

# THE GLIDER PILOT'S MANUAL



2<sup>ND</sup>  
EDITION

---

KEN  
STEWART

# THE GLIDER PILOT'S MANUAL

**KEN STEWART**

**2nd Edition**

*Illustrated by*  
**MARK TAYLOR**

**Airlife**  
England

# ACKNOWLEDGEMENTS

I would like to thank all those who have helped in the production of this book, and in particular, Peter and Harriette Disdale who put in many hours checking and correcting the text, and my wife Lynn for her support and the hours spent typing. Also I would like to thank Derek Piggott, Frank Irving and Tom Bradbury for their suggestions, which I am sure have increased the accuracy of the contents. I am indebted to Lasham Gliding Society for allowing me to reproduce their Training Progress Sheet and the British Gliding Association for allowing the reproduction of their Limitations Placard. Lastly, I would like to thank all of the students who have taught me so much.

Ken Stewart

Copyright © 1999 by Ken Stewart

First published in the UK in 1994  
by Airlife Publishing Ltd  
This edition published 1999

#### **British Library Cataloguing in Publication Data**

A catalogue record for this book  
is available from the British Library

ISBN 1 84037 084 X

The information in this book is true and complete to the best of our knowledge. All recommendations are made without any guarantee on the part of the publisher, who also disclaims any liability incurred in connection with the use of this data or specific details.

All rights reserved. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical including photocopying, recording or by any information storage and retrieval system, without permission from the Publisher in writing.

Printed in England by Livesey Ltd, Shrewsbury.

## **Airlife Publishing Ltd**

101 Longden Road, Shrewsbury SY3 9EB, England

# CONTENTS

Acknowledgements	iv
Illustrations	vii
Introduction	xiii
<b>SECTION 1 BASIC FLYING TRAINING</b>	
1 The Glider	2
2 The Gliding Site	10
3 Your First Flight	16
4 How Aeroplanes and Gliders Fly	19
5 Preparation for Flight	30
6 The Primary Controls	37
7 Turning the Glider	43
8 The Stall	50
9 The Spin	64
10 The Trimmer	73
11 The Airbrakes	78
12 Landing the Glider	84
13 The Approach	91
14 The Effect of the Wind	96
15 Wire Launching	114
16 Aerotow Launching	126
17 Circuit Planning	139
18 Launch Failures During Wire Launches	159
19 Aerotow Launch Failures and Emergencies	168
20 Sideslipping	175
21 Use of Flaps	182
<b>SECTION 2 TECHNICAL SECTION</b>	
22 Glider Design	194
23 Design Features Which Provide Good Handling	196
24 Design Features Aimed at Giving Better Performance	213
<b>SECTION 3 BASIC SOARING</b>	
25 Soaring	232
26 Hill Lift	234
27 Hill Soaring	238

28	Thermals	244
29	Thermal Soaring	251
30	Mountain Lee Waves	263
31	Wave Soaring	266
<b>SECTION 4 RULES OF THE AIR</b>		
32	Rules of the Air	274
APPENDIX 1	How the Instruments Work	276
APPENDIX 2	The Use of Radio	282
APPENDIX 3	The Use of Tailchutes	285
APPENDIX 4	Tow-plane Upsets	287
APPENDIX 5	Gliding Awards and Records	290
APPENDIX 6	Log Books and Progress Cards	293
APPENDIX 7	Converting from Power Flying to Gliding	295
APPENDIX 8	Converting to New Types of Glider	297
APPENDIX 9	Useful Conversion Factors	300
APPENDIX 10	Useful Addresses	301
INDEX		302

# ILLUSTRATIONS

1.1	The glider.	2
1.2	The main controls.	3
1.3	The airbrakes.	4
1.4	The spoilers.	4
1.5	The trim tab.	5
1.6	The cockpit layout.	6
1.7	The airspeed indicator.	7
1.8	Airspeed versus groundspeed.	8
1.9	The variometer.	9
1.10	The altimeter.	9
2.1	Car launching.	11
2.2	Reverse pulley launching.	11
2.3	Winch launching.	11
2.4	Aerotow launching.	12
2.5	Ground handling points.	14
2.6	Ground handling.	15
2.7	Parking the glider.	15
3.1	Who has control?	17
3.2	Flying by attitude.	18
4.1	Lift versus weight.	19
4.2	Bernoulli's theorem.	20
4.3	Venturi experiment.	20
4.4	Experiment showing lift.	21
4.5	The wing section.	21
4.6	Angle of attack.	22
4.7	Increasing the angle of attack.	22
4.8	Lift distribution.	23
4.9	How the controls work.	23
4.10	Drag.	24
4.11	Induced drag.	25
4.12	Forces in balance.	26
4.13	Resolution of forces.	26
4.14	Propelling the glider forwards.	27
4.15	Weight, lift and drag.	28
4.16	Lift and drag versus weight.	28
4.17	Lift and weight versus drag.	29
5.1	The daily inspection.	32
5.2	The limitations placard.	34
6.1	The axes of control.	37
6.2	Pitching the glider.	37
6.3	Rolling the glider.	38
6.4	Yawing the glider.	38
6.5	The elevator controls pitch.	39
6.6	The ailerons control roll.	39
6.7	The rudder controls yaw.	39
6.8	Air Exercise – the effect of elevator.	40

6.9	Air Exercise – the effect of aileron.	41
6.10	Air Exercise – the effect of rudder.	42
7.1	Forces in a turn.	44
7.2	Aileron drag.	45
8.1	The stall.	50
8.2	Increased stalling speed in turns.	51
8.3	Lift and drag at the stall.	51
8.4	Attitude doesn't always indicate angle of attack.	53
8.5	Buffeting at the stall.	54
8.6	Nose-drop at the stall.	55
8.7	The need for stall recovery action.	56
8.8	Air Exercise – Stalling.	57
8.9	The incipient spin.	58
8.10	Use of aileron at the stall.	59
8.11	Positive 'g'.	61
8.12	Reduced 'g'.	61
8.13	Forward control column movements and reduced g.	62
9.1	Roll dampening.	64
9.2	Autorotation.	65
9.3	The spin.	66
9.4	The danger of yawing at slow speed.	67
9.5	Spinning from a shallow turn.	68
9.6	Steeper turns are safer.	69
9.7	The spiral dive.	71
10.1	How a trim tab works.	74
10.2	The spring trimmer.	75
11.1	40:1 glide angle.	78
11.2	How airbrakes work.	79
11.3	5:1 glide angle.	79
11.4	Why airbrakes "suck" open.	80
11.5	How spoilers work.	81
11.6	The tailchute.	82
12.1	Stages of the landing.	84
12.2	The round out.	86
12.3	"Ballooning" whilst landing.	87
12.4	Round out technique.	87
12.5	Judging the point of round out.	88
13.1	The reference point.	92
13.2	Correct approach.	92
13.3	Overshooting on the approach.	93
13.4	Undershooting on the approach.	93
14.1	The wind and the glider.	96
14.2	Drift.	97
14.3	Track and heading.	98
14.4	Wind causes the glider to drift.	99
14.5	Correcting for drift.	100
14.6	Wind effect on a circling glider.	101
14.7	The wind's effect on ground distance covered.	102
14.8	The wind's effect on the take-off distance.	102
14.9	The wind's effect on wire launch heights.	103
14.10	The wind's effect on an aerotow launch.	104
14.11	Crosswind landing – crabbing method.	106
14.12	Wing-down crosswind landing technique.	106

14.13	Weathercocking.	107
14.14	Obstructions causing turbulence.	108
14.15	Curl-over at a hilltop airfield.	109
14.16	The wind gradient.	110
14.17	The wind gradient's effect on the glider's airspeed.	111
14.18	Increased angle of attack due to the wind gradient.	111
14.19	The wind gradient causing an undershoot.	112
14.20	Turning in a wind gradient.	113
15.1	The glider end of a winch launch cable.	114
15.2	Stages of a winch launch.	117
15.3	The angle of attack during a winch launch.	119
15.4	Increased stalling speed during a winch launch.	120
15.5	"Hunting" on a winch launch.	122
15.6	Correcting for drift on a winch launch.	123
16.1	The versatile aerotow launch.	126
16.2	The aerotow launch point.	128
16.3	The take-off on aerotow.	130
16.4	Aerotowing – combination just airborne.	130
16.5	The normal tow position.	131
16.6	Margins for vertical movement behind tow-plane.	132
16.7	Turning on aerotow.	133
16.8	Encountering rising air on aerotow.	133
16.9	Correcting lateral displacement on aerotow.	134
16.10	The effect of tow-rope length when aerotowing.	136
16.11	The low tow position.	137
16.12	"Boxing the tow".	137
17.1	Typical circuit pattern.	140
17.2	The high key point.	141
17.3	High key point too far away.	141
17.4	High key point too close.	142
17.5	Downwind leg too close.	142
17.6	Downwind leg too far out.	143
17.7	The low key point.	144
17.8	Lower end of the circuit.	145
17.9	Base leg.	146
17.10	Effect of a wind blowing towards the airfield.	148
17.11	Correcting for drift on the downwind leg.	148
17.12	Correcting for a strong crosswind blowing towards the airfield on the downwind leg.	149
17.13	Strong crosswind blowing away from the airfield on the downwind leg.	150
17.14	Correcting for a wind blowing the glider away from the airfield.	150
17.15	Effect of a strong wind blowing diagonally across the airfield.	151
17.16	Effect of a strong tail wind on the downwind leg.	151
17.17	Rising air on the downwind leg.	153
17.18	Rising air on the base leg.	154
17.19	Sinking air on the downwind leg.	154
17.20	Sinking air on the base leg.	155
17.21	Diagonal-style circuit.	156
17.22	Circuits at hilltop sites.	157
18.1	Angle of attack change after a cable break.	160



18.2	Landing ahead after a cable break.	162
18.3	“Dog leg” manoeuvre after a cable break.	163
18.4	360° turn versus “S” turn after a cable break.	164
18.5	Downwind landing after a cable break.	164
18.6	Impulsive use of airbrakes after a cable break.	165
18.7	Options after a cable break at a large airfield.	166
19.1	Aerotow launch failure shortly after take-off.	168
19.2	Field landing after a low aerotow launch failure.	169
19.3	Return to airfield after aerotow launch failure.	170
19.4	Aerotow launch failure in strong winds.	170
19.5	“Release immediately” signal.	171
19.6	“Check airbrakes” signal.	172
19.7	Glider unable to release tow-rope.	173
20.1	Sideslipping.	176
20.2	Forces in a sideslip.	176
20.3	The sideslip.	177
20.4	Increased lift required in a sideslip.	177
21.1	Early wing section.	182
21.2	Modern wing section.	182
21.3	Flaps.	183
21.4	Fuselage alignment with flaps.	183
21.5	Area-changing flaps.	183
21.6	Positive flap.	184
21.7	Negative flap.	184
21.8	Flap control.	185
21.9	Trailing edge airbrakes.	189
21.10	Flap brakes – stage 1 movement.	190
21.11	Flap brakes – stage 2 movement.	190
21.12	Air speed indicator calibrated with flap speeds.	192
23.1	Stability.	196
23.2	Instability.	196
23.3	Directional stability.	197
23.4	Dorsal strake.	198
23.5	Lateral stability – dihedral.	199
23.6	How dihedral works	199
23.7	Sweepback.	200
23.8	How sweepback works.	200
23.9	Longitudinal instability of the wing.	201
23.10	The tailplane gives the glider longitudinal stability.	202
23.11	Longitudinal instability due to an underweight pilot.	203
23.12	Angled lift from dihedral.	204
23.13	Horn balance.	205
23.14	Geared tab.	205
23.15	Frise ailerons.	206
23.16	Differential ailerons.	206
23.17	Nimbus 3 aileron/spoiler system.	207
23.18	Anti-balance tab.	209
23.19	Control flutter.	210
23.20	Mass balancing.	211
23.21	Washout.	211
24.1	The polar curve.	213
24.2	The polar curve of an older glider.	214
24.3	The modern glider.	215

24.4	Aspect ratio.	216
24.5	Ideal lift distribution.	217
24.6	Actual lift distribution.	217
24.7	Wing fence.	218
24.8	Winglet.	218
24.9	Sweeping the wing tips backwards.	219
24.10	Laminar boundary layer.	220
24.11	Contaminated wings.	220
24.12	Turbulators.	221
24.13	Interference drag.	222
24.14	Sealing of joints.	223
24.15	Cruciform tail.	224
24.16	"T" tail.	224
24.17	"V" tail.	225
24.18	Control surface movement on a "V" tail.	226
24.19	All moving tailplane.	227
24.20	Streamlining.	228
24.21	Water ballast.	230
25.1	Rising air arresting the glider's descent.	233
25.2	Rising air causing the glider to gain height.	233
26.1	Hill lift.	234
26.2	A wind at an angle to the hill.	235
26.3	Outcrops producing hill lift.	235
26.4	Sink near a steep hill face.	236
27.1	Area of best hill lift.	239
27.2	Tracking in the hill lift.	239
27.3	Turning at the end of each beat in the hill lift.	240
27.4	Field landing near a hill.	241
27.5	Approaching another glider head-on while hill soaring.	242
27.6	Overtaking while hill soaring.	242
28.1	Solar heating and the environmental lapse rate.	244
28.2	Dry adiabatic lapse rate.	245
28.3	Relative humidity.	246
28.4	Formation of cumulus cloud.	246
28.5	Cumulonimbus cloud	247
28.6	Thermal sources.	248
28.7	Birth of a thermal.	248
28.8	Thermal bubble.	249
28.9	Thermal column.	250
28.10	Cloud streets.	250
29.1	Life of a cumulus cloud.	251
29.2	Sloping thermal ascent.	252
29.3	The angle of the sun's rays and wind shadow thermals.	253
29.4	Thermals indicated by smoke.	255
29.5	Heading deviations due to thermals.	256
29.6	Thermal centring.	258
29.7	The need for accurate flying when thermalling.	261
30.1	Mountain lee waves.	263
31.1	Position of wave lift.	266
31.2	Wave affecting hill lift.	267
31.3	Wave interfering with thermals.	268
31.4	Wave lift position sloping with altitude.	269
32.1	Approaching another aircraft head-on.	274

32.2	Converging with another aircraft.	275
A1.1	Simplified workings of the airspeed indicator.	277
A1.2	Simplified workings of the altimeter.	278
A1.3	Simplified variometer system.	279
A1.4	Total energy system.	281
A4.1	Tow-plane upsets.	287
A4.2	One theory of how a tow-plane upset occurs.	288
A4.3	Normal load on an aerotow rope.	288
A4.4	Load increase on aerotow rope if glider diverges.	289
A6.1	Student's progress card.	293

# INTRODUCTION

Gliding is one of the most challenging of aerial sports. It requires skill in handling the glider and judgement both associated with flying the glider safely and utilising the energy present in the atmosphere to keep the glider airborne.

*Gone are the days when gliders were frail machines, which were launched to a height, only to float unceremoniously to earth again. The modern glider is a strong aircraft made of the latest composite materials, capable of speeds in excess of 150 miles per hour. Such aircraft are capable of flights lasting ten hours or more and covering distances of over 1000 miles without landing.*

Learning to fly is a process which takes time. With each new aspect learned comes a sense of achievement. The learning process is aided by good instruction, both in the air and on the ground. As gliding is a recreational activity, most glider pilots are trained by part-time instructors who although competent, do not always have the time to impart all the necessary backup theory which should be available to their students. This manual is intended not only to supply some of this information but also to give you a broader picture of where your training is leading. It also includes the exercise plans of all of the main training exercises which you can expect to complete before flying solo.

After your first solo flights you will want to progress towards the principal objective of the sport; soaring. The soaring section in this manual is designed to carry on from your basic training. Therefore this manual will give you all the information required to safely progress, from the day when you first arrive at the gliding club, to a reasonable stage of soaring proficiency. It will give you a sound base from which to develop within the sport, without delving deeply into aerodynamics and meteorology, thus remaining readable to those readers who consider themselves "non-technically minded".

The air exercises given throughout this book are included to give you an idea of what you will practise as your training progresses. Some exercises may be varied slightly, at your instructor's discretion, to allow for such variables as the weather conditions on the day, and your individual requirements. The entry speeds quoted for some of the exercises will be suitable for most training gliders, but these speeds may have to be altered for some older types of glider. Some exercises may only be demonstrated, if your instructor deems your attempting the exercise unnecessary. The order of the subjects and exercises covered is set out in a way which is designed to lead you through the knowledge required to fly a glider. From necessity, this will vary from the order in which a few of the exercises are introduced in practice. This is due to the need to make the best of conditions and the limited time in the air often available in gliding.

Where it is not practical to outline the whole of an exercise, a brief description of what is involved is given instead of the exercise layout. All exercises should be practised under the guidance of an instructor.

In addition to the exercises included in this manual, some national gliding authorities may also incorporate other exercises designed to improve your understanding of various control aspects of the glider.

Lastly, no book can replace the demonstrations and advice of a good gliding instructor. Therefore this manual is not intended as a substitute for qualified instruction and practice time in the air, but simply as an aid to your training and subsequent gliding.

# **SECTION 1**

## **BASIC FLYING TRAINING**

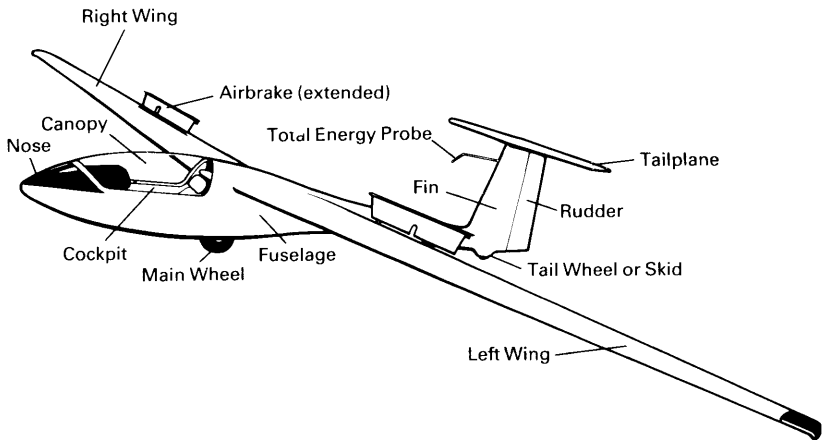
# CHAPTER 1

## THE GLIDER

Gliders come in a variety of colours, shapes and sizes, and are made of several different materials. The modern glider is an aircraft made of the latest composite materials, usually glass fibre or carbon fibre, whereas older types tend to be made of wood and fabric or metal. Almost without exception, gliders have conventional controls, similar to those on powered aircraft. Despite designers' attempts over the years to extract every small performance advantage from their designs, gliders have kept one general planform or shape. Often the only obvious variation noticeable to the casual observer is in the design of the tail area, where sometimes the tailplane is set at the top of the fin and on others it is set much lower. On some gliders the tailplanes are designed to form a "V" shape, but this is less common.

### MAIN EXTERNAL FEATURES

Fig 1.1 shows a single-seat glider with the main features illustrated.



*Fig 1.1 The glider. A typical single-seat glider.*

The WINGS are often referred to as just the WING. On older types of glider the wing was of large area when looked at from above, and of thick profile when viewed from the front. However, in modern sailplanes the wing tends to be long in relation to its width in planform and much thinner than that of older gliders. The length of the wing from wing tip to wing tip is called the WINGSPAN, or simply the SPAN.

The **FUSELAGE** is the body of the glider. It provides accommodation for the pilot, houses the controls and instruments, and the necessary control rods and cables which activate the control surfaces on the glider's wings and at the tail.

The **FIN** is that part of the rear fuselage which is vertical.

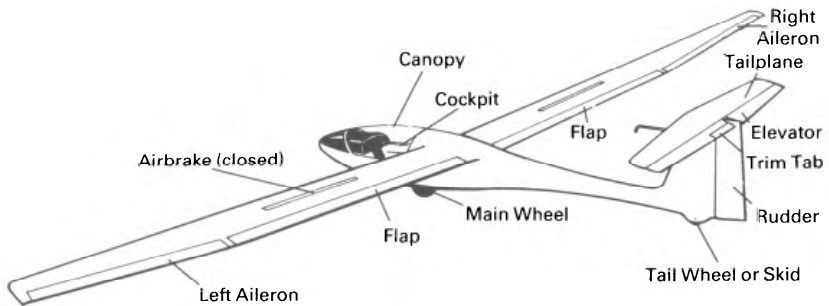
The **TAILPLANE** is the horizontal surface at the rear of the glider. It is either fitted directly onto the fuselage or on the fin, sometimes just above the fuselage but more often at the top of the fin, as in the case of the glider shown in Fig 1.1. (For obvious reasons this is known as a "T" tail.)

In addition to the main structural parts of the glider mentioned above, there are several control surfaces.

The **ELEVATOR** is the horizontal control surface which is attached to the rear of the tailplane by hinges which allow it to move up and down.

The **AILERONS** are the control surfaces situated one at the rear of each wing. Like the elevator, they are attached by hinges to enable them to move up and down. However, they are linked so that when one goes up, the other goes down.

The **RUDDER** is a vertical control surface which is attached to the rear of the fin by hinges, which allow it movement to the left and to the right.



*Fig 1.2 The main controls. The situation of the glider's control surfaces.*

The **AIRBRAKES** are flat, oblong surfaces which can be made to project vertically from either the top, or both the top and bottom, of both wings. They are linked so that, when opened, the airbrake surface on both the left-hand and right-hand wings project from the surface at the same time and to the same extent. (Fig 1.3)

On some older gliders **SPOILERS** are fitted instead of airbrakes. Unlike airbrakes which extend vertically, spoilers are hinged surfaces which, when closed, lie flush with the upper surface of the wing. When operated they hinge upwards into the airflow. (Fig 1.4)



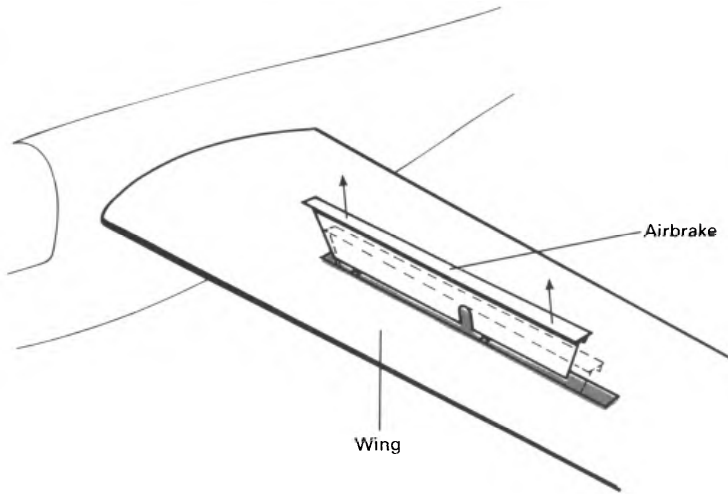


Fig 1.3 The airbrakes. Most airbrakes extend vertically from the wing.

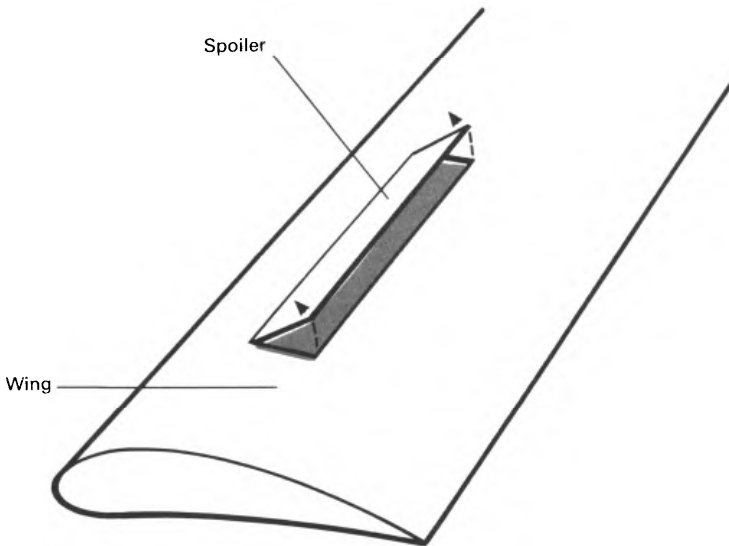
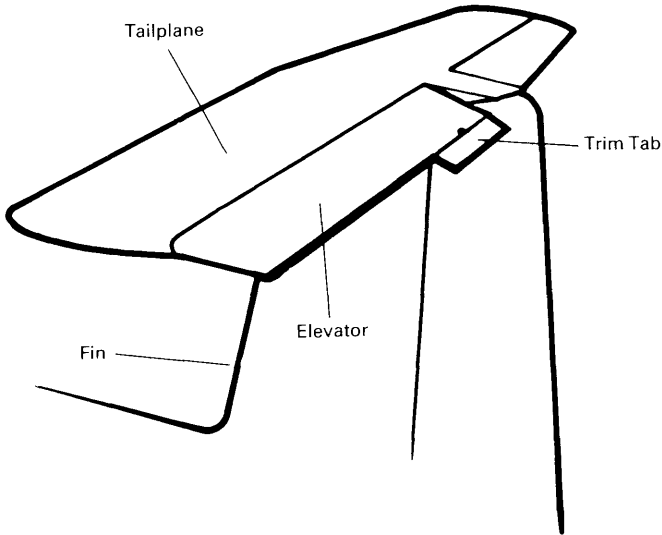


Fig 1.4 The spoilers. Spoilers hinge upwards from the top surface of the wing.

The TRIM TAB is a small surface fitted by hinges to the elevator, in much the same way as the elevator is to the tailplane. Occasionally there is a trim tab on both sides of the tailplane. It can be moved up or down. Trim tabs are not present on all gliders, as some manufacturers use other devices to do the same job.

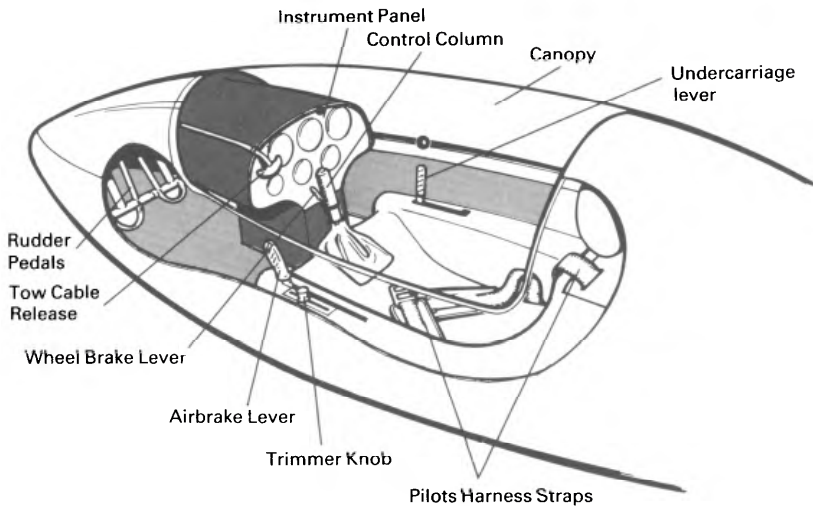


*Fig 1.5 The trim tab. A trim tab is often fitted on the trailing edge of the elevator.*

The COCKPIT is the pilot's accommodation. The cockpit determines whether the glider is a single or a two-seater. It is in the latter that all training will be done as it is equipped with, not only a second seat, but also a duplicate set of controls. These days it is covered by a perspex bubble called the CANOPY, although there are still many older types of glider to be seen which do not have this luxury.

Most gliders are fitted with only one MAIN WHEEL (referred to as the UNDERCARRIAGE). This is situated in the fuselage just aft of the cockpit. It may or may not be designed to be retracted into the fuselage in flight. Having only one main wheel means that gliders at rest will have one wing on the ground and will require an assistant to support the wing during the initial part of the take-off run. Other smaller wheels may be used on the front and rear fuselage to prevent damaging the fuselage structure. Skids may be used for this purpose on some types.

FLAPS are surfaces attached to the rear of each wing, between the ailerons and the fuselage. They are hinged so as to move up and down to the same amount and in the same direction on both wings. There are various types and they are mainly used on high performance sailplanes.



*Fig 1.6 The cockpit layout. The cockpit of a modern glider showing the various controls.*

## THE COCKPIT

### THE MAIN CONTROLS

The CONTROL COLUMN (often referred to as the STICK) is linked to the elevator and the ailerons. Forward or aft movement of the control column will move the elevator down or up respectively. Moving the control column to the left simultaneously causes the aileron on the left wing to move up and the aileron on the right wing to move down. Movement of the column to the right makes the right aileron move up and the left aileron move down. The control column controls the glider's speed and direction. Simply put, the glider will move in the same direction as the pilot moves the control column.

The RUDDER PEDALS are linked to the rudder. If the pilot moves the right rudder pedal forward the rudder moves to the right. At this stage it is important not to believe that the rudder changes the glider's direction. Unfortunately the "rudder" is badly named as it doesn't turn the glider on its own (unlike its counterpart on a boat), but only helps to make the turns smoother and more accurate. As mentioned above, it is the control column which controls the turning forces.

### ANCILLARY CONTROLS

The TRIMMER KNOB or LEVER controls the position of the trim tab (or other trimming device).

The AIRBRAKE LEVER controls the airbrake surfaces allowing them to be extended or retracted as necessary.

The TOW CABLE RELEASE is a yellow knob or handle which is used to attach the TOW-ROPE or LAUNCH CABLE before flight and to release it in

flight when desired. Sometimes a glider may have two separate release mechanisms; one near the nose for when the glider is being launched behind a light aeroplane, and another further back, for use if the glider is being launched by winch or tow car. If this is the case then this one control will operate both mechanisms.

If the glider is fitted with flaps there will be a FLAP LEVER (not shown) which allows the pilot to select the desired angle of flap for the phase of flight.

The UNDERCARRIAGE LEVER allows the pilot to raise or lower the undercarriage.

The WHEEL BRAKE LEVER is used to apply a brake on the main wheel as required. Some gliders incorporate this control in the airbrake system, either as a separate trigger type of lever or as an integral part of the airbrake system, whereby the wheel brake is applied if the airbrake lever is pulled to the limit of its range. On some other gliders a heel or toe pedal is used to apply the wheel brake.

## THE INSTRUMENTS

There are only three instruments that need to be considered by an early student.

The AIRSPEED INDICATOR (ASI) tells the pilot how fast the glider is flying *through the air*.

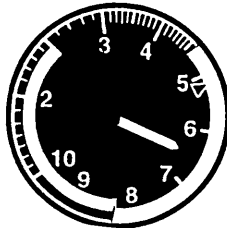


Fig 1.7 The airspeed indicator. The airspeed indicator indicates the glider's speed through the air.

It receives the information necessary to measure the glider's speed through the air from a sensing point called a PITOT TUBE which is usually situated in the nose of the glider. This information is compared to the readings of local atmospheric pressure taken at other points on the fuselage known as STATIC VENTS to give the reading shown on the airspeed indicator. These sensing points are also used by other instruments.

If there was no wind then the speed indicated on the instrument would be the same as the glider's speed over the ground (its GOUNDSPEED). However, as there is almost always some wind (that is, the air mass is moving) the airspeed indicator only indicates the speed of the glider through the air mass in which it is flying (that is, the glider's AIRSPEED) and not its speed over the ground. For instance in Fig 1.8(a) the glider is flying at an airspeed of 40 knots (40 nautical miles/hour) through a parcel of air which is stationary; that is, no wind. The glider is crossing the ground at 40 knots.

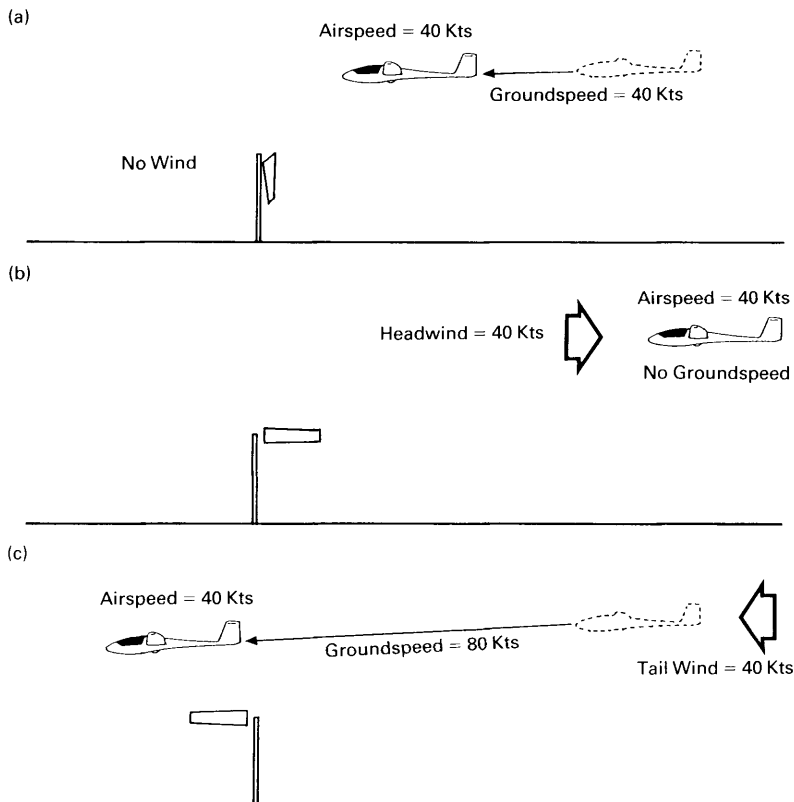


Fig 1.8 Airspeed versus groundspeed. The groundspeed will differ from the airspeed if there is any wind.

In Fig 1.8(b) the glider is flying at the same airspeed (40 knots) but now the parcel of air is moving in the opposite direction at 40 knots (that is, 40 knots of wind) and the glider is now stationary over the ground. If the glider were to turn and fly in the same direction as the wind, whilst maintaining an indicated airspeed of 40 knots, it would be crossing the ground below at 80 knots. (Fig 1.8(c))

The example given of a 40-knot wind is somewhat extreme and normally the wind strength will be much less. There will be occasions however, especially at higher altitudes, when the wind speed will reach or even be in excess of this sort of figure. The presence of such strong winds can be advantageous as you will discover later when different types of soaring are discussed.

At first this lack of ground reference may appear to make the airspeed indicator a fairly useless instrument, but the glider's control and handling depend upon the glider's speed relative to the air through which it is flying, making the airspeed indicator an essential instrument.

The VARIOMETER is a “rate of climb (or descent) indicator”. It tells the pilot how fast the glider is rising or descending. The basic instrument will be affected by changes in airspeed and the airspeed at which the glider is flying. These effects can give misleading indications. It is possible and common to modify the instrument’s output to eliminate some of these, thus giving the pilot a better idea of the vertical characteristics of the air through which the glider is flying.



*Fig 1.9 The variometer. The variometer indicates the glider’s rate of climb or descent.*

The ALTIMETER shows the pilot how high the glider is flying relative to a preset datum, which, on local training flights, is usually the airfield height. The type normally used in gliders gives a three-needle presentation which is read like the hands of a clock. (Fig 1.10) Needle A indicates 100s of feet, while needle B indicates 1,000s of feet (that is, when the needle A passes 999 feet, needle B would be at the 1 on the dial, indicating 1,000 feet. Needle A would then continue to show 100s of feet between 1,000 and 2,000 feet). Needle C behaves the same for 10,000s of feet. There is also a small sub-scale within the main dial. This is used for setting the datum air pressure but can be ignored at this stage.



*Fig 1.10 The altimeter. The altimeter indicates the glider’s height.*

Other instruments usually included are:

The TURN AND SLIP INDICATOR is an instrument used for cloud flying. It combines an electrically-driven RATE OF TURN INDICATOR, with a SLIP INDICATOR which is essentially a pendulum. The Slip Indicator is useful in that it helps the pilot judge if the glider’s turns are balanced.

A COMPASS will normally be mounted on the instrument panel or canopy. Again this is used later on and as an early student you should not concern yourself with it until it is formally introduced.

The main points in this chapter will be mentioned as you are briefed for your first flight. At this stage however, a general idea of the glider’s layout will help you appreciate the machine in which you are about to fly.

## CHAPTER 2

# THE GLIDING SITE

For someone beginning gliding, or even for power pilots visiting a gliding club, the gliding site can be a strange place.

For one thing, it can be unpredictable, both in terms of operation and size. For another, more often than not, there will be an absence of air traffic control and the strict control of aircraft and vehicle movements which exist at larger airfields. Despite this, gliding clubs operate successfully and safely, with the minimum of rules, thanks mainly to the self-discipline and airmanship of their pilots.

To attempt to discuss the average gliding site would be impossible, as gliding sites vary immensely in both size and operation. What we can do here is look at the general layout and situation of gliding sites, the launch methods used and give some safety guidance when on or flying near a gliding field.

The size and layout of a gliding site will depend, to a large extent, on the land available. Often the gliding field may be an active or disused airfield. The gliding operation may have the use of all of this area or only part of it, either because the remainder is unusable or is used by another operator such as a power-flying school. On such an airfield the gliders may take-off and land on concrete runways, operate from grass areas, or utilise both surfaces depending on availability and surface condition. Many clubs operate from "green field" sites which may be farmers' fields or areas of level heath land. (Obviously such sites will lack a runway in the usual sense of a long strip of concrete, but for convenience, the term RUNWAY will be generally used throughout the text to mean the line of the intended landing or take-off run. Similarly, mention of the AIRFIELD should be taken to mean the area of take-off or intended landing and not limited to a purpose-built aerodrome.)

The situation of gliding clubs will vary from sites in flat countryside to some on top of hills. Many of the older established gliding clubs were established on the top of a hill where gliders could be launched easily into the rising air currents which exist when the wind is deflected upwards as it encounters the hillside. As launch methods developed, being situated on top of a hill became less important and many gliding sites were formed near the bottom of ridges and hills. Once other forms of rising air other than "hill lift" were discovered, the requirement to have a hill as a neighbour diminished and gliding sites appeared in almost all landscapes.

## LAUNCHING METHODS

The type of launching employed at a particular gliding site is determined to a great extent by the size of the airfield and its surface.

Long, hard-surfaced runways will make it possible to launch gliders by CAR LAUNCH. This technique uses a powerful car or pick-up truck to drag the

glider down the runway on the end of a 1,500 feet long launch cable, until the glider reaches take-off and climb speed. The vehicle continues down the runway supplying the necessary power for the glider's climb until the glider reaches the top of the launch and releases its end of the cable.

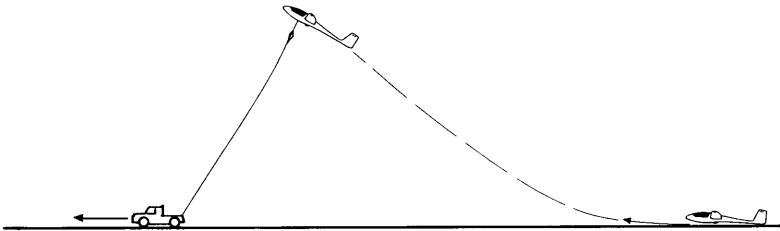


Fig 2.1 Car launching.

A variation on this technique, used when less runway length is available, or a greater height is required, involves looping the launch cable around a fixed pulley system. Using this system, known as a REVERSE PULLEY LAUNCH, the car drives back down the runway towards the glider during the launch.

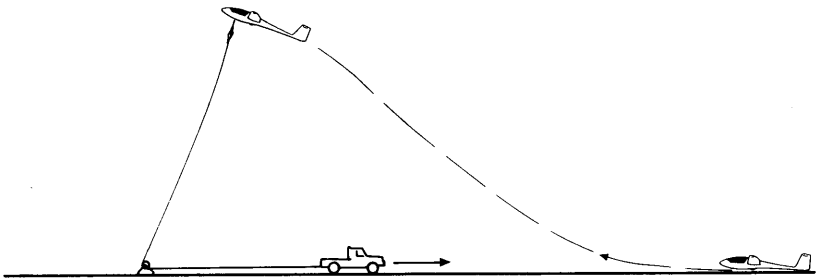


Fig 2.2 Reverse pulley launching.

By far the most common method of WIRE LAUNCH techniques is the WINCH LAUNCH. The winch launch does not require a smooth, hard surface capable of supporting a fast-moving launch vehicle. It employs a stationary winch positioned at the opposite end of the airfield to the glider. The winch is connected to the glider by a 3,000 feet long cable and provides the acceleration required for the launch, by winding in the cable as the launch commences.

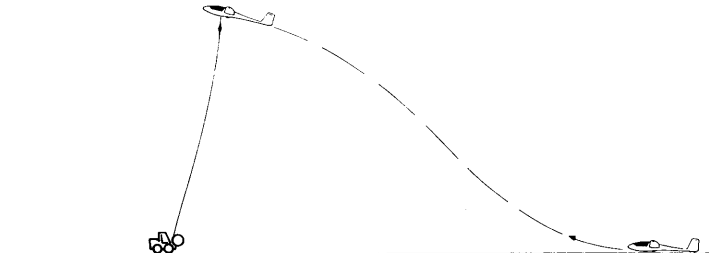


Fig 2.3 Winch launching.



Where the glider is towed into the air behind a light aircraft, this is known as AEROTOW LAUNCHING or AEROTOWING. This type of launching can be carried out from both hard and soft runway surfaces and is mostly limited by obstructions and runway length. It is a relatively more expensive method of launch, requiring considerable cost in obtaining and maintaining the towing aircraft. However, with the correct aircraft it is probably the most versatile of all launch methods.

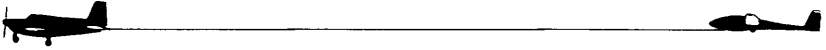


Fig 2.4 Aerotow launching.

At least one hilltop site still practises one of the oldest and most enjoyable methods of launch; that of BUNGEE (or CATAPULT) LAUNCHING. With this method a large elastic rope called a BUNGEE is used to catapult the glider into the strong wind which is being deflected upwards by the face of the hill. Bungee launching requires no fuel, only the assistance of six or more fit helpers. It may sound primitive, but no glider pilot can claim to have lived until this now rare, but delightful method of launch has been experienced.

Often, aerotowing and one of the wire launch methods will be used alongside each other on a particular airfield. It is not uncommon to find airfields which accommodate both gliding and power-flying activities. With a little organisation and co-operation the two disciplines can co-exist perfectly amicably and safely. At one airfield in the U.K., gliders share the airfield with both fixed-wing powered aircraft and helicopters, while at another the gliding club operation has to stop launching occasionally to allow an airliner to land or take-off!

## SAFETY ON THE AIRFIELD

With gliders and tow-planes taking-off or landing, launch cables moving rapidly, spinning propellers, and numerous vehicles and machines operating on it, it is important that everyone on the airfield has a high regard for safety.

The following advice, together with any local rules and the application of some common sense should help you to enjoy your gliding safely.

- When on the airfield, keep a good lookout. Landing gliders may appear from any direction and a glider can not overshoot to avoid you. You will not hear them as they approach.
- Cross landing areas only when necessary, and do not loiter on them.
- Landing tow-planes usually trail a rope, which has metal fittings on its end. Never stand close to or under their approach path.
- Never cross the take-off run of a glider, even if it does not appear ready for launch. It is safer to go around the rear of the launch point.
- Never walk near or across wire launch cables, or an area where they may be. Cables are difficult to see and move very quickly once a launch begins or if they are being retrieved after a launch.

- Do not touch cables or their attachments unnecessarily.
- Never walk in front of, or stand near a glider which has a launch cable attached.
- Never approach an aircraft which has its propeller turning, unless the pilot has acknowledged your intention. In that case keep the wing between you and the propeller as you approach. Never touch a stationary propeller; moving it even slightly may cause the engine to start.
- Winch operators are protected by a cage against a flailing cable, should the launch cable break. Stay well away from winches during a launch unless you are inside this cage.
- Tow cars travel fast and the driver's concentration will be focused on the glider being launched. Stay well clear of their path at all times.
- If flying in the vicinity of the gliding site, avoid overflying the airfield as wire launching can occur up to 3,000 feet and launch cables are difficult to see.

Once you are familiar with gliding site operation, you will discover that these safety points come naturally. You will also find yourself assisting in the launching of gliders, driving winches, tow cars and tractors, and generally joining in the teamwork which helps make gliding such an enjoyable sport. Like all situations where powerful machinery is involved, safety consciousness is essential. If you are unsure about anything do not hesitate to ask. If you see someone doing something which you think is unsafe, challenge them. What they are doing may be perfectly safe, but if they were mistaken, they will be grateful.

## GROUND HANDLING

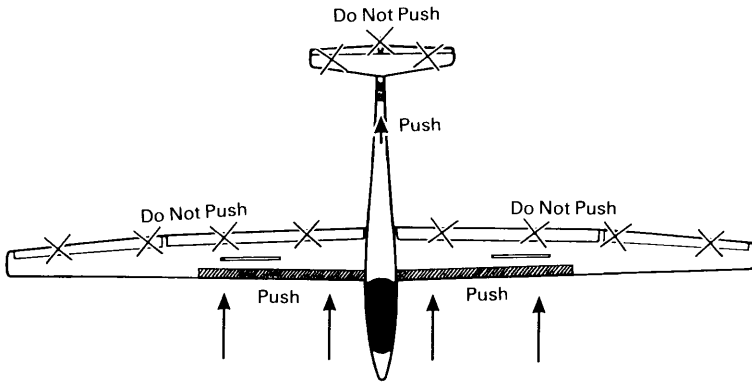
The success of a gliding club depends greatly on the equipment being maintained in good condition. Apart from the need of the individuals on the airfield to look after their own safety, they in turn must take care of the equipment, especially the gliders.

Gliders may appear elegant and graceful when in the air, but on the ground they are heavy, bulky objects which require much ground handling in order to prepare them for launch. While the glider's structure is well-designed to withstand the aerodynamic loads imposed upon it in flight, and the potentially large loads during a landing, it is not so well-designed for any mishandling it may get on the ground. In order to safeguard it against ground handling damage, some understanding of how to handle the glider on the ground is essential.

While manoeuvring the glider around the airfield, whether it is being towed behind a vehicle or pushed by individuals, it is important to know on which parts of the structure force can be applied. This is especially the case with older gliders which are often constructed of wood and fabric.

Fig 2.5 shows the areas which are strong enough to support a push or lift force and those which are not.

In general the leading edge of the wing close to where the wing meets the fuselage is the best place to push. As many gliders have tailskids, the tail



*Fig 2.5 Ground handling points. Parts of the glider where it is safe to lift or push and those where it is not.*

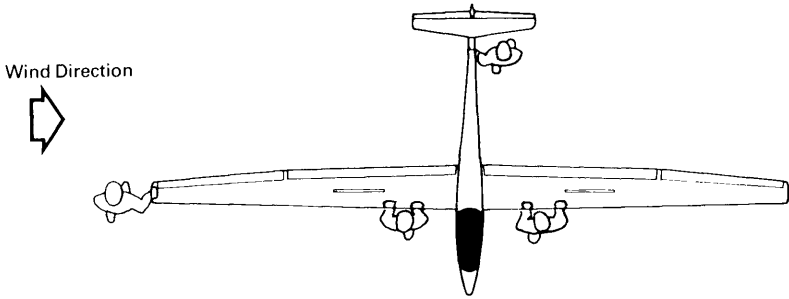
will have to be lifted if the glider is to be pushed backwards. To facilitate this, many gliders have special handles fitted to the rear fuselage. These strengthened points will also withstand pull or push forces. On gliders constructed of glass fibre, the fuselage immediately behind the wing will provide a suitable structure on which to push, if the glider is to be moved forwards.

The trailing edges of the wings, the control surfaces and the tailplane areas all tend to be of lighter construction and these areas are unsuitable for manhandling. Never lift the tail or push the glider by applying a force to the tailplane. Do not push or pull the glider by the wing tips as the large leverage created by the wings will result in considerable force being applied to the wing fittings at the point where the wing is attached to the fuselage. The strain placed on these fittings will be especially high if the ground is soft or rutted.

Whichever way the glider is moved, whether it be towed behind a vehicle or by manpower alone, the wing must be supported off the ground. This will require someone to lift and walk with the wing tip. This person is best placed to steer the glider, but should not exert forces which counter those of other helpers on the tail. Only one wing tip should be held to avoid strain being placed on the wing fittings should any confusion arise as to who is steering. In windy conditions this wing tip holder should be positioned on the windward wing tip to prevent the wind lifting the wing and potentially blowing the glider over.

When the glider is being towed behind a vehicle the tow-rope should be long enough to prevent any danger of the glider running into the back of the vehicle should an over-run occur. When towing the glider in this way there should be someone walking beside the nose of the glider to release the tow-rope in case of an over-run.

In windy conditions, more ground crew are necessary and great care must be exercised when towing the glider into wind. In such circumstances, it is advisable to have someone sit in the cockpit to reduce the chance of the glider accidentally becoming airborne and also to prevent the control surfaces banging against their stops when turning across the wind.



*Fig 2.6 Ground handling. When moving a glider on the ground the wind must be taken into account.*

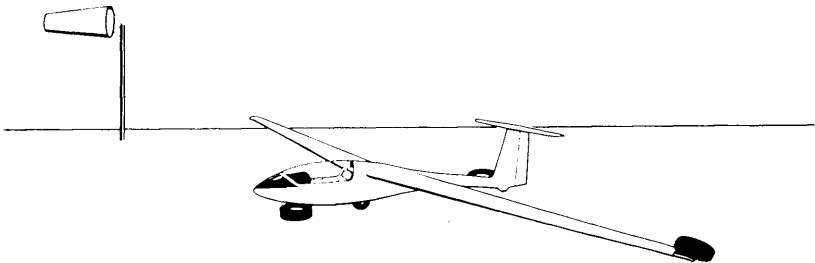
The use of fixed bar towing attachments and wing tip fittings can reduce much of the effort and risks of ground manoeuvring. Such fittings must be well-designed and of good quality otherwise they themselves can cause damage to the glider.

### **PARKING THE GLIDER**

When the glider is left unattended it should be secured so as not to be affected by the wind or the propeller wash from tow-planes or other aircraft. The canopy should be closed and locked. The glider's nose should be left pointing in such a way that the wind is not blowing from in front of the wing and such that the controls will not be caused to bang against their stops by the wind. The wing should be secured to prevent the wind lifting the wing and causing it or the other wing to hit the ground. It is common to prevent the lowered wing from rising by using old car tyres to weigh it down. However, with glass fibre gliders the wings are often supported level on trestles or tied to anchor points.

In very windy conditions, when the wind is striking the glider's tail, the glider will want to swing nose into wind. To prevent this, it will be necessary to place a tyre on the downwind side of the tail. A tyre may also be required to be jammed under the nose skid to stop the tail from rising.

One golden rule for safety is to "look after your glider and it will look after you".



*Fig 2.7 Parking the glider. The glider should be parked in such a way that the wind will not move it.*

## CHAPTER 3

---

# YOUR FIRST FLIGHT

The main aim of your instructor on your first flight is to introduce you to the sport of gliding. In so doing, your instructor will show you around the glider, its cockpit and controls, and instruct you on the relevant safety aspects such as securing your harness. You will also be shown how to adjust your seating position with respect to your comfort, your access to the various controls and to your view from the cockpit.

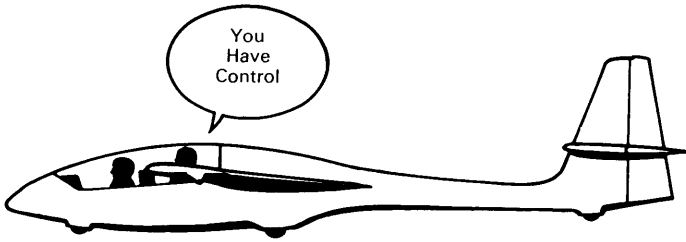
If the glider has the seats arranged in tandem, you will be given the front seat. Not only will this give you a better view, it is also the seat which you will have throughout your training on this type of glider. The reason for this is that when the day comes when your instructor decides you should fly solo, it is from the front seat that you will fly the glider. Your first solo flights will therefore be from the seating position you are used to.

Once in the air, your instructor will allow you to settle down in this new environment, and point out local features and landmarks. The primary controls will be demonstrated and you will be allowed to try some gentle manoeuvres. This will enable you to see how easy and logical flying a glider really is.

If you are launched by aerotow your instructor will probably have adequate time to give you several demonstrations, and to allow you to attempt some basic manoeuvres for yourself. These will include trying out the effects of the controls and turning the glider. If on the other hand you are launched on your first flight by car launch or winch launch, you will probably not have as much time for demonstrations and attempts as on aerotow. In this case, your instructor will structure the exercises so that they can progress easily on subsequent flights.

At all times in flight, it is important that there is no confusion as to whether you or your instructor is actually controlling the glider. After your instructor has demonstrated a manoeuvre, he will give you control by saying, "You have control". Once you have placed your hands and feet on the controls, you should reply by saying, "I have control". Your instructor can then release the controls to allow you to attempt the manoeuvre. When your instructor wants to retake control, he will say, "I have control". You can now release the controls and confirm that you have done so by saying, "You have control".

During the flight (assuming that you are new to the world of flying light aircraft) your body will be subjected to some new sensations. Don't worry, these are not the sensations experienced by the jet fighter pilot. Indeed, they are not even of the magnitude of those experienced at the fair ground. (This is one author you won't get on a big dipper!) They are worth mentioning only because they may be unexpected. If the glider is launched by winch (or to a lesser extent, by car) the initial acceleration will be quite rapid. This will have the effect of pushing you more firmly into your seat, similar to accelerating from a stationary position in a powerful car.



*Fig 3.1 Who has control? Knowing who has control is essential.*

Once in the air the sensations experienced are mainly due to the buoyancy of the air. If the day is windy or there are rising air currents then you will feel the glider being pushed up and down, or even feel as if a wing is occasionally being lifted. On a still, calm evening, the air will probably feel smooth and less of these sensations will be felt. Similar sensations can also be induced by control movements which are too rapid, especially if the control column is moved forwards too quickly.

Your instructor will explain such sensations at first, but as your time in the air increases, you will quickly get used to them and eventually be able to use them to assess the glider's position relative to rising air. Other sensations will become apparent which will help you decide whether or not you are controlling the glider accurately in turns.

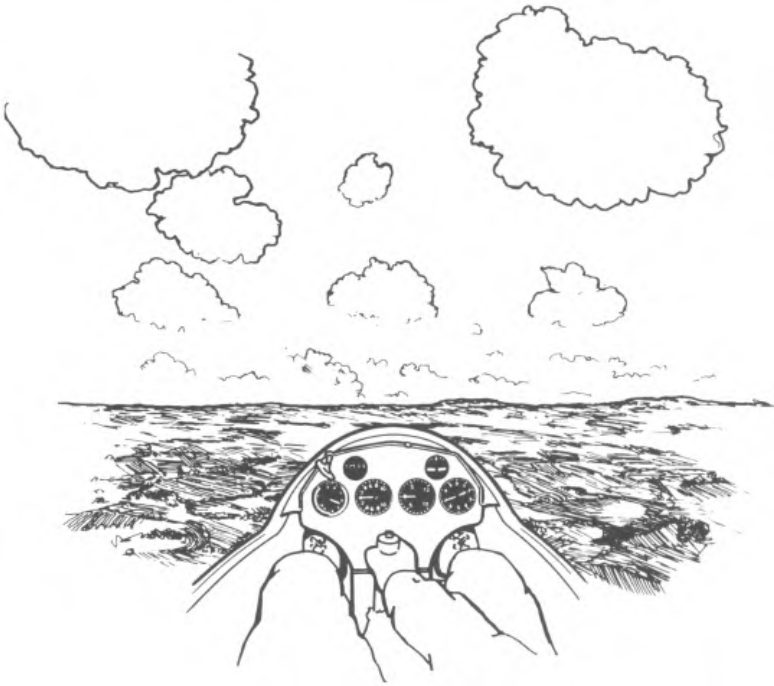
All of these sensations will be covered further in later sections as they become more relevant. For now, it is sufficient to say that on most occasions, when the glider is being flown correctly, even a pilot with a few launches in his log book will not experience any unpleasant sensations.

Apart from getting comfortable in this new environment, one of the most important aspects to prepare you for your basic instruction, is to become accustomed to the view from the cockpit, and in particular, the position of the nose of the glider relative to the horizon. This view, known as the glider's **ATTITUDE**, is of primary importance when it comes to controlling the glider. It is used to tell you if the glider is likely to be maintaining a steady and reasonable airspeed, and whether or not the wings are level.

## LOOKOUT

It is also of utmost importance, at this early stage, that you learn a lookout technique; your glider will not be the only aircraft in the air. The airspace in which you will be flying will also be used by private and commercial aeroplanes and helicopters, military traffic and other sporting activists such as microlight aircraft, hang-gliders, parachutists and of course, other gliders. It is essential that most of your attention is "outside" of the cockpit and to this aim, you will be taught to regularly scan around your field of vision, with particular emphasis when carrying out any manoeuvres such as turns.

Your first flight will probably last for fifteen to twenty minutes if you have an aerotow launch to 2000 feet. This is ample time for you to experience what gliding is like. If launched by winch or car launch, the time spent in



*Fig 3.2 Flying by attitude. The glider's attitude (the view which the pilot has over the nose of the glider) is the main reference when gliding.*

the air will be more like five minutes but there will probably be the opportunity to have a second or even a third flight on the same day.

There are very few formalities involved in preparing for your first glider flight, but in order that you know what will be required, they are outlined below.

Before flying at a gliding club, it is necessary for you to become a member. To help you avoid paying a year's subscription before knowing whether or not you will enjoy the sport, clubs normally have a temporary membership fee included in the cost of your trial flight.

You will also be asked to sign a declaration that you do not suffer from ailments such as epilepsy, heart problems or dizziness. If you have any doubts, then it does not mean you will not be able to take up gliding, but you should consult your doctor beforehand. His approval may be required. (By the way, your instructor will have been cleared by a doctor before he was allowed to become an instructor).

# INDEX

**Addresses** 301

**Adverse yaw** 44-46, 54, 205-207

**Aerotow(ing)** 12, 16-17, 76, 103-104,

126-138, 266-267, 287-289, 298

boxing the tow 137

emergency signals 171-174

failures 168-171

glider position 131-133, 173

ground run 102-104, 107, 185-186

lateral displacement 134

releasing 132, 134-136

signals 127-128

stages of 129-136

turning on 132

**Aerotow emergency signals** – air exercise 174

**Aerotow launch failures** – air exercise 171

**Aerotow launching** – air exercise 138

**Aileron(s)** 3, 6, 33, 38-39, 41, 44-49, 67-

68, 73, 85, 91, 105, 107, 118, 175,

178-179, 184-186, 188, 205-207

air exercise 41

differential 205-206

Frise 205-206

response in wind gradient 112-113

use at the stall 54, 59, 65

use on the ground run 90, 118, 129

**Aileron drag** 44-46, 85, 184, 205-207

air exercise 45-46

**Air exercise** – aerotow emergency

signals 174

aerotow launch failures 171

aerotow launching 138

aileron 41

aileron drag 45-46

airbrakes 83

approach control using airbrakes 95

circuit planning 158

effect of controls 40-42

elevator 40

further spinning 72

further stalling 60

further turning 47-49

incipient spin 60

landing 90

reduced “g” 62-63

rudder 41-42

sideslipping 180-181

spinning 70

spiral dive 72

stalling 57-58

trimming 77

turning 46

wire launch failures 167

wire launching 125

**Airbrake(s)** 3, 6, 52, 70, 72, 78-83, 86,

90, 91-95, 111-112, 144, 161-162,

165, 167, 168, 172-175, 179-181, 185

air exercise 83

attitude change 80-81, 83

check 35-36

lever 6, 35-36, 144, 165

operating forces 79-80

trailing edge 81-82, 189-191

use in the circuit 153

use in wind gradient 111-112

**Airfield** 10, 136, 161-163, 166

**Airflow** 20-25, 27, 50-52, 54, 78, 80-82,

112, 175-176, 178, 183, 187, 198-201,

204, 207, 219-223, 225, 227-229

noise 40, 52, 262

turbulent 50, 54, 219-223

**Airmanship** 57

checks “hassll” 57

when hill soaring 241-242

when thermalling 262

**Airspeed** 7-9, 17, 25, 40, 47, 48, 51-52,

57, 64, 67-68, 70-77, 89, 94, 99,

100-105, 129-130, 135, 161-163, 167,

169, 175, 177-192, 208, 210, 213-215,

218, 220, 229, 276-277, 280

during winch launch 118-124, 159

effect of airbrakes 78-83

in the circuit 143-145, 147, 153

in turbulent conditions 109

in turns 43-44, 50

in wind gradient 110-111

on the approach 85-86, 89-91, 94-95,

109

“too fast” signal 124

while hill soaring 238, 240



- while thermalling 257, 261
- while wave soaring 268-269, 272
- Airspeed indicator** 7-8, 47, 64, 85, 178-179, 191-192, 276-277
- flap speeds 191-192
- Alcohol** 31
- All-moving tailplane** 208, 227
- Altimeter** 9, 139-140, 170, 277-279
- Altitude flying** 113, 270-272, 277
- Anabatic lift/wind** 237
- Angle of attack** 21-23, 25, 44, 50, 52-56, 64-69, 89, 177, 183, 186, 199-202, 211-212
  - in wind gradient 110-111
  - on winch launch 118-119, 159-160
- Angle of bank** 41, 44, 46-48, 50, 68-72, 112-113, 132, 145, 166, 178, 258-262
- Anhedral** 201
- Anti-balance tab** 74-75, 208, 227
- Approach** 84-86, 91-95, 105, 109-112, 139, 145-146, 149, 152-158, 160, 175-181, 187-191
  - angle 91-94, 101-102
  - speed 85-86, 89-91, 94-95, 111-112
  - 158, 170, 285
- Approach control using airbrakes** – air exercise 95
- Aspect ratio** 216, 225
- Atmospheric pressure** 276
- Atmospheric stability** 237, 245
- Attitude** 17, 40, 44, 46, 47, 52-53, 56-57, 68-71, 73-77, 85, 87, 90, 91, 94, 111, 159-161, 167, 178, 186-187, 261-262, 277, 285
  - change with airbrakes/spoilers 80-81, 83
  - on winch launch 118-119, 121, 159
  - while trimming 75-76
- Audio variometer** 262, 280
- Autorotation** 64-69
- Awards** 290-292
- Back-release mechanism** 36, 115, 123
- Badges** (see “awards”)
- Balance tab** (see “geared tabs”)
- Ballast** 34-35, 50, 64, 76, 203, 297
- Ballooning** – on landing 87, 89, 94
- Bank(ing)** 41, 134, 175-180
- Bank angle** 41, 50, 68-72, 132, 258-262
  - adjustment of 41
  - in wind gradient 112-113
- Base leg** 139-140, 145-146, 148-157, 166
- Base leg turn** 145, 148-149, 151-152, 155
- Belly release hook** 7, 36, 118, 121, 297
- Bernoulli’s theorem** 20
- Blue thermals** 247, 249, 252
- Boundary layer** 219
- “Boxing the tow”** 137
- Buffet** 54, 80, 178
- Bungee launch** 12
- Cable break(s)** 114, 120, 121, 123-124, 159-167
  - recovery action 159, 167
- Cable parachute** 114-115
- Cable release** – check 36
  - knob 6-7, 118, 123, 129, 161, 173, 186
  - mechanism 6-7, 36, 115, 127
  - position 118, 121, 127, 297
- Canard** 202
- “Cannot release” signal** 173-174
- Canopy** 5, 32, 35, 241
- Capacity flask** 279-280
- Car launch** (see also “wire launch”)
  - 10-11, 16-18, 114, 124, 159
- Catapult launch** 12
- Centre of gravity** 19, 23, 37, 118, 198, 202-203, 230
- Centre of pressure** 23, 202, 212
  - movement at stall 55-56
- Centripetal force** 43
- Certificate of airworthiness** 32, 194
- “Check airbrakes” signal** 172-173
- Chord** 216
- Chord line** 21
- Circuit flying** – after a cable break 165
  - at hill sites 157-158
- Circuit planning** – 139-158
  - air exercise 158
  - correcting the circuit 147-155
  - diagonal leg 155-157
- Clothing** 30
- Cloud** – cover 270-271
  - cumulonimbus 246-247
  - cumulus 246-247, 249-252
  - lenticular 264-266, 268-270
  - rotor 265
  - shadows 253
  - streets 249-250
- Clutching hand** 234
- Cockpit** 5, 6-9, 191
  - loading 34-35, 50, 64, 76, 194, 202-203
- Collision avoidance** 147

**Compass** 9

**Complacency** – while wave soaring 270

**Condensation level** 246

**Control(s)** 6-7, 97

air exercise 40-42

axis 37-40

check 33

column 6, 33, 38-41, 44, 45, 73-77, 86-89, 117, 121-122, 177-178

confusion 16-17, 185, 191, 298

co-ordination 43-49, 60, 67-68, 72, 85, 91, 105, 130, 132, 145, 163, 166, 175, 179-180

deflection 23, 38-39, 72, 90, 196, 226-227

flutter 209-211

force(s) 23, 38, 73-78, 137, 179, 197, 204-205, 207-209

movement causing reduced “g” 60-63, 160-161

position at stall 55

primary 37-42

response at stall 54

response on aerotow 129, 130

response on approach 85, 109, 144

response on ground run 103-108, 117, 129

use on approach/landing 85-90

**Conversion factors** 300

**Crabbing approach** 105-106

**Crosswind** 105-108, 162, 165

affecting circuit 147-152

leg (see “base leg”) 147

on landing 105-108

on take-off 107-108, 118

**Cruciform tail** 223-226

**Cumulonimbus cloud** 246-247

**Cumulus cloud** 245-247, 249-252

**Curl over** 108, 234, 242

**Daily inspections** 31-33, 194

**Dew point** 245

**Differential ailerons** 205-206

**Dihedral** 198-201, 203-204

**Directional control** 85-86, 90, 91

**Directional stability** 197-198

**Dive brakes** (see also “airbrakes”) 79, 81, 82

**Dog-leg** – after cable break 163

**Dorsal strake** 198

**Downwind checks** 143-144

**Downwind landing** 104-105, 241

after launch failure 164-165, 169-171

**Downwind leg** 139-157, 166

**Drag** 24-25, 27-29, 78-82, 175-177, 182-190, 204, 206-209, 215-230, 287-288

aileron 85, 205-207

at stall 50-52, 56, 59

definition 24, 27

form 24

induced 24, 25, 44-45, 203, 216-219

interference 221-223, 225-226

profile 24, 25, 182, 203, 215, 218, 220, 225, 285

skin friction 24, 203, 219-220

**Drift** 97-100, 105, 107, 121-122, 130

during a winch launch 121-122

in the circuit 140, 147-153

while hill soaring 234, 238-239, 242

**Drugs** 31

**Dry thermals** (see “blue thermals”)

**Dry adiabatic lapse rate** 245

**Effect of controls** 38-42

air exercise 40-42

**Elevator** 3, 6, 33, 38-40, 45-49, 54, 60, 65, 73-76, 80, 81, 85-90, 91, 94, 107, 118, 129, 178, 202, 207-208, 285

air exercise 40

**Elevator springs** 74-75, 208

**Emergencies on aerotow** 171-174

**Environmental lapse rate** 244-245

**Field landing** 90, 139-140, 147, 162, 169, 171, 225, 240-241

**Fin** 3, 198, 225-226

**Final turn** 145, 149-150, 153, 155, 165

**Fitness** 18, 30-31

**Flap(s)** 5, 7, 182-192, 215

aileron interlink 184, 186

area changing 183, 215

brakes 190-191

check 35

controls 184-185

landing 184-185

lever 7, 184-186

limiting speeds 188-189

optimum settings 186-187

settings 184, 186-188

use on the approach 184-185, 187-191

**Foehn gap** 264

**Forces** – balance of 19, 23, 25-29, 43-44, 110

in a turn 6, 43-44

resolution of 25-27  
**Frise ailerons** 205-206  
**Fuselage** 3, 175, 198, 202, 221-223, 227-229  
   design 227-229  
   drag 183, 227-229  
  
**Geared tab** 204-205  
**Glide angle** 29, 78-79, 81-82, 101, 139, 157, 170-171, 175, 183, 186, 188, 214-215, 220, 229, 287  
**Glider** – converting to new types 297-299  
   description 2-9  
   design 194-230  
   performance 29, 78-79, 81-82, 143, 169, 213-230, 271  
   sealing 221-223, 229  
**Gliding site** 10-15  
**Gravity** 19, 60-61  
**Ground handling** 13-15  
**Ground loop** (see “weathercocking”) 90, 105-107, 118, 129  
**Ground reading** 252-253  
**Ground run** – aerotow launch 107, 129, 168, 185  
   after landing 84, 90, 104-107, 188  
   winch launch 107, 117-118  
**Groundspeed** 7-8, 100-104, 110-111, 152  
**Gusts** 108-109  
   while thermalling 257-259, 261  
  
**Hail** 246  
**Harness** (see straps)  
**Hassll check** 57  
**Heading** 48, 97-99, 105  
**Height** 57, 101-102, 108-113, 139-148, 152-167, 169-170, 175, 177, 179-181  
   judgement 87-89  
**High key point** 140-142  
**Hill lift** 10, 12 157-158, 234-243, 267  
**Hill sites** 10, 12, 108, 157-158  
**Hill soaring** 113, 135, 158, 238-243  
   airmanship and rules 241-242  
   curl over 108, 234, 242  
   dangers 242-243  
   orographic cloud 243  
   shape and size of hill 235-236  
   wind strength and direction 234-235  
**Hilltop airfields** 10, 12, 108  
**Hold off** 84, 89, 90, 94, 105-106  
**Horn balance** 204-205

**Humidity** 245-246  
**“Hunting” on winch launch** 121  
**Hypoxia** 271  
  
**Icing** 271  
**Incipient spin** 58-60  
   air exercise 60  
   recovery 59  
**Induced drag** 24, 25, 44-45, 203, 215-219, 225-226, 230  
**Instruments** 7-9, 35, 276-281  
**Interference drag** 221-223, 225-226  
**International Distress Frequency** 284  
  
**Judgement** 87-89, 146  
  
**Laminar airflow** 219-223, 227, 235-236  
   with lee waves 264-265  
**Laminar separation** 220-221  
**Laminar separation bubble** 220-221  
**Landing** 84-90, 91, 94-95, 96, 104-107, 146, 178-181  
   ahead after a cable break 161-162, 165-166  
   air exercise 90  
   area 84-89, 94-95, 101, 104, 111-112, 139-157, 162-167  
   crosswind 105-107  
   downwind 104-105, 240-241  
   flap 184, 187-189  
   in a field near a hill 240-241  
**Lapse rate** – environmental 244-245  
   dry adiabatic 245-246  
   saturated adiabatic 246  
**Lateral displacement on aerotow** 134  
**Lateral stability** 198-201  
**Launch** – cable 114-115, 159  
   methods 10-12  
   signals (aerotow) 127-129  
   signals (wire) 115-117, 124  
**Launch failure** –during wire launch 114, 120, 121, 123-124, 159-167  
   while aerotowing 168-171  
**Launch point controller** 115-116, 127  
**Lee waves** 113, 263-272  
   characteristics 263-265  
   entering the lift 266-268  
   favourable conditions for 264  
   position of lift 266  
   primary 263, 265  
**Lenticular clouds** 264-270  
**Lift (force)** 19-23, 27-29, 43, 47, 50-51, 56, 64-66, 78-79, 81, 86, 110-112,

- 130, 175-177, 182, 185-191, 199-204,  
215-217, 222-223, 227, 229, 287-288  
distribution 23, 216-217
- Lift (rising air)** 232-272  
anabatic 237  
effect on the circuit 144-145, 152-157  
hill 234-243  
thermal 244-262  
wave 263-272
- Lift/drag ratio** 29, 78-79, 81-82, 214, 287
- Lightening** 246
- Limitations placard** 32, 34-35, 109, 119,  
272, 276
- Log books** 293-294
- Lookout** 17, 46-47, 57, 135, 147, 241,  
262, 280, 295
- Low key point** 144-145
- Low tow position** 136-137
- Low turns** – in wind gradient 112-113
- Main wheel** 5, 228-229
- Manoeuvring** 52
- Mass balancing** 209-211, 227
- Maximum airspeed** – on winch launch  
119, 121, 124
- Mayday call** 283-284
- Medical standards** 18, 30-31
- Minimum sink speed** 214, 229
- Mountain lee waves** 113, 263-272
- Navigation** – while wave soaring 270-  
271
- Negative flap** 184-187, 189
- Negative “g”** (see “reduced g”)
- New types of glider** – converting to  
297-299
- Normal tow position** 131-132, 135, 136,  
173
- Nose drop at the stall** 54-56
- Nose wheel** 228
- Orientation** – on aerotow 136  
while wave soaring 270-271
- Orographic cloud** 243
- Ottfur rings** 115
- Oxygen** 271
- Pan call** 283-284
- Parking the glider** 15
- Performance flaps** 186-187
- Pilot fitness** 18, 30-31
- Pilot induced oscillations** 130
- Pilot weight** 34-35, 50, 64, 76, 202-203
- Pitch(ing)** 37-40, 47, 63, 159-161  
at the stall 55-56  
in the spin 64-66  
on winch launch 118, 121  
stability (see “stability-longitudinal”)
- Pitot tube** 7, 178, 276-277
- Polar curve** 213-215, 229-230
- Positive flap** 183-188
- Positive “g”** 60-61, 71
- Power pilots** – conversion to gliding  
295-296
- Pre-take-off checks** 33-36
- Preparation for flight** 30-36
- Primary lee wave** 263, 265
- Profile drag** 24, 25, 182, 203, 215, 218,  
225, 285
- Progress cards** 293-294
- Propeller wash** 131, 136-138
- Radio** 270, 282-284  
aerials 228-229  
for launch signalling 116, 128-129
- Radius of turn** 259-261
- Rate of climb** 235, 245, 254, 257, 260,  
262, 266-268, 279-280
- Rate of descent** 139, 144, 147, 153, 155,  
173-175, 178-181, 184-185, 188-190,  
213-215, 229, 232-233, 258-260, 279-  
280  
at the stall 55, 56  
in the spin 65  
in wind gradient 110-112  
on approach 86, 90, 91-94, 285
- Reaction force** 19
- Records** 292
- Reduced “g”** 60-63, 160-161  
air exercise 62-63
- Reference point** 91-95, 145
- Relative airflow** 21, 23, 27, 50-52, 64-65,  
100, 110-111, 118-119, 159, 175, 211
- Release hook** (see “cable release”)
- “Release immediately” signal** 171-172
- Releasing** – from aerotow 132, 134-136  
from wire launch 122-123
- Resolution of forces** 25-29, 175-176
- Reverse pulley launch** (see also “wire  
launch”) 11, 114, 124-125, 159
- Rising air** (see “Lift”)
- Roll(ing)** 38-39, 41, 47, 64-66  
dampening 64-65, 201
- Rotor** 265, 270
- Rotor cloud** 265

- Rough air speed** 109
- Round out** 84, 86-90, 91, 94-95, 105-106, 111-112, 162, 285
- Rudder** 3, 6, 33, 39, 41, 45-49, 54, 59, 67-72, 73, 91, 105-107, 124, 175-181, 207  
 air exercise 41-42  
 during ground run 90, 118, 129  
 over-balance 179  
 pedals 6, 33, 39, 41
- Ruddervator** 226
- Rules** – of the air 274-275  
 when hill soaring 241-242, 275  
 when thermalling 262, 275
- Runway** 10, 102-103, 107, 122
- “S” turn** 157  
 after cable break 163-164
- Safety** – general 12-13, 194  
 on airfield 12-15
- Saturated adiabatic lapse rate** 246
- Sensations** 16-17, 47, 60-63, 257-259
- Sideslip(ping)** 175-181, 199  
 air exercise 180-181
- Signals** – aerotow emergencies 171-174  
 aerotow launching 127-129  
 wire launching 115-117
- Sink(ing air)** 233-234, 236, 242, 258-259  
 effect on the circuit 144, 152-157  
 street 249-250, 257
- Skids** 5
- Skill** 87
- Skin friction** 24, 203, 219-220
- Sky reading** 251-252
- Slipping turn** 180
- Smoke** – as a thermal indicator 254-255
- Soaring** – birds 254  
 gliders 254  
 in hill lift 113, 135, 157, 238-243  
 in thermals 251-262  
 in wave lift 113, 266-272  
 principle of 232-233
- Span** 2
- Spin(ning)** 54, 58-59, 64-72, 124, 166, 178, 211, 216  
 air exercise 70  
 further exercises 72  
 incipient 58-60  
 recovery 64, 69-70
- Spiral dive** 49, 70-72  
 air exercise 72  
 recovery 49, 71-72
- Spoilers** 3, 35-36, 80-81
- Spring trimmer** 74-75
- Stabiliser** 202
- Stability** 40, 196-204  
 atmospheric 237, 245  
 directional 197-198  
 lateral 198-201  
 longitudinal 40, 201-203
- Stall(ing)** 22, 50-70, 80, 85-86, 89, 105, 111, 118, 124, 135, 166-167, 178, 211  
 air exercise 57-58  
 after cable break 159, 161  
 angle 22, 50, 52, 53, 56, 110, 118, 159  
 further exercises 60  
 recovery 52, 56-58, 159-161  
 symptoms of 52-56, 80
- Stalling speed** 50, 52, 60, 85, 105, 183, 187-189, 220  
 in turns 50, 60  
 increase with airbrakes 60, 80-81, 161-162  
 on launch 102-103  
 on winch launch 119-120
- Standing waves** (see “lee waves”)
- Static vents** 7, 178, 276, 278
- Stick** (see “control column”)
- Still air** 97-99
- “Stop” signal** 116, 127
- Straps** 35
- Streamlining** 228-229
- Sweepback** 199-200
- Sweepforward** 199-201, 203
- “T” tail** 3, 224-226
- Tail ballast** 230
- Tailchute/parachute** 78, 285-286
- Tailplane** 3, 198, 202-203, 223-227, 230  
 all-moving 227  
 design 223-227  
 drag 224-227
- Tail skid** 107, 228
- Tail wheel** 107, 228-229
- Take-off** (see also “aerotow” and “wire launch”) 76, 102-104, 107-108
- Thermal(s)** 76, 244-262, 267  
 blue 247, 249  
 centring 257-259  
 finding 251-257  
 formation 244-254  
 soaring 251-262  
 sources 247, 252-255  
 streets 249-250, 257  
 structure 248-249  
 triggers 248-249, 253

- Thermalling** – airmanship and rules 262
  - faults 260-262
- Thrust** 25
- Thunderstorms** 109, 246
- Tost rings** 115
- Total energy (probe)** 280-281
- Tow cable release** 6-7, 36, 115
- Tow car** 7, 10-11
  - failure 166-167
- Tow-plane** 103, 126-127, 168, 171-174
  - climb angle 170
  - upsets 130-132, 287-289
  - slipstream 131, 136-138
- Tow-rope** 6, 126, 168, 173
  - attaching to glider 127
  - length 127, 136
- Track(ing)** 84-85, 98-100, 105-106, 139, 149-152
  - in wave lift 268
  - while hill soaring 238-239
  - while sideslipping 176, 178
- Trailing edge airbrakes** 81-82, 189-191
- Transition point** 219-220
- Trim** – change with spoilers 81
  - tab 5, 6, 73-74
- Trimmer** 35, 73-77, 207
  - knob/lever 6, 74-77
  - spring 74-75, 208
- Trimming** 73-77, 135, 137, 208
  - air exercise 77
- Tug aircraft** (see “tow-plane”)
- Turbulators** 220-221
- Turbulence** 108-109, 156-157, 171- 172, 234-236, 242, 264-265
  - when aerotowing 132-133
- Turbulent airflow** 220-221, 228
- Turn and slip indicator** 9
- Turning** 41, 43-49, 50, 52, 67-68, 73, 75
  - air exercise 46
  - common faults 46-47
  - forces 6
  - further exercises 47-49
  - in wind gradient 112-113
  - on aerotow 132
  - polar 260
  - while hill soaring 239-240
- “Unable to release tow-rope” signal**
  - 173-174
- Undercarriage** 5, 7, 123, 130, 135, 229
  - lever 7
- Undershooting on the approach** 92-95, 111-112, 285
- “V” tail** 2, 69, 224-227
- Variometer** 9, 259, 262, 279-281
- Venturi principle** 20-22
- Washout** 211-212
- Water ballast** 229-230
- “Wave off” signal** 171-172
- Wave soaring** 113, 266-272
  - associated hazards 270-272
  - finding the lift 266-268
  - technique 268-270
- Weak link** – aerotow launch 127, 289
  - wire launch 115
- Weathercocking** 106-107, 118, 129, 176
- Weight** 19, 27-29, 43-44, 50-51, 55, 60, 229
  - definition 19, 27
- Wheel(s)** 5, 107, 228-229
  - brake 7, 79, 90
- Winch failure** 114, 166-167
- Winch launch(ing)** 11, 16, 17-18, 102-103, 114-125, 158-159, 186
  - “hunting” on 121
  - signals 115-118
  - stages of 117-123
  - release hook 7, 36, 118, 121, 297
- Wind** 7, 14-15, 96-113, 162, 164, 169-171
  - anabatic 237
  - assessment 96-97, 140
  - effect on the circuit 146-152, 155-157
  - effect on thermals 251-252
- Wind gradient** 109-113, 158, 171
  - aileron response in 112-113
  - airspeed in 110-111
  - angle of attack in 110-111
  - bank angle in 112-113
  - effect on wire launch 123-124
  - low turns in 112-113
  - use of airbrakes in 111-112
- Wind speed/strength** 8, 94, 96-97, 99, 108-113, 135-136, 149-152, 157, 170-171, 234, 247, 249, 252, 264-265, 268-270
- Wing** 2, 19-23, 43
  - area 215-216
  - camber 182-187, 215
  - chord 216
  - design 198-201, 203, 215-221
  - drop at stall 56, 58-60
  - fences 217-218
  - taper 216

- Wing section** 21
  - early glider 182-183
  - modern glider 182-183
- Wing tip sweepback** 219
- Wing tip vortices** 25, 215, 219
- Wing-down approach** 105-107
- Winglets** 217-218
- Wingspan** 2, 109, 112, 201, 212, 215-218
- Wire launch(ing)** 10-11, 52, 55, 76,  
102-103, 114-125, 135, 158-167, 267
  - air exercise 125
  - attaching wire to glider 114-115
  - into a wind gradient 123-124
  - release hook 7, 36, 118, 121, 297
  - signals 115-117
- Wire launch failures** 114, 120, 121,  
159-167
  - air exercise 167
- Workload** 57, 75, 146, 147, 191, 194,  
298
  - management 143, 161-163, 283
- Yaw(ing)** 38-39, 41, 124, 276-277
  - adverse 44-46, 54, 205-207
  - at stall 56, 58, 59, 64-69
  - due to autorotation 65-66

## **ABOUT THE AUTHOR**

Ken Stewart started gliding on a holiday course at the Cairngorm Gliding Club in the highlands of Scotland in 1972. By 1976 he held an Instructor's Rating. The following year he joined the instructing staff at Lasham Gliding Centre, reputedly the largest gliding centre in the world. What began as seasonal employment soon became full-time, resulting in his holding the position of Deputy Chief Flying Instructor and for one year, Acting Chief Flying Instructor, while his colleague Derek Piggott took a sabbatical in the USA.

In 1982 he became National Coach for the British Gliding Association and as such was involved in, among other aspects of the sport, the training of instructors, cross-country and competition training. In this role he produced many of the examination papers used by the BGA and flew at the majority of the gliding clubs in Britain.

A keen soaring pilot, he is holder of the FAI Diamond Badge and has flown in many competitions and National Championships.

Despite now working as an airline pilot, he still instructs on both gliders and motor gliders at the Soaring Centre at Husbands Bosworth in Leicestershire. Having flown over 100 types of glider and with considerable tow-plane flying experience, he is an ideal person to produce a manual on gliding.





775

*Cover picture - Aviation Picture Library, Austin Brown, London*

**Airlife Publishing Ltd.**

101 Longden Road, Shrewsbury SY3 9EB  
Shropshire, England.

ISBN 1-84037-084-X



9 781840 370843

**The Wally Kahn/British Gliding Association eBook Library**

is unable to obtain copyright approval to provide  
the reader with the complete eBook.

By including a number of pages we have endeavoured  
to provide you with the flavour and content of this book  
so that you can decide whether or not to purchase a copy.

It may be that the Publisher and/or Author are intending  
to print a further edition so we recommend you contact  
the Publisher or Author before purchasing.

If there are no details provided in the sample  
Search online to find a new or  
second hand copy.

Addall, a book search and price  
comparison web site at <http://www.addall.com> is very  
good for gliding books.

**Copyright of this book sample and the book remains  
that of the Publisher(s) and Author(s) shown in this  
sample extract.**

**No use other than personal use should be made of  
this document without written permission of all parties.**

**They are not to be amended or used on other websites.**