09 STALLING

AIM

To teach the student the feel and behaviour of the aeroplane at low speeds, the symptoms of the stall and how to recover with the minimum loss of height.

INSTRUCTIONAL GUIDE

It should be emphasized that an inadvertent stall should never occur. The student must become proficient at recognizing the approach to the stall and taking immediate action to prevent it occurring.

Although the student must be taught some method of entering the stall, it is emphasized that the method of entry is only incidental to the important task of recognizing the warnings of the impeding stall and the recovery from the developed stall.

Even if the particular aeroplane normally does not 'drop a wing' during the stall the correct stall recovery technique should be taught from the start.

The first demonstration of a stall should show the student that it is not in any way a frightening experience and should rid the pupil of any false ideas of danger and violent sensations. The first stall is best done at the end of the lesson preceding that on which stalling is to be dealt with in detail. Whilst no real instruction should be given during this demonstration, it is advisable to indicate the point of stall and the commencement of recovery.

Obviously all the points raised cannot be taught during one flight but must be spread over several. Especially in the early stages watch for symptoms of air sickness and discontinue the exercise if necessary.

Before carrying out any advanced stalling exercise it is important that sufficient height is gained to ensure recovery by 3,000 feet above ground level and that the aeroplane is in the appropriate training area. The pre-stalling check will of course vary from aeroplane to aeroplane, but will normally cover such items as harness, hatches, loose articles, trims, brakes, mixture, carburettor heat, fuel, etc. The student should be provided with and expected to learn such a check list. A turn through 360 degrees to ensure that all is clear around and below should be carried out immediately prior to commencing the first stall and a 90 degree turn should be carried out before subsequent stalls.

PRE-FLIGHT BRIEFING CONSIDERATIONS

AIRFLOW AT THE CRITICAL ANGLE

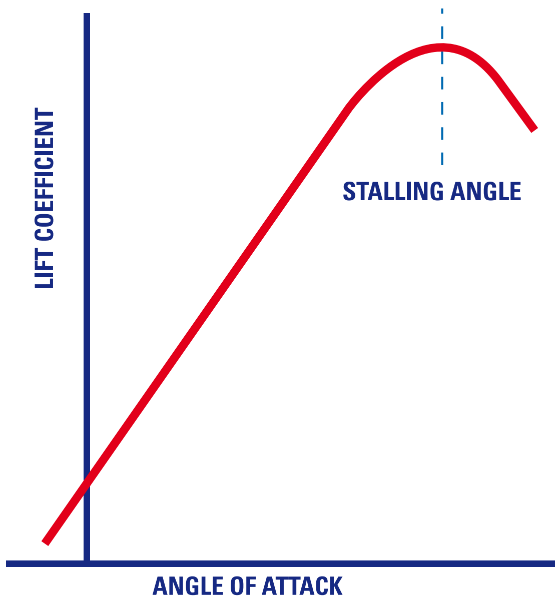
Explain and illustrate how airflow around an aerofoil varies with increasing angle of attack. Show that lift increases until the critical angle is reached. Figure 9-1 may assist with this explaination. Smooth airflow then becomes turbulent and lift is decreased. This is the stalling angle.

Show that as soon as the angle of attack is decreased below the critical angle the airflow becomes smooth again. Explain that of all the factors affecting lift the pilot can only effectively control the airspeed, angle of attack and aerofoil shape (by use of flap).

Emphasize that the critical angle may be reached at any airspeed and at any attitude.

Explain the movement of the centre of pressure.

Figure 9-1: The relationship between the coefficient of left and the stalling angle.



RELATIONSHIP BETWEEN CRITICAL ANGLE AND STALLING SPEED

Explain that for a given weight at ‘1’ g every angle of attack including the critical angle, has its associated indicated airspeed. As the angle of attack of the wings invariably cannot be observed, reference is therefore made to an aeroplane’s stalling speed.

FACTORS AFFECTING THE STALLING SPEED

The basic stalling speed of an aeroplane, such as referred to in an Operations Manual or Owner’s Handbook means the indicated airspeed at which the aeroplane will stall from straight and level flight, with power off.

Explain that the stalling speed will vary, depending on:

(a) Weight

(b) Power

(c) Flap and/or Slat position

(d) Manoeuvre

(e) Ice on or damage to wings

Explain what happens if a wing drops at the stall - auto-rotation - use of ailerons may exacerbate the problem.

CONTROL EFFECTIVENESS

Refer the student back to the exercise on operation of controls. Revise the lesson in terms of decreased control effectiveness at decreasing speed. Emphasize this point making it clear to the student that later on in the take-off and particularly the landing phase the feel, use and effectiveness of the controls will be similar to these factors in the approach to the stall phase.

STALL WARNING

Brief the student on the type of stall warning applicable to the particular aeroplane. The warning may be in the form of juddering, stall warning horn, etc. Where a stall warning horn or similar device is fitted the student should be advised that he or she will be expected to recognize the approach and onset of the stall with and without (if possible) the aid of this device.

APPLICATION IN FLIGHT

Brief the student on the way you intend to demonstrate the stall. Explain the sequence of events:

- pre-stalling checks and lookout
- decrease in power, maintenance of direction with rudder
- nose position with elevator
- Wings level with aileron

Ensure that the student is aware of the approximate attitude to use, decreasing speed, stall behavior of aeroplane at the stall and height loss.

RECOVERY WITHOUT POWER

Control column forward to un-stall the wings. As the speed increases ease out of the dive.

Emphasize that if a wing drops, rudder is used to prevent yaw into the direction of the lowered wing. The wing is raised with aileron when it is un-stalled.

RECOVERY WITH POWER

Brief the student that the recovery using power is similar to that when no power is used with the addition that full power is applied at the commencement of recovery. Point out that you will be demonstrating that use of power results in recovery being made with a much decreased height loss compared with the recovery without use of power.

It is important to stress that power, if used too late,

i.e. when the nose of the aeroplane has dropped below the horizon, will result in an increased loss of height. Stress that the recovery using power is the normal method of recovering from a stalled condition of flight.

EFFECT OF POWER AND FLAP

Brief the student on the effect of using power and flap on the stalling speed and characteristics of the particular aeroplane. These factors should be dealt with individually and then collectively, with particular reference to the landing configuration.

EFFECT OF DYNAMIC LOADING

Brief the student in the manner in which you intend to demonstrate that an increased dynamic loading will result in a increase in stalling speed. This is done in three phases, the first being performed with the aeroplane in the take-off configuration whilst executing a climbing turn raising the nose until the stall occurs. To recover, decrease the angle of attack immediately and level the wings. Emphasize that the stalling speed will be higher in the turn than in a straight climb in the take-off configuration.

The second phase is carried out with the aeroplane in the landing configuration whilst executing a gliding turn during which it is stalled. Recover to straight and level flight. Emphasize that the stalling speed will be higher than when carrying out a wings level glide in this configuration.

The third phase is demonstrated with the aeroplane in cruising configuration, a steep turn is commenced with no power increase. The stall is induced and shown to occur at a higher speed than in normal cruising flight.

AIRMANSHIP

An unintentional stall should never occur.

When intentional stalls are practiced, a pre-stalling check must always be carried out and a good lookout maintained during the whole exercise.

During the approach to, and particularly the recovery from stalls, the controls should not be moved harshly as the structural limitations of some aeroplanes can be approached and even exceeded.

Similar to the above, be careful not to exceed the flap limiting speed if they are extended

During solo operations recovery from practice stalls should be completed above 3,000FT AGL.

AIR EXERCISE

(a) Symptoms of the stall

(b) Effect of power on recovery

(c) Recovery when the wing drops

(d) Effect of power

(e) Effect of flap

(f) Recovery from the incipient stall

(g) Effect of dynamic loading

SYMPTOMS OF THE STALL

Demonstrate a stall from straight and level flight and point out the symptoms.

Close the throttle, prevent yaw with rudder and maintain height with elevator control. Point out the decreasing airspeed, decreasing control effectiveness and stall warning either aerodynamic or mechanical. At the onset of the stall point out the sink, that the nose may drop and, if applicable, that a wing drops.

Recover and allow the student to stall the aeroplane and recover from the stall.

EFFECT OF POWER ON RECOVERY

From straight and level flight close throttle, prevent yaw, maintain height. Point out the symptoms as before and at the point of stall note speed and height. Recover by easing the control column forward, gain speed, ease out of the dive, level off and apply power. Note the height lost. Allow the student to practice.

Next, stall the aeroplane as before but at the point of stall simultaneously apply full power and move the control column forward to un-stall the wings. Regain control, ease out of the dive and level off. Point out that a smaller forward movement of the control column is necessary to regain control and that considerably less height is lost.

RECOVERY WHEN THE WING DROPS

Use the standard recovery, i.e. simultaneous use of power and forward movement of the control column. In addition rudder must be used to prevent the nose of the aeroplane yawing into the direction of the lowered wing. The ailerons should be held neutral until control is regained, when the wings should be levelled.

EFFECT OF POWER

Choose a power setting applicable to the type, usually less than cruise power, and demonstrate the effect of this power on the stall. Point out that the speed reduces slowly, that there is often a shorter duration of stall warning. The stalling speed is lower, the stall may be more marked and the tendency to drop a wing may be more pronounced. Use the standard recovery, pointing out that there is normally a quick recovery with a small height loss.

EFFECT OF FLAP

Demonstrate stalls with various flap settings showing that the speed reduces rapidly and there is often a shorter duration of stall warning. The stalling speed is lower and the stall may be more marked with a tendency to drop a wing. Use a standard recovery with power, raising the flaps in stages.

RECOVERY FROM THE INCIPIENT STALL

Demonstrate the recovery at the stage where warning of the onset of the stall is apparent and that there will normally be no height loss. Demonstrations should be given with various flap and power settings, especially emphasizing the approach configuration. Emphasize that this exercise is one of the most important in the whole of the stalling exercise - stress the danger of stalling on the approach to land.

EFFECT OF DYNAMIC LOADING

Demonstrate the stall with the aeroplane in the take-off configuration. Commence a climbing turn at approximately take-off speed, then raise the nose and increase the rate of turn until the stall occurs. Point out that the stalling speed is higher in the turn than in a straight climb using the same configuration. Use a standard recovery.

Demonstrate a gliding turn with the aeroplane in the approach configuration then gradually raise the nose whilst maintaining the rate of turn, until the stall occurs. Where the aeroplane type is such that the stall cannot be induced with a gentle increase in elevator deflection, increase the elevator deflection to such an extent that the symptoms of the approaching stall are generated. Point out that the stalling speed is higher than in a straight glide. Use standard recovery technique.

Demonstrate a steep turn with the aeroplane in cruise configuration, do not increase power but stall the aeroplane with a positive backward movement of the control column. Point out that the stalling speed is much higher than in normal level flight. Show that recovery is normally immediate on releasing the back pressure on the control column.

COMMON FAULTS

When a wing drops at the stall the student instinctively tries to correct this with aileron. The use of ailerons at the point of stall must be carefully explained to the student. Even if the use of ailerons at the stall is permitted in the type of aeroplane in use the student must understand that in some types of aeroplanes the use of ailerons will aggravate the situation.

During a standard recovery a student is often hesitant or too slow in applying power. It must be stressed that the amount of height lost and the rapidity with which control is regained both depend on the prompt use of high power.

Students sometimes tend to be too harsh in moving the control column back when recovering from the dive, resulting in a high speed stall. There is also a tendency to push the control column too far forward during recovery. This results in too great a loss of height.

Other students may be reluctant to move the control column sufficiently forward in the recovery, possibly because they are uncomfortable with a nose low sight picture.