High Performance Aircraft Checkout

Pilots seeking checkout in the high performance Cessna 182 will follow the normal checkout policy if the pilot has a high performance endorsement, a minimum of 100 hours of logged pilot flight time and at least 5 hours in type. If the pilot does not meet the minimum hour requirement for the high performance checkout, a Mentone Flying Club training program of not less than 5 hours in make and model (Cessna 182) for members with more than 100 hours total time, or 10 hours in make and model (Cessna 182) for members with less than 100 hours total time, along with a satisfactory signoff on the Pilot Checkout Form. If the pilot is lacking only a high performance endorsement, a Mentone Flying Club training program of not less than 5 hours in make and model (Cessna 182) is required to obtain the log book endorsement for high performance and satisfactory signoff on the Pilot Checkout Form.

INFORMATIONAL NOTE: Information contained in this checkout packet has been derived from the Airplane Flying Handbook and follows the recommendations of the FAA for a High Performance Aircraft Checkout. This packet should be used by the student and instructor as a teaching guide in conjunction with the Aircraft Flight Manual. This packet is not an all inclusive guide, but rather a starting place for basic information.

High Performance Aircraft Checkout

Transition to a complex airplane or a high performance airplane should be accomplished through a structured course of training administered by a competent and qualified flight instructor. The training should be accomplished in accordance with a ground and flight training syllabus. [Figure 1]

Ground Instruction	Flight Instruction	Directed Practice*
1 Hour	1 Hour	
1. Operations section of flight manual 2. Line inspection 3. Cockpit familiarization	1. Flight training maneuvers 2. Takeoffs, landings and go-arounds	
1 Hour	1 Hour	1 Hour
1. Aircraft loading, limitations and servicing 2. Instruments, radio and special equipment 3. Aircraft systems	1. Emergency operations 2. Control by reference to instruments 3. Use of radio and autopilot	As assigned by flight instructor
1 Hour	1 Hour	1 Hour
1. Performance section of flight manual 2. Cruise control 3. Review	1. Short and soft-field takeoffs and landings 2. Maximum performance operations	As assigned by flight instructor
1 Hour -- CHECKOUT		
* The directed practice indicated may be conducted solo or with a safety pilot at the discretion of the instructor.		

Figure 1. Transition Training Syllabus.

This syllabus for transition training is to be considered flexible. The arrangement of the subject matter may be changed and the emphasis may be shifted to fit the qualifications of the transitioning pilot, the airplane involved, and the circumstances of the training situation, provided the prescribed proficiency standards are achieved. These standards are contained in the practical test standards appropriate for the certificate that the transitioning pilot holds or is working towards.

The training times indicated in the syllabus are based on the capabilities of a pilot who is currently active and fully meets the present requirements for the issuance of at least a private pilot certificate. The time periods may be reduced for pilots with higher qualifications or increased for pilots who do not meet the current certification requirements or who have had little recent flight experience.

HIGH PERFORMANCE AIRPLANES

Transition to a high performance airplane, can be demanding for most pilots without previous experience. ***Increased performance and increased complexity both require additional planning, judgment, and piloting skills.*** Transition to these types of airplanes, therefore, should be accomplished in a systematic manner through a structured course of training administered by a qualified flight instructor.

Under CFR 61.31(f), a private pilot or commercial pilot may not act as PIC of a high performance airplane (one that has more than 200 horsepower) unless he or she has received flight instruction in such an airplane from an authorized flight instructor, and that flight instructor has certified in the pilot's logbook that he or she is competent to pilot a high performance airplane. However, this instruction is not required if the pilot has logged flight time as PIC in high performance airplanes prior to August 4, 1997.

CONTROLLABLE-PITCH PROPELLER

Fixed-pitch propellers are designed for best efficiency at one speed of rotation and forward speed. This type of propeller will provide suitable performance in a narrow range of airspeeds; however, efficiency would suffer considerably outside this range. To provide high propeller efficiency through a wide range of operation, the propeller blade angle must be controllable. The most convenient way of controlling the propeller blade angle is by means of a constant-speed governing system.

CONSTANT-SPEED PROPELLER

The constant-speed propeller keeps the blade angle adjusted for maximum efficiency for most conditions of flight. When an engine is running at constant speed, the torque (power) exerted by the engine at the propeller shaft must equal the opposing load provided by the resistance of the air. The r.p.m. is controlled by regulating the torque absorbed by the propeller—in other words by increasing or decreasing the resistance offered by the air to the propeller. In the case of a fixed-pitch propeller, the torque absorbed by the propeller is a function of speed, or r.p.m. If the power output of the engine is changed, the engine will accelerate or decelerate until an r.p.m. is reached at which the power delivered is equal to the power absorbed. In the case of a constant-speed propeller, the power absorbed is independent of the r.p.m., for by varying the pitch of the blades, the air resistance and hence the torque or load, can be changed without reference to propeller speed. This is accomplished with a constant-speed propeller by means of a governor. The governor, in most cases, is geared to the engine crankshaft and thus is sensitive to changes in engine r.p.m.

CESSNA | SECTION 7
MODEL 182 SKYLANE | AIRPLANE & SYSTEMS DESCRIPTIONS

PROPELLER

The airplane has an all-metal, two-bladed, constant-speed, governor-regulated propeller. A setting introduced into the governor with the propeller control establishes the propeller speed, and thus the engine speed to be maintained. The governor then controls flow of engine oil, boosted to high pressure by the governing pump, to or from a piston in the propeller hub. Oil pressure acting on the piston twists the blades toward high pitch (low RPM). When oil pressure to the piston in the propeller hub is relieved, centrifugal force, assisted by an internal spring, twists the blades toward low pitch (high RPM).

A control knob on the center area of the switch and control panel is used to set the propeller and control engine RPM as desired for various flight conditions. The knob is labeled PROP RPM, PUSH INCR. When the control knob is pulled out, the blade pitch increases, thereby decreasing RPM. The propeller control knob is equipped with a vernier feature which allows slow or fine RPM adjustments by rotating the knob clockwise to increase RPM, depress the button on the end of the control knob and reposition the control as desired.

Figure 2. Cessna 182 POH excerpt.

The pilot controls the engine r.p.m. indirectly by means of a propeller control in the cockpit, which is connected to the governor. For maximum takeoff power, the propeller control is moved all the way forward to the low pitch/high r.p.m. position, and the throttle is moved forward to the maximum allowable manifold pressure position. To reduce power for climb or cruise, manifold pressure is reduced to the desired value with the throttle, and the engine r.p.m. is reduced by moving the propeller control back toward the high pitch/low r.p.m. position until the desired r.p.m. is observed on the tachometer. Pulling back on the propeller control causes the propeller blades to move to a higher angle. Increasing the propeller blade angle (of attack) results in an increase in the resistance of the air. This puts a load on the engine so it slows down. In other words, the resistance of the air at the higher blade angle is greater than the torque, or power, delivered to the propeller by the engine, so it slows down to a point where the two forces are in balance.

When an airplane is nosed up into a climb from level flight, the engine will tend to slow down. Since the governor is sensitive to small changes in engine r.p.m., it will decrease the blade angle just enough to keep the engine speed from falling off. If the airplane is nosed down into a dive, the governor will increase the blade angle enough to prevent the engine from overspeeding. This allows the engine to maintain a constant r.p.m., and thus maintain the power output. Changes in airspeed and power can be obtained by changing r.p.m. at a constant manifold pressure; by changing the manifold pressure at a constant r.p.m.; or by changing both r.p.m. and manifold pressure. Thus the constant-speed propeller makes it possible to obtain an infinite number of power settings.

TAKEOFF, CLIMB, AND CRUISE

During takeoff, when the forward motion of the airplane is at low speeds and when maximum power and thrust are required, the constant-speed propeller sets up a low propeller blade angle (pitch). The low blade angle keeps the angle of attack, with respect to the relative wind, small and efficient at the low speed. [Figure 4]

At the same time, it allows the propeller to "slice it thin" and handle a smaller mass of air per revolution. This light load allows the engine to turn at maximum r.p.m. and develop maximum power. Although the mass of air per revolution is small, the number of revolutions per minute is high. Thrust is maximum at the beginning of the takeoff and then decreases as the airplane gains speed and the airplane drag increases.
Due to the high slipstream velocity during takeoff, the effective lift of the wing behind the propeller(s) is increased.

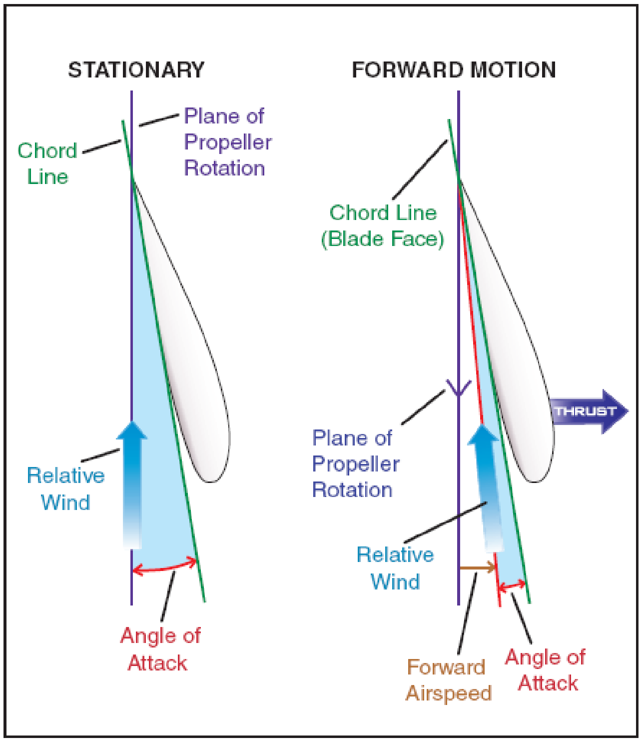


Figure 3. Propeller blade angle.

As the airspeed increases after lift-off, the load on the engine is lightened because of the small blade angle. The governor senses this and increases the blade angle slightly. Again, the higher blade angle, with the higher speeds, keeps the angle of attack with respect to the relative wind small and efficient.

For climb after takeoff, the power output of the engine is reduced to climb power by decreasing the manifold pressure and lowering r.p.m. by increasing the blade angle. At the higher (climb) airspeed and the higher blade angle, the propeller is handling a greater mass of air per second at a lower slipstream velocity. This reduction in power is offset by the increase in propeller efficiency. The angle of attack is again kept small by the increase in the blade angle with an increase in airspeed.

At cruising altitude, when the airplane is in level flight, less power is required to produce a higher airspeed than is used in climb. Consequently, engine power is again reduced by lowering the manifold pressure and increasing the blade angle (to decrease r.p.m.). The higher airspeed and higher blade angle enable the propeller to handle a still greater mass of air per second at still smaller slipstream velocity. At normal cruising speeds, propeller efficiency is at, or near maximum efficiency. Due to the increase in blade angle and airspeed, the angle of attack is still small and efficient.

BLADE ANGLE CONTROL

Once the pilot selects the r.p.m. settings for the propeller, the propeller governor automatically adjusts the blade angle to maintain the selected r.p.m. It does this by using oil pressure. Generally, the oil pressure used for pitch change comes directly from the engine lubricating system. When a governor is employed, engine oil is used and the oil pressure is usually boosted by a pump, which is integrated with the governor. The higher pressure provides a quicker blade angle change. The r.p.m. at which the propeller is to operate is adjusted in the governor head. The pilot changes this setting by changing the position of the governor rack through the cockpit propeller control.

On some constant-speed propellers, changes in pitch are obtained by the use of an inherent centrifugal twisting moment of the blades that tends to flatten the blades toward low pitch, and oil pressure applied to a hydraulic piston connected to the propeller blades which moves them toward high pitch. Another type of constant-speed propeller uses counterweights attached to the blade shanks in the hub. Governor oil pressure and the blade twisting moment move the blades toward the low pitch position, and centrifugal force acting on the counterweights moves them (and the blades) toward the high pitch position. In the first case above, governor oil pressure moves the blades towards high pitch, and in the second case, governor oil pressure and the blade twisting moment move the blades toward low pitch. A loss of governor oil pressure, therefore, will affect each differently.

GOVERNING RANGE

The blade angle range for constant-speed propellers varies from about 11 1/2 to 40°. The higher the speed of the airplane, the greater the blade angle range. [Figure 5]

Aircraft Type	Design Speed (m.p.h.)	Blade Angle Range	Pitch Low	Pitch High
Fixed Gear	160	11 1/2°	10 1/2°	22°
Retractable	180	15°	11°	26°
Turbo Retractable	225/240	20°	14°	34°
Turbine Retractable	250/300	30°	10°	40°
Transport Retractable	325	40°	10/15°	50/55°

Figure 4. Blade angle range (values are approximate).

The range of possible blade angles is termed the propeller's governing range. The governing range is defined by the limits of the propeller blade's travel between high and low blade angle pitch stops. As long as the propeller blade angle is within the governing range and not against either pitch stop, a constant engine r.p.m. will be maintained. However, once the propeller blade reaches its pitch-stop limit, the engine r.p.m. will increase or decrease with changes in airspeed and propeller load similar to a fixed-pitch propeller. For example, once a specific r.p.m. is selected, if the airspeed decreases enough, the propeller blades will reduce pitch, in an attempt to maintain the selected r.p.m., until they contact their low pitch stops. From that point, any further reduction in airspeed will cause the engine r.p.m. to decrease. Conversely, if the airspeed increases, the propeller blade angle will increase until the high pitch stop is reached. The engine r.p.m. will then begin to increase.

CONSTANT-SPEED PROPELLER OPERATION

The engine is started with the propeller control in the low pitch/high r.p.m. position. This position reduces the load or drag of the propeller and the result is easier starting and warm-up of the engine. During warm-up, the propeller blade changing mechanism should be operated slowly and smoothly through a full cycle. This is done by moving the propeller control (with the manifold pressure set to produce about 1,600 r.p.m.) to the high pitch/low r.p.m. position, allowing the r.p.m. to stabilize, and then moving the propeller control back to the low pitch takeoff position. This should be done for two reasons: to determine whether the system is operating correctly, and to circulate fresh warm oil through the propeller governor system. It should be remembered that the oil has been trapped in the propeller cylinder since the last time the engine was shut down. There is a certain amount of leakage from the propeller cylinder, and the oil tends to congeal, especially if the outside air temperature is low. Consequently, if the propeller isn't exercised before takeoff, there is a possibility that the engine may overspeed on takeoff.

An airplane equipped with a constant-speed propeller has better takeoff performance than a similarly powered airplane equipped with a fixed-pitch propeller. This is because with a constant-speed propeller, an airplane can develop its maximum rated horsepower (red line on the tachometer) while motionless. An airplane with a fixedpitch propeller, on the other hand, must accelerate down the runway to increase airspeed and aerodynamically unload the propeller so that r.p.m. and horsepower can steadily build up to their maximum. With a constantspeed propeller, the tachometer reading should come up to within 40 r.p.m. of the red line as soon as full power is applied, and should remain there for the entire takeoff.

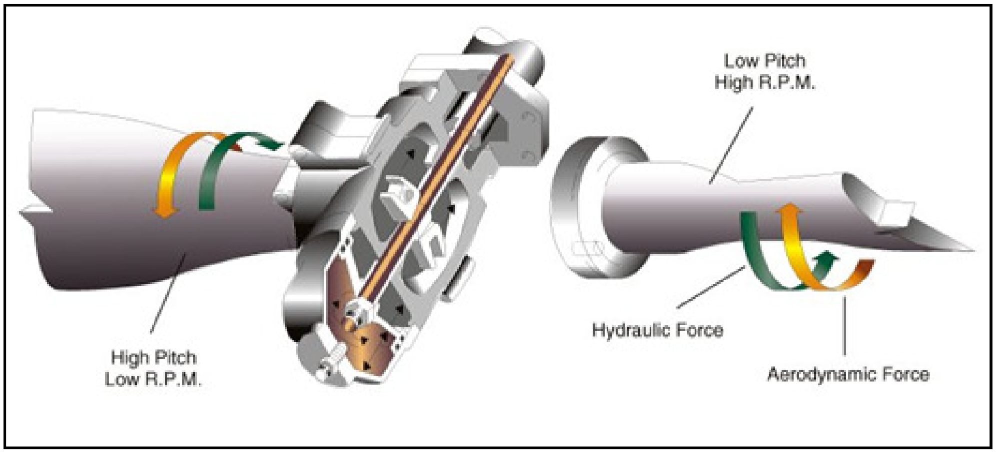


Figure 5. Propeller governor.

Excessive manifold pressure raises the cylinder compression pressure, resulting in high stresses within the engine. Excessive pressure also produces high engine temperatures. A combination of high manifold pressure and low r.p.m. can induce damaging detonation. In order to avoid these situations, the following sequence should be followed when making power changes.

- When increasing power, increase the r.p.m. first, and then the manifold pressure.
- When decreasing power, decrease the manifold pressure first, and then decrease the r.p.m.

Instructor Technique: *Always keep the 3 letters (RPM) higher than (or equal to) the 2 letters (MP). Example: **__24__**00 RPM & **__23__**" MP.*

It is a fallacy that (in non-turbocharged engines) the manifold pressure in inches of mercury (inches Hg) should never exceed r.p.m. in hundreds for cruise power settings. The cruise power charts in the AFM/POH should be consulted when selecting cruise power settings. Whatever the combinations of r.p.m. and manifold pressure listed in these charts—they have been flight tested and approved by the airframe and powerplant engineers for the respective airframe and engine manufacturer. Therefore, if there are power settings such as 2,100 r.p.m. and 24 inches manifold pressure in the power chart, they are approved for use.

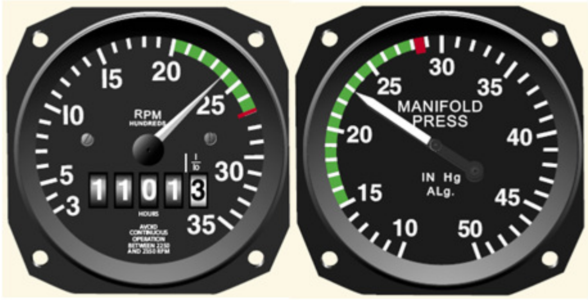


Figure 6. RPM and Manifold Pressure Gage.

With a constant-speed propeller, a power descent can be made without overspeeding the engine. The system compensates for the increased airspeed of the descent by increasing the propeller blade angles. If the descent is too rapid, or is being made from a high altitude, the maximum blade angle limit of the blades is not sufficient to hold the r.p.m. constant. When this occurs, the r.p.m. is responsive to any change in throttle setting.

Some pilots consider it advisable to set the propeller control for maximum r.p.m. during the approach to have full horsepower available in case of emergency. If the governor is set for this higher r.p.m. early in the approach when the blades have not yet reached their minimum angle stops, the r.p.m. may increase to unsafe limits. However, if the propeller control is not readjusted for the takeoff r.p.m. until the approach is almost completed, the blades will be against, or very near their minimum angle stops and there will be little if any change in r.p.m. In case of emergency, both throttle and propeller controls should be moved to takeoff positions.

Many pilots prefer to feel the airplane respond immediately when they give short bursts of the throttle during approach. By making the approach under a little power and having the propeller control set at or near cruising r.p.m., this result can be obtained.

Although the governor responds quickly to any change in throttle setting, a sudden and large increase in the throttle setting will cause a momentary overspeeding of the engine until the blades become adjusted to absorb the increased power. If an emergency demanding full power should arise during approach, the sudden advancing of the throttle will cause momentary overspeeding of the engine beyond the r.p.m. for which the governor is adjusted. This temporary increase in engine speed acts as an emergency power reserve.

Some important points to remember concerning constant-speed propeller operation are:

- The red line on the tachometer not only indicates maximum allowable r.p.m.; it also indicates the r.p.m. required to obtain the engine's rated horsepower.
- A momentary propeller overspeed may occur when the throttle is advanced rapidly for takeoff. This is usually not serious if the rated r.p.m. is not exceeded by 10 percent for more than 3 seconds.
- The green arc on the tachometer indicates the normal operating range. When developing power in this range, the engine drives the propeller. Below the green arc, however, it is usually the windmilling propeller that powers the engine. Prolonged operation below the green arc can be detrimental to the engine.
- On takeoffs from low elevation airports, the manifold pressure in inches of mercury may exceed the r.p.m. This is normal in most cases. The pilot should consult the AFM/POH for limitations.
- All power changes should be made smoothly and slowly to avoid overboosting and/or overspeeding.

Engine Cooling Systems

The burning fuel within the cylinders produces intense heat, most of which is expelled through the exhaust system. Much of the remaining heat, however, must be removed, or at least dissipated, to prevent the engine from overheating. Otherwise, the extremely high engine temperatures can lead to loss of power, excessive oil consumption, detonation, and serious engine damage.

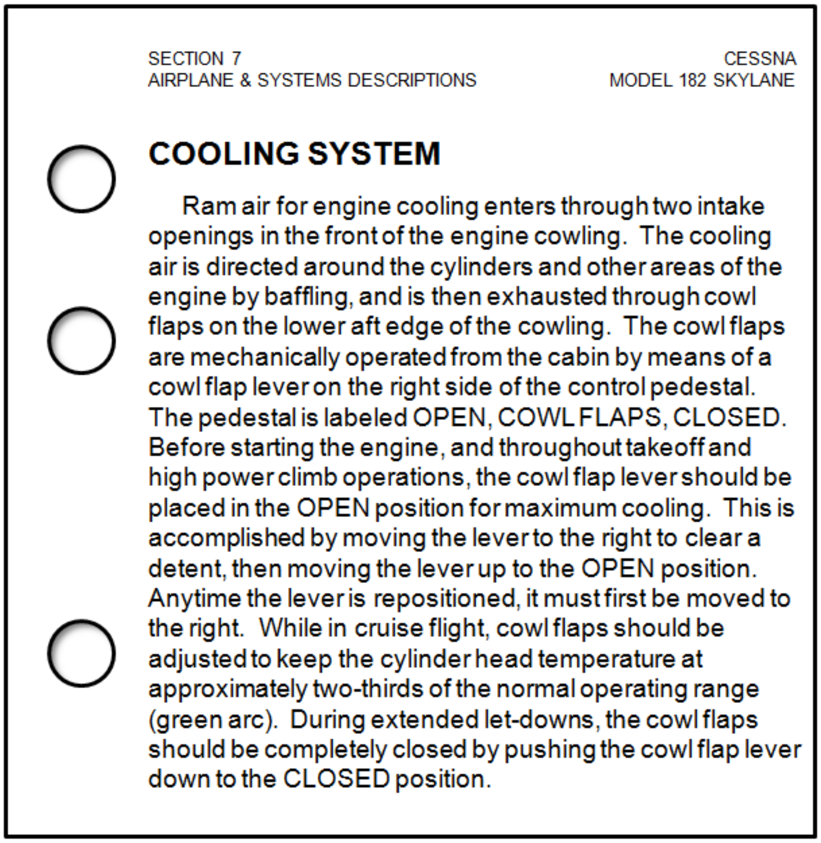

Figure 7. Cessna 182 Cowl Flaps

While the oil system is vital to the internal cooling of the engine, an additional method of cooling is necessary for the engine's external surface. Most small aircraft are air cooled, although some are liquid cooled.

Air cooling is accomplished by air flowing into the engine compartment through openings in front of the engine cowling. Baffles route this air over fins attached to the engine cylinders, and other parts of the engine, where the air absorbs the engine heat. Expulsion of the hot air takes place through one or more openings in the lower, aft portion of the engine cowling.

The outside air enters the engine compartment through an inlet behind the propeller hub. Baffles direct it to the hottest parts of the engine, primarily the cylinders, which have fins that increase the area exposed to the airflow.

The air cooling system is less effective during ground operations, takeoffs, go-arounds, and other periods of high-power, low-airspeed operation. Conversely, high-speed descents provide excess air and can shock cool the engine, subjecting it to abrupt temperature fluctuations. In order to give you more control over engine cooling, some airplanes are equipped with cowl flaps. Opening the cowl flaps creates a larger path for air to escape from the engine compartment, increasing the cooling airflow. [Figure 7]



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AIRPLANE & SYSTEMS DESCRIPTIONS | MODEL 182 SKYLANE

COOLING SYSTEM

Ram air for engine cooling enters through two intake openings in the front of the engine cowling. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through cowl flaps on the lower aft edge of the cowling. The cowl flaps are mechanically operated from the cabin by means of a cowl flap lever on the right side of the control pedestal. The pedestal is labeled OPEN, COWL FLAPS, CLOSED. Before starting the engine, and throughout takeoff and high power climb operations, the cowl flap lever should be placed in the OPEN position for maximum cooling. This is accomplished by moving the lever to the right to clear a detent, then moving the lever up to the OPEN position. Anytime the lever is repositioned, it must first be moved to the right. While in cruise flight, cowl flaps should be adjusted to keep the cylinder head temperature at approximately two-thirds of the normal operating range (green arc). During extended let-downs, the cowl flaps should be completely closed by pushing the cowl flap lever down to the CLOSED position.

Figure 8. Cessna 182 POH excerpt.

Operating the engine at higher than its designed temperature can cause loss of power, excessive oil consumption, and detonation. It will also lead to serious permanent damage, such as scoring the cylinder walls, damaging the pistons and rings, and burning and warping the valves. Monitoring the flight deck engine temperature instruments will aid in avoiding high operating temperature.

Under normal operating conditions in aircraft not equipped with cowl flaps, the engine temperature can be controlled by changing the airspeed or the power output of the engine. High engine temperatures can be decreased by increasing the airspeed and/or reducing the power.

The oil temperature gauge gives an indirect and delayed indication of rising engine temperature, but can be used for determining engine temperature if this is the only means available.

Most aircraft are equipped with a cylinder-head temperature gauge which indicates a direct and immediate cylinder temperature change. This instrument is calibrated in degrees Celsius or Fahrenheit, and is usually color coded with a green arc to indicate the normal operating range. A red line on the instrument indicates maximum allowable cylinder head temperature.

To avoid excessive cylinder head temperatures, increase airspeed, enrich the mixture, and/or reduce power. Any of these procedures help to reduce the engine temperature. On aircraft equipped with cowl flaps [Figure 7], use the cowl flap positions to control the temperature. Cowl flaps are hinged covers that fit over the opening through which the hot air is expelled. If the engine temperature is low, the cowl flaps can be closed, thereby restricting the flow of expelled hot air and increasing engine temperature. If the engine temperature is high, the cowl flaps can be opened to permit a greater flow of air through the system, thereby decreasing the engine temperature.

High Performance Airplane Endorsement: section 61.31(f).

I certify that (*First name, MI, Last name*), (*pilot certificate*), (*certificate number*), has received the required training of section 61.31(f) in a (*make and model of high performance airplane*). I have determined that he/she is proficient in the operation and systems of a high performance airplane.

/s/ [date] J. J. Jones 987654321CFI Exp. 12-31-05

High Performance Aircraft Checkout

Name:	Date:
Grade of Certificate:	Certificate Number:
Ratings and Limitations:	
Class of Medical:	Date of last Medical:
Total Flight Time:	High Performance Aircraft Hours:
Aircraft to be Used (Make and Model):	N#

GROUND INSTRUCTION — Hours of Ground Instruction:

[ ] AIRPLANE POH/AFM REVIEW
- A. General Description and Safety Features
- B. Limitations

[ ] AIRPLANE SYSTEMS INCLUDING NORMAL, ABNORMAL, AND EMERGENCY PROCEDURES
- A. Flight Instruments, Avionics, and Autopilot (if appropriate)
- B. Controls and Trim Controls
- C. Powerplant / Propeller
- D. Fuel
- E. Landing Gear
- F. Flaps
- G. Electrical
- H. Hydraulic
- I. Environmental

[ ] FLIGHT PLANNING CONSIDERATIONS
- A. Performance Data
- B. Weight and Balance
- C. Review

[ ] CHECKLIST AND OPERATIONAL PROCEDURES
- A. Review of Operational Considerations for High Performance Airplanes in the airport Traffic Pattern
- B. Review Local Departure and Arrival Procedures
- C. Review Procedures for Each Maneuver to Be Accomplished

FLIGHT INSTRUCTION — Hours of Flight Instruction:

[ ] PREFLIGHT INSPECTION

[ ] CHECKLIST & STARTING PROCEDURES

[ ] STARTING ENGINES

[ ] NORMAL DEPARTURE OPERATIONS
- A. Taxiing
- B. Pre-Takeoff Checks
- C. Normal Takeoff
- D. Climb – Ephasis on Collision Avoidance and Appropriate Power Settings
- E. Cruise – Checklist Completion and Cockpit Resource Management

[ ] AIR WORK
- A. Constant Altitude Turns
- B. Slowflight
- C. Power ON Stall
- D. Power OFF Stall
- E. Emergency Operations of ALL Systems (as per manufacturer)
- F. Recovery from Unusual Attitudes by Reference to Instruments
- G. Simulated Emergency Descent

[ ] NORMAL ARRIVAL OPERATIONS
- A. Descent and In-Range Checklist Procedures
- B. Normal Landings

[ ] PATTERN WORK
- A. Crosswind, Short and Soft-Field Takeoffs and Landings
- B. Go-Arounds
- C. Aborted Takeoff
- D. No Flap Landing
- E. Engine-Out Procedures

[ ] AFTER LANDING AND POST FLIGHT PROCEDURES

[ ] INSTRUMENT APPROACH, DEPARTURE, AND EN ROUTE PROCEDURES (if instrument rated)

Type of Approach:	Location:
Instrument Hold:	Location:
Instrument Departure:	Location:
Instrument Arrival:	Location:

OVERALL COMPLETION OF TRAINING

Remarks:		
Instructor Signature:	Certificate No.	Expiration Date:

I have received transition training to high performance airplanes and completed the ground and flight training noted above.

Pilot Signature:	Date:
High performance hours after course compleation:	