5A – EFFECT OF CONTROLS - FLAPS

INTRODUCTION

The trainee will need time to learn to fly the glider in a coordinated manner before being introduced to the effects produced by the use of flaps. In most cases this will be a post solo exercise since most two seat training aircraft are unflapped. Therefore, whilst this section is contained under the umbrella title of effect of controls this section must be given to trainees prior to transitioning on to a flapped aircraft which require an increased skill level to fly successfully.

Ideally training in a two-seat glider with flaps is given prior to conversion to a flapped single seat glider.

It is imperative that the instructor understands the flap characteristics of the aircraft being demonstrated and if a type conversion to a flapped single seater is planned, also the aircraft being converted to.

Read the flight manual of the aircraft being flown, learning on the job can be disastrous.

This chapter covers:

- Flap operation in both performance modification and in the landing configuration.
- Attitude changes.
- Speed monitoring for flap operation/changing.
- Maintaining approach speeds with high drag settings.
- Control effectiveness changes on take-off or landing roll.

THEORY BRIEFING

Aerofoil sections are generally a compromise between thermal flying and handling in landing configuration and the need to fly faster between thermals to achieve long distance flights in the best soaring conditions of the day.

To improve performance in all phases of flight flapped aircraft were developed. The most common type is the simple flap consisting of a moveable section of the wing which can be moved by the pilot from about minus ten degrees to plus forty degrees. This allows the pilot to alter the camber of the wing to increase the efficiency of the wing over a broader range. A few aircraft such as the Blanik use a fowler flap which also increases the area of the wing by having the flap extending rearwards from the wing. The simple flap is more appropriate for sailplanes and less complicated to manufacture and is most prevalent today.

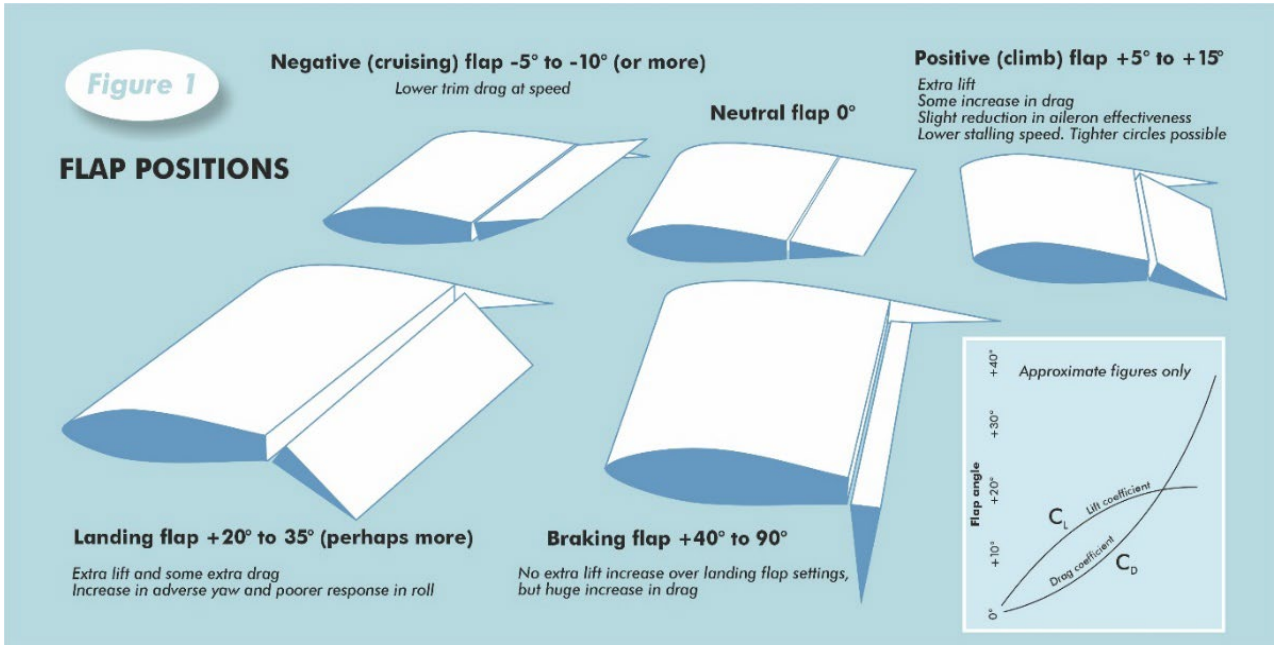
Small positive flap settings give lift increases with small drag increases. As positive flap deflections are increased the increased lift gets less and the drag increases noticeably. See the Cl and Cd graphs in figure 1.

Changes in flap settings cause trim changes altering both attitude and flight path. The more positive the setting the bigger the differences and speed control needs to be more related to airspeed than attitude i.e. similar to use of airbrakes.

Cruise/climb flap.

Cruise flap, often referred to as negative flap reduces drag and allows faster glide speed with little or no performance or handling penalty. **(The aircraft flight manual gives speed/flap setting limits)**

Climb Flap. Small amounts of positive flap (between +5° and +10°), reduce the stalling speed slightly depending upon the aerofoil section typically by about 2kts. With accurate speed control, climb flap allows slightly tighter turns in thermals and sometimes they give a slightly better minimum sink rate, useful when ridge soaring or in wave, but only with accurate speed control. It also allows slightly lower approach speeds.



Threat and Error Management

Threats:	Mitigation:
Collision	Maintain lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Inadequate speed on approach due to attitude change with flaps	Monitor ASI on approach

Even when used in small amounts the main drawback of positive flap is a slight deterioration in the handling. Adverse yaw increases, and rudder and aileron coordination are more difficult. Tip stalling and wing rocking can be irritating side effects. The roll rate is worse especially in larger gliders. Just to add insult to injury the glider will spin more readily.

Cruise/climb flap only has a beneficial effect on performance if used correctly.

Landing Flap

Landing flap is an extension of cruse/climb flap typically between +20 to +90 degrees depending on the glider type.

Landing flap produces a large amount of drag and can reduce the stalling speed by 3 or 4kts, allowing steeper approaches, slower touch-down speeds and shorter landing runs. The forward view on the approach is improved by the change in camber of the aerofoil giving the glider a markedly nose down attitude compared to normal flight. This gives a big difference between the glider's attitude and flight path therefore there is a tendency for the pilot to unconsciously raise the nose to a more familiar attitude with corresponding reduction in airspeed – **monitoring the airspeed using the ASI is paramount,** especially as the drawbacks encountered in handling in cruise/climb flap are increased markedly, increasing the tendency to drop a wing or spin on the approach. Limiting speeds with landing flap deployed can be surprisingly slow so accurate speed control is essential. The aircraft flight manual speeds must be adhered to.

Additional Considerations

The cockpit ergonomics vary considerably and flap, airbrake, trim, and undercarriage levers, are in different places on each aircraft. This coupled with cable release location can be a problem in nil wind take offs, when aileron control may be reduced if positive flap is needed to get the glider airborne before the Tug. The initial ground run may require negative flap to start with, for adequate aileron control, until sufficient speed has been reached to change to positive flap.

Check the flight manual for the specific glider for recommended flap settings for both aerotow and winch launching.

Any inattention whilst changing the flap setting may result in the cable having to be released to prevent an accident. The application of positive flap may cause a sudden increase in height dependent on the speed at the time of changing from negative to positive flap.

The Flying

AIR EXERCISE BRIEFINGS

Having carried out the ground briefing, the air exercise briefings will be limited to what is practicable on the day.

The take-off (aerotow) briefing should include flap settings for the ground run and initial take off emphasising the problems of changing flap settings whilst managing this difficult part of the flight. If speed is too high when changing from negative flap to positive there is a danger of the glider getting too high just off the ground and causing problems for the tug.

Briefing for winch take-off is easier and first positive flap setting may be appropriate so that, in the case of a launch failure, flap setting will not necessary need changing for landing. In nil wind, aileron control on a long ground run should be mentioned and zero flap setting can be more appropriate with the penalty of a longer ground run. This will depend on how powerful the winch is and therefore briefed accordingly.

Approach control exercises should be done carefully, and the briefing should contain speed limits necessary for full and landing flap configurations, also emphasis on aileron control problems causing wing drop on round out and landing run should be included.

MANOEUVRE DEMONSTRATION & LESSON

The demonstration of take-off and landing should be carried out by the instructor particularly explaining any flap movements that are necessary at the appropriate time. For the first lesson, do the launch yourself and use it as a demonstration.

Upper air demonstrations are not required but the opportunity should be taken to explore the characteristics of changing flaps setting, with regard to changes in speed and trim. When at height, get the trainee to carry out flap changes with nominated speed limits. Prompt the trainee to change speed and monitor the change in attitude and speed in various flap settings. They can also investigate the roll response in different flap settings at low speed.

Flaps must be appropriately set in the circuit. Types with modest landing flap deflections can be flown in that setting all the way from the high key area to landing. Types with large landing flap deflections cannot be operated that way. Application of the landing flap setting will normally be appropriate on early finals, or at the earliest, on the base leg. On the first flight, do the landing as a demonstration.

Approach demonstrations should use a reference point well into the field and the effect of reducing flap shown at such a (safe) height that, the effect of losing lift can be demonstrated more effectively than during upper air exercises, and recovery to appropriate speeds can be carried out safely. These demonstrations are more difficult in strong winds with significant wind gradient.

When you are happy with progress, get the trainee to do an approach and landing with the reference point well into the field. Do not be afraid to take control if the approach is unstable as errors near the ground with reduced aileron control will be difficult to rectify.

Follow this with take-off training where aileron control may be a problem and changing from negative flap to positive at a crucial part of the will cause the highest workload. Unfortunately, single seat gliders have various ergonomic layouts and cannot be taught in advance so ensuring that the trainee is coping with the high workloads caused by flap changing is the best you can do.

DE-BRIEFING

Concentrate on any major problems and suggest any further practice necessary. Make a note in the trainee's logbook. As always, end on a high, pointing out the good parts and give some further encouragement.

COMMON DIFFICULTIES

Unfortunately, flapped two-seaters frequently have flap systems with significantly different characteristics to those of the aircraft to which the trainee intends to convert.

Not reading the flight manual!

It is a good idea for the trainee to share experience with other sensible/experienced pilots who have flown the glider. Lack of information and awareness of potential difficulties causes unprepared flight and there is enough evidence that poor preparation for flight, particularly type conversions, results in accidents.

