Teaching No-Gyro and Radar Approaches

by Donna F. Wilt, Master CFI, Ph.D.

Have you executed an ASR or PAR approach? How about a no-gyro approach? Do you fly in an area where there is an ASR approach available within a reasonable distance of your home airport? If you are lucky, the answer to these questions are 'yes', but for many instructors, the answer is 'no' to all of them.

How can instructors teach radar approaches if we have never done one? Information for pilots is sketchy on how ATC handles this type of approach yet, as instructors, we need to be as realistic as possible in playing the role of the controller. The goal of this article is to give CFIIs a tool to help pilots learn and practice no-gyro and radar approaches so our students know what to expect when they do one for real.

Approach Surveillance Radar (ASR) facilities are in operation within a short distance of almost anywhere in the US. However, only a few of these facilities also provide approved radar approach capability and few of us are lucky enough to train in an area with an approved ASR approach. Even if an airport with an approved radar approach is reasonably close, ATC may not provide practice ASR approaches due to their staffing and workload.

Airports with approved ASR or PAR approaches are given in the Instrument Procedures. For example, in Florida, approved radar approaches are available at the following civilian airports: Jacksonville International, Gainesville, Fernandina, Daytona International, New Smyrna, Deland, Ormond, Tallahassee, Fort Myers, Key West, and Panama City. In Virginia, there are no radar approaches at civilian airports.

There are three guidance methods discussed in this paper: no-gyro vectors, ASR approaches, and no-gyro approaches. For no-gyro vectors, ATC provides navigational guidance by instructing the pilot to "turn left/right" and then "stop turn" so that the pilot maintains a constant heading or a constant rate of turn based on commands from ATC. For a 'normal' ASR approach, ATC provides navigational guidance by giving the pilot specific headings to fly. No-gyro approaches are a combination of an ASR approach and no-gyro vectors.

There are different situations where it makes sense to execute no-gyro vectors or a no-gyro approach. One situation is when the primary heading instrument fails. Even with backup instruments in the aircraft, there may be only a magnetic compass for heading information. Other situations, such as electrical failure at night, the viewing angle of the backup instruments, high workload combined with equipment failures, or lack of proficiency using the back-up instruments may be reasons to execute no-gyro vectors or a no-gyro approach. No-gyro vectors can augment or substitute for timed turns and magnetic compass turns.

While the Instrument Practical Test Standard (PTS) does not require an ASR or no-gyro approach, that is not a good reason to skip teaching them. The PTS does have a requirement to execute a non-precision approach with "loss of primary flight instrument indicators". Why not go farther, and teach

a no-gyro approach? During an emergency, doing something for the first time is not recommended and could have disastrous results. Successfully handling the emergency depends, in part, on successful communications between the pilot and controller and this comes from accurately practicing the procedure. This includes radar approaches.

Background

Air Traffic Control (ATC) uses the term "no-gyro" to refer to the loss of the primary heading instruments regardless of whether or not the aircraft actually uses gyroscopes to stabilize the primary heading indicator. The phrase "loss of primary flight instrument indicators" can refer to either the mechanical attitude and heading indicator or the integrated information on a primary flight display.

If a pilot losses their primary flight indicators, any radar approach facility, terminal or enroute, can provide no-gyro vectors. But only terminal facilities have the precision needed to provide radar approaches. Terminal facilities can provide a radar approach only if there is an approved radar approach for a particular airport. Any terminal facility can provide no-gyro vectors to a pilot who needs assistance to set up for an electronic instrument approach. However, they do not have the manpower to provide practice no-gyro vectors to all the pilots practicing 'partial panel' and the PTS requirement for a non-precision approach with loss of primary flight indicators (Miller, 2009).

There are two types of radar approaches: the Airport Surveillance Radar (ASR) approach and the Precision Approach Radar (PAR) approach. With both radar approaches, a controller provides course guidance and altitude information to the pilot via voice communications. The approaches differ in their accuracy and in the altitude information. The only aircraft equipment required for either approach is an operational communications transceiver. A transponder is not required (Soucy, 2009).

For an ASR approach, the controller issues headings to fly to the pilot in order to intercept and then maintain alignment with the extended centerline of the landing runway. The ASR system provides precise location information, but not precise altitude. In general, the ASR system depends on the Mode C transponder reply for aircraft altitude. The controller can monitor the Mode C altitude, but the Mode C altitude is not part of the approach and the altitude information is advisory only.

On the other hand, the Precision Approach Radar (PAR) is specifically designed as a landing aid that provides aircraft range, azimuth, and elevation information to the controller when the aircraft is on final approach. Similar to the signal transmitted by an instrument landing system (ILS), the PAR system is limited to the extended centerline of the approach runway. Since the radar information used for a PAR approach is considerably more precise than that used for an ASR approach, the accuracy of the approach is greater and lower minimums apply. This article will not cover PAR approaches because they are so rare.

Situations Where No-Gyro or ASR Approach are Warranted

Table 1 gives four different situations for when radar approach or no-gyro vectors may be warranted. Scenarios where these situations might occur are:

- 'Normal' vectors to intercept a published approach, with the aircraft flight display working properly
    - This is the typical, normal condition

- No-gyro vectors to intercept a published approach, "without flight indications". Navigation equipment and its display are still functioning. Possible scenarios:
  - Attitude, Heading & Reference System (AHRS), or vacuum pump has failed
  - Backup display is mounted in a location that is difficult to view
  - Backup display fails
  - Only the Magnetic compass for heading information and high workload
- 'Normal' vectors to, and execution of, an ASR approach when published electronic approach is *not* available and aircraft flight display is working. Possible scenario:
  - Ground equipment or GPS for published electronic approach is not available;
  - Failure of aircraft navigation equipment but flight display is working properly.
  - Don't have appropriate approach charts on board

- No-gyro vectors to, and execution of, a no-gyro approach when published electronic approach is not available *and* aircraft flight display is "without flight indications". Possible scenarios:
  - PFD and MFD have failed.
  - Complete electrical failure

Table 1. Summary of the Different Situations for No-Gyro and ASR Approaches.

Aircraft Systems	Type of approach	Where	'normal' Radar vectors	No-Gyro vectors
All aircraft systems normal	Published approach	Any ASR facility	☑	
"without primary flight indications" Course guidance still available	Published approach	Any ASR facility		☑
No course guidance available Flight Indications normal	ASR Radar approach	Only airport with published ASR approach	☑	
No course guidance available and "without primary flight indications"	ASR Radar approach	Only airport with published ASR approach		☑

Simulated Approach Procedure

The accompanying figure is an advanced organizer. An advanced organizer is a teaching aid that helps organize the material to enhance learning and retention. This figure shows how to simulate a radar or no-gyro approach by giving what to say and when to say it. It is based on the same document used by controllers, FAA document JO 7110.65T, which gives the procedure for a radar approach.

The advanced organizer has three parts:

- Set-Up: What to say to set up and maneuver the student to the final approach course
- Approach Progress: What to say and when to say it regarding the progress of the approach
- Course Correction: What to say regarding lateral deviations on the approach course

The Set Up portion includes providing lost communication procedures and current weather. The ATC communications are shown in the same order as they appear in JO 7110.65T. By using vectoring, have the pilot maneuver the plane to intercept the extended runway centerline on an approximately 30 degree intercept at least 2 nm from the simulated final approach fix. This part ends with the simulated hand-off to the final controller who will say "do not acknowledge further transmissions."

As the final approach progresses, give updates on the distance from the missed approach point. If the pilot requests it, for each mile on the approach, give altitude updates on the recommended altitude the plane should be at on the approach.

On the final approach, what to say regarding heading depends on how far the plane is off course and whether the flight path is converging or diverging with the final approach course. The Advanced Organizer shows what ATC will say for on-course, slightly and well off-course, and for different rates of divergence.

The advanced organizer is designed for simulating a no-gyro approach, but can easily be modified for an ASR approach. For the ASR approach, simply give headings to fly instead of start/stop turns. On final approach, headings should be to 1^{o} accuracy (e.g. Turn 2^{o} right, Turn right heading 273^{o}, Fly heading 273^{o}). Also, the advanced organizer only shows the nominal approach. See JO 7110.65T for what ATC will do if radar coverage is lost, if the aircraft gets too far off the approach, or it gets too high/low for a safe approach.

No-gyro and ASR approaches can be simulated by overlaying them on an existing approach in order to easily establish the final approach fix location, minimum altitudes, and final approach course. The simulated no-gyro approach or ASR approach is particularly suited for practice in a simulator or training device. In such a device, the CFII can accurately monitor the flight path on the instructor's station and simulate ATC without the distractions of an actual flight. In actual flight, CFII's are reminded they must maintain communications with the local ATC as required as well as play the roll of ATC to their student.

References

Miller, F. (2009). ATC staff specialist at Norfolk tower, Norfolk, VA. Telephone interview.

Soucy, C. (2009). FAA Oklahoma City. Telephone interview.

Bibliography

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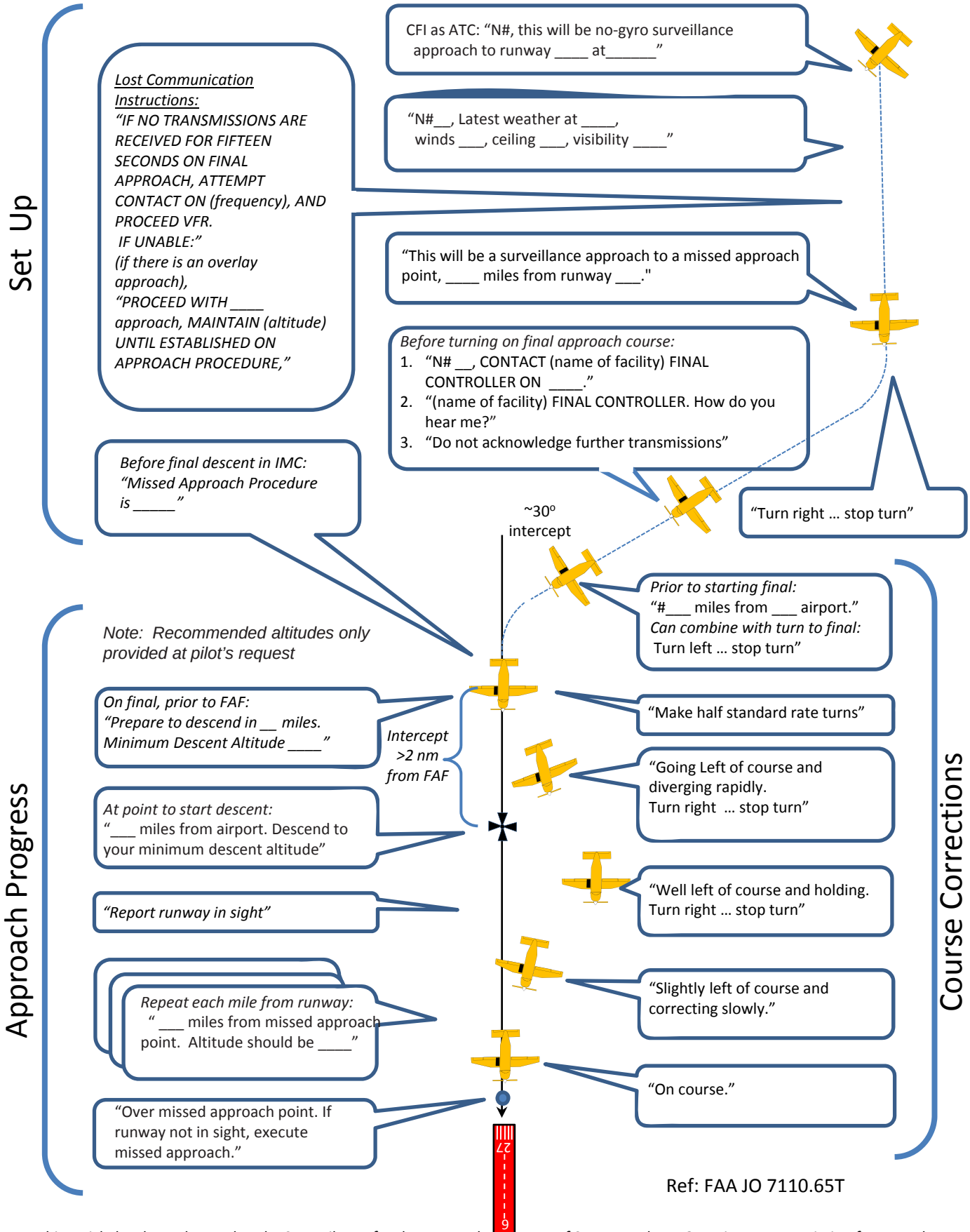
FAA, (2010). Aeronautical Information Manual. Online, http://www.faa.gov/air_traffic/publications/ATpubs/AIM/. Accessed August 17, 2010.

FAA, (2010). Order JO 7110.65T Air Traffic Control. Online http://www.faa.gov/documentLibrary/media/Order/ATC.pdf. Accessed August 17, 2010.

Simulating a No-Gyro Approach

General note: Provide information at a rate of about once/minute for set up, about every 15 seconds on final



Ref: FAA JO 7110.65T