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## AIRDROP OF ARMAMENT AND MILITARY EQUIPMENT FROM AIRCRAFT

### SUMMARY

*Air supply can be performed in two ways: by transporting the technical equipment by transport aircraft or helicopters, and unloading upon landing and by air-dropping. The airdrop can be performed by dropping without parachutes, with parachutes and by low altitude cargo extraction. In the USA - CADS (Controlled Aerial Delivery System) has been developed providing control of the falling cargo via a remote controller.*

### 1. INTRODUCTION

Dynamic combat actions are made difficult by geographic and other conditions, and may even paralyse the land and sea traffic. The lack of airports may block the air transport, and vast inter-distances can make it impossible to use helicopters. In such cases parachuting of supplies is the only solution, not only for the airborne units but also for the surrounded troops, endangered population and guerrilla forces. The advantages of this type of supply are the speed, manoeuvrability and unloading directly within the area of usage. It is included in the term "airdrop" and it is the only way of supplying the forces deep behind the enemy lines.

### 2. AIRDROP OF ARMAMENT AND MILITARY EQUIPMENT

Airdrop of armament and military equipment, simultaneously parachuting troops or subsequently providing the troops with life and combat supplies - are as old as the airborne units themselves. It all started in the ex-USSR, at the beginning of the 1930s, simultaneously with the parachuting of units during the Red Army manoeuvres and creation of the transport aviation. It proved its significance best during the Second World War in performing huge parachute assaults and paradropping supplies, but also in many local wars following the year 1945. Airdrop of material has proven its significance in war practice.

Thanks to the strong transport aviation characterised by high load capacity and almost limitless flight range, air transportation of troops and materials and parachute supplies has not only an operative but also a global significance, forming an essential element of the efficient use of the American, but also NATO forces for quick intervention around the world. It should be noted that the air transport is a complicated and very expensive system, and its application requires a number of transport aircraft, cargo parachutes, airdrop packages, appropriate meteorological conditions, supremacy in air traffic, wide protection measures, skilled personnel for cargo manipulation, neutralisation of the enemy system of anti-aircraft defence, etc. Therefore, it is used only in specific situations, when the task cannot be performed in any other way.

Until 1950s, at the time of smaller transport aircraft with piston engines and side openings, the cargo mass of the parachutes ranged around 100 kg. The cargo was dropped from the aircraft manually. Both the cargo parachutes and the airdrop packaging of material and technical equipment, were adapted to those technical possibilities. For airdrop of heavier cargo (artillery pieces, light vehicles, etc.), the solution was found in using sailplanes trailed by transport aircraft or bombers.

A qualitative leap in this field was made around the 1950s, by introducing a new generation of transport aircraft (C-130, An-12) with turbo-prop engines, of 20 t loading capacity, with cargo opening in the kite axis (under the stabiliser) and roller conveyor for shifting the cargo across the aircraft floor. At the same time, both big cargo parachutes and new airdrop packaging equipment have been designed, thus providing the possibility of parachuting single cargo of 2 to 3 tons. The next advance in heavy cargo parachuting was made in the 70s by introducing still bigger jet-powered transport aircraft (C-141, Il-76), of 40 t loading capacity and capable of parachuting single cargo of up to 16 t.

These new generations of transport aircraft, cargo parachutes, platforms, airdrop packing equipment and devices have enabled the parachuting of artillery pieces of up to 122 mm, combat and motor vehicles, rockets and anti-aircraft defence, and other combat equipment, included into the armament of airborne units. These units have thus become moto-mechanised, and their tactical mobility, firepower, and assault power have been raised to an enviable level.

For the moment, there are no technical possibilities of parachuting the extra heavy combat equipment - tanks, artillery pieces of 152 mm and more, heavier engineer equipment, etc. This problem, when necessary, is solved by airborne units first occupying the airport within the field of operation enabling the extra heavy transport aircraft (C-5A/B, An-22, An-124) to land and unload the heavy combat and other equipment.

### 3. TRANSPORT AIRCRAFT

Air transportation, capable of mastering vast distances in short times, has been given a very prominent place in modern conditions, primarily in performing unexpected military operations. The capacities and high quality of transport aircraft make them capable of ensuring the transportation of airborne units and ground troops in operative and strategic scopes, supplying the troops and population and performing various transportation activities for the UN purposes. Due to the great scientific and air technology advancements, as well as huge financial investments, a powerful transport aviation has been constructed over the last decades by the world super powers, the USA and the ex-USSR, which takes up as much as up to 25% of their air forces. The air-transportation possibilities form an essential element of their combat power. They keep this system constantly at a high level of readiness. Transport aviation is not only a factor of the military but of the political power as well. It is due to this factor that, for instance, the USA can guarantee safety to their allies, but also endanger the independence and integrity of many small countries.

The US transport aviation is intended, first of all, to reinforce the ground troops in Europe and other regions in the world, to transport and parachute forces engaged in quick interventions on the global scale, to perform quick armed interventions against "disobedient" small countries (Panama, Grenada, Haiti) and to transport military and material aid to allied countries. Within this framework, its most complex task consists in parachuting the 82<sup>nd</sup> airborne division and transportation of the 101<sup>st</sup> airborne-assault division on intercontinental scale, and supplying them from air. Since these tasks are very often performed within the enemy territory, at night, and in complex meteorologi-

cal conditions, at great distances, and with a great number of transport aircraft, such aircraft operations require detailed planning, complex airport manoeuvre, accurate flight organisation and careful security schemes of all kinds, first of all, air supremacy, and neutralisation of the enemy anti-aircraft defence system.

High-level possibilities of modern transport aircraft (loading capacity, overall dimensions of cargo bays, flight range and technical equipment), together with the new airdrop equipment, have made it possible to include the heavy combat equipment (armoured combat vehicles, heavy artillery, modern anti-aircraft and anti-armoured equipment, great number of motor vehicles, and communication equipment, engineer machines, etc.) into the airborne units formations. The consequences lie in the increased manoeuvring capabilities, fighting power, and combat force of these units, incomparable to those of the Second World War. Similarly, by transporting huge army forces, with the whole combat equipment, and their disembarkation upon landing, an airdrop operation can acquire strategic character, in which the conventional ground troops carry the operative and strategic activities.

Today, the USA has the following transport aviation forces:

- 22 groups of strategic transport aircraft, 5 of which with 119 aircraft C-5A/B and 17 groups with 26 aircraft C-141B;
- 12 groups of tactical transport aircraft with 583 aircraft C-130 Hercules, 193 of which are in the National Guards, and 130 on stand-by.
- 36 groups of aircraft-tankers - 457 of KC-135 and 59 of KC-10A.

These forces are grouped into two fleets (armies) the eastern and the western fleet. Their (theoretical) daily capacities amount to about 15,000 men or 8,000-10,000 tons of cargo. Other calculations show that the US transport aviation can transport one reinforced parachute battalion from the USA to the Middle East in 48 hours, the whole 82<sup>nd</sup> airborne division in 8 to 10 days, performing daily 850 takeoffs, or 10,000 t of cargo at a distance of 7,000 km.

For the needs of special forces and special operations, the US military aviation has three special mixed "wings", including seven groups with specially developed or modified transport aircraft:

- AC-130 of A "spectre", 10 aircraft and AC-130X "gunship", 20 aircraft, as well as 9 on stand-by, armed with two 20 mm guns each, one 40 mm Cannon, and a 105 mm howitzer each, fitted with electronic equipment for firing control, intended for special units precision firing support. This group includes also the latest AC-130U "gunship", totalling 11 aircraft, armed by six-barrelled 20 mm gun GAU, 40 mm cannon, and a 105 mm howitzer, with

computer controlled firing, and the gear platform driven by a hydraulic system instead of the former electric system;

- MC-130 E/X ("Combat talon" and "Combat talon - II"), totalling 22 aircraft, fitted with modern electronic equipment thus making them capable of flying at night and in complex weather conditions, flying along a programmed itinerary at low altitude, finding the airdrop regions and precision airdrop with no homing system, electronic self-protection, etc. These aircraft are intended for secret infiltration, supply and evacuation of special forces and for performing other special tasks deep behind the enemy lines;
- EC-130E/X, 30 aircraft, for psychological operations, and
- HC-130N/P, 24 aircraft-tankers, for in-flight fuelling of other special forces transport aircraft.

Regarding technical characteristics of transport aircraft, it would be sufficient to say that they are capable of taking off and landing on grass runways, that they have a powerful power plant consisting of four double-flow, turbo-fan engines, of maximal thrust of as much as up to 200 kN, insuring the loading capacity of 20, 40, and 120 t, that they are autonomous in fuelling, mechanised loading, unloading and parachuting of people and cargo, and that they can be fuelled in

flight, thus considerably increasing their flight range. They also have modern electronic equipment for communication, navigation, airspace and ground surveillance, airdrop and electronic counter-activities, insuring that they perform their tasks efficiently even in severe meteorological condition and at night. This reduces the need for marking the airdrop areas, for homing systems, formation flying limitations, and dependence on daylight visibility and meteorological conditions. The only limitations during airdrop are the stronger winds above ground and heavier precipitation which disturb safe landing of parachuted troops and cargo.

#### 4. SUPPLY FROM AIR

Supply from air can be carried out in two ways:

1. Transportation of material and technical equipment by transport aircraft or helicopters and their unloading upon landing and
2. by air-dropping.

Transportation and use of helicopters in transport and airdrop are topics for themselves. Air-dropping can be performed: by dropping without parachutes, with parachutes or by low-flight cargo drop (the LAPES system - Low-Altitude Parachute Extraction).

**Table 1 - Basic tactical and technical characteristics of the biggest transport aircraft**

TT characteristics	Type of Aircraft			
	An-225 "Antonov"	An-124 "Antonov"	C-5 "Galaxy"	"Super Gapi"
Power plant - type	6 × D-18T Lotarev	4 × D-18T Lotarev	4 × TF39-GE-IC General Electric	4 × 501-D22C Allison
Thrust / power	6 × 230 kN	4 × 230 kN	4 × 191 kN	4 × 3660 kN
Wingspan	88.40 m	73.30 m	67.88 m	47.62 m
Length	84.00 m	69.10 m	75.54 m	43,84 m
Height	18.10 m	20.78 m	19.85 m	14.78 m
Length of the cargo bay	43.00 m	36.00 m	44.09 m	34.00 m
Height of the cargo bay	4.40 m	4.40 m	4.09 m	7.77 m
Width of the cargo bay	6.40 m	6.40 m	5.79 m	7.65 m
Mass when not loaded	300 t	250 t	170 t	45 t
Mass with maximum loading	600 t	405 t	380 t	77 t
Payload capacity	250 t	150 t	119 t	25 t
Cruising speed	700 km/h	800 km/h	833 km/h	400 km/h
Maximum speed	850 km/h	865 km/h	910 km/h	460 km/h
Runway length for takeoffs with max. loading	ca. 3500 m	3000 m	2500 m	2450 m
Maximum range with load	200 t 4500 km	max 4500 km	max 5500 km	max 810 km

Material and technical equipment dropped from the aircraft without parachutes includes those items which are not sensitive to impact, such as certain food items (flour, sugar), clothes, footwear, blankets, bandages, etc. These are packed into double bags with the total weight not exceeding 50 kg, and are dropped at the altitude of a few hundred metres.

All the material and technical equipment of up to 16 t in mass, and dimensions which fit the aircraft cargo bay are dropped by parachutes. For the purpose of parachuting, special cargo parachutes have been designed of various loading capacities, as well as airdrop packing material and platforms, shock-absorbers to reduce the impact effect upon landing, automatic devices for controlling certain processes in the air, (retrorocket parachute system) to reduce the landing speed, etc. The altitude of parachuting ranges between 300 and 7,600 m. The Americans call the airdrop of lightweight cargo (0.1 - 1 t) HAARS - "High Altitude Airdrop Resupply System", and it includes: food, ammunition, equipment, fuel, and light combat instruments. The airdrop of heavyweight instruments (1 - 16 t) is called "High Level Airdrop Platform Delivery System".

#### 4.1. Low Altitude Cargo Extraction

People have always been trying to find a more economic system of air supply other than parachuting. One of such systems is the low altitude parachute extraction of cargo called LAPES, developed at the beginning of the 60s and accepted by the USA and some western countries. The essence lies in extremely low flight of the transport aircraft (1.5 - 5 m) above ground at the moment of airdrop, whereby an extraction parachute, 1.9 - 4 m in diameter, extracts the cargo from the cabin, which in turn hits the ground without any shock absorption, fixed on a platform and sliding across the ground in trail of the aircraft for about 100 m. The ground impact is not one of high intensity, since due to the low altitude the vertical speed of the cargo is low, and the horizontal speed acquired from the aircraft is high (up to 400 km/h). The resultant is such that the ground impact intensity is acceptable. During the sliding behind the aircraft, the extraction parachutes act as brakes. This system eliminates the bulky cargo parachutes, shock absorbing instruments, and there is no need for an airport. The cargo is delivered with precision, the aircraft can fly extremely low on its itinerary thus avoiding the radar recognition and the air-defence system. What is required is an ideally straight flat strip of land in the length of 1,000 m, good access and specially trained pilots. Although this systems proves to be very economical, it presents only a supplement to the parachute airdrop and is used in favourable geographical and combat conditions solely.

## 5. CARGO PARACHUTES

The role of a cargo parachute is to land cargo safely from the aircraft onto the ground, slowing down its drop to an acceptable value. A group of cargo parachutes, introduced during the 50s, with certain minor modifications, has remained to the present day. The major advance happened in introducing the two-phase unfolding of the parachute canopy, the so-called stabilising. After leaving the aircraft, the cargo falls for some time supported by a small, stabilising parachute, at a speed of 65-80 m/s, up to the altitude of 800 m, when an automatic device on the barometric pressure opens the main parachute canopy, or several, and the cargo continues to fall at the speed of about 8 m/s until landing. In this way the issue of parachuting men and materials at higher speeds developed by jet transport aircraft have been overcome.

The size of the canopy is proportionate to the mass of the cargo. For cargoes of up to 250 kg the canopy area amounts to 50-70 m<sup>2</sup>, for 250-1,000 kg about 300 m<sup>2</sup>, for 1-2 tons about 730-760 m<sup>2</sup>. Further increase of the canopy area would prove uneconomic, so that the parachuting of heavier cargo is done by connecting several canopies into a cluster - in the former USSR up to four, and in the USA up to eight canopies. This, however, does not solve in the best possible way the problem of the intense ground impact of heavy cargo, so that retrorocket parachute system had to be introduced.

Cargo parachute is a complex device, consisting of an extraction parachute and a 50-60 m long rope for extraction from the aircraft, stabilising parachute, braking parachute, main canopy with lines, locks for combining several canopies, lines for connecting the main canopy with the cargo or platforms, self-releasing locks from the cargo after landing, protective bags and technical booklet. Each of the mentioned parachutes has its own protective cover, lines and a knapsack for all the parts.

## 6. AIRDROP PACKING MATERIALS AND PLATFORMS

Airdrop packing materials and platforms provide safe positioning and landing of the material and technical instruments by parachutes. Their shape and design are adapted to various types of air-dropped cargo. These include: fixing straps, containers, barrels, pallets and platforms. According to the purpose and mass of the cargo loaded into or onto them, the airdrop packing materials and platforms are divided into four groups: individual, for lightweight (50-1,000 kg), heavyweight (1 - 10 t) and extra heavy weight (10 - 16 t) cargoes.

Individual: the parachutist in jump carries his personal weapons, ammunition, bombs, 1-2 kg of explosives and ignition devices, a three-day dry food supply, a water bottle, gas-mask, tent, etc. so as to survive and fight in the hostile environment. These items are packed into a knapsack (T-59 in the USA), of up to 43 kg, which is carried in front during the jump, at the knee level, and suspended in air on a 6 m long rope thus making the landing easier. The personal weapons are packed in a special protective cover.

The airdrop packing materials for lightweight cargo are used for packing lighter bulk cargo (ammunition, explosives, medical supplies, food items), links of lightweight tools, spare parts and liquids. These include soft bags, lightweight metal containers, and smaller platforms, airdrop belts for fixing factory-packed items, nets and metal barrels. These are of simple design and some are fitted with various shock-absorbers at the bottom. The US airborne units have adequate airdrop packing materials.

Heavyweight cargo platforms are made of steel or light strong alloys, of grid structure, and proper mass of about 1 t, with loading capacity of 1 - 10 t. Motor and light combat vehicles, heavy mortars, artillery pieces, multiple rocket launchers, etc. are fixed onto these. They also include various locks, hooks, fastening devices, and steel wires for fixing the cargo, adjusted for quick and easy release.

The extra heavy cargo, of 10 - 16 tons of mass, such as light "Sheridan" tanks, infantry combat vehicles, with their proper shock-absorbing systems, are not positioned onto platforms, but directly suspended on a

parachute. The rest of the extra heavy items are positioned onto light-structured platforms P-7 or PP-16000 type (Russian), i.e. "V" type in the USA.

One of the greatest problems in airdrop of heavy and extra heavy cargo is the shock absorption at ground impact. No mechanical shock absorbers, nor bigger cargo parachute canopy areas have proved useful, since the cargo dropping speed increases proportionately to the cargo mass, and this in turn affects the intensity of ground impact. With 1.5 - 2 ton cargoes, the falling speed is about 5 - 6 m/s and the intensity of impact was acceptable, 5 ton cargoes, in spite of a higher number of canopies, the falling speed was doubled to 8 - 12 m/s, and the ground impact cannot be accepted any more, causing damage to the air-dropped items. The space engineers had the same problem in capsule returning from the space to the Earth. The solution is provided in the retrorocket parachute system whose thrusting force at the moment of firing in the direction opposite to gravitation, at the altitude of 5 m above ground, decreases the cargo falling speed from 30 - 40 m/s to zero. This ensures a "soft" landing of the cargo without any damaging. Thus, the use of bulky and expensive multiple-canopy parachute systems and inadequate mechanical shock-absorbing systems have been eliminated.

#### Auxiliary means

In order to simplify the finding of cargo belonging to single units or identifying the type of air-dropped cargo, the cargo parachutes are of various colours, cargoes are visibly marked by distinct agreed marks

Table 2 - Airdrop packing material and platforms on the transport aircraft of the US military forces

Name	Structure	Purpose	Load capacity (kg)	Shock absorption
A - 7A	4 supporting and several auxiliary fastening straps	Factory-packed material-technical instruments less sensitive to impact	45-230	none
A - 21	Light alloy platform and bag-like net, with straps	Food items, medical supplies, clothes, footwear, etc.	45-500	honeycomb-structured paper blocks
A - 22	Light platform with 2 plates, and 6-9 layers of cardboard in between, cover, straps	Ammunition, explosive, light pieces, canned liquids	317-1,000	honeycomb-structured paper blocks or 18 mm cork
K-900	Plastic, cylindrically shaped container	liquids	900	wooden
MPC-10	Metal 2.74x2.44 m	Vehicles, gear, etc.	3.4 t	a 27 mm thick layer
	Metal 2.74x2.23-9.75m adaptable for all aircraft and items	All types of vehicles and heavy cargo	5-18 t	Cork, felt, etc.

and visible little flags, and at night by signalling torches of different colours. The most efficient is the radio-device (US G - RT - 13), which transmits coded signals. The helmets of the crew, attendants, drivers and superiors are fitted with receivers which receive the transmitted signals, so that they can, on the goniometric principle, more easily find "their own" cargo within a crowded airdrop region.

## 7. AERODYNAMIC WING

The need for precision landing of lightweight cargo during special combat activities, when the equipment should be delivered next to the parachutists, has stipulated the design of a parachute system which can be radio-controlled in airdrop. The USA have recently developed CADS - the Controlled Aerial Delivery System, which consists of a "wing"-type parachute, of 24 m<sup>2</sup> area, cargo packing platforms (personal and joint weapons, ammunition, explosives, food), of up to 250 kg and radio command device AN/ASN-95, whose signals are transmitted from the parachutist in jump or the ground homing person, over a remote controller, to the parachute controlling lines. There is also a similar product called P/N-M-300-3 (Para Point) and there are others as well. Its manoeuvrability has the 3X value (X representing the airdrop altitude), and the landing precision is  $\pm 100$  m. The airdrop can be performed from the altitude of 300 - 7,600 m. The significance of this system is that a special airborne unit can carry on it whatever is needed to perform a certain task, the parachutists have more freedom in jump, and the equipment is delivered in the vicinity of the group, which cannot be achieved by any other equipment. This system, similar to the human parachute of the "wing" type ensures the secrecy of airdrop operation, since the aircraft carrying this group can fly much further away from the airdrop region, and the group with the load lands into the planned area. Depending on the flight altitude and the wind power, the distance may amount to as much as 40 km.

## 8. SUPPLYING FROM THE AIRSPACE OF BOSNIA AND HERZEGOVINA

In practice, there have been air transportation as well as parachute airdrop of equipment to the Bosnian side. Publicly and legally this was performed within the framework of providing humanitarian aid of the international community to the population of the Bosnian enclaves in the form of food, clothes and other life-sustaining items.

Airports Sarajevo and Tuzla are used for the transportation of technical equipment. Here the equipment is unloaded and driven away by the UN vehicles.

The UN supervising bodies are present at these airports guaranteeing that no military material is delivered among the cargo. Materials are packed into standard air-transport containers which have been adapted to the aircraft cargo handling equipment.

### "Parachute" operation

This operation was performed by the Americans using their latest transport aircraft for special purposes, MS-130X starting from the Main-Rhine airport base near Frankfurt. The material was air-dropped by parachutes to the regions of Bosnian enclaves Goražde, Srebrenica and Žepa.

## CONCLUSION

The airdrop of armament, military equipment, and other material using parachutes is an efficient way of supplying the troops in dynamic conditions of combat activities in austere accessible regions, at greater distances, damaged traffic infrastructure, behind the enemy lines, in emergency cases, etc.

The modern low altitude cargo airdrop systems, such as LAPES, ULLA and others, allow even the light armoured combat vehicles to be air-delivered. The supply in this way is much more complex than in the conventional way (delivery by landing), requires special packing, precision navigation and meteorological protection, especially at night and in poor visibility conditions.

### SAŽETAK

#### DESANTIRANJE NAORUŽANJA I VOJNE OPREME IZ ZRAKOPLOVA

*Doprema zrakom se može obaviti na dva načina, prevoženjem materijalno-tehničkih sredstava transportnim zrakoplovima ili helikopterima i iskrcavanjem nakon slijetanja i desantiranjem. Desantiranje se može obaviti bacanjem bez padobrana, padobranima, i izvlačenjem tereta u niskom letu. U SAD je razvijen padobranski sustav (CADS) kojim se upravlja preko daljinskog upravljača u toku spuštanja.*

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