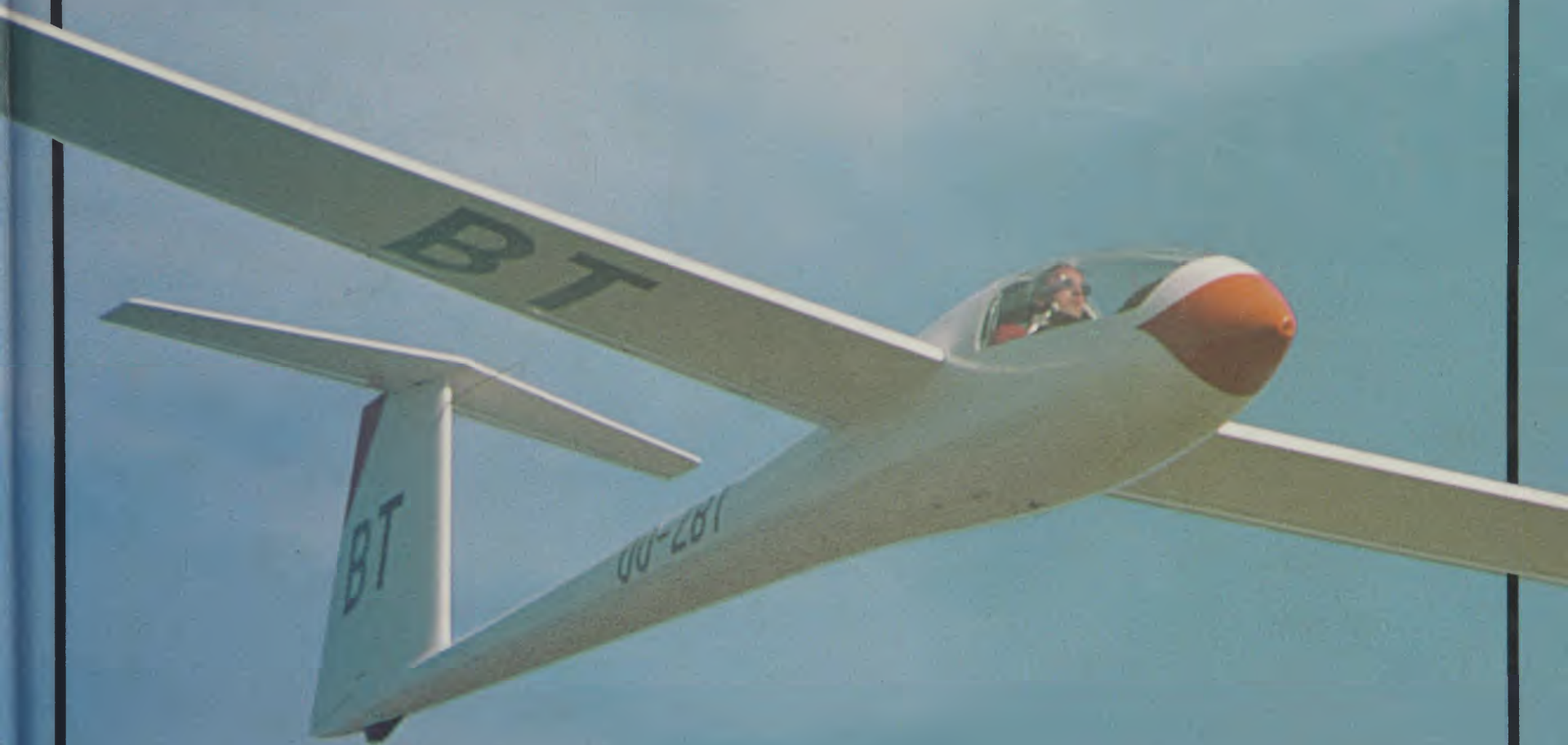


Ann Welch



The Complete  
**SOARING**  
Guide

To Wally

---

# The Complete Soaring Guide

---

**Ann Welch**

with best wishes

**In the same series:**

The Complete Cycle Sport Guide  
The Complete Hang Gliding Guide  
The Complete Microlight Guide  
The Complete Sailing Guide  
The Complete Windsurfing Guide

Ann Welch  
-

The Complete  
**SOARING** Guide

Ann Welch



**A & C Black · London**

First published 1986  
by A & C Black (Publishers) Ltd  
35 Bedford Row, London, WC1R 4JH

Copyright © 1986 Ann Welch

This book is copyright under the Berne Convention. All rights are reserved. Apart from any fair dealing for the purposes of private study, research, criticism or review, as permitted under the Copyright Act, 1956, no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, electrical, chemical, mechanical, optical, photocopying or otherwise, without the prior permission of the publishers.

Welch, Ann  
The complete soaring guide.  
1. Gliding and soaring  
I. Title  
797.5'5      GV764  
  
ISBN 0-7136-5540-2

Design: Janet Simmonett

Typeset in 10pt Helvetica Light by August  
Filmsetting, St. Helens  
Printed and bound in England by Hazell,  
Watson & Viney Ltd, Aylesbury

#### **Acknowledgements**

The author wishes gratefully to acknowledge permission to reproduce the following photographs:

British Gliding Association: p.41  
Cambridge Instruments: p.36  
Glasflugel: pp. 17, 29, 113  
Field Tech Ltd: p.23 (bottom)  
Flight: p.101  
Paul Schweizer: pp. 51, 95 (left), 115 (top left),  
139, 142  
Peter Selinger: p.44  
Colin Street: p.138  
Frank Irving: pp. 3, 79, 82, 83 (bottom)  
All other photographs (except those on pp.  
50, 65 and 93 which carry no identification)  
and illustrations are by the author.

---

# Contents

---

Introduction 7  
How to get started 8

## **PART 1 10**

The sailplane 10  
Sailplane rigging and inspection 22  
Instruments 31  
Launching methods 38  
The motor glider 43

## **PART 2 45**

Learning to fly 45  
Control of airspeed 51  
The launch 57  
Getting back on the ground 61  
Circuit planning 65  
Learning about emergencies 70  
First solo 77

## **PART 3 79**

Soaring basics 79  
Local soaring 84  
Navigation 88  
Field landings 93  
Soaring weather 102  
First cross-country 111  
Speed flying 117  
Competitions 122

Appendices 132

- 1: Units and conversions 132
- 2: Aerobatics 133
- 3: International FAI gliding badges 134
- 4: The British Gliding Association Bronze Badge 135
- 5: World records 136
- 6: World gliding championships (Classes) 137
- 7: Addresses and organisations 138
- 8: Rules of the air 139
- 9: Bibliography 141

Index 142





The three white birds, by which sailplane pilots recognise each other all over the world.



---

# Introduction

---

What are the attractions of gliding, or flying without an engine? Of risking ending up in a muddy field while, with power, you can fly where you want and arrive on schedule—at least most of the time. All over the world there are pilots who want to fly sailplanes and nothing else; and many have continued to do so for forty years or more—why?

There are many reasons. For some pilots it is the challenge of taking on the elemental forces that make the weather, of searching out the air that is rising and escaping from air that tries to force them back to earth. It is a form of combat that brings great satisfaction when you win, and does no harm—except perhaps to your pride—when you lose. For others, the pleasure of soaring is simply its beauty: to fly quietly over an ever-changing sunlit land, dotted with the deep shadows of bright clouds above, is a magnificent experience. There are also pilots who, all their lives, have been fascinated by the mastery of the birds, and now delight in soaring with them—though on one occasion an eagle did attack a sailplane intruding into its mountain territory!

Maybe it is for none of these reasons that you will, or already have, become a soaring fanatic; maybe you just want a refreshing change at weekends from a stuffy weekday office, or perhaps a friend just takes you along to help him put his sailplane together. But even if you start gliding, and for any reason do not continue,

you will have had a glimpse of a new and different world.

Soaring began as a sport some sixty years ago, with crude home-made gliders which hardly soared at all. So the challenge then was simply to stay airborne, to defeat gravity for just one more minute between the hill top from which the glider took off, down into the valley. But even an extra minute was little compensation for the hour or more needed to carry the glider back up the hill again. Then it was discovered that when there was a good wind blowing up the hill, this would support the glider for longer—provided it flew in the narrow band of lift above the edge of the hill. Pilots soon became brilliant at using every gust and gully to their advantage, and they built large, light, and very slow sailplanes to help them.

It was nearly another decade before pilots could escape from the hills, however much they loved flying among them. One day a German pilot, Max Kegel, was sucked up by a large cumulus cloud—which was rapidly developing into a cumulonimbus (cu-nb). Finally he fell out of the storm, turned his height into distance, and landed 55 km away to make the world's first true cross-country flight.

It still took a few years to learn about thermals, in spite of pilots seeing birds circling up from the warm valleys. But when it was appreciated that it was thermals that created the cumulus, this was the

start of cross-country soaring as we know it. For the next few years, until the start of the Second World War, distance flying was all that mattered: to fly further and further, exploring new country, new clouds, and to land in the evenings in new places. This was perfection—except that it took all night to retrieve the glider and drive home.

As sailplane performance continued to improve, a few pilots realised that it was becoming more sensible to fly to a turn point and to try to soar back again. But this required the pilot to fly crosswind or into wind, instead of only downwind. For this the old, slow gliders would not be good enough, and faster ones would need to be built.

In 1948 the first triangular speed record was established at a world championship; now most soaring flights are triangles. For some years the triangles became larger—up to 500 km; then with the advent of glass-fibre sailplanes faster speeds were achieved. Today triangles are both fast and large. The world record for the 100 km triangle is 195 km/h and the biggest triangle flown is 1307 km.

With such progress it might seem that there is no achievement left that is within reach of the ordinary pilot, but the intricate behaviour of the air is still not yet fully understood. Soaring is attractive because every flight is different and is an exploration in its own right. It is something worth going for.

---

# How to get started

---

In most countries flying is carried out from gliding clubs, which provide the launch equipment, trailer parks, and whatever else is needed. In the United States soaring is more of an individual activity, because of the greater distances, and the availability of towing aeroplanes and of small airfields from which to fly. Each country has a National Gliding or Soaring Association to look after the sport, and these will provide lists of clubs, schools etc. (see page 138).

There are a few people who think that gliding, and soaring, is something magical and not for them. This

is not true, since anyone who can drive a car can learn to fly a sailplane; and only normal fitness is needed. If you think you might like soaring but are not sure, go and have a flight at a club or school, or with a friend. Choose a day when the weather is fine, and you will get a good idea of how enjoyable even a simple ten-minute flight can be.

If you are now tempted to do more, it is best to go on a basic course for one or two weeks, and live at a club with other beginners. This would still not commit you to more than the cost of the course, but it would con-

centrate your training so that you can progress faster than if you fly only occasionally.

Training flights are made in two-seat sailplanes with dual control so that the instructor can show you what to do—or take over if you get into a muddle. In due course, perhaps after only two weeks of flying regularly, you will be good enough to fly solo—and you will be a pilot. A few people stop flying once they have flown solo, thinking they have achieved all they wanted, but they do not yet know anything about the fun and satisfaction of soaring.

## Using this book

This book is divided into three parts which can be read in any order, depending on your interests. The first part is about the sailplane itself, the second concerns learning to fly, and the third part covers the many aspects of soaring. This ranges from making your first cross-country flight, through to competition flying, with a

look at the weather and map reading navigation in between. The book is not intended in any way to replace the club or school instructor, but will look at those techniques and concepts which the new pilot may find difficult to remember when he is learning to fly. For many people there seem to be so many new actions

competing for concentration at the same time. As well as giving the interested newcomer a broad picture of the whole sport of gliding and soaring, it is hoped that this book will act as a useful reference to the pilot throughout all his early flying career—and even later as a refresher for that infrequently used knowledge.





The Italian Calif high performance two-seater.





## Part 1: The sailplane

A sailplane may be called an aeroplane without an engine, but that is where the similarity ends. The pure white slender-winged birds of today are the result of years of refined design work with a single objective: to produce a machine with the flattest possible glide.

If you look at any sailplane its most characteristic features are the long, narrow wings. Most sailplanes have wing spans of 15 metres (49.2 ft), with top competition sailplanes having wing spans of up to 24.5 m (80.4 ft), while the chord of the wing (its width) is often less than 1 m. This relation-

ship of span to chord is called *aspect ratio*. Compare the aspect ratios of the three sailplanes (page 12) with that of a typical small aeroplane.

Most single-seater sailplanes are built of glass fibre, but many school two-seaters are made of wood or metal. The Ka-13 (foreground) has a welded steel tube fuselage and wood wings.







The advantage of a high aspect ratio wing is that it produces less drag than a short, broad wing. The light aeroplane pilot is prepared to accept a higher drag aircraft for the convenience of short wings for taxiing and hangarage, lower construction costs, and because he has an engine to pull him along. It is also cheaper to increase engine power than to reduce drag to any appreciable extent.

*Above* Sailplanes have long, narrow wings. This ASW-22 has a span of 24 metres.

*Opposite* The seagull's ratio of span to wing width (aspect ratio) is only 10.

*Below* Glass and carbon fibres make such long unsupported wings both strong and stiff enough.



ciable extent. The sailplane pilot—and designer—do not think this way. They are purists who search for perfection. But to soar high in the summer skies even better than the birds, the pilot is prepared to accept what becomes, on the ground, an inconvenient and easily damaged—though still beautiful—piece of hardware.

## How a sailplane flies

A sailplane flies through the air in the same way as any other fixed-wing aircraft, in that the wing has to move fast enough to create enough lift to support the weight of the aircraft. To stay in the air it must have sufficient *airspeed*. To obtain the lift the wing has to meet the airflow at an angle which causes the air to flow efficiently over it: this is called the *angle of attack*. On a sailplane the angle of attack for normal flying is about  $3^\circ$ . If, when taking off, the nose is held down so that the angle of attack is less, the sailplane will not get into the air. If the angle of attack is increased to about  $12^\circ$ , the air flowing over the wing will no longer be able to do so smoothly. The wing will cease to be able to provide enough lift to continue to support the aircraft, and it will stall.

When the sailplane is being flown straight, the angle of attack is directly related to the indicated airspeed. When the nose is raised the angle of attack is increased and the airspeed indicator will show less speed. If it is lowered, the angle of attack is reduced and a greater airspeed is indicated. But this is only true for straight flight. In turns, particularly



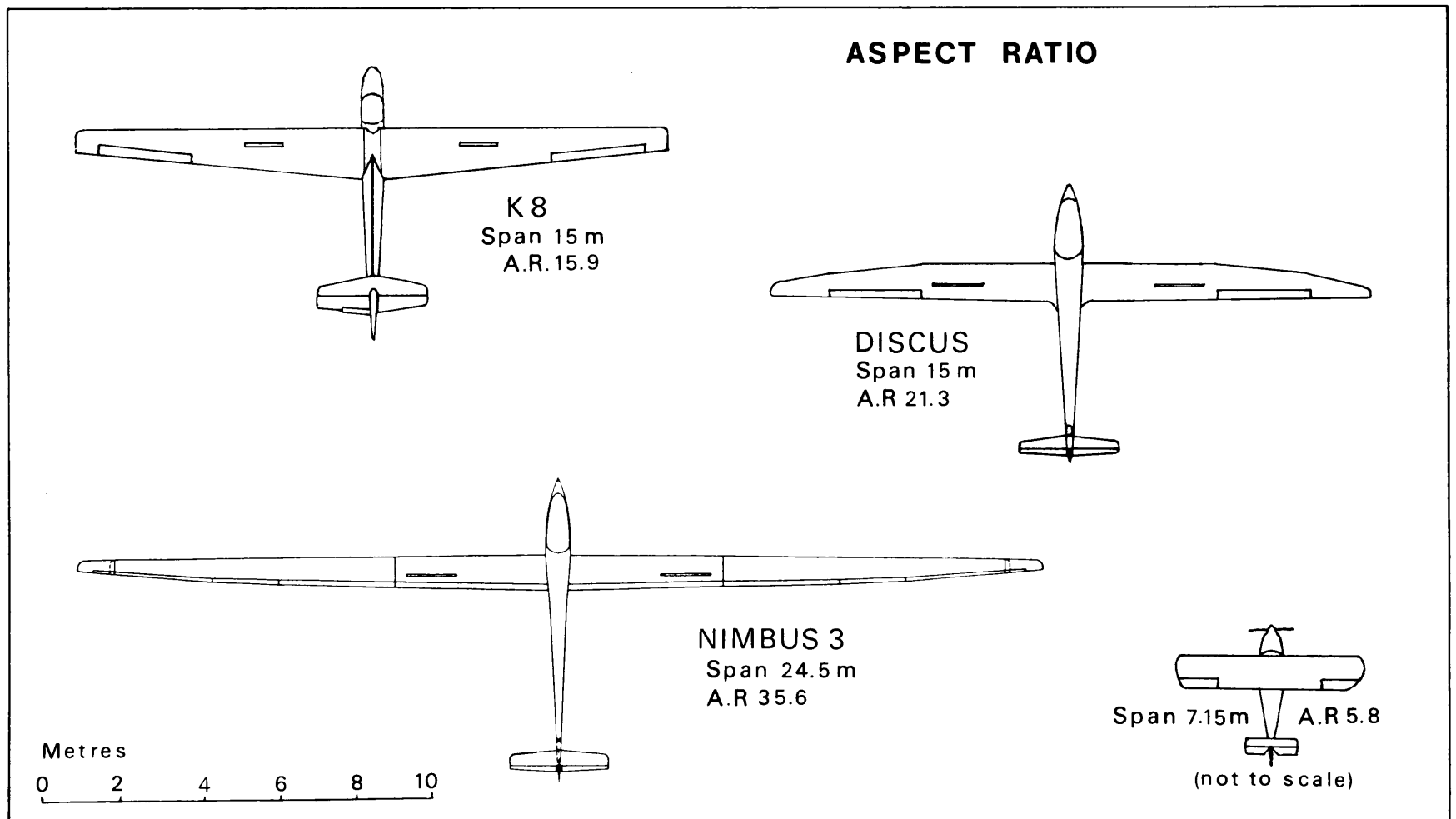
steep turns, or when pulling out of a dive, there is an extra load on the wings, and the stalling angle will be reached at a higher airspeed. This is one of the important lessons in learning to fly.

The angle of attack, at which the wing meets the airflow in flight, is not the same as the *angle of incidence*, often called rigging incidence. This is the angle at which the wing is fixed to the fuselage. The designer has to

compromise between setting this angle so that when the wing is being flown fast the fuselage will still present a low drag shape to the airflow, and relating the wing to the fuselage and its landing wheel to facilitate taking off and landing.

Unlike the aeroplane, which has an engine to provide the speed to fly, the sailplane obtains its airspeed from gravity. All the time it is airborne it is gliding down through the air; and it

still continues to glide down when flying in an upcurrent. It gains height only because it is being carried bodily upwards by the rising mass of air. Since the pilot may not always find air that is going up when he needs it, he wants his sailplane to return to earth slowly, with as flat an angle of glide as possible. This is why designers are pestered by pilots for better and better performance.







## How performance is measured

The performance of a sailplane is measured in glide ratio and sink rate. Glide ratio is the distance a sailplane will travel per unit of height lost. For example: an ordinary production sailplane having a glide ratio of 45:1 would fly 45 miles from a height of 1 mile (5280 ft), or in metric units, 45 kilometres from a height of 1 km. This is its theoretical still air performance, taking no account of inaccurate flying.

Sink rate is the rate at which the sailplane will sink back to earth if no upcurrents are encountered. Our example sailplane above would have a sink rate of 135 ft/min (0.7m/sec). The airspeed at which the sailplane will achieve its minimum sink rate is just a little slower than the speed at which it has the flattest glide.

The sailplane pilot uses his airspeed in quite a different way from the aeroplane pilot, who prefers it to remain as constant as possible. The sailplane pilot wants to fly slowly in thermals, and at a low sink rate in weak conditions. He will then have more time to find upcurrents before subsiding on to the ground. But when thermals are strong, he wants to be able to fly between them at high speeds at a flat angle of glide. He wants the best of both worlds, and designers have become remarkably good at providing it.

Regardless of how strong the lift—or how jubilant the pilot may feel—there is a design limit to the speed at which a sailplane, or any aircraft,

should be flown. This maximum permitted speed, never exceed speed (Vne), or redline speed, is the maximum allowed speed for the structural strength of the aircraft. It is a compromise between speed, strength, and weight. The maximum permitted speed for smooth air for many high performance sailplanes is around 125 knots, but the rough air maximum speed is often much lower, around 80 knots. These speeds are placarded in the cockpit.

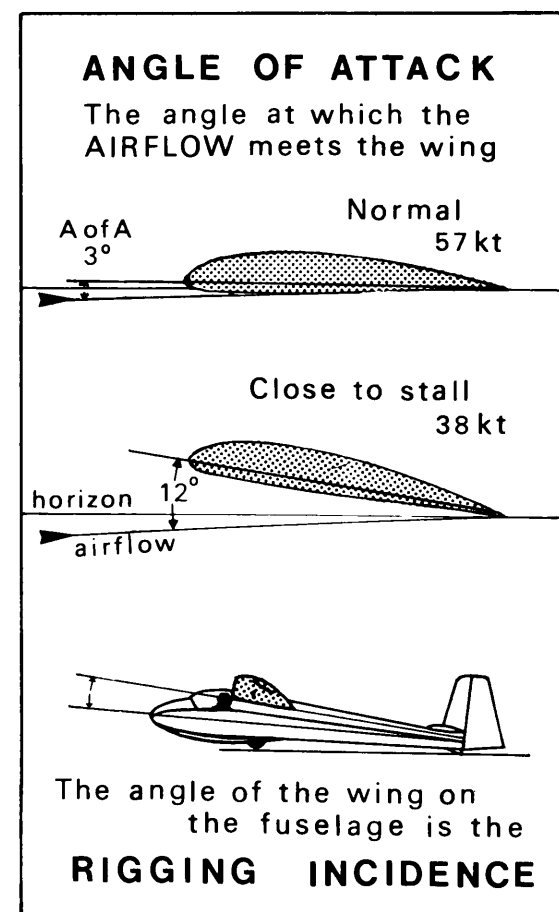
## Drag

Drag is the resistance of the air to the passage of an object moving through it. You can feel it when you try to stand against a strong wind. The more streamlined the shape of the object, therefore, the more easily it will slip through the air.

Drag on an aircraft is of two sorts: *profile drag* and *induced drag*. The profile drag of a clean sailplane, undercarriage up, is mainly due to skin friction. On older gliders, most aeroplanes and hang gliders with the pilot in the open, profile drag is greater because the air cannot flow smoothly around the many obstructions and they produce turbulent wakes. Profile drag, as would be expected, worsens as speed is increased; so as the pilot in his clean, and slippery, ship flies fast between thermals, he must allow for some deterioration in his glide performance.

Induced drag is different. It is the drag produced by the wing in creating the lift it needs to fly. The lift

produced by the wing is an upward force applied to the wing by the passing airstream. The wing also exerts a force on the air, which is pushed downwards. This downward velocity represents wasted energy that is equivalent to a drag force, and leads to the generation of vortices, mainly from the wingtips. Such vortices from the wingtips of big jets, known as wake turbulence, are a notorious hazard to small aircraft flying up to several miles behind them.





Winglets on an ASW-20 to help reduce induced drag.

Although, the induced drag vortices are comparatively small on a well designed sailplane, they cannot be eliminated—otherwise the wing would not produce lift. Much research goes on to try to minimise induced drag, including adding winglets, giving the wing leading edge sweepback, or making the tips very small, but all attempts carry some price. Winglets may reduce induced drag, but they add to profile drag at higher speeds, and tiny wingtips may adversely affect stall behaviour. The problem is that with sailplane performance as high as it

The little winglets of the Discus are overshadowed by the wing's superb surface.



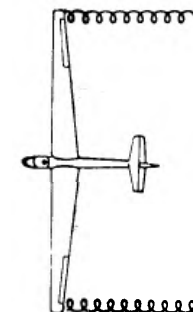
already is, it is both difficult, and often very expensive, to make even a minute improvement.

To obtain the best performance from his sailplane the pilot needs to have some understanding of drag forces, because although profile drag increases the faster he flies, induced drag lessens, and it is worst at low speeds. Because of this there is a speed for each sailplane type at which the best compromise is obtained—where the induced and profile drags are equal. This speed gives the best angle of glide; it is the speed at which the sailplane will



### PROFILE DRAG

is the drag of the structure, wheels, etc., as the aircraft moves through the air. It increases as the airspeed increases.



### INDUCED DRAG

is caused by the wing in producing the necessary lift to fly. It is worst at low speeds.





travel furthest from a given height in still air.

### **L/D or Lift over Drag**

Sometimes the glide ratio is referred to as the L/D. This is because the

glide ratio is numerically equal to it: in straight flight the lift provided by the wing is equal to the weight of the aircraft. For example, the drag on a sailplane, such as the Discus, which weighs 500 kg (1100 lb), loaded, has a glide ratio of 41 at, say, 50 knots. Its L/D ratio at this speed is also 41, so its

actual drag is therefore only  $500/41 = 12 \text{ kg (27 lb)}$ .

### **Laminar flow**

As the airflow moves over the wing the particles of air closest to the surface will be slowed down. This creates skin friction drag, so the

Flaps extended on a metal Blanik two-seater.





designer goes to great trouble to ensure that the airflow is as smooth and as laminar as possible. The decelerated air forms a region known as the boundary layer. On a good, smooth wing the laminar flow will be about 1mm thick near the leading edge, to perhaps 5mm thick further back on the wing. Further back still the laminar flow becomes upset and the boundary layer air eddies instead of flowing smoothly. This is known as the laminar transition point. The turbulent eddies increase the thickness of the boundary layer, so that at the trailing edge of the wing it may be 25mm in thickness. This increases the drag per unit area more than 5 times.

The designer chooses a wing section which will have the laminar transition point as far back on the wing surface as he can get and the manufacturing processes will allow. But any roughness, paint lines or other surface discontinuities will result in the transition point moving forwards so that a higher proportion of the wing suffers from the faster moving turbulent air particles, with consequent degradation of the performance.

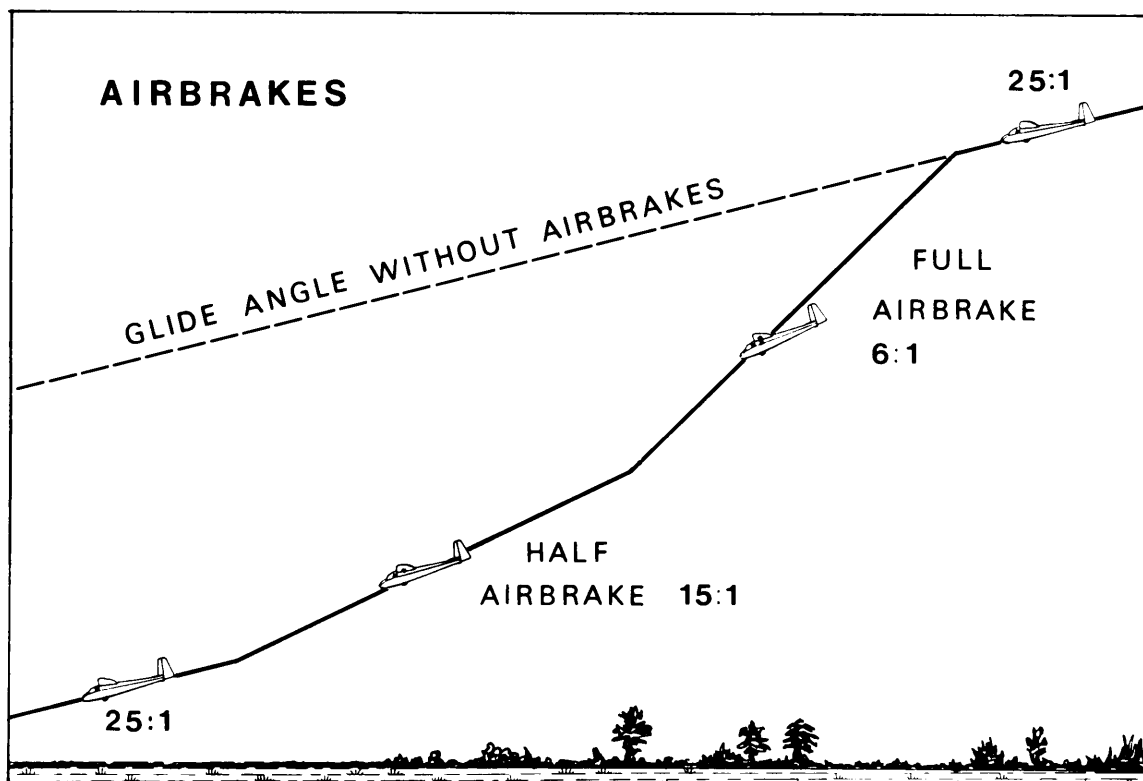
Some laminar flow wings are highly sensitive to raindrops, including water ballast dropped from another sailplane. This not only affects the performance but may also have a detrimental effect on the stall and slow speed behaviour.

## Sailplane construction

Most sailplanes, other than school gliders, are made from glass fibre and epoxy resin. With this material it is much easier to build long, and strong, unsupported wings than it was in the past with wood, or even metal. Carbon fibres are usually included in the manufacturing process to make the long wings stiffer in bending and less floppy. No wing, however, should be too rigid or it would have to be made even stronger, and thus heavier, to absorb any severe turbulence to which it might be subjected.

Glass fibre is not only an excellent construction material from which to make big-span high aspect ratio wings; the whole sailplane can also be moulded to a highly efficient shape with a superbly smooth finish. It is so good that competition pilots will keep their wing covers on until just before take off to avoid the surface being roughened by dust or flies! Glass-fibre sailplanes are almost universally white because this keeps them cooler in hot sunshine than if they were coloured. Increasingly, though, they are given coloured noses, tails, or wing tips for better identification, and so that they will be more visible against a pale sky.

Many school gliders are still made from wood or metal—often having wooden wings and a welded steel tube fuselage. The learner pilot does not need high speed or superb performance while acquiring the flying basics; in fact, he will learn more quickly on a lower performance







glider. School aircraft also have a hard working life and need to be easy to maintain and quick to repair.

## Airbrakes

Just as the designer has created such a clean, slippery, high-speed sailplane, he has also created the very characteristics which make it difficult to get back on the ground again; even a large airfield would not be big enough to land a sailplane easily whose glide angle could not be reduced below, say, 50:1. So sailplanes are fitted with airbrakes, sometimes called dive breaks, which project from the wings. When these are opened into the airflow they in-

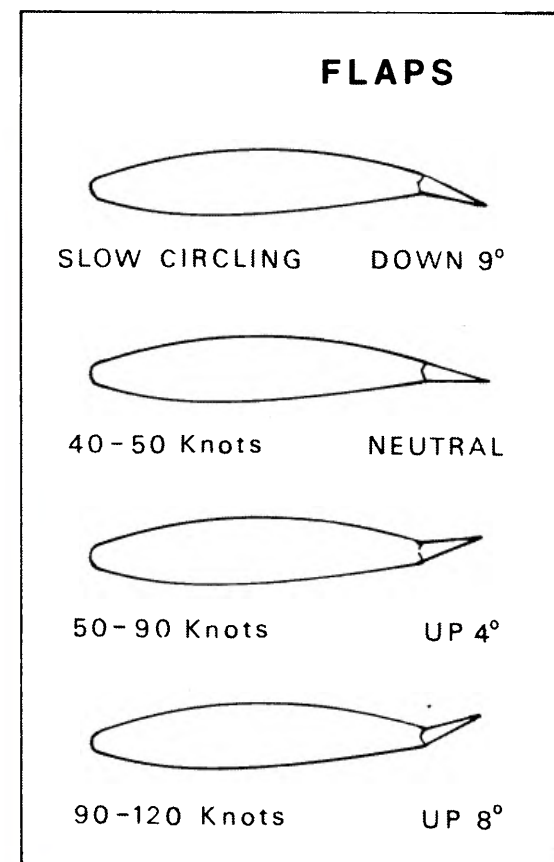
crease the sailplane's profile drag enormously, which means that it has to be flown at a much steeper glide angle to maintain the same airspeed. The pilot can adjust the amount of airbrake surface that he presents to the airflow to achieve the glide path he needs to touch down on his chosen spot. Airbrakes produce only drag, and do not noticeably affect the stall speed.

## Flaps

Flaps are different. Fitted to the trailing edges of the sailplane's wings inboard of the ailerons, they are used to alter the wing shape to give it a slower speed, higher-lift profile when

lowered, or one more suited to high speed flying when they are raised above neutral. If the flaps are arranged so that they can be lowered to an angle approaching 90°, as they are on many aeroplanes, they will additionally increase drag and steepen the glide path in the same way as do airbrakes. If the sailplane is fitted with both flaps and airbrakes the pilot, when approaching to land, will firstly lower the flaps a little so that the wings continue to provide the necessary lift at a lower airspeed. He will then use the airbrakes to obtain his desired steeper glide path. A second-

Dumping water ballast at the end of a race.





any advantage of the use of flaps, and/or airbrakes, is that the nose of the sailplane becomes lower than normal so the pilot has a better view of the landing area ahead.

Nimbus 3 pulling up after crossing the finish line.

The main reason for fitting flaps on sailplanes is not for landing, but to improve the performance range

when soaring. When circling in a thermal, or endeavouring to stay airborne in weak conditions, lowering a small amount of flap will, as stated above, make the wing more efficient





at a lower airspeed. This means that the speed for minimum sink will also be lower. The pilot will be able to circle more slowly making smaller circles, and so will find it easier to stay in the stronger core of the thermal and to climb quickly. When he leaves the thermal and flies straight, without any lift or in sinking air, he wants to fly faster. He now raises the flaps to their neutral position, or if he wants to fly faster still, to a position slightly above neutral: this changes the wing profile to a higher speed section. The stall speed will now be higher, but this is unimportant as the pilot is intending only to use the fast end of his speed range. Using flaps so that the sailplane is always in the most efficient configuration for the conditions is a key skill for the soaring pilot to develop.

## Weight

The weight at which a sailplane is flown affects both its stall speed and its performance at higher speeds. This is because weight affects the *wing loading*: this is the airborne weight of the sailplane divided by its wing area. If the sailplane is being flown by a heavy pilot, the higher wing loading will result in a slight increase in stall speed. With a light pilot the wing loading and the stall speed will both be lower.

The school glider on which the new pilot will build up his early solo flying hours weighs about 208 kg (458 lb) empty, and may be flown with a cockpit load (pilot, parachute, camera, etc.) ranging between 104 kg (229 lbs) and 57 kg (125 lb). The

wing loading will vary between 22 kg/m<sup>2</sup> (4.5 lb/ft<sup>2</sup>) and 18.7 kg/m<sup>2</sup> (3.8 lb/ft<sup>2</sup>).

The wing loading also affects the sailplane's performance at higher speeds, because at a higher wing loading it will be able to fly faster for the same glide performance than when the wing is more lightly loaded. The minimum sink rate will, of course, be higher with a heavy pilot than with a light one but, again, this is not important when the pilot is using the higher end of his speed range to fly fast between good thermals. If on a day of such thermals the pilot wants to be able to fly really fast, he will carry ballast to increase the wing loading still further. On glass-fibre sailplanes this is carried in the form of water in the wings. The maximum quantity of water which can be carried is given in the sailplane's certificate of airworthiness. Most glass-fibre sailplanes in general use can carry some 120 kg (265 lbs) of water ballast, although the capacity of a Nimbus 3 is 220 kg (485 lb). This raises the airspeed for best glide ratio (57:1) from 44 knots without ballast to the best L/D with ballast (the same, 57:1) at 53 knots.

You do not, of course, ever get something for nothing, and in addition to the expected higher stall speed (in the case of a fully loaded Nimbus 3 from 62 km/h (34 knots) to 75 km/h (41 knots)) such heavy sailplanes need a much more powerful tug to tow them into the air, have a longer take-off run, and have an appreciably higher landing speed.

When thermals weaken, either

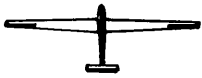
because the weather deteriorates or it is late in the day, the pilot will dump some or all of his water ballast. Now he will again be flying at a lower wing loading, and be able to use the lower, slower end of his speed range more efficiently. Before landing he dumps all water ballast to reduce the landing speed.

## Centre of gravity (or c.g.)

One important consideration concerning the weight of a sailplane is that the weight of the pilot, his equipment, and any ballast, shall be carried in such a way that the centre of gravity of the sailplane remains within the limits set by the designer. c.g. is expressed as the percentage of the mean chord of the wing, typically from 20%–36%, or from 25cm to 40cm aft of the leading edge. In a light aeroplane the pilot(s) usually sits under or above the wing close to the c.g., but in a sailplane the pilot is in front of the wing, and his weight may put the c.g. outside the limits. These limits *must* be observed, and if the pilot is so light that the minimum weight is not achieved, ballast to make up the weight must be carried in the cockpit. This usually takes the form of lead sheet or shot bags.

## The trimmer

A sailplane is designed to be stable so that if the pilot flies 'hands off', without pushing or pulling on the stick, the aircraft will continue to fly steadily at a particular speed. However, the pilot may wish to fly faster or slower than this speed and he may be heavy or light in weight, so



he needs some means of adjusting the trim speed to cope with a wide range of conditions.

Although it can be tiring to have to push continually on the stick to fly fast, or pull on it to fly slowly, the forces and movements to do this are in fact quite small. For example, a push (or pull) on the stick of, say, 1 kg will increase (or decrease) the speed by about 10 knots, while the stick movement is only 10mm or so. Nevertheless, on a long flight it is enough to be tedious. This is why it is desirable to have a trimmer.

The simplest trim control is a

spring connecting the trim lever and the elevator control. By moving the lever the force applied to the elevator circuit can be varied. An alternative is to have a small tab built in to the trailing edge of the elevator. Movement of this tab by the trim lever results in an aerodynamic force being applied to the elevator. The K-8 is fitted with a trim tab. If the pilot wants to trim the aircraft to fly at a faster speed, he moves the trim lever *forwards*. This moves the tab on the elevator *up* into the airflow, causing a downward pressure on the elevator itself, and hence an increase in

airspeed.

This section has looked at the sailplane itself. Parts 2 and 3 will refer to many of these aspects again from the pilot's point of view.

### Effect of sailplane weight on its performance

#### Nimbus 3

	Without ballast	With 220 kg ballast
wing span	24.5 m (80.36 ft)	same
wing area	16.76 m <sup>2</sup> (180.3 ft <sup>2</sup> )	same
weight	483 kg (1062 lb)	703 kg (1546 lb)
wing loading	28.8 kg/m <sup>2</sup> (5.89 lb/ft <sup>2</sup> )	41.9 kg/m <sup>2</sup> (8.57 lb/ft <sup>2</sup> )
stall speed	62 km/h (34 kt)	75 km/h (41 kt)
minimum sink rate	*0.36 m/s (0.7 kt)	*0.43 m/s (0.84 kt)
speed for minimum sink	76 km/h (41 kt)	92 km/h (49 kt)
best glide ratio	57:1	57:1
speed for best glide	80 km/h (43 kt)	96 km/h (52 kt)
sink speed at 200 km/h	2.84 m/s (5.6 kt)	2.08 m/s (4.1 kt)
glide ratio at 200 km/h	*19.4:1	*26.5:1

The effect of ballast is best shown by comparing the two sets of figures marked\*. The minimum sink speed has increased by 19%, but the glide ratio at 200 km/h (108 kt) has gone up by 37%. Unless upcurrents are very weak, or small so that increased circling speed is a disadvantage, ballast will give a higher average cross-country speed.





The pilot's headrest is attached to the canopy.  
The hole in the nose contains the airspeed  
indicator pitot head.





# Sailplane rigging and inspection

## Rigging

Sailplanes have trailers because they may land out on a cross-country flight and have to be retrieved. They are also used for normal storage,

with the aircraft being de-rigged at the end of each day's flying. Because of this frequent rigging, or dismantling, sailplanes are designed and constructed so that it is simple and quick to do, and, much more important, very difficult to do wrong. The designer, however, cannot prevent a pilot forgetting to connect up his elevator or ailerons, so the whole business of rigging is a serious one demanding both concentration and commonsense.

The wings, fuselage and tailplane are held in fittings in the trailer and are slid out on runners without any need to enter the trailer; in fact, some fit around the sailplane so closely that there is no room to do so. When

the fuselage, and afterwards the wings, are brought from the trailer they have to be temporarily held in supports until they are put together. These vary according to the pilot's system or circumstances, and some owners have so mechanised their rigging that they can do it alone. Most sailplanes, however, are rigged by two or three people, and on the morning of a good soaring day club pilots help to rig each other's machines.

There are two possible hazards when rigging—someone slips and drops a wing or tailplane, or the pilot fails to check that the rigging is correct and complete (this check should be done by the pilot because



*Upper photograph* Wings are heavy, especially when carrying them up hill.

*Lower photograph* It is easier to check everything with a helper holding the wings level.

*Opposite* Putting a Ka-6 together in Iceland can also be cold.







he is the one who is going to fly the aircraft). The risk of dropping a wing is obviously least when the person carrying or supporting it has done the job many times before, whereas it will be greatest when he does not know anything about gliding, or does not appreciate that a wing is heavy—or that a tailplane can be swept out of his hands by the wind. It is up to the pilot himself to brief such helpers carefully as to what they have to do.

Having assembled the sailplane the pilot must go round it and check that each connection has been properly made, and any pins are correctly secured. He should then double-check this by moving the stick and rudder in the cockpit to ensure that the ailerons, elevator, flaps, airbrakes, etc., move fully and freely in the *correct sense*. Only then should any fairings be attached and secured. This is the rigging check and it should be done as soon as the sailplane is assembled.

### Daily inspection

The rigging check only ensures that the sailplane has been put together properly. It does not take account of accidental damage, wear or tear, or unserviceable instruments. These things are looked after by the next check—usually called the Daily Inspection (DI). This should be done before the first take off on every flying day, after every outlanding, and whenever the sailplane has been left unattended in a public place. Some pilots think that the inspection can be carried out at the launch point, but it is only sensible to do it near the



A typical club open trailer which can be persuaded to carry different types of glider.

hangar or trailer, where it is easier to undertake any work or polishing that needs to be done. Once at the launch point there is not only distraction in talking to other pilots, but also an inclination to put off minor jobs because of the inconvenience in taking the sailplane all the way back to the hangar. Most clubs insist that the sailplane's Daily Inspection book has been signed by the pilot before he arrives out on the field to fly.

The Daily Inspection is best done with a check list. The one on page 28 covers sailplanes in general, but the wise owner will make out a special



A competition sailplane will have its own close-fitting trailer.





**A**



**B**



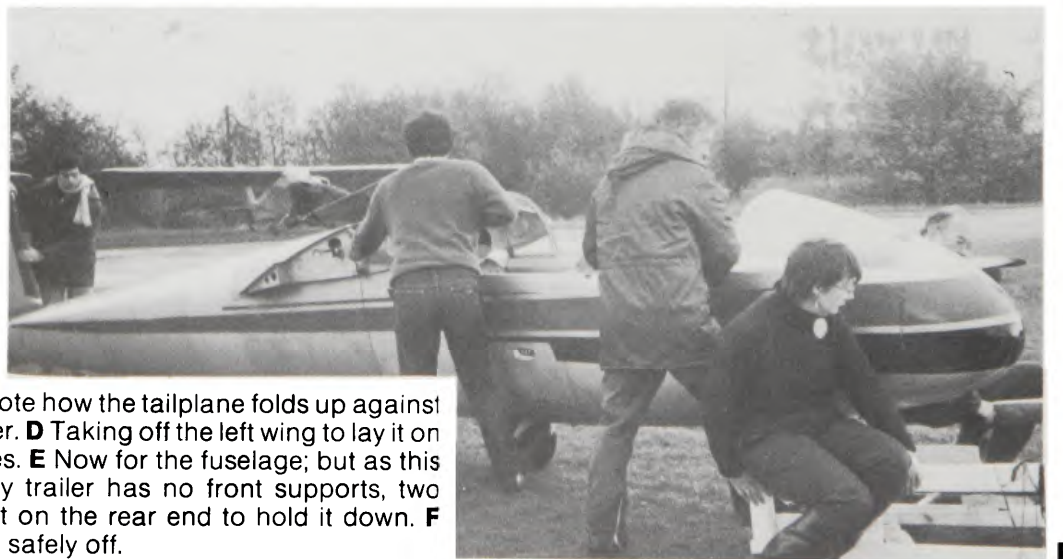
**C**



**D**



**E**



**F**

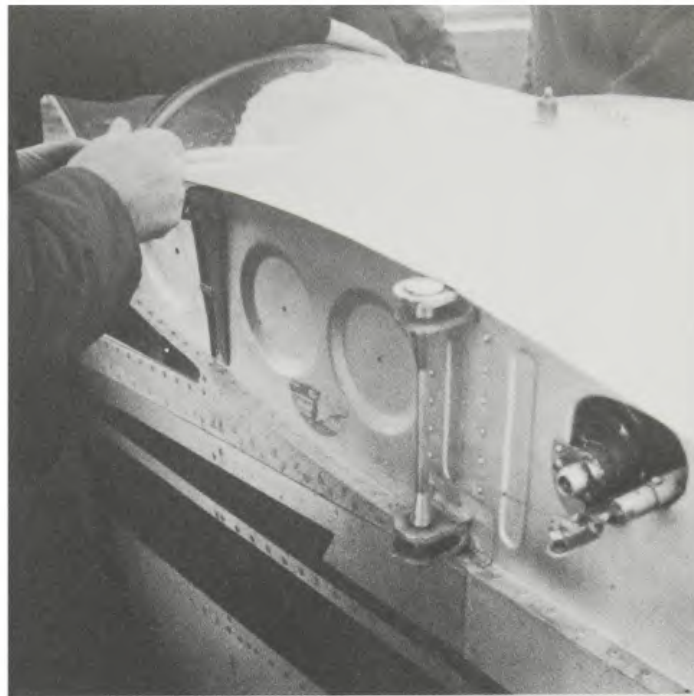
Rigging a club two-seater. This Blanik arrived after being repaired on a spare trailer to be rigged by club members—some of them doing it for the first time. **A** Putting the canopy out of harm's way, on tyres to keep it off the ground.

**B** Lifting off the right wing. **C** Undoing the lashing that had been needed to hold down the tail; note how the tailplane folds up against the rudder. **D** Taking off the left wing to lay it on more tyres. **E** Now for the fuselage; but as this temporary trailer has no front supports, two people sit on the rear end to hold it down. **F** Fuselage safely off.





**G**



**G**



**H**



**J**

**G** Greasing the main pins which attach the wings to the fuselage. **H** Now for the right wing. **I** The wing has to be held firmly and positioned carefully to line up the attachment fittings. **J** The two wingtip helpers must be careful not to exert too much leverage. By the time a newcomer has been in his gliding club for a year he will have become expert at rigging and dismantling sailplanes.



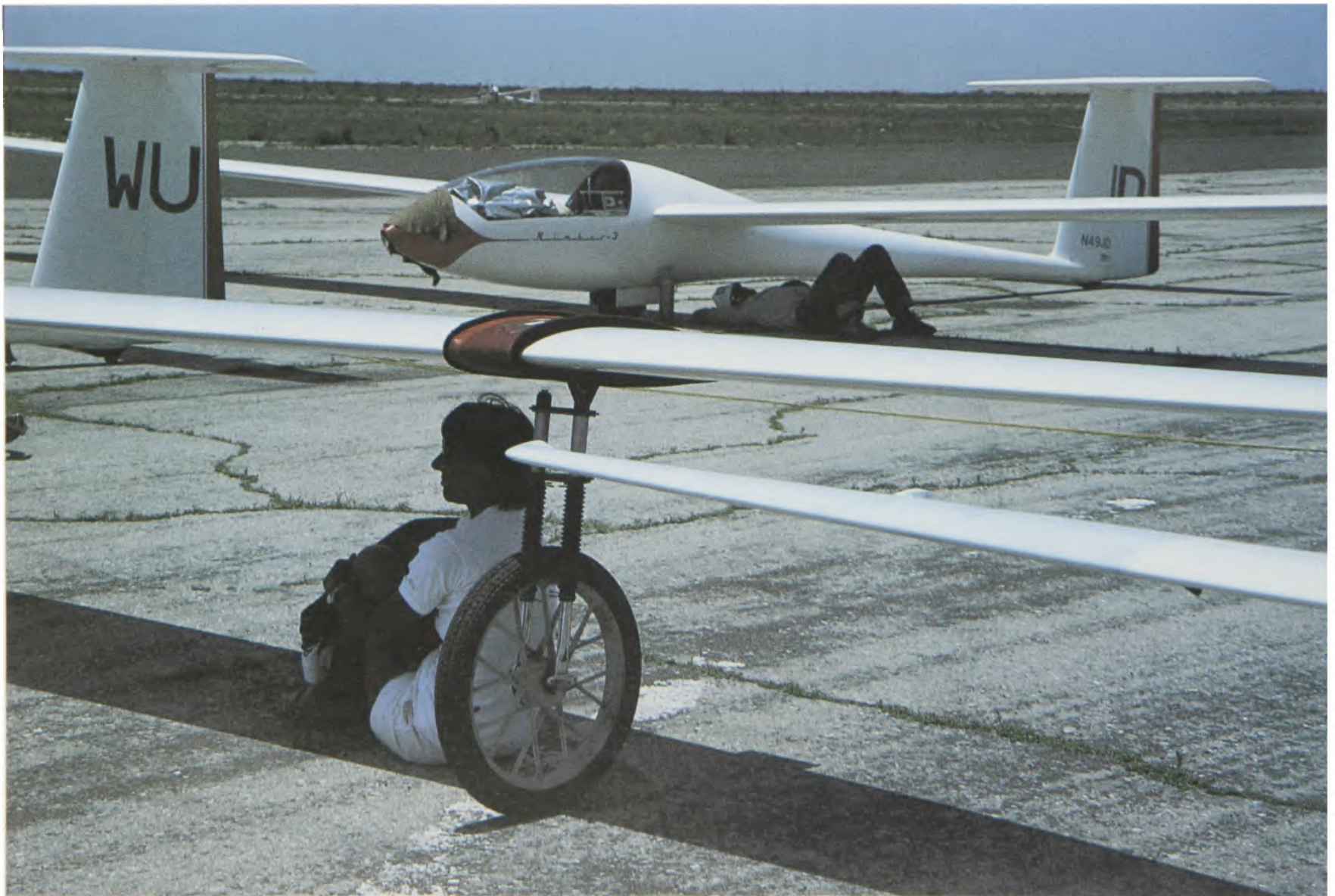


one that takes account of his own aircraft's peculiarities.

Like the rigging check the DI needs to be done systematically and thoroughly, starting at the cockpit and controls, and working right Wings on ground handling wheels make shady places on a hot day.

round the aircraft and back again to the cockpit. But even with a check list the 'inspector' must consider the use to which the aircraft is put. If it is his own sailplane, and flown only by him, he will know how much flying he has done and how the aircraft has been handled. In this case he will need to

look most carefully to see if the sailplane has been damaged after being left in the hangar, and must look for anything different from normal. More searching should be the inspection of a well-used school two-seater. Not only will it be doing a lot of flying and be subjected to





plenty of wear and tear, but it will be no stranger to heavy landings; and all sorts of things from pencils to money will have been dropped in the cockpit and may find their way into the fuselage, possibly to jam the controls.

Being interrupted while inspecting a sailplane is the best way to forget something. If distracted, you should either start again from the beginning of the check list, or re-start at least one item *before* the one you were doing when interrupted.

Every sailplane should have its own inspection or log book, whether or not required by law, and it should be signed and dated every time an inspection is made. It should also include work done, such as a tyre changed or an instrument replaced. If nothing else, a log book may make it easier to sell your sailplane when you become starry-eyed about buying a new model.

### Pre-flight check

There is a third pre-flight inspection—sometimes called a cockpit check. This is done prior to *every* take off, and since it is one of the fundamental lessons the new pilot must learn, it is dealt with in Part 2, Learning to fly.

### Inspecting the trailer

For occasional retrievals of club gliders an open trailer which will carry different types is both cheap and convenient, but for the owner who uses his trailer as his sailplane's home it has to be really worthy of its contents. It is not too difficult to make



*Top* A fuselage support to help rigging with only two people.

*Bottom* This tough detachable tailwheel saves sailplane wear when towing out over rough ground.



## Sailplane daily inspection check list

There is no special order in which an aircraft should be checked, and owners work out a system that suits them. The essential requirements are thoroughness and integrity—*not* noticing something wrong and hoping it will cure itself, or waiting for another day. The following list starts with the cockpit (and the controls) and ends at the cockpit. This time to check loose equipment.

### **COCKPIT** Check:

Airworthiness certificate valid, log book up-to-date, faults rectified.  
General cleanliness and condition of cockpit, seat, and harness.  
Controls: all moving fully and in the correct sense.  
Trimmer, flaps, and airbrakes as above.  
Undercarriage lever locked down.  
Release operating freely and release hook clean.  
Instruments working, including radio, batteries ok, altimeter set.  
Canopy undamaged and catches in good condition.

### **WINGS** Check:

For cracks, dents, holes, bruising.  
Wings correctly attached to fuselage and pins locked.  
Ailerons moving fully and correctly (double-check). Hinges ok.  
Airbrakes flush with wing surface when closed and locked.  
Flaps connected. Fairings in place and secured.

### **TAIL** Check:

For cracks, dents, holes, bruising.  
Tailplane and elevator correctly attached and locked.  
Elevator moving fully and correctly (double-check).  
Trim tab working. If fixed tab, at correct angle.  
Rudder moving fully (double-check).  
Tailskid or tail wheel in good condition.

### **FUSELAGE** Check:

For cracks, dents, holes, bruising.  
Main landing wheel and tyre in good condition. Tyre pressure correct.  
Undercarriage doors undamaged.

### **COCKPIT EQUIPMENT** Check:

Parachute in good condition. Repacking date not passed.  
Ballast (if needed) installed securely in cockpit.  
Barograph and turn point cameras installed and working.  
Water ballast tanks and taps serviceable.  
Maps to cover proposed route.

sure that it does not leak, and that the fittings will support the wings and fuselage in a way that will not cause them wear or strain, but the trailer's roadworthiness must be good as well. The two essentials are that the trailer is stable on tow; and this means slightly nose heavy and not tail heavy, and that it will not break free from the towing car. It can do this in three ways: the tow bar can come off the car, the tow bar cup can part company with the tow bar ball, or the trailer tow bar can break. If the car is bought with a tow bar already fitted, this should be carefully examined to see that welds are not cracked or bolts loose. Most countries have trailer towing regulations and, if taking a trailer to another country, it is worth finding out before you go any differences in requirements.

Some people seem to think that once the sailplane is in its trailer it will be safe, but it does not take a storm force wind to blow a trailer over. If leaving it on an airfield for any length of time, tie it down securely.



## The Complete Soaring Guide

Have you ever relished the thought of flying a glider and soaring silently high in the sunshine, or been tempted to join a gliding club? If so, this book will help remove those doubts which may have stopped you taking that all-important first step towards achieving your ambition.

Specifically aimed at the newcomer to soaring, Ann Welch's detailed but easy-to-follow text covers:

- organisation of the sport
- how a glider is flown and soared
- construction, maintenance and repair
- launching by winch and aerotow
- knowing the weather
- navigation instruments
- flying cross country
- air law and controlled airspace
- competitions and speed flying

Ann Welch has many years experience of flying and gliding, including 40 years as an instructor and 20 years in charge of testing instructors. She holds the British National Women's Goal record of 328 miles (528 km). In 1980 she was awarded the FAI's Gold Air Medal in recognition of her contribution to the development of aeronautics. She is President of the FAI International Microlight Committee, the British Microlight Aircraft Association and the British Hang Gliding Association. The author has also been awarded the OBE and is a Fellow of the Royal Aeronautical Society.

**A & C Black · London**

ISBN 0-7136-5540-2



£12.50 net

9 780713 655407

**The Wally Kahn/British Gliding Association eBook Library** has been unable to obtain copyright approval to provide the reader with the complete eBook.

By scanning 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 first.

The next step is to search online to see if you can find a 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.**