Pilot's Operating Handbook (POH)

• Part I - Systems, Procedures, Performance •

Gulfstream Turbo Commander 690B

For use with x-plane flight simulator only!

Lowcost payware for X-Plane version 8.40+.

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Introduction

The Twin Commander's history goes back to the late 40's. It turned out to be one of the savest and best twin engine props ever built, maybe the best one.

L-3085 The Aero Commander prototype

Courtesy of Jane's Information Group

Many piston engine versions have been built by the original company named Aero Commander which was taken over by Rockwell in the 50's. Many of those aircraft have been (and still are) in service for aero photo and remote sensing missions, which resulted in a continious demand for higher service altitudes, which could hardly be met by piston engines. This lead to the Turbo Commander, built by Rockwell and later by Gulfstream, and to a tremendous increase in engine power and flight performance.

While the Aero Commander 680 indicates the aircraft's TOTAL power in it's name (2 x 340hp), the Rockwell / Gulfstream Turbo Commander 690 does very much of an understatement in this aspect, since the power of each of it's engines is 717,5hp, totalling in 1.435hp. The 690B still holds several world records established by Robert A. HOOVER (USA).
http://records.fai.org/pilot.asp?from=ga&id=1951

The real Gulfstream Turbo Commander 690B I modeled here is registered in Venezuela under YV-1050P and is privately owned by a Venezuelean businessman. This type of aircraft can be seen very often in this country. Many of them have been modernized by the Dash 10 conversion, offered by Twin Commander Aircraft LLC, which keep these aircraft up to the latest level of technology.
http://www.twincommander.com/index.htm

Although the price tag of a used Turbo Commander or JetProp Commander is close to that of a private jet, the Commanders have the advantage of combining outstanding STOL capabilities with a cruise speed of close to 300 kn, in case of the JetProp Commander 1000 slightly more than that, and are also able to fly at altitudes above 30.000 ft, which means above most of all bad weather. For this reason they are much more suitable for South America with it's countless tiny landing strips on Haciendas as well as on the Caribbean Islands.

The x-plane model is meant to be a simulation of this great aircraft, rather than a toy, which demands for some attention to this manual, in particular to the descriptions and the legends of the engine's controls and instruments as well as the start-up and shut down procedures.

SPECIFICATIONS & PERFORMANCE

Performance Conditions

Performance conditions are based upon U.S. Standard (1962) atmospheric conditions, and perfomance is contingent upon engine manufacturere's guaranteed performance as indicated in FAA Type Certificate. All speeds are guaranteed within plus or minus 3%, and all climbs, ranges and altitudes are guaranteed within plus or minus 8%.

Dimensions

Wing span: 46.67'/14.23m
Length: 44.35'/13.52m
Height: 14.95'/4.56m
Tread: 15.42'/4.70m
Cabin Entry Door: 2' 21"x3.92' 11"/.67x1.19m
Cabin Height (Inside Interior): 4.47'/1.35m
Cabin Length : 14.25'/4.34m
Cabin Width (Inside Interior): 4.01'/1.22m
Cabin Volume: 224 cubic feet/6.34m
Baggage compartment height: 3.81'/1.16m
Baggage compartment width: 3.50'/1.07m
Baggage compartment length: 4.83'/1.47m
Baggage compartment volume: 46.5 cubic feet/1.32cubic meters
Baggage door height: 2.60'/.79
Baggage door width: 1.64'/.50
Baggage compartment load limit: 600lbs/272m

Propellers

Hartzel, 160-inch (269.2 cm) diameter, 3 blade, constant speed, full feathering and reversible

Power Plant

Garrett AiResearch TPE-331-5-251 single-shaft turbo-prop with integral gearbox, two-stage centrifugal compressor, three-stage axial turbine, single annular combustion chamber

Operating Speeds

@ 10,325 lbs/4,683 kg unless otherwise noted

Maximum Cruise (96%, 17,500 ft. TAS):	327mph/284kts/526kmh
Normal Cruise Speed (96%, 20,000 ft. TAS):	326mph/283kts/524kmh
Twin Engine Best Rate of Climb Speed (CAS):	161mph/140kts/259kmh
Twin Engine Best Angle of Climb Speed (CAS):	133mph/116kts/214kmh
Single Engine Best Rate of Climb Speed (CAS):	132mph/115kts/212kmh
Single Engine Best Angle of Climb Speed (CAS):	126mph/109kts/203kmh
Minimum Control Speed (CAS):	99mph/86kts/159kmh
Stall Speed, Clean (CAS):	94mph/82kts/151kmh
Stall Speed, Gear and Flaps Down (CAS):	89mph/77kts/143kmh

Loading

Wind Loading:	38.82 lbs/sq ft / 190 kg/M2
Power Landing (700 hp. engine):	7.37 lbs/SHP / 3.34 kg/HP
Power Loading Max. continuous (700 hp. engine):	7.37 lbs/SHP / 3.34 kg/HP

Engine Limits

Take-off:	717.5 SHP/101% N1/923°C ITT
Maximum Continuous:	717.5 SHP/101% N1/923°C ITT

Maximum Cabin Pressure Differential: 5.2 P.S.I. ITT

Cruising Ranges

Long range cruise at 288mph/250.3kts/463.4kmh (TAS) average at 31,000 ft., 9,449 meters, (96% rpm) with 45 min. fuel reserve:

1,688 SM/ 1,467 NM, 2,717 KM

High speed cruise range at 329mph/286kts/529kmh (TAS) average at 18,000 ft., (96% rpm 905° ITT) 5,486 meters (96% rpm) with 45 min. fuel reserve:

1,192 SM/1,036 NM/1,918 KM

Rate of Climb

Twin Engine initial rate of climb (0° Flaps):	2,821 F/M / 860 M/M
Time to climb to 10,000 ft., 3,048 meters (Min.):	4
Time to climb to 20,000 ft., 6,096 meter (Min.):	9
Single Engine initial rate of climb (0° Flaps):	878 F/M / 268 M/M

Service Ceiling

Operational Ceiling Limit:	31,000 ft/9,449m
Twin Engine Service Ceiling:	32,800 ft/9,998m
Twin Engine Absolute Ceiling:	33,800 ft/10,302m
Single Engine Service Ceiling:	19,600 ft/5,974m
Single Engine Absolute Ceiling:	20,500 ft/6,248m

Take-off Performance

Take-off Distance Ground Roll (0° Flaps):	1,458 ft/444m
Take-off Distance to Clear (50'/15.2M Obstacle):	2,259 ft/689m
Short Field Take-off Over 50'/15.2M Obstacle:	1,680 ft/512m

Landing Performance

Landing Distance Over 50'/15.2M Obstacle:	2,100 ft/640m

Landing Distance with Reverse Props:	1,613 ft/492m

Weights - Aircraft

Ramp Weight:	10,375 lbs/4,706 kg
Take-off Weight:	10,325 lbs/4,683 kg
Landing Weight:	9,675 lbs/4,389 kg
Standard Empty Weight:	6,195 lbs/2,810 kg
Useful Load:	4,180 lbs/1,896 kg
Zero Fuel Weight:	8,750 lbs/3,968 kg
Baggage:	600 lbs/272 kg

Capacities

Fuel, Total Capacity:	389 gal/1,472LI
Usable Fuel:	384 gal/1,453 LI
Wing Area:	266.00/24.71M2

Systems

Engines

The 690B has 2 fixed turboprop engines, Garrett AiResearch TPE-331-5-251 single-shaft turbo-prop with integral gearbox. The max. power of 717,5 hp at 101% N1 is also the coninuous maximum power.

IMPORTANT!
On the instrument board the engines's rotation speed is indicated in RPM, the propeller's rotation speed is indicated in %.
Look at the right table see the values of %N1 and RPM, as well as the corresponding prop rotation speed in % and RPM. Since the manual reference always uses % of N1, it is recommendable to monitor the prop RPM indicator, since the percentage of prop RPM and N1 is always identical.
Be sure ITT never exceeds the limit of 923°C!

For further information refer to chapters RUNNING UP SYSTEMS and ENGINE START-UP

Engine		Gear	Propeller	
N1 %	RPM	Ratio	%	RPM
5	360	4,52	5	80
10	720	4,52	10	159
15	1080	4,52	15	239
20	1440	4,52	20	319
25	1800	4,52	25	398
30	2160	4,52	30	478
35	2520	4,52	35	558
40	2880	4,52	40	637
45	3240	4,52	45	717
50	3600	4,52	50	796
55	3960	4,52	55	876
60	4320	4,52	60	956
65	4680	4,52	65	1035
70	5040	4,52	70	1115
75	5400	4,52	75	1195
80	5760	4,52	80	1274
85	6120	4,52	85	1354
90	6480	4,52	90	1434
91	6552	4,52	91	1450
92	6624	4,52	92	1465
93	6696	4,52	93	1481
94	6768	4,52	94	1497
95	6840	4,52	95	1513
96	6912	4,52	96	1529
97	6984	4,52	97	1545
98	7056	4,52	98	1561
99	7128	4,52	99	1577
100	7200	4,52	100	1593
101	7272	4,52	101	1609

Electrical

Refer to chapters RUNNING UP SYSTEMS and ENGINE START-UP

Hydraulic

Refer to chapters RUNNING UP SYSTEMS and ENGINE START-UP

Fuel

The 690B has 2 wing tanks of the following capacities:

Total Capacity:	389 gal/1.472 Liter
Usable Fuel:	384 gal/1.453 Liter

The available quantities are indicated by a twin instrument on the main panel.
A Fuel Tank Selector is located is located on the main panel below the PFD/HSI instrument.

Each engine has a fuel pump, which are activated by a switch with an orange indicator light on the OH-panel.
The fuel flow can be interrupted for each engine independently by red turn switches located on the OH-panel

Flaps

The Flaps Handle is located on the main panel at the right side of the center console.

The Flaps Position Indicator is located on the main panel right from the engine's N1 indicators.

The flaps may be extended in 4 steps from 0° to

- 10°
- 20°
- 30°
- 40°

Under normal conditions flap settings are:

take-off	0°
approach	0°
final approach	20°
landing	40°

Landing Gear

The 690B has a retractable front wheel and 2 retractable mainwheels which carry the taxi lights. Only the struts of the maingear is covered by the gear doors when retracted, while the wheels remain visible from below.

All gear controls and indicators are located on the main panel leftfrom the center console.

Pressurisation

The cabin can be pressurized with a differential maximum of 5.2 P.S.I. ITT, which enables a comfortable seiling of 31.000 ft. The controls and indicators are located on the lower pilot's main panel.

Cabin Altitude Indicator

Set VVI

Set Cabin Altitude
(after initial climb out)

Trim

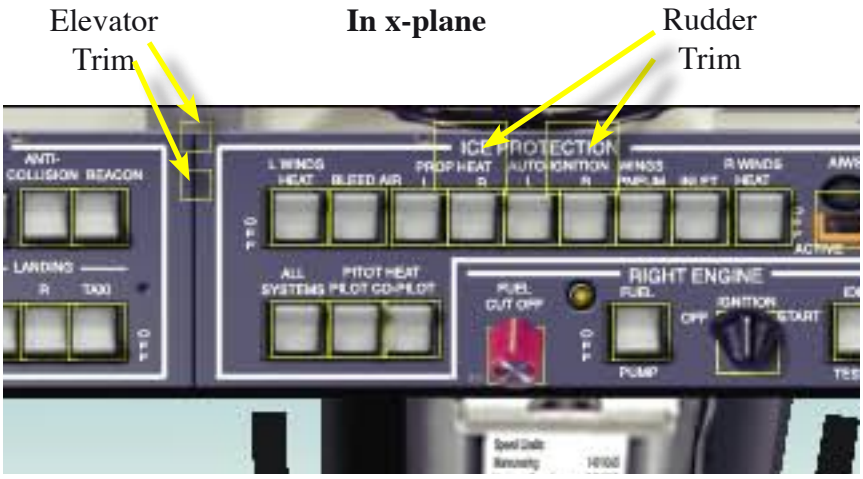
The 690B has trim tabs for the Rudder and the Elevators. In the REAL aircraft the trim actuators are located on the ceiling above the OH-panel.

In XP I did not find the space to display this part of the ceiling. I definitely did not want to place the trim wheels at a location on the panel, where they do not belong. Since most users actuate the trim by hardware (joystick or keyboard), rather than by fuddling around with the mouse on the panel, I opted for a compromise in placing the mause click areas close to the real locations, but not precisely where the belong.

Anyway, I recommend to use the hardware for trim.

Here are the keys:
(7 aileron trim)
(8 aileron trim)
9 rudder trim
0 rudder trim
[elevator trim
] elevator trim

In x-plane



Navigational Systems / Avionics

Auto Pilot

The autopilot activators and indicaters are located on a small center console avove the main panel, as is the button to set VVI.

The selectors for Altitude and Heading are located on the main panel right above the center console.

Turning the Heading knob at the HSI Instrument will also affect the Autopilot‘s Heading.

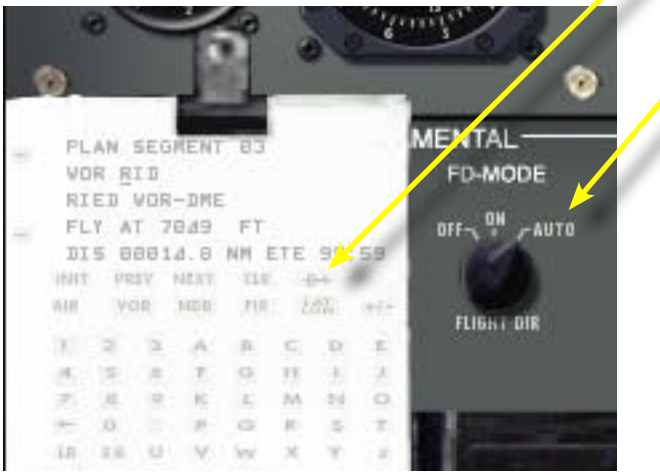
Interactive Clipboard

The interactive clipboard behaves like a Flight Management System (FSM). You can create, edit, load and save flight plans and assign them to the autopilot, Garmin 430 and GPS, exactly in the same way as with the FMS in XP. Of course this feature is compatible with the Goodway Flight Planning Software.
The lower area of the clipboard displays the FMS keyboard for data input. The upper part displays the selectet waypoint.

- To assign a flightplan to the autopilot, select GPS at the AP´s source selector.

SELECT SOURCE:
VOR 1
VOR 2
GPS

- To assign a waypoint to Garmin 430 and GPS, press the arrow button on the interactive clipboard.



Be sure the Flight Director Mode is set on AUTO (default)!

For all other instruments for Navigation and Communication turn to the REFERENCE table!

Normal Procedures

Running Up Systems - Part 1

• Engage the battery.

• Engage the following avionics systems:

Leave the 3 inverters OFF until the engines are running in order to save battery power.

Avionics Instruments

Radar Altitude (This button in XP activates the glide slope indicator in the PFD)

Engine Start Up

If your aircraft is parked close to the runway, you might wish to let the engine's oil warm up before leaving your position. If there is a significant distance to taxi, skip this section for now and return later when you are ready to leave your parking position.

Turn on the NAV. LIGHTS...
...and the BEACON to indicate that the aircraft is going to be activated.
Leave the ANTI-COLLISION LIGHTS turned OFF unless you are close to the runway, since they might disturb the traffic and the are high power consumers.

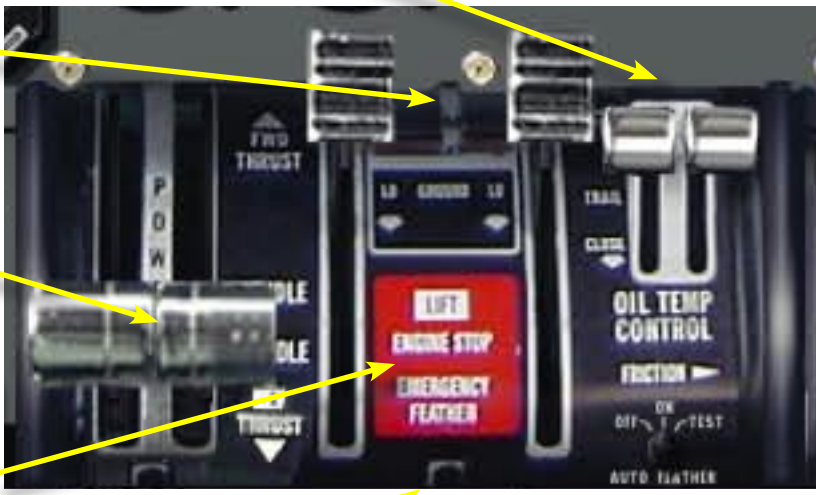
Be sure the Fuel Tank Selector at the lower end of the main panel
is set on BOTH (XP default). You may switch to the right or left

wing tank only after climb out.
Be sure the sliders for the...

...Oil Temperature Controls are set on the upper most position,

...Propeller Controls are set on the upper most position,

...Throttles are set on Ground Idle.



Before starting the engines, be aware that there is an Emergency Button, which stops both engines and feathers both propellers, if lifted up. Make sure it is on the indicated position (XP default).

IMPORTANT!
To use the EMERGENCY STOP button, click on the small spot below the button.
Do not click on the button directly or you will only move the prop sliders!

Make sure the Auto Feather Switch is turned OFF (ON = XP default).

To start the left engine,...

- set the FUEL CUTOUT button on the center up position, as indicated (default)

- set the IDLE button on HIGH (default) position as indicated (default). You may cut off the fuel for this individual engine with this button.

- switch ON the fuel pump. The orange indicator light must be ON, the indicator must switch to the green range.

- turn the STARTER switch from IGNITION to START and hold the button at this position for 3-5 seconds until the engine spools up to ~1.000 RPM. It will snap back to the IGNITION position.

Monitor the ITT! If the temperature exceeds the first red line (923°C), turn off the engine and quit the flight. The engine will need maintenace.
If the temperature stays within it's limits, the engine will spool up until appr. 3.000 RPM (as indicated).
You may switch the IDLE butten on the OH panel to LOW once the oil temperature is within the green range.

The Oil Pressure Indicator must move into the green range.

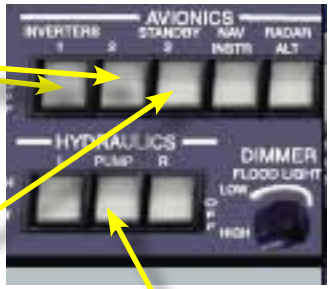
• Switch ON the Generator 1.
The Amperemeter for the left engine should switch to the indicated position.

Repeat this procedure for the right engine, ending up with the engagement of Generator 2.

Running Up Systems - Part 2

Now the Annunciator Panel should look like this, leaving only 2 Inverter lights red.

The MASTER CAUTION Annunciator is flashing.



Engage Inverter 1 + 2.

- Now the final red lights must have turned to GREEN.
- The gyro compass of the HSI is active, indicating the correct heading.
- The MASTER CAUTION Annunciator is still flashing

Turn on the 3rd Inverter, which is only for standby in case another one should fail. The MASTER CAUTION Annunciator should remain extinguished now.

If you want to turn the Standby Inverter OFF, the MASTER CAUTION Annunciator will start flashing again. Turn it OFF by clicking on it.

Engage the TRANSPONDER.
Check the Hydraulic Pumps are ON (default) and the pressure is above 1.200 Psi.

Now you are ready to post your flightplan onto your clipboard, to set up your navigation instruments and for taxi.

Taxi

Engage the Taxi Light if needed, call ATC for clearance and set Tranponder Frequency accordingly.

Monitor the Oil Temperature.
If the indicator should rise close to the upper end of the green range, you may control the temperature by moving the sliders on the center control DOWN (more cooling) or UP (less cooling).

Engage Anti-Collision Lights (Strobes) before entering the runway.
Engage the Landing Lights to be more visible for other traffic when entering the runway. Set the AUTO-FEATHER Switch to ON.

Take-off

• Flaps are be used on rare occasions on very short runways only.
• After the oil temperature is appropriate, let the prop. RPM handles remain at the frontmost position, for the max. of 101% engine N1, and push the throttle smoothly to about 70%.
• Release the brakes, gently apply full throttle, accelerate until ~95-100 kn and take-off.
• The Initial Climbrate may be up to 3.000 fpm, depending on take-off weight.
• Retract gears, turn OFF taxi light (if active) and climb to the required obstacle clearance altitude at ~116 kn. (Best Angle of Climb Speed).
• Continue climbout at ~140 kn (Best Rate of Climb Speed) to maintain +2.000 fpm.
• Set Cabin Pressure at the desired cruising altitude (max. is for 31.000 ft. aircraft altitude) and taper climb rate until reaching your cruising altitude (max. 31.000 ft.).
• Reduce N1 to 96% and throttle appropriate for level cruise speed @ ~280-284 kn TAS, depending on altitude.

NOTE:
If you are not familiar with single-shaft (fixed) turboprop engines, you might be scared by the high N1 which is maintained during almost all flight conditions. The engines limits of maximum 101% N1/ 923°C ITT are equal for take-off and continuous maximum. So you need not care too much about exceeding any limit, with the possible exception of ITT and Oil Temperature.

> • High N1 (96%) and low torque is the most economic option in respect of fuel consumption and engine stress.
> • Low N1 demands for high torque (except during idling) and causes rising temperatures. So you may damage your engine very rapidly by lowering the prop RPM below 90%, but hardly by flying always close to the max. RPM.

Landing

The props act as effective airbrakes when the throttle is reduced and prop RPM is set on maximum, thus reducing the prop‘s pitch.
• I usually approach at a high descend rate (1.000-2.000 ft/min or more) with 85-90% N1 (high pitch) with low throttle. On on lower glide slope set N1 to 91-101%.
• On about 3 miles distant from the threshold, speed is reduced by extending flaps and gears. The respective speed limits are comfortably high:

200 KIAS for wheel extension
180 KIAS for flaps on 50% down
140 KIAS for full flaps

• The final approach may require more power again. Set prop for 101% N1, wether a go-around may be an issue or not.
• After touchdown you may apply revers thrust, if needed. In XP prop reverse close to idle produces forward thrust. So use reverse prop as a short but strong back-push rather then with moderate power.
• Prop reverse may be used to manuevre the aircraft backwards on the ground, as long as the blast is not causing a desaster on the terrace of the nearby cafeteria...

Engine shut-down

• Turn OFF the AUTO-FEATHER switch.
• Turn the ignition/starter button to OFF (the left most position).
• Switch OFF the fuel pump and the generators.
• Turn the fuel tank selector to the OFF position.