

## **Unique Components to Air Transport**

Air transport has become so common in the modern world that shippers frequently take key important factors for granted, or overlook them when planning and utilizing aviation for cargo. Understanding some of these unique needs will help when planning large international shipments, but will also help understanding in-country and response specific aviation needs as well.

## **Weight as a Limiting Factor**

In all aviation, one of the largest factors that impact speed and price is the overall weight of the airframe and its contents. In cargo operations, the take-off weight of an airframe in flight can vary substantially – an airframe fully loaded with heavy cargo easily double the total weight of the same aircraft without cargo. All aircraft have what is known as a “maximum take-off weight” – or the maximum weight at which an aircraft can safely take off and reach the desired altitude and flight path. This weight is calculated as a combination of the physical aircraft, cargo, passengers, and fuel. The maximum take-off weight can also be impacted by outside conditions, such as the wind direction, ambient temperature or the length of a landing strip. Pilots and loadmasters have ultimate discretion for the safety of their aircraft and crew, and will make the final calculations on what is safe and achievable for an aircraft, and what is not.

Based on the aforementioned factors, the acceptable weight of the payload may fluctuate, changing costs and overall delivery schedules. For this reason, light but voluminous cargo might always be able to fill up an entire cargo hold – or “cube out” by reaching the maximum available load through volume – while more dense and bulky cargo might be able to take a relatively small portion of a cargo hold – or “weighing out” by reaching the maximum lift weight. The orientation of a cargo inside of an aircraft is also very important, and loadmasters and crews will need to properly place and balance loads to maximise aircraft safety while taking off, flying and landing.

## **Fuel as a Limiting Factor**

Aircrafts consume relatively large amounts of fuel per kg compared to other transport methods, and unlike other modes of transport, stopping to undergo refuelling is a complicated process. Whereas a boat or vehicle running out of fuel in mid-movement might strand a vehicle or leave it adrift, an aircraft running out of fuel has immediate and tragic consequences. In aviation, fuel calculations are estimated per flight, based on range, altitude, cargo load, wind conditions, and if the airport of arrival has refuelling capabilities. In real terms, there are many factors that might make travel over the same distance consume more or less fuel than it would in a similar route. An increase in the take-off and carriage weight increases fuel used per km, while flying into a prevailing wind-current will also increase fuel consumed per km. Knowing this, crews will increase the fuel in their tanks, which might adversely affect maximum take-off weight. In other words, the cost for kg of cargo might go up, while the total quantity of kg you can ship might go down.

## **Prevailing Conditions as a Limiting Factor**

Aircraft – though highly engineered pieces of equipment – can still be heavily impacted by the physical environment. In addition to factors that can be controlled by the crew and pilots (such as load and maintenance) some external factors that might impact an aircraft’s ability to

operate safely are:

- Take-off/landing altitude – the higher altitude a landing strip or airport is, the more hazardous take-off and landing might be. Fixed wing aircraft will need to approach landing strips at faster speed and reach a faster speed to take off, all while requiring a longer runway to accommodate both. Rotor wing aircraft will need a slightly higher rotational speed to achieve lift at higher altitudes as well.
- Wind – heavy winds can make take-off/landing and flight hazardous. For fixed wing aircraft, a strong tail wind might increase the distance for safe take off, which is why many airports will reverse the landing and take-off directions if the direction of the winds change. A sidewind blows at a perpendicular angle to the direction of movement of an aircraft in flight, takeoff and landing, and can make navigation and take-off/landing dangerous. Any strong prevailing wind can make operating a rotor wing aircraft of any kind dangerous, especially gusts that may tilt rotors during take-off/landing or cause sudden loss of altitude.
- Atmospheric conditions – Dust, fog, and heavy rain can render flight and take-off/landing difficult or impossible, especially in night time settings. Air temperature also plays major factor; excessive outside heat can make taking off difficult, and aircraft may not be able to take off in extreme heat.

## **Airport Facilities as a Limiting Factor**

Though aircraft may be able to physically fly to a destination, they may not be able to adequately service the cargo needs. Limiting factors might include:

- Lack of refuelling capability on the ground – aircraft on long haul flights may not be able to properly stop and offload if they cannot refuel.
- Lack of ground handling equipment – most commercial aircraft will require some form of specialised MHE to offload and move cargo around. Lack of proper MHE can impede or prevent offloading or loading all together. Some aircraft, especially military aircraft have the capacity to load without MHE, and may have onboard ramps to tail and nose load aircraft by hand.
- Lack of customs capability – not all airports have the ability to clear cargo through customs, limiting movement to domestic flights only.
- Lack of ground service/ground handling – ground crews help load/offload, service and conduct repairs to aircraft. Without ground crews, small technical issues may ground aircraft until proper technicians can arrive. Ground services also conduct de-icing, support catering, and provide other support services that can impact timely departures.
- Lack of storage and holding capacity – airports that lack proper ability to store cargo once offloaded may quickly become unusable for aircraft operations. Cargo building up on the apron space of the tarmac might impede the flow of ground movement and even prevent further cargo from being offloaded.
- Lack of aircraft parking space – an airport may lack the space for multiple aircraft to land, park and offload at the same time. Landing strips or airports limited to one or a small number of aircraft that can park at the same time will need to schedule flights accordingly, impacting delivery schedules
- Lack of communications equipment – immediately after disasters, surface to air communication, radar equipment or even observation towers may be damaged, which impede safe approach, landing and take-off of aircraft.

## **Regulations as a Limiting Factor**

Local and internationally recognised regulations may impede cargo operations by limiting or preventing aircraft from operating all together. Some of these regulatory factors might include:

- Overflight clearance – aircraft must obtain overflight clearance from relevant in-country CAAs to operate in any country specific airspace. Countries may have bans on specific airlines or aircraft from registered in certain countries. Overflight clearances may also be delayed or rejected based on political or security concerns.
- Landing permits – like overflight, aircraft must obtain permission to land at an airport through both the CAA and airport authorities. Restrictions might include airframe type, origin or intended purpose. Aircraft may also be limited by the already in place schedule.
- Noise restrictions – airports near urban centres may ban certain large body aircraft that have excessively loud engines. Many of the larger high lift capacity cargo aircraft also happen to be very noisy, which might impact what airports cargo can fly out of.
- Maintenance Schedules – many air craft will require annual maintenance that might take them off line for up to a month, depending on the aircraft and the location an aircraft might need to be serviced at. This will impact the availability of leased aircraft for regular activities.
- Flight-hours – both aircraft and the crews have a maximum number of flight hours they can operate at any given time. Aircraft may be restricted to the number of hours they can fly in a week or month, while crew – and especially pilots – are restricted to the number of hours they can operate in any given 24 hour period, accompanied by what is called mandatory “crew rest” hours.
- Pilot Rating – in addition to being fully licensed to operate an aircraft, pilots also must be rated for key airports or conditions. In some contexts, pilots may need to undergo additional training or simulation time to fully reach this rating, possibly impacting ad-hoc delivery of emergency goods.

## **Aircraft Registration**

Aircraft operating in any domestic airspace, or above any controlled territory of a country should be legally registered to operate. The registration process varies from country to country, and there are different types of registration depending on the intended use of the aircraft, such as military or non-international. As a general rule, most countries:

- Won't allow an aircraft to be registered twice, even in another country.
- Require that registration numbers (sometimes referred to as a tail numbers) be printed on a fireproof plate on the fuselage.
- Require aircraft be registered in the country in which the carrier is based or domiciled.

If an aircraft will operate internationally – fly between/over two or more different sovereign countries – it must also have declared an intent to operate internationally through its local CAA and comply with international standards including IATA and ICAO requirements for marking, communications equipment, and safety standards. If an aircraft operates internationally, it is considered a “flag-carrying” vessel of its originally country of registration, however while in the airspace of another country it must comply with all local laws and regulations. Without declarations of intent to operate internationally and without fully compliance with international standards, aircraft may not be allowed to register a flight plan, land or load/offload passengers or cargo, or even receive technical assistance when operating in a country outside of where the aircraft is registered.

Example Tail Numbers:

