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Herregårdsparken 3  
7400 Herning

Dato:

13. december 1993

Vor ref.:

Sagsbehandler / lokalnr.:

P. Friborg Madsen / 396

Deres brev af:

Deres ref.:

Personlig henvendelse, Materielkontrollantseminar

Emne: Stall og spind, ASK-21.

Som aftalt under materielkontrollantseminaret den 11. december 1993 fremsendes Kennblatt Nr. 339, Technische Mitteilung nr. 4 (kun godkendt i Schweiz) samt uddrag fra USAF rapporten "Schleicher ASK-21 Glider (TG-9) Stall and Spin evaluation, July 1989".

Med venlig hilsen

  
P. Friborg Madsen  
Luftfartsinspektør/Luftdygtighedskontoret

# LUFTFAHRT-BUNDESAMT

## GERÄTE-KENNBLETT (§4 LuftVZO)

Segelflugzeug - Kennblatt Nr. 339

Ausgabe 6

09. Februar 1990

Baureihen: ASK 21

### I. Zulassungsdaten des Grundmusters

1. Segelflugzeugmuster: ASK 21
2. Geräte-Nummer: 339
3. Hersteller:
  1. Alexander Schleicher  
Segelflugzeugbau  
6416 Poppenhausen
  2. Alexander Schleicher GmbH & Co.  
Segelflugzeugbau  
6416 Poppenhausen
4. Lufttüchtigkeitsgruppe:
  - a) U (Utility)
  - b) A (Acrobatic)
5. Bauvorschriften: Lufttüchtigkeitsforderungen für Segelflugzeuge und Motorsegler (LFSM), Ausgabe 23. Oktober 1975,  
  
und  
  
Richtlinien zur Führung des Festigkeitsnachweises für Bauteile aus glasfaserverstärkten Kunststoffen von Segelflugzeugen, Ausgabe März 1965
6. Antragsteller auf Zulassung: Firma Alexander Schleicher  
Segelflugzeugbau  
6416 Poppenhausen/Wasserkuppe
7. Datum der Zulassung: 18. April 1980

### II. Technische Merkmale und Betriebsgrenzen

1. Baumerkmale: Doppelsitziger, freitragender Mitteldecker in GFK-Bauweise, T-Leitwerk, Bremsklappen auf der Flügeloberseite, nicht einziehbares Fahrwerk mit Bugrad und gefedertem, bremsbarem Hauptrad.  
  
Flügelspannweite: 17,0 m

9. Ruderausschläge:	Höhenruder	
	nach oben	90 ± 5 mm
	nach unten	65 ± 5 mm
	Meßpunktentfernung von Ruderachse	230 mm
	Querruder	
	nach oben	110 ± 10 mm
	nach unten	45 ± 5 mm
	Meßpunktentfernung vom Drehpunkt	240 mm
	Seitenruder	
nach beiden Seiten	180 ± 20 mm	
Meßpunktentfernung vom Drehpunkt	375 mm	

### III. Betriebsanweisungen

1. Flughandbuch für das Segelflugzeug ASK 21, Ausgabe April 1980, LBA-anerkannt.
2. Datenschild.
3. Beladeplan.
4. Wartungshandbuch für das Segelflugzeug ASK 21, Ausgabe April 1980, LBA-anerkannt.
5. Betriebs- und Wartungsanweisung für die Schleppkupplung, Sicherheitskupplung "Europa G 72" und "Europa G 73", Ausgabe Mai 1975, LBA-anerkannt.
6. Betriebs- und Wartungsanweisung für die Schleppkupplung Bugkupplung "E 72" und "E 75", Ausgabe Mai 1975, LBA-anerkannt.

### IV. Zugelassene Wandlungsformen des Grundmusters

k e i n e .

### V. Ergänzungen oder Beschränkungen der Zulassung

1. Herstellung nur im Industriebau zulässig.
2. Alle Bauteile, die der Sonneneinstrahlung ausgesetzt sind, müssen eine weiße Oberfläche aufweisen. Ausgenommen sind davon die orange-rote Farbmarkierung von Rumpfbug, Tragflächenenden und Seitenruder.
3. Geeignet für Wolkenflug und Kunstflug (Lufttüchtigkeitsgruppe Acrobatic (A)) gemäß den Angaben im Flughandbuch.
4. Mit Durchführung der Maßnahmen gemäß Technischer Mitteilung Nr. 8 (Änderung des Flughandbuches) wird die Verwendung der folgenden Sollbruchstellen im Schleppseil zulässig:  

Bei Flugzeugschlepp	max. 600 ± 60 daN
bei Windenstart	max. 1000 ± 100 daN
5. Der Einbau der "Sicherheitskupplung Europa G 88" und der "Bugkupplung E 85" ist entsprechend den Angaben der Technischen Mitteilung Nr. 21 der Firma Schleicher zulässig.

Gegenstand : Trimmballast für Trudeleinweisung.

Betroffen : Segelflugzeug ASK 21 (nur Flugzeuge für Schweiz und Australien).

Dringlichkeit : Wahlweise.

Vorgang : Das Flugzeug trudelt nur bei Fluggewicht-Schwerpunktrücklagen von  $r = 400$  mm und mehr. Vor allem bei doppelsitzig geflogenen Flugzeug ist Ballast am Schwanz nötig.

Maßnahmen : Nach Zeichnungsblatt L-339.10-S.32 Tr 2 ist die Änderung durchzuführen.

In das Flughandbuch sind die Seiten 12 a, 12 b und 12 c einzufügen.

Im Cockpit ist im Sichtbereich des Piloten ein Schild anzubringen :

" Vor dem Start prüfen:  
1. Trudelballast am Rumpfheck abgebaut ?  
2. bei Trudeleinweisung: Trudelballast ordnungsgemäß befestigt ? "

In roter Schrift auf weißem Grund oder weißer Schrift auf rotem Grund.

Material : Siehe Zeichnung L-339.10-S.32 Tr 2.

Gewicht und Schwerpunktlage : Zu vernachlässigen.

Hinweise : Durchführung der Änderung beim Hersteller oder einem anerkannten Luftfahrttechnischen Betrieb.

Poppenhausen, den 14.11.1980

Angenommen durch  
Luftfahrtamt

29. März 1982



ALEXANDER SCHLEICHER  
Segelflugzeugbau

*Rudolf Kaiser*  
Rudolf Kaiser!

*Schwarz*

ASK 21 - Flughandbuch -

Trudelinweisung

Das Flugzeug trudelt bei Fluggewichts-Schwerpunktlagen von 400 mm und weiter zurück.

Bei Schwerpunktlagen vor diesem Punkt, wie es im doppelsitzigen Flug meistens der Fall ist, muß für Trudelversuche Ballast am Schwanz mitgenommen werden.

Nach Durchführung der TM 4 kann Ballast bis zu 12 daN an der Seitenflosse unten mitgenommen werden.

Dies reicht für ein Insassengewicht bis etwa 2 mal 95 kg.

Berechnung des Trudelballastes

## Bezeichnungen:

- $G_{p1}$  = Führergewicht vorne (kp)  
 $G_{p2}$  = Führergewicht hinten (kp)  
 $L$  = Gepüchgewicht (kp)  
 $G_R$  = Rüstgewicht (kp)  
 $r$  = Rüstgewicht SP-Lage (m)  
 $G_B$  = Trudelballast am Schwanz

$$G_{p1} \cdot 1,617 =$$

$$G_{p2} \cdot 0,480 =$$

$$L \cdot 0,150 =$$

$$G_R \cdot (0,4 - r) =$$

Summe

$$G_B = \frac{\text{Summe}}{4,929} = (\text{kp})$$

Es wird darauf hingewiesen, daß alle eingesetzten Gewichte und die Rüstgewicht-SP-Lage dem neuesten Stand entsprechen müssen.

19.02.82

ASK 21 - Flughandbuch -

Berechnungsbeispiel:

$$\begin{aligned} G_{P1} &= 88,2 \text{ kp} \\ G_{P2} &= 79,5 \text{ kp} \\ G_{Rüst} &= 393 \text{ kp} \\ r &= 0,737 \text{ m} \end{aligned}$$

$$88,2 \cdot 1,617 = 142,62$$

$$79,5 \cdot 0,480 = 38,16$$

$$0 \cdot 0,150 = 0$$

$$393 \cdot (0,4 - 0,737)$$

$$393 \cdot -0,337 = -132,4$$

---


$$48,34$$

$$G_B = \frac{48,34}{4,929} = 9,81 \text{ kp}$$

=====

19.02.82

12 c

Zu II. 8 Beladepfan

Bei eingebauter Gewichtstrimmung ergibt sich:

Anzahl der Platten	Mindestzuladung im vorderen Sitz (daN/kg)
0	70,0
1	68,75
2	67,5
3	66,25
4	65,0
5	63,75
6	62,5
7	61,25
8	60,0
9	58,75
10	57,50
11	56,25
12	55,0

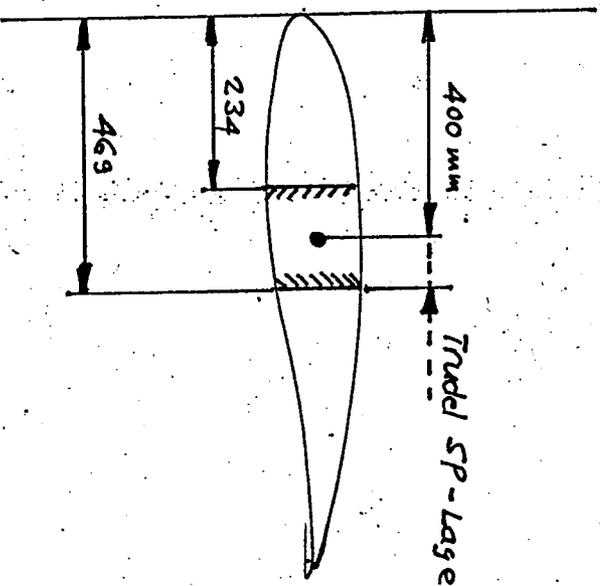
Max. Zuladung im hinteren Sitz einschließlich Fallschirm 110 kg.



23. Feb. 1984

TM-Nr. 13

10 b



Bemerkungen:

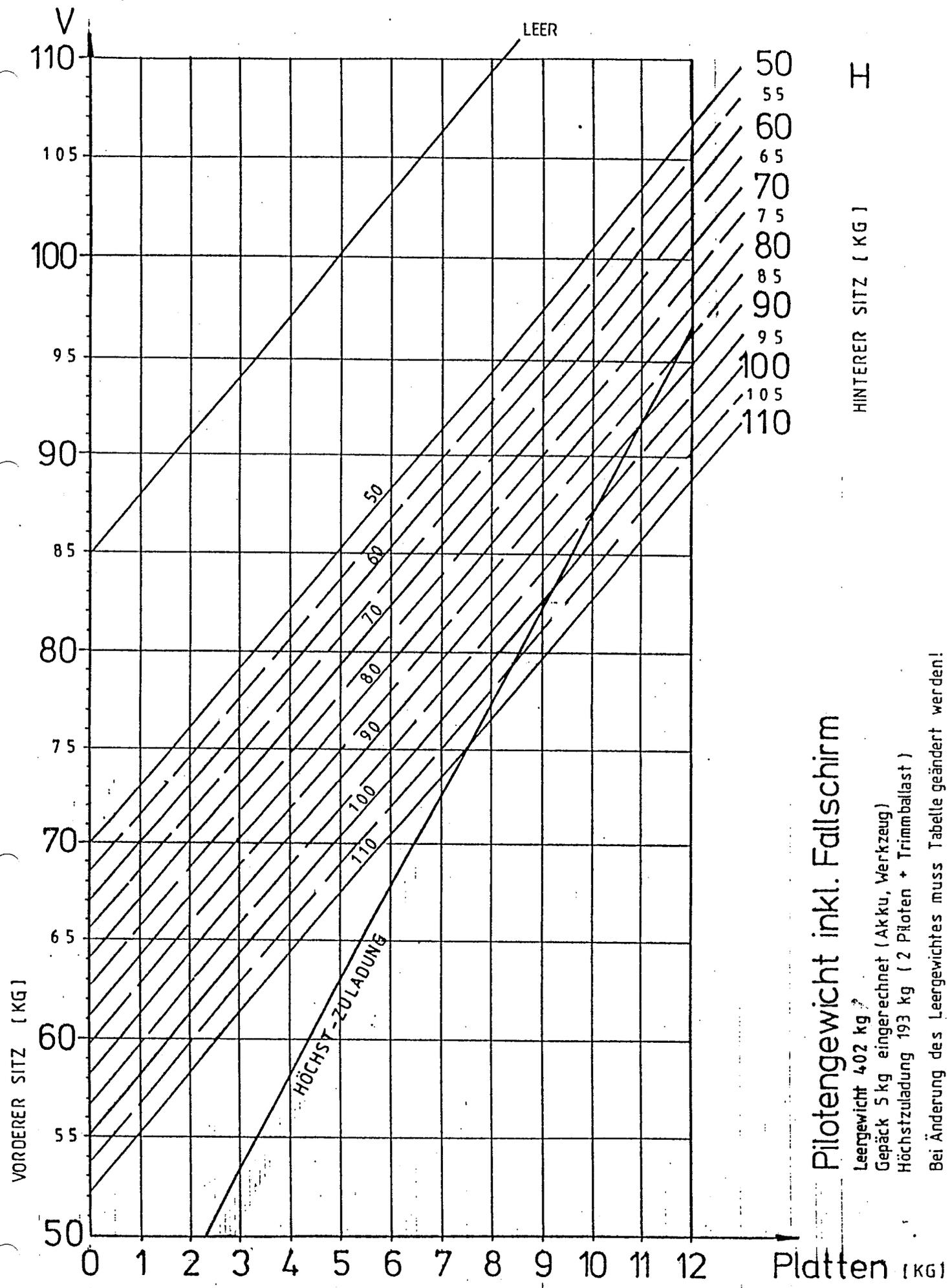
a.- Höhenruderausschläge Kontrollieren  
(90° 5mm nach oben - 65° 5mm nach unten)

b.- Trudel : SP-Lage 430 bis 450mm geht gut!

400 mm eher zu knapp!

(Flz. HB-1700)

# ASK 21 HB-1700 Trudelballast



Pilotengewicht inkl. Fallschirm

Leergewicht 402 kg

Gepäck 5 kg eingerechnet (Akku, Werkzeug)

Höchstzuladung 193 kg (2 Piloten + Trimmballast)

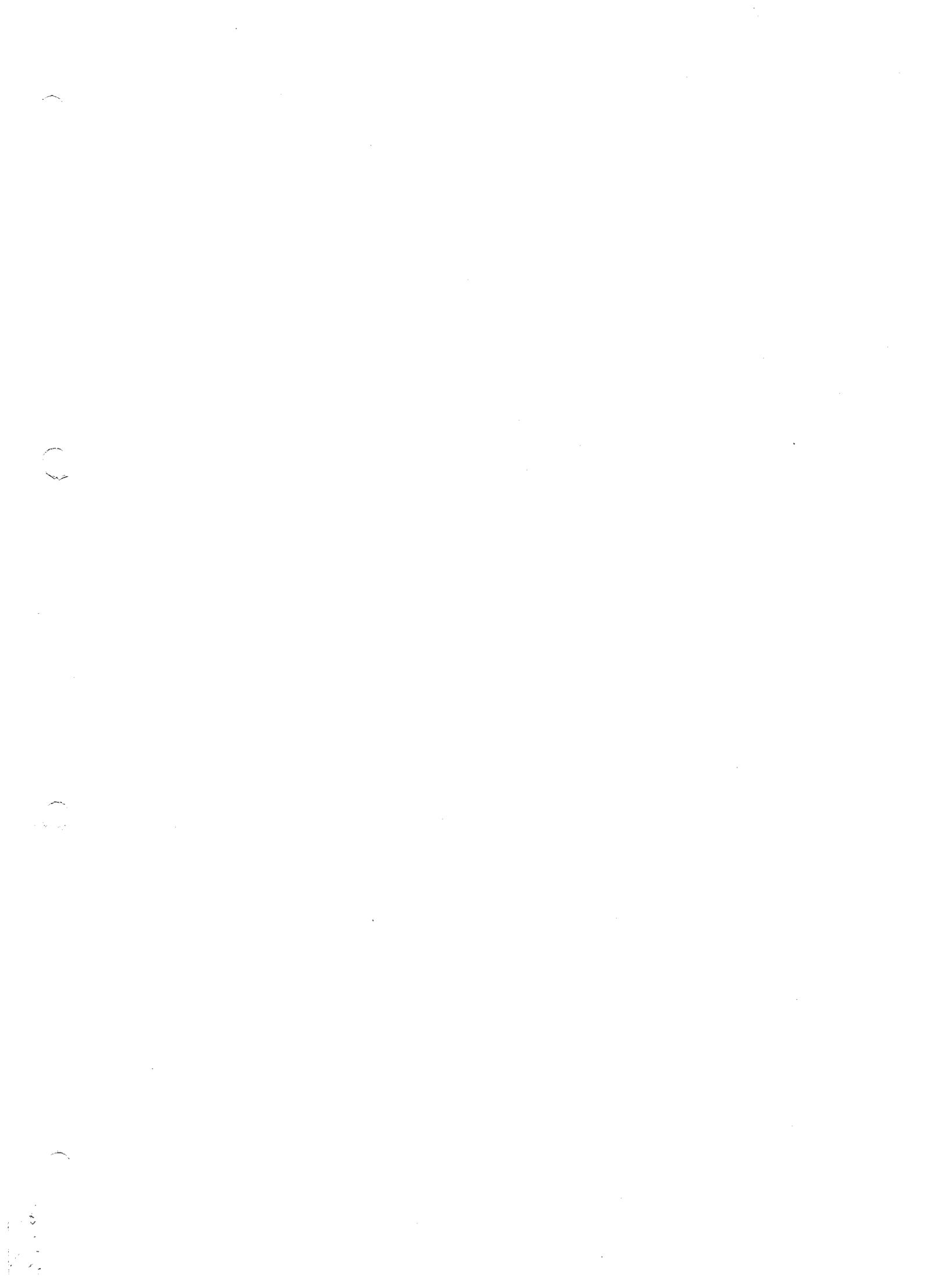
Bei Änderung des Leergewichtes muss Tabelle geändert werden!

HINTERER SITZ (KG)

H

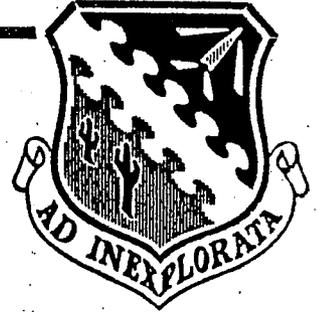
Platten [KG]

BT85



Extract

AFFTC-TR-89-27



**SCHLEICHER ASK-21 GLIDER (TG-9)  
STALL AND SPIN EVALUATION**

**DOYLE B. JANZEN**  
Project Engineer

**CHARLES J. PRECOURT, MAJOR, USAF**  
Project Pilot

**JULY 1989**

**FINAL REPORT**

**APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.**

**CONTROLLING OFFICE: OC/ALC/MMAF, TINKER AFB, OK 73145-5000**

**AIR FORCE FLIGHT TEST CENTER  
EDWARDS AIR FORCE BASE, CALIFORNIA  
AIR FORCE SYSTEMS COMMAND  
UNITED STATES AIR FORCE**

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**UNCLASSIFIED**

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## PREFACE

This report documents the results of flight tests conducted to evaluate the stall, poststall, and spin characteristics of the Schleicher ASK-21 glider. These tests were requested by the Commandant of Cadets of the USAF Academy (USAF). The objective of this test effort was to evaluate the effects of changing cg on the stall and spin characteristics.

Testing was conducted at the Air Force Flight Test Center (AFFTC), Edwards AFB, California, between 27 April and 31 May 1989. The flight test program

consisted of 43 sorties totaling 30.5 flight hours. All tests were funded under Job Order Number 921ASK.

The test team expresses their sincere appreciation to the AFFTC organizations who participated in this evaluation. In particular, a special thanks to Robert E. Lee for providing technical expertise during this test. Thanks also goes to the Weight and Thrust Measurement Facility for painstaking efforts in acquiring critical weight and balance data, and to Barbara Jenner of the 6520 Range Squadron for providing 100 percent video coverage of the spins.

## EXECUTIVE SUMMARY

This report documents the results of flight tests conducted to evaluate the stall, poststall, and spin characteristics of the Schleicher ASK-21 glider. These tests were requested by the Commandant of Cadets of the USAF Academy (USAFA) as a result of a Class A (fatal) mishap in November 1988. The investigation board recommended that the ASK-21 be tested prior to resumption of USAFA flight operations. The primary purpose of this program was to evaluate and document the effects of changing cg on the stall and spin characteristics. All test objectives were met.

Testing was conducted at the Air Force Flight Test Center (AFFTC), Edwards AFB, California, between 27 April and 31 May 1989. The flight test program consisted of 43 sorties totaling 30.5 flight hours.

The test aircraft was an Alexander Schleicher-manufactured ASK-21 glider, S/N 21235 and Registration Number N974AF. The aircraft had the USAF designation of the TG-9A, S/N 87-1974. It was owned by USAFA, 94th Airmanship Training Squadron. The glider was modified with an onboard video camera and a radar enhancing beacon (C-band) for this test. A thorough weight and balance was conducted, and the test aircraft was considered production representative.

The stall and spin characteristics of the ASK-21 were satisfactory and similar to those of other high performance sailplanes. The test team considered the aircraft to be an excellent spin trainer because cg could be accurately controlled using tail weights. This ensured that pilots of all weights could achieve the same spin results. Intentional stall and spin execution and recovery were safe and repeatable across the entire envelope of weight and cg.

The following eight major findings resulted from this test:

1. Stall warning indication was marginal, with only very light buffet, decreased cockpit noise, and very mild g-break at the stall.

2. The glider would spin at cg's forward of the manufacturer's flight manual reference value for spin entry.

3. The spin mode was oscillatory and, although it appeared flat at certain points in the oscillation, was easily recoverable. Spinning motions could be disorienting due to their oscillatory nature. Some spins terminated in spirals, requiring pilot attention to avoid excessive speeds during dive recoveries.

4. If forward stick was used without rudder to recover the aircraft from an out-of-control situation, recovery was sometimes significantly delayed.

5. The manufacturer's flight manual spin recovery procedure required up to 1 1/2 turns before rotation stopped. Using the manufacturer's flight manual procedure, the aircraft always recovered.

6. Spin entries occasionally occurred without rudder input if proper turn coordination was not exercised at speeds near stall.

7. Some spins continued indefinitely if controls were released during the developed spin.

8. Inverted spins were possible and occurred during inverted aerobatic maneuvers if cross-controlled inputs were maintained.

The current ASK-21 manufacturer's flight manual provided by the manufacturer does not accurately document spin susceptibility. Additionally, the manual does not adequately document the stall and spin characteristics. With appropriate flight manual revisions that reflect the major findings of this test, the ASK-21 glider would be suitable for spin training.

## CONCLUSIONS AND RECOMMENDATION

The stall and spin characteristics of the ASK-21 were satisfactory and similar to those of other high performance sailplanes. The test team considered the aircraft to be an excellent spin trainer because cg could be accurately controlled using tail weights. This ensured that pilots of all weights could achieve the same spin results. Intentional stall and spin execution and recovery were safe and repeatable across the entire envelope of weight and cg.

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The current ASK-21 manufacturer's flight manual does not accurately document spin susceptibility. Additionally, the manual does not adequately document the stall and spin characteristics. With appropriate flight manual revisions that reflect the major findings of this test, the ASK-21 glider would be suitable for spin training.

*1. The manufacturer's flight manual should be revised to include the text provided in Appendix G (pages 9, 11, 16, 18, 19, 20, and 21).*

## FLIGHT MANUAL REVISIONS

The U.S. Air Force is planning to write a technical order flight manual for the ASK-21 (TG-9). The following discussion is the recommended writeup for Section VI (Flight Characteristics) of the flight manual. The information is also appropriate for the manufacturer's flight manual.

### STALL CHARACTERISTICS

The approach to stall characteristics of the ASK-21 are similar to other high performance sailplanes. Flight in this regime can be made safely and routinely provided these characteristics are well understood.

#### Control Effectiveness on Approach to Stall:

At speeds below minimum sink speed in 1-g wings level flight, the controls are effective in all three axes. The elevator is the most responsive control throughout this flight regime. The ailerons and rudder are slightly more sluggish, but effective in the proper sense.

Small aileron deflections produce adverse yaw. Adverse yaw during approach to stall causes a nose slice away from the input and a subsequent wing drop. Unless the aircraft is then forced into a full stall, this wing drop does not result in departure and is controllable. Prolonged aft stick (stall) in the presence of wing drop may result in departure or spin. Departure can be prevented by coordinating with rudder (opposite the wing drop).

Up to stall, large sideslip angles (up to full cross controls) can be flown without departure from controlled flight. In sideslips, however, the rudder forces lighten to zero. When the sideslip is sufficiently great, the rudder "locks out" and has to be pushed back by pilot input. Restoring pedal forces are light and the aircraft is easily returned to coordinated flight.

#### Warning Cues:

The most significant characteristic in approach to stall is the lack of any distinctive warning cues that stall is imminent. With a cg aft of approximately 13 inches, there is only very slight airframe buffet at 2 to 3 knots indicated airspeed (KIAS) above the stall. If the center of gravity (cg) is forward of 13 inches, full aft stick is reached prior to any clear buffet onset when approach

to stall is made from level flight. The only other cue to the pilot of an impending stall, regardless of cg, is the diminished cockpit noise due to the slower speed of outside airflow.

During approach to stalls, airspeed indications are unreliable if sideslip is present. In full sideslips, indicated airspeed is zero or less (needle unwinds and points to 160 KIAS). This is due to the relative positions of the pitot and static pressure sensing ports.

#### Stall Indication:

In 1-g wings level flight, the stall is marked by a very mild g-break (nose drop) of 2 to 3 degrees or less. If the cg is forward of approximately 13 inches, this g-break does not occur. Full aft stick is reached first, indicating a saturation of tail authority. If the stick is held full aft at stall, buffeting increases and a pitch "bucking" or slow oscillation in pitch attitude occurs as tail effectiveness returns at each nose drop and produces secondary stalls. Speeds at stall range from 33 to 38 KIAS depending on gross weight.

Spoilers have no significant effect on stall characteristics, although the airframe buffet they produce further masks the natural stall buffet of the airframe. Stall speeds with spoilers are generally 2 KIAS higher than without.

Dynamic entries to stall can be flown using higher pitch attitudes and a more rapid onset rate. The dynamic effects produce a slower stall speed and a much more pronounced g-break of up to 40 degrees of nose drop, even at forward cg. Dynamic entries to stall do not result in departure. The airspeed increases rapidly above stall during the g-break even if the stick is held full aft. Approximately 100 feet of altitude loss can be expected in this type of maneuver.

During accelerated stalls, slight airframe buffet is felt in the tail at 3 to 5 KIAS above the stall. If constant altitude is maintained during turns, airspeed decreases sufficiently to produce a mild g-break. Full aft stick can be achieved in a stable turn condition, however, if slight descent or thermal conditions exist. This is due to reaching maximum tail authority prior to stall. Accelerated stalls are characterized by little warning cues in the approach to stall regime, similar to the 1-g stall.

### Stall Recovery:

Recovery from all stalls is immediate by releasing back stick pressure and allowing the nose to fall, provided a wing drop has not occurred. Straight ahead stall recovery requires as little as 50 feet altitude. Recovery can be delayed if wing drop is present at the stall. Wing drop can be caused by stall from a shallow bank turn, adverse yaw during shallow turns near the stall, or turbulence.

### **WARNING**

If a wing drop occurs at stall and forward stick is the only recovery input, the aircraft may depart controlled flight and enter an incipient spin. Opposite rudder will prevent departure in all cases if applied opposite the wing drop prior to applying forward stick. A departure at stall can require more than 500 feet of altitude to recover to level flight.

### Inverted Stalls:

The characteristics in approach to stall at -1 g are essentially unchanged from normal 1-g flight. Stall speeds at -1 g are 38 to 40 KIAS (pitot tube extension installed). Very little buffeting (even less than upright) of the airframe is noticed and the g-break is very mild unless the stall is entered from a nose high attitude. The aircraft tends to roll, seeking an upright attitude, during the g-break at stall.

## DEPARTURE AND SPIN SUSCEPTIBILITY

### Entry Techniques:

The simplest spin entry is accomplished from wings level with the pitch attitude held constant at 10 degrees nose high until stall, while smoothly applying full rudder and full aft stick. Proper timing of aileron inputs prior to stall can generate additional yaw (adverse yaw due to aileron) to assist spin entry. This is particularly true at more forward cg when rudder and elevator alone fail to produce spin entry.

Spin entry is sensitive to entry conditions. If the entry attitude is too nose high, it results in a spiral dive. If the entry attitude is too shallow, it results in a steep-banked sideslip. The spiral or sideslip occur more frequently as the cg is moved forward. Spin entry is unlikely with the in-flight cg forward of 12.4 inches.

In this case, entry attempts result in spirals or sideslips regardless of control input techniques.

### Mass Properties Effects:

Spin entry success is also sensitive to inertia loading. The ASK-21 aircraft has the unique feature of tail ballasting, meaning that it can be loaded at both ends of the fuselage. Although the tail weights were designed to control cg, they greatly effect the inertia terms that govern aircraft response to flight maneuvers. Since the tail weights significantly increase the inertia of the longitudinal axis of the aircraft, any initial yaw rotation results in more angular momentum than without tail weights. This greater momentum results in achievable spins at cg's further forward than the low inertia case.

Flight testing has produced spins at cg's as far forward as 12.9 inches. With minimum inertia loadings (solo, lightweight pilot without tail ballast), incipient spins can be achieved at cg's aft of 13.0 inches and sustained spins aft of 15.0 inches. With higher inertia loadings (two pilots and tail ballast), incipient spins can occur aft of 12.5 inches and sustained spins aft of only 13.5 inches. Therefore, the tail weights cause the target cg where spins can be expected to move progressively more forward as pilot weights increase.

Figure G1 shows flight test results by plotting cg against inertial loading. The results for spin entry and number of turns achieved follow linear boundaries within the envelope. It is extremely unlikely, but not impossible, that spin entry can be achieved to the left of the incipient boundary line. Therefore, the ASK-21 departure and spin resistance is classified as "extremely resistant" in the lower left corner of the envelope and progressively becomes less resistant as the loading is moved to the upper right. The broad area between the two boundary lines is a region where spins are only incipient (self-recover in spite of holding prospin controls). To the right of the sustained boundary line, spins can be sustained indefinitely as long as prospin controls are held.

In reference to test results shown in Figure G1, the best cg for spin training is 16.0 inches. Figure G2 shows how to load any ASK-21 glider to obtain 16.0 inches cg. Figure G3 shows how to compute cg for any loading of any ASK-21. The maximum number of tail weights permitted is 11. If pilot weights call for more than 11 tail weights when using Figure 2, use 11 tail weights which will result in a cg slightly ahead of 16.0 inches.

# ASK-21 Spin Susceptibility

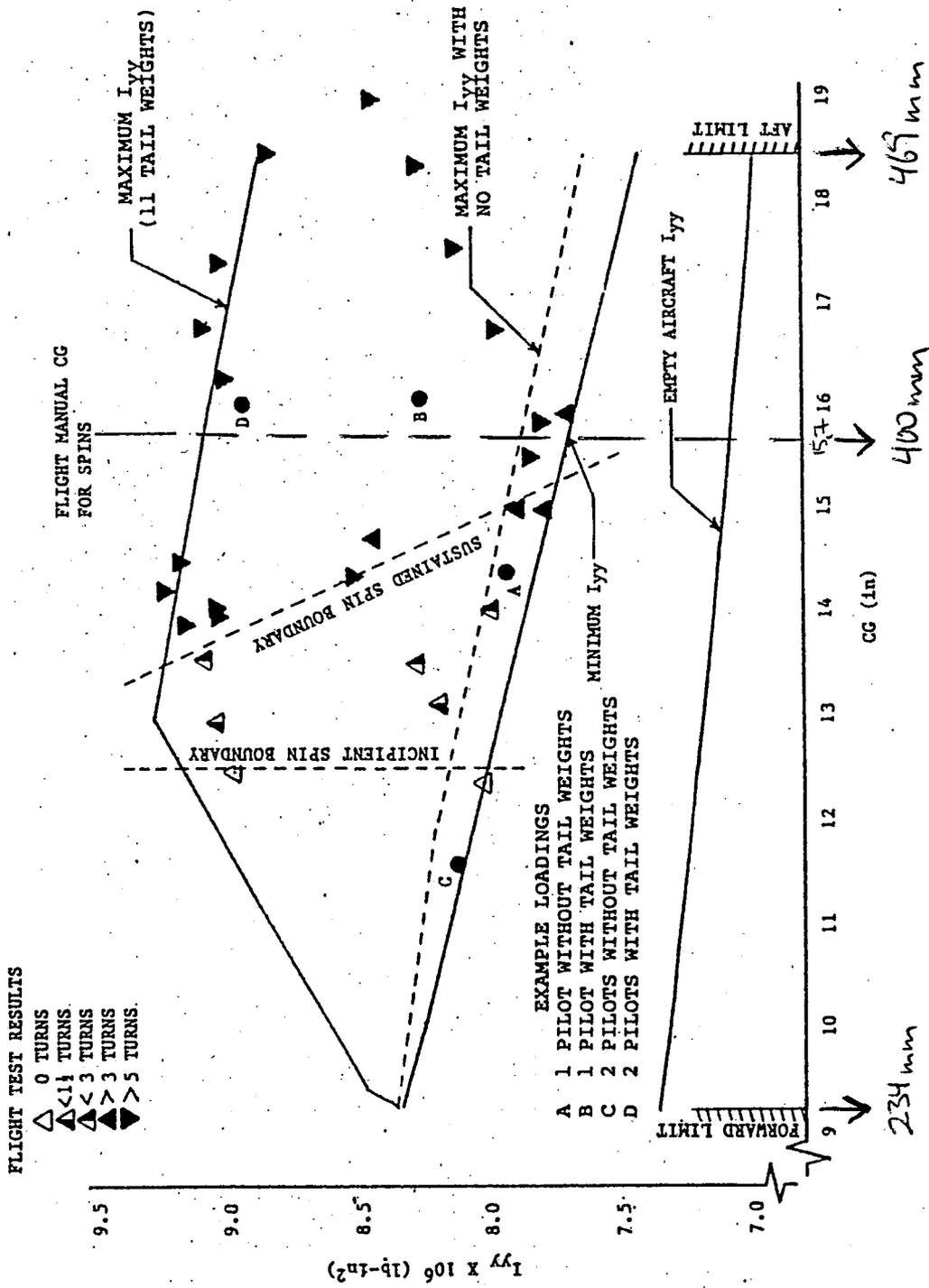
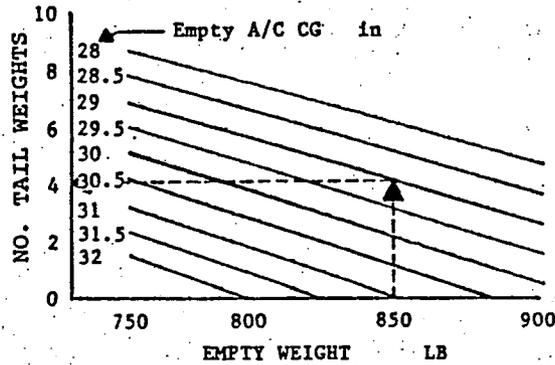


Figure G1 ASK-21 Center of Gravity Versus Pitch Inertia

## ASK-21 Spin Training Number of Tail Weights Necessary to Achieve 16 Inches Center of Gravity

- NOTES: 1. Number of tail weights is sum of increment for empty aircraft plus increment due to front and rear seat weights (rounded to nearest whole).
2. Maximum number of tail weights allowed is 11.
3. No cockpit ballast.



NOTE:  
Minimum = 0 Weights  
Maximum = 11 Weights

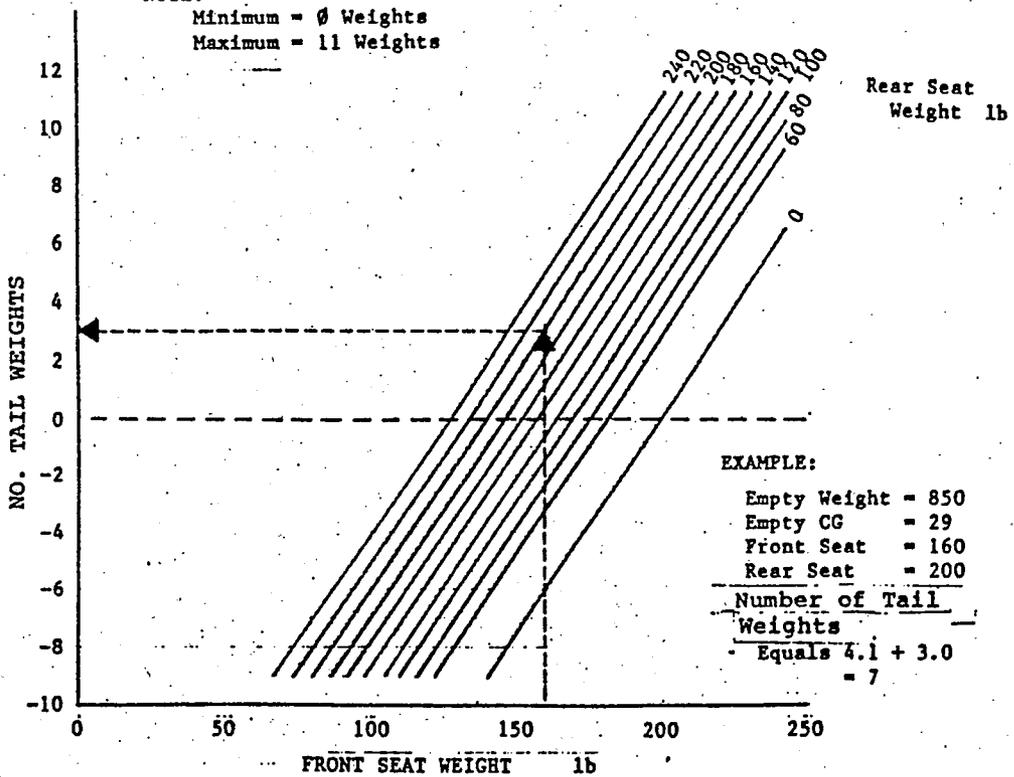


Figure G2 ASK-21 Loading Chart for Spins

### ASK-21 Center of Gravity

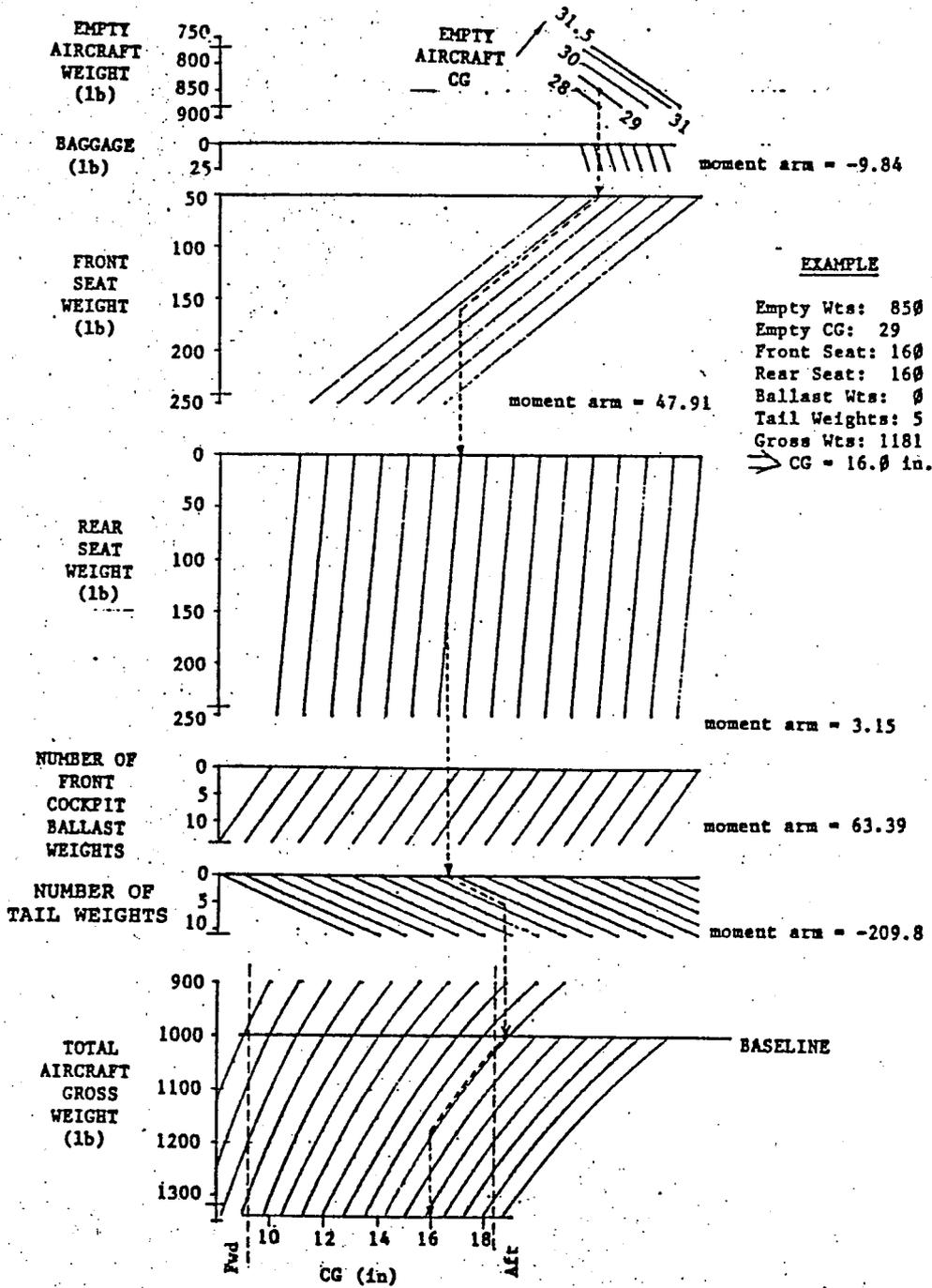


Figure G3 ASK-21 Center of Gravity Chart

Due to the higher inertia of this case, the aircraft will still spin easily for training.

### No Rudder Spin Entry:

Spin entry without using rudder input can occur under certain conditions. A wing drop at stall can generate sufficient yaw to cause the rudder to float to the prospin position. Wing drop can occur due to adverse yaw from uncoordinated aileron inputs near stall or turbulence. In this case, if recovery is not initiated by applying rudder opposite the wing drop and then breaking the stall with forward stick, a spin can develop.

### **WARNING**

If proper turn coordination is not exercised near stall, a departure or spin may occur with only stick inputs.

## SPIN CHARACTERISTICS

### Spin Modes:

The ASK-21 has two spin modes, one upright and one inverted. Both are classified as fast, steep, and oscillatory. However, the oscillation of the spin causes a variance in pitch attitude that can range from extremely steep to nearly flat. The average attitude value is classified as steep. The spin modes may also appear smooth instead of oscillatory if they are only examined for three turns or less. This is because the period and frequency of the pitch oscillation vary as a function of cg and inertia loading. Variations from one oscillation per turn to one oscillation every three turns can be seen, depending on loading.

### Spin Parameters:

The pitch attitude during ASK-21 upright spins averages 40 to 50 degrees nose low. The steep phase of the oscillation is as much as 70 degrees nose low and the flat phase as high as the horizon. In no case does the flat phase tend toward an unrecoverable situation. On some occasions, the spin attitude is steep enough that the AOA is momentarily less than stall, resulting in recovery as the aircraft pitches down out of the spin.

The oscillation occurs more frequently as the cg is moved aft, while increases in inertia loading result in a larger amplitude of the oscillation. For example, at a forward cg, the oscillation is seen every third turn. At

the aft cg limit, the oscillation occurs every 3/4 to 1 turn. At low inertia values, the pitch attitude oscillates typically  $\pm 15$  degrees about 50 degrees nose low, while at high inertia the oscillation is  $\pm 30$  degrees about 40 degrees nose low.

The rotation rate of the spin is as fast as 140 degrees per second, or one turn every 2.5 seconds. This rate occurs at the steep phase of a spin oscillation. During the flat phase, the rotation rate is as slow as 90 degrees per second or one turn every 4.5 seconds. The average rotation rate is fastest at forward cg's and high inertias, where oscillations occur least frequently. Toward the aft cg limit, where oscillations to flat attitudes are more frequent, the average rotation rate is slowest.

In all spins, the altitude loss is approximately 200 feet per turn with a variance of 150 feet minimum to 250 feet maximum. This indicates that in spite of the oscillatory nature of the spin mode, the descent rate remains relatively constant.

Airspeed indications during the spin oscillate along with pitch attitude. In most cases, airspeed oscillates between 30 and 40 KIAS. During larger oscillations in pitch attitude, higher sideslip angles are present and airspeed erroneously reads zero or less (pointer unwinds to 160 KIAS).

Since airspeed indications can be unreliable during spins, particular attention is necessary to recognize the transition to a spiral. If cockpit noise due to outside airflow continues to increase to the point that conversation between crewmembers is difficult, or if the airspeed indicator is increasing through 60 KIAS, the aircraft is no longer spinning but is likely in a spiral. Opposite rudder and relaxed back stick pressure should be used immediately to avoid potential overspeed or overstress situations associated with high-speed spirals. Spoilers should be used as necessary to control airspeeds during all spin or spiral dive recoveries.

### **CAUTION**

Initiate recovery not later than 60 KIAS to avoid exceeding 108 KIAS limiting airspeed with tail weights installed.

Cockpit noise also varies during sustained spin oscillations. During steep phases of the spin, cockpit noise from outside airflow is loudest, while during flat phases, the cockpit is very quiet.

## **WARNING**

The combination of varying cockpit noise levels, varying pitch attitudes, and varying rotation rates and airspeed indications can cause disorientation to those unfamiliar with spinning this aircraft. If this occurs, positive application of recovery controls should be initiated immediately to minimize any effects of disorientation.

Control forces during spins are light. There is a tendency for the ailerons to float into the direction of the spin, accompanied by 5 to 10 pounds of lateral force on the control stick. At the higher spin rates, the elevator and rudder forces at full prospin deflection drop to zero.

## **CONTROL EFFECTS**

### **Flight Manual Recovery:**

When opposite rudder is initiated at a slow point or flat phase of the spin, the rotation stops in 1/4 to 1/2 turn and the aircraft recovers. In the majority of cases, even at higher rotation rates, opposite rudder recovers the aircraft in 1/2 to 3/4 of a turn from the point of input. However, with cg's of 14 to 16 inches and at higher inertias, recovery can take up to 1 1/2 additional turns to recover once opposite rudder is applied. It is imperative that a slight pause occur between application of opposite rudder and forward stick or even greater delay in recovery can occur.

A recovery of 1 1/2 turns may take up to 5 seconds, which may seem excessively long to an inexperienced pilot. The flight manual procedure has a 100 percent success rate if given sufficient time to work.

### **Aileron Effects:**

For the ASK-21, ailerons against the spin produce a noticeable bank angle away from the spin turn direction as well as a nose down pitch rate. This sometimes results in recovery as the yaw rate decreases through inertial coupling and the nose pitches down leaving the aircraft in a steep sideslip to terminate the spin. In other cases, the aircraft remains in the spin with a bank angle away from the spin direction. Therefore, ailerons against the spin are not a reliable contributor to spin recovery.

Ailerons with the spin increase rotation rate but this effect is masked by the oscillatory characteristics of the spin. In the majority of cases, ailerons into the

spin achieve a slightly higher rotation rate and a more sustainable spin. The results of testing isolated aileron inputs indicate neutral aileron is the best position for recovery.

### **Elevator Effects:**

In some cases, application of forward stick with no rudder input will result in a continued spin. During either the incipient phase of the spin or at the start of a nose up oscillation, full forward stick can produce up to three more turns before recovery.

## **WARNING**

During recovery from stalls in the presence of wing drop, or from departures and spins, application of forward stick prior to opposite rudder can delay recovery up to three additional turns.

### **Hands Off:**

In the majority of cases, when the controls are released during a spin, the stick moves laterally in the direction of the spin. The stick usually reaches full aileron deflection and then starts forward toward neutral. The aircraft pitch attitude steepens and then the rudders return to neutral. At this point, the aircraft self-recovers in a steep attitude.

If the controls are released just after the pitch attitude has cycled nose low and the rotation rate is high, the stick moves abruptly into the direction of the spin and remains at full aft/full aileron deflection. Rudders also remain at full deflection, or nearly so, and the spin continues indefinitely until the pilot forces the controls to the recovery position. This is most prevalent in the 14- to 16-inch cg range with higher inertia loadings. Since airloads on the controls can occasionally cause them to "lock out" in a prospin position, releasing the controls is not a viable option for departure or spin recovery. The spin recovery procedure must be used to ensure successful recovery.

## **INVERTED SPINS**

Flight testing has verified that the ASK-21 has an inverted spin mode. Testing has been conducted between 15.8 inches cg and the aft cg limit.

## **WARNING**

Intentional inverted spins are prohibited.

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**Susceptibility:**

For cg's between 15.8 and 17.0 inches, inverted spins can be achieved if ailerons are held opposite the yaw. Aft of 17.0 inches cg, sustained spins are possible without holding ailerons against the spin. Inverted spins become less likely to occur at cg's forward of 15.8 inches since control positions become more critical. Overall, the ASK-21 is extremely resistant to inverted spins since only sustained inverted stalls result in spins, regardless of cg. Although testing indicates increased resistance forward of 15.8 inches cg, this does not imply inverted spins at more forward cg's are impossible.

**Characteristics:**

The inverted departure and spin entry are essentially a mirror image of the upright case. The nose falls to approximately 60 degrees nose low and then hesitates. Cockpit g forces build to -2 g and the nose

then oscillates back up to 40 degrees nose low. The spin develops in approximately 180 degrees of rotation and is oscillatory just as the upright spin. Altitude loss is 200 to 300 feet per turn and rotation rate is one turn every 3 to 3 1/2 seconds. At the cg's tested, the inverted spin oscillations occur every 3/4 to 1 turn. Once the spin is developed, g forces oscillate between -1 and -1.5 g. Airspeed oscillates near 40 KIAS and remains stalled throughout. Cockpit g forces are uncomfortable but other spin characteristics are very comparable to the upright case.

Inverted spin recovery is immediate (1/4 to 1/2 turn) when controls are neutralized. Altitude loss from initiating recovery to level flight is 400 to 500 feet. Since the spin includes a component of roll rate as well as yaw rate, the aircraft rolls to an upright attitude during recovery on its own, without further pilot input. Airspeeds are typically 90 to 100 KIAS maximum during inverted spin dive recoveries.



**Bundesamt für Zivilluftfahrt (BAZL)**  
**Office fédéral de l'aviation civile (OFAC)**  
**Ufficio federale dell'aviazione civile (UFAC)**  
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CH - 3003 Bern, November 29, 1990

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☎ 031/61 41 11

Telegr.: Civilair Bern  
Telex: 912601 ola ch

Ihr Zeichen  
Votre signe  
Vostro segno

Ihre Nachricht vom  
Votre communication du  
Vostra comunicazione del

Unser Zeichen  
Notre signe  
Nostro segno

Bitte in der Antwort wiederholen  
Prière de rappeler dans la réponse  
Pregasi rammentare nella risposta

Rückfrage  
Rappel ☎  
Richiamo

031/61 59 32

Gegenstand  
Objet  
Oggetto

ASK 21 - Spinning Kit

Mr. Dipl. Ing.  
B.B. Kirkegaard  
Roldvej 15  
DK-9600 Aars

21-1700/Gi/Bk

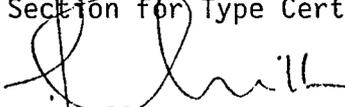
Dear Mr. Kirkegaard,

Reference is made to your telefax of November 22, 1990.

Enclosed you will find all the information we could find on the above subject. We hope these documents and the support of the glider manufacturer will be sufficient for you to get the spinning training approval in your country.

Sincerely yours,

FEDERAL OFFICE FOR CIVIL AVIATION  
Section for Type Certification

  
M. Gattler

Enclosures:

- ASK-21 Stall and spin evaluation (extract)
- ASK-21 Techn. Mitteilung Nr. 4
- ASK-21 HB-1700 Trudelballast
- ASK-21 Flughandbuch (1 sheet)

