PROPOSAL FOR IMPLEMENTING THE WORKPLACE ENGINE TEST TRANSPORT AIRCRAFT

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The text contains brief summary of the thesis of T. Chrenko issued by the Faculty of Aeronautics Technical University of Košice. The paragraphs provide information on importance of the engine testing of transport aircraft and it´s precautions and proceeding at M. R. Štefánik Airport in Bratislava. The author suggests building of a special workplace for engine tests of transport aircrafts for Boeing 737 in regard to protecting people´s health and keeping legislation.

K e y w o r d s: engine testing of transport aircraft, M. R. Štefánik Airport in Bratislava, Boeing 737, jet blast deflector

1 INTRODUCTION

Nowadays, many people are interested in civil aviation, mostly in catastrophically reports. Air transport accidents are often caused by combination of human error and technical problems. To keep the aviation transport´s highest safety it is important also perform aircraft engine tests. The biggest international airport in Slovak republic is M. R. Štefánik Airport in Bratislava.

The aim of the thesis was to propose a design of workplace of implementation of transport aircraft engine test for Boeing 737.

The work describes importance and layout of engine tests and the most important precautions. It informs about current solution of engine tests of transport aircraft at the airport in Bratislava and offers a view of possibility to build a new modern workplace for engine test running specifically designed for terms and conditions at this airport.

Procedures for each type of aeroplane can differ and therefore it is important to proceed according to the particular Aircraft Maintenance Manual – AMM.

2 ENGINE TEST

2.1 Importance and layout

Engine test is made to see correct engine utility and related systems and for ensure operational safety before returning the aircraft to service after maintenance, repair or replacement of some components. According to Aircraft Maintenance Manual for Boeing 737 engine test is divided into 13 tests. First one is Test 1 – Pneumatic Leak Test. The next tests are: Test 2 – Dry Motor Leak Check, Test 3A – Idle – Power Leak Check, Test 3B – Part – Power Leak Check, Test 5 – Power Assurance Check, Test 7 – Vibration Survey, Test 8 – Acceleration Check, Test 9 – Replacement Engine Test (Pretested), Test 10 – Replacement Engine Test (Untested), Test 12 – Actuators Test, Test 13 - Engine Run – EEC BITE Test, Test 14A – (Fan Trim Balance (Three Shot Plot Procedure) and the last of 13 tests for Boeing 737 is Test 14B – Fan Trim Balance (On Board Procedure).

Procedures for each type of aeroplane can differ and therefore it is important to proceed according to the particular Aircraft Maintenance Manual (AMM).

2.2 Precautions

Much attention is paid to precautions at motor tests. Aircraft engine tests are performed on specific airport areas by especially trained staff. The staff has to keep precautions such as correct placement of aircraft in regard to wind direction and force. Before engine tests and within them the staff proceeds according to AMM.

Aircraft engine test is made after maintenance, repair or replacement of the engine or some of its components.

The procedure of engine test running after motor replacement varies according to whether the engine had been pre-tested or not. Pretesting makes the producer or an authorized service centre.

If the replaced engine has been pretested there is a need to make a few tests as for example Engine Fire Detection, Engine Cowl Anti-Icing, Supply Pressure to the Pneumatic System, Engine Vents and Drains Inspection and the other ones, altogether 15 subtests. If the engine was conserved there is a need to de conserved it. The most of the aircraft engines is pretested so there is no need to precede any other subtests. If the engine has not been pretested there is a need to make additional subtests: Test 7 – Vibration Survey, Test 5 – Power Assurance Check, and the other subtest which are itemized in AMM.

Before beginning of the engine test, it is necessary to assure that no things that could be absorbed by the engine are near it and also that people are in the safe area. The staff has to know hazard areas to protect people´s health and lives and to prevent engine damage. The staff works with protective equipment as soundproof headphones. It is recommended to use also safety rope for person's fixation.

After engine test there is a need to make another precautions. The staff needs to be careful and to do not touch any hot part of the engine as this could cause burns. At touch of the rests of oil or fuel coul be toxic substances absorbed into skin. The lid on the pressure oil system should be not opened until the pressure is zero. It usually takes five minutes.

For eradication and prevention of ice on the aero plane on its wings, fuselage and engine-cowlings is used de-icing fluid. If de-icing fluid has been actually used it is necessary to keep more precautions: to check if de-icing fluid has not got into the engine. If so, then cleanse fan

carefully with clean cloth. Always when it is possible a throttle has to be pre-adjusted slowly and smoothly. The aero plane has to stand against wind direction. Engine test proceed at recommended wind speed.

If there is a need to precede an engine test at the workplace with traffic, it is important to do more actions to avoid treat of another people or machines. One of the possibilities is using of jet blast deflector. It is special equipment that change angle of the output current of air mostly in vertical direction. [1]

The most dangerous thing at engine running is the air. It is mainly at entry corridor where a vacuum is and therefore some things or people could be absorbed into the engine. The staff is obliged to know hazard areas and also safe ones for approach to the engine.

3 CURRENT SOLUTIONS

Nowadays, transport aircraft engine tests at our biggest airport are proceeded at all four engine modes: IDLE, BREAKAWAY, TAKE OFF and REVERSE. They are proceeded on remote taxiway D between railways 13 and 22. Tests in IDLE mode can be done after deal with operational dispatching and agreement of control tower also on aircraft stands numbers 1 - 20, 31 - 35. The engine tests in higher modes are proceed on taxiway D and are enabled just at optimal wind direction. There cannot be also any operating restrictions there. The aircraft can be at engine test on aircraft stand or in hangar A, B, C or before the hangar.

Before beginning of the test operational dispatching controls areas where the test will be done – if they are clean and operable. If necessary the dispatching ensures preparation of areas. It also ensures towing tractors according to maximum take-off weight (MTOW) of an aeroplane and escorts the plane during tugging.

At current engine tests no technical resources that would decrease adverse effects of aircrafts noise and vibrations in terms of environmental protection are used. For this reason, in order to precede the engine tests in this airside there must be optimal weather and operating conditions.

4 JET BLAST DEFLECTORS

Jet blast deflectors are used to protect people, buildings and things before output current of air at engine test. The constructions need to be very solid and firm. Jet blast deflectors begin to be used at the biggest airports from 50-ies of the 20th century. [1]

They are often also at beginning of runway, especially when there is a road or another traffic before the runway. Airports in towns are often surrounded by a special fence, which prevents the spread of air flow from the engine. As sound spread is influenced also by weather, mostly wind force and direction, this needs to be taken into account at choice of jet blast deflector.

Figure 1 Jet Blast Deflector at the airport in Budapest [1]

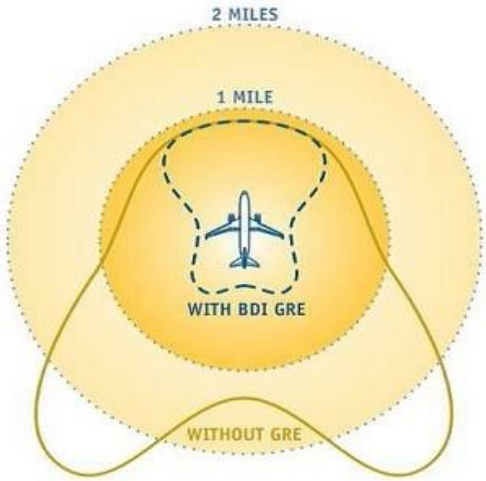

Figure 2 Influence of using jet blast deflector to sound spread [1]

5 PROPOSALS FOR NEW WORKPLACE FOR ENGINE TESTS RUNNING

On the basis of the own experiences with engine test running was the author inspired to design a workplace for engine test running.

Current workplace for engine tests is not suitable in regard to weather nor operating conditions, mainly regular and irregular air transport. Therefore, it is important to build a new workplace in suitable place. It should be taken into account also influence of noise on occupied sites.

The most appropriate option is the western part of the M. R. Štefánik Airport. The chosen area is in non-public part of the airport on apron before hangar C. The place does not interfere into local communication at the airport and does not trammel the apron, which is used as apron or as taxiway lane to tug aircrafts from and to hangars. The area has a rectangular ground plan 186 x 70 meters. In its surrounding is predominantly grass area with a few leafy trees.

The next buildings are on the south side airport stores of aviation fuel and new hangar at apron C. On the

west side after 50 meters the airport areal ends, followed by road and field to the highway at the distance 500 meters from the airport. Eastward are hangars B and A and behind them is apron and the airport runway system. On the north is located hangar C.

Figure 3 The apron with the hangar C – view from the west

Transport of service vehicles and staff is possible from close entry to the airport number 10 and 8, i.e. entry to RSY (Restricted Security Area). On the apron there is enough places to park all the service vehicles, e.g. GPU (Ground Power Unit), ASU (Air Starter Unit), vehicles for aircrafts defrosting etc. As this area is not a part of the airside there is enabled move of people, engines and vehicles without any restrictions with issued identity cards which allow the entry into this area. Movement of the aircrafts is allowed only at engine off and the transport needs to be arranged by operational dispatching.

Aircraft movement can be stopped by important state flights which ceremony occurs on aircraft stands numbers 15-18 at hangar A before Slovak government flying service. At such occasions it is usually forbidden to move any aircrafts and mechanisms. If aircrafts are in hangar C or before it on the apron, the transport to workplace is not limited. The engine tests can be done also at worse weather or in the evening.

We chose five variants of placing four versions of jet blast deflector. For every variant the noise load model was calculated for set jet blast deflector model with anti-noise walls. Final choice depends on financial possibilities of operator of engine tests workplace.

Figure 4 Variant number 1 [2]

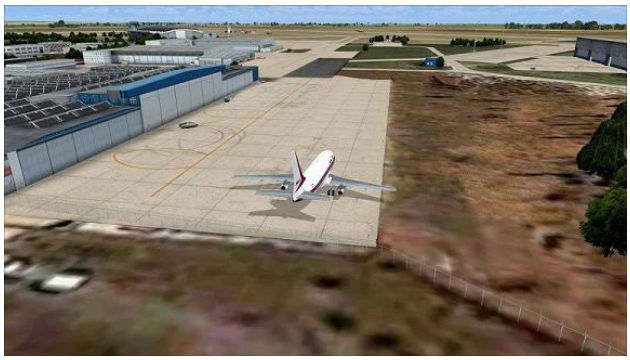

Figure 5 Variant number 2 [2]

For our airport it is suitable construction of jet blast deflector with anti-noise wall and also without it for aircrafts of category Boeing 737 and Airbus 320. This jet blast deflector is also suitable for aircrafts of lower categories.

The chosen jet blast deflector is from company Blast Deflectors, Inc. (BDI), which the last 50 years works only for aviation. BDI offers the newest technological equipment protected by patents and their well-established construction is assumption to success. The new BDI solutions are based on steady flow of outlet gases without negative turbulence. [1]

They are various jet blast deflectors with anti-noise walls. The next figure contains the recommended jet blast deflector for the airport in Bratislava.

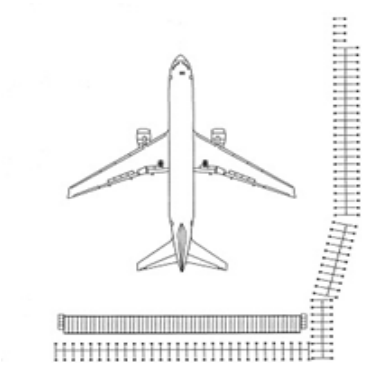

Figure 6 Recommended jet blast deflector

A jet blast deflector that is firm and rounded on the edges diverts discharge currents up and lowers the danger of recirculation. Upper inputs on anti-noise walls have oblique cylindrical shape which reduces risk of turbulence, lowers crosswind effects and enables steady flow of air at the inlet to the engine. Vented side noise barriers significantly reduce the risk of turbulence and allow the engine to absorb large volumes of air masses. At the anti-noise walls are used special materials that reduce noise.

An example of such effective solution is engine test running at Portland airport at night. Through the use of jet blast deflectors with anti-noise walls have been achieved a reduction of noise during engine tests of 75 %.

Legal requirement for outdoors noise limits are in the Decree of the Ministry of Health of the Slovak Republic number 549/2007 of the statute. According to

the decree maximal exposure limits at the airport are 70 dB and for its surrounding (roads, residential areas) from 6:00 am till 10:00 pm 50 dB and at night from 10 pm till 6 am 45 dB [3]

Admission techno-caustic parameters of the aircraft needed for calculation were used from database of company EUROAKUSTIK on the basis of measurements which were done by stuff of SL-EUROAKUSTIK.

According to noise analysis the most advantageous is localization of jet blast deflector with one anti-noise wall.

5 CONCLUSIONS

M. R. Štefánik Airport in Bratislava has very favourable location – in the central Europe, just a few kilometres from capital of Slovakia. But this advantage is connected also with a problem of increased noise ballast for inhabitants of spreader capital.

Engine test running is on the one hand problem because of noise, on the other hand it is a commercial opportunity.

The airport does not have a special workplace for engine test running and it is not counted with building of such workplace in the short-term construction.

The thesis shows possibility how to solve this problem or can be starting point for working-out of other documentation. The solution was designed with regards on actual possibilities of supply of specialized equipment jet blast deflectors and anti-noise walls.

There are more companies in the world which deal in such equipment, therefore final solution can have also other variants which can have their strengths and weaknesses.

At my proposal for implementing the workplace for engine test of transport aircraft I was inspired by similar solutions which were successfully used at other airports worldwide and I adapted them for specific conditions at Bratislava airport.

BIBLIOGRAPHY

[1] www.bdi.aero [cit. 2014-04-30]
[2] Flight Simulator X
[3] Vyhláška č. 549/2007 Z. z. Ministerstva zdravotníctva Slovenskej republiky zo 16. augusta 2007, ktorou sa ktorou sa ustanovujú podrobnosti o prípustných hodnotách hluku, infrazvuku a vibrácií a o požiadavkách na objektivizáciu hluku, infrazvuku a vibrácií v životnom prostredí

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