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INTRODUCTION AND THEORY

Safety! Safety must be paramount in all pilot duties. With all of the theories to present, the most important theory to emphasize with any type of flying is a theory of safety first. Safety should be the constant overtone to all activities associated with piloting an aircraft. These procedures have been developed with safety in mind. They have been developed with much thought and experience. They have been developed using historical background in identifying the best possible operating practices. Enhanced safety is the main impetus for developing standard operating procedures (SOPs).

There are two theories of attitude instrument flying. One is the Primary and Supporting Method and the other is the Control and Performance Method. The Primary and Supporting Method identifies the primary instrument for each attitude objective and then identifies the remaining instrument or instruments which provide the best back-up information to the primary instrument indication. The primary instrument is the one that provides the most precise and direct display of attitude objective. The supporting instruments are those that best support or confirm the information displayed on the primary instrument.

The Control and Performance Method is based on the notion that a particular make and model of aircraft, in a given configuration, will do a certain thing when a certain amount of power, trim, and control input is applied. Execution of the Control and Performance Method is done by setting the power and attitude known to produce the desired outcome, letting the aircraft stabilize, and then making any minor corrections necessary to achieve the precise objective. Setting of the power and attitude are known as CONTROL. Outcome of the settings is known as PERFORMANCE. Always remember Pitch for Altitude or Vertical speed, and Power for Airspeed. This is also called flying by the numbers.

Utah State University will teach the Performance Control theory. Students will be expected to understand this theory, fly instruments according to this theory, and be able to explain this theory during stage checks and checkrides. These instrument standard operating procedures (SOPs) will be explained according to this theory. Although Utah State University does not emphasize the Primary and Supporting theory, it recognizes that this theory teaches valuable concepts pertaining to attitude instrument flying. Students are encouraged to use this theory to support the tenants of the Control and Performance Method.

Either method requires the application of the three fundamental skills of flying instruments. They are: instrument scan and cross-check, instrument interpretation, and aircraft control. Instrument scan and cross-check is the skill of methodically observing each flight instrument and comparing it to all of the other flight instruments. This skill also implies understanding which instruments are the key instruments for the desired flight information. Instrument interpretation is the skill of accurately reading the details of the information portrayed on the instruments. Finally, aircraft control is the action you take, or don’t take, based on the correct interpretation of the instrument indications observed.
One of the greatest skills of a successful pilot is the skill of staying ahead of the aircraft. This implies that the pilot is flying the aircraft instead of the aircraft flying the pilot. The pilot must always be ahead of the aircraft by briefing the approach, planning the next hold, preparing the next crossing, and anticipating the next altitude PRIOR to reaching them. This is what is called the "next step" process. The "next step" process is the process of immediately considering the next flight attitude, altitude, course, or action to be taken after completing the preceding action. This process tracks things in sequential order and aids the pilot in identifying the next item of consideration in the sequence. Pilots can avoid missing details critical to instrument flying by using this procedure. Instrument flying is a very detail oriented type of flying. Details are crucial to safe and successful instrument flying. Aviation history is full of many pilots who have lived and died by details.

These SOPs will guide you in the use of the flight instruments but will not teach you the internal workings of the instruments. This information you will have to find from external publications. The procedures in this handbook will coach you in the execution of each maneuver but will not identify the minimum performance standards which will be expected of you for each maneuver. You will have to perform each required instrument flying task at least to the levels outlined in the current Instrument Rating Airman Certification Standards for Airplane (ACS). Use them as a reference throughout your instrument training so you will know what will be expected of your performance on your checkride. You are responsible to know for yourself the Instrument ACS requirements. You are responsible to hone your skills to a level of performance exceeding the minimums required in the ACS.
PRE-FLIGHT ACTIONS

IMC WEATHER

Weather is more critical in IFR flight than in VFR flight. It is more critical because there is a potential that an IFR flight will lead into the weather. It’s also more likely that an IFR flight will tangle much more closely with the weather than a VFR flight. Preflight actions must include a weather briefing worthy of IFR flight. Serious consideration should be given to the ability of the aircraft and pilot to handle the weather which might be encountered.

PRE-FLIGHT INSTRUMENT CHECKS

When you are flying in a dark cloud on a dark night over the dark ocean, you understand the reliance and trust you place on your instruments as well as your ability to use them correctly. In situations like these your instruments become absolutely critical! Before getting yourself into any situation where you are relying so heavily on your instruments it is important to make sure that they are functioning properly. This is the purpose behind a preflight instrument check. As you taxi out for your IFR flight, check the following:

- **Magnetic compass**

  The magnetic compass should be full of fluid. It should move freely and indicate known headings as you taxi. Each magnetic compass should have a deviation card affixed to it or located somewhere nearby. It’s good to note during your taxi that this card is available. It’s also good to note how much correction is needed and which headings require correction.

- **Airspeed indicator**

  The airspeed indicator should indicate zero. In windy conditions it may fluctuate and read slightly above zero, but it should never read anything higher than the maximum wind gust. Any speed bugs that you would like set should show at the bottom of the airspeed tape.

- **Attitude indicator**

  The attitude indicator may take as many as five minutes (or slightly more) to stabilize. This instrument should be checked later in the taxi if the initial check indicates that it is not working properly. Once stabilized, it should not move any more than 5° in any direction during taxi. The airplane symbol should be positioned parallel to the horizon and may be slightly above the horizon but never below the horizon. It should never exceed an indication of 2° pitch up on the ground during taxi.
Pre-Flight Actions

• **Altimeter**

  The altimeter should have the current altimeter setting and must indicate field elevation within 75 feet to be legal for IFR flight. If there is a deviation of less than 75 feet, positive or negative, note the deviation and consider adjusting your altitude accordingly while flying.

• **Turn coordinator**

  The turn coordinator provides two things: 1) an additional indication of bank and 2) an indication of turn coordination. The indication of bank is portrayed as a rate of turn. All turns for instrument flying, unless otherwise requested, should be made at the standard rate of 3° per second. The rate of turn indicator on the G1000 is the pink curved line that comes out from the lubber line on the heading indicator. When the end of the pink curved line touches the first line either left or right of the lubber line, the aircraft is in a half-standard rate turn. When it touches one of the second lines to the left or right of the lubber line the aircraft is in a standard rate turn.

  The indication of coordinated flight is provided by the line underneath the pointer on the attitude indicator. In coordinated flight this indicator will complete the bottom of the triangle used as the attitude indicator pointer. Un-coordinated flight is shown by the line moving from the base of the triangle to one side or the other. If the line is to the right of the triangle base, right rudder pressure is needed to bring it back to the base of the triangle. If the line is left of the triangle base, left rudder pressure is needed to bring it back to the base of the triangle. This correction is often referred to as “stepping on the ball” because the first turn coordinators used a ball inside a glass tube filled with fluid to provide indication of coordinated flight.

  On your taxi, confirm that the pink curved, bank line is showing the same direction as the turn and the coordinator triangle base line is moving opposite the turn.

• **Directional gyro**

  The directional gyro should turn freely during your taxi and remain aligned with the magnetic compass.

• **VSI**

  The VSI should indicate zero. If the VSI does not indicate zero, any deviation will be noted and used as the “new” zero.

  Each instrument should be observed during taxi to assure there is no damage which would make it inaccurate or unable to perform its function.
AIRSPEED RANGES AND LIMITATIONS

DA40

White arc
- 49 KIAS – 91 KIAS Operating range with flaps fully extended.
- 49 KIAS – 108 KIAS Operating range with T/O flaps extended

Green arc
- 52 KIAS – 129 KIAS Normal operating range.

Yellow arc
- 129 KIAS – 178 KIAS Caution range - Only in smooth air.

Red line
- 178 KIAS Maximum speed for all operations - Vne.

DA42

White arc
- 56 KIAS – 111 KIAS Operating range with flaps fully extended.

Green arc
- 62 KIAS – 155 KIAS Normal operating range.

Yellow arc
- 155 KIAS – 194 KIAS Caution range – Only in smooth air.

Blue radial
- 82 KIAS Best rate of climb speed, single engine.

Red radial
- 68 KIAS Minimum control speed, single engine.

Red radial
- 194 KIAS Maximum speed for all operations – Vne.

VA Maneuvering Speed

DA40-F- 108 KIAS (above 2161 lbs. up to 2535 lbs.) 94 KIAS (1720 lbs. up to 2161 lbs.)
DA40CS- 108 KIAS (above 2161 lbs. up to 2535 lbs.) 94 KIAS (1720 lbs. up to 2161 lbs.)
XLT ONLY- 111 KIAS (above 2284 lbs. up to 2646 lbs.) 94 KIAS (1720 lbs. up to 2284 lbs.)
DA 42- 126 KIAS (above 3400 lbs.) 120 KIAS (below 3400 lbs.)

Do not make full or abrupt control surface movements above this speed. When turbulence is experienced or when turbulence may be expected, the aircraft will not be flown above maneuvering speed!
Strap in and check the safety bars are secure. The airplane is always checked out and ready for flight. After the pre-flight checks, turn on the radio and check the weather. Check your instruments and see that the altimeters, airspeed indicators, and so forth are functioning properly. The airplane is now ready to fly.

The following rules of thumb apply:

• If your heading deviates from your intended heading, use one-half the deviation as your angle of bank to return to your desired heading.
• If you have to make altitude corrections of less than 100 feet pitch up or down, make these corrections without adjusting the throttle. Use a half bar width on the attitude indicator for these corrections.
• If the altitude change is more than 100 feet, correct back at twice the rate of climb as indicated on the VSI. In this case you probably will need to adjust the power to correct any airspeed changes.
Configuration for Straight and Level Flight

DA40-F

Select appropriate ALT and HDG for maneuver
Throttle - 2400 to 2500 RPM
Stabilize - AS, ALT, HDG, & RPM
Trim – Set
Mixture – Set
Throttle – never allow engine to exceed 2700 RPM

DA40CS

Select appropriate ALT and HDG for maneuver
Throttle – Set to Power Table
Prop – 1800-2400 RPM
Stabilize - AS, ALT, HDG, & RPM
Trim – Set
Mixture – Set

DA42

Select appropriate ALT and HDG for maneuver
Power Levers – Reduce to 70%
Stabilize - AS, ALT, HDG, & RPM
Engine Gauges – Check
Trim – Set

Level Turns

Safety! Before initiating any turns clear the direction of turn by vocally questioning your flight instructor or safety pilot with either “Clear left?” or “Clear right?”

Turns are done by simultaneously applying both aileron and rudder in the direction of the desired turn. Don’t forget the rudder! Rudder must be used on both roll-in and roll-out and must be used entering a turn as well as exiting a turn. Turns in instrument flying are to be done at standard rate (see the description of the turn coordinator). The exceptions to this are when performing a PAR approach (Precision Approach Radar) or when making corrections on a final approach course (see ILS approaches). In both of these cases, a half-standard-rate turn should be used.

The amount of bank to achieve a standard rate turn depends on the true airspeed. The best formula to estimate the amount of bank required for a standard rate turn up through about 550 knots is (TAS÷10) + 6. You may also use a rough estimate of about 15% of TAS.

A proper level turn will be a coordinated, standard rate turn. When properly executed, altitude will remain constant and airspeed will remain constant. If a bank is made from stabilized straight and level flight and the airspeed is maintained, the aircraft will
descend. If a bank is made from stabilized straight and level flight and an attempt is made to maintain altitude, airspeed will decrease. Appropriate back pressure on the yoke, or stick, and increased power are needed to maintain airspeed and altitude in a turn. Do not trim the airplane for a normal instrument turn! If the airplane was properly trimmed for straight and level flight before a turn, the trim will help the aircraft return to stabilized straight and level flight after the turn is complete.

When rolling out of a turn, start the roll-out before your desired heading. The roll-out takes some time and you will overshoot your desired heading unless you start it early enough.

**Execution of a Level Turn:**

1. Used coordinated stick and rudder pressure to bank over into a standard rate turn.
2. As bank increases, increase back pressure and power to levels sufficient to maintain airspeed and altitude.
3. Neutralize ailerons when a standard rate turn is achieved and maintain rudder coordination.
4. Anticipate your roll-out. (See Roll-out chart below)
5. As wings level, reduce back pressure and reduce excess power.

**Roll-out:**

<table>
<thead>
<tr>
<th>Bank</th>
<th>Lead</th>
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<tbody>
<tr>
<td>Up to 15°</td>
<td>5°</td>
</tr>
<tr>
<td>15° - 30°</td>
<td>10°</td>
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<tr>
<td>Above 30°</td>
<td>15°</td>
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**CHANGES OF AIRSPEEDS**

Airspeed is a function of power. To adjust your airspeed, adjust your power. **To increase your airspeed – increase your power. To decrease your airspeed – decrease your power.** Power adjustments are not intended to be arbitrary. You are not expected to guess what the power setting should be to achieve a desired airspeed. Power adjustments should be deliberate power settings matching the settings in the Pitch/Power Table.

To maintain the current aircraft attitude, a change in airspeed must be accompanied by a change in pitch attitude. **When power is added,** the aircraft will climb unless pitch attitude is decreased. **When power is reduced,** the aircraft will descend unless pitch attitude is increased. Pitch attitude adjustments should also be deliberate pitch settings in accordance with the Pitch/Power Table.
After the power setting and the pitch attitude are set for the desired airspeed, minor adjustments to both may be necessary to fine-tune the result and achieve absolute precision. The aircraft must be re-trimmed after every airspeed change! Instrument flight is precision flying and airspeeds are very critical in many phases of instrument flying.

Increase Airspeed:

1. Set higher target power setting
2. Push nose down to target pitch attitude
3. Re-trim the aircraft

Decrease Airspeed:

1. Set lower target power setting
2. Pull nose up to target pitch attitude
3. Re-trim the aircraft

CONSTANT AIRSPEED CLIMBS AND DESCENTS

Various aircraft have certain takeoff and climb power settings. More powerful and more capable aircraft may have multiple power settings for the various phases of takeoff and climb. Large transport aircraft are included in this group. The DA42 is one of these aircraft. It has a reduced power setting for climb after the initial takeoff is completed. However, the DA40 and most other light general aviation aircraft takeoff and climb using full throttle. The DA40 has different airspeeds depending on aircraft weight including different airspeeds for initial climb and secondary climb. These various airspeeds can be found in the POH, the DA40 Preflight Checklist produced by USU, and in the Pitch/Power Table included in this SOP publication.

All climbs in the DA40 will be done using full throttle. Climbs will be performed with the carburetor heat in the cold position unless circumstances require carburetor heat to be on. To initiate a climb smoothly add full throttle and increase pitch attitude to the attitude required for the desired airspeed. As with all good instrument flying, trim the aircraft for the desired airspeed.

In a climb with full throttle your airspeed is controlled by the pitch attitude. If you wish to climb at a faster airspeed, reduce the pitch attitude. If you wish to climb at a slower airspeed, increase the pitch attitude. As altitude approaches the service ceiling of your aircraft it may not have enough power to climb at any airspeed. Make sure the mixture is leaned properly throughout the climb. After any airspeed adjustments re-trim your aircraft.
Power settings during descents are different than power settings for climbs. Descents can be done throughout the entire range of power settings. Most descents are accompanied by reduced power settings. Reduced power settings are used because airspeeds can easily exceed the maximum allowable airspeeds in steep descents with normal to higher power settings. Power controls airspeed in descents. This is true until the power setting is reduced to idle. At this point an increase in pitch attitude and a decrease in rate of descent is the only way to slow airspeed further. Increasing power in a descent will increase airspeed which will, in turn, increase ground speed. This is an excellent way to speed things up if ATC is asking for your best forward speed. Be sure to trim the aircraft for the desired descent airspeed once it is achieved. Carburetor heat will be on during descents. See the Pitch/Power Table for the standard USU descent airspeeds and associated power settings.

Before initiating a climb or a descent, set the new target altitude with the altimeter bug on the G1000. The altimeter bug should always be set on your assigned altitude or a target altitude for climb or descent. When climbing or descending, announce the altitude that you are leaving and the altitude to which you are descending or climbing. All climbs must be at least 500 feet per minute unless asked otherwise by ATC, the instructor or examiner. A common call out for both climbing and descending will be at 1000 feet to go (“1,000 FEET TO GO”). In the DA40 Announce 200 feet before leveling off from a climb and announce 200 feet before leveling off from a descent (“200 FEET TO GO”). All climbs should be made at full power and at best rate of climb unless otherwise requested. If you cannot maintain a 500 foot per minute climb you must notify ATC.

CONSTANT RATE CLIMBS AND DESCENTS

Constant rate climbs and descents are very important during certain phases of instrument flight. Quite often it is necessary to maintain a certain rate of climb on a departure to comply with the requirements of the departure procedure. Flying a glide slope is a skill which requires a pilot to descend at a constant rate.

The vertical speed indicator (VSI) is the primary source of pitch information for flying a constant rate climb or descent. Adjust the pitch according to the USU Pitch/Power Table and the indication on the VSI. Because a climb in a DA40 is done at full throttle, the only way to adjust the rate of climb is by adjusting the pitch attitude of the airplane. At a constant throttle setting, the rate of climb varies inversely to the airspeed. An increase in the rate of climb is initiated by increasing back elevator pressure. This, in turn, decreases the airspeed and increases the rate of climb. To reduce the rate of climb, reduce the pitch attitude until the desired rate of climb is achieved. All climbs should be made at full power and at best rate of climb unless otherwise requested or unless conditions require. If you cannot maintain a 500 foot per minute climb you must notify ATC.
Even in a DA40, a descent can be made using a number of different power settings. **The rate of descent is controlled by the pitch and the airspeed is controlled by the power.** This is critical to understand to successfully fly an electronic glide slope! If your rate of descent is too fast, pitch up until your desired rate of descent is attained. If your rate of descent is too slow, pitch down until your desired rate of descent is attained. Trim your airplane when you have established your desired rate of descent.

Constant rate descents are also invaluable in managing a descent profile. Descents from enroute cruising altitudes must be planned carefully. You must plan to arrive at the altitude where the instrument approach procedure begins before reaching the initial approach fix. A 500 foot per minute descent will take 2 minutes to descend 1000 feet. A 1000 foot per minute descent will take 1 minute to descend 1000 feet. Therefore, if you have 6000 feet of altitude to lose it will take you 12 minutes to descend to your desired altitude if you are flying a 500 foot per minute descent; or it will take you 6 minutes if you are flying a 1000 foot per minute descent. The distance you will cover in 12 minutes or 6 minutes depends upon the ground speed you maintain during the descent. At 60 knots ground speed you will be covering 1 mile per minute; at 120 knots ground speed you will be covering 2 miles per minute; and at 180 knots ground speed you will be covering 3 miles per minute. This means that if you have 12 minutes to descend 6000 feet (500 fpm) and your ground speed is 60 knots, you must begin your descent no later than 12 miles before arriving at your initial approach fix. At a ground speed of 120 knots you will cover 24 miles in 12 minutes; therefore, if you would like to descend at 500 fpm you must begin your descent at least 24 miles before your initial approach fix. A ground speed of 180 knots and a descent rate of 500 fpm will require you to begin your descent at least 36 miles before the initial approach fix of your intended approach. If you double your descent rate to 1000 feet per minute these distances will be cut in half. In other words, the distance you will need to descend 6000 feet at 60 knots ground speed is 6 miles, at 120 knots ground speed the required distance is 12 miles, and at 180 knots the distance necessary is 18 miles.

These constant rate calculations can be worked in the other direction as well. Assume that we have 30 miles to descend 6000 feet and our ground speed is 120 knots. At 120 knots ground speed we will cover 2 miles per minute. This means we will cover our 30 miles in 15 minutes. In other words, we have 15 minutes to descend 6000 feet. Divide the 6000 feet we have to descend by the 15 minutes available to us for our descent and we have discovered that we must descend at a constant rate of at least 400 feet per minute. If instead we only have 10 miles to descend 6000 feet at 120 knots ground speed, we must descend 6000 feet in 5 minutes (2 miles per minute, according to our ground speed). This requires us to descend at a constant rate of at least 1,200 feet per minute in order to arrive at our target altitude by the time we reach our initial approach fix or other target waypoint. The following formulas are useful in calculating vertical speeds:
Basic Instrument Maneuvers

Miles per minute = ground speed ÷ 60

Time to cover total distance = total distance ÷ miles per minute

VSI required = altitude to lose or gain ÷ time to cover total distance

VSI required = required feet per NM * miles per minute

When establishing a rate of climb or descent, you must understand that the rate indication on the VSI has a lag to it. This instrument shows both trend and rate information. Trend is simply the indication on the VSI showing whether the aircraft is climbing, descending, or remaining level. The trend indication on the VSI is an instantaneous indication. You can know immediately, by looking at the VSI, whether the aircraft is pointing up, pointing down, or flying level. The climb or descent information on the VSI takes a while to stabilize to the actual rate. This is simply due to the construction of the VSI sensor. One must understand this lag and interpret the VSI accordingly. Bring the aircraft pitch up or down close to the desired climb or descent indication and hold the pitch for a while (one or two seconds) to allow the indication to stabilize. After the indication has stabilized, make any corrections necessary in the direction of the rate desired. Again, let the indication stabilize. Continue this process until you have trimmed the aircraft to precisely maintain the desired rate.

A common call out for both climbing and descending will be at 1000 feet to go (“1,000 FEET TO GO”). Announce 200 feet before leveling off from a climb and announce 200 feet before leveling off from a descent (“200 FEET TO GO”). Even with these standard calls, the leveling action doesn’t have to begin until the lead point for leveling off. The lead point is calculated using 10% of the VSI. Example: if you want to level off from a climb at 5000 feet and have a VSI reading of 500 feet per minute, you will start leveling off at 4950 feet.

TIMED TURNS TO MAGNETIC COMPASS HEADINGS

During normal instrument flight all turns should be made at standard rate. The definition of a standard rate turn may differ from faster to slower aircraft. For all USU aircraft a standard rate turn will be 3° per second. This turns out to be 360 degrees in two minutes and 180 degrees in one minute. Standard rate indication on the G1000 is the magenta line that grows from the top of the Directional Gyro. The first mark on either side of the level mark indicates a ½ standard rate and then the next marks are standard rate marks. In a malfunction where the G1000 is not displaying turn rate information, a good rule of thumb is: (Airspeed÷10) + 6= approximate bank angle for a standard rate turn. Example: 100 Knots airspeed divided by 10 is 10 then add 6 would equal a 16° bank for standard rate. 100/10+6=16
A standard-rate turn of 3° per second equates to 10 seconds required to turn 30°. Knowing this relationship allows construction of the following chart:

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<th>Time (seconds)</th>
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<td>120</td>
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</tbody>
</table>

Timed turns are used when the primary heading display is malfunctioning or inoperative and heading information is being obtained from the magnetic compass. To execute a timed turn:

1. Start the timer
2. Enter the turn using a normal turn entry
3. Maintain standard rate turn for calculated or estimated amount of time
4. When the timer indicates the calculated or estimated time, roll out of the turn in a normal manner

**MAGNETIC COMPASS TURNS**

The other way to make turns when using only the magnetic compass is by understanding the turning errors inherent in the magnetic compass and making appropriate compensation for them. These turning errors consist of:

1. Magnetic dip- magnetic north is below the horizon due to the curvature of the earth.
2. Acceleration & deceleration error – the error displayed by the compass when accelerating or decelerating on an easterly or westerly heading.

The magnetic dip error is created because the magnetic north pole is not on the surface of the earth but under it. This creates an error which goes unnoticed on an easterly or westerly heading but is rather obvious as the heading moves closer to a north or south heading. This error becomes more pronounced closer to the north or south poles. To successfully navigate using the magnetic compass you must understand how to compensate for this error. Magnetic dip does not affect the procedures for timed turns.
However, when referencing the indication on the magnetic compass while making timed turns to headings it may appear that the aircraft has turned to far or not far enough when the desired time has arrived.

**Compensation for magnetic dip according to latitude:**

1. At a standard rate turn (a bank angle of approximately 15-18°) the amount of lead or lag when turning directly north or south varies with and is a function of the current local latitude (e.g., 42° at KLGU)

2. You must either lead or lag northerly or southerly headings according to the acronym of UNOS – Undershoot North Overshoot South. Interpreted, this acronym means that when using a magnetic compass, we must roll out of a turn the appropriate number of degrees before our desired heading when turning to northerly headings and the appropriate number of degrees after passing our desired heading when turning to southerly headings.

3. When turning to a heading of 360° (or magnetic north) the degrees of lead are calculated as follows:

   Degrees of lead = function of current latitude + normal lead

   Where:

   Function of current latitude = (100-degrees of current latitude) as a percentage*your current latitude.

   Normal lead = the normal number of degrees a roll to level is initiated before a desired heading.

   The degrees of lead for a magnetic compass turn near KLGU when turning to magnetic north = ((100-42)%*42)^+5° = 29 degrees of lead

   Complete the calculation for a turn from a westerly heading to magnetic north by the formula: Desired heading-Degrees of lead = Compass indication to begin roll out; in the case of our example 360°-29° = 331°. In a right turn to magnetic north begin to roll the wings level out of the turn when the magnetic compass indicates 331°. After rolling out, maintain wings level for a few seconds giving the magnetic compass time to stabilize and indicate our new heading which should be 360°, or something very close to it. Make any corrections necessary to fine-tune the resultant heading.

   From the other direction, in other words approaching north from an easterly direction in a left turn the calculation formula would be: Desired heading+Degrees of lead = Compass indication to begin roll out. This results in a magnetic compass indication of 29° (360° or 0°+29° = 29°) to begin rolling the wings level in order to achieve a heading of 360° after rollout.

4. When turning to a heading of 180° (or directly south) one must overshoot the desired heading the appropriate degrees of lag before rolling wings level. The degrees of lag are calculated by subtracting the normal lead from the function of the current latitude instead of adding the normal lead. The reason for this is because we must begin our roll-out after our desired heading instead of before it. This means that we are approaching it from the opposite side and therefore we subtract it from our current latitude instead of adding it to our current latitude. When turning to a heading of 180° our Degrees of lag = Function of current latitude-Normal lead. The degrees of lag for a magnetic compass turn near KLGU when turning directly south = 29°-5°=24°.
When turning directly south from a westerly heading the Compass indication to begin roll out = Desired heading-Degrees of lag. This yields a rollout compass indication of 180°-24° = 156°. At 156° compass indication, roll wings level in a normal manner and allow the compass to stabilize. The compass will move backwards and indicate a wings-level heading of approximately 180°. Fine-tune this heading as required.

From an easterly heading turning directly south the Compass indication to begin rollout = Desired heading+Degrees of lag (180°+24°=204°). Because we are turning from the east, we must overshoot our desired heading of 180° which means we must add our degrees of lag to our desired heading. When the magnetic compass indicates 204° we roll our wings level in a normal manner and allow the magnetic compass to stabilize by keeping our wings level until it stops oscillating.

As a rule-of-thumb for operations around the Logan-Cache Airport use the following rollout targets (very approximate); interpolate for other directions using a 10° before (lead)/after (lag) per each 30 degrees shown on DG/compass:

<table>
<thead>
<tr>
<th>Degrees from North or South</th>
<th>Degrees Lead/Lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>90</td>
<td>0</td>
</tr>
</tbody>
</table>

Use smooth control technique and accurate pitch-and-bank control.

The **acceleration & deceleration** error happens when the aircraft is on easterly or westerly headings. The effect of this error can be remembered by the acronym **ANDS**; **Accelerate North Decelerate South**. This means that when an aircraft is accelerated on either an easterly or westerly heading the magnetic compass will show a false, momentary turn to the north. When an aircraft is decelerated on an easterly or westerly heading the magnetic compass will show a false, temporary turn to the south. The compensation action for this error is to wait for the magnetic compass to stabilize and show the correct heading after acceleration or deceleration on an easterly or westerly heading.

**Other Magnetic Compass Errors:**

1. Compass deviation- caused by metals and electrical accessories in aircraft.
2. Magnetic variation- Difference between true north and magnetic north.
UNUSUAL ATTITUDE RECOVERY

There are two different kinds of unusual attitude recoveries: nose-low and nose-high attitude recovery. The results should be to resume straight and level un-accelerated flight.

Nose-Low recovery (increasing airspeed)

1. Throttle  Idle  POWER
2. Wings  Level  BANK
3. Elevator  Pull to the Horizon  PITCH

Nose-High recovery (decreasing airspeed)

1. Throttle  Full  POWER
2. Elevators  Push to Horizon  PITCH
3. Wings  Level  BANK

The greatest dangers of a nose-low attitude are:
1. Exceeding the never exceed airspeed and
2. Exceeding any structural load factors.

These two dangers explain the nose-low recovery procedure. Power is reduced to idle to eliminate any thrust which might be adding to the increasing airspeed of the aircraft due to the nose-low attitude. Any amount of bank will increase the load factor on an aircraft. Therefore, the bank is removed before the pitch to eliminate any extra load factor which would be imposed on the aircraft by the bank. The purpose is to keep the load imposed on the aircraft to a minimum during the ensuing pull-out from the dive.

In a nose-high attitude the greatest danger is stalling the aircraft. Hence the order of recovery actions is power and pitch first to avoid a stall and last bank because it is least important during stall recovery.

In an excessively nose-low or nose-high attitude the G1000 PFD will display red chevrons pointing to the horizon starting at 50° above and 30° below the horizon line. Verify the indication of the attitude indicator with the other instruments. In a nose-low attitude, the airspeed will be high and/or increasing. In a nose-high attitude the airspeed will be low and/or decreasing and the aircraft will be close to a stall. The vertical speed indicator will indicate a negative vertical speed when in a nose-low attitude or a positive vertical speed when in a nose-high attitude. The heading indicator and the turn rate indicator should indicate a turn in the same direction as the bank indication on the attitude indicator. You know when you are level when the airspeed, altimeter and the VSI neutralize or return to zero and when the turning instruments indicate wings level. If necessary use the backup attitude indicator to correct an unusual attitude and the backup pitot-static instruments to arrest an unintended climb or descent. After recovering from an unusual attitude trim the elevator pressure to maintain pitch attitude and set power for an appropriate airspeed.
HOLDING PROCEDURES

HOLDING

Holds are used to maintain aircraft separation. They are used to sequence aircraft for approaches. They can be used to handle delays. They are used frequently in missed approach procedures. They might be used to wait for significant weather to pass. There are many places where holds can be used.

A holding pattern is defined by a holding fix, a holding course, and the direction of turns in the pattern. These three parameters are given either on a chart with a depicted hold or by ATC if the hold is not a published hold.

The direction of turns is implied as standard right turns if it is not specified by ATC in the issuance of an unpublished hold or published as a left turn hold on instrument charts. Standard holding pattern turns are Right Turns. This is the direction that a pilot should assume to turn in a holding pattern unless otherwise specified. A holding pattern with Left Turns is called a non-standard holding pattern. The only time you will do a non-standard hold is when specifically asked to do so. The direction of turns parameter of a holding fix indicates the direction the aircraft will be turned outbound after crossing the holding fix and inbound after completing the outbound leg (see the diagram below).

The holding fix is the anchor of the hold. It’s a point in space identified by electronic means. The structure of each hold is designed around the holding fix. The direction of the hold from the fix is given in rough magnetic terms (i.e. north, northeast, east, southeast, etc.); this is also the general direction of the outbound leg. Given no wind, one can expect the outbound heading to be found in the direction from the fix given in the hold clearance. This is useful because the outbound, calm wind heading allows us to determine the hold entry by referencing the HSI (or heading indicator).

The inbound leg is also known as the holding course. In the case of a GPS holding fix the holding course will most likely be given as a specified course TO the GPS waypoint. If the holding fix is a VOR the holding course will be defined by a VOR radial. An NDB holding course will be identified as a bearing TO the NDB.

The correct entry procedure (see below) and the appropriate direction of turns are important because these two things will help keep you, your passengers, and the airplane on the side of the inbound course known as the “protected side”. The protected area is the area around the fix, at a given altitude or higher, where terrain clearance is assured. This means as long as one does not get too far away from the fix during hold maneuvering and remains on the protected side and at or above the minimum altitude, he or she will remain clear of all obstacles while in the hold.
Magnetic reciprocals are often useful and even necessary during instrument flight. The reciprocal of an inbound heading or course will give the calm-wind outbound heading of the hold. Many times, a reciprocal will have to be calculated. A simple and convenient way to calculate a reciprocal is the 200 and 20 method. This entails first adding 200° if the result will equal less than 360° or subtracting 200° if the result will equal more than 360°; then applying the opposite of the initial with the 20°.

Two examples:

1. Holding on a 073° GPS course to the fix
   
   073° inbound course plus 200° minus 20° = 253°
   
   073+200°=273-20°= 253°

   The outbound course is 253°

2. Holding on the 294° radial (the outbound course is 294° because this is a VOR radial)

   294° radial, adding 200 would make it greater than 360, so we subtract
   
   294° minus 200° then add 20° = 114°
   
   294-200°=094+20°=114°

   The inbound course is 114°

Another way to decide if you will add the 200° and subtract the 20° or subtract the 200° and add the 20° to calculate a reciprocal course or heading is by identifying the location of the initial course or heading on the heading indicator. If the course or heading you’re trying to convert is located on the lower half of the heading indicator (0° - 180°) then you will begin the reciprocal calculation by adding 200°. The 200 and 20 method is the easiest and best way to calculate reciprocals in your head while flying.
APPROACHING THE HOLDING FIX

Certain items need to be done before entering the hold. These items make up the hold setup checklist. This checklist should be done at 20 NM out or as soon as possible if within 20NM of the holding fix. The checklist items consist of the following in order:

1. Set navigational equipment to identify the holding fix
2. Determine entry
3. Set holding airspeed (100 KIAS DA40/ 110 KIAS DA42) & trim for that airspeed
4. Put GPS into SUSP mode before reaching the fix
5. Set timer to be started upon reaching the fix
6. Perform cruise checklist

HOLD ENTRY

There are three different kinds of hold entries: Direct, Teardrop, and Parallel. The direction from which you are approaching the holding fix will determine the most logical entry to use. Using the recommended hold entry correctly will reduce the number of turns necessary to enter the hold and keep you on the protected side of the hold during the hold entry. The hold entries are designed to establish the aircraft in the hold track, flying the proper direction.
1. **Direct**: this hold entry is the easiest and covers a 180° fix approach sector. To enter a hold using a direct entry, cross the fix and turn in the same direction of hold turns, directly to the outbound heading corrected for wind. Continue normal hold procedures.

2. **Teardrop**: this hold entry covers a 70° fix approach sector and is made by crossing the fix and flying a course from the fix that is 30° from the inbound course into the protected area of the hold. This course is flown outbound for one minute and then a standard rate turn, in the same direction of hold turns, is executed to intercept the inbound course and fly it to the fix. Continue normal hold procedures.

3. **Parallel**: This hold entry covers a 110° fix approach sector. An important thing to remember to remain on the protected side of the hold during this entry is that the first two turns in the parallel entry are opposite to the direction of the hold turns. For a standard hold (to the right) your first two turns will be to the left, and then all other turns will be in the direction of the hold. The first turn is to intercept the course opposite the inbound course and the next turn is to turn back to the holding fix. The outbound course, the opposite of the inbound, will be flown. This is to verify that you are remaining in the protected area. After flying the reciprocal course outbound for one minute, turn the opposite direction of the hold turns and:
   a. For VOR stations and GPS waypoints- fly direct back to the holding fix. Continue normal hold procedures.
   b. For Localizer or Intersection Holds- turn to an intercept heading for the inbound course. When the course needle comes alive, intercept and track the inbound course to the fix. Continue normal hold procedures.

**DETERMINING HOLD ENTRY**

You can figure the holding entry in two different ways: visualize your position and entry on the approach chart or use the directional gyro and navigational instruments to determine the entry.

It is sometimes easy to see which of the three hold entries will be the best by looking at the depiction of the hold on a chart and visualizing your location in relation to the hold fix. Identify your approach sector by superimposing the appropriate hold entry sector diagram (found above) around the hold fix. With experience, the angle from the inbound course as you approach a holding fix will tell you which hold entry to use.

**Hold Entry Tricks**

If visualizing isn’t your thing or you would like a more practical way to determine a hold entry, the **right hand/left hand trick** or the **thumb trick** are for you. A trick is almost required to determine a hold entry for an ATC issued hold which isn’t depicted on instrument navigation charts. Either method can be used to determine the entry to any hold, including depicted holds.
Right hand/Left hand Trick

To perform this trick you have to decide which hand to use. You only have two hands so it shouldn't be too difficult to decide. If the hold is a standard hold, having right turns, you must select your right hand. If the hold is non-standard, having left turns, you must select your left hand. After determining which hand to use, set your heading bug on your assigned holding radial. Place your hand over the HSI with your index finger up representing your current heading, but not touching, the G1000 screen. The heading bug’s position tells you which hold entry procedure to fly. If the heading bug is in the area between the index and middle fingers (~70°) use a Teardrop entry. If the heading bug is in the area between the index finger and the first knuckle of the thumb (~110°) use a Parallel entry. Finally, if the heading bug is in the area below the middle finger and the first knuckle of the thumb (~180°) use a Direct entry. See figure below.

Thumb Trick

To perform this trick, you have to decide which thumb to use. You only have two thumbs so it shouldn’t be too difficult to decide. If the hold is a standard hold, having right turns, you must select your right hand thumb. If the hold is non-standard, having left turns, you must select your left hand thumb. Now that we have that decision out of the way, you must make another not-so-difficult decision. You must decide which side of the HSI to reference with your thumb. If you’ve selected your right thumb because your hold will be a standard hold with right turns, you will reference the right side of the HSI. As you might have guessed, if you have selected your left thumb because your hold will be a non-standard hold with left turns, you will reference the left side of the HSI. Now place the selected thumb in front of, but not touching, the G1000 screen and over the
associated 90° point; that is if you have selected your right thumb for a standard hold place your right thumb over the right 90° point on the HSI and if you have selected the left thumb for a non-standard hold place your left thumb over the left 90° point. An imaginary line is then drawn at an angle from 20° above the thumb to the opposite side 20° below the other 90° point. The lower half of the HSI below the slanted line identifies the **Direct entry region**. The top, center of the HSI is the separator for the teardrop and parallel entry regions. The region directly above the thumb to the top, center of the HSI identifies the **Teardrop entry region**. The region on the side opposite the thumb, from the top, center of the HSI to 20° below the 90° point identifies the **Parallel entry region**. (See diagrams below.) The next step is to find the **outbound** heading of the hold on the heading indicator. The recommended hold entry is found by identifying the region where the **outbound** heading lies. If the outbound heading lies in the teardrop region, you will perform a teardrop entry; if the outbound heading lies in the parallel region you will use the parallel entry; if the outbound heading lies in the direct region you will use the direct entry.

**Teardrop Hold Entry Details**

If the hold entry is identified as a teardrop entry, the HSI can help you determine the course you will fly outbound during the teardrop hold entry. To determine the correct outbound course for the teardrop entry move 30° from the outbound hold heading toward the top of the HSI and continue if necessary past the top of the HSI. Example: if your hold is a standard hold with an outbound, no-wind heading of 200° continue to move 30° toward the top of the HSI. This will make 170° the course to be flown outbound during the entry. (See figure above.) This is the appropriate course to fly
outbound during the teardrop hold entry even though this outbound entry course lies in the parallel sector.

To execute this teardrop hold entry:

1. Start a timer over the fix.
2. Set the HSI needle on the teardrop entry course (170° in our example above).
3. Track the entry course for 1 minute.
4. Set the HSI needle on the inbound course (020° in our example above).
5. Make a standard rate turn in the direction of hold turns to intercept the inbound Course.
6. Track the inbound course to the fix.
7. The timer should read 3:00 minutes upon crossing the fix at the end of the entry.
8. Continue normal hold procedures.

If there is no teardrop course to track outbound from the fix fly the teardrop course heading, corrected for wind, instead.

HOLDING PROCEDURES

1. All holdings will be accomplished in accordance with FAA requirements and USU SOPs.
2. Aircraft configuration for holding procedures is with the flaps retracted.
3. Holding airspeed in the DA40 is 100 KIAS and 110 KIAS in the DA42. You should use the appropriate power settings to hold this speed.
4. Begin a speed reduction to cross a point three minutes prior to reaching the fix at holding Speed.
5. Throughout the Holding Maneuver you must adjust the pattern for wind. All adjustments are made on the outbound leg. Sometimes adjustments beyond the normal adjustments must be made to comply with an EFC time.

The completion of each hold entry occurs when the holding fix is crossed in the proper direction of the hold. At station passage, make a standard rate turn in the direction of the hold (Right: standard, Left: non-standard). Continue this turn until the outbound heading, corrected for wind, is attained. Regardless of whether you have completed the outbound turn or not, start the outbound timer upon crossing the perpendicular course.

There are a few ways to identify the perpendicular course:

1. Set the HSI to the perpendicular course and wait until the needle centers
2. Wait for the RMI needle to indicate the perpendicular course
3. When the DME reads the same as the holding fix DME. (This method does not identify the perpendicular course exactly, but it is close enough.)

If none of these options are available, the timer will be started when the outbound turn is completed.
Timming Adjustment

Each lap in the hold will be timed and the next one adjusted for a 3 minute pattern. The timer will be started at the perpendicular point in the hold (also referred to as the abeam position) and it will run until crossing the fix at the end of the inbound leg of the pattern. If the time upon reaching the fix is greater or less than 3 minutes the outbound timing must be adjusted.

A time of greater than three minutes generally means there is a tail-wind on the outbound leg and a headwind on the inbound leg. To adjust for a hold time of greater than three minutes one must reduce the timing on the outbound leg. Upon crossing the fix, note the number of seconds over 3 minutes and use that number to calculate the adjusted outbound leg time. The calculation is made by dividing the number of seconds over 3 minutes by two and subtracting that from the standard outbound time of 1 minute (the same principle can be used with a different target hold pattern time, as necessary). Example: if the timing of the last lap in the hold was 3:10 seconds, in other words 10 seconds over, we will decrease the outbound leg time by 5 seconds (10÷2). If 1 minute was the last outbound leg time used, we will use 55 seconds as our next outbound leg time. The amount of time over or under 3 minutes is divided in half for the outbound correction because any change made to the outbound leg will be duplicated on the inbound leg.

A holding pattern time of less than 3 minutes indicates a headwind on the outbound leg and a tailwind on the inbound leg. To correct for this wind condition requires that the appropriate amount of time is added to the outbound leg. Again, any time discrepancy from the desired timing will be divided by 2 and the result applied to the outbound timing. For example, if the last time noted over the holding fix was 2:30 the outbound time will be adjusted by adding 15 seconds to the outbound time used last. If the last time used outbound was 1 minute the new outbound target will be 1:15 outbound. Repeating this process to hone in on the correct outbound time, given the wind conditions present, will allow a holding pattern to be completed with a consistent pattern time and a consistent outbound time.

Now for the exception, we must be over the fix at our “Expect Further Clearance” time so as to be ready to start an approach or to continue with the next leg of our flight. A standard timed hold takes a total of 4 minutes. The holding pattern will need to be adjusted as necessary so we are over the entry point at the EFC time. For example, if given and EFC of 10 minutes, we could do two full holds of 4 minutes equaling 8 minutes and be left with 2 more minutes before our EFC time. 2 minutes is not enough time to do a full 4 minute turn so we must modify our holding pattern so that the next time around takes only 2 minutes. The way to accomplish this is by doing two standard rate turns without the one minute legs between. If instead you had to reduce the holding pattern to three minutes, this could be done by two standard rate turns with 30 second legs between (assuming no wind). The standard pattern time of 4 minutes per turn is simply a standard. Different pattern times can be assigned or requested. Pattern
legs can also be assigned by distance (i.e. 10 mile legs). When legs are assigned by distance, simply fly the outbound leg until reaching:

1. **Holding inbound to the navaid/waypoint**

   ...the fix DME plus leg distance (i.e. if your holding fix has a DME reading of 10 NM and 5 mile legs have been assigned, turn inbound to intercept the inbound course when the DME reads 15 NM).

   ![Diagram](image)

2. **Holding outbound from the navaid/waypoint**

   ...the fix DME minus leg distance (i.e. if your holding fix has a DME reading of 15 NM and 8 mile legs have been assigned, turn inbound to intercept the inbound course when the DME reads 7 NM).

   ![Diagram](image)

**Wind Correction:**

Wind correction is necessary when in holds to remain in the protected area of any hold. The wind correction angle to maintain the inbound course should be noted when established on the inbound leg and approximately tripled in the opposite direction on the outbound course. Failure to do so could cause the aircraft to be blown out of the protected area and into eminent danger. Use the G1000 wind direction indicator to make sure your corrections are into the wind.
Dual Correction

Of course, it is rare to only make timing corrections or to only make corrections for wind in a hold. You must anticipate that these two corrections will be made together in order to fly a successful holding pattern. Corrections can also be anticipated before entering the hold by looking at the wind vector on the G1000. It may be appropriate to make corrections starting at the hold entry. Before entering a hold anticipate the effects of the wind and plan any corrections that might be necessary. This will make the correction process more effective and will help maintain a uniform holding pattern.
Instrument Approach Procedures

APPRAACH SET-UP

Approach set-up should begin as early as practical but no later than 30 nautical miles from the destination airport. A good mental reminder will be when the GPS switches from En-route to Terminal mode. At this point, preparation for descent and approach should be well under way or should be initiated. Descent/approach preparation includes the following: getting the current weather, selecting the appropriate approach chart(s), setting the proper radio frequencies for both communication and navigation, identifying navaids, setting courses, briefing the approach, and doing the descent/approach checklist. Approach set-up should be completed no later than 10 nautical miles before the initial approach fix.

Transition routes, DME arcs, ATC routing, and Procedure Turns

You may be asked to fly a route, vector or heading. These should all be done at 100 KIAS and with the flaps up in the DA40. In the DA42 you should fly at 110 KIAS and with the flaps up. Except that when you are vectored to a heading within 90° of the inbound course, your power setting and speed should slow to 90 KIAS and with the flaps up in the DA40. The DA42 should be flown at 100 KIAS and with the flaps up.

There are basically two ways to receive guidance to fly DME arcs:

1. If the DME arc is associated with an approach contained within the database of a GPS unit, the arc will be painted on the MFD when the approach is activated and the GPS needle will provide guidance to maintain that arc as it is navigated during the approach.
2. If the DME arc is not in the GPS database being used, the arc must be identified by indications from the associated navaid or waypoint and acceptable distance measuring equipment. Using the G1000, make sure that the appropriate waypoint is being used for distance readings. The required DME waypoint may not be the one the GPS has automatically cycled to on an approach or in a flight plan. Always confirm the DME waypoint before relying on its indication for navigation. This is extremely important to remember when flying an approach that requires DME when using the GPS for distance information. Make sure that the distance measurement is coming from the appropriate reference.

To fly a DME arc that is not in a GPS database:

1. Identify the appropriate DME navaid or waypoint.
2. Tune the RMI to the DME navaid or waypoint.
3. Fly the assigned course, or otherwise appropriate course, toward the DME arc.
4. Initiate the turn onto the arc before reaching the arc distance. When approaching the arc on a 90° course at 100 KIAS lead the turn to the arc by 0.5 NM.
5. Stop the turn when the RMI needle is pointing down the wing (90° from the heading), corrected for any wind.
6. If the DME reading is appropriate for the arc being flown, adjust the heading as required to keep the RMI needle on the wing (corrected for wind). If the DME reading is incorrect, make appropriate corrections according to the following procedures:

a. **Inside the arc by less than 0.2 NM** – maintain heading 90° off of the RMI needle indication, corrected for wind. DME reading should increase.

b. **Inside the arc by greater than 0.2 NM but less than 0.5 NM** – adjust heading to place the RMI needle 10 degrees behind the inside wing (100° from heading), corrected for wind.

c. **Inside the arc by greater than 0.5 NM but less than 1.0 NM** – adjust heading to place the RMI needle 20 degrees behind the inside wing (110° from heading), corrected for wind.

d. **Outside the arc by 0.1 NM** – adjust heading to place the RMI needle 20 degrees in front of the inside wing (70° from heading), corrected for wind.

e. **Outside the arc by greater than 0.1 NM but less than 0.5 NM** – adjust heading to place the RMI needle 30 degrees in front of the inside wing (60° from heading), corrected for wind.

f. **Outside the arc by greater than 0.5 NM** – adjust heading to place the RMI needle 45 degrees in front of the inside wing (45° from heading), corrected for wind.

Continue to track the DME arc using these procedures.

**PROCEDURE TURNS**

Depending on the instrument approach procedure and the direction from which the procedure is entered, a procedure turn may be required. A procedure turn is **not authorized** if approaching from a sector with the note “No PT” (No Procedure Turn). Otherwise, if a procedure turn is depicted on an approach plate, it is a **required** part of the maneuver unless ATC authorizes a deviation.

The DA40 should be slowed down to **100 KIAS** and the DA42 slowed to **110 KIAS** prior to the procedure turn fix. Timing for procedure turns will start when crossing the procedure turn fix outbound. The outbound course will be tracked for one minute. At the end of **one minute** the timer will continue to run and a **45° turn** will be made toward the protected side of the procedure turn. That heading will be flown for one additional minute, until the timer reads two minutes. The timing and heading may be adjusted as necessary to correct for wind. At the end of two minutes the timer will continue to run and a **180° turn** to the outside of the procedure turn will be made to establish a **45° intercept heading** to the inbound procedure turn course. The inbound course will be intercepted and the timer reset. The timer should read about 3:30 to 4:00 minutes upon intercepting the inbound course. The timer will be started crossing the procedure turn fix inbound for approach timing.
There are other course reversal procedures that may be depicted on charts or used to fly procedure turns. Any specific course reversal depicted on an approach chart must be followed as depicted, but in lieu of anything specifically depicted on an approach chart all procedure turns and standard course reversals for USU instrument operations will be flown as explained above.

**INSTRUMENT APPROACHES**

90% of all approaches are the same. They consist of IAF, IF, FAF, and MAP’s. The differences are in headings, distances, and altitudes or decision heights (DA or MDA). You will be taught the criteria for flying these as accurately as possible, but practice and chart interpretation are paramount in order to arrive at the missed approach point safely and in a condition where a decision to land or to execute the missed approach procedure can be made. The proper altitude, vertical speed, course, and aircraft configuration are required to safely and effectively execute an instrument approach.

Approach settings of $V_{tgt}$ (T/O flaps and carburetor heat ON in the DA40, APP flaps and gear down in the DA42), should be used until 200 feet above the DH or MDA. T/O flaps should be added at glide slope alive for precision approaches or at a point where a continuous descent to the MDA is expected for non-precision approaches. At the position and standard call of ‘200 FEET ABOVE MINIMUMS’ the carburetor heat will be turned OFF (in the DA40-F), the prop FULL FORWARD (in the DA40CS), and the landing gear callout will be made. The landing gear callout varies depending on the aircraft. In the DA40s and all other fixed gear aircraft the callout will be: ‘LANDING GEAR FIXED’. If the aircraft has retractable gear the pilot will confirm that the gear is down and locked and that the gear indications are correct for landing. When the status of the landing gear has been confirmed down by the pilot the callout will be: ‘GEAR DOWN, THREE GREEN’. After the 200 foot checks are completed and the necessary visual cues for landing are observed the airspeed will be slowed to $V_{ref}$. If the approach is a straight-in approach and the runway is in sight, additional flaps may be added according to the pilot’s judgment. If it is a circling approach the application of additional flaps should be postponed until a continuous descent to landing is expected from the circling maneuver.

At glide slope intercept or the final approach fix (FAF) the speed of $V_{tgt}$ will be flown until approach minimums. Once a landing is assured $V_{ref}$ speed will be flown. $V_{ref}$ and $V_{tgt}$ are explained below; they are dependent on the configuration and weight of the airplane and the effects of wind. Although not crucial to flying smaller aircraft, $V_{tgt}$ and $V_{ref}$ are calculated during instrument operations at USU to educate and prepare students for larger aircraft operations. In larger aircraft these are safety speeds indicating the slowest airspeeds to be used to maintain positive control of the aircraft while maneuvering.
**V_{tgt}**

\[ V_{tgt} = V_{ref} + 5 \text{ knots} + \frac{1}{2} \text{ the steady state of wind} + \text{Gust factor} \text{ (never exceed Vref +25)} \]

DA40 Example: Winds 340 @ 12 gusting 16 (in this example the gust factor is 4 knots, take 16-12 to get the factor.) = 71+5+6+4 =90. \( V_{tgt} \) is **86 KIAS under these conditions**. \( V_{tgt} \) speed will be flown from the FAF to minimums. Higher airspeeds may be used at the discretion of the PIC if ATC requests a higher speed for spacing. If a higher airspeed is used in place of \( V_{tgt} \) the aircraft will be slowed to regular \( V_{ref} \) when approach minimums are reached and landing is assured.

**\( V_{ref} \)**

\( V_{ref} \) speed is used after approach is at minimums and the approach lighting or runway is in sight. It is the slowest safe airspeed an aircraft can fly depending on weight and aircraft configuration. For training purposes at USU **75 KIAS will be used as \( V_{ref} \) in all DA40s.** \( V_{ref} \) of **82 KIAS will be used in the DA42.** At approach minimums, this airspeed will be flown until the MAP or until landing is assured.

After landing is assured the speeds in the following table will be used:

**\( V_{ref} \) table – landing assured**

For use after visual reference to the airport has been confirmed and aircraft is making final approach to landing.

**DA40**

<table>
<thead>
<tr>
<th>Airspeed</th>
<th>1874 lb</th>
<th>2205 lb</th>
<th>2535 lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach in cruise settings (Flaps UP or T/O)</td>
<td>60 KIAS</td>
<td>68 KIAS</td>
<td>73 KIAS</td>
</tr>
<tr>
<td>Approach for normal landing (Flaps LDG)</td>
<td>58 KIAS</td>
<td>63 KIAS</td>
<td>71 KIAS</td>
</tr>
</tbody>
</table>

**DA42**

<table>
<thead>
<tr>
<th>Airspeed</th>
<th>Below 3748 lbs.</th>
<th>Above 3748 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach in cruise settings (Flaps UP or APP)</td>
<td>82 KIAS</td>
<td>82 KIAS</td>
</tr>
<tr>
<td>Approach for normal landing (Flaps LDG)</td>
<td>76 KIAS</td>
<td>78 KIAS</td>
</tr>
</tbody>
</table>
Visual Descent Point:

A Visual Descent Point (VDP) is a point associated with a non-precision approach procedure. It is that point at the MDA of a non-precision approach from which a normal descent to landing can be made. The VDP is only practical for straight-in approaches; it is not applicable to circling approaches. You can think of a VDP as an alternative MAP. Any descent to landing from an instrument approach procedure is supposed to be made at a “normal descent rate, using normal maneuvers.” The required descent rate after the VDP to make the touchdown zone becomes too steep for a “normal descent rate.” This means that a missed approach should be initiated at the VDP instead of the MAP during straight-in, non-precision approaches. If instead the approach is to be terminated in a circling procedure, it is appropriate to continue past the VDP to the MAP if the airport or runway environment is not yet in sight. A VDP distance from runway threshold is calculated as follows:

VDP = Height Above Touchdown/300

In the case of a GPS approach with a MAP at the threshold, the VDP, as calculated by the equation above, will be the distance to the MAP read on the GPS distance readout when the MAP is the next waypoint.

If the MAP is located at other than the runway threshold or the measuring navaid is located other than the MAP, additional calculations must be made to find a useful distance measurement that can be portrayed on the flight instruments.
1. GPS approach with MAP located other than runway threshold: If the MAP is before the runway threshold the distance between the runway threshold and the MAP must be subtracted from the initial VDP to get the correct distance readout from the MAP for the VDP. If the MAP is after the runway threshold the distance between the runway threshold and the MAP must be added to the initial VDP to get the correct distance readout from the MAP for the VDP. (This method also works for a LOC approach when the MAP is defined by a LOC DME readout.)

   a. Example: KDXZ RNAV (GPS) Rwy 1

   ![](image)

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   **MDA 909’**
   
   \[
   909/300 = 3.03 \text{ NM from runway threshold} \\
   \text{VDP} = \text{distance from runway threshold} - \text{distance from MAP to runway threshold} \\
   \text{VDP} = 3.0 - 0.5 = 2.5 \text{ miles before IRQEV}
   \]

   **MDA 489’**
   
   \[
   489/300 = 1.63 \text{ NM from runway threshold} \\
   \text{VDP} = \text{distance from runway threshold} - \text{distance from MAP to runway threshold} \\
   \text{VDP} = 1.6 - 0.5 = 1.1 \text{ miles before IRQEV}
   \]
2. Measuring navaid located other than MAP: If the measuring navaid is after the MAP, the initial VDP calculation must be added to the MAP distance to get the distance readout which can be read on the flight instruments. If the measuring navaid is before the MAP, the initial VDP calculation must be subtracted from the MAP distance.

   a. Example: KPIH VOR DME Rwy 21

   388/300 = 1.29 NM from runway threshold
   VDP = MAP DME + distance from runway threshold
   VDP = 4.4 + 1.3 = 5.7 VOR DME readout
3. **Dual compensation**: In some cases you may have to compensate both for a runway threshold which is offset from the MAP and a measuring navaid located before or after the MAP.

   a. **Example: KOGD VOR DME Rwy 7**

   ![Diagram showing dual compensation example]

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   \[
   \text{VDP} = \text{MAP DME} - (\text{distance from runway threshold} - \text{MAP distance from runway threshold})
   \]

   

   \[
   \text{VDP} = 3.5 - (1.5 - 0.3) = 2.3 \text{ VOR DME readout}
   \]

   

   **VDP TIMING**

   If the MAP is based on timing rather than distance, a VDP can be calculated using the following formula:

   \[
   \frac{\text{HAT}}{\text{GS} \times 10} = \text{time in seconds to subtract from MAP time}
   \]

   Example 3:00 to runway- 0:45 (for 450' HAT and GS 100) = 2:15 to VDP

   This works when the MAP is at the threshold. If the MAP is before the threshold then the time to the VDP is greater than the time calculated by this formula and if the MAP is after the threshold the time to the VDP is less.
STANDARD CALLOUTS:

There are certain calls that must be made on every approach. This box will show in approach profiles when a callout is expected:

USU pilots will make the following callouts during instrument approaches. The word minimums will be used to signify both MDA and DA.

Here are the standard callouts:

- VOCALIZE CURRENT WEATHER AND ALTIMETER STATUS.
- “DESCENT/APPROACH CHECKLIST COMPLETE”
- “LANDING CHECKLIST COMPLETE”
- “1000 FEET ABOVE MINIMUMS”
- “200 FEET ABOVE MINIMUMS, CARB HEAT COLD, PROP FULL FORWARD, GEAR DOWN-3 GREEN”
- “MINIMUMS”
- “RUNWAY IN SIGHT”
- “MISSED APPROACH POINT, GOING MISSED”
Upon reaching the ½ mile or glide slope alive, aircraft configuration should occur. Maintain glide path with minimal pitch change. Trim for the airspeed of $V_{tgt}$ to achieve about a 450-500 feet per minute descent. Adjust Power/RPM's as necessary to maintain the required foot per minute descent. Don’t forget to look outside as you approach minimums.

Circling should be initiated at the appropriate altitude, and the proper visual references should be maintained throughout the circle. If visual reference is LOST during the circling maneuver climb and turn toward the center of the airport, then proceed as published on the missed approach.

<table>
<thead>
<tr>
<th>1/2 Mile to OM (FAF) or GS Alive</th>
<th>Circling</th>
<th>Visual, Straight-in or Final Approach</th>
<th>Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed Tape</td>
<td>$V_{tgt}$</td>
<td>$V_{tgt}$</td>
<td>$V_{ref}$</td>
</tr>
<tr>
<td>Power Setting</td>
<td>DA40F- 2000 RPM DA40CS- 18' M.P. ~2400 RPM DA42- PWR ~60-70%</td>
<td>As required</td>
<td>Idle/As Required</td>
</tr>
<tr>
<td>Configuration</td>
<td>Flaps DA40- T/O DA42- APP</td>
<td>Flaps DA40- T/O DA42- APP</td>
<td>Flaps LDG Carb Heat Cold Prop Full Forward Gear Down</td>
</tr>
</tbody>
</table>

Minimums (DH) Runway in sight: continue Runway not in sight: Missed approach
NON-PRECISION APPROACH

It is necessary on certain non-precision approaches to start a timer and follow a prescribed rate of descent calculated in feet per minute. By figuring this out you can make a stabilized approach all the way down to the MDA. To do this you take your groundspeed divided by 60 to figure out how fast you are covering the ground. Then you will look at the approach chart to see the altitude to which you must descend and the distance to the MDA, and from that figure a constant rate of descent.

Example: Your groundspeed is 110 knots. 110/60= 1.83 nautical miles per minute. If your approach started at 7,000 feet and descended to 4,800 feet, you would have 2,200 feet to descend. If the final approach to missed approach was 8 miles, then at 1.8 nautical miles a minute you have 4 minutes to descend 2,200 feet. 2,200/4= 550 feet per minute to calculate a stabilized approach for a non-precision approach.

For Circling, fly the same as a PRECISION approach, except the final notch of flaps should only be added when the runway is in sight, and the landing is assured.
DEFINITIONS

Minimum Safe Altitude (MSA) Is the safe altitude within 25NM of the airport or navaid and provides 1000’ obstacle clearance in both mountainous and non-mountainous areas. It is usually located within 30 miles of the airport and is for emergency use only.

Minimum Vectoring Altitude (MVA) Is the minimum altitude in which ATC can vector an aircraft. This guarantees 1000’ obstacle clearance in non-mountainous areas, 2000’ in mountainous areas, and 300’ within airspace.

Minimum Enroute Altitude (MEA) Is usually the lowest published altitude between radio fixes that guarantees adequate navigation signal reception and obstruction clearance (2000’ mountainous areas within 4NM, 1000’ elsewhere). Adequate communication can be expected but not guaranteed. There may be gaps up to 65 miles as indicated by “MEA GAP.”

Minimum Obstruction Clearance Altitude (MOCA) Guarantees obstacle clearance (2000’ mountainous areas within 4NM, 1000’ elsewhere), but only guarantees navigation signal coverage for 22 NM from the navigation facility. It is proceeded by an * on NOS charts and a “T” on Jeppesen charts.

Minimum Crossing Altitude Is the lowest altitude at certain fixes at which an aircraft must cross when proceeding in the direction of a higher minimum enroute IFR altitude.

Minimum Reception Altitude Is the lowest altitude at which an intersection can be determined.

Off-Route Obstruction Clearance Altitude (OROCA) Gives 2000’ obstruction clearance in mountainous areas and 1000’ elsewhere within a latitude and longitude grid area.

Non-Precision Approach Is a standard instrument approach procedure in which no electronic glide slope is provided; for example: NDB, VOR, TACAN, ASR, LDA, or SDF.

Precision Approach Is an IAP in which an electronic glideslope is provided such as an ILS, MLS, or PAR approach.

Procedure Turn (PT) Is a maneuver prescribed when it is necessary to reverse direction in order to establish an aircraft on the intermediate approach segment or on the final approach course. A procedure turn begins by over-flying a facility or fix. The maximum speed for a PT is 200 KIAS.
Final Approach Fix (FAF) Is at the glideslope intercept (lightning bolt) on a precision approach. If ATC directs a glideslope intercept altitude which is lower than that published, the actual point of glideslope intercept becomes the FAF. The Maltese Cross indicates the FAF on a non-precision approach.

Final Approach Point (FAP) Applies only to non-precision approaches with no designated FAF such as an on-airport VOR or NDB. It is the point at which an aircraft has completed the procedure turn, is established inbound on the final approach course, and may start the final descent. The FAP serves as the FAF and identifies the beginning of the final approach segment.

Glideslope Is a glide path that provides vertical guidance for an aircraft during approach and landing. Applying the glideslope angle and the ground speed to the rate of descent table gives a recommended vertical speed.

Height Above Touchdown (HAT) Is the height above the highest point within the first 3000' of the runway. It is published in conjunction with straight-in approaches and appears next to the MDA or DH of the approach plate.

Height Above Airport (HAA) Is the height above the highest point on any of the landing surfaces. It is published in conjunction with circling approaches and appears next to the MDA of the approach plate.

Threshold Crossing Height (TCH) Is the height above the threshold of the runway for a given glideslope.

Touchdown Zone Elevation (TDZE) Is the highest point within the first 3000' of the runway.

Field Elevation Is the highest point on any of the landing surfaces. It is not the highest point on the field, just the landing surface.

Minimum Descent Altitude (MDA) Is the altitude on a non-precision approach in which you must go missed or land visually and guarantees 300' obstacle clearance. The pilot can only descend below MDA when within 30° of the runway. Field Elevation + HAA = MDA

Decision Height (DH) Is the altitude on a precision approach while following a glideslope in which you must go missed or land visually. HAT + TDZE =DH
IFR FLIGHT PLANNING

Preflight Planning Required by FARs §91.103:

- Weather reports and forecasts
- Known traffic delays as advised by ATC
- Runway lengths of intended use
- Alternatives if flight cannot be completed as planned
- Fuel requirements
- Takeoff and landing distance data in the approved aircraft flight manual

Planning Steps

1. Check enroute chart
2. Review approach plates
3. ETE
4. Alternate requirements
5. File with FSS
6. Obtain Weather
7. Check for SID and DP’s- Ensure you look for Terrible T’s and A’s and AN/A’s
8. Plan Route - Consider: Take off mins, enroute weather, obstacle clearances, navigational aids
9. Enroute Consideration: - Obstructions clearance, Navigation aids, Freezing levels
10. Approaches - Consider: Weather mins, is an alternate required (1-2-3 rule), other ways to get into the field, check foot notes on approach plates
11. IFR – 1000ft ceiling, 3 miles visibility

IFR Flight Plans:

- No person may operate in controlled airspace under IFR unless that person has filed an IFR flight plan AND received an appropriate ATC clearance.
- A flight plan should be filed at least 30 min in advance. ATC will generally delete it 2 hours after estimated departure time.
- Pick up your IFR clearance 10 minutes before departure. Usually it will stay in the system for 2 hours from the time you pick it up.
- If on a VFR/IFR composite flight plan, close the VFR 5 minutes before the IFR portion.
- When filing your IFR plan, file the plan and then request a Wx brief because FSS will now know your intended route.
Filing an Alternate Airport:

- If 1 hour before and 1 hour after the time of intended landing at your primary airport the weather is predicted to be below a 2000’ ceiling and 3 SM visibility, filing an alternate airport is required. (1-2-3 rule).
- Or if the primary airport does not have a published instrument approach, you always have to file an alternate airport regardless of the weather.
- The exception to filing an alternate without an instrument approach is if a descent can be made from the MEA and land at the airport visually. (VFR)

Alternate requirements

- When an alternate is required, check the approach plate to see if the airport can legally be filed as an alternate. Look for (A NA). It needs to have approved weather reporting.
- Alternate airport weather requirements at ETA: A precision approach must have 600’ AGL ceiling and 2 miles visibility. A non-precision approach must have 800’ AGL ceiling and 2 miles visibility, if no alternate weather minimums are published.

Pre-Flight Considerations and Review

- IFR Fuel Requirements: Enough fuel to reach your primary airport, shoot an approach, fly to an alternate airport, and then fly 45-min thereafter at normal cruise power.
- Use personal minimums such as 1- 1 ½ hours of fuel instead.

Documents and Currency

Required Documents: ARROW
- Airworthiness Certificate
- Registration
- Radio License (International flight only)
- Operation Limitations (POH)
- Weight and Balance (Aircraft specific)

Flight review, Inspections & currency

<table>
<thead>
<tr>
<th>Flight Review</th>
<th>24 Calendar Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Certificate</td>
<td>24 or 60 Calendar Months-depending on age</td>
</tr>
<tr>
<td>Transponder</td>
<td>24 Calendar Months</td>
</tr>
<tr>
<td>Altimeter/Pitot/Static</td>
<td>24 Calendar Months</td>
</tr>
<tr>
<td>Annual</td>
<td>12 Calendar Months</td>
</tr>
<tr>
<td>ELT</td>
<td>12 Calendar Months</td>
</tr>
<tr>
<td>100-Hour</td>
<td>100 hour inspection-If for hire</td>
</tr>
<tr>
<td>IFR Currency</td>
<td>6 Calendar Months</td>
</tr>
<tr>
<td>VFR Currency</td>
<td>90 Days (same category and class)</td>
</tr>
<tr>
<td>VOR Test</td>
<td>30 Days</td>
</tr>
</tbody>
</table>

Appendix
Airspeed Indicator

- Measures the difference between ram air and static pressure.
  - If the entire pitot tube freezes (both the drain hole and ram pressure hole), the ASI will act like an altimeter.
- If just the ram pressure hole of the pitot tube freezes, the ASI will read zero.
- If just the drain hole of the pitot tube freezes, the ASI will read erroneously.
- Good practice is to use pitot heat when there is visible moisture, even in the summer. The pitot heat evaporates moisture.

Altimeter

- Always get the current altimeter setting before an approach.
- “Low-to-high, clear the sky”, “High-to-low, look out below.”
- There is 1” Hg change per 1000’.
- Pressure and temperature affect the altimeter.
- Colder than standard temperature will give a reading that is higher than actual.

VOR Checks

- VOT- transmits 360 deg radial, 180/TO, irrespective of position on airfield, maximum of 4 degrees error.
- Ground Check Point- you must taxi over a specified location on the airfield, maximum of 4 degrees error.
- Airborne Check- maximum of 6 degrees error.
- Airway Check- maximum of 6 degrees error.
- Dual Nav Check (on the ground or in the air)- maximum of 4 degrees difference between two nav receivers.
- Bench Check- done by approved personnel with approved equipment.
- VOR signal I.D. occurs every 15 seconds.
- DME signal I.D. occurs every 30 seconds.

VOR Types and Ranges

<table>
<thead>
<tr>
<th>VOR (T)</th>
<th>25nm</th>
<th>1000-12,000 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOR (L)</td>
<td>40nm</td>
<td>1000-18,000 feet</td>
</tr>
<tr>
<td>VOR (H)</td>
<td>40nm</td>
<td>1000-14,500 feet</td>
</tr>
<tr>
<td></td>
<td>100nm</td>
<td>14,500-18,000 feet</td>
</tr>
<tr>
<td></td>
<td>130nm</td>
<td>18,000-45,000 feet</td>
</tr>
<tr>
<td></td>
<td>100nm</td>
<td>45,000-60,000 feet</td>
</tr>
</tbody>
</table>
**FAA method:**

\[(\text{dist. off} / \text{dist. flown} \times 60) + (\text{dist. off} / \text{dist. remaining} \times 60) = \text{heading correction}\]

Time (minutes) off course x 60/degrees off course = min to station (95 % accuracy)

Time (seconds) off course/degrees off course = min to station

Minutes to station x TAS/60 = dist. to station

TAS x min flown (90 deg)/bearing change(deg) = distance

**Quick Calculations:**

Approximate ground speed (GS) = IAS - headwind component or IAS + tailwind component

Distance coverage (miles per minute) = GS ÷ 60

Time to cover distance = distance to cover + distance coverage (miles per minute)

Descent/climb rate required = altitude to lose or gain ÷ time to cover distance

Descent/climb rate required = rate per mile * distance coverage (miles per minute)

**NOTAMS**

D-Distant: National, local, or FSS, nav aids out, taxiway closures, runway closures, etc.

FDC: Changes in published procedures

**WEATHER MINIMUMS**

**Take-off requirements**

- Take Off- None required except if a specific DP exists for part 91. Part 121 and 135 must comply with published take off minimums in the front of the Approach plate book/Jeppesen plate.
- Two engines or less requires 1 mile visibility (part 121/135) no ceiling requirement.
- Three engines or more require ½ mile visibility (part 121/135) no ceiling requirement.
- Part 91 does not have take-off minimums but must comply with non standard departure procedures.
- If no procedure is specified, the standard is to climb to 400 feet before beginning a turn.

**Are you required to file an Alternate (use 1-2-3 rule)?**

- Forcast 1 Hour before thru after 1 hour after ETA
- 2000 foot ceiling minimum
- 3 miles visibility
- or if no IAP at airport
What is required of the alternate airport?

- Approved to be filed as an alternate (see foot notes on approach plates)
- 800/2 for non-precision approaches at ETA
- 600/2 for precision approaches at ETA
- If no Instrument approach, be able to descend from MEA and land under VFR conditions

Why are some approaches not authorized for alternates?

Look for the “A” in the remarks table (for the NA or not authorized for use as an alternate)

- Has no weather reporting capability
- Unmanned facility accuracy cannot be guaranteed

How do we get established on an Approach?

- Radar Vectors to Final
- Fly to IAF
- Fly from a feeder route

Circling Approach Distant Minimums-

If more than 30 degrees off the runway centerline or landing on another runway. Avoid circling beyond visibility requirements and maintain the appropriate circling altitude until in a position from which a descent to a normal landing can be made. Reference the standard or expanded circling minimums table (indicated by a black box with a “C” on the approach chart) for your category of aircraft.

Weather Information

- HIWAS – AIRMET, Sigmet, Convective Sigmet, CWA, UUA, AWW
- TWEB – Transcribed weather enroute briefing
- ASOS – Automated surface observation system
- AWOS - Automated weather observation system
- ATIS – Automated Terminal Information System
- FSS – Fight Service station

EFAS– Enroute Flight Advisory Service

- AIRMET - Of significance to light aircraft, moderate turbulence, icing and winds, IFR 50% of the area, Mt. obscuration
- SIGMET- Of significance to all aircraft, severe turbulence, icing and winds, Visibility below 3 miles, volcanic ash, dust storms, sandstorms
- Convective SIGMET-Severe condition, LLWS, tornadoes, line of thunderstorms, embedded thunderstorms, hail better than ¾” and winds better than 50 knots
CLEARANCES

Clearances (key things **) C-R-A-F-T

**Clearance Limit Destination
**Route A/F or Route, Normally “as filed”
**Altitude Maybe an EFC
**Frequency Departure
**Transponder Squawk

Void Time possibly assigned if at an uncontrolled airport

Clearances:

- Void Time Clearance is a specific takeoff time window, usually 10 minutes, issued by ATC when departing into IFR conditions from an uncontrolled field. Notify ATC if not airborne within 30 min.
- Special VFR allows pilot to operate VFR in Class B, C, D, and E to the surface of the airspace with 1-mile visibility and clear of clouds. SVFR at night requires an instrument-equipped plane and an instrument rated pilot who is current.
- Tower Enroute Control (TEC) are short flights less than 2 hours and under 10,000’ MSL that are common in California and the New England area. Basically, departure radar coverage of one airport meets approach radar coverage of another airport.
- VERY IMPORTANT: If canceling an IFR flight plan be sure you have the VFR weather requirements for that particular airspace. In addition, before canceling IFR while within controlled airspace, you MUST get a VFR clearance into the airspace prior to canceling or you will violate airspace clearance requirements.

Where to Get Clearances:

- Clearance Delivery
- Call FSS for designated area departing direct via phone
- Airborne- Air Traffic Control/flight service station

Cruise Clearance - “CRUISE 6000”

- Can fly between MEA and assigned altitude at Pilot’s discretion.
- You may climb and descend between your clearance altitude and MEA all you want unless you report leaving an altitude. The key is to not report leaving an altitude! If you report leaving an altitude you must request clearance from ATC to use that altitude again.
- You are cleared to your destination airport and may shoot ANY of the instrument approaches upon arrival without further clearance.
- Cannot get a cruise clearance on the ground!!!
- Review a sectional for terrain and obstacles to avoid CFIT.

VFR on Top - Maintain visual separation but still IFR and may want to get back down. Must maintain cloud clearances (2000’ horizontal, 1000’ above, 500 below)

Climb to VFR on Top - Cancel IFR once VFR on Top, you’re on your own, NOT ALLOWED ABOVE FL 180.
SVFR – Special VFR must be 1 mile clear of clouds and can only be accepted at night if the pilot and aircraft are IFR capable. Allowed in Class B, C, D, E airspace. Can only be authorized with an ATC clearance.  

Weather Minimums of LAHSO - 1000 feet, 3 miles visibility (N/A for USU)

FILING AND PICKING UP CLEARANCES

- File at least 30 minutes before you need it
- Pick up clearance 10 minutes before take-off
- Filed flight plans remain in system for 2 hours from ETD
- Void time allows you to depart IMC from an uncontrolled field

NOTE: “Clearance on request” means to standby for clearance. (They have to retrieve it)

DEPARTURE

Departure Procedures (DP’s) can be either

1. SIDs – Established for traffic flow, can be avoided by requesting “no DP’ on flight plan.
   a. Pilot Navigation – pilot responsible for navigation
   b. Radar Vectors – ATC is responsible for radar vectors
2. DPs – Established for obstacle clearance, must be followed.
3. VFR Climb – can only be used when the MEA can be reached in VFR conditions. The pilot is responsible for terrain and obstacle clearance.

Standard take off min (Part 121, 135) = 1 mile Vis for 2 engines or less ½ mile Vis for more than 1 engine.

ENROUTE AND ATC

Position Reports in Non-Radar Environment:

- If ETA to a fix is more than +/- 3 minutes
- Inbound from the final approach fix or outer marker
- Time and altitude at compulsory reporting points -Solid black triangle
- Whenever requested

Position Reporting:

- Position
- Time
- Altitude
- ETA over next reporting point
- Name of reporting point following next point

NOTE: Position reports are typically made in a non-radar environment. Practically they are not requested. You may even ask ATC if they need to be made.
REQUIRED REPORTS

Radar Environment
1. T= TAS unable to maintain w/l 10 knots of 5% of airspeed
2. U= Un-forecasted weather
3. U= Unable to climb or descend at 500 FPM
4. L= Loss of Facility signal
5. S= Safety of flight (Instruments/gauges inoperative)
6. A= Altitude Changes
7. H= Hold- Arriving or leaving Hold
8. A= Altitude change on VFR on Top
9. M= Mandatory or Compulsory Reports
10. M= Missed Approach Executing

Non Radar
1. C= Change in ETA at destination +/- 5 minutes
2. F= Final Approach inbound

LOST COMMUNICATIONS? (INSTRUMENT FHB 11-5) FAR § 91.185

Radio Failure (Squawk 7600), First actions:

- a) Check volume on headset, radio volume, correct frequency, comm selection, and circuit breakers
- b) Try last frequency
- c) Try to contact FSS
- d) If VFR conditions exist elsewhere, fly to it and land at suitable airport and then contact ATC
   (If operating in VFR conditions at the time of the failure, the pilot should continue the flight under VFR and land as soon as practicable.)

If no luck, follow actions below and continue with IFR flight

NOTE: If you return to land at original airport, IT IS DECLARING AN EMERGENCY

NOTE: Carry portable transceiver, and/or cell phone. Use Chart Supplement phone numbers to contact center, approach, etc.

If the failure occurs in IFR conditions, or if VFR conditions cannot be maintained, the pilot must continue the flight as follows:

Altitude for route segment (highest of)

- M= Minimum IFR for route filed
- E= Expected altitude to be assigned
- A= Assigned Altitude
Route

- A= Assigned Route
- V= Vectors, “direct to fix, route, or airway specified in vector clearance”
- E= Expected, in absence of other clearance, proceed with the clearance ATC advised you to expect
- F= Filed, “route filed in flight plan”

Approach and descent at clearance limit:

1. If the clearance limit is an initial approach fix: commence descent or descent and approach at the expect-further-clearance time if one has been received;
   a. If no “expect-further-clearance time”, commence descent or descent and approach at the estimated time of arrival (ETA) as calculated from the filed or amended (with ATC) estimated time en route.

2. 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.

While following these procedures, set the transponder to code 7600 and use all means possible to re-establish two-way radio communication with ATC. This includes monitoring navigational aids (NAVAIDs), attempting radio contact with other aircraft, and attempting contact with a nearby automated flight service station (AFSS).

HOLDING

Procedures - ATC instructions will always include:

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. Standard inbound holding leg time = 1 minute (1 minute and 30 second legs above 14,000' MSL or upon request).
5. Leg length in miles if DME hold (leg length will be specified in minutes on pilot request or if the controller considers it necessary).
6. Direction of turn if left turns are to be made, the pilot requests or the controller considers it necessary.
7. Time to expect-further-clearance (EFC) and any pertinent additional delay information.

“DiamondStar N383PS Hold northwest of the Ogden VOR on the 045 radial; expect further clearance at 40 past the hour; time now 10 past the hour”

- Holding patterns are a racetrack pattern flown by the aircraft to help maintain separation and provide a smooth flow of traffic.
- They begin and end at a holding fix, which you hold TO.
- Standard holding patterns are turns to the right. Non-standard are to the left.
• Below 14,000’ MSL holding patterns are usually two standard-rate 180° turns separated by 1-minute straight segments. With no wind, a whole pattern takes 4 min.
• Above 14,000’ MSL straight legs are 1 ½ minutes or 10 miles, whichever is less.
• Before entering the hold, you are expected to slow down 3 minutes before arriving.
• The pilot is expected to report to ATC when entering and leaving the hold.
• The ATC instruction “Hold southwest of the fix” best describes the outbound leg heading.
• When should you start timing on a VOR hold? Ans. Abeam the holding fix outbound.
• Wind correction rule of thumb: Half wind speed in degrees. (20 kts of Cross Wind = 10 degrees of correction. Or triple the outbound correction)

Holding Speed Limits
• Above 14,000 Feet 265 knots
• 6,000 to 14,000 Feet 230 knots
• Below 6,000 Feet 200 knots

Approaches

Types of Approaches
• Visual Approach- 3000 foot ceiling and 3 mile visibility, Field in sight or follow another A/C. Must be VFR. ATC can assign.
• Contact Approach- Pilot must request. Must have 1-mile visibility and COC. Must be able to safely navigate to airport; Airport must have an instrument approach.
• Circling Approach- More than 30 degrees from inbound course. May also be known as Alpha, Bravo, or Charlie approach.

Additional information

TEC- Tower Enroute Control- shorter flights, file TEC in flight plan or with ATC in a TEC system, non-turboprop below 10,000 normally
Visual Decent Point (VDP)- Point at which a descent to landing must be initiated in order to maintain a normal descent to landing

Landing Guidance

• VASI-

<table>
<thead>
<tr>
<th>OBSTACLE CLEARANCE</th>
<th>NORMAL ANGLE = 3.00 DEG. RED OVER WHITE</th>
<th>LOWER ANGLE 2.8 DEG (PAPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 deg of centerline for 4 NM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• PAPI-

| 4 Red is 2.5° or less | 3R/1W is 2.8° | 2r /2w is 3.0° (norm.) | 3W/1R is 3.2° | 4W is 3.5° and up |
Precision Approaches

- ILS – usually 3° Slope and Course, Markers OM 4-6 miles, MM 200, (IM on CAT II/ III).
- CAT I – 200 feet RVR 2400, unless you have RWCTL, RVR and TDZL reduces to 1800 RVR.
- CAT II – must be certified and authorized, 100’ RVR 1200.
- CAT III (A)– No DH, RVR 700 min, CAT III (B)– No DH, RVR 150 min, CAT III (C)– No DH, RVR 0.
- PAR- Radar Guided, told when to descend, when to turn and stop.
- LPV- Localizer type Precision approach with Vertical guidance (GPS based).
- VNAV- Vertical guidance based on GPS and could require Baro-VNAV or have temperature limits.

Non-Precision Approaches

- LOC – Localizer; signal range 35° from center to 10 NM, 10° from center to 18nm, Back course reverse sensing (more sensitive) HSI senses OK if set proper course.
- VOR- Very High Frequency Omni Directional range; Requires a VOR receiver.
- VOR/DME- Requires VOR receiver with DME capability.
- VOR/GPS - GPS overlay of existing VOR approach.
- VOR-A; inbound VOR course offset by 30 degrees or more from runway.
- NDB-Non-Directional Beacon; requires ADF. Additional NDB- NDB/DME, NDB (A).
- Arcing Approaches
  - SDF – Simplified Directional Facility; no shading on the feather, course width 6° or 12°, never have glide slopes, can be offset from runway.
  - LDA – Localizer Direction Aid; offset from runway, can have a glide slope, course width 3°-6°.
- LNAV-Lateral navigation; GPS based, equivalent to VOR. No vertical guidance- (RAIM) Receiver Autonomous Integrity Monitoring- must have enough satellites to ensure enough accuracy. IFR approved and certified to fly. Approaches usually have a holding pattern, @ IAF/IF. If RAIM fails or does not have Terminal indication prior to FAF you must go missed approach.
- LORAN - Authorized enroute only.
- RNAV (Area Nav); resets VOR and aligns them mathematically
- MLS – Microwave landing system, (eg. M-LIT)
- INS – Inertial Navigation System; internal to the aircraft and calculates via airspeed directions, time etc.
- ASR - Approach Surveillance Radar

Parallel Approaches

- Dependant ILS systems must be staggered by 3 miles
- Simultaneous
- Simultaneous Close Parallel
- Simultaneous Converging
- Localizer
Timed Approaches

- Timed from the FAF inbound
- Ceiling and vis. must be greater than the highest circ. Min for the IAP

GPS and RNAV Approaches

Precision:

1. GLS – Global Navigation Satellite System Landing System

   This type of approach includes course and glidespath information meeting the precision requirements of the ICAO. These procedures will be charted separately from the other GPS/RNAV approaches. They require Local Area Augmentation Systems (LAAS).

Non-precision:

1. LPV – Localizer Performance with Vertical guidance

   These approaches provide lateral guidance equivalent to localizer accuracy. They require Wide Area Augmentation Systems (WAAS) approved for LPV approaches and a statement in the AFM that the installed equipment supports LPV approaches. The WAAS channel number and WAAS approach identifier are found in the upper left corner of the approach charts. For the WAAS approach identifier of W-35C: W=WAAS, 35=runway 35, and C=approach sequence in a series of procedures to the specified runway (i.e. third in the series). The minimums for these approaches are shown as DAs because vertical guidance is provided.

2. LNAV/VNAV (APV) – Lateral Navigation and Vertical Navigation

   These approaches provide lateral and vertical guidance. They require WAAS and a certified barometric-VNAV system. An aircraft equipped for these types of approaches will be specifically approved in the AFM. The minimums for these approaches are shown as DAs because vertical guidance is provided.

3. LNAV – Lateral Navigation

   IFR approach approved GPS, WAAS, or RNP 0.3 systems are required to fly these approaches. Vertical guidance is not provided and therefore minimums are published as MDAs. These are the types of approaches our G1000 equipped aircraft are capable of flying.

4. Circling

   These minimums provide an approach option for any of the above procedures when a straight-in approach is not possible or prudent.

APPROACH PLATE NOTES

- PV statue miles in quarters
- RVV in Statue miles fractions of miles reported
- RVR feet reported
- Standard if not published is 400 feet before beginning turns
Required to Land (hold at MDA)

1. Visibility flight or ground (become VFR or identify filed of light to lower minimums).
2. Must be in a position to land.
3. Must have Approach lighting, allows decent to 100’ AGL.
4. Must have Runway Environment in sight (11 items) in order to be able to land (FAR 91.175).

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Approaching Runway</th>
<th>Runway</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Threshold</td>
<td>1. REIL</td>
<td>1. Runway</td>
</tr>
<tr>
<td>2. Threshold Marks</td>
<td>2. VASI or equivalent</td>
<td>2. Runway Marks</td>
</tr>
<tr>
<td></td>
<td>4. Touchdown Zone Marks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Touchdown Zone Lights</td>
<td></td>
</tr>
</tbody>
</table>

Approach Speeds are based on Vso x 1.3

- A= below 90 knots
- B= 91 to 120 knots
- C= 121-140 Knots
- D= 141-165 knots
- E= Greater than 165 knots

Substitutes for an Outer marker are:

1. LOM or Compass Locator
2. Radial off a VOR / NDB / DME
3. PAR / ASR

Substitutes for a MM are:

1. PAR
2. LOM

Approach Plate objects

- TCH- Threshold Crossing Height; height above the end of the runway on a given glide slope measured in AGL.
- TDZE- Highest point in MSL above the runway in first 3000 feet.
- Missed Approach airspeed is Vx until clear of obstacles and then Vy.
- Missed Approach on a circling to land, fly toward the runway centerline and follow missed approach procedures.
- Enroute Feeder Rings show nav aids & intersections that are part of the low altitude enroute structure used in the approach.
- Feeder Facility Rings show nav aids, fixes, intersections, directions and altitudes used by ATC to direct A/C between enroute structure and the IAF.
IAP’s use three type of lines

- Thin lines = VOR radial used to identify fixes and include course information only. (non-flyable)
- Dark Thin Lines = Feeder routes, include altitudes, course and distance information.
- Dark Bold Lines = Are instrument procedure tracks, include altitude, course and distance information.

Circling Approaches have 300 foot obstacle clearance.
MSA requires a VOR or NDB within 30 NM of an airport.

AIRPORTS

Visual Runway
Non-Precision Runway – 1000 feet mark
Precision Runways – 500, 1000 (aiming point), 1500 to 3000 marks, touchdown zone in 1st 3000 feet
ILS Critical area below 800 feet and within 2 miles

Airport Lighting
- RCLS- Guidance and tells pilot how much runway remains. Spaced every 50ft, Last 3000 feet alternating red/white, last 1000 ft all red.
- REIL- Runway End Identifier Lights- Rapid identification of approach end of runway

<table>
<thead>
<tr>
<th>Approach Lighting Systems</th>
<th>Approach Glide Slope Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ALSF1 – 2</td>
<td>• VASI</td>
</tr>
<tr>
<td>• SSALR</td>
<td>• Pulsating VASI</td>
</tr>
<tr>
<td>• MALSR</td>
<td>• PAPI</td>
</tr>
<tr>
<td></td>
<td>• TRI-Color</td>
</tr>
</tbody>
</table>

PROCEDURES

Timed Turns
- ½ Standard Rate Turn (SRT) is 1.5° per sec, 4 minutes for 360°
- Standard rate turn 3° per sec, 2 minutes for 360°

Compass Errors –
- Acceleration Error – ANDS: Accelerate North, decelerate South
- Turning Errors – UNOS: Undershoot North, Overshoot South
Partial Panel

Simulated AHRS failure= No gyro instruments (AI, DG)

DME Arcing

½ mile prior, begin turn about 90° from course, then turn aircraft 10° inbound, twist VOR/CDI 10°, once VOR aligns, repeat OR use RMI needles/GPS for alignment

When do I begin my Descent?

3 x Altitude /1000. (ie. 3 x 15,000ft / 1000 = 45 miles) or .003 x altitude

Station Passage 5 T’s

- T= Time
- T= Turn
- T= Twist
- T= Throttle
- T= Talk

AIRSPACE REVIEW

Special Use Airspace (7 Types)

Prohibited Area, Restricted Area, Alert Area, Warning Area, MOA, PJA, NSA, (also TRSA)

Other Airspace (5 Types)

<table>
<thead>
<tr>
<th>MTR</th>
<th>Airport Alert Areas</th>
<th>TFR</th>
<th>Parachute Jump Areas</th>
<th>PVFR Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes of Airspace</td>
<td>Required Wx</td>
<td>n/a</td>
<td>3 mi, COC</td>
<td>3 mi, 1,5,2</td>
</tr>
<tr>
<td>A FL180 to FL 600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B 30 nm, 10,000 AGL, shaped to fit</td>
<td></td>
<td></td>
<td>3 mi, 1,5,2</td>
<td></td>
</tr>
<tr>
<td>C 10 nm, 4000 AGL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D 4 nm, 2500 AGL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E 700AGL or 1200 AGL to the underlying airspace</td>
<td></td>
<td></td>
<td>3 mi, 2 1/5, above 10K 5 1 1/1</td>
<td></td>
</tr>
<tr>
<td>G SFC to 700 AGL or 1200 AGL</td>
<td></td>
<td></td>
<td>above 10K 5 1 1/1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Day 1200-10K – 1, 2 1/5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Night 1200-10K – 3 2 1/5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Day Below 1200 – 1, COC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Night Below 1200 – 3 2 1/5</td>
<td></td>
</tr>
</tbody>
</table>
WEATHER REVIEW

<table>
<thead>
<tr>
<th>Forecast</th>
<th>Explanation</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TAF</strong></td>
<td>Message type: TAF-routine or TAF AMD-amended forecast, METAR-hourly,</td>
<td>METAR</td>
</tr>
<tr>
<td></td>
<td>SPECI-special or TESTM-non-commisioned ASOS report</td>
<td></td>
</tr>
<tr>
<td>KPIT 091730Z</td>
<td>ICAO location indicator</td>
<td>KPIT</td>
</tr>
<tr>
<td>091818</td>
<td>Issuance time: ALL times in UTC “Z”, 2-digit date, 4-digit time</td>
<td>091955Z</td>
</tr>
<tr>
<td>091730Z</td>
<td>Valid period: 2-digit date, 2-digit beginning,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-digit ending times</td>
<td></td>
</tr>
<tr>
<td>In U.S. <strong>METAR</strong>: CORrected ob; or <strong>AUTO</strong>mated ob for automated report</td>
<td><strong>COR</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with no human intervention; omitted when observer logs on</td>
<td></td>
</tr>
<tr>
<td>15005KT</td>
<td>Wind: 3 digit true-north direction, nearest 10 degrees (or VaRiaBle);</td>
<td>22015G25KT</td>
</tr>
<tr>
<td></td>
<td>next 2-3 digits for speed and unit, KT (KMH or MPS); as needed, Gust and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximum speed; 00000KT for calm; for <strong>METAR</strong>, if direction varies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 degrees or more, Variability appended, e.g. 180V260</td>
<td></td>
</tr>
<tr>
<td>5SM</td>
<td>Prevailing visibility: in U.S., Statute Miles &amp; fractions; above 6 miles in</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TAF Plus6SM</strong>. (Or, 4-digit minimum visibility in meters and as</td>
<td></td>
</tr>
<tr>
<td></td>
<td>required, lowest value with direction)</td>
<td></td>
</tr>
<tr>
<td>Runway Visual Range: R; 2-digit runway</td>
<td>R28L/260</td>
<td></td>
</tr>
</tbody>
</table>
## CHART SUPPLEMENT REVIEW

The main 11 sections of a Chart Supplement are:

|-----------------|------------|----------|----------------------|----------------|--------|

## MNEMONICS

### Required Inspections “AVIATES”
- A = Annual inspection
- V = VOR (w/i 30 day for IFR flight)
- I = 100 hour inspection
- A = Altimeter (2 yrs)
- T = Transponder (2 yrs)
- E = ELT (1 yr or ½ useful life of battery)
- S = Static & Pitot System (2 yrs)

### VFR Equipment Required (part 91) “Tomato Flames”
- T = Tachometer
- O = Oil Pressure Guage
- M = magnetic Compass
- A = Airspeed Indicator
- T = Temperature Indicator for Liquid cooled engines
- O = Oil Temperature for Air Cooled engines
- E = ELT
- F = Fuel Quantity Indicator
- L = Landing gear Position Indicator
- A = Altimeter
- M = Manifold pressure Gauge for altitude engine
- E = Equipment for floatation if flying out of glide to land
- S = Seat Belts

### Required Additional Instruments for Instrument IFR Flight “GRAB CARD”
- G = Generator
- R = Radios
- A = Altimeter
- B = Ball of Turn Coordinator
- C = Clock
- A = Attitude Indicator
- R = Rate of Turn Indicator (Turn Coordinator)
- D = Directional Gyro

### “A LOVAR DG MAN”
- A = ATIS / Altimeter Set
- L = Localizer
- O = Outer Marker
- V = VOR
- A = ADF
- R = Radios
- D = DME
- G = GPS
- M = Missed Approach
- A = Altitudes / Approach brief
- N = Name of Outer Marker
Maintaining Instrument Proficiency

- To meet recency of experience requirement for instruments flight, you must have intercepted and tracked courses through the use of navigational electronic systems, performed holding procedures and tasks, and flown at least six instrument approaches within the preceding six calendar months.
- If you do not meet the instrument currency requirements within six calendar months (you may not file IFR) and if you fail to meet the requirements within six calendar months after that, you must pass an instrument proficiency check.

ADVANCED HUMAN FACTORS CONCEPTS

Aeronautical Decision Making: is a systematic approach to the mental process used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances. 75% of all aviation accidents are attributed to human factors related causes.

Five hazardous attitudes
Anti-Authority; Macho; Impulsivity; Invulnerability; Resignation.

Pilot-In-Command Responsibility
You are the final authority in the airplane you are flying. Pilot responsibilities must be defined before the flight.

Resource Use
Cockpit resources increase as you fly more complex aircraft with advanced systems. If you are not thoroughly familiar with the equipment in your aircraft or you rely on it so much that you become complacent, flight safety is compromised.

Single Pilot Resource Management (SRM) is the effective use of all available resources for a successful outcome of a flight (i.e. human resources, hardware, and information).

Communication
Read back of ATC clearances is crucial in the IFR environment. Do not assume controller silence after a read-back is verification of your transmission. Ask for a verbal confirmation. It is important to use standard terminology and verify that your meaning is understood.

Workload Management
Directly impacts safety by ensuring that you are prepared for the busiest segments of the flight through proper use of down time. Organizing charts in the order of use, setting radio frequencies, and writing down expected altitudes and route clearance will help you visualize and mentally prepare for what comes next.

Situational Awareness
Controlled flight into terrain (CFIT) occurs when an aircraft is flown into terrain or water with no prior awareness on the part of the crew that the crash is imminent.
AVIATION PHYSIOLOGY

**Disorientation:** Is an incorrect mental image of your position, attitude, or movement in relation to what is actually happening to your aircraft. Input from three primary sources: Vision, Vestibular, and Kinesthetic Sense.

**Spatial Disorientation:** Is a conflict between the information relayed by your central vision scanning the instruments, and your peripheral vision. Pilots are more subject to spatial disorientation if body signals are used to interpret flight attitude. The best way to overcome the effect is to rely on the aircraft instrument indications.

**Motion Sickness:** Nausea, sweating, dizziness, and vomiting are some of the symptoms of motion sickness. To overcome motion sickness without outside visual references, you should focus on the instrument panel, since it is your only source of accurate position information.

**Hypoxia:** Occurs when the tissues in the body do not receive enough oxygen.

- **Hypoxic Hypoxia**—inadequate supply of oxygen (going to high altitudes)
- **Hypemic Hypoxia**—inability of the blood to carry oxygen (Carbon Monoxide)
- **Stagnant Hypoxia**—inadequate circulation of oxygen (excessive G forces)
- **Histotoxic Hypoxia**—inability of the cells to effectively use oxygen (by alcohol or drugs)

**Supplemental Oxygen: FAR requirements**

- 12,500—14,000 ft MSL = Flight crew must use O2 after 30 minutes
- 14,000—15,000 ft MSL = Flight crew must use O2
- 15,000—Above = Flight crew must use O2 and all occupants must be provided with O2

**Hyperventilation:** Occurs with excessive loss of carbon dioxide. You need to slow the breathing rate, breath into a bag, or talk aloud.

**Decompression Sickness:** Is a painful condition that can occur if flying too soon after diving. It is very important that you allow enough time for the body to rid itself of excess nitrogen absorbed during diving.

- Ascending to 8,000 ft MSL after a dive not requiring a controlled ascent = 12 hours Above 8,000 ft MSL or any dive requiring a controlled ascent = 24 hours

**Self Assessment:** (I’m Safe, Checklist)

- Illness, Medication, Stress, Alcohol, Fatigue, Emotions