APPENDIX C
AIR TRANSPORT CONCEPTS

C.1. SCOPE

This appendix discusses basic air transport concepts such as load planning and the 463L Air Cargo System. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

C.2. DEFINITIONS

Explosive atmosphere	A condition in which the cargo compartment is filled with enough fuel vapor to explode or cause fire if ignited by a spark or high temperature. (Requirements only apply to tanker aircraft.)
Rapid decompression	Pressure differential of 8.3 psi developed in 0.5 sec.

C.3. LOAD PLANNING

Load planning is the process of identifying possible locations to park the item in the aircraft. Cargo should be parked at locations that meet aircraft flight weight limits, size limits, and any location affected by special considerations (such as venting) or special procedures (such as parking shoring). The item's proximity to other cargo and the loadmaster's ability to route tiedown chains/straps and have in-flight access are also considerations.

Not all limits defined below apply to all aircraft. Consult the T.O. 1C-XXX-9 cargo loading manuals or appendix B for details.

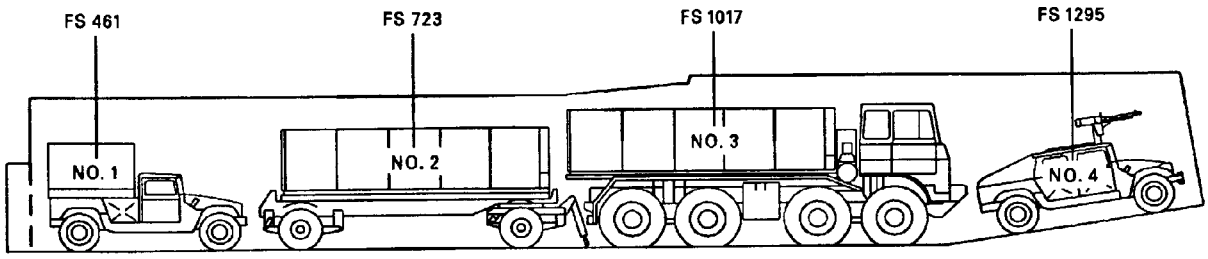
C.3.1 Access to aircraft systems.

Consideration should be given to positioning cargo near vent ports when necessary to discharge hazardous vapor, near access to aircraft communication systems if necessary, near electrical outlets if necessary, away from oxygen masks if necessary, or away from any other location identified by the loadmaster.

C.3.2 Aircraft CG limits.

Cargo shall be positioned within the aircraft's allowable CG limits. Figure C-1 is an example of multiple loads in the aircraft. The location of all the loads shall result in an overall center of gravity with the aircraft limits. Figure C-2 shows a typical aircraft cargo loading center of gravity (C.G.) limit. The overall CG location shall fall under the curve to keep the aircraft in balance.

The overall CG shall be computed as follows: Multiply the item's CG fuselage or load station position by its weight. Sum the values and divide by the sum of weights for all cargo in the cargo compartment. The result is the location of the CG, in terms of fuselage station. The calculation is shown on figure C-1. The result of the calculation for the loads shown on figure C-1 is fuselage station 891. Weights of baggage, fuel, and personnel should be included for actual missions.



	COLUMN 1	COLUMN 2	COLUMN 3 (COLUMN 1 X COLUMN 2 / 10,000)
VEHICLE	FUS STA ITEM CG	VEHICLE WT (POUNDS)	MOMENT (INCH POUNDS x 10,000)
NO. 1 TRUCK	461	9,000	415
NO. 2 TRAILER	723	20,000	1,446
NO. 3 TRUCK	1,017	30,000	3,051
NO. 4 TRUCK	1,295	8,500	1,101
TOTAL	———	67,500	6,013

$$\frac{60,130,000}{67,500} = 890.8 \text{ CG OF TOTAL LOAD}$$

FIGURE C-1. Multiple loads in aircraft.

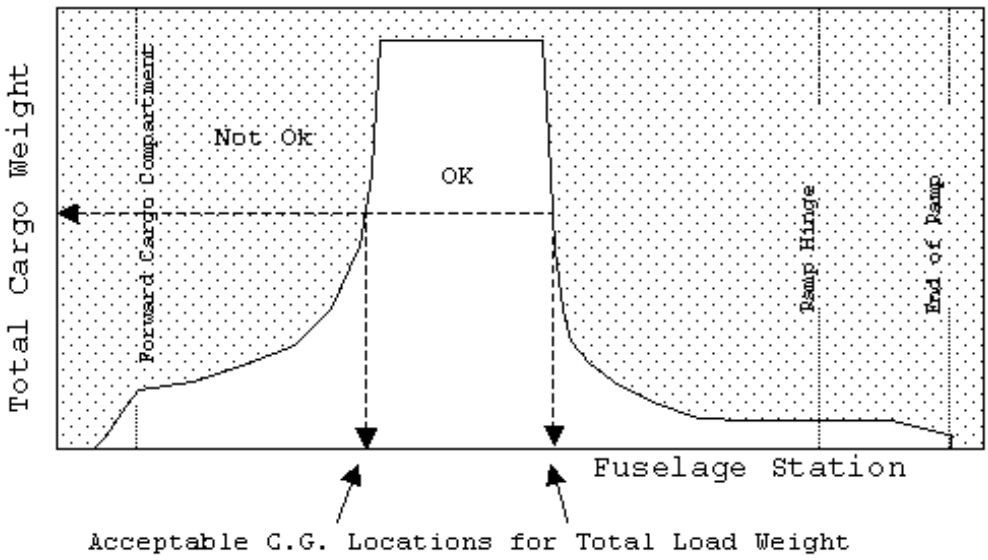


FIGURE C-2. Allowable CG locations.

C.3.3 Aircraft cargo payload.

The total weight of the cargo item, total system of multiple items, and accompanying shoring and special equipment shall not exceed the total payload capability of the aircraft. The payload weight is reduced to allow the aircraft to take off or land in hot weather, on short runways, and/or at high altitude location. The item's mission scenario or operational concept can limit the aircraft allowable payload and affect whether the item can be certified for a given type of aircraft.

For example, if the mission requires the cargo to be delivered to a high altitude area above 8,000 feet in 100 degree temperature on a 4,000 foot runway, the maximum payload will be significantly reduced for any aircraft. The published aircraft payload weight and CG limits for landing are based on a nominal mission flying into a 10,000 foot runway at standard sea level conditions.

C.3.4 Availability of tiedowns.

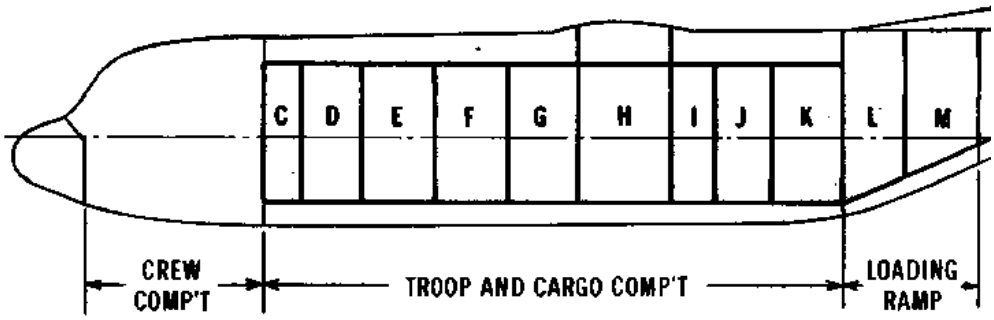
Location of the item shall allow access to a sufficient number of tiedowns (both on the aircraft floor and on the cargo item) to meet minimum restraint criteria as specified in 4.3.3 and 5.3.3.

C.3.5 Compartment size limit.

The item shall be sized to be at least 6 inches from the aircraft ceiling while maintaining access to critical areas of the aircraft, maintaining a safety passageway for egress, and sometimes, available areas for passengers. Parking shoring shall be considered, as it will increase the item's height and footprint. If the item has variable height, such as with air ride suspension, it shall not contact the ceiling at maximum inflation. (Reinflating air ride suspension after landing can result in a taller vehicle than when it was driven aboard.) Other situations that might temporarily increase the height may include raising trailer tongue or gooseneck to disconnect from prime mover or lifting (by any means) to install shoring or jack stands.

C.3.6 Compartment weight limits.

The aircraft cargo compartment is partitioned into multiple compartments for the purposes of weight limits (compartment limits) (figure C-3). Cargo shall be placed so it does not exceed individual compartment limits. The total weight of all compartments shall not exceed the aircraft's total payload limit.



GENERAL

1	Fuselage Station		245	281	337	401	457	517	597	627	682	737	803	869
2	Compartments		C	D	E	F	G	H	I	J	K	L	M	
3	Floor Area (approx)	Sq Ft	31	48	55	48	51	66	26	47	47	56	56	
4	Usable Volume	Cu Ft	280	430	495	430	460	610	235	420	420	490	280	

FLIGHT LIMITS

1	Maximum Individual Compartment Capacity	lb	8400	12 900	19 500	26 000	30 000	40 000	15 000	24 400	12 700	2500	2500

FIGURE C-3. Compartment limit chart.

C.3.7 Interference with other cargo.

Systems with multiple loads or missions requiring multiple loads also affect cargo location within the aircraft and even the ability of the aircraft to carry the cargo. Cargo placed on the ramp will rotate forward as the ramp closes. The ramp cargo shall be placed far enough aft so as not to contact cargo located forward of the ramp hinge (figure C-4).

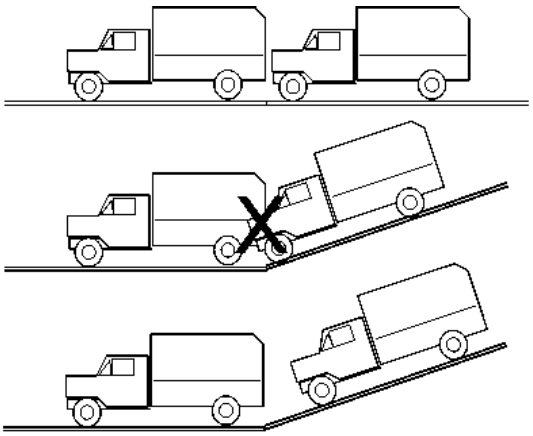


FIGURE C-4. Ramp cargo placement.

C.3.8 Lateral weight and axle limit.

Placement of cargo to one side or multiple loads side-by-side shall not exceed the aircraft lateral load limits.

C.3.9 Ramp contact.

Cargo shall have sufficient overhang ground clearance or be parked sufficiently far forward to prevent contact with the ramp when it is closed. (See B.3.1.5)

C.3.10 Sensitive areas.

Cargo shall not be parked in sensitive areas as cited by the aircraft T.O. 1C-XXX-9 cargo loading manual or appendix B. The C-17 and C-5 aircraft have lower weight limits when traversing or parking over roller trays and rail covers.

C.4 LOADING CARGO.

There are several ways cargo can be loaded into the aircraft. Cargo can be carried, pulled, or rolled up the ramp. Examples of cargo are small boxes, wounded on stretchers, large boxes, and vehicles. Cargo can also be rolled, pulled, or carried straight in from another vehicle, or moved by MHE over the cargo floor or roller conveyors. Examples are palletized cargo and vehicles.

Any preparations or reconfiguring shall be completed prior to loading for cargo to be safe to fly. Loading equipment or support material shall also be available prior to flight. Sometimes this

equipment and/or material should be positioned before the cargo is loaded. Examples of loading equipment are K-loaders and forklifts. Examples of loading material are approach shoring, lubricants, loading kits, and rolling shoring.

C.4.1 Loading through cargo door and ramp.

C.4.1.1 Ground loading.

For ground loading, the aircraft cargo door is opened and the ramp is lowered to the ground. The cargo door is rotated up and locked to the ceiling of the cargo compartment. The ramp has a skid plate at the underside of the end to support the ramp on the ground and protect the ramp during combat offload. The ramp angle varies with the height of the cargo floor above the ground. (Cargo floor height is determined by how much weight is already on the aircraft, cargo and fuel combined.) The higher the cargo floor is from the ground, the steeper the ramp angle. A steep ramp angle can cause loads with lower ground clearance to contact the ramp or the ramp hinge. Loads with a tall projected height can contact the ceiling. To prevent contact with the aircraft and prevent overloading of aircraft components, shoring may be necessary. Approach shoring decreases the ramp angle by degrees sufficient to prevent the item from contacting the ground, the aircraft ramp toes, ramp, ramp hinge, and/or ceiling (see 5.3.1.1.1). Approach shoring can also be used to prevent overloading the axles of the cargo, particularly wheeled vehicles where all axles must remain in contact with the ground or ramp. Rolling shoring under the wheels brings the weight distribution within the cargo floor's limits. See A.5.4.2, for information about approach and rolling shoring.

A ramp extension or ramp toe is attached to the lower end of the ramp to bridge the ramp top surface with the ground. The C-5 forward ramp has ramp extensions and ramp toes to bridge this gap (see appendix B). The angle for each subsequent segment differs from the ramp angle.

C.4.1.2 Straight-in loading.

Some items such as palletized cargo or cargo with extremely low ground clearance have to be loaded with the ramp in the coplanar position with the cargo floor. The cargo is carried by MHE, such as a K-loader or forklift. If the item cannot be pushed or driven in from the MHE, it may be winched in.

C.4.1.3 Material handling equipment (MHE).

Cargo can also be loaded using material handling equipment (MHE). MHE are forklifts, K-loaders, mobilizers, or special handling tools. Forklifts carry the item into the aircraft, push the item into the aircraft, and/or pick up part of the item to help the item overcome obstacles. If the forklift goes with the item inside the aircraft, the combined weight and size characteristics shall be evaluated as rolling stock to ensure the forklift and item are loaded and offloaded safely. The forklift does not necessarily have to be transported with or attached to the item. K-loaders raise the item to be level with the cargo ramp and load the cargo straight into the aircraft. Mobilizers are wheeled frames that attach to bulk cargo and convert the item into rolling stock. Special handling tools are specifically designed to load and unload unusual cargo. Adjustments to any of the MHE during the loading process are allowed. However, the procedure may need to be evaluated if there is anticipated risk of damage or loss of control.