiated, a go-around must be completed! GAPPRE 4.6

A go-around should always be considered before starting a approach, e.g. if weather permits the standard missed approach routing. No approach should be started without a valid go-around strategy. GAPPRE 4.1

Flight crew should brief and be mentally prepared for a go-around at every stage of the approach, especially in situations which are less often trained, e.g. when still being above the published go-around altitude or in case of a balked landing. GAPPRE 4.6

GAPPRE 4.6

No change of plan below the stabilization height, e.g. deciding on a different final flap setting or conducting abnormal procedures. Approaches have to be stable until touchdown within the touchdown zone. A go-around is always possible (until selection of reverse thrust) and required whenever the approach or landing becomes unstable, meteorological conditions are out of limits, failures occur, ATC instructs a go-around, any crew-member feels uncomfortable or the landing becomes too long. GAPPRE 4.6 Case Study

When expecting challenging environmental conditions (e.g. cross- or gusting winds, rain showers or low ceiling), a stabilised landing configuration should be established early to be able to monitor environmental changes and concentrate on tracking. It is recommended to disconnect the autopilot early enough to achieve a good sensation of the present conditions prior landing. GAPPRE 2.8

Landing

Landings following an unstable approach or a long landing beyond the touchdown zone should be reported to be analysed under just culture principles to learn from such events. GAPPRE 4.5

Flight crew should be aware of the runway length, associated touchdown zone and available margin beyond the calculated landing distance required. Margins of less than 400m may not allow using the full touchdown zone during flare. For instance, the touchdown zones of runways with a length of 2.400m or more, are 900m long. However, landing calculations assume a touchdown at approximately 500m (depending on ground speed during approach). Consequently, whenever the required landing distance results in less than 400m margin, the flight crew must be aware not to use the full touchdown zone anymore but abort a long flare sooner and go-around. This point is called touchdown-point-limit (TPL) and should be briefed in advance. Flight crew should discuss and brief which visual cues are available to determine the TPL, e.g. on airport moving maps, satellite pictures, etc. GAPPRE 4.2 and GAPPRE 4.7 Case Study

Pilots should not intentionally land short or long (e.g. to minimise runway occupancy time) but always land within a runway's touchdown zone, latest at the previously briefed TPL if applicable. This prevents hard landings or long flares. GAPPRE 4.7 Case Study

In case of a bounced landing, a go-around should always be the priority instead of trying a second touchdown further down the runway. This is especially valid with decreasing landing distance available. GAPPRE 4.8 Case Study

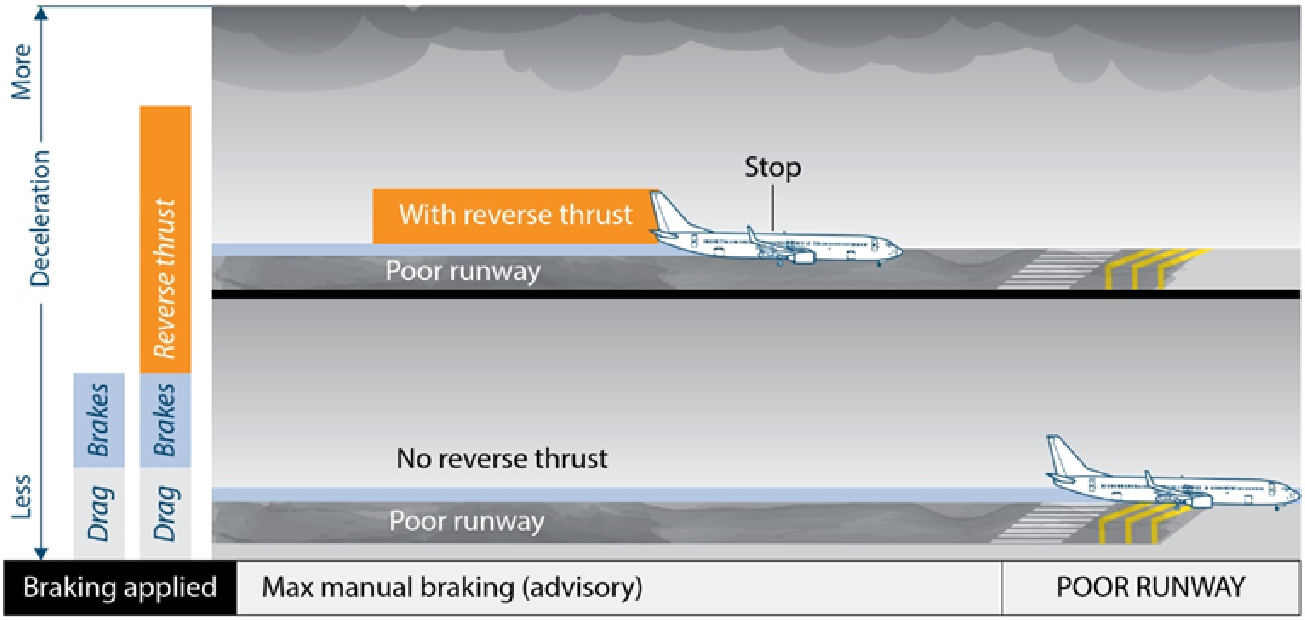
A firm touchdown is recommended, in particular on wet or contaminated runways to minimise the risk of aquaplaning. When touching down with a residual crab angle on a dry runway, the aircraft automatically realigns with the direction of travel down the runway. This does not happen on a wet or contaminated runway. GAPPRE 2.8

When the status of a runway is uncertain or possibly slippery wet, a swift use of all deceleration means available including full reverse is important. Reversers or speed brakes should not be sowed and braking efforts maintained until a safe stop is assured. GAPPRE 4.2 Case Study

The intended use of all deceleration means should be briefed to enable the PM to thoroughly observe correct activation and to intervene if the deceleration rate is unsatisfactory. GAPPRE 4.2 Case Study

Autobrakes aim for a deceleration rate. Selecting reverse thrust on a dry runway allows to optimize wheel brake energy. On slippery runways, the target deceleration associated with the selected autobrake level may not be achievable with braking alone, which is why reverse thrust is essential for stopping the aircraft even with autobrake. GAPPRE 4.2

Landings on runways with RWYCC 2 (pilot report "Medium to Poor", e.g. standing water or ice) or less should be treated with reluctance. If required, using full and symmetric reverse thrust is essential. GAPPRE 4.2



Pilots should be aware they may not be used to full braking or full reverse. They should plan accordingly and be prepared to ignore environmental restrictions (e.g. noise) when required for safety. GAPPRE 4.2

In the event that a lateral control problem occurs in strong crosswind landings, flight crew might have to reduce reverse thrust to reverse idle and release the brakes to correct back on the centreline. This will minimise the reverse thrust side force component and provide the total tyre cornering forces for realignment with the runway centreline. Pilots should be aware that these measures may lead to a significantly increased landing distance. GAPPRE 2.8

Whenever the PF may not exit the runway, e.g. due to lack of steering capabilities or company procedures, the timing and aircraft speed at handover of control should be agreed and briefed. The type of exit as well as the surface state of runway and taxiway should be considered. The handover of controls should preferably be accomplished in the low speed regime and when taxing straight ahead. GAPPRE 4.9

Abbreviations

ATC	Air Traffic Control
EMAS	Engineered Materials Arresting System
FMS	Flight Management System
ILS	Instrument Landing System
PF	Pilot Flying
PM	Pilot Monitoring
RWYCC	Runway Condition Code
SOP	Standard Operating Procedures
TEM	Threat and Error Management
TPL	Touchdown-point-limit

Disclaimer

This Best Practices document is an abstract of the Global Action Plan for the Prevention of Runway Excursions (May 2021), coordinated by Eurocontrol and the Flight Safety Foundation. Any recommendations and guidance should not be applied if it contradicts a flight crew's standard operating procedure or operating manual. Operator documentation remains primarily binding.

About ECA

The European Cockpit Association represents the collective interests of professional pilots at European level, striving for the highest levels of aviation safety and fostering social rights and quality employment.

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