NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 30, 2015

Group Chairman's Factual Report

STRUCTURES

DCA13MA081

Attachment 3

Boeing 747-400F, Weight and Balance Control and Loading Manual, Boeing Sample Manual, Document Number D043U542-MASTER
Pages from Revision dated July 31, 2003
Pages from Revision dated September 22 2005

These are only selected pages needed for the purposes of conducting the accident investigation. This is not a complete manual and not approved for commercial use.

Pages from Revision dated July 31, 2003

MAIN DECK UNIT LOAD DEVICE LOCATIONS

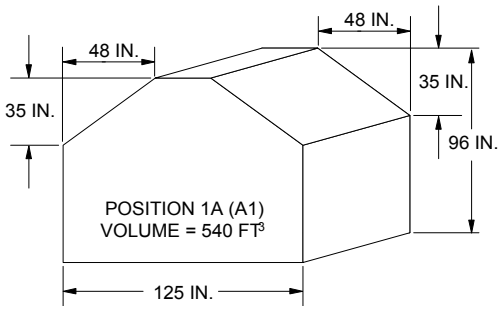
LOADING CONSIDERATIONS

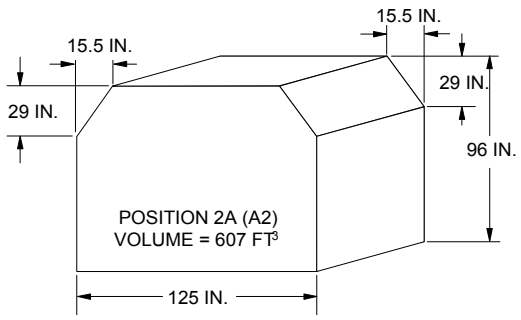
Nose Cargo Door

The following considerations should be observed when loading cargo through the nose cargo door:

- Cargo loaded through the nose cargo door is limited to 96 inches in height.
- Loading outsized cargo through the nose cargo door can impose large loads on the nose gear. Damage to the nose gear tires can result unless cargo item weight loaded through the nose cargo door is limited.

  For cargo weights less than 50000 LB (22679 KG) no special nose gear considerations need be taken. For cargo weights greater than 50000 LB (22679 KG) but less than 100000 LB (45359 KG), a nose gear jack with a load rating of 100000 LB (45359 KG) must be snugged up under the the axle jack point before loading cargo. Items over 100000 LB (45359 KG) should be coordinated with Boeing on an individual basis.
- When the nose cargo door is utilized position 1A (A1) and 2A (A2) require profiling as illustrated below.





Side Cargo Door

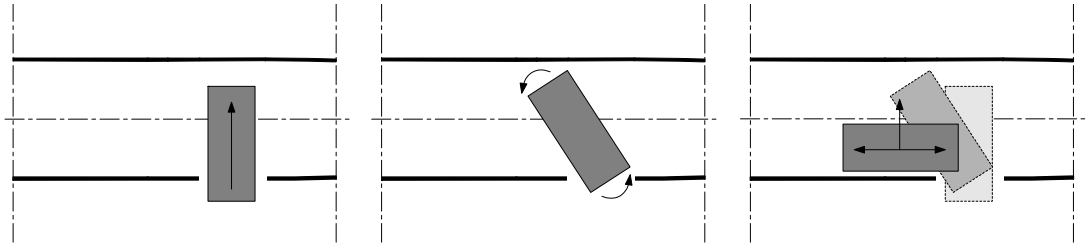
The following considerations should be observed when loading cargo through the side cargo door:

- ULDs are limited to 118 inches in height and must be positioned in the airplane aft of B.A. 777.
- ULDs longer than 240 inches (no larger than a size code G) cannot be loaded through the side cargo door because they cannot be rotated through the side cargo door.
- When positioned in the side cargo door area, ULDs are limited to 113 inches in height to allow for actuator movement.

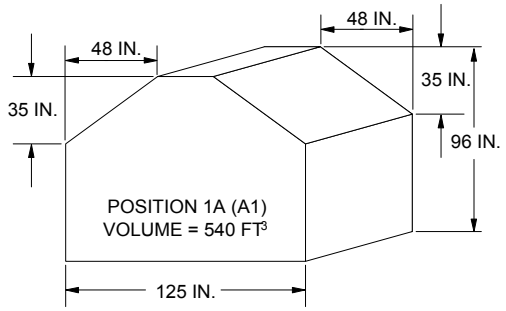
APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

MAIN DECK UNIT LOAD DEVICE LOCATIONS (Continued)

- Size codes G and R ULDs greater than 96 inches in height have profile restrictions to allow rotation through the side cargo door (see below).



- When the nose cargo door is utilized position 1A (A1) requires profiling as illustrated below.



General

The following considerations should be observed when loading cargo on the main deck:

- Only size code A and M pallets can be loaded laterally forward of B.A. 525.
- Only size code A, B, and M pallets can be loaded longitudinally forward of B.A. 525.
- Only size code A, B, F, and M pallets can be loaded aft of B.A. 2218.
- ULDs forward of B.A. 777 are limited to 96 inches in height to ensure at least a 2 inch clearance between the top of the ULD and the ceiling. This clearance is required to allow air flow around ULDs for decompression and smoke detection.
- An object is considered to be frangible if it will readily separate and conform to the airplane contour when subjected to a 9G forward load. Rigid cargo consist of items which will not separate nor conform to the airplane contour. Jet engines, wheeled vehicles, tugs and dollies are examples of rigid cargo.
- Unit load devices greater than 96 inches in height are restricted to positions aft of B.A. 777.

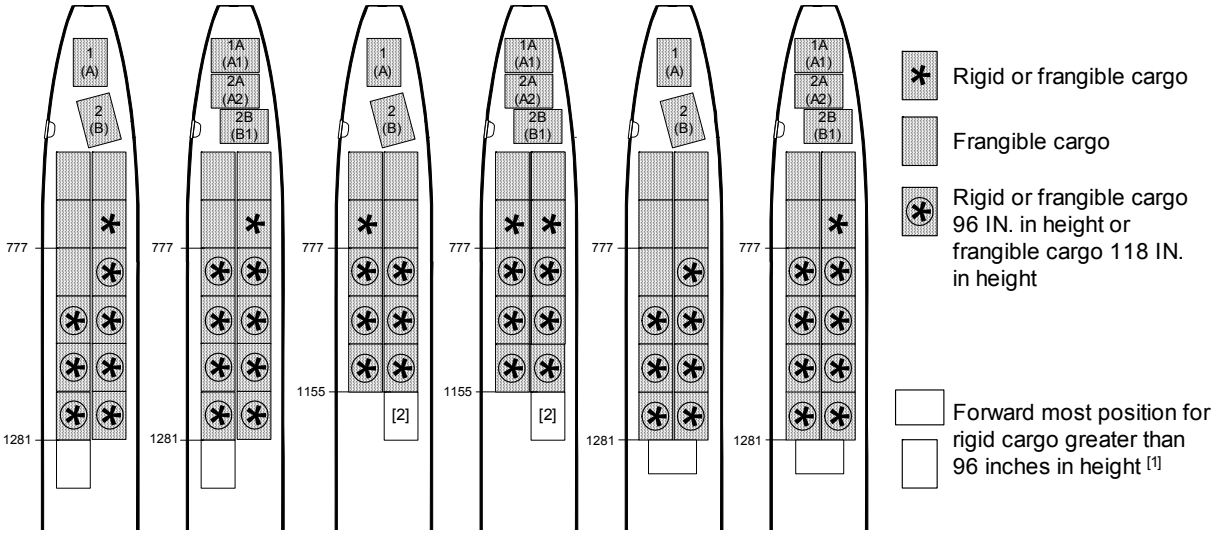
APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

MAIN DECK UNIT LOAD DEVICE LOCATIONS (Continued)

- Rigid cargo over 96 inches in height have the following additional loading restrictions:
  - The most forward rigid loaded device must be loaded aft of B.A. 1160 right side, aft of B.A. 1220 left side, or aft of B.A. 1220 center loaded. [1]
  - There must be a minimum of the equivalent of seven 125 inch long loaded unit load devices positioned directly forward of the rigid cargo greater than 96 inches in height[1].
  - Carriage of an empty ULD cannot be counted as an occupied ULD position.[1]
  - Cargo loads which may cut or pass through the upper deck barrier net must be restrained to a 9G forward condition or be placed aft of loads (subject to the restrictions above) which will not penetrate or damage the barrier net.
  - In all cases the most forward 4 pallet positions forward of the rigid device must be loaded with frangible cargo. [1]

NOTES
- When rigid cargo is carried on the right side of the airplane, any one or all of the ULD positions 1, 1A, 2, 2A, and 2B count towards the frangible ULD positions discussed in the above restrictions (See illustration below).
- When rigid cargo is carried on the left side of the airplane, any one or all of the ULD positions 1, 1A, and 2A only count towards the frangible ULD positions discussed in the above restrictions (See illustration below).

The following graphic illustrates the loading restrictions described above. All pallets shown forward of the rigid cargo are assumed to be loaded on size code M pallets (96 IN. x 125 IN.).



When loading other than size code M pallets (96 IN. X 125 IN.), the forward most position for rigid cargo greater than 96 inches in height is still B.A. 1160 right side, or B.A. 1220 center loaded. Furthermore, the mass of the cargo forward of the rigid cargo must be a minimum of the equivalent of seven size code M pallets shown in the illustration above.

[1] This restriction does not apply if the ULD with rigid cargo over 96 IN. in height, and all ULD positions aft of it, are restrained to a 9G forward load factor.

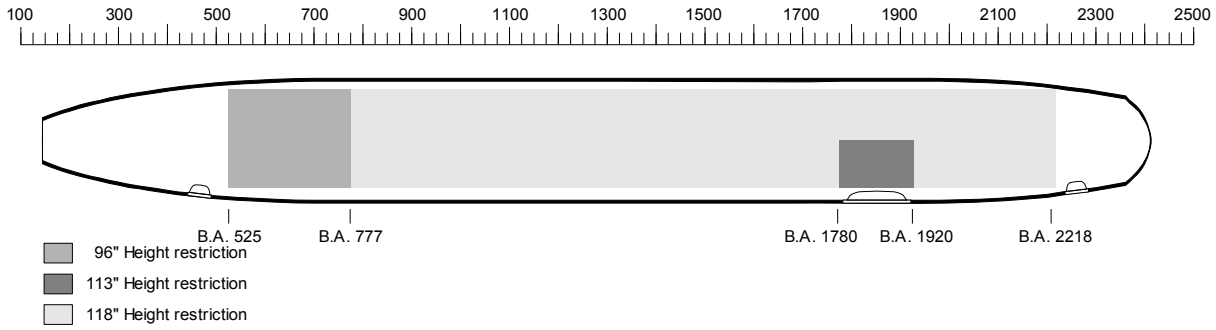
[2] Rigid cargo must be aft of B.A. 1160 on this pallet.

APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

MAIN DECK UNIT LOAD DEVICE LOCATIONS (Continued)

MAIN DECK UNIT LOAD DEVICES

The illustration below shows the allowable region in the main deck compartment for main deck unit load devices. Location data for the various ULD types is the responsibility of the STC holder of the cargo restraint system.



The following equation can be used to determine the center of gravity for each individual position.

$$\text{Position Center of Gravity} = \frac{\text{Forward Balance Arm} + \text{Aft Balance Arm}}{2}$$

APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

Pages from Revision dated September 22, 2005

MAIN DECK UNIT LOAD DEVICE LOCATIONS

LOADING CONSIDERATIONS

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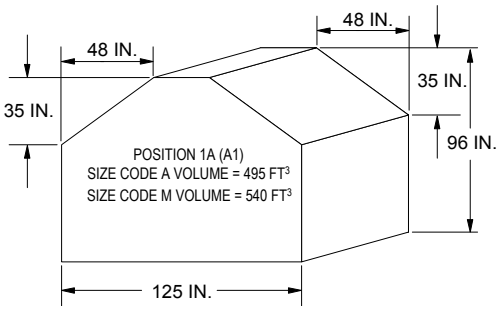

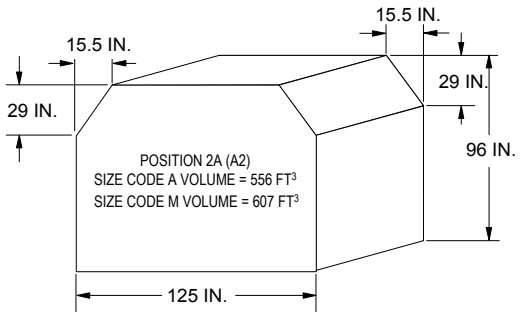

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APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

MAIN DECK UNIT LOAD DEVICE LOCATIONS (Continued)

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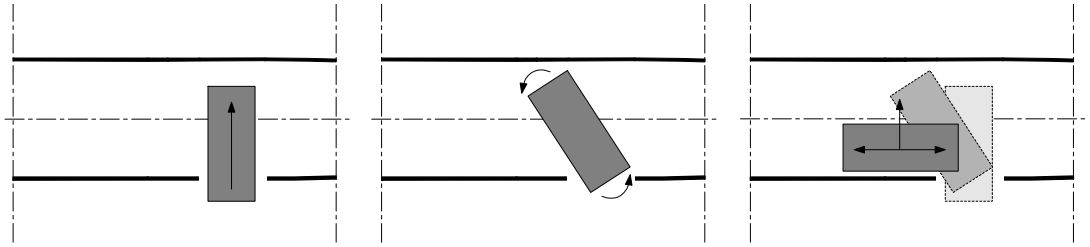
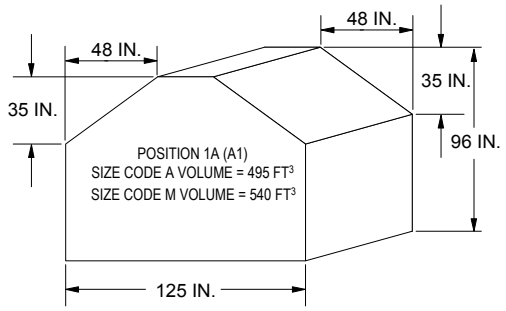


- When the side cargo door is utilized Position 1A (A1) requires profiling as illustrated below. Position 2A (A2) can be 96 inches tall without profiling.



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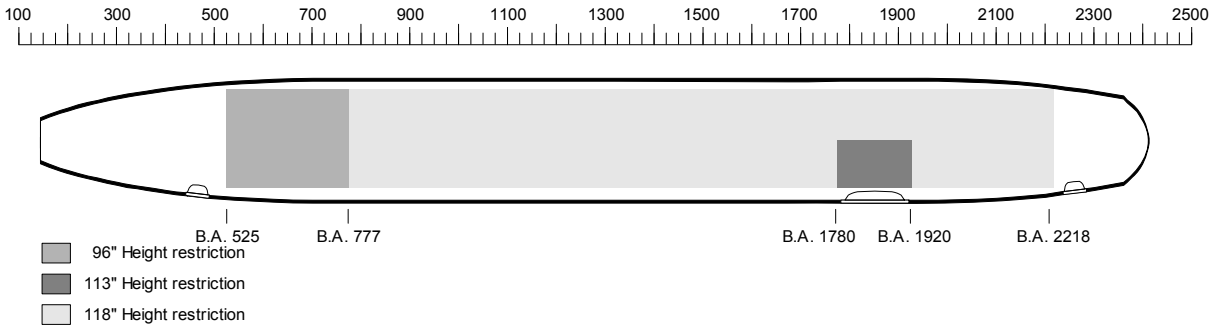
- ULDs forward of B.A. 777 are limited to 96 inches in height to ensure at least a 2 inch clearance between the top of the ULD and the ceiling. This clearance is required to allow air flow around ULDs for decompression and smoke detection.
- Aft of B.A. 777, ULDs are limited to 118 inches tall.
- The most forward position for tall rigid cargo that is 118 inches tall is B.A. 940. The most forward position for tall rigid cargo that is 110 inches tall is B.A. 777. All cargo in excess of 110 inches tall between B.A. 777 and B.A. 940 must be frangible cargo. See CHP-SEC 1-69-12X for limitations and sample problems for the loading of tall rigid cargo on the airplane. Tall rigid cargo is defined as cargo that is in excess of 96 inches tall and will not break apart during an emergency landing event (a 777 engine is an example of tall rigid cargo).

APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

MAIN DECK UNIT LOAD DEVICE LOCATIONS (Continued)

MAIN DECK UNIT LOAD DEVICES

The illustration below shows the allowable region in the main deck compartment for main deck unit load devices. Location data for the various ULD types is the responsibility of the STC holder of the cargo restraint system.



The following equation can be used to determine the center of gravity for each individual position.

$$\text{Position Center of Gravity} = \frac{\text{Forward Balance Arm} + \text{Aft Balance Arm}}{2}$$

APPLICABLE CONFIGURATIONS
Non-Boeing Restraint System

TALL RIGID CARGO

INTRODUCTION

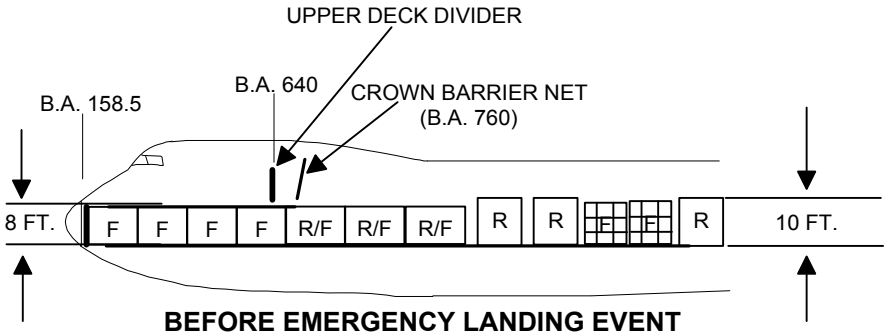
Tall rigid cargo is defined as cargo that is in excess of 96 IN. tall and will not break apart during an emergency landing event (a 777 engine is an example of tall rigid cargo).

In an emergency landing event, tall rigid cargo must be stopped before it impacts the upper deck divider at B.A. 640. This will protect all of the upper deck occupants on the airplane.

To ensure this, a sufficient volume of cargo must be loaded forward of the tall rigid cargo. In an emergency landing event, this cargo will redistribute and fill up the main deck cargo volume between the B.A. 158.5 barrier and the tall rigid cargo. This volume of cargo will stop the tall rigid cargo impacting the upper deck divider at B.A. 640.

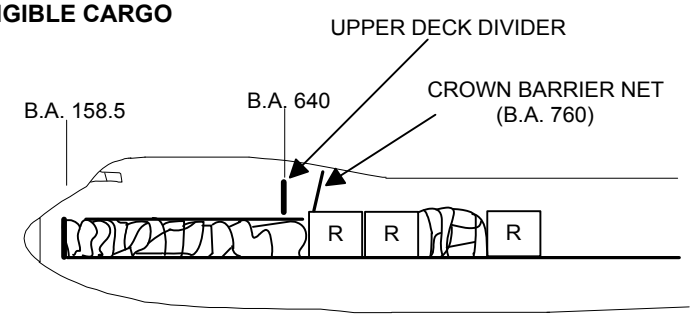
The most forward position for tall rigid cargo that is 118 IN. tall is B.A. 940. The most forward position for tall rigid cargo that is 110 IN. tall is B.A. 777. All cargo in excess of 110 IN. tall between B.A. 777 and B.A. 940 must be frangible cargo. These height restrictions will ensure at least a 16 IN. clearance between the tall rigid cargo and the airplane structure over head.

Note that all other cargo loading restrictions (compartment load limts, linear load limits, area load limits, combined load limits, and cumulative load limits) must be checked and the airplane must be within the airplane longitudinal C.G. limits (refer to CHP-SEC 1-02-xxx) and airplane lateral C.G. limits (refer to CHP-SEC 1-04-xxx).



BEFORE EMERGENCY LANDING EVENT

F = FRANGIBLE CARGO
R = RIGID CARGO
R/F = RIGID OR FRANGIBLE CARGO



AFTER EMERGENCY LANDING EVENT

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

To establish an acceptable load plan, the following steps must be taken:

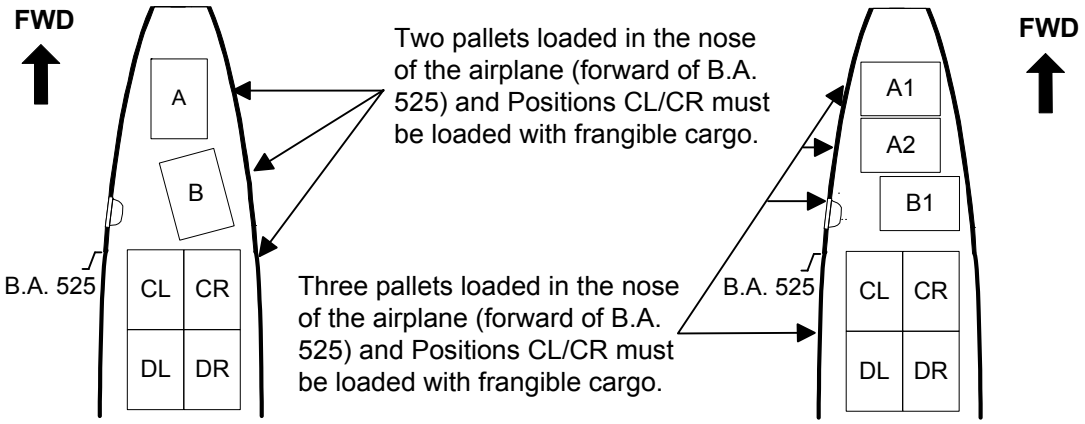
STEP 1 Define the Cargo Distribution

A. Determine the forward most balance arm (B.A.) location of the tall rigid cargo. Any cargo forward of this location will fill up the forward main deck in the event of an emergency landing event. Any cargo aft of this location will compress the cargo in the forward body.

B. ULDs are limited to 96 IN. tall forward of B.A. 777. Aft of B.A. 777 they are limited to 118 IN. tall. The most forward position for tall rigid cargo that is 118 IN. tall is B.A. 940. The most forward position for tall rigid cargo that is 110 IN. tall is B.A. 777. All cargo in excess of 110 IN. tall between B.A. 777 and B.A. 940 must be frangible cargo.

C. When tall rigid cargo is loaded on the airplane centerline, all positions forward of the tall rigid cargo must be loaded with ULDs that are 96 IN. wide (88 IN. wide cargo is not allowed).

D. Frangible cargo must be loaded in the nose positions (Positions A & B or Positions A1 & A2 & B1) and in Positions CL/CR as shown below. Frangible cargo is cargo that will easily break apart on impact (a stack of boxes is an example of frangible cargo).



APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

STEP 2 Calculate the Volume of Cargo Forward of the Tall Rigid Cargo

A. Determine the gross volume of the ULDs forward of the tall rigid cargo (forward of the B.A. determined in Step 1A). Only that portion of the volume below 96 IN. tall can be included in this determination (the portion of the volume above 96 IN. tall will impact the crown barrier net and should not be considered). Use the volumes from the following table:

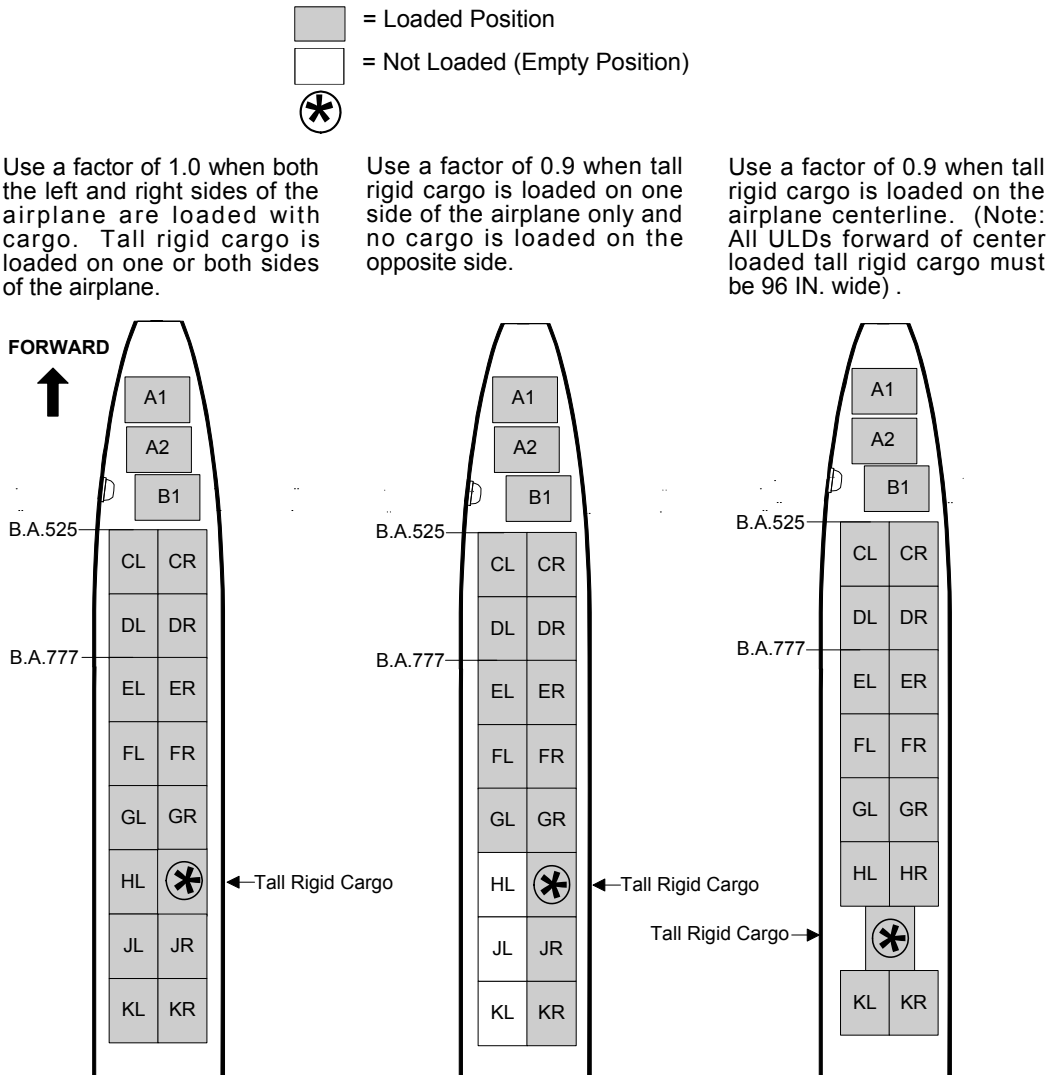
SIZE CODE	BASE DIMENSION IN.	VOLUME CU. FT.
A	88 X 125	572
		495 in Position A1 when loaded through the nose cargo door
		556 in Position A2 when loaded through the nose cargo door
B	88 X 108	482
F	96 X 117.8	572
G	96 X 238.5	1190
H	96 X 359.3	1801
J	96 X 480	2414
M	96 X 125	613
		540 in Position A1 when loaded through the nose cargo door
		607 in Position A2 when loaded through the nose cargo door
R	96 X 196	974

NOTE Only that portion of the volume below 96 IN. tall can be included in this determination (the portion above 96 IN. tall will impact the crown barrier net and should not be considered).

B. Determine the average percent full of the ULDs forward of the tall rigid cargo (forward of the B.A. determined in Step 1A). This percent full is based upon volume, not weight.

TALL RIGID CARGO (Continued)

C. Establish the configuration factor as 1.0 or 0.9 as follows:



D. Determine the effective volume of the ULDs forward of the tall rigid cargo (forward of the B.A. determined in Step 1A) by the following equation:

$$\text{Effective Volume} = [(\text{Gross Volume}) \times (\text{Percent Full} / 100)] \times (\text{Configuration Factor})$$

From Step 2A — From Step 2B — From Step 2C

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

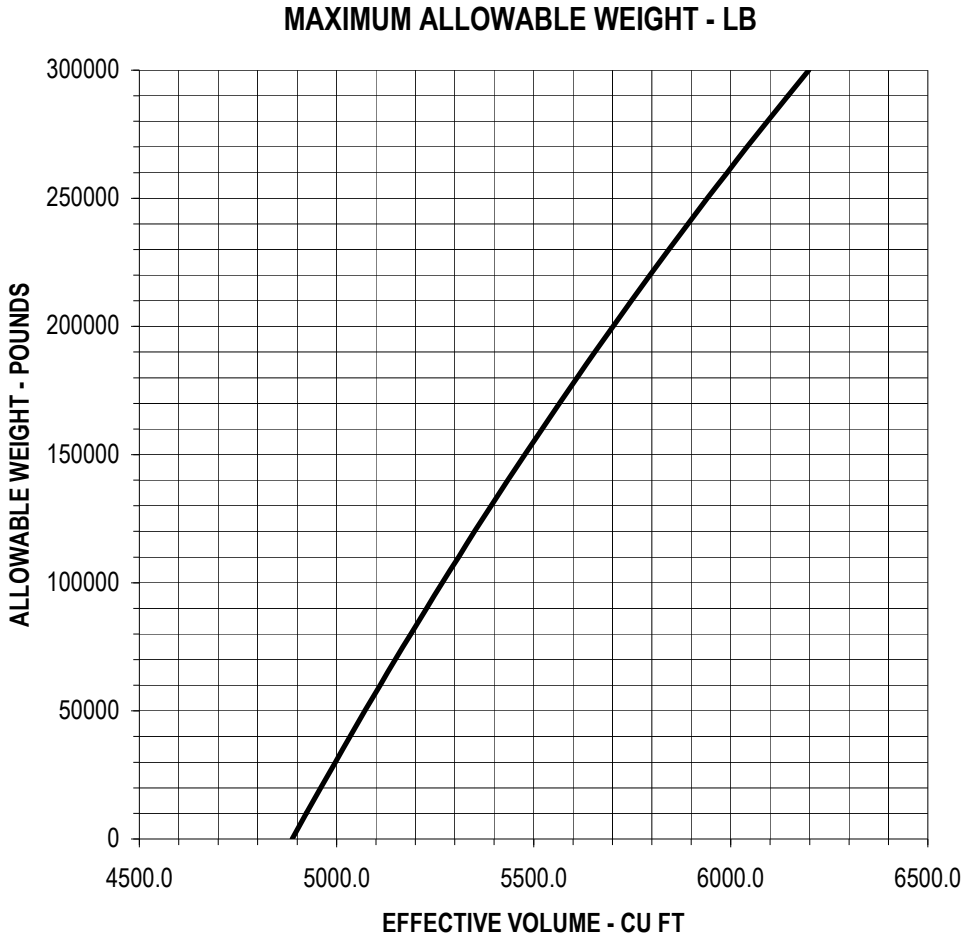
TALL RIGID CARGO (Continued)

Step 3 Determine the Maximum Allowable Weight of Cargo That Can be Stopped by the Effective Volume of Cargo Determined in Step 2

A. Use the graph below and on the following page to determine the maximum allowable weight of cargo that can be stopped by the volume of cargo determined in Step 1.

B. Locate the point on the curve intersecting the effective volume from Step 2D.

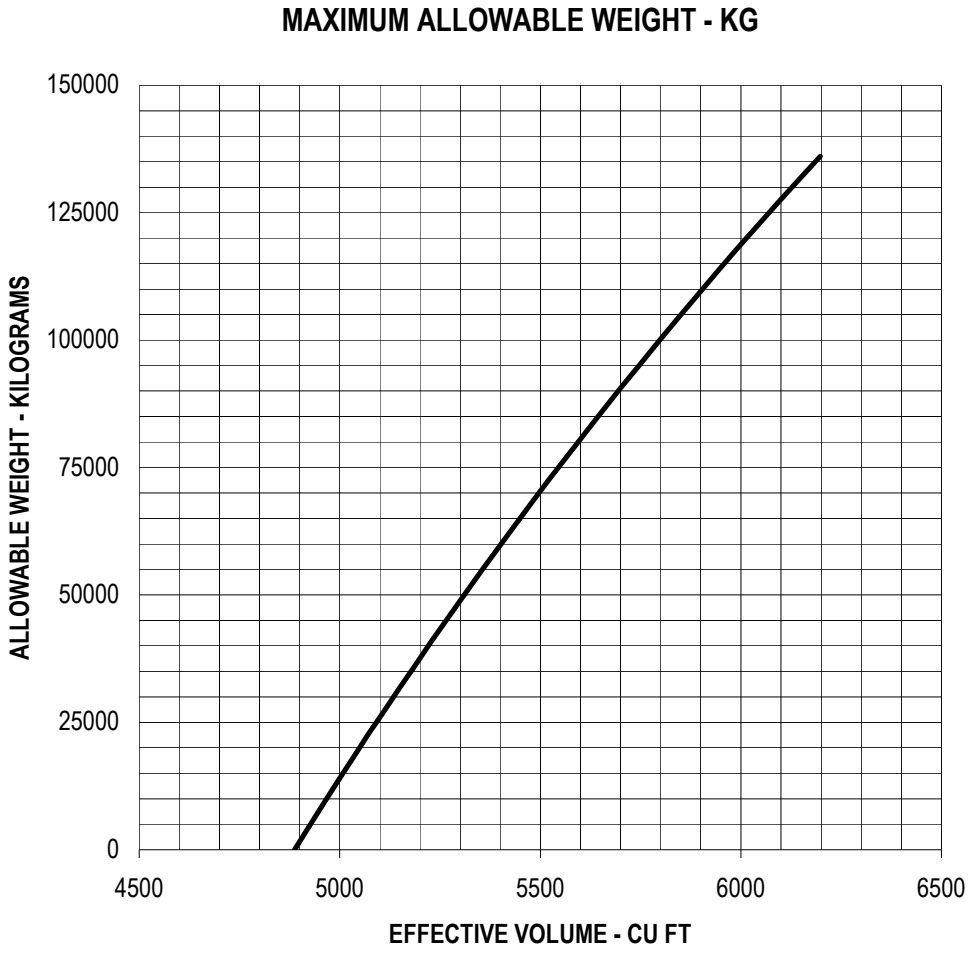
C. Determine the maximum allowable weight of cargo that can be stopped by the volume of cargo determined in Step 2.



$$\text{Allowable Weight} = \frac{(\text{Effective Volume} - 4887.2)}{[(5.98786 \times 10^{-7}) \times \text{Effective Volume} + (6.57375 \times 10^{-4})]}$$

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)



$$\text{Allowable Weight} = \frac{(\text{Effective Volume} - 4887.2) \times 0.45359237}{[(5.98786 \times 10^{-7}) \times \text{Effective Volume} + (6.57375 \times 10^{-4})]}$$

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

STEP 4 Adjust the Main Deck Cargo Loading as Required

A. Determine total weight of loaded cargo aft of the forward most location of the tall rigid cargo (from Step 1A). This includes the weight of the tall rigid cargo.

B. Compare this weight to the maximum allowable weight determined in Step 3C.

C. If the loaded cargo (Step 4A) is **less** than the maximum allowable weight (Step 4B), then an acceptable loading scheme for the tall rigid cargo has been established.

D. If the loaded cargo (Step 4A) is **greater** than the maximum allowable weight (Step 4B), then an acceptable loading scheme for the tall rigid cargo has **not** been established. Adjust the main deck cargo loading as required. Possible changes to the main deck loading are:

- Move the tall rigid cargo
- Load the tall rigid cargo adjacent to other cargo and do not centerline load the tall rigid cargo.
- Ensure the cargo forward of the tall rigid cargo is volumetrically full.
- Load less cargo aft of the tall rigid cargo.

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

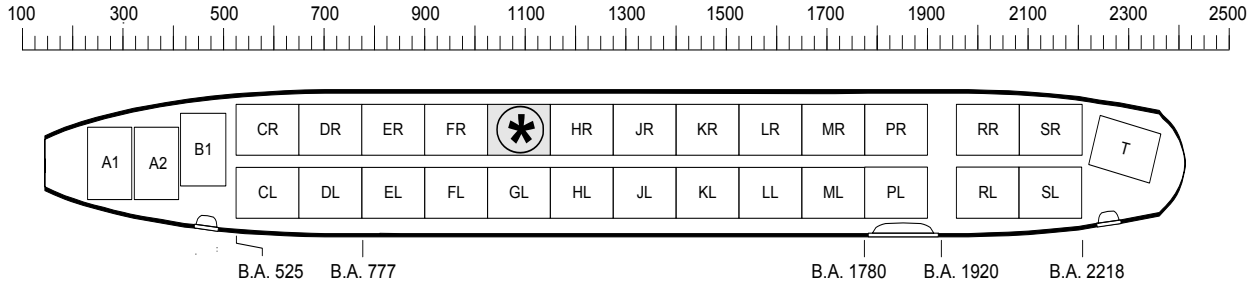
TALL RIGID CARGO (Continued)

Sample Problem No. 1

Is the following load plan acceptable for tall rigid cargo loaded in Position GR?

All positions are loaded with Size Code M pallets (96 IN. X 125 IN.).

Positions A1, A2, B1, CL, and CR are loaded with frangible cargo. The proposed loading is as follows:



The following table lists necessary data for determining an acceptable plan for carrying tall rigid cargo.

	DETAILS FOR CARGO LOADED ON LEFT SIDE				DETAILS FOR CARGO LOADED ON RIGHT SIDE			
IATA POSITIONS	WEIGHT (LB)	WEIGHT (KG)	LOADED VOLUME (% FULL)	HEIGHT OF CARGO	WEIGHT (LB)	WEIGHT (KG)	LOADED VOLUME (% FULL)	HEIGHT OF CARGO
A1	3000	1361	80	96	-	-		
A2	3200	1451	80	96	-	-		
B1	-	-			2800	1270	80	96
CL/CR	6400	2903	80	96	8000	3629	80	96
DL/DR	7400	3357	80	96	6400	2903	80	96
EL/ER	8000	3629	80	96	8200	3719	80	96
FL/FR	7000	3175	80	96	7800	3538	80	96
GL/GR	8400	3810	NA	NA	10000	4536	100	118
HL/HR	9600	4354	NA	NA	9400	4264	NA	NA
JL/JR	6800	3084	NA	NA	8000	3629	NA	NA
KL/KR	6400	2903	NA	NA	6000	2722	NA	NA
LL/LR	7000	3175	NA	NA	6800	3084	NA	NA
ML/MR	6200	2812	NA	NA	5600	2540	NA	NA
PL/PR	4000	1814	NA	NA	4400	1996	NA	NA
RL/RR	2500	1134	NA	NA	2700	1225	NA	NA
SL/SR	2900	1315	NA	NA	2800	1270	NA	NA
T	-	-			2000	907	NA	NA

Position GR is loaded with Tall Rigid Cargo

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

STEP 1 Define the Cargo Distribution

A. For this sample problem, B.A. 1030 is the leading edge of the tall rigid cargo loaded in Position GR.

B. For this sample problem, only Position GR is loaded with cargo that exceeds 96 IN. per the table on Page 8. The forward edge of Position GR is aft of B.A. 940. B.A. 940 is the forward most B.A. for tall rigid cargo that is 118 IN. tall. This is an acceptable loading.

C. For this sample problem, the tall rigid cargo is not loaded on the airplane centerline and cargo is loaded on the left and right hand sides of the airplane. Therefore a factor of 1.0 is used.

D. For this sample problem, the required frangible cargo is loaded in Positions A1, A2, B1 and CL/CR.

STEP 2 Calculate the Volume of Cargo Forward of the Tall Rigid Cargo

A. For this sample problem, the total volume is per the table below (volume forward of B.A. 1030). Positions forward of B.A. 1030 are Positions A1, A2, B1, CL/CR, DL/DR, EL/ER, and FL/FR.

B. For this sample problem, all ULDs forward of B.A. 1030 are 80 percent full per the table on Page 8.

C. For this sample problem, a factor of 1.0 for tall rigid cargo will be used per Step 1C.

D. Determine the effective volume of the ULDs forward of the tall rigid cargo (forward of the B.A. determined in Step 1A) by the following table:

VOLUME OF CARGO FORWARD OF TALL RIGID CARGO						
IATA POSITIONS	DETAILS FOR CARGO LOADED ON LEFT SIDE			DETAILS FOR CARGO LOADED ON RIGHT SIDE		
	MAXIMUM VOLUME CU FT	PERCENT FULL %	LOADED VOLUME CU FT	MAXIMUM VOLUME CU FT	PERCENT FULL %	LOADED VOLUME CU FT
A1	540	80	432.0			
A2	607	80	485.6			
B1				613	80	490.4
CL/CR	613	80	490.4	613	80	490.4
DL/DR	613	80	490.4	613	80	490.4
EL/ER	613	80	490.4	613	80	490.4
FL/FR	613	80	490.4	613	100	490.4
GL/GR and Aft[a]	0	NA	0.0	0	NA	0.0
Total Loaded Volume per side			2879.2			2452.0

[a] Volume aft of B.A. 1030 (Positions GL/GR and aft) should not be included in this calculation.

Total Volume on Left Side	2879.2 CU FT
Total Volume on Right Side	+ 2452.0 CU FT
Total Volume	5331.2 CU FT
Tall Rigid Cargo Factor	× 1.0
Effective Volume	5331.2 CU FT

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

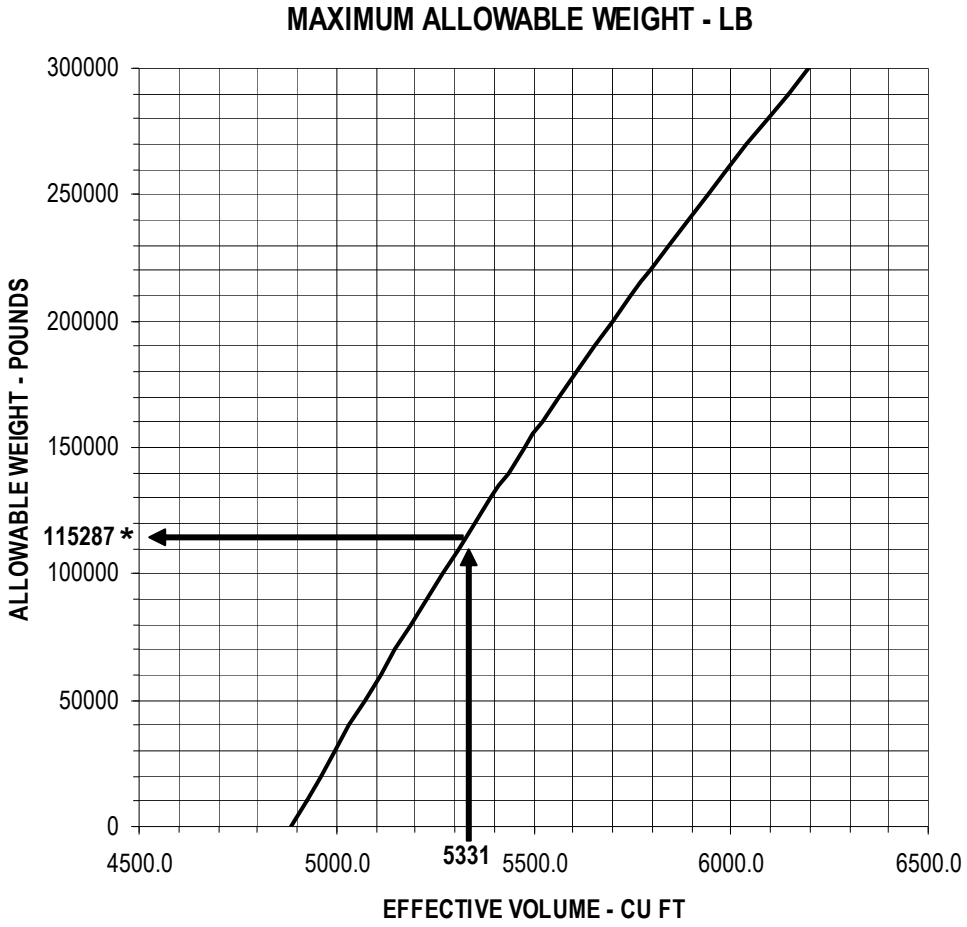
TALL RIGID CARGO (Continued)

STEP 3 Determine the Effective Maximum Allowable Weight of Cargo That Can be Stopped by the Volume of Cargo Determined in Step 2

A. Use the graphs on Pages 5 and 6 to determine the maximum allowable weight of cargo that can be stopped by the volume of cargo determined in Step 1.

B. For this sample problem, use 5331 CU FT as calculated in Step 2D.

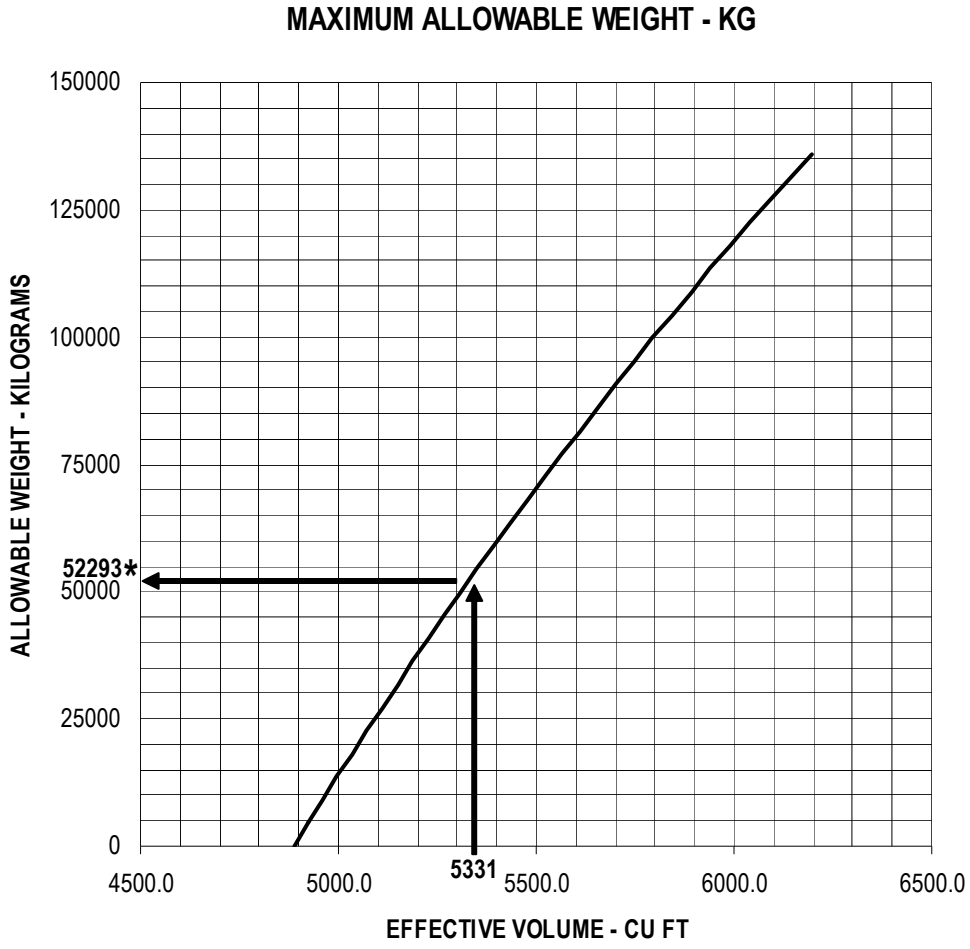
C. For this sample problem, a maximum allowable weight of cargo that can be stopped by a volume of 5331 CU FT is 115287 LB (52293 KG) as shown in the graph below and on the following page:



* Calculated using the equation on Page 5. Graphically shown here.

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)



* Calculated using the equation on Page 6. Graphically shown here.

STEP 4 Adjust the Main Deck Cargo Loading as Required

A. For this sample problem, the proposed loading has 111500 LB (50576 KG) as the weight aft of B.A. 1030. Positions aft of B.A.1030 are Positions GL/GR, HL/HR, JL/JR, KL/KR, LL/LR, ML/MR, PL/PR, RL/RR, SL/SR, and T.

B. For this sample problem, a maximum allowable weight of cargo that can be stopped by a volume of 5331 CU FT is 115287 LB (52293 KG).

C. For this sample problem, the loaded cargo 111500 LB (50576 KG) is **less** than the maximum allowable weight 115287 LB (52293 KG). This is an acceptable load plan.

The sample problem is OK for the carriage of tall rigid cargo.

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

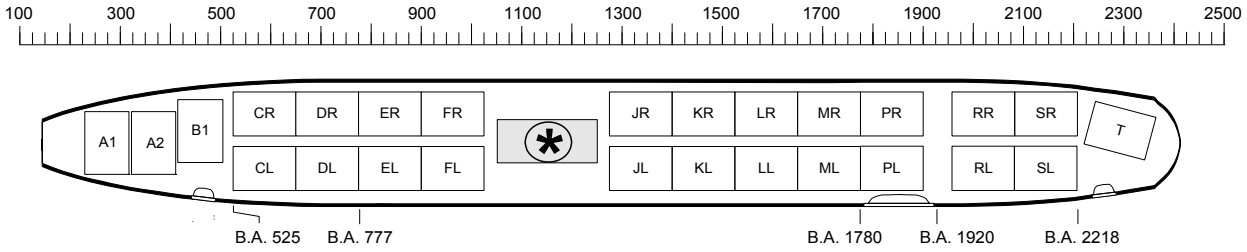
TALL RIGID CARGO (Continued)

Sample Problem No. 2

Is the following load plan acceptable for tall rigid cargo loaded in Position G/H (loaded on the centerline on a Size Code R Pallet)?

All other positions are loaded with Size Code M pallets (96 IN. X 125 IN.).

Positions A1, A2, B1, CL, and CR are loaded with frangible cargo. The proposed loading is as follows:



The following table lists necessary data for determining an acceptable plan for carrying tall rigid cargo.

	DETAILS FOR CARGO LOADED ON LEFT SIDE				DETAILS FOR CARGO LOADED ON RIGHT SIDE			
IATA POSITIONS	WEIGHT (LB)	WEIGHT (KG)	LOADED VOLUME (% FULL)	HEIGHT OF CARGO	WEIGHT (LB)	WEIGHT (KG)	LOADED VOLUME (% FULL)	HEIGHT OF CARGO
A1	3000	1361	80	96	-	-		
A2	3200	1451	75	96	-	-		
B1	-	-			2800	1270	95	96
CL/CR	6400	2903	85	96	8000	3629	90	96
DL/DR	7400	3357	85	96	6400	2903	55	96
EL/ER	8000	3629	95	96	8200	3719	75	96
FL/FR	7000	3175	90	118	7800	3538	100	118
G/H					16000	7257	100	118
JL/JR	6800	3084	NA	NA	8000	3629	NA	NA
KL/KR	6400	2903	NA	NA	6000	2722	NA	NA
LL/LR	7000	3175	NA	NA	6800	3084	NA	NA
ML/MR	6200	2812	NA	NA	5600	2540	NA	NA
PL/PR	4000	1814	NA	NA	4400	1996	NA	NA
RL/RR	2500	1134	NA	NA	2700	1225	NA	NA
SL/SR	2900	1315	NA	NA	2800	1270	NA	NA
T	-	-			2000	907	NA	NA

Position G/H is loaded with Tall Rigid Cargo

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

STEP 1 Define the Cargo Distribution

A. For this sample problem, B.A. 1030 is the leading edge of the tall rigid cargo loaded in Position G/H.

B. For this sample problem, Position G/H is loaded with tall rigid cargo that exceeds 96 IN. per the table on Page 12. This is aft of B.A. 940. B.A. 940 is the forward most B.A. for tall rigid cargo that is 118 IN. tall. Position FL/FR is also loaded with cargo that exceeds 96 IN. in height and is loaded forward of B.A. 940, but is loaded with frangible cargo.

C. For this sample problem, the tall rigid cargo is loaded on the airplane centerline. Therefore, a factor of 0.9 is used.

D. For this sample problem, the required frangible cargo is loaded in Positions A1, A2, B1 and CL/CR.

STEP 2 Calculate the Volume of Cargo Forward of the Tall Rigid Cargo

A. For this sample problem, the total volume is per the table below (volume forward of B.A. 1030). Positions forward of B.A. 1030 are Positions A1, A2, B1, CL/CR, DL/DR, EL/DR, and FL/FR.

B. For this sample problem, all ULDs forward of B.A. 1030 are between 40 and 80 percent full per the table on Page 12.

C. For this sample problem, a factor of 0.9 for tall rigid cargo will be used per Step 1C, because the tall rigid cargo is loaded on the airplane centerline.

D. Determine the effective volume of the ULDs forward of the tall rigid cargo (forward of the B.A. determined in Step 1A) by the following table:

VOLUME OF CARGO FORWARD OF TALL RIGID CARGO						
IATA POSITIONS	DETAILS FOR CARGO LOADED ON LEFT SIDE			DETAILS FOR CARGO LOADED ON RIGHT SIDE		
	MAXIMUM VOLUME CU FT	PERCENT FULL %	LOADED VOLUME CU FT	MAXIMUM VOLUME CU FT	PERCENT FULL %	LOADED VOLUME CU FT
A1	540	80	432.0			
A2	607	75	455.3			
B1				613	95	582.4
CL/CR	613	85	521.1	613	90	551.7
DL/DR	613	85	521.1	613	55	337.2
EL/ER	613	95	582.4	613	75	459.8
FL/FR	613	90	551.7	613	100[a]	613.0
GL/GR and Aft[b]	0	NA	0.0	0	NA	0.0
Total Loaded Volume per side			3063.4			2544.0

[a] Position FR is loaded with frangible cargo that is 118 IN. tall. Per Step 2A, only that portion of the volume below 96 IN. tall can be included in this volume calculation. Therefore, Position FR has a volume of 613 CU FT because it is 100% full up to a height of 96 IN.

[b] Volume aft of B.A. 1030 (Positions GL/GR and aft) should not be included in this calculation.

Total Volume on Left Side	3063.4 CU FT
Total Volume on Right Side	+ 2544.0 CU FT
Total Volume	5607.4 CU FT
Tall Rigid Cargo Factor	× 0.9
Effective Volume	5046.6 CU FT

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

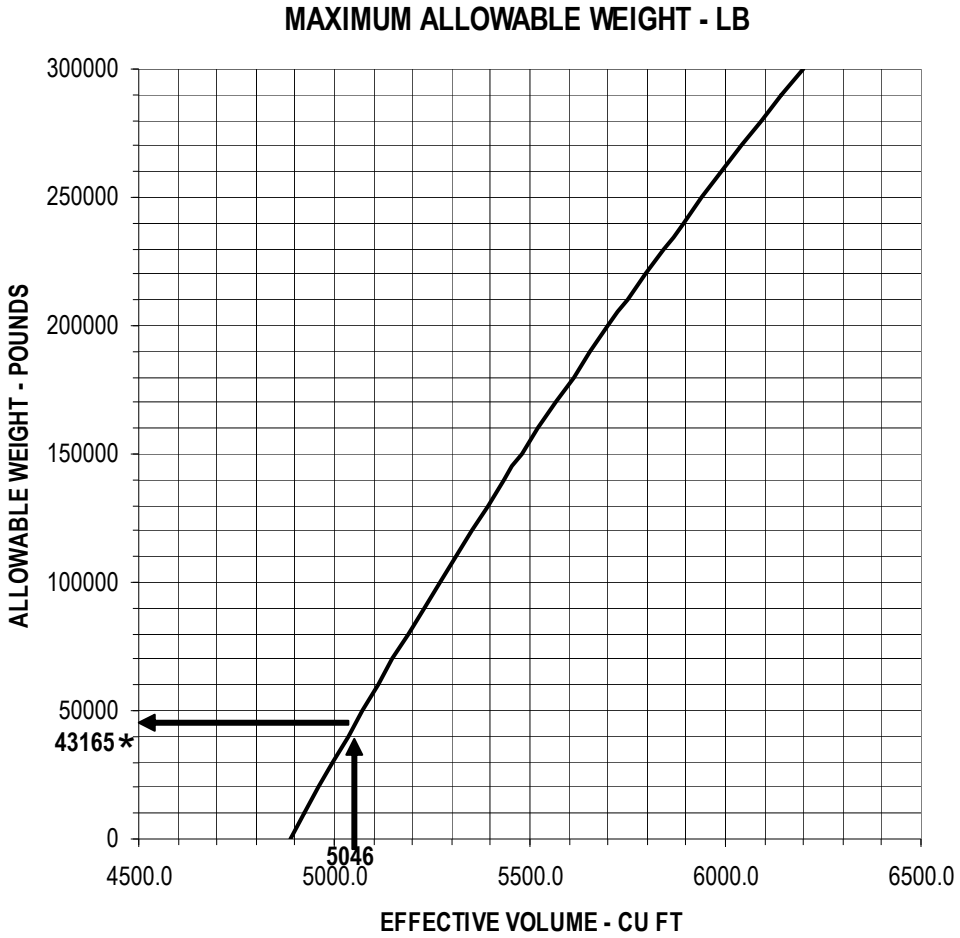
TALL RIGID CARGO (Continued)

STEP 3 Determine the Effective Maximum Allowable Weight of Cargo That Can be Stopped by the Volume of Cargo Determined in Step 2

A. Use the graphs on Pages 5 and 6 to determine the maximum allowable weight of cargo that can be stopped by the volume of cargo determined in Step 1.

B. For this sample problem, use 5046 CU FT as calculated in Step 2D.

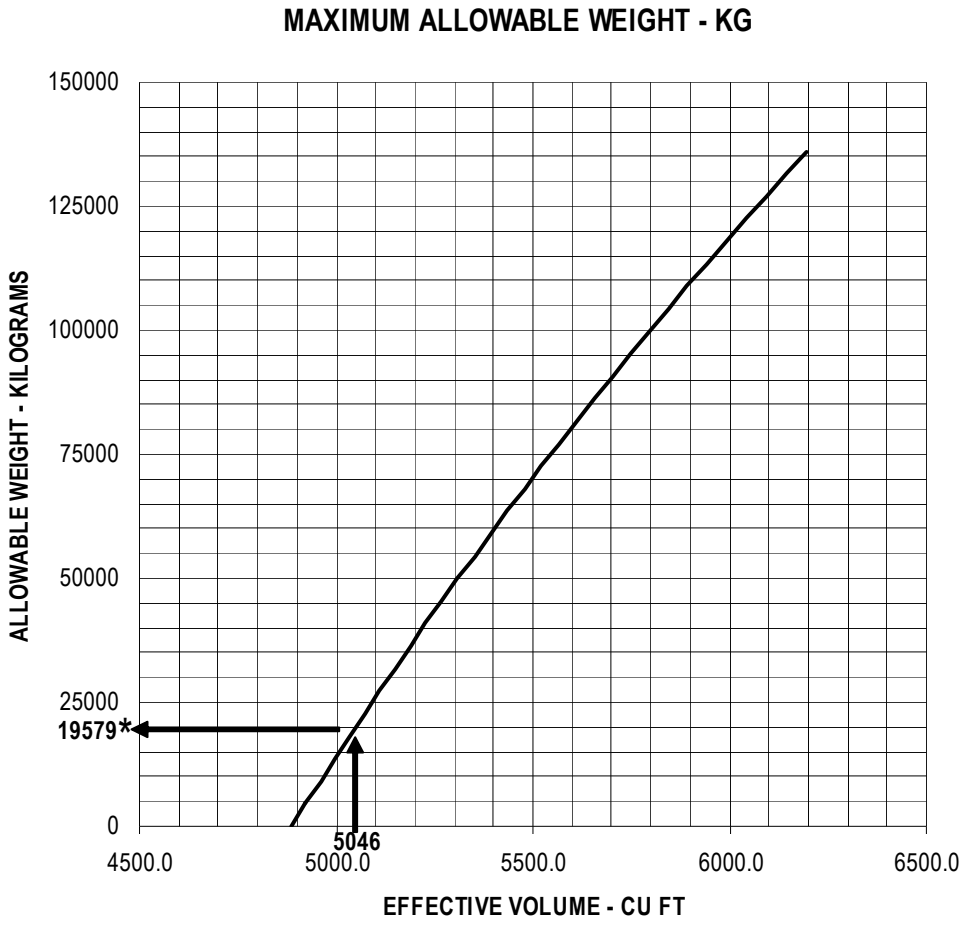
C. For this sample problem, a maximum allowable weight of cargo that can be stopped by a volume of 5046 CU FT is 43165 LB (19579 KG) as shown in the graph below and on the following page:



* Calculated using the equation on Page 5. Graphically shown here.

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)



* Calculated using the equation on Page 6. Graphically shown here.

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo

TALL RIGID CARGO (Continued)

STEP 4 Adjust the Main Deck Cargo Loading as Required.

A. For this sample problem, the proposed loading has 90100 LB (40869 KG) as the weight aft of B.A. 1030. Positions aft of B.A. 1030 are Positions G/H, JL/JR, KL/KR, LL/LR, ML/MR, PL/PR, RL/RR, SL/SR and T.

B. For this sample problem, a maximum allowable weight of cargo that can be stopped by a volume of 5046 CU FT is 43165 LB (19579 KG).

C. For this sample problem, the loaded cargo 90100 LB (40869) KG is **greater** than the maximum allowable weight 43165 LB (19579 KG). **This is not even close to an acceptable load plan.**

The sample problem is not OK for the carriage of tall rigid cargo.

Possible solutions are:

- Move the tall rigid cargo. (In this sample problem moving the tall rigid cargo to Position H/J will increase the volume forward of the tall rigid cargo and reduce the weight aft of the tall rigid cargo. Both of these results are good.)
- Do not centerline load the tall rigid cargo. This will change the configuration factor from .90 to 1.0. (In this sample problem it is likely that cargo would hit the overhead airplane structure, so center loading is likely the only option).
- Ensure the cargo forward of the tall rigid cargo is volumetrically full. (In this sample problem the ULDs forward of B.A. 1030 are mostly full, but some positions like DR are only 55% full).
- Load less cargo aft of the tall rigid cargo. (For this sample problem removing cargo aft of the tall rigid cargo is a good solution, but this means some cargo may not make this flight. Also, removing cargo from the aft body may result in the airplane zero fuel weight moving forward, possibly outside of the C.G. limits (See CHP-SEC 1-02-xxx)).

APPLICABLE CONFIGURATIONS
Tall Rigid Cargo