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Wytwórnia Sprzętu Komunikacyjnego
„PZL-WARSZAWA-OKĘCIE”

al. Krakowska 110/114 00-973 Warszawa



RECEIVED

JUL 25 1988

AIRTECH CANADA

Airtech Canada
Peterborough Airport
James S. Mewett, Chief Eng.
50 Alexander Ave.
Peterborough, ONT. K9J 6Z4

C A N A D A

Wasze pismo.....

z dnia.....

Warszawa, dnia 1988-07-12

Nazwa: TZK/40101/479/88 13783

Dotyczy:

Re. PZL-104 Wilga 80 airplane with floats

Dear Sir,

With reference to your letter we are sending you informations concerning the "Compliance Program" and two problems designated by N^o 1 in the DOT letter N^o 5010-10-229 addressed to Mr. Adam Zakrzewski (DAR-131).

The aforementioned matters are connected with the increase of the take-off weight of the PZL-104 Wilga 80 airplane with floats from 1300 kg to 1400 kg.

- Clarifications to items marked DAR-131 in the "Compliance Program" we have prepared in a separate list, providing the informations on appropriate substantiations,
- Clarifications pertaining to fatigue strength of the wing system (FAR 23.572) - owing to the similarity of PZL-104 Wilga 80 and Wilga 35 airplanes, being of one design - structural family - we have based on fatigue tests already performed on the PZL-104 Wilga 35 airplanes. The informations about the test results we have included in an extract from the reports on fatigue tests.
- As to ensuring adequate strength of the wings (FAR 23.641) for the version with floats of the PZL-104 Wilga 80 airplane weighing 1400 kg, we have complied with this requirement by introducing the appropriate design - aerodynamic modifications.

./.

- 2 -

We also take the privilege of enclosing the following documents:

- list of clarifications to the "Compliance Program"
- extract from reports on fatigue tests,
- clarifications concerned with wing strength.

We also declare our readiness to supply any further informations if need be,

We remain, dear Sir
yours very truly
Technical Director

L. Frontczak, MSc. Eng

We enclose a copy of
the letter with appendices
for Mr. A. Zakrzewski (DAR-131)

wz


LIST OF ADDITIONAL CLARIFICATIONS

to items marked DAR-131 at "COMPLIANCE PROGRAM"
concerning the increase of take-off weight from 1300 kg
to 1400 kg of the PZL-104 Wilga 80 airplane with floats

<u>REQUIREMENT</u>	<u>DESCRIPTION</u>	<u>COMMENTS</u>
23.301	Structure - general loads	Load Report ON-80-1400
23.307	Proof of structure (a)	Static test 8/BN/WB/79
23.321	Flight loads - general	Load Reports: ON-80-1400-01 ON-10-21
23.331	Symmetrical flight conditions	Load Reports: wing ON-80-1400-02 tail plane ON-80-1400-03
23.333	Flight envelope	Load Report ON-80-1400-01
23.335	Design airspeeds	Load Report ON-80-1400-01
23.337	Limit maneuvering load factors (a1) (b1) (c)	Load Report ON-10-01 Flight Test S-104/WB-L/84
23.341	Gust load factors	Load Report ON-80-1400-01
23.345	High lift devices	Load Report ON-80-1400-01
23.347	Unsymmetrical flight conditions	Load Reports: ON-10-01 ON-80-1400-02 ON-80-1400-03 ON-80-1400-04
23.349	Rolling conditions (a2) (b)	Load wing ON-80-1400-02
23.351	Yawing conditions	Vertical tailplane load ON-80-1400-04
23.373	Speed control devices	Not applied
23.391	Control surface loads	Load Reports - mention at the farther items
23.395	Control system loads	Load Report - The control systems ON-17-01 for G=1300kg, Flaps and flaps control system ON-80-1400-05 Strength analyses - flap and flaps control system ON-80-1400-06

<u>REQUIREMENT</u>	<u>DESCRIPTION</u>	<u>COMMENTS</u>
23.397	Limit controls forces & torques	As higher in point 23.395
23.407	Trim tab effects	Does not apply
23.409	Tab	" " " "
23.421	Horiz. Tail Surfaces - Balancing loads	Load Report-elevator unit OW-13-01 for $Q=1300\text{ kg}$ -horizontal tailplane OW-30-1400-03
23.423	Maneuvering Loads	Load Report -horizontal tailplane OW-30-1400-03
23.425	Gust loads	" " " "
23.427	Unsymmetrical loads (a) & (b)	" " " "
23.441	Vertical Tail Surf.-Maneuvering loads	Load Reports:-vertical tail unit OW-13-02 for $Q=1300\text{ kg}$ -vertical tail unit OW-30-1400-01
23.443	Gust loads	Load Reports:-vertical tail unit OW-13-02 for $Q=1300\text{ kg}$ -vertical tail unit OW-30-1400-04
23.455	Allerons	Load Reports:-Wing OW-12-01 for $Q=1300$ -Wing OW-30-1400-02 Flaps and flaps control system OW-30-1400-05
23.457	Wing flaps	Load Reports:-Wing OW-12-01 for $Q=1300\text{ kg}$ -Flaps and flaps control system OW-30-1400-05 -Argumentation of strength flaps and of flaps control systems OW-30-1400-06
23.471	Ground loads-general	Load Report of the undercarriage -OW-14-01 for $Q=1300\text{ kg}$ Load calculation of the Floats attachment to the fuselage
23.507	Jacking loads	Strength Report for $Q=1300\text{ kg}$
23.509	Towing loads	Strength Report for $Q=1300\text{ kg}$
23.521	Water load conditions	Calculation
23.572	Wing & associated structure	Compilation of the results of fatigue tests of the wing and fuselage structure bearing the wing loads of the PZL-104 Wilga 35 airplane Nr BZN-35-30-16. Comparable structure.

<u>REQUIREMENT</u>	<u>DESCRIPTION</u>	<u>COMMENTS</u>
23.603	Materials and workmanship	Design and test Test Report Strength drawings Technology.
23.605	Fabrication methods	Drawings Technology final factory and state inspection.
23.607	Self-locking nuts	Design, drawings
23.609	Protection of structure	Design, drawings, final factory and state inspection.
23.613	Material strength properties and design values	Design, drawings, state acceptance, strength calculations
23.619	Special factors	Strength calculation and strength Report
23.621	Casting factors	Design, drawings. Not applied
23.623	Bearing factors	Design, drawings, Strength Calculations, Joints with clearance not applicable.
23.625	Fitting factors	Static test Report
23.627	Fatigue strength	Design, drawings
23.641	Wings - proof of strength	Load Report - CIV-80-1400-02 Analysis CIV-80-1400-07 Test Report of Strength 8/BW/WS/79 Flight Test Report S104/NB-1/89
23.697	Wing flap controls	Design, Drawings, Inspection, Report of flaps load and strength: - CIV-80-1400-05; CIV-80-1400-06 Flight Test Report S104/NB-1/89
23.699	Wing flap position indicator	Design, Drawing
23.1309	Equipment, systems & installations	Design, Drawing, Inspection Flight Test Report S104/NB-1/75
23.1541	Markings & placards - general.	Design, Drawings, As dictated by Pilot's Operating Handbook and F.T. Rep., Inspection.
23.1543	Instrument markings - general.	Design, Drawings As dictated P's. O. H. and F. T. Rep. Inspection

<u>REQUIREMENT</u>	<u>DESCRIPTION</u>	<u>COMMENTS</u>
23.1545	Airspeed indicator	Design, Drawings As dictated by P's. O. H. and F.T. Rep. Inspection
23.1555	Control markings	Design, Drawings, As dictated by P's. O. H. and F.T. Rep
23.1557	Miscellaneous markings & placards	Design, Drawings, P's. O. H. Inspection
23.1559	Operating limitations placard	Design, Drawings, P's. O. H. Inspection.
23.1563	Airspeed placards	Design, Drawings, P's. O. H. Inspection.
23.1567	Flight maneuver placards	Design, Drawings, P's. O. H. Inspection.

Chief Designer
of PZL-104 Airplane
W. Gładomski
W. Gładomski, B. Sc., Eng.

Warszawa, 1988

Wytwórnia Sprzętu Komunikacyjnego

PZL - Warszawa - Okęcie

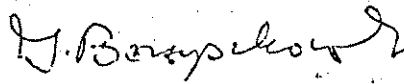
PILOT PLANT

Compilation of the results of fatigue tests of
wing and fuselage structure bearing the wing 1
of the PZL-104 "Wilga 35" airplane

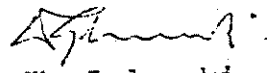
Nº BZW-35-30-16

Prepared by

Chief Designer
of the PZL-104
Wilga Airplane



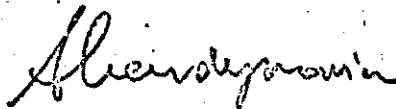
J. Borzyszkowski
M.Sc., Eng.



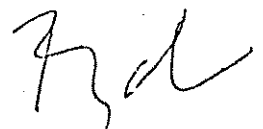
W. Gadomski
M.Sc., Eng.

Deputy Chief Designer
Aircraft Loads, Stress
and Certification

Chief Designer



A. Kaldymowicz
M.Sc., Eng.



A. Frydrychowicz
M.Sc., Eng.

Warszawa, February 1985

2. Programme of tests

Fatigue loads of the wings of the PZL-104 Wilga 3 airplane have been established in /1/ conformity with the methodics shown in /5/ for the value and number of gusts acc. to /6/. In /1/ an analysis has been carried out of fatigue loads for two profiles of operation acc. to fig. 1 and 2 and the average mass in flight $Q = 1200$ kg. The flight profile acc. to fig. 2 was shown to be fatigue dimensioning for the PZL-104 Wilga 3 airplane.

The loads in the tests were assigned for the following average operational conditions:

airplane mass $Q = 1200$ kg /this is the average mass of the airplane during flight, and not the take-off mass/

air speed $V = 170$ km/hour

average flight altitude $H = 500$ m

average flight time $T = 30$ minutes

During fatigue tests the gust loads in a flight lasting 30 minutes have been replaced by equivalent loads in the form of 30 cycles of loads ± 0.42 g, i.e. loads due 30 gusts $W = \pm 3.74$ m/sec. /fig. 3/.

The loads during take-off run, landing run, taxiing have been realized by one cycle of ground loads $n = -0.295$ g

When determining the values of gust loads in flight it has been assumed that:

$$s = \frac{gC_z}{d} = 5.15 \text{ 1/rad.}$$

3. Tests Results

During the fatigue tests the wings of the PZL-104 Wilga 3 and Wilga 35 airplane were mounted on the airplane fuselage. The results of the fatigue tests of the attachable wings are given in table 1, while those of the wing spar in the fuselage are given in table 2.

For the individual elements of the wing subassemblies the service life is:

a/ spar flange

$$L_B = \frac{14910 + 13668 + 7763}{3 \cdot 4.5} = 2700 \text{ hours.}$$

where: 4.5 - is the life factor n_B acc. to BCAR /7/ for three samples

b/ ferrules CF 231012 ed. B and D /wing ferrule/

$$L_B = \frac{6110 + 14910 + 13668 + 6447}{4 \cdot 4.2} = 2450 \text{ hours}$$

where: 4.2 - is the life factor n_B acc. to BCAR /7/ for four samples

c/ wing spar in the fuselage

$$L_B = \frac{3590 + 2 \times 13165 + 2 \times 8418}{5 \cdot 3.8} = 2450 \text{ hours}$$

where: 3.8 - is the life factor n_B acc. to BCAR /7/ for five samples

4. Additional remarks

Fig. 5 displays for information purposes the total flying hours and the average number of flights of the PZL-104 Wilga 35 airplanes when in service of the Aeroclub of the Polish People's Republic as for July 1 st - 1984.

5. Reference

1. Programme and programme motives for fatigue tests of wings, fuselage, control surfaces and main landing gear of the PZL-104 "Wilga - 3" airplane.
Prepared by: Institute of Aviation N^o 27/Z - TK, Warszawa September 1968. - in Polish
2. Fatigue tests of wings, fuselage, control surfaces, and main landing gear of the PZL-104 "Wilga 3" airplane.
Prepared by: Institute of Aviation N^o 1.73.03, Warszawa June 1970. - in Polish
3. Fatigue tests of the PZL-104 "Wilga - 35" airplane
Prepared by: Institute of Aviation N^o 1.73.06, Warszawa December 1971. in Polish
4. Proving the service life of the PZL-104 "Wilga 35" airplane.
Prepared by: Institute of Aviation, Warszawa December 1971. in Polish
5. K. D. Raithby "A Method of Estimating the Permissible Fatigue Life of the Wing Structures of a Transport Aircraft, IRAS November 1961 pages 729 - 738.
6. R.Ae.S. ESDU - Engineering Science Data
7. Civil Aviation Authority
British Civil Airworthiness Requirements,
Part D. Airplanes, edition 12
30 August 1974.

Table 1.. Results of fatigue tests of the attachable wing of the PZL-104 Wilga 3 and Wilga 35 airplanes

Nº	Amount of flying hours represented during fatigue tests	Description of damage	Source of data
1	6110 h a/	Bottom ferrule CE-2310 12 Edit. B in the section of the second row of bolts attaching to spar flange	/2/ table 1, position 2
2	14910 h	Wing spar bottom flange	/2/ table 1, position 4
3	13568 h	Wing spar bottom flange	/3/ page 22
4	6447 h	Bottom ferrule CE 231012 Edit. D in the section of the main bolt	/3/ page 8
5	7763 h.	Wing spar bottom flange	/3/ page 9

a. Results given for attachable wing in the sequence in which the particular damage took place during fatigue tests.

Table 2. Results of fatigue tests of the wing fuselage spar of the PZL-104 Wilga 3 and Wilga 35 airplanes.

№	Amount of flying hours represented during fatigue tests	Description of damage	Source of data
1	13 165 h a/	Crack in the symmetry plane of the lower flange of the spar framework	/2/ - Table 1 position 3
2	3590 h	Crack in the lower flange of the spar framework in the plane of welding in to the flange of the ferrule which fastens the attachable wing.	/2/ - Table 1 position 5
3	8418 h	Crack in the ferrule which fastens the attachable wing.	/3/ - page 8

a/ Results are given for the spar in the sequence in which the particular damage took place during the fatigue tests.

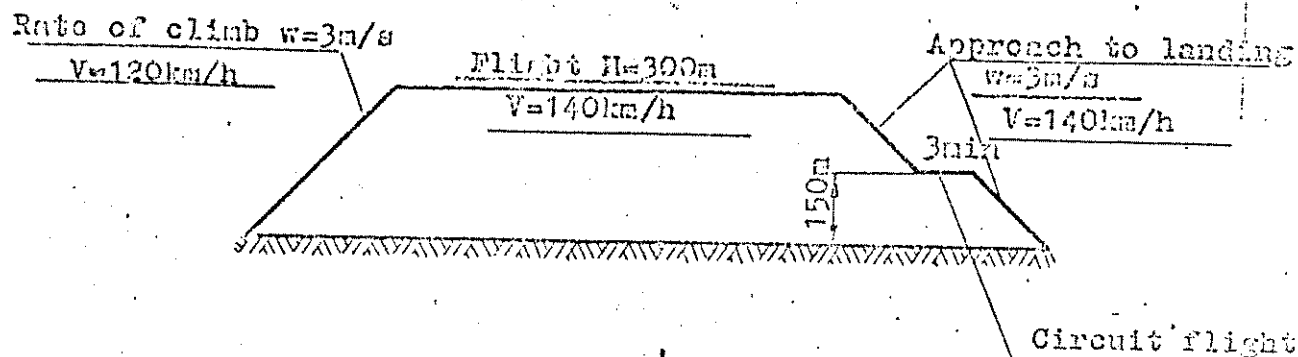


Fig.1 Flight profile for average flight time of 12 minutes.

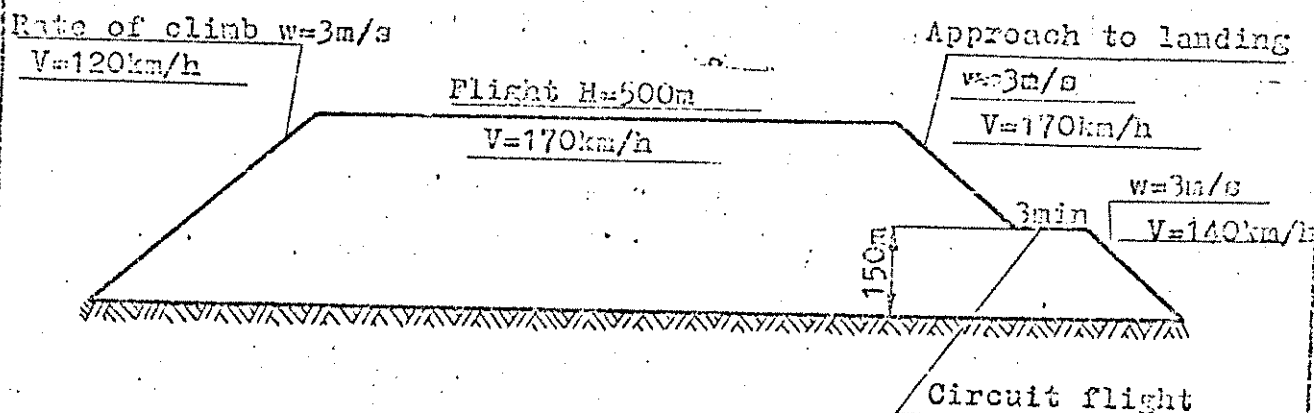


Fig.2 Flight profile for average flight time of 30 minutes.

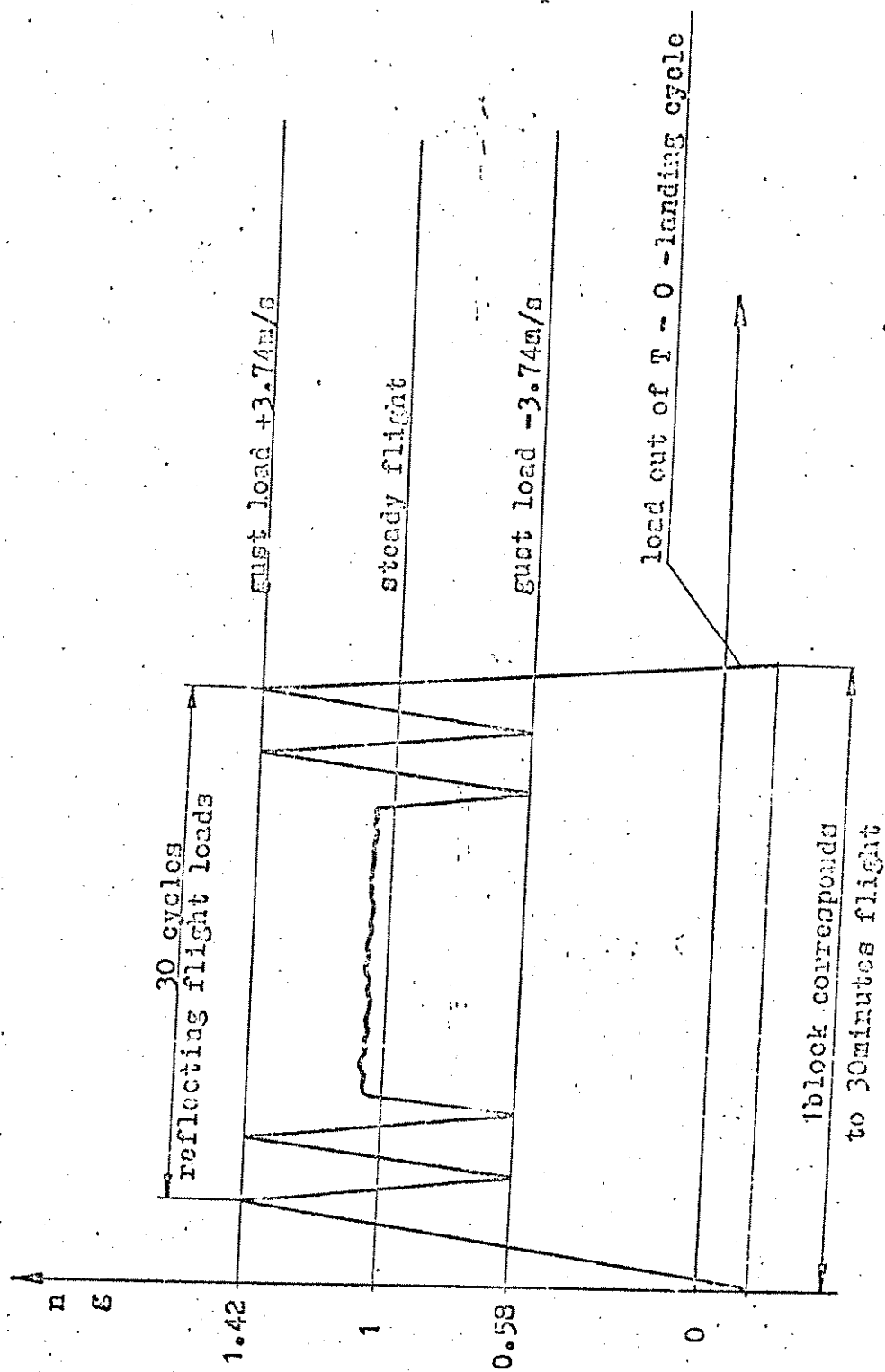


Fig. 3 Attenuations of load factor for average flight.

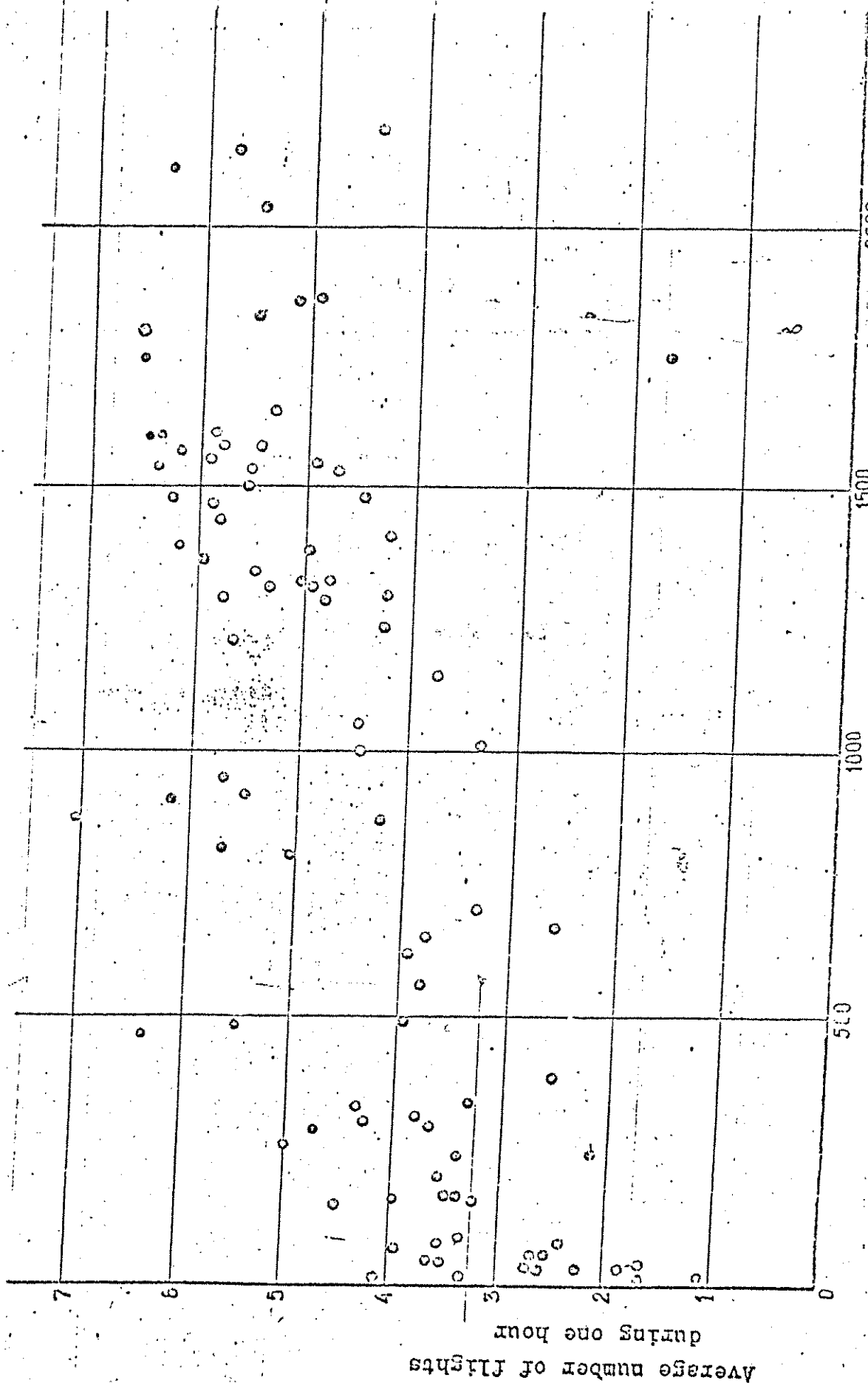


Fig: 4. Average number of flights in one hour of the PZL-104 Wilga-35

airplane carried out at the Aeroclub of the Polish People's

Republic in the function of flying hours /data as given for

1.04.84 and 1.07.84 acc. to letter of the APRU No. TZ-1/606/84

dated 19.09.84 /

84.03.13 JB

Classification

Concerns: PZL-104 Wilga-80 Airplane with Floats

The strength of the wings - as required by FAR-23-641 -
- of the PZL-104 Wilga 80 airplane (with floats) having a take-off
weight of 1400kg, has been obtained by producing - on the wings -
a comparable and verified condition of loads equal to that which
was tested on the wings of Wilga 80 airplane of 1300 kg take-off
weight.

The unchanged system of external loads was preserved due
to changing the distribution of aerodynamic loads along the wing
span. This was feasible in result of modification of the wing
section in the fuselage part by permanent displacing downward
the wing flaps by 11° . This caused a displacement of the resultant
force from aerodynamic loads closer to the fuselage.

Calculations of wing loads from the new aerodynamic distribu-
tion have demonstrated that the produced forces are comparable
to the forces for the basic version of the airplane of 1300 kg
weight, which had successfully passed the static and flight tests.

The comparison of loads has been included in the "Calculations
of External Loads" N^o OW-90-1400-02.

This has also been confirmed by successful flight tests
during which the 1400 kg airplane was subjected to manoeuvre load
factor up to $n = 3.8$ - "Report on Supplementary Tests of the
Airplane" N^o S-104/WB-1/84.

Chief Designer
of PZL-104 Airplane


Wojciech Gadomski, B.Sc.Eng.

Warszawa, 1988