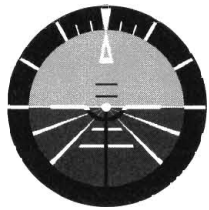


INSTRUMENT PILOT FLIGHT MANEUVERS

STEP BY STEP PROCEDURES PLUS PROFILES

BY BRAD DEINES

THIRD EDITION

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APPENDIX

He then applied and was accepted to attend Embry-Riddle Aeronautical University in Prescott, Arizona. A University known as the "Harvard of the Sky", where every subject Brad took had some connection to aviation. After four years, he left with a Bachelor of Science Degree in Aeronautical Science and a Commercial Multiengine Certificate with Instrument Privileges.

He then acquired his flight instructor ratings at a flight school located at Sky Harbor airport in Phoenix, Arizona. With a CFI and CFII in his hands now, he began giving instruction. He spent several years as a flight instructor and ground instructor. He then returned to his almamater to become a flight manager for Embry-Riddle teaching all levels of flight training. This included basic levels to the Boeing 737 simulator training program. Brad was also a certified check airman for Embry-Riddle Aeronautical University where he administered check rides for students testing for their Private Pilot Certificate, Commercial Pilot Certificate, Instrument Pilot Rating and Multi-engine license.

It was during this entire time as a flight instructor that he spent two years researching and writing this manual for his students. He wanted to give his students a comprehensive, professional manual covering all the flight maneuvers required to fly an airplane safely and efficiently in an instrument environment.

Today, Brad is a pilot for a major airline where he applies the procedures described in this manual on almost a daily basis.

Brad is the owner of Aero Tech Publications, a company which has specialized in aviation publications for over 10 years. He is also the author of *Flight Maneuvers for the Private and Commercial Pilot — Step by Step Procedures Plus Profiles.*

PREFACE

The purpose of this manual is to help in the explanation, visualization and execution of the flight maneuvers required for Instrument Rating Practical Flight Test. Students preparing for their Instrument Rating will find this manual helpful. Any pilot preparing for a recurrency checkride, such as an Instrument Competency Check, can use this manual as a refresher on maneuvers that you may not have executed in quite some time. Instrument Flight Instructor applicants and Certified Instrument Flight Instructors will find this manual a beneficial teaching aid. Instructors and flight schools can use this manual to develop thorough and standardized lesson plans.

Each maneuver is broken into six sections.

1. **Objective** — the Federal Aviation Administration's goal for a pilot as stated in the practical test standards.
2. **Completion Standards** — are taken from the instrument practical test standards. This details exactly what the Federal Aviation Administration requests of a pilot executing a maneuver. The limitations listed are the tolerances allowed on a Federal Aviation Administration's check ride. If these standards are not met, you will not pass your check ride.
3. **Description** — a brief explanation of the maneuver.
4. **Procedure** — a detailed step by step explanation of how to execute a maneuver as recommended by the Federal Aviation Administration. Each maneuver may vary slightly due to airplane type, manufacturer's recommendations, training environment and level. A Certified Instrument Flight Instructor will provide guidance on how the maneuver should vary for your particular situation.
5. **Reference** — contains the Federal Aviation Administration's Advisory Circulars (AC's) on which the previous sections are based. Page numbers are listed for location of additional information on each flight maneuver.
6. **Profiles** — most maneuvers also contain a graphic representation(s) of each maneuver. This graphic assists in visualizing the maneuver while summarizing the procedures and completion standards. On most profile pages you will have a table where you can fill in your particular aircraft airspeeds, pitch attitudes, bank angles, power settings and configurations.

All airspeeds, pitch attitudes, bank angles, power settings and configurations are referenced from the 1984 Cessna 172P Pilot's Operating Handbook based on sea level, maximum gross weight, and standard atmospheric conditions. All these settings may vary due to altitude, temperature, humidity, winds, airplane weight and configurations. Consult your airplane Pilot's Operating Handbook and/or your flight instructor for the proper airspeeds, pitch attitudes, bank angles, power settings and configurations.

HOW TO USE THIS MANUAL

Before every flight lesson, know exactly what flight maneuvers will be practiced. Reference your flight syllabus for the maneuvers to study. Divide the list into two sections: **New Maneuvers** for the maneuvers your instructor is going to introduce or teach for the first time; and **Review Maneuvers,** for maneuvers you are familiar with but will be practicing on your next flight lesson.

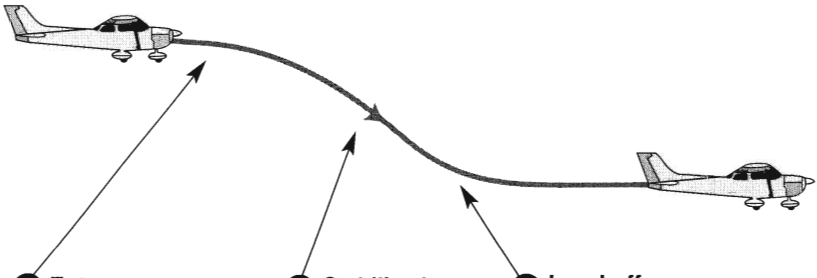
New Maneuvers — Start by reading the maneuver's six sections. If there are questions on a particular step in the maneuver, reference the appropriate Federal Aviation Administration Advisory Circular or other references listed for each maneuver. If an answer cannot be found, write it down and ask your instructor during the pre-flight briefing. Go over the procedure section several times until you every step memorized. Practice the maneuver by "chair flying" the step by step procedure. (Chair Flying - visually flying the maneuver in your comfortable chair at home). By doing all this preparation, you will impress your flight instructor with your knowledge and understanding of the maneuver before you even step into an airplane. Not to mention the money you will save in less dual flying time.

Review Maneuvers — The profile section in most cases will continue to refresh your memory on the steps required to complete the maneuver. If it has been several weeks since practicing this maneuver, it may be best to follow the steps listed for a new maneuver. Continue to "chair fly" the maneuver on your off days to maintain your proficiency.

CONSTANT RATE DESCENTS

Rules of Thumb

- **100 RPM/1" MP = 5 knots**
- **100 RPM/1" MP = 100 FPM**
- **Lead level off by 10% of VSI**
- **Lead roll out by 1/2 bank angle**



1 Entry
- Smoothly reduce power
- Maintain altitude
- Slow to airspeed
- Set pitch on AI

2 Stabilized
- Pitch for VSI
- Power for airspeed

3 Level-off
- Lead by10% of VSI
- Pitch up on AI
- Smoothly set power

	HIGH				NORMAL				LOW			
A/C	FPM	AS	POWER	PITCH	FPM	AS	POWER	PITCH	FPM	AS	POWER	PITCH
C172	1000	90	1300	-7°	500	90	1750	-3°	250	90	2100	-1°

	GLIDE SLOPE			
A/C	FPM	AS	POWER	PITCH
C172	480	90	1750	-3°

	PRIMARY			SUPPORTING		
	PITCH	POWER	BANK	PITCH	POWER	BANK
TRANSITION	AI	RPM/MP	HI	ALT/VSI	AS	TC/AI
STABILIZED	VSI	AS	HI	AI	RPM/MP	TC/AI

Limitations — Heading ±10° • Bank ±5° • Level-off ±100 Feet
Airspeed ± 10 Knots • Rate of Descent ±100 FPM

TIMED TURNS TO MAGNETIC COMPASS HEADINGS

OBJECTIVE

To teach the instrument student knowledge of the elements and procedures relating to calibrating the miniature aircraft of the turn coordinator, the operating characteristics and errors of the magnetic compass, and the performance of timed turns to specified compass headings.

COMPLETION STANDARDS

1. Establish indicated standard rate turns, both right and left.
2. Applies the clock correctly to the calibration procedure.
3. Changes the miniature aircraft position, as necessary, to produce a standard rate turn.
4. Makes timed turns to specified compass headings.
5. Maintains the altitude within 100 feet (30 meters), airspeed within 10 knots, bank angle 5° of a standard or half-standard rate turn, and rolls out on specified headings within 10°.

DESCRIPTION

Time is used to calibrate the turn coordinator. Timed turns to compass headings are accomplished by establishing and maintaining a bank angle which will provide a standard rate turn as referenced by the calibrated turn coordinator.

PROCEDURE

Calibrating the miniature airplane of the turn coordinator.

1. Set power for normal cruise, adjust pitch and trim off control pressures.
2. Roll in using the attitude indicator to establish the approximate angle of bank.
   Bank angle standard rate = (TAS/10) x 1.5
   Example: (100/10) x 1.5 = 15°
3. Check the miniature airplane of the turn coordinator, now primary for bank, for a standard rate turn indication.
4. Maintain coordinated flight.
5. Start clock.

6. As you turn through a cardinal heading on the heading indicator note the time. Check for a turn of 30 degrees for each 10 seconds.
7. Make necessary changes in indicated rate (miniature airplane position) to produce a standard rate turn.
8. Calibrate the miniature airplane of the turn coordinator for both right and left turns.
9. Note exact deflection of miniature airplane and use during all future timed turns.

Timed turns to specified compass headings.

1. Determine the number of degrees to be turned.
2. Compute the time needed to accomplish the turn at a standard rate (three degrees per second) or at half-standard rate (one and a half degrees per second). For standard rate divide the number of degrees by three or use three seconds for each ten degrees.
3. Start time when pressure is applied to roll into the turn and is stopped when pressure is applied to roll out.
4. Enter a standard or one-half standard rate turn in the direction required. Maintain a coordinated turn
5. Use the previously calibrated turn coordinator as the primary bank instrument while in the turn.
6. Crosscheck magnetic compass with clock during the turn to monitor progress and continue to calibrate the turn coordinator.
7. At the end of your computed time roll out of the turn at the same rate you rolled in.
8. With the wings level and the miniature airplane of the turn coordinator indicating zero rate of turn, the magnetic compass should indicate your desired heading.
9. For small change in heading, use half standard-rate turn as indicated by the miniature airplane of the turn coordinator.

Note: If the airplane has a turn and slip indicator, the phrase "miniature airplane of the turn coordinator" applies to the turn needle.

Note: The student will be able to demonstrate timed turns to headings using all available instruments or without the use of the attitude and heading indicators.

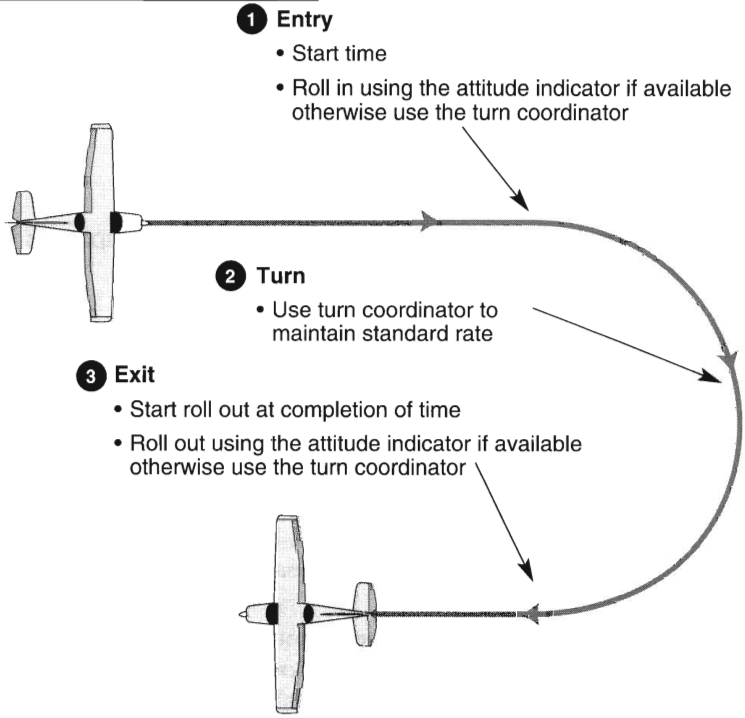
References

Instrument Rating Practical Test Standards FAA-S-8081-4C, pg. 1-9.
Instrument Flying Handbook FAA-H-8083-15, pg. 5-22 ⇒ 5-30.

TIMED TURNS TO MAGNETIC COMPASS HEADINGS

Rules of Thumb

- **Standard Rate = 3° per sec. or**
- **180° = 1 minute or**
- **360° = 2 minutes**



Formula

Bank angle for standard rate = (TAS/10) x 1.5

	STANDARD RATE			
A/C	BANK	TAS	POWER	PITCH
C172	14°	90	2200	0°

	PRIMARY			SUPPORTING		
	PITCH	POWER	BANK	PITCH	POWER	BANK
TRANSITION	ALT	AS	AI	AI/VSI	RPM/MP	TC/HI
STABILIZED	ALT	AS	TC	AI/VSI	RPM/MP	AI/HI

Limitations — Altitude ±100 feet • Airspeed ±10 knots
Bank angle ± 5° of standing rate • Rolls out on specified heading ±10°

MAGNETIC COMPASS TURNS

OBJECTIVE

To teach the instrument student knowledge of the elements and procedures relating to magnetic compass turns, the operating characteristics and errors of the magnetic compass.

COMPLETION STANDARDS

This maneuver is not required on the Instrument Rating Practical Test.

DESCRIPTION

Turns to compass headings using the magnetic compass as the reference for heading.

PROCEDURE

1. Determine the number of degrees the magnetic compass will have in error due to magnetic dip in the area where you will be flying.
   a. Maximum error on headings of North and South.
   b. Northerly error = Latitude + 1/2 bank angle.
   c. Southerly error = Latitude - 1/2 bank angle.
   d. Zero error on East and West headings. Lead each by 1/2 the bank angle.
2. Determine the number of degrees needed, interpolating if necessary, to undershoot or overshoot for the desired heading. (OSUN — Overshoot South; Undershoot North.)
3. Enter a standard rate turn in the shortest direction to the heading, or as directed. The turn coordinator is primary for bank during the turn. Maintain coordinated flight.
4. Upon reaching the roll out heading, roll out using the attitude indicator (if available) or turn coordinator.
5. Make small corrections by counting to yourself the number of seconds needed to correct back to the desired heading. (Three degrees per second using standard rate turn. One and a half degrees per second using half standard rate turn.)

Note: These rules apply only in the Northern hemisphere. They are the opposite for the Southern hemisphere.

References

Instrument Flying Handbook FAA-H-8083-15, pg. 5-25, 5-30.

MAGNETIC COMPASS TURNS

Rules of Thumb

- **Standard Rate = 3° per sec. or**
- **180° = 1 minute or**
- **360° = 2 minutes**

Maximum error on North and South Headings

Zero error on East and West Headings

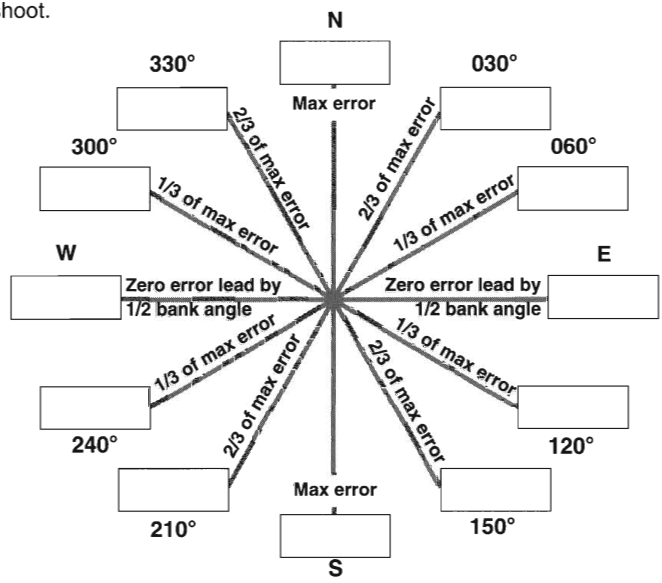
O — Overshoot
S — South
U — Undershoot
N — North

	STANDARD RATE			
A/C	BANK	TAS	POWER	PITCH
C172	14°	90	2200	0°

Formulas

Bank angle for standard rate = (TAS/10) x 1.5
North (360°) max error = Latitude + (1/2 standard rate)
South (180°) max error = Latitude - (1/2 standard rate)

Undershoot/Overshoot
Using formulas, fill in the boxes with the number of degrees to overshoot or undershoot.



	PRIMARY			SUPPORTING		
	PITCH	POWER	BANK	PITCH	POWER	BANK
TRANSITION	ALT	AS	AI	AI/VSI	RPM/MP	TC/HI
STABILIZED	ALT	AS	TC	AI/VSI	RPM/MP	AI/HI

STEEP TURNS

OBJECTIVE

To teach the instrument student knowledge of the factors relating to attitude instrument flying during steep turns.

COMPLETION STANDARDS

1. Enters a turn using a bank of approximately 45°.
2. Maintains the specified angle of bank for either 180° or 360° of turn, both left and right.
3. Maintains altitude within 100 feet (30 meters), airspeed within 10 knots, 5° of specified bank angle, and rolls out within 10° of the specified heading.
4. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

DESCRIPTION

Turns both left and right are accomplished using a constant 45° bank angle.

PROCEDURE

1. Set power for recommended entry speed and trim off control pressures.
2. Select a heading to start the maneuver.
3. Smoothly roll into a 45° bank in the specified direction by reference to the attitude indicator.
4. As bank angle steepens, adjust back pressure so as to maintain a level attitude, adjust power to maintain airspeed and trim.
5. Increase power by 200 RPM/2" MP to maintain airspeed. Airspeed is primary for power.
6. Once established at 45 degrees and stabilized, trim off control pressures.
7. The attitude indicator is primary for bank.
8. Continue to cross-check all instruments at a more rapid rate, noting how the supporting instruments aid in your interpretation and subsequent control.

9. In your scan add emphasis to the Vertical Speed Indicator (VSI). This is a trend instrument and will tell you whether you are climbing or descending before the altimeter will.
10. Maintain coordinated flight.
11. Lead your roll-out by one-half your bank angle (22°) and roll-out at the same rate you rolled in.
12. Complete the specified number of turns.
13. Reduce power to entry setting and trim off control pressures.

Note: This maneuver is performed using all available instruments.

References

Instrument Rating Practical Test Standards FAA-S-8081-4C, pg. 1-9.
Instrument Flying Handbook FAA-H-8083-15, pg. 5-26 ⇒ 5-30.

	STANDARD RATE			
A/C	AS	POWER	PITCH	BANK
C172	95	2500	+1/2°	45°

	PRIMARY			SUPPORTING		
	PITCH	POWER	BANK	PITCH	POWER	BANK
TRANSITION	AI	AS	AI	ALT/VSI	RPM/MP	TC/HI
STABILIZED	ALT	AS	AI	AI/VSI	RPM/MP	TC/HI

Limitations — Altitude ±100 Feet • Airspeed ±10 knots
Bank angle ± 5° • Rolls out on specified heading ±10°

RECOVERY FROM UNUSUAL FLIGHT ATTITUDES

OBJECTIVE

To teach the instrument student knowledge of the elements relating to attitude instrument flying during recovery from unusual flight attitudes (both nose-high and nose-low).

COMPLETION STANDARDS

1. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, and power corrections in the correct sequence to return the aircraft to a stabilized level flight attitude.

DESCRIPTION

While simulating emergency instrument conditions, the instructor/examiner will force the airplane to a critical flight attitude. When instructed, the student will take control of the airplane and recover to straight and level flight.

PROCEDURE

1. Note the original heading and altitude.
2. Two methods of establishing a critical flight attitude may be used.
   a. The hooded student is told to look down or up, close his/her eyes and place the airplane in a standard rate turn.
   b. The hooded student is told to remove his/her hands and feet from the controls, look down or up and close his /her eyes. The instructor/examiner places the airplane into a critical flight attitude.
3. In either of the above cases, when the airplane is in the critical flight attitude, the instructor/examiner will clearly tell the student to open his/her eyes and recover solely by reference to the instruments.
4. Recognize what type of critical attitude you are experiencing.
5. Interpret the instruments to produce correct control inputs.
6. Two common situations normally occur.
   a. Nose high attitude— airspeed low and decreasing.
      1. Add full power.
      2. Pitch down to level flight.
      3. Level the wings.
      4. Return to original heading and altitude.

b. Nose low attitude— airspeed high and increasing.
   1. Reduce power as required.
   2. Level wings.
   3. Pitch up for level flight.
   4. Return to original heading and altitude.

7. The pitch attitude will be approximately level when the airspeed and altimeter needles stop their movement and the vertical speed indicator reverses its trend.
8. Recover by prompt, smooth, coordinated control, using proper sequence.
9. Avoid excessive load factors, airspeeds or stalls.
10. Do not use the attitude indicator until you verify its reliability. The attitude may tumble if its limits are exceeded.

Note: The student will be able to demonstrate recovery from unusual flight attitudes using all available instruments or without the use of the attitude indicator.

Note: Any intervention by the examiner to prevent the aircraft from exceeding any operating limitations, or entering an unsafe flight condition, shall be disqualifying.

References

Instrument Rating Practical Test Standards FAA-S-8081-4C, pg. 1-10.
Instrument Flying Handbook FAA-H-8083-15, pg. 5-31 ⇒ 5-33.