# THE USE OF THERMOVISION FOR THE AIRPORT OPERATION SAFETY

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**Summary**. The aim of the article is to highlight the possibilities of the use of thermovision in the airport operations. The article is focused on the present application of thermovision for the inspection of aviation equipment and an airport area. One of the factors that may affect the smooth operation of the airport is a potential disrupt of an aircraft area during the aircraft movements around the terminal and ground equipment (near TaxiWay, Apron). This article is therefore also focused on the aircraft movement at the airport area, while provides particular cases of thermal imaging of Airbus A320 at the Airport Kosice.

**Keywords:** infrared thermography, airport, aircraft

## 1. INTRODUCTION

Safe operation is the main objective that every airport is trying achieve. Use of thermal imaging is currently increasingly getting into the awareness also in this area of the aviation industry. Within the safe operation of the airport, thermal imaging can be used for different purposes, which is show in the actual article in the following paragraphs. One of the possible dangerous situations, which may arise at the airport, is during the aircraft movements around the terminal and ground equipments. Temperature and speed of exhaust gases may during inappropriate actions of engines cause damage of surrounding objects and disrupt the smooth operation of the airport. The article focuses on possible solution of these issues and provides the results of experimental thermal imaging of the aircraft Airbus A320.

## 2. THE USE OF THERMOVISION IN THE AIRPORTS

Thermovision as a means of ensuring the smooth and safety airport operation, is currently most used for the protection of the airport area itself [1]. It is used to control the unauthorized entry and intrusion into its area. Through the thermal imaging camera it is possible at night or during adverse weather conditions to monitor movements at the airport and to detect possible distortions of the area by unauthorized persons.

To monitor the movements at the airport the stationary thermal cameras installed in an airport area [2,3] are used, or mobile monitoring and surveillance systems [4]. These systems are installed on the vehicle and they include a TV camera and a thermal imaging camera, thus enabling control of airport security at any location throughout the day. Safety systems include mainly cooled thermal cameras, that is the camera with a cooled infrared detector. These cameras compared to the conventional (uncooled) thermal imaging cameras can achieve higher image quality [5,6] and detect an object in the distance, over 5 km.

Another possibility to use thermal imaging is in the field of health checks of passengers who are moving in the airport terminal area. Through the infrared camera it is possible to detect increasing temperature of persons, who are assumed to be carriers of the viral illnesses.

Thermal imaging is currently used also in the control of aviation technics (aircraft). An infrared camera can detect water ingress into composite structures of aircraft parts [7], as wings, fuselage or engine covers, because water freezes at high altitudes and composite parts are thereby broken and


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damaged. The advantage of infrared cameras is relatively quick aircraft surface inspection after landing, when are these places easily detected and thus it can avoid of eventual complications in the further operation of aircrafts.

## 3. THERMAL IMAGING AT THE AIRPORT KOSICE

One of the possibilities where thermography can be used at the airport, is also area of aircraft control during movement on a taxiway and in the area of apron. Currently most of the commercial aircrafts dispose of powerful engines, which during a movement of aircraft near the terminal or ground equipments can cause damage to other aircrafts by increased power (breakaway power) or accidents in the surrounding area [8, 9]. An aircraft initiating movement from a full stop requires relatively more power to overcome inertia and tire friction than an aircraft already in motion.

As an experiment to verify the impact of aircraft engines on the surrounding, thermal imaging measurements were performed at Kosice Airport. Airport Kosice is the second largest airport in the Slovak republic and currently operates scheduled flights into Prague, Kiev, Warsaw or London. The airport has one runway with sign 01 and 19 with a length 3100m [10]. It is possible to see a parking map of Kosice Airport [11] with marked places (P1, P2), from where the thermal imaging was performed. First place (P1) was near the TWY Z (TaxiWay), where the aircraft was filmed during movement on the apron (APN 1). Second place (P2) was near to terminal and apron (APN 1), from where the aircraft was filmed during the movement on the runway, especially with breakaway power of engines. Thermal imaging and thus control of aircraft were performed in two dates 21.1.2016 and 4.4.2016, and they were performed from safe distance, approximately 40m and under the supervision of airport staff.

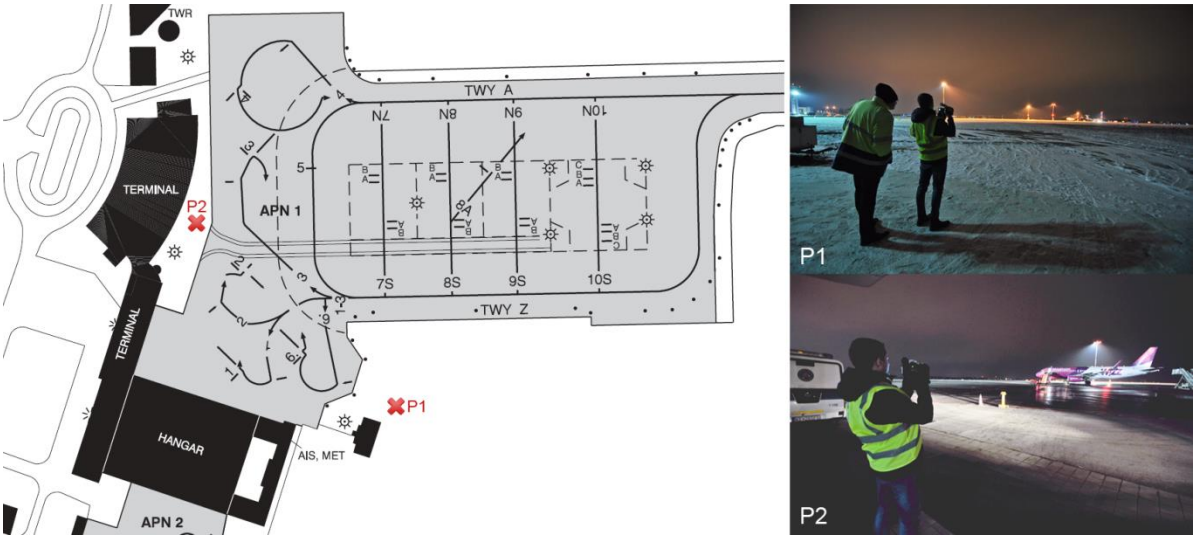


**Figure 1** Parking map of Kosice Airport with marked places of thermal imaging

### 3.1. Infrared camera

For the experiments an infrared camera NEC TH910 WB was used [12]. It includes uncooled type of detector FPA (Focal Plane Array) with size 320x240 pixels, thus output images - thermograms have the size of 320x240 pixels. The advantage of the camera is besides the size of the detector also wide range of measured temperatures, from -40°C to +1500°C. The infrared camera has built-in display (LCD display) for observation of object detection, parameter settings and camera control, which starts after the turn of the camera. For imaging it is possible to choose colour or a monochromatic screen image. Compared to stationary cameras as FLIR A40 which need for their operation a computer and AC power, the NEC camera has advantage to allow a free movement in the place of imaging. Of


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course the camera can be connected into computer and controlled with software via an IEEE 1394 (FireWire) or RS-232C.

### 3.1. Thermal imaging inspection of Airbus A320-200

At Kosice Airport there was during the two dates imaging with infrared camera the aircraft Airbus A320-200 from the company Wizz Air. Airbus A320-200 is a civil aircraft for short and medium range with range up to 6100 km [13]. Power of the aircraft is produced by two engines IAE V2500-A5 with thrust 102kN [14,15]. How aircraft engines affect their environment is specified in the document Aicraft Characteristics - Airport and Maintenance Planning for Airbus A320 [16], which is used for airport planning and maintenance of this aircraft.

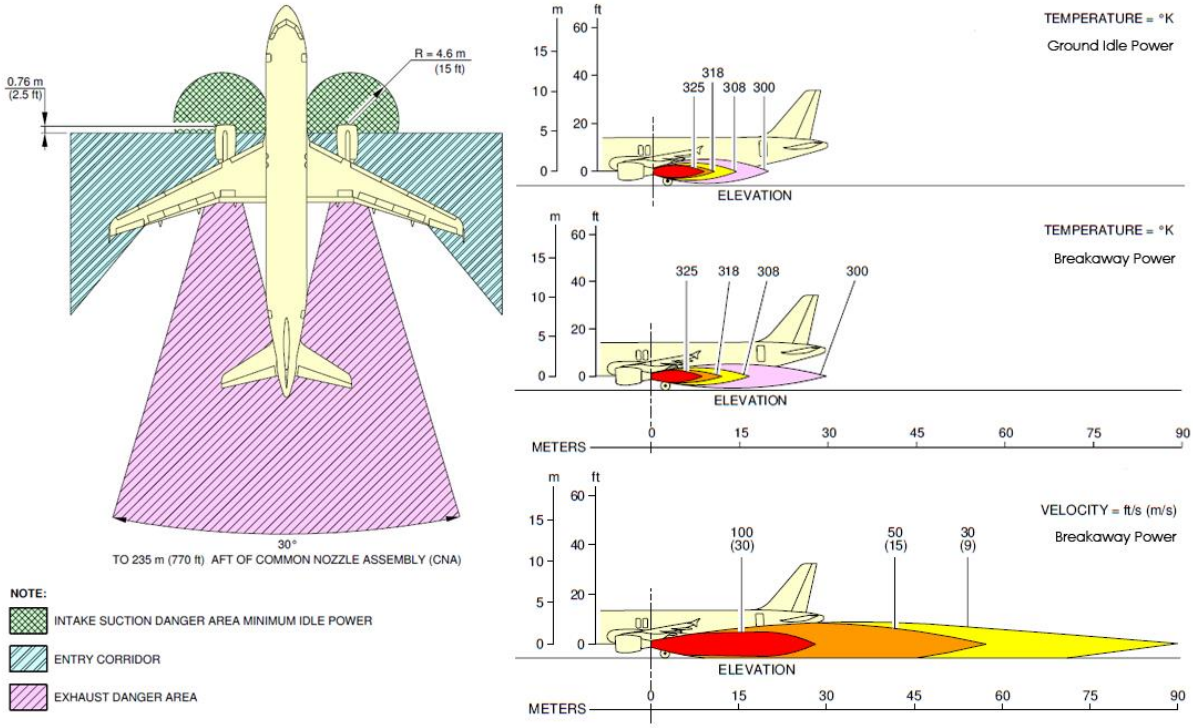


**Figure 2** Danger areas of the series engine IAE V2500 (left), engine IAE V2500 exhaust velocities and temperatures - Ground Idle Power and BreakawayPower (right) [16]

The document identifies dangerous areas for a particular type of engine, which can be seen in the figure 3 (left). They also provide velocities and temperatures of exhaust gases for Ground Idle, Breakaway and Maximum Take Off conditions of engine. Since the aircraft was imaging in movement on the apron and in the initial motion on runway, in the figure 3 (right) there are presented distances of exhaust gases (velocities and temperature) for breakaway power and to compare with ground idle power of the engine.

These data will be used for comparison and evaluation of the real situation at the airport from experimental imaging with a infrared camera. Because the aim of the imaging was not measure an accurate temperature of exhaust gases, but only the area, which exhaust gages interference, for evaluation we used set distances according to the figures. Measuring of accurate temperature affects many factors as a distance from the object, a technical equipment and meteorological conditions.

In the figures 4-6 are illustrated thermal images (thermograms) from imaging of Airbus A320-200 at Airport Kosice. Because the camera allows to capture at the same time not only a thermal image but also a real image of the object, both images are shown for better comparison.

In the figure 4 it is possible to view an aircraft after landing and taxiing on TWY Z towards the airport terminal. In the figure it is possible to observe, that exhaust gases interference to distance about 7 meters. Except of exhaust gases it is also possible observe elevated temperature of the entire area of


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the engine, landing gear and avionics in the area of the aircraft cabin. Also in the other two figures (Fig. 5 and 6) it is possible to observe, that at the initial movement of aircraft (breakaway power of engine) towards on runway, exhaust gases interference to distance about 7 meters. There is no disturbance of surrounding objects and thus also of a safe airport operation. Compared with figure 3 (right) it is possible to view, that captured temperature differences of exhaust gases do not interference into greater distance as it is illustrated in this figure.

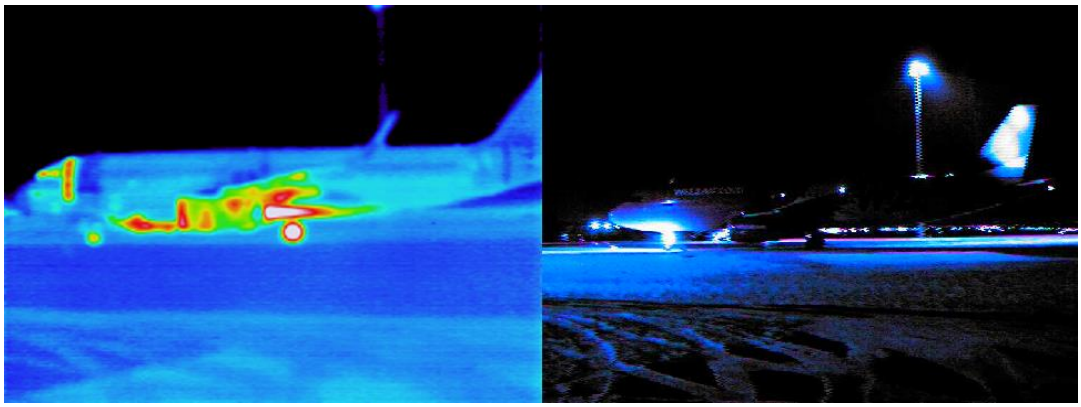

**Figure 3** The thermal image of Airbus A320-200 taxiing on TWY Z after landing (21.1.2016)


**Figure 4** The thermal image of Airbus A320-200 on the apron at initial movement (21.1.2016)

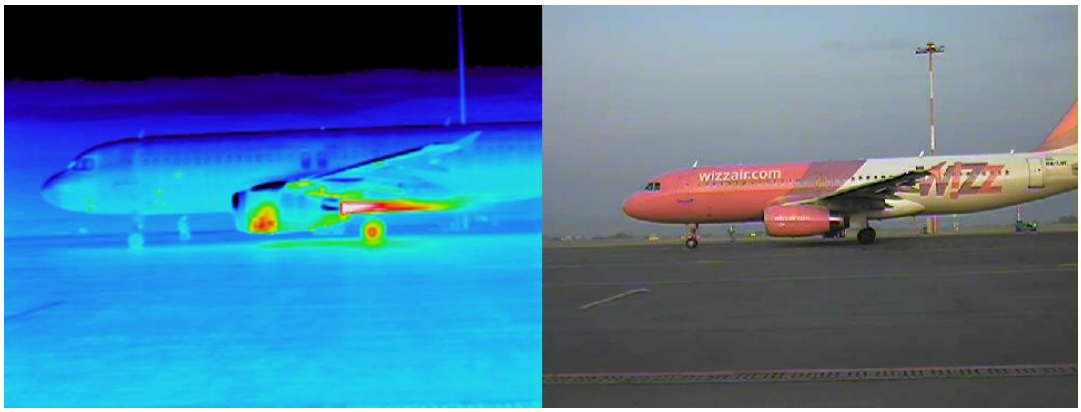


**Figure 5** The thermal image of Airbus A320-200 on the apron at initial movement (4.4.2016)

## 4. CONCLUSION

From the results of experimental imaging with the infrared camera at Airport Kosice it is possible to conclude, that a temperature distance of exhaust gases does not threat objects of the airport. The


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engine operation in these regimes is therefore safe and the aircraft in motion does not affect the area of terminal and ground equipments. These results can be taken as an initial for the further research in this area. In this case there were evaluated distances of temperature ranges of exhaust gases. An interesting thing and certainly also an asset for the airport would be to determine, at what operation of those types of aircraft engines and at what distance of an aircraft from an object, would disrupt safe airport operation, for example: a disruption of terminal construction in the form of broken windows. Velocities of exhaust gasses should also be taken into account, because the velocities of exhaust gases define also their distance of possible disruption of objects. Of course the solution of this issue would have to be realized by appropriate computer simulations and visualization, as it would be very costly and dangerous in real-world operations. The results could then be used to specify and clarify existing safety rules in the airport area.

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