

POSSIBILITIES OF TRANSPORTATION OF HUMANITARIAN AID BY THE MID-RANGE MILITARY TRANSPORT AIRCRAFT CASA C-295

MOŽNOSTI PŘEPRAVY HUMANITÁRNÍ POMOCI PROSTŘEDNICTVÍM STŘEDNÍHO VOJENSKÉHO LETOUNU CASA C-295

Miroslav JANOŠEK¹, Jan KYSELÁK²

ABSTRACT:

The contribution analyzes the possibilities of transport humanitarian aid by mid-range military aircraft of the CASA C-295. These are the possibilities of transport of persons and material, including special equipment and equipment, which must be transported at the scheduled time. The article highlights the importance of pre-flight training to maintain maximum flight safety. The following are the characteristics of the CASA C-295 as part of their passenger and freight transport and their practical use. The final part of the paper presents additional transport possibilities of the CASA C-295 and some examples of humanitarian and development assistance with these aircraft over the past years, too.

KEYWORDS: CASA C-295 aircraft, Czech Air Force, humanitarian aid, logistic security.

INTRODUCTION

The Czech Republic, like other developed countries, is involved in the provision of humanitarian aid abroad, in accordance with Act No. 151/2010 Coll., On Foreign Development Cooperation and Humanitarian Aid Abroad and on Amendments to Related Acts [1]. The provider of humanitarian aid to the Member States of the European Union and other states forming the European Economic Area is the Ministry of the Interior. It also decides on its scope and form. The Ministry of Foreign Affairs informs about the provision of humanitarian aid. It is the guarantor of the provision of humanitarian aid to countries outside the European Union and the European Economic Area, which also decides on its scope and form. In deciding on the provision of material and rescue aid, it cooperates with the Ministry of the Interior [1].

We can transport humanitarian aid by cars, by train or by aircrafts. The aircrafts are very effective for fast and long-haul transportation. CASA C-295 military transport aircrafts of the 24th Air Transport Base at Prague - Kbely carry out this transport from The Czech Republic. It is in accordance with Act No.

219/1999 Coll., On the Armed Forces of the Czech Republic [2].

Air transport carries a wide range of safety rules that must no doubt be complied with, whether it concerns flight itself or pre-flight preparation. From the pre-flight training, the success or failure of the flight has been developed. It is very important to know the good practices and risks that are dealt with in the pre-flight preparation. It is very important to correctly determine the weight of the airplane and the cargo carried, the position of the center of gravity to the boundaries to meet all the restrictive conditions that occur during transport and to observe all the procedures for loading the transported cargo and to secure it properly. Any mistake could have fatal consequences for years.

Air transport is very convenient in terms of speed and distance. However, its constraining factor is the transport capacity, which is small compared to other means of transport. In air transport it must therefore be very carefully considered where and how to use it so as to be as effective as possible.

¹ Miroslav Janošek, Assoc. prof., Dipl. Ing., Ph.D., Department of Air Force, Faculty of Military Technology, University of Defence in Brno. Kounicova 65, 662 10 Brno, Czech Republic. Tel.: +420 973 442 439, e-mail: miroslav.janosek@unob.cz.

² Jan Kyselák, Dipl. Ing., Ph.D., Department of Population Protection, Faculty of Logistics and Crisis Management, Tomas Bata University in Zlín. Studentské náměstí 1532, 686 01 Uherské Hradiště, Czech Republic. Tel.: +420 576 038 065, e-mail: kyselak@utb.cz.

To the questions, "What are the properties of CASA C-295?" Or "What are the possibilities for human and humanitarian transportation of human and other humanitarian aid?" This article offers answers.

1. CHARACTERISTICS OF THE CASA C-295 AIRPLANE IN TERMS OF ITS PASSENGER AND FREIGHT TRANSPORT OPTIONS

The CASA C-295 – fig. 1 mid-range military transport aircraft is manufactured by the Spanish manufacturer EADS-CASA. It is powered by two Pratt & Whitney Canada PW127G turbo propellers with 1.956 m of hexagonal propellers and at maximum speeds of 1200 per minute. The airplane is a high wing with a retractable undercarriage. It is equipped with an overpressure and air conditioning system. The basic construction is all metal with the use of composite materials on uneven parts of the dragon. The airplane is also capable of operating from unpaved landing areas. It is capable of short take-off and landing. It is certified for freight, passenger and air evacuation operations. Thanks to the Compatible Pallet System, it enables all types of landings. The aircraft has a large cargo space, it has a short take-off and landing distance even on unpaved areas and acceptable acquisition and operating costs [3], [4].



Figure 1 The CASA C-295 aircraft in flight [5]

Bulky cargo can be easily inserted and removed using rear ramp doors, which can also be opened during flight for offshore operations. The airplane can easily change the cargo cab configuration. Two or three rows of seats can be fitted for transporting people.

It should be further noted that it is difficult or impossible for the wheeled vehicle to enter the ramp. This is due to the thickness of the ramp. The earth touches only the outer part of the

ramp, and the inner edge forms an elevation. The ramp ramps, which are very narrow at both ends, serve as a smooth ramp. Each auxiliary ramp has hooks that are trapped in two of the twelve hinges at the end of the ramp and secured against falling out. The auxiliary load ramps are installed symmetrically to the ramp axis, which means that the two auxiliary ramps will be spaced from the axle half of the axle width of the wheeled technique being loaded. Auxiliary landing ramps can be installed both on an open-to-ground ramp and on a ramp in a horizontal position when loaded on an auxiliary loader.

Another important aircraft equipment is the winch which is located in the front of the load compartment under the floor cover. It is used to wind up wheeled machines or pallets with a maximum weight of 1 000 kg. For easy cargo attachment, the hook has a retractable hook at the end. It can be unwound up to a maximum length of 25.9 m. It wraps at a rate of about 0.17 m.s^{-1} , depending on the friction between the materials. Winding and unwinding is controlled via a six-meter cable that is connected to the control unit to the right of the door from the crew door. The winch can also be controlled from the left-hand side door where it is better to control the winding load or the end of the fuselage, from which it is directed to take off the anchor ropes from the landing, or it can be pulled back into the aircraft by the captured paratrooper.

In order to maintain flight safety, it is not important to respect only the limits of the total airplane, such as the maximum take-off and landing masses and adherence to the prescribed limits of the airplane, but also compliance with the limits of individual components of the airplane, such as chassis limits, weight limits and cargo dimensions in cargo and ramp correct deployment, correct fuel deployment, number of passengers and their deployment, etc. It is also important to meet the limits of auxiliary costing techniques [6].

The chassis of the C-295 is very solid and has been designed for take-off and landing both on paved and unpaved lanes. It is capable of absorbing large shocks in landings. The permissible vertical descent speed limit of a landing of an airplane with a total landing mass of up to 20,700 kg is 10 feet per second, with a maximum landing mass of 23,200 kg, the vertical descent rate of up to 9 feet per second.

The Casa C-295 - fig. 2 has four fuel tanks, two inner and two outer. The internal tank holds up to 1,570 litres and the external fuel up to 2,280 litres, together 7,700 litres. The weight of the fuel depends on its density. In this case, the mass of 7,700 litres of fuel is approximately 5,900 kg. The cargo space is 12.694 m long. The floor level is 2.344 m wide and the available cargo height is 1.716 m. Four anchor rails are installed along the entire load floor. On the side walls of the load compartment are hull marking and frame numbers, serving as reference points during loading.



Figure 2 **CASA C-295 at Kabul Airport** [7]

The load compartment floor consists of aluminium panels fixed to the longitudinal and transverse beams forming the supporting floor structure. These floor panels are separated by four anchor bars. The floor is covered with non-slip material for improved vehicle adhesion and ease of movement for workers. On both sides of the load cabin – fig. 3 are reinforced belts so that the floor can withstand the load of the stored wheel technology. Belts range from F-15 to F-30. The loading ramp is 3.040 m long and, after closure, extends from F-30 to F-38. When it opens, a hole in the load compartment of 2.300 m width and 1.710 m height is created. When rollers are installed, the opening height is 1.660 m. When the load ramp is fully open to the ground, it will create a slope between 15.1 and 19.8 degrees depending on the overall weight and center of gravity of the airplane. The load ramp is also installed in the floor along its entire length with four anchor rails. The entire length of the rear cargo door shall not be used for cargo purposes.



Figure 3 **Pilot cabin of the CASA C-295** [7]

The cargo cab floor has a general design load of 1000 to 1300 kg per ordinary meter. Generally, a regular meter is a rectangle whose one side is equal to one meter, and the other side is equal to the width of the item being measured that is constant over its entire length. In the case of the CASA C-295, the normal meter with respect to the width of the load compartment has the shape of a rectangle of 1 x 2.344 m. In normal conditions, the total maximum weight of the cargo can be 9250 kg. For flights requiring more maneuvering, the total maximum cargo weight may be 7050 kg [8].

When loading and unloading long objects or wheeled vehicles with a ramp open to the ground, there may be a problem. When long objects are drawn into the load compartment after a sloping ramp, they will not run parallel to the hull ceiling, but the hull ceiling will approach the corner of the cargo before the center of gravity arrives at the ramp suspension and does not fall into the cargo compartment. The impacts themselves would not benefit the airplane, and the corner of the cargo would hit the ceiling and jump. Therefore, it is advisable to pull long objects into the load compartment on the ramp horizontally open [8].

In the wheeled technique, the chassis height could be too low and the chassis would hit the ramp suspension. Therefore, it is also advisable to pull the wheeled low-lift wheeled technique into the load compartment on a horizontally open ramp or on a ramp open to the ground at a lower angle and supported by a ramp. Fastening nets are used to secure and stabilize cargo on pallets. Three networks are used to secure one pallet. The two green side nets HCU-7 / E are installed on the sides of the pallet load and the yellow net HCU-15 / C is installed at the top of the cargo. These three networks are interconnected and downloaded and secured cargo. The weight of all three nets

is 29.500 kg. If the load is low and the grids are not sufficient for proper tightening, seven CGU-1 / B straps are added and the load is withdrawn.

2. CARRIAGE OPTIONS OF THE CASA C-295

Transport of persons and material is a very important factor. Transport has played an important role ever since and has been steadily developing. Transportation is getting faster, more people and material are transported, cheaper and safer, and thus more efficient. At first, the material and people were transported by walking, later used for transport purposes animals, boats, first transport machines and nowadays modern transport aircraft. In operations, the speed and capacity of the means of transport will be important transport factors. Modern warfare requires the supply of a great deal of all kinds of forces. Aviation cannot meet these great demands. Therefore, air travel should always be carefully considered and used only where it is not possible to supply another type of transport at the required time [8].



Figure 4 Aircraft CASA C-295M [7]

The CASA C-295M – fig. 4, 5 aircraft allow for logistics. The cargo space allows the C-295M to efficiently transport personnel, paratroopers, pallet loads, or bulky cargo, such as light vehicles or aircraft engines. The C-295M also allows the installation of stretchers for medical displacement. The cargo space C-295M can be quickly rebuilt to meet requirements such as passenger transport, landing, freight transport without pallets, pallet cargo transportation, transport of vehicles, medical removal, etc.

The cargo space can be converted into two basic versions for the transport of troops and one basic version, which serves rather to transport persons. The transport of troops can take place by installing two or three rows of

seats. In a double row version, the seats extend along the entire length of the load compartment on both sides of the hull so that the passengers sit facing the load compartment axis. Normally, the C-295 seats 24 seats on the right and 25 seats on the left. The load can be transported and placed directly on the floor of the load compartment. The floor load limits and the weight, size, guard and safety material limits must be respected. Unlading freight is virtually unavailable directly to the load compartment floor. If the pallets are not available, the load must be dismantled as much as possible and properly secured. Direct bulk tents or power generators can be transported directly on the floor.

The transport of dangerous goods must be carried out in accordance with ICAO regulations. There are different categories of dangerous goods depending on their nature and hazards. Dangerous cargo must be properly packed, labelled and documented. In-flight transport must be as far away from heat sources as possible and as far back as possible. There must be easy access to it so that the other material does not have to be transferred to it. According to the ICAO Code, the carrier is responsible for the correct packaging and completion of the Dangerous Goods Declaration.

When transporting aviation fuel, cargo safety must be guaranteed. Under normal circumstances, tanks of transported vehicles can contain 1/2 fuel total tank capacity. In exceptional cases, vehicle tanks may contain 3/4 fuel total tank capacity and vehicles whose axles are partly on the ramp, 1/2 tank volume. The vehicles will be drawn into the airplane after the sloping ramp so that their fuel is higher than the fuel tank.

Generators, hydraulic aggregates and power generators are exhausted, cleaned and vented. Under exceptions or under emergency conditions, 1/2 of the total fuel tank contents can be contained. Tank vehicles are mostly not certificated for tanker fluid transport. The fluid would cause problems with the airplane's balance when overloaded. The tanks are therefore transported drained, cleaned and ventilated. Fuel canisters can only be transported if the fuel type is approved for air transport. The canister must be filled with fuel at least 2.5 cm (1 inch) below the neck of the canister [9].



Figure 5 **The CASA C-295M aircraft at Ostrava Mošnov [7]**

Aircraft engines must be transported as best as possible and all pipes must be closed. Engines must be ready for air transport in accordance with the procedures specified in their specific documentation. Aerial fuel tanks will be transported in exhausted, cleaned and ventilated, or transported while retaining liquids inside, in accordance with the preparatory procedures specified in their specific documentation. If fuel is spilled when loading equipment or materials, the use of electrical equipment must be minimized, the lights should not be illuminated and the switching on and switching off of the device can all cause a spark. All doors must be opened and wiped with absorbent material [9].

An important factor is the range is the factor that expresses the distance to which the airplane is able to fly without stopping and without refuelling the fuel. Generally, with more fuel in the tanks, the airplane will fly further and with a higher load weight, hence with a higher total weight, its range will be shorter. Important milestones are fuel consumption per unit time and travel speed. In general, it is better to fly slower with less fuel consumption. The role is also played by the height in which the flight is performed. At lower altitudes, there is a higher air density, which gives the aircraft greater resistance. The air temperature is also affected. The warmer the air is smoother and the airplane has less resistance. The direction and speed of the wind is also a significant factor in the range.

Values for different airplanes performance can be read from the tables in the airplane manual. In the CASA C-295 manual, according to the total airplane weight, air temperature at sea level, flight height and flight mode, a corresponding table is selected to read the node speed and the hourly fuel consumption per engine. From the hourly fuel consumption and the amount of fuel for a flight, it is possible to calculate the possible flight time and the flight time and flight speed range.

3. EXAMPLES OF APPLICATION OF CASA C-295 IN THE PROVISION OF HUMANITARIAN AID ABROAD

CASA C-295 aircraft have been used several times for the transport of material humanitarian aid or the transport of expert teams. This is for example (the summary is not exhaustive, just illustrative) about the following cases:

Year 2010, Albania

Transport of humanitarian aid to floods affected by Albania (December). Closer to [10].

Year 2011, 2012, 2016, Mongolia

Air transport of endangered Przewalski's horses from the Czech Republic to Mongolia. See [11] and [12].

Year 2011, Libya

Transport of humanitarian aid after the Civil War in Libya (October). It is also closer to [13].

Year 2016, Syria

After agreement with the Syrian Arab Red Crescent, transportation of medical supplies (wheelchairs, crutches, walkers, etc.) and four mobile kitchens. The shipment took place in June, the trip was carried out twice (June) – see [14].

In October of the same year, the transport of other medical supplies and appliances – fig. 6 (e.g. wheelchairs, dialysis units) and selected foods – e.g. dried milk released from state material reserves - was provided for, for example in [11].



Figure 6 **Transfer of humanitarian aid to Syria [11]**

Year 2018, Czech Republic

ECMO Transport – fig. 7 (*Extracorporeal membrane oxygenation*) team to help a critically endangered child from Prague to Ostrava [12].

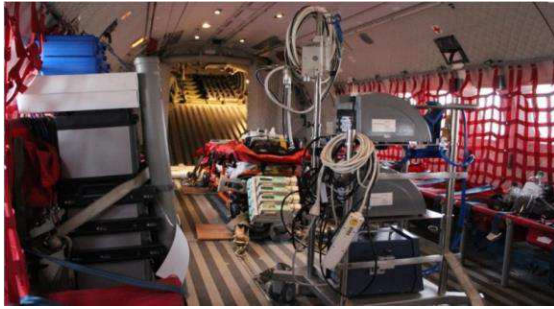


Figure 7 **ECMO Medical Equipment on the CASA C-295 transporting to Ostrava** [12]

CONCLUSION

Great effort is needed to prepare pre-flight training. Carefully fill in the load-sheet and calculate the center of gravity position. Incorrect positioning of the center of gravity and failure to recognize an error could lead to an airplane crash. Also, all take-off and landing limits and the flight itself must be met, their non-compliance could also lead to disaster. In addition, it is necessary to carefully consider the size, weight, layout, backing and securing of the material in order not to exceed the limits of the dimensional, weight, allowable floor load and to avoid load displacements.

It is important to keep all the limiting factors in order to ensure maximum flight safety. Computer programs are able to calculate flight parameters very well nowadays. Human control is, however, irreplaceable.

Air transport is very convenient in terms of speed and distance to which it can be made. However, its constraining factor is the transport capacity, which is small compared to other means of transport. Air transport must

therefore be very carefully considered where and how to use it so as to be as effective as possible.

The armed forces of the Czech Republic have at their disposal four pieces of the central transport aircraft CASA C-295M, which are used mainly for military purposes, but also for the civilian sector. They are compatible with a range of auxiliary means for loading and unloading the transported cargo, thus saving a lot of time and effort, which are very important factors in war situations. The CASA C-295M can easily meet the various requirements for a variety of shipments thanks to easily adjustable load compartments. Whether it concerns transport of soldiers, civilian persons, paratroopers, freight transport with and without pallets, wheeled vehicles, transport of wounded, and special operations that are not pre-specified.

The CASA C-295M is capable of operating from a non-stop operating airport across Europe to the east of Asia and North Africa. With stopovers for fuelling its sector is expanding many times, and thanks to its ability to land on unpaved areas it would be able to operate almost all over the world.

In conclusion, CASA C-295 satisfies the requirements for the transport of the medium transport aircraft. Its cargo space is very variable and can be rebuilt for various types of transport. Each mode of transport may have several deployment variants, and combinations of variants may occur.

Only a perfect knowledge of transport conditions contributes to the successful implementation of humanitarian aid and will meet the expectations of all stakeholders.

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