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This Flight Standards Service (AFS) advisory circular (AC) contains guidance on cargo loading. It is intended for air operators, Original Equipment Manufacturers (OEM), Supplemental Type Certificate (STC) holders, Parts Manufacturer Approval (PMA) holders, Technical Standard Order (TSO) holders, and aircraft owners and operators who manufacture their own parts.

This AC responds to a recent aircraft accident involving a part 121 air carrier that was transporting heavy military vehicles, known as “special cargo.” It was revised after evaluating special cargo operations, load planning, restraint calculations, restraint methods, freight staging, freight forwarding, and interlining of cargo. It enhances the safety of flight operations by clearly identifying responsibilities of parties and enhances guidance concerning the operator’s Weight and Balance (W&B) control program and procedures for cargo restraint and aircraft loading; unit load devices (ULD) and restraint devices; and the transport of special cargo. It also provides clarity regarding cargo handling training requirements. Adhering to the recommendations in this AC is one means, but not the only means, for air carriers to better manage their cargo operations.

ORIGINAL SIGNED BY

/s/ John S. Duncan
Director, Flight Standards Service

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CHAPTER 1. GENERAL INFORMATION

1.1.1 Purpose. This advisory circular (AC) provides operators with recommended procedures for managing cargo operations. Developing and using these comprehensive procedures is key to establishing a safe and efficient cargo operation. The AC provides guidance for aircraft cargo loading systems (CLS), restraints, special cargo, and unit load devices (ULD). This AC is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, of complying with applicable regulations to manage cargo operations.

- The terms *must* and *will* are used in this AC to reflect regulatory requirements.
- When this AC uses suggestive and permissive language (e.g., *should* and *may*), it is used to describe recommended or acceptable means, but not the only means, to comply with this AC.

1.1.2 Audience. Air operators, Original Equipment Manufacturers (OEM), Supplemental Type Certificate (STC) holders, Parts Manufacturer Approval (PMA) holders, Technical Standard Order (TSO) holders, and aircraft owners and operators who manufacture their own parts.

1.1.3 Background. This air cargo operations AC was developed in 2005, after an accident involving a McDonnell Douglas DC-8 aircraft, in response to National Transportation Safety Board (NTSB) safety recommendations. Those recommendations detailed training requirements for cargo handling personnel, and development of advisory material for Title 14 of the Code of Federal Regulations (14 CFR) part 121 carriers and principal operations inspectors (POI). That curriculum content includes but is not limited to Weight and Balance (W&B), cargo handling, cargo restraint, hazards of misloading, and training for cargo handling personnel.

1.1.3.1 Revision. In April 2013, a Dubai-bound Boeing 747-400 crashed just after takeoff from Bagram Air Base, Afghanistan. It was transporting heavy military vehicles, known as “special cargo” loads. Following that accident, this AC was revised after evaluating W&B personnel training, special cargo operations, load planning, restraint calculations, restraint methods, freight staging, freight forwarding, and interlining of cargo.

1.1.3.2 Cargo Operations Program. An operator’s cargo operations program constitutes the foundation for safely transporting air cargo. This program includes such features as:

- Acceptance of cargo by the operator;
- Associated engineering analysis supporting the carriage of that cargo, as applicable;
- Maintenance and airworthiness of CLS components;
- Processes for the buildup, handling, loading and restraint of cargo by ground personnel; and
- Calculations and verification of the W&B of an aircraft by ground and flight personnel.

1.1.4 Document Organization. This AC has four chapters and several appendices. Chapter 1 contains general information about the AC. Chapter 2 addresses operational processes and

procedures, and Chapter 2 address separate operational processes and procedures of cargo operations, with individual sections that address separate operational aspects. Chapter 3 details background information for the certification and continued airworthiness of ULDs, restraint devices, and CLSs installed on aircraft. Chapter 4 describes how to get more information regarding this AC. The appendices contain information related to regulations supporting the AC, a list of related publications, related definitions, acronyms, passenger-to-cargo conversion information, and outward-opening cargo door information, example of a tiedown scheme for single item, Active ULD marking, and a flow chart for special handling as it relates to ULD and special cargo.

1.1.5 Where You Can Find This AC. You can find this AC on the Federal Aviation Administration (FAA)'s Web site at http://www.faa.gov/regulations_policies/advisory_circulars.

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CHAPTER 2. OPERATIONAL PROCESSES AND PROCEDURES

SECTION 2.1. GENERAL

2.1.1 Purpose. This chapter informs operators of the importance of providing necessary guidance to loading personnel for proper cargo buildup, weighing and restraint, and aircraft loading and unloading.

2.1.2 Airplane W&B Manual. The Weight and Balance Manual (WBM) is part of the operating limitations section of the Airplane Flight Manual (AFM). In accordance with 14 CFR part 21, § 21.41, the operating limitations are part of the airplane type certificate (TC) and, therefore, can be modified only by changing that certificate; that is, by obtaining an amended TC or Supplemental Type Certificate (STC). Revisions to the AFM are approved as AFM supplements, and the approval is based on a finding that, with the AFM revisions, the airplane continues to meet the applicable airworthiness standards. Operators are required to comply with the operating limitations by 14 CFR part 91, § 91.9(a). The aircraft WBM is often a separate document, but remains part of the AFM. Title 14 CFR part 25, § 25.1583(c) authorizes the WBM as a separate document.

2.1.3 Company Operating Manuals. If the procedures provided by the aircraft manufacturers do not have sufficient detail and guidance, an operator may develop supplemental procedures and submit it to the FAA for approval. Any time the operator develops a procedure it can not contradict regulation. Regulation always supercedes company manuals. Supplemental procedures ensures that cargo handling personnel have the guidance necessary to maintain safety of flight operations. An operator should have a training program in place for cargo buildup, cargo loading system (CLS) configuration, aircraft loading/unloading, carriage of hazardous materials (hazmat), and special cargo. Personnel associated with these job functions and the supervising of cargo loading operations should be trained and qualified in these positions.

NOTE: Appendix B lists guidance materials that can be used as a resource to develop your supplemental procedures. However, the FAA may still request additional data based on the submitter's operation.

2.1.4 Process and Procedure Recommendations. The FAA recommends the following be included in an operator's manual that is essential to air cargo operations. These recommendations are discussed in more detail throughout this chapter. This is not an all-inclusive list.

2.1.4.1 Have procedures for control of Weight and Balance (W&B) for both aircraft and cargo.

2.1.4.2 Have procedures to study and evaluate the capability of any aircraft the operator may use to transport any type of cargo, including special cargo. This determination should be made prior to accepting a shipment. Operators may include a reference to the source document for this evaluation.

2.1.4.3 Have procedures for loading and unloading all types of cargo, including Company Material (COMAT).

2.1.4.4 Have procedures to restrain cargo in aircraft compartments, including main deck, lower deck, fore and aft compartments, or pods, in accordance with the requirements of the Original Equipment Manufacturer (OEM)'s WBM, Supplemental Type Certificate (STC) W&B supplement for certified ULDs, non-certified ULDs, bulk loaded cargo, and special cargo.

2.1.4.5 Have procedures for the use, storage and evaluation of the condition of cargo restraints (e.g. straps, netting, and ropes) used to restrain bulk, ULD, or special cargo. Procedures should provide for routine serviceability checks and the identification and removal of any unserviceable restraint devices. Procedures should also provide the process to follow if failed restraints are identified while in use.

2.1.4.6 Have procedures to control the use, calibration, or verification of weigh scales for operators and vendors.

2.1.4.7 Have procedures to control the repair of ULDs, aircraft cargo loading systems (CLS), cargo restraint devices, and other miscellaneous aircraft cargo handling equipment required for loading or unloading aircraft. This also includes installed nets and installed smoke barriers.

2.1.4.8 Have procedures in its manual system for the control of all manuals and manual revisions applicable to air cargo operations. These procedures should ensure the operator:

- Has current versions of the manuals, and
- Provides authorized maintenance personnel and vendors with current manuals and manual revisions.

2.1.4.9 Have procedures to assure that all personnel are properly trained, qualified, and authorized to perform their job function(s).

2.1.4.10 Have procedures for reconfiguring the CLS and document that the appropriate personnel have been notified. This ensures maintenance, flightcrew, and the loading crew are aware that center of gravity (CG) limits may have changed for current and future flights.

2.1.4.11 Have procedures and processes for determining the carriage of special cargo.

2.1.4.12 Have procedures for freight forwarding, interlining, and freight staging.

2.1.4.13 Have procedures for the carriage of hazardous materials (hazmat).

2.1.4.14 Have procedures for incorporating a Continuing Analysis and Surveillance System (CASS) to verify the performance and effectiveness of its CLS maintenance program and provide corrections to any deficiencies discovered in the program.

2.1.4.15 Have procedures for incorporating a closed-loop system that monitors the elements of surveillance, analysis, corrective action, and follow-up to verify the performance and effectiveness of its W&B control program (including cargo operations) and provide corrections to any deficiencies discovered in the program.

NOTE: Under 14 CFR part 121, § 121.137, all manuals must be under the control of the operator even if they are located at a remote site.

SECTION 2.2. WEIGHT AND BALANCE CONTROL PROGRAM

2.2.1 Develop a W&B Control Program. Type-certificated (TC) aircraft have an FAA-approved WBM provided by the OEM. The OEM WBM for an aircraft is the basis for an operator's W&B control program. Operating instructions may be used to achieve the limitations in the WBMs.

2.2.1.1 Modified Aircraft. For aircraft with a passenger-to-cargo conversion, or other modifications—such as an aircraft CLS—a W&B supplement describing the modification's effect on the aircraft is FAA approved and is issued as part of an STC or amended TC.

2.2.1.2 W&B Control Program. An operator's W&B control program should include at a minimum:

2.2.1.2.1 Loading limitations, including limitations on empty or unoccupied positions with missing or damaged restraints;

2.2.1.2.2 Information on aircraft cargo restraint systems, such as aircraft CLSs, installed nets, ULDs, and other restraint devices;

2.2.1.2.3 Requirements for special cargo loads;

2.2.1.2.4 A list of ULDs compatible with the CLS;

2.2.1.2.5 Aircraft operating weights;

2.2.1.2.6 Information for the determination of an aircraft's CG;

2.2.1.2.7 Weight limitations for each compartment and zone, when applicable;

2.2.1.2.8 Procedures for incorporating fuel loading and usage into the aircraft's W&B calculations;

2.2.1.2.9 Instructions for, and samples of, load documents and manifests, to include special cargo loading documents;

2.2.1.2.10 Aircraft loading schedules; and

2.2.1.2.11 Processes and procedures to monitor the W&B control program.

2.2.2 Contents of an Operator's W&B Manual. Operator WBMs must be based on an aircraft's W&B data, amended TCs, and applicable STCs.

2.2.2.1 Aircraft Basic Operating Weight Control. An aircraft must conform to the basic operating weight determined by the operator.

2.2.2.2 Zone and Compartment Weight Limitations. An operator's aircraft must conform to all zone weight limitations and compartment weight limitations under the aircraft manufacturer, TC holder and STC holder W&B requirements.

2.2.2.3 CG Range Limitations. The operator must include reference charts and tables in its W&B manual, or other manual that provide the FAA-approved weight and CG range limitations.

2.2.2.4 Aircraft Weight. An operator's aircraft must conform to the aircraft manufacturer's W&B requirements, and should establish procedures for weighing the aircraft using the manufacturer's WBM requirements or other FAA-approved or accepted methods. One accepted method is contained in the current edition of AC 120-27, Aircraft Weight and Balance Control.

2.2.2.5 Aircraft Major Alteration Requirements.

2.2.2.5.1 A major alteration to an aircraft that changes the W&B requirements and/or limitations must be accomplished utilizing approved data.

2.2.2.5.2 The operator must have a procedure in place to ensure all supplemental information developed, issued, and approved for that aircraft is incorporated into the operator's W&B control program. An operator should apply the most restrictive ranges of the alteration incorporated to the operation of that aircraft. For example, if multiple STCs apply, the operator should use the STC with the most restrictive W&B limitations when incorporating the supplemental information into the operator's W&B control program.

2.2.2.5.3 In cases of multiple STCs applied to a single aircraft, the STCs should be evaluated for effect on each other and the appropriate limitations applied. At a minimum, an operator should include the supplemental information described above and cross-reference the supplemental information in the operator's WBM. In addition, the operator should organize the supplemental information in a way that facilitates use by loading personnel. Finally, the operator should include the supplemental information in the operator's WBM and any charts or tables that indicate proper weight and CG range limitations. The operator must incorporate CLS STCs into its maintenance program.

2.2.2.6 Aircraft CLS Limitations. The operator must conform to, and apply, the W&B and CG limitations of the aircraft CLSs, as established by the OEM/STC WBM. The operator should apply the most restrictive limitations considering all major alterations made to the aircraft. Reconfiguration of the CLS, such as re-positioning pallet locks, should only be accomplished using the OEM/STC WBM. The operator must have a method to determine W&B calculations for any reconfiguration of a CLS.

2.2.2.7 Carriage of Other Persons (Other than Flightcrew). The regulations (§ 121.583) allow for the carriage of certain persons aboard an airplane without complying with certain passenger-carrying requirements of part 121. These persons are commonly referred to as supernumeraries. They may be carried aboard an airplane because of their necessity for the safety of the flight, their relationship with the air carrier, or by virtue of certain knowledge and abilities attributed to them through selection and mandatory training. An operator must establish procedures for the carriage of supernumeraries. See Chapter 3, Certification, for further discussions of supernumeraries. At a minimum, the procedures must address:

2.2.2.7.1 A method for calculating the weight of supernumeraries and their carry-on and checked baggage, such as actual weight or standard average weight. Refer to AC 120-27 for guidance on calculating weights;

2.2.2.7.2 Any special procedures or limitations when carrying supernumeraries aboard an aircraft. These limitations may be specified as part of the type design in the Type Certificate Data Sheet (TCDS) or a limitation in the 14 CFR part 25 exemption for the carriage of supernumeraries; and

2.2.2.7.3 Instructions for documenting the weight of supernumeraries, and for communicating the information to the pilot in command (PIC) or other authorized, trained, and qualified personnel for determining W&B.

SECTION 2.3. CLASSIFYING CARGO COMPARTMENT FOR FIRE SUPPRESSION, CARGO LOADING SYSTEM COMPONENTS, INSTALLED NETS, AND SMOKE BARRIERS

2.3.1 Classification of Cargo Compartments for Fire Suppression. Aircraft cargo compartments are designed to accept and restrain cargo in various ways. Cargo compartments are classified as class A, B, C, or E in 14 CFR parts 25 and 121, depending on accessibility and fire protection requirements. Some cargo compartments accept ULDs and some do not. In general:

2.3.1.1 Class A compartments are accessible by the flightcrew for firefighting, usually from the flight deck or areas adjacent to the flight deck.

2.3.1.2 Class B compartments are accessible by the flightcrew for firefighting.

2.3.1.3 Class C compartments are used on passenger aircraft for carrying baggage or other cargo. These compartments require a fire suppression and detection system controlled from the pilot or flight engineer station. The compartment is not accessible to the flightcrew during flight.

2.3.1.4 Class E compartments are on airplanes used only for the carriage of cargo.. These compartments are on both the main deck and lower lobe areas and, require fire detection systems.

2.3.2 Cargo Compartments Designed to Accept ULDs. These compartments are equipped with an aircraft CLS designed to restrain ULDs in the aircraft. CLSs also position ULDs, enabling them to move easily in and out of the aircraft. The CLS comprises various assemblies, such as restraint locks, side rails, and ball and roller conveyors. Some CLSs are powered, and some may be installed in main deck and/or lower deck compartments. When the flightcrew and/or other persons are seated on the same deck forward of the CLS, a smoke barrier is installed (as applicable) between the CLS and those persons.

2.3.3 Cargo Compartments Not Designed to Accept ULDs. These cargo compartments are called bulk compartments, and may have vertical or horizontal nets. Depending on its design and purpose, the net may restrain cargo from shifting vertically, longitudinally, and laterally within the compartment or from shifting onto the cargo door or cargo door area within the compartment. Bulk compartments protect aircraft systems and structures against damage from shifting cargo for all flight and landing conditions.

NOTE: Care should be taken when loading bulk cargo in these compartments to ensure that it does not block fire detection sensors or fire suppression agent nozzles, if installed.

2.3.4 Substituting CLS Components. An operator may substitute aircraft CLS components under several different procedures, depending on the certification method for the components being substituted. Substitution also may involve replacing CLS components, or subcomponents of an aircraft cargo restraint assembly, with those of another design. If an operator substitutes a CLS component, the operator must have a procedure that addresses:

- The load-bearing components that the operator may substitute;
- The level of substitution, such as a complete assembly or parts of an assembly, the operator allows and the conditions that support each process; and
- The FAA-approved data used.

NOTE: CLS components are certificated under methods such as a Parts Manufacturer Approval (PMA), Technical Standard Order (TSO), Production Certificate (PC), TC, amended TC, STC, or under rules governing owner-produced parts.

2.3.5 Substituting PMA Products. An operator may substitute aircraft CLS components manufactured under a PMA. Installation data and any limitations may be found in the:

- The component maintenance manual (CMM);
- The manufacturer's illustrated parts catalog or the air carrier's supplemental manual;
- The operator's instructions based on FAA-approved data, the aircraft manufacturer, or STC holder; and
- The manufacturer's Service Bulletins (SB) or service letters.

2.3.6 Substituting TSO Products. An operator may substitute CLS components manufactured under a TSO if the operator has procedures to determine whether the unit is eligible for installation. An operator may substitute products approved under a TSO using information from:

- SBs;
- STCs;
- Aircraft manufacturer's TC;
- CMMs; or
- Manufacturer's illustrated parts catalogs.

2.3.7 Substituting PC, TC, Amended TC, AND STC Products. Parts can be approved through the PC, TC, amended TC, and STC processes. These processes include instructions for interchanging CLS components. An operator may substitute these components using the following source documentation for these processes:

- Type Certificate Data Sheet (TCDS);
- SBs, service letters, or equivalent FAA-approved data; and
- Manufacturer's instructions for continued airworthiness (ICA).

2.3.8 Substituting Owner-Produced Parts. Title 14 CFR part 21 indicates an operator may manufacture parts for use on its own aircraft. In such cases, an operator must have processes to:

- Identify components manufactured for the aircraft CLS in its maintenance program;
- Ensure another operator or vendor does not sell or distribute the parts it manufactures;

- Show its owner-produced parts meet the equipment manufacturer CLS type design; and
- Maintain the continued airworthiness of the owner-produced part.

2.3.9 Addressing CLS Component Discrepancies. An operator may address aircraft CLS component discrepancies by replacing or repairing the applicable component. If the operator discovers systemic problems with the reliability of its components, the operator should report such problems to the component manufacturer. An operator's CASS should track all cargo loading component discrepancies to measure the performance and effectiveness of the operator's maintenance and inspection program.

2.3.10 Replacing a CLS Component. An operator may replace a CLS component with a new, rebuilt, overhauled, or repaired serviceable component. This component must meet requirements for installation on the particular aircraft.

2.3.11 Repairing a CLS Component.

2.3.11.1 Operator Responsibility. An operator may repair a component on the aircraft, or may have a vendor repair a component. Under certain circumstances, an accepted manual may allow minor repairs using FAA-accepted data. The repair vendor may be under the direct control of an operator, or may be a vendor the operator designates. The operator has primary responsibility for determining that:

2.3.11.1.1 The component meets applicable regulatory requirements, and

2.3.11.1.2 The repair vendor is authorized to repair the component.

2.3.11.2 Vendor Repair. CLS components repaired by a vendor should undergo a receiving inspection using operator procedures. The component should also have documentation to (1) confirm each component is certified as serviceable, and (2) provide traceability to the data used for repair. The documentation should include:

2.3.11.2.1 Identity of the company that owns the component;

2.3.11.2.2 FAA repair station certificate number, if applicable, and vendor name;

2.3.11.2.3 Component part number;

2.3.11.2.4 Component serial number, if applicable;

2.3.11.2.5 Component nomenclature;

2.3.11.2.6 Component times and/or cycles, if applicable;

2.3.11.2.7 Quantity of components;

2.3.11.2.8 Specifications used for repair;

2.3.11.2.9 Certification statement of procedures used;

2.3.11.2.10 Traceability documentation; and

2.3.11.2.11 Signature of an authorized agent.

2.3.11.3 Retention of Repair Records. The operator must retain its repair records in accordance with its established procedures to comply with the requirements of § 121.380.

2.3.12 CLS Components in the Minimum Equipment List (MEL).

2.3.12.1 Dispatch Deviation Procedures. An operator must ensure the aircraft MEL contains adequate instructions, or references an appropriate manual, for dispatch deviation procedures that describes:

2.3.12.1.1 The total number of items installed and minimum number required for dispatch;

2.3.12.1.2 The loading limitations because of missing or defective equipment;

2.3.12.1.3 The references showing location of loading restrictions;

2.3.12.1.4 The appropriate category for repair; and

2.3.12.1.5 The instructions for ensuring MEL limitations are included in W&B computations and the load plan.

2.3.12.2 Procedures for Inoperative or Missing CLS Components. An operator should include procedures for inoperative or missing CLS components in the operator MEL. These procedures should include any requirements for:

2.3.12.2.1 Reconfiguration of the aircraft, if necessary;

2.3.12.2.2 Voiding of adjacent positions, if necessary;

2.3.12.2.3 Accounting for limitations;

2.3.12.2.4 Notification to the PIC and other appropriate personnel the operator deems necessary of the missing components;

2.3.12.2.5 Instructions for ensuring MEL limitations and/or restrictions are included in W&B computations and the load plan; and

2.3.12.2.6 Annotation in the aircraft maintenance logbook.

2.3.13 Installed Nets in the Maintenance Program. An operator maintenance program must contain procedures for maintenance and inspection of installed vertical and horizontal cargo compartment nets and 9G barrier nets.

2.3.13.1 The Program Should Encompass:

2.3.13.1.1 In-house or vendor repair procedures;

2.3.13.1.2 Receiving inspection procedures; and

2.3.13.1.3 Serviceability limitations.

2.3.13.2 Authorized Vendor List. The operator should include vendors on its authorized vendor list, and any required inspection item requirements.

2.3.14 Smoke Barriers.

2.3.14.1 Smoke Barrier Control Procedures. All smoke barriers act as a blockade between the cargo and crew, preventing smoke and flames from entering the passenger cabin and flight deck areas of the aircraft. They can be permanent or attachable and in a variety of forms, such as doors or curtains. An operator must have procedures to control the airworthiness and subsequent operational serviceability of smoke barriers. The operator should provide aircraft-specific training on the description, operation, function, and preflight of smoke barriers.

2.3.14.2 Inspection. Inspect the overall condition of the smoke barrier curtain, if installed, or cockpit door seal, barrier net assembly, or solid bulkhead. Ensure that the net (if used) has the proper rating for its intended G-loading. Inspections of the smoke barrier should include, at a minimum:

2.3.14.2.1 The smoke barrier curtain must be free of tears, holes, and cuts to prevent smoke from entering the forward cabin and flight deck;

2.3.14.2.2 The cockpit door seal, for condition and integrity;

2.3.14.2.3 The barrier net, for condition and security (i.e., check for frayed straps, hardware integrity, and proper markings);

2.3.14.2.4 Cargo compartment retention nets, for condition and security;

2.3.14.2.5 The solid bulkhead, for condition and security; and

2.3.14.2.6 The required placards (such as loading, fire suppression, and so forth) for condition, legibility, and security.

SECTION 2.4. UNIT LOAD DEVICES AND CARGO RESTRAINT DEVICES

2.4.1 Restraints. Aircraft cargo restraint methods come in two general categories: primary and supplemental. An operator has overall responsibility for ULDs and other cargo restraint devices and should have FAA-accepted procedures to control the operational serviceability of them, whether a primary or a supplemental restraint. When primary or supplemental restraint is attached directly to the aircraft structure, see Section 2.8, Transport of Special Cargo, for additional guidance.

2.4.2 Primary Restraint. This is the restraint of the cargo payload to the aircraft structure for regulatory load conditions (e.g., flight and emergency landing). This restraint secures cargo in the forward, aft, vertical, and lateral directions. Primary restraint is used to secure:

2.4.2.1 Cargo:

2.4.2.1.1 To a pallet using applicable net (net is the primary restraint);

2.4.2.1.2 Within a container (container is the primary restraint); or

2.4.2.1.3 To the aircraft structure (straps, ropes, etc. is the primary restraint).

2.4.2.2 ULD—to the aircraft structure using the CLS (e.g., locks and side rails).

2.4.2.3 WBM Provisions. Some airplane WBMs may provide additional tiedown to the aircraft structure to restrain ULDs if the following conditions exist:

2.4.2.3.1 The ULD weight limit is limited either by restraint configurations or by missing and/or inoperative restraints.

2.4.2.3.2 The ULD is loaded to a weight greater than allowable for the chosen loading position with all restraints operative, and a greater weight is allowed by the aircraft WBM with tiedown (e.g., the floor is more capable than the restraint system).

NOTE: See Section 2.8 for additional guidance.

2.4.3 Supplemental Restraint. Supplemental restraint is additional restraint that prevents shifting and is used to stabilize cargo to a pallet or container. When supplemental restraints are attached to the CLS or aircraft structure, it creates a parallel load path to the ULD, therefore classified as special cargo. See Section 2.8 for additional guidance. An exception would be stabilization straps in a certified bulk compartment.

2.4.4 ULDS and Other Cargo Restraint Devices.

2.4.4.1 ULD Definition. A ULD is a device for grouping, transferring, and restraining cargo for transit. It may consist of a cargo pallet and cargo net combination or a container as defined in the current editions of National Aerospace Standard (NAS) 3610, Cargo Unit Load Devices – Specification For; Aerospace Standards (AS) 36100, Air Cargo Unit Load Devices – Performance Requirements and Test Parameters; and TSO-C90, Cargo Pallets, Nets and

Containers (Unit Load Devices). These documents do not include a cargo pallet and cargo strap combination. When restraining a pallet and net ULD into the aircraft, the aircraft may be the weakest link in the certified load path. The term ULD includes the following equipment:

2.4.4.1.1 Pallets and nets.

2.4.4.1.2 Certified and non-certified aircraft containers.

2.4.4.2 Types of ULDs.

2.4.4.2.1 Background.

2.4.4.2.1.1 Certified ULDs are defined in aircraft WBMs and require no further analysis. However, non-certified ULDs and other payloads require further analysis to determine if the aircraft and restraint system is structurally adequate.

2.4.4.2.1.2 ULDs designs may exceed the structural capability of an aircraft. To preclude failures of the aircraft cargo restraint system the requirements of the aircraft WBM must be observed.

2.4.4.2.2 Certified ULD. A ULD meeting the requirements of TSO-C90; STC requirements, if applicable; or other FAA-approved certification standards. A certified ULD is structurally capable of restraining a load and/or protecting the aircraft systems and structure. Only ULDs that are permitted by the aircraft WBM (TC or STC) are certified for use on that aircraft. To remain a certified ULD for an aircraft, the ULD must be restrained by the aircraft's CLS, such as pallet locks and side guides. A certified pallet and a certified net can be combined and certified as a unit. The operator should have on file for all its certified ULDs an FAA approval letter, certificate, or other certifying document, such as a conformance certificate provided by the ULD equipment manufacturer.

2.4.4.2.3 Certified Cargo Pallet and Net (ULD). Most operator WBMs recognize a TSO cargo pallet and net combination as the primary restraint for unitized cargo. A cargo pallet net is the only restraint device that takes the shape of the cargo while restraining the load in all directions, so that the load is spread to the net fittings and pallet edge rails.

2.4.4.2.4 Non-Certified ULDs. A ULD that does not meet the TSO-C90 or PMA certification requirements, and/or is not listed in the aircraft WBM (TC or STC). Non-certified ULDs should meet a standard (see Appendix B, Guidance Material, for suggested standards). The operator should have documentation stating its design criteria for manufacturing the non-certified ULD.

2.4.4.2.5 Active ULDs.

2.4.4.2.5.1 Active ULDs are ULDs with active temperature control systems for transporting temperature sensitive cargo. Unlike the typical ULD, active ULDs are capable of heating and/or refrigerating as required. These systems consist of a highly insulated container with a battery operated heating/cooling system integrated into the construction of the container. Active ULDs are intended to be operating during flight. Active ULDs are battery powered in

flight and are only recharged while on the ground. The “active” components of these units typically consist of a vapor cycle refrigeration/heat pump type system that is powered by various types of large batteries, depending on the manufacturer.

2.4.4.2.5.2 Only Active ULDs approved under part 21, § 21.8(d) or § 21.305(d); a TC; or an STC may be used on U.S.-registered aircraft and marked with an “Active Unit Load Device” placard (see Appendix I, Active Unit Load Device Marking). Additionally, if an operator intends to deploy these containers in their fleet, they should have procedures in their manuals to ensure only containers that are properly prepared, and which meet the handling and airworthiness requirements of the manufacturer, are carried on an aircraft. To carry these devices, operators should incorporate or reference the pertinent parts of the device’s certification documents into its manual. These may include:

1. Required markings, placards, and labeling;
2. ICAs to include proposed limitations and restrictions necessary to safely carry the device on an aircraft; and
3. Operating instructions for the device.

NOTE: Hazmat procedures in Title 49 of the Code of Federal Regulations (49 CFR) may apply to the container’s contents.

NOTE: A recodification of part 21, effective April 2011, changed the reference § 21.305(d) to § 21.8(d).

2.4.4.2.6 Temperature-Controlled Shipping Containers. Temperature-controlled shipping containers are devices designed to maintain their contents within strict temperature controls. These devices may bear a TSO, STC; PMA, or be allowed by the TC. These units should be approved in the limitations section of the certification document for use with certain Net-Pallet combinations. To carry these devices, operators should incorporate or reference the pertinent parts of the device’s certification documents into its manual. These may include:

- 2.4.4.2.6.1 Required markings, placards, and labeling;
- 2.4.4.2.6.2 ICAs, to include proposed limitations and restrictions necessary to safely carry the device on an aircraft; and
- 2.4.4.2.6.3 Operating instructions for the device.

NOTE: Hazmat procedures in 49 CFR may apply to the container’s contents.

2.4.4.3 Other Restraint Devices.

2.4.4.3.1 Other Types of Cargo Restraint Devices. The operator may use cargo restraints such as straps, ropes, cables, and nets. These restraints must be approved per aircraft manufacturer W&B documentation or STC holder documentation. The operator’s manual should

address their use, serviceability limitations and a process to follow if failed restraints are identified while in use. If the operator doesn't use an authorized cargo pallet/net combination as the primary restraint, the operator's manual should have policies and procedures to address this issue. For example, if a strap is used as the primary restraint, the cargo may be:

- Loaded in an aircraft compartment that meets the type design for compartment restraint, or
- Restrained by cargo straps or other authorized devices to the aircraft as described in the aircraft's manual, an STC supplement, or a WBM.

2.4.4.3.2 **Certified Straps.** These devices should meet the requirements of TSO-C172, Cargo Restraint Strap Assemblies. In it, the FAA describes the minimum performance standards (MPS) by which cargo restraint strap assemblies are approved and identified with applicable TSO markings.

2.4.5 Determining ULD Compatibility. It is critical to safety of flight for the operator to have procedures confirming that ULDs on board an aircraft are compatible with the aircraft, regardless of who owns the ULD. Not all ULDs are authorized as compatible with all aircraft, so an operator should have procedures for:

2.4.5.1 **Compatibility.** Ensure certified and non-certified ULDs are compatible with the aircraft and do not present a hazard to the aircraft.

2.4.5.2 **Standards.** Ensure non-certified ULDs meet a standard (see Appendix B for suggested standards).

2.4.5.3 **Communicate.** Inform employees and vendors loading aircrafts converted from passenger to all-cargo by an STC that the aircraft could have different ULD requirements than other STC conversions or production aircraft configurations in the operator's fleet.

2.4.5.4 **Differences.** Ensure personnel understand that compatibility, limits, or restrictions may exist between similar aircraft types with STC conversions, and that the aircraft may have been produced as a freighter by a TC holder. The following list details examples of the differences:

- 2.4.5.4.1 Aircraft weight limits;
- 2.4.5.4.2 Cargo zone index changes forward/aft body;
- 2.4.5.4.3 CG limits;
- 2.4.5.4.4 Forward and aft body structure loading limits;
- 2.4.5.4.5 Fuel index tables;
- 2.4.5.4.6 Individual compartment maximum loads;
- 2.4.5.4.7 Lateral cargo unbalances;

- 2.4.5.4.8 Main deck door opening variances;
 - 2.4.5.4.9 Maximum allowable loads limited by restraint;
 - 2.4.5.4.10 Maximum allowable takeoff weight limits;
 - 2.4.5.4.11 Maximum area load limits;
 - 2.4.5.4.12 Maximum cargo zone load limits, including cumulative loads above and below deck;
 - 2.4.5.4.13 Maximum cumulative loads aft to forward;
 - 2.4.5.4.14 Maximum floor loading limits;
 - 2.4.5.4.15 Maximum ramp weight limits;
 - 2.4.5.4.16 Maximum ULD gross weight restrictions by aircraft position;
 - 2.4.5.4.17 Missing inoperative cargo restraint limits;
 - 2.4.5.4.18 Reduced over wing zone capabilities;
 - 2.4.5.4.19 ULD height restrictions;
 - 2.4.5.4.20 Asymmetrical load limits; and
 - 2.4.5.4.21 Zero fuel weight restrictions.
- 2.4.5.5 ULD Contour and Dimensions. Compare the size of the main and lower deck compartment door openings with the contour and dimensions of ULDs to be loaded. An operator should take into consideration any height restriction within the aircraft cargo compartments.
- 2.4.5.6 Approved ULD Limitations. Ensure approved ULD limitations are maintained in the manual. An operator should base these limitations on data from applicable aircraft WBM or STC supplemental WBMs. The limitations should identify which ULDs are compatible with specific aircrafts, and should also be easily accessible by all affected persons.
- NOTE: The limitations section of the AFM or AFM supplement may include information from the aircraft WBM.**
- 2.4.5.7 Authorized ULDs. Ensure its aircraft WBM or other appropriate manual states which ULDs may be carried aboard the aircraft on the main deck or lower lobes. In certain instances, particularly with an aircraft's lower lobes, certain compartments may be certified to carry bulk or restrained cargo, or both. The WBM or other appropriate manual should identify the ULDs by the type authorized to be carried aboard the aircraft, considering the aircraft and CLS capabilities.

2.4.5.8 Use of Non-Certified ULDs. Ensure the operator does not use non-certified ULDs in any compartment of an all-cargo or combination aircraft, unless (1) the ULDs are authorized by aircraft manufacturer or WBM, or (2) tiedown instructions describe how to restrain the ULDs as bulk cargo.

2.4.5.9 Unauthorized Pallet and Net Combinations. Ensure employees and vendors don't combine incompatible nets and pallets.

2.4.6 Responsibilities for the Maintenance and Repair of ULDs, Pallets, and Nets. ULDs, pallets, and nets must be maintained under an operator's or vendor/supplier's maintenance program that satisfies the ICAs of the ULD manufacturer. The operator should have a program to determine the serviceability of the ULD when it is intended to be placed on board the aircraft and ULD traceability through their authorized vendor list which is made available to the FAA.

2.4.7 Responsibilities of an Operator After Purchasing/Leasing a ULD.

2.4.7.1 Certified and Non-Certified ULDs.

2.4.7.1.1 Certified ULDs.

2.4.7.1.1.1 New Certified ULDs. When an operator purchases/leases new certified ULDs, it should perform a first article inspection (see Appendix C, Definitions Related To Air Cargo Operations) of the ULD to confirm its conformance to the type design, and is eligible for installation on the operator's aircrafts. The equipment manufacturer must show conformity on subsequent deliveries of new ULD equipment.

2.4.7.1.1.2 Used Certified ULDs. When an operator purchases/leases used certified ULDs, it should perform a serviceability inspection, conducted by appropriately trained FAA-certificated personnel, if existing records don't confirm the ULD's serviceability. After completing the inspection, the operator issues a tag verifying the serviceability of the ULD before placing it into service. After an initial inspection, the operator should then maintain its own maintenance inspection and repair records for the ULD. If the ULD has appropriate records to verify its serviceability, the operator should perform a receiving inspection in accordance with its procedures.

2.4.7.1.2 Non-Certified ULDs. When purchasing or leasing a new or used non-certified ULDs, the operator should:

2.4.7.1.2.1 Obtain the manufacturer's current CMMs and illustrated parts list, subsequent manual revisions, service letters, or SBs;

2.4.7.1.2.2 Verify that the manufacturer establishes clearly defined and tested serviceability limits in accordance with IATA, SAE, or ISO standards, or another standard acceptable to the FAA;

2.4.7.1.2.3 Provide a trained, qualified, and authorized person to perform a quality audit of a repair/overhaul facility where the ULDs are repaired/overhauled;

2.4.7.1.2.4 Check that the manufacturer designs all ULD equipment to allow venting during changes in air pressure, if required;

2.4.7.1.2.5 Check that only OEM-approved parts were used during manufacturing;

2.4.7.1.2.6 Check that the manufacturer issues spare part conformity certificates;
and

2.4.7.1.2.7 Perform a first article inspection of the ULD received to ensure its serviceability.

2.4.7.1.3 Active ULDs. In addition to the certified ULD requirements under subparagraph 2.4.7.1.1 above, consult with the FAA certificate management office (CMO) on the operational requirements.

2.4.7.2 Receiving a Purchased/Leased ULD. When receiving a ULD, an operator should have a trained, qualified, and authorized personnel perform a receiving inspection of the ULD, using the operator's procedures. The receiving procedures should include processes, instructions, and guidelines to:

2.4.7.2.1 Check each ULD before it is put into service;

2.4.7.2.2 Review the required documentation for new and repaired ULDs to ensure the ULD is serviceable; and

2.4.7.2.3 Conduct a visual inspection of the ULD.

NOTE: FAA-certificated personnel do not need to conduct receiving checks. The operator may designate a trained, authorized, and qualified person to conduct the checks. Receiving checks don't determine the airworthiness of a ULD because a repair vendor or the ULD equipment manufacturer has confirmed the ULD's serviceability before return to service.

2.4.7.3 Maintaining ULD Repair Records. An operator should have procedures for retaining certified and non-certified ULD repair records. An operator may maintain its own records, or have repair vendors maintain the records, provided the operator can access them upon request within a reasonable period of time.

2.4.7.4 Procedures for Maintaining and Repairing ULDs. An operator should have procedures to maintain and repair certified and non-certified ULDs. The procedures should be the same for both types of ULDs, except for establishing appropriate damage limits and specific repair procedures. The procedures should:

2.4.7.4.1 Clearly state the data supporting the maintenance and repair.

2.4.7.4.2 Detail transporting damaged ULDs aboard its aircraft to a repair station, provided the damaged ULDs do not pose a hazard to the safety of flight. The procedures would include restraining the ULD as bulk cargo if necessary.

2.4.7.4.3 Address how frequently the operator or repair vendor should check ULD tare weights, and how it should mark updated tare weights on ULDs. The operator should manage control of ULD tare weights by documenting them and retaining the documentation using operator procedures.

2.4.7.5 Standards for Repair of ULDs. An operator should have procedures to ensure that:

2.4.7.5.1 Personnel who repair ULDs are trained, qualified, and authorized;

2.4.7.5.2 ULDs are repaired per the operator's maintenance program;

2.4.7.5.3 Parts for ULD repair meet or exceed equipment manufacturer standards, and are authorized by either the ULD manufacturer or the operator's processes using FAA-accepted data;

2.4.7.5.4 The appropriate current data is available to repair the ULD, including operator maintenance manuals, ULD manufacturer maintenance manuals, SBs, Airworthiness Directives (AD), ULD manufacturer CMMs, or other FAA-accepted data;

2.4.7.5.5 The tare weight of each ULD is checked using the operator's procedures;

2.4.7.5.6 The new tare weight is marked on each ULD using the operator's procedures; and

2.4.7.5.7 ULD and associated component or article repair is per part 43, whether the operator or a repair vendor performs the repairs.

2.4.7.6 Use of a Repair Station/Vendor to Repair ULDs.

2.4.7.6.1 An operator should provide its repair vendors with written authorization to repair its ULDs, and ensure the availability of all necessary data and manuals for repairing its ULDs.

2.4.7.6.2 An operator should conduct audits of contracted repair stations:

2.4.7.6.2.1 For the vendor's training program, and

2.4.7.6.2.2 To ensure repair stations comply with the operator's maintenance program requirements.

2.4.7.7 Returning a ULD to Service. An operator should have procedures for repairing unserviceable ULDs and approving them for return to service. As required by part 43, only appropriately trained and FAA-certificated personnel can return a ULD to service. Personnel should return ULD equipment to service under the requirements of the applicable CMM or operator instructions. FAA-certificated repair stations operating under 14 CFR part 145 should return ULDs to service using operator procedures.

2.4.7.7.1 An operator may use FAA-accepted data in place of the requirements of the manufacturer's CMM. An operator may also choose to strictly follow the manufacturer's maintenance procedures. Regardless, an operator should clearly state which data it uses in its manual system.

2.4.7.7.2 An operator should use its CASS to verify the performance and effectiveness of its CLS maintenance program and provide corrections to any deficiencies discovered in the program.

2.4.8 ULD and Restraint Damage Limits.

2.4.8.1 Identifying or Revising Damage Limits. It is important that the operator specify damage limits for ULDs and related restraint equipment. The operator may use the damage limits provided by the manufacturer or may develop its own damage limits, with FAA acceptance. If the operator develops its own damage limits, it should:

2.4.8.1.1 Establish a procedure for developing the new damage limits;

2.4.8.1.2 Provide the FAA with data to support its new damage limits; and

2.4.8.1.3 Obtain FAA acceptance before using the new damage limits.

2.4.8.2 Standardization of Damage Limits for ULDs. An operator may standardize damage limits for ULDs transported upon their aircraft. The operator doesn't need FAA approval if the operator applies the most restrictive damage limits categorized by the type of ULD. An operator publishing less restrictive damage limits should provide the FAA with engineering data to support its decisions.

2.4.8.3 Exceeding Allowable Damage Limits of a ULD. A container that exceeds allowable damage limits, with damage to its shell, may be accepted for use by installing an authorized net over the shell and using an authorized pallet/net combination. A reduced-weight requirement may be necessary when an operator uses this procedure. The operator should develop procedures for using the damaged ULD with a net.

2.4.9 Establishing Usage Limits for Cargo Straps. Cargo strap assemblies should be determined serviceable prior to use. If a cargo strap manufacturer does not provide damage limitations for their cargo straps, an operator should develop guidance to include, at a minimum, not using the strap if:

2.4.9.1 Buckle Latch Mechanism. A buckle latch mechanism will not lock or stay engaged. This allows the web to slip while under tension, or may result in the web binding or being out of alignment.

2.4.9.2 Mechanism Integrity. Attached mechanisms, fittings, hooks, and rings are bent, deformed, cracked, broken, or missing.

2.4.9.3 Webbing Integrity. Webbing is partially cut or torn, knotted, unraveling, or has loose or missing sewn stitches.

2.4.9.4 Environmental Conditions. The strap is deteriorated due to environmental conditions.

NOTE: TSO-C172 is available and outlines requirements for manufacturing new cargo restraint straps. Cargo restraint strap assemblies authorized under previous Technical Standard Order Authorization (TSOA) may still be manufactured under the provisions of its original approval.

2.4.10 Additional Procedures for Cargo Nets. If the operator owns or leases cargo nets, it should consider using additional procedures for cargo nets, such as:

- Assigning a unique marking or serial number to nets and placarding that marking or number on the nets;
- Placarding nets with their damage limits;
- Attaching an identification tag to the operator's nets; or
- Ensuring proper storage when not in use to prevent damage.

2.4.11 Temporary Installation of Restraints on a Cargo Net.

2.4.11.1 Installation Requirements. An operator may install temporary restraints on a cargo net if:

2.4.11.1.1 The temporary restraints are authorized for use;

2.4.11.1.2 The operator has a process in the manual system addressing the use and limits of temporary restraints; and

2.4.11.1.3 Personnel that install the temporary restraints are trained, qualified, and authorized.

2.4.11.2 Purpose. The operator may install temporary restraints for the purpose of addressing items such as:

2.4.11.2.1 Using a bridge strap to bridge cut or otherwise damaged ropes, or missing or damaged fittings;

2.4.11.2.2 Installing temporary fittings and hooks to compensate for damaged or missing fittings, using equipment manufacturer or operator procedures; or

2.4.11.2.3 Installing net corner and supplemental lashing lines.

2.4.12 Performing Operational Checks on ULDs or Other Cargo Restraint Devices. An operator should perform an operational check for damage before using ULDs and other restraint devices for movement or buildup, and should conduct a final serviceability check before loading cargo aboard the aircraft.

2.4.12.1 Purpose. Operational checks should not determine a ULD's airworthiness. Instead, they ensure the ULD or other restraint devices do not have obvious damage greater than their damage

limits. An operator should not use ULDs or other restraint devices with damage greater than damage limits specified.

2.4.12.2 Individuals Who May Perform Operational Checks. Although it is acceptable, FAA-certificated personnel don't have to perform operational checks. Operators should train, qualify, and authorize personnel to perform serviceability checks. Operator procedures should identify who performs these checks and when the checks are performed.

2.4.12.3 ULDs That Fail an Operational Check. An operator should have a procedure for clearly marking or identifying ULDs and other restraint devices that fail operational checks. The method for identifying failed equipment should clearly distinguish these items from serviceable equipment so the operator or cargo loading vendor does not inadvertently place failed equipment into service. A procedure should be in place for individuals to report damage to persons responsible for maintaining the ULD.

NOTE: The operator may correct clerical, data entry, or other errors of omission resulting in misidentifying or removing a ULD from service, and the ULD returned to service, provided the operator has a procedure in its manual system for identifying and correcting such errors.

SECTION 2.5. CARGO WEIGH SCALES

2.5.1 Responsibility for Ensuring the Weight of Loaded Cargo is Accurate. An operator must ensure the weight of cargo loaded aboard its aircraft is accurate, and may use tolerances established by scale equipment manufacturers or tolerances based on FAA-accepted data. The operator's W&B program should account for allowed tolerances to maintain certified W&B limitations.

2.5.2 Ensuring Weigh Scales are Accurate. An operator should have a program to periodically check the accuracy of scales used for weighing cargo. The operator should conduct a periodic functional check using the weight recommended by the scale manufacturer for a periodic functional check. As an alternative, use weights simulating a typical load placed on the operator's aircraft. Periodic function and calibration checks should be performed in accordance with the operator's procedures and timeframes. Frequent checks and periodic calibrations ensure an operator accurately weighs the cargo loaded on its aircraft.

2.5.3 Ensuring Weigh Scales are Calibrated. An operator should conduct periodic calibration of scales to ensure they are appropriately serviced and accurate to a known standard. Calibration records should show that scales are calibrated using a standard established by appropriate country, state, or local government regulations. Such standards could include the National Institute of Standards and Technology (NIST), an equivalent standard acceptable to the FAA, or standards recommended by the scale manufacturer.

NOTE: For more information on the standards provided by NIST, visit NIST's Web site at <http://www.nist.gov/>.

2.5.4 Maintaining Records of Calibration Checks. An operator should keep a record of its scale calibrations, with the following criteria:

2.5.4.1 The records should be in the English language. If the records are not in the English language, operators should have the records interpreted, when necessary. If the operator cannot provide an English language interpretation of operator records, that operator should allow those individuals using the scales to inspect the scales and perform a functional check onsite to ensure scale accuracy.

2.5.4.2 The operator should establish procedures to maintain the records.

2.5.5 Performing Functional Checks on Weigh Scales.

2.5.5.1 Procedures. An operator should have procedures to functionally check scales used for weighing cargo between scale calibrations. A functional check should consist of field-testing the scale's accuracy to within ± 1 percent with an item of known weight.

2.5.5.2 Frequency. At a minimum, the operator should ensure that functional checks are performed at intervals specified in (1) the operator's procedures, or (2) the scale manufacturer's recommendations. The operator also should conduct the functional checks at intervals

commensurate with the frequency of scale use, and conduct functional checks more often for scales used more frequently.

2.5.5.3 Recordkeeping. An operator should record completion of functional checks. The operator should maintain functional check records using accepted procedures. These records should include:

- 2.5.5.3.1 The identification number of the scale;
- 2.5.5.3.2 The date and time of the functional check;
- 2.5.5.3.3 The name or the initials of the person who performed the functional check;
- 2.5.5.3.4 The applied known weight of the item used for the functional check;
- 2.5.5.3.5 The scale's indication of the applied known weight; and
- 2.5.5.3.6 The difference between the applied known weight and the registered weight.

NOTE: If the registered weight recorded for the item of an applied known weight is outside the tolerances specified for the scale in the operator's procedures, the operator *should not* use the scale until the scale is inspected and calibrated.

2.5.6 Items for Which an Operator Should Know the Tare Weight. Authorized loading personnel weighing cargo on a scale, and using equipment such as dollies, slave frames, containers, and carts, should know the tare weight of this equipment and subtract this weight from the total weight to calculate the cargo weight. An operator should determine the tare weight of this equipment by weighing it on a calibrated scale.

2.5.7 Reweighing Loading Equipment for Tare Weight After Maintenance, Repair, or Modification. Immediately after any repair, maintenance, or modification of equipment such as dollies, slave frames, containers, and carts, the operator should provide a new tare weight by reweighing the equipment. Operators should establish a method to communicate new tare weights to loading personnel before using the equipment to weigh cargo on a scale. This method may be in the form of the operator communicating the tare weight by stenciling it on the equipment or by providing notices to operator loading personnel.

SECTION 2.6. OPERATIONS FOR CARGO HANDLING AND AIRCRAFT LOADING

2.6.1 Overview. This section explains how to apply the content in Section 4 to an operator's cargo operations.

2.6.1.1 Procedures. An operator should have procedures in its manual system for ULDs, cargo requiring unique or special handling, special cargo, cargo buildup, loading and unloading, and restraining cargo. The procedures should include bulk loading and unloading of cargo, both compartment-restrained and restrained by other devices, if the operator permits. The procedures should use the operator WBM and aircraft manufacturer/STC WBM.

2.6.1.2 Procedures for Authorized Restraint Devices. An operator should have specific procedures for cargo restraint devices it is authorized to use and a process to follow if failed restraints are identified while in use. Examples of these devices include installed nets, a CLS, certified ULDs, non-certified ULDs, and other restraints.

2.6.2 Operator Procedures on ULD Buildup and Cargo Restraint. An operator's procedures about ULD buildup and cargo restraint should address:

2.6.2.1 ULD CG Limits. Procedures should address maintaining longitudinal, lateral, and vertical CG limits of a built-up ULD. The operator should consider the following guidelines when developing the procedures:

2.6.2.1.1 Place sturdier, heavier, and larger cargo pieces on the bottom of the load and evenly distribute them over the length and width of the pallet base.

2.6.2.1.2 Place smaller, lighter, and fragile cargo pieces on top and evenly distribute them from the center over the length and width of the ULD.

2.6.2.1.3 Level off the cargo in the ULD when less than full.

2.6.2.1.4 Interlock or overlap small pieces when practical.

2.6.2.2 Voided Space in ULDs. To minimize voided space within a ULD and between cargo pieces, the operator should consider using the following:

2.6.2.2.1 Supplemental restraint devices to restrain cargo within a container when less than full; and

2.6.2.2.2 Dunnage in voided spaces.

2.6.2.3 Cargo Contours. The operator should have procedures about contouring cargo loads for the aircraft's interior dimensions when using a pallet/net combination, pallet/strap combination, or other restraint methods/devices. The operator should consider using techniques such as contour templates or charts. Also, the operator should consider procedures for operational conditions in which variance in contouring might occur. For example, variance in contouring might occur when forming an aisle to access hazmat or to ensure the integrity of a particular load. The operator also should account for height restrictions if required by the TC/STC WBM.

2.6.2.4 ULD Identification Tags. The procedures should include tags to identify ULDs loaded aboard operator aircrafts, especially when using pallet/net or pallet/strap combinations; their identification is not always visible. The operator may use electronic tagging if it is authorized by an STC or other FAA-authorized means for the particular aircraft.

NOTE: Electronic tagging may present a concern about interference with onboard avionics equipment. The operator should ensure that if it carries electronically tagged ULDs, they are FAA approved for use on the particular aircraft on which the ULD is loaded. Refer to the current edition of AC 20-162, Airworthiness Approval and Operational Allowance of RFID Systems.

2.6.2.5 ULD Weight Limits. The operator should include procedures so that cargo does not exceed ULD gross weight or area load limits if stated by the ULD manufacturer.

2.6.2.6 Serviceability Checks. The procedures should include checking the condition of ULDs and other restraint devices for damage before using them, conducting serviceability checks to ensure noted damage does not exceed damage limits, and a process to follow if failed restraints are identified while in use. The operator should base serviceability checks on information from (1) the equipment manufacturer, (2) the STC, or (3) other data acceptable to the FAA.

2.6.2.7 Fastening Container Components. The operator's procedures should address the correct method of positive closure and locking of container nets, curtains, and rigid or flexible doors after buildup. The operator should base these procedures on information from (1) the container manufacturer, (2) the STC holder, or (3) another source with information acceptable to the FAA.

2.6.2.8 Fastening a Cargo Net to a Pallet. The operator's procedures should address how to fasten a cargo net to a pallet properly after buildup. The operator should base these procedures on information supplied by the pallet/net manufacturer or the STC holder.

NOTE: Personnel whose job functions include determining compatibility of pallet and net combinations (per operator's procedures), pallet and airframe compatibility, and cargo restraint device (e.g., intermixing straps) should have training in these areas.

2.6.3 Operator Procedures on Cargo Loading and Unloading. An operator's procedures about aircraft loading and unloading should address:

2.6.3.1 Sill Guards (if applicable). The operator's procedures should detail using, attaching, and detaching these devices. If an operator stows sill guards in the aircraft when they are not in use, the procedures should include the proper stowage in the aircraft.

2.6.3.2 Tail Posts (if applicable). The operator's procedures should address using a nonstructural device called a tail post if the operator needs it to measure the distance between the aircraft's tail section and the ground during loading and unloading. Procedures should include instructions on attaching, detaching, and using it. If an operator stows the tail post in the aircraft when not in use, the procedures should include the proper stowage in the aircraft.

2.6.3.3 Tail Stands (if applicable). The operator's procedures should address using a structural device called a tail stand if the operator needs it to prevent the aircraft from settling on its tail during loading and unloading. The procedures should include instructions on attaching, detaching, and using it.

2.6.3.4 Tail Tipping Avoidance. The operator's procedures should address methods to prevent the aircraft from tipping on its tail during loading and unloading. Examples of these methods include step loading and unloading of cargo, or nose gear tethering.

2.6.3.5 Aircraft Doors, Nets, and Smoke Barriers. The operator's procedures should address the proper use of cargo compartment and bulkhead doors, installed nets, and smoke barriers.

2.6.3.6 Aircraft Floor and ULD Base Load Limits. The operator's procedures should address the aircraft's floor load limits if the operator loads cargo directly onto the aircraft's floor. These limits can be expressed as area load or linear/running load limits. The procedures also should address floor load limits for a ULD base if the ULD manufacturer has a limit. Operators should base these procedures on information from (1) the aircraft manufacturer or (2) an STC WBM or supplement. The procedures should address how to distribute, or shore, cargo weight greater than a floor load limit. For more information, see paragraph 2.6.7, Procedures for Cargo Shoring.

2.6.3.7 Aircraft Weight Limits. The operator's procedures should address the weight limits for aircraft cargo positions, floors, zones, and compartments, and measures to ensure the operator does not exceed them. The operator should base these limits on information from (1) the aircraft manufacturer or (2) STC WBM or supplements.

2.6.3.8 Aircraft CG Range Limits. The operator's procedures should address the CG range limits for the aircraft, and longitudinal, lateral, and vertical CG limits for cargo positions. The procedures also should prevent an operator from exceeding these limits. The operator should base these procedures on information from (1) the aircraft manufacturer or (2) STC WBM or supplements.

2.6.3.9 Cargo Access Aisle. The operator's procedures should address a method for creating a flightcrew access aisle to cargo requiring access during flight. Examples of cargo requiring such access includes certain hazmat or live animals.

2.6.3.10 Aircraft Damage Avoidance. The operator's procedures should prevent damage during loading and unloading to the cargo handling system, cargo liners, smoke detectors, light fixtures, fire retardant flow nozzles, and similar devices.

2.6.3.11 Aircraft Damage Notification. The operator's procedures should notify flightcrew members or authorized maintenance personnel of a damaged, missing, or inoperative cargo compartment, cargo handling system, installed net, or smoke barrier and related components. These procedures should include a general guideline or list of what specific items cargo loaders should report to flightcrew members or authorized maintenance personnel, such as holes in the cargo compartment liner, and damaged or missing cargo handling system restraints and rollers, and installed nets and smoke barriers.

2.6.3.12 Cargo Clearance. The operator's procedures should detail the minimum clearance, or distance, requirements between cargo and airplane systems and structure (e.g., cargo compartment liners, light fixtures, fire suppression systems, and smoke detectors.).

2.6.3.13 CLS. The operator's procedures should describe how to use the aircraft's CLS to restrain ULDs. The operator must engage all CLS restraints for loading ULDs and in voided positions. Engaging cargo restraints in voided positions prevents cargo shift resulting from floor lock failure.

NOTE: Only FAA-certificated personnel may adjust CLS components by physical removal and reinstallation. Trained, qualified, and authorized loading personnel may adjust or reposition a component if it is part of the operational instructions of the CLS.

2.6.3.14 Bulk Loaded Cargo. The operator's procedures should properly load bulk cargo in cargo compartments and pods certified for bulk cargo. The operator must not bulk load cargo in a cargo compartment or pod unless the aircraft manufacturer's WBM or STC authorizes it, and unless it is included in the operator manual system. If the aircraft manufacturer's WBM or STC doesn't contain enough detail for bulk loading cargo, the operator should establish procedures to ensure the safety of flight that address:

2.6.3.14.1 Cargo Clearance. The minimum clearance, or distance, requirements between cargo and airplane systems and structure (e.g., light fixtures, smoke detectors, etc.).

2.6.3.14.2 Load Distribution. Evenly distributing, or spreading, the cargo within compartments and pods over their length, width, and height.

2.6.3.14.3 Aircraft Nets. Properly using installed nets.

2.6.3.14.4 Aircraft Smoke Barriers. Properly using installed smoke barriers between cargo and flightcrew members and passengers.

2.6.3.15 Cargo Requiring Special Handling Procedures. Some cargo may require additional or unique procedures to protect cargo or the aircraft during handling, acceptance or loading, or in flight. Examples of special handling procedures include ceremony or instructions for transporting human remains, feeding live animals in transit, signature service forms for tracking mail/cargo, compatibility with hazmat, protective gear when handling cryogenics, etc. The operator's procedures should address cargo loads requiring special handling, which may include the following:

2.6.3.15.1 Offset cargo;

2.6.3.15.2 Overweight cargo;

2.6.3.15.3 Overhanging cargo;

2.6.3.15.4 Outsized cargo;

- 2.6.3.15.5 Sharp or piercing cargo;
- 2.6.3.15.6 Crated heavy machinery;
- 2.6.3.15.7 Reels or spools;
- 2.6.3.15.8 Motor vehicles and other wheeled cargo;
- 2.6.3.15.9 Tall cargo;
- 2.6.3.15.10 Rigid cargo;
- 2.6.3.15.11 Tall rigid cargo (TRC);
- 2.6.3.15.12 Cargo not fully restrained by the CLS;
- 2.6.3.15.13 Human remains;
- 2.6.3.15.14 Foodstuff, feed, and postal mail;
- 2.6.3.15.15 Hazmat (in compliance with 49 CFR and 14 CFR part 121, Subpart Z);
- 2.6.3.15.16 Active ULDs (FAA-approved);
- 2.6.3.15.17 Temperature control ULD containers (FAA-approved); and
- 2.6.3.15.18 Live animals:

2.6.3.15.18.1 Small animals, such as mice, rats, dogs, and cats, typically shipped in self-contained boxes or containers and typically loaded with other cargo in bulk compartments and ULDs. The procedures should address measures to:

- Reduce the risk of animals escaping from containers while in the aircraft.
- Identify animals that have escaped from their containers in the aircraft.
- Remove escaped animals from the aircraft.

2.6.3.15.18.2 Large animals, such as horses and cattle typically shipped in special containers, stalls, or penning systems that are STC approved or approved by other FAA means. The procedures should address measures to:

- Verify that special containers, stalls, or penning systems are compatible and authorized for the aircraft.
- Ensure special containers, stalls, or penning systems are properly installed in the aircraft.
- Protect the aircraft from damage by animal waste, such as urine or solid waste.
- Manage out-of-control animals in the aircraft.
- Remove animal waste from the aircraft.

NOTE: Under 14 CFR part 382, the Department of Transportation (DOT) makes a distinction between service animals, such as seeing-eye dogs, and animals kept as cargo, such as pets. Under part 382, an animal that a passenger can properly identify as a service animal must accompany the passenger at the passenger's seat. The operator should treat animals not classified as service animals under part 382 as pets and handle them as a special cargo load as discussed above.

NOTE: Under 14 CFR part 234, the term "animal" is defined as a warm- or cold-blooded animal that, at the time of transportation, is being kept as a pet in a family household in the United States. In this AC, "live animals" refers to all animals transported as cargo, regardless of whether they are kept as pets as defined in part 234. The operator should review incident reporting requirements of part 234, § 234.13.

2.6.3.15.19 ULDs;

2.6.3.15.20 Special cargo; and

NOTE: Cargo requiring special handling procedures is a separate but related concept to special cargo. See Section 2.8 for more information and to assist in identifying when one of the *cargo requiring special handling* examples listed above is classified as special cargo.

2.6.3.15.21 Radio Frequency Identification (RFID) cargo.

2.6.4 Use of Cargo Restraint Devices Other Than ULDs. An operator may use other restraint devices as the primary restraint of cargo if authorized by (1) the aircraft manufacturer WBM or (2) STC supplementary WBM. The authorizing document should include serviceability limits, operational and repair procedures, and meet the flammability requirements of part 25.

2.6.5 Procedures for Use of Primary Restraint Devices Other Than the CLS. If an operator uses straps and other restraint devices as primary cargo restraints, it should have procedures for their use. These procedures must be based on the information provided by (1) the aircraft manufacturer or (2) STC holder. These procedures should address:

2.6.5.1 Installing straps or other restraint devices to aircraft structure to include the CLS (e.g., floor tracks, rings, and hardware). An operator should emphasize in its procedures that reduced load limits and minimum separation requirements may exist between tiedown points if using the same aircraft floor track, ring, or hardware for multiple tiedowns. Operators must address minimum tiedown separation requirements for pallets so it does not overstress the aircraft floor attachments. Reference aircraft manufacturer prohibitions.

NOTE: Intermixing cargo restraint devices made of different materials is not recommended.

2.6.5.2 Calculating other restraint devices for a given cargo load based on the restraint criteria in the aircraft's WBM.

2.6.5.3 Calculating the number of straps or restraint devices required based on the device's rated strength and limiting factors specified in the aircraft WBM or its supplement. The manufacturer's WBM or its supplement may require strength reductions of the strap or other restraint devices based on limiting factors such as aircraft sidewall or floor angles and the strength of attachment hardware.

NOTE: The best method to determine the effectiveness of a strap or other restraint devices is that the reaction to load must be in the same direction as force is applied. Consideration should be given to strap installation angle and resulting reduction in available restraint.

2.6.5.4 Properly arranging straps or other restraint devices around the cargo or attached to the cargo. Instructions should include correctly cinching adjacent net panels together with a net corner lashing rope and secure the end of the rope to the net panel to prevent disengagement.

2.6.5.5 Restraining cargo using the aircraft's ultimate load conditions described by the manufacturer's WBM or its supplement. The operator should consider that these devices must provide restraint in the forward, aft, vertical, and lateral directions.

NOTE: The FAA does not recommend that an operator tie multiple pieces on a pallet with straps or other restraint devices without an approved TSO net encompassing the load. Cargo, because of its size, condition, or shape that cannot be netted, must be classified and transported as special cargo.

2.6.6 Operator Procedures for Supplemental Cargo Restraint Devices. If the operator uses other restraint devices as supplemental cargo restraints, it should have procedures for their use. These procedures should be based on the information provided by (1) the aircraft manufacturer, (2) the STC holder, or (3) other sources acceptable to the FAA. These procedures should address:

- Using and attaching other restraint devices to the aircraft's installed seat track, tiedown track, and/or tiedown rings (See Section 2.8);
- Using and attaching other restraint devices to the pallet base tiedown track of commercial pallets according to the ULD manufacturer requirements and rings of military pallets; and
- Properly arranging other restraint devices around the cargo or attached to the cargo.

NOTE: The operator should use care when positioning straps on cargo to prevent contact with sharp edges or irregular surfaces. The strap must not be prone to slippage from its intended position on cargo, and the operator should engage the lock mechanism so the strap is taut without being over-tightened.

2.6.7 Procedures for Cargo Shoring. Aircraft floors and some pallet bases have a load bearing weight limit, also called a floor load limit. Shoring is a technique to distribute the weight of a cargo piece over a larger area greater than its original load bearing area, which is also called

a footprint or contact area. Cargo pieces heavier than a load bearing weight limit require shoring. The operator should have procedures describing:

- Materials acceptable for use in shoring, such as wood planks or plywood;
- Calculations or methods for determining the amount and thickness of shoring materials; and
- Methods for applying shoring material to the cargo piece.

2.6.8 Blocking and Bracing Techniques. An operator may need to stabilize cargo pieces such as large cable reels, motor vehicles, wheeled cargo, and odd-shaped cargo to prevent shifting during loading, unloading, and flight conditions. The operator should use blocking and bracing techniques to stabilize such cargo pieces. The operator's procedures should describe:

- Acceptable materials for blocking and bracing;
- Calculations or methods for determining the amount and thickness of blocking and bracing materials; and
- Methods for applying blocking and bracing materials to the cargo piece.

2.6.9 Frangible (Compressible) Cargo. Frangible cargo may be required in certain positions for protection of the aircraft, occupants, and its ability to withstand emergency landing conditions, as required by the aircraft manufacturer W&B document. An aircraft manufacturer's W&B document varies on this definition, therefore, you should reference their document prior to developing procedures.

2.6.10 Cargo Loading Procedures for Combi-Configured Aircraft. Aircraft configured for carrying passengers and cargo on any deck such as combi-configured aircrafts, may require special cargo loading procedures. The operator should have special procedures to load such aircraft, and these special procedures should be based on requirements established by the aircraft manufacturer or STC holder.

SECTION 2.7. LOAD SUPERVISION, LOAD VERIFICATION, AND OPERATOR AUDITS

2.7.1 Supervising Cargo Loading. An operator should designate a trained, qualified, and authorized person or persons with the duty of supervising the loading of the aircraft, such as a load supervisor, to ensure:

- All cargo is properly built up and weighed;
- Vendor's cargo scales have current calibration certificates;
- Planning and calculation of cargo and passenger placement maintains the aircraft within permissible CG and structural load limits;
- Cargo is properly secured with the appropriate type(s), quantity and placement of cargo restraint, and all pallet locks are engaged when used;
- The aircraft is correctly loaded and unloaded using the operator's procedures;
- Cargo is placed on the aircraft in such a way as to prevent overloading sensitive sections of the airframe and cargo floor;
- CLS, ULDs, and other restraint devices are in serviceable condition and properly used;
- Standard average weight or actual baggage weights are confirmed (refer to AC 120-27);
- Flightcrew members or authorized maintenance personnel are notified of damaged, missing, or inoperative cargo compartments, CLSs, installed cargo nets, or smoke barrier components;
- All cargo-related documents are accurate and properly completed before submission to flightcrew members; and
- The load manifest is signed by a trained, qualified, and authorized person.

NOTE: Operators may use different terminology to identify person who has the duty of supervising the loading of aircraft or the load supervisor function, such as loadmaster, load lead, and load chief. The load supervisor may physically load the aircraft, but primarily supervises loading crews and procedures.

NOTE: The signature of the person supervising the load, on the load manifest, indicates the aircraft is loaded correctly.

2.7.2 How to Verify Cargo was Loaded Properly. Operators should designate personnel to provide information to (1) the PIC, or (2) the operator's authorized, trained, and qualified loading personnel, about how the aircraft was loaded. The designated loading personnel may provide loading information on one or more forms or documents, and may present it in hardcopy or electronic form. They may include additional information and certifications based on operator-specific requirements for cargo, such as hazmat, live animals, or special cargo. Operators should note that this information does not impact the requirements for a load manifest per § 121.665.

2.7.3 Information Needed to Verify Cargo is Loaded Properly. The information indicating that cargo is properly loaded should include:

2.7.3.1 The flight date.

2.7.3.2 The flight number.

2.7.3.3 The aircraft registration number.

2.7.3.4 The origin of the flight leg.

2.7.3.5 The destination of the flight leg.

2.7.3.6 The ULD numbers (for cargo carried in ULDs).

2.7.3.7 The weight of each ULD loaded aboard the aircraft.

2.7.3.8 The weight of the bulk cargo, by compartment or position, as applicable.

2.7.3.9 The load schematic for special cargo.

2.7.3.10 A certification statement verifying that:

2.7.3.10.1 All ULD locks are up;

2.7.3.10.2 All installed nets or smoke barriers are properly attached;

2.7.3.10.3 All ULDs loaded are in an operational condition;

2.7.3.10.4 All cargo was loaded using operator cargo loading procedures;

2.7.3.10.5 Tail stand or post was removed, as applicable; and

2.7.3.10.6 All cargo was loaded aboard the aircraft as depicted on the load plan form, verification form, or other similar documents.

2.7.3.11 The signature, or electronic equivalent, of the load supervisor or other authorized, trained, and qualified loading personnel.

2.7.4 Maintaining Records of Cargo Loading Verification Information. Operators must have procedures to retain a completed and signed copy, or electronic equivalent, of the document(s) containing the information listed in paragraph 2.7.3 above with the load manifest, per § 121.695 or § 121.697, as applicable.

2.7.5 Performing Cargo Buildup and Loading Audits. Operators should have a program acceptable to the FAA for periodic audits of cargo planning, building, and loading. The audits should be of sufficient scope and frequency to ensure that all cargo handling personnel are following operator's cargo procedures. (See Section 2.2, Operator's Evaluation System for W&B Control.

SECTION 2.8. TRANSPORT OF SPECIAL CARGO

2.8.1 What is Special Cargo? Cargo that is not contained in a ULD certified for the airplane CLS or enclosed in a cargo compartment certified for bulk loading is special cargo. This type of cargo requires special handling and securing/restraining procedures.

2.8.2 Special Cargo Analysis Function (SCAF). The operator should identify a person who has overall responsibility for the SCAF. Operators should develop policies and procedures for the identification, acceptance, and carriage of special cargo. If an operator carries special cargo, it must comply with the TC/STC WBM. Operators should use the SCAF to determine if the cargo is indeed special cargo, evaluate associated risks, and develop a plan to ensure a safe flight using TC/STC WBM data. The operator should ensure participants are trained, qualified, and authorized to perform functions listed below in paragraph 2.8.3.

2.8.2.1 Person with Overall Responsibility. Examples of a person with overall responsibility of the SCAF that do not require the technical expertise of SCAF functions may be:

- 2.8.2.1.1 Director of Safety (DOS);
- 2.8.2.1.2 Chief pilot;
- 2.8.2.1.3 Director of Operations (DO); or
- 2.8.2.1.4 Director of Maintenance (DOM);

2.8.2.2 SCAF Participants. Examples of SCAF participant(s) who will require technical expertise in SCAF functions may include:

- 2.8.2.2.1 Loadmaster;
- 2.8.2.2.2 Engineering; or
- 2.8.2.2.3 Other trained and qualified persons.

2.8.3 Procedures for Planning a Special Cargo Transport. The operator should develop policies and procedures for transporting special cargo. Procedures must be based on approved data from the aircraft manufacturer/STC WBM.

2.8.3.1 SCAF Responsibilities. Based on the operator's procedures, the SCAF will:

2.8.3.1.1 Evaluate Cargo Transport. Determine the aircraft's ability to safely transport the cargo without causing structural damage. Evaluate the cargo and identify its tiedown capabilities. Take into account the special handling needs, placement of special cargo, weight limits, floor loads, and cargo clearance. See paragraph 2.8.4, which provides characteristics associated with special cargo in assisting the SCAF in determining special cargo.

2.8.3.1.2 Determine Restraint. Provide a method to determine the appropriate quantity and types of restraint, shoring, and arrangement confirming the determination of the

load's restraint capability in each direction. The operator should demonstrate that the orientation secures the load for all aircraft operations. Restraint loads must not exceed the rating of cargo tiedown points, pallet tiedown fittings, or aircraft structure. The operator should also demonstrate restraints are distributed in accordance with the airplane/STC WBM.

2.8.3.1.3 Construct a Load Schematic. Construct a diagram/pictorial schematic based on FAA-approved airplane WBM/supplement. The schematic should:

2.8.3.1.3.1 Illustrate restraint calculations and a proposed tiedown scheme for each special cargo item.

2.8.3.1.3.2 Include the number and angle of restraints and the attachment points from the special cargo to the aircraft structure confirming the determination of the load's restraint capability in each direction.

2.8.3.1.3.3 Illustrate the position of all pieces of special cargo in relation or adjacent to the CLS and all other cargo having special requirements resulting from the carriage of the special cargo. Refer to Appendix H, Example Proposed Tiedown Scheme.

NOTE: The special cargo tiedown scheme will comply with the FAA-approved airplane WBM/supplement and can be incorporated into the operator's manuals. A separate load schematic will not be necessary for the items incorporated in the operators' manuals. However, when using this procedure, the operator should reference the manual and page number on a cargo loading document and retain it with load manifest.

2.8.3.2 Operator's Responsibilities. The operator should:

2.8.3.2.1 Loading. Make load schematic and any necessary instructions available to the loadmaster, load supervisor, ground personnel, and flightcrew, as appropriate. Documents should be made available to those personnel involved with, or responsible for, the loading and securing of cargo.

NOTE: The operator should ensure that persons with the duty of supervising the cargo loading utilizes schematic and instructions during cargo loading.

2.8.3.2.2 Record Retention. File the load schematic as outlined above in subparagraph 2.8.3.1.3 with the load manifest.

2.8.4 Characteristics Associated with Special Cargo. Anytime restraint is attached directly to the aircraft floor, the cargo should be classified as special cargo. This includes supplemental restraints because it creates parallel load paths. The acceptance of special cargo requires a determination that the loading and restraint capabilities of the airframe and associated restraint devices provide compliance with all limitations contained in the FAA-approved TC/STC, AFM, and WBM. The operator should have procedures to determine if the cargo is indeed special cargo. The following list contains examples of characteristics to help make this determination:

2.8.4.1 Offset Cargo. Cargo positioned on the pallet in a manner that the cargo is shifted beyond the perimeter of the pallet resulting in either 1) the CG limits of the pallet being exceeded, or 2) the restraint by the net to the pallet becoming ineffective in protecting the aircraft and preventing cargo shift. A reason for offsetting the cargo could be to meet aircraft clearance requirements. Offset cargo is special cargo.

2.8.4.2 Overweight Cargo. Cargo that exceeds the maximum allowable weight as defined by the aircraft WBM for aircraft ULD position.

2.8.4.3 Overhang Cargo. Cargo that extends beyond the perimeter of the pallet in at least one direction but still allows the net to perform its intended function. The pallet can still be restrained by the CLS and does not require additional straps to the aircraft structure.

2.8.4.4 Outsized Cargo. Cargo that exceeds the maximum allowable contour of an aircraft ULD such that the ULD must be loaded on board an aircraft as a non-CLS restrained ULD.

2.8.4.5 Sharp or Piercing Cargo. Cargo of a piercing or penetrating nature, or cargo with sharp edges or corners, such as rods, pipes, extrusions, or beams, that could become a projectile hazard during flight operations.

2.8.4.6 Unusually Shaped Cargo. Cargo that is irregular in nature, such as crated heavy machinery, reels, spools, compressed springs, and actuators. Risks associated with these items include:

2.8.4.6.1 Can roll and shift during transportation due to their shape;

2.8.4.6.2 Hard to lift and move without damaging the edges;

2.8.4.6.3 Can be bundled together and require blocking and bracing techniques to prevent cargo shift;

2.8.4.6.4 Can become projectiles if not handled and secured properly; and

2.8.4.6.5 The weight is concentrated in a very small area and often exceeds the floor-bearing weight capacity of the aircraft.

2.8.4.7 Motor Vehicles and Other Wheeled Cargo. Motor vehicles and other wheeled cargo with heavy weights represent a higher hazard and should be systematically handled with reinforced precautions, checks, and cross-checks, to include:

2.8.4.7.1 Fuel levels,

2.8.4.7.2 Load shoring and restraint,

2.8.4.7.3 Blocking and bracing (chocking) wheels to restrict movement, and

2.8.4.7.4 Tiedown attachment points.

2.8.4.8 Tall Cargo and TRC. Currently, TRC only applies to the B-747. Tall cargo is cargo greater than 98 inches tall. Certain sections of tall cargo can be frangible and certain sections can be rigid. If any part of the rigid section of tall cargo is above 98 inches, the tall cargo is TRC. If the entire rigid section of tall cargo is at or below 98 inches, the tall cargo is not TRC. It is the responsibility of the operator to determine if cargo is tall cargo or TRC.

2.8.4.9 Cargo Not Restrained by the Aircraft CLS. Cargo not fully engaged by the cargo loading restraint system but secured to the aircraft structure. Cargo not fully restrained by the aircraft CLS becomes special cargo.

2.8.4.10 Cargo Using a Sandwich Pallet. A sandwich pallet is the practice of placing a pallet on top of another pallet for various reasons such as additional shoring, the upper pallet being damaged, or when stacking empty pallets. In some cases, wood (skid or plywood) is placed in between the pallets. In all cases, the upper pallet becomes cargo. A base pallet that is not secured by the CLS is special cargo.

2.8.4.11 Floating Pallet. ULD positioned over one or more pallet position and not fully restrained by the aircraft CLS, but restrained to the aircraft structure by means of strapping to tiedown fittings. Floating pallets are special cargo.

SECTION 2.9. USE OF MULTIPLE ENTITIES

2.9.1 Interlining. Interlining is considered when cargo is transferred from one operator to another, whether using the same or different aircraft types. The receiving operator must ensure that all cargo being transferred is acceptable and capable of transportation on the receiving operator's aircraft.

2.9.1.1 Procedures an Operator Should Have for Interlining. The operator should develop standards for accepting cargo in accordance with their policies and procedures, which include, at a minimum:

2.9.1.1.1 Cargo check (visual examination) including serviceability of ULDs;

2.9.1.1.2 ULD compatibility with aircraft (see paragraph 2.4.6, Determining ULD Compatibility); and

2.9.1.1.3 Special cargo verification and validation, if applicable.

2.9.1.2 Using Vendors to Interline or Build Up Cargo. The use of third parties, foreign and/or domestic, reduces the need for the operator to employ personnel or to contract directly for interlining built-up cargo, aircraft loading, unloading, and cargo handling at a particular location. See Appendix C, Definitions Related to Air Cargo Operations, and paragraph 2.9.2, Vendors, for additional information on vendors.

2.9.2 Vendors.

2.9.2.1 Vendors Performing ULD Handling or Buildup.

2.9.2.1.1 As previously mentioned, the operator is ultimately responsible for the security of the cargo and safety of flight. There are multiple entities involved in the movement of cargo. Examples of these entities include shippers, vendors, freight forwarders, contractors, subcontractors, customs brokers and service providers. All play a role in the air transportation of cargo, and these roles may include cargo buildup, freight staging, cargo loading, and tiedown. Vendors performing ULD handling or buildup must ensure that:

2.9.2.1.1.1 Requirements are met in accordance with the instructions of the operator;

2.9.2.1.1.2 Sufficient and proper ULD storage capacity is available for all units handled;

2.9.2.1.1.3 All staff and supervising staff receive training appropriate to the tasks performed; and

2.9.2.1.1.4 Full access is guaranteed to enquiries or audits from the operator's quality control (QC) departments.

2.9.2.1.2 An operator should have a system in place to perform audits of a vendor at regular time intervals.

2.9.2.2 Operator Program for Vendors to Use in ULD Buildup or Loading. Given that it is common practice for an operator to carry cargo loads that vendors have built up or loaded, an operator should have a program that ensures vendors perform cargo buildup and loading using the operator's procedures. Under such a program, an operator should have procedures to:

2.9.2.2.1 Train a vendor employee to train other vendor employees (train-the-trainer method), or accept the vendor's training program and procedures provided they meet or exceed the standards established in the operator's training program and procedures.

2.9.2.2.2 Designate a trained, qualified, and authorized person to oversee the vendor services to ensure the vendor performs the services in accordance with the operator procedures.

2.9.2.2.3 Audit vendors for compliance with operator procedures and training programs.

2.9.2.2.4 Have a recordkeeping system to track all trained individuals, including vendors, in cargo operations that are authorized, qualified, and trained by the operator.

NOTE: All cargo built by authorized, trained, and qualified personnel must meet operator standards before being loaded.

2.9.3 Freight Forwarding. An operator may engage with other companies such as freight forwarders for organized shipment of cargo. An operator should have a system in place to perform audits of a freight forwarder at regular time intervals.

2.9.4 Responsibility for Multiple Entities. The FAA recognizes it is common practice for multiple entities to perform different services associated with air cargo operations but the operator is always ultimately responsible for cargo loading and securing and safety of flight. Therefore, the operator should ensure multiple entities are trained, qualified, and authorized to perform duties, audit third party operations, and ensure adherence to the operator's procedures, when applicable.

SECTION 2.10. FREIGHT STAGING

2.10.1 Staging Cargo at Different Operating Locations. An operator may engage in the process of staging cargo at different operating locations. When storing or staging cargo, the operator should ensure the following:

- Proper security of all cargo is maintained;
- Proper special handling of cargo is provided;
- Proper storage of cargo that is also safe from natural elements;
- Appropriate climate control for cargo is provided, if applicable (e.g. refrigerated); and
- Proper documentation of all cargo is maintained.

2.10.2 Transporting Stored/Staged Cargo. Prior to loading the aircraft, the operator should ensure when transporting cargo that has been stored or staged, an acceptance check is performed to ensure:

- Documentation and cargo weights are accurate;
- Cargo is clear of debris such as sand, snow, or water; and
- Cargo meets Transportation Security Administration (TSA) and Customs clearance requirements.

SECTION 2.11. CHECKLISTS AND JOB AIDS

2.11.1 Using Checklists and Job Aids. The operator should develop a system when performing tasks to incorporate controls as part of their processes and procedures. In other words, checks and restraints are designed into a process to ensure a desired result. This could be a checklist or job aid. For example, a loading checklist or job aid and predeparture checklist or job aid may be used together to positively verify that the condition, weight, and sequencing of each pallet is correct for each loaded position on the aircraft. Examples of checklists and job aids with related items (not all inclusive) to accomplish this may include the following:

2.11.1.1 Cargo Acceptance:

2.11.1.1.1 Documentation;

2.11.1.1.2 Visual check;

2.11.1.1.3 Special cargo (Contact SCAF); and

2.11.1.1.4 Hazmat (See Hazardous Materials Acceptance Checklist).

2.11.1.2 ULD Serviceability:

2.11.1.2.1 Receiving check; and

2.11.1.2.2 Damage limits.

2.11.1.3 Cargo Buildup:

2.11.1.3.1 CG;

2.11.1.3.2 Cargo contour; and

2.11.1.3.3 Marking and labeling.

2.11.1.4 Aircraft Pre-loading, Loading, and Unloading:

2.11.1.4.1 Pre-loading: Visual check of CLS for broken missing components;

2.11.1.4.2 Loading: Adequate restraint used to secure cargo; and

2.11.1.4.3 After loading: Check that all locks are in the up position.

2.11.1.5 Flightcrew Predeparture and Post-Flight Cargo:

2.11.1.5.1 Final check that cargo is secured properly;

2.11.1.5.2 Load manifest signed and supporting documentation available; and

2.11.1.5.3 After flight, were any broken restraint devices identified?

2.11.1.6 Hazmat:

2.11.1.6.1 Hazardous Materials Acceptance Checklist accomplished; and

2.11.1.6.2 Notification to PIC.

2.11.1.7 Live Animal: Dry ice not compatible with live animal.

2.11.1.8 Special Cargo:

2.11.1.8.1 SCAF; and

2.11.1.8.2 Cargo restraint schematic.

2.11.1.9 Vehicle Inspection:

2.11.1.9.1 Leaking fluids; and

2.11.1.9.2 Gas tank levels.

2.11.1.10 Station Audit:

2.11.1.10.1 Documentation;

2.11.1.10.2 Training records;

2.11.1.10.3 Scale calibration;

2.11.1.10.4 Operators manuals; and

2.11.1.10.5 Vendor audits.

SECTION 2.12. OPERATOR'S EVALUATION SYSTEM FOR W&B CONTROL

2.12.1 Overview. An operator should establish and maintain a closed-loop system for the continuing analysis, evaluation, and surveillance of the performance and effectiveness of its W&B control program. The closed-loop system should include at least: surveillance, root cause analysis, corrective action, and followup. This system periodically monitors the performance and effectiveness of the W&B control program, which includes cargo operations, to ensure constant compliance. (These elements can be found in the current edition of AC 120-79, Developing and Implementing an Air Carrier Continuing Analysis and Surveillance System.) Operators can add this system to their CASS or they can develop their own closed-loop system.

NOTE: This is a shared responsibility between operations and maintenance roles. A process should be in place to ensure that the operator reports and tracks this information to the CASS or similar parallel closed-loop system.

2.12.2 System List. The system should define how and when the operators/applicants audit the W&B cargo operation control system to include, at a minimum:

- Aircraft loading;
- Cargo buildup;
- Carriage of Special Cargo;
- Vendors;
- Personnel training;
- Freight forwarders; and
- CLS.

2.12.3 System Performance. System performance should be monitored to include such items as load plans, load manifests, aircraft configuration changes, cargo loading and restraint system performance (e.g., broken straps identified after use in flight and in-flight shift of cargo), and human factors issues with loaders, load supervisors, and vendors.

2.12.4 System Effectiveness. System effectiveness should be monitored to identify the reliability of the overall performance for cargo operations.

SECTION 2.13. TRAINING PROGRAMS

2.13.1 Training Programs. Operators should develop a cargo operations and W&B training programs. Training should explain employee functions (commensurate to their tasks and responsibilities), and express expectations of job duties and responsibilities according to the operator's procedures. An operator should have procedures to train its employees, managers, and vendors to its standards, as applicable. Personnel performing cargo operation functions must be trained, qualified, and authorized, as defined in the operator's manual. This training must be easily identified by documentation in training records and authorization documents readily available.

2.13.2 Training Program Components. The operator's training program should include:

2.13.2.1 A curriculum acceptable to the FAA.

2.13.2.2 Procedures for maintaining training records using the operator's policy or applicable regulations.

2.13.2.3 Recurrent training requirements and intervals not to exceed 24 months.

NOTE: In accordance with part 121 regulatory requirements, pilots and aircraft dispatchers require recurrent W&B training every 12 calendar-months.

2.13.2.4 A description of the training program methods. The program may consist of one or more of the following methods:

2.13.2.4.1 Classroom sessions;

2.13.2.4.2 On-the-job training (OJT);

2.13.2.4.3 Computer-based training (CBT); or

2.13.2.4.4 Other training methodologies operators consider appropriate;

2.13.2.5 A periodic review and update of the program.

2.13.2.6 Proper identification of employees authorized to provide the training.

2.13.2.7 General awareness and familiarization with hazmat training.

2.13.2.8 Content, application, and use of OEM/STC WBM's (source documents).

2.13.3 Identifying Individuals Who Need Training. An operator should have procedures to properly identify those individuals who need training. An operator should provide training to operator and vendor loading personnel. These individuals may include:

- Aircraft loading personnel;

- Maintenance personnel;
- Crewmembers;
- Dispatchers/flight followers;
- Purchasing agents;
- Receiving personnel;
- Freight forwarders and shippers;
- Cargo sales employees and general cargo sales agents;
- Supervisory loading personnel;
- Personnel whose job function entails control of the amount and placement of fuel on board the aircraft;
- Ground handlers;
- Cargo buildup personnel;
- Load planners; and
- Persons involved with W&B and CG calculations.

2.13.4 Curriculum for W&B Training and Cargo Operations.

2.13.4.1 W&B.

2.13.4.1.1 W&B Fundamentals. All operator and vendor personnel involved in a cargo program should receive fundamental W&B training at a general subject matter level to include:

2.13.4.1.1.1 Familiarization with varying aircraft weights based on manufacturer requirements;

2.13.4.1.1.2 The importance of conforming to and applying aircraft manufacturer and TC/STC requirements and zone or compartment limits;

2.13.4.1.1.3 The importance of accurate W&B calculations; and

2.13.4.1.1.4 The importance of proper communication among various personnel.

2.13.4.1.2 W&B and CG Calculations. The operator's training course for personnel or contractors involved with W&B and CG calculations should include, at a minimum:

2.13.4.1.2.1 Conforming and applying weight limitations by position, zone, or compartment of an aircraft using the aircraft manufacturer's requirements;

2.13.4.1.2.2 Determining CG limits for the aircraft;

2.13.4.1.2.3 Loading the aircraft per CG limits;

2.13.4.1.2.4 Calculating W&B and CG using operator procedures, to include automated or manual calculation systems;

2.13.4.1.2.5 Notifying the flightcrew of the W&B of the aircraft;

2.13.4.1.2.6 Accounting for the effect of weights of crews, other persons, cargo, and baggage;

2.13.4.1.2.7 Communicating W&B or CG issues to personnel involved with cargo loading;

2.13.4.1.2.8 Position of cargo and baggage;

2.13.4.1.2.9 Processes that factor CG offsets into cargo, both loaded into ULDs and loaded onto the aircraft; and

2.13.4.1.2.10 Processes and procedures to train and qualify personnel to calculate W&B.

2.13.4.2 CLS. An operator should provide CLS training to personnel with job functions involving equipment installed to the floor of an aircraft cargo compartment used to restrain ULDs. The CLS usually consists of rollers, side guides, and locks for securing ULDs to the aircraft structure. Operators should qualify personnel under a training program that includes procedures, as applicable, for:

2.13.4.2.1 Inspections for serviceability, including accounting for damaged or missing restraint devices;

2.13.4.2.2 Repairs;

2.13.4.2.3 Reconfiguration;

2.13.4.2.4 MEL and Configuration Deviation List (CDL);

2.13.4.2.5 Loading procedures and their effect on aircraft performance;

2.13.4.2.6 Potential hazards to flight caused by improper loading;

2.13.4.2.7 Passenger baggage and cargo is properly loaded and restrained; and

2.13.4.2.8 Authorized restraint systems for each of the operator's aircraft types.

2.13.4.3 Cargo Buildup. All operator, freight forwarder, and other vendor personnel involved in cargo buildup and breakdown should receive cargo buildup training, as well as personnel whose job functions include verifying eligibility of cargo, and selecting, assembling, and palletizing cargo for airlift. Elements of cargo buildup training include:

2.13.4.3.1 Concentrated loads;

2.13.4.3.2 Pallet load limitations;

2.13.4.3.3 Restraint;

- 2.13.4.3.4 Damage limits for ULDs and restraint devices;
- 2.13.4.3.5 Compatibility of aircraft/pallet and net/pallet combinations;
- 2.13.4.3.6 Hazmat;
- 2.13.4.3.7 Scales;
- 2.13.4.3.8 Proper ULD configuration;
- 2.13.4.3.9 Container configurations and conditions;
- 2.13.4.3.10 CG offsets, profiling, and authorization for use on a particular aircraft;
- 2.13.4.3.11 Training on how to build up a ULD to comply with CG control; and
- 2.13.4.3.12 Documentation.

2.13.4.4 ULD. All operator and vendor personnel involved in cargo loading should receive ULD training. Personnel whose job functions include determining compatibility of pallet/net combinations (per operator's procedures), pallet and airframe compatibility, and cargo restraint devices (e.g., intermixing straps) should have training in these areas.

2.13.4.4.1 Elements the ULD Training Program Should Contain. The operator should develop a training program that includes:

2.13.4.4.1.1 ULD identification. This should include a review of unique ULDs and identify the risks of loading a ULD not authorized for loading aboard the aircraft.

2.13.4.4.1.2 ULD damage limits and changes to limits. If a ULD's damage limits are modified, the operator notifies all appropriate loading personnel and the training program is modified to reflect the new limits;

- 2.13.4.4.1.3 ULD CG Limits;
- 2.13.4.4.1.4 Voided space in ULD;
- 2.13.4.4.1.5 Cargo contours;
- 2.13.4.4.1.6 ULD identification tags;
- 2.13.4.4.1.7 ULD weight limits;
- 2.13.4.4.1.8 Serviceability checks;
- 2.13.4.4.1.9 Fastening container components;
- 2.13.4.4.1.10 Fastening a cargo net to a pallet; and

2.13.4.4.1.11 Recurrent training for all loading personnel involved in ULD buildup. Operators should determine the time and type of recurrent training appropriate to the type of operation. Operators should require requalification and reauthorization training if loading personnel involved in ULD buildup are no longer considered properly trained, qualified, and authorized.

2.13.4.4.2 ULD Maintenance. Persons performing ULD maintenance should undergo training on the operator's maintenance program that includes:

2.13.4.4.2.1 Acceptance inspection;

2.13.4.4.2.2 Routine inspection;

2.13.4.4.2.3 Damage limits;

2.13.4.4.2.4 Repair;

2.13.4.4.2.5 Maintenance records; and

2.13.4.4.2.6 Return to service.

2.13.4.5 Special Cargo Analysis. Elements of SCAF:

2.13.4.5.1 TRC: Determining TRC, loading procedures and restraint methods.

2.13.4.5.2 Frangible cargo: Determining frangible cargo requirements, usage and procedures and provide training instructions.

2.13.4.5.3 Procedures for transporting special cargo.

2.13.4.5.4 Proficient with the content of OEM/STC WBM.

2.13.4.6 Loading/Unloading Training. All operator and vendor personnel involved in cargo loading and unloading should receive training appropriate to their function. This includes personnel whose cargo handling functions include ground transportation of cargo, movement of cargo onto or off of an aircraft, or movement/securing of cargo aboard the aircraft with appropriate devices and equipment. Elements of loading/unloading training include:

2.13.4.6.1 Sill guards (if applicable);

2.13.4.6.2 Tail posts (if applicable);

2.13.4.6.3 Tail stands (if applicable);

2.13.4.6.4 Tail tipping avoidance;

2.13.4.6.5 Aircraft doors, nets, and smoke barriers;

2.13.4.6.6 Aircraft floor and ULD base load limits;

2.13.4.6.7 Aircraft weight limits;

2.13.4.6.8 Aircraft CG range limits;

2.13.4.6.9 Cargo access aisle;

2.13.4.6.10 Aircraft damage avoidance;

2.13.4.6.11 Damage notification;

2.13.4.6.12 Cargo clearance;

2.13.4.6.13 CLS;

2.13.4.6.14 Bulk loaded cargo;

2.13.4.6.15 Cargo requiring special handling;

2.13.4.6.16 Shoring usage;

2.13.4.6.17 Blocking and bracing;

2.13.4.6.18 Hazmat;

2.13.4.6.19 Restraint, including calculating forward, aft, lateral, and vertical restraint; the proper usage of the floor tracks and side rail attachment points for loadmasters; and/or personnel supervising the cargo load on these areas;

2.13.4.6.20 Special cargo;

2.13.4.6.21 Frangible cargo; and

2.13.4.6.22 Material handling equipment.

2.13.4.7 Supervising Cargo Loading.

2.13.4.7.1 Responsibilities. The operator should train, qualify, and authorize the person responsible for loading cargo on an aircraft. This person supervises the sequencing, loading, unloading, and securing of cargo, and is the last load control verification before signing the load manifest.

2.13.4.7.2 Elements of Cargo Loading Supervision Training. Load supervision candidates should be trained in the elements listed in subparagraphs 2.13.4.1, 2, 3, 4, and 6; as well as the below topics:

2.13.4.7.2.1 Interlining;

2.13.4.7.2.2 Aircraft cargo handling;

2.13.4.7.2.3 Cargo loading documentation;

2.13.4.7.2.4 Load planning;

2.13.4.7.2.5 Interface with foreign agencies and military units;

2.13.4.7.2.6 COMAT; and

2.13.4.7.2.7 Familiarity with the accepted operator's W&B control program or operator's manuals, including the necessary OEM/STC WBMs.

2.13.5 Accident/Incident Reporting. An operator should have procedures to ensure it trains its personnel in accident/incident reporting procedures.

2.13.6 Providing Air Cargo Information to Flightcrew Members. An operator's flight operations training should adequately inform the flightcrew, at a minimum, of the following:

- Potential hazards to flight caused by improper loading;
- Procedures used to ensure the aircraft weight is correct;
- Procedures to report unserviceable ULDs;
- Loading and weight limitations for removing or deferring cargo restraint components;
- Proper load configurations when using nets, straps, or containers;
- Requirements when loading and restraining special cargo; and
- General awareness and familiarization hazmat training.

2.13.7 Use of Vendors to Provide Training. An operator may designate a person employed by a vendor, such as an aircraft company, ground handling company, or a freight forwarder authorized to train that company's employees. The operator should have procedures to accept the program.

2.13.8 Evaluation of Training. An operator's closed-loop system, which monitors the elements of surveillance, analysis, corrective action, and followup, should include an evaluation of the operator's cargo training program. The operator also may use an internal evaluation program to review its training program. The operator should ensure it has procedures to periodically review the training program and make changes as necessary.

2.13.9 Training Records.

2.13.9.1 Retention. An operator should retain its current training records for the duration of employment plus 90 days. The operator should have procedures for retention of such records.

2.13.9.2 Who Retains Records. The operator is responsible to ensure that training records are retained. The operator may retain these records itself, or it may choose to have the vendor retain them. The operator or the vendor may maintain the training records in electronic form or hardcopy.

2.13.10 Training Record Contents. At a minimum, an operator's training records should contain:

- The name of the person trained;
- The initial training date and most recent recurrent training date;
- A description, copy, or the location of training material used;
- The name and location of the person that provided the training; and
- Certification that the person was tested and successfully completed training.

CHAPTER 3. CERTIFICATION

SECTION 3.1. GENERAL

3.1.1 Purpose. This chapter provides background information for the certification and continued airworthiness of cargo aircraft. Examples of cargo aircraft include combi, passenger, all-cargo, commuter, or regional used for carrying cargo, including cargo loading systems (CLS), unit load devices (ULD), and other primary restraints.

3.1.2 Information Provided. This chapter includes general information for converting passenger aircraft to freighter configuration or combi service, and content of applicable information in relevant Weight and Balance (W&B) documents.

SECTION 3.2. AIRCRAFT CONFIGURATION

3.2.1 Certification Requirements for Cargo-Carrying Aircraft. An aircraft designed to carry cargo, whether an all-cargo aircraft, combination cargo-passenger aircraft, or passenger aircraft, has special access requirements, structural modifications to accommodate unique loading conditions, restraint devices, appliances, and measures to ensure the security of cargo throughout the operational envelope of the aircraft. If an operator incorporates any of these design features or modifications into the aircraft design, it needs to meet certification requirements of the appropriate airworthiness standards of 14 CFR part 25 or Civil Air Regulations (CAR) 4b, as applicable, and have documents providing instructions for continued airworthiness (ICA). The current edition of Order 8110.54, Instructions for Continued Airworthiness Responsibilities, Requirements, and Contents, provides an ICA checklist.

3.2.2 Differences Between a Bulk Load and Nonbulk Load Cargo Compartment. A cargo compartment is categorized or defined as bulk load or nonbulk load.

3.2.2.1 Bulk Load. The aircraft should have provisions inherent in the design and construction that prevent the cargo from:

3.2.2.1.1 Shifting and damaging aircraft systems and structures; and

3.2.2.1.2 Shifting to the extent that the aircraft center of gravity (CG) exceeds the certified limits. The design should include the requirement that the construction of the aircraft prevents unrestrained cargo, when subjected to the flight, ground, and landing loads of the appropriate airworthiness standards, from damaging aircraft systems and structure by impact.

3.2.2.2 Nonbulk Load. An aircraft's systems and structures with a nonbulk load cargo compartment are protected by ULDs and the cargo restraint system. ULDs and other load restraints will ensure that the cargo structural loads are only applied to the aircraft through the ULD-aircraft interface of the cargo restraint system. The ULDs and cargo restraint system must meet the Technical Standard Order (TSO)-C90, Cargo Pallets, Nets and Containers (Unit Load Devices) aircraft certification requirements about the retention of cargo, which provides certification requirements for the specification of the ULDs.

3.2.3 Freighter Conversions. The FAA has issued Supplemental Type Certificates (STC) to convert the configuration of certain transport category aircraft from *passenger-carrying* to *cargo-carrying*. These freighter conversions include modifications such as:

- Removing the passenger interior;
- Modifying the structure to accommodate changes in structural loading resulting from carrying cargo and installing cargo restraint systems;
- Installing a cargo interior;
- Installing main deck cargo doors; and
- Altering hydraulic, pneumatic, and electrical systems.

NOTE: See Appendices 5 through 7 for information pertaining to freighter conversions.

3.2.4 Features of Cargo Restraint Systems.

3.2.4.1 Cargo Restraint System. The cargo restraint system installed in an aircraft is a critical design feature. The cargo restraint system is the primary means of ensuring the cargo loads introduced into the aircraft structure are properly distributed, and all items of mass are restrained from movement or from damaging critical aircraft systems when subjected to (1) flight, landing, and ground operational loads; and (2) loads resulting from emergency landing conditions.

3.2.4.2 Cargo Restraint System Inclusion. The cargo restraint system may include barriers, ULDs, nets, straps, chains, tiedowns, and floor locks. A cargo restraint system must have sufficient strength under the certification requirements to restrain the cargo safely and must ensure the cargo will not shift and block or reduce access to emergency exits, obstruct the flow of required fire retardants, and interfere with other design features, such as flight controls, that are critical to the safety of flight. The minimum requirements are defined in appropriate airworthiness standards.

3.2.4.3 Protection During Emergency Landings. An operator should determine whether (1) the cargo restraint system or (2) a barrier will protect all occupants from shifting cargo during emergency landings. This decision affects the aircraft's structural requirements, ULDs, and cargo restraint system. Guidance and restraint system configurations are in the current editions of AC 25-5, Installation Approval on Transport Category Airplanes of Cargo Unit Load Devices Approved as Meeting the Criteria in NAS 3610; AC 25-18, Transport Category Aircrafts Modified for Cargo Service; and TSO-C90.

3.2.4.4 Appliances. The cargo restraint system and the devices used to restrain the cargo to the aircraft structure are appliances.

3.2.5 Ensuring the Integrity of a Cargo Restraint System. Even though the original design of a cargo restraint system may be in compliance with the applicable certification regulations, the installation of the system may not be adequately defined. Inspections of some aircrafts have revealed wrong part numbers of installed locks, missing locks, damaged equipment needing repair or replacement, and modifications made to the cargo restraint system that appeared to compromise its integrity. To maintain the integrity of the cargo restraint system, the operator should ensure that replacement parts are authorized for the cargo restraint system components on which they are installed. It is important also to note that the operating environment for cargo restraint systems is generally more severe than what most aircraft structures ensure. Many traditional marking methods are not permanent in this environment, and to enhance the integrity of its system, an operator should ensure that its cargo restraint system markings are permanent.

3.2.6 Fire Protection Design Features of Aircraft that are Essential to Operational Safety. While AC 25-18 discusses the various classes of cargo compartments and associated fire protection requirements, it is important to emphasize the dependence on the continued airworthiness of certain FAA-approved design features of cargo compartments essential to operational safety. For class A and B compartments, ensuring accessibility by a crewmember and availability of an authorized fire extinguisher are critical to safety in the event of hazardous quantities of smoke or fire. For the class C and E compartments, the functions of specific design features must be preserved to ensure operational safety. The integrity of the cargo compartment

liner must be maintained and the decompression features uncompromised because the liner often serves the dual purpose of fire and smoke containment while providing ventilation paths for decompression events. Smoke detectors for class C and E compartments and fire suppression equipment for Class C compartments are the essential equipment required for operational safety. Therefore, it is imperative that care should be taken when loading bulk cargo in class B, C, and E cargo compartments to ensure that it does not block fire detection sensors and fire suppression agent nozzles.

3.2.7 Installing Accommodations for Supernumeraries on Aircraft Certificated Under Part 25.

3.2.7.1 Exemption Under 14 CFR Part 11. Part 25 doesn't describe installing accommodations for supernumeraries, as detailed in 14 CFR part 121. A type certificate (TC) holder or an operator must petition for and receive an exemption under part 11 from the part 25 sections to install accommodations for supernumeraries. The FAA reviews each petition for exemption on its own merits. The enhanced capabilities of supernumeraries over passengers allow the FAA to issue an exemption in certain instances from selected type design requirements normally included for passenger safety. In all cases, however, the desired result is the retention of all passenger safety features to the maximum extent possible, when all factors are considered, and an overall level of safety for supernumeraries comparable to that afforded to passengers. Under part 11, the FAA grants an exemption if it finds the exemption is in the public interest and will provide a level of safety equivalent to that provided under the regulations.

3.2.7.2 Accommodations for Supernumeraries. The FAA has granted exemptions from part 25 to allow operators to install accommodations for supernumeraries. In addition to persons necessary for the safe conduct of the flight, such as large animal handlers, exemptions have been granted for transporting personnel. The exemptions usually involve only a few supernumeraries and the accommodations located immediately aft of the flight deck, consistent with part 121, § 121.583. In granting the exemptions, the FAA has had concerns allowing accommodations for supernumeraries outside the flight deck. The FAA wants exemption holders to:

3.2.7.2.1 Provide a suitable means for preventing smoke penetration into this occupied area;

3.2.7.2.2 Find each occupant physically able;

3.2.7.2.3 Brief all occupants on emergency equipment and procedures;

3.2.7.2.4 Ensure occupant willingness to use the emergency equipment and means of emergency egress provided; and

3.2.7.2.5 Comply with any other requirements of the exemption.

3.2.7.3 Additional Concerns. The FAA may have additional concerns based on the particular aircraft configuration or other features and may require an exemption holder to provide palletized flightcrew rest facilities and access to the cargo compartment to care for live animals.

3.2.8 Modifications and Alterations That Could Impact W&B. While the impact of a modification or alteration may be evident with many changes to W&B, the impact of some modifications are not readily evident, such as the following:

3.2.8.1 A modification to incorporate a winglet may change the cargo loading limitation over the wing box;

3.2.8.2 The change in zero fuel weight may alter aircraft fore and aft CG limits;

3.2.8.3 The conversion of class D cargo compartments to class C may heighten the potential for damage to certain design features in the class C compartment intended to sense smoke and discharge a fire retardant when necessary; and

3.2.8.4 The addition of an auxiliary fuel tank depending on its installation might change zonal payload weight limits on the structure.

3.2.9 Design Elements That Could Affect the Cargo Location. The cargo aircraft design should accommodate uncertainties in cargo CG location expected within normal operational accuracies and tolerances. Loading personnel must consider the effect on structural loads from variations in cargo CG location in computing cargo restraint system and cargo deck loads. Unless the CG of the cargo is actually measured, the assumed location of cargo CG is based on the envelope achieved in operation. This expected variation should be part of the design and is normally a CG position loading limitation on the aircraft. These limitations are normally selected so that they can be achieved by the application of loading procedures. Cargo loading procedures for bulk and nonbulk, such as cargo contained in a ULD, should be reviewed to ensure the cargo CG is within the assumed envelope to avoid safety issues with the cargo restraint system and the affected aircraft structure.

3.2.10 Design Approval Projects That Require ICAs. According to part 21, § 21.50(b), all design approval applicants must submit an ICA as part of the type design for approval.

3.2.11 Design Approvals. A design approval is any approved change or amendment of the type design granted by the FAA or its designees. A design approval defines or alters the approved configuration of an aircraft, aircraft engine, propeller, part, or appliance. The following are examples of design approvals and are subject to the requirements of § 21.50(b):

- TCs.
- Amended TCs.
- STCs.
- Amended STCs.
- Parts Manufacturer Approvals (PMA).
- TSO Authorizations.
- Major repairs and alterations approved by FAA Form 337, Major Repair and Alteration (Airframe, Powerplant, Propeller, or Appliance).

SECTION 3.3. UNIT LOAD DEVICES

3.3.1 Classification of ULDs. Certified ULDs, meaning containers or pallets/net combinations, are part of the aircraft cargo restraint system. TSO-C90 provides the certification requirements for ULD specification by reference to (1) National Aerospace Standard (NAS) 3610, Cargo Unit Load Devices—Specifications For, and (2) Aerospace Standard (AS) 36100, Cargo Handling Committee. This specification formally classifies ULDs for which certain strength capabilities have been demonstrated. But the specification also doesn't approve the installation or use of the ULD where the protection of an aircraft's systems and structure depends upon the integrity of the ULD. The vertical restraint configuration establishing the ULD type and strength capabilities are part of the classification of a ULD. As appropriate to the type design, the specification of ULDs compatible with a particular aircraft should be identified in the aircraft W&B or cargo loading document. This is the primary means for ensuring the proper ULDs are used in the operation of the aircraft.

NOTE: If an operator uses fire containment covers or fire-resistant containers for enhanced fire protection, the operator should provide instructions in its manual on the proper inspection, installation, storage, cleaning, and use of these products.

3.3.2 Using Certified Nets and Straps.

3.3.2.1 Net and Pallet Combinations. Net and pallet combinations are defined as ULDs by NAS 3610 and AS 36100, which also defines load capability for particular net and pallet combinations. If authorized for use, their arrangement and attachment to an aircraft structure, are identified in Original Equipment Manufacturer (OEM) reference documents. The strength capability of tiedown hardware should be provided, along with any limitations on use or acceptable configuration. The operator will have to obtain FAA approval for the proper use of nets if the OEM has not provided the information. Regardless, the lack of information may result in a failure by an operator to ensure proper restraint of the cargo and a possible unsafe condition.

3.3.2.2 Tiedown Straps. Some approved cargo restraint systems use tiedown straps as a primary restraint means. These systems generally provide instructions for determining the quantity and arrangement of straps required to properly restrain the cargo. In many cases, the strap specification provided by the OEM may be only a required strap rating, such as "5,000-Pound Rated Straps." In this situation, the operator must obtain FAA approval for the particular straps that it is using. The operator should have procedures (1) for selecting or defining straps that meet the requirements of the approved cargo restraint system, and ensuring that purchased or manufactured straps meet the OEM requirements; and (2) in place that ensure the continued airworthiness of the straps. The straps authorized by the operator should be uniquely identified, such as with a manufacturer part number, in the operator's operating manuals, and should meet the minimum requirements of TSO-C172, Cargo Restraint Strap Assemblies.

3.3.2.3 Tiedown Strap Authorization. With cargo restraint systems that use tiedown straps as a primary means of restraint, typically the approval is for tiedown to the aircraft's structure using installed tracks and fittings. These systems do not generally use straps to restrain cargo to pallets, nor does approval per TSO-C90 standards address this issue. If an operator uses straps as a

primary means of restraint to a TSO-C90 pallet, the process must be approved by the FAA. In obtaining approval from the aircraft certification office in accordance with Order 8110.4C, the operator must provide the data necessary to demonstrate compliance with the appropriate regulations, including:

3.3.2.3.1 Establishing strap rating requirements.

3.3.2.3.2 How to determine the appropriate quantity of straps and their arrangement. In determining this, the operator must demonstrate that (a) the orientation of the straps secures the load for all loading conditions, (b) the loads in the straps do not exceed the strap rating, and (c) the strap loads don't exceed the capability of the pallet tiedown fittings or tracks. The operator must also demonstrate that using tiedown straps does not introduce loads into the pallet that would exceed the tested strength of the pallet with regard to distributing the load from the pallet tiedown to the cargo restraint system latches, or the strength of the latches.

3.3.2.3.3 Providing the limitations for using the straps. For example, a limitation might be that the use of the straps as a primary restraint of cargo to a TSO-C90 pallet may only be applicable to a single piece of cargo, or packaged or crated goods, where the cargo or package container is inherently strong enough to be restrained by straps or keep the contents from dispersing.

3.3.3 CG Offset Limits.

3.3.3.1 Not Adhering to CG Offset Limits. A ULD specification document such as NAS 3610 and AS 36100 specifies in part the CG offset for which a ULD should have demonstrated specific strengths. If the operator doesn't adhere to the CG offset limits in operation, the operator may jeopardize the ULD's restraint of the load and the aircraft's ability to safely react to loads imposed by the ULD.

3.3.3.2 Floor Design. The design of the cargo floor and cargo restraint system is based on the assumption of loads applied to floor beams. Assumptions used in the floor design may not necessarily be the same as the ULD limits, and ULD CG offset limits for some aircrafts are more restrictive than the TSO-C90 limits. The floor loads should include the total distributed load of the cargo in the ULD and the CG offset that may apply.

3.3.3.3 Design Assumptions. If the designer of the aircraft structural system and CLSs has assumed only a limited CG offset to which the systems must react, the operator must ensure the loaded cargo is within these design assumptions. If an operator doesn't adhere to the limitations of the design, the operator may impact the safety of operation.

CHAPTER 4. ADMINISTRATIVE INFORMATION

4.1.1 How to Obtain Copies of Publications.

4.1.1.1 A listing of the Codes of Federal Regulations (CFR) is in the current version of AC 00-44, Status of Federal Aviation Regulations, and a listing of all ACs is in the current version of AC 00.2, Advisory Circular Checklist and Status of Other FAA Publications.

4.1.1.2 Readers may view and print the CFRs, Aircraft Certification Service (AIR) and Flight Standards Service (AFS) ACs on the FAA's Regulatory and Guidance Library (RGL) at <http://rgl.faa.gov/>.

4.1.2 Additional Information. For information concerning this AC, contact the Air Carrier Maintenance Branch (AFS-330) at (202) 267-1675. Submit direct comments regarding this AC to:

Federal Aviation Administration Headquarters
Air Carrier Maintenance Branch, AFS-330
5th Floor, 950 L'Enfant Plaza SW
Washington, D.C. 20024

APPENDIX A. RELATED REGULATIONS**A.1 Title 14 of the Code of Federal Regulations (14 CFR) Part 21, Certification Procedures for Products and Parts. Part 21, Subpart E, Supplemental Type Certificates. Part 21, Subpart K, Parts Manufacturer Approvals. Part 21, Subpart O, Technical Standard Order Approvals.**

A.1.1 Section 21.21, Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.

A.1.2 Section 21.50, Instructions for Continued Airworthiness and Manufacturer's Maintenance Manuals Having Airworthiness Limitations Sections.

A.1.3 Section 21.101, Designation of Applicable Regulations.

A.1.4 Section 21.303, Application.

A.2 Part 25, Airworthiness Standards: Transportation Category Airplanes.

A.2.1 Section 25.23, Load Distribution Limits.

A.2.2 Section 25.301, Loads.

A.2.3 Section 25.787, Stowage Compartments.

A.2.4 Section 25.851, Fire Extinguishers.

A.2.5 Section 25.853, Compartment Interiors.

A.2.6 Section 25.855, Cargo or Baggage Compartments.

A.2.7 Section 25.857, Cargo Compartment Classification.

A.2.8 Section 25.858, Cargo or Baggage Compartment Smoke or Fire Detection Systems.

A.2.9 Section 25.1301, Function and Installation

A.2.10 Section 25.1309, Equipment, Systems, and Installation.

A.2.11 Section 25.1519, Weight, Center of Gravity, and Weight Distribution.

A.2.12 Section 25.1529, Instructions for Continued Airworthiness.

A.2.13 Section 25.1581, General.

A.2.14 Section 25.1583(c), Operating Limitations, Weight and Loading Distribution.

A.2.15 Section 25.1721, Protection of EWIS.

A.2.16 Appendix F to Part 25.

A.2.17 Appendix H to Part 25—Instructions for Continued Airworthiness.

A.3 Part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration.

A.4 Part 45, § 45.15, Marking requirements for PMA articles, TSO articles, and critical parts.

A.5 Part 119, Certification: Air Carriers and Commercial Operators.

A.5.1 Section 119.49, Contents of Operations Specifications.

A.5.2 Section 119.55, Obtaining deviation authority to perform operations under a U.S. military contract.

A.6 Part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations. Part 121, Subpart G, Manual Requirements.

A.6.1 Section 121.153, Aircraft Requirements: General.

A.6.2 Section 121.363, Responsibility for Airworthiness.

A.6.3 Section 121.367, Maintenance, Preventive Maintenance, and Alteration Programs.

A.6.4 Section 121.373, Continuing Analysis and Surveillance.

A.6.5 Section 121.375, Maintenance and Preventive Maintenance Training Programs.

A.6.6 Section 121.419, Pilots and Flight Engineers: Initial, Transition, and Upgrade Ground Training.

A.6.7 Section 121.422, Aircraft Dispatchers: Initial and Transition Ground Training.

A.6.8 Section 121.693, Load Manifest: All Certificate Holders.

A.6.9 Section 121.1001 – 1007 (Subpart Z), Hazardous Materials Training Program; and Appendix O, Hazardous Materials Training Requirements for Certificate Holders.

A.7 Part 145, Repair Stations.

A.8 Part 234, Airline Service Quality Performance Reports. Section 234.13, Reports by Air Carriers on Incidents Involving Animals During Air Transport.

A.9 Part 382, Nondiscrimination on the Basis of Disability in Air Travel. Section 382.55(a)(1), Miscellaneous Provisions.

A.10 Title 49 of the Code of Federal Regulations (49 CFR), Transportation, Subtitle B – Other Regulations Relating to Transportation, Chapter I—Pipeline and Hazardous

**Materials Safety Administration, Department of Transportation, Subchapter C—
Hazardous Materials Regulations, as applicable.**

A.11 Related International Regulations.

A.11.1 ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air.

A.11.2 ICAO Safety Management Manual (SMM).

APPENDIX B. GUIDANCE MATERIAL**B.1 Advisory Circulars (AC) (current editions):**

- B.1.1 AC 00-58, Voluntary Disclosure Reporting Program.
- B.1.2 AC 20-62, Eligibility, Quality, and Identification of Aeronautical Replacement Parts.
- B.1.3 AC 21-43, Production Under 14 CFR Part 21, Subparts F, G, K, and O.
- B.1.4 AC 25-5, Installation Approval on Transport Category Airplanes of Cargo Unit Load Devices Approved as Meeting the Criteria in NAS 3610.
- B.1.5 AC 25-9, Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures.
- B.1.6 AC 25-22, Certification of Transport Airplane Mechanical Systems.
- B.1.7 AC 25-18, Transport Category Aircrafts Modified for Cargo Service.
- B.1.8 AC 120-16, Air Carrier Maintenance Programs.
- B.1.9 AC 120-27, Aircraft Weight and Balance Control.
- B.1.10 AC 120-59, Air Carrier Internal Evaluation Programs.
- B.1.11 AC 120-92, Safety Management Systems for Aviation Service Providers.
- B.1.12 AC 121-27, Guide for Air Carriers, Freight Forwarders, and Shippers in Obtaining Information Dealing With the Transportation of Hazardous Material by Air.
- B.1.13 AC 145-9, Guide for Developing and Evaluating Repair Station and Quality Control Manuals.

B.2 Federal Aviation Administration (FAA) Orders, Forms, Bulletins, and Technical Standard Orders (TSO) (current editions):

- B.2.1 FAA Order 8150.4, Certification of Cargo Containers with Self-Contained Temperature Control Systems (Active ULDs).
- B.2.2 FAA Order 8120.22, Production Approval Procedures.
- B.2.3 FAA Form 337, Major Repair and Alteration.
- B.2.4 FAA Form 8100-9, Organization Designation Authorization.
- B.2.5 FAA Form 8110-3, Statement of Compliance with Airworthiness Standards.
- B.2.6 FAA Form 8130-3, Authorized Release Certificate, Airworthiness Approval Tag.

B.2.7 TSO-C90, Cargo Pallets, Nets and Containers (Unit Load Devices).

B.2.8 TSO-C172, Cargo Restraint Strap Assemblies.

B.3 Cargo AC Development Information:

B.3.1 Air Cargo System Implementation Plan, March 2003.

B.3.2 Cargo Strategic Action Plan, April 2002.

B.3.3 Compliance Document for ULD Center of Gravity Control on B-727 Aircraft, October 2000.

B.3.4 Civil Reserve Air Fleet Aircraft Procedures for the U.S. Military, FM 55-9.

B.4 Industry Information (current editions):

B.4.1 International Air Transport Association (IATA) ULD Regulations (ULDR).

B.4.2 IATA Airport Handling Manual (AHM).

B.4.3 IATA Cargo Services Conference Recommended Practice (RP) 1640 (Use of Radio Frequency Technology for the Automatic Identification of Unit Load Devices).

B.4.4 IATA Ground Operations Manual (IGOM).

B.4.5 IATA Perishable Cargo Regulations (PCR).

B.4.6 IATA Live Animal Regulations (LAR).

B.4.7 IATA Dangerous Good Regulations (DGR).

B.4.8 IATA Temperature Control Regulations (TCR).

B.4.9 IATA Lithium Battery Shipping Guidelines (LBSG).

B.4.10 International Organization for Standardization (ISO) International Standard ISO 4118, Air Cargo – Non-certified Lower Deck Containers – Specification and Testing, and other pertinent International Standards.

B.4.11 National Aerospace Standard (NAS) 3610, Cargo Unit Load Devices – Specification for/AS 36100, Air Cargo Unit Load Devices – Performance Requirements and Test Parameters.

B.4.12 Society of Automotive Engineers (SAE) Aerospace Standards (AS):

B.4.12.1 AS 1677, General Requirements for Noncertified Cargo/Baggage Containers.

B.4.12.2 AS 1130G, Air and Air/Surface (Platform) Cargo Pallets.

- B.4.12.3 AS 1131, Air and Air/Surface (Platform) Cargo Pallet Nets.
- B.4.12.4 AS 1491, Interline Air Cargo Pallets.
- B.4.12.5 AS 1492, Interline Air Cargo Pallet Nets.
- B.4.12.6 AS 4041, Air Mode General Purpose Containers.
- B.4.12.7 AS 5385, Cargo Restraint Straps – Design Criteria and Testing Methods.
- B.4.12.8 AS 5896, Certified Containers for Lower Deck Compartments.
- B.4.12.9 AS 36101, Air Cargo Unit Load Devices - Load Distribution Model.
- B.4.12.10 AS 36100, Air Cargo Unit Load Devices – Performance Requirements and Test Parameters.
- B.4.13 SAE ARP:
 - B.4.13.1 ARP 1334, Ground Equipment Requirements for Compatibility with Aircraft Unit Load Devices.
 - B.4.13.2 ARP 1554, Vehicle Transport Unit Load Device (ULD).
 - B.4.13.3 ARP 1621, ULD for Aircraft Transportation of Horses.
 - B.4.13.4 ARP 1840, Aircraft Engine Transport Devices.
 - B.4.13.5 ARP 5486, Air Cargo Pallets - Utilization Guidelines.
 - B.4.13.6 ARP 5595, Cargo Restraint Straps - Utilization Guidelines.
 - B.4.13.7 ARP 5596, Cargo Shoring Guidelines.

APPENDIX C. DEFINITIONS RELATED TO AIR CARGO OPERATIONS

C.1 Active Unit Load Devices (ULD). ULDs with active temperature control systems for transporting temperature-sensitive cargo. These systems consist of a highly insulated container with a battery-operated heating/cooling system integrated into the construction of the container. Active ULDs are intended to be operating during flight. Active ULDs are battery-powered in flight and are only recharged while on the ground. The “active” component of these units typically consists of a vapor cycle refrigeration/heat pump type system that is powered by various types of large batteries, depending on the manufacturer.

C.2 Aircraft Loading Schedule. The loading schedule is used to document compliance with the certificated Weight and Balance (W&B) limitations contained in the manufacturer’s Aircraft Flight Manual (AFM) and W&B manual (WBM). The loading schedule is developed by the operator based on its specific loading calculation procedures and provides the operational limits for use with the operator’s W&B program accepted under this AC.

C.3 Approved Parts. Unless used with reference to another person, means parts approved by the Administrator.

C.4 Cargo. For the purpose of this AC, cargo refers to passenger-checked baggage, freight, Company Materials (COMAT), special cargo, and hazardous materials (hazmat). Cargo does not include passenger carry-on baggage.

C.5 Cargo Handling. An operator’s methods of accepting, weighing, securing, transporting cargo on the ground, and the loading and unloading of an aircraft.

C.6 Cargo Loading System (CLS). Equipment installed to the floor of an aircraft cargo compartment to restrain aircraft ULDs against the ground/flight loads. It usually consists of such items as rollers, side guides, and locks for securing ULDs to the aircraft structure. It does not include ULDs, barriers and tiedown straps.

NOTE: The CLS is certified as part of either the aircraft’s type certification (TC) or a Supplemental Type Certificate (STC).

C.7 Certified Restraint Straps. These devices should meet the requirements of TSO-C172, Cargo Restraint Strap Assemblies. In it, the FAA describes the minimum performance standards (MPS) by which cargo restraint strap assemblies are approved and identified with applicable TSO markings.

C.8 Certified Unit Load Device (ULD). A ULD meeting the requirements of TSO-C90, Cargo Pallets, Nets and Containers (Unit Load Devices), as amended; STC requirements, if applicable; or other FAA-approved certification standards.

C.9 Company Materials (COMAT). Company material, commonly called COMAT, is an industry term used by operators to describe nonrevenue materials and supplies owned by the operator that are shipped by the operator in support of its operations.

C.10 Dunnage. Materials used to support and protect cargo in an aircraft cargo compartment or padding used in a shipping container to protect the container's contents.

C.11 Dynamic Load. Loads imparted on the structure of the aircraft by loaded cargo during taxi, takeoff, cruise, and landing.

C.12 First Article Inspection. Inspection of the first of a manufactured component to ensure compliance with certification and airworthiness requirements.

C.13 Floating Pallet. ULD positioned over one or more pallet position and not fully restrained by the aircraft ULD restraint system, but restrained to the aircraft structure by means of strapping to tiedown fittings.

C.14 Frangible (Compressible) Cargo. Aircraft manufacturer's W&B documents vary on this definition; therefore, you should reference their document.

C.15 Freight Staging. The holding of cargo awaiting transportation and the delivery of cargo to the aircraft in the right sequencing of cargo according to the load plan.

C.16 Hazardous Materials (hazmat). Materials or substances meeting the definition of hazardous material in Title 49 of the Code of Federal Regulations (49 CFR) part 171, § 171.8.

C.17 Interlining. Transfer from one operator to another, whether the same or different aircraft types are used. For example, a ULD transferred from a domestic operator to a foreign operator.

C.18 Load Supervisor. An operator-determined name, such as loadmaster or load lead, identifying the job function of the person with overall responsibility for supervising the loading of the aircraft. This person is responsible for signing the load manifest. Refer to Title 14 of the Code of Federal Regulations (14 CFR) part 121, § 121.665, Load Manifest.

C.19 Non-certified Unit Load Device (ULD). A ULD that is not certified by the ULD manufacturer, does not meet the TS-O C90 or Parts Manufacturer Authority (PMA) certification requirements, and/or is not listed in the OEM aircraft WBM (TC or STC).

C.20 Offset Cargo. Cargo positioned on the pallet in a manner that the cargo is shifted beyond the perimeter of the pallet resulting in either 1) the center of gravity (CG) limits of the pallet being exceeded, or 2) the restraint by the net to the pallet becoming ineffective in protecting the aircraft and preventing cargo shift.

C.21 Overweight Cargo. Cargo that exceeds the maximum allowable weight as defined by the aircraft WBM for aircraft ULD position.

C.22 Overhang Cargo. Cargo that extends beyond the perimeter of the pallet in at least one direction but still allows the net to perform its intended function. The pallet can still be restrained by the CLS and does not require additional straps to the aircraft structure.

C.23 Outsized Cargo. Cargo that exceeds the maximum allowable contour of an aircraft ULD such that the ULD must be loaded on board an aircraft as a non-CLS restrained ULD.

C.24 Pallet (Air Cargo). A flat platform with flat under-surface of standard dimensions, on which cargo is assembled and secured and which interfaces directly with the aircraft handling and restraint system.

C.25 Piercing Cargo. Piece of cargo of a piercing or penetrating nature, such as rods, pipes, extrusions, beams, etc., that could become a projectile hazard under flight operational loads.

C.26 Pod. An external container attached to an aircraft for carrying cargo.

C.27 Primary Restraint. The restraint of the cargo payload to the aircraft structure for flight and other loads.

C.28 Rigid Cargo. Cargo with a density that is rigid in nature, as defined in the aircraft manufacturer's W&B document.

C.29 Sharp Cargo. Cargo that has a piercing or penetrating nature, or cargo with sharp edges or corners.

C.30 Special Cargo. Cargo not contained in a ULD certified for the airplane CLS or not enclosed in a cargo compartment certified for bulk loading is special cargo. This type of cargo requires special handling and securing/restraining procedures.

C.31 Special Handling Procedures. Additional or unique procedures, as determined by the operator, which may be required for some cargo in order to protect the cargo or the aircraft during handling acceptance, loading, or in flight. Hazmat must be handled per regulatory requirements.

C.32 Supernumeraries. Persons that are not members of the crew, who are carried on board all-cargo aircraft that do not comply with all passenger-carrying requirements of part 121.

C.33 Supplemental Restraint. Restraint that is utilized in addition to primary restraint in order to stabilize cargo and prevent shifting.

C.34 Tall Rigid Cargo (TRC). Tall cargo is cargo greater than 98 inches tall. Certain sections of tall cargo can be frangible and certain sections can be rigid. If any part of the rigid section of tall cargo is above 98 inches, the tall cargo is TRC. TRC is only applies to the Boeing 747 aircraft.

C.35 Tare Weight. The weight of the empty ULD, including its normal complement of loading restraint devices. Also, the empty weight of other material handling equipment (e.g., baggage carts and dollies) used to weigh cargo on a scale.

C.36 Temporary Restraint Device. Temporary net restraint fittings installed in place of damaged or missing fittings, or temporary net take-up hooks and net corner lashing lines.

C.37 Unit Load Device (ULD). A device for grouping, transferring, and restraining cargo for transit. It may consist of a pallet with a net or it may be a container.

C.38 Unitized. Consolidated multiple packages or items loaded into or on a ULD.

C.39 Vendor. Any person or entity performing a service for the operator. This includes, but is not limited to, a freight forwarder, service providers, contractor, subcontractors, customs brokers, shipper, and another operator that performs cargo buildup, aircraft loading, and unloading for the operator. This also includes repair services provided by an FAA-certificated entity.

C.40 Zone Weight. Cumulative weight as loaded within a designated zone within the aircraft such as a specific area on the upper deck cargo area plus the cargo loaded on the lower deck directly beneath.

APPENDIX D. ACRONYMS AND ABBREVIATIONS

14 CFR	Title 14 of the Code of Federal Regulations
AC	Advisory Circular
AD	Airworthiness Directive
AFM	Airplane Flight Manual
CASS	Continuing Analysis and Surveillance System
CFR	Code of Federal Regulations
CG	Center of Gravity
CLS	Cargo Loading System
CMM	Component Maintenance Manual
COMAT	Company Material
CRAF	Civil Reserve Air Fleet
DER	Designated Engineering Representative
FAA	Federal Aviation Administration
hazmat	Hazardous Materials
IATA	International Air Transport Association
ICA	instructions for continued airworthiness
ISO	International Organization for Standardization
MEL	Minimum Equipment List
MPS	Minimum Performance Standard
NAS	National Aerospace Standard
NIST	National Institute of Standards and Technology
NTSB	National Transportation Safety Board
OEM	Original Equipment Manufacturer
PC	Production Certificate
PMA	Parts Manufacturer Approval
SAE	Society of Automotive Engineers
SB	Service Bulletin
SCAF	Special Cargo Analysis Function
STC	Supplemental Type Certificate
TC	Type Certificate
TRC	Tall Rigid Cargo
TSO	Technical Standard Order
ULD	Unit Load Device

APPENDIX E. SUGGESTED STRUCTURAL DATA FOR PASSENGER-TO-CARGO CONVERSION PROJECT

An applicant should submit the following data to the Federal Aviation Administration (FAA) as structural substantiation in support of a passenger-to-cargo conversion project. This list is not all-inclusive, and each project should be individually evaluated to determine if additional data are necessary. The applicant and the approving authority representative should come to an agreement on the necessary data early in the program as part of the certification plan.

NOTE: Documents with an asterisk (*) are required by Title 14 of the Code of Federal Regulations (14 CFR).

E.1 Aircraft Flight Manual (AFM).* Identifies all operating limitations, including operating speeds and door operation, and contains allowable aircraft fuel and cargo loading directly or by reference. Any additional information necessary to safely operate the aircraft should also be provided.

E.2 Aircraft Loading Document.* Describes the types of cargo containers allowed, how the containers are restrained, and loading requirements when latches are missing or broken. This may be contained in the Weight and Balance (W&B) manual. Ensures compatibility of the cargo loading system (CLS) with the cargo conversion. These modifications have often been incorporated independent of each other. In addition, if the use of tiedown fittings is permitted, the tiedown strength and limitation data should be provided.

E.3 Assembly/Installation Drawings.* Details how all parts are assembled and identifies the number and types of fasteners used.

E.4 Cargo Restraint System. Designed for all critical ground, flight, and emergency landing loads. This includes seat tracks, pallet locks, side restraints, and roller trays. The 9G rigid barrier or cargo restraint net, if required, and its attachment, and the fuselage surrounding structure must be analyzed for critical payloads.

E.5 Certification Plan. Lists all steps necessary to complete FAA certification of the modification. At a minimum, the plan should discuss scope of the project, schedule, use of Designated Engineering Representatives (DER), data submittals, and conformity issues.

E.6 Compatibility Evaluation. The applicant evaluates each aircraft to be modified to ensure it is compatible with the Supplemental Type Certificate (STC) modification. The applicant also identifies and evaluates modifications, alterations, or the incorporation of other STCs that change the type design of the aircraft to be modified. The applicant notes and makes accommodations for differences and necessary drawing changes.

E.7 Compliance Checklist. Lists all applicable rules from the certification basis of the modification of the aircraft. Also identifies necessary compliance with outstanding Airworthiness Directives (AD) and the methods of compliance.

E.8 Configuration Deviations.* Lists all nonconformities with their engineering dispositions.

E.9 Damage Tolerance Assessment (DTA).* Required for all 14 CFR part 25 post-Amendment-45-certified aircraft. The applicant should create a DTA for pre-Amendment-45 aircraft in support of a supplement to a standard that is required by an AD. The DTA should evaluate whether an existing principal structural element has been changed or if one has been created by the modification. Fail-safe requirements should be addressed as necessary.

E.10 Decompression Analysis. The substantiation must show that the cargo compartment is designed to withstand the effects of a sudden release of pressure. Consider impact of solid 9G barrier in decompression scenarios (part 25, § 25.365(e); Civil Air Regulations (CAR) 4b.216(c)(4)).

E.11 Design Criteria. A list of design, analysis, and production methodologies, and requirements used in creating the modification.

E.12 Detail Drawings.* There should be a detail drawing for each part manufactured for use in the modification and some means of controlling the source of all vendor-supplied items.

E.13 Door Mechanical Systems. The applicant analyzes the door opening, latching, and locking mechanisms for most critical loads, which should include maximum hydraulic actuator output and possible jam conditions.

E.14 Door Surround Structure. The door surround structure must be analyzed for the redistributed loads resulting from the door cutout. This includes the fuselage skin, doublers, sills, headers, footers, surrounding frames, and longerons/stringers, latches, and their attachments. An analysis of the door and the door hinge should also be included.

E.15 External Loads Analysis.* Should include most critical aircraft weight distribution at both minimum and maximum weights and critical loading throughout the center of gravity (CG) range, including raised vertical CG, and must consider all points within the operating envelope (that is, gust and maneuver). External loads should also include the effects of loads on pallet locks, load impingement on main deck floors by lower deck, unrestrained cargo, and shift in unit load devices (ULD) or bulk load cargo CG locations consistent with pallet approvals and usage.

E.16 Final Documentation. Documentation showing that all structural margins are positive for the critical load case.

E.17 Floors. The floor beams, fuselage frames, and posts/struts should be analyzed for the most critical loading conditions.

E.18 Flutter Substantiation.* A cargo conversion can change the fuselage stiffness or change the mass distribution, which can have an effect on the aircraft's flutter characteristics, particularly aft cargo doors.

E.19 Functional Check.* Performed to ensure proper operation of the main cargo door. The number of open-close cycles are to be decided upon with the aircraft certification office. The test

could include determining the mean time between failure of components, validating the failure modes and effects analyses, and monitoring the wear of latches (§ 25.1301, CAR 4b.601).

E.20 Identification of Supplemental Type Certificate (STC) Team Members. Identify STC team members and DERs whose experience is commensurate with these kinds of projects (that is, external loads, systems safety assessment, finite element modeling, and validation).

E.21 Illustrated Parts Catalog. Catalog of all parts contained in the STC for procurement purposes.

E.22 Installation Instructions. Any installation instructions necessary other than what is listed in the installation drawings. Ensure that there are adequate instructions for the installation of cargo compartment liners and floor panels to minimize the use of a shop practice that may result in blind drilling of holes that could induce damage (double-drilled holes and short-edge margins) to floor beam caps and fuselage frames.

E.23 Instructions for Continuous Airworthiness (ICA). ICAs are a set of instructions as referenced in 14 CFR part 21, § 21.50, Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections; and part 25, § 25.1529, Instructions for continued airworthiness, of the regulations that provide information on how to properly maintain a product in an Airworthy condition, including any inspections or other procedures, as necessary, to prevent catastrophic failure of the product. Without acceptable ICAs, a product cannot be maintained in an Airworthy condition. Order 8110.54 provides additional information on the scope of the ICA to be considered as a function of the original design and/or modifications to a transport aircraft.

E.24 Internal Loads Analysis.* Distribution of loads within the affected airframe structure. Load distribution should be validated.

E.25 Maintenance Instructions.* Continued airworthiness requirements for the inspection program, which includes the frequency and extent of those inspections.

E.26 Maintenance Manual.* Instructions for continued airworthiness of the modifications.

E.27 Master Data List. Lists all process specifications and reports that substantiate the structural strength and damage tolerance of the modification, along with all test reports (that is, flutter, pressurization, finite element method (FEM) validation).

E.28 Master Drawing List.* Controls all drawings and process specifications that define design of the modification.

E.29 Methodology Description. Describes the methodology used to define (1) the barrier load distributions and intensities and distribute the barrier loads to the monocoque, and (2) the ULD load distributions and intensities and distribute the loads to the restraint system components and floor.

E.30 Pressure Test.* The structure must be designed to withstand (limit load) the maximum pressure relief valve setting combined with flight loads (§ 25.365(a), CAR 4b.216(c)(1)), and the

maximum relief valve setting omitting other loads times a factor of 1.33 or 1.67, as appropriate (§ 25.365(d), CAR 4b.216(c)(3)). If the modification or conversion involves changes to the pressure barrier, such as a new door installation, it must be pressure tested per § 25.843 or CAR 4b.376.

E.31 Structural Repair Manual. Instructions for repair of the modifications.

E.32 Structural Substantiation.* Positive margins of safety should be shown for all modified structures. Assumptions used in any analysis or test must be consistent with how the loads are applied and the way the structure carries these loads. A margin of safety table should be published for each structural analysis.

E.33 Weight and Balance (W&B) Manual.* Describes aircraft fuel and payload distributions and CG restrictions. Defines applicable ULDs. Provides any other relevant information necessary for the safe operation of the aircraft.

APPENDIX F. PASSENGER-TO-CARGO CONVERSIONS SUPPLEMENTAL TYPE CERTIFICATE DATA PACKAGE FOR SYSTEMS AND EQUIPMENT

F.1 An applicant should submit the following information to the Federal Aviation Administration (FAA).

F.1.1 Certification Plan. Helps determine the scope of the conversion project, that is, full passenger-to-cargo conversion, cargo door-only conversion, or smoke detection system-only conversion, and whether supernumeraries are included. A systems description document may have been included in the certification plan, system failure modes, and effects analyses. It is likely that safety analyses were not prepared; you may have to learn about the system based on drawings and diagrams.

F.1.2 Compliance Checklist. Helps determine methods to comply to all applicable Title 14 of the Code of Federal Regulations (14 CFR)/Civil Air Regulations (CAR).

F.1.3 Master Data List/Top Drawing List. Helps link the Supplemental Type Certificate (STC) drawings/reports down to detailed levels.

F.2 Based on, or lacking, the above data, the following areas should be reviewed for the conversions to determine that the modifications are safe:

F.2.1 Cargo Door. Should include:

F.2.1.1 Safety analyses (including any latch/lock/pin failures that could cause door to unlock);

F.2.1.2 Drawings;

F.2.1.3 Wiring qualification (flammability);

F.2.1.4 Wiring diagrams/schematics;

F.2.1.5 Electrical load analysis;

F.2.1.6 Hydraulic components qualification test;

F.2.1.7 System pressure proof/burst test;

F.2.1.8 Any conformity reports (parts, test article, installation);

F.2.1.9 Flammable fluid fire protection;

F.2.1.10 Aircraft Flight Manual (AFM) and limitations;

F.2.1.11 Cargo door opening, closing, and locking mechanisms, including vent door design with its associated power sources (electrical, hydraulics, mechanical), door opening retention system safety during cargo loading, and system isolation during flight; and

F.2.1.12 Cargo door warning system and its redundancy features (door control panel and cockpit displays, sensors, placards).

F.2.2 Continued Airworthiness. Maintenance/overhaul manual, flightcrew operating manual, minimum equipment list (MEL), certification maintenance requirements (if required by safety analyses), and any other relevant information for all systems.

F.2.3 Crew Emergency Exit. Interior arrangement drawing and compliance inspection to determine crew accessibility under any cargo loading condition.

F.2.4 Critical Component. Drawings, reports, or issue papers addressing means of protection of critical controls, lines, and equipment in the cargo compartment.

F.2.5 Smoke Barrier. Should include:

F.2.5.1 Drawings/installation;

F.2.5.2 Smoke penetration test plan and report (may be included in the smoke detection system test report);

F.2.5.3 Flight test report; and

F.2.5.4 Conformity reports (parts, test article, installation).

F.2.6 Smoke Detection System. Should include:

F.2.6.1 Installation drawings;

F.2.6.2 A test plan and report (including testing in MEL configuration);

F.2.6.3 Wiring qualification (flammability);

F.2.6.4 Wiring diagrams/schematics;

F.2.6.5 Electrical load analysis;

F.2.6.6 Technical Standard Order (TSO)-approved smoke detector (or other testing done for an STC);

F.2.6.7 System control panel qualification and installation;

F.2.6.8 Flight test report;

F.2.6.9 Conformity reports (parts, test article, installation);

F.2.6.10 Failure modes and effects analyses;

F.2.6.11 AFM and limitations; and

F.2.6.12 Compliance inspection to determine cargo interference with fire protection features.

F.2.7 Title 14 CFR Part 121, § 121.583, Carriage of Persons without Compliance with the Passenger-Carrying Requirements of this Part. Data should include exemption approvals from the FAA and interior arrangement drawings. This includes all 14 CFR part 25 regulations applied for carriage of passengers such as emergency egress assist means and escape routes, emergency lighting, emergency exit access, seats, safety harness, oxygen equipment and supply, portable breathing equipment, safety equipment, markings and placards, and compliance inspection.

F.2.8 Ventilation System. The ventilation may have been modified to provide a means to shut off ventilation to the cargo compartment in case of a fire. Data should include:

- F.2.8.1 Detailed design/drawings;
- F.2.8.2 Wiring diagrams;
- F.2.8.3 Electrical load analysis;
- F.2.8.4 Safety analyses;
- F.2.8.5 AFM and limitations; and
- F.2.8.6 Cockpit smoke evacuation procedures (may be required).

APPENDIX G. DESIGN CRITERIA FOR OUTWARD OPENING DOORS

The following is an excerpt from a Federal Aviation Administration (FAA) Memorandum to the Director of Airworthiness and Technical Standards of the Air Transportation Association of America ATA, dated March 20, 1992 that defined criteria for outward opening doors.

“(1) Indication System:

- (a) The indication system must directly monitor the closed, latched, and locked positions.
- (b) The indicator should be amber unless it concerns an outward opening door whose opening during takeoff could present an immediate hazard to the aircraft. In that case, the indicator must be red and located in plain view in front of the pilots. An aural warning is also advisable. A display on the master caution/warning system is also acceptable as an indicator. For the purpose of complying with this paragraph, an immediate hazard is defined as significant reduction in controllability, structural damage, or impact with other structures, engines, or controls.
- (c) Loss of indication or a false indication of a closed, latched, and locked condition must be improbable.
- (d) A warning indication must be provided at the door operator’s station that directly monitors the door latch and lock conditions, unless the operator has a visual indication that the door is fully closed and locked. For example, a vent door that monitors the door locks and can be seen from the operator’s station would meet this requirement.”

“(2) *Means to Visually Inspect the Locking Mechanism:* There must be a visual means of directly inspecting the locks. Where all locks are tied to a common lock shaft, a means of inspecting the locks at each end may be sufficient to meet this requirement provided no failure condition in the lock shaft would go undetected when viewing the end locks. Viewing latches may be used as an alternate to viewing locks on some installations where there are other compensating features.”

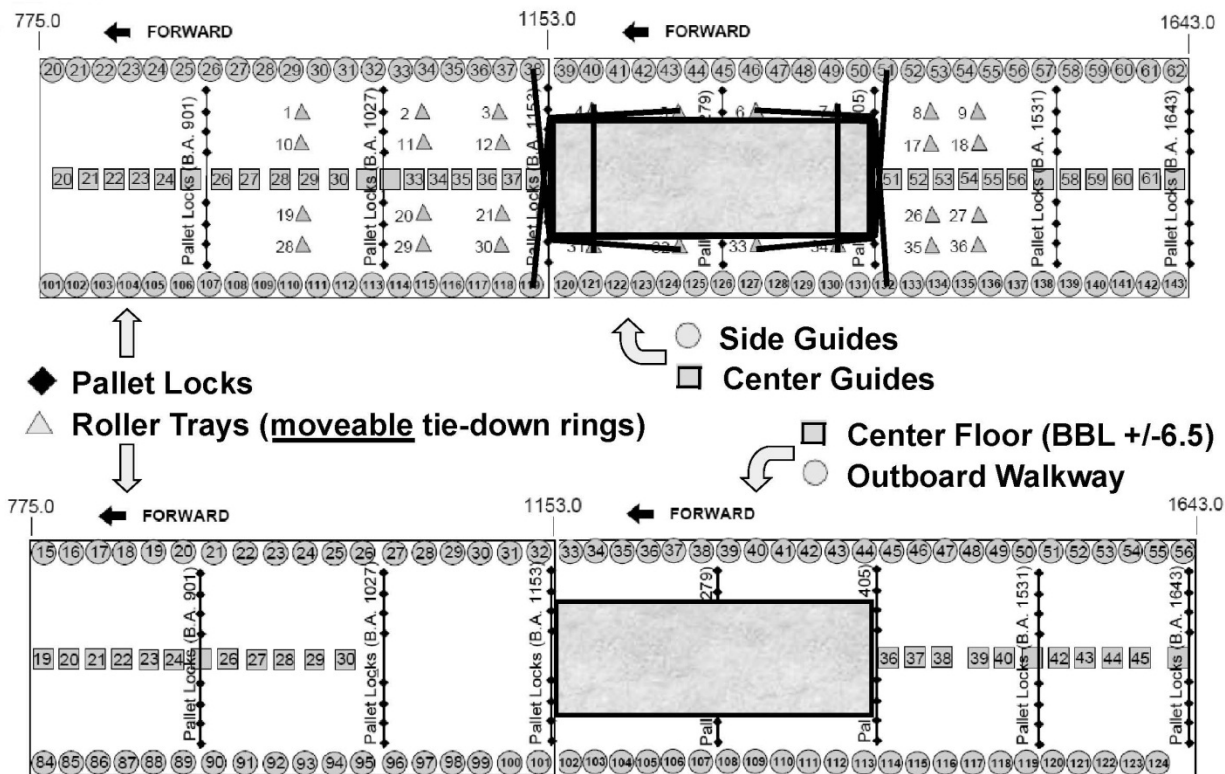
“(3) *Means to Prevent Pressurization:* All doors must have provisions to prevent initiation of pressurization of the aircraft to an unsafe level if the door is not fully closed, latched, and locked.”

“(4) *Lock Strength:* Locks must be designed to withstand the maximum output power of the actuators and maximum expected manual operating forces treated as a limit load. Under these conditions, the door must remain closed, latched, and locked.”

“(5) *Power Availability:* All power to the door must be removed in flight, and it must not be possible for the flightcrew to restore power to the door while in flight.”

APPENDIX H. EXAMPLE PROPOSED TIEDOWN SCHEME FOR A SINGLE SPECIAL CARGO ITEM

Proposed tie-down locations for 6 straps



NOTE: This example does not include the complete aircraft load.

APPENDIX I. ACTIVE UNIT LOAD DEVICE MARKING

