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INLET DUCT ENGINE TEST FACILITIES IN INDONESIA LOW SPEED TUNNEL (ILST)

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Abstract

Designing activities covering various aspects of fighter aircrafts are very complex such as aircraft airframe, propulsion system, anti-radar, the problem of structure and materials used. In this paper the author examines the field of propulsion-related air intake inlet. In the area of the inlet piping support incoming airflow to the engine driving the aircraft is a fairly important part. The development forms the inlet piping is also an influence on aircraft flying at Mach number range from 0.3 to 2. Requirements to be met are a form of air inlet piping providers so that the pressure recovery closes to 100% and the value of the Aerodynamic pressure distortion Plane Interface (AIP). Tests prepared on measuring the inlet piping using pressure measurement techniques. There are two types of facilities were assessed for testing aircraft Engine Inlet Duct. The first is based on the numerical simulation techniques with commercial code computational fluid dynamics and the second with air injection technique with the desired flow rate. The study showed that the facilities can be applied in Indonesia Low Speed Tunnel (ILST) for testing in subsonic regime.

1 Introduction

Indonesia recently develops civil aircraft as well as military aircraft. Any type of aircraft development requires testing in a wind tunnel so that obtained the most reliable performance. Testing also applied to the inlet duct test to gain knowledge of whether the air supply to the engine is adequate at the occurrence takeoff and landing. Air supply inlet flows through the duct system within the shape of the letter S, known as the S-duct and continue to flow towards Aerodynamics Interface Panel (AIP) finally gets into the engine.

In carrying out the testing needed amenities such as on-site test wind tunnel software, Computational Fluid Dynamic (CFD) and human resource. ILST equipped with measuring forces, pressure and has a pressurized air system to drive the propeller testing done at the power on test.

2 Test Facility

The main facilities the development testing of the aircraft is the wind tunnel [1]. ILST is a large wind tunnel test section size is 4 x 3 m^2 and the wind speed can be up to 100 m/s, [2] which can be seen in Figure 1. While Figure 2 shows a diagram of ILST.

Fig. 1. Indonesia Low Speed Tunnel.

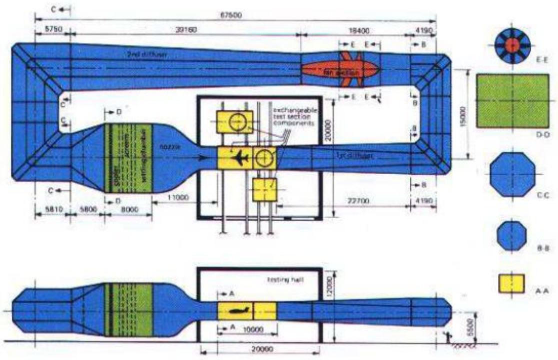

Fig. 2. Indonesia Low Speed Tunnel (diagram).

In addition National Laboratory for Aerodynamics Aero-elastics and Aero-acoustic has the facility of computing with Fluent software [3].

3 Theory

As far as we known in order to adequately the supply of air to the aircraft engine, the inlet pressure and the total pressure in the AIP are not going change. This can be expressed as a ratio of Ptot inlet / Ptot AIP = 1 [4].

The shape of the pipeline which is often used in fighter aircraft-shaped letter S or Y [5] [6]. The form is useful to reduce the capture by radar [7]. Measurement on AIP using pressure rake as shown in Figure 3. While the value inlet total pressure approximately equal to the total pressure tunnel reference.

Fig. 3. Pressure rake to measure total pressure PT2 at AIP.

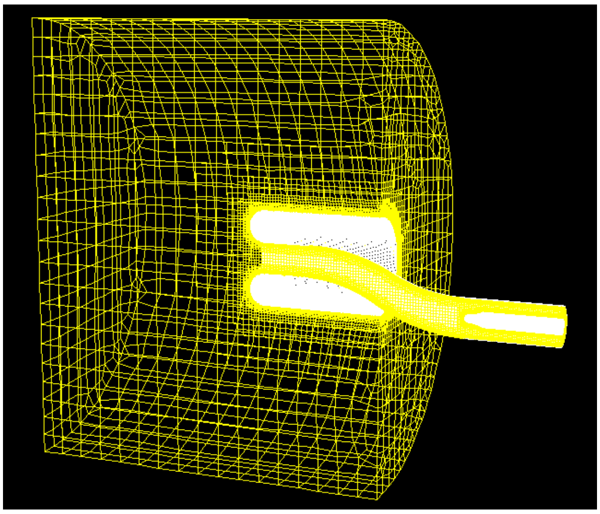

Fig. 4. Mesh or grid of the S duct model.

In order to know the flow in the duct comprehensively we carried out a simulation by solving the Navier Stokes equations of motion. To solve NS equation turbulence model by using k-omega sst model. Furthermore the mesh or grid is needed to perform simulation. Mesh of model ducting shown in the figure 4.

4 Result and Discussion

CFD simulation results presented below with vertical axis is pressure recovery ratio of PT2/PT0 vs. horizontal axis mass flow with Mach number variation can be seen in Figure 5.

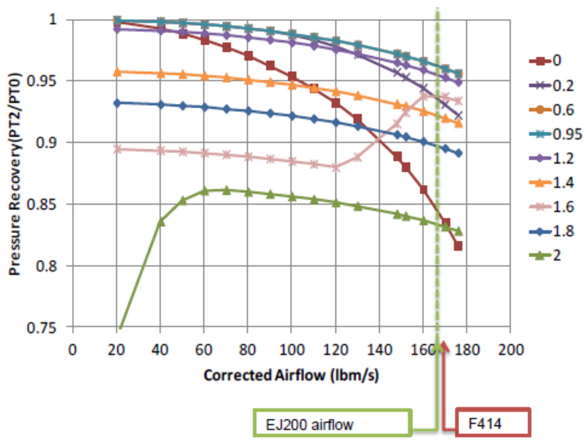

Fig. 5. Pressure recovery vs. mass flow.

5 Conclusion

In the development of civil and military aircraft requires in-depth study. Research of air-duct suppliers both in numeric simulation or experiment is very important.

The results of the simulation are presented in Figure 5 in the regime subsonic with Mach number 0.2 show the pressure recovery is quite good although generally decreased with increasing mass flow.

At transonic to supersonic regime indicates that the pressure recovery have rates above 0.9 with mass flow under 160 lbm/s except for Mach number 1.6 and 2.

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