Don't 'Dive and Drive"

Putting **precision** in the non-precision **approach**

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There is something strangely prehistoric about the way many of us continue to fly what we grew up calling a "non-precision" instrument approach. After flying across continents and oceans with navigational precision measured in decimals, we push the nose over a thousand feet per minute "or so" and wait for the minimum descent altitude (MDA). That altitude is measured with an altimeter accurate to plus or minus 75 ft., plus whatever temperature tolerances may exist, and based on an altimeter setting that may be an hour or more old. This status quo method has been killing people since the dawn of instrument flight. There has to be a better way; fortunately, there is.

You can fly a smooth, continuous descent from the final approach fix down to 50 ft. above the landing threshold. You don't need any fancy avionics to do this, if you have the technology to fly an NDB approach you can fly a Continuous Descent Final Approach (CDFA). Of course, as with most things in aviation, having a high-tech cockpit will make it easier.

The Old — 'Dive and Drive'

We all breathe a sigh of relief when we first spot the "rabbit" after a well-flown ILS or LPV approach. But we should all feel a sense of worry when spotting the lights after flying along a minimum descent altitude. How far away is the runway? When do we start down? Are there any unlit obstacles between here and there? There are more than a few problems with how we've always done it in the past:

(1) Leaving the final approach fix with a 1,000 fpm rate of descent means we have to remember to start the level-off before the MDA. Even with an autopilot we have to make sure it is programmed correctly, can handle the level-off precisely, and doesn't get "mode confusion" along the way. In 1995, the crew of American Airlines Flight 1572 may have succumbed to these problems at East Granby, Connecticut. The airplane was substantially damaged, but nobody was seriously hurt.

(2) Even if we succeed at leveling off at the MDA, we need to make sure we don't start down after spotting the runway until it is safe to do so. At night, in poor visibility, we are terrible judges of distance. DME helps, to be sure, but after spotting the runway the temptation to nose it over is too much for some. In 2004, the crew of Corporate Airlines Flight 5966 spotted Kirksville Regional Airport in Missouri a few miles early in marginal weather. They hit the ground a few miles early too, killing most on board.

(3) Fog and low-level clouds are far from uniform. Just because you've spotted the runway from the MDA doesn't mean you will keep sight of it. The aircraft's vector should not be pointed down until that vector is assured to end up on the runway. In 2001, the crew of Crossair Flight 3597 spotted the runway at Berlin-Tegel Airport in Germany and started down from the MDA. They didn't have the runway in sight for long and impacted well short, killing most of the crew and passengers.

(4) When flying along the MDA you don't technically have to go around until the missed approach point, which typically sits at the approach end of the runway. Spotting the runway this late in the approach is too late to land the airplane. In 1994, the crew of Korean Air Flight 2033 tried to do just this at Cheju Airport in Seoul. They were unable to get the airplane stopped on the runway. While the airplane was destroyed in the overrun, everyone survived.

(5) Pilots are mission-oriented and if they don't get in on the first try there is a strong urge to try it again, "just a little lower." Reaching a decision altitude along a glidepath is fairly cut and

dried; driving along an MDA leaves time to explore the regions of "a little lower." In 1988, a B-1B pilot couldn't resist that urge on his second attempt to land at minimums. The supersonic bomber was destroyed; ejection seats spared the crew.

Any instrument pilot with several hundred approaches to minimums will tell you that when you are at minimums, you should never point the airplane earthward unless there is a runway directly ahead. Any "precision" approach with vertical guidance meets this criterion. A "non-precision" approach flown under "dive and drive" techniques does not.

The New — CDFA Mandatory in a Country Near You

It has become clear to most aviation authorities that it makes better sense to approach the runway with some type of vertical guidance, even if the instrument approach doesn't have a glideslope of some sort. Better sense, yes. But mandatory?

The FAA's Advisory Circular 120-108 recommends it for all approaches with a published vertical descent angle or glideslope. International Civil Aviation Organization (ICAO) Document 8168, Volume 1, Amendment 3 says operators should use the CDFA technique whenever possible. The European Union, in Commission Regulation No. 859/2008, OPS 1.430, says a CDFA shall be flown unless the country approves otherwise.

So it depends. You have to check the country's aeronautical information publication or other state pages to be sure. If you fly to France or Switzerland, to name just two, a CDFA is mandatory.

Is the Approach CDFA Eligible?

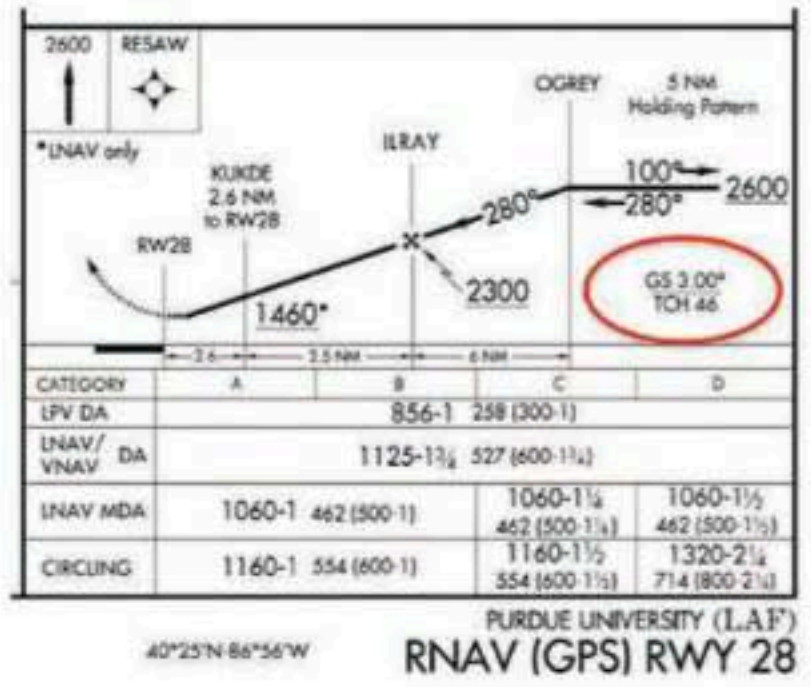
While a CDFA makes sense and in some cases is mandatory, you can't use the technique on all approaches. In the U.S., the approach has to have a published glideslope (GS) or vertical descent angle (VDA) from the final approach fix (FAF) or in some cases a step-down fix, to the threshold crossing height (TCH). You need to study your chart provider's legend. Here are the FAA and Jeppesen methods.

An FAA chart will spell out "GS" as well as the angle right on the profile view of an approach that includes an ILS or RNAV (GPS) glideslope.

A Jeppesen chart will show glideslope "feathers" along the glidepath.

If a non-RNAV or RNAV approach without a glideslope has a validated vertical descent angle, it will be shown with an angle symbol on the profile view of an FAA chart.

On a Jeppesen chart it will be depicted by a dotted gray line below the DA/MDA.



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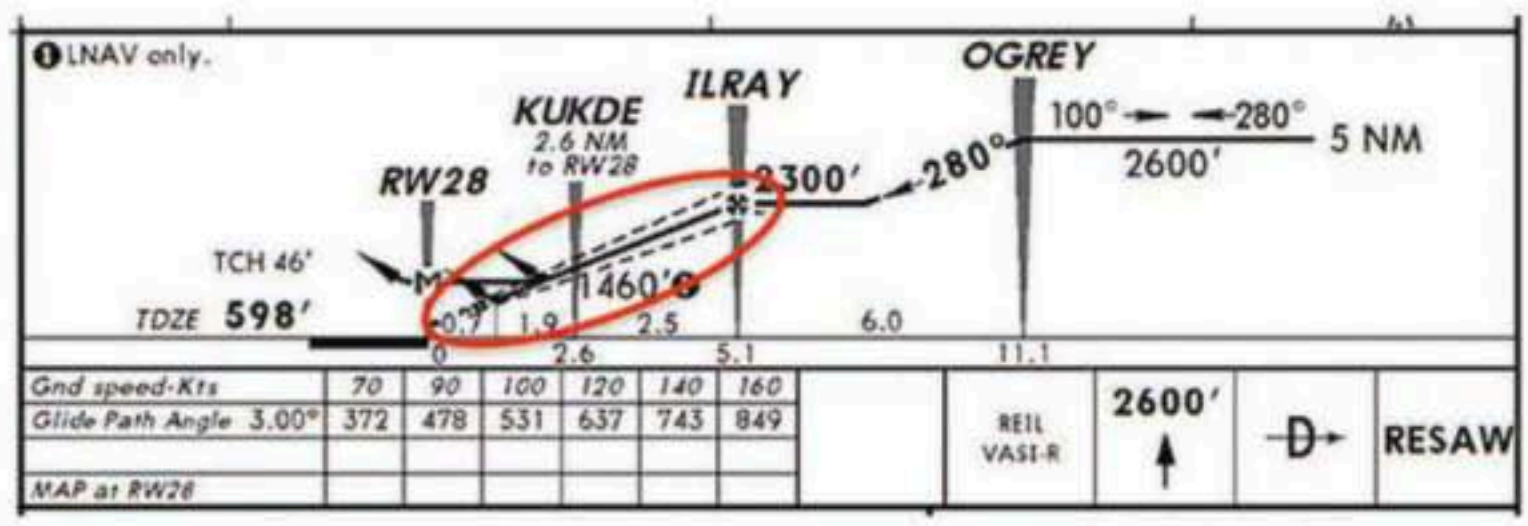
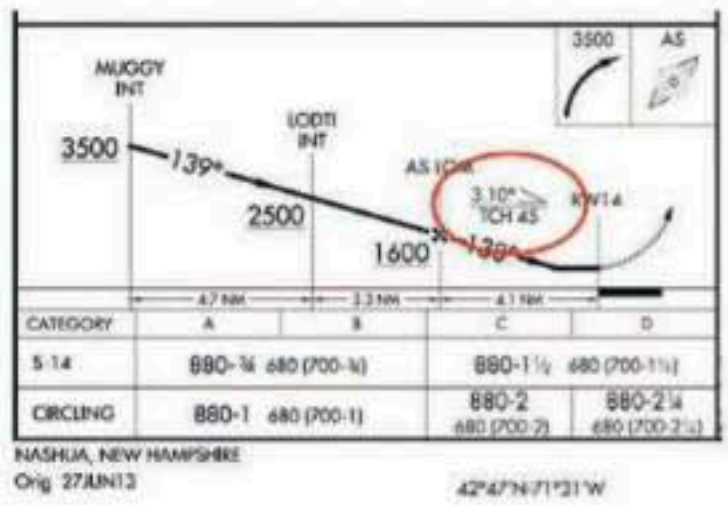
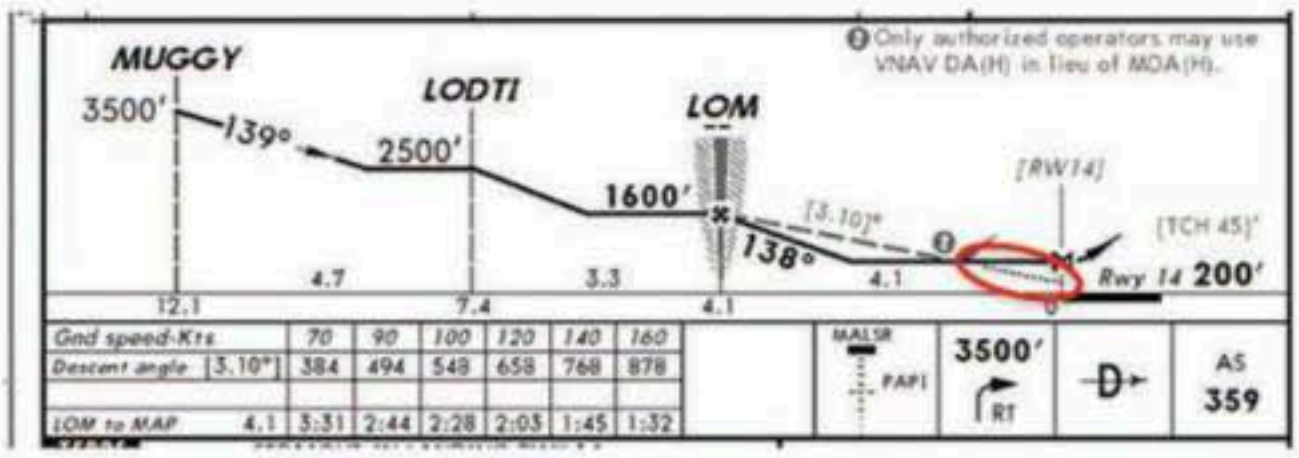
RNAV (GPS) RWY 28

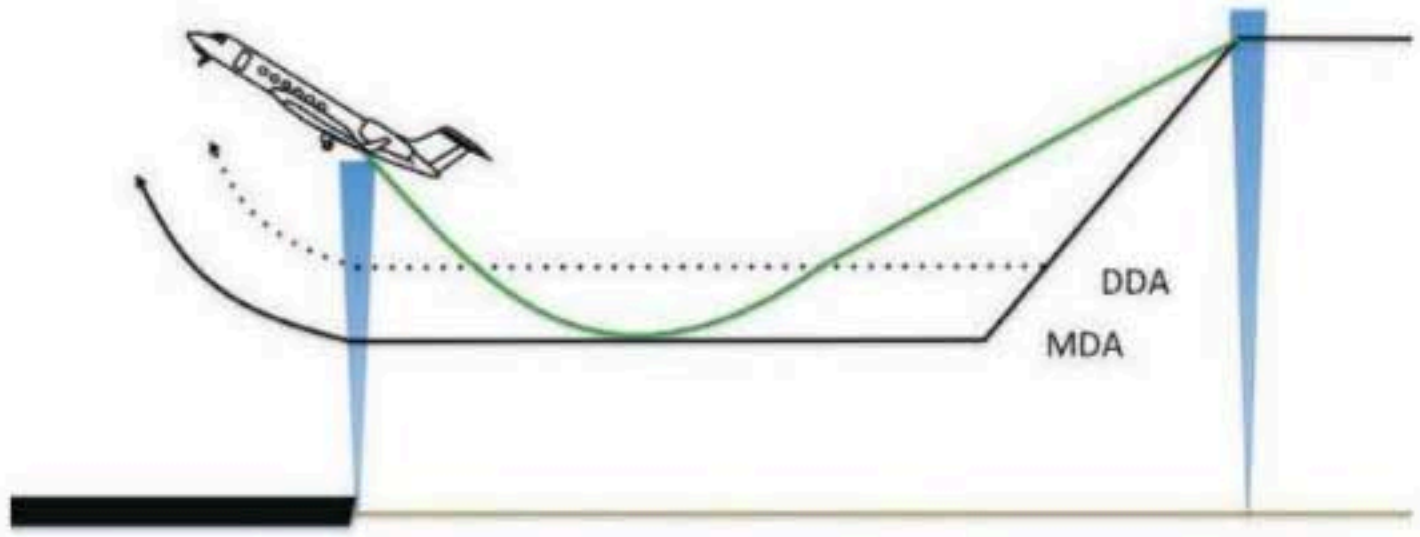




NASHUA, NEW HAMPSHIRE
Orig 27JUN13
42°47'N-71°21'W



What Is Your DDA?



In most cases the MDA is the lowest you can go without seeing the runway. If you are aiming the airplane to the touchdown zone, you will need an altitude increment to give you and your autopilot the necessary space to go around. This increment is added to the MDA to determine a Derived Decision Altitude (DDA).

Some countries specify a height increment, but most leave it to the operator. Your aircraft manuals may specify the increment or give you a maximum certified height loss. In the Gulfstream G450, for example, the Airplane Flight Manual specifies: "Maximum demonstrated altitude loss for coupled go-around is 60 ft." So in this case: DDA = MDA + 60.

Flying a CDFA — Basic Procedures

The objective of a CDFA is to leave the final approach fix fully configured, on speed, and ready to land. You should not have to destabilize the aircraft by making thrust, airspeed or trim adjustments when spotting the runway. GV and G550 pilots often withhold the last increment of flaps as a courtesy to faster moving aircraft, but if flying a CDFA in instrument conditions, it may be wiser to configure earlier.

Low-Tech Procedures

Even if you don't have an autopilot or flight director, you can fly a CDFA. FAA-H-8083-15B, Instrument Flying Handbook, includes a descent table that converts the angle of descent into the feet/nm to lose and a descent rate for given ground speeds. (An abbreviated extract is shown below.)

If, for example, your ground speed once fully configured is 120 kt. flying a vertical descent angle of 3.0 deg., your VVI should be 637 fpm.

You can check your progress along the way by subtracting the feet/nm every mile. If the FAF is at 2,000 ft., after 1 mi. you should be 2,000 – 318 = 1,682 ft. It would be a good idea to work out target altitudes when briefing the approach and write them on the approach plate.

A U.S. Example

Flying the VOR DME Runway 7 into Lebanon, New Hampshire, is not a good place to drone along at the MDA, where you will be within several hundred feet of very rugged terrain. The approach has a published VDA of 3.40 deg., making it a perfect candidate for a CDFA.

▶ **Low Tech** – If your aircraft does not have a VNAV system, you can use the descent table below to convert the 3.40-deg. angle of descent to 361 ft. per nautical mile. You should fully configure by RIZZO and check your ground speed.

If you don't have a ground speed readout, you can add or subtract reported runway winds to your approach speed. Your initial VVI will be 722 fpm. You should write mile marker checkpoints on the approach plate, as shown, each based on losing 361 ft. per mile. If you have a 60-ft. height increment, you make your decision to land or go around at 1,600 ft., as if you were on an ILS.

▶ **VNAV** – If you have a VNAV system you can program it to fly the approach just as if the approach were to an LNAV/VNAV using RNAV with one possible exception. If you do not have OpSpec/MSpec/LOA C073, you need to add your height increment to the MDA to get your DDA. If you do have C073, you are

Rate of Descent Table, FAA-H-8083-15B, Figure 1-19

Vertical Path Angle	Angle of Descent	Feet/NM	Ground Speed (knots)										
			30	45	60	75	90	105	120	135	150	165	180
	2.0	210	105	160	210	265	320	370	425	475	530	585	635
	2.5	265	130	200	265	330	395	465	530	595	665	730	795
	2.7	287	143	215	287	358	430	501	573	645	716	788	860
	2.8	297	149	223	297	371	446	520	594	669	743	817	891
	2.9	308	154	231	308	385	462	539	616	693	769	846	923
	3.0	318	159	239	318	398	478	557	637	716	796	876	955
	3.1	329	165	247	329	411	494	576	658	740	823	905	987
	3.2	340	170	255	340	425	510	594	679	764	849	934	1019
	3.3	350	175	263	350	438	526	613	701	788	876	963	1051
	3.4	361	180	271	361	451	541	632	722	812	902	993	1083
	3.5	370	185	280	370	465	555	650	740	835	925	1020	1110
	4.0	425	210	315	425	530	635	740	845	955	1060	1165	1270

an "authorized operator" noted in the profile view ball note. You can use the published MDA as a DA and do not need to add the height increment.

Making Sense of Individual Country CDFA Rules

Many countries have adopted CDFAs as mandatory but the application of the technique is not consistent. In France, for example, a CDFA is listed under the minimums but the minimums are listed as "DA/MDA" and already include the height increment — you don't need to add to it.

Switzerland, on the other hand, does not list CDFA in the approach plate but does show a "DA" under minimums. Since they do not mention the height increment, it would be prudent to add it.

Flying a CDFA is the safer way to fly almost all "non-precision" approaches. In some countries it is a mandatory procedure; in others it is highly recommended. You need to research each country you visit to figure out any specific requirements. After one of its DC-9s ran into some trees short of a runway in 1996, American Airlines felt compelled to remind its crews, "Despite its name, a non-precision approach must be flown with exacting precision."

Yes, you need to do that. But you can further stack the odds in your favor by making sure your airplane is never pointed short of the runway after you leave the final approach fix. **B&CA**

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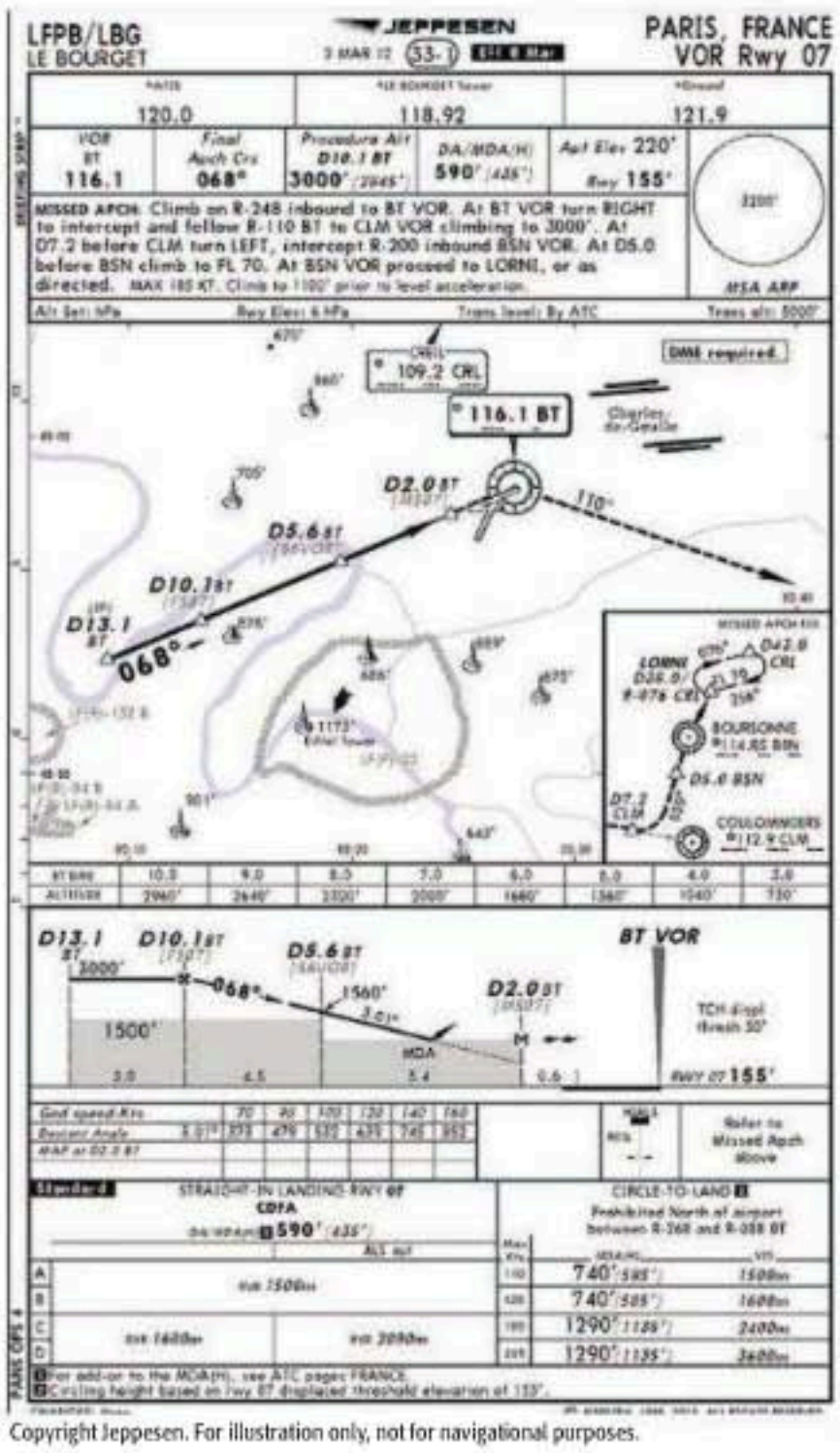

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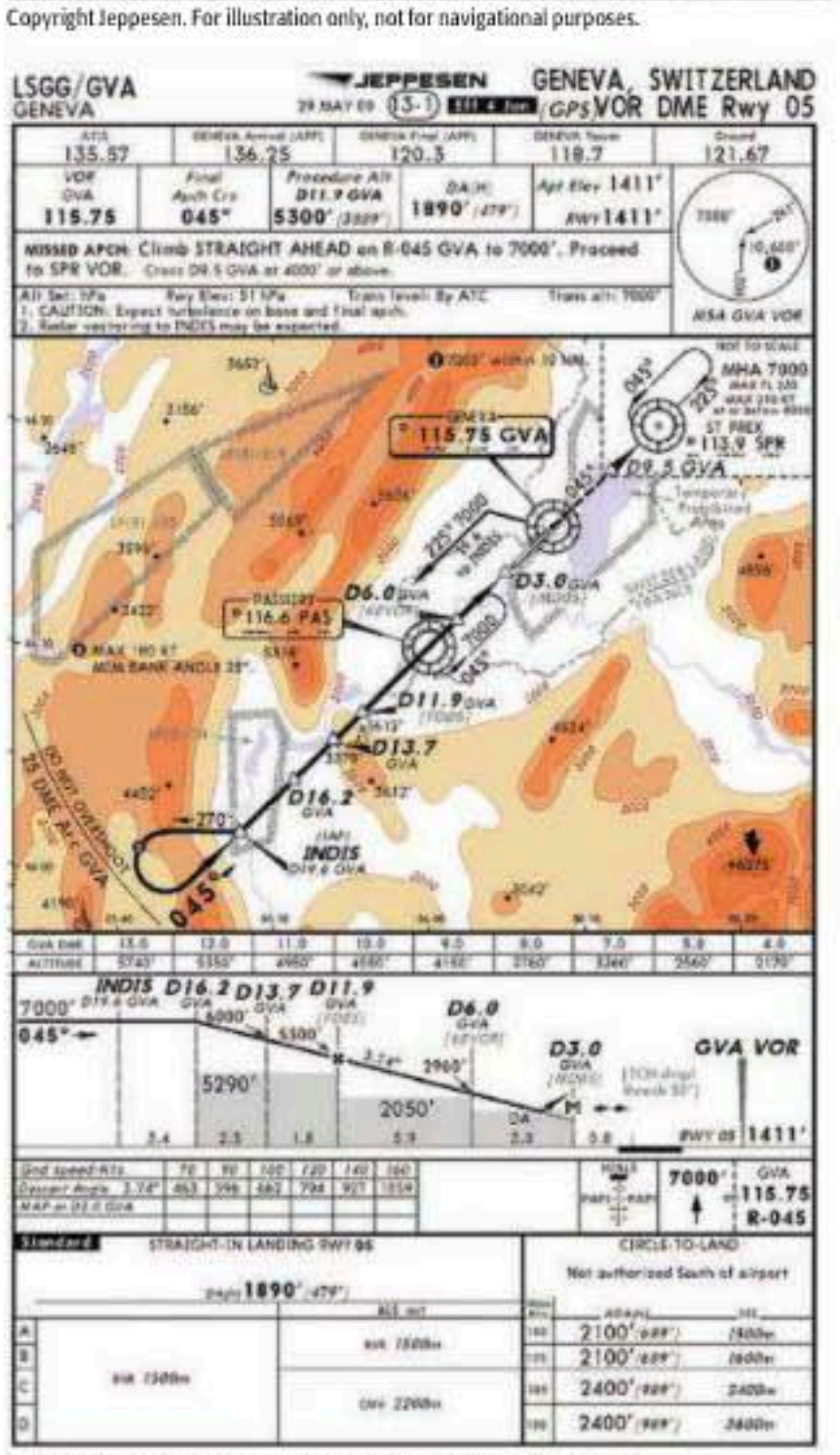

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