AMERICAN FLYERS

VISION THROUGH INSTRUMENTS

INSTRUMENT RATING FLIGHT MANUAL

FIVE BY FIVE
Educational Services

CONTENTS

AMERICAN FLYERS

INTRODUCTION

For the experienced VFR pilot, an instrument rating is the next logical step in training if one wants to be a safe, well-qualified pilot. For the training to be effective, it must follow a logical and proven syllabus. This instrument flight manual presents the syllabus used for instrument training at American Flyers. It effectively ensures that each block of knowledge and skill development to which you are exposed is introduced at the proper time. Each phase serves as a building block upon which the next phase is built. It is essential that you thoroughly understand the instruction given during each period in order to gain the maximum benefits from your training.

The transition from visual to instrument flight is understandably going to cause problems for a pilot who has spent hundreds, or even thousands, of hours in the air relying mostly on visual references. Once you are deprived of outside references to determine aircraft attitude, you must rely solely on instrument indications. To make this transition successfully, you must learn to disregard some of the natural senses that have served you well in VFR flight. Under instrument conditions, you will receive stimuli from four different sources:

1. FEEL - Without visual references, the sense of balance will often give you erroneous indications of pitch and bank attitude, and the natural tendency is to make the seemingly appropriate control response.

2. SIGHT - When in actual instrument conditions, it is usually possible to see outside the aircraft to at least some limited degree; therefore, there is a natural tendency to use whatever is seen as a reference for the plane's attitude relative to the ground.

3. ANTICIPATION - Flying VFR you have learned to anticipate control pressures required for a given maneuver. To initiate a turn, for example, it is necessary to use rudder and aileron and, to maintain altitude in the turn, additional back pressure must be held. The natural tendency under instrument conditions is to anticipate similar needs for control movement and apply the pressures without regard to instrument indications.

4. INSTRUMENT INDICATIONS - As opposed to the first three natural senses, this unnatural, mechanical source of seemingly unrelated information has little meaning until it is thoroughly understood.

Of the above four sources of information, the first two, sight and feel, are natural references that have served you well during flight (and for a lifetime of other activities). The third, anticipation, has been a reliable guide for your VFR flying. However, none of these can be trusted for instrument flight.

Feel, without visual reference, is completely useless, as a simple experiment will prove. Balance on one foot with your eyes open and then with your eyes closed. It is easy to do when you can see but impossible for any length of time when you cannot. Under instrument conditions, without visual reference, this sense of feel will give false indications of the aircraft's attitude.

Although when flying in clouds you can generally see beyond the immediate confines of the cockpit, what you see is unusable for aircraft control. Varying cloud densities will show as light and dark areas. Apparent horizons may be available in the form of layered clouds or the top of a cloud deck. Although such formations may give an impression of a usable horizon, there is no way to know for sure if they are, in fact, aligned with the true horizon or angled across it. Thus, whatever can be seen outside the airplane must be disregarded.

Anticipation is less likely to get you into trouble than the misleading references of feel and sight, but still it must be avoided. Even in a familiar airplane, the normal and expected control movements will not always be the necessary ones for a given maneuver. This is particularly true in turbulent air. If a pilot arbitrarily uses a normal amount of aileron input in starting a turn, and then encounters rough air that drops a wing ten or fifteen degrees, the general result will be an excessively banked turn and the possibility of a dangerous attitude. Anticipation of this sort can cause an undue amount of work for the pilot, since it is a lot more taxing to recover from a poorly executed maneuver than it is to begin the maneuver correctly in the first place.

Instrument flight must be accomplished strictly by reference to instrument indications and all other stimuli must be disregarded. An untrained pilot, continuing flight into conditions requiring instrument flight may become an accident statistic due to the pilot's reliance on one or more of the above references. The only reliable references for instrument flight are the instrument indications.

To learn to fly instruments safely you must first learn to read the instruments properly, understand the information they provide, and understand their limitations. This part is relatively simple. However, being able to scan the instruments and do the maneuvers with any degree of ease and without undivided attention is another matter. This is a skill that will require several hours of practice.

Another facet of instrument flying that may seem foreign at first is the emphasis on procedures and the techniques for accomplishing them. Instrument flying is, by its very nature, more disciplined than VFR flying. The air traffic control system exists to provide for the safe, orderly, and expeditious movement of aircraft during all types of weather. To maintain safe aircraft separation, air traffic controllers depend on instrument pilots to fly with precision and accuracy. The demands of safety also require instrument pilots to adhere to established procedures for the various phases of flight. A pilot who, for example, deviates from the prescribed instrument approach procedure during an instrument let down to an airport in mountainous terrain is inviting disaster.

While the procedures of instrument flying are inflexible, the techniques pilots may use to accomplish each procedure are as varied as the individuals themselves. The standardized techniques your instructors will teach are those that have proven to be usable and efficient for more than fifty years of instructional experience. Throughout your training, keep this in mind - the techniques we at American Flyers recommend are those that are time tested to meet three important criteria. First, and foremost, the technique must promote learning. Any technique that inhibits your progress will cost you time and money. Second, the technique must be general enough to fit any anticipated situation. Third, the technique must enable a single pilot, operating in instrument meteorological conditions, to safely and properly accomplish the procedure while maintaining continuous awareness of the airplane's flight path and position. It is vital that you thoroughly understand the techniques as well as the procedures presented during training. Only by understanding why you are to do something in a certain way will it be possible to put your knowledge and skill to practical use.

As you advance into the different phases of instrument flying, you will realize that it is not possible to learn a specific technique to handle each of the infinite variety of individual situations that can and do develop. You will, however, learn the fundamentals that you can put to use in various combinations to handle specific situations. If you make an honest effort to understand the fundamentals, you will not forget them. You will be able to handle a wide variety of possible situations with sufficient insight to determine the proper solution, though you may not have been specifically trained for each individual situation. Our goal is to help you become a safe and competent instrument pilot, not just instrument rated.

AMERICAN FLYERS

CHAPTER 1

ATTITUDE INSTRUMENT FLYING

Revised 0995

In this chapter you will learn about the operation, use, and limitations of the flight instruments. You will learn to perform basic instrument flight maneuvers and to visualize attitude by reference to flight instruments. You will also learn about the relationship between attitude, power, and airplane performance.

ATTITUDE INSTRUMENT FLYING

Controlling attitude and power to produce the desired performance is the essence of attitude instrument flying.

This concept is represented by the formula:

Attitude + Power = Performance.

The term attitude refers to the relationship of the airplane's pitch, roll, and yaw axes to the natural horizon. Power refers to the engine output.

7° Nose up
Full power
will give Vy

The natural horizon is your primary attitude reference for visual flight. In attitude instrument flying your reference is similar, but your windshield is smaller. Your new windshield is the attitude indicator. Your interpretation of the attitude indicator gives you a mental picture of the airplane's pitch and roll attitude.

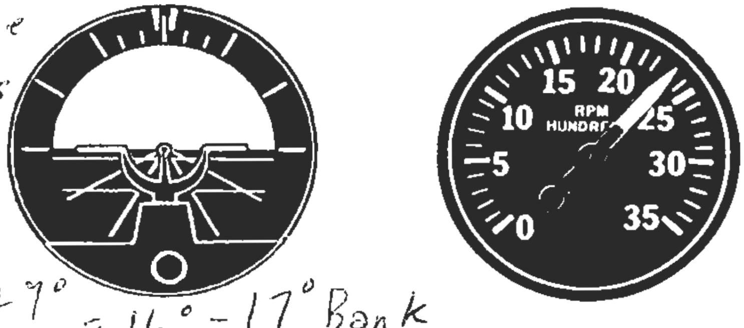
Control Instruments

Control instruments are those that provide immediate and direct indications. The attitude indicator is the only instrument that shows an immediate and direct indication of attitude.

Desent
500ft/min =
Bottom of Green arc
2100 - 2000 ± 0°-2°
Nose down

The power control instrument for an airplane with a fixed pitch propeller is the tachometer. If the airplane has a constant speed propeller, the power control group consists of the manifold pressure gauge and tachometer.

Level flight = Cruise
2300 RPM = 95-100kts
& Pointer



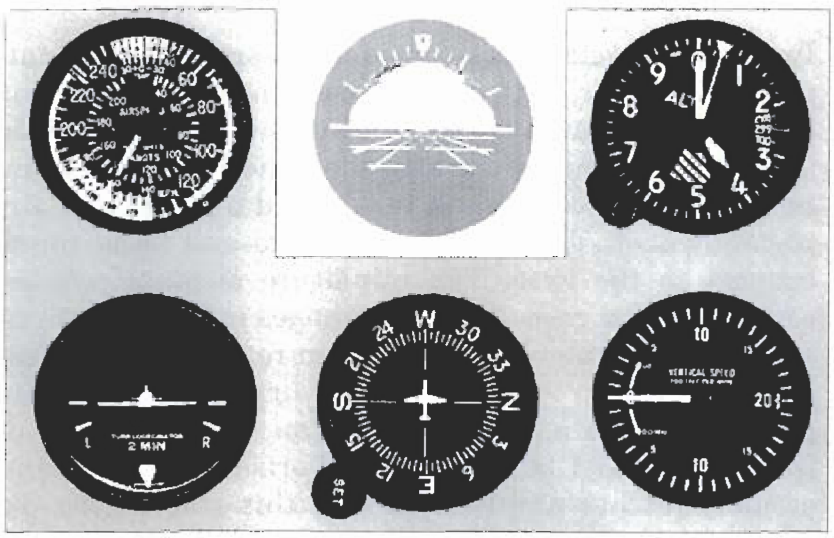
Turn 3°/sec = $\frac{\text{AirSpeed}}{10} + 7^\circ = 16^\circ - 17^\circ$ Bank

CONTROL INSTRUMENT GROUP

Considered together, the attitude indicator and power indicator form the control group. Accurate control of performance requires that you make changes in attitude and power by reference to the control instruments.

Performance Instruments

Performance instruments are those from which you can interpret the result of any attitude and power combination. The altimeter, airspeed indicator, vertical speed indicator, turn coordinator, heading indicator, and magnetic compass are performance instruments. Your interpretation of the performance instruments provides a mental picture of the flight path.



PERFORMANCE INSTRUMENT GROUP

Attitude instrument flying is a continuous process of:

1. Establishing a definite, predetermined attitude and power combination on the control instruments.

2. Trimming to relieve control pressures.

3. Scanning to visualize resulting performance.

4. Adjusting the attitude and power combination as needed to correct deviations.

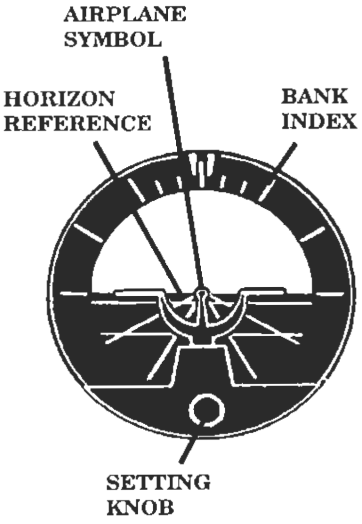
Before getting into the technique of attitude instrument flying it is appropriate to review the operation and use of the flight instruments.

Understanding how the flight instruments operate is important to safe and efficient flight. This knowledge enables you to interpret the normal indications of the flight instruments. It also equips you to recognize the failure of any instrument or instrument power source.

GYROSCOPIC INSTRUMENTS

You probably learned to ride a bicycle as a child. Keeping your balance on a bicycle requires some skill, but a large contribution to stability comes from the rigidity of a gyro. A gyro is any rotating body, a bicycle wheel, for example. Rigidity refers to the tendency of a gyro to resist forces which try to change its position or plane of rotation. The faster a gyro turns, the greater its rigidity.

Attitude Indicator



Imagine a bicycle wheel, considerably smaller and rotating much faster, with its axle pointing vertically. This image is similar to the gyro contained in an attitude indicator. The face of the attitude indicator displays the horizon reference, a bank index, and a miniature airplane symbol. The horizon reference and bank index connect to the gyro. The miniature airplane symbol connects to the case. Attitude changes in flight result in apparent movement of the horizon reference and bank index in relation to the miniature airplane symbol. The gyro maintains a constant position with its plane of rotation parallel to the natural horizon. The airplane actually pitches and rolls around this stable gyro. To assist in interpreting the attitude indicator, imagine you are at a point in space behind your airplane viewing it against the natural horizon.

Drag created by the gyro mounting bearings and the forces created during maneuvers affect gyroscopic rigidity. Precession is the turning reaction of a gyro in response to overpowering forces. Attitude indicators contain a self erecting mechanism to correct for precession.

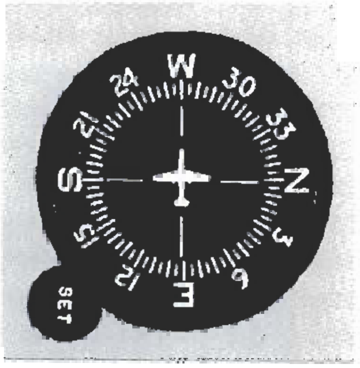
The action of the self erecting mechanism is apparent as the gyro comes up to speed after engine start. The horizon reference will bounce and wiggle until the gyro reaches its stabilized position. **The attitude indicator is operating normally if the horizon reference becomes parallel with the natural horizon within 5 minutes after engine start.**

A setting knob allows you to adjust the position of the miniature airplane symbol in relation to the horizon reference. Once the horizon reference settles down, adjust the small airplane symbol so that it exactly matches the horizon. This establishes a reference for a level pitch attitude. Of course, if your airplane is not in a level flight attitude during taxi, this initial setting will need to be corrected accordingly.

The heading indicator also makes use of gyroscopic rigidity. An important fact to remember is that the heading indicator does not know on its own where north is. You must initially set the heading indicator to match the magnetic compass.

Unlike the attitude indicator, the heading indicator has no built in correction for precession. **You must periodically compare the heading indication against the magnetic compass and reset the heading indicator as needed. Do this just before takeoff, at least once every 15 minutes during flight, and always before beginning an approach.**

Heading Indicator



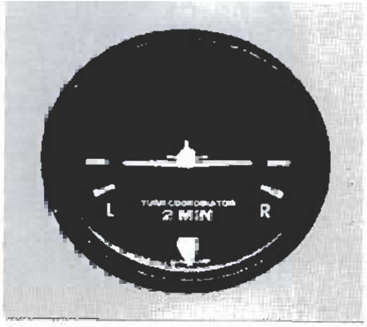
The gyros of the attitude and heading indicators are normally vacuum powered. The source of air pressure is an engine driven vacuum pump. Some vacuum gauges have a green arc to indicate normal pressure to the instruments. Others may have red pop out indicators to show pressure is below normal. A warning light in some systems indicates low vacuum pressure.

Vacuum Power Source

The turn coordinator makes use of gyroscopic precession to display the rate of heading change during a turn. The turn needle connects to an electrically powered gyro which deflects in response to roll and yaw. A wingtip aligned with the turn index shows a standard rate turn. Standard rate is 3° per second. A heading change of 360° takes 2 minutes at standard rate. A 180° change takes 1 minute, and a 90° change takes 30 seconds.

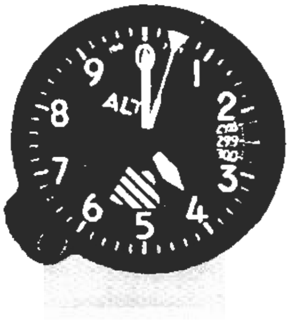
The ball of the turn coordinator displays the quality of the turn. During a coordinated turn the ball remains centered in its race.

Turn Coordinator



PRESSURE INSTRUMENTS

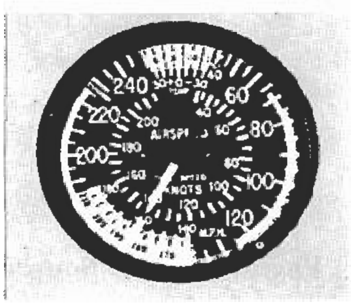
Altimeter



The altimeter senses the air pressure around the airplane through the static vent(s). The altimeter setting window allows you to set the reference pressure to the current pressure existing at sea level. When set to the current local altimeter setting, the altimeter shows indicated altitude which is your height above mean sea level (MSL).

Check the altimeter before each flight by dialing in the current altimeter setting and noting the indicated altitude. Altimeter accuracy is questionable if the indication is in excess of 75 feet from the known field elevation.

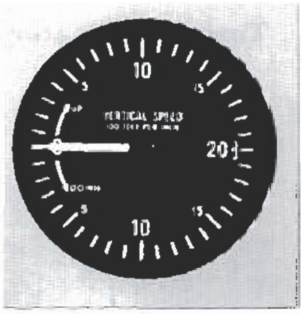
Airspeed Indicator



The airspeed indicator senses pressure at the pitot tube. This dynamic pressure results from the relative wind. The greater the dynamic pressure the greater the indicated airspeed. The airspeed indicator also connects to the static vent(s). This balances the effects of changing static pressure. Check for a zero airspeed indication before flight.

An electric heating element serves to *prevent* icing of the pitot tube. Turn on the pitot heat before flight in visible moisture when temperatures at or below freezing.

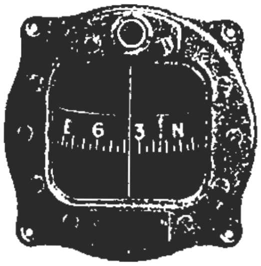
Vertical Speed Indicator



The vertical speed indicator (VSI) senses changes in static air pressure through the static vent(s). It gives indications of both the direction and the rate of change in pressure. Beginning a climb, for example, results in an immediate climb trend indication. Accurate rate information is not available until the climb stabilizes.

Instrument flight rules do not require a VSI, but almost every IFR certified airplane has one. Check the VSI for a zero indication before flight. A slight climb or descent indication is acceptable, but you must remember to use that indication as the zero point in flight.

Magnetic Compass



A magnetic compass requires no power system. Magnets within the compass align with the Earth's magnetic field. A compass card, to which the magnets attach, displays the compass heading. This makes the magnetic compass a very reliable direction indicator. Unfortunately, its construction causes unreliable indications during turns, airspeed changes, and in turbulence. Expect accurate indications only during unaccelerated level flight.

Required Flight Instruments

Instrument Flight Rules require the following flight instruments:

A gyroscopic attitude indicator
A gyroscopic heading indicator
A gyroscopic rate of turn indicator
A sensitive altimeter
An airspeed indicator
A magnetic compass

Although almost all IFR certified airplanes are equipped with a vertical speed indicator, it is *not* a required instrument for IFR flight.

BASIC INSTRUMENT MANEUVERS

Any instrument flight is simply a series of connected basic instrument flight maneuvers. These basic maneuvers are:

Normal climb
Climbing turns
Normal cruise
Level turns
Cruise descent
Descending turns
Level flight at approach airspeed
Approach airspeed descent

For each of these maneuvers you need to know the correct values of altitude, heading, airspeed, bank angle, rate of climb or descent, etc. You also must know the attitude and power combination which will result in the desired performance. Appendix A of this manual provides approximations of this information for American Flyers' Cessna 172 and Cessna 172RG. A blank form is also provided for your use if you are using your own airplane for training.

ATTITUDE FLYING TECHNIQUE

To accurately control performance during any maneuver you must accurately control the attitude and power combination. Accurate control of airplane attitude requires that you:

1. Can maintain a constant attitude.
2. Know when and by how much to change the attitude.
3. Can smoothly change the attitude by a definite, predetermined amount.

Although the attitude indicator provides an immediate and direct indication of airplane pitch and roll attitude, you must interpret its indications. Think of your view of the small airplane symbol as though you were viewing your own airplane from directly behind. You can then easily form a mental picture of the attitude in relation to the horizon. It is this mental process of *visualization* that enables you to make the appropriate control responses to obtain a definite, predetermined attitude.

Power control is accomplished by throttle adjustment and reference to the power indicator. Experience in a particular airplane will help you learn how far to move the throttle to obtain a given change, reducing the amount of time you spend looking at the power indicator. Again, as with attitude changes, you cannot accurately control airplane performance unless you know the appropriate power setting to use for the given situation. After you have set the power, adjust the throttle friction lock so there is no tendency of the throttle to vibrate open or closed.

USE OF TRIM

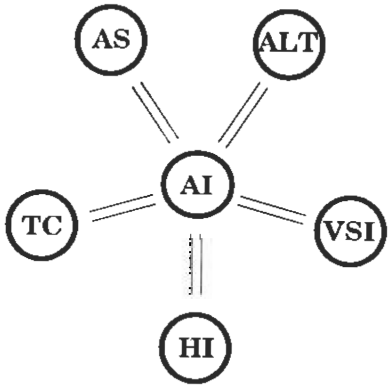
An airplane is correctly trimmed when it is maintaining a constant attitude with all control pressures relieved. With a constant power setting, trim tabs are responsive to airspeed. This means that in order to properly trim the airplane you must hold whatever control pressures are necessary to maintain a constant attitude until the airspeed has stabilized. Once airspeed is constant, adjust the trim to relieve control pressures. You must retrim the airplane after any significant or prolonged change in airspeed. A significant power change may also require a readjustment of trim. The technique remains the same - hold control pressure to maintain a constant attitude. When the airspeed has stabilized, trim to relieve control pressure. Proper trimming technique is essential to reduce fatigue and enable you to divert attention from flying the airplane to the many navigation, communication, and other cockpit management tasks required during an instrument flight.

INSTRUMENT SCAN

Once the attitude and power are set and the airplane is properly trimmed, you need to know if the actual airplane performance matches the desired airplane performance. You do this by interpreting the performance instruments. Instrument scan is the visual technique of gathering performance information from all the instruments while never concentrating your attention on any one indicator. The information obtained during your scan must be interpreted, using your knowledge of each instrument's function and limitations, and the attitude and resulting performance visualized. Only then will you be able to recognize when an attitude or power change is required.

Developing a good instrument scan means developing the ability to refer to the appropriate instrument at the appropriate time and for an appropriate length of time. Although information from all instruments must be continuously interpreted, the attitude indicator is the instrument that best enables you to achieve vision through instruments.

To help develop a good scan technique, imagine the performance instruments arranged in a circle, centered on the attitude indicator. Your scan must by directed from the center outward to a performance instrument, back to center, then outward to another performance instrument, then back to center on the attitude indicator. When scanning in this fashion, you will automatically refer to the attitude indicator immediately before and immediately after each check of a performance instrument. This technique will insure your attention is never diverted from the attitude indicator for any great length of time.



While the control instruments provide immediate and direct indications of changes in attitude and/or power, changes in the indications of the performance instruments will lag slightly behind. This lag is due to the inertia of the airplane as well as the operating principles of the performance instruments.

Lag in the performance instruments should not interfere with maintaining or smoothly changing attitude and/or power. Smooth and gentle application of control pressures will help the performance instrument indications stabilize quickly, or at least change smoothly. This, in turn, increases the speed with which you can interpret the indications and visualize airplane attitude. Smoothness on the controls is important to minimize lag, especially in rough air.

Never allow yourself to be lured into making attitude and/or power adjustments in response to the lag indications of the performance instruments. This invariably leads to "chasing the needles" with resulting loss of precise control of airplane performance, not to mention feelings of ineffectiveness and insecurity on the part of the pilot.

Proper division of attention is also important to developing a good scan technique. A common error is that of concentrating on the "eye-catching" instruments while ignoring others. A 10° heading change can go undetected, while it is hard to ignore a 500 foot per minute change on the vertical speed indicator. You can avoid these errors by applying the scan technique described earlier.

Once you have interpreted the indication of the performance instruments and visualized airplane attitude, you must make adjustments in attitude and/or power to correct deviations from desired performance. Attitude and power changes are made by reference to the control instruments as described earlier. In order to correct for deviations in airplane performance, you must know *what* to change as well as *how much* of an attitude or power change is required.

Knowing what to change is based on your understanding of the single most important principle of attitude flying:

ATTITUDE + POWER = PERFORMANCE

You must always keep this simple formula in mind when adjusting attitude or power by reference to the control instruments. The combination of attitude and power, taken together, must always be considered whenever an adjustment is required.

Knowing how much to adjust attitude and/or power is, initially, an estimate based on your familiarity with the airplane and your knowledge of the appropriate rate of change for a given situation. To help you gain this experience, you will begin by learning to coordinate changes in pitch and power while in level flight.

Before beginning your first session in the trainer, your instructor will have set and trimmed the trainer for level flight at normal cruise power setting. This will enable you to begin learning to control airplane performance from a known reference point.

Unlike the airplane, the trainer allows you to learn and apply skills in a logical sequence. For example, your instructor will "freeze" the roll function of the trainer while you work on learning to control pitch and power. Likewise, when you begin working on turns, your instructor will "freeze" the pitch function. This process will help you develop your skills quite rapidly. Keep in mind that the purpose of the trainer is to help you understand and apply the *techniques* essential to accomplishment of instrument procedures. Actual development of competence in the procedures themselves will occur in the airplane.

Once the trainer is turned on, and with altitude constant and airspeed stabilized at normal cruise, adjust the small airplane symbol of the attitude indicator so that it is aligned with the horizon reference. This adjustment establishes your zero reference point for all pitch attitude changes. You will also need to do this in the airplane, first on the ground before takeoff and once again when in level flight at cruise airspeed.

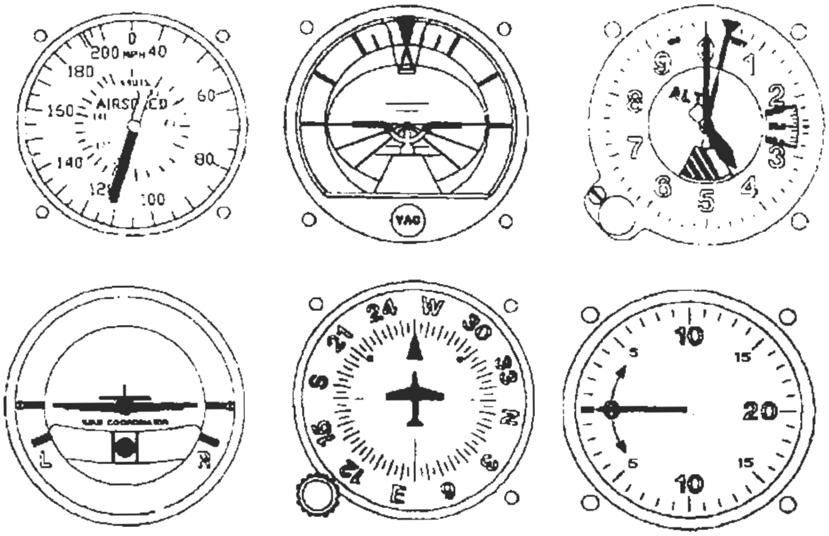
LEVEL FLIGHT

Maintaining Altitude

Level flight, of course, means altitude is constant. With the correct cruise power setting established on the power indicator, maintaining level flight becomes a matter of maintaining the appropriate level flight pitch attitude. At normal cruise airspeed, the appropriate pitch attitude is one which superimposes the small airplane symbol with the horizon bar. This is the zero reference point you established earlier.

The altimeter, vertical speed indicator, and airspeed indicator also provide information which is necessary to maintain level flight, but it is important to remember that these performance instruments provide an indirect indication of pitch attitude that must be interpreted before it is of any use.

Your visualization of performance instrument indications will dictate when and if a control correction is needed. Should the altimeter indicate a gain in altitude, cross check the attitude indicator. Most likely, the nose is slightly above the reference level flight attitude.



A decrease in altitude is most likely the result of the nose being below the reference level flight attitude.

Don't be in a hurry to make corrections. Allow for instrument lag by holding a constant pitch attitude and then noting the rate of movement of the performance instrument indications. Making large or abrupt attitude changes leads to over controlling. Make corrections in small steps to avoid this tendency.

Correct for small deviations in altitude (100 feet or less) by attitude change alone if the resulting change in airspeed is slight and of no consequence to the existing situation. First, stop any altitude change noted on the altimeter by reestablishing the reference level flight attitude on the attitude indicator. Next, visualize the attitude that will smoothly and slowly return the airplane to the desired altitude. Apply control pressures to make the attitude indicator display match your mental picture. Confirm that the correction is taking place by scanning and interpreting the performance instruments. Finally, when back at the desired altitude, return to the reference level flight attitude on the attitude indicator.

Experience will enable you to judge what rate of correction is appropriate to a given situation. As a guide, the rate of altitude correction, in feet per minute, should be approximately equal to twice the altitude error. If you are 100 feet below the desired altitude, for example, establish a pitch attitude on the control instrument that will result in a 200 foot per minute rate of climb.

Correcting larger altitude deviations (more than 100 feet) generally requires changes in both pitch and power. This means establishing the proper attitude and power combination for a climb or descent, as appropriate, to return to the desired altitude.

AIRSPEED CHANGES IN LEVEL FLIGHT

Reducing to approach airspeed in level flight is a basic maneuver you will use often on instrument flights. Slowing for an instrument approach, before entering a holding pattern, or at ATC's request in the terminal area are typical situations. As a training exercise, this maneuver will help you better understand the relationship between attitude, power and performance as well as improve your scan technique.

Whether you are decreasing or increasing airspeed, the steps are the same. First, adjust power by reference to the power indicator to the appropriate *initial* setting. Next, adjust to the appropriate pitch attitude on the attitude indicator.

Determining the initial power setting is fairly straight forward. In most small airplanes, changing power by 150 to 200 RPM or 1 1/2" to 2" Hg while maintaining level flight results in about 10 knots of airspeed change. Your instructor will discuss the power settings and airspeeds appropriate to your airplane.

Determining the appropriate pitch attitude is a matter of practice and experience. Your instructor will show you the approximate pitch attitude required. Practice in reducing from cruise to approach airspeed and increasing back to cruise will enable you to fix the proper pitch attitude and power setting combinations in your mind.

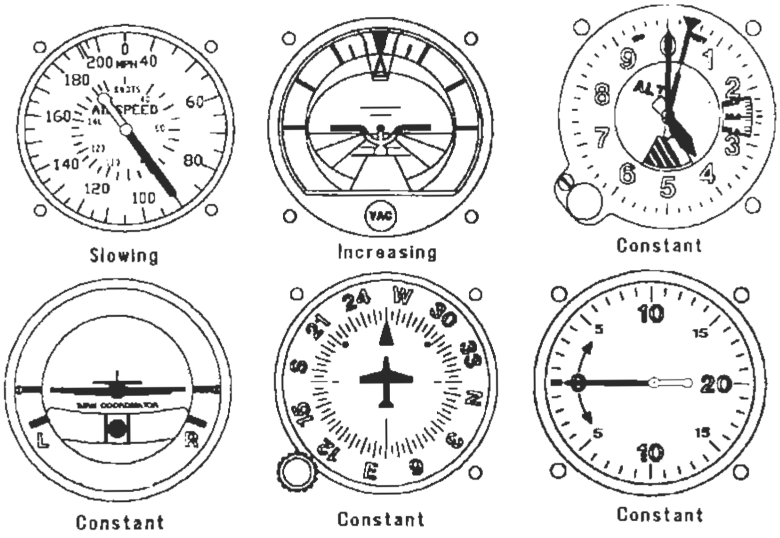
To slow from cruise airspeed to approach airspeed, first adjust power to the predetermined initial setting, then, by reference to the attitude indicator, smoothly increase the pitch attitude to the predetermined picture. Increase the speed of your scan during the transition from cruise to approach airspeed in order to maintain a constant altitude and heading. The appropriate rate at which pitch attitude should be increased can be determined by reference to the altimeter. Respond to any downward trend of the altimeter by increasing the pitch attitude until reaching the predetermined picture. Keep in mind the earlier cautions about pressure instrument lag. Smooth control pressures and proper reference to the control instruments will enable you to avoid needle chasing.

DECREASING AIRSPEED

Decrease Power

Increase Pitch

**When airspeed is constant:
Trim**



The airspeed indicator should not be included in your scan at this time since airspeed is decreasing slowly and its actual value is of no importance at the moment. If you set the attitude and power correctly, the airspeed will stabilize close to the desired value. Continue a fairly rapid scan from attitude indicator to altimeter, back to attitude indicator, to heading indicator, back to attitude indicator, and so forth.

When you have established the predetermined pitch attitude, include the airspeed indicator in your scan. When airspeed is constant, trim to relieve control pressure.

Don't be in a hurry to make attitude or power adjustments if the airspeed is not correct. Take the time to visualize attitude and performance from all available instruments before deciding on what correction to make and how much of a correction is needed. You must visualize the performance obtained as a result of the current attitude and power setting, then make small adjustments of the attitude and power combination to achieve the desired result.

Don't neglect the less "eye-catching" performance instruments during the transition. Include the heading indicator and turn coordinator in your scan. This will enable you to detect the need for aileron and/or rudder pressures to maintain straight, coordinated flight throughout the maneuver.

INCREASING AIRSPEED

Increase Power

Decrease Pitch

When airspeed is constant: Trim

Increasing airspeed from approach to cruise is essentially the same process. First, increase power to the predetermined cruise setting. Next, smoothly adjust to the appropriate pitch attitude. Apply the scan techniques discussed above to monitor airplane performance during the transition to cruise airspeed. Don't forget to trim once you have established the proper pitch attitude and the airspeed is stabilized.

Practice in reducing and increasing airspeed while maintaining altitude will help you develop competence in coordinating attitude and power changes. You will be able to accomplish precise changes to *any* airspeed within the capabilities of your airplane if you remember to increase the speed of your scan during the transition, apply smooth control pressures, and always refer to the control instruments to set and maintain a predetermined power setting and attitude.

STRAIGHT CLIMBS AND DESCENT

Normal climbs are conducted at a constant airspeed, accepting whatever rate of climb the airplane is capable of producing under the existing conditions. You will also practice rate climbs in which maintaining a constant rate of climb is the goal.

A cruise descent is accomplished at cruise airspeed and a specified rate. Approach descents are also conducted at a constant airspeed and constant rate.

Your instructor will discuss the airspeeds and power settings for normal climb, cruise descent, and approach descent appropriate for the airplane you will be flying.

Determining the appropriate pitch attitude is again a matter of practice and experience. Your instructor will show you the approximate pitch attitudes required for each climb and descent. Practice will enable you to fix the proper pitch attitude and power setting combinations in your mind.

Normal Climb

(Constant Airspeed)

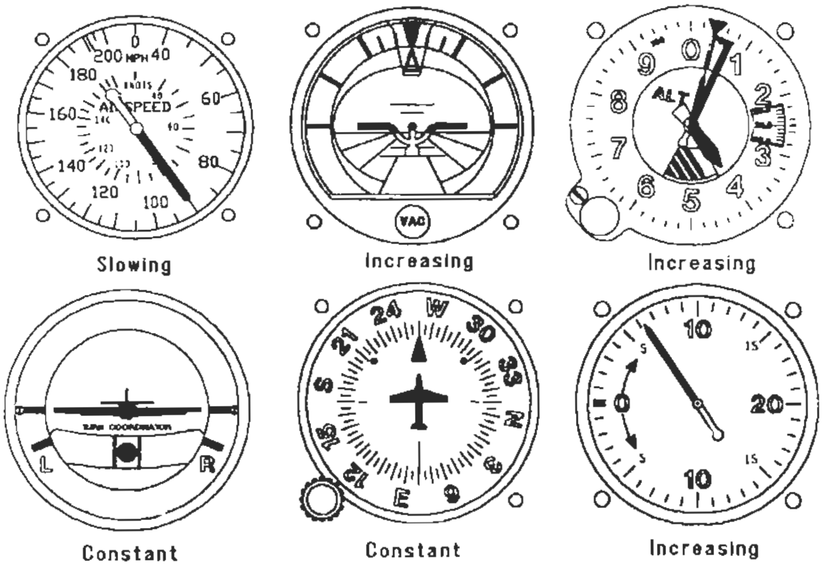
Entry

To begin a normal climb, first establish the predetermined pitch attitude by reference to the attitude indicator, then adjust power to the climb setting. Do not wait for airspeed to decrease to climb speed before adding power. When attitude and airspeed are constant, trim to relieve control pressures.

Increase Pitch

Increase Power

When airspeed is constant:
Trim



Slowing Increasing Increasing

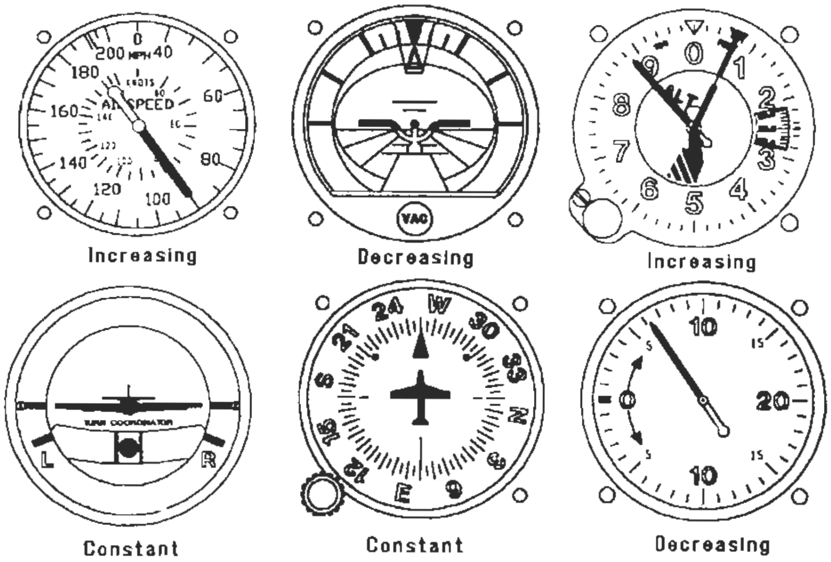
Constant Constant Increasing

The airspeed indicator is the best source of information about the accuracy of the pitch attitude during the climb. Since power is normally fixed during climb, corrections require definite, predetermined changes in pitch attitude.

Remember that left turning tendencies are most pronounced at low airspeeds and high power settings. Use aileron and rudder pressure as necessary (by interpretation of the performance instruments) to maintain straight, coordinated flight during the transitions and as well as throughout the climb.

Level Off

Begin the level off from a climb before reaching the desired altitude. The amount of lead to use for level off depends on the rate of climb and pilot technique. Smooth transitions from climb to level flight generally require a lead of approximately 10 percent of the rate of climb. If climbing at 500 feet per minute, for example, begin level off when the altimeter indicates about 50 feet below the desired altitude.



Decrease Pitch

As airspeed reaches cruise: Decrease Power

When airspeed is constant: Trim

To level off from a climb, first smoothly establish the predetermined pitch attitude on the attitude indicator. Allow the airspeed to increase to cruise before reducing power to the proper cruise setting. Reducing power early only prolongs the acceleration time, increasing your workload. When attitude and power are set and airspeed is constant, trim to relieve control pressures.

Constant Rate Climb

Constant rate climbs differ only slightly from normal climbs. Entry is the same as for a normal climb. Once the climb is established, refer to the VSI rather than the airspeed indicator to determine the need for any pitch correction. Since climb power is generally not a variable in the climb, corrections to achieve the desired rate of climb require definite, predetermined changes in pitch attitude.

Cruise Descent

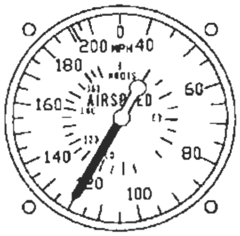
Entry

Cruise descent for most small general aviation aircraft may be planned for 500 feet per minute and at the same airspeed as level cruise. To begin a cruise descent, first reduce power to the predetermined cruise descent power setting and then establish the proper pitch attitude by reference to the attitude indicator. Very little trim change should be required since the trim is already set for the required airspeed. Minor adjustments to pitch and/or power may be required to maintain the desired airspeed and descent rate.

Decrease Power

Decrease Pitch

Trim



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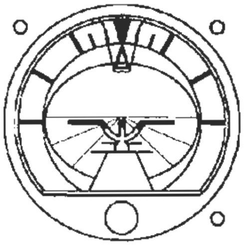
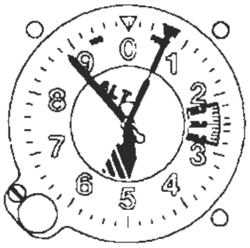


Decreasing



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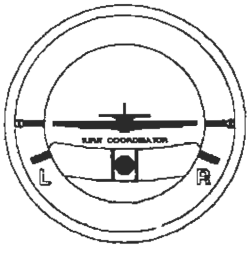

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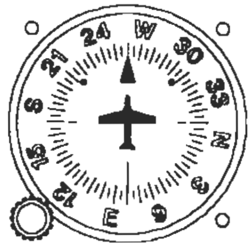

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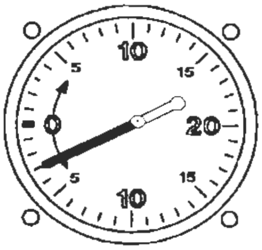
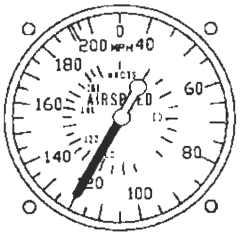


Rate Increasing

During cruise descent, the airspeed indicator is the best source of information about the accuracy of the power setting and the VSI is the best source of information about the accuracy of the pitch attitude. However, remember that it is always a specific combination of attitude and power that will give the desired performance.

Level Off

To avoid passing through your desired altitude, start leveling off from the descent prior to reaching the altitude. A good rule of thumb for beginning the level off is at an altitude equal to 10 percent of the descent rate. For a 500 foot per minute rate of descent, begin to level off approximately 50 feet before the desired altitude.



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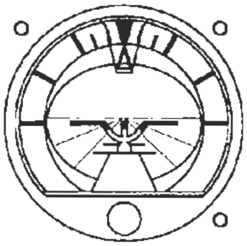
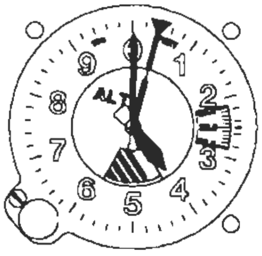


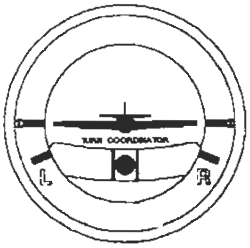
Increasing



Decreasing

Increase Pitch and Power (Together)

Trim



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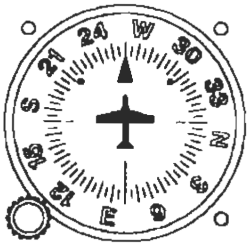

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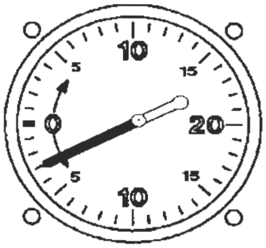


Rate Decreasing

Level off requires a simultaneous increase in pitch and application of power. Pitch is returned to level by reference to the attitude indicator while power is increased to the cruise power setting. When done smoothly, the aircraft will transition to level flight with the airspeed remaining constant at the cruise value and the altimeter steady on the new altitude. Again, little if any trim change should be required because the airspeed is being held constant.

Approach Airspeed Descent

Generally, you will slow to approach airspeed before beginning descent. The techniques for descents at approach airspeed are essentially the same as for cruise airspeed descent, only the power settings and attitudes will vary.

STRAIGHT FLIGHT

Maintaining a Heading

Straight flight means that the airplane's heading is constant. The heading will remain constant as long as the wings are level and there is no yaw present.

The attitude indicator provides a direct and immediate indication of the roll attitude. The heading indicator, turn coordinator, and magnetic compass also provide information which is necessary to maintain straight flight, but it is important to remember that these performance instruments provide an indirect indication of roll attitude that must be interpreted before it is of any use.

The turn coordinator provides information about the yaw attitude as well as the roll attitude. The turn needle indicates the direction and quantity of a turn, while the ball indicates the quality of a turn.

Once the airplane is established on the desired heading, maintaining that heading becomes a matter of maintaining coordinated flight with a wings level attitude on the attitude indicator. Deviations from a desired heading are not as “eye-catching” as are altitude deviations. Your scan must include the heading indicator often so that you can detect and correct heading deviations while they are small.

As with pitch attitude corrections, don’t be in a hurry to correct heading errors. Avoid overcontrolling by correcting in small steps. As soon as you detect a heading deviation, reestablish a wings level indication on the attitude indicator. Next, visualize the attitude that will smoothly and slowly return the airplane to the desired heading. Apply smooth control pressures to make the attitude indicator display match your mental picture. Confirm that the correction is taking place by scanning and interpreting the performance instruments. Finally, when back on the desired heading, return to a wings level attitude by reference to the attitude indicator.

As with pitch attitude corrections, experience will enable you to judge what rate of correction is appropriate to a given situation. As a guide, correct heading deviations by establishing a bank attitude equal in degrees to the heading error. If you are off heading by 10°, for example, a 10° bank attitude is sufficient. In no case should the bank angle exceed that required for a standard rate turn.

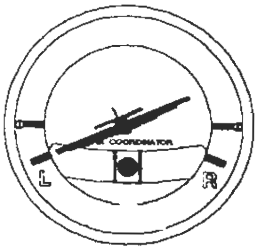
TURNS

A turn is made by rolling the airplane into a bank. The angle of bank used during instrument flight is one that will result in a standard rate turn. Standard rate is 3° per second, or 2 minutes for a 360° turn.

The degree of bank angle required for a standard rate turn varies directly with the indicated airspeed. Before beginning a turn you need to know exactly what bank angle you will roll to so that you can visualize the desired attitude on the control instrument. A rough rule of thumb for determining bank angle for a standard rate turn is:

Standard Rate = 3°/second

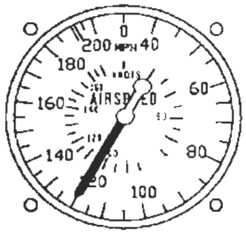
$$\text{Bank Angle } (^\circ) = \frac{\text{Airspeed (Kts)}}{10} + 7$$



A standard rate turn while cruising at 100 knots would require a bank angle of:

$$\text{Bank Angle } (^\circ) = \frac{100}{10} + 7 = 10 + 7 = 17^\circ$$

To establish a standard rate turn, roll to the predetermined initial bank angle by reference to the attitude indicator. Cross check the altimeter and make any necessary pitch attitude adjustment by reference to the attitude indicator. When the bank angle is constant, cross check the turn needle to confirm that the turn is standard rate. A turn rate less than standard rate means the bank angle is too shallow, while a turn rate greater



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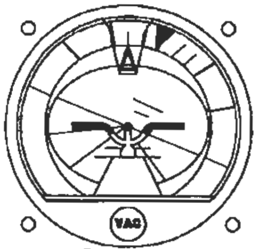

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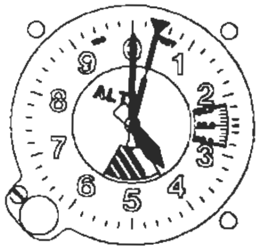

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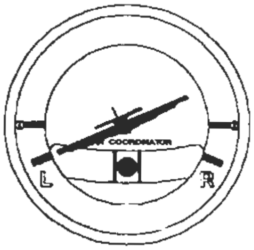

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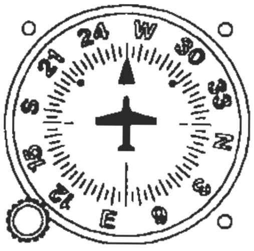
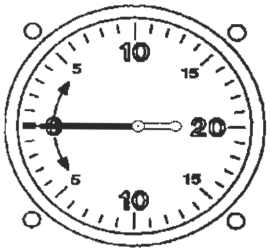


Turning



Constant

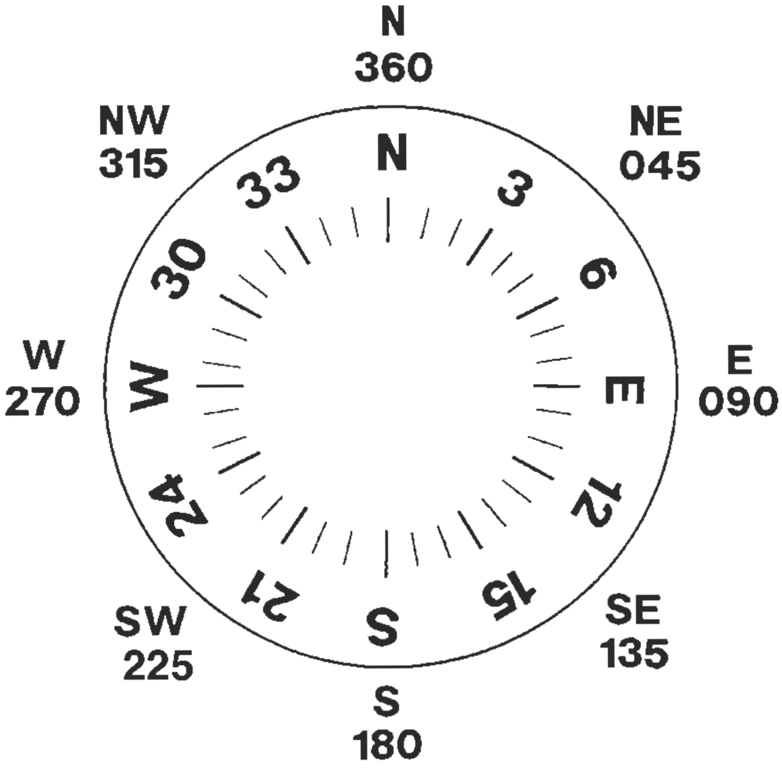
than standard rate means the bank is too steep. Make any required bank angle adjustment by reference to the attitude indicator, not by reference to the turn needle.

To stop the turn, roll to a wings level attitude by reference to the attitude indicator. Cross check the altimeter and make any necessary pitch attitude adjustment by reference to the attitude indicator.

During your initial practice, strive to roll in and out of the bank smoothly and at a uniform rate. The actual rate of roll is not critical, but consistency will improve your ability to roll out on a specific heading. If, for example, you take 5 seconds to establish the required bank angle on entry to the turn, you should also take 5 seconds to roll to a wings level attitude at the completion the turn.

TURNS TO HEADINGS

During this session you should concentrate not only on the skills of attitude instrument flying, but also on the ability to visualize. You must be able to translate the indications of the instruments into a mental picture of where your airplane is and, most importantly, where it is going.



Visualization of the compass rose is essential to developing this ability. The first step is to begin thinking of headings in terms of geographic direction rather than mere numbers. Start forming the habit of never turning from one number to another, but from one direction to another.

Learn the compass rose so that you can see it clearly in your mind. You need to know the eight cardinal directions and their corresponding numerical equivalents. This basic knowledge, and the habit of always thinking in terms of direction, will save time and frustration when you begin radio navigation. Except when tracking a specific course or when being radar vectored, there are really only eight directions (headings) to fly.

A common error when turning to a specific heading is to recover by reference to the heading indicator. Proper entry and recovery is accomplished by reference to the control instrument— the attitude indicator. Reference to the heading indicator is critical only for establishing the roll-out point. The actual roll-out must be made by reference to the attitude indicator only.

ROLL OUT LEAD = ½(BANK ANGLE)

A rule of thumb for leading the desired heading is to begin roll-out a number of degrees before the desired heading equal to one half the degree of bank. This will vary with individual technique, but should enable you to roll-out very close to the desired heading. If a small correction is needed after roll-out, bank no more than the number of degrees you need to turn. If, for example, you roll-out 5° short of the heading, smoothly and *slowly* roll to a 5° bank in the proper direction, then roll smoothly and just as slowly back to a wings level attitude. This technique will prevent over controlling.

It is in turns that errors of anticipation are most likely. Most pilots want to use a little aileron, some rudder, and a bit of back pressure while rolling into a turn. It is very important, instead, to wait for instrument indications and then respond as needed. Do your best to avoid anticipating the need for control pressures by concentrating on use of the control instruments and applying good scan technique. Remember also that the rudder controls yaw, as indicated by the ball of the turn coordinator. It is the bank angle that makes the airplane turn.

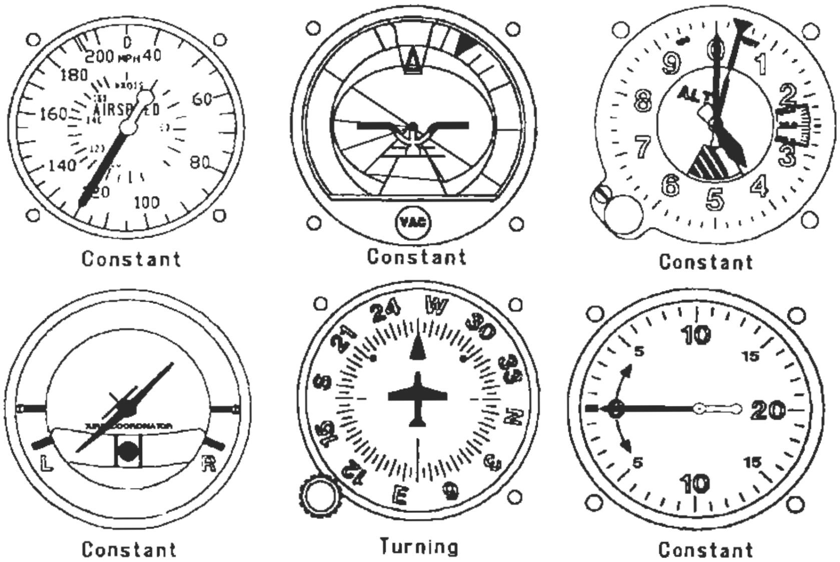
CLIMBING AND DESCENDING TURNS

Climbing and descending turns, whether at constant airspeed or constant rate, involve combining the skills you have developed up to this point. Aside from their practical application, they can help put the finishing touches on your ability to scan, interpret, visualize, and control, as well as coordinate attitude, power, and trim to achieve desired performance.

The "vertical S" is a training maneuver that will challenge your attitude flying skills. There are several variations which you instructor may use, but in its most challenging form, the vertical S consists of a climbing 180° turn in which altitude is increased 500 feet, followed by a descending turn in the opposite direction, returning to the entry heading and altitude. Using a standard rate turn and 500 feet per minute rate of climb and descent, the maneuver takes two minutes to complete. Reversal of both vertical and turn direction takes place half way through. Again, this is a training maneuver designed to sharpen your skills.

STEEP TURNS

Another training maneuver not normally used during instrument flight is the steep turn. When flying by instrument references, any turn in excess of standard rate is, by definintion, a steep turn and should be avoided.



For training purposes only, a bank angle of 45° will be used when performing this maneuver. As with normal turns, anticipation of the rudder pressure and back pressure required is a common error during steep turns. As with any other instrument maneuver, knowing the desired attitude picture is essential to smooth performance.

Enter steep turns from cruising flight, at or below maneuvering speed. Smoothly roll into the bank and established the predetermined pitch attitude as the bank angle steepens. When established, cross check the altimeter to verify the attitude is correct. Cross check the airspeed indicator. A power adjustment may be necessary to maintain airspeed within 10 knots of the entry airspeed.

Steep turns should be held through 180° or 360° of heading change. Lead the roll-out heading by 20° to 25° (about 1/2 the angle of bank). At the roll-out point, smoothly roll to wings level and reestablish the reference level flight attitude. Adjust power as necessary to maintain the entry setting.

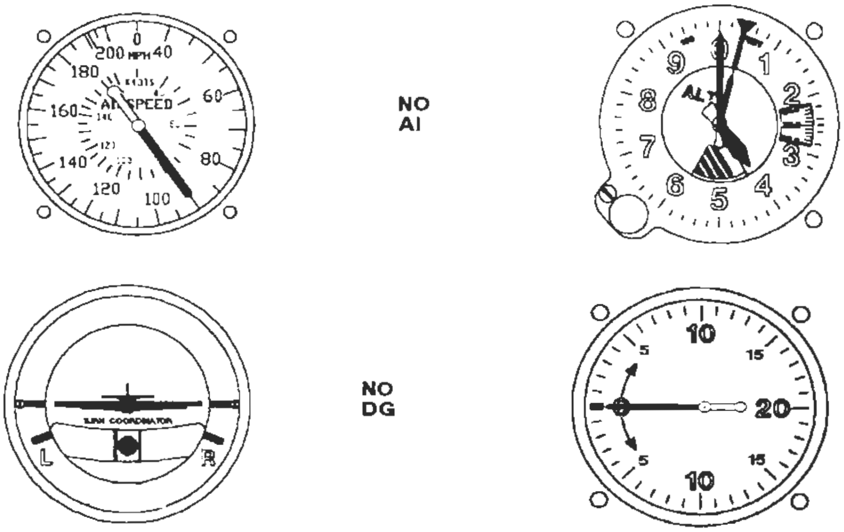
IMMINENT STALLS

Practice in recognition and recovery from imminent stalls is another training maneuver designed to sharpen your attitude instrument flying skills. Generally, you will enter a stall demonstration from level flight at reduced airspeed. Stalls will be performed power-off and power-on. In either case, your goal is prompt recognition of an imminent stall and recovery with minimum altitude loss.

Recover from an imminent stall by reducing the angle of attack. This will generally require reducing the pitch attitude. Simultaneously, level the wings with coordinated aileron and rudder pressures. Coordination during entry and recovery is important. A slip or skid creates yawing moments which may lead to an incipient spin. Minimize altitude loss by adding all available power and establishing a climb as soon as a safe climb airspeed is attained. Complete recovery by returning to the entry altitude and heading at normal cruise airspeed.

PARTIAL PANEL

In most general aviation airplanes, the attitude indicator and heading indicator are gyro instruments powered by an engine-driven vacuum pump. If the vacuum pump or an instrument malfunctions, you must be able to control the aircraft by reference to the remaining flight instruments. Under such "partial panel" operations, there is no instrument that will provide *direct* pitch and roll information. You have no choice but to control attitude by reference to the *indirect* indications of the performance instruments.



Three instruments provide indirect pitch attitude information (altimeter, VSI, and airspeed indicator) and two instruments provide indirect roll attitude information (turn coordinator and magnetic compass).

Several years ago, the FAA recognized the hazards of continued flight using partial panel in actual instrument conditions. The remedy has been to require instrument rating applicants to demonstrate competence in partial panel operations, including instrument approaches. It is vital that you do not misconstrue your training in partial panel operations. You will gain competence in partial panel operations, but vacuum failure is an emergency and should be dealt with as such. While accurate control is certainly possible under partial panel conditions, you should not expect to attain the same degree of proficiency using partial panel as with full panel.

DETECTING MALFUNCTIONS

Early detection of a malfunction or failure is important. Include the engine instruments and system monitors in your scan. If you note low vacuum pressure, assume the indications of the attitude indicator and heading indicator are unreliable and revert to partial panel.

Instrument malfunction or failure is harder to detect and may lead to the development of an unusual flight attitude before being noticed. A sudden increase in the rate of precession of a heading indicator probably indicates impending failure. Loss of the attitude indicator is subtle and likely to be noticed as a disagreement between its indications and those of the performance instruments. For example, as the gyro of a failed attitude indicator slows down, it will lose rigidity. The pilot, unaware of the instrument malfunction, will initially respond with control inputs to keep a level pitch and roll indication on the attitude indicator. Although the AI shows a level attitude, the altimeter and VSI might be indicating a loss of altitude while the airspeed is increasing. This disagreement between the expected performance based on the indications of the control instrument and the actual performance is good cause to revert to partial panel procedures.

In case of vacuum pump or gyro instrument malfunction, cover the affected instruments with a scrap of paper. This will reduce distraction and enable you to concentrate on maintaining accurate control.

NOTIFY ATC

If VMC - Stay that way

Climb/Descent to VMC

Vector to VMC

No-gyro ASR

Several options exist for dealing with loss of the vacuum powered gyro instruments. Notify ATC of the failure and indicate the nature and extent of assistance desired. If failure occurs while in visual meteorological conditions, you would logically elect to remain in VMC, deviating to an alternate airport if necessary. If failure occurs while in IMC, an altitude change or off course vector may be in order to reach VMC. If unable to reach VMC and continue flight to a landing under visual conditions, a no-gyro airport surveillance radar (ASR) approach would be a good choice. Only after exhausting all other alternatives should you consider flying a standard instrument approach, in IMC, by partial panel.

The techniques of attitude instrument flying do not change because you have had a vacuum failure. After all, the airplane doesn't know it's on partial panel. Response to your control inputs will be the same, but rather than the immediate and direct indications of the control instrument, you must interpret the attitude from the indirect indications of the performance instruments. You must not make large or abrupt changes in control pressures, but instead ease gentle pressure on the controls and adjust the pressures gradually as the desired indications are reached on the performance instruments. In other words, GO SLOWLY!

Whether the failure occurred during climb, cruise, or descent, the airplane probably was in a trim condition (airspeed contant) at the time of failure. Relax pressure on the controls and allow the airplane to seek this trim condition.

STRAIGHT AND LEVEL

For level flight, the altimeter is the most important pitch trend indicator, supported by the VSI and airspeed indicator. For straight flight, the turn needle is the most pertinent reference, supported by the magnetic compass.

AIRSPEED CHANGES

Change Power

Change Pitch Attitude

Trim

When power is reduced, the airspeed will decrease and an increase in pitch will be required to maintain altitude. When power is increased, the airspeed increases and a decrease in pitch attitude will be required to maintain altitude. Set power to the predetermined setting by reference to the control instrument, then adjust pitch as necessary to keep the altimeter from changing. Remember there will be some amount of lag in the response of the performance instruments, so patience and smoothness are important. The technique is the same as with full panel - Change power, change pitch attitude, trim.

CLIMB AND DESCENT

The same sequence is used for partial panel as for full panel when starting a climb from cruise flight. Change attitude, then change power. Apply back pressure to start the altimeter indication moving upward. Adjust the pressure as the VSI rate indication catches up with the actual rate of climb. When the airspeed is stabilized, trim to relieve control pressures. Don't neglect the turn coordinator during the transition. Keep the turn needle and ball centered to maintain the heading.

Leading the desired altitude by approximately 10% of the rate of climb, gradually increase forward elevator pressure to bring the altimeter indication to a stop. As airspeed approaches cruise, set power, then trim to relieve control pressure.

To establish cruise descent, reduce power to the predetermined power setting. Apply pressure smoothly to start the altimeter indication moving downward. Adjust elevator pressure as the VSI rate catches up with the actual rate of descent. When airspeed is constant, trim to relieve control pressure.

Level off from the descent increasing power and increasing back pressure together. When airspeed is constant, trim to relieve any control pressure.

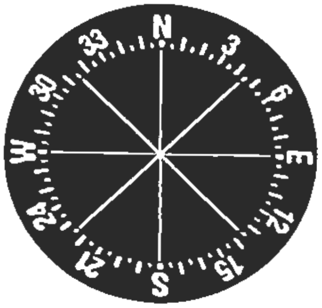
During constant airspeed climbs and descents, the airspeed indicator, rather than the VSI, provides the most pertinent information regarding the pitch attitude.

TIMED TURNS

As with full panel, turns are made at standard rate. Without an attitude indicator, there is no way to directly establish a specific bank angle and, without the heading indicator, it is difficult to know your exact heading at any given moment during a turn. By turning at a known rate you can make timed turns to the desired heading.

Don't be in a hurry to begin a turn until you are sure of the direction and number of seconds required to complete it. Think in terms of the eight cardinal points of the compass. The compass rose is divided into eight "pieces of pie" - each piece taking 15 seconds of turn at standard rate.

TO TURN	TIME (Sec)
45°	15
90°	30
135°	45
180°	60



Before beginning a timed turn, always visualize the relationship between your present heading and the desired heading to determine which direction to turn.

Start the turn when the second hand of the clock is on one of the four cardinal points of the clock. Cross check the altimeter during roll-in and adjust the pitch attitude as necessary. Continue to apply steady aileron pressure until the turn needle indicates standard rate. Adjust control pressures as needed to maintain a standard rate of turn. When the time is up, smoothly roll out, gradually relaxing aileron pressure as the turn needle indicates a zero rate of turn. Give the magnetic compass time to stabilize before you look at it to determine your actual heading. If small corrections are needed to fine tune your heading, make them at half standard rate. For example, a 10° correction at half standard rate would require about seven seconds of turn. Rather than timing these small corrections with the clock, it usually is easier to count the seconds off to yourself.

RECOVERY FROM UNUSUAL ATTITUDES

Practicing unusual attitude recovery simulates conditions in which the airplane has reached an attitude well beyond that of normal flight. These conditions may occur in actual instrument conditions due to thunderstorms, turbulence, improper control by the pilot, or various other reasons. Practice in unusual attitude recovery is intended to help you learn to respond by instrument indications alone and not by feel. Recovery from extreme attitudes should not be rushed. To minimize wing loading it will be necessary to use smooth and precise control inputs.

Airspeed Low:

Add Power

Decrease Pitch

Level the Wings

The technique for recovery depends on whether the unusual attitude is a *low and decreasing* airspeed situation or a *high and increasing* airspeed situation. The danger of the first is a stall, while the danger of the second is exceeding red line and/or load factor limits. Because extreme attitudes can tumble the attitude and heading indicators, recoveries stress use of partial panel.

Your instructor will place you in a condition simulating one of these unusual attitudes. When you are told to recover, look first at the airspeed indicator to determine which type of attitude exists. In a low and decreasing airspeed situation, apply full power, lower the nose, and level the wings. Return to the assigned heading and altitude once the airplane is completely under control.

Airspeed High:

Reduce Power

Level the Wings

Increase Pitch

The technique for recovery from a high and increasing airspeed situation is to decrease power smoothly to idle, level the wings, and increase pitch to a level attitude. If an attempt is made to raise the nose before the wings are leveled, the bank angle will increase and the load factor will increase dramatically. It is quite possible that entry into a steep spiral will follow. If the airspeed is in the yellow arc or higher, very smooth pitch changes must be made to keep wing loading to a minimum.

While changing the pitch attitude, note the indications of the pressure instruments. Their movement will slow, stop, then reverse in trend. The moment at which the movement of the pressure instrument indications stops indicates a level flight attitude. Your goal is to learn to recover smoothly without over controlling.

NO GYRO ASR APPROACH

A surveillance approach (ASR) is one in which a controller provides navigation guidance in azimuth. The pilot is furnished with headings to fly to align the airplane with the extended runway centerline. A no-gyro ASR approach is available to a pilot under radar control who experiences loss of gyro stabilized heading guidance. A pilot should so advise ATC and request a no-gyro vector or approach. Rather than assign specific headings to fly, the controller will direct the pilot to "TURN RIGHT/ LEFT" and to "STOP TURN". The controller will time the turn, thus establishing the airplane on the desired heading. Pilots should make all turns at standard rate during vectors until informed that the airplane is on final approach. At that time all turns are to be half standard rate. Complete ASR and no-gyro approach procedures are described in the Aeronautical Information Manual.

INSTRUMENT COCKPIT CHECK

The checklist printed on American Flyers' route log form is useful in preparing for an instrument departure.

1. Copy ATIS
2. Set Gyros & Altimeter
3. VOR Test
4. ADF Test
5. Request Clearance
6. Set Up NAV Radios
7. Transponder Test & Set
8. Request Taxi
9. Systems Check
10. Departure Procedures
11. Transponder ON
12. Note Time Off ________

This checklist is accomplished after completing the manufacturer's engine start checklist. Of special interest at this time are items 2 and 9.

2. Set Gyros & Altimeter - Check the suction gauge to confirm normal vacuum system operation. Note the indication of the magnetic compass and set the heading indicator to the current magnetic heading. Note the attitude indicator. It should be stable and erect, indicating roughly a level flight reference attitude. Adjust the miniature airplane symbol as necessary to compensate for your seating position relative to the instrument and for any variation in the actual airplane attitude. Set the altimeter to the setting obtained from ATIS and note the indicated altitude (±75' of field elevation is acceptable).

9. Systems Check - Verify normal operation of all flight instruments during taxi. Airspeed indicator - zero. Attitude indicator - stable and erect, not more than 5° bank indication during turns. Altimeter set and indicating field elevation ±75'. VSI - zero (or note indication for zero reference). Heading indicator - set to magnetic compass, indicates correctly during and after turns. Turn coordinator - No flag, needle indicates correct direction during turns, ball moves freely opposite turn direction. Magnetic compass - full of fluid, card moves freely, indicates known headings correctly.

Use of the above checklist will be discussed in greater detail in later sections of this manual.

AMERICAN FLYERS

CHAPTER 2

RADIO NAVIGATION

VOR NAVIGATION

The **V**ery High Frequency **O**mnidirectional Radio **R**ange (VOR) is the primary ground based navigation aid for civil aviation in the National Airspace System. VOR is primarily a position indicator. The display must be interpreted and translated in terms of direction so that you can visualize your position at all times. In order to do this, you must not only know how to operate the VOR equipment, but must completely understand it.

During this phase of training, take the time to become familiar with the en route charts you intend to use. Familiarity with the format and various symbols will minimize the time needed in the trainer and airplane. Study the legend carefully. While you cannot memorize specific information, you can memorize the layout and symbols. Know exactly where to look for any item of information. In this way, chart reference during flight can be kept to a minimum. After all, it's difficult to fly instruments when your not looking at them. If you have any questions regarding charted information, your instructor will be more than happy to provide assistance.

It is also important that you learn to tune the navigation radios with very little attention diverted from the flight instruments. The are many brands of VOR receivers and each may have slight differences from the others, but all have the following common components:

1. Frequency Selector - used to tune the station frequency in the range from 108.0 and 117.95 MHz.
2. OBS (Omni Bearing Selector) - rotates to allow selection of the desired course.
3. CDI (Course Deviation Indicator) or needle - indicates your position relative to the selected course. The needle centers when the aircraft is on the selected radial or its reciprocal.
4. TO/FROM Indicator - shows whether the selected course will take the aircraft TO or FROM the station. It does NOT indicate whether the aircraft is heading to or from the station.
5. OFF Flag - comes into view when no signal is present or when an unreliable signal is received.

In the trainer you will gain understanding of the operation and interpretation of VOR by solving orientation problems.

To proceed DIRECT to a VOR from an unknown position:

1. *Tune and identify* the station.
   Each VOR station transmits a three letter Morse Code identifier. Some stations also use a voice identification feature that transmits the name of the station. Example: "DFW V-O-R." Always listen for the Morse Code or voice identification to be sure the station is usable for navigation. The identifier is either removed or replaced with the code letters T-E-S-T (— • ••• —) when the station is unusable.

2. *Center the needle TO* the station. Rotate the OBS until the TO/FROM indicator shows TO. Continue to rotate the OBS until the CDI centers.

3. *Turn to the heading shown* on the OBS. The OBS shows the course to the station. Initially, your heading should match the course. This will be referred to as the COURSE HEADING.

4. *Re-center the needle* by rotating the OBS. Adjust the heading to match. The amount the needle is deflected after rollout on the course heading depends on your distance from the station and the amount of heading change that was required.

You have probably used a technique similar to that described above during VFR flight. While it is useful and often used to comply with IFR clearances, an instrument pilot needs to develop the ability to *visualize* position solely by reference to the navigation instruments. The problem above can be solved with little mental activity beyond rote repetition of the listed steps. Actual instrument flying will be more demanding of your talents and skills. Safety during instrument flight depends on your ability to maintain an accurate mental picture of your position at all times. Developing this ability is the goal during this training.

Starting from an unknown position you can determine your position relative to a VOR using the following steps.

1. *Tune and identify* the station.

2. *Center the needle FROM* the station. Rotate the OBS until the TO/FROM indicator shows FROM. Continue to rotate the OBS until the CDI centers.

3. *Visualize* your position in geographic terms by interpreting the number under the OBS index. If, for example, the OBS reads 360°, you are north of the station. A reading of 135° indicates you are southeast of the station.

Think not only in terms of degrees from the station, but form a mental picture of your location from the station with respect to one of the eight cardinal points of the compass. Visualization is the key to maintaining positional awareness.

Notice that the heading of the airplane has no bearing at all on determining position relative to the station. The technique described above will always tell you what radial the airplane is on (or is crossing) at the moment. A radial, by definition is the magnetic bearing FROM a VOR. Each radial is named for the magnetic direction in which it proceeds from the station. Your magnetic heading may or may not match the name of the radial. To avoid confusion, think of VOR radials as streets. The street through the middle of town is called Main Street regardless of which way you are traveling on it. It's still called Main Street even if you are simply crossing it.

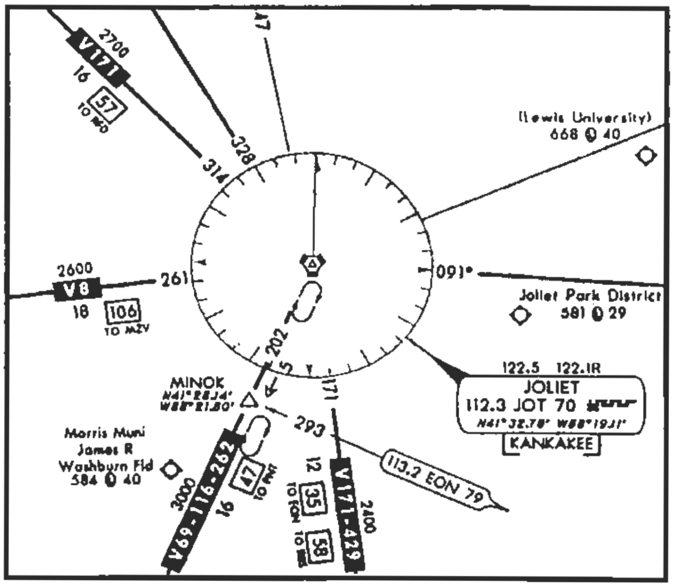
INTERCEPTING AN AIRWAY (RADIAL)

Although during an actual IFR flight you should never be in an unknown position, the process of VOR orientation has a practical application. Consider the following clearance issued to an IFR flight.

> "CESSNA 12345, CLEARED TO JOLIET VOR VIA VICTOR ONE SEVENTY ONE."

To comply with this clearance you would:

1. Tune and identify Joliet VOR. Refer to the chart for frequency and coded identifier.
2. Center the needle with a FROM.
3. Turn to the cardinal heading which comes *closest* to a perpendicular intercept of V171. Determine this heading by visualizing your position relative to the specified airway. The only need for chart reference at this point is to find the radial which makes up the airway. Once this information is obtained, visualization can be accomplished while you are looking at the instruments. Don't stare at the chart once you have the needed information!



4. When established on the intercept heading, set the OBS to the direction you will fly after intercepting the airway.

Note that the airway is defined by the JOT 314° radial and the JOT 171° radial (which is strictly coincidence). Since the clearance specifies V171 as the route, and not a particular radial, it is up to you to determine which radial to intercept. For example, if your determine you are southeast of JOT, then fly west to intercept the 171° radial. If, on the other hand, you are north of JOT, fly southwest to intercept the 314° radial.

To determine a reciprocal:

Add 200, then subtact 20;
or
Subtract 200 then add 20.

Example:

314°	**Radial**
-200°	
114°	
+20°	
134°	**Course TO**

When established on the intercept heading, set the OBS to the INBOUND course TO the JOT VOR. Always set the OBS to the *direction* you will fly after intercept.

The process of intercepting the airway requires you to turn to a heading equal to the course to be flown. The challenge lies in the fact that you must arrive on this heading with the airplane precisely on the centerline of the airway. When to begin the turn from the intercept heading to the COURSE HEADING is a matter of judgement based on the rate of VOR needle movement and pilot technique. If during the turn, it becomes apparent you will reach the heading before the needle centers, roll out early and maintain a lesser intercept angle. If, on the other hand, the needle passes through center before you reach the desired heading, turn beyond the course by 20 or 30°. You should never exceed a standard rate turn while attempting to intercept a course.

You must complete the intercept before you can reasonably expect to begin tracking the course. The intercept is complete when the airplane is positioned on the desired course with the heading equal to the course to be flown.

TRACKING

Tracking a course means remaining on the centerline of the desired course. During flight planning, you commonly use a flight computer to determine the wind correction angle necessary to track a desired course. From this wind correction, you determine the heading to fly. Of course, once in the air, adjustments to the computed heading are normally necessary.

Bracketing is a technique for accomplishing the tracking procedure. The importance of learning and always using the proper bracketing technique cannot be overemphasized. Bracketing is the foundation on which good navigation is built. A pilot unable to bracket a course will have difficulty in all other phases of radio navigation. Although the technique is simple, it must be practiced to be properly learned. Once learned, the same technique will enable you to accurately track a radial, a localizer, or an NDB bearing.

Bracketing begins as soon as the intercept is complete. Two indications are required to begin bracketing:

1. The airplane must be on course (the VOR needle centered), and
2. The heading must be identical to the course (zero wind correction).

Once the process of bracketing begins, you must maintain the heading as closely as possible. This requires that your attention to be concentrated on the flight instruments, not on the CDI. By maintaining the heading exactly equal to the course, any movement of the VOR needle will be the result of wind drift. This COURSE HEADING becomes one side of your bracket.

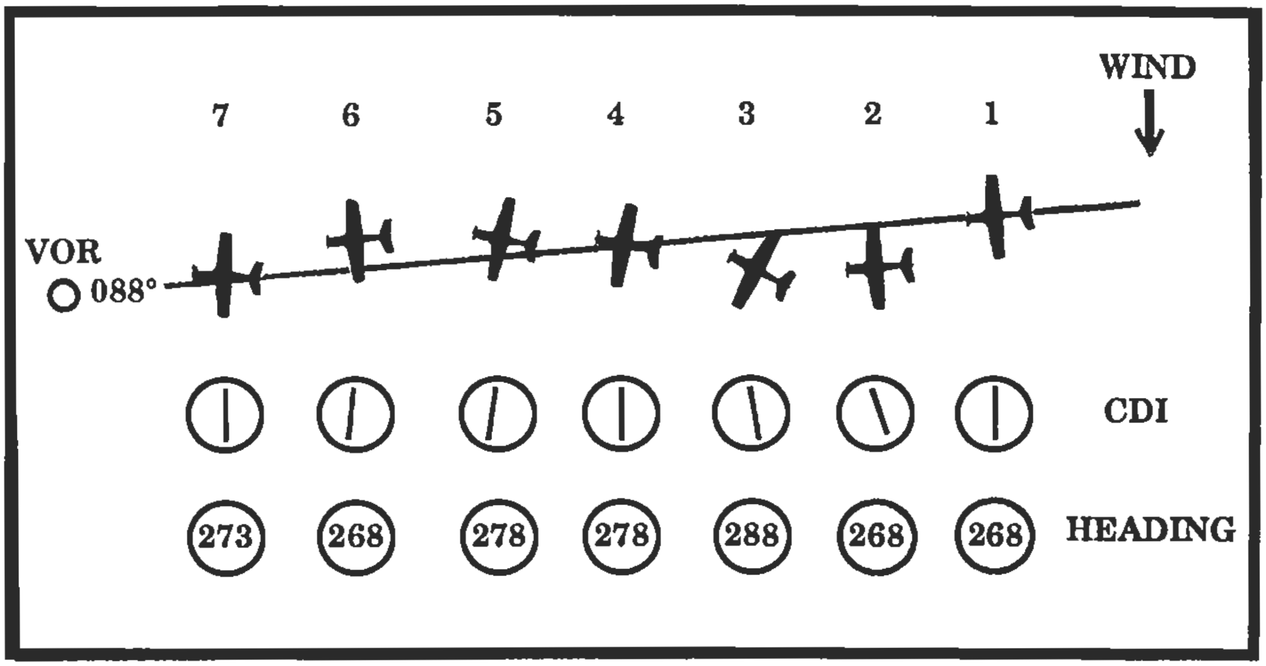
As soon as you determine that you are drifting off course, visualize the direction (right or left) from which the wind is blowing and make an immediate 20° heading correction toward the course (into the wind). The amount of turn and the maintenance of the exact heading are important. A 20° turn will, in most wind conditions, be enough to bring you back on course. If no needle movement toward center is apparent after a minute or two, increase the intercept angle to 30°. If the new heading results in the movement of the CDI back to center, you now have established both sides of your bracket.

If the course heading did not keep you on course and the 20° intercept heading brought you back, then the heading that will keep you on course lies somewhere between the two. Also, you now know that any time the airplane is off course, you can return to course with one or the other of the bracket headings. Once back on course, turn to a heading halfway between the two bracket headings. If this new heading fails to keep you on course, you have narrowed your bracket to 10°. Take up the previous bracket heading that will return you to course and again, split the difference.

Through this bracketing technique, you will find the exact heading needed to stay on course. From this point until station passage, you should always know the headings needed and, most importantly, know exactly what reaction to expect from the CDI when on those headings.

Let's take a specific example to more fully illustrate the technique of bracketing.

Assume you are to track to the VOR via the 088° radial.



Position 1 is the *zero reference point* from which bracketing begins - the OBS setting and the heading are the same (268°) and the CDI is centered.

At position 2, you notice that the needle has moved to the right. Since the heading is still 268°, The needle movement is the result of wind drift. The course is to your right and there is a crosswind component from the right.

Position 3 - Now take up a 20° intercept heading toward the course, a new heading of 288°. In most cases this 20° correction will return you to the the course and, if it does, you now know the following information:

1. A 268° heading results in the CDI moving right,
2. A 288° heading results in the CDI moving left,
3. A heading between 268° and 288° will keep you on course.
4. The crosswind is from the north (your right side).

Position 4 - When you have returned to the course (needle centered), split the difference between 268° and 288° and turn to a heading of 278°. Concentrate on holding this heading and watch for any movement of the CDI.

Position 5 - The needle moves slowly to the left. You now know that your correction into the wind was too great. The heading 278° replaces 288° as the right hand extreme of your bracket. You now know that:

1. A 268° heading results in the CDI moving right,
2. A 278° heading results in the CDI moving left,
3. A heading between 268° and 278° will keep you on course.
4. The crosswind is from the north (your right side).

Position 6 - Turn back to 268° and let the wind blow you back on course.

Position 7 - When back on course, split the difference and turn to a heading of 273°. Time will tell whether the heading 273° gives too much, too little, or exactly the correct amount of wind correction. Should the CDI move left, 273° replaces 278° as the right hand extreme of your bracket. Should the CDI drift right, then 273° replaces 268° as the left hand extreme.

You will recognize when you are getting close to the station when the established heading fails to produce the expected results. Do not make drastic turns in an effort to center the needle! However, do not ignore the needle indications either. Instead, make small heading corrections in an effort to keep the needle steady.

Though the above procedure may seem complicated at first, in actual practice it is quite simple. Remember, this procedure is the foundation for proper navigation. Learn it and always use it whenever you must track a course, and don't forget to visualize your position.

INTERSECTION ORIENTATION

Intercepting and tracking an airway to a VOR intersection is simply an extension of the process of intercepting and tracking a radial to a VOR station. If you follow the four steps listed here, you will have no problem with intersection orientation.

1. Tune and identify the station that makes up the airway or radial that you are to follow to the intersection. Center the needle with a FROM indication by twisting the OBS.

2. Turn the airplane to the cardinal heading that will intercept the airway or radial at the best intercept angle.

3. Using the second VOR receiver, tune and identify the other station which makes up the intersection. Center the needle with a FROM indication by twisting the OBS. This will tell you which side of the intersection you are on so you will know which direction to fly when you intercept the airway.

4. Set the OBS of the first VOR receiver to the course you will fly on the primary airway or radial to the intersection. Set the OBS of the second VOR receiver to the radial that makes up the intersection.

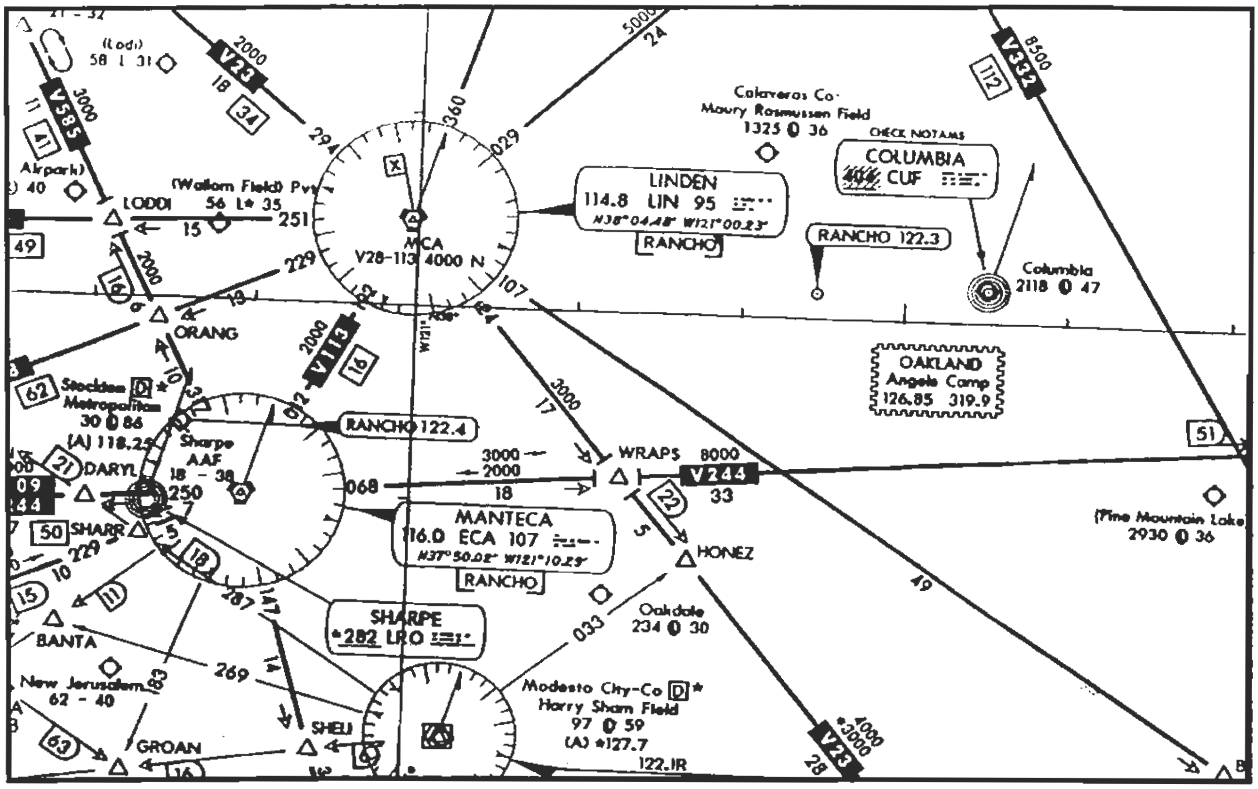
Assume the following clearance:

"CESSNA 12345 CLEARED TO WRAPS INTERSECTION VIA VICTOR TWO FORTY FOUR..."

1. Tune and identify ECA VOR on 116.0 MHz. Center the OBS with a FROM indication. Let's assume that it centers with the OBS set on 050 degrees. This tells us we are north of V244.

2. Visualize the cardinal headings and fly south, a heading of 180°.

3. Tune and identify LIN VOR on 114.8 MHz. Center the OBS with a FROM indication. Let's assume that it centers with the OBS set on 150°. This tells us we are west of the WRAPS intersection.



4. Set the OBS of the number 1 VOR (ECA) to 068°, which is the direction we will fly. Set the OBS of the number 2 VOR (LIN) to 124°, which is the radial identifing WRAPS. After intercepting V244, track to the intersection.

VOR intersection orientation is not a difficult process if you remember to follow the steps listed above and, as always, VISUALIZE.

Perhaps the most common error in instrument flying is falling behind the airplane. A pilot, especially when in instrument conditions must know not only where the airplane is at the moment, but where it will be at some time in the future. A pilot who waits until arriving at a point where action is needed before thinking that action through will always be behind the airplane and could become a hazard. One method of staying ahead of the airplane is to always be asking yourself two questions: "What am I waiting for?" and "What will I do when it happens?" At any point during an instrument flight, you will be waiting for something to occur before you can proceed with the next task. You may be waiting for station passage, a certain time to elapse, an altitude to be reached, the CDI needle to center, or any number of other events. If you always have in mind what event you are waiting for and discipline your scan technique to include the instrument which will tell you when it has happened you will not fall behind on your navigation.

THE 6 T'S

TURN
TIME
TWIST
THROTTLE
TALK
TRACK

The answer to the second question ("What will I do when it happens?") is always the same— the 6 T's. The 6 T's form a mental checklist for you to use each time a change needs to be made. In the heat of the battle, it is easy to forget to accomplish one of several items that may need to be done. The 6 T's will help you accomplish the right tasks at the right time and in the right sequence. Memorizing and using the 6 T's will keep you from forgetting to accomplish an important task.

As a mental checklist, the 6 T's work well for planning as well as for execution.

TURN - In what direction and to what heading do I turn after crossing the fix?

TIME - Is the time of the event important? Do I need to begin timing a segment?

TWIST - What course should be set on the OBS?

THROTTLE - Do I need to slow down or begin a descent?

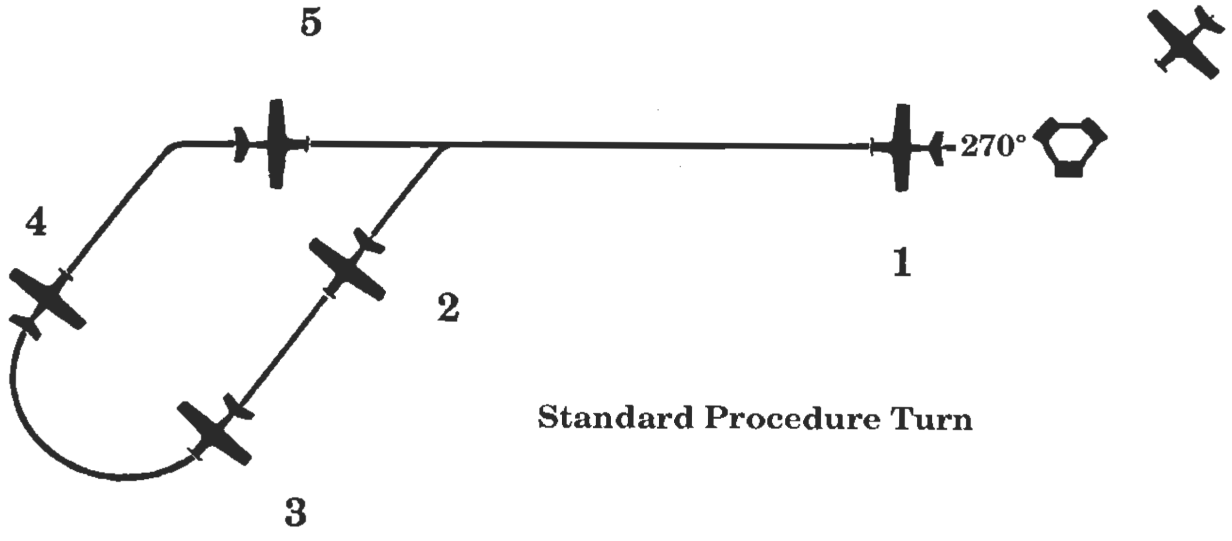
TALK - Is a report required? (Note this task is always next to last, NEVER first).

TRACK - Do I need any correction to stay on my new course?

Develop the habit of repeating the 6T's to yourself every time you cross a fix or make a turn. Not all six will be needed at every point, but by reviewing each of the 6 T's, an important item will not be forgotten. Students who memorize and use the 6T's invariably learn more quickly and make fewer mistakes than students who never take time to use them.

PROCEDURE TURN

To enhance your understanding and further develop your navigation skill, you will learn to accomplish procedure turns. A procedure turn is a method of reversing course and its practice lays the groundwork for flying full instrument approaches.



Standard Procedure Turn

Position 1 - Use the 6 T's to get established outbound on the desired radial. You will track outbound for a specified time (generally two or three minutes).

Position 2 - When the specified time is up, begin a standard procedure turn by turning to a heading 45° to the left of the outbound course. (A non-standard procedure turn would require an initial turn to the right). You will fly this heading for one minute. The objective is to get far enough away from the radial to allow you to turn around and reintercept it. In the example above the heading is 225°. Use the 6 T's - Turn to 225°, note the time, twist the OBS to the inbound course (090° in this case), adjust throttle if necessary, make any requested report. Tracking is not necessary, just hold the heading until time runs out.

Position 3 - At the end on one minute, turn to the reciprocal heading, in this case 045°. This turn is always in a direction *away* from the navaid.

Position 4 - You are on a 45° intercept to the 270° radial.

Position 5 - Intercept, then track the radial inbound.

NONDIRECTIONAL RADIO BEACONS

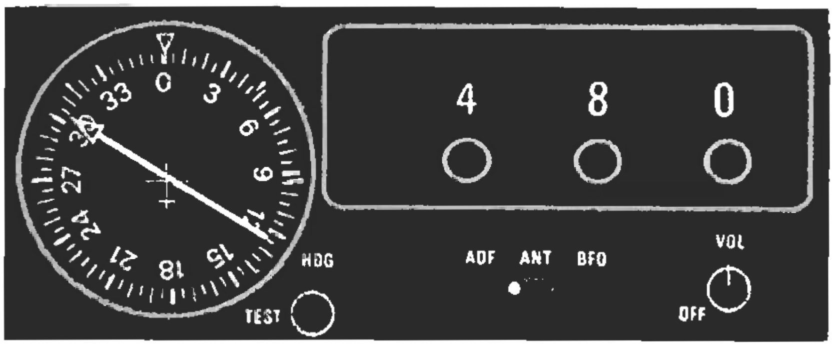
Low frequency **N**on**D**irectional radio **B**eacons (NDB) are ground based facilities installed at various locations to provide navigation or approach fixes. The transmitter, operating, in the frequency range between 190 and 535 kHz, provides a nondirectional radiation pattern.

The NDB has come to assume a secondary role to the VOR in terms of importance for navigation. It has not been phased out, however, because it is still useful for:

- — Backup navigation.
- — Position monitoring while enroute.
- — Approaches when no other aid is available.
- — Auxiliary navigation information while on approaches of other kinds.
- — Monitoring position while being vectored for an ILS or LOC approach.
- — As a substitute for a marker beacon.

An instrument pilot needs to understand and be able to use the ADF. Many students approach NDB navigation with apprehension. However, if you concentrate on visualization, then learning ADF will be no more difficult than was learning to use the VOR system.

ADF RECEIVERS AND INDICATORS



The **A**utomatic **D**irection **F**inder (ADF) is the airborne equipment used with NDB facilities. The two main components are the ADF receiver with which to tune and identify the NDB station, and the ADF indicator which has either a fixed or rotatable compass card and a single bearing pointer. Receivers generally cover a frequency range of 190 to 1750 kHz. This range includes the standard NDB navigation facilities as well as the commercial AM broadcast stations (from 550 to 1600 kHz).

While you may use commercial broadcast stations for backup navigation information, they are not suitable for primary navigation because they do not have the normal identification features and may not produce equal signal strength in all directions.

The ADF employs two antennas. A directional antenna which conducts the radio signal more efficiently in one direction than another, and a single-wire sense antenna which is nondirectional. Directional antennas for ADF receivers are usually in the form of loops. The older loop antennas were a simple loop of wire. On modern equipment the loop is electronic. If the loop is aligned with the direction from which the radio signal is being transmitted, it provides the strongest signal. When it is aligned perpendicular to the direction of the signal it provides the weakest signal. The ADF receiver electronically translates signal strength into the direction from which the signal is coming and the drives the bearing pointer of the indicator in that direction.

The bearing pointer of the ADF will always point *TO* the station. As the airplane turns or changes position, the bearing pointer will turn so that it is always pointed toward the station. Since the bearing pointer can do nothing other than point to the station, visualization is the key to determining position from the ADF display.

Most ADF receivers have a function switch with at least two positions— ANT and ADF. The ANT position operates the receiver on the non-directional sensing antenna only. In this position, the receiver is simply a portable radio. There is no direction finding capability in this position. In the ADF position, the direction of the signal is translated into a reading on the ADF indicator. A third position (BFO) is available to identify unmodulated AM signals which are common outside the US.

A TEST function is available on an ADF receiver to confirm the usability of a particular signal. Engaging the TEST function drives the pointer from its bearing position. When the TEST button is released, the pointer should return to the original bearing. Sluggish return or no return indicates a malfunctioning system or a signal that is too weak.

ADF LIMITATIONS

When flying over an NDB station, the performance of some ADF antenna installations is not reliable. The relationship between the signal picked up by the loop and sense antenna is the determining factor in over the station performance and some installations indicate false reversals before actual station passage.

The metal in the airplane itself can cause reflection and distortion of the radio waves. This error is at a minimum at the cardinal points (off the nose, wing tips, and tail) and is at a maximum at bearings of 045, 135, 225, and 315 relative to the nose of the airplane. You should, therefore, expect the ADF to be most accurate when the station is directly in front or directly behind the airplane. The error is increased or decreased by the physical location of the loop antenna on the airplane.

Another problem that needs to be considered in using the ADF is the weather and atmospheric factors which can case erratic and unreliable indications. During thunderstorm activity the bearing pointer will tend to point towards lightning strikes. During times of a great number of discharges, the ADF may be entirely unusable. Flight through rain or snow can create precipitation static which, in turn, can cause unreliable indications. Night effect, especially strong just after sunset and just before sunrise, may cause the bearing point to oscillate.

Improperly shielded electrical fields within the airplane may also cause unreliable ADF indications. If you suspect this is the case, refer the problem to a qualified mechanic or repair shop.

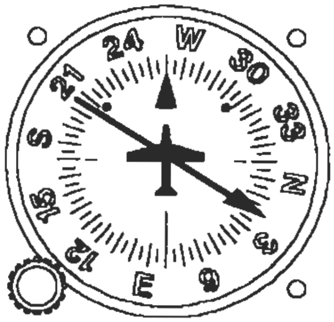
While the ADF is not as reliable as the VOR, it continues to live on in usefulness because of its simplicity. Somewhat like the magnetic compass, with its many errors and features which makes it difficult to use yet an old friend when properly understood, the ADF continues to be an important part of instrument flying.

ADF ORIENTATION

Typically, ADF bearing information is displayed separately from the heading. Unlike VOR, the heading of the airplane is crucial to visualizing position based on the indications of the ADF. This means that the instrument pilot needs a quick and reliable method to combine the bearing pointer indications of the ADF and the heading of the airplane to arrive at a mental image of airplane position. Math formulas and a calculator work great when taking a written test, but are too cumbersome for use in the cockpit.

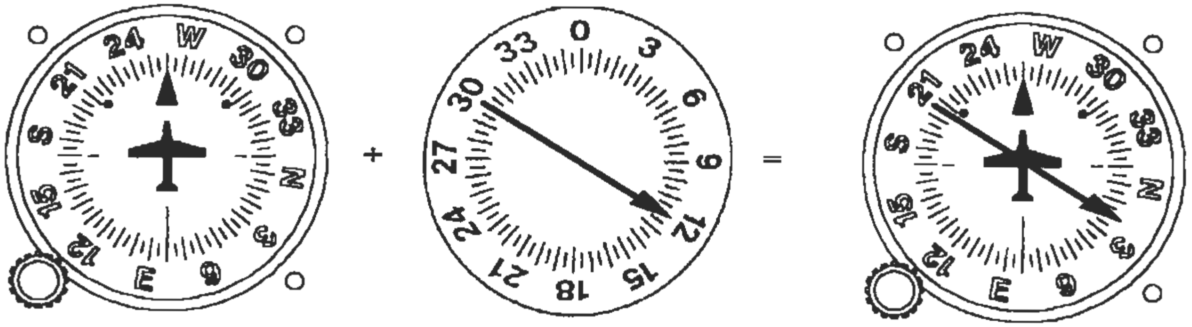
Instrument manufacturers recognized this need long ago and developed the Radio Magnetic Indicator (RMI). The RMI simply combines ADF bearing information and airplane heading onto one gyro-stabilized intrument.

RMI



The RMI to the right indicates a heading of 260°. The ADF bearing pointer indicates the course TO the station by the number on the compass rose under the head of the pointer, 020° in this case. The bearing FROM the station is 200°, as indicated by the number on the compass rose under the tail of the bearing pointer.

Unfortunately, few general aviation airplanes are equipped with RMI's. We are left to make the combination mentally, a sort of "poor man's RMI". In order to accomplish this, remember that the ADF indicator displays bearing information *relative* to the airplane as follows: 360° represents the nose of the airplane, 090° represents the right wingtip, 180° represents the tail, and 270° represents the left wingtip.



H/I **ADF**

The ADF indicator above points TO a station that is 30° "behind" the right wingtip (represented by the 090° position on the ADF indicator). On the heading indicator, this direction is generally North, and specifically 020°. The bearing FROM the station is equal to the heading which is 30° "ahead" of the left wingtip. In this case a direction of South, specifically a bearing FROM of 200°.

Many ADF indicators have a manually rotatable compass card under the bearing pointer. This is designed to provide some of the features of the RMI without all of the the expense. However, while it may appear to be a good idea, it actually increases the pilot workload and introduces the possibility of additional errors, most commonly forgetting to readjust the compass card after a turn. Since the "poor man's RMI" technique is quite easy to use, we recommended that the compass card be left on zero.

As you did with VOR, you will gain understanding of the operation and interpretation of ADF by solving orientation problems.

To fly DIRECT to a NDB from an unknown position:

1. Tune and identify the station.
   After listening to the Morse Code identifier, adjust the volume so that the coded identifier is just barely audible. Since the ADF has no "OFF" flag alarm, loss of the ID would be you only indication of a receiver malfunction or loss of usable navigation signal.

2. Determine COURSE TO the station by reference to the bearing pointer.

3. Turn to the heading equal to the course TO.

4. Adjust heading as needed to place the ADF bearing at the nose position (360°).

Starting from an unknown position you can determine your position relative to a NDB using the following steps.

1. Tune and identify the station.

2. Determine the BEARING FROM the station by reference to the tail of the bearing pointer.

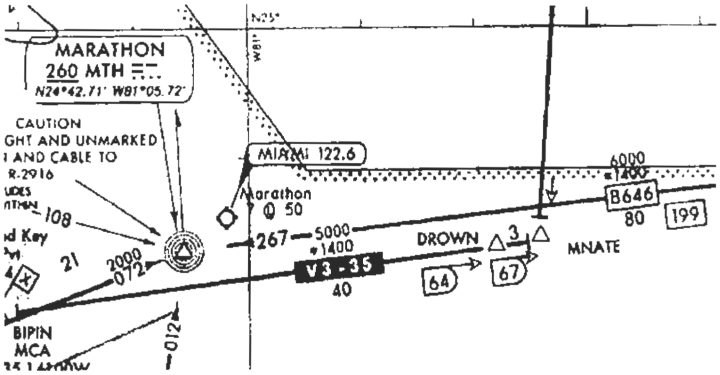
3. Visualize your position in geographic terms FROM the station.

Visualize your location from the station with respect to one of the eight cardinal points of the compass. Visualization is the key to maintaining positional awareness.

INTERCEPTING NDB BEARINGS

Consider the following clearance issued to an IFR flight.

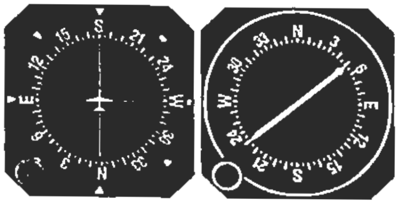
> "CESSNA 12345, CLEARED TO MARATHON NDB VIA BRAVO SIX FORTY SIX."



To comply with this clearance you would:

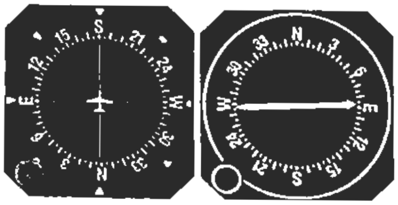
1. Tune and identify the Marathon NDB.
2. Determine your course TO the NDB by reference to the bearing pointer.
3. Turn to the cardinal heading closest to a perpendicular intercept of B646. Determine this by visualizing your position relative to the specified course.
4. Once established on the cardinal heading, you may fine tune the heading to the desired intercept angle.

Assume your position in the example above is northeast of the NDB. A south heading will take you to B646. While on a south heading, the inbound course TO the NDB, 267°, is 3° ahead of the right wingtip. When the ADF indicates the station is 3° ahead of the right wingtip, you will be on course.



Northeast of MTH

When intercepting a VOR radial, you must begin the turn to the COURSE HEADING before the CDI centers. Similarly, you must lead the ADF indication by a few degrees. The amount of lead depends on your distance from the station and the angle of intercept. You may find it necessary to roll out early, or to turn past the course heading to complete the intercept.



"On course"

TRACKING TO AN NDB

In this example, you are to track to the NDB via the 270° course TO.

Position 1 - This is the *zero reference point* from which bracketing begins - the station is directly ahead (360° bearing) and the heading is equal to the specified course.

Position 2 - You notice the bearing pointer has moved to the right. Since the heading is still 270°, the pointer movement can only be the result of wind drift. The course is to your right and there is a right crosswind component.

Position 3 - Turn 20° toward the course, a new heading of 290°. Notice that the bearing pointer has moved 20° as well (from 5° right of the nose to 15° left of the nose). Remember, the pointer always points TO the station.

Position 4 - The bearing pointer reaches a position 20° left of the nose (equal in amount to your intercept angle and opposite in direction). This indicates you have returned to course. Your bracket headings are 270°, which causes the bearing pointer to move to the right, and 290°, which moves the bearing pointer to the left.

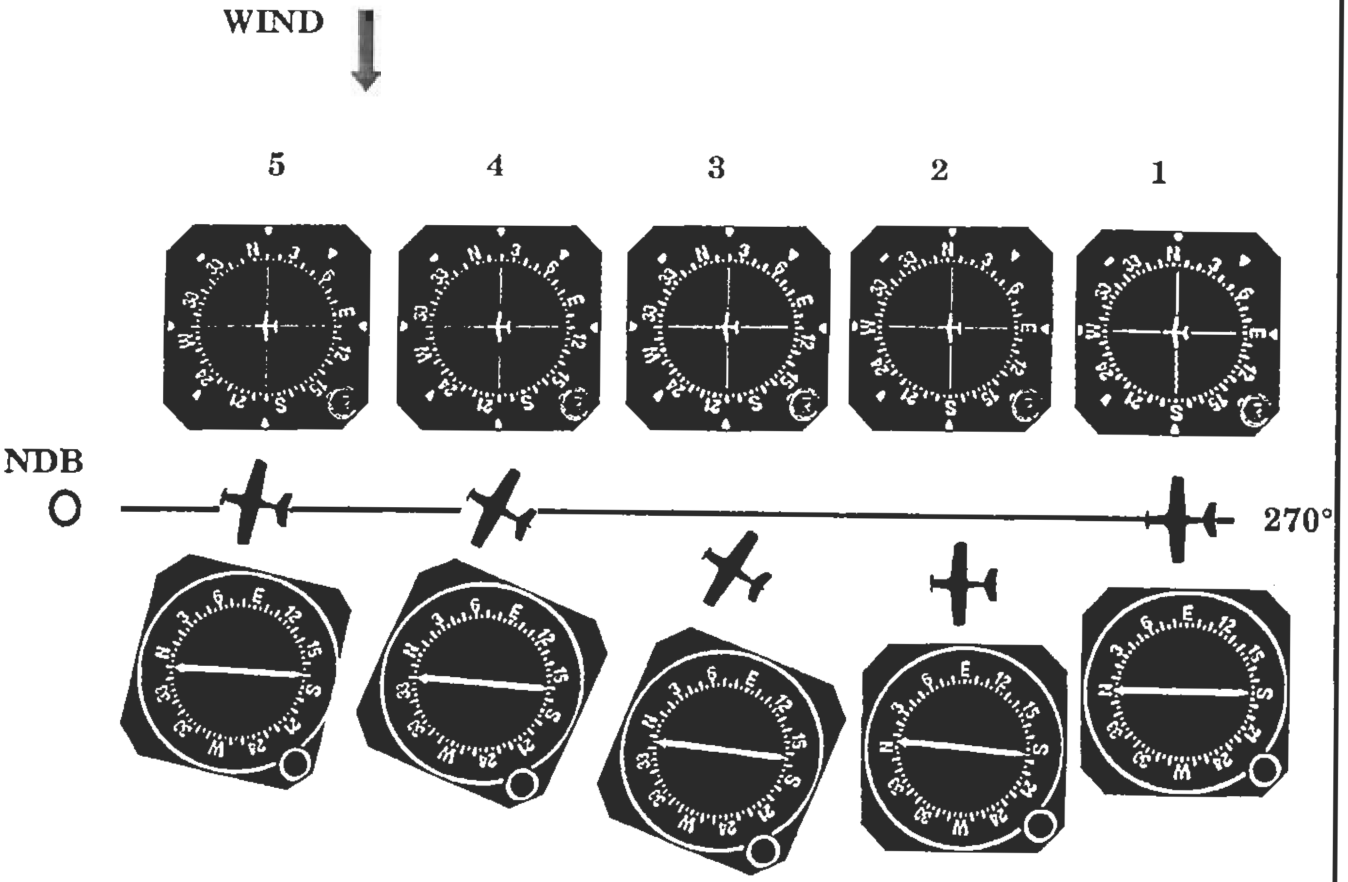
Position 5 - Once on course, you split the difference between the bracket headings. Since the current heading 280° is 10° *right* of the course, the on-course indication of the bearing pointer is 10° *left* of the nose.

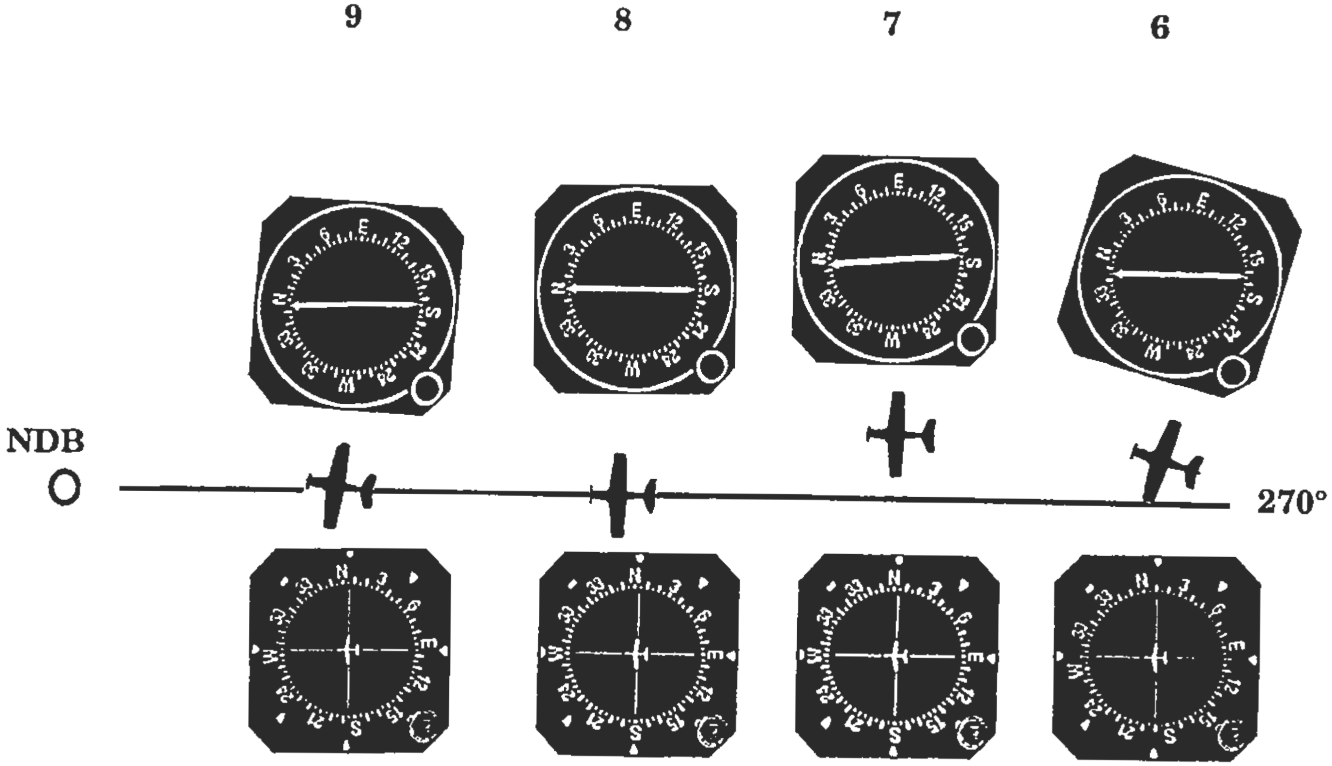
Position 6 - You notice the bearing pointer has moved left. The 10° correction is too much and you have flown off course.

Position 7 - Return to the bracket heading which you know will move the bearing pointer to the right— 270°.

Position 8 - The 270° heading returns you to course. Your bracket headings are now 270° and 280°.

Position 9 - Split the difference between the new bracket headings and fly a heading of 275°. Note the on-course indication is now 5° left of the nose.


WIND
5
4
3
2
1
NDB
270°


9
8
7
6
NDB
270°

TRACKING FROM AN NDB

In this example, you are to track outbound on the 270° bearing from the NDB.

Position 1 - This is the *zero reference point* from which bracketing begins - the station is directly behind (180° bearing) and the heading is equal to the specified course.

Position 2 - You notice the bearing pointer has moved counter-clockwise, to the right-hand side of the tail position. Since the heading is still 270°, the pointer movement can only be the result of wind drift. The course is to your right and there is a right crosswind component.

Position 3 - Turn 20° toward the course, a new heading of 290°. Notice that the bearing pointer has moved 20° as well (from 5° right of the tail to 25° right of the tail). Remember, the pointer always points TO the station.

Position 4 - The bearing pointer moves clockwise, closer to the tail position, to a bearing 20° right of the tail. This is equal in amount to your intercept angle and in same direction, which indicates you have returned to course. Your bracket headings are 270° and 290°.

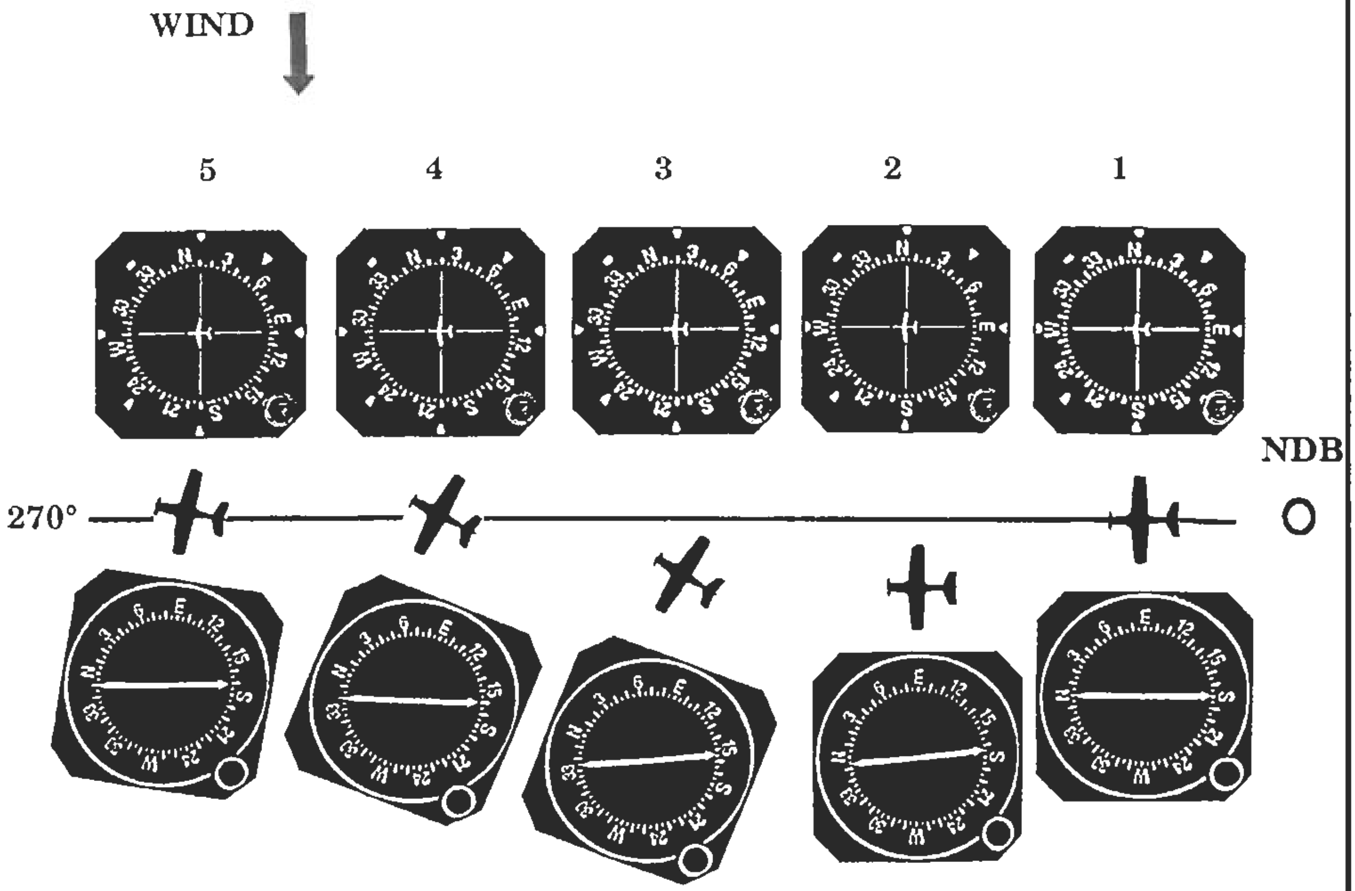
Position 5 - Once on course, you split the difference between the bracket headings. The current heading of 280° is 10° *right* of the course. Since you are outbound, the on-course indication of the bearing pointer is 10° *right* of the tail position.

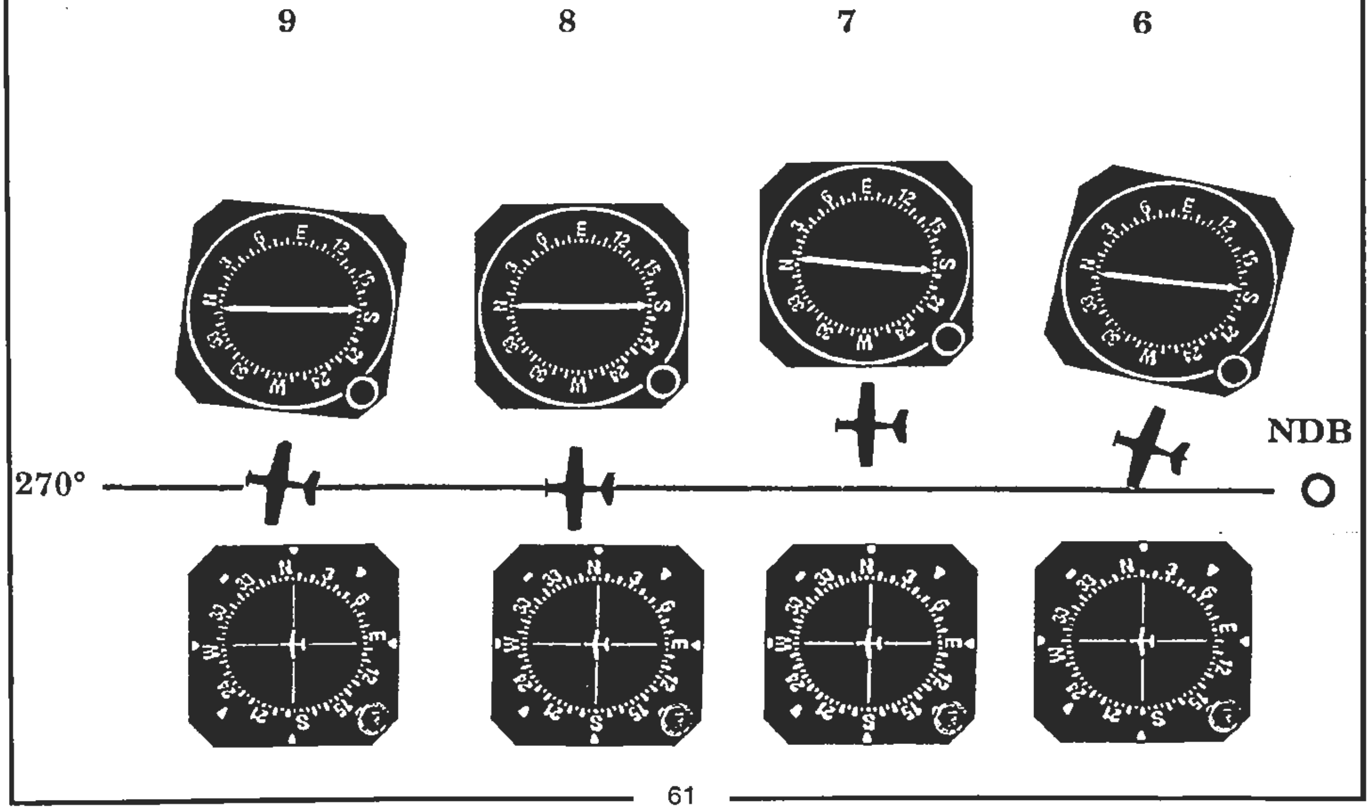
Position 6 - You notice the bearing pointer has moved closer to the tail. This indicates the 10° correction is too much and you have flown off course.

Position 7 - Return to the bracket heading which you know will return you to the course— 270°.

Position 8 - The 270° heading returns you to course. Your bracket headings are now 270° and 280°.

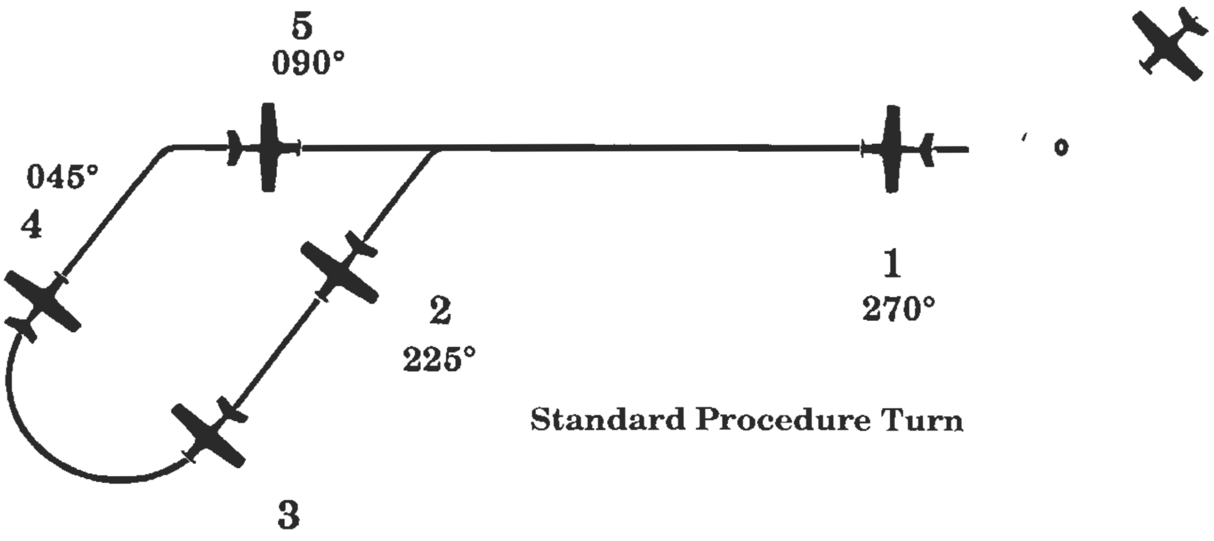
Position 9 - Split the difference between the new bracket headings and fly a heading of 275°. Note the on-course indication is now 5° right of the tail.


WIND
5
4
3
2
1
NDB
270°


9
8
7
6
NDB
270°

PROCEDURE TURNS

To enhance your understanding and further develop your navigation skill, you will learn to accomplish procedure turns. A procedure turn is a method of reversing course and its practice lays the groundwork for flying full instrument approaches.



Standard Procedure Turn

Position 1 - Use the 6 T's to get established outbound on the desired bearing. You will track outbound for a specified time (generally two or three minutes).

Position 2 - When the specified time is up, begin a standard procedure turn by turning to a heading 45° to the left of the outbound course. (A non-standard procedure turn would require an initial turn to the right). You will fly this heading for one minute. The objective is to get far enough away from the bearing to allow you to turn around and reintercept it. In the example above the heading is 225°. Use the 6 T's - Turn to 225°, note the time, adjust throttle if necessary, make any requested report. Tracking is not necessary, just hold the heading until time runs out.

Position 3 - At the end of one minute, turn to the reciprocal heading, in this case 045°. This turn is always in a direction *away* from the navaid.

Position 4 - You are on a 45° intercept to the 090° course TO the NDB.

Position 5 - Intercept, then track the inbound course.

AMERICAN FLYERS

CHAPTER 3

INSTRUMENT APPROACHES

123 rule

1 hr. before - 1 hr After ETA
2 thousand ceiling
3 miles VISIBILTY

Alternate
Precision 2 miles & 600ft Ceiling
Non precision 2 miles & 800ft Ceiling

During this phase of your training, you will learn to perform VOR, NDB, Localizer, and ILS approaches. There are certain terms that apply to all approaches and, so that there will be no misunderstanding when your instructor uses them, they are defined below.

APPROACH TERMINOLOGY

STANDARD INSTRUMENT APPROACH PROCEDURE - The series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a point from which a landing can be made visually.

PRECISION APPROACH - A standard instrument approach procedure in which an electronic glideslope/ glidepath is provided; e.g. ILS/MLS and PAR.

NON-PRECISION APPROACH - A standard instrument approach procedure in which no electronic glideslope is provided; e.g. VOR, NDB, LOC, LOC (BC), ASR, LDA, or SDF.

APPROACH CORRIDOR - The volume of airspace in which an airplane maneuvering in accordance with a standard instrument approach procedure is provided adequate clearance from obstacles. The approach corridor is defined by the mandatory courses, the minimum altitudes, and the maximum distances prescribed for a particular standard instrument approach procedure.

FULL APPROACH - A standard instrument approach procedure during which it is necessary to make a course reversal to establish the airplane inbound in the approach corridor.

STRAIGHT-IN APPROACH - A standard instrument approach procedure in which the airplane is established inbound in the approach corridor by a method other than a course reversal.

STRAIGHT-IN LANDING - A landing made, after completing a standard instrument approach procedure, on the runway designated as the straight-in runway in the minimums section of that standard instrument approach procedure.

CIRCLE-TO-LAND - A maneuver required, after completing a standard instrument approach procedure, to descend and land on a runway other than the one designated as the straight-in runway in the minimums section of that standard instrument approach procedure.

DECISION HEIGHT (DH) - The minimum height at which a decision must be made during an ILS, MLS, or PAR instrument approach to either continue the approach or to execute a missed approach.

MINIMUM DESCENT ALTITUDE (MDA) - The lowest altitude to which descent is authorized on final approach or during circle to land maneuvering in execution of a non-precision approach.

INITIAL APPROACH FIX (IAF) - The fix depicted on instrument approach procedure charts that identifies the beginning of the initial approach segment.

FINAL APPROACH FIX (FAF) - The fix from which the final approach segment begins. It is designated on the NOS charts by the Maltese Cross symbol for non-precision approaches and by a lightning bolt symbol for precision approaches.

STEP DOWN FIX - A fix that permits additional descent within a segment of an instrument approach procedure by identifying the point at which a controlling obstacle has been safely overflown. A controlling obstacle is the highest obstacle within the segment maneuvering area. The height of the controlling obstacle dictates the minimun segment altitude. Special equipment, not otherwise required to fly the particular approach, may be needed to identify a step-down fix.

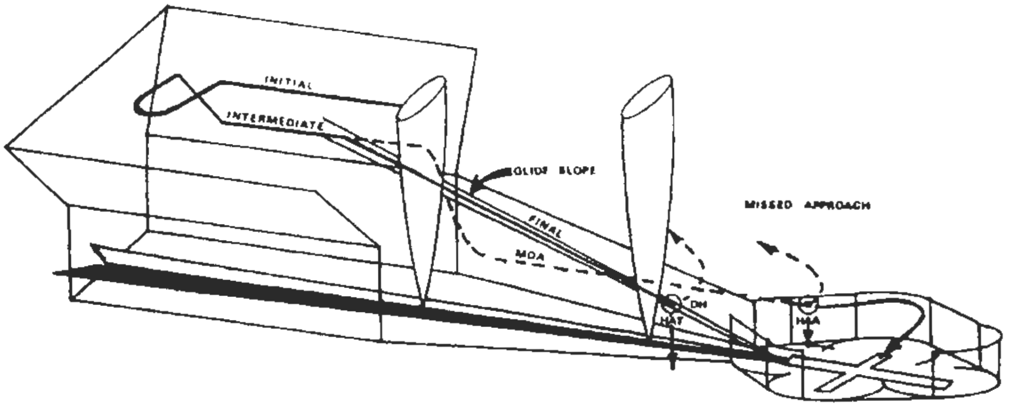
MISSED APPROACH POINT (MAP) - A point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist. The missed approach point may be designated as a point in space (decision height) for a precision approach or defined as a geographic position in the case of a non-precision approach.

SEGMENTS OF THE APPROACH

A standard instrument approach procedure generally consists of four segments— initial, intermediate, final, and missed approach. The courses, altitudes, and distances prescribed for each segment define the limits of the approach corridor. Although not technically a segment, a terminal route is an integral part of an instrument approach procedure because it serves as the transition between the en route system of airways and the instrument approach procedure. Knowledge of these segments is necessary to enable you to visualize your progress along the approach corridor, to recognize what information is needed and to know what tasks must be accomplished.

TRANSITION - The transition connects the enroute system to the initial segment of the approach. A transition may be an airway, a terminal route published on an approach chart, a Standard Terminal Arrival Route (STAR), or a direct route.

INITIAL SEGMENT - The initial segment begins at the Initial Approach Fix (IAF). The purpose of the initial segment is to position the airplane inbound in the approach corridor. A procedure turn is an initial segment. The initial segment may alternatively consist of a specified radial, bearing, heading, or combinations thereof. Radar vectors, DME arcs, and holding patterns can also serve as initial segments.



The initial segment ends at the point where the airplane is established on the intermediate segment or on the final segment if the procedure has no intermediate segment.

The initial segment altitude is published in the profile view of the approach chart. This altitude provides at least 1000 feet of obstacle clearance within the limits of the segment. Depending on the type of initial segment, course and distance information is depicted in the plan view and/or the profile view of the approach chart.

INTERMEDIATE SEGMENT - The intermediate segment blends the initial approach segment with the final approach segment. It is the segment of the approach where the final airspeed, configuration and altitude adjustments are made for entry into the final segment. Not all approaches have an intermediate segment.

The intermediate segment altitude, shown on the profile view of the approach procedure chart, provides at least 500 feet of obstacle clearance. The intermediate segment is generally 10 miles long, but the distance can vary between 5 and 15 miles, as indicated on the approach chart.

FINAL SEGMENT - This segment begins at the Final Approach Fix (FAF), at glide slope intercept at the published altitude or at the end of the initial segment, depending on the specific approach. The final segment is where alignment and descent in preparation for landing are made.

The final segment ends at touchdown or, in the event landing requirements are not met, at the missed approach point.

Final segment minimum altitudes are published in the minimums section of the approach charts. An ILS provides positive obstacle clearance during descent to DH. The DH itself is usually established at 200 feet above the runway touchdown zone elevation. For non-precision approaches, the MDA establishes minimum obstacle clearance of 250 feet for a straight-in landing and 300 feet for circle-to-land maneuvers. Descent below the DH or MDA is permitted only when all landing requirements are continuously met.

MISSED APPROACH SEGMENT - This segment provides obstacle clearance and routing during the climb out and reentry into the initial segment or the enroute system. The missed approach segment begins at the Missed Approach Point (MAP). The MAP is either a geographic point, as in the case of a non-precision approach, or occurs upon arrival at DH on the glideslope of an ILS.

The missed approach segment ends at the missed approach fix. Altitudes and route information for the missed approach procedure are published on the plan view and profile view of the approach procedure charts.

INSTRUMENT APPROACH PROCEDURE CHARTS

During flight in IMC, descent below the minimum safe en route altitude can be safely made only by following a procedure that will assure obstacle and terrain clearance until the airplane is established in conditions which permit landing by visual references. Such assurance is the purpose of standard instrument approach procedures. The FAA has established standards for designing instrument approach procedures which assure safety for IFR flights. Each standard instrument approach procedures is prescribed by FAR Part 97, therefore, adherence to published procedures is required by regulation as well as common sense.

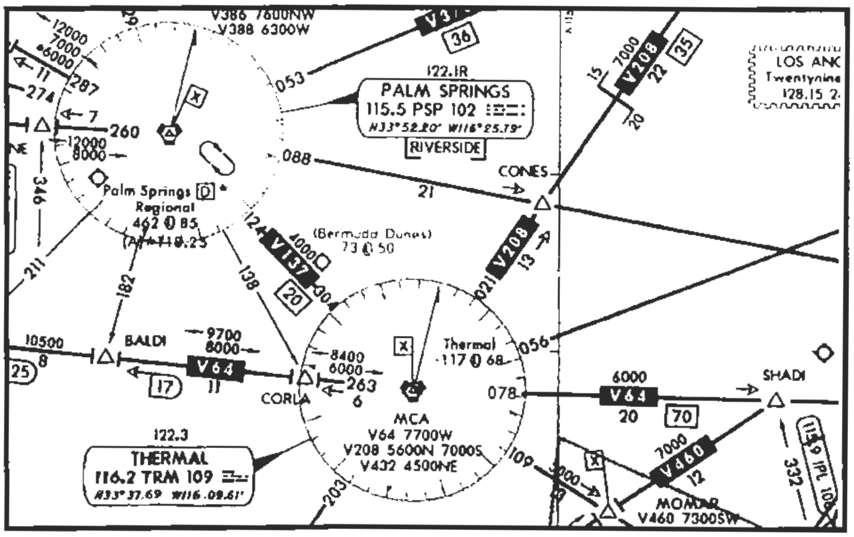
Standard Instrument Approach Procedures (SIAP's), published by the National Ocean Service and commercial concerns, are available by subscription. Approach charts present the precribed instrument approach procedure in a format that is readily usable by a pilot while in flight. Readily usable, that is, *if* the pilot knows what information is needed, when the information is needed, and where to look on the chart to get the information.

It is essential that you combine your knowledge of the segments of an instrument approach with a technique for planning and performance— the 6T's. You also need a thorough understanding of the organization and symbology of the instrument approach charts you will be using. Study the legends provided with the charts. You can also "fly" approaches at home, following through each segment in turn. Your goal is not to memorize specific chart information, but to learn to keep chart reference to an absolute minimum. Remember, the less time you spend looking at a chart, the more time your have to concentrate on your instrument scan and visualization.

FULL VOR APPROACHES

An instrument approach is a procedure. As such, prescribed altitudes, courses and distances are mandatory. As mentioned earlier, often there is more than one good technique by which a given procedure can be accomplished. Where on the approach to slow down or when to lower the landing gear are examples of technique. The techniques outlined in this section were developed at American Flyers to support a single pilot operation in a typical general aviation airplane in IMC. Our goal is to provide you with techniques that, to the greatest extent possible, enable you to do the same thing with the airplane at the same place during *any* approach.

To illustrate the execution of a typical full VOR approach, assume you are inbound to the TRM VORTAC from the east on Victor 64 at 8 thousand feet. Your destination is Bermuda Dunes airport (UDD).



As you near your destination you need certain information to plan for approach and landing. You need the most current weather report for ceiling, visibility, wind, and altimeter setting. If the airport has several instrument approaches, you need to know which one is currently in use and how you may expect to transition to it. You also need to know the active runway.

While the ATC facility providing approach control services to an arriving IFR flight is responsible to insure that the pilot *receives* advance approach information, that ATC facility will not necessarily *deliver* the information. In high traffic density areas, for example, advance approach information needed by pilots is available on ATIS. The purpose of ATIS is to broadcast essential non-control information without creating frequency congestion. It is important that you plan ahead and get the ATIS information early. Controllers will expect you to announce on initial call, using the phonetic code letter, that you have the current ATIS information.

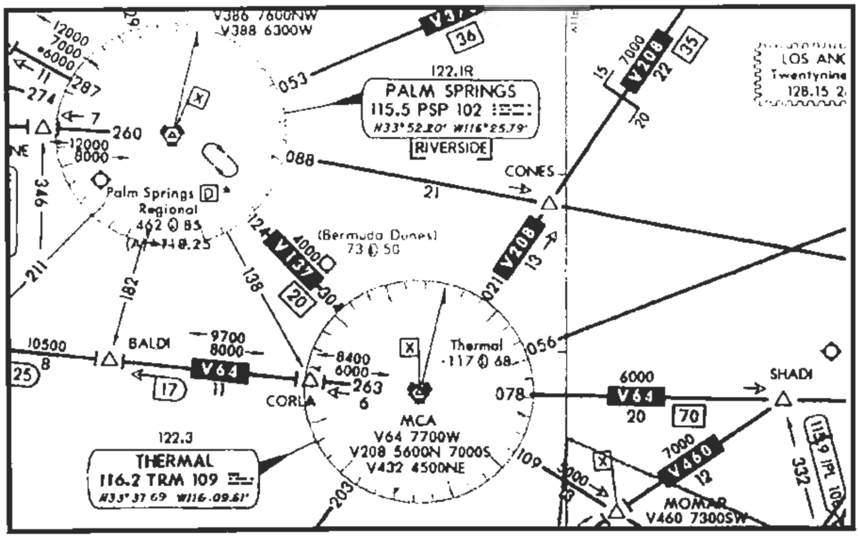
CHART REFERENCE 1

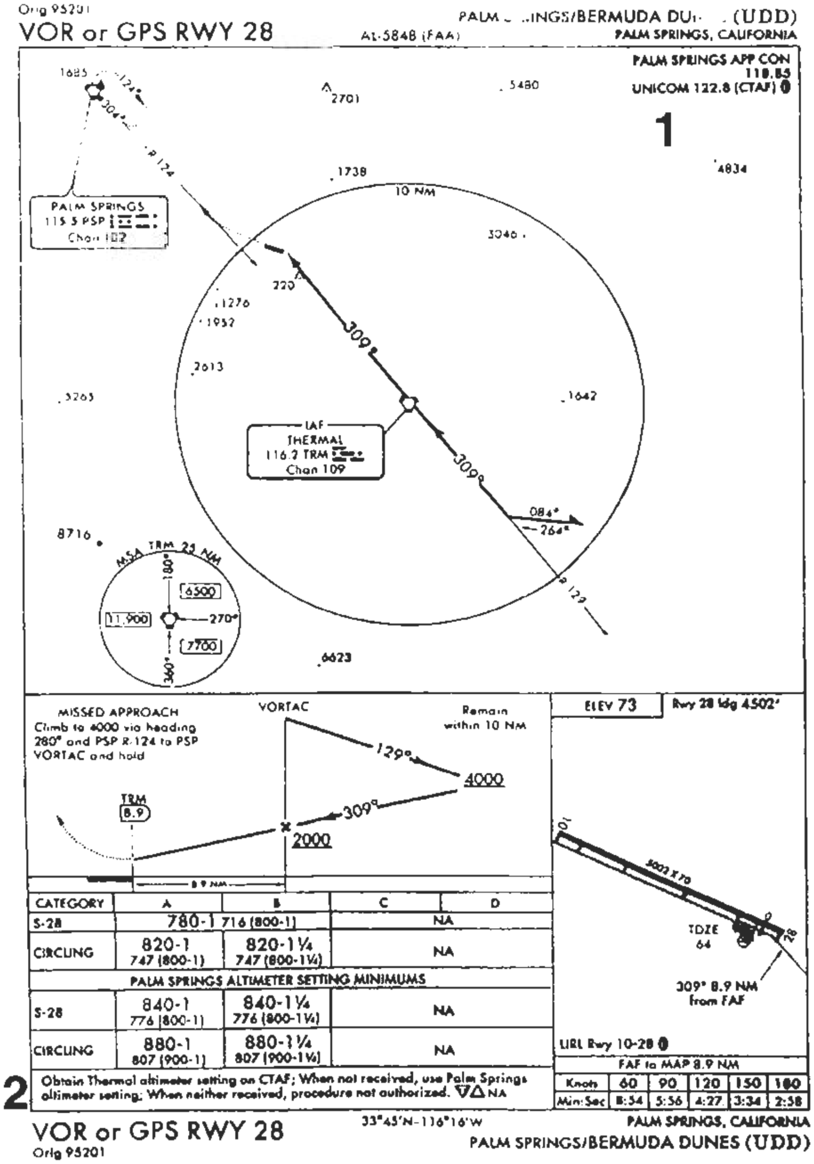
At locations without ATIS, the controller responsible for issuing the approach clearance will provide each arriving aircraft with the needed information. Be ready to receive this information— current weather, approach in use, method of transition, and active runway on initial contact. ATIS, ATC, and CTAF frequencies are tabulated in the upper corner of the plan view of the approach chart. In this example, you would anticipate receiving approach clearance from Palm Springs Approach on 118.85 mHz. No ATIS frequency is indicated for UDD. When handed off to Palm Springs Approach, be ready to copy, and then act on, the advance approach information. Always check and reset the altimeter upon receipt of a new altimeter setting. This is also a good time to check and reset the heading indicator.

Get in the habit of beginning to gather advance approach information as soon as possible. Twenty to thirty minutes before your ETA at destination is not too soon, but be ready for changing situations. Weather and traffic are dynamic. A wind shift or changing traffic conditions may result in a change in the landing runway, the type of approach, or both.

CHART REFERENCE 2

Another factor to encourage advance planning is illustrated clearly by the example. The notes in the remarks section of the UDD VOR RWY 28 approach indicate the pilot is responsible for obtaining the Thermal altimeter setting on the CTAF, 122.8 mHz in this case. From this note you can infer that Palm Springs Approach will issue the Palm Springs weather and altimeter to arriving pilots. If you do not (or cannot) obtain the local altimeter setting through Thermal Unicom, higher minimums for the approach apply as indicated.





CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ∇A NA

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

METHODS OF TRANSITION

Determining the method of transition to the approach corridor is also part of efficient advance planning. If not specifically issued by ATC, you must determine the method to be used. When making a full approach, the transition leads from the last en route fix to the Initial Approach Fix (IAF). Three common methods of transition to the IAF are: an airway transition; a published terminal route; and a direct route. In each case, the transition is to the IAF, the beginning point for the initial approach segment.

CHART REFERENCE 3

In the example, you are flying V64 westbound to TRM at 8,000 feet. By reference to the plan view you note that TRM is the IAF for the VOR RWY 28 approach. You will transition from the en route environment to the approach corridor along V64. This method is called an airway transition.

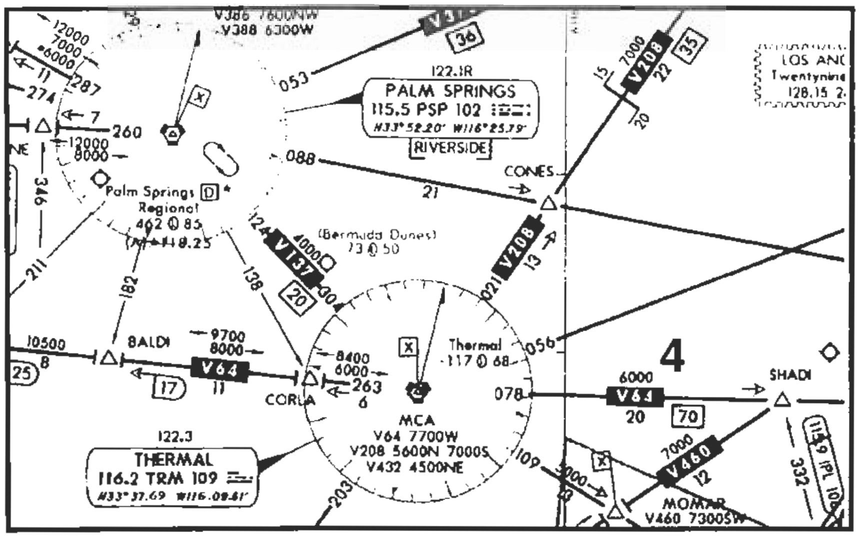
CHART REFERENCE 4

CHART REFERENCE 5

Knowing the method of transition enables you to determine the initial approach altitude. Once cleared for an approach, you may descend, at pilot's discretion to the lowest authorized IFR altitude FOR YOUR POSITION. Since you will transition along V64, the lowest authorized IFR altitude is the MEA, in this case 6,000 feet. Before deciding on the MEA as the initial approach altitude, check the initial segment altitude (procedure turn altitude) in the profile view. In this case it is 4,000 feet. In general, when making an airway transition, the initial approach altitude will be the higher of the MEA or the initial segment altitude. (You may use the MOCA in lieu of MEA, but only when within 22 NM of the VOR). In this case, when cleared for the approach, you may descend to 6,000 feet on V64.

A published transition, found on the plan view, specifies the minimum altitude, which may be the same or higher than the initial segment altitude.

If your transition occurs along a direct route to the IAF, the initial approach altitude is your last assigned altitude, or lower altitude authorized by ATC. This altitude applies until you are established on a published route or a segment of the approach. For more detail, refer to FAR §91.175 and the Aeronautical Information Manual.

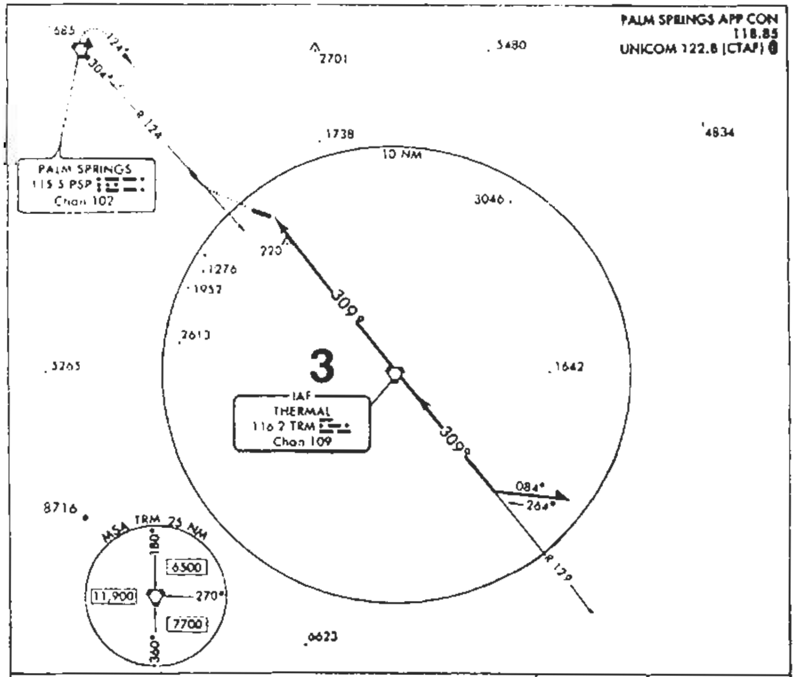


Orig 95201

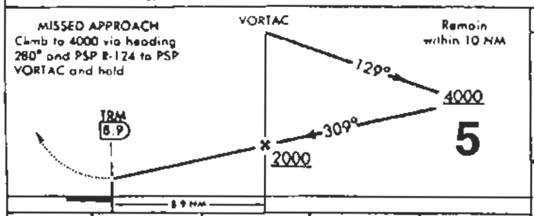
VOR or GPS RWY 28

AL-584B (FAA)

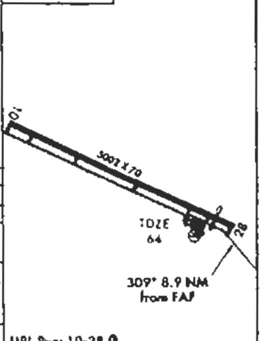
PALM SPRINGS/BERMUDA DUNES (UDD)
PALM SPRINGS, CALIFORNIA



MISSED APPROACH
Climb to 4000 via heading 280° and PSP R-124 to PSP VORTAC and hold



ELEV 73 | Rwy 28 ldg 4502'



LIRL Rwy 10-28

CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45'N-116°16'W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

As soon as possible during the transition, set up the navigation radios as needed for the approach. In general, for a full VOR approach:

1. The VOR facility on which the approach is based should be selected on the number one radio.
2. Use the number two radio to identify intermediate fixes, step-down fixes, or the missed approach fix.
3. Other NAVAIDS should be selected as required by the instrument approach procedure.

CHART REFERENCE 6 & 7

Accomplishing the radio configuration requires reference to the plan view of the approach chart. For the VOR RWY 28 approach to UDD, the #1 VOR receiver is tuned to TRM (116.2) and #2 is tuned to PSP (115.5), the missed approach fix.

As soon as the radios are configured, use the 6T's to plan for the initial approach segment.

CHART REFERENCE 8

TURN— To the outbound course of 129°.
TIME— Generally three minutes. Adjust for wind and circumstances to insure you remain within the 10 NM distance limitation.
TWIST—The OBS to 129°.
THROTTLE— Slow to approach airspeed and descend to 4,000 feet, the initial segment altitude.
TALK— If ATC requests, report "VOR, OUTBOUND".
TRACK— The 129° radial outbound.

Approach control issues the following:

"CESSNA 12345, CLEARED VOR RUNWAY TWO EIGHT APPROACH, REPORT THE VOR OUTBOUND."

Clearance for an approach is clearance to descend to the lowest IFR altitude *for your position*. At this time you report leaving 8,000 and begin descent to 6,000. Upon crossing the IAF, the clearance authorizes you to descend in accordance with the published instrument approach procedure.

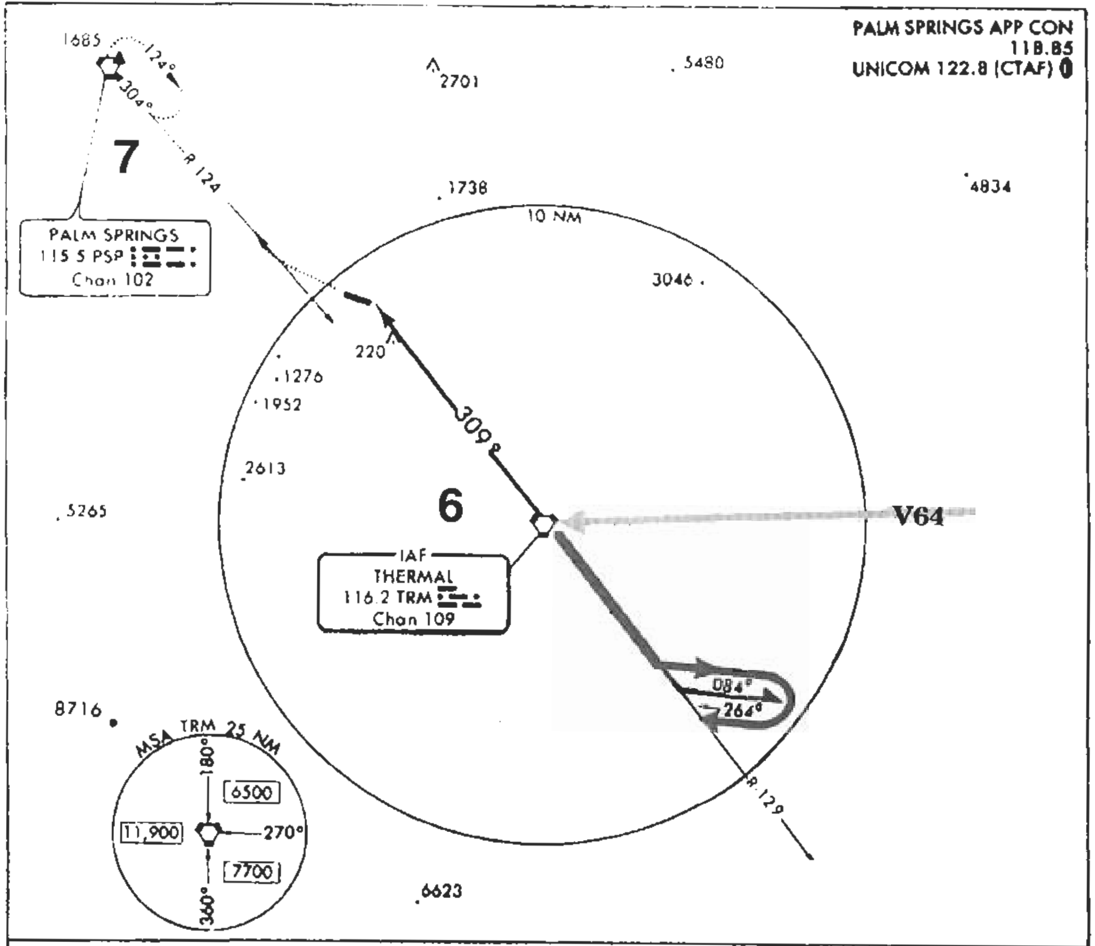
At reversal of the TO/FROM indicator, begin the initial segment by executing the 6T's.

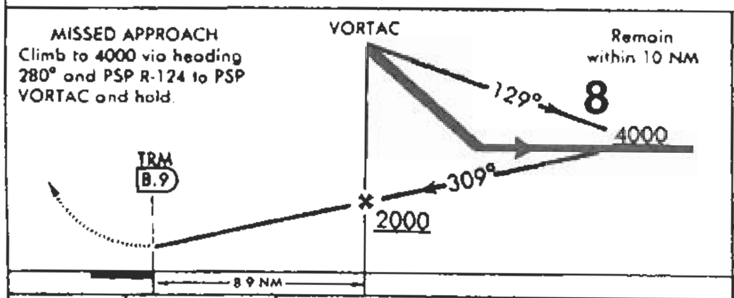
Orig 95201

VOR or GPS RWY 28

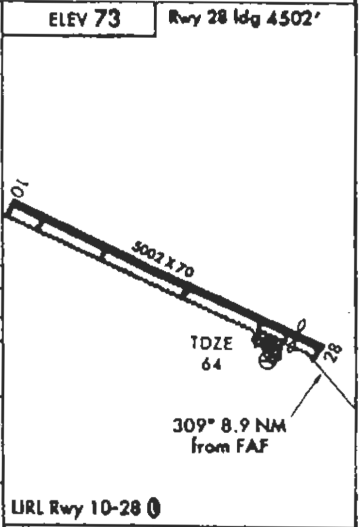
AL-5848 (FAA)

PALM SPRINGS/BERMUDA DUNES (UDD)
PALM SPRINGS, CALIFORNIA





MISSED APPROACH
Climb to 4000 via heading 280° and PSP R-124 to PSP VORTAC and hold.



CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45'N-116°16'W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

INITIAL SEGMENT

Obstacle clearance is assured during the initial segment provided you remain within the protected airspace. This requires you to accurately track the 129° radial, to descend no lower than 4,000 feet, to complete course reversal on the east side of the course, and to remain within 10 NM of TRM.

Keep in mind the purpose of the initial segment— to establish the airplane inbound in the approach corridor at the appropriate altitude, speed and configuration to enable successful completion of the approach. The actual time flown outbound on the initial segment should be sufficient to permit the required descent and planning to be completed, but not so long as to exceed the distance limitation. Adjustments for any significant headwind or tailwind must be considered. In a no wind condition, 3 minutes outbound on the initial segment will generally allow sufficient descent and planning time, and keep the airplane within the approach corridor. At 90 knots groundspeed, you will fly 4.5 NM in 3 minutes. At 120 knots, you will fly 6 miles.

CHART REFERENCE 9

CHART REFERENCE 10

Refer to the plan view to determine the direction and heading for the first portion of the course reversal. In this case a left turn to 084° is recommended. Refer to the plan view and note the inbound course is 309°. At the end of the outbound time, use the 6T's as you begin the procedure turn

TURN— Left to 084°.
TIME— Note. You will fly 084° for 1 minute or full scale CDI deflection. The objective is to position the airplane far enough away from the 129° radial to permit reinterception without overshoot.
TWIST—The OBS to 309°, the inbound course for the intermediate segment.
THROTTLE— No change.
TALK— Report if requested.
TRACK— Hold the 084° heading.

CHART REFERENCE 11

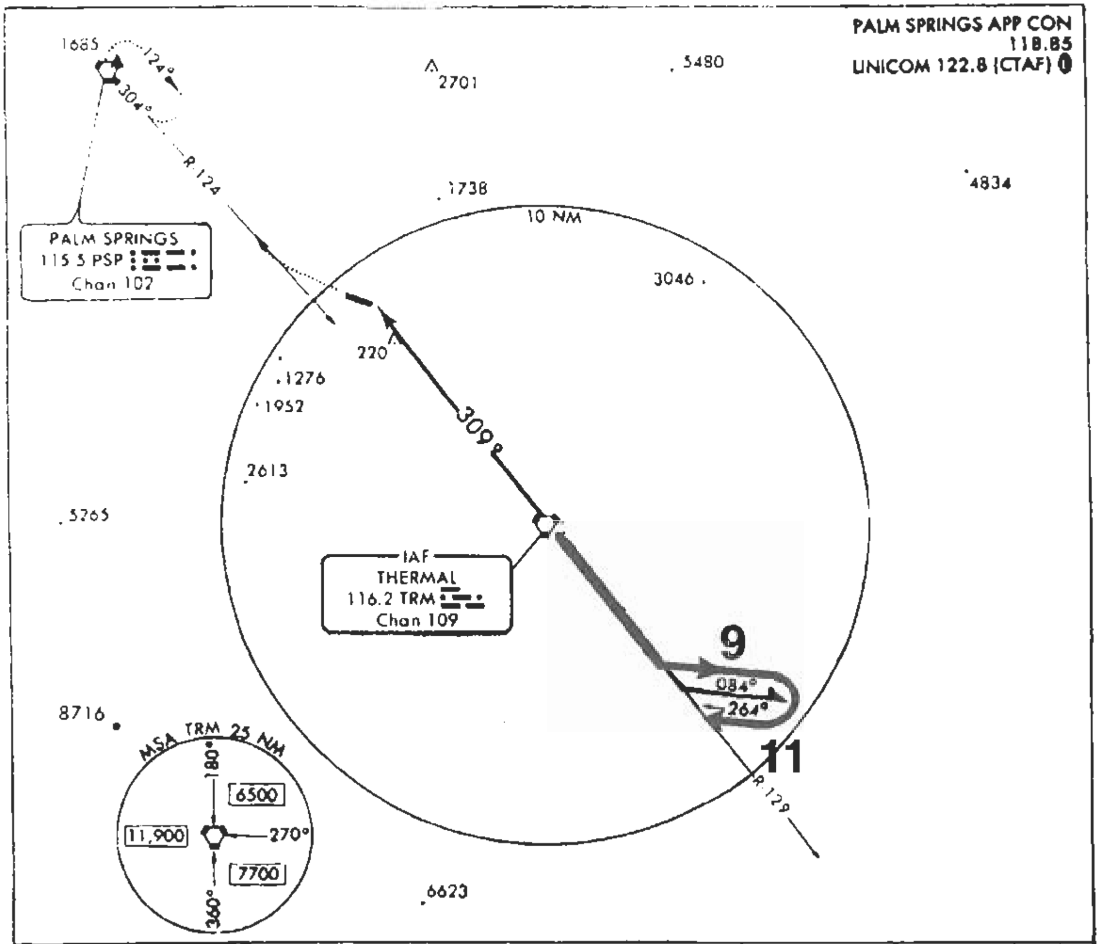
Refer to the plan view for the inbound heading, 264°. When time is up, note the CDI. It should just be reaching full scale deflection indicating you are approximately 10° off course. If not, continue outbound until you note full scale deflection, then turn *right* to 264°.

Orig 95201

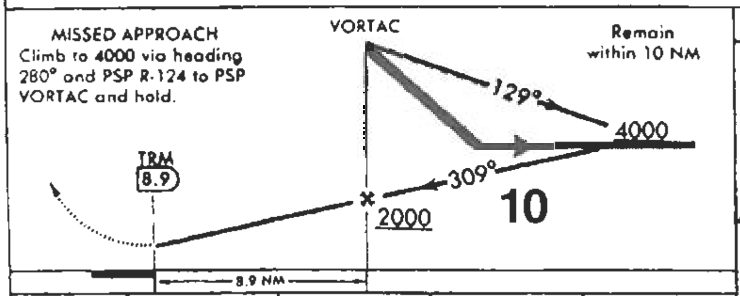
VOR or GPS RWY 28

AL-5848 (FAA)

PALM [illegible]INGS/BERMUDA DU[illegible] (UDD)
PALM SPRINGS, CALIFORNIA



MISSED APPROACH
Climb to 4000 via heading 280° and PSP R-124 to PSP VORTAC and hold.

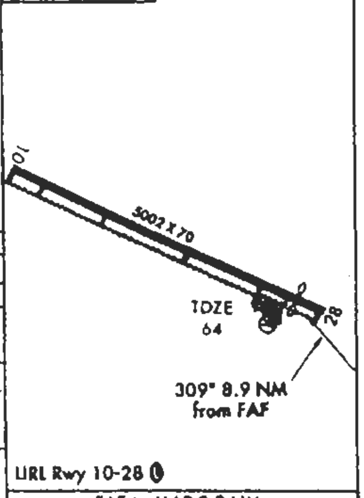


CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

ELEV 73

Rwy 28 ldg 4502'



URL Rwy 10-28 ●

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27.	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45'N-116°16'W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

INTERMEDIATE SEGMENT

The intermediate segment begins at completion of the course reversal. Entry onto the intermediate segment is entry into the approach corridor. The intermediate segment can be visualized as beginning at a point 10 NM from TRM on the 129° radial and extending to the Final Approach Fix. The approach corridor narrows as you proceed inbound to the FAF. During the intermediate segment, final configuration changes are made in preparation for the final segment.

CHART REFERENCE 12

When established wings level on the 264° heading, refer to the profile view to determine the intermediate segment altitude which, for this approach, is 2,000 feet. Also verify the intermediate segment and final segment courses. Ocassionally the final segment course is a dogleg. In this case both are 309°. Lead the movement of the CDI to intercept the 309° course inbound. Using the 6T's:

TURN— Right to 309°.
TIME— Not needed.
TWIST—Not needed.
THROTTLE— Begin descent to 2,000 feet.
TALK— Report if requested.
TRACK— The 309° course inbound.

Now complete the landing checklist. This includes lowering the landing gear in a retractable gear airplane.To prepare for the final segment, ask yourself three questions: How low? How long? Which way?

CHART REFERENCE 13

HOW LOW? - What is the MDA? Refer to the minimums section for the type of landing and your airplane approach category. If you will be landing on RWY 28, a STRAIGHT-IN LANDING, the MDA is 780 feet (assuming you have the Thermal altimeter setting). If landing on RWY 10, the circling MDA of 820 feet would apply.

CHART REFERENCE 14

HOW LONG? - What is the time to the missed approach point? The distance from FAF to MAP, shown under the airport sketch, is 8.9 NM. At 90 knots, this will take 5 minutes, 56 seconds.

CHART REFERENCE 15

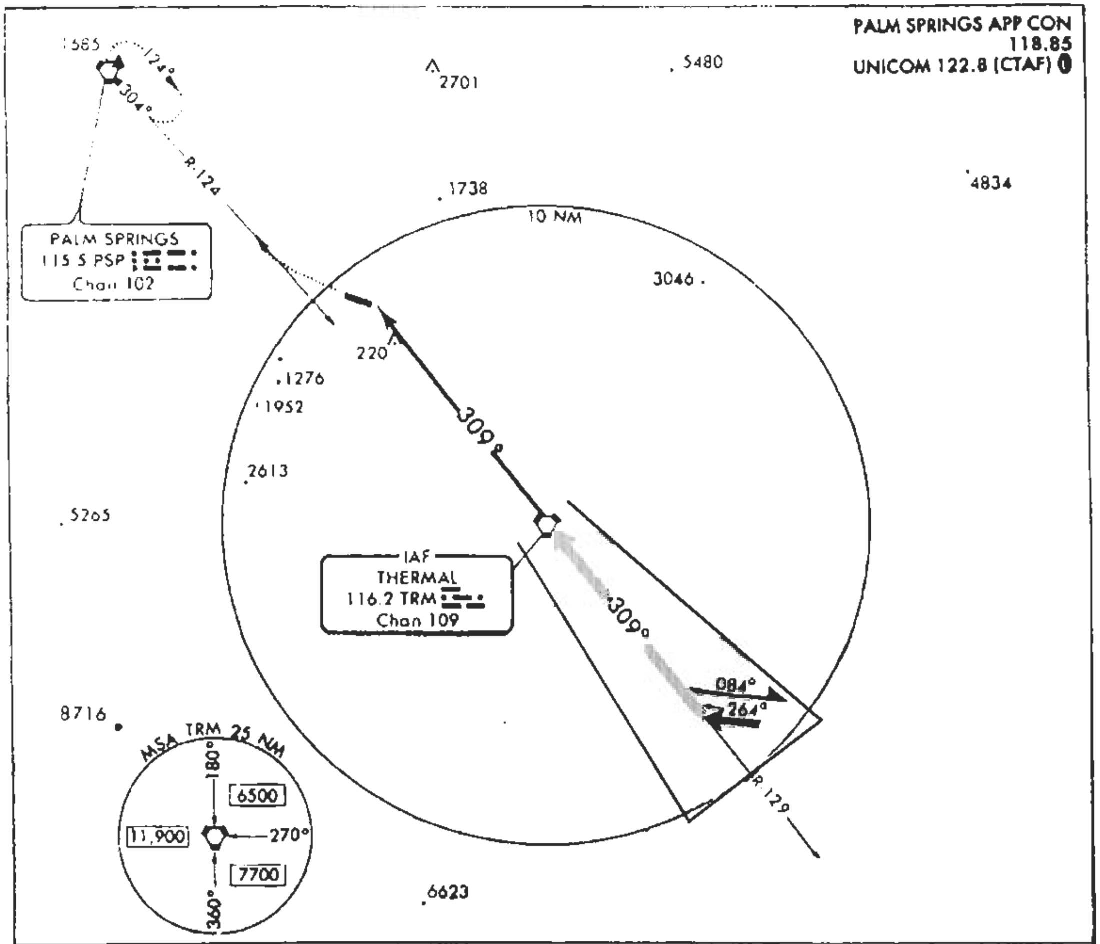
WHICH WAY? - In which direction do you initally fly in the event of a missed approach? The missed approach procedure in the profile view specifies an initial heading of 280°.

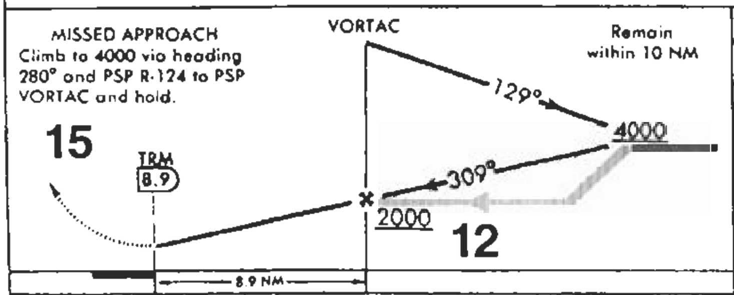
Orig 95201

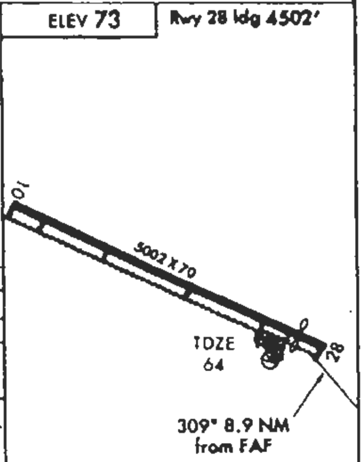
VOR or GPS RWY 28

AL-5848 (FAA)

PALM ... INGS/BERMUDA DU... (UDD)
PALM SPRINGS, CALIFORNIA







CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

13

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45'N-116°16'W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

FINAL SEGMENT

Station passage marks the beginning of the final segment. Use the 6T's:

TURN— Not needed.
TIME— Note time - segment extends for 5:56 (assuming 90K groundspeed).
TWIST—Not needed.
THROTTLE— Begin descent to applicable MDA.
TALK— Report "VOR INBOUND". (FAF inbound is a mandatory report if non-radar).
TRACK— The 309° radial outbound.

NORMAL DESCENT IS 300 FEET/MILE

A descent rate of 700 to 800 feet per minute will assure arrival at the MDA in sufficient time to look for the runway. Develop the habit of noting 1,000 feet, 500 feet, and 100 feet above MDA to aid in leveling off without descending through the MDA. Your goal is to maintain a rate of descent which allows level off at the MDA to be completed at a distance from the runway which will allow a descent to touchdown at a normal rate. For this approach, the MDA is 716 feet above the RWY 28 elevation. A "normal" descent for landing would start about 2 miles from the threshold, which, at 90 knots is 1 and 1/2 minutes. At a minimum, you should level off at MDA a distance from the MAP at least equal to the required visibility for landing. The minimum visibility is 1 statute mile. At 90 knots this is about 40 seconds flying time.

Once level at the MDA, and within a minute and 1/2 of the missed approach point, start including the windshield in your scan. Avoid the urge to transition to visual references too early. What you see straight down is of little value for landing and not necessarily representive of the slant visibility toward the runway. Continue to fly the approach, including the windshield in your scan, until you are sure you have visual reference to the landing runway.

You may continue the approach beyond the missed approach point only if you have the runway or runway environment in sight *and* you determine that the flight visibility is at least equal to the minimum specified for the procedure. The runway environment is the runway, the runway markings, or associated approved lighting aids.

Once the above criteria are met, you may descend below the MDA provided you are in a position from which a normal rate of descent to a landing on the intended runway can be made.

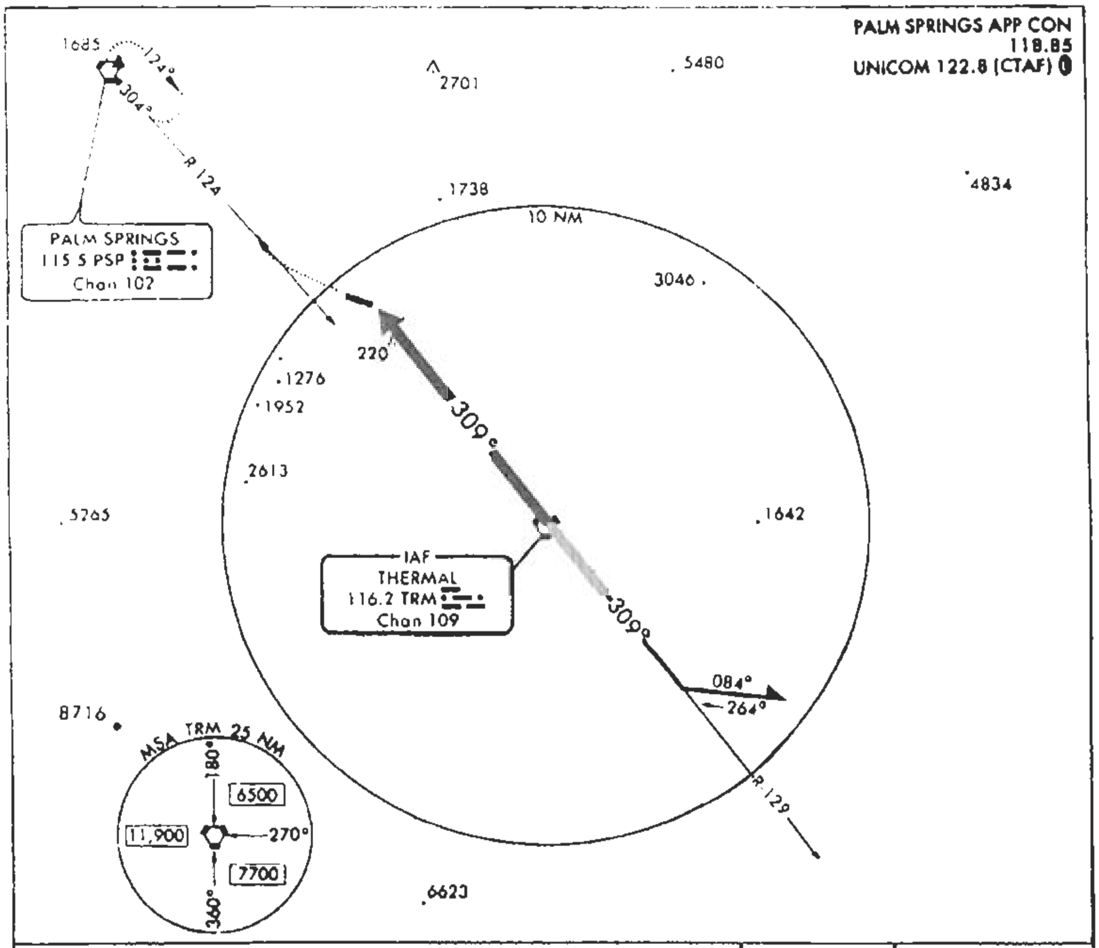
Orig 95201

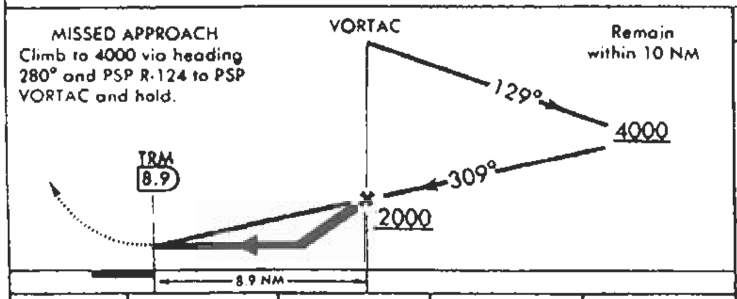
VOR or GPS RWY 28

AL-5848 (FAA)

PALM INGS/BERMUDA DU (UDD)
PALM SPRINGS, CALIFORNIA

PALM SPRINGS APP CON
118.85
UNICOM 122.8 (CTAF) ⓿

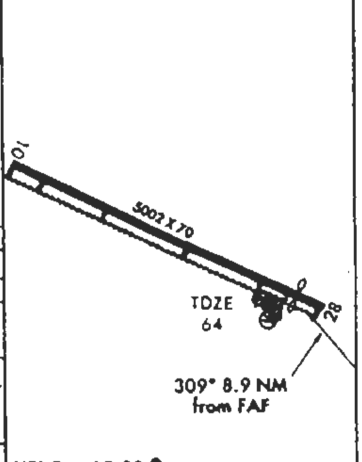



MISSED APPROACH
Climb to 4000 via heading 280° and PSP R-124 to PSP VORTAC and hold.

CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

ELEV 73 | Rwy 28 ldg 4502′



URL Rwy 10-28 ⓿

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45′N-116°16′W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

MISSED APPROACH SEGMENT

The missed approach segment generally begins at the missed approach point and returns you to either the initial segment or the en route system.

A missed approach must begin immediately if the runway environment is not in sight upon arrival at the missed approach point, regardless of altitude. If visual reference is lost while operating beyond the MAP or when operating below the MDA, regardless of position, a missed approach must be initiated immediately.

The most important aspect of the missed approach is to maintain safe control of the airplane. Transition smoothly to a climb, "clean up" the airplane, following the manufacturer's checklist, then comply with the initial heading you determined earlier. Once established in the climb and generally within the missed approach segment protected airspace, you can refer to the details of the procedure as described on the approach chart.

Use the 6T's as a checklist for performing the missed approach. A missed approach report is mandatory, but remember that TALK is next to last on the list.

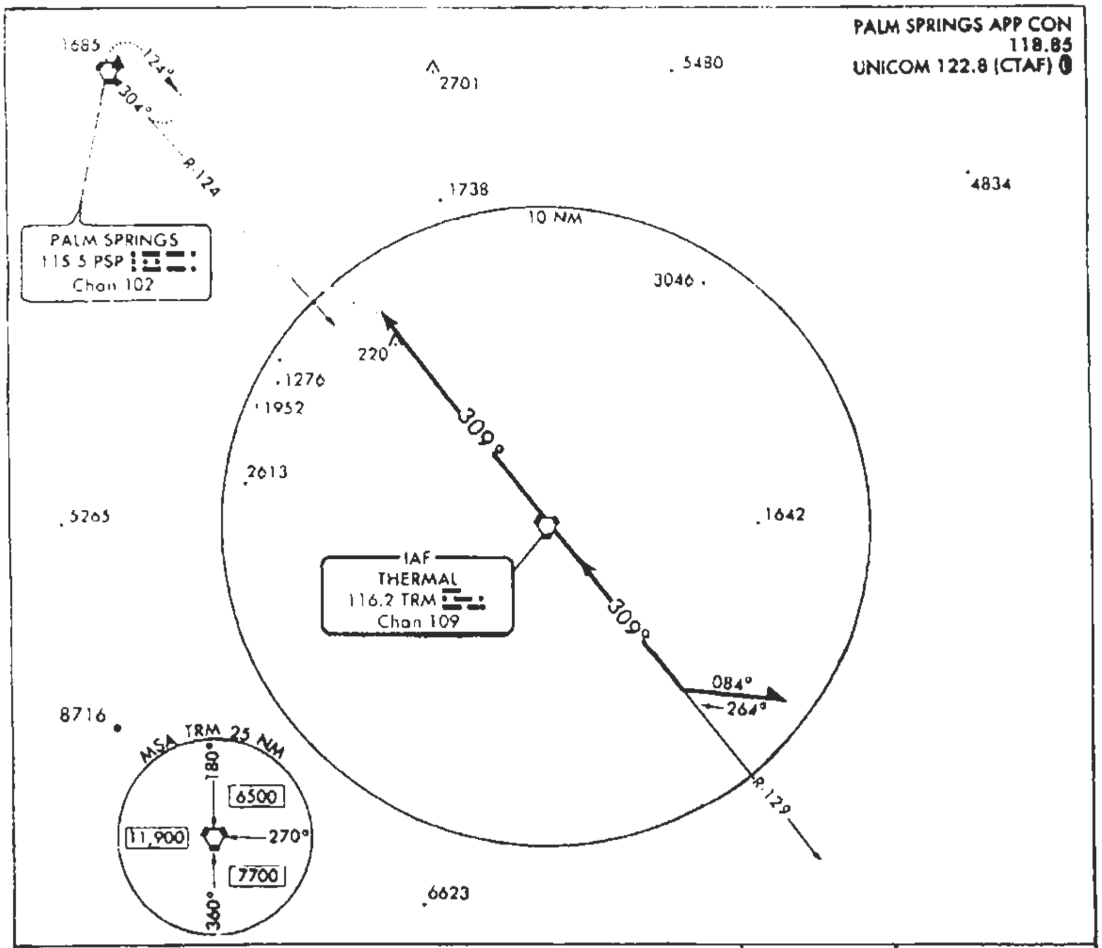
During this full VOR approach, your attention was diverted away from your instrument scan to the en route or approach charts a total of 15 times. Allowing 4 seconds to gather the necessary information each time, this means your attention was diverted from the primary task of flying the airplane for only one minute out of about 15 minutes required to fly the procedure. The importance of knowing what information is needed, when to refer to the chart to get that information, and where to look on the chart for that information cannot be over emphasized.

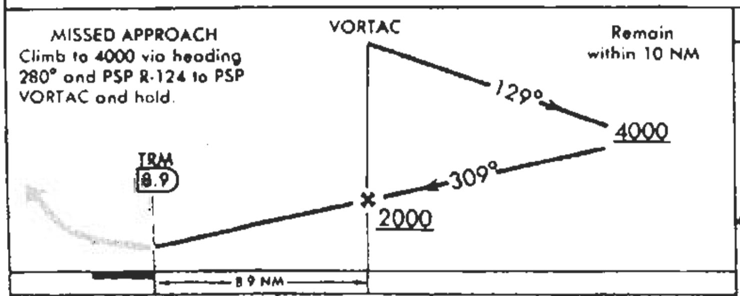
Orig 95201

VOR or GPS RWY 28

AL-5848 (FAA)

PALM SPRINGS/BERMUDA DUNES (UDD)
PALM SPRINGS, CALIFORNIA

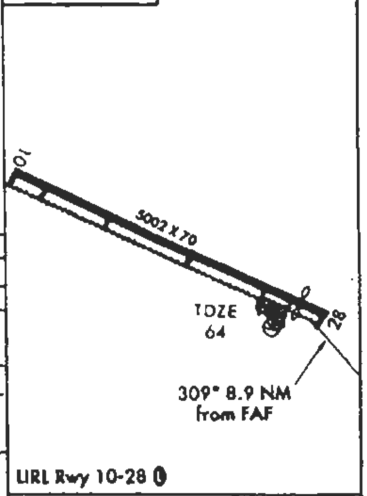




MISSED APPROACH
Climb to 4000 via heading 280° and PSP R-124 to PSP VORTAC and hold.

ELEV 73

Rwy 28 ldg 4502′



URL Rwy 10-28 🄻

CATEGORY	A	B	C	D
S-28	780-1 716 (800-1)		NA	
CIRCLING	820-1 747 (800-1)	820-1¼ 747 (800-1¼)	NA	
PALM SPRINGS ALTIMETER SETTING MINIMUMS				
S-28	840-1 776 (800-1)	840-1¼ 776 (800-1¼)	NA	
CIRCLING	880-1 807 (900-1)	880-1¼ 807 (900-1¼)	NA	

Obtain Thermal altimeter setting on CTAF; When not received, use Palm Springs altimeter setting; When neither received, procedure not authorized. ▽△ NA

FAF to MAP 8.9 NM

Knots	60	90	120	150	180
Min:Sec	8:54	5:56	4:27	3:34	2:58

VOR or GPS RWY 28

Orig 95201

33°45′N–116°16′W

PALM SPRINGS, CALIFORNIA
PALM SPRINGS/BERMUDA DUNES (UDD)

FULL NDB APPROACH

As with VOR approaches, NDB approaches are a combination of orientation, intercepts, and tracking. The approach PROCEDURES do not change. The segments are the same and the techniques for planning and execution are essentially the same. However, because course guidance is provided by a nondirectional beacon, there are certain additional points to consider:

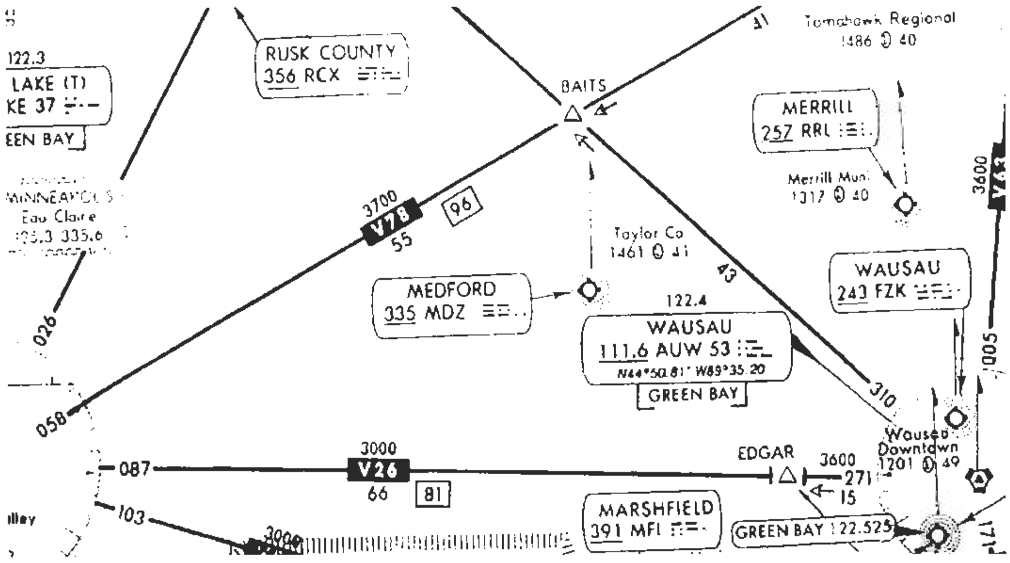
1. The ADF display does not have an "OFF" flag alarm to alert you to receiver or ground station malfunction. After identifying the station, set the receiver volume so that the NDB identifier is still audible. Loss of the identifier is an indication of usable signal loss.

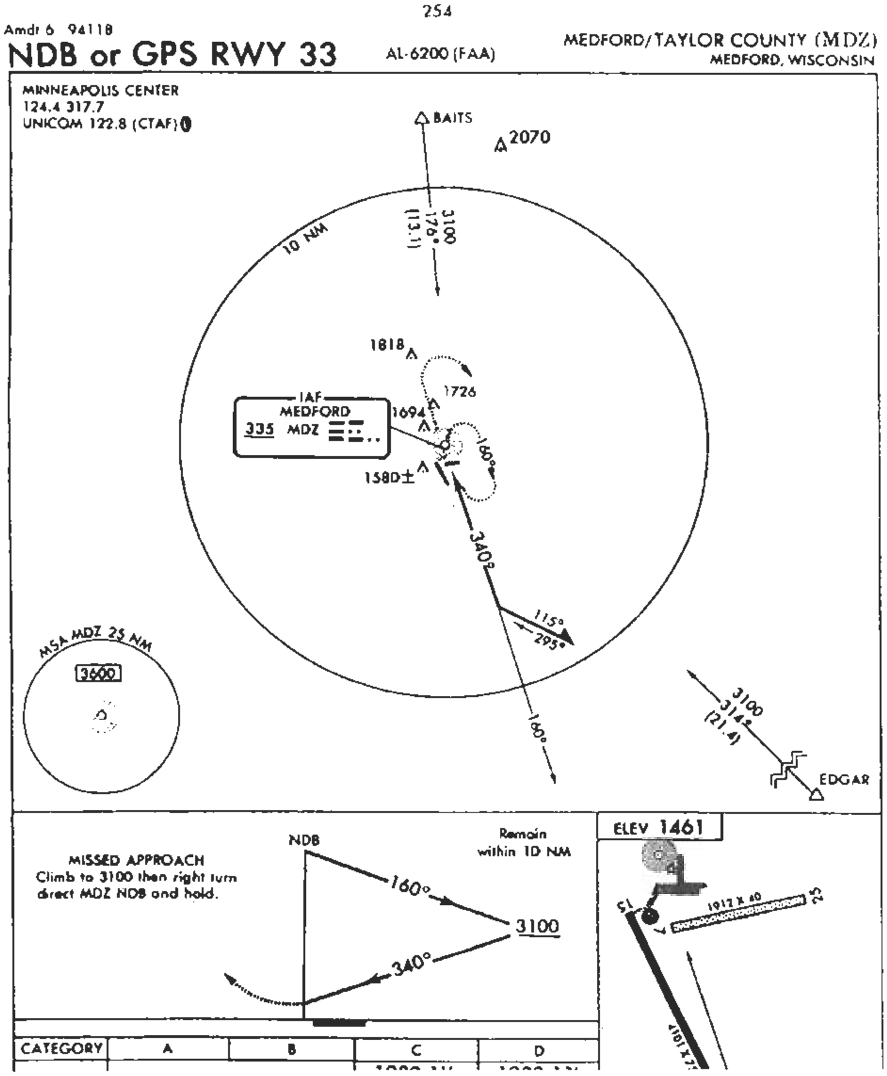
2. The accuracy of an NDB approach depends entirely on the accuracy of your heading indicator. Reset the HI to match the magnetic compass immediately before beginning the approach. Recheck the HI against the magnetic compass after every major turn.

3. The ADF bearing pointer tends to "wander" when close to the station. Avoid overcontrolling or "chasing the needle" when close to the station.

The chart excerpts to the right illustrate a typical NDB approach. Note that the facility (MDZ NDB) is not part of the en route structure, but lies off the airways. For this reason, there are published terminal routes connecting en route fixes with the IAF. Two such terminal routes are shown in the plan view of the approach chart, the BAITS transition and the EDGAR transition. In each case, the transition course, distance, and minimum altitude are indicated in the plan view.

Another feature of this particular approach is that one approach segment is missing. Because the MDZ NDB is on the airport, there is no intermediate segment. Note in the profile view that there is no final approach fix designated for this procedure. Upon completion of the procedure turn (initial segment), you are established immediately on the final segment. This configuration is not unique to NDB approaches. A VOR approach based on a VOR or VORTAC located on the field would look the same. Conversely, an NDB approach based on a facility located off the airport would usually have an intermediate segment

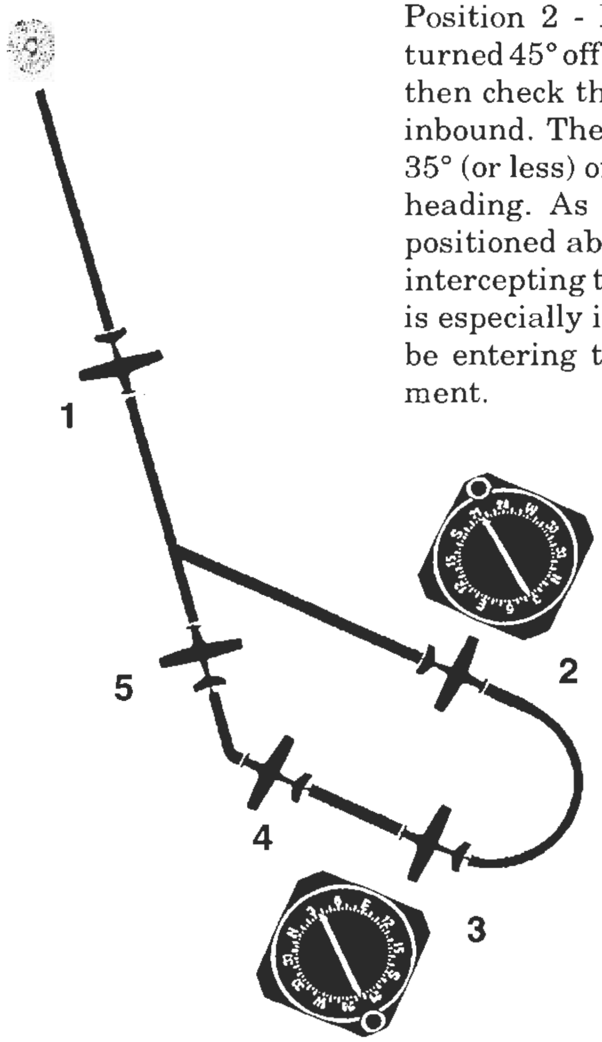

RUSK COUNTY
356 RCX
122.3
LAKE (T)
KE 37
EEN BAY
MINNEAPOLIS
Eau Claire
BAITS
Tomahawk Regional
1486 40
MERRILL
257 RRL
Merrill Muni
1317 40
3600
V63
3700
V78
55
96
Taylor Co
1461 41
43
MEDFORD
335 MDZ
122.4
WAUSAU
111.6 AUW 53
N44°50.81' W89°35.20
GREEN BAY
WAUSAU
243 FZK
005
026
058
310
087
3000
V26
66
81
EDGAR
3600
271
15
Wausau Downtown
1201 49
103
MARSHFIELD
391 MFI
GREEN BAY 122.525
171


254
Amdt 6 94118
NDB or GPS RWY 33
AL-6200 (FAA)
MEDFORD/TAYLOR COUNTY (MDZ)
MEDFORD, WISCONSIN
MINNEAPOLIS CENTER
124.4 317.7
UNICOM 122.8 (CTAF)
BAITS
2070
10 NM
3100
176°
(13.1)
1818
1726
IAF
MEDFORD
335 MDZ
1694
160°
1580±
340°
115°
295°
160°
MSA MDZ 25 NM
3600
3100
314°
(21.4)
EDGAR
MISSED APPROACH
Climb to 3100 then right turn direct MDZ NDB and hold.
NDB
Remain within 10 NM
160°
3100
340°
ELEV 1461
15
33
1912 X 60
4101 X 7
CATEGORY
A
B
C
D

When making a full NDB approach, there are several key points during the procedure turn where you should verify the position of the ADF bearing pointer.

Position 1 - You are outbound on the initial segment. The heading is 160° and the bearing pointer is on the tail (180°) of the airplane.

Position 2 - Beginning the procedure turn, you have turned 45° off course. Continue this heading for 1 minute, then check the bearing pointer *before* starting the turn inbound. The bearing pointer should show the station 35° (or less) off the tail. If not, continue on the outbound heading. As with a VOR approach, you want to be positioned about 10° off the course in order to allow for intercepting the course inbound without overshoot. This is especially important since, on this approach, you will be entering the approach corridor on the FINAL segment.



Position 3 - When you determine you are at least 10° off course, turn back inbound to intercept the final segment. The published procedure turn heading is a 45° intercept. As soon as you complete the turn, verify that the ADF bearing pointer is at a position less than 45° off the nose. If it is less, you are in great shape. If the bearing pointer is already at 45° or more off the nose, you have flown through the course.

Position 4 - Begin the turn into the corridor when the bearing pointer indicates 45° (minus lead) off the nose.

Position 5 - The intercept is complete when the heading equals the course and the bearing pointer is on the nose (0°). Apply your bracketing technique to stay on course during descent to the MDA.

When the facility is on the airport, the MAP is indicated by station passage.

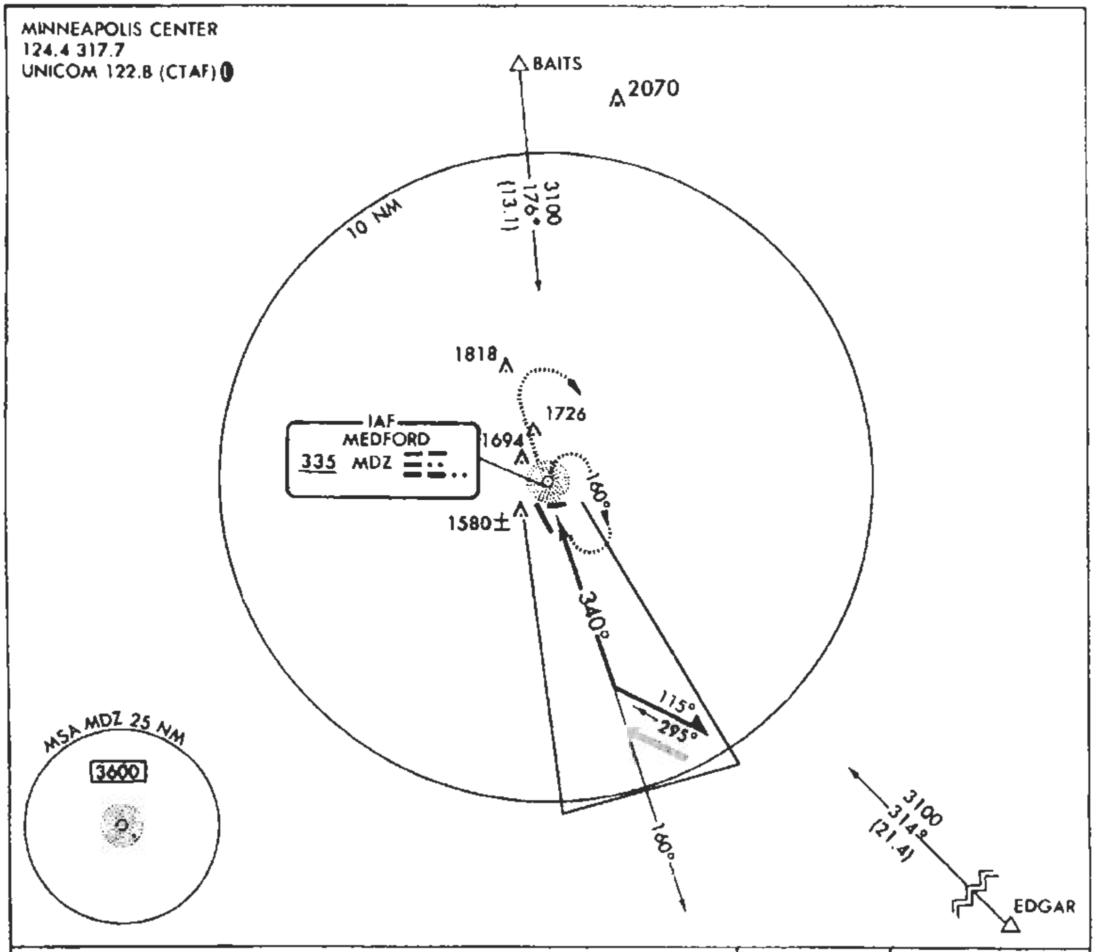
Amdt 6 94118

NDB or GPS RWY 33

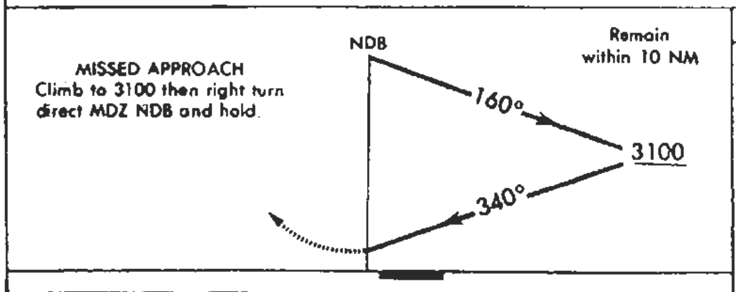
AL-6200 (FAA)

MEDFORD/TAYLOR COUNTY (MDZ)
MEDFORD, WISCONSIN

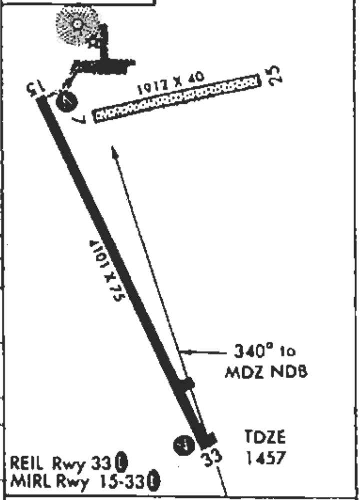
MINNEAPOLIS CENTER
124.4 317.7
UNICOM 122.8 (CTAF) Ⓛ



MISSED APPROACH
Climb to 3100 then right turn direct MDZ NDB and hold.



ELEV 1461



REIL Rwy 33 Ⓛ
MIRL Rwy 15-33 Ⓛ

CATEGORY	A	B	C	D
S-33	1980-1 523 (600-1)		1980-1½ 523 (600-1½)	1980-1¾ 523 (600-1¾)
CIRCLING	1980-1 519 (600-1)		1980-1½ 519 (600-1½)	2040-2 579 (600-2)
WAUSAU ALTIMETER SETTING MINIMUMS				
S-33	2100-1 643 (700-1)		2100-1¾ 643 (700-1¾)	2100-2 643 (700-2)
CIRCLING	2100-1 639 (700-1)		2100-1¾ 639 (700-1¾)	2140-2¼ 679 (700-2¼)

Obtain local altimeter setting on CTAF; when not received, use Wausau altimeter setting. ▽Ⓐ NA

Knots	60	90	120	150	180
Min:Sec					

NDB or GPS RWY 33

45°06'N – 90°18'W

MEDFORD, WISCONSIN
MEDFORD/TAYLOR COUNTY (MDZ)

FULL ILS APPROACH

The ILS (Instrument Landing System) is the primary instrument approach facility in use today. All major airports have one or more ILS installations and many secondary airports are also equipped. At any airport with additional approach facilities (VOR or NDB), you will normally be cleared for the ILS approach unless you request another type, or if landing direction makes another approach more practical.

The techniques for making a full ILS approach (or a LOC or a LOC (BC) approach) are essentially the same as those for a full VOR or NDB approach. Even though an ILS approach consists of a transition followed by the initial, intermediate, final, and missed approach segments, the ILS is, by its design, unique and several points require consideration.

To illustrate these differences, assume you are arriving at Long Island Mac Arthur Airport (ISP) from over the Calverton (CCC) VORTAC, expecting the ILS RWY 6 approach.

TRANSITION

While the VOR system serves both en route and approach navigation needs, the ILS is designed only as a precision approach to a particular runway. You arrive in the terminal area, then, via the VOR airways and must transition to the ILS. The plan view of the approach chart shows the Calverton transition. Following the CCC R-249 for 21.5 NM you will arrive at the IAF. Unlike a VOR or NDB approach, the IAF is not the same facility as the one providing course guidance for the approach procedure. In this example, the IAF is LOKKS LOM (compass locator, outer marker). The ADF should be tuned to 366 kHz, the facility identified and the bearing pointer indication confirmed before beginning the transition. The balance of the navigation radio set-up for the approach is accomplished once you are established on the transition:

1. The localizer facility should be selected on the number one radio. Often, this is the only receiver with glide slope capability.
2. The number two radio should be set to CCC VORTAC for use during the transition and as the missed approach fix.
3. The marker beacon receiver should be armed, and the lights functionally tested.

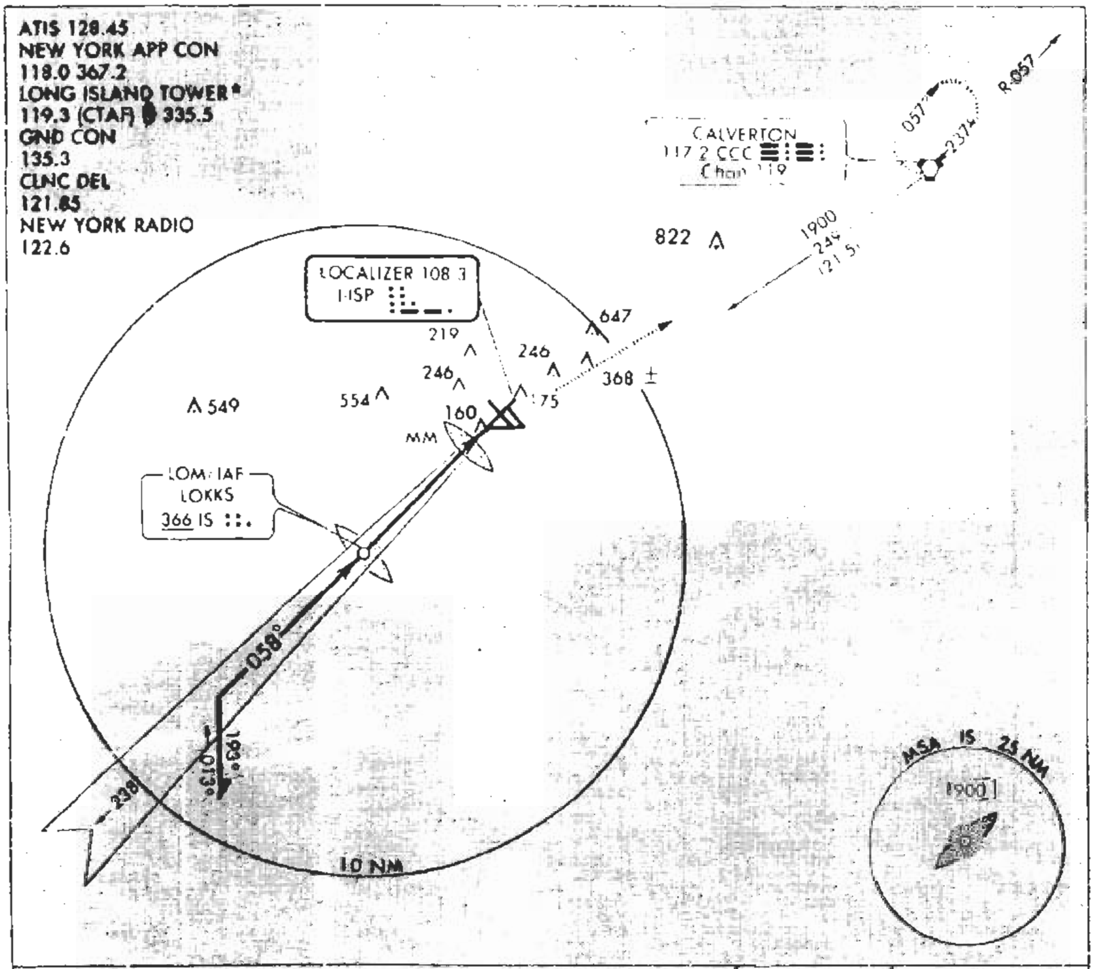
Amdt 21A 95089

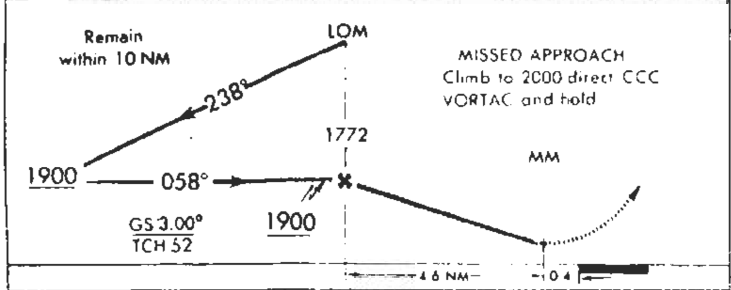
ILS RWY 6

AL-948 (FAA)

ISLIP-LONG ISLAND MAC ARTHUR (ISP)
ISLIP, NEW YORK

ATIS 128.45
NEW YORK APP CON
118.0 367.2
LONG ISLAND TOWER*
119.3 (CTAF) ● 335.5
GND CON
135.3
CLNC DEL
121.85
NEW YORK RADIO
122.6



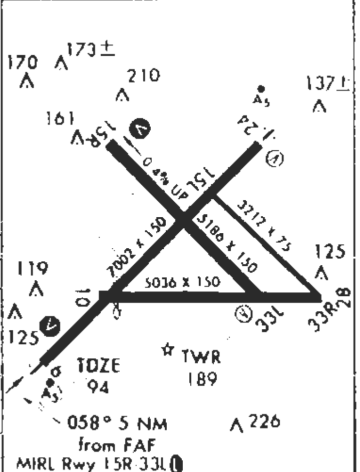


MISSED APPROACH
Climb to 2000 direct CCC VORTAC and hold

CATEGORY	A	B	C	D
S-ILS 6	294-½ 200 (200-½)			
S-LOC 6	400-½ 306 (400-½)			400-¾ 306 (400-¾)
CIRCLING	580-1 481 (500-1)		580-1½ 481 (500-1½)	660-2 561 (600-2)

▽
△ NA

ELEV 99 | Rwy 10 ldg 4671'



MIRL Rwy 15R-33L
HIRL Rwy 6-24
REIL Rwy 33L

FAF to MAP 5 NM

Knots	60	90	120	150	180
Min:Sec	5:00	3:20	2:30	2:00	1:40

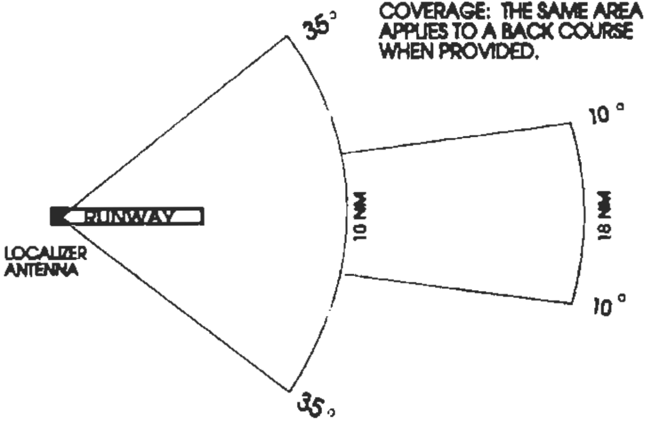
ILS RWY 6

Amdt 21A 9

40°48'N-73°06'W

ISLIP, NEW YORK
ISLIP-LONG ISLAND MAC ARTHUR (ISP)

Revised 0995



NORMAL LIMITS OF LOCALIZER COVERAGE: THE SAME AREA APPLIES TO A BACK COURSE WHEN PROVIDED.

Usable localizer signals are available along the approach course to a distance of 18 NM from the antenna and up to 4,500 feet above the antenna elevation. Proper off course indications are assured only when within 35° of the approach course to a distance of 10 NM and within 10° of the approach course to a distance of 18 NM. This limited service volume may require you to delay localizer facility identification and may cause "OFF" flag alarms to be displayed on the localizer while on the transition. The facility must be identified and usable guidance confirmed before starting the initial segment.

Once cleared for the approach, you descend to 1,900 feet as published for the transition. Then use the 6Ts to plan the initial segment:

TURN— Left to 238°.
TIME— Outbound to remain within 10 NM of IAF.
TWIST— OBS to 238° (if not already set).
THROTTLE— Slow to approach airspeed at 1,900 feet.
TALK— If requested.
TRACK— Outbound (238°) on the *LOCALIZER* course.

The outer marker light and audio tone alert you to arrival at LOKKS. Reversal of the ADF bearing pointer indicates station passage. You now extecute the 6Ts to begin the initial segment.

INITIAL SEGMENT

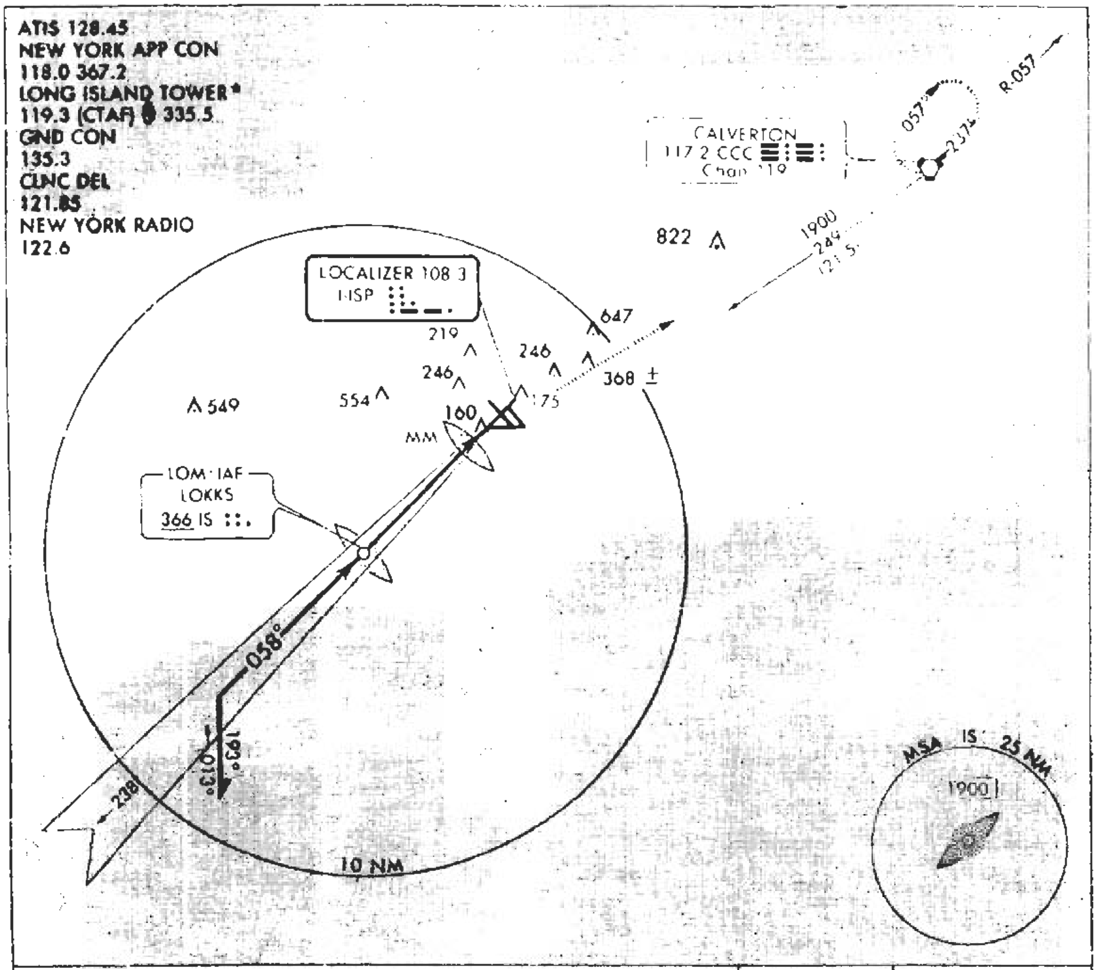
The initial segment (procedure turn) requires you to track outbound on the localizer course. Remember that the localizer, unlike VOR, transmits only one course. It lies along the extended centerline of the runway, creating the FRONT COURSE and BACK COURSE. The FRONT COURSE is the course serving the runway named on the IAP chart (ILS RWY 6). The back course, along the reciprocal runway, is usable only if a procedure is published. The important fact to remember while tracking the localizer is that the CDI centers only when the airplane is on the extended centerline of the runway. The OBS setting has no effect on the CDI indications. Additionally, as with VOR, airplane heading has no affect on CDI indications, other than as it affects ground

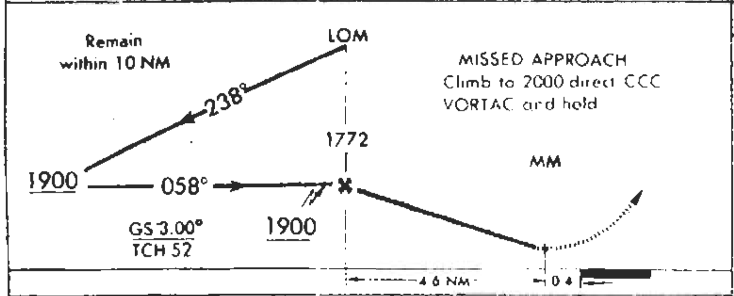
Amdt 21A 95089

ILS RWY 6

AL-948 (FAA)

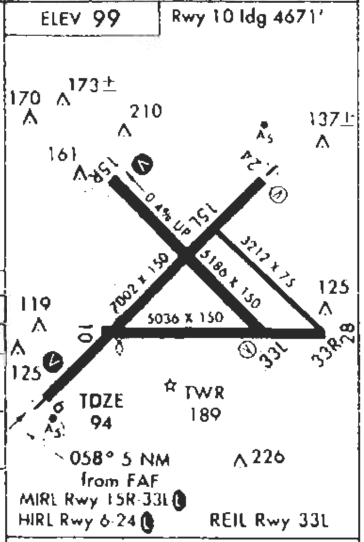
ISLIP/LONG ISLAND MAC ARTHUR (ISP)
ISLIP, NEW YORK





CATEGORY	A	B	C	D
S-ILS 6	294-½ 200 (200-½)			
S-LOC 6	400-½ 306 (400-½)			400-¾ 306 (400-¾)
CIRCLING	580-1 481 (500-1)		580-1½ 481 (500-1½)	660-2 561 (600-2)

▽
△ NA



FAF to MAP 5 NM

Knots	60	90	120	150	180
Min:Sec	5:00	3:20	2:30	2:00	1:40

ILS RWY 6

Amdt 21A 9

40°48'N-73°06'W

ISLIP, NEW YORK
ISLIP/LONG ISLAND MAC ARTHUR (ISP)

track and position relative to the extended runway centerline. Because of this, the CDI appears to work in reverse when flying outbound along the front course, as you are during the initial segment of the full ILS approach. Often this is called "reverse sensing", but the equipment is sensing just fine. What is required is "reverse thinking". At any rate, while flying opposite the intended approach direction, you must bracket the localizer by turning AWAY from the direction the CDI deflects. (This also applies while flying inbound on a back course). The habit of always setting the OBS to the course to be flown places important course heading information in view on the instrument panel rather than leaving it to memory or repeated chart reference.

The localizer course is also significantly narrower than a VOR radial. The CDI is more sensitive, meaning your bracket corrections must be made as sooner and should be smaller than when bracketing a VOR radial.

As with the other types of approaches, completion of the procedure turn is entry into the approach corridor and begins the intermediate segment. When established on the intermediate segment, complete the landing checklist and determine:

How low?— 294 feet (the DH for straight-in landing).
How long?— 3:20 (at 90 kts) to MAP as backup.
Which way?— Turn right to 070° heading.

FINAL SEGMENT

The final segment begins upon intercepting the glide slope at the published altitude (or higher altitude assigned by ATC.) From the profile view of the approach chart you note that glide slope intercept occurs at 1,900 feet just before crossing the LOM. This point marks the beginning of the final segment for the precision approach. If the glide slope is inoperative or not used, then the LOM serves as the FAF for the nonprecision localizer approach.

As the glide slope needle centers, begin descent at a rate appropriate to the glide slope angle and your estimated ground speed. At 90 knots groundspeed, a 3° glide slope requires a rate of descent of about 500 feet per minute. Crossing the LOM on the glide path, note the time, cross check that your altimeter indicates approximately 1,770 feet, and report as needed to ATC.

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ILS RWY 6

AL-948 (FAA)

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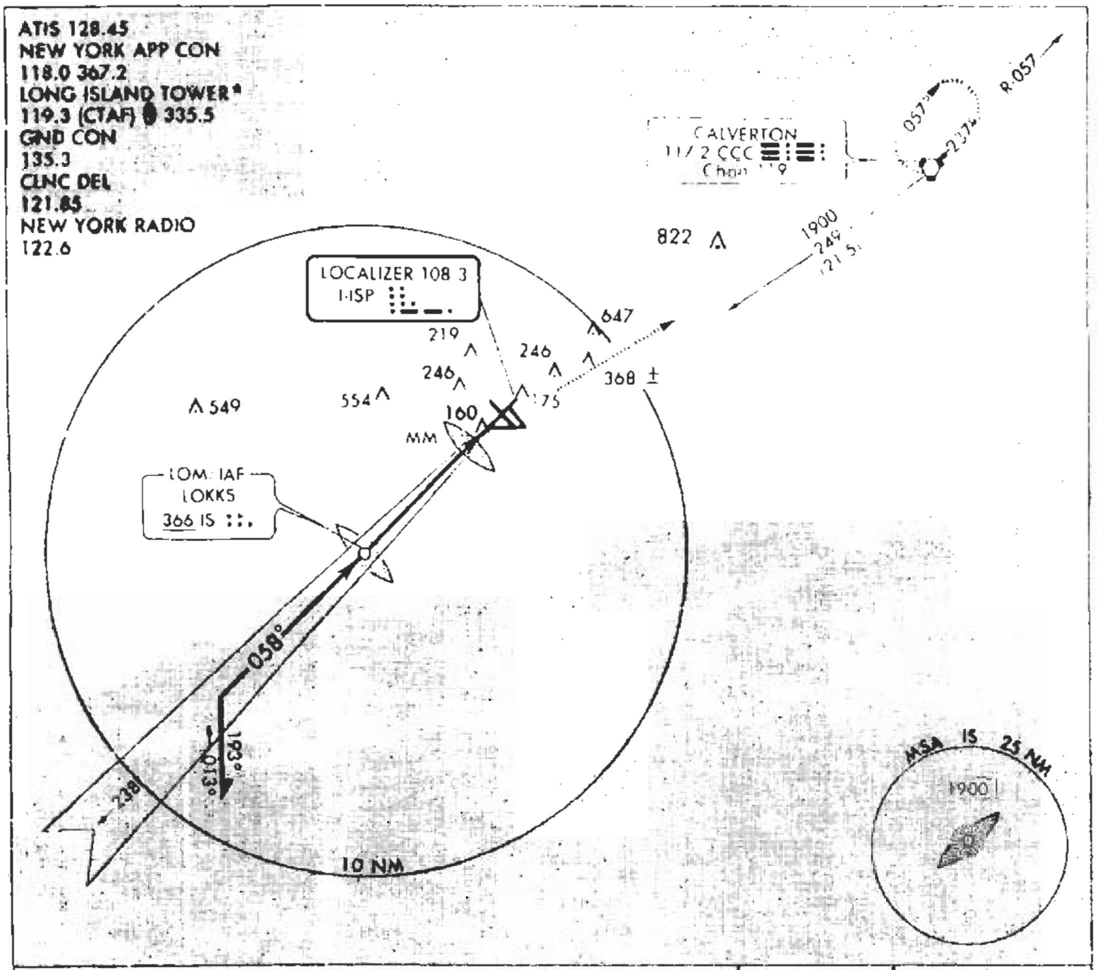
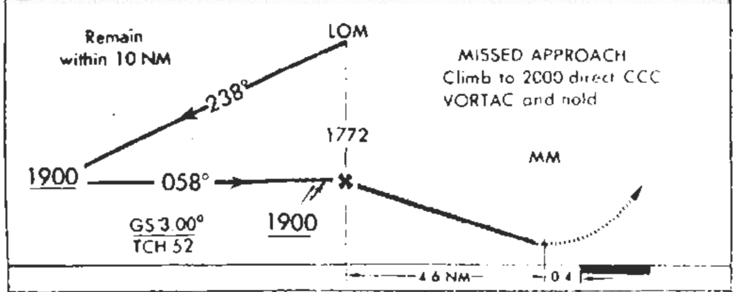
ATIS 128.45
NEW YORK APP CON
118.0 367.2
LONG ISLAND TOWER*
119.3 (CTAF) ● 335.5
GND CON
135.3
CLNC DEL
121.85
NEW YORK RADIO
122.6





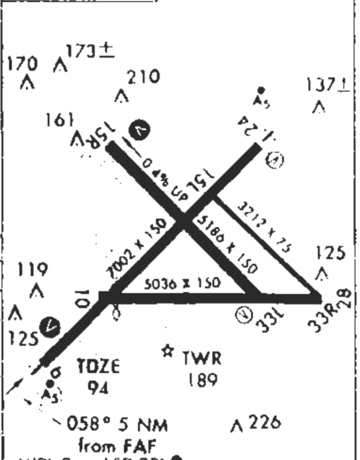
MISSED APPROACH
Climb to 2000 direct CCC
VORTAC and hold

CATEGORY	A	B	C	D
S-ILS 6	294-½ 200 (200-½)			
S-LOC 6	400-½ 306 (400-½)			400-¾ 306 (400-¾)
CIRCLING	580-1 481 (500-1)		580-1½ 481 (500-1½)	660-2 561 (600-2)

▽
△ NA

ELEV 99

Rwy 10 ldg 4671'



058° 5 NM from FAF
MIRL Rwy 15R-33L
HIRL Rwy 6-24
REIL Rwy 33L

FAF to MAP 5 NM

Knots	60	90	120	150	180
Min:Sec	5:00	3:20	2:30	2:00	1:40

ILS RWY 6

Amdt 21A 9

40°48'N-73°06'W

ISLIP, NEW YORK
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Bracketing the glide slope is similar to bracketing the localizer course, except that you will use the vertical speed indicator rather than the heading indicator as a reference. If, for example, your initial rate of descent of 500 feet per minute causes you to descend below then glide slope, adjust the pitch attitude to reduce the rate of descent to 300 feet per minute. If this reduced rate of descent returns you to the glide slope, then you have established the initial bracket rates. Establish a rate halfway between the two— 400 feet per minute. Time will tell if this rate is too little or too much. Adjust the brackets accordingly until the correct rate of descent for existing conditions is found.

Do not allow yourself to get so caught up in the process of bracketing the localizer and glide slope that you ignore the altimeter. "Callouts" at 1,000 feet, 500 feet, and 100 feet above decision height should become habit.

DESCENT BELOW DH

Arrival at decision height is simultaneously arrival at the missed approach point. In order to continue the approach below the decision height you must—

1. have the runway environment in sight;
2. determine that the flight visibility is at or above the minimum prescribed for the approach; and
3. be in a position from which a landing can be made using normal maneuvers.

Avoid the common tendency to reduce power and increase the rate of descent upon sighting the runway. Remember that most glide slope installations provide a threshold crossing height (TCH) of about 50 feet and that the touchdown aim point is anywhere from 500 to 1000 feet down the runway, depending on the runway length.

If at the DH, or any time when below the DH, any one of the three criteria for continuing the descent to a landing are not met, execute the missed approach.

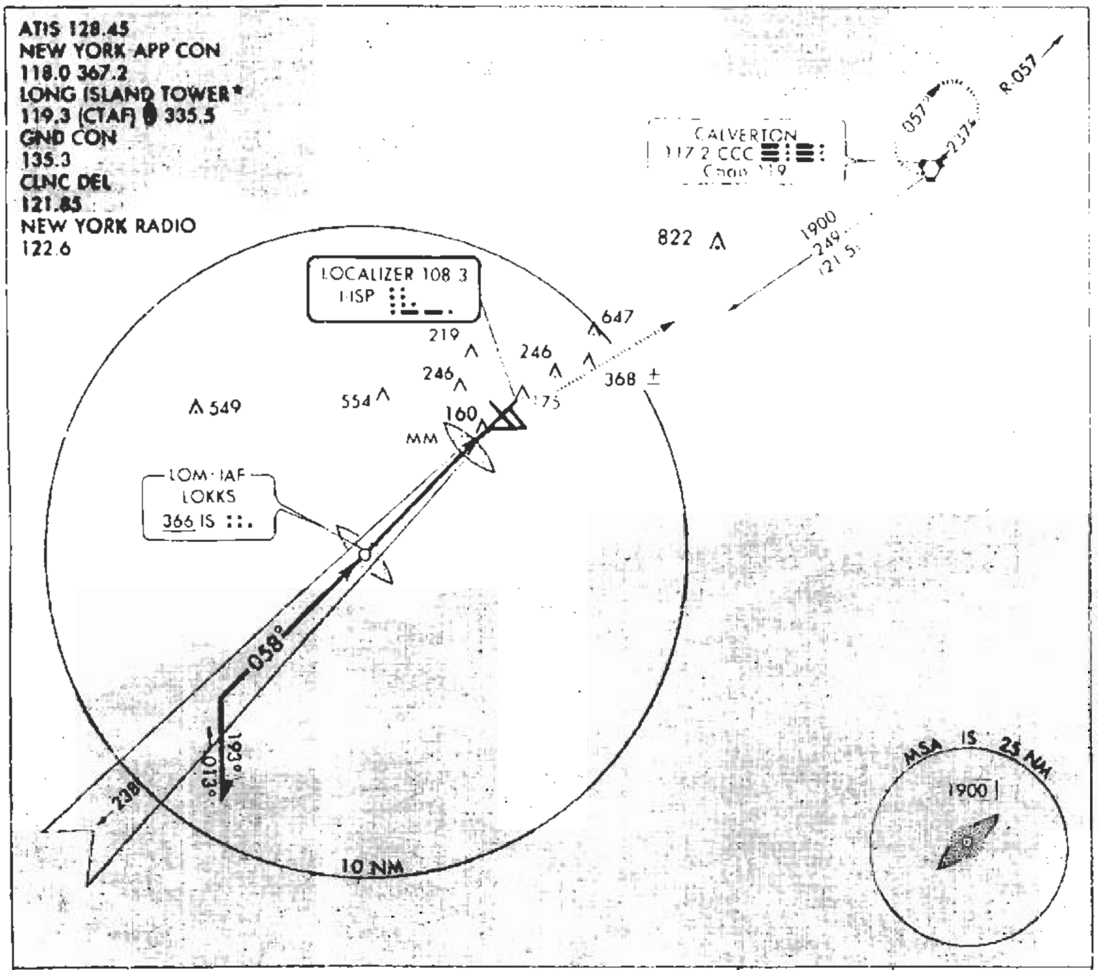
An ILS may be flown when the landing runway is not the straight-in runway. In this case, the approach becomes a nonprecision localizer approach, although ATC will refer to it as the ILS, since that is the title printed on the approach chart. Descent on final will be to the published circling MDA.

Amdt 21A 95089

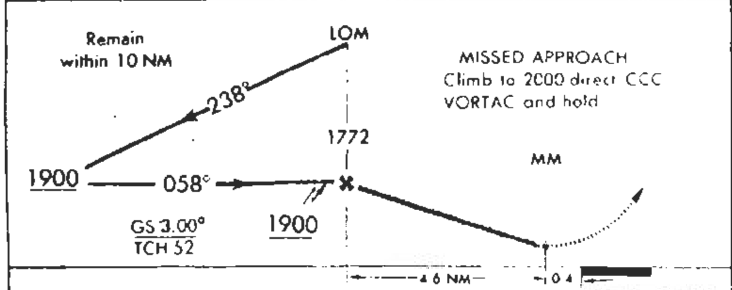
ILS RWY 6

AL-948 (FAA)

ISLIP LONG ISLAND MAC ARTHUR (ISP)
ISLIP, NEW YORK



ATIS 128.45
NEW YORK APP CON
118.0 367.2
LONG ISLAND TOWER*
119.3 (CTAF) 🄻 335.5
GND CON
135.3
CLNC DEL
121.85
NEW YORK RADIO
122.6

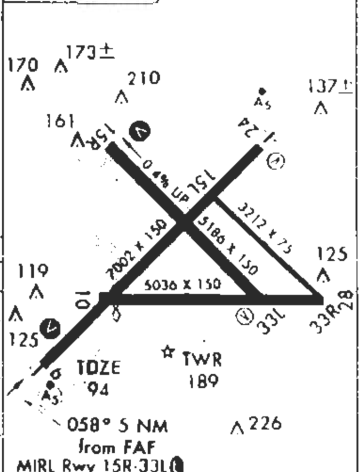


MISSED APPROACH
Climb to 2000 direct CCC
VORTAC and hold

CATEGORY	A	B	C	D
S-ILS 6	294-½ 200 (200-½)			
S-LOC 6	400-½ 306 (400-½)			400-¾ 306 (400-¾)
CIRCLING	580-1 481 (500-1)		580-1½ 481 (500-1½)	660-2 561 (600-2)

▽
△ NA

ELEV 99 | Rwy 10 ldg 4671′



058° 5 NM
from FAF
MIRL Rwy 15R-33L 🄻
HIRL Rwy 6-24 🄻
REIL Rwy 33L

FAF to MAP 5 NM

Knots	60	90	120	150	180
Min:Sec	5:00	3:20	2:30	2:00	1:40

ILS RWY 6

Amdt 21A 9

40°48′N-73°06′W

ISLIP, NEW YORK
ISLIP/LONG ISLAND MAC ARTHUR (ISP)

PILOT RESPONSIBILITY

The responsibilities of a pilot with respect to ATC clearances are spelled out in the FARs and the AIM. The responsibilities of the pilot and the controller intentionally overlap in many areas providing a degree of redundancy. This overlapping responsibility is expected to compensate for errors or omissions that may affect safety. However, as PIC you must know that you are directly responsible for, and the final authority as to the safe operation of your aircraft. NEVER fully place the responsibility for the operation of your aircraft in the hands of a controller. ALWAYS be aware of where you are and what the effect of a controller's instructions will be on the operation of your airplane. If there is ever any doubt of your ability to comply, or of the safety of complying with an ATC clearance, always bring that concern to the attention of the controller. Never allow ATC to talk you into a course of action that you deem to be unsafe. On the other hand, as much as possible, be cooperative. There is a distinction between being inconvenienced (which, unfortunately, is a part of instrument flying) and being unsafe.

Specific pilot responsibilities concerning ATC clearances are:

1. Acknowledge receipt and understanding of an ATC clearance. Use your aircraft call sign with each transmission. Read back all clearances containing altitudes or headings.
2. Request clarification or amendment, as appropriate, any time a clearance is not fully understood or is considered unacceptable from a safety standpoint.
3. Promptly comply with an ATC clearance upon receipt, except as necessary to comply with an emergency.

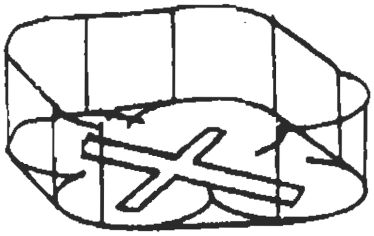
AIM Section 5 covers the pilot and controllers responsibilities under various situations. It would be worth studying in some detail to understand the interrelationship of these responsibilities.

APPROACH MINIMUMS

Determining the applicable minimums for any given approach requires knowledge of several items, one of which is the aircraft approach category that applies to your airplane. Approach minimums are based, in part, upon the speed at which the approach is flown; the idea being, the faster the approach, the higher the minimums (usually it is a higher visability that is required). The approach categories are based on 1.3 times the stall speed, at gross landing weight, in the landing configuration.

Range of $1.3V_{SO}$	Approach Category
0-90 kts	A
91-120 kts	B
121-140 kts	C
141-165 kts	D
Above 165 kts	E

A particular airplane fits in only one approach category. However, if you are maneuvering at a speed higher than the upper limit of your approach category, use the minimums for the category that is appropriate to the higher speed. A category A airplane circling to land at 100 knots, for example, should use category B circling minimums. This is logical since the radius of turn is directly proportional to groundspeed. Higher speeds during circling maneuvers require more room, and possibly more altitude and/or visibility.



Circling Approach Obstacle Clearance Area

Category	Radius
A	1.3 miles
B	1.5 miles
C	1.7 miles
D	2.3 miles
E	4.5 miles

Another factor in determing applicable minimums is whether you will land straight-in or circle to land. Since circling mininums provide obstacle protection in a much larger area, they are often higher than the straight-in minimums. You need to plan for the circle-to-land maneuver as early as possible, the best time being when you received the weather information on the transition segment.

One other factor is the source of the altimeter setting. Many approaches have minimums that have to be adjusted if a local altimeter setting cannot be obtained. If a tower closes at night and the next nearest altimeter reading is some distance away, the minimums will be higher to account for the likely difference in the altimeter setting at the landing airport.

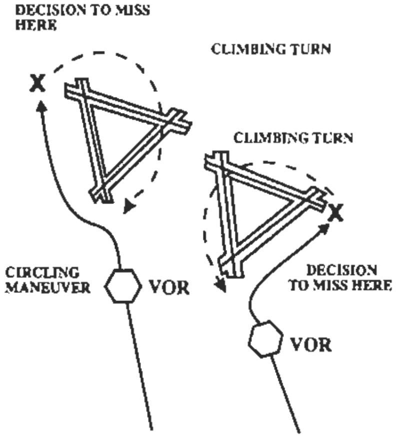
Temporary changes to approach minimums, or permanent changes that occur before a new chart being published, are disseminated as FDC NOTAMs. FDC NOTAMs can be obtained from FSS, DUAT, or may be broadcast on ATIS. They are regulatory in nature and replace the published chart minimums.

CIRCLE-TO-LAND MANEUVERS

If the active runway is other than that designated as the straight-in runway on the instrument approach procedure, a circling maneuver will be required. Maneuvering to land on a parallel runway is considered to be a circling maneuver unless side step minimums are published for that parallel runway.

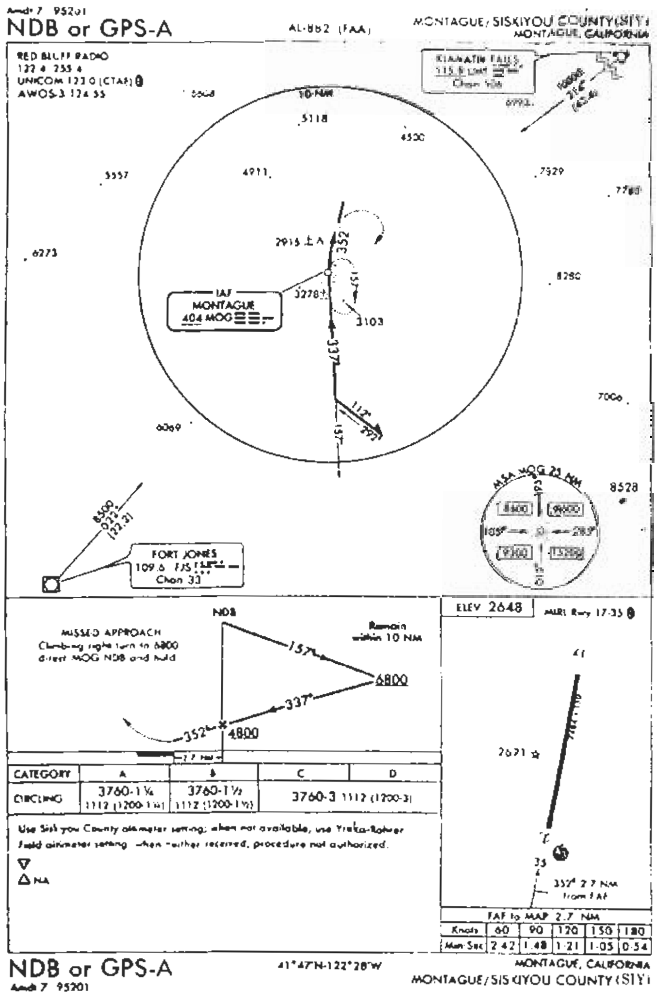
There are three basic rules for circling maneuvers. First, NEVER descend below the circling MDA until you have maneuvered into a position from which a *normal* descent to a *normal* landing on the intended runway can be made land. Since circling MDAs are generally well below the normal traffic pattern altitude, descent must usually be delayed until turning final. If landing flaps are to be used, their extension should be delayed until the descent to the runway is started.

The second rule is— if, after passing the missed approach point you lose sight of the airport, (except if due to normal banking maneuvers) or after commencing descent from MDA you lose sight of the runway of intended landing, you must execute a missed approach. The "traffic pattern" you use during the circle-to-land maneuver is entirely up to you. Unless ATC or traffic requires you to circle in a specific direction, you can use whatever maneuvering you deem appropriate. However, certain considerations make some maneuvers more practical than others. Especially under low visibility conditions, your choice of maneuvering should be such that you are most likely to be able to keep the runway in sight at all times.



The third rule is, if a missed approach becomes necessary during the circling maneuver, turn to a heading that will take you over the top of the airport as you gain altitude. The published missed approach is based upon starting the missed approach segment at the MAP. Once you have gone beyond that point the published procedure no longer applies. Turning over the center of the airport will keep you within protected airspace as you transition to the missed approach climb. At circling minimums, you are guaranteed at least 300 feet of obstacle clearance within the designated circling area.

Not all instrument approach procedures designate a straight-in runway. Straight-in minimums are published provided final approach descent gradient and missed approach climb gradient criteria are met and the final approach course is aligned within 30 degrees of the runway centerline. Procedures which do not meet these requirements are published with circling minimums only. The procedures is identified by letter, rather than a runway number (VOR-A, NDB-B, etc.). Even though straight-in minimums are not published for a particular runway, you may land "straight-in" provided you have the landing runway in sight in sufficient time to safely make a straight-in landing and you receive any necessary ATC clearance to land.



CATEGORY	A	B	C	D
CIRCLING	3760-1¼ 1112 (1200-1¼)	3760-1½ 1112 (1200-1½)	3760-3 1112 (1200-3)	

Use Siskiyou County altimeter setting; when not available, use Yreka-Rohrer Field altimeter setting. When neither received, procedure not authorized.

▽
△ NA

FAF to MAP 2.7 NM

Knots	60	90	120	150	180
Min:Sec	2:42	1:48	1:21	1:05	0:54

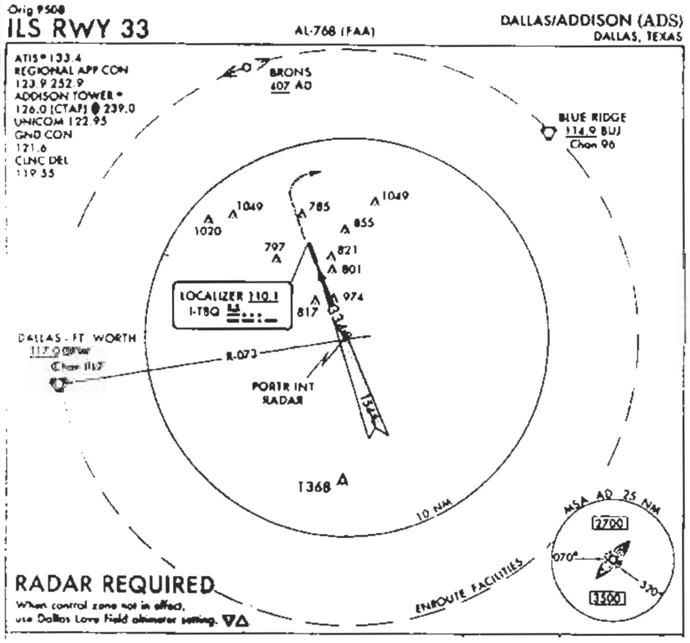
STRAIGHT-IN APPROACHES

During a full approach, the procedure turn serves to position the airplane inbound in the approach corridor. Accomplishing this with a course reversal is time consuming. A straight-in approach is one in which the procedure turn is replaced with another method of positioning the airplane inbound in the approach corridor. The purpose of a straight-in approach is to save time. Traffic flow into an airport is increased by eliminating the need for aircraft to make a procedure turn.

You must not confuse the term STRAIGHT-IN APPROACH with the term STRAIGHT-IN LANDING. A straight-in LANDING means that landing is accomplished on the runway designated by the instrument approach procedure as the straight-in runway. A straight-in APPROACH means the need for a procedure turn has been eliminated.

The fours methods of eliminating a procedure turn are:

1. Radar vectors.
2. A NoPT transition.
3. A DME arc.
4. An authorized hold at the approach fix.



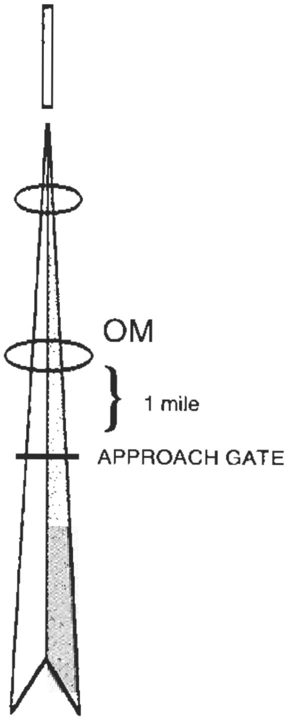
When radar is available for approach control services, arriving IFR pilots can expect to be vectored to the approach course of published non-radar approaches (ILS, LOC, VOR, NDB, etc.). The availability of radar is indicated in the A/FD by the symbol Ⓡ and on IAP charts by the notation "ASR". In high traffic volume areas, the procedure turn is often not charted and the approach procedure indicates "RADAR REQUIRED".

From the advance approach information you determine the method of transition from the en route phase of flight to the approach phase. The statement "expect radar vectors" on the ATIS or stated by the controller tells you clearly how the transition will be made.

RADAR VECTORS

Radar vectors not only serve as the transition but, by eliminating the need for the procedure turn, also serve as the initial approach segment. The controller will assign headings and altitudes to establish sequencing and separation of traffic, and to position each arriving aircraft at the appropriate point to proceed inbound in the approach corridor. The controller will state you can expect vectors to the "final approach course". Actually the vectors will terminate, and you will resume responsibility for navigation, at essentially the same place a procedure turn would have placed you— on an intercept heading to the intermediate segment of the approach. Specifically, the controller's reference point for vectoring is referred to as the APPROACH GATE.

Approach Gate—An imaginary point used within ATC as a basis for vectoring aircraft to the final approach course. The gate will be established along the final approach course 1 mile from the outer marker on the side away from the airport for precision approaches and 1 mile from the final approach fix on the side away from the airport for nonprecision approaches. In either case, when measured along the final approach course, the gate will be no closer than 5 miles from the landing threshold.



Begin your radio set-up for the approach as soon as you begin the transition. Maintaining positional awareness throughout the vectoring process is vitally important. You know where the vectors started, and you know basically where the vectors will end. Keeping track of your progress between those two points can be accomplished in several ways. If a compass locator is available, use the ADF to constantly indicate bearing to the station. If available, use a nearby VOR to determine position periodically during the vectors. You can even estimate your position based on heading, groundspeed, and time. When no other means are available, ask the controller. The important point is, *never allow yourself to lose track of your position* while being vectored.

ATC will not assign an altitude below the minimum vectoring altitude (MVA) for your position. Unfortunately, MVAs are not published on IAP charts. If you are assigned an altitude below the initial segment altitude, or below the MSA, clarify the altitude with ATC.

ATC is required to vector aircraft to intercept the approach course at least 2 miles outside the approach gate. *EXCEPTION:* If the ceiling is at least 500 feet above the MVA and the visibility is at least 3 miles, expect to intercept the approach course at the approach gate.

The controller will issue approach clearance only when you are positioned properly to begin the approach. Generally, the last vector heading and the approach clearance are issued together:

> "CESSNA 345, 3 MILES FROM THE OUTER MARKER, TURN RIGHT HEADING 040, CLEARED ILS RUNWAY 6 APPROACH, MAINTAIN 2,000 UNTIL ESTABLISHED, TOWER 120.4 AT THE MARKER."

The final heading assigned by ATC is intended to insure an intercept angle of not more than 30° (20° if intercepting the course less than 2 miles from the approach gate).

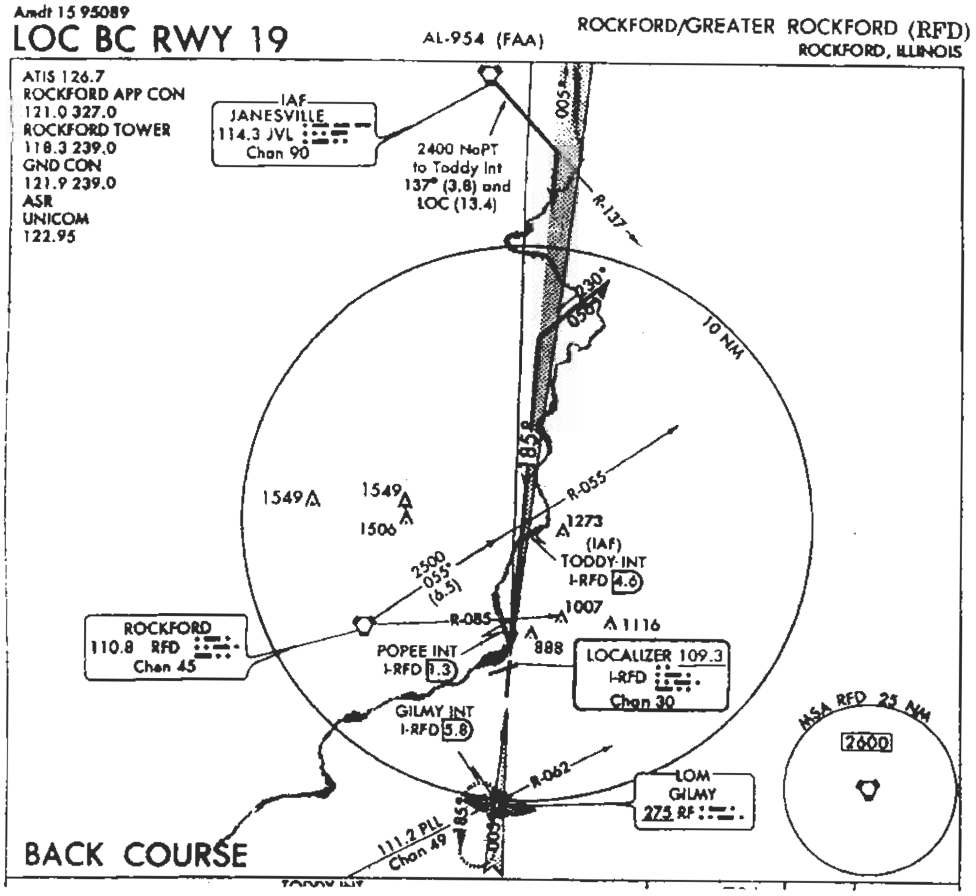
To insure yourself adequate time to configure the airplane for the final segment, you may want to request a turn on to the approach course at least 3 miles from the outer marker (or FAF for a nonprecision approach). Make this request with ATC as early as possible during the vectors.

ATC will normally inform you if it is necessary to vector you across the approach course for spacing. If approach crossing appears imminent and you have not been informed you will be vectored across the approach course, query the controller as to the plan. You are not to turn inbound on the approach course unless ATC has either instructed you to intercept the course inbound or cleared you for the approach.

When cleared for the approach, you must maintain the last assigned altitude to assure obstacle clearance until you are established on a segment of the approach. Generally, a live CDI (or less than 10° off course in the case of an NDB) can be considered as safely established on the segment. Once inbound on the intermediate segment, complete the landing checklist and determine: How low?; How Long?; and Which Way? As always, use the 6T's when you enter the final segment.

NoPT TRANSITION

A published transition specifying NoPT (No Procedure Turn) is another method of entering the approach corridor. As illustrated below, a pilot arriving over the JVL VOR and cleared for the LOC BC RWY 19 approach will fly the JVL 137° radial to the localizer back course, then the localizer back course to Toddy intersection. The transition from over JVL indicates the minimum altitude is 2400 feet and clearly indicates NoPT, meaning the approach will be straight-in, no procedure turn is necessary or authorized for entry into the approach corridor. Notice that JVL is designated as an IAF for the approach. The segment from JVL to a point on the localizer back course 10 miles north of Toddy is actually the initial segment of the approach. The term NoPT transition is a misnomer, but it is a more inclusive description of what is accomplished during this type of initial segment and will be used throughout this course.



DME ARC

A DME arc is a curved flight path flown at a specific distance from a VORTAC or VOR/DME station. A DME arc leads to entry into the approach corridor. A DME arc approach is, then, a straight-in approach. A procedure turn is neither necessary nor authorized when cleared for a DME arc. Notice on the procedure below that the 7 mile DME fix on the 082° radial and the 7 DME fix on the 228° radial are Initial Approach Fixes (IAF). The DME arc is an initial approach segment.

Flying a DME arc can be divided into three distinct parts: intercepting the arc; maintaining the arc; and intercepting the approach course.

INTERCEPTING THE ARC

Assume you are inbound to LFK VORTAC on the 228° radial (048° course) and have been cleared for the VOR RWY 33 approach via the 7 mile DME arc south of the VORTAC. When the DME reads 7.5 (a 1/2 mile lead is good for ground speeds up to 150 knots), turn right approximately 90° to a heading of 130°. If during the turn it appears you will undershoot the arc (DME is greater than 7) then roll out 20° early. If it appears you will overshoot (DME less than 7) continue 20° past the intended heading.

MAINTAINING THE ARC

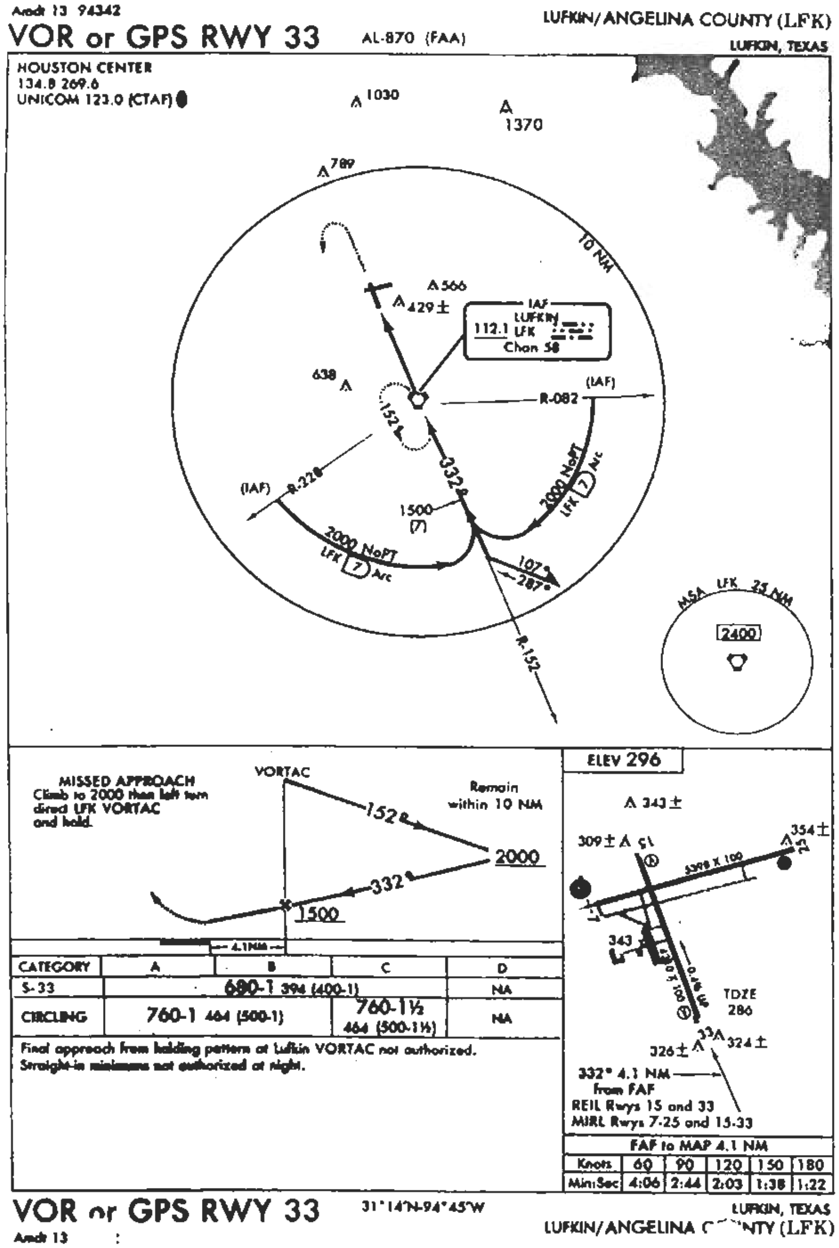
To maintain the arc, you will fly a series of short, straight legs, checking the DME indication at selected reference points. The first reference point is the radial about 20° "ahead" of your current position. Set the OBS to 030°. Note the DME as the CDI centers. Turn 20° left to a heading of 110°. Reset the OBS 20° ahead to 010°. When the CDI centers, turn left 20° to a heading of 090°. Set the OBS to 350°. When the CDI centers, turn left 20° to a heading of 070°.

INTERCEPTING THE APPROACH COURSE

Setting the OBS ahead 20° would take you past the approach course, therefore set the OBS to the inbound course, 332°. As the CDI centers, plan your turn to the 332° heading so as to intercept the 152° radial inbound. Note that at this point you are established inbound in the approach corridor.

From this point, complete the landing checklist and answer the questions: How Low?; How Long?; and Which Way?. Use the 6T's crossing the FAF and entering the final segment.

If you maintain the correct heading, deviations from the arc will be due to wind drift which can be corrected as follows: If at any reference point during the arc (centered CDI), the DME is less than 6.5 miles, maintain your heading until re-intercepting the arc. If, on the other hand, the DME reads more than 7.5 miles as the CDI centers, you will need a greater heading change to re-intercept the arc.



CATEGORY	A	B	C	D
S-33	680-1 394 (400-1)			NA
CIRCLING	760-1 464 (500-1)		760-1½ 464 (500-1½)	NA

Final approach from holding pattern at Lufkin VORTAC not authorized.
Straight-in minimums not authorized at night.

332° 4.1 NM from FAF
REIL Rwys 15 and 33
MIRL Rwys 7-25 and 15-33

FAF to MAP 4.1 NM

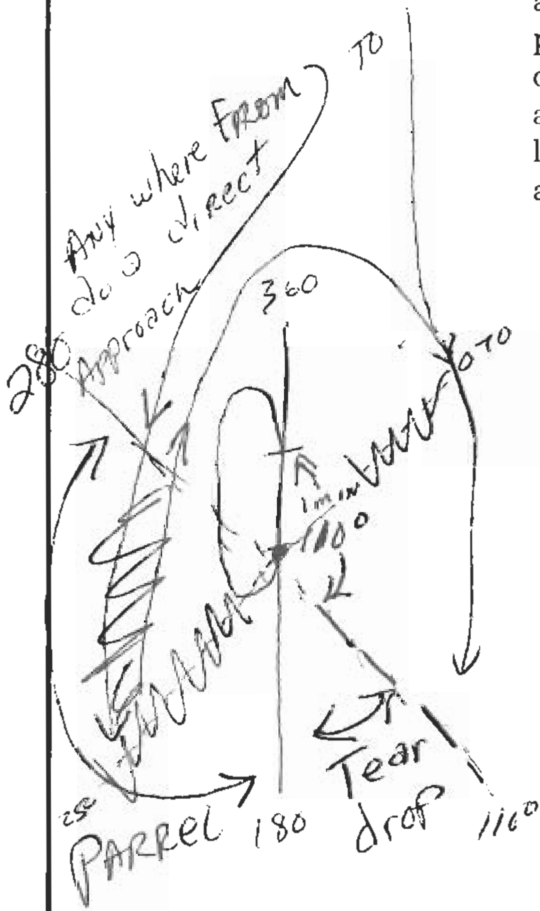
Knots	60	90	120	150	180
Min:Sec	4:06	2:44	2:03	1:38	1:22

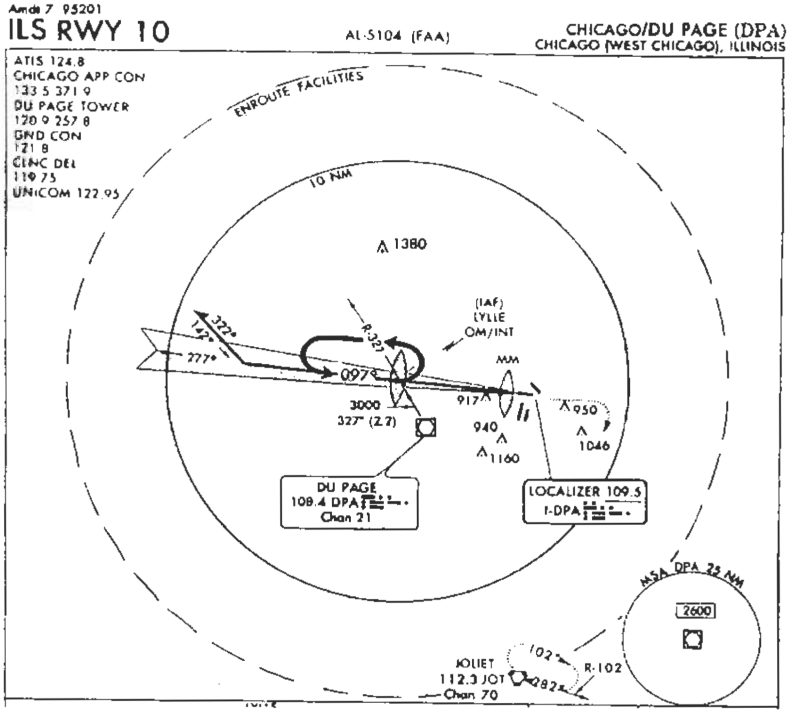
.5 miles before
Turn 90°
Center CDI
Fly 1/2 Scale
Turn 10°
Tune 10°
Fly 1/2 Scale
Turn 10°
Tune 10

Revised 0995

AUTHORIZED HOLD

Unless the procedure indicates "final approach from holding pattern not authorized", a procedure turn is not required when the approach corridor is entered from a properly aligned holding pattern. An authorized hold is a holding pattern on the approach course, at the approach fix, and in which turns are made on the same side of course as prescribed for the procedure turn. For example, an airplane holding west of LYLLE, on the localizer, with left turns, is established inbound in the approach corridor upon completion of the turn inbound.





Holding Clearance
"hold SE of Millsap
on 090° radial
@ 3000 Ft Right
TURN expect
Further Clearance
@ (some time)

When cleared for the approach, ATC expects you to proceed straight-in. Descent to the intermediate segment altitude cannot begin until the airplane is established on the intermediate segment. If you elect to make additional circuits to lose altitude or to become better established on course, you must advise ATC upon receipt of the approach clearance.

Often, a published holding pattern replaces the standard procedure turn. Course reversal must be accomplished within the limitations indicated on the chart. Procedures and techniques for holding patterns are covered in a later chapter in this manual.

AMERICAN FLYERS

CHAPTER 4

IFR FLIGHT PLANNING

Clearance
Route
Altitude
Freq.
Transponder

Flight planning for an IFR flight involves many of the elements with which you are already familiar. As with any flight, your planning concerns are the weather, the route, the airplane, and the pilot. In addition, you will need to understand and anticipate the demands of the ATC system.

WEATHER BRIEFING

A multitude of weather sources exist which can provide helpful information for a pilot planning an IFR flight. Television offers a tremendous amount of useful weather information. Evening weather segments of local news broadcasts can provide an excellent overview of weather systems that may influence a flight planned for the next day. Dedicated weather channels on cable TV provide vast amounts of information that may be used for outlook planning. Your general knowledge of the "big picture" obtained from these sources is valuable background for understanding the specific formal weather briefing for your flight.

While it is still possible to obtain face-to-face weather briefings at a local FSS or NWS office, automation of weather briefings is definitely the trend. The automation of weather information, whether obtained by telephone from an automated FSS, or a Direct User Access Terminal System (DUATS) computer, means that you will have to be able to understand raw weather data and make informed decisions based on your level of experience and understanding of meteorology. This trend puts the responsibility of when, where, and how to fly in any given weather situation directly on you, the pilot in command; exactly where the responsibility belongs.

The most common source of aviation weather is still a telephone briefing by a weather briefer at a nearby FSS. One must realize, however, that FSS briefers may or may not be pilots and that they are not trained meteorologists. Their training is in interpreting the weather products available to them and passing this information on to you. The go/no go decision should never be put in the hands of a briefer, but must rest in the hands of a well informed and well educated pilot in command.

Three kinds of briefings are available from the FSS:

A STANDARD briefing should be requested when you need to have all the available information.

An ABBREVIATED briefing is requested when you already have some of the information from another source and only want the briefer to give you certain items.

An OUTLOOK briefing should be requested anytime the estimated departure time is six hours or more away.

The Direct User Access Terminal System (DUATS) is a way for pilots to access weather information using a personal computer or airport computer terminal. Several different vendors offer DUATS services to the public. While the formats may vary slightly, the information they present is identical regardless of which vender is used.

Your instructor will show you how to use the DUATS system to obtain weather information, as well as any PIREPS and NOTAMS that may affect your flight. In addition, the DUATS system may be used to file, amend, or cancel a flight plan.

Generally speaking, there are two kinds of weather information available: Reports of conditions that have occurred, and forecasts for weather that is expected to occur at a given time in the future. Both are necessary to make informed weather decisions. Just how much information is needed and how detailed it must be varies with conditions. Use the back of the AMERICAN FLYERS route log as a guide. When using DUATS, the codes for these weather products are:

Aviation weather reports	SA
Terminal Aerodrome Forecasts	FT
Area Forecasts	FA
Winds Aloft	FD
SIGMETS/AIRMETS	WST/WS/WA
Radar Summary	SD
Pilot reports	UA
NOTAMS	NO

CURRENT WEATHER					FORECAST WEATHER			
Location	Wind	Visibility	Ceiling	Altimeter	Time	Wind	Visibility	Ceiling

WINDS ALOFT		
Level	Location	Location
3		
6		
9		
12		

SIGMETS - AIRMETS

CLOUD TOPS

FREEZING LEVEL

RADAR SUMMARY

NEAREST VFR

PIREPS

NOTAMS

FSS BRIEFING FORMAT

Adverse Conditions
Synopsis
Current Weather
En Route Forecast
Destination Forecast
Winds Aloft
Notices to Airmen
Known ATC Delays
Pilot Requests

Get the current weather for:

The **DESTINATION** to determine if the weather is at least at or above the published minimums;

The **DEPARTURE** airport to determine if it has adequate takeoff conditions and also if a return could be made should a malfunction occur during takeoff or departure;

Likely **ALTERNATE** airports, if required, to determine if the weather is at or above the required alternate minimums;

Any **EN ROUTE** airports because the weather there may influence your decisions should any problems arise while en route.

If the weather is really marginal, get the observations for the past several hours for all these locations. From this information you can better determine the actual trend and compare it to the forecasts. Don't permit the FSS briefer to rush through this information during a telephone briefing. Write down *all* the key items such as wind, visibility, ceiling, and altimeter. In the event of a communications failure, this may be the most up-to-date information you have available for planning an instrument approach.

Next, get the forecast weather. This may be in the form of TAF or Area Forecasts— ask if the briefer does not clearly state which is being used. You should request forecasts for a *specific time period* for:

The **DESTINATION** to be compared to the actual trend of recent reports.

The **DEPARTURE** airport, for possible return in the event of an emergency situation;

Any **EN ROUTE** airports, again, for contingency planning and possible use as alternate airports.

Get the winds and temperatures aloft for use in computing the ETE. You will most likely need to ask for specific levels and locations to get the most usable information.

Don't neglect to get information concerning the latest radar summary and any available PIREPs. An aircraft is the only tool available to measure certain phenomena. PIREPs provide the most reliable information on cloud tops, icing, thunderstorms, and tubulence. When thunderstorm activity is reported, PIREPs, in conjuction with the radar summary information can help you develop a three dimensional view of the situation. Depending on the time of year and your location, freezing level information may be crucial.

Never consider your IFR weather briefing complete unless you know the answer to the question: What direction do I fly to find the nearest VFR weather? This is to determine the best escape route in case of an emergency.

Notices to Airmen (NOTAMs) contain time-critical aeronautical information which could affect your decision to make the flight. NOTAMs include information on airport or primary runway closures, changes in the status of navigational aids, ILSs, radar service availability, and other essential information. NOTAMs are available from automated sources during weather briefings, unless the NOTAM has been published in the bi-weekly Notice to Airmen publication. If you do not have access to this publication during your flight planning, ask the briefer to review it for possible NOTAMs affecting your flight.

Flight Data Center (FDC) NOTAMs contain information related to amendments to published instrument approach procedures and other current aeronautical charts. FDC NOTAMs are regulatory in nature, since IAP's are established in FAR Part 97.

ANALYZING THE WEATHER BRIEF

There are three adverse weather situations for which you should always have an "out"— icing conditions, thunderstorms, and below minimums weather.

Unless your airplane is approved for flight in known icing conditions, you're grounded if icing conditions are known and reported along your route. However, if icing conditions are a forecast possibility, you should seek additional information during pre-flight planning. Where are the cloud layers? Unless there is freezing rain in the area, you will only encounter icing in clouds. Consequently, if you can fly on top or between layers you should not pick up ice en route. Determine the surface temperatures along your route. If they are above freezing, icing can be escaped by descending into the warmer air below. Also, take a look at the temperatures aloft. Frontal weather forces the warmer air aloft causing a temperature inversion. It might be possible to climb into warmer air should icing be encountered.

Concerning possible thunderstorm encounters, know what kind of activity is occurring. If it is air mass thunderstorms, they will probably be scattered and, therefore, can be seen and avoided. If frontal thunderstorms are approaching your destination, you probably can proceed on-course as long as you know you can turn away from the frontal thunderstorms and divert to an airport well ahead of the approaching front.

Concerning forecast destination weather at or near minimums, if you are sure that there exists a suitable alternate within IFR fuel reserve range, marginal weather forecast for the destination need not prevent the flight from being made.

ALTERNATE AIRPORT

You are required to list an alternate airport on your IFR flight plan. An exception to this requirement is provided if your destination is forecasting reasonably good weather. The rule governing this states that an alternate airport is not required to be listed in the flight plan if:

1. The destination has a published instrument approach; and

2. For at least 1 hour before and 1 hour after your ETA, the weather reports or forecasts, or any combination of them, indicate the ceiling will be at least 2,000 feet and the visibility at least 3 statute miles.

The airport you select as an alternate must meet certain requirements. If the alternate airport has a published instrument approach, then:

1. Current weather forecasts must indicate that at your ETA the ceiling and visibility will be at or above the alternate airport weather minimums specified in that procedure. (Specified alternate minimums are indicated on NOS charts by the symbol A in the remarks section); or

2. If alternate minimums are not specified in the approach procedure then the weather forecasts must indicate that at your ETA the ceiling and visibility will be at least:

    a. Precision approach— 600-2
    b. Nonprecision approach— 800-2

    These are known as standard alternate minimums.

If no instrument approach has been published for the alternate airport then weather conditions forecast at your ETA must allow descent from the MEA and landing to be made under basic VFR. The symbology A-NA in the remarks section of a SIAP chart does not preclude the airport from being used as an alternate, but due to unmonitored NAVAIDs or lack of weather reporting service, the forecast for your ETA at that alternate airport must indicate that descent from MEA and landing can be made under basic VFR.

FUEL REQUIREMENTS

An alternate airport is of little value if you don't have enough fuel to fly to it. Instrument Flight Rules require that, at takeoff, the airplane have on board enough fuel to fly to the first airport of intended landing, then fly to the alternate and fly after that for 45 minutes at normal cuising speed. This reserve fuel requirement and the need for an alternate will dictate, in large part, the ultility of a particular airplane in a given weather situation.

FUEL REQUIRED	
Enroute	2:30
Approach	:15
Alternate	:15
Approach	:15
Reserve	:45
Total	4:00

Assume, for example, your airplane has a fuel endurance, at "normal cruise" of 4 hours. Further assume your time en route to the destination is 2 hours and 30 minutes. Allowing 15 minutes for an approach there, 15 minutes for an approach at an alternate, and 45 minutes reserve, you have enough fuel for no more than 15 minutes flying time to an alternate. Converting this time to distance gives you a "radius of action" in which your alternate airport, if required, must be located.

An alternate airport is your assurance of a place to land in the event the destination weather goes below landing minimums. It would be advisable to have an alternate that allows you the lowest possible minimums. Therefore, an ILS approach is very desirable at an alternate airport. The major airports, with the most services, are normally the most desirable to use as alternates. Look first in the general direction of better weather as indicated in your briefing. If no suitable alternate is available within your radius of action, a refueling stop will be necessary.

THE ROUTE

The route of flight is significantly influenced by the demands of the ATC system. ATC is charged with insuring the safe, orderly, and expeditious movement of air traffic. Departure and arrival routes are designated in terminal areas to reduce the amount of coordination required between controllers. This establishes a flow pattern segregating inbound and outbound flights by, what is in effect, a system of "one-way streets".

Between major cities, this system extends to the entire route. ATC publishes its system of preferred routes in the Airport/Facility Directory (A/FD). If a preferred route exists between your departure point and destination, that is the route you should plan and file, since that is the route along which you will be cleared. In some high traffic density areas, coded IFR routes are frequently used within the airspace of adjoining approach control facilities. Information about these routes and applicable altitudes is most readily available from the FSS.

Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs) give both a graphic and textual description of the established flow patterns. You should include the SID or STAR as part of your route whenever they are available and applicable.

If no preferred route is listed in the A/FD for your destination and no SIDs or STARs exist, the flow patterns for departure and arrivals can be determined from published holding patterns on the en route or terminal area charts. Those fixes with published holds are generally inbound feeder fixes. Except during very slow traffic periods, you will not be cleared to depart over an inbound fix.

Your last reference in determining the logical route is to identify the approach transition fixes at the departure airport and the destination. These fixes are the inbound fixes. Identifying them on the en route chart should give a good idea of the flow pattern in the particular area.

NAVAID SERVICE VOLUME

Terminal VOR (T) - 25 NM

Low altitude VOR (L) - 40NM

High altitude VOR (H) - 40 NM

Your route of flight between the outbound fix at the departure point and the transition fix at the destination most commonly will be along the established airways or you may file direct routes within the service volume limitations of the NAVAIDs involved.

ALTITUDE

Consider four factors when selecting an altitude:

1. Weather— Not just favorable winds, but cloud tops, turbulence, freezing level, etc. During training, you want to file for an altitude that will give you valuable IMC experience. After you are rated, file an altitude that will be in the sunshine.

2. MEA's— If at all practical, file an altitude at least as high as the highest MEA along the route. In mountainous areas, a lower initial cruising altitude may be

appropriate. If your route is off airways, observe the Off-Route Obstruction Clearance Altitude (OROCA).

3. Equipment capability— Aircraft limitations such as service ceiling, climb capability, oxygen availablity, altitude to which the altimeter has been tested, and navigation or radio equipment aboard the airplane influence your choice of altitude.

4. Direction of flight— This is the least important of considerations, and is not a requirement. Unless conflicting factors require otherwise, ATC assigns altitudes to flights below 18,000 feet in controlled airspace based on magnetic course as follows:

   a. 0° to 179°, any odd thousand foot level;
   b. 180° to 359°, any even thousand foot level.

In lieu of an assigned cruising altitude, you may request VFR-on-top. This clearance allows you to select your own altitude, and you must concerned with both visual and instrument flight rules.

ROUTE LOG

Single pilot instrument flying can be very demanding. Anything that can be done to reduce your workload makes it easier for you to do your primary job of flying the airplane. Much of the work required for an IFR flight can be accomplished on the ground prior to departure. One of those items is the IFR route log. The route log records all the pertinent navigational information on one organized sheet of paper. Both the process of preparing the route log and then referring to it during the flight can be of great benefit to you in reducing the actual mental effort required for navigation during the flight.

Once the weather information has been obtained and the route and altitude of flight chosen, you are ready to fill in the route log. Most of the information needed can be taken directly from the low altitude en route chart. Computations will need to be made to determine groundspeed, estimated time enroute (ETE), estimated time of arrival (ETA), and fuel requirements.

Estimate your time enroute by computing groundspeed based on the anticipated TAS (from the airplane performance data) and the winds aloft. You may find the

Tach In ________ Hobbs In ________
Tach Out ________ Hobbs Out ________
Total ________ Total ________

AMERICAN FLYERS

Departure Point	Navigation Frequency	Magnetic Course/Hdg	Leg Distance	TIME			Ground Speed	Radio Facilities Enroute			ATIS
				ETE	ETA	ATA		FSS	TOWER	GROUND	Departure
Checkpoint											
											Arrival
Destination			Total								

1. Copy Atis
2. Set Gyros & Altimeter
3. VOR Test
4. ADF Test
5. Request Clearance
6. Set Up NAV Radios
7. Transponder Test & Set
8. Request Taxi
9. Systems Check
10. Departure Procedures
11. Transponder ON
12. Note Time Off ________

1. TYPE	2. AIRCRAFT IDENTIFICATION	3. AIRCRAFT TYPE/SPECIAL EQUIPMENT	4. TRUE AIRSPEED	5. DEPARTURE POINT	6. DEPARTURE TIME	7. CRUISING ALTITUDE
8. ROUTE OF FLIGHT						
9. DESTINATION	10. EST. TIME ENROUTE HOURS	MINUTES	11. REMARKS			
12. FUEL ON BOARD HOURS	MINUTES	13. ALTERNATE AIRPORT(S)	14. PILOT'S NAME & ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE 17. DESTINATION CONTACT & TELEPHONE NUMBER (OPTIONAL)			15. NUMBER ABOARD
16. COLOR OF AIRCRAFT						

Clearance

quadrant method of determining groundspeed quicker, yet as accurate as your flight computer. This method is described in Appendix A.

In addition to the navigational computations, the flight log provides a single place in which needed frequencies for departure, enroute, and destination, can be recorded for easy reference. It also provides a place for recording your clearance and keeping your flight plan.

Having a complete flight log available during the flight will allow you to give the maximum time to flying the airplane.

FILING THE FLIGHT PLAN

Instrument flight plans may be submitted to the nearest FSS either in person, by telephone or by radio. Pilots should file an IFR flight plan at least 30 minutes prior to the estimated time of departure. Flight plans may also be filed via the DUAT computer system, but must be submitted at least one hour prior to departure.

IFR flight plans follow this format:

Block 1 - Check IFR if you intend to operate under instrument flight rules regardless of actual weather.

Block 2 - Enter the complete aircraft identification number including the prefix “N”.

Block 3 - Enter the aircraft make and model followed by a slash and the equipment suffix, (e.g. C172/U) The complete list of codes can be found in the AIM.

Equipment Codes:

/U - Transponder, Mode C
/A - DME, Transponder, Mode C
/R - RNAV, Transponder, Mode C
/G - GPS, Transponder, Mode C

Block 4 - Use the performance data in the AFM/POH to determine the TAS under the conditions that apply to your flight.

Block 5 - Enter the FAA identifier code for the departure airport. These codes may be found in the A/FD. If you don't know the code, enter the airport name.

Block 6 - Enter the proposed departure time in Coordinated Universal Time (UTC), “Zulu time”.

Block 7 - Enter your requested *initial* cruising altitude. If other altitudes are required enroute, these are best coordinated with the appropriate controller. If you plan to fly an unpublished route (direct) you must comply with the following minimum altitudes:

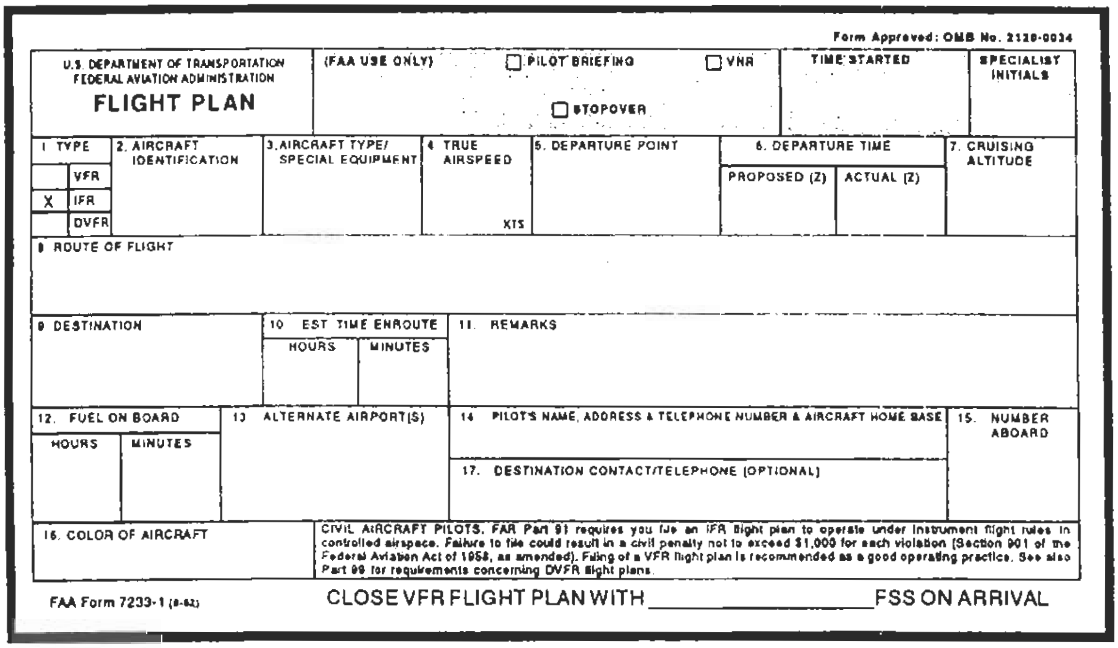
1. In mountainous terrain - at least 2,000 feet above the highest obstacle within 4 NM of your position.
2. Otherwise - at least 1,000 feet above the highest obstacle within 4 NM of your position.

Block 8 - Enter the route of flight as determined earlier.

Block 9 - Enter the FAA identifier code for your destination airport. If not known, enter the airport and city names.

Block 10 - Enter your estimated time enroute based upon the the TAS filed in Block 4, the appropriate winds aloft forecast, and the total distance to the destination airport.

Block 11 - Enter any remarks that ATC would need to know to handle your flight. These remarks might include limitations, such as, no over-water flights, or requests, such as, routing due to weather. Be aware, however, these remarks are not necessarily passed on to each controller.



Form Approved: OMB No. 2120-0024

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
FLIGHT PLAN

(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR ☐ STOPOVER
TIME STARTED
SPECIALIST INITIALS

1. TYPE ☐ VFR ☒ IFR ☐ DVFR
2. AIRCRAFT IDENTIFICATION
3. AIRCRAFT TYPE/ SPECIAL EQUIPMENT
4. TRUE AIRSPEED KTS
5. DEPARTURE POINT
6. DEPARTURE TIME PROPOSED (Z) ACTUAL (Z)
7. CRUISING ALTITUDE
8. ROUTE OF FLIGHT
9. DESTINATION
10. EST. TIME ENROUTE HOURS MINUTES
11. REMARKS
12. FUEL ON BOARD HOURS MINUTES
13. ALTERNATE AIRPORT(S)
14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE
15. NUMBER ABOARD
16. COLOR OF AIRCRAFT
17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)

CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

FAA Form 7233-1 (8-82)

CLOSE VFR FLIGHT PLAN WITH ________________ FSS ON ARRIVAL

Block 12 - Enter the actual amount of fuel on board in terms of time.

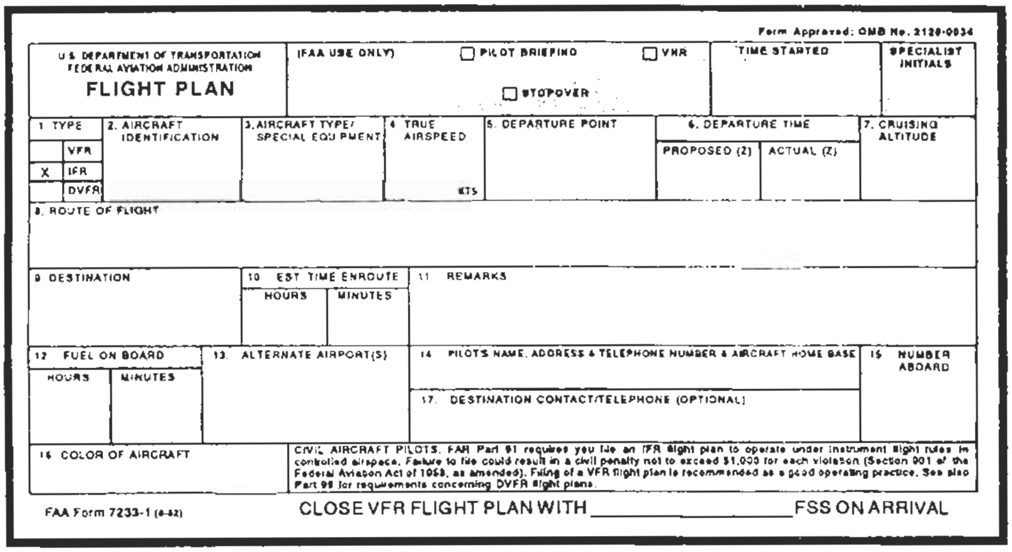
Block 13 - Enter the FAA identifier code for your alternate airport. If not known, enter the airport and city names.

Block 14 - Enter the name, address, and phone number of the PIC. Also include the airport at which the aircraft is based. For training flights, enter your instructor's name, the school phone number and location.

Block 15 - Enter the total number of people on board.

Block 16 - Enter the predominant colors of the airplane.

Block 17 - Optional for search and rescue purposes.



Form Approved: OMB No. 2120-0026

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
FLIGHT PLAN

(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR ☐ STOPOVER

TIME STARTED

SPECIALIST INITIALS

1. TYPE
☐ VFR
☒ IFR
☐ DVFR

2. AIRCRAFT IDENTIFICATION

3. AIRCRAFT TYPE/SPECIAL EQUIPMENT

4. TRUE AIRSPEED KTS

5. DEPARTURE POINT

6. DEPARTURE TIME
PROPOSED (Z) ACTUAL (Z)

7. CRUISING ALTITUDE

8. ROUTE OF FLIGHT

9. DESTINATION

10. EST. TIME ENROUTE
HOURS MINUTES

11. REMARKS

12. FUEL ON BOARD
HOURS MINUTES

13. ALTERNATE AIRPORT(S)

14. PILOTS NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE

15. NUMBER ABOARD

17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)

16. COLOR OF AIRCRAFT

CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

FAA Form 7233-1 (8-82)

CLOSE VFR FLIGHT PLAN WITH ________________ FSS ON ARRIVAL

THE AIRPLANE

From the standpoint of documents and inspections, determine if the airplane is ready for flight. The following documents must be aboard:

Airworthiness certificate
Registration certificate
Radio station license
Operating limitations
Weight and balance data
Equipment list

The airplane records must indicate that the following inspections and checks have been accomplished within the specified time:

1. An annual inspection - 12 calendar months.
2. ELT - 12 calendar months.
3. ELT battery - as specified in the records.
4. Altimeter and static system - 24 calendar months.
5. Transponder and Mode C - 24 calendar months.
6. VOR accuracy - 30 days.

In the case of an American Flyers' airplane, a 100 hour inspection.

It is your responsibility as PIC to determine that the documents and records are in order.

THE PILOT

To serve as pilot in command you must:

1. have your pilot certificate and current medical certificate (appropriate to the pilot privileges being exercised) in your personal possession;

2. have met the flight review requirements of FAR §61.56 with the preceding 24 calendar months.

3. meet the appropriate recent experience requirements of FAR §61.57 if passengers are to be carried.

In addition, to serve as PIC under IFR, you must meet the recent IFR experience requirements of FAR §61.57(e). This regulation requires that within six calendar months prior to the date of the flight, you must have logged at least six hours of instrument time under actual or simulated instrument conditions, at least three hours of which were in flight in an airplane. You must also have logged at least six instrument approaches during the preceding 6 calendar months. Three hours of instrument experience and any or all of the approaches may be gained in flight in a different category of aircraft, or in a pilot ground trainer. Ground trainer time used to meet this requirement must be certified by the appropriately rated instructor who gave you the instruction.

INSTRUMENT COMPETENCY CHECK (ICC)

If you have not met the IFR requirements above, you have a six month grace period during which you may, with the use of a safety pilot, obtain the necessary hours and approaches to meet the requirement. However, you may not operate as PIC on an IFR flight during this grace period until the requirements are met. Failing to meet these requirements within the six month grace period will necessitate successfully completing an instrument competency check with a certified instrument flight instructor before you may exercise the privileges of an instrument rated pilot.

One final word on pilot fitness— being legally current is not the same as being proficient and safe. All pilot skills, and especially instrument flying skills, are perishable. Nothing helps your skill level and sense of confidence as much as recent experience. If you have not had recent IFR experience, the time and money spent for a few hours review with a good CFII are well spent. In fact, for pilots who do not regularly fly instruments, and even those who do, obtaining an instrument competency check every six months is not only a good way to stay current, it can also be worth significant insurance discounts.

AMERICAN FLYERS

CHAPTER 5

ATC PROCEDURES

AIR TRAFFIC CONTROL

In this section you will gain understanding of the Air Traffic Control procedures applicable to IFR. You will also gain some insight into the techniques controllers use to accomplish those procedures. In the process, you will also understand your responsibilities as PIC under IFR.

The FAA divides the Air Traffic Control system into two main categories— Terminal, assigned to Air Traffic Control Tower (ATCT) facilities and En Route, assigned to Air Route Traffic Control Centers (ARTCC).

The typical sequence of contact with and the functions of each controller in these facilities is listed below:

CONTROLLER	FUNCTION
ATIS*	Essential non-control information
Clearance Delivery	Issue initial IFR clearance
Ground Control	Taxi instructions
Tower	Initial departure instructions and takeoff clearance
Departure Control	Establish in En Route system
Center	Separation while En Route
ATIS*	Advance approach information
Approach Control	Approach clearance
Tower	Landing clearance
Ground Control	Taxi instructions

* Recorded information

IFR CLEARANCE

An IFR clearance is authorization by ATC for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions in controlled airspace. An IFR clearance contains specific information in the following order:

1. Clearance limit. Normally the destination airport filed in your flight plan.
2. Route of flight to the clearance limit. Includes departure procedure or SID, if applicable.
3. Altitude data in the order flown. May include an expected altitude.
4. Frequency and transponder code information.

In most cases you will obtain your initial IFR clearance on the discrete clearance delivery frequency. At locations without clearance delivery or when positions are combined, you will contact ground control. State the fact that you are IFR and the name of your destination airport on initial contact. This helps the controller quickly locate the correct flight plan and, in areas where the tower controller must call approach control or the center by landline for your clearance, identifies the correct position for the controller to call.

In today's automated ATC environment, most control towers utilize a "silent clearance" concept. This procedure enables the controller to issue initial IFR clearances to departing aircraft without contacting the parent approach control or center facility. When a controller responds to your inital call with "CLEARANCE ON REQUEST", you should recognize that the controller is required to obtain your clearance by contacting the parent ATC facility by interphone. Once obtained, the controller will advise "... I HAVE YOUR CLEARANCE, ADVISE READY TO COPY."

Whenever possible, ATC will issue an abbrieviated clearance. This clearance simply substitutes the term "AS FILED" for a lengthy route of flight when the route is approved with little or no change by ATC. The term "AS FILED" applies only to the *route* of flight, the altitude is always stated in the clearance and may be different than that filed. If you have made changes in a previously filed flight plan, or cancelled and re-filed a flight plan, you should request a "full route" clearance. ATC will issue a full route clearance when they must issue a route different from that which you filed.

Do not try to interpret an IFR clearance while you are copying it. Simply write it down exactly in the order issued. There is plenty of time to study and interpret the clearance after you have copied it and had it confirmed as correct. Good operating practice dictates, and every controller expects, a full read-back upon receipt.

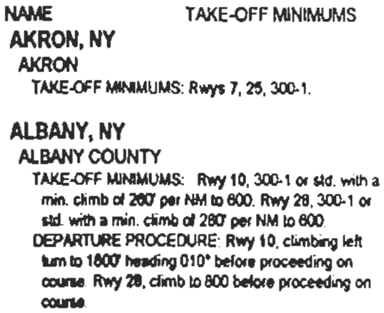
At uncontrolled airports you may obtain your IFR clearance in one of several ways. Many ATC facilities have remote communications outlets (RCO's) which enable controllers to communicate by radio with pilots on the ground at an uncontrolled field. The procedure for obtaining clearance in this situation is as described above. If an RCO is not available at the departure airport, and the weather permits, you may depart VFR and contact ATC directly for your clearance. When the weather will not allow VFR departure, you must contact the appropriate FSS by telephone for your clearance.

CLEARANCE VOID TIME

An IFR clearance relayed through a flight service station will differ slightly from one received directly from ATC. The clearance will be prefaced with the statement "ATC CLEARS..." and will contain a CLEARANCE VOID TIME. A clearance void time is simply the latest time at which you may depart under the terms of the clearance. The clearance void time is necessary to avoid adverse impact on other IFR operations to or from that airport. ATC will protect the required airspace until you establish two-way radio communications with them or until the clearance void time. When you receive a clearance void time and you are unable to depart before the void time, you must contact ATC and advise them of your intentions. This fact is stated in the original clearance and usually requires such contact not more than 30 minutes after the clearance void time.

TAKEOFF UNDER IFR

Before takeoff, it is your responsibility to determine what departure procedure applies to your flight. A specific departure procedure may be included as part of a SID or may be indicated on the approach chart. The symbol ▼ on NOS charts indicates nonstandard takeoff minimums apply and/or an *IFR departure procedure* has been established for that airport. IFR takeoff minimums apply to commercial operators, but your use of such minimums is certainly not precluded. In many cases, the ▼ symbol directs your attention to a detailed IFR departure procedure designed to insure safe obstruction clearance during initial climb in IMC.



NAME TAKE-OFF MINIMUMS

AKRON, NY

AKRON

TAKE-OFF MINIMUMS: Rwys 7, 25, 300-1.

ALBANY, NY

ALBANY COUNTY

TAKE-OFF MINIMUMS: Rwy 10, 300-1 or std. with a min. climb of 260' per NM to 600. Rwy 28, 300-1 or std. with a min. climb of 260' per NM to 600.

DEPARTURE PROCEDURE: Rwy 10, climbing left turn to 1600' heading 010° before proceeding on course. Rwy 28, climb to 800 before proceeding on course.

If no special departure procedure applies, and the weather prevents visual avoidance of obstructions, a good practice is to climb to at least the circling MDA before making any turns.

Review of departure procedures is a checklist item on the American Flyers route log form. This item should be completed before calling the tower for takeoff clearance. Initial departure heading and/or altitude information is usually issued along with the takeoff clearance. Always read back clearances containing headings or altitudes for confirmation by ATC.

Just before you take the runway for departure, complete the balance of the route log checklist— transponder ON (Mode C or ALT position), and note the time off.

After takeoff, the tower will advise when to contact departure control. Include your full call sign, actual altitude, and the altitude to which you are climbing on your initial contact with departure control. The controller is required to confirm your Mode C altitude readout by comparing it with your reported altitude. Controllers will accept your Mode C as valid if it is within 300 feet of your reported altitude.

The departure controller's role is to provide clearances to establish you in the en route environment. This is often accomplished through a series of radar vectors. Before radar can be used to provide separation or navigation assistance, the controller must confirm the identity of your target on the radar scope.

Example:

> "CESSNA 12345, RADAR CONTACT 2 MILES NORTH OF EXECUTIVE AIRPORT."

Advise ATC immediately if you disagree with the position stated. The term RADAR CONTACT means only that the controller has identified your target on the radar display. The provision of additional services such as vectoring, traffic advisories, and safety alerts are dependent on the controller's workload and ability to provide such services. If weather conditions permit VFR flight, the responsibility for collision avoidance remains yours.

Departure control will effect a hand off to the en route controller. You will know this has been accomplished when you are issued a frequency change. Once you have been advised "RADAR CONTACT", this fact will not be repeated by subsequent controllers, unless you have been advised "RADAR SERVICE TERMINATED" or "RADAR CONTACT LOST".

EN ROUTE

The following reports to ATC are required:

1. Vacating an assigned altitude for a newly assigned altitude.

2. Any altitude change when operating on a VFR-On-Top clearance.

3. If unable to climb or descend at a rate of at least 500 feet per minute.

4. Change in true airspeed of 5 percent or 10 knots, whichever is greater, from that filed in the flight plan.

5. Time and altitude upon reaching an assigned holding fix or clearance limit fix.

6. Leaving an assigned holding fix.

7. A missed approach.

8. Any loss of navigation or communication capability.

9. Any hazardous weather encountered.

10. Any information relating to safety of flight.

If you are not in radar contact, make the following reports to ATC:

1. Position reports.

2. Leaving the final approach fix or outer marker inbound on an instrument approach.

3. A correction to a previously forwarded ETA which is in error by more than 3 minutes.

Position reports at compulsory reporting points (solid triangles) are required without ATC request. Position reports at other points along airways (open triangles) are to be made only upon ATC request. Fixes listed in the flight plan as defining a direct route are compulsory reporting points for that flight.

Make position reports as indicated below:

1. Identification
2. Position
3. Time
4. Altitude
5. ETA to the next reporting point
6. Name only of next succeeding reporting point along the route of flight
7. Remarks

Example:

> "FORTWORTH CENTER, CESSNA 12345, OVER CHILDRESS AT 1410, 7,000, WICHITA FALLS AT 1455, BRIDGEPORT".

ARRIVAL

As you near your destination the center will instruct you to contact approach control and issue the appropriate frequency. At airports not within an approach control facility's area, the center will provide approach control services.

Get the ATIS information, if available, before being switched to approach control. The best technique is to ask ATC if you may leave the frequency momentarily to obtain the ATIS. You can listen to it once, write it down, then return to the assigned ATC frequency while you analyze the information.

VISUAL APPROACH

When weather conditions permit, ATC will expedite the flow of traffic by offering IFR arrivals a visual approach instead of a standard instrument approach procedure.

ATC may initiate visual approaches at both controlled and uncontrolled airports. The ceiling must be at least 500 feet above the minimum vectoring altitude and the visibility at least 3 miles. If weather reporting service is not available at the airport, the controller may ask you if you can accept a visual approach.

ATC will not clear you for a visual approach until you report the airport or the traffic you are to follow in sight. You accept separation and wake turbulence avoidance responsibility when you accept a visual approach clearance. If you prefer to make a SIAP rather than a visual approach, advise the controller of your request as soon as possible.

CONTACT APPROACH

A contact approach is a visual procedure that may be used instead of a published instrument approach. ATC can authorize a contact approach only upon pilot request. The requirements for this procedure are:

1. The airport to which you request a contact approach MUST have an instrument approach available.
2. You must remain clear of clouds at all times during the approach and landing.
3. The flight and reported ground visibility must be at least 1 statue mile.

ATC will continue to provide separation between aircraft flying a contact approach and other IFR and Special VFR (SVFR) aircraft.

CANCELLING IFR

You can cancel your IFR flight plan anytime you are flying in VFR conditions (except in Class A airspace).

Your IFR flight plan is automatically cancelled by the control tower upon landing at your destination. You must cancel your flight plan when landing at an uncontrolled airport. Cancel by radio directly with ATC if weather conditions permit. If you are not able to cancel in the air, contact the nearest FSS or ATC facility by radio or telephone as soon as possible after landing.

AMERICAN FLYERS

CHAPTER 6

HOLDING PATTERNS

HOLDING PATTERNS

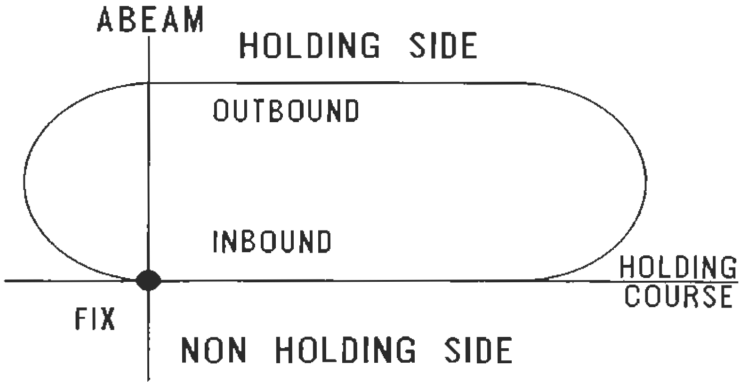
In this section you will learn to visualize holding patterns based on ATC clearances, determine the proper entry procedure and develop skill in maneuvering in holding patterns.

ATC utilizes holding patterns as a means of delaying a flight's arrival at a certain point. This may be necessary to effect separation between aircraft or to establish an orderly sequence of arrivals. Holding may also be used to absorb a delay while waiting for destination weather to improve.

TERMINOLOGY

HOLDING FIX - The fix at which the holding pattern is based. It can be any point that can be identified. (VOR, NDB, intersection, OM, a DME fix on an airway or localizer, waypoint, etc.)

HOLDING COURSE - The course on which the inbound leg is flown. You always hold inbound to the fix.



INBOUND LEG - The leg which takes you inbound to the fix on the holding course.

OUTBOUND LEG - The reciprocal of the holding course.

ABEAM POSITION - The position directly opposite the holding fix on the outbound leg.

HOLDING SIDE - The side of the holding course on which the major portion of the protected airspace lies.

NON-HOLDING SIDE - The side of the holding course opposite the holding side.

HOLDING CLEARANCE

ATC issues holding clearances consisting of the following:

1. DIRECTION - The geographic direction *from* the holding fix where the holding course will be found. This direction is expressed as one of the eight cardinal compass directions.
2. FIX - The name of the fix at which to hold. The fix name may be omitted if it is clearly stated as the clearance limit at the beginning of the clearance.
3. COURSE - The radial, course, bearing, airway, or other flyable route that will serve as the inbound leg.
4. EFC (Expect Further Clearance) TIME - The time at which you may resonably expect to depart the hold. The EFC time is also the time you would leave the holding fix if two-way radio communications failure occurred after receiving holding clearance.

Right turns are standard and assumed unless turn direction is specified in the holding clearance. If non-standard turns (left turns) are to be made, ATC will state "...LEFT TURNS."

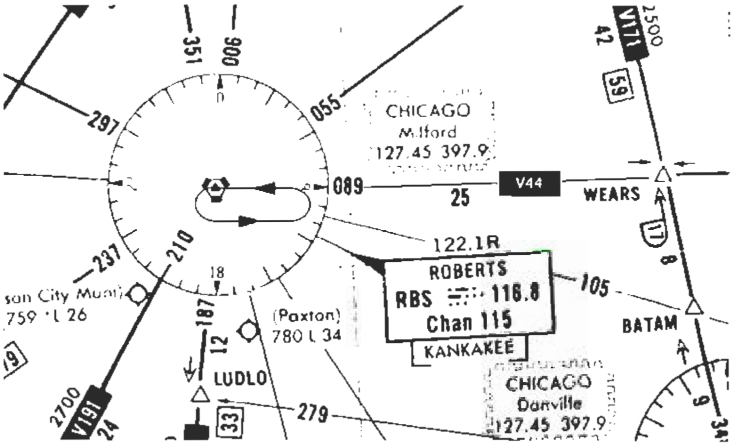
LIMITATIONS

To remain within the airspace protected by ATC for the holding pattern, adhere to the following:

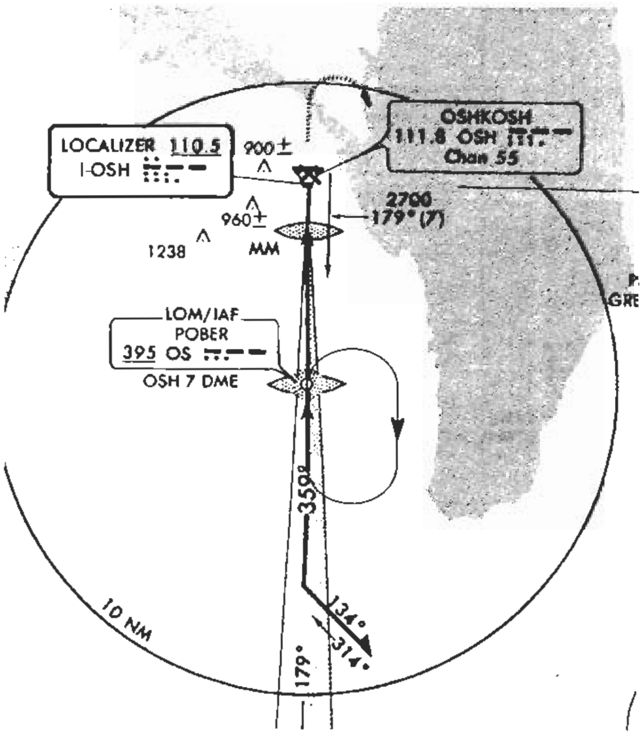
1. Make all turns at three degrees per second (standard rate), 30° of bank, or 25° of bank if using a flight director, whichever is less.
2. The maximum indicated airspeed for propeller driven aircraft is 175 kts IAS.
3. The inbound leg is 1 minute long (1 1/2 minutes above 14,000 feet MSL).

If your airplane has DME, ATC may specify the length of the OUTBOUND leg as a DME distance. The specified OUTBOUND leg length then replaces the timed inbound leg requirement.

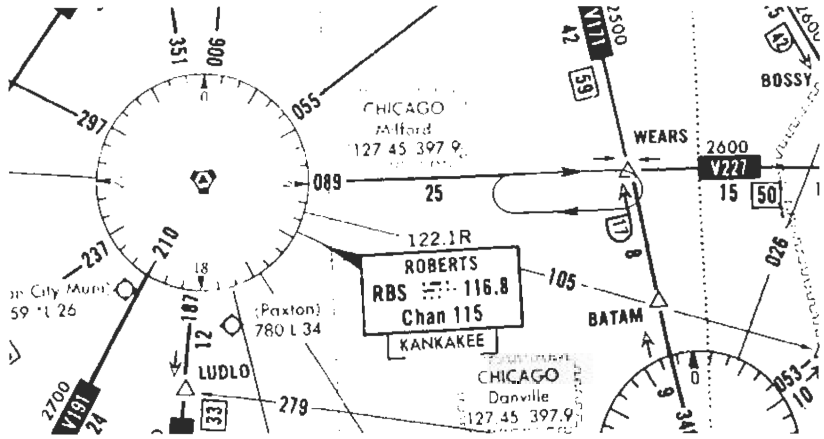
Holding clearance examples:



"HOLD EAST OF ROBERTS VORTAC ON VICTOR FORTY FOUR, LEFT TURNS, EXPECT FURTHER CLEARANCE AT ONE SIX FOUR FIVE."



"HOLD SOUTH OF POBER OUTER COMPASS LOCATOR ON THE LOCALIZER, EXPECT FURTHER CLEARANCE AT ONE SEVEN THREE ZERO."



The **DIRECTION** clarifies which segment of an airway is the holding course. V227 lies both east and west of WEARS.

"CLEARED TO WEARS INTERSECTION, HOLD WEST ON VICTOR TWO TWENTY SEVEN, EXPECT FURTHER CLEARANCE AT ONE FOUR TWO FIVE."

As with all IFR navigation, the first step in successfully executing a holding pattern is to VISUALIZE the hold. To do this:

1. Locate the holding fix on the chart.
2. Identify the holding course. If the holding course is an airway, the segment you are concerned with is the segment which lies in the direction *from* the fix as specified in the clearance.
3. Visualize yourself proceeding inbound toward the fix and along the holding course.
4. After passing the fix, turn right 180° (or left, if so specified in the clearance).

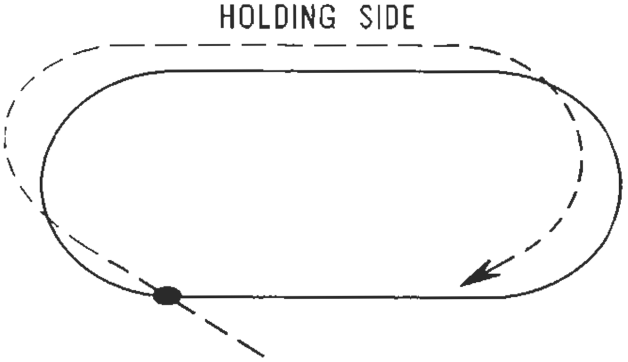
Draw the holding pattern directly on your chart whenever possible.

ENTRY PROCEDURES

Once you have visualized and sketched the holding pattern you must decide on the type of entry to use. The procedure for holding pattern entry requires you to remain within the protected airspace ATC establishes for the holding pattern. There are three techniques for holding pattern entry that, if properly applied, will enable you to easily comply with the procedure.

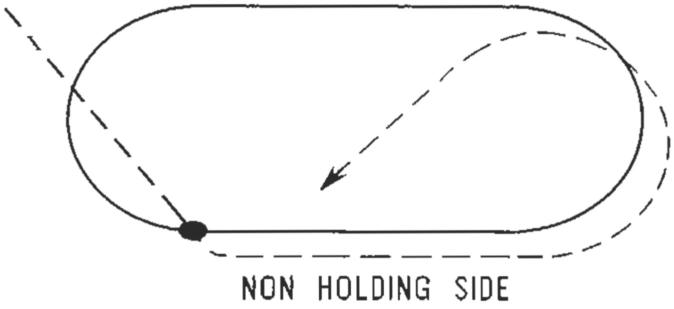
The proper entry technique is dictated by the heading on which you approach the holding fix. Determine the proper technique by visualizing where the airplane will be AFTER crossing the holding fix.

DIRECT ENTRY

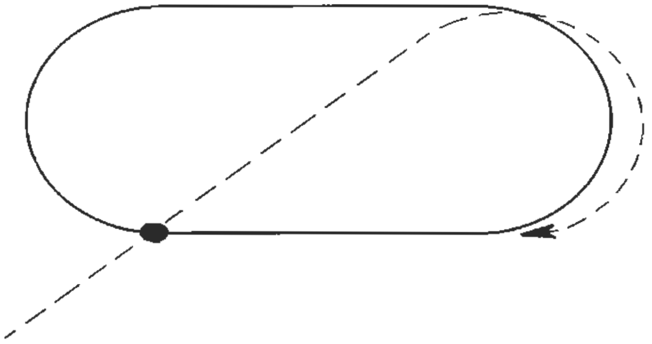


DIRECT ENTRY - After crossing the fix, turn to the outbound heading (the reciprocal of the inbound course). Maintain this heading for one minute beyond the abeam position (adjusted for any known wind). Turn TOWARD the holding course to intercept it and proceed inbound.

PARALLEL ENTRY



PARALLEL ENTRY - After crossing the fix, turn to the outbound heading. Maintain this heading for one minute (adjusted for any known wind). Turn TOWARD the holding course to intercept it and proceed inbound. You will most likely fly through the holding course during the turn at the outbound end of the pattern. Continue the turn past the inbound course heading to approximately a 45° intercept.



TEARDROP ENTRY

TEARDROP ENTRY - After crossing the fix, turn to a heading 30° from the outbound heading, on the holding side. Maintain the heading for one minute (adjusted for any known wind). Turn TOWARD the holding course to intercept it and proceed inbound.

If you sketch the holding pattern directly on your chart and physically trace through the entry process, selecting the correct entry technique will be nearly intuitive.

The entry to the hold is usually a critical time since you are uncertain what effect the wind will have. Proper visualization of the airplane's position relative to the holding course is imperative. The first turn at the end of the outbound leg must be made TOWARD the course to assure the airplane remains within protected airspace.

Due to improper execution, timing errors, and wind effect, the turn at the outbound end of the holding pattern, if made directly to the inbound course heading, will often result in the plane being well off the holding course. If you are nearing the inbound heading, but are still short of the holding course, *roll out early* and maintain a heading that will allow you to intercept the holding course before reaching the holding fix. If you will pass through the holding course before reaching the inbound course heading, continue the *turn beyond* the inbound course heading to a heading that will allow you to intercept the holding course before reaching the holding fix.

VOR HOLDS

Once your choice of entry technique has been made, you should have two numbers in mind— the HEADING you will turn to after passing the fix and the COURSE YOU WILL SET ON THE OBS after making the turn. With these numbers in mind, when you cross the fix use the 6 T's—TURN, TIME, TWIST, THROTTLE, TALK, TRACK.

The airplane is considered in the hold as of the time it first passes over the holding fix during the entry to the hold. If your airplane cruises above the maximum holding airspeed, you should reduce to at least the maximum holding airspeed within three minutes of your ETA to the holding fix. Otherwise, remain at cruise until over the fix. Any reduction in speed after entering the hold is optional. If the hold is expected to be brief, you may elect to stay at cruise. For lengthy holds or in rough air, you would probably reduce speed. When holding at an approach fix, it would be best to slow to approach airspeed.

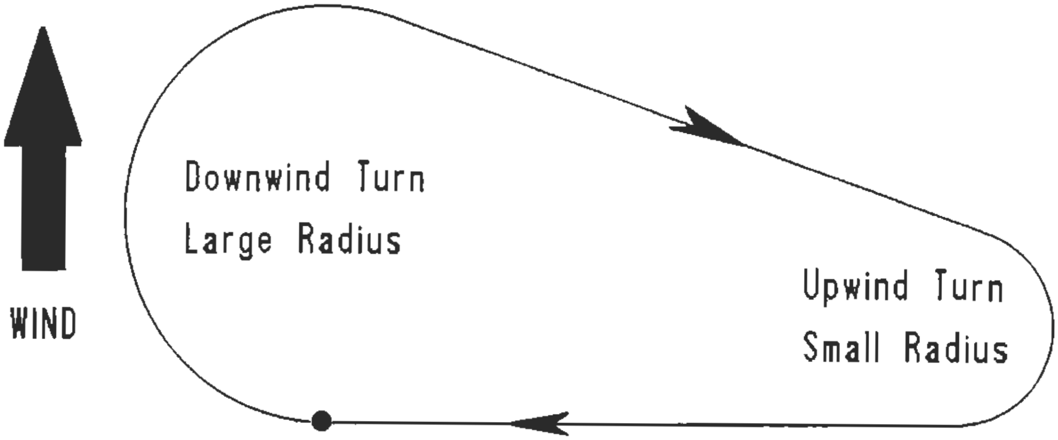
Since the length of the outbound leg must be adjusted to make the inbound leg one minute long, it is important that the outbound timing is started at the same point each time. This point should be abeam the fix outbound, if possible. When holding at a VOR station, the abeam position can be identified by noting the time at which the TO/FROM indicator changes from the FROM position to the OFF position. (Assuming the OBS is set to the inbound holding course AS IT SHOULD BE.) If the hold is at an intersection, it may not be possible to determine the abeam position, such as when the two radials intersect at an angle much less than 90°. If the abeam position cannot be determined, outbound timing begins when you roll wings level on the outbound heading.

If the wind is not known, fly the first outbound leg for one minute, time the inbound leg and adjust the next outbound leg as necessary.

Use normal bracketing techniques to track inbound on the holding course. When flying a holding pattern, you compensate for wind by adjusting the length and the heading of the outbound leg. The success of the holding pattern depends on starting each outbound turn from exactly over the holding fix. In order to be exactly over the fix each time, you must properly bracket the holding course.

Unless the wind effect is known, the first complete holding pattern should be made flying outbound on the reciprocal heading of the inbound course. If this is done, and the turn at the outbound end results in undershooting or overshooting the holding course, the next outbound leg heading should be altered to compensate for the crosswind effect.

The outbound correction must be greater than the inbound correction because the radius of both turns is affected by the wind. This difference must be compensated for in addition to the correction needed to parallel the holding course.



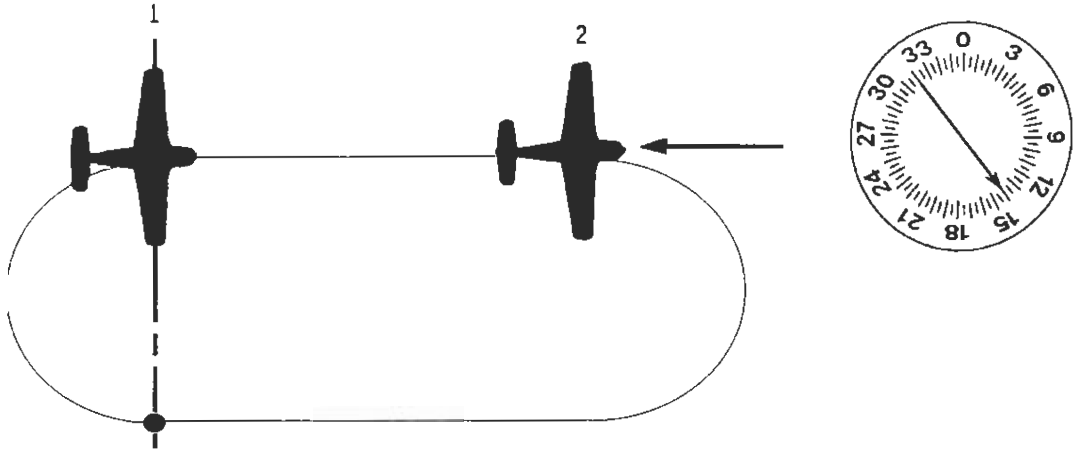
Initially, use a 20° correction into the wind on the outbound leg and adjust that correction as needed each time until the inbound turn ends with the airplane on the holding course.

INTERSECTION HOLDS

Holding will be practiced at VOR stations first. As you gain competency, holding will be practiced at intersections. While holding at the intersection of two VOR radials may seem more difficult than holding at a VOR station, the requirements to enter the pattern and any necessary wind corrections are the same as when holding at a VOR. The key again is visualization. Once you can visualize your position relative to the intersection, this type of hold is no more difficult than a VOR holding pattern.

NDB HOLDS

NDB holding procedures are the same as for all other holds, but the techniques change slightly because course guidance is provided by an NDB station. Visualization, using the "poor man's RMI," should be used to determine your position with respect to the station during the hold. In a no wind situation, the abeam position is indicated when the ADF bearing pointer is directly on the wingtip reference as in position 1 (090° if right turns, 270° if left turns).



After one minute outbound (position 2), check the bearing pointer. If it is indicating 140°, you are in great shape. If it is pointing to a larger number (closer to the tail position), you are too close to the holding course and most likely will have to turn inbound to a heading greater than the inbound course heading. If, at position 2, the bearing pointer indicates a number lower than 140° (farther from the tail) you are too far from the holding course and will most likely have to roll out of the turn early to intercept the holding course. If left turns are specified, the key number is 220°

Again, as in other phases, the key to satisfactory progress is visualization. This cannot be stressed enough. Most problems result from flying mechanically, making errors in figuring reciprocals, turning the wrong way, etc. Properly visualizing the desired pattern will make it possible to prevent many of these pitfalls and catch those errors that do occur before they become serious. Learn to cross-check at your HI, OBS setting, CDI, and the TO/FROM indicator and use this information to visualize your position relative to the holding course and fix.

AMERICAN FLYERS

CHAPTER 7

EMERGENCY PROCEDURES

EMERGENCY PROCEDURES

An emergency, like beauty, is to a great degree in the eye of the beholder. Some pilots can make an emergency out of a mag check, while others, if they lost a wing would simply request a lower altitude. Your idea of what constitutes an emergency is going to change as your level of proficiency improves and you gain experience. But whatever your level of experience, if you THINK you have an emergency, you probably have. Don't feel embarrassed. Confess your problem and try to get some help.

There isn't any way to list and plan for every possible emergency. Your training is designed to give you basic procedures in the types of trouble that most often occur and this, combined with good judgement, should give you the insight to cope with any situation that you might encounter. And, there are rules, regulations, and recommended good operating practices that you must know so that should certain situations occur, you will know what ATC expects you to do.

VACUUM FAILURE

In most general aviation type airplanes, the vacuum pump drives the attitude indicator and the directional gyro. Should the pump fail, these are the instruments you would lose and you would be on "emergency" or "partial panel". Assuming you are in IFR weather conditions, the preference of action is:

* Radar vectors to VFR conditions nearby.
* If ceilings are high enough, clearance for an enroute descent to VFR conditions.
* Radar vectors to the nearest airport where a "no-gyro" ASR approach is available.
* If your proficiency is high enough, an instrument approach to a suitable airport.

ENGINE FAILURE (SINGLE ENGINE)

ASSUMING RESTART IS IMPOSSIBLE.

* Trim for best glide speed (REMEMBER YOU ARE ON PARTIAL PANEL).
* Notify ATC. Request the nearest weather information.
* Turn into the last known wind if able (NO MOUNTAINS, ETC.).
* Limit electrical load.
* Upon breaking out of the clouds, pick your spot.

LOSS OF OUTSIDE SOURCE OF STATIC AIR

Activate alternate static air source.

* If not equipped with an alternate static air source, break the glass on the VSI. Remember that now the airspeed and altimeter read high and, if not damaged, the VSI indications are reversed.

COMMUNICATIONS FAILURE

If unable to contact a controller:

* Go back to the last assigned frequency - if no contact
* Go to the FSS frequency - if no contact
* Go to 121.5 - if no contact

Continue to broadcast your intentions in the blind on 121.5 (YOU MAY STILL BE ABLE TO TRANSMIT EVEN THOUGH YOU CAN'T RECEIVE). Monitor the VOR frequency. ATC may ask FSS to broadcast a clearance or instructions.

If you definitely establish that you have a comm failuresquawk code 7600. If in VFR conditions, maintain VFR and land as soon as practicable. Notify ATC as soon as possible after landing. If in IMC, proceed as follows:

ROUTE— Follow the last assigned route, expected route, or the route you filed in the flight plan. If being radar vectored, go direct to the fix, route, or airway to which you were being vectored.

ALTITUDE— Maintain the last assigned altitude or the MEA of the airway, whichever is highest. If you have been advised to climb or descend at a certain point, or have been advised to EXPECT a different altitude at a certain point, then upon reaching that point— comply.

Unless you have received specific holding instructions that include an EFC, proceed all the way to your destination. If you arrive prior to your ETA, hold at the facility or fix from which the approach begins. If this fix is also the approach facility, hold on the approach course, procedure turn side. If the approach chart shows a published hold that is used for the approach, hold in the published hold. You must remain in the hold, at the last assigned altitude, until your ETA at which time you descend and make the approach.

If you arrive at your destination after your ETA, you immediately begin the approach (IF YOU MUST LOSE ALTITUDE, THIS CAN BE DONE IN A HOLDING PATTERN AS DESCRIBED ABOVE).

A large amount of your training concentrates on how to deal with situations that we hope will never occur. For example, in training, every approach is down to simulated minimums. In actual practice, the weather will seldom be that bad. Likewise, the emergency situations that we contrive are always the worst that could happen. In reality, if emergencies occur at all, they usually occur to a lesser degree. However, LEARN THESE LESSONS WELL so that you will be as prepared as possible to handle whatever situation takes place.

AMERICAN FLYERS

CHAPTER 8

HOW A NEW INSTRUMENT PILOT CAN BECOME AN OLD INSTRUMENT PILOT

It is Instrument Rating Day plus one. The ink is barely dry on your new temporary pilot's certificate that has that long sought addition— INSTRUMENT RATING.

You have a glow of elation and, perhaps a bit of celebration, knowing that those difficult training hours are behind you and old "Simon Legree" instructor will no longer be giving you a hard time. It is now that the new instrument rated pilot has his or her first thoughts of concern. The instructor is no longer there to catch your occasional mistakes, such as clearance misinterpretation, wrong OBS setting, wrong station frequency, etc.

For many pilots who receive less than first class IFR training, this concern continues to increase, often to the point that they seldom, if ever, use their instrument rating. Even those who were properly trained and are fully qualified as far as technical proficiency is concerned, will often look for excuses not to file. They rationalize that "next time" circumstances will be better suited for filing IFR. Some even seek a crutch and ask a friend who is an experienced IFR pilot to come along for company.

Correctly, the pilot needs to file IFR as soon as possible after the checkride. He should be the only pilot, preferably the only person, in the plane so he must handle everything himself. Our graduates are no exception. We know our graduates are properly trained and technically qualified. In fact, we are immodest enough to believe our graduates have received the best training available anywhere.

But new graduates still lack that one important ingredient necessary to fully utilize an instrument rating safely. That ingredient is confidence. Up to now you have always had an instructor with you. Even though the instructor was not called upon to correct any mistakes on your last flight before graduation, the very fact that he was there and *could* catch mistakes, made it a different ball game than doing the same thing solo.

You achieve confidence only by flying instruments with no one else to rely on during the flight. It is the responsibility of the check pilot giving the flight test only to decide if you have the technical ability to go it alone. If so, further dual will do little to achieve full confidence in the fact that you are a capable pilot. So, when he passes you, he is in effect saying, "You can do the job. All you lack is true confidence. You obtain this only be filing and flying under IFR rules ALONE. I will certify you so that you may do so. You should do it as soon and as often as possible now to improve yourself. I know that you will make mistakes on your initial IFR flights, but also that you will recognize and properly correct them, and utilize ATC personnel instead of your instructor for clarification when needed."

So, new graduate, get out of the nest at the earliest opportunity. However, do this in VFR weather condition. It lessens concern considerably as you face your first IFR flight to know that any errors you may make may be embarrassing but not dangerous as they might be in actual IFR weather conditions. The fact that anytime you wish you may announce "Cancel my IFR flight plan" is a great asset to peace of mind. This flight is for confidence building, so don't burden yourself with the added responsibility of trying it in difficult, actual IFR conditions. The confidence building begins by just making the decision to go IFR alone right away. A cold shower gets colder the longer you stand there thinking about what it will feel like to step in.

Plan the flight carefully as if it was going to be in IFR weather. Follow your training sequence step by step to secure full weather information, NOTAMS, etc. Complete your route log and flight plan in detail. Arrange things in the cockpit for orderly use. Above all, take your time. Enjoy the ability to do everything at your own pace and in your own way now that the instructor is no longer there. Also, keep in mind that this will be a routine IFR flight. During instruction hours, all training was done as though every flight was in minimum IFR weather, clearance complications were encountered regularly, delays were certain, and all approaches were down to published minimums. On routine flights, the workload will be much less.

Be sure your flight includes an instrument approach at your destination. You will benefit more from solo approach experience than from the departure and en route phases. The clearances for the approach will be made just the same as if actual IFR weather exists. You must have the approach chart studied in advance and properly plan the procedure you will follow. All reports and frequency changes will be done just as in actual IFR weather. Your workload will closely follow that of actual IFR and confidence in your ability to plan and execute the approach will result. A word of caution— most other traffic will be VFR. Don't become so engrossed in the instruments and navigation that you fail to scan for other traffic. Do not attempt exact course line maintenance, altitudes, or descent rates. It is not essential to your purposes and attempting to do so will certainly result in too much "inside the cockpit" attention.

If this VFR/IFR routine is followed for two or three flights prior to attempting actual IFR, you will certainly benefit from the experience by increasing your proficiency. However, the main benefit is simply the peace of mind you will have once you prove you can hack it alone. Consider the aspects of this VFR/IFR flight that will be no different as far as proficiency requirements are concerned, than if it were in minimum weather conditions for the entire flight. Every single detail of the preflight preparation and departure procedure is identical, whether you enter the clouds at 600 feet or continue in clear weather. Intercepting and following your first airway will require the same planning, station selection, OBS setting, and visualization of position as if you were in the clouds. You cannot see the airway radial any better today just because you are not wearing a hood or flying in clouds. If any of your flight is without radar monitoring, you will have to do intersection orientations and make position reports. Even with radar, it is advisable to keep track of your position for the practice it gives you. Holding clearances may be issued by ATC even though the weather is VFR, to provide separation from other IFR aircraft. Whenever possible, ATC will usually cooperate when you voluntarily request holding delay at a check point so that you can go through the procedure. When things are slow, cover your HI and AI for a few minutes to maintain the ability to cope with a vacuum or instrument failure. You may request a routing change en route and benefit from the experience of changing your working route log.

So, it is obvious the VFR/IFR is not only a good way to build confidence, it also maintains and develops proficiency in all aspects of IFR flying.

THE FOUR POINT PROGRAM

The Four Point Program to maintain proficiency as an IFR pilot does not require an undue amount of actual IFR flying. In fact, short IFR flights done with a reasonable amount of regularity are much better than more hours flown at less frequent intervals. Even though your total flying time per year may average 100 to 200 hours, you can maintain satisfactory IFR proficiency with American Flyers' Four Point Program. In fact, the less you fly, the more important it is to follow this program carefully.

The points are:

1. File IFR on every possible flight.
2. Use a hood for IFR practice whenever practical.
3. Choose an altitude that will keep you in IFR conditions as much as practical.
4. Schedule refresher training at least once a year.

POINT 1

If you file an IFR flight plan only when weather conditions require, you may go for long intervals without filing if you do not fly regularly. Filing and flying an IFR flight plan in VFR weather exposes you to all of the aspects of IFR flying in which you must maintain proficiency. Although you may not have to control the airplane solely by reference to flight instruments, this is the first IFR ability you acquired and once properly learned is not easily lost. What is of primary benefit on this type of flight is the regular exposure to clearance interpretation and adherence, navigation and position determination by radio reference, the necessity of planning ahead and developing sound IFR work habits, working with ATC, and the use of standard instrument approach procedures. You will gain familiarity and develop proficiency in all these areas on VFR/IFR flights as well as when you are completely on instruments.

The flights need not be long to develop this proficiency. Exposure to preflight planning with the departure, en route, and approach under ATC control is as effective on a flight with an en route time of 20 minutes as it is on one of four hours. The important thing is the procedural practice you receive.

The flight does not need to begin or end at a controlled airport. You can file by telephone and pick up your IFR clearance in the air if you depart from an uncontrolled airport. This can be done through FSS or directly from the ARTCC if a direct or remote communications outlet is available. If your destination airport is uncontrolled, file to a nearby airport that has an approved instrument approach. After the practice there, cancel your IFR flight plan and complete the flight VFR.

The time required to file, and fly IFR usually does not involve much more additional time than a VFR flight. Preparing a simple flight plan and filing the request does not take much time once you become accustomed to doing it. On trips you fly often, the same flight plan can be used over and over again since facilities do not change too often. IFR routes seldom require much extra flying time when compared to VFR routes and direct routes will frequently be approved by ATC when requested.

Approaching an unfamiliar airport is much easier, especially in urban areas or in restricted visibility, when you are under ATC control. Instead of delaying you initial contact with the tower until your are almost in the Class D airspace, you will make radio fix reports, receive vectors, and always know your position. You not only approach the correct airport, but you are often aligned with the landing runway well out from the airport.

So, file regularly to stay current and up-to-date on IFR procedures.

POINT 2

Always have an IFR hood conveniently available in the airplane so that, when accompanied by a qualified safety pilot, you may use it to get IFR practice and log the required hours toward the minimum recent experience requirements for IFR (6 hours in the preceding 6 months and 6 instrument approaches). We recommend that this hood be a collapsible type that can be carried in your flight bag. Then it is always available, even if you are not in your own plane.

Be sure the person serving as your safety pilot is at least a private pilot and rated in the category (airplane) and the appropriate class (single-engine or multiengine). Also, insure that the safety pilot's field of view is not blocked in any way. You and the safety pilot should decide beforehand on procedures to be used to deal with possible collision hazards.

POINT 3

Since the hood is uncomfortable, it is much easier to select an altitude that will keep you in the clouds whenever possible. This actual IFR time will not only help you maintain proficiency, but often results in a more comfortable flight than flying under the clouds or on top. If the air is smooth in the clouds, you are more comfortable and avoid the necessity of constant scanning for VFR traffic— often a quite tiring necessity in hazy conditions. You also avoid the heat and glare of the sun, especially in warm weather. If your trip is a long one and you tire of IFR flying, you can always request an altitude change to VFR conditions.

POINT 4

An airline pilots, highly skilled and IFR current, are required to take recurrent training (and evaluation) every six months. Even though there may be no deterioration of skills, new techniques or procedures may be developed that should be brought to the pilot's attention. For the non-professional pilot who flies much less frequently, refresher training is even more important. He has no chief pilot to inform him of new mandatory FAR's, no check pilot to make him aware of new techniques, and he hasn't the hours of IFR flying that regularly expose the pilot to even the most infrequently used procedures. The amount of refresher time need not be excessive. A one day training session combining ground, simulator, and flight is generally adequate for pilots flying 100 to 200 hours per year.

Enjoy the increased flexibility and reliability your instrument rating provides. Follow the *Four Point Program* and, above all, fly safely. See you next year!

AMERICAN FLYERS

APPENDIX A

GENERAL

AIRPLANE INFORMATION*

	Cessna 172P (KIAS)	C172RG (KIAS)	
V_{SO}/V_{S1}	33/44	42/51	
Normal lift-off speed	55	55	
V_X (sea level)	60	67	
V_Y (sea level)	76	84	
Normal climb	70-85	85-95	
Normal cruise	110	130	
Instrument approach	90	90 (gear down)	
Best glide speed	65	73	
V_A (gross weight)	99	106	
V_{NO}	127	145	
V_{NE}	158	164	
V_{FE} 0° - 10°	110	130	
10° - 30°	85	100	
V_{LO}	N/A	140	
V_{LE}	N/A	164	
Usable fuel	40 gal	62 gal	
Avg fuel consumption	9 gal/hr	10 gal/hr	
Min fuel grade	100LL	100LL	
Endurance	4:10	6:00	
Oil Capacity	7 qts	8 qts	
Oil (minimum)	5 qts	6 qts	
Max gross weight	2400 lbs	2650 lbs	

* Values are typical. Refer to AFM/POH for information applicable to a particular airplane.

PERFORMANCE CRITERIA

Aircraft Make/Model Cessna 172P HP 160 Prop FP

ITEM	MP	RPM	SPEED	RATE	GEAR	FLAPS
Climb	X	FULL	80	500 FPM	X	UP
Cruise	X	2300	100	LEVEL	X	UP
En Route Descent	X	2100	100	500 FPM	X	UP
Approach	N/A	N/A	N/A	LEVEL	UP	N/A
Approach Descent	N/A	N/A	N/A	500 FPM	UP	N/A
Approach	X	2100	90	LEVEL	DN	UP
Approach Descent	X	1700	90	500 FPM	DN	UP

Bank Angle for Standard Rate Turn: Cruise 17° Approach 16°

Notes:

PERFORMANCE CRITERIA

Aircraft Make/Model Cessna 172RG HP 180 Prop CS

ITEM	MP	RPM	SPEED	RATE	GEAR	FLAPS
Climb	25	2500	90	500 FPM	UP	UP
Cruise	23	2300	120	LEVEL	UP	UP
En Route Descent	20	2300	120	500 FPM	UP	UP
Approach	20	2300	90	LEVEL	UP	UP
Approach Descent	15	2300	90	500 FPM	UP	UP
Approach	21	2300	90	LEVEL	DN	UP
Approach Descent	16	2300	90	500 FPM	DN	UP

Bank Angle for Standard Rate Turn: Cruise 19° Approach 16°

Notes:

PERFORMANCE CRITERIA

Aircraft Make/Model ______________________ HP ______ Prop______

ITEM	MP	RPM	SPEED	RATE	GEAR	FLAPS
Climb	____	______	______	______	_____	______
Cruise	____	______	______	LEVEL	_____	______
En Route Descent	____	______	______	500 FPM	_____	______
Approach	____	______	______	LEVEL	UP	______
Approach Descent	____	______	______	500 FPM	UP	______
Approach	____	______	______	LEVEL	DN	______
Approach Descent	____	______	______	500 FPM	DN	______

Bank Angle for Standard Rate Turn: Cruise __________ Approach ____________

Notes: ____

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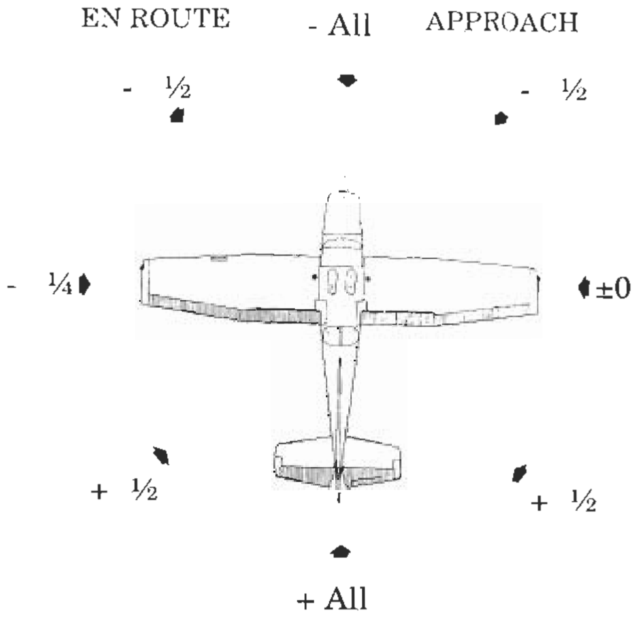
QUADRANT METHOD OF DETERMINING GROUNDSPEED

To get a quick estimate of ground speed, apply the corrections to the true airspeed as indicated. For example, if you have a quartering headwind, subtract 1/2 the wind speed from the true airspeed to obtain the ground speed. While this method is not exactly correct, it is quite accurate for its intended purpose. Note that for approach estimates, since the distances are relatively short, the effects of a direct crosswind can safely be ignored.



For those students who like to use rules of thumb to come up with a quick ETA while en route, or to determine when they are approximately one mile out during an approach, the following speed factors may be helpful. Remember, these are no substitute for careful and accurate flight planning on the ground before takeoff when there is plenty of time. Remember, if applied to airspeed the solution is for a no wind situation. Applied to known or estimated ground speed, the results are very accurate.

SPEED	SPEED FACTOR
90	.7
100	.6
120	.5
130	.4 + 1 min.
150	.4
200	.3

Multiply the known mileage by the appropriate speed factor. This gives the time to cover that distance. Example: At 100 K, you will travel 20 NM in (20 X .6) = 12 minutes.

To determine when you are approximately one mile from the airport during the approach, subtract the number of seconds below from your time to missed approach.

GROUND SPEED	SECONDS FOR 1 MILE
70	52
80	45
90	40
100	36
110	33
120	30
125	29
130	28
140	26

Example: GS is 80K, time from FAF to MAP is 3:45. At 3:00 after FAF you will be about 1 mile out.

AMERICAN FLYERS

APPENDIX B

AERONAUTICAL INFORMATION MANUAL

(EXCERPTS FOR INSTRUMENT PILOTS)

CHAPTER 1 SECTION 1
RADIO NAVIGATION AIDS

1-1-1. GENERAL

Various types of air navigation aids are in use today, each serving a special purpose. These aids have varied owners and operators, namely: the Federal Aviation Administration (FAA), the military services, private organizations, individual states and foreign governments. The FAA has the statutory authority to establish, operate, maintain air navigation facilities and to prescribe standards for the operation of any of these aids which are used for instrument flight in federally controlled airspace. These aids are tabulated in the Airport/Facility Directory.

1-1-2. NONDIRECTIONAL RADIO BEACON (NDB)

a. A low or medium frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft properly equipped can determine bearings and "home" on the station. These facilities normally operate in the frequency band 190 to 535 kHz and transmit a continuous carrier with either 400 or 1020 Hz modulation. All radio beacons except the compass locators transmit a continuous three-letter identifier in code except during voice transmissions.

b. When a radio beacon is used in conjunction with the Instrument Landing System markers, it is called a Compass Locator.

c. Voice transmissions are made on radio beacons unless the letter "W" (without voice) is included in the class designator (HW).

d. Radio beacons are subject to disturbances that may result in erroneous bearing information. Such disturbances result from such factors as lightning, precipitation static, etc. At night, radio beacons are vulnerable to interference from distant stations. Nearly all disturbances which affect the ADF bearing also affect the facility's identification. Noisy identification usually occurs when the ADF needle is erratic. Voice, music or erroneous identification may be heard when a steady false bearing is being displayed. Since ADF receivers do not have a "flag" to warn the pilot when erroneous bearing information is being displayed, the pilot should continuously monitor the NDB's identification.

1-1-3. VHF OMNI-DIRECTIONAL RANGE (VOR)

a. VORs operate within the 108.0 to 117.95 mHz frequency band and have a power output necessary to provide coverage within their assigned operational service volume. They are subject to line of sight restrictions, and the range varies proportionally to the altitude of the receiving equipment. The normal service ranges for the various classes of VORs are given in paragraph 1-8d VOR/DME/TACAN STANDARD SERVICE VOLUMES (SSV).

b. Most VORs are equipped for voice transmission on the VOR frequency. VORs without voice capability are indicated by the letter "W" (without voice) included in the class designator (VORW).

c. The only positive method of identifying a VOR is by its Morse Code identification or by the recorded automatic voice identification which is always indicated by use of the word "VOR" following the range's name. Reliance on determining the identification of an omnirange should never be placed on listening to voice transmissions by the Flight Service Station (FSS) (or approach control facility) involved. Many FSSs remotely operate several omniranges with different names. In some cases, none of the VORs have the name of the "parent" FSS. During periods of maintenance, the facility may radiate a T-E-S-T code (- . ... -).

d. Voice identification has been added to numerous VORs. The transmission consists of a voice announcement, "AIRVILLE VOR" alternating with the usual Morse Code identification.

e. The effectiveness of the VOR depends upon proper use and adjustment of both ground and airborne equipment.

1. Accuracy: The accuracy of course alignment of the VOR is excellent, being generally plus or minus 1 degree.

2. Roughness: On some VORs, minor course roughness may be observed, evidenced by course needle or brief flag alarm activity (some receivers are more susceptible to these irregularities than others). At a few stations, usually in mountainous terrain, the pilot may occasionally observe a brief course needle oscillation, similar to the indication of "approaching station". Pilots flying over unfamiliar routes are cautioned to be on the alert for these varagies, and in particular, to use the "to/from" indicator to determine station passage.

(a) Certain propeller RPM settings or helicopter rotor speeds can cause the VOR Course Deviation Indicator to fluctuate as much as plus or minus six degrees. Slight changes to the RPM setting will usually smooth out this roughness. Pilots are urged to check for this modulation phenomenon prior to reporting a VOR station or aircraft equipment for unsatisfactory operation.

1-1-4. VOR RECEIVER CHECK

a. The FAA VOR test facility (VOT) transmits a test signal which provides users a convenient means to determine the operational status and accuracy of a VOR receiver while on the ground where a VOT is located. The airborne use of VOT is permitted; however, its use is strictly limited to those areas/altitude specifically authorized in the Airport/Facility Directory or appropriate supplement.

b. To use the VOT service, tune in the VOT frequency on your VOR receiver. With the Course Deviation Indicator (CDI) centered, the omni-bearing selector should read 0 degrees with the to/from indicator showing "from" or the omni-bearing selector should read 180 degrees with the to/from indicator showing "to". Should the VOR receiver operate an RMI (Radio Magnetic Indicator), it will indicate 180 degrees on any omni-bearing selector (OBS) setting. Two means of identification are used. One is a series of dots and the other is a continuous tone. Information concerning an individual test signal can be obtained from the local FSS.

c. Periodic VOR receiver calibration is most important. If a receiver's Automatic Gain Control or modulation circuit deteriorates, it is possible for it to display acceptable accuracy and sensitivity close into the VOR or VOT and display out-of-tolerance readings when located at greater distances where weaker signal areas exist. The likelihood of this deterioration varies between receivers, and is generally considered a function of time. The best assurance of having an accurate receiver is periodic calibration. Yearly intervals are recommended at which time an authorized repair facility should recalibrate the receiver to manufacturer's specifications.

d. Federal Aviation Regulations (Part 91.171) provides for certain VOR equipment accuracy checks prior to flight under instrument flight rules. To comply with this requirement and to ensure satisfactory operation of the airborne system, the FAA has provided pilots with the following means of checking VOR receiver accuracy:

1. VOT or a radiated test signal from an appropriately rated radio repair station.

2. Certified airborne check points.

3. Certified check points on the airport surface.

e. A radiated VOR test signal (VOT) from an appropriately rated radio repair station serves the same purpose as an FAA VOR test signal and the check is made in much the same manner as a VOT with the following differences:

1. The frequency normally approved by the Federal Communications Commission is 108.0 mHz.

2. Repair stations are not permitted to radiate the VOR test signal continuously; consequently, the owner or operator must make arrangements with the repair station to have the test signal transmitted. This service is not provided by all radio repair stations. The aircraft owner or operator must determine which repair station in the local area provides this service. A representative of the repair station must make an entry into the aircraft logbook or other permanent record certifying to the radial accuracy and the date of transmission. The owner, operator or representative of the repair station may accomplish the necessary checks in the aircraft and make a logbook entry stating the results. It is necessary to verify which test radial is being transmitted and whether you should get a “to” or “from” indication.

f. Airborne and ground check points consist of certified radials that should be received at specific points on the airport surface or over specific landmarks while airborne in the immediate vicinity of the airport.

1. Should an error in excess of plus or minus 4 degrees be indicated through use of a ground check, or plus or minus 6 degrees using the airborne check, IFR flight shall not be attempted without first correcting the source of the error.

CAUTION: No correction other than the correction card figures supplied by the manufacturer should be applied in making these VOR receiver checks.

2. Locations of airborne check points, ground check points and VOT's are published in the Airport/Facility Directory.

3. If a dual system VOR (units independent of each other except for the antenna) is installed in the aircraft, one system may be checked against the other. Tune both systems to the same VOR ground facility and note the indicated bearing to the station. The maximum permissible variations between the two indicated bearings is 4 degrees.

1-1-5. TACTICAL AIR NAVIGATION (TACAN)

a. For reasons peculiar to military or naval operations (unusual siting conditions, the pitching and rolling of a naval vessel, etc.) the civil VOR/DME system of air navigation was considered unsuitable for military or naval use. A new navigation system, TACAN, was therefore developed by the military and naval forces to more readily lend itself to military and naval requirements. As a result, the FAA has been in the process of integrating TACAN facilities with the civil VOR/DME program. Although the theoretical, or technical principles of operation of TACAN equipment are quite different from those of VOR/DME facilities, the end result, as far as the navigating pilot is concerned, is the same. These integrated facilities are called VORTAC's.

b. TACAN ground equipment consists of either a fixed or mobile transmitting unit.

The airborne unit in conjunction with the ground unit reduces the transmitted signal to a visual presentation of both azimuth and distance information. TACAN is a pulse system and operates in the UHF band of frequencies. Its use requires TACAN airborne equipment and does not operate through conventional VOR equipment.

1-1-6. VHF OMNI-DIRECTIONAL RANGE/TACTICAL AIR NAVIGATION (VORTAC)

a. A VORTAC is a facility consisting of two components, VOR and TACAN, which provides three individual services: VOR azimuth, TACAN azimuth and TACAN distance (DME) at one site. Although consisting of more than one component, incorporating more than one operating frequency, and using more than one antenna system, a VORTAC is considered to be a unified navigational aid. Both components of a VORTAC are envisioned as operating simultaneously and provided the three services at all times.

b. Transmitted signals of VOR and TACAN are each identified by three-letter code transmission and are interlocked so that pilots using VOR azimuth with TACAN distance can be assured that both signals are from the same ground station. The frequency channels of the VOR and the TACAN are "paired" in accordance with a national plan to simplify airborne operation.

1-1-7. DISTANCE MEASURING EQUIPMENT (DME)

a. In the operation of DME, paired pulses at a specific spacing are sent out from the aircraft (this is the interrogation) and are received at the ground station. The ground station (transponder) then transmits paired pulses back to the aircraft at the same pulse spacing but on a different frequency. The time required for the round trip of this signal exchange is measured in the airborne DME unit and is translated into distance (Nautical Miles) from the aircraft to the ground station.

b. Operating on the line-of-sight principle, DME furnishes distance information with a very high degree of accuracy. Reliable signals may be received at distances of up to 199 NM at line-of-sight altitude with an accuracy of better than ½ mile or 3 percent of the distance, whichever is greater. Distance information received from DME equipment is SLANT RANGE distance and not actual horizontal distance.

c. DME operates on frequencies in the UHF spectrum between 962 mHz and 1213 mHz. Aircraft equipped with TACAN equipment will receive distance information from a VORTAC automatically, while aircraft equipped with VOR must have a separate DME airborne unit.

d. VOR/DME, VORTAC, ILS/DME, and LOC/DME navigation facilities established by the FAA provide course and distance information from collocated components under a frequency pairing plan. Aircraft receiving equipment which provides for automatic DME selection assures reception of azimuth and distance information from a common source when designated VOR/DME, VORTAC, ILS/DME, and LOC/DME are selected.

e. Due to the limited number of available frequencies, assignment of paired frequencies is required for certain military noncollocated VOR and TACAN facilities which serve the same area but which may be separated by distances up to a few miles. The military is presently undergoing a program to collocate VOR and TACAN facilities or to assign nonpaired frequencies to those that cannot be collocated.

f. VOR/DME, VORTAC, ILS/DME, and LOC/DME facilities are identified by synchronized identifications which are transmitted on a time share basis. The VOR or localizer portion of the facility is identified by a coded tone modulated at 1020 Hz or a combination of code and voice. The TACAN or DME is identified by a coded tone modulated at 1350 Hz. The DME or TACAN coded identification is transmitted one time for each three or four times that the VOR or localizer coded identification is transmitted. When either the VOR or the DME is inoperative, it is important to recognize which identifier is retained for the operative facility. A single coded identification with a repetition interval of approximately 30 seconds indicates that the DME is operative.

g. Aircraft equipment which provides for automatic DME selection assures reception of azimuth and distance information from a common source when designated VOR/DME, VORTAC, and ILS/DME navigation facilities are selected. Pilots are cautioned to disregard any distance displays from automatically selected DME equipment when VOR or ILS facilities, which do not have the DME feature installed, are being used for position determination.

1-1-8. NAVAID SERVICE VOLUMES

a. Most air navigation radio aids which provide positive course guidance have a designated standard service volume (SSV). The SSV defines the reception limits of unrestricted NAVAIDS which are usable for random/unpublished route navigation.

b. A NAVAID will be classified as restricted if it does not conform to flight inspection signal strength and course quality standards throughout the published SSV. However, the NAVAID should not be considered usable at altitudes below that which could be flown while operating under random route IFR conditions (Part 91.177), even though these altitudes may lie within the designated SSV. Service volume restrictions are first published in the Notices to Airmen (NOTAM) and then with the alphabetical listing of the NAVAID's in the Airport/Facility Directory.

c. Standard Service Volume limitations do not apply to published IFR routes or procedures.

d. Standard Service Volumes are indicated in Table 1-8. The SSV of a station is indicated by using the class designator as a prefix to the station type designation (e.g. TVOR, LVOR/DME, HVORTAC).

e. NDB's are classified according to their intended use. The ranges of NDB service volumes are shown in Table 1-8.

1-1-9. MARKER BEACON

a. Marker beacons serve to identify a particular location in space along an airway or on the approach to an instrument runway. This is done by means of a 75 mHz transmitter which transmits a directional signal to be received by aircraft flying overhead. These markers are generally used in conjunction with en route NAVAIDs and ILS as point designators.

b. There are three classes of en route marker beacons: Fan Marker (FM), Low Powered Fan Markers (LFM) and Z Markers. They transmit the letter "R" (dot dash dot) identification, or (if additional markers are in the same area) the letter "K", "P", "X", or "Z".

1. Class FM's are used to provide a positive identification of positions at definite points along the airways. The transmitters have a power output of approximately 100 watts. Two type of antenna array are used with class FM's.

(a) The first type used, and generally referred to as the standard type, produces an elliptical shaped pattern, which, at an elevation of 1,000 feet above the station, is about 4 NM wide and 12 NM long. At 10,000 feet the pattern widens to about 12 NM wide and 35 NM long.

(b) The second array produces a dumbbell or bone shaped pattern, which, at the "handle", is about three miles wide at 1,000 feet. The bone shaped marker is preferred at approach control locations where "timed" approaches are used.

2. The class LFM or low powered FM's have a rated power output of 5 watts. The antenna array produces a circular pattern which appears elongated at right angles to the airway due to the directional characteristics of the aircraft receiving antenna.

3. The Station Location, or Z Marker, was developed to meet the need for a positive position indicator for aircraft operating under instrument flight conditions to alert the pilot when passing directly over a low frequency navigational aid. The marker consists of a 5 watt transmitter and a directional antenna array which is located on the range plot between the towers or the loop antennas.

1-1-10. INSTRUMENT LANDING SYSTEM (ILS)

a. GENERAL

1. The ILS is designed to provide an approach path for exact alignment and descent of an aircraft on final approach to a runway.

2. The ground equipment consists of two highly directional transmitting systems and, along the approach, three (or fewer) marker beacons. The directional transmitters are known as the localizer and glide slope transmitters.

3. The system may be divided functionally into three parts:

(a) Guidance information - localizer, glide slope

(b) Range information - marker beacon, DME

(c) Visual information - approach lights, touchdown and centerline lights, runway lights

4. Compass locators located at the Outer Marker (OM) or Middle Marker (MM) may be substituted for marker beacons. DME, when specified in the procedure, may be substituted for the OM.

5. Where a complete ILS system is installed on each end of a runway; (i.e. the approach end of Runway 4 and the approach end of Runway 22) the ILS systems are not in service simultaneously.

b. LOCALIZER

1. The localizer transmitter operates on one of 40 ILS channels within the frequency range of 108.10 to 111.95 mHz. Signals provide the pilot with course guidance to the runway centerline.

2. The approach course of the localizer is called the front course and is used with other functional parts, e.g. glide slope, marker beacons, etc. The localizer signal is transmitted at the far end of the runway. It is adjusted for a course width of (full scale fly-left to a full scale fly-right) of 700 feet at the runway threshold.

3. The course line along the extended centerline of a runway, in the opposite direction to the front course is called the back course.

CAUTION: Unless the aircraft's ILS equipment includes reverse sensing capability, when flying inbound on the back course it is necessary to steer in the direction opposite the needle deflection when making corrections from off-course to on-course. This "fly away from the needle" is also required when flying outbound on the front course of the localizer. DO NOT USE BACK COURSE SIGNALS for approach unless a BACK COURSE APPROACH PROCEDURE is published for that particular runway and the approach is authorized by ATC.

4. Identification is in International Morse Code and consists of a three-letter identifier preceded by the letter I (..) transmitted on the localizer frequency.

EXAMPLE: I-DIA

5. The localizer provides course guidance throughout the descent path to the runway threshold from a distance of 18 NM from the antenna between an altitude of 1,000 feet above the highest terrain along the course line and 4,500 feet above the elevation of the antenna site. Proper off-course indications are provided throughout the following angular areas of the operational service volume:

(a) To 10 degrees either side of the course along a radius of 18 NM from the antenna, and

(b) From 10 to 35 degrees either side of the course along a radius of 10 NM.

6. Unreliable signals may be received outside these areas.

1-1-13. NAVAID IDENTIFIER REMOVAL DURING MAINTENANCE

During periods of routine or emergency maintenance, coded identification (or code and voice, where applicable) is removed from certain FAA NAVAID's. Removal of identification serves as a warning to pilots that the facility is officially off the air for tune-up or repair and may be unreliable even though intermittent or constant signals are received.

NOTE- During periods of maintenance VHF ranges may radiate a T-E-S-T code (- . ... -).

1-1-14. NAVAID'S WITH VOICE

a. Voice equipped en route radio navigation aids are under the operational control of either an FAA AFSS or an approach control facility. The voice communication is available on some facilities. The HIWAS broadcast capability on selected VOR sites is in the process of being implemented throughout the conterminous United States and does not provide voice communication. The availability of two-way voice communication and HIWAS is indicated in the A/FD and aeronautical charts.

b. Unless otherwise noted on the chart, all radio navigation aids operate continuously except during shutdowns for maintenance. Hours of operation of facilities not operating continuously are annotated on charts and in the A/FD.

1-1-15. USER REPORTS ON NAVAID PERFORMANCE

a. Users of the National Airspace System (NAS) can render valuable assistance in the early correction of NAVAID malfunctions by reporting their observations of undesirable NAVAID performance. Although NAVAID's are monitored by electronic detectors, adverse effects of electronic interference, new obstructions or changes in terrain near the NAVAID can exist without detection by the ground monitors. Some of the characteristics of malfunctions or deteriorating performance which should be reported are: erratic course or bearing indications; intermittent, or full, flag alarm; garbled, missing, or obviously improper coded identification; poor quality communications reception; or, in the case of frequency interference, an audible hum or tone accompanying radio communications or NAVAID identification.

b. Reporters should identify the NAVAID, location of the aircraft, time of the observation, type of aircraft and describe the condition observed; type of receivers in use is also useful information. Reports can be made in any of the following ways:

1. Immediate report by direct radio communication to the controlling Air Route Traffic Control Center (ARTCC), Control Tower, or FSS. This method provides the quickest result.
2. By telephone to the nearest FAA facility.
3. By FAA Form 8000-7, Safety Improvement Report, a postage-paid card designed for this purpose. These cards may be obtained at FAA FSSs, General Aviation District Offices, Flight Standards District Offices, and General Aviation Fixed Base Operations.

c. In aircraft that have more than one receiver, there are many combinations of possible interference between units. This can cause either erroneous navigation indications or, complete or partial blanking out of the communications. Pilots should be familiar enough with the radio installation of the particular airplanes they fly to recognize this type of interference.

1-1-22. GLOBAL POSITIONING SYSTEM

a. GENERAL

1. GPS is a United States satellite-based radio navigational, positioning, and time transfer system operated by the Department of Defense (DoD). The system provides highly accurate position and velocity information and precise time on a continuous global basis to an unlimited number of properly-equipped users. The system is unaffected by weather and provides a worldwide common grid reference system based on the earth-fixed coordinate system. For its earth model, GPS uses the World Geodetic System of 1984 (WGS-84) datum.

2. GPS provides two levels of service: Standard Positioning Service (SPS) and Precise Positioning Service (PPS). SPS provides, to all users, horizontal positioning accuracy to 100 meters with a probability of 95 percent and 300 meters with a probability of 99.99 percent. PPS is more accurate than SPS; however, this is limited to authorized U.S. and allied military, federal government, and civil users who can satisfy specific U.S. requirements.

3. GPS operation is based on the concept of ranging and triangulation from a group of satellites in space which act as precise reference points. A GPS receiver measures distance from a satellite using the travel time of a radio signal. Each satellite transmits a specific code, called a course/acquisition (CA) code, which contains information on the satellite's position, the GPS system time, its clock error, and the health and accuracy of the transmitted data. GPS satellites have very accurate atomic clocks in order to calculate signal travel time. Knowing the speed at which the signal traveled (approximately 186,000 miles per second) and the exact broadcast time, the distance traveled by the signal can be computed from the arrival time.

4. The GPS receiver matches each satellite's CA code with an identical copy of the code contained in the receiver's database. By shifting its copy of the satellite's code, in a matching process, and by comparing this shift with its internal clock, the receiver can calculate how long it took the signal to travel from the satellite to the receiver. The distance derived from this method of computing distance is called a pseudo-range because it is not a direct measurement of distance, but a measurement based on time. Pseudo-

range is subject to several error sources; for example, an ionospheric delay, and time disparities between the atomic clocks in the satellites and the GPS receiver.

5. In addition to knowing the distance to a satellite, a receiver needs to know the satellite's exact position in space; this is known as its ephemeris. Each satellite's signal transmits ephemeris information about its exact orbital location. The GPS receiver uses this information to precisely establish the position of the satellite.

6. Using the calculated pseudo-range and the position information supplied by the satellite, the GPS receiver mathematically determines its position by triangulation. The GPS receiver needs at least three satellites with timing corrections from a fourth satellite to yield an unaided, unique, and true three-dimensional position (latitude, longitude, and altitude) and time solution. The GPS receiver computes navigational values such as distance and bearing to a waypoint, ground speed, etc. by using the aircraft's known latitude/longitude and referencing these to a database built into the receiver.

7. The GPS constellation of 24 satellites is designed so that a minimum of five are always observable by a user anywhere on earth. The receiver uses data from the best four satellites above its horizon, adding signals from one as its drops signals from another, to continually calculate its position.

8. The GPS receiver verifies the integrity of signals received from the GPS constellation through receiver autonomous integrity monitoring (RAIM) by determining if a satellite is providing corrupted information. At least one satellite, in addition to those required for navigation, must be in view for the receiver to perform RAIM function; thus, RAIM needs 5 satellites in view, or 4 satellites and baro-aiding to work. RAIM needs 6 satellites in view (or 5 satellites and baro-aiding) to isolate the corrupt satellite signal and remove it from the navigation solution. Baro-aiding is a method of augmenting the GPS solution equation by using a non-satellite input source. Baro-aiding uses the pressure altitude corrected for the local barometric pressure setting to provide accurate altitude information to the GPS receiver.

9. The Department of Defense declared initial operational capability of the U.S. Global Positioning System (GPS) on December 8, 1993. The Federal Aviation Administration (FAA) has granted approval for U.S. civil operators to use GPS equipment as a primary means of navigation in oceanic airspace and certain remote areas. GPS equipment may be used as a supplemental means of IFR navigation for domestic en route, terminal operations, and certain instrument approach procedures (IAP's). This approval permits the use of GPS in a manner that is consistent with current navigation requirements.

b. GENERAL REQUIREMENTS

1. General Requirements: Authorization to conduct any GPS operation under IFR requires that:

(a) The GPS navigation equipment used must be approved in accordance with the requirements specified in TSO C-129, or equivalent, and the installation must be made in accordance with Notice 8110.47 or 8110.48, the equivalent Advisory Circular or the Flight Standards/Aircraft Certification (AFS/AIR) joint guidance memorandum dated July 20, 1992. Equipment approved to TSO C-115a do not meet the requirements of TSO C-129.

(b) Aircraft using GPS equipment under IFR must be equipped with an approved and operational alternate means of navigation appropriate to the flight.

Active monitoring of the alternative navigation equipment is not required if the installation uses RAIM for integrity monitoring. For these systems, active monitoring by the flight crew is only required when the RAIM capability of the GPS equipment is lost.

(c) Procedures must be established for use in the event that the loss of RAIM capability predicted to occur. In situations where this is encountered, the flight must rely on other approved equipment, delay departure, or cancel the flight.

(d) The GPS operation must be conducted in accordance with the FAA-Approved aircraft flight manual (AFM) or flight manual supplement.

(e) Aircraft navigating by GPS are considered to be RNAV aircraft. Therefore, the appropriate equipment suffix must be included in the ATC flight plan.

(f) Prior to any GPS IFR operation, the pilot should review the appropriate NOTAM's. NOTAM's will be issued to announce outages. Pilots may obtain these NOTAM's from FSS briefers upon request.

(g) Air carrier and commercial operators conducting GPS IFR operations shall meet the appropriate provisions of their approved operations specifications.

c. USE OF GPS FOR OCEANIC, DOMESTIC EN ROUTE, and TERMINAL AREA OPERATIONS

1. GPS IFR operations in oceanic areas can be conducted as soon as the proper avionics systems are installed provided all general requirements are met. A GPS installation with TSO C-129 authorization in class A1, A2, B1, B2, C1, or C2 may be used to replace one of the other approved means of long-range navigation such as dual INS or dual Omega. A single GPS installation with these classes of equipment which provides RAIM for integrity monitoring may also be used on short oceanic routes which have only required one means of long-range navigation.

2. GPS domestic en route and terminal IFR operations can be conducted as soon as the proper avionics systems are installed provided all general requirements are met. The avionics necessary to receive all of the ground-based facilities appropriate for the route to the destination airport and any required alternate airport must be installed an operational. The ground-based facilities necessary for these routes must also be operational.

3. The GPS Approach Overlay Program permits pilots to use GPS avionics under IFR for flying existing instrument approach procedures, except localizer (LOC), Localizer directional aid (LDA), and simplified directional facility (SDF) procedures. In the future, stand alone GPS approaches will be developed and introduced into the NAS.

4. GPS IFR approach operations can be conducted in accordance with Phase I, Phase II or Phase III of the GPS Approach Overlay Program, as appropriate, as soon as the proper avionics systems are installed and the following requirements are met. This general approval to use GPS to fly instrument approaches is limited to U.S. airspace. The use of GPS in any other airspace must be expressly authorized by the Administrator. GPS instrument approach operations outside the United States must also be authorized by the appropriate sovereign authority.

d. EQUIPMENT AND DATABASE REQUIREMENTS.

1. Authorization to fly approaches under IFR using GPS avionics systems require that:

(a) A pilot use GPS avionics with TSO C-129 authorization in class A1, B1, B3, C1, or C3; and

(b) The specific approach procedure to be flown must be retrievable from the airborne navigation database associated with the TSO C-129 equipment.

NOTE- GPS AVIONICS SYSTEMS INSTALLED AND OPERATED IN ACCORDANCE WITH THE AFS/AIR GUIDANCE DATED JULY 20, 1992, ARE NOT APPROVED FOR "OVERLAY" PROGRAM PHASE II OR III.

e. PHASES OF THE APPROACH OVERLAY PROGRAM.

1. Phase I: Under Phase I, GPS avionics can be used as the IFR flight guidance system for approaches as long as the ground-based NAVAID(s) required by the published procedure is operational and actively monitored while conducting the approach. Approach clearances must be requested and approved using the published title of the existing approach procedure such as "VOR Rwy 24."

2. Phase II: Under Phase II, GPS avionics can be used as the IFR flight guidance system for an approach without actively monitoring the ground-based NAVAID(s) which defines the approach. However, the ground-based NAVAID(s) must be operational. In addition, the related avionics must be installed an operational but need not be turned-on during the approach. Approaches must be requested and approved using the published title of the existing approach procedure such as "VOR Rwy 24."

3. Phase III: Phase III begins when FAR Part 97 instrument approach procedures are re-titled "GPS or VOR Rwy 24." When this phase begins, ground-based NAVAID's are not required to be operational and the associated aircraft avionics need not be installed, operational, turned-on or monitored. GPS approaches will be requested and approved using the GPS title, such as "GPS Rwy 24." Pending FAA's publication of FAR Part 97 GPS approaches, stand alone GPS approaches will be developed and authorized on a case-by-case basis.

NOTE- IN EACH PHASE, ANY REQUIRED ALTERNATE AIRPORT MUST HAVE AN APPROVED INSTRUMENT APPROACH PROCEDURE, OTHER THAN GPS OR LORAN-C, WHICH IS ANTICIPATED TO BE OPERATIONAL AND AVAILABLE AT THE ESTIMATED TIME OF ARRIVAL.

SECTION 2 RADAR SERVICES

1-2-1. RADAR

a. Capabilities

1. Radar is a method whereby radio waves are transmitted into the air and are then received when they have been reflected by an object in the path of the beam. Range is determined by measuring the time it takes (at the speed of light) for the radio wave to go out to the object and then return to the receiving antenna. The direction of a detected object from a radar site is determined by the position of the rotating antenna when the reflected portion of the radio wave is received.

2. More reliable maintenance and improved equipment have reduced radar system failure to a negligible factor. Most facilities actually have some components duplicated- one operating and another which immediately takes over when a malfunction occurs to the primary component.

b. Limitations

1. It is very important for the aviation community to recognize the fact that there are limitations to radar service and that ATC controllers may not always be able to issue traffic advisories concerning aircraft which are not under ATC control and cannot be seen on radar.

(a) The characteristics of radio waves

are such that they normally travel in a continuous straight line unless they are:

(1) "Bent" by abnormal atmospheric phenomena such as temperature inversions;

(2) Reflected or attenuated by dense objects such as heavy clouds, precipitation, ground obstacles, mountains, etc.; or

(3) Screened by high terrain features.

(b) The bending of radar pulses, often called anomalous propagation or ducting, may cause many extraneous blips to appear on the radar operator's display if the beam has been bent toward the ground or may decrease the detection range if the beam is bent upward. It is difficult to solve for the effects of anomalous propagation, but using beacon radar and electronically eliminating stationary and slow moving targets by a method called moving target indicator (MTI) usually negate the problem.

(c) Radar energy that strikes dense objects will be reflected and displayed on the operator's scope thereby blocking out aircraft at the same range and greatly weakening or completely eliminating the display of targets at a greater range. Again, radar beacon and MTI are very effectively used to combat ground clutter and weather phenomena, and a method of circularly polarizing the radar beam will eliminate some weather returns. A negative characteristic of MTI is that an aircraft flying at a speed that coincides with the canceling signal of the MTI (tangential or "blind" speed) may not be displayed to the radar controller.

(d) Relatively low altitude aircraft will not be seen if they are screened by mountains or are below the radar beam due to earth curvature. The only solution to screening is the installation of strategically placed multiple radars which has been done in some areas.

(e) The are several other factors which affect radar control. The amount of reflective surface of an aircraft will determine the size of the radar return. Therefore, a small light airplane or a sleek jet fighter will be more difficult to see on radar than a large commercial jet or military bomber. Here again, the use of radar beacon is invaluable if the aircraft is equipped with an airborne transponder. All ARTCCs' radars in the conterminous U.S. and many airport surveillance radars have the capability to interrogate MODE C and display altitude information to the controller from appropriately equipped aircraft. However, there are a number of airport surveillance radars that don't have Mode C display capability and therefore altitude information must be obtained from the pilot.

(f) At some locations within the ATC en route environment, secondary-radar-only (no primary radar) gap filler radar systems are used to give lower altitude radar coverage between two larger radar systems, each of which provides both primary and secondary radar coverage. In those geographical areas served by secondary radar only, aircraft without transponders cannot be provided with radar service. Additionally, transponder equipped aircraft cannot be provided with radar advisories concerning primary targets and weather.

(g) The controllers' ability to advise a pilot flying on instruments or in visual conditions of the aircraft's proximity to another aircraft will be limited if the unknown aircraft is not observed on radar, if no flight plan information is available, or if the volume of traffic and work load prevent issuing traffic information. The controller's first priority is given to establishing vertical, lateral, and longitudinal separation between aircraft flying IFR under the control of ATC.

c. FAA radar operates continuously at the locations shown in the Airport/Facility Directory, and their services are available to all pilots, both civil and military. Contact the associated FAA control tower or ARTCC on any frequency guarded for initial instructions, or in an emergency, any FAA facility for information on the nearest radar service.

1-2-2. AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

a. The ATCRBS, sometimes referred to as secondary surveillance radar, consists of three main components:

1. Interrogator: Primary radar relies on a signal being transmitted from the radar antenna site and for this signal to be reflected or "bounced back" from an object (such as an aircraft). This reflected signal is then displayed as a "target" on the controller's radarscope. In the ATCRBS, the Interrogator, a ground based radar beacon transmitter-receiver, scans in synchronism with the primary radar and transmits discrete radio signals which repetitiously requests all transponders, on the mode being used, to reply. The replies received are then mixed with the primary returns and both are displayed on the same radarscope.

2. Transponder: This airborne radar beacon transmitter-receiver automatically receives the signals from the interrogator and selectively replies with a specific pulse group (code) only to those interrogations being received on the mode to which it is set. These replies are independent of, and much stringer than a primary radar return.

3. Radarscope: The radarscope used by the controller displays returns from both the primary radar system and the ATCRBS. These returns, called targets, are what the controller refers to in the control and separation of traffic.

b. The job of identifying and maintaining identification of primary radar targets is a long and tedious task for the controller. Some of the advantages of ATCRBS over primary radar are:

1. Reinforcement of radar targets.
2. Rapid target identification.
3. Unique display of selected codes.

c. A part of the ATCRBS ground equipment is the decoder. This equipment enables a controller to assign discrete transponder codes to each aircraft under their control. Normally only one code will be assigned for the entire flight. Assignments are made by the ARTCC computer on the basis of the National Beacon Code Allocation Plan. The equipment is also designed to receive MODE C altitude information from the aircraft.

d. It should be emphasized that aircraft transponders greatly improve the effectiveness of radar systems.

1-2-3. SURVEILLANCE RADAR

a. Surveillance radars are divided into two general categories: Airport Surveillance Radar (ASR) and Air Route Surveillance Radar (ARSR).

1. ASR is designed to provide relatively short-range coverage in the general vicinity of an airport and to serve as an expeditious means of handling terminal area traffic through observation of precise aircraft locations on a radarscope. The ASR can also be used as an instrument approach aid.

2. ARSR is a long-range radar system designed primarily to provide a display of aircraft locations over large areas.

3. Center Radar Automated Radar Terminal Systems (ARTS) Processing (CENRAP) was developed to provide an alternative to a nonradar environment at ter-

minal facilities should an Airport Surveillance Radar (ASR) fail or malfunction. CENRAP sends aircraft radar beacon target information to the ASR terminal facility equipped with ARTS. Procedures used for the separation of aircraft may increase under certain conditions when a facility is utilizing CENRAP because radar target information updates at a slower rate than the normal ASR radar. Radar services for VFR aircraft are also limited during CENRAP operations because of the additional work load required to provide services to IFR aircraft.

b. Surveillance radars scan through 360 degrees of azimuth and present target information on a radar display located in a tower or center. This information is used independently or in conjunction with other navigational aids in the control of air traffic.

1-2-4. PRECISION APPROACH RADAR (PAR)

a. PAR is designed to be used as a landing aid, rather than an aid for sequencing and spacing aircraft. PAR equipment may be used as a primary landing aid, or it may be used to monitor other types of approaches. It is designed to display range, azimuth and elevation information.

b. Two antennas are used in the PAR array, one scanning a vertical plane, and the other scanning horizontally. Since the range is limited to 10 miles, azimuth to 20 degrees, and elevation to 7 degrees, only the final approach area is covered. Each scope is divided into two parts. The upper half presents altitude and distance information, and the lower half presents azimuth and distance.

CHAPTER 5 SECTION 2 DEPARTURE PROCEDURES

5-2-1. PRE-TAXI CLEARANCE PROCEDURES

a. Certain airports have established Pretaxi Clearance programs whereby pilots of departing IFR aircraft may elect to receive their IFR clearances before they start taxiing for takeoff. The following provisions are included in such procedures:

1. Pilot participation is not mandatory.
2. Participating pilots call clearance delivery or ground control not more than 10 minutes before proposed taxi time.
3. IFR clearance (or delay information, if clearance cannot be obtained) is issued at the time of initial call-up.
4. When the IFR clearance is received on clearance delivery frequency, pilots call ground control when ready to taxi.
5. Normally, pilots need not inform ground control that they have received IFR clearance on clearance delivery frequency. Certain locations may, however, require that the pilot inform ground control of a portion of the routing or that the IFR clearance has been received.
6. If a pilot cannot establish contact on clearance delivery frequency or has not received an IFR clearance before ready to taxi, the pilot should contact ground control and inform the controller accordingly.

b. Locations where these procedures are in effect are indicated in the Airport/Facility Directory.

5-2-2. TAXI CLEARANCE

Pilots on IFR flight plans should communicate with the control tower on the appropriate ground control frequency or clearance delivery frequency, prior to starting engines, to receive engine start time, taxi, and/or clearance information.

5-2-3. ABBREVIATED IFR DEPARTURE CLEARANCE (CLEARED ... AS FILED) PROCEDURES

a. ATC facilities will issue an abbreviated IFR departure clearance based on the ROUTE of flight filed in the IFR flight plan, provided the filed route can be approved with little or no revision. The abbreviated clearance procedures are based on the following conditions:

1. The aircraft is on the ground or it has departed VFR and the pilot is requesting IFR clearance while airborne.
2. That a pilot will not accept an abbreviated clearance if the route or destination of a flight plan filed with ATC has been changed by the pilot or the company or the operations officer before departure.
3. That it is the responsibility of the company or operations office to inform the pilot when they make a change to the filed flight plan.
4. That it is the responsibility of the pilot to inform ATC in the initial call-up (for clearance) when the filed flight plan has been either:
    (a) amended, or
    (b) canceled and replaced with a new flight plan.

NOTE- THE FACILITY ISSUING A CLEARANCE MAY NOT HAVE RECEIVED THE REVISED ROUTE OR THE REVISED FLIGHT PLAN BY THE TIME A PILOT IS REQUESTING CLEARANCE.

b. Controllers will issue detailed clearance when they know that the original filed flight plan has been changed or when the pilot requests a full route clearance.

c. The clearance as issued will include the destination airport filed in the flight plan.

d. ATC procedures now require the controller to state the SID name, the current number and the SID transition name after the phrase "Cleared to (destination) airport and prior to the phrase, "then as filed," for ALL departures when the SID or SID transition is to be flown. The procedures apply whether or not the SID is filed in the flight plan.

e. STAR's, when filed in a flight plan, are considered a part of the filed route of flight and will not normally be stated in an initial departure clearance. If the ARTCC's jurisdictional airspace includes both the departure airport and the fix where the STAR or STAR transition begins, the STAR name, the current number and the STAR transition name MAY be stated in the initial clearance.

f. "Cleared to (destination) airport as filed" does NOT include the en route altitude filed in the flight plan. An en route altitude will be stated in the clearance or the pilot will be advised to expect an assigned or filed altitude within a given time frame or at a certain point after departure. This may be done verbally in the departure instructions or stated in the SID.

g. In both radar and nonradar environments, the controller will state "Cleared to (destination) airport as filed" or:

1. If a SID or SID transition is to be flown, specify the SID name, the current SID number, the SID transition name, the assigned altitude/Flight Level, and any additional instructions (departure control frequency, beacon code assignment, etc.) necessary to clear departing aircraft via the SID or SID transition and the route filed.

EXAMPLE- NATIONAL SEVEN TWENTY CLEARED TO MIAMI AIRPORT INTERCONTINENTAL ONE DEPARTURE, LAKE CHARLES TRANSITION THEN AS FILED, MAINTAIN FLIGHT LEVEL TWO SEVEN ZERO.

2. When there is no SID or when the pilot cannot accept a SID, the controller will specify the assigned altitude of Flight Level, and any additional instructions necessary to clear a departing aircraft via an appropriate departure routing and the route filed.

NOTE- A DETAILED DEPARTURE ROUTE DESCRIPTION OR A RADAR VECTOR MAY BE USED TO ACHIEVE THE DESIRED DEPARTURE ROUTING.

3. If it is necessary to make a minor revision to the filed route, the controller will specify the assigned SID or SID transition (or departure routing), the revision to the filed route, the assigned altitude or flight level and any additional instructions necessary to clear a departing aircraft.

EXAMPLE- JET STAR FOUR TWO FOUR CLEARED TO ATLANTA AIRPORT, SOUTH BOSTON TWO DEPARTURE THEN AS FILED EXCEPT CHANGE ROUTE TO READ SOUTH BOSTON VICTOR 20 GREENSBORO, MAINTAIN ONE SEVEN THOUSAND.

4. Additionally, in a nonradar environment, the controller will specify one or more fixes, as necessary, to identify the initial route of flight.

EXAMPLE- CESSNA THREE ONE SIX ZERO FOXTROT CLEARED TO CHARLOTTE AIRPORT AS FILED VIA BROOKE, MAINTAIN SEVEN THOUSAND.

h. To ensure success of the program, pilots should:

1. Avoid making changes to a filed flight plan just before departure.

2. State the following information in the initial call-up to the facility when no change has been made to the filed flight plan: Aircraft call sign, location, type operation (IFR) and the name of the airport (or fix) to which you expect clearance.

EXAMPLE- "WASHINGTON CLEARANCE DELIVERY (OR GROUND CONTROL IF APPROPRIATE) AMERICAN SEVENTY SIX AT GATE ONE, IFR LOS ANGELES."

3. If the flight plan has been changed, state the change and request a full route clearance.

EXAMPLE- "WASHINGTON CLEARANCE DELIVERY, AMERICAN SEVENTY SIX AT GATE ONE, IFR SAN FRANCISCO, MY FLIGHT PLAN HAS BEEN AMENDED (OR DESTINATION CHANGED). REQUEST FULL ROUTE CLEARANCE."

4. Request verification or clarification from ATC if ANY portion of the clearance is not clearly understood.

5. When requesting clearance for the IFR portion of a VFR/IFR flight, request such clearance prior to the fix where IFR operation is proposed to commence in sufficient time to avoid delay. Use the following phraseology"

EXAMPLE- "LOS ANGELES CENTER, APACHE SIX ONE PAPA, VFR ESTIMATING PASO ROBLES VOR AT THREE TWO, ONE THOUSAND FIVE HUNDRED, REQUEST IFR TO BAKERSFIELD."

5-2-4. DEPARTURE RESTRICTIONS, CLEARANCE VOID TIMES, HOLD FOR RELEASE, AND RELEASE TIMES

a. ATC may assign departure restrictions, clearance void times, hold for release, and release times, when necessary, to separate departures from other traffic or to restrict or regulate the departure flow.

1. CLEARANCE VOID TIMES: A pilot may receive a clearance, when operating from an airport without a control tower, which contains a provision for the clearance to be void if not airborne by a specific time. A pilot who does not depart prior to the clearance void time must advise ATC as soon as possible of their intentions. ATC will normally advise the pilot of the time allotted to notify ATC that the aircraft did not depart prior to the clearance void time. This time cannot exceed 30 minutes. Failure of an aircraft to contact ATC within 30 minutes after the clearance void time will result in the aircraft being considered overdue and search and rescue procedures will be initiated.

NOTE- OTHER IFR TRAFFIC FOR THE AIRPORT WHERE THE CLEARANCE IS ISSUED IS SUSPENDED UNTIL THE AIRCRAFT HAS CONTACTED ATC OR UNTIL 30 MINUTES AFTER THE CLEARANCE VOID TIME OR 30 MINUTES AFTER THE CLEARANCE RELEASE TIME IF NO VOID TIME IS ISSUED.

CAUTION- PILOT WHO DEPART AT OR AFTER THEIR CLEARANCE VOID TIME ARE NOT AFFORDED IFR SEPARATION AND MAY BE IN VIOLATION OF FAR 91.173 WHICH REQUIRES THAT PILOTS RECEIVE AN APPROPRIATE ATC CLEARANCE BEFORE OPERATING IFR IN CONTROLLED AIRSPACE.

EXAMPLE- CLEARANCE VOID IF NOT OFF BY (CLEARANCE VOID TIME) AND, IF REQUIRED, IF NOT OFF BY (CLEARANCE VOID TIME) ADVISE (FACILITY) NOT LATER THAN (TIME) OF INTENTIONS.

2. HOLD FOR RELEASE: ATC may issue "hold for release" instructions in a clearance to delay an aircraft's departure for traffic management reasons (i.e., weather, traffic volume, etc.). When ATC states in the clearance, "hold for release," the pilot may not depart utilizing that instrument flight rules (IFR) clearance until a release time or additional instructions are issued by ATC> In addition, ATC will include departure delay information in conjunction with "hold for release" instructions. The ATC instruction "hold for release," applies to the IFR clearance and does not prevent the pilot from

departing under visual flight rules (VFR). However, prior to takeoff the pilot should cancel the IFR flight plan and operate the transponder on the appropriate VFR code. An IFR clearance may not be available after departure.

EXAMPLE- (AIRCRAFT IDENTIFICATION) CLEARED TO (DESTINATION) AIRPORT AS FILED, MAINTAIN (ALTITUDE), AND, IF REQUIRED (ADDITIONAL INSTRUCTIONS OR INFORMATION), HOLD FOR RELEASE, EXPECT (TIME IN HOURS AND/OR MINUTES) DEPARTURE DELAY.

3. RELEASE TIMES: A "release time" is a departure restriction issued to a pilot by ATC, specifying the earliest time an aircraft may depart. ATC will use "release times" in conjunction with traffic management procedures and/or to separate a departing aircraft from other traffic.

EXAMPLE- (AIRCRAFT IDENTIFICATION) RELEASED FOR IMMEDIATE DEPARTURE AT (TIME IN HOURS AND/OR MINUTES).

b. If practical, pilots departing uncontrolled airports should obtain IFR clearances prior to becoming airborne when two-way communications with the controlling ATC facility is available.

5-2-5. DEPARTURE CONTROL

a. Departure Control is an approach control function responsible for ensuring separation between departures. So as to expedite the handling of departures, Departure Control may suggest a take off direction other than that which may normally have been used under VFR handling. Many times it is preferred to offer the pilot a runway that will require the fewest turns after take off to place the pilot on course or selected departure route as quickly as possible. At many locations particular attention is paid to the use of preferential runways for local noise abatement programs, and departure routes away from congested areas.

b. Departure Control utilizing radar will normally clear aircraft out of the terminal area using SID's via radio navigation aids. When a departure is to be vectored immediately following take off, the pilot will be advised prior to take off of the purpose of the heading. Pilots operating in a radar environment are expected to associate departure headings with vectors to their planned route of flight. When given a vector taking the aircraft off a previously assigned nonradar route, the pilot will be advised briefly what the vector is to achieve. Thereafter, radar service will be provided until the aircraft has been reestablished "on course" using an appropriate navigation aid and the pilot has been advised of the aircraft's position or a handoff is made to another radar controller with further surveillance capabilities.

c. Controllers will inform pilots of departure control frequencies and, if appropriate, the transponder code before takeoff. Pilots should not operate their transponder until ready to start the takeoff roll or change to the departure control frequency until requested. Controllers may omit the departure control frequency if a SID has or will be assigned and the departure control frequency is published on the SID.

5-2-6. INSTRUMENT DEPARTURES

a. STANDARD INSTRUMENT DEPARTURES (SID)

1. A SID is an ATC coded departure procedure which has been established at certain airports to simplify clearance delivery procedures.

2. Pilots of civil aircraft operating from

locations where SID procedures are effective may expect ATC clearance containing a SID. Use of a SID requires pilot possession of at least the textual description of the SID procedures. Controllers may omit the departure control frequency if a SID clearance is issued and the departure control frequency is published on the SID. ATC must be advised immediately if the pilot does not possess a charted SID or a preprinted SID description or, for any other reason, does not wish to use a SID. Notification may be accomplished by filing "NO SID" in the remarks section of the filed flight plan or by the less desirable method of verbally advising ATC.

3. All effective SID's are published in textual and graphic form by the National Ocean Service in Terminal Procedures Publication (TPP).

4. SID procedures will be depicted in one of two basic forms.

(a) Pilot Navigation (Pilot Nav) SID's: are established where the pilot is primarily responsible for navigation on the SID route. They are established for airports when terrain and safety related factors indicate the necessity for a pilot NAV SID. Some pilot NAV SID's may contain vector instructions which pilots are expected to comply with until instructions are received to resume normal navigation on the filed/assigned route or SID procedure.

(b) Vector SID's: are established where ATC will provide radar navigational guidance to a filed/assigned route or to a fix depicted on the SID.

b. OBSTRUCTION CLEARANCE DURING DEPARTURE

1. Published instrument departure procedures and SID's assist pilot conducting IFR flight in avoiding obstacles during climbout to Minimum En Route Altitude (MEA). These procedures are established only at locations where instrument approach procedures are published. Standard instrument takeoff minimums and departure procedures are prescribed in FAR Part 91.175. Airports with takeoff other than standard (one statute mile for aircraft having two engines or less and one-half statute mile for aircraft having more than two engines) are described in airport listings on separate pages titled IFR TAKE-OFF MINIMUMS AND DEPARTURE PROCEDURES, at the front of each U.S. Government Terminal Procedures Publication (TPP). The approach chart and SID chart for each airport where takeoff minimums are not standard and/or departure procedures are published is annotated with a special symbol . The use of this symbol indicates that the separate listing should be consulted. These minimums also apply to SID's unless the SID's specify different minimums.

2. Obstacle clearance is based on the aircraft climbing at least 200 feet per nautical mile, crossing the end of the runway at least 35 feet AGL, and climbing to 400 feet above airport elevation before turning, unless otherwise specified in the procedure. A slope of 152 feet per nautical mile, starting no higher than 35 feet above the departure end of the runway, is assessed for obstacles. A minimum obstacle clearance of 48 feet per nautical mile is provided in the assumed climb gradient.

(a) If no obstacles penetrate the 152 feet per nautical mile slope, IFR departure procedures are not published.

(b) If obstacles do penetrate the slope, avoidance procedures are specified. These procedures may be: a ceiling and visibility to allow the obstacles to be seen and avoided; a climb gradient greater than 200 feet per nautical mile; detailed flight maneuvers; or a combination of the above. In extreme cases, IFR takeoff may not be authorized for some runways.

EXAMPLE- RWY 17, 300-1 OR STANDARD MINIMUM WITH MINIMUM CLIMB OF 220 FEET PER NM TO 1100.

3. Climb gradients are specified when required for obstacle clearance. Crossing restrictions in the SID's may be for traffic separation or obstacle clearance. When no gradient is specified, the pilot is expected to climb at least 200 feet per nautical mile to MEA unless required to level off by a crossing restriction.

EXAMPLE- "CROSS ALPHA INTERSECTION AT OR BELOW 4000; MAINTAIN 6000." THE PILOT CLIMBS AT LEAST 200 FEET PER NAUTICAL MILE TO 6000. IF 4000 IS REACHED BEFORE ALPHA, THE PILOT LEVELS OFF AT 4000 UNTIL PASSING ALPHA; THEN IMMEDIATELY RESUMES AT LEAST 200 FEET PER NAUTICAL MILE CLIMB.

4. Climb gradients may be specified to an altitude/fix, above which the normal gradient applies.

EXAMPLE- "MINIMUM CLIMB 340 FEET PER NM TO 2700." THE PILOT CLIMBS AT LEAST 340 FEET PER NAUTICAL MILE TO 2700, THEN AT LEAST 200 FEET PER NAUTICAL MILE TO MEA.

5. Some IFR departure procedures require a climb in visual conditions to cross the airport (or an on-airport NAVAID) in a specific direction, at or above a specified altitude.

EXAMPLE- "CLIMB IN VISUAL CONDITIONS SO AS TO CROSS THE McELROY AIRPORT SOUTHBOUND, AT OR ABOVE 6000, THEN CLIMB VIA KEEMMLING R-033 TO KEEMMLING VORTAC."

(a) When climbing in visual conditions it is the pilot's responsibility to see and avoid obstacles. Specified ceiling and visibility minimums will allow visual avoidance of obstacles until the pilot enters the standard obstacle protection area. Obstacle avoidance is not guaranteed if the pilot maneuvers farther from the airport than the visibility minimum.

(b) That segment of the procedure which requires the pilot to see and avoid obstacles ends when the aircraft crosses the specified point at the required altitude. Thereafter, standard obstacle protection is provided.

6. Each pilot, prior to departing an airport on an IFR flight should consider the type of terrain and other obstacles on or in the vicinity of the departure airport and:

(a) Determine whether a departure procedure and/or SID is available for obstacle avoidance.

(b) Determine if obstacle avoidance can be maintained visually or that the departure procedure or SID should be followed.

(c) Determine what action will be necessary and take such action that will assure a safe departure.

CAUTION- THE TERM RADAR CONTACT, WHEN USED BY THE CONTROLLER DURING DEPARTURE, SHOULD NOT BE INTERPRETED AS RELIEVING PILOTS OF THEIR RESPONSIBILITY TO MAINTAIN APPROPRIATE TERRAIN AND OBSTRUCTION CLEARANCE.

7. Terrain/obstruction clearance is not provided by ATC until the controller begins to provide navigational guidance, i.e. radar vectors.

CHAPTER 5 SECTION 3
EN ROUTE PROCEDURES

5-3-1. ARTCC COMMUNICATIONS

a. Direct Communications, Controllers and Pilots:

1. ARTCC's are capable of direct communications with IFR air traffic on certain frequencies. Maximum communications coverage is possible through use of Remote Center Air/Ground (RCAG) sites comprised of both VHF and UHF transmitters and receivers. These sites are located throughout the U.S. Although they may be several hundred miles away from the ARTCC, they are remoted to the various ARTCC's by land lines or microwave links. Since IFR operations are expedited through the use of direct communications, pilots are requested to use these frequencies strictly for communications pertinent to the control of IFR aircraft. Flight plan filing, en route weather, forecasts, and similar data should be requested through FSS's, company radio, or appropriate military facilities capable of performing these services.

2. An ARTCC is divided into sectors. Each sector is handled by one or a team of controllers and has its own sector discrete frequency. As a flight progresses from one sector to another, the pilot is requested to change to the appropriate sector discrete frequency.

b. ATC Frequency Change Procedures:

1. The following phraseology will be used by controllers to effect a frequency change:

EXAMPLE- (AIRCRAFT IDENTIFICATION) CONTACT (FACILITY NAME OR LOCATION NAME AND TERMINAL FUNCTION) (FREQUENCY) AT (TIME, FIX, OR ALTITUDE)

NOTE- PILOTS ARE EXPECTED TO MAINTAIN A LISTENING WATCH ON THE TRANSFERRING CONTROLLER'S FREQUENCY UNTIL THE TIME, FIX, OR ALTITUDE SPECIFIED. ATC WILL OMIT FREQUENCY CHANGE RESTRICTIONS WHENEVER PILOT COMPLIANCE IS EXPECTED UPON RECEIPT.

2. The following phraseology should be utilized by pilots for establishing contact with the designated facility:

(a) When a position report will be made:

EXAMPLE- (NAME) CENTER, (AIRCRAFT IDENTIFICATION), (POSITION).

(b) When no position report will be made:

EXAMPLE- (NAME) CENTER, (AIRCRAFT IDENTIFICATION), (POSITION) ESTIMATING (REPORTING POINT AND TIME) AT (ALTITUDE OR FLIGHT LEVEL) (CLIMBING OR DESCENDING) TO MAINTAIN (ALTITUDE OR FLIGHT LEVEL).

(c) When operating in a radar environment and no position report is required: On initial contact, the pilot should inform the controller of the pilot's assigned altitude preceded by the words "level," or "climbing to," or "descending to," as appropriate. Also, when on other than published routes, the pilot should include the presently assigned routing on initial contact with each air traffic controller.

EXAMPLE- (NAME) CENTER, (AIRCRAFT IDENTIFICATION), LEVEL (ALTITUDE OR FLIGHT LEVEL), HEADING (EXACT HEADING).

EXAMPLE- (NAME) CENTER, (AIRCRAFT IDENTIFICATION), LEAVING (EXACT ALTITUDE OR FLIGHT LEVEL), CLIMBING TO (ALTITUDE OR FLIGHT LEVEL), PROCEEDING TO (NAME) V-O-R VIA THE (NAME)(NUMBER) RADIAL.

EXAMPLE- (NAME) CENTER, (AIRCRAFT IDENTIFICATION), LEAVING (EXACT ALTITUDE OR FLIGHT LEVEL), DESCENDING TO (ALTITUDE OR FLIGHT LEVEL), DIRECT (NAME) V-O-R.

NOTE- EXACT ALTITUDE OR FLIGHT LEVEL MEANS TO THE NEAREST 100 FOOT INCREMENT. EXACT ALTITUDE OR FLIGHT LEVEL REPORTS ON INITIAL CONTACT PROVIDE ATC WITH INFORMATION REQUIRED PRIOR TO USING MODE C ALTITUDE INFORMATION FOR SEPARATION PURPOSES.

3. At times controllers will ask pilots to verify that they are at a particular altitude. The phraseology used will be "VERIFY AT (altitude)." In climbing or descending situations, controllers may ask pilots to "VERIFY ASSIGNED ALTITUDE AS (altitude)." Pilots should confirm that they are at the altitude stated by the controller or that the assigned altitude is correct as stated. If this is not the case, they should inform the controller of the actual altitude being maintained or the different assigned altitude.

CAUTION- PILOTS SHOULD NOT TAKE ACTION TO CHANGE THEIR ACTUAL ALTITUDE OR DIFFERENT ASSIGNED ALTITUDE TO THE ALTITUDE STATED IN THE CONTROLLER'S VERIFICATION REQUEST UNLESS THE CONTROLLER SPECIFICALLY AUTHORIZES A CHANGE.

c. ARTCC Radio Frequency Outage: ARTCC's normally have at least one backup radio receiver and transmitter system for each frequency, which can usually be placed into service quickly with little or no disruption of ATC service. Occasionally, technical problems may cause a delay but switchover seldom takes more than 60 seconds. When it appears that the outage will not be quickly remedied, the ARTCC will usually request a nearby aircraft, if there is one, to switch to the affected frequency to broadcast communications instructions. It is important, therefore, that the pilot wait at least 1 minute before deciding the ARTCC has actually experienced a radio frequency failure. When such an outage does occur, the pilot should, if work load and equipment capability permit, maintain a listening watch on the affected frequency while attempting to comply with the following recommended communications procedures:

1. If two-way communications cannot be established with the ARTCC after changing frequencies, a pilot should attempt to re-contact the transferring controller for the assignment of an alternative frequency or other instructions.

2. When an ARTCC radio frequency failure occurs after two-way communications have been established, the pilot should attempt to reestablish contact with the center on any other known ARTCC frequency, preferably that of the next responsible sector when practicable, and ask for instructions. However, when the next normal frequency change along the route is known to involve another ATC facility, the pilot should contact that facility, if feasible, for instructions. If communications cannot be reestablished by either method, the pilot is expected to request communications instructions from the FSS appropriate to the route of flight.

NOTE- THE EXCHANGE OF INFORMATION BETWEEN AIRCRAFT AND AN ARTCC THROUGH AN FSS IS QUICKER THAN RELAY VIA COMPANY RADIO BECAUSE THE FSS HAS DIRECT INTERPHONE LINES TO THE RESPONSIBLE ARTCC SECTOR. ACCORDINGLY, WHEN CIRCUMSTANCES DICTATE A CHOICE BETWEEN THE TWO, DURING AN ARTCC FREQUENCY OUTAGE, RELAY VIA FSS RADIO IS RECOMMENDED.

5-3-2. POSITION REPORTING

The safety and effectiveness of traffic control depends to a large extent on accurate position reporting. In order to provide the proper separation and expedite aircraft movements, ATC must be able to make accurate estimates of the progress of every aircraft operating on an IFR flight plan.

a. Position Identification:

1. When a position report is to be made passing a VOR radio facility, the time reported should be the time at which the first complete reversal of the "to/from" indicator is accomplished.

2. When a position report is made passing a facility by means of an airborne ADF, the time reported should be the time at which the indicator makes a complete reversal.

3. When an aural or light panel indication is used to determine the time passing a reporting point, such as a fan marker, Z marker, cone of silence or intersection of range courses, the time should be noted when the signal is first received and again when it ceases. The mean of these two times should then be taken as the actual time over the fix.

4. If a position is given with respect to distance and direction from a reporting point, the distance and direction should be computed as accurately as possible.

5. Except for terminal area transition purposes, position reports or navigation with reference to aids not established for use in the structure in which flight is being conducted will not normally be required by ATC.

b. Position Reporting Points: FAR's require pilots to maintain a listening watch on the appropriate frequency and, unless operating under the provisions of subparagraph c., to furnish position reports passing certain reporting points. Reporting points are indicated by symbols on en route charts. The designated compulsory reporting point symbol is a solid triangle and the "on request" reporting point symbol is the open triangle. Reports passing an "on request" reporting point are only necessary when requested by ATC.

c. Position Reporting Requirements:

1. Flights along airways or routes: A position report is required by all flights regardless of altitude, including those operating in accordance with an ATC clearance specifying "VFR ON TOP," over each designated compulsory reporting point along the route being flown.

2. Flights Along a Direct Route: Regardless of the altitude or flight level being flown, including flights operating in accordance with an ATC clearance specifying "VFR ON TOP," pilots shall report over each reporting point used in the flight plan to define the route of flight.

3. Flights in a Radar Environment: When informed by ATC that their aircraft are in "Radar Contact," pilots should discontinue position reports over designated reporting points. They should resume normal position reporting when ATC advises "RADAR CONTACT LOST" or "RADAR SERVICE TERMINATED."

NOTE- ATC WILL INFORM PILOTS THAT THEY ARE IN "RADAR CONTACT"
(A) WHEN THEIR AIRCRAFT IS INITIALLY IDENTIFIED IN THE ATC SYSTEM; AND
(B) WHEN RADAR IDENTIFICATION IS RE-ESTABLISHED AFTER RADAR SERVICE HAS BEEN TERMINATED OR RADAR CONTACT LOST.

SUBSEQUENT TO BEING ADVISED THAT THE CONTROLLER HAS ESTABLISHED RADAR CONTACT, THIS FACT WILL NOT BE REPEATED TO THE PILOT WHEN HANDED OFF TO ANOTHER CONTROLLER. AT TIMES, THE AIRCRAFT IDENTITY WILL BE CONFIRMED BY THE RECEIVING CONTROLLER; HOWEVER, THIS SHOULD NOT BE CONSTRUED TO MEAN THAT RADAR CONTACT HAS BEEN LOST. THE IDENTITY OF TRANSPONDER EQUIPPED AIRCRAFT WILL BE CONFIRMED BY ASKING THE PILOT TO "IDENT," "SQUAWK STANDBY," OR TO CHANGE CODES. AIRCRAFT WITHOUT TRANSPONDERS WILL BE ADVISED OF THEIR POSITION TO CONFIRM IDENTITY. IN THIS CASE, THE PILOT IS EXPECTED TO ADVISE THE CONTROLLER IF IN DISAGREEMENT WITH THE POSITION GIVEN. ANY PILOT WHO CANNOT CONFIRM THE ACCURACY OF THE POSITION GIVEN BECAUSE OF NOT BEING TUNED TO THE

NAVAID REFERENCED BY THE CONTROLLER, SHOULD ASK FOR ANOTHER RADAR POSITION RELATIVE TO THE TUNED NAVAID.

d. Position Report Item:

1. Position reports should include the following items:

(a) Identification.

(b) Position.

(c) Time.

(d) Altitude or flight level (include actual altitude or flight level when operating on a clearance specifying VFR-ON-TOP.)

(e) Type of flight plan (not required in IFR position reports made directly to ARTCC's or approach control),

(f) ETA and name of next reporting point.

(g) The name only of the next succeeding reporting point along the route of flight, and

(h) Pertinent remarks.

5-3-3. ADDITIONAL REPORTS

a. The following reports should be made to ATC or FSS facilities without a specific ATC request:

1. At all times:

(a) When vacating any previously assigned altitude or flight level for a newly assigned altitude or flight level.

(b) When an altitude change will be made if operating on a clearance specifying VFR ON TOP.

(c) When unable to climb/descend at a rate of at least 500 feet per minute.

(d) When approach has been missed. (Request clearance for specific action; i.e., to alternative airport, another approach, etc.)

(e) Change in the average true airspeed (at cruising altitude) when it varies by 5 percent or 10 knots (whichever is greater) from that filed in the flight plan.

(f) The time and altitude or flight level upon reaching a holding fix or point to which cleared.

(g) When leaving any assigned holding fix or point.

(h) Any loss, in controlled airspace, of VOR, TACAN, ADF, low frequency navigation receiver capability, complete or partial loss of ILS receiver capability or impairment of air/ground communications capability. Reports should include aircraft identification, equipment affected, degree to which capability to operate under IFR in the ATC system is impaired, and the nature and extent of assistance desired from ATC.

NOTE- OTHER EQUIPMENT INSTALLED IN THE AIRCRAFT MAY EFFECTIVELY IMPAIR SAFETY AND/OR THE ABILITY TO OPERATE UNDER IFR. IF SUCH EQUIPMENT (E.G. AIRBORNE WEATHER RADAR) MALFUNCTIONS AND IN THE PILOT'S JUDGMENT EITHER SAFETY OR IFR CAPABILITIES ARE AFFECTED, REPORTS SHOULD BE MADE AS ABOVE.

(i) Any information relating to the safety of flight.

2. When not in radar contact:

(a) When leaving final approach fix inbound on final approach (nonprecision approach) or when leaving the outer marker or fix used in lieu of the outer marker inbound on final approach (precision approach).

(b) A corrected estimate at anytime it becomes apparent that an estimate as previously submitted is in error in excess of 3 minutes.

b. Pilots encountering weather conditions which have not been forecast, or hazardous weather conditions which have been forecast, are expected to forward a report of such weather to ATC.

5-3-4. AIRWAYS AND ROUTE SYSTEMS

a. Two fixed route systems are established for air navigation purposes. They are the VOR and L/MF system and the jet route system. To the extent possible, these route systems are aligned in an overlying manner to facilitate transition between each.

1. The VOR and L/MF Airway System consists of airways designated from 1,200 feet above the surface (or in some instances higher) up to but not including 18,000 feet MSL. The airways are depicted on En Route Low Altitude Charts.

NOTE- THE ALTITUDE LIMITS OF A VICTOR AIRWAY SHOULD NOT BE EXCEEDED EXCEPT TO TRANSITION WITHIN OR BETWEEN ROUTE STRUCTURES.

(a) Except in Alaska and Costal North Carolina, the VOR airways are predicated solely on VOR or VORTAC navigation aids; are depicted in blue on aeronautical charts; and are identified by a "V" (Victor) followed by the airway number (e.g., V12).

NOTE- SEGMENTS OF VOR AIRWAYS IN ALASKA AND NORTH CAROLINA (V56, V290) ARE BASED ON L/MF NAVIGATION AIDS AND ARE CHARTED IN BROWN INSTEAD OF BLUE ON EN ROUTE CHARTS.

(1) A segment of an airway which is common to two or more route carries the numbers of all the airways which coincide for that segment. When such is the case, pilots filing a flight plan need to indicate only that airway number for the route filed.

NOTE- A PILOT WHO INTENDS TO MAKE AN AIRWAY FLIGHT, USING VOR FACILITIES, WILL SIMPLY SPECIFY THE APPROPRIATE "VICTOR" AIRWAY(S) IN THE FLIGHT PLAN. FOR EXAMPLE, IF A FLIGHT IS TO BE MADE FROM CHICAGO TO NEW ORLEANS AT 8,000 FEET, USING OMNIRANGES ONLY, THE ROUTE MAY BE INDICATED AS "DEPARTING FROM CHICAGO-MIDWAY, CRUISING 8,000 FEET VIA VICTOR 9 TO MOISANT INTERNATIONAL." IF FLIGHT IS TO BE CONDUCTED IN PART BY MEANS OF L/MF NAVIGATION AIDS AND IN PART ON OMNIRANGES, SPECIFICATIONS OF THE APPROPRIATE AIRWAYS IN THE FLIGHT PLAN WILL INDICATE WHICH TYPES OF FACILITIES WILL BE USED ALONG THE DESCRIBED ROUTES, AND, FOR IFR FLIGHT PERMIT ATC TO ISSUE A TRAFFIC CLEARANCE ACCORDINGLY. A ROUTE MAY ALSO BE DESCRIBED BY SPECIFYING THE STATIONS OVER WHICH THE FLIGHT WILL PASS, BUT IN THIS CASE SINCE MANY VOR'S AND L/MF AIDS HAVE THE SAME NAME, THE PILOT MUST BE CAREFUL TO INDICATE WHICH AID WILL BE USED AT A PARTICULAR LOCATION. THIS WILL BE INDICATED IN THE ROUTE OF FLIGHT PORTION OF THE FLIGHT PLAN BY SPECIFYING THE TYPE OF FACILITY TO BE USED AFTER THE LOCATION NAME IN THE FOLLOWING MANNER: NEWARK L/MF, ALLENTOWN VOR.

(2) With respect to position reporting, reporting points are designated for VOR Airway Systems. Flights using Victor Airways will report over these points unless advised otherwise by ATC.

(b) The L/MF airways (colored airways) are predicated solely on L/MF navigation aids and are depicted in brown on aeronautical charts and are identified by color name and number (e.g., Amber One). Green and Red airways are plotted east and west. Amber and Blue airways are plotted north and south.

NOTE- EXCEPT FOR G13 IN NORTH CAROLINA, THE COLORED AIRWAY SYSTEM EXISTS ONLY IN THE STATE OF ALASKA. ALL OTHER SUCH AIRWAYS FORMERLY SO DESIGNATED IN THE CONTERMINOUS U.S. HAVE BEEN RESCINDED.

2. The Jet Route system consists of jet routes established from 18,000 feet MSL to FL 450 inclusive.

(a) These routes are depicted on En Route High Altitude Charts. Jet Routes are depicted in black on aeronautical charts and are identified by a "J" (Jet) followed by the airway number (e.g., J12). Jet routes, as VOR airways, are predicated solely on VOR and VORTAC navigation facilities (except in Alaska).

NOTE- SEGMENTS OF JET ROUTES IN ALASKA ARE BASED ON L/MF NAVIGATION AIDS AND ARE CHARTED IN BROWN COLOR INSTEAD OF BLACK ON EN ROUTE CHARTS.

(b) With respect to position reporting, reporting points are designated for Jet Route systems. Flights using Jet Routes will report over these points unless otherwise advised by ATC.

3. Area Navigation (RNAV) Routes:

(a) RNAV is a method of navigation that permits aircraft operations on any desired course within the coverage of station referenced signals or within the limits of a self-contained system capability or combination of these.

(b) Fixed RNAV routes are permanent, published routes which can be flight planned for use by aircraft with RNAV capability. A previously established fixed RNAV route system has been terminated except for a few high altitude routes in Alaska.

(c) Random RNAV routes are direct routes, based on area navigation capability, between waypoints defined in terms of latitude/longitude coordinates, degree-distance fixes, or offsets from established routes/airways at a specified distance and direction. Radar monitoring by ATC is required on all random RNAV routes.

b. Operation above FL 450 may be conducted on a point-to-point basis. Navigational guidance is provided on an area basis utilizing those facilities depicted on the En Route High Altitude Charts.

c. Radar Vectors: Controllers may vector aircraft within controlled airspace for separation purposes, noise abatement considerations, when an operational advantage will be realized by the pilot or the controller, or when requested by the pilot. Vectors outside of controlled airspace will be provided only on pilot request. Pilots will be advised as to what the vector is to achieve when the vector is controller initiated and will take the aircraft off a previously assigned nonradar route. To the extent possible, aircraft operating on RNAV routes will be allowed to remain on their own navigation.

d. When flying in Canadian airspace, pilots are cautioned to review Canadian Air Regulations.

1. Special attention should be given to the parts which differ from U.S. FAR's.

(a) The Canadian Airways Class B airspace restriction is an example. Class B airspace is all controlled low level airspace above 12,500 feet MSL or the MEA, whichever is higher, within which only IFR and controlled VFR flights are permitted. (Low level airspace means an airspace designated and defined as such in the Designated Airspace Handbook.)

(b) Regardless of the weather conditions or the height of terrain, no person shall operate an aircraft under VFR conditions within Class B airspace except in accordance with a clearance for VFR flight issued by ATC.

(c) The requirement for entry into Class B airspace is a student pilot permit (under the guidance or control of a flight instructor).

(d) VFR flight requires visual contact with the ground or water at all times.

2. Segments of VOR airways and high level routes in Canada are based on L/MF navigation aids and are charted in brown color instead of blue on en route charts.

5-3-5. AIRWAY OR ROUTE COURSE CHANGES

a. Pilots of aircraft are required to adhere to airways or routes being flown. Special attention must be given to this requirement during course changes. Each course change consists of variables that make the technique applicable in each case a matter only the pilot can resolve. Some variables which must be considered are turn radius, wind effect, airspeed, degree of turn, and cockpit instrumentation. An early turn is one method of adhering to airways or routes. The use of any available cockpit instrumentation, such as Distance Measuring Equipment, may be used by the pilot to lead the turn when making course changes. This is consistent with the intent of FAR Part 91.181, which requires pilots to operate along the centerline of an airway and along the direct course between navigational aids or fixes.

b. Turns which begin at or after fix passage may exceed airway or route boundaries.

c. Without such actions as leading a turn, aircraft operating in excess of 290 knots true airspeed (TAS) can exceed the normal airway or route boundaries depending on the amount of course change required, wind direction and velocity, the character of the turn fix (DME, overhead navigation aid, or intersection), and the pilot's technique in making a course change. For example, a flight operating at 17,000 feet MSL with a TAS of 400 knots, a 25 degree bank, and a course change of more than 40 degrees would exceed the width of the airway or route; i.e. 4 nautical miles each side of centerline. However, in the airspace below 18,000 feet MSL, operations in excess of 290 knots TAS are not prevalent and the provision of additional IFR separation in all course change situations for the occasional aircraft making a turn in excess of 290 knots TAS creates an unacceptable waste of airspace and imposes a penalty upon the preponderance of traffic which operate at low speeds. Consequently, the FAA expects pilots to lead turns and take other actions they consider necessary during course changes to adhere as closely as possible to the airways or route being flown.

d. Due to the high airspeeds used at 18,000 feet MSL and above, FAA provides additional IFR separation protection for course changes made at such altitude levels.

5-3-6. CHANGEOVER POINTS (COP'S)

a. COP's are prescribed for Federal Airways, Jet Routes, Area Navigation Routes, or other direct routes for which an MEA is designated under FAR Part 95. The COP is a point along the route or airway segment between two adjacent navigation facilities or waypoints where changeover in navigation guidance should occur. At this point, the pilot should change navigation receiver frequency from the station behind the aircraft to the station ahead.

b. The COP is located midway between the navigation facilities for straight route segments, or at the intersection of radials or courses forming a dogleg in the case of dogleg route segments. When the COP is NOT located at the midway point, aeronautical charts will depict the COP location and give the mileage to the radio aids.

c. COP's are established for the purpose of preventing loss of navigation guidance, to prevent frequency interference from other facilities, and to prevent the use of different facilities by different aircraft in the same airspace. Pilots are urged to observe COP's to the fullest extent.

5-3-7. HOLDING

a. Whenever an aircraft is cleared to a fix other than the destination airport and delay is expected, it is the responsibility of the ATC controller to issue complete holding instructions (unless the pattern is charted), an EFC time and best estimate of any additional en route/terminal delay.

NOTE- ONLY THOSE HOLDING PATTERNS DEPICTED ON U.S. GOVERNMENT OR COMMERCIALLY PRODUCED (MEETING FAA REQUIREMENTS) LOW/HIGH ALTITUDE EN ROUTE, AND AREA OR STAR CHARTS SHOULD BE USED.

b. If the holding pattern is charted and the controller doesn't issue complete holding instructions, the pilot is expected to hold as depicted on the appropriate chart. When the pattern is charted, the controller may omit all holding instructions except the charted holding direction and the statement AS PUBLISHED; e.g., HOLD EAST AS PUBLISHED. Controllers shall always issue complete holding instructions when pilots request them.

c. If no holding pattern is charted and holding instructions have not been issued, the pilot should ask ATC for holding instructions prior to reaching the fix. This procedure will eliminate the possibility of an aircraft entering a holding pattern other than that desired by ATC. If unable to obtain holding instructions prior to reaching the fix (due to frequency congestion, stuck microphone, etc.), then enter a standard holding pattern on the course on which the aircraft approached the fix and request further clearance as soon as possible. In this event, the altitude/flight level of the aircraft at the clearance limit will be protected so that separation will be provided as required.

d. When an aircraft is 3 minutes or less from a clearance limit and a clearance beyond the fix has not been received, the pilot is expected to start a speed reduction so that he will cross the fix, initially, at or below the maximum holding airspeed.

e. When no delay is expected, the controller should issue a clearance beyond the fix as soon as possible and, whenever possible, at least 5 minutes before the aircraft reaches the clearance limit.

f. Pilots should report to ATC the time and altitude/flight level at which the aircraft reaches the clearance limit and report leaving the clearance limit.

CAUTION- IN THE EVENT OF TWO-WAY COMMUNICATIONS FAILURE, PILOTS ARE REQUIRED TO COMPLY WITH FAR PART 91.185.

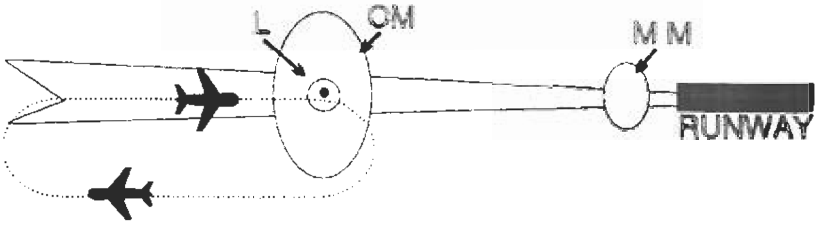
g. When holding at a VOR station, pilots should begin the turn to the outbound leg at the time of the first complete reversal of the to/from indicator.

h. Patterns at most generally used holding fixes are depicted (charted) on U.S. Government or commercially produced (meeting FAA requirements) Low or High Altitude En Route, Area and STAR Charts. Pilots are expected to hold in the pattern depicted unless specifically advised otherwise by ATC.

i. An ATC clearance requiring an aircraft to hold at a fix where the pattern is not charted will include the following information:

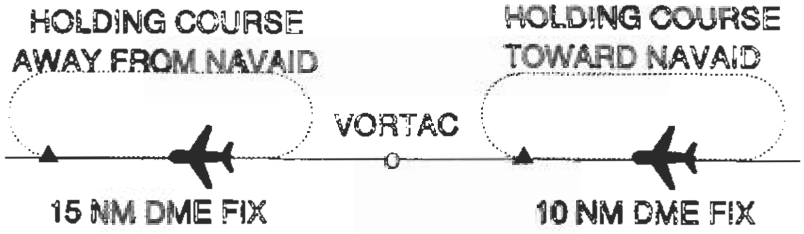
1. Direction of holding from the fix in terms of the eight cardinal compass points (i.e., N, NE, E, SE, etc.).
2. Holding fix (the fix may be omitted if included at the beginning of the transmission as the clearance limit).
3. Radial, course, bearing, airway or route on which the aircraft is to hold.
4. Leg length in miles if DME or RNAV is to be used (leg length will be specified in minutes on pilot request or of the controller considers it necessary).

EXAMPLES OF HOLDING



TYPICAL PROCEDURE ON AN ILS OUTER MARKER

TYPICAL PROCEDURE AT INTERSECTION OF VOR RADIALS



TYPICAL PROCEDURE AT DME FIX

5. Direction of turn if left turns are to be made, the pilot requests, or the controller considers it necessary.

6. Time to expect further clearance and any pertinent additional delay information.

j. Holding pattern protected airspace is based on the following procedures.

1. Descriptive Terms:

(a) Standard Pattern: Right turns.

(b) Nonstandard Pattern: Left turns.

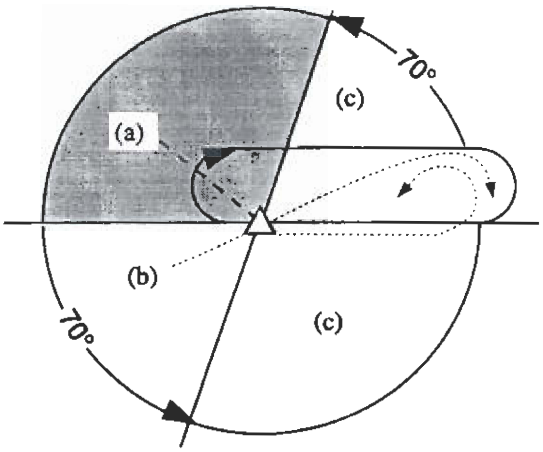
2. Airspeed (maximum): Propeller driven aircraft, including turboprop 175 KIAS.

3. Entry Procedure:

(a) Parallel Procedure: When approaching the holding fix from anywhere in sector (a), the parallel entry procedure would be to turn to a heading to parallel the holding course outbound on the nonholding side for one minute, turn in the direction of the holding pattern through more than 180 degrees, and return to the holding fix or intercept the holding course inbound.

(b) Teardrop Procedure: When approaching the holding fix from anywhere in sector (b), the teardrop entry procedure would be to fly to the fix, turn outbound to a heading for a 30 degree teardrop entry within the pattern (on the holding side) for a period of one minute, then turn in the direction of the holding pattern to intercept the inbound holding course.

STANDARD PATTERN



(c) Direct Entry Procedure: When approaching the holding fix from anywhere in sector (c), the direct entry procedure would be to fly directly to the fix and turn to follow the holding pattern.

(d) While other entry procedures may enable the aircraft to enter the holding pattern an remain within protected airspace, the parallel, teardrop and direct entries are the procedures for entry and holding recommended by the FAA.

4. Timing:

(a) Inbound Leg:

(1) At or below 14,000 feet MSL: 1 minute.

(2) Above 14,000 feet MSL: 1½ minutes.

NOTE- THE INITIAL OUTBOUND LEG SHOULD BE FLOWN FOR 1 MINUTE OR 1½ MINUTES (APPROPRIATE TO ALTITUDE). TIMING FOR SUBSEQUENT OUTBOUND LEGS SHOULD BE ADJUSTED, AS NECESSARY, TO ACHIEVE PROPER INBOUND LEG TIME. PILOTS MAY USE ANY NAVIGATIONAL MEANS AVAILABLE; I.E., DME, RNAV, ETC., TO INSURE THE APPROPRIATE INBOUND LEG TIMES.

(b) Outbound Leg timing begins over/abeam the fix, whichever occurs later. If the abeam position cannot be determined, start timing when turn to outbound is completed.

5. Distance Measuring Equipment (DME): DME holding is subject to the same entry and holding procedures except that distances (nautical miles) are used in lieu of time values. The outbound course of a DME holding pattern is called the outbound leg of the pattern. The length of the outbound leg will be specified by the controller. The end of the outbound leg is determined by the odometer reading.

6. Pilot Action:

(a) Start speed reduction when 3 minutes or less from the holding fix. Cross holding fix, initially, at or below the maximum holding airspeed.

(b) Make all turns during entry and while holding at:

(1) 3 degrees per second, or

(2) 30 degrees bank angle, or

(3) 25 degrees bank provided a flight director system is used.

NOTE- USE WHICHEVER REQUIRES THE LEAST BANK ANGLE.

(c) Compensate for wind effect primarily by drift correction on the inbound and outbound legs. When outbound, triple the inbound drift correction to avoid major turning adjustments; e.g. if correcting left by 8 degrees when inbound, correct by 24 degrees when outbound.

(d) Determine entry turn from aircraft heading upon arrival at the holding fix; ±5 degrees in heading is considered to be within allowable good operating limits for determining entry.

(e) Advise ATC immediately if any increased airspeed is necessary due to turbulence, icing, etc., or if unable to accomplish any part of the holding procedures. When such higher speeds become no longer necessary, operate according to the appropriate published holding airspeed and notify ATC.

NOTE- AIRSPACE PROTECTION FOR TURBULENT AIR HOLDING IS BASED ON A MAXIMUM OF 280 KIAS/MACH 0.8, WHICHEVER IS LOWER. CONSIDERABLE IMPACT ON TRAFFIC FLOW WILL RESULT WHEN TURBULENT AIR HOLDING PATTERNS ARE USED; THUS, PILOT DISCRETION WILL ENSURE THEIR USE IS LIMITED TO BONA FIDE CONDITIONS OR REQUIREMENTS.

7. Nonstandard Holding Pattern: Fix end and outbound end turns are made to the left. Entry procedures to a nonstandard pattern are oriented in relation to the 70 degree line on the holding side just as in the standard pattern.

k. When holding at a fix and instructions are received specifying the time of departure from the fix, the pilot should adjust the aircraft's flight path within the limits of the established holding pattern in order to leave the fix at the exact time specified. After departing the holding fix, normal speed is to be resumed with respect to other governing speed requirements, such as terminal area speed limits, specific ATC requests, etc. Where the fix is associated with an instrument approach and timed approaches are in effect, a procedure turn shall not be executed unless the pilot advises ATC, since aircraft holding are expected to proceed inbound on final approach directly from the holding pattern when approach clearance is received.

l. radar surveillance of outer fix holding pattern airspace areas.

1. Whenever aircraft are holding at an outer fix, ATC will usually provide radar surveillance of the outer fix holding pattern airspace area, or any portion of it, if it is shown on the controller's radar scope.

2. The controller will attempt to detect any holding aircraft that stray outside the holding pattern airspace area and will assist any detected aircraft to return to the assigned airspace area.

NOTE- MANY FACTORS COULD PREVENT ATC FROM PROVIDING THIS ADDITIONAL SERVICE, SUCH AS Work load, NUMBER OF TARGETS, PRECIPITATION, GROUND CLUTTER, AND RADAR SYSTEM CAPABILITY. THESE CIRCUMSTANCES MAY MAKE IT INFEASIBLE TO MAINTAIN RADAR IDENTIFICATION OF AIRCRAFT TO DETECT AIRCRAFT STRAYING FROM THE HOLDING PATTERN. THE PROVISION OF THIS SERVICE DEPENDS ENTIRELY UPON WHETHER CONTROLLERS BELIEVE THEY ARE IN A POSITION TO PROVIDE IT AND DOES NOT RELIEVE A PILOT OF THEIR RESPONSIBILITY TO ADHERE TO AN ACCEPTED ATC CLEARANCE.

3. If an aircraft is established in a published holding pattern at an assigned altitude above the minimum holding altitude and subsequently cleared for the approach, the pilot may descend to the published minimum holding altitude. The holding pattern would only be a segment of the IAP if it is published on the instrument procedure chart and is used in lieu of a procedure turn.

m. For those holding patterns where there are no minimum published holding altitudes, the pilot, upon receiving an approach clearance, must maintain the last assigned altitude until leaving the holding pattern and established on the inbound course. Thereafter, the published minimum altitude of the route segment being flown will apply. It is expected that the pilot will be assigned a holding altitude that will permit a normal descent on the inbound course.

CHAPTER 5 SECTION 4 ARRIVAL PROCEDURES

5-4-1. STANDARD TERMINAL ARRIVAL (STAR)

a. A STAR is an ATC coded IFR arrival route established for application to arriving IFR aircraft destined for certain airports. Its purpose is to simplify clearance delivery procedures.

b. Pilots of IFR civil aircraft destined to locations for which STAR's have been published may be issued a STAR whenever ATC deems it appropriate. Until military STAR publications and distribution is accomplished, STAR's will be issued to military pilots only when requested in the flight plan or verbally by the pilot.

c. Use of STAR's requires pilot possession of at least the approved textual description. As with any ATC clearance or portion thereof, it is the responsibility of each pilot to accept or refuse an issued STAR. Pilots should notify ATC if they do not wish to use a STAR by placing "NO STAR" in the remarks section of the flight plan or by the less desirable method of verbally stating the same to ATC.

d. STAR charts are published in the Terminal Procedures Publication (TPP) and are available on subscription from the National Ocean Service.

5-4-2. LOCAL FLOW MANAGEMENT PROGRAM

a. This program is a continuing effort by the FAA to enhance safety, minimize the impact of aircraft noise and conserve aviation fuel. The enhancement of safety and reduction of noise is achieved in this program by minimizing low altitude maneuvering or arriving turbojet and turboprop aircraft weighing more than 12,500 pounds and, by permitting departure aircraft to climb to higher altitudes sooner, as arrivals are operating at higher altitudes at the points where their flight paths cross. The application of these procedures also reduces exposure time between controlled aircraft and uncontrolled aircraft at the lower altitudes in and around the terminal environment. Fuel conservation is accomplished by absorbing any necessary arrival delays for aircraft included in this program operating at the higher and more efficient altitudes.

b. A fuel efficient descent is basically an uninterrupted descent (except where level flight is required for speed adjustment) from cruising altitude to the point when level flight is necessary for the pilot to stabilize the aircraft on final approach. The procedure for a fuel efficient descent is based on an altitude loss which is most for the majority of aircraft being served. This will generally result in a descent gradient window of 250-350 feet per nautical mile.

c. When crossing altitudes and speed restrictions are issued verbally or are depicted on a chart, ATC will expect the pilot to descend first to the crossing altitude and then reduce speed. Verbal clearances for descent will normally permit an uninterrupted descent in accordance with the procedure as described in paragraph b. above. Acceptance of a charted fuel efficient descent (Runway Profile Descent) clearance requires the pilot to adhere to the altitudes, speeds, and headings depicted on the charts unless otherwise instructed by ATC.

CAUTION- PILOTS RECEIVING A CLEARANCE FOR A FUEL EFFICIENT DESCENT ARE EXPECTED TO ADVISE ATC IF THEY DO NOT HAVE RUNWAY PROFILE DESCENT CHARTS PUBLISHED FOR THAT AIRPORT OR ARE UNABLE TO COMPLY WITH THE CLEARANCE.

5-4-3. APPROACH CONTROL

a. Approach control is responsible for controlling all instrument flight operating within its area of responsibility. Approach control may serve one or more airfields, and control is exercised primarily by direct pilot an controller communications. Prior to arriving at the destination radio facility, instructions will be received from ARTCC to contact approach control on a specified frequency.

b. Radar Approach Control:

1. Where radar is approved for approach control service, it is used not only for radar approaches (ASR and PAR) but is also used to provide vectors in conjunction with published nonradar approaches based on radio NAVAID's (ILS, MLS, VOR, NDB, TACAN). Radar vectors can provide course guidance and expedite traffic to the final approach course of any established IAP or to the traffic pattern for a visual approach. Approach control facilities that provide this radar service will operate in the following manner:

(a) Arriving aircraft are either cleared to an outer fix most appropriate to the route being flown with vertical separation and, if required, given holding information or, when radar handoffs are effected between the ARTCC and approach control, or between two approach control facilities, aircraft are cleared to the airport or to a fix so located that the handoff will be completed prior to the time the aircraft reaches the fix. When radar handoffs are utilized, successive arriving flights may be handed off to approach control with radar separation in lieu of vertical separation.

(b) After release to approach control, aircraft are vectored to the final approach course (ILS, MLS, VOR, ADF< etc.). Radar vectors and altitude or flight levels will be issued as required for spacing and separating aircraft. Therefore, pilots must not deviate from the headings issued by approach control. Aircraft will normally be informed when it is necessary to vector across the final approach course for spacing or other reasons. If approach course crossing is imminent and the pilot has not been informed that the aircraft will be vectored across the final approach course, the pilot should query the controller.

(c) The pilot is not expected to turn inbound on the final approach course unless an approach clearance has been issued. This clearance will normally be issued with the final vector for interception of the final approach course, and the vector will be such as to enable the pilot to establish the aircraft on the final approach course prior to reaching the final approach fix.

(d) In the case of an aircraft already inbound on the final approach course, approach clearance will be issued prior to the aircraft reaching the final approach fix. When established inbound on the final approach course, radar separation will be maintained and the pilot will be expected to complete the approach utilizing the approach aid designated in the clearance (ILS, MLS, VOR, radio beacon, etc.) as the primary means of navigation. Therefore, once established on the final approach course, pilots must not deviate from it unless a clearance to do so is received from ATC.

(e) After passing the final approach fix on final approach, aircraft are expected to continue inbound on the final approach course and complete the approach or effect the missed approach procedure published for that airport.

2. Whether aircraft are vectored to the appropriate final approach course or provide their own navigation on published route to it, radar service is automatically terminated when the landing is completed or when instructed to change to advisory frequency at uncontrolled airports, whichever occurs first.

5-4-4. ADVANCE INFORMATION ON INSTRUMENT APPROACH

a. When landing at airports with approach control services and where two or more IAP's are published, pilots will be provided in advance of their arrival with the type of approach to expect or that they may be vectored for a visual approach. This information will be broadcast either by a controller or on ATIS. It will not be furnished when the visibility is three miles or better and the ceiling is at or above the highest initial approach altitude established for any low altitude IAP for the airport.

b. The purpose of this information is to aid the pilot in planning arrival actions; however, it is not an ATC clearance or commitment and is subject to change. Pilots should bear in mind that fluctuating weather, shifting winds, blocked runway, etc., are conditions which may result in changes to approach information previously received. It is important that pilots advise ATC immediately if they are unable to execute the approach ATC advised will be used, or if they prefer another type of approach.

c. When making an IFR approach to an airport not served by a tower or FSS, after the ATC controller advises "CHANGE TO ADVISORY FREQUENCY APPROVED" you should broadcast your intentions, including the type of approach being executed, your position, and when over the final approach fix inbound (nonprecision approach) or when over the outer marker or fix used in lieu of the outer marker inbound (precision approach). Continue to monitor the appropriate frequency (UNICOM, etc.) for reports from other pilots.

5-4-5. INSTRUMENT APPROACH PROCEDURE CHARTS

a. FAR Part 91.175a (Instrument Approaches to Civil Airports) requires the use of SIAP's prescribed for the airport in FAR Part 97 unless otherwise authorized by the Administrator (including ATC). FAR Part 91.175g (Military Airports) requires civil pilots flying into or out of military airports to comply with the IAP's and takeoff and landing minimums prescribed by the authority having jurisdiction at those airports.

1. All IAP's (standard and special, civil and military) are based on joint civil and military criteria contained in the U.S. Standard for TERP's. The design of IAP's based on criteria contained in TERP's, takes into account the interrelationship between airports, facilities, and the surrounding environment, terrain, obstacles, noise sensitivity, etc. Appropriate altitudes, courses, headings, distances and other limitations are specified and, once approved, the procedures are published and distributed by government and commercial cartographers as instrument approach charts.

2. Not all IAP's are published in chart form. Radar IAP's are established where requirements and facilities exist but they are printed in tabular form in appropriate U.S. Government Flight Information Publications.

3. A pilot adhering to the altitudes, flight paths, and weather minimums depicted on the IAP chart or vectors and altitudes issued by the radar controller, is assured of terrain and obstruction clearance and runway or airport alignment during approach for landing.

4. IAP's are designed to provide and IFR descent from the en route environment to a point where a safe landing can be made. They are prescribed and ap-

proved by appropriate civil or military authority to ensure a safe descent during instrument flight conditions at a specific airport. It is important the pilots understand these procedures and their use prior to attempting to fly instrument approaches.

5. TERP's criteria are provided fro the following type of instrument approach procedures:

(a) Precision approaches where an electronic glide slope is provided (PAR and ILS) and,

(b) Nonprecision approaches where glide slope information is not provided (all approaches except PAR and ILS).

b. The method used to depict prescribed altitudes on instrument approach charts differs according to techniques employed by different chart publishers. Prescribed altitudes may be depicted in three different configurations: Minimum, maximum, and mandatory. The U.S. Government distributed charts produced by Defense Mapping Agency (DMA) and National Ocean Service (NOS). Altitudes are depicted on these charts in the profile view with an underscore, overscore, or both to identify them as minimum, maximum, or mandatory.

1. Minimum Altitude will be depicted with the altitude value underscored. Aircraft are required to maintain altitude at or above the depicted value.

2. Maximum Altitude will be depicted with the altitude value overscored. Aircraft are required to maintain altitude at or below the depicted value.

3. Mandatory Altitude will be depicted with the altitude value both underscored and overscored. Aircraft are required to maintain altitude at the depicted value.

CAUTION- THE UNDERSCORE AND OVERSCORE TO IDENTIFY MANDATORY ALTITUDES AND THE OVERSCORE TO IDENTIFY MAXIMUM ALTITUDES ARE USED ALMOST EXCLUSIVELY BY DMA FOR MILITARY CHARTS. WITH VERY FEW EXCEPTIONS, CIVIL APPROACH CHARTS PRODUCED BY NOS UTILIZE ONLY THE UNDERSCORE TO IDENTIFY MINIMUM ALTITUDES. PILOTS ARE CAUTIONED TO ADHERE TO ALTITUDES AS PRESCRIBED BECAUSE, IN CERTAIN INSTANCES, THEY MAY BE USED AS THE BASIS FOR VERTICAL SEPARATION OF AIRCRAFT BY ATC. WHEN A DEPICTED ALTITUDE IS SPECIFIED IN THE ATC CLEARANCE, THAT ALTITUDE BECOMES A MANDATORY ALTITUDE AS DEFINED ABOVE.

c. Minimum Safe Altitudes (MSA) are published for emergency use on IAP charts except RNAV IAP's. The MSA is defined using NDB or VOR type facilities within 25 NM (normally) or 30 NM (maximum) of the airport. The MSA has a 25 NM (normally) or 30 NM (maximum) radius. If there is no NDB or VOR facility within 30 NM of the airport, there will be no MSA. The altitude shown provides at least 1,000 feet of clearance above the highest obstacle in the defined sector. As many as four sectors may be depicted with different altitudes for each sector displayed in rectangular boxes in the plan view of the chart. A single altitude for the entire area may be shown in the lower right portion of the plan view. Navigational course guidance is not assured at the MSA within these sectors.

d. Minimum Vectoring Altitudes (MVA) are established for use by ATC when radar ATC is exercised. MVA charts are prepared by air traffic facilities at locations where there are numerous different minimum IFR altitudes. Each MVA chart has sectors large enough to accommodate vectoring of aircraft within the sector at the MVA. Each sector boundary is at least 3 miles from the obstruction determining the MVA. To avoid a large sector with an excessively high MVA due to an isolated prominent obstruction, the obstruction may be enclosed in a buffer whose boundaries are at least 3 miles from the obstruction. This is done to facilitate vectoring around the obstruction.

1. The minimum vectoring altitude in each sector provides 1,000 feet above the highest obstacle in nonmountainous areas and 2,000 feet above the highest obstacle in designated mountainous areas. Where lower MVA's are required in designated mountainous areas to achieve compatibility with terminal route or to permit vectoring to an IAP, 1,000 feet of obstacle clearance may be authorized with the use of Airport Surveillance Radar (ASR). The minimum vectoring altitude will provide at least 300 feet above the floor of controlled airspace.

NOTE- OROCA IS AN OFF-ROUTE ALTITUDE WHICH PROVIDES OBSTRUCTION CLEARANCE WITH A 1,000 FOOT BUFFER IN NONMOUNTAINOUS TERRAIN AREAS AND A 2,000 FOOT BUFFER IN DESIGNATED MOUNTAINOUS AREAS WITHIN THE UNITED STATES. THIS ALTITUDE MAY NOT PROVIDE SIGNAL COVERAGE FROM GROUND-BASED NAVIGATIONAL AIDS, AIR TRAFFIC CONTROL RADAR, OR COMMUNICATIONS COVERAGE.

2. Because of differences in the areas considered for MVA, and those applied to other minimum altitudes, and the ability to isolate specific obstacles, some MVA's may be lower than the nonradar Minimum En Route Altitudes (MEA), Minimum Obstruction Clearance Altitudes (MOCA), or other minimum altitudes depicted on charts for a given location. While being radar vectored, IFR altitude assignments by ATC will be at or above MVA.

e. Visual Descent Points (VDP) are incorporated in selected nonprecision approach procedures. The VDP is a defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference required by FAR Part 91.175(c)(3) is established. The VDP will normally be identified by DME on VOR and LOC procedures. The VDP is identified on the profile view of the approach chart by the symbol: **V**.

1. VDP's are intended to provide additional guidance where they are implemented. No special technique is required to fly a procedure with a VDP. The pilot should not descend below the MDA prior to reaching the VDP and acquiring the necessary visual reference.

2. Pilots not equipped to receive the VDP should fly the approach as though no VDP had been provided.

5-4-6. APPROACH CLEARANCE

a. An aircraft which has been cleared to a holding fix and subsequently "cleared ... approach" has not received new routing. Even though clearance for the approach may have been issued prior to the aircraft reaching the holding fix, ATC would expect the pilot to proceed via the holding fix (his last assigned route), and the feeder route associated with that fix (if a feeder route is published on the approach chart) to the initial approach fix (IAF) to commence the approach.

CAUTION- WHEN CLEARED FOR THE APPROACH, THE PUBLISHED OFF AIRWAY (FEEDER) ROUTES THAT LEAD FROM THE EN ROUTE STRUCTURE TO THE IAF ARE PART OF THE APPROACH CLEARANCE.

b. If a feeder route to an IAF begins at a fix located along the route of flight prior to reaching the holding fix, and a clearance for an approach is issued, a pilot should commence the approach via the published feeder route; i.e. the aircraft would not be expected to overfly the feeder route an return to it. The pilot is expected to commence approach in a similar manner at the IAF, if the IAF for the procedure is located along the route of flight to the holding fix.

c. If a route of flight directly to the initial approach fix is desired, it should be so stated by the controller with phraseology to include the words "direct...," "proceed direct" or a similar phrase which the pilot can interpret without question. When uncertain of the clearance, immediately query ATC as to what route of flight is desired.

d. The name of an instrument approach, as published, is used to identify the approach, even though a component of the approach aid, such as the glide slope on an Instrument Landing System is inoperative or unreliable. The controller will use the name of the approach as published, but will advise the aircraft that the inoperative or unreliable approach aid component is unusable.

5-4-7. INSTRUMENT APPROACH PROCEDURES

a. Minimums are specified for various aircraft approach categories based upon a value 1.3 times the stalling speed of the aircraft in the landing configuration at maximum certificated gross landing weight. If it is necessary, while circling to land, to maneuver at speeds in excess of the upper limit of the speed range for each category, due to the possibility of extending the circling maneuver beyond the area for which obstruction clearance is provided, the circling minimum for the next higher approach category should be used. For example, an aircraft which falls in Category C, but is circling to land at a speed of 141 knots or higher should use the approach category "D" minimums when circling to land.

b. When operating on an unpublished route or while being radar vectored, the pilot, when an approach clearance is received, shall, in addition to complying with the minimum altitudes for IFR operations, maintain the last assigned altitude unless a different altitude is assigned by ATC, or until the aircraft is established on a segment of a published route or IAP. After the aircraft is so established, published altitudes apply to descent within each succeeding route or approach segment unless a different altitude is assigned by ATC. Notwithstanding this pilot responsibility, for aircraft operating on unpublished routes or while being radar vectored, ATC will, except when conducting a radar approach, issue an IFR approach clearance only after the aircraft is established on a segment of a published route or IAP, or assign an altitude to maintain until the aircraft is established on a segment of a published route or instrument approach procedure. For this purpose, the Procedure Turn of a published IAP shall not be considered a segment of that IAP until the aircraft reaches the initial fix or navigation facility upon which the procedure turn is predicated.

EXAMPLE- CROSS REDDING VOR AT OR ABOVE FIVE THOUSAND, CLEARED VOR RUNWAY THREE FOUR APPROACH.

or

FIVE MILES FROM OUTER MARKER, TURN RIGHT HEADING THREE THREE ZERO, MAINTAIN TWO THOUSAND UNTIL ESTABLISHED ON THE LOCALIZER, CLEARED ILS RUNWAY THREE SIX APPROACH.

NOTE- THE ALTITUDE ASSIGNED WILL ASSURE IFR OBSTRUCTION CLEARANCE FROM THE POINT AT WHICH THE APPROACH CLEARANCE IS ISSUED UNTIL ESTABLISHED ON A SEGMENT OF A PUBLISHED ROUTE OR IAP. IF UNCERTAIN OF THE MEANING OF THE CLEARANCE, IMMEDIATELY REQUEST CLARIFICATION FROM ATC.

c. Several IAP's, using various navigation and approach aids may be authorized for an airport. ATC may advise that a particular approach procedure is being used, primarily to expedite traffic. If issued a clearance that specifies a particular approach procedure, notify ATC immediately if a different one is desired. In this event it may be necessary for ATC to withhold clearance for the different approach until such time as traffic conditions permit. However, a pilot involved in an emergency situation will be given priority. If the pilot is not familiar with the specific approach procedure, ATC should be advised and they will provide detailed information on the execution of the procedure.

d. At times ATC may not specify a particular approach procedure in the clearance, but will state "CLEARED APPROACH." Such clearance indicates that the pilot may execute any one of the authorized IAP's for that airport. This clearance does not constitute approval for the pilot to execute a contact approach or a visual approach.

e. When cleared for a specifically prescribed IAP; i.e. "cleared ILS runway one niner approach" or when "cleared approach" i.e. execution of any procedure published for the airport, pilots shall execute the entire procedure as described on the IAP chart unless an appropriate new or revised ATC clearance is received, or the IFR flight plan is cancelled.

f. Pilots planning flights to locations served by special IAP's should obtain advance approval from the owner of the procedure. Approval by the owner is necessary because special procedures are for the exclusive use of the single interest unless otherwise authorized by the owner. Additionally, some special approach procedures require certain crew qualifications training, or other special considerations in order to execute the approach. Also, some of these approach procedures are based on privately owned navigational aids. Owners of aids that are not for public use may elect to turn off the aid for whatever reason they may have; i.e., maintenance, conservation, etc. Air traffic controllers are not required to question pilots to determine if they have permission to use the procedure. Controllers presume a pilot has obtained approval and is aware of any details of the procedure if an IFR flight plan was filed to that airport.

g. When executing an instrument approach and in radio contact with an FAA facility, unless in "radar contact," report passing the final approach fix inbound (nonprecision approach) or the outer marker or fix used in lieu of the outer marker inbound (precision approach).

h. If a missed approach is required, advise ATC and include the reason (unless initiated by ATC). Comply with the missed approach instructions for the instrument approach procedure being executed, unless otherwise directed by ATC.

5-4-8. PROCEDURE TURN

a. A procedure turn is the maneuver prescribed when it is necessary to reverse direction to establish the aircraft inbound on an intermediate or final approach course. It is a required maneuver except when the symbol NoPT is shown, when RADAR VECTORING is provided, when a holding pattern is published in lieu of a procedure turn, when conducting a timed approach, or when the procedure turn is not authorized. The altitude prescribed for the procedure turn is a *minimum* altitude until the aircraft is established on the inbound course. The maneuver must be completed within the distance specified in the profile view.

1. On U.S. Government charts, a barbed

arrow indicates the direction or side of the outbound course on which the procedure turn is made. Headings are provided for the course reversal using the 45 degree type procedure turn. However, the point at which the turn may be commenced and the type and rate of turn is left to the discretion of the pilot. Some of the options are the 45 degree procedure turn, the racetrack pattern, the tear-drop procedure turn, or the 80 degree—260 degree course reversal. Some procedure turns are specified by procedural track. These turn must be flown exactly as depicted.

2. When the approach procedure involves a procedure turn, a maximum speed of not greater than 250 knots (IAS) should be observed and the turn should be executed within the distance specified in the profile view. The normal procedure turn distance in 10 miles. This may be reduced to a minimum of 5 miles where only Category A or helicopter aircraft are to be operated or increased to as much as 15 miles to accommodate high performance aircraft.

3. A teardrop procedure turn or penetration turn may be specified in some procedures for a required course reversal. The teardrop procedures consists of departure from an initial fix on an outbound course followed by a turn toward and intercepting the inbound course at or prior to the intermediate fix or point. Its purpose is to permit an aircraft to reverse direction and lose considerable altitude within reasonably limited airspace. Where no fix is available to mark the beginning of the intermediate segment, it shall be assumed to commence at a point 10 miles prior to the final approach fix. When the facility is located on the airport, an aircraft is considered to be on final approach upon completion of the penetration turn. However, the final approach segment begins on the final approach course 10 miles from the facility.

4. A procedure turn need not be established when an approach can be made from a properly aligned holding pattern. In such cases, the holding pattern is established over an intermediate or a final approach fix. The holding pattern maneuver is completed when the aircraft is established on the inbound course after executing the appropriate entry. If cleared for the approach prior to returning to the holding fix, and the aircraft is at the prescribed altitude, additional circuits of the holding pattern are not necessary nor expected by ATC. If pilots elect to make additional circuits to lose excessive altitude or to become better established on course, it is their responsibility to so advise ATC upon receipt of their approach clearance.

5. A procedure turn is not required when an approach can be made directly from a specified intermediate fix to the final approach fix. In such cases, the term "NoPT" is used with the appropriate course and altitude to denote that the procedure turn is not required. If a procedure turn is desired, and when cleared to do so by ATC, descent below the procedure turn altitude should not be made until the aircraft is established on the inbound course, since some NoPT altitude may be lower than the procedure turn altitudes.

b. Limitations on Procedure Turns:

1. In the case of a radar initial approach to a final approach fix or position, or a timed approach from a holding fix, or where the procedure specifies NoPT, no pilot may make a procedure turn unless, when final approach clearance is received, the pilot so advises ATC and a clearance is received to execute a procedure turn.

2. When a teardrop procedure turn is depicted and a course reversal is required, this type turn must be executed.

3. When a holding pattern replaces the procedure turn, the standard entry and

holding pattern must be followed except when RADAR VECTORING is provided or NoPT is shown on the approach course. As in the procedure turn, descent from the minimum holding pattern altitude to the final approach fix altitude (when lower) may not commence until the aircraft is established on the inbound course.

4. The absence of the procedure turn barb in the Plan View indicates that a procedure turn is not authorized for that procedure.

5-4-9. TIMED APPROACHES FROM A HOLDING FIX

a. TIMED APPROACHES may be conducted when the following conditions are met:

1. A control tower is in operation at the airport where the approaches are conducted.

2. Direct communications are maintained between the pilot and the center or approach controller until the pilot is instructed to contact the tower.

3. If more than one missed approach procedure is available, none require a course reversal.

4. If only one missed approach procedure is available, the following conditions must be met:

(a) Course reversal is not required; and

(b) Reported ceiling and visibility are equal to or greater than the highest prescribed circling minimums for the IAP.

5. When cleared for the approach, pilots shall not execute a procedure turn. (FAR Part 91.175.)

b. Although the controller will not specifically state the "timed approaches are in progress," the assigning of a time to depart the final approach fix inbound (nonprecision approach) or the outer marker or fix used in lieu of the outer marker inbound (precision approach) is indicative that timed approach procedures are being utilized, or in lieu of holding, the controller may use radar vectors to establish a mileage interval between aircraft that will insure the appropriate time sequence between the final approach fix/outer marker or fix used in lieu of the outer marker and the airport.

c. Each pilot in an approach sequence will be given advance notice as to the time they should leave the holding point on approach to the airport. When a time to leave the holding point has been received, the pilot should adjust the flight path to leave the fix as closely as possible to the designated time.

5-4-10. RADAR APPROACHES

a. The only airborne radio equipment required for radar approaches os a functioning radio transmitter and receiver. The radar controller vectors the aircraft to align it with the runway centerline. The controller continues the vectors to keep the aircraft on course until the pilot can complete the approach and landing by visual reference to the surface. There are two types of radar approaches: Precision (PAR) and Surveillance (ASR).

b. A radar approach may be given to any aircraft upon request and may be offered to pilots of aircraft in distress or to expedite traffic, however, and ASR might not be approved unless there is an ATC operational requirement, or an unusual or emergency situation. Acceptance of a PAR or ASR by a pilot does not waive the prescribed weather minimums for the airport or for the particular aircraft operator concerned. The decision to make a radar approach when the reported weather is below the established minimums rests with the pilot.

c. PAR and ASR minimums are published on separate pages in the NOS Terminal Procedures Publication (TPP).

1. A PRECISION APPROACH (PAR) is one in which a controller provides highly accurate navigational guidance in azimuth and elevation to a pilot. Pilots are given headings to fly, to direct them to, and keep their aircraft aligned with the extended centerline of the landing runway. They are told to anticipate glide path interception approximately 10 to 30 seconds before it occurs and when to start descent. The published Decision Height will be given only if the pilot requests it. If the aircraft is observed to deviate above or below the glide path, the pilot is given the relative amount of deviation by use of the terms "slightly" or "well" and is expected to adjust the aircraft's rate of descent/ascent to return to the glide path. Trend information is also issued with respect to the elevation of the aircraft and may be modified by the terms "rapidly" and "slowly"; e.g., "well above glide path, coming down rapidly." Range from touchdown is given at least once each mile. If an aircraft is observed by the controller to proceed outside of specified safety zone limits in azimuth and/or elevation and continue to operate outside these prescribed limits, the pilot will be directed to execute a missed approach or to fly a specified course unless the pilot has the runway environment (runway, approach lights, etc.) in sight. Navigational guidance in azimuth and elevation is provided the pilot until the aircraft reaches the published decision height (DH). Advisory course and glide path information is furnished by the controller until the aircraft passes over the landing threshold, at which point the pilot is advised of any deviation from the runway centerline. Radar service is automatically terminated upon completion of the approach.

2. A SURVEILLANCE APPROACH (ASR) is one in which a controller provides navigational guidance in azimuth only. The pilot is furnished headings to fly to align the aircraft with the extended centerline of the landing runway. Since the radar information used for the surveillance approach is considerably less precise than that used for a precision approach, the accuracy of the approach will not be as great and higher minimums will apply. Guidance in elevation is not possible but the pilot will be advised when to commence descent to the Minimum Descent Altitude (MDA) or, if appropriate, to an intermediate step-down fix Minimum Crossing Altitude and subsequently to the prescribed MDA. In addition, the pilot will be advised of the location of the Missed Approach Point (MAP) prescribed for the procedure and the aircraft's position each mile on final from the runway, airport or heliport or MAP, as appropriate. If requested by the pilot, recommended altitudes will be issued at each mile, based on the descent gradient established for the procedure, down to the last mile that is at or above the MDA. Normally navigational guidance will be provided until the aircraft reaches the MAP. Controllers will terminate guidance and instruct the pilot to execute a missed approach unless at the MAP the pilot has the runway, airport or heliport in sight or, for a helicopter point-in-space approach, the prescribed visual reference with the surface is established. Also, if, at any time during the approach the controller considers that safe guidance for the rest of the approach cannot be provided, the controller will terminate guidance and instruct the pilot to execute a missed approach. Similarly, guidance termination and missed approach will be effected upon pilot request and, for civil aircraft only, controllers may terminate guidance when the pilot re-

ports the runway, airport/heliport or visual surface route (point-in-space approach) in sight or otherwise indicates that continued guidance is not required. Radar service is automatically terminated at the completion of the radar approach.

NOTE- THE PUBLISHED MDA FOR STRAIGHT-IN APPROACHES WILL BE ISSUED TO THE PILOT BEFORE BEGINNING DESCENT. WHEN A SURVEILLANCE APPROACH WILL TERMINATE IN A CIRCLE-TO-LAND MANEUVER, THE PILOT MUST FURNISH THE AIRCRAFT APPROACH CATEGORY TO THE CONTROLLER. THE CONTROLLER WILL THEN PROVIDE THE PILOT WITH THE APPROPRIATE MDA.

ASR APPROACHES ARE NOT AVAILABLE WHEN AN ATC FACILITY IS USING CENRAP.

3. A NO-GYRO APPROACH is available to a pilot under radar control who experiences circumstances wherein the directional gyro or other stabilized compass is inoperative or inaccurate. When this occurs, the pilot should so advise ATC and request a No-Gyro vector or approach. Pilots of aircraft not equipped with a directional gyro or other stabilized compass who desire radar handling may also request a No-Gyro vector or approach. The pilot should make all turns at standard rate and should execute the turn immediately upon receipt of instructions. For example, "TURN RIGHT," "STOP TURN." When a surveillance or precision approach is made, the pilot will be advised after the aircraft has been turned onto final approach to make all turns at half standard rate.

5-4-17. SIDE-STEP MANEUVER

a. ATC may authorize an approach procedure which serves either one of parallel runways that are separated by 1,200 feet or less followed by a straight-in landing on the adjacent runway.

b. Aircraft that will execute a side-step maneuver will be cleared for a specific approach and landing on the adjacent parallel runway. Example, "cleared ILS runway 7 left approach, side-step to runway 7 right." Pilots are expected to commence the side-step maneuver as soon as possible after the runway or runway environment is in sight.

c. Landing minimums to the adjacent runway will be higher than the minimum to the primary runway, but will normally be lower than the published circling minimums.

5-4-18. APPROACH AND LANDING MINIMUMS

a. Landing Minimums: The rules applicable to landing minimums are contained in FAR Part 91.175.

b. Published Approach Minimums: Approach minimums are published for different aircraft categories and consist of a minimum altitude (DH, MDA) and required visibility. These minimums are determined by applying the appropriate TERPs criteria. When a fix is incorporated in a nonprecision final segment, two sets of minimums may be published: one, for the pilot that is able to identify the fix, and a second for the pilot that cannot. Two sets of minimums may also be published when a second altimeter source is used in the procedure.

c. Obstacle Clearance: Final approach obstacle clearance is provided from the start of the final segment to the runway or Missed Approach Point, whichever occurs last. Side-step obstacle protection is provided by increasing the width of the final approach obstacle clearance are. Circling approach protected areas are defined by the tangential connection of arcs drawn from each runway end. The arc radii distance differs by approach category. Because of obstacles near the airport, a portion of the circling area may be restricted by a procedural note: e.g., "Circling NA E of RWY 17-35." Obstacle clearance is provided at the published minimums for the pilot that makes a straight-in approach, side-steps, circles, or executes the missed approach. Missed approach obstacle clearance requirements may dictate the published minimums for the approach.

d. Straight-in Minimums: Are shown on the IAP when the final approach course is within 30 degrees of the runway alignment and a normal descent can be made from the IFR altitude shown on the IAP to the runway surface. When either the normal rate of descent or the runway alignment factor of 30 degrees is exceeded, a straight-in minimum is not published and a circling minimum applies. The fact that a straight-in minimum is not published does not preclude pilots from landing straight-in if they have the active runway in sight and have sufficient time to make a normal approach for landing. Under such conditions and when ATC has cleared them for landing on that runway, pilots are not expected to circle even though only circling minimums are published. If they desire to circle, they should advise ATC.

e. Side-Step Maneuver Minimums: Landing minimums for a side-step maneuver to the adjacent runway will normally be higher than the minimums to the primary runway.

f. Circling Minimums: In some busy terminal areas, ATC may not allow circling and circling minimums will not be published. Published circling minimums provide obstacle clearance when pilots remain within the appropriate area of protection. Pilots should remain at or above the circling altitude until the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers. Circling may require maneuvers at low altitude, low airspeed, and in marginal weather conditions. Pilots must use sound judgment, have an in-depth knowledge of their capabilities, and fully understand the aircraft performance to determine the exact circling maneuver since weather, unique airport design, and the aircraft position, altitude, and airspeed must all be considered. The following basic rules apply:

1. Maneuver the shortest path to the base or downwind leg, as appropriate, considering existing weather conditions. There is no restriction from passing over the airport or other runways.

2. It should be recognized that circling maneuvers may be made while VFR or other flying is in progress at the airport. Standard left turns or specific instruction from the controller for maneuvering must be considered when circling to land.

3. At airports without a control tower, it may be desirable to fly over the airport to observe wind and turn indicators and other traffic which may be on the runway or flying in the vicinity of the airport.

g. Instrument Approach At a Military Field: When instrument approaches are conducted by civil aircraft at military airports, they shall be conducted in accordance with the procedures and minimums approved by the military agency having jurisdiction over the airport.

5-4-19. MISSED APPROACH

a. When a landing cannot be accomplished, advise ATC and, upon reaching the Missed Approach Point defined on the approach procedure chart, the pilot must comply with the missed approach instructions for the procedure being used or with an alternate missed approach procedure specified by ATC.

b. Protected obstacle clearance areas for missed approach are predicated on the assumption that the abort is initiated at the missed approach point not lower than the MDA or DH. Reasonable buffers are provided for normal maneuvers. However, no consideration is given to an abnormally early turn. Therefore, when an early missed approach is executed, pilots should, unless otherwise cleared by ATC, fly the IAP as specified on the approach plate to the missed approach point at or above the MDA or DH before executing any turning maneuver.

c. If visual reference is lost while circling-to-land from an instrument approach, the missed approach specified for that particular procedure must be followed (unless an alternate missed approach procedure is specified by ATC.) To become established on the prescribed missed approach course, the pilot should make an initial climbing turn toward the landing runway and continue the turn until established on the missed approach course. Inasmuch as the circling maneuver may be accomplished in more than one direction, different patterns will be required to become established on the prescribed missed approach course, depending on the aircraft position at the time visual reference is lost. Adherence to the procedure will assure that an aircraft will remain within the circling and missed approach obstruction clearance areas.

d. At locations where ATC Radar Service is provided, the pilot should conform to radar vectors when provided by ATC in lieu of the published missed approach procedure.

e. When approach has been missed, request clearance for specific action; i.e., to alternate airport, another approach, etc.

5-4-20. VISUAL APPROACH

a. A visual approach is conducted on an IFR flight plan and authorizes a pilot to proceed visually to the airport. The pilot must have either the airport or the preceding identified aircraft in sight. This approach must be authorized and controlled by the appropriate air traffic control facility. Reported weather at the airport must have a ceiling at or above 1,000 feet and visibility 3 miles or greater. ATC may authorize this type approach when it will be operationally beneficial. Compliance with FAR Part 91.155 is not required.

b. OPERATING TO AN AIRPORT WITHOUT WEATHER REPORTING SERVICE: ATC will advise the pilot when weather is not available at the destination airport. ATC may initiate a visual approach provided there is a reasonable assurance that weather at the airport is a ceiling at or above 1,000 feet and visibility 3 miles or greater (e.g. area weather reports, PIREPS, etc.).

c. OPERATING TO AN AIRPORT WITH AN OPERATING CONTROL TOWER: Aircraft may be authorized to conduct a visual approach to one runway while other aircraft are conducting IFR or VFR approaches to another parallel, intersecting, or converging runway. When operating to airports with parallel runways separated by less than 2,500 feet, the succeeding must report sighting the preceding aircraft unless standard separation is being provided by ATC. When operating to parallel runways separated by at least 2,500 feet but less than 4,300 feet, controllers will clear/vector aircraft to the final at an angle not greater than 30 degrees unless radar, vertical, or visual separation is provided during the turn-on. The purpose of the 30 degree intercept angle is to reduce the potential for overshoots of the final and to preclude side-by-side operations for with one or both aircraft in a belly-up configuration during the turn-on. Once the aircraft are established within 30 degrees of final, or are on final, these operations may be conducted simultaneously. When the parallel runways are separated by 4,300 feet or more, or intersecting/converging runways are in use, ATC may authorize a visual approach after advising all aircraft involved that other aircraft are conducting operations to the other runway. This may be accomplished through the use of ATIS.

d. SEPARATION RESPONSIBILITIES: If the pilot has the airport in sight but cannot see the aircraft to be followed, ATC may clear the aircraft for a visual approach; however, ATC retains both separation and wake vortex separation responsibility. When visually following a preceding aircraft, acceptance of the visual approach clearance constitutes acceptance of pilot responsibility for maintaining a safe approach interval and adequate wake turbulence separation.

e. A visual approach is not an IAP and therefore has no missed approach segment. If a go around is necessary for any reason, aircraft operating at controlled airports will be issued an appropriate advisory/clearance/instruction by the tower. At uncontrolled airports, aircraft are expected to remain clear of clouds and complete a landing as soon as possible. If a landing cannot be accomplished, the aircraft is expected to remain clear of clouds and contact ATC as soon as possible for further clearance. Separation from other IFR aircraft will be maintained under these circumstances.

f. Visual approaches reduce pilot/controller work load and expedite traffic by shortening flight paths to the airport. It is the pilot's responsibility to advise ATC as soon as possible if a visual approach is not desired.

g. Authorization to conduct a visual approach is an IFR authorization and does not alter IFR flight plan cancellation responsibility.

h. Radar service is automatically terminated, without advising the pilot, when the aircraft is instructed to change to advisory frequency.

5-4-21. CHARTED VISUAL FLIGHT PROCEDURES (CVFP)

a. CVFP's are charted visual approach procedures established at locations with jet operations for noise abatement purposes. The approach charts depict prominent landmarks, courses, and recommended altitudes to specific runways.

b. These procedures will be used only in a radar environment at airports with an operating control tower.

c. Most approach charts will depict some NAVAID information which is for supplemental navigational guidance only.

d. Unless indicating a Class B airspace floor, all depicted altitudes are for noise abatement purposes and are recommended only. Pilots are not prohibited form flying other than recommended altitudes if operational requirements dictate.

e. When landmarks used for navigation are not visible at night, the approach will be annotated "PROCEDURE NOT AUTHORIZED AT NIGHT."

f. CVFP's usually begin within 15 flying miles from the airport.

g. Published weather minimums for CVFP's are based on minimum vectoring altitudes rather than the recommended altitudes depicted on charts.

h. CVFP's are not instrument approaches and do not have missed approach segments.

i. ATC will not issue clearances for CVFP's when the weather is less than the published minimum.

j. ATC will clear aircraft for a CVFP after the pilot reports siting a charted landmark or a preceding aircraft. If instructed to follow a preceding aircraft, pilot are responsible for maintaining a safe approach interval and wake turbulence separation.

k. Pilots should advise ATC if at any point they are unable to continue an approach or lose sight of a preceding aircraft. Missed approaches will be handled as a go-around.

5-4-22. CONTACT APPROACH

a. Pilots operating in accordance with an IFR flight plan, provided they are clear of clouds and have at least 1 mile flight visibility and can reasonably expect to continue to the destination airport in those conditions, may request ATC authorization for a contact approach.

b. Controllers may authorize a contact approach provided:

1. The contact approach is specifically requested by the pilot. ATC cannot initiate this approach.

EXAMPLE- REQUEST CONTACT APPROACH.

2. The reported ground visibility at the destination airport is at least 1 statute mile.
3. The contact approach will be made to an airport having a standard or special instrument approach procedure.
4. Approved separation is applied between aircraft so cleared and between these aircraft and other IFR or special VFR aircraft.

EXAMPLE- CLEARED CONTACT APPROACH (AND, IF REQUIRED) AT OR BELOW (ALTITUDE) (ROUTING) IF NOT POSSIBLE (ALTERNATIVE PROCEDURES) AND ADVISE.

c. A contact approach is an approach procedure that may be used by a pilot (with prior authorization from ATC) in lieu of conducting a standard or special IAP to an airport. It is not intended for use by a pilot on an IFR flight clearance to operate to an airport not having an authorized IAP. Nor is it intended for an aircraft to conduct an instrument approach to one airport and then, when "in the clear," to discontinue that approach and proceed to another airport. In the execution of a contact approach, the pilot assumes the responsibility for obstruction clearance. If radar service is being received, it will automatically terminate when the pilot is told to contact the tower.

5-4-23. LANDING PRIORITY

A clearance for a specific type of approach (ILS, MLS, ADF, VOR, or Straight-in Approach) to an aircraft operating on an IFR flight plan does not mean that landing priority will be given over other traffic. ATCT's handle all aircraft, regardless of the type of flight plan, on a "first-come, first-served" basis. Therefore, because of local traffic or runway in use, it may be necessary for the controller in the interest of safety, to provide a different landing sequence. In any case, a landing sequence will be issued to each aircraft as soon as possible to enable the pilot to properly adjust the aircraft's flight path.

CHAPTER 5 SECTION 5
PILOT/CONTROLLER ROLES AND RESPONSIBILITIES

5-5-1. GENERAL

a. The roles and responsibilities of the pilot and controller for effective participation in the ATC system are contained in several documents. Pilot responsibilities are in the FAR's and the air traffic controller's are in the Air Traffic Control Order (FAA Order 7110.65) and supplemental FAA directives. Additional and supplemental information for pilots can be found in the current Aeronautical Information Manual (AIM), Notices to Airmen, Advisory Circulars and aeronautical charts. Since there are many other excellent publications produced by non-government organizations, as well as other government organizations, with various updating cycles, questions concerning the latest or most current material can be resolved by cross-checking with the above mentioned documents.

b. The pilot in command of an aircraft is directly responsible for, and is the final authority as to the safe operation of that aircraft. In an emergency requiring immediate action, the pilot in command may deviate from any rule in the General Subpart A and Flight Rules Subpart B in accordance with FAR Part 91.3.

c. The air traffic controller is responsible to give first priority to the separation of aircraft and to the issuance of radar safety alerts, second priority to other services that are required, but do not involve separation of aircraft, and third priority to additional services to the extent possible.

d. In order to maintain a safe and efficient air traffic system, it is necessary to insure that each party fulfill their responsibilities to the fullest.

e. The responsibilities of the pilot and the controller intentionally overlap in many areas providing a degree of redundancy. Should one or the other fail in any manner, this overlapping responsibility is expected to compensate, in many cases, for failures that may affect safety.

f. The following, while not intended to be all inclusive, is a brief listing of pilot and controller responsibilities for some commonly used procedures or phases of flight. More detailed explanations are contained in other portions of this publication, the appropriate FAR's, AC's, and similar publications. The information provided is an overview of the principles involved and is not meant as an interpretation of the rules, nor is it intended to extend or diminish responsibility.

5-5-2. AIR TRAFFIC CLEARANCE

a. Pilot:

1. Acknowledges receipt and understanding of an ATC clearance.
2. Reads back any hold short of runway instructions issued by ATC.
3. Requests clarification or amendment, as appropriate, any time a clearance is not fully understood or considered unacceptable from a safety standpoint.
4. Promptly complies with an air traffic clearance upon receipt except as necessary to cope with an emergency. Advises ATC as soon as possible and obtains an amended clearance, if deviation is necessary.

CAUTION- A CLEARANCE TO LAND MEANS THAT APPROPRIATE SEPARATION ON THE LANDING RUNWAY WILL BE ENSURED. A LANDING CLEARANCE DOES NOT RELIEVE THE PILOT FROM COMPLIANCE WITH ANY PREVIOUSLY ISSUED ALTITUDE CROSSING RESTRICTION.

b. Controller:

1. Issues appropriate clearances for the operation to be conducted, or being conducted, in accordance with established criteria.

2. Assigns altitudes in IFR clearances that are at or above minimum IFR altitudes in controlled airspace.

3. Ensures acknowledgment by the pilot for issued information, clearances, or instructions.

4. Ensures that readbacks by the pilot of altitude, heading, or other items are correct. If incorrect, distorted, or incomplete, makes corrections as appropriate.

5-5-3. CONTACT APPROACH

a. Pilot:

1. Must request a contact approach and makes it in lieu of a standard or special instrument approach.

2. By requesting the contact approach, indicates that the flight is operating clear of clouds, has at least 1 mile flight visibility, and reasonably expects to continue to the destination airport in those conditions.

3. Assumes responsibility for obstruction clearance while conducting a contact approach.

4. Advises ATC immediately if unable to continue the contact approach or if encounters less than 1 mile flight visibility.

5. Is aware that if radar service is being received, it may be automatically terminated when told to contact the tower.

b. Controller:

1. Issues clearance for a contact approach only when requested by the pilot. Does not solicit the use of this procedure.

2. Before issuing the clearance, ascertains that reported ground visibility at destination airport is at least 1 mile.

3. Provides approved separation between the aircraft cleared for a contact approach and other IFR or special VFR aircraft. When using vertical separation, does not assign a fixed altitude, but clears the aircraft at or below an altitude which is at least 1,000 feet below any IFR traffic but not below Minimum Safe Altitudes prescribed in FAR Part 91.119.

4. Issues alternative instructions if, in their judgment, weather conditions may make completion of the approach impracticable.

5-5-4. INSTRUMENT APPROACH

a. Pilot:

1. Be aware that the controller issues clearance for approach based only on known traffic.

2. Follows the procedure as shown on the IAP, including all restrictive notations, such as:

(a) Procedure not authorized at night;

(b) Approach not authorized when local altimeter not available;

(c) Procedure not authorized when control tower not in operation;

(d) Procedure not authorized when glide slop not used;

(e) Straight-in minimums not authorized at night; etc.

(f) Radar required; or

(g) The circling minimums published on the instrument approach chart provide adequate obstruction clearance and pilots should not descend below the circling altitude until the aircraft is in a position to make final descent for landing. Sound judgment and knowledge of the pilot's and the aircraft's capabilities are the criteria for determining the exact maneuver in each instance since airport design and the aircraft position, altitude and airspeed must all be considered.

3. Upon receipt of an approach clearance while on an unpublished route or being radar vectored:

(a) Complies with the minimum altitude for IFR, and

(b) Maintains the last assigned altitude until established on a segment of a published route or IAP, at which time published altitudes apply.

b. Controller:

1. Issues an approach clearance based on known traffic.

2. Issues an IFR approach clearance only after the aircraft is established on a segment of a published route or IAP, or assigns an appropriate altitude for the aircraft to maintain until so established.

5-5-5. MISSED APPROACH

a. Pilot:

1. Executes a missed approach when one of the following conditions exists:

(a) Arrival at the Missed Approach Point (MAP) or the Decision Height (DH) and visual reference to the runway environment is insufficient to complete the landing.

(b) Determined that a safe landing is not possible.

(c) Instructed to do so by ATC.

2. Advises ATC that a missed approach will be made. Includes the reason for the missed approach unless the missed approach is initiated by ATC.

3. Complies with the missed approach instructions for the IAP being executed unless other missed approach instructions are specified by ATC.

4. If executing a missed approach prior to reaching the MAP or DH, flies the instrument procedure to the MAP at an altitude at or above the Minimum Descent Altitude (MDA) or DH before executing a turning maneuver.

5. Radar vectors issued by ATC when informed that a missed approach is being executed supersedes the previous missed approach procedure.

6. If making a missed approach from a radar approach, executes the missed approach procedure previously given or climbs to the altitude and flies the heading specified by the controller.

7. Following a missed approach, requests clearance for specific action; i.e., another approach, hold for improved conditions, proceed to an alternate airport, etc.

b. Controller:

1. Issues an approved alternate missed approach procedure if it is desired that the pilot execute a procedure other than as depicted on the instrument approach chart.

2. May vector a radar identified aircraft executing a missed approach when operationally advantageous to the pilot or the controller.

3. In response to the pilot's stated intentions, issues a clearance to an alternate airport, to a holding fix, or for reentry into the approach sequence, as traffic conditions permit.

5-5-6. RADAR VECTORS

a. Pilot:

1. Promptly complies with headings and altitude assigned by the controller.

2. Questions any assigned heading or altitude believed to be incorrect.

3. If operating VFR and compliance with any radar vector or altitude would cause a violation of any FAR, advises ATC and obtains a revised clearance or instruction.

b. Controller:

1. Vectors aircraft in Class A, Class B, Class, C, Class D and Class E airspace:

(a) For separation.

(b) For noise abatement.

(c) To obtain an operational advantage for the pilot or controller.

2. Vectors aircraft in Class A, Class B, Class, C, Class D, Class E and Class G airspace when requested by the pilot.

3. Vectors IFR aircraft at or above the Minimum Vectoring Altitudes.

4. May vector VFR aircraft, not at an ATC assigned altitude, at any altitude. In these cases, terrain separation is the pilot's responsibility.

5-5-7. SAFETY ALERT

a. Pilot:

1. Initiates appropriate action if a safety alert is received from ATC.

2. Be aware that this service is not always available and that many factors affect the ability of the controller to be aware of a situation in which unsafe proximity to terrain, obstructions, or another aircraft may be developing.

b. Controller:

1. Issues a safety alert if aware that an aircraft under their control is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain, obstructions, or another aircraft. Types of safety alerts are:

(a) Terrain or Obstruction Alert: Immediately issued to an aircraft under their control if aware the aircraft is at an altitude believed to place the aircraft in unsafe proximity to terrain or obstructions.

(b) Aircraft Conflict Alert: Immediately issued to an aircraft under their control if aware of an aircraft not under their control at an altitude believed to place the aircraft in unsafe proximity to each other. With the alert they offer the pilot an alternative, if feasible.

2. Discontinue further alerts if informed by the pilot action is being taken to correct the situation or that the other aircraft is in sight.

5-5-8. SEE AND AVOID

a. Pilot: When meteorological conditions permit, regardless of type of flight plan or whether or not under control of a radar facility, the pilot is responsible to see and avoid other traffic, terrain, or obstacles.

b. Controller:

1. Provides radar traffic information to radar identified aircraft operating outside positive control airspace on a work load permitting basis.

2. Issues safety alerts to aircraft under their control if aware the aircraft is at an altitude believed to place the aircraft in unsafe proximity to terrain, obstructions, or other aircraft.

5-5-9. SPEED ADJUSTMENTS

a. Pilot:

1. Advises ATC any time cruising airspeed varies plus or minus 5 percent or 10 knots, whichever is greater, from that filed in the flight plan.

2. Complies with speed adjustments from ATC unless:

(a) The minimum or maximum safe airspeed for any particular operation is greater or less than the requested airspeed. In such cases, advises ATC.

CAUTION- IT IS THE PILOT'S RESPONSIBILITY AND PREROGATIVE TO REFUSE SPEED ADJUSTMENTS CONSIDERED EXCESSIVE OR CONTRARY TO THE AIRCRAFT'S OPERATING SPECIFICATIONS.

(b) Operating at or above 10,000 feet MSL on an ATC assigned speed adjustment of more than 250 knots IAS and subsequent clearance is received for descent below 10,000 feet MSL. In such cases, pilots are expected to comply with FAR Part 91.117(a).

3. When complying with speed adjustment assignments, maintains an indicated airspeed within plus or minus 10 knots or 0.02 mach number of the specified speed.

(b) Controller:

1. Assigns speed adjustments to aircraft when necessary but not as a substitute for good vectoring technique.

2. Adheres to the restrictions published in the Air Traffic Control Order (FAA Order 7110.65) as to when speed adjustment procedures may be applied.

3. Avoids speed adjustments requiring alternate decreases and increases.

4. Assigns speed adjustments to a specified IAS (knots)/mach number or to increase or decrease speed using increments of 10 knots or multiples thereof.

5. Advises pilots to resume normal speed when speed adjustments are no longer required.

6. Gives due consideration to aircraft capabilities to reduce speed while descending.

7. Does not assign speed adjustments to aircraft at or above FL390 without pilot consent.

5-5-10. TRAFFIC ADVISORIES

a. Pilot:

1. Acknowledges receipt of traffic advisories.

2. Informs controller if traffic not in sight.

3. Advises ATC if a vector to avoid traffic is desired.

4. Does not expect to receive radar traffic advisories on all traffic. Some aircraft may not appear on the radar display. Be aware that the controller may be occupied with higher priority duties and unable to issue traffic information for a variety of reasons.

5. Advises controller if service not desired.

b. Controller:

1. Issues radar traffic to the maximum extent consistent with higher priority duties except in Class A airspace.

2. Provides vectors to assist aircraft to avoid observed traffic when requested by the pilot.

3. Issue traffic information to aircraft in Class B, Class C, Class D surface areas for sequencing purposes.

5-5-11. VISUAL APPROACH

a. Pilot:

1. If a visual approach is not desired, advises ATC.

2. Complies with controller's instructions for vectors toward the airport of intended landing or to a visual position behind a preceding aircraft.

3. The pilot must, at all times, have either the airport or the preceding traffic in sight. After being cleared for a visual approach, proceed to the airport in a normal manner or follow the preceding aircraft. Remain clear of clouds while conducting a visual approach.

4. If the pilot accepts a visual approach clearance to visually follow a preceding aircraft, the pilot is required to establish a safe landing interval behind the aircraft the pilot is instructed to follow. The pilot is responsible for wake turbulence separation.

5. Advise ATC immediately if the pilot is unable to continue to follow the preceding aircraft, cannot remain clear of clouds, or lose sight of the airport.

6. Be aware that radar service is automatically terminated, without being advise by ATC, when the pilot is instructed to change to advisory frequency.

7. Be aware that there may be other traffic in the traffic pattern and the landing sequence may differ from the traffic sequence assigned by approach control or ARTCC.

b. Controller:

1. Do not clear an aircraft for a visual approach unless reported weather at the airport ceiling at or above 1,000 feet and visibility 3 miles or greater. When weather is not available for the destination airport, inform the pilot and do not initiate a

visual approach to that airport unless there is reasonable assurance that descent and flight to the airport can be made in VFR conditions.

2. Issue visual approach clearance when the pilot reports sighting either the airport or a preceding aircraft which is to be followed.

3. Provide separation except when visual separation is being applied by the pilot.

4. Continue flight following and traffic information until the aircraft has landed or has been instructed to change to advisory frequency.

5. Inform the pilot when the preceding aircraft is a heavy.

6. When weather is available for the destination airport, do not initiate a vector for a visual approach unless the reported ceiling at the airport is 500 feet or more above the MVA and visibility is 3 miles or more. If vectoring weather minima are not available but weather at the airport is ceiling at or above 1,000 feet and visibility of 3 miles or greater, visual approaches may still be conducted.

7. Informs the pilot conducting the visual approach of the aircraft class when pertinent traffic is known to be a heavy aircraft.

5-5-12. VISUAL SEPARATION

a. Pilot:

1. Acceptance of instructions to follow another aircraft or to provide visual separation from it is an acknowledgment that the pilot will maneuver the aircraft as necessary to avoid the other aircraft or to maintain in-trail separation.

2. If instructed by ATC to follow another aircraft or to provide visual separation from it, promptly notify the controller if you lose sight of that aircraft, are unable to maintain continued visual contact with it, or cannot accept the responsibility for your own separation fro any reason.

3. The pilot also accepts responsibility for wake turbulence separation under these conditions.

b. Controller: Applies visual separation only:

1. In conjunction with visual approaches.

2. Within the terminal area when a controller has both aircraft in sight or by instructing a pilot who sees the other aircraft to maintain visual separation from it.

3. Within en route airspace when aircraft are on opposite courses and one pilot reports having seen the other aircraft and that the aircraft have passed each other.

5-5-13. VFR-ON-TOP

a. Pilot:

1. This clearance must be requested by the pilot on an IFR flight plan, and if approved, allows the pilot choice (subject to any ATC restrictions) to select an altitude or Flight Level in Lieu of an assigned altitude.

NOTE- VFR-ON-TOP IS NOT PERMITTED IN CERTAIN AIRSPACE AREAS, SUCH AS POSITIVE CONTROL AIRSPACE, CERTAIN RESTRICTED AREAS, ETC. CONSEQUENTLY, IFR FLIGHT OPERATING VFR-ON-TOP WILL AVOID SUCH AIRSPACE.

2. By requesting a VFR-ON-TOP clearance, the pilot assumes the sole responsibility to be vigilant so as to see and avoid other aircraft and to:

(a) Fly at the appropriate VFR altitude as prescribed in FAR 91.159.

(b) Comply with the VFR visibility and distance from cloud criteria in FAR Part 91.155 (Basic VFR Weather Minimums).

(c) Comply with instrument flight

rules that are applicable to this flight; i.e., minimum IFR altitudes, position reporting, radio communications, course to be flown, adherence to ATC clearance, etc.

3, Should advise ATC prior to any altitude change to ensure the exchange of accurate traffic information.

b. Controller:

1. May clear an aircraft to maintain VFR-ON-TOP if the pilot of an aircraft on an IFR flight plan requests the clearance.

2. Informs the pilot of an aircraft cleared to climb to VFR-ON-TOP the reported heights of the tops or that no top report is available; and once the aircraft reports reaching VFR-ON-TOP, reclears the aircraft the maintain VFR-ON-TOP.

3. Before issuing a clearance, ascertains that the aircraft is not or will not enter positive control airspace.

5-5-14. INSTRUMENT DEPARTURES

a. Pilot:

1. Prior to departure considers the type of terrain and other obstructions on or in the vicinity of the departure airport.

2. Determines if obstruction avoidance can be maintained visually or that the departure procedure should be followed.

3. Determines whether a departure procedure and/or SID is available for obstruction avoidance.

4. At airports where IAP's have not been published, hence no published departure procedure, determines what action will be necessary and takes such action that will assure a safe departure.

b. Controller:

1. At locations with airport traffic control service, when necessary, specifies direction of takeoff, turn, or initial heading to be flown after takeoff.

2. At locations without airport traffic control service but within Class E surface area when necessary to specify direction of takeoff, turn, or initial heading to be flown, obtains pilot's concurrence that the procedure will allow the pilot to comply with local traffic patterns, terrain, and obstruction avoidance.

3. Includes established departure procedures as part of the ATC clearance when pilot compliance is necessary to ensure separation.

5-5-15. MINIMUM FUEL ADVISORY

a. Pilot:

1. Advise ATC of your minimum fuel status when your fuel supply has reached a state where, upon reaching your destination, you cannot accept any undue delay.

2. Be aware this is not an emergency situation, but merely an advisory that indicates an emergency situation is possible should any undue delay occur.

3. On initial contact the term "minimum fuel" after stating call sign.

EXAMPLE- SALT LAKE APPROACH, UNITED 621, MINIMUM FUEL.

4. Be aware a minimum fuel advisory does not imply a need for traffic priority.

5. If the remaining fuel supply suggests the need for traffic priority to ensure a safe landing, you should declare an emergency due to low fuel and report remaining fuel in minutes.

b. Controller:

1. When an aircraft declares a state of minimum fuel, relay this information to the facility to whom control jurisdiction is transferred.

2. Be alert for any occurrence which might delay the aircraft.

— END —

AMERICAN FLYERS

APPENDIX C

FEDERAL AVIATION REGULATIONS

(EXCERPTS FOR INSTRUMENT PILOTS)

The Federal Aviations Regulations (FAR's) reprinted in this Appendix have been edited for ease of study. Included are sections of FAR Part 61 and FAR Part 91 which affect instrument flight operations.

PART 61
CERTIFICATION OF PILOTS AND FLIGHT INSTRUCTORS

SUBPART A - GENERAL

61.1 APPLICABILITY

(a) This Part prescribes the requirements for issuing pilot and flight instructor certificates and ratings, the conditions under which those certificates and ratings are necessary, and the privileges and limitations of those certificates and ratings.

(b) Except as provided in §61.71, an applicant for a certificate or rating must meet the requirements of this part.

61.3 REQUIREMENT FOR CERTIFICATES, RATING AND AUTHORIZATIONS

(a) *Pilot Certificate.* No person may act as pilot in command or in any other capacity as a required pilot flight crewmember of a civil aircraft of United States registry unless he has in his personal possession a current pilot certificate issued to him under this Part. However, when the aircraft is operated within a foreign country a current pilot certificate issued by the country in which the aircraft is operated may be used.

(b) *Pilot Certificate: Foreign Aircraft.* No person may, within the United States, act as a pilot in command or in any other capacity as a required pilot flight crewmember of a civil aircraft of foreign registry unless he has in his personal possession a current pilot certificate issued to him under this Part, or a pilot license issued to him or validated for him by the country in which the aircraft is registered.

(c) *Medical Certificate.* Except for free balloon pilots piloting balloons and glider pilots piloting gliders, no person may act as pilot in command or in any other capacity as a required pilot flight crewmember of an aircraft under a certificate issued to him under this Part, unless he has in his personal possession an appropriate current medical certificate issued under Part 67 of this chapter. However, when the aircraft is operated within a foreign country with a current pilot certificate issued by that country, evidence of current medical qualification for that license, issued by that country may be used. In the case of a pilot certificate issued on the basis of a foreign pilot license under §61.75, evidence of current medical qualification accepted for the issue of that license is used in place of a medical certificate.

(d) *Flight Instructor Certificate.* Except for lighter-than-air flight instruction in lighter-than-air aircraft, and for instruction in air transportation service given by the holder of an Airline Transport Pilot Certificate under §61.169, no person other than the holder of a flight instructor certificate issued by the Administrator with an appropriate rating on that certificate may-

(1) Give any of the flight instruction required to qualify for a solo flight, solo cross-country flight, or for the issue of a pilot or flight instructor certificate or rating;

(2) Endorse a pilot logbook to show that he has given any flight instruction; or

(3) Endorse a student pilot certificate or logbook for solo operating privileges.

(e) *Instrument Rating.* No person may act as pilot in command of a civil aircraft under instrument flight rules, or in weather conditions less than the minimum prescribed for VFR flight unless-

(1) In the case of an airplane, he holds an instrument rating or an airline transport pilot certificate with an airplane category rating on it;

(2) In the case of a helicopter, he holds a helicopter instrument rating or an airline transport pilot certificate with a rotocraft category and helicopter class rating not limited to VFR;

(3) In the case of a glider, he holds an instrument rating (airplane) or an airline transport pilot certificate with an airplane category rating; or

(4) In the case of an airship, he holds a commercial pilot certificate with lighter-than-air category and airship class ratings.

(f) *Category II Pilot Authorization.*

(1) No person may act as pilot in command of a civil aircraft in a Category II operation unless he holds a current Category II authorization for that type aircraft or, in the case of a civil aircraft of foreign registry, he is authorized by the country of registry to act as pilot in command of that aircraft in Category II operations.

(2) No person may act as second in command of a civil aircraft in a Category II operation unless he holds a current appropriate instrument rating or an appropriate airline transport pilot certificate or, in the case of a civil aircraft of foreign registry, he is authorized by the country of registry to act as second in command of that aircraft in Category II operations.

(g) *Category A Aircraft Pilot Authorization.* The Administrator may issue a certificate of authorization to the pilot of a small aircraft identified as a Category A aircraft in §97.3(b)(1) of this chapter to use that aircraft in a Category II operation, if he finds that the proposed operation can be safely conducted under the terms of the certificate. Such authorization does not permit operation of the aircraft carrying persons or property for compensation or hire.

(h) *Inspection of Certificate.* Each person who holds a pilot certificate, flight instructor certificate, medical certificate, authorization, or license required by this Part shall present it for inspection upon the request of the Administrator, an authorized representative of the National Transportation Safety Board, or any Federal, State, or local law enforcement officer.

61.14 REFUSAL TO SUBMIT TO A DRUG OR ALCOHOL TEST

(a) This section applies to an employee who performs a function listed in appendix I or appendix J to part 121 of this chapter directly or by contract for a part 121 certificate holder, a part 135 certificate holder, or an operator as defined in §135.1(c) of this chapter.

(b) Refusal by the holder of a certificate issued under this part to take a drug test required under the provisions of appendix I to part 121 or an alcohol test required under the provisions of appendix J to part 121 is grounds for-

(1) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of such refusal; and

(2) Suspension or revocation of any certificate or rating issued under this part.

61.15 OFFENSES INVOLVING ALCOHOL OR DRUGS

(a) A conviction for the violation of any Federal or state statute relating to the growing, processing, manufacture, sale, disposition, transportation, or importation of narcotic drugs, marihuana, or depressant or stimulant drugs or substances is grounds for -

(1) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of final conviction; or

(2) Suspension or revocation of any certificate or rating issued under this part.

(b) The commission of an act prohibited by §91.17(a) or §91.19(a) of this chapter is grounds for -

(1) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of that act; or

(2) Suspension or revocation of any certificate or rating issued under this part.

(c) For the purposes of paragraphs (d) and (e) of this section, a motor vehicle action means -

(1) A conviction after November 29, 1990, for the violation of any Federal or state staute relating to the operation of a motor vehicle while intoxicated by alcohol or a drug, while impaired by alcohol or a drug, or while under the influence of alcohol or a drug;

(2) The cancellation, suspension, or revocation of a license to operate a motor vehicle after November 29, 1990, for a cause related to the operation of a motor vehicle while intoxicated by alcohol or a drug, while impaired by alcohol or a drug, or while under the influence of alcohol or a drug; or

(3) The denial after November 29, 1990, of an application for a license to operate a motor vehicle by a state for a cause related to the operation of a motor vehicle while intoxicated by alcohol or a drug, while impaired by alcohol or a drug, or while under the influence of alcohol or a drug.

(d) Except in the case of a motor vehicle action that results from the same incident or arises out of the same circumstances, a motor vehicle action occuring within 3 years of a previous motor vehicle action is grounds for-

(1) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of the last motor vehicle action; or

(2) Suspension or revocation of any certificate or rating issued under this part.

(e) Each person holding a certificate issued under this part shall provide a written report of each motor vehicle action to the FAA, Civil Aviation Security Division (AAC-700), P.O. Box 25810, Oklahoma City, OK 73125, not later than 60 days after the motor vehicle action. The report must include -

(1) The person's name, address, date of birth, and airman certificate number;

(2) The type of violation that resulted in the conviction or administrative action;
(3) The date of the conviction or administrative action;
(4) The state that holds the record of conviction or administrative action; and
(5) A statement of whether the motor vehicle action resulted from the same incident or arose out of the same factual circumstances related to a previously reported motor vehicle action.

(f) Failure to comply with paragraph (e) of this section is grounds for -
(1) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of the last motor vehicle action; or
(2) Suspension or revocation of any certificate or rating issued under this part.

61.16 REFUSAL TO SUBMIT TO AN ALCOHOL TEST OR FURNISH TEST RESULTS

A refusal to submit to a test to indicate the percentage by weight of alcohol in the blood, when requested by a law enforcement officer in accordance with §91.17(c) of this chapter, or a refusal to furnish or authorize release of the test results requested by the Administrator in accordance with §§91.17(c) or (d) of this chapter, is grounds for-

(a) Denial of an application for any certificate or rating issued under this part for a period of up to 1 year after the date of that refusal; or
(b) Suspension or revocation of any certificate or rating issued under this part.

61.17 TEMPORARY CERTIFICATE

(a) A temporary pilot or flight instructor certificate, or a rating, effective for a period of not more than 120 days, is issued to a qualified applicant pending review of his qualifications and the issuance of a permanent certificate or rating by the Administrator. The permanent certificate or rating is issued to an applicant found qualified and a denial thereof is issued to an applicant found not qualified.

(b) A temporary certificate issued under paragraph (a) of this section expires-
(1) At the end of the expiration date stated thereon; or
(2) Upon receipt by the applicant of-
(i) The certificate or rating sought; or
(ii) Notice that the certificate or rating sought is denied.

61.23 DURATION OF MEDICAL CERTIFICATES

(a) A first-class medical certificate expires at the end of the last day of-
(1) The sixth month after the month of the date of examination shown on the certificate, for operations requiring an airline transport pilot certificate;
(2) The 12th month after the month of the date of examination shown on the certificate, for operations requiring only a commercial pilot certificate; and
(3) The 24th month after the month of the date of examination shown on the certificate, for operations requiring only a private, recreational, or student pilot certificate.

(b) A second-class medical certificate expires at the end of the last day of-
(1) The 12th month after the month of the date of examination shown on the certificate, for operations requiring a commercial pilot certificate or an air traffic control tower operator certificate; and
(2) The 24th month after the month of the date of examination shown on the certificate, for operations requiring only a private, recreational, or student pilot certificate.

(c) A third-class medical certificate expires at the end of the 24th month after the month of the date of examination shown on the certificate, for operations requiring a private, recreational, or student pilot certificate.

61.25 CHANGE OF NAME

An application for the change of name on a certificate issued under this Part must be accompanied by the applicant's current certificate and a copy of the marriage license, court order, or other document verifying the change. The documents are returned to the applicant after inspection.

61.27 VOLUNTARY SURRENDER OR EXCHANGE OF CERTIFICATE

The holder of a certificate issued under this Part may voluntarily surrender it for cancellation, or for the issue of a certificate of lower grade, or another certificate with specific ratings deleted. If he so requests, he must include the following signed statement or its equivalent:

"This request is made for my own reasons, with full knowledge that my (insert name of certificate or rating, as appropriate) may not be reissued to me unless I again pass the tests prescribed for its issue."

61.29 REPLACEMENT OF LOST OR DESTROYED CERTIFICATE

(a) An application for the replacement of a lost or destroyed certificate issued under this Part is made by letter to the Department of Transportation, Federal Aviation Administration, Airman Certification Branch, Post Office Box 25082, Oklahoma City, OK 73125. The letter must-

(1) State the name of the person to whom the certificate was issued, the permanent mailing address (including zip code), social security number (if any), date and place of birth of the certificate holder, and any available information regarding the grade, number, date of issue of the certificate and the ratings on it; and

(2) Be accompanied by a check or money order for $2.00, payable to the Federal Aviation Administration.

(b) An application for the replacement of a lost or destroyed medical certificate is made by letter to the Department of Transportation, Federal Aviation Administration, Aeromedical Certification Branch, Post Office Box 25082, Oklahoma City, OK 73125, accompanied by a check or money order for $2.00.

(c) A person who has lost a certificate issued under this Part, or a medical certificate issued under Part 67 of this chapter, or both, may obtain a telegram from the FAA confirming that it was issued. The telegram may be carried as a certificate for a period not to exceed 60 days pending his receipt of a duplicate certificate under paragraph (a) or (b) of this section, unless he has been notified that the certificate has been suspended or revoked. The request for such a telegram may be made by letter or prepaid telegram, including the date upon which a duplicate certificate was previously requested, if a request had been made, and a money order for the cost of the duplicate certificate. The request for a telegraphic certificate is sent to the office listed in paragraph (a) or (b) of this section, as appropriate. However, a request for both airman and medical certificates at the same time must be sent to the office prescribed in paragraph (a) of this section.

61.31 GENERAL LIMITATIONS

(a) *Type ratings required.* A person may not act as pilot in command of any of the following aircraft unless he holds a type rating for that aircraft:

(1) A large aircraft (except lighter-than-air).

(2) A helicopter, for operations requiring an airline transport pilot certificate.

(3) A turbojet-powered airplane.

(4) Other aircraft specified by the Administrator through aircraft type certificate procedures.

(b) *Authorization in lieu of a type rating.*

(1) In lieu of a type rating required under paragraphs (a)(1), (3), and (4) of this section, an aircraft may be operated under an authorization issued by the Administrator, for a flight or a series of flights within the United States, if-

(i) The particular operation for which authorization is requested involves a ferry flight, a practice or training flight, a flight test for a pilot type rating, or a test flight of an aircraft, for a period that does not exceed 60 days;

(ii) The applicant shows that compliance with paragraph (a) of this section is impracticable for the particular operation; and

(iii) The Administrator finds that an equivalent level of safety may be achieved through operating limitations on the authorization.

(2) Aircraft operated under an authorization issued under this paragraph-

(i) May not be operated for compensation or hire; and

(ii) May carry only flight crewmembers necessary for the flight.

(3) An authorization issued under this paragraph may be reissued for an additional 60-day period for the same operation if the applicant shows that he was prevented from carrying out the purpose of the particular operation before his authorization expired.

The prohibition of paragraph (b)(2)(i) of this section does not prohibit compensation for the use of an aircraft by a pilot solely to prepare for or take a flight test for a type rating.

(c) *Category and class rating: Carrying another person or operating for compensation or hire.* Unless he holds a category and class rating for that aircraft, a person may not act as pilot in command of an aircraft that is carrying another person or is operated for compensation or hire. In addition, he may not act as pilot in command of that aircraft for compensation or hire.

(d) *Category and class rating: Other operations.* No person may act as pilot in command of an aircraft in solo flight in operations not subject to paragraph (c) of this section, unless he meets at least one of the following:

  (1) He holds a category and class rating appropriate to that aircraft.

  (2) He has received flight instruction in the pilot operations required by this Part, appropriate to the category and class of aircraft for first solo, given him by a certificated flight instructor who found him competent to solo that category and class of aircraft and has so endorsed his pilot logbook.

  (3) He has soloed and logged pilot in command time in that category and class or aircraft before November 1, 1973.

(e) *High performance airplanes.* A person holding a private or commercial pilot certificate may not act as pilot in command of an airplane that has more than 200 horsepower, or that has a retractable landing gear, flaps, and a controllable propeller, unless he has received flight instruction from an authorized flight instructor who has certified in his logbook that he is competent to pilot an airplane that has more than 200 horsepower, or that has a retractable landing gear, flaps, and a controllable propeller, as the case may be. However, this instruction is not required if he has logged flight time as pilot in command of high performance airplanes before November 1, 1973.

(f) *High altitude airplanes.*

  (1) Except as provided in paragraph (f)(2) of this section, no person may act as pilot in command of a pressurized airplane that has a service ceiling or maximum operating altitude, whichever is lower, above 25,000 feet MSL unless that person has completed the ground and flight training specified in paragraphs (f)(1)(i) and (ii) of this section and has received a logbook or training record endorsement from an authorized instructor certifying satisfactory completion of the training. The training shall consist of:

    (i) Ground training that includes instruction on high altitude aerodynamics and meteorology; respiration; effects, symptoms, and causes of hypoxia and any other high altitude sicknesses; duration of consciousness without supplemental oxygen; effects of prolonged usage of supplemental oxygen; causes and effects of gas expansion and gas bubble formations; preventive measures for eliminating gas expansion, gas bubbles, and high altitude sicknesses; physical phenomena and incidents of decompression; and any other physiological aspects of high altitude flight; and

    (ii) Flight training in an airplane, or in a simulator that meets the requirements of §121.407 of this chapter, and which is representative of an airplane as described in paragraph (f)(1) of this section. This training shall include normal cruise flight operations while operating above 25,000 feet MSL; the proper emergency procedures for simulated rapid decompression without actually depressurizing the airplane; and emergency descent procedures.

  (2) The training required in Paragraph (f)(1) of this section is not required if a person can document accomplishment of any of the following in an airplane, or in a simulator that meets the requirements of §121.407 of this section, and that is representative of an airplane described in paragraph (f)(1) of this section:

    (i) Served as pilot in command prior to April 15, 1991;

    (ii) Completed a pilot proficiency check for a pilot certificate or rating conducted by the FAA prior to April 15, 1991;

    (iii) Completed an official pilot in command check by the military services of the United States; or

    (iv) Completed a pilot in command proficiency check under Part 121, 125, or 135 conducted by the FAA or by an approved pilot check airman.

(g) *Tailwheel airplane.* No person may act as pilot in command of a tailwheel airplane unless that pilot has received flight instruction from an authorized flight instructor who has found the pilot competent to operate a tailwheel airplane and has made a one time endorsement so stating in the pilot's logbook. The endorsement must certify that the pilot is competent in normal and crosswind takeoffs and landings, wheel landings unless the manufacturer has recommended against such landings, and go-around procedures. This endorsement is not required if a pilot has logged flight time as pilot in command of tailwheel airplanes prior to April 15, 1991.

(h) *Exception.* This section does not require a class rating for gliders, or category and class ratings for aircraft that are not type certificated as airplanes, rotorcraft, or lighter-than-air aircraft. In addition, the rating limitations of this section do not apply to-
  (1) The holder of a student pilot certificate;
  (2) The holder of a recreational pilot certificate when operating under the provisions of §61.101(f), (g), and (h);
  (3) The holder of a pilot certificate when operating an aircraft under the authority of an experimental or provisional type certificate;
  (4) An applicant when taking a flight test given by the Administrator; or
  (5) The holder of a pilot certificate with a lighter-than-air category rating when operating a hot air balloon without an airborne heater.

61.33 TESTS: GENERAL PROCEDURE

Tests prescribed by or under this part are given at times and places, and by persons, designated by the Administrator

61.35 WRITTEN TEST: PREREQUISITES AND PASSING GRADES

(a) An applicant for a written test must-
  (1) Show that he has satisfactorily completed the ground instruction or home study course required by this part for the certificate or rating sought;
  (2) Present as personal identification an airman certificate, driver's license, or other official document; and
  (3) Present a birth certificate or other official document showing that he meets the age requirement prescribed in this part for the certificate sought not later than 2 years from the date of application for the test.

(b) The minimum passing grade is specified by the administrator on each written test sheet or booklet furnished to the applicant.

This section does not apply to the written test for an airline transport pilot certificate or a rating associated with that certificate.

61.37 WRITTEN TESTS: CHEATING OR OTHER UNAUTHORIZED CONDUCT

(a) Except as authorized by the Administrator, no person may-
  (1) Copy or intentionally remove, a written test under this part;
  (2) Give to another, or receive from another, any part or copy of that test;
  (3) Give help on that test to, or receive help on that test from, any person during the period that test is being given; or
  (4) Intentionally cause, assist, or participate in any act prohibited by this paragraph.

(b) No person whom the Administrator finds to have committed an act prohibited by paragraph (a) of this section is eligible for any airman or ground instructor certificate or rating, or to take any test therefore, under this chapter for a period of 1 year after the date of that act. In addition, the commission of that act is a basis for suspending or revoking any airman or ground instructor certificate or rating held by that person.

61.39 PREREQUISITES FOR FLIGHT TESTS

(a) To be eligible for a flight test for a certificate, or an aircraft or instrument rating issued under this part, the applicant must-
  (1) Have passed any required written test since the beginning of the 24th month before the month in which he takes the flight test;
  (2) Have the applicable instruction and aeronautical experience prescribed in this part;
  (3) Hold a current medical certificate appropriate to the certificate he seeks or, in the case of a rating to be added to his pilot certificate, at least a third class medical certificate issued since the beginning of the 24th month before the month in which he takes the flight test;
  (4) Except for a flight test for an airline transport pilot certificate, meet the age requirement for the issuance of the certificate or rating he seeks; and
  (5) Have a written statement from an appropriately certificated flight instructor certifying that he has given the applicant flight instruction in preparation for the flight test within 60 days preceding the date of application, and finds him competent to pass the test and to have satisfactory knowledge of the subject areas in which he is shown to be deficient by his FAA airman

written test report. However, an applicant need not have this written statement if he-

(i) Holds a foreign pilot license issued by a contracting State to the Convention on International Civil Aviation that authorizes at least the pilot privileges of the airman certificate sought by him;

(ii) Is applying for a type rating only, or a class rating with an associated type rating; or

(iii) Is applying for an airline transport pilot certificate or an additional aircraft rating on that certificate.

(b) Notwithstanding the provisions of paragraph (a)(1) of this section, an applicant for an airline transport pilot certificate or rating may take the flight test for that certificate or rating if-

(1) The applicant-

(i) Within the period ending 24 calendar months after the month in which the applicant passed the first of any required written tests, was employed as a flight crewmember by a U.S. air carrier or commercial operator operating either under Part 121 or as a commuter carrier under Part 135 (as defined in Part 298 of this title) and is employed by such a certificate holder at the time of the flight test;

(ii) Has completed initial training, and, if appropriate, transition or upgrade training; and

(iii) Meets the recurrent training requirements of the applicable part; or

(2) Within the period ending 24 calendar months after the month in which the applicant passed the first of any required written tests, the applicant participated as a pilot in a pilot training program of a U.S. scheduled military air transportation service and is currently participating in that program.

61.43 FLIGHT TESTS: GENERAL PROCEDURES

(a) The ability of an applicant for a private or commercial pilot certificate, or for an aircraft or instrument rating on that certificate to perform the required pilot operations is based on the following:

(1) Executing procedures and maneuvers within the aircraft's performance capabilities and limitations, including the use of the aircraft's systems.

(2) Executing emergency procedures and maneuvers appropriate to the aircraft.

(3) Piloting the aircraft with smoothness and accuracy.

(4) Exercising judgment.

(5) Applying his aeronautical knowledge.

(6) Showing that he is master of the aircraft, with the successful outcome of a procedure or maneuver never seriously in doubt.

(b) If the applicant fails any of the required pilot operations in accordance with the applicable provisions of paragraph (a) of this section, the applicant fails the flight test. The applicant is not eligible for the certificate or rating sought until he passes any pilot operations he has failed.

(c) The examiner or the applicant may discontinue the test at any time when the failure of a required pilot operation makes the applicant ineligible for the certificate or rating sought. If the test is discontinued the applicant is entitled to credit for only those entire pilot operations that he has successfully performed.

61.45 FLIGHT TESTS: REQUIRED AIRCRAFT AND EQUIPMENT

(a) *General.* An applicant for a certificate or rating under this part must furnish, for each flight test that he is required to take, an appropriate aircraft of United States registry that has a current standard or limited airworthiness certificate. However, the applicant may, at the discretion of the inspector or examiner conducting the test, furnish an aircraft of U. S. registry that has a current airworthiness certificate other than a standard or limited, an aircraft of foreign registry that is properly certificated by the country of registry, or a military aircraft in an operational status if its use is allowed by an appropriate military authority.

(b) *Required Equipment (other than controls).* Aircraft furnished for a flight test must have-

(1) The equipment for each pilot operation required for the flight test;

(2) No prescribed operating limitations that prohibit its use in any pilot operation required on the test;

(3) Pilot seats with adequate visibility for each pilot to operate the aircraft safely, except as provided in paragraph (d) of this section; and

(4) Cockpit and outside visibility adequate to evaluate the performance of the applicant, where an additional jump seat is provided for the examiner.

(c) *Required Controls.* An aircraft (other than lighter-than-air) furnished under paragraph (a) of this section for any pilot flight test must have engine power controls and flight controls that are easily reached and operable in a normal manner by both pilots, unless after considering all the factors, the examiner determines that the flight test can be conducted safely without them. However, an aircraft having other controls such as nose-wheel steering, brakes, switches, fuel selectors, and engine air flow controls that are not easily reached and operable in a normal manner by both pilots may be used, if more than one pilot is required under its airworthiness certificate, or if the examiner determines that the flight can be conducted safely.

(d) *Simulated Instrument Flight Equipment.* An applicant for any flight test involving flight maneuvers solely by reference to instruments must furnish equipment satisfactory to the examiner that excludes the visual reference of the applicant outside of the aircraft.

(e) *Aircraft with Single Controls.* At the discretion of the examiner, an aircraft furnished under paragraph (a) of this section for a flight test may, in the cases listed herein, have a single set of controls. In such case, the examiner determines the competence of the applicant by observation from the ground or from another aircraft.

  (1) A flight test for addition of a class or type rating, not involving demonstration of instrument skills, to a private or commercial pilot certificate.

  (2) A flight test in a single-place gyroplane for-

    (i) A private pilot certificate with a rotorcraft category rating and gyroplane class rating, in which case the certificate bears the limitation "rotorcraft single-place gyroplane only"; or

    (ii) Addition of a rotorcraft category rating and gyroplane class rating to a pilot certificate, in which case a certificate higher than a private pilot certificate bears the limitation "rotorcraft single-place gyroplane, private pilot privileges only".

  The limitations prescribed by this subparagraph may be removed if the holder of the certificate passes the appropriate flight test in a gyroplane with two pilot stations or otherwise passes the appropriate flight test for a rotorcraft category rating.

61.47 FLIGHT TESTS: STATUS OF FAA INSPECTORS AND OTHER AUTHORIZED PILOT EXAMINERS

An FAA inspector or other authorized flight examiner conducts the flight test of an applicant for the purpose of observing the applicant's ability to perform satisfactorily the procedures and maneuvers on the flight test. The inspector or other examiner is not pilot in command of the aircraft during the flight test unless he acts in that capacity for the flight, or portion of the flight, by prior arrangement with the applicant or other person who would otherwise act as pilot in command of the flight, or portion of the flight. Notwithstanding the type of aircraft used during a flight test, the applicant and the inspector or other examiner are not, with respect to each other (or other occupants authorized by the inspector or other examiner), subject to the requirements or limitations for the carriage of passengers specified in this chapter.

61.49 RETESTING AFTER FAILURE

(a) An applicant for a written or practical test who fails that test may not apply for retesting until 30 days after the date the test was failed. However, in the case of a first failure, the applicant may apply for retesting before 30 days have expired provided the applicant presents a logbook or training record endorsement from an authorized instructor who has given the applicant remedial instruction and finds the applicant competent to pass the test.

(b) An applicant for a flight instructor certificate with an airplane category rating, or for a flight instructor certificate with a glider category rating, who has failed the practical test due to deficiencies of knowledge or skill relating to stall awareness, spin entry, spins, or spin recovery techniques must, during the retest, satisfactorily demonstrate both knowledge and skill in these areas in an aircraft of the appropriate category that is certificated for spins.

61.51 PILOT LOGBOOKS

(a) The aeronautical training and experience used to meet the requirements for a certificate or rating, or the recent flight experience requirements of this Part must be shown by a reliable record. The logging of other flight time is not required.

(b) Logbook Entries. Each pilot shall enter the following information for each flight or lesson logged:

(1) General.
  (i) Date.
  (ii) Total time of flight.
  (iii) Place, or points of departure and arrival.
  (iv) Type and identification of aircraft.

(2) Type of Pilot Experience or Training.
  (i) Pilot in command or solo.
  (ii) Second in command.
  (iii) Flight instruction received from an authorized instructor.
  (iv) Instrument flight instruction from an authorized instructor.
  (v) Pilot ground trainer instruction.
  (vi) Participating crew (lighter-than-air).
  (vii) Other pilot time.

(3) Conditions of Flight.
  (i) Day or night.
  (ii) Actual instrument.
  (iii) Simulated instrument conditions.

(c) Logging of Pilot Time.

(1) Solo Flight Time. A pilot may log as solo flight time only that flight time when he is the sole occupant of the aircraft. However, a student pilot may also log as solo flight time that time during which he acts as the pilot in command of an airship requiring more than one flight crewmember.

(2) Pilot in Command Flight Time.

(i) A recreational, private, or commercial pilot may log as pilot in command time only that flight time during which that pilot is the sole manipulator of the controls of an aircraft for which the pilot is rated, or when the pilot is the sole occupant of the aircraft, or, except for a recreational pilot, when acting as pilot in command of an aircraft on which more than one pilot is required under the type certification of the aircraft or the regulations under which the flight is conducted.

(ii) An airline transport pilot may log as pilot in command time all of the flight time during which he acts as pilot in command.

(iii) A certificated flight instructor may log as pilot in command time all flight time during which he acts as a flight instructor.

(3) Second in Command Flight Time. A pilot may log as second in command time all flight time during which he acts as second in command of an aircraft on which more than one pilot is required under the type certification of the aircraft, or the regulations under which the flight is conducted.

(4) Instrument Flight Time. A pilot may log as instrument flight time only that time during which he operates the aircraft solely by reference to instruments, under actual or simulated instrument flight conditions. Each entry must include the place and type of each instrument approach completed, and the name of the safety pilot for each simulated instrument flight. An instrument flight instructor may log as instrument time that time during which he acts as an instrument flight instructor in actual instrument weather conditions.

(5) Instruction Time. All time logged as flight instruction, instrument flight instruction, pilot ground trainer instruction, or ground instruction time must be certified by the appropriately rated and certificated instructor from whom it was received.

(d) Presentation of Logbook.

(1) A pilot must present his logbook (or other record required by this section) for inspection upon reasonable request by the Administrator, an authorized representative of the National Transportation Safety Board, or any State or local law enforcement officer.

(2) A student pilot must carry his logbook (or other record required by this section) with him on all solo cross-country flights, as evidence of the required instructor clearances and endorsements.

(3) A recreational pilot must carry his or her logbook that has the required instructor endorsements on all solo flights-
  (i) In excess of 50 nautical miles from an airport at which instruction was received;
  (ii) In airspace in which communication with air traffic control is required;
  (iii) Between sunset and sunrise; and
  (iv) In an aircraft for which the pilot is not rated.

61.53 OPERATIONS DURING MEDICAL DEFICIENCY

No person may act as pilot in command, or in any other capacity as a required pilot flight crewmember while he has a known medical defieiency, or increase of a known medical deficiency, that would make him unable to meet the requirements for his current medical certificate.

61.56 FLIGHT REVIEW

(a) A flight review consists of a minimum of 1 hour of flight instruction and 1 hour of ground instruction. The review must include-
  (1) A review of the current genral operating and flight rules of Part 91 of this chapter; and
  (2) A review of those maneuvers and procedures which, at the discretion of the person giving the review, are necessary for the pilot to demonstrate the safe exercise of the privileges of the pilot certificate.

(b) Glider pilots may substitue a minimum of three instructional flights in a glider, each of which includes a 360° turn, in lieu of the 1 hour of flight instruction required in paragraph (a) of this section.

(c) Except as provided in paragraphs (d) and (e) of this section, no person may act as pilot in command of an aircraft unless, since the beginning of the 24th calendar month before the month in which that pilot acts as pilot in command, that person has-
  (1) Accomplished a flight review given in an aircraft for which that pilot is rated by an approriately rated instructor certificated under this Part or other person designated by the Administrator; and
  (2) A logbook endorsed by the person who gave the review certifying that the person has satisfactorily completed the review.

(d) A person who has, within the period specified in paragraph (c) of this section, satisfactorily completed a pilot proficiency check conducted by the FAA, an approved pilot check airman, or a U.S. Armed Force, for a pilot certificate, rating, or operating privilege, need not accomplish the flight review required by this section.

(e) A person who has, within the period specified in paragraph (c) of this section, satisfactorily completed one or more phases of an FAA-sponsored pilot proficiency award program need not accomplish the flight review required by this section.

(f) A person who holds a current flight instructor certificate who has, within the period specified in paragraph (c) of this section, satisfactorily completed a renewal of a flight instructor certificate under the provisions of §61.197(c), need not accomplish the 1 hour of ground instruction required in subparagraph (a)(1) of this section.

(g) The requirements of this section may be accomplished in combination with the requirements of §61.57 and other applicable recency requirements at the discretion of the instructor.

61.57 RECENT FLIGHT EXPERIENCE: PILOT IN COMMAND

(a) Reserved.

(b) Reserved.

(c) *General experience.* No person may act as pilot in command of an aircraft carrying passengers, nor of an aircraft certificated for more than one required pilot flight crewmember, unless within the preceding 90 days, he has made at least three takeoffs and three landings as the sole manipulator of the flight controls in an aircraft of the same category and class and, if a type rating is required, of the same type. If the aircraft is a tailwheel airplane, the landings must have been made to a full stop in a tailwheel airplane. For the purpose of meeting the requirements of this paragraph, a person may act as pilot in command of a flight under day VFR or day IFR if no persons or property other than as necessary for for his compliance thereunder are carried. This paragraph does not apply to operations requiring an airline transport pilot certificate, or operations conducted under Part 135 of this chapter.

(d) *Night experience.* No person may act as pilot in command of an aircraft carrying passengers during the period beginning 1 hour after sunset and ending 1 hour before sunrise (as published in the American Air Almanac) unless, within the preceding 90 days he has made at least three takeoffs and three landings to a full stop during that period in the category and class of aircraft to be used. This paragraph does not apply to operations requiring an airline transport pilot certificate.

(e) *Instrument.*
  (1) *Recent IFR experience.* No pilot may act as pilot in command under IFR, nor in weather conditions less than the minimums prescribed for VFR, unless he has, within the past 6 calendar months-
    (i) In the case of an aircraft other than a glider, logged at least 6 hours of instrument time under actual or simulated instrument conditions, at least 3 of which were in flight in the category of aircraft involved, including at least 6 instrument approaches, or passed an instrument competency check in the category of aircraft involved.

(ii) In the case of a glider, logged at least 3 hours of instrument time, at least half of which were in a glider or an airplane. If a passenger is carried in the glider, at least 3 hours of instrument flight time must have been in gliders.

(2) *Instrument Competency Check.* A pilot who does not meet the recent instrument experience requirements of paragraph (e)(1) of this section during the prescribed time or 6 calendar months thereafter may not serve as pilot in command under IFR, nor in weather conditions less than the minimums prescribed for VFR, until he passes an instrument competency check in the category of aircraft involved, given by an FAA inspector, a member of an armed force of the United States authorized to conduct flight tests, an FAA-approved check pilot, or a certificated instrument flight instructor. The Administrator may authorize the conduct of part or all of this check in a pilot ground trainer equipped for instruments or an aircraft simulator.

(f) *Exemptions.* This section does not apply to a pilot in command, employed by a 14 CFR Part 121 or Part 135 operator, engaged in a flight operation under 14 CFR Part 91, 121, or 135 for the operator.

61.59 FALSIFICATION, REPRODUCTION, OR ALTERATION OF APPLICATIONS, CERTIFICATES, LOGBOOKS, REPORTS, OR RECORDS

(a) No person may make or cause to be made—

(1) Any fraudulent or intentionally false statement on any application for a certificate, rating, or duplicate thereof, issued under this Part;

(2) Any fraudulent or intentionally false entry in any logbook, record, or report that is required to be kept, made, or used, to show compliance with any requirement for the issuance, or exercise of the privileges, of any certificate or rating under this Part;

(3) Any reproduction, for fraudulent purpose, of any certificate or rating under this Part; or

(4) Any alteration of any certificate or rating under this Part.

(b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for suspending or revoking any airman or ground instructor certificate or rating held by that person.

61.60 CHANGE OF ADDRESS

The holder of a pilot or flight instructor certificate who has made a change in his permanent mailing address may not after 30 days from the date he moved, exercise the privileges of his certificate unless he has notified in writing the Department of Transportation, Federal Aviation Administration, Airman Certification Branch, Post Office Box 25082, Oklahoma City, OK 73125, of his new address.

SUBPART B - AIRCRAFT RATINGS AND SPECIAL CERTIFICATES

61.61 APPLICABILITY

This subpart prescribes the requirements for the issuance of additional aircraft ratings after a pilot or instructor certificate is issued, and the requirements and limitations for special pilot certificates and ratings issued by the Administrator.

61.63 ADDITIONAL AIRCRAFT RATINGS (OTHER THAN AIRLINE TRANSPORT PILOT)

(a) *General.* To be eligible for an aircraft rating after his certificate is issued to him an applicant must meet the requirements of paragraphs (b) through (d) of this section, as appropriate to the rating sought.

(b) *Category Rating.* An applicant for a category rating to be added on his pilot certificate must meet the requirements of this Part for the issuance of the pilot certificate appropriate to the privileges for which the category rating is sought. However, the holder of a category rating for powered aircraft is not required to take a written test for the addition of a category rating on his pilot certificate.

(c) *Class Rating.* An applicant for an aircraft class rating to be added on his pilot certificate must—

(1) Present a logbook record certified by an authorized flight instructor showing that the applicant has received flight instruction in the class of aircraft for which a rating is sought and has been found competent in the pilot operations appropriate to the pilot certificate to which his category rating applies; and

(2) Pass a flight test appropriate to his pilot certificate and applicable to the aircraft category and class rating sought.

A person who holds a lighter-than-air category rating with a free balloon class rating who seeks an airship class rating, must meet the requirements of paragraph (b) of this section as though seeking a lighter-than-air category rating.

(d) *Type Rating.* An applicant for a type rating to be added on his pilot certificate must meet the following requirements:
  (1) He must hold, or concurrently obtain, an instrument rating appropriate to the aircraft for which a type rating is sought.
  (2) He must pass a flight test showing competence in pilot operations appropriate to the pilot certificate he holds and to the type rating sought.
  (3) He must pass a flight test showing competence in pilot operations under instrument flight rules in an aircraft of the type for which the type rating is sought or, in the case of a single pilot station airplane, meet the requirements of paragraph (d)(3)(i) or (ii) of this section, whichever is applicable.
    (i) The applicant must have met the requirements of this paragraph in a multiengine airplane for which a type rating is required.
    (ii) If he does not meet the requirements of paragraph (d)(3)(i) of this section and he seeks a type rating for a single-engine airplane, he must meet the requirements of this subparagraph in either a single or multiengine airplane, and have the recent instrument experience set forth in §61.57(e) when he applies for the flight test under paragraph (d)(2) of this section.
  (4) An applicant who does not meet the requirements of paragraphs (d)(1) and (3) of this section may obtain a type rating limited to "VFR only." Upon meeting these instrument requirements or the requirements of §61.73(e)(2), the "VFR only" limitation may be removed for the particular type of aircraft in which competence is shown.
  (5) When an instrument rating is issued to the holder of one or more type ratings, the type ratings on the amended certificate bear the limitation described in paragraph (d)(4) of this section for each airplane type rating for which he has not shown his instrument competency under this paragraph.
  (6) On and after April 15, 1991, an applicant for a type rating to be added to a pilot certificate must-
    (i) Have completed ground and flight training on the maneuvers and procedures of Appendix A of the Part that is appropriate to the airplane for which a type rating is sought, and received an endorsement from an authorized instructor in the person's logbook or training records certifying satisfactory completion of the training; or
    (ii) For a pilot employee of a Part 121 or Part 135 certificate holder, have completed the certificate holder's approved ground and flight training that is appropriate to the airplane for which a type rating is sought.

61.65 INSTRUMENT RATING REQUIREMENTS

(a) *General.* To be eligible for an instrument rating (airplane) or an instrument rating (helicopter), an applicant must-
  (1) Hold at least a current private pilot certificate with an aircraft rating appropriate to the instrument rating sought;
  (2) Be able to read, speak, and understand the English language;
  (3) Comply with the applicable requirements of this section.

(b) *Ground Instruction.* An applicant for the written test for an instrument rating must have received ground instruction, or have logged home study in at least the following areas of aeronautical knowledge appropriate to the rating sought.
  (1) The regulations of the chapter that apply to flight under IFR conditions, the Airman's Information Manual, and the IFR air traffic system and procedures;
  (2) Dead reckoning appropriate to IFR navigation, IFR navigation by radio aids using the VOR, ADF, and ILS systems, and the use of IFR charts and instrument approach plates;
  (3) The procurement and use of aviation weather reports and forecasts, and the elements of forecasting weather trends on the basis of that information and personal observation of weather conditions; and
  (4) The safe and efficient operation of airplanes or helicopters, as appropriate, under instrument weather conditions.

(c) *Flight Instruction and Skill - Airplanes.* An applicant for the flight test for an instrument rating (airplane) must present a logbook record certified by an authorized flight instructor showing that he has received instrument flight instruction in an airplane in the following pilot operations, and has been found competent in each of them:

(1) Control and accurate maneuvering of an airplane solely by reference to instruments.

(2) IFR navigation by the use of the VOR and ADF systems, including compliance with air traffic control instructions and procedures.

(3) Instrument approaches to published minimums using the VOR, ADF, and ILS systems (instruction in the use of the ADF and ILS may be received in an instrument ground trainer and instruction in the use of the ILS glide slope may be received in an airborne ILS simulator).

(4) Cross-country flying in simulated or actual IFR condition, on Federal airways or as routed by ATC, including one such trip of at least 250 nautical miles, including VOR, ADF, and ILS approaches at different airports.

(5) Simulated emergencies, including the recovery from unusual attitudes, equipment and instrument malfunctions, loss of communications, and engine-out emergencies if a multiengine airplane is used, and missed approach procedures.

(d) *Instrument Instruction and Skill - Helicopters.* An applicant for the flight test for an instrument rating (helicopter) must present a logbook record certified by an authorized flight instructor showing that he has received instrument flight instruction in a helicopter in the following pilot operations, and has been found competent in each of them:

(1) The control and accurate maneuvering of a helicopter solely by reference to instruments.

(2) IFR navigation by the use of the VOR and ADF systems, including compliance with air traffic control instructions and procedures.

(3) Instrument approaches to published minimums using the VOR, ADF, and ILS systems (instruction in the use of the ADF and ILS may be received in an instrument ground trainer and instrution in the use of the ILS glide slope may be received in an airborne ILS simulator).

(4) Cross-country flying in simulated or actual IFR condition, on Federal airways or as routed by ATC, including one such trip of at least 100 nautical miles, including VOR, ADF, and ILS approaches at different airports.

(5) Simulated IFR emergencies, including equipment malfunctions, missed approach procedures, and deviations to unplanned alternates.

(e) *Flight Experience.* An applicant for an instrument rating must have at least the following flight time as a pilot:

(1) A total of 125 hours of pilot flight time, of which 50 hours are as pilot in command in cross-country flight in a powered aircraft with other than a student pilot certificate. Each cross-country flight must have a landing at a point more than 50 nautical miles from the original departure point.

(2) 40 hours of simulated or actual instrument time, of which not more than 20 hours may be instrument instruction by an authorized instructor in an instrument ground trainer acceptable to the Administrator.

(3) 15 hours of instrument flight instruction by an authorized flight instructor, including at least 5 hours in an airplane or a helicopter, as appropriate.

(f) *Written Test.* An applicant for an instrument rating must pass a written test appropriate to the instrument rating sought on the subjects on which ground instruction is required by paragraph (b) of this section.

(g) *Practical Test.* An applicant for an instrument rating must pass a flight test in an airplane or a helicopter, as appropriate. The test must include instrument flight procedures selected by the inspector or examiner conducting the test to determine the applicant's ability to perform competently the IFR operations on which instruction is required by paragraph (c) or (d) of this section.

FAR PART 91 - GENERAL OPERATING AND FLIGHT RULES
SUBPART A - GENERAL

91.1 APPLICABILITY

(a) Except as provided in paragraph (b) of this section and §91.703, this Part prescribes rules governing the operation of aircraft (other than moored balloons, kites, unmanned rockets, and unmanned free balloons, which are governed by Part 101 of this chapter, and ultralight vehicles operated in accordance with Part 103 of this chapter) within the United States, including the waters within 3 nautical miles of the U.S. coast.

(b) Each person operating an aircraft in the airspace overlying the waters between 3 and 12 nautical miles from the coast of the United States shall comply with §§91.1 through 91.12; §§91.101 through 91.143; §§91.151 through 91.159; §§91.167 through 91.193; §91.203; §91.205; §§91.209 through 91.217; §91.221; §§91.303 through 91.319; §91.323; §91.605; §91.609; §§91.703 through 91.715; and §91.903.

91.3 RESPONSIBILITY AND AUTHORITY OF THE PILOT IN COMMAND

(a) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

(b) In an in-flight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency.

(c) Each pilot in command who deviates from a rule under paragraph (b) of this section shall, upon request of the Administrator, send a written report of that deviation to the Administrator.

(Approved by the Office of Management and Budget under OMB control number 2120-0005)

91.5 PILOT IN COMMAND OF AIRCRAFT REQUIRING MORE THAN ONE REQUIRED PILOT

No person may operate an aircraft that is type certificated for more than one required pilot flight crewmember unless the pilot in command meets the requirements of §61.58 of this chapter.

91.7 CIVIL AIRCRAFT AIRWORTHINESS

(a) No person may operate a civil aircraft unless it is in an airworthy condition.

(b) The pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. The pilot in command shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.

91.9 CIVIL AIRCRAFT FLIGHT MANUAL, MARKING, AND PLACARD REQUIREMENTS

(a) No person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane or Rotorcraft Flight Manual, markings, and placards or as otherwise prescribed by the certificating authority of the country of registry.

(b) No person may operate a U.S. registered civil aircraft-
  (1) For which an Airplane or Rotorcraft Flight Manual is required by §21.5 of this chapter, unless there is available in the aircraft a current, approved Airplane or Rotorcraft Flight Manual or the manual provided for in §121.141(b); and
  (2) For which an Airplane or Rotorcraft Flight Manual is not required by §21.5 of this chapter, unless there is available in the aircraft a current approved Airplane or Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof.

(c) No person may operate a U.S. registered civil aircraft unless that aircraft is identified in accordance with Part 45 of this chapter.

(d) Any person taking off or landing a helicopter certificated under Part 29 of this chapter at a heliport constructed over water may make such momentary flight as is necessary for takeoff or landing through the prohibited range of the height-speed envelope established for that helicopter if that flight through the prohibited range takes place over water on which a safe ditching can be accomplished and if the helicopter is amphibious or is equipped with floats or other emergency flotation gear adequate to accomplish a safe emergency ditching on open water.

91.11 PROHIBITION AGAINST INTERFERENCE WITH CREWMEMBERS

No person may assault, threaten, intimidate, or interfere with a crewmember in the performance of the crewmember's duties aboard an aircraft being operated.

91.13 CARELESS OR RECKLESS OPERATION

(a) *Aircraft operations for the purpose of air navigation.* No person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another.

(b) *Aircraft operations other than for the purpose of air navigation.* No person may operate an aircraft, other than for the purpose of air navigation, on any part of the surface of an airport used by aircraft for air commerce (including areas used by those aircraft for receiving or discharging persons or cargo), in a careless or reckless manner so as to endanger the life or property of another.

91.15 DROPPING OBJECTS

No pilot in command of a civil aircraft may allow any object to be dropped from that aircraft in flight that creates a hazard to persons or property. However, this section does not prohibit the dropping of any object if reasonable precautions are taken to avoid injury or damage to persons or property.

91.17 ALCOHOL OR DRUGS

(a) No person may act or attempt to act as a crewmember of a civil aircraft-
  (1) Within 8 hours after the consumption of any alcoholic beverage;
  (2) While under the influence of alcohol;
  (3) While using any drug that affects the person's faculties in any way contrary to safety; or
  (4) While having .04 percent by weight or more alcohol in the blood.

(b) Except in an emergency, no pilot of a civil aircraft may allow a person who appears to be intoxicated or who demonstrates by manner or physical indications that the individual is under the influence of drugs (except a medical patient under proper care) to be carried in that aircraft.

(c) A crewmember shall do the following:
  (1) On request of a law enforcement officer, submit to a test to indicate the percentage by weight of alcohol in the blood when -
    (i) The law enforcement officer is authorized under State or local law to conduct the test or to have the test conducted; and
    (ii) The law enforcement officer is requesting submission to the test to investigate a suspected violation of State or local law governing the same or substantially similar conduct prohibited by paragraph (a)(1), (a)(2), or (a)(4) of this section.
  (2) Whenever the Administrator has a reasonable basis to believe that a person may have violated paragraph (a)(1), (a)(2), or (a)(4) of this section, that person shall, upon request by the Administrator, furnish the Administrator, or authorize any clinic, hospital, doctor, or other person to release to the administrator, the results of each test taken within 4 hours after acting or attempting to act as a crewmember that indicates the percentage by weight of alcohol in the blood.

(d) Whenever the Administrator has a reasonable basis to believe that a person may have violated paragraph (a)(3) of this section, that person shall, upon request by the Administrator, furnish the Administrator, or authorize any clinic, hospital, doctor, or other person to release to the administrator, the results of each test taken within 4 hours after acting or attempting to act as a crewmember that indicates the presence of any drugs in the body.

(e) Any test information obtained by the Administrator under paragraph (c) or (d) of this section may be evaluated in determining a person's qualifications for any airman certificate or possible violations of this chapter and may be used as evidence in any legal proceeding under section 602, 609, or 901 of the Federal Aviation Act of 1958.

91.19 CARRIAGE OF NARCOTIC DRUGS, MARIHUANA, AND DEPRESSANT OR STIMULATANT DRUGS OR SUBSTANCES

(a) Except as provided in paragraph (b) of this section, no person may operate a civil aircraft within the United States with the knowledge that narcotic drugs, marihuana, depressant or stimulant drugs or substances as defined in Federal or State statutes are carried aboard the aircraft.

(b) Paragraph (a) of this section does not apply to any carriage of narcotic drugs, marihuana, and depressant or stimulant drugs or substances authorized by or under any Federal or State statute or by any Federal or State agency.

91.21 PORTABLE ELECTRONIC DEVICES

(a) Except as provided in paragraph (b) of this section, no person may operate, nor may any operator or pilot in command of an aircraft allow the operation of, any portable electronic device on any of the following U.S. registered civil aircraft:
  (1) Aircraft operated by a holder of an air carrier operating certificate or an operating certificate; or
  (2) Any other aircraft while it is operated under IFR.
(b) Paragraph (a) of this section does not apply to-
  (1) Portable voice recorders;
  (2) Hearing aids;
  (3) Heart pacemakers;
  (4) Electric shavers; or
  (5) Any other portable electronic device that the operator of the aircraft has determined will not cause interference with the navigation or communication system of the aircraft on which it is to be used.
(c) In the case of an aircraft operated by a holder of an air carrier operating certificate or an operating certificate, the determination required by paragraph (b)(5) of this section shall be made by that operator of the aircraft on which the particular device is to be used. In the case of other aircraft, the determination may be made by the pilot in command or other operator of the aircraft.

91.25 AVIATION SAFETY REPORTING PROGRAM: PROHIBITION AGAINST USE OF REPORTS FOR ENFORCEMENT PURPOSES

The Administrator of the FAA will not use any reports submitted to the National Aeronautics and Space Administration under the Aviation Safety Reporting Program (or information derived therefrom) in any enforcement action, except information concerning accidents or criminal offenses which are wholly excluded from the program.

91.92 TEMPORARY RESTRICTION ON FLIGHT OPERATIONS DURING ABNORMALLY HIGH BAROMETRIC PRESSURE CONDITIONS

(a) *Special flight restrictions.* When any information indicates that barometric pressure on the route of flight currently exceeds or will exceed 31 inches of mercury, no person may operate an aircraft or initiate a flight contrary to the requirements established by the Administrator and published in a Notice to Airmen issued under this section.
(b) *Waivers.* The Administrator is authorized to waive any restriction issued under paragraph (a) of this section to permit emergency supply, transport, or medical services to be delivered to isolated communities where the operation can be conducted with an acceptable level of safety.

SUBPART B - FLIGHT RULES

91.101 APPLICABLITY

This Subpart prescribes the flight rules governing the operation of aircraft within the United States and within 12 nautical miles from the coast of the United States.

91.103 PREFLIGHT ACTION

Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include -
(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which the pilot in command has been advised by ATC.
(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:
  (1) For civil aircraft for which an approved airplane flight manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and
  (2) For civil aircraft other than those specified in subparagraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

91.105 FLIGHT CREWMEMBERS AT STATIONS

(a) During takeoff and landing, and while en route, each required flight crewmember shall-
  (1) Be at the crewmember station unless the absence is necessary to perform duties in connection with the operation of the aircraft or in connection with physiological needs; and
  (2) Keep the seat belt fastened while at the crewmember station.

(b) Each required flight crewmember of a U.S. registered civil airplane shall, during takeoff and landing, keep his or her shoulder harness fastened while at his or her assigned duty station. This paragraph does not apply if -
  (1) The seat at the crewmember's station is not equipped with a shoulder harness; or
  (2) The crewmember would be unable to perform required duties with the shoulder harness fastened.

91.107 USE OF SAFETY BELTS, SHOULDER HARNESSES, AND CHILD RESTRAIN SYSTEMS

(a) Unless otherwise authorized by the Administrator-
  (1) No pilot may takeoff a U.S. registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificated before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board is briefed on how to fasten and unfasten that person's safety belt and, if installed, shoulder harness.
  (2) No person may cause to be moved on the surface, takeoff, or land a U.S. registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificated before November 2, 1987) unless the pilot in command of that aircraft ensures that each person on board has been notified to fasten his or her safety belt and, if installed, his or her shoulder harness.
  (3) Except as provided in this paragraph, each person on board a U.S. registered civil aircraft (except a free balloon that incorporates a basket or gondola, or an airship type certificated before November 2, 1987) must occupy an approved seat or berth with a safety belt and, if installed, shoulder harness properly secured about him or her during movement on the surface, takeoff, and landing. For seaplane and float equipped rotorcraft operations during movement on the surface, the person pushing off the seaplane or rotorcraft from the dock and the person mooring the seaplane or rotorcraft at the dock are excepted from the preceding seating and safety belt requirements. Notwithstanding the preceding requirements of this paragraph, a person may:
  (i) Be held by an adult who is occupying a seat or berth if that person has not yet reached his or her second birthday;
  (ii) Use the floor of the aircraft as a seat, provided that person is on board for the purpose of engaging in sport parachuting; or
  (iii) Notwithstanding any other requirement of this chapter, occupy an approved child restraint system furnished by the operator or one of the persons described in paragraph (a)(3)(iii)(A) of this section provided that:
    (A) The child is accompanied by a parent, guardian, or attendant designated by the child's parent or guardian to attend to the safety of the child during the flight;
    (B) The approved child restrain system bears one or more labels as follows:
      (1) Seats manufactured to U.S. standards between January 1, 1981 and February 25, 1985, must bear the label "This child restraint system conforms to all applicable Federal motor vehicle safety standards." Vest- and harness-type child restraint systems manufactured before February 26, 1985, bearing such a label are not approved for the purposes of this section;
      (2) Seats manufactured to U.S. standards on or after February 26, 1985, must bear two labels:
      (i) "This child restraint system conforms to all applicable Federal motor vehicle safety standards"; and
      (ii) "THIS RESTRAINT IS CER-

TIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT" in red lettering;

(3) Seats that do not qualify under paragraphs (a)(3)(iii)(B)(1) and (a)(3)(iii)(B)(2) of this section must bear either a label showing approval of a foreign government or a label showing that the seat was manufactured under the standards of the United Nations; and

(C) The operator complies with the following requirements:

(1) The restraint system must be properly secured to an approved forward-facing seat or berth;

(2) The child must be properly secured in the restrain system and must not exceed the specified weight limit for the restraint system; and

(3) The restraint system must bear the appropriate label(s).

(b) Unless otherwise stated, this section does not apply to operations conducted under Part 121, 125, or 135 of this chapter. Paragraph (a)(3) of this section does not apply to persons subject to §91.105.

91.109 FLIGHT INSTRUCTION: SIMULATED INSTRUMENT FLIGHT AND CERTAIN FLIGHT TESTS

(a) No person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls. However, instrument flight instruction may be given in a single-engine airplane equipped with a single, functioning, throwover control wheel in place of fixed, dual controls of the elevator and ailerons, when-

(1) The instructor has determined that the flight can be conducted safely; and

(2) The person manipulating the controls has at least a private pilot certificate with appropriate category and class ratings.

(b) No person may operate a civil aircraft in simulated instrument flight unless-

(1) The other control seat is occupied by a safety pilot who possesses at least a private pilot certificate with category and class ratings appriopriate to the aircraft being flown;

(2) The safety pilot has adequate vision forward and to each side of the aircraft, or a competent observer in the aircraft adequately supplements the vision of the safety pilot; and

(3) Except in the case of a lighter-than-air aircraft, that aircraft is equipped with fully functioning dual controls. However, simulated instrument flight may be conducted in a single-engine airplane equipped with a single, functioning, throwover control wheel in place of fixed, dual controls of the elevator and ailerons, when-

(i) The safety pilot has determined that the flight can be conducted safely; and

(ii) The person manipulating the controls has at least a private pilot certificate with appropriate category and class ratings.

(c) No person may operate a civil aircraft that is being used for a flight test for an airline transport pilot certificate or a class or type rating on that certificate, or for a Part 121 proficiency flight test, unless the pilot seated at the controls, other than the pilot being checked, is fully qualified to act as pilot in command of the aircraft.

91.111 OPERATING NEAR OTHER AIRCRAFT

(a) No person may operate an aircraft so close to another aircraft as to create a collision hazard.

(b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation.

(c) No person may operate an aircraft, carrying passengers for hire, in formation flight.

91.113 RIGHT-OF-WAY RULES: EXCEPT WATER OPERATIONS

(a) *Inapplicability.* This section does not apply to the operation of an aircraft on water.

(b) *General.* When weather conditions permit, regardless of whether an operation is conducted under Instrument Flight Rules or Visual Flight Rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft in compliance with this section. When a rule of this section gives another aircraft the right-of-way, he shall give way to that aircraft and may not pass over, under, or ahead of it, unless well clear.

(c) *In Distress.* An aircraft in distress has the right-of-way over all other air traffic.

(d) *Converging.* When aircraft of the same category are converging at approximately the same altitude (except head-on, or nearly so) the aircraft to the other's right has the right-of-way. If the aircraft are of different categories -
  (1) A balloon has the right-of-way over any other category of aircraft;
  (2) A glider has the right-of-way over an airship, airplane or rotorcraft; and
  (3) An airship has the right-of-way over an airplane or rotorcraft.

However, an aircraft towing or refueling other aircraft has the right-of-way over all other engine driven aircraft.

(e) *Approaching Head-on.* When aircraft are approaching each other head-on, or nearly so, each pilot of each aircraft shall alter course to the right.

(f) *Overtaking.* Each aircraft that is being overtaken has the right-of-way and each pilot of an overtaking aircraft shall alter course to the right and pass well clear.

(g) *Landing.* Aircraft, while on final approach to land, or while landing, have the right-of-way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right of way, but shall not take advantage of this rule to cut in front of another which is on final approach to land, or overtake that aircraft.

91.115 RIGHT-OF-WAY RULES: WATER OPERATIONS

(a) *General.* Each person operating an aircraft on the water shall, insofar as possible, keep clear of all vessels and avoid impeding their navigation, and shall give way to any vessel or other aircraft that is given the right-of-way by any rule in this section.

(b) *Crossing.* When aircraft, or an aircraft and a vessel, are on crossing courses, the aircraft or vessel to the other's right has the right-of-way.

(c) *Approaching Head-on.* When aircraft, or an aircraft and a vessel, are approaching head-on, or nearly so, each shall alter its course to the right to keep well clear.

(d) *Overtaking.* Each aircraft or vessel that is being overtaken has the right-of-way, and the one overtaking shall alter course to keep well clear.

(e) *Special Circumstances.* When aircraft, or an aircraft and a vessel, approach so as to involve risk of collision, each aircraft or vessel shall proceed with careful regard to existing circumstances, including the limitations of the respective craft.

91.117 AIRCRAFT SPEED

(a) Unless otherwise authorized by the Administrator, no person may operate an aircraft below 10,000 feet MSL at an indicated airspeed of more than 250 knots (288 m.p.h.).

(b) Unless otherwise authorized or required by ATC, no person may operate an aircraft at or below 2,500 feet above the surface within 4 nautical miles of the primary airport of a Class C or Class D airspace area at an indicated airspeed of more than 200 knots (230 m.p.h.). This paragraph (b) does not apply to any operations within a Class B airspace area. Such operations will comply with paragraph (a) of this section.

(c) No person may operate an aircraft in the airspace underlying a Class B airspace area, or in a VFR corridor designated through such a Class B airspace area at an indicated airspeed of more than 200 knots (230 m.p.h).

(d) If the minimum safe airspeed for any particular operation is greater than the maximum speed prescribed in this section, the aircraft may be operated at that minimum speed.

91.119 MINIMUM SAFE ALTITUDES: GENERAL

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) *Anywhere.* An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) *Over Congested Areas.* Over any congested area of a city, town, or settlement, or over an open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) *Over Other Than Congested Areas.* An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In that case, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) *Helicopters.* Helicopters may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section if the operation is conducted without hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with any routes or altitudes specifically prescribed for helicopters by the Administrator.

91.121 ALTIMETER SETTINGS

(a) Each person operating an aircraft shall maintain the cruising altitude or flight level of that aircraft, as the case may be, by reference to an altimeter that is set, when operating -

- (1) Below 18,000 feet MSL, to -
  - (i) The current reported altimeter setting of a station along the route and within 100 miles of the aircraft;
  - (ii) If there is no station within the area prescribed in paragraph (a)(1)(i) of this section, the current reported altimeter setting of an approprite available station; or
  - (iii) In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure; or
- (2) At or above 18,000 feet MSL, to 29.92" Hg.

(b) The lowest usable flight level is determined by the atmospheric pressure in the area of operation, as shown in the following table:

Current altimeter setting	Lowest usable flight level
29.92 (or higher)	180
29.91 through 29.42	185
29.41 through 28.92	190
28.91 through 28.42	195
28.41 through 27.92	200
27.91 through 27.42	205
27.41 through 26.92	210

(c) To convert minimum altitude prescribed under §§91.119 and 91.177 to the minimum flight level, the pilot shall take the flight level equivalent of the minimum altitude in feet and add the appropriate number of feet specified below, according to the current reported altimeter setting:

Current altimeter setting	Adjustment factor
29.92 (or higher)	None
29.91 through 29.42	500
29.41 through 28.92	1,000
28.91 through 28.42	1,500
28.41 through 27.92	2,000
27.91 through 27.42	2,500
27.41 through 26.92	3,000

91.123 COMPLIANCE WITH ATC CLEARANCES AND INSTRUCTIONS

(a) When an ATC clearance has been obtained, no pilot in command may deviate from that clearance, except in an emergency, unless that pilot obtains an amended clearance. However, except in Class A airspace, this paragraph does not prohibit that pilot from canceling an IFR flight plan if the operation is being conducted in VFR weather conditions. When a pilot is uncertain of an ATC clearance, that pilot must immediately request clarification from ATC.

(b) Except in an emergency, no person may operate an aircraft contrary to an ATC instruction in an area in which air traffic control is exercised.

(c) Each pilot in command who deviates, in an emergency, from an ATC clearance or instruction shall notify ATC of that deviation as soon as possible.

(d) Each pilot in command who (though not deviating from a rule of this Subpart) is given priority by ATC in an emergency shall submit a detailed report of that emergency within 48 hours to the manager of that ATC facility, if requested by ATC.

(e) Unless otherwise authorized by ATC, no person operating an aircraft may operate that aircraft according to any clearance or instruction that has been issued to the pilot of another aircraft for radar air traffic control purposes.

91.125 ATC LIGHT SIGNALS

ATC light signals have the meaning shown in the following table.

Color and type of signal	Meaning with respect to aircraft on the surface	Meaning with respect to aircraft in flight
Steady green	Cleared for takeoff	Clear to land.
Flashing green	Cleared to taxi	Return for landing(to be followed hy steady green at proper time).
Steady red	Stop	Give way to other aircraft and continue circling.
Flashing red	Taxi clear of runway in use	Airport unsafe - do not land.
Flashing white	Return to starting point on airport	Not applicable.
Alternating red and green	Exercise extreme caution	Exercise extreme caution.

91.126 OPERATING ON OR IN THE VICINITY OF AN AIRPORT IN CLASS G AIRSPACE

(a) *General.* Unless otherwise authorized or required, each person operating an aircraft on or in the vicinity of an airport in a Class G airspace area must comply with the requirements of this section.

(b) *Direction of turns.* When approaching to land at an airport without an operating control tower in Class G airspace-

(1) Each pilot of an airplane must make all turns of that airplane to the left unless the airport displays approved light signals or visual markings indicating that turns should be made to the right, in which case the pilot must make all turns to the right; and

(2) Each pilot of a helicopter must avoid the flow of fixed wing aircraft.

(c) *Flap settings.* Except when necessary for training or certification, the pilot in command of a civil turbojet-powered aircraft must use, as a final flap setting, the minimum certificated landing flap setting set forth in the approved performance information in the Airplane Flight Manual for the applicable conditions. However, each pilot in command has the final authority and responsibility for the safe operation of the pilot's airplane, and may use a different flap setting for that airplane if the pilot determines that it is necessary in the interest of safety.

(d) *Communications with control towers.* Unless otherwise authorized or required by ATC, no person may operate an aircraft to, from, through, or on an airport having an operational control tower unless two-way radio communications are maintained between that aircraft and the control tower. Communications must be established prior to 4 nautical miles from the airport, up to and including 2,500 feet AGL. However, if the aircraft radio fails in flight, the pilot in command may operate that aircraft and land if weather conditions are at or above basic VFR weather minimums, visual contact with the tower is maintained, and a clearance to land is received. If the aircraft radio fails while under IFR, the pilot must comply with §91.185.

91.127 OPERATING ON OR IN THE VICINITY OF AN AIRPORT IN CLASS E AIRSPACE

(a) Unless otherwise required by Part 93 of this chapter or unless otherwise authorized or required by the ATC facility having jurisdiction over the Class E airspace area, each person operating an aircraft on or in the vicinity of an airport in a Class E airspace area must comply with the requirements of §91.129.

(b) Departures. Each pilot of an aircraft must comply with any traffic patterns established for that airport in Part 93 of this chapter.

(c) *Communications with control towers.* Unless otherwise authorized or required by ATC, no person may operate an aircraft to, from, through, or on an airport having an operational control tower unless two-way radio communications are maintained between that aircraft and the control tower. Communications must be established prior to 4 nautical miles from the airport, up to and including 2,500 feet AGL. However, if the aircraft radio fails in flight, the pilot in command may operate that aircraft and land if weather conditions are at or above basic VFR weather minimums, visual contact with the tower is maintained, and a clearance to land is received. If the aircraft radio fails while under IFR, the pilot must comply with §91.185.

91.129 OPERATION IN CLASS D AIRSPACE

(a) *General.* Unless otherwise authorized or required by the ATC facility having jurisdiction over the Class D airspace area, each person operating an aircraft in Class D airspace must comply with the applicable provisions of this section. In addition, each person must comply with §§91.126 and 91.127. For the purpose of this section, the primary airport is the airport for which the Class D airspace area is designated. A satellite airport is any other airport within the Class D airspace area.

(b) *Deviations.* An operator may deviate from any provision of this section under the provisions of an ATC authorization issued by the ATC facility having jurisdication over the airspace concerned, ATC may authorize a deviation on a continuing basis or for an individual flight, as appropriate.

(c) *Communications.* Each person operating an aircraft in Class D airspace must meet the following two-way radio communications requirements:

  (1) *Arrival or through flight.* Each person must establish two-way radio communications with the ATC facility (including foreign ATC in the case of foreign airspace designated in the United States) providing air traffic services prior to entering that airspace and thereafter maintain those communications while within that airspace.

  (2) *Departing flights.* Each person operating an aircraft-

    (i) From the primary airport or satellite airport with an operating control tower must establish and maintain two-way radio communications with the control tower, and thereafter as instructed by ATC while operating in the Class D airspace area; or

    (ii) From a satellite airport without an operating control tower, must establish and maintain two-way radio communications with the ATC facility having jurisdication over the Class D airspace area as soon as practicable after departing.

(d) *Communications failure.* Each person who operates an aircraft in a Class D airspace area must maintain two-way radio communications with the ATC facility having jurisdication over that area.

  (1) If the aircraft radio fails in flight under IFR, the pilot must comply with §91.185 of this Part.

  (2) If the aircraft radio fails in flight under VFR, the pilot in command may operate that aircraft and land if-

    (i) Weather conditions are at or above basic VFR weather minimums;

    (ii) Visual contact with the tower is maintained; and

    (iii) A clearance to land is received.

(e) *Minimum altitudes.* When operating to an airport in Class D airspace, each pilot of-

  (1) A large or turbine-powered airplane shall, unless otherwise required by the applicable distance from cloud criteria, enter the traffic pattern at an altitude of at least 1,500 feet above the elevation of the airport and maintain at least 1,500 feet above the elevation of the airport until further descent is required for a safe landing;

  (2) A large or turbine-powered airplane approaching to land on a runway served by an instrument landing system (ILS), if the airplane is ILS equipped, shall fly that airplane at an altitude at or above the glide slope between the outer marker (or point of interception of the glide slope, if compliance with the applicable distance from cloud criteria requires interception closer in) and the middle marker; and

  (3) An airplane approaching to land on a runway served by a visual approach slope indicator shall maintain an altitude at or above the glide slope until a lower altitude is necessary for a safe landing.

  Paragraphs (e)(2) and (e)(3) of this section do not prohibit normal bracketing maneuvers above and below the glide slope that are conducted for the purpose of remaining on the glide slope.

(f) *Approaches.* Except when conducting a circling approach under Part 97 of this chapter or unless otherwise required by ATC, each pilot must-
  (1) Circle the airport to the left, if operating an airplane; or
  (2) Avoid the flow of fixed-wing aircraft, if operating a helicopter.

(g) *Departures.* No person may operate an aircraft departing from an airport except in compliance with the following:
  (1) Each pilot must comply with any departure procedures established for that airport by the FAA.
  (2) Unless otherwise required by the prescribed departure for that airport or the applicable distance from cloud criteria, each pilot of a turbine-powered airplane and each pilot of a large airplane must climb to an altitude of 1,500 feet above the surface as rapidly as practicable.

(h) *Noise abatement.* Where a formal runway use program has been established by the FAA, each pilot of a large or turbine powered airplane assigned a noise abatement runway by ATC must use that runway. However, consistent with the final authority of the pilot in command concerning safe operation of the aircraft as prescribed in §91.3(a), ATC may assign a different runway if requested by the pilot in the interest of safety.

(i) *Takeoff, landing, taxi clearance.* No person may, at any airport with an operating control tower, operate an aircraft on a runway or a taxiway, or takeoff or land an aircraft, unless an appropriate clearance is received from ATC. A clearance to "taxi to" the takeoff runway assigned to the aircraft is not a clearance to cross that assigned takeoff runway, or to taxi on that runway at any point, but is a clearance to cross other runways that intersect the taxi route to that assigned takeoff runway. A clearance to "taxi to" any point other than an assigned takeoff runway is clearance to cross all runways that intersect the taxi route to that point.

91.130 OPERATIONS IN CLASS C AIRSPACE

(a) *General.* Unless otherwise authorized by ATC, each aircraft operation in Class C airspace must be conducted in compliance with this section and §91.129. For the purpose of this section, the primary airport is the airport for which the Class C airspace area is designated. A satellite airport is any other airport within the Class C airspace area.

(b) *Traffic patterns.* No person may takeoff or land at a satellite airport within a Class C airspace area except in compliance with FAA arrival and departure traffic patterns.

(c) *Communications.* Each person operating an aircraft in Class C airspace must meet the following two-way radio communications requirements:
  (1) *Arrivals and through flights.* Each person must establish two-way radio communication with the ATC facility (including foreign ATC in the case of foreign airspace designated in the United State) providing air traffic services prior to entering that airspace and thereafter maintain those communications while within that airspace.
  (2) *Departing flights.* Each person operating an aircraft-
    (i) From the primary airport or satellite with an operating control tower, must establish and maintain two-way radio communications with the control tower and thereafter as instructed by ATC while operating in the Class C area; or
    (ii) From a satellite airport without an operating control tower, must establish and maintain two-way radio communications with the ATC facility having jurisdiction over the Class C airspace area as soon as practicable after departing.

(d) *Equipment requirements.* Unless otherwise authorized by the ATC facility having jurisdiction over the Class C airspace area, no person may operate an aircraft within a Class C airspace area unless that aircraft is equipped with the applicable equipment specified in §91.215.

(e) *Deviations.* An operator may deviate from any provision of this section under the provisions of an ATC authorization issued by the ATC facility having jurisdiction over the airspace concerned. ATC may authorize a deviation on a continuing basis or for an individual flight, as appropriate.

91.131 OPERATIONS IN CLASS B AIRSPACE

(a) *Operating rules.* No person may operate an aircraft within a Class B airspace area except in compliance with §91.129 and the following rules:

(1) The operator must receive an ATC clearance from the ATC facility having jurisdiction for that area before operating an aircraft in that area.

(2) Unless otherwise authorized by ATC, each person operating a large turbine engine-powered airplane to or from a primary airport for which a Class B airspace area is designated must operate at or above the designated floors of the Class B airspace area while within the lateral limits of that area.

(3) Any person conducting pilot training operations at an airport within a Class B airspace area must comply with any procedures established by ATC for such operations in that area.

(b) *Pilot requirements.*

  (1) No person may takeoff or land a civil aircraft at an airport within a Class B airspace area or operate a civil aircraft within a Class B airspace area unless-

    (i) The pilot in command holds at least a private pilot certificate; or,

    (ii) The aircraft is operated by a student pilot or recreational pilot who has met the requirements of §61.95 of this chapter.

  (2) Notwithstanding the provisions of (b)(1)(ii) of this section, no person may takeoff or land a civil aircraft at those airports listed in section 4 of appendix D of this part unless the pilot in command holds at least a private pilot certificate.

(c) *Communications and navigation equipment requirements.* Unless otherwise authorized by ATC, no person may operate an aircraft within a Class B airspace area unless that aircraft is equipped with -

  (1) *For IFR operation.* An operable VOR or TACAN receiver; and

  (2) *For all operations.* An operable two-way radio capable of communications with ATC on appropriate frequencies for that Class B airspace area.

(d) *Transponder requirements.* No person may operate an aircraft in a Class B airspace area unless the aircraft is equipped with the applicable operating transponder and automatic altitude reporting equipment specified in paragraph (a) of §91.215, except as provided in paragraph (d) of that section.

91.133 RESTRICTED/PROHIBITED AREAS

(a) No person may operate an aircraft within a restricted area contrary to the restrictions imposed, or within a prohibited area, unless that person has the permission of the using or controlling agency, as appropriate.

(b) Each person conducting, within a restricted area, an aircraft operation (approved by the using agency) that creates the same hazards as the operations for which the restricted area was designated may deviate from the rules of this subpart that are not compatible with his operation of the aircraft.

91.135 OPERATIONS IN CLASS A AIRSPACE

Except as provided in paragraph (d) of this section, each person operating an aircraft in Class A airspace must conduct that operation under instrument flight rules (IFR) and in compliance with the following:

(a) Clearance. Operations may be conducted only under an ATC clearance received prior to entering the airspace.

(b) Communications. Unless otherwise authorized by ATC, each aircraft operating in Class A airspace must be equipped with a two-way radio capable of communicating with ATC on a frequency assigned by ATC. Each pilot must maintain two-way radio communications with ATC while operating in Class A airspace.

(c) Transponder requirement. Unless otherwise authorized by ATC, no person may operate an aircraft within Class A airspace unless that aircraft is equipped with the applicable equipment specified in §91.215.

(d) ATC authorizations. An operator may deviate from any provision of this section under the provisions of an ATC authorization issued by the ATC facility having jurisdiction of the airspace concerned. In the case of an inoperative transponder, ATC may immediately approve an operation within a Class A airspace area allowing flight to continue, if desired, to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made, or both. Requests for deviation from any provision of this section must be submitted in writing, at least 4 days before the proposed operation. ATC may authorize a deviation on a continuing basis or for an individual flight.

91.137 TEMPORARY FLIGHT RESTRICTIONS

(a) The Administrator will issue a Notice to Airmen (NOTAM) designating an area within which temporary flight restrictions apply and specifying the hazard or condition requiring their imposition, whenever he determines it is necessary in order to-

(1) Protect persons and property on the surface or in the air from a hazard associated with an incident on the surface;

(2) Provide a safe environment for the operation of disaster relief aircraft; or

(3) Prevent an unsafe congestion of sightseeing and other aircraft above an incident or event which may generate a high degree of public interest.

The Notice to Airmen will specify the hazard or condition that requires the imposition of temporary flight restrictions.

(b) When a NOTAM has been issued under paragraph (a)(1) of this section, no person may operate an aircraft within the designated area unless that aircraft is participating in the hazard relief activities and is being operated under the direction of the official in charge of on scene emergency response activities.

(c) When a NOTAM has been issued under paragraph (a)(2) of this setion, no person may operate an aircraft within the designated area unless at least one of the following conditions is met:

(1) The aircraft is participating in hazard relief activities and is being operated under the direction of the official in charge of on scene emergency response activities.

(2) The aircraft is carrying law enforcement officials.

(3) The aircraft is operating under an ATC approved IFR flight plan.

(4) The operation is conducted directly to or from an airport within the area, or is necessitated by the impracticability of VFR flight above or around the area due to weather, or terrain; notification is given to the Flight Service Station (FSS) or ATC facility specified in the NOTAM to receive advisories concerning disaster relief aircraft operations; and the operation does not hamper or endanger relief activities and is not conducted for the purpose of observing the disaster.

(5) The aircraft is carrying properly accredited news representatives, and, prior to entering the area, a flight plan is filed with the appropriate FSS or ATC facility specified in the NOTAM and the operation is conducted above the altitude used by the disaster relief aircraft, unless otherwise authorized by the official in charge of on scene emergency response activities.

(d) When a NOTAM has been issued under paragraph (a)(3) of this section, no person may operate an aircraft within the designated area unless at least one of the following conditions is met:

(1) The operation is conducted directly to or from an airport within the area, or is necessitated by the impracticability of VFR flight above or around the area due to weather, or terrain and the operation is not conducted for the purpose of observing the incident or event.

(2) The aircraft is operating under an ATC approved IFR flight plan.

(3) The aircraft is carrying incident or event personnel, or law enforcement officials.

(4) The aircraft is carrying properly accredited news representatives and, prior to entering that area, a flight plan is filed with the appropriate FSS or ATC facility specified in the NOTAM.

(e) Flight plans filed and notifications made with an FSS or ATC facility under this section shall include the following information:

(1) Aircraft identification, type and color.

(2) Radio communications frequencies to be used.

(3) Proposed times of entry of, and exit from, the designated area.

(4) Name of news media or organization and purpose of flight.

(5) Any other information requested by ATC.

91.138 TEMPORARY FLIGHT RESTRICTIONS IN NATIONAL DISASTER AREAS IN THE STATE OF HAWAII

(a) When the Administrator has determined, pursuant to a request and justification provided by the Governor of the State of Hawaii, or the Governor's designee, that an inhabited area within a declared national disaster area in the State of Hawaii is in need of protection for humanitarian reasons, the Administrator will issue a Notice to Airmen (NOTAM) designating an area to which temporary flight restrictions apply. The Administrator will designate the extent and duration of the temporary flight restrictions necessary to provide for the protection of persons and property on the surface.

(b) When a NOTAM has been issued in accordance with this section, no person may operate an aircraft within the designated airspace unless:

(1) That person has obtained authorization from the official in charge of associated

emergency or disaster relief response activities, and is operating the aircraft under the conditions of that authorization;

(2) The aircraft is carrying law enforcement officals;

(3) The aircraft is carrying persons involved in an emergency or a legitimate scientific purpose;

(4) The aircraft is carrying properly accredited newspersons, and that prior to entering the area, a flight plan is filed with the appropriate FSS or ATC facility specified in the NOTAM and the operation is conducted in compliance with the conditions and restrictions established by the official in charge of on scene emergency response activities; or

(5) The aircraft is operating in accordance with an ATC clearance or instruction.

(c) A NOTAM issued under this section is effective for 90 days or until the national disaster area designation is terminated, whichever comes first, unless terminated by notice or extended by the Administrator at the request of the Governor of the State of Hawaii or the Governor's designee.

91.139 EMERGENCY AIR TRAFFIC RULES

(a) This section prescribes a process for utilizing Notices to Airmen (NOTAMs) to advise of the issuance of and operations under emergency air traffic rules and regulations and designates the official who is authorized to issue NOTAMs on behalf of the Administrator in certain matters under this section.

(b) Whenever the Administrator determines that an emergency condition exists, or will exist, relating to the FAA's ability to operate the air traffic control system and during which normal flight operations under this chapter cannot be conducted consistent with the required levels of safety and efficiency-

(1) The Administrator issues an immediately effective air traffic rule or regulation in response to that emergency condition, and

(2) The Administrator or the Associate Administrator for Air Traffic may utilize the NOTAM system to provide notification of the issuance of the rule or regulation. Those NOTAMs communicate information concerning the rules and regulations that govern flight operations, the use of navigation facilities, and designation of that airspace in which the rules and regulations apply.

(c) When a NOTAM has been issued under this section, no person may operate an aircraft or other device governed by the regulation concerned, within the designated airspace except in accordance with the authorizations, terms, and conditions prescribed in the regulation covered by the NOTAM.

91.141 FLIGHT RESTRICTIONS IN THE PROXIMITY OF THE PRESIDENTIAL AND OTHER PARTIES

No person may operate an aircraft over or in the vicinity of any area to be visited or traveled by the President, Vice President, or other public figures contrary to the restrictions established by the Administrator and published in a Notice to Airmen (NOTAM).

91.143 FLIGHT LIMITATIONS IN THE PROXIMITY OF SPACE FLIGHT OPERATIONS

No person may operate any aircraft of United States registry, or pilot any aircraft under the authority of an airman certificate issued by the Federal Aviation Administration within areas designated in a NOTAM for space flight operations except when authorized by ATC, or operated under the control of the Department of Defense, Manager for Space Transportation Systems Contingency Support Operations.

VISUAL FLIGHT RULES

91.153 VFR FLIGHT PLAN: INFORMATION REQUIRED

(a) *Information required.* Unless otherwise authorized by ATC, each person filing a VFR flight plan shall include the following information:

(1) The aircraft identification number and, if necessary, its radio call sign.

(2) The type of the aircraft or, in the case of a formation flight, the type of each aircraft and the number of aircraft in the formation.

(3) The full name and address of the pilot in command or, in the case of a formation flight, the formation commander.

(4) The point and proposed time of departure.

(5) The proposed route, cruising altitude (or flight level) and true airspeed at that altitude.

(6) The point of first intended landing and the

estimated elapsed time until over that point.

(7) The amount of fuel on board (in hours).

(8) The number of persons in the aircraft, except where that information is otherwise readily available to the FAA.

(9) Any other information the pilot in command or ATC believes is necessary for ATC purposes.

(b) *Cancellation.* When a flight plan has been activated, the pilot in command, upon cancelling or completing the flight under the flight plan, shall notify an FAA Flight Service Station or ATC facility.

91.155 BASIC VFR WEATHER MINIMUMS

(a) Except as provided in paragraph (b) of this section and §91.157, no person may operate an aircraft under VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude and class of airspace in the following table:

Altitude	Flight visibility	Distance from clouds
Class A	Not Applicable	Not Applicable
Class B	3 statute miles	Clear of clouds
Class C	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class D	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class E:		
Less than 10,000 feet MSL	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
At or above 10,000 feet MSL	5 statute miles	1,000 feet below 1,000 feet above 1 statute mile horizontal
Class G:		
1,200 feet or less above the surface (regardless of MSL altitude)		
Day, except as in §91.155(b)	1 statute mile	Clear of clouds
Night, except as in §91.155(b)	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface, but less than 10,000 feet MSL		
Day	1 statue mile	500 feet below 1,000 feet above 2,000 feet horizontal
Night	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface and at or above 10,000 feet MSL	5 statute miles	1,000 feet below 1,000 feet above 1 mile horizontal

(b) *Class G Airspace.* Notwithstanding the provisions of paragraph (a) of this section, the following operations may be conducted in Class G airspace below 1,200 feet above the surface:
  (1) *Helicopter.* A helicopter may be operated clear of clouds if operated at a speed that allows the pilot adequate opportunity to see any air traffic or obstruction in time to avoid a collision.
  (2) *Airplane.* When the visibility is less than 3 statute miles but not less than 1 statute mile during night hours, an airplane may be operated clear of clouds if operated in an airport traffic pattern within one-half mile of the runway.

(c) Except as provided in §91.157, no person may operate an aircraft beneath the ceiling under VFR within the lateral boundaries of controlled airspace designated to the surface for an airport when the ceiling is less than 1,000 feet.

(d) Except as provided in §91.157, no person may takeoff or land an aircraft, or enter the traffic pattern of an airport, under VFR, within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport-

(1) Unless ground visibility at that airport is at least 3 statute miles; or

(2) If ground visibility is not reported at that airport, unless flight visibility during landing or takeoff, or while operating in the traffic pattern is at least 3 statute miles.

(e) For the purpose of this section, an aircraft operating at the base altitude of a Class E airspace area is considered to be within the airspace directly below that area.

91.157 SPECIAL VFR WEATHER MINIMUMS

(a) Except as provided in appendix D, section 3, of this part, special VFR operations may be conducted under the weather minimums and requirements of this section, instead of those contained in §91.155, below 10,000 feet MSL within the airspace contained by the upward extension of the lateral boundaries of the controlled airspace designated to the surface for an airport.

(b) Special VFR operations may only be conducted-
  (1) With an ATC clearance;
  (2) Clear of clouds;
  (3) Except for helicopters, when flight visibility is at least 1 statute mile; and
  (4) Except for helicopters, between sunrise and sunset (or in Alaska, when the sun is 6° or more above the horizon) unless-
    (i) The person being granted the ATC clearance meets the applicable requirements for instrument flight under part 61 of this chapter; and
    (ii) The aircraft is equipped as required in §91.205(d).

(c) No person may takeoff or land an aircraft (other than a helicopter) under special VFR-
  (1) Unless ground visibility is at least 1 statute mile; or
  (2) If ground visibility is not reported, unless flight visibility is at least 1 statute mile.

91.159 VFR CRUISING ALTITUDE

Except while holding in a holding pattern of 2 minutes or less, or while turning, each person operating an aircraft under VFR in level cruising flight more than 3,000 feet above the surface shall maintain the appropriate altitude prescribed below, unless otherwise authorized by ATC:

(a) When operating below 18,000 feet MSL and -
  (1) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude plus 500 feet (such as 3,500, 5,000, or, 7,500); or
  (2) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude plus 500 feet (such as 4,500, 6,500, or 8,500).

(b) When operating above 18,000 feet MSL to flight level 290 (inclusive) and -
  (1) On a magnetic course of zero degrees through 179 degrees, any odd flight level plus 500 feet (such as flight level 195, 215, or, 235); or
  (2) On a magnetic course of 180 degrees through 359 degrees, any even flight level plus 500 feet (such as flight level 185, 205, or 225).

(c) When operating above flight level 290 and -
  (1) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 300 (such as flight level 300, 340, 380); or
  (2) On a magnetic course of 180 degrees through 359 degrees, any any flight level, at 4,000-foot intervals, beginning at and including flight level 320 (such as flight level 320, 360, 400).

91.161 — 91.165 [RESERVED]

INSTRUMENT FLIGHT RULES

91.167 FUEL REQUIREMENTS FOR FLIGHT IN IFR CONDITIONS

(a) Except as provided in paragraph (b) of this section, no person may operate a civil aircraft in IFR conditions unless it carries enought fuel (considering weather reports and forecasts and weather conditions) to—
  (1) Complete the flight to the first airport of intended landing;
  (2) Fly from that airport to the alternate airport; and
  (3) Fly after that for 45 minutes at normal cruising speed or, for helicopters, fly after that for 30 minutes at normal cruising speed.

(b) Paragraph (a)(2) of this section does not apply if—
  (1) Part 97 of this chapter prescribes a standard instrument approach procedure for the first airport of intended landing; and
  (2) For at least 1 hour before and 1 hour after the estimated time of arrival at the airport, the weather reports or forecasts or any combination of them indicate—
    (i) The ceiling will be at least 2,000 feet above the airport elevation; and
    (ii) The visibility will be at least 3 statute miles.

91.169 IFR FLIGHT PLAN: INFORMATION REQUIRED

(a) *Information required.* Unless otherwise authorized by ATC, each person filing an IFR flight plan shall include in it the following information:
  (1) Information required under §91.153(a).
  (2) An alternate airport, except as provided in paragraph (b) of this section.

(b) *Exceptions to applicability of paragraph (a)(2) of this section.* Paragraph (a)(2) of this section does not apply if Part 97 of this chapter prescribes a standard instrument approach procedure for the first airport of intended landing and, for at least 1 hour before and 1 hour after the estimated time of arrival, the weather reports and forecasts, or any combination of them, indicate—
  (1) The ceiling will be at least 2,000 feet above the airport elevation; and
  (2) The visibility will be at least 3 statute miles.

(c) *IFR alternate airport weather minimums.* Unless otherwise authorized by the Administrator, no person may include an alternate airport in an IFR flight plan unless current weather forecasts indicate that, at the estimated time of arrival at the alternate airport, the ceiling and visibility will be at or above the following alternate airport weather minimums:
  (1) If an instrument approach procedure has been published in Part 97 of this chapter for that airport, the alternate airport minimums specified in that procedure or, if none are so specified, the following minimums:
    (i) Precision approach procedure: Ceiling 600 feet and visibility 2 statute miles.
    (ii) Nonprecision approach procedure: Ceiling 800 feet and visibility 2 statute miles.
  (2) If no instrument approach procedure has been published in Part 97 of this chapter for that airport, the ceiling and visibility minimums are those allowing descent from the MEA, approach, and landing under basic VFR.

(d) *Cancellation.* When a flight plan has been activated, the pilot in command, upon cancelling or completing the flight under the flight plan, shall notify an FAA Flight Service Station or ATC facility.

91.171 VOR EQUIPMENT CHECK FOR IFR OPERATIONS

(a) No person may operate a civil aircraft under IFR using the VOR system of radio navigation unless the VOR equipment of that aircraft—
  (1) Is maintained, checked, and inspected under an approved procedure; or
  (2) Has been operationally checked within the preceding 30 days, and was found to be within the limits of the permissible indicated bearing error set forth in paragraph (b) or (c) of this section.

(b) Except as provided in paragraph (c) of this section, each person conducting a VOR check under paragraph (a)(2) of this section shall—
  (1) Use, at the airport of intended departure, an FAA operated or approved test signal or a test signal radiated by a certificated and appropriately rated radio repair station or, outside the United States, a test signal operated or approved by an appropriate authority to check the VOR equipment (the maximum permissible indicated bear-

ing error is plus or minus 4 degrees); or

(2) Use, at the airport of intended departure, a point on the airport surface designated as a VOR system checkpoint by the Administrator or, outside the United States, by an appropriate authority (the maximum permissible bearing error is plus or minus 4 degrees);

(3) If neither a test signal nor a designated checkpoint on the surface is available, use an airborne checkpoint designated by the Administrator or, outside the United States, by an appropriate authority (the maximum permissible bearing error is plus or minus 6 degrees); or

(4) If no check signal or point is available, while in flight—
  - (i) Select a VOR radial that lies along the centerline of an established VOR airway;
  - (ii) Select a prominent ground point along the selected radial preferably more than 20 nautical miles from the VOR ground facility and maneuver the aircraft directly over the point at a reasonably low altitude; and
  - (iii) Note the VOR bearing indicated by the receiver when over the ground point (the maximum permissible variation between the published radial and the indicated bearing is 6 degrees).

(c) If dual system VOR (units independent of each other except for the antenna) is installed in the aircraft, the person checking the equipment may check one system against the other in place of the check procedures specified in paragraph (b) of this section. Both systems shall be tuned to the same VOR ground facility and note the indicated bearings to that station. The maximum permissible variation between the two indicated bearings is 4 degrees.

(d) Each person making the VOR operational check, as specified in paragraph (b) or (c) of this section, shall enter the date, place, bearing error, and sign the aircraft log or other record. In addition, if the test signal radiated by a repair station, as specified in paragraph (b)(1) of this section, is used, an entry must be made in the aircraft log or other record by the repair station certificate holder or the certificate holder's representative certifying to the bearing transmitted by the repair station for the check and the date of transmission.

(Approved by the Office of Management and Budget under OMB control number 2120-0005)

91.173 ATC CLEARANCE AND FLIGHT PLAN REQUIRED

No person may operate an aircraft in controlled airspace under IFR unless that person has—

(a) Filed an IFR flight plan; and

(b) Received an appropriate ATC clearance.

91.175 TAKEOFF AND LANDING UNDER IFR

(a) *Instrument approaches to civil airports.* Unless otherwise authorized by the Administrator, when an instrument letdown to a civil airport is necessary, each person operating an aircraft, except a military aircraft of the United States, shall use a standard instrument approach procedure prescribed for the airport in Part 97 of the chapter.

(b) *Authorized DH or MDA.* For the purpose of this section, when the approach procedure being used provides for and requires the use of a DH or MDA, the authorized DH or MDA is the highest of the following:
  - (1) The DH or MDA prescribed by the approach procedure.
  - (2) The DH or MDA prescribed for the pilot in command.
  - (3) The DH or MDA for which the aircraft is equipped.

(c) *Operation below DH or MDA.* Where a DH or MDA is applicable, no pilot may operate an aircraft, except a military aircraft of the United States, at any airport below the authorized MDA or continue an approach below the authorized DH unless—
  - (1) The aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers, and for operations conducted under Part 121 or Part 135 unless that descent rate will allow touchdown to occur within the touchdown zone of the runway of intended landing.
  - (2) The flight visibility is not less than the visibility prescribed in the standard instrument approach procedure being used; and
  - (3) Except for a Category II or Category III approach where any necessary visual reference requirements are specified by the Administrator, at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:

- (i) The approach light system, except that the pilot may not descend below 100 feet above the touchdown zone elevation using the approach lights as a reference unless the red terminating bars or the red side row bars are also distinctly visible and identifiable.
- (ii) The threshold.
- (iii) The threshold markings.
- (iv) The threshold lights.
- (v) The runway end identifier lights.
- (vi) The visual approach slope indicator.
- (vii) The touchdown zone or the touchdown zone markings.
- (viii) The touchdown zone lights.
- (ix) The runway or runway markings.
- (x) The runway lights.

(d) *Landing.* No pilot operating an aircraft, except a military aircraft of the United States, may land that aircraft when the flight visibility is less than the visibility prescribed in the standard instrument approach procedure being used.

(e) *Missed approach procedures.* Each pilot operating an aircraft, except a military aircraft of the United States, shall immediately execute an appropriate missed approach procedure when either of the following conditions exist:

- (1) Whenever the requirements of paragraph (c) of this section are not met at either of the following times:
  - (i) When the aircraft is being operated below the MDA; or
  - (ii) Upon arrival at the missed approach point, including a DH where a DH is specified and its use is required, and at any time after that until touchdown.
- (2) Whenever an identifiable part of the airport is not distinctly visible to the pilot during a circling maneuver at or above MDA, unless the inability to see an identifiable part of the airport results only from a normal bank or the aircraft during the circling approach.

(f) *Civil airport takeoff minimums.* Unless otherwise authorized by the Administrator, no pilot operating an aircraft under Parts 121, 125, 127, 129, or 135 of this chapter may takeoff from a civil airport under IFR unless weather conditions are at or above the weather minimums for IFR takeoff prescribed for that airport under Part 97 of this chapter. If takeoff minimums are not prescribed under Part 97 of this chapter for a particular airport, the following minimums apply for takeoffs under IFR for aircraft operating under those Parts:

- (1) For aircraft, other than helicopters, having two engines or less— 1 statute mile visibility.
- (2) For aircraft having more than two engines— 1/2 statute mile visibility.
- (3) For helicopters— 1/2 statute mile visibility.

(g) *Military airports.* Unless otherwise prescribed by the Administrator, each person operating a civil aircraft under IFR into or out of a military airport shall comply with the instrument approach procedures for takeoff and landing minimum prescribed by the military authority having jurisdiction of that airport.

(h) *Comparable values of RVR and ground visibility.*

- (1) Except for Category II or Category III minimums, if RVR minimum for takeoff or landing are prescribed in an instrument approach procedure, but RVR is not reported for the runway of intended operation, the RVR minimums shall be converted to ground visibility in accordance with the table in paragraph (h)(2) of this section and shall be the visibility minimum for takeoff or landing on that runway.
- (2) RVR Table:

RVR (feet)	Visibility (statute miles)
1,600	1/4
2,400	1/2
3,200	5/8
4,000	3/4
4,500	7/8
5,000	1
6,000	1 1/4

(i) *Operations on unpublished route and use of radar in instrument approach procedures.* When radar is approved at certain locations for ATC purposes, it may be used not only for surveillance and precision radar approaches, as applicable, but also may be used in conjunction with instrument approach procedures predicated on other types of radio navigational aids. Radar vectors may be authorized to provide course guidance through the segments of an approach to the final course or fix. When operating on an unpublished route or while being radar vectored, the pilot, when an approach clearance is received, shall, in addition to complying with §91.177. maintain the last altitude assigned to that pilot until the aircraft is established on a segment of a published route or instrument approach procedure unless a different altitude is assigned by ATC. After the aircraft is so established, published altitudes apply to descent within each succeeding route or approach segment unless a different altitude is assigned by ATC. Upon reaching the final approach course or fix, the pilot may either complete the instrument approach in accordance with a procedure approved for the facility or continue a surveillance or precision radar approach to a landing.

(j) *Limitation on procedure turns.* In the case of a radar vector to a final approach course or fix, a timed approach from a holding fix, or an approach for which the procedure specifies "NoPT", no pilot may make a procedure turn unless cleared to do so by ATC.

(k) *ILS components.* The basic ground components of an ILS are the localizer, glide slope, outer marker, middle marker, and, when installed for use with Category II or Category III instrument approach procedures, an inner marker. A compass locator or precision radar may be substituted for the outer or middle marker. DME, VOR, or nondirectional beacon fixes authorized in the standard instrument approach procedure or surveillance radar may be substituted for the outer marker. Applicability of, and substitution for, the inner marker for Category II or III approaches is determined by the appropriate Part 97 approach procedure, letter of authorization, or operations specification pertinent to the operation.

91.177 MINIMUM ALTITUDE FOR IFR OPERATIONS

(a) *Operation of aircraft at minimum altitudes.* Except when necessary for takeoff or landing, no person may operate an aircraft under IFR below—

- (1) The applicable minimum altitudes prescribed in Parts 95 and 97 of this chapter; or
- (2) If no applicable minimum altitude is prescribed in those Parts—
  - (i) In the case of operations over an area designated as a mountainous area in Part 95, an altitude of 2,000 feet above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown; or
  - (ii) In any other case, an altitude of 1,000 feet above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown.

However, if both a MEA and a MOCA are prescribed for a particular route or route segment, a person may operate an aircraft below the MEA down to, but not below, the MOCA, when within 22 nautical miles of the VOR concerned (based on the pilot's reasonable estimate of that distance).

(b) *Climb.* Climb to a higher minimum IFR altitude shall begin immediately after passing the point beyond which that minimum altitude applies, except that when ground obstacles intervene, the point beyond which that higher minimum alltitude applies shall be crossed at or above the applicable MCA.

91.179 IFR CRUISING ALTITUDE OR FLIGHT LEVEL

(a) *In controlled airspace.* Each person operating an aircraft under IFR in level cruising flight in controlled airspace shall maintain the altitude or flight level assign that aircraft by ATC. However, if the ATC clearance assigns "VFR-conditions-on-top", that person shall maintain an altitude or flight level as prescribed by §91.159.

(b) *In uncontrolled airspace.* Except while holding in a holding pattern of 2 minutes or less or while turning, each person operating an aircraft under IFR in level cruising flight in uncontrolled airspace shall maintain an appropriate altitude as follows:

- (1) When operating below 18,000 feet MSL and—
  - (i) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude (such as 3,000, 5,000, or 7,000); or
  - (ii) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude (such as 2,000, 4,000, or 6,000).
- (2) When operating at or above 18,000 feet MSL but below flight level 290, and—
  - (i) On a magnetic course of zero degrees through 179 degrees, any odd flight level (such as 190, 210, or 230); or
  - (ii) On a magnetic course of 180 degrees through 359 degrees, any even flight level (such as 180, 200, or 220).
- (3) When operating at flight level 290 and above, and—

- (i) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 290 (such as 290, 330, or 370); or
- (ii) On a magnetic course of 180 degrees through 359 degrees, any any flight level, at 4,000-foot intervals, beginning at and including flight level 310 (such as 310, 350, or 390).

91.181 COURSE TO BE FLOWN

Unless otherwise authorized by ATC, no person may operate an aircraft within controlled airspace under IFR except as follows:

- (a) On a Federal airway, along the centerline of that airway.
- (b) On any other route, along the direct course between navigational aids or fixes defining that route.

However, this section does not prohibit maneuvering the aircraft to pass well clear of other traffic or the maneuvering of the aircraft in VFR conditions to clear the intended flight path both before and during climb or descent.

91.183 IFR RADIO COMMUNICATIONS

The pilot in command of each aircraft operated under IFR in controlled airspace shall have a continuous watch maintained on the appropriate frequency and shall report by radio as soon as possible—

- (a) The time and altitude of passing each designated reporting point, or the reporting points specified by ATC, except that while the aircraft is under radar control, only the passing of those reporting points specifically requested by ATC nedd be reported;
- (b) Any unforecast weather conditions encountered; and
- (c) Any other information relating to the safety of flight.

91.185 IFR OPERATIONS: TWO-WAY RADIO COMMUNICATIONS FAILURE

- (a) *General.* Unless otherwise authorized by ATC, each pilot who has two-way radio communications failure when operating under IFR shall comply with the rules of this section.
- (b) *VFR conditions.* If the failure occurs in VFR conditions, or if VFR conditions are encountered after the failure, each pilot shall continue the flight under VFR and land as soon as practicable.
- (c) *IFR conditions.* If the failure occurs in IFR conditions, or if paragraph (b) of this section cannot be complied with, each pilot shall continue the flight according to the following:
  - (1) *Route.*
    - (i) By the route assigned in the last ATC clearance received;
    - (ii) If being radar vectored, by the direct route from the point of radio failure to the fix, route, or airway specified in the vector clearance;
    - (iii) In the absence of an assigned route, by the route that ATC has advised may be expected in a further clearance, or
    - (iv) In the absence of an assigned route or a route that ATC has advised may be expected in a further clearance, by the route filed in the flight plan.
  - (2) *Altitude.*
    At the highest of the following altitudes or flight levels for the route segment being flown:
    - (i) The altitude or flight level assigned in the last ATC clearance received;
    - (ii) The minimum altitude (converted, if appropriate, to minimum flight level as prescribed in §91.121(c)) for IFR operations; or
    - (iii) The altitude or flight level ATC has advised may be expected in a further clearance.
  - (3) *Leave clearance limit.*
    - (i) When the clearance limit is a fix from which an approach begins, commence descent or descent and approach as close as possible to the expect-further-clearance time if one has been received, or if one has not been received, as close as possible to the estimated time of arrival as calculated from the filed or amended (with ATC) estimated time en route.
    - (ii) If the clearance limit is not a fix from which an approach begins, leave the clearance limit at the expect-further-clearance time if one has been received, or if none has been received, upon arrival over the clearance limit, and proceed to a fix from which an approach begins and commence descent or descent and approach as close as

possible to the estimated time of arrival as calculated from the filed or amended (with ATC) estimated time en route.

91.187 OPERATION UNDER IFR IN CONTROLLED AIRSPACE: MALFUNCTION REPORTS

(a) The pilot in command of each aircraft operated in controlled airspace under IFR shall report as soon as practical to ATC any malfunctions of navigational, approach, or communication equipment occurring in flight;

(b) In each report required by paragraph (a) of this section, the pilot in command shall include the—

- (1) Aircraft identification;
- (2) Equipment affected;
- (3) Degree to which the capability of the pilot to operate under IFR in the ATC system is impaired; and
- (4) Nature and extent of assistance desired from ATC.

91.189 CATEGORY II AND III OPERATIONS: GENERAL OPERATING RULES

(a) No person may operate a civil aircraft in a Category II or Category III operation unless:

- (1) The flight crew of the aircraft consists of a pilot in command and a second in command who hold the appropriate authorizations and ratings prescribed in §61.3 of this chapter;
- (2) Each flight crewmember has adequate knowledge of, and familiarity with, the aircraft and the procedures to be used; and
- (3) The instrument panel in front of the pilot who is controlling the aircraft has appropriate instrumentation for the type of flight control guidance system that is being used.

(b) Unless otherwise authorized by the Administrator, no person may operate a civil aircraft in a Category II or Category III operation unless each ground component required for that operation and the related airborne equipment is installed and operating.

(c) *Authorized DH.* For the purpose of this section, when the approach procedure being used provides for and requires the use of a DH, the authorized DH is the highest of the following:

- (1) The DH prescribed by the approach procedure.
- (2) The DH prescribed for the pilot in command.
- (3) The DH for which the aircraft is equipped.

(d) Unless otherwise authorized by the Administrator, no person operating an aircraft in a Category II or Category III approach that provides and requires the use of a DH may continue the approach below the authorized decision height unless the following conditions are met:

- (1) The aircraft is in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers, and where that descent rate will allow touchdown to occur within the touchdown zone of the runway of intended landing.
- (2) At least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:
  - (i) The approach light system, except that the pilot may not descend below 100 feet above the touchdown zone elevation using the approach lights as a reference unless the red terminating bars or the red side row bars are also distinctly visible and identifiable.
  - (ii) The threshold.
  - (iii) The threshold markings.
  - (iv) The threshold lights.
  - (v) The touchdown zone or the touchdown zone markings.
  - (vi) The touchdown zone lights.

(e) Unless otherwise authorized by the Administrator, each pilot operating an aircraft shall immediately execute an appropriate missed approach whenever prior to touchdown, the requirements of paragraph (d) of this section are not met.

(f) No person operating an aircraft using a Category III approach without decision height may land that aircraft except in accordance with the provisions of the letter of authroization issued by the Administrator.

(g) Paragraphs (a) through (f) of this section do not apply to operations conducted by the holders of certificates issued under Parts 121, 125, 129, or 135 of this chapter. No person may operate a civil aircraft in a Category II or Category III operation conducted by the holder of a certificate issued under Parts 121, 125, 129, or 135 of this chapter unless the operation is conducted in accordance with that certificate holder's operations specifications.

91.191 CATEGORY II MANUAL

(a) No person may operate a civil aircraft of United States registry in a Category II operation unless—
   (1) There is available in the aircraft a current, approved Category II manual for that aircraft;
   (2) The operation is conducted in accordance with the procedures, instructions, and limitations in that manual; and
   (3) The instruments and equipment listed in the manual that are required for a particular Category II operation have been inspected and maintained in accordance with the maintenance program contained in that manual.

(b) Each operator shall keep a current copy of the approved manual at its principal base of operations and shall make it available for inspection upon request of the Administrator.

(c) This section does not apply to operations conducted by the holder of a certificate issued under Part 121 of this chapter.

(Approved by the Office of Management and Budget under OMB control number 2120-0005)

91.193 CERTIFICATE OF AUTHORIZATION FOR CERTAIN CATEGORY II OPERATIONS

The Administrator may issue a certificate of authorization authorizing deviations from the requirements of §§91.189, 91.191, and 91.205(f) for the operation of small aircraft identified as Category A aircraft in §97.3 of this chapter in Category II operations if the Administrator finds that the proposed operation can be safely conducted under the terms of the certificate. Such authorization does not permit operation of the aircraft carrying persons or property for compensation or hire.

91.195 — 91.199 [RESERVED]

SUBPART C EQUIPMENT, INSTRUMENT, AND CERTIFICATE REQUIREMENTS

91.201 [RESERVED]

91.203 CIVIL AIRCRAFT: CERTIFICATIONS REQUIRED

(a) No person may operate a civil aircraft unless it has within it the following:
  (1) An appropriate and current airworthiness certificate. Each U.S. airworthiness certificate used to comply with this subparagraph (except a special flight permit, a copy of the applicable operations specifications issued under §21.197(c) of this chapter, appropriate sections of the air carrier manual required by parts 121 and 135 of this chapter containing that portion of the operations specifications issued under §21.197(c), or an authorization under §91.611), must have on it the registration number assigned to the aircraft under part 47 of this chapter. However, the airworthiness certificate need not have on it an assigned special identification number before 10 days after that number is first affixed to the aircraft. A revised airworthiness certificate having on it an assigned special identification number, that has been affixed to an aircraft, may only be obtained upon application to an FAA Flight Standards district office.
  (2) An effective U.S. registration certificate issued to its owner or, for operation within the United States, the second duplicate copy (pink) of the Aircraft Registration Application as provided for in §47.13(b), or a registration certificate issued under the laws of a foreign country.

(b) No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

(c) No person may operate an aircraft with a fuel tank installed within the passenger compartment or a baggage compartment unless the installation was accomplished pursuant to part 43 of this chapter, and a copy of FAA Form 337 authorizing that installation is on board the aircraft.

(d) No person may operate a civil airplane (domestic or foreign) into or out of an airport in the United States unless it complies with the fuel venting and exhaust emissions requirements of part 34 of this chapter.

91.205 POWERED CIVIL AIRCRAFT WITH STANDARD CATEGORY U.S. AIRWORTHINESS CERTIFICATES: INSTRUMENT AND EQUIPMENT REQUIREMENTS

(a) *General.* No person may operate a powered civil aircraft with a standard category U.S. airworthiness certificate in any operation described in paragraphs (b) through (f) of this section unless that aircraft contains the instruments and equipment specified in those paragraphs (or FAA approved eqivalents) for that type of operation, and those instruments and equipment are in operable condition.

(b) *Visual Flight Rules (day).* For VFR flight during the day, the following instruments and equipment are required:
  (1) Airspeed indicator.
  (2) Altimeter.
  (3) Magnetic direction indicator.
  (4) Tachometer for each engine.
  (5) Oil pressure gauge for each engine.
  (7) Oil temperature gauge for each air-cooled engine.
  (9) Fuel gauge indicating the quantity of fuel in each tank.
  (10) Landing gear position indicator, if the aircraft has a retractable landing gear.
  (11) If the aircraft is operated for hire over water and beyond power-off gliding distance from shore, approved flotation gear readily available to each occupant, and at least one pyrotechnic signaling device. As used in this section, "shore" means that area of the land adjacent to the water which is above the high water mark and excludes land areas which are intermittently under water.
  (12) Except as to airships, an approved safety belt with an approved metal-to-metal latching device for each occupant 2 years of age or older.
  (13) For small civil airplanes manufactured after July 18, 1978, an approved shoulder harness for each front seat. The shoulder harness must be designed to protect the occupant from serious head injury when the occupant experiences the ultimate in-

ertia forces specified in §23.561(b)(2) of this chapter. Each shoulder harness installed at a flight crewmember station must permit the crewmember, when seated and with the safety belt and shoulder harness fastened, to perform all functions necessary for flight operations. For purposes of this paragraph-

(i) The date of manufacture of an airplane is the date the inspection acceptance records reflect that the airplane is complete and meets the FAA-approved type design data; and

(ii) A front seat is a seat located at a flight crewmember station or any seat located alongside such a seat.

(14) An emergency locator transmitter, if required by §91.207.

(15) For normal, utility, and acrobatic category airplanes with a seating configuration, excluding pilot seats, of 9 or less, manufactured after December 12, 1896, a shoulder harness for-

(i) Each fron seat that meets the requirements of §23.785(g) and (h) of this chapter in effect on December 12, 1985;

(ii) Each additional seat that meets the requirements of §23.785(g) of this chapter in effect on December 12, 1985.

(16) For rotorcraft manufactured after Setember 16, 1992, a shoulder harness for each seat that meets the requirements of §27.2 or §29.2 of this chapter in effect on September 16, 1991.

(c) *Visual Flight Rules (night).* For VFR flight at night, the following instruments and equipment are required:

(1) Instruments and equipment specified in paragraph (b) of this section.

(2) Approved position lights.

(3) An approved aviation red or aviation white anticollision light system on all U.S. registered civil aircraft. Anticollison light systems initially installed after August 11, 1971, on aircraft for which a type certificate was issued or applied for before August 11, 1971, must at least meet the anticollision light standards of part 23, 25, 27, or 29, as applicable, that were in effect on August 10, 1971, except that the color may be either aviation red or aviation white. In event of failure of any light of the anticollision light system, operations may be continued to a stop where repairs or replacement can be made.

(4) If the aircraft is operated for hire, one electric landing light.

(5) An adequate source of electrical energy for all installed electrical and radio equipment.

(6) One spare set of fuses, or three spare fuses of each kind required, that are accessible to the pilot in flight.

(d) *Instrument Flight Rules.* For IFR flight, the following instruments and equipment are required:

(1) Instruments and equipment specified in paragraph (b) of this section, and, for night flight, instruments and equipment specified in paragraph (c) of this section.

(2) Two-way radio communications system and navigational equipment appropriate to the ground facilities to be used.

(3) Gyroscopic rate-of-turn indicator, except on the following aircraft:

(i) Airplanes with a third attitude instrument system usable through flight attitudes of 360° of pitch and roll and installed in accordance with the instrument requirements prescribed in §91.305(j) of this chapter; and

(ii) Rotorcraft with a third attitude instrument system usable through flight attitudes of ±80° of pitch and ±120° of roll and installed in accordance with §29.1303(g) of this chapter.

(4) Slip-skid indicator.

(5) Sensitive altimeter adjustable for barometric pressure.

(6) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.

(7) Generator or alternator of adequate capacity.

(8) Gyroscopic pitch and bank indicator (artificial horizon).

(9) Gyroscopic direction indicator (Directional gyro or equivalent).

(e) *Flight at and above 24,000 feet MSL (FL 240).* If VOR navigation equipment is required under paragraph (d)(2) of this section, no person may operate a U.S.-registered civil aircraft within the 50 states and the District of Columbia at or above FL 240 unless that aircraft is equipped with approved distance measuring equipment (DME). When DME required by this paragraph fails at and above FL 240, the pilot in command of the aircraft shall notify ATC immediately, and then may continue operations at and above FL 240 to the next airport of intended landing at which repairs or replacement of the equipment can be made.

(f) *Category II Operations.* For Category II operations the instruments and equipment specified in paragraph (d) of this section and Appendix A to this Part are required. This paragraph does not apply to operations conducted by the holder of a certificate issued under Part 121 of this chapter.

91.207 EMERGENCY LOCATOR TRANSMITTERS

(a) Except as provided in paragraphs (e) and (f) of this section, no person may operate a U.S.-registered civil airplane unless -

(1) There is attached to the airplane an approved automatic type emergency locator transmitter that is in operable condition for the following operations, except that after June 21, 1995, an emergency locator transmitter that meets the requirements of TSO-C91 may not be used for new installations.

(i) Those operations governed by the supplemental air carrier and commercial operator rules of Parts 121 and 125 of this chapter;

(ii) Charter flight governed by the domestic and flag air carrier rules of Part 121 of this chapter; and

(iii) Operations governed by Part 135 of this chapter.

(2) For operations other than those specified in paragraph (a)(1) of this section, there must be attached to the airplane an approved personal type or an approved automatic type emergency locator transmitter that is in operable condition, except after June 21, 1995, an emergency locator transmitter that meets the requirements of TSO-C91 may not be used for new installations.

(b) Each emergency locator transmitter required by paragraph (a) of this section must be attached to the airplane in such a manner that the probability of damage to the transmitter in the event of crash impact is minimized. Fixed and deployable automatic type transmitters must be attached to the airplane as far aft as practicable.

(c) Batteries used in the emergency locator transmitters required by paragraphs (a) and (b) of this section must be replaced (or recharged if the battery is rechargeable)-

(1) When the transmitter has been in use for more than 1 cumulative hour; or

(2) When 50 percent of their useful life (or, for rechargeable batteries, 50 percent of their useful life of charge), has expired as established by the transmitter manufacturer under its approval.

The new expiration date for replacing (or recharging) the battery must be legibly marked on the outside of the transmitter and entered in the aircraft maintenance record. Paragraph (c)(2) of this section does not apply to batteries (such as water-activated batteries) that are essentially unaffected during probable storage intervals.

(d) Each emergency locator required by paragraph (a) of this section must be inspected within 12 calendar months after the last inspection for-

(1) Proper installation;

(2) Battery corrosion;

(3) Operation of the controls and crash sensor; and

(4) The presence of sufficient signal radiated from its antenna.

(e) Notwithstanding paragraph (a) of this section, a person may-

(1) Ferry a newly acquired airplane from the place where possession of it was taken to a place where the emergency locator transmitter is to be installed; and

(2) Ferry an airplane with an inoperative emergency locator transmitter from a place where repairs or replacements cannot be made to a place where thay can be made.

No person other than required crewmembers may be carried aboard an airplane being ferried under paragraph (e) of this section.

(f) Paragraph (a) of this section does not apply to-

(1) Turbojet-powered aircraft.

(2) Aircraft while engaged in scheduled flights by scheduled air carriers;

(3) Aircraft while engaged in training operations conducted entirely within a 50-nautical mile radius of the airport from which such local flight operations began;

(4) Aircraft while engaged in flight operations incident to design and testing;

(5) New aircraft while engaged in flight operations incident to their manufacture, preparation, and delivery;

(6) Aircraft while engaged in flight operations incident to aerial application of chemicals and other substances for agricultural purposes;

(7) Aircraft certificated by the Administrator

for research and development purposes;

(8) Aircraft while used for showing compliance with regulations, crew training, exhibition, air racing, or market surveys;

(9) Aircraft equipped to carry not more than one person; and

(10) An aircraft during any period for which the transmitter has been temporarily removed for inspection, repair, modification, or replacement, subject to the following:

  (i) No person may operate the aircraft unless the aircraft records contain an entry which includes the date of initial removal, the make, model, and serial number, and reason for removing the transmitter, and a placard located in view of the pilot to show "ELT not installed."

  (ii) No person may operate the aircraft more than 90 days after the ELT is initially removed from the aircraft.

91.209 AIRCRAFT LIGHTS

No person may, during the period sunset to sunrise (or, in Alaska, during the period a prominent unlighted object cannot be seen from a distance of 3 statute miles or the sun is more than 6° below the horizon)-

(a) Operate an aircraft unless it has lighted position lights;

(b) Park or move an aircraft in, or in dangerous proximity to, a night flight operations area of an airport unless the aircraft-

  (1) Is clearly illuminated;

  (2) Has lighted position lights; or

  (3) Is in an area which is marked by obstruction lights.

(c) Anchor an aircraft unless the aircraft-

  (1) Has lighted position lights; or

  (2) Is in an area where anchor lights are not required on vessels; or

(d) Operate an aircraft, required by §91.205(c)(3) to be equipped with an anticollision light system unless it has approved and lighted aviation red or aviation white anticollision lights. However, the anticollision light system need not be lighted when the pilot in command determines that because of operating conditions, it would be in the interest of safety to turn the lights off.

91.211 SUPPLEMENTAL OXYGEN

(a) *General.* No person may operate a civil aircraft or U.S. registry-

  (1) At cabin pressure altitudes above 12,500 feet (MSL) up to and including 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration;

  (2) At cabin altitudes above 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen during the entire flight time at those altitudes; and

  (3) At cabin pressure altitudes above 15,000 feet (MSL) unless each occupant of the aircraft is provided with supplemental oxygen.

(b) *Pressurized cabin aircraft.*

  (1) No person may operate a civil aircraft of U.S. registry with a pressurized cabin-

    (i) At flight altitudes above flight level 250 unless at least a 10-minute supply of supplemental oxygen, in addition to any oxygen required to satisfy paragraph (a) of this section, is available for each occupant of the aircraft for use in the event that a descent is necessitated by loss of cabin pressurization; and

    (ii) At flight altitudes above flight level 350 unless one pilot at the controls of the airplane is wearing and using an oxygen mask that is secured and sealed and that either supplies oxygen at all times or automatically supplies oxygen whenever the cabin pressure altitude of the airplane exceeds 14,000 feet (MSL), except that the one pilot need not wear and use an oxygen mask while at or below flight level 410 if there are two pilots at the controls and each pilot has a quick-donning type of oxygen mask that can be placed on the face with one hand from the ready position within 5 seconds, supplying oxygen and properly secured and sealed.

  (2) Notwithstanding paragraph (b)(1)(ii) of this section, if for any reason at any time it is necessary for one pilot to leave the controls of the aircraft when operating at flight altitudes above flight level 350, the remaining pilot at the controls shall put on and use an oxygen mask until the other pilot has returned to that crewmember's station.

91.213 INOPERATIVE INSTRUMENTS AND EQUIPMENT

(a) Except as provided in paragraph (d) of this section, no person may takeoff an aircraft with inoperative instruments or equipment installed unless the following conditions are met:
  (1) An approved Minimum Equipment List exists for that aircraft.
  (2) The aircraft has within it a letter of authorization, issued by the FAA Flight Standards district office having jurisdiction over the area in which the operator is located, authorizing operation of the aircraft under the Minimum Equipment List The letter of authorization may be obtained by written request of the airworthiness certificate holder. The Minimum Equipment List and the letter of authorization constitute a supplemental type certificate for the aircraft.
  (3) The approved Minimum Equipment List must-
    (i) Be prepared in accordance with the limitations specified in paragraph (b) of this section; and
    (ii) Provide for the operation of the aircraft with the instruments and equipment in an inoperable condition.
  (4) The aircraft records available to the pilot must include an entry describing the inoperable instruments and equipment.
  (5) The aircraft is operated under all applicable conditions and limitations contained in the Minimum Equipment List and the letter authorizing the use of the list.

(b) The following instruments and equipment may not be included in a Minimum Equipment List:
  (1) Instruments and equipment that are either specifically or otherwise required by the airworthiness requirements under which the aircraft is type certificated and which are essential for safe operations under all operating conditions.
  (2) Instruments and equipment required by an airworthiness directive to be in operable condition unless the airworthiness directive provides otherwise.
  (3) Instruments and equipment required for specific conditions by this part.

(c) A person authorized to use an approved Minimum Equipment List issued for a specific aircraft under Part 121, 125, or 135 of this chapter shall use that Minimum Equipment List in connection with operations conducted with that aircraft under this Part without additional approval requirements.

(d) Except for operations conducted in accordance with paragraphs (a) or (c) of this section, a person may takeoff an aircraft in operations conducted under this Part with inoperative instruments and equipment without an approved Minimum Equipment List provided -
  (1) The flight operation is conducted in a-
    (i) Rotorcraft, nonturbine-powered airplane, glider, or lighter-than-air aircraft for which a Master Minimum Equipment List has not been developed: or
    (ii) Small rotorcraft, nonturbine-powered small airplane, glider, or lighter-than-air aircraft for which a Master Minimum Equipment List has been developed; and
  (2) The inoperative instruments and equipment are not -
    (i) Part of the VFR-day type certification instruments and equipment prescribed in the applicable airworthiness regulations under which the aircraft was type certificated;
    (ii) Indicated as required on the aircraft equipment list or on the Kinds of Operations Eqipment List for the kind of flight operation being conducted;
    (iii) Required by §91.205 or any other rule of this Part for the specific kind of flight operation being conducted; or
    (iv) Required to be operational by an airworthiness directive; and
  (3) The inoperative instruments and equipment are-
    (i) Removed from the aircraft, the cockpit control placarded, and the maintenance recorded in accordance with §43.9 of this chapter; or
    (ii) Deactivated and placarded "Inoperative". If deactivation of the inoperative instrument or equipment involves maintenance, it must be accomplished and recorded in accordance with Part 43 of this chapter; and
  (4) A determination is made by the pilot, who is certificated and appropriately rated under Part 61, or by a person who is certificated and appropriately rated to perform maintenance on the aircraft, that the inoperative instrument or equipment does not constitute a hazard to the aircraft. An aircraft with inoperative instruments or equipment as provided in paragraph (d) of this section is considered to be in a properly altered condition acceptable to the Administrator.

(e) Notwithstanding any other provision of this section, an aircraft with inoperable instruments or equipment may be operated under a special flight permit issued in accordance with §§21.197 and 21.199 of this chapter.

91.215 ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT AND USE

(a) *All airspace: U.S.-registered civil aircraft.* For operations not conducted under Part 121, 127, or 135 of this chapter, ATC transponder equipment installed must meet the performance and environmental requirements of any class of TSO-C74b (Mode A) or any class of TSO-C74c (Mode A with altitude reporting capability) as appropriate, or the appropriate class of TSO-C112 (Mode S).

(b) *All airspace.* No person may operate an aircraft in the airspace described in paragraphs (b)(1) through (b)(5) of this section, unless that aircraft is equipped with an operable coded radar beacon transponder having either Mode 3/A 4096 code capability, replying to Mode 3/A interrogations with the code specified by ATC, or a Mode S capability, replying to Mode 3/A interrogations with the code specified by ATC and intermode and Mode S interrogations in accordance with the applicable provisions of TSO-C112, and that aircraft is equipped with automatic pressure altitude reporting equipment having a Mode C capability that automatically replies to Mode C interrogations by transmitting pressure altitude information in 100 foot increments. This requirement applies-

(1) *All aircraft.* In Class A, Class B, and Class C airspace areas;

(2) *All aircraft.* In all airspace within 30 nautical miles of an airport listed in appendix D, section 1 of this Part from the surface upward to 10,000 feet MSL;

(3) Notwithstanding paragraph (b)(2) of this section, any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certificated with such a system installed, balloon or glider may conduct operations in the airspace within 30 nautical miles of an airport listed in appendix D, section 1 of this Part provided such operations are conducted-

(i) Outside any Class A, Class B, or Class C airspace area; and

(ii) Below the altitude of the ceiling of a Class B or Class C airspace area designated for an airport or 10,000 feet MSL whichever is lower; and

(4) *All aircraft.* In all airspace above the ceiling and within the lateral boundaries of a Class B or Class C airspace area designated for an airport upward to 10,000 feet MSL; and

(5) All aircraft except any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certificated with such a system installed, balloon or glider-

(i) In all airspace of the 48 contiguous states and the District of Columbia at and above 10,000 feet MSL, excluding the airspace at and below 2,500 feet above the surface; and

(ii) In the airspace from the surface to 10,000 feet MSL within a 10 nautical mile radius of any airport listed in Appendix D, section 2 of this Part, excluding the airspace below 1,200 feet outside of the surface area of the airspace designated for that airport.

(c) *Transponder on operation.* While in the airspace as specified in paragraph (b) of this section or in all controlled airspace, each person operating an aircraft equipped with an operable ATC transponder maintained in accordance with §91.413 of this Part shall operate the transponder, including Mode C equipment if installed, and shall reply on the appropriate code or as assigned by ATC.

(d) *ATC authorized deviations.* Requests for ATC authorized deviations must be made to the ATC facility having jurisdiction over the concerned airspace within the time periods specified as follows:

(1) For operation of aircraft with an operating transponder but without operating automatic pressure altitude reporting equipment having a Mode C capability, the request may be made at any time.

(2) For operation of an aircraft with an inoperative transponder to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made or both, the request may be made at any time.

(3) For operation of aircraft that is not equipped with a transponder, the request must be made at least one hour before the proposed operation.

SUBPART D - SPECIAL FLIGHT OPERATIONS

91.303 ACROBATIC FLIGHT

No person may operate an aircraft in acrobatic flight-

(a) Over any congested area of a city, town, or settlement;

(b) Over an open air assembly of persons;

(c) Within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport;

(d) Within 4 nautical miles of the centerline of any Federal airway;

(e) Below an altitude of 1,500 feet above the surface; or

(f) When flight visibility is less than three miles.

For the purposes of this section, acrobatic flight means an intentional maneuver involving an abrupt change in the aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.

91.305 FLIGHT TEST AREAS

No person may flight test an aircraft except over open water, or sparsely populated areas, having light air traffic.

91.307 PARACHUTES AND PARACHUTING

(a) No pilot of a civil aircraft may allow a parachute that is available for emergency use to be carried in that aircraft unless it is an approved type and-

(1) If a chair type (canopy in back), it has been packed by a certificated and appropriately rated parachute rigger within the preceding 120 days; or

(2) If any other type, it has been packed by a certificated and appropriately rated parachute rigger-

(i) Within the preceding 120 days, if its canopy, shrouds, and harness are composed exclusively of nylon, rayon, or other similar synthetic fiber or materials that are substantially resistant to damage from mold, mildew, or other fungi and other rotting agents propogated in a moist environment; or

(ii) Within the preceding 60 days, if any part of the parachute is composed of silk, pongee, or other natural fiber, or materials not specified in paragraph (a)(2)(i) of this section.

(b) Except in an emergency, no pilot in command may allow, and no person may make, a parachute jump from an aircraft within the United States except in accordance with Part 105.

(c) Unless each occupant of the aircraft is wearing an approved parachute, no pilot of a civil aircraft, carrying any person (other than a crewmember) may execute any intentional maneuver that exceeds-

(1) A bank of 60 ° relative to the horizon; or

(2) A nose-up or nose-down attitude of 30° relative to the horizon.

(d) Paragraph (c) of this section does not apply to-

(1) Flight tests for pilot certification or rating; or

(2) Spins and other flight maneuvers required by the regulations for any certificate or rating when given by-

(i) A certificated flight instructor; or

(ii) An airline transport pilot instructing in accordance with §61.169 of this chapter.

(e) For the purposes of this section, "approved parachute" means-

(1) A parachute manufactured under a type certificate or a technical standard order (c-23 series); or

(2) A personnel carrying military parachute identified by an NAF, AAF, or AN drawing number, an AAF order number, or any other military designation or specification number.

91.309 TOWING: GLIDERS

(a) No person may operate a civil aircraft towing a glider unless-

(1) The pilot in command of the towing aircraft is qualified under §61.69 of this chapter.

(2) The towing aircraft is equipped with a tow-hitch of a kind, and installed in a manner, that is approved by the Administrator.

(3) The towline used has a breaking strength not less than 80 percent of the maximum certificated operating weight of the glider and not more than twice this operating weight. However, the towline used may have a breaking strength more than twice the maximum certificated operating weight of the glider if-

(i) A safety link is installed at the point of attachment of the towline to the glider with a breaking strength not less than 80 percent of the maximum certificated operating weight of the glider and not greater than twice this operating weight.

(ii) A safety link is installed at the point of attachment of the towline to the towing aircraft with a breaking strength greater, but not more than 25 percent greater, than that of the safety link at the towed glider end of the towline and not greater than twice the maximum certificated operating weight of the glider.

(4) Before conducting any towing operation within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport, or before making each towing flight within such controlled airspace if required by ATC, the pilot in command notifies the control tower. If a control tower does not exist or is not in operation, the pilot in command must notify the FAA Flight Service station serving that controlled airspace before conducting any towing operations in that airspace; and

(5) The pilots of the towing aircraft and the glider have agreed upon a general course of action, including takeoff and release signals, airspeeds, and emergency procedures for each pilot.

(b) No pilot of a civil aircraft may intentionally release a towline, after release of a glider, in a manner so as to endanger the life or property of another.

91.311 TOWING: OTHER THAN UNDER §91.309

No pilot of a civil aircraft may tow anything with that aircraft (other than under §91.309) except in accordance with the terms of a certificate of waiver issued by the Administrator.

SUBPART E - MAINTENANCE, PREVENTIVE MAINTENANCE, AND ALTERATIONS

91.401 APPLICABILITY

(a) This Subpart prescribes rules governing the maintenance, preventive maintenance, and alteration of U.S.-registered civil aircraft operating within or outside the United States.

(b) Sections 91.405, 91.409, 91.411, 91.417, and 91.419 of this Subpart do not apply to an aircraft maintained in accordance with a continuous airworthiness maintenance program as provided in Parts 121, 127, 129, or 135.411(a)(2) of this chapter.

(c) Sections 91.405 and 91.409 of this Part do not apply to an airplane inspected in accordance with Part 125 of this chapter.

91.403 GENERAL

(a) The owner or operator of an aircraft is primarily responsible for maintaining that aircraft in an airworthy condition, including compliance with Part 39 of this chapter.

(b) No person may perform maintenance, preventive maintenance, or alterations on an aircraft other than as prescribed in this Subpart and other applicable regulations, including Part 43 of this chapter.

(c) No person may operate an aircraft for which a manufacturer's maintenance manual or instructions for continued airworthiness has been issued that contains an airworthiness limitations section unless the mandatory replacement times, inspection intervals and related procedures set forth in an operations specification approved by the Administrator under PArt 121, 127, or 135 of this chapter or in accordance with an inspection program approved under §91.409(e) have been complied with.

91.405 MAINTENANCE REQUIRED

Each owner or operator of an aircraft-

(a) Shall have that aircraft inspected as prescribed in Subpart E of this Part and shall between required inspections, except as provided in paragraph (c) of this section, have discrepancies repaired as prescribed in Part 43 of this chapter;

(b) Shall ensure that maintenance personnel make appropriate entries in the aircraft maintenance records indicating the aircraft has been approved for return to service;

(c) Shall have any inoperative instruments or item of equipment, permitted to be inoperative by §91.213(d)(2) of this Part, repaired, replaced, removed, or inspected at the next required inspection; and

(d) When listed discrepancies include inoperative instruments or equipment, shall ensure that a placard has been installed as required by §43.11 of this chapter.

91.407 OPERATION AFTER MAINTENANCE, PREVENTIVE MAINTENANCE, REBUILDING, OR ALTERATION

(a) No person may operate any aircraft that has undergone maintenance, preventive maintenance, rebuilding, or alteration unless-

  (1) It has been approved for return to service by a person authorized under §43.7 of this chapter; and

  (2) The maintenance record entry required by §43.9 or §43.11, as applicable, of this chapter has been made.

(b) No person may carry any person (other than crewmembers) in an aircraft that has been maintained, rebuilt, or altered in a manner that may have appreciably changed its flight characteristics or substantially affected its operation in flight until an appropriately rated pilot with at least a private pilot certificate flies the aircraft, makes an operational check of the maintenance performed or alteration made, and logs the flight in the aircraft records.

(c) The aircraft does not have to be flown as required by paragraph (b) of this section if, prior to flight, ground tests, inspections, or both show conclusively that the maintenance, preventive maintenance, rebuilding, or alteration has not appreciably changed the flight characteristics or substantially affected the flight operation of the aircraft.

(Approved by the Office of Management and Budget under OMB control number 2120-0005)

91.409 INSPECTIONS

(a) Except as provided in paragraph (c) of this section, no person may operate an aircraft unless, within the preceding 12 calendar months, it has had-

  (1) An annual inspection in accordance with Part 43 of this chapter and has been approved for return to service by a person authorized by §43.7 of this chapter; or

  (2) An inspection for the issue of an airworthiness certificate in accordance with Part 21 of this chapter.

No inspection performed under paragraph (b) of this section may be substituted for any inspection required by this paragraph unless it is performed by a person authorized to perform annual inspections, and it is entered as an "annual" inspection in the required maintenance records.

(b) Except as provided in paragraph (c) of this section, no person may operate an aircraft carrying any person (other than a crewmember) for hire, and no person may give flight instructions for hire in an aircraft which that person provides, unless within the preceding 100 hours of time in service it has received an annual or 100 hour inspection and been approved for return to service in accordance with Part 43 of this chapter. The 100 hour limitation may be exceeded by not more than 10 hours if necessary to reach a place at which the inspection can be done. The excess time used to reach a place where the inspection can be done must be included in computing the next 100 hours of time in service.

(c) Paragraphs (a) and (b) of this section do not apply to-

  (1) An aircraft that carries a special flight permit, a current experimental certificate, or a provisional airworthiness certificate;

  (2) An aircraft inspected in accordance with an approved aircraft inspection program under Part 125, 127, or 135 of this chapter and so identified by the registration number in the operations specifications of the certificate holder having the approved inspection program;

  (3) An aircraft subject to the requirements of paragraph (d) or (e) of this section; or

  (4) Turbine-powered rotorcraft when the operator elects to inspect that rotorcraft in accordance with paragraph (e) of this section.

(d) *Progressive Inspection.* Each registered owner or operator of an aircraft desiring to use a progressive inspection program must submit a written request to the FAA Flight Standards district office having jurisdiction over the area in which the applicant is located, and shall provide-

(1) A certificated mechanic holding an inspection authorization, a certificated airframe repair station, or the manufacturer of the aircraft to supervise or conduct the progressive inspection;

(2) A current inspections procedures manual available and readily understandable to pilot and maintenance personnel containing, in detail-

(i) An explanation of the progressive inspection, including the continuity of inspection responsibility, the making of reports, and the keeping of records and technical reference material;

(ii) An inspection schedule, specifying the intervals in hours or days when routine and detailed inspections will be performed and including instructions for exceeding an inspection interval by not more than 10 hours while en route and for changing an inspection interval because of service experience;

(iii) Sample routine and detailed inspection forms and instructions for their use; and

(iv) Sample reports and records and instructions for their use;

(3) Enough housing and equipment for necessary dissassembly and proper inspection of the aircraft; and

(4) Appropriate current technical information for the aircraft.

The frequency and detail of the progressive inspection shall provide for the complete inspection of the aircraft within each 12 calendar months and be consistent with the manufacturer's recommendations, field service experience, and the kind of operation in which the aircraft is engaged. The progressive inspection schedule must ensure that the aircraft, at all times, will be airworthy and will conform to all applicable FAA aircraft specifications, type certificate data sheets, airworthiness directives, and other approved data. If the progressive inspection program is discontinued, the owner or operator shall immediately notify the FAA Flight Standards district office, in writing, of the discontinuance. After the discontinuance, the first annual inspection under §91.409(a)(1) is due within 12 calendar months after the last complete inspection of the aircraft under the progressive inspection. The 100-hour inspection under §91.409(b) is due with 100 hours after that complete inspection. A complete inspection of the aircraft, for the purpose of determining when the annual and 100-hour inspections are due, requires a detailed inspection of the aircraft and all its components in accordance with the progressive inspection. A routine inspection of the aircraft and a detailed inspection of several components is not considered to be a complete inspection.

(e) *Large airplanes (to which Part 125 is not applicable), turbojet multiengine airplanes, turbopropeller-powered multiengine airplanes, and turbine-powered rotorcraft.* No person may operate a large airplane, a turbojet multiengine airplane, a turbopropeller-powered multiengine airplane, or a turbine-powered rotorcraft unless the replacement times for life-limited parts specified in the aircraft specifications, type data sheets, or other documents approved by the Administrator are complied with and the airplane or turbine-powered rotorcraft, including the airframe, engines, propellers, rotors, appliances, survival equipment, and emergency equipment, is inspected in accordance with an inspection program selected under paragraph (f) of this section, except that, the owner or operator of a turbine-powered rotorcraft may elect to use the inspection provisions of §91.409(a), (b), (c), or (d) in lieu of an inspection option of §91.409(f).

(f) *Selection of inspection program under paragraph (e) of this section.* The registered owner or operator of each airplane or turbine-powered rotorcraft described in paragraph (e) of this section must select, identify the aircraft maintenance records, and use one of the following programs for the inspection of the aircraft:

(1) A continuous airworthiness inspection program that is part of a continuous airworthiness maintenance program currently in use by a person holding an air carrier operating certificate or an operating certificate issued under Part 121, 127, or 135 of this chapter and operating that make and model aircraft under Part 121 of this chapter or operating that make and model

under Part 135 of this chapter and maintaining it under §135.411(a)(2) of this chapter.

(2) An approved aircraft inspection program approved under §135.419 of this chapter and currently in use by a person holding an operating certificate issued under Part 135 of this chapter.

(3) A current inspection program recommended by the manufacturer.

(4) Any other inspection program established by the registered owner or operator of that airplane or turbine-powered rotorcraft and approved by the Administrator under paragraph (g) of this section. However, the Administrator may require revision to this inspection program in accordance with the provisions of §91.415.

Each operator shall include in the selected program the name and address of the person responsible for scheduling the inspections required by the program and make a copy of that program available to the person performing inspections on the aircraft and, upon request, to the Administrator.

(g) *Inspection program approved under paragraph (e) of this section.* Each operator of an airplane or turbine-powered rotorcraft desiring to establish or change an approved inspection program under paragraph (f)(4) of this section must submit the program for approval to the local FAA Flight Standards district office having jurisdiction over the area in which the aircraft is based. The program must be in writing and include at least the following information:

(1) Instructions and procedures for the conduct of inspections for the particular make and model airplane or turbine-powered rotorcraft, including necessary tests and checks. The instructions and procedures must set forth in detail the parts and areas of the airframe, engines, propellers, rotors, and appliances, including survival and emergency equipment required to be inspected.

(2) A schedule for performing the inspections that must be performed under the program expressed in terms of time in service, calendar time, number of system operations, or any combination of these.

(h) *Changes from one inspection program to another.* When an operator changes from one inspection program under paragraph (f) of this section to another, the time in service, calendar times, or cycles of operation accumulated under the previous program must be applied in determining inspection due times under the new program.

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91.411 ALTIMETER SYSTEM AND ALTITUDE REPORTING EQUIPMENT TESTS AND INSPECTIONS

(a) No person may operate an airplane, or helicopter, in controlled airspace under IFR unless-

(1) Within the preceding 24 calendar months, each static pressure system, each altimeter instrument, and each automatic pressure altitude reporting system has been tested and inspected and found to comply with Appendix E of Part 43 of this chapter;

(2) Except for the use of system drain and alternate static pressure valves, following any opening and closing of the static pressure system, that system has been tested and inspected and found to comply with paragraph (a), Appendices E and F, of Part 43 of this chapter; and

(3) Following installation or maintenance on the automatic pressure altitude reporting system of the ATC transponder where data correspondence error could be introduced, the integrated system has been tested, inspected, and found to comply with paragraph (c), Appendix E, of Part 43 of this chapter.

(b) The tests required by paragraph (a) of this section must be conducted by-

(1) The manufacturer of the airplane, or helicopter, on which the tests and inspections are to be performed;

(2) A certificated repair station properly equipped to perform those functions and holding-

(i) An instrument rating, Class I;

(ii) A limited instrument rating appropriate to the make and model of appliance to be tested;

(iii) A limited rating appropriate to the test to be performed;

(iv) An airframe rating appropriate to the airplane, or helicopter, to be tested; or

(v) A limited rating for a manufacturer issued for the appliance in accordance with §145.101(b)(4) of this chapter; or

- (3) A certificated mechanic with an airframe rating (static pressure system tests and inspections only).
- (c) Altimeter and altitude reporting equipment approved under Technical Standard Orders are considered to be tested and inspected as of the date of their manufacture.
- (d) No person may operate an airplane, or helicopter, in controlled airspace under IFR at an altitude above the maximum altitude at which all altimeters and the automatic altitude reporting system of that airplane, or helicopter, have been tested.

91.413 ATC TRANSPONDER TESTS AND INSPECTIONS

- (a) No person may use an ATC transponder specified in §91.215(a), §121.345(c), §127.123(b) or §135.143(c) of this chapter unless, within the preceding 24 calendar months, that ATC transponder has been tested and inspected and found to comply with Appendix F of Part 43 of this chapter; and
- (b) Following any installation or maintenance on an ATC transponder where data correspondence error could be introduced, the integrated system has been tested, inspected, and found to comply with paragraph (c), Appendix E of Part 43 of this chapter.
- (c) The tests and inspections specified in this section must be conducted by-
  - (1) A certificate repair station properly equipped to perform those functions and holding-
    - (i) A radio rating, Class III;
    - (ii) A limited radio rating appropriate to the make and model transponder to be tested;
    - (iii) A limited rating appropriate to the test to be performed;
    - (iv) A limited rating for a manufacturer issued for the transponder in accordance with §145.101(b)(4) of this chapter; or
  - (2) A holder of a continuous airworthiness maintenance program as provided in Part 121, 127, or §135.411(a)(2) of this chapter; or
  - (3) The manufacturer of the aircraft on which the transponder to be tested is installed, if the transponder was installed by that manufacturer.

91.415 CHANGES TO AIRCRAFT INSPECTION PROGRAMS

- (a) Whenever the Administrator finds that revisions to an approved aircraft inspection program under §91.409(f)(4) are necessary for the continued adequacy of the program, the owner or operator shall, after notification by the Administrator, make any change in the program found to be necessary by the Administrator.
- (b) The owner or operator may petition the Administrator to reconsider the notice to make any changes in a program in accordance with paragraph (a) of this section.
- (c) The petition must be filed with the FAA Flight Standards district office which requested the change to the program within 30 days after the certificate holder receives the notice.
- (d) Except in the case of an emergency requiring immediate action in the interest of safety, the filing of the petition stays the notice pending a decision by the Administrator.

91.417 MAINTENANCE RECORDS

- (a) Except for work performed in accordance with §§91.411 and 91.413, each registered owner or operator shall keep the following records for the periods specified in paragraph (b) of this section:
  - (1) Records of the maintenance, preventive maintenance, and alteration, and records of the 100 hour, annual, progressive, and other required or approved inspections, as appropriate, for each aircraft (including the airframe) and each engine, propeller, rotor, and appliance of an aircraft. The records must include -
    - (i) A description of the work performed;
    - (ii) The date of completion of the work performed; and
    - (iii) The signature and certificate number of the person approving the aircraft for return to service.
  - (2) Records containing the following information:
    - (i) The total time in service of the airframe, each engine, each propeller, and each rotor.
    - (ii) The current status of life limited parts of each airframe, engine, propeller, rotor, and appliance.
    - (iii) The time since last overhaul of all items installed on the aircraft which

are required to be overhauled on a specified time basis.

(iv) The current inspection status of the aircraft, including the time since the last inspection required by the inspection program under which the aircraft and its appliances are maintained.

(v) The current status of applicable airworthiness directives (AD) including, for each, the method of compliance, the AD number, and revision date. If the AD involves recurring action, the time and date when the next action is required.

(vi) Copies of the form prescribed by §43.9(a) of this chapter for each major alteration to the airframe and currently installed engines, rotors, propellers, and appliances.

(b) The owner or operator shall retain the following records for the periods prescribed:

(1) The records specified in paragraph (a)(1) of this section shall be retained until the work is repeated or superceded by other work or for 1 year after the work is performed.

(2) The records specified in paragraph (a)(2) of this section shall be retained and transferred with the aircraft at the time the aircraft is sold.

(3) A list of defects furnished to a registered owner or operator under §43.11 of this chapter shall be retained until the defects are repaired and the aircraft is approved for return to service.

(c) The owner or operator shall make all maintenance records required to be kept by this section available for inspection by the Administrator or any authorized representative of the National Transportation Safety Board (NTSB). In addition, the owner or operator shall present Form 337 described in paragraph (d) of this section for inspection upon request of any law enforcement officer.

(d) When a fuel tank is installed within the passenger compartment or a baggage compartment pursuant to Part 43 of this chapter, a copy of FAA Form 337 shall be kept on board the modified aircraft by the owner or operator.

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91.419 TRANSFER OF MAINTENANCE RECORDS

Any owner or operator who sells a U.S.-registered aircraft shall tranfer to the purchaser, at the time of sale, the following records of that aircraft, in plain language form or in coded form at the election of the purchaser, if the coded form provides for the preservation and retrieval of information in a manner acceptable to the Administrator.

(a) The records specified in §91.417(a)(2).

(b) The records specified in §91.417(a)(1) which are not included in the records covered by paragraph (a) of this section, except that the purchaser may permit the seller to keep physical custody of such records. However, cutody of records by the seller does not relieve the purchaser of the responsibility under §91.417(c), to make the records available for inspection by the Administrator or any authorized representative of the National Transportation Safety Board (NTSB).

91.421 REBUILT ENGINE MAINTENANCE RECORDS

(a) The owner or operator may use a new maintenance record, without previous operating history, for an aircraft engine rebuilt by the manufacturer or by an agency approved by the manufacturer.

(b) Each manufacturer or agency that grants zero time to an engine rebuilt by it shall enter in the new record-

(1) A signed statement of the date the engine was rebuilt;

(2) Each change made as required by airworthiness directives; and

(3) Each change made in compliance with manufacturer's service bulletins, if the entry is specifically requested in that bulletin.

(c) For the purpose of this section, a rebuilt engine is a used engine that has been completely dissassembled, inspected, repaired as necessary, reassembled, tested, and approved in the same manner and to the same tolerances and limits as a new engine with either new or used parts. However, all parts used in it must conform to the production drawing tolerances and limits for new parts or be of approved oversize or undersize dimensions for a new engine.

91.423 - 91.499 [Reserved]

AMERICAN FLYERS

APPENDIX D

SAFETY PROCEDURES

Safety is the prime consideration at American Flyers. Safety must never be derogated for expediency, convenience or any other reason. While equipment is expensive, life and limb are even more dear and more difficult, if not impossible to replace. Recognizing that accidents do not just happen, but are made to happen, the following procedures and practices have been developed as guide lines. Prudence, caution and a sound understanding of individual and equipment capabilities and limitations are the real basis of an accident free program.

To insure the safest possible environment, all American Flyers employees and students will adhere to these procedures and practices. Violations will not be tolerated.

FLIGHT DISPATCHING

All training flights will be dispatched as follows:

Dual instructional flights

The instructor assigned as pilot in command will insure that all dispatch requirements of this section are met.

Solo flights

An instructor present at the airport at the time of dispatch will review the student's preparation and qualifications for the planned flight. The instructor will assist the student in completing a solo flight plan form and when satisfied that all dispatch requirements of this section are met, and the student is prepared and qualified to complete the flight safely, sign the solo flight plan form. Operations personnel will issue the dispatch log to students only upon receipt of a completed and signed solo flight plan form.

DISPATCH LOG

The dispatch log consists of a three ring binder containing forms for recording or verifying:

1. The pilot's name, the beginning and ending recording tachometer readings, the beginning and ending hobbs meter readings, the amount of fuel, and the amount of oil added, either before or after the flight;
2. The current inspection status of the airplane to aid the pilot in determining whether or not the airplane is in condition for safe flight;
3. The VOR test required under FAR §91.171 for operations under IFR;
4. Any discrepancies affecting the airplane; and
5. The procedures to be followed in the event of an unprogrammed landing during the training flight.

WEATHER MINIMUMS

Dual instrument instructional flights may be dispatched in instrument meteorological conditions under the following circumstances:

1. The instructor has been cleared by the chief flight instructor to instruct in instrument conditions in the aircraft involved, and
2. All required flight instruments, navigation, and communications equipment, including transponder if installed, are known to be functional, and

3. A suitable alternate airport that meets the requirements of FAR Part §91.169 is available and filed with ATC, and

4. There are no known icing conditions, thunderstorms or other other hazards to flight in the area of the contemplated flight.

Dual instructional flights which require visual meteorological conditions may be dispatched under the following conditions:

1. The weather at the time of takeoff, and the forecast for the estimated time of return plus 1 hour meet basic VFR minimums.

2. In the event that the weather at the base of operations does not meet basic VFR criteria,and it is known that visual meteorological conditions exist in the practice area that can be reached with a short range IFR clearance, dual instructional flights may be dispatched under the following conditions:

    a. The instructor has been cleared by the chief flight instructor to instruct in instrument conditions in the aircraft involved, and

    b. All required flight instruments, communications and navigation equipment, including transponder if installed, are known to be functional, and

    c. A suitable alternate airport that meets the requirements of FAR Part §91.169 is available and filed with ATC, and

    d. There are no known icing conditions, thunderstorms or other hazards to flight in the area of the contemplated flight.

VFR solo practice flights may be dispatched only if the weather at the departure airport, enroute, and in the practice area(s) is at least equal to or better than basic VFR minimum, and forecast to remain so for the duration of the contemplated flight plus 1 hour.

Solo practice flights will not be dispatched, regardless of the weather conditions at the base of operations, if known hazardous weather conditions such as icing, thunderstorms, high winds, etc. exist within the area of the contemplated flight.

Students may be dispatched on solo cross country flights under IFR provided:

1. The student possesses a valid and current instrument rating- airplane and has either

    a. completed instrument training, including flight test with American Flyers or

    b. has accomplished an instrument competency check conducted by the chief flight instructor or his designated assistant.

2. All required flight instruments, communications and navigation equipment, including transponder if installed, are operational.

3. The weather forecasts available at the time of dispatch indicate that the ceiling and visibility at all airports of intended landing will be, from the time of takeoff until completion of the intended flight plus 1 hour, at least 500 feet above the lowest authorized decision height or minimum descent altitude and 1/2 statute mile greater than the lowest authorized landing minimum respectively.

4. Suitable alternate airports that meet the requirements of FAR Part 91.169 are available for each destination and filed with ATC.

5. There are no known or forecast icing conditions, thunderstorms or other hazards to flight in the area of the contemplated flight.

Once a flight is dispatched the final go/no go decision shall rest with the pilot in command.

LIMITING WIND CONDITIONS

The limiting crosswind component for takeoff and landing will be the maximum demonstrated crosswind component specified for the aircraft involved or, in the case of a solo flight, the value indicated by instructor endorsement in the student's training record.

American Flyers aircraft shall not be taxied or towed in winds or wind gusts greater than 30 knots unless wing walkers are used or other suitable precautions are taken.

AIRCRAFT - CHECKLISTS AND EQUIPMENT

Each aircraft provided by American Flyers has a checklist that covers all phases of ground and flight operations, day or night, VFR and IFR, and all commonly anticipated emergencies. Both flight instructors and students are expected to be familiar with the checklists for the aircraft they are flying, and adhere to them.

Students, while flying their own aircraft in an American Flyers training program, must furnish a checklist suitable to the aircraft, and acceptable to the school. All such aircraft will be equipped with dual controls.

PROPELLER DANGER AREAS

Any area within 6 feet of a propeller arc should be considered a hazardous area whether the engine is running or static. Inspection of the propeller, propeller hub, nose section, etc., should be made visually. If it is considered necessary for any reason to touch the propeller it should be handled at all times as though the engine were going to start at any time. Walking through or putting any part of the body into the propeller arc is extremely hazardous and must be avoided.

STARTING OF AIRCRAFT

The starting of all American Flyers aircraft shall be in accordance with the appropriate checklists and established procedures, and the following general precautions:

1. On the preflight walk around ascertain that the propeller area and the taxi area are clear of all loose objects and debris such as chocks, towbars, etc. If necessary, reposition the aircraft so that a brake failure on start will not cause the aircraft to roll into an area where collision damage could occur. If necessary, reposition the aircraft to prevent hazards to persons or property behind the aircraft after engine start.

2. Before engaging the starter apply and hold the brakes. Visually and orally clear the propeller danger area before starting.

3. Engine speed should not be allowed to go above 1,100 RPM on start in order to minimize wear and tear, (unless the aircraft flight manual states otherwise). If oil pressure has not

started upward within 30 seconds after start, shut down the engine.

4. At no time will any student enter or exit an aircraft while the engine is running.

5. Under no circumstances will an aircraft be started by hand propping. Use auxiliary power or jumper cables.

TAXIING

The American Flyers hangar and ramp areas are confined and often congested. A great deal of caution is required while maneuvering in these areas. The pilot in command is solely responsible for the safety of the aircraft from the time he enters it for flight, until it is shutdown and secured. While ramp personnel and others may assist a taxiing aircraft in close quarters, the responsibility remains with the pilot in command. If in doubt, STOP! When taxiing in the ramp areas, or other confined areas, taxi speed shall be no faster than a brisk walk.

Yellow lines may be painted on taxiways and in the ramp areas. While these lines are not infallible, taxiing with the nose wheel on the yellow line will clear the aircraft of all normal obstacles. Departure from the yellow line should be done only to avoid obstacles or to clear other aircraft or vehicles.

Use extreme caution when taxiing behind large (over 12,500 lbs) propeller driven aircraft and jets. Breakaway taxi thrust engine exhaust velocities can be expected to be as high as 45 MPH within 350 feet behind a large jet. When taxiing behind a large aircraft or jet is unavoidable, maintain at least a 500 foot separation, and exercise extreme caution. Remain alert for any unexpected increases in jet thrust. Under no circumstances are American Flyers' aircraft to be taxied into or out of hangars.

AIRCRAFT FIRES

The subject of aircraft engine and cabin fires is a part of every individuals checkout in the aircraft. Follow the procedures outlined in the checklist and take action as dictated by the situation and good judgement.

In the event of a fire on the ground, attempt to call for assistance on any radio frequency available, and evacuate the aircraft immediately upon determining that the fire is uncontrollable.

In the event of an uncontrollable fire in flight, land as soon as possible. After landing contact the school office as soon as possible by any means available.

In the event of a controllable fire in flight, land at the nearest suitable airport. Do not attempt to restart an engine that has had a fire unless an extreme emergency dictates otherwise. After landing contact the school office for instructions.

FIRE AND FIRE DRILL PROCEDURES

The following procedure shall be followed for both an actual fire and for fire drills except that the fire department shall not be notified in the case of a fire drill.

1. Office Staff - Turn in a fire alarm to the local fire department, by telephone or by any other means available. Specify the location and type of fire. After the alarm has been turned in, supervise the evacuation and securing of the building.

2. Instructors - Assist in the evacuation of the students. Assist in securing the building by turning off lights and electrical equipment and appliances, and closing all doors and windows as the building is evacuated. If feasible, fight the fire until arrival of the fire department, then evacuate the building to the American Flyers parking lot for accounting.

3. Students - Evacuate the building as expeditiously and orderly as possible by the nearest exit, or as directed by the school staff. Proceed to the American Flyers parking lot for accounting.

REDISPATCH PROCEDURES

In the event that dual instructional flights find it necessary to make unprogrammed landings at other airports due to weather, traffic delays, refueling, etc., it shall be the responsibility of the flight instructor to redispatch his flight in accordance with established company policies and rules for dispatch. Excessive delays should be reported to the company offices by collect telephone call to preclude activation of missing aircraft procedures.

Unprogrammed landings for maintenance, other than refueling, shall be reported to the school office, by telephone, as soon as possible. Redispatch after maintenance or repair work shall be the responsibility of the school dispatcher. No flight will be redispatched after maintenance without consultation with the school maintenance representative.

Unprogrammed landings on airports by solo pilots, for whatever reason, shall be reported to the school office by telephone. Redispatch of solo flights shall be accomplished by an instructor employed by American Flyers who has communicated directly, either in person, by telephone, or by radio, with the student assigned as pilot in command of the flight.

Unprogrammed landings off airports shall be reported to the school office as soon as possible by any means available. Takeoff from unprepared surfaces will not be attempted without clearance from a company official.

AIRCRAFT DISCREPANCIES

Forms for reporting discrepancies (squawks) are available to instructors and students at the operations counter. Solo students will receive assistance in completing a squawk form from operations personnel. Pilots complete the squawk sheet in duplicate, placing one copy in the dispatch log, and the other in the tray at the operations counter.

The color of the squawk sheet indicates the nature of the discrepancy as indicated below:

Color	Meaning
Green	Cosmetic discrepancy not affecting airworthiness
Yellow	Discrepancy imposes an operational limitation
Red	Discrepancy grounds the airplane

FAR Part 91.213(d) permits the operation of an airplane with inoperative instruments or equipment when:

1. The instrument or equipment is not required by the type certificate, regulation, or airworthiness directive;
2. The instrument or equipment is removed or deactivated and placarded "INOPERATIVE"; and
3. A qualified pilot or mechanic deter-

mines that the inoperative instrument or equipment is not a hazard.

If the above applies, an appropriately rated pilot or mechanic may placard the instrument or equipment as "INOPERATIVE" and should indicate on the squawk sheet that this has been accomplished. Except as provided by Deviation Authority, Waiver, or Exemption granted American Flyers by the Administrator, if the item of inoperative equipment is removed, a maintenance record entry and revision of the equipment list and weight and balance is required. Associated equipment rendered inoperative will also be placarded "INOPERATIVE".

Any squawk that cannot be verified on the ground, is intermittent, or a one-time indication or occurrence should include a request for verification by either an appropriately rated pilot or an American Flyers mechanic. The condition will be checked on the next flight. If the squawk is confirmed, it will be handled as described in this section. If the condition is verified as non-existent, the squawk sheet will be removed from the dispatch log and no further action is required.

When maintenance is required to correct a discrepancy, an appropriate entry in the airplane maintenance records as required by FAR Part 43 will be made. The original copy of the squawk sheet is then removed from the dispatch log.

Discrepancies may not be deferred except as provided by FAR §91.213(d). When this is done the mechanic will state this on the squawk sheet along with his signature, A&P number and date. He will also placard the inoperative equipment. This squawk will stay in the dispatch log until the discrepancy is corrected. If a discrepancy which may be deferred under the provisions of FAR §91.213(d) is found during scheduled maintenance or inspection and can not be corrected at the time, the mechanic will placard the inoperative equipment, complete a squawk sheet as previously described, and file the squawk in the dispatch log to inform instructors, students, and operations personnel of the discrepancy.

SECURING OF AIRCRAFT

It is the sole responsibility of the pilot in command to assure that the aircraft is properly secured prior to his leaving it, whether at the home base of operations or at another airport. Proper securing shall be accomplished by reference to the aircraft checklist and the following general procedures.

At the home base, the aircraft should normally be chocked and left with the brakes off and all doors and windows locked. Consideration must be given, however, to local weather conditions, and if they so dictate the pilot in command should assure that the aircraft is properly tied down or hangared.

At airports other than the home base, the pilot in command should assure that the aircraft is properly parked, chocked, tied down and left with the brakes off and the doors and windows locked. In addition, all outside air vents should be closed and pitot and vent covers, if available, installed.

FUEL RESERVES

IFR training flights proceeding on flight plans filed with ATC shall be governed by the provisions of FAR Part 91.151 in so far as fuel and reserve fuel requirements are concerned.

VFR local training flights shall be planned and executed so as to arrive at the base of operations with a minimum of 45 minutes of fuel on board, computed at normal cruising altitudes and power settings.

VFR solo cross country training flights shall be planned to arrive at the next point of intended landing with a minimum of 45 minutes of fuel, computed at normal cruising altitudes and power settings.

All night flights require a minimum of 45 minutes of fuel reserve.

AVOIDANCE OF OTHER AIRCRAFT

It is incumbent upon each pilot aboard an aircraft to exercise constant vigilance for other aircraft, both on the ground and in the air, and to inform the pilot controlling the aircraft of all such traffic that could be a factor affecting safety.

The right of way rules of FAR Part 91.111 and 91.113 shall apply at all times, however, when in doubt as to the actions of the other aircraft do not hesitate to give way.

Be particularly vigilant when flying in the vicinity of navigation aids and uncontrolled airports.

Fly proper traffic patterns, follow recommended CTAF procedures, and be alert for the pilot who isn't.

Make use of radar advisory services when available, but always keep in mind that radar does not necessarily see all aircraft, and is not a substitute for constant vigilance.

When cruising VFR, use the hemispherical rule of cruising altitudes.

Make clearing turns prior to entering or practicing any maneuver.

Know the blind spots of your aircraft and periodically maneuver as necessary to see into the blind spots.

Execute periodic "S" turns during prolonged climbs and descents in order to clear the airspace in front of you.

PRACTICE AREAS

VFR practice areas have been designated by the school and are posted in the flight planning area.

All solo practice flights, other than cross country flights, shall be conducted within one or more of the designated practice areas.

In so far as possible within the limitations imposed by ATC, solo pilots are expected to follow the school established routes or, in the absence of an established route, proceed directly to and from the practice areas/airports.

SIMULATED EMERGENCIES

All simulated emergency practice shall be conducted by the flight instructor on dual flights. Engine failure in single-engine airplanes will be simulated only by closing the throttle. The mixture control or fuel selector valve will never be used to "simulate" an engine failure in a single-engine airplane. Below 3,000 feet AGL, engine failure in a multiengine airplane will be simulated only by reducing power on the selected engine to a zero thrust setting.

Emergency landing practice will not be conducted over any congested area of a city, town or settlement, or over an open air assembly of persons.

In uncongested areas a practice emergency landing will not descend to such an altitude that it will put the aircraft closer than 500 feet to any person, vehicle, or structure.

Practice emergency landings shall be not be carried to a height of less than 500 feet above the surface, except at an airport where, in the judgement of the flight instructor, the procedure can be carried to a safe landing without disruption of other airport traffic.

Pilots on solo practice flights will not practice simulated emergencies.

MINIMUM ALTITUDES FOR TRAINING MANEUVERS

No training maneuvers, except as necessary for takeoff and landing, will be conducted over any congested area of a city, town or settlement, or over an open air assembly of persons.

During conduct of an instrument approach in either actual instrument conditions or under simulated instrument conditions, flight will not be conducted below the applicable MDA or DH until all requirements of FAR §91.175 applicable to such descents are met.

Ground reference maneuvers, except for eights-on-pylons, will be conducted at an altitude not less than 1,000 feet AGL. Eights-on-pylons will not be demonstrated or practiced in wind conditions which dictate a minimum altitude for proper performance that is less than 500 feet AGL.

Stalls, either imminent or full, maneuvering at minimum controllable airspeed, steep turns, chandelles, and lazy eights will be conducted at an altitude which allows recovery to be effected at not less than 1,500 feet AGL in single-engine airplanes.

Stalls, either imminent or full, maneuvering at minimum controllable airspeed, steep turns, and engine out procedures involving feathering of a propeller or securing an engine, will be conducted at an altitude which allows recovery to be effected at not less than 3,000 feet AGL in multiengine airplanes. Feathering a propeller or securing an engine will be performed only when in a position from which a safe landing can be made should difficulty be encountered in unfeathering or restarting.

COMPLIANCE WITH FEDERAL AVIATION REGULATIONS

Notwithstanding any requirement or prohibition stated above, all American Flyers dispatched training flights will, at all times, be conducted in accordance with applicable Federal Aviation Regulations. The pilot in command of a flight is responsible for assuring such compliance.

AMERICAN FLYERS

APPENDIX E

FAA-S-8081-4B

INSTRUMENT RATING

PRACTICAL TEST STANDARDS

(Issued October 1, 1994)

PRACTICAL TEST STANDARDS

INTRODUCTION

The Flight Standards Service of the Federal Aviation Administration (FAA) has developed this practical test book as a standard to be used by FAA inspectors and designated pilot examiners when conducting airman practical tests (oral and flight tests). Instructors are expected to use this book when preparing applicants for practical tests.

This publication sets forth the practical test requirements for the addition of an instrument rating to a pilot certificate in airplanes, helicopters, and airships.

The FAA gratefully acknowledges the valuable assistance provided by a nation-wide public "Job Task Analysis" team that developed the knowledge, skills, and abilities which appear in this book; as well as contributing individuals for effective detail given and legal assistance supplied.

Information considered directive in nature is described in this practical test standard in terms such as "shall" and "must", and means that the actions are mandatory. Guidance information is described in terms such as "will", "should", or "may", and indicate actions that are desirable, permissive, or not mandatory and provide for flexibility.

This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Comments regarding this publication should be sent to:

U.S. Department of Transportation
Federal Aviation Administration
Flight Standards Service
Operations Support Branch, AFS-630
P.O. Box 25082
Oklahoma City, OK 73125

PRACTICAL TEST STANDARD CONCEPT

Federal Aviation Regulations (FAR's) specify the areas in which knowledge and skill must be demonstrated by the applicant before the issuance of an instrument rating. The FAR's provide the flexibility to permit the FAA to publish practical test standards containing specific TASKS (procedures and maneuvers) in which pilot competency must be demonstrated. The FAA will add, delete, or revise TASKS whenever it is determined that changes are needed in the interest of safety. Adherence to provisions of the regulations and the PTS is mandatory for the evaluation of instrument pilot applicants.

FLIGHT INSTRUCTOR RESPONSIBILITY

An appropriately rated flight instructor is responsible for training the student to the acceptable standards in all subject matter areas and objectives of each TASK within the appropriate practical test standard. The flight instructor must certify that the applicant is able to perform safely as an instrument pilot and is competent to pass the required practical test.

EXAMINER RESPONSIBILITY

The examiner who conducts the practical test is responsible for determining that the applicant meets standards outlined in the objective of each TASK within the appropriate PTS. The examiner shall meet this responsibility by accomplishing an action that is appropriate for each TASK. For each TASK that involves "knowledge only" elements, the examiner will orally quiz the applicant on those elements. For each TASK that involves both "knowledge and skill" elements, the examiner will orally quiz the applicant regarding knowledge elements and ask the applicant to perform the skill elements. The examiner will determine that the applicant's knowledge and skill meet the objective in all required TASKS. Oral questioning may be used at any time during the practical test.

The word "examiner" is used throughout this standard to denote either the FAA inspector or FAA designated pilot examiner who conducts an official practical test.

The examiner may not assist the applicant in the management of the aircraft, radio communications, navigational equipment, and/or navigational charts. In the event the test is conducted in an aircraft operation requiring a crew of two, the examiner may assume the duties of the second in command. Most helicopters certified for IFR operations must be flown using two pilots or single pilot with an approved autopilot or stability augmentation system (SAS). Therefore, when conducting practical tests in a helicopter (without autopilot, SAS, or copilot), examiners may act as an autopilot (e.g., hold heading and altitude), when requested, to allow applicants to tune radios, select charts, etc. Examiners may perform the same functions as an autopilot but should not act as a copilot performing more extensive duties. The examiner shall remain alert for other traffic at all times.

EMPHASIS ON ATTITUDE INSTUMENT FLYING AND PARTIAL-PANEL SKILLS

The FAA is concerned about numerous fatal aircraft accidents involving spatial disorientation of instrument-rated pilots who have attempted to control and maneuver their aircraft in clouds with inoperative gyroscopic heading and attitude indicators.

Many of the light aircraft operated in instrument meteorological conditions (IMC) are not equipped with dual, independent, gyroscopic heading or attitude indicators and in many cases are equipped with only a single-vacuum source. Therefore, the FAA has stressed that it is imperative for instrument pilots to aquire and maintain adequate partial-panel instrument skills and that they be cautioned not to be overly reliant upon the gyro-instrument systems.

The Instrument Rating Practical Test Standards place increased emphasis on basic attitude instrument flying and require the demonstration of parial-panel, nonprecision instrument approach procedures.

Applicants may have an unfair advantage during partial-panel TASKS during an instrument approach due to the location of the magnetic compass in some aircraft. When cross-checking the magnetic compass heading, a view of the runway or other visual clue may be sighted. It is the examiner's responsibility to determine if the applicant is receiving visual clues from outside the cockpit. If an examiner feels that the applicant is receiving outside visual clues, the examiner may devise other options to limit the applicant's view. By no means shall the examiner limit his or her view as the safety pilot.

AREA OF OPERATION IV requires the performance of basic instrument flight TASKS under both full-panel and partial-panel conditions. These TASKS are described in detail in AC 61-27, Instrument Flying Handbook. The TASKS require a knowledge of attitude instrument flying procedures and a demonstration of the skills to perform the basic instrument maneuvers with full-instrument-panel and with certain instruments inoperative. The attitude instrument flying system of teaching is described in AC 61-27 and is recommended by the FAA because it requires specific knowledge and interpretation of each individual instrument during training. The Instrument Flight Instructor Lesson Guide in AC 61-27 also provides a course of training which is designed to develop the student's partial-panel skills.

A nonprecision partial-panel approach is considered one of the most demanding situations that could be encountered. If applicants can master this situation, they can successfully complete a less difficult precision approach. **If an actual partial-panel approach in IMC becomes necessary, a less difficult precision approach should be requested, if available. Sound judgment would normally dictate such requests. However, this TASK during the Instrument Practical Test requires that a nonprecision approach be performed.**

Examiners should determine that the applicant demonstrates competency in either the PRIMARY and SUPPORTING or the **CONTROL** and **PERFORMANCE CONCEPT** method of instrument flying.

COCKPIT RESOURCE MANAGEMENT (CRM)

CRM "...refers to the effective use of ALL available resources; human resources, hardware, and information." Human resources "...includes all other groups routinely working with the cockpit crew (or pilot) who are involved in decisions that are required to operate a flight safely. These groups include. but are not limited to: dispatchers, cabin crewmembers, maintenance personnel, and air traffic controllers." CRM is not a single TASK, it is a set of skill competencies that must be evident in all TASKS in this PTS as applied to the single pilot or a crew operation.

The standards for each CRM competency as generally stated and applied are subjective. Conversely, some of the competencies may be found objectively stated as required operational procedures for one or more TASKS. Examples of the latter include briefings, radio calls, and instrument approach callouts. Whether subjective or objective, application of CRM competencies are dependent upon the type of flight operation (single pilot vs. multicrew). In all cases, the standards for CRM competencies may be related to the safe outcome of the flight. There should never be doubt that the flight will be accomplished safely.

Examiners are required to exercise proper CRM competencies in conducting tests as well as expecting the same from applicants.

PRACTICAL TEST BOOK DESCRIPTION

This book contains the practical test standards for the addition of an instrument rating to the private and commercial pilot airplane, rotorcraft/helicopter, and airship certificates. The FAA will revise this book whenever it is determined that changes are needed in the interest of safety.

PRACTICAL TEST STANDARD DESCRIPTION

The AREAS OF OPERATION are phases of flight arranged in a logical sequence within this standard. They begin with the flight's preflight preparation and end with postflight procedures. The examiner, however, may conduct the practical test in any sequence that results in a complete and efficient test.

There is a proposed change to FAR Part 61 to require an instrument rating practical test for airships. Therefore, provisions are being made in this book to include airship instrument rating TASKS. This provision for airships will be in effect upon the FAR revision date.

Another change concerns added ratings for airplanes and helicopters. The applicant that holds an airplane or helicopter instrument rating will not have to take the entire test when applying for an added rating. The TASKS that are required will be indicated as abbreviated in the following paragraph.

The abbreviations with parentheses immediately following a TASK title indicates whether the TASK is appropriate to airplanes, helicopters, airships, and added ratings. The meaning of the abbreviations follow:

IA	Airplane
AA	Airplane Added
A	Airship
IH	Helicopter
HA	Helicopter Added

The REFERENCE identifies the publication(s) that describe(s) the TASK. Descriptions of TASKS are not included in the standard because this information can be found in the current issue of the listed references. Publications other than those listed may be used for references if their content conveys substantially the same meaning as the referenced publications.

The following list contains references and study material pertaining to these practical test standards:

FAR Part 61	Certification: Pilots and Flight Instructors
FAR Part 91	General Operating and Flight Rules
AC 00-6	Aviation Weather
AC 00-45	Aviation Weather Services
AC 61-13	Basic Helicopter Handbook
AC 61-21	Flight Training Handbook
AC 61-23	Pilot's Handbook of Aeronautical Knowledge
AC 61-27	Instrument Flying Handbook
AC 61-84	Role of Preflight Preparation
AC 90-48	Pilot's Role in Collision Avoidance
AIM	Airman's Information Manual
SID	Standard Instrument Departures
STAR	Standard Terminal Arrivals
AFD	Airport/Facility Directory
FDC NOTAM	National Flight Data Center/Notice to Airmen
IAP	Instrument Approach Procedures
	Pertinent Pilot Operating Handbooks and FAA-Approved Flight Manuals
	En Route Low Altitude Chart

NOTE: The lastest revision of the references shall be used.

The Objective lists, in sequence, the important elements that must be satisfactorily performed to demonstrate competency in a TASK. The Objecive includes:

1. specifically what the applicant should be able to do,
2. the conditions under which the TASK is to be performed, and
3. the minimum acceptable standards of performance.

USE OF THE PRACTICAL TEST STANDARD BOOK

This book contains only one practical test standard. The TASKS apply to airplanes, helicopters, and airships. In certain instances, notes describe differences in the performance of a TASK by an "airplane" applicant, "helicopter" applicant, or "airship" applicant. When using the practical test book, the examiner must evaluate the applicant's knowledge and skill in sufficient depth to determine that the standards of performance listed for all TASKS are met.

All TASKS in this PTS are required for the issuance of an instrument rating in airplanes, helicopters, and airships. However, when a particular element is not appropriate to the aircraft, its equipment, or operational capability, that element may be omitted. Examples of these element exceptions would be high altitude weather phenomena for helicopters, integrated flight systems for aircraft not so equipped, unusual attitudes for airships, or other situations where the aircraft or operation is not compatible with the requirement of the element.

It is not intended that the examiner follow the precise order in which the AREAS OF OPERATION and TASKS appear in this test book. The examiner may change the sequence or combine TASKS with similar Objectives to conserve time. Examiners will develop a written plan of action that includes the order and combination of TASKS to be demonstrated by the applicant in a manner that will result in an efficient and valid test.

TASKS with similar Objectives may be combined to conserve time, although, the Objective of all TASKS must be demonstrated and evaluated at some time during the practical test. It is of utmost importance that the examiner accurately evaluates the applicant's ability to perform safely as a pilot.

Examiners will place special emphasis upon areas of aircraft operation which are most critical to flight safety. Among these areas are positive aircraft control and sound judgment in decision making. Although these areas may not be shown under each TASK, they are essential to flight safety and will receive careful evaluation throughout the practical test. If these areas are shown in the Objective, additional emphasis will be placed on them. The examiner will also emphasize division of attention, control touch, two-way radio communications, and other areas as directed by future revisions of this test book.

METRIC CONVERSION INITIATIVE

To assist pilots in understanding and using the metric measurement system, the practical test standards refer to the metric equivalent of various altitudes throughout. The metric altimeter is arranged in 10 meter increments; therefore, when converting from feet to meters, the exact conversion, being too exact for practical purposes, is rounded to the nearest 10 meter increment or even altitude as necessary.

PRATICAL TEST PREREQUISITES

An applicant for an instrument rating practical test is required by the FAR's to

1. hold at least a current private pilot certificate with an aircraft rating appropriate to the instrument rating sought;
2. pass the appropriate instrument rating knowledge test since the beginning of the 24th month before the month in which the practical test is taken;
3. obtain the applicable instruction and aeronautical experience prescribed for the instrument rating sought;

4. posses at least a third-class medical certificate issued since the beginning of the 24th month before the month in which the flight test is taken; and
5. obtain a written statement from an appropriately certificated flight instructor certifying that the applicant has been given flight instruction in preparation for the practical test within 60 days preceding the date of application. The statement shall also state that the instructor finds the applicant competent to pass the practical test and that the applicant has satisfactory knowledge of the subject area(s) in which a deficiency was indicated by the airman knowledge test report.

AIRCRAFT AND EQUIPMENT REQUIREMENTS FOR THE PRACTICAL TEST

The applicant is required to provide an appropriate and airworthy aircraft for the practical test. Its operating limitations must not prohibit the TASKS required on the practical test. Flight instruments are those required for controlling the aircraft without outside references. The required radio equipment is that necessary for communications with ATC and for the performance of VOR, NDB, and ILS (glide slope, localizer, and marker beacon) approaches.

To obtain an instrument rating with multiengine privileges, an applicant must demonstrate competency in a multiengine airplane not limited to center thrust. If an instrument flight test is conducted in a multiengine airplane limited to center thrust, a limitation shall be placed on the applicant's certificate; (INSTRUMENT RATING, AIRPLANE MULTIENGINE LAND, LIMITED TO CENTER THRUST). The multiengine airplane that is used to obtain multiengine privileges must have a V_{MC} speed established by the manufacturer and produce an assymetrical thrust configuration with the loss of one or more engines.

When applicants use a single-engine aircraft for the initial instrument practical test, they must complete all the TASKS except the TASKS applying to multiengine aircraft. When applicants use a multiengine aircraft for the initial practical test, they must complete all TASKS including the multiengine TASKS. An applicant with a single-engine instrument rating applying for a multiengine instrument rating must satisfactorily complete only: AREA OF OPERATION II (TASKS A, B, and C) and AREA OF OPERATION VII (TASKS B, C, and D).

USE OF AN APPROVED FLIGHT SIMULATOR OR TRAINING DEVICE

The applicant must demonstrate all of the instrument approach procedures required by FAR Part 61. At least one instrument approach procedure must be demonstrated in an airplane or helicopter as appropriate. There are no flight simulators or training devices that represent airship class aircraft; therefore, no allowance is made for their use toward an airship instrument rating. At the discretion of the examiner, the instrument approach(es) and missed approach(es) not selected for actual flight demonstration may be performed in a flight simulator or training device that meets the requirements of appendix 1 of this PTS.

SATISFACTORY PERFORMANCE

The ability of an applicant to perform the required TASKS is based on:

1. executing TASKS within the aircraft's performance capabilities and limitations, including use of the aircraft's systems;
2. executing emergency procedures and maneuvers appropriate to the aircraft;
3. piloting the aircraft with smoothness and accuracy;
4. exercising good judgment;
5. applying aeronautical knowledge; and
6. showing mastery of the aircraft within the standards outlined in this test book, with the successful outcome of a TASK never seriously in doubt.

UNSATISFATORY PERFORMANCE

If, in the judgment of the examiner, the applicant does not meet the standards of performance of any TASK performed, the applicable AREA OF OPERATION is failed and therefore, the practical test is failed. The examiner or the applicant may discontinue the test at any time after the failure of an AREA OF OPERATION makes the applicant ineligible for the certificate or rating sought. The test will be continued only with the consent of the applicant. If the test is either continued or discontinued, the applicant is entitled to credit for those AREAS OF OPERATION satisfactorily performed. However, during the retest and at the discretion of the examiner, any TASK may be re-evaluated including those considered satisfactory.

Specific reasons for disqualification are:

1. Consistently exceeding tolerances stated in the Objective or failure to take prompt, corrective action when tolerances are exceeded.

2. Any action, or lack of action, by the applicant which requires corrective intervention by the examiner to maintain safe flight will be disqualifying. It is vitally important that the applicant and examiner use proper and effective scanning techniques to clear the area before performing maneuvers.

RECORDING UNSATISFACTORY PERFORMANCE

The term "AREA OF OPERATION" is used in regulations to denote areas (procedures and maneuvers) in which the applicant must demonstrate competency prior to being issued a pilot certificate or additional rating. When a disapproval notice is issued, the examiner will record the applicant's unsatisfactory performance in terms of AREA OF OPERATION appropriate to the practical test conducted.

I. AREA OF OPERATION: PREFLIGHT PREPARATION

A. TASK: WEATHER INFORMATION (IA, IH, A)

REFERENCES: FAR Part 61; AC 00-6, AC 00-45; AIM.

NOTE: Where current weather reports, forecasts, or other pertinent information is not available, this information will be simulated by the examiner in a manner which will adequately measure the applicant's competence.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to aviation weather information by obtaining, reading, and analyzing the applicable items such as—

    a. weather reports and forecasts.
    b. pilot and radar reports.
    c. surface analysis charts.
    d. radar summary charts.
    e. significant weather prognostics.
    f. winds and temperatures aloft.
    g. freezing level charts.
    h. stability charts.
    i. severe weather outlook charts.
    j. tables and conversion graphs.
    k. SIGMETs and AIRMETs.
    l. ATIS reports.

2. Correctly analyzes the assembled weather information pertaining to the proposed route of flight and destination airport, and determines whether an alternate airport is required, and, if required, whether the selected alternate airport meets the regulatory requirement.

B. TASK: CROSS-COUNTRY FLIGHT PLANNING (IA, IH, A)

REFERENCES: FAR Part 61, 91; AC 61-27; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements by presenting and explaining a preplanned cross-country flight, as previously assigned by the examiner (preplanning at the examiner's discretion). It should be planned using real time weather and conform to the regulatory requirements for instrument flight rules within the airspace in which the flight will be conducted.

2. Exhibits adequate knowledge of the aircraft's performance capabilities by calculating the estimated time enroute and total fuel requirement based upon such factors as—

    a. power settings.
    b. operating altitude or flight level.
    c. wind.
    d. fuel reserve requirements.

3. Selects and correctly interprets the current and applicable enroute charts, SID (standard instrument departure), STAR (standard terminal arrival), and standard instrument approach procedure charts.
4. Obtains and correctly interprets applicable NOTAM information.
5. Determines the calculated performance is within the aircraft's capability and operating limitations.
6. Completes and files a flight plan in a manner that accurately reflects the conditions of the proposed flight. (Does not have to be filed with ATC).

II. AREA OF OPERATION: PREFLIGHT PROCEDURES

A. TASK: AIRCRAFT SYSTEMS RELATED TO IFR OPERATIONS (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27.

Objective. To determine that the applicant exhibits adequate knowledge of the elements related to applicable aircraft anti-icing/deicing system(s) and their operating methods to include:

1. Airframe.
2. Propeller/intake.
3. Fuel.
4. Pitot-static.

B. TASK: AIRCRAFT FLIGHT INSTRUMENTS AND NAVIGATION EQUIPMENT (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits knowledge of the elements related to applicable aircraft flight instrument system(s) and their operating characteristics to include—

    a. pitot-static.
    b. altimeter.
    c. airspeed indicator.

   d. vertical speed indicator.
   e. attitude indicator.
   f. horizontal situation indicator.
   g. magnetic compass.
   h. turn-and-slip indicator/turn coordinator.
   i. heading indicator.

2. Exhibits adequate knowledge of the applicable aircraft navigation system(s) and their operating methods to include—

   a. VHF omnirange (VOR).
   b. distance measuring equipment (DME).
   c. instrument landing system (ILS).
   d. marker beacon receiver/indicators.
   e. transponder/altitude encoding.
   f. automatic direction finder (ADF).

C. TASK: INSTRUMENT COCKPIT CHECK (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to preflighting instruments, avionics, and navigational equipment cockpit check by explaining the reasons for the check and how to detect possible defects.
2. Performs the preflight on instruments, avionics, and navigation equipment cockpit check by following the checklist appropriate to the aircraft flown.
3. Determines that the aircraft is in condition for safe instrument flight including—

   a. radio communications equipment.
   b. radio navigation equipment including the following, as appropriate, to the aircraft flown:

      (1) VOR/VORTAC receiving equipment.
      (2) ADF receiving equipment.
      (3) ILS receiving equipment.

   c. magnetic compass
   d. heading indicator.
   e. attitude indicator.
   f. altimeter.
   g. turn-and-slip indicator/turn coordinator.

   h. vertical speed indicator.
   i. airspeed indicator.
   j. clock.
   k. power source for gyro-instruments.
   l. pitot heat.

4. Notes any discrepancies and determines whether the aircraft is safe for instrument flight or requires maintenance.

III. AREA OR OPERATION: AIR TRAFFIC CONTROL CLEARANCES AND PROCEDURES

NOTE: The ATC clearance may be an actual or simulated ATC clearance based upon the flight plan.

A. TASK: AIR TRAFFIC CONTROL CLEARANCES (IA, IH, A)

REFERENCES: FAR Parts 61, 91,; AC 61-27; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to ATC clearances and pilot/controller responsibilities to include tower enroute control and clearance void times.
2. Copies correctly, in a timely manner, the ATC clearance as issued.
3. Determines that it is possible to comply with ATC clearance.
4. Interprets correctly the ATC clearance received and, when necessary, requests clarification, verification, or change.
5. Reads back correctly, in a timely manner, the ATC clearance in the sequence received.
6. Uses standard phraseology when reading back clearance.
7. Sets the appropriate communication and navigation frequencies and transponder codes in compliance with the ATC clearance.

B. TASK: COMPLIANCE WITH DEPARTURE, ENROUTE, AND ARRIVAL PROCEDURES AND CLEARANCES (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AC 61-27; SID; EnRoute Low Altitude Charts; STAR.

Objective: To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to SIDs, EnRoute Low Altitude Charts, STARs, and related pilot/controller responsibilities.
2. Uses the current and appropriate navigation publications for the proposed flight.

3. Selects and uses the appropriate communications frequencies; selects and identifies the navigation aids associated with the proposed flight.
4. Performs the appropriate aircraft checklist items relative to the phase of flight.
5. Establishes two-way communications with the proper controlling agency, using proper phraseology.
6. Complies, in a timely manner, with all ATC instructions and airspace restrictions.
7. Exhibits adequate knowledge of two-way radio communications failure procedures.
8. Intercepts, in a timely manner, all courses, radials, and bearings appropriate to the procedures, route, or clearance.
9. Maintains the applicable airspeed within 10 knots; headings within 10°; altitude within 100 feet (30 meters); and tracks a course, radial, or bearing.

C. TASK: HOLDING PROCEDURES (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AC61-27; AIM.

NOTE: Any reference to DME will be disregarded if the aircraft is not so equipped.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to holding procedures.
2. Changes to the holding airspeed appropriate for the altitude or aircraft when 3 minutes or less from, but prior to arriving at, the holding fix.
3. Uses an entry procedure that ensures the aircraft remains within the holding pattern airspace for a standard, nonstandard, published, or nonpublished holding pattern.
4. Recognizes arrival at the holding fix and initiates prompt entry into the holding pattern.
5. Complies with ATC reporting requirements.
6. Uses the proper timing criteria, where applicable, as required by altitude or ATC instructions.
7. Complies with pattern leg lengths when a DME distance is specified.
8. Uses proper wind correction procedures to maintain the desired pattern and to arrive over the fix as close as possible to a specified time.
9. Maintains the airspeed within 10 knots; altitude within 100 feet (30 meters); headings within 10°; and tracks a specified course, radial, or bearing.

IV. AREA OF OPERATION: FLIGHT BY REFERENCE TO INSTRUMENTS

NOTE: The examiner shall require the performance of all TASKS. At least two of the TASKS, A through E as selected by the examiner, shall be performed without the use of the attitude and heading indicators. TASK F shall be performed using all available instruments. TASK G shall be performed without the use of the attitude indicator.

A. TASK: STRAIGHT-AND-LEVEL FLIGHT (IA, IH, A, AA. HA)

REFERENCES: FAR Parts 61; AC 61-27.

Objective: To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to attitude instrument flying during straight-and-level flight.
2. Maintains straight-and-level flight in the aircraft configuration specified by the examiner.
3. Maintains the heading with 10°, altitude within 100 feet (30 meters), and airspeed within 10 knots.
4. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

B. TASK: CHANGE OF AIRSPEED (IA, IH, AA, AH)

REFERENCES: FAR Part 61; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to attitude instrument flying during changes of airspeeds in straight-and-level flight and in turns.
2. Establishes a proper power setting when changing airspeed.
3. Maintains the heading with 10°, angle of bank within 5° when turning, altitude within 100 feet (30 meters), and airspeed within 10 knots.
4. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

C. TASK: CONSTANT AIRSPEED CLIMBS AND DESCENTS (IA, IH,A, AA, HA)

REFERENCES: FAR Part 61; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to attitude instrument flying during constant airspeed climbs and descents.
2. Demonstrates climbs and descents at a constant airspeed, between specific altitudes in straight or turning flight as specified by the examiner.
3. Enters constant airspeed climbs and descents from a specified altitude, airspeed, and heading.
4. Establishes the appropriate change of pitch and power to establish the desired climb and descent performance.
5. Maintains the airspeed within 10 knots, heading within 10° or, if in a turning maneuver, within 5° of the specified bank angle.
6. Performs the level-off within 100 feet (30 meters) of the specified altitude.
7. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

D. TASK: RATE CLIMBS AND DESCENTS (IA. IH, A, AA, HA)

REFERENCES: FAR Part 61; AC 61-27.

Objective: To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to attitude instrument flying during rate climbs and descents.
2. Demonstrates climbs and descents at a constant rate, between specific altitudes in straight or turning flight as directed by the examiner.
3. Enters rate climbs and descents from a specified altitude, airspeed, and heading.
4. Establishes the appropriate change of pitch, bank, and power to establish the specified rate of climb or descent.
5. Maintains the specified rate of climb and descent within 100 feet per minute, airspeed within 10 knots, heading within 10° or, if in a turning maneuver, within 5° of the specified bank angle.
6. Performs the level-off within 100 feet (30 meters) of the specified altitude.
7. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

E. TASK: TIMED TURNS TO MAGNETIC COMPASS HEADINGS (IA, IH)

REFERENCES: FAR Part 61; AC 61-27.

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

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of 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.
2. Establishes indicated standard rate turns, both right and left.
3. Applies the clock correctly to the calibration procedure.
4. Changes the miniature aircraft position, as necessary, to produce a standard rate turn.
5. Makes timed turns to specified compass headings.
6. 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°.

F. TASK: STEEP TURNS (IA, IH, AA, HA)

REFERENCES: FAR Part 61; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the factors relating to attitude instrument flying during steep turns.
2. Enters a turn using a bank of approximately 45° for an airplane and 30° for a helicopter.
3. Maintains the specified angle of bank for either 180° or 360° of turn, both left and right.
4. 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.
5. Uses proper instrument cross-check and interpretation, and applies the appropriate pitch, bank, power, and trim corrections.

G. TASK: RECOVERY FROM UNUSUAL FLIGHT ATTITUDES (IA, IH, AA, HA)

REFERENCES: FAR Part 61; AC 61-27.

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

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements relating to attitude instrument flying during recovery from unusual flight attitudes (both nose-high and nose-low).
2. Uses proper instrument cross-check and interpretation, and applies appropriate pitch, bank, and power corrections in the correct sequence to return the aircraft to a stabilized level flight attitude.

V. AREA OF OPERATION: NAVIGATION AIDS

A. TASK: INTERCEPTING AND TRACKING VOR/VORTAC RADIALS AND DME ARCS (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AC 61-27; AIM

NOTE: Any reference to DME arc shall be disregarded if the aircraft is not DME equipped.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to VOR/VORTAC radial and DME arc interception and tracking.
2. Tunes and correctly identifies the VOR/VORTAC facility.
3. Sets and correctly orients the radial to be intercepted into the course selector or correctly identifies the radial on the RMI.
4. Intercepts the specified radial at a predetermined angle, inbound or outbound from a VOR/VORTAC facility.
5. Maintains, while intercepting and tracking VOR/VORTAC radials, the airspeed within 10 knots, altitude within 100 feet (30 meters), and selected headings within 5°.
6. Applies proper correction to maintain a radial, allowing no more than three-quarter-scale deflection of the CDI or within 10° in case of an RMI.
7. Determines the aircraft position relative to the VOR/VORTAC facility.
8. Intercepts a DME arc and maintains that arc within 1 nautical mile.
9. Recognizes VOR/VORTAC receiver or facility failure, and, when required, reports the failure to ATC.

B. TASK: INTERCEPTING AND TRACKING NDB BEARINGS (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AC 61-27; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements of NDB bearing interception and tracking.
2. Tunes and correctly identifies the NDB facility.
3. Sets the volume to a level that allows constant monitoring of the NDB facility.
4. Determines accurately the relative bearing of the NDB facility.
5. Intercepts a specific bearing to or from the NDB facility, using appropriate intereption procedures.
6. Maintains, while intercepting and tracking NDB bearings the airspeed within 10 knots, altitude within 100 feet (30 meters), selected headings within 5°.
7. Applies proper correction to maintain a bearing within 10°.
8. Determines the aircraft position relative to the NDB facility.
9. Recognizes ADF receiver or NDB facility failure, and, when required, reports the failure to ATC.

VI. AREA OF OPERATION: INSTRUMENT APPROACH PROCEDURES

A. TASK: VOR/VORTAC INSTRUMENT APPROACH PROCEDURE (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27; Standard Instrument Approach Procedure Chart; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to a VOR/VORTAC instrument approach procedure.
2. Selects and complies with the appropriate VOR/VORTAC instrument approach procedure to be performed.
3. Establishes two-way communications with ATC, as appropriate, to the phase of flight or approach segment, and uses proper radio communications phraseology and technique.
4. Selects, tunes, identifies, and confirms the operational status of navigation equipment to be used for the approach procedure.
5. Complies with all clearances issued by ATC or the examiner.
6. Recognizes if heading indicator and/or attitude indicator is inaccurate or inoperative, advises controller, and proceeds with approach.

7. Advises ATC or examiner anytime the aircraft is unable to comply with a clearance.
8. Establishes the appropriate aircraft configuration and airspeed considering turbulence and wind shear, and completes the aircraft checklist items appropriate to the phase of flight.
9. Maintains, prior to beginning the final approach segment, altitude within 100 feet (30 meters), heading within 10° and allows less than a full-scale deflection of the CDI or within 10° in the case of an RMI, and maintains airspeed within 10 knots.
10. Applies the necessary adjustments to the published MDA and visibility criteria for the aircraft approach category when required, such as—

    a. FDC and Class II NOTAMs.
    b. inoperative aircraft and ground navigation equipment.
    c. inoperative visual aids associated with the landing environment.
    d. National Weather Service (NWS) reporting factors and criteria.

11. Establishes a rate of descent and track that will ensure arrival at the MDA prior to reaching the MAP with the aircraft continuously in a position from which descent to a landing on the intended runway can be made at a normal rate using normal maneuvers.
12. Allows, while on the final approach segment, no more than three-quarter-scale deflection of the CDI or within 10° in case of an RMI, and maintains airspeed within 10 knots.
13. Maintains the MDA, when reached, within +100 feet (30 meters), -0 feet to the MAP.
14. Executes the missed approach procedure when the required visual references for the intended runway are not distinctly visible and identifiable at the MAP.
15. Executes a normal landing from a straight-in or circling approach when instructed by the examiner.

B. TASK: NDB INSTRUMENT APPROACH PROCEDURE (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27; Standard Instrument Approach Procedure Chart; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to an NDB instrument approach procedure.
2. Selects and complies with the appropriate NDB instrument approach procedure to be performed.
3. Establishes two-way communications with ATC, as appropriate to the phase of flight or approach segment, and uses proper radio communications phraseology.

4. Selects, tunes, identifies, confirms, and monitors the operational status of ground and aircraft navigation equipment to be used for the approach procedure.
5. Complies with all clearances issued by ATC or the examiner.
6. Recognizes when heading indicator and/or attitude indicator is inaccurate or inoperative, advises controller, and proceeds with approach.
7. Advises ATC or the examiner anytime the aircraft is unable to comply with a clearance.
8. Establishes the appropriate aircraft configuration and airspeed considering turbulence and wind shear, and completes the aircraft checklist items appropriate to the phase of flight.
9. Maintains, prior to beginning the final approach segment, the altitude within 100 feet (30 meters), heading and bearing within 10°, and airspeed within 10 knots.
10. Applies the necessary adjusments to the published MDA and visibility criteria for the aircraft approach category when required, such as—

    a. FDC and Class II NOTAMs.
    b. inoperative aircraft and ground navigation equipment.
    c. inoperative visual aids associated with the landing environment.
    d. National Weather Service (NWS) reporting factors and criteria.

11. Establishes a rate of descent and track that will ensure arrival at the MDA prior to reaching the MAP with the aircraft continuously in a position from which descent to a landing on the intended runway can be made at a normal rate using normal maneuvers.
12. Maintains, while on the final approach segment, a deviation of not more than 10° from the specified bearing, and maintains airspeed within 10 knots.
13. Maintains the MDA, when reached, within +100 feet (30 meters), -0 feet to the MAP.
14. Executes the missed approach procedure when the required visual references for the intended runway are not distinctly visible and identifiable at the MAP.
15. Executes a normal landing from a straight-in or circling approach when instructed by ATC or the examiner.

C. TASK: ILS INSTRUMENT APPROACH PROCEDURE (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27; Standard Instrument Approach Procedure Chart; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements of an ILS instrument approach procedure.
2. Selects and complies with the appropriate ILS instrument approach procedure to be performaed.
3. Establishes two-way communications with ATC, as appropriate to the phase of flight or approach segment, and uses proper radio communications phraseology and technique.
4. Selects, tunes, identifies, and confirms the operational status of ground and aircraft navigation equipment to be used for the approach procedure.
5. Complies with all clearances issued by ATC or the examiner.
6. Advises ATC or examiner anytime the aircraft is unable to comply with a clearance.
7. Establishes the appropriate aircraft configuration and airspeed, considering turbulence and wind shear, and completes the aircraft checklist items appropriate to the phase of flight.
8. Maintains, prior to beginning the final approach segment, specified altitude within 100 feet (30 meters), heading or course within 10°, and airspeed within 10 knots.
9. Applies the necessary adjusments to the published DH and visibility criteria for the aircraft approach category when required, such as—

    a. FDC and Class II NOTAMs.
    b. inoperative aircraft and ground navigation equipment.
    c. inoperative visual aids associated with the landing environment.
    d. National Weather Service (NWS) reporting factors and criteria.

10. Establishes an initial rate of descent at the point where the electronic glide slope is intercepted, which approximates that required for the aircraft to follow the glide slope.
11. Allows, while on the final approach segment, no more than three-quarter-scale deflection of either the localizer or glide slope indications, and maintains the specified airspeed within 10 knots.
12. Avoids descent below the DH before initiating a missed approach procedure or transitioning to a normal landing approach.
13. Initiates immediately the missed approach procedure when, at the DH, the required visual references for the intended runway are not distinctly visible and identifiable.
14. Transitions to a normal landing approach when the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers.

D. TASK: MISSED APPROACH PROCEDURES (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91; AC 61-27; Standard Instrument Approach Procedure Chart; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to missed approach procedures associated with standard instrument approaches.
2. Initiates the missed approach promptly by applying power, establishing a climb attitude, and reducing drag in accordance with the aircraft manufacturer's recommendations.
3. Reports to ATC beginning the missed approach procedure.
4. Complies with the published or alternate missed approach procedure.
5. Advises ATC or examiner anytime the aircraft is unable to comply with a clearance, restriction, or climb gradient.
6. Follows the recommended checklist items appropriate to the go-around procedure.
7. Requests, if appropriate, ATC clearance to the alternate airport, clearance limit, or as directed by the examiner.
8. Maintains the recommended airspeed within 10 knots; heading, course, or bearing within 10°; and altitude(s) within 100 feet (30 meters) during the missed approach procedure.

E. TASK: CIRCLING APPROACH PROCEDURE (IA, AA, A)

REFERENCES: FAR Parts 61, 91; AC 61-27; Standard Instrument Approach Procedure Chart; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to a circling approach procedure.
2. Selects and complies with the appropriate circling approach procedure considering turbulence and wind shear and considering the maneuvering capabilities of the aircraft.
3. Confirms the direction of traffic and adheres to all restrictions and instruction issued by ATC and the examiner.
4. Does not exceed the visibility criteria or descend below the appropriate circling altitude until in a position from which a descent to a normal landing can be made.

F. TASK: LANDING FROM A STRAIGHT-IN OR CIRCLING APPROACH PROCEDURE (IA, AA, A)

REFERENCES: FAR Parts 61, 91; ac 61-27; AIM.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements related to the pilot's responsibilities, and the environmental, operational, and meteorological factors which affect a landing from a straight-in or a circling approach.
2. Transitions at the DH, MDA, or VDP to a visual flight condition, allowing for safe visual maneuvering and a normal landing.
3. Adheres to all ATC (or examiner) advisories such as: NOTAMs, wind shear, wake turbulence, runway surface, braking conditions, and other operational considerations.
4. Completes appropriate checklist items for the pre-landing and landing phase.
5. Maintains positive aircraft control throughout the complete landing maneuver.

VII. AREA OF OPERATION: EMERGENCY OPERATIONS

A. TASK: LOSS OF COMMUNICATIONS (IA, IH, A)

REFERENCES: FAR Parts 61, 91; AIM.

Objective. To determine that the applicant exhibits adequate knowledge of the elements related to applicable loss of communications procedures to include:

1. Recognizing loss of communication.
2. Continuing to destination according to the flight plan.
3. When to deviate from the flight plan.
4. Timing for beginning an approach at destination.

B. TASK: ENGINE FAILURE DURING STRAIGHT-AND-LEVEL FLIGHT AND TURNS (MULTIENGINE) (IA, IH, A, AA, HA)

REFERENCES: FAR Part 61; AC 61-21; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the procedures used if engine failure occurs during straight-and-level flight and turns while on instruments.
2. Recognizes engine failure simulated by the examiner during straight-and-level flight and turns.
3. Sets all engine controls, reduces drag, and identifies and verifies the inoperative engine.
4. Establishes the best engine-inoperative airspeed and trims the aircraft.

5. Verifies the accomplishment of prescribed checklist procedures for securing the inoperative engine.
6. Establishes and maintains the recommended flight attitude, as necessary, for best performance during straight-and-level and turning flight.
7. Attempts to determine the reason for the engine failure.
8. Monitors all engine control functions and makes necessary adjustments.
9. Maintains the specified altitude within 100 feet (30 meters), (if within the aircraft's capability), airspeed within 10 knots, and the specified heading within 10°.
10. Assesses the aircraft's performance capability and decides an appropriate action to ensure a safe landing.
11. Avoids loss of aircraft control, or attempted flight contrary to engine-inoperative operating limitations of the aircraft.

C. TASK: INSTRUMENT APPROACH - ONE ENGINE INOPERATIVE (MULTIENGINE) (IA, IH, A, AA, HA)

REFERENCES: FAR Part 61; AC 61-21; AC 61-27.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements by explaining the procedures used during an instrument approach in a multiengine aircraft with one engine inoperative.
2. Recognizes promptly engine failure simulated by the examiner.
3. Sets all engine controls, reduces drag, and identifies and verifies the inoperative engine.
4. Establishes the best engine-inoperative airspeed and trims the aircraft.
5. Verifies the accomplishment of prescribed checklist procedures for securing the inoperative engine.
6. Establishes and maintains the recommended flight attitude and configuration for the best performance for all maneuvering necessary for the instrument approach procedures.
7. Attempts to determine the reason for the engine failure.
8. Monitors all engine control functions and makes necessary adjustments.
9. Requests and receives an actual or simulated ATC clearance for an instrument approach.
10. Follows the actual or simulated ATC clearance for an instrument approach.
11. Establishes a rate of descent that will ensure arrival at the MDA prior to reaching the MAP with the aircraft continuously in a position from which descent to a landing on the intended runway can be made straight-in or circling.
12. Maintains, where applicable, the specified altitude within 100 feet (30 meters), (if within the aircraft's capability), the airspeed within 10 knots, and the heading within 10°.

13. Sets the navigation and communication equipment used during the approach and uses the proper communications techniques.
14. Avoids loss of aircraft control, or attempted flight contrary to the engine-inoperative operating limitations of the aircraft.
15. Complies with the published criteria for the aircraft approach category when circling.
16. Allows, while on final approach segment, nor more than three-quarter-scale deflesction of either the localizer or glide slope indications, or within 10° of the NDB or VOR final approach course.
17. Completes a safe landing.

D. TASK: LOSS OF GYRO ATTITUDE AND/OR HEADING INDICATORS (IA, IH, AA, HA)

REFERENCES: FAR Part 61; AC 61-27.

NOTE: This task may be considered satisfactory if applicant has successfully completed a nonprecision approach without the use of attitude and heading indicators (in appropriate class aircraft).

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements relating to recognizing if attitude indicator and/or heading indicator is inaccurate or inoperative, and advises ATC or the examiner.
2. Advises ATC or examiner anytime the aircraft is unable to comply with a clearance.
3. Completes instrument approach if applicable.

VIII. AREA OF OPERATIONS: POSTFLIGHT PROCEDURES

TASK: CHECKING INSTRUMENTS AND EQUIPMENT (IA, IH, A, AA, HA)

REFERENCES: FAR Parts 61, 91.

Objective. To determine that the applicant:

1. Exhibits adequate knowledge of the elements relating to all navigation equipment for proper operation.
2. Notes all flight equipment for proper operation.
3. Notes all equipment and/or aircraft malfunctions and makes a written record of improper operation or failure of such equipment.