

*L. W. MacFarlane Co. 48*

FOR OFFICIAL USE ONLY

AIR PUBLICATION 1591B

Pilot's Notes

0 180

PILOT'S NOTES  
THE HARVARD II AEROPLANE  
WASP S3H1 ENGINE

This handbook is promulgated for the information  
and guidance of all concerned.

BAC/11/40/NAA.

AIR MINISTRY



FOR OFFICIAL USE ONLY

AIR PUBLICATION 1691B

Pilot's Notes

PILOT'S NOTES  
THE HARVARD II AEROPLANE  
WASP S3H1 ENGINE

This handbook is promulgated for the information  
and guidance of all concerned.

AIR MINISTRY

BAC/11/40/NAA.

Published By  
NORTH AMERICAN AVIATION, INC.

Printed in U.S.A.

FOR OFFICIAL USE ONLY

ALL INFORMATION CONTAINED

HEREIN IS UNCLASSIFIED

PILOT'S NOTES

THE HARVARD II AIRPLANE

WAS RECOVERED

This document is classified "Confidential" and contains information the disclosure of which could be injurious to the national defense.

CONFIDENTIAL

CONFIDENTIAL

Classified by  
10-TH AIR FORCE SECURITY GROUP  
ON 08-11-88

## AMENDMENT CERTIFICATE

Incorporation of an amendment list in this publication should be certified by inserting the amendment list number, initialling in the appropriate column and inserting the date of incorporation.

Holders of the Pilot's Notes will receive only those amendment lists applicable to the preliminary matter, introduction and Sections 1 and 2.

Amendt. List No.																			
Prelimy. matter																			
Leading Partics.																			
Introduc.																			
Section 1																			
Section 2																			
Section 3																			
Section 4																			
Section 5																			
Section 6																			
Section 7																			
Section 8																			
Section 9																			
Section 10																			
Section 11																			
Section 12																			
Date of incorp.																			



Note to official users

Air Ministry Orders and Volume II leaflets as issued from time to time will affect the subject matter of this publication. It should be understood that amendment lists are not always issued to bring the publication into line with the orders or leaflets and it is for holders of this book to arrange the necessary linking-up.

Where an order or leaflet contradicts any portion of this publication, an amendment list will generally be issued, but when this is not done the order or leaflet must be taken as the overriding authority.

CONFIDENTIAL

The following information was obtained from the records of the Department of the Interior, Bureau of Land Management, and is being furnished to you for your information. It should be understood that this information is being furnished to you in confidence and is not to be disseminated outside your agency without the express written consent of the Bureau of Land Management.

It is noted that the above information was obtained from the records of the Department of the Interior, Bureau of Land Management, and is being furnished to you for your information. It should be understood that this information is being furnished to you in confidence and is not to be disseminated outside your agency without the express written consent of the Bureau of Land Management.

LIST OF SECTIONS AND ILLUSTRATIONS

(A detailed Contents List is given  
at the beginning of each Section)

Introduction

Illustrations -

Harvard II Aeroplane - Left Side View

Forward Cockpit - Port Side

Forward Cockpit - Starboard Side

Section 1 - Controls and equipment in cockpits

Section 2 - Handling and flying notes for pilot

LIST OF BUILDINGS AND ILLUSTRATIONS

IN ORDER OF CONSTRUCTION AND IN ORDER  
OF THE LOCATION OF EACH BUILDING

Illustrations

Illustrations

Figure 1 - Foundation - East Side View

Figure 2 - Foundation - West Side

Figure 3 - Foundation - North Side

Figure 4 - Foundation and adjacent to building

Figure 5 - Building and flying wires for light

- INTRODUCTION -

Note. - The following introductory notes are complementary to the detailed description given in Volume I of this Air Publication.

1. The Harvard II Aeroplane is a two-seater, low-wing monoplane, powered with a Wasp S3H1 engine driving a 9 ft. diameter, Hamilton Standard constant-speed two-blade airscrew. Except for fabric covered control surfaces, all-metal construction is employed throughout. The aeroplane is designed as a general purpose training aircraft, and is equipped for the following services: - gunnery, bombing, navigation and instrument flying. It has a span of 42 ft. 1/4 inch, an overall length of 28 ft. 11-7/8 inches, and an overall height of 9 ft. 4-41/64 inches with tail down.

2. The fuselage is composed of a welded steel tubular frame, with detachable aluminum alloy side panels and an after semi-monocoque section of aluminum alloy. The frame incorporates a pylon between the cockpits to protect the crew from injury should the aeroplane overturn. The tandem cockpits are under a transparent roof with a sliding section above each seat. These sections can be operated from outside or inside, and locked at closed, open, or intermediate positions. They have glass panels which can be released by the crew for emergency exit. Provision is made for heating and ventilating the cockpits. There is a walkway on the centre plane on each side of the fuselage, handholds on either side of the forward cockpit instrument panel shield, and a metal foot step adjacent to each cockpit on the port side of the fuselage.

3. The main plane is a semi-monocoque structure and consists of a centre plane and two outer planes. Split-type trailing edge flaps, hydraulically operated, extend in three sections from aileron to aileron. The ailerons have trimming tabs which may be adjusted on the ground.

4. The alighting gear consists of two independent retractable undercarriage units and a steerable tail wheel (which also automatically locks in the trailing aft position). Each undercarriage unit is retracted inward by hydraulic power, and the wheels are fitted with hydraulic brakes, pressure being applied by the action of depressing the brake pedals, which are mounted in the rudder pedals.

5. The tail unit is a cantilever structure, with semi-monocoque fin and tail plane. The rudder and elevators are of the balanced type, with trimming tabs.

6. There are two fuel tanks in the centre plane, one on either side, with a total capacity of 92.4 Imperial gallons. The starboard tank holds half this amount, but the port one has a standpipe which cuts off 15.8 gallons as a reserve. The oil tank is under the top cowling, forward of the fireproof bulkhead, and holds 8.5 Imperial gallons.

7. A fixed Browning gun can be mounted in the leading edge of the starboard outer plane. It is operated by compressed CO<sub>2</sub> stored in a cylinder, and fired by pressing a button on the front control column ring grip. The ammunition box is on the outboard side of the gun compartment, and holds 250 rounds.

8. Provision is made for installing a cine camera gun in the leading edge of the port outer plane. Exposure is made by the gun firing button, and the camera may be operated selectively or simultaneously with the gun by positioning the air selector valve.

9. Brackets are fitted on the lower surface of each outer plane for a light series type E.M. bomb carrier. The bombs can be released selectively or simultaneously by switches on the electrical system control panel in the forward cockpit.

10. A No. 3 Mark I signal pistol fires through a tube on the starboard side of the forward seat, and a rack for stowing nine (9) cartridges is fitted on the starboard side of the cockpit.

11. Launching tubes for two standard 4-inch forced landing flares are situated abaft the baggage compartment. The flares can be released individually by two toggle handles on the starboard side of the pilot's seat in the forward cockpit. These handles can also be reached from the aft cockpit.

12. An instrument flying hood can be drawn over the aft cockpit. It is released either by a lever situated below the edge of the aft instrument panel shield or by a knob on the port side of the forward instrument panel.

13. Provision is made for carrying a maximum of eight 17-1/2 pound removable ballast weights, when necessary, in the upper part of the fuselage abaft the rear cockpit, and there is an inspection window for checking their number.

14. The engine-driven generator has a maximum output of 750 watts at 15 volts, and the supply is maintained by a 12 volt, 68 ampere-hour accumulator, cooled and ventilated by an air duct, on the forward side of the fireproof bulkhead. The main fuse panel is on the port side of the fuselage, abaft the wall. Output to the accumulator is controlled by a voltage regulator below the aft seat. The electrical system includes cockpit lighting, fuel contents indication, undercarriage position indication, intercommunication, navigation and identification lamps, landing lamps, and a booster coil for the engine magnetos (for use when starting).

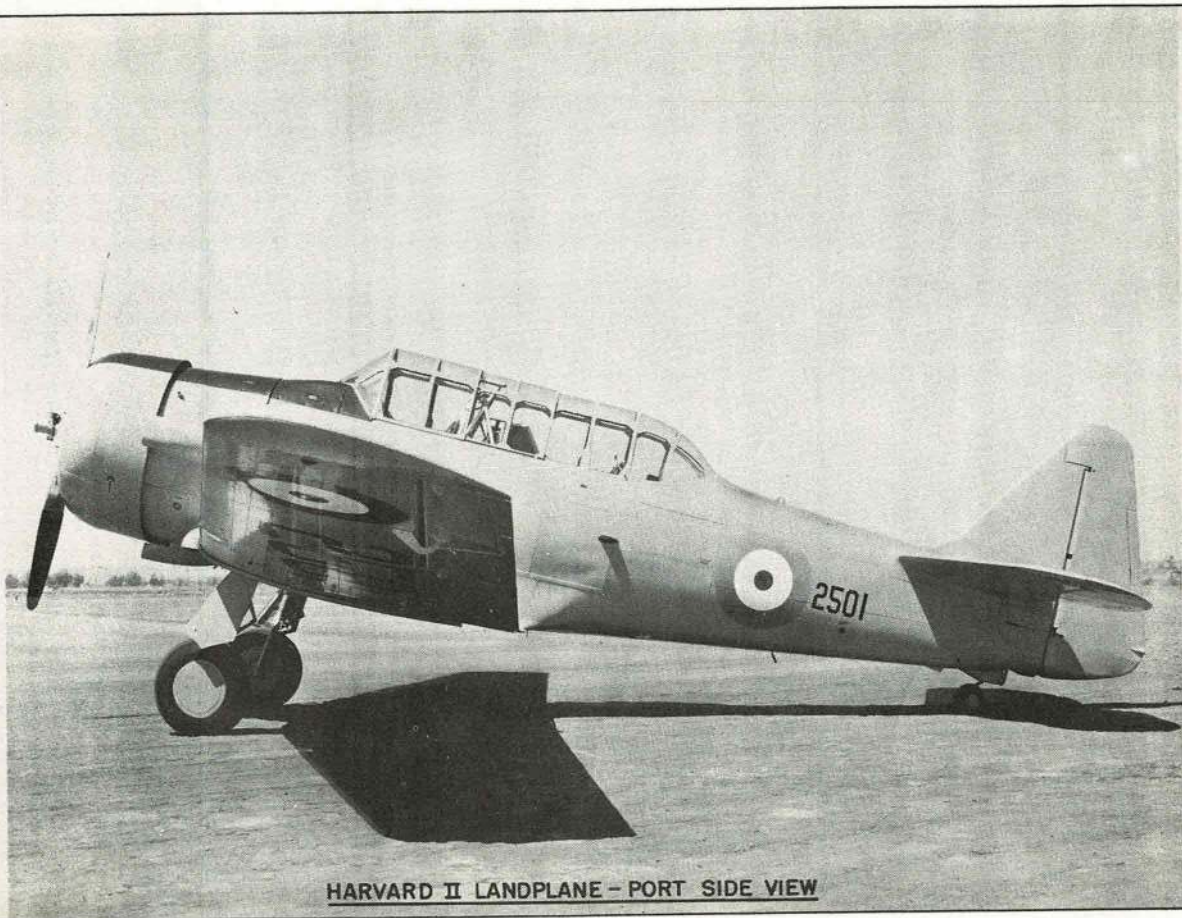
A.P. 1691B Pilot's Notes, Introduction

15. An inertia starter for the engine is provided and it may be energized by a hand-crank or electrically. An external supply socket for the electrical motor is fitted to port fuselage side, just aft of the fireproof bulkhead and above the upper surface of the centre plane.

U. S. DEPARTMENT OF THE INTERIOR

THE UNITED STATES OF AMERICA  
BUREAU OF LAND MANAGEMENT  
WASHINGTON, D. C. 20250

FS./3



HARVARD II LANDPLANE - PORT SIDE VIEW

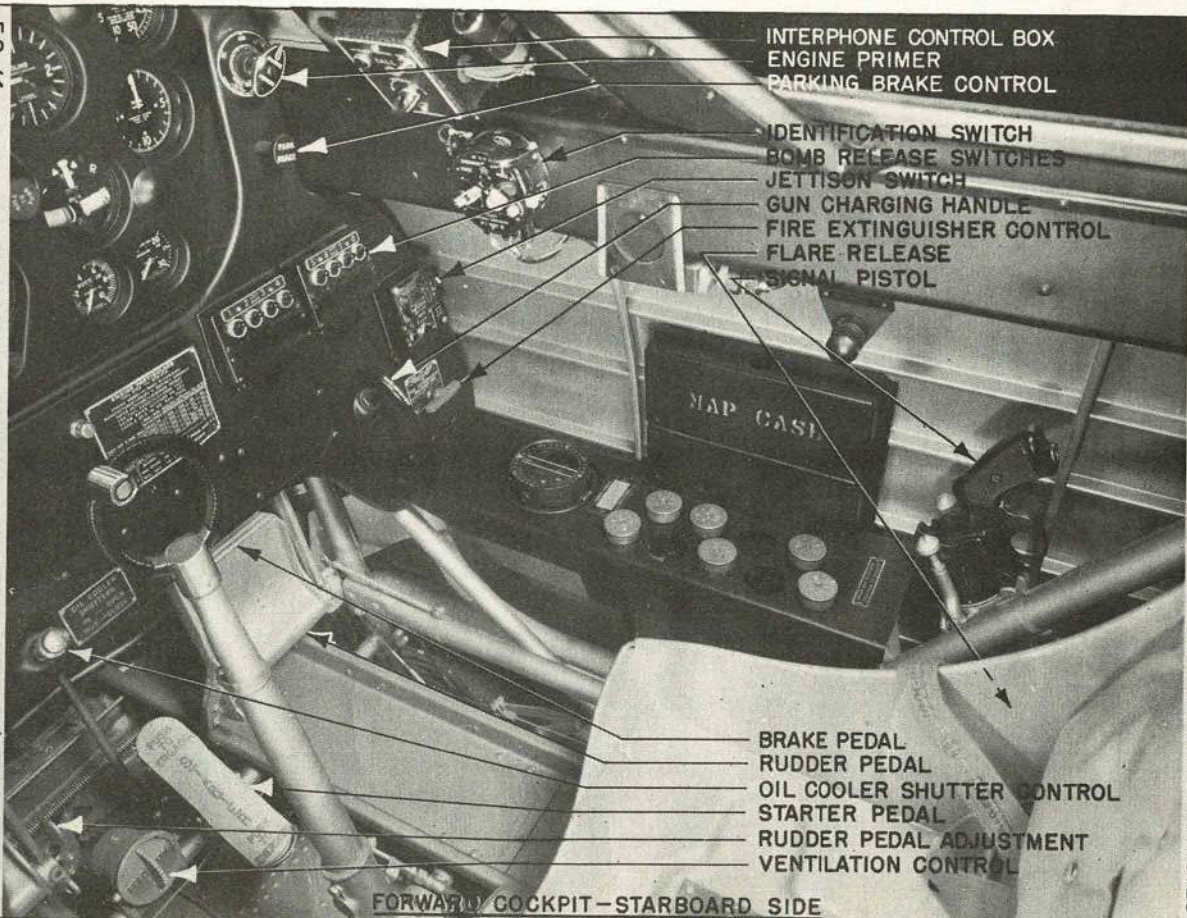
A.P. 1691B PILOT'S NOTES

BOMB FIRING BUTTON  
UNDERCARRIAGE POSITION LIGHT SWITCH  
FLYING HOOD RELEASE  
IGNITION SWITCH  
THROTTLE CONTROL  
MIXTURE CONTROL  
AIRSCREW CONTROL  
FRICTION WHEEL  
HAND FUEL PUMP  
RUDDER TRIM  
ELEVATOR TRIM  
UNDERCARRIAGE CONTROL  
HAND HYDRAULIC PUMP  
FUEL TANK SELECTOR

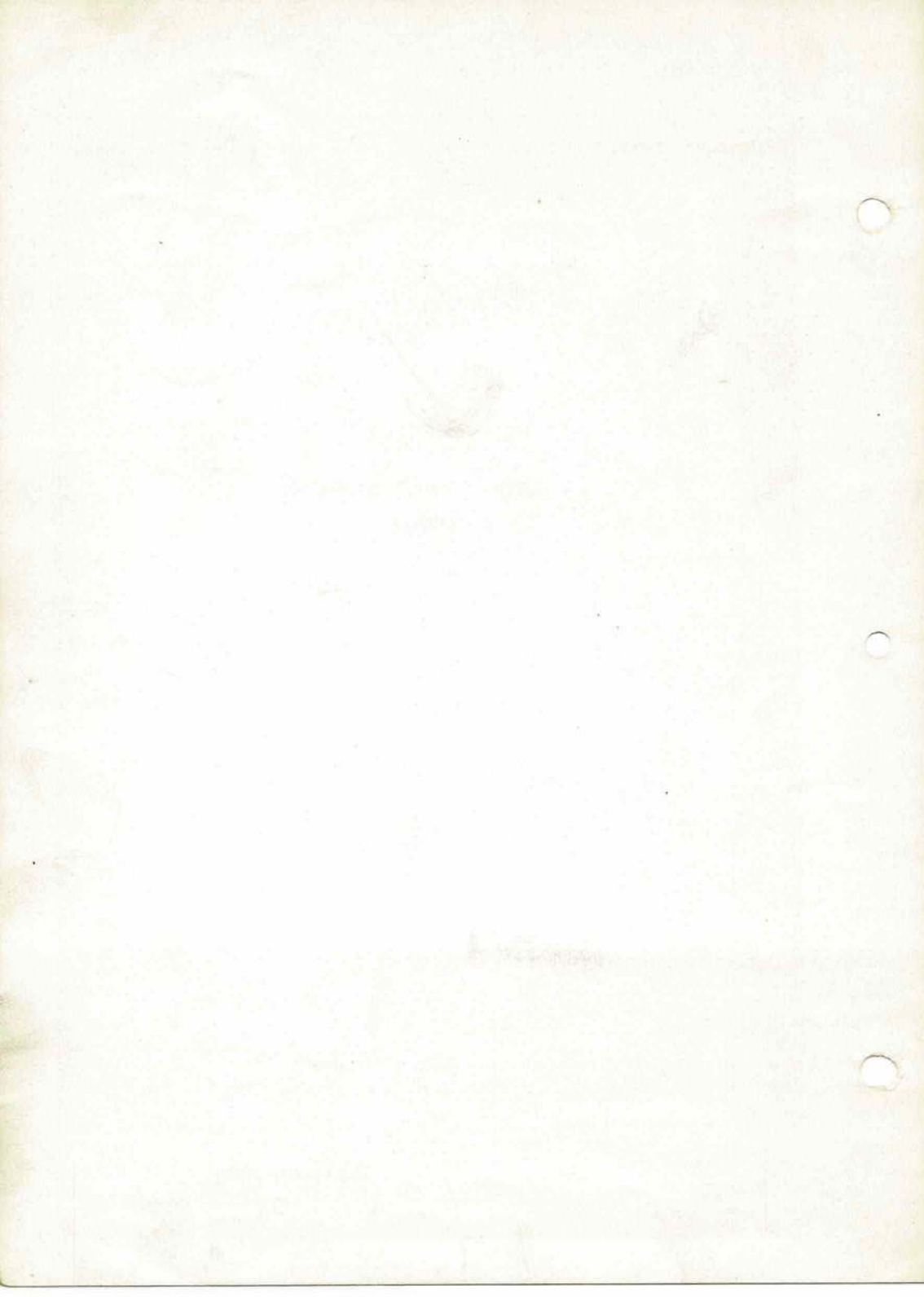
HYDRAULIC POWER CONTROL  
LANDING FLAP CONTROL  
GYRO SELECTOR VALVES  
CARBURETOR AIR HEAT  
ELECTRICAL SWITCH PANEL  
MACHINE AND CAMERA GUN CONTROL  
CONTROL COLUMN  
SURFACE CONTROL LOCK

FORWARD COCKPIT-PORT SIDE

F.S./4



A.P. 1691B PILOT'S NOTES



October, 1940

AIR PUBLICATION 1691B  
Pilot's Notes

SECTION I  
CONTROLS AND EQUIPMENT IN  
COCKPITS

THE UNIVERSITY OF CHICAGO  
LIBRARY

1950

1950

THE UNIVERSITY OF CHICAGO  
LIBRARY

1950

SECTION I  
LIST OF CONTENTS

	<u>Para.</u>
General _____	1
Cockpit roof and EMERGENCY exit _____	2
Control columns and control locking device _____	3
Rudder pedals, adjustment and brake controls _____	4
Trimming tabs _____	5
Flaps and flap control _____	6
Undercarriage _____	7
Warning horn release _____	9
Hydraulic control _____	10
Hydraulic hand pump _____	11
Mixture control _____	12
Exhaust gas analyser (fuel-air ratio) _____	13
Cylinder temperature _____	17
Manifold pressure (i.e. boost) _____	19
Airscrew pitch control _____	21
Oil temperature regulator shutter control _____	22
Fire extinguishers _____	23
Seat adjustment _____	25
Sutton harness release _____	26
Gyro selector valves _____	27
Carburettor air heat control _____	28
Heating and de-frosting control _____	30
Ventilating control (cockpits) _____	31
Instrument flying hood _____	32
Fuel system _____	33
Oil system _____	35
Ballast _____	36
Electrical system and controls _____	37
Landing flare release _____	40
Signal pistol _____	41
Gun control _____	42
Bomb release controls _____	43

SECTION 1  
LIST OF CONTENTS

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

1. Introduction  
2. Background  
3. Objectives  
4. Methodology  
5. Results  
6. Discussion  
7. Conclusion  
8. References  
9. Appendix A  
10. Appendix B  
11. Appendix C  
12. Appendix D  
13. Appendix E  
14. Appendix F  
15. Appendix G  
16. Appendix H  
17. Appendix I  
18. Appendix J  
19. Appendix K  
20. Appendix L  
21. Appendix M  
22. Appendix N  
23. Appendix O  
24. Appendix P  
25. Appendix Q  
26. Appendix R  
27. Appendix S  
28. Appendix T  
29. Appendix U  
30. Appendix V  
31. Appendix W  
32. Appendix X  
33. Appendix Y  
34. Appendix Z  
35. Appendix AA  
36. Appendix AB  
37. Appendix AC  
38. Appendix AD  
39. Appendix AE  
40. Appendix AF  
41. Appendix AG  
42. Appendix AH  
43. Appendix AI  
44. Appendix AJ  
45. Appendix AK  
46. Appendix AL  
47. Appendix AM  
48. Appendix AN  
49. Appendix AO  
50. Appendix AP  
51. Appendix AQ  
52. Appendix AR  
53. Appendix AS  
54. Appendix AT  
55. Appendix AU  
56. Appendix AV  
57. Appendix AW  
58. Appendix AX  
59. Appendix AY  
60. Appendix AZ  
61. Appendix BA  
62. Appendix BB  
63. Appendix BC  
64. Appendix BD  
65. Appendix BE  
66. Appendix BF  
67. Appendix BG  
68. Appendix BH  
69. Appendix BI  
70. Appendix BJ  
71. Appendix BK  
72. Appendix BL  
73. Appendix BM  
74. Appendix BN  
75. Appendix BO  
76. Appendix BP  
77. Appendix BQ  
78. Appendix BR  
79. Appendix BS  
80. Appendix BT  
81. Appendix BU  
82. Appendix BV  
83. Appendix BW  
84. Appendix BX  
85. Appendix BY  
86. Appendix BZ  
87. Appendix CA  
88. Appendix CB  
89. Appendix CC  
90. Appendix CD  
91. Appendix CE  
92. Appendix CF  
93. Appendix CG  
94. Appendix CH  
95. Appendix CI  
96. Appendix CJ  
97. Appendix CK  
98. Appendix CL  
99. Appendix CM  
100. Appendix CN

SECTION I

CONTROLS AND EQUIPMENT IN COCKPITS

1. General. - This section deals with the controls and equipment in both cockpits, and equipment situated elsewhere with which the pilot should be familiar. Illustrations and more detailed particulars of the various items described in these Notes are given in A.P. 1691B, Vol. I.
2. Cockpit roof and EMERGENCY exit. - The tandem cockpits are under one transparent roof with individually operated sliding sections for access. The forward and aft sliding sections can be locked at three and four intermediate positions, respectively, between the open and closed positions. The sections are unlocked from inside by pulling inward on handles located near the port front edge of the forward one, and near the port aft edge of the after one. They can be unlocked from outside by pulling upward on two small levers situated opposite the inboard handles. The glass panels in the sides of the sliding sections can be released by means of handles situated on the lower inner sides, thereby providing an emergency exit.
3. Control columns and control locking device. - The control column in the aft cockpit is detachable and when not in use should be removed and locked in the stowed position in the socket on the lower starboard side of the cockpit. The handle for locking and releasing all surface controls is situated to the port and forward of the control column in the forward cockpit. To lock controls, neutralize rudder pedals and place control column forward, centering it laterally. Release the plunger holding the lock in the stowed position, and engage the control column socket in the lock recess, allowing the plunger to locate itself in the locked position. To release, reverse the above procedure.
4. Rudder pedals, adjustment and brake controls. - The rudder pedals in both cockpits are adjustable by pressing the lever situated on the inner side of each pedal. When this lever is pressed, the rudder pedal can be moved forward or backward by a spring along a channel provided with holes. When the pedal is in position to suit the pilot, engage the plunger on the lever in the appropriate hole. Ensure that the pedals are in corresponding holes. If not, rudder will be applied in one direction when the pedals are neutral. The brakes are hydraulically controlled and can be operated from either cockpit. To apply the parking brakes pull out the control knob situated on the starboard side of the instrument panel in the forward cockpit, marked PARK BRAKE, and press forward on both rudder pedals; release brake pedals and then release control knob. To release parking brakes, press brake pedals forward. This can be done from either cockpit.
5. Trimming tabs. - The elevators and rudder have adjustable trimming tabs which are operated by two control wheels, clearly marked, situated on the port side of each cockpit. The tabs should be adjusted as required to obtain directional and

longitudinal trim. It will be found that this aeroplane requires right rudder bias when climbing or flying level. This bias will have to be eased off when gliding. The elevator tabs are not to be used to assist in recovering from a dive or for manoeuvring. The aileron tabs may be used as trimming tabs of the fixed type by lengthening or shortening the tab connecting rods.

6. Flaps and flap control. - The main plane is equipped with trailing edge split type flaps, hydraulically operated. A flap position indicator, calibrated in degrees, is situated on the port side of each cockpit, forward of the control handle marked FLAP. The forward position of this handle selects the DOWN position of the flaps and the aft position of the handle selects the UP position of the flaps. The centre, LOCK position is used only when it is desired to stop the flaps at any intermediate position as indicated by the flap position indicator. To operate flaps, engage hydraulic pressure control lever and move handle to the desired position, as described in para. 10. Should the engine driven pump fail, proceed as in para. 11. Flaps are not normally used for take-off, except when set at 15° to get out of a small space; but they should be fully down for landing (see also Section 2, paras. 23 and 25). Do not lower flaps when flying above 125 m.p.h., I.A.S. reading. The aeroplane will become nose-heavy when the flaps are lowered and the airspeed will decrease.

7. Undercarriage. - This is hydraulically operated. The aeroplane is fitted with indicator lamps (two red and two green), a warning horn and mechanical indicator. The mechanical indicator is only a supplement to the lamps and should not be used as a positive indication that the undercarriage is locked. The undercarriage can be raised from the forward cockpit only (the safety catch on the control lever is on the quadrant in that cockpit); but it can be lowered from either cockpit by using the control handle marked LAND GEAR, situated on the port side of each cockpit. Normal movement of the handle forward selects the DOWN position of the undercarriage and vice-versa. The undercarriage must not be lowered at airspeeds above 150 m.p.h. I.A.S., but after lowering it the speed may be increased up to that of all-out level flight (about 170 m.p.h. I.A.S.). Prior to operating the undercarriage, press the hydraulic pressure control lever. To raise the undercarriage, pull the undercarriage control handle up and then right back. In raising the undercarriage, move the control handle from DOWN to UP position, fairly rapidly. If the movement is made slowly, the hydraulic pressure may reach the retracting leg before the latch is disengaged. The lock then will be difficult to disengage. If the control handle tends to be difficult to move after having moved part way to UP, due to the handle having been moved slowly, first return the handle to DOWN and then when ready to do so, move quickly to UP. When the undercarriage is fully up, the two red lamps are on, the mechanical indicators (on port side of cockpit beside flap indicator) right back, and the warning horn will sound as the throttle setting is reduced for landing. (The warning horn will continue to sound until the undercarriage is locked in the DOWN position). When the undercarriage is fully down, the two green lamps are on and the mechanical indicators are right forward. These position indicator lamps are situated on the electrical switch panel on the port side of the forward cockpit only. A dimmer switch is also on this panel.

This switch should be at DAY for day use. (See Section 2, paras. 36 and 37 for emergency operation.)

8. The undercarriage causes considerable drag when it is in the down position.

9. Warning horn release. - This is a white coloured push-button situated on the electrical switch panel on the port side of the forward cockpit only. Its purpose is to render the warning horn inoperative when it is desired to close the throttle during flight with the undercarriage up. This is done by pushing the button in. The warning horn is automatically brought back to normal operation by opening the throttle.

10. Hydraulic system. - The flaps and undercarriage are operated by means of an engine-driven hydraulic pump. The time lag pressure control lever for controlling this operation is situated on the port side of each cockpit and is marked PUSH. After the pressure control lever has been pushed down, set control handles in desired positions. It is not necessary to hold lever down after it has been pushed. The power control remains engaged for a given period of time regardless of pressure, that is, it does not disengage concurrently with the completion of undercarriage and flap operation. However, under normal operating conditions, the power control should not remain engaged for more than approximately 2 minutes.

11. Hydraulic hand pump. - The hand pump can be used if the engine-driven pump fails. It is situated at the port side of the pilot's seat in the forward cockpit, and is marked HAND: HYD. PUMP. To operate, select desired position of flaps or undercarriage, pull up the handle of the hand pump, lock it in the extended position by turning it anti-clockwise, and pump.

12. Mixture control. - The mixture control is not of the automatic type. The control lever is situated in the throttle quadrant, and is marked M. Fully back position gives RICH mixture and fully forward gives WEAK. A latch mechanism is incorporated in the throttle control of the forward cockpit only, so that when the throttle is closed it pulls the mixture control back into RICH position. The design of the latch renders it ineffective upon the mixture control as the throttle is pressed forward. The latch may be released if desired. The fully WEAK position of the mixture control provides for positive stoppage of the engine through a slow-running cut-out device incorporated in the carburettor. During take-off, climb at nearly maximum rate, and high speed level flight below 5,000 feet, the mixture control lever should be maintained in the fully RICH position. For all operations above 5,000 feet, the mixture may be weakened only sufficiently to maintain smooth engine operation, except when cruising at or below 70% normal rated power. The use of the mixture control at any time depends on cylinder temperature, which must be within the limits laid down (see paras. 17 and 18). Before descending from altitude at which the mixture control was set, reset the control to fully RICH.

13. Exhaust gas analyser (fuel-air ratio instrument in cockpit). - This instrument indicates the fuel-air ratio of the mixture entering the engine by analysing electrically a sample of the exhaust gas. Normally, the indicator will respond in 5 or 6 seconds to a change in mixture and this time should be allowed when taking a reading. A correct fuel-air ratio indication does not lessen the importance of the cylinder head temperature indicator. Should detonation occur, the pointer of the mixture indicator will move erratically, generally towards the RICH end of the scale.

14. To assist in making adjustment to the correct mixture, a manifold pressure scale is incorporated above the fuel-air ratio scale. The mixture indicator does not measure manifold pressure, the scale being used solely for reference.

15. When using the mixture control, the pilot should observe the existing pressure on the manifold pressure gauge (see paras. 19 and 20) and then adjust the mixture control to cause the pointer of the mixture indicator to move to the corresponding pressure on the manifold pressure scale above the fuel-air ratio, whereupon the correct fuel-air ratio is obtained. The mixture should never be weakened to cause the fuel-air ratio indicator to show less than .072.

16. When hot air is applied to the carburettor, it is necessary to weaken the mixture to restore the former fuel-air ratio. Enrich the mixture prior to turning carburettor heat off, otherwise the mixture might become too weak (see para. 29).

17. Cylinder Temperature. - Operation of the engine must be such that cylinder temperatures are maintained within the following limits: -

- (1) Take-off and short climbs - maximum for 5 minutes -  $288^{\circ}\text{C}$   
(The minimum cylinder temperature for take-off is  $160^{\circ}\text{C}$ )
- (11) Continuous climbing - maximum -  $260^{\circ}\text{C}$
- (111) Cruising, maximum -  $230^{\circ}\text{C}$  (The temperature should normally remain between  $150^{\circ}$  and  $200^{\circ}\text{C}$ .)

18. Prolonged steep climbing may result in high cylinder temperatures. An increase in airspeed of 5 to 10 m.p.h. will reduce cylinder temperatures considerably, with very little sacrifice in rate of climb.

19. Manifold pressure. - This is controlled by movement of the throttle and corresponds to boost. The pressure is registered by the manifold pressure gauge on the instrument panel in each cockpit. For take-off, the airscrew fine pitch limit stop should be set so that the engine speed is at the rated 2,250 r.p.m. with 36 in.Hg. manifold pressure. The engine is run up with the throttle against the gate and airscrew pitch fully fine while the aeroplane is on the ground.

20. For cruising and similar conditions of continuous operation, the throttle opening, manifold pressure, and r.p.m. should be reduced in accordance with the following table (see para. 21).

I.A.S.	Condition	Max. manifold press. (in. Hg)	Max. r.p.m.	Min. fuel-air ratio	Fuel Consump. gal./hr. (approx.)
-	Take-off	36.0	2,250	full RICH	-
117	Climb	32.5	2,200	.089	-
-	Level flight (maximum)	32.5	2,200	.089	-
150	At 5,000 ft. Cruising (desired)	26.5	2,000	.072	26
143		24.5	1,900	.072	23
262	Diving (maximum)	10 - 20	2,800	-	-

Note. - An information plate giving these particulars is fixed to the locker door below the instrument panel in the forward cockpit.

21. Airscrew pitch control. - This aeroplane has a 9 ft. diameter, Hamilton Standard, constant-speed, two-blade airscrew. The setting of the blades at the 42 in. station is 27° coarse and 11° fine. The control lever is situated in the throttle quadrant, and is marked P. Forward travel of the lever decreases airscrew pitch with consequent increase in engine r.p.m. Backward movement of the lever increases airscrew pitch, with a resulting decrease in r.p.m. The forward travel is limited by a stop on the quadrant which should be adjusted so that the engine speed does not exceed 2,250 r.p.m. when the throttle is opened against the gate for take-off. Fine pitch is also used for climbing and landing. When diving, the 27° coarse pitch limit of the airscrew may not be sufficient to permit continuation of the governing action at the extremely high airspeeds. Under these conditions, the airscrew will act like a fixed-pitch airscrew, allowing the engine to turn in proportion to the airspeed and throttle opening. To prevent excessive r.p.m., the throttle must be partially closed and/or the diving attitude of the aeroplane modified. The maximum allowable engine r.p.m. of 2,800 must never be exceeded, and operations calling for more than 2,000 r.p.m. should be of as short duration as possible.

22. Oil temperature regulator shutter control. - A control handle for controlling the open or closed position of the shutter located on top of the oil regulator is situated at the bottom of the instrument panel in the forward cockpit. These shutters control the acceleration of heating the oil for warming-up purposes.

23. Fire extinguishers. - A carbon tetrachloride, hand-operated fire extinguisher is installed on the inner side of a door located on the port side of the fuselage in the aft cockpit. The extinguisher is easily accessible to the ground crew as well as to the occupant of the rear cockpit.

24. In addition to the hand-operated fire extinguisher, provision is made for flooding the engine compartment with carbon dioxide by means of a five-pound capacity, carbon dioxide, pressure type fire extinguisher. The handle for its operation is situated on the starboard side of the forward cockpit, in line with the main instrument panel.

25. Seat adjustment. - The lever controlling this is at the lower starboard side of each seat.

26. Sutton harness release. - A lever for releasing the Sutton harness, to enable pilots to lean forward, is located on the lower port side of each seat.

27. Gyro selector valves. - The gyro instruments can be operated by either the engine-driven vacuum pump or the venturist. Two selector valves are situated on the port side of the forward cockpit instrument panel. The upper valve controls the vacuum pump and has two positions - OFF and ON - for the instruments of both cockpits. The lower valve controls the venturi and has three positions - OFF, front cockpit instruments ON, and rear cockpit instruments ON. Use the venturi only in case of vacuum pump failure. When either of the two valves is ON, make certain that the other valve is OFF.

28. Carburettor air heat control. - The use of the carburettor air heat is necessary to prevent or remove ice formation in the carburettor, which is most likely to occur at part throttle (moderate to low manifold pressures) under high humidity conditions over a considerable range of temperatures. Formation of ice in the carburettor can generally be detected at cruising throttle by a gradual decrease of manifold pressure at a fixed throttle setting in steady, level flight. At greater throttle openings, it is more difficult to detect except from irregular engine operation.

29. To prevent icing under adverse weather conditions, the carburettor air temperature should be maintained at from 32°C to 38°C. The air temperature thermometer is fitted in the carburettor air intake. Adjust carburettor mixture after setting carburettor air heat control (see para. 16). It is important, owing to the high manifold pressure allowed for take-off, that the carburettor air heat control is set at COLD AIR before taking-off,

except when operating in unusually cold or damp weather. This is necessary, owing to the resulting high air temperature with the control set for HOT AIR, which materially reduces the engine power and may cause detonation and its accompanying serious effects. The control is on the port side of the forward cockpit, by the gyro selector valves below the main instrument panel. The handle is put down to admit hot air to the carburettor and up to admit cold air. Notches enable the amount of hot air to be regulated. The temperature of the air entering the carburettor is indicated in degrees C on an instrument mounted on the port side of the main instrument panel.

30. Heating and de-frosting control. - A handle to control the heating of the cockpits and fixed gun compartment in the star-board outer plane and to control the de-frosting system is located at the right side of the forward cockpit, below the cartridge container. The one handle controls the entire heating and de-frosting system.

31. Ventilating control (cockpits). - A valve for controlling the ventilating system of the cockpits is situated between the rudder pedals in the forward cockpit. The valve is operated by rotating the notched wheel with the foot. A small door, situated below the fire extinguisher door in the aft cockpit, provides an additional means of ventilation. The opening of the door is controlled by a handle on the door. Further ventilation of the cockpits can be obtained by opening the sliding roofs to any of the intermediate positions.

32. Instrument flying hood. - This is installed in the aft cockpit. When not in use it is folded back and held down by means of a clamp and shock cord arrangement which is attached to the structure of the aircraft. To lock the hood in an operating position, pull it forward and engage catch over first bow of hood. To release the hood from the aft cockpit, press on the lever of the catch assembly. To release it from the forward cockpit, push forward on the knob extending through the trim strip on the port side of the cockpit.

33. Fuel system (fuel used D.T.D. 230, Stores Ref. 34A/59). - The two fuel tanks have a total capacity of 92.4 gallons, sufficient for 4 hours' cruising at normal operation. Each tank holds 46.2 gallons, but the port tank has a standpipe which prevents petrol being taken below the level of its top. The fuel cocks are mounted on the control shelf at the port side of each cockpit and the dials have four positions: - OFF, RIGHT ON, LEFT ON, and RESERVE ON. The tanks are not connected, and therefore it is necessary to switch from one tank to the other and then to the reserve. The standpipe in the port tank cuts off 15.8 gallons (as reserve) from the 46.2 gallons in that tank, so that when flying with the cock set at LEFT ON, 30.4 gallons only are available in that tank, and to obtain the remaining 15.8 gallons the cock has to be turned to RESERVE ON.

The following procedure is to be adopted under the conditions named: -

- (1) Starting up. - Set cock LEFT ON, warm up and run up engine on this tank, then switch to RIGHT ON before taxiing out to take-off. The right tank is flown off first, owing to the fact that the reserve petrol is in the left tank and the cock can be switched from LEFT ON to RESERVE ON quicker than from RIGHT ON to RESERVE ON, the LEFT ON being the intermediate position. By starting up on the left tank, sufficient petrol is used from it to obviate any overflow (thereby causing a loss of petrol) due to attitude. It should, however, be noted that the engine can be primed and started up from either tank (including the reserve) if necessary.
- (11) Local flying. - Change from right tank to left when the right gauge shows 10 gallons. Change from left tank to reserve when left gauge shows 25 gallons.
- (111) Cross-country flying (when low flying is not involved). - Change from right tank to left tank and subsequently, left to reserve, when the fuel pressure warning lamp shows red and the fuel pressure drops to zero. This procedure should be supplemented, at Flying Training Schools and Stations where flying training is carried out, by regular dual instruction, which is done by the instructor turning off the petrol without warning and the pupil taking the necessary corrective action. The pupil should be able to turn on the petrol before the engine shows signs of stopping. If the pressure does not return to normal when the petrol is turned on, use the hand pump which is situated on the port side of each cockpit between the rudder and elevator trimming tab control wheels. When teaching pupils forced landing procedure, the petrol is not to be turned off in the air to simulate engine failure.

34. The normal fuel pressure in flight should be from 4 to 6 lbs./sq.in. A fuel pressure warning signal shows a red light on the main instrument panel in each cockpit should the pressure fail. The fuel contents gauges are mounted on each tank and are situated on either side of the seat in the forward cockpit. Each gauge is provided with a lamp which can be lit by the appropriate switch on the panel in the forward cockpit. The gauges can be read from the aft cockpit, but not accurately.

35. Oil system (Oil used D.T.D. 109, Stores Ref. 34A/32 and 33). - The capacity of the oil tank is 8.5 gallons, and air space of 1.5 gallons is provided. Other details are as follows: -

#### Oil Pressure

Take-off \_\_\_\_\_ 70 to 90 lbs./sq.in.

In flight \_\_\_\_\_ 70 to 90 lbs./sq.in.

Minimum permissible \_\_\_\_\_ 50 lbs./sq.in.

Oil Temperature

Minimum permissible for take-off \_\_\_\_\_ 40°C

Maximum permissible in level flight \_\_\_\_\_ 85°C

Maximum permissible on ground or in climb \_\_\_\_\_ 85°C

36. Ballast. - Provision for eight 17-1/2 lb. removable ballast weights is made in the upper portion of the fuselage, aft of the rear cockpit. An inspection window is provided to aid in determining the number of ballast weights carried. For any condition of solo flight (forward pilot only) three weights should be used. The aeroplane can also be flown dual with these three weights in. If three ballast weights are carried, with two pilots, then the flares must not be aboard. Restrictions regarding the amount of luggage which may be carried are stencilled inside the luggage compartment. If two pilots are aboard and luggage is carried, no ballast weights should be carried.

37. Electrical system and controls. - (For full details see A.P. 1691B, Vol. I). Spare lamps and sockets are stowed in an accessible box mounted above the rudder pedal support tube in the aft cockpit. All instrument panel and cockpit lamps may be replaced during flight. Spare fuses are in the electrical switch panel at the port side of each instrument panel. The lamp bulbs on each instrument panel can be changed by opening the front piece of each panel. This is done by turning the thumb screw on each side at the top so that arrow points are vertical, and pulling the front piece forward on its hinge at the bottom.

38. All switches and rheostats for control of electrical equipment are situated within shielded panels at the port side of each cockpit. Each switch and rheostat is plainly marked to indicate its operation. The only controls in the aft cockpit are the aft instrument panel, aft cockpit lamps and the fuel gauge lamps. Controls for the forward instrument panel, forward cockpit lamps and all other electrical equipment are on the switch panel of the forward cockpit.

39. An external accumulator supply socket, to be used in starting the engine, is situated on the port side of the fuselage, just aft of the engine and above the centre plane. Access to the sockets is gained through a hinged door.

40. Landing flare release. - Provision is made for releasing two standard 4-inch forced landing flares through launching tubes situated aft of the baggage compartment. The two release handles are of the toggle type and are on the starboard side of the pilot's seat in the forward cockpit. The flares are released individually by these handles. Reconnaissance flares can be carried in the bomb carriers if required, and released by means of the bomb release mechanism and controls.

41. Signal pistol. - Provision is made for the installation of a No. 3 Mark I signal pistol located on the starboard side of the forward cockpit. A rack for stowing nine cartridges runs along the starboard side of the forward cockpit.

42. Gun control. - One Browning gun can be installed in the leading edge of the starboard main plane. An air selector valve, used in operating the gun, is mounted near the starboard side of the fuselage, just aft of the forward seat. To operate the gun, pull outward on the gun-charging handle situated on the starboard side of the control panel, rotate the air selector valve lever 180° in either direction from the OFF position and press the trigger button on the forward control column. The machine gun and G.42 cine camera (which can be installed in the leading edge of the port main plane) may be operated selectively or simultaneously by corresponding positions of the air selector valve.

43. Bomb release controls. - A light series Type E.M. bomb carrier can be installed on the lower surface of each main plane. Switches for controlling the release of bombs are installed on the control panel in the forward cockpit. To release bombs, either selectively or simultaneously, press the master switch in the electrical control panel upward, operate the selective or jettison switches situated on the right side of the control panel as desired, and press the release switch mounted in the upper left-hand corner of the control panel.

October, 1940

AIR PUBLICATION 1691B  
Pilot's Notes

SECTION 2

HANDLING AND FLYING NOTES

FOR PILOT

ATK BULLDOZER 1941B  
1941B 1941B

October 1941

SECTION 1

HANDLING AND PLACING WORK

FOR FIELD

2.2.2

SECTION 2  
LIST OF CONTENTS

	<u>Para.</u>	
Fitness of aeroplane for flight	1	
Preliminaries	2	
Starting the engine and warming up	4	
Testing engine and installations	6	
Taxying out	8	
Delay prior to take-off	9	
Final preparation for take-off - drill of vital actions	10	
Take-off	11	
Immediate action after take-off	12	
Action subsequent to take-off	13	
Engine failure during take-off	14	
Climbing	15	
Cruising	16	
General flying	17	
Characteristics	17	(i)
Turning	17	(ii)
Change of trim	17	(iii)
Trimming tabs	17	(iv)
Slow flying	17	(v)
Sideslipping	17	(vi)
Flying by instruments	18	
Stalling	19	
With flaps and undercarriage up	19	(i)
With flaps and undercarriage down	19	(ii)
General	19	(iii)
Spinning	20	
With flaps and undercarriage down	20	(i)
With flaps and undercarriage up	20	(ii)
Gliding	21	
General	21	(i)
Approach glide	21	(ii)
Gliding turns	21	(iii)
Engine-assisted glide	21	(iv)
Diving	22	
Approach and landing - general and methods of executing	23	
Preliminary approach	24	
Engine-assisted approach and landing	25	
Notes on landing	26	
Glide approach and landing without use of engine	28	
Approach with engine - final glide without engine	29	
Power approach and landing	30	
Approach speeds	31	
Tabulated summary of correct speeds for various approach methods	31	(1)
General notes about the approach	32	

	<u>Para.</u>
Landing across wind _____	33
Procedure after landing _____	35
Undercarriage emergency operation _____	36
Space required for precautionary landing _____	38
Flying in rain or poor visibility _____	39
Forced landing due to engine failure _____	40
Partial engine failure (some power available) _____	40 (1)
Total engine failure _____	40 (ii)
Aerobatics _____	42
Loop _____	42 (1)
Slow roll _____	42 (ii)
Half-roll off the top of a loop _____	42 (iii)
Position error table _____	44
Limits of speeds and leading particulars _____	45
Notes on the Wasp engine _____	46
Fuel and oil capacity, endurance, range and consumption _____	47
Load distribution _____	48
Notes on night flying _____	49
Preparation _____	49 (1)
Taxying _____	49 (ii)
Before take-off _____	49 (iii)
Take-off _____	49 (iv)
In the air _____	49 (v)
Approach and landing _____	49 (vi)
Danger of carrying non-standard loads _____	50

SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

FITNESS OF AEROPLANE FOR FLIGHT

1. Note the following: -

- (i) These Notes should be read in conjunction with Flying Training Manual, Chapter III, which sets forth in detail the technique outlined here.
- (ii) If flying solo, see that the correct number of ballast weight is fitted (see Section 1, para. 36).

Warning. - The danger which may arise from the carriage of non-standard loads is explained in paras. 50 to 52. It is of the greatest importance that these paragraphs should be read and understood.

PRELIMINARIES

2. Before flying solo take the following precautions: -

- (i) See that the aft control column is stowed and locked in its socket on the starboard side of the cockpit.
- (ii) Ensure that the Sutton harness in the aft cockpit is fastened.
- (iii) See that the aft cockpit sliding roof is closed and locked.

3. On entering the forward cockpit, make the following preparations: -

- (i) Unlock (if locked) the controls and check the movement of all flying controls.
- (ii) Set rudder pedals to comfortable position, giving full control on the brakes when taxiing.
- (iii) Apply parking brakes and wheel chocks.
- (iv) Check the contents of the two fuel tanks.
- (v) Switch on main generator.
- (vi) Switch on pitot head heater if flight is to be in cold atmosphere.

- (vii) Set altimeter to zero.
- (viii) Keep cockpit sliding roof open till after take-off.
- (ix) If intercommunication with passenger or pupil is desired, ensure that he is connected up.
- (x) Push button left of undercarriage indicator lamps and see that they light.

#### STARTING THE ENGINE AND WARMING UP

Note. - The practice of idling the engine for long periods of time should be avoided as much as possible, as this tends to shorten the serviceable life of the spark plugs.

#### 4. Starting engine: -

- (i) Turn fuel to LEFT ON.
  - (ii) Place airscrew pitch control at COARSE PITCH (fully backward).
  - (iii) Place mixture control at RICH (fully backward).
  - (iv) Set carburetor heater at COLD (see Section 1, para. 29).
  - (v) Set throttle about 1/2 inch open.
  - (vi) Ascertain that oil cooler shutter is closed.
  - (vii) Pump up fuel pressure by hand to read 3 to 4 lbs. on fuel pressure gauge when the hand pump is pushed slowly through a complete stroke. While doing this: -
  - (viii) Prime engine with priming pump - 4 to 6 full strokes if engine is cold, or 2 to 4 strokes, if engine is warm. Do not prime if engine is hot. Turn off priming pump after priming. Lock in this position, otherwise, there is danger of the engine cutting out, or loosing power during cruising flight.
  - (ix) See that all personnel are clear of the airscrew; then switch on main ignition.
- Note. - When this is done, the undercarriage lamps and the fuel pressure warning lamps will also be switched on.
- (x) Press on rear end of starter pedal situated between the rudder pedals in the forward cockpit, to energise starter motor. (The ignition switch must be in the ON position

before the starter can be energised). When ready (i.e., when a high pitched note has been reached): -

- (xi) Press on forward end of starter pedal to engage starter to engine.
- (xii) If the engine does not start, repeat (x) and (xi) and if battery is low, use the external accumulator (see Section 1, para. 39). Should engine still not start, prime with a further 2 strokes of the priming pump. Failure to start after this will require investigation.
- (xiii) Caution. - During starting do not "pump" the throttle, as this may cause flooding, with a great risk of fire should a backfire occur.
- (xiv) If hand cranking for energising the starter motor has to be resorted to, the crank handle is in the baggage compartment.
- (xv) Open throttle so as to reach 600 r.p.m. or less, as soon as possible, and hold this engine speed for 30 seconds or until oil pressure reaches 50 lbs./sq.in.; then increase opening. If oil pressure does not show within 30 seconds, stop engine and investigate.

Note. - It is strongly recommended that the pilot should himself carry out preparation and starting up. This will ensure that he knows the procedure thoroughly and that unnecessary running of the engine before take-off is avoided.

5. Warming up after starting engine: -

- (1) Put airscrew control fully forward (fine pitch) as soon as oil pressure is normal (50 lbs./sq.in.) and engine is running smoothly.
- (1i) Slowly open throttle to 1,000 r.p.m. for warming up.
- (1ii) Keep mixture control at RICH.
- (1v) Oil temperature for take-off: minimum 40°C; maximum 85°C.
- (v) Maximum engine cylinder temperature 260°C on ground.

TESTING ENGINE AND INSTALLATIONS

6. During warming up: -

- (1) Test hydraulic hand pump by lowering and raising flaps.
- (1i) Check oil pressure and fuel pressure.

- (iii) Ensure that Sutton harness and that of passenger (if carried) is fastened tightly and securely.
  - (iv) Ensure that parachute and that of passenger (if carried) is securely fastened.
  - (v) Check electric switches (undercarriage and fuel gauge lamps, etc.).
  - (vi) Set dimmer switch for undercarriage lamps to DAY or NIGHT (as applicable).
  - (vii) See that main generator switch is ON.
  - (viii) Set the trim adjustment of the artificial horizon with the instrument caged, so that the aeroplane silhouette coincides with the centre of the horizon bar.
  - (ix) Uncage the artificial horizon as follows: -
    - (a) Pull out the knob and rotate it as far as it will go in an anti-clockwise direction.
    - (b) Release the knob and check, without pulling it, that it cannot be rotated in either direction.
  - (x) To obtain reliable indications from the artificial horizon and direction indicator during take-off, the engine should be run for at least 2-1/2 minutes at a speed such that the engine-driven pump provides a suction of 3-1/2 inches of mercury as shown by the suction gauge. This is necessary to allow the gyroscopes to attain sufficient speed and for that in the artificial horizon to erect to the vertical. It should be noted that the horizon bar will settle to the tail down attitude of the aircraft; the trim adjustment as set in (viii) must not be altered on this account.
  - (xi) Set the direction indicator to agree with the compass and uncage it by pulling out the knob.
7. During running up: - When engine is warm (oil temperature 40°C and engine cylinder temperature 150°C): -
- (i) Open throttle up gently but firmly to the gate.
  - (ii) Static r.p.m. (fine pitch) should not be less than 2,200.
  - (iii) Manifold pressure (boost) should be 36 inches.
  - (iv) Test each magneto at 29 in.Hg manifold pressure. (Drop in r.p.m. should be less than 100, and the engine should run smoothly. As this is a constant speed airscrew the drop in r.p.m. should only be momentary.) If drop is more than 100 r.p.m. check magnetos.

- (v) At 1,600 r.p.m. check AMPS. for 50 maximum and suction 3.8 to 4.1 in.Hg.
  - (vi) Oil pressure should be between 70 and 90 lbs./sq.in.
  - (vii) Fuel pressure should be 4 to 6 lbs./sq.in.
  - (viii) If everything is in order, wave away chocks and release parking brakes.
- Note. - The throttle should not be kept fully open for more than 10 seconds.

#### TAXYING OUT

8. Proceed as follows: -
- (1) Use brakes as little as possible. Always taxi slowly, as the aeroplane is easier to control and there is less risk of damage should a swing result from "weather cocking" in a strong wind.
  - (ii) If taxiing is prolonged, check engine cylinder temperature.
  - (iii) Steer a "zig-zag" course, as the nose obstructs the view ahead.
  - (iv) When attempting to turn the aircraft on the ground, if the rudder is held hard against the stops, giving the rudder its full travel in the direction the aeroplane is to be turned, it will aid considerably in disengaging the tail wheel locking mechanism, thereby allowing the tail wheel to become a free swiveling unit. With the aid of the free swiveling tail wheel, the aeroplane can be turned very easily by hand or with very little brake pressure and engine power.

#### DELAY PRIOR TO TAKE-OFF

9. If the take-off is delayed for any reason, the engine should be cleared by opening up against the brakes to about 25 in.Hg manifold pressure (1,900 r.p.m.). The engine should not "tick over" for more than 2 or 3 minutes without being cleared in this manner.

#### FINAL PREPARATION FOR TAKE-OFF - DRILL OF VITAL ACTIONS

10. On reaching the take-off position, stop across wind, facing the circuit, so that approaching aircraft can be seen. Then, with as little delay as possible, carry out the

drill of vital actions, as follows: -

- (1) Set elevator trimming wheel slightly forward of the neutral position and rudder trimming wheel to neutral.
- (ii) See that mixture control is fully back (RICH).
- (iii) See that airscrew pitch control is fully forward (fine).
- (iv) Make sure that the flaps are up. If high obstacles are to be cleared and only a short run is available, set flaps at 15° down. High air temperature conditions will increase the run.

Note. - This drill may be done before taxiing out, with the exception of setting the flaps at 15° (if necessary) as damage is likely to result if the aeroplane is taxied with the flaps down, particularly in a strong down wind. The drill must, however, be carried out in its correct order immediately before take-off. It may assist the pilot to remember this order if he thinks of it in the form of letters, as follows: -

T = Trimming  
M = Mixture  
P = Pitch  
F = Flaps

#### TAKE-OFF

11. (1) Turn into wind and take-off without delay. Open the throttle with one motion until it is hard against the gate, taking only about 2 to 3 seconds in doing so. This will give 2,250 r.p.m. and 36 in.Hg manifold pressure. The manifold pressure of 36 in.Hg is not to be exceeded.
- (ii) Keep straight with rudder against any tendency to swing. Do not attempt to pull the aeroplane off the ground too early by depressing the tail. Maintain a constant attitude until it flies itself off.
12. Immediate action after take-off: -
  - (1) Directly the aircraft is finally clear of the ground, raise the undercarriage.
  - (ii) Ease back the throttle to 32.5 in.Hg manifold pressure.
  - (iii) Ease back airscrew pitch control to give 2,200 r.p.m. Do (ii) and (iii) when airspeed reaches 120 m.p.h. Accelerate to climbing speed (120 I.A.S. reading) before the normal climbing angle is assumed.
  - (iv) If the flaps have been partly lowered for the take-off, raise them, provided the airspeed is at least 100 m.p.h. and safe height has been attained (300 to 400 feet), so that there is no risk of the aeroplane sinking back on to the ground as it will do if the flaps are raised at too low an airspeed.

13. Action subsequent to take-off: -

- (i) Check oil pressure.
- (ii) Note cylinder and oil temperature.
- (iii) Close cockpit sliding roofs the desired amount.
- (iv) Look round the cockpit systematically.
- (v) Climb at 117 m.p.h. I.A.S.

Feet may be taken off the rudder. Adjust rudder trimming wheel so that aircraft will fly straight with feet off.

ENGINE FAILURE DURING TAKE-OFF

14. If the engine fails immediately after take-off, act as follows: -

- (i) Maintain speed by depressing nose at once so that airspeed does not drop below 95 m.p.h.
- (ii) Make sure that the undercarriage has started to come up. There is not time to take further action, and even if only unlocked and on the way up, it will collapse on landing. Do not try to lower undercarriage. There is less likelihood of personal injury if the aircraft is landed with the undercarriage up.
- (iii) Lower flaps fully if possible.
- (iv) Land straight ahead, only changing direction sufficiently to miss obstructions.
- (v) If there is time, switch off the engine before landing to lessen the risk of fire; but in any case do it immediately after landing, and turn off the petrol (see paras. 40 and 41).

CLIMBING

15. (i) Climb at 2,200 r.p.m. and 32.5 in.Hg manifold pressure. At this setting the best climbing speed is 117 m.p.h. I.A.S. reading to full throttle height (about 5,000 feet) reducing speed by 3 m.p.h. per 2,000 feet to the service ceiling (22,600 feet with full load). The mixture control must be used as directed in Section 1, para. 10. The rate of climb at this setting is 1,200 feet per minute.

- (ii) Watch the engine temperatures. The maximum cylinder temperature for 5 minutes during climb is 288°C, and maximum oil temperature 85°C (see Sect. 1, paras. 17 and 18).
- (iii) Use cockpit heater if desired (see Sect. 1, paras. 30 and 31).

#### CRUISING

16. (Further instructions and data are given in Sect. 1, para. 20 and Sect. 2, para. 46).
- (i) The engine should normally be run at the lowest speed necessary for the occasion. The aeroplane has a good reserve of power and should be flown at the desired cruising conditions. This will economise fuel and reduce maintenance. The maximum cruising r.p.m. are 2,200 at 32.5 in.Hg manifold pressure, but only for a short period. The maximum continuous r.p.m. of 2,000 at 30 in.Hg manifold pressure should only be exceeded in emergency.
- (ii) Economical cruising. - The lowest fuel consumption is obtained by using weak mixture control setting and throttling down the engine to the lowest speed at which the aircraft will fly satisfactorily and the engine run smoothly. This speed is 110 m.p.h. I.A.S. reading with 1,320 r.p.m. at 22.5 in.Hg manifold pressure and airscrew in coarse pitch at approximately 5,000 feet. At this setting the fuel-air ratio will be correct (gauge reading .078) if the mixture control lever is against the latch on the throttle (about one inch open). Although slightly less economical, the desired cruising conditions of 1,900 r.p.m. at 24.5 in.Hg manifold pressure (I.A.S. reading approximately 145 m.p.h.) are more practicable for ordinary conditions. Greater economy will be effected if the aeroplane is flown at approximately 5,000 feet (if weather permits). Temperature of cylinder heads should not exceed 235°C, and of oil 85°C (see Sect. 1, paras. 17 and 35).
- (iii) Mixture control. - Always use the mixture control when cruising steadily for any length of time, but be careful not to use too weak a mixture, or serious damage may result. Instructions for using it are given in Sect. 1, paras. 12 to 16.

#### GENERAL FLYING

17. (i) Characteristics. - This aeroplane is quite nice to fly and easy to manoeuvre. Special attention is, however, drawn to the stall, the spin, and aerobatics, which are fully described in paras. 19, 20, 42, and 43. Provided

its characteristics in these manoeuvres are clearly understood and the necessary care and precautions are exercised, a pilot should find the handling of this aeroplane quite straightforward. It is stable and the controls are easy to handle. It is rather sensitive fore and aft. It can be flown with feet off if the necessary correction on the rudder trimming tab has been made.

- (ii) Turning is done by aileron and elevator. (See Flying Training Manual, Chapter III) Rudder control is not required. This eliminates the need for careful co-ordination of hand and foot, and is particularly valuable in flying by instruments. Care in turns must be exercised, (see para. 19).
- (iii) Change of trim. - The effect of operation of the flaps and undercarriage on the trim of the aeroplane in flight is as follows: -
- (a) Undercarriage raised: No effect.
  - (b) Undercarriage lowered: No effect.
  - (c) Flaps lowered: Aeroplane becomes "nose heavy".
  - (d) Flaps raised: Aeroplane becomes "tail heavy". (Compensate for (c) and (d) by adjusting elevator trimming wheel). If the flaps are raised at less than about 85 m.p.h. I.A.S. reading, the aeroplane will sink (approximately 20 feet at 80 m.p.h. and 40 feet at 75 m.p.h. I.A.S. reading).
- (iv) Trimming tabs. - The rudder and aileron tabs have fine adjustments. The elevator tab requires frequent use to compensate for change of trim owing to variation of throttle setting or other reasons. It must not be used for manoeuvring, as great stresses can be put on the aeroplane by it (see Sect. 1, para. 5). The wheel should be turned back for landing to assist the elevator control but not beyond half way, or the pilot will have difficulty in preventing the nose from rising if full throttle is needed after a mislanding. This aeroplane requires rudder bias to the right when climbing or flying level. Bias has to be eased off when gliding.
- (v) Slow flying. - Flying at slow speeds down to the stall should be practised at a safe height in order that the pilot may become familiar with the feel of the controls. Feet should be kept on the rudder pedals at low speeds. This practice should be carried out with the flaps and undercarriage up and with them down; with airscrew in full fine pitch and at setting for cruising (1,900 r.p.m.).

- (vi) Sideslipping. - This aeroplane can be sideslipped but difficulty is experienced in maintaining a steady forward speed and direction. Care must be taken that the airspeed does not drop below 90 m.p.h. and recovery from a sideslip should be effected above 200 feet.

#### FLYING BY INSTRUMENTS

18. It has already been mentioned in para. 17 (i) and (ii) that this aeroplane can best be flown without use of rudder control. This is particularly important when flying by instruments, as the mental concentration required of the pilot is reduced.

#### STALLING

19. Though the stall most commonly occurs at low speed, the pilot should remember that it may occur at any speed if the control column can be brought back far enough to put the aeroplane at stalling incidence. The following is a brief description of the stalling characteristics of this aeroplane: -

- (i) With flaps and undercarriage up. - Stalling incidence is reached at about 75 m.p.h. I.A.S. reading, and a wing will drop. If the wing drops and the backward movement of the control column is continued, the aeroplane goes into a spin, very steep at first, then more normal.
- (ii) With flaps and undercarriage down. - Stalling incidence is reached at approximately 65 m.p.h. I.A.S. As speed is reduced, the aeroplane drops a wing (usually the right) very quickly and unless recovery is effected immediately, it may flick into a half roll and attempt to spin.

Unless recovery is made at once, the speed will become excessive (about 140 I.A.S. reading) and a severe strain will be put on the flaps. At the same time, care must be taken not to ease the control column back too soon. If this is done at too low a speed, there is a possibility that the aeroplane will spin in the opposite direction.

- (iii) General. - A noticeable characteristic of this aeroplane near the stalling speed is that with the flaps up, the stalling incidence is reached with the control column only a short distance back from the normal position, owing to the light and sensitive elevator. This is not the case, however, with flaps down or in flattening out to land, when the control column should be brought right back. It is very easy to check a "flick" half roll at the stall if the control column is put forward as the "flick" starts, and opposite rudder is applied; but if the pilot delays putting the control column forward until aeroplane is on its back,

the result may be an inverted spin. If the control column is eased only very slightly forward when the wing drops, it is possible that a very fast "flick" roll about a nearly vertical axis will result. No warning of a stall should ever be relied upon, although buffeting and pitching of the aircraft is likely to take place before the stall proper. All pilots should practise stalling at a safe height (not below 4,000 feet), so that they may be better able to avoid doing it unintentionally. The sliding roof should be open during practise. Do not pull the nose up to stall, but counteract its tendency to sink by easing the control column back gently. When a wing drops, put the stick forward at once, and apply opposite rudder.

## SPINNING

20. (i) Flaps and undercarriage down. - This aeroplane should not be spun intentionally with the flaps and undercarriage down owing to the great strain on the flaps and other parts. Should an unintentional spin occur, recovery (as described below) should be effected immediately. Centralise rudder directly the aeroplane is in a straight dive to prevent a spin in the opposite direction.
- (ii) Flaps and undercarriage up. - In the case of a pupil this is only to be done with an instructor. Recovery from all intentional spins in this aeroplane must be commenced at not less than 6,000 feet.
- (a) To the right: - The aeroplane "flicks" to the right and after approximately one turn, the spin becomes normal. The control column must be kept right back and rudder hard over during the spin. Recovery is effected by applying full opposite rudder first and then pushing the control column firmly forward. The aeroplane will recover after 1-1/2 or 2 turns. Centralise rudder immediately aeroplane is in a straight dive and ease out of it without delay. Do not bring the control column back coarsely to recover from the resultant dive, nor until adequate speed has been attained, or stalling incidence may again be reached and another spin ensue.
- (b) To the left: - The spin to the left is the same as to the right except that, normally, the entry is not so violent. The method of recovery is the same.

Note.—The rudder, though moderately light near the central position, becomes very heavy at large angles, even at the stall. Recovery will be easy and rapid if the rudder is put over as hard as possible. The sliding roofs of the cockpits must be open before an intentional spin is commenced. Before making intentional spins, it is necessary

that the pilot's seat be placed in a lowered position to assure that full rudder movement can be obtained.

#### GLIDING

21. (1) General. - Gliding may be carried out at any safe speed down to the necessary margin of about 25% above stalling speed. With the flaps and undercarriage up, the glide is very flat and at the optimum gliding speed of about 100 m.p.h. I.A.S. reading, long distances can be covered for a comparatively small loss of height. Lowering of either the flaps or the undercarriage (or both) greatly steepens the gliding angle for a given speed; and the rate of descent is much increased.
- (11) Approach glide. - The correct gliding speed for the final approach without use of engine is 95 m.p.h. I.A.S. reading (about 50% above the stall). The lowest safe speed for this type of approach is 90 m.p.h. I.A.S. reading.
- (111) Gliding turns. - Speed should be increased above that for safe gliding in a straight patch, especially at a low altitude or with flaps down. Steep gliding turns must not be done near the ground.
- (1v) Engine-assisted glide. - Airspeed should be 85 m.p.h. I.A.S. If it is necessary to land with flaps up, the approach speed should not be less than 100 m.p.h. This would only be necessary should one or both flaps fail to lower.
- (v) During a glide the cylinder temperature gauge should be carefully watched and if the temperature falls below 100°C, the engine should be opened up for a short period. The carburettor air-intake heat control must be in the HOT position if the engine shows signs of becoming unduly cold or if there is the least chance of "icing-up".

#### DIVING

22. The maximum diving speed is 260 m.p.h. I.A.S. reading; engine r.p.m. must not exceed 2,800 and manifold pressure (boost) should be 10 - 20 in.Hg, with the throttle open one-third or more. If the throttle is less than one-third open, 2,200 r.p.m. are not to be exceeded. When diving, the flaps and undercarriage must be up, and the airscrew put in positive coarse pitch 30 seconds before the dive. The airscrew control must be moved to the coarse position while the throttle is still open, to prevent the airscrew blades remaining set in fine pitch during the dive. Elevator tabs must not be used to assist recovery from a dive, except as a last resort and then only by a very small and slow movement (see Sect.1, para. 5).

APPROACH AND LANDING

23. General remarks. - The landing should always be made with the flaps fully down, by one of the following methods: -

- (1) Engine-assisted approach and landing.
- (ii) Glide approach and landing (for forced landing without use of engine).
- (iii) A combination of these two methods, by making an engine-assisted approach and the final glide and landing without use of engine.
- (iv) Power approach and landing (a low flat approach for landing in a small space).

24. Preliminary approach. - As the aeroplane nears the aerodrome; throttle down to a speed of less than 130 m.p.h. I.A.S. reading, and carry out drill of vital actions as follows: -

- (1) Undercarriage down (check position by all methods given in Sect. 1, para. 7).
- (ii) Pitch to full fine.

It will assist the pilot to remember these vital actions if he thinks of the word "UP".

25. Engine-assisted approach and landing. -

- (1) Fly to the leeward side of the aerodrome, turn towards the aerodrome, lower flaps fully, adjust elevator control wheel half way back.
- (ii) Regulate the approach with the throttle and maintain a constant speed of 90 m.p.h. I.A.S. reading (95 if "bumpy" or strong wind).
- (iii) Flatten out with engine running at this speed, then close throttle fully and make normal landing. Keep straight with rudder and, if necessary, apply brakes carefully. If the tail lifts, release brakes and re-apply.
- (iv) Having stopped, look down and raise the flaps.

26. Notes on landing. -

- (1) There is no tendency to drop a wing in landing, even when the control column is brought fully back before the wheels touch the ground, provided the "hold-off" has not been too high.

- (11) After a three-point landing the pilot can be certain of stopping within 200 yards.

27. Mislanding. -

- (1) In the case of an unsuccessful attempt to land, the aeroplane will climb satisfactorily with flaps and undercarriage down.
- (11) Raise the undercarriage immediately.
- (111) Do not touch the flap control until a safe height (about 500 feet) is reached. Then put the nose down slightly, increase speed to 100 m.p.h. I.A.S. reading, and raise flaps.

28. Glide approach and landing without use of engine. -

- (1) Approach speed without engine should be 95 m.p.h. I.A.S.
- (11) Glide to leeward side of aerodrome and lower the undercarriage.
- (111) Turn in not lower than 500 feet, and lower flaps when quite sure of getting in. As flaps go down, maintain the correct gliding speed (90 to 95 m.p.h. I.A.S. reading).
- (iv) Flatten out and land.

29. Approach with engine - final glide without engine. - This method is mainly used in training pilots to land without engine, as in a forced landing. It must not be regarded as the normal method, but may be used by pilots accustomed to this type of aeroplane, favourable conditions, the approach speeds being as already given in preceding paragraphs.

30. Power approach and landing. - This is an almost flat approach with nearly enough engine power for level flight. It enables the pilot to land close to a desired point with great accuracy, and is used for precautionary landings (landings away from an aerodrome for other reasons than engine failure) and landing on small landing grounds. It is to be regarded as an emergency method.

- (1) Fly to leeward and turn in for the final straight approach.
- (11) Lower the flaps fully and lose height at approach speed until the aeroplane is 200 to 300 yards short of the field.
- (111) Reduce speed to 80 m.p.h. I.A.S. reading, using ample engine power to make a flat approach straight towards the edge of the field and as close to the ground as possible. Immediately after crossing the boundary, close the throttle fully.
- (iv) It is very important not to close the throttle until the aeroplane is close to the ground.

31. Approach speeds. - It will be noted that the most suitable approach speed varies with the amount of engine power employed during the approach, the highest speed being required when no power is used.

Tabulated summary of correct speeds for various approach methods: -

Stalling speed _____	65 m.p.h. I.A.S. reading
Basic gliding speed - not to be attempted _____	80 m.p.h. I.A.S. reading
Speed for glide without use of engines (about 40% above stall) _____	90 to 95 m.p.h. I.A.S. reading
Speed for engine-assisted glide (33% above stall) _____	85 m.p.h. I.A.S. reading
Speed for power approach - small space (25% above stall) _____	80 m.p.h. I.A.S. reading

32. General notes about the approach. - It is not possible to vary the angle of glide once the flaps are down, except by use of the engine. This is because an effective sideslip cannot be done, and raising the flaps, once down, does not give an extended glide; because although the drag is reduced, lift is also reduced, the aeroplane sinks, and the initial loss of height more than counteracts the subsequent flatter glide. Raising the flaps is, however, effective at greater heights (for example - in a forced landing from 2,000 to 3,000 feet). Controls, especially the rudder, are a little more sluggish with the flaps down; therefore, turns must not be done on the final approach, with flaps fully down, lower than 500 feet.

#### LANDING ACROSS WIND

33. As it has a wide track undercarriage and a landing speed of about 65 m.p.h. I.A.S. reading, this aeroplane may safely be landed across wind.

34. Drift may be partly counteracted by keeping one wing slightly down into wind until near the ground.

#### PROCEDURE AFTER LANDING

35. Raise the flaps. Then: -

- (1) Change to coarse pitch while taxiing to tarmac.

- (11) Run engine with throttle right back for about a minute to allow the oil to settle in the sump, whence it can be removed by the scavenger pump.
- (11i) Turn off the fuel cock.
- (iv) Release catch on throttle and move mixture control fully forward (weak). This acts as a cut-out and can only be done from the front cockpit.
- (v) Switch off main ignition after engine ceases to fire.
- (vi) Push in indicator lamps master switch (a black knob above main ignition switch). This switch automatically comes on again when the main ignition switch is turned on.
- (vii) Switch off main generator and all other switches on panel in front cockpit.
- (viii) Apply parking brakes if necessary.
- (ix) Cage the gyro compass and artificial horizon (if not already done).

#### UNDERCARRIAGE EMERGENCY OPERATION

36. In the event of complete hydraulic failure (engine-driven pump and hand pump), the undercarriage units will fall when the control handle is set in the DOWN position. When the undercarriage has reached this position without the use of either pump, the latches may not engage until the aeroplane is rocked to throw the units into place. The mechanical indicators will denote when the undercarriage has dropped (they will be in the forward position), but a landing must not be made until the warning horn stops and/or the green indicator lights are operating to indicate that the undercarriage is locked.

37. Landing gear latch. - Failure of the spring in the DOWN position latch may prevent the latch pin from going into place. This condition will be indicated when the warning horn and/or the position indicator lights warn that it is unsafe to land, when the landing gear has otherwise functioned normally; (the horn will continue to sound and the green lights will not come on, after the normal procedure for lowering the undercarriage has been adopted). If this occurs it is then necessary to pull up on the undercarriage control handle and then push the handle to the extreme forward position at the end of the quadrant. This portion of the handle travel forces the lock pins in place. That it is safe to land will then be indicated by the warning horn ceasing to sound (when the throttle is closed) and the green indicator lights will come on. This extra portion of the control handle travel is to be used only in this emergency and not in normal operation.

SPACE REQUIRED FOR PRECAUTIONARY LANDING

38. The Harvard II can be stopped in less than 200 yards with any load in a light wind, and on level ground, with flaps down and using brakes, provided that a three-point landing has been made.

FLYING IN RAIN OR POOR VISIBILITY

39. When flying in conditions of bad visibility, open the sliding roof. In rain the window panel may become opaque even when outer visibility is good. If landmarks are being followed, keep these on one side rather than straight ahead. It is advisable to reduce speed in order to facilitate navigation, and to obviate the risk of collision with suddenly rising ground. In extreme cases flaps should be partly or fully lowered and the airscrew put in fine pitch to reduce vibration at low r.p.m. In such a case the engine temperature must be watched carefully. The pilot must use his discretion about the speed suitable to the weather conditions. If a landing becomes necessary, the undercarriage should only be lowered if the pilot is able to select a field suitable for a safe landing.

FORCED LANDING DUE TO ENGINE FAILURE

40. This can be divided into partial engine failure (some power available) and total engine failure.

- (1) Partial engine failure. - In such case proceed as follows:
- (a) Fly to the leeward side of field, and lower the undercarriage. Carry out other vital actions for landing except the lowering of the flaps.
  - (b) Get into position just beyond normal gliding distance.
  - (c) Turn in and lower flaps.
  - (d) Approach by an engine-assisted glide straight towards the edge of the field.
  - (e) Flatten out, close the throttle and land. Remember that it is vital not to overshoot, as it is impossible to make a second attempt after a mislanding.
  - (f) If the engine should fail completely during the approach, put the nose down to the glide approach angle, maintain speed and land straight ahead as well as possible.

It is pointed out that should a partial engine failure occur, it may be better to treat the forced landing as a total engine failure, as described below.

- (ii) Total engine failure. - In the case of total engine failure, the principles of forced landing are exactly as outlined in Flying Training Manual, Chapter III.

On this aircraft: -

- (a) An effective sideslip is difficult, owing to the large fin area.
- (b) "S" turns should only be employed above 2,000 to 3,000 feet.
- (c) A further adjustment of angle is provided by the flaps, the lowering of which may be delayed until the last 300 to 400 feet; they may be lowered progressively, but it must be remembered that once lowered they cannot be raised (see para. 32).
- (d) The question of whether to lower the undercarriage or not is decided by the size and surface of the landing ground. If in doubt, land with undercarriage up. As the undercarriage causes considerable drag, it should be left up to extend the glide if necessary, whether or not it is to be lowered finally; but, it must be lowered in good time if it is to be used.

41. Summary. - If a landing without engine is inevitable, act as follows: -

- (i) Turn off petrol.
- (ii) Switch off engine.
- (iii) Approach the selected field by "S" turns if above 2,000 and 3,000 feet.
- (iv) Decide and act about the undercarriage.
- (v) Turn in gradually with a little surplus height.
- (vi) Lower the flaps, maintaining speed.
- (vii) Flatten out and land.

#### AEROBATICS

42. Aerobatics are quite easy on this aeroplane, but attention is drawn to the result of tightening up a loop, and this also applies to a half-roll off the top of a loop. For all aerobatics set the constant-speed airscrew control lever to give 1,900 r.p.m.

and the throttle lever to give a manifold pressure of 24.5 in.Hg. Flaps and undercarriage are to be up.

- (1) Loop. - Dive the aeroplane to a speed of 200 m.p.h. I.A.S. reading, and fly it round. If an attempt is made to tighten the first half of the loop by easing back the control column by more than a very small amount, stalling incidence is reached and the aeroplane may flick into a half-roll off the top without any application of rudder; similarly, if the second half of the loop, i.e., the resultant dive, is tightened up, the aeroplane may spin (at least 1-1/2 turns, usually to the right) without any application of rudder.
- (11) Slow Roll. - The speed required for a slow roll is 160 m.p.h., I.A.S. reading.
- (111) Half-roll off the top of a loop. - Dive the aeroplane gently and attain a speed of 220 m.p.h., I.A.S. reading; then proceed as for a loop in (1).

43. The speeds given for the foregoing aerobatics are those at which they can be done smoothly by inexperienced pilots.

Note. - Do not use the elevator tabs. Set them at "neutral".  
(See Sect. 1, para. 5)

#### POSITION ERROR

44. The following are the corrections for the position error of the airspeed indicator pressure head: -

<u>I.A.S. reading</u>		<u>Position error correction</u>
80 m.p.h.	subtract	1 m.p.h.
100 m.p.h.	add	2 m.p.h.
120 m.p.h.	add	3 m.p.h.
140 m.p.h.	add	4 m.p.h.
160 m.p.h.	add	5 m.p.h.
180 m.p.h.	add	6 m.p.h.

#### LIMITS OF SPEEDS AND LEADING PARTICULARS

45. The following are brief details of the above (see also Sect. 1, para. 18 and Sect. 2, paras. 16 and 22): -

Normal gross weight \_\_\_\_\_ 5239 lb.  
 Maximum gross weight \_\_\_\_\_ 5340 lb.  
 Total wing area \_\_\_\_\_ 253.72 sq.ft.

Wing span \_\_\_\_\_ 42 feet - 1/4 inch  
Rated altitude \_\_\_\_\_ 5,000 feet  
Wing loading \_\_\_\_\_ 20.65 lb./sq.ft.  
Maximum speed at rated altitude \_\_\_\_\_ 203.5 m.p.h.  
Maximum speed at sea level \_\_\_\_\_ 190 m.p.h.  
Service ceiling - full load \_\_\_\_\_ 22,600 feet  
Take-off distance (in still air,  
at sea level) \_\_\_\_\_ 520 feet  
Cruising speed - 62.5% power \_\_\_\_\_ 182.5 m.p.h.  
(Full throttle altitude)  
Limits of C.G. are 9.35 inches to 12.59 inches, aft  
of the C.G. datum line.

#### NOTES ON THE WASP ENGINE

46. The following are brief details of the engine: -

Type: \_\_\_\_\_ 9-cylinder, air-cooled, radial

Make: \_\_\_\_\_ Pratt and Whitney, model S3H1

Fuel used: \_\_\_\_\_ D.T.D. 230 (Stores Ref. 34A/59)

Oil used: \_\_\_\_\_ D.T.D. 109 (Stores Ref. 34A/32 and 33)

Rating. -

Take-off: \_\_\_\_\_ 600 b.h.p. at 2,250 r.p.m. with 36 in.Hg  
manifold pressure

Climb: \_\_\_\_\_ 550 b.h.p. at 2,200 r.p.m. at 5,000 feet,  
with 32.5 in.Hg manifold pressure

Maximum cruising: \_\_\_\_\_ 400 b.h.p. at 2,000 r.p.m. at  
10,500 feet with 27 in.Hg mani-  
fold pressure

Rated power of engine: \_\_\_\_\_ 550 b.h.p.

Power loading: \_\_\_\_\_ 9.53 lbs./b.h.p.

FUEL AND OIL CAPACITY, ENDURANCE,  
RANGE AND CONSUMPTION

47. Details are as follows: -

Fuel capacity: 92.4 Imp. gallons (two tanks, 46.2 Imp. gallons each)

Reserve (included in above total): 15.8 Imp. gallons in port tank

Duty	Endurance (hours)	Range (miles)	Consumption (galls./hour)
Cruising speed	3.96	723	28
High speed	2.02	410	55
		(At critical altitude; see para. 16 (ii))	
Normal flying (cruising, circuits and landings)	-	-	About 28
Normal, with occasional aerobatics	-	-	28 - 33
Continued aerobatics and high speed	-	-	Up to 55

Oil capacity: 8.5 gallons and air space of 1.5 gallons

Consumption: About 2-1/2 pints per hour

## LOAD DISTRIBUTION

48. The following table may be used to assist in calculating the C.G. position: -

Item	Weight (lb.)	Distance from leading edge in inches	Moment lb.in.
Aeroplane empty	4009	25.53	102,350
Front pilot and parachute	200	45	9,000
Rear pilot and parachute	200	97	19,400
Gun, sight and ammunition	44.5	15	670
Flares	37.0	165	6,105
Signal pistol and cartridges	6	43	258
Ballast weights (3)	52.5	191	10,028
Fuel	666	36	23,976
Oil	76.5	-9	-689
Bombs and racks	107	41	4,387
Camera gun	10	12	120

Note. - The distance from the datum point to the leading edge of the wing is 19.26 inches; hence, for calculations relative to the datum point, the above arms must be reduced by 19.26 inches.

## NIGHT FLYING

49. The Harvard II is quite easy to fly and land at night, provided the sequences are even more strictly observed than in daylight. These notes do not include operational detail.

### (1) Preparation. -

(a) Switch on each landing lamp in turn and see that it is in working order. The switch for each lamp is on the switch panel in the front cockpit. Do not keep these powerful lamps on for more than a few seconds.

(A 12-volt, 20 ampere, 240-watt landing lamp is installed in the leading edge of each outer plane. They are of the

fixed focus type and are so arranged that the centre lines of the beams of light are horizontal when the aeroplane is in the normal three-point position. Each lamp is fitted with an anti-glare device.)

- (b) Switch on the navigation lamps. The switch is on the panel in the front cockpit.
  - (c) Switch on (to test) the upward and downward identification lamps. The switch is on the identification switch box on the starboard side of the front cockpit. If they are in order, switch off.
  - (d) Switch on flight instrument lamps, engine instrument lamps, and cockpit lamps. The switches for these lamps are clearly marked and are situated on the left side and at the bottom of the instrument panel of both cockpits. The intensity of these lights can be regulated by rotating each switch.
  - (e) Turn the dimmer switch for the undercarriage warning lamps to NIGHT.
  - (f) Carry out all the necessary cockpit drill of vital actions as in daytime.
  - (g) Start-up, warm-up and run-up engine as in daytime, (see paras. 2 to 7).
- (ii) Taxying. - Taxy slowly. Do not use the landing lamps except in emergency (see para. 8).
- (iii) Before take-off. -
- (a) Adjust the intensity of all lamps in the cockpit so that instruments can be read easily without bright lights.
  - (b) Check the drill of vital actions again as laid down in para. 10. When permission to take-off is received, clear the engine by opening the throttle against the brakes.
- (iv) Take-off. -
- (a) Take-off in the normal way (see para. 11). Switch off the upward identification light before taking off, as this will cause glare on the glass of the sliding roofs. Get the undercarriage up at once, hold in slight climb to 120 m.p.h. I.A.S. reading, then take action as laid down in paras. 12 and 13.
  - (b) Watch the airspeed and altimeter, and maintain steady climb.

(c) On a dark night, the landing lamp may be used to light up the ground until a safe height of 200 or 300 feet is reached.

(d) If the engine should fail after take-off, put on one landing lamp and land straight ahead as best possible. Maintain plenty of speed. See that undercarriage is up or coming up.

(v) In the air. -

(a) The all-round view from inside the cabin is not good, and if the visibility is bad, open the sliding roof (see para. 39).

(b) The landing lamp should only be used for landing (and take-off, if necessary).

(c) Get used to the position of the various lamp switches by feel, especially those for identification and landing lamps.

(vi) Approach and landing. - The following is the sequence: -

(a) Get into position to approach the flare path from the port quarter (lee quadrant) on a left-hand circuit.

(b) Start sending aeroplane letter when flying downwind before entering port quarter.

(c) When given permission to land, switch on the upper and lower identification lamps and complete the circuit of the flare path, lowering the undercarriage meanwhile, and carrying out the rest of the drill of vital actions as in daylight (see para. 24). Adjust the light of the cockpit floodlamps as for take-off.

(d) Fly to leeward.

(e) Turn in, lower flaps (watch indicator) and approach on a semi-flat power glide at about 85 m.p.h. I.A.S. reading. Switch off the upward identification lamp after turning in, as this will cause glare when landing.

(f) Switch on the landing lamp 300 yards short of the flare path.

(g) Flatten out, close the throttle and land.

(h) Keep straight after landing.

(i) Switch off the landing lamp and downward identification lamp at once, raise the flaps and taxi in.

DANGER OF CARRYING NON-STANDARD LOADS

50. When any load is carried other than the normal crew and military load, it is of the greatest importance to ensure that it is disposed of in such a way that the balance of the aircraft is not disturbed. Serious accidents have occurred on a number of types of aircraft due to tail heaviness from additional load carried in the after portion of aircraft.

51. As a rough rule, no additional load should be carried aft of a point approximately one-third of the wing chord behind the leading edge at the wing root, unless it is balanced by an approximately equal load the same distance forward of this point.

52. Wherever possible, however, the C.G. position should be determined by the data provided and the loading should be adjusted to bring the C.G. within the range notified in the Weight Sheet Summary as the safe range for the particular aircraft.

Attention is drawn to A.M.O.A. 254/1936.

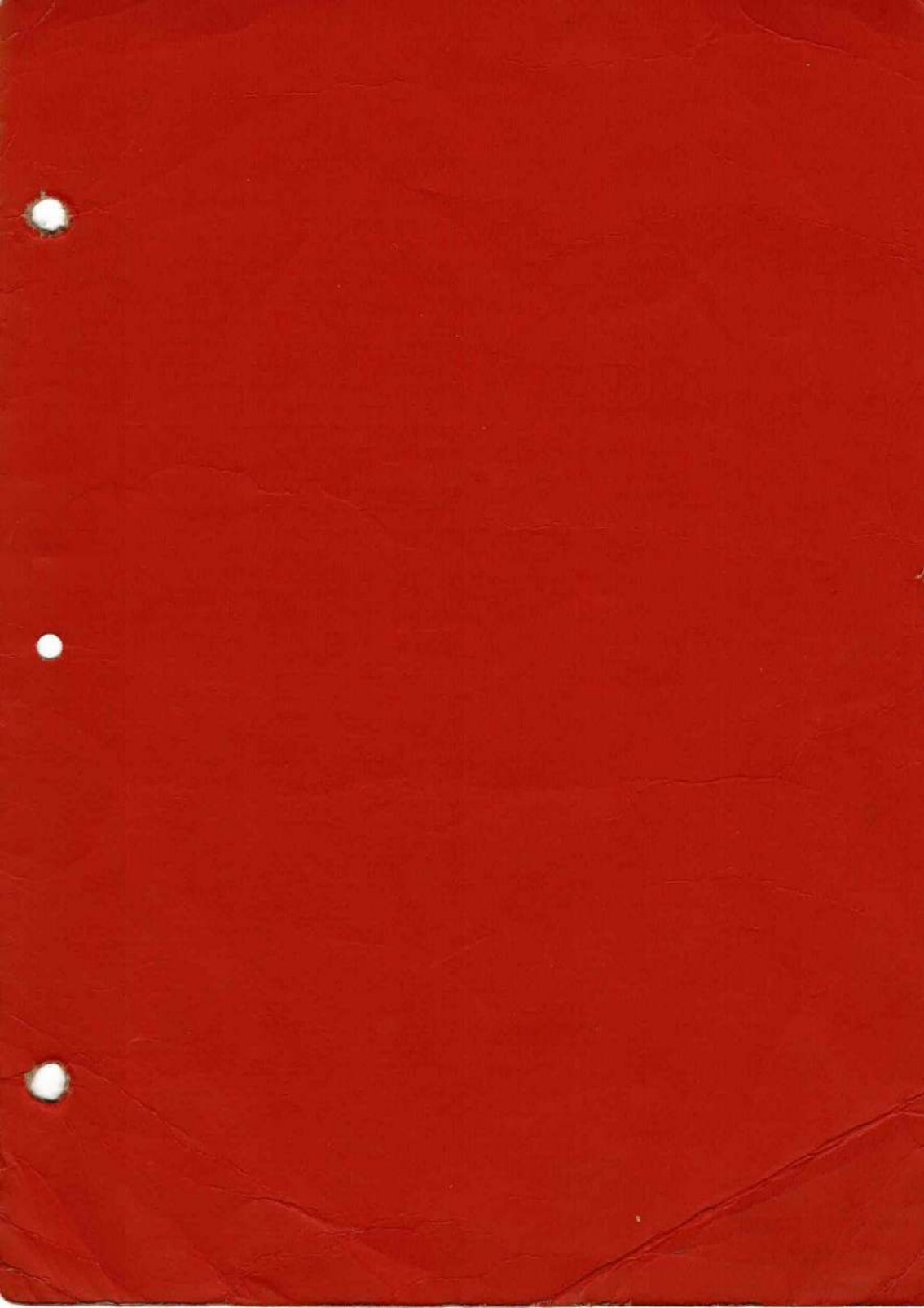
DANGER OF CARRYING NON-STANDARD LOADS

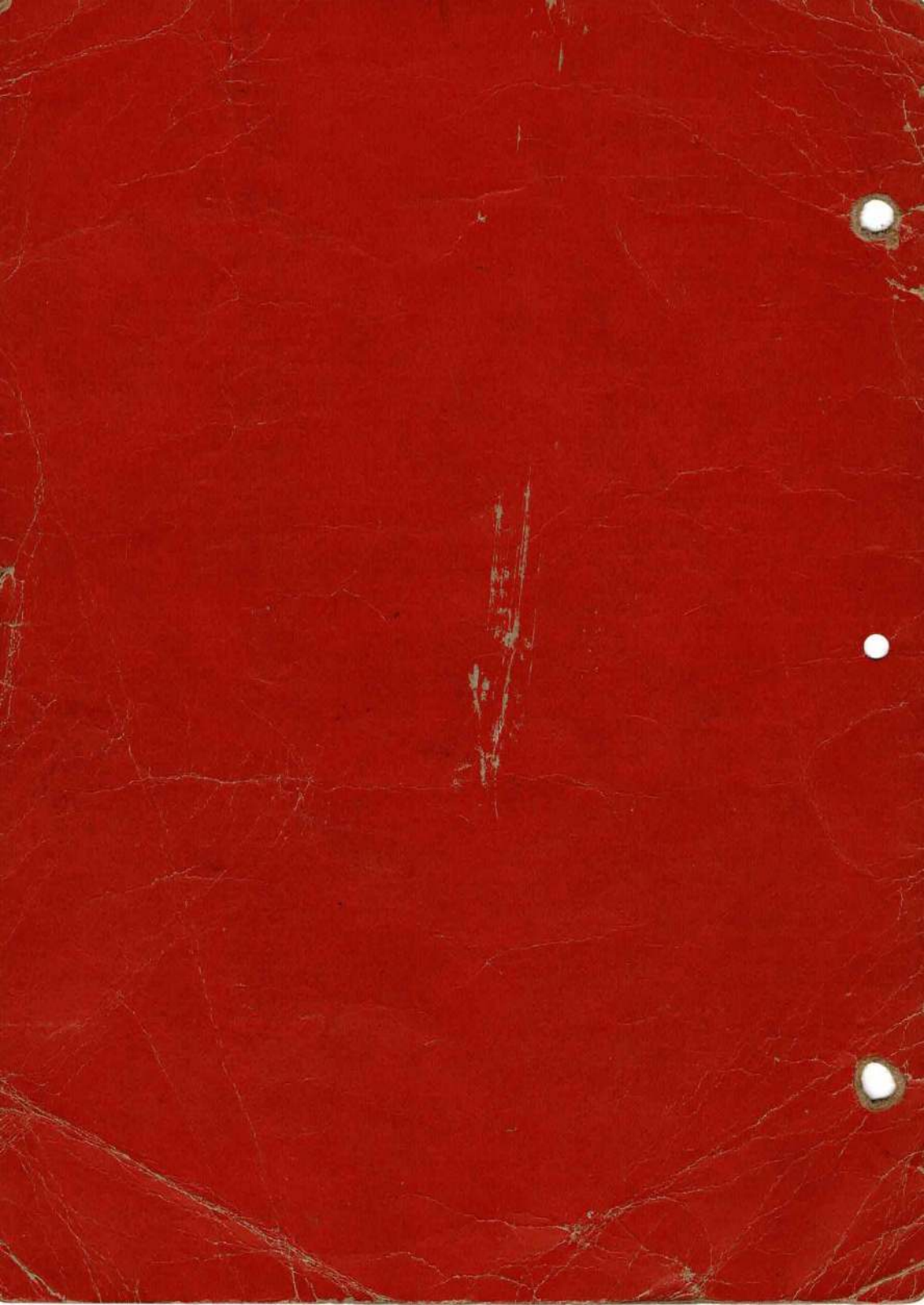
20. When any load is carried other than the normal crew and military loads, it is of the greatest importance to ensure that it is disposed of in such a way that the balance of the aircraft is not disturbed. Various accidents have occurred as a result of types of aircraft due to fail to maintain their additional load on the floor position of aircraft.

21. It is a rough rule, no additional load should be carried at a point approximately one-third of the wing chord behind the leading edge at the wing root, unless it is balanced by an equal weight about the same distance forward of this point.

22. Whatever possible, however, the C.G. position should be determined by the data provided and the loading should be adjusted to bring the C.G. within the range outlined in the Weight and Balance Manual as the safe range for the particular aircraft.

Attention is drawn to A.M.P.A. Section 10





This file was downloaded  
from the RTFM Library.

Link: [www.scottbouch.com/rtfm](http://www.scottbouch.com/rtfm)

Please see site for usage terms,  
and more aircraft documents.

