

Конвертоплан: перспективи

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Сучасний авіатранспорт щораз частіше потребує високошвидкісних літаків з метою ефективнішого функціонування. Проте кожен літак платить набагато вищу ціну за збільшення швидкості: поступається в якості польоту, дальності, вантажопідйомності та тривалості польоту. Поєднання вищої швидкості зі здатністю вертикального зльоту та приземлення забезпечило б унікальні транспортні (і не лише) можливості, проте ще дорожчою ціною. Цією ціною є розвиток технологій, виробництва та керування літаком. Зрозуміло, що будь-який літак, який усуває або певним чином обмежує залежність від конкретних злітних смуг, надає будь-якому диспетчеру, військовому чи цивільному, незрівнянну операційну здатність і гнучкість. Гелікоптер, мабуть, ще не досяг меж своїх можливостей, але їх вдосконалення вимагатиме більш інноваційних технологій, ніж тих, які використовувалися досі. Фахівці-інженери вже довгий час визнають необмежені можливості збільшення якості польоту гелікоптерів, особливо унікальні технічні труднощі та виклики, пов'язані з їхньою крейсерською швидкістю. Протягом більш, ніж п'яти десятиліть гвинтокрильна промисловість також проявляла зацікавленість до альтернативних концепцій, намагаючись поєднати неперевершену здатність зависання гелікоптера з набагато вищими крейсерськими швидкостями літаків. Конвертоплани з поворотними крилами – гібридні конвертовані гвинтові концепти. Завдяки своєму дизайну конвертоплани можуть літати на набагато вищій крейсерській швидкості, ніж гелікоптери, вносячи, отже, принаймні одну велику перевагу у якість польоту. Проте, як і гелікоптер, конвертоплан – компромісне інженерне рішення (мабуть, навіть більше), і він не є настільки аеродинамічно ефективним, як гелікоптер у завислому польоті або літак у горизонтальному польоті.

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Tiltrotor – no thoroughfare or way ahead?

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The concept of tiltrotor aircraft is nothing new. Its roots came to 1930s when the first design, which resembles to modern tiltrotors was patented. The problem was that the technology in that times was not able to support such a complex program. Only in recent years the demands for a new design combining the advantages of helicopter and aircraft in combination with advanced technology base led to various experiments, testing phases and following production of new tiltrotor aircrafts. This article is dealing with advantages and disadvantages of tiltrotor design aircraft and concentrates on two types – military V-22 Osprey and civilian BA-609.

Keywords – tiltrotor, helicopter, transport, speed, airplane, rotor

I. Introduction

The tiltrotor's advantage compared to helicopters is primarily the speed. Although a helicopter is a remarkable rotating-wing aircraft and proof of aeronautical engineering mastery, it is also a technically compromised aircraft with several performance limitations including range and cruising speed. In a helicopter the maximum forward speed is defined by the speed that the rotor turns at, at some point the helicopter will be moving forward at the same speed as the backward-moving side of the rotor is spinning, so that side of the rotor sees zero airspeed, and stalls. In reality the maximum speed is even less than this. However with the tiltrotor this problem is avoided, because the rotors are perpendicular to the motion in the high-speed portions of the flight regime. This means the tiltrotor has relatively high maximum speed, up to 300 knots (560 km/h) has been demonstrated in the two major types of tiltrotors flown. They require about 50% more installed power as a helicopter of the same lifting capacity, meaning that the tiltrotor requires larger engines for a given mission, increasing its cost and reducing the time it can hover (for a given fuel load). However, the wing of the tiltrotor is significantly more efficient than the rotor of a helicopter, so that they use considerably less fuel per unit distance when at high speed. This helps offset the smaller payload of the tilt rotor, especially at longer ranges. These abilities are notably important for the military, where speed and time are critical factors. Commercial sector has also recognised advantages of this configuration so we can expect a wide spread of civilian tiltrotors. Apart from the unmanned aerial vehicle (UAV) prototypes and proposed larger four-rotor military medium cargo airplane, in active service is now only one tiltrotor (military V-22 Osprey) and one is in pre-production phase (civilian BA-609).

II. Bell-Boeing V-22 Osprey

The V-22 Osprey, an aircraft that has been in development for about 25 years and has a very controversial past and uncertain future. It was designed for future irregular warfare environment covering full

scale of missions, especially in third-world conflicts with lack of infrastructure. But its operational problems and deployment experience raise serious questions whether the aircraft can accomplish the full range of missions of the helicopter it was intended to replace, or the range of missions provided by other modern helicopters.

Every new design is struggling with problems such as unreliable component parts, development delays and many funding debates. V-22 is not an exception. Deployment experience shows that Osprey has successfully completed all missions assigned but only in a low threat theater of operations. Tiltrotor applied its enhanced speed and range and the ability to fly at higher altitudes in airplane mode avoiding the threat of small arms fire while carrying up to 24 Marines. On the other hand, the Osprey is very vulnerable to hostile fire, lacks sufficient maneuverability and is unreliable in „hot and high“ conditions. Further, the V-22 does not have a pressurised cabin and worse, it cannot autorotate to a safe landing.

III. Bell/Agusta BA-609

The BA-609 is the world's first commercially available tiltrotor aircraft. This tiltrotor can carry up to nine passengers in pressurised composite cabin. The BA-609 is pressurised to fly at altitudes up to 25,000ft and its de-icing capability with heated rotor blades allows flight into known icing conditions. Crashworthy seats for crew and passengers are fitted as standard.

The spectrum of possible roles is vast: from corporate transport with maximum range of 900km, offshore utility, coast guard, emergency medical service to search and rescue missions. Unlike the Osprey, the BA-609 successfully demonstrated dual engine out capability by performing numerous autorotations, demonstrating airplane mode windmill state and performing power off reconversions from airplane mode to helicopter mode. The autorotations to power recovery demonstrated that the flare could reduce the vertical speeds and ground speeds close to landing gear design speeds. BA-609 is now waiting only for a successful dual certification from Federal Aviation Administration (FAA) and International Civil Aviation Organization (ICAO) which is necessary for flourishing enter to main world markets. However, additional research focusing on noise and downwash reduction would be still needed, because especially the second feature is critical for aircraft which cannot land at rescue sites.

IV. Conclusion

Simply said, the tilt rotor technology is based on ability switching the rotor into a propeller.

This technology and design is still in its infancy. Several prototypes has been built on this convertible basis and some of them are still waiting on drawing boards. Cruise speed, main advantage of tiltrotors, is not the only metric for measuring the transport utility of any type of aircraft – what is fundamentally important to an operator (military or civilian) is payload and range, as well as transportation efficiency benefit versus cost. Osprey proved its justification at least among US officials, but has a long way to improve its combat abilities and especially safety. Now it is time for civilian tiltrotors to show their options. First of them, BA-609 has a great commercial potential and holds strong promise for a variety of missions. Unfortunately, due to several fatal crashes concerning the V-22 Osprey, this type and its successors will be under the microscope of entire public and even small faults could threat or suspend the whole program. However, first impressions of BA-609 type are more than good and probably we should expect commercial achievement of this concept.

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