



Worked example for tyre in yawed motion on a dry or wet runway surface

An application of ESDU 13007



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An aircraft manufacturer wishes to estimate the resistive force normal to the plane of a single tyre from a main gear of a transport aeroplane.

1. INTRODUCTION

This Data Item forms part of a series of worked examples which illustrate the application of the methods described in References 1, 5 and 6 for determining the resistive forces acting on a tyre operating on runway surface. Worked examples featuring a single aircraft tyre, and a ground-test machine, operating in linear motion on a runway surface can be found in References 3 and 4 respectively. Reference 10 is a worked example that illustrates the influence that the water content of snow has on the resistive forces acting on the tyre. Background information relating to the application of the models can be found in Reference 2.

This particular worked example is an application of Reference 6, which relates to a tyre in yaw. Relevant data and mathematical relationships from References 7 and 8 are also incorporated.

An unbraked aircraft tyre is travelling along a runway surface at a ground speed (V_G) of 100 knots (168.8 ft/s) at a yaw angle (ψ) of 1° . The objective is to determine the resistive force normal to the plane of the tyre, G_{YAW} . Relevant data for the tyre and runway surface are listed in Section 2. Analyses are performed for a dry runway surface in Section 3 and a water-covered runway surface in Section 4.

Note that the values of all variables listed must be converted to a coherent set of units, as specified in Reference 6. A full list of relevant notation can be found in References 6, 7 and 8.

The calculation processes have been implemented in a computer program. Additionally, the program encompasses the methods relating to aircraft tyres operating in longitudinal motion on dry and contaminated runway surfaces that are described in References 1 and 5. Details of the computer program are given in Reference 11.

2. TYRE AND RUNWAY INFORMATION

2.1 Tyre Data

The relevant tyre data are listed in Table 2.1.

TABLE 2.1 Aircraft tyre data

Tyre parameter	Value	Unit
D	41 (3.4167)	in (ft)
w	14 (1.1667)	in (ft)
d_{TREAD}	0.4 (0.0333)	in (ft)
p_{ABS}	25156.2)	lbf/ft ²
μ_{REF}	1.02 [†]	—

[†] This value is obtained from Table 5.1 of Reference 1.

The normal load acting on the tyre, Z , at a V_G of 100 knots is 18750 lbf.

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