Polyteknikkojen Ilmailukerho ry
PL 69
02151 ESPOO

AIRCRAFT FLIGHT MANUAL SUPPLEMENT FOR ACROBATIC CATEGORY

FOR SAILPLANE

PIK-20D

SERIAL NUMBER: _____ REGISTRATION: _____

This sailplane must be handled in acrobatic operations according to the guidance and limitations given in this supplement in so far as the guidance or limitations in this supplement differ from the original Aircraft Flight Manual. This supplement must be kept in the sailplane whenever using the plane for acrobatic operations.

Approved by the Finnish Civil Aviation Authority May 7th 1997

Aircraft Flight Manual Supplement by

Ari Vahtera March 10th 1996

Translated by the Finnish Civil Aviation Authority February 4th 2008

LIST OF CHANGES

NUMBER	PAGES	REASON FOR CHANGE	AUTHORITY APPROVAL OR APPROVAL REFERENCE

CONTENTS

1 TECHNICAL DATA

Technical data is according to the original PIK-20 D Flight Manual.

2 SAILPLANE DESCRIPTION

The sailplane to which this Flight Manual Supplement applies is designed and approved for a gross weight of up to 360 kg according to OSTIV 1971 – Airworthiness Requirements for Sailplanes 1971, Category A, Acrobatic.

Other parts of sailplane description are according to the original PIK-20 D Flight Manual.

3 LIMITATIONS

These limitations entirely replace the original limitations presented in PIK-20 D Flight Manual section 3 for Acrobatic Category. The limitations in Acrobatic Category are as follows:

3.1 Airspeed Limits (IAS)

Never exceed V_{NE}	292 km/h
Gusty conditions V_B	200 km/h
Maneuvering V_A	190 km/h
On winch tow V_W	125 km/h
On aero tow V_T	190 km/h
Flap speed (flaps deflected down) V_F	150 km/h

3.2 Flight load factors

Maximum positive load factor

- at speed 190 km/h +6.6
- at speed 292 km/h +5.3

Between 190 … 292 km/h the load factor changes linearly from 6.6 to 5.3.

Maximum negative load factor

-	at speed 190 km/h	-4.6
-	at speed 292 km/h	-3.0

Between 190 … 292 km/h the load factor changes linearly from -4.6 to -3.0.

Maximum positive load factor with flaps deflected down	+4.0

3.3 Operating limits

Day, night and cloud flying

Day, VFR and cloud flying	allowed
Night flying	not allowed.

Maneuvers and acrobatic flight maneuvers

Allowed control deflections (not abrupt):

-	up to a speed of 190 km/h	full deflections
-	at speed 292 km/h	1/3 of full.

Between 190 … 292 km/h allowable control deflections decrease linearly.

Allowed flap deflections in acrobatic maneuvers for different speeds:

-	up to a speed of 190 km/h	0° … -12°
-	at speeds over 190 km/h	-4° ... -12°

Positive flap deflections in acrobatic maneuvers	not allowed.

Normal piloted acrobatic maneuvers are allowed according to section 5.6 and Table 1. Allowed maneuvers are steep turn, spin, lazy eight, chandelle, loop, stall turn, roll, inverted flight, split-S, immelmann and barrel roll and normal combinations and variations of these maneuvers (such as performing maneuvers with intentional heading changes, cuban eight, inverted flight turns).

Prohibited maneuvers are

- snapped (un-piloted) maneuvers (such as snap roll)
- maneuvers in which the sailplane is moving backwards (such as tail slide)
- maneuvers which require large negative load factors (such as outside loop) and
- intentional inverted spin.

Minimum equipment

The sailplane must have the minimum instruments in accordance with the airworthiness requirements depending on the types of operations mode but at least an airspeed indicator, altimeter and magnetic compass for day VFR operations; additional instruments required for cloud flying are variometer and turn and slip indicator. In acrobatic category the sailplane must also have a recording accelerometer installed.

3.4 Weight and balance and Center of Gravity

Maximum gross weight	360 kg
Maximum weight of nonlifting parts	220 kg
C.G. limits	
- aft of datum	2,085…2,225 m
- % MAC	20…40 %
Pilot and parachute	55…110 kg
Maximum balance weight in nose	10 kg
Water ballast use	not allowed.

3.5 Weak links

Weak link on aero and winch tow must be rated for a maximum weight of 500 kg.

4 MARKINGS

4.1 Placards

The following additional placard shall be installed on the right hand side of the cockpit near the original limitation placard:

GUIDANCE AND LIMITATIONS FOR ACROBATIC CATEGORY ARE GIVEN IN FLIGHT MANUAL SUPPLEMENT.

Otherwise the placards are in accordance with the original PIK-20 D Flight Manual.

4.2 Symbols for controls

According to the original PIK-20 D Flight Manual.

4.3 Other markings

According to the original PIK-20 D Flight Manual.

4.4 Flight instrument markings

Airspeed indicator

According to the original PIK-20 D Flight Manual.

Accelerometer

Maximum positive acceleration; Red radial	+6.6
Maximum negative acceleration; Red radial	-4.6

5 NORMAL PROCEDURES

5.1 Pre-flight Check

According to the original PIK-20 D Flight Manual.

5.2 Take-off by winch tow

According to the original PIK-20 D Flight Manual, except for the maximum gross weight.

5.3 Take-off by aero tow

According to the original PIK-20 D Flight Manual, except for the maximum gross weight.

5.4 Flight

According to the original PIK-20 D Flight Manual, except for the maximum gross weight.

5.5 Landing

According to the original PIK-20 D Flight Manual.

5.6 Acrobatic flight

Instructions given in this section entirely replace the instructions given in Section 5.6 of the original PIK-20 D Flight Manual, unless otherwise stated below.

WARNING

In addition to these instructions, safe execution of acrobatic maneuvers requires acrobatic pilot training in a two seated sailplane.

WARNING

Elevator forces are low especially the stick force per g. Rough handling of elevator causes danger of overload.

WARNING

Inverted flight cannot be flown with flap position 0. In inverted flight the flap position must be negative (at least -4 degrees).

General instructions for acrobatic flight

Water ballast is forbidden.

Recommended flap position is -4 degrees for all maneuvers. Flaps must not be deflected downwards. Flap position 0 is allowed only in maneuvers in which the airspeed never exceeds 190 km/h. Flap position shall be at least -4 degrees in all maneuvers in which the sailplane is subjected to inverted flight (negative acceleration). In inverted flight and in inverted turn even larger flap deflections (-8 degrees) can be used. Flap deflection must not be changed during the acrobatic maneuver.

The sailplane must be trimmed for the appropriate speed (e.g. 150 km/h) before executing the acrobatic maneuvers. Trim setting shall not be changed during the maneuvers. Full control deflections are not allowed in airspeeds over 190 km/h. Snapped figures are not allowed.

The sailplane must have a serviceable, recording accelerometer installed. The accelerometer shall be set to zero before initiating acrobatic maneuvers. After the acrobatic maneuvers, the largest accelerations shall be read from the accelerometer. If the maximum airspeed allowed or the maximum acceleration allowed have been exceeded during the acrobatic maneuver (the maximum acceleration allowed depends on the airspeed used according to section 2.2), then high speeds and large accelerations shall be avoided and the sailplane is to be landed as soon as possible.

Approved maneuvers and detailed instructions

The instructions given in the original PIK-20 D Flight Manual apply to spin and steep turn. Other approved acrobatic maneuvers and detailed instructions concerning acrobatic maneuvers, entry speeds and acceleration values are listed in Table 1. The table also shows examples of combinations and variations of the approved maneuvers.

TABLE 1

APPROVED ACROBATIC MANEUVERS
Recommended entry speeds and recommended acceleration values:

STEEP TURN Entry speed: 120 km/h Acceleration: +2 G Flaps: -4 degrees Piloting method and control technique is normal.
SPIN Piloting method, control technique and recovery are normal. Check specific instructions from the original PIK-20 D Flight Manual. In addition, the normal recovery technique is presented in section 8 of this supplement.
LAZY EIGHT Entry speed: 150 -180 km/h Acceleration: +2,5 G Flaps: -4 degrees Piloting method and control technique is normal.
CHANDELLE Entry speed: 150 -180 km/h Acceleration: +2,5 G Flaps: -4 degrees Piloting method and control technique is normal.
LOOP Entry speed: 190 km/h Acceleration: +4 G Flaps: -4 degrees Choose a fixed point and accelerate to entry speed. Pull on stick decisively but not abruptly. Pull must be tightened almost to the top of the loop. Stick force will, however, diminish as the speed decreases. At peak of the loop the back pressure shall be relaxed for a moment, after which levelling pull shall be initiated. During levelling pull the stick force will increase constantly due to increasing speed, but the back pressure must be relaxed steadily so that the finishing speed will be equal to entry speed.

STALL TURN

Entry speed:	190 km/h
Acceleration:	+3...4G
Flaps:	-4 degrees

Entry speed and G amount are almost the same as with loop. Maneuver initiation as with loop. Look to the side towards the intended direction of the stall turn and check the attitude of the plane. Once the plane is (almost) vertical the back pressure shall be relaxed so that the attitude stays the same. A moment later, rudder shall be moved to the limit gently but decisively, not abruptly. Ailerons shall be used to keep the bank of the plane at 90 degrees (opposite aileron). After the peak the stick shall be pushed slightly forward if needed, in order to keep the plane from entering too flat an attitude. Just before the nose is directed straight down you shall stop the rotating motion by giving momentarily the opposite rudder. Shortly after this, begin the straightening pull which is piloted in the same way as the ending of a loop. Finishing speed is equal to entry speed.

If the rudder is not given at the right moment and correctly, the plane might enter a tail slide. During tail slide the controls must be held firmly with both hands and feet in neutral position to avoid control surfaces hitting the limiters.

ROLL

Entry speed:	170 - 190 km/h
Acceleration:	-1 / +2,5 G
Flaps:	-4 degrees

Choose a fixed point and accelerate to entry speed. The nose shall be slightly over the horizon. Relax the back pressure so that the nose position stays the same. Apply decisively but not abruptly full aileron deflection and hold it there. When approaching a fully banked position give opposite rudder. When approaching inverted position push the stick slightly to keep the nose above the horizon. When approaching the later fully banked position give rudder in the direction of the roll. Do not pull on stick too early when the plane is entering level flight, but let the nose dive slightly below the horizon. If needed, give more rudder in the direction of the roll to compensate aileron drag. Finishing speed in level flight is equal to entry speed.

Avoid too strong use of rudder and too much push in inverted position. Too strong aileron usage can suddenly accelerate rotation at both sides of the inverted position.

An unsuccessful roll attempt shall never be interrupted by pulling out of inverted flight, but it must be followed through with ailerons.

HALF-ROLL INTO INVERTED FLIGHT

Entry speed: 160 - 180 km/h

Acceleration: -1,5 / +2,5 G

Flaps: -4 degrees

Entry speed is equal to or slightly lower than in a complete roll and piloting technique is also the same. When in inverted position, the aileron is to be centred, the speed is adjusted by pushing the stick and slip is removed by rudder.

INVERTED FLIGHT

Entry speed: 140 -150 km/h

Acceleration: -1 G

Flaps: -4 degrees

The nose is kept over the horizon in a suitable position by pushing on the stick. The airspeed indicator shall also be monitored regularly. The stick must be pushed constantly. The stick force is indefinite. Aileron drag is higher than in normal flight, and the effect is corrected with opposite rudder. Banking, slips and deviations in speed are to be corrected immediately.

Too slow an airspeed causes unpleasant yaw-roll oscillation (dutch roll). The minimum airspeed is around 110 -120 km/h, depending on the weight and cg position, with the flap setting of -4 degrees.

An unsuccessful inverted flight attempt shall be levelled immediately by taking the aileron to either limit (no pull, no push). An inverted flight attempt shall never be interrupted by pulling out of inverted flight.

RECOVERING FROM INVERTED FLIGHT BY HALF-ROLL

Entry speed: 160 km/h

Acceleration: -1,5 / +2,5 G

Flaps: -4 degrees

Allow the speed to increase slightly (10 -20 km/h) above the normal inverted flight airspeed by letting the stick backwards. The nose is then raised slightly higher than in normal inverted flight position by pushing on the stick. Aileron shall be fully deflected and after a moment the rudder shall also be deflect in the direction of the roll. The rest of the maneuver as with roll.

HALF LOOP INTO INVERTED FLIGHT

Entry speed:	220 -230 km/h
Acceleration:	+5 G
Flaps:	-4 degrees

Required entry speed and acceleration are considerably higher than with a normal loop. Accelerate to entry speed and pull firmly on the stick, but beware of too extensive stick deflection (airspeed is greater than maneuvering speed and the required stick force is small). When the nose is slightly over the horizon, the loop is stopped by pushing firmly on the stick so that the nose stays there. If half loop is executed correctly, the airspeed at this point is just sufficient to continue inverted flight. Allow airspeed to increase gradually to normal inverted flight speed by releasing the stick slightly backwards. Airspeed is then adjusted (as needed) by pushing on the stick again.

RECOVERING FROM INVERTED FLIGHT BY HALF-LOOP

Entry speed:	110 -120 km/h (in inverted flight)
Acceleration:	+3...+4G
Flaps:	-4 degrees

In inverted flight the speed is reduced by pushing on the stick so that the nose is clearly higher than in a normal inverted flight attitude. Slips are prevented by rudder. Airspeed is allowed to drop as low as possible before initiating the half loop. Levelling pull shall be initiated at the latest when yaw-roll oscillation (dutch roll) strengthens, or when shaking is felt as a warning of an incipient stall in inverted flight. At first pull quite a lot (the required force is quite small) and relax the back pressure when airspeed grows as at the final stage of a loop (the force increases). Finishing speed is equal to the entry speed of a normal loop, or slightly (20 km/h) higher.

If airspeed does not remain under control, it is absolutely forbidden to pull out of inverted flight, but the plane shall be levelled by taking the stick to either side limit (no pull, no push).

Recovering from inverted flight by half-loop is not recommended after a long period of inverted flight or after an inverted flight turn.

SPLIT-S

Entry speed:	160 -180 km/h
Acceleration:	-1,5 / +3...4 G
Flaps:	-4 degrees

Combine half-roll into inverted flight and recovering by half-loop. Entry speed can be slightly lower than with a full roll. Choose a fixed point behind in advance or use a visible line recognisable from both directions as an aid. The nose is pulled up at initiation, the higher the greater entry speed is used. The speed is slowed down to the minimum (110 -120 km/h) before initiating the pull out of inverted flight.

If airspeed does not remain in control, the pull out of inverted flight shall not be made under any circumstances, but the motion is to be finished with aileron (no pull, no push).

IMMELMANN

Entry speed:	230 km/h
Acceleration:	-1,5 / +5 G
Flaps:	-4 degrees

Combine half-loop and half-roll. Required entry speed and acceleration are considerably higher than in a normal loop. Choose a fixed point behind in advance or use a visible line recognisable from both directions as an aid. Accelerate to entry speed and pull on stick decisively, but beware of too much stick deflection (airspeed is higher than maneuvering speed and the required stick force is small). Once the nose is slightly over the horizon, stop the loop by pushing the stick decisively forward so that the nose stops there. Continue inverted flight for a moment. Give full aileron and, after a moment, also give rudder in the direction of the roll. Do not pull on the stick too early, but let the nose go slightly below the horizon. If necessary, more rudder in the direction of the roll may be given in order to counteract aileron drag. Finishing airspeed in level flight position is slightly higher than at entry into a half-roll.

As a variation to this maneuver, you can perform a Cuban Eight (twice 5/8 of a loop - half-roll - 1/8 loop). Required entry speed and acceleration are lower than in an immelmann.

BARREL ROLL

Entry speed:	170 -190 km/h
Acceleration:	+2,5...+3,5 G
Flaps:	-4 degrees

Barrel roll can be considered as a combination of a loop and a roll: during the first half loop turn 90 degrees to the side, and during the second half loop continue the turn 90 degrees to the same direction. Since the latter turn starts in inverted flight, the direction is returned to the original.

Suitable entry speed and G amount are the same as with loop or slightly lower. Choose fixed point(s) and accelerate to entry speed. The pull is initiated as with a straight loop – no aileron. Aileron is deflected only when the nose is pointing upwards at an angle of about 30 – 45 degrees. Aileron drag is corrected with rudder in the direction of the roll. The back pressure is neither relaxed nor (considerably) tightened after aileron deflection. When entering into inverted flight position, the back pressure is momentarily relaxed but not to the point of weightlessness, while keeping the aileron deflected and the slip meter centred with rudder. During levelling pull the aileron is still kept deflected and slip meter centred with rudder until the wings are horizontal. At this point the nose should be below the fixed point. Aileron is centred. The levelling pull continues here as when finishing a loop.

INVERTED TURNS

Entry speed:	150 -160 km/h
Acceleration:	-1...-1,5 G
Flaps:	-4 degrees

For inverted turns the same instructions apply as with inverted flight. From airspeed slightly faster than the normal inverted flight speed initiate the turn by rolling the plane calmly with a stick movement of one centimetre. Aileron drag is stronger than in normal flight and its influence is corrected by opposite rudder. Slips and speed diversions shall be corrected immediately. The nose is held at the correct height in relation to the horizon by pushing on the stick. Also the airspeed indicator shall be monitored constantly. The turn is steepened (when slips and airspeed remain under control) with a similar technique – with stick movements of one centimetre and by correcting slips and airspeed deviations immediately – until the desired turn steepness is reached.

An unsuccessful inverted turn attempt shall be levelled immediately by taking the aileron to either limit (no pull, no push). An inverted turn attempt shall never be interrupted by pulling out of inverted flight.

6 WEIGHT AND BALANCE

6.1 Allowable weights

Maximum gross weight	360 kg
Water ballast	not allowed.

Otherwise the weights are in accordance with the original PIK-20 D Flight Manual.

6.2 Allowable Centre of Gravity

According to the original PIK-20 D Flight Manual.

6.3 Balance instructions

According to the original PIK-20 D Flight Manual, except for the use of water ballast.

7 PERFORMANCE

According to the original PIK-20 D Flight Manual.

8 SPECIAL FLIGHT CONDITIONS AND EMERGENCY PROCEDURES

According to the original PIK-20 D Flight Manual with the following additions:

Levelling a spin (normal procedure)

1) Opposite rudder fully deflected

2) Relax the back pressure

3) When the spinning has ended centre controls; level the dive and bank normally; beware too strong levelling pull.

Exceeding operational limitations

If maximum speed or maximum acceleration value has been exceeded

1) Avoid fast airspeeds and great accelerations

2) Land the plane as soon as possible.

After the flight make a note in the log book of exceeding the operational limitations and a thorough damage inspection shall be performed before continuing flight operations; the damage inspection and its result shall also be marked in the log book.