STAR - 007 V1 – March 06	OVERRUNS ON LANDING

Introduction

Pilots' performance calculations of Landing Distance Required (LDR), using manufacturers' data and guidance, are no guarantee that the actual landing distance will fall within that available (LDA): despite planning margins of 60/70% for turbo-jet/prop. Recent accidents and incidents resulting from runway overruns indicate that there is a need for flight crew to better understand the actual factors which affect landing distances.

The purpose of this STAR is to: provide an understanding of the potential threats to a safe landing within the LDA and suggest ways of reducing associated risks, thereby making an overrun less likely.

General Planning

Plan ahead to identify and analyse the potential threats: plan to avoid these threats and, in mitigation, review associated recommended operating techniques and procedures. Inadequate preparedness can lead to oversight of a threat and the encounter of unforeseen risks all leading to an overrun.

- **Pressonitis will dramatically increase the risk of an accident on approach and landing.**
- **Performance:** Landing performance data on wet and contaminated runways assumes the use of reverse thrust. Loss of reverse thrust, or delayed application, can dramatically increase LDR.

✈ Consider using performance data for no thrust reverse when planning a landing on a wet or contaminated runway.

✈ **Briefing:** No approach should be attempted without a thorough and accurate briefing: include all flight crew; and if conditions are encountered which have not been covered in a previous briefing, take time out to consider them and re-brief.

✈ **Recheck:** There will be a need to check that the assumptions made during performance planning are still applicable for the actual conditions at the time of landing. This is especially crucial if the destination has changed or when diverting. Consideration should be given to all variables including aircraft weight, wind, surface condition/contamination, temperature, pressure altitude etc.

✈ **Select:** Try to obtain the most appropriate runway for landing with consideration given to runway length, LDA, wind direction, surface condition/contamination and PIREPS.

✈ **MEL:** Consideration must be given to any equipment and system unserviceabilities or limitations.

✈ **Braking:** Be prepared to apply appropriate levels of braking dependent on actual aircraft weight.

Approach

Assuming all performance planning is adequate, and the runway conditions catered for, how the approach is flown is probably the most crucial factor in determining whether an overrun will occur.

✈ **Stabilised:** It is always essential to fly a stabilised approach. Landing from a non-stabilised approach is not recommended and is likely to lead to delays in: touchdown point; directional control on the runway; and application of brakes, reverse thrust and spoilers/lift dumps.
For info on Stabilised Approaches: http://www.flightsafety.org/alar/alar_bn7-1stablizedappr.pdf

✈ **Speed adjustments:** If speed corrections (add-ons) for events such as gusting winds, wind-shear, or icing are required, then ensure that re-planning considers this change and the LDR is adjusted appropriately

- It is helpful to have a company policy limiting the maximum add-on value, where several conditions exist, and each requiring a separate add-on.

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- **Groundspeed at threshold:** IAS is a critical element of a stabilised approach; if the IAS at threshold is in excess of the Reference Speed, the groundspeed upon which the performance calculations are based will be incorrect, and a greater LDA than planned will be required. Similarly if the actual wind encountered on the approach is different than that planned, or even if the pressure altitude and OAT vary, the threshold groundspeed and subsequent LDR may be affected.
- **Descent profile:** If the threshold crossing height is greater than 50ft, then touchdown will be delayed and a greater LDR than planned for will result. Similarly if the ROD is too great at touchdown, a bounced landing may ensue and valuable runway retardation distance will be lost.
- ✈ The approach should remain stabilised right down to the touchdown target zone.
- ✈ If a landing can not be guaranteed in the predetermined touchdown target zone, performing a Go-Around is the best option.
- ✈ Never decide to aim for a late touchdown zone (ie on long runways in order to reduce taxi distance or help ATC with traffic capacity).
- **Beware –** that concentrating on a pre-marked landing zone can increase the chances of a tail-scrape following a steep approach.
- ✈ **If in doubt – GO AROUND – it is never wrong.**

Flare

Problems that are encountered during the flare may result in bouncing, floating and necessary extra directional control inputs, all leading to: delayed application of brakes, reverse thrust and spoilers/lift dumps; and therefore a greater LDR than planned.

- ✈ if landing cannot be assured within the predetermined touchdown zone, the best option is to perform a balked approach.
- ✈ **Never delay touchdown** (ie long flare on long runways), even if ATC imply this would help traffic capacity
- ✈ **Appropriate landing:** Aim for a safe landing which avoids too high a ROD at touchdown and therefore a risk of bouncing, but also avoid trying for a 'comfort' landing which is likely to result in a long flare.
- A good landing is described as a "positive" landing.
- Touchdown speed will influence stopping distance and is usually around 7kts lower than V_{ref}.
- **Cross-winds:** controlling the aircraft during a crosswind landing may delay active retardation and therefore increase the LDR.
- ✈ **Slope:** Be prepared for a longer touchdown if the runway is sloping downhill in the direction of landing. It should be possible to replicate this scenario during simulator exercises.
- ✈ **Ensure that crosswinds and runway slope are both considered in your planning.**

Roll-out and Stopping

Following a successful landing, appropriate rates of retardation are essential in ensuring that the actual LD occurs within the LDA.

- ✈ Do not delay the following actions, and conduct them in the required sequence:
  - lowering the nose-wheel
  - application of reverse thrust, spoilers/lift dumps
  - application of appropriate braking levels

- ✈ Aim to:
  - avoid 'over-consideration' for comfort
  - brake early and dissipate energy whilst still at high speed, and
  - when necessary for safety purposes apply full braking.

- Note that spoilers and lift dump are most effective at higher speeds; their use can also enhance braking efficiency.
- Aircraft certification flights are conducted using maximum braking on runways with known friction.
- Pilots are rarely trained in the application of maximum braking and daily operational factors and conditions rarely match those of certification flights.
- ✈ **Allowance must be made for differences in certification flights and daily conditions.**
- Utilising a groundspeed readout can help avoid an undesired high-speed turn off.

Reverse thrust: Although the use of reverse thrust is not considered in landing performance calculations for dry runways do not be tempted to think it is never required. Application of reverse thrust whilst still at high speed is most efficient; it can always be de-selected later during the landing run. Furthermore, for turboprops, use of reverse thrust increases braking efficiency by reducing wing lift and increasing weight on wheels. Also note that on wet or contaminated runways reverse thrust is likely to be more effective than the brakes.

- ✈ **Always consider the use of Reverse Thrust.**
- ✈ Pre-arming of thrust reversers (for jets) should maximise their use
- ✈ For turboprops immediate selection of beta range after touchdown will increase braking efficiency.
- ✈ Fears of infringing noise restrictions should not override safety considerations.

Wind

The direction, speed and stability of the wind, encountered during an approach, will directly influence the pilot's ability to land within the target zone and commence effective retardation as early as possible; they will also directly affect the Groundspeed at touchdown. Therefore,

- ✈ it is essential to include the effects of wind when planning the LDR.

The actual wind encountered on landing is very likely to be different to that used for planning, therefore

- ✈ the regulatory requirements (ICAO Annex 6, Chapter 5, Attachment C-1; and JAR OPS 1.515/1.520) to never consider more than 50% of headwind or less than 150% of tailwind in performance planning should be adhered to; it may even be recommended to always consider double the tailwind.

The wind speed at 50 ft is usually significantly higher than the wind speed at touchdown: it may be hard to lose this kinetic energy: therefore, when the predicted approach wind is a tailwind,

- ✈ consideration should be given to using a higher value than forecast or reported.
- A sudden decrease in the force of tailwind (not uncommon close to the ground) will result in an increase of airspeed, which can result in floating and thus a late touch-down.

The actual wind experienced on landing will likely be different to that broadcast by ATC, METAR, TAF or the ATIS; especially in dynamically changing conditions (eg gusts, shear and thermal turbulence).

- METAR wind is based on an average of wind over a 10 minute period.
- Tolerances of direction and speed to trigger a broadcast change can be quite large (10 kts and 30°), and tolerances in measurement can be 5% speed and 5° direction.
- The wind given by the ATC Tower is an average aerodrome wind usually over the previous 2 minutes, taken from wind measuring points that are generally not at the touchdown zone; but more specific winds *can be* provided on request.
- ✈ **When in doubt about the touchdown zone wind – ASK ATC.**
- ✈ Selecting a readout of the real-time wind on the FMS during the final approach will help in assessing any potential windshear. Pilots should understand the limitations of their FMS.

Gusts: A rule-of-thumb for the northern hemisphere when landing with a *headwind* component - a gust from the left will decrease the crosswind component and increase the headwind, but a gust from the right will increase the crosswind component thereby reducing the headwind. However, gusts associated with CB activity or microbursts may not follow this expected pattern.

- ✈ Be careful when landing with a tailwind component in gusting crosswind conditions; sudden increases in tailwind or crosswind components are likely; both situations will affect your LDR.

Runway condition

The condition of the runway surface in terms of construction, maintenance and most of all deposits of water, snow, slush and ice, can be the largest threat to your ability to stop within the LDA.

- **Transient weather, such as flash storms and hailstones, present a significant risk**
- Always check (ask for) runway contamination and aerodrome weather conditions prior to landing – they may have changed since the arrival brief.
- Runway friction can be greatly reduced to very low levels on contaminated runways.
- Rubber deposits can be considered as contamination that reduces runway friction.
- Crosswinds may prevent adequate runway drainage of water, causing pooling.
- Flight manuals may contain specific performance data for wet and contaminated runways; if not, then appropriate margins should be added to the LDR.
- ✈ **Always use the manufacturer's recommended planning data and methods; and always apply (at least) safety margins as required by regulations.**
- Aquaplaning is likely to occur at touchdown speed, rendering the brakes ineffective, and possibly directional control also.
- ✈ An appropriate (positive) landing will reduce the risk of aquaplaning.
- ✈ Certain aircraft systems, may not be available under conditions of low runway friction.
- ✈ Using the emergency brake(s) may not necessarily aid retardation, as other services may be lost.
- ✈ Reverse thrust must be applied as soon as possible after touchdown.

Runway friction measurements can be unreliable (especially when water is present) and different devices produce different coefficients which neither immediately correlate with each other, nor with planning criteria of GOOD/MEDIUM/POOR Braking Action. Aerodromes should issue a SNOWTAM whenever the runway friction reduces below a published minimum coefficient, even when there is no contamination present: this can be the case when "Slippery When Wet" has been issued by NOTAM.

Too often runway friction testing intervals are not frequent enough and aerodromes do not issue SNOWTAMs, publish the minimum coefficient, nor provide details of the measuring device used. This can leave pilots uncertain about the actual runway friction.

- ✈ Always attempt to obtain information about the runway friction – the coefficient, measuring device used, and when last measured.
- ✈ Airlines should pressure their aerodromes of business to fully comply with ICAO Annex 14 on these matters.
- Some national regulations may forbid landings whenever braking-action is reported as POOR.

References

A self-study power-point on avoiding overruns is available at:
http://www.flightsafety.org/ppt/managing_threat.ppt

An interesting article on Slippery When Wet is available from:
http://www.casa.gov.au/fsa/2000/sep/FSA41-43.pdf