PBY Catalina

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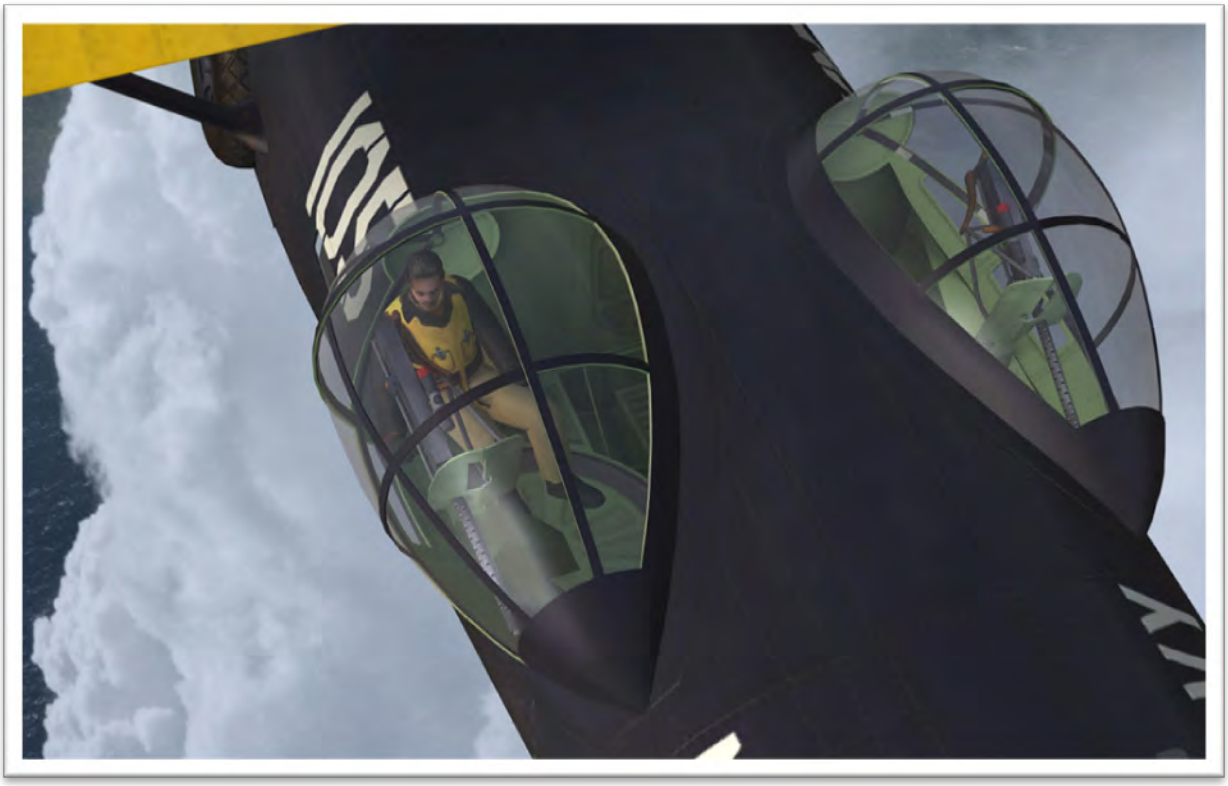

Introduction

The Catalina was always very high on our list of possible projects, but only with FSX around did we get the platform that could do all the details and special options we wanted to include. There are two reasons why the Catalina was so important to us, first (of course) because it is a very important aircraft, back in the days it hunted down submarines but even now in its new role as crowd pleaser at air shows. Secondly because it is just the most whacky looking aircraft we know. Seen from the front it looks like a dinosaur and from the side it looks like three different aircraft and a boat were glued together. But despite looking strange it was a remarkable effective and successful aircraft and we are proud to offer it to you.

This manual contains two distinct parts. The first part (the one you are reading now) deals with the aircraft in FSX and the second part is about the 'real' aircraft. The second part of the manual is not one for the simulated version but from an actual flying PBY 5A. We feel so confident about our simulation that we include that with permission of the Stichting Exploitatie Catalina PH-PBY (http://www.catalina-pby.nl).

System requirements

- Microsoft Flight Simulator FSX (with SP2 or Acceleration Pack)
- Dual Core CPU
- 2 GB RAM internal memory
- 512 MB graphic card
- Adobe Acrobat® Reader 8 minimal to read and print the manual ([1])

([1]) Available for free, download at: http://www.adobe.com/prodindex/acrobat/readstep.html

Credits

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Testing:	Several good folks who will all be getting a free copy

With special thanks to the the Stichting Exploitatie Catalina PH-PBY (http://www.catalina-pby.nl) and the Danish Technical Museum (http://www.tekniskmuseum.dk) that provided us with a lot of information. At the museum you will soon be able to fly this aircraft.

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We feel strongly about support. Buying one of our products gives you the right to waste our time with questions you feel might be silly. They are not.

Models and versions

The Catalina is one of those aircraft that was done in many distinct models and dozens of versions and hundreds of variations. A few hours after being received by a new crew it would have been customized with new gear added and other things thrown out. This process did not stop after the aircraft were put into non-military service; in fact it was probably more visible as gun turrets and radar domes were removed. As with other projects we decided not to be obsessed with this and to simulate not an existing aircraft but to merge thousands of images into five base models;

- PBY-5. Pure floater model but able to be equipped with a beaching gear to drag it around on land.
- PBY-5A Period Military. This model reflects what the aircraft looked like around 1944 in it absolute heyday. The radio room is not modeled fully as it would be too complex to ensure fluent framerates but it will allow basic communication and navigation. On some aircraft the flight engineer’s controls were already moved to the main cockpit and our model shows this.
- PBY-5A Modern. This model is done like the many PBY-5A’s that fly around the world at this moment. The barely functional autopilot has been replaced with an avionics set that allows flights into a modern aviation environment. Far from a state of the art glass cockpits it does include a serious GPS system and all communication equipment you will need.
- PBY-6 Period Military. This model is internally identical to the PBY-5A Period Military but externally it is different and allows repaints of some of the best know Catalinas.
- PBY-6 Modern. This model is internally identical to the PBY-5A modern but externally it is different and allows repaints of some of the best know Catalinas.

In total there are 11 different aircraft in the 1.00 release version, with a few more to come as customers request models to be repainted.

Limitations

It is best to start with things that do not work as we would like them to or not as good as we would like.

Gear/Floats

In FSX the gear and moving floats are linked to the same system (hydraulic, pneumatic or electrical). In the real PBY the gear is hydraulic and the floats are operated electrically. As we felt the gears were more important the floats are now also hydraulic and need hydraulic pressure to operate.

Behavior on water

We can say this nice or nasty but the effect is the same. FSX aircraft that float on water are like paper aircraft that have no weight. The movements are enough to make us nauseous. There is hardly any control and it's not at all as it should be and the bigger the aircraft the worse it seems. Blame Microsoft and not us.

BUT... we think this aircraft behaves far better on the water than any other because we tricked flaps, water rudders and other things. You will find the aircraft more sluggish than others but this is most certainly more realistic.

Hardware

If you have hardware mixture controls it is best to leave them at full rich settings to allow the mixture control of the Catalina to work.

If spoilers or flaps are assigned to hardware control axes, set them to fully retracted position and leave them there in order not to intervene how they are operated by the Catalina.

Views

The Catalina is designed with the utmost care towards framerates. This means that TrackIR users will be able to move their head in positions that we did not design the aircraft for. As an example, since the radio view in the period models is fixed, you cannot pan around. Yet with a TrackIR you can override this and will see that the backwall of the cockpit is transparent. This is done to save framerates and will never be seen from the viewpoints we intended to be used.

Failure model and special features

FSX has an extensive failure model but there are a few things missing that we felt should be added. These failures are typical for the type of aircraft and are not (or not well enough) provided by FSX. They are certainly important when you fly the more modern versions. They are all museum items and although mostly lovingly restored and in fine condition, they are many decades old and more prone to problems when abused. Of course when you fly the war time versions it can be expected that they are pushed to the red lines on the gauges more often.

Cylinder Head Temperature overheat

When the top of the cylinder is overheating a lot of parts are likely to fail. Sparkplugs, valves and even the cylinder itself can deform or fail. More likely however is premature ignition of the fuel/air mixture. This will abruptly reduce power and can cause serious damage. **Overheating starts to get serious at 260°C, but the exact value depends on how fast the CHT is increasing**. The faster it warms up, the sooner the engine will fail.

Cylinder head temperature can be kept within limits by use of the cowl flaps that augment the normal cooling mechanisms. The onset of overheat is recognized by a quick drop in engine performance. If CHT can be forced down before the engine fails, then engine power will be restored. But there is little time.

Oil Temperature overheat

When the oil is too hot it will chemically break down and will get too thin to coat all the surfaces that need lubrication. This increased friction causes even more heat and as the oil itself is an important part of the cooling system problems can start slowly but will quickly grow in severity. Opening the cowl flaps and a richer mixture (more fuel, less air) will reduce the temperature but high RPM will always lead to higher temperature and in the end you will have to reduce your power settings to **avoid oil temperatures over 100°C.** Engine overheat is more likely to happen due to high CHT than because of high oil temperatures.

Carburetor icing

When ambient temperature is low and there is moisture in the air, ice can form on any surface. In the carburetor this is even more likely because the air is decompressed and cools down. To prevent the engines from being strangled the carburetors are electrically heated or as in the case of the Catalina warmed with heat from the exhaust stacks.

Although FSX does feature carburetor icing, it is a very simple model. In the Catalina there are more variables used and you will have to be more careful when you are running with low revs or in air with high moisture content (in clouds or in any reduced visibility condition). It is best to maintain the carburetor **air temperature above 32°C in any possible icing condition** to prevent a build-up of ice. This will keep the air in the venturi above 10°C (as the temperature can drop 20°C because of the decompression). When icing starts to build up engine power will drop and the engine could even stop. When the carburetors are heated and the ice is removed they will be running normal again (or can be restarted).

If carburetor air temperature is getting too high, the engine will lose power, because hot air contains less oxygen. Keep the carburetor air temperature above 32°C and below 50°C.

Structural icing

For an aircraft that was used so much in arctic condition it has rather pitiful de-icing systems. Now normally this is not a real problem in FSX, but we included an advanced structural icing system. When you get into freezing rain, ice will build up on your wings, tail and fuselage. Freezing rain is present when it´s raining and ambient temperature is between +15° and 0°. This will increase drag and weight and will reduce the efficiency of the wings. The result is that you will lose speed and eventually will not be able to maintain altitude. Keep an eye on the temperature gauge and when you run the risk of icing try to stay outside clouds. Icing in the carburetor and the pitot tube normally starts before structural icing and are serious warning signs of impending problems ahead.

Early Catalinas had rubber inflatable boots on the wings to break build up ice. Later models fed hot exhaust gases into the front sections on the wing to avoid icing. This is controlled with a switch on the back panel. Pitot heat and propeller de-icing are controlled with switches on the control bar.

Fouled sparkplugs

If RPM is kept under 1000 RPM for a longer period the sparkplugs will foul. A coating of half burned fuel and other material forms on the metal parts and the spark will not be as strong as it should be and the engine will lose power and will run on lower RPM than expected. In an extreme case the sparkplugs will fail and will have to be cleaned or replaced by a mechanic. In our model this means the aircraft has to be reloaded. When the RPM is high this residue will burn off and the sparkplug is cleaned. A short burst of high revs before take-off is a good remedy to prevent problems.

Shock cooling

Though disputed, shock cooling is a danger to older engines. The situation where rapid cooling arises is on descent at idle or near idle power settings. In this condition the engine is producing much less heat. In a descent, the plane's airspeed increases, simultaneously increasing the cooling rate of the engine. As parts of the engine will cool at different rates the metal gets stressed and may fail. Cylinder heads and valves are most affected. The most likely scenario of running into this problem is a full power climb with high Cylinder Head Temperature into a very cold air layer, directly followed by an idle descent through the same layer. Material failures due to shock cooling accumulate over time and though you might run into these conditions many times before a failure happens, there is always a risk. Keep an eye on you Cylinder Head Temperature!

Aerosoft Sound Control

This aircraft is equipped with Aerosoft Sound Control that enhances the sound options of this aircraft in FSX. Depending on the product up to 200 additional sounds can be added. ASC is based on a special gauge that is loaded from the PANEL.cfg and is controlled by an ASC.cfg file in the panel folder. The module is linked to the aircraft and we added it with an ID code. Should you see an error that the module does not recognize the aircraft, please contact us on support@aerosoft.com.

The module should not conflict with any other FSX product and the sounds are always expanding the aircraft and not the simulated pilot, ATC or external environment. Of course the module can be disabled by commenting the load line (adding // in front of gauge**=ASC!MAIN, 0,0, 10, 10, 1 in the panel.cfg)

If you get an error pointing to this module it is most likely caused by a problem related to Microsoft.VC90.CRT.It is known that some people got a problem in the C++ 2008 runtime files. You can find a correct set here: http://www.microsoft.com/downloads/details.aspx?FamilyID=9b2da534-3e03-4391-8a4d-074b9f2bc1bf&displaylang=en

Flight model

The flight model has been done with great care and you will find our Catalina flies almost exactly to the numbers you'll find in the manuals. It has been flown in FSX by two operators of the Catalina and both confirmed that (within the limits of FSX) we got it all correct. Please note that although the Catalina does not have flaps, water rudders and spoilers you will find those in the aircraft.cfg. These are used to simulate drag for gills and to perfect behavior on the water. You will note that the Catalina is stable under almost all conditions. That's how it was built and if you operate very close to the surface you don't want the aircraft to dive every time you sneeze.

Using the switches and knobs

As there are many switches that have more than one setting (something that is not common in modern aircraft) we decided to use the same method for all controls. You can either left click for one direction or right click for the other direction or use the mouse wheel. Using the mouse wheel for all controls is far more natural, just put the cursor on the control and wheel up or down. Imagine the mouse wheel to be the switch and it all will seem very natural. This will work for rotary controls and switches. A tool tip will almost always give you the detailed setting.

Interactive Checklist

The interactive Checklist is like having the help of a co-pilot while you run over the checklist. It is very simple to use. . Just click on the line you have checked and a checkmark will appear. When the co-pilot (aka the Interactive Checklist) agrees with you the checklist will be green. When you see a red checkmark it means you might have clicked on the line but the actual setting is still not correct. The image here shows I ticked the Radio Master that needs to be OFF but in fact it is still on. To make the checkmark green (and to correct the mistake, just set the Radio Master to OFF and the checkmark will turn green. Normally you would not move to the next checklist before all icons are green.

The Startup page works a little bit different as it will show all the red and green checkmarks without clicking on the items in the list. If all your previous checklists were done correctly all should be green but if you see any red check marks you know the startup will most likely not be possible. Please note that the Performance page is rotated. This means that if you undock the checklist to another screen you will see a black area. This cannot be avoided but should cause no problems.

The blue bookmark leads to a configuration page that allows you to switch between a cold and dark aircraft (as if it had not flown before that day) or a fully configured aircraft with running engines, ready for take-off. You can also select if you want the standard reliable engines or the more advanced engine model that forces you to manage the engines far more detailed.

On the bottom of the checklist you will find click zones to clear the current page (so all checkmarks are removed), close the checklist or move to the front/index page.

Avionics, 1940's military cockpit

Of course an aircraft as old as the PBY Catalina has a limited set of instruments compared to the modern cockpits and a lot of the instruments that were standard in the 1940's do not make a lot of sense today because they are either very complex to operate or very hard to simulate. So we decided to lose a bit of realism in this area and make all the aircraft useable in the current simulated world. The Sperry Autopilot and the modern equipment are highly accurate.

There are two base sets of avionics. One is based on how most of the Catalinas that fly at this moment are equipped and one is loosely based on a 1940's model. They share most of the standard instruments but the autopilot, radio and navigation are different. The models that flew in and directly after World War II had a massive amount of communication and navigation equipment that filled the whole section where Catalinas now have 8 seats -- a fine example of the miniaturization of equipment.

Communication and navigation

We combined the most important and most logical functions into a single panel that allows you to navigate and communicate. We added a transponder that's slightly more modern so you can use this aircraft in online flights on IVAO, VATSIM or online communities like that. The radios have been modeled to look like the radios used during WW2 and a short period after, but with frequency bands resembling those used by FSX. On the VHF nav and com radios you use the small knob to control the 3 whole digits (**XXX**.xx) and the larger centre knob to control the fractions (xxx.**XX**). The switches control if you hear the transmission (like in a modern audio panel). On the ADF radios you use the centre knobs to select the section of the band and the rotating

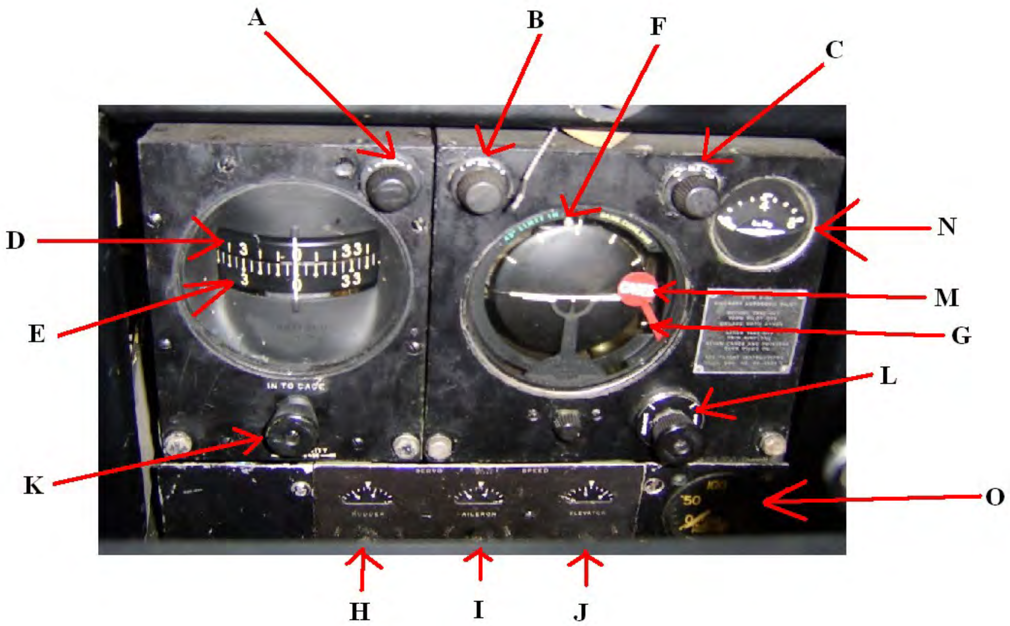
levers to set the frequency. The scale will show you the strength of the signal and should peak when you are very close to the transmitter.

Small tip: Tune ADF 2 radio to 1300 kHz.

Sperry Autopilot

The first autopilot was invented in 1912 and demonstrated by Lawrence Sperry in 1914. The autopilot was refined during the following years. It used gyroscopes for heading and attitude reference. The gyroscopes were driven by vacuum, while the actuators for moving the control surfaces were driven hydraulically. The Sperry autopilot was a far cry from the modern autopilots used in modern aircraft. It was not a "set and leave" device, but required the pilot to check the correct outcome. The following autopilot functions were available:

- Heading hold (Rudder knob)
- Pitch hold (aka attitude hold, Elevator knob)
- Bank hold (Aileron knob)



A Rudder knob	**I** Aileron gain Knob
B Aileron Knob	**J** Elevator gain Knob
C Elevator Knob	**K** Gyro compass align knob
D Selected Heading	**L** Gyro Horizon Cage knob
E Gyro Compass	**M** Gyro Caged flag
F Selected bank indexer	**N** Suction gauge
G Selected pitch indexer	**O** Hydraulic pressure gauge
H Rudder gain Knob	

Engaging the autopilot

Engaging the autopilot required that vacuum was present for the gyros. The suction pressure could be checked on the suction gauge on the autopilot unit. The necessary hydraulic pressure was supplied from the Catalinas right engine (or aux. electrical hydraulic pump). Supply of hydraulic pressure was controlled by the “Master Autopilot” control lever, mounted in the roof, behind the throttle quadrant. Pressure could be read on a gauge on the autopilot control unit. This gauge also indicated if the autopilot was active or not. The Sperry autopilot is active when suction pressure is higher than 2 inHg and the hydraulic pressure gauge reads more than 105 Psi, controlled by the “Master Autopilot” lever. Engaging the Sperry autopilot by setting the “Master Autopilot” lever to On, doesn´t mean that it will control the aircraft, but only that the various modes can be engaged via the gain knobs.

Gain settings

Actual hydraulic pressure for moving the controls was supplied through proportional flow valves, mounted on the lower part of the Sperry autopilot unit. These valves where used for controlling how fast the actuators should react, and could be adjusted gradually. Turning these knobs to low values helped dampening autopilot control. The knobs where called “Rudder gain”, “Elevator gain” and “Aileron gain”. Be aware that the higher the gain setting, the more “nervous” the autopilot becomes! Open the valves slowly until the aircraft starts to get “nervous” – then close the valves again just a little. Heading hold was only becoming active if the actual heading was within 10° of the selected heading. The pilot had to turn the aircraft until it was within ±10° of the selected heading set with the “Rudder” knob, before engaging heading hold, which was done by opening the “Rudder gain” knob.

Heading

The selected heading was read on the upper “compass” scale, while the actual heading was read on the lower “Gyro compass” scale. Since the gyroscope would drift over time, the pilot needed to adjust the gyro compass with the gyro compass align knob. The autopilot had no altitude hold function, but could hold pitch. To use pitch hold the pilot had to set the engines to either climb, cruise or descend settings and level the aircraft.

Pitch

Engaging pitch hold was done by opening the “Elevator gain” knob. The pilot could now adjust the pitch with the “Elevator” knob, to make the aircraft fly with a certain vertical speed or keep it level. Be aware that as fuel was burned and the aircraft became lighter, the aircraft would start to climb. Also changing the engines’ settings would make the aircraft start to climb or descend.
The selected pitch could be read on the pitch reference indexer on the right side of the attitude indicator gauge. Once the aircraft was established on the desired pitch, the horizon bar should coincide with the pitch reference indexer, when flown un-banked.

Bank

Bank hold was engaged by opening the “Aileron gain” knob. Desired bank was set by turning the “Aileron” knob. The selected bank angle could be read on top of the Sperry attitude indicator gauge. If both Heading hold and Bank hold were active (both the “Rudder gain” and the “Aileron gain” knobs were open), the aircraft would roll to the desired bank angle and turn until it fell within ±10° of the selected heading, where after it would follow the selected heading.

If the autopilot was flying on a desired heading with heading hold active, this had to be deactivated before being able to use bank hold.

Avionics, modern cockpit

Well ‘modern’ should be taken with a grain of salt because it remains a very basic cockpit. On the modern version that we based on the equipment of several Catalinas that are still flying , the Sperry autopilot was removed and replaced with a radio and navigation console. The radio room is now converted into a passenger compartment on most airworthy Catalinas.

Bendix King KT 76c Transponder

The transponder is a radio transmitter / receiver operating on radar frequencies. If it receives a ground radar interrogation signal, it will return a coded response of pulses and ID itself on the ground based ATC radar screen. This will give ATC information of ID, altitude and ground speed. To operate the transponder, there are a number of knobs and buttons described below:

OFF	Turns the transponder off
SBY	Turns the transponder on, but doesn’t reply to interrogations
TST	
ON	Turns the transponder on and replies to interrogations in Mode A operation
ALT	Turns the transponder on and replies to interrogation in Mode C operation (Gives altitude reporting) An “Alt” announcement is displayed

- **Buttons 0 -7:** Used to enter the 4 digit transponder code. If a full 4 digit code has not been entered and 4 seconds have elapsed since the last button press, the transponder will revert to the previous set code.
- **CLR button:** Used to clear code entry if a wrong digit has been entered. Press the CLR button and re-enter the full 4 digit code once more. After having pressed the CLR button the previous code will be shown on the display.
- **VFR button:** Used to set the transponder to the VFR code 1200. The left 3 digit number is the current flight level marked with “FL”. Flight level is your altitude in hundreds of feet, in reference to a barometric setting of 29.92 “Hg or 1013 mbar. 075 equal 7500 feet pressure altitude. Pressure altitude is NOT true altitude.

The right 4 digits are the current transponder code or the code that is being entered with the 0-7 buttons. The flashing “R” indicates when the transponder is sending a reply to an interrogation.

Bendix King KR 87 ADF receiver.

To switch the KR 87 ADF receiver on, click on the power knob. The display will show the active ADF frequency to the left and the standby frequency to the right. The outer (large) knob will increase / decrease the 1,000th and the 100th numbers. The inner (small) knob will increase / decrease the 10th and the 1 digit numbers.

Pressing the FREQ/--- button will swap the active frequency with the standby frequency.
Pressing the FLT/ET button will call up the Flight timer - indicated by “FLT” in the upper right corner.

The flight timer indicates time elapsed since the KR 87 was turned on, and can be used to display total flight time. Subsequent pressing of the FLT/ET, will toggle the display between Flight Time and Elapsed Time - indicated by “ET” in the lower right corner. When in ET mode, pressing the SET/RST button will reset the ET timer to zero, thus making it available as a count up timer. When in FLT or ET mode, the active ADF frequency can be set directly with the outer and inner knobs.

Keeping the SET/RST button pressed for 2 seconds will invoke the countdown timer. “ET” will start to flash and the countdown minutes can be set with the outer (large) knob, While the seconds can be set with the inner (small) knob - max setting is 59:59. After having set the timer, press the SET/RST button and the timer will start to count down from the preset time. During countdown, the active ADF frequency can be set with the outer and inner knobs. When the countdown timer reaches 00:00

an audible alarm will sound, the timer display will flash for 15 seconds and the timer will start its normal ET count up sequence.

Pressing the FREQ/--- button, when in FLT or ET mode, will return the KR 87 to the Active / Standby frequency mode.

Bendix King KN62A DME display.

The KN62A DME display, will show distance, ground speed and time referring to the tuned NAV2 radio. To switch the unit on, click the On / Off switch. With the mode switch in RMT, distance, ground speed and time to station passage are displayed. With the mode switch in FREQ, distance and tuned NAV2 frequency are displayed. The mode GS/T is the same as RMT in the Catalina, since FSX only has two NAV radios available. On the real unit RMT means tuning the requested VOR station with the NAV radio.G/T means tuning the requested VOR station with the built-in NAV receiver of the KN62A . That is the reason why the knobs on the FSX version are INOP.

Bendix King KMA24 Audio panel

The KMA24 audio panel is used to select various audible indicators via the speaker. The KMA24 includes marker beacon lights, indicating passing the Outer, Middle and Inner marker beacons during approach. They are labeled AOM. The marker beacon lights can be tested by pressing the test button .

The upper row of buttons is used to select audible signals received, to be sent to the speakers. COM1 and COM2 are used to select what Com radio you want to listen to via the speakers. Having pressed both will make it possible to listen to both radios simultaneously.

NAV1, NAV2, DME and ADF to will make it possible to hear the Morse code ID of the tuned VOR station. MRK will let you hear the marker beacon sound, when passing the marker beacon during approach. The lower two COM1 and COM2 buttons are used for selecting what Com radio to transmit on. Note that only one COM radio can be selected at the same time for transmitting, while both can be selected for receiving.

The rest of the buttons and knobs are not simulated in the Catalina due to FSX limitations.

Coms Radio and GPS receiver

A Bendix King KX 165A Transceiver is a communication and navigation radio and a Bendix King KLN 90B GPS Navigation System are included as well. As these need more extensive manuals they are added as Appendixes to the manual.

Engine Settings

The following settings are ideal settings and are used on most Catalinas flying at this moment. They war models were of course driven harder, but this can lead to failures and other problems. There is a power settings page in the onboard checklist as well.

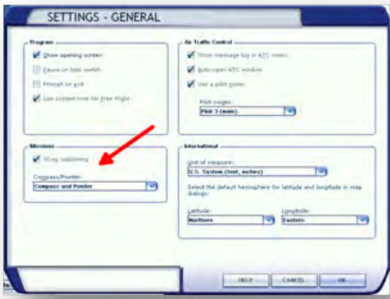
	RPM	Man Press	Cylinder Head	Oil Inlet Temp	Oil Press	Mixture	Fuel Boost	Fuel Press	Cowl Gills	AIS
Warming up	1000		Amb-100	Amb-40	80	Auto Rich	off	15	Open/close	
Warmed up/ idle	1000		100	40	90	Auto Rich	off	15	open	
During takeoff	2700	48	210	80	90	Auto Rich	On	17	trail	95
Climb	2300	35	210	80	85	Auto rich	Off	17	open	95-100
Slow cruise	2050	27	195	80	80	lean	Off	17	close	107
Cruise/ cruise climb	2050	30	205	80	80	lean	Off	17	close	113
Cruise Descent	2050	20	180	80	80	lean	Off	17	close	Cruise
Descent	2050	17	180	80	75	Auto Rich	Off	17	close	Cruise
Approach/ gear down	2050	20	180	80	80	Auto Rich	On	17	open	95
Final	2050	20	180	80	80	Auto Rich	On	17	open	90

- Cowl gills closed at sub zero conditions on start up.
- Carburetor air on at expected icing conditions (visibility <1500 meters and temp <10 degrees). When on the carburetor temp will almost always show a solid 30 degrees.
- Approach and final with gear down, 50 feet over runway, props to full and RPM stays at 1800 RPM to anticipate a GA.
- Cylinder head temp shown for 15° Celsius.
- Mixture goes to lean when Cylinder Head temp drops below 200 depending on ambient conditions. Here shown as 15° C in relation to the cowl gills.

Mission

Although there will be a complete mission pack for the Catalina available, there is one mission included in the base product. You will find it with the other missions, under the *Aerosoft Flights* Category.

We strongly recommend you activate *Show captioning* and *Compass and Pointer* in the Settings – General configuration.



This will give you more assistance during the mission.

Appendix A: Simplified checklist

Although the complete checklists in the real flight manual or the interactive checklist that is part of the panel are the best way to go, we included a step-by-step guide here for your first flights. Start with a cold and dark aircraft (that you can select using the interactive checklist/ configuration tab).

Power Up

- .... **All Electrical Switches Off**
  - Check all electrical switches are off
  - Check all bilge pump switches are off
  - Check battery master switch is off
- .... **Master Magneto and Switches** .... **Off**
  - Check master magneto is pulled
  - Check magneto switches are in off position
- .... **Gear Lever Down**
  - Check gear lever is in down position and lock is in locked position
- .... **Battery Master Switch On**
- .... **Battery Voltage Check**
  - Minimum voltage 21 volts
- .... **GPU (if avail) Connect**
  - Connect and start GPU
  - Check voltage on GPU (26-28 V)
- .... **Parking Brake Set**
  - Check Hydraulic pressure (Min 800 psi)
  - Sit down in right hand seat and set parking brakes
- .... **Cowl Gills Open**
  - Set cowl gills to full open position with spring-loaded switches
- .... **Battery Master Switch Off /On**
  - In case no GPU is available switch off battery master switch
  - In case GPU is available leave battery master on to recharge the battery
- .... **Avionics Check**
  - Check if VHF 1/NAV1 and VHF2/NAV2 and transponder are switched off
  - Check if GPS is properly installed and switched off
- .... **Hydraulic aux. Pump Check**
  - Switch pump on and Check pump is momentarily on operation
- .... **Clock Check**
  - Check if clock is running and showing right time
  - Do not wind clock all the way tight
- .... **Emergency Shut Off Valves** .... **Open**
  - Check the two guards are closed

- .... **Throttles Cracked**
    - Open throttles appr. ¼ inch
- .... **Prop Levers Full Fine**
    - Check prop levers fully forward
- .... **Mixtures I.C.O.**
    - Check mixture levers are in idle-cut-off position
- .... **Master Magneto In**
    - Check master magneto switch is pushed in
- .... **Magneto Switches Off**
    - – Check both magneto switches are in the off position
- .... **Fuel Quantities Gals/Hr**
    - Mention amount of Gallons and Endurance
- .... **Altimeters Set**
    - Check both altimeters are set to current QNH value

Before Starting

- .... **Battery Master Switch On**
- .... **Windows Doors and Hatches .... Closed**
- .... **Cowl Gills Open**
- .... **Radio Master Switch On/Off**
    - Switch Radio Master On
    - Check if intercom is working
    - Request start up, radio master switch Off
- .... **Anti Collision Light On**

Engine Starting

After start-up approval has been obtained by the PM and the Before Starting Checklist has been completed, the engines are started. Engine starting will be done according to the crew co-ordination procedure below. The PF devotes his full attention to starting the engines and monitors the engine parameters. The PM monitors the PF and pays attention to any possible hand signals from the ground engineer. It is good practice to motor the engine through at least twelve blades with the ignition switches off before starting the engine. This enables the oil pump to supply oil to the reduction gear area and at the same time it will disclose the presence of any oil in the cylinders (Hydraulicing)

Check that:

- Battery Switch is ON (27 volts minimal, reload aircraft when battery is low)
- All other electrical switches are OFF
- Cowl Gills are OPEN
- Parking Brakes are SET

Switch to Back Wall View

1. Beacon light ON
2. Right Fuel Selector to BOTH
3. Right Mixture Control to FULL RICH

Switch to Main Virtual Cockpit View

4. Throttle slightly open (cracked)
5. Right Fuel Booster to ON
6. Right Starter ON and wait 6 seconds (12 blades count)
7. Right Prime to ON for a 4 seconds and repeat and
8. Immediately Right Magneto to BOTH
9. When engine starts Right Mixture Control to AUTO RICH
10. Right Starter to OFF
11. Right Fuel Booster to OFF
12. Repeat for Left Engine

When engine does not start

- Starter to OFF
- Fuel Boost to OFF
- Ignition to OFF
- And repeat with at item 4 with more priming.

Before Taxi

- .... **Oil Pressure Check**
    - Check oil pressure between 80-100 psi
- .... **Booster Pumps Off**
- .... **Fuel Pressure Check**
    - Check fuel pressure between 14-16 psi
- .... **Hydraulic/ Brake Pressure** .... **Check**
    - Check pressure between 850-1050 +/- 50psi
- .... **Temperatures Check**
    - Check oil temp between 40°-100°C before using the engines
    - Check cylinder head temp between 120°-200° C before using engines
- .... **Suction Check**
    - Check pressure between 2.8 –4.5 psi
- .... **Generators/ Radio Master switch** .... **On**
- .... **Radio's On**
    - Switch VHF/NAV1 and VHF/NAV2 On
    - Switch Transponder Stby
    - Set Transmit/ Receive panel for departure
- .... **Nav/Comm Setup Set**

  - Set VHF/NAV1 and VHF/NAV2 to proper frequencies
  - Switch GPS master on
  - Set GPS for intended flight
- .... **Gyros Set**
- .... **Ground Equipment Removed**

Taxi Out

- .... **Brakes Check**
  - Check brakes and announce
- .... **Gyros and Instruments.. Check**
  - Check gyros in turn
  - Check instruments
- .... **Carburetor Heat (First Flight Only)... Check**
  - Open valves with spring-loaded switch and check light is on
  - Close valves and check lights are out (wait 2 minutes before take-off)

Run-Up

This check may be done without checklist, PNF will do checklist after run-up

- .... **Mixture Auto Rich**
  - Check mixture in Auto-Rich position
- .... **Temps &Pressures Check**
  - Check all temps and pressure gauges are indicating in the green
- .... **RPM 1700 Set**
- .... **Feather Buttons Checked**
  - Push feather button individually and verify RPM drop with Ampere increase in the ampere gauge. Do not let RPM drop below 1200 RPM
- .... **Propeller lever Cycle**
  - With warm oil, one cycle is sufficient, otherwise cycle 3 times to create a warm oil flow in the propeller dome.
- .... **Magnetos Check**
  - Check L/R magneto per engine
- .... **Power lever Idle**
  - Verify idling RPM
- .... **1000 RPM Set**

Before Take Off (land + sea)

- .... **Wing Floats Check**
    - With water landing intended run floats all the way down and up with generators online (more than 1200 RPM)
- .... **Gear A/R**
    - Clearly state configuration
- .... **Hydraulic Pressure Check**
    - Check pressure between 850-1050 +/- 50psi
- .... **Transponder On**
- .... **Carburetor Heat Cold**
    - Check carburetor valve lights are out
    - Check if 2 min. have passed since last movement of the valves before T/O
- .... **Cowl Gills Trail**
    - Close cowl gills and open them to trail position
    - Check generators on-line above 1200 RPM
- .... **Magneto's Both**
- .... **Landing and Strobe Lights .... On**
- .... **Pitot Heat A/R**
- .... **Mixtures Auto Rich**
- .... **Prop Levers Full Fine**
- .... **Trims and Tensions Set**
    - Check if Trims and Tensions are properly set for take off
- .... **Controls Check and Free**
    - Check flight controls through complete motion
- .... **Temps and Pressures Check**
    - Check all temps and pressures are in the green bands
    - Check cylinder head temp(C.H.T.) is between 120° and 200° C
- .... **Windows Doors and Hatches .... Closed**
- .... **Runway Heading Set**
    - Check runway heading against compass and directional gyro and adjust if necessary

After Take Off

- .... **Gear and Floats Up**
    - In case of land take off check gear fully up and gear handle is locked
    - Check if amber nose door closed light is on
    - Check if red gear up and locked light is on
    - In case of water take off check if floats are visually up
    - Check that float motor stopped running
    - Set float switch in neutral position
- .... **Power Set**
    - State required power and check
- .... **Temps and Pressures Check**
    - Check oil pressures
    - Check oil temperatures
    - Check carburetor temperatures
    - Check cylinder head temperatures (C.H.T.)
- .... **Visual Engine Check Dry and Clean**
- Each pilot checks his/her side engine on condition
- .... **Mixture A/R**
    - Set mixture lever to Auto Lean if C.H.T. is between 180°-200° C
- .... **Cowl Gills A/R**
    - Set gills to keep C.H.T. between 180°-200° C
- .... **Carburetor heat A/R**
    - Use carburetor heat to keep carburetor inlet temperature above freezing
- .... **Generators Check**
    - Switch off one gen.- check if load is taken over by other generator & switch back on
    - Same for other generator
- .... **Altimeters Set**
    - Mention QNH when cruise is at altitude and mention 1013 when cruise is at level.
- .... **Landing Lights A/R**

Approach

- .... **Mixtures Auto Rich**
- .... **Carburetor Heat As Required**
- .... **Cowl Gills As Required**
- .... **Landing Lights On**
- .... **Temps and Pressures Check**
- .... **Hydraulic Pressure Check**

Landing (Land)

- .... **Gear Down and Check**
    - In case of land landing check if gear handle is locked
    - Check if green down and lock light is on
    - Check visually if main and nose gear is down and locked
- .... **Brakes and Pressure Check**
    - PF pushes brakes and PNF checks if parking brake is released
    - Check brake pressure is sufficient
- .... **Prop Levers TO GO**
    - PNF moves prop levers to full fine on command of PF when he is retarding the throttles to idle in the flare.

Landing (Sea)

- .... **Gear Up and Check**
    - Check if red gear up and locked light is on
    - Check physically and visually if main gear is up and locked
    - Check visually if nose gear is up through aft window
- .... **Nose Wheel Doors Closed and Check**
    - Check if amber nose door closed light is on
    - Check visually at daylight in nose wheel compartment
- .... **Wing Floats TO-GO/Down**
    - In case of water landing check if floats are visually down
    - Check that float motor stopped running
    - Set float switch to neutral position
    - In rough water it is allowed to lower the floats after touch down
- .... **Prop Levers TO-GO**
    - PNF moves prop levers to full fine on command of PF when he is retarding the throttles to idle in the flare

Taxi In

- .... **Cowl Gills Open**
- .... **Landing and Strobe Lights**
  .... **Off**
- .... **Pitot Heat Off**
- .... **Carburetor heat Off**
- .... **Transponder Stby**

After Parking/Docking

- .... **Parking Brake A/R**
- .... **Rudder Lock On**
- .... **GPS Off**
- .... **Nav Lights Off**

- .... **Internal lighting Off**
- .... **Mixtures I.C.O.**
- .... **Anti Collision Light Off**
- .... **Radio Master Switch Off**
- .... **Battery Master Switch Off**
- .... **Magneto Switches Off**
- .... **Master Magneto Out**
- .... **Throttles Fwd**
    - Move throttles forward to prevent head bumping while trying to get out

Termination

- .... **Parking Brake Release**
- .... **Cowl Gills Close**

Appendix B: KX 165A TSO

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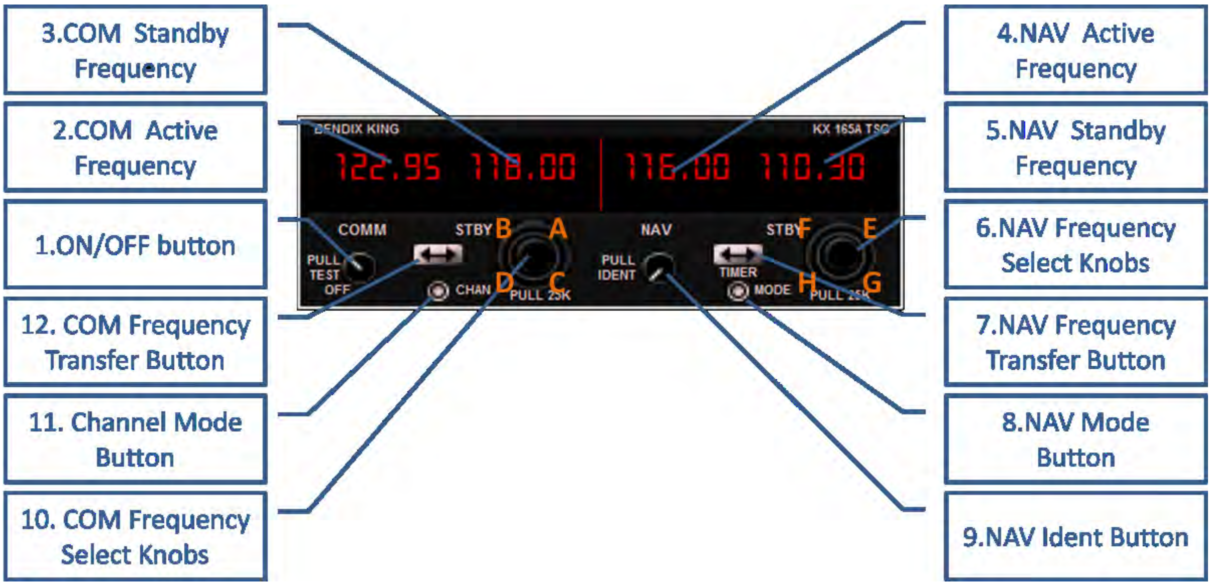
INTRODUCTION

The KX 165A Transceiver is a communication and navigation radio. Two frequencies, active and standby, are available for both communications and navigation. Frequencies are typically entered into the standby frequency, and then exchanged with the active frequency to become active by using the COM or NAV FREQUENCY TRANSFER BUTTONs. There is also a "direct tune" mode which allows the user to change either the Com or Nav active frequencies directly. There is a PAGE mode and a CHANNEL mode for communications that allows the user to store up to 6 Com frequencies which can be exchanged directly with the active frequency at the click of a button. In addition, OBS, bearing-to, radial-from, count-up and count-down timer modes are available for navigation. All of the controls for the radio are located on the front of the radio. The displays and controls for the communication functions are presented on the left side of the unit, the displays and controls for the navigation functions are on the right side. Communication controls include the COM FREQUENCY TRANSFER BUTTON, the CHANNEL MODE BUTTON, and the COM FREQUENCY SELECT KNOBS. Navigation controls include the NAV FREQUENCY TRANSFER BUTTON, the NAV MODE BUTTON, and the NAV FREQUENCY TRANSFER BUTTONs. All of the communications functions, excluding the display of the active frequency, are displayed at the location of the COM STANDBY FREQUENCY. Similarly, all navigation functions are displayed at the location of the NAV STANDBY FREQUENCY.

OVERVIEW



1. **ON/OFF BUTTON**: Powers the unit on and off.

2. **COM ACTIVE FREQUENCY**: Digital display of the active communications frequency.

3. **COM STANDBY FREQUENCY:** Digital display of the standby communications frequency.

4. **NAV ACTIVE FREQUENCY:** Digital display of the active navigation frequency.

5. **NAV STANDBY FREQUENCY**: Digital display of the standby navigation frequency.

6. **NAV FREQUENCY SELECT KNOBS**: An outer and an inner knob. The outer knob increments/decrements the navigation frequency in 1 MHz steps, and the inner button increments/decrements in 50 kHz steps. The outer knob is increased by clicking on the letter E at the upper right side of the knob and decreased by clicking on the letter F at the left. The inner knob is increased by clicking on the letter G at the bottom right, and decreased by clicking on the letter H at the bottom left. The NAV FREQUENCY SELECT KNOBs are also used to enter count-down values in the count-down mode. The outer knob increments/decrements the time in 1 minute steps. The inner knob increments/decrements time in 1 second steps. Click spots are the same as above. The NAV FREQUENCY SELECT INNER KNOB has 2 positions, an out and an in position. Clicking directly on

the button will toggle between these 2 positions. The out position is the default position. Functions requiring the out position include entry into the direct tune mode, active and standby Nav frequencies exchange in the OBS, bearing, and radial modes, resetting the count-up timer, and entering and exiting the count-down timer mode. Functions requiring the in position include active and standby Nav frequencies exchange in the default screen, direct active frequency change in the OBS, bearing and radial modes, and entering data, stopping, and resetting the count-down timer.

7. **NAV FREQUENCY TRANSFER BUTTON:** This button is used primarily to exchange the active and standby navigation frequencies. In the default screen the NAV FREQUENCY SELECT INNER KNOB must be in the "in" position, and in the "out" position in the OBS, bearing, and radial modes for the exchange to occur. This button is used to enter the direct tune mode, to reset the count-up timer, and to stop and/or reset the count-down timer. It is also used to enter and exit the count-down timer mode.

8. **NAV MODE BUTTON:** Used to sequentially step through the different navigation screens. Clicking the button at the last screen will "wrap around" to open the default screen.

9. **NAV IDENT BUTTON:** Turns on Nav IDENT when toggled to the out position. The corresponding Nav "on" annunciator on the GMA 340 will illuminate.

10. **COM FREQUENCY SELECT KNOBS:** An outer and an inner knob. The outer knob increments/decrements the communications frequency in 1 MHz steps, and the inner button increments/decrements in 25 kHz steps. The outer knob is increased by clicking on the letter A at the upper right side of the knob and decreased by clicking on the letter B at the left. The inner knob is increased by clicking on the letter C at the bottom right, and decreased by clicking on the letter D at the bottom left. The COM FREQUENCY SELECT KNOBs are also used to enter frequency values in the direct tune and page modes. The knobs increment/decrement the values as discussed above. The inner, kHz knob, is also used to step through the pages and channels of the page and channel modes, respectively.

11. **CHANNEL MODE BUTTON**: Used to enter and exit the page and channel modes.

12. **COM FREQUENCY TRANSFER BUTTON**: This button is used primarily to exchange the active and standby communications frequencies. No other buttons are required for the exchange. This button is also used to enter the direct tune mode, and to allow the entering of frequencies in the page mode.

POWER

Power the unit on by clicking the ON/OFF BUTTON. Make sure it is OFF when the engines are being started.

SETTING FREQUENCIES

Set Com and Nav frequencies using the COM- and NAV- FREQUENCY SELECT KNOBS, respectively. The active frequencies can be entered in two ways:

1. Dial the desired number in as the standby frequency and then click on the COM or NAV FREQUENCY EXCHANGE BUTTON to place the entered number into the active frequency (note: the NAV FREQUENCY SELECT KNOB must be in the "in" position to exchange the Nav frequencies)

2. Hold down the COM or NAV FREQUENCY EXCHANGE BUTTON longer than 2 seconds and enter the value directly into active frequency (direct tune). The standby frequency is not displayed in the direct tune mode. Click the exchange button again to exit the direct tune mode. The standby frequencies can be entered directly using the appropriate knobs.

STORING FREQUENCIES

Enter Com frequencies into storage for later easy retrieval (up to 6 frequencies can be stored). The frequencies are entered in the PAGE mode. To enter the PAGE mode, hold the CHANNEL MODE BUTTON for longer than 2 seconds.

There is a "PG *" (* denotes page number) annunciation to show you are in the PAGE MODE, and at this time a semi-transparent rectangle will appear behind the annunciation. There are now 2 choices:

1. Click on the COM FREQUENCY EXCHANGE BUTTON to enter numbers using the COM FREQUENCY SELECT KNOB. In this data entry state the rectangle behind the PG * annunciation will disappear and a larger rectangle will appear behind the frequency numbers. Click again on the COM FREQUENCY EXCHANGE BUTTON to exit the entry state. The large rectangle will disappear and the smaller rectangle behind the PG * annunciations will reappear .

2. Sequentially step up or down through the different pages in the PAGE mode by clicking on the inner, kHz, knob (letters C and D in the above picture). Click on the CHANNEL MODE BUTTON to exit the PAGE mode.

Numbers are entered into the specific pages by going to that page, and then entering them as discussed above. You cannot change pages when in the data entry state. The PG * annunciation and the rectangle behind it indicate that you are in the PAGE mode and that you can step through the pages. The rectangle behind the frequency, and the PG * annunciation, show you are in the data entry state of the PAGE mode. Clicking on the CHANNEL MODE BUTTON while in the PAGE mode data entry state will take you directly to the CHANNEL mode. Clicking on the CHANNEL MODE BUTTON again takes you back to the default screen and enters the number into the standby frequency.

RETRIEVING FREQUENCIES

When desired, the stored frequencies can be retrieved and placed into the active frequency by going into the CHANNEL mode. This is done by clicking on the CHANNEL MODE BUTTON for less than 2 seconds. A "CH *" annunciation will appear with a semitransparent rectangle behind it to show you are in the CHANNEL mode. The number displayed is the CHANNEL mode number and corresponds directly to a specific PAGE mode number. Use the inner, kHz, COM FREQUENCY SELECT KNOB (click spots C and D) to step sequentially through the channel pages. You can now enter that number into the standby frequency by clicking again on the CHANNEL MODE BUTTON and then entering it as the active frequency by clicking on the COM FREQUENCY EXCHANGE BUTTON. Clicking on the CHANNEL MODE BUTTON will also take you out of the CHANNEL mode back to the default screen.

NAVIGATION PAGES

The different NAV pages can be viewed sequentially using the NAV MODE BUTTON. Each click of the button steps the display to the next page, and the last click recycles the pages back to the first page. The active Nav frequency can be directly changed in the OBS, BEARING, RADIAL, and Timer pages by clicking on the NAV FREQUENCY SELECT KNOB and then using the knob to enter the new value. When entering data there is a rectangle behind the active frequency to indicate you are in the data entry state. The active frequency can be exchanged in these pages by clicking the NAV FREQUENCY EXCHANGE BUTTON.

NAVIGATION OBS PAGE

In the default page, click the NAV MODE BUTTON once to get to the OBS page. The OBS page displays a typical CDI with a needle that shifts left or right depending on the relative position of the aircraft to a received signal. Centering the CDI needle using the EFIS CONTROL PANEL will also center the needle in the KX 165A. A TO or FROM annunciation will be displayed in the center of the CDI scale if a DME signal is being tracked. Also, the direction to the signal will be displayed in the standby frequency location. A dashed horizontal line and the word FLAG are displayed if no signal is received. If the signal is from a localizer, the direction annunciation is replaced by the letters LOC.

NAVIGATION BEARING PAGE

Click on the NAV MODE BUTTON once again to get to the BEARING page. This page displays the bearing to or from a received signal station. The value is in degrees magnetic north. When tracking to a station the letters TO will be annunciated.

NAVIGATION RADIAL PAGE

Clicking the NAV MODE BUTTON again brings up the RADIAL page. The radial page displays the radial in degrees magnetic north from the station. The letters FR will be annunciated to show that tracking is occurring.

TIMER PAGE

Click the NAV MODE BUTTON again to get to the timer page. The timer is displayed in a min:sec format. The default page shows the count-up timer. If the timer has not been reset, the time shown will be the time passed from when the unit was powered up. The count-up timer can be reset to 0 by clicking on the NAV FREQUENCY EXCHANGE BUTTON. Depressing the NAV FREQUENCY EXCHANGE BUTTON for longer than 2 seconds when the NAV FREQUENCY SELECT KNOB is in the out position will stop the count-up timer and bring up the count-down timer. When entering this page, there is a rectangle over the time display showing the readiness to enter a value to count down from. Enter the value desired using the NAV FREQUENCY SELECT KNOB. (note: the NAV FREQUENCY SELECT KNOB must be in the out position to enter data into the count-down timer, else the knob will be used to change the active frequency). Click on the NAV FREQUENCY CHANGE BUTTON to start the countdown. When the count-down has started, clicking on the NAV FREQUENCY SELECT KNOB will reset the value back to the value entered. The count-down timer is stopped by clicking on the NAV EXCHANGE BUTTON again. To exit the count-down timer page and return to the count-up timer page, hold down the FREQUENCY EXCHANGE BUTTON for longer than 2 seconds. Clicking the NAV MODE BUTTON again will get you back to the main Nav page.

Appendix C: KLN-90B User Manual

Design & Copyrights of gauge, graphics and manual Don Kuhn

www.FS2X.com

Part of Aerosoft PBY Catalina
Manual changes Mathijs Kok (Aerosoft)
Graphic alternations Mathijs Kok (Aerosoft)

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INTRODUCTION

Although not state of the art when we release the Aerosoft PBY Catalina X, the KLN-90B is one of the most used navigation systems in aircraft . The main reason is that it is a very easy replacement as it fits in the avionics bay, all the connections are available and you can pick up a copy for a very reasonable price. And for that price you get a whopping load of information, not only a solid database of navaids, waypoints and airports but also the answer to just about any calculation you might need.

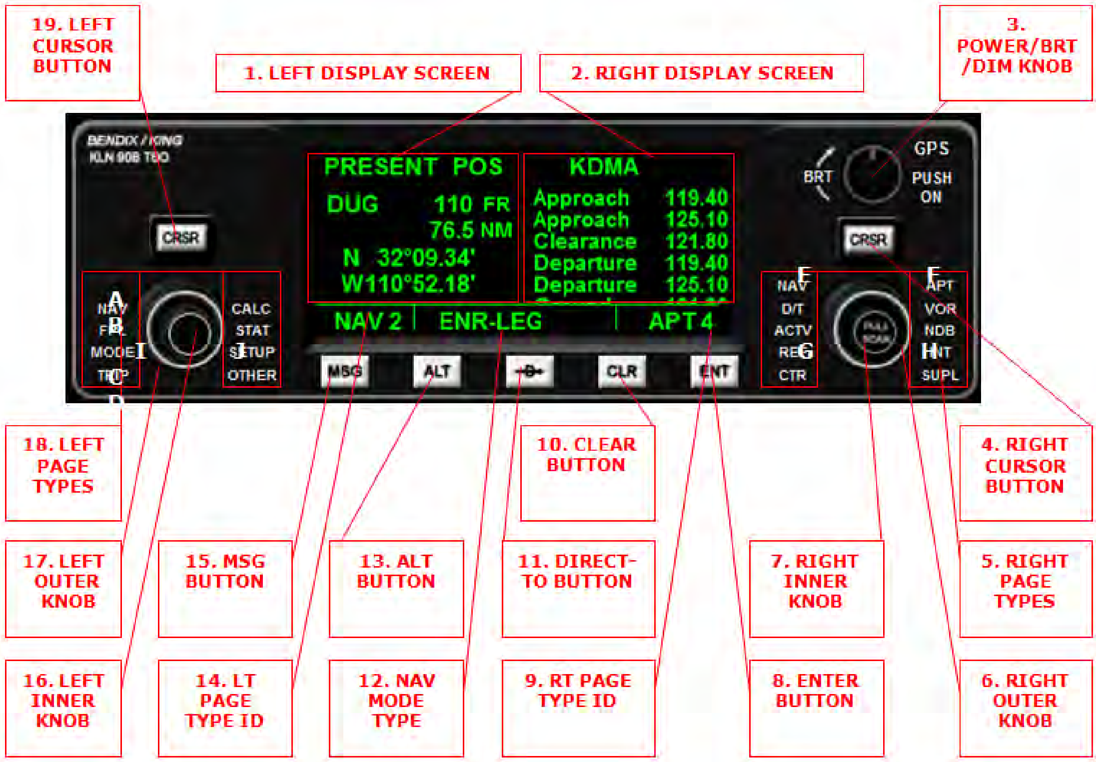
The problem is that the KLN-90B is small. It has just a few knobs and a small screen. So everything has many functions or is shown in abbreviated text. Yet the interface is logical and when you know one function you understand the next a lot faster. It's a steep learning curve that ends on a smooth platform where just about everything you need is displayed and connected to your aircraft. You need to invest a few hours to really learn to use it. But the people at Bendix/King are the kings (pun intended) of avionics and the KLN-90B sold many tens of thousands of copies and is still in high demand.

> Because the instrument is complex and not easy to operate we decided to only use a 2d representation that can be used. The 3d version in the VC will always show the correct display however.

Aerosoft licensed these gauges from Don Kuhn. He has become a friend by now.

Mathijs Kok
Aerosoft Concepts & Developments

OVERVIEW



The KLN 90B GPS Navigation System contains a wealth of aeronautical information. This information is presented on the display screen in the form of "pages". Each page contains specific and related information presented in a specific format. Related information pages are grouped into 17 page "types", and most are further divided into related sub-groups to give over 50 different information pages. The information contained in these pages includes fuel and air data, lateral and vertical navigation, unit conversions, flight and trip planning, and direct-to navigation, to name a few. In addition, there are 9 pages each of the nearest airports, VORs, and NDBs. A zoomable, moving map is also presented as a page.

DEFINITIONS:

1. **LEFT DISPLAY SCREEN:** Displays the current left group page information.
2. **RIGHT DISPLAY SCREEN:** Displays the current right group page information.
3. **POWER/BRT/DIM KNOB:** Used to turn the unit on and off, and to adjust screen brightness. Click on the knob to turn power on/off. Click to the right of the knob to increase screen brightness, and to the left to decease it.
4. **RIGHT CURSOR BUTTON:** Initializes data entry mode to allow data entry into the right group pages. A background rectangle highlights the value to be changed. Except for the right NAV type page, the RIGHT INNER KNOB must be "in" for this button to function. Also used to exit the data entry mode. The letters CRSR are displayed in place of the page type name and number when the cursor function is on.

5. **RIGHT PAGE TYPES:** Lists the 10 page types available in the right group. Scroll forwards or backwards through the list using the RIGHT OUTER KNOB.
6. **RIGHT OUTER KNOB:** Primary function is to scroll forwards and backwards through the right group page types. The RIGHT INNER KNOB must be in the default "out" position. Also used to scroll through highlighted fields when the RIGHT INNER KNOB is "in" and the RIGHT CURSOR BUTTON function is on. Click on the letter E to go backwards, and on the letter F to go forwards.
7. **RIGHT INNER KNOB:** Primary function is to scroll forwards and backwards through the right group page type sub-pages. The knob must be in the default "out" position. Also used to scroll through highlighted fields and, in some cases, enter data when it is pushed "in" and the RIGHT CURSOR BUTTON function is on. Click on the letter G to go backwards, and on the letter H to go forwards. The NAV type pages have a "wrap-around" feature; the other pages scroll up and down only.
8. **ENTER BUTTON:** Used to set entered data in the current data entry highlighted field into the active state.
9. **RT PAGE TYPE ID:** Displays the current right group page type and sub-page number.
10. **CLEAR BUTTON:** Used to clear, or exit, the highlighted current data entry field. Also used to de-clutter the moving map in the NAV 5 and Super NAV 5 pages.
11. **DIRECT-TO BUTTON:** Use this button to initiate entry of the ICAO identification code of the desired airport on the direct-to page. The RIGHT INNER KNOB must be in and rotated once to the right to allow code entry by the keyboard. The entered destination is activated, and the direct-to page exited, by clicking on the ENTER BUTTON. If you are currently GPS tracking, the aircraft will immediately begin to track directly to the new destination.
12. **NAV MODE TYPE:** Indicates if the unit is in the ENROUTE-LEG or the OBS mode of navigation.
13. **ALT BUTTON:** Used to enter the altitude alert page. Altitude alerting is used when in the vertical navigation mode (NAV 4 page) to provide an ALERT warning that a specified altitude is reached. On this page the altitude alerting function is turned on and off, and the altitude to initiate the alarm is entered here. Data is entered using the left group knob and cursor button. Also used to exit the altitude alert page.
14. **LT PAGE TYPE ID:** Displays the current left group page type and sub-page number.
15. **MSG BUTTON:** Used to view messages on the message page. The letters MSG will be displayed on the right of the lower, middle rectangle when a message is available. Hold the button down for 2 seconds to delete the prompt.
16. **LEFT INNER KNOB:** Primary function is to scroll forwards and backwards through the left group page type sub-pages. The LEFT CURSOR BUTTON function must be off. Used to enter data when the LEFT CURSOR BUTTON function is on. Click on the letter A to go backwards, and on the letter B to go forwards. The NAV type pages have a "wrap-around" feature; the other pages scroll up and down only. This knob is also used to zoom the map out (letter I) and in (letter J).
17. **LEFT OUTER KNOB:** Primary function is to scroll forwards and backwards through the left group page types. The LEFT CURSOR BUTTON function must be off. Used to scroll through highlighted fields when the LEFT CURSOR BUTTON function is on. Click on the letter C to go backwards, and on the letter D to go forwards.
18. **LEFT PAGE TYPES:** Lists the 8 page types available in the left group. Scroll forwards or backwards through the list using the LEFT OUTER KNOB.
19. **LEFT CURSOR BUTTON:** Initializes data entry mode to allow data entry into the left group pages. A background rectangle highlights the value to be changed. Also used to exit the data

entry mode. The letters CRSR are displayed in place of the page type name and number when the cursor function is on.

SYSTEM USE

The basic setup of the KLN 90B is straight forward. There are 5 buttons along the bottom of the unit which serve specific pages or functions (discussed later). The remaining pages are divided into 2 separate groups whose associated functions are located on the left (8 page types) or right (10 page types) side of the unit. Each side contains 2 concentric buttons to enter data, a cursor button to initiate data entry, and a display screen to display the page information. Normally, both left and right group screens are displayed at the same time. However there are exceptions such as in the case of the Super Nav1 and Super Nav2 pages.

The page annunciations, names, and numbers are listed below:

Page	Knob	Page Name	Page Numbers
Left Group:			
NAV	NAV	Navigation	1-5
CAL	CALC	Calculator	1-7
STA	STAT	Status	1-5
SET	SETUP	Setup	0-2
OTH	OTHER	Other	5-10
TRI	TRIP	Trip Planning	0-2
MOD	MODE	Mode	1-2
FPL	FPL	Flight Plan	0-0
Right Group:			
NAV	NAV	Navigation	1-5
APT	APT	Airport Waypoint	1-8
VOR	VOR	VOR Waypoint	0-0
NDB	NDB	NDB Waypoint	0-0
INT	INT	Intersection Waypoint	0-0
SUP	SUP	Supplemental Waypoint	0-0
CTR	CTR	Center Waypoint	1-2
REF	REF	Reference Waypoint	0-0
ACT	ACTV	Active Waypoint.	0-0
D/T	D/T	Distance/Time	1-4

Information retrieval and data entry are also straight forward in the KLN 90B. Information is retrieved by going to the page containing the desired information using the outer and inner knobs.

The current page type name and sub-page number is displayed below the screen. To change pages, the cursor button function must be off, and in the case of the right group, the RIGHT INNER KNOB must be out.

Data entry into the left group pages is initiated by going to the appropriate page and then clicking on the LEFT CURSOR BUTTON. When the cursor button is clicked, a rectangle will appear behind the first data entry field and the value can be changed using the LEFT INNER KNOB. Data entry fields, and the accompanying background rectangle, are changed using the LEFT OUTER KNOB. When changed to a new field, the inner knob is used once more to change the value. Click again on the cursor button to exit the cursor function.

Below is an example of entering 3 numbers into a page:

- Switch the unit on by clicking on the POWER/BRT/DIM KNOB BUTTON, and then clicking the ENTER BUTTON once to accept the information and to enter the pages.
- Say we want to replace the value 205 with the value 123 as the calculated airspeed (CAS).
- Use the LEFT INNER and OUTER KNOBs to go to the CAL 2 page.
- Now click on the LEFT CURSOR BUTTON and a rectangle appears behind the number 2.
- Click on the bottom left of the left inner knob to decrease the 2 to a 1.
- Now click on the upper right or left outer knob to shift the data entry field, and rectangle to the second digit, 0.
- Click on the bottom right inner knob 2 times to increase the value to 2.
- Click on the outer knob to get to the next field, and then click 2 times on the left inner knob to decrease the value from 5 to 3. If a mistake is made, you can scroll back to the mistaken value with the left outer knob and then change it using the left inner knob.
- The value 123 is now displayed, and clicking on the cursor button will enter the value and exit the cursor function. In general, the cursor function can be exited at any time by clicking on the cursor button. Also keep in mind that the numbers can be entered using your keyboard.

Data is entered into the right group pages in the same manner as described for the left group. The major difference is that the RIGHT INNER KNOB has an "in" and "out" position, and each is involved in different functions. Below is an example of changing the VOR from ABC to XYZ:

- Use the RIGHT OUTER KNOB to go to the VOR page.
- Click the RIGHT INNER KNOB to the in position, and then click on the RIGHT CURSOR BUTTON.
- The data entry field to be changed is highlighted by a background rectangle.
- Click the RIGHT INNER KNOB and a rectangle appears over the first data entry field.
- Use the right inner knob to change the letter A to the letter X.
- Next click on the right outer knob to shift the data entry field, and rectangle, over to the next letter.
- Use the right inner knob to change the letter B to the letter Y.
- Use the outer and inner knobs to change the last field as above.

- Click on the right cursor button to enter the value and exit the cursor function. Note you can also use your keyboard to enter the letters.

The following pages describe each different page in some detail. The approach taken is to discuss the pages of the left group starting with the NAV type page and going "forward" through the pages until the left NAV type is displayed again. The right group will be discussed next, again going forward through the pages from the NAV page until all pages are discussed. The pages served by the 5 buttons will be discussed last. The format will be to display an example figure, a brief description of the functions performed on each page, a definition of the information on each line, and last a description on how to use each page when required.

NAV: NAVIGATION PAGES

The navigation pages contain information specifically related to the navigational status of the flight. There are 5 navigation pages. The first 3 pages are information only pages that require no user input. The navigation pages are unique among the different page types in they are the only page types present in both left and right page type groups. This feature allows each page to be displayed at the same time on the left and right screens. It also provides a way to display the "super" NAV 1 and NAV 5 pages (discussed below).

NAV 1: Navigation 1 Page (NAV 1)

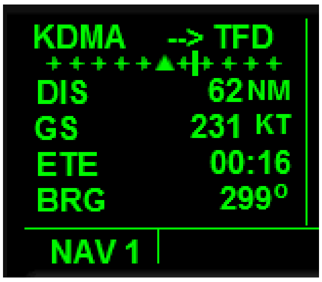


Fig 1.1 **Fig 1.2**

Examples of a typical NAV 1 page are shown above. The NAV 1 page has 6 lines of information as listed below:

- **Line 1**: Displays the active navigation leg. **Fig 1.1** shows the display when tracking waypoints of a flight plan. The identifier at the left is the previous waypoint, and to the right the next waypoint. The arrow shows you are tracking to the next waypoint. Fig**1.2** shows the display when tracking directly to a destination in the Direct-To mode. There is no previous waypoint, and a letter D is displayed over the arrow.
- **Line 2:** Displays a course deviation indicator. The vertical bar slides to the left and right to indicate distance from the desired track. The aircraft is on track when the needle is directly over the triangle. Each plus sign on the scale represents 1 nm off-track, therefore the CDI covers 5 nm to the left and 5 nm to the right of the desired track. The triangle in the center

of the scale points up when tracking to a waypoint, and points down when tracking from a waypoint.

- Note: the CDI scale factor can be changed from 5 nm to 1 nm, or to 0.2 nm in either the MOD 1 or MOD 2 page.
- **Line 3:** Displays the distance to the next active waypoint in nautical miles (nm). In the Direct-To mode the destination is the next active waypoint.
- **Line 4:** Displays the ground speed in knots (kt).
- **Line 5:** Displays the estimated time enroute (ETE) to the next active waypoint. The format is HH:MM.
- **Line 6:** Displays the bearing to the next active waypoint in degrees magnetic north.

SUPER NAV 1: Super navigation 1 page

Fig 1.3

The Super NAV 1 page is displayed when both the left and right page type groups are set to the NAV 1 page. A typical example is shown in **Fig 1.3**. It displays the exact same information displayed on the NAV 1 page, but presented in a larger and easier to read format.

NAV 2: Navigation 2 Page (NAV 2)

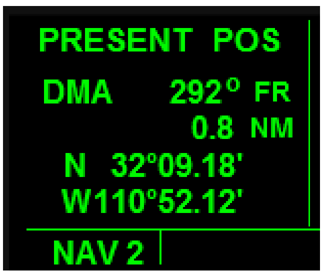


Fig 1.4

The navigation 2 page displays the present position of the aircraft in 2 ways. The first way is by listing the direction and distance to the nearest VOR. The second way is by listing the latitude and longitude of the aircraft. This page is set as the left screen display at startup to allow the user to determine the aircraft position at that time. The navigation 2 page has 5 lines of information and an example of this page is shown in **Fig 1.4**. Listed below is a description of the different lines of information.

- **Line 1:** Display to indicate the information referring to the present position of the aircraft.
- **Line 2:** Display listing the nearest VOR to the current aircraft position. The VOR identifier code is shown on the left. The next display to the right is the magnetic north degrees to or from the VOR, with an annunciation to show the direction from the VOR.
- **Line 3:** Display listing the distance to the VOR in nm.
- **Line 4:** Display showing the present latitude of the aircraft.
- **Line 5:** Display showing the present longitude of the aircraft.

NAV 3: Navigation 3 Page (NAV 3)

Fig 1.5

The navigation 3 page is shown in **Fig 1.5**. This page has 6 lines of information which are discussed below.

- **Line 1:** The display on this line is exactly the same as the NAV 1 page line 1 display. The annunciation shown in the above figure shows the display when in the Direct-To mode.
- **Line 2:** Displays the desired track to the active waypoint in degrees magnetic north.
- **Line 3:** Displays the aircrafts current track over the ground in degrees magnetic north.
- **Line 4:** Displays the cross track error correction in nm. The number lists the distance from the desired track, and the arrow indicates which way the aircraft needs to fly to get back on track.
- **Line 5:** Displays the minimum safe altitude. For this aircraft (not the real one) the MSA is defined as the indicated altitude of the aircraft plus 1000 feet when the aircraft is below 5000 ft AGL, and plus 2000 feet when above this altitude.
- **Line 6:** Displays the minimum enroute safe altitude. Not functional in this unit.

NAV 4: Navigation 2 Page (NAV 4)

Fig 1.6

Fig 1.7

Fig 1.8

Fig 1.9

The navigation 4 page is used to enter the parameters used by the unit to compute ascending or descending paths in the vertical navigation mode (VNV). This page interfaces with the autopilot, and usually the autopilot altitude hold function is used during vertical navigation. There are 5 lines of information on this page; the last 3 lines are changed by the user during vertical navigation. There are two ways to use the vertical navigation feature. One way is to begin an ascent or descent from the current location and another is to begin at a later time and place. Both ways are discussed below. The NAV 4 page can be displayed on either the left or right display screens, or simultaneously on both.

The basic idea in this type of vertical navigation is to define a point in space before and above the next active waypoint, defined in terms of distance from the waypoint and feet above ground, and then choose the vertical speed and airspeed you would like to use to get to that point. The KLN 90B uses this information to determine an "advisory" altitude to "advise" you of the altitude you need to be at, at any given time during VNAV, in order to arrive at the chosen point in space. Both the indicated and advisory altitudes will increase and decrease as you ascend or descend, respectively, and the idea is to keep the indicated altitude value matched with the advisory altitude value during the descent. Note that the advisory altitude changes according to the entered vertical speed and airspeed values, which are usually not the true, exact values. The values should remain close, however if they do not, the vertical speed can be adjusted to get them to match. If they are matched when the aircraft levels off at the designated altitude, you will be at the height and distance from the active waypoint you set earlier.

Examples of the vertical navigation page are shown in **Figs 1.6-1.9** above. The information presented in line 1 of **Figs 1.**7 and **1.8** is not displayed when in the time mode. The meaning of each line of this page is discussed below.

- **Line 1:** The information displayed on the right of this line changes according to the state of vertical navigation. The VNV annunciation on the left indicates you are on the vertical navigation page, and is always displayed when on this page. **Fig1.6** shows the display when vertical navigation is off. INACT is annunciated to indicate vertical navigation is inactive. **Fig1.7** shows the display when vertical navigation is on and you are more than 10 minutes from the determined ascent or descent point. If you are between 0 and 10 minutes from the point, line 1 will appear as shown in **Fig1.8**. **Fig1.9** shows this line as it is displayed when you are ascending or descending, with the advisory altitude on the far right.
- **Line 2:** Display of the indicated altitude in feet above MSL. Match this value to the advisory altitude during ascent or descent by changing the vertical speed value on the KAS 297C pre-altitude selector.
- Line 3: Displays the height above MSL of the point in space you are defining. Enter the desired value by going to the NAV 4 page, clicking on the **cursor** button, using the **outer knob** to change data entry fields, and changing the values with the **inner knob**. The altitude value increments/decrements in units of 100.
- **Line 4:** Displays the distance from the next active waypoint to the point in space you are defining. Enter the desired value by going to the NAV 4 page, clicking on the **cursor** button, using the **outer knob** to change data entry fields, and changing the values with the **inner knob**. The distance value increments/decrements in units of 10 and 1 to a maximum of 99. The next active waypoint identity is displayed on the left side of the line. The "-" sign displayed to the immediate left of the entered number indicates you are in the descend mode of vertical navigation. It is replaced by a "+" sign when in the ascending mode.
- **Line 5:** Displays the angle of the aircraft flight path used to ascend or descend to the chosen point in space. When in the immediate descend mode this value is not changed by the user, and the current angle will be displayed throughout the descent. The value increases as you get nearer to the next active waypoint. If in the vertical navigation delay mode the angle value is set by the user and is the angle the unit uses to determine the advisory altitude. The "-" sign displayed to the immediate left of the entered number indicates you are in the descend mode of vertical navigation. It is replaced by a "+" sign when in the ascending mode. To determine the vertical speed in feet per minute for a given angle, go to the CAL 4 page and use the program to calculate the fpm from the angle and the airspeed. When entering the airspeed on that page, however, remember the desired airspeed is the speed to be used during the descent and not necessarily the current airspeed.

There are several ways to use the vertical navigation feature. One way is to begin to ascend or descend from the current location at the vertical speed dictated by the displayed angle. The angle displayed at this time is the angle the unit has determined will take you from your current location, at your current airspeed to the defined point in space.

To use this calculator page,

1. Use the angle value on Line 6, along with the desired airspeed, on the CAL 4 page to determine the corresponding vertical speed in feet per minute.
2. Enter the desired altitude and distance from the next active waypoint in Lines 3 and 4, respectively, of the NAV 4 page.
3. Click on the outer knob when the cursor is over the last data field of Line 4 (x1 digit), to move the cursor to the next data field on Line 5, and activate the vertical speed mode. A green transparent rectangle will appear behind the ANGLE annunciation. When the vertical navigation mode is activated, the new altitude and the determined vertical speed must be set into the KAS 297C if using the autopilot.
4. Keep the indicated altitude matched to the advisory altitude during the ascent or descent to arrive at your chosen point in space. Use of the vertical speed hold function of the KAS 297C is advised.
5. Alternatively, if you know the angle of ascent or descent you want to use, you can enter the altitude and distance from the next active waypoint on the NAV 4 page and watch as the angle increases as you get nearer to the waypoint. When the angle displayed is equal to the angle you have chosen, vertical navigation is started as described above. Again, keep the indicated altitude matched to the advisory altitude during the ascent or descent to arrive at your chosen point in space.
6. You can also set the desired values for vertical navigation ahead of time and allow the KLN 90B to compute, and notify you when it is time to start the ascent or descent. Unlike above, the user also enters the desired angle of ascent or descent in Line 5. With this additional information the unit determines the time when the ascent or descent must be started to travel at that angle to get to the desired point in space. This feature of vertical navigation is activated when the cursor is moved to the angle data field on Line 5, past the ANGLE annunciation.
7. When activated, and the aircraft is further than 10 minutes from the ascent or descent point, the word ARMED will be displayed on the right of Line 1 as shown in **Fig 1.7**. When the aircraft is between 0 and 10 minutes from the ascent or descent point, a count-down timer will be displayed as shown in **Fig 1.8**. The words "VNV ALERT" will be displayed across the screen in red between 90 and 60 seconds from the ascent or descent point to alert the user of the impending start. This is a good time to prepare for the descent or ascent, specifically the airspeed and vertical speed.
8. At 0 time the advisory altitude is displayed on the right side of Line 1 as shown in **Fig 1.9** and the value starts to go up (ascending) or down (descending). The user then sets the KAS 297C altitude and vertical speed to get to the desired point in space as discussed above. Use the KAS 297C vertical speed feature to keep the indicated altitude matched to the advisory altitude.

An example using the latter vertical navigation type on a Direct-To GPS flight from Tuscon International (KTUS) to Phoenix Sky Harbor (KPHX) is illustrated below:

Figs 1.6-**1.9** show the displays of the NAV 4 page at different times of the trip. I first set the KLN 90B for a direct flight using the Direct-To feature. After take-off and climbing, I leveled off at 12,000 ft above MSL at 225 kts GS with the NAV 4 page displayed as shown in **Fig 1.6**. At approximately 75 miles outside of KPHX, I set the selected altitude to 2100 feet (MSL), and the distance to 10 nm to get to the KPHX pattern altitude of 2100 ft above MSL at 10 miles out. I decided to descend to that point at a rate of 1600 fpm at 200 kts GS. On the CAL 4 page I calculated that this vertical speed and GS corresponded to an angle of ~4.1 degrees. I then entered this value in Line 5 of the NAV 4 page. The INACT annunciation in Line 1 was replaced by the ARMED annunciation showing the unit was activated. At 10 minutes from the descend point the unit began to count down from 10 minutes. **Fig 1.8** shows a display of the NAV 4 page taken at 6 minutes and 10 seconds from the descend point. When there was ~5 minutes to go to the descend point, I used the autopilot airspeed function to slow the aircraft to ~200 kts groundspeed. At 0 time, the advisory altitude replaced the ARMED annunciation. I set the KAS 297C altitude value to 2100 ft, and the vertical speed to 1600 fpm. **Fig. 1.9** shows the display at about 4400 ft above MSL. At this time I was doing well on the descent as shown by the closeness of the indicated and advisory altitudes, and by the remaining distance. The autopilot leveled the aircraft at 2100 ft and the distance to KPHX was 10 nm.

NAV 5: Navigation 5 Page (NAV 5)

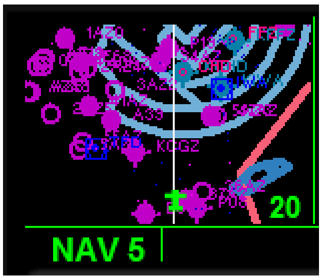


Fig1.10

The navigation 5 page displays a moving map. The range value of the map can be changed by zooming in or out using the LEFT INNER KNOB (letters I and J), and the map display can be "de-cluttered" using the CLR button. Note using the zoom function on the left screen will cause the Nav1 page to be displayed on the right screen. The range values go from 200 ft to 500 nm and the current value is annunciated at the lower right of the screen. ILS arrows for ILS capable runways to be displayed on the map to aid in ILS approaches. The symbolic aircraft shows your position on the map.

SUPER NAV 5: Super Navigation 5

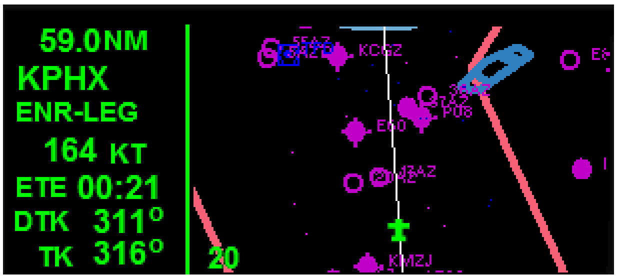


Fig 1.11

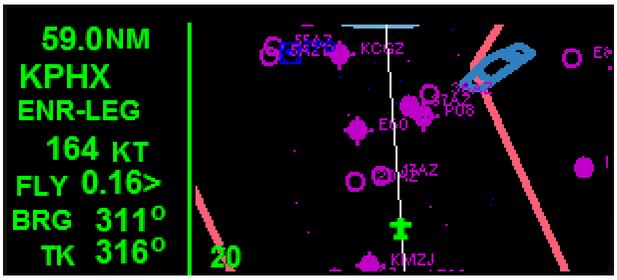


Fig 1.12

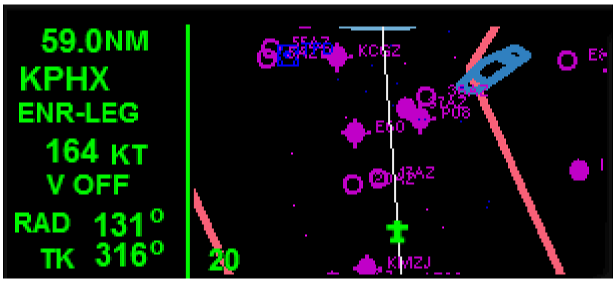


Fig 1.13

The super navigation 5 page is displayed when the NAV 5 page is chosen from both left and right page groups at the same time. This page provides the user with basic relevant navigation data displayed in the context of a moving map. The information displayed on the map is exactly the same information displayed on the NAV 5 page, and the range and clutter can be changed as discussed. On this page however, the map is larger and the range factor is displayed at the lower left of the map. All of the data contained on the map is informative only and the values cannot be changed by the user directly (except for the range factor).

Figs 1.11-1.13 show examples of the super navigation 5 page. There are 7 lines of navigational information. The information displayed in the first 4 lines cannot be changed, however the information fields displayed in the last 3 lines can be changed to display different information field (see the figures above). The information displayed in the 7 lines is discussed below.

- **Line 1:** Displays the distance to the next active waypoint, in nm.
- **Line 2:** Displays the ICAO code of the next active waypoint.
- **Line 3:** Indicates if navigation is in the ENROUTE LEG or OBS mode.
- **Line 4:** Displays the current GS in kts.
- **Line 5:** Displays 1 of 3 information fields: 1) estimated time enroute (ETE) in a min:sec format, 2) cross track error in nm accompanied by a relative position arrow, or 3) vertical navigation information as displayed on the upper right hand screen of the NAV 4 page. This allows you to observe the progress of vertical navigation while viewing the super navigation 5 page.
- **Line 6:** Displays 1 of 3 information fields: 1) the desired track to the next active waypoint in degrees magnetic north, 2) the bearing to the next active waypoint in degrees magnetic north, or 3) the radial from the next active waypoint in degrees magnetic north.
- **Line 7:** Displays 1 of 3 information fields: 1) the current aircraft track over the ground in degrees magnetic north, 2) the bearing to the next active waypoint in degrees magnetic north, or 3) the radial from the next active waypoint in degrees magnetic north.

As stated above, the last 3 lines of the super navigation 5 page can be changed to display 3 different information fields each.

1. To change the information fields, first click on the LEFT CURSOR BUTTON while in the super navigation 5 page. This will set the active cursor in Line 5. A rectangle will appear over the line with the annunciations "ETE", "FLY" or "VNAV" depending on the current information field.
2. Use the LEFT INNER KNOB to scroll forward and backward through the 3 choices. The annunciations displayed in the rectangle only tell you which information field is current; the information in the field is not observed until you set the value by moving to another line or by exiting using the LEFT CURSOR BUTTON.
3. Next, click on the LEFT OUTER KNOB to move to Line 6. The information in Line 5 is now observable and the cursor rectangle is positioned in Line 6 showing one of the following annunciations: "DTK", "BRG", or "RAD". Again, use the LEFT INNER KNOB to choose the information field desired.
4. Click on the LEFT CURSOR BUTTON to exit data entry or click on the LEFT OUTER KNOB to move the cursor rectangle to Line 7.
5. Repeat the above process to choose the desired information field in Line 7.
6. Next click on the LEFT CURSOR BUTTON to exit the data entry mode, or use the LEFT OUTER KNOB to scroll back to Lines 5 or 6.
7. The LEFT INNER KNOB is used to change the range factor of the map when the cursor function is on. If the cursor is positioned in Line 5, you can click on the left side of the LEFT OUTER KNOB to go directly to the range field. A rectangle will appear behind the range factor annunciation located on the bottom left side of the map. Use the LEFT INNER KNOB to increase or decrease the range factor. Alternatively, scrolling past Line 7 by clicking on the right side of the LEFT OUTER KNOB will also get you to the range field.

CALC: CALCULATOR PAGES

The calculator pages allow the user to determine the effect which changing a navigation parameter has on other interrelated navigation parameters. The manufacturer calls these pages the "what if" pages. For example, what if you wanted to know the new heading to use to stay on course if the wind direction changed? If you were enroute and knew the wind direction was different up ahead of you, you could go to the calculator pages and determine the new heading before you get to the change. Changes in the air are not the only flight-related variables that can be calculated on these pages. A partial list includes variables such as pressure and density altitude, TAS, winds aloft, temperature, and VNAV angle. There are also several conversion functions, including a time conversion table that can be used to compare local times between all of the different time zones in the world.

The calculator pages are setup by default to show the current flight-related information. This information will be displayed only as long as the values are not changed. This allows you to see the current values immediately before changing them. There are 7 different calculator pages, and each is discussed below. The ":" is displayed in lines of information that can be changed by the user.

CALC 1: Calculator 1 Page (CAL 1)

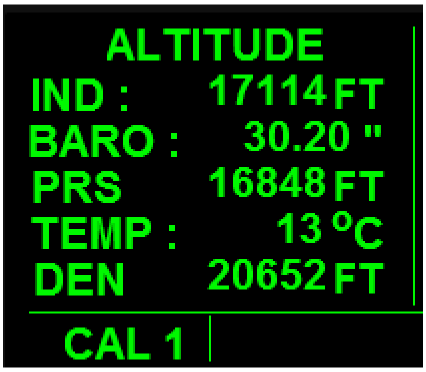


Fig 2.1

The calculator 1 page is used to determine pressure and density altitudes at any given combination of indicated altitude, barometric pressure and temperature. The latter 3 values are entered by the user. There are 6 Lines of information.

- **Line 1:** Indicates this page displays and calculates altitude data.
- **Line 2:** Displays the user entered altitude in feet above MSL.
- **Line 3:** Displays the user entered barometric pressure in inches of Hg. Can also be set to display millibars of pressure using the SET 6 page.
- **Line 4:** Displays the calculated Pressure Altitude in feet above MSL based on the altitude and barometric pressure entered by the user.

- **Line 5:** Displays the user entered ambient temperature in degrees Celsius.
- **Line 6:** Displays the Density Altitude in feet above MSL based on the ambient temperature and the Pressure Altitude.

To use this calculator page:

1. Display the CAL 1 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. The Pressure and Density Altitudes will be computed as you enter the data.
3. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

CALC 2: Calculator 2 Page (CAL 2)

Fig 2.2

The calculator 2 page is used to calculate the aircraft's true airspeed (TAS) based on user-entered values of calibrated airspeed, indicated altitude, barometric pressure, and the total air temperature. There are 6 lines of information, 4 of which are used for data entry.

- **Line 1:** Display to indicate this page is used to calculate TAS.
- **Line 2:** Display of the user-entered calibrated airspeed (indicated airspeed) in knots.
- **Line 3:** Display of the user-entered altitude in feet above MSL.
- **Line 4:** Display of the user-entered barometric pressure in inches of Hg. Can also be set to display millibars of pressure using the SET 6 page.
- **Line 5:** Displays the user-entered total air temperature in degrees Celsius.
- **Line 6:** Displays the TAS of the aircraft in knots as calculated from the user-entered values.

To use this calculator page:

1. Display the CAL 2 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. The TAS will be computed as you enter the data.
3. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

CALC 3: Calculator 3 page (CAL 3)

Fig2.3

The calculator 3 page is referred to as the "wind" page. Use this page to determine the headwind or tailwind based on the TAS and aircraft heading. This page also displays the direction (true north) and strength of the wind. There are 6 lines of information.

- **Line 1:** Indicates this page is used for calculations relating to wind parameters.
- **Line 2:** Displays the user-entered TAS in knots.
- **Line 3:** Displays the user-entered aircraft heading in degrees magnetic north.
- **Line 4.** Displays if the wind has a headwind or tailwind component relative to the aircraft heading. Also displays the strength of the wind component in knots. HDWIND refers to a headwind, and TLWIND refers to a tailwind.
- **Line 5:** Displays the wind direction in degrees true north.
- **Line 6:** Displays the wind strength in knots.

To use this calculator page:

1. Display the CAL 3 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT
3. INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. The wind component type and strength will be computed as you enter the data.
4. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

CALC 4: Calculator 4 page (CAL 4)

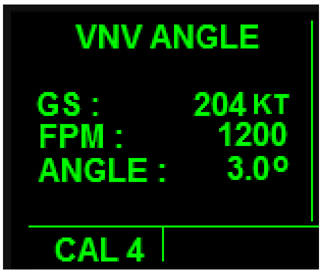


Fig.2.4

The calculator 4 page is used to convert the flight path angle into feet per minute, and vice versa. Put the groundspeed in to use during ascent or descent along with the angle displayed n Line 5 of the NAV 4 page, and the unit will calculate what this value corresponds to in fpm. Enter the fpm value into the KAS 297C vertical speed page. Alternatively, enter the GS and the fpm you want, and the unit will compute the corresponding angle to enter in Line 5 of the NAV 4 page. If you are tracking to a waypoint, the default page will display the angle required to go from the current location to the point in space previously defined, based on the current airspeed. There are 4 lines of information displayed on this screen.

- **Line 1:** Display to show you are on the page used to calculate ascent or descent flight paths for vertical navigation.
- **Line 2:** Display of the user-entered GS in knots.
- **Line 3:** Display of the -user entered, or calculated, vertical speed in fpm.
- **Line 4:** Display of the user-entered, or calculated, ascent/descent flight path angle in degrees relative to the ground.

To use this calculator page:

1. Display the CAL 4 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. All values will be computed as you enter the data.
3. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

CALC 5: Calculator 5 Page (CAL 5)

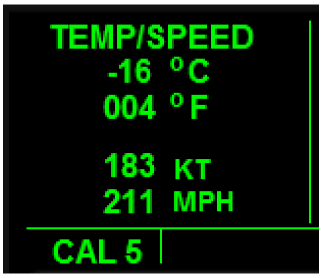


Fig2.5

The calculator 5 page is used to convert degrees Celsius to Fahrenheit and vice versa, and to convert between nautical and statute miles per hour. There are 5 lines of information.

- **Line 1:** Display to indicate the page is used for temperature and speed conversions.
- **Line 2:** Display of the user-entered or corresponding Fahrenheit temperature in degrees Celsius.
- **Line 3:** Display of the user-entered or corresponding Celsius temperature in degrees Fahrenheit.
- **Line 4:** Display of the user-entered or corresponding mph speed in nautical miles per hour.
- **Line 5:** Display of the user-entered or corresponding nm per hour speed in statute miles per hour.

To use this calculator page:

1. Display the CAL 5 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT
3. INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. All values will be computed as you enter the data.
4. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

CALC 6: Calculator 6 Page (CAL 6)

Fig 2.6

The calculator 6 page is used to convert the time in one time zone to the corresponding time in another zone. Lines 2 and 3 in **Fig2.6** display the time, 3 letter time zone code, and time zone name for one set, and Lines 4 and 5 shows the corresponding information in another set. The user can change the time and time zone of either set, and when the time is changed in one set it is changed in the other set accordingly. A default screen example is shown in **Fig2.6**. The top set of information is set to the local time, and is referring to universal time displayed in the bottom set. A list of available time zones and their 3 letter codes is shown below. There are 5 lines of information.

- **Line 1:** Indicates the page is used to for time conversion calculations.
- **Line 2:** Display of user-entered information. The left-most information is the time in an hrs:min format, while the right side of the line displays the time zone code.
- **Line 3:** Displays the time zone name corresponding to the 3 letter time zone code entered in Line 2.
- **Line 4:** Display of user-entered information. The left-most information is the time in an hrs:min format, while the right side of the line displays the time zone code.
- **Line 5:** Displays the time zone name corresponding to the 3 letter time zone code entered in Line 4.

Time Zones	**UTC Reference Time**	**Time Zone**
Coordinated Universal Time	ZULU	UTC
Greenland Standard Time	UTC-3	GST
Greenland Day Time	UTC-2	GDT
Atlantic Standard Time	UTC-4	AST
Atlantic Day Time	UTC-3	ADT
Eastern Standard Time	UTC-5	EST
Eastern Day Time	UTC-4	EDT
Central Standard Time	UTC-6	CST
Central Day Time	UTC-5	CDT
Mountain Standard Time	UTC-7	MST

Mountain Day Time	UTC-6	MDT
Pacific Standard Time	UTC-8	PST
Pacific Day Time	UTC-7	PDT
Alaska Standard Time	UTC-9	AST
Alaska Day Time	UTC-8	ADT
Hawaii Standard Time	UTC-10	HST
Hawaii Day Time	UTC-9	HDT
Samoa Standard Time	UTC-11	SST
Samoa Day Time	UTC-10	SDT

To use this calculator page:

1. Display the CAL 6 page on the left screen and click on the LEFT CURSOR BUTTON.
2. Use the LEFT OUTER KNOB to scroll through data entry fields, and the LEFT INNER KNOB to change the values. Each data entry field is highlighted with a background rectangle to show the current field to be changed. All values will be computed as you enter the data.
3. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

To use the time conversion calculator:

1. Refer to **Fig 2.6** as the starting point. This figure shows the relationship between Pacific Day Time and UTC. We want to change the PDT to EDT.
2. Go to the CAL 6 page and click on the LEFT CURSOR BUTTON. A rectangle will appear behind the hour display in the upper set and the value can be changed using the LEFT INNER KNOB if desired.
3. Click on the LEFT OUTER KNOB to position the cursor over the 10 minute value. Change if desired.
4. Click again on the LEFT OUTER KNOB to position the cursor over the 1 minute value and change with the LEFT INNER KNOB if desired.
5. Click the LEFT OUTER KNOB again to position the cursor rectangle over the PDT annunciation. Use the LEFT INNER KNOB to scroll through the list of time zones and choose EDT. The UTC time listed on Line 4 will now change to 20:09 if the time has not been changed from what is listed in **Fig. 2.6**.
6. To see what time 16:09 in the EDT zone is in Alaska Day Time without changing the upper set display, use the LEFT OUTER KNOB to position the rectangle over the time zone code in the bottom set. Use the LEFT INNER KNOB to scroll through the time zones until ADT is displayed. The time displayed on Line 5 will now be 12:09, 4 hours behind EDT, and 8 hours behind UTC. The same information would have been obtained if the ADT had been chosen into the upper set, and the EDT entered into the lower set.
7. Click on the LEFT CURSOR BUTTON at any time to exit data entry.

CALC 7: Calculator 7 page (CAL 7)

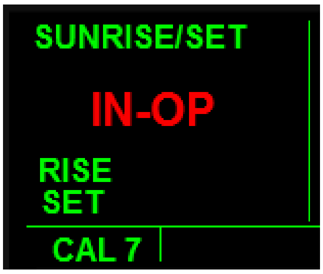


Fig 2.7

This page displays the sunrise and sunset for all waypoints in the data base. It is currently IN-OPERABLE, and is only included to show the KLN 90B's full potential.

STAT: STATUS PAGES

The status pages contain information relating to the status of the satellite reception of the KLN 90B. There is no such information in the flight simulator, and accordingly these pages are displayed in this aircraft for learning purposes only. There are 4 status pages. Status pages 1 and 2 display information about the GPS receiver and the GPS satellite being tracked. Status pages 3 and 4 display supplemental information pertaining to the KLN 909B.

SETUP: SETUP PAGES

The setup pages are used to set a number of variables used by other pages. For example, the SET 7 page is used to set barometric pressure values in the CAL 1 and 2 pages as inches of Hg or millibars of pressure. The SET 4 page allows the user to set the flight timer on the D/T 4 page to begin when the unit is powered on, or when the airspeed is greater than 30 knots. Nearest airport runway criteria and altitude alerting pages are also grouped in these pages.

SETUP 1: Setup 1 Page (SET 1)

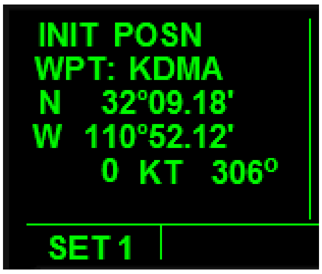


Fig 3.1

The setup 1 page is used primarily to show the information used by the GPS to obtain an initial position fix. It is basically a nearest airport page and can be viewed at any time to get a quick "fix" on the nearest airport without going to the nearest airport pages. This page also displays the longitude and latitude of the nearest airport whose information is not supplied on the nearest airport pages. There are 5 lines of information.

- **Line 1:** Display to identify this page as the initial position "fix" page.
- **Line 2:** Display listing the identity of the nearest airport by its ICAO identification code.
- **Line 3:** Display of the nearest airport latitude.
- **Line 4:** Display of the nearest airport longitude.
- **Line 5:** Displays the 1) current ground speed in knots, and 2) direction to the nearest airport listed in Line 2 in degrees magnetic north.

SETUP 2: Setup 2 Page (SET 2)

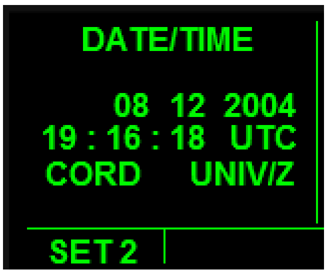


Fig 3.2

Fig 3.3

The setup 2 page displays date and time information. The default screen displays this information as Zulu date and time (**Fig3.2**), but the display can be changed to show the local date and time (**Fig3.3**) if desired. There are 4 lines of information.

- **Line 1:** Display showing the current page is used for date and time functions.
- **Line 2:** Display of the current day, month and year, respectively.

- **Line 3:** Display showing the current time in an hh:mm:sec format. The time zone code corresponding to this time is displayed on the right side.
- **Line 4:** Display of the time zone corresponding to the date and time shown.

Click the LEFT CURSOR BUTTON when on this page and use the LEFT INNER KNOB to toggle between Zulu and local dates and time.

SETUP 3: Setup 3 Page (SET 3)

Fig 3.4

The setup 3 page is used to set the minimum runway length and surface type conditions that must be met for an airport to be included in the nearest airport list. The runway length specified can be up to a maximum of 5000 ft, and the choices for runway surface type are "hard" and "soft". (note: the 'HRD/SFT' function is currently in-operable). **Fig3.4** shows a situation where only airports with a minimum runway length of 3500 ft and a hard surface are to be included in the nearest airport list. There are 6 Lines of information.

- **Lines 1 and 2:** The annunciation in these 2 lines indicate the page is used to calculate nearest airport criteria.
- **Line 3:** Display to indicate that the number entered directly below is the minimum runway length.
- **Line 4:** Displays the user entered minimum runway length that must be met to include the airport in the nearest airport list.
- **Line 5:** Display indicating the runway surface type entered directly below is the surface type chosen.
- **Line 6:** Displays the user entered runway surface type an airport must have to be included in the nearest airport list.

To use this setup page:

1. Display the SET 3 page on the left screen and click on the LEFT CURSOR BUTTON.
2. A rectangle will appear behind the entire minimum runway value.
3. Use the LEFT INNER KNOB to change the value to the desired value. The value is incremented and decremented in units of 100 ft up to a maximum value of 5000 ft.

4. Click on the LEFT OUTER KNOB to shift the cursor to the runway surface type location (Line 6). A rectangle will appear behind 1 of 3 annunciations; 1) "HRD SFT", "HRD", or 3) "SFT". The "HRD SFT" annunciation is the unset default display and indicates the 2 set choices available. The other 2 annunciations are displayed if their values had been set previously in the flight.
5. Use the LEFT INNER KNOB to toggle between the unset (#1), hard (#2), and (#3) soft surface type criteria choices. The choice will be highlighted with a background rectangle to show the cursor location, and will remain displayed when data entry is completed and the rectangle is not visible.
6. Each data entry field is highlighted with a background rectangle to show the current field to be changed. All values will be computed as you enter the data.
7. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained.

SETUP 4: Setup 4 Page (SET 4)

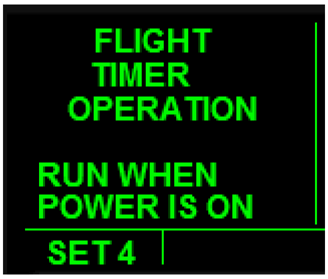


Fig 3.5

The setup 4 page is used to set the conditions for the automatic start of the flight timer displayed in Line 2 of the D/T 4 page. The choices include starting the flight timer when the unit is powered on, as displayed in **Fig3.5**, or when the aircraft airspeed is greater than 30 knots. There are 6 lines of information.

- **Lines 1-3:** These 3 lines show you are on the flight timer setup page.
- **Line 4:** Display to indicate that the choice made in the next line. Will cause the timer to start running.
- **Line 5:** Displays the condition which will start the timer automatically.

To use this setup page:

1. Display the SET 4 page on the left screen and click on the LEFT CURSOR BUTTON. A long rectangle will appear behind the word annunciation.
2. Use the LEFT INNER KNOB to toggle between the 2 choices.
3. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. The background rectangle will disappear. All data entered in the session will be retained.

SETUP 5: Setup 5 Page (SET 5)

Fig3.6

The setup 5 page functions in the Height Above Airport Alert feature of the KLN 90B. The height above airport alert feature is a feature to alert the user when the aircraft altitude is at a certain height above (user-entered value), but less than 2000 ft, and within 5 nm of the next active waypoint. One obvious use of this feature is to be notified when you are at pattern altitude during an approach. The height above the airport is set on this page, and the feature is also turned **on** and **off** on this page. The height value entered is the actual height above the airport, not the altitude above MSL. The value entered is added to the altitude of the next active waypoint. A large red "APT ALERT" annunciation is displayed on the screen when the entered height is reached, and remains on until the feature is reset or turned off. There are 5 lines of information.

- **Lines 1 and 2:** Indicates the page displayed is the height above airport alert feature setup page.
- **Line 3:** Displays if the height above airport alert feature is ON or OFF.
- **Line 4:** Indicates the entered value below is the height value used in this feature.
- **Line 5:** Displays the user entered height above the airport to use when the feature is on.

To use this setup page:

1. Display the SET 5 page on the left screen and click on the LEFT CURSOR BUTTON.
2. A rectangle will appear behind the word ON or OFF, depending on the current annunciation.
3. Use the LEFT INNER KNOB to toggle between ON and OFF.
4. Click on the LEFT OUTER KNOB to go to the height entry line (Line 5). The rectangle behind the ON/OFF annunciation will go off, and a rectangle will appear behind the 1000 place digit of the number.
5. Use the LEFT INNER KNOB to change this number as desired. The maximum value of this digit is 2.
6. Use the LEFT OUTER KNOB to move the active field location, and the LEFT INNER KNOB to enter values until the desired height is entered. The last 3 digits of the height value have a maximum value of 9, but will be inactive any time the height value reaches 2000 ft.

7. Exit the data entry mode at any time by clicking on the LEFT CURSOR BUTTON. All data entered in the session will be retained. All data entry fields can be scrolled through forwards and backwards.

SETUP 6: Setup 6 Page (SET 6)

Fig3.6

The setup 6 page is used to toggle the barometric pressure readout on the initial page, and the CAL 1 and 2 pages, between units of inches of Hg and millibars pressure. There are 4 Lines of information.

- **Lines 1and 2:** Indicates the page viewed is used to set the barometric pressure readout units.
- **Line 3:** Displays an ' " ' annunciation if the setting is for unit readout in inches of Hg; displays MB if the readout is in millibars pressure.
- **Line 4:** Display to show if the barometric pressure readout is set for "INCHES" or "MILLIBARS".

To use this setup page:

1. Display the SET 6 page on the left screen and click on the LEFT CURSOR BUTTON. A long rectangle will appear behind the current annunciation at the bottom.
2. Use the LEFT INNER KNOB to toggle between the 2 choices.
3. Click on the LEFT CURSOR BUTTON to exit data entry. The rectangle disappears and the choice displayed at the bottom is used for readout values.

SETUP 7: Setup 7 Page (SET 7)

Fig3.7

The setup page 7 is used to adjust the volume of the altitude aural alert. It is currently INOPERATIVE.

OTHER: OTHER PAGES

The other pages are designed to assist the user in fuel management, and to provide pertinent air data information. There are 6 "other" pages: the first 4 are being used for fuel management, and the last 2 are used to display air data information. Only the first 2 pages have a choice of user input. User input lines have an ":" annunciation. The default screens display the current values based on the flightsim input, and will do so until changed by the user. “Other pages 1-4” contain information about the internal functioning of the unit, and are not accessible by the user.

OTHER 5: Other 5 Page (OTH 5)

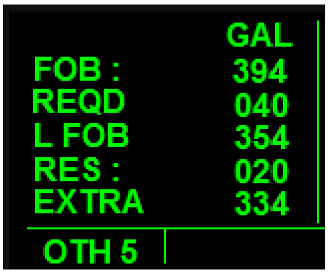


Fig 4.1

The “other 5 page” displays fuel-related information with little input from the user. The user can enter a" fuel on board" amount, and an amount to be held as a reserve, and the unit computes the amount of fuel required to reach the destination waypoint, the amount of fuel remaining, and an "extra" amount that takes the amount of fuel designated as a reserve into consideration. The amount of fuel reserve is designated by the user. The values displayed on the page are determined by current flight parameters, such as ground speed and power setting, and are therefore subject to change. There are 6 lines of information on this page.

- **Line 1:** Annunciation indicating the values on this page are expressed in gallons.
- **Line 2:** Displays the current number of gallons of fuel on board in the default screen, or displays the value entered by the user.
- **Line 3:** Displays the required number of gallons of fuel necessary to reach the destination waypoint.
- **Line 4:** Displays the calculated total gallons of fuel remaining on board at the destination waypoint.
- **Line 5:** Displays the user-entered gallons of fuel to "place" on reserve. The value is 0 unless changed by the user.
- **Line 6:** Displays the "extra" amount of fuel remaining at the destination waypoint taking into account the amount of fuel placed in reserve.

To use this other page:

1. Display the OTH 5 page on the left screen. The information displayed shows the current values. Click on the LEFT CURSOR BUTTON and a rectangle will appear behind the first digit of the FOB line (Line 2).
2. Use the LEFT INNER KNOB to change the current value if desired. Use the LEFT OUTER KNOB to change cursor location, and then use the LEFT INNER KNOB to change the value. Repeat this process until all desired numbers have been entered. Only the values displayed in Lines 2 and 5 can be changed by the user directly.
3. Click on the LEFT CURSOR BUTTON to exit data entry.

OTHER 6: Other 6 Page (OTH 6)

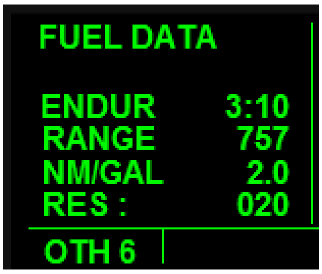


Fig4.2

The “other 6” page displays fuel information including the length of time (endurance) and the distance (range) the aircraft can stay aloft based on the current flight parameters. The user can enter a fuel value to be held in reserve which will be included in the endurance and range calculations. This page also displays the current number of nm traveled per gal of fuel. There are 5 lines of information.

- **Line1:** Display indicating the current page contains fuel data.
- **Line 2:** Displays the time the aircraft could go before running out of fuel under the present flight conditions; in an hh:mm format.
- **Line 3:** Displays the distance the aircraft could travel under the current flight conditions; in nautical miles.
- **Line 4:** Displays the current distance traveled on a gallon of fuel; in nm per gal.
- **Line 5:** Displays the user-entered gallons of fuel to hold in reserve. This value will be subtracted from the total amount of fuel used in endurance and range calculations.

To change the amount of fuel held in reserve, go to the OTH 6 page, click on the LEFT CURSOR BUTTON, and change the value using the LEFT INNER and LEFT OUTER KNOBS as discussed previously.

OTHER 7: Other 7 Page (OTH 7)

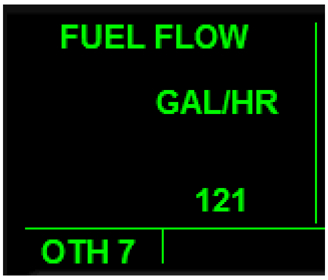


Fig 4.3

The “other page 7” displays the fuel flow in gals per hour. There are 3 lines of information. The first line displays the page "functional" title, the second line indicates that the data displayed is expressed in gallons of fuel per hour, and the third line displays the actual fuel flow value. There is no user input on this page.

OTHER 8: Other 8 Page (OTH 8)

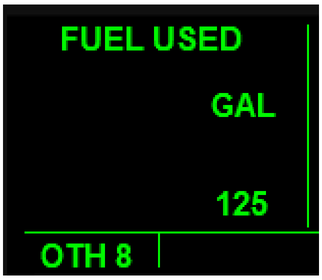


Fig 4.3

The “other page 8” displays the number of gallons of fuel used since the last set point. There are 3 lines of information. The first line displays the page "functional" title, the second line indicates that the data displayed is expressed in gallons of fuel used, and the third line displays the actual fuel used in gallons. There is no user input on this page.

OTHER 9: Other 9 Page (OTH 9)

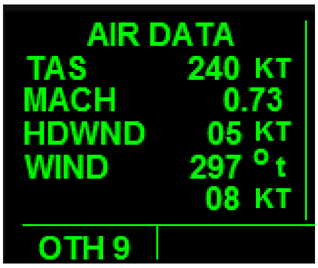


Fig4.4

The other 9 page displays pertinent air data information. The information displayed on this page is similar to that displayed on the CAL 3 page. There is no user input. There are 6 lines of information.

- **Line 1:** Displays the functional title of the page.
- **Line 2:** Displays the TAS of the aircraft in kts.
- **Line 3:** Displays the mach speed number.
- **Line 4:** Displays the headwind or tailwind component of the wind knots.
- **Line 5:** Displays the wind direction in degrees true north.
- **Line 6:** Displays the current air velocity in knots.

OTHER 10: Other 10 Page (OTH 10)

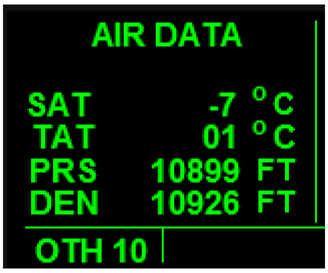


Fig4.5

The other 10 page displays additional air data information. This information includes the temperature of the surrounding air, the total air temperature, pressure altitude, and density altitude. There is no user input. There are 5 lines of information.

- **Line 1:** Indicates the page viewed contains air data information.
- **Line 2:** Display of the saturated air temperature in degrees Celsius.
- **Line 3:** Display of the total air temperature in degrees Celsius.
- **Line 4:** Displays the current pressure altitude in ft.
- **Line 5:** Displays the current density altitude in ft.

TRIP: TRIP PLANNING PAGES

The trip planning pages are used to determine the amount of time, and the fuel required to go directly from the present position to any other position in the world (within 10,000 nm). There are 3 trip planning pages. The first page is used to enter the TAS and wind data. This data is used by the KLN 90B to calculate an estimated GS to be used in planning specific trips on the TRI 1 and TRI 2 pages. Alternatively, the user can enter and use any GS desired on these 2 pages. The data on the trip planning pages is used by the unit to calculate estimates of distance, ETE, bearing, and fuel requirements.

The TRI 1 and TRI 2 pages display the same type of information; the difference being that the TRI 1 page is used to plan a trip from your current position to a waypoint, and the TRI 2 page to plan a trip to anywhere.

TRIP 0: Trip Planning 0 Page (TRI 0)

Fig.5.1

The trip planning 0 page is used to enter the TAS, wind direction, and wind strength that will be encountered during the trip that is planned on the TRI 1 or TRI 2 pages. The wind direction, wind strength, and destination direction are used to determine the headwind/tailwind component of the wind which is then used with the TAS to get an estimated GS. The GS is then used with the destination distance to determine the ETE. The GS is also used with the entered fuel flow to determine the fuel required. There are 5 lines of information.

- **Lines 1 and 2:** Functional title of the TRI 0 page.
- **Line 3:** Displays the user entered TAS in knots.
- **Line 4:** Displays the user entered wind direction in degrees true north.
- **Line 5:** Displays the wind velocity in knots.

To use this trip page:

1. Display the TRI 0 page on the left screen. Click on the LEFT CURSOR BUTTON and a rectangle will appear behind the first digit of the TAS line (Line 3).
2. Use the LEFT INNER KNOB to change the current value if desired. Use the LEFT OUTER KNOB to change cursor location, and then use the LEFT INNER KNOB to change the value. Repeat this process until all desired numbers have been entered.
3. Click on the LEFT CURSOR BUTTON to exit data entry.

TRIP 1: Trip Planning 1 Page (TRI 1)

Fig5.2

The trip planning 1 page is used to plan a trip directly from your position to any waypoint in the databank. The GS determined by the KLN 90B can be used for calculations on this page, or the user can enter any GS to be used directly. The user enters the destination waypoint, and the unit determines the distance and direction to get there. The user can also enter an estimated fuel flow rate and amount to be held in reserve and the unit will calculate the amount of fuel required to get to the destination. If you choose to enter the GS on this page yourself, you do not have to enter any values on the TRI 0 page.

There are 6 Lines of information.

- **Line 1:** Display to show the planned trip goes from your present position to a specific waypoint. The waypoint is listed on the right side of the line. In the figure above the waypoint is KPHX.
- **Line 2:** Displays the distance in nm (left side) and the direction in degrees magnetic north (right side) to the entered destination waypoint.
- **Line 3:** Displays the GS in knots (left side) and the time enroute in an hh:mm format to the entered waypoint.
- **Line 4:** Displays the user entered fuel flow rate in gallons per hour.
- **Line 5:** Displays the user entered amount of fuel to be used as a reserve in gallons. The amount of fuel in reserve is added to the amount required.
- **Line 6:** Displays the amount of fuel required for the trip in gallons.

To use this trip planning page:

1. Display the TRI 1 page on the left screen. Click the RIGHT INNER KNOB to the "in" position and then click the RIGHT CURSOR BUTTON.
2. Next click on the LEFT CURSOR BUTTON and a blinking rectangle will appear behind the waypoint annunciation.
3. Click on the right side of the RIGHT INNER KNOB to activate data entry. Use the RIGHT INNER KNOB or the keyboard to enter the destination waypoint ICAO identifier code.

4. Click on the ENTER BUTTON 3 times to enter the waypoint.
5. Now click on the LEFT CURSOR BUTTON to enter the remaining data. A rectangle will be present behind the first digit of the GS data field (left side of Line 3) at this time.
6. Use the LEFT INNER KNOB to change the current value if desired. Use the LEFT OUTER KNOB to change cursor location, and then use the LEFT INNER KNOB to change the value. Repeat this process until all desired numbers have been entered.
7. Click on the LEFT CURSOR BUTTON to exit data entry. The unit will now display the ETE and fuel required for the trip based on the data entered.

TRIP 2: Trip Planning 2 Page (TRI 2)

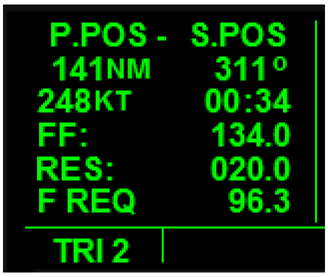


Fig5.3

The trip planning 2 page displays the same type of information as the TRI 1 page, however on this page you can plan a trip from your present position to anywhere in the world. Unlike on the TRI 1 page, you enter the distance and direction to a destination point instead of a waypoint. The KLN 90B then calculates the information based on the entered data. If you set the GS or fuel flow on the TRI 1 page, they will be displayed when you enter this page and can be used in the calculations, or you can enter different values directly. If you choose to enter the GS on this page yourself, you do not have to enter any values on the TRI 0 page. There are 6 Lines of information.

- **Line 1:** Display to show the planned trip goes from your present position to a set position. The annunciation "S.POS" listed on the right side of the line stands for "set position", and indicates this is the TRI 2 page.
- **Line 2:** Displays the distance in nm (left side) and the direction in degrees magnetic north (right side) to the entered destination point.
- **Line 3:** Displays the GS in knots (left side) and the time enroute in an hh:mm format to the entered point.
- **Line 4:** Displays the user-entered fuel flow rate in gallons per hour.
- **Line 5:** Displays the user-entered amount of fuel to be used as a reserve in gallons. The amount of fuel in reserve is added to the amount required.
- **Line 6:** Displays the amount of fuel required for the trip in gallons.

To use this trip planning page:

1. Display the TRI 2 page on the left screen. Click on the LEFT CURSOR BUTTON and a rectangle will appear behind the first digit of the GS display on line 3.

2. Use the LEFT INNER KNOB to change the current value if desired. Use the LEFT OUTER KNOB to change cursor location, and then use the LEFT INNER KNOB to change the value. Repeat this process until all desired numbers have been entered.
3. Click on the LEFT CURSOR BUTTON to exit data entry. The unit will now display the ETE and fuel required for the trip based on the data entered.

MOD: MODE PAGES

The primary use of the mode pages is to switch navigation modes between LEG and OBS modes. In the LEG mode, the KLN 90B tracks the course laid out in the GPS flight plan, including automatic sequencing of waypoints and Direct-To navigation. In the OBS mode, the KLN 90B interfaces with the EFIS and tracks the navigation type chosen with the EFIS. Another use of the mode pages is to change the CDI scale factor. Choices are 5, 1, and 0.2 nm to the left or right of the desired track, the default setting is 5 nm. This includes all CDI scales on the panel gauges. If a CDI scale has 5 markers, then the default scale value is 1 nm per mark. If the scale factor is set to 1 nm, then each mark is 0.2 nm, and if set to 0.2 nm, each mark is 0.04 nm. There are 2 mode pages, the LEG and the OBS pages, and the CDI scale factor can be set on either page. Both the LEG and OBS modes have a Direct-To function which allows the user to track directly to a destination. In the LEG mode tracking is to a waypoint (discussed in the Direct-To section), and in the OBS mode it is to a station (MOD 2 section).

MODE 1: Mode 1 Page (MOD 1)

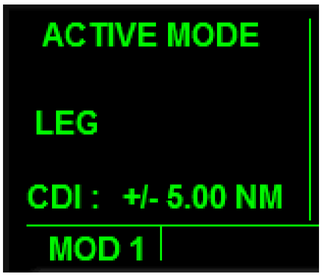


Fig6.1

The mode 1 page is used to set the navigation type to the LEG mode. The mode 1 page is the default page, and the navigation type is automatically the LEG mode when on this page. **Fig6.1** shows an example of the MOD 1 page with the CDI scale set to +/- 5 nm. There are 3 Lines of information.

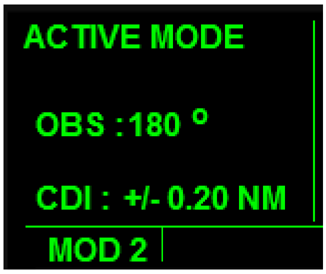
- **Line 1:** Indicates the LEG mode (MOD 1) is the active mode.
- **Line 2:** Indicates that it is the LEG mode that is the active mode.
- **Line 3:** Displays the user entered CDI scale factor. Choices include 5, 1, and 0.2 nm off the desired track.

To use this mode page:

1. Display the MOD 1 page on the left screen. Click on the LEFT CURSOR BUTTON and a long rectangle will appear behind the scale factor value on Line 3.
2. Use the LEFT INNER KNOB to toggle between the 3 choices.

3. Click on the LEFT CURSOR BUTTON to exit data entry. The unit will display the CDI scale factor entered and the scale will change on all CDIs.

MODE 2: Mode 2 Page (MOD 2)



The mode 2 page is used to set the navigation type to the OBS mode. The OBS is not set until the ENTER BUTTON is clicked. **Fig6.2** shows an example of the MOD 2 page with the CDI scale set to +/- 5 nm and the OBS not yet activated. **Fig6.3** shows an example of the MOD 2 page with the CDI scale set to +/- 0.2 nm and the OBS mode activated. The OBS direction displayed in the middle line corresponds to the navigation type chosen with the EFIS. The choices are Nav1, Nav2, and ADF1; the active source is annunciated on the left side of the EFS 50. The ENR-LEG annunciation on Line 3 of the Super Nav 5 page will change to annunciate the word OBS when in the OBS mode, and the ENR-LEG annunciation in the long rectangle at the bottom will change to ENR: xyz, where "xyz" is the OBS heading to track in degrees magnetic north.

There is also an OBS Direct-To feature available from this page. If the Direct-To BUTTON is clicked when in the OBS mode on the MOD 2 page, the aircraft will track directly to the signal in the heading displayed on Line 2, and will not respond to changes made using the COURSE SELECT KNOB. In the OBS Direct-To mode, the ENR: 123 annunciation will change to "D--> CRS 123". There are 3 lines of information.

- **Line 1:** Prompts the user to click on the ENTER BUTTON to activate the OBS mode. Also indicates when the OBS mode is active.
- **Line 2:** Indicates the OBS mode is the active mode, and displays the heading to the received signal in degrees magnetic north.
- **Line 3:** Displays the user-entered CDI scale factor. Choices include 5, 1, and 0.2 nm off the desired track.

To use this mode page:

1. Display the MOD 2 page on the left screen. Click on the LEFT CURSOR BUTTON
2. and a long rectangle will appear behind the scale factor value on the bottom line.
3. Use the LEFT INNER KNOB to toggle between the 3 choices.
4. Click on the LEFT CURSOR BUTTON to exit data entry. The unit will display the
5. CDI scale factor entered and the scale will change on all CDIs.

6. Click on the ENTER BUTTON to activate the OBS mode.
7. Click 3 times on the DIRECT-TO BUTTON to enter the OBS Direct-To mode.
8. To exit the OBS Direct-To mode, go back to the MOD 1 page by clicking on the left side of the LEFT INNER KNOB (letter C).

FPL: FLIGHT PLAN PAGE

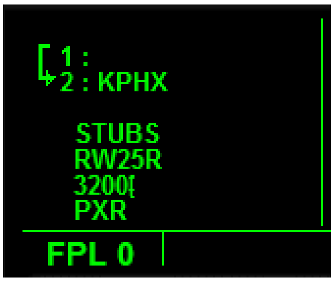


Fig 7.1

The flight plan page is used to display information specific to the active flight plan. This information includes a list of the waypoints, numbered in numerical order, with an arrow to indicate the current active waypoint. If an approach has been loaded, the FPL 0 page also displays the approach waypoints and an arrow to show the active leg. The same information is displayed if the flight plan is Direct-To, except the starting location is not annunciated (see Line 1 in **Fig 7.1**). The data displayed on the FPL 0 page is information only, so you cannot change any data on this page. All flight planning is done through the FS9 Flight Planner via the drop-down box (FLIGHTS-->Flight Planner). There is only 1 flight plan page, and the number of lines of information is variable.

- **Upper Lines:** The upper lines of the FPL 0 page identify the enroute waypoint legs. The enroute waypoint legs are distinguishable by listing a numerical value of each waypoint according to their order in the active flight plan. The arrow indicates the current active flight plan leg.
- **Lower Lines:** The lower lines of the FPL 0 page identify the approach legs. The approach legs do not have a numerical value displayed with them, but they are listed in order of approach. The arrow indicates the current active approach leg.

The FLP 0 page has a scrolling feature to enable viewing of all listed waypoints. Click on the right cursor button when on the FPL 0 page and a rectangle appears behind the waypoint listed in line 1. Use the RIGHT OUTER KNOB to scroll up and down through the waypoints, the rectangle will move up and down accordingly. Note that this function will cause the current D/T page to be displayed on the right screen.

NAV: NAVIGATION PAGES (right screen)

The right group navigation pages viewed on the right side screen contain all the same information as the left group navigation pages. However, there are 2 differences: with the right group pages you use the right buttons and knobs to enter data on the NAV 4 page for vertical navigation. The sequence and usage is the same. The other difference is that the RIGHT CURSOR BUTTON must be clicked in order to change the range factor of the moving map, which is done as before using the LEFT INNER KNOB. If the left NAV page is set to NAV 5, zooming on the right screen map will cause the NAV 1 page to be displayed on the left.

APT: AIRPORT PAGES

The airport pages contain more information than any of the other Page Group pages. There are 8 airport pages that contain information about airport longitude and latitude, elevation, approach types available, runway lengths and directions, COM and NAV frequencies, and available services. The airport pages are also used to choose, load, and activate an approach. In addition, there are 9 nearest airport pages containing information such as longest runway length, direction to or from, and distance. The frequencies page, APT 4, is the default screen displayed when the unit is powered up, and lists the various frequencies of the current airport location for easy access.

APT 1: Airport 1 Page (APT 1)

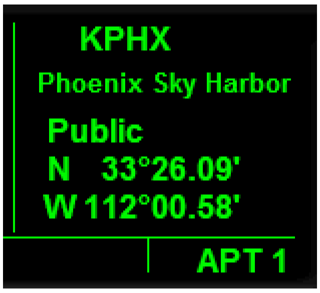


Fig8.1

The airport 1 page displays information specific to the user-entered airport listed in the top line. The user can enter the ICAO code for any airport in the data bank at any time regardless of the flight navigation status. Information includes the airport name, type, and latitude and longitude. There are 5 lines of information.

- **Line 1:** Displays the user-entered ICAO code of the airport desired.
- **Line 2:** Displays the chosen airport name.
- **Line 3:** Displays the chosen airport type. Choices include public, military, and private.
- **Line 4:** Displays the chosen airport latitude.
- **Line 5:** Displays the chosen airport latitude.

To use this airport page:

1. Display the APT 1 page on the right screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO code name.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

APT 2: Airport 2 Page (APT 2)

Fig 8.2

The airport 2 page displays the city name, elevation, hours relative to Zulu time, best approach type, and radar capability of the user entered airport. There are 5 lines of information.

- **Line 1:** Displays the user-entered ICAO code of the airport desired.
- **Line 2:** Displays the chosen airport city name.
- **Line 3:** Displays the chosen airport elevation in ft.
- **Line 4:** Displays the time offset relative to Zulu time.
- **Line 5:** The left side of the line displays the best approach type for the airport chosen. The right side of the line indicates if the chosen airport has radar capability. YES or NO is displayed.

To use this airport page:

1. Display the APT 2 page on the right screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO code name.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

APT 3: Airport 3 Page (APT 3)

Fig 8.3

Fig 8.4

The airport 3 page is used to display runway information for the user-selected airport. There are 2 screens of information. **Fig. 8.3** shows an example of the default screen when you first open the APT 3 page, and **Fig. 8.4** shows an example of the second screen. The default screen displays the runways of the selected airport in a north/south orientation. The name of the airport, its elevation, runway length, and Center frequency are also displayed on the screen. The second screen displays information about one specific runway at a time. The information includes specific runway information for the selected airport such as direction orientation, lighting, length, and surface type. The runways available at any selected airport can be viewed and selected for display from the second page via a popup window. The default screen displays the longest runway. The discussion immediately below refers to the information displayed on the second screen (**Fig. 8.4**).

- **Line 1:** Displays the airport identifier code.
- **Line 2:** The left side of this line displays the magnetic orientation of the runway in degrees magnetic north. The right side of the line displays runway lighting information. The choices and their annunciations are as follows:
    - blank -no runway lighting
    - L -lighting from sunset to sunrise
    - LPC -lighting is pilot controlled
    - LPT -lighting is part-time or on request
- **Line 3:** The left side of line 3 displays the runway length in ft. The right side displays the surface type of the runway. The choices and their annunciations are as follows:
    - HRD -hard surfaces (asphalt, concrete, tarmac, brick and bitumen)
    - TRF -turf
    - DRT -dirt
    - GRV -gravel
    - SND -sand
    - ICE -ice
    - MAT -steel matting
    - SHL -shale
    - SNW -snow
    - Blank -runway surface type unknown

To use this airport page:

1. Display the APT 3 page on the right screen. The first screen, or default screen, is displayed. Zoom in or out by clicking on the LEFT CURSOR BUTTON and then using the LEFT INNER KNOB to zoom in (letter J) or out (letter I).
2. Click the RIGHT INNER KNOB to the in position, and then click on its right side (letter H) to display the second screen.
3. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") on Line 1.
4. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO code name.
5. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
6. To view all runways present, click on the RIGHT OUTER KNOB to change the data entry field so the rectangle covers the runway orientation display (left side of Line 2).
7. Now click on the RIGHT INNER KNOB to view the popup screen, and then to scroll through the runways to choose one for display.
8. Click the ENTER BUTTON twice to exit data entry and go back to the second screen.
9. Click the left side of the RIGHT INNER KNOB (letter G) to go back to the default screen.
10. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

APT 4: Airport 4 Page (APT 4)

Fig.8.5

The airport 4 page is used to display communication frequencies for the selected airport. The KLN 90B displays the frequencies of the current airport on the airport 4 page at start-up so the user can obtain the needed information without changing data. Frequencies displayed include approach, ATIS, tower, ground, center, departure, clearance, UNICOM, FSS, and ILS frequencies. There are multiple lines of information depending on the chosen airport.

- **Line 1:** Displays the user-selected airport identifier code.
- **Lines 2…:** Multiple lines displaying the communications frequencies of the user selected airport. The frequency type is listed on the left side of the screen, and the corresponding frequencies are listed on the right.

To use this airport page:

1. Display the APT 4 page on the right screen to view the information.
2. To display information for a different airport, click the RIGHT INNER KNOB to the in position.
3. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") on Line 1.
4. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO code name.
5. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
6. Click 2 times on the ENTER BUTTON to exit data entry, or 1 time to allow for scrolling through the different frequencies of the selected airport. If the ENTER BUTTON is clicked once; the rectangle behind the airport identifier will stop blinking.
7. Use the RIGHT OUTER KNOB to scroll through all frequencies available.
8. Use the CLR or ENTER BUTTON to exit scrolling. The rectangle will disappear.

APT 5: Airport 5 Page (APT 5)

Fig 8.6

The airport 5 page is currently UNAVAILABLE.

APT 6: Airport 6 Page (APT 6)

Fig 8.7

The airport 6 page is used to display the fuel services available at a user-selected airport. The lines of information depend on the available fuel services.

- **Line 1:** Displays the user selected airport ICAO identifier code.
- **Lines 2-:** Displays the available fuel services.

To use this airport page:

1. Display the APT 6 page on the left screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO identifier.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

APT 7: Airport 7 Page (APT 7)

Fig 8.8

The airport 7 page is used to display SID/STAR procedures in real life. In FSX, except for Direct-To, all flight planning is done through the FSX Flight Planner pages. These pages are accessible through the drop down bar: Flights -> Flight Planner.

APT 8: Airport 8 Page (APT 8)

Fig 8.9

Fig 8.10

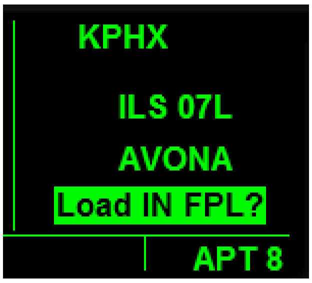


Fig 8.11

The airport 8 page is used to display non-precision approach information for the user-selected airport. This is also the page to load and activate the entered approach. The user enters the desired airport identifier code, and then chooses the various approaches available for the selected airport. These changes will be shown on the FPL 0 page. There are 4 lines of information.

- **Line 1:** Displays the user-selected airport identifier.
- **Lines 2 and 3:** Displays the user-selected approach procedures.
- **Line 4:** Display to indicate the approach choices can be entered into the flight plan. The line will display the word "ACTIVATE?" if the approach has been entered, and activation can begin.

To use this airport page:

1. Display the APT 8 page on the left screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the airport ICAO (or "----") in Line 1. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO identifier.
3. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
4. Click the ENTER BUTTON twice to exit data entry and go back to the default screen, or click once to allow for scrolling through the approach choices.
5. If the airport identifier has a rectangle behind it, clicking on the RIGHT OUTER KNOB will change data entry fields in the default screen. Clicking on the RIGHT INNER KNOB will bring up a popup screen listing the approach choices (**Fig 8.10**). Repeated clicks on the RIGHT INNER KNOB will scroll through the choices. Clicking on the ENTER BUTTON will enter the data into the flight plan.
6. Repeat the procedure listed in Line 6 until all information has been entered. When the ENTER BUTTON has been clicked to enter the last data, you are being prompted to decide if you want to load the information into the flight plan (**Fig8.11**). If you are ready, click the ENTER BUTTON again.
7. The chosen approach can be loaded or activated at any time by clicking the RIGHT
8. INNER KNOB to the in position, clicking on the RIGHT CURSOR BUTTON, and then clicking on the RIGHT OUTER KNOB until Line 4 is reached to display the prompt "Load in FPL?" or "ACTIVATE". Clicking on the ENTER BUTTON at this time will enter the choice.
9. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

NEAREST Airport Pages

Fig 8.12

The nearest airport pages display information about the 9 airports nearest to your current location in order of their nearness. An example of the nearest airport page 3 is presented in **Fig 8.12** showing the display format used on all 9 nearest airport pages. These pages are always updating so the airports and their order will always be current.

The information on the nearest pages are "read only", they cannot be changed directly by the user. There are 4 lines of information.

- **Line 1:** The left side of Line 1 displays the airport identifier code. The right side displays the nearest airport page; shown as a boxed display. In **Fig 8.12** the box displays NR 3, indicating the viewed page contains information relating to the 3rd nearest airport to your current location.
- **Line 2:** Displays the length in ft of the longest runway at the user-selected airport.
- **Line 3:** Displays the bearing to or from the airport from your current location in degrees magnetic north. To and FR annunciations on the right of the line shows if to or from the nearest airport.
- **Line 4:** Displays the distance in nm to the user-selected airport.

To view the nearest airport pages:

1. Display the APT 1 page using the RIGHT OUTER and INNER KNOBs. Ensure the RIGHT INNER KNOB is in the out position.
2. Click on the left side of the RIGHT INNER KNOB (letter C) repeatedly to scroll down the nearest airport list. The list is scrolled upwards by clicking on the right side of the RIGHT INNER KNOB (letter D).
3. Clicking on the right side of the RIGHT INNER KNOB when the NR 1 page is displayed takes you back to the APT 1 page.

VOR: VOR Page

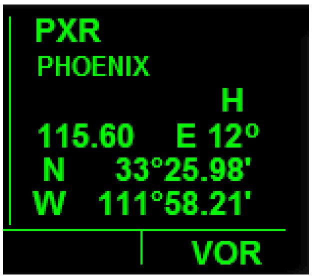


Fig 9.1

The VOR page provides the user with the ability to view information about any VOR in the data bank. The desired VOR is entered by the user and the KLN 90B displays the name, type, frequency, magnetic variation, and latitude and longitude of the VOR. There are 6 lines of information.

- **Line 1:** Displays the user-entered VOR identifier.
- **Line 2:** Displays the VOR name.
- **Line 3:** Displays the VOR class. The annunciation meanings are listed below:
    - T -Terminal
    - L -Low altitude
    - H -High altitude
    - U -undefined
- **Line 4:** The left side of Line 4 displays the VOR frequency. The right side displays the magnetic variation in degrees.
- **Line 5:** Displays the VOR latitude.
- **Line 6:** Displays the VOR longitude.

To use this VOR page:

1. Display the VOR page on the right screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the VOR identifier (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO identifier.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

NEAREST VOR Pages

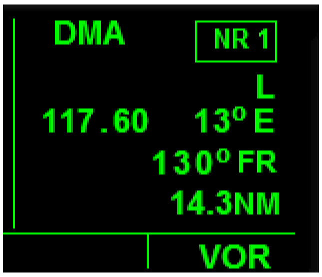


Fig9.2

The nearest VOR pages display information about the 9 VORs nearest to your current location in order of their nearness. An example of the nearest VOR page 1 is presented in **Fig9.2** showing the display format used on all 9 nearest VOR pages. These pages are always updating so the VORs and their order will always be current. The information on the nearest pages are "read only", they cannot be changed directly by the user. There are 4 lines of information.

- **Line 1:** The left side of the line displays the VOR identifier, and the left side displays a boxed presentation of the nearest page number.
- **Line 2:** Displays the VOR class. Annunciation definitions are the same as on the primary VOR page.
- **Line 3:** The left side of this line displays the VOR frequency. The right side displays the VOR magnetic variation.
- **Line 4:** The left side of Line 4 displays the VOR frequency. The right side displays the
- magnetic variation in degrees, and shows if the station is "TO" or "FROM" your location.
- **Line 5:** Displays the VOR latitude.
- **Line 6:** Displays the VOR longitude.

To view the nearest VOR pages:

1. Display the VOR page using the RIGHT OUTER and INNER KNOBs. Ensure the RIGHT INNER KNOB is in the out position.
2. Click on the left side of the RIGHT INNER KNOB (letter C) repeatedly to scroll down the nearest VOR list. The list is scrolled upward by clicking on the right side of the RIGHT INNER KNOB (letter D).
3. Clicking on the right side of the RIGHT INNER KNOB when the NR 1 page is displayed takes you back to the VOR page.

NDB: NDB Page

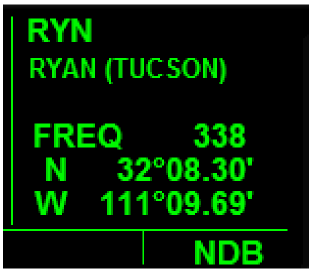


Fig10.1

The NDB page provides the user with the chance to view information about any NDB in the data bank. The desired NDB is entered by the user and the KLN 90B displays the name, type, frequency, magnetic variation, and latitude and longitude of the NDB. There are 5 lines of information.

- **Line 1:** Displays the user-entered NDB identifier.
- **Line 2:** Displays the user-entered NDB name.
- **Line 3:** Displays the frequency of the user-selected NDB.
- **Line 4:** Displays the NDB latitude.
- **Line 5:** Displays the NDB longitude.

To use the NDB page:

1. Display the NDB page on the right screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the NDB identifier (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO identifier.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

NEAREST NDB Pages

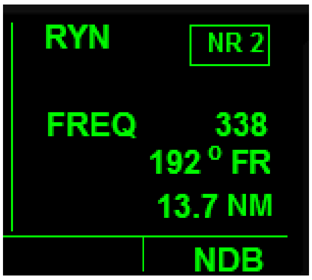


Fig10.2

The nearest NDB pages display information about the 9 NDBs nearest to your current location in order of their nearness. An example of the nearest NDB page 2 is presented in **Fig10.2** showing the display format used on all 9 nearest NDB pages. These pages are always updating so the NDBs and their order will always be current. The information on the nearest pages are "read only", they cannot be changed directly by the user. There are 4 lines of information.

- **Line 1:** The left side of the line displays the NDB identifier, and the left side displays a boxed presentation of the nearest page number.
- **Line 2:** Displays the frequency of the user-selected NDB.
- **Line 3:** Displays the bearing to or from the selected NDB station in degrees magnetic north.
- **Line 4:** Displays the distance to or from the NDB station in nm.

To view the nearest NDB pages:

1. Display the NDB page using the RIGHT OUTER and INNER KNOBs. Ensure the RIGHT INNER KNOB is in the out position.
2. Click on the left side of the RIGHT INNER KNOB (letter C) repeatedly to scroll down the nearest airport list. The list is scrolled upward by clicking on the right side of the RIGHT INNER KNOB (letter D).
3. Clicking on the right side of the RIGHT INNER KNOB when the NR 1 page is displayed takes you back to the NDB1 page.

INT: INTERSECTION PAGE

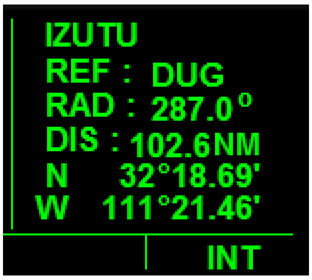


Fig 11.1

The intersection page displays pertinent information about an intersection selected by the user. This includes low altitude, high altitude, approach, and SID and STAR intersections. It also includes outer marker and compass locators, and displays the radial and distance to or from the intersection. There are 6 lines of information.

- **Line 1:** Displays the intersection, outer marker, or outer compass locator name.
- **Line 2:** Displays the identifier code of the intersection, outer marker, or outer locator.
- **Line 3:** Displays the radial to or from the intersection, outer marker, or outer locator in degrees.
- **Line 4:** Displays the distance to the intersection, outer marker, or outer locator in nm.
- **Line 5:** Displays the latitude of the selected intersection.
- **Line 6:** Displays the longitude of the selected intersection.

To use the intersection page:

1. Display the intersection page on the right screen. Click the RIGHT INNER KNOB to the in position.
2. Click on the RIGHT CURSOR BUTTON and a blinking rectangle will appear behind the intersection name (or "----") on Line 1.
3. Click on the right side of the RIGHT INNER KNOB (Letter H) to activate data entry. A blinking rectangle will now be present behind the first digit of the airport ICAO identifier.
4. Use the RIGHT INNER KNOB, or keyboard, to enter the desired ICAO code.
5. Click the ENTER BUTTON twice to exit data entry and go back to the default screen.
6. Clicking on the CLR BUTTON at any time will exit the data entry mode without entering any newly added data.

SUPL: SUPPLEMENTAL PAGE (SUP)

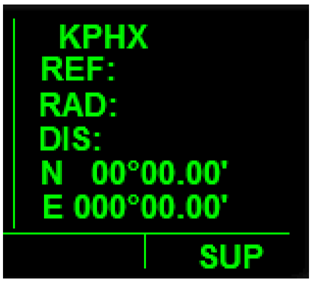


Fig 12.1

Fig 12.1 shows the display format for the supplemental waypoint page. Supplemental waypoints are user-defined waypoints other than airport, VOR, or NDB waypoints. Clicking on the RIGHT CURSOR BUTTON while on this page will direct you to the FS9 Flight Planning page.

CTR: CENTER WAYPOINT PAGE

Fig 13.1

Fig 13.2

The center 1 page is used to add center waypoints to a flight plan. Center waypoints are waypoints located at the intersection of a flight plan and the boundary of air traffic control centers or area control centers. Except for a Direct-To flight plan, all other flight planning is done on the FS9 / FSX

Flight Planner page. The default screen is shown in **Fig 13.1**, and **Fig 13.2** shows the display when the FPL 0 page is opened.

REF: REFERENCE WAYPOINT PAGE

Fig14.1

The reference waypoint page is used to add reference waypoints to a flight plan. Reference waypoints are waypoints that lie on the "great circle" route where the flight plan route passes closest to the selected point. All waypoint entries, except Direct-To, are set on the FS9 Flight Planning page.

ACTV: ACTIVE WAYPOINT PAGE (ACT)

Fig14.1

The active waypoint page displays information specific to the next waypoint of a flight plan. This page allows the user to view pertinent navigational information specific to the next active waypoint, regardless of waypoint type, without further user input. The next waypoint can be of any type including airport, VOR, NDB, or intersection waypoints. **Fig14.1** shows a typical ACT page (right screen). All of the information displayed on this screen will change to the next active waypoint as each leg of the flight plan changes. This page contains 5 lines of information.

- **Line 1:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the next active waypoint.
- **Line 2:** The left side of this line displays the distance to the next active waypoint in nm. The right side displays the magnetic bearing to the next active waypoint in degrees.

- **Line 3:** The left side of this line displays the time to the next active waypoint with the current flight conditions. The format is hrs:min. The right side of the line shows the CourseTo Steer to the next active waypoint in degrees magnetic north.
- **Line 4:** Displays the latitude of the next active waypoint.
- **Line 5:** Displays the longitude of the next active waypoint.

D/T: DISTANCE/TIME PAGES

As the name implies, the D/T pages provide information about the distance and time between active legs of a flight plan, and between any position on the flight plan to the destination waypoint. Both the ETE and the ETA are displayed on these pages. There are 4 D/T pages. The D/T pages are designed to be viewed in conjunction with flight plan information, and as such the first 3 D/T pages are displayed in a different format when the FPL 0 page is open at the same time on the left screen. There is no data entry on the D/T pages.

D/T 1: DISTANCE/TIME 1 PAGE (D/T 1)

Fig15.1

The distance/time 1 page is used to display the distance and time to the next active waypoint, and to the destination waypoint. In addition, the waypoint identifier and the sequential number of each waypoint are listed for easy reference. **Fig15.1** shows an example of the default D/T 1 page. There are 6 lines of information.

- **Line 1:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the next active waypoint.
- **Line 2:** Displays the distance to the next active waypoint in nm.
- **Line 3:** Displays the time to the next active waypoint under the current flight conditions. The format is hrs:min.
- **Line 4:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the destination waypoint.
- **Line 5:** Displays the distance to the destination waypoint in nm.
- **Line 6:** Displays the time to the destination waypoint with the current flight conditions. The format is hrs:min.

D/T PAGE 1 WITH FLP 0:

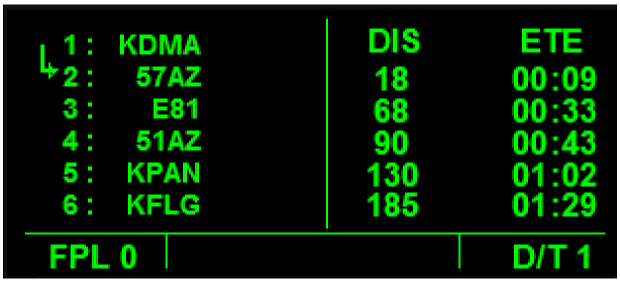


Fig15.2

The format displayed on the D/T 1 page when the FPL 0 page is open simultaneously on the left screen is shown in **Fig15.2**. The distance and ETE information on the D/T 1 page is listed in order of the distance to the destination waypoint, and corresponds to the order displayed on the FPL 0 page. The first line on the D/T 1 page with distance and ETE information will always correspond to the next active waypoint leg and will be indicated by the arrow on the FPL 0 page; as you pass a waypoint leg, the corresponding information displayed on the D/T 1 page will disappear. There are 2 columns of information.

- **Left Column:** Displays the distance to the corresponding waypoint of the flight plan in nm.
- **Right Column:** Displays the ETE to the corresponding waypoint of the flight plan in an hrs:min format.

D/T 2: Distance/Time 2 Page (D/T 2)

Fig15.3

The distance/time 2 page is used to display the distance and arrival time to the next active waypoint and to the destination waypoint. In addition, the waypoint identifier and the sequential number of each waypoint are listed for easy reference. **Fig15.3** shows an example of the default D/T 2 page. There are 6 lines of information.

- **Line 1:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the next active waypoint.
- **Line 2:** Displays the distance to the next active waypoint in nm.
- **Line 3:** Displays the estimated arrival time to the next active waypoint under the current flight conditions. The format is hrs:min.
- **Line 4:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the destination waypoint.
- **Line 5:** Displays the distance to the destination waypoint in nm.
- **Line 6:** Displays the estimated arrival time to the destination waypoint under the current flight conditions. The format is hrs:min.

D/T PAGE 2 WITH FLP 0:

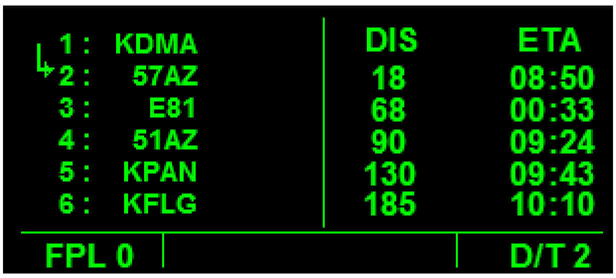


Fig 15.3

The format displayed on the D/T 2 page when the FPL 0 page is open simultaneously on the left screen is shown in **Fig 15.3**. The distance and ETA information on the D/T 2 page is listed in order of the distance to the destination waypoint, and corresponds to the order displayed on the FPL 0 page. The first line on the D/T 2 page with distance and ETA information will always correspond to the next active waypoint leg and will be indicated by the arrow on the FPL 0 page; as you pass a waypoint leg, the corresponding information displayed on the D/T 2 page will disappear. There are 2 columns of information.

- **Left Column:** Displays the distance to the corresponding waypoint of the flight plan in nm.
- **Right Column:** Displays the ETA at the corresponding waypoint of the flight plan in an hrs:min format.

D/T 3: Distance/Time 3 Page (D/T 3)

Fig15.5

The distance/time 3 page is used to display the distance and bearing to the next active waypoint, and to the destination waypoint. In addition, the waypoint identifier and the sequential number of each waypoint are listed for easy reference. **Fig15.5** shows an example of the default D/T 3 page. There are 6 lines of information.

- **Line 1:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the next active waypoint.
- **Line 2:** Displays the distance to the next active waypoint in nm.
- **Line 3:** Displays the bearing to the next active waypoint with the current flight conditions.
- **Line 4:** The number on the left side of the line is the sequential waypoint number, and to the right of it is the waypoint identifier of the destination waypoint.
- **Line 5:** Displays the distance to the destination waypoint in nm.
- **Line 6:** Displays the bearing to the destination waypoint under the current flight conditions.

D/T PAGE 3 WITH FLP 0:

Fig15.6

The format displayed on the D/T 3 page when the FPL 0 page is open simultaneously on the left screen is shown in **Fig15.6**. The distance and ETA information on the D/T 3 page is listed in order of the distance to the destination waypoint, and corresponds to the order displayed on the FPL 0 page. The first line on the D/T 3 page with distance and bearing information will always correspond to the next active waypoint leg and will be indicated by the arrow on the FPL 0 page; as you pass a waypoint leg, the corresponding information displayed on the D/T 3 page will disappear. There are 2 columns of information.

- **Left Column:** Displays the distance to the corresponding waypoint of the flight plan in nm.
- **Right Column:** Displays the bearing to the corresponding waypoint of the flight plan in degrees magnetic north.

D/T 4: Distance/Time 4 Page (D/T 4)

Fig 15.7

The D/T 4 page displays time information regarding the entire flight to the destination waypoint. This includes the time when departing the initial airport, the local time, the flight time, the estimated time enroute to the destination waypoint, and the time of arrival at the destination waypoint. The time format is hrs:mins. There are 6 lines of information.

- **Line 1:** The left side of line 1 displays the destination waypoint identifier. The right

- display indicates the times in the column below it are local mean times.
- **Line 2:** Displays the departure time from the initial airport. Departure time is taken as the time when the aircrafts GS reaches 30 knots.
- **Line 3:** Displays the local time.
- **Line 4:** Displays the estimated time of arrival at the destination waypoint.
- **Line 5:** Displays the flight time. The time when the flight timer starts is set on the SET 4 page. The choices are to start the timer when the unit is turned on (the default choice), or to start the timer when the GS reaches 30 knots.
- **Line 6:** Displays the estimated time enroute to the destination waypoint.

MESSAGE PAGE

The following discussion is about the functions associated with the message

(MSG), altitude alert (ALT), and Direct-To (-D->) buttons.

MESSAGE PAGE: MSG Button

Fig 16.1

Fig 16.2

The message page is used to alert the pilot of a situation that may require their attention. When the KLN 90B has an alert message to be displayed, the letters "MSG" will appear on the right side of the long rectangular box, just below the display screens, with a blinking rectangle behind it (**Fig 16.1**). Clicking on the MSG BUTTON at this time will display the alert message over the entire screen as shown in **Fig. 16.2**. Click the MSG BUTTON a second time to exit the message screen. To turn messaging off, click and hold the MSG BUTTON down for several seconds. No annunciation is displayed if messaging is turned off.

ALTITUDE ALERT PAGE: ALT Button

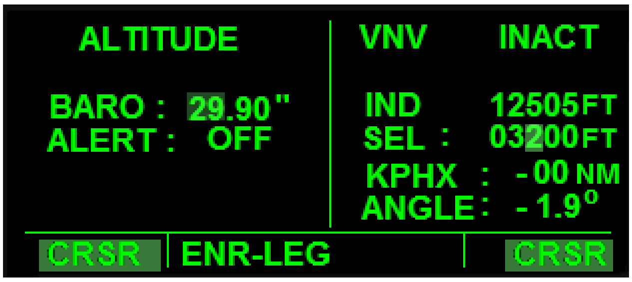


Fig17.1

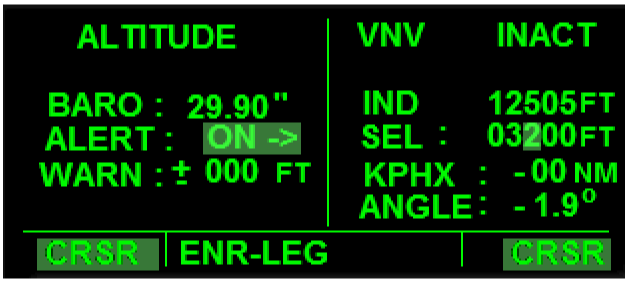


Fig 17.2

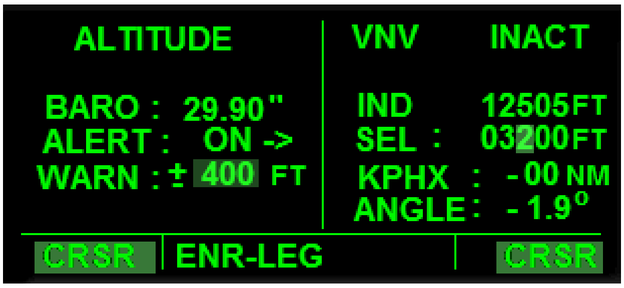


Fig 17.3

The altitude alert page is used in conjunction with the SEL field of the NAV 4 page to alert the pilot when the aircraft has reached a specified number of feet above a pre-selected altitude. Clicking on the ALT BUTTON will display the altitude alert page on the left screen and the NAV 4 page on the right screen as shown in **Fig17.1**. The number of feet above the altitude is entered on the altitude alert page and the selected alert altitude is entered on the NAV 4 page. Only the SEL altitude field is used on the NAV 4 page, the rest are used in vertical navigation. **Fig17.1** shows the default screen with both cursors on and rectangles highlighting data entry fields that are ready to be changed. The altitude alerting feature is also turned on and off on this page. The current barometric pressure is displayed when this page is opened (default), and if it is not changed it will be used in altitude calculations. There are 4 lines of information on the altitude alert page.

- **Line 1:** Display showing the page viewed is the altitude alert page.
- **Line 2:** Displays the user-entered barometric pressure in inches of Hg.
- **Line 3:** Displays the on/off status of the altitude alert feature. When turned on, the information in Line 4 is displayed.
- **Line 4:** Displays the user entered feet above the altitude, selected on the NAV 4 page, to be notified.

To use the altitude alert page:

1. Click on the ALT BUTTON to display the altitude alert page on the left screen and the NAV 4 page on the right screen.
2. Click on the LEFT CURSOR BUTTON and a rectangle will appear behind the first 2 digits of the barometric pressure on the altitude alert page and the left cursor will be on, indicating data is ready to be entered (**Fig 17.1**).
3. Use the LEFT INNER KNOB to change the first 2 digits to the desired barometric pressure.
4. Click on the LEFT OUTER KNOB to scroll to the next field. Again use the LEFT INNER KNOB to change the value. Repeat the steps again to enter the correct barometric pressure.
5. Click on the LEFT OUTER KNOB again to position the rectangle over the OFF/ON annunciation on Line 3 (**Fig 17.2**). Use the LEFT INNER KNOB to toggle between off and on; off is the default setting. If set to OFF, the information on Line 4 will not be displayed.
6. If the altitude alert feature is turned ON, click on the LEFT OUTER KNOB to position the rectangle over the number displayed on Line 4 (**Fig17.3**). Use the LEFT INNER KNOB to change the value.
7. To enter the selected altitude on the NAV 4 page, click on the RIGHT CURSOR BUTTON and then use the RIGHT INNER KNOB to enter the value.
8. Click on the ALT BUTTON to exit the altitude alert page at any time. The LEFT OUTER KNOB can be used to scroll forwards or backwards through the data entry fields.
9. When the number of feet above the selected altitude reaches 0, a large red "ALT ALERT" annunciation will be displayed across both screens until the altitude alert feature is either turned off or reset.

DIRECT-TO PAGE

Fig18.1

The Direct-To page is used to enter the Direct-To mode of navigation, whereby the aircraft will start to track directly to the waypoint selected on this page. The Direct-To mode can be entered regardless of whether a flight plan was previously active or not. Simply click on the DIRECT-TO BUTTON, enter the identifier of the waypoint you want to go to, and the KLN 90B will navigate you there. There is a Direct-To feature for the ENROUTE LEG and OBS modes. As discussed previously, the mode to be used is chosen on the Mode pages.

To use the Direct-To page:

1. Click on the DIRECT-TO BUTTON and the Direct-To page will be displayed on the left screen (**Fig18.1**). A blinking rectangle highlights the waypoint identifier field.
2. Click the RIGHT INNER KNOB to the in position and click once on the RIGHT INNER KNOB to activate data entry. A smaller, blinking rectangle appears behind the first data field to be changed at this time.
3. Use the RIGHT INNER and OUTER KNOBs, or your keyboard, to enter the desired waypoint identifier.
4. Click the ENTER BUTTON 3 times to enter the data and begin tracking to the selected waypoint. The Direct-To page will disappear and the original page will again be displayed on the left screen. The information on the FPL 0 page will change accordingly.

Stichting Exploitatie Catalina PH - PBY

PART B

Aircraft Operating Matters

COPY NUMBER

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TEMPORARY REVISION RECORD

Incorporation of a Temporary Revision to this Manual must be recorded by adding the date and signature in the appropriate column.

TR.No	Date entered	Incorporated by	Date removed
01	25-05-2006		01-04-2006
02			
03			
04			
05			
06			
07			
08			
09			
10			

TEMPORARY REVISION INDEX

Opposite to this page, the latest Temporary Revision Index page (on yellow paper) must be inserted; this page contains the “TR no.”, “Effectivity Date”, “Sections Affected”, “Subject” briefly described and “Status”.

REVISION RECORD

Incorporation of a Revision to this Manual must be recorded by adding the date and signiture in the appropriate column.

Revision N°	Date entered	Incorporated by
00	18-05-2004	SEC
01	25-05-2005	SEC
02	01-04-2006	SEC
03		
04		
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REASON FOR REVISION RECORD

Listed is the Revision to this Manual, the Reason for issue of the Revision and the Section involved.

Rev. No	Reason for Issue	Section
00	Initial issue	All
01	Max TOM Change to 11.999kg incorporation of water supplement	1,6 App A
02	Water Ops ,Edditorial, of water supplement	2.3.5, App A
03		

0 ADMINISTRATION AND CONTROL OF OPERATIONS MANUAL

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0.1 ADMINISTRATION AND CONTROL OF OPERATIONS MANUAL

01 INTRODUCTION

The Operations Manual of the Stichting Exploitatie Catalina PH-PBY(further STICAT or Stichting Catalina PH-PBY) is issued in accordance with the Joint Aviation Requirements.

The manual is for the use and guidance of all Flight Department personnel, who are to ensure that all flights are planned and executed in accordance with its policies and requirements.

02 MANUAL SYSTEM

The manual is broadly sub-divided into the following Parts:

Manual System	
Part A	General/Basic Information, Requirements and Operations.
Part B	Aircraft Type Operating Procedures and Requirements.
Part C	Flight Guide (This Part is the botlang route guide)
Part D	Training Manual
Part E	Cabin crew procedures and Instructions

Where necessary, specific terms are defined at the beginning of the sections to which they are appropriate.

03 INTERPRETATION

For brevity the pronoun ‘he’ is used throughout Parts A, B, C. D and E. Where appropriate, the pronoun ‘she’ should be inferred or assumed.

04 AMENDMENT AND REVISION

The Operations Manual is issued on the authority of Stichting Catalina PH-PBY, and the Head flight Department will authorize all amendments to it, as required by Stichting Catalina PH-PBY or by IVW-DL. Any proposed amendment should be forwarded, through Head Flight Department, on an ‘Amendment Proposal Form’ (see overleaf All amendments will be in the form of printed, replacement pages; manuscript amendments are not permitted. Revision pages will be annotated to show the date of issue (and date of effect if different); an amendment list record will be maintained at the front of each manual.

It is a requirement that a copy of the manual is available for carriage in each aircraft. Sufficient additional copies will be provided to ensure that all operating staff has ready access to them when required, and to enable one copy to be lodged with the IVW-DL. An up-to-date list of manuals, together with their copy numbers and their locations, or the name/appointment of the copyholder, as appropriate shall be held. Amendments will be issued to copyholders or nominated individuals who will be required to amend particular number copies. Amendments should be entered on receipt, and the amendment record completed.

05 AMENDMENT PROPOSAL FORM

AMENDMENT PROPOSAL FORM

The following amendment/addition/deletion* is proposed to Part A/B/D/E* Para. .... of the Operations Manual:

*Delete where applicable

PROPOSED AMENDMENT: (continue on separate sheet if necessary)

REASON FOR AMENDMENT

Signature of Proposer:

Position:

Postholder Flight Operations:

Signature:

Authorised by:

Position:

See over for guidelines on the completion of this form.

Amendment Proposal Form (continued)

GUIDELINES ON THE COMPLETION OF THIS FORM

1) Proposed amendments to the Operations Manual will only be considered if submitted on this form.
2) This form should be completed, signed and handed to Manager Flight Operations for comment/approval.

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0.2 LIST OF EFFECTIVE PAGES

Section	Page	RevNo	Date	Section	Page	RevNo	Date
Front		00	18-5-2004	6	1-2	00	18-5-2004
Rev Rec	1- 4	02	1-4-2006	6.1	1	02	1-4-2006
0	1-2	00	18-5-2004	6.1	2-3	00	18-5-2004
0.1	1-4	00	18-5-2004	6.1	4	01	25-5-2005
0.2	1	02	1-4-2006	7	1-2	00	18-5-2004
0.2	2	00	18-5-2004	7.1	1-4	00	18-5-2004
0.3	1-2	00	18-5-2004	8	1-2	00	18-5-2004
0.4	1-6	00	18-5-2004	9	1-2	00	18-5-2004
1.0	1-2	00	18-5-2004	9.1	1-2	00	18-5-2004
1.1	1	01	25-5-2005	9.2	1-22	00	18-5-2004
1.1	2	00	18-5-2004	10.1	1-2	00	18-5-2004
1.2	1	01	25-5-2005	11	1-2	00	18-5-2004
1.2	2-6	00	18-5-2004	12	1-4	00	18-5-2004
1.3	1-2	00	18-5-2004	12.6	1-6	00	18-5-2004
2.0	1-2	00	18-5-2004	12.23	1-2	00	18-5-2004
2.1	1-2	00	18-5-2004	12.24	1-6	00	18-5-2004
2.1	1-6	01	25-5-2005	12.25	1-2	00	18-5-2004
2.2	1-12	01	25-5-2005	12.26	1-2	00	18-5-2004
2.3.1	1-2	00	18-5-2004	12.27	1-4	00	18-5-2004
2.3.2	1-4	01	25-5-2005	12.28	1-4	00	18-5-2004
2.3.3	1-6	01	25-5-2005	12.29	1-4	00	18-5-2004
2.3.4	1-2	01	25-5-2005	12.31	1-4	00	18-5-2004
2.3.5	1-3	01	25-5-2005	12.32	1-4	00	18-5-2004
2.3.5	4-6	02	1-4-2006	12.33	1-2	00	18-5-2004
3.0	1-2	00	18-5-2004	12.34	1-2	00	18-5-2004
3.1	1-18	01	25-5-2005	12.36	1-2	00	18-5-2004
3.2	1-2	00	18-5-2004	12.53	1-4	00	18-5-2004
3.3	1-6	01	25-5-2005	12.61	1-2	00	18-5-2004
4.0	1-2	00	18-5-2004	12.72	1-6	00	18-5-2004
4.1	1-20	00	18-5-2004	12.79	1-4	00	18-5-2004
4.1.1	1-4	00	18-5-2004	App A	1-32	02	1-4-2006
5	1-2	00	18-5-2004				
5.1	1-12	00	18-5-2004				

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0.3 MANUAL BASIS

06 GENERAL

In this paragraph, all the relevant publications with their revision status are listed, which are used to compile this Part A

07 PUBLICATIONS

JAR-OPS 1
ATA Specification 100
Aircraft operating manual ZK-PBY
Aircraft operating manual Enterprise Air inc
PBY Training manual C.Ellsworth
Pratt & Whitney R1830-92 engine operating manual

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0.4 ABBREVIATIONS AND DEFENITIONS

01 ABBREVIATIONS

See part A section 0.4

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SECTION 1 LIMITATIONS

1.1 AIRSPEED LIMITATIONS

1.2 FLYING LIMITATIONS

1.3 POWER PLANT AND INSTRUMENT MARKINGS

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1.1 AIRSPEED LIMITATIONS

01 AIRSPEED LIMITATIONS

1. 2. 3. 4. 5. 6.	Never exceed speed (Vne) Structural cruising speed (Vc) Maximum Float Operating Speed Maximum speed-gear operating (Vlo) Maximum speed with gear extended (Vle) Maximum Maneuvering speed (Va)	173 knots IAS 137 knots IAS 130 knots IAS 122 knots IAS 139 knots IAS 106 knots IAS
7.	Minimum Speed at which airplane is controllable in flight with one engine inoperative, its propeller wind milling, floats and gear up, and other engine at take off power (Vmca)	83 knots IAS
8.	Flap settings Cowl Flaps	There are no wing flaps Cowl Flaps may be controlled as necessary for all airplane operations.

02 STALLING SPEEDS 11999KG (26458 LBS) AUW

Stalling speed aircraft clean throttles closed Stalling speed gear down 2300 APM 12 ins boost Stalling speed floats down 2300 APM 12 ins boost	63.5 kts 55 kts 57 kts

03 OPERATIONAL SPEEDS

Maneuver Speed/Turbulence penetration speed Climb Speed Base leg Speed Minimum Threshold Speed Water "Threshold" speed All single engine operations	106 kts 90-95kts 90 kts 80 kts 73 kts 87 kts

04 CROSS-WIND LIMITATIONS

Critical Cross-Wind Component **15 Kts** demonstrated

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1.2 FLYING LIMITATIONS

01 GENERAL

The aircraft is designed for duty as a general reconnaissance flying boat. Intentional spinning and aerobatics are prohibited. All flying must be In accordance with STICAT rules and procedures.

02 ENGINE LIMITATIONS

Refer to engine operational charts In Section 5.1

03 WAVE HEIGHT LIMITATION

Two feet maximum

04 WEIGHT LIMITS

Take-off	11999 kg (26458 lbs)
Landing	11999 kg (26458 lbs)

05 C OF G LIMITATIONS 11999 KG (26458 IBS) AUW

Forward CG.limit	22.9% MAC (242.2.ins)
Aft C.G.limit	28.5% MAC (251.5 ins)
Datum	3 inches aft of the bow nose

06 LOAD FACTOR LIMITATIONS

26458 lbs AUW	2.9+ve accel, 1.5-ve accel, at 106 kts 175 kts max speed
26458 lbs	3.0+ve accel, 1.5-ve accel, at 106 kts 182 kts max speed
26000lbs	3.2+ve accel, 1.6-ve accel, at 106 kts 190 kts max speed

07 MAXIMUM PASENGERS

Cabin arrangements Allows for 8 seats in Forward and 8 seats in Aft Compartment. One seat is dedicated cabin crew seat. Maximum passengers allowed 15.

08 MAXIMUM PASSENGERS IN BLISTER

During Take-Off and Landing the maximum number of persons in the blister area is one. (1). This person. Is to be a crewmember strapped securely into the side (Inboard) facing seat.
At other times during normal flight the number of persons in the blister area is to be limited to four (4).

09 MINIMUM FLIGHT CREW

Ferry flights only	2		
Land Operations	3	With passengers	3
Water Operations	3	With passengers	3

1. Pilot
2. Co-pilot
3. A third crewmember is required to give assistance with visual gear checks, attend to passengers when carried, and to help when on the water with the security of the aircraft and mooring procedures.

10 APPROVED OPERATIONS

Only VFR operations are approved

11 PROHIBITED IMANOEUVRES

Only normal flight maneuvers are permitted, and these must conform to the 'NORMAL FLIGHT ENVELOPE'.

Special dispensation for stalling practice during conversion training will be given when under instruction and for continuation flying when only the minimum flight crew is on board.

Inadvertent entry towards spinning must be countered immediately.

Spinning is prohibited.

Aerobatics are prohibited

Exceeding maximum speeds is prohibited

Exceeding acceleration limits is prohibited

12 INSTRUMENT MARKINGS

Red radial line	Maximum or minimum limits
Yellow arc	Caution Range
Green arc	Normal operating range

See table for specific instrument range markings

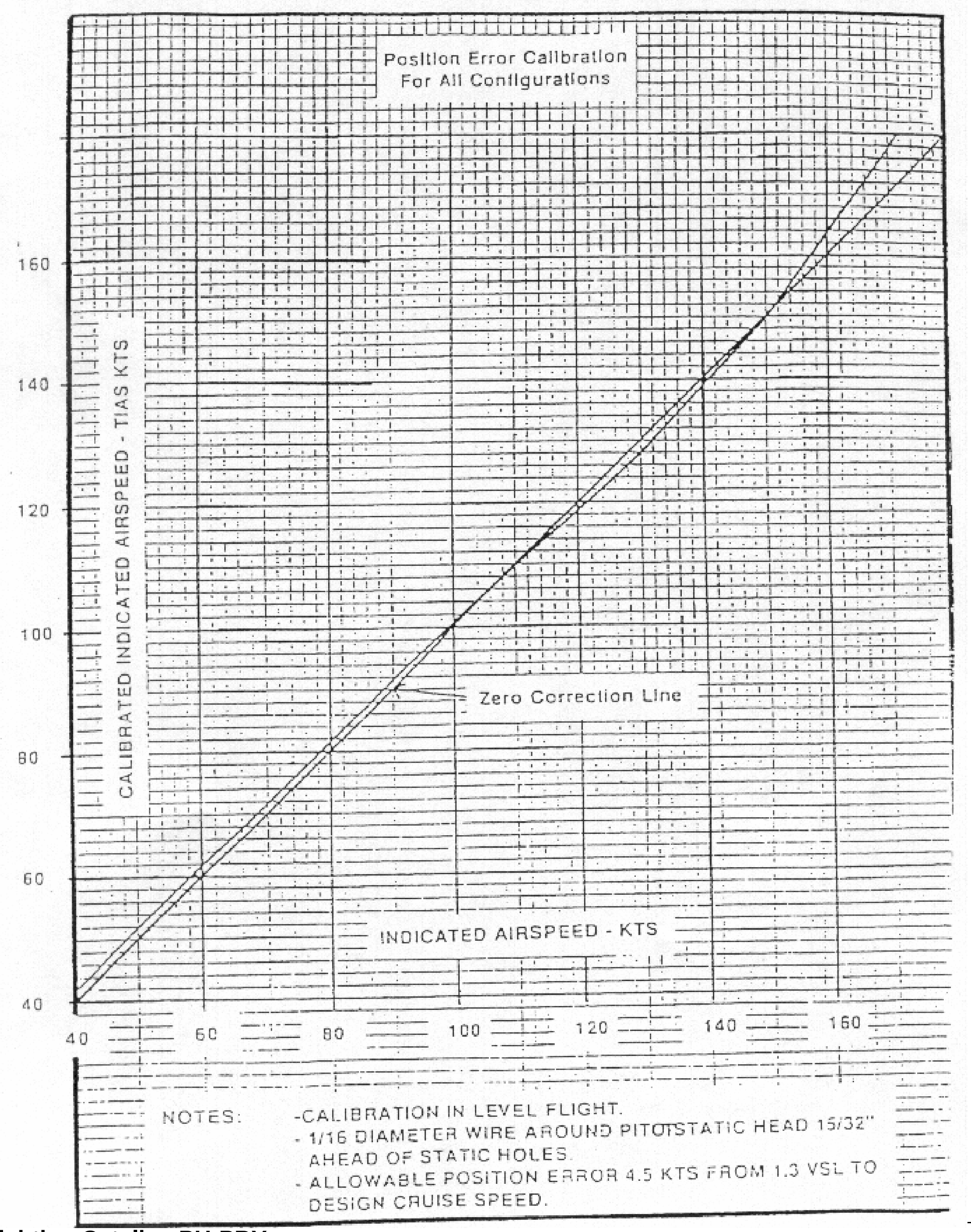
13 POSITION ERROR CORRECTIONS. (PEC)

With A.S.I's. connected to the normal static vents the PEC can be ignored.

POSITION ERROR CORRECTION USING ALTERNATE STATIC SOURCE. (Switch on co-pilots instrument panel)

From	70	90	Knots I.A.S.
To	90	100	Knots I.A.S.
Add	6	8	Knots

See also PEC Chart Figure for specific graph of operating range,



14 TAXYING LIMITATIONS

Caution should be exercised during taxiing to ensure engine temperatures remain within limits, especially when on the water.

When intending to operate on the water the windows and ventilation ports are to be closed to prevent ingress of water.

15 MAXIMUM RANGE

Range speed is dependent upon weight.
At 26458lbs 92 Kts will give best range.

Refer to **Section 5** for charts and graphs at other weights, for speeds, fuel consumption and configuration.

16 ENDURANCE SPEED

Endurance speed is the lowest speed compatible with aircraft control. At low weights it can be as low as 80 Kts but a minimum of 83 kts is to be used, which is compatible with Vmca. Refer to Section 5 for speeds, fuel consumption and aircraft configuration.

17 FUEL CAPACITY AND "NOMINAL FUEL CONSUMPTION

Maximum fuel capacity	6600L

Use 375 Lph for Flight Planning purposes
Refer to Section 5 for consumption at specific speeds / configurations

18 OIL CAPACITY AND CONSUMPTION

Maximum oil Capacity per engine	54 Imp Gallons

If actual consumption is not known use one half Imp Gal/eng/hr.

19 USE OF CARBURETTOR COLD AIR AND CARB HEAT

While taxiing, use. Cold air unless icing is suspected, in which case use full hot. Use cold air for take-off and on finals to land.
Monitor Carb temp. Gauges and use Carb heat as required at other times
Refer Section 5. For information on icing conditions

20 FLIGHT PLACARDS

The following placards are to be placed in the Pilot's compartment

1	"This airplane must be operated in compliance with approved operating limitations."
2	"No aerobatic maneuvers (including spinning) are approved."
3	"Do not exceed engine temperature limits during water taxiing"

21 STOPPING ENGINES

Maximum cylinder head temp	200 deg C

22 RPM RANGE RESTRICTIONS

To reduce the risk of vibration damage avoid the ranges 1700-1850 RPM and 2450-2550 APM; except as necessary to increase or decrease RPM.

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1.3 POWERPLANT AND INSTRUMENT MARKINGS

INSTRUMENT AND CONDITION	READING	MARKING
Tachometer RPM		
1 Max limit	2700	Red Radial Line
2 Take off or precautionary range	2550-2700	Yellow Arc
3 Min Limit 1700 RPM	1700-2550	Green Arc
4.Overspeed 3060 RPM 30 sec	1700	Red Radial Line
Manifold Pressure In Hg		
1.Maximum Limit	48.0	Red Radial Line
2.Take off or precautionary range	42.0-48.0	Yellow Arc
3.Normal Operating Range	20.0-42.0	Green Arc
Cylinder Head Temperature-C		
1.Maximum Limit	260	Red Radial Line
2 precautionary range	232-260	Yellow Arc
3.Normal Operating Range	120-232	Green Arc
4 Minimum Limit	120	Red Radial Line
Oil Inlet temperature –C		
1.Maximum Limit	100	Red Radial Line
2 precautionary range	85-100	Yellow Arc
3.Normal Operating Range	40-85	Green Arc
4 Minimum Limit	40	Red Radial Line
Oil Pressure in PSI		
1.Maximum Limit	110	Red Radial Line
2 precautionary range	90-110	Yellow Arc
3.Normal Operating Range	65-90	Green Arc
4 Minimum Limit	65	Red Radial Line
Fuel Pressure in PSI		
1.Maximum Limit	18	Red Radial Line
2.Normal Operating Range	15-17	Green Arc
3 Minimum Limit	14	Red Radial Line
Carburettor Heat In C		
1.Maximum Limit	38	Red Radial Line
2.Normal Operating Range	20-28	Green Arc
3 precautionary range	10-20	Yellow Arc
Airspeed Indicator Markings		
1 Never Exceed Speed(Vne)	173	Red Radial Line
2 Precautionary Range	137-173	Yellow Arc
3 Normal Operation	87-137	Green Arc

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SECTION 2 FLIGHT TECHNIQUES

2.1 REPRODUCTION NORMAL CHECKLIST

2.2 EXPANDED NORMAL CHECKLIST

2.3.1 OPERATING POLICY

2.3.2 CREW COORDINATION AND MONITORING

2.3.3 NORMAL TAKE OFF

2.3.4 CLIMB CRUISE DESCENT

2.3.5 APPROACH AND LANDING

2.3.6 WATER OPERATIONS

2.3.1 GENERAL

1. Operating policy
2. Crew co-ordination and monitoring

2.3.2 GROUND OPERATION

1. Push back/tow procedures
2. Engine starting
3. Engine starting with battery power only
4. Before taxiing
5. Taxiing

2.3.3 TAKE-OFF AND CLIMB

1. Departure crew briefing
2. Take-off powersettings
3. Speeds
4. Normal take-off
5. Rejected take-off
6. Minimum manoeuvring conditions after take-off
7. Climb speed schedule

2.3.4 CRUISE AND DESCENT

1. Cruise
2. Descent

2.3.5 APPROACH AND LANDING

1. Approach policy
2. Arrival crew briefing
3. Approach initiation
4. Manual crew co-ordination
5. Normal landing
6. Crosswind landing
7. Landing on contaminated/slippery runway
8. Crew Coordination SEA
9. Crew Coordination SEA Glassy Water

2.3.6 GO-AROUND AND WAVE-OFF

1. Go-around
2. Wave-off

2.3.7 SINGLE ENGINE OPERATION

1. Engine fire/failure before V1
2. Engine fire/failure during take-off after V1
3. Single engine climb/cruise or descent
4. Single engine approach and landing
5. Engine fire/failure during approach
6. Single engine go-around

2.3.8 CRITICAL FLIGHT CONDITIONS

1. Windshear

2.1 OPERATING POLICY

01 GENERAL

STICAT Standard Operating Policy is laid down in the STICAT Part A. These general policies are not, or only partially, covered in this Part B. To comply with the STICAT standard operating policies, good knowledge of the applicable chapters of the Part A is mandatory.

Pilot duties are interchangeable and the crew co-ordination procedure thus use the terminology pilot flying (PF) and pilot not flying (PNF). The abbreviation SCD stands for Subject to Captains Discretion.
The PF normally occupies the LH seat.

For take-off and landing the pilots shall adjust their seats to obtain the optimum combination of outside view and instrument visibility.

There is one way of controlling the aircraft:
Manual Flight

Because the aircraft is controlled manually, the PF should keep his hands at the controls and refrain from any other handling and the PNF should have his full attention in monitoring the flight path and refrain from any non essential duty.

2.2 CREW COORDINATION AND MONITORING

01 GENERAL

During all phases of flight good crew co-ordination and communication will enable the crew to be permanently aware of each other's actions, aircraft configuration, system status, aircraft position and ATC communication. All crew actions and tasks are to be monitored by each pilot.
Errors in judgment or deviations from standard procedures are to be reported at once to the other pilot.

Standard warning calls are:

'BANK'	when the maneuvering limit is exceeded.
'SPEED HIGH/LOW'	during approach, when the speed deviates more than +10/-5 kt from the correct value.
'SINK RATE'	during approach, when the rate of descent exceeds 1000 ft/min.

For crew co-ordination procedures refer also to the relevant block diagrams.

02 ASSIGNMENT OF DUTIES

The assignment of the first officer to PF duties is SCD and preferably done during pre-flight preparation and with the intention that he fulfills these duties for the whole flight.

03 CHANGING OVER CONTROLS

Should the captain wish to take over control ,or the PF wish to resume controls he will clearly state: “MY CONTROLS'.
Should the PF wish to hand over control he will clearly state: 'YOURCONTROLS'.
This transfer of control shall be acknowledged.

04 NORMAL OPERATION

Operating procedures have been developed to achieve the optimum use of both pilots. Many duties may be carried out by either pilot depending on which one at the particular time is more readily available. However, system handling by the PF shall never interfere with his main task of flying the aircraft. For that reason the following basic rules shall be complied with:

- The Normal Checklist will be read by the PNF, while both pilots must be at their flightstations.
- When the aircraft is on blocks, actions in response to the checklist must as far as possible be completed by the PF. The PNF shall ascertain the correct checking and setting of the systems and must check the given answer to be correct.
- When the aircraft is off blocks, the PNF must read and complete the relevant checklists.
- Reading and response must always be done aloud, regardless which pilot completes the necessary action.

All actions related to the handling of the aircraft shall be made by the PNF upon command of the PF. Before making the selection the PNF will convince himself that operating limitations and flight procedures allow the configuration or power change; if not, he will inform the PF accordingly. Commands of which completion requires some time (gear and power selections), shall be repeated by the PNF and acknowledged as soon as the desired position or action has been obtained or completed.

05 PUSH BACK/TOW PROCEDURES

At many airfields push-back procedures are in force and local regulations should be checked to determine whether a push-back or towing will occur before or after engine starting.
If a push-back/tow procedure occurs the following applies:

The Catalina is normally towed with its own special towbar that fits onto the axle of the nose wheel. Before towing the aircraft in this manner, the scissors bolt must be removed.This enables the nose wheel to caster beyond the maximum 30° limit. If the bolt is not removed and the wheel is turned beyond the limit, **damage** results. It is the responsibility of the captain to see that the scissors bolt is removed before towing and replaced before taxiing.

The "Before Taxi" checklist must always be completed.

It is essential that a positive confirmation of a BRAKES ON/OFF request is obtained when communicating with the ground engineer.

06 ENGINE STARTING

After start-up approval has been obtained by the PNF and the Before Starting Checklist has been completed, the engines are started. Engine starting will be done according the crew co-ordination procedure below.

The PF devotes his full attention to starting the engines and monitors the engine parameters.
The PNF monitors the PF and pays attention to any possible hand signals from the ground engineer.

It is good practice to motor the engine through at least twelve blades with the ignition switches off before starting the engine. This enables the oil pump to supply oil to the reduction gear area and at the same time it will disclose the presence of any oil in the cylinders (Hydraulicing)

FLIGHT PHASE/EVENT	PF	PNF
Start approval	Contact ground engineer for starting right hand engine by hand signal. Call: 'CHECK RIGHT HAND ENGINE' Call: 'STARTING RIGHT HAND ENGINE' Push starter switch to right hand engine Check and call: 'STARTER LIGHT ON' and count 12 blades **IF ANY HESITATION IN THE ROTATION OF THE PROPELLER, RELEASE THE STARTER SWITCH AND INVESTIGATE.**	Verify and call: 'PROPELLER STATIONARY, FINE AND FREE' Verify
After 12 blades	Switch booster pump right hand engine on Switch magneto's right hand engine to both Start priming continuously when engine is cold/ intermittently when engine is warm When engine starts running call: 'MIXTURE AUTO RICH' Releases start switch and priming switch and calls: 'STARTER LIGHT OUT'	Slowly moves mixture control to auto rich and responds: 'AUTO RICH' Verify
Stabilizing	Adjust throttle to 1000 RPM or lower to keep oil pressure below 100 PSI.	Verify
	Call: RIGHT HAND ENGINE IS STABILIZED'	

Repeat procedure for the left hand engine. PF will than verify and call if propeller is stationary, fine and free.
After the start procedure for both engines is completed, the PF: signals ground crew member to remove GPU and wheel chocks and asks for the BEFORE TAXI CHECKLIST.

07 ENGINE STARTING WITH BATTERY POWER ONLY

Starting with battery power only should be avoided to save the batteries.

08 BEFORE TAXIING

Complete Before Taxi Checklist. Both pilots should confirm that the area around the aircraft is free of obstacles before commencing taxiing.

09 TAXIING

During taxiing the locks, including the rudder lock, should be removed. The purpose of the rudder lock is to prevent damage to the rudder caused by wind when the aircraft is left unattended.
The aircraft is quite easy to taxi with differential use of the engine power and full rudder application assisted when necessary by moderate use of the brakes.
Release the parking brake and advance the throttles slowly to commence rolling and check the brakes.
The pilot should realize that his position is well forward of the main gear. Ensure that the main wheels do not cut corners.
When taxiing, in crosswind conditions, asymmetric engine power may be necessary to keep the aircraft straight, with upwind engine at higher power.
During taxiing, both pilots must at all times be aware of the aircraft position. The PNF should be able to advise the PF of the correct taxi routing and should therefore have the relevant charts readily available.
Avoid sharp turns at high speed, as the tricycle landing gear resists changes of direction and can cause nose wheel skidding.

When parking, the nose wheel should be straight so that it will resist any weather cocking effect created by a cross wind and also to make either a right or left turn possible when taxiing is started.

2.2 DEPARTURE CREW BRIEFING

Within the Normal Checklist two references to crew briefing requirements prior to departure will be found. The PF will conduct the crew briefing in accordance with the requirements outlined below.

Use the ANWB sequence

A	Aircraft Status
N	Notams wich are applicable to the flight
W	Weather conditions to be expected during flight
B	Briefing for departure/arrival

The crew briefing shall either start with **'STANDARD'** if the following conditions are met:
Standard crew co-ordination procedures
Standard flight techniques
Standard engine failure procedure
Full take off power

Or with **'NON STANDARD'**, after which only the deviating conditions(s) shall be mentioned.

In addition the crew briefing shall at least cover:

- Departure procedure
- All other items operationally required.

In case a take-off has to be made in a mountainous area or enroute obstacles are to be overflown during the first part of the flight, the captain should, in addition to the single engine climb-out procedure, give due consideration to a safe procedure, which enables:
Climb to a safe altitude in order to return to the airport of departure.
Enroute climb and single engine cruise in order to proceed to the most suitable airport.

2.2.1 NORMAL TAKE-OFF

01 TAKE-OFF POWER SETTING

The standard take-off power setting is 48' MAP/2700 RPM

02 SPEEDS

Take-off speed V1 = 83 kts IAS (is Vmca)

- Speed Relations

Vmca = 83kts IAS
Vr = 1,05* Vmca = 87 kts IAS
V2 = 1,1 * Vmca = 91 kts IAS

03 NORMAL TAKE OFF

When lined up, compass heading and aircraft position should be checked for positive runway identification.
Where obstacles, noise abatement or instrument departure routes require such, this procedure should be amended accordingly.
A rolling take-off is recommended, except in limited runway length conditions.
When making a take-off from the brakes advance the throttles and just before reaching take-off power release the brakes.
Pitch trim setting is normally 0 so the stick-forces at rotation vary with the CG.
To apply take-off power, advance the power levers slowly.
For all take-offs the landing lights shall be switched on unless weather conditions are such that undue glare results.
During crosswind take-off the tendency for the upwind wing to lift should be counteracted by decisive use of aileron during the take-off run, rotation and lift-off.
Directional control during take-off run must be maintained by rudder control. Nosewheel should be straight before power application.
Keep aft pressure on the control column during the whole take-off run with the wind on the nose or slight crosswind. With more than10 kts crosswind keep the nose on the ground but avoid shimmy on the nosewheel.

Normal Take Off Crew Coordination

FLIGHT PHASE	PF	PNF
Commencing the take-off roll	• Hold control column and set aileron into the wind • Release the brakes • Advance throttles to 30'MAP and call: "SET TAKE OFF POWER. Move hand up the throttles in order to be still able to reject the take off. • Move hand down.	• Check engine parameters • Set 48' MAP and call: "TAKE OFF POWER IS SET"
At approximately 60 kt		• Check if both airspeed indicators are showing approximately 60 kts
At V1	• Release throttles	Call: 'V1'
At Vr	• Rotate smoothly to take-off attitude.	Call: 'ROTATE'
Airborne (positive climb)	Call: 'GEAR UP'	• Repeat • Select
At 200 ft	Call: "SET METO POWER" (41.5"MAP/2550RPM)	• Repeat • Select • Confirm
When gear is up and 400ft	Call: 'SET CLIMB POWER' (32.5" MAP/2325RPM)	• **Confirm** • Repeat • Select • Confirm
When at VFR altitude, leveled off and cruise speed	Call: 'SET CRUISE POWER" (28,5" MAP/2050RPM) Call: "AFTER TAKE OFF CHECKLIST	• Repeat • Select • Confirm • Perform

Following a correct rotation, the speed at lift-off is normally around 90 kts IAS

04 REJECTED TAKE-OFF

Rejection of a take-off at high speed can be hazardous, in particular when the runway length
and/or condition is critical from a performance point of view. The decision to reject may only be made before V1.

The rejection of the take-off should be restricted to:

1) All observed failures and/or exceedances.
2) An engine failure
3) An engine fire
4) Conditions, which render the aircraft clearly unflyable
5) e.g. jammed controls, fire, explosions etc.

If the first officer is the PF, he may reject the take-off on his own initiative in case of an engine failure, an engine fire or a malfunction directly affecting aircraft control. However in all other cases he must await the command 'STOP'.
The accelerate stop distance for a Catalina under ISA conditions, MTOW, full take off power, dry runway, no slope, no wind is approx. 1300 meters.

RTO CREW CO-ORDINATION

FLIGHT PHASE	**CAPTAIN** **PF**	**FIRST OFFICER** **PNF**
Failure/malfunction or Conflicting situation. Decision to abort	Call: 'STOP' Reject take-off	State nature of failure
Decision to continue	Call: 'CONTINUE' Continue take-off	
	FIRST OFFICER **PF**	**CAPTAIN** **PNF**
Engine Failure/fire or Flight controls Problems	Call: 'STOP' Reject take-off	When Captain decides due nature of failure to abort he calls: “STOP”
Decision to continue	Continue take-off	Call: ’CONTINUE’

RTO PROCEDURE

FLIGHT PHASE/EVENT	PF	PNF
Rejected Take off Aircraft stopped	Pull throttles to idle. Apply full brakes. Relief nose wheel by gently pulling back the control column. Call: “SET PARKING BRAKE”	MonMonitor procedure to stop Aircraft. Helps pulling back the control column Sets parking brake State nature of failure
	Captain	**First Officer**
Confirmation of failure and evaluation of situation	Command: ‘TAKEACTION’ Make PA announcement: ’CABIN CREW AND PASSENGERS, REMAIN SEATED” Inform ATC	Perform applicable actions or procedures.

- Be prepared for an ON GROUND EMERGENCY/EVACUATION procedure.
- Keep in mind the Runway length remaining and use the brakes accordingly

05 HOT BRAKES

An rejected take-off will normally cause hot brakes. If a subsequent take-off is considered feasible a brake cooling time of 30 to 60 minutes is advisable. Do not use the parking brake when the brakes are hot.

If extremely hot brakes are expected or fire/smoke is reported by ATC /Cabin staff the following guidelines are applicable:

- Stop clear of runway.
- Inform ATC, request fire fighting equipment, ground engineer, towing equipment and a stairway.
- Shut down engines.
- Keep in contact with ATC.
- If not safe, disembark via the entrance and have passengers kept well away from the wheels.

06 FAILURES AFTER V1

The PF devotes full attention to fly the aircraft, while the PNF states the nature of the failure.

In case of engine failures refer to Part B section 3

2.2.2 MINIMUM MANOEUVRING CONDITIONS AFTER TAKE-OFF

Minimum altitude and speed for turns after take-off

- During normal departures adhere to minimum altitude of 500 ft HAA.
- During special engine-out procedures adhere to minimum altitude of 100 ft HAA with speed 87 kts and not more than 15° AoB.
- Compliance with noise abatement procedures always remains SCD and should be consistent with the safety of flight.

01 MAXIMUM BANK ANGLE FOR TURNS AFTER TAKE-OFF

If a turn is required below 500 ft HAA, limit bank angle to 15 deg.

2.2.3 CLIMB CRUISE DESCENT

01 CLIMB SPEED SCHEDULE

- Normal climb speed..90-95 kts.
- Maximum gradient of climb speed.......................….91 kts
- Maximum rate of climb speed is ……....................95 kts.

02 CRUISE

For cruise settings see performance section

03 DESCENT

Cruising altitude should be maintained as long as practical, however a number of factors affecting the top of descent point are:

- Altitude
- Conditions during descent (wind, turbulence, aircraft weight).
- Weather at destination and alternate.
- Terminal area procedure.
- Runway in use.

To avoid harmful vibrations and counter weight distress, power settings should adhere to the rule that for every 1”of MAP there should not be more than 100 RPM. If the MAP is 20”, the RPM should not exceed 2000.

For normal descent planning preference must be given to the clean configuration. When speed reduction is mandatory, the use of gear should be considered as reserve feature giving a greater operating flexibility.

At top of decent point gradually lower pitch, reduce power to +/- 20” MAP and maintain cruise speed.

Standard descent	Speed kt	Power MAP	R/D ft/min
	Vcruise	20’	500

2.2.4 APPROACH AND LANDING

01 APPROACH POLICY

In general all approaches should be flown stabilized.

'Stabilized' means:
- Established 90 kts IAS
- Stabilized power (20”MAP/ 2050 RPM)

To avoid harmful vibrations and counter weight distress, power settings should adhere to the rule that for every 1”of MAP there should not be more than 100 RPM. If the MAP is 20”, the RPM should not exceed 2000. For this reason we recommend to fly a visual glide path of 2°.

Threshold crossing speed is1.3 Vstall wich is approximately 80 Kts

02 ARRIVAL CREW BRIEFING

It is recommended to perform the arrival crew briefing while at cruising altitude. The crew briefing should be completed by the PF before terminal area penetration, so that both crew members are familiar with descent altitude restrictions, terminal area characteristics, approach facilities and airport data.

The crew briefing will cover the previous mentioned ANWB sequence with the following items:
- Any deviation from the standard Part B procedures.
- TOD and applicable minimum altitudes.
- Type of approach.
- Missed Approach Procedure
- Taxi-in route.
- Set-up of NAV-equipment.
- Operational impact of local situation, weather and aircraft deficiencies, if not yet covered.
- Obstacles in the circling area.
- Transition to published missed approach procedure from any position in the visual part.

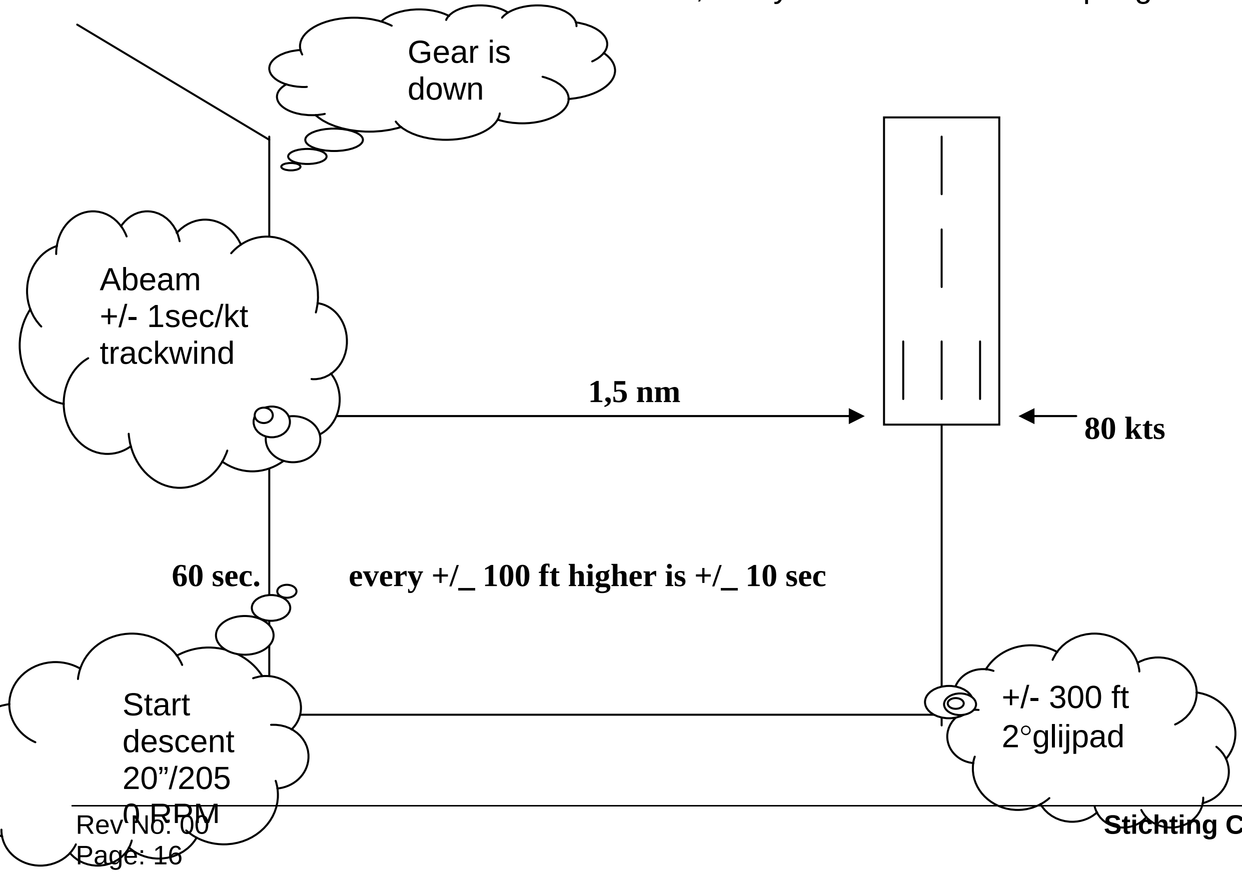
03 APPROACH INITIATION

Perform the approach checklist +/- 15 minutes prior landing and lower the gear in a very early stage in order to make a visual check possible which will not interfere with the higher workload during the actual approach.

04 APPROACH CREW CO-ORDINATION PROCEDURE

Flight phase or event	PF	PNF
Down wind stabilized, 90 kts and gear down	• Call: 'LANDING CHECKLIST'	• Perform
On final and landing assured	• Reduce speed to cross the threshold with 80 kts	
In the flare	• Call: "PROPS FULL FINE"	• Move propellers full fine
Established in landing roll	• **KEEP NOSE OFF THE GROUND AS LONG AS POSSIBLE AND USE AS AERODYNAMIC BRAKING** • if needed apply brakes until speed is reduced to taxi speed •Keep the aircraft straight with rudder as long as possible	• Assist
Runway vacated	• Call: 'TAXI IN CHECKLIST'	• Perform

- In case downwind is extended, delay descent until intercepting 2° G/P.



05 NORMAL LANDING

- Aim to cross the runway threshold with 85 kts
- Flare to a slightly nose-up attitude and retard the power levers smoothly to idle.
- Do not prolong the flare.
- After touchdown on the main wheels keep the nose wheel off the ground as long as possible to avoid shimmy.

06 CROSSWIND LANDING

On final approach maintain runway alignment by crabbing into the wind.
Just prior to touchdown, apply rudder to align the aircraft with the runway center line and bank into the wind to counteract drift (3° to 5° bank angle).

- Do not delay touchdown after decrabbing is completed.
- After landing, keep straight with rudder and counteract the tendency of the upwind wing to lift by decisive use of aileron.

07 LANDING ON CONTAMINATED/SLIPPERY RUNWAY

The landing and deceleration on a contaminated runway where reduced braking action or risk of hydroplaning exists, must always be considered critical. A high speed landing on a contaminated runway with no headwind or a tailwind greatly increases the possibility of hydroplaning.

In case of heavy rain or thunderstorms, delay the landing until weather and runway conditions improve.

<u>Runway selection</u>
The runway must be long enough to allow a reasonable margin above the normal landing distance, taking into account the braking action and the type of runway contamination.
<u>Approach</u>
The approach must be flown using the normal techniques. The threshold must be crossed at the correct speed.
<u>Flare and Touchdown</u>
Avoid floating and make a positive landing to assure wheel spin-up.
<u>Deceleration</u>
Start wheel braking not sooner than 2-3 seconds after the main wheels are firmly on the runway and initially apply light brake pressure, gradually increasing as speed is reduced. If no brake pressure is felt, expect hydroplaning. Release brakes completely for 2-3 seconds to allow the wheels to spin-up, then apply light brake pressure again.

08 GO-AROUND

The go-around procedure has to be initiated when the approach has to be abandoned.

Go-Around requirements:

- Quick and correct power application.
- Stopping of sink rate by proper rotation.
- Speed at least 90-85 kts during the procedure.

If go-around is initiated :

<u>above</u> 500 ft HAA select **CLIMB** power (32,5”MAP/2325 RPM)
<u>between</u> 200-500 ft HAA select **METO** power (41” MAP/2550 RPM)
<u>below</u> 200 ft HAA select **T/O** power (48” MAP/2700 RPM)

Go-around two engines:

PF	PNF
• Call: 'GO-AROUND, SET POWER' • Rotate to nose up attitude. • Command when positive rate: “GEAR UP”	• Set power and state: ‘POWER SET’ • Monitor procedure and rotation. • Repeat, select confirm
Continue as for Normal Take-off, refer to Part B 2.2.1	

Note:- When an engine fails during a go-around maintain a speed of 87 kts IAS
Proceed as for ‘engine failure/fire during take-off after V1’

09 WAVE-OFF

The wave-off procedure (rejected landing) is similar to the go-around procedure for two engines except that the maneuver begins with the power levers near or at flight idle and at altitudes below 50 ft.

Pay special attention to the following aspects:

- Initially rotate only to stop the descent.
- During power application devote full attention to pitch attitude control.
- Do not rotate to a climb attitude until the speed is a minimum of 85 kts
- Touching of the main wheels on the runway must be expected as it takes
- a few seconds for the engines to deliver take-off power.

Notes: The trim change on applying take-off power is significant but the stick force can be held with one hand.
A rapid opening of the power levers create initially a tendency for the propellers to fine-off with the associated drag
A wave-off during single engine operation is not possible.

1. ENGINE FIRE/FAILURE BEFORE V_1

Reject the take-off.

For crew co-ordination, refer to AOM 2.3.3/5.

2. ENGINE FIRE/FAILURE DURING TAKE-OFF AFTER V1

- For failures after V1 also refer to AOM 2.3.3/5.
- For crew co-ordination also refer to AOM 2.3.1/2, Emergency/Abnormal Operation.

If an engine fails after V1, the take-off should be continued.
The first indication of a loss in thrust is a drop in manifold pressure.
The minimum speed is in all the segments is V2 (87 kts).
Use rudder and aileron trim as required. A maximum of 5 deg bank towards the live engine is allowed to maintain heading. This may require almost full deflection of the control wheel at V2 and a heavy aircraft.

If a check must be done when a propeller is actually feathered than this must be done by looking actually at the propeller.

When propeller is still windmilling maintain speed 83 kts IAS or greater with other engine at METO power. Trade altitude for speed and start descending to maintain Vmca or more. If necessary make an emergency landing on water or soft terrain with gear up, or on a runway with, if possible, gear down.

Flying on one engine in a twin engine aircraft is considered an emergency.

The captain should determine a safe flight path based on his own judgment. Before accelerating to speeds above V2 first climb to a safe altitude.

Calling/stating or confirming any engine failure should not be accompanied by the engine number but by stating:
e.g. 'Engine Fire' or 'Engine Failure'

- If an engine fails at a speed between V2 and V2 + 10, maintain that speed.
- If an engine fails at a higher speed, gradually reduce to V2 + 10.

ENGINE FAILURE/FIRE DURING TAKE-OFF AFTER V1

FLIGHT PHASE/EVENT	PF	PNF
Engine fire/failure	• • Apply ailerons towards live engine to ensure wings level.	• State nature of failure.
At Vr	• Rotate smoothly to appropriate attitude	
Airborne positive climb	• Call: 'GEAR UP'	• In case of right hand engine failure/fire, switch on aux. Hydraulic pump • Repeat, select, confirm
In case of engine failure/fire	• Call: 'TAKE ACTION	• Perform memory items. **Identify engine not below 200 ft**
Initial climb.	• Maintain speed, minimum V2	• Monitor speed/attitude.
	• • Call: “SET METO POWER”	Call: “MEMORY ITEMS COMPLETED” • Repeat, select, confirm
When appropriate	• Call: ’EMERGENCY CHECKLIST’ • Call: ’AFTER TAKE-OFF CHECKLIST’	• Repeat, perform, confirm • Repeat, perform, confirm

Notes:- *For, emergency/abnormal operation, crew coordination refer to AOM2.3.1./0*

General

ATC shall be informed as soon as practicable by MAYDAY or PANPAN call.
Inform ATC when deviating from the published departure.
During climb limit bank angle to 15°.
Minimum turning height is 100 ft HAA, refer to AOM 2.3.3/6.
During turn below 400 ft maintain V2.
Preferably make turns towards the live engine.
When landing conditions are below minima, climb to a minimum safe altitude andproceed to the nearest suitable airport.

3. SINGLE ENGINE CLIMB/CRUISE OR DESCENT

When an engine fails during climb, cruise or descent, take action according the Emergency checklist and set METO power on the live engine.

Single engine climb performance and single engine ceiling are based on the use of METO Power and V2.If present altitude can not be maintained and terrain clearance is a factor, set METO power and decelerate to V2. Descent with METO power and V2 and check drift down restrictions.
In case terrain clearance is no limiting factor maintain a speed of 100 kts.

4. SINGLE ENGINE APPROACH AND LANDING

The single engine approach closely resembles the two engines approach :

Refer to AOM 2.3.5.

5. ENGINE FIRE/FAILURE DURING APPROACH

If an engine fails/sets on fire during the approach:

Increase power to maintain speed and glide slope.
Shut down failed engine, depending on the nature of the failure and/or time available, according the applicable memory items or emergency checklist procedures.
Depending on the circumstances continue single engine approach or initiate a single engine go-around.

- Below 500 ft HAA, it is recommended to continue the approach and landing in case of an engine fire.

6. SINGLE ENGINE GO-AROUND

PF	PNF
Call: 'GO-AROUND, ‘SET TAKE OFF POWER’ Rotate to nose up attitude. When positive ROC Command: 'GEAR UP'	Set TAKE OFF power on life engine and state ‘POWER SET’ Monitor procedure and rotation. **10** ***REPEAT, SELECT CONFIRM***
Continue as for 'Engine Fire/Failure during Take-off after V1, AOM 2.3.7	

Note:
- *When applying power on remaining engine be prepared to use coarse aileron and rudder, particularly at low speeds.*

- Climb to circuit altitude or follow published Missed Approach Procedure.

1. OVERWEIGHT LANDING

- In case technical or operational reasons require a landing at a weight above the maximum landing weight: Check available landing distance and perform a normal approach and landing.
- Any landing in excess of the maximum structural landing weight is considered an overweight landing .
- Any overweight- or hard landing must be reported in the AML and to the Chief Pilot.

REPRODUCTION NORMAL CHECKLIST

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Walk Around

Outside

External Damage to Airframe ....Check
Evidence of Fuel, Oil, Hydraulic Leaks................................Check
Evidence of Water Leaking ....Check
All Covers..Remove
Hull and Float Drain Plugs..Check in
External Control Clamps ....Remove

- Remove first before internal aileron and elevator lock

Tires Damage and Pressures..Check
Oleo Leg Extensions ....Check
Main Gear External Lock..Remove
NLG External Lock ....Remove
NLG Scissor bolt ....A/R
NLG Doors Firm ....Check
Forward End of NLG Doors..Check
Tow Bar...A/R
Fuel Sumps ....Drain
Upper Surface of Wing and Stabilizer ....Check
Antennas ....Check
Oil..Check
Fuel ....Check
Hydraulic Fluid..Check
Condition Cowl Gills Brackets and Bolts ....Check
Engine Exhaust Plugs ....Remove

inside

Cicuit Breakers..Check
Fuel Filters..Drain
Float crank...Check
Down Latch Rod..Check
NLG Ratchet Handle ....Check
Life Jackets ....Check
Life Raft...Check
Emergency Exits & Tail Door..Secure
Emergency Equipment..Check
Internal Aileron and Elevator Lock.......................................Remove

- **IMPORTANT** First remove external control clamps

Ships papers ....Check

Power Up

All Electrical Switches.. Off
Master Magneto and Switches... Off
Gear Lever... Down
Battery Quick Disconnect.. Connect
Battery Master Switch.. On
Battery Voltage .... Check
GPU (if avail) .... Connect
Parking Brake .... Set
Hydraulic Pressure .... Check
Fuel Cocks... R.o.R./L.o.L.
Cowl Gills... Open
Battery Master Switch.. Off /On

First Flight Of The Day

Emergency Equipment.. Check
Bilge Pumps... Check
Static Selector.. Normal
Warning and Caution Lights.. Check
Trims... Check
Avionics. .... Check
Cuno Filter .... Turn
Hydraulic aux. pump .... Check
Clock... Check
Documentation... Check

Cockpit Preparation

Circuit Breakers ....Check
Hull and Float Drain Plugs ....Check
Clamps ....On board
NLG scissor pin ....Installed
Gear locks (3X) ....On board
Fasten Seat Belts and No Smoking ....On
Emergency Shut Off Valves ....Open
Throttles ....Cracked
Prop Levers ....Full Fine
Fuel Cocks ....R.o.R./L.o.L.
Mixtures ....I.C.O.
Master Magneto ....In
Magneto Switches ....Off
Fuel Quantities .... ___ Gals Checked
Oil Quantities .... ___ Gals Checked
Altimeters .... ___ Set
Flight Plan, Wt and Balance ....Complete
Briefing ....Complete

Mb	In HG	Mb	In HG
985	29,17	1011	29,94
986	29,20	1012	29,97
987	29,23	1013	29,99
988	29,25	1014	30,02
989	29,28	1015	30,05
990	29,31	1016	30,08
991	29,34	1017	30,11
992	29,37	1018	30,14
993	29,40	1019	30,17
994	29,43	1020	30,20
995	29,46	1021	30,23
996	29,49	1022	30,26
997	29,52	1023	30,29
998	29,55	1024	30,32
999	29,58	1025	30,35
1000	29,61	1026	30,38
1001	29,64	1027	30,41
1002	29,67	1028	30,44
1003	29,70	1029	30,47
1004	29,73	1030	30,50
1005	29,76	1031	30,53
1006	29,79	1032	30,56
1007	29,82	1033	30,59
1008	29,85	1034	30,62
1009	29,88	1035	30,65
1010	29,91	1036	30,68

Before Starting

Battery Master Switch.. On
Access Ladder, Tail Stand.. Stowed
Windows Doors and Hatches.. Closed
Rudder Pedals and Seats... Adjusted
Cowl Gills... Open
Radio Master Switch... On
Anti Collision Light .... On

Before Taxi

Oil Pressure... Check
Booster Pumps .... Off
Fuel Pressure .... Check
Hydraulic / Brake Pressure .... Check
Temperatures .... Check
Suction.. Check
Generators/Radio masterswitch... On
Radio's .... On
Nav/Comm .... Set
Gyro's .... Set
Ground Equipment.. Removed

Taxi

Brakes.. Check
Gyro's and Instruments.. Check
Carburetor Heat (First Flight Only).................................... Check
Wing Floats.. Check
Trims and Tensions. .... Set
Hydraulic Pressure .... Check
Briefing... Complete
Cabin .... Ready

Run UP

Mixture.. Auto Rich
Temps & Pressures .... Check
RPM.. 1700
Propellor Levers.. Cycle (2x)
Feather Buttons .... Check
Magnetos... Check
Throttles... Idle
1000 RPM... Set

Before Take Off (land + sea)

Gear ....Check
Transponder ....Set
Magneto's...Both
Carburetor Heat..Cold
Landing and Strobe Lights ....On
Pitot Heat...As Required
Mixtures...Auto Rich
Fuel Cocks ....R.o.R./L.o.L.
Trims and Tensions..Set
Prop Levers..Full Fine
Controls...Check Free

Temps and Pressures ....Check
Windows Doors and Hatches ....Closed
Cowl Gills ....Trail
Runway Heading ....Set

After Take Off

Gear and Floats..Up
Power .... ___Set
Boost Pumps ....off
Temps and Pressures ....Check
Visual Engine Check ....Dry / Clean
Mixture ....A/R
Generators ....Check
Cowl Gills ....A/R
Carburetor heat ....A/R
Altimeters .... ___Set
Fasten Seatbelts and No Smoking ....A/R
Landing Lights ....A/R
Bilge Pumps ....A/R

Approach

Fuel Cocks .... R.o.R./L.o.L.
Mixtures .... Auto Rich
Carburetor Heat .... Cold
Cowl Gills .... Set
Landing Lights .... On
Fasten Seat Belts and No Smoking .... On
Temps and Pressures .... Check
Hydraulic Pressure… .... Check
Crew Briefing .... Completed

Landing (Land)

Gear .... **Down** Check
Brakes and Pressure .... Check
Booster Pumps .... Set
Prop Levers .... TO GO
Cabin .... Ready

Landing (Sea)

Gear ....**Up** Check
Nose Wheel Doors ....**Closed**
Wing Floats ....Sby/Down
Booster Pumps...Set
Prop Levers..TO GO
Cabin...Ready

Taxi In

Rudder Lock .... On
Cowl Gills.. Open
Landing / Strobe Lights.. Off
Pitot Heat... Off
Carburettor heat.. Off
Transponder .... Stby

After Parking

Parking Brake .... Set
GPS .... Off
Nav Lights.. Off
Internal lighting .... Off
Mixtures .... I.C.O.
Anti Collision Light .... Off
Radio Master Switch.. Off
Battery Master Switch.. Off
Magneto Switches .... Off
Master Magneto... Out
Throttles... Fwd
Internal Aileron and Elevator Lock .... Installed

Termination

All covers .... Install
External Control Clamps... Install
Gear External Locks. .... Install
Nose Gear scissor pin .... Remove
Hull and Float Drain Plugs .... Remove
Chocks... In Place
Parking Brake. .... Release
Cowl Gills.. A/R
Battery Quick Disconnect.. Disconnect

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Full Feather Check

Every 30 days a full feather check has to be completed according to Hamilton standard sb 657
This check is done after a flight.

GPU .... connect
Temps and Pressure .... Check
Mixtures .... I.C.O.
Magnetos .... off
Feather button #1 .... press
Check Button pops out after propeller is feathered
Feather button #2 .... press
Check Button pops out after propeller is feathered

With GPU connected Unfeather propellers by pressing the feather button and release when in full fine pitch.

Logbook / AML.. Make entry

Reference Check

Once every 30 days a reference check has to be performed.

After Run UP checklist.

MAP Engine #1... Field BM
Propeller RPM #1 .... Note
MAP Engine #2.. Field BM
Propeller RPM #2 .... Note
Logbook / AML.. Make entry

2.2 EXPANDED CHECKLIST

Power Up

All Electrical Switches.. Off

- Check all electrical switches are off
- Check all bilge pump switches are off
- Check battery master switch is off

Master Magneto and Switches.. Off

- Check master magneto is pulled
- Check magneto switches are in off position

Gear Lever.. Down

- Check gear lever is in down position and lock is in locked position

Battery Quick Disconnect.. Connect

- Connect battery quick disconnect to battery

Bilge Pump C.B.. In

- Check Bilge C.B's in Main electrical distribution panel Starboard side

Battery Master Switch... On

Battery Voltage.. Check

- Minimum voltage 21 volts

GPU (if avail).. Connect

- Connect and start GPU
- Check voltage on GPU (26-28 V)

Parking Brake... Set

- Check Hydraulic pressure (Min 800 psi)
- Sit down in right hand seat and set parking brakes

Fuel Cocks.. L.o.L./R.o.R.

- Check fuel cocks to L.o.L./R.o.R.

In principle the fuel cocks are kept in this position. Only used in case of fuel inbalance.

Cowl Gills.. Open

- Set cowl gills to full open position with spring-loaded switches

Battery Master Switch.. Off /On

- In case no GPU available switch off battery master switch
- In case GPU is available leave battery master on to recharge the battery

First Flight Of The Day

Emergency Equipment.. Check

- Check Fire Axe
- Check Fire extinguishers on date and condition
- Check Fire gloves
- Check Megaphone
- Check Life vests
- Check Flashlights

Bilge Pumps.. Check

- Check each one of the bilge pumps on running while
- listening, only when water operation is intended

Static Selector.. Normal

- Check both selectors in normal position

Warning and Caution Lights.. Check

- Push each light on working condition

Trims.. Check

- Check elevator and rudder trim on full deflection and reset in T/O position
- Check aileron trim in neutral position

Avionics.. Check

- Check if VHF 1/NAV1 and VHF2/NAV2 and transponder are switched off
- Check if GPS is properly installed and switched off

Cuno Filter... Turn

- Turn Cuno Filter handle 360° clockwise

Hydraulic aux. pump…………………………………………………… Check

- Switch pump on and Check pump momentarily on operation

Clock... Check

- Check if clock is running and showing right time
- Do not wind clock all the way tight

Documentation.. Check

- Check if journal is on board,
- Check Authorisation book is completed and if applicable copies are made when book is carried on board.
- Check if "aircraft documents are on board" and check its contents
- Make sure i.c.o. flight abroad that insurance is covered and overflight clearance recieved
- Check Aircraft's Maintenance Log on DDL's and released for service by T.D.
- Check if navigation maps and charts are available to cover the whole flight
- Flight plan, Notams, and weather are checked and on board.

Cockpit Preparation

Circuit Breakers... Check

- Check if the circuit breakers on the box situated left of the PF, the instrument panel, the emergency shut off panel and on the electric panel are all in

Hull and Float Drain Plugs.. Check

- Check if the plugs are all in and box is empty and on board

Clamps.. On Board

- Check two clamps on board

Gear locks and pin……………………………………………………….On Board

- Check three gear locks and the nosegearpin on board.

Fasten Seat Belts and No Smoking.. On

Emergency Shut Off Valves.. Open

- Check the two guards are closed

Throttles... Cracked

- Open throttles appr. ¼ inch

Prop Levers.. Full Fine

- Check prop levers fully forward

Mixtures... I.C.O.

- Check mixture levers are in idle-cut-off position

Master Magneto.. In

- Check master magneto switch is pushed in

Magneto Switches... Off

- Check both magneto switches are in the off position

Fuel Quantities.. . . . .Gals/Hr

- Mention amount of Gallons and Endurance

Oil Quantities.. . . . .Gals/Hr

- Mention amount of Gallons and Endurance

Altimeters... . . . .Set

- Check both altimeters are set to current QNH value

Weight and Balance.. Complete
- Check on board and completed

Briefing.. Complete

Before Starting

Battery Master Switch... On

Access Ladder, Tail Stand, Sea Stands... Stowed

Windows Doors and Hatches... Closed

Rudder Pedals and Seats.. Adjusted

Cowl Gills.. Open

Radio Master Switch……….. On/Off
- Switch Radio Master On
- Check if intercom is working
- Request start up , radio master switch Off

Anti Collision Light.. On

Before Taxi

Oil Pressure.. Check
- Check oil pressure between 80-100 psi

Booster Pumps... Off

Fuel Pressure.. Check
- Check fuel pressure between 14-16 psi

Hydraulic/ Brake Pressure.. Check
- Check pressure between 850-1050 +/- 50psi

Temperatures..………… Check
- Check oil temp between 40°-100°C before using the engines
- Check cylinder head temp between 120°-200° C before using engines

Suction.. Check
- Check pressure between 2.8 –4.5 psi

Generators/ Radio Masterswitch.. On

Radio's.. On
- Switch VHF/NAV1 and VHF/NAV2 On
- Switch Transponder Stby
- Set Transmit/ Receive panel for departure

Nav/Comm Setup... Set
- Set VHF/NAV1 and VHF/NAV2 to proper frequencies
- Switch GPS master on
- Set GPS for intended flight

Gyro's.. Set

Ground Equipment.. Removed

Taxi Out

Brakes.. Check
- Check brakes and announce

Gyro's and Instruments.. Check
- Check gyro's in turn
- Check instruments

Carburetor Heat (First Flight Only)... Check
- Open valves with spring-loaded switch and check light is on
- Close valves and check lights are out (wait 2 minutes before take off)

Run-Up

This Check may be done without checklist, PNF will do checklist after run-up

- Mixture………………………………………………………….... Auto Rich

Check mixture in Auto-Rich position

- Temps &Pressures………………………………………………. Check

Check all temps and pressure gauges are indicating in the green

- RPM 1700………………………………………………………. Set
- Feather Buttons…………………………………………………….. Checked

Push feather button individually and verify RPM drop with Ampere increase in the ampere gauge. Do not let RPM drop below 1200 RPM

- Propellor lever……………………………………………………. Cycle

With warm oil, one cycle is sufficient, otherwise cycle 3 times to create a warm oil flow in the propeller dome.

- Magnetos…………………………………………………………. Check

Check L/R magneto per engine

- Power lever……………………………………………………….. Idle

Verify idling RPM

- 1000 RPMr……………………………………………………….. Set

Before Take Off (land + sea)

Wing Floats.. Check
- With water landing intended run floats all the way down and up
- With generators online (more than 1200 RPM)

Gear………………………………………………………………… A/R
- Clearly state configuration

Hydraulic Pressure.. Check

_ Check pressure between 850-1050 +/- 50psi

Cabin.. Ready & Warned
- Check if “cabin ready “is received
- Verbally through intercom Command: “cabin crew take your seats”

Briefing.. Complete
- Amend briefing on any changes relative to the planned departure

Transponder... On

Carburetor Heat... Cold
- Check carburetor valve lights are out
- Check if 2 min. have passed since last movement of the valves before commencing T/O

Cowl Gills.. Trail
- Close cowl gills and open them to trail position
- Check generators on-line Above 1200 RPM

Magneto's... Both

Landing and Strobe Lights.. On

Pitot Heat... A/R

Mixtures... Auto Rich

Prop Levers.. Full Fine

Trims and Tensions.. Set
- Check if Trims and Tensions are properly set for take off

Controls.. Check and Free
- Remove flight control lock if still attached (hold column before
- Removing the flight control lock)
- Remove rudder lock if still on
- Check flight controls through complete motion

Temps and Pressures...Check
- Check all temps and pressures are in the green bands
- Check cylinder head temp(C.H.T.) is between 120° and 200° C

Windows Doors and Hatches.. Closed

Runway Heading... Set
- Check runway heading against compass and directional gyro and adjust if necessary

After Take Off

Gear and Floats…………………………………………………….. Up
- In case of land take off check gear fully up and gear handle is locked
- Check if amber nose door closed light is on
- Check if red gear up and locked light is on
- In case of water take off check if floats are visually up
- Check that float motor stopped running
- Set float switch in neutral position

Power………………………………………………………………... . . . .Set
- State required pwr and check

Temps and Pressures………………………………………….. Check
- Check oil pressures
- Check oil temperatures
- Check carburetor temperatures
- Check cylinder head temperatures (C.H.T.)

Visual Engine Check…………………………………………….. Dry and Clean
- Each pilot checks his/hers side engine on condition

Mixture…………………………………………………………….. A/R
- Set mixture lever to Auto Lean if C.H.T. is between 180°-200° C

Cowl Gills………………………………………………………… A/R
- Set gills to keep C.H.T. between 180°-200° C

Carburetor heat………………………………………………….. A/R
- Use carburetor heat to keep carburetor inlet temperature above freezing

Generators……………………………………………………….. Check
- Switch off one generator and check if load is taken over by other generator and switch back on
- Same for other generator

Altimeters………………………………………………………. . . . . Set
_ Mention QNH when cruise is at altitude and mention 1013 when
_ cruise is at level.

Fasten Seatbelts and No Smoking…………………………… A/R

Landing Lights…………………………………………………… A/R

Bilge Pumps……………………………………………………… A/R
- Check bilge lights if water is in the hull and operate concerning pump if necessary
- Check when lights are out if pumps are switched off

Approach

Fuel Cocks………………………………………………………………… R.o.R./L.o.L.

Mixtures……………………………………………………………........... Auto Rich

Carburetor Heat……………………………………………………………. As Required

Cowl Gills………………………………………………………………….. As Required

Landing Lights…………………………………………………………….. On

Fasten Seat Belts and No Smoking……………………………………….. On

- Inform cabin verbally "cabin crew prepare for landing" this must be
- approximately 10 minutes before landing.

Temps and Pressures………………………………………………………. Check

Hydraulic Pressure…………………………………………………………. Check

Crew Briefing……………………………………………………………….. Completed

Landing (Land)

Gear…………………………………………………………………………. Down and Check

- In case of land landing check if gear handle is locked
- Check if green down and lock light is on
- Check visually if main and nose gear is down and locked

Brakes and Pressure…………………………………………………......... Check

- PF pushes brakes and PNF checks if parking brake is released
- Check brake pressure is sufficient

Prop Levers…………………………………………………………………. TO GO

- PNF moves prop levers to full fine on command of PF when he is retarding the throttles to idle in the flare

Cabin………………………………………………………………………… Ready and Warned

- Check if "cabin ready "is received and command "cabin crew take your seats".

Landing (Sea)

Gear…………………………………………………………………… Up and Check

- Check if red gear up and locked light is on
- _ Check physically and visually if main gear is up and locked
- _ Check visually if nose gear is up through aft window

Nose Wheel Doors…………………………………………………. Closed and Check

- Check if amber nose door closed light is on
- Check visually on daylight in nose wheel compartment

Wing Floats……………………………………………………………. TO-GO/Down

- In case of water landing check if floats are visually down
- Check that float motor stopped running
- Set float switch in neutral position
- In rough water it is allowed to lower the floats after the touch

Prop Levers……………………………………………………………….. TO-GO

- PNF moves prop levers to full fine on command of PF when he is retarding the throttles to idle in the flare

Cabin……………………………………………………………………….. Ready & Warned

- Check if “cabin ready “is received and command “cabin crew take your seats”.

Taxi In

Cowl Gills.......…………………………………………...............……….. Open

Landing and Strobe Lights..........……………………………………. Off

Pitot Heat..........……………………………………………........………. Off

Carburettor heat………………………………………………………... Off

Transponder.................…………………………………........………. Stby

After Parking/Docking

Parking Brake.. A/R

Rudder Lock.. On

ELT Guard Frequency.. Check

- Check with 121.5 on VHF if ELT is off

GPS.. Off

Nav Lights.. Off

Internal lighting…………………………………………………….. Off

Mixtures…………………………………………………………….. I.C.O.

- When propellers are stationary
- Command:“cabin crew doors may be opened”.

Anti Collision Light...Off

Radio Master Switch..Off

Battery Master Switch..Off

Magneto Switches.. Off

Master Magneto... Out

Throttles..Fwd

Move throttles forward to prevent head bumping while trying to get out

Internal Aileron and Elevator Lock...Installed

Termination

All covers...	Install
External Control Clamps..	Install
Gear External Locks..	Install
Hull and Float Drain Plugs...	Remove
Chocks..	In Place
Parking Brake...	Release
Cowl Gills..	Close
Battery Quick Disconnect...	Disconnect

2.3.1 OPERATING POLICY

01 GENERAL

Stichting Exploitatie Catalina PH-PBY Standard Operating Policy (SEC)is laid down in the SEC Part A. These general policies are not, or only partially, covered in this Part B. To comply with the Stichting Exploitatie Catalina PH-PBY standard operating policies, good knowledge of the applicable chapters of the Part A is mandatory.

Pilot duties are interchangeable and the crew co-ordination procedure thus use the terminology pilot flying (PF) and pilot not flying (PNF). The abbreviation SCD stands for Subject to Captains Discretion.
The PF normally occupies the LH seat.

For take-off and landing the pilots shall adjust their seats to obtain the optimum combination of outside view and instrument visibility.

There is one way of controlling the aircraft:
Manual Flight

Because the aircraft is controlled manually, the PF should keep his hands at the controls and refrain from any other handling and the PNF should have his full attention in monitoring the flight path and refrain from any non essential duty.

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2.3.2 CREW COORDINATION AND MONITORING

01 GENERAL

During all phases of flight good crew co-ordination and communication will enable the crew to be permanently aware of each other's actions, aircraft configuration, system status, aircraft position and ATC communication. All crew actions and tasks are to be monitored by each pilot.
Errors in judgment or deviations from standard procedures are to be reported at once to the other pilot.

Standard warning calls are:

'BANK'	when the maneuvering limit is exceeded.
'SPEED HIGH/LOW'	during approach, when the speed deviates more than +10/-5 kt from the correct value.
'SINK RATE'	during approach, when the rate of descent exceeds 1000 ft/min.

For crew co-ordination procedures refer also to the relevant block diagrams.

02 ASSIGNMENT OF DUTIES

The assignment of the first officer to PF duties is SCD and preferably done during pre-flight preparation and with the intention that he fulfills these duties for the whole flight.

03 CHANGING OVER CONTROLS

Should the captain wish to take over control ,or the PF wish to resume controls he will clearly state: “MY CONTROLS'.
Should the PF wish to hand over control he will clearly state: 'YOURCONTROLS'.
This transfer of control shall be acknowledged.

04 NORMAL OPERATION

Operating procedures have been developed to achieve the optimum use of both pilots. Many duties may be carried out by either pilot depending on which one at the particular time is more readily available. However, system handling by the PF shall never interfere with his main task of flying the aircraft. For that reason the following basic rules shall be complied with:

- The Normal Checklist will be read by the PNF, while both pilots must be at their flight stations.
- When the aircraft is on blocks, actions in response to the checklist must as far as possible be completed by the PF. The PNF shall ascertain the correct checking and setting of the systems and must check the given answer to be correct.
- When the aircraft is off blocks, the PNF must read and complete the relevant checklists.
- Reading and response must always be done aloud, regardless which pilot completes the necessary action.

All actions related to the handling of the aircraft shall be made by the PNF upon command of the PF. Before making the selection the PNF will convince himself that operating limitations and flight procedures allow the configuration or power change; if not, he will inform the PF accordingly. Commands of which completion requires some time (gear and power selections), shall be repeated by the PNF and acknowledged as soon as the desired position or action has been obtained or completed.

05 PUSH BACK/TOW PROCEDURES

At many airfields push-back procedures are in force and local regulations should be checked to determine whether a push-back or towing will occur before or after engine starting.
If a push-back/tow procedure occurs the following applies:

The Catalina is normally towed with its own special towbar that fits onto the axle of the nose wheel. Before towing the aircraft in this manner, the scissors bolt must be removed. This enables the nose wheel to caster beyond the maximum 30° limit. If the bolt is not removed and the wheel is turned beyond the limit, **damage** results. It is the responsibility of the captain to see that the scissors bolt is removed before towing and replaced before taxiing.
The "Before Taxi" checklist must always be completed.
It is essential that a positive confirmation of a BRAKES ON/OFF request is obtained when communicating with the ground engineer.

06 ENGINE STARTING

After start-up approval has been obtained by the PNF and the Before Starting Checklist has been completed, the engines are started. Engine starting will be done according the crew co-ordination procedure below.

The PF devotes his full attention to starting the engines and monitors the engine parameters.
The PNF monitors the PF and pays attention to any possible hand signals from the ground engineer.

It is good practice to motor the engine through at least twelve blades with the ignition switches off before starting the engine. This enables the oil pump to supply oil to the reduction gear area and at the same time it will disclose the presence of any oil in the cylinders (Hydraulicing)

It is allowed to start the engines by use of scan flows before using the Checklists. This to warm up the engine and use the time, while warming up the engines, for briefings and checklists.

FLIGHT PHASE/EVENT	PF	PNF
Start approval	Contact ground engineer for starting right hand engine by hand signal. Call: 'CHECK RIGHT HAND ENGINE' Call: 'STARTING RIGHT HAND ENGINE' Push starter switch to right hand engine Check rotation and count 12 blades **<u>IF ANY HESITATION IN THE ROTATION OF THE PROPELLER, RELEASE THE STARTER SWITCH AND INVESTIGATE.</u>**	Verify and call: 'PROPELLER STATIONARY, FINE AND FREE' Verify
After 9-12 blades After 12 blades	Start prime Stop priming at 12 blades Switch magneto's right hand engine to both When engine starts running call: 'MIXTURE AUTO RICH' Releases start switch and priming switch and calls: 'STARTER LIGHT OUT'	Slowly moves mixture control to auto rich and responds: 'AUTO RICH' Verify
Stabilizing	Adjust throttle to 1000 RPM or lower to keep oil pressure below 100 PSI.	Verify
	Fuel Boost pump off verify fuel pressure	Verify
	Call: RIGHT HAND ENGINE IS STABILIZED'	Check

Repeat procedure for the left hand engine. PF will than verify and call if propeller is stationary, fine and free.
After the start procedure for both engines is completed, the PF: signals ground crew member to remove GPU and wheel chocks and asks for the BEFORE TAXI CHECKLIST.

07 ENGINE STARTING WITH BATTERY POWER ONLY

Starting with battery power only when no GPU available.

08 BEFORE TAXIING

Complete Before Taxi Checklist. Both pilots should confirm that the area around the aircraft is free of obstacles before commencing taxiing.

09 TAXIING

During taxiing the controllocks, should be removed. The rudderlock may be set until after run-up checks. The purpose of the rudder lock is to prevent damage to the rudder caused by wind when the aircraft is left unattended.
The aircraft is quite easy to taxi with differential use of the engine power and by moderate use of the brakes.
Release the parking brake and advance the throttles slowly to commence rolling and check the brakes.
The pilot should realize that his position is well forward of the main gear. Ensure that the main wheels do not cut corners.
When taxiing, in crosswind conditions, asymmetric engine power may be necessary to keep the aircraft straight, with upwind engine at higher power.
During taxiing, both pilots must at all times be aware of the aircraft position. The PNF should be able to advise the PF of the correct taxi routing and should therefore have the relevant charts readily available.
Avoid sharp turns at high speed, as the tricycle landing gear resists changes of direction and can cause nose wheel skidding.

When parking, the nose wheel should be straight so that it will resist any weather cocking effect created by a cross wind and also to make either a right or left turn possible when taxiing is started.

2.3.3 NORMAL TAKE-OFF

01 DEPARTURE CREW BRIEFING

Within the Normal Checklist two references to crew briefing requirements prior to departure will be found. The PF will conduct the crew briefing in accordance with the requirements outlined below.

Use the ANWB sequence

A	Aircraft Status
N	Notams which are applicable to the flight
W	Weather conditions to be expected during flight
B	Briefing for departure/arrival

The crew briefing shall either start with **'STANDARD'** if the following conditions are met:
Standard crew co-ordination procedures
Standard flight techniques
Standard engine failure procedure
Full take off power

Or with **'NON STANDARD'**, after which only the deviating conditions(s) shall be mentioned.

In addition the crew briefing shall at least cover:

- Departure procedure
- All other items operationally required.

In case a take-off has to be made in a mountainous area or enroute obstacles are to be overflown during the first part of the flight, the captain should, in addition to the single engine climb-out procedure, give due consideration to a safe procedure, which enables:
Climb to a safe altitude in order to return to the airport of departure.
Enroute climb and single engine cruise in order to proceed to the most suitable airport.

02 NORMAL TAKE-OFF

TAKE-OFF POWER SETTING

The standard take-off power setting is 48' MAP/2700 RPM

SPEEDS

Take-off speed V1 = 83 kts IAS (is Vmca)

- Speed Relations

Vmca = 83kts IAS
Vr = 1,05* Vmca = 87 kts IAS
V2 = 1,1 * Vmca = 91 kts IAS

Operational Vyse/V2 is 90 kts

When lined up, compass heading and aircraft position should be checked for positive runway identification.
Where obstacles or noise abatement require such, this procedure should be amended accordingly.
A rolling take-off is recommended, except in limited runway length conditions.
When making a take-off from the brakes advance the throttles and just before reaching take-off power release the brakes.
Pitch trim setting is normally 0 so the stick-forces at rotation vary with the CG.
To apply take-off power, advance the power levers slowly.
For all take-offs the landing lights shall be switched on unless weather conditions are such that undue glare results.
During crosswind take-off the tendency for the upwind wing to lift should be counteracted by decisive use of aileron during the take-off run, rotation and lift-off.
Directional control during take-off run must be maintained by rudder control and use off differential power during the beginning of the take-off roll. Nosewheel should be straight before power application.
During the take-off roll keep control column full aft until the nosewheel loses contact with the runway, then gradually release back pressure on the control column so much that the nose wheel will not touch the runway. (do not over rotate !!!)
During the take-off roll in this configuration the aircraft will fly itself off the runway.
Once airborne lower the nose and fly level in ground effect to 95 kts, than readjust pitch to a climb attitude. And maintain airspeed of 95 kts.

Normal Take Off Crew Coordination

FLIGHT PHASE	PF	PNF
Commencing the take-off roll	• Hold control column full aft and set aileron into the wind • Release the brakes • Advance throttles to 30'MAP and call: "SET TAKE OFF POWER".	• Check engine parameters • Set 48' MAP and call: "TAKE OFF POWER SET" Fine tune the power lever setting above hand off PF who will hold the power levers in a way to facilitate this.
At approximately 60 kt		• Check if both airspeed indicators are showing approximately 60 kts
At V1/Vrot 83 kts	•	Call: 'Rotate'
Airborne (positive climb)	Call: 'GEAR UP' • Select	• Repeat
Accelerate in ground effect to 95 kts		•Monitor
At 95 kts and climb attitude	Call "set climb power"." (32.5" MAP/2325RPM)	•Repeat • Select • Confirm
At +/-200 ft	Visual check and call: "gear up and clean engine my side	•Visual check and call: "gear up and clean engine my side
When level at cruise altitude,	Call: 'SET CRUISE POWER" (28,5" MAP/2050RPM) Call: "AFTER TAKE-OFF CHECKLIST"	• Repeat • Select • Confirm • Perform

The call rotate from the PNF will aware the PF, it may be possible that the aircraft is already airborne. The PF will keep holding the power levers in order to facilitate a rejected take-off incase of engine failure during transition to climb speed and attitude. This obviously only when sufficient runway is available.
Once the gear is selected up a rejected take-off shall not be initiated

03 REJECTED TAKE-OFF

Rejection of a take-off at high speed can be hazardous, in particular when the runway length and/or condition is critical from a performance point of view. The decision to reject may only be made before V1. Once airborne and gear is selected up a rejected TO should also not be made, this because it may be possible that the aircraft is already airborne before V1.

The rejection of the take-off should be restricted to:

1) All observed failures and/or exceedances.
2) An engine failure
3) An engine fire
4) Conditions, which render the aircraft clearly unflyable
5) e.g. jammed controls, fire, explosions etc.

If the first officer is the PF, he may reject the take-off on his own initiative in case of an engine failure, an engine fire or a malfunction directly affecting aircraft control. However in all other cases he must await the command 'STOP'.

- The accelerate stop distance Land for a Catalina under ISA conditions, MTOW, full take off power, dry runway, no slope, no wind is approx. 1200 meters. (3600ft)
- The accelerate stop distance SEA for a Catalina under ISA conditions, MTOW, full take off power, no wind is approx. 2000 meters. (6000ft)

RTO CREW CO-ORDINATION

FLIGHT PHASE	**CAPTAIN PF**	**FIRST OFFICER PNF**
Failure/malfunction or Conflicting situation. Decision to abort	Call: 'STOP' Reject take-off	State nature of failure
Decision to continue	Call: 'CONTINUE' Continue take-off	

	FIRST OFFICER PF	**CAPTAIN PNF**
Engine Failure/fire or Flightcontrol Problems	Call: 'STOP' Reject take-off	When Captain decides due nature of failure to abort he calls: “STOP”
Decision to continue	Continue take-off	Call: ’CONTINUE’

RTO PROCEDURE

FLIGHT PHASE/EVENT	PF	PNF
Rejected Take off Aircraft stopped	Pull throttles to idle. Apply brakes. Relief nose wheel by pulling back the control column. Call: “SET PARKING BRAKE”	Monitor procedure to stop Aircraft. Helps pulling back the control column Sets parking brake State nature of failure
	Captain	**First Officer**
Confirmation of failure and evaluation of situation	Command: My Control my R/T make PA announcement ’CABIN CREW AND PASSENGERS, REMAIN SEATED ‘TAKEACTION’ Make PA announcement: ’CABIN CREW AND PASSENGERS, REMAIN SEATED” Inform ATC	Perform applicable actions or procedures.

- Be prepared for an ON GROUND EMERGENCY/EVACUATION procedure.
- Keep in mind the Runway length remaining and use the brakes accordingly

04 HOT BRAKES

An rejected take-off will normally cause hot brakes. If a subsequent take-off is considered feasible a brake cooling time of 30 to 60 minutes is advisable. Do not use the parking brake when the brakes are hot.

If extremely hot brakes are expected or fire/smoke is reported by ATC /Cabin staff the following guidelines are applicable:

- Stop clear of runway.
- Inform ATC, request fire fighting equipment, ground engineer, towing equipment and a stairway.
- Shut down engines.
- Keep in contact with ATC.
- If not safe, disembark via the entrance and have passengers kept well away from the wheels.

05 FAILURES AFTER V1

The PF devotes full attention to fly the aircraft, while the PNF states the nature of the failure.

In case of engine failures refer to Part B section 3.3

06 MINIMUM MANOEUVRING CONDITIONS AFTER TAKE-OFF

Minimum altitude and speed for turns after take-off

- During normal departures adhere to minimum altitude of 200 ft HAA.
- During special engine-out procedures adhere to minimum altitude of 100 ft HAA with speed 90 kts and not more than 15° AoB.
- Compliance with noise abatement procedures always remains SCD and should be consistent with the safety of flight.

07 MAXIMUM BANK ANGLE FOR TURNS AFTER TAKE-OFF

If a turn is required below 500 ft HAA, limit bank angle to 15 deg.

2.3.4 CLIMB CRUISE DESCENT

01 CLIMB SPEED SCHEDULE

- Normal climb speed..95 kts.
- Maximum gradient of climb speed.......................….91 kts
- Maximum rate of climb speed is ……....................95 kts.
- Single engine climb speed…………………………90 kts

02 CRUISE

For cruise settings see performance section

03 DESCENT

Cruising altitude should be maintained as long as practical, however a number of factors affecting the top of descent point are:

- Altitude
- Conditions during descent (wind, turbulence, aircraft weight).
- Weather at destination and alternate.
- Terminal area procedure.
- Runway in use.

For normal descent planning preference must be given to the clean configuration. When speed reduction is mandatory, the use of gear should be considered as reserve feature giving a greater operating flexibility.

At top of decent point gradually lower pitch, reduce power to +/- 20” MAP and maintain cruise speed.

Standard descent	Speed kt	Power MAP	R/D ft/min
	Vcruise	20’	500

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2.3.5 APPROACH AND LANDING

01 APPROACH POLICY

In general all approaches should be flown stabilized.

'Stabilized' means:
- Established 90 kts IAS
- Stabilized power (20"MAP/ 2050 RPM)

Threshold crossing speed is1.3 Vstall wich is approximately 75 Kts

02 ARRIVAL CREW BRIEFING

It is recommended to perform the arrival crew briefing while at cruising altitude. The crew briefing should be completed by the PF before terminal area penetration, so that both crew members are familiar with descent altitude restrictions, terminal area characteristics, approach facilities and airport data.

The crew briefing will cover the previous mentioned ANWB sequence with the following items:
- Any deviation from the standard Part B procedures.
- TOD and applicable minimum altitudes.
- Type of approach.
- Missed Approach Procedure
- Taxi-in route.
- Set-up of NAV-equipment.
- Operational impact of local situation, weather and aircraft deficiencies, if not yet covered.
- Obstacles in the circling area.
- Transition to published missed approach procedure from any position in the visual part.

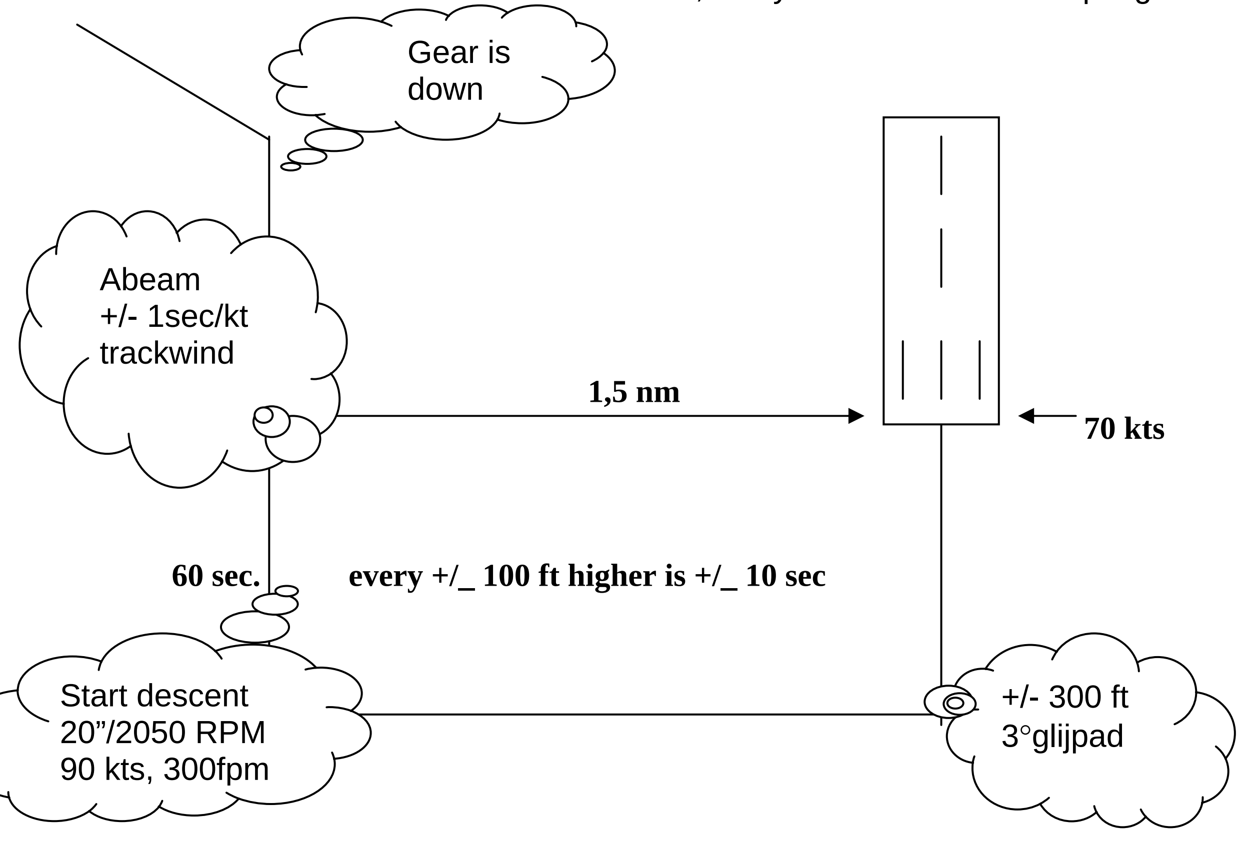
03 APPROACH INITIATION

Perform the approach checklist +/- 10 minutes prior landing and lower the gear in a very early stage in order to make a visual check possible which will not interfere with the higher workload during the actual approach. Also 10 min before landing announcement: "Cabincrew prepare for landing".

04 APPROACH CREW CO-ORDINATION PROCEDURE LAND

Flight phase or event	PF	PNF
Down wind stabilized, 90 kts and gear down	• Call: 'LANDING CHECKLIST'	• Perform
On final and landing assured	• Reduce speed to cross the threshold with 70 kts	
In the flare	• Call: "PROPS FULL FINE"	• Move propellers full fine
Established in landing roll	• **KEEP NOSE OFF THE GROUND AS LONG AS POSSIBLE AND USE AS AERODYNAMIC BRAKING** • if needed apply brakes until speed is reduced to taxi speed •Keep the aircraft straight with rudder as long as possible	• Assist
Runway vacated	• Call: 'TAXI IN CHECKLIST'	• Perform

- In case downwind is extended, delay descent until intercepting 3° G/P.



05 NORMAL LANDING

- Aim to cross the runway threshold with 70 kts
- Flare to a slightly nose-up attitude and retard the power levers smoothly to idle.
- Do not prolong the flare.
- After touchdown on the main wheels keep the nose wheel off the ground as long as possible to avoid shimmy.

06 CROSSWIND LANDING

On final approach maintain runway alignment by crabbing into the wind.
Just prior to touchdown, apply rudder to align the aircraft with the runway center line and bank into the wind to counteract drift (3° to 5° bank angle).

- Do not delay touchdown after decrabbing is completed.
- After landing, keep straight with rudder and counteract the tendency of the upwind wing to lift by decisive use of aileron.

07 LANDING ON CONTAMINATED/SLIPPERY RUNWAY

The landing and deceleration on a contaminated runway where reduced braking action or risk of hydroplaning exists, must always be considered critical. A high speed landing on a contaminated runway with no headwind or a tailwind greatly increases the possibility of hydroplaning.

In case of heavy rain or thunderstorms, delay the landing until weather and runway conditions improve.

<u>Runway selection</u>
The runway must be long enough to allow a reasonable margin above the normal landing distance, taking into account the braking action and the type of runway contamination.
<u>Approach</u>
The approach must be flown using the normal techniques. The threshold must be crossed at the correct speed.
<u>Flare and Touchdown</u>
Avoid floating and make a positive landing to assure wheel spin-up.
<u>Deceleration</u>
Start wheel braking not sooner than 2-3 seconds after the main wheels are firmly on the runway and initially apply light brake pressure, gradually increasing as speed is reduced. If no brake pressure is felt, expect hydroplaning. Release brakes completely for 2-3 seconds to allow the wheels to spin-up, then apply light brake pressure again.

08 APPROACH CREW CO-ORDINATION PROCEDURE SEA

Flight phase	PF	PNF
Down wind stabilized, 100 kts and gear UP	• Call: 'LANDING CHECKLIST SEA'	• Perform
On final min 300'ft AWL	• Reduce speed to 90 kts	
On final 200'ft AWL	Check Attitude, Speed and Power setting **Below 200 ft PF will not look inside**	Call '200 feet'
On final until Touchdown	Adjust Speed and ROD with power Maintain Landing Attitude	Call Alltitude, Speed and ROD
In the flare	• Call: "PROPS FULL FINE"	• Move propellers full fine
Established on water	Smoothly Reduce power •Keep the aircraft straight with rudder as long as possible	• Assist
Slow taxi	• Call: 'TAXI IN CHECKLIST'	• Perform

Note: In case of Splash and Go, or extended High speed 'Step' taxiing. PNF will call out speed, If speed Falls below 65 kts PF Should progressively increase Power.

SECTION 3 ABNORMAL FLIGHT TECHNIQUES

3.1 REPRODUCTION EMERGENCY CHECKLIST

3.2 EXPANDED EMERGENCY CHECKLIST

3.3 ABNORMAL FLIGHT TECHNIQUES

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EMERGENCY PROCEDURES

PART 1 GENERAL

PART 2 ENGINE FAILURE PROCEDURES

PART 3 FIRE

PART 4 PROPELLERS

PART5 HYDRA ULI CS

PART6 ELECTRICAL FAILURES

PART 7 EMERGENCY EQUIPMENT

PART 8 ABNORMAL LANDINGS

PART 9 PILOT INCAPACITATION

PART 10 CREW DUTIES DURING EMERGENCIES

3.1 GENERAL

01 EMERGENCY/ABNORMAL OPERATION

Procedure priorities are:

1) Fly Aircraft
2) Memory items
3) Emergency checklist
4) Normal checklist
5) Part B
6) Inform ATC and Passengers

02 CREW CO-ORDINATION PROCEDURE:

Either pilot announces the applicable emergency/abnormal condition.
The PF commands **'TAKE ACTION'** .If the applicable procedure contains memory items:Both pilots perform their respective memory items, and confirm completion by calling **'MEMORY ITEMS COMPLETED'**.If the applicable procedure contains no memory items: The PNF calls '**NO MEMORY ITEMS'**.
The PF commands **'EMERGENCY CHECKLIST, MY RT'** The PNF performs the Emergency Checklist, and confirms completion by calling**'EMERGENCY CHECKLIST COMPLETED'**

Commands to initiate the On Ground Emergency/Evacuation procedure will be given by the captain.

03 ENGINE FEATHERING PROCEDURE:

After an engine failure/fire or engine shutdown the engine must be feathered according the following crew coordination procedure based on '<u>dead foot, dead engine':</u>
In case of an engine failure after T/O the engine failure Checklist will not be initiated below 400 ft AGL

04 EMERGENCY AIRSPEEDS <28000 IBS

<u>All speeds listed are IAS</u>

Air Minimum Control Speed (Vmca)	85 Kts
Single Engine Best Rate of Climb (Vy)	87 Kts
Single Engine Best Angle of Climb (Vx)	87 Kts
Single Engine En-Route Climb	87 Kts
Single Engine Cruise Speed	87 Kts
Single Engine Landing Base Leg	90 Kts
Single Engine Final Approach	85 Kts
Minimum Speed for Unfeathering	90 Kts
Glide Speed for Range	90 Kts
Emergency Descent	30 Kts

05 SINGLE ENGINE OPERATION

Two major factors govern single engine operation Airspeed and, Directional Control.

The aircraft can be safely manoeuvred and trimmed for hands off flight provided sufficient airspeed is maintained.

To assist with directional control at lower airspeeds the use of shallow (<10 degrees) bank towards the live engine is permissible. However the main control is rudder and the seat and rudder pedals should be adjusted prior to flight to ensure that individual pilots are able to maintain its full use.
Failure to adhere to this basic procedure could place the aircraft in jeopardy.

The Catalina requires considerable effort on rudder pedals to effectively cope with single engine flight, especially at lower airspeeds.

06 DETERMINING INOPERATIVE ENGINE

The following checks will assist in determining which engine has failed

1) LAZY LEG = LAZY MOTOR i.e. The rudder pressure required to maintain directional control will be on the side of the live engine.
2) THROTTLE partially close the throttle of the "dead" engine No change of control pressures or sound of the engine should occur if the correct throttle has been selected.

WARNING. At low airspeed this check is to be used with extreme caution.

CAUTION *Do not use engine instruments to determine the inoperative engine. These often indicate near normal readings.*

07 EMERGENCY EXITS

The following exits are available for emergency evacuation

1. Bow mooring hatch
2. Captain's flight station overhead sliding hatch
3. First Officer's flight station overhead sliding hatch
4. Port hatch in forward passenger compartment (main door)
5. Overhead hatch in forward passenger compartment
6. Port blister lift up hatch
7. Starboard blister central perspex panel

08 PRE TAKE-OFF EMERGENCY BRIEFING

To be given by each flying pilot of each crew combination at their first flight of each day.

Fire at engine start

Throttles	Open
Mixtures	Idle Cut-off
Fuel booster pumps	Off
Fuel Selector	Off
Starter	Keep engaged

If fire not consumed: act as for…………………

FIRE ON THE GROUND

Throttles	Closed
Brakes	Stop / Park
Mixtures	Idle Cut-off
Fuel Boost pumps	Off
FWSO valves	Pull handles
Cowl flaps	Closed
Fire extinguisher	Select No 1 or No 2
Fire extinguisher	Discharge

PNF: Vacate to main cabin, assist passenger and crew evacuation, be last to leave.

PF:Notify ATC, Ignition off, Emergency Lights ON, Battery master switch OFF. Vacate via overhead hatch, assist passengers outside aircraft.

09 DECISION SPEED V'S AIRBORNE SPEED

In the Catalina Decision Speed (V1) will nearly always be higher than Take-Off Speed. A speed of 80 Kts has therefore been determined to separate being 'on the ground' (<80kts) or 'in the air' (>80kts).

Below 80 kts, if an emergency arises, the aircraft is to be placed firmly on the ground and the procedures for 'Engine failure during Take-Off On The Ground' are to be followed.

Above 80 Kts the aircraft will be truly airborne and the procedures for 'Engine Failure In The Air' are to be followed.

3.2.1 EMERGENCY DURING TAKE-OFF

01 GENERAL

Never attempt to pull the nose of the aircraft up before sufficient airspeed has been obtained.

Banks must be made towards the live engine (dead engine high).

Only Shallow banks should be attempted (max 10 AOB)

02 ENGINE FAILURE DURING TAKE-OFF 'ON THE GROUND' (BELOW 83 KNOTS)

Throttles	Closed
Brakes	Stop Aircraft then Park
Mixture	Idle Cut-off Dead engine
Boost Pump	Off dead engine
Ignition	Off dead engine
ATC	Lnform

Subsequent actions depend upon the circumstances. if possible, clear the runway on the side of the dead engine. Beware of locking brakes and blowing tyres during run out.

Release brakes from park when completely stopped due overheating. Do not restart until fault has been identified and corrected.

03 ENGINE FAILURE DURING FLIGHT (GENERAL)

Land as soon as practicable. Continued flight on one engine cannot be assured with the remaining engine being asked to perform at an unusually high power setting.

The aircraft should be clean, and attitude sacrificed to maintain speed thus preserving the remaining engine with due regard for safety.

Given time during an in-flight emergency, alternative avenues should be explored to correct the cause of the failure, with the safety of the aircraft, crew and passengers being the prime objective.

04 ENGINE FAILURE DURING FLIGHT (ABOVE SAFE HEIGHT)

Befoe completing engine failure checklist according Flight Techniques continue With the trouble checks.

TROUBLE CHECKS IF TIME PERMITS

Fuel	Contents, cocks, pressures, cross feed Temps and
Engine	Pressures
Ignition	On, check L, R, Both
Icing	Carb air to hot if icing suspected
Mechanical	Damage check
Partial Power	Use if available

TROUBLE NOT RECTIFIED, THEN

Complete engine failure procedure.

CLEAN UP CHECKS

Suction	Check
Fuel	Cross feed as required, check range options
Cowl Flaps	Closed on dead engine
Ignition	Off on dead engine
Generators	Check charge rate
Hydraulics	If starboard engine failed use Aux Pump
ATC	Advise of requirements, review options

05 ENGINE FAILURE DURING APPROACH

Same as for engine failure After Take-off (below Safe Altitude)

Feather engine immediately
Review options for gear down,
Use auxiliary hydraulic pump if necessary.
Not lower the gear until sure of making the runway.
Continue for the landing.
Advise A TC

06 SINGLE ENGINE CRUISE

The charts for Single Engine Cruise are found in Section 5 and should be consuited for range, fuel consumption, power available and best altitude. In general the aim should be to conserve the engines by using the lowest power settings possible consistent with safety. The Catalina will not maintain attitude with cruise power set on the live engine, even at sea level, and its best rate of climb at sea level at 28000 lbs AUW with Take-Off power set is 150 feet per minute.

Unless distance is the objective to make a land fail then the aim should be to land at the nearest available airfield suitable for a landing. In this case altitude may be sacrificed to maintain a speed compatible with cruise power in auto lean, on the remaining engine, and consistent with safety aspects of the route to be flown. if this is not possible, use higher power in Auto Rich to conserve height.

The IAS to fly is 87 Kts. This speed may only be obtained at an altitude below full Throttle height for the remaining engine, as power required is a function ofTAS x Drag. if the aircraft continues to descend below this altitude without stabilising, a ditching or forced landing must be considered. if extreme power settings are used to maintain altitude a second engine failure is a real possibility.
In all cases of single engined flight Air Traffic Control is to be kept informed of the intentions of the crew and to speed Search and Rescue action should that become necessary.

<u>Land As Soon As Possible</u>

07 SINGLE ENGINE CIRCUIT

Normal circuit procedures are to be followed with the exception that the gear is not to be lowered until a landing is assured.

Maintain a minimum of 87 Kts in the circuit pattern and only reduce this to 85 Kts on final approach once the landing is assured. The gear may then be lowered and power reduced.

The aircraft should be in a guaranteed position to land at a "decision height" of 300ft above ground level, straight in on final approach before the gear is lowered. If a Go Around is contemplated the decision must be made before "decision height" is reached, and the terrain should be such that a low level circuit can be flown using small angles of bank, to reposition for another approach.

Once the gear is lowered on finals the aircraft is committed to land. A Go-Around will no longer be possible.

Normal across the fence speed of 80 Kts is used followed by normal braking. Provision for turning off the runway towards the dead engine should be considered.

08 SINGLE ENGINE GO AROUND

A Go Around using one engine can only be accomplished if height above ground is available when the decision is made.

For Go-Around use:
1) Full Power
2) Aircraft clean
3) 87 Kts
4) Maximum of 15 Deg angle of bank Do Not Descend

A Decision Height of 300 feet above ground level is used as an absolute minimum for a Go-Around decision.
A single engine climb rate of 200 fpm or less does not permit the aircraft to be manoeuvred safely in confined areas.
Terrain clearance is important in the decision to go around.
The aircraft is not to be flown below terrain height unless the approach is assured.

A Go-Around on one engine is not a good option and it is important not to allow the aircraft to get into this situation.

WARNING: Under no circumstances should the floats or gear be down in a Go-Around.

09 FEATHERING

Battery power and engine oil in the feathering sump are necessary to enable the propeller to feather completely.

If the propeller will not feather then set it at minimum RPM where it will windmill. The severe drag in this situation makes a landing inevitable. The aircraft will not stay airborne even with Take-Off power in this condition.

Failed Engine Throttle	Close
Failed Engine Propeller	Minimum RPM
Failed Engine Mixture	Idle Cut-off
Feather Button	Confirm and Press
Feather, Selected Engine	Confirm, ensure button out
Mixture Live Engine	Full Rich
Power Live Engine	As Required
Clean Up Checks	Complete

CLEAN UP CHECKS

Suction Fuel	Check Cross feed as required check range options
Cowl Flaps	Closed on dead engine, open on live
Ignition	Off on dead engine
Generators	Check charge rate
Hydraulics	If starboard engine failed use Aux Pump Advise of requirements
ATC	Review options

QUICK FEATHERING SEQUENCE

Feather button	Confirm and Press
Mixture	Idle Cut-off
Ignition Fuel	Off
Fuel	Off
Cowl Flaps	Closed
Clean Up Checks	A/R
Power	A/R

10 UNFEATHERING (MIN SPEED 90 KTS)

Fuel	On
Booster Pump	On
Mixture	Idle Cut-off
Propeller	Minimum RPM
Throttle	Set minimum power
Ignition	On both
Feather Button	In ………Pullout at 800 RPM
Mixture	Auto Lean
Warm up 1600/25"	Cyl head temp 120°C
Temps and pressures	Satisfactory
Cowl flaps	A/R
Generators	On -check load
Power	Adjust to Cruise

11 SIMULATED ASYMMETRIC FLIGHT

Simulated asymmetric flight in the Catalina can be achieved by throttling back the 'dead' engine to 15" manifold pressure at 1500 RPM.

In all cases of simulated asymmetric flight both RPM levers are to remain set together on the quadrant, and are to be moved together when resetting RPM, using only the "live" engine's tachometer to set both lever positions.

In the circuit pattern from Base Turn to Round Out the asymmetric simulation can be achieved by the Training Captain maintaining a differential throttle setting. At Round Out, both throttles will be fully closed.

During this procedure the student pilot will only be required to operate the engine which is deemed to be 'Live'.

In a Go Around situation it is the Training Captains role to set 15" on the selected 'Dead' engine, and for the student pilot to use whatever power is necessary on the 'Live' engine to effect the Go Around.

12 ENGINE FIRE DURING START

This type of fire is usually associated with the carburettor. The aim is to induct the fumes and/or fire back into the air intake.

Throttles	Closed
Mixtures	Idle Cut-off
Fuel Boost Pump	Off
Fuel Selector	Off
Starter	Keep engaged

If fire not out: act as for FIRE ON THE GROUND

Throttles	Closed
Mixtures	Idle Cut-off
Fuel Boost Pumps	Off
FWSO valve	Pull handle
Cowl flaps	Closed
Engine Extinguisher	Select No 1 or No2 and Discharge
Evacuate Aircraft	Duties as below

13 ENGINE FIRE DURING TAKE-OFF (BELOW 83 KTS)

If an engine fire occurs during Take-Off before becoming safely airborne (80 Kts) the aircraft is to be brought to a stop, the engines secured and the aircraft vacated.

Throttles	Closed
Brakes	Stop 1 Park
Mixtures	Idle Cut-off
Fuel Boost Pumps	Off
FWSO Valves	Pull handie
Fuel Cocks	Off
Cowl Flaps	Closed
Engine Fire Extinguisher	Select No.1 or No.2 then Discharge

Captain Leaves via cabin, assists passender evacuation, is last out of aircraft

Co-Pilot Notify A TC, Ignition off, Emergency lights on, Battery Master Switch Off, Exits through cockpit roof hatch, assists passengers outside.

14 ENGINE FIRE IN THE AIR (INCLUDING ON TAKE-OFF ABOVE 83 KNOTS)

The procedure is to shut down the affected engine, extinguish the fire and land as soon as possible. Single engined flight procedures as listed in this manual are to be followed.

ENGINE FIRE

*Mixtures.. Auto Rich
*Prop Lever.. Full Fine
*Power lever... Add on Live
*Aux. Hydraulic Pump... On
*Gear/Floats.. Up
*Identify L/R Engine Power lever................................Closed
*Featherbutton... Push
*Featherbutton... Check Cut Out
*Check Prop.. Feathered
Fuel Cock... Off
Booster Pump.. Off
Mixture... I.C.O.
Firewall Shutoff... Closed
Fire Selector... Select
Discharge Handle.. Pull
Magneto Switch... Off
Generator... Off
Cowl Gill... Closed
Prop Lever.. Full Coarse

If fire not out, land ASAP
If fire out or there is no fire, complete emergency engine shutdown checklist (clean up)

Failed engine Fuel Selector	Off
Failed engine boost pump	Confirm off
Fuel Cross feed	A/R
Failed engine Ignition	Off
Hydraulic pressure	Check, use Aux Pump if required
Failed engine Generator	Off, check charge
Flight Instruments	Check
Suction	Check
Temps and pressures	Check
ATC	Notified, advised of requirements
Flight Plan	Review options / diversion

15 WING FIRE

Actions depend upon circumstances, but the probability is that a wing fire is engine related. Carry out engine fire drill on the engine, discharge the extinguisher as required, inform ATC and land as soon as possible.

Turn affected Wing fuel tank selector OFF and check Cross Feed is OFF.

16 CABIN FIRE

Isolate seat of fire, use hand extinguishers and when fire is out ventilatie the aircraft. The extinguishers carried on PBY are non toxic but do deprive the fire of oxygen. Ventilation is important after the emergency.

17 BRAKE FIRE

A brake fire will not be immediately evident to those in the Flight Station. The alert will usually come from outside the aircraft through R/T, or possibly an alert crew member will report the problem.

The emergency is to be treated as an aircraft fire on the ground

Aircraft	Stop
Brakes	Do NOT set Park Brake
Engines	Stopped
ATC	Alerted

Passengers and Crew Evacuate Away from Affected Wheel
Battery Master Switch Off
Hand Extinguishers Use to Stop Fire Spreading

WARNING: Cold extinguisher fluids on the hot brakes can cause them to explode. Extreme care must be taken when using extinguishers.

18 RUNAWAY PROPELLER

The indication of a ruaway propeller will be an unexpected and continuing increase in RPM which cannot be contained by using RPM controls or reducing manifold pressure. This will probably be accompanied by a sudden increase in noise from the now ungoverned engine. Action required is :

Throttle	Closed
Speed	Reduce immediately to 90 Kts
Propeller	Affected Engine Minimum RPM
Mixture	Affected Engine Idle Cut-off
Feather Button	Affected Engine Press and Confirm
Gear/Floats	Fx
Mixture	Up or Coming Up
Propeller	Live Engine Auto Rich
Throttle	Live Engine Maximum RPM
	Live Engine A/R for 90 Kts
Clean Up Checklist	
Airspeed	Complete
	Maintain 90 Kts

If the affected Propeller has feathered correctly the subsequent actions will be as for engine failure during flight above safe attitude.

See Single Engine Cruise

If the Propeller does not feather then it must be determined whether the aircraft can stay airborne, and for how long.

This will probably not be the case unless the aircraft is very light.

Whatever the outcome the situation is a desperate one due to the high power required from the Live engine.

A forced landing or ditching must be expected and planned for whilst using all remaining time to advantage, executing a diversion to the nearest airfield. See **Forced Landing and Ditching** section xx

PART 5 HYDRAULIC EMERGENCIES

EMERGENCY HYDRAULICS SYSTEM OPERATION

19 AUXILIARY ELECTRIC HYDRAULIC PUMP

Normal back-up for the hydraulic system is the electric hydraulic pump situated on the forward bulkhead in the Galley near the top of the fuselage. This pump drains outboard to Starboard and the drain should be checked during Preflight to ensure that no leakage is occurring.

The switch for this pump is located on the Yoke.

The electric hydraulic pump carries out all the functions of the engine driven pump, but its use should be monitored. It is a high drain on the electrical system if the generators are not charging, so will deplete the batteries quickly. If it is used during flight then it should be restricted to use only when a hydraulic service is to be operated.

In normal operation the hydraulic system is 'idled' by an unloading valve. It is not operating under pressure, but supplies pressure only when asked to by a service being operated. The electric pump should only be operated when a service is to be used, to prevent undue wear and heating of the pump, and undue loading of the electrical system.

20 EMERGENCY HYDRAULIC HAND PUMP

The emergency hand pump is situated on the floor between the two Pilots It Is activated by inserting it's handle (kept behind F/O's seat) and pumping fore and aft vigorously. Provided fluid remains in the hydraulic system all normal hydraulic procedures can be completed by using the hand pump.

WARNING. The Hydraulic Hand pump has no pressure relief valve associated with its use. The system can be overloaded by pumping too vigorously. The Hydraulic Pressure Gauge must be monitored whenever the hand pump is used.

21 FIG 3/1

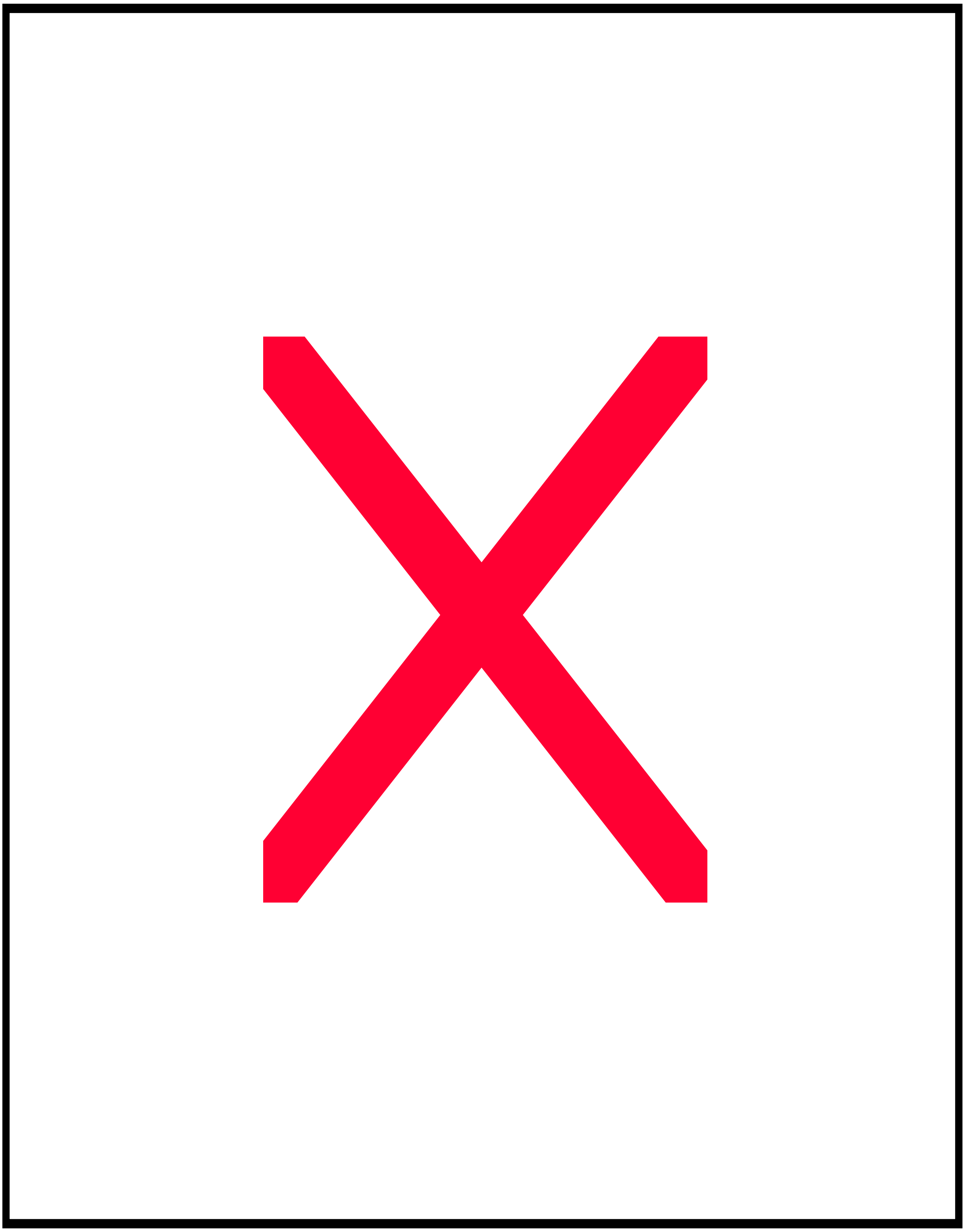
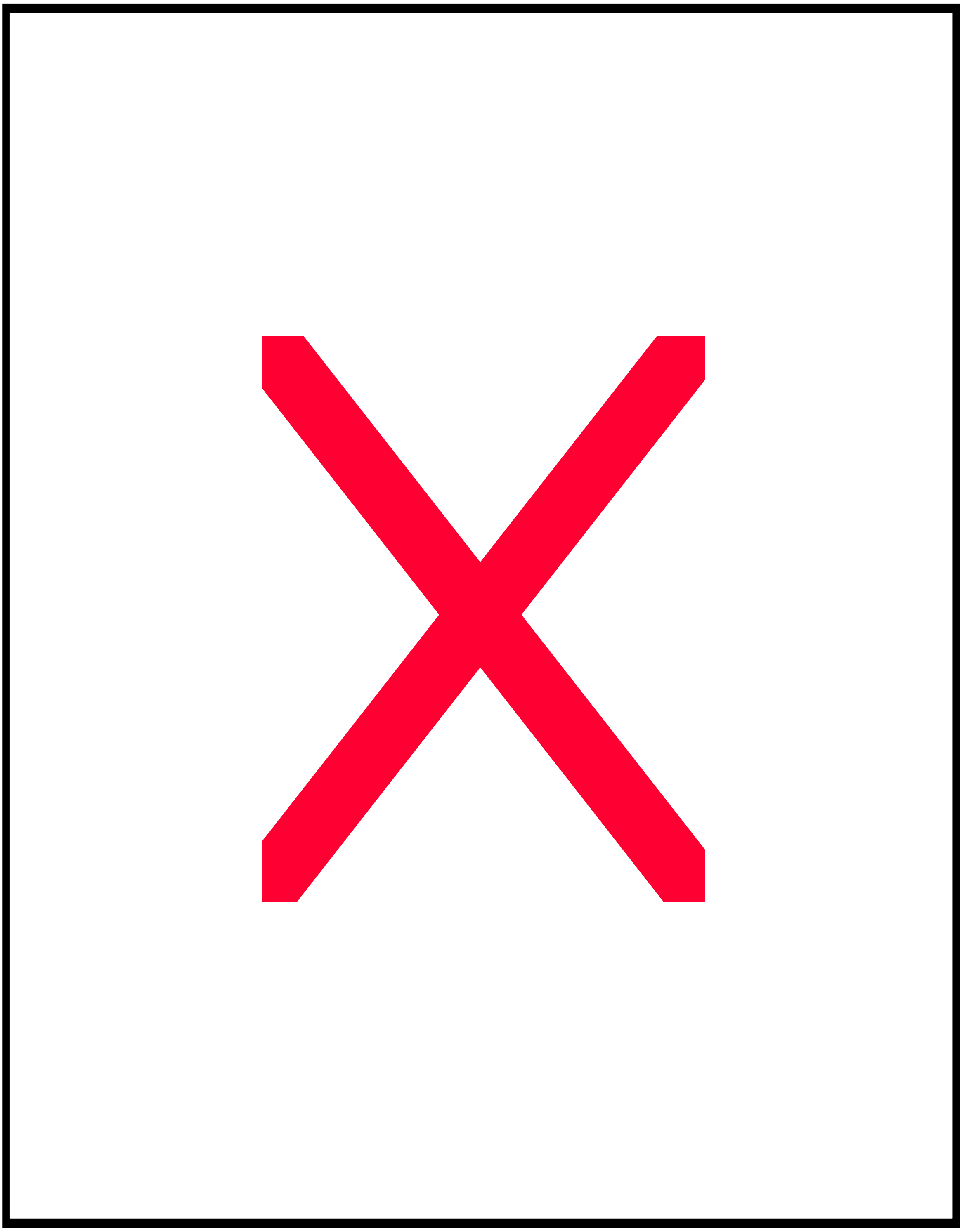


Fig 3/2



22 EMERGENCY LANDING GEAR OPERATION MAIN GEAR

If gear failure is not due to loss of hydraulic pressure and gear will not cycle as selected, check hydraulic pressure and repeat selection of up/down position. Pressure should be more than 800psi. If unsuccessful in raising gear return for landing after carrying out the following actions. Also if gear will not lower, then:
Refer to diagram.

1	Leave gear selected "DOWN"
2	Release wheel up locks by pulling out the "T" handles at the main wheel wells and turning handles 90 Deg
3	Work gear down by rocking aircraft and yawing from side to side, or push out by hand.
4	Use emergency lever to straighten main gear locking strut into locked position and check reference lines to confimllock.

23 NOSE GEAR

Refer to diagram

1	Unlock the nose wheel doors by pulling the door lock handle (located on the Stb side forward ofbuikbead No 1) up and back, thus retracting the nose door lock pins.
2	Insert the emergency lever 1 handle in the aft end of the Stb nose gear door torque tube (aft end of No 2 bulkhead) and push inwards (anti clockwise), rotating the torque tube to open the nose wheel doors.
3	Lock the torque tube in the "doors open" position by swinging the locking link inboard over the lug on the torque tube fitting. Insert locking pin and safety clip.
4	Remove the tape cover from central nose wheel bay hole. Insert the emergency lever into the hole and sthke the end of the up lock sharply, to unlock the nose wheel, The wheel should fail under it's own weight.
5	Attach the emergency lever to the torque tube between the packing unit and the jack fitting so that the ratchet pawl fits into the teeth. Using the lever as a ratchet, force the gear into the down position. To lock the gear use a slow heavy push. This may require leg force to give sufficient leverage.
6	Examine the downiock through the forward nose wheel bay access hole. Use the lever as a measure to determine if the down lock is engaged. If it is, the band on the lever will be just below the floor level of the nose wheel bay.

CAUTION: After an emergency lowering release the emergency door locking bar and pin before operating the gear again.

24 EMERGENCY BRAKE OPERATION

As the brake mechanism relies upon hydraulic pressure for its operation it is essential that a minimum of 600 psi is in the system for the brakes to work correctly.

Without hydraulic oil the hydraulic system will be inoperative, including the auxiliary pump and hand pump, but the emergency brake pressure cylinder is air pressurised to 600 psi. This is sufficient pressure to allow 4- 5 brake applications should the fluid in the brake system still be intact.

Without fluid in the braking system the brakes will be inoperative

If the braking system is intact refer to the section Emergency Hydraulic System Operation to obtain hydraulic pressure.

PART 6 ELECTRICAL FAILURES

25 GENERATOR FAILURE

The failure of one generator is not serious as the normal electrical load is able to be supplied by either generator by itself. Frequent monitoring of the generator load during flight is necessary to determine that the generators are functioning correctly.

Normal charge rate is between 5 and 20 amps at 26-28 volts depending upon the state of the batteries.

Maximum charge rate of either generator is 40 amps. Should this level be reached the load must be reduced until the rate is reduced. The high charge rate is indicative of an electrical fault and the cause should be found

1	Reduce known electrical load to reduce charge rate(s)
2	If only one generator is showing high charge rate switch it off and then on again. If the fault persists leave the generator off, and reduce load so that flight can continue on one generator.
3	If one generator ceases to charge during flight switch the generator OFF and continue as in 2 above.
4	If both generators show abnormal charge rates or cease to charge both should be switched off. The flight should be terminated as soon as possible, and the remaining battery power conserved for use by essential services such as the radios for safe entry into Controlled Airspace and the alerting of ATC.

Abnormally high electrical loads risks an electrical fire.Therefore:

Generator Switches	Off
Battery switch	Off
Circuit Breakers	Turn off equipment in use
Generator and Battery Switches	Restore
Charge rate	If normal restore power in turn to determine faulty equipment. If abnormal switch generators off.Continue as in 4 above

26 BOILING BATTERIES

Boiling batteries are a direct result of abnormal charge rates

Check each generator charge rate in turn to determine if either generator is overcharging the batteries due to over voltage. If this is the case turn the errant generator Off and continue using the remaining generator.

Reduce electrical load so that single generator operation remains within limits.

If the charge rate remains uncontrollable, and it has been determined that equipment failure is not the cause then the generators must be left Off and the flight continued as for Generator Failure above.

27 ELECTRICAL SMOKE OR FIRE

To determine where fault(s) exists and isolate fault(s):

1	Battery and Generator Switches	Off
2	Electrical Switches	Off

Ensure fire is out and ventilate Aircraft

3	Battery and Generator Switches	On in turn

If fault persists with only batteries supplying electrical power turn battery master switch OFF.
Continue flight as per section for total loss of electhcal power

If fault persists with either Generator turn that Generator OFF. Continue as for flight on single Generator

Turn electrical equipment on in turn to identify faulty equipment and then isolate defective item(s).

28 STARTER ENGAGED WARNING LIGHT ON

After engine start, should the starter relay remain engaged the starter will remain energised. The Starter Engaged Warning Light will remain illuminated indicating that damage will occur to the starter system and/or electrical system should the situation persist.

Starter Switch	Ensure Off
Mixture	Idie Cut-off
Ignition	Off
Battery Master Switch	Off

Investigate fault and do not attempt a restart until fault rectified

29 EMERGENCY FLOAT OPERATION

WARNING: Before starting manual float operation place operating switches on yoke to "OFF", and isolate the float electrical system by turning the float power switch to "OFF" at the Main Distribution Panel.

If the electrical system fails the floats may be operated manually:

EMERGENCY FLOAT OPERATION DIAGRAM

To lower floats
1 .

1	Remove the crank handle from the buikhead in the Galley.
2	Engage crank in "FAST" socket and crank anti clockwise.
3	Visual check and crank load will show that the floats are down. The throttle check below 15" will confirm the latching of the down lock.
4	Remove and re-stow crank handje

To raise floats

1	Insert crank in "FAST" socket and crank clockwise until load gets too heavy. Transfer to "SLOW" socket and continue until floats are up.
2	Remove and re-stow crank handle

PART 7 EMERGENCYEQUIPMENT

EMERGENCY EQUIPMENT CHECKLIST

An Emergency Equipment Checklist is detailed on page 32 at the end of this section. All items are to be checked during the Preflight Inspection by either the Pilot or a designated crew member responsible for that part of the Preflight Inspection.

ENGINE FIRE EXTINGUISHER

The engine fire extinguisher bottle is located behind the Captains seat on the Flight Deck and is filled with a mixture of CO2 and Argon. It is electrically discharged by operating a switch on the Main Electrical Panel. Prior to operating the Discharge Switch the Selector Valve (also found on the Main Electrical Panei) must be turned to the engine intended to receive the charge. See Part 3 of this Section.

WARNING: Electrical power must be on before engine fire extinguisher system can be used.

30 CABIN FIRE EXTINGUISHERS (3)

Portable fire extinguishers are located:

1) Behind the Co-Pilot's seat
2) Forward buikhead in the Galley
3) Forward buikhead in port Blister Compartment

All are 2,5 kg BCF type extinguishers that require servicing when "recharge" is indicated on the smail dial on each extinguisher. **CAUTION**: BCF is non toxic but excludes oxygen and therefore use in confined spaces is dangerous. Vacate the affected area and ventilatie the aircraft as soon as possible after the fire is out.

31 PORTABLE LOUD HAILER (10 WATT)

A portable load hailer is stowed in the toilet area behind the Co-Pilot. Follow directions on the loud hailers case.

The hailer is effective up to 250 meters and has a useful working life of six (6) hour.

32 FIRST AID KITS

Two types of First Aid Kits are carried

1	Standard Kit.	For use in emergencies as authorised by the Captain. A record is to be kept of use for replacement.
2	Daily Kit	For immediate "In Service" use of crew and pax

The "Standard Kit" is stowed under the starboard seaboarding in the Blister Compartmen 1 Two "Daily Kits" are stowed, one in the area behind the Co-Pilot and the other in tht Blister area.

The contents of the Kits are in accordance with CAA requirements

33 LIFE JACKETS (19)

Life Jackets are provided for all personnel on the aircraft if the flight is over water. Flightcrewjackets are red coloured whilst the passenger jackets are yellow.

In all cases the jackets are stowed near to each seat and It is the crew's duty to point out the location of the jackets to passengers during the Preflight briefing.

The method of operation of the jackets is also to be shown in addition to pointing ou the Safety Briefing Card.

All jackets have:
Twin chambers
Inflation by CO2 cylinder
Oral inflation tubes
Water activated batery for light (1/2 hour)

34 LIFE RAFTS

Life rafts will be carried as determined by CAA rules,

The type of life raft and complete operating instructions will be available prior to the flight and a complete briefing is to be given to crew and passengers before Take-Off.

Sufficient space on rafts will be available for all persons on the aircraft

35 TORCHES

Three dry cell torches are provided on the aircraft.

The torches are located:
1) In storage area behind the Captain's seat
2) On the forward Galley buikhead
3) In the storage locker in the Blister area

36 CRASH AXES

A crash axe is located in the storage area behind the the Captain's seat.

37 EQUIPMENT CHECK LIST

Engine Fire Extinguisher	Check Security and Selector
Axe	Check Security
BCF Fire Extinguishers (3)	Check Charged Full
Life Jackets	Check quantity and State
Torches (3x)	Check Serviceable
Cabin Signs	Check Serviceable
Intercom	Check Serviceable
Life raft	Check Secure and Complete
Emergency Exits	Check and Secure
First Aid Kits	Check Quantity and Seals Intact
ELBA (Aircraft)	Check on AUTO and Secure
ELBA (Portable)	Stowed and Secure
Loud Hailer	Stowed and secure
Ladders	Stowed and secure
Smoke Detector	State and Security

When the check is complete report to the Captain as part of the Preflight Check. This report will normally form part of the passenger and cargo procedures including the manifest and load sheet.

PART 8 ABNORMAL LANDINGS

38 GENERAL

The amphibian configuration presents the crew with more than the usual abnormal landing possibilities.

However, the water landing capability also presents a great safety factor in the face (a forced landing emergency (more options).

It is imperative that drills are followed precisely so that a situation is not worsened by landing in the incorrect configuration for the surface.

WARNING: Under no circumstances should the aircraft be landed on water with wheels down. The open bow door creates a very dangerous configuration which will resuit in the immediate loss of the aircraft, and danger to life of the crew and passengers.

39 GEAR UP LANDING

The obvious place to complete a wheels up landing is on the water.

The place chosen should be in accordance with normal fiying criteria as covered in Section 5.

Added features should include access to beaching facilities, or areas for grounding, and to assistance when securing the aircraft.

Should the aircraft be landed on a solid surface, damage can be expected to the Hull A carefully executed wheels up landing can resuit in damage being limited to the bottom of the keel. A sealed runway surface is often better in this regard and landing: on grass can produce more damage to a greater area of the hull.
The landing should be completed using normal approach speeds so that the hull is a parallel to the surface as possible at impact, and then the elevator used to keep the nose up as much as possible as speed decreases in the run out, much as in a water landing.

Carry out normal drills to the round out with Gear Up, Floats Up:

Throttles	Closed
Mixtures	ldie Cut-off
FWSO Valves	Pull handles, Time Permitting
Fuel Selectors I	Off
gnition	Off
Generators	Off
Battery Master switch	Off

Vacate aircraft immediately when aircraft stops

40 NOSE WHEEL SHIMMY

Nose wheel shimmy is hard on the nose wheel structuren and very damaging to the nose wheel tyre.
The shimmy can be the result of mishandling during the run out,or through mechanical problems in the shimmy damper or wheel balance. The correct action is to prevent It occurring and to minimise its effect. After touch down use the following technique:

Nose Attitude	Hold the nose wheel off the runway as long as possible before placing It down before elevator control is lost.
Elevator	Move positively forward to help dampen the wheel shimmy
Brakes	Apply as required to slow the aircraft without noticeable strain.

Once through the shimmy speed relax the braking effect.

If shimmy persists establish the cause and eliminatie the problem before the next flight.

41 OVER HEATED BRAKES

Harsh braking will over-heat the brakes. This not only causes undue wear and tear on the braking system but also poses the hazard of brake fire if they become too hot. Over heated brakes will be apparent by smoke issuing from the discs, but more importantie the Pilot will know how much braking was necessary and will know if the brakes will be hot. Brake fire has been covered in Part 2,should It occur.

With brake overheating or fire:

Brakes	Reduce use of brakes during taxying
Speed	Keep the airflow over the wheels by taxying.
Park Brake	Do Not Set. Use chocks.
Coolant	Do not use cooling extinguishers such as water or CO_2 on the brakes. Allow them to cool by themselves, keeping watch for further fire, and keep personnel away.

42 LANDING WITHOUT BRAKES

At 12700kg AUW, PBY can be landed safely using 65 Kts across the fence speed.

The aircraft is operating on the back of the drag curve and therefore needs considerabie power to maintain the slow approach with less than the normal 300 fpm rate of descent.A shallower approach path than normal is to be used, and floats may be used to increase drag.

Use the runway which will provide the greatest into wind / landing distance combination. Land up slope in nil or light wind conditions. Use the approach charts to determine the shortest landing distance and compare this with distance available. If there is doubt then proceed to another airfield where the distance available is adequate.

Once on the ground consider shut down of both engines, fuel cocks, ignition and battery master switchesturned off on the run out

It may be necessary towards the end of the run to steer the aircraft onto the grass to use up momentum, or to avoid collision. The safest option will have to be assessed at the time.

Retracting the gear whilst moving is likely to cause considerable damage and must only be the last resort to bring the aircraft to a stop.

PART 9 PILOT INCAPACITATION

43 GENERAL

If the pilot becomes incapacitated the aircraft and passengers are immediately placed at risk. In PBY where two Pilots will be available the problem is of a less severe nature. Nevertheless there may be times when only one qualified Pilot will be on board such as on training flights, and It is necessary for all to be on the alert for signs of crew incapacitation.

During Take-Off and landing It is necessary for two pilots to be in the cockpit seats and for them both to monitor the performance of the pilot at the controls (Flying Pilot). It is not out of place to comment on the performance of the Flying Pilot, in the interests of safety, or to question decisions should they appear not to be in accordance with the approved operation of the aircraft.

Other crew members should be aware of subtle incapacitation where both Pilots can be overcome by the same problem. It is common sense for all crew members to monitor each others actions and to question actions which are not in keeping with safe aircraft operation.

Subtle incapacitation is most likely to occur due to hypoxia at attitudes higher than PBY operates. However, It could also occur secondary to fumes or carbon monoxidc poisoning of the flight deck crew.AII crew members should be alert for symptoms such as:

Drowsiness
Poor concentration
Simple uncharacteristic mistakes
Character change
Trembling, tremor, shakes
Poor co-ordination
Headaches Nausea

If evident, ventilatie the aircraft, relieve crew as required to overcome the problem

WARNING: A collapsed pilot may fail forward onto the controls making It extremely difficult for the remaining pilot to maintain control. Other crew members will have to assist by restraining the collapsed pinot and removing him/her from the flight station.

PART 10 CREW DUTIES DURING EMERGENCIES

CAPTAINS DUTIES -EMERGENCY LANDING (LAND)

1	Advise Crew and Pax of emergency and intentions.
2	Advise AOM / CA of time to landing.
3	Brief First Officer in detail of intended actions.
4	Use Emergency checklists
5	After landing supervise Pax evacuation.
6	Last out through main door.(Torch, First Aid, Supplies, ELBA)

FIRST OFFICER DUTIES -EMERGENCY LANDING (LAND)

1	Assist Captain in planning landing.
2	Use Emergency checklist -wheels up landing this section. -
3	After landing,notify ATC, ensure Flight Station is secure.
4	Vacate through roof hatch, assist outside.
5	

AQM 1 CIA's DUTIES -EMERGENCY LANDING (LAND)

1	Inform and reassure passengers.
2	Ensure all crew and pax strapped in correctly.
3	Ensure crew/pax detailed to open hatches after landing.
4	Report to Captain that aircraft prepared for landing.
5	After landing, co-ordinate evacuation with Captain.
6	Retrieve portable ELBA, First Aid Kits, Supplies,check aircraft ELBA on and vacate aircraft.
7	Crew and pax check once away from aircraft.

CAPTAINS DUTIES -DITCHING

1	Advise Crew and Pax of emergency and intentions.
2	Advise AOM of time to ditcmng and any special provisions.
3	Brief First Officer in detail of intended actions.
4	Use Emergency Checklists
5	After landing supervise evacuation
6	Ensure ELBA, First Aid kits and Emergency Supplies taken on board life
7	raft
8	Last off aircraft
	Manifest check with AQM

FIRST OFFICER DUTIES DITCHING

1	Assist Captain with the planrung for ditching
2	Use Emergency Checklists
3	After ditching ensure Flight Station secure

4	Assist in evacuation where possible
5	Board life raft as requested. Assume senior position on raft

AQM-CIA'S DUTIES DITCHING

	Inform and reassure passengers. Ensure all crew and pax strapped in correctly Detail crew to launch life raft and open hatches. Advise Captain when aircraft prepared for ditching. After landing, supervise evacuation with Captain Retrieve ELBA, Torches, First Aid kit and Emergency Supplies then board life raft. Crew and pax check away from aircraft.

ALTERNATE STATIC AIR SOURCE

The alternate static source switch is located on the Starboard side of the F/O's Instrument Panel.

Should it become necessary to use the alternate static source (e.g., blockage in main system), the switch should be operated.

WARNING ERRORS IN IAS WILL BE INTRODUCED WHEN USING THE ALTERNATE STATIC SOURCE. REFER TO THE POSITION ERROR CHART FOR CORRECTIONS

44 AIRCRAFT VENTILATION

There is a natural flow of air through the aircraft due to its construction.

if, because of toxic fumes, fire, or the discharge of a fire extinguisher it becomes necessary to increase the flow of air through the aircraft, opening all vents and windows will rapidly disperse any fumes.
There is no means to pressure ventilate the aircraft and it is not possible to open any hatch in flight.

EMERGENCY CHECKLIST REPRODUCTION

✈ INTENTIONALLY LEFT BLANK ✈

CATALINA PBY 5A EMERGENCY CHECKLIST

✈ INTENTIONALLY LEFT BLANK ✈

EMERGENCY AIRSPEEDS

<u>All speeds listed are IAS</u>

Air Minimum Control Speed (Vmca)	85 Kts
Single Engine Best Rate of Climb (Vy)	87 Kts
Single Engine Best Angle of Climb (Vx)	87 Kts
Single Engine En-Route Climb	87 Kts
Single Engine Cruise Speed	87 Kts
Single Engine Landing Base Leg	90 Kts
Single Engine Final Approach	85 Kts
Minimum Speed for Unfeathering	90 Kts
Glide Speed for Range	90 Kts
Emergency Descent	130 Kts

FIRE AT ENGINE START

*Throttles .... Open
*Mixtures.. Idle Cut Off
*Fuel booster pumps.. OFF
*Fuel Selector .... OFF
*Starter.. Keep Engaged

STARTER ENGAGED WARNING LIGHT ON

*Starter Switch... Check OFF
*Mixture .... Idle Cut Off
*Ignition .... OFF
*Battery Master Switch .... OFF

Investigate fault and do not attempt a restart until fault rectified

ENGINE SHUTDOWN / FIRE AFTER V1

'TAKE ACTION'
*Mixtures ....Full Rich
*Propellers ....MAX RPM (full Fine)
*Throttles ....Take-Off Power
*Gear/Floats ....Selected up
*Aux Hydraulic pump ....On

'TAKE FEATHER ACTION'
* engine #...Identify
* engine #...Verify
* throttle # ....Closed
* propeller # ....Min RPM
* mixture #...Idle Cut-off
* feather # ....Press feather button
* Propeller # ....Confirm feather
* Gear / Floats...Check up

'TAKE FIRE ACTION'
* engine #...Identify
* engine #...Verify
* power Lever #..Closed
* propeller # ....Min RPM
* mixture #...Idle Cut-off
* feather # ....Press feather button
* propeller # ....Confirm feather
* gear / floats...Check up
* boost pump #..OFF
* FWSO valve # ....Closed
* cowl flaps #...Closed
* fire extinguisher ....Select engine on fire
* fire extinguisher ....Discharge

***if FIRE NOT OUT..land ASAP**

When circumstances permit, carry out AFTER SHUTDOWN checklist

ENGINE TROUBLE CHECKS IF TIME PERMITS

Fuel .... Check
Engine .... Check
Ignition .... On, check L, R, Both
Icing .... Carb hot
Mechanical .... Damage check
Partial Power .... Use if available

AFTER SHUTDOWN CHECKS

Suction .... Check
Fuel .... Cross feed A/R
Cowl Flap F/E... Closed
Cowl Flap L/E... A/R
Ignition F/E .... OFF
Generator F/E... OFF
Generator L/E... Check charge rate
Hydraulics If #2 engine failed .... use Aux Pump for Gear
ATC .... Advise

FEATHERING

Egine .... Identify
Throttle .... Close
Propeller .... Minimum RPM
Mixture .... Idle Cut-off
Feather Button .... Confirm and Press
Propeller,.. Fx, ensure button out
Mixture Live Engine .... Full Rich
Power Live Engine .... As Required
After Shutdown Checks .... Complete

QUICK FEATHERING SEQUENCE

Engine .... Identify
Feather button # .... Confirm and Press
Mixture #.. Idle Cut-off
Ignition #.. OFF
Fuel # .... OFF
Cowl Flaps.. Closed
After Shutdown Checks... A/R
Power .... A/R

UNFEATHERING (MIN SPEED 90 KTS)

Fuel ....ON
Booster Pump ....ON
Mixture ....Idle Cut-off
Propeller ....Minimum RPM
Throttle ....Set minimum power
Ignition ....On both

Feather Button ....In ………Pullout at 800 RPM
Mixture ....Auto Lean
Warm up 1600/25" ....Cyl head temp 120°C min
Temps and pressures ....Within Limits
Cowl flaps ....A/R
Generator ....On & check load
Power ....Adjust to Cruise

UNCONTROLABLE PROPELLER RPM

*Speed ....Reduce 90 Kts
*Mixture L/E ....Auto Rich
*Propeller L/E...Max RPM
*Throttle L/E...A/R for 90 Kts
*Throttle A/E ....Closed
*Propeller A/E ....Minimum RPM
*Mixture A/E...Idle Cut-off
*Feather Button #..Press
*Propeller...Confirm Feather
*Gear/Floats ....Up or Coming Up

Airspeed...Maintain 90 Kts
When circumstances permit, carry out AFTER SHUTDOWN checklist

CABIN FIRE

Fire .... Isolate and Extinguish
Ventilate .... A/R

BRAKE FIRE

Aircraft .... Stop
Brakes .... Do **NOT** set Park Brake
Engines .... Stop
ATC .... Inform
Battery Master Switch .... OFF
Crew and Pax .... Evacuate

ELECTRICAL SMOKE OR FIRE

Battery and Generator Switches................................ OFF
Electrical switches .... OFF
To determine where fault(s) exists and isolate fault(s):

Ensure fire is out and ventilate Aircraft

Battery and Generator Switches................................ ON in turn

If unable to restore battery power only; proceed with total loss electrical power

EMERGENCY HYDRAULICS SYSTEM OPERATION

Aux electrical Hydraulic pump....................................ON
Pressure ....Check
If No pressure Indicated

Hydraulic Hand Pump...Operate
Pressure ....Check
If No pressure Indicated

Continue with Emergency landing gear operation Checklist

EMERGENCY BRAKE OPERATION

Hydraulic pressure ....Check (min 600 psi)
Brake ....Apply (4-5 applications available)

If the braking system is intact refer to Emergency Hydraulic System Operation to obtain hydraulic pressure.

Caution No hydraulic fluid no brakes

LANDING WITHOUT BRAKES

Rate of descent..A/R
Floats..A/R
Runway length and direction ....MIN 4000ft

OVER HEATED BRAKES

With brake overheating or fire:
Brakes ....Reduce use of brakes
Speed ....Keep the airflow over the wheels by taxiing.
Park Brake...Do Not Set. Use chocks
Coolant ....Do not use

Allow brakes to cool by themselves, keeping watch for further fire, and keep personnel away

LOW FUEL PRESSURE

Fuel Boost pump..ON
Fuel pressure ....Check
IF Fuel pressure Normal..Continue flight
IF Fuel Pressure **NOT** Normal ....Monitor Engine performance
Consider Shut Down

LOW FUEL QUANTITY

Fuel gauge .... Check
Fuel Boost pump .... ON
Fuel pressure .... Check
IF Fuel pressure Normal... Continue flight land ASAP
IF Fuel Pressure **NOT** Normal .... Monitor Engine performance
Consider Shut Down

ELECTRICAL

Normal operating limits
Volts...26-28
Amps 5-20
Max Amps...40

TOTAL LOSS ELECTRICAL POWER

Generators...Check / OFF
Battery master switch ....OFF
Emergency avionics..ON

Systems powered are: VHF COM 1
Transponder

AMPS ABOVE MAX

Check charge rate ....If high reduce load
Generator Charge rates..If one generator high switch off and continue with one generator
If two generators high switch off both and continue battery only
If no charge rate switch off generator

ABNORMALLY HIGH ELECTRICAL LOAD

Generator Switches ....OFF
Battery switch ....OFF
Circuit Breakers ....Turn off equipment in use
Gen. and Batt. Switches ....Restore
Charge rate..If normal: restore power to determine faulty equipment.

If abnormal switch generators off.

Continue with Total Loss electrical power

BOILING BATTERIES

Amps ....Check
Volts..Check
Generators...A/R

EMERGENCY LANDING GEAR OPERATION

Emergency gear up

Hydraulic pressure .... Check (min 800 psi)
Gear .... recycle

Emergency main gear down

1 Leave gear selected "DOWN"
2 Release wheel up locks by pulling out the "T" handles at the main wheel wells and turning handles 90 Degrees
3 Work gear down by rocking aircraft and yawing from side to side, or push out by hand.
4 Use emergency lever to straighten main gear locking strut into locked position and check reference lines to confirm lock

Emergency nose gear down

1 Unlock the nose wheel doors by pulling the door lock handle (located on the Starboard side forward of bulkhead No 1) up and back, thus retracting the nose door lock pins.
2 Insert the emergency lever 1 handle in the aft end of the Starboard nose gear door torque tube (aft end of No 2 bulkhead) and push inwards (anti clockwise), rotating the torque tube to open the nose wheel doors.
3 Lock the torque tube in the "doors open" position by swinging the locking link inboard over the lug on the torque tube fitting. Insert locking pin and safety clip.
4 Remove the tape cover from central nose wheel bay hole. Insert the emergency lever into the hole and stake the end of the up lock sharply, to unlock the nose wheel, The wheel should fail under it's own weight.
5 Attach the emergency lever to the torque tube between the packing unit and the jack fitting so that the ratchet pawl fits into the teeth. Using the lever as a ratchet, force the gear into the down position. To lock the gear use a slow heavy push. This may require leg force to give sufficient leverage.
6 Examine the down lock through the forward nose wheel bay access hole. Use the lever as a measure to determine if the down lock is engaged. If it is, the band on the lever will be just below the floor level of the nose wheel bay.

CAUTION: After an emergency lowering release the emergency door locking bar and pin before operating the gear again.

EMERGENCY FLOAT OPERATION

WARNING: Before starting manual float operation place operating switches on yoke to "OFF", and isolate the float electrical system by turning the float power switch to "OFF" at the Main Distribution Panel.

If the electrical system fails the floats may be operated manually:

To lower floats

1 Remove the crank handle from the bulkhead in the Galley.
2 Engage crank in "FAST" socket and crank anti clockwise.
3 Visual check and crank load will show that the floats are down. The throttle check below 15" will confirm the latching of
4 the down lock.
5 Remove and re-stow crank handle

To raise floats

1 Insert crank in "**FAST**" socket and crank clockwise until load gets too heavy. Transfer to "**SLOW**" socket and continue until floats are up.
2 Remove and re-stow crank handle

ABNORMAL LANDINGS

GEAR UP LANDING ON LAND

Preparation

CA .... Inform
ATC .... Inform
Transponder 7700
Loose equipment .... Stow
Land & evacuation procedures.................................. Review
Fuel weight .... Reduce (if possible)
ELT... Set
Briefing .... Completed

Pre Landing

Approach and Landing checklist................................ Completed
ELT... ON
Exterior lights... ON
Seat belts No smoking .... ON
Cabin status .... Ready
Configuration .... Confirm

500 ft

*Command .... Brace for impact

Impact

*All electrical switches .... OFF
*FWSO valves... Close
*Throttles.. Closed
*Mixtures .... I.C.O.
*Ignition .... OFF

*Evacuation .... As Required

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ON GROUND EMERGENCY

*Throttles .... Closed
*Parking Brake .... Set
*Mixtures .... ICO
*Fuel Boost pumps .... OFF
*FWSO valves .... Closed

IF FIRE IS INDICATED

*Cowl flaps .... Closed
*Fire extinguisher .... Select No 1 or No 2
*Fire extinguisher .... Discharge

***Evacuation required** Capt. Commands "**Evacuate Aircraft**"

Captain: Vacate to main cabin, assist passenger and crew evacuation, be last to leave.

First Officer: Notify ATC, Ignition off, Emergency Lights ON, Battery master switch OFF. Vacate via overhead hatch, assist passengers outside aircraft.

***Evacuation not required** Capt. Commands "**cabin crew and passengers remain seated**".'

3.2 EXPANDED EMERGENCY CHECKLIST

To be issued

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3.3 ABNORMAL FLIGHT TEGNIQUES

01 GO-AROUND

The go-around procedure has to be initiated when the approach has to be abandoned. Make sure to select prop RPM before setting TO PWR

Go-Around requirements:
- Quick and correct power application.
- Stopping of sink rate by proper rotation.
- Speed at least 90-85 kts during the procedure.

If go-around is initiated:
<u>Above</u> 500 ft HAA select **CLIMB** power (32,5"MAP/2325 RPM)
<u>Between</u> 200-500 ft HAA select **METO** power (41" MAP/2550 RPM)
<u>Below</u> 200 ft HAA select **T/O** power (48" MAP/2700 RPM)

Go-around two engines:

PF	**PNF**
• Call: 'GO-AROUND, SET POWER' • Rotate to nose up attitude. • Command when positive rate: "GEAR UP"	• Set power and state: 'POWER SET' • Monitor procedure and Rotation. • Repeat, select confirm
Continue as for Normal Take-off, refer to Part B 2.3.3	

Note: - When an engine fails during a go-around maintain a speed of 87 kts IAS min if sufficient altitude exists accelerate spd 90 kts and climb
Proceed as for 'engine failure/fire after V1'

02 WAVE-OFF

The wave-off procedure (rejected landing) is similar to the go-around procedure for two engines except that the maneuver begins with the power levers near or at flight idle and at altitudes below 50 ft. Continue as a normal Take off and accelerate 90 kts before climb.

Pay special attention to the following aspects:
- Initially rotate only to stop the descent.
- During power application devote full attention to pitch attitude control.
- Do not rotate to a climb attitude until the speed is a minimum of 9~~8~~0~~5~~ kts
- Touching of the main wheels on the runway must be expected as it takes
- A few seconds for the engines to deliver take-off power.

Notes: The trim change on applying take-off power is significant but the stick force can be Held with one hand.
A rapid opening of the power levers create initially a tendency for the propellers to Fine off with the associated drag
A wave-off during single engine operation is not possible.

03 ENGINE FIRE/FAILURE BEFORE V_1

Reject the take-off.
For crew co-ordination, refer to Part B 2.3.3 03.

04 ENGINE FIRE/FAILURE DURING TAKE-OFF AFTER V1

If an engine fails after V1, the take-off should be continued.
The first indication of a loss in thrust is a drop in manifold pressure.
Accelerate 90 kts in ground effect and clbThe minimum speed is in all the segments is V2 (87 kts).

Use rudder and aileron trim as required. A maximum of 5 deg banks towards the live engine is allowed to maintain heading. This may require almost full deflection of the control wheel at V2 and a heavy aircraft.

If a check must be done when a propeller is actually feathered than this must be done by looking actually at the propeller.

When propeller is still windmilling maintain speed 83 kts IAS or greater with other engine at METO power. Trade altitude for speed and start descending to maintain Vmca or more. If necessary make an emergency landing on water or soft terrain with gear up, or on a runway with, if possible, gear down.

Flying on one engine in a twin-engine aircraft is considered an emergency.

The captain should determine a safe flight path based on his own judgment. First climb to a safe altitude before going into cruise and doing checklists.

Calling/stating or confirming any engine failure should not be accompanied by the engine number but by stating:
E.g. 'Engine Fire' or 'Engine Failure'

- If an engine fails at a speed between V2 and V2 + 10, maintain that speed.
- If an engine fails at a higher speed, gradually reduce to V2 + 10.

ENGINE FAILURE/FIRE DURING TAKE-OFF AFTER V1

FLIGHT PHASE/EVENT	PF	PNF
Engine fire/failure	• Apply ailerons towards live engine to ensure wings level.	• State nature of failure.
Airborne positive climb in ground effect.	• Call: 'GEAR UP' Accelerate 90 kts • Call: 'TAKE ACTION'	• In case of right hand engine failure/fire, switch on aux. Hydraulic pump • Repeat, select, confirm • Perform memory items.
Initial climb.	• Maintain speed, minimum V2 (90kts)	• Monitor speed/attitude.
Established CLB	Call 'TAKE FEATHER / FIRE ACTION'	• Perform memory items
	• Call: "SET METO POWER"	Call: "MEMORY ITEMS COMPLETED" • Repeat, select, confirm
When appropriate	• Call: 'EMERGENCY CHECKLIST' • Call: 'AFTER TAKE-OFF CHECKLIST'	• Repeat, perform, confirm • Repeat, perform, confirm

Notes: - *For, emergency/abnormal operation, crew coordination refer to AOM2.3.1. /0*
- Before the PNF operates a Feather button, a Fire Extinguisher or Closing a Mixture control a confirmation from the PF must be obtained.

General

ATC shall be informed as soon as practicable by MAYDAY or PANPAN call.
Inform ATC when deviating from the published departure.
During climb limit bank angle to 15°.
Minimum turning height is 100 ft HAA,.
During turn below 400 ft maintain V2.
Preferably make turns towards the live engine.
When landing conditions are below minima, climb to a minimum safe altitude and proceed to the nearest suitable airport.

05 SINGLE ENGINE CLIMB/CRUISE OR DESCENT

When an engine fails during climb, cruise or descent, take action according the Emergency checklist and set METO power on the live engine.

Single engine climb performance and single engine ceiling are based on the use of METO Power and V2.If present altitude can not be maintained and terrain clearance is a factor, set METO power and decelerate to V2. Descent with METO power and V2 and check drift down restrictions.
In case terrain clearance is no limiting factor maintain a speed of 100 kts.

06 SINGLE ENGINE APPROACH AND LANDING

The single engine approach closely resembles the two engines approach:

07 ENGINE FIRE/FAILURE DURING APPROACH

If an engine fails/sets on fire during the approach:

Increase power to maintain speed and glide slope.
Shut down failed engine, depending on the nature of the failure and/or time available, according the applicable memory items or emergency checklist procedures.
Depending on the circumstances continue single engine approach or initiate a single engine go-around.

Note: Below 500 ft HAA, it is recommended to continue the approach and landing in case of an enginefailure/ fire.

08 SINGLE ENGINE GO-AROUND

PF	PNF
Call: 'GO-AROUND, ‘SET TAKE OFF POWER’ Rotate to nose up attitude. When positive ROC Command: 'GEAR UP'	Set TAKE OFF power on life Engine and state ‘**POWER SET**’ Monitor procedure and rotation. Repeat, select confirm

Note:When applying power on remaining engine be prepared to use coarse aileron and rudder, particularly at low speeds.

- Climb to circuit altitude or follow published Missed Approach Procedure.

09 OVERWEIGHT LANDING

- In case technical or operational reasons require a landing at a weight above the maximum landing weight: Check available landing distance and perform a normal approach and landing.
- Any landing in excess of the maximum structural landing weight is considered an overweight landing.
- Any overweight- or hard landing must be reported in the Journal and to the MFO.

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SECTION 4 PERFORMANCE

4.1 AIRCRAFT PERFORMANCE CHARTS AND DATA

4.1.1 ENGINE PERFORMANCE ICING CONDITIONS

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4.1 AIRCRAFT PERFORMANCE CHARTS AND DATA

01 GRADIENT FACTORS

<u>Upward Slope</u>

Take-Off.	Increase distance by 1 % for every 1% upward gradient.
Landing.	Reduce distance by 1% for every 1% of upwards gradient

<u>Downwards Slope</u>

Take-Off	Reduce distance by 1% for every 1% of downwards gradient
Landing	Increase distance by 1% for every 1% of downward gradient

02 TAKE-OFF CLIMB AND LANDING CHART

FLIGHT OPERATING CHARTS, TABLES CURVES AND DIAGRAMS

AIRCRAFT MODEL(S) PBY-5A

ENGINE MODEL(S) R-1830-92

TAKE-OFF, CLIMB & LANDING CHART

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	HARD SURFACE AT SEA LEVEL TO CLEAR 50' OBJ.	HARD SURFACE AT 3000 FEET GROUND RUN	HARD SURFACE AT 3000 FEET TO CLEAR 50' OBJ.	HARD SURFACE AT 6000 FEET GROUND RUN	HARD SURFACE AT 6000 FEET TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	SOD-TURF AT SEA LEVEL TO CLEAR 50' OBJ.	SOD-TURF AT 3000 FEET GROUND RUN	SOD-TURF AT 3000 FEET TO CLEAR 50' OBJ.	SOD-TURF AT 6000 FEET GROUND RUN	SOD-TURF AT 6000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	SOFT SURFACE AT SEA LEVEL TO CLEAR 50' OBJ.	SOFT SURFACE AT 3000 FEET GROUND RUN	SOFT SURFACE AT 3000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE AT 6000 FEET GROUND RUN	SOFT SURFACE AT 6000 FEET TO CLEAR 50' OBJ.
28,000	0	0	1100	2160	1290	2460	1440	2980	1180	2240	1400	2870	1670	3160	1450	2610	1730	2900	2110	3350
	12	10	810	1710	993	1965	1100	2375	870	1760	1070	2345	1270	2445	1080	1970	1320	2296	1610	2695
	23	20	550	1408	780	1610	950	1870	580	1445	840	1870	1020	2040	840	1405	1040	1870	1280	2310
	35	30	410	1160	420	1324	710	1610	350	1175	670	1375	810	1475	480	1320	810	1595	1040	1895
31,000	0	0	1410	2800	1440	3185	1840	3850	1540	2860	1780	3305	2140	4080	1840	3330	2300	3845	2880	4800
	11	10	1040	2315	1380	2650	1490	3125	1150	2320	1350	2650	1640	3245	1440	2824	1760	3060	2220	3835
	23	20	880	1440	1000	2100	1140	2630	850	1830	1080	2150	1290	2640	1170	2140	1410	2510	1790	3110
	35	30	580	1510	810	1820	840	2100	740	1570	880	1870	1080	2230	910	1740	1110	2150	1480	2410
34,000	0	0	1750	3490	2040	4120	2420	4845	1460	3800	2300	4200	2750	5385	3040	4480	3040	5140	3850	6585
	12	10	1340	2805	1590	3320	1880	4120	1420	3245	1790	3440	2140	4370	2320	3585	2380	4110	3080	5310
	23	20	1070	2280	1210	2710	1440	3430	1100	2510	1330	2800	1740	3540	1810	2920	1880	3330	2440	4400
	35	30	880	1882	1030	2240	1120	2600	875	2010	1125	2260	1380	2880	1502	2400	1410	2730	1880	3540

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: [illegible]

OPTIMUM TAKE-OFF WITH 2700 RPM, 48 IN.HG. & 0 DEG.FLAP IS [illegible] OF CHART VALUES

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL BEST I.A.S. MPH	AT SEA LEVEL BEST I.A.S. KTS	AT SEA LEVEL RATE OF CLIMB F.P.M.	AT SEA LEVEL GAL. OF FUEL USED	AT 5000 FEET BEST I.A.S. MPH	AT 5000 FEET BEST I.A.S. KTS	AT 5000 FEET RATE OF CLIMB F.P.M.	AT 5000 FEET FROM SEA LEVEL TIME MIN.	AT 5000 FEET FROM SEA LEVEL FUEL USED	AT 10,000 FEET BEST I.A.S. MPH	AT 10,000 FEET BEST I.A.S. KTS	AT 10,000 FEET RATE OF CLIMB F.P.M.	AT 10,000 FEET FROM SEA LEVEL TIME MIN.	AT 10,000 FEET FROM SEA LEVEL FUEL USED	AT 15,000 FEET BEST I.A.S. MPH	AT 15,000 FEET BEST I.A.S. KTS	AT 15,000 FEET RATE OF CLIMB F.P.M.	AT 15,000 FEET FROM SEA LEVEL TIME MIN.	AT 15,000 FEET FROM SEA LEVEL FUEL USED	AT 20,000 FEET BEST I.A.S. MPH	AT 20,000 FEET BEST I.A.S. KTS	AT 20,000 FEET RATE OF CLIMB F.P.M.	AT 20,000 FEET FROM SEA LEVEL TIME MIN.	AT 20,000 FEET FROM SEA LEVEL FUEL USED	AT FEET BEST I.A.S. MPH	AT FEET BEST I.A.S. KTS	AT FEET RATE OF CLIMB F.P.M.	AT FEET FROM SEA LEVEL TIME MIN.	AT FEET FROM SEA LEVEL FUEL USED
28,000	89	77	830	50	89	77	635	6.0	75	89	77	480	12.2	100	89	77	425	21.2	130	89	77	170	37.9	195					
31,000	93	81	740	50	93	81	690	7.25	80	93	81	530	14.9	110	93	81	280	27.3	155										
34,000	98	85	610	60	98	85	580	8.9	85	93	85	400	18.5	120	98	85	150	38.7	190										

POWER PLANT SETTINGS: (DETAILS ON FIG. [illegible] SECTION III)

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

FUEL USED (U.S.GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH POWER OFF MPH	POWER OFF KTS	POWER ON MPH	POWER ON KTS	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	HARD DRY AT SEA LEVEL TO CLEAR 50' OBJ.	HARD DRY AT 3000 FEET GROUND ROLL	HARD DRY AT 3000 FEET TO CLEAR 50' OBJ.	HARD DRY AT 6000 FEET GROUND ROLL	HARD DRY AT 6000 FEET TO CLEAR 50' OBJ.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	FIRM DRY SOD AT SEA LEVEL TO CLEAR 50' OBJ.	FIRM DRY SOD AT 3000 FEET GROUND ROLL	FIRM DRY SOD AT 3000 FEET TO CLEAR 50' OBJ.	FIRM DRY SOD AT 6000 FEET GROUND ROLL	FIRM DRY SOD AT 6000 FEET TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	WET OR SLIPPERY AT SEA LEVEL TO CLEAR 50' OBJ.	WET OR SLIPPERY AT 3000 FEET GROUND ROLL	WET OR SLIPPERY AT 3000 FEET TO CLEAR 50' OBJ.	WET OR SLIPPERY AT 6000 FEET GROUND ROLL	WET OR SLIPPERY AT 6000 FEET TO CLEAR 50' OBJ.
28,000	83	72	77	67	980	2250	1080	2410	1170	2590	1150	2415	1250	2690	1370	2780	3900	5160	4200	5500	4610	6090
34,000	96	82	88	76	1290	2800	1410	3000	1540	3240	1500	3020	1650	3180	1800	3600	4580	6100	5000	6600	5480	7180

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

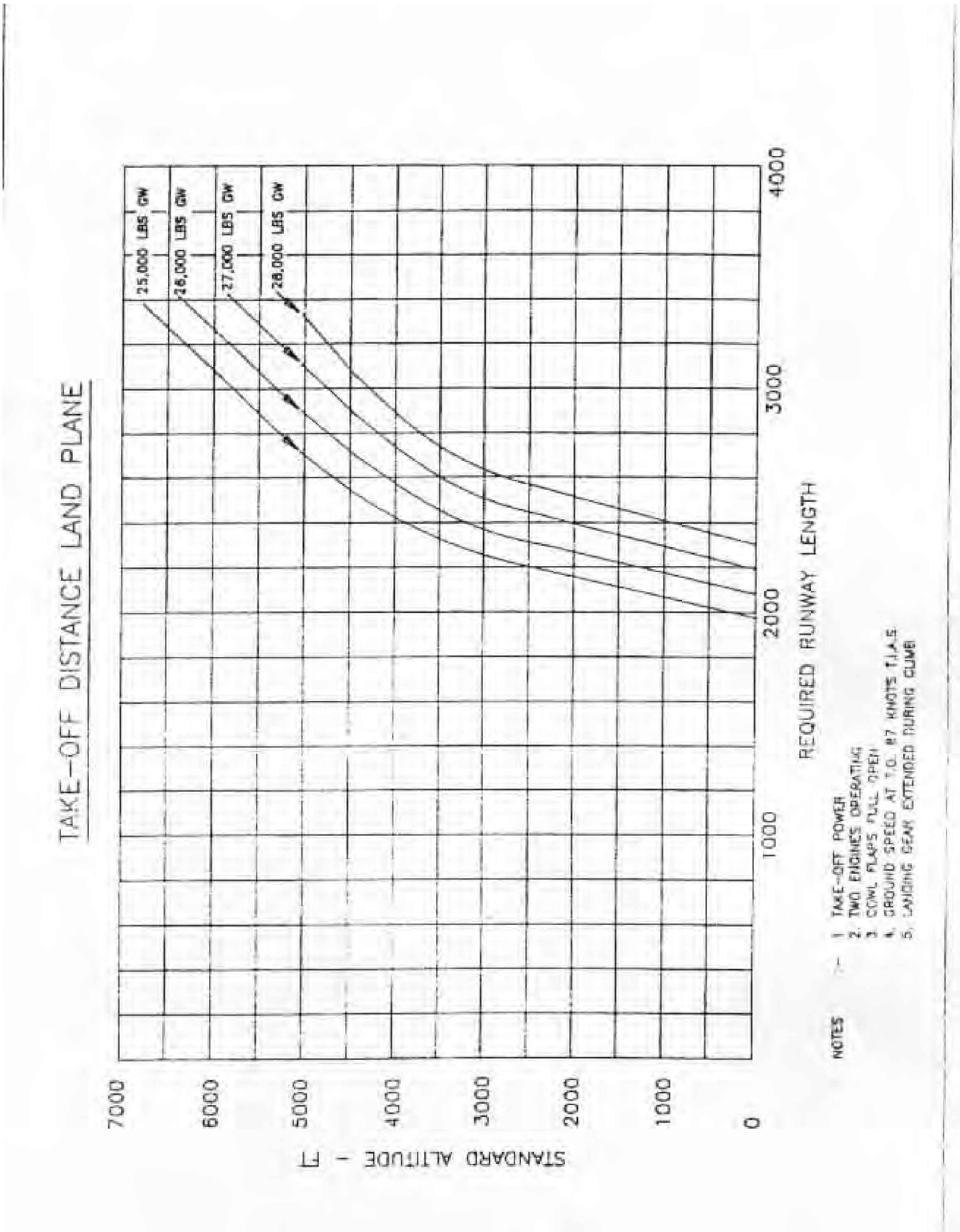
OPTIMUM LANDING IS [illegible] OF CHART VALUES

REMARKS:

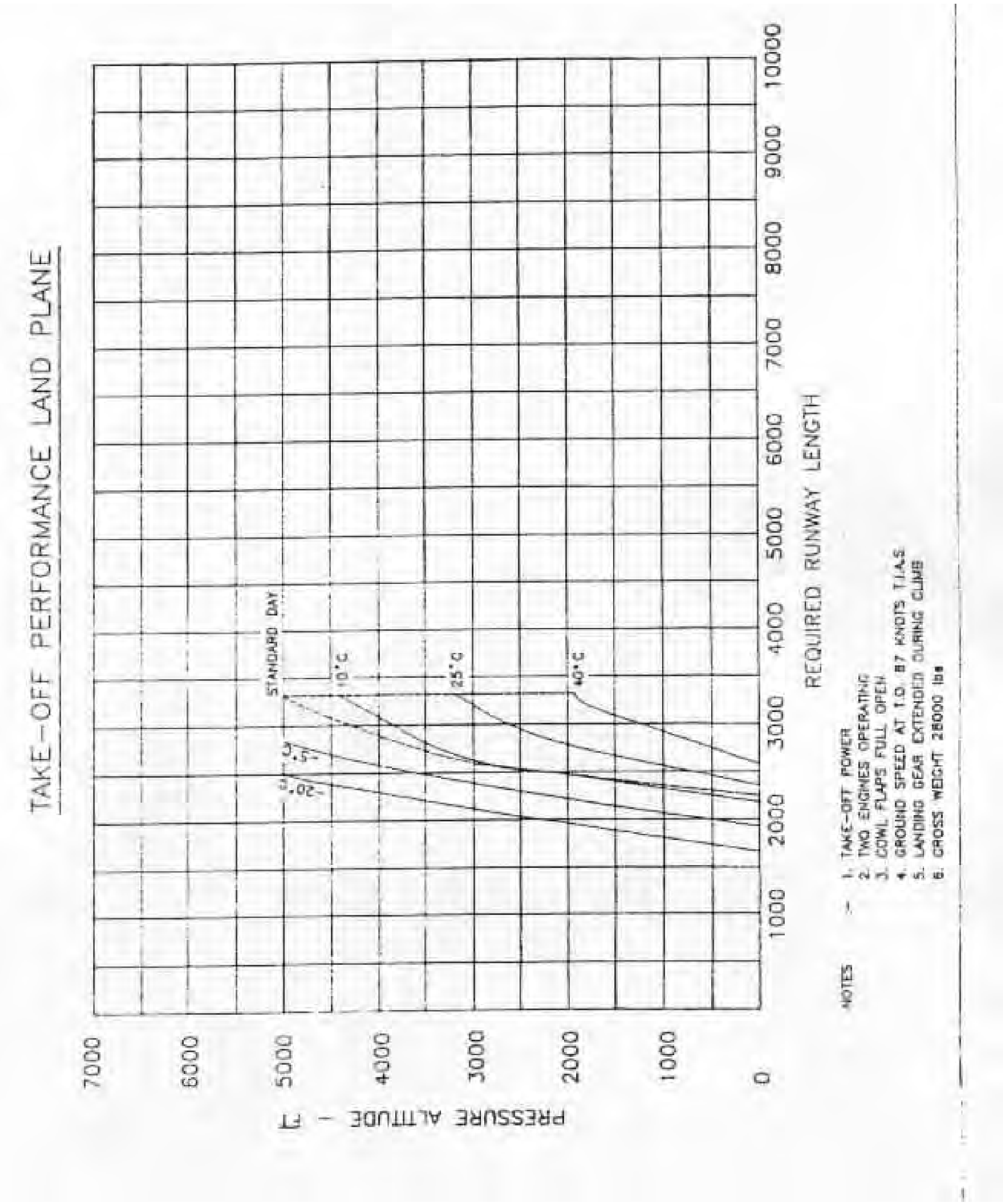
NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

LEGEND

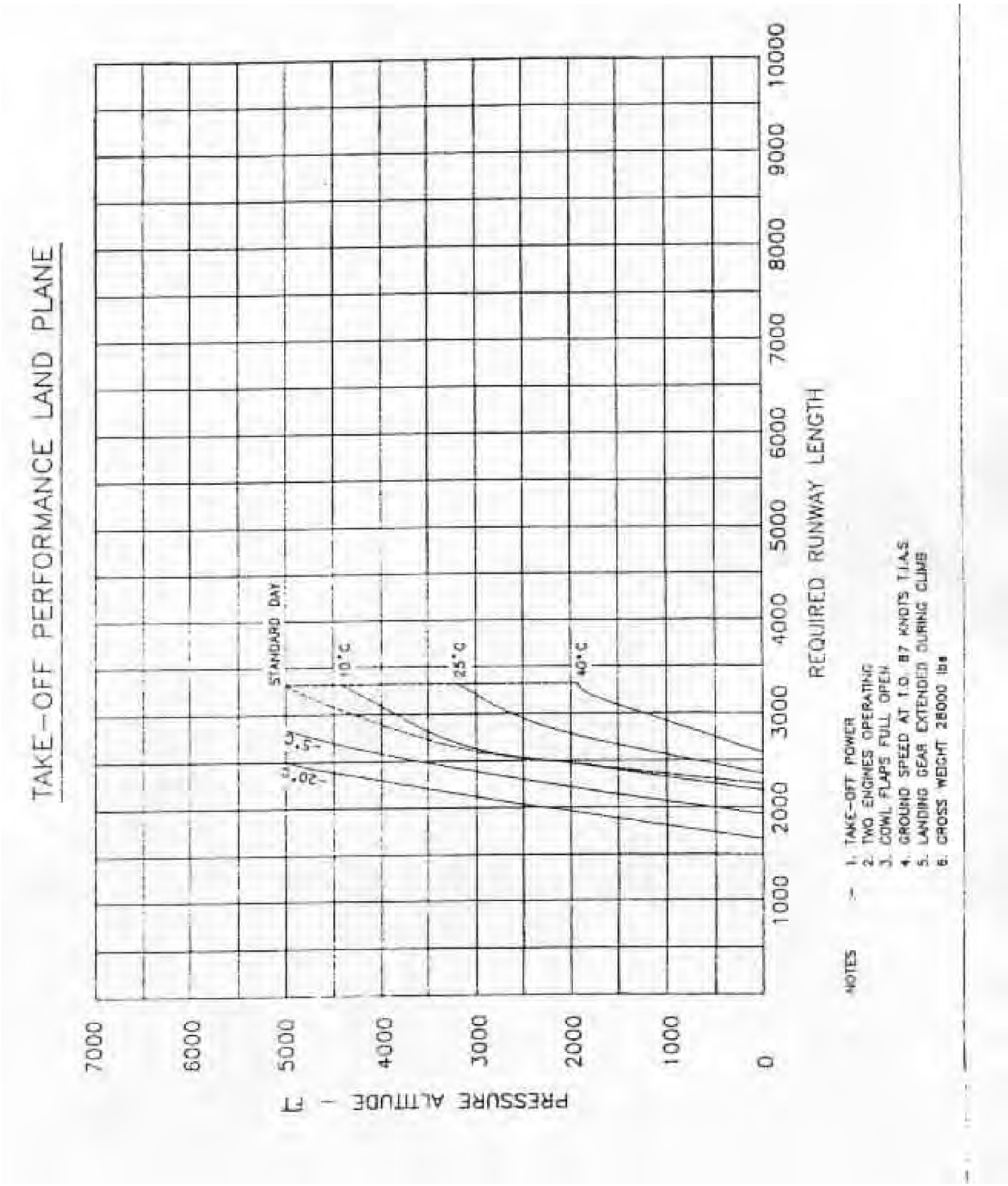
I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE


TAKE-OFF DISTANCE LAND PLANE
25,000 LBS GW
26,000 LBS GW
27,000 LBS GW
28,000 LBS GW
STANDARD ALTITUDE – FT
7000
6000
5000
4000
3000
2000
1000
0
REQUIRED RUNWAY LENGTH
1000
2000
3000
4000
NOTES :-
1. TAKE-OFF POWER
2. TWO ENGINES OPERATING
3. COWL FLAPS FULL OPEN
4. GROUND SPEED AT T.O. 87 KNOTS T.I.A.S
5. LANDING GEAR EXTENDED DURING CLIMB

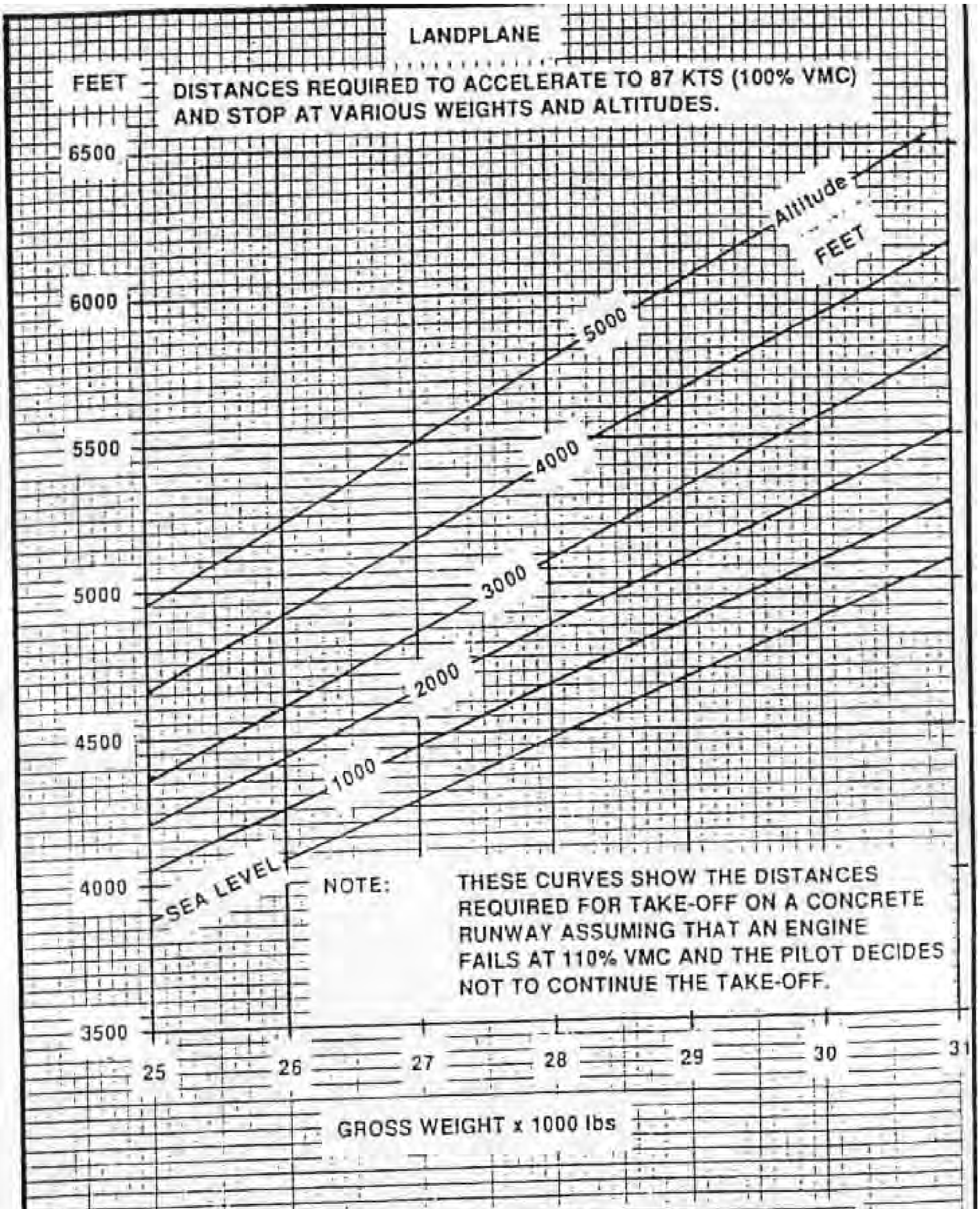
03 TAKE OFF DISTANCE LAND PLANE



04 TAKE OFF PERFORMANCE LAND PLANE

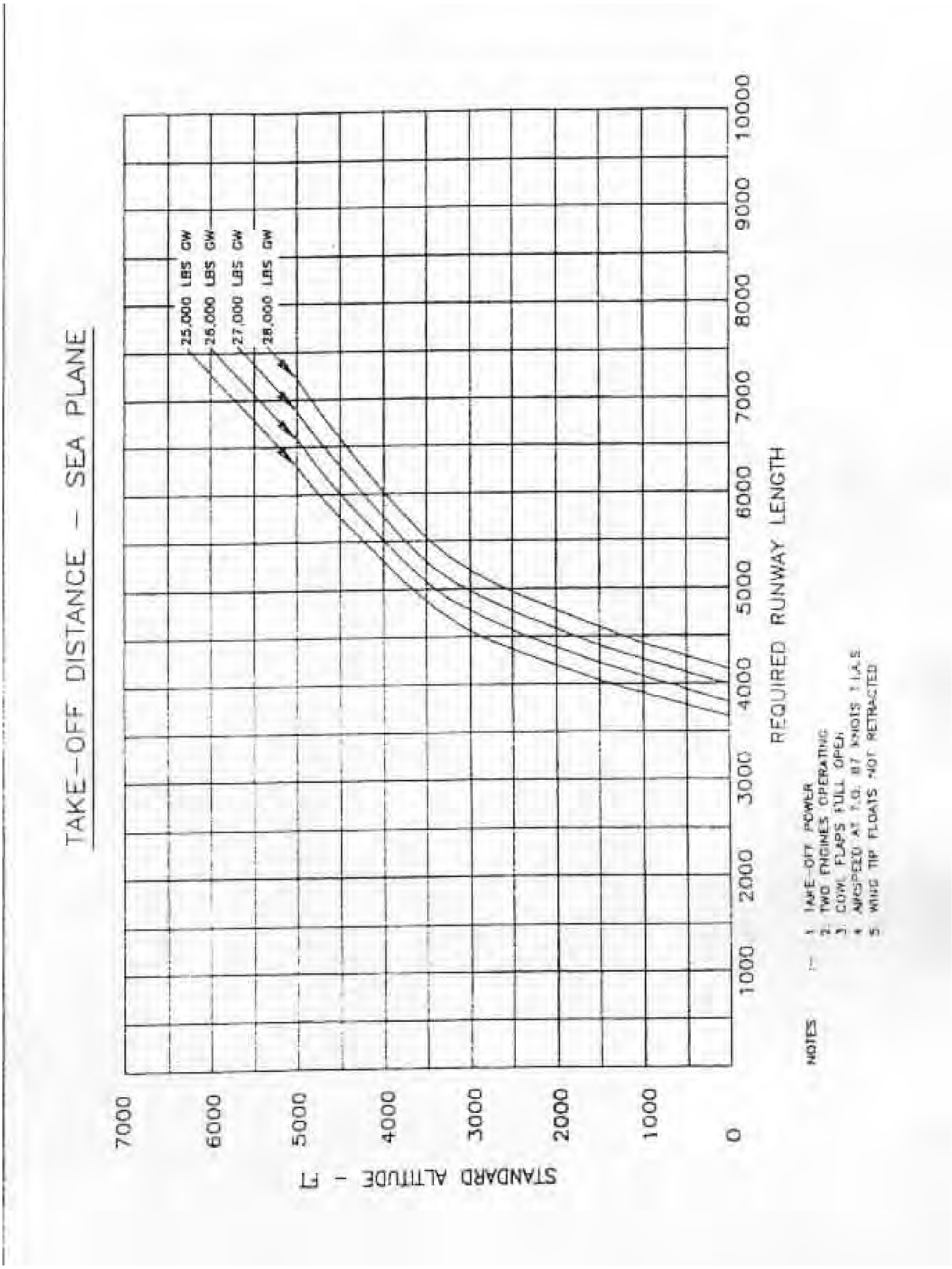


05 ACCELERATE STOP DISTANCE LAND PLANE

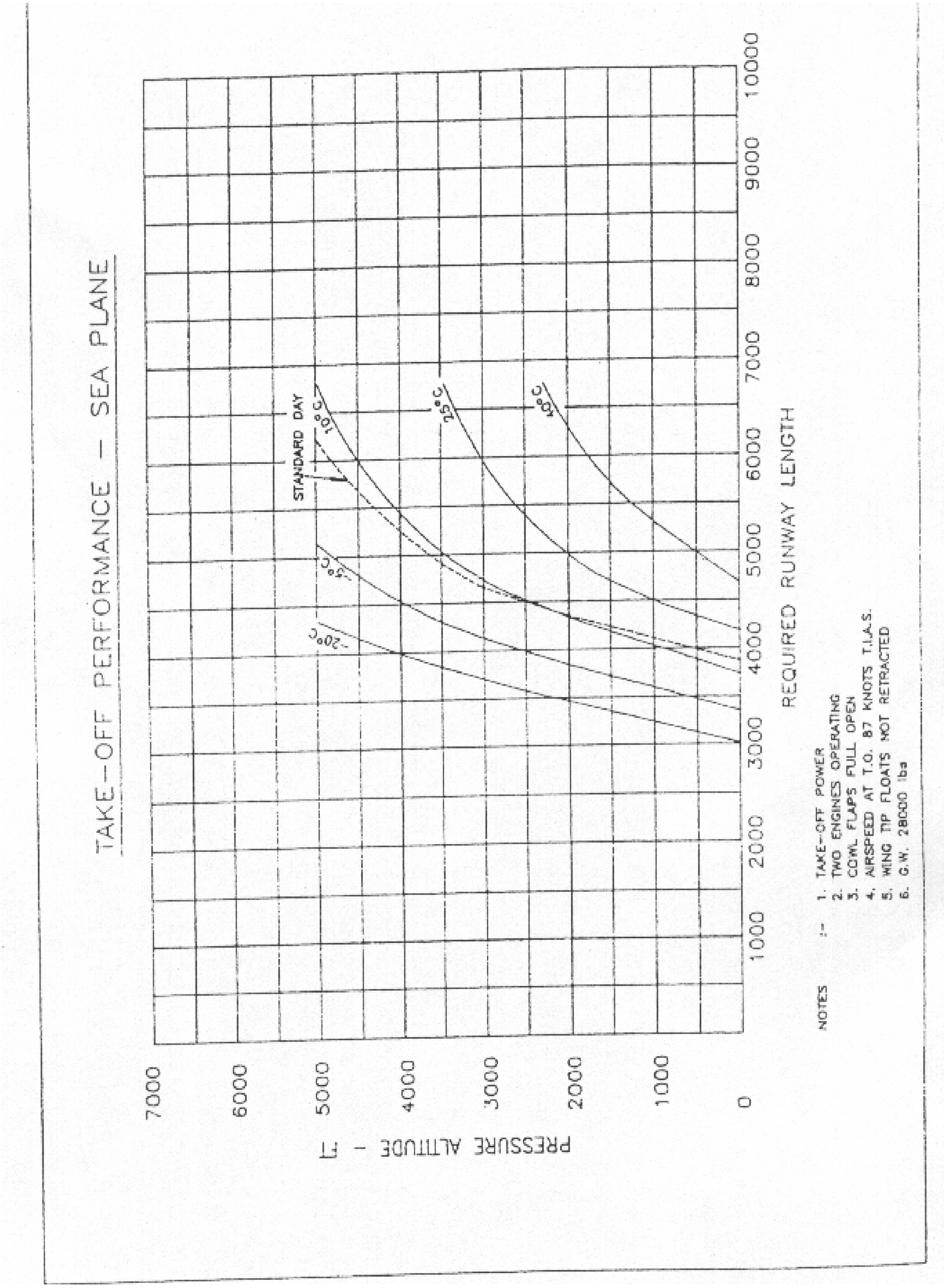


ELEV.	25,000	26,000	27,000	28,000	29,000	30,000	30,500
S.L.	3,880	4,080	4,270	4,460	4,700	4,820	4,960
1,000	4,050	4,250	4,460	4,700	4,860	5,070	5,170
2,000	4,220	4,430	4,640	4,860	5,070	5,290	5,400
3,000	4,360	4,600	4,840	5,080	5,320	5,560	5,680
4,000	4,660	4,915	5,160	5,410	5,660	5,910	6,040
5,000	4,960	5,230	5,500	5,760	6,030	6,300	6,440

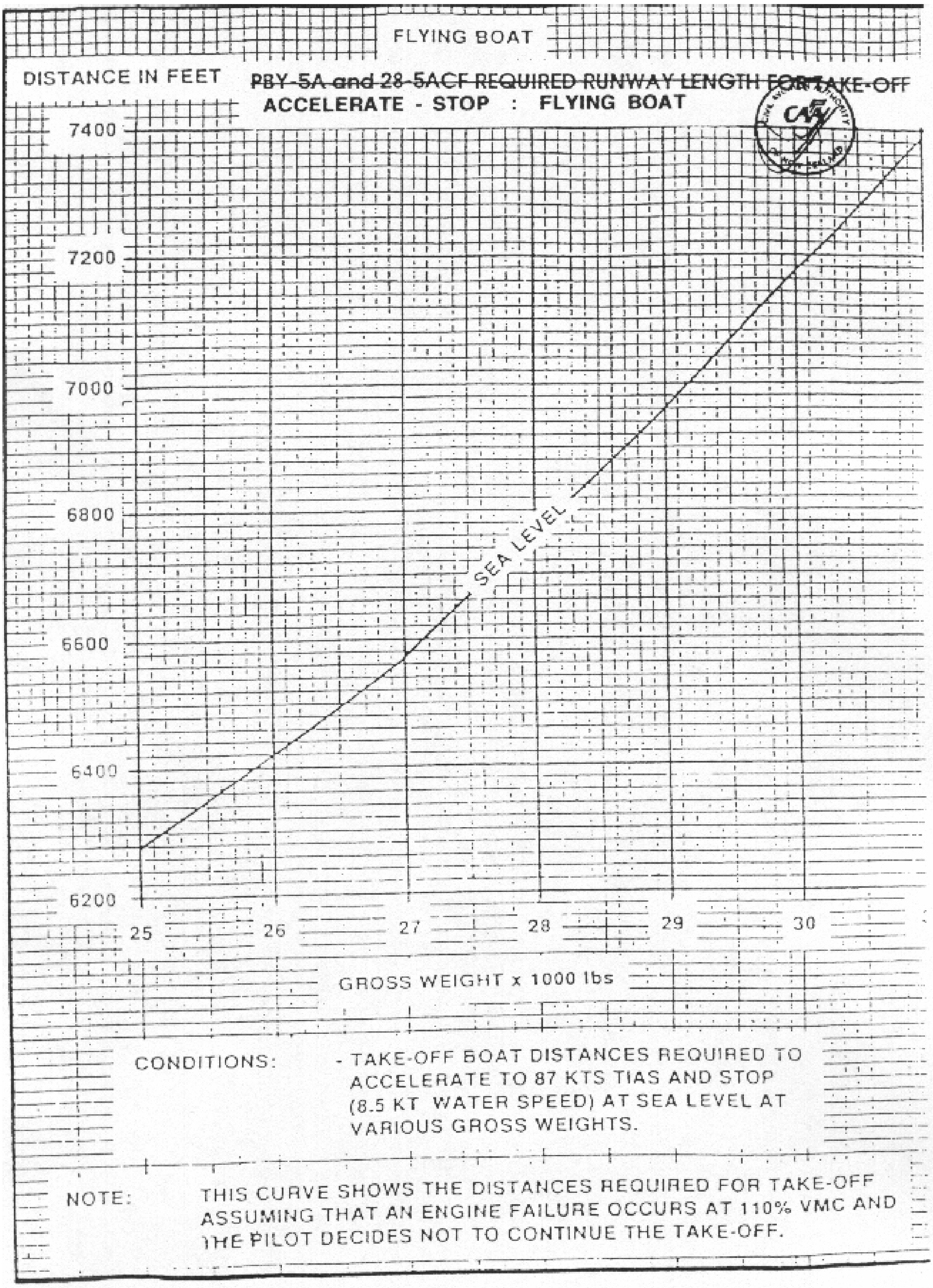
06 TAKE OFF DISTANCE SEA PLANE



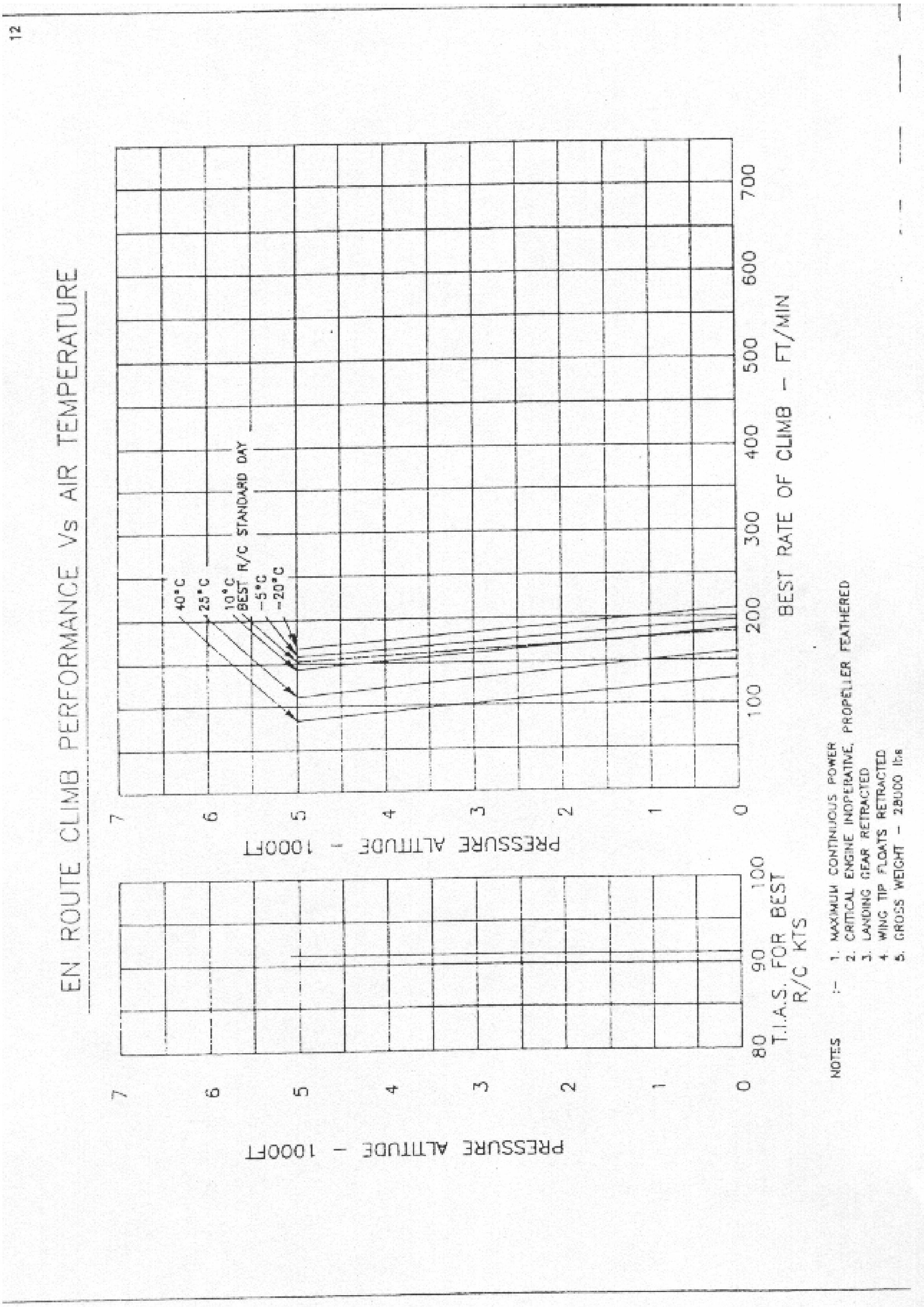
07 TAKE OFF PERFORMANCE SEA PLANE



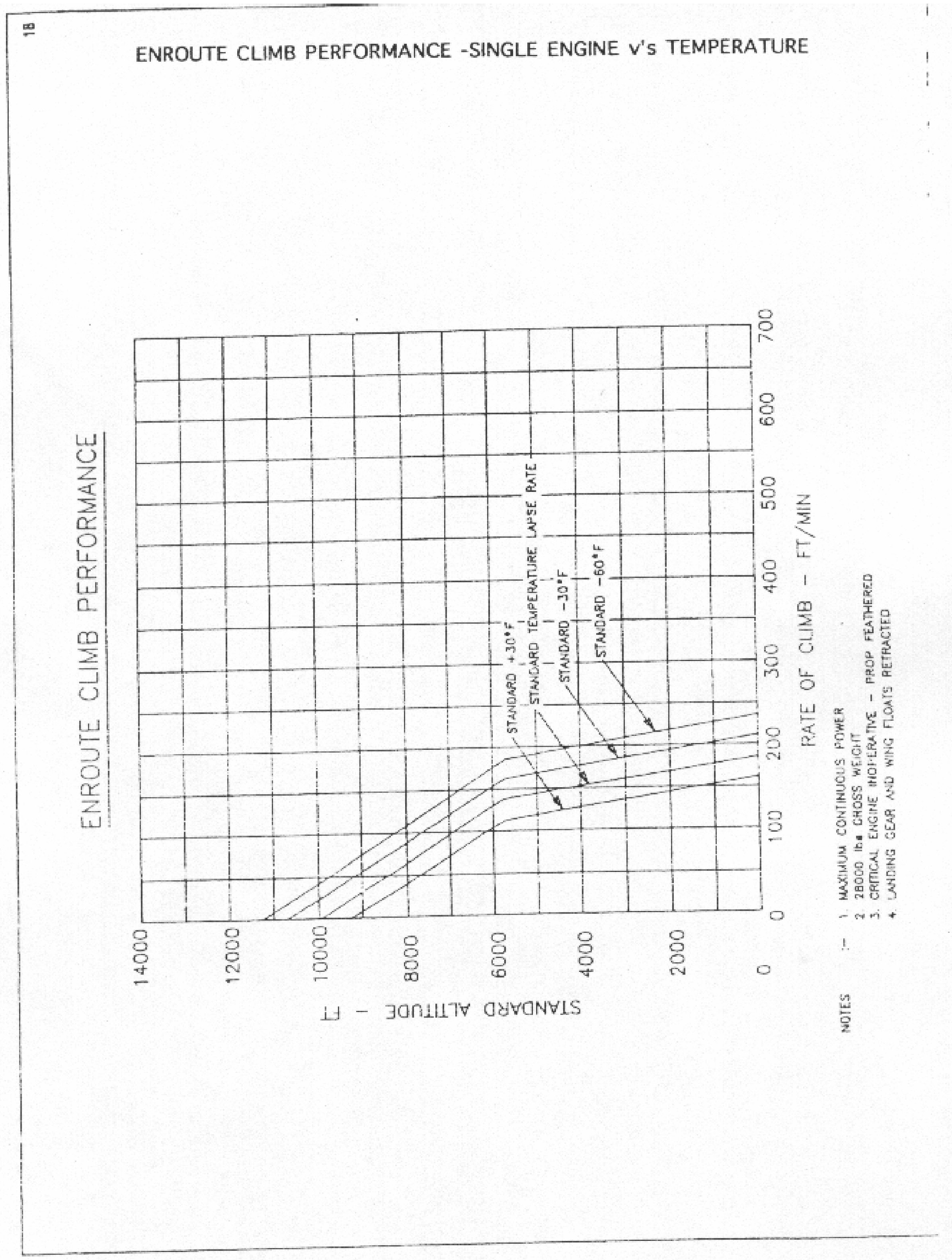
08 ACCELERATE STOP DISTANCE SEA PLANE



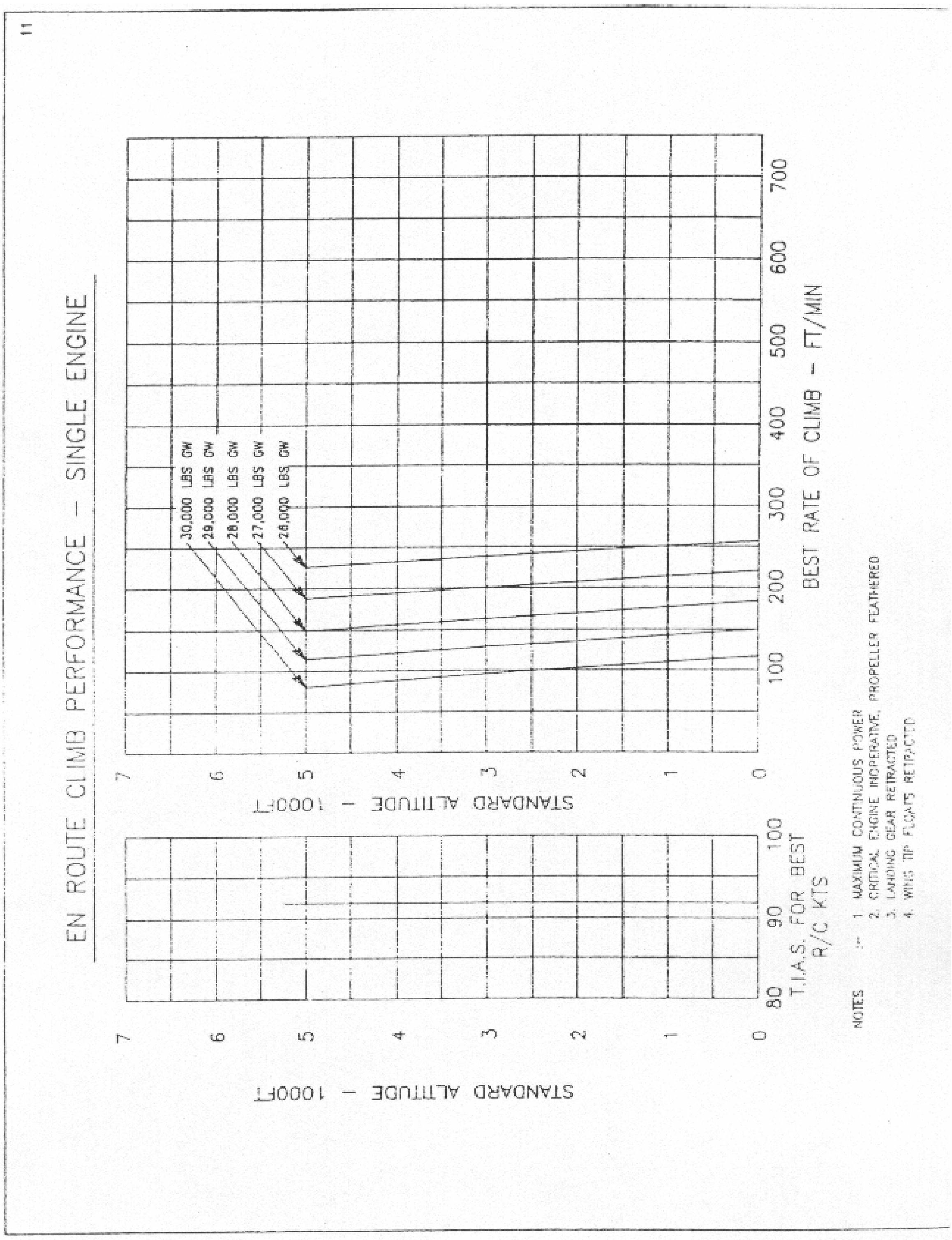
09 CLIMB PERFORMANCE MCP 28000LBS



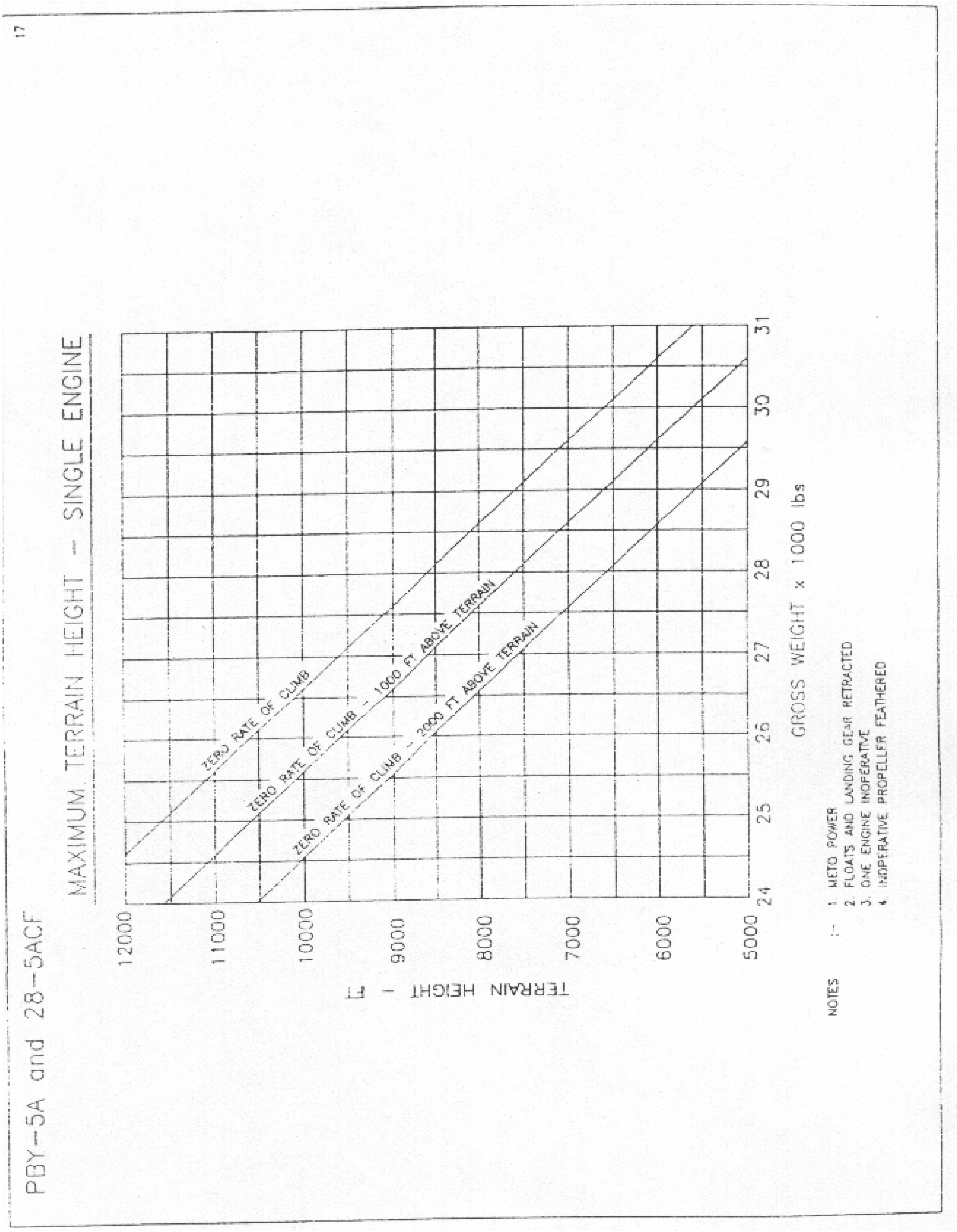
10 CLIMB PERFORMANCE MCP TEMP



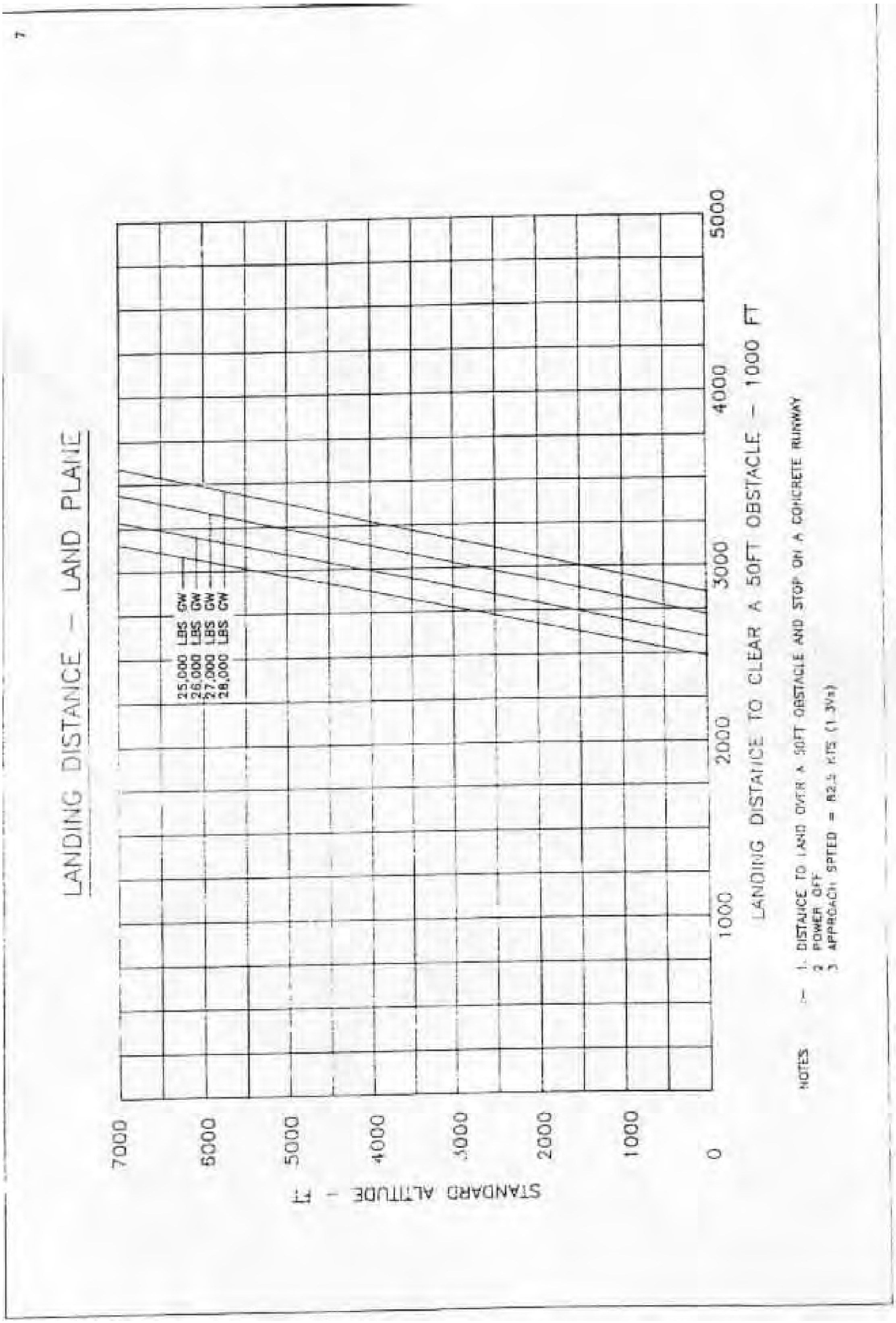
11 CLIMB PERFORMANCE MCP WEIGHT



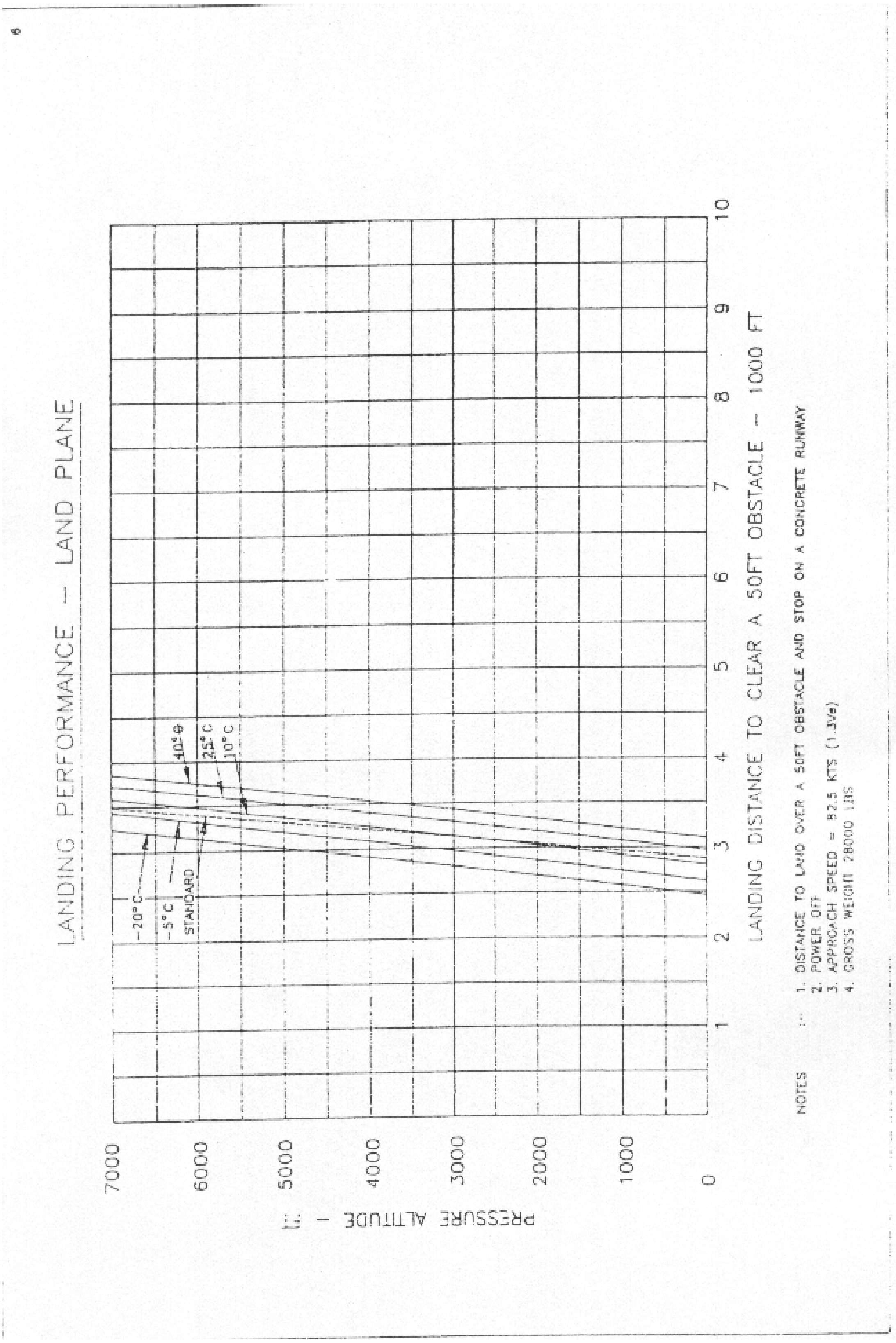
12 SINGLE ENGINE CEILING



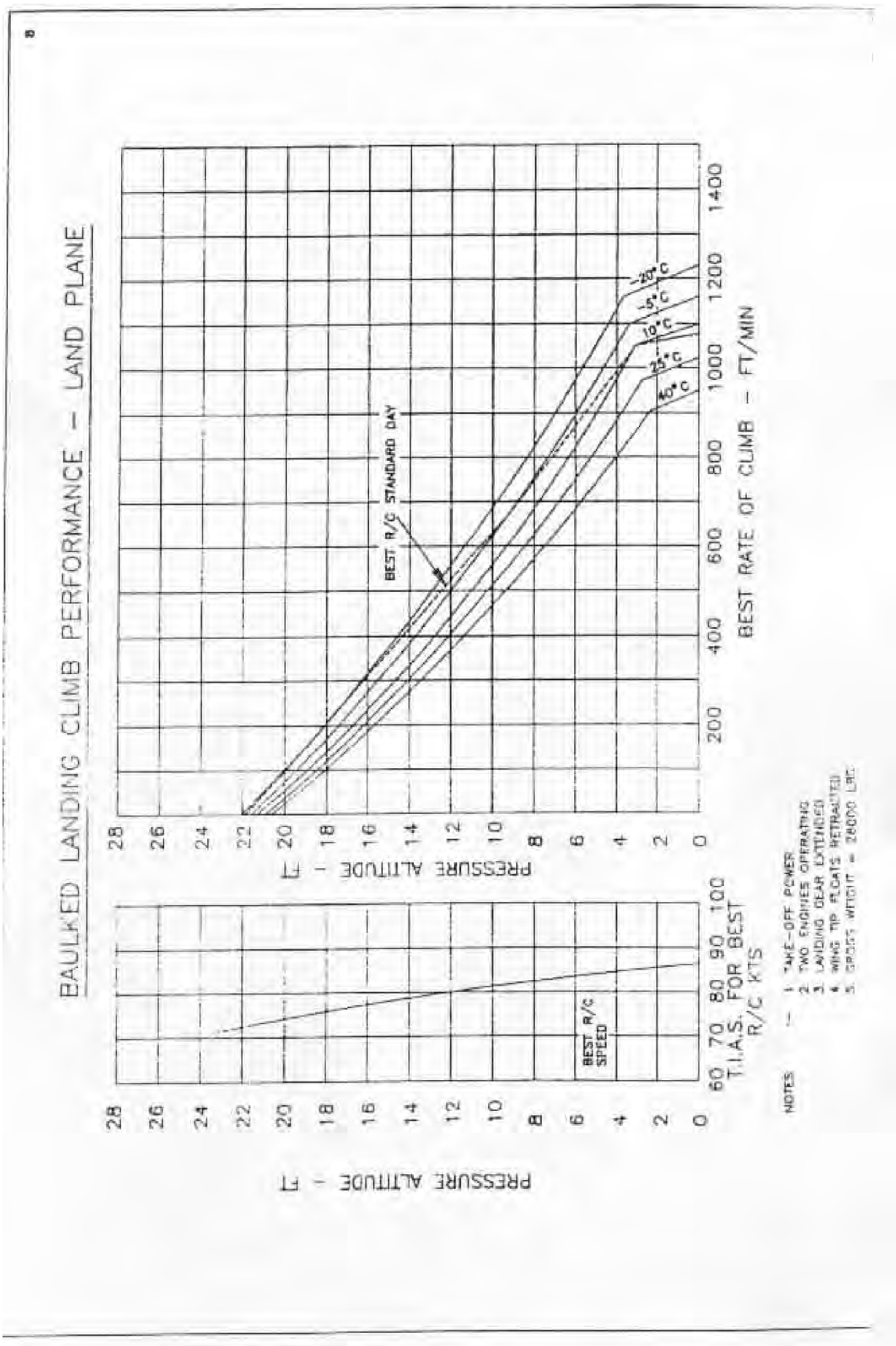
13 LANDING DISTANCE LAND PLANE



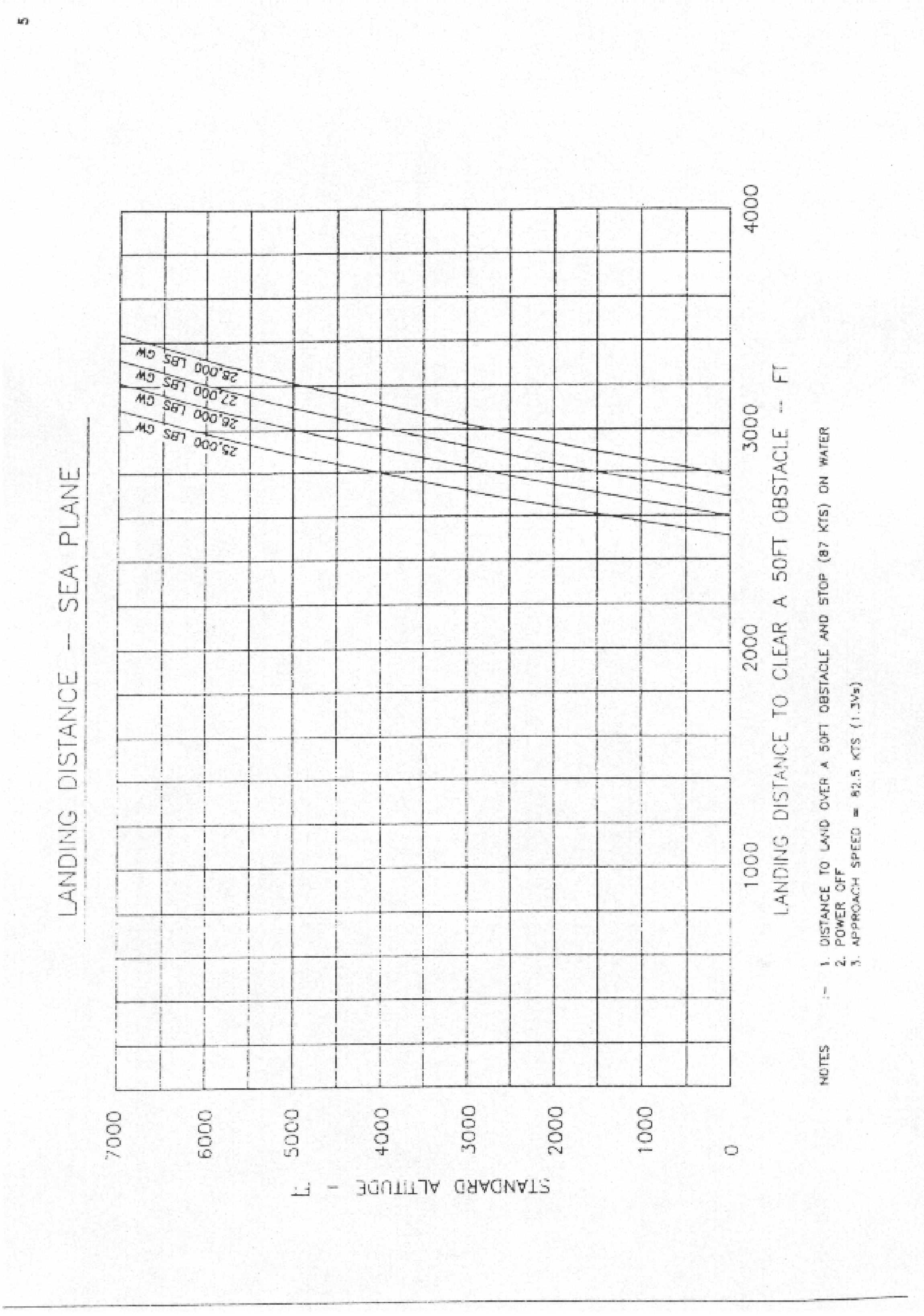
14 LANDING PERFORMANCE LAND PLANE



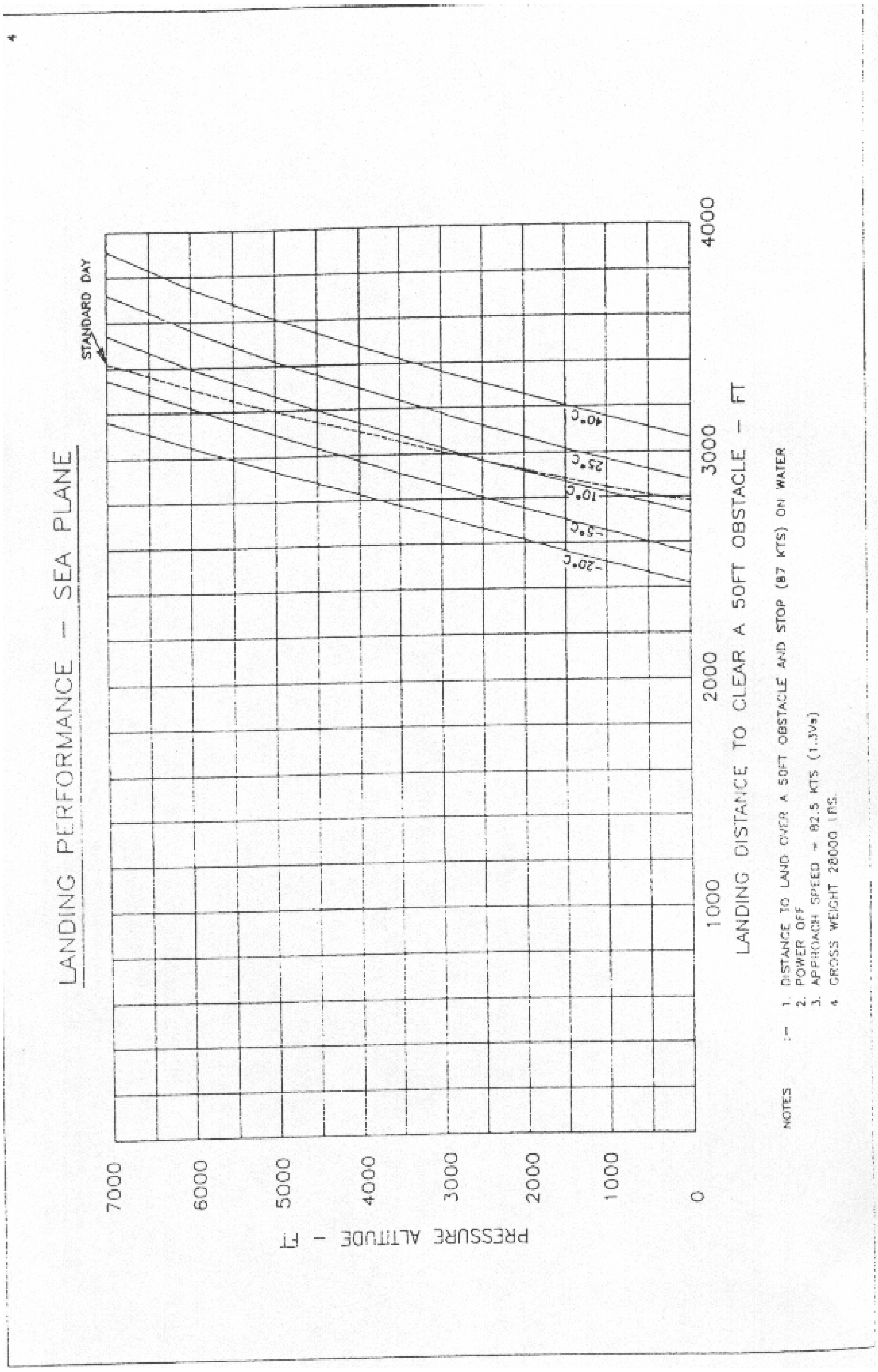
15 BAULKED LANDING CLIMB PERFORMANCE LAND PLANE



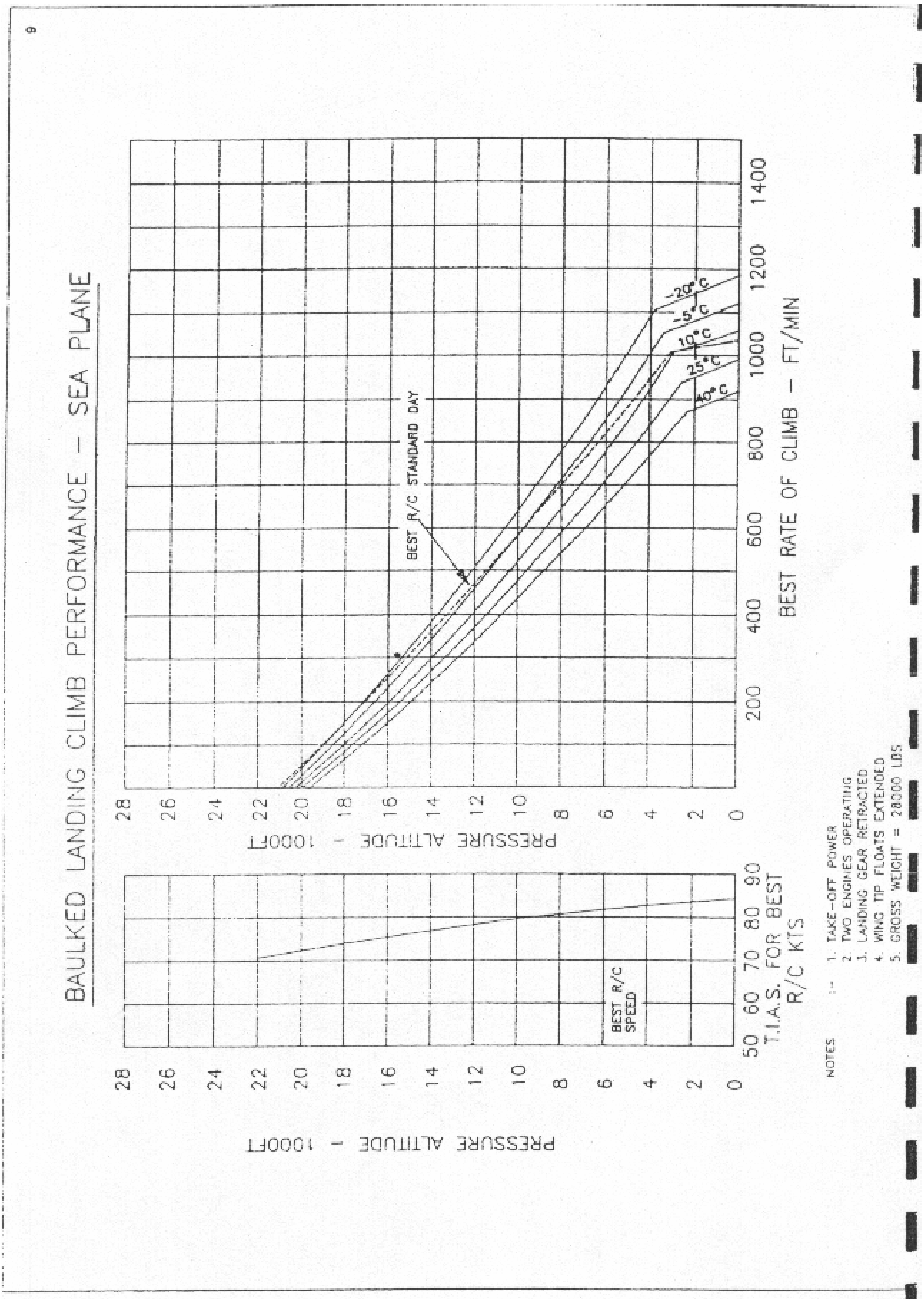
16 LANDING DISTANCE SEA PLANE



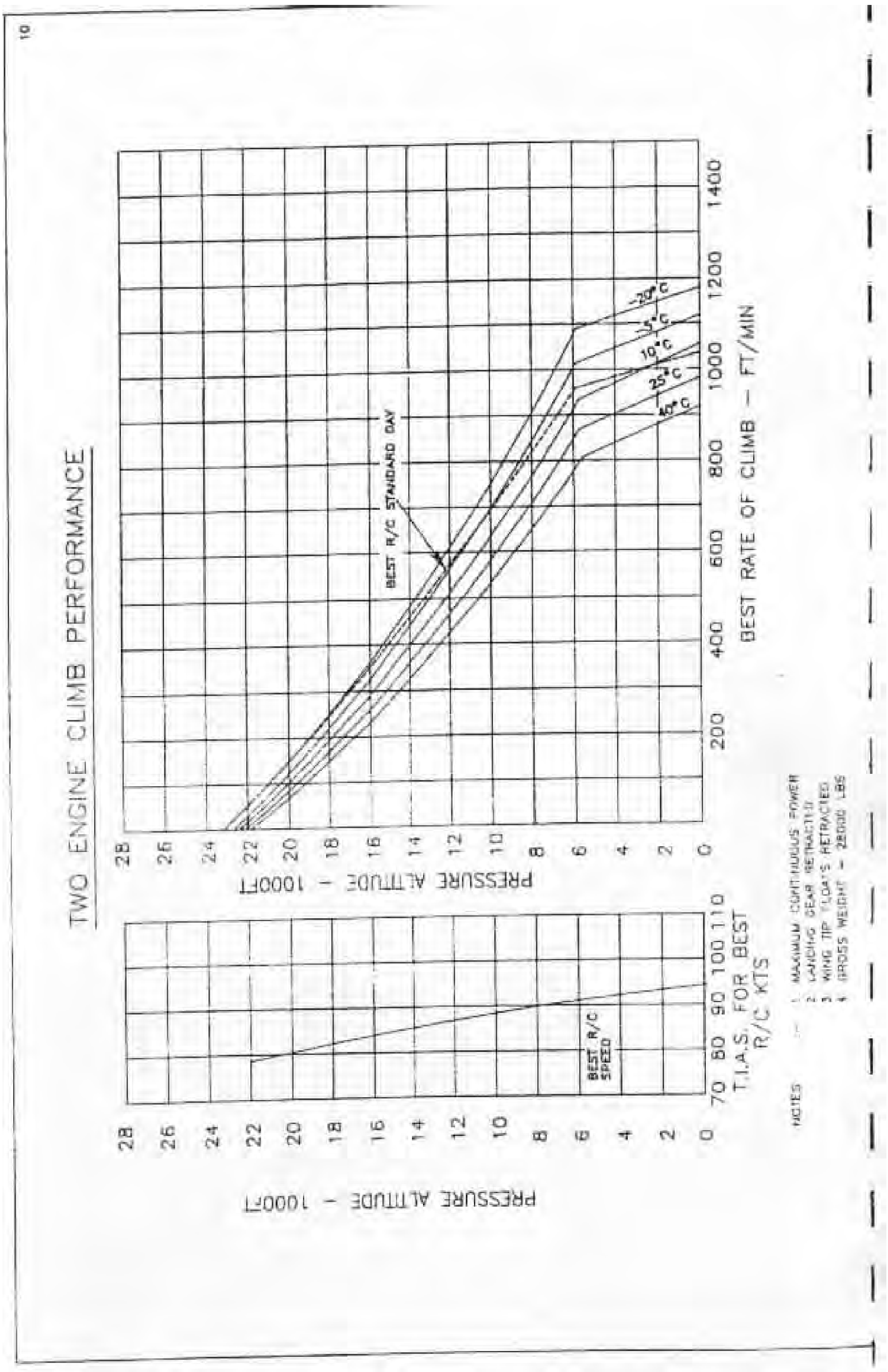
17 LANDING PERFORMANCE SEA PLANE



18 BAULKED LANDING CLIMB PERFORMANCE SEA PLANE



19 TWO ENGINE CLIMB PERFORMANCE



4.1 AIRCRAFT PERFORMANCE CHARTS AND DATA

01 GRADIENT FACTORS

Upward Slope

Take-Off.	Increase distance by 1 % for every 1% upward gradient.
Landing.	Reduce distance by 1% for every 1% of upwards gradient

Downwards Slope

Take-Off	Reduce distance by 1% for every 1% of downwards gradient
Landing	Increase distance by 1% for every 1% of downward gradient

02 TAKE-OFF CLIMB AND LANDING CHART

FLIGHT OPERATING CHARTS, TABLES CURVES AND DIAGRAMS

AIRCRAFT MODEL(S) PBY-5A

ENGINE MODEL(S) R-1830-92

TAKE-OFF, CLIMB & LANDING CHART

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.
28,000	0	0	1100	2160?	1290	2460?	1460?	2980?	1180	2240	1400	2870	1670	3160	1450	2610	1730	2900	2110	[illegible]
	11	10	810	1710	982?	1965?	1180	2375	870	1760	1070	2046?	1270	2445?	1080	1970	1320	2296	1610	2695?
	23	20	550?	1408	780	1610	950	1870	580	1445	840	1670	1020	2040	840	1466	1040	1870	1200	2010?
	34	30	410?	1160	820?	1324	760	1413	350?	1195	670	1375	810	1475	480	1320	810	1585?	1040	1695?
31,000	0	0	1410	3000?	1440	3165?	[illegible]	[illegible]	1540	2860?	1780	3306	2140	4060?	[illegible]	[illegible]	2300	3846	2800?	4600?
	11	10	1000	2318	1380	2660	1490?	3124?	1150	2328	1160	2650	1660	3266	1480	2524	1760	3060	2320	3036
	22	20	690	1640	1000	2100	1140	2630	950	1930	1080	2180	1290	2880	1170	2180	1410	2810	1790	3110?
	33	30	485?	1510	610	1520	862?	2180?	740	1570	880	1870	1060?	2230?	910?	1760?	1130	2190	1460	2410
34,000	0	0	1760	3590?	2040	4120	2420	4645?	[illegible]	3000?	2300	4260?	2780	5385?	2440?	[illegible]	3060?	5140	[illegible]	4585?
	12	10	1340	2605?	1590?	3320	1880	4120	1520	3345?	1780	3440	2140	4370	2020?	3585?	2380	4110	3080	4810?
	23	20	1070	2380?	1210	2710	1510	3420	1100	2510	1320?	3000?	1740	3540?	1610	2920	1880	3330	2550?	4400
	35	30	850?	1882?	1030	3240	1320	1600?	875	1010?	1125?	2550?	1180?	2582?	1102?	2400?	1340?	2730	1880	3560?

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: [illegible]

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

OPTIMUM TAKE-OFF WITH 2700 RPM, [illegible] IN.HG. & [illegible] DEG. FLAP IS [illegible] OF CHART VALUES

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	GAL. OF FUEL USED	AT 5000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 10,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 15,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 20,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED
28,000	89	77	890	50	89	77	835	6.0	75	89	77	680	12.2	100	89	77	425	21.2	130	89	77	170	37.9	195					
31,000	93	81	740	50	93	81	690	7.25	80	93	81	530	14.9	110	93	81	280	27.3	155										
34,000	98	85	610	60	98	85	580	8.9	85	93	85	400	18.5	120	98	85	150	38.7	190										

POWER PLANT SETTINGS: (DETAILS ON FIG. [illegible] SECTION III)

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH POWER OFF MPH	KTS	POWER ON MPH	KTS	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.
28,000	83	72	77	67	980	2250	1080	2410	1170	2590	1150	2415	1250	2590	1370	2780	3900	5160	4280	5500	4680	6090
34,000	96	82	88	76	1290	2800	1410	3000	1540	3240	1500	3020	1650	3160	1800	3600	4580	6100	5000	6600	5480	7180

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

OPTIMUM LANDING IS [illegible] OF CHART VALUES

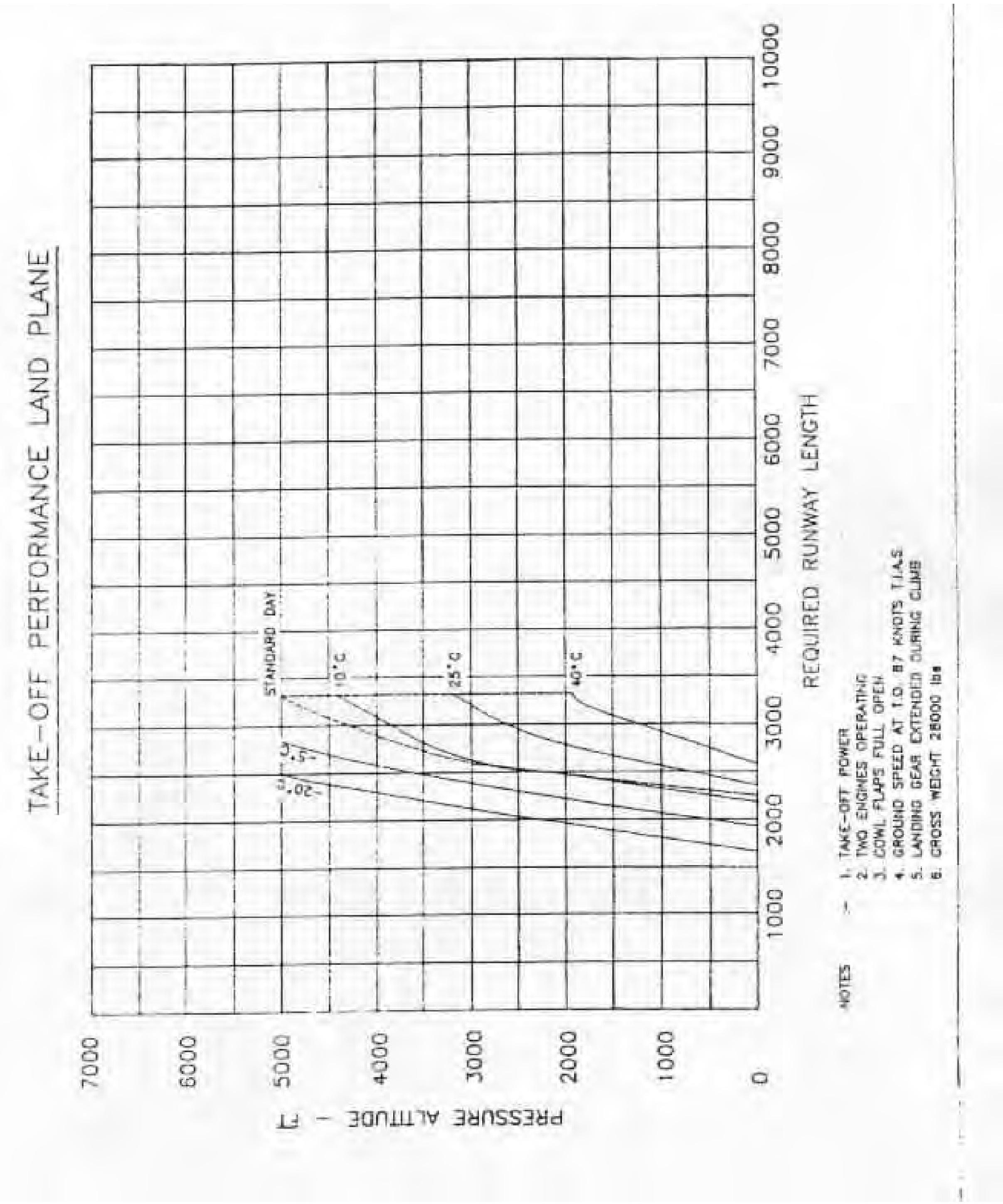
REMARKS:

NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

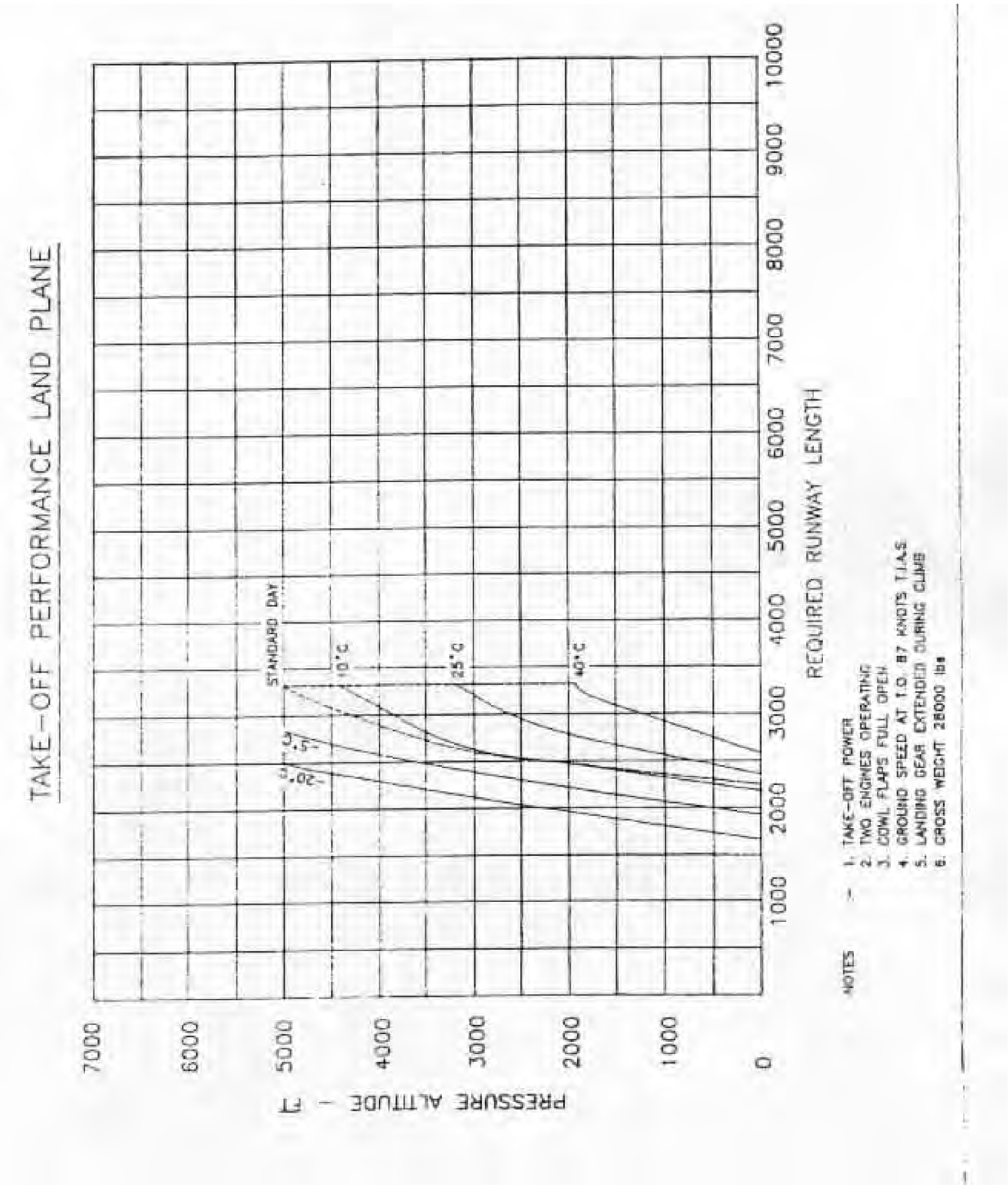
LEGEND

I.A.S. = INDICATED AIRSPEED
M.P.H. = MILES PER HOUR
KTS. = KNOTS
F.P.M. = FEET PER MINUTE

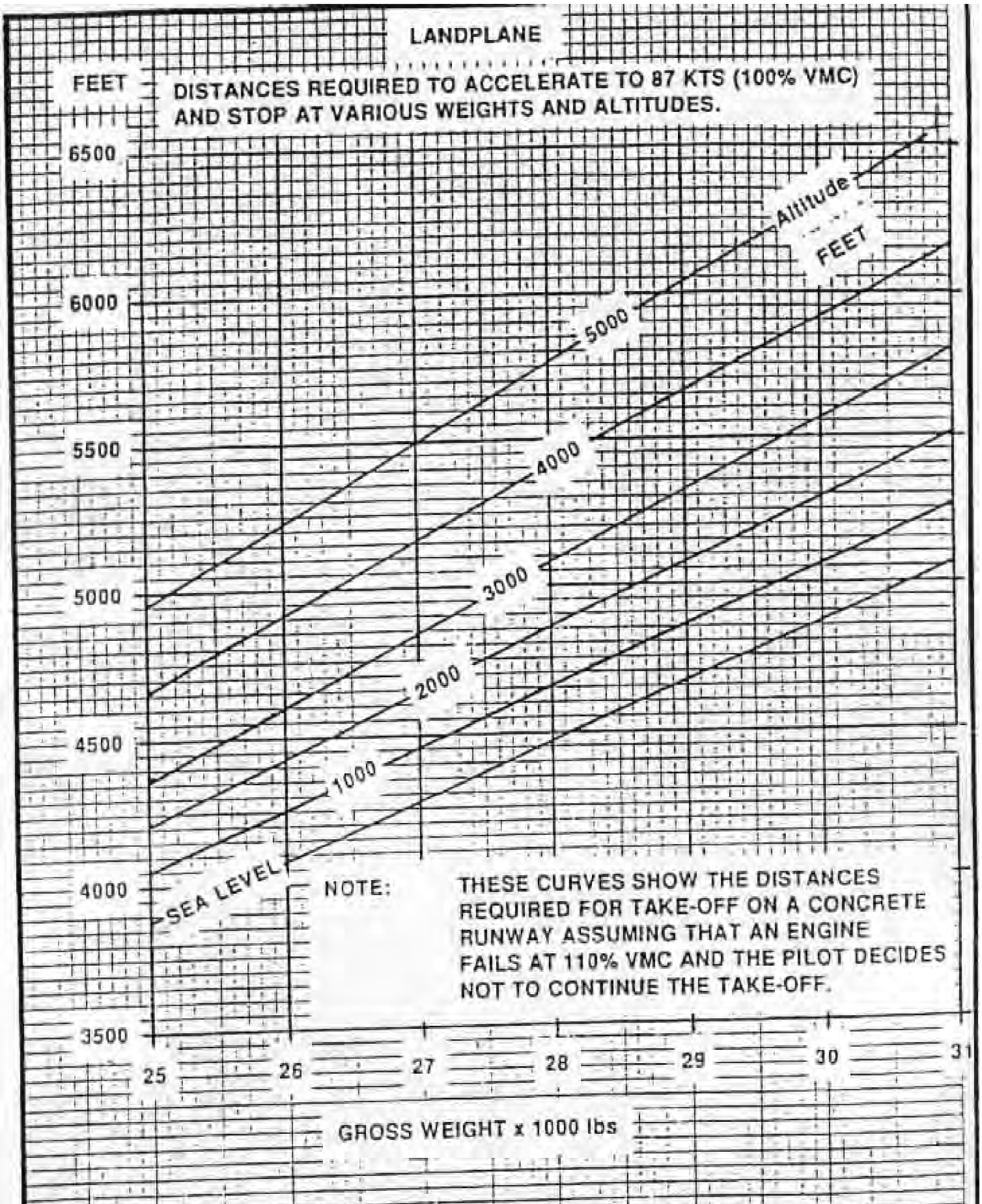
03 TAKE OFF DISTANCE LAND PLANE



04 TAKE OFF PERFORMANCE LAND PLANE

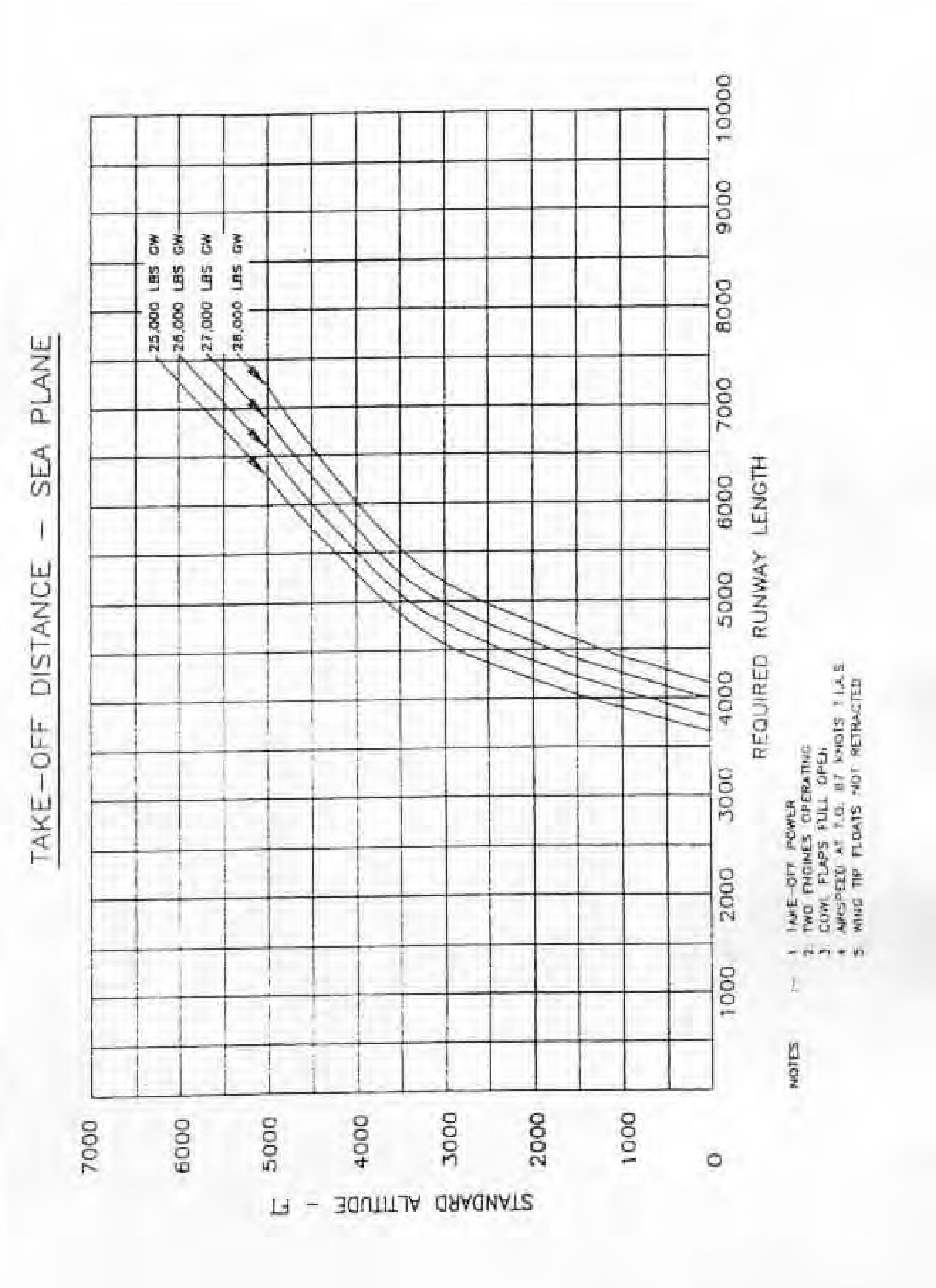


05 ACCELERATE STOP DISTANCE LAND PLANE

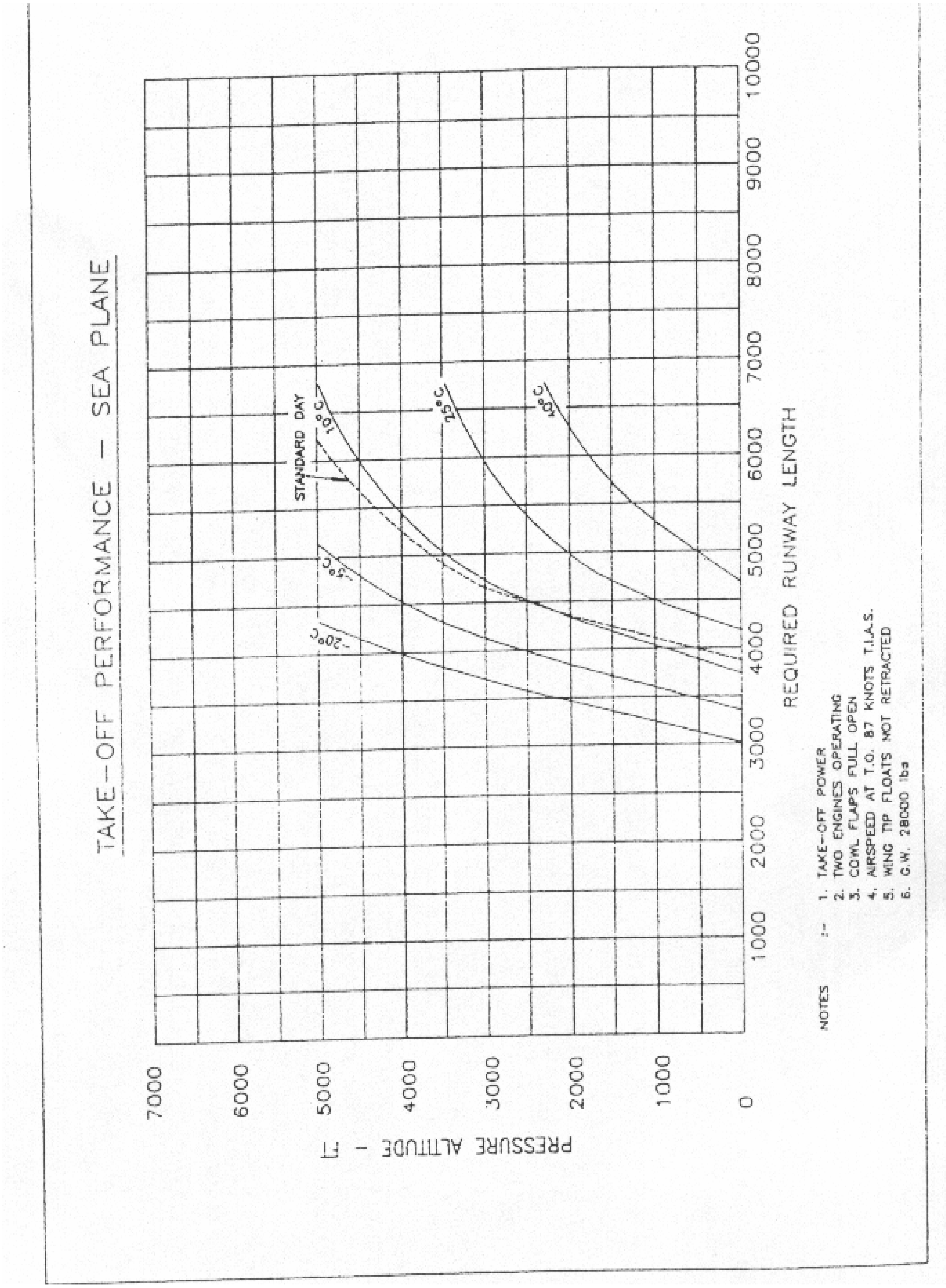


ELEV.	25,000	26,000	27,000	28,000	29,000	30,000	30,500
S.L.	3,880	4,080	4,270	4,460	4,700	4,820	4,960
1,000	4,050	4,250	4,460	4,700	4,860	5,070	5,170
2,000	4,220	4,430	4,640	4,860	5,070	5,290	5,400
3,000	4,360	4,600	4,840	5,080	5,320	5,560	5,680
4,000	4,660	4,915	5,160	5,410	5,660	5,910	6,040
5,000	4,960	5,230	5,500	5,760	6,030	6,300	6,440

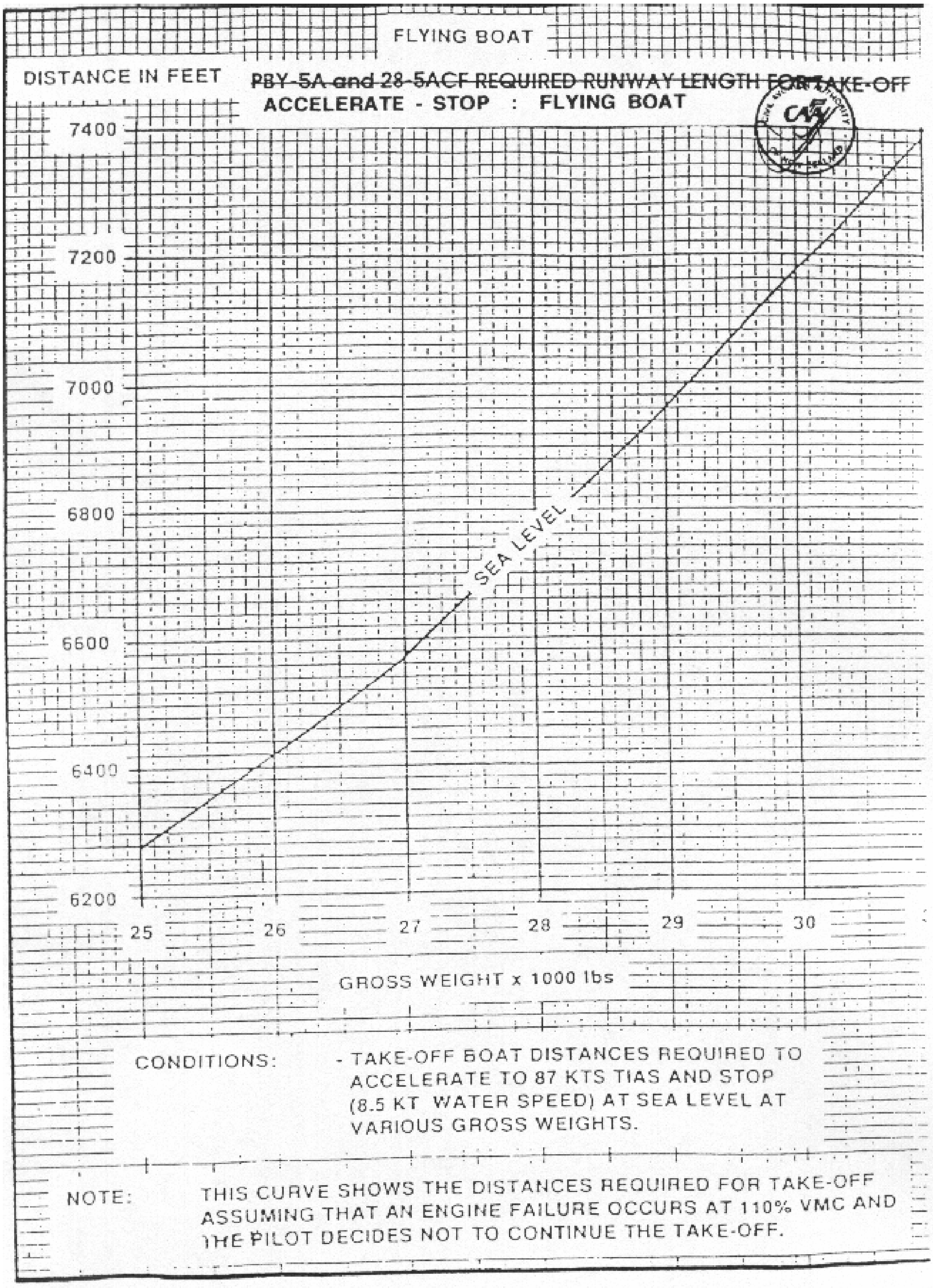
06 TAKE OFF DISTANCE SEA PLANE



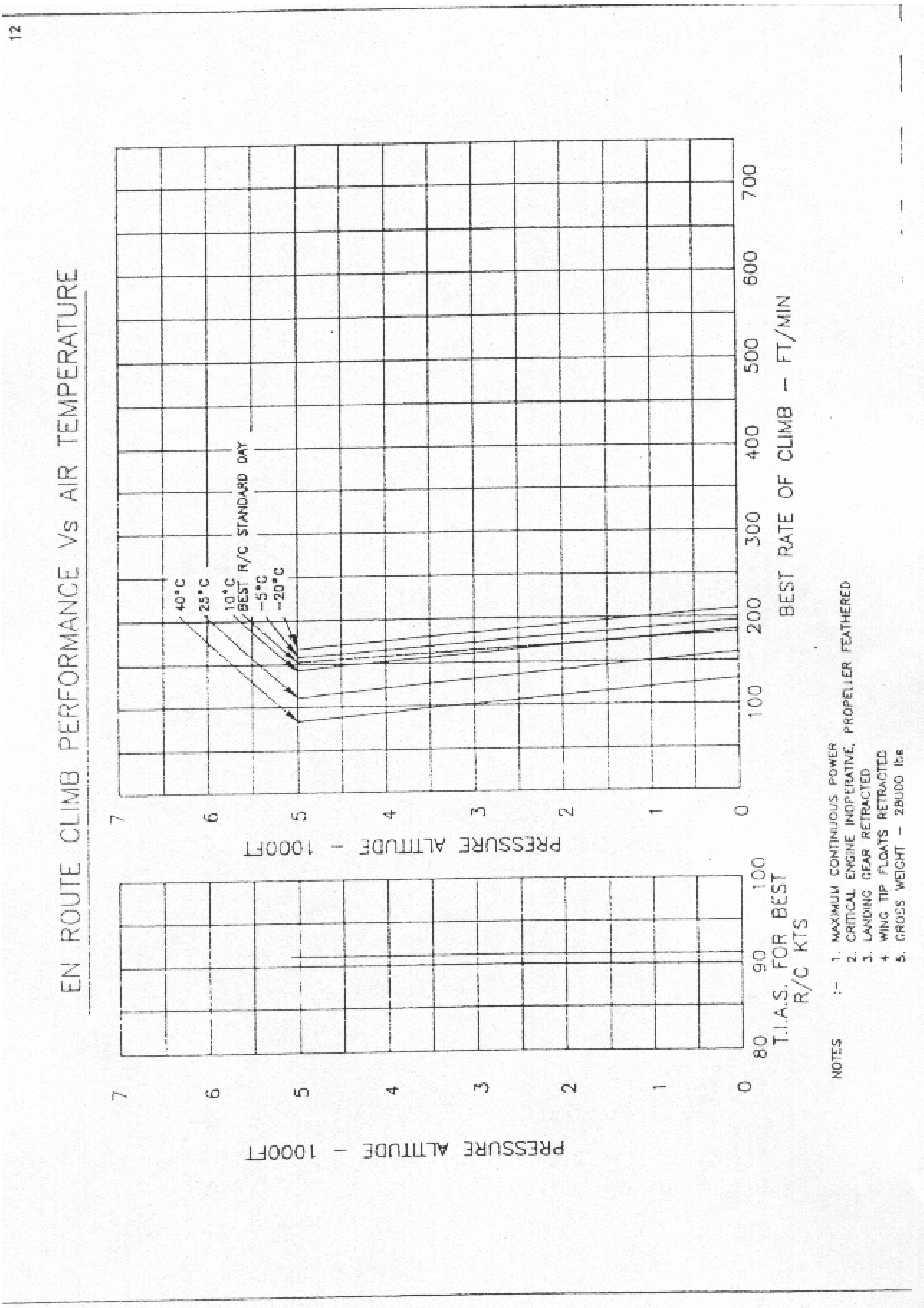
07 TAKE OFF PERFORMANCE SEA PLANE



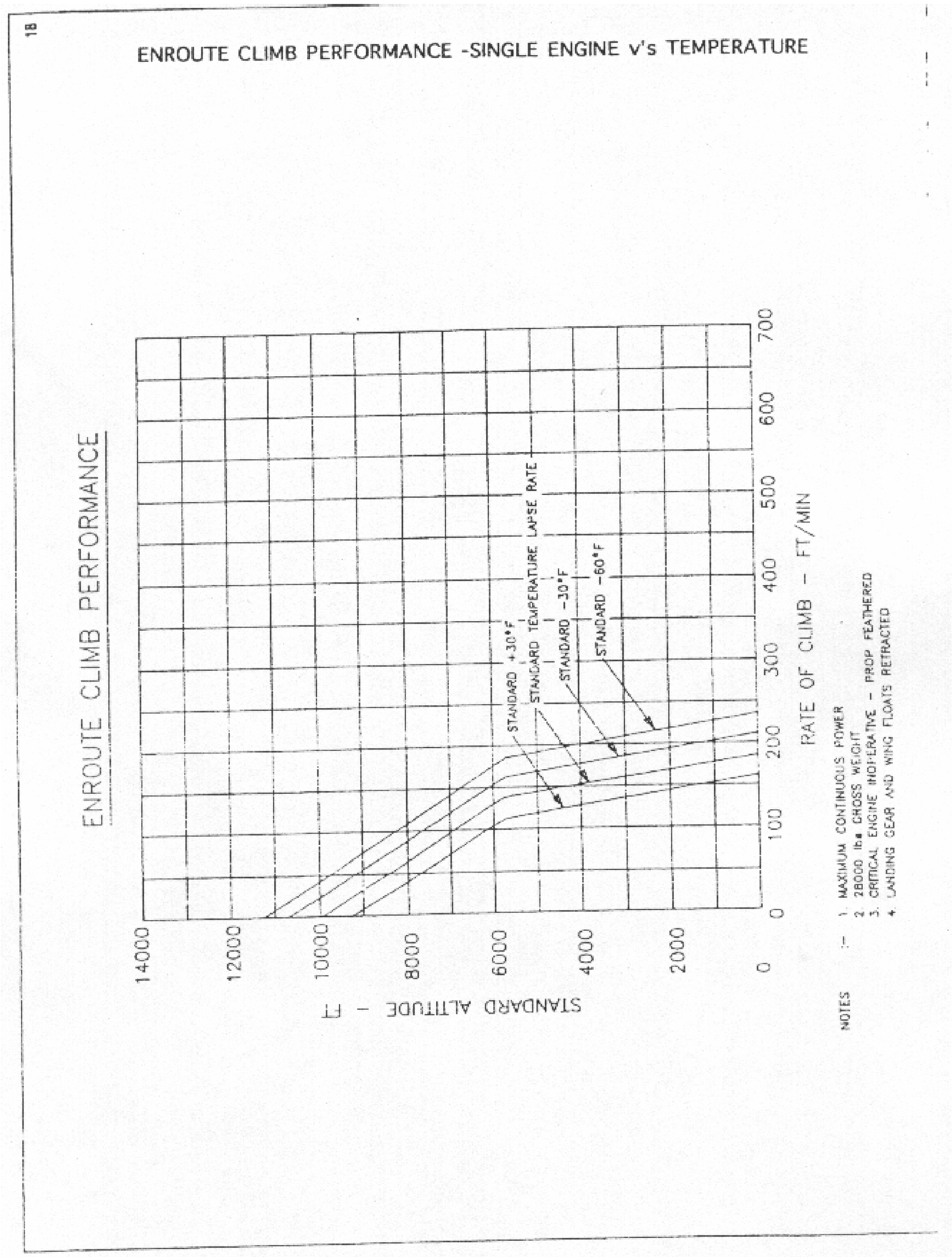
08 ACCELERATE STOP DISTANCE SEA PLANE



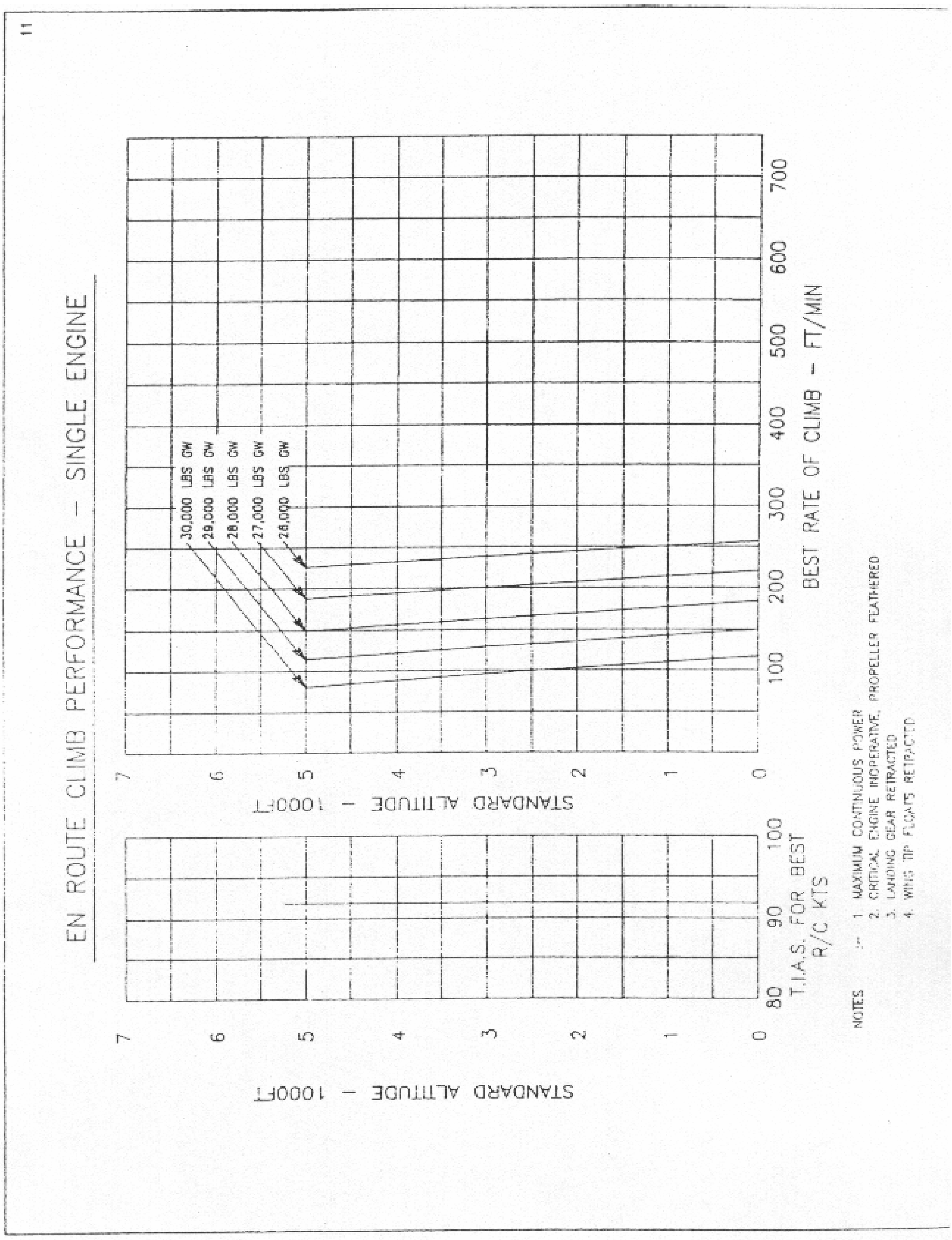
09 CLIMB PERFORMANCE MCP 28000LBS



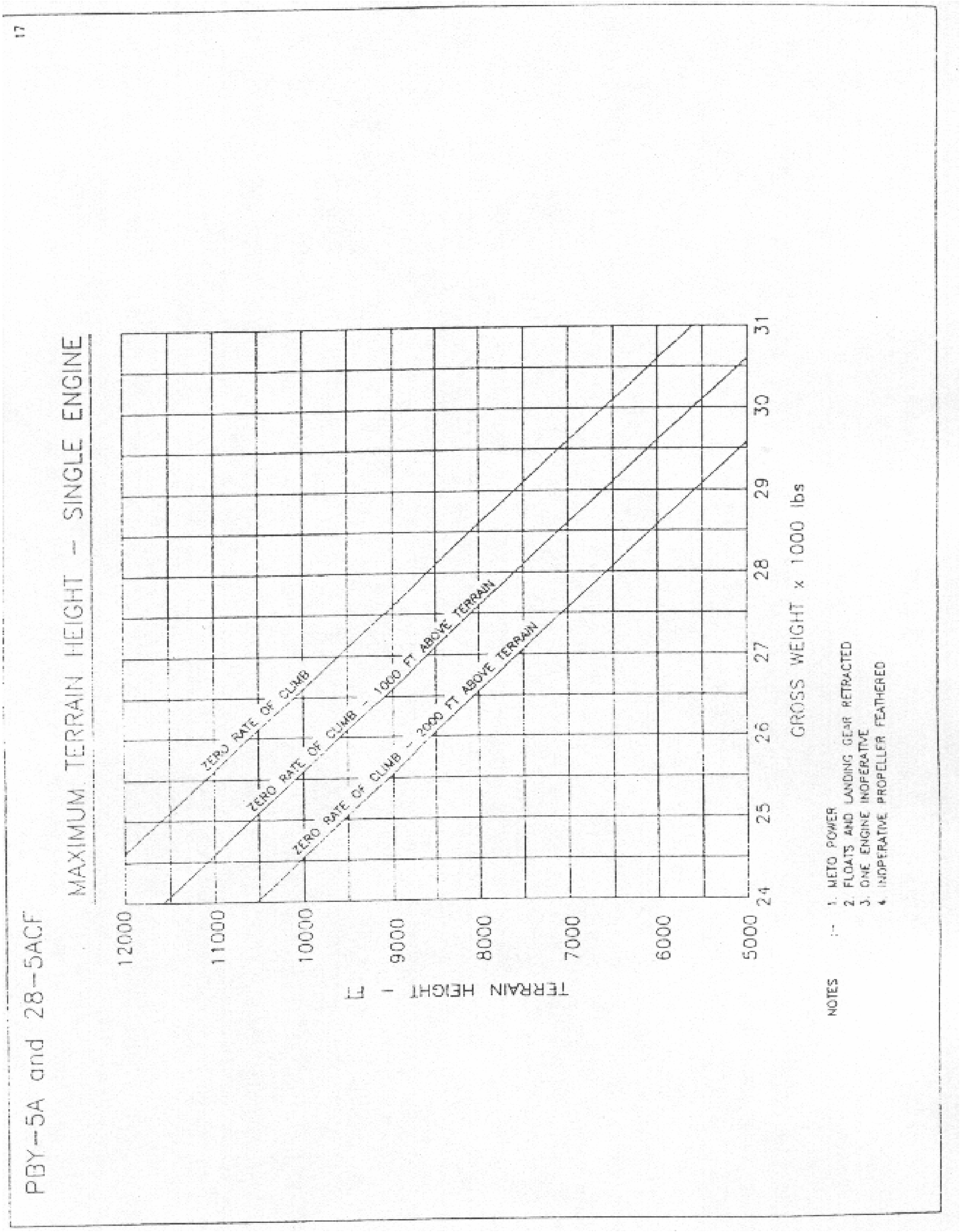
10 CLIMB PERFORMANCE MCP TEMP



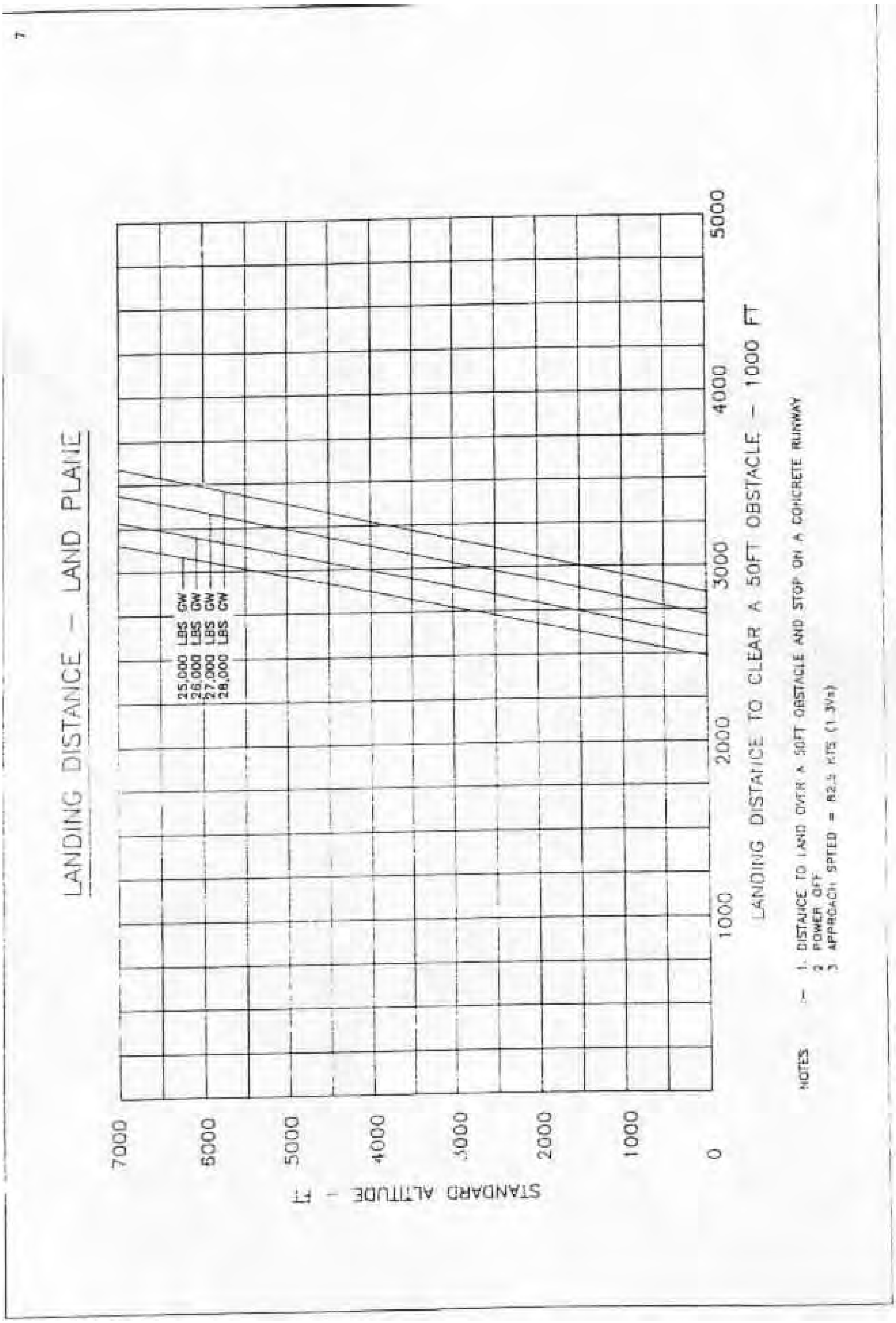
11 CLIMB PERFORMANCE MCP WEIGHT



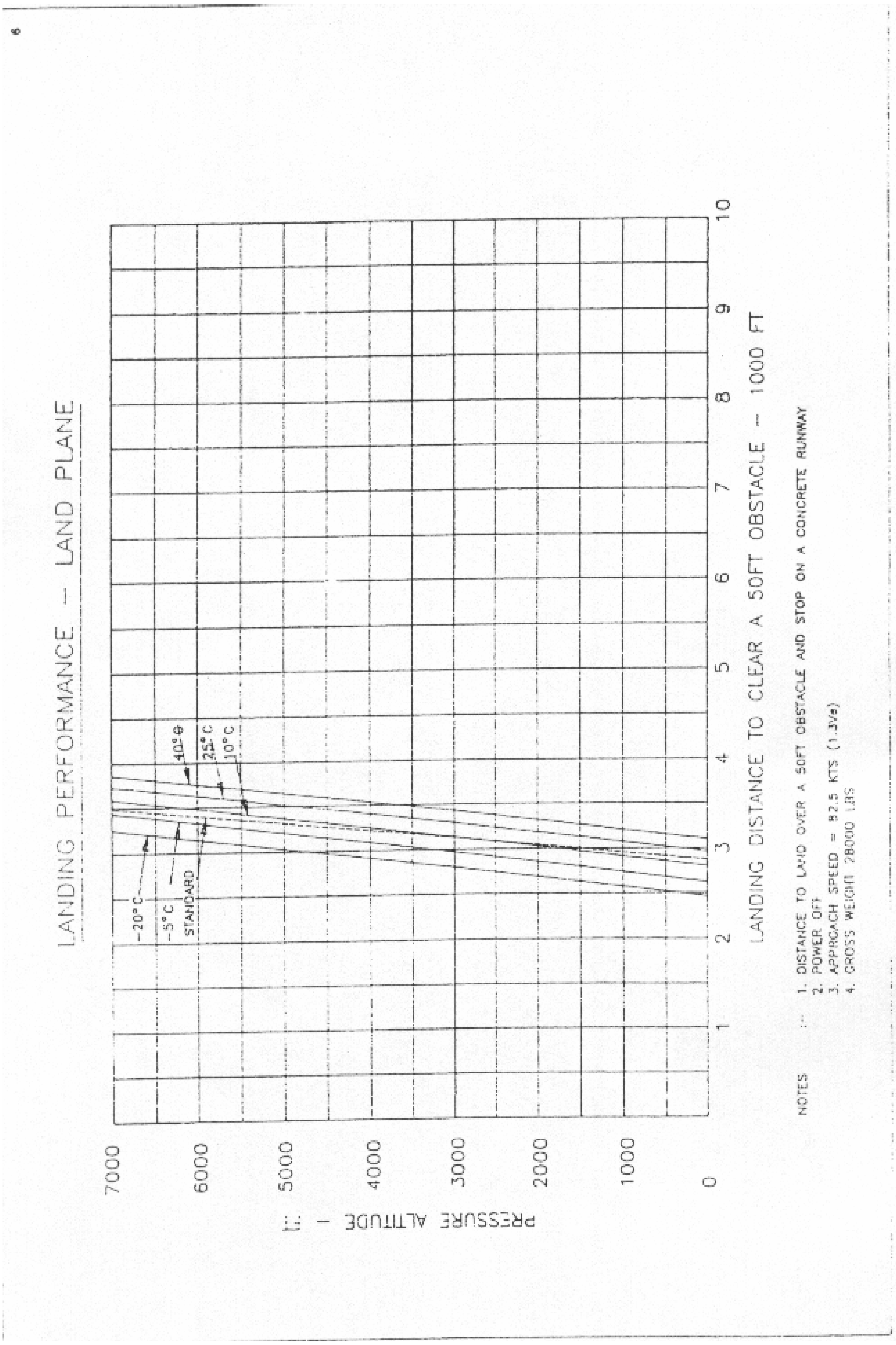
12 SINGLE ENGINE CEILING



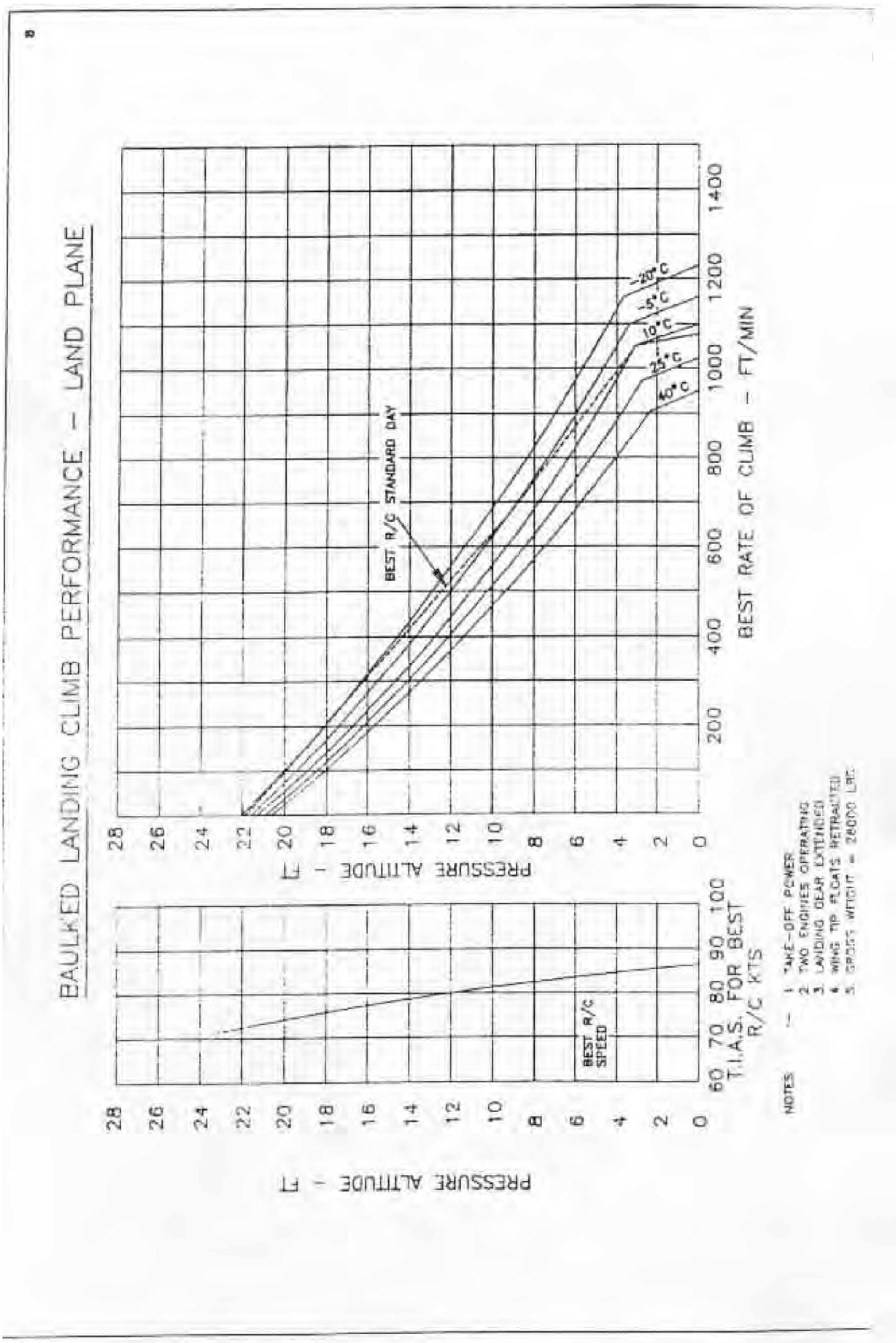
13 LANDING DISTANCE LAND PLANE



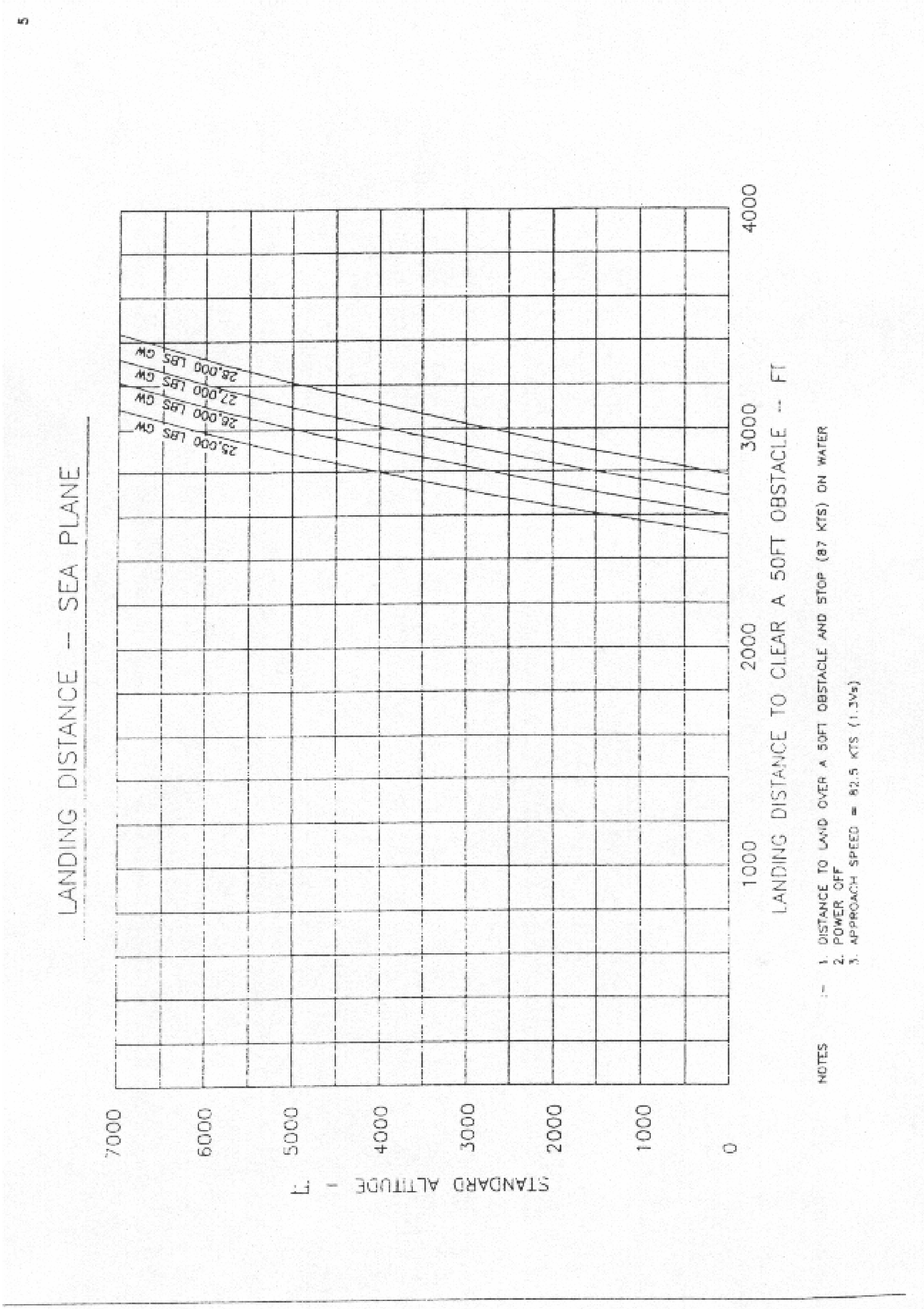
14 LANDING PERFORMANCE LAND PLANE



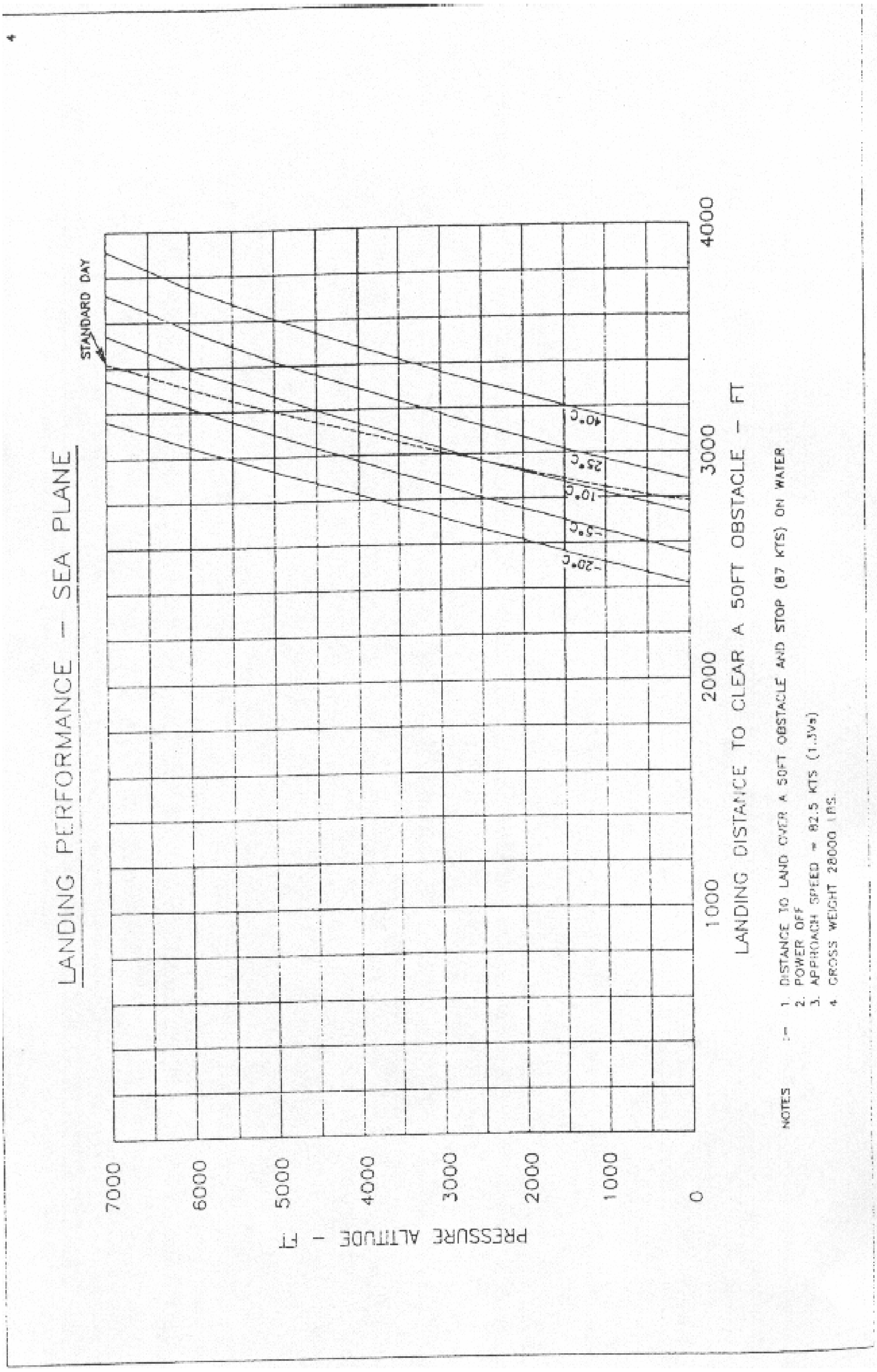
15 BAULKED LANDING CLIMB PERFORMANCE LAND PLANE



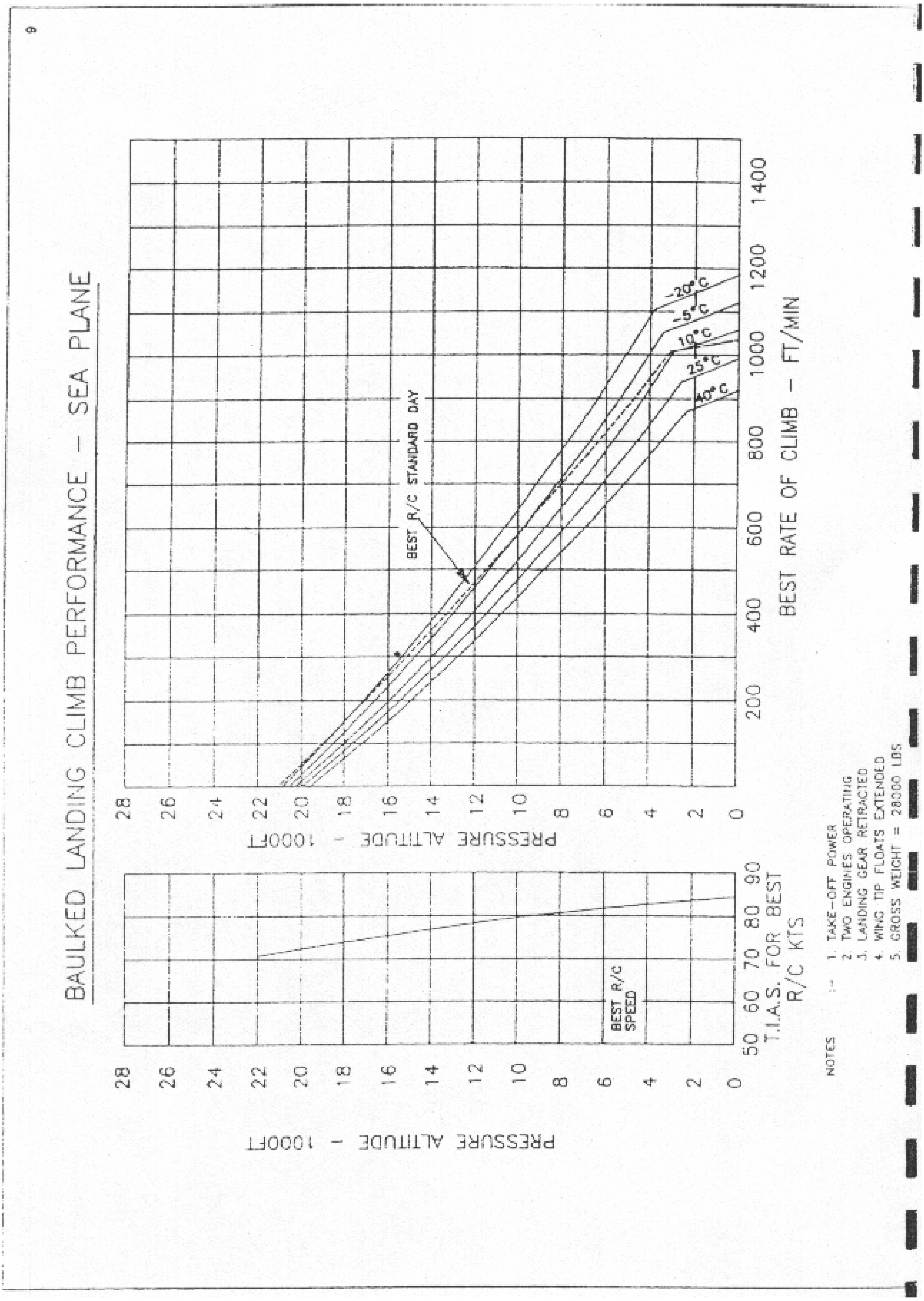
16 LANDING DISTANCE SEA PLANE



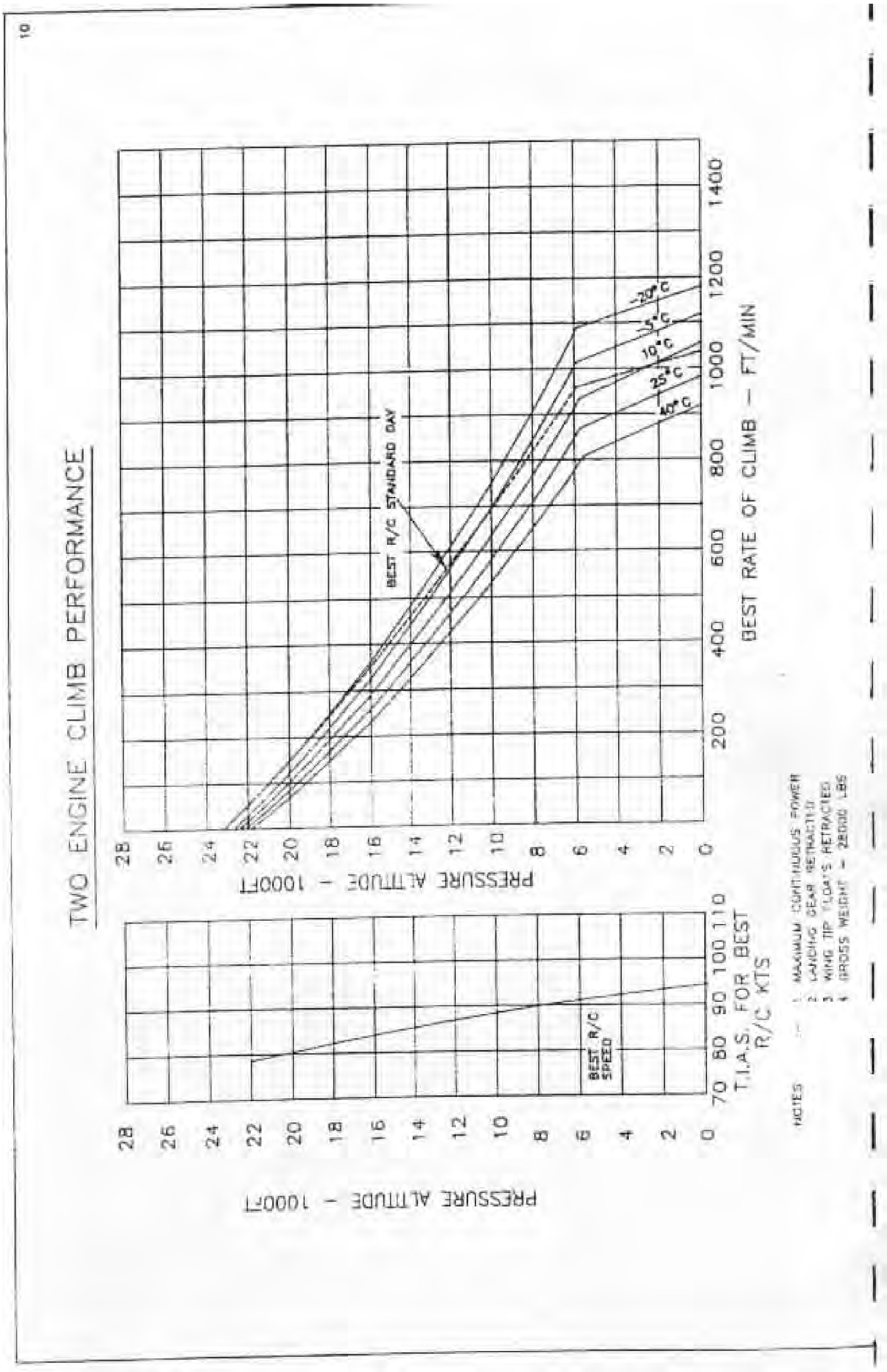
17 LANDING PERFORMANCE SEA PLANE



18 BAULKED LANDING CLIMB PERFORMANCE SEA PLANE



19 TWO ENGINE CLIMB PERFORMANCE



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4.1.1 ENGINE PERFORMANCE ICING CONDITIONS

01 GENERAL

Specific information regarding engine power settings, expected power output, performance and fuel consumption can be found in section 5
In addition the following factors affecting engine performance should be understood.

02 CARBURETTOR ICING

Icing Conditions

Visible moisture at temperatures below freezing, either in the form of clouds or as precipitation, forms impact ice in the air scoop and in or on the carburetor metering elements.

High humidity with a carburetor air temperature below 30 deg C forms throttle ice on the carburetor throttle plate at low throttle settings.

High humidity with carburetor air temperatures in the range from 0 dig to 32 degC forms evaporation ice in the region between the carburetor and the impeller. Be alert for such Icing, which occurs at
Relatively high temperatures in sultry weather not generally associated with ice formation.

Prolonged exposure to severe low temperature conditions, from approximately minus 5 deg C and below, can lower the fuel temperature to the point where it may cause icing in the internal passages of the carburetor during subsequent operation in a high humidity atmosphere. This is known as mixture control bleed icing and is usually accompanied by severe enrichment of the mixture. It is most apt to occur if the aircraft is cold soaked for many hours, possibly parked on the ramp. Experience indicates that it is not likely to occur if the temperature of the fuel entering the carburetor is at or above 0 deg C.

03 ICING PREVENTION

It is preferable to take action to prevent icing rather than have to rely on more drastic de-icing procedures once icing has occurred. When icing conditions are anticipated or encountered:

A	Set mixture control to Auto Rich
B	Apply preheat to maintain 32 degC (or up to 38 degC maximum) carburetor air temperature.
C	After carburetor air temperature and engine operation have stabilized, adjust mixture to desired setting.
D	In flight, it is best to use preheat at least 15 minutes before entering known or anticipated icing conditions. Preheat is most effective at preventing of icing (and accompanying power loss) if applied and maintained well in advance of encountering these conditions. As a precaution therefore, when atmospheric conditions are conducive to the formation of carburetor ice, it is recommended to cruise with the preheat control set to maintain between 15 -25 degC carburetor temp, and to be prepared to increase the temperature to 32 degC (38 degC Maximum) if required.
E	To prevent icing during take-off, maintain 32 degC to 38 degC carburetor air temperature during warm-up and ground running, but set Carb heat COLD several minutes before take-off. Keep carb heat COLD for take-off and be ready to apply 32 degC (or up to 38 degC maximum) carburetor air temperature for ice protection during climb

04 ICING INDICATORS

When operating in icing conditions without carburetor heat, there may be little warning that icing has occurred until it has produced sufficient ice to seriously impair engine performance. The following indications may accompany icing:

A	Decreasing power and airspeed at constant throttle and APM, either with or without an accompanying decrease in Manifold Pressure. If there is no decrease in manifold pressure, the power loss is probably due to leaning or enrichment of the mixture. If there is a reduction in manifold pressure, the power loss is probably due to restricted airflow through the induction system.
B	A rapid loss of power, possibly accompanied by rough or erratic engine operation, indicates severe leaning or enrichment of the carburetor
C	Uneven response of manifold pressure to changed throttle settings may occur due to ice jamming or sticking the carburetor throttle.
D	Erratic engine operation due to ice on metering elements, with resulting changes in mixture or mixture distribution to the cylinders.

05 DE-ICING PROCEDURE

If icing does occur, use the following de-icing procedure

A	Shift mixture control to Auto Rich
B	Apply FULL CARBURETTOR HEAT HOLD fully 'ON' for 30 seconds. **CAUTION** -If appreciable engine icing develops; the loss of power will be accompanied by a loss of Carb heat capacity, sharply reducing the effectiveness of full preheat in eliminating ice.
C	Check whether manifold pressure is restored by slowly returning Carb heat control toward COLD. If the increase in manifold pressure from full hot to full cold is consistent on successive checks, the ice is probably eliminated.
D	Adjust preheat to maintain 32 degC carburetor air temperature.

When it is known that the temperature of the fuel is well below freezing which may cause power loss due to mixture control bleeding icing:

A	Adjust Carb heat control to maintain maximum permissible Carb temperature (38degC). This type of icing may require constant 38degC heat for a considerable period of time (5 to 15 minutes or longer) before normal operation returns. Once engine runs normally,
B	Readjust preheat control to maintain 32degC carburetor air temperature.

06 DETONATION

Detonation and Pre-Ignition are caused by:

1) Incorrect Ignition timing
2) Incorrect Grade of Fuel
3) Carbon Deposits in the Cylinder
4) Over Boosting.

The Pilot has direct control over the Boost (Manifold Pressure). It is important that the correct settings are used at all times, and that the chart settings are adhered to.

Detonation is normally preceded by pre-ignition. Indications of both conditions are hard to detect, but high cylinder head temperatures are good indicators that combustion is **abnormal**.

Prevention is the best action, and that means keeping the Brake Mean Effective Pressures (B.M.E.P.) within engine limitations. The charts further on in this Section have limiting values for all power settings.

To prevent Pre-Ignition and Detonation from occurring

A	Use correct mixture setting
B	Do not over boost
C	Maintain correct engine operating temperatures

If either condition is suspected:

A	Use a richer mixture setting
B	Reduce boost and/or power
C	Increase RPM

07 USE OF ENGINE CONTROLS

When increasing the power RPM is to be increased before the Manifold Pressure is increased.

When decreasing power reduce the manifold pressure before RPM

Ensure that the mixture control is at Auto Rich prior to increase power

After the power has been reduced to cruise move the Mixture to Auto Lean after a period of time has elapsed to adjust the cylinder head temperatures to settle at or below 200degC

SECTION 5 FLIGHT PLANNING

5.1 FLIGHT PLANNING

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5.1 FLIGHT PLANNING

01 TAKE-OFF POWER **2700RPM**

48 ins Manifold Pressure

Do not use longer than 1 minute for land operations and 2 minutes for water operations
For engine failure at or after V1 maximum Take-Off Power for 5 minutes

02 METO POWER **2550RPM**

41 5 ins Manifold Pressure

Maximum continuous power rating, e.g. single engine or high performance demands.

03 CLIMB POWER **2325RPM**

32 5 ins Manifold Pressure Normal climb setting

04 *CRUISE POWER* ***2050RPM***

26-28 ins Manifold Pressure

Pwr Rating	Man Press	RPM
T/O	48.0	2700
METO	41.5	2550
CLB	32.5	2325
CRZ	26-28	2050

Normal Cruise setting but see charts for settings at various configurations

05 MINIMUM SPECIFIC FUEL CONSUMPTION

To maintain the best range speed it is necessary that the engines develop the most efficient power. This power is normally much less than Maximum Cruise Power and use of low power settings is desirable for preservation of engine life and and for engine efficiency.

For maximum efficiency maximum BMEP (torque) is selected with the minimum RPM necessary to obtain it. The settings for Manifold Pressure and APM to obtain maximum efficiency are obtained from in the BMEP Cruising Chart.
For maximum range the Cruising Control Chart is to be consulted for the Minimum Specific Consumption settings. See Range Flying and Endurance Flying this Section.

06 FUEL CONSUMPTION

Total Capacity 6600L
Use 375Ltr per hour for flight planning

Dip tanks before flight. Fuel gauges give approximate readings only and are unreadable below 400L.

Use charts for range or endurance power settings. Use 90-92 kts for best range

APPROXIMATE FUEL CONSUMPTION (LITRES /HOUR) at 1000FEET

MIXTURE	BOOST ins	2700RPM	2550RPM	2300RPM	2050RPM	1900RPM	1800RPM
Auto Rich	47	1200					
Auto Rich	41		925				
Auto Rich	35		700	550			
Auto Lean	30				350	320	290
Auto Lean	28				300	285	275
Auto Lean	27				285	275	265
Auto Lean	26				280	270	255
Auto Lean	25				270		245

07 OIL CONSUMPTION AND CAPACITY

There are two oil tanks, one on each engine with 54 Imp gals capacity each. Working oil capacity should be about 30 gal per side and if oil is less than 25 gal per side flight should not take place except in extenuating circumstances.

Consumption of oil should be assessed frequently by dipping the tanks There are no oil contents gauges

In-the absence of a directly observed consumption, use a figure of one gallon per engine per hour as an 'expected' use

08 RANGE FLYING

Range Speed is dependent upon weight. At 28000 Ibs AUW the speed is 92 K kts.

The C of G should be as far forward as possible. The aircraft should be clean.

Use Carb Heat Cold unless icing is suspected.

Refer to charts this section for speeds, consumption and height to fly

09 ENDURANCE FLYING

Endurance Speed is the lowest speed comparable with aircraft safety and control. This can be as low as 80 Kts but should be restricted to 85 Kts (Vmca)

Fly the aircraft as low as possible, but normally not below 1000 ft. The aircraft should be clean, and G of G as far forward as possible Use Garb Air cold unless icing is suspected.

Refer to charts this Section for details

Unless Range or Endurance flying is being conducted the standard cruise power setting is to be used:
2050RPM 28 ins Manifold Pressure

10 EMERGENCY EN-ROUTE POWER SETTINGS

A	Mixture	Automatic Rich
B	Propeller Below 9000 feet METO Above 9000 feet T/O	 2550 rpm Maximum 2700 rpm Maximum
C	Throttle With 2550 rpm METO With 2700 rpm T/O	Man Pressure 41.5 in Hg Maximum 48. 0 in Hg Maximum
D	Carburetor Heat	As Required

11 LIMITS

A	Cylinder Head Temperature	260degC Maximum
B	Oil Inlet Temperature	100degC Maximum 40degC Minimum
C	Oil Pressure	80 psi Minimum
D	Fuel Pressure	14 psi Minimum
E	Carburetor Air Temperature	

NOTE: If more power is required for a short interval,
RPM not to exceed 2700 and manifold pressure not to
Exceed 48 in. Hg.

12 INTERMEDIATE SINGLE-ENGINE SETTINGS

A	Up to METO POWER may be used for single-engine cruise
B	The fuel flows listed below are for an altitude of 5000 ft. Maintaining the same settings at altitudes greater than 5000 feet will result in an increase of fuel flow of approximately 1/2 GPH per engine per 100 feet.

MIXTURE	BHP	RPM	MAN, PRESS	LPH (1 Eng)
Autorich	1050	2550	41.0in	460
Autorich	930	2550	37.0	390
Autorich	850	2550	35.0	350
Autorich	870	2450	35.0	330
Autorich	850	2350	35.0	320

13 CRUISING CHART

CRUISING CHART

PRESSURE ALTITUDE FEET	MAXIMUM CRUISE 140 BMEP – AUTO LEAN		INTERMEDIATE CRUISE 140 BMEP – AUTO LEAN		MIN. SPEC. CONSUMPTION 140 BMEP – AUTO LEAN	
	RPM	MAN. PRES. "HG. (ABS)	RPM	MAN. PRES. "HG. (ABS)	RPM	MAN. PRES. "HG. (ABS)
1,000	2170	33.5	1950	33.5	1610	33.0
4,000	2170	32.0	1950	32.0	1610	32.0
7,000	2170	31.0	1950	31.0	1650	F.T.*
10,000	2170	30.5	2050**	F.T.*	**	
13,000	2275**	F.T.*	**		**	

* FULL THROTTLE ALTITUDE VARIES WITH OPERATING CONDITIONS.

** INCREASE RPM TO MAINTAIN POWER (140 BMEP NO LONGER AVAILABLE).

14 SPECIFIC ENGINE FLIGHT CHART

FORM ASC-613A

AIRPLANE MODELS: PBY-5A

SPECIFIC ENGINE FLIGHT CHART

ENGINE MODELS: PRATT & WHITNEY R-1830-92

CONDITION	FUEL PRESSURE (LB/SQ. IN.)	OIL PRESSURE (LB/SQ. IN.)	OIL TEMP. °C	OIL TEMP. °F	CYLINDER TEMP. °C	CYLINDER TEMP. °F		
DESIRED	17	85	65	149				
MAXIMUM	18	100	100	212				
MINIMUM	16	65	40	104				
IDLING	11	15	40	104				

MAX. PERMISSIBLE DIVING RPM: 3060 (30 SECONDS DURATION ONLY)

CONDITION	ALLOWABLE OIL CONSUMPTION
NORMAL RATED (MAX. CONT.)	........U.S.QT/HR........IMP.PT/HR
MAX. CRUISE	........U.S.QT/HR........IMP.PT/HR
MIN. SPECIFIC	........U.S.QT/HR........IMP.PT/HR

OIL GRADE: 1120, AN-VV-O-446

SUPERCHARGER TYPE: SINGLE STAGE - SINGLE SPEED BLOWER TYPE FUEL GRADE: 100/130, AN-F-28

OPERATING CONDITION	RPM	MANIFOLD PRESSURE (BOOST)	HORSE-POWER	CRITICAL ALTITUDE WITH RAM	CRITICAL ALTITUDE NO RAM	BLOWER	USE LOW BLOWER BELOW:	MIXTURE CONTROL POSITION	FUEL FLOW (GAL/HR/ENG.) U.S.	FUEL FLOW (GAL/HR/ENG.) IMP.	MAXIMUM CYL. TEMP. °C	MAXIMUM CYL. TEMP. °F	MAXIMUM DURATION (MINUTES)
TAKE-OFF	2700	48	1200	S.L.	S.L.			AR	150	118	260	500	5
WAR EMERGENCY													
MILITARY	2700	45 **	1200	S.L. TO 4800	4800			AR	150	118	260	500	5
NORMAL RATED (MAX. CONT.)	2550	39.5	1050	S.L. TO 7500	7000			AR	114	95	260, 232	500, 450	60 CONTINUOUS
MAXIMUM CRUISE	2170	30.5	700	S.L. TO 15,000	10200			AL	60	50	232	450	CONTINUOUS
MINIMUM SPECIFIC CONSUMPTION	1750 *	31 *	560	S.L.	6600			AL	37	31	232	450	CONTINUOUS

REMARKS:

* This representative power setting will give best engine economy at 140 psi bmep, but not necessarily best miles per gallon.

** Limit at 4800 feet. Reduce manifold pressure proportionately with increasing altitude from 48" Hg. at S.L. to 45" Hg. at 4800 feet. Manifold pressures listed are limits at no-ram critical altitudes.

15 BASIC ENGINE OPERATING TABLE

BASIC ENGINE OPERATION TABLE - TWIN WASP (R-1830) SIC3G
TAKE-OFF, CLIMB AND CRUISE - NO RAM (1,2)

Power Condition	Mixture Control Position	BHP (2)	RPM	Manifold Pressure In. Hg (3,4)	Critical Altitude (5)	Approx. Fuel Gal/Hr/Eng IMP GALS
Take-off	Auto-Rich	1200	2700	46.0 (48.0 S.L.)	4800	125.0
Normal Rated	Auto-Rich	1050	2550	41.0 (42.5 S.L.)	7000	105.0
Climb	Auto-Rich	810-860	2300	35.0	8700	68.0
Climb	Auto-Rich	640-700	2050	31.0 / 29	10,000	46.0
Cruise	Auto-Lean	600	2050	27.5 (30.5 S.L.)	13,000	37.5
Cruise	Auto-Lean	575	2050	26.5 (29.5 S.L.)	14,000	36.0
Cruise	Auto-Lean	550	2050	25.5 (28.5 S.L.)	15,000	34.5
Cruise	Auto-Lean	500	2050	23.0 (27.0 S.L.)	17,500	31.5

NACASTANDARD DAY TEMPERATURES (2,4)

PRESSURE ALTITUDE - FEET / O.A.T. or C.A.T. -°C	S.L.	2000	4000	6000	8000	10,000	12,000	14,000
	15	11	7	3	-1	-5	-9	-13

NOTES:

1) Critical altitudes will be increased by the amount of ram developed in any particular installation.

2) All power settings are based upon NACA standard atmospheric conditions of temperature and pressure ith no carburettor heat.

3) The manifold pressures shown for each cruise power setting include both the manifold pressure required at the critical altitude and that required at Sea level. The throttle correction required to obtain a selected BHP at any altitude below the critical is to increase the manifold pressure shown for the critical altitude by approximately 0.2 In.Hg for each thousand feet that the operating altitude is below the critical altitude.

4) The part throttle manifold pressure correction for any variation from NACA STd. Temp. is to add approx. 0.5 In. Hg. for each 10°C increase above NACA Std, day vlues, or subtract 0.5 In.Hg. for each 10° below NACA Std day termperatures. The full throttle correction is to increase engine speed 20rpm for each 12° above standard temperature.

5) To maintain constant climb or cruise powers above the altitude at which the engine reaches full throttle, increase engine speed 50rpm for each 1,000 feet above the full throttle (critical) altitude.

16 POWER RATINGS

ENGINE OPERATIONAL LIMITS — POWER RATINGS

Engine Check Chart - Twin Wasp R-1830 S103G Eng

Carburettor: PD-12H4 OR PD-12H1

Fuel: Grade 91/98 (min) (10)
Oil: S.U.S. at 210°F - 100 or 120

Power Settings: Curve Inst 1680-11 1680-12

FLIGHT OPERATING CONDITION						OPERATIONAL LIMITS						
Power Rating or Setting	BHP	Mixture Control Position	Critical Altitude	RPM	Maximum Manifold Pressure IN. HG	Oil inlet Temp °C Min	Oil inlet Temp °C Max	Oil Pressure PSI Min	Oil Pressure PSI Max	Cylinder Head Temp °C Recom-mended	Cylinder Head Temp °C Max	Maximum Carb. Air Temp °C (1)
Take-off (2 min)	1200	Auto Rich	4800	2700	46.0 (48.0 S.L)	40	100	80	110	120 min 150 to 200 (pre take-off)	260	38
Normal Rated Power	1050	Auto Rich	7000	2550	41.0 (42.5 S.L)	40	100 max climb 85 (2)	80	110	260 max climb 232 max climb 200 or less	(3) 232	38
Normal Rated Alternative	1000	Auto Rich	10,000	2700	38.0 (39.0 S.L)	40	85 (2)	80	110	200 or less	(3) 232	38
Maximum Cruising Power (4)	700	Auto Lean	14,800	2325	28.0 (31.0 S.L)	40	85 (5)	65	90	200 or less	232	38
Approach and Landing		Auto Rich		(6) 2300	As req'd	40	85	65			232	38

NOTES APPLICABLE TO LIMITS — **Overspeed: 3060 RPM for 30 secs - avoid operation 1700-1850 RPM**

(1) Limit on carburettor air temperature applies only when preheat is used.
(2) 100°C allowed during climb.
(3) 260°C allowed during climb.
(4) Maximum BMEP 140 psi when operating with Auto Lean Mixture.
BMEP = 432 X BHP/RPM
(5) Desired normal 60°C to 75°C.
(6) Propeller control setting - not actual RPM.
(7) Cowl flaps must be fully open for all ground operation and for at least 15 minutes after shutdown.
(8) Operation above 200°C should be confined to the minimum possible period of high power operation. Engine should be cooled below 200°C before shutdown.
(9) Use field barometric pressure. This reading may be obtained by reading the manifold pressure gauge before starting.
(10) Engine may be operated on Grade 100/130 fuel with no change in ratings.

17 GROUND OPERATING DATA

OPERATING DATA

GROUND PROCEDURE CHECKS AND LIMITS
TWIN WASP 41830 S1C3G ENG

Procedure	Mixture Control Position	Propeller Control	Throttle Control	Oil Inlet Temp °C		Oil Pressure PSI		Cyl. Head Temp °C
				Min	Max	Min	Max	Max
Pre-Start	Motor Engine Over With Starter							
Start	Idle Cut-Off Then Auto Rich	High RPM	1/10 to 1/4 OPEN			Show Almost Immediately		
Warm - Up	Auto Rich	High RPM	1000 RPM		85+	40		200
Ground Test	Auto Rich	High RPM		40	85+	65	100	232
Stop	Idle Cut-Off	High RPM			85+	15 For Idle		200

+ tropical conditions only.

OIL PRESSURE:-

Max . . . . 110 lb/sq in.
Min. Idling . . . . 15 lb/sq in.

Desired adjustment at 2200 RPM and 60° Oil Inlet Temperature: 80-90 PSI

Normal Operating Range:		
	2550 - 2700 rpm	80 - 100 psi
	2000 - 2200 rpm	65 - 100 psi
	1600 rpm	55 - 90 psi
	1400 rpm	40 psi minimum
	Idling	15 psi minimum

X

TEMPERATURE FOR TAKE OFF:-

Oil-Min . . . . 40°C
Cylinder Min . . . . . . (Absolute Minimum 120°C). . . . . . 150°C
Max . . . . 260°C

FUEL PRESSURE:-

Max . . . . 16 lb/sq in. DESIRED . . . . 15 lb./sq in.
Min . . . . 14 lb/sq in. IDLING . . . . 7 lb./sq in.

18 POWER CHARTS

POWER CHARTS - TWIN WASP (R-1830) SIC3G

TAKE-OFF POWER - 1200 RHP

Min. Octane 91/98 TAKE-OFF MANIFOLD PRESSURE 2700 RPM

PRESSURE ALTITUDE Feet	°CARBURETTOR AIR TEMPERATURE - VARIATION FROM STANDARD 0°					
	-30 to -20	-20 to -10	-10 to 0	0 to 10	10 to 20	20 to 30
S.L.	46.0	46.5	47.0	47.5	48.0	48.5
1000	45.7	46.2	46.7	47.2	47.7	48.2
2000	45.4	45.9	46.4	46.9	47.4	47.9
3000	45.0	45.5	46.0	46.5	47.0	47.5
4000	44.7	45.2	45.7	46.2	46.7	47.2
4800	44.5	45.0	45.5	46.0	46.5	47.0

NORMAL RATED POWER - TWIN WASP (r-1830) SIC3g - 1050 BHP

Min. Octane 91/98 RATED MANIFOLD PRESSURE 2550 RPM

PRESSURE ALTITUDE Feet	°CARBURETTOR AIR TEMPERATURE - VARIATION FROM STANDARD 0°					
	-30 to -20	-20 to -10	-10 to 0	0 to 10	10 to 20	20 to 30
S.L.	40.5	41.0	41.5	42.0	42.5	43.0
2000	40.1	40.6	41.1	41.6	42.1	42.6
4000	39.9	40.4	40.9	41.4	41.9	42.4
6000	39.7	40.2	40.7	41.2	41.7	42.2
7000	39.6	40.1	40.6	41.1	41.6	42.1

NOTE: Above the full throttle altitude, approximately 7,000 feet, an alternate rated power setting is available using 2700 RPM and a maximum of 38" M.P. up to 10,000 feet. This setting delivers 1000 BHP.

CLIMB POWER SETTINGS AND LIMITS - (R-1830) SIC3G
810-860 BHP CONSTANT MANIFOLD PRESSURE

Oil Pressure 65psi min.

PRESSURE ALTITUDE Feet	MIXTURE CONTROL POSITION	BHP	RPM	MANIFOLD PRESSURE IN.HG
S.L.	Auto-Rich	810	2300	35.0
5000	Auto-Rich	835	2300	35.0
8700	Auto-Rich	860	2300	35.0 (F.T.)
9500	Auto-Rich	840	2300	34.0 (F.T.)
10,500	Auto=Rich	810	2300	33.0 (F.T.)

a) Climbs shall normally be conducted at the above settings, and at approximately 130 mph IAS.

b) Increase manifold pressure 0.5 in. Hg for each 10°C rises of carburettor temperature from standard altitude temperature, or decrease 0.5 in. Hg for each 10°C that carburettor air temperature s below standard altitude temperature, up to full throttle altitude.

Alternate Climb Powers At the discretion of the piot and as circumstances require, the following additional climb power settings may be used:

a) 640-700 BHP Climb as per Engine Operation Table.
b) 1050 BHP Rated Power (Emergency only).

Mar 1995 NWB

550 BHP CRUISING CHART

Min. Octane 91/98 MANIFOLD PRESSURE IN. HG (2050 RPM)

PRESSURE ALTITUDE Feet	°CARBURETTOR AIR TEMPERATURE - VARIATION FROM STANDARD 0°					
	-30 to -20	-20 to -10	-10 to 0	0 to 10	10 to 20	20 to 30
S.L.	26.5	27.0	27.5	28.0	28.5	29.0
2000	26.2	26.7	27.2	27.7	28.2	28.7
4000	26.0	26.5	27.0	27.5	28.0	28.5
6000	25.8	26.3	26.8	27.3	27.8	28.3
8000	25.6	26.1	26.6	27.1	27.6	28.1
10000	25.4	25.9	26.4	26.9	27.4	27.9
12000	25.2	25.7	26.2	26.7	27.2	27.7

600 BHP CRUISING CHART

Min Octane 91/98 2050 RPM

PRESSURE ALTITUDE Feet	°CARBURETTOR AIR TEMPERATURE - VARIATION FROM STANDARD 0°					
	-30 to -20	-20 to -10	10 to 0	0 to 10	10 to 20	20 to 30
S.L.	28.5	29.0	29.5	30.0	30.5	31.0
2000	28.2	28.7	29.2	29.7	30.2	30.7
4000	28.0	28.5	29.0	29.5	30.0	30.5
6000	27.8	28.3	28.8	29.3	29.8	30.3
8000	27.6	28.1	28.6	29.1	29.6	30.1
10000	27.4	27.9	28.4	28.9	29.4	29.9
12000	27.2	27.7	28.2	28.7	29.2	29.7

CONTROL SETTINGS

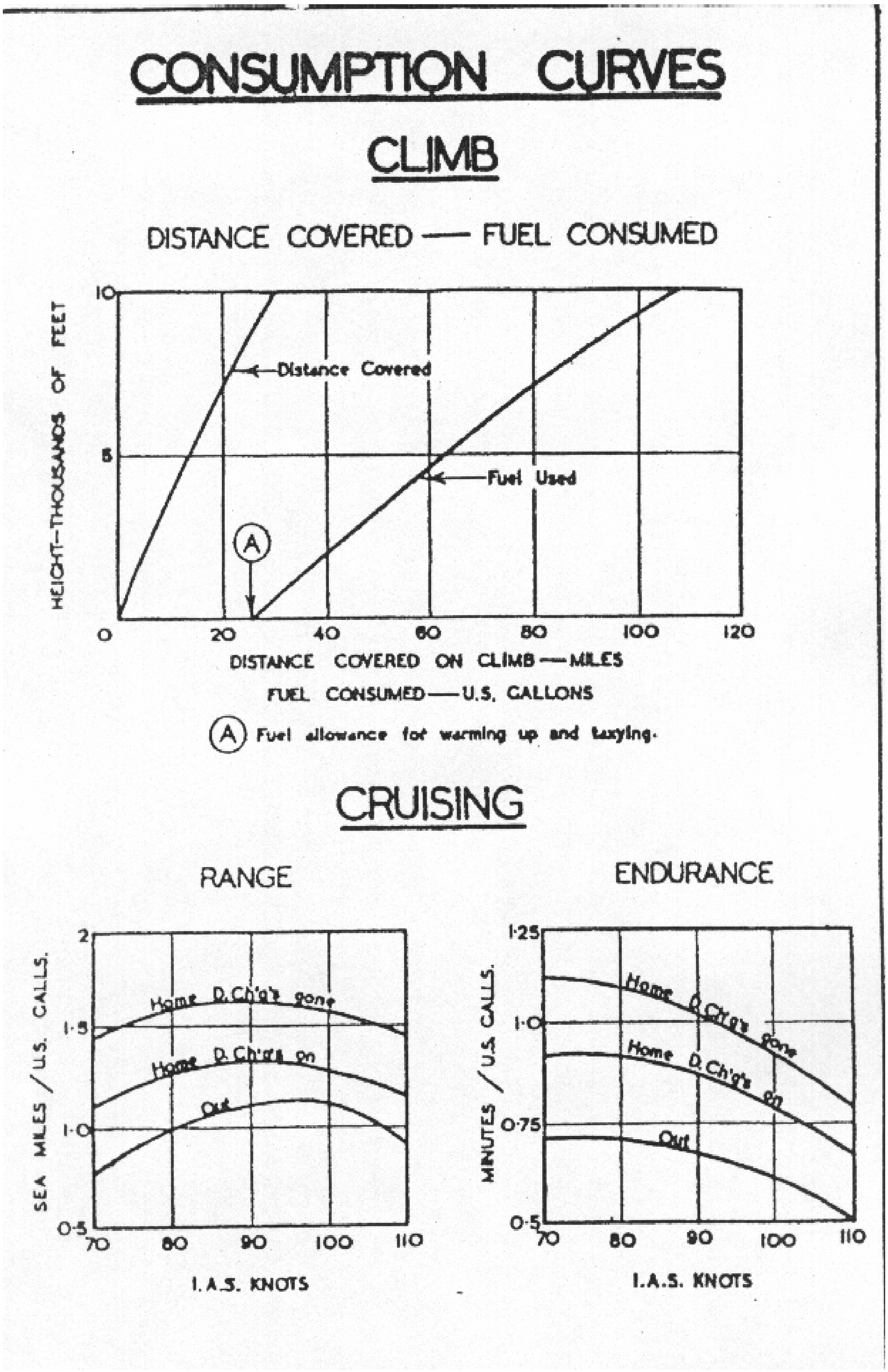
a) Mixture . . . Automatic Lean

b) Propeller . . . 2050 rpm

c) Throttle . . . As per above charts

d) Carburettor Heat . . . As required - recommended 15 - 25°

19 FUEL CONSUMPTION CHARTS



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SECTION 6 WEIGHT AND BALANCE

6.1 WEIGHT AND BALLANCE

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6.1 WEIGHT AND BALLANCE:

01 TAKE-OFF AND LANDING WEIGHT

For this aircraft the take-off and landing weight are the same, And is due various reasons (conversion to Passenger Plane / Insurance) reduced from original to 11.999 KG (26.458 Lbs)
The various graphs relating to take-off and landing performance are to be referred to, to determine the distances for a particular day or condition. These figures must then be compared to available field length

The PIC will make the final decision with regard to AUW for take-off. He will sign the relevant loading documents prior to take-off and duplicates should be left at the point of departure for every flight. They can be left with the flight plan or in the possession of a responsible person for later reference if required.

The PIC is also responsible for the loading of the aircraft and it's airworthiness for flight. Delegation of duties with regard to the distribution of load, passenger seating and the security of the cargo do not absolve the PIC of the final responsibility for the overall safety of the aircraft.

Before take-off the PIC will ensure that all precautions have been taken with regard to the load, and he will discuss the loading arrangements with the loadmaster and cabin crew. Safety is paramount, and all crewmembers are jointly to ensure that the aircraft is fully serviceable and safe for flight.

02 FUEL FOR TAXY AND RUN-UP

A total of 45kg (100 Ibs) of Fuel is to be allowed for Taxi and Run-Up under normal circumstances.

If more is to be used, this should be reflected in the Weight and Balance Chart calculation.

03 AIRCRAFT BALANCE

It is the PIC's responsibility to ensure the aircraft Weight and Balance keeps the Centre of Gravity (C of G) within limits at all times. Attention must be paid to:

A	Gear extraction and retraction
B	Fuel and oil consumed
C	Movement of cargo and/or passengers

04 CENTRE OF GRAVITY LIMITATIONS

Forward Limit	22.9% MAC or 242.2 ins aft of datum
Aft Limit	28.5% MAC or 251 .5 ins aft of datum
Datum	3 inches aft of the Bow Nose

05 COMPARTMENT DATA STATION LIMITS

COMPT	STN NO	LIMITS	CENTROIDS
Bow	0-1	0 -58.75	29.37
Pilot	1-2	58.75 -122.75	108
Fwd Pax	2-4	122.75 -	175.75
Galley	4-5	228.75	265.37
Rear Pax	5-6	228.75 -302	343. 87
Blister	6-7	302 -385. 75	436.62
Tunnel	7-8	385.75-487.5	523.5
Tail	8+	487.5 -563.5	Nil allowed
		563.5 +	

Notes. Limits are expressed as inches aft of datum along HRL
Centroid is average point centrally in compartment
Average weight of person is 170 Ibs (76 kg)
Average weight of person's baggage is 30 Ibs (13 kg)
Cargo must be weighed

06 GENERAL INFORMATION

MAC or Mean Aerodynamic Chord	165.3 ins
Leading Edge of MAC	204.39 ins aft
Formula for % MAC	$\frac{(\text{CofGArm} - 204.39) \times 100}{165.3}$
C of G in ins	$\frac{\text{Total Moment}}{\text{Total Weight}}$
Index Formula	$70 - \frac{\text{Wgt}\ (258 - \text{Arm})}{10,000}$
	$70 - \frac{\text{xxxx}(258-\text{xxxx})}{10,000}$
	=xxxx
Gear Extraction	+12,485 in lbs

07 METHOD OF COMPUTATION

1	Enter aircraft details for PBY
2	Enter Pax numbers, weights, and positions
3	Enter cargo weights and positions
4	Total the compartment weights
5	Enter fuel volume and weight
6	Enter oil volume and weight
7	Add weights to obtain Ramp weight
8	Use 100lbs (45kg) fuel burn off for Taxi and Run Up
9	Obtain Take Off Weight
10	Subtract calculated flight burn off = Landing weight
11	Enter top of graph at index (xxxx for PH-PBY)
12	Move down graph compartment by compartment moving curser by the relative amounts
13	At final curser position move vertically to intercept Aircraft TOW to obtain take-off C of G
14	Subtract fuel and oil burned. Move curser vertically to obtain landing C of G

08 LOADSHEET LBS

Stichting Exploitatie Catalina PH - PBY Loadsheet

					Mass (Lbs)	Arm (Inch)	Moment (InchLbs) 1000
Date							
From							
To							
DOM					**19980**	**248**	4958,19
Cockpit							
Crew	2	X	180	Lbs	360	110	39,60
Forward Cabin							
Row 1	0	X	180	Lbs	0	140	0,00
Row 2	0	X	188	Lbs	0	218	0,00
Luggage		X		Lbs	0	173	0,00
Aft Cabin							
Row 3	0	X	180	Lbs	0	326	0,00
Row 4	0	X	188	Lbs	0	368	0,00
Luggage		X		Lbs	0	347	0,00
Tail							
Equipment			0	Lbs	0	540	0,00
					+		+
ZFM					**20339,8**	**245,7**	**4997,79**
Fuel							
Left			0	Imp	0	267	0,00
Right			0	Imp	0	267	0,00
Oil							
Left			0	US	0	209	0,00
Right			0	US	0	209	0,00
					+		+
TOM					**20339,8**	**245,7**	**4997,79**
			MTOM		26458		
Trip Fuel			0	Imp	0	267	0,00
					-		-
LDM					**20339,8**	**245,7**	**4997,79**
			MLDM		26458		
CoG Limits			TO		242,2	**245,7**	251,0
			LDG		242,2	**245,7**	251,0

Signature Commander :

SECTION 7 LOADING

7.1 LOADING

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7.1 LOADING

01 FORWARD PAX COMPARTMENT

Length Width Height Floor Area Total Capacity Seating	101 in 108 in 62 in 31 sq ft each side 240 cu ft 8 Pax	2.565 m 2.743 m 1.600 m 9.72 sq 6.86 cu m

02 PYLON

Length Width Height' Floor Area Total Capacity Seating	79 in 119 in at sta 4 105 in at sta 5 67in 25 sq ft each side 270 cu ft Nil	1 .778 m 3.022 m 2.667 m 1 .702 m 7.84 sq m 7.72 cu m

03 REAR PAX COMPARTMENT

Length Width Height Floor Area Total capacity Seating	101 in 105 in at sta 5 94 in at sta 6 61 in 31 sq ft each side 240 cu ft 8 Pax	2.565 m 2.667 m 2.388 1.550 m 9.72 sq m 6.86 cu m

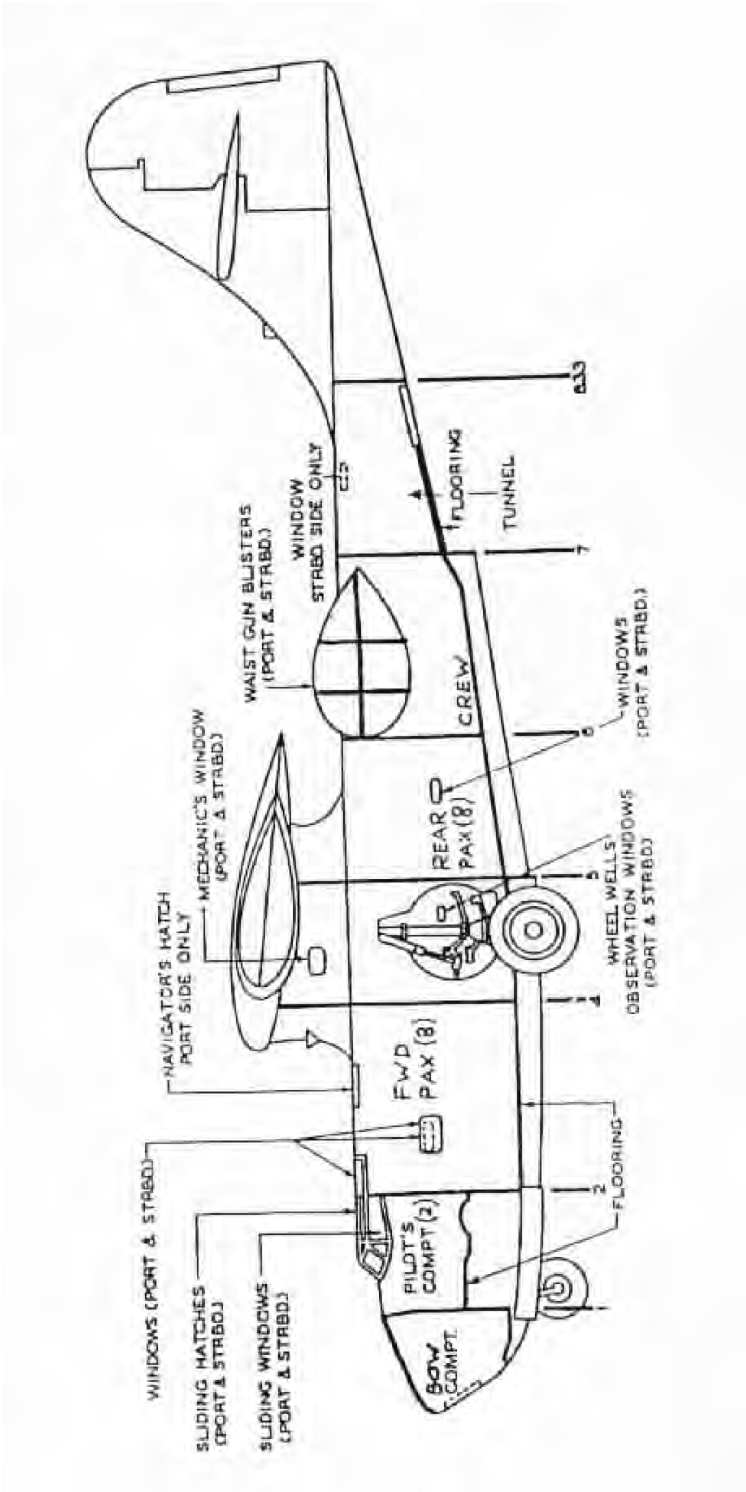
04 BLISTER

Length Width Height Floor area Total capacity Seating	81 in 94 in at sta 6 85 in at sta7 60 in 35 sq ft 220 cu ft Up to two (crew only with seat belts)	2.057 m 2.388 m 2.159 m 1.525m 10.9 sq m 6.28 cu m

05 COMPARTMENTI LOADING DATA

1	BOW COMPARTMENT Mooring equipment only No storage in this compartment		stn 0 -1
2	Pilots Compartment Two people and flight gear		stn 1-2
3	Forward Passenger Compartment a. Max Unit load b. Max Load Port side c. Max Load Stb side d. Max load total	 83 psf 1870 lbs(835 kg) 1870 Ibs (835 kg) 3740 Ibs (1670 kg)	Stn 2-4
4	Pylon Compartment a. Max Unit Load 35 pst b. Max Total Load 9361bs (420kg) c. Must use all 50 sq ft of floor space. Tie down mandatory Reduce load inproportion to floor space available.		Stn 4-5
5	Rear Passenger Compartment a. Max Unit load b. Max Load Port side c. Max Load Stb side d. Max load total	 83psf 2050 Ibs (915 kg) 2050 Ibs (915 kg) 4100 Ibs (1830 kg)	STN 5-6
6	Blister Compartment a. Max unit load 83 pst b. Max total load 3240 Ibs (1450 kg) c. Mus use all 39 sq ft of floor area. Tie down mandatory Reduce load in proportion to floor space available.		Stn 6-7
7	Tunnel a: No cargo in this area B: Light items of aircraft maintenance gear only e.g ladders, engine stands, cleaning equipment		Stn 7-8
8	Tail Area Not to be used no storage in this area		Stn 8+

06 CATALINA COMPARTMENTS



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8 CONFIGURATION DEVIATION LIST

01 GENERAL

Not available for Catalina PBY-5a

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9 MINIMUM EQUIPMENT LIST

9.1 MINIMUM EQUIPMENT LIST

9.2 MASTER MINIMUM EQUIPMENT LIST

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9.1 MINIMUM EQUIPMENT LIST

01 MASTER MINIMUM EQUIPMENT LIST

The minimum equipment list used in Catalina PH-PBY is the master MEL. From the factory

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SECTION 10 SURVIVAL AND EMERGENCY EQUIPMENT

10.1 EMERGENCY EQUIPMENT

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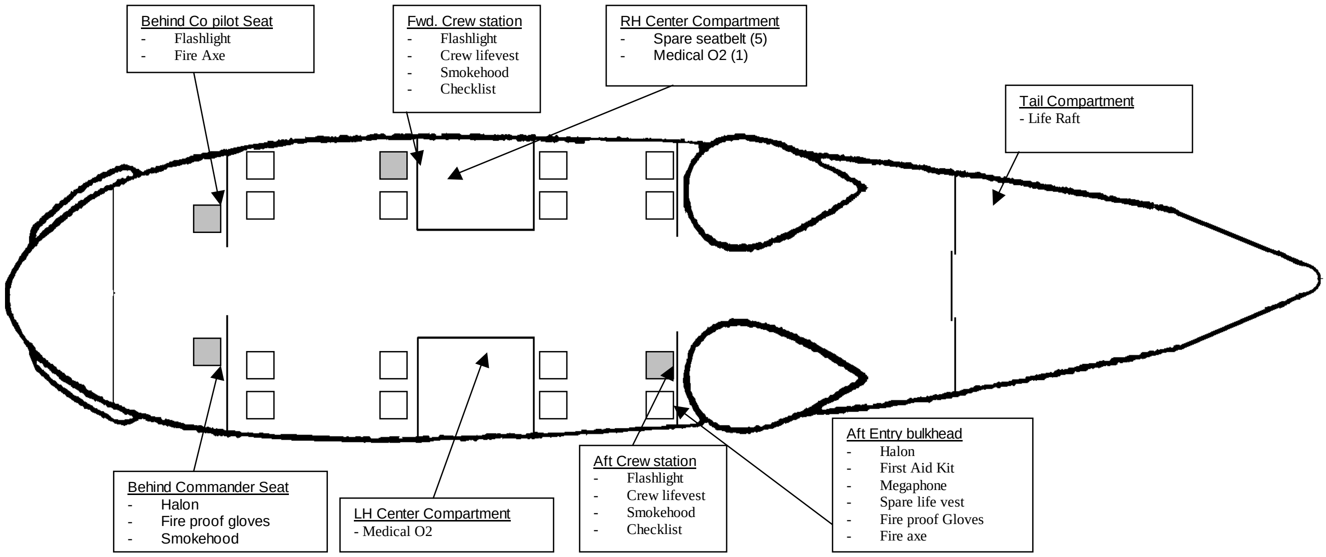
10.1 EMERGENCY EQUIPMENT

01 LAYOUT



02 LIST OF FLIGHT SAFETY EQUIPMENT

Items	Amount/total amount
Flashlight	3
Fire axe	2
Fire extiguise bottle	2
Fire proof gloves	2
Crew lifevest	5
Smokehood	2
Emergency checklist	2
Copy “Cabin procedures	1
Medical O2	2
Life raft	2
First aid kit	1
Megaphone	1

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11 EMERGENCY EVACUATION PROCEDURES

01 SEE PART E SECTION 3

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12 SYSTEM DESCRIPTION

12.6 AIRCRAFT HULL AND SPECIFICATIONS

12.23 COMMUNICATION

12.24 ELECTRICAL POWER

12.25 FLIGHT STATION, ACCOMODATION AND EQUIPMENT

12.26 FIRE PROTECTION

12.27 AIRCRAFT CONTROLS

12.28 FUEL SYSTEM

12.29 HYDRAULIC POWERS

12.31 INSTRUMENTS

12.32 LANDING GEAR AND BRAKES

12.33 LIGHTS

12.34 NAVIGATION

12.36 PITOT STATIC SYSTEM

12.53 AIRFRAME

12.61 PROPELER SYSTEM

12.72 ENGINES

12.79 OIL SYSTEM

12.6 AIRCRAFT HULL AND SPECIFICATIONS

01 GENERAL

The aircraft is a high wing monoplane amphibian flying boat, powered by two Pratt and Whitney R 1830-92 engines. It has a tricycle undercarriage which retracts for water landings, and can be fitted with beaching gear if necessary the event of gear failure.

The engines are fitted with fully feathering Hamilton Standard propellers.

A crew of three is necessary for all land operations (excluding Ferry flights) and preferably four for water work.

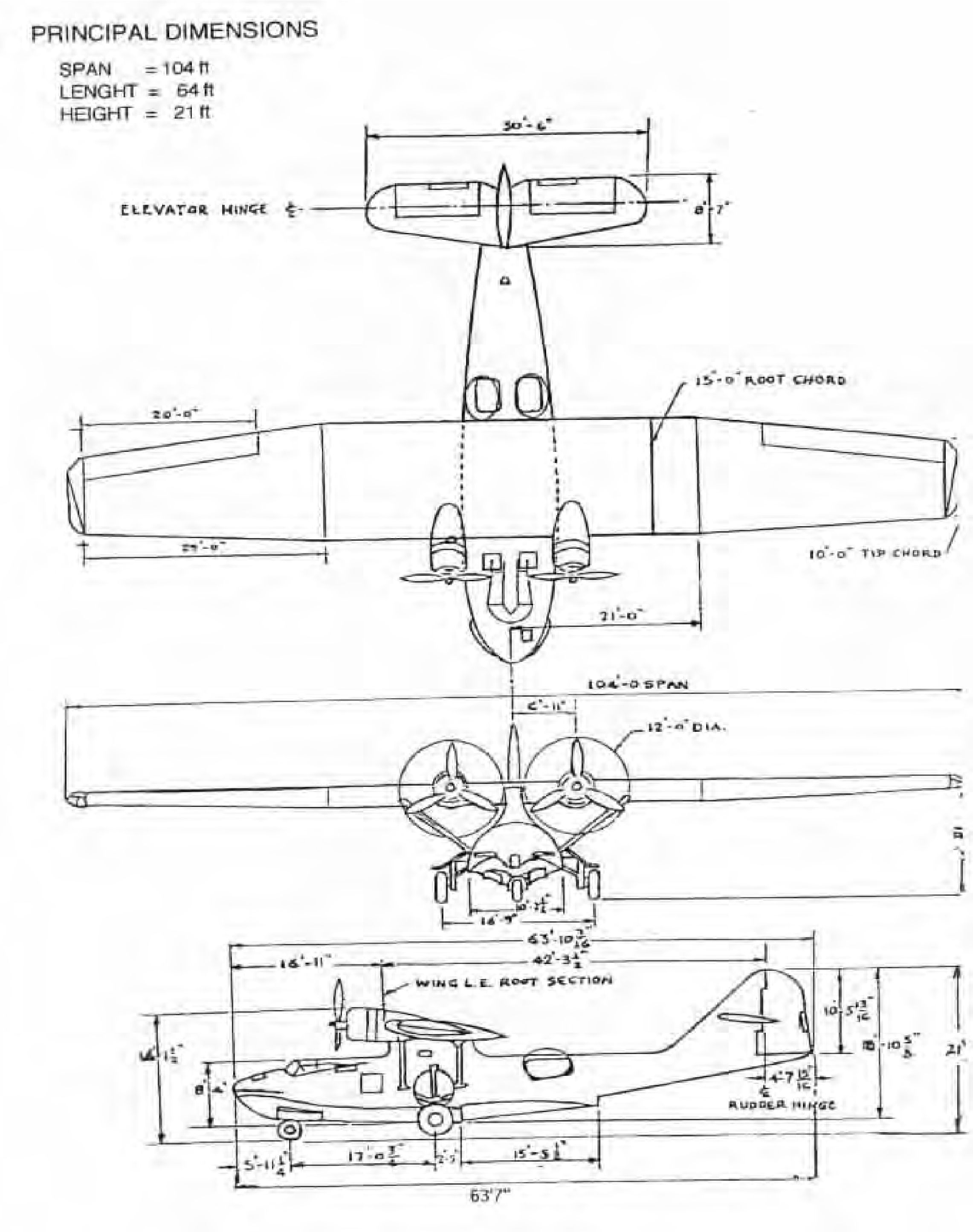
If passengers are carried a Cabin Attendant is necessary, with the number of attendants being in accordance with Commercial practice. The Cabin Attendant is responsible for the general security of the aircraft in whilst flight.

Cabin Crew members are to have access to intercom facilities

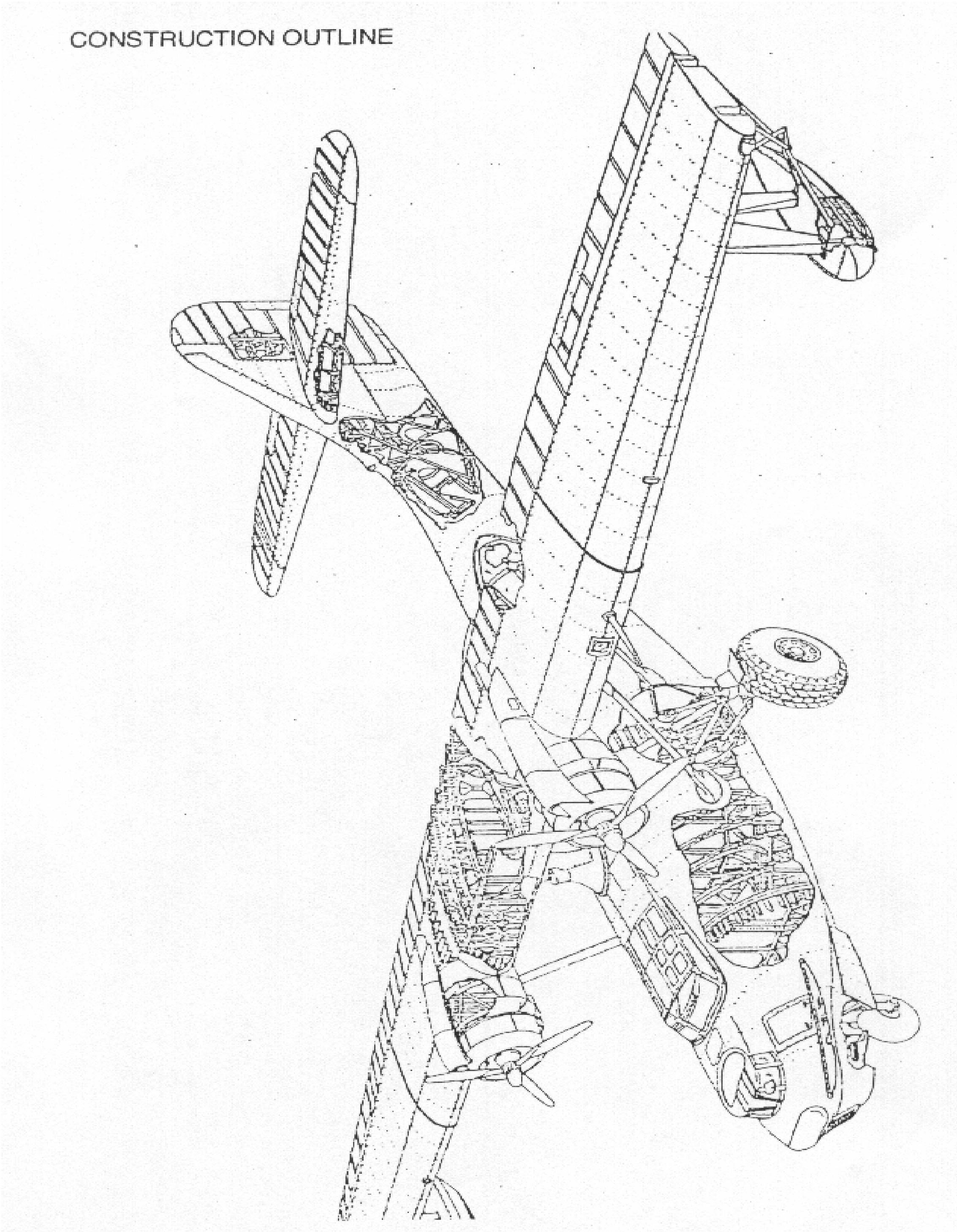
NOTE: *This manual contains an abbreviated collection of handling information to enable The aircraft to be operated safely both on the ground and in the air, and this manual does not contain all of the expanded information that is contained in the technical reference manuals.*

02 PRINCIPAL DIMENSIONS

Span 104ft
Length 64ft
Height 21ft



03 CONSTRUCTION OUTLINE



General

1	Span	104ft00in
2	Length (over-all)	63ft107/16in
3	Height over Wing	13ft51/2in
4	Height (on landing gear with propeller Blade vertical at top)	21ft01in

Wing

1	Airfoil Section	NACA 21
2	Chord at root	15 ft 00 in
3	Chord at tip	10 ft 00 in
4	Incidence	6 deg positive
5	Dihedral (outer panel taper)	2 deg 20’
6	Sweepback (at outer panel)	2 deg 58’

Stabilizer

1	Span	30 ft 06 in
2	Maximum Chord	8 ft 00 in
3	Incidence	4 deg positive

Hull

1	Width (maximum)	10 ft 2,5 in
2	Height (maximum)	8 ft 00 in
3	Length	63 ft 11 1/6 in

Areas

1	Wings (less ailerons)	1300 sq ft
2	Ailerons (total)	100 sq ft
3	Stabilizers (incl. 3.5 sq ft hull fin sq ft area and 18.4 sq ft contained elevator balance)	138.2 sq ft
4	Elevators (including tabs)	66.6 sq ft
5	Elevator trim tabs (total)	3.9 sq ft
6	Fin	35 sq ft
7	Rudder (including tabs)	40.4 sq ft
8	Rudder trim tab	2.6 sq ft

Wheel Landing Gear

1	Type	Tricycle, hydraulically retractable
2	Track	16ft 09in, from/to centre of tire

Wingtip Floats

1	Length.	10ft 37/8 in
2	Track	89ft 04in (keel to keel)
3	Type	Electrically or manually retractable

✈ INTENTIONALLY LEFT BLANK ✈

12.53 AIRFRAME

01 GENERAL

The wing is mounted on a superstructure built up from the hull, and is braced by four struts from the hull, two on each side. It is an all aluminium structure with stressed skin, semi cantilevered construction. The trailing edges are metal braced and fabric covered while the leading edges and the main wing box are metal. The wing also incorporates the engine nacelles, fuel and oil tanks and two retractable floats with their mechanism.

At the stern the hull tapers to a point and then sweeps up
To form the Dorsal Fin which in turn becomes the lower portion of the vertical stabilizer.
The horizontal stabilizer is bolted to this, followed by the remainder of the vertical stabilizer
.The horizontal stabilizer is metal with reinforced fabric covered tips and elevators

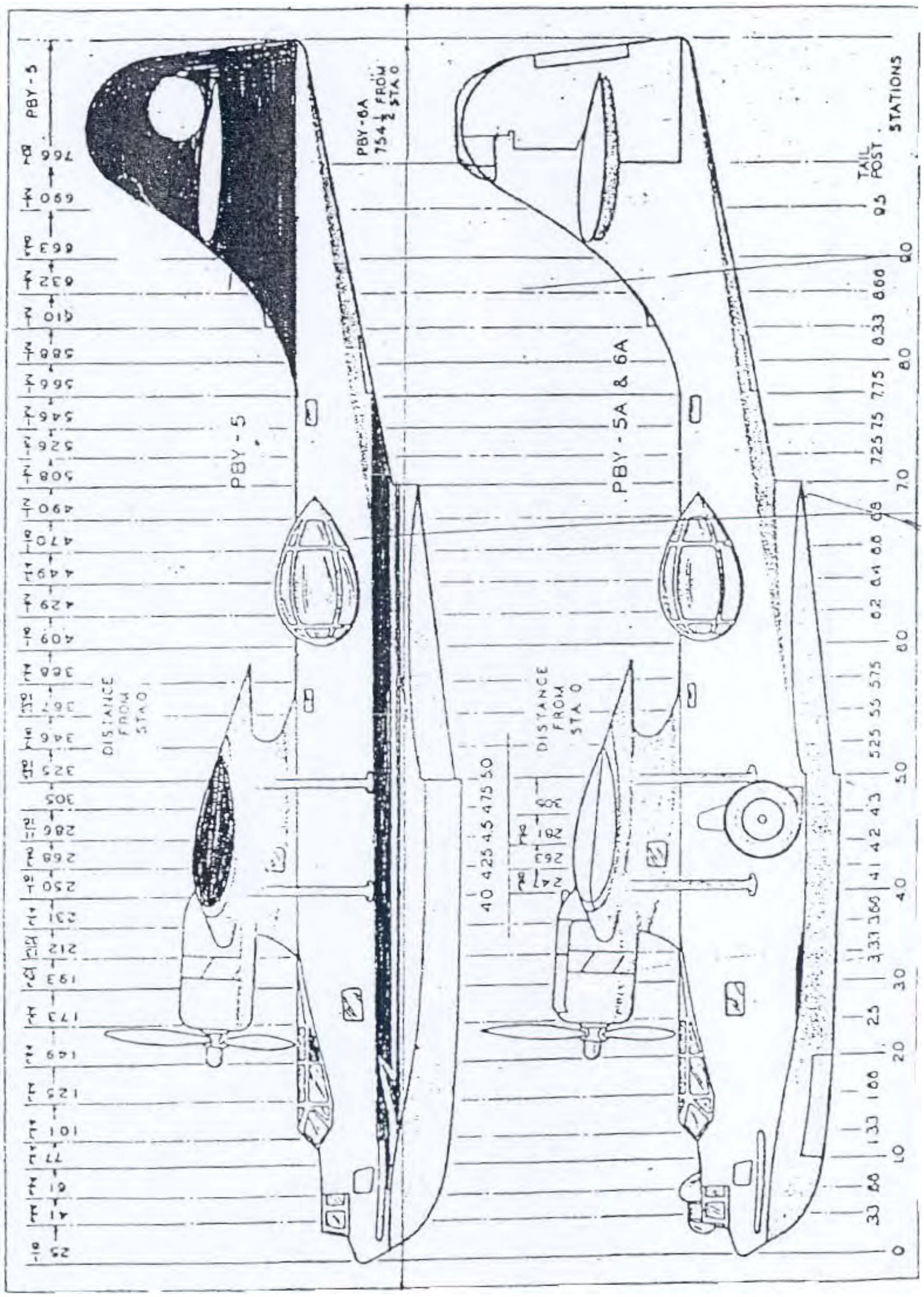
02 THE HULL

The all aluminium hull is divided into 5 sections separated by bulkheads that are watertight up to the lower part of the door frames. The doors have been removed from the 3 main bulkheads (Station No's 2,4,6). For water operations the door at Bulkhead No 7 must be in place and secure.

The integrity of the Hull is to be determined as part of the external checks of the Preflight inspection.

WARNING: Operating on the water with a damaged Hull is inherently dangerous and can lead to the loss of the aircraft.

03 BULKHEADS AND STATIONS



HULL DRAIN PLUGS

There are 12 plugs in the Hull to drain the compartments and these are accessible only from the outside. Two plugs are in the front wheel well.

Considerable water can collect in some compartments after rain and after water operations. The drain plugs should be removed regularly as part of the Preflight inspection. The presence of other fluid such as fuel or hydraulic oil in the bilges should be investigated.

FLOAT DRAIN PLUGS

There are two plugs in the Port float and one in the Starboard float. The floats are from different iv1arks of Catalina. Little or no water enters the floats during rain but if floats are used “on the water" the plugs should be removed and the compartments drained soon afterwards

04 MARINE EQUIPMENT

The full Marine Equipment fit has yet to be determined

When it is intended to operate on the water ropes and boat hooks are to be carried in order to pick up buoy hoops. The header rope to be used to hold the aircraft is to be of a substantial thickness and at no stage is the bow to be left unattended until the strop has been fitted to the mooring attachment on the buoy.

For beaching, sufficient rope must be available for bow, blister and wing lines to be passed ashore.

CAUTION Any work on the water where the engines are to be stopped requires specific STICAT approval. Until crewmembers are certified as 'Competent' in water operations they are not authorized to be part of a crew operating the aircraft on the water.

For all water work life Jackets are to be carried, sufficient for all persons on board.
This situation only applies within The Netherlands, and then only in enclosed waters such as lakes and harbours. For open water work and International operations. More stringent regulations apply and these are in accordance International Civil Aviation Organization (ICAO) rules.

05 MANOEUVRING EQUIPMENT

Drogues may be carried when it is intended to maneuver on the water. Because the engines are fitted close to the centerline of the aircraft maneuvering can prove difficult and high power settings are sometimes required to turn the aircraft especially when the wind is greater than 5 knots.

Because of the high drag of the drogues (which is their purpose) emergency release may become necessary. Suitable axes or cutting tools are therefore also to be carried.

06 ANCHORS

It is difficult to drop anchor from this aircraft due to the modification of the bow hatch. It is even more difficult to retrieve the anchor. Hull damage is a distinct possibility without extreme care and competence.

07 CABIN LAYOUT AND SEATING

Sixteen seats, eight in each of the passenger compartments, provide seating for passengers. Four seats in each compartment are rearwards facing, the remainder forward facing. Lap seat belts are provided at all seats.

Two Pilot seats are in the Flight Station. A four-point safety harness is provided for each pilot.

12.27 AIRCRAFT CONTROLS

01 GENERAL

All control runs are duplicated with each Pilot offered full control of the aircraft, from their Pilot's seats. There are no power-assisted controls; cable runs plus associated pulleys, turnbuckles, chains and sprockets operate all flight controls. All controls are adjustable.

Because of their large area, the control surfaces exert large forces on the control mechanism and the pilot. When taxiing on land the rudder lock is left on, but on the water rudder control is necessary for maneuvering.

02 CONTROL COLUMN

The yoke incorporates aileron and elevator controls and the horizontal yoke bar provides a mounting for a variety of switches. The mechanical control lock can be left in place and removed as part of the Line Up checks.

03 RUDDER AND ELEVATOR

These surfaces have an aluminium frame and are fabric covered. Both have metal trim tabs controllable from the Flight Station.

04 RUDDER CONTROLS

Two sets of rudder controls operate conventionally and the pedals are adjustable for Pilot leg length. Pilot’s seats are adjustable for comfort, and to ensure complete movement of all controls is possible.

WARNING: Failure to properly adjust seat and rudder pedals to ensure full travel will place the aircraft at risk should engine failure occur soon after take off.

05 ELEVATOR CONTROLS

Forward and rearward movement of the Yoke operates elevators

06 AILERONS

The two ailerons have aluminium frames and are fabric covered. The port aileron has a metal trim tab, which is adjusted from the flight deck. The Starboard aileron has a fixed tab adjustable only when the aircraft is on the ground.

07 CONTROL LOCKS

Elevator and ailerons are clamped by means of a detachable bar. This bar is secured to the left column by pins and the Captain's seat belt. The control-locking bar locks both columns via the Yoke.

The rudder has a separate locking pin activated by a lever on the fuselage to the left of the Captain's seat. It is usually left locked for taxiing, unless on the water when full rudder may be required.

Gust damage can occur to the control surfaces and control runs in windy conditions on the ground. If the elevator and aileron lock is out, it is important to hold the control column steady whilst taxiing to prevent such damage. This is the responsibility of the non-flying pilot.

External locks may also be fitted if aircraft is to be left outdoors in stormy conditions. With external locks fitted it is impossible to release the Flight Station Control Locks

08 TRIM TABS

All control surfaces have metal trim tabs, which are adjustable by the Pilots.

The elevator and rudder controls are overhead in the Flight Station while the aileron control is located to the left of centre below the instrument panel.

Trim tab control runs must be checked for full travel as part of the Pre Start checklist.

09 CONTROL SURFACE RANGE OF MOVEMENT

1	Rudder Right Rudder Left	17 Deg 17 Deg
2	Elevator Up Elevator Down	30 Deg 20 Deg
3	Aileron Up Aileron Down	21 Deg 19.75Deg
4	Rudder Trim Tab Right Rudder Trim Tab Left	15 Deg 20 Deg
5	Elevator Trim Tab Up Elevator Trim Tab Left	5 Deg 5 De9
6	Aileron Trim Tab Up Aileron Trim Tab Down	16 Deg 16 Deg

10 RETRACTABLE WING TIP FLOATS

The pilots operate the floats electrically. The float switch is on the Yoke. If the throttles are retarded to below 15 inches Manifold Pressure the float warning lights will illuminate, until the floats are down and locked. The wheel indicator lights will also be activated, together with the nose wheel door locked light. See also Emergency Operations.

CAUTION MAX SPEED FOR OPERATING WING FLOATS **130KTS**

11 FLOAT CONTROL SWITCH

The Yoke switch for electrical operation of the floats has UP-OFF-DOWN positions. The switch should always be left at the OFF position when not in use, to de-energies the solenoids and prevent burn out of the float motor.

WARNING: When operating the float switch it should never be moved from UP to DOWN or vise versa without pausing at the OFF position. The reverse of Torque can strip the gearing, damage the torque tubes and damage the wing

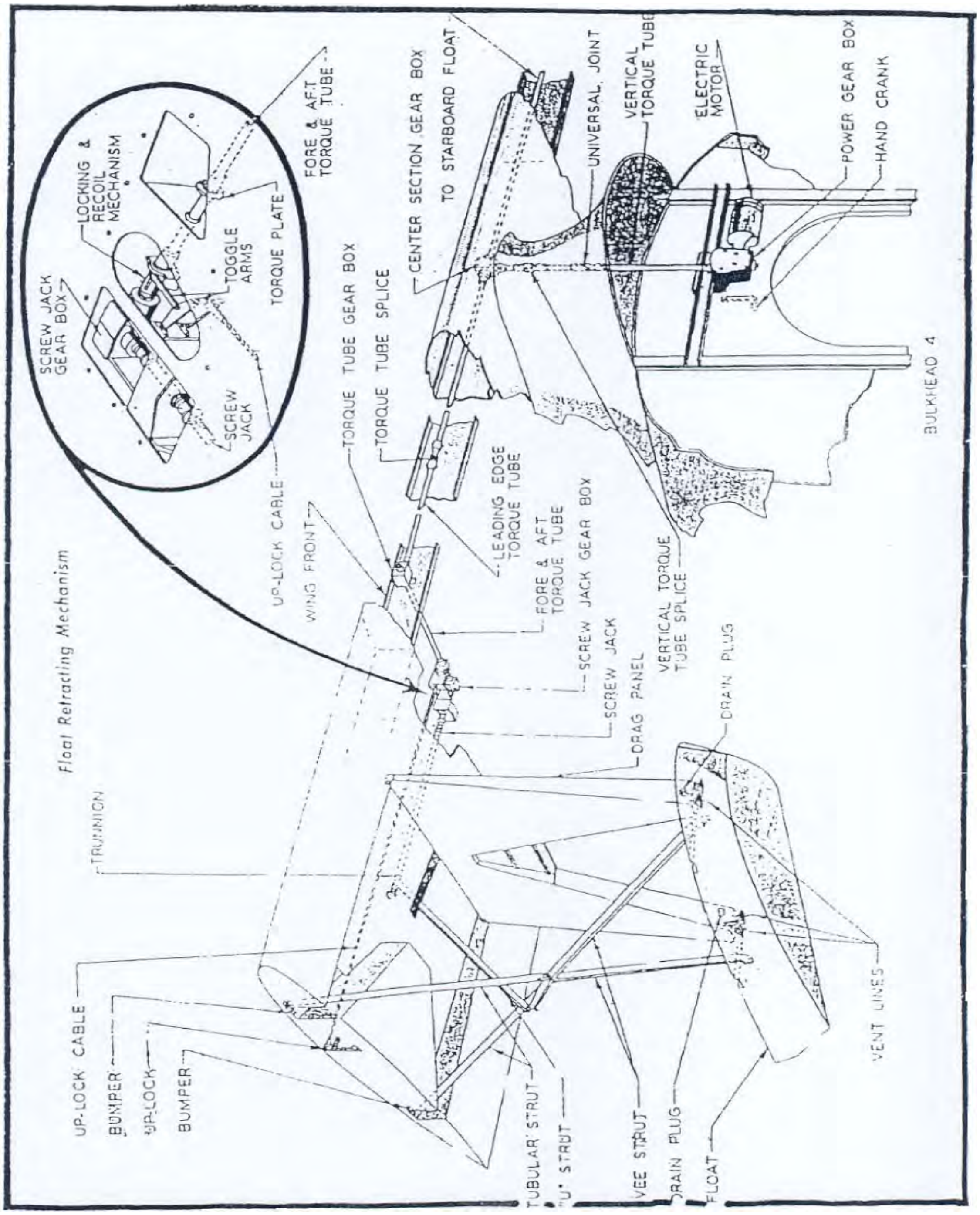
If the floats have been lowered on land to tie down overnight, they may be hand cranked up.

If the engines are used they should be warmed and then opened up enough for the generators to be cut in (1700 rpm) before the floats are raised electrically.

Floats should always be raised before take-off on land

With floats down the airspeed is reduced by approximately 5kts and aileron control is appreciably reduced.

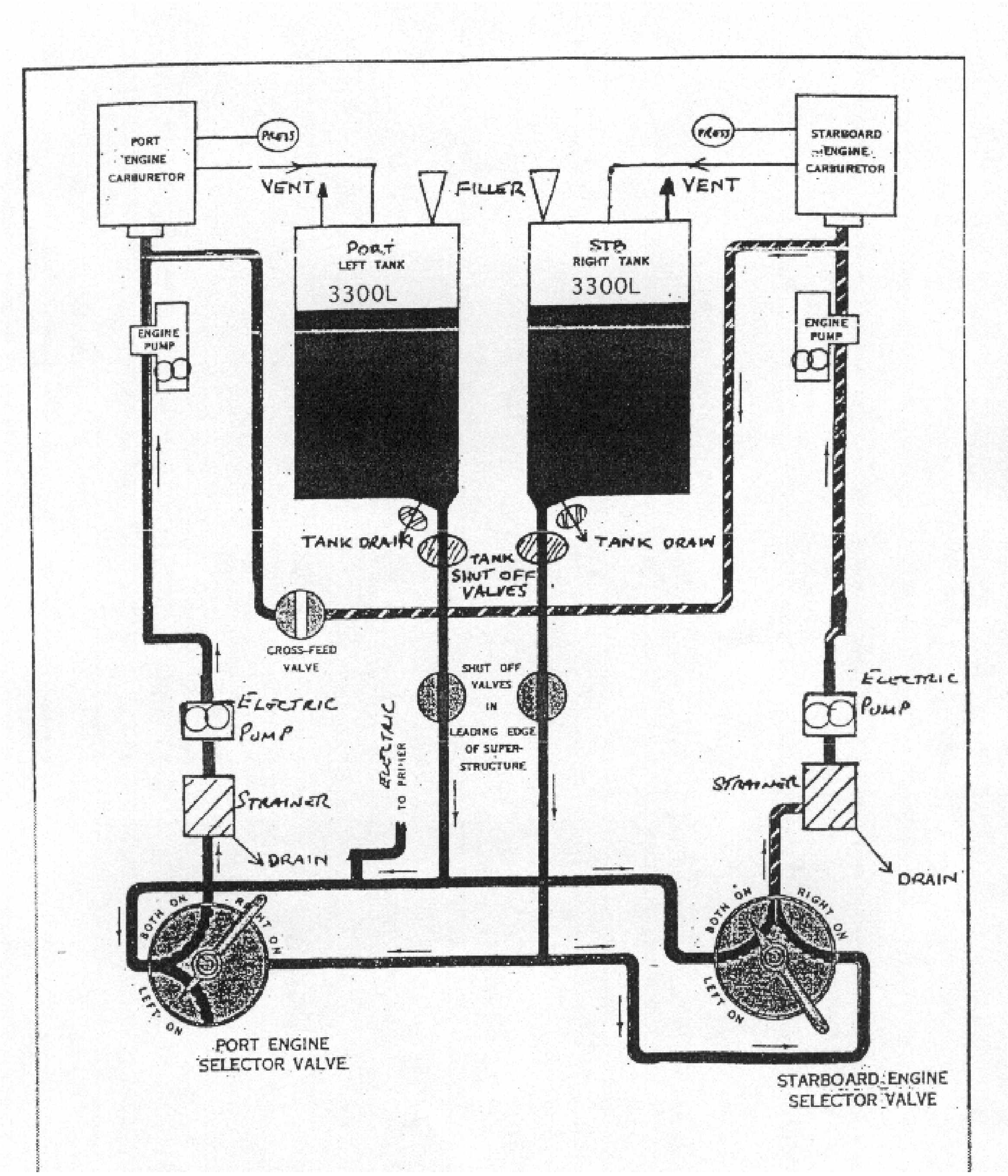
12 FLOAT OPERATION SCHEMATIC



12.28 FUEL SYSTEM

01 GENERAL

The fuel system comprises two fuel tanks and a duplicated delivery system that allows fuel to be feed from either tank to either engine via either engine driven fuel pump. The system layout is best explained by diagram



02 FUEL SPECIFICATION

Aviation Gasoline with Octane rating **100/130 (100ll)** is the correct fuel. Fuel down to a rating of
91 /96 (Purple/Yellow) can be used

03 FUEL TANKS

Two tanks, one in each wing centre section, are integrally built with sealed chambers and accommodate 3300L each for a total usable total usable fuel of 6600L .The tanks have sealed filling caps on the upper wing surface and are vented to the top of the wing.

04 FUEL COCKS

A main fuel cock for each engine is mounted on the bulkhead behind the pilots. Each cock may be set at "left on", 'both on", "right on" or 'off', referring to the tanks selected for that engine. With both cocks at "both on", both tanks are feeding both engines.

The normal position for the fuel cocks is left engine feeding from left tank ("LEFT ON LEFT") and right engine feeding from right tank ("RIGHT ON RIGHT").

A pressure cross feed cock, normally kept closed, allows fuel to be fed to both engines from one engine driven fuel pump in the case of failure of the other one.

CAUTION: *If cross -feeding in circumstances other than pump failure, the pump which is not cooled by fuel will over- heat if cross feed is used for long periods of time.*

05 FUEL QUANTITY GAUGES

A fuel gauge is fitted for each tank and these are calibrated from 0-2000L in 400L increments. Above 2000L the gauges will still indicate but have not been calibrated and below 400L the gauges will read zero.

The tanks should be dipped prior to flight and the gauge and dipstick reading should correlate.

06 FUEL SHUT-OFF VALVES

The shut-off valves are located beneath the main fuel tanks behind the forward galley bulkhead protected by a panel secured by fasteners.

These valves may be closed to stop the flow of fuel from the tanks into the fuel system.

07 FUEL STRAINERS

Located on the forward galley bulkhead these are to be drained for water prior to each flight.

The drain cock is accessible through the Engineers sliding window on both sides of the aircraft. They drain outboard.

08 FUEL PUMPS

Electric boost pumps switched from the yoke support the engine driven fuel pumps.

The engine pumps drain below the engine and can be a source of leakage.

Normal operating pressure is 14-16 psi

09 FUEL BOOST PUMPS

The electric boost pumps are used back up the engine driven fuel pumps when necessary and to supply fuel pressure to the engines for starting.

The switches are on the yoke; they are switched off after starting

Apart from during the start the Boost Pumps are used during
1) Takeoff
2) Landing
3) Cross Feed operation
4) Flight in turbulence
5) At pilot's discretion

To preserve their life, the fuel boost pumps are to be switched OFF whenever they are not required.

10 PRIMING PUMPS

Electric priming pumps are operated from the yoke. They are used sparingly as it is easy to over-prime. No priming should be done until the blades have been pulled through.

The primer sends raw fuel into the manifold, and this can create a fire hazard if too much fuel overflows out of the manifold.

Priming will not occur unless the Booster Pumps are operating to give a minimum fuel pressure of 14 psi.

11 FUEL PRESSURE GAUGES

Fuel pressure gauges are included in the central engine instrument panel. The presence of static fuel pressure in the lines is checked prior to start and boost pumps should be used to have fuel pressure reach and stabilize at a minimum of 14 psi.

12 CROSS FEED VALVES

The function of Cross Feed has been outlined above (see Fuel Cocks)

Incorrect use will cause unbalanced fuel flow from the tanks and may starve one fuel pump of fuel causing it to overheat.

13 MIXTURE CONTROL SETTINGS

The mixture control handles are between the fuel cocks, on the bulkhead, behind the pilots. Be sure that at each position the handle detent is correctly engaged. This will ensure reliable performance and fuel economy. Intermediate positions can be use if necessary as for example in using mixture to help control Cylinder Head Temperature.

The mixture settings are:

1. Full rich
2. Auto Rich
3. Auto Lean
4. Idle Cut-Off

14 FIREWALL SHUT OFF VALVES

These valves, one for each engine, are actuated by firmly pulling the yellow 'T' handle next to the fuel cocks. In the event of an engine fire they will help prevent spread of the fire to the wings. The use of the valves is explained in Section 4 (pg429)

Via a cable and pulley system the flow of fuel and oil through the firewall to the engine is stopped and on the starboard engine the hydraulic fluid is also stopped.

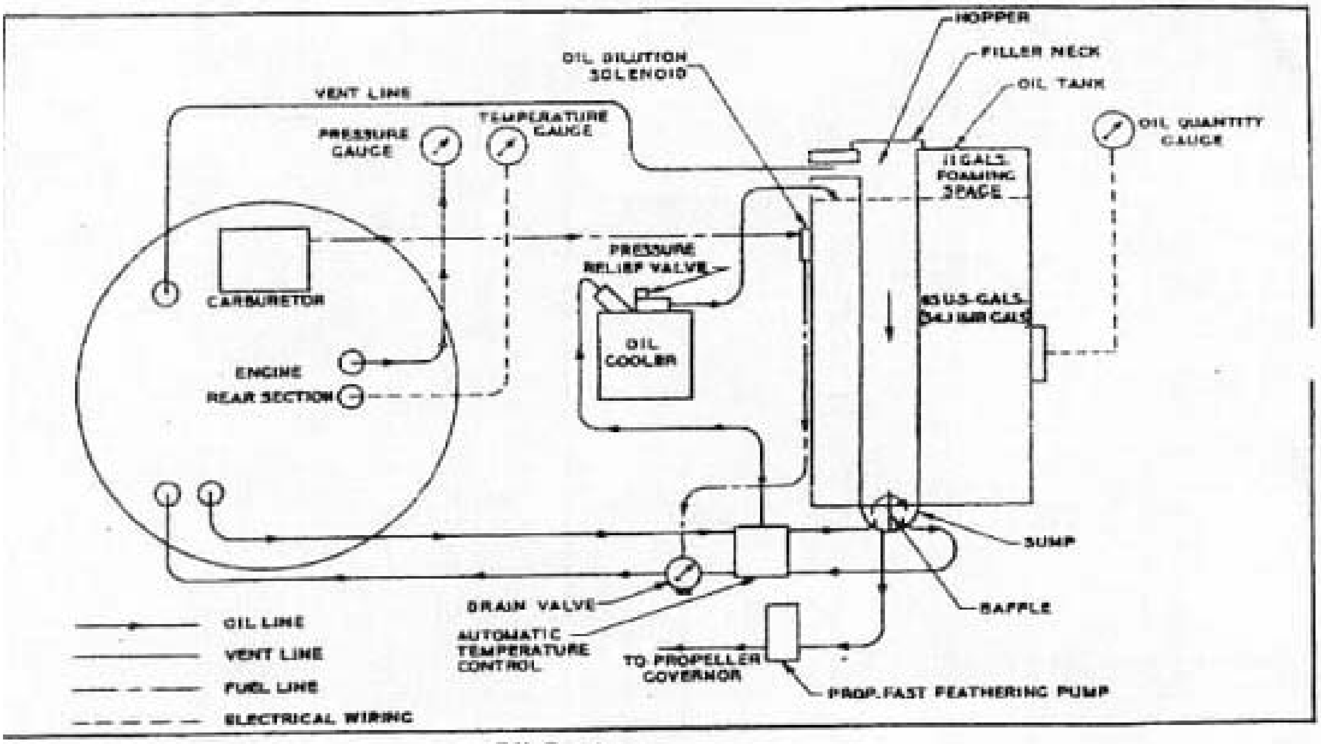
Caution: *To pull the ‘T' handles requires considerable force. The non-flying pilot may need to turn out of his seat to be able to pull hard enough to break the lock wires and pull the cables.*

Note: The Firewall Shut Off Valves can only be reset on the ground. Once the Firewall Shut Off 'T' handle is pulled, the cut in fuel, oil and hydraulic fluid flow is irrevocable.

12.79 OIL SYSTEM

01 GENERAL

There is a separate and independent oil system for each engine with the oil tank in the nacelle behind the firewall. The oil cooler and automatic oil temperature control are below the engine accessory compartment.



Oil System

02 OIL SPECIFICATION

Aero engine oil of grade Aero Shell W100 or Air BP 0100 is required

03 OIL QUANTITY AND CONSUMPTION

The tanks for each engine hold 54 Imperial Gallons. This amount of oil is for long range and endurance flying, so that for club use a minimum amount has to be specified. Oil in the tanks at the end of the flight **must not be less than 25 Imperial Gallons.**

The tanks are to be dipped prior to flight. There are no oil quantity gauges

Consumption for the aircraft should be assessed regularly. Consumption will often differ in the two engines and will vary according to circumstances with circuit flying producing relatively high consumption compared to long range cruise.

A consumption of one half Imperial Gallon per engine per hour is to used for flight planning purposes.

04 OIL TANKS

The oil tank for each engine is located behind the firewall and is accessible from the top of the wing. The volume of each tank is 63 Imp Gals but they are only to be filled to 54 Imp Gals leaving 9 Gallons of air space for foaming.
It is not necessary to carry a full load of oil. Sufficient must be carried to allow for consumption during flight and to end the flight with 25 Imp Gals. A normal oil load for club operations is 30 Imp Gals but a long-range flight should start with full oil tanks.

The oil filler cover, dip stick, filler access and gauze screen are at the top of the tank. Care is to be taken to ensure that the filler cover is secure prior to starting engines. If this is not so, the oil will be sucked out very quickly during flight.

Caution *A full tank of oil can be lost in one circuit if the cap is not secure therefore double check that the filler cover is tightly closed preflight.*

A sump at the bottom of the oil tank contains a reservoir of oil for the Fast Feathering System. This reservoir of oil is not lost should the engine develop an oil leak and the engine oil supply pumped dry.
This supply of oil ensures that feathering action will take place in the event that the Engine fails due to lack of lubrication. Note also that the feathering pump is electrically driven.

05 OIL TEMPERATURE CONTROL AND GAUGES

Oil temperature control is automatic. The airflow through the oil cooler is unregulated but the oil flow is varied according to oil temperature.

The oil temperature gauges are electric and are located centrally on the pilot's instrument panel. They are fused through the "electrical instruments" circuit breaker.

06 OIL FILTERS

The oil filters are located at the bottom of the engine and can be examined to detect contamination.
This process will take about an hour and requires the use of the engine stands.

The filters are not 'Dropped' as a matter of course but can be examined if doubt exists about the cleanliness of the oil or to see if metal particles exist from engine malfunction.

Normally, examination of the screen found with the dipstick in the top of the tank is sufficient for preflight inspection.

07 OIL DRAIN VALVE

The drain valve is located at the bottom of the oil sump and can be a cause of leaks visible during the preflight walk around.

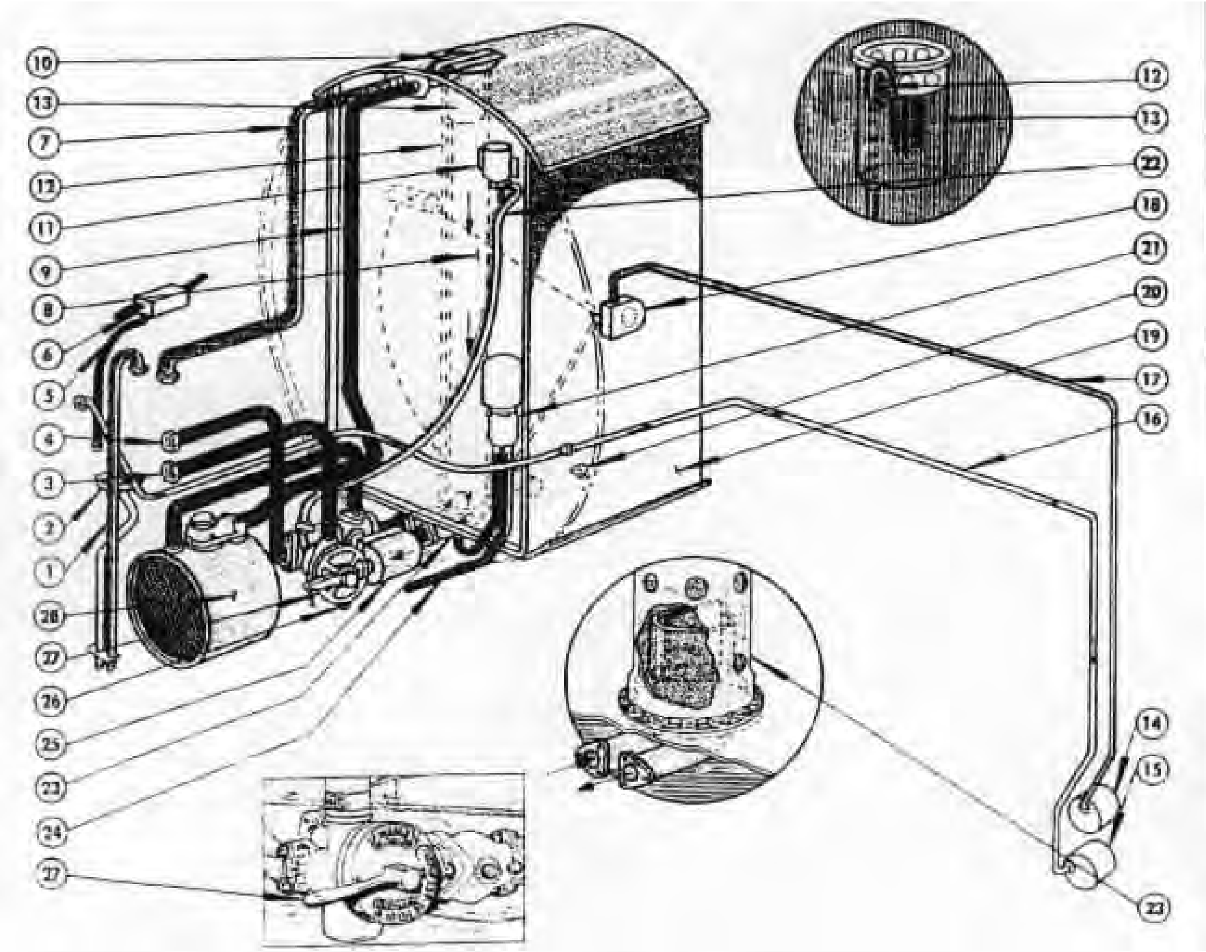
08 OIL PUMPS

The oil pump is an engine accessory driven off a geared drive at the rear of the engine. This drive is also the drive for the fuel pump. Oil pressure is boosted for control of propeller pitch but should the drive fail the electric feathering pump can supply oil at sufficient pressure to feather the propeller. There is an electric back up for pumping fuel also but no back up pump for engine oil.

During cold starts when the oil is thick the oil pump can deliver pressures over 300 psi. This pressure is due to the bypass system not functioning
At the oil cooler at low temperatures. These extra high oil pressures must be monitored and the RPM kept as low as possible until the oil temperature rises and bypasses the oil cooler.

CAUTION: Oil pressure should register within 15 seconds of start. If this does not occur, shut the engine down immediately and investigate the cause.

09 OIL SYSTEM



1 CRANKCASE BREATHER LINE
2 DRAIN BELOW OIL SCREEN CHAMBER
3 ENGINE OIL "INLET" CONNECTION
4 ENGINE OIL "OUTLET" CONNECTION
5 RETURN LINE FROM OIL SEPARATOR
6 OIL SEPARATOR
7 VENT LINE FROM ENGINE TO TANK
8 HOPPER
9 RETURN LINE TO TANK
10 FILLER COVER
11 DILUTION SOLENOID
12 SOUNDING ROD
13 STRAINER
14 OIL QUANTITY INDICATOR
15 OIL PRESSURE INDICATOR
16 PRESSURE INDICATOR LINE
17 LIQUIDOMETER ELECTRICAL WIRING
18 LIQUIDOMETER
19 OIL TANK
20 DRAIN PLUG
21 PROPELLER FAST FEATHERING PUMP
22 OIL DILUTION FUEL LINE
23 SUMP
24 PRESSURE LINE TO PROPELLER GOVERNOR
25 AUTOMATIC OIL TEMPERATURE CONTROL
26 DRAIN PLUG
27 DRAIN & SHUT-OFF VALVE
28 OIL COOLER

NOTES

1. CAPACITY: TOTAL 76 U.S. GALLONS (63.2 IMP. GALS.) USABLE 65 U.S. GALLONS (54.1 IMP. GALS.) FOAMING SPACE - 11 U.S. GALLONS (9.2 IMP. GALS.)
2. ALL OIL LINES ARE MARKED WITH 1/2 INCH YELLOW BANDS

12.61 PROPELLER SYSTEM

01 PROPELLER SPECIFICATIONS

Manufacturer	Hamilton Standard U.S.A.
Model	Hamilton Standard Hydromatic 23^{E}50-473 Design no6353A-12
Governor	Hamilton Constant Speed Governor Model No4-I-11
Blades	Three bladed aluminium alloy.
Diameter	Max11’6-3/8” Min 11’3-3/8” No further reduction permitted
Min Low Pitch Max High Pitch	18 Deg at 42 “station 88 Deg at 42” station
Weight	446lbs
Feather Pump	Pesco No 1 E-AR-280-BH
Time to feather	10 sec
Feather pressure	1000psi for maximum of one minute
Repeat time	15 min minimum
Governor pressure	180-200 psi

02 PROPELLER CONTROLS

Hamilton Standard hydromatic, fully feathering propellers are fitted. Constant speed levers project downwards from the throttle quadrant, with the throttle friction nut controlling their stiffness of operation.

Feathering buttons are mounted on the front of the quadrant, and are operated by pushing upwards. The buttons hold in electrically to feather, but must be checked to have 'popped' out at the end of the feather sequence and should be pulled out if necessary. They must be held in during the unfeathering sequence and positively pulled out once the engine starts and before 1OOO RPM is reached.

03 PROPELLER OPERATION

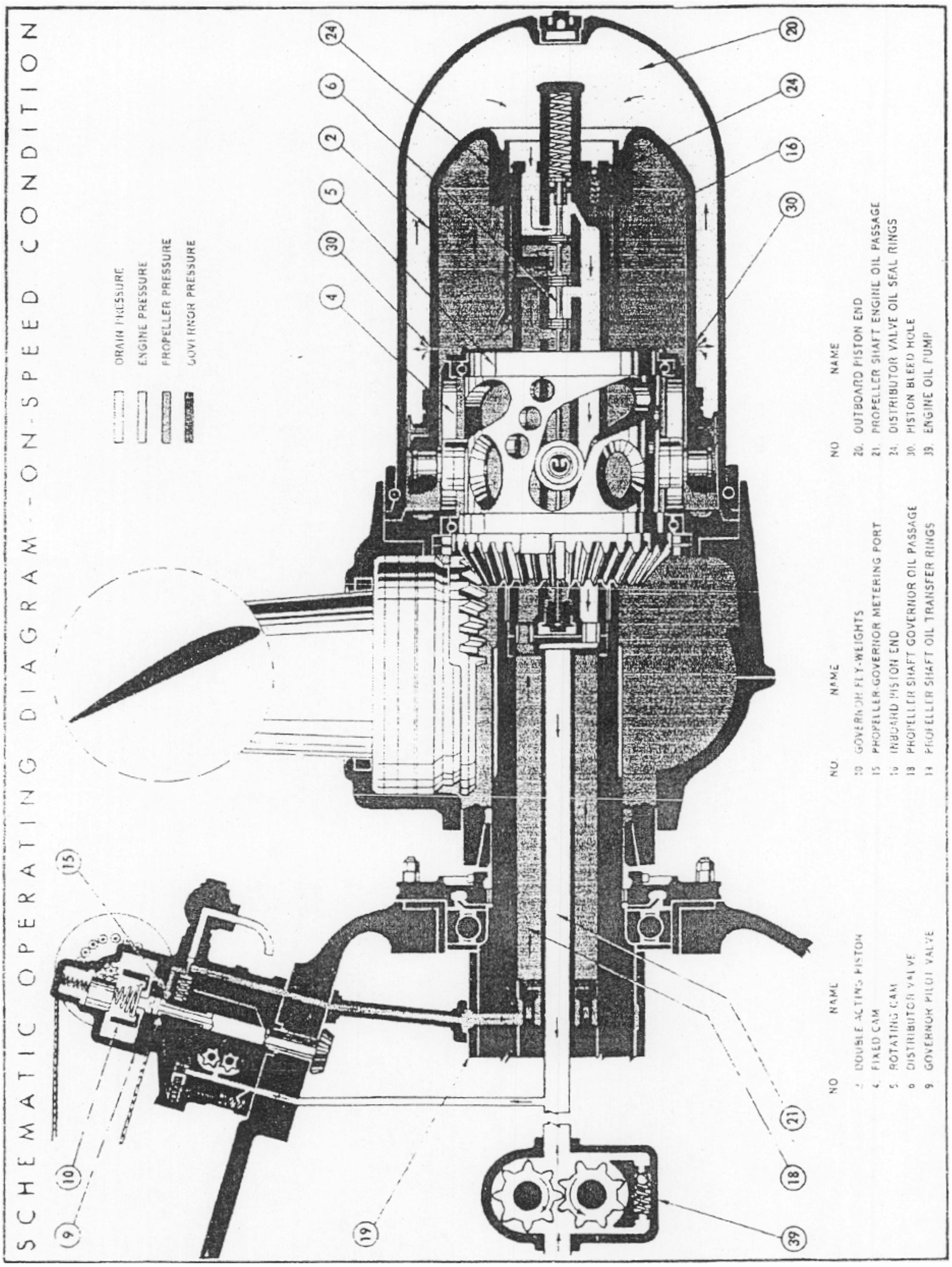
The Hamilton Standard propeller uses engine oil pressure and aerodynamic forces to increase pitch, and boosted engine oil pressure to reduce pitch. The pitch levers in the Flight Station connect directly to the Constant Speed unit on the front of the engine via cables and pulleys.

The movement of the cables changes the enclosed gyroscope balance so directing oil pressure to or from the propeller pitch mechanism. The Governor Pump supplies the boosted engine oil pressure.

Propeller pitch changes, allowing more or less RPM to develop, and the Governor gyroscope is returned to a balanced state.

When feathering or unfeathering takes place the oil ports are manually selected in the CSU by positioning the pitch lever at minimum RPM (Full Coarse). A feathering pump is then employed to create sufficient oil pressure to drive the propeller to or from the feathered position.

The feathering pump has its own oil supply from a slump in the bottom of the main oil tank, and it has a separate electrical system controlled from the Flight Station.



12.29 HYDRAULIC SYSTEM

01 GENERAL

The hydraulic system is a high-pressure accumulator system provided for operation of the undercarriage and the brakes. The system can be supplied with pressure from:

1) Engine pump
2) Electric pump
3) Hand pump

Normal operating pressure is 800-1000 psi

The system comprises of a hydraulic reservoir, an engine driven pump on the starboard engine (with back up electric and hand pumps), accumulators, selector valves, a filter and the necessary hydraulic lines and actuating and latching cylinders. Gauges on the First Officers instrument panel and in the nose compartment can monitor the pressure within the system.

02 HYDRAULIC RESERVOIR

The reservoir tank is in the Starboard engine nacelle, outboard, accessed through a lift up panel secures by fasteners. The tank holds 2 Imperial Gallons of hydraulic oil and the fill marks are ringed on the dipstick, which is located next to the tank. The fluid level should be between the top and middle marks when the system pressure is up. It is very easy to over
Tighten the cap for the reservoir.

03 HYDRAULIC OIL SPECIFICATION

Mineral based (red dyed) fluid Mil H.5606 with total capacity 7 Imp Gals

04 ENGINE DRIVEN HYDRAULIC PUMP

The engine driven pump, mounted on the starboard engine. Will not supply full pressure below 1500 RPM.

Under normal conditions the pump is idled by a bypass valve, which unloads the system once, pressure has built up to normal operating pressure of 800- 1000psi. When a service is employed and the pressure drops below 800 psi the hydraulic pump comes on line and replenishes the used pressure and oil.

The pump has a safety pressure relief valve, which operates at 1250 psi

05 SYSTEM CAPACITY

The full capacity of the system is 7 Imp gals, with 2 Imp gals being held in the reservoir. A further supply of hydraulic oil may be kept in the wing cavity just outboard of the reservoir, together with a funnel for topping up the tank. More usually the container of hydraulic oil is stored in the Galley Compartment but the funnel remains in the wing next to the reservoir.

06 ACCUMULATORS

Two accumulators of 5 inches and 10 inches diameter hold operating pressure for the hydraulic system.

The 5-inch accumulator supplies initial pressure to the Gear to release it from the locks. The Hydraulic Pump is required to operate the remainder of the Gear cycle because of the fluid volume and pressure required. Emergency gear operation can be achieved by using the electric or hand pumps should the Engine Hydraulic Pump fail, or the Gear can be lowered manually
The brake system accumulator of 10 inches holds sufficient pressure for 5 to 6 brake applications giving a measure of safety should the pumps fail.

Recharging depleted hydraulic pressure can be by use of the electric pump or the hand pump if fluid still remains in the system.

07 HYDRAULIC FILTER

The Filter is located in the Nose compartment. The filter handle should be rotated once per day as pan of the preflight checks. This clears accumulated contamination from the filter screens, which are then cleaned at inspection times.

08 ELECTRIC AUXILIARY HYDRAULIC PUMP

The Auxiliary Pump is located behind the co-pilot’s seat.

The pump consumes considerable electrical power. It is connected directly to the Main Distribution Panel while its control (switch) power is fused by circuit breaker on the Co-Pilots Electrical Panel. The control switch is on the Yoke.

The Auxiliary Pump is powerful enough to carry out all hydraulic functions satisfactorily. The pump is to switched off when not required because of the heavy drain on the electrical system.

09 EMERGENCY HYDRAULIC HAND PUMP

The emergency hand pump is situated on the floor between the two Pilots. It is activated by inserting it's handle into the socket and pumping fore and aft vigorously. Provided fluid remains in the hydraulic system all normal hydraulic procedures can be completed by using the pump.

The Emergency Hand pump handle is stowed behind the Co-Pilot's seat when not in use. The handle can be inserted into its socket during the Pre Flight checks and may be left there for the duration of the aircraft operation. It should be in place during critical phases of flight.

Hand pump operation is not subject to Pressure Relief Valve protection. It draws its supply of hydraulic fluid directly from the tank, and discharges directly into the Hydraulic System bypassing the pressure relief valve. It is therefore possible to over pressurize but the forces required are considerable.

10 HYDRAULIC PRESSURE GAUGES

Three hydraulic pressure gauges are fitted

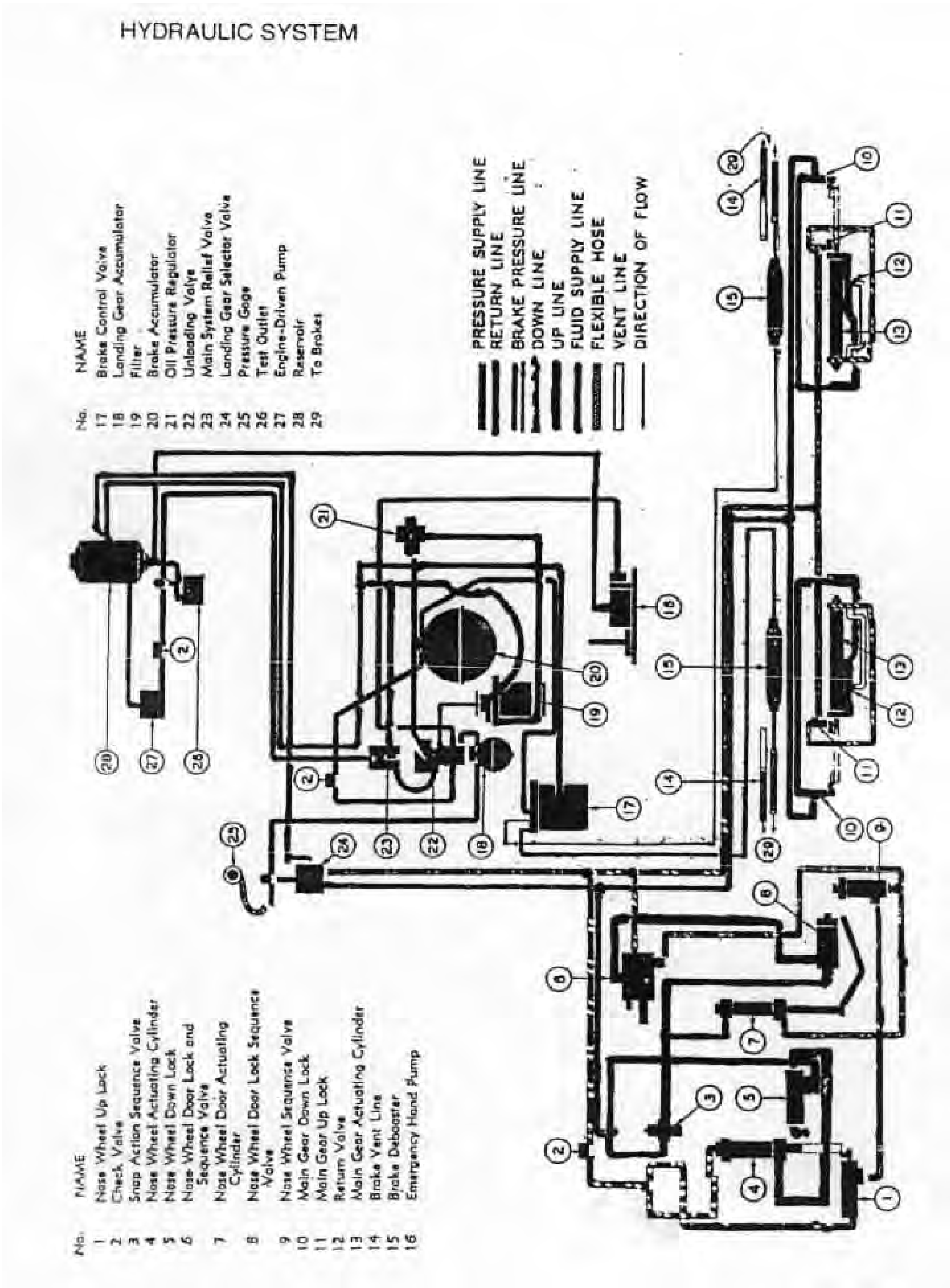
One gauge on the right hand side of the instrument panel indicates actual pressure in the hydraulic system. This pressure bleeds away when the aircraft is not in use and can read zero after a period of time.

The upper of the two gauges in the Nose reads the pressure in the 5-inch accumulator. When the hydraulic system is completely discharged of hydraulic pressure it will indicate the air pressure remaining in the 5-inch accumulator, normally 600 psi. When the hydraulic system has a
Pressure greater than the air pressure in the 5-inch accumulator this gauge will then indicate the higher pressure, i.e. the same as the pressure shown by the gauge on the instrument panel.
The lower of the two pressure gauges in the Nose reads Emergency Brake Pressure, i.e. the pressure in the 10-inch accumulator. The pressure in this accumulator is isolated from the main hydraulic system by a non-return valve so that it is able to charge but not discharge into the system. When the hydraulic system is completely discharged of Pressure, this gauge will read the air pressure in the accumulator which should be 600 psi. This pressure is the minimum required to achieve a full brake application. The pressure should normally be 800-1000 psi.

Taxiing should not commence if the Brake Accumulator Pressure is below 800 psi.

Normal operating pressure for the hydraulic system is 800 -1000 psi, and with all systems operating this is the pressure which should register on all three gauges.

11 HYDRAULIC SYSTEM SCHEMATIC



12.32 LANDING GEAR AND BRAKES

01 GENERAL

The Catalina PBY 5a is fitted with a tricycle landing gear
For detail of the landing gear and brake structure see the Aircraft Technical Manual.

02 LANDING GEAR CONTROL

A control handle located on the lower part of the Instrument Panel operates the Landing Gear. It is left of centre and can be operated by either *of* the two Pilots though to do so is difficult for the First Officer. It is most important that the lever be operated in one complete movement without pausing between the 'UP' and 'DOWN' positions.

Such a pause may cause a build up of backpressure in the hydraulic system activating the sequence valves out of their normal order. A re- cycling of the gear will be required.

CAUTION: Maximum Landing Gear Operation Speed is 122 kts

Before every landing the Gear has to be visually checked for security in the 'DOWN' position. A crewmember is to be delegated to carry out this function and he/she must have been trained in the procedure. Positive confirmation of 'Gear Down' is to be obtained before landing.

WARNING: Correct and safe operation of the landing gear requires the Following:

1) Smooth, complete movement of the gear selection handle.
2) Correct hydraulic pressure before, during and after gear operation.
3) Audible 'SNAP' of the gear into place.
4) Visual confirmation by a trained crewmember that the gear is safely 'DOWN and LOCKED'.

03 BRAKES

Each pilot has a set of brake pedals, which are interlined. Only one set of pedals can be used at a time and **pilots cannot help each other to Apply more brake pressure.**

Pressure to activate the brakes is obtained from the main hydraulic system with a minimum of 600 psi necessary to obtain full brake pressure.

Goodyear multiple disc brakes are operated by via cables to the brake valve located to the right of the co-pilot on the hull.

A 10-inch accumulator (reservoir) is charged by air to 600 +/- 25 psi through its air connection. The accumulator is located in the Bow together with the Brake Accumulator Air Pressure Gauge and the Brake Accumulator Hydraulic Pressure Gauge. Hydraulic pressure further pressurizes the accumulator to 800-1000 psi normal operating pressure, with a pressure relief valve operating at 1250 psi.

There is no reservoir should the hydraulic system become totally depleted of hydraulic fluid hence, NO FLUID = NO BRAKES.

On the ground, and with sufficient fluid in the Hydraulic System, recharging can be accomplished by air to 600 psi. The residual pressure in the system is known as the Emergency Brake Pressure and registers on the lower of the two gauges the Bow. This pressure is normally 800- 1000psi once the hydraulic system is operating.
There is only one hydraulic pump and it is on the Starboard engine. If the Starboard engine is shut down or the pump fails then emergency brake pressure is available for 5 or 6 brake applications using the emergency pressure stored in 10-inch accumulator in the Bow.

The hydraulic system can be pressurized in flight by:
1) Normal use of engine driven pump.
2) Using the electric hydraulic pump
3) Using the hydraulic hand pump.

But only if sufficient fluid remains in the system.

Lack of hydraulic fluid will be registered on the brake pressure gauge in the Bow

When using the brakes it is better to do so in short gentle bursts rather than one long application. This will avoid overheating of the fluid in the lines at the wheels, and of the brake pads. Harsh braking is to be avoided at all times.

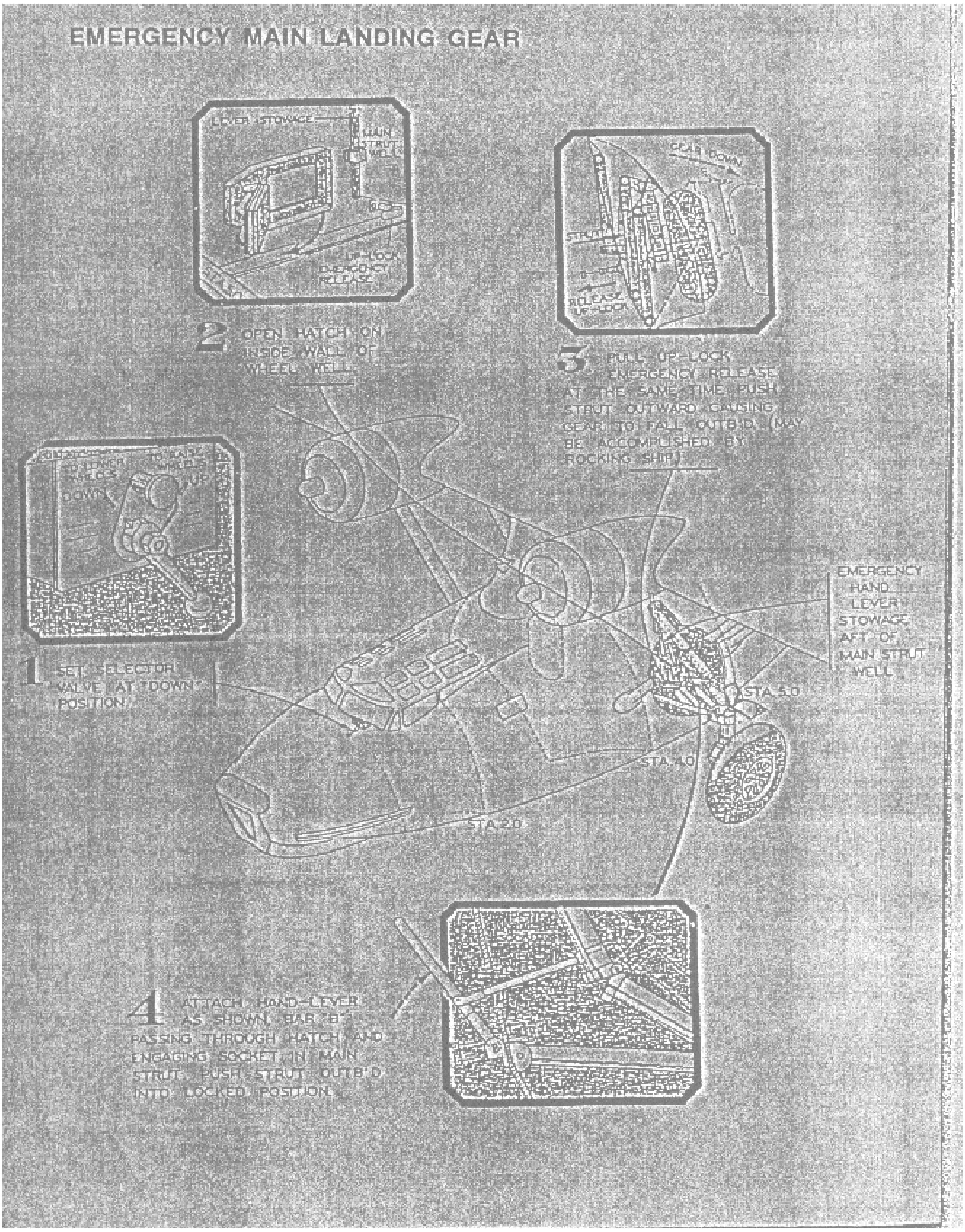
During the Preflight Inspection it is important to check for leakage in the lines and especially at the wheels. Corrosion is to be watched for. The brake drain can be tested for water. Frequent brake inspections are recommended if the aircraft is used for water work, and any moisture found in the brake drain system is cause for close examination to determine the cause.

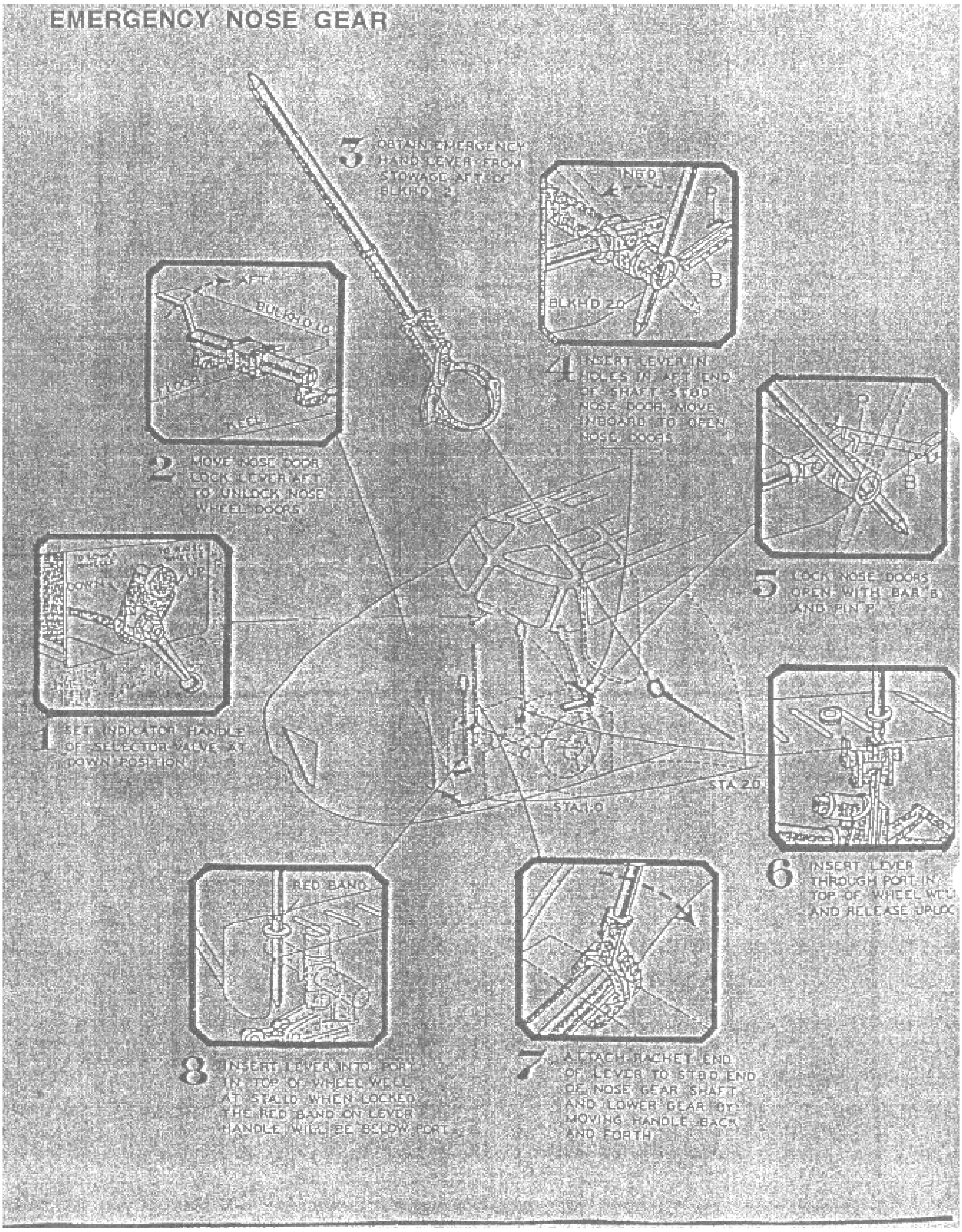
04 PARKING BRAKE

The knob for the parking brake is below the Captain's panel. However the First Officer normally operates the mechanism by pulling on the activating cable to the right of the F/O 's control column. Foot pressure is then relaxed before releasing .the cable.

The Parking Brake requires hydraulic pressure to operate as the locking paw traps pressured oil inside its cylinder. If insufficient pressure exists in the system it can be recharged by anyone of four methods:
1) Engine pump.
2) Electric hydraulic pump.
3) Hydraulic hand pump.
4) Pressure air (600 psi) through the recharging valve

05 EMERGENCY LANDING GEAR OPERATION




EMERGENCY NOSE GEAR
1 SET INDICATOR HANDLE OF SELECTOR VALVE AT DOWN POSITION
DOWN
UP
2 MOVE NOSE DOOR LOCK LEVER AFT TO UNLOCK NOSE WHEEL DOORS
AFT
FLOOR
KEEL
3 OBTAIN EMERGENCY HAND LEVER FROM STOWAGE AFT OF BLKHD. 2
4 INSERT LEVER IN HOLES IN AFT END OF SHAFT STBD NOSE DOOR. MOVE INBOARD TO OPEN NOSE DOORS
BLKHD 2.0
P
B
5 LOCK NOSE DOORS OPEN WITH BAR B AND PIN P
6 INSERT LEVER THROUGH PORT IN TOP OF WHEEL WELL AND RELEASE UPLOCK
STA 2.0
STA 1.0
7 ATTACH RACHET END OF LEVER TO STBD END OF NOSE GEAR SHAFT AND LOWER GEAR BY MOVING HANDLE BACK AND FORTH
8 INSERT LEVER INTO PORT IN TOP OF WHEEL WELL AT STA 1.0 WHEN LOCKED THE RED BAND ON LEVER HANDLE WILL BE BELOW PORT
RED BAND

12.24 ELECTRICAL SYSTEM

01 GENERAL DESCRIPTION

The main electrical system is 28V dc for the aircraft circuits. Two 24-volt batteries are located at floor level on starboard side of the Pylon Compartment, beside the Main Distribution Panel, supply power for the electrical systems when the generators are not operating. Each engine drives a 28V dc generator.

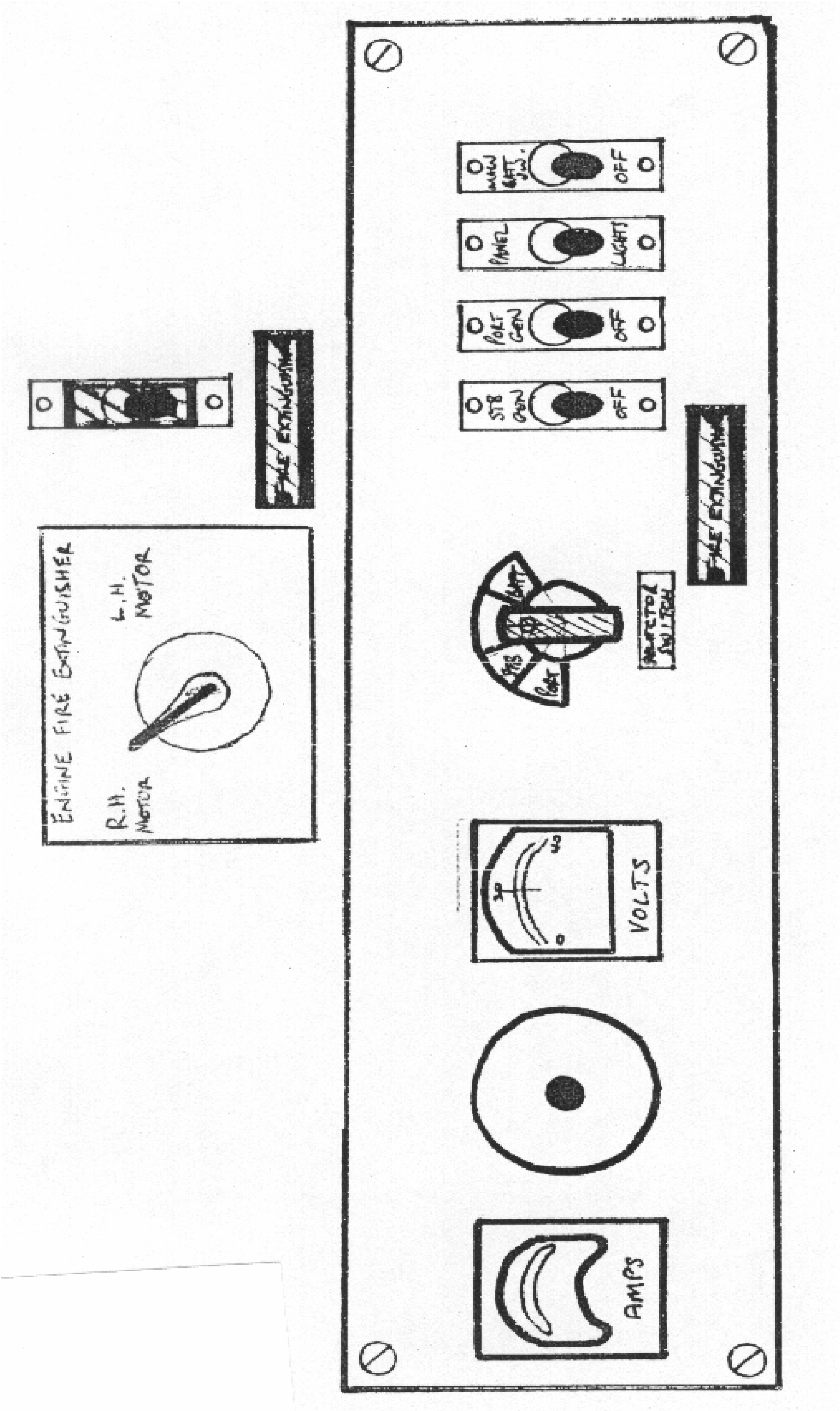
Some aircraft systems are not fused but are connected directly to the aircraft batteries through the main battery relays. The Battery Switch in the Flight Station activates these relays. These circuits are the higher-powered circuits such as feather pump, but in all cases the control mechanism is fused or supplied through circuit breakers.

All electrical services are controllable by the pilots, with battery starting being the norm. The main battery switch is on the bulkhead panel behind the pilot, called the Pilot's Main Electrical Panel. External power may be provided from battery cart.

The external power connection is located on the fuselage Port side of pylon compartment, behind the forward wing strut.

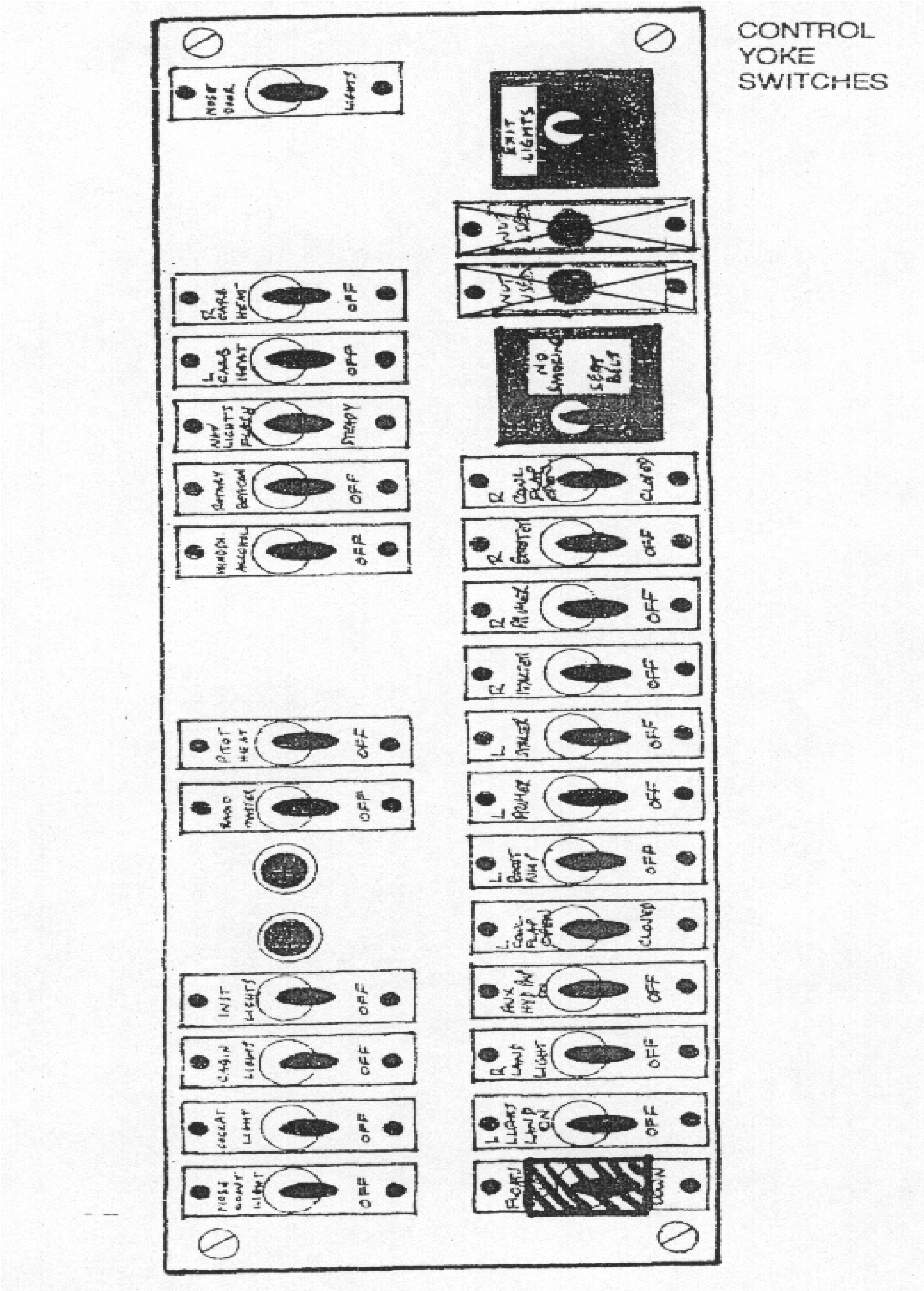
02 PILOTS MAIN ELECTRICAL PANEL

This panel is located over the bulkhead door, behind the pilots. It contains the voltmeter/ammeter panel, main battery switch, generator switches, and fire. Extinguisher switches for the engines.


ENGINE FIRE EXTINGUISHER
R.H. MOTOR
L.H. MOTOR
PANEL
LIGHTS
OFF
VOLTS
AMPS

03 YOKE SWITCH PANEL

The control column Yoke has many switches for the pilots to operate aircraft electrical systems. Functions switched from the Yoke are labeled



04 MAIN ELECTRICAL DISTRIBUTION PANEL

The main power distribution panel is located in the Pylon, on the starboard side of the rear of bulkhead 4, the panel contains the starter relays and reverse current relays. It is also the main earthing point in the aircraft and the main junction box for all services

05 REVERSE CURRENT RELAYS

Three Eclipse (100 ampere) reverse current relays are in the bottom of the Main Distribution Panel. From inboard to outboard, they control the following units:

1) Port engine generator
2) Starboard engine generator
3) External power

The purpose of the first two reverse current relays is to prevent the main batteries supplying current to the generators when the engines are at rest or turning at low speed. This would deplete the batteries.

The third relay prevents discharge of the batteries into an external power system.

The switches in the top two rows are bus selectors. Each has three positions. The central position is "OFF" and the up and down positions are busses "A" and "B" respectively. Each bus connects only to the bus selector switches and it is therefore possible to have two separate generators and load circuits operating at the same time, isolated from each other. Inside the main distribution panel box are relays and main fuses for all circuits, except the two fuses for the landing lights and those for the radio equipment. The two relays on the outboard sidewall are for the starter circuits.

06 GENERATORS:

There are two ECLIPSE NEA-3 generators, each rated at 28.0 volts, 60 amperes D.C. The rated speed is 2400 to 4200 rpm.

The generators are mounted on the rear of the engines and are driven at 1.4 times engine speed. Two flexible conduits with connector plugs make electrical connection.

Electrical control switches for the D.C. output of the generators are on the Pilots Main Panel. These switches allow single or parallel operation of the generators

<u>Generator Overload</u>
Maximum charge rate is 35 amps. If charge exceeds 35 amps for two minutes reduce loads and/or switch generators off to protect batteries. Charge rate must be reduced to less than 35 amps, and the faulty system isolated, to prevent damaging the batteries.

07 CIRCUIT BREAKERS

Radio equipment circuit breakers are located next to radio panel.

Generators are fused in the Main Distribution Panel, and are switched from the Pilots Main Panel position.

Two types of circuit breakers are used, in addition to the special 'HOLD IN' style used in the Feather/Unfeather circuits. Some circuit breakers look like normal switches but can be reset after being tripped. Other breakers are of the push/pull type.

CAUTION The propeller feathering circuit breaker is the "non-trip free" type. If the circuit breaker will not remain normally set in the contact position, the button can be held in for emergency operation. It should be realized that operation under these circumstances might result in the destruction of the equipment involved. Take advantage of the "non-trip free" action of the propeller feathering circuit breaker only in an emergency.

WARNING. The star1er, float and feathering systems are not fused. They are however fed through the main relays and can be disconnected by operating the Battery Master switch.

08 BATTERIES

All batteries are in the pylon area. Battery maintenance is covered in the Technical Manual. It is necessary that the batteries be checked during the Preflight for security, leakage, and any obvious mechanical defects. The state of the batteries electrically can be determined from the voltmeter on the Pilots Main Electrical Panel. This should be checked prior to engine start.

Two 24 Volt NiCad (d.c.) batteries are connected to give 24V d.c. Operating voltage. This is a nominal voltage and can be up to 28 V D.C. when the batteries are fully charged and the generators are charging.

If Ground Power is used for starting, the aircraft generators will then recharge the batteries. To stop overloading (max 35 amps), the charge rate checked on the Pilots Main Panel. The correct position on the selector switch must be used to obtain the charge rate for each generator

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12.36 PITOT STATIC SYSTEM

01 PITOT STATIC SYSTEM

The pitot head is a single, non-detachable unit. It's mounted with its axis parallel to the thrust line of the aircraft, on the centre section leading edge of the Port wing.

The switch for the operation of the Pitot Heat is on the yoke. This switch should be off whilst operating on the ground unless icing is suspected, and used only whilst airborne in icing conditions.

Pitot-static tubes are designed to operate satisfactorily under all operating conditions, including those in which rain and ice are encountered. Snow and ice are melted by the heating element and the resulting water is prevented from entering the connecting tubing by drain traps in the Nose. An accessible drain plug incorporated in the lowest point of each system of connecting tubing removes water. These plugs are located beneath the port side of the instrument panel.

An Alternate Static source is available in the flight station, switched from the far right side of the instrument panel.

02 DE-ICING EQUIPMENT

All of the de-icing gear has been removed from the aircraft, including the heat exchange mechanism for de-icing the wings and tail.

The anti icing systems remaining are the electrically operated Carburetor Heat and Pitot Heat, both switched from the Yoke.

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12.72 ENGINES

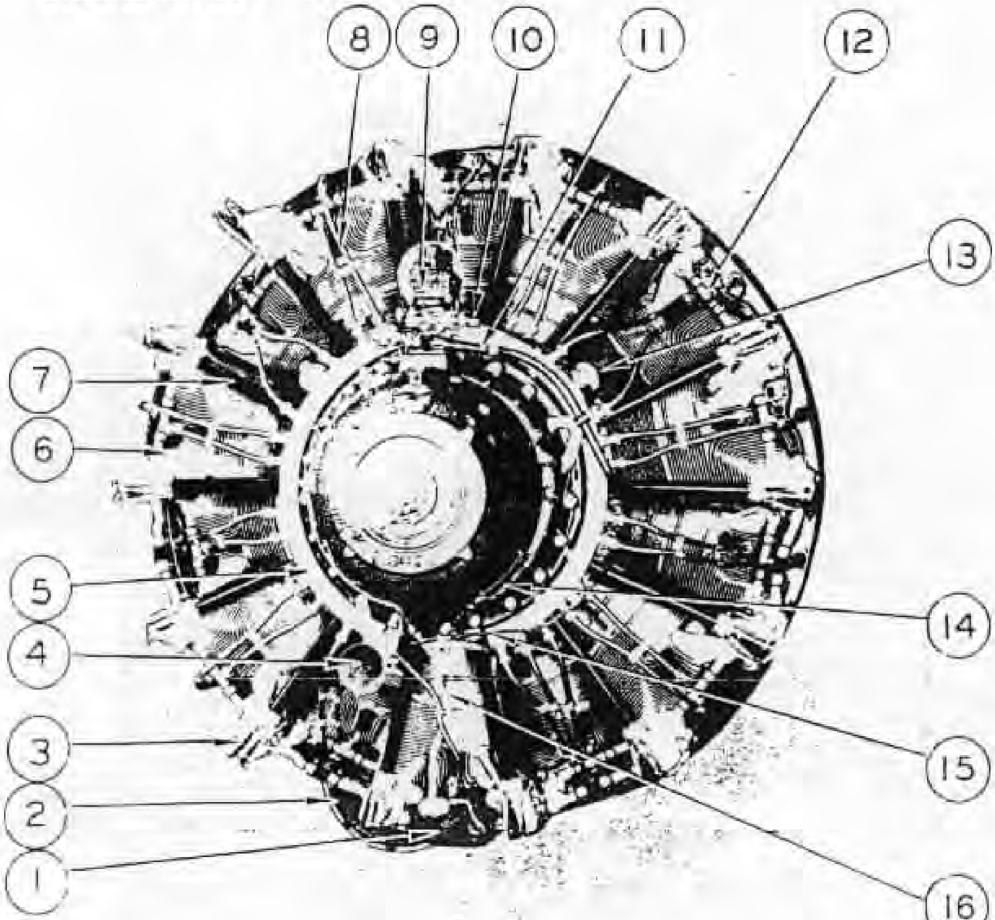
01 ENGINE SPECIFICATIONS

Pratt and Whitney Twin Wasp R1830-92 (SIC3-G)

Weight Propeller	1446lbs	
Propeller Prop Gear Ratio	Hamilton Standard Hydromatic (3 blade) Hub 23E50 Blades 6353A-12 Pitch Feathered 88deg Low 18deg at 42" Sta Diameter 11' 6-3/8 ins Min 11' 3-3/8" 16:9	
Fuel	100/130 Octane Min 91/96 W100 or W120	
Oil	W100 or W120	
Carburetor	PD12H1 Dash 1 Setting Min operating pressure 14 psi No fuel delivered at less than 4 psi Manual mixture control	
Timing	25 deg BTDC	
Power Rating	1200 BHP@ 2700 RPM 48" Boost 1200 BHP@ 2750 RPM 47" Boost	
Idling RPM	1000 RPM, plugs will not foul	
Generator Cut In	1200 RPM	
Cylinders	14 (two banks of 7)	
Rotation	Clockwise (From rear)	
Supercharging	Single Stage (7,15:1)	
Compression Ratio	6,7:1	
Bore and Stoke	5,5 inches	
Displacement	1830 Cu ins	
Numbering	Clockwise from the rear No 1 at top of rear bank	
Accessory drives	Starter	Fuel pump
	Generator	Prop Governor
	Vacuum pump	Hydraulic pump STB only
	Tachometer	Magnetos
Magnetos (2)	RH mag to front plugs	

02 ENGINE LAYOUT FRONT

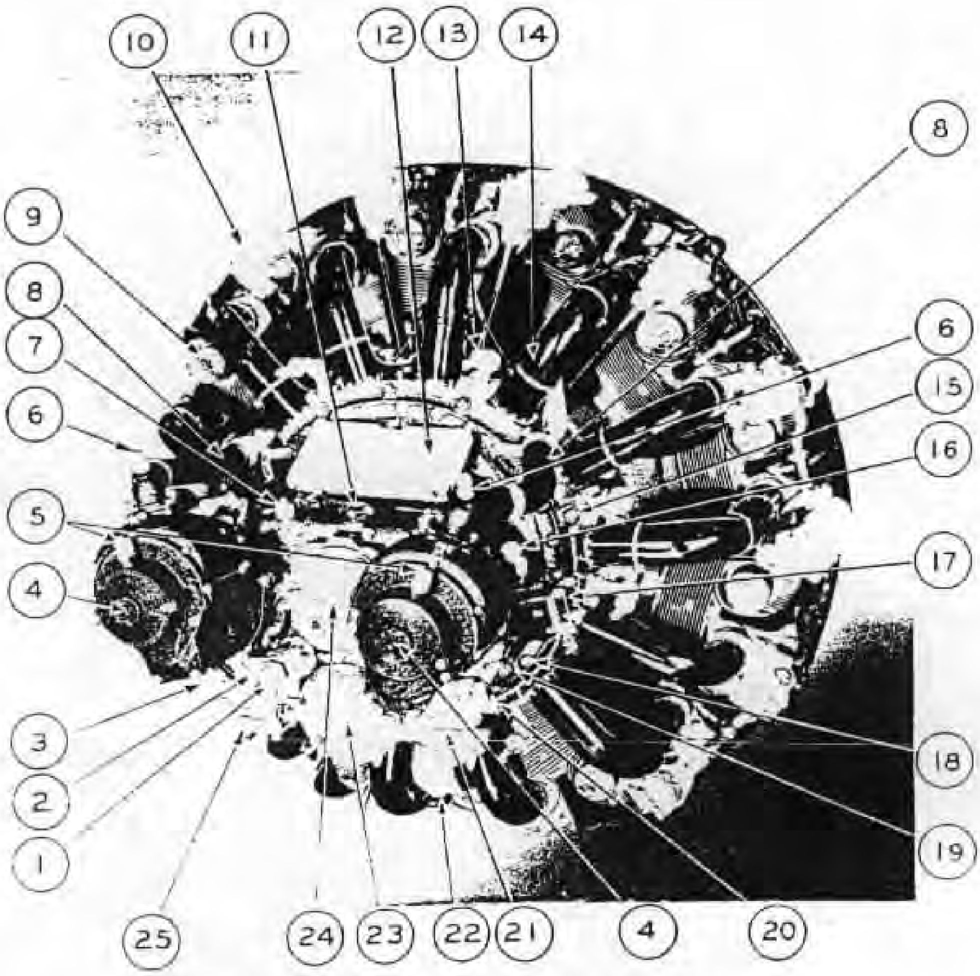
ENGINE LAYOUT -FRONT



1. Rocker Sump.
2. Oil Cooler.
3. Nose Cowl Mounting Bracket (28D5026).
4. Magneto Blast Tube Air Scoop (12P281).
5. Ignition Shielding.
6. Rocker Box.
7. Push Rod.
8. Spark Plug Cable.
9. Propeller Governor.
10. Pressure Switch Electrical Cable.
11. Fast Feathering Line.
12. Inter-cylinder Oil Drain Pipes.
13. Magneto Flex.
14. Data Plate.
15. Propeller Anti-Icer Line (28P5000-10).
16. Oil Scavenge and Breather Pipe Assembly.

R-1830-92 Engine, Three-Quarter Front View

03 ENGINE LAYOUT BACK



1. Oil Pressure Relief Valve.
2. Oil Outlet Flange.
3. Oil Inlet Flange.
4. Magneto.
5. Magneto Ground Connection.
6. Magneto Booster Connection.
7. Oil Tank Vent Connection.
8. Magneto Flex Tube.
9. Exhaust Port (Plugged).
10. Rocker Box.
11. Rear Crankcase Breather Connection.
12. Carburetor Mounting Flange (Wooden Cover).
13. Engine Mount Rigid Pedestal.
14. Intake Pipe.
15. Manifold Pressure Fitting.
16. Tachometer Drive.
17. Hydraulic Pump Drive.
18. Oil Pressure Gage Connection.
19. Oil Temperature Connection.
20. Oil Strainer By-Pass Relief Valve.
21. Oil Strainer Screen Chamber.
22. Oil Sump Drain Plug.
23. Generator Drive.
24. Starter Drive.
25. Fuel Pump Drive.

R-1830-92 Engine, Three-Quarter Rear View.

04 IGNITION SWITCHES

These are mounted on the yoke in front of the Captain's position and below the other Yoke switches.

A knob marked "pull off' switches off all magnetos for "blipping" engines on the water. Each engine has a separate switch, which controls individual magnetos and is Marked "BOTH, L, R, OFF."

05 THROTTLE CONTROLS

The control levers project down from the cockpit roof between the two pilot seats. There is no auto boost control so that over boosting is
Possible
If RPM and Manifold Pressure are not closely monitored. Throttle friction is adjusted by large wing nuts each side of the mounting.

During critical maneuvers such as Take Off one pilot must always have his hand on the throttle levers in case the Manifold Pressure alters with movement of the aircraft

06 PROPELLER CONTROLS

The propeller levers form part of the Control Quadrant located above and between the Pilots, projecting downwards. To increase RPM (fine pitch) the levers are moved forward.

The levers are connected to the Constant Speed Units on the front of the engines via cables and pulleys.

Friction Nuts on the quadrant adjust the friction of both the propeller levers and the throttles. During Take-Off it is necessary for the non-flying pilot to place his /her hands on the four quadrant levers to ensure that they do not vibrate out of setting.

Feathering buttons are mounted on the front of the control quadrant. The buttons are operated by pushing upwards and are held in by solenoids until feathering is complete, when they should pop out. If not the buttons must be pulled out to prevent overloading of the electric and hydraulic systems.
During unfeathering the button must sometimes be held in while unfeathering takes place due to the high hydraulic pressures in the system. Once unfeathering is completed they are to pulled out (800- 1000 RPM)

07 FUEL CONTROLS

Refer to 12.3

08 MIXTURE CONTROLS

The Mixture Quadrant is located behind the Pilots on the bulkhead. The Mixture Levers are detented at all main positions, and are connected to the carburetor via cables and pulleys.

09 PRIMING SWITCHES

The priming pumps are located on the rear of bulkhead 4 in the pylon and are switched from the Yoke. The Priming Pumps are protected by circuit breaker under 'Starter Control' on the Co-Pilot's Switch Panel.

10 STARTER SWITCHES

The two starter switches are located on the yoke. The starter motor will immediately engage when the switch is operated. They are protected by a clutch should the engine backfire or hydraulicing occur.

The starter circuit also supplies boosted voltage to the front set of plugs on both engines.

The engines are to be "pulled through" on the starter prior to starting by counting 12 blades prior to using the primer and switching on the magnetos.

Refer also to starter engaged warning Lights under Electrical System in this section

11 FEATHERING AND UN FEATHERING

Feathering is achieved by the use of a powerful electric hydraulic pump mounted below the main oil tank. The pump is supplied with oil from a sump in the bottom of the oil tank, and this sump retains its supply of oil even if the main tank empties.

Sufficient oil is retained to ensure that feathering may be accomplished in the event that the main supply is lost. The pump is controlled from the feather buttons on the Throttle Quadrant. The control circuit is protected by a circuit breaker, but the pumps are connected directly to the batteries, and are supplied through the Battery Master Switch on the Pilots Main Panel.

12 COWL FLAPS

The cowl flaps are electrically controlled from the yoke. They should be open for starting and then controlled as necessary for correct temperature control of the engines. E.g. closed for descents.

Each cowl flap motor has its own circuit breaker on the Co Pilot's Switch Panel.

The are problems maintaining the Cowl Flap motors and when a motor is not functioning or is absent the corresponding Cowl Flaps will be lock- wired in a partially open position.

13 CARBURETTOR AIR CONTROL

Switches on the Yoke operate the carburetor air control.

Carburetor air temperature is indicated on a dual gauge on the instrument panel. The air temperature should always be monitored and kept out of the red or yellow arcs, where icing can occur.

The switch has a central position (OFF) where it should always be positioned unless in use.

Two red lights on the instrument panel, one for each engine, indicate when the carb air control is at fully cold.

12.31 INSTRUMENTS

01 FUEL QUANTITY GAUGES

A fuel gauge for each tank is fitted to the aircraft. They are electrically operated. The gauges are protected by the Electrical Instrument circuit breaker on the Co-Pilot's Switch Panel.

For detail of the calibration of these gauges and the correct fuel management see Part 3, Operating Systems this Section.

02 FUEL PRESSURE GAUGES

Fuel pressure is fed directly to the instruments through a tube connected directly to the carburetors.

The instruments operate on the Bourdon tube principle, and are calibrated to read PSI.

03 ENGINE INSTRUMENTS

All engine-operating gauges are located centrally on the instrument panel. Some are electrically operated and protected by the Electrical Instruments circuit breaker on the Co-Pilot's Switch Panel. Others are instruments of the direct read type.

04 HYDRAULIC PRESSURE GAUGES

The main Hydraulic Pressure Gauge is on the far right hand side of the Instrument Panel.

Brake pressure is read from the lower gauge in the Nose. It can be seen by the Captain (with difficulty), but under normal operating conditions viewing of this gauge is not necessary, as the main hydraulic gauge will register the same pressure.

If the Hydraulic system fails it will be necessary to refer to emergency brake pressure gauge to ensure that sufficient pressure is available for braking.

The upper gauge in the Nose reads the pressure in the 5 Inch hydraulic accumulator and is used to charge this cylinder to 600 psi during ground servicing. The 10-inch cylinder can be similarly charged.

05 TEST INSTRUMENTS

Electrical test instruments are to the rear of the pilots on the Pilot’s Main Electrical Panel. Each generator can be tested in turn for voltage and current drain/charge by switching the selector switch to the appropriate engine.

When the engines are at rest the battery voltage can be read at the third switch position, and this test can also be performed with the engines operating by switching the generators OFF.

06 OUTSIDE AIR TEMPERATURE

This gauge should be mounted through the windscreen in front of the Captain as a self contained unit but is currently not fitted

07 FLIGHT INSTRUMENTS

The flight instruments are duplicated for Captain and First Officer. The vacuum source is derived from both engines into a common manifold, with non-return valves incorporated to safeguard loss of suction should one pump fail. The instruments for each Pilot are listed as follows:

CAPTAIN:	FIRST OFFICER:
Altimeter	Altimeter
Air Speed Indicator*	Air Speed Indicator*
Direction Indicator*	Direction Indicator*
Artificial Horizon*	Artificial Horizon*
Turn and Slip indicator	Turn and Slip indicator
Rate of Climb indicator	Rate of Climb indicator
VOR indicator	VOR indicator
ADF indicator	Hydraulic Pressure gauge
ILS indicator	
Suction Gauge	
Clock	

08 VACUUM SYSTEM

Each engine has a rear-mounted vacuum pump.

Both suction lines feed into a common manifold so that under normal operation it is not possible to determine if both pumps are operating.

To check the pumps individually it is necessary to start the engines in a different order from time to time.

Operating pressure is 4.0 -5.0 inches vacuum

09 CENTRE MAIN INSTRUMENT PANEL

Fuel Pressure Gauges
Oil Pressure Gauges
Carburetor Air Temperature Gauges
Outside Air Temperature Gauges
Cylinder Head Temperature Gauges
Fuel Pressure Warning Lights
Oil Pressure Warning Lights
Fire Warning Lights
GPS

In general the aircraft is set up for IFR flight from the left hand seat. However not all the controls can be easily operated by one pilot so that the minimum flight station crew is two pilots. The weight of the aircraft also dictates two Pilots, as per JAA Rules.

10 CYLINDER HEAD TEMPERATURE GAUGES

The cylinder head temperature gauges are electrically operated and protected through a circuit breaker on the Co-Pilot's Switch Panel.

The leads to these instruments are cut to an exact length with the excess being coiled into squares, and stowed in the Pylon compartment. The leads should not be cut and shortened; otherwise the readings to the thermo- coupled instruments will be in error.

The thermo- couples are mounted under the Number 1 cylinder rear spark plug.

11 ENGINE OIL TEMPERATURE GAUGES

The oil temperature gauges operate electrically and are protected by the Electrical Instrument circuit breaker on the Co-Pilots Switch Panel.

The systems are of a resistance bulb type, with the bulbs being mounted in the rear of the crankcase to complete a Wheatstone bridge circuit.

12 TACHOMETERS

The tachometers have their own transmitter mounted on the rear of the engine. The transmitter consists of a small generator which produces voltage in proportion to the engine RPM.

The receiver is a small instrument which reads the generated voltage with the scale graduated to read engine RPM.

Note that the propellers rotate slower than the engine at a ratio of 16:9

The instruments are not fused or protected

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12.25 FLIGHT STATION, ACCOMMODATION AND EQUIPMENT

01 DOORS AND HATCHES

Entry to the aircraft is via the port blister or the hatch beneath the port engine, using ladders. Additionally, if they are open, entry may be gained through the Bow hatch or the two sliding hatches above the pilot's seats.

The starboard blister has emergency exit only.

When not in use the aircraft is locked. The port blister is secured from inside the aircraft before vacating, and the port hatch is then padlocked.

When hatches are opened they must be secured to prevent inadvertent closure. The heavy port blister is especially dangerous and is to be securely latched back to the yellow painted 'eye' on the fuselage roof.

There are seven exit hatches for emergency use; three of the exits give access to above the fuselage. Three give direct access to the ground whilst the bow exit gives access to both the wing and the ground.

The available exits are: **Bow hatch,**
Pilot's roof hatches (2),
Starboard emergency exit (FWD Pax Compartment),
Port emergency exit (AFT Pax compartment),
Port blister door,

Normal access to above the wing is by climbing up over the main wheels and wing struts. It can also be gained through the two pilots roof hatches or the bow hatch.

02 PILOT'S SEATS

Each pilot’s seat slides up and forwards and is locked in position by a lever. Each seat is also adjustable for tilt with locking levers at the front of the seat. Removable squabs are provided.

It is most important that both Pilots adjust their seats so that they can have complete control of the aircraft, especially with regard to rudder control. Each pilot must be able to apply full rudder to control the aircraft safely in emergency asymmetric situations.

The worst situation is an engine failure after take-off, and both pilots must to be in a position to assume full control, should this occur. This is especially important in the event of control of the aircraft having to change hands at a critical moment.

03 PILOTS VENTILATION

Sliding windows for captain and first officer allow for contact with ground personnel and during mooring operations. These windows also provide ventilation for the flight station. These windows must be closed for water work.

Openings in each side of the hull provide fresh air for pilots. These openings must be closed and waterproof for water take-off and landing. Control knobs are within easy reach.

04 CABIN LAYOUT AND PASSENGER SEATING

A maximum of 16 seats are available for passengers. The passenger seats are in two cabins of eight seats

Floor loading limitations are listed in Section 6 Weight and Balance.

Storage is to be found throughout the aircraft. The main compartment
For freight is the Pylon compartment where provision. For tie downs and restraining nets is found. All freight is to be securely fastened before Take-Off.

Ladders are stowed in the rear hull compartment. (Tunnel)

Life jackets are located close to each passenger seat their position is to be pointed out to all passengers in the pre fight brief by either a Pilot or Flight Attendant

05 AIRCRAFT VENTILATION

Vents are located in the passenger compartments. These vents must be shut during landings and take offs especially on the water. They are to be checked and reported by the crew as part of the "Cabin Secure" call.

12.34 NAVIGATION

01 GENERAL

All the Avionics units are mounted centrally on the Instrument Pane! In front of the pilots. The units are powered from the Main Battery Switch, through a Master circuit breaker, through their own circuit breakers, and then individually switched ON at the unit.

02 NAVIGATION EQUIPMENT

2. VHF NAV
King KX 165A VHF Navigation receiver
Aerial on cockpit roof, Glide slope under tail.

1. GPS
Garmin GPS-100

Protected by the Avionics master switch

1 DME
King KN 62A

1 Transponder
King KA 60

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12.26 FIRE PROTECTION

01 GENERAL

Engine fire protection is done by a single fire loop behind the firewall. The red fire warning lights above the radio panel will indicate a fire. Fire extinguishing by halon from a single cylinder located in the cockpit.
Before discharging take care to select proper engine first. On Pilots main electrical panel, see figure section 12.24 / 02

02 SMOKE DETECTION

No smoke detection provided in the Catalina

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12.33 LIGHTS

01 LIGHTS

All external lights are controlled from the Flight Station, as are the nose compartment, cabin lights and nose door lights.

Internal compartment lights and auxiliary outlets are independently switched near to the lights themselves. The main battery switch controls these circuits, which also have a circuit breaker on the Co-Pilot’s Switch Panel, marked Compartment Lights.

02 EXTERIOR LIGHTING

All exterior lighting is controlled from the flight station. The control switches are located on the Yoke with circuit breakers on the Co-Pilot's Switch Panel.
Landing lights have control and power circuit breakers, as do most other lights with switching on the Yoke and protection on the Co-Pilots Switch Panel

03 INTERIOR LIGHTING

The interior lighting such as is provided in the passenger areas and other compartments is provided to enable movement throughout the aircraft and is operated by switches near the facility. The master switch is on the Yoke with the circuit breaker on the Co Pilots Switch Panel.

04 INSTRUMENT PANEL LIGHTS

Are panel mounted and controlled by switch and rheostat. A separate switch on the pilots control panel is for a spotlight, mounted in the roof. Lighting is adequate but not bright.

05 WARNING LIGHTS

Float Warning:	Illuminates if power is reduced to <15 inches MP without the floats or gear being down.
Gear Up Nose Gear Down: Gear Down:	This indicates Main Gear position only. It is operative but is not to be used as a substitute for manual gear checks.

Other **Warning Lights** include:

Starter Engaged Warning:	Two orange lights on the instrument panel in front of the Captain are illuminated when the starter is engaged. If these lights stay on after the starter switch is released that engine must be stopped to prevent damage to the starter mechanism.
Engine Fire Warning:	Two red lights are located on the instrument panel above the radios one indicates for each nacelle. If either illuminates it indicates overheating in the area of the detectors, and possibly fire. These lights can and should be tested each first flight of the day.
Oil Pressure Warning:	Indicate failure in the oil system with pressure unacceptably low. These lights will be illuminated at slow idle engine speeds.
Fuel Pressure Warning:	As above but for the fuel system. These lights should be off at all times after engine start
Garb Heat Operation:	Red light indicate Garb Heat 'GOLD', The lights go out soon after Garb Heat 'ON' is selected.

The last three are found to the right of centre on the instrument panel beneath the engine gauges for oil temp, oil pressure and fuel Pressure.

12.23 COMMUNICATIONS

01 GENERAL

All communication equipment is switched on via the avionics master switch.
In case of electrical emergency the VHF COM 1 and the Transponder can be switched to an avionics hot battery bus.

02 RADIO COMMUNICATION EQUIPMENT

2. VHF
King KY 190B Com 1 / and 2

1 Marine band
TBN

03 CREW INTERPHONE

A pilots interphone / switch panel is located on either side of the cockpit for both pilots. A third interphone outlet is located at the cabin crew station in the rear pox compartment.

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A.1 INTRODUCTION

This document is produced as a part of the Aircraft Operating Manual for PH-PBY.

Contained is the information required for safe operation of the aircraft during water operations and information to allow an understanding of the factors that affect aircraft performance during water work. For more detailed explanations of seaplane flying and seamanship the reader should consult the listed references.

This manual is not a substitute for experience and currency. All flight and cabin crew must have specific training and approval to undertake water operations. Minimum crew numbers for water operations are 3.

Water operations check lists are contained within the Aircraft Operating Manual and the cockpit checklists. They are reprinted in this supplement as are some performance graphs and data for ease of reference.

01 REFERENCES

1) Canso Operating Manual, PBY -SA and 28-SACF Airplanes
2) Performance Graph, PBY -5A and 28-5ACF Airplanes.
3) Performance Graphs, Consolidated Vultee Corporation Model 28-5ACF
4) Baj, C. and de Remer, 0: Seaplane Operations; Edizioni newspress, 1998.
5) Hamilton, G: Flying Boats for Recreation; Eastern Dakota Publishers, 1997.
6) Faure, CM: Flying a float plane; 3rd edition, Mc Graw-Hill, 1996
7) Scanlon, M: Safety in Small Craft (revised), Royal NZ Coastguard Federation, 1994

02 AIR

The behaviour of air in the atmosphere and the interrelationship of temperature, pressure, density, humidity, dew point, freezing level etc should be known to all pilots. Atmospherics affect water flying more than land flying because of the changes air movement causes to the landing and take off areas. The effect of air density on aircraft performance must be remembered in all conditions.

03 WIND

Air movement (wind) is particularly important because of the influence it has on the water surface and the effect it has on the aircraft when it is on the water. For example, wind can cause difficulties with taxiing and if gusts are erratic landing can be dangerous. Particular types of wind are likely to influence water operations with PBY:

04 SEA BREEZES AND LAND BREEZES

Heating of the land during daylight produces upward movement of air over the land and cooler more dense air is drawn in from over the sea (or large lake). This onshore movement of air is the sea breeze and normally is noted late morning and is most intense at from mid to late afternoon. Wind strength can reach 15-20 knots
More rapid cooling of the land
overnight can produce a less intense air flow from land to sea during the night but this is rarely stronger than 10 knots.

05 VALLEY AND MOUNTAIN BREEZES

More rapid cooling of air at altitude leads to downhill and down valley air flow at night (mountain breeze)
The rise of more rapidly heated valley floor air during the day can give an up valley wind direction of importance around mountain lakes (valley breeze).

06 ANABATIC AND CATABATIC WINDS (STAU AND FÖHN)

Warm strong winds in the lee of mountains (e.g. the Canterbury Northwester) will produce conditions of good visibility until dust becomes a problem, but lake and sea conditions tend to be rough or very rough.

07 EFFECT OF LAND AND WATER

The lee sides of islands and "venturi" effects on narrow lakes and rivers are examples of the land affecting the wind conditions often to the detriment of the seaplane pilot. "Boundary layer" effects where the wind speed drops as it is measured closer to the water surface also occur resulting in wind-shear and turbulence. For example, a wind of 20 knots at 50 feet above the water may be only 10 knots at 6 feet above due to surface friction retarding the air flow. This change may be enough to ruin an otherwise satisfactory approach.

08 WIND STRENGTH

It is not likely that PBY will operate on or off the water in high wind conditions or rough water and with all operations it must be remembered that the operating limit for wave height is two (2) feet only. This will normally mean operating in winds no stronger than 10-15 knots. For example:

Calm	No wind	glassy water	
Light Air	1-3 Knots	ripples on the water	
Light Breeze	4-6 Knots	Small wavelets, crests glassy, waves <6’	
Gentle breeze	7-10 Knots	Large wavelets, crests may break, waves <10’	
Moderate breeze	11-15 Knots	small waves, frequent white caps, waves <16'	
Fresh breeze	16-20 Knots	Larger longer waves, some spray, waves < 24'	

09 WIND DIRECTION

Wind vanes on the water, wind "shadows" along the up wind shore, smoke, flag orientation, sails, and the direction moored boats face are all indicators of wind direction.

Take Off, approach and landing out of wind will introduce a cross wind component and reduce the head wind component as occurs on land. Reference should be made to the crosswind component graph

10 VISIBILITY

The atmosphere over the water surface and the refraction of light by the water surface commonly produces optical illusions. The commonest are the poor and often dangerously inaccurate depth perception associated with glassy water conditions and the occurrence of "mirage" images particularly in hot conditions.
Water

11 WAVES

Waves are the product of wind action over the water surface. Waves may be described according to their wavelength, speed of propagation through the body of water, period, and height. The wave moves in the direction of the wind that created it but the water itself does not need to be moving the same way.
Wave size depends on the wind strength, and the distance over which the wind has acted to produce the wave (called the wave fetch). Thus waves caused by the same wind get bigger with duration of wind action and will be bigger in larger bodies of water. Waves produced by a wind that is no longer with them gradually weaken but may travel great distances producing swells. Frequently, waves of different form travelling in different directions may be present in the same body of water at the same time.
Some people refer to the waves with the currently occurring wind as "primary” or "live" waves and those that have moved from their area of origin or were caused by a previous wind as "secondary" or "dead" waves.
Waves will break whenever they reach a height of about 1/7 of their wavelength so this can occur as wind strengthens and wave height increases (part of the formation of whitecaps), or as the water depth decreases and the wave comes into "ground effect". Here the wave height is increasing as the water depth decreases and the water in contact with the bottom is slowed allowing the surface water to continue. Eventually the surface

water overruns the deeper water and the wave breaks. Breaking waves should be avoided by pilots!
Wave activity around obstructions is varied but predictable. Wave propagation speed generally decreases, wave direction will change according to where the wave is first affected by the obstruction, and wave height often decreases. Hence the use of breakwaters in and around harbours

12 WAVES RELATED TO HULL LENGTH

- Wavelets: 10 or more waves per hull length. Always live waves, will lie perpendicular to wind and move with it, and provide good cavitations to aid in unsticking the aircraft on take-off.
- Short waves: 4-7 wave crests per hull length. Almost always live waves, generally good operating conditions though rougher than above.
- Medium waves: Wave length comparable to hull length. The most dangerous wave form for flying boats since broaching is a risk. Usually needs the sea or a very large lake for Catalina sized medium waves to develop.
- Long waves: Length greater than the hull length. In general it is easier to handle the flying boat in these conditions than with medium waves. The longer the wavelength the more readable and predictable the wave system becomes.

13 TIDES

Tide effects are due to the relative gravitational pulls of the sun and the moon. The strength of the tide in any body of water depends on the size of the body, the relationship of the sun and moon positions and the patterns of water flow in the body. The main problem for the seaplane pilot is the change in water level associated with the tide flow. Differences may be only a few centimetres in some large lakes but may reach 10-15 metres in some ocean areas.

14 CURRENTS AND WATER LEVELS

These may be drift currents caused by wind, tidal currents, or water flows associated with temperature gradients in the body of water. All currents are modified by the Coriolis-effect (right deviation in northern hemisphere). Lake outflows into rivers will often produce current effects some distance back into the lake and pilots should remember that the outflow from many lakes is regulated for hydro generation and may change at any time. For the same reason, pilots must be prepared to find river and lake levels quite variable, even over relatively short periods of time.

A.2 MECHANICS OF WATER FLYING

01 FORCES

Forces acting on the aircraft weight (Gravitational force)
Weight acts vertically downwards from the centre of gravity. It acts the same when on water as when in the air and CofG is movable depending on loading. On water it is possible for the aircraft hull to be supported by two wave crests but be unsupported near the CofG (sagging), or to rest on one wave crest but be unsupported at bow and stern (hogging). The hull strength required to cope with these situations is greater than that required for impact with the surface and imposes a weight penalty.

02 BUOYANCY (HYDROSTATIC FORCE)

Water exerts a force on all surfaces of the hull it is in contact with. The resultant force is buoyancy and this can be considered to act vertically upwards from the Centre of Buoyancy. It has intensity equal to the weight of water displaced by the aircraft which is in turn equal to the weight of the aircraft C.of.B is also a movable point depending on how the aircraft sits in the water, whether or not the water is moving and how the aircraft is loaded.

03 THRUST / DRAG COUPLE

The thrust line is that of the engine propeller shaft but is set higher than the drag line resulting in pitch changes with power change on the water This produces a nose down pitch with increasing power from the start of the take-off and is one of the reasons for full up elevator at the start of the run.

04 HYDRODYNAMIC FORCES

The planing hulls of the flying boat or floatplane are designed for maximum hydrodynamic lift and minimum hydrodynamic drag at typical take-off speed. At low speed, as at the start of the take-off run the hydrodynamic drag is great and the hydrodynamic lift is poor, and the drag operates below the CofG and C.of.B while the thrust is above both. The hull will want to plow through the water not plane over it. Up elevator helps to keep the thrust line developing some lift, keeps the bow from plowing and encourages an increase in speed and improved planing. The step in the hull helps separate the water from the hull to reduce drag and surface tension.

05 AERODYNAMIC FORCES

An increase in speed over the water allows the normal aerodynamic force couples of lift / weight and thrust / drag to operate as for any other aircraft and the hydrodynamic forces decrease. As the aircraft leaves the water it changes from being supported by water at the C.of.B to being supported by lift at the wing Centre of Pressure. The C.of.P is well forward of the C.of.B and so the aircraft will tend to pitch up at take-off. This is a slow attitude transition for some aircraft and a rapid change for others. It explains in part, the need to check forward slightly on the controls of PBY to maintain correct attitude in the climb after take-off. This effect is also caused by the aerodynamic lift provided by the exposed hull after this clears the water.

L = W
L = F aerodynamic +F hydrodynamic+ F Hydrostatic
W = F gravity

06 ASYMMETRIC EFFECTS IN TAXIING

Although not affected as much as in a single engine floatplane the Catalina is acted on by forces producing turning moments. These are; propeller torque; propeller slipstream; asymmetric thrust of the propeller disc; and gyroscopic precession. All but the last will result in a left turn in the Catalina. The result of these is a slight left turning tendency as power is applied although the gyroscopic precession wants to command a right turn as the nose rises. As the nose is lowered once the aircraft comes up onto the step there is a gyroscopic force commanding a left turn. Considerable right rudder is required to keep straight, even in steady headwind or no wind conditions.

07 ASYMMETRIC EFFECTS OF WIND ON CONTROL SURFACES

It takes very little force to turn an aircraft on the water in calm conditions. The effect of wind on the large fin and rudder of the Catalina easily yaws the aircraft into wind. The greater drag provided by a downward deflected aileron can be used to provide a turning moment or to counter the tendency to weathercock into wind.

08 ATTITUDES ON THE WATER WHEN STATIONARY

The aircraft will position itself in an attitude that puts the CofG and. C.of.B on the same vertical line. This will be affected to a degree by loading and by water conditions. Rotations round the C.of.B can occur but those about the longitudinal axis are resisted by the wingtip floats and those about the transverse axis are countered by the CofG and C.of.B returning to their co-axial relationship. Force applied transversely at the C.of.B will tend to move the aircraft sideways but force applied ahead of or behind the C.of.B will rotate the aircraft about the vertical axis.

An aircraft not moving through the water can not be steered even if water rudders were fitted. It is the effects of wind that will dictate how the aircraft rests on the water in any given conditions.

09 LOW SPEED TAXIING

The attitude is determined as above plus the pitch down of thrust and the pitch up of hydrodynamic forces as forward movement begins. The pitch up is reinforced by airflow over the up elevators. Pitch up increases in intensity with speed but acts further back on the hull so its moment arm reduces. At low speed taxi it can be considered constant and only alters significantly as the aircraft accelerates through the plow configuration to achieve the step. Control of rotation about the vertical axis is by differential power use to overcome the weather cocking tendency since the Catalina has no water rudder. The inertia of the aircraft must be remembered and effects of power and wind anticipated. Power changes need to be made ahead of the desired course. Directional stability can be enhanced by lowering the landing gear (greater keel effect) but the danger of salt water in wheel bearings must be considered if operating in the sea.
Taxi speed will be <5 knots and engine power settings kept as low as possible. Any cross wind component during the taxi will cause drift which must be taken into account especially if operating in confined areas. Drift may also be caused by movement of the body of water in which the aircraft is floating.

10 SAILING WITH POWER OFF

Once weather-cocked into wind the aircraft will "sail" backwards but direction can be modified by placing the rudder hard over in the direction required and putting in full down aileron on the same side. Thus rudder is towards direction of travel and control wheel turned in the opposite direction. This will turn the aircraft and allow it to "keel sail" backwards and to one side. The degree to which a sideways component of sailing can be maintained depends on the rudder and aileron ability to counter the weather-cocking tendency and so is affected by wind strength.

11 SAILING WITH POWER ON

If conditions allow lateral keel sailing, other directions can be achieved as well. Once nose direction has been set by the use of rudder and aileron, sailing in most directions can be achieved by using power to equalise or exceed the backward component of the wind vector. The forces required are not great so the power needed is often little but correspondingly the speeds achieved with sailing are low and to achieve and maintain control requires patience and concentration from the pilots.

12 PLOW TAXI

In a single engine aircraft one advantage of the plow taxi is the ability to turn downwind especially to the left (see hydrodynamic forces) but in PBY this ability can be provided by asymmetric thrust and the poor visibility over the nose of the aircraft means the use of the plow taxi is seldom if ever used.

13 HIGH SPEED TAXI (ON THE STEP)

Once power is applied and the aircraft accelerates it begins to cross its own transverse waves. This, combined with the presence of a step in the hull allows air and water to mix under the hull. Small waves on the water surface add to this effect. As speed increases the control back pressure is relaxed to allow the hull to settle into a planing attitude supported by the area of hull just forward of the step. An attitude exists for best planing efficiency and that offers least drag from the water and best acceleration for the aircraft. A lower nose attitude results in greater drag from the increased hull contact forward of the step and a higher attitude compromises the air/water mixing behind the step and may prevent the aircraft getting onto the step at all. This is particularly a problem if heavily loaded, with the CofG too far rearward or in high density altitude conditions where less power is available. As acceleration continues and the centre of buoyancy moves rearward some elevator back pressure will be required to maintain the best attitude. A change as little as 1/2 degree in attitude can make all the difference to take off performance.

On the step the aircraft is supported by a balance of hydrodynamic and aerodynamic forces. The wing is set to be at its best low speed angle of attack at the same time as the hull sits at the best planing attitude. This explains the slight nose down appearance of a Catalina in cruise flight.

Once on the step and with best attitude achieved the aircraft will continue to accelerate until it takes off. To keep the aircraft on the step requires a power reduction and 25in Manifold Pressure is usually sufficient to keep PBY step taxiing.
Directional control can be achieved by the use of the rudder fairly early on in acceleration (floatplanes have their water rudders raised for operation on the step). Because the aircraft is being supported by a very small area of hull, small bank angles will produce a horizontal

component of lift sufficient to turn the aircraft. To maintain a heading it is therefore important to keep the wings level when using rudder to turn there is a centrifugal force tending to bank the aircraft away from the direction of turn and if allowed to occur this adds a horizontal component of lift that counters the desired turn. This tendency must be countered by a balancing control input (aileron slightly into the turn).
Control of the aircraft on the step is important in take off and landing phases c flight and during high speed manoeuvring.

14 PORPOISING

This is a dynamic instability in pitch resulting in a series of oscillations, which tend to grow larger, producing nose low pitch on water contact which worsens with each oscillation, hull damage or destruction can result. Porpoising may occur just after climbing onto the step during take off or high speed taxi or just before coming off the step after landing. A couple of oscillations are common at these times and generally cause no trouble. Once on the step the aircraft is more hydro dynamically stable than during transition to it so the oscillations rarely continue and once off the step after landing the stability again increases. The time where dangerous porpoising can begin is at high speed on the step just before take off. Failure to maintain the correct pitch trim angle at this time will result in large forces being applied to the hull through forward or rearward movement of the centre of buoyancy. This may result in pitch change, further altering the hydrodynamic forces and then worsening instability with progressively larger oscillations. In calm conditions this is likely to be the pilots fault, but waves (even low waves of long wavelength) can induce the problem. Incorrect or over loading and hot/high conditions also make porpoising more likely.
Early on, porpoising can be arrested by returning the aircraft to the correct trim angle. As porpoising worsens, more control input is required. So….

15 PORPOISING RECOVERY (GENERAL TECHNIQUES)

8) Return to best trim angle and hold that attitude.
9) As the bow reaches its most nose up point in the oscillation, add control back pressure and then slowly lower the nose to the correct pitch angle as the aircraft "squats" into the water nose high. Timing is critical. Then restabilise on the step.
10) Push the controls fore and aft to counter the pitch changes. Input must be slightly ahead of the motion. This is difficult to time. Experience is essential, since timed badly this can worsen the oscillations. (Do not use in PBY, instead go to No 4 below.)
11) Porpoising Abort. Close the throttles and draw back on the controls. Time this for when the nose is rising. Let the aircraft come off the step.

***WARNING**: Abort early before the oscillations get severe.Do not try to fly out of porpoising by applying power.*

16 SKIPPING (& OCCLUSION OF THE STEP)

Contact with the water at higher than normal rate of descent, especially with a nose up pitch attitude, can result in sudden immersion of the step and the area behind it. The reaction to this is to force the aircraft back into the air when its forward speed can not sustain flight. The generation of the forces to rebound the aircraft can be reduced by the Vee shape of the hull and by air ducts at the step to allow trapped air out and smooth flow of air back in to the area behind the step.
Less violent skips can occur when the aircraft contacts the water at higher than ideal approach speed usually off a shallow approach and with a higher than ideal nose attitude.

The aircraft literally ricochets back into the air like a stone skipped across a pond. With power off such skipping usually stops after 2-4 bounces but slight nose down attitude adjustment (back to the optimum landing attitude) will stop the skipping promptly.

17 SURFACE CONTACT WITH DRIFT

Landplane pilots are used to judging drift by reference to a fixed surface, usually the runway. When landing on water an approach that seems to have no drift will still have drift equal to the movement of the wavelets. Although the Catalina is robust, compensation for drift must be added in as much as possible and extra compensation added to allow for water movements.

18 SURFACE CONTACT OUT OF BALANCE

Contact with the ball out of centre results in a rapid realignment of the longitudinal axis of the aircraft. This will produce a rolling moment that can be sufficient to dig in one wingtip float. This can be disastrous if the nose attitude is at all low and will usually result in failure of the nose gear doors and a water loop. The ball usually goes out to the right as power is reduced and this will be an additive to a destabilizing crosswind from the left. Power on approaches are safer in this regard.

19 TOWING THE AIRCRAFT

It is not anticipated that towing will be necessary but if due to engine failure or the like towing is the only safe way to handle the aircraft the following should be considered.
Tow line force, hydrodynamic forces, aerodynamic forces and buoyancy all influence the behaviour of the aircraft under tow.

<u>Upwind</u>

Towing is more or less stable. Yaw induced by wind and/or waves will tend to be countered by the tow force and return the aircraft to the tow path direction.
Crosswind Towing can be stable but the aircraft longitudinal axis will not be parallel to the tow direction. Towing in waves sees the tow line force vary periodically and when the line is slack the aircraft will yaw more into wind. This yaw increases the tow line force and stabilizes the situation.

<u>Downwind</u>

towing can be stable only if the tow line force overcomes the aerodynamic forces trying to weather-cock the aircraft into wind. This requires higher tow speeds and becomes impractical in all but the most gentle breeze. Towing the aircraft by the tail can make things more manageable but the best solution is the use of a sea anchor or drogue to increase the hydrodynamic force to balance the aerodynamic forces.

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A.3 SEAMANSHIP

01 INTRODUCTION

Once on the water the Catalina is a boat and is bound by the rules for normal, safe operation of marine craft. The pilots therefore need to know the rules of maritime traffic and must develop skills at anticipating the movement of boats and shipping. A basic understanding of marine terminology and some experience in the use of nautical equipment is also required. Fortunately there is some commonality in the nautical and aeronautical languages.

02 MARINE EQUIPMENT

Anchor:
This is a basic item and should always be stowed in an accessible place with at least 30m of suitable line attached and 10m of chain. The line required to hold a Catalina in rough and windy conditions is sturdy indeed and the braided line currently fitted is only suitable for light conditions. Alternative anchors are available.

Lines:
Braided lines are easier to work with than the older style twisted (laid) lines but for heavy towing or anchoring the twisted type is probably better. Synthetic materials have all but replaced the traditional manila and sisal fibres. Nylon lines are strong and flexible and stretch well so while versatile, they will whip badly if they break and they do not float. Nylon absorbs very little water and is the strongest material for a given diameter line. Polypropylene lines are less elastic than nylon, are usually cheaper and do float but are stiffer to work with, and are weaker than nylon for a give size. Polypropylene is however lighter than nylon for a given length of the same diameter. Never use polypropylene or other floating line on an anchor; it is too easily snagged by the propellers of manoeuvring boats.

Sufficient lines should be carried for security at docks, beaches, ramps etc as well as a suitable anchor line. A minimum of 4 lines each of 30m length should be on board for most water operations.

Lifejackets:
A full complement of 19 jackets is to be carried for all water operations with passengers on board. These are standard aviation approved jackets with lights.

Life raft:
A raft will be carried as required by ICAO rules. At present this is required for flights greater than 200NM off shore. The raft must be large enough to accommodate all the aircraft occupants, have a location indicator light, a survival kit, one or more pyrotechnic signalling device and one ELT fitted

Bilge Pumps:
Four electrically driven bilge pumps are fitted in the hull. One under the front passenger cabin floor, two under the pylon compartment floor and one under the floor of the rear passenger cabin. They are powered by a 12Vdc system independent of the aircraft electrical system (24Vdc) but charged by the aircraft generators via a voltage regulator. The pumps are “hot wired” to the battery bus.

03 PBY EQUIPMENT

While no defined marine equipment list exists for PBY the above items and the following should be on board and checked prior to water operations:

1) Hull and float bungs in place and spares carried.(red box)
2) Water proof containers.
3) Boat hook and or long pole on board.
4) Charts of the operating area available if possible.
5) Sea anchor or drogue stowed on board.
6) Knife and/or axe to cut away lines in an emergency must be available.

This equipment is additional to the Standard aircraft emergency equipment.

04 KNOTS

While many elaborate and complicated knots exist, a good knowledge of a number of simple knots is all that is required for most situations. What is needed are techniques for joining lines even if they are of different diameters, for securing a bight or loop on a line, and ways of securing lines to poles, bollards trees etc. The following is probably sufficient. Refer to diagrams

For joining lines:

Reef knot:
Useful for narrow cordage. Not good on larger lines. Easily miss-tied into a Granny knot.

Sheet Bend:
Good for lines of equal or unequal size. Ties securely

Fisherman's knot:
Very easy and secure way to join lines of same or different size but hard to undo if it has been under load.

To make and secure a loop:

Bowline:
Reliable, quick to tie, never slips, can be tied with loose line or line under tension, easy to undo after load. An indispensable knot and by far the best way to create a loop on a line.

Securing line to post etc:

Clove Hitch:
Easy to tie but can jam if it has been loaded heavily, Can slip along the pole or post and can work loose if intermittently loaded. With an extra locking turn it becomes a Rolling Hitch which is more secure.

Round Turn and Two Half Hitches:
Easy to tie, secure once loaded, but remains easy to undo.

Anchor Hitch:
Similar to above but even less likely to loosen. It is however harder to undo after loading.

Other special use knots:

Sheepshank:

Used to shorten a line without having to cut it. Only reliable if line remains under tension

Slippery hitch:

Useful to allow the aircraft to drift back from a buoy or post mooring before engine start. Once under way the running end can be pulled to untie but if need be the aircraft can be pulled back up to the buoy using the standing part of the hitch. Don't forget which end is which!

Figure 8 knot:

Useful for securing frayed ends on a line or as a stopper knot to prevent a line running through a block or pulley.

05 BUOYS AND MARKS

These are essentially the "road signs" for marine traffic. For detailed information regarding buoys and marks it is advisable to obtain the “vaarbewijs”.

Buoys float while marks are fixed to the sea floor or river bed. The majority of buoy systems are at harbours and estuaries although some will be encountered during operations on lakes. Since we operate on fresh water only it is unlikely we will need to be guided through complex buoy systems but the basic meanings of the buoys commonly used is included here for reference.

Lateral Mark and Buoy systems

are set for a specific buoyage direction (usually inbound to a harbour or clockwise round the North or the South Island. Both buoy shape and colour may indicate which side of the buoy should be passed.

For example, can shaped buoys should be passed so that they remain to port, conical buoys to starboard while spherical buoys can be passed either side. Pillar and spar shaped buoys give no information as to side of channel unless they are fitted with a topmark of can or cone shape.

Red buoys indicate that they should be passed on the port hand (keep them to your left), green should be passed on the starboard hand (keep them to your right)

Preferred Channel Marks and Buoys are used to mark where channels split and tell on which side the preferred channel lies. Such marks and buoys will be can shaped and/or be red with a central green band if they mark the left side of the main channel (keep them to your left). Conversely they will be conical and/or green with a central red band if marking the right side of the main channel (keep them on your right).

Cardinal Marks and Buoys

indicate on which cardinal point of the compass you should pass to avoid an obstacle or danger to navigation. They are yellow and black with coded triangular topmarks. (See diagram)

Isolated Danger Marks and Buoys

show small areas of danger where navigable water exists all around. They are black and red in colour and commonly have two black spheres as a topmark.

Safe Water Marks and Buoys
are mid channel marks and may be any shape but are coloured with red and white vertical stripes

Special Marks and Buoys
indicate cable and pipeline areas, military exercise areas etc and are yellow coloured with X shaped topmarks. White triangle signboard type markers also show cable areas.
Local Marks include the orange and black posts and buoys used to mark waterski lanes and surfing lanes etc.

06 RULES OF THE ROAD ON THE WATER

Many of the rules for the identification and separation of aircraft have their in rules for shipping. The navigation light system of red on the left (port) side green on the right (starboard) side plus a white light to the rear are the same for ships and aircraft. In addition vessels on water are required to show certain masthead light patterns depending on vessel size and activity but since it is highly unlikely that PBY will be operating in shipping lanes at night the details will not be covered here.
Collision avoidance regulations are internationally standardised and to all craft of all sizes including flying boats and floatplanes on the water. In the Netherlands a flying boat or sea-plane is obliged to give way to all other traffic on the water. Internationally the rules are similar to the rules in aviation. In all circumstances a good look out is mandatory, good crew co-operation and communication ensured and speed and direction controlled accurately.

- Overtaking:The vessel being overtaken has right of way
- Converging:If sailing, port tack (wind from the left) gives way to starboard tack or most windward vessel gives way. Under power, give way to traffic on the right, and if approaching head on, each vessel should alter course to the right.
- Narrow channel:Keep right and keep as visible as possible to other

It is generally accepted that seaplanes should do their best to keep clear of other marine traffic, but seaplane operations often attract the interest of boaties Where several seaplanes are operating, those taxiing or taking off have right of way over those landing (the reverse of the situation on land), and aircraft on the step have right of way over those in displacement conditions. Due to their greater instability on the water it is considerate for floatplanes to have right of way over flying boats. Aircraft approaching a dock or mooring have right of way over those departing but manoeuvrability or the lack of it may dictate that the reverse apply in some circumstances. Use common sense and caution

Speed is regulated to be less than five (5) knots in the following circumstances
1) Within 200m of a shore, structure, or anchorage (>5boats)
2) Within 200m of a vessel flying the "A" flag (diver below)
3) Within 30m of any vessel whether underway or stopped or moored.
4) Within 30m of any person swimming.
5) Within 30m of any group of 5 or more boats (this constitutes an anchorage)

Harbour Boards and Port Companies may have bylaws that affect seaplane operations. Efforts should be made to determine this ahead of time if possible. Contact with the local harbour authority or Regional Council is advised.

A.4 AIRCRAFT OPERATIONS ON THE WATER

01 ENGINE START AND RUN UP

The starting of the engines on the water produces movement of the aircraft. There are no brakes to hold the aircraft during start, engine warm up, run-up and pre-take off checks. The aircraft must be clear of buoys, markers, moorings and of other marine craft before starting engines.
From a mooring it is often best to pay out line from the bow while still secured by a bow line fixed to the mooring using a slippery hitch. Similarly, from anchor, out more line then start and taxi back up to the anchor position while the anchor is hauled in. Should there be a problem getting the engines started it is easier pull back up to the mooring or anchor position rather than be forced to re-anchor or have the aircraft drift.
The starting sequence is the same as for operations on land but to have the aircraft quickly under control a prompt start is preferred. This will minimise the turning of the aircraft on asymmetric power. Combining power and sailing techniques, clear the mooring area and allow the engines to warm up. Gentle circular turn patterns can minimise the water area required.
Once clear of all obstructions the engines can be run up using the Standard up checklist. The engines can be run up one at a time allowing the aircraft to steadily in circles first one way then the other. Alternatively the 1700RPM checks can be done for both engines at the same time so long as the non-flying pilot keeps the control yoke fully back and a good lookout is maintained by all crewmembers.

02 TAXIING

Low Speed (Displacement) Taxi: Considerable practice is necessary for successful water taxiing. There are no water rudders to aid in directional control. Differential power, rudder deflection (towards desired turn), aileron drag (turn away from turn direction), lowering undercarriage and using drogues are all of value in handling the aircraft on the water. The engines are close to the centreline and differential power is there less sensitive than would be ideal so the other methods must be used in confined areas, such as when close to docks and beaches or among boats, they moored or under way.
<u>Into wind taxiing</u>
is the easiest direction to master. With a wind speed of 10-12 knots the aircraft can come to a stop with engines idling. With a good airflow over the wings the ailerons can be used to help keep a chosen wingtip float in the water providing water drag and improving turning ability. This is a more powerful way of controlling a turn than relying on aerodynamic drag from the "down" aileron (sailing) but requires a wind of about 10 knots to become effective.
<u>Cross wind taxiing</u>
is more difficult because of the strong weather-cocking tendency of the Catalina. A higher power setting on the up-wind engine is necessary and results in a higher taxi speed. As wind speed increases the cross wind taxi ability decreases and in strong winds the pilots must power taxi as far across the wind as can be achieved then shut down engines and tack the aircraft in "sailing" mode before restarting the engines, so zigzagging in the desired direction. A drogue streamed from the leeward side of the aircraft allows cross wind taxiing in stronger wind conditions and the drag provided usually means 1000RPM can be maintained on the leeward engine with higher power on the windward engine. Plug fouling on the leeward engine is then less likely but overheating of the windward engine is still a risk.

Down wind taxiing
is possible but getting the aircraft to turn downwind is difficult in all but the lightest conditions. Once directed downwind, short burst of power alternately applied can be used to keep the aircraft straight. If the tail is allowed to wander out of a strictly down wind position considerable power may be needed to correct the aircraft's path. A higher taxi speed will also occur and engine overheating is likely. Lowering the landing gear adds drag to overcome this problem as can streaming a drogue from each side of the aircraft. With drogues and landing gear down it is possible to taxi a Catalina down wind in quite strong wind conditions.

Note: If good control can not be maintained taxiing down wind, allow the aircraft to turn into wind and "sail" it backwards, tacking sideways a little as required.

Lowering the landing gear helps in all displacement taxiing since it improves lateral stability, tightens the radius of a turn and provides protection against shallow water, sand bars, reefs etc. PBY has a nose gear isolation system to allow lowering of the main wheels alone, but after use, landing gear hydraulic sequencing problems are more likely.

***WARNING**: Always ensure that landing gear is UP at the end of water taxi*

03 SAILING

This is included here because it is one way of controlling the aircraft's movement across the water and is therefore technically a form of taxiing. The aerodynamic and hydrodynamic principles have been covered in section 02.10.
Sailing may be achieved with power off or power on. With power on sailing the advantage is that the engine power will counter the wind force moving the aircraft downwind, so better control on the water is possible.
In general to, sail the aircraft, these guidelines should be followed:

1) Allow the aircraft to weathercock into wind. The aircraft sails downwind backwards.
2) To sail in a direction other than directly downwind turn the rudder direction of the turn required and the ailerons in the reverse direction make use of rudder and aileron drag effects. The aircraft should proceed downwind and to the desired side. (Keel sailing)
3) Add a small amount of power to overcome the down wind component of wind allowing more cross wind heading to be maintained.
4) In strong wind conditions alternately sail down and across wind and taxi under power as much up and across wind as possible, thus tacking the aircraft in the desired overall direction.

04 HIGH SPEED (STEP) TAXI

While a very good way of covering distance over the water quickly, the step taxi has limitations as well as advantages. This procedure is done with the floats selected in the UP position.
The main practical uses of the step taxi are fast taxiing to reposition the aircraft for take-off or to travel from a landing area to a beaching or mooring area. These can be accomplished quickly and without overheating the engines taxiing on the step.
Step taxiing is also a good training manoeuvre since it allows practice of the correct Minimum Drag /Maximum Acceleration trim angle for the take-off run avoiding porpoising during the take-off run. If not current on the water some taxi practice is very useful before a full take off run is initiated.

For practice, select a 2-3 mile water run with wave conditions one foot or less. With the controls hard back the power should be brought up to take-off settings (47 ins Manifold Pressure and 2700 RPM) and the aircraft allowed to rise up over the "hump" and onto the step. Elevator back pressure can then be relaxed a little and the aircraft will continue to accelerate at the correct attitude. Once a speed of 45-50 knots has been reached power is reduced to about 25 ins Manifold Pressure and if correct attitude is maintained speed will be held steady.

Directional control is established early as airflow increases over the rudder and once up on the step, rudder step turns can be used easily. There is a tendency for the wing on the outside of any turn to drop due to the centrifugal effect but this is in part countered by the faster airflow over the outside wing during the turn. Which effect predominates depends on the wind and water conditions but at all times the pilot must keep the wings level. An occasional quick glance at the floats is useful. During the step taxi the floats should be just out of the water, so a float sitting high above suggests the other one will be dragging. A float in the water requires corrective aileron input. The non-flying pilot can keep a watch on float position during the manoeuvre as well.

05 PORPOISING

This is due to a low nose attitude and the oscillations must be overcome by prompt return to the correct nose attitude before the oscillations reach the point that the nose gear doors are taking load. The principles of porpoising recovery have been covered under Part 2 of this supplement:

06 PORPOISING RECOVERY (FOR THE CATALINA)

1) Return to best trim angle by elevator back pressure and hold that attitude until the porpoising ceases then confirm that acceleration is continuing and adjust attitude if necessary. If unsuccessful,
2) Porpoising Abort. Close the throttles and draw back on the controls. Time this for when the nose is rising. Abort the take off and let the aircraft come down off the step.

WARNING*: Abort early before the oscillations get severe.Do not try to fly out of porpoising by applying power.*

07 TAXIING IN CURRENTS

When taxiing downstream the main problem is the sensation of speed relative to the shore which often tempts the pilot to reduce power. This may reach the point that so little power is left "on" that the aircraft is not really moving relative to the water and is essentially drifting out of control. Regular checking that rudder control remains should occur as power is reduced.
Taxiing up current is easier. The aircraft will have more power on for the same speed over the ground and is more controllable. Small power adjustments make a controlled track easier to maintain and in all cases the approach to a shore or a dock should be made up current. The exception is where strong eddy currents run upstream close to the bank of a major river.

08 TAKEOFF

Choice of Takeoff Path
Choice of Takeoff direction and planning the takeoff is more complicated then for operations on land. The following need to be considered:
Shape and size of the Takeoff area. Because visual estimates are inaccurate it is best to examine the area well from the air before landing. If that is not possible an assessment from charts plus inspection by taxiing or by boat before take off is desirable.
Submerged obstacles are best identified by aerial inspection (if water clear) chart, local knowledge (if available) or by slow back taxi over the full length of the takeoff run.
Wind direction and speed should be estimated and in almost all cases take off should be made into the wind. Tailwind takeoffs are particularly risky in hull type seaplanes such as PBY due to the exaggerated tendency to porpoise and the reduced elevator effectiveness to counter this. Signs to help read the wind direction include;

1) the aeroplane itself by weather cocking,
2) Moored boats,
3) Sails, flags and sailing direction of boats,
4) Shoreline trees, flags, smoke etc,
5) Wind vanes on the water.

Wind strength is best assessed by a combination of factors. These were introduced in 01/08 of this section

Surface Conditions including waves, wave form and direction, glassy water areas, potential for boat wakes to disturb the takeoff, surface markers and obstructions must all be studied to determine the best takeoff area and direction.

Currents can be used to advantage and where a down current takeoff run is into wind that should be chosen. If wind and current direction are the same, choose a takeoff direction into wind even though that is against the current.

09 PERFORMANCE CONSIDERATIONS

For a standard takeoff in light winds at sea level and ISA conditions and with the aircraft at 11999 kg AUW (26485 lbs) PBY requires 1200m (4000ft) for takeoff. This basic value will be affected by:

<u>Density Altitude</u>
which will increase the takeoff distance as DA increases. Propeller efficiency decreases, wing efficiency decreases, T AS is higher for the same IAS, even though engine power loss is compensated for by supercharging. Allow 12% longer Takeoff run for each 1000 ft increase in DA. Allow 12% longer for each 8 deg C above standard for the pressure altitude.
<u>Weight reduction</u>
below MAUW will improve takeoff performance and shorten the takeoff run.
Allow 10% less for takeoff run for each 5% reduction in AUW.
<u>Wind strength</u>
affects takeoff run as it does on land. A down wind takeoff is undesirable due to the longer period of time in contact with the water and the greater speed through the water for a given IAS. Thus forces on the aircraft are much more severe downwind while elevator control is poorer. Allow 10% reduction in Takeoff run for each 10 knots headwind component.

Water surface
conditions can affect takeoff run and especially important is the difficulty unsticking the aircraft off glassy water. Hull resistance is reduced by cavitations of wavelets on the rear of the hull.
Humidity
affects takeoff run by its effect on density. Humid air is less dense so in high humidity conditions as are often found round large bodies of water, take-off performance may suffer.
Centre of Gravity
position has a variable effect. A rearward CofG makes it harder to get the aircraft up onto the step but once on the step a rearward CofG makes getting off the water easier and shortens the takeoff run.

10 TAKEOFF TECHNIQUE (NORMAL CONDITIONS)

Preparation for a water takeoff is complicated by the fact that the aircraft will be moving. A good lookout must be kept while at the same time completing the takeoff checklist. It is sometime best to leave asymmetric power set (say 800RPM on one and 1100RPM on the other so that the aircraft turns in a gentle circle during the pre-takeoff checks. The risk of hitting shoals, reefs, boats or other obstructions is reduced if the direction of movement is planned and controlled by the pilots.
Once pre-takeoff checks are complete, the aircraft should be taxied into win< until clear of its own swells. The line-up checklist is then completed.
With the control column hard back, power is smoothly and quickly increased the takeoff setting of 48 ins Manifold Pressure.
As the aircraft moves forwards and climbs the water "hump", visibility forward will be temporarily lost due to spray and water over the windscreen. Gyro heading reference should be noted before this and the heading maintained. Wings should be kept level by aileron input as soon as this is effective. The nose will rear up until the aircraft "climbs" up onto the step. Once there the control back pressure is relaxed until the aircraft is hydroplaning in a slightly nose up attitude.
By adjusting the nose attitude slightly the best acceleration can be felt. With the nose too high flying speed will not build up and with the nose too low porpoising will occur. Because of the risk to the nose wheel doors porpoising must be countered immediately (see above).

Once established on the step there will be good rudder and aileron control to keep the wings level and the track straight. If yaw develops the wings are probably not level so check the horizon, float position and AH (Artificial Horizon) and correct as necessary.

Speed will build up rapidly at the correct trim angle and at 55-60 knots PBY will come off the water. At high weights, a higher speed may be necessary before this will occur. Gentle elevator back pressure usually ensures a smooth breaking free of the water. At the weights PBY is flown it is safe to assume that at 55 knots she can be pulled off the water (for example to clear a log or obstacle). She may not stay airborne without a bounce or two but the obstacle can be cleared.

As the aircraft comes off the water there is a tendency for the nose to pitch up fractionally due to the loss of drag from the hull. The pilots should concentrate
on nose attitude and fly level in ground effect until a speed of 95 kts, then change to Climb attitude and maintain 95 kts.

With 95 knots IAS the nose may be re-trimmed and power reduced to CLB power settings.

We taxi on the step with the floats up but there are risks in raising the floats before the aircraft is safely airborne. Although raising the floats does reduce drag and marginally improve acceleration, digging in a half raised float will be more damaging to the float support structure and will increase the likelihood of a waterloop or cartwheel.

Once at climb speed and Climb power complete the after takeoff checklist.

11 TAKEOFF TECHNIQUE (GLASSY WATER)

In glassy water it is sometimes difficult to get the aircraft established on the step The aircraft instead plows through the water and a considerable distance may be required before hydroplaning is achieved. Some seaplane pilots rock the controls vigorously fore and aft inducing a porpoising motion until the aircraft gets over the hump and onto the step. There is no evidence that this aids the takeoff in Catalina flying boats. Once on the step, nose attitude must be that best acceleration and this should be held until the aircraft lifts off. Once in the air refrain from flying level in ground effect, just proceed in a climb attitude and accelerate toward 95 kts. Only in this situation the engine failure after Take off is considered less demanding then flying in ground effect over glassy water.
The takeoff path should be aligned to keep a shoreline or series of reference points in the pilots view at all times. This is particularly important if the takeoff has to be abandoned after leaving the water since otherwise the pilot has no idea where the surface is.
Depth perception on and after leaving the water surface is unreliable. It is critical that the correct takeoff attitude be maintained until well after the aircraft leaves the water. Note the attitude at takeoff, hold it with reference to the horizon an do not change the attitude until high enough for depth perception to return, This is one take off where acceleration to 95 knots is less important than attitude stability.
If the takeoff must be aborted after leaving the water, achieve and maintain the correct landing attitude until the aircraft touches. Remember, glassy water is harder than it looks. Rough water is waves with air spaces between and the air at least is compressible. Glassy water looks smooth but is very solid and can tear the nose doors off easily if attitude is neglected.

12 TAKEOFF TECHNIQUE (CHOPPY WATER)

Where there are no large waves or swells but the wind is 10-15 knots there will be small whitecaps and wave height of 1-2 feet. This is probably the roughest conditions that we will operate in.
Takeoff in these conditions is similar to that discussed for light conditions but there will be more spray during the early part of the takeoff run and holding the correct attitude for best acceleration is difficult because of the waves.

Continuous small adjustments to the elevator input are required to maintain a constant attitude, allowing the aircraft to accelerate to flying speed. Do not allow the aircraft to be thrown into the air by the waves. Keep the correct attitude and let speed build, then ease back on the controls at 55-60 knots and deliberately take the aircraft off the water and continue with a normal Take-off technique.

13 TAKEOFF TECHNIQUE (ROUGH WATER)

There is no set point of transition from choppy to rough conditions. Rough water usually implies strong winds which mean the aircraft will lift off at a lower ground speed, shortening the time she is in contact with the waves. Countering that is the difficulty the pilot will have maintaining correct attitude as the nose pitches up and down with the waves. While PBY is unlikely to be operating in rough conditions knowledge of the technique may be helpful in marginal conditions.

Full elevator back pressure is only required at the very start of the run. Some pilots believe the power should be applied when the nose is at its lowest so that by the time power is increasing the nose will be high. It is often necessary to force the nose down to the proper position to hydroplane on the step. The elevator control pressure will have to be constantly adjusted, sometimes vigorously and rapidly to stop the nose dropping and rising with each wave. Failure to check the nose pitching could dig the nose in with disastrous results or bounce the aircraft out of the water prematurely.

If the aircraft leaves the water before flying speed is attained, the pilot has two choices:
1) Abort the takeoff and stall the aircraft onto the water .or...
2) Attempt to gain speed between bounces and eventually take off.

WARNING: Never force the aircraft back onto the water after a bounce. Check back slightly on the controls to lessen the rate of descent, reducing the impact force for each bounce. Do not let the nose drop below takeoff attitude.

If the correct attitude can be maintained until 55 knots IAS is reached the aircraft should take off easily. A bounce into the air at this speed should be followed by elevator back pressure to keep the aircraft from going back onto the water. Unless overloaded the aircraft is likely to stay airborne with this action.

14 TAKEOFF TECHNIQUE (SWELLS)

Swells really only occur at sea or in very large bodies of water. Takeoff in light swell conditions can be handled as for a rough water takeoff. The slight nose up attitude required for takeoff can be held only with frequent and sometimes vigorous control manipulations. The aircraft can accelerate but feels to the crew that it is going up and down over a series of hills.
Larger swells are very dangerous and a takeoff should never be attempted into a large swell system. If absolutely necessary, takeoff parallel to the swells even in cross wind conditions. Open sea takeoff exposes the hull to tremendous forces, especially if the aircraft is thrown into the air before flying speed is reached since bouncing will result.

15 CROSSWIND TAKEOFF

Where the body of water being used is restricted in size (e.g. on rivers) it may be necessary to take off with a cross wind component. In light conditions, taxi and line up the aircraft and perform a normal takeoff with particular care to keep the wings level. With a strong crosswind it may be necessary to stay into wind until power is brought up to give adequate airflow over the rudder for direction to be maintained. Keep some into wind aileron in to maintain wings level and be ready for the yaw that will occur on lift off.
The most critical time in a crosswind takeoff is just after lift-off. Should an engine fail at this stage there will be substantial sideways drift as the aircraft goes back onto the water. This will be suddenly taken out as she touches the water which can be uncomfortable for the crew and passengers and may damage the aircraft structure. A turn into wind soon after takeoff aids obstacle clearance and should be considered when above Vmca.
***Warning**: Avoid a retouch in a cross wind take-off*

16 CLIMB PERFORMANCE

As the floats are selected up by the PNF the climb out will be similar to a land take off On float retraction, if one float does not retract the yaw is considerable, probably worse than following engine failure. Options available to counter this include putting both floats back down then hand cranking the floats up or, reducing power on the engine opposite to the stuck float. Keep airspeed 95 knots.

17 LANDING

Choice of Landing Area
The landing phase is probably the most critical in water flying. In PBY, all water landings are optional. There is virtually always an alternative available at an airfield. If pilots feel unhappy about the conditions they should not complete the water landing.

The landing area should be carefully and completely assessed The following list covers most issues. Do not forget that the best way to assess taxi routes from the landing area to the beach, ramp, dock or mooring is also from the air.

Consider:

Wind	Direction, strength, Local variations, protected areas
Current	Direction and strength.
Area	Size of available landing area and alternates available. Note major surface and underwater obstructions
Conditions:	Wave height is difficult to pick. Check boat movements (Double your guess from 500 ft will be roughly correct) Note sun position, haze, dust etc
Touchdown	Choose touchdown point and landing direction
Approach	Plan circuit for safe under or overshoot and go-around
Technique	e.g. Power on, glide, glassy water etc
Taxi Path	Minimum turns from completion of landing run to shore Note obstructions on the taxi route inbound and out.
Mooring	Safe and suitable.
Take Off	Note taxi path and take off distance required

A preliminary inspection should be undertaken at 1000 ft AWL and a circuit planned for inspection of the area from all directions. An approach is then flown with a "dummy" run along the landing area at 500 ft AWL. If unsure of the conditions or safety of the area repeat the dummy run several times.

Estimating distance available is not easy but during the inspection flight the following figures can be used but this is really dependent on ground speed:

At 90 knots ground speed:

25 sec	1150 m (3800ft)
30 sec	1400 m (4500ft)
35 sec	1600 m (5300ft)
40 sec	1850 m (6100ft)

18 LANDING TECHNIQUE (INTRODUCTION)

There is a particular angle of attack that for each seaplane produces the gentlest transition from air to water. In Catalina's that occurs at an airspeed of 72 knots. At that speed the rear part of the hull near the step is the only that contacts the water. Deceleration forces are behind the centre of gravity the situation is stable (like a tricycle undercarriage)
If speed is >80 knots the angle of attack is too low (flat attitude) and will cause the front of the hull to contact the water. If the hull forward of the centre of gravity contacts first, the deceleration forces are ahead of the CofG, an unstable configuration (like a tail dragger). Turning forces may then be difficult to handle, resulting in a spectacular water loop. The flat attitude also puts water impact forces on the nose wheel doors and these may collapse or tear off with disastrous results.
If speed is <65 -70 knots the excessive nose up attitude will cause a skip or bounce in most water conditions. This is not dangerous if the correct technique is followed and the all important attitude is re-established. Do not lower the nose below the normal water landing attitude. While not as dangerous as a fast approach it can be uncomfortable for all on board.
Concentrate on aircraft nose attitude at all times. If landing in choppy conditions be-aware that the nose will pitch up with the waves. Be ready to counter this with elevator as required. Keep the attitude constant (nose up) throughout the time on the step and move the controls steadily back as the aircraft slows. Controls should be hard back as the aircraft come down off the step and must stay that way until the aircraft stops, (see below)

19 LANDING TECHNIQUE (POWER ASSISTED)

This is the Standard seaplane approach and landing technique for good conditions.
After completion of the approach checklist, manoeuvre to downwind with a minimum speed of 95 kts. 20 seconds after passing abeam touch down point reduce power to 15 ins and make speed 95 kts. Turn final and plan to be established on final at 300 ft AWL. While turning final make a last check to confirm aircraft configuration "landing gear UP" Final speed 85 kts. And power set at 12 ins. At flare altitude, flare and aim for touch with a speed of 72 kts.

After the touch, slowly close the throttles and the aircraft will slow once on the water and once below 50 knots it can not leave the water. As the aircraft slows the control column needs to be eased steadily back and should be fully back as she comes down off the step. Keeping the nose up protects the nose gear doors, and keeps the deceleration forces behind the CofG, maximising control and minimising the risk of a water loop. This is particularly important at the end of the landing run as the aircraft comes down off the step. More water loops occur at this time than in the early part of the landing run.

The controls should be kept fully back until the aircraft comes to a complete stop.
After touch down at 72 knots the lower speeds at the end of the landing run feel very slow, especially if conditions are choppy or rough and a bounce or two have occurred early on. It is easy to relax as the speed decays and allow the controls to move forward thinking that the aircraft is well off the step when in fact it is not or is only just, and still has significant forward speed. This is a very risky time for water looping. Maintain concentration and keep the controls hard back.

20 LANDING TECHNIQUE (GLIDE APPROACH)

This approach technique is seldom necessary. It is dangerous for a landing in rough water and can be fatal if tried onto glassy water. Its only application is when landing on small areas of water with approach over hills or high trees.

Due to the Catalina's "mushy" low speed handling characteristics a glide approach should be conducted faster than usual with 95 knots being best at the weights PBY is operated at. The faster speed makes for a flatter final approach and a longer period of float. A gentle round out is started at 20 ft AWL with speed bleeding off to be below 72 knots by touchdown. On no account let the aircraft touch at a speed >75 knots, the attitude will be too nose low.

21 LANDING TECHNIQUE (MODIFIED GLIDE APPROACH)

To combine the advantages of the steeper glide approach of the with the control and safety of the power assisted technique the approach can be made at a 90 knot glide and power reintroduced at about 12 ins Manifold Pressure at 15-20 ft A WL. Proceed then as for a power assisted landing. The modification is more useful than the pure glide technique.

22 LANDING TECHNIQUE (GLASSY WATER)

The surface of glassy water can not be seen as it is approached. Some people think they can perceive it but they can not. Glassy water is the most dangerous conditions for a flying boat landing. Power assisted techniques can be use the approach can be flown over or next to a point of land or obstacle that provides visual reference for depth perception. Even that is risky. It is safer to use the proper glassy water technique. Glassy water dangers apply not only on mirror like water in nil wind conditions. Brown river and lake water is often difficult to judge if conditions are hazy or overcast and even rippled water is hard to judge if the landing must be conducted in rain. When in any doubt about the conditions, use the glassy water technique. The recommended technique effect an instrument approach. External reference to the horizon may be used for attitude but speed and rate of descent are controlled by monitoring the instruments.
The initial approach is a glide at 90 knots with the throttle closed early on finals and speed reduced to 72 knots. As the speed passes though 80 knots bring power at 16-17 ins Manifold Pressure and the speed should stabilise at 72 with a descent rate of 150-200 fpm. Do not let the airspeed go above 75 kts, 72 knots guarantees the nose will be high enough to protect the nose gear doors.
Power can be adjusted to set the correct rate of descent if necessary. The pilot can look to the horizon for attitude information but must not look at the water the nose attitude should be correct or close to it and only small adjustments are necessary. Occasionally, if slightly too much power has been used the aircraft can refuse to touch down and continues along in water effect. A slight reduction in power will usually give a good landing in this case. Never close the throttles and round out, you may still be 20 ft AWL and stall the aircraft in. On touchdown the nose tends to "dig" in so there needs to be a very gentle pressure on the controls just as the aircraft touches and as power is changed thereafter.
Higher descent rates, even up to 500 fpm can be coped with by the airframe but there will be complaints from crew and passengers!
If a bounce occurs, hold the aircraft off and keep a nose up attitude until the aircraft touches again then reduce power, or, close the throttles and hold off until the aircraft stalls

onto the water (controls fully back), or, apply power an go around. Do not lower the nose until well above the water surface (>100 ft).
The glassy water approach uses a longer run over the water before touchdown but is still the only way to safely cope with poor depth perception. At any time any approach, if the pilot feels glassy type conditions do or may exist, the approach must be a glassy water approach. Even late on finals, if the water suddenly seems "glassy", go around and set up a glassy water approach.

23 LANDING TECHNIQUE (CROSSWIND)

The sideways forces on the hull when landing crosswind can only be partly reduced because the wing tip floats mean no effective bank angle can be applied. As stated in Part 2 there is a need to allow for more drift than you believe to be present due to the movement of the wavelets. Keep the crab approach until just above the water then yaw to put the nose in line with the aircraft's track with wings level. It is better to have the hull strike the water with sideways component of force than to dig in a wing tip float. A landing could be made with floats up and the floats be lowered as soon as the aircraft is on the step with wings level. However, it is best to avoid crosswind landings if possible

24 LANDING TECHNIQUE (SWELLS AND ROUGH WATER)

Waves in excess of 3 ft have traditionally been regarded as rough water and are more often than not associated with swells. Either a power assisted approach a semi-stalled landing may be used. A maximum wave height off 2 ft for water operations is the limit, so the techniques for rough water are not likely to be used.
The power assisted technique is the best as earlier described, but the throttles should be closed as soon as the aircraft touches the water. A series of jolts will then rock the aircraft with each successive wave. The pilot needs a sense of rhythm to work the controls to keep the attitude correct by checking forward as each wave is hit and checking back between the waves. As speed drops below 50 knots the controls are steadily brought to the fully back position. If a bounce occurs, hold off with the controls well back and power off, the flying speed will decay and the aircraft settle onto the water. Timing the pull back on the controls is a matter of experience but it is safer to pull back and produce a bounce than to have the nose too low.

Stall and semi-stalled landings for rough and swell conditions describe techniques for delivering the aircraft onto the water in a controlled fashion with minimal forward speed. The Catalina stays nose up during the stall and just descends so the landing is in a safe attitude. Semi-stalled describes a stall occurring just as the aircraft touches the water. The throttles are closed and the aircraft held off from about 15 ft AWL reaching the stall at touchdown. Stalling earlier results in the aircraft dropping into the water and it will stay there. Failing to reach the stall in time will result in a bounce, in which case hold off with controls back and a stall will occur. The controls must be firmly held back and gripped tightly to avoid them being pulled forward as the aircraft hits the water.

In emergency landings in very rough conditions the stall can be entered at 25 ft AWL which results in a high rate of descent but very low forward speed.

In swells, the landing should be along the primary swell, down the secondary swell and as into wind as possible. The wind is the minor consideration unless blowing 20 knots or more. A stall type landing should be initiated at 15-20 ft AWL with the wing kept parallel to the water over which the aircraft is flying not necessarily parallel to the horizon. Avoid touching down on the up side of an oncoming swell, the radical pitch changes are hard to control and the forces on the airframe are great.

The sideways lurch associated with crosswind landing is hardly noticed in rough water perhaps because the landing is so rough anyway and perhaps because of the eddies of wind behind the swells reducing the drift.

A.5 DOCKING, RAMPING, BEACHING, MOORING, ANCHORING.

01 DOCKING

Docking should always be conducted into wind. It is a time where troubles occur quickly. So anchor and lines must be ready for use and a boat hook or pole available for fending. Side on docking is favoured by seaplane operators but there are few floating docks that allow for aircraft with a span like a Catalina!

Head on docking tends to be used by smaller flying boats with wing tip floats but this is a tricky manoeuvre. Power must be cut at just the right moment for the aircraft to arrive at the dock with almost nil forward speed.

If there is any wind at all the upwind float must be secured immediately to avoid the aircraft slewing around into wind which risks damage to itself, the dock and other aircraft or boats. For such docking to work for a Catalina a crew member needs to be atop the wing as soon as the engines are stopped with a line prepared for the upwind wing tip and there must be assistance on the dock.
The effect of wind and current must be assessed well out from the dock and adjustments to power and heading made accordingly. In strong wind conditions where an into wind approach is not possible it may be necessary to cut power and sail the aircraft to the dock.

02 RAMPING

These are wooden ramps specifically for bringing seaplanes ashore. In general ramps are approached head on although angled approaches may be necessary until the last minute due to wind conditions. Power is increased as the ramp is reached this give a more nose up attitude, increases speed slightly and the bow wave produced wets the ramp. Floatplanes are usually driven onto the ramp sufficiently strongly to "stick" them and prevent weathercocking. Flying boats are rarely ramped and there would need to be enough room for PBY to weathercock before ramping could be performed safely.

03 BEACHING

Approach to a beach must be conducted even more carefully than that to a dock or ramp. The beach is not prepared for seaplane operation so a good look out is necessary for obstacles in the water.
It is best to taxi in on a 30-45 degree angle to the beach, as into wind as possible and with the wheels down to protect the hull. Always lower the landing gear in sufficient water depth to enable them to fully extend before the wheels bottom. To do otherwise may damage the hydraulic system.
As the first wheel touches, increase power to bring the aircraft onto it's wheel and turn further into wind along the line of the beach. Keep and eye on the over beach wing tip. Continue until the nose wheel is turned away from the beach in preparation for departure. Do not attempt to climb up a beach nose first; the nose wheel is most likely to dig into the sand.
Bow on beaching can be considered in offshore wind conditions but remember getting the aircraft turned around for departure will be difficult.

In onshore conditions where downwind taxiing will be difficult and fast it is best to turn into the wind and sail backwards until the main wheels touch the beach. Pure floatplanes and flying boats often beach with the heels of the floats or hull on the beach secured by hull and wingtip lines. This makes departure straight forward.

04 MOORING TO A BUOY

Approaching a buoy requires very accurate taxiing and can really only be achieved from downwind, taxiing directly upwind to the buoy. When power is cut the aircraft will turn into wind about its C.of.B not about the nose so only by being correctly oriented into wind will the bow stay at the buoy while a line is secured.

The crew member at the bow station needs to capture the buoy and either take the line attached to it or thread a line through the loop and payout line if the aircraft is drifting. The aircraft can then be brought up to the buoy and formally secured.

05 ANCHORING

Usually, anchoring is considered a temporary situation and mooring or docking is considered more reliable. In choppy or rough conditions approaching a dock, buoy or beach may be considered unsafe and anchoring becomes the only way to secure the aircraft.

The anchor should be dropped (not thrown) from the bow station and line paid out that is about 6-8 times the water depth. This keeps the anchor line at a shallow enough angle to allow it to dig in. The length of chain usually fitted to anchors increases this security of angle. The free end of the line should always be secured to the aircraft to prevent loss of the anchor.

Originally the anchor line was fastened via a pendant clamp and steel cable to the keel of the aircraft but this arrangement is no longer fitted. The bow cleat is not strong enough to take the load of the anchored aircraft in rough conditions so PBY must be considered unsafe to leave at anchor. Further anchors can be used from the port blister or tied to float fittings.

The crew must be sure the anchor is not dragging before leaving the flight station and there should always be someone on board who can start the engines and taxi the aircraft if the anchor drags later.

06 INTERACTIONS WITH BOATS

Moving boats should not be approached. Seaplane operations often attract a boating audience. It is safest to assume that the boatie knows nothing about seaplane operations and the Catalina crew should anticipate foolish and close approaches by boats. Small boats have been known to approach under Catalina wings while the engines are still running. The Catalina crew must be prepared to cut engines at any time.

If there is a need to operate with small boats it is generally best to have the boat approach the aircraft but most boaties are clumsy in their docking abilities with flying boat size vessels and may easily cause damage to tail plane, hull, wing struts etc. Have the boat stop well away from the aircraft and give clear concise instructions to the boat operator. A slow steady approach on a convergent angle to the blister area is probably best.

If a large boat is involved it is best to approach the stationary boat head on and into wind. If mooring to a boat this needs to be by a line long enough to eliminate the risk of the wing being damaged by striking the boat as the aircraft swings on its line.

07 MAN OVERBOARD

This is most likely to occur during the anchoring, mooring etc or whilst working with boats. If taxiing into wind when a crew member is lost overboard it is best to stop engines and sail back until a life line can be thrown to the person.

If that is not possible, throw over a life jacket (inflated) or life belt as a marker then move on , turn the aircraft and track back to the marker so as to approach the marker in an into wind direction.

Some pilots have found lost crew by taking off away from where the person was lost, searching from the air then landing so as to approach the person into the wind after landing.

✈ INTENTIONALLY LEFT BLANK ✈