

INCH-POUND

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DETAIL SPECIFICATION

MANUALS, TECHNICAL - AIRCRAFT CARGO LOADING AND OFF-LOADING



Comments, suggestions, or questions on this document should be addressed to AFLCMC/HIAM Technical Data Section, 4170 Hebble Creek Road, Bldg. 280, Door 15, Area A, Wright-Patterson AFB, OH 45433-5653 or emailed to SGMLsupport@us.af.mil. Since contact information can change, the currency of this address information should be verified using the ASSIST Online database at <https://assist.dla.mil/>.

AMSC N/A

AREA TMSS

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This specification is approved for use by all Departments and Agencies of the Department of Defense.

1 SCOPE

1.1 Scope. This detail specification reflects the requirements of multiple Services (see 6.7) to be utilized for the preparation of publications that provide information and instructions for loading, securing loads, and off-loading aircraft cargo, including handling of airdrop loads and nuclear weapons cargo. Certain provisions of this specification (see 3.2.5) are the subject of North Atlantic Treaty Organization (NATO) Standardization Agreement STANAG-3767 (see 6.6).

2 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL STANDARDIZATION AGREEMENTS

STANAG-3767 Exchange of Data on Load Capabilities of Transport Aircraft

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5096 Manuals, Technical – Inspection and Maintenance Requirements; Acceptance and Functional Check Flight Procedures and Checklists; Inspection Work Cards; and Checklists; Preparation of

MIL-DTL-85025 NATOPS Program Technical Publications and Products; Style, Format, and Common Technical Content

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-38784 General Style and Format Requirements for Technical Manuals

(Copies of federal and military specifications, standards and handbooks are available at <http://quicksearch.dla.mil/> or from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2.2 Other government documents, drawings and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation or contract (see 6.2).

MULTI-SERVICE MANUALS

FM 4-20.102, MCRP 4-11.3J, NAVSEA SS400-AB-MMO-010 and TO 13C7-1-5

Airdrop of Supplies and Equip -- Rigging Airdrop Platforms; Airdrop Derigging and Recovery Procedures; Reference Data for Airdrop Platform Loads (TM 4-48.02)

(Copies of these documents required by users with "mil" government web address access are available online at <https://www.my.af.mil/etims/ETIMS/index.jsp>. Refer to helpdesk information if obtaining copies without a TO subscription account. Copies of documents required by contractors in connection with specific procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

AIR FORCE INSTRUCTIONS

AFI 91-104 Nuclear Surety Tamper Control and Detection Programs

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(Copies of this document are available online at <http://www.e-publishing.af.mil>. Copies of documents required by contractors in connection with specific procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

3.1 General requirements. The general manner of development and preparation for aircraft cargo loading and off-loading Technical Manuals (TM), hereafter called manuals, and checklists shall be in accordance with MIL-STD-38784 and MIL-DTL-5096.

3.1.1 Format. Format of the manuals shall be in accordance with the requirements of MIL-STD-38784, except as otherwise specified herein. Unless otherwise specified by the acquiring activity, chapters and sections shall be arranged as identified herein (see 6.2b).

3.1.2 Contents. The manuals shall contain all essential information and instructions for loading, securing loads, and off-loading cargo aircraft. Typical loads consist of vehicles, weapons, heavy equipment, bombs, warheads, missiles, aircraft, troops, litters, containers, airdrop modular platforms, and general cargo-palletized and unpalletized. The manuals shall contain only handling procedures and associated information used when the aircraft is on the ground. Inflight procedures shall not be included in the manuals.

3.1.3 Illustrations and tables. In addition to those specified herein, illustrations (including charts, diagrams, etc.) and tables which distinctly contribute to the clarity and understanding of instructions and procedures shall be used. Illustrations and tables for each chapter shall be placed at the end of the chapter following the text. Illustrations shall be grouped together followed by the tables.

3.2 Loading Instructions Manual. The Loading Instructions Manual shall be arranged as follows. Appendix A provides the directions for obtaining digital tools for the electronic preparation of this manual.

- a. Front Matter. (See 3.2.1.)
- b. Chapter 1 – Introduction. (See 3.2.2.)
- c. Chapter 2 – Description of Aircraft Features. (See 3.2.3.)
- d. Chapter 3 – Aircraft Configuration. (See 3.2.4.)
- e. Chapter 4 – General Procedures. (See 3.2.5.)
- f. Chapter 5 – Emergency Procedures. (See 3.2.6.)
- g. Chapter 6 – Specific Procedures. (See 3.2.7.)
- h. Chapter 7 – Airdrop Procedures (Personnel and Cargo). (See 3.2.8.)
- i. (M)(N) Chapter 7 – Wheeled Cargo. (For rotary wing and tilt rotor aircraft only: see 3.2.9.)
- j. (M)(N) Chapter 8 – Airdrop Procedures (Personnel and Cargo). (For rotary wing and tilt rotor aircraft only: see 3.2.10.)
- k. Alphabetical Index. (See 3.2.11.)

3.2.1 Front matter. The front matter shall be in accordance with MIL-STD-38784 except the (A)(N) Foreword/Preface/Introduction requirements of MIL-STD-38784 shall be contained in Chapter 1, Introduction.

3.2.2 Chapter 1 – Introduction. Chapter 1 shall state the type of aircraft, series, and model designation and shall briefly describe the aircraft covered by the manual. It shall also provide the following information.

3.2.2.1 Purpose of manual. The following shall be included as a standard paragraph to cover the intended purpose of the manual:

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“The purpose of this manual is to provide cargo handling personnel with sufficient information and data to load, secure, and off-load all types of cargo efficiently and safely and to explain the restrictions governing these operations. The manual includes procedures pertaining to ground functions and air drop procedures.”

3.2.2.2 Brief chapter descriptions. The following brief chapter descriptions shall be included as standard paragraphs in Chapter 1:

- a. “Chapter 2 – Description of Aircraft Features. This chapter presents a general description of the cargo compartment, including profile and cross sections, cargo loading ramp (where applicable), entrances and exits, cargo floor, roller conveyors and guides, restraint rails (where applicable), tiedown fittings, seat and litter provisions, cargo loading aids, and storage provisions for all cargo loading aids and tiedown devices.”
- b. “Chapter 3 – Aircraft Configuration. This chapter presents aircraft preparation instructions with respect to aircraft cargo loading, airdrop provisions and personnel equipment.”
- c. “Chapter 4 – General Procedures. This chapter contains instructions relative to load preplanning, loading, postloading, and off-loading procedures to include checklist.”
- d. “Chapter 5 – Emergency Procedures. This chapter describes all ground preparations required for cargo emergency procedures.”
- e. “Chapter 6 – Specific Procedures. This chapter contains all necessary instructions relative to preloading, loading, postloading, preflight, and off-loading procedures for cargo which, due to physical characteristics, cannot be handled in accordance with the general procedures of chapter 4 and therefore requires special handling.”
- f. “Chapter 7 – Airdrop Procedures. This chapter presents instructions relative to the procedures required for airdrop of personnel and cargo.”
- g. (M)(N) “Chapter 7 – Wheeled Cargo. This chapter presents instructions relative to the procedures required for the load planning, loading, restraining, post-loading, and off-loading of wheeled cargo.” Note: To be used in conjunction with the Chapter 7 requirements for rotary wing and tilt rotor aircraft in [3.2.9](#).
- h. (M)(N) “Chapter 8 – Airdrop Procedures. This chapter presents instructions relative to the procedures required for airdrop of personnel and cargo.” Note: To be used in conjunction with the Chapter 8 requirements for rotary wing and tilt rotor aircraft in [3.2.10](#).

3.2.3 Chapter 2 – Description of Aircraft Features. Chapter 2 shall contain the following information, in the order specified, with necessary explanatory notes, text, and figures.

- a. General Aircraft Description. (See [3.2.3.1](#).)
- b. Aircraft Cargo Area. (See [3.2.3.2](#).)
- c. Aircraft Cargo Aids. (See [3.2.3.3](#).)

3.2.3.1 General Aircraft Description. A general description of the aircraft and of the aircraft cargo, troop carrying, litter carrying, and airdrop capabilities shall be included. A brief description of safety belts and harnesses shall also be included.

3.2.3.2 Aircraft Cargo Area. A general description of the aircraft cargo area shall be provided, including, but not limited to, the following:

- a. Cargo Compartment. Envelope profile and cross sectional drawings, showing all dimensions in inches and compartment identification by letter, shall be provided. Critical dimensions which limit full use of the cargo compartment shall also be provided. Coverage shall include information pertaining to location of electrical outlets and type of electrical power supplied in the cargo compartment as well as brief coverage of communication systems and lighting equipment which may be used during cargo loading and off-loading. Information on the location, type, and dimensions of each cargo compartment overboard vent shall be provided. (M)(N)

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Note: The following applies to rotary wing and tilt rotor aircraft only. Supporting illustrations (see examples in figure 20) shall be provided showing diagrams of the cargo compartment loading zones that indicate fuselage stations, cargo compartment tiedown fittings, and compartment envelope dimensions. Figures shall be referenced in the text.

- b. Cargo Area Floors. A description shall be given of the main cargo floors, treadways (when required), and maneuvering areas. Plan views of the cargo floor, showing locations of tiedown fittings, roller conveyors, and restraint/guide rails shall also be included.
- c. Cargo Loading Ramps. Where applicable, description of all parts of the aircraft ramp system (basic ramps, ramp extensions and ramp toes) shall be provided. This shall include the relative angles between system components and between the system, the ground and the cargo floor. Plan views of the ramp system, showing the location of tiedown fittings, roller conveyors, and restraint/guide rails and locks shall also be included.
- d. Personnel and Troop Provisions and Access Areas. Personnel and troop entrance and exit doors shall be identified and described with any pertinent features included. A plan view of troop seating arrangement and litter provisions shall be included. A general description of comfort provisions shall also be included. Emergency provisions and exits shall be identified.
- e. Cargo Doors. Cargo doors shall be identified and any pertinent features described, including limiting dimensions.
- f. Cargo Tiedown Fittings. Cargo tiedown fittings shall be described listing type, strength ratings (specify design limit or ultimate), and location in the cargo area, including stowage locations, when applicable. Identifying color codes and markings shall be explained.

3.2.3.3 Aircraft Cargo Aids. Where applicable, a description of aircraft cargo loading and off-loading aids and cargo securing equipment shall include, but not be limited to, the following:

- a. Auxiliary Ramps/Bridges.
- b. Beveled Step-Up Shoring.
- c. Splice Plates.
- d. Cargo Ramp Support Stand.
- e. Cranes/Hoists.
- f. Snatch Blocks.
- g. Pulleys.
- h. Winches.
- i. Tiedown Devices.
- j. Roller Conveyors/Ball Transfer Pads.
- k. Guide/Restraint Rails.
- l. Tail Support Devices.
- m. Pry bars.

3.2.3.3.1 Cargo aid stowage. Stowage provisions shall be described for all cargo aids which are carried on the aircraft.

3.2.4 Chapter 3 – Aircraft Configuration. The Aircraft Configuration chapter shall be arranged to present all information necessary for aircraft preparation, functional checks and step-by-step installation instructions for the following aircraft equipment:

- a. Tail supports, ramps, and doors.
- b. Restraint rails and roller conveyors.
- c. Sidewall and centerline seats.

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- d. Stanchion kit.
- e. Litter provisions.
- f. Rigid aft or forward facing seats, troop seats, safety belts, and harnesses.
- g. Oxygen system.
- h. Crane and winch.
- i. Load assist devices.
- j. Support jacks.
- k. Airdrop systems installation.
- l. Cargo tiedown fittings.

3.2.5 Chapter 4 – General Procedures. The General Procedures chapter shall contain general instructions relative to load pre-planning/planning, loading, postloading, off-loading, and winching/hoisting procedures (charts, scales, drawings, etc.). The data and information presented in this chapter shall pertain to cargo which can be loaded and transported in the aircraft without the use of special handling procedures such as those discussed in 3.2.7. Unless otherwise specified by the acquiring activity (see 6.2c), Chapter 4 shall be divided into five sections as follows:

- a. Section I – Load Planning. (See 3.2.5.1.)
- b. Section II – Load Methods and Restraint. (See 3.2.5.2.)
- c. Section III – Winching. (See 3.2.5.3.)
- d. Section IV – On/Off-Loading Procedures. (See 3.2.5.4.)
- e. Section V – Charts and Graphs. (See 3.2.5.5.)

3.2.5.1 Section I – Load Planning. Unless otherwise specified by the acquiring activity (see 6.2d), load planning shall present instructions for, but not limited to the following:

- a. Aircraft Capability/Capacity Data. (See 3.2.5.1.1.)
- b. General Weight and Balance Requirements. (See 3.2.5.1.2.)
- c. Loading and Placement of Hazardous Cargo. (See 3.2.5.1.3.)
- d. Maximum Weight Per Mission. (See 3.2.5.1.4.)
- e. Weight and Balance Factors and Formulas. (See 3.2.5.1.5.)
- f. Center of Gravity Computations for Aircraft and Cargo. (See 3.2.5.1.6.)
- g. Weight and Balance Computer Operation. (See 3.2.5.1.7.)

3.2.5.1.1 Aircraft Capability/Capacity Data. The following strength and physical limitation information for cargo area floors and roller conveyors shall be provided to support load planning.

- a. Cargo area floors. Strength capability data for the main cargo floors, treadways (if applicable), and maneuvering areas shall be provided. A plan view of the cargo floor showing variations in floor strength and local concentrated load limitations in various areas shall also be included. Strength data for the ramps, where applicable, shall be included. The data provided shall include, but shall not be limited to, the following parameters:
 - 1. Maximum allowable loads on and off treadways, if applicable, for both loading/off-loading and flight conditions, shall be shown for the entire cargo floor area, including the ramp. This information shall be derived from test data and shall represent the actual floor strength capability.
 - 2. Crushing allowable in pounds per square inch (psi), as well as working allowable (in psi), for both loading/off-loading and flight conditions shall be shown for all areas of the cargo floor, including the ramp. This information shall be based on actual floor strength test data.

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3. Allowable wheel loads on and off treadways, if applicable, for both loading/off-loading and flight conditions, shall be determined for the entire cargo floor and ramp using actual floor capability test results. These data shall cover solid rubber, pneumatic, and steel wheels, and shall be shown in graphic form for various width wheels, i.e., wheel width versus (vs) allowable load for specified floor regions. The data provided shall also include sample problems for skid and tracked vehicle loads.
 4. Shoring requirements shall be established for steel and rubber wheels, pneumatic tires, and for rolling and parking loads on and off the treadway, if applicable. This information shall be derived from test data.
 - b. Roller conveyors. Information shall be provided on the load carrying capabilities. Load carrying data provided shall include individual roller strength based on test data and the capabilities of various combinations of rollers (i.e., per row of rollers across the cargo floor, per specific length or given number of rollers in one conveyor, etc.). Locations shall be in terms of aircraft/ramp buttlines and stations. The types of rollers in each conveyor, and conveyor interchangeability information shall also be provided.
- 3.2.5.1.2 General Weight and Balance Requirements. This paragraph shall include all the factors that must be taken into consideration before actual loading is accomplished.
- 3.2.5.1.3 Loading and Placement of Hazardous Cargo. This paragraph shall identify the planning required for all classes of hazardous materials that may be transported, their location on the aircraft and appropriate jettison information.
- 3.2.5.1.4 Maximum Weight Per Mission. A statement shall be included that prior to loading, loading personnel shall assemble data pertinent to the aircraft weight and the item(s) of equipment to be loaded (such as weight, dimensions, center of gravity (CG) location, contact area, and contact area ground pressure) for use in positioning the load.
- 3.2.5.1.5 Weight and Balance Factors and Formulas. This paragraph shall contain a graph or list of various formulas used in computing aircraft weight and balance calculations (see figure 1).
- 3.2.5.1.6 Center of Gravity Computations for Aircraft and Cargo. A graph showing approximate allowable net cargo CG vs fuselage stations shall be included. The graph shall include loading from zero to maximum cargo and minimum to maximum fuel. The graph shall be based upon a range of aircraft basic weights and CG locations to allow for anticipated variations in these values. The graph shall contain instructions to the effect that final loading for operation of the particular aircraft shall be within the CG range (include a reference to the applicable Basic Weight Checklist and Loading Data TM). An example of the computation required to determine the CG of a typical cargo load shall be included (see figure 2).
- 3.2.5.1.7 Weight and Balance Computer Operation. If a weight and balance computer is installed, a reference to the computer as the source of information for computation of final load position in the aircraft shall be included.
- 3.2.5.2 Section II – Load Methods and Restraints. The Load Methods and Restraints section shall have the following arrangement. Appropriate warnings, cautions, and notes as required to assure safety of operations shall be included.
- a. General. (See 3.2.5.2.1.)
 - b. Loading Methods. (See 3.2.5.2.2.)
 - c. General Vehicle On/Off-Loading. (See 3.2.5.2.3.)
 - d. Palletized Cargo On/Off-Loading. (See 3.2.5.2.4.)
 - e. Passenger/Troop On/Off-Loading. (See 3.2.5.2.5.)
 - f. Restraint Criteria. (See 3.2.5.2.6.)
- 3.2.5.2.1 General. This paragraph shall discuss the general contents of this section relative to cargo on/off-loading and restraints (on/off-loading, restraining, and securing cargo).

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3.2.5.2.2 Loading Methods. Loading methods shall include information pertaining to floor structure, material handling equipment, and mission accomplishment. Procedures shall be required for specific items of cargo depending on the size, weight, and physical characteristics. Portable loading ramp extension assembly/disassembly information and the use of steel bridge plates, pry bars, winches, and forklifts shall be included.

3.2.5.2.3 General Vehicle On/Off-Loading. Instructions, safety precautions, shoring requirements, and the use of hand signals for loading and off-loading of equipment and placing it into position by in-flight axle loads on the cargo floor shall be included. (N) For hand signals, see figures 3 through 12. Instructions for securing vehicles for turbulence and the following procedures shall also be included:

- a. Assembly of equipment for loading (e.g., vehicles, tiedown devices, chocks, and loading aids).
- b. Operation of cargo doors, ramps, load assist devices, aircraft support struts/jacks, etc.
- c. Assembly and checking of off-loading aids.
- d. Releasing of cargo restraint devices.
- e. Preparation of cargo compartment and floor including stowage of seats, installation of fittings, etc.

3.2.5.2.4 Palletized Cargo On/Off-Loading. Instructions, safety precautions, shoring requirements, and use of hand signals for loading and off-loading of palletized cargo shall include those requirements in 3.2.5.2.3 a. through e, in addition to a. through e. below. (N) For hand signals see figures 3 through 12.

- a. Pallet construction.
- b. Pallet load limitations.
- c. Pallet preparation.
- d. Limitations/restraints for shipping of empty pallets.
- e. Aircraft pallet positions and loading procedures.

3.2.5.2.5 Passenger/Troop On/Off-Loading. A description of all steps necessary for loading and off-loading troops shall be included as follows:

- a. Instructions for Operation of Safety Belts and Harnesses or a reference to the appropriate Flight Manual Passenger Briefing.
- b. Instructions for Troop Loading Procedure.
- c. Instructions for Troop Off-Loading Procedure.

3.2.5.2.6 Restraint Criteria. Restraint criteria shall be provided, as applicable, for the aircraft model and shall include the following instructions:

- a. Application Of Applied Restraints. This shall include the following as it applies to the load forces encountered during flight and crash landing:
 1. Fundamental principles of cargo restraint.
 2. Cargo restraint load factors.
 3. Minimum resistance force.
 4. Effects of applying restraints at angles.
- b. Application of Tiedown Device. Application of tiedown devices shall take into account that the load on a tiedown device shall be compatible with the strength of the fitting. Instructions for tying down the equipment or cargo and methods of attaching tiedowns shall include the following:
 1. Determination of type and quantity of tiedown devices required.
 2. Show location of tiedown rings.
 3. General rules for applying tiedowns.
 4. Tiedown angles.

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5. Tiedown angle ratio method.
6. Tiedown rings – vertical restraint limits.

3.2.5.3 Section III – Winching. The Winching section shall have the following arrangement: Appropriate warnings, cautions, and notes as required to assure safety of operations shall be included.

If required by the acquiring activity, this section shall include the method for calculating the required cargo winch cable pull, based on the vehicle weight, loading method and associated friction coefficient. This section shall also provide a way to determine the required number of snatch blocks or pulleys based on the vehicle weight and method of loading.

- a. General. (See 3.2.5.3.1.)
- b. Friction Effects on Winching. (See 3.2.5.3.2.)
- c. Winching Procedures. (See 3.2.5.3.3.)

3.2.5.3.1 General. This paragraph shall discuss the general contents of this section and the need for winching procedures for certain cargo loads.

3.2.5.3.2 Friction Effects on Winching. The effects of friction during winching operations shall be explained by use of the descriptive requirements identified below:

- a. Friction.
- b. Coefficient of friction.
- c. Rolling friction.
- d. Average coefficient of friction.
- e. Winching up an incline.
- f. Winching along horizontal cargo floor.

3.2.5.3.3 Winching Procedures. These procedures shall contain instructions for on/off-loading of cargo by winching as identified below:

- a. Preparation.
- b. Winch cables.
- c. Cargo winch operating procedures using cargo winch control panel or remote control grip assembly.
- d. Portable heavy cargo winch (installation, preoperational checkout, and operation).
- e. Winch loading (palletized cargo or airdrop platforms).
- f. External winching using vehicle mounted winch.
- g. Vehicle self winching.

3.2.5.4 Section IV – On/Off-Loading Procedures. The On/Off-Loading Procedures section shall contain checklist information to be used for quick reference during on/off-loading as identified below. A statement shall be included stating that this section is incomplete without the loadmaster checklist (see figure 13).

- a. Load Planning checklist.
- b. General Winching Preparation checklist.
- c. General Winching checklist.
- d. Palletized Cargo Loading checklist.
- e. Vehicle Inspection checklist.
- f. Vehicle Loading checklist.
- g. Cargo Off-Loading checklist.
- h. Personnel Loading checklist.
- i. Personnel Off-Loading checklist.

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3.2.5.5 Section V – Charts and Graphs. The Charts and Graphs section shall contain charts and graphs for determining cargo size, weight, shoring requirements, and loading area clearance limits. The arrangement shall be as shown below. Appropriate warnings, cautions, and notes as required to assure safety of operations shall be included.

If required by the acquiring activity, this section shall include the method for calculating approach and cresting shoring. This section shall also include any requirements in terms of the required length of contact of the ramp toes and the shoring or the ramp pedestal support and shoring in order to ensure that the ramp and ramp toe structure can withstand the loads imposed during loading.

- a. General. (See 3.2.5.5.1.)
- b. Geometric Considerations. (See 3.2.5.5.2.)
- c. Structural Considerations. (See 3.2.5.5.3.)
- d. Shoring Requirements. (See 3.2.5.5.4.)
- e. Roller Conveyor Limits. (See 3.2.5.5.5.)

3.2.5.5.1 General. This paragraph shall discuss the general content and purpose of this section.

3.2.5.5.2 Geometric Considerations. For the purpose of identifying cargo size limitations based on the internal dimensions of the cargo compartment and forward and aft openings, explanatory text, charts, and graphs shall include but not be limited to, the following:

- a. Cargo Size Limitations.
- b. Cargo Weight Loading Envelope.
- c. Forward and Aft Loading Area Clearance Limits.
- d. Forward and Aft Loading Vehicle Projection Limits.
- e. Vehicle Critical Dimensions.
- f. Ramp Crest Heights and Crest Limits.
- g. Parking Overhang Clearance Limits.
- h. Loading Overhang Limits.
- i. Cargo Compartment Plan View.

3.2.5.5.3 Structural Considerations. Loading limitations based on the weight of the cargo, floor limits and compartment loads shall be identified by the use of explanatory text, charts, and graphs, including but not limited to, the following:

- a. Cargo Weight and Cargo Floor Limitations.
- b. Typical Cargo Loading Within Floor Loading Limitations.
- c. Forward and Aft Cargo Ramp On/Off-Loading Limitations.
- d. Cargo Maximum Allowable Lateral CG Location.
- e. Concentrated Floor Loads.
- f. Concentrated Floor Loads with Rubber and Non-Rubber Contact Area.
- g. Maximum Allowable Floor Loads for Hard Rubber, Steel Wheels, or Track Pads.
- h. Maximum Allowable Floor Loads for Concentrated Cargo Located Over Restricted Areas.
- i. On/Off-Loading Maximum Allowable Loads.

3.2.5.5.4 Shoring Requirements. Shoring requirements that may be needed for loading concentrated loads to protect the ramp and cargo shall be identified by the use of explanatory text, charts and graphs, including, but not limited to, the following:

- a. Shoring Materials.

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- b. Shoring for Weight Distribution.
- c. Rolling, Parking, and Sleeper Shoring.
- d. Calculation of Required Shoring for Concentrated Loads.

3.2.5.5.5 Roller Conveyor Limits. Logistics and Aerial Delivery System (ADS) conveyor limits shall be identified by the use of explanatory text, charts, and graphs to identify unit weight and CG location, contact points on roller conveyors, length of roller conveyors, and roller load factors.

3.2.6 Chapter 5 – Emergency Procedures. The Emergency Procedures chapter shall contain all ground preparations required for cargo emergency procedures. It shall include, ground preparation for emergency in-flight jettison of cargo loaded on pallets, ADS cargo loaded on airdrop platforms, nuclear weapon cargo, and reference to the applicable service directives pertaining to hazardous cargo. Unless otherwise specified by the acquiring activity (see 6.2e), this chapter shall have the following arrangement:

- a. Emergency Procedures.
- b. Preflight and Postflight Emergency Procedures.
- c. Inflight Jettison Procedures.

3.2.7 Chapter 6 – Specific Procedures. Chapter 6 shall contain specific instructions for preloading, loading, restraining, postloading, preflight, special handling, and off-loading procedures for all cargo which, due to physical characteristics, prevents it from being classified as general cargo (see 6.4.1). Instructions, listed in proper sequence, shall be provided for preparation of the item for loading and safe restraint of the load item, or combination of items. This chapter shall be so arranged that the instructions for each item of outsized cargo are divided into separate sections to enable deletion, if necessary, or addition of new material without affecting other major sections of the manual. Each item covered shall include a general description paragraph and an identification line drawing. Text may reference appropriate paragraphs in Chapters 3 and 4 for applicable configuration and general procedures.

3.2.7.1 Introductory text. A statement shall be included that a loading diagram is not provided for each item listed, but that one diagram may serve for all items grouped according to similarity of special instructions. The applicable diagram for each item can be found in the List of Illustrations.

3.2.7.2 Illustrations. Illustrations shall consist of a floor plan drawing which depicts all floor fittings (see figure 14). Items such as vehicles showing bumpers, wheels, axle centerline, etc., to indicate the areas for location of the item, or items, can be superimposed over the floor plan drawing to show tiedowns and points of attachments. Keyed to the floor plan drawing shall be a tiedown index similar to the one shown on figure 15. The floor plan illustration shall be large enough to be clearly legible. More than one tiedown index and floor plan drawing may be used if necessary for clarity of a typical load.

(F) Electronic presentation: The floor plan illustration and the tiedown index shall be displayed together in the same view (preferred) or provisions made for toggling between illustrations.

Print presentation: Foldout pages shall be used for this purpose, if specified by the acquiring activity (see 6.2f). The floor plan illustration and the tiedown index shall be on facing pages but may be on the same page if space allows and clear legibility can be obtained.

3.2.7.3 Loading data table. A table of loading data shall be furnished for each major item covered. Format shall be similar to that shown on figure 16. The typical loads used shall not result in values which exceed the approved gross weight or CG limits established for the aircraft. The system of restraint shall be such that the load is in equilibrium when secured in the aircraft.

3.2.7.4 Miscellaneous equipment. Limited instructions and details for outsized cargo not requiring special tiedown features or the complex detailed data as specified in paragraphs 3.2.7 through 3.2.7.3 shall be included. However, when minor modification of this equipment is required for loading and off-loading this information shall also be included. The data shall be similar to the miscellaneous equipment loading data table shown on figure 17.

3.2.8 Chapter 7 – Airdrop Procedures (Personnel and Cargo). Note: If the TM is being developed for rotary wing or tilt rotor aircraft, refer to 3.2.i. The Airdrop Procedures (Personnel and Cargo) chapter shall

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contain specific instructions relative to preloading, preflight, loading, and off-loading procedures for airdrop of personnel and cargo. Nomenclature shall be the same as TO 13C7-1-5 (FM 4-20.102). A chart showing standard extraction parachutes and lock setting data shall be provided and include information similar to that shown on figure 18. This chart shall have the same criteria as contained in TO 13C7-1-5 (FM 4-20.102).

(N) A rigging material chart similar to the one shown on figure 19 shall also be provided. This chapter shall be divided into two sections. The sections shall provide all necessary information with respect to aircraft rigging, of extraction parachutes, setting and checking of platform locks, etc. Unless otherwise specified by the acquiring activity (see 6.2g), the sections shall include but not be limited to, the following:

- a. Section I – Airdrop of Personnel. (See 3.2.8.1.)
- b. Section II – Airdrop of Cargo. (See 3.2.8.2.)

3.2.8.1 Section I – Airdrop of Personnel. This section shall have the following arrangement. Appropriate warnings, cautions, and notes as required to assure safety of operations shall be included.

- a. General (personnel airdrop mission).
- b. Preloading Procedures.
- c. Equipment Installation and Checkout.
- d. Preflight Procedures.
- e. Loading Procedures.
- f. Off-Loading Procedures.

3.2.8.2 Section II – Airdrop of Cargo. This section shall have the following arrangement. Appropriate warnings, cautions, and notes as required to assure safety of operations shall be included.

- a. General (cargo airdrop mission).
- b. System Components.
- c. Platform Acceptance Check.
- d. Loading Procedures.
- e. Emergency Restraint Requirements.
- f. Extraction Parachutes Release Mechanism.
- g. Inspection/Rigging of Extraction Parachutes and Sling Extraction Line Bag.

3.2.9 (M)(N) Chapter 7 – Wheeled Cargo. (M)(N) The following requirements for Chapter 7 – Wheeled Cargo shall apply to rotary wing and tilt rotor aircraft publications, in place of the requirements of 3.2.8, when NAVAIR is the internal cargo certification activity. This chapter shall contain specific instructions for load planning, loading, restraining, post-loading, and off-loading procedures for wheeled cargo. Applicable warnings, cautions, and notes shall be included throughout in accordance with MIL-STD-38784. Unless otherwise specified by the acquiring activity (see 6.2h), the following sections shall be included:

- a. Section I – Introduction. (See 3.2.9.1.)
- b. Section II – Load Methods and Restraints. (See 3.2.9.2.)
- c. Section III – Marshalling. (See 3.2.9.3.)
- d. Section IV – Transport of All Terrain Vehicles and Motorcycles. (See 3.2.9.4.)
- e. Section V – Transport of Certified Vehicles. (See 3.2.9.5.)

3.2.9.1 Section I – Introduction. The Introduction section shall explain the purpose of the chapter, to provide specific instructions relative to load planning and loading, restraining, post-loading, and off-loading procedures for wheeled cargo. It shall state that all wheeled cargo must meet the requirements in this chapter.

3.2.9.2 Section II – Load Methods and Restraints. The Load Methods and Restraints section shall consist of the following topics. Each topic shall be a primary paragraph with supporting procedures arranged in subordinate paragraphs. Internal cross-references shall be included where applicable.

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- a. Vehicle Loading. (See 3.2.9.2.1.)
- b. Ramp Crest Clearance. (See 3.2.9.2.2.)
- c. Parking Overhang Limits. (See 3.2.9.2.3.)
- d. Loading Overhang Clearance. (See 3.2.9.2.4.)
- e. Vehicle Projection Limits. (See 3.2.9.2.5.)
- f. Vehicle Limits. (See 3.2.9.2.6.)

3.2.9.2.1 Vehicle Loading. The Vehicle Loading primary paragraph shall provide the vehicle dimensions to check and recommendations for configuration options to be successful in loading the vehicle (e.g. removing tops, deflating tires).

3.2.9.2.1.1 Vehicle Preparation. This subparagraph(s) shall provide the steps required to prepare the vehicle for loading. The following procedures shall be covered, as applicable, including appropriate warnings, cautions, notes, and internal references to illustrations:

- a. Determine overall dimensions of vehicle to ensure it can be loaded. When applicable, include linking reference to Vehicle Projection Limits (see 3.2.9.2.5).
- b. Determine if structural requirements are met for Load Limits for Pneumatic Tires (include linking to reference related to 3.2.9.2.6.2, when applicable).
- c. Determine center of gravity for vehicle.
- d. Fold mirrors, windshields, tail gates, weapon systems, and antennas.
- e. Secure loose equipment in vehicle.
- f. Load in accordance with NAVSUP 505 PUB/MCO P4030.19/AFMAN 24-204, Preparing Hazardous Materials for Military Air Shipments.
- g. Check vehicle brakes.
- h. Inspect general condition of vehicle (leaks, etc.).
- i. Ensure that fuel tanks are no more than three-quarter full. (Equipment transported with fuel in tanks must be checked in accordance with NAVSUP PUB 505/MCO P4030.19/AFMAN 24-204.)
- j. Ensure cargo loaded on vehicles, loose accessories and equipment on or inside vehicles, are secured for transport.
- k. Direct operator to check brakes and directional controls.

3.2.9.2.1.2 Vehicle Loading Procedures. This subparagraph(s) shall contain the general vehicle loading procedures, including appropriate warnings, cautions, and internal references. For example:

- a. Whether vehicles may be loaded into the aircraft under their own power (engine or winch), or by use of the aircraft winch or by both.
- b. Stowing troop seats and cargo roller rails.
- c. Pre-positioning cargo straps in cabin.
- d. Aligning vehicle carefully with ramp.
- e. Driving or winching vehicle up ramp, and into aircraft ensuring that adequate clearance remains on both sides and top/bottom of vehicle.
- f. Positioning vehicle at proper position inside aircraft.
- g. Tuning vehicle ignition off.
- h. Setting parking brakes.
- i. Driver egress from the vehicle.
- j. Chocking springs and installing sleeper shoring when applicable.
- k. Restraint of vehicle to proper g-levels.

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3.2.9.2.1.3 Vehicle Loading Special Considerations. This subparagraph shall contain instructions, other than general loading procedures, that are special to vehicles. These procedures shall include applicable warnings, cautions, and notes, as well as instructions including but not limited to the following:

- a. The vehicle driver must follow instructions of the ground guide. Caution against attempts by the driver to judge clearances instead of following the ground guide. Prearranged maneuvering signals must be clearly understood.
- b. Caution about the difficulty of backing trailers up the ramp into the aircraft. To aid in loading, trailers should be winched into aircraft whenever possible.
- c. When loading vehicles without brakes, strap gates should be installed to prevent equipment from rolling beyond its loading position.

3.2.9.2.1.4 Vehicle Tiedown. In this subparagraph, the following general guidelines shall be provided for all certified vehicles for which a tiedown has not been provided:

- a. Ensure straps are pre-tensioned properly for spring suspension vehicles to prevent straps becoming slack during flight.
- b. When applying tiedown devices, do not permit them to chafe hydraulic lines, fuel lines, or electrical wiring.
- c. When possible, attach devices to tow hooks, tiedown rings, bumper supports, or frame members.
- d. Do not attach devices to steering mechanisms, tie rods, drive shafts, headlights, grills, and fender brackets.
- e. Ensure cargo carried on the vehicle is properly restrained to the vehicle.
- f. Include a statement that tiedown patterns for the vehicles that have gone through the NAVAIRSYSCOM certification process can be found at the end of this chapter (see 3.2.9.5).

3.2.9.2.2 Ramp Crest Clearance. The Ramp Crest Clearance primary paragraph shall provide crest clearance related guidelines, including specific clearances, dimensions, etc., that are necessary when loading vehicles across the ramp crest from the ground.

3.2.9.2.3 Parking Overhang Limits. Parking Overhang Limits primary paragraph shall provide guidelines for situations when vehicles are parked at the far aft end of the cargo compartment to achieve maximum use of available cargo compartment space.

3.2.9.2.4 Loading Overhang Clearance. Loading Overhang Clearance primary paragraph shall provide guidelines for situations where vehicle structures that have lengthy extensions past the front or rear axles may have difficulty with overhang clearances while loading up the inclined ramp from the ground.

3.2.9.2.5 Vehicle Projection Limits. Vehicle Projection Limits primary paragraph shall provide guidelines requiring attention to difficulties presented by vehicle height profiles relative to cargo compartment entrances while loading on an inclined ramp.

3.2.9.2.6 Vehicle Limits. The Vehicle Limits primary paragraph shall contain the following information that identify vehicle limitations that impacts loading in accordance with the cargo envelope of the aircraft.

3.2.9.2.6.1 Vehicle Size Limits. This subparagraph shall identify vehicle size limitations in accordance with the cargo envelope of the aircraft for width, height, and any other critical dimension.

3.2.9.2.6.2 Load Limits for Pneumatic Tires. This subparagraph shall identify vehicle limitations in accordance with the cargo envelope and limitations of the aircraft relative to the loading limitations of wheel weights, axle weights, minimum wheel track, minimum wheel base, and floor contact pressure. Supporting illustrations (see examples in figure 21) shall be provided containing diagrams with guidance for determining pneumatic tire contact area, use of floor contact pressure formulas, and cabin loads limits for pneumatic tires.

3.2.9.2.6.3 Load Limits for Hard Rubber Tires/Rigid Wheels. This subparagraph shall identify vehicle limitations in accordance with the cargo envelope and limitations of the aircraft relative to loading vehicles

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with hard rubber tires, steel wheels/casters, or similar wheels. Supporting illustrations (see example in figure 22) shall be provided containing diagrams for determining shoring for hard rubber tires or steel wheels.

3.2.9.3 Section III – Marshalling. The Marshalling section shall provide guidance for use of marshalling with wheeled cargo and forklifts that supplements the marshalling instructions previously provided herein. Marshalling instructions shall be written to safely direct vehicles and forklifts around the aircraft. Supporting illustrations (see examples in figure 23) shall be provided showing the hand signals required for use by the loading team. Instructions shall be provided based on the following guidelines, to prevent damage to the aircraft (warnings and cautions to be provided as needed):

- a. The entire loading team will be briefed; the vehicle driver will be briefed on hand signals to be used.
- b. Only one person will direct the driver; the marshaller will always be in direct view of the driver and ensure driver can see hand movements; the team will be made aware that darkness, weather, or gloves may make visibility of hand signals difficult; guides will be assigned to observe critical clearances.
- c. Ensure no personnel are between the vehicle and the aircraft ramp.
- d. Major adjustments will be made at least 10 feet from aircraft ramp.
- e. Chocks will be pre-positioned on the ground for forklift operations.

3.2.9.4 Section IV – Transport of All Terrain Vehicles (ATV) and Motorcycles. The Transport of All Terrain Vehicle (ATV) and Motorcycles section shall provide any special handling considerations for vehicles that fall under the ATV or motorcycle category. When this section is not required, the section heading (section number and title) shall be included, followed by “Not Applicable.” Section information should reflect the following:

- a. The total weight of these vehicles is typically around the aircraft limitation of a single wheel weight (other limitations on vehicle size may be applicable).
- b. These vehicles are required to meet limitations for pneumatic tires except for wheel base and track.
- c. The tiedown rings shall not be used for restraint on ATVs unless they have been structurally certified by a DoD agency.
- d. If tiedown rings on the ATV do not exist or cannot be used, straps should be wrapped around adequate structure on the ATV to ensure proper restraint.
- e. Kickstands on motorcycles (if utilized) shall be shored with a piece of wood prior to restraints.

3.2.9.5 Section V – Transport of Certified Vehicles. The Transport of Certified Vehicles section shall provide the certification procedures for loading certified vehicles. Coverage for individual vehicles shall be contained in separate primary paragraphs within the section; the paragraph headings shall indicate the type of vehicles. Figures shall be incorporated as needed to support the procedures (see example illustrations provided in figure 24).

3.2.10 (M)(N) Chapter 8 – Airdrop Procedures (Personnel and Cargo). (M)(N) Chapter 8 – Airdrop Procedures (Personnel and Cargo) shall be included in the manual when (M)(N) Chapter 7 – Wheeled Cargo (see 3.2.9) requirements are being exercised for rotary wing or tilt rotor aircraft and shall follow the requirements of Chapter 7 – Airdrop Procedures (Personnel and Cargo) contained in 3.2.8.

3.2.11 Alphabetical index. An alphabetical index shall be included and prepared in accordance with the requirements of MIL-STD-38784.

3.3 Nuclear Weapon Cargo Loading Manual. The Nuclear Weapon Cargo Loading Manual shall be arranged as follows. Appendix B provides the directions for obtaining digital tools for the electronic preparation of this manual.

- a. Front matter.
- b. Chapter 1 – Introduction. (See 3.3.1.)
- c. Chapter 2 – Loading, Off-Loading, and General Procedures. (See 3.3.2.)

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- d. Chapter 3 – Bombs – Specific Procedures. (See 3.3.3.)
- e. Chapter 4 – Warheads – Specific Procedures. (See 3.3.4.)
- f. Chapter 5 – Missiles and Other Nuclear Weapon Cargo – Specific Procedures. (See 3.3.5.)
- g. Chapter 6 – Emergency Procedures. (See 3.3.6.)
- h. Chapter 7 – Logistic Movement Procedures. (See 3.3.7.)
- i. Alphabetical index.

3.3.1 Chapter 1 – Introduction. Chapter 1 shall be prepared in accordance with the requirements of 3.2.2, except that the following information shall also be included:

- a. Nuclear Safety Certification Statement.
- b. Two-Person Concept.
- c. Designation of Bombs, Warheads, Basic Assemblies, and Carriers.

3.3.1.1 Nuclear Safety Certification Statement. The following statement shall be included as a standard paragraph:

“The support equipment and procedures contained herein have been evaluated and are acceptable for this prescribed routine use with nuclear weapons.”

3.3.1.2 Two-Person Concept. Unless otherwise specified by the acquiring activity (see 6.2i), the definition of the two-person concept as given in (F) AFI 91-104 or (N) AIRLANT/AIRPAC Instructions shall be included in this paragraph.

3.3.2 Chapter 2 – Loading, Off-Loading, and General Procedures. Unless otherwise specified by the acquiring activity (see 6.2j), this chapter shall contain loading and off-loading procedures common to all nuclear weapon cargo, using various methods and equipment. This chapter shall have the following arrangement with appropriate warnings, cautions, and notes to assure safety of operation.

- a. General. (See 3.3.2.1.)
- b. General Precautions and Practices. (See 3.3.2.2.)
- c. Restrictions on Tiedown. (See 3.2.5.2.6.)
- d. Shoring. (See 3.2.5.5.4.)
- e. Loading Aids. (See 3.2.3.3.)
- f. Winch Preparation. (See 3.2.5.3.3.)
- g. Loading/Off-Loading and Jettisoning. (See 3.2.5.2.)

3.3.2.1 General. This paragraph shall discuss the general content and purpose of this chapter and shall contain a reference to the appropriate Loading Instructions Manual (see 3.2) and checklist (see 3.4) to be used in conjunction with these procedures.

3.3.2.2 General Precautions and Practices. Information relative to proper inspections and general precautions to be followed when loading nuclear weapon cargo shall be included.

3.3.3 Chapter 3 – Bombs – Specific Procedures. In addition to the information in 3.2.7 this chapter shall include a general paragraph containing a brief description of each bomb to be loaded and off-loaded.

3.3.4 Chapter 4 – Warheads – Specific Procedures. In addition to the information in 3.2.7 this chapter shall include a general paragraph containing a brief description of each warhead to be loaded and off-loaded.

3.3.5 Chapter 5 – Missiles and Other Nuclear Weapon Cargo – Specific Procedures. In addition to the information in 3.2.7 this chapter shall include a general paragraph containing a brief description of each missile or nuclear weapon to be loaded or off-loaded.

3.3.6 Chapter 6 – Emergency Procedures. Unless otherwise specified by the acquiring activity (see 6.2k), this chapter shall contain policies and procedures for communication, firefighting, general accidents, emergency

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destruction, unscheduled landings, accident/incident follow-up procedures, and applicable information contained in 3.2.6. These procedures shall be covered by reference to other manuals or detailed instructions.

3.3.7 Chapter 7 – Logistic Movement Procedures. This chapter shall cover emergency logistic movement of nuclear weapon cargo for maximum tested and maximum density aircraft loads. Arrangement shall be similar to chapters 2, 3, 4, and 5. Exception: Routine loading and off-loading procedures contained in chapter 2 shall not be repeated in this chapter.

3.4 Checklists. Unless otherwise specified by the acquiring activity (see 6.2l), loadmaster checklists and nuclear weapon cargo checklists shall be prepared to cover each phase of the specified procedures. The format shall be as shown on figure 13 and shall conform to the general checklist requirements of (F) MIL-DTL-5096 or the general requirements of (N) MIL-DTL-85025. The checklists shall include, but not be limited to the categories shown below. Appendix C provides the directions for obtaining digital tools for the electronic preparation of this manual.

- a. Title page/screen.
- b. Print presentation: List of Effective Pages (LEP).
- c. (F) Electronic presentation: List of Changes (LOC)-see MIL-STD-38784.
- d. Introduction.
- e. Table of Contents (TOC).
- f. Load planning.
- g. General winching preparation.
- h. General winching.
- i. Palletized cargo loading.
- j. Vehicle inspection.
- k. Vehicle loading.
- l. Cargo off-loading.
- m. Personnel loading.
- n. Personnel off-loading.

4 VERIFICATION

4.1 Verification requirements. When the technical data produced according to this specification is offered for acceptance, all tests, reviews, and verifications required by the acquiring activity to determine that it conforms to the requirements in Section 3 of the specification, shall be accomplished as specified (see 6.2m and 6.8).

4.2 Compliance. TMs shall meet all requirements of section 3 of this specification and the appropriate Markup Language Tool appendix, as required by the acquiring activity (see 6.2). The requirements set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any requirements in this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies, submitted to the government for acceptance, comply with all requirements of the contract. Use of sampling inspections shall be at the discretion of the contractor, and in accordance with commercially acceptable quality assurance procedures. However, use of sampling in QA procedures does not authorize submission of known defective material, either indicated or actual, nor does it commit the government to accept defective material.

5 PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the

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Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Manuals and checklists prepared in accordance with this document are intended for use in properly loading, securing loads, and off-loading cargo. They are specific to military cargo aircraft and are military unique in that they are used in combat related conditions as well as contain information on airdrop of military personnel and cargo.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this document.
- b. If arrangement of chapters and sections is to be other than as specified in this document (see 3.1.1).
- c. If arrangement of chapter 4 will be other than as specified in this document (see 3.2.5).
- d. If load planning is to be other than as specified in this document (see 3.2.5.1).
- e. If arrangement of chapter 5 will be other than as specified in this document (see 3.2.6).
- f. Print presentation: If foldout pages are required for floor plans (see 3.2.7.2).
- g. If chapter 7 section arrangement is to be other than as specified in this document (see 3.2.8).
- h. (M)(N) If chapter 7 section arrangement is to be other than as specified in this document (see 3.2.9).
- i. If inclusion of the definition of the two-person concept will be other than as specified in this document (see 3.3.1.2).
- j. If chapter 2 is to contain other than loading and off-loading procedures common to all nuclear weapon cargo (see 3.3.2).
- k. If chapter 6 emergency procedures are to be prepared other than as specified in this document (see 3.3.6).
- l. If loadmaster and nuclear weapon cargo checklists are to be prepared other than as specified in this document (see 3.4).
- m. The requirements for tests, reviews, and verifications specified for manuals developed under this specification (see 4.1).
- n. Specify which apply for this contract: (F) electronic presentation or print presentation requirements in section 3; identify any exceptions by specific paragraph number (see 6.4).

6.3 Technical manuals. The requirement for TMs should be considered when this specification is applied on a contract. If TMs are required, specifications and standards that have been authorized and assigned an Acquisition Management Systems Control (AMSC) number must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The TMs must be acquired under separate contract line item in the contract.

6.4 Definitions. To clarify the terms used throughout this specification, the following definitions are given:

6.4.1 Cargo requiring specific procedures. Items that are transportable but require special instructions regarding loading procedures, restraint, shoring, restricted locations in the aircraft, or which may be transportable if partially disassembled.

6.4.2 Electronic presentation. Unique formatting and functionality requirements for developing TMs as modular or content-oriented data (as opposed to linear document-oriented/printed publications) to be rendered digitally, e.g., in HTML or equivalent, for display in a browser, viewer, etc.

6.4.3 Print presentation. Unique formatting and functionality requirements for developing TM data to be rendered as linear document-oriented/printed publications, including ISO 32000-1:2008 (or later) Document

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management -- Portable document format data. Note: Features of electronic functionality, e.g., hot-linking, bookmarks, etc., native to ISO 32000-1 displayable documents may be used.

6.5 Subject term (key word) listing.

- Aircraft configuration
- Airdrop procedures
- Emergency procedures
- General procedures
- Specific procedures

6.6 International standardization agreement implementation. This specification implements STANAG-3767 Exchange of Data on Load Capabilities of Transport Aircraft. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the US National Point of Contact for the international standardization agreement, as identified in the ASSIST database at <https://assist.dla.mil>.

6.7 Specific Service requirements. Throughout this publication requirements that are only applicable to specific United States Military Services are indicated by the following: (A) Army, (F) Air Force, (M) Marine Corps, and (N) Navy. See 1.1.

6.8 TM verification requirements. The Air Force Technical Order Policy and Procedures (AF TOPP) team, AFMC/A4FI, provides the specific requirements for verification of technical data developed and delivered through this specification, as well as guidance for including these requirements in the solicitation or contract (see TO 00-5-3, AF Technical Order Life Cycle Management, available through the AF ETIMS website—see 2.2.2 for obtaining copies). See 4.1.

6.9 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

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1.	WEIGHT AND BALANCE FORMULAS: $ARM \times WEIGHT = MOMENT$ $MOMENT \div ARM = WEIGHT$ $MOMENT \div WEIGHT = ARM$ $\frac{LENGTH \ OF \ MAC \times \ DESIRED \ \% \ MAC}{100} + DISTANCE \ TO \ LEMAC$ $DESIRED \ AIRPLANE \ CG \ STATION$ $GROSS \ MOMENT \div GROSS \ WEIGHT = AIRPLANE \ CG \ STATION$ $\frac{AIRPLANE \ CG \ STATION - LEMAC}{LENGTH \ OF \ MEAN \ AERODYNAMIC \ CHORD} \times 100 = \% \ OF \ MAC$
2.	VEHICLE CG FORMULAS: $\frac{DISTANCE \ FROM \ FRONT \ AXLE \ TO \ CG \times VEHICLE \ GROSS \ WEIGHT}{WHEEL \ BASE} = REAR \ AXLE \ WEIGHT$ $\frac{REAR \ AXLE \ WEIGHT \times WHEEL \ BASE}{VEHICLE \ GROSS \ WEIGHT} = DISTANCE \ FROM \ FRONT \ AXLE \ TO \ VEHICLE \ CG$
	NOTE FOR VEHICLES HAVING MORE THAN TWO AXLES, MULTIPLY EACH AXLE WEIGHT BY ITS DISTANCE FROM THE FRONT AXLE, AND ADD THEM ALL TOGETHER. DIVIDE THIS SUM BY THE SUM OF ALL THE AXLE WEIGHTS TO GET THE DISTANCE FROM THE FRONT AXLE TO THE VEHICLE CG
3.	$\frac{AXLE \ WEIGHT}{NUMBER \ OF \ WHEELS} = WHEEL \ LOAD \ (POUNDS)$
4.	PSI AND PSF FORMULAS: A. SQUARE OR RECTANGULAR BOXES: $\frac{WEIGHT \ OF \ BOX}{LENGTH \ X \ WIDTH} = PSI \ OR \ PSF$ B. DRUMS WITHOUT RIMS: $\frac{WEIGHT \ OF \ DRUM}{0.785 \ X \ DIAMETER \ SQUARED} = PSI \ OR \ PSF$ C. DRUMS WITH RIMS: $\frac{WEIGHT \ OF \ DRUM}{(OD \div ID) \ (OD - ID) \ X \ 0.785} = PSI \ OR \ PSF$ D. SKIDDED BOXES: $\frac{WEIGHT \ OF \ BOX}{LENGTH \ OF \ SKID \ X \ WIDTH \ OF \ SKID \ X \ NUMBER \ OF \ SKIDS} = PSI \ OR \ PSF$ E. BOXES WITH TRIANGULAR SHAPED BASES: $\frac{WEIGHT \ OF \ BOX}{\frac{1}{2} \ HEIGHT \ OF \ TRIANGLE \ X \ BASE \ OF \ TRIANGLE} = PSI \ OR \ PSF$ F. PNEUMATIC TIRES: $\frac{TIRE \ LOAD}{LENGTH \ X \ WIDTH \ X \ 0.785} = PSI \ OR \ PSF$
5.	CABLE PULL FORMULA $(\cosine \ OF \ RAMP \ ANGLE \ X \ FRICTION \ COEFFICIENT \ + \ sine \ OF \ RAMP \ ANGLE) \ X \ WEIGHT = CABLE \ PULL \ (POUNDS)$
6.	LOAD SHIFT FORMULA $LOAD \ SHIFT \ ARM \ X \ LOAD \ SHIFT \ WEIGHT = GROSS \ WEIGHT \ X \ CG \ CHANGE \ IN \ INCHES.$
7.	MAC = 370.52 LEMAC = 1254.24

FIGURE 1. Typical load planning formulas.

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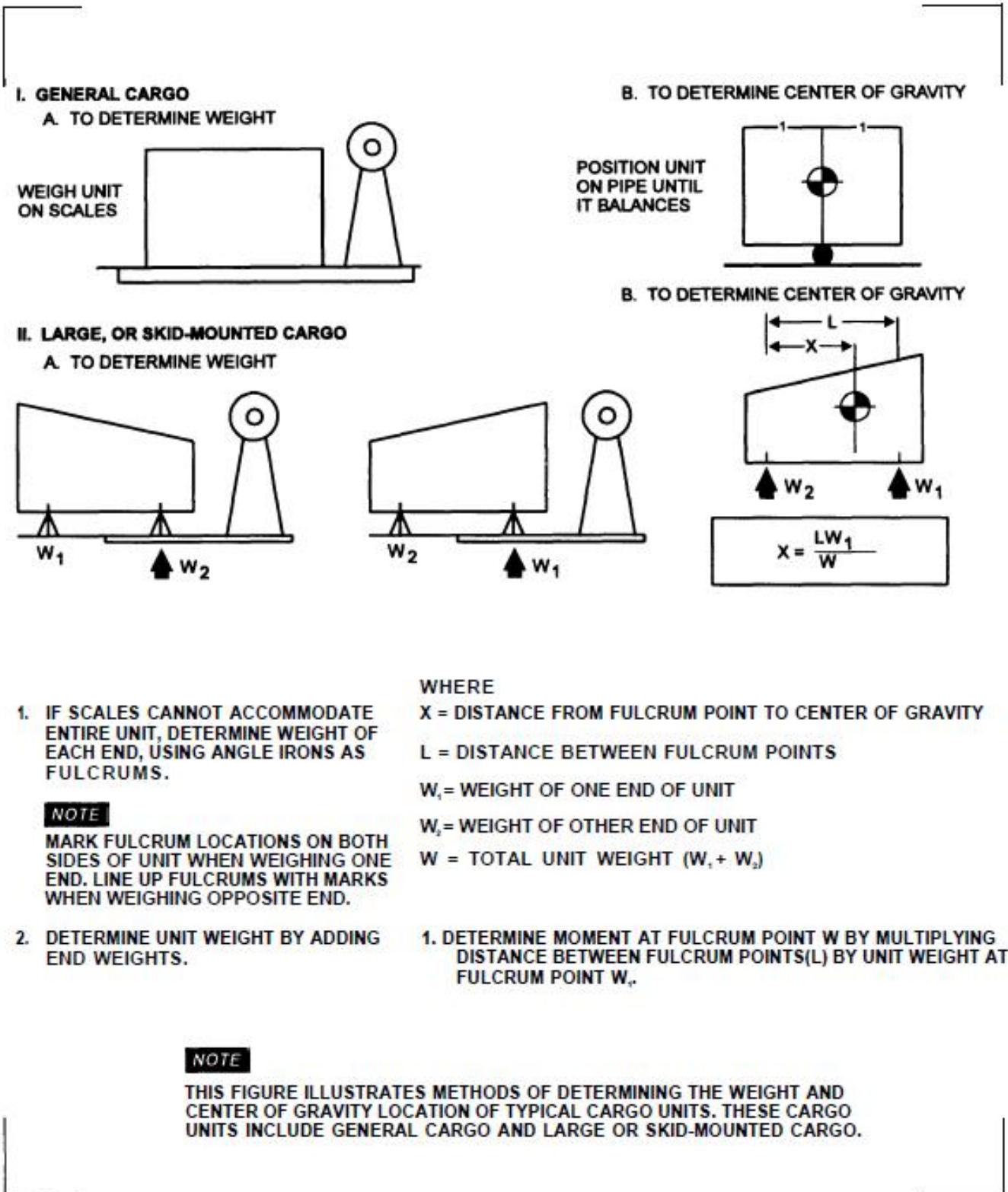


FIGURE 2. Example of computations required for typical cargo load.

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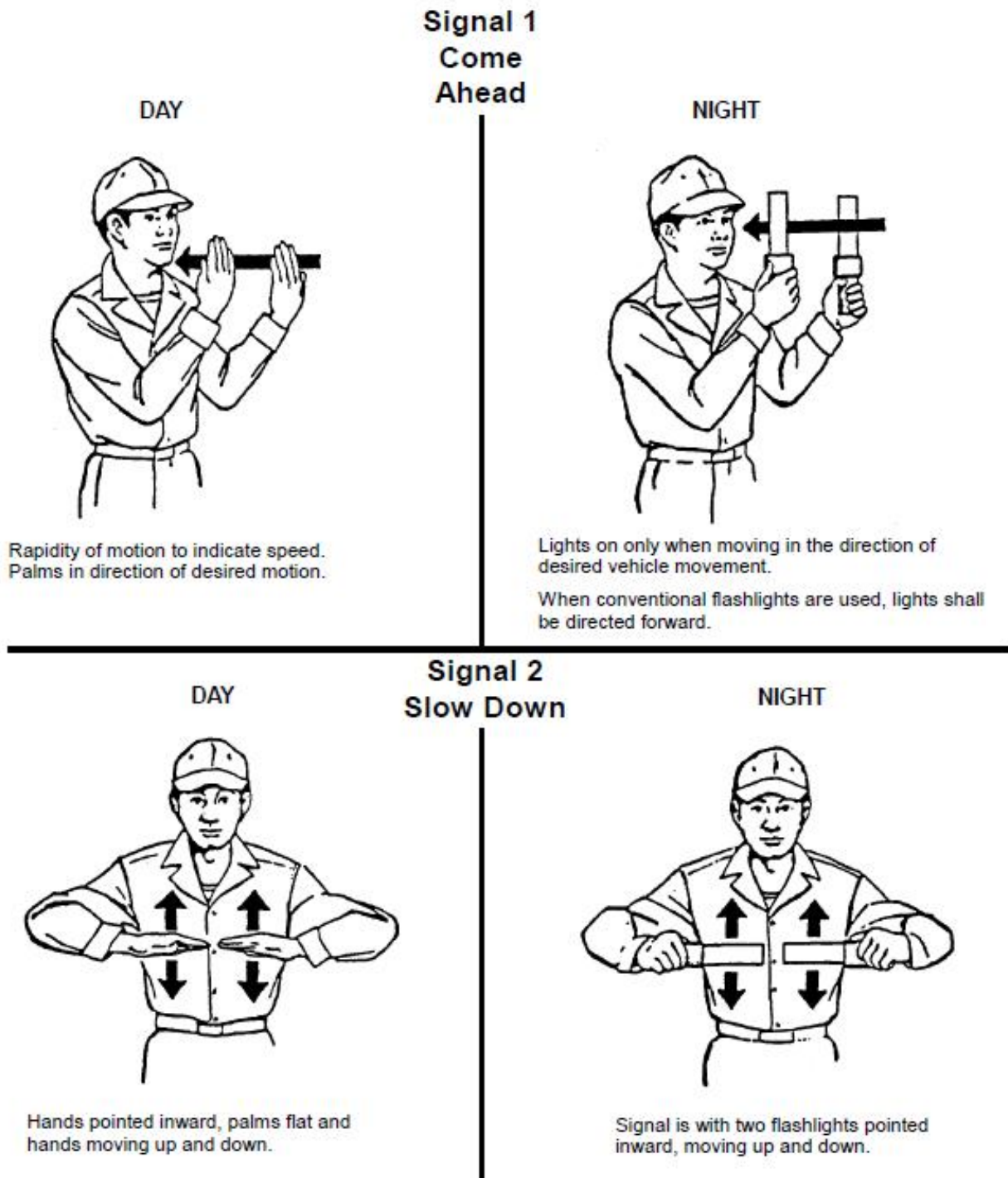


FIGURE 3. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 1 of 10).

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**Signal 3
Stop or Halt**



Palms flat, right hand pointed upward, left hand pointed downward.



Night signal with lights in right hand pointed upward, blinking. Left hand with steady light pointed downward. When conventional flashlights are used, light in right hand shall be directed forward blinking.

**Signal 4
Move in Reverse**



Palms in direction of desired motion.



Lights on only when moving in direction of desired movement of vehicle. When conventional flashlights are used, lights shall be directed forward.

FIGURE 4. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 2 of 10).

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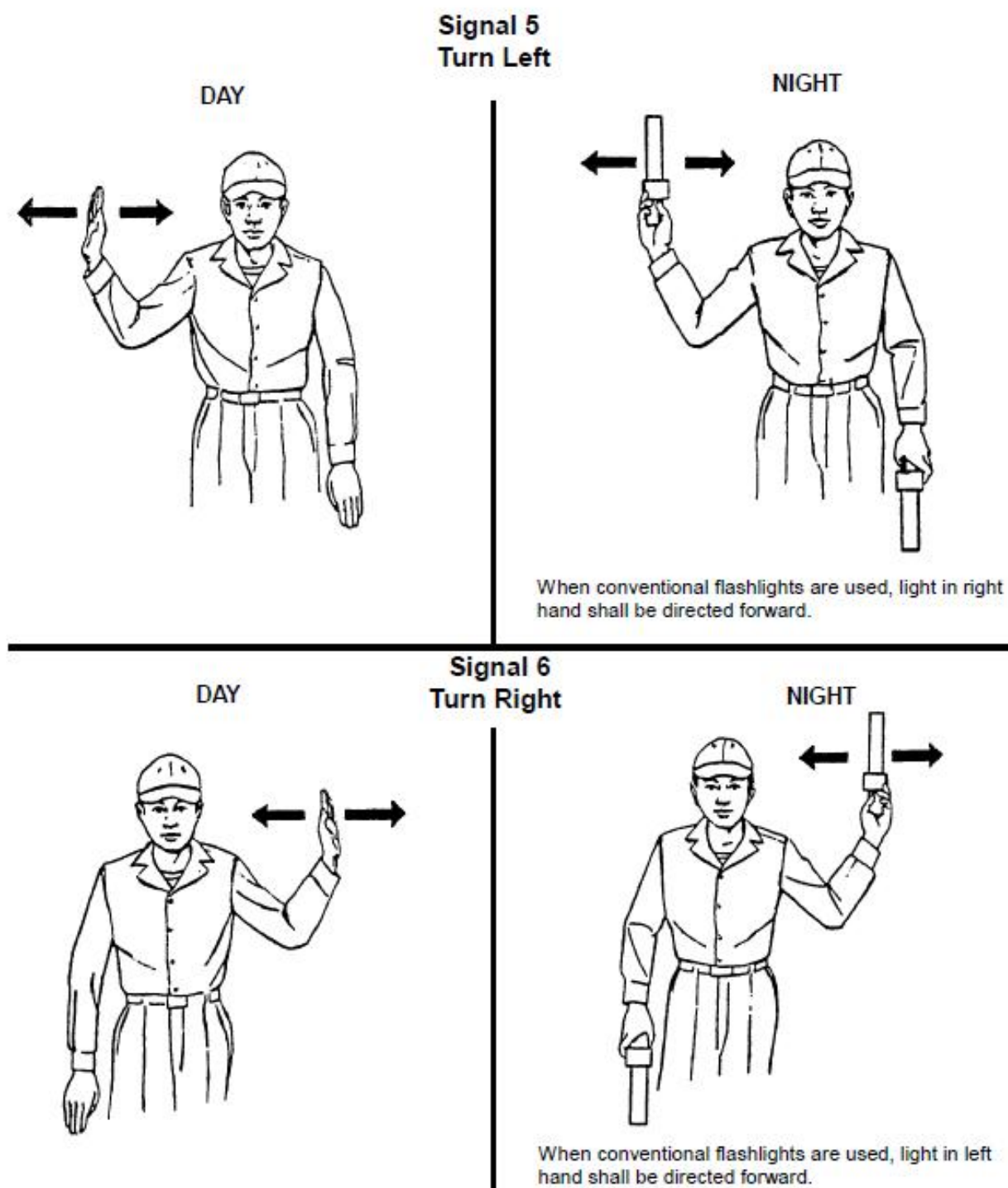
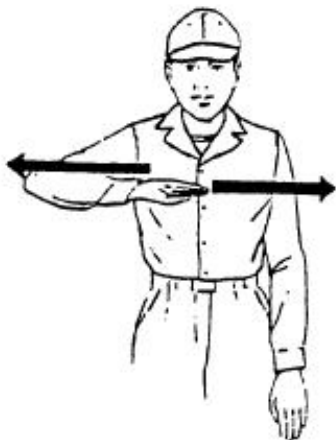


FIGURE 5. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 3 of 10).

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Signal 7
Turn Off Engine

DAY



NIGHT



Light in left hand pointed downward. When conventional flashlights are used, light in right hand shall be directed forward.

Signal 8
Increase Speed

DAY



NIGHT



Steady light in right hand. Light in left hand pointed downward. When conventional flashlights are used, light in right hand shall be directed forward.

FIGURE 6. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 4 of 10).

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**Signal 9
Start Engines**



Light in right hand rotating. Light in left hand pointed downward. When conventional flashlights are used, light in right hand shall be directed forward.

**Signal 10
As You Were**



When conventional flashlights are used, lights shall be directed forward

FIGURE 7. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 5 of 10).

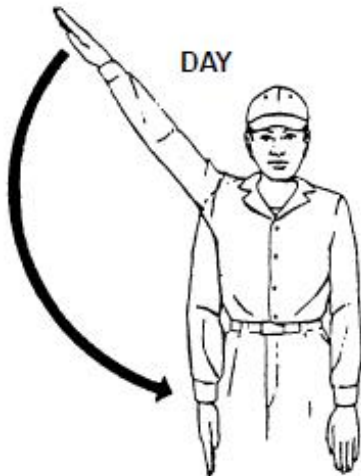
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**Signal 11
Assemble**



Move right hand light in circle over head pointed upward. Light in left hand pointed downward

**Signal 12
Dismount**



Light in right hand move up and down. Light in left hand pointed downward. When conventional flashlights are used, light in right hand shall be directed forward.

FIGURE 8. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 6 of 10).

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**Signal 13
Mount**



Light in right hand moves up and down. Light in left hand held waist high pointed upward. When conventional flashlights are used, light in right hand shall be directed forward.

**Signal 14
Attention**

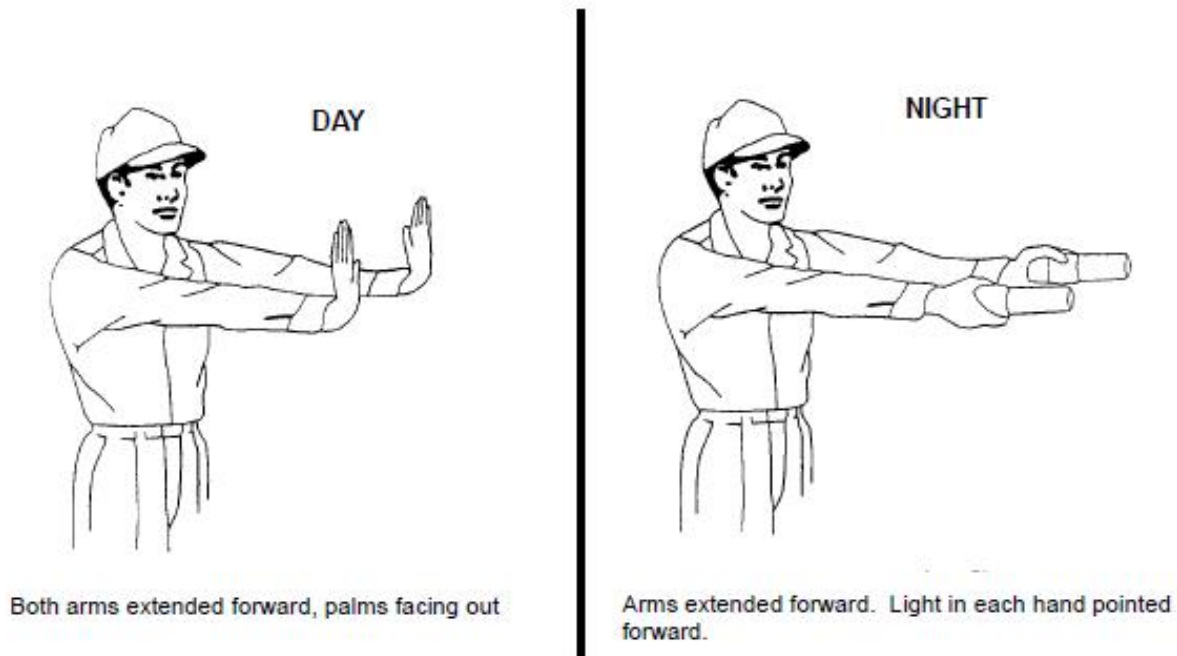


Blinking light in right hand. Light in left hand pointed downward, steady. When conventional flashlights are used, light in right hand shall be directed forward.

FIGURE 9. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 7 of 10).

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**Signal 15
Ready**



**Signal 16
Extended (Open Up)**

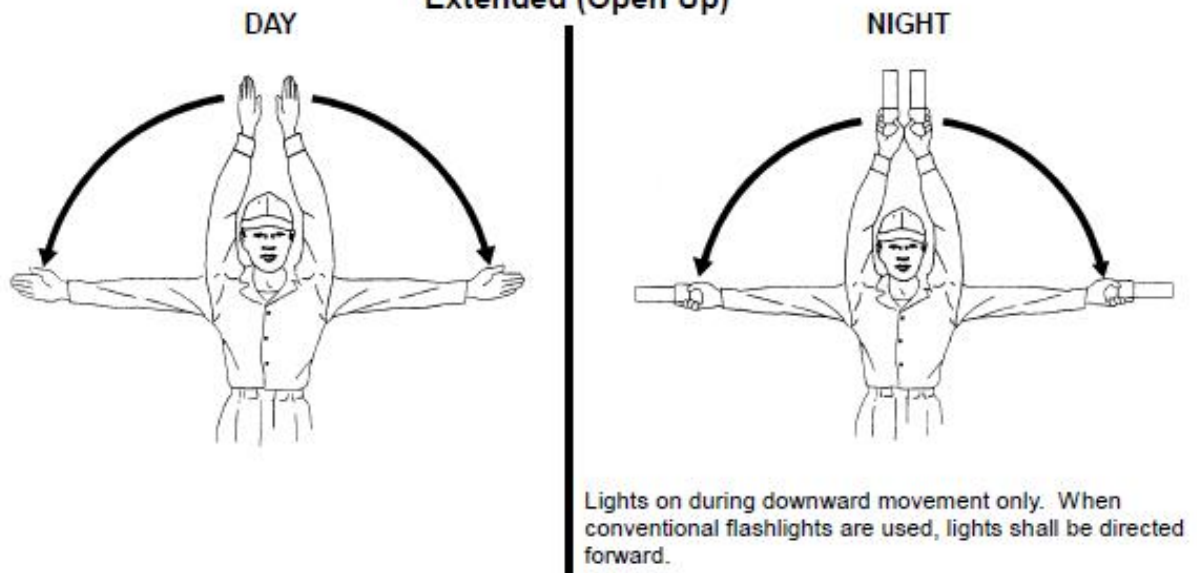
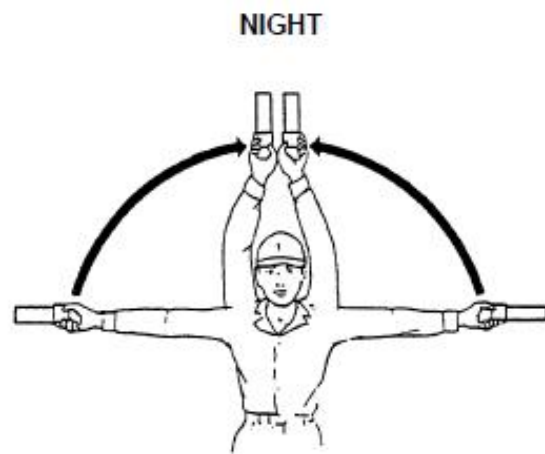
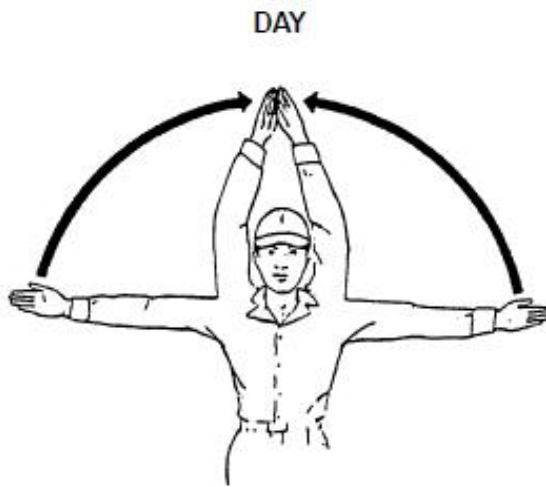


FIGURE 10. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 8 of 10).

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Signal 17
Close Up



Lights on during upward movement only. When conventional flashlights are used, lights shall be directed forward.

Signal 18
Close Up and Stop



Arms extended up. Bring arms extended to the front and down, pointing to the ground.



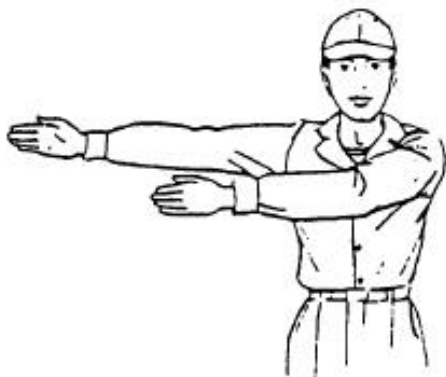
When conventional flashlights are used, lights shall be directed forward.

FIGURE 11. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 9 of 10).

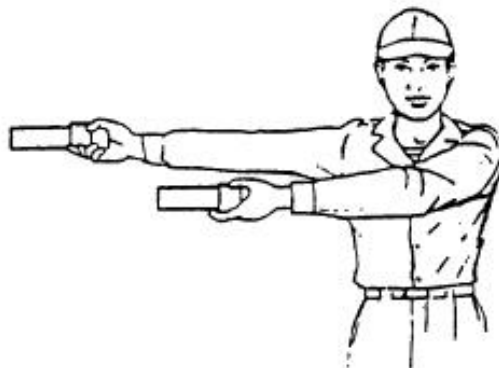
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**Signal 19
By the Flank**

DAY



NIGHT



Arms extended to the right. When conventional flashlights are used, light shall be directed forward.

DAY



**Signal 20
Up and Down**

NIGHT



Light in right hand used to indicate direction (up or down).
Light in left hand steady pointed downward.

FIGURE 12. Hand signals for directing vehicle movement and winching on cargo aircraft (sheet 10 of 10).

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CARGO PREPARATION

- | | |
|--|---|
| 1. Vehicle brakes and engines | - CHECKED FOR PROPER OPERATION. |
| 2. Vehicle fuel tanks | - DRAINED SUFFICIENTLY TO PREVENT OVERFLOW. |
| 3. Vehicle fuel tank, oil, and battery caps | - TIGHTENED. |
| 4. Missile dollies, helicopter skids, and like equipment | - CHECKED FOR SECURITY OF ATTACHMENT. |
| 5. Missiles, helicopters, and like cargo | - PROPERLY CRADLED ON CARRIERS. |
| 6. Contact area pressure of cargo limits | - DETERMINED FOR SHORING REQUIREMENTS. |
| 7. Cargo unit dimensions and weights | - DETERMINED. |

NOTE: If cargo unit dimensions appear critical, check dimensions against cargo size limit chart.

- | | |
|---|-----------------------------------|
| 8. Center of gravity location | - DETERMINED FOR ALL CARGO UNITS. |
| 9. Dimensions, weight, and center of gravity location | - MARKED ON CARGO UNITS. |

LOAD PLANNING

- | | |
|--|---|
| 1. Cargo sketches | - POSITIONED ON AIRCRAFT PROFILE, GIVING CONSIDERATION TO LOCATION OF JETTISONABLE CARGO. |
| 2. Center of gravity station location | - DETERMINED FOR EACH CARGO UNIT. |
| 3. Total load center of gravity location | - CALCULATED AND CHECKED AGAINST FORWARD AND AFT LIMITS. |
| 4. Compartment loads | - CALCULATED AND CHECKED AGAINST COMPARTMENT LOAD LIMITATIONS. |
| 5. Zone loads | - CALCULATED AND CHECKED AGAINST ZONE LOAD LIMITATIONS. |
| 6. Restraint criteria | - CALCULATED AND TIE DOWN PATTERN PLANNED TO RESTRAIN ALL POSSIBLE CARGO MOVEMENT. |

FIGURE 13. Example of loadmaster checklist.

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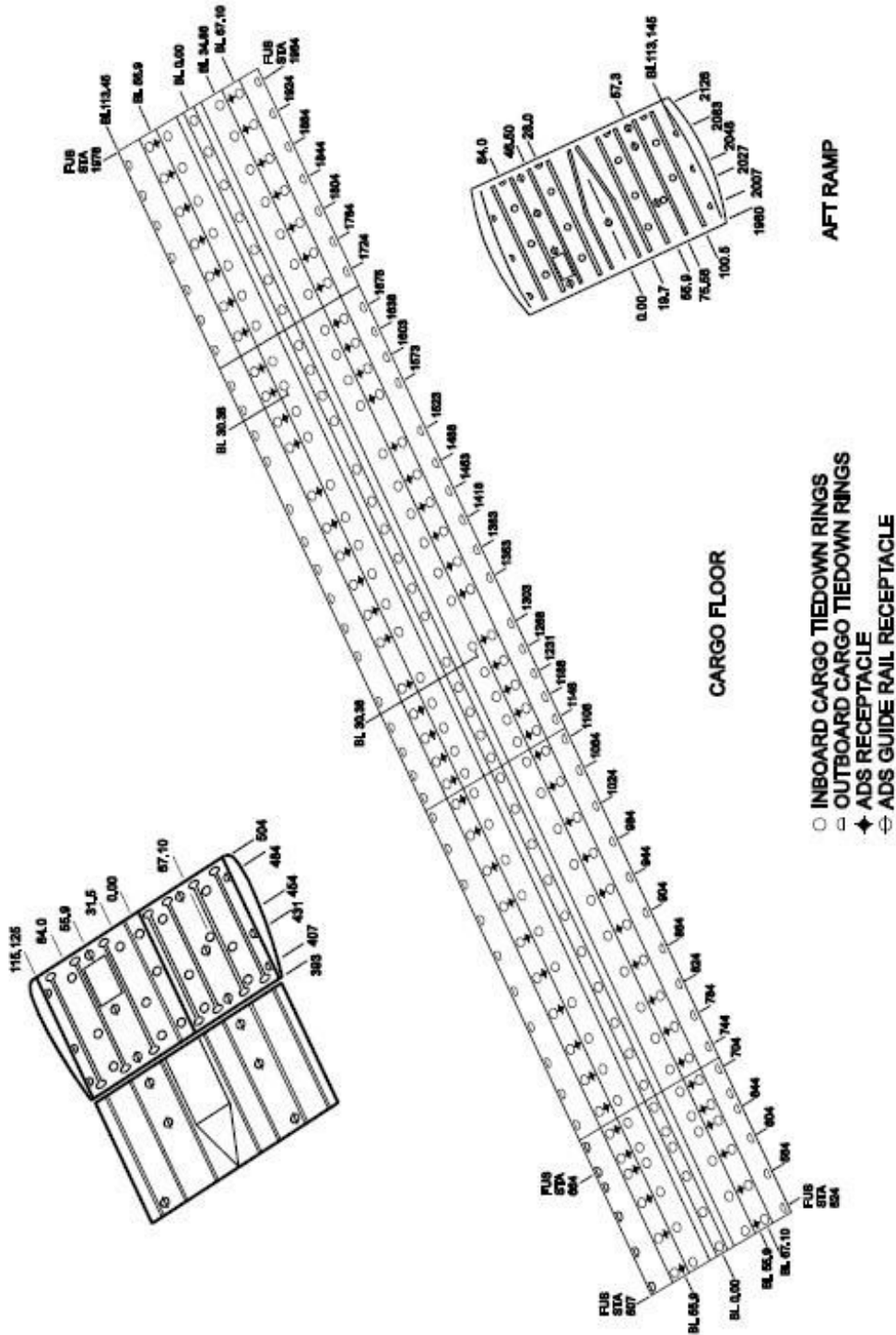


FIGURE 14. Example of tiedown floor plan.

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VEHICLE NUMBER	TIEDOWN FITTING	TIEDOWN DEVICE		ATTACH TO VEHICLE AT:
		QUANTITY	SIZE	
1	22E/22F	1	10,000	ONE TURN AROUND TAIL WHEEL, FORK AND SPINDLE ASSEMBLY
	12G	1	10,000	RIGHT LANDING GEAR SHOCK SHOE
	5G	1	10,000	RIGHT LANDING GEAR SHOCK SHOE
	12A	1	10,000	LEFT LANDING GEAR SHOCK SHOE
	6A	1	10,000	LEFT LANDING GEAR SHOCK SHOE
	2	11A/15A	1	5,000
11C/15C		1	5,000	ONE TURN AROUND 2 BY 12 ABOVE WEDGE NEAR TOP OF RACK
21A/25A		1	5,000	ONE TURN AROUND 2 BY 12 ABOVE WEDGE NEAR TOP OF RACK
21C/25C		1	5,000	ONE TURN AROUND 2 BY 12 ABOVE WEDGE NEAR TOP OF RACK
13A/13C		1	5,000	OVER WING RACKS
23A/23C		1	5,000	OVER WING RACKS
3		18F/18G	1	5,000
	23F/23G	1	5,000	OVER STABILIZER RACK
	19F/19G	1	5,000	ONE TURN AROUND CONTROL BAR OF HORIZONTAL STABILIZER ASSEMBLY

FIGURE 15. Example of tiedown index.

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CARGO	U-6 AIRCRAFT			MB-1 REFRIGERATOR VAN		WG-1 CHASSIS	14-A GENERATOR	M82K-1 TRAILER DOLLY SET
	FUSELAGE	WING	STABILIZER	LOADED	UNLOADED			
LENGTH INCHES								
WIDTH INCHES								
HEIGHT INCHES								
TOTAL WT LB								
VEHICLE FACES								
REFERENCE POINT DESCRIPTION LOCATION								
AXLE WT FRONT								
AXLE WT REAR								
LOCATION FRONT AXLE STATION								
CG LOCATION								
TIE DOWNS REQUIRED								
SHORING REQUIRED								
LOADING METHOD								

FIGURE 16. Example of loading data table.

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UNIT NOMENCLATURE	LOADING METHOD	DIMENSIONS WT AND CG	MODIFICATIONS AND/OR SUGGESTED LOADING PROCEDURES
010 011A/E FIRE TRUCK TO 36A12-6-12-1	Winch load backwards, operate engine for steering and brakes	376 by 102 by 125 32,350 lb (empty)	Remove turret, drain agent, fuel tank max 3/4 full, tire air pressure 50% of normal hard surface req.
Delcer Unit AF/S32M (MB-3) TO 13E-17-6-1	Winch load cab first	364 by 100 by 138 22,550 lb CG 42" fwd tandem axle center	Retract platform (basket) to lowest point, App angle of 40°

NOTE: This equipment requires only minor modification and limited procedures for loading. Chapter 3, Aircraft Configuration and Chapter 4, General Procedures for loading, securing and off-loading must be complied with, as applicable, in addition to the procedures specified above.

FIGURE 17. Example of miscellaneous equipment loading data table.

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EXTRACTION PARACHUTE (RING SLOT)	ALLOWABLE LOAD RANGE (LBS)	150 KCAS No. OF LOCKS PER PLATFORM						TYPE EXTRACTION LINE REQUIRED
		1	2	3	4	5	6	
REEFED 15 FOOT	2,520 TO 6,600	1.55						1 LOOP 2 PLY TYPE X NYLON
UNREEFED 15 FOOT	5,100 TO 1,000	1.95	1.15					1 LOOP 6 PLY TYPE X NYLON
22 FOOT	10,000 TO 18,750		1.90	1.50				3 LOOP 6 PLY TYPE X OR TYPE XXVI NYLON
28 FOOT	17,350 TO 35,000			2.40	1.95	1.65	1.45	3 LOOP 6 PLY TYPE X OR TYPE XXVI NYLON

FIGURE 18. Example of extracting parachute vs allowable load range and lock setting table.

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NOMENCLATURE (COMMON NAME)	TYPE	BREAKING STRENGTH (LB)	SIZE (WIDTH)	NOTES
Webbing, Textile, Woven, Nylon (Type VIII Nylon)	VIII	3,600	1-23/32 in.	Parachute retaining web. Troop static line 2 black threads in center.
Webbing, Textile, Woven, Nylon (Type X Nylon)	X	8,700	1-23/32 in.	
Webbing, Textile, Woven, Cotton Warp	VIII	2,900	1-3/4 in.	2 black threads in center. Nylon filling yarns used.
Webbing, Textile Woven, Cotton Warp (Rigging Web)	X	5,000	1-3/4 in.	Nylon filling yarns used.
Webbing, Textile Woven, Cotton Warp (Rigging Web)	XV	4,500	1-3/4 in.	2 red threads along edge. Nylon filling yarns used.
Webbing, Nylon, Tubular		3,000	1 in.	Natural and OD.
Webbing, Nylon, Tubular		1,000	½ in.	Natural and OD.
Tape, Cotton, Reinforcing (1/4 inch tape)	I	80	1/4 in.	Natural and OD Plain.
Cord, Shock, 75 pound		75		Natural.
Thread, Cotton	IV B	32	Ticket No 8/7	Shoe thread, glazed finish.
Cord, Nylon	II	375	Weight 105 yd per lb	1 black thread in sleeve natural color.
Cord, Nylon (550 cord)	III	550	Weight 75 yd per lb	Natural.
Cord, Nylon (coreless)	IV	1,000	Weight 40 yd per lb	Natural and OD (used as pigtail on extraction parachute).

FIGURE 19. Example of rigging material data.

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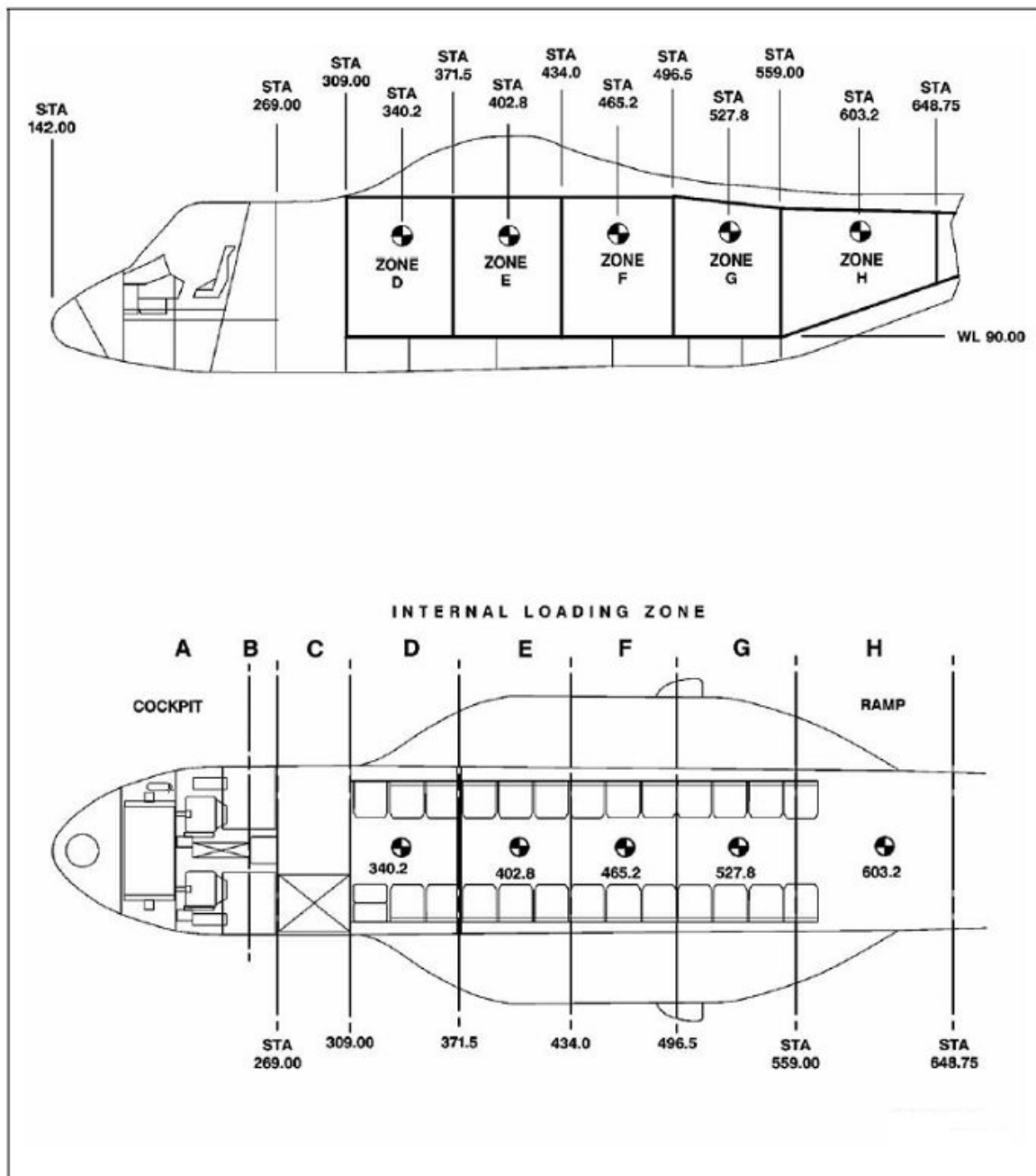


Figure 2-1. Cargo Loading Zones

FIGURE 20. (M)(N) Example cargo compartment diagrams.

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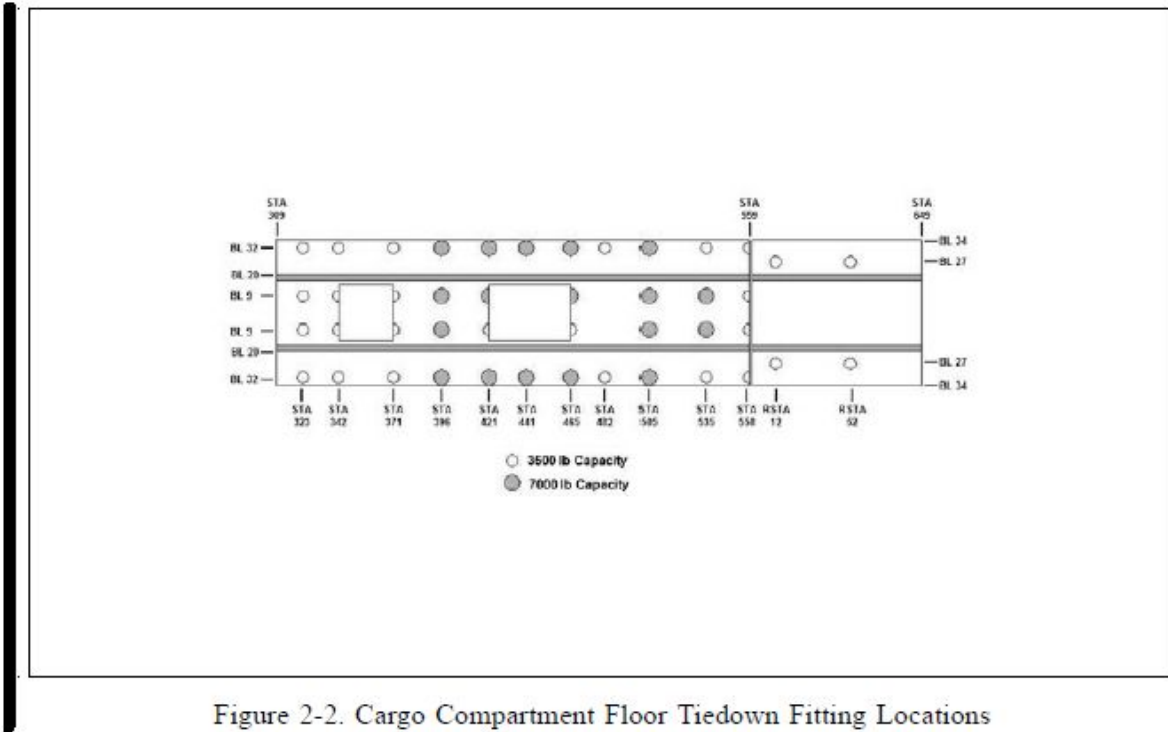


Figure 2-2. Cargo Compartment Floor Tiedown Fitting Locations

FIGURE 20. (M)(N) Example cargo compartment diagrams. - Continued.

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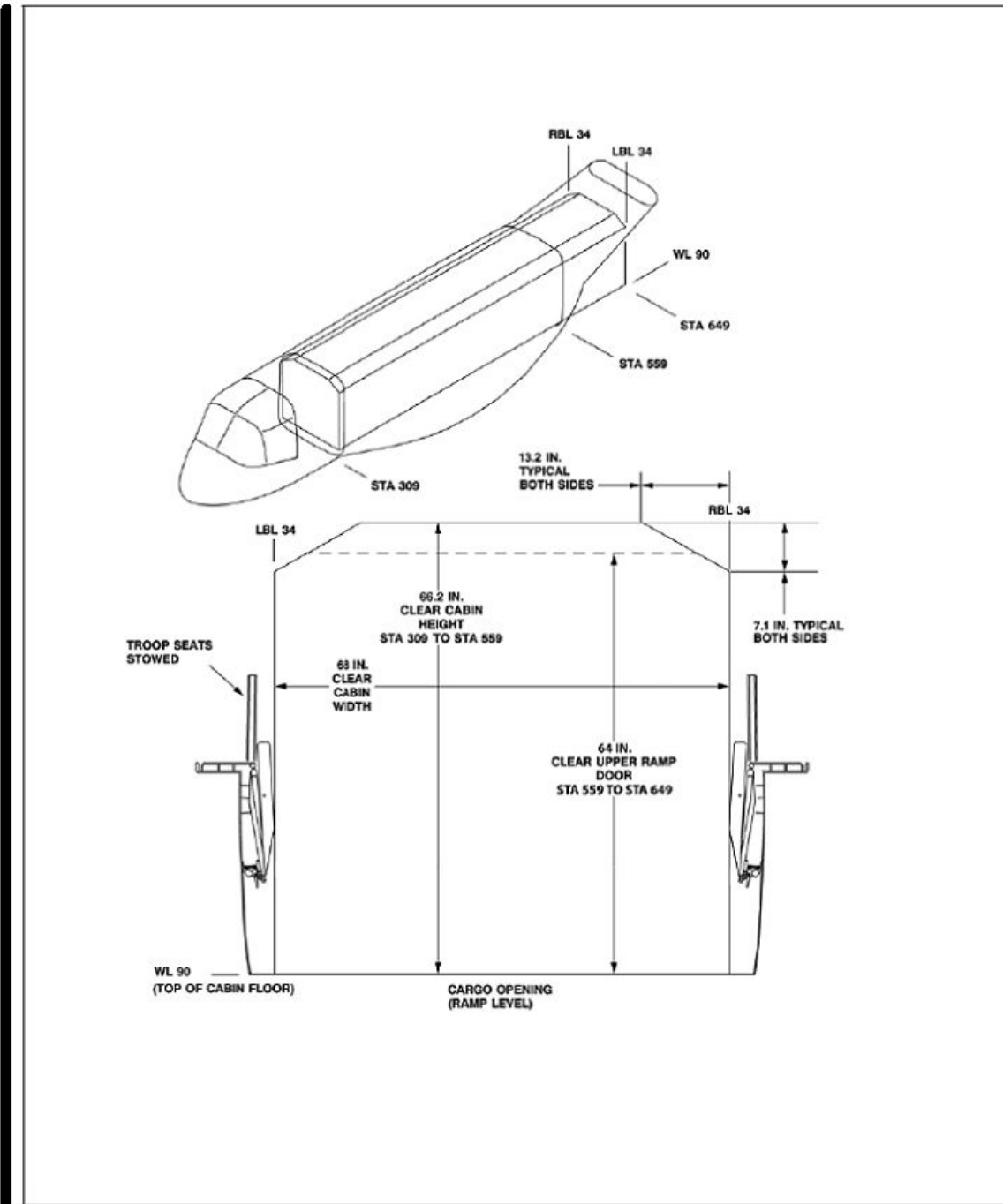


Figure 2-3. Cargo Compartment Dimensions

FIGURE 20. (M)(N) Example cargo compartment diagrams. - Continued.

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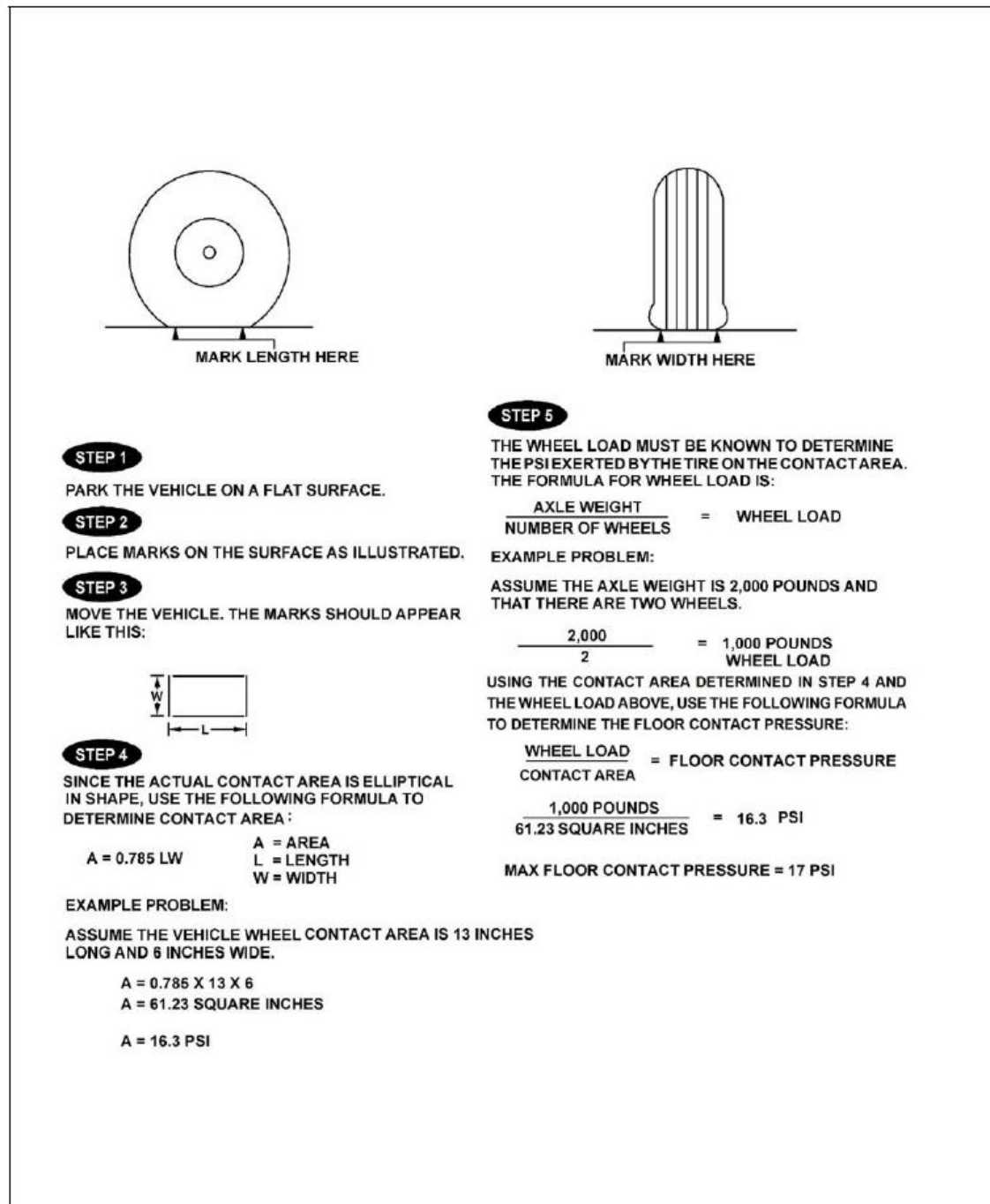


Figure 7-1. Pneumatic Tire Contact Area and Floor Contact Pressure Formula

FIGURE 21. (M)(N) Example diagrams for pneumatic tire load limits computations.

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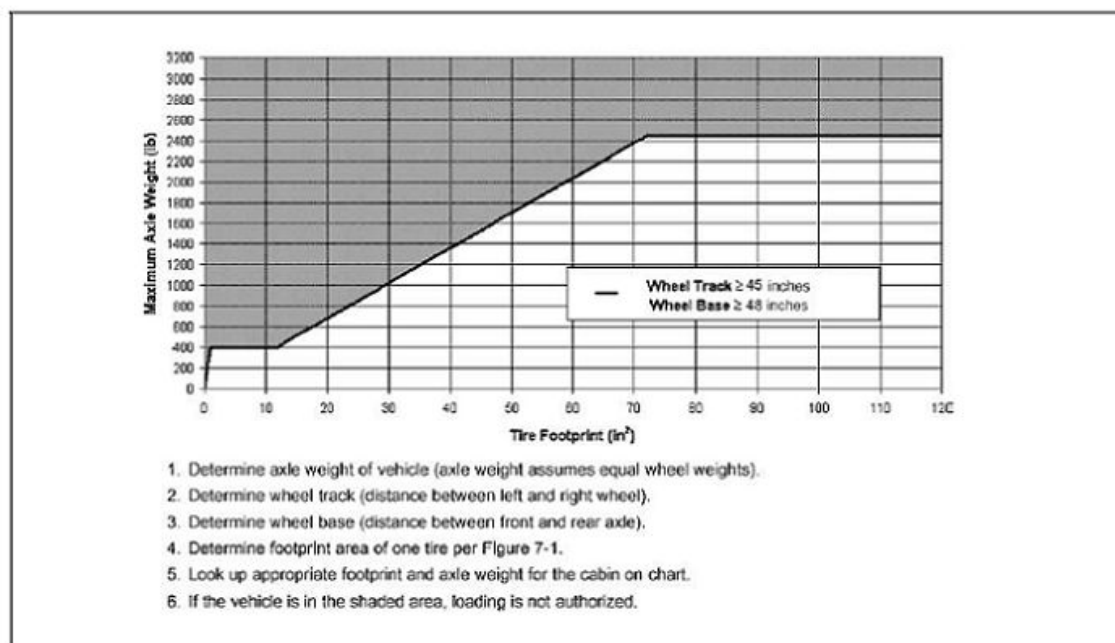


Figure 7-2. Cabin Loads Limits for Pneumatic Tires

■ FIGURE 21. (M)(N) Example diagrams for pneumatic tire load limits computations. - Continued.

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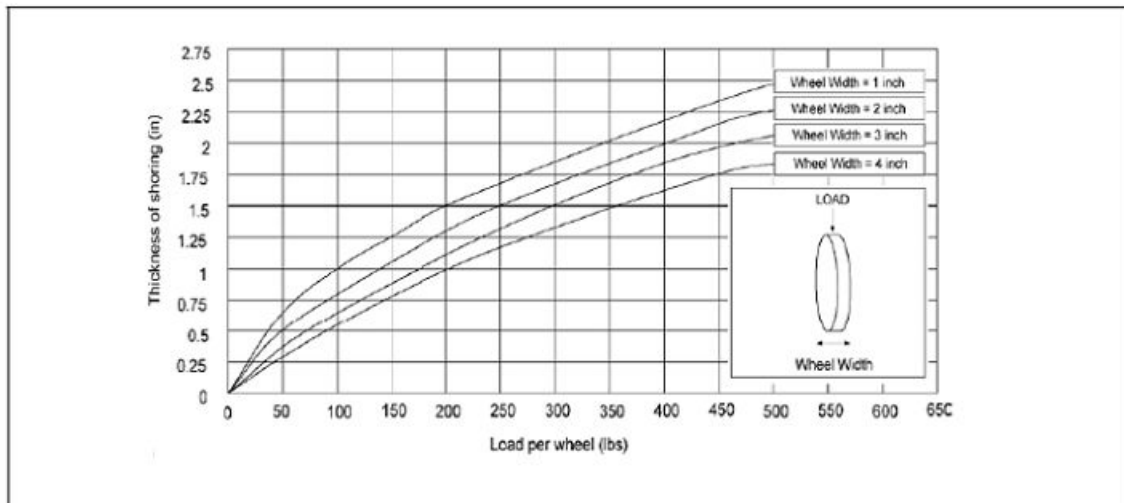


Figure 7-3. Shoring Thickness Required for Hard Rubber Tires or Steel Wheels

FIGURE 22. (M)(N) Example diagram for determining shoring thickness for hard rubber tires/steel wheels.

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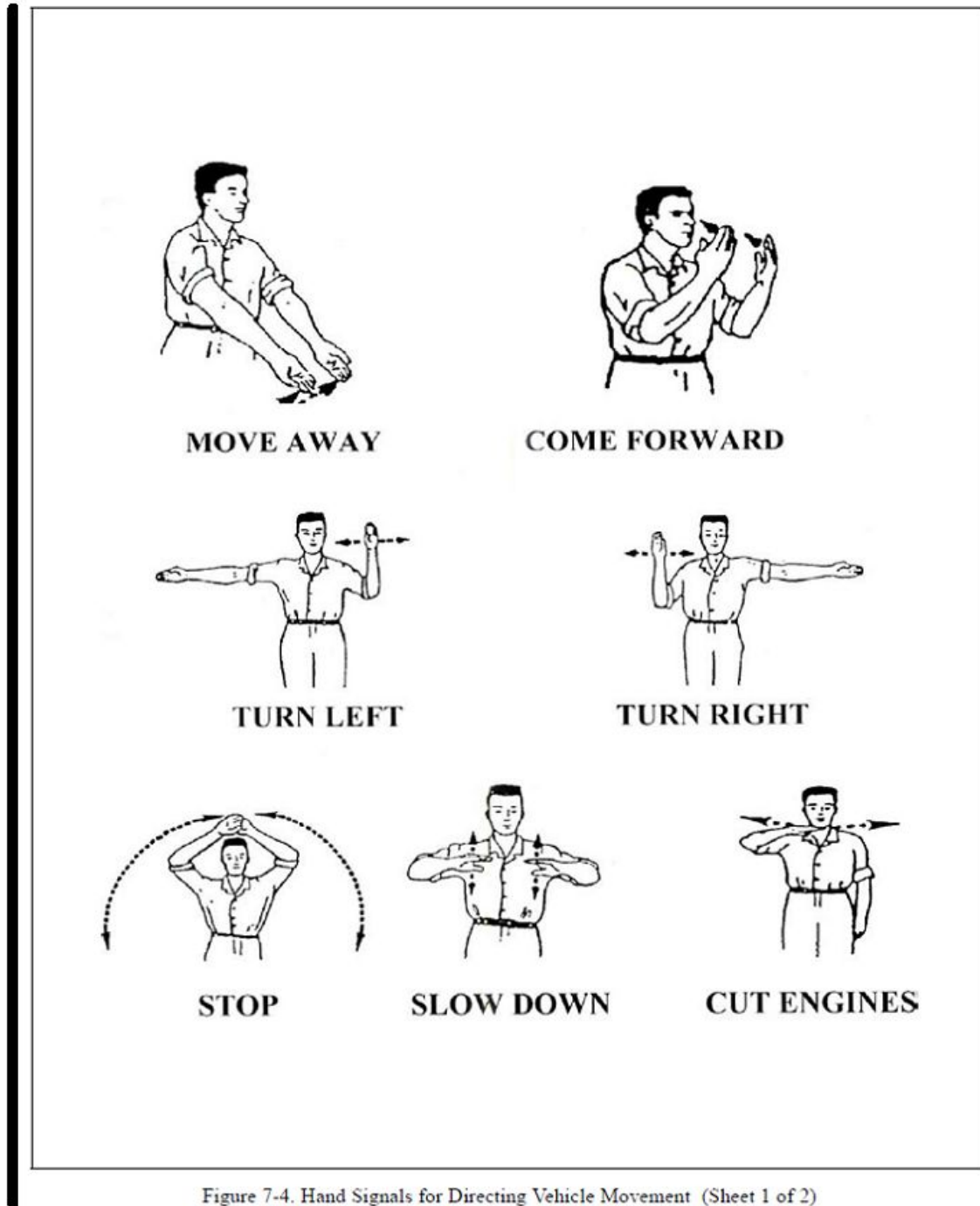
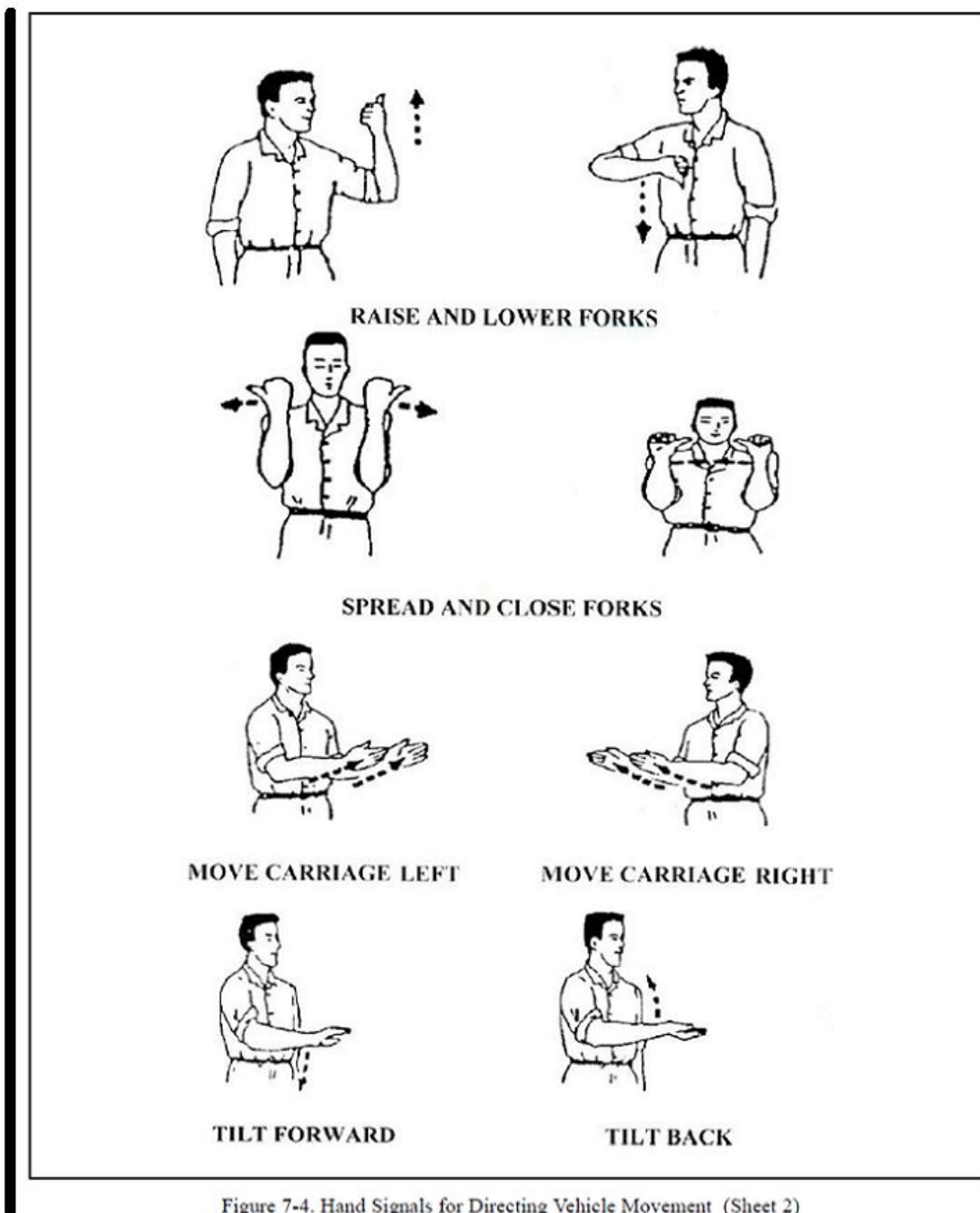


FIGURE 23. (M)(N) Example illustrations of marshalling for wheeled cargo/forklifts.

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■ FIGURE 23. (M)(N) Example illustrations of marshalling for wheeled cargo/forklifts. - Continued.

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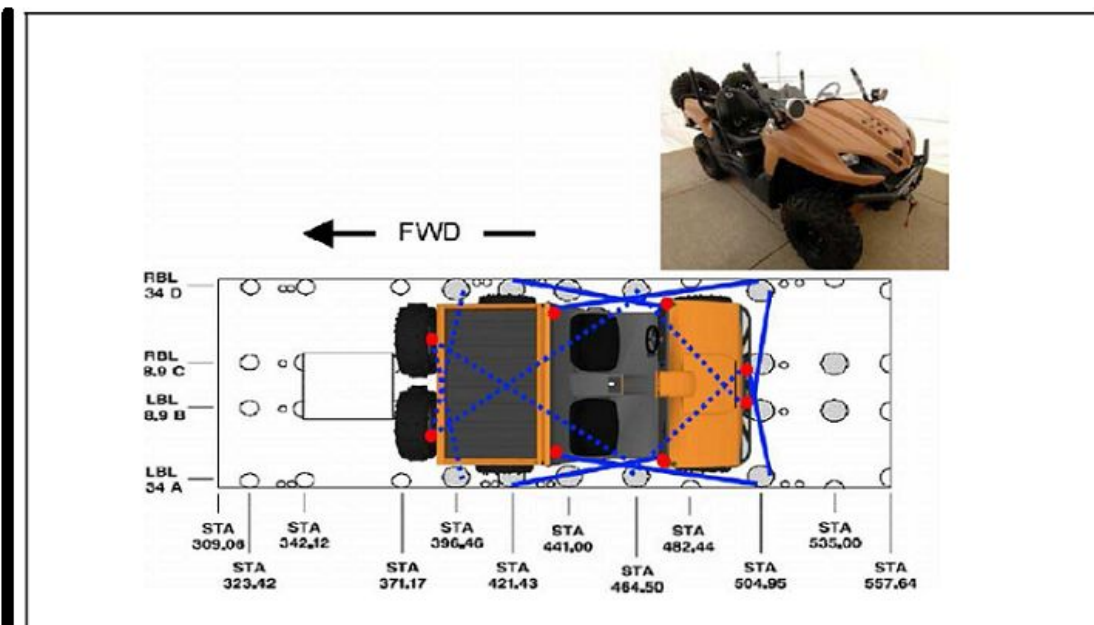


Figure 7-5. LTATV Backed In Configuration

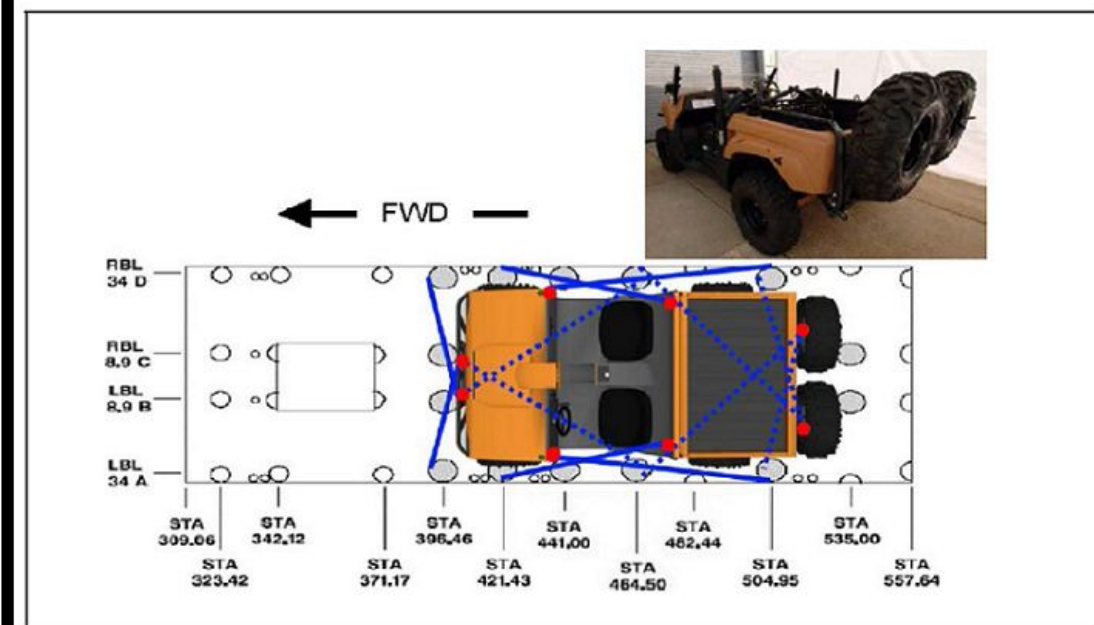


Figure 7-6. LTATV Driven In Configuration

■ FIGURE 24. (M)(N) Example illustrations for certified vehicle transport loading procedures.

MIL-DTL-5288K**APPENDIX A****LOADING INSTRUCTIONS MANUAL
MARKUP LANGUAGE TOOLS****A.1 SCOPE.**

A.1.1 Scope. This appendix describes the standard Air Force (AF) markup language digital tools created for developing and delivering AF Technical Manuals (TMs). These tools are available in the Digital Support Suites (DSS) provided by the AF Technical Manual Specifications and Standards (TMSS) activity (see [A.2](#)). This appendix is a mandatory part of this detail specification. The information herein is intended for compliance.

A.1.2 Template Tool. The Document Type Definition (DTD) is the primary tool used as a template for authoring AF TMs and is based on rules outlined in MIL-PRF-28001 and ISO 8879. See [A.2.1](#) for information about the DTD specified for this appendix subset.

A.2 DSS.

The DSS is comprised of the following tools for authoring and rendering the TM. See [A.3](#) for information about obtaining DSS component files in digital format through the TMSS activity web site. For information about the current status and availability of DSS tools, see [A.3.4](#).

A.2.1 DTD. The DTD provides the structure and content template in accordance with the content specific requirements covered under [3.2](#), with the exception of elements marked (M)(N) for rotary wing and tilt rotor aircraft. To be delivered digitally, the TM shall be tagged using the applicable DTD provided through the TMSS activity. Information concerning the markup language type and use of DTDs currently provided, i.e., Standardized General Markup Language (SGML), may be obtained through the contacts listed under [A.3](#).

A.2.2 Tag Description Table (TDT). The TDT provides detailed descriptions of the elements contained in the DTD. The TDT contains the element tagging structure, parent elements, full element name, source paragraph, attribute descriptions unique to the element, and entities.

A.3 OBTAINING DSS TOOLS.

A.3.1 Obtaining files by users with mil web site access. The following applies to those interested in obtaining DSS component files who are on a mil internet domain, having mil web address access.

A.3.1.1 AF TMSS web site. DTDs, TDTs, and other files in the DSS can be accessed on the TMSS web site at <https://techdata.wpafb.af.mil/TMSS/>. On the web page, the “Baseline” menu option in the left pane contains three bulleted options called “Specifications”, “Standards”, and “Handbooks”. Hover the cursor over “Specifications” and a listing of the TMSS specifications will appear. Hover over the desired specification number and another drop down list will appear that contains an entry indicating the PDF version of the specification and other entries for the associated appendices. To obtain the preferred subset DTD, select the desired appendix from the list. The following items will appear on the downloading page: The name of the specification, the appendix number and name, the current version of the DSS, buttons to download specific DSS files provided and a “Download” button to download the entire DSS zip file.

A.3.2 Obtaining files by users with a Public Key Infrastructure (PKI) certificate or a Common Access Card (CAC). The following applies to those interested in obtaining DSS component files who have a PKI certificate or a CAC:

A.3.2.1 AF TMSS SharePoint web site. DTDs, TDTs, and other files in the DSS can be accessed at the AF TMSS SharePoint web site: <https://cs3.eis.af.mil/sites/OO-LG-MC-38/default.aspx>.

A.3.3 Obtaining files by users without mil access, PKI certificate, or CAC. Those seeking to obtain DSS files who do not have mil web access, a PKI certificate, or a CAC should contact their government Program Management Office (PMO) or see [A.3.4](#) to obtain information.

A.3.4 TMSS Helpdesk assistance. Address any requests relating to the DSS by E-mail to SGMLSUPPORT@us.af.mil (organizational address: Wright-Patterson AFLCMC/HIAM_AF TMSS HLPDSK)

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APPENDIX A

or by postal mail to Air Force Technical Manual Specifications and Standards, AFMC/AFLCMC/HIAM, 4170 Hebble Creek Road, Building 280, Door 15, Wright-Patterson AFB OH 45433-5653.

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APPENDIX B

**NUCLEAR WEAPON CARGO LOADING MANUAL
MARKUP LANGUAGE TOOLS**

B.1 SCOPE.

See [A.1](#).

B.2 DSS.

See [A.2](#) (see below for specific DTD information).

B.2.1 DTD. The DTD provides the structure and content template in accordance with the content specific requirements covered under [3.3](#).

B.3 OBTAINING DSS TOOLS.

See [A.3](#).

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APPENDIX C

**LOADMASTER/NUCLEAR WEAPON CARGO CHECKLISTS
MARKUP LANGUAGE TOOLS**

C.1 SCOPE.

See [A.1](#).

C.2 DSS.

See [A.2](#) (see below for specific DTD information).

C.2.1 DTD. The DTD provides the structure and content template in accordance with the content specific requirements covered under [3.4](#).

C.3 OBTAINING DSS TOOLS.

See [A.3](#).

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CONCLUDING MATERIAL

Custodians:

Army - TM

Navy - AS

Air Force - 16

Preparing activity:

Air Force - 16

(Project TMSS-2017-002)

Review activities:

Army - AV, MI, MT

Air Force - 11, 184

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.