Virtual Air Traffic Simulation
VATCAR Division

CENTER (ENROUTE) STUDY GUIDE

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Steve Good, VATCAR Director

Jose A. Vega, VATCAR Training Director

Note: This is not for real-world training

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INTRODUCTION

This VATCAR Center Study Guide is designed to expand on the knowledge you have gained from the previous guides. Many of the basic radar skills you'll need in the Center such as vectoring and speed adjustment were covered in the Approach/Departure Guide. However, the perspective was from a terminal environment serving a single airport. A Center controller is much more involved with the "Big Picture." The vast amount of airspace and multiple airports, some with and some without an approach control or tower, make working in a Center a challenge. There will be times when you find yourself busier than the proverbial "One-Armed Paper Hanger" as you control aircraft arriving and departing from airports hundreds of miles apart. It may seem a bit daunting at first, but don't let that discourage you. Keep at it and practice all the things you've learned. That is the best way to become proficient.

This guide is the last in the VATCAR series. As you have progressed through the Basic, Ground Control, Tower, Approach/Departure, and finally, this Center Guide, your knowledge of the Air Traffic Control System and its procedures has grown. We hope this has enhanced your enjoyment of the VRC/SquawkBox Experience. If you have any suggestions to improve any of these guides please contact the VATCAR Training Staff. We'll be glad to hear from you.

CHAPTER 1 - ALTIMETER SETTINGS AND LOWEST USABLE FLIGHT LEVEL

1-1. When you issue an altimeter setting in a Center you must always identify its source, e.g. "MYNN ALTIMETER 3008."

1-2. Centers must issue the altimeter:

- To en route aircraft below the local transition level at least once while in your airspace or any time you issue descent below the lowest usable flight level. Use the altimeter for the airport closest to the aircraft's position.
- To arrivals when 50 NM from their destination if there is no approach control. In this case, use the destination airport altimeter.

1-3. Flight levels are based on a standard altimeter setting of 29.92/1013.3. If the local pressure falls below that there is no longer 1,000 feet separation between normal altitudes and flight levels.

1-3-1. Some flight levels become unusable as the pressure drops. Which ones depends on how far the pressure drops. You may not assign these unusable flight levels to aircraft.

1-3-1-1. If the local pressure is between 29.91 and 28.92, the local Transition Altitude (TA) is unusable and may not be assigned. You must add 1,000' for the Lowest Useable Flight Level Eg. If the local TA is FL180, FL190 now becomes the Lowest Usable Flight Level.

1-3-1-2. If the local pressure is between 28.91 and 27, you must add 2,000; to the local TA for the Lowest Useable Flight Level. Eg. FL200 becomes the Lowest Useable Flight Level.

1-3-1-3. In the unlikely event the pressure drops below 27.92, you are probably in a hurricane. You must add 3,000' to the local TA for the Lowest Usable Flight Level. Eg. FL210 becomes the Lowest Useable Flight Level.

CHAPTER 2 - ALTITUDE ASSIGNMENTS

2-1. Let's review the NEODD-SWEVEN rule you learned in the Basic ATC Study Guide.

2-1-1. Aircraft flying from 4,000 ft up to and including FL410 on a North and Eastbound (360-179) course are assigned ODD altitudes; South and Westbound (180-359) aircraft get EVEN altitudes.

2-1-2. Above FL 410, only odd flight levels are used alternating westbound and eastbound.

2-2. When traffic, weather, or aircraft performance limits prevent following these rules you may assign any altitude so long as the aircraft remains within your airspace. If it will enter another controller's airspace, the Wrong Altitude For Direction Of Flight (WAFDOF) must be coordinated with and approved by the receiving controller.

2-3. Regardless of the direction of flight any altitude you assign must be at or above the Minimum Enroute Altitude for the airway being used or the Minimum Instrument Altitude for the area the aircraft is in.

2-4. Another altitude you may assign if the pilot requests it is VFR-ON-TOP. As the name implies, the aircraft is on an IFR flight plan but flying under Visual Flight Rules On Top of any clouds or other weather. Do not use VFR-On-Top in Class A airspace.

2-4-1. When flying VFR-On-Top, the pilot flies at the appropriate altitude for direction of flight plus 500 feet (North-Eastbound ODD + 500, South-Westbound EVEN + 500).

2-4-2. The pilot is responsible for his own separation from other traffic. You only provide traffic advisories and safety alerts as necessary.

2-4-3. When you assign VFR-On-Top as an altitude there are four things you must do:

- Tell the pilot the height of the tops (from PIREPS) or that no tops report is available, e.g. "CLIMB TO AND REPORT REACHING VFR-ON-TOP, TOPS REPORTED 12,000" OR "NO TOPS REPORTED."
- Ensure separation from all other traffic until the aircraft reaches VFR-On-Top.
- Issue alternate instructions in case the aircraft can't reach VFR-On-Top, e.g. "IF NOT ON TOP AT FL160 MAINTAIN FL160 AND ADVISE."
- Re-clear the aircraft when it reports reaching VFR-On-Top, e.g. "MAINTAIN VFR-ON-TOP."

CHAPTER 3 - ARTCC SEPARATION

3-1. Centers are responsible for much more airspace and use a different radar system than Approach Controls. Therefore, the separation standards they apply are slightly different as well.

3-2. Vertical Separation

3-2-1. Up to and including FL280 - 1,000 feet.

3-2-2. FL290 thru FL410

- RVSM Approved aircraft – 1,000 feet
- Non-RVSM approved aircraft – 2,000 feet

3-2-3. FL410 thru FL590 – 2,000 feet

3-2-4. Above FL600 military aircraft only - 5,000 feet.

3-2-5. In oceanic airspace, above FL450 between a supersonic and any other aircraft - 4,000 feet.

3-3. Radar Separation

3-3-1. Below FL 600- 5 NM.

3-3-2. At or above FL 600- 10 NM

3-3-3. When accepting a handoff on a departure - 3 NM increasing to 5 NM if the aircraft are on diverging courses or the first aircraft is and will remain faster.

3-4. Centers may also use visual separation except in Class A airspace.

CHAPTER 4 - DESCENT PROCEDURES

4-1. Once the aircraft is at its cruising altitude the next thing to determine is when to start its descent. The actual point can be affected by terrain, traffic, and adjacent airspace.

4-2. Here is a simple formula to give you a general idea of when to start a typical aircraft down.

1) Subtract the destination airport elevation (rounded to the nearest 1000 feet) from the aircraft's current altitude (in thousands of feet).

2) Simplify by dropping the hundreds value

3) Multiply the resulting number by 4.

4) The product is the number of flying miles from the destination where the aircraft should start its descent.

   Example::

- Airport elevation - 668 (round up to 1,000)
- Aircraft altitude - FL310 (31,000 feet)
- 31,000 - 1,000 = 30,000
- Simplify to 30
- 30 x 4 = 120

An inbound aircraft at FL310 should start descent approximately 120 flying miles from the airport.

4-3. Military jet aircraft descend even faster than civilian aircraft (4-6,000 fpm vs. 800-1,500 fpm). The formula for figuring their starting point is even easier.

4-3-1. Add 10 to the required descent altitude in thousands of feet. Example

- Descent from FL450 to 10,000 feet = 35,000 feet
- 35 + 10 = 45 NM

4-4. Another handy tool for determining when to start an aircraft's descent is to use the term "DESCEND AT PILOT'S DISCRETION." You must still assign an appropriate IFR altitude to maintain e.g. "DESCEND AT PILOT'S DISCRETION, MAINTAIN 8,000" but this shifts the burden of choosing the right point to start descent from you over to the pilot.

4-4-1. If necessary to have the aircraft at a certain altitude by a certain point you may include a restriction, e.g. "DESCEND AT PILOT'S DISCRETION, CROSS 40 DME PJG (VOR, NDB or FIX) AT AND MAINTAIN 10,000." In this case the pilot can start whenever and descend at any rate he wants as long as he crosses 40 DME PJG at 10,000.

4-4-2. "DESCEND AT PILOT'S DISCRETION" does not relieve you of you responsibility to assign an altitude which ensures separation from terrain, obstructions, or other traffic. If an aircraft calls outside of your airspace requesting descent, inform the aircraft of the altitude to enter your airspace and advise the pilot to "OUTSIDE CONTROLLED AIRSPACE, DESCEND AT YOUR OWN RISK, CROSS 50 DME AT OR ABOVE 17,000, MAINTAIN 17,000."

CHAPTER 5 - OPERATIONS AT UNCONTROLLED AIRPORTS

5-1. Uncontrolled Airports are those that do not have an operating Control Tower.

5-2. The following procedures should be followed for Uncontrolled Airports that are not within a "Controlled Airspace" such as Classes B, C or special Terminal Control Areas (TCA).

Note * Airports that are within Controlled Airspace are handled as IFR and are covered in the Approach/Departure Study Guide.

5-3. ATC service to Uncontrolled Airports is not mandatory, but can be provided by Center controllers on a "workload permitting" basis.

5-4. All takeoffs, landings and ground operations are at the pilots discretion and risk. Pilots should be advised to announce their intentions on the Advisory frequency

5-5. IFR departure clearances can be authorized via two different methods:

- The pilot can depart VFR (weather conditions permitting) and request an IFR clearance when airborne and on initial course heading, or
- The pilot can request IFR clearance while on the ground.

5-6. After issuing an IFR clearance to an aircraft prior to departure and readback has been confirmed, controllers must give a "Released For Departure" clearance. There are severa options available to the controller.

5-6-1. Option 1. When traffic conditions do not permit immediate takeoff, include the phrase "HOLD FOR RELEASE." This way the aircraft has its clearance but may not depart until you call it back and issue a departure release. Example:

> "CLEARED TO TNCM AIRPORT AS FILED, MAINTAIN 14,000, SQUAWK 4301, HOLD FOR RELEASE."
>
> "RELEASED FOR DEPARTURE

5-6-2. Option 2. Release the aircraft when you issue its IFR clearance. This way the aircraft may depart any time it is ready. Example:

> "CLEARED TO MDSD AIRPORT AS FILED MAINTAIN 13,000, SQUAWK 4301. RELEASED FOR DEPARTURE."

5-6-3. Option 3. Include a release time and time check with the clearance. This way the aircraft may not depart until the release time. Example:

> "CLEARED TO MKJP AIRPORT AS FILED. MAINTAIN FL190, SQUAWK 4301 RELEASED FOR DEPARTURE AT 1700. TIME NOW 1632."

5-6-4. Option 4. Issue a clearance void time and a time check. This way the aircraft may depar anytime up until the void time but not after it. Example:

> "CLEARED TO MYNN AIRPORT AS FILED, MAINTAIN 8,000, SQUAWK 4301. RELEASED FOR DEPARTURE, CLEARANCE VOID IF NOT OFF BY 1345 TIME NOW 1315."

5-7. Arrivals to Uncontrolled Airports not within a controlled airspace are handled as follows.

5-8. It is the pilot's responsibility to select landing runway and desired approach based on current weather conditions.

5-9. Center controller can give initial vectors to either the arrival airport, or to an Initial Approach Fix (IAF) for the approach requested, then, issue a clearance for the approach. Examples:

> "PROCEED DIRECT TJBQ", or
>
> "CLEARED DIRECT TJMZ, CROSS MELLA AT OR ABOVE 5,000, CLEARED ILS RWY 9 APPROACH."

5-9-1. If a pilot does not have the approach plate, the simplest option is to have the aircraft hold over a nearby fix until you are able to provide the pilot with the necessary approach information. The required information consists of:

- Initial approach fix altitude.
- Direction and distance from the holding/initial approach fix within which procedure turn is to be completed.
- Altitude at which the procedure turn is to be made.
- Final approach course and altitude.
- Missed approach procedures if considered necessary.

5-10. After issuing Approach clearance, advise pilot to switch to the Advisory frequency to announce his intentions for landing. Doing so automatically terminates your radar service. However, it does not terminate your clearance, close or cancel his IFR flightplan, or release airspace for other IFR aircraft.

5-11. Although it is not necessary to advise the pilot of radar service termination, a common example phrase to use is:

"RADAR SERVICE TERMINATED, CHANGE TO ADVISORY FREQUENCY APPROVED, ADVISE CANCELLING IFR NOW OR AFTER TOUCHDOWN ON THIS FREQUENCY."

5-12. In real-world ATC, you must wait until the first aircraft has landed, or canceled IFR, before you may clear the second aircraft for approach to an uncontrolled airport. However, because ASRC always has radar contact, if you choose to, you may have more than one aircraft cleared for approach at uncontrolled airports..

5-13. Arrivals and departures at uncontrolled airports are usually handled as one in-one out. Hold the departure until the arrival has landed or canceled IFR or hold the arrival until the departure is airborne.

5-14. If you want to try mixing-and-matching you have two choices

5-14-1. Because VRC always has radar contact, you may apply the arrival/departure separation of 2 NM if separation will increase to 3 NM/5 NM within one minute.

5-14-2. You may also use non-radar separation and assign a void time to the departure. If you issue a void time, tell the pilot to advise his intentions within 30 minutes (or less) after the void time and issue a time check, e.g. "CLEARANCE VOID IF NOT OFF BY 1710, IF NOT OFF BY 1710, ADVISE NOT LATER THAN 1725 OF INTENTIONS. TIME 1655."

5-15. Non-radar separation between an arrival and a departure is:

5-15-1. When takeoff direction differs by at least 45 degrees from the reciprocal of the final approach course, the departure must depart before the arrival leaves a fix not less than 4 NM from the airport.

5-15-2. When takeoff direction does not differ by at least 45 degrees from the reciprocal of the final approach course, the departure must depart and be established on a course diverging by at least 45 degrees from the reciprocal of the final approach course before the arrival leaves a fix not less than 4 NM from the airport inbound.

5-15-3. If there isn't a fix 4 NM from the airport:

5-15-4. When takeoff direction differs by at least 45 degrees from the reciprocal of the final approach course the departure must depart at least 3 minutes before the arrival estimating the airport.

5-15-5. When takeoff direction does not differ by at least 45 degrees from the reciprocal of the final approach course the departure must depart and be established on a course diverging by at least 45 degrees from the reciprocal of the final approach course 5 minutes before the arrival is estimating the airport or before it starts procedure turn.

5-16. At uncontrolled airports the pilot decides if he will make a circling approach. Do not include circling instructions in the approach clearance.

5-17. VFR arrivals and departures from uncontrolled or non-tower airports do not require radar control.

5-17-1. In the real-world, it is not mandatory that VFR aircraft file a flightplan, however most do for safety reasons. In VRC/SB, pilots "should" file a VFR flightplan so that their flight information can be available to controllers, even though it is not always displayed in a data block.

5-17-2. Takeoff and/or landing clearances are not required for VFR aircraft. If a pilot requests either of these clearances:

- Advise them that the clearance is not necessary.
- Change to advisory frequency for arrival or departure.
- If aircraft is a departure, contact you when airborne if “flight following” is desired.

CHAPTER 6 - NAVAID USE LIMITATIONS AND GPS

6-1. When assigning routes based on VORs or NDBs remember:

6-1-1. The typical range of an FS VOR above FL180 is 130 NM. Below FL180 it can be as little as 40 NM depending on terrain and the aircraft’s altitude.

6-1-2. The range of most NDBs is approximately 50 NM but this also varies with terrain and altitude.

6-1-3. Unless the aircraft is on an airway, you must constantly watch the aircraft on radar and provide course corrections as necessary.

6-2. Global Positioning Systems such as the SB FMS are making direct routings more common. Using GPS you are no longer limited to only clearing aircraft direct to VORs or NDBs. You may clear the aircraft direct to virtually any navaid, intersection, DME fix, or airport.

6-2-1. Two things you should be careful of when using GPS:

6-2-1-1. Not all SB pilots are proficient or even familiar with operating the FMS. A direct routing in the flight plan does not necessarily mean the pilot really wants it. He just may not know how to plan a route. Unless the aircraft equipment suffix indicates GPS/FMS, use direct routings to other than VORs and NDBs with caution.

6-2-1-2. The pilot may not have entered the fixes you assign into his FMS. It may take a while for him to reprogram or he may refuse the direct routing and require vectors or routing via VORs or NDBs.