SECTION 9 - SUPPLEMENTS

PA-30 * 3600 LBS GROSS WEIGHT

Table of Contents

SUPPLEMENTS

PA-30 * 3600 LBS GROSS WEIGHT

INTRODUCTION

This section is used to provide supplemental information. Each supplement covers miscellaneous information, a single piece of optional equipment, or an optional operating system that is installed on the Airplane. To ensure proper operation of the airplane with optional equipment installed, the owner/operator should always refer to all supplements, whether issued by Piper Aircraft or vendor issued STC supplements, for possible changes or additions to the airplane's limitations, placards, normal or emergency operating procedures, and performance characteristics. Supplements must be kept with the POH when the subject equipment is installed on the airplane. Limitations contained in the supplements are FAA approved and required to be observed by Regulation.

LOG OF SUPPLEMENTS

This Supplement Log is used to maintain a listing of all equipment revisions to the airplane whether the equipment was delivered with the airplane when new or installed by STC authority.

Revision No.	Description of Revision	Part Number	Date

SUPPLEMENT 1 - COMPLETE OPERATING AND LIMITING AIRSPEEDS

PA-30 * 3600 LBS GROSS WEIGHT

V_A - Design Maneuvering Speed / Turbulent Air Penetration Speed

At 3,600 lbs Gross Weight	162 mph	141 kt
At 2,450 lbs Gross Weight	135 mph	117 kt

**** CAUTION ****

Maneuvering speed decreases at lighter weight as the effects of aerodynamic forces become more pronounced. Linear interpolation may be used for intermediate gross weights. Maneuvering speed should not be exceeded while operating in rough air.

V_{APP} - Final Approach to Landing Speed	95 mph	83 kt
V_{APP} - Final Approach (W/Zero Degrees of Flap)	100 mph	87 kt
V_{APP} - Final Approach (IFR Approach/Clean)	120 mph	104 kt
V_C - Design Cruising Speed	183 mph	159 kt
V_D - Demonstrated Diving Speed	256 mph	222 kt
V_{FE} - Flap Extension Speed	125 mph	108 kt
V_{FE} - Recommended	100 mph	87 kt
V_H - Maximum Operating Speed	205 mph	178 kt
V_{IMD} - Maximum Endurance Speed	100 mph	87 kt
V_{IMR} - Maximum Range Speed	130 mph	113 kt
V_{LE} - Landing-Gear Extended Speed	150 mph	130 kt
V_{LO} - Landing-Gear Operation Speed	150 mph	130 kt
V_{LO} - Recommended	125 mph	108 kt
V_{MCA} - Single Engine Minimum Control Speed	90 mph	78 kt
V_{NE} - Never Exceed Speed	230 mph	200 kt
V_{NO} - Normal Operating Speed / Maximum Structural Cruising Speed	194 mph	169 kt
V_R - Rotation Speed (W/Zero Degrees of Flap)	90 mph	78 kt
V_{S0} - Stall Speed (Power Off - Full Flaps and Gear Extended)	69 mph	60 kt
V_{S1} - Stall Speed (Power Off - Clean)	76 mph	66 kt
V_{SSE} - Minimum Intentional Single Engine Speed	97 mph	84 kt
V_X - Best Angle-of-Climb Speed (At Sea Level)	90 mph	78 kt
V_{XSE} - Best Single Engine Angle-of-Climb Speed	94 mph	82 kt
V_Y - Best Rate-of-Climb Speed (At Sea Level)	112 mph	97 kt
V_{YSE} - Best Single Engine Rate-of-Climb Speed	105 mph	91 kt

Emergency Airspeeds

Best Engine-Out Glide Speed (Optimum)	110 mph	96 kt
Best Engine-Out Glide Speed (Endurance)	90 mph	78 kt

Other Speeds

Best En Route Rate-of-Climb Speed	130 mph	113 kt
Demonstrated Crosswind Component	20 mph	17 kt

SUPPLEMENT 2 - ADDITIONAL PLACARDS NOT LISTED IN SECTION 2

The following is a list of placards that are not a part of the FAA approved placards that are listed in Section 2 (Limitations). They are provided here as they appear on the airplane.

1.) In Full View of the Pilot:

TAKEOFF CHECK LIST

COWL FLAPS ---------- OPEN	ELECTRIC FUEL PUMPS - ON
SEAT BELTS ---- FASTENED	MIXTURE CONTROLS --- SET
CONTROLS -------------- FREE	ALT. AIR ---------------------- OFF
TRIM TAB ------------------ SET	PROPELLERS --------------- SET
WING FLAPS -------------- SET	ENGINE GAUGES ----- CHECK
FUEL ---- ON PROPER TANK	DOOR --------------------- LATCH

LANDING CHECK LIST

COWL FLAPS -------------------- OPEN	MIXTURE CONTROLS ------------ SET
SEAT BELTS -------------- FASTENED	PROPELLERS ------------------------ SET
FUEL -------------- ON PROPER TANK	LANDING GEAR DOWN --- LOCKED
ELECTRIC FUEL PUMPS --------- ON	FLAPS ------ DOWN UNDER 100 MPH

2.) On Instrument Panel: (When Item is Installed)

WARNING

TO AVOID SPATIAL DISORIENTATION
TURN OFF STROBE LIGHTS WHEN IN CLOSE
PROXIMITY TO THE GROUND, OR DURING
FLIGHT THROUGH CLOUDS, FOG OR HAZE.

3.) Inside Cabin Door:

ENGAGE LATCH BEFORE FLIGHT

4.) Adjacent to the Parking Brake Handle:

PARKING BRAKE - PULL ON

WARNING
NO BRAKING WILL OCCUR IF AIRPLANE
BRAKES ARE APPLIED WHILE PARKING
BRAKE HANDLE IS PULLED AND HELD.

SUPPLEMENT 2 - ADDITIONAL PLACARDS (Cont.)

5.) Inside Landing Gear Motor Release Arm Access Door:

INSTRUCTIONS FOR EMERGENCY EXTENSION OF LANDING GEAR

1. REDUCE POWER - AIRSPEED NOT TO EXCEED 100 M.P.H.
2. PLACE LANDING GEAR SELECTOR SWITCH IN CENTER "OFF" POSITION.
3. DISENGAGE MOTOR - RAISE MOTOR RELEASE ARM AND PUSH FORWARD THROUGH FULL TRAVEL.
4. EXTEND EMERGENCY GEAR HANDLE TO FULL LENGTH.
5. ROTATE HANDLE FORWARD FULL TRAVEL TO EXTEND LANDING GEAR. GREEN LIGHT ON PANEL INDICATES LANDING GEAR DOWN AND LOCKED.

DO NOT RE-ENGAGE MOTOR IN FLIGHT

6.) On Brake Fluid Reservoir:

BRAKE FLUID
HYDRAULIC OIL
MIL-H-5606

7.) Adjacent to Fuel Filler Caps:

MAIN FUEL

91-96 OCTANE MIN.
TANK CAPACITY 30 GAL.
USABLE CAPACITY 27 GAL.
FILLING INSTRUCTIONS
TO OBTAIN MAXIMUM
CAPACITY, AIRPLANE
MUST BE APPROXIMATELY
LEVEL WITH LANDING
GEARS EQUALLY EXTENDED

AUX. FUEL

91-96 OCTANE MIN.
CAPACITY 15 GAL.

8.) Adjacent to Oil Filler Cap:

ENGINE OIL SPEC.

VISCOSITY	OUTSIDE AIR TEMP.
SAE 50	ABOVE 40 DEGREES F.
SAE 30	BELOW 40 DEGREES F.
SAE 20	BELOW 10 DEGREES F.

OIL CAPACITY 8 QTS.

SUPPLEMENT 2 - ADDITIONAL PLACARDS (Cont.)

9.) On Battery Compartment Cover:

ALWAYS ADD WATER - NEVER ADD ACID
DO NOT FILL ABOVE BAFFLES
FULLY CHARGED SPECIFIC GRAVITY 1.275
CHARGING RATE
START 4 AMPERES - FINISH 2 AMPERES
MAXIMUM TEMPERATURE ON CHARGE 120 DEGREES F.
KEEP CHARGED TO PREVENT FREEZING

10.) Inside The Propeller Spinner Cap:

PROPELLER CHAMBER PRESSURE REQUIREMENTS
(HIGH PRESSURE TYPE)

TEMP. DEGREES F.	PRESS. (PSI)	TEMP. DEGREES F.	PRESS. (PSI)
100	188	30	165
90	185	20	162
80	182	10	159
70	178	0	154
60	175	-10	152
50	172	-20	149
40	168	-30	146

PROPELLER CHAMBER PRESSURE REQUIREMENTS
(LOW PRESSURE TYPE)

TEMP. DEGREES F.	PRESS. (PSI)
100	53
70	50
40	47
10	44
-20	42

NOTE: DO NOT CHECK PRESSURE WITH PROPELLER IN FEATHER POSITION.

11.) At Each Oxygen Outlet: (When Item is Installed)

NO SMOKING WITH OXYGEN IN USE

SUPPLEMENT 2 - ADDITIONAL PLACARDS (Cont.)

12.) Above Alternate Static Source Valve: (When Item is Installed)

ALTERNATE STATIC SOURCE
PULL AFT TO OPEN

INSTRUCTIONS FOR USE OF ALTERNATE STATIC SOURCE

1. IN CASE OF STATIC PRESSURE TUBE MALFUNCTION DUE TO ICE OR OTHER OBSTRUCTIONS CLOSE WINDOW AND ACTIVATE ALTERNATE STATIC SOURCE VALVE.

2. THE FOLLOWING AIRSPEEDS APPLY WHEN ALTERNATE STATIC SOURCE IS USED.

INDICATOR READS	ACTUAL
104 MPH IAS	100 MPH IAS
140 MPH IAS	130 MPH IAS
163 MPH IAS	150 MPH IAS
185 MPH IAS	170 MPH IAS

13.) On Wing Flap Indicator:

TAKEOFF	15°
LANDING	27°

14.) On The Instrument Panel:

CAUTION

THIS AIRPLANE IS EQUIPPED WITH A MANUALLY CONTROLLED ALTERNATE ENGINE INDUCTION AIR SYSTEM. ALTERNATE AIR IS AVAILABLE ONLY BY PULLING "ALT AIR" CONTROL FULL ON.

SUPPLEMENT 3

OFFICIAL WORLD RECORDS HELD BY MAX CONRAD IN COMANCHE AIRCRAFT

World class records recognized by the Federation Aeronautique Internationale and the National Aeronautic Association.

Category: C (Airplanes)
Group: 1 (Piston Engine)
Class: 1 (Landplanes)

WORLD RECORD #1

Sub Class: D - 1,750 to 3,000 kg (3,858 to 6,614 lb)
Record: Distance in a Straight Line (Non-Stop)
From: Casablanca, Morocco - To: Los Angeles, California
Distance: 7,668 sm * 6,663 nm * 12,338 km
Time: 58 Hours, 38 Minutes
Date: June 02, 1959
Airplane Model: Piper Comanche PA-24-250

WORLD RECORD #2

Sub Class: C - 1,000 to 1,750 kg (2,204 to 3,858 lb)
Record: Distance in a Straight Line (Non-Stop)
From: Casablanca, Morocco - To: El Paso, Texas
Distance: 6,967 sm * 6,053 nm * 11,212 km
Time: 56 Hours, 26 Minutes
Date: November 24, 1959
Airplane Model: Piper Comanche PA-24-180

WORLD RECORD #3

Sub Class: C - 1,000 to 1,750 kg (2,204 to 3,858 lb)
Record: Distance in a Closed Circuit (Non-Stop)
From: Minneapolis, Minnesota - To: Chicago, Illinois - To: Des Moines, Iowa - To: Minneapolis, Minnesota
Distance: 6,921 sm * 6,014 nm * 11,139 km
Time: 60 Hours, 10 Minutes
Date: July 14, 1960
Airplane Model: Piper Comanche PA-24-180

WORLD RECORD #4

Sub Class: E - 3,000 to 6,000 kg (6,614 to 13,228 lb)
Record: Distance in a Straight Line (Non-Stop)
From: Capetown, South Africa - To: St. Petersburg, Florida
Distance: 7,879 sm * 6,845 nm * 12,677 km
Time: 56 Hours, 8 Minutes
Date: December 24, 1964
Airplane Model: Piper Twin Comanche PA-30

SUPPLEMENT 4 - COMPARISON OF PRODUCTION MODEL SINGLE ENGINE COMANCHES

SPECIFICATIONS

Type Designation	PA-24-180	PA-24-250	PA-24-250	PA-24-250	PA-24-250	PA-24-260	PA-24-260	PA-24-260B	PA-24-260B	PA-24-260C	PA-24-260T	PA-24-400
Year(s) Manufactured	1957-64	1958-60	1961	1962-64	1962-64	1965	1965	1966-68	1966-68	1969-72	1970-72	1964-65
Approximate Number Built	1,143	1,526	407	604	N/A	300	N/A	504	N/A	225	N/A	146
Length (ft)	24.7	24.9	24.9	24.9	24.9	25.0	25.0	25.3	25.3	25.8	25.8	25.7
Height (ft)	7.3	7.3	7.3	7.3	7.3	7.5	7.5	7.5	7.5	7.5	7.5	7.8
Wing Span (ft)	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Powerplant (Lycoming)	O-360-A	O-540-A	O-540-A	O-540-A	IO-540-C	IO-540-D	O-540-E	IO-540-D	O-540-E	IO-540-N	IO-540-R	IO-720-A
BHP-RPM	180-2700	250-2575	250-2575	250-2575	250-2575	260-2700	260-2700	260-2700	260-2700	260-2700	260-2700	400-2650
TBO (hr)	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	1,800	1,800
Wing Area (sq ft)	178	178	178	178	178	178	178	178	178	178	178	178
Wing Loading (lb/sq ft)	14.3	15.7	16.3	16.3	16.3	16.3	16.3	17.4	17.4	18.0	18.0	20.2
Power Loading (lb/bhp)	14.2	11.2	11.6	11.6	11.6	11.2	11.2	11.9	11.9	12.3	12.3	9.0
Seats	4	4	4	4	4	4	4	4-6	4-6	4-6	4-6	4
Fuel Capacity (US gal)	60	60	90	90	90	90	90	90	90	90	90	130
Baggage Capacity (lb)	100/200	200	200	200	200	200	200	250	250	250	250	200
Gross Weight (lb)	2,550	2,800	2,900	2,900	2,900	2,900	2,900	3,100	3,100	3,200	3,200	3,600
Max Landing Weight (lb)	2,550	2,800	2,900	2,900	2,900	2,900	2,900	2,945	2,945	3,040	3,040	3,600
Standard Empty Weight (lb)	1,455	1,600	1,630	1,690	1,690	1,700	1,700	1,728	1,728	1,773	1,894	2,110
Max Useful Load (lb)	1,095	1,200	1,270	1,210	1,210	1,200	1,200	1,372	1,372	1,427	1,306	1,490
Max Useful Load W/Full Fuel (lb)	735	840	730	670	670	660	660	832	832	887	766	710

PERFORMANCE

Fuel Flow @ 75% Power (gph)	10.0	14.0	14.0	14.0	13.7	14.1	14.5	14.1	14.5	14.1	14.1	20.0
Fuel Flow @ 55% Power (gph)	7.4	10.3	10.3	10.3	11.0	11.4	10.7	11.4	10.7	11.4	11.4	15.5
Endur @ 75% Power W/45 min Rsv (hr)	5.2	3.7	5.7	5.7	5.9	5.7	5.5	5.7	5.5	5.7	5.3	5.6
Endur @ 55% Power W/45 min Rsv (hr)	7.1	5.1	7.8	7.8	7.3	7.1	7.5	7.1	7.5	7.1	6.7	7.2
Range @ 75% Power W/45 min Rsv (sm)	832	670	1,032	1,032	1,068	1,055	1,018	1,037	1,001	1,055	1,177	1,193
Range @ 55% Power W/45 min Rsv (sm)	994	836	1,279	1,279	1,197	1,193	1,260	1,157	1,223	1,228	1,313	1,426
Cruise Speed @ 75% Power (mph)	160	181	181	181	181	185	185	182	182	185	222	213
Cruise Speed @ 55% Power (mph)	140	164	164	164	164	168	168	163	163	173	196	198
Rate of Climb (ft/min)	910	1,350	1,350	1,350	1,350	1,500	1,500	1,370	1,370	1,320	1,320	1,600
Climb Gradient (ft/nm)	658	890	890	890	890	938	938	856	856	817	817	923
Ceiling (ft)	21,000	22,000	22,000	22,000	22,000	22,000	22,000	21,400	21,400	21,000	25,000	21,000
Takeoff Distance, Ground Run (ft)	1,370*	1,095	1,180	1,180	1,180	1,090	1,090	1,260	1,260	1,360	1,360	980
Total Over a 50 ft Obstacle (ft)	2,250*	1,575	1,675	1,675	1,675	1,540	1,540	1,725	1,725	1,800	1,800	1,500
Landing Distance, Ground Roll (ft)	460	885	920	920	920	920	920	925	925	965	965	1,180
Total Over a 50 ft Obstacle (ft)	1,340	1,390	1,420	1,420	1,420	1,420	1,420	1,435	1,435	1,465	1,465	1,820

LIMITING AND RECOMMENDED AIRSPEEDS (MPH)

V_A - Design Maneuvering Speed	154	144	144	144	144	144	144	144	144	150	150	160
V_{FE} - Max Flap Extension Speed	100/125	125	125	125	125	125	125	125	125	125	125	125
V_H - Max Operating Speed	167	190	190	190	190	195	195	194	194	195	233	223
V_{LO} - Max Gear Operation Speed	125/150	150	150	150	150	150	150	150	150	150	150	150
V_{NE} - Never Exceed Speed	202	227	227	227	227	227	227	227	227	227	227	250
V_{NO} - Normal Operation Speed	160	180	180	180	180	180	180	180	180	180	180	210
V_R - Rotation Speed *	75	85	85	85	85	85	85	85	85	85	85	90
V_{S0} - Stall Speed (Landing Configuration)	60	64	62	63	63	63	63	67	67	67	67	68
V_{S1} - Stall Speed (Clean)	67	71	75	71	71	71	71	75	75	77	77	78
V_X - Best Angle-of-Climb Speed	75	84	85	85	85	85	85	87	87	88	88	92
V_Y - Best Rate-of-Climb Speed	96	105	105	105	105	110	110	111	111	112	112	120
Engine-Out Glide Speed (Optimum)	95	100	100	100	100	100	100	105	105	105	105	115

* = With Zero Degrees of Flap   N/A = Information Not Available

SUPPLEMENT 5 - COMPARISON OF PRODUCTION MODEL TWIN COMANCHES

SPECIFICATIONS

Type Designation	PA-30	PA-30T	PA-39	PA-39T
Years Manufactured	1963-69	1964-69	1970-72	1970-72
Approximate Number Built	2,000	N/A	155	N/A
Length (ft)	25.2	25.2	25.2	25.2
Height (ft)	8.2	8.2	8.2	8.2
Wing Span (ft)	36.0	36.8	36.0	36.8
Powerplant (Lycoming)	IO-320-B	IO-320-C	IO-320-B	IO-320-C
Ratings (bhp-rpm)	160-2700	160-2700	160-2700	160-2700
TBO (hr)	2,000	1,800	2,000	1,800
Wing Area (sq ft)	178	178	178	178
Wing Loading (lb/sq ft)	20.2	20.9	20.2	20.9
Power Loading (lb/bhp)	11.3	11.7	11.3	11.7
Seats	4-6	4-6	4-6	4-6
Fuel Capacity (US gal)	90	120	90	120
Baggage Capacity (lb)	200-250	200-250	250	250
Gross Weight (lb)	3,600	3,725	3,600	3,725
Maximum Landing Weight (lb)	3,600	3,725	3,600	3,725
Standard Empty Weight (lb)	2,207	2,384	2,270	2,416
Maximum Useful Load (lb)	1,393	1,341	1,330	1,309
Maximum Useful Load W/Full Fuel (lb)	853	621	790	589

PERFORMANCE

Fuel Flow @ 75% Power (gph)	17.2	17.2	17.2	17.2
Fuel Flow @ 65% Power (gph)	15.2	15.2	15.2	15.2
Fuel Flow @ 55% Power (gph)	13.4	13.4	13.4	13.4
Range @ 75% Power W/45 min Reserve (sm)	892	1,316	892	1,316
Range @ 65% Power W/45 min Reserve (sm)	967	1,353	967	1,353
Range @ 55% Power W/45 min Reserve (sm)	1,015	1,386	1,015	1,386
Endurance @ 75% Power W/45 min Reserve (hr)	4.6	5.9	4.6	5.9
Endurance @ 65% Power W/45 min Reserve (hr)	5.2	6.7	5.2	6.7
Endurance @ 55% Power W/45 min Reserve (hr)	5.9	7.7	5.9	7.7
Cruise Speed @ 75% Power (mph)	194	223	194	223
Cruise Speed @ 65% Power (mph)	186	202	186	202
Cruise Speed @ 55% Power (mph)	172	180	172	180
Rate of Climb(ft/min)	1,460	1,290	1,460	1,290
Single-Engine Rate of Climb(ft/min)	260	165	260	165
Climb Gradient (ft/nm)	903	798	903	798
Service Ceiling (ft)	18,600	25,000	18,600	25,000
Absolute Ceiling (ft)	20,000	25,000	20,000	25,000
Single-Engine Service Ceiling (ft)	5,800	8,800	5,800	8,800
Single-Engine Absolute Ceiling (ft)	7,100	12,600	7,100	12,600
Accelerate - Stop Distance (ft)	3,000	3,100	2,470	2,560
Takeoff Distance, Ground Run (ft)	1,250	1,300	940	990
Total Over a 50 ft Obstacle (ft)	2,160	2,285	1,530	1,590
Landing Distance, Ground Roll (ft)	700	700	700	725
Total Over a 50 ft Obstacle (ft)	2,100	2,155	1,870	1,900

LIMITING AND RECOMMENDED AIRSPEEDS (MPH)

V_A - Design Maneuvering Speed	162	162	162	162
V_{FE} - Maximum Flap Extension Speed	125	125	125	125
V_H - Maximum Operating Speed	205	240	205	240
V_{LO} - Maximum Gear Operation Speed	150	150	150	150
V_{MCA} - Minimum Control Speed W/Critical Engine Inoperative	90	90	80	80
V_{NE} - Never Exceed Speed	230	230	230	230
V_{NO} - Normal Operation Speed	194	194	194	194
V_R - Rotation Speed	90	90	90	90
V_{S0} - Stall Speed (Landing Configuration)	69	69	70	70
V_{S1} - Stall Speed (Clean)	76	76	76	76
V_{SSE} - Minimum Intentional Single-Engine Speed	97	97	97	97
V_X - Best Angle-of-Climb Speed	90	90	90	90
V_{XSE} - Best Single-Engine Angle-of-Climb Speed	94	94	94	94
V_Y - Best Rate-of-Climb Speed	112	112	112	112
V_{YSE} - Best Single-Engine Rate-of-Climb Speed	105	105	105	105
Both Engine Out Glide Speed (Optimum)	110	110	110	110

N/A = Information Not Available

SUPPLEMENT 6 - EMERGENCY PROCEDURES INFORMATION

Engine-Out Glide Speed:

During the era when Piper Aircraft was producing the Twin Comanche, no flight tests were conducted to determine the best (both) engine-out glide speed for the airplane. The one exception to this was the Turbo 260C, and it is estimated that only two dozen were built. The figures in this Handbook have been determined by the following method:

Use of the term "best" is a misnomer, however, best glide speed is most generally referred to as the optimum, or maximum-range glide speed, and results in the best glide ratio.

Best glide ratio is obtained when the wing is operated at an angle of attack that will produce the best lift-drag ratio, or L/D_{max}. This is basically true of the airplane's best rate-of-climb speed also.

Theoretically, optimum glide speed will be close to the best rate-of-climb speed, but included among the variables in the mathematical formulas related to the best rate-of-climb speed are the elements of thrust and drag. Because efficiency is reduced by the dead engines (thrust is now zero), and airplane drag is increased (even when the propellers are feathered), optimum glide speed can be expected to be a value somewhat less than V_Y.

The generally accepted formula for estimating the both-engine-out glide speed in a typical reciprocating-engine, propeller-driven, light twin airplane when it is not provided by the aircraft manufacturer is to multiply 1.5 times V_{S1}.

V_Y for the Twin Comanche both with and without wingtip fuel tanks is 112 mph, and 1.5 times V_{S1} is 114 mph. Therefore, for the purposes of this Handbook, the best both-engine-out glide speed for the Twin Comanche at 3725 lbs and 3600 lbs maximum allowable gross weight has been established to be 110 mph IAS.

Glide testing done on sub-sonic aircraft by the military has produced graphs which show that a five-percent deviation from best glide speed will not cause a significant reduction in glide ratio. This means that if this figure is not exactly correct, the error is not enough to produce a measurable difference.

In addition, since optimum glide speed decreases as the airplane's gross weight decreases, this fact also allows the specifying of glide speeds for a range of gross weights. An example of when use of a lower glide speed applies would be a solo pilot who is totally out of fuel. In this case the airplane would be several hundred pounds below maximum allowable gross weight, and use of an airspeed below 110 mph IAS would be appropriate.

Airplane Gross Weight	Suggested Glide Speed
3725 lbs	110 mph (96 kt)
3600 lbs	110 mph (96 kt)
3400 lbs	106 mph (92 kt)
3200 lbs	102 mph (87 kt)
3000 lbs	98 mph (85 kt)

SUPPLEMENT 6 - EMERGENCY PROCEDURES INFORMATION (Cont.)

Engine-Out Glide Speed: (Cont.)

Equally important in any discussion of both engine-out glide speed is the best endurance, or minimum sink glide speed. This airspeed is used when glide range is not important (such as when directly over an airport at an altitude of several thousand feet AGL), and the possibility of re-starting the engines is a factor (such as when engine failure is due to having run the selected fuel tanks dry, but then starting difficulty is experienced after switching tanks).

Best endurance glide speed is typically equal to 75 percent of the optimum glide speed. However, there is a problem associated with this figure due to the fact that this airspeed is close to the airplane's stall speed. This condition could become dangerous for the pilot who is otherwise distracted by the emergency.

For this reason, the generally accepted formula for estimating best endurance glide speed is to multiply 1.2 times V_{S1}. This results in an airspeed of 90 mph IAS for the Twin Comanche.

It is suggested that at approximately 1000 feet AGL, the pilot should establish optimum glide speed in preparation of landing. The additional airspeed will provide maneuvering control, and a safety margin to counter any unexpected low-level wind shear. Also, if the airplane is operated close to stall, there may be insufficient airspeed with which to flare on landing.

For the individual who wants a more in-depth knowledge of this subject, the books by Kershner and Hurt referenced in the Preamble of this Handbook are recommended reading.

Glide Ratio:

Both-engines-out glide ratio for the Twin Comanche with landing gear and flaps retracted and propellers windmilling is 10 to 1, or approximately two miles of gliding distance for each 1,000 feet of altitude above the terrain. Drag is substantially reduced when the propellers are feathered, and glide ratio improves to 13 to 1. When the landing gear is extended, drag is increased and glide ratio is radically reduced to approximately 7 to 1. For this reason, it is suggested that the landing gear and flaps not be extended in most engine-out emergencies until over the threshold of the landing area. Landing gear down operating time is approximately 7 seconds.

SUPPLEMENT 7 - NORMAL PROCEDURES INFORMATION

Best Range Speed:

High speed and the resultant savings in time is one of the major reasons for using an aircraft as transportation. In recent years, however, increasing fuel costs have led to an interest in efficiency to minimize fuel usage. In addition, every year there are a large percentage of accidents caused by fuel exhaustion and poor fuel management. Moreover, there can be unexpected headwinds or adverse weather conditions that result in a much longer flight than anticipated. For all of these reasons, a pilot will want to give consideration to getting the maximum range possible from an aircraft. Range and endurance records established by Max Conrad in various models of the Comanche are substantial, and are listed in this Handbook.

Tests were not conducted by Piper Aircraft to determine the airspeeds that will result in maximum range (V_{IMR}) and maximum endurance (V_{IMD}) for the Twin Comanche. In the absence of this information, the following is provided:

The aerodynamic principals that are involved in determining maximum gliding distance for a typical reciprocating-engine, propeller-driven, light twin airplane (see Emergency Procedures Information in this section) are the same that are used in determining its maximum range. Maximum range is obtained when the wing is operated at the angle of attack that produces the best lift-drag ratio or L/D_{max}. This is basically true of the best rate-of-climb speed, but V_{IMR} can be expected to be some value higher than V_Y because other factors are involved such as the lift coefficient of the wing, and the propulsive efficiency of the engine/propeller combination.

A common method of estimating the best range speed when it is not provided by the aircraft manufacturer is to use a figure that is approximately 15 percent greater than V_Y which for the Twin Comanche is equal to 129 mph. Another generally accepted formula for estimating V_{IMR} is to multiply 1.7 times V_{S1}. This also results in a figure of 129 mph. Studies have shown that a five-percent deviation from optimum range speed will not cause a significant variation in the range obtained. For this reason, the figure of 130 mph is suggested. This figure is applicable for the airplane at full gross weight and will decrease at a rate of approximately two mph for every 100 pound decrease in weight.

Along with airspeed, other factors to consider when there is a need to obtain maximum range are:

1.) Decrease the aircraft weight and avoid headwinds.

2.) If possible, redistribute any movable weight within the airplane to obtain the most rearward center of gravity within C.G. limits. This will reduce drag and increase efficiency.

3.) Reduce rpm so the engines will consume less fuel. Operation at low rpm will typically result in a relatively high manifold pressure, but this is not a problem as long as the engines are operated within allowable rpm and manifold pressure limits as designated in the Lycoming charts.

4.) Adjust the mixtures to the lean side of peak EGT. This condition is also acceptable because the power developed by the engines can be expected to be equal to 40 percent and less.

SUPPLEMENT 7 - NORMAL PROCEDURES INFORMATION (Cont.)

Best Range Speed: (Cont.)

**** CAUTION ****

Never use low power settings during an engine's break-in period. This practice will result in glazed cylinder walls and high oil consumption. Also, routine operation at low power and the resultant low operating temperature can lead to problems such as high oil consumption and sticking valves. These problems are amplified during cold weather operation, so the practice of cruising at low power settings is not recommended as a standard operating procedure.

Best Endurance Speed:

The most common application where there is a need to obtain maximum endurance from the airplane is when directed into a holding pattern by Air Traffic Control. Best endurance speed is typically equal to 75 percent of the best range speed. The generally accepted formula for estimating best endurance speed is to multiply 1.3 times V_{S1}. Seventy-five percent of 130 mph is 98 mph, and 1.3 times V_{S1} is 99 mph. Therefore, for the purposes of this Handbook, maximum endurance airspeed is suggested to be 100 mph.

An airspeed of 100 mph is not practical in many applications due to the increased angle of attack at this relatively low speed which results in high induced drag and poor aerodynamic efficiency. In addition, an airspeed this low will result in comparatively sluggish control response requiring the pilot to have to work that much harder to control the airplane. For these reasons, the pilot may wish to operate off-optimum when seeking to extend the airplane's endurance. Since the most common application of the use of the best endurance speed is the holding pattern, it is suggested that the airplane's IFR approach speed of 120 mph be used.

Another factor to consider is the fact that maximum endurance is obtained at sea level, so it is advisable to use the lowest practical altitude. Also, wind is not a factor with endurance, but turbulence should be avoided, if possible, because of the drag that turbulence will induce.

These are the major factors involved in extending an aircraft's range and endurance, but they do not provide actual figures that the pilot can expect to obtain. It is therefore recommended that the aircraft owner/operator conduct his own tests using these techniques to determine the specific fuel consumption that can be expected from the airplane. For the individual who wants a more in-depth knowledge of this subject, the books by Kershner and Hurt referenced in the Preamble of this Handbook are recommended reading.

IFR Approach Speed:

There are several factors involved in IFR approach stability, most of which are beyond the scope of this discussion. The aircraft needs to be stable at all times during an IFR approach, and one of the most important factors contributing to approach stability is the aircraft's speed. The airspeed chosen by the pilot when making an IFR approach is dependent on several factors.

SUPPLEMENT 7 - NORMAL PROCEDURES INFORMATION (Cont.)

IFR Approach Speed: (Cont.)

Among the most significant factors to consider are:

1.) Requirements and demands of single-pilot IFR. FAR Part 135 specifies that an auto-pilot is required when operating single-pilot IFR. The rules in Part 135 are not required of most private pilots, but they are nonetheless a good guideline. Therefore the limitations of the auto-pilot should be considered. Most auto-pilots approved for use in the Twin Comanche have a minimum airspeed limitation of 110 mph, so this figure is used to define the low end of airspeeds for consideration.

2.) Air Traffic Control requirements and the pilot's responsibility to expedite traffic flow. The pilot making an instrument approach will comply with ATC airspeed instructions in most circumstances, however, prior to reaching the Final Approach Fix/Point the pilot will want to be established at the airspeed normally used to make the final approach. Since the choice of this airspeed is left to the pilot's discretion, choice of a reasonably high speed is preferable.

3.) Airplane controllability. Aircraft stability is greater the higher the airspeed and this reduces the pilot's work load. For this reason the highest airspeed within the aircraft's limitations is preferred.

4.) Limitations of the aircraft. The Comanche has a wing-flap operating limitation of 125 mph so it is this figure that is used to define the high end of airspeeds for consideration. Choice of an airspeed just below this limitation gives a buffer in the event of any deviation in airspeed control, and some pilots prefer the option of using partial flaps on approach.

5.) Transition from approach configuration to touchdown configuration. FAR Part 91 requires that the pilot must be able to use normal maneuvers to land, and FAR Part 135 requires that the airplane must touch down within the touchdown zone which is defined as the first 3,000 ft of the runway. Under conditions of hard IFR (200 ft ceiling, and 1/2 mile visibility) and a 5,000 ft runway, it is not likely that the pilot will be able to transition the airplane, get it on the ground, and land it safely if the airspeed is much above 125 mph. Consistency is important in the IFR environment, for this reason the instrument pilot should be prepared for these minimal conditions even though they are not what he faces with every instrument approach and landing. Operating in conditions of hard IFR into an airport with a relatively short runway is not the time to be improving your proficiency.

Therefore, for the purposes of this Handbook, the IFR approach speed for the Twin Comanche has been established to be 120 mph.