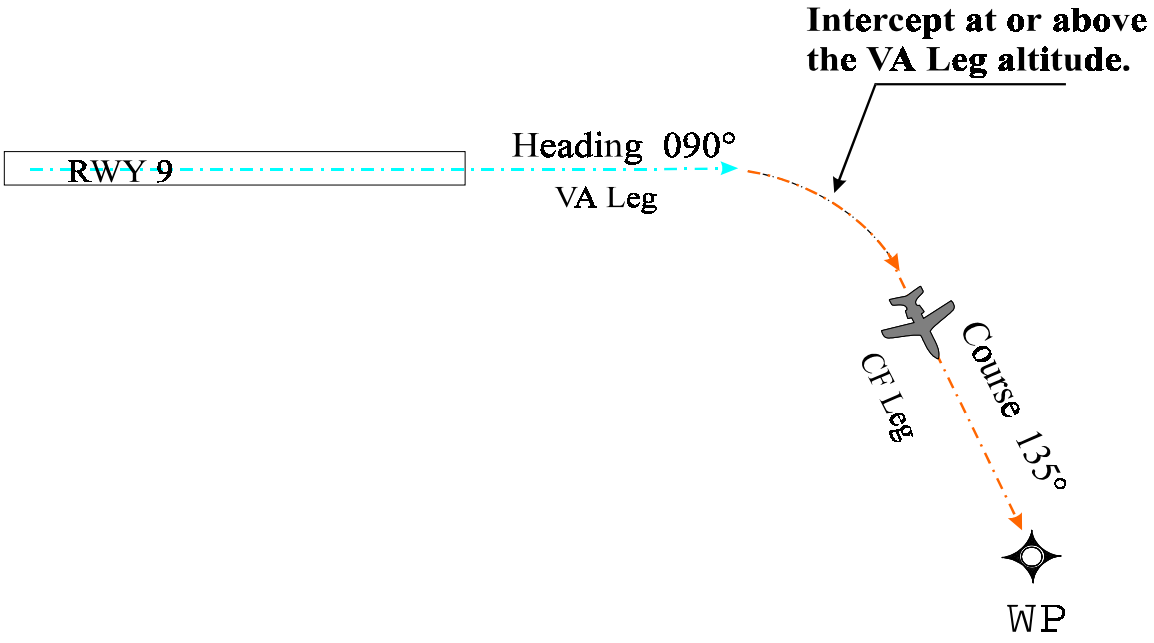
Attachment
TIL01-024
July 24, 2001

a. Definition:

Heading To An Altitude (VA). A leg segment allowing the aircraft to climb to an altitude on a specified heading (see figure 1).

Course To Fix (CF). A leg segment that provides the aircraft with a specified course to a fix (see figure 1).

Figure 1. VA Leg - CF Leg



b. General Criteria:

(1) The VA leg to CF leg construction begins at the departure end of the runway (DER) and proceeds on a specified heading to intercept a course to the CF leg waypoint.

(2) Apply the magnetic variation of the departure airport to determine the CF leg magnetic course.

(3) Apply a climb gradient of 200 feet per NM to determine the minimum required distance from DER on a VA heading to a CF course interception. If a shorter distance is required, publish a climb gradient to the specified altitude as appropriate.

(4) The MAXIMUM VA leg length is 10 NM.

(5) The specified VA leg heading must intercept the CF leg course.

(6) Align the VA leg to the runway centerline extended.

(7) The MAXIMUM VA/CF course interception angle is 120 degrees.

c. Minimum Leg Length

(1) **If the CF leg terminates at a fly-over fix,** calculate the minimum CF leg length based on the DTA value required for the turn at the VA/CF leg intersection. Use DTA radius values in table 3 of Order 8260.44A.

(2) **If the CF leg terminates at a fly-by fix,** calculate the minimum CF leg length based on the DTA value required for the turn at the CF leg termination fix added to the DTA value required for the turn at the VA/CF leg intersection.

CASE 1 - CF LEG TERMINATES AT FLY - OVER FIX

$$d = R1 \times \tan\left(\frac{a}{2}\right)$$

where R1 = radius for turn at VA/CF intersection from Table 3
d = Minimum Leg Length
a = angle of turn at the VA/CF intersection

Example : Speed : 250 KIAS, Altitude : < 10000 therefore R1 = 4.2 NM, a = 60°

$$d = 4.2 \times \tan\left(\frac{60}{2}\right) = 2.42 \text{ NM} = 2.5 \text{ NM}$$

CASE 2 - CF LEG TERMINATES AT A FLY - BY FIX

$$d = R1 \times \tan\left(\frac{a}{2}\right) + R2 \times \tan\left(\frac{b}{2}\right)$$

where R1 = radius for turn at VA/CF intersection from Table 3
R2 = radius for turn at CF Leg termination fix
a = angle of turn at VA/CF intersection
b = angle of turn at CF leg termination fix

Example : Speed at VA/CF intersection : 250 KIAS, Speed at CF leg termination fix : 310 KIAS
Altitude at VA/CF intersection < 10000, at CF leg termination fix > 10000
R1 = 4.2 NM, R2 = 7.7 NM, a = 60°, b = 75°

$$d = 4.2 \times \tan\left(\frac{60}{2}\right) + 7.7 \times \tan\left(\frac{75}{2}\right) = 8.33 = 8.4 \text{ NM}$$

d. VA-CF Obstacle Clearance Area:

Use the following method for the construction of obstacle clearance areas of a VA to CF leg (see Figure 3).

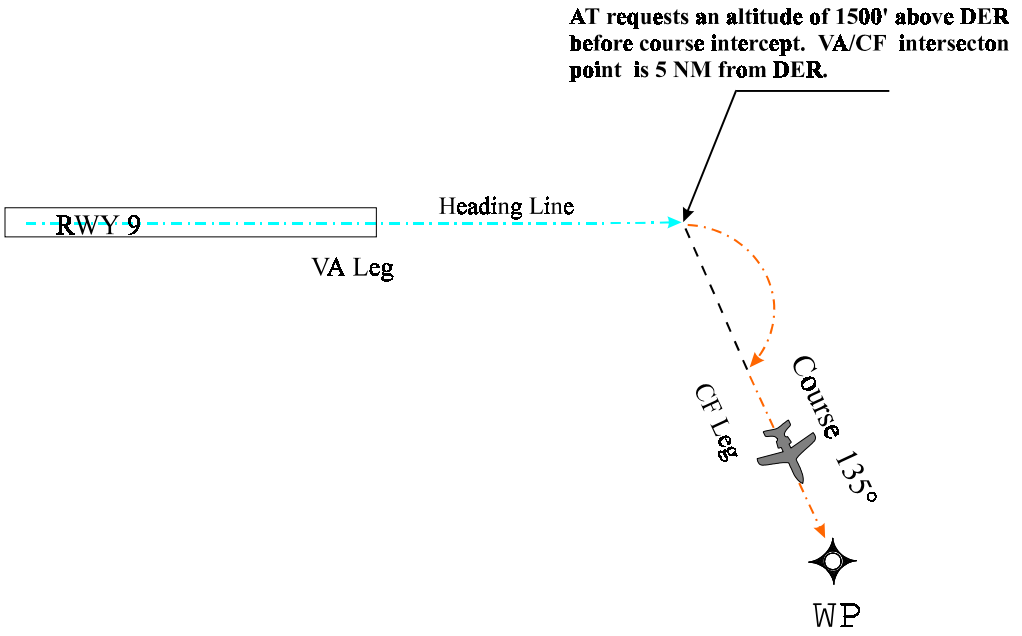
Step 1. Draw the VA course line (VA heading).

Step 2. Establish the CF leg termination waypoint and draw the reciprocal of the specified CF course until it intersects the VA course in step 1.

Step 3. Determine the turn altitude. If the CF course must cross the VA course line prior to the length required for a 200 ft per NM climb to that altitude, calculate the required climb gradient.

Example:
AT requests a "climb to" altitude of 1500 ft above DER. The required VA/CF leg intersection point is 5 NM from DER. A climb gradient of 300 ft per NM will be required in the departure instructions (see figure 2).

Figure 2. VA Leg - CF Leg



Step 4. Splay the VA primary obstacle clearance area boundary lines 15 degrees relative to the VA heading line from points 500 feet each side of the runway centerline at the DER. Extend these lines until they intersect a line drawn perpendicular to the VA course line at the VA leg-CF leg intersection point (line A-D in figure 3). At the VA-CF intersection point, also draw a line perpendicular to the CF leg course.

Step 5. Rotate line (A-D) constructed in Step 4 around the intersection point to form line (C-C'). Continue the 15-degree splay relative to the CF leg course until the CF leg termination waypoint or until full expansion is reached whichever occurs

first. Full expansion is ±3 NM for Level 1 criteria and ±6 NM for level 2. (see figure 3).

Step 6. **Outside Turn Expansion**

Swing an arc (A-B) with radius (R) of 2.9 NM centered on the line (A-D) (or an extension if required) starting from point A and extending to the CF leg splay line. Draw a line tangent to this arc and 30-degrees to the CF course to point B'. The arc and tangent line form the outside boundary of the expanded turn area. From point B' draw a line (B'-P) perpendicular to the CF course extending to the opposite side of the primary area of the turn (see figure 3).

Step 7. **Inside Turn Expansion**

Determine the DTA from Order 8260.44A using 2.9 NM (or less as allowed in table 3 of the order) to calculate DTA. Locate a point on the 15-degree splay line (point O) on the inside of the turn at a distance equal to the DTA measured back from line (A-D). From point O splay the primary area by an angle equal to half of the course change at the VA-CF intersection point. Extend the splay line until it intersects the primary area boundary of the CF leg at point O' (see figure 3).

Step 8. **CF Leg Secondary Area**

If the 15-degree splay has reached full expansion (see figure 4), secondary areas are applied at line (P-B') (Level 1 secondary areas are 1 NM and Level 2 secondary areas are 2 NM). If the 15-degree splay has not reached full expansion, start a 7.5-degree splay for the primary area and continue a 15-degree splay for the secondary area relative to the CF course from points P and B' until full width dimensions of the primary and secondary areas are complete. Full width dimensions are stated in paragraph 9.12, of Order 8260.44A (see figure 3).

Step 9. **Splay Incomplete at CF Termination Waypoint.**

If full splay expansion is not complete by the CF leg termination waypoint apply the following:
Draw a line perpendicular to the inbound course. Rotate this line, with the same primary and secondary dimensions, around the waypoint to a position perpendicular to the outbound course, similar to step 5. Continue splaying the primary and secondary areas 7.5 and 15 degrees respectively to the full widths stated in step 8. Use the construction methods of Order 8260.44A for inside expansion areas in paragraph 12.2.2 for fly-by waypoints and for outside expansion areas in paragraph 12.3 for fly-over waypoints.

Figure 3. VA to CF Leg Construction

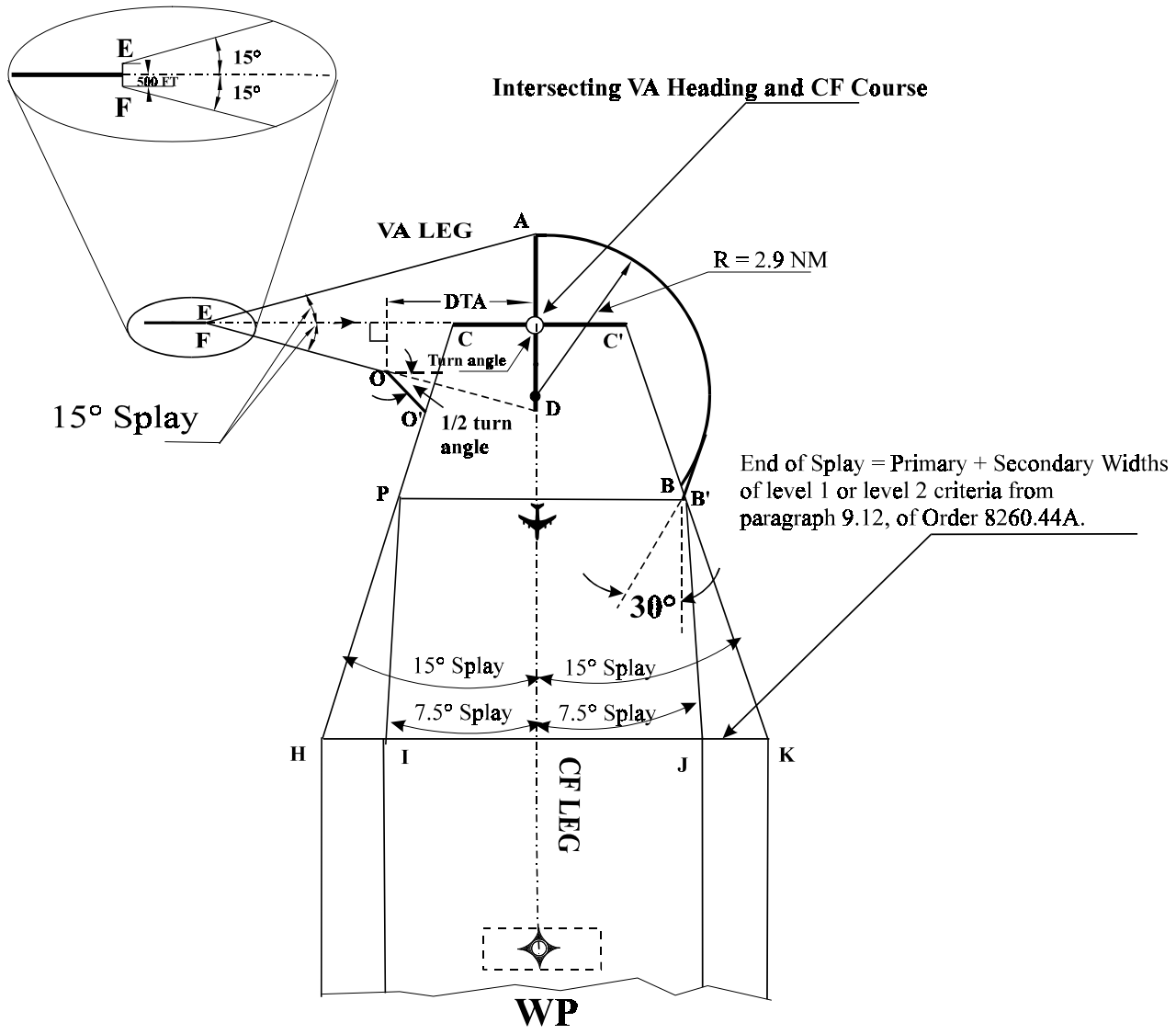
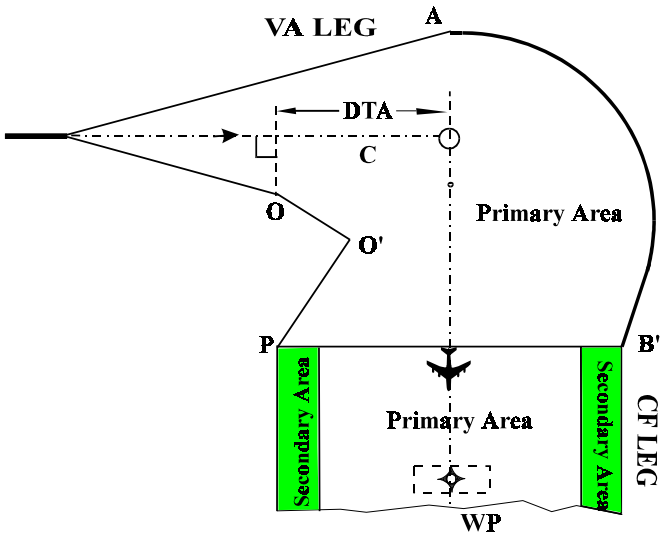


Figure 4. VA to CF Leg Construction (splay complete at P-B′ line)



e. Climb Instructions:

Chart the following climbing instructions for procedures with and without climb gradients required on the VA leg. VA leg "climb to" altitudes are optimally expressed in 100′ increments. Where rounding to the next higher 100′ increment results in a 60-foot or greater increase in the climb gradient, rounding to the next higher 20-foot increment may be used.

Case 1. With climb gradient.

CLIMB RUNWAY HEADING TO 1740, THEN CLIMB TO 5000 VIA THE 130 COURSE TO (WAYPOINT NAME).

NOTE: Climb to 1740 at 300 ft/NM or greater.

Case 2. Without climb gradient.

CLIMB RUNWAY HEADING TO 1600, THEN CLIMB TO 5000 VIA THE 130 COURSE TO (WAYPOINT NAME).