Computer Based Instruction is provided at:

http://www.aaainnovate.com/CA53.html
INSTRUCTIONS TO SUBJECT PILOTS, NASA AMES
IM CMS FOR ATD-1 (IM-CA 5.3)
APRIL 2014

Interval Management Users Guide

Revision 003, April 2014

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INTERVAL MANAGEMENT (IM)

DESCRIPTION

Using another aircraft’s precise position and state data, the pilot will be given speed cues to follow that will position his aircraft a precise time interval from the other aircraft over a point in space. This point could be the runway threshold, final approach fix, gateway waypoint, or any other desired position. IM will not change normal procedures. Airspeed prompts will be received from the onboard IM system instead of ATC. The system is designed to maintain within 15% of an optimized profile descent or published arrival.

DEFINITIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>AGD</td>
<td>ADS-B Guidance Display</td>
</tr>
<tr>
<td>EFB</td>
<td>Electronic Flight Bag</td>
</tr>
<tr>
<td>IM</td>
<td>Interval Management</td>
</tr>
<tr>
<td>IM Commanded Speed</td>
<td>Commanded Speed that is displayed to the pilot. Pilot flies this speed to</td>
</tr>
<tr>
<td></td>
<td>meet either an RTA or a spacing interval behind another aircraft</td>
</tr>
<tr>
<td>IM WAYPOINT</td>
<td>Position in space that spacing will occur</td>
</tr>
<tr>
<td>IM GOAL</td>
<td>Spacing Interval in seconds or distance that is to be achieved between</td>
</tr>
<tr>
<td></td>
<td>aircraft at the IM Waypoint</td>
</tr>
<tr>
<td>Optimized Profile Descent (OPD)</td>
<td>An arrival where aircraft are cleared to descend from cruise altitude to</td>
</tr>
<tr>
<td></td>
<td>final approach using the most economical power setting at all times</td>
</tr>
<tr>
<td>Ownership</td>
<td>Aircraft that is being flown by subject pilot</td>
</tr>
<tr>
<td>Paired Mode</td>
<td>Ownership is receiving valid ADS-B information from Target Aircraft</td>
</tr>
<tr>
<td></td>
<td>and is actively spacing</td>
</tr>
<tr>
<td>STA</td>
<td>Scheduled Time of Arrival over a waypoint</td>
</tr>
<tr>
<td>Target Aircraft</td>
<td>Aircraft that is selected and entered into the IM system. Ownership will</td>
</tr>
<tr>
<td></td>
<td>achieve a desired spacing interval behind this aircraft</td>
</tr>
</tbody>
</table>
BACKGROUND

Merging aircraft into a manageable sequence and controlling their spacing on final approach are essential to improving the productivity of the National Airspace System (NAS). Airport arrival capacities are governed by runway configurations, runway occupancy times, and wake turbulence separation requirements. Air traffic controllers often add buffers to in-trail arrival spacing due to the limitations of ground-based surveillance, the procedures used to communicate and confirm speed commands, as well as uncertainties about how instructions will be followed. This leads to large variances in the actual arrival separation values. By increasing aircraft separation accuracy and precisely spacing aircraft over the runway threshold, the need for such buffers may be reduced. In turn, this would reduce the spacing variance, effectively increasing airport arrival capacity without lowering separation minima.

Interval management (IM) concepts were derived from development activities within the FAA and the global aviation community. IM is designed to facilitate the needs of aircraft operators while providing Air Traffic Controllers with an easier way to manage the sequence and spacing of aircraft into any airport. This is done by providing the flight crew with automated speed guidance to fly during IM operations. By following IM speed guidance, precise time intervals can be achieved between successive aircraft on approach.

IM employs a new onboard avionics system that provides speed guidance to the flight crew. This speed guidance is generated by the NASA Langley Airborne Spacing for Terminal Arrival Routes (ASTAR) algorithm. The speed guidance is presented to the aircrew either on the primary flight display in an integrated system, or on an external electronic device in a non-integrated solution.

ASTAR uses relatively small speed changes to achieve the desired spacing interval by the designated point. This is done in a predictable and safe operation that allows the merging of multiple arrival streams and the delivery of aircraft to the runways within a 5 second window. For situations where multiple arrival routes are being flown to common or parallel runways, the IM speed guidance also ensures safe and accurate merging at the points where arrival routes converge.

IM operations and Optimized Profile Descents (OPDs) are part of the FAA’s Next Generation Air Transportation System (NextGen). Many of the NextGen applications will rely on the predictability of an aircraft’s speed and vertical path for separation assurance. To ensure the predictability of vertical paths during IM operations, flight crews will be required to modulate thrust and drag to stay on both the IM speed profile and the OPD vertical path.

During the CA 5.3 experiment, flight crews will fly charted RNAV Arrivals to an ILS approach into Phoenix Sky Harbor International Airport (KPHX) airport while following IM speed guidance. IM avionics and the ASTAR algorithm will be accessed through an Electronic Flight Bag (EFB).

EXPERIMENT PURPOSE AND DESCRIPTION

The purpose of this experiment is to validate crew procedures for IM operations as well as the ASTAR algorithm itself. The IM Clearance will be received verbally over the radio and entered into the IM system via an Electronic Flight Bag (EFB). This clearance will contain the spacing interval (in seconds), the target aircraft’s callsign, and the target aircraft’s arrival routing. Once valid ADS-B data is received from the target aircraft, the IM system will “pair” with it. A command speed will be displayed to achieve the required spacing from that aircraft at the final approach fix. The assigned spacing interval will meet wake vortex and IFR separation criteria. Information about the target aircraft and the precise time interval to be achieved at the designated point are used by the ASTAR algorithm to generate IM speed guidance.

The merge to the same lateral path behind the target aircraft landing on the same runway may occur at altitude, during descent, or in the terminal area. IM speed guidance is only given until Ownship reaches the FAF. At this point the system will terminate and the pilot is expected to configure the aircraft with landing flaps and landing airspeed. During IM operations, the separation between aircraft should never be less than the standard separation criteria used today. Air Traffic Control (ATC) is still responsible for separation assurance and may discontinue IM spacing if separation is a concern.
Equipment & Avionic

IM AVIONICS

Two key pieces of avionics will be used to conduct the IM operation: the Electronic Flight Bag (EFB) and the Configurable Glass Display (CGD). Pilots will use the EFB to enter ownship and target aircraft information. The EFB is also used to activate, suspend, resume, and cancel the IM spacing. Additionally the EFB displays the IM commanded speed, a Fast/Slow Indicator, and a CDTI showing the location of the target aircraft and all other ADS-B out aircraft. The commanded speed, fast/slow indicator, and system messages are also displayed on the CGD, which is positioned in the forward field of view of the pilot. When the IM commanded speed changes, the pilot will manually set it in the speed window of the Mode Control Panel (MCP).

Electronic Flight Bag (EFB)

1 – CMD SPD shows the current airspeed the airplane should fly to achieve the spacing goal.

2 – Speed Conformance Information. Shows the deviation actual speed is from commanded speed.

3 – Status Box. Displays current status of IM system. Values are: CALCULATING, SPACING BEHIND, and SUSPENDED.

4 – Alerting Box. Displays cautions generated by the IM system.

5 – Situation Display. Ownship is displayed as a white triangle centered in the circle. Lead aircraft is shown as two chevrons with the inner chevron white and the outer green. Lead aircraft’s information block is also displayed showing callsign and altitude information. Other ADS-B out aircraft are shown as blue chevrons.

6 – OWN INFO. Allows the pilot to enter ownship information into the Interval Management System.

7 – Next Waypoint displays the next waypoint on the arrival that the aircraft will fly over. This field is for information only and cannot be modified.

8 – Descent Forecast Winds allows the pilot to enter up to 8 altitude winds for the arrival. This information may be entered manually or uploaded with an ACARS or CPDLC message.

9 – IM GOAL allows the pilot to enter in the spacing goal
10 – TARGET AIRCRAFT allows the pilot to select and identify the aircraft that will be spaced with.
11 – TARGET RTE allows the pilot to enter in the Target aircraft’s arrival routing, transition, and approach so that the Interval Management System knows the target’s ground track.
12 – Range Selectors. Using the ZOOM IN and ZOOM OUT buttons will change the range on the situation display of the EFB.
13 – Top Bezel Buttons
   MENU – Displays Main Menu of EFB
   BACK BUTTON – Returns to previous main page
   PGUP/PGDN – cycles through pages if more than one is needed to display information
   XFR – inoperative
   ENTER – Enters inputted information into the IM system
Configurable Glass Display (CGD)
Displays IM commanded speed and FAST/SLOW indications in the pilot’s forward field of view.

1 - Commanded Speed. Displays IM Commanded Speed. When an IM speed change occurs the speed will be highlighted for 10 seconds. If the pilot does not respond within 10 seconds, the commanded speed will blink until the displayed speed is set in the MCP.

2 – FIM Status Indication. Will display CALCULATING, SPACING, or SUSPENDED.

3 – Target Aircraft Callsign when receiving ADS-B information

4 - FAST / SLOW Speed. Displays difference between actual and IM Commanded Airspeed. During deceleration this value may be used to see how closely you are to the desired deceleration rate.

5 – System Caution and Information Messages
Procedures

The aircraft will perform Interval Management to the final approach fix (FAF). Once ADS-B information is received from the target aircraft, the IM system will provide commanded speeds for the pilot to fly to achieve a precise interval behind the lead aircraft at the FAF. Pilot actions are basically the same as the pilot performs today. He or she will fly assigned speeds while maintaining the vertical profile to meet all restrictions. The only difference is that the assigned speeds will come from the automation and not the controller.

If ATC expects the aircraft to fly IM Procedures, they will issue an IM clearance. This clearance will contain the spacing interval to achieve, target aircraft’s call sign, and target aircraft’s arrival routing. An aircraft is considered paired with a target aircraft once valid ADS-B information from that target aircraft is received, and a commanded airspeed is displayed. Once paired to a target aircraft, the ownship speed is compared to the information known about the target aircraft and an IM commanded speed is generated for the pilot to fly that will achieve the assigned spacing interval when the aircraft crosses the FAF. The system is designed for limited airspeed changes and to conform as closely as possible to an Optimized Profile Descent (OPD) or published arrival. At airports saturated with arrival aircraft, the greatest capacity benefits may be realized by having sequences of aircraft operating in IM mode, with each aircraft actively spacing off the aircraft ahead of it.

Speed guidance is displayed on the EFB in the CMD SPD block and is duplicated on the CGD located in the pilot’s forward field of view. The aircraft's airspeed is controlled by setting the IM Commanded Speed in the MCP speed window. The pilot flying (PF) will fly the arrival and instrument approach on autopilot. The use of the autopilot system reduces pilot workload and allows precise spacing intervals to be established. For a majority of the descent the aircraft will descend in VNAV SPD mode with the throttles in the HOLD mode. To ensure the predictability of vertical paths during IM operations, flight crews will be required to modulate thrust and drag to stay on the IM speed profile and the OPD path. The aircraft will pitch to maintain the speed window’s set speed. Throttles and drag devices will be used to nominally maintain the aircraft within ±400 feet of the VNAV path. After crossing the FAF, IM speed guidance will be removed from the display and the pilot will configure the aircraft for landing.

PROCEDURE OVERVIEW

1) Program FMC with arrival routing, VNAV descent, and forecast winds. Tune radios
2) Load ownship information into the EFB
3) Load Descent Forecast Winds into EFB
4) Load Spacing Interval into EFB
5) Load Target Aircraft Callsign into EFB
6) Load Target Aircraft Arrival routing into EFB
7) Activate IM in EFB
8) Fly IM Commanded airspeed on arrival while maintaining VNAV path
9) At FAF configure airplane for landing
DETAILED PROCEDURES

This IM experiment begins near the terminal area of Phoenix Sky Harbor International Airport (KPHX). Your arrival clearance will consist of the STAR and approach you are to fly. You are expecting a continuous descent from cruise to the runway threshold.
The scenario begins at cruise altitude with autopilot and auto throttles engaged. LNAV and VNAV PATH will be active.

1. The arrival and approach are already entered into the FMC.
2. The FMC VNAV descent page is already programed for the descent profile.
3. Load Forecast Descent Winds in the FMC VNAV Forecast Page and EFB via CPDLC message.
4. Program Ownship information into the EFB.
   Ownship information would normally be programmed sometime earlier in the flight.

Press the OWN INFO Key to enter Ownship information
Ownship Route Information page appears. Enter the cruise altitude, cruise Mach at altitude, and the planned descent Mach and CAS at crossover for the descent by entering each value in the scratchpad and then by either pressing the associated field on the EFB or the adjacent bezel button.

Mach may be entered without the leading decimal (80). DES MAC/CAS must contain the slash (80/300)

DEST AIRPORT Block. This will make the OWNSHIP RTE button appear with a caret symbol that indicates it is selectable. Press OWNSHIP RTE block to enter ownship route information.

Select the arrival, transition, and approach that will be flown by either pressing the block on the touch screen or by pressing the button located next to the block (ILS26), An ENTER button will appear in the lower right to show all required elements have been selected. Press the ENTER button to enter the arrival into the FIM system and return to the Ownship Route Information Page.
Once all the required elements have been entered, an ENTER Key will appear. Press the ENTER key to return to the main screen.

NOTE: If ATC descends the aircraft to a lower altitude prior to Top of Descent or changes cruise/descent speeds, the pilot needs to update these values on this page.

OWN INFO block now shows the arrival transition to indicate ownship information has been entered.
5. **Descent Forecast Winds**

For IM to work efficiently it must have good wind information. This wind forecast will be provided normally by the aircraft’s company and will be at altitudes that have major wind shifts. The wind information will normally be uploaded through a CPDLC message but may be entered manually.

Press the DES FCST WINDS block to enter the Forecast Descent Winds

Enter the altitude into the scratchpad. Three number values will be interpreted as Flight Levels while four and five number values will be entered as MSL altitudes. Enter the value by pressing the altitude block or the adjacent bezel button. The BKSP button will erase one number while the CLR button will clear the whole scratchpad. Delete will allow you to delete a value already loaded into the field by pressing Delete and then the desired field.

Enter the direction and speed values separated by a slash. Enter the value by pressing the associated DIR/SPEED block or the adjacent bezel button.

Press the ENTER key located on the touchscreen or the top of the EFB to return to the EFB Main Page

There are two Descent Forecast Pages allowing you to enter in a total of eight altitude winds for the descent. Use the PGUP and PGDN buttons located on the top of the EFB to switch between pages.
6. Receive IM Clearance and program IM Goal and Target aircraft information into the EFB
The IM clearance will be given by ATC over the radio. The clearance will contain the IM Goal, Target Aircraft, and Target Aircraft’s Arrival Routing.

‘NASA 12, when able space 90 seconds behind Delta Alpha Lima 877 who is on the EAGUL 5 Zuni Transition, Runway 26. Advise when paired behind Delta Alpha Lima 877’

Press the IM GOAL Key to Enter in spacing goal.

‘space 90 seconds’

Enter the spacing goal as given in the IM clearance. The default value is seconds. The scratchpad may be cleared by using the CLR button located on the bottom row of the keyboard. The CANCEL button will cancel the input and return to the Interval Management page. Pressing ENTER will enter the time into the IM system and return you to the Interval Management Page.

The IM-S GOAL now shows 90 seconds. To select TGT ACFT press the TGT ACFT block on the touchscreen or the bezel button located beside it.
The Target Aircraft page appears. This page will show all the aircraft within ADS-B range sorted alphabetically. If there are more aircraft than can fit on one page, the page up and down buttons will be used. Select the target aircraft by either pressing on the touchscreen or pressing the button located beside it.

Once a callsign is selected, the ENTER and CLEAR prompts will be active. Pressing the CLEAR prompt will clear the selection. Pressing the ENTER prompt will enter the callsign into the IM system and return you to the Interval Management Page. If the target aircraft is not in ADS-B range, the pilot may enter it manually by pressing the MANUAL button.

DAL 877 is now shown as the target aircraft. To enter the Target Aircraft’s route press the TGT RTE block or the bezel button located beside it.

Select the Target Aircraft’s arrival, transition, and approach in the same manner you selected your own aircraft’s route. The target aircraft will always be landing on the same runway that ownship is landing.

Once all items are selected an ENTER button appears. Press the ENTER button to input the Target Aircraft’s route into the FIM system and return to the main Interval Management Page.
7. Activate IM System

Once entered, the TGT ACFT and TGT RTE will be filled in with this information. An ACTIVATE button will appear once all required information has been entered.

Once the information has been verified by both pilots, the ACTIVATE button will be pressed to start Interval Management Operations.

The ASTAR algorithm will initially need time to compute speed commands. During this period, CALCULATING will be displayed. NEXT WPT, TGT ACFT, and TGT RTE fields turn into labels. These items cannot be changed once IM is activated. The OWN INFO and IM GOAL can be changed if the original IM clearance is amended. The NEXT WPT field displays the next waypoint ownship will fly over on the arrival.

The CGD located in the pilot’s forward field of view will also become active displaying CALCULATING and the target Aircraft’s callsign. The callsign will display white to indicate the target aircraft is not yet paired and no commanded speed is shown.
Once a commanded speed has been calculated, the target aircraft will be paired. A command speed will appear. The pilot will open the MCP speed window and fly this speed. A Fast / Slow indication also appears to indicate the difference between commanded and actual airspeed.

The CGD will also change to indicate the paired status. SPACING will appear in the Status block and the target aircraft’s callsign will turn green. A command speed will appear and the Fast /Slow indication will be presented graphically on the left side. Once paired, the pilot is allowed to fly IM operation using the CGD exclusively.

The pilot will notify ATC with a radio call:

“NASA 12 is paired behind Delta 877. Commanded speed is 280 knots”
8. Arrival Interval Management Procedures

- (PF, PM) Airspeed Requirements
  - Observe and announce IM Speed changes and mode changes on CGD/EFB
    - Speed changes will highlight for 10 seconds than will blink if not set
  - Set IM commanded speed in speed window on MCP

  **NOTE:** When IM is active, fly the IM commanded speed and disregard any charted speeds on the arrival. Use the FAST/SLOW indicator for deceleration/acceleration rate guidance.

- Configure aircraft as necessary to maintain IM commanded speed

- (PF, PM) Vertical Path Requirements
  - Verify VNAV SPD is active mode
  - Ensure aircraft starts a descent at Top of Descent (TOD) Point
  - Use drag devices and thrust as necessary to maintain VNAV path within ±400 feet (PF)
  - Monitor that aircraft stays on path and all restrictions will be met

- (PF, PM) Spacing Requirements
  - No Status messages on EFB (See non normal below for action)
  - Notify ATC when initially spacing behind target aircraft with Commanded airspeed
  - Notify each new ATC check in with “Paired behind”
  - Notify ATC if unable IM spacing (see additional procedures)

9. Final Segment Interval Management Procedures

- (PF, PM) Configuration and Energy Management
  - Extend Flaps as necessary
  - VNAV PTH will engage at flap extension
  - Maintain least amount of flaps required to maintain IM speed and vertical path

  **NOTE:** IM commanded speed might increase above current flap max speed. Reduction of flaps may be required.

  - When IM commanded speed blanks at the FAF
    - Gear down
    - Target Speed set in MCP Window
    - Configure as necessary to be stable by 1000 feet AGL

- Automation Procedures
  - Aircraft will transition to VNAV PTH when flaps are extended
  - Arm approach mode between 6-2 miles prior to FAF
  - Ensure aircraft will capture both the localizer and glideslope

  **NOTE:** If aircraft is on VNAV PTH profile the aircraft will be on or slightly below glideslope when established on final

- Set Target Speed in MCP speed window when crossing the FAF and IM Commanded Speed is removed from the EFB and CGD.
**Communication**

Precise and correct terminology is critical to the success of Interval Management operations. ATC will advise the aircraft that a spacing clearance is coming. The aircrew should be ready to copy the clearance that will come in the format <Spacing Interval>, <Target Aircraft Callsign>, <Target Aircraft Route>. The aircrew will repeat the clearance back to ATC for verification. There will be two variations of the clearance to indicate when spacing should occur (aircrew presses the ACTIVATE button). A “WHEN ABLE” clearance means the aircrew should activate spacing immediately. An “AFTER <waypoint>” clearance indicates the aircrew should wait to cross the waypoint before pressing ACTIVATE. This type of clearance indicates that ATC expects further vectors to occur before clearing the aircraft to descend via the arrival.

**Interval Management Clearance Procedures**

**ATC:** "NASA 6, CLEARANCE AVAILABLE, ADVISE WHEN READY TO COPY.”

**NASA 6:** “READY TO COPY”

**Interval Management clearance to commence as soon as feasible**

**ATC:** “NASA 6, WHEN ABLE, SPACE 100 SECONDS BEHIND UNITED TWO-FIVE-FOUR ON THE KOOLY Four ARRIVAL. REPORT PAIRED.”

**NASA 6:** “NASA 6, WHEN ABLE, SPACE 100 SECONDS BEHIND UNITED TWO-FIVE-FOUR ON THE KOOLY FOUR ARRIVAL. REPORT PAIRED.”

**Interval Management clearance to commence after a waypoint**

**ATC:** “NASA 6, After HOMRR, WHEN ABLE SPACE 100 SECONDS BEHIND UNITED TWO-FIVE-FOUR ON THE KOOLY FOUR ARRIVAL. REPORT PAIRED.”

**NASA 6:** “NASA 6, WHEN ABLE, SPACE 100 SECONDS BEHIND UNITED TWO-FIVE-FOUR ON THE KOOLY FOUR ARRIVAL. REPORT PAIRED.”

**Interval Management spacing commencing**

When the system has the required information and has calculated and displayed a commanded speed, the aircraft is considered “PAIRED” with the target aircraft. This must be reported to ATC along with the FIM commanded speed.

**NASA 6:** “NASA 6 IS PAIRED BEHIND UNITED TWO-FIVE-FOUR. AIRSPEED IS 290 KTS.”

**ATC:** “NASA 6, ROGER”

**ATC SUSPENDS the FIM operation**

ATC might have to suspend interval spacing for a length of time for various reasons. If this would to occur, ATC will provide an airspeed for the aircrew to fly. The aircrew should assume that spacing would recommence at a later time.

**ATC:** “NASA 6, SUSPEND INTERVAL SPACING, SLOW TO 230 KNOTS.”

**NASA 6:** “NASA 6, SUSPEND INTERVAL SPACING, SLOW TO 230 KNOTS.”
ATC RESUMES the FIM operation

ATC: "NASA 6, RESUME INTERVAL SPACING BEHIND UNITED TWO-FIVE-FOUR."
NASA 6: "NASA 6, RESUME INTERVAL SPACING BEHIND UNITED TWO-FIVE-FOUR."

UNABLE Interval Spacing

NASA 6: "NASA 6, UNABLE INTERVAL SPACING DUE TO <reason>"
ATC: "NASA 6, MAINTAIN CURRENT SPEED, ADVISE WHEN ABLE TO INTERVAL SPACE."

Interval Spacing Available (after reported UNABLE)

NASA 6: "NASA 6, IS ABLE TO INTERVAL SPACING BEHIND UNITED TWO-FIVE-FOUR"
ATC: "NASA 6, RESUME INTERVAL SPACING BEHIND UNITED TWO-FIVE-FOUR"
NASA 6: "NASA 6, ROGER, RESUME INTERVAL SPACING BEHIND UNITED TWO-FIVE-FOUR"

Interval Spacing Amendment

ATC: "NASA 6, AMEND SPACING CLEARANCE, WHEN ABLE SPACE 120 SECONDS BEHIND UNITED TWO-FIVE-FOUR"
NASA 6: "NASA 6, WHEN ABLE SPACE 120 SECONDS BEHIND UNITED TWO-FIVE-FOUR"

Terminate Interval Spacing

ATC: "NASA 6, CANCEL INTERVAL SPACING, MAINTAIN CURRENT SPEED"
NASA 6: "ROGER, NASA 6 CANCEL INTERVAL SPACING AND MAINTAIN CURRENT SPEED"

NOTE: ATC may issue the IM Clearance with the following callsign variations:

"United 234"
"UAL 234"
"Uniform Alpha Lima 234"
Additional Procedures
The following procedures may be requested by ATC.

AMENDMENT OF SPACING GOAL

ATC may amend the Interval Management Clearance with a new IM STA or IM GOAL.

*NASA 6, space 110 SEC behind DAL 877*

Press IM GOAL and enter the new value into the system. The other pilot will check the new value after it has been entered.
SUSPEND AND RESUME

ATC may need to suspend Interval Management Spacing for a period of time. If a Suspend instruction is received the aircrew will assume that Interval Management Spacing will resume at a later time.

‘NASA 6, Suspend Interval Spacing and slow 10 knots’

Upon receiving a Suspend Instruction, press the SUSPEND Button on the IM PAGE.

All speeds are removed from the EFB and AGD and SUSPENDED is displayed in the IM Page Status Box. Follow ATC instruction for airspeed.
Upon receiving a Resume Instruction, press the RESUME button on the IM Page.

All IM airspeed information is displayed on the EFB and AGD. Follow the IM CMD SPD at this time.

Pilot reports to ATC:

“NASA 6, paired behind Delta 877. Commanded speed 280 knots”
UNABLE SPACING

If the CMD SPD disappears due to a caution, fly current airspeed and advise ATC. ATC will decide on the appropriate action. If ATC instructs, "advise when able to resume spacing," the crew will monitor the CMD SPD block. If a value returns to the block the aircrew will advise ATC and follow instructions.

“Center, NASA 6, Unable spacing due to target off path”

ATC: “NASA 6, Fly current speed, when able resume interval spacing, report paired”

Once CMD SPD returns aircrew reports to ATC:

“NASA 6 is paired behind Delta 877. Commanded speed 280 Kts”

ATC: “NASA 6, Roger”
CANCEL SPACING

ATC may cancel the Interval Management Clearance. This may be followed by airspeed/heading instructions or a new IM clearance.

NASA 15, Cancel Interval Spacing

Upon receiving a Cancel Instruction, press the SUSPEND button on the IM Page.

Press the CANCEL IM button to cancel the IM clearance. This will remove all information from all fields. A new clearance will have to be entered to Activate Interval Spacing.
## Alerts: Cautions, Advisory and Memos

The IM system and its associated ASTAR algorithm have the following alerts:

<table>
<thead>
<tr>
<th>Alert Level</th>
<th>Status Message</th>
<th>Meaning</th>
<th>Pilot Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caution</td>
<td>IM DISENGAGED</td>
<td>Loss of ownship flight path data, failure of the interface between the spacing algorithm and the aircraft avionics, ADS-B receiver failure, or other aircraft avionic failures</td>
<td>Fly Current Airspeed and advise ATC “Unable Spacing due to equipment failure”</td>
</tr>
<tr>
<td>Caution</td>
<td>IM TGT OFF PATH</td>
<td>Target aircraft is not on the flight path given by the ATC IM clearance</td>
<td>Fly Current Airspeed and advise ATC “Unable Spacing due to Target off path”</td>
</tr>
<tr>
<td>Caution</td>
<td>IM TGT ADSB LOST</td>
<td>Target aircraft ADS-B information is lost</td>
<td>Fly Current Airspeed and advise ATC “Unable Spacing due to Target ADS-B Loss”</td>
</tr>
<tr>
<td>Caution</td>
<td>IM OWN OFF PATH</td>
<td>Aircraft is greater than 2.5 NM laterally, 6000’ vertically, or 90 degrees of heading from the planned flight path</td>
<td>Fly Current Airspeed and advise ATC “Unable Spacing due to Ownship off path”</td>
</tr>
<tr>
<td>Caution</td>
<td>FIM SPACING EARLY</td>
<td>Aircraft unlikely to achieve spacing goal</td>
<td>Advise ATC</td>
</tr>
<tr>
<td>Caution</td>
<td>FIM SPACING LATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advisory</td>
<td>IM SPD LIMITED</td>
<td>IM would command a different speed but is limited by the 15% constraint</td>
<td>Advisory only. No crew action.</td>
</tr>
</tbody>
</table>