



Pilot's Operating Handbook

HelisAS – STABILITY AUGMENTATION SYSTEM
AND AUTOPILOT



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Table of Contents

Sec.		Pg.
1	Overview.....	1-1
	1.1 Document Organization.....	1-3
	1.2 Purpose.....	1-3
	1.3 General.....	1-3
	1.4 HeliSAS Components.....	1-3
	1.5 System Description.....	1-4
	1.6 Safety Monitors.....	1-7
2	Pre-Flight Procedures.....	2-1
	2.1 Pre-Flight Procedures.....	2-3
3	In-Flight Procedures.....	3-1
	3.1 Normal Operating Procedures.....	3-3
	3.1.1 Trim.....	3-3
	3.2 Pilot Technique with SAS.....	3-3
	3.3 Closely Monitor the Controls.....	3-4
	3.4 Liftoff and Hover.....	3-4
	3.5 Accerleration from Hover.....	3-4
	3.6 Cruise.....	3-4
	3.7 Deceleration to Hover.....	3-5
	3.8 Landing.....	3-5
	3.9 Disengage SAS/Autopilot.....	3-5
4	Non-Normal Procedures SAS Procedures.....	4-1
	4.1 SAS Failures and Automatic Disengagement.....	4-3

Cobham Avionics Integrated Systems (CAIS)	
4.2	Autorotation.....4-3
4.3	Hydraulic System Failure.....4-3
4.4	Icing.....4-3
5	Normal Inflight Procedures - Autopilot.....5-1
5.1	Heading Mode.....5-3
5.2	Navigation Mode with CDI Mode Set to VLOC.....5-3
5.2.1	If HDG is not Active - Fixed Intercept Angle.....5-4
5.2.2	Pilot Selected Intercept Angle.....5-5
5.3	Backcourse (BC) Mode.....5-5
5.4	Navigation (NAV) with CDI Mode Set to GPS.....5-5
5.4.1	Pre-programmed Intercept Angle.....5-6
5.4.2	Pilot Selected Intercept Angle.....5-6
5.4.3	Course Reversals and Holding Patterns.....5-6
5.5	Altitude Hold (ALT).....5-6
5.6	Vertical Modes (VRT).....5-7
5.7	Missed Approach.....5-8
5.7.1	CDI Mode is VLOC (ILS or VOR Approach).....5-8
5.7.2	CDI Mode is GPS (LPV/VNAV, or LNAV + V Approach)...5-9

List of Figures

Fig.	Pg.
1-1	Cyclic Buttons.....1-4
1-2	HeliSAS System Diagram.....1-6
5-1	HeliSAS Control Panel (HCP).....5-3

List of Tables

Table	Pg.
2-1 Power-Up Test.....	2-4

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SECTION 1 OVERVIEW

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1.1 Document Organization

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 Normal Inflight Procedures - SAS

Section 4 Non-Normal Procedures - SAS Failures

Section 5 Normal Inflight Procedures - Autopilot

1.2 Purpose

This Pilot's Operating Handbook (POH) provides pre-flight and in-flight operating procedures for the Cobham Avionics HeliSAS Stability Augmentation System and Autopilot (SAS/AP).

This POH can only be used in conjunction with the Federal Aviation Administration (FAA) approved Rotorcraft Flight Manual (RFM) and Rotorcraft Flight Manual Supplement (RFMS) for HeliSAS.

1.3 General

HeliSAS is an attitude-based flight control system that provides a significant reduction in pilot workload from takeoff to landing. It is intended that the SAS be engaged before liftoff and disengaged after touchdown. The autopilot modes become available at airspeeds above 44 Kts.

HeliSAS makes it possible to fly for indefinite periods with hand-off the cyclic. However, it is important that the pilot understand that the unstable nature of helicopters is such that a SAS disconnect due to a system failure requires that the pilot assume immediate control. The existence of stability augmentation and rotor RPM governing does not relieve the helicopter pilot of the necessity to closely monitor aircraft attitude and rotor RPM at all times.

1.4 HeliSAS Components

The HeliSAS system consists of the following components:

- Dual Processor Fail Passive Digital Flight Control Computer (FCC).
- HeliSAS Control Panel (HCP) to select and annunciate SAS and autopilot modes.
- Servo-actuators – one each for the pitch and roll axes.
- Panel-mounted gyro horizon indicator. The HeliSAS attitude gyro takes the place of the standard attitude gyro that is installed in most instrument panels.
- An Attitude Heading Reference System (AHRS) may be used to supply pitch and roll attitude to the HeliSAS FCC in lieu of the panel mounted attitude gyro.

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HeliSAS can be interfaced with the following avionics and instruments.

- GPS navigation receiver – The autopilot will track the active course, fly procedure turns and holding patterns, and fly LNAV/VNAV approaches.
- VHF navigation receiver – The autopilot will track VOR courses and will fly ILS and backcourse localizer approaches.
- Horizontal Situation Indicator (HSI) - The HSI is required if it is desired to use the autopilot for VOR/ILS tracking. The heading bug on the HSI allows the pilot to select headings for the autopilot to fly while in the HDG mode.
- EFIS system such as Cobham Flight Logic or equivalent compatible EFIS System.
- A directional gyro with heading bug is available as an alternative to the HSI or EFIS. While the directional gyro provides a less expensive and lighter alternative, it does not allow the autopilot to be used for VOR/ILS tracking.

1.5 System Description

The basic SAS consists of two electromechanical servo-actuators, a flight control computer, HeliSAS Control Panel (HCP) for autopilot mode selection, a panel-mounted attitude indicator or an attitude heading reference system (AHRS), two control buttons on the cyclic stick, and interconnecting cables. One servo-actuator controls pitch and the other servo-actuator controls roll. The servo-actuators are connected to the cyclic through electromagnetic clutches.

The cyclic-mounted force trim release (FTR) and AP DISC buttons as installed on a Bell 206B cyclic is shown in Figure 1-1.



Figure 1-1. Cyclic Buttons

The FTR button is used to reset the trim pitch and roll attitude when in SAS mode. Holding the trim button for more than 1.25 seconds engages the SAS as long as the system is in standby mode. The AP DISC button allows disengagement with hands on controls.

The HeliSAS Control Panel (HCP) is used to engage the SAS and/or autopilot modes. Available modes may include altitude hold, heading hold, navigation signal tracking, and approach guidance depending on installed avionics. The far left button controls the basic SAS. The SAS must be engaged prior to engaging an autopilot mode. The NAV mode will track whatever course is active on the HSI or EFIS display (VLOC or GPS). The system automatically adjusts its gain to account for the tighter tracking required for instrument approaches, so there is no need for the Approach (APP) button found on many autopilots.

A mode may be disengaged by pressing the associated button on the HCP. If any of the autopilot modes are armed or active, pressing the cyclic-mounted AP DISC button once disengages all autopilot modes but leaves the underlying SAS mode active. If the cyclic-mounted AP DISC button is kept pressed for more than 1.25 seconds after the autopilot disengages or if it is pressed without any autopilot modes being armed or active the SAS mode will disengage leaving the HeliSAS in the standby mode (i.e., SAS is ready for engagement).

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A diagram showing the interaction of components of HeliSAS is shown in Figure 1-2.

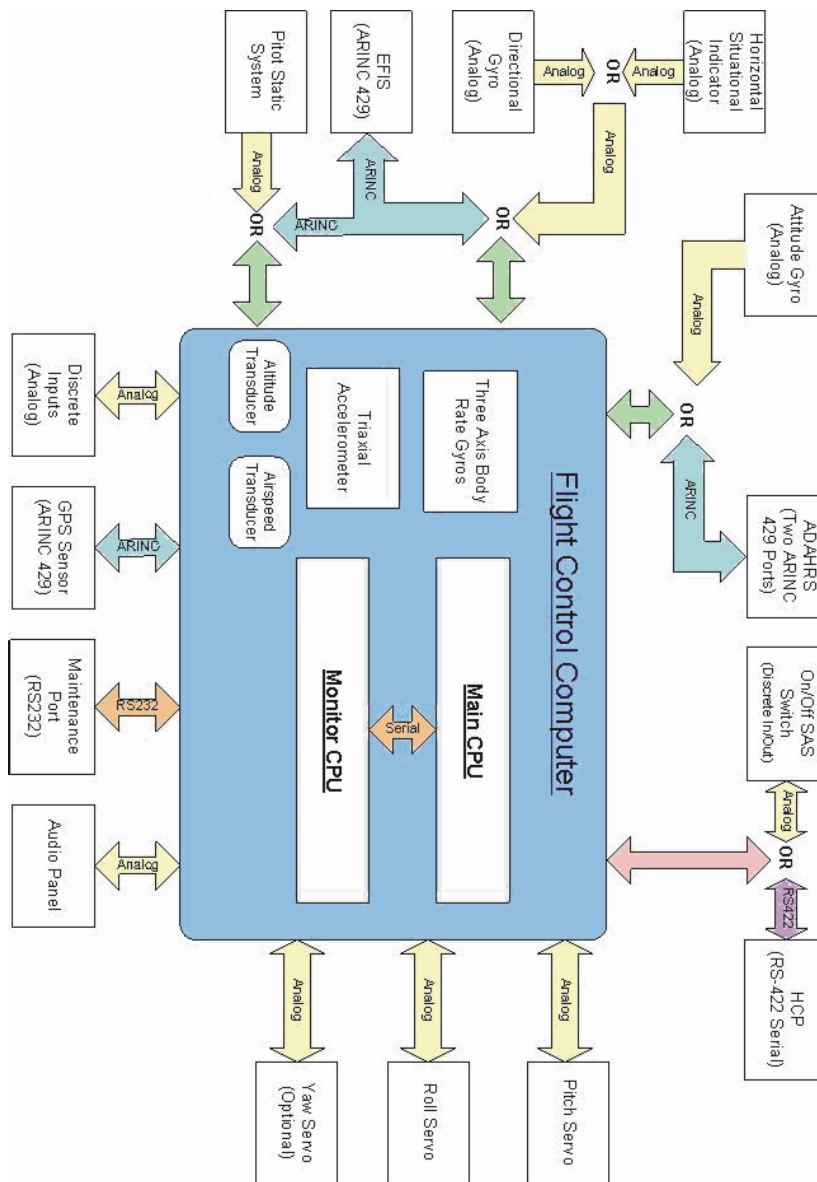


Figure 1-2. HeliSAS System Diagram

1.6 Safety Monitors

Safety monitors automatically disengage the system if a malfunction is detected. Four beeps sound in the headset at 600 Hz anytime the system is disengaged either automatically or by the pilot. The four beep sequence also occurs once during each start-up self-test.

The pilot must be prepared to takeover immediately following a system disconnect.

Loss of a valid navigation signal during NAV tracking will cause the associated autopilot mode to disconnect. For example, loss of a VOR signal will result in disconnect of the NAV mode, leaving lateral control in SAS mode (maintains roll attitude level). If engaged, altitude hold would remain engaged.

Failure of the altitude sensor will cause ALT to disconnect, and longitudinal control will revert to SAS (holds current pitch attitude). If engaged, HDG or NAV would remain engaged.

An autopilot mode disengagement that is not commanded by the pilot is indicated by a single 600 Hz beep in the headset. Intentional disengagement of an autopilot mode does not trigger a headset beep.

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SECTION 2 PRE-FLIGHT PROCEDURES

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2.1 Pre-Flight Procedures

The SAS will be in standby without any pilot action as it is wired to the avionics bus without an on-off switch. This is done so that the SAS can be engaged immediately if needed, such as might occur due to possible loss of control resulting from spatial disorientation in poor visibility or at night over sparsely lit terrain. If for some reason, it is not desired to have the SAS/AP in standby mode, you can pull the HeliSAS circuit breaker.

The SAS or autopilot mode indicator lights will flash as soon as the master switch is turned on. This indicates that the flight control computer (FCC) is booting up. When the lights stop flashing and a steady white SAS indicator light is displayed, the system is in standby mode indicating that the SAS may be engaged.

If an AHRS is used as the pitch and roll attitude sensor, the system will enter standby after the alignment process is complete. If the Castleberry panel-mounted mechanical attitude gyro is used, the system will not enter standby mode unless the attitude gyro bank angle is less than 6 degrees. If the attitude gyro bank angle is greater than 6 degrees, pulling and releasing the gyro caging knob will expedite the boot up process.

Once the system enters standby mode, perform the preflight actions shown in Table 2-1. For each action, verify the corresponding response where applicable.

Table 2-1. Power-Up Test

ACTION	RESPONSE
1. Immediately after starting engine or immediately after powering the helicopter.	Note: Alternate white and green flashing annunciator light(s) on the HCP.
2. Adjust cyclic friction to full off.	Note: Essentially no resisting force on cyclic.
3. Engage SAS after lights stop flashing and SAS annunciator is white.	Note: The SAS LED is a steady green.
4. Displace the cyclic slightly in pitch and release.	Note: Resisting force and that cyclic returns to trim position when released.
5. Displace the cyclic slightly in roll and release.	Note: Resisting force and that cyclic returns to trim position when released.
6. Depress and hold the trim button and move the cyclic in pitch and roll.	Note: Very low resisting force.
7. Depress AP DISC button on cyclic.	Note: Four beeps in the headset and that the SAS annunciator turns white.
8. Move cyclic in pitch and roll.	Note: Lack of any resisting force.

SECTION 3 IN-FLIGHT PROCEDURES

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3.1 Normal Operating Procedures

3.1.1 Trim

When the SAS is initially engaged, it will maintain the current rotorcraft attitude. The system will not trim to attitudes greater than those defined during configuration settings at the time of the STC (Standard configurations: 6 degrees nose-down pitch, 11 degrees nose-up pitch, or ± 5 degrees bank). If the FTR button is activated (pressed and released) outside these limits, the system will return to the closest limit. For example, if the FTR is pressed and released at a 20 degree bank angle and the cyclic is released, the helicopter will achieve a 5 degree bank in the same direction.

If the SAS is engaged when the pitch attitude is outside a range of pitch attitude between -10 and +15 degrees, or roll attitude of ± 6 deg, it will recover to a nearly level attitude. This is intended to serve as a “panic button” in the event the pilot becomes disoriented and engages the SAS. Note that the SAS must be in the standby mode to achieve immediate engagement.

The proper technique for flying with the SAS is to “fly through” the SAS to achieve the desired attitude and activate the FTR. Activation of the FTR refers to a press and release of the button on the cyclic. Activation of the FTR will remove the need to apply force on the cyclic grip and the helicopter will hold the attitude that existed when the trim button is released.

Workload will be significantly reduced if the FTR is activated any time there is residual force on the cyclic.

It is best to avoid holding the FTR button down while trying to establish a trimmed attitude as this negates the stabilization provided by the SAS. It is better to fly through the SAS and activate the FTR when the desired attitude is achieved.

With the SAS in standby mode, pushing and holding the trim button for 1.25 seconds will engage the SAS.

3.2 Pilot Technique with SAS

HeliSAS uses very small movements of the cyclic to perform its stabilizing function. If the pilot holds the cyclic grip very tightly, the stabilizing action could be inhibited. Proper technique requires that the cyclic grip be held loosely so that cyclic can move slightly within the pilot’s hand to allow HeliSAS to compensate for helicopter instability. This is especially true in hover.

NEVER use cyclic friction with the SAS or autopilot engaged. Cyclic friction will inhibit the ability of the system to stabilize the helicopter. The cyclic friction must be all the way off when HeliSAS is engaged.

Without SAS the hydraulic controls result in no force feedback to the pilot. The SAS provides a force gradient that acts like a centering spring. This is often referred to as a force feel system. When maneuvering with the SAS engaged, the pilot will feel some resistance on the controls. This is referred to as “flying through” the system. It is possible to accomplish all normal maneuvering both in low speed and hover and up-and-away by flying through the system.

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As airspeed changes the force on the cyclic required to hold a given attitude changes. It is recommended that you activate the FTR button to remove residual force from the cyclic. Trimming reduces pilot workload considerably.

3.3 Closely Monitor the Controls

The SAS is intended to enhance safety by reducing pilot workload. It is not a substitute for adequate pilot skill nor does it relieve the pilot of the responsibility to maintain adequate outside visual reference.

With HeliSAS engaged, it is possible to fly for indefinite periods without touching the cyclic. This significantly reduces pilot workload and therefore improves safety as long as the pilot remains aware that the helicopter is inherently unstable. A disengagement of the SAS due to a failure may result in a rapid roll or pitch excursion that requires immediate pilot takeover to avoid dangerous attitudes. Other events that require immediate takeover are engine or drive train failures or a hydraulic system failure.

It is required that the pilot have a hand on the cyclic below 44 KIAS when operating in close proximity to the terrain. It is recommended that the pilot have a hand on the controls at airspeeds near and above V_{NE} . At low airspeeds near the ground this is simply a matter of good practice. At high airspeeds, this recommendation is made because a system failure is much more critical near redline.

3.4 Liftoff and Hover

Once all preflight checks are done, engage the SAS and verify that the SAS annunciator light is green. With the trim button held down make cyclic adjustments as the helicopter becomes light on the skids. Once the proper cyclic position has been achieved, release the trim button and lift into a hover. Make needed cyclic adjustments to hold the hover position, and then activate the FTR to eliminate any residual force on the cyclic.

Maximum benefit will be obtained from the SAS if the cyclic grip is held loosely. This allows the SAS to provide stabilization for hover with the pilot applying small and infrequent inputs to correct for slight changes in wind velocity and direction. In light winds, it is possible to hover with no inputs to the cyclic.

3.5 Acceleration from Hover

Accelerate from hover normally, activating the FTR as necessary to compensate for changing forces on the cyclic due to increasing airspeed.

3.6 Cruise

It is possible to cruise indefinitely in SAS mode with no inputs to the cyclic once the helicopter is properly trimmed. Autopilot modes may be engaged at airspeeds greater than 44 kts and less than V_{NE} .

3.7 Deceleration to Hover

Accomplish the deceleration to hover normally by flying through the system and activating the FTR as necessary to remove forces on the cyclic as airspeed decreases. If one or more autopilot modes are engaged, they will automatically disengage as the airspeed decreases below 44 kts. This will be accompanied by a single 600 Hz beep in the headset.

3.8 Landing

Establish a stable hover by flying through the SAS. Activate the FTR to establish the trimmed cyclic position and helicopter hover attitude. Use the collective control normally to accomplish a vertical descent and touchdown. Workload is minimized if only small occasional cyclic inputs are made to eliminate drift during the vertical descent.

Disengage the SAS and set the cyclic friction after the helicopter is on the ground. It is acceptable to allow the SAS to be engaged indefinitely while on the ground.

3.9 Disengage SAS/Autopilot

The SAS is normally disengaged by pressing the AP DISC button on the cyclic grip or the SAS button on the HCP. It is also possible to disengage the SAS by pulling the SAS circuit breaker.

If one or more autopilot modes are engaged, pressing the AP DISC button causes the autopilot modes to disengage. A second press of the AP DISC button disengages the SAS.

With one or more autopilot modes engaged, both the SAS and autopilot may be disengaged by holding the AP DISC button down for more than 1.25 seconds.

A disengagement of the SAS will always be accompanied by four 600 Hz beeps in the headset.

The pilot's hand must be on the cyclic when the SAS is disengaged. This is necessary because the helicopter is inherently unstable and therefore may diverge from steady flight when the SAS is disengaged.

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SECTION 4
Non-Normal Procedures
SAS Failures

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4.1 SAS Failures and Automatic Disengagement

The SAS has been designed to be very reliable. However, any system can encounter a hardware failure and safe operation dictates that the pilot become familiar with actions to take in the event of such failures. HeliSAS is a fail passive system meaning that it will automatically disengage prior to any significant cyclic motion when system safety monitors sense a failure. This is accompanied by an aural warning of 4 beeps in the headset. Testing has shown that cyclic motions following system failures are very small. Nonetheless, even small cyclic motions can result in moderately rapid pitch or roll rates. This means that the pilot must closely monitor the cyclic control and helicopter attitude and be ready to takeover immediately.

If the pilot's hand is on the cyclic at the point of failure, the only cue will be that a small force may be felt that cannot be alleviated with the FTR. In that case simply continue to fly through the system and disengage when practical using the AP DISC button on the cyclic or the SAS button on the panel.

If the cyclic exhibits abrupt or erratic motion, or exhibits a large resisting force, fly through the system to retain control and disengage the SAS as soon as practical. Note that small cyclic motions are normal, especially when flying in turbulence.

If the SAS automatically disengages, it is acceptable to attempt to re-engage as long as the system is in standby (SAS LED on HCP is white).

A false trip of the safety monitors may occur if the attitude gyro is not fully erected after engine start and an aggressive departure is accomplished. This may occur if the period between startup and liftoff is short (order of less than 3 minutes). If that occurs, simply re-engage the SAS using the FTR button or the SAS button on the HCP.

4.2 Autorotation

It is acceptable to accomplish autorotations from any flight condition to touchdown with the SAS engaged.

For autorotations from forward flight, it will be necessary to apply aft force on the cyclic as the collective is rapidly lowered to maintain rotor RPM. Once the proper pitch attitude is achieved, activate the FTR. The SAS will then hold that attitude with essentially no pilot inputs to the cyclic. Accomplish the flare and touchdown normally by flying through the SAS.

4.3 Hydraulic System Failure

The SAS will not function properly without functioning hydraulic flight controls. In the event of a hydraulic system failure, disengage the SAS.

4.4 Icing

The SAS or autopilot may not function properly in the extremely unusual situation where there is significant ice buildup inside the cockpit. Pilot may notice a very slight increase in cyclic force if there is ice buildup inside the cockpit, even with the SAS disengaged. This is due to the possibility of ice buildup on the servo actuators causing the clutch to be ineffective. The force to backdrive the servo-actuators is less than one pound.

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SECTION 5

Normal In-Flight Procedures- Autopilot

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Autopilot modes are selected on the HeliSAS Control Panel in Figure 5-1.



Figure 5-1. HeliSAS Control Panel (HCP)

The LEDs above the mode select button indicate the status of that mode as follows.

- LED is dark – Off
- LED is white – Armed
- LED is green – Engaged

5.1 Heading (HDG) Mode

Set the Heading Bug to the desired heading on the horizontal situation indicator (HSI) or directional gyro (DG) compass card and then press the HDG mode button on the HCP to engage the heading mode. The LED above the HDG button will illuminate green when HDG is engaged.

The helicopter will turn to selected headings with a maximum bank angle of 20 degrees. When making heading changes, it is acceptable to fly-through the system to achieve larger or smaller bank angles.

If a heading source (e.g., HSI or directional gyro) is not available and a GPS navigation radio is receiving a valid signal, HeliSAS will hold the current GPS-derived track angle when the HDG mode is selected. The commanded track can be resynchronized by activating the trim button on the cyclic grip at the desired track angle. This backup feature is not available if the heading source is in an AHRS.

5.2 Navigation (NAV) Mode with CDI Mode Set to VLOC

NAV tracks the course on the HSI if the CDI mode on the navigation receiver is VLOC and tracks the active GPS course if the CDI mode is GPS. If an HSI is not installed, NAV will only track the active GPS course and this section does not apply.

5.2.1 If HDG is Not Active - Fixed Intercept Angle

Select the VOR or ILS frequency on the navigation receiver and set the selected course arrow on the HSI to the desired course.

Press the NAV mode button on the HCP to engage the navigation mode. If the Course Deviation Indicator (CDI) deflection and rate indicate that the helicopter is on the selected course or is predicted to cross the selected course in 15 seconds or less, the NAV annunciation on the HCP will illuminate green to indicate that NAV has captured and is tracking the course.

If the CDI deflection and rate indicate that the estimated time to cross the selected course is greater than 15 seconds, the autopilot will establish the helicopter on a 45 degree intercept angle relative to the selected course. In this case the NAV annunciation will be white, indicating that NAV is armed.

When the CDI deflection is less than 75% full scale and the estimated time to cross the selected course is greater than 15 seconds and less than 90 seconds, the intercept angle is reduced to 30 degrees.

Due to limitations on the analog course error signal received from the HSI, the helicopter must be tracking within 90 degrees of the selected course in order to establish the proper intercept angle when NAV is selected. This limitation does not apply when the CDI mode on the navigation receiver is set to GPS.

As the helicopter approaches the selected course, the autopilot senses the deflection rate of the CDI as it approaches center and initiates a turn to capture the course. This occurs when the lateral deviation is less than 25% full scale and tracking within 15 degrees of the final approach course, or the estimated time to cross the selected course is 15 seconds or less.

At course capture, the NAV annunciation transitions from white to green. The bank angle at course capture depends on the distance from the VOR, or final approach fix for a localizer, but will never exceed 20 degrees.

For a VOR course, the bank angle is limited to 10 degrees 30 seconds after the autopilot captures the selected course (annunciator changes from white to green). For a localizer course the bank angle is limited to 15 deg 30 seconds after capture. The autopilot automatically adjusts the tracking gains depending on whether the course is a VOR or localizer.

If an ILS or localizer approach is programmed into the GPS, the GPS navigation radio may automatically switch from GPS to VLOC. If the NAV mode is active, the autopilot will automatically transition from tracking an active GPS course to the course that is set on the HSI. The autopilot will remain in NAV mode during this transition. There may be a slight lateral transient at this transition if the localizer course does not exactly overlay the final approach course defined by the GPS.

If NAV is in track mode (green annunciation) and the course deviation subsequently increases to full scale for 30 seconds, the autopilot will turn to recapture the selected course at an angle of 45 or 30 degrees depending the estimated time to recapture as noted above. This might occur if the pilot selects a new course.

5.2.2 Pilot Selected Intercept Angle

To select an intercept angle other than 45 degrees, set the heading bug on the HSI to achieve the desired intercept angle. Set the selected course arrow on the HSI to the desired course. Select HDG and then select NAV. This will cause the HDG annunciation to be green and the NAV annunciation to be white (armed).

As the helicopter approaches the selected course, the autopilot senses the corresponding rate at which the CDI needle deflection approaches center and initiates a turn to capture the course. This will occur when the lateral deviation is less than 75% full scale and the estimated time to cross the selected course is 15 seconds or less.

At course capture, the NAV annunciation transitions from white to green. The bank angle at course capture depends on the distance from the VOR, or final approach fix for a localizer, and the selected intercept angle, but will never exceed 20 degrees.

5.3 Backcourse (BC) Mode

Backcourse Mode (BC) is identical to NAV but with reverse sensing for backcourse approaches. The course on the CDI should be set to the inbound front course in this mode (tail of HSI course needle points toward runway). BC mode only applies if the CDI mode on the navigation receiver is set to VLOC.

5.4 Navigation (NAV) Mode with CDI Mode Set to GPS

NAV mode requires that an active course has been programmed into the GPS as a flight planned route, instrument approach procedure, or a direct-to a waypoint. The navigation receiver CDI mode must be GPS.

The autopilot does not use the HSI for this mode. If an HSI is installed, it is useful to set the selected course arrow to the desired track angle to maintain situational awareness. However, this has no effect on autopilot performance.

The autopilot uses the GPS roll steering commands for enroute terminal area flying. The switch from GPS roll steering to internal control laws occurs when the GPS mode switches from TERM to an approach mode (e.g., LPV). A slight roll transient may be felt when this occurs because the internal control laws provide more accurate lateral tracking and will turn to minimize any small errors.

If the navigation receiver does not provide a valid roll steering command, the autopilot internal control laws will be used for all tracking.

The autopilot will follow the GPS roll steering through holding patterns and published course reversals on instrument approach procedures. This feature is only available if the GPS receiver is WAAS capable, and if roll steering is valid.

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5.4.1 Pre-Programmed Intercept Angle

Ensure that HDG is not engaged and press the NAV mode button on the HCP to engage the navigation mode. The NAV mode will engage (green annunciation on HCP) and the autopilot will follow the GPS roll steering commands to capture and track the active course. If the helicopter is offset from the selected leg, the intercept angle will be set by the roll-steering logic in the navigation receiver. The bank angle is limited to 20 degrees.

If roll steering is not valid, the internal control laws will capture the selected course at a 45 degree angle.

This mode of control does not require an HSI or DG.

5.4.2 Pilot Selected Intercept Angle

To select an intercept angle to an active GPS course, set the heading bug on the HSI or DG to achieve the desired intercept angle. Select HDG and then select NAV. This will cause the HDG annunciation to be green and the NAV annunciation to be white (armed). This is especially useful if being vectored to final for a GPS instrument approach procedure.

As the helicopter approaches the selected course, NAV will transition from armed (white) to active (green) and HDG will disengage (dark). The autopilot will smoothly capture and track the active course. The bank angle is limited to 20 degrees.

Note that capture will not occur if the selected heading does not cause the helicopter to intercept the active course.

If an HSI or DG is not installed, it is still possible to select an intercept angle using the HDG mode. Select HDG and then NAV as is done when a DG or HSI is installed. HDG will annunciate as green (active) and NAV as white (armed). With no heading source, the autopilot will hold the current GPS-derived track angle. The desired track to intercept the active course can be achieved by flying through the autopilot with lateral cyclic and activating the FTR button on the cyclic grip to reset the reference track angle. As the helicopter approaches the selected course, NAV will transition from armed (white) to active (green) and HDG will disengage (dark). The autopilot will smoothly capture and track the active course.

5.4.3 Course Reversals and Holding Patterns

The autopilot will follow the GPS roll steering commands through holding patterns and published course reversals as long as GPS roll steering is valid. If GPS roll steering is not valid, and for non-WAAS GPS receivers, it will be necessary to accomplish these procedures in HDG mode.

5.5 Altitude Hold (ALT)

Altitude Hold Mode may be engaged at any time and is annunciated by a green LED above the ALT button. It is not possible to arm the ALT mode.

ALT holds barometric altitude at the altitude where the mode is engaged. If the helicopter is in a climb or descent, when ALT is engaged, it will gently initiate a pitch rate to stop the rate of climb or descent. It will then command a rate of climb or descent to return to altitude where the mode was engaged. Because of lags in the altimeter, the helicopter may not return to the exact indicated altitude where ALT was engaged, especially if the climb or descent rate is large.

The target altitude may be reset by manually flying through the autopilot to the desired altitude and activating the FTR button.

The autopilot uses pitch attitude to control altitude so airspeed will vary with power setting. To accomplish an airspeed change while ALT is engaged, slowly move the collective to the new power setting.

A rapid change in collective will cause the helicopter to deviate from the target altitude. That is because collective is a powerful control of vertical rate and it is not possible for the autopilot to counter rapid power changes with pitch attitude. Nonetheless, the autopilot will gradually return to the reference altitude, albeit at a different airspeed.

When following ground references at low altitude, it is useful to engage ALT and leave the roll axis in SAS mode. This allows following of ground references by flying through the lateral SAS, and allowing ALT to hold altitude.

5.6 Vertical Modes (VRT)

The Vertical Navigation Mode (VRT) allows the autopilot to track an ILS glideslope or GPS VNAV, LNAV + V, or LPV glidepath.

VRT must be armed prior to intercepting the glidepath. An armed VRT mode is indicated by a white LED. NAV must be armed or active and the GPS must be in the approach mode (e.g., LPV) for VRT to arm. If NAV is not armed or active (annunciation white or green) or the GPS has not transitioned to an approach mode, pushing the VRT button will have no effect (VRT annunciation will remain dark). It is necessary to wait for the GPS to transition from TERM to an approach mode such as LPV or LNAV/VNAV to arm VRT.

For an ILS approach the navigation receiver CDI mode must be VLOC, and a valid ILS signal must be present to arm VRT. An HSI must be installed for the autopilot to accomplish a coupled ILS approach.

For GPS approaches, the autopilot will track the VNAV glidepath without an HSI, albeit with no visual indication of the glideslope error.

De-selecting and re-selecting ALT while VRT is armed will cause VRT to disarm. It is therefore necessary to re-arm VRT if ALT is cycled while setting up for an ILS or VNAV approach.

VRT will switch from armed to active (LED from white to green) at glidepath intercept. This transition can occur with the pitch axis in the SAS or ALT modes. If in ALT mode, ALT will transition from green to dark when VRT becomes active.

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The recommended technique is to slowly reduce collective prior to glidepath intercept to a power setting that will cause the autopilot to track the glideslope at the desired airspeed. It is important to minimize changes in collective during glideslope tracking as this can result in excursions from the glideslope. If collective changes are necessary to change airspeed, make them very slowly.

With collective held fixed, airspeed will change to maintain glideslope in the presence of vertical atmospheric disturbances.

Glideslope tracking will become less accurate at low airspeeds because the helicopter is approaching the backside of the power required curve. The VRT mode will automatically disengage if the airspeed decreases below 44 kts.

For ILS approaches the autopilot control laws use GPS groundspeed to enhance ILS glideslope tracking. If a GPS receiver is not available, VRT will still function, but glideslope tracking will be less accurate.

It is recommended that the GPS overlay be loaded for ILS and localizer approaches. While this is not essential, it serves two useful purposes. First situational awareness is enhanced by having the final approach course displayed on the moving map. Second, when the GPS overlay is active, the autopilot control laws use GPS-derived track angle to enhance localizer intercept and tracking, especially in crosswinds.

At minimums, disengage the autopilot by pressing the red AP DISC button on the cyclic grip and accomplish the deceleration in SAS mode.

5.7 Missed Approach

5.7.1 CDI Mode is VLOC (ILS or VOR Approach)

At the missed approach point accomplish the following:

1. Change the CDI mode from VLOC to GPS – As long as the GPS overlay is active, this causes the autopilot to track the extended runway centerline by remaining in NAV mode.
2. VRT will disengage when the CDI is changed from VLOC to GPS and the pitch mode will change from VRT to SAS. This will be accompanied by a one second beep in the headset. The one second beep occurs because VRT disengaged without pressing the VRT button on the HCP.
3. Add power and pitch to the desired climb attitude and press and release the FTR button.
4. When reaching the point where the missed approach procedure requires a turn to a new course, push the OBS button on the navigation receiver. The autopilot will remain in NAV mode and turn to intercept the published missed approach course. If the missed approach procedure requires a heading, set the heading bug on the HSI or DG and engage HDG.
5. The autopilot will follow the GPS steering commands to accomplish the missed approach procedure including a holding pattern.

This procedure only works if the ILS overlay is programmed into the GPS. If that is not the case, disengage the autopilot at minimums and complete the missed approach using SAS, HDG, and ALT.

5.7.2 CDI Mode is GPS (LPV, LNAV/VNAV, or LNAV + V Approach)

At the missed approach point, disengage VRT by pressing the VRT button on the HCP. The lateral autopilot mode will remain NAV, and the pitch mode will change from VRT to SAS. Accomplish steps 3 through 5 as above. Alternatively, it is possible to fly through the autopilot in pitch and VRT will disable automatically (becomes invalid after passing a point approximately 1000 feet past the runway threshold).

An alternative missed approach procedure is to press the AP DISC button on the cyclic at the missed approach point, and manually fly the missed approach in SAS mode

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