



**Civil Air Patrol
New Mexico Wing**



**Turbocharged Single Engine Aircraft
TCA Guidelines**

16-Dec-2017

All Civil Air Patrol (CAP) pilots in New Mexico (NM) Wing requesting privileges to act as Pilot-In-Command (PIC) in CAP Turbocharged Cessna Aircraft (TCA) must receive ground and flight training and an endorsement from a CAP TCA Instructor Pilot (IP)/Check Pilot (CP) assigned to NM Wing as required by the NM Wing Supplement to CAPR 70-1.

Objective:

The objective of the NM Wing TCA Standard Operating Procedure (SOP) is to standardize the operation of TCA and properly train CAP pilots to operate the NM TCA with ample knowledge, using correct procedures, and proficiency. This guide does not constitute or mandate a separate CAP Form-5 check ride, but provides a guide on how to operate TCA to the standards set forth by NM Wing and outlines the training requirements to receive a CAP Turbo endorsement/qualification. Due to the high likelihood and operational requirement to operate in flight regimes where the use of supplemental oxygen will be required, the proper use of the on-board oxygen system is also included in this SOP/training guide. The Wing Standardization/Evaluation (DOV) team has developed this TCA SOP in consultation with experienced pilots from other regions and Cessna Factory instructors.

Requirements:

- Pilots have to already meet the requirements of CAPR 70-1 for Single-Engine High Performance Airplanes and be at least CAP G-1000 VFR and Transport Mission Pilot qualified to begin training in the NM Wing TCA and receive a Turbo endorsement.
- Pilots with no prior TCA experience will be required to undergo the ground training outlined herein and receive flight instruction in NM Wing TCA to include, at a minimum, 3 hours of flight training time, in order to receive an endorsement from a CAP TCA IP/CP signifying that the pilot is proficient to operate TCA to the NM Wing SOP standards.
- Pilots with previous TCA experience will initially present their documentation and discuss their experience with NM Wing DOV, and upon confirmation of sufficient experience, will be required to receive ground and flight instruction in NM Wing TCA to include a minimum 1 hour of flight training time and to receive an endorsement from the CAP TCA IP/CP signifying that the pilot is proficient to operate TCA to the NM Wing SOP standards.
- Instructor/Check Pilots that desire to instruct Turbo procedures and perform TCA checkouts will undergo the training required by this SOP before being qualified to provide Turbo endorsements.

Standard Operating Procedures for Turbocharged Single Engine Aircraft:

1. Power Management in TCA

NOTE: *Make all power changes slowly and smoothly. Do not make unnecessary large power changes - Plan to keep power settings in the green or normal operating area, except for takeoff and landing. Any power increases should be accomplished by increasing the propeller RPM first then increasing the manifold pressure particularly when operating turbocharged engines. Power reductions should be accomplished by reducing the manifold pressure first, then the RPM.*

a. Takeoff: Before takeoff engine checks should not be accomplished until oil temperature is at least 75° F (minimum approved operating limit). Takeoff should not be started until oil temperature is above 100° F and oil pressure is below 100 psi to assure proper oil flow to the turbocharger and its actuating system. Takeoff is accomplished using full rated power. On the current T-206H Nav III aircraft, the waste gate is automatically adjusted, so the pilot only needs to refer to the manifold pressure (MP) and fuel flow (FF) and adjust accordingly during takeoff to confirm it does not exceed operating limits. Advance the throttle slowly, pausing momentarily at approximately 30" MP to permit turbine speed to stabilize, then gradually open the throttle to obtain takeoff manifold pressure.

Caution: *39" / 2500 RPM / 34 GPH (usually Full Rich setting even at our high density altitudes) is required to achieve Maximum Continuous Power (MCP) - Know the equipment you are flying!*

b. Climb Out: Once established in enroute climb, power may be adjusted to less than MCP as recommended in the Pilot Operating Handbook (POH). Recommended procedure is to reduce power for enroute climb (normally 30"MP and 2400 RPM for cruise climb 95-105 KIAS) as soon as practical after reaching at least pattern altitude if obstacle or terrain clearance is not a factor, unless climbing to high altitude, where maintaining full MCP may be more advantageous, but consider the trade-off of high fuel burn to achieve this performance.

c. Cruise, Descent and Landing: In accordance with the POH, recommend for cruise power setting 65% power or 23" MP / 2300 RPM for maximum engine life and fuel efficiency. Keep engine in the green operating area on the MP during cruise descents or at least until the Cylinder Head Temperature (CHT) drops after a minute or two to prevent shock cooling of the cylinder heads and turbocharger. Recommend initial reduction to 25" MP until CHT stabilizes then use 20" MP in cruise descents. Another highly recommended technique is to reduce 2" MP every 2 minutes for descents from higher altitudes.

d. Balked Landings: Maximum power should be used in go-arounds. Any throttle increase above 30" must be performed slowly and deliberately.

e. Engine Cool Down: Modern Turbo cool-down is normally not an issue. The engine is operating at lower power settings throughout the final approach, landing, taxi and shutdown

process. This provides adequate time for the turbo temperature to stabilize. However, ensure that prior to engine shutdown the engine is operated at idle RPM for approximately 5 minutes to allow the turbocharger to cool and slow down. This 5 minutes may be calculated from landing touchdown.

2. Mixture Control in TCA

NOTE: *Operation on the lean side of peak is not allowed.*

a. Engine Start and Taxi: Engine start is by the POH. After startup, the mixture should be leaned to a maximum RPM setting @ 1200 RPM. At high density altitude (above 5,000 ft) it is advisable to stop mixture control before reaching Full Rich during start up to prevent engine flooding and bog down, then further lean as indicated above once engine is successfully started.

b. Run Up: Prior to run up, the mixture may need to be slightly enriched to allow the engine to run at 1700-1800 RPM. If prolonged ground times are expected/planned, reset lean mixture setting for taxi until ready for takeoff to prevent/minimize plug fouling, prevent engine bog down and increase fuel efficiency.

c. Take Off: Just prior to take off, the mixture shall be adjusted to achieve a 34 GPH minimum and develop MAX power (usually Full Rich setting).

d. Climb Out: MCP setting may be maintained all the way to high altitude level-off (39" MP/34 GPH FF all the way up to 17,000', then reductions per POH). The recommended procedure is to reduce power for enroute climb as soon as practical after reaching at least pattern altitude whenever obstacle or terrain clearance is not a factor. If a power reduction is desired on climb out set the MP first, then RPM and finally the mixture should be adjusted in accordance with the POH (top of the green bars works fairly well). While the POH recommends 20 GPH for reduced power climb, monitor CHT as well and try to maintain a cylinder head temperature below 380° – 400° C to prolong engine life by using a combination of cowl flaps and richer mixture to keep CHT from exceeding this temperature.

e. Cruise: During engine power settings between 65% and 75%, the mixture should be set to 75° C **rich of peak**. Leaning on TCA is accomplished with reference to Turbine Inlet Temperature (TIT). While the T-206H Nav III has a lean assist function, it is possible to reach maximum continuous TIT of 1675° C before the lean assist feature register a peak TIT, in this case set lean mixture to approximately 1600° C. Monitor CHT as well and try to keep cylinder head temperature no higher than 380° – 400° C to prolong engine life by using a combination of cowl flaps and richer mixture setting up to 150° rich of peak to keep CHT from exceeding this temperature range for prolonged periods. When operational situation permits, it is recommended to run engine @ 65% or less for maximum engine life and fuel efficiency (i.e. approximately 23"/2300 RPM which result in approximately 55% power).

f. Descent: Enrich mixture, as necessary, to keep the engine running smoothly, using the top of the green fuel flow indicator bar as a guide, although normally you will not have to enrich mixture significantly for descents.

g. Approach and Landing: The mixture control should be set to the same approximate setting as used during climb out when operating in similar environments as your departure altitudes while on approach. This setting will keep the engine running at low to idle power. Once ready to begin final approach set mixture to rich, this will still provide smooth operation at idle but permit MCP if a go-around is necessary.

h. Balked Landing: Immediately after selecting go-around power with the throttle (above 25"), ensure the mixture is at full rich to ensure a minimum of 34 GPH once the climb out is established.

i. Taxi After Landing: Leaning for taxi back is recommended as stated earlier in paragraph a. of this section. The aircraft is very susceptible to bogging down and even engine stalling as soon as you try to add power to taxi clear of the runway, therefore a recommended after landing flow is to raise the flaps, open the cowl flaps and then select mixture control knob out approximately 1" (two finger widths) after aircraft is well under control on roll out before any power additions are attempted to clear the runway and taxi back to parking.

3. Precise Flight Oxygen Face Mask and Oxymizer Cannula System Use

a. Personal cannulas are the responsibility of individual CAP members (pilots and other crew members) and are required to be carried on every flight planned to operate above 10,000' MSL. Due to the high altitude capabilities and potential to operate at high altitudes, it is recommended that individual cannulas be carried on every flight. The oxygen equipment kit will be carried on all flights anticipated to exceed 10,000' MSL and will contain a minimum number of Precise Flight A-5 Flowmeters and emergency use cannulas/masks for the anticipated/planned number of crewmembers/passengers. If only personal cannulas are available, maximum operating altitude is limited to 18,000' MSL per the POH. Only instrument rated pilots on an IFR flight plan may operate above 18,000' MSL with approved masks. Due to the inherent risks of operating at these altitudes, specific permission from NM Wing/CC, on a flight case by case basis, will be required to operate above 18,000' MSL.

b. Pilot/Observer Masks. Pilots and observers wishing to operate the TCA are highly encouraged to provide personal microphone-equipped face masks to aid in smooth operations and communications. If all occupants have approved face masks, operations are permitted up to 25,000' MSL per the POH. Cannulas are acceptable and very functional up to 18,000' MSL.

c. Oxygen Use. It is highly encouraged that NM CAP crewmembers use supplemental oxygen anytime they will be operating in the TCA for prolonged periods above 10,000' MSL. Refer to 14 CFR 91.211 for minimum regulatory requirements for oxygen use. It is the responsibility of the PIC to ensure enough oxygen is on board for the planned/anticipated operation. If oxygen is used, it should be refilled as part of the aircraft servicing at the

completion of each sortie if this service is available at the landing location, otherwise it is imperative that the PIC advise maintenance officer as soon as feasible so that the aircraft oxygen system can be serviced as soon as possible to ensure the aircraft remains fully mission capable at all times.

Training by IP or CP:


This training guide sets forth the training required to receive an endorsement for NM CAP pilots to operate TCA. This endorsement can be documented using the current CAP Form-5, marking the abbreviated check box and documenting the completion of training by initialing the “Turbo” area in the “Additional CAP Endorsements” area of the CAP Form-5 and documenting the **total** training time used to achieve satisfactory performance using this SOP as the standard. This is an Instructor certification only and does not need a check pilot to endorse. IP’s are authorized to use and sign the CAP Form-5 to document the training.

NOTE: *A complete/annual CAP Form-5 check ride can be used to achieve this endorsement as well, depending on the training and evaluation requirements situation for an individual CAP pilot. A check pilot is required to perform the check ride and endorsement and sign the CAP Form-5 in this instance.*

Upon completion of the training, the individual CAP pilot desiring Turbo qualification must upload the CAP Form-5 into eServices for documentation of training and validation of the initial/recurring endorsement.

Academic Ground Training:

NOTE: *The Power Point presentation to aid with this ground training can be found at: <http://www.nmcap.org/images/operations/NMWingTCASOP.pdf>.*

 Pilots will receive and demonstrate oral and written knowledge in the following areas: *(Included but not limited to)*

- Schematic design and description of the turbocharger system.
- Waste gate system operation.
- Engine Monitoring Systems (to include Turbine Inlet Temperature).
- TCA POH limitations and performance calculations.
- Momentary overshoot of manifold pressure conditions and limitations.
- Normal procedures differences between aspirated and turbocharged engines for Engine Start, Taxi, Run up, Takeoff, Climb out, Cruise, Descent, Approach, Landing, Balked landing, Taxi, and Engine cool down (TCA Operating Techniques).
- Mixture/Power management for all flight configurations.
- High Altitude operations considerations.
- Emergency Procedures, Failure of Turbocharger in flight.
- Oxygen System components, operations, Warnings and Cautions.
- Oxygen System duration chart interpretation.
- Tactical Repeater installation on aircraft, precautions and operation.

Flight Training:

- The IP/CP will ensure the flight training provided includes (*but is not limited to*):
 - Sampling of operations as outlined in this SOP: Engine Start, Initial Taxi, Takeoff, Climb-out, Cruise, Descent, Approach and Landing, Go-Arounds, After Landing Taxi and Shut-down procedures.
 - Representative sampling of normal flight maneuvers as outlined on the CAP Form-5 for normal flight operations, but at a minimum: Cruise flight power control and leaning, slow flight (representative of Search Operations), power management on descent from high altitudes, approaches, normal and no-flap landings.
 - Emergency procedures with emphasis on turbocharger abnormal operations, Inadvertent Icing encounters and Emergency Descents from altitude.
 - It is encouraged that heavier weight operations (ballast added) be demonstrated in at least one of the training sorties.
 - Special equipment demonstration (oxygen system use, propeller de-icing boots, etc.)
- Recommended scenarios to be used:
 - **Flight #1:** Mission scenario is a High Bird sortie to representative grid (recommend KABQ to grid ABQ035 C&D, altitude assignment is 14,500' MSL as there will be other CAP aircraft at 12,500' MSL and below). Normal climb, G-1000 navigation and automation procedures and enroute leaning procedures will be accomplished. After reaching and establishing in grid, oxygen use will be incorporated and sample operations in the grid will be executed (slow flight and other maneuvers at the discretion of the IP/CP), followed by an emergency descent and a diversion to KSAF will be performed. After full stop taxi-back and G-1000 flight plan reprogramming, a return flight using airway navigation back to KABQ will be performed.
 - **Flight #2:** If heavy-weight procedures were not accomplished in Flight #1, they shall be accomplished in this flight. If candidate is instrument rated an instrument flight procedures flight will be accomplished to KLAM using RNAV procedures. If oxygen use was not accomplished in first sortie, this will be demonstrated in flight #2. An inadvertent flight into icing conditions will be simulated and de-icing boots will be activated and icing procedures will be reviewed, followed by an approach and landing at KLAM. If VFR only pilot, VFR enroute procedures to KLAM without icing encounter will be practiced, leaning and turbocharger malfunction procedures will be reinforced. Short field take-off will be performed out of KLAM with an RTB to KABQ, simulated G-1000 malfunction on return flight will be practiced.
- After successful ground evaluation (oral) of the academic topics covered in this SOP, completion and grading of an Aircraft Questionnaire and demonstration of the above operations and maneuvers to standards, a Turbo endorsement can be provided to the CAP pilot candidate.