

Design of a Modern Passenger Aircraft with Diesel Engine and Propeller

Purpose – This project investigates the economic viability of a large diesel-powered passenger aircraft based on the Airbus A320-200 Top Level Aircraft Requirements (TLAR) and its possible contribution to reducing CO₂ emissions.

Methodology – A redesign of the A320-200 is used as reference aircraft. In a second step, a turboprop aircraft that meets the previously defined requirements is prepared. The difference is just in the engines and the cruise Mach number reduced from 0.78 to 0.68. In a third step, an aircraft with diesel engines and propellers is sized. The required parameters for this engine are determined from literature. In addition, a possible use of the diesel aircraft for a shorter flight distance is examined. Preliminary sizing is done with existing spreadsheets (Figure 1) adapted to diesel engine parameters.

Findings – The power-specific fuel consumption of the turboprop and the diesel aircraft were both set to 210 g/kWh. While the maximum take-off mass of the turboprop aircraft is only 2% higher than that of the turbofan aircraft, it is as much as 84% higher for the diesel aircraft. This is due to the low power density of the diesel aircraft, which is just 1 kW/kg, while being 4.15 kW/kg for the turboprop. As a result, the turboprop only consumes 3.5% more fuel than the turbofan, while the diesel aircraft consumes about 87% more fuel than the turbofan. With range reduced from 2125 NM to 500 NM, maximum take-off mass and fuel mass increase is less, but still very high for the diesel aircraft. Therefore, it is not possible to use large passenger diesel aircraft in an economically or ecologically reasonable way.

Research limitations – Work is done on preliminary sizing level.

Practical implications – The existing preliminary sizing tools for turboprop aircraft can now also be used for the calculation of aircraft with piston engines.

Social implications – A comparison of large passenger aircraft with turbofan, turboprop, and diesel aircraft is now possible. This allows a fact-based discussion about a possible use of diesel engines for large passenger aircraft.

Originality – A comparison of engine options for large passenger aircraft including diesel engines could not be found in the literature. It is now part of the scientific body of knowledge.

This informative poster is based on a student project with the same title. Details here:

<https://nbn-resolving.org/urn:nbn:de:gbv:18302-aero2023-10-07.018>

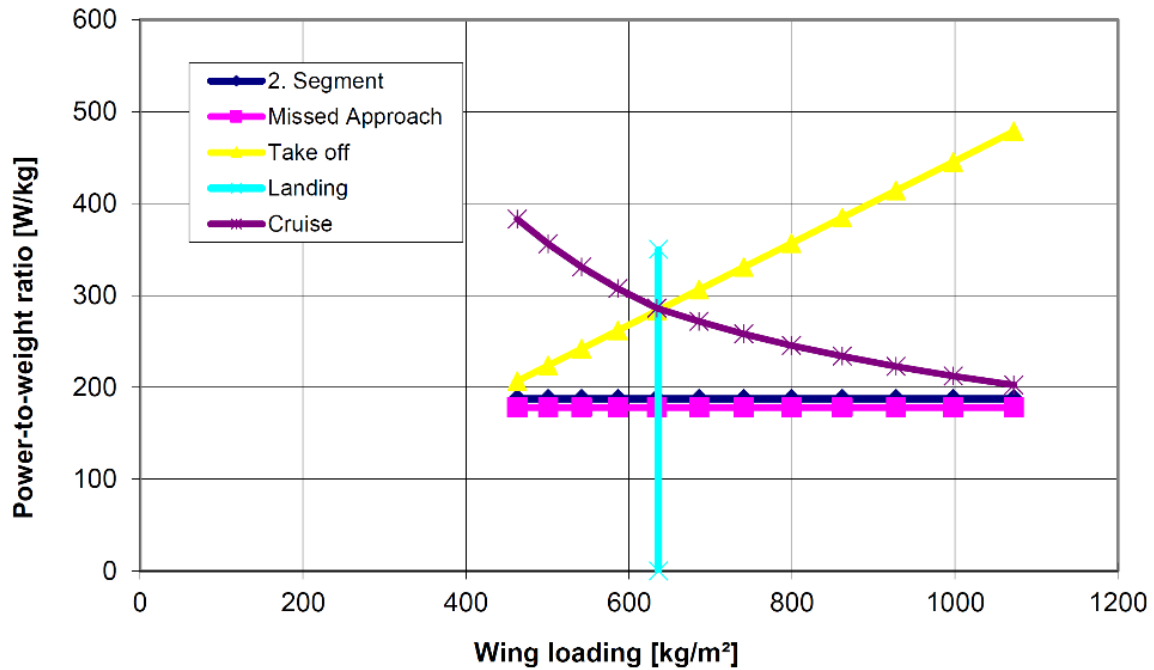


Figure 1: Matching chart of the diesel aircraft – just one result from the used spreadsheet.

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