PROPOSAL OF HYDRANT SYSTEM OF AIRCRAFT TANKING AT THE AIRPORT KOŠICE

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This article discusses the draft hydrant system performance of aircraft at the airport. Its role is collect and analyzes all available sources of information and facts dedicated to this issue. Contains information on both fuels as well as options for their fueling. A substantial part article is devoted to the design, construction and practical use hydrant system. The following sections are described not only advantages but also disadvantages hydrant system implementation. It also includes information relating to the design and technical design specifications. The last part of the article specify further needs and possibilities for building a system for the implementation of large aircraft to APN1 airport Košice.

K e y w o r d s: aviation fuel, fueling, hydrant fueling system, design, airport.

1 INTRODUCTION

Operating fluid as such, have aviation priority status because its unique and highly specialized features not only provide smooth operation of aircraft, as well as other technical means used in aviation. Among the most important, but also the most commonly used fluids used in aviation includes aviation fuel. There are several types aviation fuels, the use of which depends both on the construction, as well as the requirements of the particular aircraft engine. The most common fuels used in aviation includes aviation gasoline (AVGAS) and kerosene (JET). Process of filling a particular type of aircraft fuel can be performed in two ways, depending on whether the airport is, or is not provided with a hydrant system. If the airport does not have a hydrant filling system implementation is carried out with the assistance of mobile tanks or using dispensers (POP UP system). Where there are built hydrant system, implementation is done directly from the storage tanks using either a hydrant carts, hydrant dispenser or connecting to the dispenser built right on the ramp.

2 AVIATION FUEL

Aviation fuel can be characterized as a specialized type of fuel composed of oil used to power aircraft engines. Compared with fuel intended for road transport, the attained well higher quality claims. It contains additives that reduce the risk of icing or explosion due to high temperatures. Aviation fuels can be divided into two large groups. The first group consists of aviation fuel used in piston and rotary engines and other jet fuel designed for turbine and jet engines. The next section will be devoted to jet fuel because airports have the most widespread use.

2.1 Jet fuel

Jet fuel represents the most widespread aviation fuel used to power jet and turboprop aircraft. There are several specifications for it now. The most spread and most commonly used specifications for jet fuel used by us is a kerosene type Jet A-1. Jet fuel has a number of quality requirements, which can be divided into several groups. The most important are: fuel purity, flowability and low temperature properties, stability, contamination of unwanted impurities and stability of fuel.

Quality requirements kerosene Jet A-1 must meet once more parameters listed in the following Table 1.

Parameter		JET A-1
Appeatance		clear, bright, without free water and mechanical impurities
Mechanical impurities, mg/l	max	1,0
Total acidity, mg KOH/g	max.	0,015
Aromatic content, % (V/V)	max.	25,0
Total sulfur, % (m/m)	max.	0,30
Content sweetened, % (m/m)	max.	0,0030
Destilation kurve, °C		
10 % (V/V) before destils at	max.	205
end of the destilation	max.	300
Flash point °C	min.	38
Density, kg/m3		775,0 - 840,0
Freezing point, °C	max.	-47
Viscosity/-20°C, cSt	max.	8,000
Caloric value	min.	42,80
Sootless flame height	min.	25,0
Copper Corrosion	max.	trieda 1
Thermal stability JFTOT at 260 °C		
differential pressure on the filter	max.	25,0
deposits (visual)	max.	<3, no red or abnormal deposits
Real resin, mg/100 ml	max.	7
Reaction with water, the phase boundary	max.	1 b
MSEP fuel antistatic	min.	70
Electrical conductivity, pS/m		50 – 600
Lubricity, BOCLE wsd, mm	max.	0,85
Antioxidants, mg/l		17,0 - 24,0
Content antistatic additive, mg/l	max.	3,0

Tab. 1 Quality requirements of jet fuel Jet A-1

3 HYDRANT FUELING SYSTEMS

One of the priorities for the development of hydrant fueling system was to refuel and carry large amounts of fuel from storage tanks to aircraft. The refueling aircraft fuel tank filler provide first, but as the capacity of these tanks was only about 20 000 liters that this system is effective only for the performance of a relatively small aircraft. Since it has been shown that this method of filling the aircraft with large aircraft not only inefficient but also time consuming. Therefore at large airports occur to construct hydrant systems. The first hydrant system was built during the years 1940-1950. Operates on the principle of direct distribution of fuel to the aircraft, fuel was pumped from one filling drawer located on the edge of the apron.

To existing airports in the implementation of transport aircraft used hydrant system performance of the aircraft at a constant pressure, which is advantageous to install both large and small airports. This fueling method a flow more than 9000 liters fuel per minute.

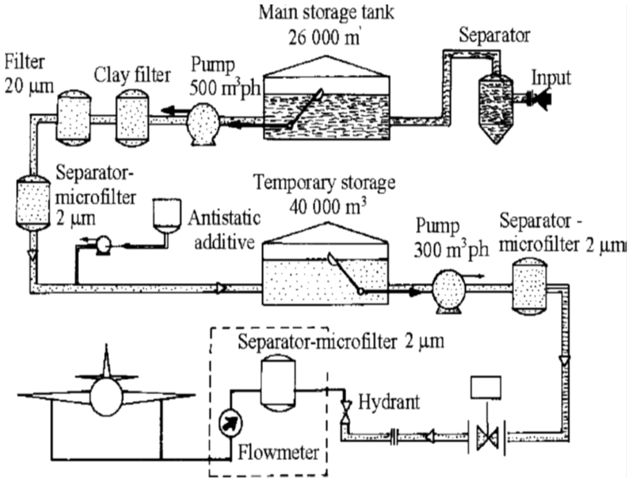
The hydrant system is further characterized in that it is constantly under pressure and tension, and also automatically responds to refueling. In view of these technical advances is no longer needed oversight of its operation. Remove the service station runs in automatic mode and provides emergency shutdown control center. Another advantage is also that same fuel can get any number of aircraft parked along the filling loop. This whole process takes place at full capacity flow in the system. Furthermore, while for other aircraft implementation is under way, with another fuel can be pumped out.

Hydrant fuel system, as such, forms a vast network of underground pipes that distribute fuel from underground tanks to aircraft stalls located right on the apron. A network of underground pipes is designed to hydrant system led directly to parked aircraft. The hydrant pit is located hose that is connected to the truck or cart to the control valve located in a pit and then is another hose from the same trolley attached directly to the aircraft. After starting aviation fuel flows through the filters, pressure gauges and fuel flow passes directly to aircraft.

Using the hydrant refueling system is much more efficient than refueling tankers also because the hydrant system pumps can deliver aviation fuel indefinitely in large quantities. Another advantage is also that they are designed so that they can serve several planes at once. However, the most substantial advantage in terms of finances is also an overall reduction in operating costs. Among other things, hydrant system helps to reduce contamination of the fuel during refueling aircraft, which ultimately contributes to increased security.

4 PARTS OF THE HYDRANT FUELING SYSTEM

Hydrant system performance of aircraft consists of a large number of components. It includes, in addition to filtration and overhead operations center, petrol station, control center and loop hydrant, hydrant service resources, control stations and the like. Components include a service station pumps, horizontal filter/ separators as well as pressure transmitters and automatic control valves. The system also includes control valves at each hydrant. In addition, there are other various devices such as: control panels, gauges, fire equipment, water detectors, sump pumps, compressed air systems and electronic measuring instruments.



Picture 1. Scheme of hydrant fueling system

4.1 Tanks

The basic components of the delivery system include hydrant tank. In general, each hydrant fueling system has at least two reservoirs. The first is the tanks used to store fuel, known as a main storage tank can be designed either above ground or underground. The tanks are made of steel and are coated inside. The bottom has a sloping floor with a slope of 5% towards the center of the tank, which is used for sedimentation of impurities.

Second tank is a temporary distribution tank, which contains fuel that has undergone a process of filtration and sedimentation, and as such is used for filling tanks aircraft. As well as storage tank is made of steel and has a double wall in the bottom of the installed turbine pump. The tank is also equipped with sensors upper and lower fuel level to ensure you achieve them off the fuel supply.

4.2 Pipelines

Pipelines constitute a substantial part of hydrant systems and their role is to distribute fuel from storage to service stations through the filters until connections hydrant system. Most of them are set in the ground, with the exception of those involved on their surface and apparatus for controlling and monitoring. Pipelines are either coated or aluminum is made entirely of stainless steel. Because all underground metallic pipes are protected by an outer layer as well as cathodes protection.

4.3 Pumps

They are used either rotary or positive displacement self-priming centrifugal pumps, which must be mounted on the side in the direction of fuel distribution. Horizontally split centrifugal pumps or turbines are used as pumps for transferring fuel from the tank above ground and are installed in a position that prevents it from clogging. Vertical turbine pumps are mainly used for pumping from underground tanks or cut tank cover.

Selecting pumps and piping systems must be taken into account in particular the necessary amount of fuel dispensing at a certain time. Fountain pumps are designed as either horizontal centrifugal pumps or vertical pumps. Pumps are used for fuel distribution rotor with sliding vanes. The distribution of fuel from waste receptacles are used turbine-type pumps. Their switching can be transferred either automatically or manually.

In addition to the above mentioned pumps hydrant fuel distribution system also uses sump pumps, used to remove water or other liquids from desludging pit.

4.4 Measuring devices

Fuel distribution systems typically used to measure the fuel flow volumetric meters in unidirectional or bidirectional flow, which differ in their location. While, unidirectional flow meters are installed on the truck or filling dispenser, two-way flow meter is installed in the filter pit hydrant system. Both types of gauges provide information about the actual amount issued or drawing of fuel, but also on the filling pressure.

4.5 Filters/Separators

These devices serve a detention impurity, thus preserving the purity of aviation fuel, which is located in facilities for the delivery and transfer of aviation fuel. Part of the filtering system is coalescing separation and filter cartridges.

- Coalescing filter elements are filter components First Instance filtration of aviation fuel, which are mounted in the housing of the filter / separator and are designed to remove free and bound water and contaminants from aviation fuel.
- Separation filter cartridge filter elements are second stage of filtration of aviation fuel in the filter mounted and designed to extract water from aviation fuel.

For both groups the filter rule, are designed so that their liners can be easily replaced with new ones. The filter must contain a gauge indicating the pressure difference directly input respectively. filter outlet. It must be equipped with automatic air separator. At the inlet and outlet pipe filter must be installed tap sampling of aviation fuel.

Also, the spot on the blow must be a filter to the lowest point below the tailing sleeve and the body must be mounted manually operated valve stainless steel. The filter must also be installed automatic shut-off valve to the excessive amount of water in desludging socket automatically closes the fuel flow through the filter.

4.6 Valves

The hydrant system implementation will meet soon with several types of valves distributed in several respects. In terms of divided control valves manually and automatically operated. Manual valves are generally used for isolation of parts of the fuel system and for controlling the flow of fuel and the weight of the insulation of the fuel pipe by fault or repairs. Manual valves are set for slow openings that were not caused by pressure surges.

Automatically operated valves are generally the most used valve. The most common valve in the hydrant system include: closing and drain valves. They are used as positive shut-off valves in the vicinity of tanks and pipes. All the above mentioned valves shall meet the specification according to API.

Nowadays, the hydrant system are implementation with three-port two-way filling/drain valves. Are particularly unique in that they allow the fuel flow in two directions through the same valve- direction is one for refueling, another for its deletion.

Another type of valve is called check valve needed to ensure the performance of each deep turbine pumps. Is used later to power surges detrimental to the pump and then the other devices and thus prevent back flow of fuel through the fuel filters. Finally, are called ball valves, which are used to quickly detach the valve, such as pipes to the dispenser, and between the pump head and the head of the pump and filter.

4.7 Dispensing Equipment for refueling aircraft

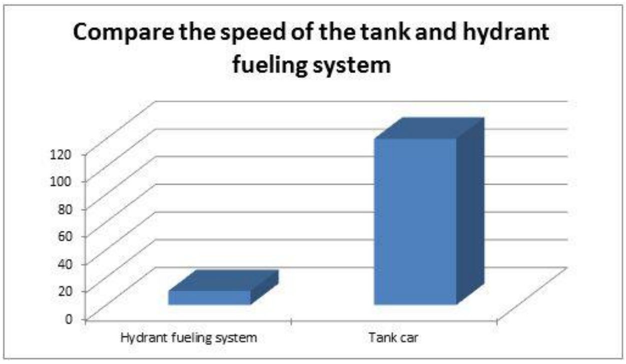
Use of dispensing equipment depends on both the type of hydrant fueling system, as well as the possibility of being placed on the ramp. Resources to fulfill the aircraft used in airports with a hydrant system implementation consists hydrant trucks and hydrant dispensers.

- The hydrant dispenser vehicles represent-Self-propelled, which pumped fuel from the aircraft hydrant system located under the apron with up to 4000 l for 1 minute. Aerial platforms are equipped with a range of up to 4.2 meters.
- Hydraulic truck-like device consisting of hydrant dispenser, but with the difference that this device is not self-propelled, towed, therefore, most often by hand.
- Hydrant dispensing stations - are placed directly on the ramp. It has universal connections that meet the specifications for the performance of the aircraft.

5 JUSTIFICATIONS FOR BUILDING A HYDRANT SYSTEM IMPLEMENTATION AT THE KOŠICE AIRPORT

Although the building hydrant system is implementation rather costly affair, not forgetting the fact that this is still a financially repayable investments. Which in sufficient density of traffic and large sampling capacity will not only provide efficient, time-efficient but also safer conditions for aviation? Although currently Košice airport will cover fuel capacity also use their mobile tanks, as would happen to the development and improvement of air transport in the region and would require the implementation of at least 100 000 liters a day, then would already be building hydrant system not only profitable but also imperative.

Another reason to build a hydrant system performance of aircraft at the airport Košice in the future could be over time as the total time, as one tank is around 2 hours. Moreover, while in the performance of two pieces of tanks are needed 5 workers at the hydrant delivery system is all automated and sufficient one employee.



Picture 2. Compare the speed of the tank and HS

Thus, in the future we can assume that if at that airport operations conducted large cargo planes with high volume fuel tanks, the time needed to meet these aircraft would be an important indicator. In this case, it would build a hydrant system implementation aircraft profitable not only in time but also in terms of the capacity.

8 CONCLUSION

Aviation fuels are among some of the most important but also the most prevalent operating fluids used in aviation. In the beginning was the aviation refueling and storage included as one of the least demanding activities, today situation is different. With the rapid development of air transport have been increasing demands on the quantity and quality of fuel. Introduction of new aircraft types was a quantitative as well as quantitative increase in demands for storage and supply of aircraft fuel. Implementation of mobile aircraft tanks were the world's great airports replaced by a much more modern and efficient hydrant systems. Given to the development of air transport in the future should all consider this modern airports, although expensive, but repayable investments.

BIBLIOGRAPHY

[1] KAZDA, Antonin – CAVES, Robert: Airport Design And Operation. Oxford: ELSEVIER, 2007. 535s. ISBN-13: 978-0-08-045104-6

[2] Chevron Global Aviation: Aviation Fuels Technical Review. Houston, 2007 [cit. 6.3.2014], Available on the internet: https://www.cgabusinessdesk.com/document/aviation_tech_review.pdf

[3] Aviation Jet Fuel Information [cit. 18.4.2014], Available on the internet: http://www.csgnetwork.com/jetfuel.html

[4] UNIFIELD FACILITIES CRITERIA, Operation and maintenance: Maintenance of petroleum systems, [cit. 23.3.2014], Available on the internet: http://www.wbdg.org/ccb/DOD/UFC/ufc_3_460_03.pdf

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