

# Holding Pattern Entries



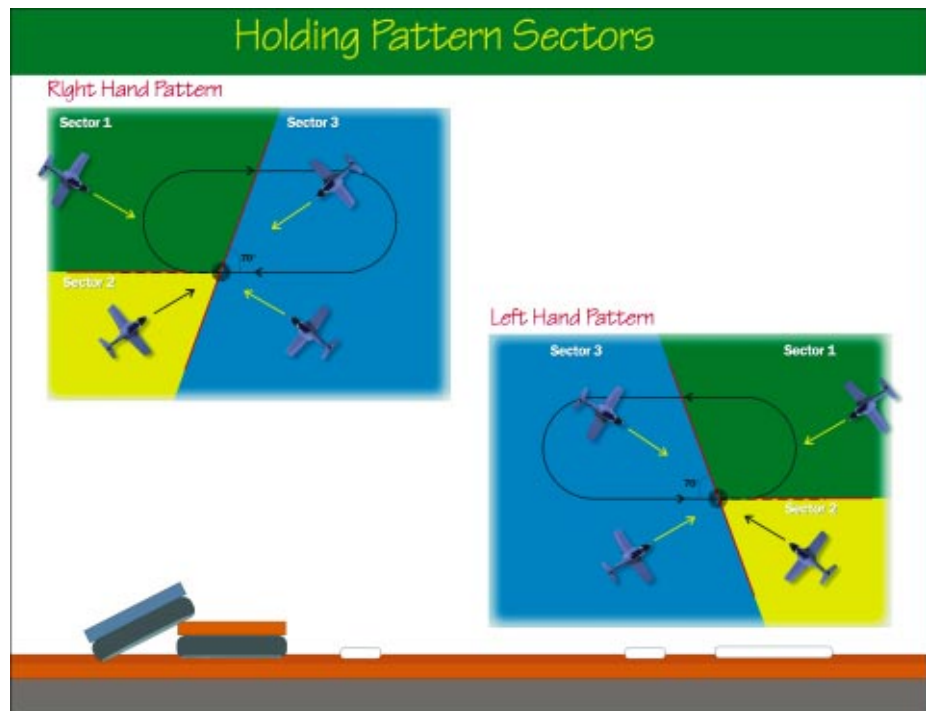
Skill Level: **Intermediate**

By Brent McColl

*It's great to be back again in 1998, with the promise of a wonderful year ahead in flight simulation. The challenge for the developers of these, dare I say it, 'games' is to conquer the domain of a serious training device. One where time spent on the Sim contributes to your aviation experience both practically and legally. Microsoft has made notable steps in this area with the endorsement of FS98 by Flight Safety. I look forward to the day when we can leap gently from our desktop to the cockpit. Then can we say that desktop flight simulation has come of age.*

A few articles ago we introduced the Holding Pattern (Vol 2, Issue 5), and earlier last year we had our first look at the Instrument Approach (Vol 2, Issue 4). The entry into both these procedures - the transition from en-route to the procedure itself - is what we cover in this lesson. The Sector Entry allows for an aircraft to manoeuvre safely, clear of obstacles, from the cruise phase to a position where entry into either the pattern or the approach can be commenced. It doubles as a lesson on IF orientation as you twist and turn the aircraft about the navigation aid to establish yourself in the procedure.

We begin with a bit of theory on the entry procedure sectors, then complete the lesson with some practical flying exercises. You may perform the flying exercises either in cloud (Create an overcast cloud layer from 1,000 feet to 10,000 feet) or in



The 3 Sectors based on the imaginary 70° line.

For example, if the inbound course on the right-hand pattern is 270° (as shown above, left) then you are in:

**Sector 1** if your heading is between 090° through 200°

**Sector 2** if your heading is between 020° through 090°

**Sector 3** if your heading is between 200° through 020°

Notice that it is your heading that is used to determine what sector not your inbound course.

the clear. You may find that flying the first few entries in the clear will help you visualise the procedure.

## The Three Sectors

The entry into a holding pattern (or into an instrument approach) is referred to as a sector entry. This comes from the fact that the procedure you follow depends on the direction you are approaching the beacon about which the holding pattern is based. Depending on which of the 3 sectors you are approaching from determines which manoeuvre is used to establish the Holding Pattern.

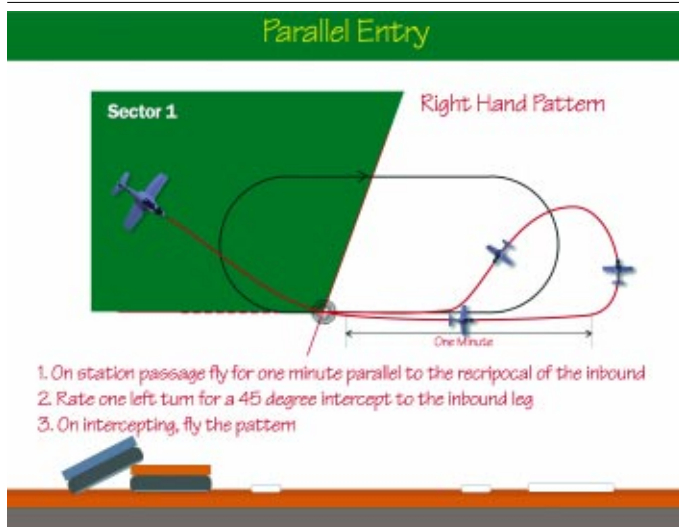
The sectors are based on an imaginary line canted at 70° to the inbound holding

course. This line, combined with the extended inbound course, divide the entry procedure into 3 Sectors as shown above.

The intention of the sectors is to ensure that the aircraft is manoeuvred within the protected area of the holding pattern. This area is effectively bounded within the racetrack pattern, but naturally contains a buffer area around the pattern within which you can be assured of obstacle clearance.

Sector 1 has the most manoeuvring, Sector 2 a moderate amount and Sector 3 has the least manoeuvring. This may help you remember which sector has which type of entry procedure. Let's look at each in turn.

## Parallel Entry



Don't forget, the flight path is straight to the beacon, then a perfect curve left onto 090°, then a perfect curve left onto about 225° then a perfect curve right to pick up the 270° inbound (forming a classic procedure turn shape)

## Sector 1 - Parallel Entry

The most complex of the procedures is Sector 1:

- On station passage the aircraft is turned to parallel the reciprocal of the inbound course for 1 minute. (For our 270° pattern this would equate to 090°);
- A procedure turn left to set up an intercept of the inbound course. (For our 270° inbound, this would be a turn onto, say 225° to set up a 45° intercept);
- On intercepting the inbound course, turn to follow the pattern.

## Sector 2 - Teardrop Entry

Not as complex as the Sector 1 Entry, this entry involves a simple teardrop pattern to reverse and pick up the inbound:

- On station passage the aircraft is turned to a course 30° less than the reciprocal of the inbound track for 1 minute. (For our 270° pattern this would equate to 060°);
- A gentle turn to pick up the inbound track completes the entry.

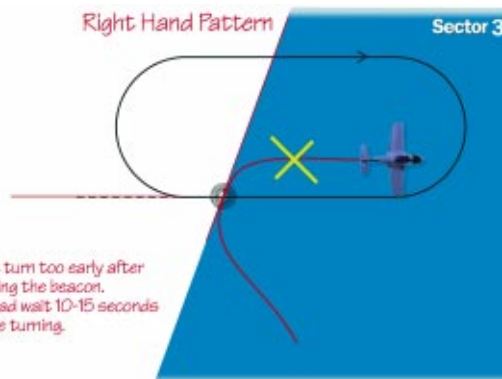
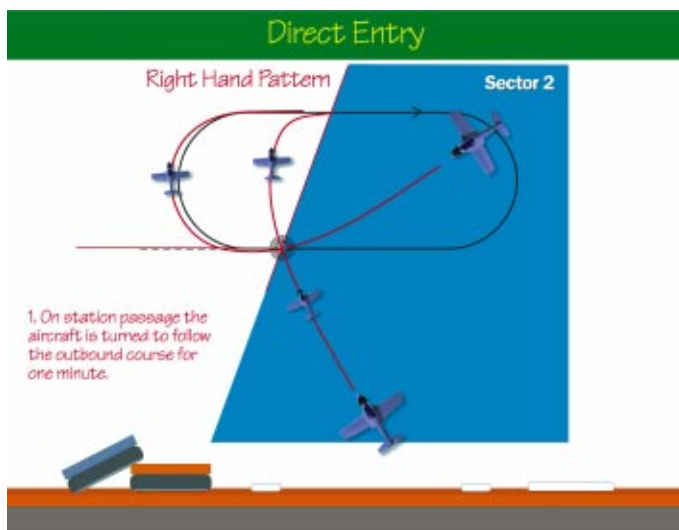
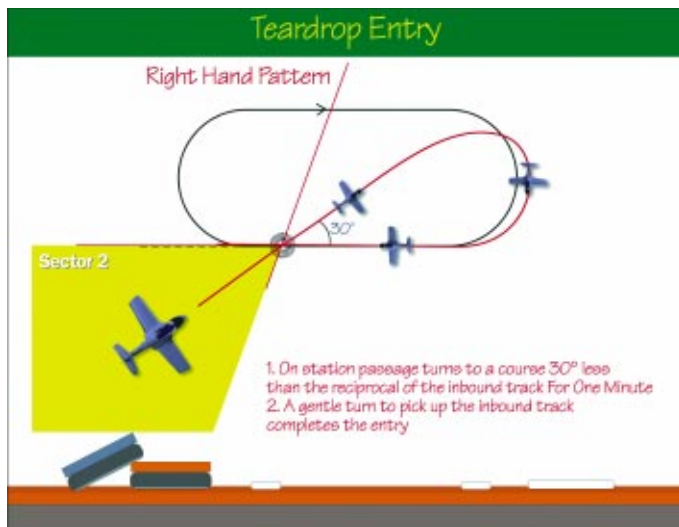
## Sector 3 - Direct Entry

The simplest of them all! Entry is performed by simply turning onto the outbound course as follows:

- On station passage the aircraft is turned to follow the outbound course for 1 minute. (For our 270° pattern this would equate to 090°).

Timing should start when you are abeam the beacon, or on establishing the outbound heading, whichever occurs last. So in the first Sector 3 example, the 090° heading would probably occur before you fly abeam the station, so begin the timing when abeam.

Notice in the second Sector 3 example that because you are cutting across the pattern during the entry that the heading is held for a time to assist you in picking up the outbound course accurately. If you turn immediately you pass overhead the beacon, then you will be caught with a tight turn to pick up the inbound as shown in this example.

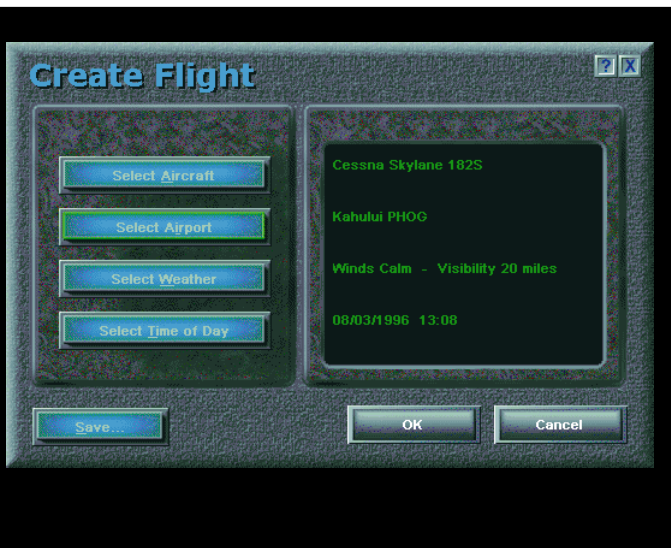


When crossing the pattern like so, it is best to hold the crossing heading to give some distance from then inbound course.

Turning immediately will mean you must turn very tightly to pick-up the inbound. 10 or 15 seconds is sufficient.

## Let's go Flying!

For training purposes we will concentrate our flying at the beautiful coastal airport of Kahului in Maui, Hawaii. Hey, who said training can't be fun? It is shown on page 26 of the Microsoft Flight Simulator 98 - Pilot's Guide. You will find Kahului has both a VOR (Maui on 114.3 MHz) and an NDB (Valley Island on 327 kHz), so its ideal for some intense Sector Entry practice. We will create some imaginary Holding Patterns for the purposes of our training.



Create a basic scenario for this lesson using the Create Flight option as shown here. I have deliberately kept clear skies for the initial practice. And we will use the autopilot heavily for the initial demonstrations.

Click the **Select Aircraft** and **Select Airport** buttons to set up the parameters. You can keep the defaults for Weather and Time if you like.

Next, from **Aircraft... | Navigation...** set the VOR frequency of 114.3 and the OBS to 270°. From the ADF tab set the frequency 327.

Finally, preset the Autopilot from **Aircraft... | Autopilot...** to maintain heading 060° and an altitude of 2000. We will initially track outbound on this heading, turn right and perform a **Sector 3 Direct Entry** into an imaginary Holding Pattern established at MAUI VOR, 270°, Right Turns, 1 Minute pattern.

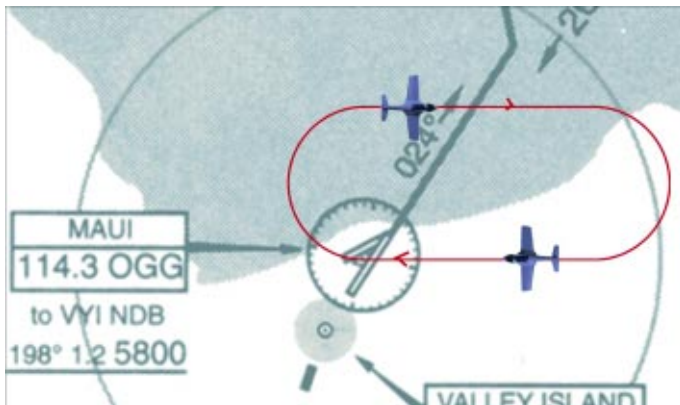
**Save the situation for re-use throughout this lesson.**

Because we will be holding over the water, I have set the minimum altitude to 2,000 feet.

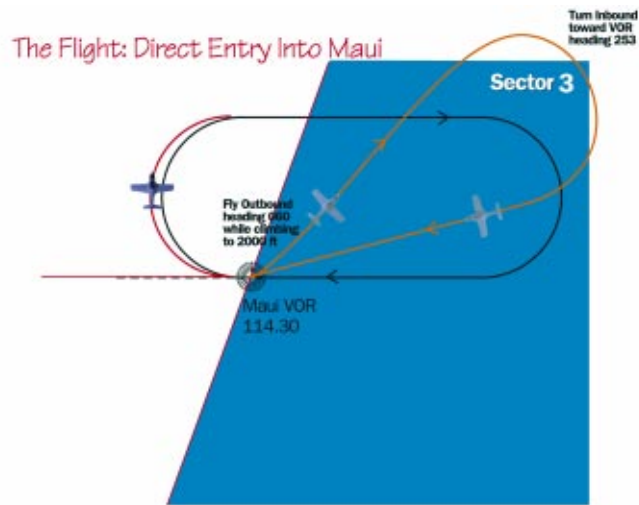
**WARNING:** This setting of approach and holding minimums is the domain of the Approach Designer, and has been done here for training purposes only. You must never design your own Holding Minimums where it would result in you holding below a published minimum.

**Performing a Sector 3 - Direct Entry**

Depart from runway 2 at Kahului and allow the autopilot to turn the aircraft to 060° as you climb to 2,000 feet. When established at 2,000 feet, trimmed at cruise speed, turn right and track



Our 'Training Pattern' established at MAUI VOR.



From Take-off to the start of the Sector 3 entry.

direct to the VOR. This will mean a turn onto about 253°. You can initiate the turn with the heading bug by clicking to the right of the Orange knob on the Heading Indicator.

As the autopilot turns the aircraft, dial up 250° on the OBS for Nav 1. This should be pretty close to your inbound course as you approach the aid for the sector 3 entry.



Heading 255° (red) tracking inbound 253° (blue) with 3.4 miles to run (green).

Visualise your inbound course to the beacon, as if the beacon was in the middle of the HI. The 70° line is from 200° to 020°, so we are definitely in sector 3.

On station passage, you simply turn right onto the outbound 090° course. Remember to dial 270° on the OBS once established outbound.

Now, you can put a little finesse in this Entry by compensating for the slight displacement you will introduce by crossing the beacon at an angle. The result will be that you will roll out on the outbound a little too close to the inbound course. You can compensate by holding the perpendicular heading (090° - 90° = 0°) for about 5-10 seconds. This will have you better positioned on the outbound. This entry is relatively well aligned, imagine if you entered inbound from about 030°.

In a moment, perform the entry and at least one pattern. Remember to begin your timing as you roll out, or you pass abeam,



We are definitely in Sector 3. This can be determined by noting the imaginary line at  $70^\circ$  to the inbound. This line would be  $(270^\circ \text{ inbound} - 70^\circ) 200^\circ$  through  $020^\circ$ .



Once established at 2,000 feet, turn left onto  $055^\circ$ . You will find the OBI needle is more or less centred when you roll out. Make small adjustments to either your heading to re-intercept, or the OBS to centre the needle.



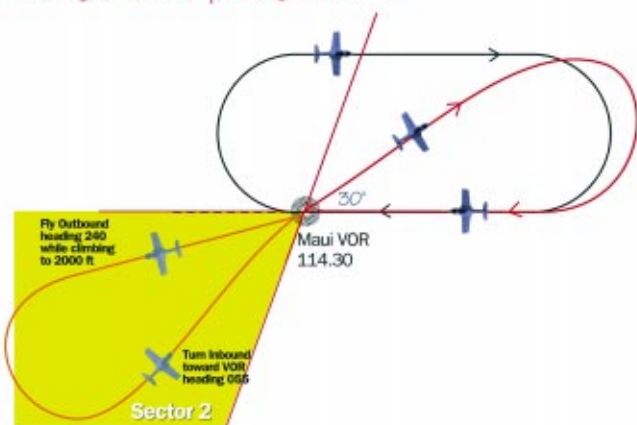
Established outbound in the teardrop. Time will be up at 08:17:20 (3 seconds from now). I then turn onto  $270^\circ$  and set  $270^\circ$  on the OBS during the turn.

whichever is later. Do you remember how to determine the abeam position? (Check Volume 2, Issue 5, Page 52 under 'Step 4').

**Try It Now!**

**Performing a Sector 2 - Teardrop Entry**

*The Flight: Teardrop Entry Into Maui*



We can ensure that a Sector 2 Entry is required by departing off runway 2 and turning left to fly around to the southwest of the beacon. Setting a heading of  $240^\circ$  on the autopilot should do the trick. This is shown above.

Reset the situation using the `{;}` key. Set the autopilot to  $240^\circ$  and keep the altitude setting at 2,000 feet. You could set the OBS to  $055^\circ$  which should be pretty close to the inbound course you will fly as you approach the beacon from the southwest.

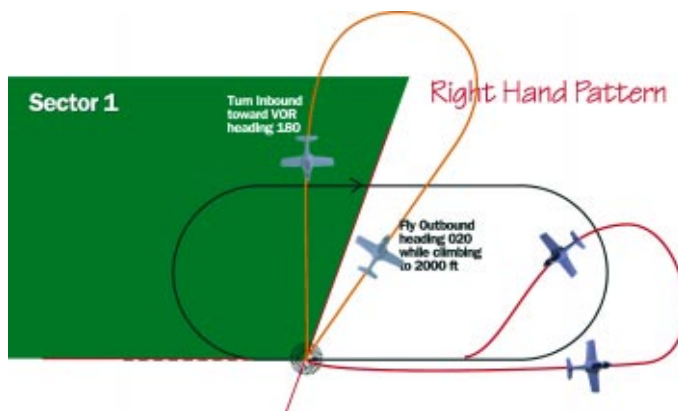
**Try It Now!**

On station passage, begin your timing as you turn to  $060^\circ$ . This can be guided by the VOR, so set  $060^\circ$  on the OBS and track this course for the 1-minute duration.

On completion of the time, begin a turn onto  $270^\circ$  to intercept the inbound course of the pattern. Remember to set  $270^\circ$  on the OBS, continue a full pattern, and then move onto the next section.

**Try It Now!**

**Performing a Sector 1 - Parallel Entry**



We can ensure that a Sector 1 Entry is required by departing off runway 2 and turning left to fly inbound on about 180° to the beacon.

Reset the situation using the {} key. Set the autopilot to 180° and keep the altitude setting at 2,000 feet. Also, set the OBS to 180° in anticipation that this will be our inbound course.

For this flight, continue climb on runway heading to 2,000 feet then begin a left turn onto 180°.



A stunning view inbound for our Sector 1 - Parallel Entry. Visualise the pattern as overlaid here. You should be preparing for that left turn onto the reciprocal 090° heading.

Depart now, and fly the initial maneuvering onto the start of the Sector entry. When you are established inbound on 180°, pause the sim as we discuss the entry.

#### Try It Now

On station passage, immediately begin a left turn onto 090° (the reciprocal of the inbound 270°). Begin your timing as you roll-out on 090°. In nil wind this will have you tracking parallel to the inbound course. When wind is involved you will need to compensate for the drift.



Established on the parallel leg with 270° set up on the OBS in preparation for the inbound intercept. I am waiting for the time (8:15:40) before I begin a turn all the way left to pick up the inbound leg.

Continue the exercise now, passing over the beacon and setting 090° heading. Once established outbound, set your inbound course, 270° on the OBS. Don't forget to note the time on roll-out.

On completion of 1 minute, pause the sim for further discussion.

#### Try It Now

Begin the reversal turn inbound by turning left - through nearly 3/4 of a full circle - onto about 225° to set up an intercept of 270° inbound. During this turn you will inevitably cross the 270° inbound course, the OBI needle will cross from right to left. At this point, when established on an intercept heading with the needle to the left, you must be ready to roll back onto 270° once the intercept has occurred.

Once established, maintain 270° and complete at least one pattern

#### Try It Now

#### In Summary

Well that was a whirlwind tour of Sector Entries, in nil wind, and using the VOR only. In later lessons we will cover them with the ADF, where a whole new set of orientation problems occur. For further practice, try setting up some Holding Patterns of your own, perhaps near your favourite airport.

If you're really game, try the Missed Approach for Kahului, Rwy 20 NDB. It's published on page 26 of the Handbook. It will involve a nav-aid change from the MAUI VOR to LNY VOR or NDB (117.7 or 353 as required).

Fly Safe. →

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