
PILOT

- A pilot must continually make decisions about competency, condition of health, mental and emotional state, level of fatigue, and many other variables.

AIRCRAFT

- A pilot frequently bases decisions on evaluation of the airplane, such as performance, equipment, or airworthiness. This task will concentrate on the aircraft (ASEL – Airplane Single Engine Land). Aircraft performance and limitations, such as Takeoff and Landing distances, altitude, fuel burn, density altitude, power settings and weight & balance are key components to every flight for safety.

ENVIRONMENT

- The environment encompasses many elements that are not pilot or airplane related, including such factors as weather, air traffic control (ATC), navigational aids, terrain, takeoff and landing areas and surrounding obstacles. Weather is one element that can change drastically over time and distance.

EXTERNAL PRESSURES

- The pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical it is to maintain the schedule, and if the trip is worth the risks.

P – Pilot for the Private Pilot:

Start with I’M SAFE: Illness, medication, stress, alcohol (.04), fatigue (acute and chronic) and eating/emotional factors. If any of these factors apply, you should not fly. As a private pilot, you are required to carry your pilot’s certificate, medical and a government ID. As a private pilot, you are allowed to carry passengers (not for hire) – 61.113, fly when visibility is less than 3 miles (SVFR – Special VFR) and can fly without visual reference to the surface. Special requirements for the Private Pilot are: Must be a Private Pilot to take off and land within (KSFO) Class B Airspace (AIM 3-2-3) and can fly at night. Must maintain currency to carry passengers: 1.) 3 touch-n-go’s during the day and 3 full stop landings at night every 90 days – 61.57. 2.) Complete a BFR (Flight Review) (minimum 1 hour of ground and 1 hour of flight – every 24 calendar months – 61.56. 3.) Have a First Class (valid for 6 months), Second Class (valid for 12
months) or Third Class (valid for 2 years if over 40 years old or 5 years if under 40 years old) medical certificate to be pilot in command.

A – Aircraft for the Private Pilot:

Remember A R O W. Airworthiness Certificate (Has the aircraft had an Annual, 100 hour, Progressive - 91.409, Pitot Static/Transponder check (24 months - 91.411, 91.413), Aircraft has the required equipment – 91.205 if NOT Special Flight Permit 21.197 & 21.199, ELT check - 91.207 and all AD’s have been complied - 91.403 39.3, Registration (Every Three Years) – 47.41, Operating Limits (Section 2 of POH, Pilot’s Operating Handbook) – 91.9 and Weight and Balance (Section 6 of POH). Fuel requirements for all flights (30 minutes Day, 45 minutes Night) - 91.151. The required takeoff and landing distances, runway lengths and weather forecasts - 91.103. Avionics familiarity, density altitude and a current sectional information.

V – Environment for the Private Pilot:

Think of the Airport and weather conditions: Crosswind, Takeoff and Landing distances, Ceiling conditions, visibility and your personal minimums. Plan on the weather for your Departure, En-route and Destination. For example: Current Metar, TAF and FA (Area Forecast), surface analysis chart, radar summary chart, winds and temperature aloft, significant weather prognostic chart, convective outlook chart, Airmets and Sigmets, PIREPs, wind shear reports, icing and freezing levels and AWOS, ASOS and ATIS reports for the route and destination. The pilot wants to make a competent “go/no-go” decision based on available weather information. Reference Weather Information – Task C in RAM Study Guide.

E – External Pressures for the Private Pilot:

Think about “Get there Itis.” The determination to reach a destination, combined with hazardous weather, claims the lives of dozens of pilots and their passengers yearly. Think about the hazardous attitudes: Anti-authority, Impulsivity, Invulnerability, Macho and Resignation to see if they may apply to this flight. Allowance for delays and diversions, alternative plans and personal equipment. After you use the PAVE checklist (step 1), use the CARE checklist (Consequences, Alternatives, Reality and External pressures) (step 2) and determine the level and severity of the risk. (Step 3) perform the TEAM checklist. Transfer Risk, Eliminate Risk, Accept Risk and Mitigate Risk.
Exceeding Limitations:

The pilot should always be aware of the consequences of overloading. An overloaded aircraft may not be able to leave the ground, or if it does become airborne, it may exhibit unexpected and unusually poor flight characteristics. If not properly loaded, the initial indication of poor performance usually takes place during takeoff. Excessive weight reduces the flight performance in almost every respect. For example, the most important performance deficiencies of an overloaded aircraft are:

- Higher takeoff speed
- Longer takeoff run
- Reduced rate and angle of climb
- Lower maximum altitude
- Shorter range
- Reduced cruising speed
- Reduced maneuverability
- Higher stalling speed
- Higher approach and landing speed
- Longer landing roll
- Excessive weight on the nose wheel or tail wheel

The pilot must be knowledgeable about the effect of weight on the performance of the particular aircraft being flown. Preflight planning should include a check of performance charts to determine if the aircraft’s weight may contribute to hazardous flight operations. Excessive weight in itself reduces the safety margins available to the pilot, and becomes even more hazardous when other performance-reducing factors are combined with excess weight. The pilot must also consider the consequences of an overweight aircraft if an emergency condition arises. If an engine fails on takeoff or airframe ice forms at low altitude, it is usually too late to reduce an aircraft’s weight to keep it in the air.
Balance, Stability, and Center of Gravity:

Balance refers to the location of the CG of an aircraft, and is important to stability and safety in flight. The CG is a point at which the aircraft would balance if it were suspended at that point.

The primary concern in balancing an aircraft is the fore and aft location of the CG along the longitudinal axis. The CG is not necessarily a fixed point; its location depends on the distribution of weight in the aircraft. As variable load items are shifted or expended, there is a resultant shift in CG location. The distance between the forward and back limits for the position of the center for gravity or CG range is certified for an aircraft by the manufacturer. The pilot should realize that if the CG is displaced too far forward on the longitudinal axis, a nose-heavy condition will result. Conversely, if the CG is displaced too far aft on the longitudinal axis, a tail heavy condition results. It is possible that the pilot could not control the aircraft if the CG location produced an unstable condition.

Location of the CG with reference to the lateral axis is also important. For each item of weight existing to the left of the fuselage centerline, there is an equal weight existing at a corresponding location on the right. This may be upset by unbalanced lateral loading. The position of the lateral CG is not computed in all aircraft, but the pilot must be aware that adverse effects arise as a result of a laterally unbalanced condition. In an airplane, lateral unbalance occurs if the fuel load is mismanaged by supplying the engine(s) unevenly from tanks on one side of the airplane.
Forward vs. Aft C.G.

What are the handling Characteristics of an airplane with a Forward CG?

- Generally more stable
- Fly at a slower TAS (true airspeed) due to more drag
- Stall at a higher indicated stall speed

What are the handling Characteristics of an airplane with an AFT CG?

- Generally unstable aircraft
- Fly at a higher TAS (true airspeed), less drag, better fuel burn
- May be impossible to recover from a stall or spin

Yes, we want the CG to be within the CG Range of the aircraft, but which is better a Forward CG or an AFT CG?

To keep it simple, loading the aircraft with a forward CG within limits will increase the aircraft's stability as opposed to loading an aircraft with a more aft (rearward) CG within limits of course will decrease stability. Now, there are benefits and drawbacks to both. A forward CG with the increase in stability will make it easier to recover from a stall, however moving the CG forward will also increase drag and with drag comes a reduction in cruise speeds and fuel efficiency. When you start loading an aircraft with a more aft CG you start to lose some of that stability and it may become more difficult to recover from a stall, but this will also decrease drag resulting in higher cruise speeds and better fuel efficiency. With the types of training aircraft you are most likely flying these differences will be minimal as long as the CG stays within the designed limits set by the manufacturer.

So is it better to have a forward CG or aft CG? Well there is really no set answer to that question; it’s up to you as the pilot-in-command to base your answer off the type of operations you will be conducting for that flight.
Compute Weight and Balance: PA38-112

Max Gross Weight: 1670.00 LBS
Useful Load: 504.00 LBS
Basic Empty Weight (N2406K): 1166.00 LBS
Useable Fuel: 30 GAL (180 LBS)

Weight x Arm = Moment (divide by 1000 for smaller numbers)

Moment divided by Weight = Center of Gravity x 1000 = C.G.

Weight and Balance Example:

<table>
<thead>
<tr>
<th></th>
<th>WEIGHT</th>
<th>X</th>
<th>ARM</th>
<th>=</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Empty Weight</td>
<td>1166</td>
<td>X</td>
<td>73.5</td>
<td>=</td>
<td>85.7202</td>
</tr>
<tr>
<td>Pilot Left Side</td>
<td>180</td>
<td>X</td>
<td>85.5</td>
<td>=</td>
<td>15.39</td>
</tr>
<tr>
<td>Pilot Right Side</td>
<td>185</td>
<td>X</td>
<td>85.5</td>
<td>=</td>
<td>15.8175</td>
</tr>
<tr>
<td>Baggage Area</td>
<td>10</td>
<td>X</td>
<td>115.0</td>
<td>=</td>
<td>1.15</td>
</tr>
<tr>
<td>Fuel</td>
<td>120</td>
<td>X</td>
<td>75.4</td>
<td>=</td>
<td>9.048</td>
</tr>
<tr>
<td>Ramp Weight/Mom</td>
<td>1661</td>
<td></td>
<td></td>
<td></td>
<td>127.1252</td>
</tr>
<tr>
<td>Taxi/Run-Up</td>
<td>-1.5</td>
<td>X</td>
<td>75.4</td>
<td>=</td>
<td>-0.1131</td>
</tr>
<tr>
<td>Takeoff Weight</td>
<td>1659.5</td>
<td></td>
<td></td>
<td></td>
<td>127.0121</td>
</tr>
<tr>
<td>Takeoff C.G.</td>
<td>76.54</td>
<td></td>
<td></td>
<td></td>
<td>Refer to Section 6 of the POH</td>
</tr>
<tr>
<td>En-route Fuel Burn</td>
<td>-72.0</td>
<td>X</td>
<td>75.4</td>
<td>=</td>
<td>-5.4288</td>
</tr>
<tr>
<td>Landing Weight</td>
<td>1587.5</td>
<td></td>
<td></td>
<td></td>
<td>121.5833</td>
</tr>
<tr>
<td>Landing C.G.</td>
<td>76.59</td>
<td></td>
<td></td>
<td></td>
<td>Refer to Section 6 of the POH</td>
</tr>
</tbody>
</table>
Determine Operating Limits: PA38-112 Takeoff and Landing C.G

New Weight and Balance App’s on an I-pad or phone, make it easy.
Determine Climb Performance:

Your Airplane Flight Manual also publishes data for climb performance. The maximum, or best rate of climb, is the rate of climb which will gain the most altitude in the least time and is used to climb after take-off until ready to leave the traffic circuit.

Many Airplane Manuals also publish charts for cruise climb. Cruise climb, or normal climb, is the climb airspeed used for a prolonged climb. The chart indicates the fuel used, time required to reach altitude, and still air distance covered in order to reach various altitudes when climbing at a certain indicated airspeed with various power settings.
Determine Takeoff Performance:

- Ensure proper tire inflation.
- Lean the engine properly on run-up, climb, and cruise—there is a significant power impact.
- Use correct takeoff temperature (ATIS is not ambient; many manuals specify ambient); density altitude versus pressure altitude for various manuals.
- Prescribed flap settings for normal and short-field landings vary, even within brands; check the charts.
- Use the correct performance chart (i.e., short field versus normal takeoff).
- Note specific obstruction, liftoff, and rotation speeds (some are specified).
- Investigate runway slope and the general airfield environment.
- Disregard takeoff headwind in computations—what if you count on it and it stops? Do not take off in tailwind; depending on your liftoff speed, departure in a 10-knot tailwind could increase your takeoff distance by 21 to 56 percent.
- Observe performance chart limits; some charts stop at 8,000 feet. Don't extrapolate.
- Hold brakes, check full throttle...then release brakes.
- Most speeds are based on zero instrument error (but most instruments have errors; some are very significant in the area of stall speed).
- One manual notes that dry grass will increase ground run by 15 percent over book value.
Determine Cruise Performance:

Performance figures for cruise at gross weights are also given in most Airplane Flight Manuals. These charts show the fuel consumption, true airspeed, endurance and range that may be expected when cruising at a certain altitude with the engine being operated at normal lean mixture at various combinations of rpm and MP settings (to give a required % of power).
Determine Landing Performance:

Landing performances

Many of these points are in documents other than the performance charts.

- Options are important; read the fine print on every chart--one manual specifies data valid only for "standard wheels, tires, and brakes. Power off, 40 degrees flaps, paved level dry runway, full-stall touchdown, max braking." It also has separate data for "heavy duty landing gear." What does your POH say? Flight manuals and handbooks seldom mention grass, soft runways, hydroplaning, and other factors that have effect, though some comments are listed below; they won't be found in most manufacturer materials, though one manufacturer says, "add 15 percent for dry grass." Some comments from the FAA's On Landing pamphlets are:
  - If the runway is wet, airplane braking might be ineffective because of hydroplaning--sliding on the water.
  - "Book" landing data was derived from perfect technique by factory test pilots under ideal conditions. Most computations are based on touchdown at 1.1 times stall speed. If you touch down even 10 percent above that, your landing roll will be over 20 percent longer than "book."
  - Flying "final approach" airspeed into the flare (rather than slowing to 1.3 times the stall speed as recommended in most manuals) nearly doubles your landing distance; if you're carrying extra airspeed for gusts (as you should), understand that it will cost you even
more landing distance to dissipate it. Developing a "feel" for these book values can be priceless when faced with marginal situations.

- Handbooks generally use either a specific speed (usually 1.3 times stall speed) based on gross weight or a specific recommended speed on final approach. The small print might or might not specify other speeds. Check it out. Take care how you manage all of them.
- Many pilots use the "bottom of the white arc" to determine stall speed when, in actuality, that is stall speed with flaps down at maximum gross weight—if your flaps aren't fully down or the aircraft is loaded to less than max gross weight, this will not be your stall speed.
- Even 200 to 300 pounds in a general aviation airplane can make a difference in your "float" and cost you precious runway space.
- Landing in a 10-kt tailwind—and touching down 10 kt fast—will almost double your landing distance; do you have enough runway? Don't land downwind unless you know you can afford it.
Determining Effects of Atmospheric Conditions:

Air density decreases with altitude. At high elevation airports, an airplane requires more runway to take off. The aircrafts rate of climb will be less and the aircrafts approach will have to be faster, to stabilize the effects of lower air density.

Air density also decreases with temperature. Warm air is less dense than cold air because there are fewer air molecules in a given volume of warm air than in the same volume of cooler air. As a result, on a hot day, an airplane will require more runway to take off, will have a poor rate of climb and a faster approach and will experience a longer landing roll.

In combination, high and hot, a situation exists that can well be disastrous for an unsuspecting, or more accurately, an uninformed pilot. The combination of high temperature and high elevation produces a situation that aerodynamically reduces drastically the performance of the airplane. The horsepower out-put of the engines decrease because its fuel-air mixture is reduced. The propeller develops less thrust because the blades, as airfoils, are less efficient in the thin air. The wings develop less lift because the thin air exerts less force on the airfoils. As a result, the take-off distance is substantially increased, climb performance is substantially reduced and may, in extreme situations, be non-existent.

Humidity also plays a part in this scenario. Although it is not a major factor in computing density altitude, high humidity has an effect on engine power. The high level of water vapor in the air reduces the amount of air available for combustion and results in an enriched mixture and reduced power.

Mountain airports are particularly treacherous when temperatures are high, especially for a low performance airplane. The actual elevation of the airport may be near the operational ceiling of the airplane without the disadvantage of density altitude. Under some conditions, the airplane may not be able to lift out of ground effect or to maintain a rate of climb necessary to clear obstacles or surrounding terrain.
Density altitude is pressure altitude corrected for temperature. It is the altitude at which the airplane thinks it is flying based on the density of the surrounding air mass. We relate aircraft performance to density altitude. Too often, pilots associate density altitude only with high elevation airports. Certainly, the effects of density altitude on airplane performance are increasingly dramatic in operations from such airports, especially when the temperature is also hot. But it is important to remember that density altitude also has a negative effect on performance at low elevation airports when the temperature goes above the standard air value of 15° C at sea level. Remember also that the standard air temperature value decreases with altitude.

In order to compute the density altitude at a particular location, it is necessary to know the pressure altitude. To determine the latter, set the barometric scale of the altimeter to 29.92" Hg and read the altitude. Density altitude can be calculated for any given combination of pressure altitude and temperature, by using the circular slide rule portion of a flight computer.

Calculating Density Altitude: Density altitude in feet = pressure altitude in feet + (120 x (OAT - ISA temperature))

- **Pressure altitude** is determined by setting the altimeter to 29.92 and reading the altitude indicated on the altimeter.
- **OAT** stands for outside air temperature (in degrees Celsius).
- **ISA** stands for standard temperature (in degrees Celsius).

Keep in mind the standard temperature is 15 degrees C but only at sea level. It decreases about 2 degrees C (or 3.5 degrees F) per 1,000 feet of altitude above sea level. The standard temperature at 7,000 feet msl, therefore, is only 1 degree C (or 34 degrees F).

For example, the density altitude at an airport 7000 feet above sea level, with a temperature of 18 degrees Celsius and a pressure altitude of 7000 (assuming standard pressure) would be calculated as follows.

- \[18 - 1 = 17\]
- \[17 \times 120 = 2040\]
- \[2040 + 7000 = 9040\] feet Density Altitude
This means the aircraft will perform as if it were at 9,040 feet.

Another example of how we calculate density altitude? There are just two pieces of information you’ll need for a rough approximation: pressure altitude and temperature. Where do you find this information? Easy: for temperature, you look at the thermometer in your airplane. For pressure altitude, set the window in your altimeter to 29.92. Whatever value it reads is pressure altitude.

Finding pressure altitude when you’re not sitting in the airplane is a bit more complicated, but here’s a nifty formula:

Pressure altitude = (standard pressure - your current pressure setting) x 1,000 + field elevation

That’s a pretty simple formula since two of the variables will always be the same and the other two are easy enough to find. Let’s say our current altimeter setting is 29.45 and the field elevation is 5,000 feet. That means (29.92 - 29.45) x 1,000 + 5,000 = 5,470 feet.

Easy! Now let’s move on to step two, finding density altitude. Here’s the formula:

density altitude = pressure altitude + [120 x (OAT - ISA Temp)]

Now, before your eyes glaze over, here’s how simple this formula is: We already have the value for pressure altitude from our last calculation; OAT is degrees Celsius read off our thermometer (let’s say it’s a balmy 35 °C today) and ISA Temp is always 15 °C at sea level. To find ISA standard temperature for a given altitude, here’s a rule of thumb: double the altitude, subtract 15 and place a - sign in front of it. (For example, to find ISA Temp at 10,000 feet, we multiply the altitude by 2 to get 20; we then subtract 15 to get 5; finally, we add a - sign to get -5.)

So, in the example above: density altitude = 5,470 + [120 x (35 - 5)]

Working out the math, our density altitude is 9,070 feet.

See PDF – FAA Density Altitude, for more information.
Density Altitude:
FINDING TRUE AIRSPEED AND DENSITY ALTITUDE ON E6B

A. Air density affects the indications of the airspeed indicator and the performance of the airplane.

1. Density altitude is the theoretical altitude in the standard atmosphere where the density is the same as the actual density you are experiencing in flight.
   a. Density altitude is found by correcting pressure altitude for nonstandard temperature.
   b. Pressure altitude can be determined by setting the airplane's altimeter to 29.92 and then reading the altitude.
      1. If this is done in flight, make a note of the altimeter setting before turning it to 29.92.
      2. After you determine the pressure altitude, reset the altimeter to the current setting.
   c. The outside air temperature (OAT) can be determined by reading the current temperature on the airplane's OAT gauge.
      1. You will need to use the Celsius scale.
2. True airspeed (TAS) is the actual speed of the airplane through the air.
   a. TAS is found by correcting calibrated airspeed (CAS) for density altitude.
   b. See your airplane's Pilot's Operating Handbook to determine CAS based on indicated airspeed.
      1. Generally, there is little error at cruise speeds; i.e., CAS equals indicated airspeed (IAS).
      2. Thus, as a practical matter, you may usually use IAS rather than CAS to determine true airspeed.
B. Determining True Airspeed and Density Altitude

1. True airspeed and density altitude can be calculated on the calculator side of your flight computer.

2. Rotate the inner scale until the numbers on the inner and outer scales match.
   
a. The window that is between "1:30" and "1:50" on the hour scale is labeled "DENSITY ALTITUDE" and the arrow points to the density altitude.

   1. The numbers that rotate through this window are in thousands of feet and range from -10 (or -10,000 ft.) to 45 (or +45,000 ft.).
b. The window on the right side below "2:00" and "2:30" on the hour scale is used to set the OAT (above the window) over the pressure altitude (numbers in the window).

1. The OAT is in 5°C increments from +50°C on the left side to -70°C on the right side.

2. The numbers in the window are in thousands of feet and range from -2 (or -2,000 ft.) to 50 (or 50,000 ft.).

3. EXAMPLE: What is the TAS and density altitude if the IAS is 130 kt., OAT is -15°C, and the pressure altitude is 5,000 ft.?

   a. Using the inner window on the right side, locate the OAT of -15°C and rotate the disk so the pressure altitude of 5,000 ft. (which is labeled "5" on the scale) is under -15°C, as shown in the figure.

   b. In the window labeled "DENSITY ALTITUDE," read the density altitude of approximately 2,500 ft.

   c. Locate the IAS of 130 kt., or "13," on the inner scale. Without moving the disk, read the TAS on the outer scale opposite the IAS, which is 135 kt.

4. Use your flight computer to solve these practice problems (answers are located below).

<table>
<thead>
<tr>
<th>OAT</th>
<th>Pressure Altitude</th>
<th>IAS/CAS</th>
<th>TAS</th>
<th>Density Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>+10°C</td>
<td>4,500</td>
<td>95 kt.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>0°C</td>
<td>7,000</td>
<td>130 kt.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>-20°C</td>
<td>10,000</td>
<td>150 kt.</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>-10°C</td>
<td>9,500</td>
<td>115 kt.</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

5. Answers to practice problems

   a. 102 kt., 4,900 ft.
   b. 144 kt., 6,800 ft.
   c. 169 kt., 8,100 ft.
   d. 131 kt., 8,900 ft.
### Critical Situations:

<table>
<thead>
<tr>
<th>MALFUNCTION</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of r.p.m. during cruise flight (non-altitude engines)</td>
<td>Carburetor or induction icing or air filter clogging</td>
<td>Apply carburetor heat. If dirty filter is suspected and non-filtered air is available, switch selector to unfiltered position.</td>
</tr>
<tr>
<td>Loss of manifold pressure during cruise flight</td>
<td>Same as above</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Gain of manifold pressure during cruise flight</td>
<td>Turbocharger failure</td>
<td>Possible exhaust leak. Shut down engine or use lowest practicable power setting. Land as soon as possible.</td>
</tr>
<tr>
<td>Low oil temperature</td>
<td>Engine not warmed up to operating temperature</td>
<td>Warm engine in prescribed manner.</td>
</tr>
<tr>
<td>High oil pressure</td>
<td>Cold oil</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Low oil pressure</td>
<td>Broken pressure relief valve</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Insufficient oil</td>
<td>Burned out bearings</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Fluctuating oil pressure</td>
<td>Low oil supply, loose oil lines, defective pressure relief valve</td>
<td>Same as above.</td>
</tr>
<tr>
<td>High cylinder head temperature</td>
<td>Improper cowl flap adjustment</td>
<td>Adjust cowl flaps.</td>
</tr>
<tr>
<td>Insufficient airspeed for cooling</td>
<td>Improper mixture adjustment</td>
<td>Increase airspeed.</td>
</tr>
<tr>
<td>Detonation or preignition</td>
<td>Forth coming internal engine failure</td>
<td>Adjust mixture.</td>
</tr>
<tr>
<td>Low cylinder head temperature</td>
<td>Excessive cowl flap opening</td>
<td>Reduce power, enrich mixture, increase cooling airflow.</td>
</tr>
<tr>
<td>Excessively rich mixture</td>
<td>Estimated glide without clearing engine</td>
<td>Adjust cowl flaps.</td>
</tr>
<tr>
<td>Ammeter indicating discharge</td>
<td>Alternator or generator failure</td>
<td>Adjust mixture control. Clear engine long enough to keep temperatures at minimum range.</td>
</tr>
<tr>
<td>Load meter indicating zero</td>
<td>Same as above.</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Surging r.p.m. and overspeeding</td>
<td>Deffective propel!er</td>
<td>Adjust propeller r.p.m. Consult maintenance.</td>
</tr>
<tr>
<td>Deffective engine</td>
<td>Deffective propel!er governor</td>
<td>Adjust propeller control. Attempt to restore normal operation. Consult maintenance.</td>
</tr>
<tr>
<td>Deffective tachometer</td>
<td>Improper mixture setting</td>
<td>Readjust mixture for smooth operation.</td>
</tr>
<tr>
<td>Loss of airspeed in cruise flight with manifold pressure and r.p.m. constant</td>
<td>Possible loss of one or more cylinders</td>
<td>Land as soon as possible.</td>
</tr>
<tr>
<td>Rough running engine</td>
<td>Improper mixture control setting</td>
<td>Adjust mixture for smooth operation. Consult maintenance.</td>
</tr>
<tr>
<td>Defectiveignition or valves</td>
<td>Detonation or preignition</td>
<td>Reduce power, enrich mixture, open cowl flaps to reduce cylinder head temp. Land as soon as possible.</td>
</tr>
<tr>
<td>Induction air leak</td>
<td>Plugged fuel nozzle (Fuel injection)</td>
<td>Reduce power. Consult maintenance.</td>
</tr>
<tr>
<td>Excessive fuel pressure or fuel flow</td>
<td>Turn on boost tanks.</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Loss of fuel pressure</td>
<td>Engine driven pump failure</td>
<td>Switch tanks, turn on fuel.</td>
</tr>
<tr>
<td></td>
<td>No fuel</td>
<td>Turn on boost tanks.</td>
</tr>
</tbody>
</table>
Emergency Procedures: Learn the recommended procedures for the various types of emergencies and critical situations provided in section 3 of your approved Pilot’s Operating Handbook listed below.

- Partial or complete power loss
- Engine roughness
- Carburetor or induction icing
- Loss of oil pressure
- Fuel starvation
- Electrical malfunction
- Vacuum/pressure, and associated flight instruments malfunction
- Pitot/static system malfunction
- Landing gear or flap malfunction
- Inoperative trim
- Inadvertent door or window opening
- Structural icing
- Smoke/fire/engine compartment fire
- Any other emergency appropriate to the airplane
- Glass cockpit operations

Study Scenarios:

1. **An abnormally high engine oil temperature indication may be caused by**
   
   The oil level being too low

2. **Excessively high engine temperatures will**
   
   Cause loss of power, excessive oil consumption, and possible permanent internal engine damage

3. **For internal cooling, air cooled engines are especially dependent on**
   
   The circulation of lubricating oil

4. **If the engine oil temperature and cylinder head temperature gauges have exceeded their normal operating range, the pilot may have been operating with**
   
   Too much power and with the mixture set too lean
5. What action can a pilot take to aid in cooling an engine that is overheating during a climb?

   Reduce rate of climb and increase airspeed

6. What is one procedure to aid in cooling an engine that is overheating?

   Enrich the fuel mixture

7. A precaution for the operation of an engine equipped with a constant speed-propeller is to

   Avoid high manifold pressure settings with low RPM

8. What is an advantage of a constant-speed propeller

   Permits the pilot to select the blade angle for the most efficient performance

9. One purpose of the duel ignition system on an aircraft engine is to provide for

   Improved engine performance

10. If the ignition switch ground wire becomes disconnected, the magneto

    May continue to fire

11. The presence of carburetor ice in an aircraft equipped with a fixed-pitch propeller can be verified by applying carburetor heat and noting

    A decrease in RPM and then a gradual increase in RPM

12. Generally speaking, the use of carburetor heat tends to

    Decrease engine performance
13. Applying carburetor heat will

Enrich the fuel/air mixture

14. What chance occurs in the fuel/air mixture when carburetor heat is applied?

The fuel/air mixture becomes richer

15. The basic purpose of adjusting the fuel/air mixture at altitude is to

Decrease the fuel flow in order to compensate for decreased air density

16. While cruising at 9,500 feet MSL, the fuel/air mixture is properly adjusted. What will occur is a descent to 4,500 feet MSL is made without readjusting the mixture?

The fuel/air mixture may become excessively lean

17. The uncontrolled firing of the fuel/air charge in advance of normal spark ignition is known as

Pre-ignition

18. If the grade of fuel used in an aircraft engine is lower than specified for the engine, it will most likely cause

Detonation

19. Should it be necessary to hand-prop an airplane engine, it is extremely important that a competent pilot

Be at the controls in the cockpit

20. An electrical system failure (battery and alternator) occurs during flight. In this situation, you would experience?

Avionics equipment failure