

[Slide Air 1]

Cargo Securing at Air Transport



**Cargo securing to prevent cargo
damages on road, sea, rail and air**

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Slide Air 2

Cargo Securing at Air Transport General

Transport system needs air transport services in places where cargo is transported long distances and fast
Cargo is typically small and include expensive products



Photos: Arne Fischer


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Slide Air 3

Cargo Securing at Air Transport General

In transport chain, where air transport is involved, the transport is a coordinated multimodal service.
Cargo is always moved from other modes into the air transport mode and then vice versa. Then loading and unloading are necessary operations in this mode.



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Cargo Securing at Air Transport

General

Transport system needs air transport services in places where cargo is transported long distances and fast. Cargo is typically small, when it is transported in passenger aircraft's belly department. Cargo aircrafts can carry also heavy cargo. In addition, airfreight is used, when a product is expensive and at the same time the distance is long.

Regarding the airfreight, the transportation system is a coordinated multimodal service. Multimodal means that cargo is transported by one mode to air port's terminal or warehouse then unloaded and after that reloaded into an aircraft. As a matter of fact this transportation system needs a land delivery services for the final or first leg of the journey. The land delivery is transported mainly by road.

The goods need to be delivered to end-users within a limited time window. With the limited time window we mean a short period, especially with regards to express services.

Notes


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Slide Air 4

Cargo Securing at Air Transport

Typical Factors for Air Transport


- Highly specialized transport mode
- Airfreight cargo securing requirements and methods exceed the securing requirements of road transport significantly.
- Airfreight's cargo unit is called "Unit Load Device" (ULD)
- ULD and other innovative cargo units have made it possible to increase airfreight
- ULD can also be transported by truck (truck with rollerbed system)
- Airfreight's cargo is typically small



The illustration shows a stylized landscape with a factory, a truck, a ship, a train, and an airplane. A large white arrow points from the truck towards the airplane, indicating the flow of cargo. The background is light blue with clouds.

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Education and Culture DG



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Typical factors for air transport

Airfreight is highly specialized transport mode, which typically transports small cargo. Small cargo can be transported by passenger aircraft. Large cargo can be transported by cargo aeroplanes. The weight of the cargo varies a lot.

The material flow “stops” in air freight terminal because of cargo securing rules. Airfreight cargo securing requirements and methods exceed the securing requirements of road transport significantly and that’s why material handling is necessary in terminal.

Airfreight’s cargo unit is called “Unit Load Device” (ULD). The name can be regarded as slang word within airfreight operators. The ULD can be a specifically designed box for carrying packages or strictly specified way lashed and secured cargo unit for instance on a pallet. The cargo unit must be specifically designed, because strong forces towards cargo will be created in the start of the flight, at the end of the flight and in the air.

ULD and other innovative cargo units have made possible to increase airfreight. ULD suites also to road-air transport system well. Airfreight is door-to-door system, where the final leg is carried by a truck or van. Typically, the Rollerbed System in trucks are used, because they are fast to load and unload.

Teacher's Manual: Cargo Securing at Air Transport



Notes

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Slide Air 5

Cargo Securing at Air Transport Consequences of Insufficient Cargo Securing

The issue has two aspects:
Consequences

- 1) in flight
- 2) in other parts of the transport chain

Insufficient cargo securing in the latter part, normally for truck can create dramatic consequences like

- Loss of cargo
- Damages to other vehicles on the road
- Damages to environment

and in worst case

- Loss of vehicles
- Loss of lives



Photo: Arne Fischer

Consequences in flight are always dramatic!

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Consequences of insufficient cargo securing

Because of the nature of multimodal transport system the consequences have two aspects: 1) consequences in flight and 2) consequences in other parts of the transport chain.

The cargo securing in aircraft has to be made according to instructions so that the securing can withstand stresses that different accelerations create in flight.

Consequences that flight accident can create are always dramatic.

In the final leg of the cargo's journey (or in the first leg) truck or van is used. Insufficient cargo securing in this vehicle consequences can be dramatic in the form of:

- Loss of cargo
- Damages to other vehicles on the road
- Damages to environment

Notes

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Slide Air 6

Cargo Securing at Air transport


Cargo transport units and their cargoes in airfreight

Cargo Transport Units are cargo aircrafts and aircrafts with lower deck compartments, such as:

- Boeing MD11F
- Airbus A300


Goods are transported in special kind of containers or on any kind of pallets

- General cargo
- Small machines
- Food
- Different kinds of vehicles
- Spare parts




Air freight container




Aircraft Loading – Boeing MD11F



Aircraft Loading – Airbus A319



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Cargo Transport Units and their Cargoes in airfreight

In airfreight a cargo aircraft and a passenger aircraft are Cargo Transport Units. Passenger aircrafts carry goods in their belly department. Goods are transported in a special kind of container or on a pallet. This cargo transport unit is called Unit Load Device (ULD). Goods on pallet are always covered by tarpaulin or a net, so that the cargo unit is tight and withstand stresses that accelerations create.

Typical cargoes are:

- General cargo
- Small machines
- Food
- Different kinds of vehicles, for instance cars and motorcycles
- Spare parts

Notes

[Slide Air 7]

Slide Air 7

Cargo Securing at Air transport Cargo Transport Units – Unit Load Devices (ULD)

IATA has developed a standard of equipment and devices to facilitate the loading and unloading of goods from the aircraft.

The different types of pallets and containers are called ULD (Unit Load Devices)




Pallet

Container

Special pallet for transport of cars

Special container for transport of horses

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Cargo transport units – Unit Load Devices (ULD)

IATA has developed a standard of equipment and devices to facilitate the loading and unloading of goods to and from the aircraft.

The different types of pallets and containers are called ULD (Unit Load Devices). The Unit Load Device allows a large quantity of cargo to be bundled into a single unit. ULD has two forms: pallets and containers. There are wide variety of pallets and containers. Pallets are for instance rugged sheets of aluminum with rims designed to lock cargo nets. ULD containers are closed containers made usually of aluminum. If food is transported, the container includes a built-in refrigeration.

Unit Load Devices have to have also aircraft compatibility. So, this is one consideration that needs to be accounted for by the personnel of airport terminal.

The slide presents some Unit Load Devices but there are a large variety of forms available.

Notes

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Slide Air 8

Cargo Securing at Air transport

Lashing Equipment

There are mainly two different type of lashing equipment to secure the cargo to the ULD or directly to the aircraft:

- net or
- straps

The lashing equipment shall be manufactured and marked according standard ISO 16049.



Photo: Arne Fischer

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Lashing Equipment

There are mainly two different type of lashing equipment to secure the cargo to the ULD or directly to the aircraft:

- net or
- straps

The lashing equipment shall be manufactured and marked according standard ISO 16049.

Also ropes are used. Ropes and straps are fastened to rings of containers and pallets.

Notes

[Slide Air 9]

Slide Air 9


Cargo Securing at Air transport

Cargo Transport Units and their Cargoes in road-air transport system

In the road-air transport system cargo transport units are:
Vehicles and trailers

and their cargoes are:


- Air freight containers
- Cargo on pallets



Air freight containers in a road vehicle

Air freight container

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Cargo Transport Units and their Cargoes in road-air transport system

Here we have defined the multimodal transport system with road-air transport system, because mainly a truck or van is used in the first or final leg of the journey. So, in the road-air transport system cargo transport units are: vehicles and trailers. Then their cargoes are air freight containers, cargo on pallets etc.

Notes

[Slide Air 10]

Slide Air 10

Cargo Securing at Air transport Terminal Operation - to airplane and to truck

- To aeroplane
- To truck



Source:
<http://mediabase.lufthansa.com/mediabase>



Photo: DB/Ralf Braum



Source:
<http://mediabase.lufthansa.com/mediabase>



Photo: Arne Fischer

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Terminal Operation – to airplane and to truck

When the cargo arrives at airport's terminal, it is unloaded from a road vehicle and repackaged and then reloaded into the aircraft. The packaging and loading into the belly of a aeroplane is made by terminal personnel.

When the cargo arrives from the flight, the cargo will be moved to the terminal to unload from UDL and then it is repacked onto pallets, which in turn are loaded to the road vehicle.

The UDL can be loaded right away to the road vehicle, but in this case we are talking about Road Feeder Service. When UDLs are loaded to the road vehicle, typically a special vehicle (rollerbed) is needed.

Notes


[Slide Air 11]

Slide Air 11

Cargo Securing at Air Transport

Liabilities - general

International Air Transport Association (IATA) represent and serve the airline industry, which includes 240 airlines and covers 84 % of total air traffic.




IATA



- Safety standards for airfreight
- Unit Load Device (ULD) regulations
- Airport Handling Manual

ICAO

- Air cargo security standards



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Education and Culture DG
Lifelong Learning Programme

Liabilities - general

The basis for all contracts and operation procedures are created by aviation organizations IATA and ICAO. These organizations create also design and manufacturing standards for ULD. The airfreight terminal operator follows then these standards and especially the manuals of ULD manufacturers.

International Air Transport Association (IATA)

“The International Air Transport Association (IATA) is the trade association for the world’s airlines, representing some 240 airlines or 84% of total air traffic. IATA support many areas of aviation activity and help formulate industry policy on critical aviation issues.”

IATA have drawn up Unit Load Device regulations. Regulations give the knowledge required to handle, transport and manage unit load devices in airport operations. Regulations give also understanding, how to handle ULDs safely, securely and efficiently. ULD regulations contain both technical and operational standards and regulatory requirements as well as the carrier's requirements applicable to overall ULD operations. Note that only airfreight is considered.

Airport handling manual covers load control, baggage, cargo and mail handling, aircraft movement control, aircraft loading, departure control systems, passenger handling. See also the **slide 15**, Acting forces in the air transport.

International Civil Aviation Organization (ICAO)

A specialized agency of the United Nations, the International Civil Aviation Organization (ICAO) was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. The Organization serves as the forum for cooperation in all fields of civil aviation among its 191 Member States.

Teacher's Manual: Cargo Securing at Air Transport



Sources:

<http://www.iata.org/Pages/default.aspx>

<http://www.icao.int/Pages/default.aspx>

Notes

[Slide Air 12 & 13]

Slide Air 12

Cargo Securing at Air Transport Liabilities in air freight

The load that is arriving in a truck at airfreight terminal, is unloaded totally and then repacked into air transport's specific equipment called Unit Load Device (ULD).

The airport terminal personnel is responsible for the cargo securing for flight.



Photo: Esko Vainio



Photo: Arne Fischer

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Cargo Securing at Air transport Liabilities in road-air transport

- The airfreight terminal operator is responsible for cargo securing of the truck, when ULDs and Road Feeder Service system are in question.
- When cargo is unpacked from ULD and then repacked onto pallet in airport's terminal, then normally the driver will load the road vehicle and is therefore responsible for the cargo securing.



Source: <http://mediabase.lufthansa.com/mediabase>



Photo: Arne Fischer

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Liabilities in airfreight

The airport terminal personnel is responsible for the cargo securing for flight.

The cargo securing is done at the airport terminal supervised by a cargo master who is familiar with the rules and instruction from the actual liner and type of aircraft.

Liabilities in road-air transport

Often the personnel of the airfreight terminal operator loads a truck or van with cargo that has arrived from a flight. This is the case especially, when ULDs are loaded for Road Feeder Service system. In this case the airfreight personnel is responsible for cargo securing. Also terminal operator's rules obliges making cargo securing. (See the definition of Road Feeder Service in the next page).

When cargo is unpacked from ULD and then repacked onto pallet in airport's terminal, then normally the driver will load the road vehicle and is therefore responsible for the cargo securing. Cargo securing follows then EN 12195-1:2010 standard.

Notes

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[Slide Air 14]

Slide Air 14

Cargo Securing at Air transport Regulations, standards, guidelines

Air freight related:

- National Aviation Acts and safety agencies' aviation regulations
- ICAO-TI
- Unit Load Device (ULD) regulations
- Airport Handling Manual
- European Unions Commission Regulation (EC) No 859/2008 (EU-OPS 1)
- DGR

Road freight related:

- EN 12195-1:2010
- ADR
- National laws
- European Best Practice Guidelines on Cargo Securing for Road Transport



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Regulations, standards and guidelines

In Cargo securing at air transport we can divide regulations, standards and guidelines into two categories: Air freight related and Road freight related.

Air freight related

National aviation act typically considers passenger and cargo flights broadly beginning with general definitions, aeroplanes and their registration and ending up to civil aviation safety and administrative issues like licensees. Cargo securing is not considered. A nation has generally a traffic and safety agency for aviation matters. Traffic and safety agency gives detail instruction about many aviation matters. One important matter regarding the cargo securing is instructions for carrying dangerous goods. Safety agency follows ICAO's standards and instructions. For instance in Finland the safety agency follows aviation regulations OPS M1 – 18.

European Union's Commission Regulation (EC) No 859/2008 (EU-OPS 1)

The document No 859/2008 (EU-OPS1) is a large document that covers comprehensively safety matters in operations. The document considers also loading an aeroplane and transporting dangerous goods.

ICAO-TI: Technical Instructions for the Safe Transport of Dangerous Goods by Air (2011-2012 Edition), (Doc 9284-AN/905)

Convention on International Civil Aviation (also known as Chicago Convention) determines many standards.

IATA

Teacher's Manual: Cargo Securing at Air Transport



Information is key to any safety program, no less for dangerous goods in air transport. Through its Dangerous Goods Regulations (DGR) and a comprehensive and effective training program, IATA ensures that shippers, forwarders, and carriers have the tools and resources to ship dangerous goods safely.

Road freight related

Air transport's cargo securing will encounter EN 12195-1:2010 standard by Road Feeder Service system that is a service offered by a scheduled cargo operator to move its carried goods to and from the aircraft by road. This service allow a carrier to offer services to a city to which it does not fly aircraft.

Also EN 12195-1:2010 is followed in normal air-truck transport chain, where airfreight cargo is unloaded from ULD and reloaded onto pallet. This operation is called "loose loading".

In road freight national laws are followed.

Sources:

<http://www.iata.org/whatwedo/cargo/dgr/Pages/index.aspx>

<http://www.icao.int/>

<http://eur-lex.europa.eu/>

Notes

[Slide Air 15]

Slide Air 15

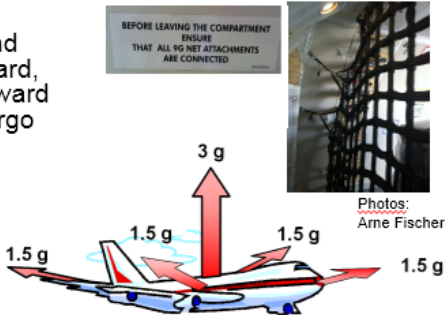
Cargo Securing at Air transport Acting forces in the air transport

During take-off, flight and landing forward, backward, sideways as well as upward forces occur and act cargo


These forces are:

- acceleration
- deceleration
- yawing
- lift

The first three are considered with 1.5 g, the last with 3 g.



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Acting forces in the air transport

The cargo securing for the airfreight is an integral part of the airfreight operations. Hence, the airport's terminal workers are responsible for cargo securing.

In the air transport different forces occur and act cargo during take-off, flight and landing. Acting forces specifically considers forces that act cargo inside the aircraft. These forces are:

- Acceleration
- Deceleration
- Yawing
- Lift

Acting forces upward (lift) may be strong and that's why cargo securing has to take into account such force as 3 g.

Cargo has to be secured so that lashing or blocking bears 1,5 times the weight of the cargo forwards, backwards and transverse direction.

IATA Airport handling manual AHM 450 determines load restrained forces in Standardization of Gravity Forces as follows:

It is recommended that, when no other values (in accordance with the aircraft's Weight and Balance Manual) are available the following standard gravity (g) force values are used for load securing instructions and requirements of lashing equipment in both compartments and main decks:

Teacher's Manual: Cargo Securing at Air Transport



- Forward 1.5 g (9 g in the cabin and main deck if a secure bulkhead is missing)
- Backward 1.5 g
- Sideways 1.5 g
- Upwards 3 g

Commentary

There are differences in the restraint requirements (g forces) for each type of aircraft by national aviation authorities and aircraft manufacturers. Uniformity will reduce the risk of loading errors arising from procedures differences, punctuality will be protected and staff training made easier.

Notes

[Slide Air 16]

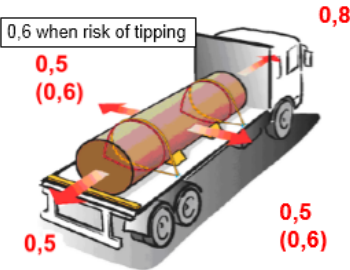
Slide Air 16

Cargo Securing at Air transport

Acting forces in the road-air transport system

During road transport the forces are:

- acceleration
- deceleration
- gravity
- vibration




0,6 when risk of tipping

0,5 (0,6)

0,8

0,5 (0,6)

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Acting forces in the road-air transport system

The journey starts for instance at off-site depot and goes to airport terminal. Off-site depot is for instance a warehouse.

Emphasize here that the driver has to follow standard EN 12195-1:2010. Accordingly, acting forces are the same as in road transport. When the journey starts at airport terminal, in loose cargo situation the forces are the same as in road transport. In situation where ULDs are transported acting forces are the same as in road transport, though the goods in ULD are secured according to standards of air transport's cargo securing.

Notes

[Slide Air 17]

Slide Air 17

Cargo Securing at Air transport

Securing principles and methods in the air transport

Cargo securing principles:

- tightness
- stability
- different covers
- specifically designed containers

Securing methods:

- blocking
- lashing

Note! Securing methods follow air transport's own standards and are therefore stricter than in road transport or rail transport




Photo: Arne Fischer





Photo: Esko Vainio

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Securing principles and methods in the air transport

Cargo securing in the air transport follows the principles:

- Tightness
- Stability
- Different covers
- Specifically designed containers
- Mostly used securing methods are blocking and lashing.
- Note that securing methods follow air transport's own standards and securing is stricter and demanding than securing in road or rail transport.

Notes

[Slide Air 18]

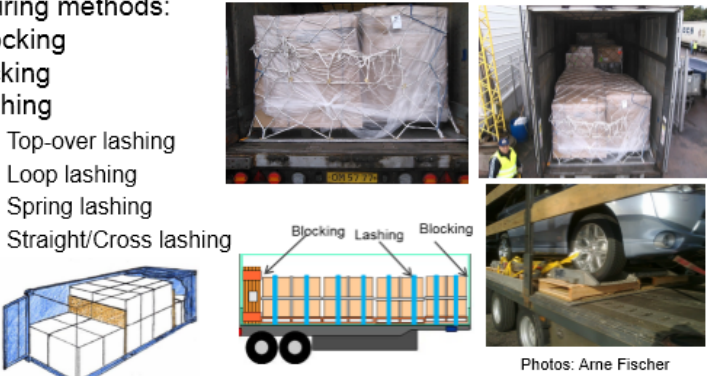
Slide Air 18

Cargo Securing at Air transport

Securing methods in the road-air transport system


Securing methods:

- blocking
- locking
- lashing
 - Top-over lashing
 - Loop lashing
 - Spring lashing
 - Straight/Cross lashing



Photos: Arne Fischer

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Securing methods in the road-air transport system

When taking into account the road-air transport system, then follow European Standard EN12195-1:2010. Securing methods are:

- Blocking
- Locking
- Lashing
 - Top-over lashing (frictional lashing)
 - Loop lashing
 - Spring lashing
 - Straight/Cross lashing

When the rollerbed system is in question the operation of loading and securing is implemented as follows:

The rollerbed system has three or four rollconveyors in the platform of cargo transport unit. Roll-conveyors facilitate to move cargo into the load carrier.

Pneumatic or non-powered roller track or roll conveyor in truck's platform has long been used to convey air cargo pallets and airfreight containers into truck. In the truck's cargo transport unit there are three or four roller tracks that can be raised up from the slots of the floor. When cargo units have been pulled into the truck the roller tracks are lowered, so that cargo units rest on the wooden floor. The wooden floor can be covered with anti-slip material so as to increase friction.

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Side walls hinder the transverse movement and ULDs themselves are blocked with each other in longitudinal direction. If needed, additional bars or batten are used. The cargo on or in the ULD is secured for aircraft operation forces.

Sources:

Arne Fischer, Lufthansa Cargo

<http://rollerbedsys.com>

Notes

[Slide Air 19]

Slide Air 19

Cargo Securing at Air transport

Securing principles and methods in the air transport

Examples of securing cargo for air transport



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Examples of securing cargo for air transport

This slide present some examples for the cargo securing in aircraft.

The picture on top left presents cargo securing with a net. The cargo is small packages on a pallet. The picture on top in the middle presents large cargo that has been covered with plastic foil and then the cargo is secured by a net. In the picture on top and right ULDs are transported to the aircraft. At bottom ULDs have been loaded into the compartment of an aircraft.

Notes
