# WIND COMPENSATION ON IFR PROCEDURES

## 1. Introduction

Instrument procedures are elaborated following a great number of rules implemented in ICAO Documentation 8168.
This set of rules is to be followed for any implementations of IFR procedures.

It includes multiple standards and recommendations to ensure:

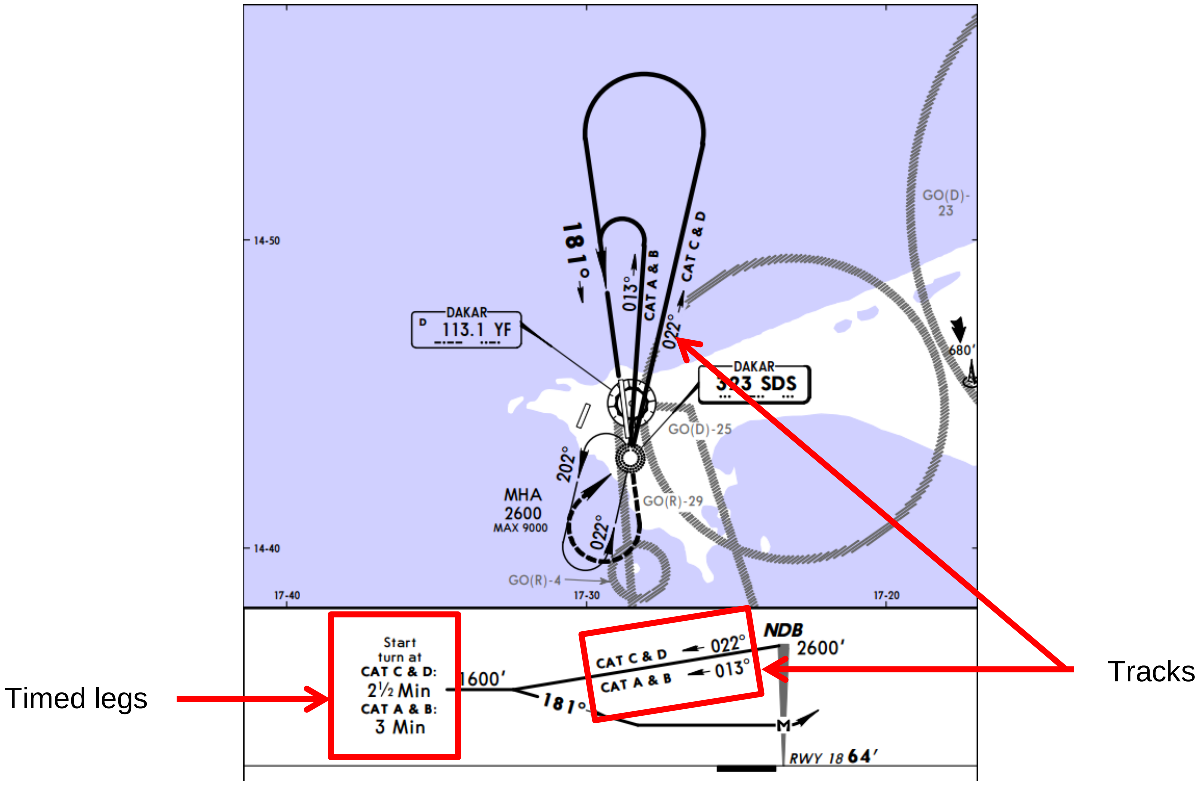
- Airworthiness of such procedure like turn rates and speed limitations;
- Margins regarding the crew and environmental constraints like reaction time to perform a manoeuver;
- Obstacle assessment methods to comply with safety margins in effect depending on the flight phase.

In this particular documentation, we are going to deal with the effect of the wind while flying IFR procedures (SID, STAR and APP).

## 2. Correction criteria

An IFR flight needs to be corrected for three aspects:
- Impact on the track of the aircraft that will be tampered due to crosswind component.
- Impact on timed legs that will be tampered due to effective wind component.
- Impact during turn when performing racetracks and holdings.

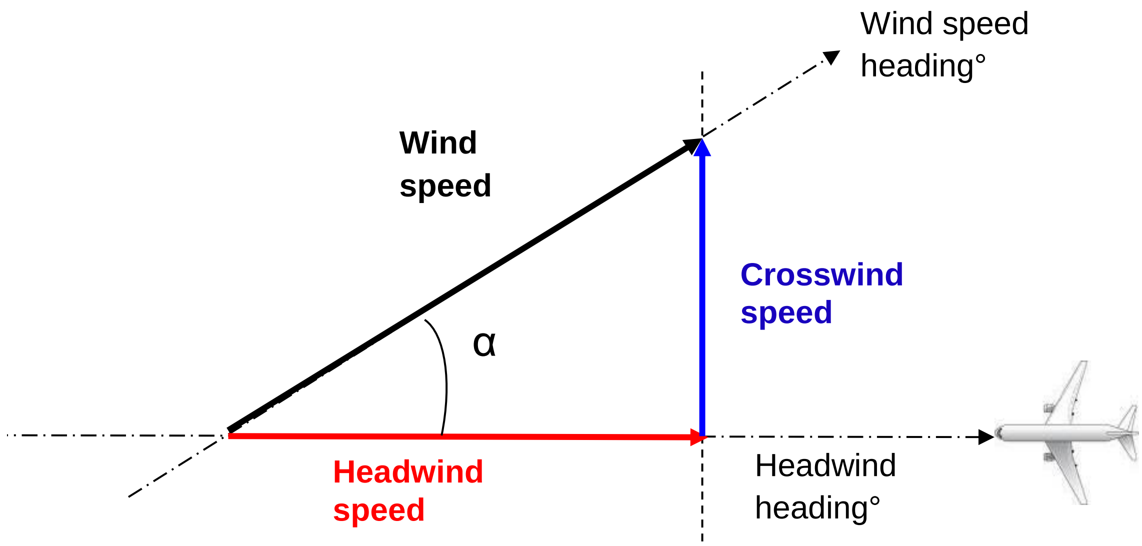
This documentation will not deal with basic wind component and base factor calculations.




# 3. Track compensation

## 3.1. Angle of the wind

α is the angle of the wind from direction of travel.




$$\alpha = (\text{Wind speed heading}° - \text{Headwind Heading}°)$$

Crosswind = Wind speed * sin (α)

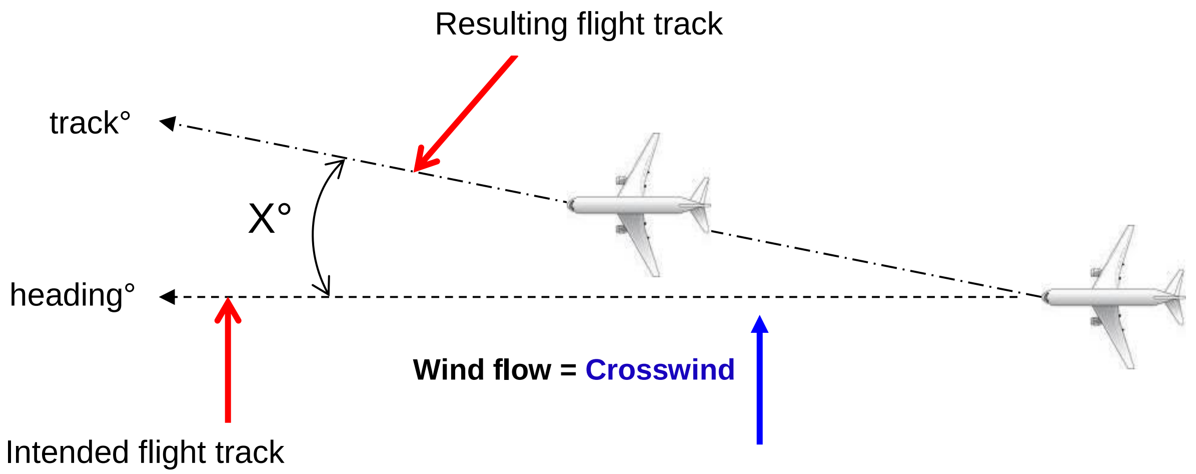
Crosswind = Wind speed * cos (α)

See appropriate documentation to learn the wind component principles and calculation.

## 3.2. Drift Angle

When an aircraft flies with a crosswind not equal to zero, the crosswind will push the aircraft outside the intended flight track and as a consequence the aircraft will fly a flight track presented on the figure below.

If aircraft heading is not corrected for wind and is too far from the intended flight track, especially in case of published IFR procedures, the **aircraft is flying outside safety margins!**




**X°** is the drift angle.

Drift angle **X°** can be computed with the following formula:

| |
|---|
| X°= Drift (°) = Base Factor × Crosswind (kts)<br>Base factor (min/NM) = 60 / TrueAirSpeed (kts) |

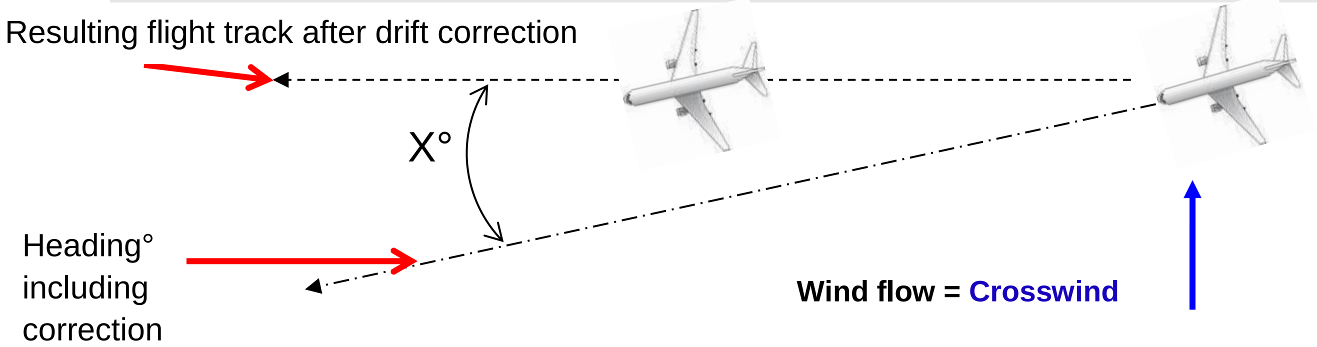
Resulting wind compensation is as follow:

| |
|---|
| Corrected Heading (°) = Track (°) +/- Drift Angle (°) |

**Remember to correct the drift in the good direction: the aircraft must turn toward the wind axis**.

Example: Your aircraft intends to fly along track 270° at 120kts TAS. You are facing the following wind 240°/20kts.
What is the correct heading to remain on your intended flightpath?

- Crosswind = 10 KT and Base Factor = 0.5
- Drift Angle = BF x Cw = 5°
- Corrected Heading = 270° - 5° = 265° (Wind travel from the left)



# 4. Headwind compensation in timed legs

## 4.1. Generalities

For timed legs, the main method to compensate for wind effect is given by the following method:

1. Determine headwind component along the followed track
2. Apply following correction: **Correction (sec) = Headwind (kts) / N**, where N is:
   a. N = 2 for speed below 200 kts
   b. N = 3 for speed equal or above 200 kts
3. Apply this correction **per minute of flight**

Example: Your aircraft must follow a track during 2 minutes on track 090° at 220 kts. Headwind component is 12 kts.

- Correction (sec) = 12 / 3 = 4 seconds
- Total correction for a 2 minutes leg results in a flight time of 2 minutes 8 seconds. (2min + 2*4sec)

**If the effective component derives from a tailwind, time should be decreased.**

Example: Your aircraft must follow a track during 2 minutes on track 090° at 220 kts. Tailwind component is 6 kts.

- Correction (sec) = 6 / 3 = 2 seconds
- Total correction for a 2 minutes leg results in a flight time of 1 minutes 56 seconds. (2min -2*2sec)

## 4.2. Conventional turn

When IFR procedures include a 180-degree-or-more turn, this part of the procedure must be treated as a segment lasting 1 minute.

**Caution:** some conventional turns will require straight-in legs before opening. It is the case in particular for 45/180 turns. Therefore, corrections should be made in two parts: first correction until the opening, second correction subsequent to the opening.

### 4.2.1. Base turn

Total minutes of flight to take into account for the correction is: **Outbound time (min) + 1 (1 turn)**

Example: For a standard base turn including a 2-minute outbound time, correction should be applied three times.

### 4.2.1. 45/180 turn

Total minutes of flight to take into account for the correction is: **Outbound time (min) + 1 (1 turn)**

Example: For a standard 45/180 turn including a 1-minute-15-second outbound time, correction should be applied 2.25 times.

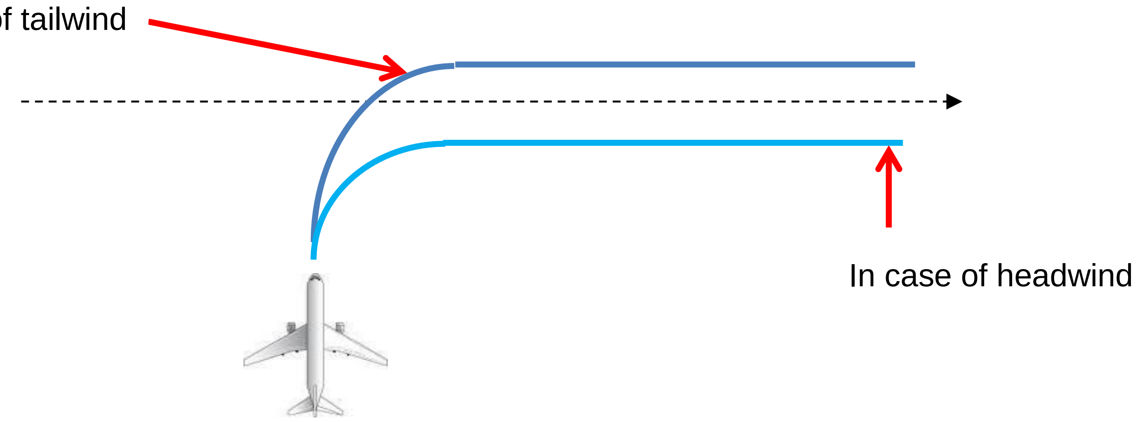
### 4.2.2. Racetrack

Total minutes of flight to take into account for the correction is: **Outbound time (min) + 2 (2 turns)**

Example: For a standard racetrack turn including a 1-minute outbound time, correction should be applied three times.

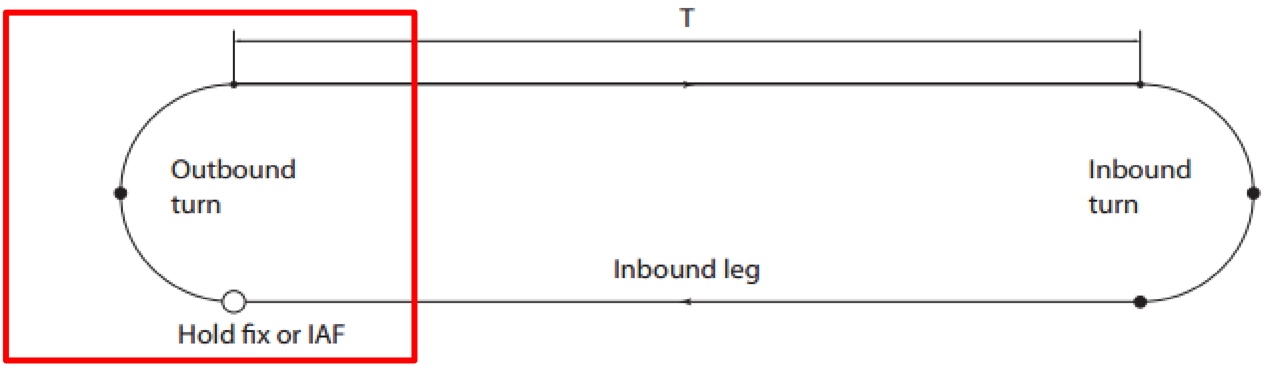
# 5. Turn compensation

Most aircraft operate with a defined bank angle of 25° at normal speed when performing IFR procedures. When turning with default bank angle, this headwind or tailwind wind component will induce an undershoot or overshoot of the intended flight path. This drift shall be corrected.




Holdings and racetracks include safety margins for strong (>36 kts + 1 kt / 1000ft) tailwinds on outbound turn. For anticipation, taking groundspeed instead of true airspeed is sufficient.

We can compensate for the crosswind component on the outbound turn.




The correction method to be followed is:

1. Determine a perpendicular track during the outbound turn in regard to the inbound leg track
2. Compute crosswind component along inbound track
3. **Fly perpendicularly for X second per knot of crosswind component** where X is:
   a. 1 second for speed below 200 kts
   b. 0.5 second for speed equal or above 200 kts
4. Continue the outbound turn toward the outbound leg

Example: Your aircraft is in a standard holding at TAS = 100kts. The inbound track is track 270° and wind is 300/14. How many seconds do you fly perpendicularly to compensate for the wind?

- Perpendicular track = 360°
- Headwind component on perpendicular track = 7 kts
- Aircrew will fly on track 360° for 7 seconds