

1. Autopilot In-Flight Tuning Procedures

Flight Test Preparation



The flight test should be conducted on a clear, VFR day. It is recommended that clearing turns be performed before executing each procedure.



At many points, the pilot's attention will be divided between documentation, configuring SkyView, and maintaining situational awareness. Before commencing the flight test, ensure that you have adequate altitude, clear weather, no traffic, no obstructions in the flight path, great visibility, no airspace conflicts, etc. *If possible, bring someone along on the first autopilot test flight.*

If autopilot behavior, performance, or interference with the controls is cause for concern while flying, remember that the autopilot can be disconnected in any of the following ways:

- Press the Disconnect/CWS button
- If using the SIMPLIFIED controls:
 - Enter the AP Menu (MAIN MENU > AP MENU) and press the TRK+ALT button
 -  indicates the autopilot is engaged
 -  indicates the autopilot is not engaged
- If using the EXPERT controls:
 - Enter the AP Menu (MAIN MENU > AP MENU) and press the AP button
 -  indicates the autopilot is engaged
 -  indicates the autopilot is not engaged
- Turn off the autopilot circuit breaker/switch or remove the fuse



Roll Axis In-Flight Tuning Procedure

This procedure tunes the roll autopilot servo and thus, the flight characteristics of the aircraft in heading holds and turns. This procedure should be performed with the autopilot roll axis in track (TRK+ALT) mode, where the purpose of the autopilot is to keep the aircraft's GPS ground track aligned with the track bug (as well as hold altitude). Before executing this procedure:

1. The autopilot controls should be changed to SIMPLE mode (SETUP MENU > AUTOPILOT SETUP > AUTOPILOT CONTROLS)

In-Flight Procedure

The following list is an overview of the procedure. Each step is described in more detail after the list, in flow-chart and textual formats.

1. Establish trimmed level flight on a fixed heading
2. Engage Autopilot (AP) in TRK+ALT mode
3. Allow a few minutes of stable flight under AP control
4. Change the TRK target 90 degrees from the current target
5. Check for ROLL SLIP indications
 - a. If observed, disconnect AP, increase ROLL TORQUE by 10% and start over
 - b. If ROLL TORQUE is already set to 100%, contact Dynon
6. Check if aircraft is slow to respond
 - a. If observed, disconnect AP, increase ROLL SENSITIVITY by 2 and start over
 - b. If ROLL SENSITIVITY is already maxed out, contact Dynon
7. Check if aircraft is "twitchy" in ROLL axis
 - a. If observed, decrease ROLL SENSITIVITY by 1
 - b. Change the TRK target 90 degrees from the current target
 - c. Check if aircraft overshoots TRK target
 - i. If observed, disconnect AP, increase ROLL GAIN by 0.2 and start over
8. Check if aircraft overshoots TRK target
 - a. If observed and you have been changing ROLL GAIN, disconnect AP, increase ROLL GAIN by 0.2 and start over
 - b. If observed and you have not been changing ROLL GAIN
 - i. If ROLL SENSITIVITY is maxed out, disconnect AP, increase ROLL GAIN by 0.2 and start over
 - ii. Otherwise, disconnect AP, increase ROLL SENSITIVITY by 2 and start over
9. Verify acceptable AP Roll performance
 - a. If unacceptable, refer to Roll Troubleshooting Section
 - b. If acceptable, procedure is complete



Detailed Flowchart

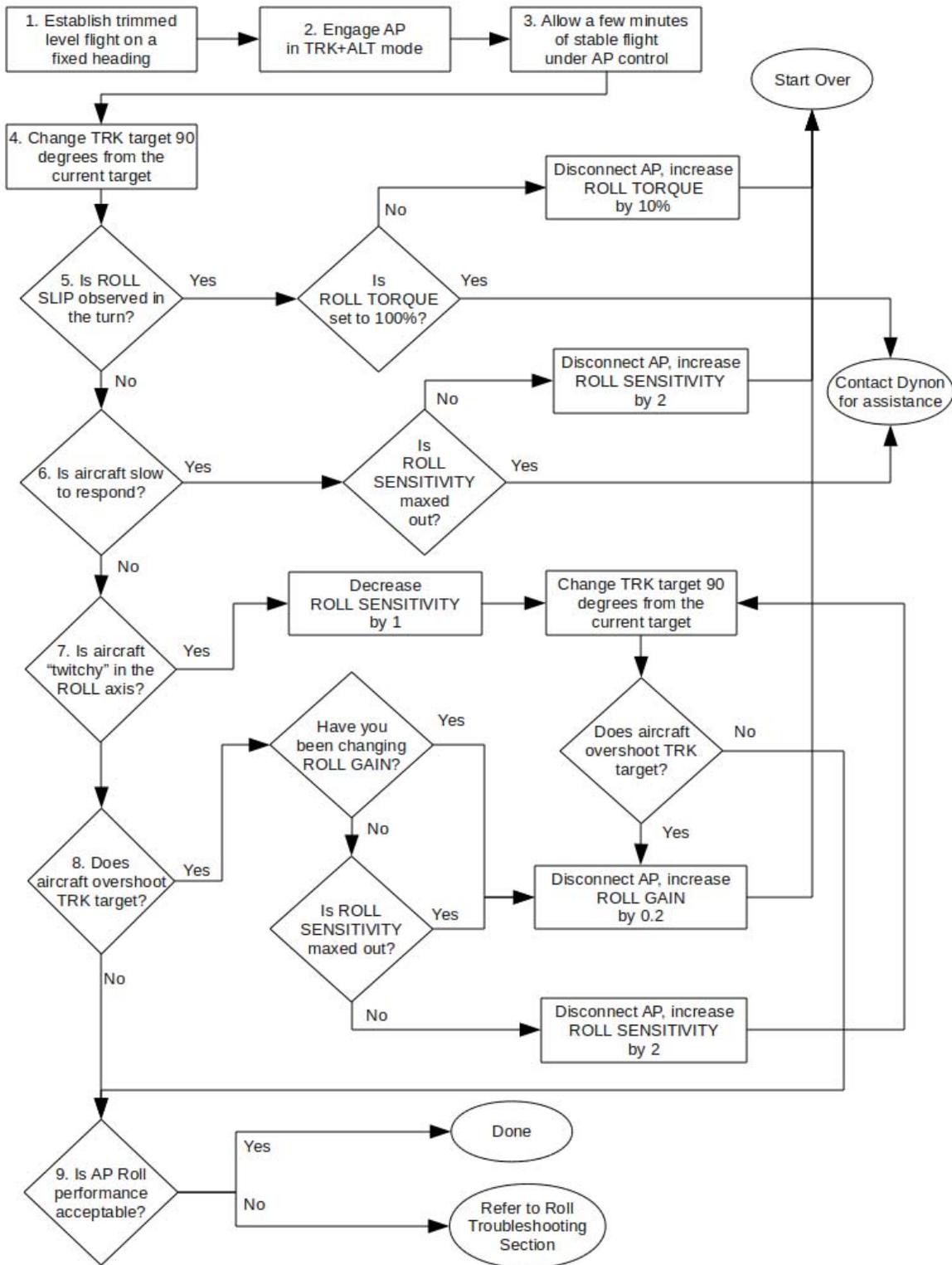


Figure 1 – Roll Axis – Flight Test Procedure

Detailed Explanation

1. Establish trimmed level flight on a fixed heading

You should start the procedure by placing the aircraft in level flight, in neutral trim, on a fixed heading. Try to maintain a constant altitude during the procedure.

2. Engage the Autopilot (AP) in TRK+ALT mod

To engage the autopilot in TRK+ALT mode:

1. Enter the AP Menu (MAIN MENU > AP)
2. Press button 3, TRK+ALT

3. It should be highlighted and look like 

Note that the heading (HDG) bug under the DG changes to the track (TRK) bug in track mode.

3. Allow a few minutes of stable flight under AP control

Ensure that you are not affecting the autopilot's control of the roll axis, so you can determine the autopilot's track hold and turn performance.

4. Change the TRK target 90 degrees from the current target

Change the heading bug to 90 degrees to the left or right of current heading.

1. Configure a joystick to control the heading bug. The label above the joystick should read (TRK)
2. Turn the joystick either way until the track bug reads 90 degrees to the left or right of current TRK target
3. The aircraft should immediately begin turning toward the new TRK target

5. Check for ROLL SLIP indications

Observe the autopilot status indicator on the Top Bar while the autopilot flies. If the **ROLL SLIP** banner is shown frequently, it is an indication that the roll servo is slipping and the servo torque needs to be increased. Occasional slips due to turbulence are acceptable.

If frequent ROLL SLIPS are observed, disconnect the autopilot and increase ROLL TORQUE by 10% (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > TORQUE).



If you have adjusted the roll servo torque to 100% and are still seeing frequent slips, you may need to try a higher strength servo (e.g., if you have an SV32 installed, try swapping for an SV42). Contact Dynon for assistance.

6. Check if aircraft is slow to respond

Observe the speed at which the autopilot responds to changes in TRK setting.

If the autopilot seems too slow to respond or "sluggish", disconnect the autopilot and increase ROLL SENSITIVITY by 2 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > SENSITIVITY).



If you have adjusted the roll servo sensitivity to its maximum setting and are still observing unacceptably slow behavior, contact Dynon for assistance.

7. Check if aircraft is “twitchy” in ROLL axis

Observe if the flight controls twitch excessively or seem overly aggressive.

If it does, this is an indication that the ROLL SENSITIVITY needs to be decreased. Decrease ROLL SENSITIVITY by 1 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > SENSITIVITY). There is no need to disconnect the autopilot before making this change.

After making this adjustment, change the TRK target 90 degrees from the current target, and check if the autopilot overshoots the new TRK target. If TRK target overshoot is observed, disconnect the autopilot, increase ROLL GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > GAIN) and start over. Otherwise, proceed to the next step.

8. Check if aircraft overshoots TRK target

Observe if the autopilot is overshooting or wandering around the track target. The autopilot should keep the open triangle of the track bug closely aligned with the small, magenta ground track triangle.

If an overshoot is observed and you made a recent ROLL GAIN adjustment, disconnect the autopilot, increase ROLL GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > GAIN) and start over

Otherwise, if you have not made a recent ROLL GAIN adjustment:

1. If ROLL SENSITIVITY is maxed out, disconnect the autopilot, increase ROLL GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > GAIN) and start over
2. Otherwise, disconnect the autopilot, increase ROLL SENSITIVITY by 2 (SETUP MENU > AUTOPILOT SETUP > ROLL AXIS > SENSITIVITY) and start over

9. Verify acceptable autopilot ROLL performance

At this point, the autopilot should be appropriately tuned in the roll axis. Performing numerous heading holds and turns will help verify this. Once satisfied with autopilot roll performance, this procedure is complete. If autopilot roll performance is not acceptable, refer to the Roll Troubleshooting section of this document.



Pitch Axis – IAS Hold – In-Flight Tuning Procedure

This procedure tunes the autopilot pitch servo and the flight characteristics of the aircraft in indicated airspeed (IAS) holds. Before executing this procedure:

1. The autopilot controls should be changed to EXPERT mode (SETUP MENU > AUTOPILOT SETUP > AUTOPILOT CONTROLS)
2. The ALT bug should be set to an altitude many thousands of feet above the intended flight testing altitude. This is to keep the autopilot in IAS Hold mode throughout the procedure.

In-Flight Procedure

The following list is an overview of the procedure. Each step is described in more detail after the list, in flow-chart and textual formats.

1. Establish trimmed level flight on a fixed heading
2. Engage the Flight Director (FD) in TRK and IAS mode
3. Engage the Autopilot (AP)
4. Allow a few minutes of stable flight under AP control
5. Increase IAS target by 10 knots
6. Check for PITCH SLIP indications
 - a. If observed, disconnect AP, increase PITCH TORQUE by 10% and start over
 - b. If PITCH TORQUE is already set to 100%, contact Dynon
7. Check if aircraft lags FD command bars
 - a. If observed, disconnect AP, increase PITCH SENSITIVITY by 2 and start over
 - b. If ROLL SENSITIVITY is already maxed out, contact Dynon
8. Check if aircraft is “twitchy” in PITCH axis
 - a. If observed, decrease PITCH SENSITIVITY by 1
 - b. Increase IAS target by 10 knots
 - c. Check if aircraft overshoots IAS target
 - i. If observed, disconnect AP, increase PITCH GAIN by 0.2 and start over
9. Check if aircraft overshoots IAS target
 - a. If observed and you have been changing PITCH GAIN, disconnect AP, increase PITCH GAIN by 0.2 and start over
 - b. If observed and you have not been changing PITCH GAIN
 - i. If PITCH SENSITIVITY is maxed out, disconnect AP, increase PITCH GAIN by 0.2 and start over
 - ii. Otherwise, disconnect AP, increase PITCH SENSITIVITY by 2 and start over
10. If this step has never been reached before, proceed to step 11.
 - a. Otherwise, skip step 11 and proceed to step 12.
11. Decrease IAS target by 10 knots and return to step 6.
12. Verify acceptable AP Pitch performance
 - a. If unacceptable, refer to Pitch Troubleshooting Section
 - b. If acceptable, procedure is complete



Detailed Flowchart

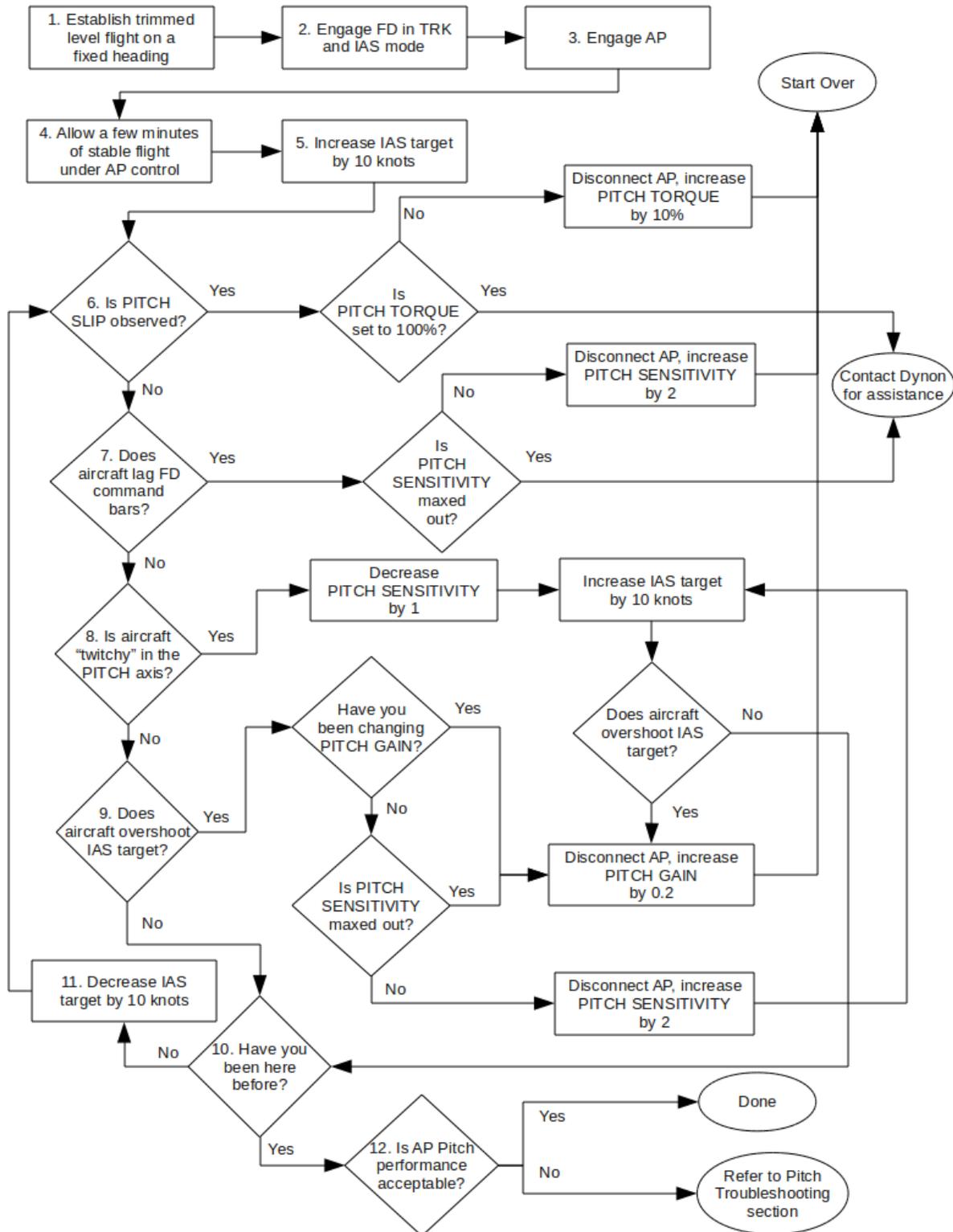


Figure 2 – Pitch Axis – IAS Hold – Flight Test Procedure



Detailed Explanation

1. Establish trimmed level flight on a fixed heading

You should start the procedure by placing the aircraft in level flight, in neutral trim, on a fixed heading. Try to maintain a constant heading during the procedure.

2. Engage the Flight Director (FD) in TRK and IAS mode

To engage the flight director in TRK and IAS mode:

1. Enter the AP Menu (MAIN MENU > AP)
2. Press the FD button
3. Press button 4, ROLL, then button 3, TRK
 - a. It should be highlighted and look like 
4. Press the BACK button
5. Press button 5, PITCH, then button 3, IAS
 - a. It should be highlighted and look like 
6. Example: if the Flight Director were engaged in TRK mode on a TRK of 360 degrees and an IAS of 100, the top bar would look like this:
 - a. 

3. Engage the Autopilot (AP)

To engage the autopilot:

1. Enter the AP Menu (MAIN MENU > AP)
2. Press AP
3. The AP and FD buttons should look like 

4. Allow a few minutes of stable flight under AP control

Ensure that you are not affecting the autopilot's control of the pitch axis, so you can determine the autopilot's IAS hold performance.

5. Increase IAS target by 10 knots

Change the IAS bug to 10 knots above the current IAS target.

1. Configure a joystick to control the IAS bug. The label above the joystick should read (IAS).
2. Turn the joystick clockwise until the IAS bug reads 10 knots higher than it did when the Flight Director was engaged.
3. The aircraft should immediately begin descending toward the new IAS target.



6. Check for PITCH SLIP indications

Observe the autopilot status indicator on the Top Bar while the autopilot flies. If the **PITCH SLIP** banner is shown frequently, it is an indication that the pitch servo is slipping and the servo torque needs to be increased. Occasional slips due to turbulence are acceptable.

If frequent PITCH SLIPS are observed, disconnect the autopilot and increase PITCH TORQUE by 10% (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > TORQUE).



If you have adjusted the pitch servo torque to 100% and are still seeing frequent slips, you may need to try a higher strength servo (e.g., if you have an SV32 installed, try swapping for an SV42). Contact Dynon for assistance.

7. Check if aircraft lags FD command bars

Observe the speed at which the autopilot responds to changes in IAS setting, and if the aircraft lags behind the Flight Director command bars.

If the autopilot seems too slow to respond or “sluggish”, disconnect the autopilot and increase PITCH SENSITIVITY by 2 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > SENSITIVITY).



If you have adjusted the pitch servo sensitivity to its maximum setting and are still observing unacceptably slow behavior, contact Dynon for assistance.

8. Check if aircraft is “twitchy” in PITCH axis

Observe if the flight controls twitch excessively or seem overly aggressive.

If it does, this is an indication that the PITCH SENSITIVITY needs to be decreased. Decrease PITCH SENSITIVITY by 1 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > SENSITIVITY). There is no need to disconnect the autopilot before making this change.

After making this adjustment, increase the IAS target by 10 knots, and check if the autopilot overshoots the new IAS target. If IAS target overshoot is observed, disconnect the autopilot, increase PITCH GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > GAIN) and start over. Otherwise, proceed to the next step.

9. Check if aircraft overshoots IAS target

Observe if the autopilot is overshooting or wandering around the IAS target. The autopilot should keep the open triangle of the IAS bug closely aligned with the IAS pointer on the airspeed tape.

If an overshoot is observed and you made a recent PITCH GAIN adjustment, disconnect the autopilot, increase PITCH GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > GAIN) and start over

Otherwise, if you have not made a recent PITCH GAIN adjustment:

1. If PITCH SENSITIVITY is maxed out, disconnect the autopilot, increase PITCH GAIN by 0.2 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > GAIN) and start over



2. Otherwise, disconnect the autopilot, increase PITCH SENSITIVITY by 2 (SETUP MENU > AUTOPILOT SETUP > PITCH AXIS > SENSITIVITY) and start over

10. If this step has never been reached before, proceed to step 11

The steps above should be verified for increasing IAS targets and decreasing IAS targets (IAS climbs and descents).

If IAS climbs have not yet been tested, proceed to step 11.

If both IAS climbs and descents have been tested, proceed to step 12.

11. Decrease IAS target by 10 knots

Change the IAS bug to 10 knots below the current IAS target.

1. Configure a joystick to control the IAS bug. The label above the joystick should read (IAS).
2. Turn the joystick counter-clockwise until the IAS bug reads 10 knots lower than it did when the Flight Director was engaged.
3. The aircraft should immediately begin climbing toward the new IAS target.

At this point, return to step 6 to re-verify the settings above.

12. Verify acceptable autopilot PITCH performance

At this point, the autopilot should be appropriately tuned in the pitch axis for IAS holds. Performing numerous IAS climbs and descents will help verify this. Once satisfied with autopilot pitch performance, this procedure is complete. If autopilot pitch performance is not acceptable, refer to the Pitch Troubleshooting section of this document.

3. Appendix A: Autopilot Settings –Defaults

Parameter	Min	Max	Default
ROLL > TORQUE	10%	100%	100%
ROLL > SENSITIVITY	1	24	10
ROLL > ROLL GAIN	0.0	5.0	0.0
ROLL > CDI GAIN	0.1	5.0	1.0
ROLL > CDI DOT GAIN	0.1	9.9	1.0
ROLL > BANK ANGLE TARGET	5°	45°	20°
PITCH > TORQUE	10%	100%	100%
PITCH > SENSITIVITY	1	24	10
PITCH > DEFAULT CLIMB VERT SPD	100 ft/min	3000 ft/min	500 ft/min
PITCH > DEFAULT DESCENT VERT SPD	100 ft/min	3000 ft/min	500 ft/min
PITCH > MAXIMUM AIRSPEED	1.30 * Vs1	0.95 * Vn0	0.90 * Vn0
PITCH > MINIMUM AIRSPEED	1.30 * Vs1	0.95 * Vn0	1.35 * Vs1
PITCH > PITCH GAIN	0.1	3.0	2.0
PITCH > ALTITUDE GAIN	0.1	2.5	0.6
PITCH > VSI GAIN	0.10	2.50	0.6
PITCH > PULL RATE	1.0	2.0	1.0
PITCH > G ERROR LIMIT	0.10	1.00	0.25
PITCH > G ERROR GAIN	0.0	4.0	1.0
PITCH > GSI GAIN	0.1	5.0	1.0
PITCH > GSI DOT GAIN	1	100	15