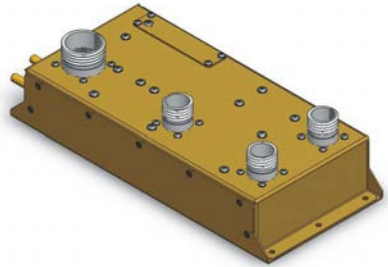
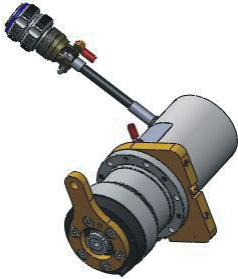




Stability Augmentation System and Autopilot

Pilot's Operating Handbook



List of Effective Pages	* Asterisk indicates pages changed, added, or deleted by current revision.	
<p>Page No. Issue</p>		
Record of Revisions	Retain this record in front of handbook. Upon receipt of a revision, insert changes and complete table below.	
Revision Number	Revision Date	Insertion Date/Initials
1 st Ed.	May 13, 11	
2 nd Ed.	Feb 05, 15	
3 rd Ed.	Apr 04, 16	
4 th Ed.	Jun 10, 16	

Page Intentionally Blank

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.....	1-4
	1.5 System Description.....	1-4
	1.6 Safety Monitors.....	1-8
2	Pre-Flight Procedures.....	2-1
	2.1 Pre-Flight Procedures.....	2-3
3	Normal In-Flight Procedures - SAS.....	3-1
	3.1 Normal Operating Procedures - SAS.....	3-3
	3.1.1 Trim.....	3-3
	3.2 Recommended Pilot Technique with SAS.....	3-4
	3.3 Closely Monitor the Controls.....	3-5
	3.4 Liftoff and Hover.....	3-5
	3.5 Acceleration from Hover.....	3-5
	3.6 Cruise.....	3-6
	3.7 Deceleration to Hover.....	3-6
	3.8 Landing.....	3-6
	3.9 Disengage SAS/Autopilot.....	3-6
4	Non-Normal Procedures - SAS Failures.....	4-1
	4.1 SAS Failures and Automatic Disengagement.....	4-3

Genesys Aerosystems

- 4.2 Autorotation.....4-3
- 4.3 Hydraulic System Failure.....4-3
- 4.4 Icing.....4-3
- 5 Normal In-Flight Procedures - Autopilot.....5-1
 - 5.1 Heading (HDG) Mode.....5-4
 - 5.2 Navigation (NAV) Mode - VLOC.....5-4
 - 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 (Applicable to Ver51 and Lower).....5-5
 - 5.4 Navigation (NAV) Mode - GPS.....5-6
 - 5.4.1 Preprogrammed Intercept Angle.....5-6
 - 5.4.2 Pilot Selected Intercept Angle.....5-6
 - 5.4.3 Course Reversals and Holding Patterns.....5-7
 - 5.5 Speed (SPD) Hold Mode (Applicable to Ver52 and Higher).....5-7
 - 5.6 Altitude (ALT) Hold.....5-7
 - 5.7 Vertical (VRT) Mode.....5-8
 - 5.8 Missed Approach.....5-9
 - 5.8.1 VLOC (ILS or VOR Approach).....5-9
 - 5.8.2 GPS (LPV, LNAV/VNAV, or LNAV + V Approach).....5-10
- 6 Glossary.....6-1

List of Figures

Fig.		Pg.
1-1	Cyclic Buttons.....	1-5
1-2	HeliSAS System Diagram.....	1-7
5-1	HeliSAS Control Panel (HCP) with BC Button (Ver51).....	5-3
5-2	HeliSAS Control Panel (HCP) with SPD Button (Ver52).....	5-3

List of Tables

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

Page Intentionally Blank

SECTION 1 OVERVIEW

Page Intentionally Blank

1.1 Document Organization

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 Normal In-Flight Procedures - SAS

Section 4 Non-Normal Procedures - SAS Failures

Section 5 Normal In-Flight Procedures - Autopilot

Section 6 Glossary

1.2 Purpose

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

This POH is intended to be used with the Federal Aviation Administration (FAA) approved Rotorcraft Flight Manual (RFM) and Rotorcraft Flight Manual Supplement (RFMS) for HeliSAS.

This POH is applicable to the following versions of HeliSAS:

- Flight Control Computers (FCC) with Ver51 and lower software.
 - Identified with suffix dash numbers of less than 100 (i.e. 01311-03-01).
 - Use HeliSAS Control Panels (HCP) with a "BC" button (01309-01-01).
- Flight Control Computers with Ver52 and higher software.
 - Identified with suffix dash numbers of greater than 100 (i.e. 01311-03-101).
 - Use HCPs with a "SPD" button (01309-03-01).

1.3 General

HeliSAS is an attitude-based flight control system that provides a significant reduction in pilot workload from takeoff to landing. SAS may be engaged or left engaged during any phase of flight from before liftoff to after touchdown. The autopilot modes become available at airspeeds above 44 Kts.

HeliSAS makes it possible to fly 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:

- Flight Control Computer (FCC).
- HeliSAS Control Panel (HCP) to select and annunciate SAS and autopilot modes (or a SAS On/Off switch to select and annunciation SAS for a SAS-Only configuration).
- Servo-actuators – one each for the pitch and roll axes (2ea for systems utilizing a primary and backup HeliSAS).
- Attitude Reference source can be one of the following:
 - An analog panel-mounted gyro horizon indicator.
 - A digital Attitude Heading Reference System (AHRS) or Air Data Attitude Heading Reference System (ADAHRS).

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 approaches.
- Horizontal Situation Indicator (HSI) or a functional equivalent on an Electronic Flight Instrument System (EFIS) display – The heading bug on the HSI allows the pilot to select headings for the autopilot to fly while in the HDG mode. The course pointer on the HSI allows the pilot to select the desired course for VOR/ILS tracking while in the NAV mode, and provides visual representation of deviation from the desired path.
- 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. An optional BeepTrim four-way momentary switch on the cyclic can be used to modify the attitude target in SAS mode on certain models.

The cyclic-mounted buttons as installed on a Bell 407 (left) and Robinson R44/66 (right) cyclic are shown in Fig. 1-1.



Fig. 1-1. Cyclic Buttons

The Force Trim Release (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 and not configured for use with a backup HeliSAS. The AP DISC/OFF button allows disengagement with hands on controls. The optional beep trim switch may be installed in addition to the FTR button, and allows the pilot to proportionally modify the trim pitch and roll attitudes in SAS mode. This is a four-way momentary switch on the cyclic grip. Holding the switch aft results in a steadily increasing change in trim pitch attitude (nose up). Pushing it forward results in a steadily decreasing trim pitch attitude (nose-down). Holding it right causes the trim roll attitude to increase right wing down, and holding it left causes the trim roll attitude to increase in a left-wing down direction. The maximum trim attitudes that may be achieved with beep trim are the same as for the FTR button.

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, speed hold, and approach guidance depending on installed avionics and version HeliSAS Flight Control Computer. 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 (APR) 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/OFF button once disengages all autopilot modes but leaves the underlying SAS mode active. If the cyclic-mounted AP DISC/OFF 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).

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

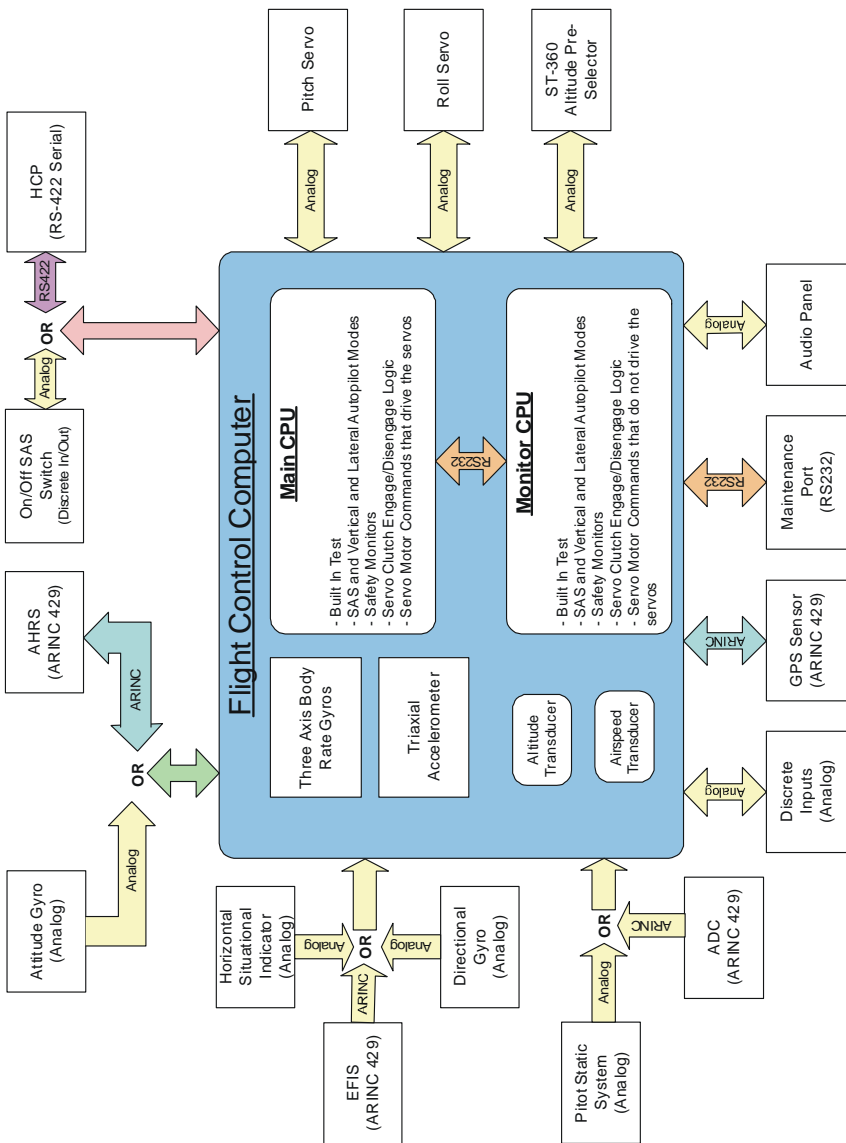


Fig. 1-2. HeliSAS System Diagram

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.

SECTION 2 PRE-FLIGHT PROCEDURES

Page Intentionally Blank

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.

The indicator lights will flash as soon as the master switch is turned on. This indicates that the FCC is initializing. 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 then be engaged by the pilot.

Note:

If using Ver52 as a SAS-Only (no HCP, just SAS-On/Off switch), the SAS-On/Off annunciators do not flash during initialization; they will be dark until the initialization is complete, and then the SAS-Off annunciator light will become white indicating the SAS is in standby mode.

If an AHRS/ADAHRS is used as the pitch and roll attitude sensor, the system will enter standby after the alignment process is complete. If the analog panel-mounted mechanical attitude gyro (e.g. Castleberry) is used, the system will not enter standby mode unless the attitude gyro bank angle is less than 6°. If the attitude gyro bank angle is greater than 6°, 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.

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/OFF button on cyclic.	Note: 4 beeps in the headset and that the SAS annunciator turns white.
8. Move cyclic in pitch and roll.	Note: Lack of any resisting force.

Table 2-1. Power-Up Test

SECTION 3
NORMAL IN-FLIGHT PROCEDURES -
SAS

Page Intentionally Blank

3.1 Normal Operating Procedures - SAS

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 in the configuration settings.

- Ver51 and Lower Configurations:
 - Standard: 6° nose-down pitch, 11° nose-up pitch, and $\pm 5^\circ$ bank
 - R44/66: 6° nose-down, 11° nose-up, and $\pm 10^\circ$ bank
 - EC130: 10° nose-down, 11° nose-up, and $\pm 5^\circ$ bank
 - EC130T2: 10° nose-down, 11° nose-up, and $\pm 10^\circ$ bank
- Ver52 and Up Configurations:
 - Standard: 10° nose-down, 11° nose-up, or and 10° bank

If the FTR button is activated (pressed and released) outside these limits while SAS is engaged, the system will return to the closest limit. For example, if the FTR is pressed and released at a 20° bank angle and the cyclic is released, the helicopter will achieve a 10° bank (EC130T2 config) in the same direction.

If the SAS is engaged from standby (SAS light white) when the pitch attitude is outside a range of pitch attitude between -10° and +15°, or roll attitude of $\pm 6^\circ$, it will recover to a level attitude. This is intended to serve as a “panic button” in the event the pilot needs to quickly establish level attitude.

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.

Note:

This feature is not applicable to a HeliSAS configuration using a backup HeliSAS (available in Ver52 and up).

3.2 Recommended 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.

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.

Note:

When using a Ver51 or lower FCC, FTR must be repeatedly pressed to re-trim the cyclic and hold a commanded attitude throughout airspeed changes; however, when using a Ver52 FCC, HeliSAS will automatically compensate for the needed cyclic trim throughout speed changes and hold the commanded attitude.

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 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.

The divergence following a HeliSAS disengagement is significantly more rapid for helicopters with a semi-rigid rotor system, especially at higher airspeeds (e.g., 120 kts and greater). Such helicopters are fitted with a second independent backup HeliSAS system. If the aircraft is equipped with such a backup HeliSAS (applicable to Ver52 and up), the backup system will automatically engage in SAS mode and hold the attitude that was present at the moment the primary system was disengaged, however, as long as the backup system is the only stabilization system available, the pilot should continue to operate with a hand on the controls. 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 when using a Ver51 and lower FCC. When using a Ver52 and higher FCC, HeliSAS will automatically compensate for the needed cyclic trim throughout speed changes and hold the commanded attitude, so activating the FTR only needs to be used to set a new commanded/desired attitude.

3.6 Cruise

It is possible to cruise 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. 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, however when using a Ver52 and higher FCC without a discrete input from a skid sensor wired to the FCC, it is recommended the system be disengaged to standby mode or that the pilot press FTR once more after established on the ground to sync the commanded attitude with the aircraft attitude on the ground in order to avoid cyclic drift.

3.9 Disengage SAS/Autopilot

The SAS is normally disengaged by pressing the AP DISC/OFF button on the cyclic grip, the SAS button on the HCP, or the SAS On/Off switch on the instrument panel (if installed as a SAS-Only system). 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/OFF button causes the autopilot modes to disengage. A second press of the AP DISC/OFF button disengages the SAS.

With one or more autopilot modes engaged, both the SAS and autopilot may be disengaged by holding the AP DISC/OFF 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.

SECTION 4 NON-NORMAL PROCEDURES - SAS FAILURES

Page Intentionally Blank

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/OFF 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 on HCP or the SAS On/Off switch on the instrument panel 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 on the servos. Pilot may notice a very slight increase in cyclic force, even with the SAS disengaged. This is due to the ice buildup on the servo-actuators causing the clutch to be ineffective. The force to backdrive the servo-actuators is less than one pound.

Page Intentionally Blank

SECTION 5 NORMAL IN-FLIGHT PROCEDURES - AUTOPILOT

Page Intentionally Blank

Autopilot modes are selected on the HeliSAS Control Panel in Fig. 5-1 and Fig. 5-2.



Fig. 5-1. HeliSAS Control Panel (HCP) with BC Button (Ver51)



Fig. 5-2. HeliSAS Control Panel (HCP) with SPD Button (Ver52)

The LEDs above the mode select buttons indicate the status of the modes as follows:

- LED is dark – Mode is not engaged or armed.
- LED is white – Autopilot mode is armed or SAS is in standby.
- LED is green – Mode is engaged.

5.1 Heading (HDG) Mode

Set the Heading Bug to the desired heading on the HSI or EFIS 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°. When making heading changes, it is acceptable to fly-through the system to achieve larger or smaller bank angles.

If a heading bug source is not available (e.g., HSI not installed) 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.

5.2 Navigation (NAV) Mode - 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 (or functional equivalent on an EFIS display) 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° 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°.

Due to limitations on the analog course error signal received from the HSI, the helicopter must be tracking within 90° of the selected course in order to establish the proper intercept angle when NAV is selected. This limitation does not apply when 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° 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 is limited to 20°.

For a VOR course the bank angle is limited to 10°, 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°, 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 selected 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° 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°, 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 on the HCP. 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, and the HDG annunciation transitions from green to dark (off). 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 is limited 20°.

5.3 Backcourse (BC) Mode (Applicable to Ver51 and Lower)

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 navigation receiver is set to VLOC.

5.4 Navigation (NAV) Mode - 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 must be selected to GPS.

The autopilot does not use the selected course on 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 selected course on an EFIS display will generally auto-slew to the desired GPS course.

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.

5.4.1 Preprogrammed 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°.

If roll steering is not valid, the internal control laws will capture the selected course at a 45° 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 to achieve the desired intercept angle. Select HDG and then select NAV on the HCP. 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 an 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°.

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 Speed (SPD) Hold Mode (Applicable to Ver52 and Higher)

The SPD mode provides pitch attitude commands to hold a selected VS (Vertical Speed) or IAS (Indicated Airspeed). It can be a stand-alone mode or with altitude pre-select (ALT armed), depending on the following:

- A single press of the SPD button holds the Indicated Airspeed that exists when the SPD mode is selected. The reference speed may be reset at any time by pressing and releasing the FTR button on the cyclic grip. This is the stand-alone SPD mode indicated by a green SPD light. Pressing the ALT button on the HCP will cause ALT to engage and SPD to disengage.
- After selecting VS and ALT targets (either via a digital source such as an EFIS or an analog VS bug from an S-TEC preselector or similar device), pressing the SPD and ALT buttons simultaneously will set SPD (green) with ALT armed (white). This mode holds the commanded/selected Vertical Speed until the selected altitude is reached.
- After selecting IAS and ALT targets (via a digital source such as an EFIS), pressing the SPD and ALT buttons simultaneously will set SPD (green) with ALT armed (white). This holds the commanded/selected Indicated Airspeed until the selected altitude is reached.

If there are no VS or IAS targets available and no ALT target available, the Dual SPD/ALT button press will not function. Only stand-alone SPD (holds current airspeed with single press of SPD button) will be available.

When in dual SPD (green) and ALT (white), ALT stays armed until the selected altitude is reached, at which point, ALT will become active (green) and SPD will go off (dark). If both VS and IAS targets are present at the same time, the VS target is the priority.

5.6 Altitude (ALT) Hold

Altitude Hold Mode may be engaged at any time above 200ft off the ground and is announced by a green LED above the ALT button. It is not possible to arm the ALT mode using a Ver51 FCC, however arming ALT is possible if using a Ver52 FCC with a valid pre-selected altitude as described above in Section 5.5 (Speed 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 the 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.

5.7 Vertical (VRT) Mode

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.

SPD mode cannot remain active with VRT armed. Pressing VRT while in SPD mode, will activate ALT (green) and arm VRT (white) until glidepath intercept.

For an ILS approach the navigation receiver must be selected to VLOC, and a valid ILS signal must be present to arm VRT. An HSI or EFIS 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 dis-arm. 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.

The recommend 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/OFF button on the cyclic grip and accomplish the deceleration in SAS mode.

5.8 Missed Approach

5.8.1 VLOC (ILS or VOR Approach)

At the missed approach point accomplish the following:

1. Add power to arrest rate of descent and change the selected navigation source 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. If using a Ver52 or higher FCC, SPD mode can be used to accomplish the climb-out at a desired IAS or VS rather than using the pitch hold portion of SAS.
4. Resume waypoint sequencing 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 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.

5.8.2 GPS (LPV, LNAV/VNAV, or LNAV + V Approach)

At the missed approach point, add power to arrest rate of descent and 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 described in Section 5.8.1. 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/OFF button on the cyclic at the missed approach point, and manually fly the missed approach in SAS mode.

SECTION 6 GLOSSARY

Page Intentionally Blank

Term	Meaning
AHRS	Attitude Heading Reference System
ALT	Altitude Hold
AP	Autopilot
AP DISC	Autopilot Disconnect
APP	Approach
BC	Back Course
CDI	Course Deviation Indicator
DG	Directional Gyro
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FCC	Flight Control Computer
FTR	Force Trim Release
GPS	Global Positioning System
HCP	HeliSAS Control Panel
HDG	Heading
HSI	Horizontal Situation Indicator
HZ	Hertz
IAF	Initial Approach Fix
IFR	Instrument Flight Rules
ILS	Instrument Landing System
KIAS	Knots Indicated Airspeed
KTS	Knots
LNAV	Lateral Navigation
LNAV+V	Lateral Navigation with Advisory Vertical Guidance
LPV	Lateral Precision with Vertical Guidance
NAV	Navigation
PN	Part Number
POH	Pilot's Operating Handbook
RFM	Rotorcraft Flight Manual
RFMS	Rotorcraft Flight Manual Supplement
RPM	Revolutions Per Minute
SAS	Stability Augmentation System
SPD	Speed Mode
STC	Supplement Type Certificate
VHF	Very High Frequency
VLOC	VOR or LOC Frequency
VNAV	Vertical Navigation
VOR	Very High Frequency Omnidirectional Radio Range
VRT	Vertical Mode
WAAS	Wide Area Augmentation System

Page Intentionally Blank



Information contained in this document is subject to change without notice. © 2016 Genesys Aerosystems. All rights reserved. Printed in the United States of America. Genesys Aerosystems and the HeliSAS logo are registered trademarks of Genesys Aerosystems.

Notice:

Contact S-TEC Customer Support at 800-872-7832 for a Service Repair Order (SRO) number prior to the return of any component for any reason.

**One S-TEC Way
Municipal Airport
Mineral Wells, TX 76067-9236
Tel: 800-872-7832
Fax: 940-325-3904
www.genesys-aerosystems.com
S-TEC PN 87295**