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Flight Tests, Performances, and Flight Certification of a Twin-Engine Light Aircraft

Fabrizio Nicolosi,* Agostino De Marco,† and Pierluigi Della Vecchia‡
University of Naples "Federico II," 80125 Naples, Italy

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This paper deals with flight-test activities performed on the P2006T, a twin-engine light aircraft recently designed and produced by Tecnam. Research activities and flight tests have been conducted during the flight certification of the P2006T for the normal category under European regulation CS-23. All the acquired data and flight results presented have been focused on both aircraft certification and aircraft performance, stability, and flight quality measurements. The data have been acquired through light, accurate, and reliable flight instrumentation available at the University of Naples "Federico II" department of aerospace engineering. Some flight data about aircraft leveled speed, stall speed, climb characteristics, and ground performances (takeoff and landing) will be presented. After preliminary flight tests, winglets have been designed and added to the final configuration in order to obtain good climb performances in one-engine inoperative conditions. Accurate stall tests have been performed in all configurations, and the influence of both the entry rate and the load factor on stall speed have been highlighted. Excellent ground performances have been measured with short takeoff and landing distances compared with similar airplanes. All measured flight performances can be considered very good for this aircraft category and have been used to demonstrate aircraft safety and to obtain CS-23 certification.

Nomenclature

AR = wing aspect ratio
a_Z = vertical acceleration, g
c = chord (also mean aerodynamic chord)
$C_{L\max}$ = maximum lift coefficient, (nW/qS)
C_{Ls} = stall lift coefficient, (W/qS)
e = induced drag efficiency factor
Hp = pressure altitude, ft
n = load factor, a_Z/g
PIW = generalized power parameter
q = flight dynamic pressure, $\frac{1}{2}\rho V^2$
S = wing area
T = temperature
THP_r = thrust horse power required
V = flight speed
VIW = generalized velocity parameter
V_2 = flight speed over obstacle (takeoff)
V_{CAS} = calibrated air speed (usually in kt)
V_{IAS} = indicated air speed (usually in kt)
V_{LOFF} = liftoff speed (takeoff)
V_{NE} = never exceed speed
V_R = rotation speed (during takeoff)
V_{REF} = reference flight speed over obstacle during approach (landing)
V_S = stall speed
V_{TD} = touchdown speed (landing tests)
W = generic aircraft weight during tests
W_{std} = standard aircraft weight
W_{TO} = maximum takeoff weight
X_{cg} = dimensional position of aircraft c.g. on mean aerodynamic chord
α = angle of attack, deg
β = angle of sideslip, deg
δ_a = aileron deflection, deg
δ_r = rudder deflection, deg
δ_S = stabilator deflection, deg
η_p = propeller efficiency
ρ = air density
ρ_0 = sea level air density, standard atmosphere
Φ = bank angle, deg

I. Introduction

THIS paper deals with flight-testing research activity performed on the P2006T aircraft, an innovative twin-engine airplane produced by Tecnam Aeronautical Industries (www.tecnam.com). A large amount of postdesign work and many flight tests have been carried out by the authors during the flight certification of this airplane according to the European Aviation Safety Agency (EASA) regulation CS-23 [1]. The design of this very light twin-engine propeller aircraft with a maximum takeoff weight (MTOW) of 1180 kg has been presented extensively by Nicolosi and Pascale in previous papers [2,3], and its main features are summarized in the next section.

The authors are involved in the flight-research activities of the Aircraft Design and Aeroflightdynamics Group at the University of Naples "Federico II," Department of Aerospace Engineering (DIAS). Researchers of this group have been gaining experience in flight testing since 1997. Light and ultralight airplanes have been one of author's focus in recent years. The details of past experiences are found in the cited [4–6]. Most of the flight-test work has dealt with aircraft flight certification and flight-quality assessment.

All flight data have been acquired through light, fast, and reliable flight instrumentation available at the DIAS. The importance of the reliability and accuracy of flight-test instrumentation has already been experienced by de Oliveira et al. [7], Coiro et al. [8], and Giordano et al. [9], and the instrumentation (both the sensors and the acquisition system) used is the evolution of that used for ultralight aircraft (ULM) flight tests since 1998. A continuous improvement of the sensors and the acquisition system has been realized during the past years. The present system represents a very good compromise

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*Assistant Professor, Department of Aerospace Engineering (DIAS), Via Claudio 21; fabrnico@unina.it. Senior Member AIAA.

†Assistant Professor, Department of Aerospace Engineering (DIAS), Via Claudio 21; agodemar@unina.it. Senior Member AIAA.

‡Ph.D. Student, Department of Aerospace Engineering (DIAS), Via Claudio 21.