# JEPP'S BRIEFING

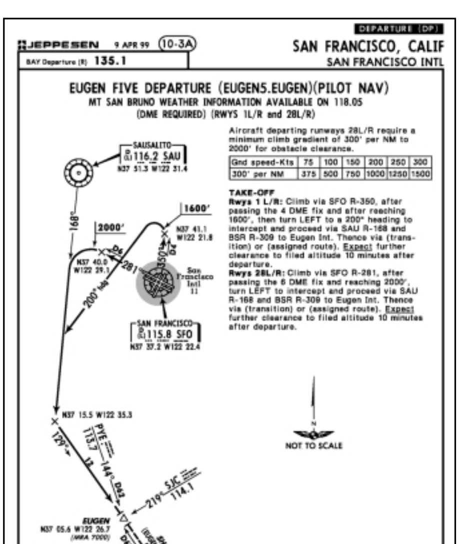

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen


# The Chart Clinic – Database Series

"Snowbird 527, cleared to Houston as filed, Eugen Five Departure, Salinas Transition, maintain 6,000 feet." Assuming the active runways for departures are runways 1 left and right, the published departure for both runways proceeds on a series of headings, courses, and tracks that connect you to your planned enroute airways. As a pilot, when you fly the Eugen departure procedure with your FMS or your GPS, things happen. And sometimes they happen at different times than you expect. Then you ask, "Why?"

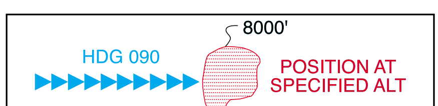
The departure says the first thing to do is to climb out on the SFO 350˚ radial. The radial is to be flown until passing the 4 DME fix and after reaching 1,600 feet. Then turn left to fly a heading of 200˚ to intercept and fly the SAU 168˚ radial and the BSR 309˚ to Eugen intersection. All of this happens in only a few minutes, but to make this all happen automatically, a number of codes need to be loaded into the database that represent the paths to be flown and the way they are terminated.

Each of the path/terminators is determined by the database supplier since they are not specified by the governments who design the basic procedure. ATC typically designs departures based on where they want the airplanes to go, and they leave the details of how to comply with the pilot when flying manually and up to the database coder when flying with an automated navigation system.




## The First Path/Terminator Leg after Takeoff

If you were to fly the Eugen Five departure procedure without automation, you would maintain runway heading up to some predetermined altitude before turning left to capture the SFO 350˚ radial. And – what would that altitude be? Should it be at 35 feet above the runway? At 50 feet? Or can your turn start when you are comfortable to make the turn? The altitude for making the turn is specified in the *Aeronautical Information Manual* and states, "Obstacle clearance for all departures, including diverse, is based on the pilot crossing the end of the runway at least 35 feet AGL, climbing to 400 feet above the departure end of runway elevation before turning, and at least 200 feet per nautical mile unless a higher climb gradient is specified in the DP, or unless required to level off by a crossing restriction."



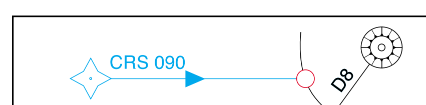

**VA Leg – Heading to an Altitude**

Because of the AIM statement and other statements similar to this in FAR Parts 23 and 25, *virtually all the first legs after takeoff include are coded as a VA leg*. Since the first letter (V in VA) indicates the path and the second letter indicates how the path is terminated, this means the path is a heading (V implies vector, or heading) and is terminated when reaching an altitude (the A in VA). The first leg on the Eugen Five departure from runway 1 left and right is a VA leg and it includes a heading of 012˚ to an altitude of 411 feet (400 feet above the airport elevation of 11 feet). As the leg is implemented in the avionics system, it reads the compass system, and provides the autopilot or flight director with a steering command that will null out any deviation from the desired heading. If installed, the system will also be monitoring its barometric altitude input, then sequence legs when the terminating altitude of 411 feet has been reached. (Note: The altimeters in most single-engine aircraft are simple pneumatic altimeters, which do not have external digital output capabilities.) As soon as the altitude is reached, the computer will then sequence to the next leg which will capture and track the 350˚ radial from the SFO VOR.

In the illustration of the VA leg, the path shows as a series of arrows followed by a "blob" which implies the end of the heading leg could be in many different locations depending on the wind and the climb rate of the airplane.

## Fix to a DME Termination

The next portion of the takeoff procedure says to "Climb via SFO R-350, after passing the 4 DME fix and after reaching 1,600 feet, . . . " Since this leg is to end at a DME fix (actually the 4 DME arc since a heading will rarely reach a given fix), the leg terminates at a DME reading and the second letter of the path/terminator is the letter "D" (for DME). The 350˚ radial actually begins back at the VOR so the leg begins back at the VOR. *Thise leg type is termed an FD leg*. This leg has two conditions – both the 4 DME and 1,600 feet so both conditions are loaded into the computer. Since both conditions must be met, the airplane won't turn with an electronic coupled departure until both conditions are satisfied. If the airplane reaches 1,600 feet *after passing* the 4 DME, the airplane will turn after reaching 1,600 feet. If the airplane reaches 1,600 feet *before passing* the 4 DME fix, it will wait until passing the 4 DME fix.

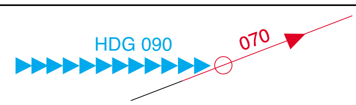



**FD Leg – Fix to a DME Termination**

Look closely at the wording for the termination of the leg. It says "after passing 4 DME . . . " This means that the *4 DME fix is a fly-over fix* and not a fly-by fix. The database rules in the avionics system state that all legs that end as a DME fix will be fly-over fixes. This ensures that the airplane will not turn before 4 DME is reached.

## Heading to an Intercept

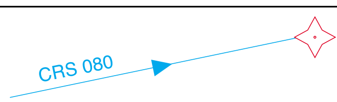
After passing the 4 DME fix, the departure runway takeoff continues by turning left to a heading of 200˚ to intercept and proceed via the SAU 168˚ radial. To make the computer fly a heading of 200˚, the first letter of the path terminator is "V" for vector. (Actually, the letter "H" makes more sense but it was already taken for holding patterns). The termination end of the heading leg occurs when the radial is intercepted. The path terminator for this type of leg is VI – heading to an intercept. In the database coding, the heading of 200˚ is included with the record. Also, since the heading has such a large turn, there is a command of L (left) included to ensure the airplane doesn't turn right after passing the 4 DME fix.




**VI Leg – Heading to Intercept Next Leg**

## Course to a Fix

Once the airplane has intercepted the 168˚ radial from Sausalito (SAU), it captures and flies the radial until the turning point indicated by the letter "X" on the Departure Procedure chart. Since all systems that use airborne databases need identifiers on fixes that establish turning points, an identifier is created for the turning point. The turning point is 36 nautical miles from SAU, so the identifier SAU36 is created and loaded into the database.




**CF Leg – Course to a Fix**

## Track to a Fix

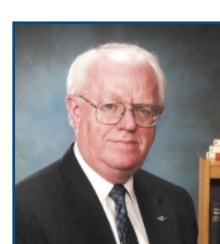
From the SAU36 fix to Eugen, which is the end of the takeoff procedure, a TF leg (track to a fix) is used. The turning point is considered a fly-by fix so you can expect the aircraft to begin the turn slightly before SAU36 so it can easily capture and fly the 129˚ course to Eugen.

### *BIG LIMITATION*

By looking at all the coding it takes to make this procedure work, you can see that it takes some very sophisticated equipment to make all the legs work. The autopilot needs input from the heading indicator, from the altimeter, from the VOR radials, and from the database. Even though some of the avionics systems have the ability to interface with some of the other aircraft systems, not all avionics have implemented all the path/terminators. When flying the Eugen Five Departure with some avionics systems, it is quite likely that the first sequence your system would show is a straight line from the airport to the Eugen intersection. This makes it necessary for you to manually fly all the legs and end each one as stated in the takeoff procedure.



In the next article, we will look at many of the differences that you will see between the information on your charts and what you see on your avionics display – and why.



*James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.*
*For comments, please Email: JimTerps@jeppesen.com*