DOWNLOAD PDF FOLLOW-ON LOW NOISE FAN AERODYNAMIC STUDY

Chapter 1 : Preliminary Fan Design for a Silent Aircraft | Journal of Turbomachinery | ASME DC

NASA / CR Follow-on Low Task Final Report Noise Fan Aerodynamic Study Nathan J. Heidegger, Edward J. Hall, and Robert A. Delaney Allison Engine Company, Indianapolis, Indiana.

Mechanisms of sound production[edit] Small general aviation aircraft produce localized aircraft noise. Helicopter main and tail rotors produce aerodynamic noise. Aircraft noise is noise pollution produced by an aircraft or its components, whether on the ground while parked such as auxiliary power units, while taxiing, on run-up from propeller and jet exhaust, during take off, underneath and lateral to departure and arrival paths, over-flying while en route, or during landing. This movement propagates through the air as pressure waves. If these pressure waves are strong enough and within the audible frequency spectrum, a sensation of hearing is produced. Different aircraft types have different noise levels and frequencies. The noise originates from three main sources: Engine and other mechanical noise Aerodynamic noise Noise from aircraft systems Engine and other mechanical noise[edit] Much of the noise in propeller aircraft comes equally from the propellers and aerodynamics. Helicopter noise is aerodynamically induced noise from the main and tail rotors and mechanically induced noise from the main gearbox and various transmission chains. The mechanical sources produce narrow band high intensity peaks relating to the rotational speed and movement of the moving parts. In computer modelling terms noise from a moving aircraft can be treated as a line source. Aircraft gas turbine engines jet engines are responsible for much of the aircraft noise during takeoff and climb, such as the buzzsaw noise generated when the tips of the fan blades reach supersonic speeds. However, with advances in noise reduction technologiesâ€"the airframe is typically more noisy during landing. The high velocity jet leaving the back of the engine has an inherent shear layer instability if not thick enough and rolls up into ring vortices. This later breaks down into turbulence. The SPL associated with engine noise is proportional to the jet speed to a high power. Therefore, even modest reductions in exhaust velocity will produce a large reduction in Jet Noise. The PowerJet SaM in the Sukhoi Superjet features 3D aerodynamic fan blades and a nacelle with a long mixed duct flow nozzle to reduce noise. This type of noise increases with aircraft speed and also at low altitudes due to the density of the air. Jet-powered aircraft create intense noise from aerodynamics. Low-flying, high-speed military aircraft produce especially loud aerodynamic noise. The shape of the nose, windshield or canopy of an aircraft affects the sound produced. Much of the noise of a propeller aircraft is of aerodynamic origin due to the flow of air around the blades. The helicopter main and tail rotors also give rise to aerodynamic noise. This type of aerodynamic noise is mostly low frequency determined by the rotor speed. Typically noise is generated when flow passes an object on the aircraft, for example, the wings or landing gear. There are broadly two main types of airframe noise: Bluff Body Noise â€" the alternating vortex shedding from either side of a bluff body, creates low-pressure regions at the core of the shed vortices which manifest themselves as pressure waves or sound. The separated flow around the bluff body is quite unstable, and the flow "rolls up" into ring vorticesâ€"which later break down into turbulence. Other internal aircraft systems can also contribute, such as specialized electronic equipment in some military aircraft. Health effects from noise Aircraft engines are the major source of noise and can exceed decibels dB during takeoff. While airborne, the main sources of noise are the engines and the high speed turbulence over the fuselage. Elevated workplace or other noise can cause hearing impairment , hypertension , ischemic heart disease , annoyance , sleep disturbance , and decreased school performance. The health data of over one million residents around the Cologne airport were analysed for health effects correlating with aircraft noise. The results were then corrected for other noise influences in the residential areas, and for socioeconomic factors, to reduce possible skewing of the data. Statistically significant health effects did however start as early as from an average sound pressure level of 40 decibels. These standards designate changes in maximum noise level requirements by "stage" designation. Cabin noise can be studied to address the occupational exposure and the health and safety of pilots and flight attendants. In , 64 commercial airline pilots were surveyed regarding hearing loss and tinnitus. Noise mitigation programs[edit] Noise-reducing chevrons on a Boeing turbofan [19] In the United States, since aviation noise became a public issue in the late s, governments have enacted legislative controls. Aircraft designers, manufacturers, and operators have developed quieter aircraft and better operating procedures. Modern high-bypass turbofan engines, for example, are quieter than the turbojets and low-bypass turbofans of the s. This has resulted in lower noise exposures in spite of increased traffic growth and popularity. Congress authorized the FAA to devise programs to insulate homes near airports. While this does not address the external noise, the program has been effective for residential interiors. A computer model is used which simulates the effects of aircraft noise upon building structures. Variations of aircraft type, flight patterns and local meteorology can be studied. Then the benefits of building retrofit strategies such as roof upgrading, window glazing improvement, fireplace baffling, caulking construction seams can be evaluated. The trials demonstrated that using satellite-based navigation systems it was possible to offer noise relief to more surrounding communities, although this led to a significant unexpected rise in noise complaints 61, [26] due to the concentrated flight paths. The study found that steeper angles for take-off and landing led to fewer people experiencing aircraft noise and that noise relief could be shared by using more precise flight paths, allowing control of the noise footprint of departing aircraft. Noise relief could be enhanced by switching flight paths, for example by using one flight path in the morning and another in the afternoon. NASA expects a cumulative 20â€"30 dB below Stage 4 limits by â€", but keeping aircraft noise within airport boundaries requires at least a 40â€"50 dB reduction. Landing gear , wing slats and wing flaps also produce noise and may have to be shielded from the ground with new configurations. NASA found over-wing and mid-fuselage nacelles could reduce noise by 30â€"40 dB, even 40â€"50 dB for hybrid wing body which may be essential for open rotors. Package delivery UAS will need to characterize their noise, establish limits and reduce their impact.

Chapter 2 : Low Noise & High Efficiency Fan (Blade/Impeller) Design, Testing & Problem Analysing

Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.

Chapter 3 : Aircraft noise - Wikipedia

the fan noise, in order to study the noise Qibai Huang [18] and Hemond [19]. In our study, a theoretical method for making low-noise fans is combined with a study of aerodynamic characteristics.

Chapter 4 : An Experimental and Numerical Study on Wake Vortex Noise of a Low Speed Propeller Fan

Study on the aerodynamic noise of internal flow of regenerative flow compressors for a fuel-cell car sound source for the low Mach number fan blade.