5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.5. cont.

EVACUATION PROCEDURE:

Flight Engineer -

1. Turn off all fuel tank cocks
2. Inspect aircraft and bilges for damage and sea-worthiness and report to Captain.
3. Start APU if electrical equipment required
4. If fire, take portable CO2 to seat of fire
5. Take verey pistol and cartridges, proceed to No. 1 dinghy and commence launching procedure.
6. Assist in evacuation of passengers
7. Collect torches
8. Board No. 1 dinghy and inflate life jacket.

5.4.6. CABIN ATTENDANT'S DUTIES

First warning of an emergency will be ringing on the alarm bell or P/A call from the Captain

Steward to report immediately to the flight compartment.

Captain will advise -

1. Nature of the emergency
2. Approximate flight time available
3. Exits to be used
4. Cargo to be jettisoned (if required)
5. Positioning of dinghies

Proceed to Cabin

Brief the passengers, public address system if necessary covering -

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.6. cont.

(a) Nature of the emergency
(b) Expected time of the landing
(c) The final signal from the flight deck.

For Emergency Landing only (on land)

(a) Positions and method of using exits
(b) Remove high heeled shoes
(c) To fasten seat belt firmly, but not around a child being nursed
(d) To remain seated until aircraft completely at rest
(e) To move well away from the aircraft as soon as possible

For Forced Landing/Ditching only:

(a) Passengers to remove glasses, dentures, pens, pencils and hard objects from pockets, rings and jewellery, loosen tight clothing and retain hats.
(b) Remove and stow high heels, loosen show laces
(c) Remove stockings (forced landing only)
(d) Method of fitting life jackets - DO NOT INFLATE
(e) Pillows and rugs - use to cushion impact
(f) Ditching position :
    (i) Seat in upright position
    (ii) Sit well back in seat
    (iii) Seat belt fastened firmly below abdomen
    (iv) Legs straight down, feet placed firmly on floor
    (v) Body bent forward
    (vi) Arms cradled on knees
    (vii) Head resting on arms

Warn passengers they must assume this position when the final warning is given, and must remain positioned until the aircraft is finally at rest.

(g) To fasten the seat belt firmly but not around a child being nursed
(h) Evacuation method - brief on use of upper deck exits.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.6. cont.

FOR ALL EMERGENCIES -

(a) Reseat passengers near exits to be used (keeping families together)
(b) Select and brief passengers to assist in the evacuation
(c) Instruct selected passengers to pass on "BRACE" signals to passengers adjacent to Emergency Exits (Warn those passengers of high noise level)
(d) Check all buffet equipment for security
(e) Remove loose equipment and articles in the cabin and stow in the toilet.
(f) Prepare first aid kits, food, liquid, rugs etc. for rapid evacuation.
(g) Don own life jacket
(h) Procure torch from holder for evacuation
(i) Immediately on receipt of final call occupy ditching position and fasten seat belt.

EVACUATION PROCEDURE

Cabin Attendants:

1. Emergency exits to be opened only when instructed

2. Report any damage to Captain and assist injured passengers

3. On instructions evacuate passengers through emergency exits using ropes for upper deck exits.

4. On instructions proceed to dinghies, commence launching procedure and direct passengers to respective dinghies.

5. Ensure all available food and water is placed on board.

6. On Captain's instructions take positions separately in dinghies in order to afford the greatest assistance to the largest number of passengers.

7. Inflate life jackets

NOTE: AVOID PANIC
WEAR UNIFORM CAPS

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.7. PREPARATION OF AIRCRAFT

(a) Normal Landing

The preparation of the aircraft for all landings and take-offs should be such as to afford maximum safety in the event of an emergency landing.

All loose equipment (cabin baggage) should be stowed on the floor between seats or in freight lockers to avoid any forward or aft movement.

Galley equipment should be correctly stowed and locked in position.

All crew members must be seated in allocated seats with safety straps correctly secured.

(b) Emergency Landing (on land)

In the event of an emergency landing the aircraft should be prepared as follows :-

All loose equipment should be stowed in toilets.

Galley equipment should be correctly stowed and locked in position.

All galley heating appliances should be switched off.

Escape ropes should be prepared for use by opening covers on each side.

Passengers must be warned and instructed when to brace for landing. Seat belts are to be fitted as tightly as possible. Women with babies or pregnant women should be seated in the aft facing seats, and instructed to brace in the fully upright position,

The Captain or first officer should instruct passengers over P/A system: e.g.

"It will be necessary to carry out an emergency evacuation of the aircraft after landing. This can be done successfully but you must remember :-

5.4. **EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES** (CONT'D)

5.4.7. cont.

1. Ensure that your seat belt is secure and remain in your seat until the aircraft stops.
2. Follow your crew member's instructions implicitly.
3. Do not open emergency exits unless your crew member instructs you to do so.
4. Evacuate through doors or exits as directed by your crew member and DO NOT OVERCROWD DOORS.
5. After evacuation, move well away from the aircraft.
6. Your crew member will now instruct and prepare you for evacuation.

(c) Crew Emergency Stations -

In the event of an unforseen emergency landing, crew stations will be normal take-off and landing positions.

Whenever possible, the captain should nominate at least one crew member to be positioned near the aft hatch. This may necessite the removal of a passenger from that position to another seat in the cabin. It must be remembered that under normal seating configurations, maximum passenger loading and evacuation will be in the aft section of the aircraft where the least number of crew members are normally positioned.

(d) Evacuation

When an unforseen emergency landing has occurred, it is necessary to advise passengers to evacuate the aircraft and if the public address system is not available this must be done from the cabin.

The First Officer should evacuate the aircraft immediately with a CO2 extinguisher and standby for possible fire. Other crew members should remain in the cabin and supervise the evacuation of passengers through the nominated doors or exits.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.7. cont.

Use of Upper Deck Exits

The opening of Upper Deck exits when fire is present in that area could permit the fire to enter the cabin. Evidence of fire in this area may not always readily be seen and it is therefore recommended that should any part of the engines or wings be on the ground the upper deck exits should NOT be used.

5.4.8. DITCHING

1. General

The end result of ditching an aircraft is influenced by many factors such as - sea conditions, weather, degrees of darkness, reasons for ditching etc.

All of these will influence the smoothness of landing and the aircraft structural damage incurred during ditching.

The success or otherwise is dependent to a very large degree on the operating crew's familiarity with recommended procedures and accordingly are outlined hereunder to provide as much information as considered necessary to guide personnel involved in such an emergency.

2. Flying and Touchdown Technique

The principal objectives of the flying technique when ditching are to touch the water at minimum forward and sinking speeds and in the most favourable attitude to avoid excessive declerations and damage to the aircraft.

To achieve this, the aircraft should be ditched using fully extended flaps and normal approach speeds until quite close to the water, whereupon speed should be reduced to the minimum possible without encountering the stall or losing directional control in unsymmetrical power situations.

Accordingly, the following ditching procedures are recommended to attain a maximum of passenger safety and a minimum of aircraft damage :-

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

(a) Consume as much fuel as possible retaining sufficient for sea evaluation and to retain manoeuvring power to the point of touchdown.

(b) Carry out sea evaluation for ditching heading.

(c) Land aircraft, flaps full down, and maintain normal landing approach speed until very close to the water. Hold the aircraft off while decreasing the speed as much as possible. Enter the water with both minimum forward speed and maximum sinking speed.

3. Sea Conditions

To judge sea condition from the air, the pilot must have a knowledge of what forces combine to create the disturbance on the surface. The "sea" is the condition of the surface that is the result of waves and swells. Wave (or chop) is the condition of the surface caused by local winds. It is characterised by its irregularity, short distance between crests, whitecaps, and breaking motion. Swell is the condition of the surface which has been caused by a distance disturbance. The individual swell appears to be regular and smooth, with considerable distance between the rounded crests. The waves move in the same direction as the local wind and waves do not exist for long unless the wind is blowing. The swells are almost never absent in the open sea, whether the wind is blowing or not and there is no relationship between the direction of a swell and the local wind direction. When the waves leave the area in which they were generated their energy is slowly dissipated and at the same time their wave length, period and velocity gradually increase. For both of these reasons, the height decreases. The shorter waves have less energy, and, therefore, dissapear relatively quickly. The longer waves become more regular; their crests lengthen out so that in a swell coming from a great distance a single crest may extend hundreds of yards. An ocean surface with only one system of swells is very rare.

- 5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

The usual ocean surface consists of a predominant swell three or four feet high and 500 to 1,000 feet from crest to crest. On top of this ground swell appear usually one or more shorter swell systems coming from 5 degrees to 60 degrees apart. The periods of these systems are different. On top of this slowly heaving surface is a lively chop driven by the existing wind and with heights proportional to the wind strength. An aircraft should be flown at 2,000 feet or higher to observe the major swell systems and just above the water to observe the wave action and minor swell systems. The secondary swell system is often from the same direction as the wind. Periodically the swell and sea wave systems are in opposite phase and the crests of one tend to fill the troughs of the other with a resultant smoother surface. Occasionally relatively smooth areas exist, which persist longer than those explainable by the temporary coincidence of waves in opposite phase. These areas should be sought for the touchdown point. The opposite conditions will develop when the swell systems meet "in phase". The height of the swell will approximately be equal to the sum of the heights of the two systems. These areas should be avoided. Never land into the face of a primary swell system (or within 35 to 45 degrees of it) unless the winds are extremely high.

The length and velocity of swells can be determined by timing successive swell crests to determine the swell period and using the formulae:

1. The square of the period in seconds multiplied by five equals the length of the swell in feet.

2. The period in seconds multiplied by three equals the velocity of the swell in knots.

The simplest method of estimating the wind direction and velocity is to examine the wind streaks on the water. Whitecaps fall forward with the wind but are overtaken by the waves to produce the illusion that the foam is sliding backward. The wind direction is easily determined by observing the direction of the streaks. The wind velocity can be accurately estimated by noting the appearance of the whitecaps.foam and wind streaks. The following Beaufort scale is useful in estimating the wind :-

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

Beaufort Number	Velocity Knots	Sea Indications	Height of waves, feet
0	Calm	Like a mirror	0
1	1-3	Ripples with the appearance of scales	1/2
2	4-6	Small wavelets; crests have glossy appearance and do not break.	1
3	7-10	Large wavelets; crests begin to break. Foam of glossy appearance; few very scattered whitecaps.	2
4	11-16	Small waves, becoming longer, fairly frequent whitecaps.	5
5	17-21	Moderate waves making a pronounced long foam; many whitecaps.	10
6	22-27	Large waves begin to foam; white foam crests are more extensive; some spray.	15
7	28-33	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of waves.	20
8	34-40	Moderately high waves of greater length; edges of crests break into spindrift; foam blown in well marked streaks in direction of the wind.	25
9	41-47	High waves. Dense streaks of foam; sea begins to roll; spray affects visibility.	30
10	48-55	Very high waves with overhanging crests; foam in great patches blown in dense white streaks. Whole surface of sea takes on a white appearance. Visibility is affected.	35

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

4. Selecting the Ditch Heading

The objective is to select a landing direction that will result in the minimum relative speed between the aircraft and the swell system. The best heading for ditching is usually parallel to the major swell system. There is a choice of two headings paralleling the primary system. One heading is downwind and down the secondary swell; the other heading is into the wind and into the secondary swell. The choice of heading will depend on the velocity of the wind versus the velocity and the height of the secondary swell.

The next best heading for ditching is parallel to the minor swell system and down the major swell system.

The choice of these will be determined by the heading that gives the greatest component of wind on the nose of the aircraft.

A descent is then made to 200 feet and the aircraft flown on successive headings each decreased by 45 degrees until the full 360 degrees has been evaluated. The heading on which the sea appears the smoothest should be noted and checked against the directions of the main swell system as observed at 2,000 feet. The final heading should parallel the main system with minor adjustments to accommodate the secondary systems and the same time taking advantage, where possible, of the wind. The ditching configuration is flaps full down and the final approach at normal speed. Assuming manoeuvring power available, the pilot will look ahead for extra rough areas and try to avoid them. He will look for a relatively smooth area and establish a rate of descent of 200-300 feet per minute. The aircraft should be levelled off 8-10 feet above the crest of the swell and with the period of the swell determined in the prior evaluation of the sea the next approaching crest can be anticipated. The throttles should be closed, the aircraft rotated slightly nose up and contact with the water made with minimum forward speed and at the minimum sink speed.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

Sea Evaluation

The pilot must know the sea and wind conditions to select a suitable ditching heading. If an emergency occurs shortly after darkness he may have an estimate of the best ditching heading from observations made during the daylight. It is for this reason that pilots when flying into the dusk must note the sea conditions and determine a ditching heading prior to darkness.

Many ships at sea, including ocean station vessels send frequent weather reports, including sea conditions. This information may sometimes be obtained through the air ground station, which obtains it from the Rescue Co-ordination Centre. It should be realised however, that a forecast based on scattered ship reports, and under changing weather conditions, is subject to error.

5. Ditching Under Night and Instrument Conditions

1. All bright internal lights should be switched off to accustom the eyes to the external darkness. Red lights may be used for flight deck reference.

2. Set up a power-attitude combination for a rate of descent of 200 feet per minute and maintain normal speed until touchdown.

3. Extend landing lights for 4 seconds to position beam at 45°. Switch landing lights ON. Care must be taken when landing lights are used as reflections from a smooth surface make it difficult to determine aircraft height above water. When heavy spray from wind is present there is a possibility of glare and in this event the port light should be switched OFF and the pilot in right hand seat should advise his estimate of heights when the surface is visible.

4. This approach should be maintained until the aircraft makes contact with the water, or until visual contact is established for ditching.

NOTE: The pressure altimeter may be several hundred feet in error.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

6. Preparation For Ditching

All crew members and passengers must put on life jackets. Jackets are to be inflated by pulling the tag after leaving the aircraft.

(a) Captain's Duties

If fuel exhaustion is the reason for ditching, the pilot will utilise the remaining fuel to make the sea evaluation. The actual ditching time must be established so that there will be sufficient fuel to retain manoeuvring power to point of touchdown.

The captain will instruct the crew to prepare for ditching and nominate a time. He will establish a course for the nearest picket ship, other surface vessel or sea lane and endeavour to make radio contact. As soon as possible, the captain should make the following announcement to passengers over the P/A:-

"LADIES & GENTLEMEN,

THIS IS YOUR CAPTAIN SPEAKING, I WISH TO INFORM YOU THAT A STATE OF EMERGENCY EXISTS AND THAT IT WILL BE NECESSARY TO ALIGHT ON THE SEA. THIS CAN BE DONE QUITE SAFELY.

CREW MEMBERS WILL INSTRUCT YOU ON THE PROCEDURES TO BE FOLLOWED AND DIRECT YOU IN DUE ORDER TO THE EXITS AND LIFE RAFTS.

WOULD YOU PLEASE FIT YOUR LIFE JACKET, REMOVE YOUR SHOES AND LOOSEN COLLARS AND TIES.

I WILL ORDER YOU TO BRACE FOR IMPACT JUST PRIOR TO OUR LANDING - REMEMBER THAT THERE COULD BE MORE THAN ONE IMPACT AND YOU SHOULD REMAIN IN THIS POSITION UNTIL THE AIRCRAFT STOPS.

WOULD YOU PLEASE FOLLOW YOUR CREW MEMBERS' INSTRUCTIONS IMPLICITLY AND DO NOT OVERCROWD EXITS DURING EVACUATION.

THANK YOU"

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

The first officer will obtain a position report and commence the frequent transmissions of distress signals and position reports.

The captain will order the steward and engineer to jettison cargo.

The steward will proceed to the cabin and supervise the preparation. It is his responsibility to instruct passengers which exits to be used when evacuating aircraft.

The captain will keep crew members and passengers advised upon the progress of the ditching procedure over intercomm and 30 seconds before touchdown announce "Brace for Impact".

(b) Cabin Attendants' Duties

The cabin attendants' primary responsibilities are to ensure that all passengers have donned life jackets and all seat belts are fastened.

The cabin attendants will distribute pillows, blankets and coats with instructions to passengers to place these items in position for bracing.

All loose items of equipment will be collected and stowed in freight lockers prior to ditching.

All passengers will be instructed to :-

1. Loosen collars and ties
2. Life jackets not to be inflated inside the aircraft and fully inflated after evacuation
3. Adjust seats to upright position
4. Remove sharp objects from pockets
5. Take rugs into raft
6. Do not overcrowd exits during the evacuation.

Check all emergency equipment and prepare it for quick removal from the aircraft. All available foods, fluids, torches and first aid kits should be made ready for removal.

It may be advisable for the cabin attendants to enlist the aid of some of the male passengers to assist after ditching in the removal of the life rafts through the exits.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

The cabin attendants, by preserving a calm demeanor can do much to instill confidence and to forestall panic in the passengers.

7. Abandonment

All emergency exits not previously removed are to be jettisoned and life rafts launched.

Provision is made for the stowage of two (20 man) life rafts which are stowed near the freight lockers.

One adjacent to forward entrance hatch
One adjacent to the aft entrance hatch

The opening of the door of each freight locker allows the life raft to be removed to the floor close to the exit.

Each raft is equipped with static line enclosed in a press-stud pocket of the raft container. Prior to launching, one end of this static line should be secured to the aircraft and on launching a sharp tug will automatically inflate the raft. The static line attaching the raft to the aircraft will snap should the aircraft sink prior to the line being cut. It is important therefore, not to moor the raft to the aircraft with escape ropes as these are strong enough to pull the rafts under.

To add comfort to those in the raft, passengers are to be instructed to take their rugs (used for impact) into the raft. Should time permit, crew members should take with them a CO2 extinguisher from the aircraft as these can be used for manual inflation or topping up of the raft by unscrewing the funnel on end of CO2 outlet.

The Gibson Girl Emergency Radio is stowed in the forward freight locker adjacent to the forward life raft and the flight engineer is to ensure this equipment is removed and delivered to the life raft.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

Procedures in Brief

1. Rig escape ropes from the upper deck emergency exits.
2. Keep life rafts away from damaged aircraft structure that might tear them.
3. Direct passengers to the most suitable exits for embarking in the rafts. This might vary depending upon aircraft damage, wave and wind action, and aircraft attitude in water.
4. Caution passengers not to jump into rafts. Shoes and sharp objects should be removed prior to getting into the rafts.
5. Distribute emergency supplies among the rafts and tie down to prevent loss in the event the raft should capsize.
6. See that each passenger's life jacket is inflated after leaving the aircraft.
7. Load available rafts equally.
8. As each raft is loaded move it clear of the aircraft.
9. Secure all rafts together with approximately 25 feet of line. (Sufficiently long to prevent a raft from being pulled under or breaking the line when another raft drops into a trough).
10. Make an effort to remain in the vicinity of the aircraft to search for survivors.
11. Ensure sea anchor is operating to reduce drift to a minimum. Search will start at the ditching position if known and rescue will be expedited by reducing drift from the area as much as possible.
12. Erect canopy. Every effort must be made to reduce exposure to the elements to a minimum. The raft floor should be kept as dry as possible and rugs used to sit on. Extra clothing and rugs should be distributed and all crew members must be constantly alert to the symptoms of shock on the passengers.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

8. Crew Responsibilities During Evacuation & Abandonment

(Refer "CREW CHECK LISTS")

Captain

1. Supervise and assist in the launching and loading of life rafts.
2. Ensure all passengers and crew have evacuated aircraft
3. Take command of own raft and supervise the rallying together of the rafts.

First Officer

1. Assist with launching and loading of life rafts
2. Launch own raft and join up with others. Assist in tying all rafts together using the rescue line if nothing else is initially available but ensure this line is secured to both rafts at the TOWING POINT.

Flight Engineer

Same as First Officer

Cabin Attendants

1. Assist in launching life rafts
2. Distribute and secure emergency supplies in launched rafts
3. Assist in the evacuation of passengers
4. Cabin attendants will take positions separately in rafts in order to afford the greatest assistance to the largest number of passengers.

9. Summary of Procedures

DITCHING

(a) Note or Sketch This Information

i) MAJOR SWELL direction -
ii) MINOR SWELL direction -
iii) WIND -
iv) DITCH HEADING -

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

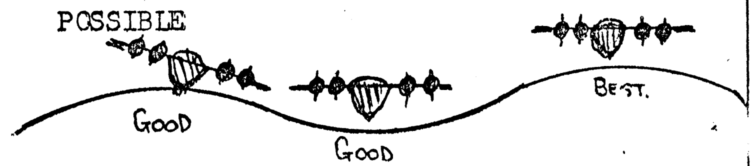
5.4.8. cont.

(b) Selection of Ditching Heading

Average run out on ditching requires 2000 feet taking approximately 20 seconds.

i) 1st Choice

LAND PARALLEL TO THE SWELL OR AS NEAR AS POSSIBLE



DIRECTION OF SWELL MOVEMENT

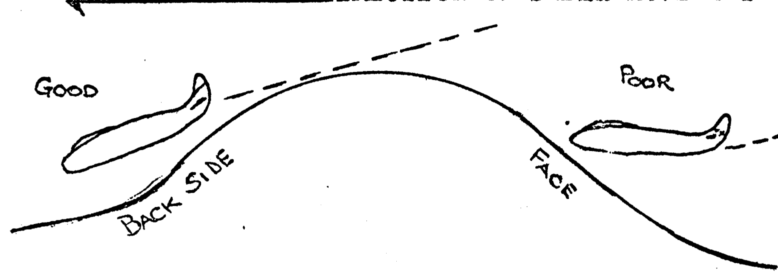
ii) 2nd Choice

LAND DOWN SWELL

This choice depends on length of swell. The aircraft touching down on the crest must come to rest short of the next crest.

In the long swells of the Pacific this technique would be a logical one. However, shorter swell lengths ordinarily prevent this heading except when landing down a secondary swell system. (In some cases, selection of a ditching heading to parallel a major swell system may require landing down swell on a minor system).

DIRECTION OF SWELL MOVEMENT



5.4. **EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES** (CONT'D)

5.4.8. cont.

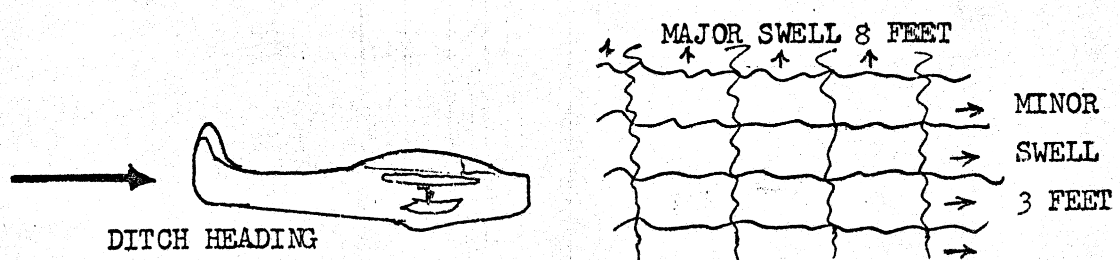
If only one swell system exists the problem is relatively simple - even with a high fast system - PARALLEL THE SWELL.

Most cases involve two or more systems running in different directions.

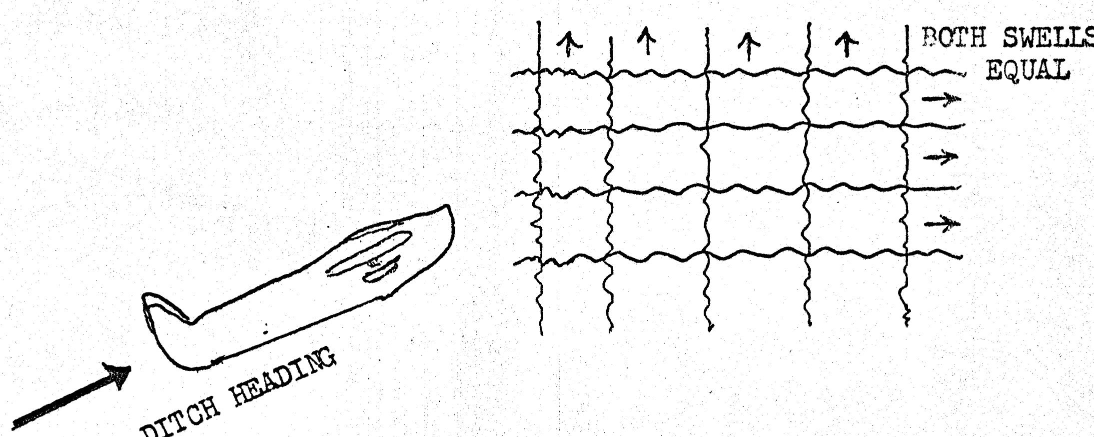
When two swell systems are at right angles the aircraft must be ditched parallel to one and down the other.

e.g. Major Swell 8 feet high
Minor Swell 3 feet high

Land parallel to Major and down Minor



If both systems are of equal height, select an intermediate heading at 45 degrees down swell to both systems.



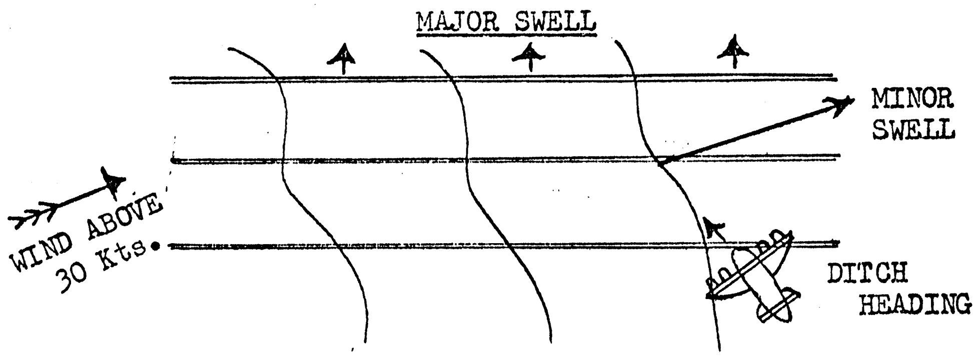
5.4. EMERGENCY LANDING & FORCED LANDING/DITCHING PROCEDURES (CONT'D)

5.4.8. cont'd.

(c) Winds

a) below 30 knots - land in relation to swells ignoring the wind or keeping as much ahead as possible.

b) Above 30 knots - accept a 30 - 40 degree crosswind component in order to avoid landing directly into the swell.

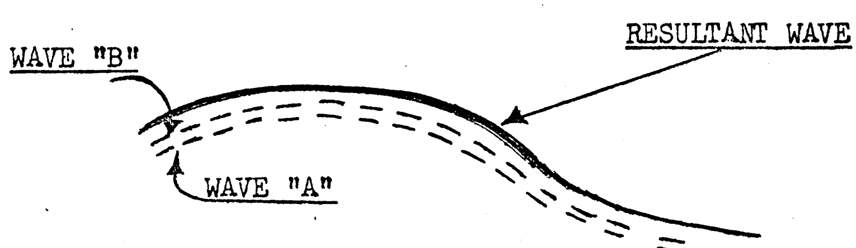


d) Selection of Touchdown Point

On final approach look ahead and observe the surface of the sea. There may be shadows and whitecaps - signs of large seas. Shadows & whitecaps close together indicate that the seas are rough and short - avoid these areas.

Select and touch down in an area (about 2000 feet is needed) where the shadows & whitecaps are not so numerous.

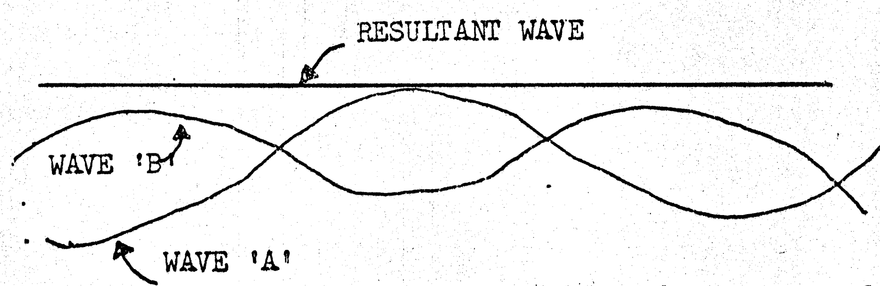
AVOID ROUGH SPOTS (waves in phase)



5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

SELECT THIS (waves in opposition)



NOTE: Touchdown should be on near edge of this flat spot to avoid overshooting and landing on rough area where waves are again in phase.

10. Communications

(a) Alert Phase

Aircraft informs ATC centre of abnormal operation e.g. engine failure etc.

(b) There are three classifications of aircraft emergency messages :-

(i) Distress category covers aircraft threatened by grave and imminent danger and in need of immediate assistance. It has highest priority and given on captain's authority only.

(ii) Urgency category identifies a very urgent message concerning the safety of an aircraft or of some person on board or within sight.

(iii) Safety category includes messages regarding the safety of navigation or containing important meteorological warnings.

(c) Distress Frequencies

Primary en route frequencies

Secondary en route frequencies

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

Any other network frequency

121.5 mc International VHF

8364 Kc International HF

2182 Kc Marine R/T calling and distress frequency

8939 Kc Australian Domestic only

NOTE: Prior to changing frequency and if time permits state the frequency to which you intend changing.

(d) Distress Call and Message

This should be repeated at intervals until an answer is received.

MAYDAY MAYDAY MAYDAY

THIS IS: Aircraft Ident 3 times

FREQUENCY:

POSITION AND TIME: Lat. and Long

HEADING (TRUE):

INDICATED AIRSPEED

ALTITUDE:

TYPE OF AIRCRAFT:

NATURE OF DISTRESS AND ASSISTANCE REQUIRED:

TOTAL NUMBER OF PERSONS ON BOARD:

ESTIMATED TIME AIRCRAFT CAN STAY AIRBORNE: AND INTENDED COURSE OF ACTION:

NOTE: TO ENSURE MESSAGE IS INTERPRETED CORRECTLY AND IF TIME PERMITS SUB HEADINGS SHOULD BE TRANSMITTED WITH MESSAGE TEXT.

IMPORTANT: Changes of pilot's intentions (e.g. change of heading) should be communicated to and acknowledged by authority rendering assistance.

5.4. EMERGENCY LANDING AND FORCED LANDING DITCHING PROCEDURES (CONT'D)

5.4.8. cont.

(e) Urgency Call

(Addressed to specific station)

PAN PAN PAN

THIS IS: Aircraft Ident 3 times.
followed by text of message.

(f) Safety Call

(Addressed to specific station)

SECURITE SECURITE SECURITE

THIS IS: Aircraft Ident 3 times,
followed by text of message.

(g) Plan Alfa

Plan "Alfa" brings into effect a system for the utilisation of surface vessels to provide assistance to an aircraft in distress.

Ship position information is prepared and supplied to aircraft departing on Trans Pacific flights through despatching officers of the various air carriers.

Messages between a distressed aircraft and a selected vessel would normally be handled by SAR Sector Co-ordinator through the normal radio traffic station. However, it is most desirable for the distressed aircraft in an approach to a vessel prior to ditching, to establish direct communication on 2182 Kcs. To establish this means of communication the ground station would alert the appropriate vessel to maintain a continuous guard on 2182 Kcs and transmit on 410 Kcs for homing purposes.

The rescue capabilities of shipping varies and is therefore given classification as follows:

5.4. EMERGENCY LANDING AND FORCED DITCHING PROCEDURES (CONT'D)

5.4.9. WINGTIP FLOAT DAMAGE/LOSS

The structural features of the flying boat with its heavy keel beam, the tear resistance of the hull and general tightness of the airframe contribute to its soundness in the event of an emergency landing or ditching. However, it has been found that in the carrying out of such a situation, the wingtip floats are the sections of the aircraft most susceptible to damage. The procedures to be adopted are various and can be influenced by :

Whether lost on take-off, landing or taxying under conditions of high winds or rough seas, or under ditching conditions in the open sea with large swells.

The recommended procedure is to -

Maintain lateral level throughout the run endeavouring to keep the damaged float or wingtip clear of the water, As the aircraft speed slows a slight turn toward the damaged side may help in this regard. Continue with the turn, if the way ahead is clear and it is apparent that the damaged float assembly can be kept clear of the water. In favourable wind conditions a position lying across wind may also help to achieve this.

As soon as possible all available personnel should proceed onto the undamaged wingtip in an endeavour to maintain the serviceable float in the water. Consideration should be given to closing the engines on that side in order not to be a danger or hindrance to personnel.

In this connection speed could be the essence as once the damaged wingtip is in the water and commences to fill, difficulty may be experienced in saving the aircraft.

The control launch should be advised immediately and if possible consider the manoeuvring of a launch under the damaged wingtip.

Life jackets should be passed to personnel and life lines passed over the wing and secured. Endeavour to reassure passengers and prevent lower deck emergency exits from being opened.

5.4. EMERGENCY LANDING AND FORCED DITCHING PROCEDURES (CONT'D)

5.4.9. cont.

PHASE 1	THROTTLES	CLOSED
	MIXTURES	I.C.O.
	IGNITION SWITCHES	OFF
	ASTRO HATCH	DOWN F/ENG
	EMERGENCY LIFE LINES	ONTO UNDAMAGED WING F/ENG.
	WARN STEWARD	FIT LIFE JACKETS ON DO NOT INFLATE IN A/C
	PERSONNEL	ALL AVAILABLE ONTO THE UNDAMAGED WING IN ORDER TO KEEP THE DAMAGED WINGTIP CLEAR OF THE WATER. CONSIDER USE OF VOLUNTEER PASSENGERS
PH 2	LAUNCHES	CALL ASSISTANCE AND CONSIDER USE TO PROP UP DAMAGED WING.
	EMERGENCY EVACUATION	IF SUFFICIENT LAUNCHES AVAILABLE CARRY OUT EVACUATION.

NOTE: In the event of the aircraft losing its seaworthiness consider beaching in an opportune area.

5.4.10. IMPACT DRILL "A"

PHASE 1	1.	MIXTURES	I.C.O.
	2.	F.W.S.O.V.'S	SHUT
	3.	BATTERY/MASTER	OFF F/ENG
	4.	IF FIRE, BATTERY ON,	USE EXTINGUISHERS
	5.	SECURE COCKPIT AND CARRY OUT EVACUATION PROCEDURE	
	6.	BATTERY MASTER	OFF F/ENG
	7.	FUEL COCKS	OFF F/ENG

5.5. EMERGENCY EQUIPMENT AND EXITS

5.5.1. GENERAL

Emergency equipment for S25 aircraft includes lights, fire extinguishers and first aid kits for use in the event of in-flight or landing emergency. Escape ropes, and crash axes are installed to assist in abandoning the aircraft or aid in rescue operations. Life rafts, emergency radio and life jackets are provided for use after ditching.

5.5.2. EMERGENCY LIGHTS

Emergency lights are installed to illuminate each exit and door. Lights in the passenger cabin provide illumination for each emergency exit sign, for the interior of the aircraft in the vicinity of the exit and for the area of wing or ground immediately outside the opened exit. The lights are controlled by ON-OFF switches in the galley and an ON-OFF switch on the Flight Engineers panel.

5.5.3. OXYGEN

Portable Oxygen - Two 15 minute oxygen cylinders are stowed in the linen locker on the rear passenger gangway. They have a 3/4 litre per minute constant flow with plastic disposal masks for crew and passenger use in an emergency. Advise Captain prior to use of these cylinders for passengers.

5.5.4. LIFE RAFTS (20 MAN)

Provision is made for the stowage of two 20 man life rafts which are stowed in the locker adjacent to the forward and aft entrance hatches.

Each raft consists of twin buoyancy tubes. Inflation is by an individual CO2 system for each buoyancy tube and both are actuated by pulling on a static line which must be attached to the aircraft prior to launching. The emergency equipment and canopy is stowed in the centre and can be opened from either side of the raft by tearing a waterproof rip strip.

5.5. EMERGENCY EQUIPMENT AND EXITS (CONT'D)

5.5.4. cont.

The canopy is fastened to the centre of the raft and when erecting, it is necessary to open and pass over the heads of the occupants and fasten to points on the upper main buoyancy tube. When in position a CO2 system positioned on the centre pole of the canopy is actuated by pulling the firing lever and inflation is automatic.

A boarding ramp is automatically inflated with the raft to afford ease in boarding from the water.

The total weight of complete life raft pack including raft equipment and emergency pack is 165 lbs. The complete pack consists of the following :-

Life raft equipment

	Boarding Ramp
	Inflatable Canopy
2 off	Metal Oars
2 "	Sponges
1 "	Set Repair Plugs
1 "	Hand Bellows
2 "	Knives (one each side of raft)
1 "	Rescue Line
1 "	Sea Anchor
1 "	Baler
1 "	Radar Reflector

Emergency Pack

1 off	Plastic Measuring Glass 2 oz.
3 "	De Salting Kits (6 pint)
4 "	Solar Stills
5 "	Tins Water (16 oz)
4 "	Tubes Burn Cream
2 "	Sunglasses
1 "	Waterproof Torch
3 "	Water Storage Bags
6 "	Two Star Distress Signals
12 "	Day Nite Distress Signals
6 "	Sea Marker Dye
2 "	Heliographs
1 "	Whistle

5.5. EMERGENCY EQUIPMENT AND EXITS (CONT'D)

5.5.4. cont.

1 off	Compas
1 "	First Aid Kit
1 "	Shark Repellant
1 "	Fishing Kit
1 "	Survival Manual
	Barley Sugar
50 feet	Nylon Cord

5.5.5. GIBSON GIRL EMERGENCY RADIO

A Gibson Girl emergency radio is stowed alongside the forward dinghy. High priority must be placed on delivering the Gibson Girl to the appropriate life raft.

The Gibson Girl emergency radio transmits on 500 and 8364 Kcs. The signals are a succession of SOS, followed by a 20 second dash for homing purposes.

Ranges are as follows :-

500 Kc	250 - 500 miles
8364 Kc	1500 - several thousand miles

5.5.6. LIFE JACKETS

One life jacket per person is carried on each aircraft. Passenger life jackets (yellow) are stowed behind each passenger seat. Six additional jackets are carried, two stowed above the lower cabin attendant's seat and four behind rear seats in upper deck cabin.

Stowage of crew life jackets is :

Technical Crew - Under nav. table
Cabin Attendants - in Galley

5.5. EMERGENCY EQUIPMENT AND EXITS (CONT'D)

5.5.6 cont.

(a) Beaufort Jacket. Packed in a small yellow plastic bag, the jacket is comprised of a buoyancy chamber of high-grade cotton textile, rubber proofed and pigmented, with the following accessories attached:-

A light alloy cylinder containing compressed carbon dioxide for inflation purposes.
A plastic whistle for attracting attention.
A light - illuminated by a water operated battery. The battery has small holes at top and bottom, through which water enters. To conserve battery power until it is needed (nightfall), these holes are covered by waterproof tape.

To operate light:- Remove tape from holes; water will enter, the battery will be activated and will give up to 20 hours useful output.

A mouth inflation tube, with red mouthpiece and red valve release pin.
To inflate:- Place mouth to mouthpiece and blow HARD.
To deflate:- Place pin into mouthpiece - this will release valve. Press gently on to jacket, air will be expelled.

To fit Life Jacket:- Insert head through hole.
Pass tapes around back, cross-over and tie in front, UNDER life jacket.
Inflate by pulling down on cord attached to inflation cylinder.
Mouth inflation tube used if automatic method fails, or to re-inflate.

(b) R.F.D. Jacket. Similar in design to the Beaufort Jacket, with the following exceptions:-

Light - is illuminated by an oblong blue plastic water operated battery, with one hole on each side. Holes are sealed by plastic plugs, and a tagged cord is attached to plugs. Pull cord until plugs are completely released.

5.5. EMERGENCY EQUIPMENT AND EXITS (CONT'D)

5.5.6 cont.

Mouthpiece - consisting of a spring loaded valve, with a metal collar holding it in a non-returnable position.

To inflate:- Screw metal collar clockwise; push down valve and blow into it whilst still in the "Down" position. After inflation, release valve and screw metal collar back to its original position.

To deflate:- Screw metal collar clockwise; push down valve, press jacket gently to expel air.

To fit Life Jacket:-
Same method as Beaufort Jacket.

5.5.7 ESCAPE ROPES

Escape ropes are located adjacent to each upper deck emergency exit. Ropes are installed in tubes in the cabin ceiling circumferential and are attached to the cabin structure above the openings. The ropes serve as handrails from exit to the surface after forced landing or ditching. Two escape ropes, one for each side of the aircraft are located on the flight deck near the astro hatch and may also be used as life lines on the wing by the attachment of snap hooks on the lines themselves to lugs on the wing.

5.5.8 EMERGENCY EXITS

The location of individual Emergency exits is hereunder:-

On Flight Deck
- Pilots sliding windows
- Astro Hatch

Top Deck ("C Cabin")
- Two kick out windows
- Two emergency hatches

Lower Deck
- Forehead main entrance hatch
- Aft. main entrance hatch
- Two kick out windows ("B Cabin")

5.5 EMERGENCY EQUIPMENT AND EXITS (CONTINUED):

5.5.8 continued

Galley window hatch
Ladies' toilet window hatch (VP-LVE only)

5.5.9 FIRE EXTINGUISHERS

(4) Four CO^2 extinguishers for petrol,oil and electrical fires (weight each 11 lbs.)
(3) Three water extinguishers for fabric and paper fires

see diagram 5.5.17 for locations

5.5.10 FIRST AID KITS

Two First Aid Kits are carried on each aircraft in the locations listed below:

VP-LVE (see page 50 B)
FRONT On coat locker, near bulkhead, adjacent to main front entrance hatch, port side
REAR Immediately aft of rear freight hatch, starboard side

VP-LVF (see page 50 A)
FRONT On rear bulkhead, starboard side of forward freight locker
REAR Immediately aft of rear freight hatch, starboard side

CONTENTS Asprin, Kwells (Motion Tablets), Dettol Solution, Sal Valatile, Acriflavine, Borasic Eye Lotion, Zinc Cream, Neo-Synephrine Jelly, Hydrochloride Jelly, Tannifax, Anryl Nictrate Capsules, Cotton Wool, Band-aids, 1" and 2" Bandages, Sling Bandage, Eye Bath, Eye Dropper, and Medicine Glass.

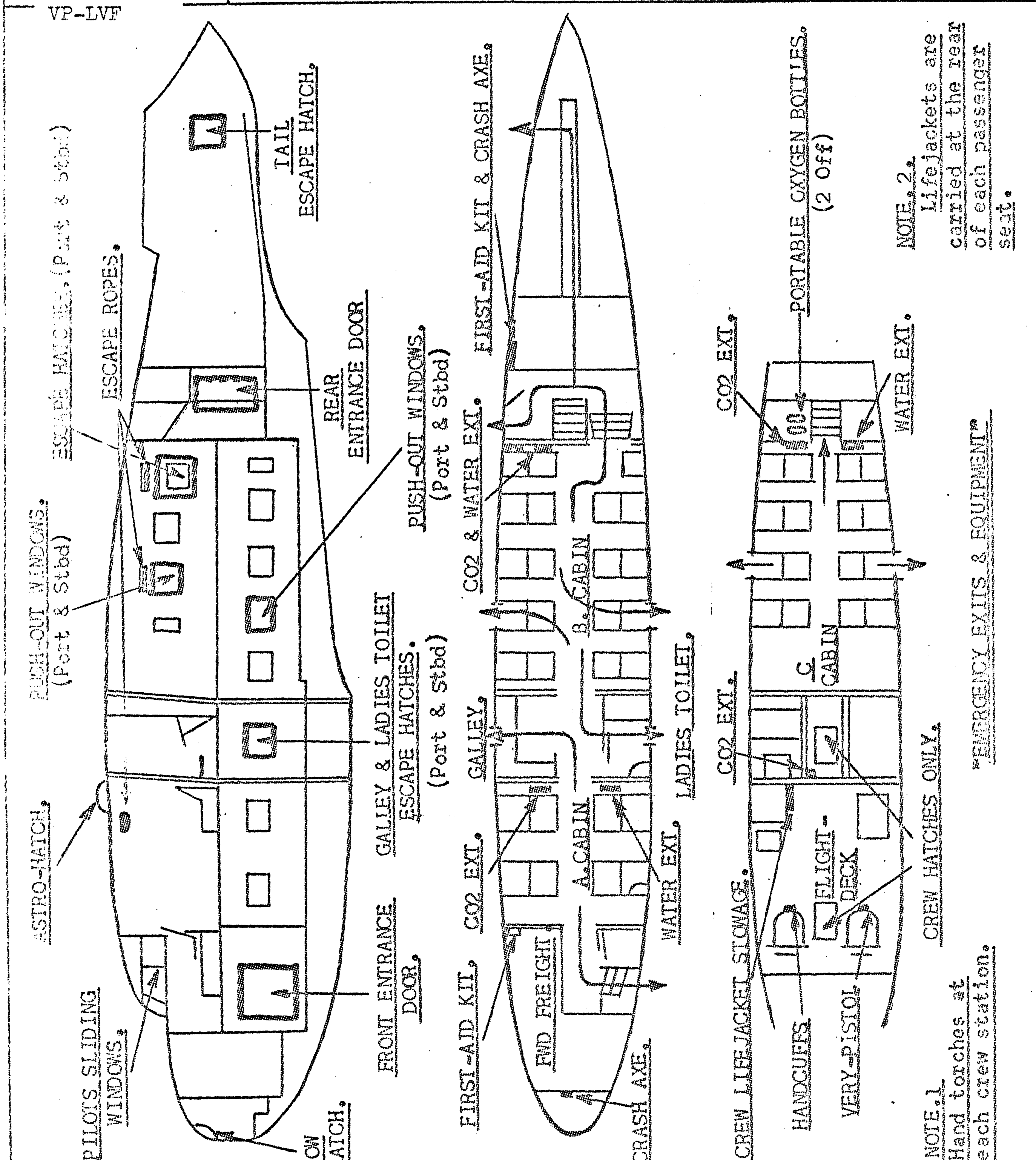
5.5.11 AXES

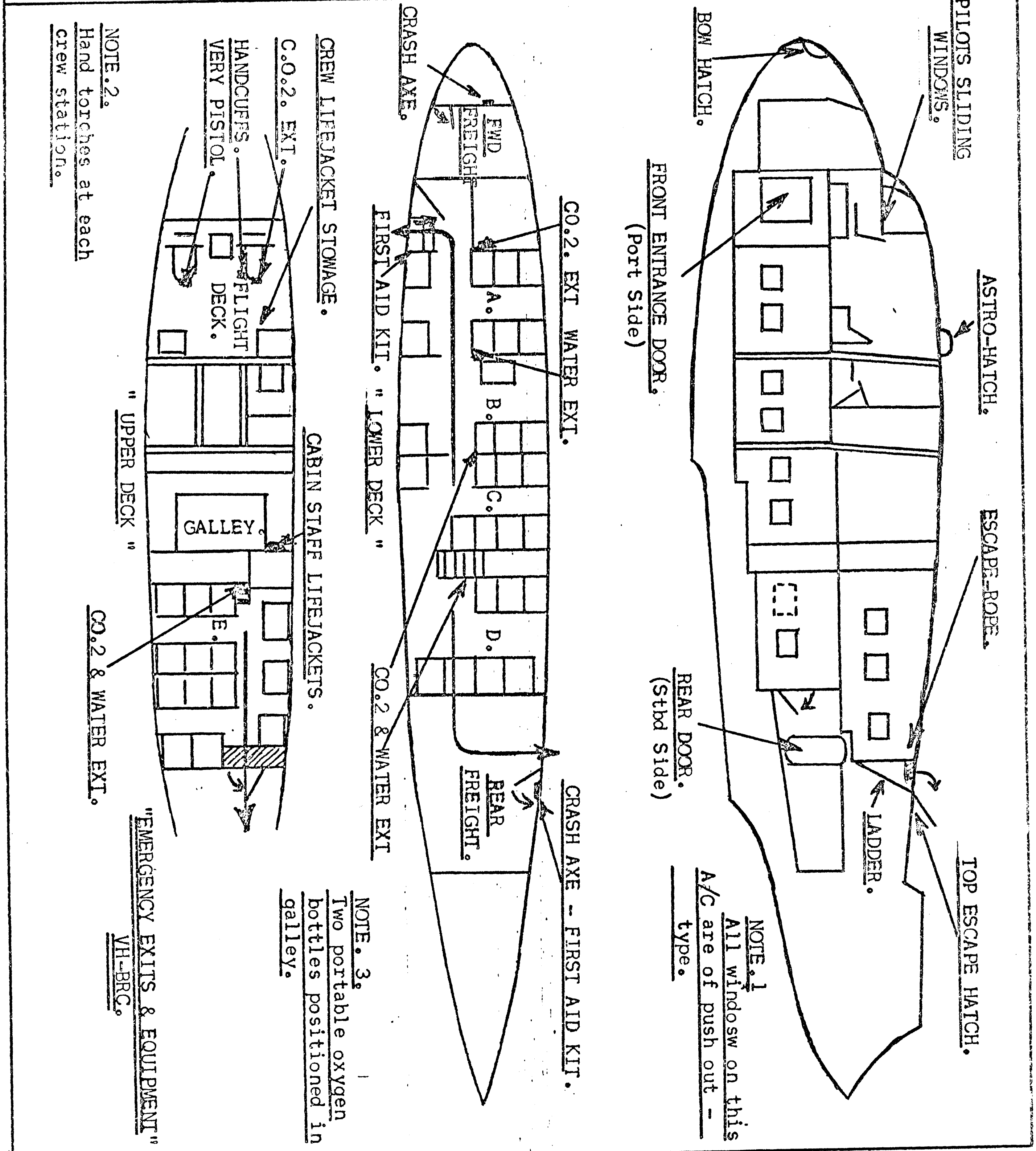
2 axes are carried on the aircraft. One is located in the rear freight locker on the starboard side and the other is in the mooring compartment.

5.5.12 TORCHES

Three water-proof torches are located adjacent to each crew member's seat on the flight deck.

VP-LVF


TAIL ESCAPE HATCH.
ESCAPE HATCHES, (Port & Stbd)
ESCAPE ROPES.
REAR ENTRANCE DOOR
PUSH-OUT WINDOWS. (Port & Stbd)
PUSH-OUT WINDOWS. (Port & Stbd)
GALLEY & LADIES TOILET ESCAPE HATCHES. (Port & Stbd)
ASTRO-HATCH.
FRONT ENTRANCE DOOR.
PILOTS SLIDING WINDOWS.
BOW HATCH.
FIRST-AID KIT & CRASH AXE.
CO2 & WATER EXT.
B. CABIN
GALLEY.
LADIES TOILET.
CO2 EXT.
A. CABIN
WATER EXT.
FIRST-AID KIT.
FWD FREIGHT
CRASH AXE.
PORTABLE OXYGEN BOTTLES. (2 Off)
CO2 EXT.
WATER EXT.
C CABIN
CO2 EXT.
FLIGHT DECK
CREW HATCHES ONLY.
CREW LIFE-JACKET STOWAGE.
HANDCUFFS
VERY-PISTOL
NOTE. 2. Lifejackets are carried at the rear of each passenger seat.
"EMERGENCY EXITS & EQUIPMENT"
NOTE.1 Hand torches at each crew station.


"EMERGENCY EXITS & EQUIPMENT" VH-BRC.
PILOTS SLIDING WINDOWS.
BOW HATCH.
FRONT ENTRANCE DOOR. (Port Side)
ASTRO-HATCH.
ESCAPE-ROPE.
REAR DOOR. (Stbd Side)
LADDER.
TOP ESCAPE HATCH.
NOTE.1 All windosw on this A/C are of push out - type.
CRASH AXE.
FWD FREIGHT
CO.2. EXT
FIRST AID KIT.
A.
WATER EXT.
B.
C.
" LOWER DECK "
D.
CO.2 & WATER EXT
REAR FREIGHT.
CRASH AXE - FIRST AID KIT.
NOTE. 3. Two portable oxygen bottles positioned in galley.
CREW LIFEJACKET STOWAGE.
C.O.2. EXT.
HANDCUFFS.
VERY PISTOL
FLIGHT DECK.
NOTE.2. Hand torches at each crew station.
" UPPER DECK "
GALLEY
CABIN STAFF LIFEJACKETS.
E.
CO.2 & WATER EXT.

5. (Cont'd)

5.6. (cont'd)

5.6.1. Flap Indication System Failure:

Should the flap indicating system fail, the relative flap positions can be inspected for travel by observation from the upper deck.

The flaps have a red line painted across the upper surface parallel to the wing trailing edge and is visible when the flaps have reached the 1/3rd out position. The 2/3rds out position is marked by a green line painted on the upper surface of the flap. The desired painted line giving the required flap setting should be just visible and coincidental with the wing trailing edge.

5.7. ICING

5.7.1. Carburettor Icing:
Procedure to prevent or eliminate ice formation under icing conditions:

The use of carburettor heat for the prevention of ice and loss of power when in excessively high moisture atmosphere is most effective if applied and maintained in advance of encountering these conditions.

Procedure for Applying Pre-heat:
1. Raise carburettor heat to 15° - 20°.
2. Adjust boost to maintain desired horsepower.

Removal of Pre-heat:
1. SLOWLY remove carburettor pre-heat.
2. Adjust power accordingly.

NOTE: When pre-heat is removed, the carburettor, due to AMC leg, will still be flowing fuel for a low density air flow, whilst actually inducting high density air. The AMC will not adjust itself to the higher density air for approximately 2 minutes and a lean mixture will result.

The Effects of Carburettor Ice Formation:
1. Loss of power through restriction of the carburettor air passage with ultimate engine stoppage through lack of fuel, if the ice formation is not checked.

2. Fouling of the throttle valve action.

5. (cont'd)

5.7. ICING (CONT'D)

5.7.1. (cont'd)

3. Rough engine performance.

4. Damage to the vanes of the supercharger impeller, due to pieces of ice being dislodged into the airstream.

5. Interference with fuel flow discharge nozzle, causing upset fuel air ratio.

6. Uneven mixture distribution to the cylinders.

The Detection of Carburettor Icing:

1. Steady drop in manifold pressure.
2. Uneven engine performance and loss of power due to over lean or an over rich mixture which is associated with bleed ice, when drop in manifold pressure may not necessarily occur.

Procedure for removing Carburettor Icing:

1. Mixture to auto-rich.

2. Raise carburettor heat to maximum available and hold for 30 secs.

3. Thereafter reduce heat to $15^{\circ} - 35^{\circ}$(max.)

4. Adjust boost to maintain desired horsepower, and reduce mixture to auto-lean.

Removal of Carburettor Bleed Icing:

1. Apply carburettor heat, maximum available for 30 secs.
2. Return to maximum 35°C.
3. Lean off slowly till head temperature and power have recovered.
4. Reduce carburettor heat 15°-20°.
5. Mixture to auto-lean.

NOTES:

1. Unless these temperatures can be maintained, take steps to get into an area of better weather.

2. The drastic procedure of leaning the mixture to the point of engine back-firing, in an effort to dislodge throttle ice already formed, is only employed in

5. CONT'D

5.7. ICING (CONT'D)

5.7.1. (cont'd)

NOTES (CONT'D)

2. (cont'd)
extreme emergency.

N.B. When using this procedure carburettor controls must be full cold, otherwise damage to the control shutter will result.

3. Because appreciable loss in brake horsepower results from carburettor heat application owing to restricted air intake, and lower density of pre-heated air, throttles must be advanced whenever heat is applied, and the boost pressure adjusted to the new C.A.T. figure to maintain a given horsepower.

5.7.2. Aircraft Icing:

Sandringham aircraft are not fitted with airframe or propeller de-icing or anti-icing equipment and whilst a limited amount of icing is allowable during flight, the Captain should endeavour to proceed at an altitude where icing is least, having regard to safety heights and restrictions on altitude due to oxygen requirements. A diversion from track may be necessary as in the case of circumnavigation of a cumulo-nimbus cloud.

No attempt to take-off or land should be made with ice on the aircraft.

Prior to entering rain, cloud or icing conditions switch pitot heaters on.

When flying in conditions of icing, it is adviseable to disengage the auto-pilot and hand fly the aircraft so that the effects of airframe icing can be detected more readily.

5.8. TURBULENCE

PHASE 1		
	1.	Always avoid severe turbulence where practicable.
	2.	Warn the cabin attendant.
	3.	Switch the seat belt sign on.
	4.	Establish the stabilised penetration speed of 120K.
	5.	Endeavour to hold a constant attitude, do not chase air-speed, or altitude.
	6.	Avoid overcorrecting and manoeuvring.

(cont'd)

5. CONT'D

5.8. TURBULENCE (CONT'D)

PHASE 1	(cont'd)
	7. Set up a base power for the penetration speed, and if power variations are necessary, use this power as a datum.
	8. Both pilots are to continually monitor flight instruments.

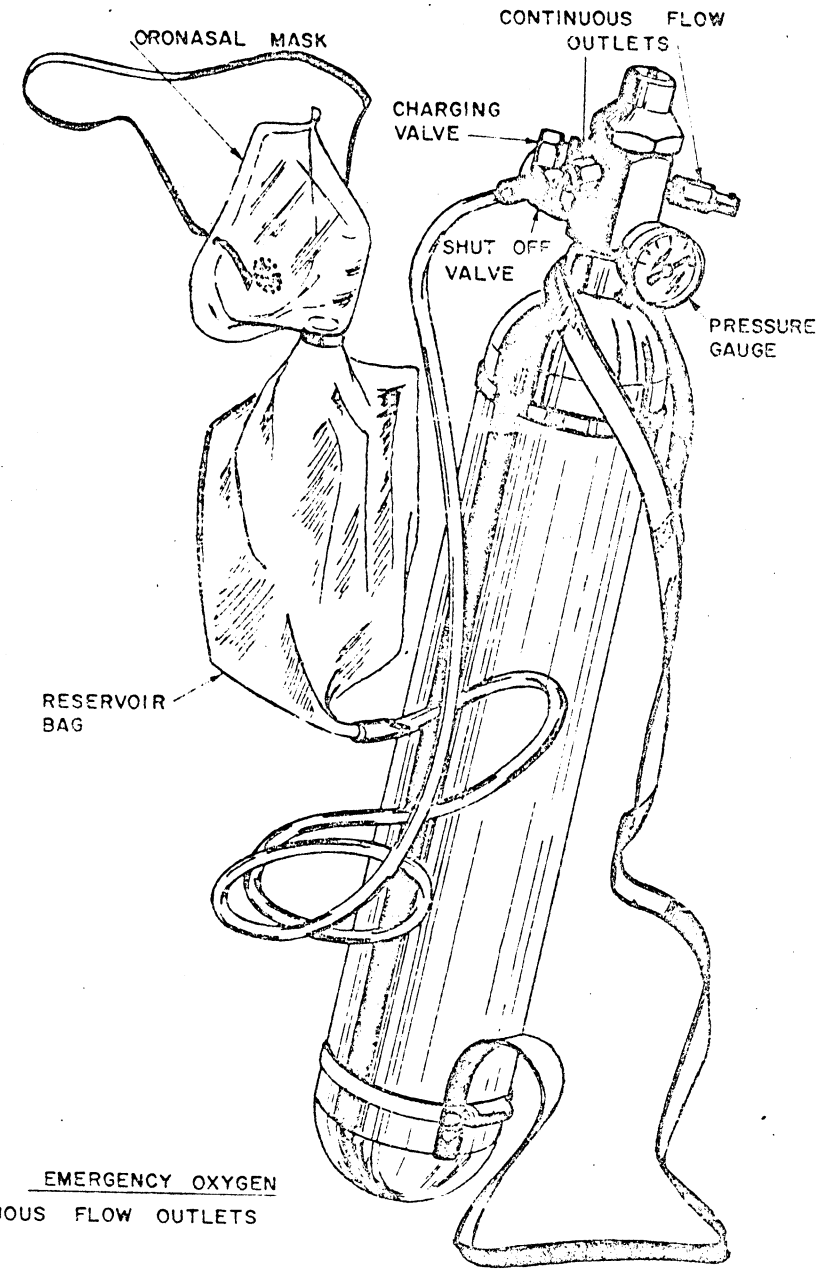
5.9. RECOVERY FROM UNUSUAL ATTITUDE OR UPSET:

Recommended procedure irrespective of altitude -

(a)	Reduce Power.
(b)	Using rudder and aileron, stop the turn using the turn indicator.
(c)	Ease out of the dive; appreciate airspeed lag and reduce back stick, when airspeed stops increasing.
(d)	Apply power as airspeed reduces and resume level flight.

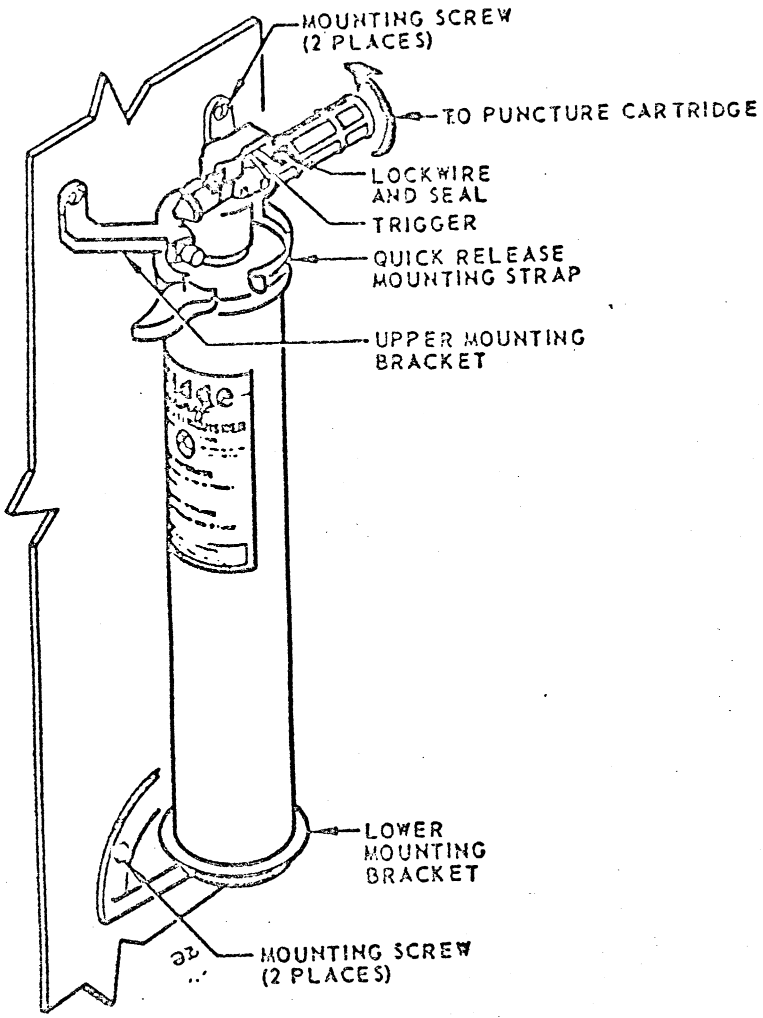
5.10. RECOVERY FROM STALL OR LOSS OF ELEVATOR EFFECTIVENESS:

Ease yoke forward and apply power.

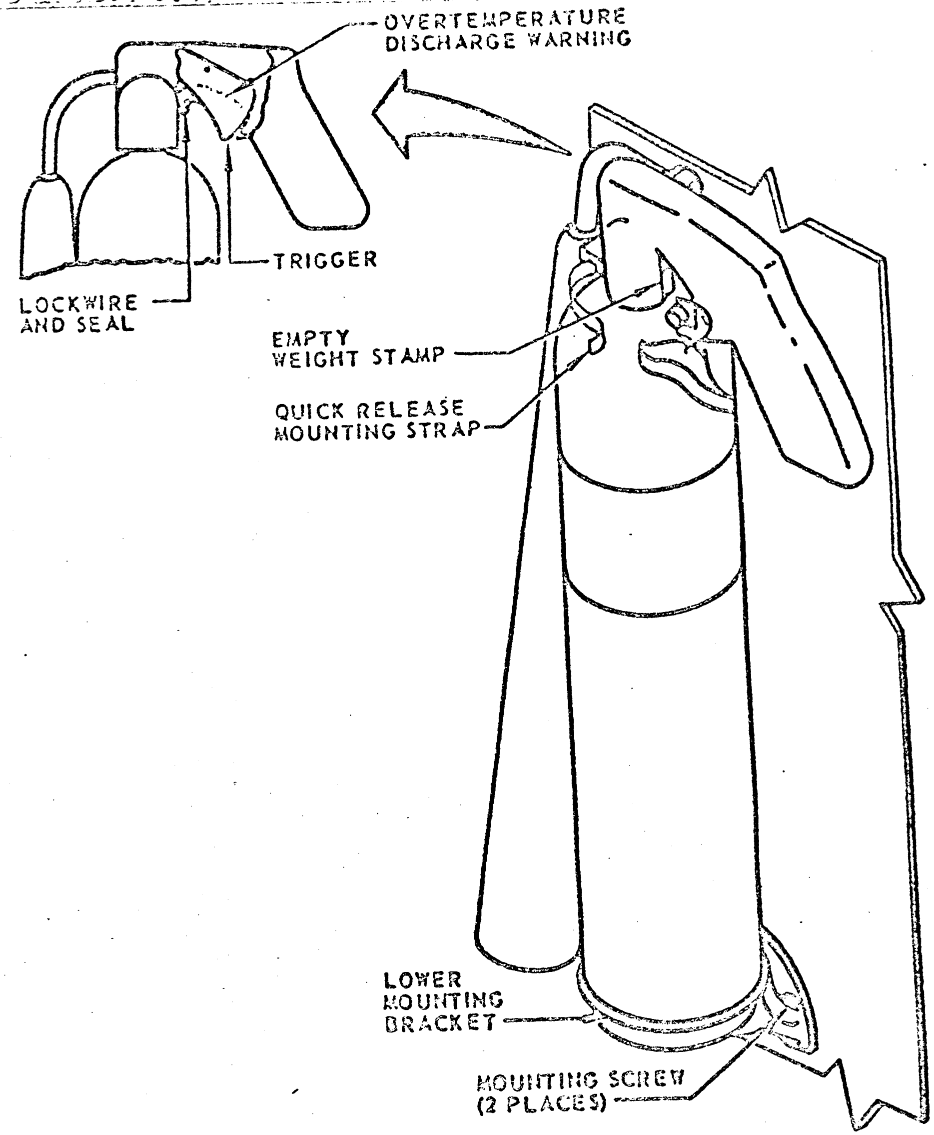


EMERGENCY OXYGEN
TWO CONTINUOUS FLOW OUTLETS

PORTABLE FIRE EXTINGUISHERS



TYPICAL WATER FIRE EXTINGUISHER INSTALLATION



TYPICAL CO2 FIRE EXTINGUISHER INSTALLATION

PAGE NO:

6. GLOSSARY OF AIRCRAFT TERMS:

I.A.S. Indicated Air Speed: The reading of the pitot static airspeed system as installed in the aeroplane, without correction for airspeed indicator system errors. This normally assumes zero mechanical error in the instrument.

D.I.A.S. Dial Indicated Air Speed: This term is often used in the same sense as Indicated Airspeed. For both I.A.S. and D.I.A.S. the scale of the indicator has been corrected for adiabatic compressible flow (i.e. free of shock waves) at sea level.

C.A.S. Calibrated Air Speed: I.A.S. corrected for airspeed indicator system errors e.g. mechnaical errors such as zero displacement and positions errors. This is equivalent to True Airspeed in the standard atmosphere at sea level.

E.A.S. Equivalent Air Speed: C.A.S. corrected for compressibility at altitude - this is equivalent to True Indicated Air Speed T.I.A.S.

T.A.S. True Air Speed: The True speed of the aircraft relative to undisturbed air.

$$\text{T.A.S.} = \frac{\text{EAS}}{\sqrt{\sigma}}$$ Where σ = relative density of the air.

T.I.A.S. True Indicated Airspeed: $\text{T.I.A.S.} = \text{T.A.S.} \times \sqrt{\sigma}$ and is a theoretical value of the indicated airspeed assuming no errors.

PRESSURE ALTITUDE Is that altitude in the I.C.A.N. standard atmosphere at which the pressure is the same as that prevailing at the reference location. Pressure altitude may be obtained by setting the altimeter datum at 1013 mb. (29,92 ins Hg.) and applying, where applicable, the appropriate position error correction to the altimeter reading so obtained. Mechanical error in the instrument is neglected.

DENSITY ALTITUDE Is that altitude in the I.C.A.N. standard atmosphere at which the denisty of the air is the same as that at the reference location. Charts and computors are available which permit the calculation of density altitude provided pressure altitude and temperature are known.

6. GLOSSARY OF AIRCRAFT TERMS: (CONT'D)

RELATIVE DENSITY Is the term applied to the ratio between a particular density and the density at sea level under I.C.A.N. Standard conditions. The standard sea level density ratio is given the Greek symbol sigma (σ).

Airspeed indicator readings are dependent on air density and hence on relative density. The relationship is expressed in the definitions above, i.e.

$$T.A.S. = \frac{T.I.A.S.}{\sqrt{\sigma}} \quad \text{or } T.I.A.S. = T.A.S. \times \sqrt{\sigma}$$

STANDARD ATMOSPHERE For design purposes a range of standard climates are assumed ranging from arctic to tropical conditions. However, the basic reference is that defined as the International Standard (I.S.A.) atmosphere. This is a theoretical atmosphere in which the density and pressure variations with height are laid down and it is normal practise to express heights or densities in terms of altitude in the standard atmosphere. c.f. above

At sea level in the I.S.A. atmosphere, the temperature is 59° F (15°C) the pressure is 1013.2 mb. (29.92 in Hg. 14.7 lb/sq. in) and the density, as defined by the temperature and pressure is 0.002378 slugs/cu.ft. (0.07652 lb/c.ft.)

The temperature lapse rate in the standard atmosphere is 1.98°C (3.56°F) per 1000 ft.

MACH.NO. is the relationship between the speed of the object in question and the speed of sound under the same conditions. As the speed of sound varies with temperature, the Mach No. for a given T.A.S. will also vary with temperature. At sea level in the standard atmosphere, the speed of sound is 761 mph. and decreases to 707 mph. at 20,000 ft.

POSITION ERROR Refers to the error due to the location of pitot and static sources relative to the airflow. This will vary with airspeed and may be associated with ground effect for the take-off and landing runs. In this case a separate correction is provided for the ground run condition.

6. GLOSSARY OF AIRCRAFT TERMS: (CONT'D)

GROUND EFFECT refers to the effect of the interference due to the ground plane on the airflow pattern in the vicinity of an aircraft wing. The result is an improvement in lift and a reduction in induced drag which is measurable up to a height of approximately two wing spans. The modified airflow pattern may also affect the position error correction.

AMBIENT TEMPERATURE Is the free air temperature at the particular location. The effect of airspeed is to give a reading on the O.A.T. gauge in excess of the free air temperature due to the dynamic heat rise. The O.A.T. reading must be corrected for this temperature to get actual free air of ambient temperature.

V_1 SPEED Otherwise known as the Critical Engine Cut Speed is a speed chosen to correspond with a decision point on the take-off flight path: Should an engine fail below this point, the take-off should be discontinued. This speed is normally chosen such that the accelerate-stop distance after failure of the critical engine is equal to the distance required to reach a height of 50 ft. However, when the field lengths are unbalanced this speed may be varied to match. The optimum speed is that at which the "stopway" and "clearway" distances are fully availed.

A stipulation is that the V_1 speed shall never fall below the Minimum Controllability speed.

V_2 SPEED Or take-off Safety Speed is the minimum speed at which climb away can be initiated. It can never be less than 110% V_{mc} of 115% of the zero thrust stalling speed in the take-off configuration (V_{S1}) in the case of a four engined aircraft or 120% V_{s1} for a twin engined aircraft.

APPROACH SAFETY SPEED For multi engines aircraft the approach safety speed shall not be less than $1.1V_{mc}$ where $V._{S1}$ is appropriate to final approach conditions.

V_{mc} SPEED or Minimum Control Speed is the minimum speed at which, with the aircraft in the second segment configuration and take off power on all engines, if the critical engine is abruptly cut and the propeller is allowed to windmill or take up that position it would automatically assume after engine

6. GLOSSARY OF AIRCRAFTTERMS: (CONT'D)

V_{mc} SPEED (cont'd)
failure, the aircraft can be kept within certain specified limits of attitude and heading. It is usually specified that this should be measured out of the range of ground effect.

VMcq. SPEED or Minimum ground control speed may be defined as minimum control speed taking ground effect into account.

V_{S1} SPEED denotes the measured stalling speed with the aircraft in a particular configuration with all engines developing zero thrust at a speed not greater than 110 per cent of the Measured Stalling Speed.

V_{so} Stalling Speed: Denotes the measured stalling speed with the aricraft in the landing configuration with all engines developing zero thrust at a speed not greater than 110 per cent of measured stalling speed or a steady flight speed.

VF SPEED is the maximum speed with wing flaps in an extended position. This speed may be quoted for full flap only/or a range of flap positions. Gust and measuring loads are taken into account in assessing this speed -
(vertical gust velocity 15 ft/sec.-) U.S.
25 ft/sec.-) British

V_A is the Design Manoeuvring speed corresponding to a particular design load factor. It normally corresponds to the point at which a 2.5 load factor will cause stall.

V_B is the Design Speed for maximum gust intensity. It is the speed at which if a (40 ft/sec. U.S. vertical gust (66 ft/sec. British) is met, the aircraft will be just on the point of stall.

V_C is the Design Cruising speed and this condition is investigated structurally for manoeuvring load factor varying with weight and for a vertical gust velocity of (30 ft/sec. U.S.
(50 ft/sec. British

6. GLOSSARY OF AIRCRAFT TERMS: (CONT'D)

V_D — is the Design Diving Speed for which the aircraft structure is checked under manoeuvring loads and for gust velocities of (15 ft/sec. U.S.
(25 ft/sec. British.

V_A, V_B, V_C, and V_D are design rather than operational speeds. The difference between the British and U.S. design gust velocities is explained by different assumption on the degree of sharpness of the gust and both in fact give a similar resultant load.

V_{NO} — is the placarded maximum speed for normal operation and is the operational equivalent of V_C. V_{NO} must not exceed the design cruising speed.

V_{NE} — is the placarded speed which is never to be exceeded in operation. This speed must be chosen to be not more than 90% of the design diving speed V_D. This V_{NE} speed is sometimes loosely termed the maximum dive speed.

MAXIMUM SPEED IN TURBULENCE: This is the operational equivalent of V_B, It is the recommended maximum airspeed in severe turbulence and is a compromise speed chosen sufficiently high to obviate any possibility of stall due to gusts but not so high as to invite structural damage. This speed is usually varied with weight and sometimes also with fuel load.

LIMITING SPEEDS: In addition to the above limiting speeds there are various other self explanatory limits such as the limiting speed for landing gear operation and auto-pilot operation.

In some cases limiting speeds for maximum flight control operation are quoted where these are not limited by some other factors, such as pilot effort or manoeuvring load factors.

FLIGHT LOAD FACTORS: Load Factors may be defined as the ratio of a prescribed load to the total weight of the aeroplane, the specified load may be expressed in terms of any of the following:- aerodynamic forces, intertia forces or ground or water reactions.

6. GLOSSARY OF AIRCRAFT TERMS: (CONT'D)

FLIGHT LOAD FACTORS: (cont'd)

Flight Load Factors are divided into two main categories, namely:-

(a) Manoeuvring Load Factor which is the total aerodynamic lift of the aeroplane caused by movement of the control surfaces, acting perpendicularly to the flight path, divided by the total weight of the aeroplane. In straight and level flight, this load factor is equal to 1.0.

(b) Gust Load Factor which is the total aerodynamic lift of the aeroplane, caused by gusts of air assumed acting perpendicularly to the Flight Path, divided by the total weight of the aeroplane.

Load factors are often expressed in terms of gravitational acceleration. That in level flight is called 1_g. Doubling the load results in a load factor of 2 which may be expressed as a 2_g loading. An accelerometer is a device for measuring such load factors.

ENGINE DEFINITIONS

Brake Horse Power (BHP) is the actual power available from the engine for doing work. It is the net horse power available at the propeller shaft and power take-off including ancilliary drives, after the power required for motoring the engine and basic auxiliaries has been extracted. However, BHP is also used to express the actual power available at the propeller but for purposes of distinction it is preferable to term this torquemeter horsepower.

Torquemeter Horsepower: (T.H.P.) is a term sometimes applied to the useful power delivered at the propeller shaft and is determined from a knowledge of the revs and the torque availed at that point. For an engine with no additional accessory loads, T.H.P = B.H.P.

B.M.E.P.

Brake Mean Effective Pressure: is an expression of the average pressure required in the cylinders to give the required Torquemeter Horsepower if all losses are neglected. It is accordingly a measure of the loading on the cylinder and of the likelihood of detonation. Restrictions are set on the permissible B.M.E.P. under various power and mixture settings. Torquemeter indicators are usually calibrated to read directly in B.M.E.P.

6. GLOSSARY OF AIRCRAFT TERMS (CONT'D)

B.M.E.P. (cont'd)

Calculation of T.H.P. (or B.H.P.)

$$T.H.P. = \frac{B.M.E.P. \times R.P.M.}{K}$$

Where K is a constant dependant on the swept volume of the engine and its propeller reduction gear ratio.

In the case of the R 1830 engine K = 432

$$\text{then } T.H.P. = \frac{B.M.E.P. \times R.P.M.}{432}$$

NOTE: For the B.H.P. as calculated from R.P.M. and M.P. to agree precisely with T.H.P. as calculated from torquemeter reading a number of factors must be taken into account including the effect of temperature, humidity and accessory loads on the actual B.H.P. available at the propeller.

6.1. OPERATING LIMITATIONS::

6.1.1. Weight and C.G. Limitations - See Section 10

6.1.2. Airspeed Limitations:
The following speed limitations must be observed for the specified conditions of flight.

Maximum Never Exceed Speed	200 Kts.
" with Full Flap down	110 "
" with 2/3 Flap down	115 "
" Auto Pilot Speed	150 "
Minimum " " "	105 "

6.1.3. Cross Wind Limitations:
The Maximum permissible crosswind component for normal operation is limited to 15 Kts. for both Take-off and Landing. This componwnt can be derived from the table below if Runway and Wind direction and wind strength are known.

6. GLOSSARY OF AIRCRAFT TERMS (CONT'D)

6.1. OPERATIONS LIMITATIONS (cont'd)

6.1.3. Cross Wind Limitations:

CROSS WIND COMPONENT
(Quick reference)

Wind Angle - Relative to Runway Direction	Fraction of Wind's Speed	WIND SPEED KTS 10	15	20	25	30	35	40	45	50	55	60
10	1/6				4	5	6	7	8	9	10	10
20	1/3			7	8	10	13	14	16	17	18	20
30	½			10	13	15	17	20+	20+	20+	20+	20+
40	2/3			13	16	18	20+					
50	¾			15	19	20+						
60	5/6			17	20+							
70	9/10			19								
80)	1)			20								
90)	)		15	20								

6.2. OPERATIONS:

6.2.1. Take-off:

6.2.1.1. All Engines Take-off: Full take-off power must be used at all times with climb away initiated at a speed not less than 105 knots.

6.2.1.2. Engine Failure on take-off:
The Minimum Controllability Speed (VMC) is 90Kts. I.A.S., and it is the minimum speed at which it is possible to retain control of the aircraft, and subsequently maintain a straight flight path, after the Critical (Port outer engine has failed and while take-off power is applied to the operating engines.

6.2.2. Climb Performance:

6.2.2.1. Four Engines: Climb performance, achieved at the normal climb speed of 120K. I.AS., should always be in excess of minimum requirements, and therefore detailed consideration is not significant. (See Section 7 for Climb Powers).

6. GLOSSARY OF AIRCRAFT TERMS (cont'D)

6.2. OPERATIONS (CONT'D)

6.2.2. Climb Performance (cont'd)

6.2.2.2. Three Engines: Angle v. Rate of Climb); For weights up to 59,000 lbs. - 105 kts. provides the best gradient of climb and therefore Optimum Performance (for maximum terrain clearance) during initial climb-out. However, it does not provide the best rate of climb.

After performance has been established, and not less than 300 ft. above terrain, the best rate of climb will be achieved by accelerating to a climb speed of 110 Kts. and METO power on operative engines. (See Section 7).

6.2.2.2.1. Required Optimum Performance following engine failure on take-off: (Max. A.U.W. port outer engine inoperative, I.S.A. conditions).

1st Segment: Prop windmilling -) Climb
T.O. Power Operative engine) to 50'

2nd Segment: Prop. windmilling -
T.O. Power operative engines) 116ft. min.

3rd Segment: Prop. feathered -)266 ft.
T.O. Power operative engine)min.

(The 3rd Segment terminates at the end of 2 mins. of Take-off Power).

6.2.2.2.2. Required En Route Performance: (Max.A.U.W., Port outer engine inoperative, I.S.A. conditions).

Flaps UP, - Prop. feathered -) 140 ft./min.
METO Power on operative engines) at C.A. 7000'

The Sandringham S.25 Flying boat was tested by D.C.A. in July 1956 when a rate of climb of 211' per minute in the enroute segment at 115 Kts. I.A.S.. 59000 lbs, 5000 ft. pressure altitude and a temperature of I.S.A. - $2\frac{1}{2}$°C. This performance was considered to be very satisfactory for an aircraft of this type as it fully meets the required performance standards.

6. GLOSSARY OF AIRCRAFT TERMS (CONT'D)

6.2. OPERATIONS (CONT'D)

6.2.2. Climb Performance (cont'd)

6.2.2.2.3. Adjustements to Required Performance Figures:

It will be obvious that variations in A.U.W., temperature, pressure, etc. will vary the performance figures quoted (6.2.3.2.1. and 6.2.3.2.2.)for Max. A.U.W. and I.S.A. conditions.

Adjustments necessary are:

T.O. Climb:

(i) Deduct 15 ft/min. for each 1000 ft. Press. Alt. is above standard;

(ii) Deduct 20 ft/min. for each 5°C. O.A.T. is above standard temp.;

(iii) Add 40 ft/min. for each 1000 lbs. of weight below maximum permissible A.U.W.

En Route: (Up to C.A. 7000 ft).

(i) Add 10 ft/min. for each 1000 ft. Press. altitude below C.A.

(ii) Deduct 20 ft/min. for each 5°C temperature is above Standard temp.;

(iii) Add 35 ft/min. for each 1000 lbs. of weight below maximum permissible A.U.W.

(Above C.A.):

(i) Deduct 35 ft/min. for each 1000 ft. Press. altitude above C.A.

(ii) Deduct 30 ft/min. for each 5°C temperature is above standard.

(iii) Add 35 ft/min. for each 1000 lbs weight below maximum permissible A.U.W.

6.2.3. Cruise:

The cruise powers for normal and emergency use are fully detailed in Section 7.

6.2.3.1. Maximum Range: This is achieved by the least possible power at the lowest safe altitude to attain best performance. (See Section 7).

6. GLOSSARY OF AIRCRAFT TERMS (cont'd)

6.2. OPERATIONS (CONT'D)

6.2.3.2. Maximum Endurance: This will be obtained at the speeds quoted in Constant Speed Cruise Graphs where wind component has not been considered.

NOTE: Selection of a power to achieve either Maximum Range or Maximum Endurance must be confined to listed powers in Section 7.

6.2.4. Approach and Landings:

6.2.4.1. Normal: Rate of descent should not exceed 500 ft/min. circuit entry speed and therefore speed for lowering flaps is 120 kts. Up to 1/3 flap may be extended at 120 Kts., but full flap must not be extended above 110 Kts. Normal final approach should be made at not less than 90 Kts. depending on all up weight of the aircraft.

6.2.4.2. Flapless: Should no flaps be available, approach speeds should be 10 kts. above those used for normal flapped approach. The tendency to float is more pronounced in this configuration.

See Section 4 for Zero Flap Technique.

6.2.5. Flight Loading: Manoeuvre and Gust Loads.

Load Factors:
A transport aircraft is designed for a limited range of manoeuvres relying on the experience of the crew to avoid excessive load factors due to operation of controls.

6.2.6. Speed in Gusty Air:
The best speed for operation in gusty air conditions is approximately 120 kts. Higher speeds increase the likeli-hood of structural damage, while at lower speeds the aircraft might easily be stalled by an abnormal gust with subsequent loss of control.

6.2.7. Zero Thrust Stalling Speeds:

Gross Weight Aircraft lbs.	Flaps Up	Flaps Down
	Kts.	Kts.
45000	74	63
54000	83	67
59000	88	73

N.B. Power on speeds will be slightly lower.

7. POWER

7.1. POWER PLANT

7.1.1. Description:

S.25 aircraft are equipped with Pratt & Whitney R.1830-90D. aircraft engines mounted on the forward face of each nacelle.

The engines are fitted with Stromberg injection carburettors and Hamilton Standard three (3) blade propellers.

FEATURE	R.1830/90D.
Carburettor type	PD 12/H5
Propeller (Diameter (Hub (Blades (Fine Pitch (Feathered	11 ft. 7 ins. 23 E 50-473 Paddle 6519A-12 19 degrees 90 degrees
Reduction Gear	16 : 9
Supercharger Ratio	7.15 : 1
Fuel Grade	100-120 Octane
Oil Grade	W100 second (Red Band)
Hydraulic Fluid	Aeroshell No.4

These Twin wasp engines have the following characteristics.

1. 14 cylinders arranged in two banks of seven each.
2. Radial design, air cooled.
3. Compression Ratio 6.7 to 1.
4. 1830 cubic inches of cylinder displacement.

7.1.2. Engine Installation

1. Front or Nose Section
   This section houses the propellor reduction gear which is a means of reducing propellor speed relative to crankshaft speed the ratio being 16:9. Mounted on this section is the propellor constant speed unit with the necessary oil passages, which lead the oil to the propellor via the centre of the propellor shaft.

7. POWER (CONT'D)

7.1. POWER PLANT (CONT'D)

7.1.2. Engine Installation (cont'd)

2. Power section
This section secured to the aft end of the (front or reduction gear section) consists of the crankcase which houses the crankshaft attached to which is the master rod and connecting rods for the pistons which operate in the cyclinders supported around the crankcase. The cam packs and cam followers used to operate the overhead valves on each cyclinder via their respective push rods, are also in the crankcase. The induction system and exhaust system manifolds complete the power section.

3. Blower Section:
The blower section secured to the aft end of the power section has the mounting pads for the carburettor on its top surface and also this section houses the impellor (Supercharger) and diffuser which is the means of increasing the pressure of the charge which is led to the respective cyclinders via their induction pipes. This casing has a fuel drain (volute drain) positioned in its lower surface, the purpose of this valve is to drain away to atmosphere any excess fuel that may collect in the bottom of the casing prior to start up; after start up, the valve automatically closes due to pressure difference between this case and atmosphere.

4. Rear Section
This section secured to the aft end of the blower section houses the necessary driving gear trains that operate all the accessories that are attached to the surface of this casing such as:- fuel pump oil pump, starter motor, generator, magnetos, vacuum pump etc.

7.1.3. Engine Ignition
The ignition system includes ignition switches, induction vibrator, magnetos, ignition harness and spark plugs. The two Scintilla magnetos installed on the rear accessory section of each engine distribute the current to the spark plugs through the ignition wiring and harness. The ignition switch leads connect with the left magneto and the induction vibrator, the induction

7. POWER (CONT'D)

7.1. POWER PLANT (CONT'D)

7.1.3. Engine Ignition:(cont'd)

Vibrator then connects to the right magneto.

Two Lodge spark plugs are installed in each of the 14 cyclinders, individual leads extend from the distributor block of the magneto to each spark plug.

The ignition switch unit incorporates two ignition switches for each engine. When both switches are "OFF" the circuits are grounded out and inoperative. When the left or NO.1 switch is "OFF" and the right or No.2 switch is "ON" the right magneto circuit is "OPEN" and spark is furnished to the front spark plugs of all cyclinders. When the left No.1 switch is "ON" and the right No.2 switch is "OFF" the left magneto circuit is "OPEN" and spark is furnished to the rear plugs. When both switches are "ON" both circuits are open and both magnetos are operating

7.1.4. Throttle Controls:

Each throttle control consists of its own completely sealed exactor hydraulic system. The transmitter is located below the throttle lever on the control pedestal and movement is transmitted by hydraulic pressure through a copper pipeline to the exactor receiver mounted on the forward face of the engine firewall and from the receiver by a control rod to the control on the carburettor.

All four throttles (systems) must be "bled" before each start. This is accomplished by placing the throttles in the full open position and holding them against their spring tension for approximately 5 secs. In the event of failure of a throttle oil line in the exactor hydraulic_system the carburettor butterfly will move to the open position. To ensure overboosting of the engine does not occur, remain above rated altitude, feather below 7,500 ft.

7.1.5. Mixture Controls:

The mixture control is a direct cable control from a pulley below the control lever on the pedestal to another pulley on the forward face of the engine firewall thence via a control rod to the mixture control unit on the carburettor. The control positions for Auto Lean and Auto Rich are felt on the pedestal when the notches on the clover leaf plate of the mixture

7. POWER (cont'd)
7.1. POWER PLANT (cont'd)
7.1.5. Mixture Controls (cont'd)

control unit themselves are engaged. The quadrant is also suitably marked to show the relevent mixture control positions.

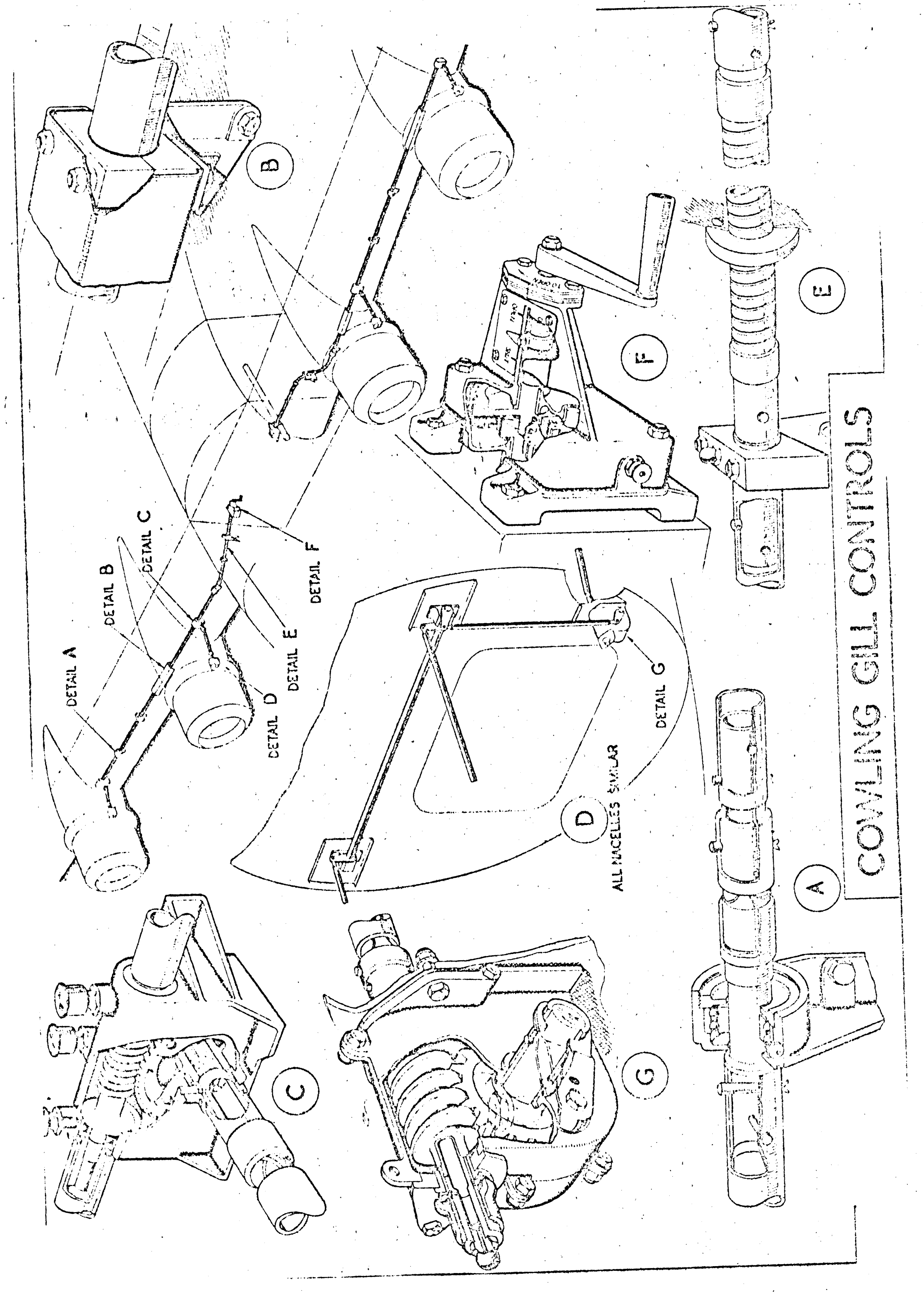
The mixture control has four positions:-

Emergency Rich
Auto Rich
Auto Lean
Idle Cut Off

When the mixture control is in the Auto Rich or Auto Lean position, an aneriod diaphragm automatically adjusts the fuel/air ratio for altitude. In emergency rich, the aneriod does not operate and the carburettor passes the sea level rich flow of petrol at all altitudes. Emergency Rich should only be used in the case of malfunctioning of an engine due to a faulty aneriod, or to pass extra fuel to cool the engine if the head temperature rises in excess of 232°C. Auto Rich mixture should be used for all operations requiring more than 700 BHP (climb on asymmetric) and if the head temperature rises above 220°c. at any time. Auto lean mixture should be used in all cruising operations when the power used will be 700 BHP or less. The mixture control should not be placed in the Auto Lean position while the head temperature is above 220°c. On all occasions when it is necessary to stop an engine, including feathering, it shall be done by placing the mixture control in the IDLE CUT OFF position.

7.1.6. Carburettor Air Controls:
The carburettor air induction system to each engine is controlled by levers, operated from the flight engineers panel. Each control lever has a thumb-operated catch-type lock that enables the control to be locked in the fully closed position. The control is held in the fully open position by spring tension.

A venetian type shutter on the air scoop mounted on the top of each engine controls the amount of cold air entering the system. When the passage from the scoop is closed by the shutter warm air from around the engine compartment is admitted to the


COWLING GILL CONTROLS
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
ALL NACELLES SIMILAR
A
B
C
D
E
F
G

7. POWER (CONT'D)

7.1.6. Carburettor Air Controls (cont'd)
carburettor system. The shutter is held open by a spring and is operated by direct cable to the control lever on the panel.

Carburettor heat is only to be used when required for preventing carburettor ice. Normally a carburettor air temperature of 15° to 38°C will keep the carburettor free from ice. In extreme cases there may not be sufficient heat to clear the ice after it has formed, so when entering icing areas at very low temperatures, 15° to 20°C of carburettor heat should be applied before ice forms. If the carburettor cannot be kept clear of ice, the steps listed under (ICING Section 4.) should be applied.

7.1.7. Cowl Gills:
Cowl gill operation is by means of hand cranks located at the Flight Engineers compartment bulkhead. Cowl gills should be used at all times to carefully maintain cylinder head temperatures within the operating limits.

7.2. ENGINE LIMITATIONS.

INSTRUMENT.	MIN.	MAX.	DESIRED.
Cylinder Head Temp.C°:			
Ground Run.	100.	232.	-
Pre Take-Off.	100.	200.	120/170.
Take-Off.	120.	260.	200/232.
Climb.	120.	232.	200/220.
Cruise.	120.	232.	180/200.
Three Engine. (M.E.T.O.)	-	260.	-
Three Engine. (Normal).	120.	232.	-
Oil Pressure, lb/sq.in.			
Ground Run.	80.	100.	80/90.
Take-Off.	80.	100.	80/90.
Rated Power. (M.E.T.O.)	80.	100.	80/90.
Cruise.	65.	95.	75/95.
Idling Min.	15.	-	-

7. POWER. (CONT'D)

7.2 Engine Limitations. (Cont'd)

INSTRUMENT.	MIN.	MAX.	DESIRED.
Oil Temp. °C.			
Ground Run.	40.	70.	-
Pre Take-Off.	40.	70.	-
Take-Off.	40.	85.	65/70.
Climb.	40.	85.	65/80.
Cruise.	40.	80.	65/75.
Three Engine. (M.E.T.O.)	-	85.	-
Three Engine. (Normal.)	-	85.	70/80.
Fuel Press. lbs/sq.in.			
Ground Run.	15.	19.	16/18.
Pre Take-Off.	15.	19.	16/18.
All other cond's.	15.	19.	16/18.
Carb Air Temp. °C.			
	Pre-heat of 25°C under any cond of O.A.T.	35°C.	FUll COLD. or 35°C in icing cond.
Vacuum Pressure.	3.75"Hg,	4"Hg.	4.25"Hg.

7.2.1. Considerations.

Idling engines at 800-1000 r.p.m.
During prolonged periods of idling, clear plugs with bursts to 1200 r.p.m. particularly just prior to take-off.
Limit taxying r.p.m. to 1300 r.p.m. under normal conditions.

Ground Run. (Static Boost Check) is to be carried out prior to take-off at all times, at sea level Barometric Pressure (BARO). Full power r.p.m. , is indicated on placard in cockpit.(PLACARD).

If cylinder head temperatures exceed maximum prior to Take-Off (200°C) overheating may be encountered during T/O or initial climb. Temperatures should be reduced to at least maximun allowed pre T/O by idling engines at 800-1000 r.p.m.

NOTE. Engines should not be shut down to allow cooling as this can cause (Cooked) leads , with subsequent failure of the ignition system.

Take-Off. Limit T/O power to 2 minutes maximum. Mixture control in Auto-Rich.(Emergency Rich results in loss of power.) Reduce to Rated Power at 105 Kts.

7. POWER (CONT'D)

7.2. ENGINE LIMITATIONS (CONT'D)

7.2.1. Considerations:

Reduce to Climb power at 500' and check temperatures and pressures.

Climb and Three Engine Operation - Mixture Control to be in Auto Rich. Use Emergency Rich to keep Cylinder Head Temperatures below maximum if necessary.

Holding and Maximum Endurance - Normal operation, Mixture Control to be in Auto Lean and at Lowest safe Altitude.

Cruising between 1900 and 2050 r.p.m. and below 1700 r.p.m. is prohibited.

Normal Descent - All normal descents should be conducted at a maximum of 500 FPM and the power used should be the normal cruise power setting, except in turbulence when a power consistent with Flight conditions should be used. Care must be taken not to let the MP build up in excess of that shown for the particular altitude shown on the Power Chart with carburettor air temperature corrections applied.

Emergency or Rapid Descent - In the event that circumstances dictate a descent with reduced power, it is important to consider the possibility of engine damage resultant from the use of too low a manifold pressure in relation to RPM, causing a negative cylinder pressure which if prolonged is likely to cause a master rod bearing failure. Failures of this nature are invariably associated with evidence of excessive centrifugal loads as would be consistent with the use of high RPM and low boost combinations. This takes place when the prop is literally driving the motor with practically no balancing force when the throttle is nearly closed in higher than average airspeed conditions. The bearing is designed to operate continuously on positive loads and will not withstand negative loading excepting to a comparatively minor degree. It has always been good operating practice to consider a minimum manifold pressure for the RPM being used. The operating instructions for Pratt & Whitney engines specify that if manifold pressure is

7. POWER (CONT'D)
7.2. ENGINE LIMITATIONS (CONT'D)
7.2.1. Considerations (Cont'd)
Emergency or Rapid Descent (cont'd)

to be maintained below 20" Hg. the RPM should be reduced below 2,000. A more complete rule of thumb is to ensure that at least 1" Hg. of manifold pressure be used for each 100 RPM. Thus at 1,800 RPM 18" Hg. is the minimum manifold pressure unless a serious emergency exists.

Approach and Landing - It will be obvious that if 1" Hg. of manifold pressure for each 100 RPM is to be maintained during final approach, in most circumstances the application of this rule will be impracticable on some approaches, therefore lower manifold pressure settings will necessarily have to be used. However it is of the utmost importance that all power reductions be made as slowly as possible unless it is absolutely necessary for safety reasons to do otherwise.

Stopping Engines - When stopping the inboard engines the RPM should be increased to 1000 to clear excess fuel from the induction system and oil from the crahkcase; and the mixture control moved to IDLE CUT OFF. As the engines die the throttles should then be slowly advanced to the fully open position. When the engines have ceased to turn the ignition switches should be turned off.

NOTE: As a check on the operation of the vacuum pump on the stbd. inner engine the starboard outer engine should be stopped prior to the Stbd. inner engine at least once during a scheduled operation to ensure satisfactory operation of the pump. The starboard outer engine vacuum pump is checked when starting that engine.

7.3. POWER CHARTS (P. & W. R1830-90D)
7.3.1. General:
Engine operation is limited by a number of different factors.
High RPM results in destructive centrifugal and reciprocating strains.
Large BHP's impose dangerous loads on engine parts

7. POWER CONT'D

7.3. POWER CHARTS (P. & W. R.1830-90D)

7.3.1. General Cont'd.

High M.P's force into the cylinder heavy charges of fuel and air whose combustion may lead to excessive pressures and temperatures, if not to detonation. Relationship of these factors to the maximum pressure which may be developed in the cylinder during the power stroke, usually ex pressed indirectly in terms of BMEP and PSI.

Cylinder pressure is a useful guide to the pilot in selecting the particular combination of RPM and MP best suited to a given type of operation.

Since MP and cylinder pressure are closely related, this is equivalent to saying that a desired BHP may be obtained with an endless number of RPM cylinder pressure combinations.

On the other hand, if a low RPM is selected the cylinder pressure must be high, and may impose dangerous strain on the engine or bring about high cylinder temperature.

On the other hand, if, to avoid this condition, a High RPM is selected, internal friction, wear and fuel consumption will all be increased, with consequent inefficient operation.

AS the engines are supercharged and fitted with constant speed airscrews, care is required in their operation to ensure that the maximum allowable BMEP is not exceeded. All operations are to be in accordance with the Power Charts listed in this section, and care is to be exercised to ensure that the manifold pressure does not exceed that shown for any particular RPM setting or altitude.

7.3.2. Power Chart Procedures

1. The manifold pressures indicated on the power chart are computed for standard free air temperatures at each altitude. Since BHP is a function of manifold pressure, the latter must be corrected for carb. air temperature variations to produce a given BHP. The weight of the fuel/air charge delivered to the cylinders in a given time controls the engines power output, and if the temperature of the charge is raised its weight per unit volume at a particular manifold

7. POWER (CONT'D)

7.3. POWER CHARTS (CONTD)

7.3.2. (cont'd)

pressure decreases and power output falls off correspondingly. Hence, to maintain the weight of the charge and the engines BHP, manifold pressure must be increased as the carburettor air temperature is raised, and conversely decreased as the carb. air temperature lowers from those of standard temperature at altitudes as follows:-

1. Above standard temperature ADD .5" Hg. for each 6°C of carb. air temperature above standard.

2. Below standard temperature REDUCE .5" Hg. for each 6°C of carb. air temperature below standard.

NOTE: (a) No carburettor air temperature corrections are permitted for "Take Off" or power settings of 1000 BHP and above.

(b) The maximum CAT correction for ABOVE standard temperatures shall be restricted any time to a maximum of .5" Hg.

(c) Full CAT corrections shall be applied for all temperatures BELOW standard.

2. To maintain constant cruise or climb above full throttle increase engine speed by 50 RPM per 1000 feet above full throttle altitude.

3. Normal cruise power should be used for all descents. Ensure that manifold pressures are kept within limits for each altitude specified with CAT corrections applied.

4. Low cruise power should only be used when it is expected that the aircraft will arrive in excess of 20 minutes ahead of schedule.

5. Holding power manifold pressure settings should be reduced to maintain 120 knots indicated.

7.3.3. Normal Operation Power Chart (See Page - Opposite)

7.3.3. NORMAL OPERATION POWER CHART

PRESSURE ALTITUDE	TAKE-OFF 1200 BHP 2700 RPM AUTO RICH 192 BMEP	STAND. AIR TEMP.	INITIAL CLIMB 1050 BHP 2550 RPM AUTO RICH 178 BMEP	NORMAL CLIMB 800 BHP 2300 RPM AUTO RICH 150 BMEP	CRUISE CLIMB 700 BHP 2100 RPM AUTO RICH 144 BMEP	NORMAL CRUISE 600 BHP 2050 RPM AUTO LEAN 125 BMEP	LOW CRUISE 500 BHP 1900 RPM AUTO LEAN 116 BMEP	HOLDING 450 BHP 1800RPM AUTO LEAN 108 BMEP
SEA LEVEL	48	15°	42	- -	- -	30.2	28.5	- -
500'	48	14	42		32.5	30.2	28.2	- -
1,000		13	42	34.5	32.5	30.2	28.2	27.0
2,000		11		34.2	32.2	30.0	28.0	26.7
3,000		9		34.1	32.0	29.5	27.5	26.5
4,000		7		34.0	32.0	29.2	27.2	26.2
5,000		5		33.8	31.7	29.0	27.0	26.0
6,000		3		33.6	31.5	28.7	26.7	25.7
7,000		1		33.4	31.2	28.5	26.5	25.5
8,000		-1		33.2	31.0	28.2	26.2	25.2
9,000		-3		33.0	31.0	28.2	26.0	25.0
10,000		-5	--	32.9	30.7	28.0	25.7	24.7
11,000		-7	--		FT	FT	25.5	24.7
12,000		-9	--		FT	FT	25.2	24.5

7. POWER ((CONT'D)

7.3. POWER CHARTS (CONT'D)

7.3.4. Three Engine Power Chart Procedures

1. If an engine fails when using climb or cruise power, complete vital items listed in the cockpit check list and select initially full rated power (1050 BHP).

2. There after reduce power progressively through each three engine power range until an indicated speed of 115 knots is attained. Maintain this speed during cruise by further power reductions as required. (See Three Engine Cruise Charts for particular all Up Weight).

3. Carburettor Air Temperature corrections for variation from standard temperature should be made for all power with the exception of those of 1,000 BHP and above.

   (a) Above standard temperature ADD ½" MP for each 10°C of carburettor air temperature below standard.

   (b) Below standard temperature REDUCE ½" MP for each 10°C of carburettor air temperature below standard.

7.3.5. Three Engine Power Chart -(opposite)

7.3.5. THREE ENGINE POWER CHART

PRESSURE ALTITUDE	1050 BHP 2550 RPM 178 BMEP AUTO RICH FUEL CONS 309	1000 BHP 2250 RPM 169BMEP AUTO RICH FUEL CONS 294	STAND. AIR TEMP °C	950 BHP 2550 RPM 161 BMEP AUTO RICH FUEL CONS 273 GPH	910 BHP 2400 RPM 163 BMEP AUTO RICH 249 GPH	880 BHP 2400 RPM 158 BMEP AUTO RICH 237 GPH	850 BHP 2400 RPM 153 BMEP AUTO RICH 225 GPH	825 BHP 2300 RPM 155 BMEP AUTO RICH 210 GPH	800 BHP 2300 RPM 150 BMEP AUTO RICH 198 GPH
1,000'	42	40.3"	13°	38.3"	37.5"	36.5"	35.4"	35.6"	34.5"
2,000	41	40.0	11	38.1	37.3	36.3	35.2	35.3	34.2
3,000	41	39.8	9	37.8	37.2	36.1	35.0	35.2	34.1
4,000		39.5	7	37.6	37.0	35.9	34.8	35.0	34.0
5,000		39.2	5	37.4	36.8	35.7	34.6	34.8	33.8
6,000		39.0	3	37.2	36.6	35.5	34.4	34.6	33.6
7,000		38.8	1	37.0	36.4	35.3	34.2	34.3	33.4
8,000		38.6	-1.5	36.8	36.2	35.1	34.1	34.2	33.2
9,000			-3	36.6	36.0	35.0	34.0	34.0	33.0
10,000			-5	---	---	34.8	33.8	33.8	32.9

7. POWER (CONT'D)

7.3. POWER CHARTS (CONT'D)

7.3.6. Flight Plan Preparation:

1. All climb computations shall be computed from a IAS of 120 knots and an average rate of climb of 300 to 400 FPM.

2. Cruising speed shall be computed from a TAS of 140 knots using the power settings as per Cruise Power Charts.

3. Descent speed shall be based on cruise speed plus 5 knots depending on cruise altitude and distance to be covered.

4. Three engine TAS as required for critical point calculations shall be based on an indicated air speed of 115 knots corrected for altitude and forecast temperature.

5. Fuel loads in accordance with A.I.P's requirements shall be computed using the following consumption rates.

   (a) Take-off climb and cruise to destination at less than 3½ hours duration - 170 GPH.

   (b) On flights where the total flight time including the alternate (if required) exceeds 3½ hours the first 3½ hours shall be computed at 170 GPH and the remaining flight time computed at the rate of 150 GPH.

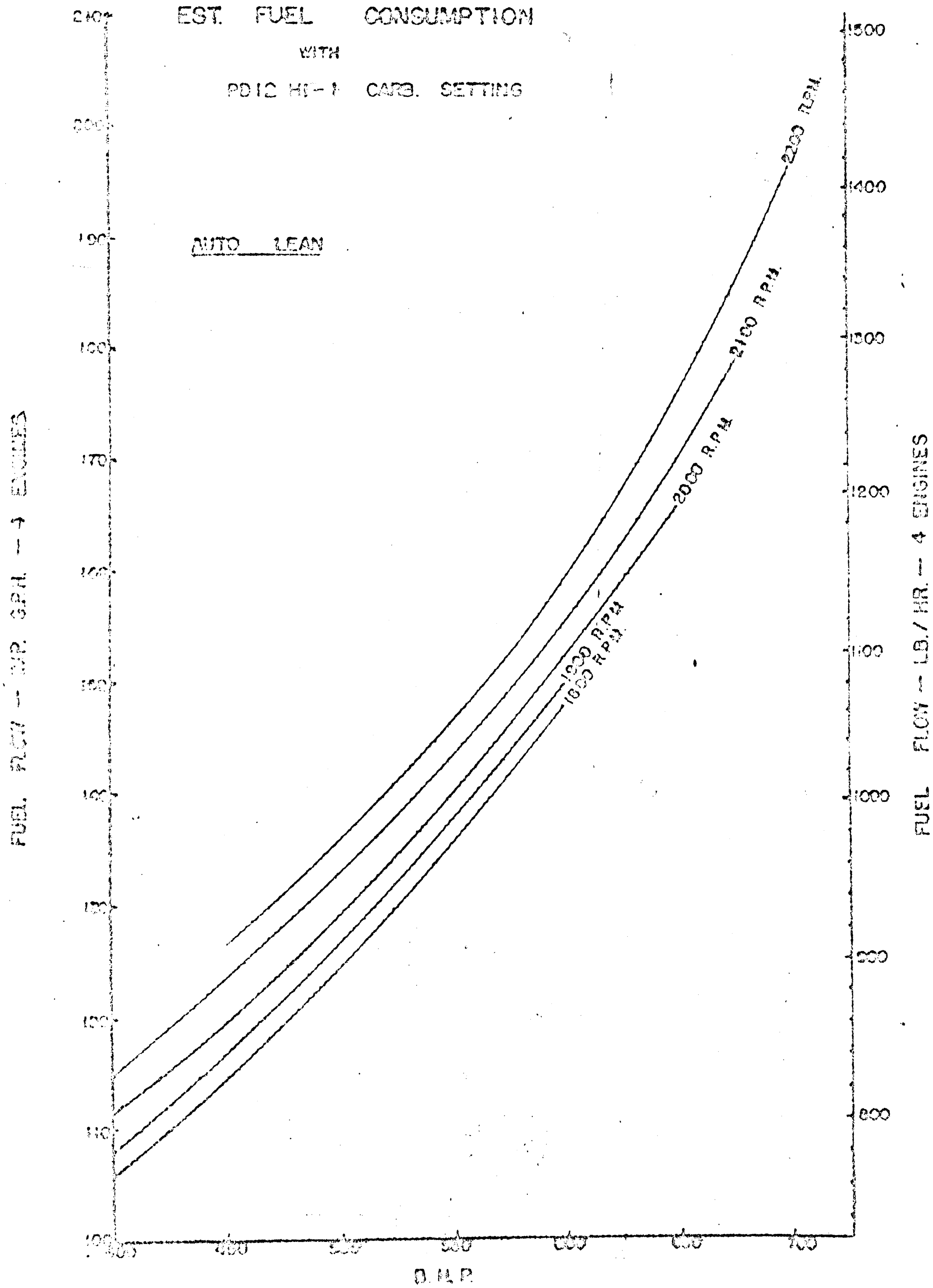
   (c) Holding fuel (where required) - 140 GPH.

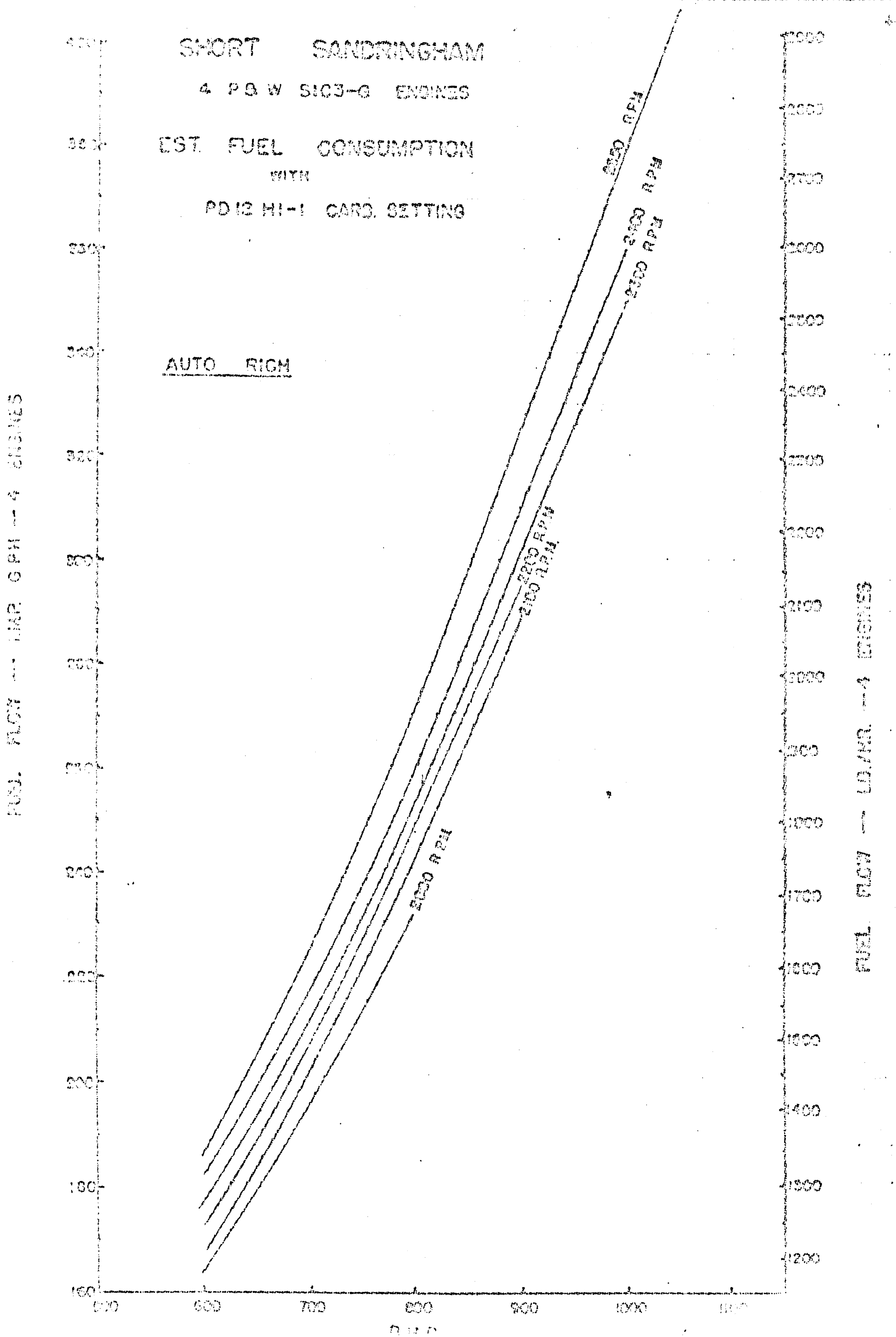
   (d) Three engine consumption rates as applicable for critical point calculations shall be based at the rate of 180 GPH.

   (e) Fuel Reserves shall be based at the rate of 150 GPH.

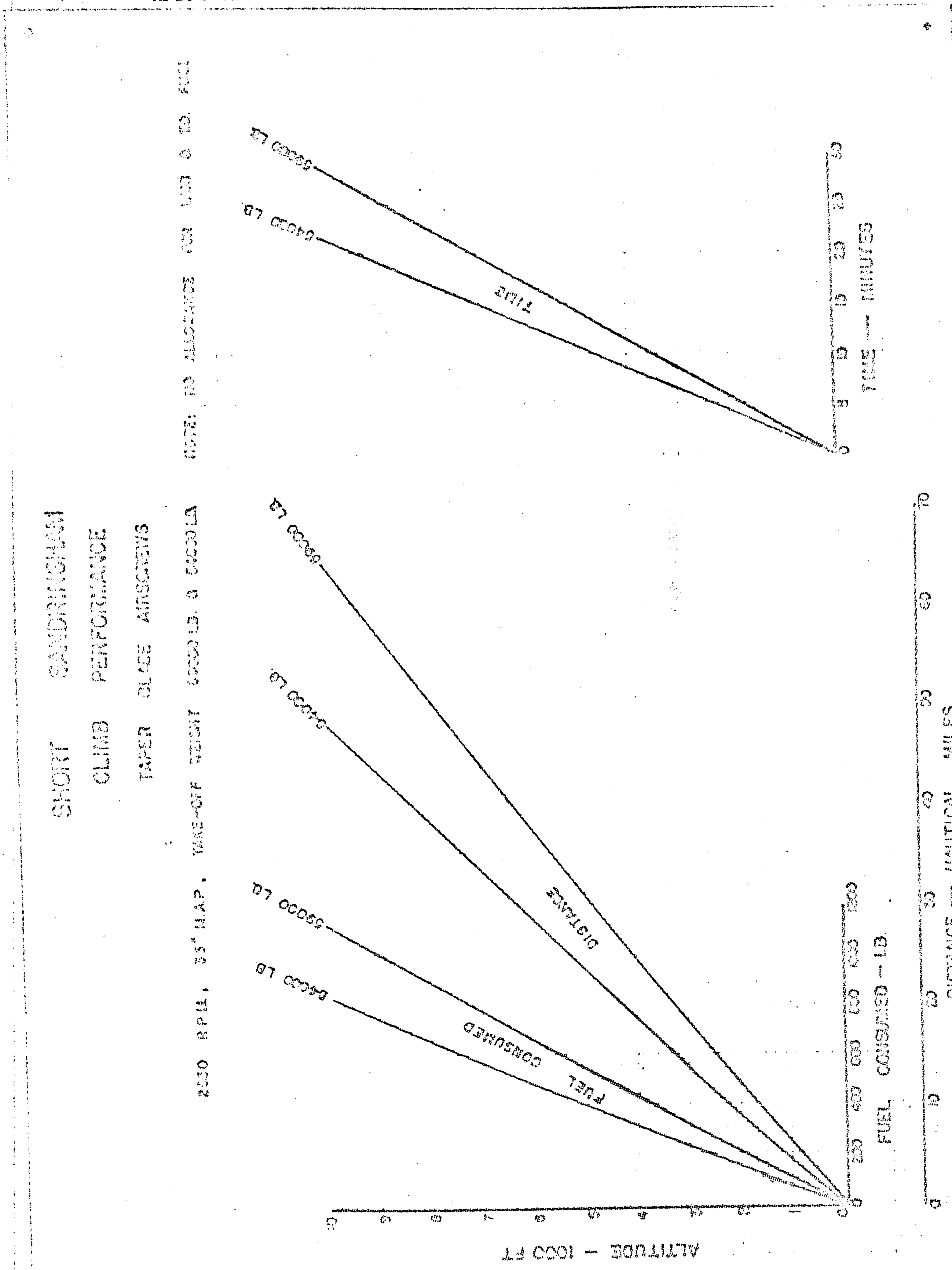
SHORT SANDRINGHAM

4 P & W S1C3-G ENGINES




SHORT SANDRINGHAM
4 P & W S1C3-G ENGINES
EST. FUEL CONSUMPTION
WITH
PD12 H1-1 CARB. SETTING
AUTO RICH
2550 RPM
2400 RPM
2300 RPM
2200 RPM
2100 RPM
2000 RPM
FUEL FLOW — LB/HR. —4 ENGINES
1200
1300
1400
1700
2400
2500
600
700
800
900
1000

CLIMB PERFORMANCE



7.3.11. Constant Speed Cruise 53000/47000 lbs.

SHORT SANDRINGHAM — P & W S1C3-G ENGINES

125 KNOT CONSTANT SPEED CRUISE

WEIGHT 53000 - 51000 LBS.

PRESS. ALTITUDE FT.	TEMPERATE SUMMER STD TEMP °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F. LBS./HR.
2000	23	125	131	525	2050	27	982
2500	22	125	132	529	2050	27	986
3000	21	125	133	532	2050	27¼	990
3500	20	125	134	537	2050	27¼	997
4000	19	125	135	541	2050	27¼	1004
4500	18	125	136	545	2050	27½	1011
5000	17	125	137	549	2050	27½	1018
5500	16	125	138	554	2050	27½	1024
6000	15	125	139	558	2050	27½	1030
6500	14	125	140	563	2050	27¾	1039
7000	13	125	142	567	2050	27¾	1047
7500	12	125	143	571	2050	27¾	1052
8000	11	125	144	575	2050	28	1058
8500	10	125	145	580	2050	28	1067
9000	9	125	146	584	2050	28¼	1075
9500	8	125	147	589	2050	28¼	1083
10000	7	125	148	593	2050	28¼	1090

WEIGHT 51000 - 49000 LBS.

PRESS. ALTITUDE FT.	TEMPERATE SUMMER STD TEMP °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
2000	23	125	131	507	2050	26½	955
2500	22	125	132	512	2050	26½	961
3000	21	125	133	514	2050	26½	966
3500	20	125	134	518	2050	26¾	971
4000	19	125	135	522	2050	26¾	976
4500	18	125	136	526	2050	26¾	983
5000	17	125	137	530	2050	26¾	987
5500	16	125	138	534	2050	26¾	994
6000	15	125	139	538	2050	27	998
6500	14	125	140	542	2050	27	1005
7000	13	125	142	546	2050	27	1012
7500	12	125	143	551	2050	27	1018
8000	11	125	144	555	2050	27¼	1025
8500	10	125	145	560	2050	27¼	1035
9000	9	125	146	564	2050	27¼	1042
9500	8	125	147	569	2050	27¼	1049
10000	7	125	148	573	2050	27¼	1055

WEIGHT 49000 - 47000 LBS.

PRESS. ALTITUDE FT.	TEMPERATE SUMMER STD TEMP °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
2000	23	125	131	489	2050	25¾	950
2500	22	125	132	493	2050	25¾	954
3000	21	125	133	496	2050	25¾	937
3500	20	125	134	500	2050	26	945
4000	19	125	135	504	2050	26	948
4500	18	125	136	508	2050	26	955
5000	17	125	137	512	2050	26	961
5500	16	125	138	516	2050	26	968
6000	15	125	139	520	2050	26	973
6500	14	125	140	524	2050	26¼	979
7000	13	125	142	528	2050	26¼	985
7500	12	125	143	532	2050	26¼	990
8000	11	125	144	535	2050	26¼	995
8500	10	125	145	540	2050	26¼	1002
9000	9	125	146	544	2050	26¼	1009
9500	8	125	147	549	2050	26¼	1018
10000	7	125	148	553	2050	26¼	1023

ADD 0·25" M.A.P. FOR EACH 0°C RISE IN CARBURETTOR AIR TEMPERATURE ABOVE TEMPERATE SUMMER STD TEMPO [illegible]

59000/53000 lbs.

CRUISING CONTROL

SHORT SANDRINGHAM — P & W S1C3-G ENGINES

125 KNOT CONSTANT SPEED CRUISE

PRESS. ALTITUDE FT.	TEMPERATURE STD TEMP °C	WEIGHT 59000 - 57000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F. LBS./HR.	WEIGHT 57000 - 55000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.	WEIGHT 55000 - 53000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
2000	23	125	131	584	2050	29¾	1075	125	131	566	2050	29	1043	125	131	544	2050	28	1010
2500	22	125	132	588	2050	29¾	1082	125	132	570	2050	29	1051	125	132	548	2050	28	1015
3000	21	125	133	593	2050	29¾	1088	125	133	575	2050	29	1060	125	133	552	2050	28	1020
3500	20	125	134	597	2050	29¾	1102	125	134	579	2050	29	1066	125	134	556	2050	28¼	1027
4000	19	125	135	602	2050	30	1110	125	135	583	2050	29	1073	125	135	560	2050	28¼	1034
4500	18	125	136	607	2050	30	1118	125	136	588	2050	29¼	1082	125	136	565	2050	28¼	1043
5000	17	125	137	611	2050	30	1125	125	137	592	2050	29¼	1090	125	137	570	2050	28½	1051
5500	16	125	138	615	2050	30	1136	125	138	596	2050	29¼	1102	125	138	575	2050	28½	1060
6000	15	125	139	620	2100	29½	1157	125	139	601	2050	29½	1110	125	139	579	2050	28½	1066
6500	14	125	140	625	2100	29¾	1167	125	140	606	2050	29½	1117	125	140	584	2050	28¾	1077
7000	13	125	142	630	2100	29¾	1178	125	142	611	2050	29½	1125	125	142	588	2050	28¾	1082
7500	12	125	143	634	2150	29½	1207	125	143	615	2050	29½	1136	125	143	592	2050	28¾	1090
8000	11	125	144	639	2150	29½	1217	125	144	620	2100	29½	1157	125	144	596	2050	29	1102
8500	10	125	145	644	2150	29½	1230	125	145	625	2100	29½	1167	125	145	600	2050	29	1107
9000	9	125	146	649	2150	29½	1234	125	146	630	2100	29½	1178	125	146	605	2050	29	1115
9500	8							125	147	635	2150	29¼	1207	125	147	610	2050	29	1125
10000	7							125	148	640	2150	29¼	1217	125	148	615	2050	29¼	1136

ADD 0.25" M.A.P. FOR EACH 6°C RISE IN CARBURETTOR AIR TEMPERATURE ABOVE [illegible] STD TEMP [illegible]

7.3.12. Three Engine Cruise 59000/[illegible] lbs

CRUISING CONTROL

SHORT SANDRINGHAM — P & W S1C3-G ENGINES

THREE ENGINE CRUISE - 115 KNOTS I.A.S.

AUTO RICH MIXTURE

WEIGHT 59000 - 57000 LBS.

PRESS. ALTITUDE FT.	STD. TEMP. °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
[illegible]	23	115	120	[illegible]	2550	32	[illegible]
[illegible]	22	115	121	[illegible]	2550	32¼	[illegible]
[illegible]	21	115	122	[illegible]	2550	32½	1464
[illegible]	20	115	123	800	2550	32¾	1481
4000	19	115	124	807	2550	33	1499
4500	18	115	125	813	2550	33	1515
5000	17	115	126	819	2550	33¼	1530
[illegible]	16	115	127	825	2550	33½	1547
[illegible]	15	115	128	832	2550	33½	1564
[illegible]	14	115	129	837	2550	33¾	1581
7000	13	115	130	845	2550	34	1598
7500	12	115	131	850	2550	34	1615
[illegible]	11	115	132	856	2550	34¼	1630
[illegible]	10	115	133	863	2550	34¼	1650
[illegible]	9	115	134	871	2550	34¼	1670
[illegible]	8	115	135	878	2550	34½	[illegible]
[illegible]	7	115	136	885	2550	34½	1710

WEIGHT 57000 - 55000 LBS.

PRESS. ALTITUDE FT.	STD. TEMP. °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
[illegible]	23	115	120	762	2400	32¼	1310
[illegible]	22	115	121	768	2400	32¼	1325
[illegible]	21	115	122	773	2550	[illegible]	1405
[illegible]	20	115	123	779	2550	32	1415
4000	19	115	124	785	2550	32¼	1433
4500	18	115	125	791	2550	32¼	1451
5000	17	115	126	797	2550	32½	1469
[illegible]	16	115	127	803	2550	32½	1486
[illegible]	15	115	128	809	2550	32¾	1503
[illegible]	14	115	129	815	2550	32¾	1520
7000	13	115	130	822	2550	33	1535
7500	12	115	131	828	2550	33	1553
[illegible]	11	115	132	834	2550	33¼	1572
[illegible]	10	115	133	841	2550	33¼	1591
[illegible]	9	115	134	848	2550	33½	1610
[illegible]	8	115	135	855	2550	33½	1629
[illegible]	7	115	136	861	2550	33¾	1643

WEIGHT 55000 - 53000 LBS.

PRESS. ALTITUDE FT.	STD. TEMP. °C	I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
[illegible]	23	115	120	733	2400	31¼	1248
[illegible]	22	115	121	740	2400	31½	1261
[illegible]	21	115	122	744	2400	31½	1274
[illegible]	20	115	123	751	2400	31¾	1287
4000	19	115	124	757	2400	32	1300
4500	18	115	125	762	2400	32	1313
5000	17	115	126	768	2400	32	1325
[illegible]	16	115	127	774	2550	32	1407
[illegible]	15	115	128	780	2550	32	1424
[illegible]	14	115	129	786	2550	32	1440
7000	13	115	130	791	2550	32	1457
7500	12	115	131	797	2550	32¼	1474
[illegible]	11	115	132	[illegible]	2550	32¼	1490
[illegible]	10	115	133	[illegible]	2550	32¼	1507
[illegible]	9	115	134	815	2550	32¼	1524
[illegible]	8	115	135	822	2550	32½	1540
[illegible]	7	115	136	[illegible]	2550	32½	1555

ADD 0.25" M.A.P. FOR EACH 5°C RISE IN CARBURETTOR AIR TEMPERATURE ABOVE TEMPERATURE [illegible]

7.3.13. Three Engine Cruise 53000/47000 lbs.

CRUISING CONTROL

SHORT : SANDRINGHAM — P & W S1C3-G ENGINES

THREE ENGINE CRUISE - 115 KNOTS I.A.S.

AUTO RICH MIXTURE

PRESS. ALTITUDE FT.	TEMPERATURE NUMBER STD. TEMP °C	WEIGHT 53000 - 51000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.	WEIGHT 51000 - 49000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.	WEIGHT 49000 - 47000 LBS. I.A.S. KNOTS	T.A.S. KNOTS	B.H.P./ENG.	ENG./R.P.M.	M.A.P. INS. HG.	EST. F/F LBS./HR.
2000	23	115	120	708	2300	31¼	1160	115	120	682	2200	31½	1080	115	120	681	2200	31	1040
2500	22	115	121	713	2300	31¼	1171	115	121	687	2200	31½	1090	115	121	666	2200	31	1051
3000	21	115	122	718	2300	31¼	1182	115	122	692	2200	31½	1100	115	122	671	2200	31	1062
3500	20	115	123	723	2300	32	1194	115	123	697	2200	31¾	1110	115	123	676	2200	31	1073
4000	19	115	124	729	2300	32	1205	115	124	702	2300	31	1150	115	124	681	2200	31	1084
4500	18	115	125	734	2400	31½	1248	115	125	708	2300	31½	1162	115	125	686	2200	31	1095
5000	17	115	126	740	2400	31½	1261	115	126	713	2300	31½	1174	115	126	691	2200	31¼	1105
5500	16	115	127	745	2400	31½	1274	115	127	718	2300	31½	1186	115	127	697	2200	31¼	1115
6000	15	115	128	752	2400	31¾	1287	115	128	724	2300	31½	1198	115	128	702	2300	30½	1150
6500	14	115	129	757	2400	31¾	1300	115	129	730	2300	31½	1210	115	129	707	2300	30½	1162
7000	13	115	130	763	2400	32	1312	115	130	735	2400	31	1255	115	130	713	2300	31	1174
7500	12	115	131	769	2400	32	1325	115	131	741	2400	31	1268	115	131	718	2300	31	1186
8000	11	115	132	775	2550	31½	1405	115	132	747	2400	31	1281	115	132	724	2300	31¼	1198
8500	10	115	133	781	2550	31½	1421	115	133	753	2400	31½	1294	115	133	730	2300	31¼	1210
9000	9	115	134	787	2550	31¾	1437	115	134	759	2400	31½	1307	115	134	736	2400	30½	1235
9500	8	115	135	793	2550	31¾	1453	115	135	765	2400	31½	1320	115	135	743	2400	31	1273
10000	7	115	136	800	2550	32	1470	115	136	771	2400	31½	1335	115	136	747	2400	31	[illegible]

ADD 0.25" M.A.P. FOR EACH 6°C RISE IN CARBURETTOR AIR TEMPERATURE ABOVE TEMPERATURE SHOWN ON THESE TABLES

7.3. 14. CRUISE

PRESS. ALTITUDE	Std. Temp. °C.	CRUISE POWER (Mixture Auto Lean)								
		BHP 650	640	620	600	580	560	540	520	500
		BMEP 134	132	128	126	122	127	123	125	120
		GPH 171	168	163	155	153	142	137	130	124
		RPM 2100	2100	2100	2050	2050	1900	1900	1800	1800
		MP	MP	MP	MP	MP	MP	MP	MP	MP
1000	13	31.5	31.25	30.5	30.25	29.5	30.5	29.75	30	29
2000	11	31.5	31	30.5	30	29.5	30.25	29.25	29.75	28,75
3000	9	31.2	30.75	30.25	29.5	29.	30.	29.	29.25	28.5
4000	7	31.	30.5	29.75	29.25	29	29.5	28.75	29.	28.25
5000	5	30.7	30.25	29.5	29.	28.5	29.25	28.5	28,75	28.
6000	3	30.5	30	29.25	28.75	28,25	29	28.25	28,5	27.75
7000	1	30.25	29.75	29.25	28.75	28	29	28	28.25	27.5
8000	-1	30	29.75	28.75	28.5	28	28.75	28	28.25	27.25
9000	-3	29.75	29.5	28.75	28.5	27.5	28.5	27.75	28	27
10000	-5	29.5	29.5	28.5	28.25	27.5	28.25	27.5	27.75	26.75
11000	-7	29.25	29.25	28.25	28	27.25	28	27.25	27.5	26.5

NOTES:
1. Prohibited range 1900-2050 and below 1700 R.P.M.
2. Use auto rich to keep cylinder head temperature below 232°C.
3. For every 10°C Carb. Air is above standard add 5" ($\frac{1}{2}$") MP.
4. For every 10°C below standard subtract - 5" ($\frac{1}{2}$") M.P. Maximum adjustment 1" M.P.
   Maximum Carb. Air Temperature 35°C.
5. Maximum Oil Temperature 85°C.

7.3.15 Holding - Maximum Endurance

ALTITUDE	Std. Temp.	HOLDING POWER (Mixture Auto Lean)				
		BHP 500	475	450	425	400
		GPH 125	120	110	105	100
		RPM 1800	1800	1700	1700	1700
		MP	MP	MP	MP	MP
1000	+13	29	28.25	28.25	27.25	26
2000	+11	28.75	28	28	27	25.75
3000	+9	28.5	27.5	27.75	26,75	25.5
4000	+7	28.25	27.25	27.5	26.5	25.25
5000	+5	28	27	27.25	26.25	25
6000	+3	27.75	26.75	27	26	
7000	+1	27.5	26.5	26.75	25.75	
8000	-1	27.25	26.25	26.5	25.5	
9000	-3	27	26	26.25	25.25	
10000	-5	26.75	25.75	26	25	
11000	-7	26.5	25.5	25.75	24.75	

NOTE:
1. Prohibited range 1900-2050 and below 1700 R.P.M.
2. Use Auto Rich to keep Cylinder Head Temperature below 232°C.
3. For every 10°C Carb. Air is above Standard, add .5" (½")M.P. For every 10°C below subtract .5" (½")M.P. Maximum adjustment 1" M.P.
4. Maximum Carb. Air Temperature 35°C.
5. Maximum Oil Temperature 85°C.

	MAXIMUM ENDURANCE: (Mixture Auto Lean)		
Altitude 2000	BHP 425 GPH 105 RPM 1700 MP 27 IAS 115	400 100 1700 25.75 110	375 95 1700 24.75 * 110

NOTE:
1. IAS in knots for Maximum Endurance at Lowest safe altitude
2. For each 1000 feet. altitude above 2000 ft., reduce MP .25" (¼")

7. POWER (CONT'D)

7.4. EMERGENCY CLIMB POWERS (One or two engine inoperative)

In a specific case of emergency, the Captain will decide the extent to which emergency power will be applied. Due regard must be given to the necessary compromise between the safety of the aircraft and its occupants and the inevitable increase in engine wear incurred by the use of high power output.

Sufficient power should be applied to afford a reasonable safety margin wherever possible.

When operating engines at high outputs check cylinder head and oil temperatures frequently, and use richer mixture and open cowl gills respectively to maintain these temperatures within safe limits.

7.5. EMERGENCY CRUISE POWERS:

Emergency cruise power will normally only be applied when one engine is inoperative.

For normal three engine operation, set up METO power initially and refer to Section 7.3.7. - Three Engine Cruise.

It is important that very low cruising airspeed be avoided as overheating of cylinder Heads and oil will result.

The lower speeds should be used in smooth air conditions and speeds should be increased with increasing turbulence to enable height to be maintained.

The power required to maintain these airspeeds will vary with aircraft gross weight, altitude and severity of turbulence.

8. GENERAL PARTICULARS

The Sandringham IV is a high wing monoplane flying boat fitted with four Pratt & Whitney "Twin Wasp" power plants type R1830-90D.

The Hull is of light-alloy construction with the planing bottom divided into water-tight compartments by vertical bulkheads. It has transverse frames with intercostal stiffeners and heavily constructed double-frames for main plane attachment. The main planes are of light alloy construction, and have torsion box spars consisting of a front and rear truss built of "T" section extruded booms and tublar struts. The engine nacelles are built onto the leading edge of the mainplane. A portion of the leading edge on both sides of each engine nacelle hinges downwards to facilitate engine servicing. "Gouge" type trailing edge flaps are fitted below the mainplane and "Frise" type ailerons with fabric covering and metal nosing are attached outboard. There are fixed Trimming tabs on each aileron.

The tail unit consists of the tail plane elevators fin and rudder all of which are light alloy construction similar to the mainplane.

The elevators have a metal covered leading edge and a fabric covered trailing edge with a three-hinge attachment to the tailplane. A Pilot operated Trimming Tab is inset at the inboard edge of the Trailing edge.

The rudder is similar in construction to the elevators with an automatic balance tab fitted.

The wing tip floats are of light alloy construction with streamlined attachment struts and wire bracing.

The flying controls for the ailerons rudder and elevators are runs of tie-rods, cables and chains and the trimming tabs for rudder and elevators are control runs of cables and chains.

The leading particulars are:-

1.	Span	112 ft. 9.5. ins.
	Length	85 ft. 4.1. ins.
	Height with A/C on Beaching Chassis	32 ft. 2 ins.
2.	Mainplane	
	Chord-mean-aerodynamic	15 ft. 8.5 ins.
	Incidence	5 degrees
	Dihedral	50 minutes
	Sweep back	4 degrees in 15 ft

8. GENERAL PARTICULARS (CONT'D)

3. Fin and Rudder

Chord at the root	12 ft. 6 ins.
" theoretical at tip	6 ft. 4 ins.
" meanaero	9 ft. 9 ins.

4. Hull

Length Overall	85 ft. 4.1 ins
Height over fin stub	17 ft.10.37 ins.
Max. width	10 ft. 2.3. ins.
Distance between floats	68 ft. 4 ins.

5. Wing Areas

Mainplanes - total with Ailerons and Flaps	1487.61 sq. ft.
Ailerons Total	134.4 sq. ft.
Flaps Total	286.24 sq. ft.

8.1. FUEL SYSTEM::

8.1.1. Description:

The fuel system includes:-

2 Inner tanks, 2 centre tanks and 2 outer tanks
Tank selector valves.
Balance cock
2 Booster pumps operated by switches.
Priming system for each engine.
Multiple contents gauges.
Engine driven fuel pumps (one each engine with integral relief valves).

Fuel flowmeters.
~~Automatic~~ mixture control.
Manual Mixture control.
Fuel filter for each engine.
Fire Wall Shut off valves (one for each engine).

8.1.2. Fuel:

Carburettors have been adjusted and powers placarded for use of 100/130 Octane fuel (GREEN), which should be used at all times.

100 OCTANE fuel shall be used for all normal operations. If in an emergency it is necessary to accept 91 Octane fuel it is desirable when possible that such requirements be placed in an outboard tank and reserved for operation if required during CRUISE. It should be noted that because of the -1 carburettor setting as applicable for 100 octane useage,

8. GENERAL PARTICULARS. (CONT'D).

8.1.2. FUEL SYSTEMS: (CONT'D).

8.1.2. Fuel (cont'd)

operation at normal power settings with 91 octane fuel will possibly entail detonation , resultant from a reduced fuel flow and as a precaution therefore it will be essential to reduce the normal indicated manifold pressure for each power used by 2" Hg. This proceedure should also apply in the event of the need to add 91 octane to tanks already containing 100 octane.

NOTE:- Should it be necessary to reduce power at take-off by 2" Hg , under the above set of circumstances an All Up Weight reduction should be made to counter the loss of take-off B.H.P.

8.1.3. Tanks:

Fuel tanks are located within the centre wing and are vented to atmosphere. Both Port and Starboard side tanks feed to a common distributor box located in each wing root.

The distributor boxes are fitted with weatherhead drains so that water checks can be carried out after refueling.

Port and starboard carburettor vapour vent lines feed back to their respective inboard fuel tanks.

Tank capacities:		
	Inboard Tanks.	529 imp galls each.
	Centre Tanks.	355 imp galls each.
	Outboard Tanks.	132 imp galls each.

Total fuel capacity thus being: 2032 imp galls.

Provision is also made for the fitting of two additional trailing edge tanks in either wing.
Capacities of these tanks when fitted are:-

Inboard trailing edge tank 111 imp galls.
Outboard trailing edge tank 149 imp galls.

Total Fuel Tank Capacities (All Tanks Fitted).

Outboard Tanks.	264 imp galls.
Centre Tanks.	710 imp galls.
Inboard Tanks.	1058 imp galls.
Rear Inner Tanks	222 imp galls.
Rear Outer Tanks	298 imp galls.
Total Fuel Capacity	2552 imp galls.

8. GENERAL PARTICULARS. (CONT'D).

8.1. FUEL SYSTEMS. (CONT'D).

8.1.4. Fuel Tank Selector Valves:

Selector valve control levers located at flight engineers station. Use fuel from inboard tanks, followed by centre tanks , and finally outboard tanks.

8.1.5. Fuel Balance & Crossfeed.

Fuel crossfeeding or balancing is controlled from the flight engineers station , and can be carried out either by gravity feeding via the balance valve or pressure feed utilizing the aircraft booster pumps, and 5 way wing junctions.

8.1.6. Electric Fuel Booster Pumps.

These are used to provide fuel pressure for engine priming on start , back up of engine driven fuel pumps during take-off or at altitude , in the event of an engine driven pump failure and in conjunction with cross feeding.
The two pumps (Port & Starboard) immediately aft of each inboard engine are controlled from the flight engineer's station.

8.1.7. Engine Priming System.

The priming solenoid connects into the fuel pressure line , and is switch operated from the engine starting panel. A push button switch also situated on the starting panel is used to operate the fuel booster pump , which when used in conjunction with the solenoid switch allows fuel to flow to the supercharger section , then to the cylinders.

8.1.8. Automatic Mixture Control.

The A.M.C. is an aneriod partly filled with a light damping oil to prevent vibration, space remaining being filled with nitrogen at a pressure approaching the atmosphere its purpose being to provide a response to changes of pressure and temperature at altitude. The upper end of the aneroid attaches to the unit housing,the lower end to a metering needle which controls airflow from the impact tubes to chamber "A" of the air diaphragm unit; this unit is bypassed when mixture control is placed in "EMERGENCY RICH" position.
At sea level the A.M.C. is in full rich position , therefore the fuel/air mixture delivered to the engine will the same in either "AUTO-RICH" or "EMERGENCY-RICH" positions. However, in the "AUTO-RICH" or "AUTO-LEAN" positions,any rise in altitude will cause the aneroid to expand and expand the the metering needle, so partially closing the passage, thus reducing the airflow to chamber"A". As the poppet valve is controled by the

8. GENERAL PARTICULARS. (CONT'D).

8.1. FUEL SYSTEMS. (CONT'D).

8.1.8. Automatic Mixture Control.(Cont'd)

air pressure balance in chambers "A" and "B" reduction of pressure in "A" will cause the poppet valve to close in pro-portion , thus maintaining the correct fuel/air ratio at any altitude.

Any rise in temperature will also cause this capsule to expand and lean the mixture in proportion.

Failure Of The Mixture Control Unit Aneriod.

As previously explained in this section , the aneriod in the automatic mixture control is filled with nitrogen and inert oil at approximately 28"Hg , which is slightly less than the standard atmospheric pressure. In the event of the sylphon puncturing , the resultant increase pressure expands the sylphon , thus inserting the calibrating needle further into the air metering orifice , which in turn restricts the airflow to chamber "A". This will tend to close the poppet valve , thereby leaning the mixture , and as a result limiting the the available manifold pressure to approximately 40".

This condition is overcome by selecting "EMERGENCY RICH" which opens the by-pass valve and permits full impact pressure to chamber "A" , thus permitting a full rich mixture.

8.1.9. Manual Mixture Control.

The manual mixture control is a rotating disc valve having three lobes which cover or uncover ports in a fixed plate. These ports are connected to the lean and rich jets and the regulator chamber vents. The manual control is also connected to the automatic bypass valve.

There are four positions for the manual mixture control valve:-

(1) IDLE CUT-OFF. in which all ports are closed.

(2) AUTO-LEAN. in which the LEAN and VENT ports are open.

(3) AUTO-RICH. in which the LEAN, RICH and VENT ports are open.

(4) EMERGENCY RICH. in which the LEAN, RICH and VENT ports are open , and the AUTO mixture bypass valve is also open.

8. GENERAL PARTICULARS. (CONT'D)

8.1?. FUEL SYSTEM. (CONT'D)

8.1.10. Fuel Filter.

The function of the fuel filter is to prevent foreign substances from entering the system and causing blockages and/or interruption to the fuel flow.

The fuel filter is fitted with a vent cock for venting and is located on the top of the filter, it is also spring loaded to the shut-off position.

8.1.11. Fire Wall Shut-Off Valves.

The F.W.S.O.V. is located between the fuel filter and the five-way valve. Its function is to cut off the fuel flow to the pump and so to the engine.

It is only to be used in an emergency as dictated in " EMERGENCY PROCEEDURES." Section 5 of this manual.

It is operated by a lever in the cockpit roof above the pilots pedastal , (One lever for each engine).

This handle is a common handle which operates fuel and oil shut-off valves together. The port outer shut-off valve also cuts off the hydraulic oil supply when operated.

8.1.12. Fuel Flow Indicating System.

The fuel flow indicators mounted on the flight engineers instrument panel operate in conjunction with a rotating vane type flowmeter which is installed in the fuel system aft of each engine and in the main supply line. The fuel flowmeter measures the volume of fuel flowing to each carburettor and operates electrically. The action of the electrical contacts transmits an electrical signal to the indicator. The indicator receives and counts the number of signals received from the contacting mechanism during a given time interval and translates this information into an indication of the flow rate on the indicator dial. The indicator will only record pounds per hour flow rate, and because of its location in the system the fuel flow to the carburettor.

It does not record the fuel that may be vented back from the engine carburettors to the main fuel tanks. However for operation at the lower altitudes the amount vented back to the fuel tanks may be disregarded completely.

NOTE.

Certain of the flowmeter indicator gauges are also calibrated in Gallons Per Hour , however care should be exercised if using this method for calculating fuel flows , as gallons per hour as indicated are in U.S.Gallons NOT IMPERIAL.

8. GENERAL PARTICULARS. (CONT'D).

8.1. FUEL SYSTEMS. (CONT'D).

8.1.12. Fuel Flow Indication System.
The indicating system requires 115 Volt AC power for its operation.

8.1.13. Cause Of Engine Failing To Stop When I.C.O Selected.

(A) I.C.O. selector not in full "CUT-OFF" position.

(B) Engine primer left "ON".
In this case fuel feeds through the primer in sufficent quantities to keep the engine just kicking over.
NOTE. Check that the spring loaded solenoid energiser or operating switch has not stuck in the "ON" position.

(C) Carburettor fill valve stuck open or dirt under the seat.

(D) Manual mixture control clover leaf face damaged or dirty.

8.1.14. Cause Of Fuel Pressure Failure: (Flight Engineer)

(A) Fuel Supply - check fuel tank contents.

(B) Fuel tank valve not correctly selected.

(C) Engine fuel pump failure.

(D) Fuel line failure.

8.2. OIL SYSTEM.

8.2.1. Description.
An independent iol system is provided for each engine and includes:-

Oil Tank.
Oil Pump.
Oil Filter.
Oil Pressure Gauge.
Oil Cooler.
Oil Cooler Relief Valve.
Oil Temperature Gauge.
Oil System Drain Cock.
Fire Wall Shut Off Valve.

8.2.2. Oil Tank.

The tank is fitted with a filler cap , filter , circulating chamber and a dipstick (arranged within a sleeve to eliminate errors when reading due to foam). Provision is made for the oil tank to vent via an external line to the engine rear cover.

8. GENERAL PARTICULARS. (CONT'D)

8.2. OIL SYSTEM. (CONT'D)

8.2.2. Oil Tank. (cont'd)

The main tank outlet (to engine oil pump) is by way of a stand-pipe protruding upwards immediately above the oil tank sump , this stand pipe ensures an emergency supply of oil (approx 1.75 gallons) being available for feathering of the propeller should the rest of the oil supply have been lost.
The oil tank sump in addition to providing the main oil outlet source also incorporates a mesh type filter, thus ensuring the oil is filtered of any forign substances liable to damage the oil pump.
The return oil inlet is situated at top rear of the oil tank an internal line then carries the oil across the top of the tank to the circulating chamber.
Total Oil Tank Capacity:- 34.5 gallons.(6.5 being air space).
Total Oil Capacity:- 112 Imp Gallons.
Location of the oil tank is in the roof of the nacelle, immediately aft of the firewall of its particular engine.

8.2.3. Oil Pump.

This is contained within the rear cover section of the engine , it is an engine driven gear type pump having two functions ie Pressure and Scavange. The pressure side of the pump operates in conjunction with an external relief valve situated on the rear cover section of the engine.
The scavange side of the pump has double the capacity to that of the pressure side thus ensuring complete scavanging at all times.

8.2.4. Oil System Filters.

In addition to the tank filter previously mentioned there are two other filters in the system , one being a pressure filter situated within the rear cover section and the other being a magnetic plug this is installed in the rocker box sump. (Both must be removed for cleaning.) their purpose being to filter impurities from the oil.

8.2.5. Oil Pressure Gauge.

These instruments (one for each engine) are located on the flight engineers panel. The gauge line taps into the system on the outlet side of the oil pressure filter , to eliminate where possible any time lag in registering of oil pressure at the gauge.The line is primed with a light oil.(Aeroshell No4) which is replaced periodically as over a period it becomes impregnated with engine oil.

8.2.6. Oil Cooler.

These are located below each engine nacelle, the cooler is a simple radiator in which the volume of air passing through the tubes cools the oil surrounding them.

8. GENERAL PARTICULARS. (CONT'D).

8.2. OIL SYSTEM.(CONT'D).

8.2.7. Oil Cooler Anti-Surge Valve.

This is mounted on the oil cooler housing , and remains closed until the oil temperature reaches 39°C when it will commence to open.
The purpose of this valve is to protect the cooler from high pressures resulting from cold or congealed oil.

8.2.8. Oil Temperature Gauge.

This instrument is electrically operated by a resistance type bulb inserted into the inlet side of the system.
A gauge for each engine is located on the flight engineers instrument panel.

8.2.9. Oil System Drain Cock.

A drain cock is located on the base of the oil tank sump , to completely drain the oil tank however it is necessary to remove the feathering line , thus allowing the feathering reserve to be drained. (Should it be necessary to drain the complete system the engine sump and oil cooler are drained as separate items).

8.2.10. Automatic Oil Temperature Control.

An automatic oil temperature control is mounted on the oil cooler , this thermostatically controlled unit regulates the temperature of the oil entering the engine.
When the oil is cold it is bypassed from the oil cooler , and is fed direct to the oil tank circulating chamber , and thence returned to the engine.
This process continues until the temperature of the oil entering the engine rises sufficiently to operate the D.V.8. thermostatic valve , which from then on maintains the oil temperature within the normal operating limits.

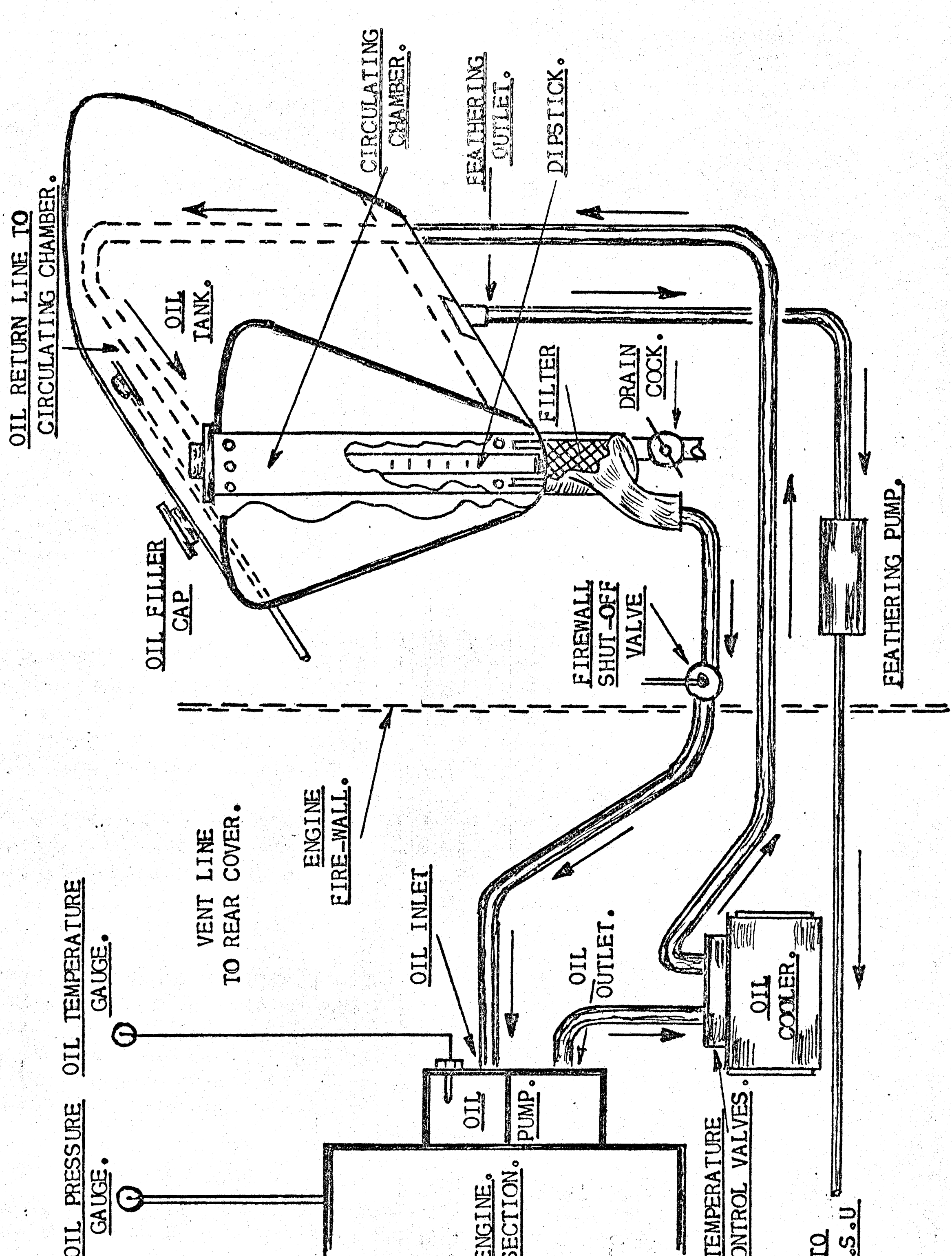
8.2.11. Oil Flow.

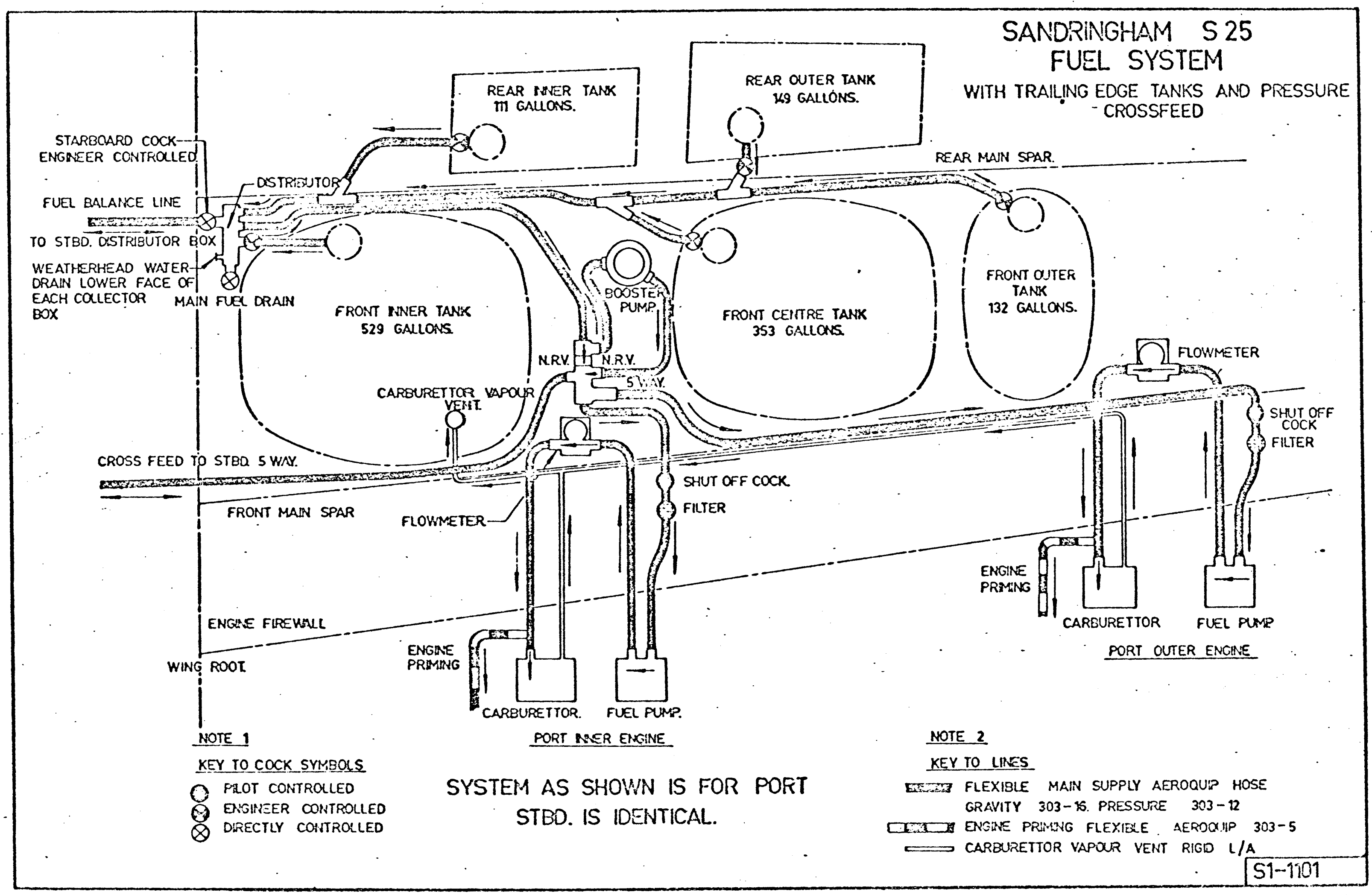
Oil is drawn from the tank via the sump (after passing through the filter) , and directed to the pressure side of the engine oil pump thence through the pressure filter and pressure relief valve to the various working sections of the engine. The scavange oil pump returns the oil to the oil cooler where according to temperature it is either directed through the oil cooler to the oil tank , or directly back to the oil tank circulating chamber.

8.2.12. Fire Wall Shut Off Valve.

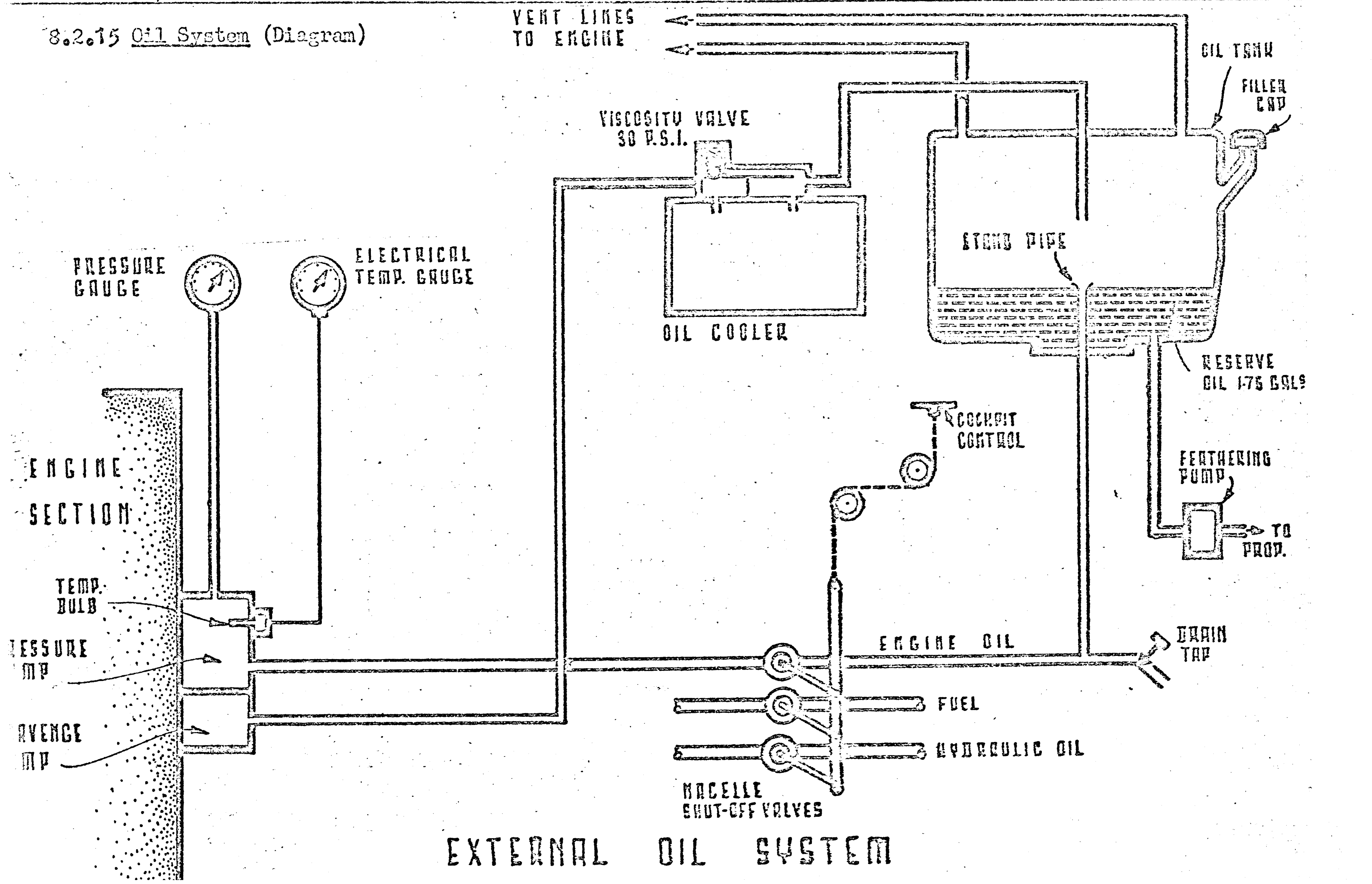
This valve located in the main supply line , and positioned on the engine firewall is used to cut off the oil flow to the engine , and must only be used in an emergency.

"SANDRINGHAM S.25. OIL SYSTEM."
(SCHEMATIC)




SANDRINGHAM S 25
FUEL SYSTEM
WITH TRAILING EDGE TANKS AND PRESSURE CROSSFEED
REAR INNER TANK
111 GALLONS.
REAR OUTER TANK
149 GALLONS.
REAR MAIN SPAR.
STARBOARD COCK—ENGINEER CONTROLLED
DISTRIBUTOR
FUEL BALANCE LINE
TO STBD. DISTRIBUTOR BOX
WEATHERHEAD WATER-DRAIN LOWER FACE OF EACH COLLECTOR BOX
MAIN FUEL DRAIN
FRONT INNER TANK
529 GALLONS.
BOOSTER PUMP.
FRONT CENTRE TANK
353 GALLONS.
FRONT OUTER TANK
132 GALLONS.
FLOWMETER
N.R.V.
N.R.V.
5 WAY.
CARBURETTOR VAPOUR VENT.
SHUT OFF COCK
FILTER
CROSS FEED TO STBD. 5 WAY.
SHUT OFF COCK.
FILTER
FRONT MAIN SPAR
FLOWMETER
ENGINE PRIMING
CARBURETTOR
FUEL PUMP
PORT OUTER ENGINE
ENGINE FIREWALL
WING ROOT.
ENGINE PRIMING
CARBURETTOR.
FUEL PUMP.
PORT INNER ENGINE
NOTE 1
KEY TO COCK SYMBOLS
PILOT CONTROLLED
ENGINEER CONTROLLED
DIRECTLY CONTROLLED
SYSTEM AS SHOWN IS FOR PORT
STBD. IS IDENTICAL.
NOTE 2
KEY TO LINES
FLEXIBLE MAIN SUPPLY AEROQUIP HOSE
GRAVITY 303-16. PRESSURE 303-12
ENGINE PRIMING FLEXIBLE AEROQUIP 303-5
CARBURETTOR VAPOUR VENT RIGID L/A
S1-1101

8.2.15 Oil System (Diagram)



8. GENERAL PARTICULARS (CONT'D)

8.2. OIL SYSTEM (CONT'D)

8.2.12. Fire Wall Shut-off Valve: (cont'd)

It is operated in the cockpit, by a handle (one for each engine) located in the Flight Deck Roof above the throttle quandrant.

This handle is a common handle which operates fuel, engine and hydraulic oil shut-off valves together.

8.2.13. Oil Specification:

Aircraft lubricating oil is classified as to its viscosity according to the Saybolt Universal System .

This property is determined by the Saybolt Viscometer which measures the time taken for 50 cc's of oil at 210°F. to flow through the viscometer with a fixed head of flow.

Use only 100 seconds Aviation Oil (Red band), or Shell W.100.

8.2.14. Oil Consumption: (Each Engine)

Normal Average consumption:
.75 g.p.h. per engine.

Maximum Allowable comsumption:
1.5 g.p.h. per engine

8.3. Flaps Control System:

8.3.1. Description and operation:

The flaps are "Gouge" type and are of stressed metal skin construction. They are electircally operated by a ½ H.P. motor and gear box mounted above the upper deck, just aft of the centre section.

The gear box is coupled to a series of universally jointed torque tubes running transversely across the hull extending outboard to a worm gearbox and screw jack anchored to the lower rear spar-boom in each wing.

The screw jack consists of a square threaded spindle operating in two square-threaded nuts riveted in a tublar casing. The end of the spindles is attached to the flap and the rotation of the casing by the worm

8. GENERAL PARTICULARS (CONT'D)

8.3. Flaps Control System: (CONT'D)

8.3.1. Descritpion and Operation:

gear causes the spindle to extend or retract and raises or lowers the flaps.

Limit switches fitted on a unit adjacent to the motor act as cut outs for the flap electric motor and stop the motor automactically when the flaps are within a ½ inch of their maximum travel up or down to prevent damage to the flaps, flap rollers and runners.

The switches are actuated by a travelling arm on a screw shaft, the latter being operated through a worm gear by the control torque tubes.

The electric flap motor is controlled from a three position "IN"-"OFF"-"OUT" switch on the pilots header panel. The switch unit also operates a transmitter and ramp, the transmitter controls a flap position indicator on the pilots instrument panel and the ramp operates a switch for an indicator lamp which shows red when the flaps are one-third out and remains on until they are returned past this position.

The flap selection switch has three positions "IN" "OFF" and "OUT" and before a reverse selection is made the switch should momentarily be held in the OFF position. As the flap motor is not equipped with a dynamic brake sudden reversal of the flap selection switch could cause damage to the flap motor.

The flap travel indicating system consists of an ON/OFF switch a green "ON" light and a flap ⅓ out red light. In the event of electrical failure or instrument malfunction no flap travel indication would be available. However, the flaps can be visually inspected for travel by observation from the upper deck passenger cabin. The flaps have a red line painted accross the upper surface parallel to the wing trailing edge and is visible when the flaps have reached the ⅓ out position. The ⅔rds out position is marked by a green line painted on the upper surface of the flap. The desired painted line giving the required flap setting should be just visible and coincidental with the wing trailing edge.

A hand operating gear can be used in an emergency should the electric motor fail. The clutch is disengaged by pulling the knurled barrel away from the gearbox and rotating the top of the barrel aft.

8. GENERAL PARTICULARS (CONT'D)
8.3. FLAPS CONTROL SYSTEM (CONT'D)
8.3.1. Description and Operations:

A winding handle is fitted and turned clockwise to wind the flaps in.

NOTE: After each take-off it is essential that the flaps be wound in manually. As the limit switches restrict final travel of the flaps continuous operation with flaps not fully in will cause "chattering" and possible damage to the flap runners. The amount normally required to bring the flaps onto the stops is 6 to 8 turns of the handle.

8.4. AUTOMATIC PILOT
8.4.1. Description:
A type A3 Automatic Pilot is provided and consists essentially of:-
Two Gyro control units and mounting unit.
Three Servo units and control valves.
Speed Control valve assembly
Air and oil filters
Sump tank and pressure regulator
Oil pressure ON/OFF valve.

The Automatic Pilot performs the following function:-
(a) to maintain the aircraft on a steady course
(b) to visually indicate the attitude of the aircraft in yaw, pitch and roll.

Principles of Operation:
The directional gyro supplies the referene for rudder control. The bank and climb gyro supplies the reference for the aileron and elevator control.

The servo Units are normally actuated by hydralic pressure from the engine driven pump on the port outer engine and operate the control surfaces of the aircraft; the hydraulic pressure into the Servo Units being controlled indirectly by the gyros.

The control knobs on the gyro units enable the Pilot to control the aircraft through the Automatic Pilot.

The speed control valves vary the rate of flow of hydraulic fluid to the Servo units and thus vary the speed of movement of the control surfaces.

8. GENERAL PARTICULARS (CONT'D)
8.4. AUTOMATIC PILOT (CONT'D)

8.4.1. Description (cont'd)

Overpower valves in the Servo Units permit the Pilot to overpower the Automatic Pilot in an emergency.

Normal operating hydraulic pressure	-	100/120 p.s.i.
Normal operating suction	-	3.75 to 4.25 mins HG
Overpowering pressure	-	80% of operation pressure.

8.4.2. Speed Control Valves:

The speed control valves are located below the control boxes & serve to control the flow of oil through the balanced oil valves. The speed at which each servo control operates may be adjusted by setting the opening of the particular speed control valve.

When the gyropilot is engaged there may be an oscillation of one or more of the controls with the speed control valves wide open. The valve corresponding to the oscillating control should be slowly turned toward closed position until the oscillation ceases. After the speed valve has been closed enough to stop oscillation in a control, the setting knob for that control should be moved back and forth a small amount to be sure control operation has not been stopped by closing the speed valve too far. Speed valve settings should not be changed unless it is desired to increase materially the speed of control in rough air. The numbers on the valve dials represent turns of the valve and may be used as a reference for bringing the valve back to a desired setting. When there is no oscillation present, speed control valves should be left wide open, unless reduced speed of control is desired. When proper adjustment is obtained for all three controls, the airplane should not yaw, pitch, or roll more than 1° (plus or minus) from the set course. There should be no overcontrolling or hunting of the control surfaces. If the ailerons are hunting, they will cause a yaw, even though they do not move enough to cause a wing to drop. Adjustment of the aileron speed control valve will usually correct this. Turning any of the three speed control valves to the "OFF" position locks the corresponding control surface in whatever position it happens to be, and should be avoided.

8. GENERAL PARTICULARS (CONT'D)

8.4. AUTOMATIC PILOT (CONT'D)

8.4.3. Auto Pilot Hydraulic Oil System:

The Auto Pilot is supplied with hydraulic fluid from an engine driven pump mounted on the port inner engine.

The auto-pilot shut-off valve on the fuselage port side is used to shut off fluid supply to the auto pilot system in an emergency and at the same time relieve pump pressure by by-passing the fluid to the system reservoir. Capacity of hydraulic oil reservoir is ½ gallon.

8.4.4. Follow Up System:

The follow up cable system functions as part of the automatic pilot control system by conveying to each gyro control unit the position of the corresponding control surface. The three follow up cables connect from the forward ends of the servo units to corresponding spring loaded pulleys at the back of the gyro mounting unit.

8.4.5. Auto Pilot Bleeding (On Ground):

Gyro units UNCAGE.
After engines are started - Directional Gyro cards ALIGN.
Aileron and Elevator index marks ALIGN.
Vacuum check (3 to 5 ins. Hg).
Auto Pilot shut-off valve "ON".
Servo Control SLOWLY ON.
Engines running at 1000 r.p.m. - Oil Pressure CHECK (100 to 120 p.s.i.)
Air in hydraulic system CHECK (Controls should NOT be springy and indices should NOT move).
Remove air from Hydraulic system if necessary by:

(a) Open speed control valves to 6 on dials.
(b) Rotate all indices control knobs clockwise until all controls move to extreme positions and indices are approximately 10°, or ¼ inch off set.
(c) Manually hold controls in this position and disengage Pilot for approximately 30 seconds.
(d) Re-engage pilot and rotate controls indices anti-clockwise until controls move to opposite extreme position and indices are again off set.
(e) Repeat as in "C" above.
(f) Place controls neutral and align indices.
(g) Re-engage and check for spring.
(h) Disengage Pilot.

(OVER POWER FORCE CHECK)(Movement of all controls each way should not require excessive force.) See 8.4.11.

8. GENERAL PARTICULARS (CONT'D)

8.4. AUTOMATIC PILOT (CONT'D)

8.4.6. Automatic Flight Operation:

Straight and level:

The aircraft will normally be flown manually during climb and descent. Auto Pilot shut-off valves "ON".
TRIM aircraft "Hands Off".
Speed control valves SET (DO NOT turn the knobs fully CLOCKWISE as this will LOCK THE CONTROLS).
Directional Gyro set to magnetic heading and UNCAGE.
Bank and Climb Gyro UNCAGE.
Gyro Cards and index marks ALIGN.
Servo control SLOWLY ON.
Course and altitude SET.
Speed control valves SET only sufficiently slow to STOP OSCILLATION.
Disengage Auto Pilot and RETRIM aircraft at 20 minute intervals.

CAUTION: Do not align elevator follow up index with the horizon bar, as relative movement between the elevator alignment index and the horizon bar is in opposite directions.

Turns:

Rotate RUDDER KNOB on Gyro unit SLOWLY in desired direction. Changes of direction of more than 10 degrees shall be performed MANUALLY with Auto Pilot disengaged.

Before Descent:

Take over MANUAL control.
Servo Control OFF.

8.4.7. Malfunctioning of Auto Pilot:

Take over MANUAL control. Auto Pilot CAN BE OVERPOWERED.
Servo control "OFF".
Oil valve "OFF".
If Gyros are malfunctioning CAGE.

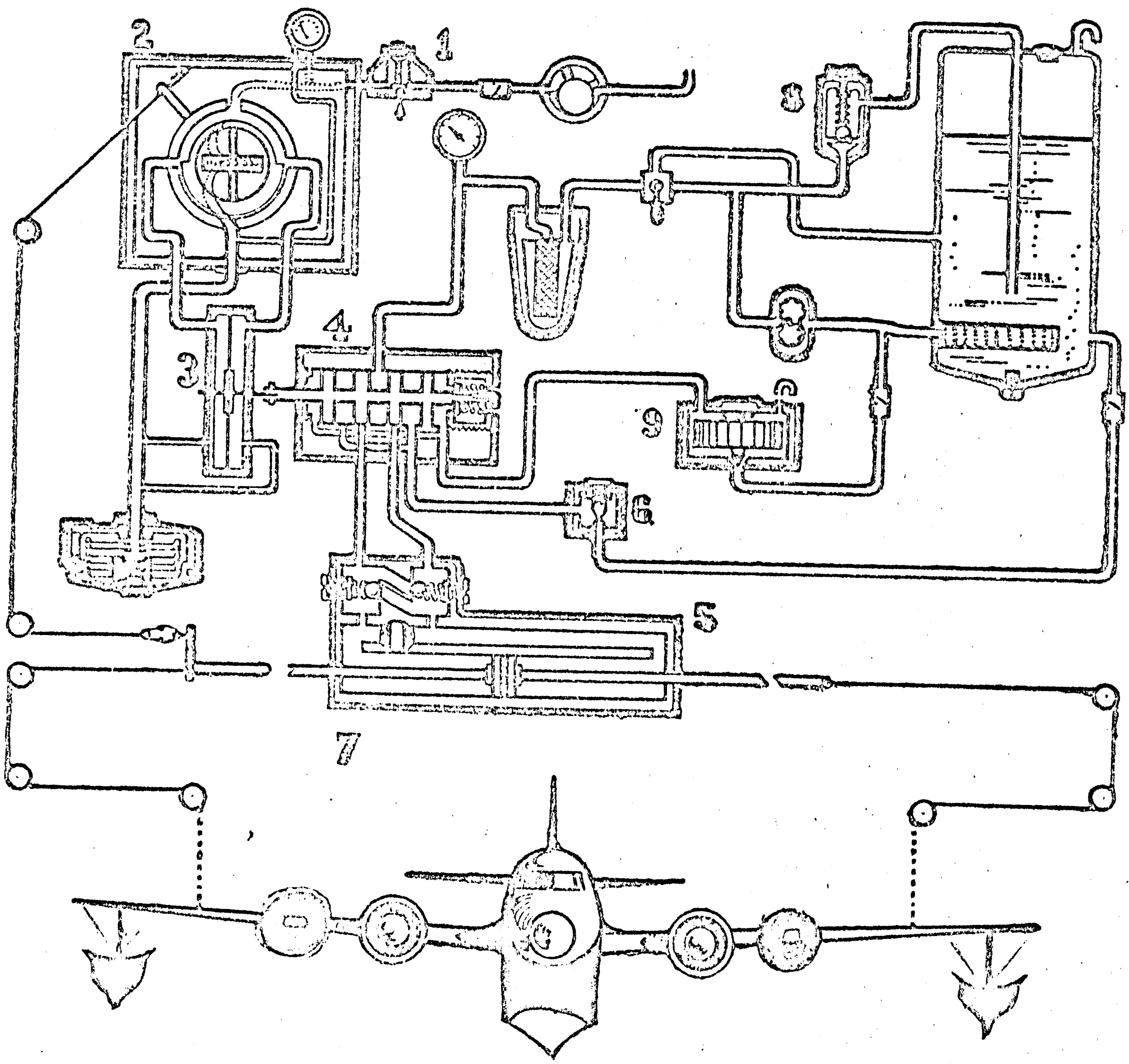
8.4.8. Icing Conditions:

DISENGAGE Auto Pilot FREQUENTLY and move the controls manually to see that they are free.

8.4.9. Oil leak or Oil Pressure Failure:

Servo control "OFF" - take over MANUAL CONTROL.
Oil valve "OFF".

S.4.12. Auto Pilot Schematic Diagram.



(1) SUCTION REGULATING VALVE

(2) GYRO CONTROL UNIT

(3) AIR RELAY VALVE

(4) BALANCED OIL VALVE

(5) SERVO UNIT [DOUBLE ACTING]

(6) SPEED CONTROL VALVES

(7) 'ON-OFF' CONTROL

(8) HYDRAULIC PRESSURE REGULATOR

(9) DRAIN TRAP

AUTOMATIC PILOT -S.25 SCHEMATIC

8. GENERAL PARTICULARS (CONT'D)

8.4. AUTOMATIC PILOT (CONT'D)

8.4.10. Rough Air

Auto Pilot may be left "ON".
ADJUST speed control valves if necessary to improve operation.
Under extremely violent conditions take over MANUAL control.

8.4.11. Over Power Relief Valve:

An over power relief valve is fitted to each servo cylinder to enable the pilot to over power the auto pilot in any emergency. To check the overpower valve relief pressure, bleed the auto pilot, align the indicies and engage the auto pilot. Turn the emergency shut-off valve to the "OFF" position and over power each control in turn; note the pressure registered on the auto pilot pressure gauge and that the over power relief valve is relieving.

8.5. ELECTRICAL SYSTEM

8.5.1. Description:

A 24 volt, direct, current, negative erath twin wire system is used. A generator is fitted to each engine and the aircraft electrical system will operate on any generator separately in an emergency.

Four 12 volt 80 amp/Hr batteries are connected in series and in parallel to afford a single 24 volt supply. These are adequate to keep the electrical system functioning for a limited time if all load not essential to flight is turned off, and if the batteries are fully charged.

Components: A Voltmeter on the Flight Engineers panel allows the state of the batteries to be determined.

Generator Circuit:

These are four 75 amps generators, one mounted on the rear cover of each engine and connected by a direct drive. The maximum load of each generator is 75 amps and t the output 1500 watts.

The generators feed through generator field switches through an 80 amp fuse to the main bus bar. They are controlled by four carbon pile voltage regulators and the connections are made automatically to the aircraft's circuit by four reverse current relays. The generators are required to more orless "share" evenly whatever electrical load is on the system. Voltage regulators require careful adjustment for this desired condition of"balanced"generators

8. GENERAL PARTICULARS (CONT'D)

8.5. ELECTRICAL SYSTEM

8.5.1. to exist. Without such setting it is found that ohe generator can take over practically the whole load while the others charge at a very slow rate. This state of affairs overloads the high charging generator and could result in it being burnt out.

The gernerator voltage regulator set at 27.5 volts automatically controls generator output, or charging rate, in accordance with whatever load is being demanded by the electrical system, and the condition of charge of the batteries. When the batteries are low, and/or when there is a heavy load on the system, the generator may charge at its full rated current output. A high ammeter reading will then indicate a substantial flow of generator current. If the batteries are fully charged and there is only slight load, generator output will decrease until only a very slight charge is indicated on the ammeter. In these circumstances, switching on a heavy unit, such as landing light, or radio transmitter, will substantially increase the charging rate. This regulating system saves batteries from being ruined through over charging.

The reverse current cut out set at 26.5 volts prevents discharge of current from the batteries back through the generators when engines are stopped or idling. When the current reaches 3-5 amps. the relay opens and so prevents the batteries discharging through the windings of the génerator.

Four ammeters located on the Flight Engineers panel allow the respective generator outputs to be noted.

Starter Circuit: The engines are turned for starting by an electric starter motor fitted to each engine. The relay switches for the starters are controlled by starter push buttons in the cockpit which are in series with switches on each engine platform so that the starter motors will not turn unless the two engine platforms to each motor are fully closed. Also mounted in each nacelle are the four induction vibrators which are also operated by the starter buttons, but they can be isolated by four individual switches inside the aircraft located on the starting panel adjacent to the dorsal hatch.