Crosswind Landings

This document is divided into two sections. The first is a general description of crosswind landing techniques in Transport Type aircraft. The details are based on the authors two decades of crosswind landing experience in the Northern Artic Region where high winds and frozen, ice covered runways are a way of life for many pilots.

The second section is an assembly of information directly from the Airbus Flight Crew Training Manual (FCTM).

Crosswind landing Techniques:

In flight, the aircraft moves in an air mass, which like the aircraft, is also in motion. The keep a specific track relative to the ground, the heading of the aircraft has to be altered accordingly to maintain a specified track over the ground. Whist on the ground, the aircraft moves relative to the ground only.

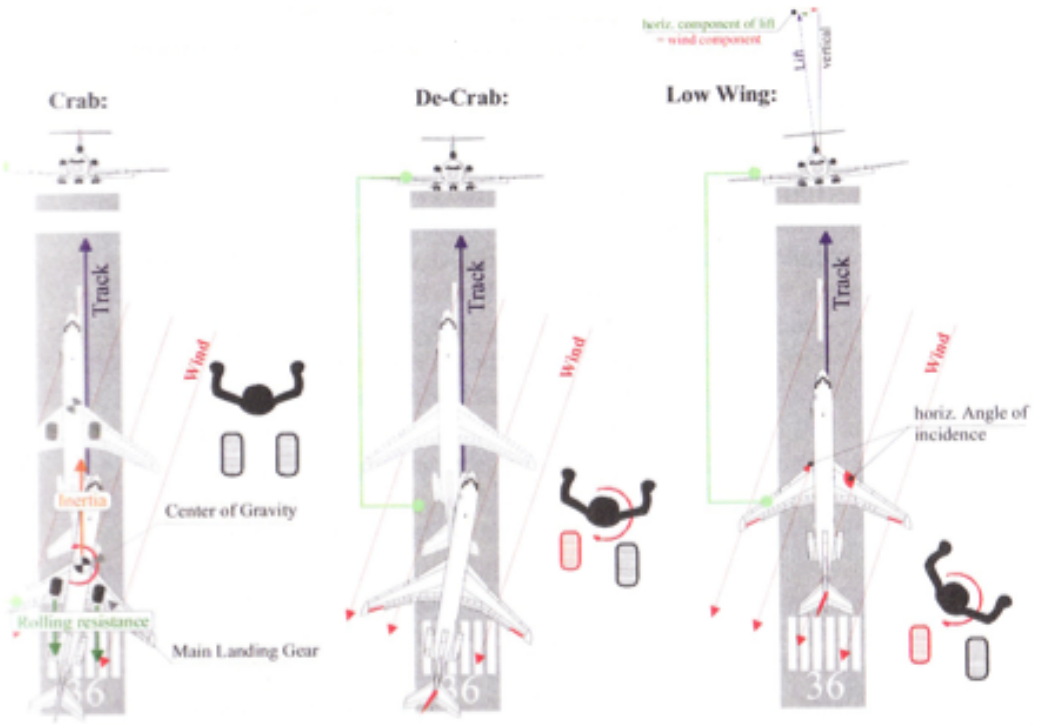
Landings in crosswind conditions are otherwise transitions from the moving air onto the "Fixed" ground. Conversely, take-off's in crosswind conditions are transitions from the 'Fixed" ground into the moving air.

During take-off the wind acts on the vertical stabilizer and tries to "Yaw" the aircraft into the wind much like a weather vane would point itself into the wind. Opposite rudder is required to maintain the runway centerline.

The upwind wing generates more lift than the downwind wing. The fuselage shelters a portion of the downwind wing when that wing is rectangular. On swept wing aircraft, the sheltered portion is proportionally greater.

Furthermore, swept wing designs additionally generate more lift on the upwind wing because the horizontal angle of incidence is closer to 90 degrees on the upwind wing. Therefore, Aileron input into the wind is required to correct these effects.

Once airborne the aircraft is in a sideslip. Depending on the directional stability of the airplane it will take several seconds before this sideslip ceases with rudder centered.



Three methods of crosswind landing exist; Crab; De-Crab; and Low Wing. Each has advantages and disadvantages.

Crab:

The runway track is maintained with the ailerons only. This is possible with ALL tricycle landing gear airplanes, because the centre of gravity is ahead of the main landing gear and the track aligned with the runway. The inertia of the aircraft and the rolling resistance of the main landing gear will straighten the aircraft with little rudder input.

Although this is the safest method in all crosswind conditions, it comes at the expense of very high side forces on the main landing gear and very high tire wear. Additionally, this method is uncomfortable for passengers seated at the rear of the aircraft.

Unless the pilot is an expert with crosswind landings, the crab method is the best choice of techniques.

De-crab:

Using the de-crab technique, the aircraft is flown to the "Flare" in much the same manner as with the "Crab" technique, except that during the flare the aircraft heading is aligned with the runway by applying downwind rudder in the flare prior to touchdown. Simultaneous upwind aileron MUST be

given to keep the wings level. In fact, failure to apply the upwind correction is the major cause of many crosswind-landing incidents.

The wind drift in the short period of time is usually negligible. Keep the wings level,by reacting to the roll from the downwind rudder input. This action is necessary to prevent inadvertent roll in the wrong direction caused by aerodynamic forces on the upwind wing.

This method is only slightly less uncomfortable for passengers seated at the rear of the aircraft than the Crab method. However, this method will reduce the wear and tear mentioned in the previous method (Crab) but requires a greater level of pilot skill.

Low Wing:

The low wing technique requires that the aircraft be flown in a sideslip before the flare. Rudder inputs align the airplane's heading with the runway track while the lateral offset is corrected with aileron.

The resulting horizontal component of the lift equals the crosswind component when stabilized. However, rudder and aileron inputs are HIGHLY coupled; changing one variable requires the immediate change to the other.

The advantages to the Low Wing method are the transition from "Flight" to "Ground" can be completed over a relative greater time, thereby greatly improving passenger comfort. Additionally, there is no additional Wear and Tear on the landing gear or tires.

However, this crosswind landing technique should considered as an "Expert Only" technique, as it requires a greater level of skill, especially with low wing aircraft and under-wing mounted engines.

Strong crosswind landings should be performed with auto brake medium, and NO Reverse Thrust (Details in next section).

Airbus Specific Details

Vietnam Airlines A330/A340 FLIGHT CREW TRAINING MANUAL	OPERATIONAL PHILOSOPHY PRELIMINARY PAGES SUMMARY OF HIGHLIGHTS

Localization Title	Page	ID	Reason
OP-030 AUTOTHRUST (A/THR)	3/14	1	During the approach, with the A/THR active, Airbus recommended to set the thrust levers above the CL detent (but below the MCT detent), in exceptional circumstances, if the speed significantly dropped below Vapp. However this procedure has finally more drawbacks than advantages. Therefore, Airbus does no longer recommend to use this procedure. The procedure is deleted from the operational documentation. If the A/THR performance is not satisfactory, the flight should manually take over, and control the thrust manually.
			Deleted part inside

Note: Recent changes to long held airbus philosophies.

LATERAL AND DIRECTIONAL CONTROL

FINAL APPROACH

In crosswind conditions, a crabbed-approach should be flown.

FLARE

The objectives of the lateral and directional control of the aircraft during the flare are:

- To land on the centerline
- And, to minimize the loads on the main landing gear.

Note: During Final Approach it is recommended to fly a "Crabbed Approach". However, during the flare the objective is to minimize the loads on the main landing gear (De-Crab / Low wing method)

During the flare, rudder should be applied as required to align the aircraft with the runway heading. Any tendency to drift downwind should be counteracted by an appropriate lateral (roll) input on the sidestick.
In the case of a very strong cross wind, the aircraft may be landed with a residual drift (up to about 5 °) to prevent an excessive bank (up to about 5 °). Consequently, combination of the partial de-crab and wing down techniques may be required.

MAXIMUM DEMONSTRATED CROSSWIND FOR LANDING

Applicable to: ALL

The maximum demonstrated crosswind at landing is 32 kt, with gusts up to 40 kt.

Note: "...consequently a combination of the partial de-crab and wing down techniques may be required..."

Note: The crosswind is a Maximum Demonstrated, therefore the value is NOT limiting. Pilots have to use their own judgment and experience to determine whether their individual limits are greater or less than the published values.

ROLL OUT

Applicable to: ALL

NORMAL CONDITIONS

During the roll out, the rudder pedals will be used to steer the aircraft on the runway centreline. At high speed, directional control is achieved with rudder. As the speed reduces, the Nose Wheel Steering (NWS) becomes active. However, the NWS tiller will not be used until taxi speed is reached.

CROSSWIND CONDITIONS

The above-mentioned technique applies. Additionally, the pilot will avoid to set stick into the wind as it increases the weathercock effect. Indeed, it creates a differential down force on the wheels into the wind side.
The reversers have a destabilizing effect on the airflow around the rudder and thus decrease the efficiency of the rudder. Furthermore they create a side force, in case of a remaining crab angle, which increases the lateral skidding tendency of the aircraft. This adverse effect is quite noticeable on contaminated runways with crosswind. In case a lateral control problem occurs in high crosswind landing, the pilot will consider to set reversers back to Idle.
At lower speeds, the directional control of the aircraft is more problematic, more specifically on wet and contaminated runways. Differential braking is to be used if necessary. On wet and contaminated runways, the same braking effect may be reached with full or half deflection of the pedals; additionally the anti skid system releases the brake pressure on both sides very early when the pilot presses on the pedals. Thus if differential braking is to be used, the crew will totally release the pedal on the opposite side to the expected turn direction.

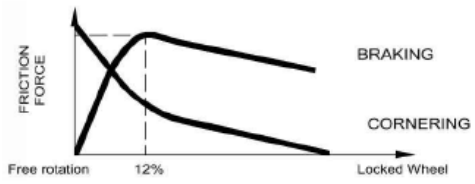
Note: This section concerns "Roll Out" not "Approach" or "Flare".

Note: "...reversers have a destabilizing effect on the airflow around the rudder and thus decrease the efficiency. Furthermore, they create a side force...."

CROSS WIND CONDITIONS

The reverse thrust side force and crosswind component can combine to cause the aircraft to drift to the downwind side of the runway if the aircraft is allowed to weathercock into wind after landing. Additionally, as the anti-skid system will be operating at maximum braking effectiveness, the main gear tire cornering forces available to counteract this drift will be reduced.

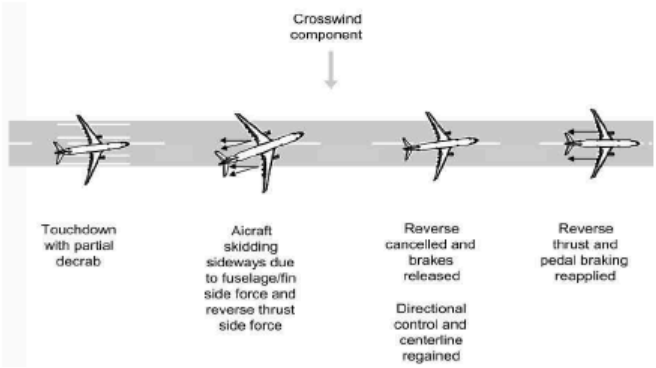
Braking force and cornering force vs skid ratio



Note: "...the reverse thrust side force and crosswind component can combine to cause the aircraft to drift to the downwind side of the runway..."

To correct back to the centreline, the pilot must reduce reverse thrust to reverse idle and release the brakes. This will minimise the reverse thrust side force component, without the requirement to go through a full reverser actuating cycle, and provide the total tire cornering forces for realignment with the runway centreline. Rudder and differential braking should be used, as required, to correct back to the runway centreline. When re-established on the runway centreline, the pilot should re-apply braking and reverse thrust as required.

Directional Control during Crosswind Landing



I hope this document has eliminated some of the mystery concerning crosswind landings in large transport aircraft. Fly safe.

Captain Paul Jeeves

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