

MOONEY AIRCRAFT CORPORATION
P. O. Box 72
Kerrville, Texas 78028

FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT
FOR
MOONEY M20J - (S/N 24-0773, 24-0939, 24-1094 AND UP)

WITH

KING KFC 200 AUTOMATIC FLIGHT CONTROL SYSTEM
WITH FLIGHT DIRECTOR

Model No. M20J

Reg. No. N1170N

Ser. No. 24-1316

This supplement must be used in conjunction with the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KFC 200 Automatic Flight Control System is installed in accordance with Mooney dwg. 830125. The information contained herein supplements or supersedes the basic manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic airplane flight manual.

FAA APPROVED:

D.A. Paul
Don P. Watson, Chief
Engineering & Mfg. Branch
FEDERAL AVIATION ADMINISTRATION
Southwest Region, Fort Worth, TX

DATE: JUL 16 1980

MOONEY AIRCRAFT CORPORATION
P. O. Box 72
Kerrville, Texas 78028

LOG OF REVISIONS

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vertical black lines in the margin.

*Don P. Watson, Chief, Engineering & Manufacturing Branch

SECTION I

GENERAL

This manual is to acquaint the pilot with the operation of the KFC 200 Automatic Flight Control System with Flight Director as installed in the M20J airplane. The airplane must be operated within the limitations herein specified.

The KFC 200 System with Flight Director may be operated as a Flight Director alone with the pilot steering the airplane to satisfy the Flight Director command presentation or the autopilot may be engaged to automatically steer the airplane to satisfy the Flight Director commands.

The KFC 200 System autopilot is certified in this airplane with 2 axis control, pitch and roll or 3 axis control if optional Yaw Axis is installed. The optional 3rd axis (Yaw) when installed gives 3 axis damping and control whenever the autopilot mode is engaged. With the installation of an optional KC 291 Yaw Damper Mode Controller, Yaw Damping and turn coordination is available with or without the basic autopilot mode being engaged. Both the 2 axis and 3 axis version of the system are described in this manual.

The airplane is equipped with an electric pitch trim system which is controlled by pilot operation of the trim switch. When autopilot coupled, the autopilot uses the electric trim system to accomplish automatic trimming to unload the autopilot elevator servo so that autopilot disengagement does not result in transient airplane motion. An autotrim/electric pitch trim monitor is provided in the autopilot. Autotrim and/or electric pitch trim faults are visually annunciated on the Mode Annunciator and accompanied by an audible warning.

This airplane is equipped with a manual electric trim system designed to withstand any type inflight single malfunction, provided that the system is fully functional during the preflight operational check.

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

AFCS	Automatic Flight Control System
ALT	Altitude or Altitude Hold
AP	Autopilot
APPR	Approach
ARM	System Arm for Capture

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Symbols, Abbreviations and Terminology cont...

BC	Back Course
CDI	Course Deviation Indicator or Control
CPLD	Coupled
CWS	Control Wheel Steering
DISC	Disconnect
FCS	Flight Control System
FD	Flight Director System
GA	Go Around
GS	Glideslope
HDG	Heading Select
NAV	Navigation
PAH	Pitch Attitude Hold
PNI	Pictorial Navigation Indicator
FDI	Flight Director Indicator
LOC	Localizer

SECTION II

LIMITATIONS

- A. During autopilot operation, the pilot must be seated at the controls with seat belt fastened. Operation is limited to the left side pilot position.
- B. Maximum speed for autopilot operation is 207 mph/180 kts indicated airspeed. Minimum speed for Autopilot operation is 92 mph/80 kts indicated airspeed.
- C. During autopilot operation, the wing flaps must not be extended beyond 15° (Take-off position).
- D. The autopilot must be disengaged during take-off and landing.
- E. System approved for Category I operation only (APPR Mode selected).

Autopilot attitude command limits:

Pitch	+15°
Roll	+20°
Yaw	NA

Placards:

- 1) AP DISC Location - Pilot's control wheel, left horn.

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- | | |
|--|---|
| 2) TRIM
INTERRUPT | Location - Pilot's control wheel,
right horn. |
| 3) CWS | Location - Pilot's control wheel,
right horn. |
| 4) TRIM DN
UP | Location - Pilot's control wheel,
left horn. |
| 5) GO AROUND | Location - Instrument panel, directly
above the throttle. |
| 6) 3 AXIS AP CONTROL | Location - Immediately adjacent to KC 290
(If equipped with a 3rd axis
without KC 291). |
| 7) CONDUCT AFCS PREFLIGHT
CHECK IN ACCORDANCE
WITH FLIGHT MANUAL | Location - Directly above the KC 290
Mode Controller. |

NOTE

IN ACCORDANCE WITH FAA RECOMMENDATION, USE OF ALTITUDE HOLD
("ALT") MODE IS NOT RECOMMENDED DURING OPERATION IN SEVERE
TURBULENCE.

SECTION III

EMERGENCY PROCEDURES

A. Autopilot/Yaw Damp Malfunction:

1. AP DISC Switch - Hold the Control Wheel firmly and
press the AP DISC Switch.

B. Electric Trim Malfunction (either manual electric or autotrim)

1. TRIM INTERRUPT SWITCH - Press and hold down until
recovery can be made.
2. ELEV TRIM switch - OFF.
3. AIRPLANE - Manually retrim.

C. Autopilot/Yaw Damp Manual Disengagement.

1. The autopilot and/or Yaw Damp can be manually disengaged
by the following methods:

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- a) Press the AP DISC switch on the Pilot's control wheel.
 - b) Move the Autopilot ON-OFF handle to the OFF position.
(Dumps AP only with KC291 Yaw Controller installed).
 - c) Turn off the Radio Master switch.
 - d) Operate manual electric trim switch UP or DN.
 - e) Depressing the GA switch on panel near engine throttle.
(Dumps AP only with KC291 Yaw Controller).
 - f) Cycle the Yaw Damp Switch. (with KC291 Yaw Controller.
Dumps Yaw Damp only).
- D. The following conditions will cause the Autopilot/Yaw Damp to automatically disengage:
- 1. Power failure.
 - 2. Internal Flight Computer Power supply failure.
 - 3. With the KCS 55A compass system, a loss of compass valid (displaying HDG flag) disengages the AP and FD when a mode using heading information is engaged. With the HDG flag present only vertical modes can be selected.
- E. Manual electric pitch trim can be disengaged by:
- Press TRIM INTERRUPT switch and hold down until recovery can be made, then turn off ELEV TRIM switch and manually retrim the airplane using the manual trim control wheel.

NOTE

IF "ELEV TRIM" SWITCH IS TURNED OFF, THE AIRPLANE ELECTRIC TRIM SYSTEM WILL BE DISABLED ("TRIM" WARNING ANNUNCIATOR FLASHES). IN THIS EVENT THE AUTOPILOT SHOULD BE DISENGAGED AND NOT USED.

- F. Maximum altitude losses due to autopilot malfunctions.

<u>Configuration</u>	<u>Alt Loss</u>
Cruise, Climb, Descent	360'
Maneuvering	80'
APPR	80'

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CAUTION

WHEN THE AUTOPILOT IS ENGAGED, MANUAL APPLICATION OF A FORCE TO THE PITCH AXIS OF THE CONTROL WHEEL FOR A PERIOD OF THREE SECONDS OR MORE WILL RESULT IN THE AUTO TRIM SYSTEM OPERATING IN THE DIRECTION TO CREATE A FORCE OPPOSING THE PILOT. THIS OPPOSING MISTRIM FORCE WILL CONTINUE TO INCREASE AS LONG AS THE PILOT APPLIES A FORCE TO THE CONTROL WHEEL AND WILL ULTIMATELY OVERPOWER THE AUTOPILOT. IF THE AUTOPILOT IS DISENGAGED UNDER THESE CONDITIONS, THE PILOT MAY BE REQUIRED TO EXERT CONTROL FORCES IN EXCESS OF 50 POUNDS TO MAINTAIN THE DESIRED AIRPLANE ATTITUDE. THE PILOT WILL HAVE TO MAINTAIN THIS CONTROL FORCE WHILE HE MANUALLY RETRIMS THE AIRPLANE.

SECTION IV

NORMAL PROCEDURES

- A. The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off electrical power to all flight control systems while the problem is isolated.
- B. The RADIO MASTER switch supplies power to the avionics buss bar of the radio circuit breakers and autopilot circuit breaker.
- C. The KFC 200 is controlled by the following circuit breakers:
 - Autopilot (AUTOPILOT) This supplies power to the FCS KC 295 Computer, KC 290 Mode Controller, KA 285 Annunciator Panel, KI 256, and AP Pitch and Roll Servos. When optional yaw damper system is installed, this breaker also supplies power to the KC 296 Yaw Computer, the Yaw Servo, and the KC 291 if so equipped.
 - RADIO MASTER This switch/circuit breaker supplies power to the avionics buss.
 - ELEV TRIM This switch/circuit breaker supplies power to the FCS autotrim and manual electric pitch trim systems.
 - COMP. SYSTEM (HSI) This supplies power to the KCS 55A Compass System.

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D. Pilot's control wheel switch functions:

TRIM INTERRUPT	This is a single detent switch that will interrupt the power to the electric trim system when depressed and disconnect the FD, and AP if engaged. In the event of electric trim failure the switch can be held down which removes all power from both the electric and autotrim system to allow the pilot time to turn off the Elev Trim switch.
AP DISC	The left hand portion of the manual electric trim switch provides the AP and yaw damp disconnect functions. Momentarily moving the switch forward or backwards will interrupt the power going to the servo engage clutches and cause both AP and Yaw Damp engage switches to disengage.
CWS	This switch, when depressed and held, will allow the pilot to manually fly the airplane in pitch and roll without disengaging the AP. When the switch is released the AP will resume control (within the pitch and roll attitude limits). The CWS switch will resync the FD and PAH, or ALT hold mode and will transfer the GA mode to PAH.
TRIM DN UP	Manual electric pitch trim is activated by a dual action type switch that requires both portions to be moved simultaneously for actuating up or down trim commands. Operation of the manual electric pitch trim switch will disengage the AP lever switch on the Mode Controller and switch the YAW DAMP mode off.

CAUTION

UNDER SOME CONDITIONS IT IS POSSIBLE THAT WHEN THE MANUAL ELECTRIC TRIM RUNS THE LONGITUDINAL TRIM TO THE LIMIT STOP, THERE MAY NOT BE SUFFICIENT TORQUE TO RUN THE TRIM IN THE OPPOSITE DIRECTION (AWAY FROM THE STOP). IF THIS OCCURS, MANUAL REPOSITION OF THE TRIM AWAY FROM THE LIMIT STOP MAY BE REQUIRED.

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D. (continued)

GA

The GA switch is located on the airplane panel adjacent to the throttle and the operation of the switch will indicate a fixed angle of climb of 6° on the FDI. Selection of the GA Mode when in the APPR or NAV CPLD Mode will disengage the mode and revert to the FD Mode (wings level) for lateral steering. The AP, if engaged, will disengage. The AP, however, can be engaged or re-engaged with GA mode selected and will follow the pitch command to climb at the fixed angle.

E. FCS Warning Flags and Annunciators Designation and Operation:

The KI 256 Flight Director Indicator does not have a warning flag. However, the command bars will be biased out of view whenever the system is invalid or a FD mode is not engaged.

HDG

This warning flag, mounted in the Pictorial Navigation Indicator, will be in view whenever the Directional Gyro information is invalid. If a HDG invalid occurs with either NAV, APPR, or HDG modes selected, the AP and/or FD is disengaged. Basic FD mode may then be re-engaged along with any vertical mode and the AP re-engaged.

TRIM

The TRIM Warning light, located in the lower right corner of the annunciator panel, will flash and be accompanied by an audible warning whenever autotrim and/or manual electric pitch trim failures occur. The Trim servo running without a command is monitored for both manual electric trim and Autotrim. The Trim servo motor not running when commanded to run, and the trim servo motor running in the wrong direction are monitored on Autotrim only. The TRIM warning light will flash at least 4 times but not more than 6 times and the audible warning sound when the test switch on the mode controller is depressed.

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E. (continued)

GS

The Glideslope valid, (GS pointer being in view on PNI) has to be present before GS may couple. If, after GS CPLD, the valid is lost, the system will flash the GS Annunciator and revert from GS CPLD back to PAH with the FDI pitch steering bar providing pitch attitude steering information. If the GS valid returns the system will revert back to GS CPLD.

NAV

The NAV or APPR Modes (ARM or CPLD) may be selected and will function with or without a NAV warning flag present. The FDI bank steering will continue to provide steering information with or without a valid NAV signal.

AP Disconnect Alert

A two second solid audio warning will sound whenever the Autopilot engage lever on the mode controller is disengaged.

F. Before Engaging Flight Control System:

1. Check that all circuit breakers for the system are in.
2. Allow sufficient time for gyros to come up to speed and system warm-up. (3 to 4 minutes).

G. Preflight Check: Perform prior to each flight.

1. With no modes engaged and power applied to all systems, depress the Test Button on the KC 290 Mode Controller. The Yaw Damp ON light will illuminate (if KC291 yaw controller is installed) and all modes will be indicated on the KA 285 Mode Annunciator including the three marker lights. Also, the red TRIM failure light will flash. At least four but not more than six flashes must be observed to indicate proper operation of the autotrim/manual electric pitch trim monitor and the audible warning should sound.
2. Engage the FD. Then engage the AP and Yaw Damp, depress the CWS switch, center the flight controls and then release the CWS switch. Apply force to the controls to determine if the AP and Yaw Damp can be overpowered.
3. With the FD, AP and Yaw Damp engaged press the AP DISC switch to see that it disengages the Autopilot and Yaw Damp.

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4. Perform the following manual electric pitch trim checks:
 - a. Verify that the Elev TRIM Switch is on.
 - b. Actuate the left-side switch to the fore and aft positions. The trim solenoid should engage, but the trim servo should not run.
 - c. Actuate the right-side switch to the fore and aft positions. The trim solenoid should not engage and the trim should not run.
 - d. Run the trim from full nose up to full nose down: The time required is 37 ± 6 seconds.
 - e. Grasping the manual trim wheel, run the electric trim in both the up and down directions and check the overpower capability.
 - f. Press the TRIM INTERRUPT switch down and hold. The manual electric pitch trim will not operate either up or down.
5. Disengage AP and set airplane manual pitch trim to take off position.

CAUTION

IF THE AUTOPILOT OR ELECTRIC TRIM FAILS PREFLIGHT TEST, THE AUTOPILOT CIRCUIT BREAKER SHOULD BE PULLED AND ELEV TRIM SWITCH SHOULD BE TURNED OFF AND NEITHER AUTOPILOT NOR ELECTRIC TRIM SHOULD BE USED.

- H. Preflight check: Perform prior to first flight of the day.
 1. Check operation of pilot's control wheel switch functions.
 2. Engage the FD and AP and put in a pitch (UP) command using the vertical trim switch on the Mode Controller. Hold the control column to keep it from moving and observe the autotrim run in the nose-up direction after approximately three seconds delay. Press the CWS Switch and resync the autopilot. Use the vertical trim switch and put in a pitch (DN) command. Hold the control column and observe the autotrim run in the nose-down direction after approximately 3 seconds.

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H. (continued)

3. Engage the HDG mode and the AP. Set the HDG bug to command a right turn. The control wheel will rotate clockwise. Set the HDG bug to command a left turn. The control wheel will rotate counterclockwise.

CAUTION

DISENGAGE THE AP AND CHECK THAT THE AIRPLANE MANUAL PITCH TRIM IS IN THE TAKEOFF POSITION PRIOR TO TAKEOFF.

NOTE

IF THE AUTOPILOT CIRCUIT BREAKER IS PULLED, THE RED "TRIM" FAILURE LIGHT ON THE ANNUNCIATOR PANEL WILL BE DISABLED AND THE AUDIBLE WARNING WILL CONTINUOUSLY SOUND INDICATING THAT THE FAILURE LIGHT IS DISABLED. IN THIS EVENT THE "ELEV TRIM" SWITCH SHOULD BE TURNED OFF AND INFLIGHT TRIM ACCOMPLISHED BY USING THE MANUAL PITCH TRIM WHEEL.

I. In-Flight Operation

1. Engage Procedure:

After takeoff, clean up airplane and establish climb. Engage the FD mode first, monitor flight controls and engage AP. The AP will lock on any pitch attitude up to $\pm 15^\circ$.

NOTE

DO NOT ENGAGE AUTOPILOT IN ATTITUDES BEYOND AUTOPILOT LIMITS.

Engaging and holding the CWS switch allows the pilot to momentarily revert to manual control while retaining his previous modes, except GA, and conveniently resume the profile at his discretion.

2. Disengage Procedure:

Check the airplane trim by monitoring the command bars before disengaging the AP. While holding the flight controls firmly, disengage the system by one of the following methods: depressing the pilot's AP DISC switch or by the operation of the engage lever on the Mode Controller. The AP light on the annunciator panel will flash at least four times and remain off and an audible warning will be heard to indicate that the AP is disengaged. To deactivate the flight director system, depress the FD switch on the Mode Controller or press the TRIM INTERRUPT switch on the pilot's control wheel.

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NOTE

IF THE AIRPLANE IS EQUIPPED WITH KC 291, THE OPTIONAL YAW DAMPER MODE WILL DISENGAGE WITH THE USE OF THE PILOT'S CONTROL WHEEL "AP DISC" SWITCH, BUT WILL NOT DISENGAGE AUTOMATICALLY WHEN THE MODE CONTROLLER "AP" SWITCH IS DISENGAGED. THE YAW DAMPER CAN BE DISENGAGED AT ANY TIME BY DEPRESSING THE YAW CONTROLLER "YAW DAMP" SWITCH.

3. Flight Director Mode (FD):

The FD mode must be engaged before the AP can be engaged. The FD alone indicates PAH and wings level. The pilot may choose to fly the FDI commands manually, without the AP engaged, by depressing the FD mode switch on the Mode Controller and selecting any of the other modes he wishes to follow. When the AP is engaged, the airplane will automatically follow the FDI commands.

The FD may be disengaged by depressing the FD mode switch on the Mode Controller at any time the AP is not engaged or by pressing the TRIM INTERRUPT switch on the pilot's control wheel with or without the AP engaged. FD mode engagement is displayed on the annunciator.

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO TRIM THE COMMAND PITCH ATTITUDE AT A RATE OF ONE DEGREE PER SECOND (THE PITCH ATTITUDE DEGREES LEGEND ON THE AIRPLANE ATTITUDE INDICATOR WILL NOT SERVE TO INDICATE ACCURATE FDI PITCH STEERING BAR PITCH ATTITUDES IN DEGREES).

4. Altitude Hold Mode (ALT):

When the ALT switch on the Mode Controller is pressed, the FDI will provide commands for maintaining the pressure altitude existing at the time the switch is depressed. For smooth operation, engage the ALT at no greater than 500 ft. per minute climb or descent. ALT will automatically disengage when glideslope couples or the GA switch is depressed. ALT hold may be turned off at any time by depressing the ALT switch. ALT engagement is displayed on the annunciator panel.

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO CHANGE OR TRIM THE COMMAND ALTITUDE UP OR DOWN AT 500 TO 700 FPM WITHOUT DISENGAGING THE MODE. THE NEW PRESSURE ALTITUDE THAT EXISTS WHEN THE SWITCH IS RELEASED WILL THEN BE HELD.

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5. Heading Mode (HDG)

Set the heading bug to desired heading on the PNI, depress the HDG switch on the Mode Controller and HDG will be displayed on the annunciator panel. The airplane FDI and/or AP will command a turn to the heading selected and hold. The pilot may then choose any new heading by merely setting the bug on a new heading. The airplane FDI and/or AP will automatically command a turn in the direction of the new setting. To disengage the HDG Mode, depress the HDG switch on the Mode Controller and observe the HDG light go out on the annunciator. The HDG mode will automatically disengage when APPR or NAV CPLD is achieved.

6. Navigation Mode (NAV):

The Navigation mode may be selected by tuning the NAV receiver to the desired frequency, setting the CDI to the desired radial and depressing the NAV switch on the Mode Controller. The annunciator will indicate NAV ARM until intercepting the selected course, unless the NAV switch is engaged with wings level and a centered needle on the CDI. Then the mode will go directly to NAV CPLD as displayed on the annunciator panel. The system can intercept at any angle up to 90° and will always turn toward the course pointer. If a condition requiring a capture exists at mode engagement, the pilot is required to set up an intercept angle using either HDG or FD mode. NAV may be disengaged by depressing the NAV switch or by engaging HDG when in NAV CPLD or APPR when in NAV CPLD/ARM.

CAUTION

THE "NAV" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMAND AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW). ALSO ERRONEOUS NAVIGATION INFORMATION MAY RESULT FROM COMM RADIO INTERFERENCE WITH NAV RADIO. THIS ERRONEOUS INFORMATION MAY CAUSE PREMATURE NAV CAPTURES AS WELL AS ERRONEOUS STEERING INFORMATION. SHOULD THIS OCCUR RE-SELECT "HDG" MODE AND THEN RE-SELECT "NAV" MODE.

7. Approach Mode (APPR):

The Approach mode may be selected by tuning the NAV receiver to the desired VOR or LOC frequency, setting the CDI to the desired radial or inbound heading and depressing the APPR switch on the Mode Controller. The annunciator will indicate APPR ARM until the course is intercepted unless the APPR switch is engaged with the wings level and there is a centered needle on the CDI. In that situation, the mode will go directly to APPR CPLD as displayed on the annunciator panel. The

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7. Approach Mode (APPR) (continued)

system can intercept at any angle up to 90° and will always turn toward the course pointer. See approach procedure for more detail. APPR mode can be disengaged by depressing the GA switch on the control panel or by engaging HDG or NAV when in APPR CPLD. The annunciator panel indicates the status of the approach mode.

CAUTION

THE "APPR" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMANDS AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW). ALSO ERRONEOUS NAVIGATION INFORMATION MAY RESULT FROM COMM RADIO INTERFERENCE WITH NAV RADIO. THIS ERRONEOUS INFORMATION MAY CAUSE PRE-MATURE APPR CAPTURES AS WELL AS ERRONEOUS STEERING INFORMATION. SHOULD THIS OCCUR RE-SELECT "HDG" MODE AND THEN RE-SELECT APPR MODE.

8. Back Course Mode (BC):

For BC operation proceed as for normal approach mode, but engage BC after selecting APPR. The BC switch reverses the signals in the computer and cannot be engaged without a LOC frequency selected. BC status is indicated on the annunciator panel. BC mode can be disengaged by depressing either the BC, APPR or GA switches, or by selecting other than a LOC frequency on the NAV receiver.

9. Trim Up/DN:

Operation of the vertical trim switch on the Mode Controller provides a convenient means of adjusting the ALT hold or PAH angle function without disengaging the mode.

10. Go Around Mode (GA):

The GA mode may be engaged at any time by depressing the GA switch on the airplane panel. GA will illuminate on the annunciator panel indicating mode status. The GA mode provides a fixed pitch up angle of 6° degrees for climbout. The AP, if engaged will disengage. GA will cancel all other vertical modes as well as APPR or NAV CPLD.

11. Yaw Damper Mode (YAW DAMP):

The optional Yaw Damper mode engages automatically when the AP is engaged or may be engaged or disengaged separately by the use of the YAW DAMP switch on the optional Yaw Controller. The Yaw Damper provides lateral damping plus turn coordination

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11. Yaw Damper Mode (YAW DAMP) (continued)

as a third axis with AP engaged or as a stand alone system with only the YAW DAMP on. If no KC 291 is used, the Yaw Damper will disengage with AP disengagement.

J. VOR Procedures:

1. Tune NAV receiver to the appropriate frequency.
2. Set the desired heading with the HDG bug to intercept the radial and engage HDG and AP (Maximum recommended intercept angle is 90°).
3. Select the desired radial and engage NAV. The FCS will remain on HDG as indicated on the annunciator panel and in ARM on the NAV mode. When the airplane intercepts the beam, the system will automatically couple and track in NAV mode and indicate CPLD on the annunciator.
4. A new course may be selected over the VOR station when operating in the NAV mode, by selecting a new radial when the To-From indication changes.
5. For VOR approach, see approach procedure.

K. Approach Procedures:

1. Tune ILS or VOR.
2. Set CDI to front course.
3. Set Heading Bug and engage HDG to intercept beam. (Maximum recommended intercept angle is 90°).
4. Engage APPR and note APPR ARM on the annunciator panel.
5. When the airplane approaches the beam, APPR will couple, HDG will decouple, the FDI and/or AP will give commands to track LOC or VOR, and CPLD will illuminate on the annunciator panel. If a satisfactory capture is not achieved, reselect HDG, select a new intercept heading, and then engage APPR. This places the system back in APPR Arm and a new capture cycle is commanded.
6. Flaps not to exceed 15° (Take off) position.
7. When the glideslope beam is intercepted, the glideslope will couple automatically and indicate GS on the annunciator panel. If ALT was engaged prior to intercepting the glideslope, it will automatically disengage when GS couples. Airplane FDI and/or AP will now provide command to track LOC and GS. Adjust throttle to control speed

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7. (continued)

on descent. Set HDG bug for missed approach but do not engage HDG.

NOTE

SHOULD THE "GA" MODE BE INADVERTENTLY SELECTED DURING "APPR" MODE OPERATION, CANCEL THE "GA" MODE (PRESS CWS) PRIOR TO RE-SELECTION OF THE "APPR" MODE. IT MAY BE NECESSARY TO USE SOME COMBINATION OF VERTICAL TRIM AND POWER TO RE-CENTER THE GLIDESLOPE FOR "GS" COUPLING. FAILURE TO FOLLOW THIS PROCEDURE WILL RESULT IN THE "GS" MODE BEING INHIBITED.

8. When middle marker signal is received, system will automatically switch to a more stable track mode.

NOTE

OPERATION OF THE MARKER TEST FUNCTION AFTER APPROACH COUPLED WILL REDUCE THE FLIGHT CONTROL SYSTEM GAINS. IF THIS SHOULD OCCUR THE APPROACH MODE SHOULD BE RECYCLED.

9. Landing or missed approach.

- a) Disengage AP and land.
- b) Go around by depressing the GO AROUND switch on the airplane panel. The AP will disengage if engaged and the FDI will command a 6° climb attitude. APPR may be engaged for a straight away missed approach or HDG may be engaged to turn to the missed approach heading.

L. Back Course Procedure:

Same as front course except that BC is engaged after APPR is engaged and the airplane must be set for descent manually by holding the vertical trim switch DN on the MODE CONTROLLER if in ALT hold or by establishing the desired PAH using CWS or Vertical Trim Switch.

SECTION V.

PERFORMANCE

No change.

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*Don P. Watson, Chief, Engineering & Manufacturing Branch

MOUNTAIN FLYING

Avoid flight at low altitudes over mountainous terrain, particularly near the lee slopes. If the wind velocity near the level of the ridge is in excess of 25 knots and approximately perpendicular to the ridge, mountain wave conditions are likely over and near the lee slopes. If the wind velocity at the level of the ridge exceeds 50 knots, a strong mountain wave is probable with strong up and down drafts and severe or extreme turbulence. The worst turbulence will be encountered in and below the rotor zone which is usually 8 to 10 miles downwind from the ridge. This zone is characterized by the presence of "roll clouds" if sufficient moisture is present; alto cumulus standing lenticular clouds are also visible signs that a mountain wave exists, but their presence is likewise dependent on moisture. Mountain wave turbulence can, of course, occur in dry air and the absence of such clouds should not be taken as any assurance that mountain wave turbulence will not be encountered. A mountain wave downdraft may exceed the climb capability of your airplane. Avoid mountain wave downdrafts.

VFR - LOW CEILINGS

If you are not instrument rated, avoid "VFR On Top" and "Special VFR". Being caught above an undercast when an emergency descent is required (or at destination) is an extremely hazardous position for the VFR pilot. Accepting a clearance out of certain airport control zones with no minimum ceiling and one-mile visibility as permitted with "Special VFR" is not a recommended practice for VFR pilots.

Avoid areas of low ceilings and restricted visibility unless you are instrument proficient and have an instrument equipped airplane. Then proceed with caution and have planned alternates.

SECTION X SAFETY INFORMATION

VFR AT NIGHT

When flying VFR at night, in addition to the altitude appropriate for the direction of flight, pilots should maintain a safe minimum altitude as dictated by terrain, obstacle such as TV towers, or communities in the area flown. This is especially true in mountainous terrain, where there is usually very little ground reference and absolute minimum clearance is 2,000 feet. Don't depend on your being able to see obstacles in time to miss them. Flight on dark nights over sparsely populated country can be almost the same as IFR and should be avoided by untrained pilots.

VERTIGO - DISORIENTATION

Disorientation can occur in a variety of ways. During flight, inner ear balancing mechanisms are subjected to varied forces not normally experienced on the ground. This combined with loss of outside visual reference can cause vertigo. False interpretations (illusions) result and may confuse the pilot's conception of the altitude and position of his airplane.

Under VFR conditions the visual sense, using the horizon as a reference, can override the illusions. Under low visibility conditions (night, fog, clouds, haze, etc.) the illusions predominate. Only through awareness of these illusions, and proficiency in instrument flight procedures, can an airplane be operated safely in a low visibility environment.

Flying in fog, dense haze or dust, cloud banks, or very low visibility, with strobe lights, and particularly rotating beacons turned on frequently causes vertigo. They should be turned off in these conditions, particularly at night.

All pilots should check the weather and use good judgment in planning flights. The VFR pilot should use extra caution in avoiding low visibility conditions.

Motion sickness often precedes or accompanies disorientation and may further jeopardize the flight.

STALLS, SPINS AND SLOW FLIGHT

Stalls, and slow flight should be practiced at safe altitudes to allow for recovery. Any of these maneuvers should be performed at an altitude in excess of 6,000 feet above ground level.

Spins may be dangerous and should be avoided. In fact, most airplanes are placarded against intentional spins. Spins are preceded by stalls. A prompt and decisive stall recovery protects against inadvertent spins.

All airplanes are required to have flight characteristics that give adequate advance warning of an impending stall or they must be equipped with an artificial stall warning device. Keep the artificial system in good working order. Do not operate the airplane with the device made inoperative by the use of circuit breakers or other means.

Stalls should be practiced at safe altitudes for ample recovery. Should a spin be encountered inadvertently, spin recovery should be initiated immediately.

As stall attitude is approached, be alert. Take prompt corrective action to avoid the stall or if you are practicing stalls, react the moment the stall occurs. The following is suggested:

1. Do not carry passengers. Be certain that the airplane's center of gravity is as far forward as possible. Forward CG aids spin recovery.
2. Be certain that both student pilot and instructor pilot have a full set of operable controls.
3. Conduct such practicing at altitudes in excess of 6,000 feet above ground level.

Remember that an airplane at or near traffic pattern altitude probably will not recover from a spin before impact with the ground. When descending to traffic pattern altitude and during operation in the traffic pattern and approach, maintain a safe margin above stall speed. During takeoff or go-around, be especially careful to avoid departure stalls associated with turns at low speed. Maintain speeds recommended in the handbook.

SECTION X
SAFETY INFORMATION

STANDARD PROCEDURE FOR SPIN RECOVERY

In the event of an inadvertent spin, the following recovery procedure should be used:

1. Rudder - Apply FULL RUDDER opposite the direction of spin.
2. Control Wheel - FORWARD of neutral in a brisk motion. Additional FORWARD elevator control may be required if the rotation does not stop.
3. Ailerons - NEUTRAL.
4. Throttle - RETARD to IDLE.
5. Flaps - If extended, RETRACT as soon as possible.
6. Rudder - NEUTRALIZE.
7. Control Wheel - Smoothly move aft to bring the nose up to a level flight attitude after spin has stopped.

VORTICES - WAKE TURBULENCE

Every airplane generates wakes of turbulence while in flight. Part of this is from the propeller or jet engine and part from the wing tip vortices. The larger and heavier the airplane the more pronounced and turbulent the wakes will be. Wing tip vortices from large heavy airplanes are very severe at close range, degenerating with time, wind and space. These are rolling in nature from each wing tip. In test, vortex velocities of 133 knots have been recorded. Exhaust velocities from large airplanes at takeoff have been measured at 25 mph, 2100 feet behind medium large airplanes.

Encountering the rolling effect of wing tip vortices within two minutes or less after passage of large airplanes is the most hazardous to the light airplanes. This roll effect can exceed the maximum counter roll obtainable in an airplane.

The turbulent areas may remain for as long as three minutes or more, depending on wind conditions, and may extend several miles behind the airplane. Plan to fly slightly above or to the side of the other airplanes flight path.