San Juan CERAP – Radar Training Manual

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Document Information

Purpose

This document is designed to serve as the primary resource for Radar Control (S3 & C1) training at the San Juan CERAP. It is designed to contain the necessary knowledge and procedures to work the terminal and en-route environment within the boundaries of the San Juan CERAP. Controllers are required to be familiar with the provisions of this document that pertain to the position they will control and to exercise their best judgment if they encounter situations not covered in this manual.

Distribution

The San Juan CERAP Radar Training Manual is distributed to all controllers of San Juan CERAP.

Responsibility

The San Juan CERAP Air Traffic Manager (ATM) and Training Administrator (TA) are responsible for the maintenance of this document. Prior to public release this document requires the approval of the VATSIM Caribbean Division (VATCAR) Training Director.

Updates and changes

This version is the initial release of this document. Any updates to this document are noted in the Table of Revisions section of this document.

Cancellation

This document cancels any previous release version of the San Juan CERAP - Radar Training Manual.

Table of Revisions

Date (mm/dd/yyyy)	Revision	Editor
03/07/2023	v1.0 - Initial Release	Francis Reilly

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Preface

Welcome to the San Juan CERAP!

The San Juan CERAP (Consolidated En-Route Approach Control) is part of the Caribbean Division of the VATSIM network, known as VATCAR. We are pleased you have chosen to join our team of controllers.

The following document is designed to provide you with the theory and practical knowledge required to become certified as an Approach or Center Controller. This document assumes controller proficiency with regards to basic ATC knowledge (types of airspace, weather theory, tower cab procedures, etc.) for refresher material regarding those topics please refer to the *San Juan CERAP – Tower Cab Training Manual*.

We are here to ensure you succeed in your goal of becoming a VATSIM S3/C1 controller and look forward to working with you.

Francis Reilly
Air Traffic Manager – San Juan CERAP

Chapter 1: Approach / Departure (Terminal)

Position Responsibilities

In VATSIM, many of the responsibilities of the radar controller rely on one person, while in real-life some of these tasks are distributed among different team members. TRACON stands for Terminal Radar Approach Control. The terminal radar controller is responsible for ensuring separation of aircraft under their control, initiating control instructions, monitoring and operating radios, accepting and initiating automated handoffs, scanning the radar display and correlating target information with flight progress strip information, coordination with adjacent facilities (including point-outs). As a terminal radar controller your job is to get departures from the terminal area to the en-route phase of flight and to transition arrivals from the en-route structure to the terminal environment.

At the tower level, you used mostly visual techniques to separate aircraft (in real life some towers do have certified tower radar displays (CTRDs) but we rarely use them in VATSIM). At the TRACON you will only use radar. Radar stands for "Radio Detection And Ranging"; it works by sending out radio signals, detecting the reflected signal, and displaying a target on the radar scope. The depicted target is known as a primary target since it does not provide any additional information aside from position on the radar scope. Most aircraft are equipped with a transponder that can transmit additional information such as altitude and beacon code. When altitude and beacon code information are present the target is known as a secondary target.

Duty Priority

When working the radar controller position, priority should be given to separating and issuing safety alerts to airborne aircraft. It is expected that controllers use their best judgement to manage traffic accordingly. When providing Top-Down services priority goes to aircraft in the APP/DEP controller's airspace, then TWR aircraft, and ultimately GND/DEL aircraft.

Coordination

The Approach/Departure controller must actively coordinate with underlying Tower controllers regarding any pertinent arrival or departure flight information, IFR releases, go-around instructions, VFR arrivals and any other operationally relevant items.

Handoffs

An action taken by the radar controller to transfer the radar identification of an aircraft from one controller to another if the aircraft will enter the receiving controller's airspace and radio communications with the aircraft will be transferred.

<u>Transferring controller handoff</u>

The transferring controller must:

- Complete a radar handoff prior to an aircraft entering the airspace delegated to the receiving controller.

- Verbally obtain the receiving controller's approval prior to making any changes to an aircraft's flight path, altitude, or data block information while the handoff is being initiated or after acceptance.
- Ensure that, prior to transferring communications:
  - Potential violations of adjacent airspace and potential conflicts between aircraft in their own area of jurisdiction are resolved.
  - Restrictions issued to ensure separation are passed to the receiving controller.
- Comply with restrictions issued by the receiving controller unless otherwise coordinated.
- Transfer communications when the transfer of radar identifications has been accepted.
- Advise the receiving controller of pertinent information not contained in the data block or flight progress strip unless covered in a LOA or SOP. Pertinent information includes:
  - Assigned heading
  - Airspeed restrictions
  - Altitude information issued
  - Observed track or deviation from the last route clearance
  - Any other pertinent information
- Advise the receiving controller that radar monitoring is required when the aircraft is on a direct route initiated by ATC that exceeds usable NAVAID distances.
- Issue restrictions to the receiving controller which are necessary to maintain separation from other aircraft within your area of jurisdiction before releasing control of the aircraft.
- Consider the target being transferred as identified on the receiving controller's display when the receiving controller acknowledges receipt verbally or has accepted an automated handoff.

<u>Receiving controller handoff:</u>

The receiving controller must:

- Ensure that the target position corresponds with the position given by the transferring controller before accepting a handoff.
- Issue restrictions that are needed for the aircraft to enter your sector safely before accepting the handoff.
- Comply with restrictions issued by the initiating controller unless otherwise coordinated.
- Before you issue control instructions directly to an aircraft that is within another controller's area of jurisdiction that will change that aircraft's heading, route, speed, altitude, or beacon code, ensure that coordination has been accomplished with the controller within whose area of jurisdiction the control instruction will be issued.
- If you decide, after accepting the transfer of radar identification, to delay the aircraft's climb or descent through the vertical limits of the transferring controller's area of jurisdiction, advise the transferring controller of that decision as soon as possible. You now have the responsibility to ensure that the necessary coordination is accomplished with any intervening controller(s) whose area of jurisdiction is affected by that delay, unless otherwise specified in a LOA or SOP.

Point Out

"Point-outs" are commonly used when an aircraft under your control will briefly cross over to another controller's airspace/sector, but no transfer of control or communications will occur.

A point-out may be carried out through the radar client or through verbal communication with the other controller.

When communicating verbally, a point-out should include the following information:

- The phrase "point-out"
- The location of the aircraft
- Aircraft callsign or squawk code if no callsign is displayed
- Altitude
- Any additional pertinent information
- Your controller intentions

The receiving controller can reply with one of the following phrases:

- *"Point-out approved"* - aircraft may enter airspace and you can retain control.
- *"Radar contact"* – you must transfer control and comms to the other controller
- *"Unable/Denied"* – aircraft must remain outside other controller's airspace
- *"Traffic"* – you must separate your aircraft from the specified aircraft. Use the phrase "traffic observed" to indicate you see the traffic and will keep clear of it.

The transferring controller must:

- Obtain verbal approval before permitting an aircraft to enter the receiving controller's delegated airspace. TERMINAL Automated approval may be utilized in lieu of verbal approval, provided automated point out function is operational, and the procedures are specified in a SOP/LOA.
- Obtain the receiving controller's approval before making any changes to an aircraft's flight path, altitude, or data block information after the point out has been approved.
- Comply with restrictions issued by the receiving controller unless otherwise coordinated.
- Be responsible for subsequent radar handoffs and communications transfer, including flight data revisions and coordination, unless otherwise agreed to by the receiving controller or as specified in a LOA.

The receiving controller must:

- Ensure that the target position corresponds with the position given by the transferring controller or that there is an association between a computer data block and the target being transferred prior to approving a point out.
- Be responsible for separation between point out aircraft and other aircraft for which the controller has separation responsibility.
- Issue restrictions necessary to provide separation from other aircraft within there area of jurisdiction.

Phraseology:

- Handoff/Point-out/Traffic (aircraft position) (aircraft ID) (altitude restrictions and other appropriate information if applicable)
- Example:
    - Handoff, 7 miles southwest of San Juan VOR, N123AB, 7000.
- When receiving a handoff, point-out, or traffic restrictions, respond to the transferring controller as follows:
    - (Aircraft ID) (restrictions, if applicable) RADAR CONTACT.
    - (Aircraft ID or discrete beacon code) (restrictions, if applicable) POINT OUT APPROVED.
    - "Traffic observed"
    - "Unable" (appropriate information, as required).

Surveillance Radar

For approach control, the typical radar site is called Airport Surveillance Radar (ASR) and is normally located at the airports. The most modern kind of radar is ASR-11, which consists of a primary surveillance radar and a secondary surveillance radar. The primary surveillance radar uses a continually rotating antenna mounted on a tower to transmit electromagnetic waves that reflect, or backscatter, from the surface of aircraft up to 60 miles from the radar. The radar system measures the time required for a radar echo to return and the direction of the signal. Using this information, the system can then measure the distance of the aircraft from the radar antenna, as well as the azimuth (direction) of the aircraft in relation to the antenna. The secondary radar uses a second radar antenna attached to the top of the primary radar antenna to transmit and receive area aircraft data for barometric altitude, identification code, and emergency conditions. Military, commercial, and some general aviation aircraft have transponders that automatically respond to a signal from the secondary radar by reporting an identification code and altitude.

Primary Surveillance Radar (PSR)

(Information obtained from VATUSA Academy)

The PSR is the concave dish seen in *Figure 1*. It includes that big back plate and the arm extending off the radar dish. The PSR does a very simple thing, it scans the skies and returns a hit on anything it can find. It may pick up birds, balloons, snow, skydivers, practically anything that is dense enough to bounce a radio signal. The PSR is particularly good at picking up airplanes on radar and will return a hit as seen in *Figure 2* when it does. This is called "Primary Target" and it is quite literally a target picked up by the PSR.

Figure 1. SkySearch-3000 co-mounted PSR, SSR.

The SSR is the flatter longer piece on top of the radar dish as seen in Figure 1. The SSR is a bit more complex than the PSR in what it does and provides us as the ATC more precise and meaningful information about the aircraft. The SSR functions based on the aircraft having a transponder on board.

All transponders have one thing in common, they can select a 4-digit code with numbers ranging from 0 to 7 in each place, however different transponder "modes" have different capabilities.

Transponders come in 3 flavors, Mode A, Mode C, and Mode S.

- Mode A transponders are the oldest and do not broadcast altitude information to the SSR.
- Mode C transponders (what everyone on VATSIM is assumed to have) are similar to Mode A transponders except they transmit altitude information to the SSR.
- Mode S transponders are Mode C transponders with a specific 24 bit address assigned to it which allows for systems in Europe to have non-discrete beacon codes assigned and still use SSR to identify the aircraft.

The above assumes the combination of each transponder mode as you move up the scale, technically Mode C is just altitude reporting, but is almost always combined with Mode A to form a full transponder as most people know it.

When a SSR picks up a Mode C transponder it will return a target as displayed in Figure 3, commonly referred to as a beacon slash.

Now you understand the difference between PSR and SSR lets move onto each form of ID and how we can apply them.

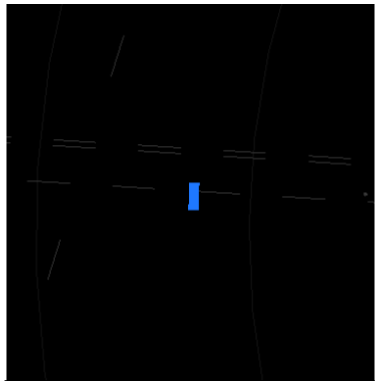


Figure 2. Primary target radar depiction

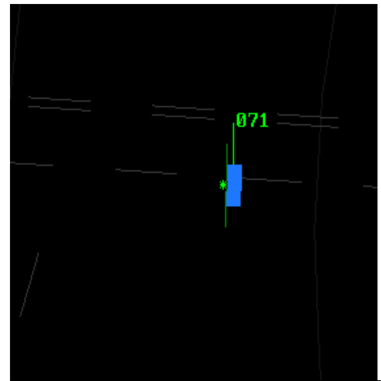


Figure 3. Secondary target radar depiction.

Radar Identification

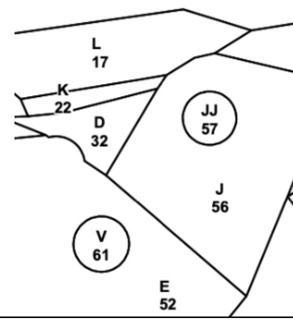
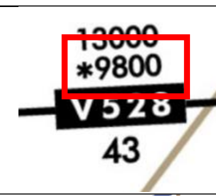
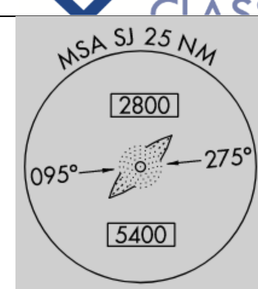
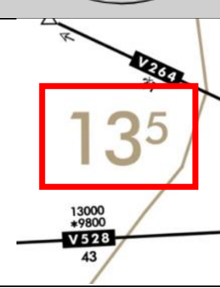
Before you can provide radar services, the controller must establish radar identification of the aircraft involved.

- Primary Radar Identification
    - A primary, radar beacon, or ADS-B target is identified by one of the following methods:
        - Observing a departing aircraft target within 1 mile of the takeoff runway end at airports with an operating control tower, provided one of the following methods of coordination is accomplished:
            - A verbal rolling/boundary notification is issued for each departure aircraft
            - A non-verbal rolling/boundary notification is used for each departure aircraft
        - Observing a target whose position with respect to a fix (displayed on the video map) or a visual reporting point corresponds with a direct position report received from an aircraft and the observed track is consistent with the reported heading or route of flight.
        - Observing a target make an identifying turn or turns of 30 degrees or more, provided the following conditions are met:
            - A pilot position report is received (unless in the case of a lost aircraft)
            - Only one aircraft is observed making these turns
            - For aircraft operating in accordance with an IFR clearance, you issue a heading away from an area which will require an increased minimum IFR altitude or have the aircraft climb to the highest minimum altitude in your sector before issuing a heading
- Beacon Identification Methods
    - When the aircraft is already squawking a discrete code, requesting the aircraft to activate the “IDENT” feature of the transponder, and observing the identification display.
        - *“N12345, ident.... (ident is observed).... N12345, squawk (code) and ident.”*
    - Request the pilot to change their transponder to “standby”. After you observe the target disappear for sufficient scans to assure loss of the target, request the pilot to return the transponder to normal operation and observe the reappearance of the target.
    - Request the aircraft to squawk a discrete code and observe the change in the target data tag.

- Examples:
  - Departing aircraft within 1 mile of the takeoff runway end at airport with operating control tower:
    - *"N12345, San Juan Departure, radar contact..."*
  - Target whose position corresponds with pilot position report:
    - *"N12345, San Juan Approach, radar contact..."*
  - For all other radar identification methods, you must provide the aircraft's location with reference to a fix/navaid. If aircraft equipped with Mode-C transponder (mandatory in VATSIM) include indicated altitude:
    - *"N12345, San Juan Approach, radar contact one five west of the Dorado NDB, five thousand five hundred."*
- Aircraft receiving VFR flight following or those that cancel IFR must be informed when radar services are terminated and instructed to squawk VFR or 1200.
  - *"N12345, radar services terminated, squawk VFR, contact Isla Grande Tower (or) change to advisory frequency approved.*

Minimum IFR Altitudes

Altitude assignments in the terminal environment must ensure separation from other aircraft and terrain. IFR altitude minima are not uniform across a controller's airspace and are subject to Navaid range and terrain obstructions.

Altitude	Definition	Example
Minimum Vectoring Altitude (MVA)	The lowest altitude at which an aircraft may be vectored to meet IFR obstacle clearance. May be lower than published MEA/MIA.	
Minimum IFR Altitude (MIA)	Lowest IFR altitude that may be substituted for an MVA when no MVA is published.	
Minimum En-route Altitude (MEA)	The minimum altitude the aircraft may fly along that portion of an applicable SID, STAR, or airway for terrain and signal coverage.	
Minimum Obstacle Clearance Altitude (MOCA)	The minimum altitude an aircraft may fly on a route segment to guarantee terrain clearance (signal coverage is not guaranteed).	
GPS Minimum Altitude	The MEA for RNAV equipped aircraft. The lower altitude is possible because radio signal coverage isn't required.	
Minimum Safe Altitude (MSA)	Altitudes depicted on approach charts that provide at least 1000' of obstruction clearance in the published area. MSAs are for emergency use only and do not assure signal coverage.	
Off Route Obstruction Clearance Altitude (OROCA)	An off-route altitude that provides obstruction clearance, but not necessarily signal coverage.	

IFR Radar Separation

Radar separation may be applied between:

- Radar identified aircraft
- An aircraft taking off and another radar identified aircraft when the departing aircraft will be radar identified within 1 mile of the runway departure end
- A radar identified aircraft and one not radar identified when either is cleared to climb/descend through the altitude of the other

Apply radar separation:

- Between the centers of primary radar targets, however, do not allow a primary target to touch another primary target or a beacon control slash.
- Between the ends of beacon control slashes
- Between the end of a beacon control slash and the center of a primary target

Target resolution (not applicable to Mosaic radar systems) is a procedure designed to ensure that correlated radar targets do not touch. When employing target resolution, traffic advisories and safety alerts must be issued.

Separation minima between aircraft will vary according to the radar surveillance equipment used by the controlling facility. As a rule of thumb, basic IFR separation between non-heavy aircraft of the same weight class is 3 miles lateral separation or vertical separation of at least 1000 ft. Wake turbulence procedures must be applied when providing separation for aircraft of different wake classes that are directly behind, within 2500 ft laterally, or less than 1000 ft below the heavier aircraft.

Wake turbulence considerations in the Terminal environment	
Weight Category	**Minimum in trail distance**
Heavy (behind super)	6 miles
Large (behind super)	7 miles
Small (behind super)	8 miles
Small (behind heavy)	6 miles
Small (behind large)	4 miles

Once radar targets have passed or diverged from each other, radar separation procedures may be discontinued. Wake turbulence, however, must remain in consideration as necessary.

Visual Separation

Below FL180, visual separation may be used in lieu of altitude or radar separation. Weather conditions must allow the aircraft to remain within sight until other separation exists. Visual separation is not authorized when the lead aircraft is a Super.

Vectoring

Vectoring is useful tool at the disposal of radar controllers. In controlled airspace, vectoring is primarily used for ensuring aircraft separation, noise abatement procedures, an operational advantage, avoiding weather, among others.

Vectoring procedures can only be applied to aircraft once at or above the minimum vectoring altitude (MVA) or the minimum IFR altitude, except in the case of radar departures, special VFR or VFR operations.

VFR aircraft may be vectored by ATC at any altitude and it is the pilot's responsibility to comply with the applicable sections of 14 CFR Part 91.

When vectoring an aircraft, ensure that the aircraft will be able to resume its own navigation while within radar coverage.

Vectoring instructions can be provided in different ways depending on the action the controller wants the pilot to perform.

Instruction	Phraseology
Direction of turn (left or right) and magnetic heading to be flown	*"N12345, turn Left, heading one five zero"*
Magnetic heading to be flown (aircraft decides which way to turn to reach assigned heading)	*"N12345, fly heading two seven zero"*
Number of degrees, group form, to turn and the direction of turn	*"N12345, turn right twenty degrees"*
Fly its present heading	*"N12345, fly/maintain present heading"*
Depart a navaid/fix on a particular heading	*"N12345 depart BEANO heading one niner zero"*

When initiating a vector instruction, advise the pilot of the purpose, and if appropriate, what to expect when radar navigational guidance is terminated.

- Examples:
- *"N12345 turn left heading one three zero, vectors to intercept the localizer"*
- *"N12345 turn right heading one one zero, vectors to join RTE2"*
- *"N12345 turn right heading one one zero, vectors to final approach course"*
- *"N12345 turn left heading one four zero, vectors for sequencing"*
- *"N12345 turn right heading one one zero, vectors to intercept San Juan VOR outbound zero eight zero radial"*

There are three rules that apply to vectoring:

1. Whenever you initiate a vector, you must tell the pilot the reason for the vector.
2. Whenever you vector a pilot across a localizer/airway/radial that they are expecting to join you must specify that they are expected cross said localizer/airway/radial.
3. Aircraft must be vectored to join the localizer of final approach course at no more than 30 degrees if more than 2 nm from the final approach gate (FAF). If within 2 nm from the FAF, the aircraft must be vectored to join the localizer at no more than 20 degrees. If handling a helicopter, vectors to join a localizer should be no more than 45 degrees.

When vectoring or approving course deviations, assign an altitude to maintain and, if necessary, a speed.

Aircraft may not be vectored off an Obstacle Departure Procedure (ODP) or issued an altitude lower than the published altitude on an ODP until at or above the MVA/MIA, at which time the ODP is canceled.

Aircraft vectored off an RNAV route must be re-cleared to the next waypoint or as requested by the pilot.

Altitude Assignment

Aircraft on an IFR flight plan must be assigned altitudes above the MEA for the route segments being flown.

When issuing altitude instructions, provide any additional information that may be operationally beneficial. The following table provides common altitude assignment instructions:

Instruction	Definition	Phraseology
Climb and maintain / Descend and maintain	Pilot is expected to commence its climb / descent upon receipt of the instruction.	*"N12345, climb and maintain, eight thousand."*
Climb / Descend at pilot's discretion	The pilot is authorized to conduct their climb or descent when they deem appropriate.	*"N12345, descend at pilot's discretion, maintain six thousand"*
Cross at and maintain, Cross at or below, Cross at or above	The pilot will, at their discretion, initiate a climb / descent to meet the crossing restriction at the specified fix / waypoint.	*"N12345, cross CHAKA at or above six thousand"* *"American 123, cross BEANO at or above 11000, descend and maintain 6000"*
Climb / Descend now, then...	The pilot is expected to comply with the initial altitude instruction and after complying with the initial instruction will adhere to the conditions established afterwards. This type of instruction is commonly issued when there's a need for establishing radar separation between two or more targets.	*"N12345, climb now to six thousand, then climb at pilot's discretion to eight thousand"*
After passing (fix, waypoint, etc.)		*"N12345, after passing SAALR, descend and maintain 6000"*

Speed Adjustment

Speed adjustments should only be issued when necessary to achieve or maintain required or desired spacing.

The following should be considered when issuing speed adjustments:

- Determine the interval (spacing) required and by when it should be met.
- Priority of speed adjustment instructions is determined by the relative speed and position of the aircraft involved and the spacing requirement.
  - Keep in mind that speed adjustments are not achieved instantaneously.

Speed control techniques:

- Reduce the trailing aircraft first
- Increase the leading aircraft first
- Assign a specific airspeed to aircraft if required to maintain a specific spacing

Keep the number of speed adjustment to the minimum required to achieve and maintain spacing.

Do not issue speed adjustments when aircraft are:

- Inside the Final Approach Fix (FAF) or a point 5 miles from the runway, whichever is closer.
- Receiving an approach clearance, only re-state a speed assignment if issued prior to approach clearance.

If a speed adjustment is no longer necessary, instruct the aircraft to resume normal speeds.

Instructions such as *"maintain best forward speed"* or *"maintain slowest practical speed"* can be used when desired.

Phraseology:

- "Say airspeed"
- "Maintain present speed"
- "Maintain (specified speed) knots"
- "Maintain (specified speed) knots or greater"
- "Do not exceed (specified speed) knots"
- "Maintain maximum forward speed"
- "Maintain slowest practical speed"
- "Increase/reduce speed to (specified speed in knots in individual form)"

Note: Published STAR/SID speed restrictions are cancelled if the aircraft is vectored off, or if deviations from the SID/STAR are approved. If speed control is necessary, assign a speed along with the vector or deviation approval.

Holding

Whenever orderly flow of arrivals into an airport is interrupted due to adverse weather conditions or other factors such as runway or airport closures, holding instructions may need to be issued to airborne aircraft. Operational factors such as the length of delay into the destination airport, airspace limitations, altitude and weather should be considered prior to clearing an aircraft to a fix other than their destination airport. The standard hold is one that consists of right-hand turns and 1-minute legs. When a hold is necessary, the controller should issue the following:

- Clearance limit
  - If route after holding is terminated will differ from the original route, the controller must issue the pilot the route they should expect beyond the clearance limit.

  - Example: *"N12345 cleared to the San Juan V-O-R, expect further clearance via San Juan V-O-R, RTE7 TUUNA intersection, direct St. Croix"*
- Holding instructions
  - When the assigned procedure or route being flown includes a charted holding pattern, you may omit all holding instructions except the charted holding direction and the statement *"as published"*. Always issue complete holding instructions if requested by the pilot.
  - The phraseology for issuing a holding instruction to a published hold is: "HOLD (direction) of (fix) AS PUBLISHED". Do not forget to issue an "Expect Further Clearance Time (EFCT) as well.
    - "American 113, Hold south of BEANO as published. Maintain 11,000. Expect further clearance at 1345z."
  - When issuing holding instructions, specify:
    - Direction of holding from the fix/waypoint
    - Holding fix/waypoint
    - Radial (if VOR), course (if RNAV), bearing (if NDB), airway, or route on which the aircraft is to hold.
    - Leg length in miles if DME or RNAV is to be used. Specify leg length in minutes if the pilot requests it or you consider it necessary.
    - Direction of holding pattern turns only if left turns are to be made (right turns are the standard), the pilot requests it, or you consider it necessary.
- Expected Further Clearance (EFC) time
  - The pilot will expect to hold until the time specified by the controller. This number is typically estimated based on when the destination airport expects to resume operations.

Examples:

- *"N12345 cleared to the JETSS intersection, hold North on the 090 inbound course, one zero mile legs, left turns, maintain 8000, expect further clearance at zero four one five zulu"*.
- *"N12345 cleared to the San Juan V-O-R, hold South on the one three zero radial, two-minute legs, maintain 4000, expect further clearance at one five three zero zulu."*

IFR Departures

Departing aircraft must be issued the current altimeter setting unless they are operating scheduled air service operations.

Departing IFR or VFR Flight Following aircraft shall be radar identified and issued a climb instruction to the radar sector's ceiling or the aircraft's cruise altitude, whichever is lower.

Once the aircraft is above the applicable MVA, it should be given vectors to join the assigned route (if required).

Handoff the aircraft to the appropriate Center (en route) facility with appropriate time to allow for an uninterrupted climb into the Center's airspace. Prior to issuing a handoff to Center, the Terminal (Approach/Departure) controller must ensure the following conditions are met:

- Same direction aircraft are separated by at least 3 miles with separation increasing to 10 miles.
- Any potential conflicts or deviations from routing must be resolved or coordinated prior to handoff and transfer of communications.

Standard Instrument Departures (SIDs)

Departure procedures describe to pilots in a pictorial and textual manner guidelines on initial climb, headings, or tracks to follow. Departure procedures can be divided into:

- Obstacle Departure Procedures (ODP)
  - An ODP is a preplanned instrument flight rule (IFR) departure procedure to provide obstruction clearance via the least onerous route from the terminal area to the appropriate en route structure. ODPs are recommended for obstruction clearance and may be flown without ATC clearance unless an alternate departure procedure (SID or radar vector) has been specifically assigned by ATC.
  - ODPs are primarily used by IFR aircraft departing from an uncontrolled field. ATC can request an aircraft to fly the ODP when providing an IFR clearance.

- Standard Instrument Departures (SID)
  - SIDs are primarily designed for system enhancement to expedite traffic flow and to reduce pilot/controller workload. ATC clearance must always be received prior to flying a SID.

Standard Instrument Departures can be subdivided into three categories:

- Pilot-nav
  - A pilot-nav SID is a SID where the pilot is primarily responsible for navigation along the SID route.
  - It allows for the aircraft to get from the runway to its assigned route with no vectoring required from air traffic control.
  - They are established for airports where terrain and related safety factors dictate a specific ground track be flown.
- Radar vector
  - A radar vector SID is used where air traffic control provides radar navigational guidance to a filed or assigned route or to a fix depicted on a SID.
  - Flying a vector SID may require first flying an obstacle departure procedure (ODP).
  - This is usually annotated in the ODP section stating, "Fly runway heading to (xxx altitude) prior to making any turns." This ensures the aircraft is clear of any obstacles.
  - Vector SIDs give air traffic control more control over air traffic routing than do pilot-nav SIDs.
- Hybrid
  - A hybrid SID is a departure that combines elements of both the pilot-nav and radar vector departures.
  - A hybrid SID usually requires the pilot to fly a set of instructions, then be vectored to a defined route to a transition to leave the terminal area.

Standard Terminal Arrival Routes (STARs)

STARs serve to create a uniform and orderly flow of traffic into an airport. Typically, STARs will contain altitude restrictions that the arriving aircraft are expected to comply with unless told otherwise. Some STARs also contain speed restrictions. The radar controller may cancel published STAR altitude or speed restrictions if deemed operationally beneficial.

When a STAR indicates that a pilot should *“expect”* a specific altitude, or there are no altitude restrictions, the controller must issue a *“cross at”* or a *“descend and”* altitude instruction.

- Note: A *“descend via”* instruction is not applicable.

When a STAR has published crossing restrictions, aircraft can be authorized to *“descend via”* the arrival.

- Note: Aircraft that are vectored off a STAR after being issued a *“descend via”* instruction must be given a new altitude to maintain.

Initial Contact with IFR Arrivals

The approach controller must provide current approach information to aircraft destined to airports for which they provide approach control services. This information must be provided on initial contact or as soon as possible thereafter. Approach information contained in the ATIS broadcast may be omitted if the pilot states the appropriate ATIS code on initial contact.

- Example 1 (ATIS code provided by pilot):
    - Pilot: *“San Juan Approach, N12345 descending through twelve thousand five hundred for one one thousand, with information Echo.”*
    - ATC: *“N12345, San Juan Approach, thanks for Echo, descend and maintain six thousand.”*

Otherwise, advise the controller of the current altimeter setting, current ATIS code and approach to expect:

- Example 2 (ATIS code not provided by pilot):
    - Pilot: *“San Juan Approach, N12345 level at one one thousand, direct SAALR.”*
    - ATC: *“N12345, San Juan Approach, information Echo now current, altimeter 29.98, expect vectors ILS 10 approach.”*

For aircraft destined to an airport without ATIS, issue approach information by including the following:

- Approach clearance or type of approach to be expected if two or more approaches are published and the clearance limit does not indicate which will be used.
- Runway if different from that to which the instrument approach is made (i.e. if circle-to-land would be required).
- Surface winds
- Ceiling and visibility if the reported ceiling at the airport of intended landing is below 1000 ft or below the highest circling minimum, or the visibility is less than 3 miles.
- Altimeter setting for the airport of intended landing.

Instrument Approach (IAP)

An instrument approach procedure is a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. Additionally, if a landing is not completed the IAP provides the necessary instructions to guide an aircraft to a position at which holding or en route obstacle clearance criteria apply.

There are several types of IAPs and each provide different forms of guidance (lateral, vertical) based on the equipment used and have different minima to continue or discontinue the instrument approach.

- Precision approaches (PA) – is a type of instrument approach where the pilot(s) receive vertical and lateral guidance that is provided by ground-based navigation aids, glideslope (vertical) and localizer (lateral), or by satellite generated navigation data. ATC can also provide the pilot with radar vectors to the runway.
  - Instrument Landing System (ILS)
    - Uses both a localizer and glideslope to provide navigational guidance to the runway. Every ILS approach plate details the flight visibility and approved visual reference requirements for that approach.
  - Ground Based Augmentation System (GBAS) Landing System (GLS)
    - This type of approach provides exact alignment and descent guidance to an aircraft. GBAS/LASS look similar to ILS approaches but are based on GPS signals that are supplemented by ground equipment.
  - Precision Approach Radar (PAR)
    - This type of approach involves radar and two-way radio communications. The controller provides the pilot headings, altitudes, and necessary corrections to remain on course. The military mostly uses PAR approaches in the United States.

- Non-precision approaches (NPA) – are standard instrument approach procedures with only lateral guidance from the localizer signal. Vertical guidance is not provided.
  - Area Navigation (RNAV)
    - Uses the Global Navigation Satellite System (GNSS) or GPS. RNAV approaches vary on capabilities:
      - LNAV (lateral navigation)
      - LNAV + V (lateral navigation with advisory glideslope)
      - LNAV/VNAV (lateral/vertical navigation)
      - LPV (localizer performance with vertical guidance)
  - Localizer Performance (LP)
    - Non-precision approaches with WAAS lateral guidance. Vertical guidance to the runway is not provided. Furthermore, LP approaches are located where terrain or obstruction do not allow a vertically guided procedure.
  - Very-High Frequency Omnidirectional Range (VOR)
    - Use a ground-based signal transmitting an omni-directional radial. VOR signals are line of sight due to terrain blocking.
  - Non-Directional Beacon (NDB)
    - Is a ground-based, low frequency radio transmitter. The NDB transmits an omni-directional signal received by an Automatic Direction Finder (ADF) onboard the aircraft.

  - Localizer (LOC)
    - This type of approach utilizes only the localizer equipment of the ILS to provide guidance to the runway. No vertical guidance is not provided.
  - Approach Surveillance Radar (ASR)
    - Similar approach to the PAR. However, this type of approach does not provide vertical guidance. ATC guides the pilot laterally giving heading assignments or corrections.
  - Localizer Type Directional Approach (LDA)
    - Is used where the approach is offset from the runway 6-12 degrees.
  - Simplified Directional Facility (SDF)
    - Are similar to the ILS localizer. The course in this approach may not be aligned with the runway and may be wider.

- Approaches with vertical guidance (APV) – are based on a navigation system that does not meet the ICAO precision approach standards. APV approaches provide course and glidepath deviation information and are more accurate than RNAV approaches.

IAPs may have as many as four separate segments depending on how the approach procedure is structured.

- Initial Approach
  - The segment between the initial approach fix (IAF) and the intermediate fix (IF) or the point where the aircraft is established on the intermediate course of final approach course.
- Intermediate Approach
  - The segment between the intermediate fix (IF) or point and the final approach fix (FAF).
- Final Approach
  - The segment between the final approach fix or point and the runway, airport, or missed approach point (MAP).
- Missed Approach
  - The segment between the missed approach point or the point of arrival at decision height and the missed approach fix at the prescribed altitude.

Instrument Approach Clearance

A standard instrument approach procedure must begin at an initial approach fix (IAF) or an intermediate fix (IF) if there is not an IAF.

Wherever adequate radar coverage exists, radar facilities may vector aircraft to the final approach course. The radar controller must ensure the following when vectoring an aircraft to the final approach course:

- Aircraft is at least 2 miles outside the approach gate (FAF – Final Approach Fix)
- Provide a minimum of 1000 ft vertical separation between aircraft on opposite base legs unless another form of approved separation is established during turn-on to final approach.
- For a precision approach (ILS), at an altitude not above the glideslope/glidepath or below the minimum glideslope intercept altitude specified on the approach procedure chart.
- For a non-precision approach (RNAV, LOC, VOR, NDB, etc), at an altitude which will allow descent in accordance with the published procedure.

The radar controller must assign heading that will permit final approach course interception on a track that does not exceed the interception angle specified on the following table:

Distance from interception point to an approach gate (FAF)	Maximum interception angle
Less than 2 miles	20 degrees
2 miles or more	30 degrees (45 degrees for helicopters)

Visual Approach Clearance

A visual approach is an ATC authorization for an aircraft on an IFR flight plan to proceed visually and clear of clouds to the airport of intended landing. It is not a standard instrument approach procedure and has no published missed approach.

A vector for a visual approach may be initiated if the reported ceiling at the airport of intended landing is at least 500 ft above the MVA/MIA and the visibility is 3 miles or greater.

Aircraft can be cleared for a visual approach when the pilot reports:

- *"Airport and runway in sight"* (at Towered Airports)
- *"Airport in sight"* (at non-Towered airports)

Additionally, when issuing a visual approach clearance, ensure that the aircraft is:

- number one in sequence, or
- has the preceding aircraft in sight and is instructed to follow it to the same runway

When issuing a visual approach clearance to a non-Towered airport, do not specify the runway for landing.

- Example: *"N12345, cleared visual approach to the Vieques airport."*

IFR Operations at Non-Towered Airports

Aircraft on an IFR flight plan that are arriving or departing from a non-Towered airport are handled differently than at a Towered airport.

Radar coverage is not necessarily guaranteed for all airports within a specific approach sector, this may be due to obstructions due to terrain, or weak radar signal at far distances. For this reason, non-radar separation is used, allowing one IFR aircraft into or out of the airport at a particular time. This is commonly known as the "One in / One out" rule.

IFR Departures:

Given that radar coverage cannot be guaranteed, pre-planned IFR departure procedures known as Obstacle Departure Procedures (ODPs) have been designed for most airports. These procedures provide a textual and sometimes graphical depiction of the departure procedure that must be flown to ensure terrain or obstacle avoidance.

When issuing IFR clearances to aircraft at non-towered fields it is a good practice to issue them *"as filed"* since it gives the pilot the freedom to establish their own terrain clearance and navigation, below the applicable MVA. An initial heading may be assigned for the aircraft to fly upon reaching the MVA if necessary.

Given that non-Towered airports operate on the "One in / One out" rule, it is often beneficial to "Hold" aircraft for "IFR release" until they are holding short of the runway and ready for departure. If no inbound IFR traffic is expected, you may "Release" an aircraft once the clearance is given and issue a "Void time" that would cancel the IFR release if they are not airborne before then.

Examples:

- *"N12345, cleared to the Mayagüez airport as filed, climb and maintain four thousand, upon crossing two thousand six hundred, fly heading 260."*
- Once pilot reads back clearance: *"N12345, readback correct, hold for release, advise on this frequency number one ready for departure, frequency change to UNICOM approved."*
- Pilot reports number one for departure: *"N12345, released for departure, clearance void if not airborne by 1020z, time now 1015z, if not off by 1030z advise of your intentions. Report airborne on this frequency, frequency change to UNICOM approved."*

Release times can be in Zulu format or in minutes.

<u>IFR Arrivals:</u>

IFR arrivals into non-towered fields are treated basically the same as towered field arrivals up to the point when the approach clearance is given. At this point, the airspace "belongs" to the IFR arrival until it has landed, cancelled IFR, or returned to the radar environment due to a missed approach.

Once the inbound aircraft is established on the final approach course, and prior to reaching the FAF, the plane will be released to the advisory frequency.

Use the following phraseology: *"N12345, report IFR cancellation or missed approach on this frequency. Change to advisory frequency approved."*

When an IFR aircraft cancels their IFR flight plan:

- If airborne: *"IFR cancellation received, radar services terminated, squawk VFR, frequency changed approved."*
- On the ground: *"IFR cancellation received."*

VFR Traffic: General

VFR aircraft can also receive basic radar services while in flight. These services commonly referred to as "Flight Following" include the following:

- Safety alerts
- Traffic advisories
- Limited radar vectoring - pilot requested or operationally advantageous –
- Sequencing, when established by a facility LOA

Basic VFR services shall be provided on a workload permitting basis. Terminate radar services at an appropriate distance that allows sufficient time for the aircraft to change to the appropriate tower or traffic advisories frequency.

- Example: *"N12345, no traffic observed between you and the Arecibo airport, radar services terminated, squawk VFR (1200), frequency change to UNICOM is approved."*

Practice Approaches

Practice approaches may be performed by aircraft operating on an IFR or VFR flight plan. When on an IFR flight plan, aircraft must be given the appropriate IFR separation until the aircraft lands, and the flight plan is terminated, or when the pilot cancels the IFR flight plan. Aircraft practicing approaches while on a VFR flight plan are not provided with separation services and the controller must instruct the pilot to maintain VFR and advise that no separation services are being provided.

If an altitude is being assigned to aircraft conducting practice approaches, they must meet the MVA, MSA or MIA criteria for that sector.

In the case of a missed approach while conducting a practice approach:

- IFR flight plan: aircraft is automatically authorized to conduct the published missed approach for the approach being flown
- VFR flight plan: not automatically authorized to conduct the published missed approach. The pilot must request to fly the published missed approach and the request must be approved by the controller. When a published missed approach is approved, separation services must be provided for the aircraft.

VFR-on-top

An aircraft may be cleared to *"maintain VFR-on-top"* if the pilot of the aircraft on an IFR flight plan requests the clearance. Aircraft cleared to maintain VFR-on-top are responsible for:
flying at an appropriate VFR altitude
complying with VFR visibility and distance from cloud criteria
remaining vigilant to see-and-avoid other aircraft
complying with instrument flight rules applicable to the flight (e.g. adhering to ATC clearances)

IFR separation is not applied for aircraft operating VFR-on-top. However, the radar controller must continue to provide traffic advisories, safety alerts and apply merging target procedures when applicable.

You may clear an aircraft to climb through clouds, smoke and haze and then to maintain VFR-on-top if the following conditions are met:
it is requested by the pilot
you inform the pilot of the reported height of tops (if available)
you ensure separation from all other traffic for which you have separation responsibility
when an aircraft is climbing to and reports reaching VFR-on-top, reclear the aircraft to maintain VFR-on-top

Examples:
If aircraft already above tops: *"N12345, maintain VFR-on-top at or above one two thousand five hundred"*
If aircraft below tops: *"N12345, climb to and report reaching VFR-on-top... tops reported at four thousand eight hundred... if not on top at four thousand eight hundred... maintain five thousand and advise"*

Airborne IFR Clearances

VFR aircraft may sometimes request an IFR clearance once in the air (due to weather, or other factors). This is commonly referred to as a "Pop-Up IFR".

When a VFR aircraft requests a "Pop-Up IFR" proceed as follows:

- If not on VFR flight following assign a squawk code and radar identify the aircraft
- Verify that the aircraft is above the MVA/MIA for that airspace
    - If above: issue a clearance and an altitude to maintain
    - If below:
        - Ask the pilot if they can maintain terrain and obstruction clearance while climbing to the minimum IFR altitude (MIA)
            - If yes: Issue clearance and altitude to maintain
            - If not: Issue the pilot to maintain VFR and state intentions (aid the pilot as necessary)
- Unless operationally advantageous, issue a direct to destination clearance.
    - Example: *"N12345, radar contact one five miles south of the St. Thomas V-O-R, cleared to the San Juan airport via direct, climb and maintain four thousand."*

Chapter 2: Center (En route)

Position Responsibilities

The Center, or En route controller, provides separation and ATC services to aircraft operating on an IFR flight plan and, workload permitting, aircraft on basic VFR services. Center controllers must have a thorough understanding of IFR procedures since they are controlling a significantly larger airspace and can be simultaneously running various types of operations, particularly when operating in a top-down capacity. This can include en-route separation, approach control services, tower operations, among others.

The use of "heavy" or "super" designations is not required when controlling aircraft within the Center airspace.

Duty Priority

Given the increased complexity of running top-down operations in the VATSIM network. Controllers should assign priorities as operationally required to provide adequate service to the aircraft flying within the San Juan CERAP airspace.

Center controllers should also develop the skills to pro-actively anticipate when assistance from underlying controllers (APP, TWR, GND) may be required to ensure expeditious and quality service.

Coordination

A center controller must ensure that aircraft departing their airspace are able to meet any routing and/or altitude requirements that are specified by a letter of agreement (LOA) with a neighboring Flight Information Region (FIR) or Air Route Traffic Control Center (ARTCC).

Whenever operationally beneficial or at a pilot's request, a shortcut or direct to amendment can be issued to expedite an aircraft's transit through the Center airspace. Whenever this is done, ensure that the shortcut lies within the lateral boundaries of your airspace or sector. If the shortcut requested is on an adjacent sector or FIR, proper coordination between controllers must be carried out prior to issuing the shortcut.

Airspace

The Center controller is responsible for all the controlled airspace within the lateral boundaries of the San Juan CERAP. In VATSIM this includes any Approach sectors or Towered airports that are not under the control of another VATSIM controller.

Separation Requirements

In the En route environment, controllers are tasked with providing appropriate radar separation to aircraft operating on an IFR flight plan or on basic VFR services (Flight Following). Given that the Center airspace can typically extend hundreds of miles away from the radar station. Separation requirements between targets needs to be greater than in the Approach (Terminal) environment.

The separation requirements will vary according to the radar surveillance equipment that is being used.

- ERAM (En Route Automation Modernization) – Is the system architecture used by Center facilities across the continental (lower 48 states) in the United States.
    - When ERAM systems are being used the following lateral separation minima apply:
        - Below FL 600: 5 miles
        - At or above FL 600: 10 miles
- MEARTS (Microprocessor En Route Automated Radar Tracking System) – Is radar processing system that was designed for use in the San Juan CERAP, Honolulu Control Facility and the Alaska Air Route Traffic Control environments. It combines a mixture of long- and short-range radars, which allow it to provide both En route and Terminal services. It is also capable of processing and displaying ADS-B data.
    - When MEARTS systems are in use the following lateral separation minima apply:
        - Below FL 600: 5 miles
        - At or above FL 600: 10 miles
        - Within 60 miles from the radar antenna and at or below FL 230: 3 miles

If a super is operating at or below FL 240 and below 250 knots separate aircraft in trail by the following standards:
- Heavy – 6 miles
- Large – 7 miles
- Small – 8 miles

Vertical separation standards:
- At or below FL 410: 1000 ft
- Above FL 410: 2000 ft

IFR Arrivals into Towered Airports without Overlying Approach Control

When controlling inbound aircraft to a towered airport that does not have an overlying approach control facility, TJBQ for example, forward the following information to the tower controller as soon as practical to allow for adjustment of the local traffic flow:
- Aircraft identification
- Type of aircraft
- ETA
- Type of instrument approach procedure the aircraft will execute

Speed Adjustment

Do not issue an airspeed less than 250 knots, or the equivalent mach number, to aircraft operating between 10,000 ft and FL240.

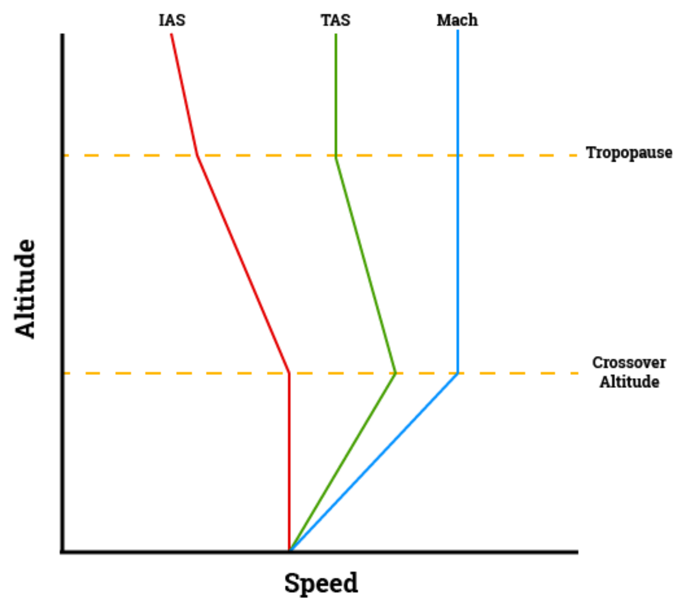
Most aircraft transition from mach numbers to indicated airspeed (IAS) between FL 260 – FL 320, the exact "crossover altitude" varies according to atmospheric conditions. For this reason, it is recommended to issue IAS adjustments for aircraft in a descent. Mach adjustments should be primarily issued to aircraft in their cruise phase above FL 290. When an aircraft on a previously assigned speed adjustment will transition from Mach to IAS, inform the pilot of a new speed to maintain.

- Example: *"N12345, as you transition from mach, maintain 280 knots or greater."*

On a standard day, the mach numbers equivalent to 250 knots are:

Altitude	Equivalent Mach
FL 240	0.60
FL 250	0.61
FL 260	0.62
FL 270	0.64
FL 280	0.65
FL 290	0.66

Above the crossover altitude but below the tropopause, aircraft on the same mach number but different cruise level will have different true airspeeds (TAS). The following diagram highlights this relationship.



Note: Do not assign speed adjustments to aircraft flying at or above FL 390 without their consent.

- Example: *"N12345, are you able to maintain mach 0.76?"*

Hazardous Weather

Adverse weather may be encountered at all phases of flight. Weather reporting systems have been established to notify pilots of weather phenomena that may be encountered in flight.

AIRMETS – inform the pilot of potentially hazardous weather conditions through an aircraft's route of flight.

- Sierra: Issued for mountain obscurations or IFR
- Tango: Issued for turbulence
- Zulu: Issued for icing or freezing levels

SIGMETS – inform the pilot of severe weather through an aircraft's route of flight that may pose a significant risk to the aircraft.

- Convective – Issued for areas where a thunderstorm is present or likely to occur
- Non-convective – Issued for any other severe weather phenomena

Controllers may forward AIRMET/SIGMET information to pilots as deemed necessary or upon request from the pilot.

Section B13 of the VATSIM Code of Conduct states: "Pilots are encouraged to utilize current real-world weather at all times. Pilots must utilize at least the following current, real-world weather parameters throughout all phases of flight: (a) Winds, (b) Pressure, (c) Temperature".

Thus, a pilot may request to deviate from their planned route for the purposes of avoiding significant weather (typically heavy precipitation or thunderstorms). If operationally feasible, approve the pilots request to deviate and advise them to re-join their assigned routing as soon as practical. If a specific pilot request cannot be accommodated, offer alternative instructions for the pilot.

Fuel Dumping

When performing a long-distance flight, Heavy and Super category aircraft will depart with a takeoff weight (TOW) that is greater than the maximum landing weight for that aircraft (MLW). This is due to the fuel requirements to safely reach the intended destination and have sufficient fuel to reach an alternate destination if necessary. Fuel consumption throughout the flight will reduce the aircraft's weight to a number below the MLW. However, in cases of emergency prior to reaching the MLW an aircraft will have to hold at a particular NAVAID to burn off excess fuel or accelerate the process by dumping fuel.

As a controller, when information is received that an aircraft plans to dump fuel, you must determine the route and altitude the aircraft will fly and the weather conditions in which the operation will be conducted.

Except when dumping fuel is necessary for emergency situations, an aircraft operating in VFR or IFR conditions may be requested to fly a different route.

If in IFR conditions aircraft must be assigned an altitude that is at least 2000 ft above the highest obstacle within 5 nm of the route or pattern being flown.

Separate IFR aircraft from the fuel dump (FD) aircraft by one of the following criteria:

- 1000 ft above FD aircraft
- 2000 ft below FD aircraft
- 5 nm laterally from FD aircraft

Separate radar-identified VFR aircraft from FD aircraft by 5 nm laterally.

Formation Flight Form-Up, Break-Up, and Separation

Formation flights are commonly performed by military aircraft, but they can also be performed by civilian pilots.

When a request for a formation flight is made, the Flight Lead becomes the only person responsible for communicating with ATC. Information for the formation will be transmitted using the lead's callsign.

A formation flight join-up will be supported when the following conditions are met:

- The participating pilot (or flight lead) requests it
  - Pilot: *"San Juan Center, SHARK 52 has SHARK 51 in sight, requesting formation join-up with SHARK 51 at FL 190, SHARK 51 will be the lead."*
- All participating pilots (or flight lead) concur
  - ATC: *"SHARK 51, verify requesting join-up with SHARK 52 and you have SHARK 52 in sight."*
- Each participating pilot (or flight lead) reports all aircraft in sight
  - Pilot: *"SHARK 51, confirms join-up with SHARK 52, we have SHARK 52 in sight."*
  - ATC: *"SHARK 52, climb and maintain FL 190, advise when formation join-up complete."*

When aircraft are in standard formation (less than 1 mile laterally and less than 100 ft vertically), only the lead aircraft should have a squawk code. All other aircraft can be instructed to squawk standby.

When a formation flight break-up is requested, issue appropriate instructions to ensure that separation will be achieved after break-up and that formation aircraft will contact you on your frequency. If necessary, relay new squawk codes to the formation aircraft via the Flight Lead.

Aerial Refueling

Authorize aircraft to conduct aerial refueling operations along published or special tracks at their flight plan altitude.

- *"PACK 91, cleared to conduct refueling between GABYY and DAKES along L325. Maintain FL 240."*

During aerial refueling, the tanker aircraft is responsible for receiver aircraft communication with ATC and for their navigation along the track. Air refueling airspace is not "sterile" and other aircraft may transit the airspace if vertical or lateral separation are provided from the refueling aircraft.

MARSA (Military Assumes Responsibility for Separation of Aircraft) – Begins when the tanker and receiver aircraft enter the refueling airspace and the tanker aircraft notifies ATC that MARSA has been accepted. MARSA ends when the tanker and receiver aircraft are vertically positioned within the air refueling airspace and advise that MARSA has ended.

Unless some other routing has been determined, clear the aircraft to depart the refueling track at a navigational reference point.

Military Operation Areas (MOAs)

An MOA is an airspace that defined both laterally and vertically for military flight training use.

An MOA is considered "hot" when a military aircraft has been cleared into the airspace. However, there is no requirement to keep aircraft clear of the airspace. IFR aircraft can be cleared into through an MOA provided that IFR separation can be met. VFR aircraft can transit through an MOA at any time. Note that VFR traffic receiving flight following services must be notified of an MOA being active if they are going to transit through one.

MOA clearance for military traffic:

- *"SHARK 51, cleared into the Salinas 1 and 2 MOA, between 3000 and 8000 ft."*
- *"SHARK 51, change to discrete frequency is approved, contact me on (CTR freq) at 6000 ft prior to exiting the MOA."*

Military Training Routes (MTRs)

MTRs have been developed for use by the military to conduct low-altitude, high-speed training. These are generally below 10,000 ft and are depicted on sectional and IFR low charts.

MTRs where no segments are above 1500 ft are depicted with the IR (IFR) or VR (VFR) prefix followed by a four-digit number.

MTRs that include one or more segments that go above 1500 ft are depicted with the IR or VR prefix followed by a three-digit number.

References

The San Juan CERAP – Radar Training Manual is composed of material readily available from the FAA JO 7110.65Z Basic w Chg 1, 2, and 3 (effective June 17, 2022).

Additionally, material from the Boston Virtual ARTCC – ATC Handbook was extracted to complete this document. In particular, the following sections: *Formation Flight Form-up, Break-up and Separation, Aerial Refueling, Military Operating Areas (MOAs), Military Training Routes (MTRs)*. Additionally, formatting for tables was inspired by those created by BVARTCC.