THE GROUND HANDLING OF THE HIGH CAPACITY WIDE-BODY AIRCRAFTS

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The topic of the master thesis is the ground handling of the large wide-body airplanes focising on the means for performing the ground handling of the wide-body airplanes. The thesis describes the importance and function of the ground handling of the planes in the airport operation, description of the two well-known wide-body airplanes, the description is presented from the point of view of the ground-handling staff, necessary equipment for ground handling of these planes.

K e y w o r d s: aircraft ground handling, airport handling manual, ground support equipment, vehicle, baggage, passengers

1 INTRODUCTION

The ground handling services include activities designed to provide the operability of the aircraft. The aim of the thesis is a proposal of the basic ground support equipment set for the ground handling of the wide-body planes as considered important from the point of view of airport operation.

2 THE IMPORTANCE AND FUNCTIONS OF AIRCRAFT GROUND HANDLING

The first chapter describes the importance and function of the ground handling of the planes in the airport operation. There are many documents, norms in aircraft ground handling. Every equipment or vehicle has his own technical documentation, but the most important document for aircraft ground handling is airport handling manual. This manual contains the latest updates of a series of procedures and specifications which have been approved by the IATA Airport Services Commitee as industry standarts. The standards have been devoloped by specialist groups under the direction and approval of the Airport Services Commitee as the most practical economical standarts which, airlines, ground handling companies and airports are recommanded to follow.

The aircraft ground handling consist of this services: aircraft towing/pushback, supply of electricity, by GPU/ASU, supply of fuel, to ensure boardin/deboarding passengers, loading and unloadinf of cargo, baggage and catering, potable water service, servicing of lavatory, supply of nitrogen and oxygen, to ensure air conditioning and heated air, and finally to ensure de-icing/anti-icing of aircraft.

3 THE GROUND HANDLING OF THE HIGH CAPACITY AIRCRAFTS

The most famous high-capacity wide-body aircrafts are definitely A380 from Airbus Industries and B747-4000 from Boeing Industries.

The double-deck A380 is the world's largest commercial aircraft flying today, with capacity to carry 525 passengers in a comfortable three-class configuration, and up to 853 in a single-class configuration that provides wider seats than its competitor. Overall, the A380's two decks offer 50 per cent more floor surface than any other high-capacity aircraft. With superior range of 15,700 km., the A380 is the ideal solution to alleviate traffic congestion at busy airports. It has two full-length passenger levels with true widebody dimensions: a main deck and an upper deck, which are conveniently linked by fixed stairs forward and aft. This type of aircraft has this ground handling requirements:

- Electrical system - power requirement is 180 to 360 kVA, four conections x 90 kVA,
- Air conditioning - four connections 1.625 kg/s each, maximum flow rate is 390 kg/min, maximum output pressure is 70 mbar.
- Pneumatic - maximum pressure is 4.3 kg/cm^2
- Potable water - Total capacity is 1700 l, optional 2270 l.
- Lavatory - total waste capacity is 2096 l, total rinse capacity is 140 l.[1]

Instantly recognized by passengers around the world, the Boeing 747 is the world's favorite airplane as well as the world's only 400-seat airplane. The 747-400 is a proven performer with high reliability. It incorporates major aerodynamic improvements over earlier 747 models, including the addition of winglets to reduce drag, new avionics, and a new flight deck.

The 747 fits into today's infrastructure, serving more than 210 airports around the world; is the world's best freighter; and is also the world's fastest commercial jetliner. [2]

Apart from the basic passenger 747-400 model, a number of variants have been offered including the winglet-less 747-400 Domestic optimised for Japanese short haul domestic sectors, the 747-400M Combi passenger/freight model, and the 747-400F Freighter (which combines the 747-200F's fuselage with the -400's wing). This type of aircraft has this ground handling requirements:

- Electrical - Power requirement 2x90 kVA, 400 Hz, 3 Phase.
- Air conditioning - maximum flow rate is 317 kg/min.
- Pneumatic - maximum pressure is 3.10 kg/cm^2
- Potable water - Total capacity is 1250 l.
- Lavatory - Total capacity is 1040 l (four tanks), flow rate is 38 l/min a recommended pressure is 2.11 kg/cm^2. [1][2]

4 DESCRIBE OF GROUND SUPPORT EQUIPMENT

The ground support equipments are special equipments for to provide aircraft ground handling.

4.1 Towing equipment

The next is characterized necessary equipment for ground handling of these planes. The towbarless tractor equipment is designed for aircrafts towing and aircraft pushback which is moving a loaded aircraft backwards from a parking position to the taxiway. The tractor shall be designed for one-person operations, all functions shall be performed by the driver. The overal dimensions of towbarless tractor shall be kept to a minimum in accordance with aircraft types to be handled.Variable tractive force is required depending of a aircraft type. This force must be sufficient to move the aircraft from standstill under all surface conditions and with aircraft engines running at idle speed. [1]

4.2 Supply of electricity

A means of supplying electricity consist of ground power unit, which is the main equipment for this, auxiliary power unit and air start unit. Ground power unit can be mobile as a trailer mounted, truck mounted on standard chassis cabin truck or mounted on pushback tractor, airport bridge, etc. The air start unit shall consist of appropriate frame for installing systems: power source, air compressor, flow regulator, output hoses, control panel and fuel tank. [1]

4.3 Supply of fuel

The equipments which are intended for the supply of fuel can be mobile cisterns or in ground fuelling systems, it depends it on the airport facilities. The capacity of mobile cistern can be from 2 000 l to 40 000 l. The fuel dispensers are used in case that the airport is equipped by the in ground fuelling system. The fuel is pumped from underground tanks to the aircrafts. [1]

4.4 Passengers boarding/deboarding

There are used passenger stairs, airport bridges, airport buses or lifting vehicle for passengers with reduce mobility in boarding/ deboarding process.

The passenger stairs can be towed or self-propelled. The stairs shall be preferably mounted on standard commercially available truck and consist of telescopic section with intermediate and upper or main platforms, and provide a straight ascent/descent to and from the aircraft door.

The airport bridge or jetway is an enclosed, movable connector which extends from an airport terminal gate to an airplane, allowing passengers to board and disembark without going outside. Depending on building design, sill heights,

fueling positions and operational requirements, it may be fixed or movable, swinging radially or extending in length.

The airport bus or shuttle bus is used for transport passengers to or from aircrafts and airport terminals. The number and location of the doors shall be based on the quick and safe embarkation and disembarkation flow of passengers on both sides of the vehicle. The overal dimensions and capacity shall be in accordance with the conditions prevailing at the airport where the unit is to be used.

The vehicle for boarding passengers with reduce mobility shall be capable of transporting, lifting, elevating or lowering to or from the aircraft main or upper deck passenger doors. [1]

4.5 Loading/unloading of baggage

There are used the belt loaders and baggage cart in loading or unloading baggage process. The belt loader cab be towed or self-propelled, it is designed for loading and unloading baggage cargo or mail to/from aircraft lower lobe bulk holds with sill height. The conveyor.belt loader shall have a boom and a operators driving position.

The designe of the carts shall allow for one person handling. The empty weight of the baggage cart shall be as low as possible. Also the cart shall be designed to withstand rough handling. Drainage can be provided to avoid accumulation of water on the platform. [1]

4.6 Loading/unloading of catering, cargo and mail

The equipment for catering loading/unloading shall be equipped with an elevating van body. This vehicle shall be capable of transporting and loading/unloading catering into or from the aircraft main deck or upper deck. The unit shall be capable of servicing aircraft doorsil heights up to 8.4 m. The recommended payload of the vehicle shall be in a range from 3 500 kg to 4 600 kg.

There si used lower, main and upper deck loader in loading/unloading of catering, cargo and mail. The dimensions, between guides, of a lifting platform shall be capable of handling minimum one full size ULD lengthtwise. [1]

4.7 Servicing of potable water

This equipment can be designed on two versions, as a towed water cart or a self-propelled water service truck.The unit shall be used only to supply aircraft potable water. The self-propelled potable water service truck consists basicly of:

- a water tank,
- a water pumping system,
- a operators platform adequate accesa to the a/c service panel,
- a suitable self propelled chassis.

The tank capacity of this vehicle should be in the range of 1 500 - 400 l. The tank shall be made of non-corosive material and shall be easily washable. The water pump shall be directly connected to the outlet of water tank and driven either by the vehicle engine or by an auxiliary power source. [1]

4.8 Servicing of lavatory

The lavatory service truck should provide adequate ground service to aircraft lavatory connections, transport and dispose of the lavatory waste removed from the aircraft and allow for quick flushing and cleaning of the waste tank. This vehicle basicly consist of:

- independent tanks (rinsing, drain),
- a flushing system for the waste tank,
- a water pumping system,
- a operators platform adequate accesa to the a/c service panel,
- a suitable self propelled chassis.

The unit shall have a minimum of two separated and independent tanks (a waste collections tank, rinsing water tank). [1]

4.9 Supply of oxigen and nitrogen

There are used small towed carts, bigger towed carts or motorized vehicle in supply of oxigen and nitrogen process. [1]

4.10 Air conditions and ground heaters

The air conditioning unit shall consist of a power source prime-mover, compressor, condenser evaporator, thermal expansion valves, blower duct, output hose, air delivery, coupling, dump valve, control valves, refrigerant charging valves and accessories. This unit is designed like a towable aircraft air conditioning (cooling) unit applicable to commercial aircrafts. The unit shall be so designed that the entire operation of the unit on the aircraft can be performed/ accomplished by one person. The power source of ground air conditioning shall be capable of continuous operation at maximum output for a minimum of 8 hours.

The aircraft ground heater shall consist of:

- an appropriate frame for installing system,
- heat exchanger,
- thermal regulator,
- output hose,
- control panel
- an air heat exchange for engine coolant,
- an exhaust gas heat exchanger,
- an internal combustion engine.

The aircraft ground heater shall be designed in order to be handled by only one person. The body shall offer protection of the electrical and mechanical components against the rain, humidity and snow. [1]

4.11 Aircraft de-icing/anti-icing unit

The self-propelled aircraft de-icing/anti-icing unit shall be highly maneuverable for the de-icing/anti-icing all exterior surfaces of narrow body and wide body aircraft. The unit shall be suitable for day and night operations. The unit and all associated systems shall operate satisfactorily under temperature condition as low as - 40 ºC and in continuous humidity up to 100 %. The unit shall consist of:

- a suitable self-propelled chassis,
- an aerial device with personnel basket constructed and mounted in accordance with applicable national safety standards,
- fluid supply tanks,
- a fluid pumping system and an optional heater for applying heated de-icing fluid to all necessary aircraft surfaces. [1]

5 PROPOSAL OF THE BASIC GROUND SUPPORT EQUIPMENT SET FOR THE GROUND HANDLING OF HIGH CAPACITY WIDE-BODY AIRCRAFTS

Proposal of the basic ground support equipment set depend on follow factors:

- airport facility,
- types of handled aircrafts,
- finance of handling company,

5.1 Towing equipment

The largest and most powerful, full-featured, towbarless aircraft handling tractor from Dougles is TBL 600.

The TBL - 600 is designed with a unique cradle capturing system for the aircraft's nose landing gear. Because of this design these tractors provide increased responsiveness and easier handling with greater manoeuvrability. The key applications of this towbarless tractor are:

- pushbacks,
- inter-gate towings,
- higher speed, longer distance maintanance towing.

The TBL - 600 is suitable for pushback, inter-gate and longer distance maintenance towing operations at higher speeds with the following aircraft:

- Airbus: A310/A300, A330 and A340-200/300/500/600, A380-800, 800F, 900
- Boeing: B767, B777 and B747 (all series)
- Lockheed: L1011
- McDonnell Douglas: DC10, MD11[3]

5.2 Supply of electricity

Company Guinault has been manufacturing Ground Power Units for Aviation Industry for 60 years (1949). Guinault uses its expertise in electronic and engine control to give a significant product advantage and to design highly reliable solutions for extreme operational conditions. Guinault also limits the obsolescence risk as we also

manufacture our own electrical/electronics-components.

GPU:

From 90 up to 180kVa with 1 or 2 AC 400Hz 115/200Vac output(s) and/or 28,5Vdc-output, this GPU (Ground Power Unit) model is ideal for Ground Power Supply to all aircraft-types.

- available with Deutz, Iveco, Perkins, Cumins engine, -
- optional low speed GUINAULT alternator running at 1714rpm forreduced fuel consumption --> lowest Total Cost of Ownership, TCO,
- many options available,
- GPU (Ground Power Unit) can be truck mounted (Izusu, Mercedes, Iveco, etc.).

ASU:

- Large powerfull Air Start,
- GHH RAND air screw compressor coupled with DEUTZ diesel engine,
- From 180 up to 400 ppm - 42psi(g) air pressure as per IATA standard,
- Exclusive engine speed regulation (from 1250rpm to 2000rpm) forreduced fuel consumption and noise level.[4]

5.3 Supply of fuel

High flow rate hydrant dispenzer from Titan Aviations has this fuelling performances, 3800 L/min (1000 gpm) through the 2 deck hoses and 1000 L/min (250 gpm) through the 2'' long hose EN1361-C HD type (under wing nozzle). This unit consist also of elevating platform. Scissor type hydraulically operated. Elevation of platform ground up to 4,20m height, for operations up to 6,00m height.

Low profile semi-trailer refueller from the same company Titan Aviations with capacity 35 000 l is suitable for airports without in ground fuelling system. Fuelling performance:

- 3800 L/min (1000 gpm) through the 2 deck hoses,
- 1000 L/min (250 gpm) through the 2'' long hose EN1361-C HD type (under wing nozzle),
- 260 L/min (65 gpm) through the 20m long 2'' hose EN1361-C HD type (under wing nozzle).

Defuelling performance:

- 400 L/min (100 gpm) through the underwing nozzle line by suction alone,
- 1200 L/min (300 gpm) capability through the underwing nozzle line through aircraft booster.[5]

5.4 Passengers boarding/deboarding

The JBT Aerotech airport bridges are appropriate for high capacity and wide-body aircrafts. The passenger stairs Sitnar SPS-3518 is also suitable for this aircrafts. Chassis is Ford F-350, engine 6.2L Triton V-8 230 kW, platform load capacity is 454 kg, operating range is 244-580 cm.[6]

The shuttle bus Cobus 2700 is used to transport passengers between the airport terminal and aircraft. Up to 99 passengers fit comfortably in the COBUS 2700. That is almost double the amount that fits into a normal solo city bus. Short "turn arounds" optimise terminal capacities and the transport concept of the COBUS makes the quickest way of moving passengers to remote positions possible through comfort and performance. Three oversized double doors each side of the vehicle allow quick and easy embarking or disembarking. The pneumatic "kneeling system" assures that passengers of any age group are guaranteed a safe and comfortable step height making both entering and exiting a short time process. Up to 13 seats assure a relaxed and comfortable stay on board and the optimised arrangement of the hand rails ensures safety everywhere inside. Tilting side windows, an exceptionally high interior ceiling and two electrically operated roof hatches guarantee a comfortable and pleasant atmosphere throughout the passenger compartment.[7]

5.5 Loading/unloading of baggage

The ECO-850 self-propelled belt loader will safely interface with all aircraft up to wide-body B747/B777 and A340/A380. This ECO-850 is equipped with a corrosion resistant chassis on heavy duty axles with energy absorbing tubular collision deflector, environmentally friendly diesel engine

with electronic automatic transmission incorporating 'on-the-move' reverse gear inhibit, 7.5, 8.2 or 9 (nominal) metre 1,000kg capacity boom assemblies, fitted with continuous hard wearing grip faced belt and soft boom ends.[8]

The baggage cart Aero 2900 is appropriate for transport of baggage to the aircraft. Capacity of this cart is 3629 kg.[6]

5.6 Loading/unloading of catering, cargo and mail

The TXL-838-SUP (Superior) is a self-propelled, dual-platform loader designed to transfer containers and pallets weighing up to 7 600 kg (16,700 lbs.) With the ability to interface 178 cm (70"), 254 cm (100"), or 356 cm (140") doors, this heavy-duty loader can be used to service the following aircraft:

- Lower Lobe: 747, 757, 767, 777, DC-10, MD-11, L-1011, A300, A310, A320, A330, A340, A380, IL76
- Main Deck: 707, 727, 737, 747, 757, 767, A300, A310, A320, A330, A340, A380, DC-8, DC-9, DC-10, BAE-146, MD-11, MD-80, L1011[9]

The 2927 cargo-pallet trailer is appropriate for transport ULD and palet to the aircraft. Cargo capacity is 6 804kg, pallet capacity 234.84 cm x 317.5 cm. [6]

For loading and unloading of catering is suitable A380 Aeromax 1 catering vehicle. The platform maximum hight is 8 050 mm +/- 50 mm, payload capacity is 4 000 kg.[10]

5.7 Servicing of potable water

TK-QS-30 potable water vehicle is low gravity , and it's supplying system is made up of stainless material.

The potable water vehicle is designed by TECHKING , supplying portable water for the airplane.

It has two series and 4 kinds products. Also the warming equipment can be installed on the vehicle for the cold situation. ISUZU engine and large power make perfect driving function and supplying water . The weight of this vehicle is 3 200 kg and potable water tank capacity is 3 000 kg. Potable water pump rated flow is 20 l/min.

5.8 Servicing of lavatory

Vacuum lavatory truck from Accessair company is equipped by tanks constructed of stainless steel with rounded sanitary corners for better cleaning and structural strength, sight gauge, 508mm manhole, waste tank of capacit from 570 - 3000 l, flush tank of capacity 190 - 1500 l, flexible and non- collapsible hose material with standard aircraft couplings in accordance with ISO R47.[11]

5.9 Supply of oxigen and nitrogen

The service cart SC10-004 serves for checking resp. refilling and shock absorbers at the aircraft. Nitrogen system for four nitrogen bottles, for tyre inflation and filling of the landing gear struts (bottles not included). One instrument box with two pressure regulators, two spring retracted hose drums, one for low and one for high pressure.[6]

5.10 Air conditions and ground heaters

Air cabin heater from Guinault are used for aircraft air cabin heating during night stop (for maintenance operation or in anti-freeze mode) or before passenger boarding.

The aircraft diesel engine air cabin heater type GR from 90 to 200 kW has this specifications:

- output air temperature: adjustable, maximum temperature increase of 80 ºC,
- air flow: from 2200 m^3/h to 6500 m^3/h,
- engine: water cooled diesel engine Deutz or Kubota,
- hetaing technology: burning device with patented air heat exchanger
- temperature regulation: ± 2,5 °C.[4]

DAC 120 mobile pre-conditioning air unit is self-cointained diesel power PCAir for comfortable conditioning of wide-body jumbo passenger aircraft canbins. Endurance is approximately 8 hours of

continuous operation per full fuel tank. Unit can be trailer mounted for towing or truck mounted on a suitable chassis. [12]

5.11 Aircraft de-icing/anti-icing unit

The Safeaero 223XXL with extensive operational radius (nozzle reach horizontal 14m, vertical 23 m and operators eye height 17m) in combination with its very compact size, make it the ideal de-icer to perform de-icing operations on aircrafts ranging from turboprops up to the Airbus A380. The uniqueness of the 223XXl is in designe. It was designed specificially for one person operation which results in faster de-icing, eliminates communication problems between opertor and driver. Another unique feature of this vehicle is its large tank capacity, which means longer pad time and less down time spent on refuelling. The compact and low profile design along with a completely enclosed cabin and large windows, provides excellent visibility. Under-wing de-icing can also be easily performed from the operators cabin. [13]

5 CONCLUSION

The aim of the thesis is a proposal of the basic ground support equipment set for the ground handling of the wide-body planes as considered important from the point of view of airport operation. The set consist of this equipments:

- towbarless aircraft handling tractor Dougles TBL 600,
- Guinault GPUs from 90 up to 180kVa,
- Guinault ASUs from 180 up to 400 ppm,
- High flow rate hydrant dispenzer from Titan Aviations,
- Low profile semi-trailer refueller from the same company Titan Aviations,
- The JBT Aerotech airport bridge,
- The passenger stairs Sitnar SPS-3518,
- The shuttle bus Cobus 2700,
- The ECO-850 self-propelled belt loader,
- The baggage cart Aero 2900,
- The TXL-838-SUP cargo loader,
- The 2927 cargo-pallet trailer,
- A380 Aeromax 1 catering vehicle,
- TK-QS-30 potable water vehicle,
- Vacuum lavatory truck from Accessair,
- The service cart SC10-004,
- Air cabin heater from Guinault,
- DAC 120 mobile pre-conditioning air unit,
- The Safeaero 223XXL

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