

Appendix I

Copy of a letter from Hawker Siddeley Aviation Limited

Mr Collins,
Deputy Managing Director,
Channel Airways Limited,
Southend Airport,
Essex.

23rd July, 1965

Dear Sir,

H.S.748 Grass Airfield Operation

Further to the recent visit by our Mr. Flannigan, it is understood that background information on H.S.748 grass airfield operations is required.

This subject was first taken up with the A.R.B. with reference to the Skyways Lympe operation, tests done at Lympe resulting in agreement that take-off performance from grass surfaces was definable by increasing the appropriate hard surface distances by the following amounts, as now stated in the Series 2 Performance Manual.

Balanced Field Length	+ 17%
Take-off Run	+ 16%
Emergency Distance	+ 22%
Take-off distance	+ 12%

The measured increases in landing distances from 50 ft. were also found to range from 8% on a dry and hard grass surface to 17% on damp grass with fairly firm sub-soil and to 33% on a very wet and soft surface, but Skyways subsequently obtained the agreement of the Ministry of Aviation that, because of the particular operating circumstances, these distances could be regarded as being part of the normal 67% factor, and no additional factor was required.

When our negotiations concerning the purchase of 748 aircraft were in progress, the question of Portsmouth operation was raised with the A.R.B., who wrote a letter dated April 27th, 1965, the substance of which was made known by our Mr. Edgerton, to, it is believed, Squadron Leader Jones, but which anyway reads as follows:—

“Following comparative examinations of the surfaces at Lympe and Portsmouth, it is agreed that the correction factors on take-off and landing distances already agreed for use at Lympe may also be used for operations at Portsmouth”

It is hoped that this information is adequate for your purpose but if not, we should be pleased to try to assist you further.

Yours faithfully,
for and on behalf of
Hawker Siddeley Aviation Limited

F.O.Sanders
Technical Sales Manager

Appendix II

Copy of a letter from the Air Registration Board

Reference: ARO 1402

21st March, 1966

Hawker Siddeley Aviation Ltd.,
Avro Whitworth Division,
Greengate,
Middleton,
MANCHESTER.

For the attention of Mr. D.C.Wood

Dear Sir,

Performance of the HS 748 when operating from
grass airfields

We have received several requests for information on increases to the take-off and landing distances when operating from grass airfields.

You will recall that tests were run at Lympne in November 1961 and your Flight Test Department produced a report on the subject. Some information, apparently based on your report, appears in the Skyways operations manual.

We feel the time has come to incorporate this information in a 748 Flight Manual appendix, and we would like you to prepare a suitable statement. The correction factors should be applicable to the full range of conditions scheduled for take-off and landing.

Because of the difficulties of defining Wet and Dry grass surfaces this information can only be regarded as best information available. However the Hatfield division of your company have recently done similar work on the HS 125, and it would be advantageous if you could establish whether comparable changes in rolling drag and braking μ 's resulted from your tests.

Yours faithfully,

D.R. Murrin
for Secretary
Air Registration Board

Appendix III

Copy of a letter from Hawker Siddeley Aviation

SALES/76/18

31st March, 1966

Mr. B.F. Collins,
Channel Airways Ltd.,
Southend Airport,
Southend-on-Sea,
Essex.

Dear Mr. Collins,

Thank you for sending the relevant pages of your Operations Manual referring to grass field operation. We shall use this in the case we are now preparing to put to the Air Registration Board.

For your information I am enclosing a copy of the only official indication we have had on this matter and as you will see the letter contains no inference of any kind that the factors already agreed upon will be increased or altered in any way. Any alteration to these factors, unless it was to improve them, would naturally be contested by ourselves, and you may rest assured that the interests of this company are entirely in keeping with your own interests in trying to obtain the maximum performance from the Hawker Siddeley 748 on grass airfields.

Yours sincerely,

K. Edgerton
Assistant Sales Manager

NOTICE TO OPERATORS

H.S.748. AIRCRAFT

SERIES 1, 2, 2A

MODELS AFFECTED
All Models.

LANDING ON SLIPPERY SURFACES – ADDITIONAL FACTORS ON
LANDING DISTANCE

HS.748 aircraft are operating world wide from all types of runway surfaces. In 1967, two incidents occurred in the U.K. on the same day involving landings on a grass airfield which due to unusual weather conditions had a very slippery top surface on a very hard base. The aircraft were unable to come to a complete stop under these conditions within the runway length available.

As a result of these incidents, the U.K. Board of Trade and the Air Registration Board initiated a series of measurements on an in-service HS.748 to assess the effect of various surfaces on the landing distance. The tests covered concrete and grass surfaces in both a damp and wet condition. Simulation of the very slippery surface condition was made by measuring distances without wheel braking. Part worn brakes and tyres were used throughout the tests which were conducted with both engines operating.

The landing distances required given in the Flight Manual include factors on the measured distances to cover operational variables. These include an allowance for variability of the surface. Most surfaces in typical conditions are covered by the Flight Manual factors. However these recent tests have shown that in certain extreme conditions an additional factor on the landing distance required can be necessary. The magnitude of this factor depends not only on the surface friction between the wheels and the ground, but also on the hardness which determines the degree to which the wheels sink into the surface.

Figure 1 has been constructed on the basis of the tests results to show the additional factor recommended. Surface friction and hardness are expressed in the way they were measured during the tests, i.e., friction coefficient at 30 m.p.h., μ 30, and hardness as California Bearing Ratio (CBR) at a depth of 3 ins. The conditions covered in the tests, and the estimated conditions applying at the time of the two incidents, are listed in the following tables :—

NOTICE TO OPERATORS

H.S.748 AIRCRAFT

Surface Conditions Tested

Surface	Friction μ 30	Hardness CBR	Additional factor from Fig. 1
Concrete, damp	0.80	Concrete	1.0
Concrete, wet	0.65	Concrete	1.0
Concrete, no braking	0.05	Concrete	1.9
Grass, damp	0.27	2% CBR (Soft)	1.0
Grass, wet	0.11	1.5% CBR (Very Soft)	1.0

Approximate Surface Conditions at Time of Incidents

Surface	Friction μ 30	Hardness	Additional factor from Fig. 1
Grass, wet	0.1	20% CBR	1.46

It will be noted that the only conditions likely to require an additional factor on the landing distance are a combination of a hard surface and a very low friction coefficient, e.g. an ice covered paved runway or an unpaved runway with very hard sub-soil and a thin slippery layer on top. On such surfaces the high drag from the discing propellers and the large flaps rapidly reduces the aircraft speed from touchdown to about 40 knots. By this speed the propeller drag has fallen to a low value and changes to a small thrust as the speed approaches zero. This characteristic, common to all Dart engine/propeller combinations, causes the final part of the ground run to increase considerably on the slippery surface.

It is impossible to quote precise values of CBR for varying surfaces, but as a guide CBR's less than 5% represent soft or very soft surfaces producing marked rutting, surfaces of CBR 15% are firm and would show little or no rutting, and surfaces with CBR's greater than 20% are effectively hard. Operators will in general have good local knowledge of their own particular airfields under varying weather conditions. This experience will be the best guide as to whether hard, very slippery surface conditions are likely to be encountered during their operations, and whether any additional factor will be necessary when making a decision to carry out a particular landing or to divert.

When making landings on runways which may be slippery, care should be taken to touchdown as close to the start of the runway as practicable

without excess speed. The flight fine pitch stops should be withdrawn immediately on touchdown.

REFERENCES: The Crew Manual is being revised in accordance with above information.

February 10/70

NTO. No.1
Page 3.

NOTICE TO OPERATORS

H.S. 748 AIRCRAFT

EFFECT OF SURFACE FRICTION AND HARDNESS ON LANDING DISTANCE REQUIRED

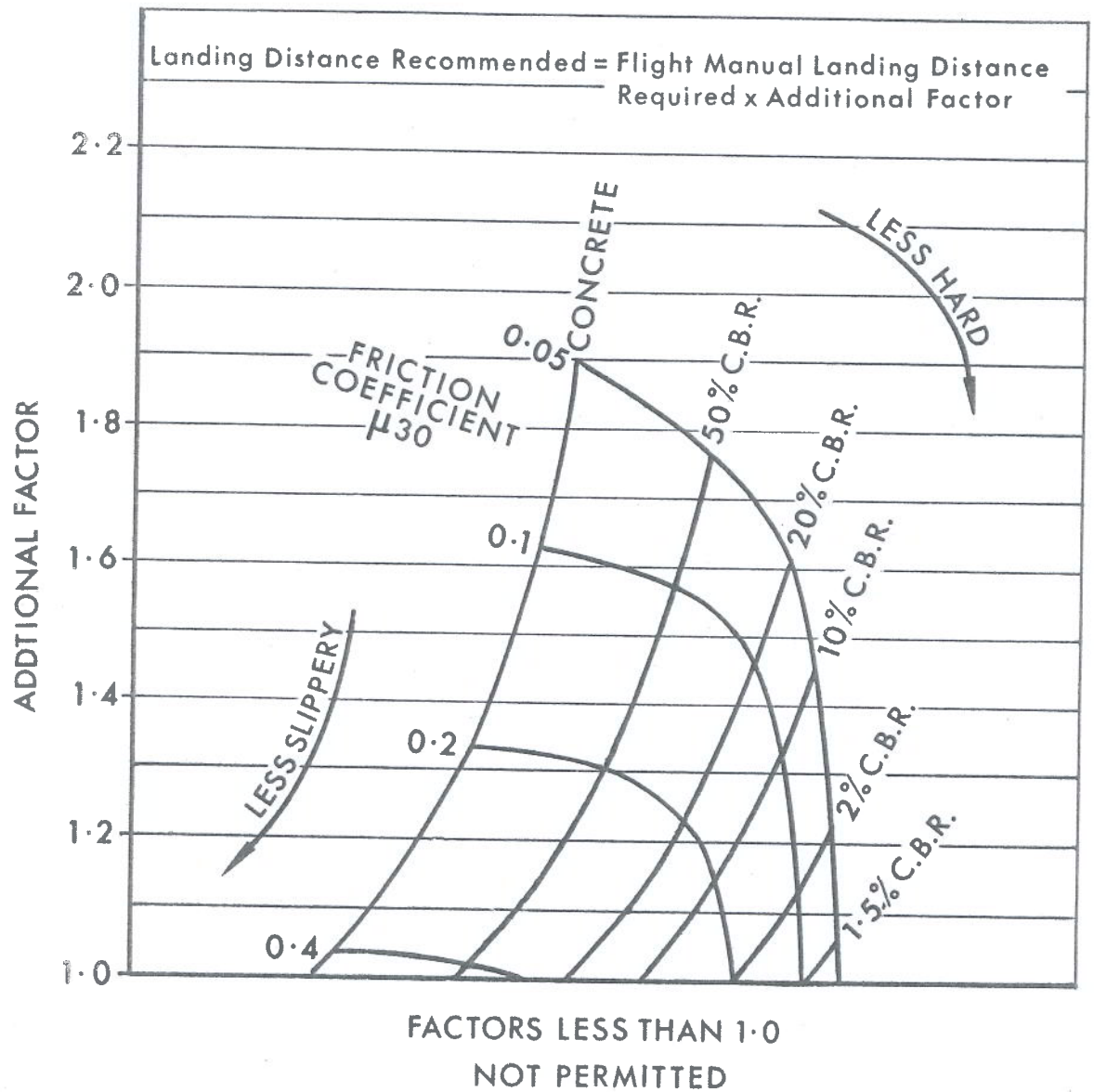


FIGURE 1

February 10/70

NTO. No.1

Page 3