NATO STANDARD

AEP-93

SLINGING AND TIE DOWN FACILITIES FOR LIFTING AND TYING DOWN MILITARY EQUIPMENT FOR MOVEMENT BY LAND AND SEA

Edition A, Version 1

MAY 2016

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED ENGINEERING PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

27 May 2016

1. The enclosed Allied Engineering Publication AEP-93, Edition A, Version 1 SLINGING AND TIE DOWN FACILITIES FOR LIFTING AND TYPING DOWN MILITARY EQUIPMENT FOR MOVEMENT BY LAND AND SEA, which has been approved by the nations in the Military Committee Land Standardization Board, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4062.

2. AEP-93, Edition A, Version 1, is effective upon receipt.

4. This publication shall be handled in accordance with C-M (2002)60.

Edvardas MAŽEIKIS
Major General, LTUAF
Director, NATO Standardization Office

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RESERVED FOR NATIONAL LETTER OF PROMULGATION

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
BEL	1. Not applicable for our currently existing Eqt (BEL did not ratify the previous edition of the STANAG). Only applicable for Eqt that will be acquired in the future. 2. Concerning the marking (Chapter 2, Par 2.7.1 and 2.7.2, pages 2.3 and 2.4): attaching a "data shipping plate" in a conspicuous location is in conflict with the need for minimal visibility of our combat vehicles/Eqt (camouflage, use of IR-paint), so this will not necessarily be applied.

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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CHAPTER 1 INTRODUCTION

1.1. REFERENCES

Publications that are referred to in this document are listed at Annex A.

1.2. AIM

The aim of this standard is to ensure that adequate slinging and tie-down facilities, also known as provisions, are provided on all military equipment except that listed below in paragraphs 1.3.b. and c.

1.3. AGREEMENT

Participating nations agree to adopt the characteristics for slinging and tie-down facilities contained in this publication.

This agreement:

a. Applies to all future military equipment designs, new procurement of existing designs, and modifications to equipment (where practicable) when the modification renders the existing slinging or tie-down facilities unusable. For airdropped equipment, STANAG 3548 also applies.

b. Excludes administrative use vehicles (vehicles not intended for combat or combat support), fixed-wing aircraft, marine craft, railway equipment, and all equipment weighing less than 230 kilograms (kg) (500 pounds (lb)).

c. Excludes equipment intended to be transported by air only, which shall be equipped with lifting and tie-down facilities as specified in STANAG 3548.

1.4. TERMS AND DEFINITIONS

Terms and Definitions that are used in this document can be found at Annex C.

1.5. DETAILS OF THE AGREEMENT

1.5.1. SAFETY AND PROTECTION

The safety of personnel and equipment, in the vicinity of lifting operations using slings and in tie-down (lashing) operations for carriage of vehicles and equipment by land and sea, shall be ensured by the provision of suitable slinging (lifting) and tie-down facilities as described in Chapter 2. The protection of military equipment during lifting operations, handling and transportation by land and sea shall be ensured by provision of the facilities described in this document.

CAUTION. Do not use facilities that are specific only for ‘tie-down’ to sling and lift military equipment. The improper use of tie-down facilities to sling and lift military equipment can damage the equipment and more importantly place ground personnel at risk of injury.

1.5.2. MATERIEL DESIGN

Materiel design requirements are not provided within, and materiel requirements for high-tensile steel should be sized to fit the appropriate hooks.

1.6. IMPLEMENTATION

This document is implemented when the necessary orders and/or instructions have been issued to the forces concerned.

CHAPTER 2 DETAILED REQUIREMENTS FOR SLINGING AND TIE-DOWN FACILITIES

2.1. QUANTITY

The number of facilities provided for lifting and for tie-down on all vehicles, equipment, or parts sectionalized for transport shall be adequate to provide safety and stability during lifting and transport operations by devices commonly used in the transportation environment. Equipment shall be provided with not less than:

a. Four multipurpose facilities (preferred), or

b. Four slinging and four tie-down facilities, or

c. Four slinging and four tie-down points specified by the supplier of any standard commercial equipment to be used for military purpose except those exempted in paragraphs 1.3.b. and c. of this publication.

2.2. LOCATIONS OF SLINGING AND TIE-DOWN FACILITIES

Facilities shall conform to the following location requirements:

a. In general, facilities shall be located so that:

1. Not less than 25 mm (1 in) of clearance is maintained between the slings or tie-down restraints and the equipment except when a structure (such as an overhead guard, tracks, tank attached to the chassis, etc.) has sufficient strength to withstand contact with the loaded sling or tensioned tie-down restraint.

2. Damage to the sling or restraint, due to contact with the equipment, is avoided.

3. There is no interference with the functioning of the equipment.

4. Any increase in square footage or cubage is minimized. Facilities should not stand out from the vehicle profile in a way that they endanger traffic to a greater extent than is avoidable.

5. Maximum accessibility to the facility is maintained.

b. Slinging facilities, as depicted on Figure 3-1, shall be located so that:

1. Attached slinging legs converge over the center of gravity (CG) of the equipment lifted at its maximum shipping weight (MSW) using sling legs of equal length, when possible. Facilities should be higher than the CG.

2. The attached sling apex does not exceed a height of 7.3 meters (24 ft.) above the lowest part of the equipment.

3. The rake angle of any component leg of the sling does not exceed 45 degrees from the vertical.

4. Necessity for using spreader bars is minimized or eliminated. If required, spreader bars (or Kevlar lifting slings, etc.) should be provided and stowed with the equipment.

5. The load remains stable during lifting.

6. The plane of the slinging facility is in approximate alignment with the anticipated angle of the sling facility.

7. The location of facilities should also allow use when sling lifting from the corners of a 20-foot International Organization for Standardization (ISO) container handling spreader bar[1].

c. Tie-down facilities shall be located so that:

1. Restraints are placed symmetrically around the equipment, preferably mounted on the front and rear ends.

2. The movement induced by the sprung weight of the equipment is effectively restrained.

3. The range of working angles is depicted at Figure 3-2.

4. They are higher than the CG of the equipment at MSW, if possible.

5. Restraints are not routed under the equipment, if possible.

2.3. STRENGTHS

Details of required strengths are outlined at Chapter 4.

2.4. DIMENSIONS

The dimensions of facilities shall conform with Chapter 5 for the equipment at its MSW.

[1] For an example, see Figure 6-1.

2.5. COMMERCIALLY SUPPLIED VEHICLES AND EQUIPMENT

Standard commercial vehicles and equipment do not require slinging, tie-down, or multipurpose facilities if their structural members contain suitable holes or other facilities designed for lifting and tie-down purposes that meet the strength, dimensional, and safety criteria contained in Chapters 3 through 5.

2.6. REMOVABLE FACILITIES

The use of removable facilities should be avoided. If there are no practicable design alternatives, the following criteria must be observed as a minimum:

a. Location of the slinging facilities shall be in accordance with Chapter 3.

b. Strength of the assembled facilities, when attached to the vehicle or equipment, shall be in accordance with Chapter 4.

c. The removable facilities shall be stowable on the equipment and available for use.

2.7. MARKING

2.7.1. SHIPPING DATA PLATE[2]

A shipping data plate (see Figure 2-1) shall be furnished and attached permanently to the vehicle or equipment. The shipping data plate shall be attached by screws, bolts, or rivets in a conspicuous location. The shipping data plate includes important details on slinging and tie-down points and CG of the equipment. The information on the plate helps ensure that proper tie-down facilities are used for land and sea transport of equipment, as well as, proper slinging facilities are used during slinging operations.

a. The shipping data plate shall show a silhouette of the equipment in transport position indicating:

1. The CG along each axis (configuration without payload).

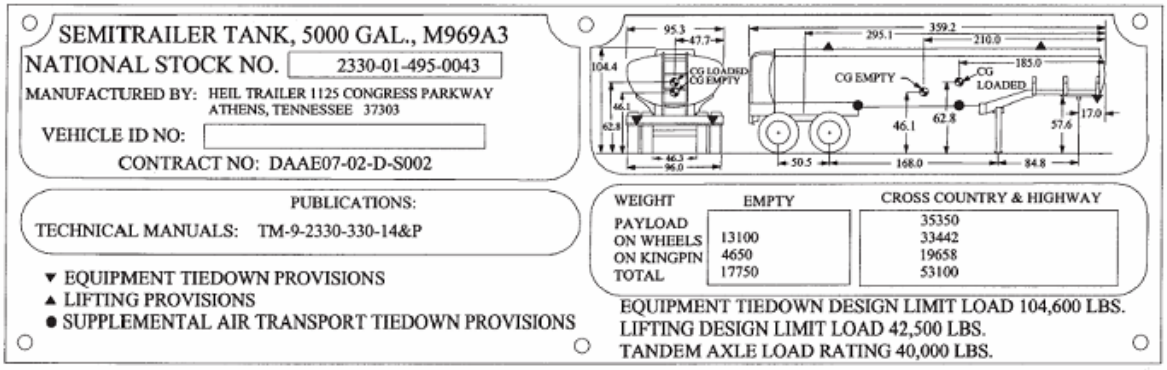
2. The location and strength of each facility.

3. The location of alternative or supplementary tie-down facilities.

4. List any special procedures.

5. Include any notice of limitations (e.g., facilities do not meet STANAG 4062 criteria; equipment is not crane lift able; etc.).

[2] For information on a manufacturer data plate, reference STANAG 2829.



FACILITY	DESIGN LIMIT LOAD
▼ EQUIPMENT TIEDOWN PROVISIONS	47,446 kg (104,600 lb)
▲ LIFTING PROVISIONS	19,278 kg (42,500 lb)
● SUPPLEMENTAL AIR TRANSPORT TIEDOWN PROVISIONS	{REQUIRED}

Figure 2-1: Example[3] of a Shipping Data Plate with Details on Supplementary Tie-down Facilities (or Provisions)

2.7.2. IDENTIFICATION

The identification and location of slinging and tie-down facilities shall be stencilled or marked on the exterior of the vehicle or equipment. Attachments resembling facilities for lifting or tie-down shall be located or designed to avoid mistaken use and marked as unacceptable for lifting or tie-down.

2.8. MATERIAL FINISH

The exterior surface of each facility shall be rounded, chamfered, or smoothed to prevent damage to slings or tie-down restraints, and to prevent injury to personnel.

[3] This is an example of a USA shipping data plate.

CHAPTER 3 APEX HEIGHT AND OPTIMUM WORKING ANGLES FOR SLINGING FACILITIES

3.1. GENERAL

Illustrations of working angles for slinging and tie-down facilities are shown:

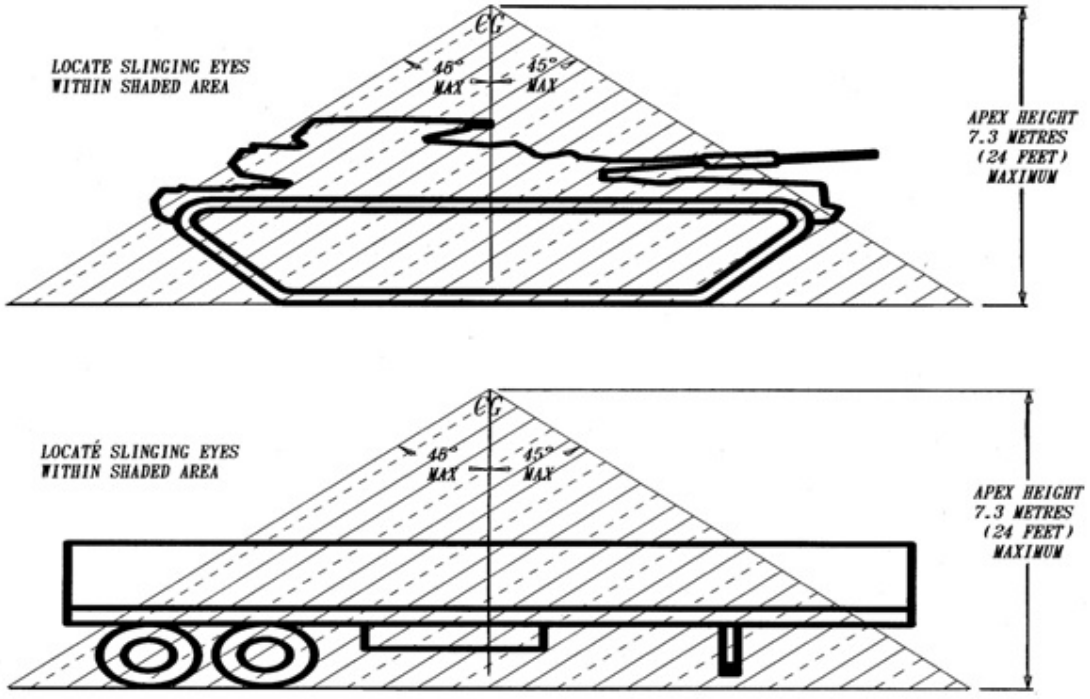


Figure 3-1: Illustrations for Apex Height and Optimum Working Angles

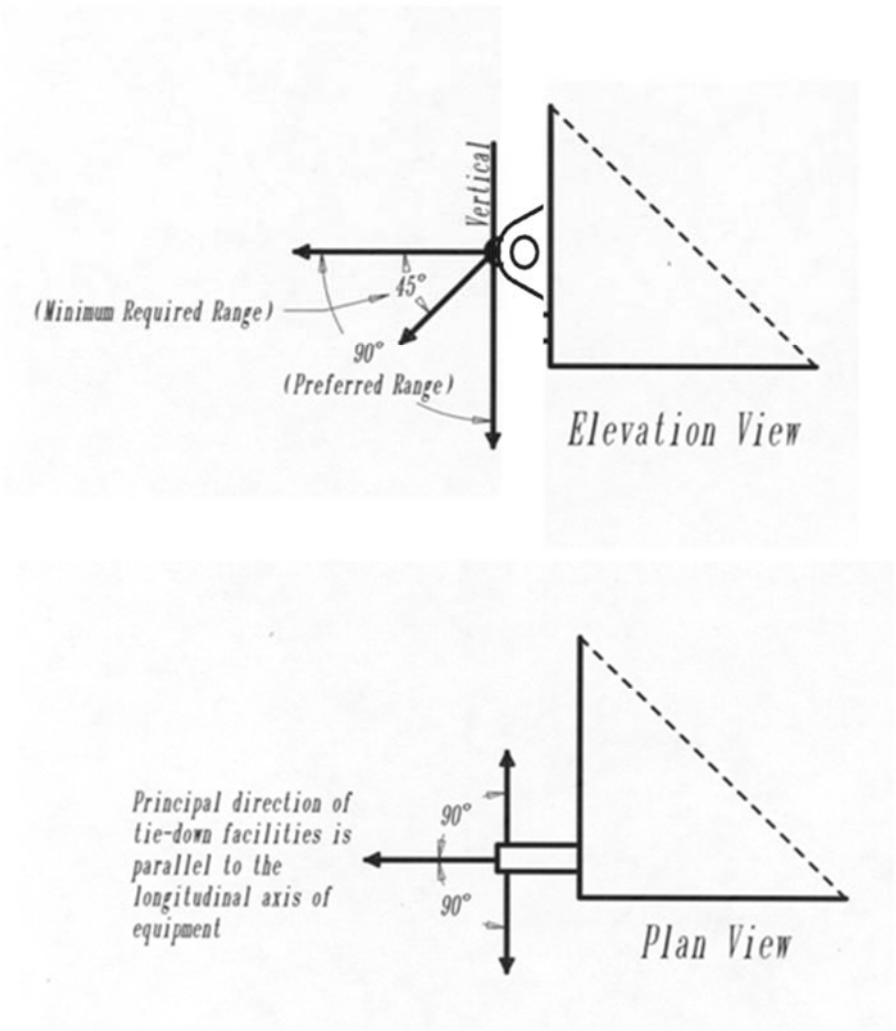


Figure 3-2: Range of Working Angles for Tie-Down Facilities
(Type of facilities shown is for illustration purposes only.)

CHAPTER 4 STRENGTH CRITERIA AND WORKING LOADS

4.1. SLINGING FACILITIES

Each slinging facility, including the connection to the structural frame of the vehicle or equipment, shall withstand (without permanent deformation) a force equal to the safe working load (or maximum static resultant force) multiplied by a factor of 2.3. The safe working load is the load imposed on the facility under actual service or working conditions with the slinging leg acting at a true angle of 45 degrees from the vertical, and is obtained by vectorially adding the maximum horizontal component and the maximum vertical component of the force component calculated for the individual slings under dead weight loading conditions. The ultimate strength of each facility shall equal or exceed 3.45 times the working load (i.e., working load times 2.3 times 1.5 safety factor). If helicopter transport is required, facilities shall also be in accordance with STANAG 3542.

4.2. TIE-DOWN FACILITIES

Each tie-down facility, including the connection to the structural frame, shall withstand (without permanent deformation) its proportionate share of the following loading: 4.0 times the MSW in the forward and aft direction of the longitudinal axis of the equipment, 2.0 times the MSW in the downward direction of the vertical axis, and 1.5 times the MSW in each direction of the lateral axis. These directional loads shall be applied statically and independently through the CG of the equipment and be distributed among the tie-down facilities that would effectively resist motion along that axis. There shall be no permanent deformation or set of the facility or other equipment structural components as a result of the applied loads to the tie-down. The ultimate load that each tie-down facility can withstand shall be 1.5 times the above directional loads (i.e., proportional load times 4.0 times 1.5 safety factor). If airdrop is required, facilities shall also be in accordance with STANAG 3548.

4.3. MULTIPURPOSE FACILITIES

Multipurpose facilities shall meet the requirements of both slinging and tie-down facilities as stated in paragraphs 4.1 and 4.2.

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CHAPTER 5 OPENING AND CLEARANCE DIMENSIONS OF FACILITIES

5.1. GENERAL

Information on opening and clearance dimensions for slinging and tie-down facilities is shown:

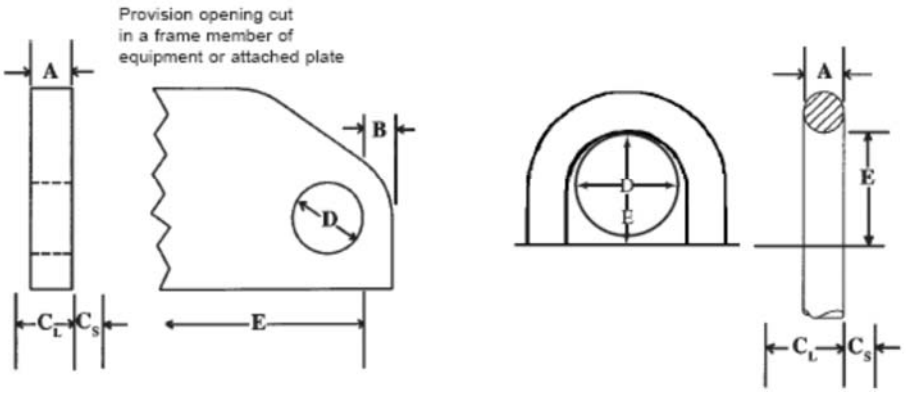

Figure 5-1: Illustrations

Gross Weight of Equipment[1]		A_{max} and B_{max2}		C_{Lmin3}		$C_{S\ min3}$		D_{min4}		E_{min}	
lb	kg	in	mm	in	mm	in	mm	in	mm	in	mm
0 to <10,000	0 to <4,536	1.00	25	7.00	178	3.00	76	3.00	76	3.20	81
10,000 to <25,000	4,536 to <11,340	1.50	38	9.00	229	4.00	102	3.00	76	3.40	86
25,000 to <50,000	11,340 to <22,680	1.75	44	12.00	305	5.00	127	3.50	89	3.90	99
50,000 to <82,000[5]	22,680 to <37,195	1.75[6] 2.00[7]	44[6] 51[7]	12.00	305	7.00	179	4.50[6] 3.50[7]	114[6] 89[7]	5.30	135
>82,000[5]	>37,195	1.75[6] 2.25[7]	44[6] 57[7]	12.00	305	7.00	179	4.90[6] 3.50[7]	124[6] 89[7]	5.30	135

Table 5-1: Opening and Clearance Dimensions for Slinging and Tie-down Facilities[4]

[4] Due to high rail impact requirements in North America, the USA follows more stringent requirements as described in MIL-STD-209.

Notes, which pertain to Table 5-1, are contained within the box text below and the following page:

Note$_1$: Helicopters do not have to meet the dimensions of this table. The dimensions of lifting and equipment tie-downs on helicopters shall be designed such that they are compatible with the appropriate number of polyester straps, or chains required for adequate restraint for air, marine and highway transport.

Note$_2$: For tie-down facilities, the maximum dimensions of the resulting cross section must be capable of being inscribed in a 51 mm (2 in) diameter circle[5].

Note$_3$: C_L and C_S –the numbers in this column are based on the amount of clearance that will be needed on either side of the provision to attach the hooks or lifting shackles into or onto the provision. Either side of the facility may be used as the datum from which to measure C_L and C_s.

Note$_4$: Facilities may be designed to swivel or rotate, however dimension D_{min} shall be met throughout the full range of motion.

Note$_5$: For equipment weighing 22,680 kg (50,000 lb), two holes[6] may be used in lieu of one large opening for the equipment tie-down facilities. Each of the two holes must have a D_{min} of 89 mm (3.5 in).

Note$_6$: Equipment tie-down facilities and multipurpose facilities.

Note$_7$: Lift facilities.

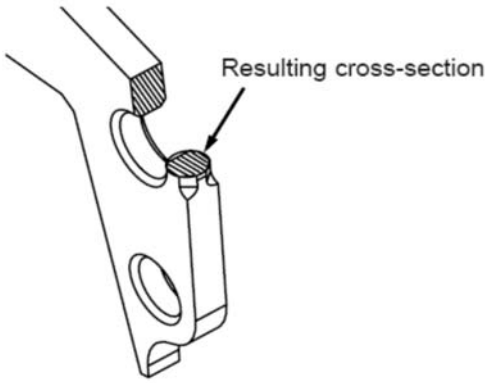

Figure 5-2: Example of Resulting Cross-section that should be inscribed in a 51 mm (2 in) diameter circle.

[5] For an example, see Figure 5-2.
[6] For an example, see Figure 5-3.

Figure 5-3: Example of an Equipment Tie-down Facility with Two Openings[7]

[7] This option applies for equipment with a gross weight of 22,680 kg (50,000 lb) or more.

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CHAPTER 6 ISO CONTAINER SPREADER BEAM (BAR)

6.1. GENERAL

Attachment points of ISO container spreader beam are at approximately 5.8 m by 2.3 m (19 ft. by 7.5 ft.). Lifting sling sets (e.g. Kevlar lifting slings, etc.) and ISO container spreader bars available at ports are typically equipped with four locations for lifting.

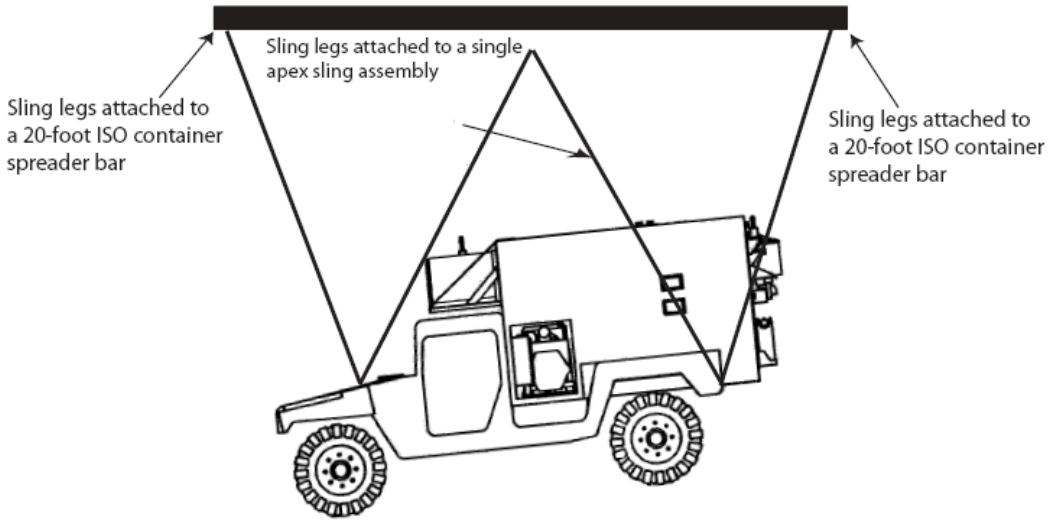

Figure 6-1: Example Showing the Range of Sling Leg Orientations

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ANNEX A RELATED PUBLICATIONS

A.1. GENERAL

This annex contains publications that are referred to in this document as well as others that are useful to logisticians. NATO Allied Publications (APs) and Standardization Agreements (STANAGs) are available on the NATO Standardization Office protected web site. http://nso.nato.int/nso/

SHORT NAME	TITLE
AAP-6	NATO Glossary of Terms and Definitions
STANAG 2236	Multimodal Transport Issues (AMovP-5)
STANAG 2468	Technical Aspects of the Transport of Military Materials by Railroad (AMovP-4)
STANAG 2829	Materials Handling Equipment
STANAG 2830	Materials Handling Aids
STANAG 3542	Technical Criteria for the Transport of Cargo by Helicopter
STANAG 3548	Tie-Down Fittings on Air Transported and Air-Dropped Equipment and Cargo Carried Internally by Fixed Wing Aircraft
STANAG 4101	Towing Attachments
STANAG 4478	Emergency Towing and Recovery Facilities for Tactical Land Vehicles
ISO 668	Series 1 freight containers – Classifications, dimensions and ratings
USA MIL-STD-209[8]	Lifting and Tiedown Provisions

[8] Copies of MIL-STD-209 are available at no charge to nations and are found online at: http://www.assistdocs.com/search/search_basic.cfm.

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ANNEX B PROCEDURES FOR SECURING MILITARY EQUIPMENT

B.1. GENERAL

AMovP-4 (STANAG 2468) and AMovP-5 (STANAG 2236) address the procedures to properly secure military equipment for rail and road movement.

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ANNEX C GLOSSARY OF TERMS AND DEFINITIONS

C.1. GENERAL

The annex contains terms and definitions that are used in this document for the purpose of this document:

maximum shipping weight
The weight of the equipment plus the weight of all the packages, ancillary components or accompanying supplementary loads which are fixed to the equipment or located inside it. (AAP-24)

multipurpose facility
A fitting or device which may be used for either slinging (lifting) or tie-down (lashing) purposes that is integrated into the equipment structure.

restraint of loads
The process of binding, lashing and wedging items into one unit and onto or into its transporter in a manner that will ensure immobility during transit. (AAP-24)

safety factor
Ratio between the breaking load and the maximum force in use. Its value depends on the application concerned and is set in the specific STANAGs for each type of ancillary component. The values generally accepted are five for lifting and two for tie-down. (AAP-24)

safe working load
The maximum (working) load, which, under specified conditions as listed at Chapter 4, for which the equipment can be used. Also maximum mass, expressed in kilograms or in tonnes that a sling is permitted to lift vertically. (AAP-24)

sling
Ropes or chains fastened round an object that is to be lifted by crane etc, and provides a point of suspension. (AAP-24)

slinging (lifting) facility
A fitting or device, or part of a fitting, sometimes called a provision, padeye, lug, or lifting attachment, which may include a shackle or ring as an integral part of the equipment structure.

spreader beam or frame
A beam or frame specially designed so that the suspended load is taken vertically from the attachment points, usually over an area. (AAP-24)

tie-down (lashing) facility
A fitting or device, or part of an item or fixture of attachment, sometimes called a provision, eye, fixture, or attachment, which may include a ring or shackle as an integral part. A tie-down has an opening for attachment of a restraint to secure the item during movement.

ultimate strength
The maximum force an item or device can withstand before breaking failure occurs. (AAP-24)

ANNEX D LIST OF ABBREVIATIONS

D.1. GENERAL

This annex contains abbreviations used in this document.

ABBREVIATION	FULL MEANING
CG	Centre of Gravity
ISO	International Organization for Standardization
MSW	Maximum Shipping Weight

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ANNEX E EVALUATION DATA SHEET

E.1. OBJECTIVE

The objective of this test is to determine the interface between participating nations' equipment and the transportation system, and provision for lifting and tie-down of equipment during road/highway transport. For the tie-down portion of this test to be valid for other transport modes, other transport systems (railcars, aircraft) are required to be used.

E.1.1. TEST AREA

Large level improved surface area to allow for operation of crane with sufficient capacity and with sling set(s) suitable for lifting equipment being evaluated, and for parking of tractor semi-trailer.

E.1.2. TEST EQUIPMENT

Crane of sufficient capacity to lift any equipment and/or item being evaluated and tractor semi-trailer(s) (with restraint devices) of sufficient capacity for transport of any equipment item.

E.1.3. TEST PROCEDURE

a. Examine equipment item to determine availability of four lifting and four tie-down facilities, the size of facility openings, and accessibility for installation of lift slings (e.g., Kevlar lifting slings, etc.) or restraint devices. Record if number of provisions is incorrect, and if facilities are not accessible as defined in this publication.

b. Placing equipment at crane, attach lifting slings and lift by the crane. Record any problems encountered, including hook up incompatibility, sling contact to equipment, etc.

c. Lower equipment, disconnect from sling and then move to semi-trailer and load by drive-on or lifting, as appropriate. Restrain equipment to semi-trailer using provided restraint devices. Record any damage to facilities or problems encountered in restraining equipment.

d. Remove the equipment from the semi-trailer. If any problems were encountered during the above-mentioned procedures, report these problems to the test officer for further evaluation and analysis.

e. The test officer shall evaluate/analyse each problem to determine if the equipment item or the test equipment induced the cause. If equipment induced, was the problem a result of the equipment not being in accordance

with the publication? If test equipment induced, does this item represent equipment normally used for military transport?

f. Examine equipment to determine if equipped with a shipping data plate and marked according to this publication.

E.1.4. DATA COLLECTION TABLE

Instructions: After completing each of the steps in the test procedure, place an “X” in the appropriate box if there was no problem. If there was a problem encountered, place the subsequent number of the “Note” in the appropriate box and explain the problem in the “Note” section.

Nation / Task	BEL	CAN	CZE	DEU	FRA	GBR	HUN	etc.
Examine lift/tie-down facilities								
Crane lift equipment item								
Restrain to semi-trailer								
Examine shipping data plate								
NOTES:								

Table E-1: Evaluation Data Sheet

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