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## PROCEDURES FOR FLYING RNAV SIDs

### General

This bulletin describes flight crew procedures when flying RNAV SIDs. It is in response to the lessons learned from the RNAV SIDs implemented at DFW and ATL. In January and February 2010, we experienced a significant increase in the number of deviations on the DFW RNAV SIDs. ***If these deviations do not stop, the RNAV SIDs may be suspended or terminated which will eliminate the safety benefits our pilots enjoy from having RNAV off the runway and result in a financial impact to our air-line.***

Three points are critical to successful RNAV SID operations:

1. After loading the SID, crosscheck the navigation display (ND) map and LEGS page against the Jeppesen chart. Do not modify the procedure.
2. Before takeoff, ensure the ND runway symbol / ID and lateral track agrees with the departure clearance.
3. After takeoff, engage LNAV or NAV and fly the departure track as accurately as possible.

#### NOTES

The navigational accuracy of RNAV SIDs is on par with an instrument approach. With lateral and vertical flight guidance and deviation alerting, RNAV procedures must be flown as "precision" procedures.

In this bulletin "FMS" denotes either a GPS FMS (GFMS) or a non-GPS FMS.

### Preflight / Ground Operations

#### FMS Route Loading

The FMS route lateral and vertical flight profile is manually loaded into the FMC during preflight. To ensure the correct sequence of waypoints, it's important to load the route correctly. The

recommended sequence to load the FMS route is:

1. DEPARTURE RUNWAY AND ROUTE
2. SID AND TRANSITION

This sequence creates a lateral track from the departure runway to the arrival procedure that includes any runway specific waypoints associated with the SID and minimizes the possibility of missing / incorrectly sequenced waypoints or inappropriate discontinuities.

#### NOTE

The navigation database must be current to fly RNAV procedures. Do not manually construct ("build") RNAV procedures on the LEGS page. Changes to the route to comply with ATC clearances (e.g., "cleared direct to...") are acceptable.

#### Pre-takeoff Route and Legs Verification Checks

After receipt of the departure clearance (via PDC or radio), verify the FMS route and legs waypoint sequencing against the clearance.

#### NOTES

Route and legs checks compared to the flight plan do not count unless the departure clearance agrees with the flight plan.

If filed on a conventional SID, check the pre-departure clearance received via ACARS (PDC) to ensure that ATC hasn't revised the clearance to an RNAV SID.

Always check FMS SID waypoints against the appropriate Jeppesen page.

Resolve discrepancies in the departure route prior to takeoff or get an amended departure clearance from ATC. If the active route is modified (e.g., change in departure, arrival, or enroute portion), complete the LEGS verification check to confirm the amended portion of the route is correct. This is especially important if the departure runway, SID, and / or transition is modified.

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If the departure runway, SID and / or transition change, the recommended sequence to modify the FMS route is:

1. DEP / ARR PAGE ..... LOAD DEPARTURE RUNWAY
2. SID AND TRANSITION ..... SELECT
3. ROUTE ..... ACTIVATE AND EXECUTE
4. LEGS / ND ..... CHECKED

## Pre-takeoff Navigation Accuracy Checks

Approaching the takeoff runway, check the ND to ensure the aircraft symbol (FMS position) relative to the departure runway is accurate and the departure track (magenta line) agrees with the assigned departure (Ref. Figures 1 and 2).

### CAUTION

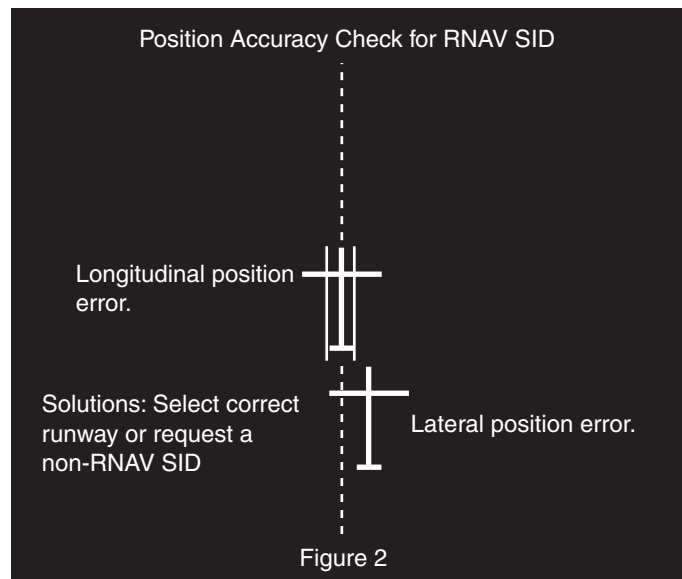
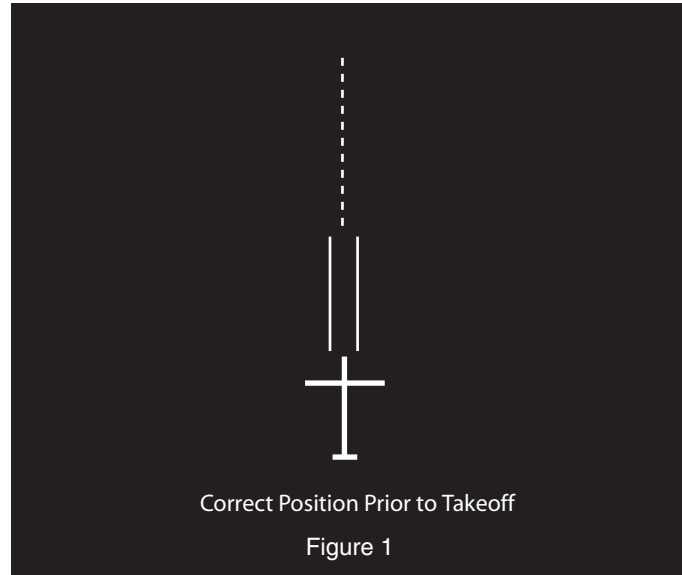
*Proper depiction of the aircraft symbol vs. the runway symbol on the map is important even for GPS aircraft. A discrepancy indicates an incorrect FMS departure runway or a position error. When LNAV or NAV is engaged after takeoff, these errors will cause a deviation from the intended flight path and may violate minimum safe separation with other aircraft, airspace, terrain, or other hazards.*

### Non-GPS FMS

Since these aircraft do not have GPS, the flight crew must verify FMS position accuracy on the ND before takeoff. This check ensures acceptable IRU performance until the aircraft is airborne and the FMS begins radio navigation updating.

For RNAV SIDs, FMS accuracy is acceptable if the apex of the aircraft symbol falls within the lateral confines of the runway symbol on a 10 NM MAP range (Ref. Figures 1 and 2). A runway with a displaced threshold may appear with the aircraft symbol short or long of the runway position on the map. If the FMS and runway positions are not coincident or are obviously in error, verify proper runway is entered on the FMS ROUTE page, accomplish an IRS align downmode (quick-alignment) or request a conventional (non-RNAV) SID from ATC as appropriate.

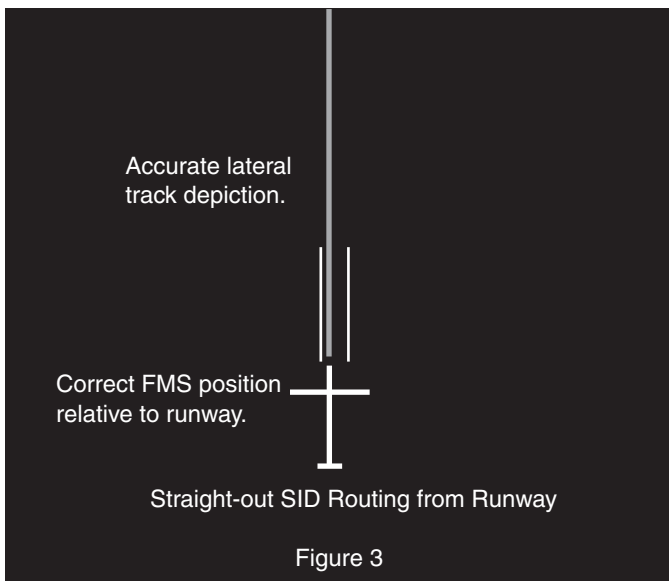
Coordinate with ATC for a quick-alignment to prevent traffic delays. If a quick-alignment is not feasible, request a non-RNAV SID or radar vectors from ATC.



Check the ND lateral track against the departure clearance (Ref. Figure 3). If the SID begins from the runway, ensure the LNAV or NAV track is displayed correctly. This check is especially important if the FMS departure runway or SID / transition route is modified.

### NOTE

Verifying the lateral track depiction is especially important when conducting simultaneous operations off parallel runways (e.g., DFW or ATL).



### Changing the Departure Runway, SID, or Transition

If the departure runway changes, make the route modification on the DEP/ARR page. Always verify the correct runway on the ND before takeoff. After changing the FMS runway, re-select the SID and transition from the DEP/ARR page.

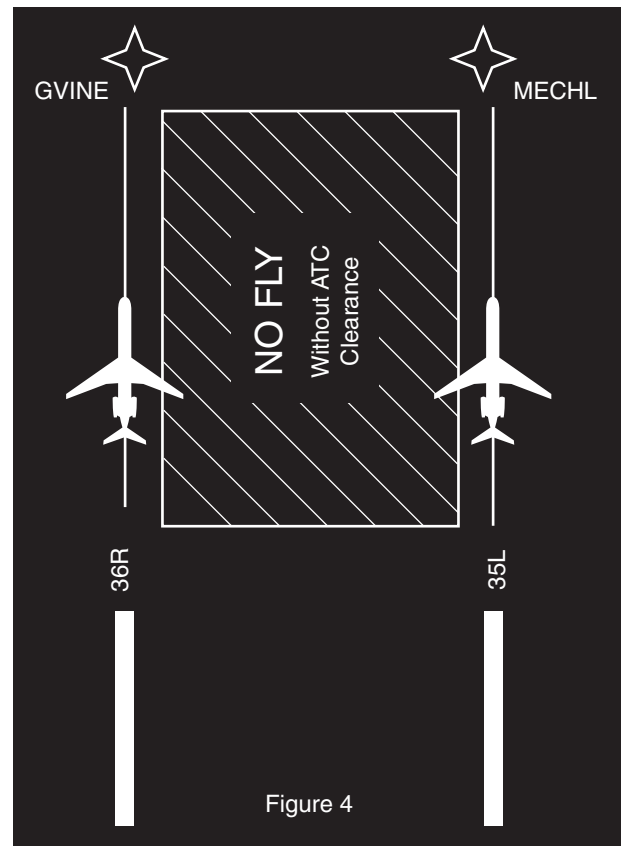
#### **NOTE**

For RNAV SIDs, if a runway change is received after FMC routing is entered, change the FMC runway and then re-select the SID to ensure the RNAV routing begins from the new runway and the correct transition is selected. A route and/or waypoint sequencing (legs) verification check should be accomplished for the revised portion of the routing.

If the SID and/or transition change, select the appropriate SID or transition from the DEP/ARR page. Do not modify the LEGS page for a revised SID or transition clearance. Changes to the SID to comply with ATC clearances (e.g., "cleared direct to...") are acceptable on the LEGS page.

### Parallel Departures

Parallel departures must not encroach on the airspace between extended parallel runway centerlines without an ATC clearance to do so (Ref. Figure 4). For example, if departing eastbound from DFW runway 36R, ATC may clear the flight direct to a waypoint northeast of the airport. In this situation, it's acceptable to fly towards the Runway 35 complex (Ref. Figure 5).



#### **CAUTION**

*Every parallel RNAV SID is designed with course divergence after takeoff. A flight director or autopilot commanded turn into the airspace between the runways without a specific ATC clearance to do so is an error that the flight crew must counter immediately. If necessary, disconnect the autopilot and/or turn off the flight director, immediately turn away from the parallel runway and return to the correct track. Flight crews have been violated for allowing their aircraft to deviate towards the other parallel runway complex.*

Both DFW and ATL had ATC violations caused by flights having the wrong runway in the FMS. These violations require ATC to intervene and vector aircraft away from parallel traffic. The seriousness of these deviations caused the FAA to mandate radar vectors off the runway in ATL which defeats many of the economic benefits of RNAV SIDs. As mentioned earlier, DFW is in jeopardy of having radar vectors implemented as well if flight path deviations don't stop.

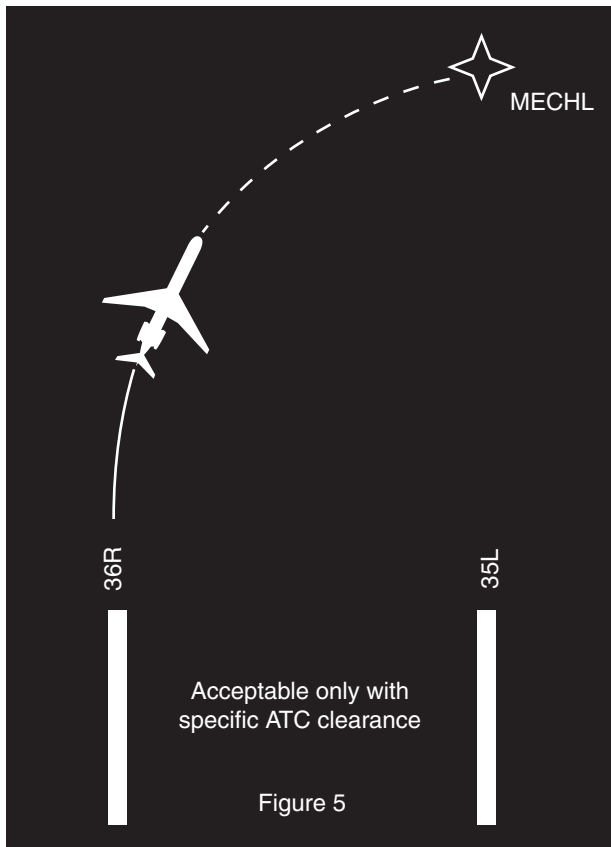
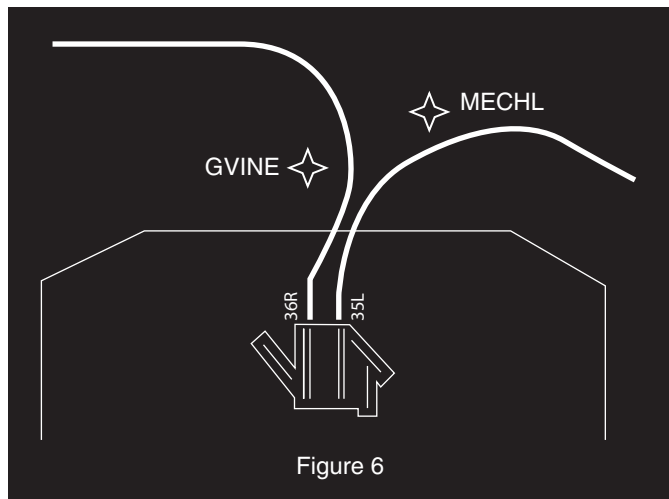


Figure 6 depicts the actual ground track of a flight departing DFW 36R (left track) with Runway 35L incorrectly loaded in the FMS. It clearly illustrates the separation problem created with a parallel departure off 35L (right track)



## Flying the Departure

### Roll Guidance

The standard takeoff profile selects the correct roll mode at 400 feet AGL. For an RNAV SID, the roll mode is NAV.

### CAUTION

*LNAV or NAV must be engaged no later than 500 feet AGL to minimize deviations from the desired RNAV track. Failure to do so may result in loss of separation with other traffic.*

### NOTE

If the departure procedure or route does not start at the end of the runway, it may be necessary to use a heading select mode to intercept the desired RNAV track.

After takeoff, monitor the aircraft symbol vs. the LNAV or NAV track. The track depicted on the map is drawn based on the speed the FMS is using to calculate the turn. If the depicted track is based on 200 knots and the flight crew elects to accelerate to 250, then the aircraft may deviate off track in the turn even with LNAV or NAV and / or the autopilot engaged. With strong overshooting winds, these deviations can become even more excessive. On RNAV SIDs with a significant turn (greater than 45°) shortly after takeoff, consider limiting airspeed and delaying flap retraction as appropriate until the turn is complete.

**NOTE**

Since flight director turn guidance is dependent on many factors such as aircraft ground speed, change in course angle, etc., increasing or decreasing bank angle relative to the flight director guidance may be required to remain on track.

Crews are expected to *fly as close to the lateral track as possible* by precisely following the flight director or engaging the autopilot. On an RNAV SID, ATC expects the aircraft to remain within approximately 0.5 NM of the depicted track.

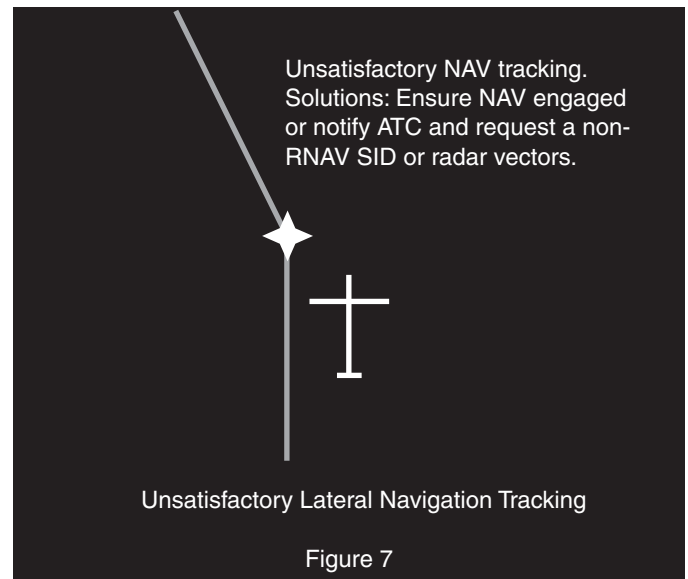
**CAUTION**

*Every parallel RNAV SID is designed with course divergence after takeoff. A flight director or autopilot commanded turn into the airspace between the runways without a specific ATC clearance to do so is an error that the flight crew must counter immediately. If necessary, disconnect the autopilot and/or turn off the flight director, immediately turn away from the parallel runway and return to the correct track.*

On a 10-mile map with a triangle FMS position symbol, the base of the aircraft symbol is approximately 1 NM wide. Keeping the magenta track within the lateral confines of the base of the aircraft symbol ensures the lateral deviation is less than approximately 0.5 NM. Lateral track deviation is also presented on the FMS page PROG 2/2, but crews are discouraged from going heads-down to monitor this information. The simplest way to ensure accurate lateral track deviation is to observe the PFD NAV course deviation scale and ND map (10 mile scale is preferred) and keep the aircraft symbol over the magenta track. (Ref. Fig. 7)

**NOTE**

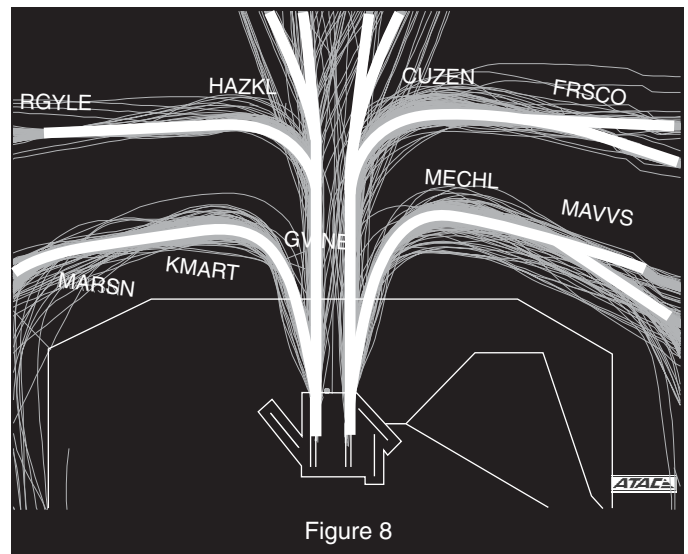
This must not be misinterpreted to mean that deviations of 0.5 NM are acceptable - they are not. With runways separated by 1 NM, 0.5 NM errors are unacceptable and FAA action is likely.

**CAUTION**

*If unable to comply with the SID profile, either laterally or vertically, immediately notify ATC.*

DFW RNAV SID Flight Track Analysis

Figure 8 shows a sample of DFW RNAV SID ground tracks. This level of dispersion is simply unacceptable for a precision procedure which is what an RNAV SID is intended to be. For scale, 0.25 NM left / right containment areas (0.5 NM wide path) are depicted as white bands along the desired flight path. Ensuring LNAV or NAV is engaged at 400 feet



and the flight director followed precisely, or the autopilot be engage is critical to ensure the precision of these departure tracks.

This precision is critical in places where RNAV procedures are utilized to ensure terrain separation. Terrain, other aircraft or restricted airspace are all hazards that RNAV is intended to avoid. This avoidance requires the pilots to fly the procedure as perfectly as possible.

## Summary

The safety and efficiency benefits to airlines from flying RNAV procedures are significant. Potential savings from DFW RNAV SIDs alone are measured in millions, not counting the safety benefits of knowing the departure track and reduced radio communications.

Three points are critical to successful RNAV SID operations:

1. After loading the SID, crosscheck the navigation display (ND) map and LEGS page against the Jeppesen chart. Do not modify the procedure.
2. Before takeoff, ensure the ND runway symbol / ID and lateral track agrees with the departure clearance.
3. After takeoff, engage LNAV or NAV and fly the departure track as accurately as possible.

RNAV promises to provide all airlines significant benefits from more efficient and environmentally friendly SIDs. Proper execution of procedures and techniques which minimize deviations from the desired profiles are key to ensuring the timely proliferation of these RNAV benefits throughout the US and abroad.

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