NATO STANDARD

AEP-4478

RECOVERY AND TOWING FACILITIES FOR TACTICAL LAND VEHICLES AND TRAILERS

Edition A, Version 1
NOVEMBER 2022

NORTH ATLANTIC TREATY ORGANIZATION

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NORTH ATLANTIC TREATY ORGANIZATION

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

24 November 2022

1. The enclosed Allied Engineering Publication AEP-4478, Edition A, Version 1, RECOVERY AND TOWING FACILITIES A FOR TACTICAL LAND VEHICLES AND TRAILERS, which has been approved by the nations in the NATO ARMY ARMAMENT GROUP (NAAGH), is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4478.

2. AEP-4478, Edition A, Version 1, is effective upon receipt.

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

Dimitrios SIGOULAKIS
Major General, GRC (A)
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
NOR	NOR will implement the Edition 2 of this STANAG for future acquirements of tactical land vehicles where fulfilment of requirements are technically possible.
PRT	Portuguese Army does not have the capability to verify all requisites and specifications required by this STANAG. The implementation of this STANAG will be safeguarded under the following conditions: The Family of Tactical Vehicles in service of Portuguese Army, which are nearing the end of their life cycle, do not justify the investment to meet the requirements of AEP-4478.
USA	Some vehicles currently being procured do not meet this standard, but future designs of tactical land vehicles will meet the standards as listed in the “Standard 1” column of Table 1. The “Standard 2” column of Table 1 is a different sizing standard which likely would not be compatible with U.S. vehicles.
Note: The reservations listed on this page include only those that were recorded at the 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]
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CHAPTER 1 – INTRODUCTION

1.1. DEFINITIONS

The following terms and definitions are used for the purposes of this Agreement:

a. **Empty weight (weight without cargo)**
The weight of a vehicle/trailer, fully equipped and serviced for operation, including filled fuel and coolant tank, lubricants and complete vehicle equipment (e.g. on-board tools, fire extinguisher, first-aid box, spare wheel), but without cargo and cargo-carrying equipment. The empty weight also includes the weight of a driver. Furthermore, the empty weight of tactical vehicles takes the personal equipment of the driver into account. The empty weight is also known as empty mass or net weight.

b. **Gross Vehicle Weight Rating (GVWR)**
The maximum authorised operating weight of a vehicle, including the weight of the vehicle's chassis, body, engine, engine fluids, fuel, vehicle tools and equipment, driver, passengers and payload. It is the sum of the empty weight plus the load-carrying capacity of a vehicle. In case of a vehicle combination the GVWR is the sum of the GVWR vehicle plus GVWR trailer. The term Maximum Authorised Mass is a synonym.

c. **Payload**
The load a vehicle is authorised to carry in addition to its empty weight until the Gross Vehicle Weight Rating is reached. The payload is also referred to as load-carrying capacity.

d. **Recovery, Towing and Winching**
Recovery means pulling out or raising a disabled, stuck or immobilized vehicle. Recovery ends when the vehicle is operational again or ready for towing/removal to a maintenance point.

Towing
Towing can be encompassed by the following methods:

1. **Rigid tow**
This type of tow is subdivided into two categories:

a) Straight Bar or Bar Tow
A type of tow that uses a bar (e.g. a metal bar) that attaches to the casualty vehicle's towing facility and the towing / recovery facility on the towing vehicle. This type of tow keeps all vehicle wheels in contact with the ground.

b) "A" Frame or Drawbar Tow
A type of tow that uses a drawbar system, a movable tow bar or an "A" frame, which keeps the towed vehicle in contact with the ground. This is a safer method of towing vehicles, particularly if the brakes of the casualty vehicle are inoperative. Compared with towropes, this method significantly reduces the shock loading that acts on the tow lugs and towing facilities.

2. **Rope or sling tow**
A type of tow where a rope, chain, length of webbing or a round-sling is attached between both the casualty vehicle and the towing vehicle. The casualty vehicle must have a functioning braking and steering system. The rope or sling tows should generally only be used for short durations.

3. **Suspended tow**
A type of tow where a proportion of the casualty vehicle is lifted so not all of the wheels are in contact with the ground. This type of tow involves that the towing device (e.g. crane) of the towing vehicle are at the same level with or above the attached towing facilities of the casualty vehicle.

4. **Supported tow**
A type of tow using a towing vehicle, with a proportion of the casualty vehicle being lifted so not all of the wheels are in contact with the ground. This type of tow involves that the towing device (e.g. underlift with cradle) of the towing vehicle are **below** the attached towing facilities of the casualty vehicle.

5. **Winching**
Use of winch to recover a casualty vehicle from the place where it has become disabled, stuck or immobilized.

e. **Maximum allowed load (MAL)**
The maximum allowed load is the defined load permitted to act on each lug as determined by the vehicle manufacturer. The indication unit is kN.

f. **Yield load (YL)**
The maximum load allowed to act on each lug without suffering damage or permanent deformation. The yield load (YL) is also known as elastic load. The indication unit is kN.

g. **Ultimate load (UL)**.
The maximum load allowed to act on each lug without breaking. The ultimate load (UL) is also known as breaking load. The indication unit is kN.

h. **Towing capacity (TC)**
The defined rolling mass of a vehicle allowed to be towed by the lugs, as determined by the vehicle manufacturer. The indication unit is metric ton (t).

i. **Recovery and towing facilities**
The term "recovery and towing facilities" as used in this AEP refer to the lugs on a tactical land vehicle and trailers that are used for towing and recovering.

j. **Tactical land vehicle**
A military vehicle, whether primarily designed or adapted from a commercial vehicle for military use.

k. **Compounded lugs**
A compounded lug is created, when two different lugs (in acc. with AEP- 4478) will be combined and mount as a recovery and towing facility unit on the vehicle. It shall be considered, that the same requirements of the AEP-4478 apply for compounded lugs as for single lugs.

1.2. ANNEXES

A. LUGS - GEOMETRIC DIMENSIONS.
B. LUGS - GEOMETRIC CLEARANCE
C. LUGS - FORCES AND DESIGN SPECIFICATIONS
D. LUGS - MAXIMUM ALLOWED LOAD

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CHAPTER 2 - DETAILS

2.1 Scope of standard

a. AEP-4478 is for use by the following NATO forces:

(1) NATO Army forces.
(2) Those elements of NATO Naval and Air Forces operating in a ground role, e.g. Marines, naval landing parties and Air Force ground personnel.

b. This standard applies to the following:

(1) New procurement projects for tactical land vehicles and trailers.
(2) In-service tactical land vehicles and trailers that could be modified at reasonable cost and without major restrictions concerning their military characteristics.

c. Deviation - Reservation:

The contractor shall notify the customer or purchaser about any AEP-4478 requirements that cannot be implemented at all or only with disproportionate efforts. Deviations from standard requirements must be authorized by the customer or purchaser in particular in binding agreements.

2.2 General

This AEP defines basic requirements and criteria in terms of construction and geometry for the technical design of the recovery and towing facilities. The places and kinds of attachment of the facilities to the vehicles shall ensure that the loads induced on the vehicles via these facilities do not lead to deformations of the vehicle structure.

Recovery and towing facilities shall meet the following criteria**:**

a. Number of facilities on vehicles

At least four facilities for recovery and towing shall be installed per vehicle. Two facilities shall be fitted to the front of the vehicle and two to the rear. These facilities shall have identical drilling hole diameters and shall be arranged in such a way that the holes are horizontally aligned (see ANNEX A, figure 1). Note: The diameter of the front lug can be different from the rear lug.

b. Number of facilities on trailers

At least four facilities for recovery and towing shall be installed per trailer. Two facilities shall be fitted to the front of the trailer and two to the rear. These facilities shall have identical drilling hole diameters and shall be arranged in

such a way that the holes are horizontally aligned. Note: The diameter of the front lug can be different from the rear lug.

c. Design and design specification

(1) Each recovery and towing facility on a vehicle shall withstand a static pull load and pressure load corresponding to at least 1.5[1] times the GVWR within a cone of 22,5° without suffering damage or permanent deformation, see ANNEX C.
For a strength compliance demonstration by means of FE simulation, a maximum plastic material elongation of 2 % is permissible for yield load in the contact area of lug hole and pin.

(2) Each recovery and towing facility on a vehicle must have an elongation at break exceeding 10% and must be temperature-resistant in the range from -40°C to +70°C. The minimum notch impact energy has to be at least 27 Joule at -40°C.

d. Safety and safety factors

The Maximum Allowed Load (MAL) is limited by the minimum of decreased Ultimate Load (UL) and Yield Load (YL).

$$MAL = \min (MAL_{UL} ; MAL_{YL})$$

(1) A safety factor of 2.0 (S_{fU} = 2.0) against breakage is required. The ultimate load must exceed the maximum allowed load by a factor of at least 2.0.

$$MAL_{UL} \leq UL / 2.0$$

(2) A safety factor of 1.25 (S_{fY} = 1.25) against permanent deformation is required. The yield load must exceed the maximum allowed load by a factor of at least 1.25.

$$MAL_{YL} \leq YL / 1.25$$

(3) Compliance to the safety factors shall be demonstrated by accepted test procedures (see section j).

(4) The maximum allowed load (MAL) for each lug in the vertical and horizontal articulation angle ranges from 0° to 90° and has to be shown in tables as illustrated in ANNEX D. The first table has to list the MAL of each lug without an adapter and the next table has to be related to an adapter (e.g. shackle, T-hook etc.) used on the respective lug. The adapter, also called connector, used in determining the MAL has to be clearly identified – by product part name, part number, NSN, manufacturer – on the data sheet.

[1] *The design factor of 1.5 (f_d=1.5) for the lug design has been adopted from the previously valid STANAG 4478*

These data sheets (tables) have to be added to the vehicle operating instructions. Displaying these technical data additionally (in concise form) at a suitable point of the vehicle, whether externally or internally, is recommended.

e. Dimensions

The relevant dimensions of lugs are listed in Table 1 to ANNEX A. The aim is to ensure an identical dimension design for weight classes of tactical land vehicles.

f. Clearance

The clearance around any recovery or towing facility is necessary for attaching towing and recovery equipment and should, as a rule, be as large as possible. The minimum clearance values are identified in Annex B.

g. Minimum articulation angles

The articulation angle ranges of recovery and towing facilities should be as large as possible. The minimum articulation angles are identified in Annex B.

h. User information – user manual

The performance data of each towing and recovery facilities shall be described in a user manual. The user manual shall primarily inform the operator about the allowable loads and the towing capacity. That information shall also displayed in concise form at a suitable point of the vehicle near the towing and recovery facility. In addition, the user manual shall contain information on options of use, on assembly and disassembly, inspection, maintenance, risks etc. Furthermore, the user manual shall include the information that the towing and recovery facility must not be used for a complete vehicle lifting.
In preparing the user manual, the standards of the country or countries in which the vehicle will be registered shall be observed. Inspections shall be determined by the operator; minimum one inspection per year. The user manual shall also include the note that only authorized entities are allowed to perform repairs on towing and recovery facilities. Decommissioning criteria shall also be determined in the user manual. The vehicle manufacturer shall be obliged to hand over this user information, when the vehicle passes into the user's possession.

i. Identification and marking

(1) Towing and recovery facilities produced in accordance with AEP 4478 shall carry a marking identifying the lug: “4478 - standard size”. For example: “4478-3”.

(2) In addition, the marking shall allow traceability. It must be clear and permanent.

j. Test

1. General Information

1.1. Objective of testing

The objective of testing is to provide evidence, that the essential requirements of AEP-4478 regarding towing and recovery facilities are met. The following test requirements define the boundary conditions has to be observed.

If all testing requirements identified are met and compliance is confirmed by an accredited test organization, the Contractor will transmit the test results with the test report to the Customer. This will constitute evidence that the required testing of a towing and recovery facility installed on a certain type of vehicle has successfully been performed, in the sense of a first-article inspection.

1.2. Test occasions

Testing is necessary whenever a towing and recovery facility in accordance with this AEP-4478 is integrated with a new type of vehicle. Testing also becomes necessary whenever a vehicle that is already in service and newly or additionally fitted with a towing and recovery facility in accordance with this AEP-4478.

2. Practical and simulation-based strength test

A practical test with the recovery and towing facility is necessary for providing evidence of strength and dimensions. Testing shall be carried out with the test procedure described below. Evidence of the strength of the towing and recovery facility may also be provided by means of FE simulation; in this case, the vehicle manufacturer must prove with a reference test, that the simulation can be regarded as equivalent to a practical test - in conjunction with an accredited testing organisation or test center.

2.1. Reference test

The resistance of the towing and recovery facility to deformation and breaking shall be determined in a practical test as described in para 2.3 below. If the determination of MAL for the different angle areas will be carried out by simulation, evidence of the equivalence of a practical and simulation-based strength test shall be proved by a reference test procedure. In the first stage of this test procedure the following two practical tests shall be carried out:

A) Horizontal tensile test in longitudinal direction (0°)
B) Horizontal tensile test in transverse direction (90°)

The horizontal tensile test in 90° transverse direction shall primarily be carried out in the direction in which the 90° clearance required for this purpose exists on the vehicle. If that clearance exists both, for the +90° and -90° angle, the

direction shall be selected for which most critical loads for the vehicle structure can be expected.

For the tests referred to A) and B) above, three (3) towing and recovery facilities each are required as test specimens.

Notes:

(1) Suitable test aids shall be used for the tests, see 2.4

(2) If the same towing and recovery facility shall be integrated at a place on the vehicle, where the vehicle structure is substantially different, a second test series is required. An additional test series is also required, if a different sized towing and recovery facility shall be integrated on the same vehicle.

(3) If the tensile tests are not carried out on the vehicle itself, the towing and recovery facility shall be attached to a test rig that is similar to the structure of the vehicle. In this case, the attachment method (bolts, welding etc.) must be identical to the original method of attaching the towing and recovery facility to the vehicle. The structure and strength of the test rig used shall be described in the test report.

The second stage of the test procedure is the equivalence assessment (see para 2.2)

2.2. Equivalence assessment

Evidence of the equivalence of practical and simulation tests are fulfilled, if the practical test results reaches at least the simulations results of the reference tests A) and B).

2.3. Practical test of component strength – test procedure

2.3.1. Test of resistance to deformation

Resistance to deformation shall be tested by applying a tensile force that is 1.25 times the maximum allowed load.

$$F_{YL} = 1.25 \times MAL$$

In these yield load tests, the test force F_{YL} shall be applied using the following angles[2]:

a) Horizontal: ± 0, ± 22.5°, ± 45°, ± 67.5°, ± 90°
b) Vertical ± 0, ± 22.5°, ± 45°, ± 67.5°, ± 90°

Note:
(1) The number of measuring angles to be applied might be limited by the vehicle contour.
(2) The test force shall be applied for at least 3 minutes.

2 Deviations from the nominal angles of up to ±2,5° will be tolerated in the tests, especially the practical tests.

(3) The test shall be carried out at a component and ambient temperature of 20°C ± 5°C.
(4) After load relief, there must be no permanent deformation that impairs the function of the towing and recovery facility.

2.3.2. Test of resistance to breaking strength

The test for resistance to deformation (yield load test) shall be followed by a test of the resistance to breaking (ultimate load test) by applying a tensile force that is equal to 2.0 times the maximum allowed load (MAL).

$$F_{UL} = 2.0\ MAL$$

In these ultimate load tests, the test force F_{UL} shall be applied using the following angles[3]:

a) Horizontal: ± 0, ± 22.5°, ± 45°, ± 67.5°, ± 90°
b) Vertical ± 0, ± 22.5°, ± 45°, ± 67.5°, ± 90°

Note:
(1) The number of measuring angles to be applied might be limited by the vehicle contour.
(2) The test shall be carried out at a component and ambient temperature of 20°C ± 5°C.
(3) The test has been passed, if there is no break before reaching F_{UL}

2.4. Test equipment,

a) For the determination of the breaking force when horizontal tensile strain is applied at angles of 0°, 22.5°, 45°, 67.5°, a suitable towing equipment shall be used, e.g. shackles[4].

b) For the determination of the breaking force when horizontal tensile strain is applied in transverse direction (90°), a testing pin has to be designed with
- diameter P (see Annex A; figure 1)
- suitable towing device (e.g. eye, hook) at load application side
- anchor surface (with max. twice the pin diameter P) on contact side

c) For the determination of the breaking force in the vertical angles, the same towing equipment shall be used as stated in point a) above.

All test equipment, used in the practical tests shall be documented in the test report, including photographs, sketches, part numbers and other information.

3 Deviations from the nominal angles of up to ±2,5° will be tolerated in the tests, especially the practical tests.
4 *The towing equipment used for the breaking resistance tests must have strength values that are proportionately higher than those of the towing and recovery facility to be verified. The pin shall be based on diameter P (see ANNEX A, figure 1)*

3. Evaluation of material parameters

Material parameters specified below shall be proven for the towing and recovery facility and the associated pin:

a) R_m Tensile strength (N/mm²)
b) R_e Yield strength (N/mm²)
c) A_5 Elongation at break (%)

If evidence of compliance with the material parameters cannot be provided by presenting a test certificate of the material manufacturer, these parameters shall be determined by means of a tensile test in accordance with ISO 6892. To this end, three standard samples shall be taken during production and shall be used for the test.

d) Low-temperature resistance:

If evidence of compliance with the required low-temperature resistance cannot be provided by presenting a test certificate of the material manufacturer, the notched impact strength shall be determined in a notch impact test in accordance with ISO 148-1 at -40 °C.

The test results or test certificates providing information on the material parameters mentioned in a), b), c) and d) above shall be attached to the test report.

4. Check of geometric dimensions

The dimensions A, B, C and E described in ANNEX A, figure 1, shall be determined *before and after* the test referred to para 2.1 and 2.3 above and documented as Target values and Actual values in the test report. Once the vehicle integration of the towing and recovery facilities has been completed, the resulting dimensions D and Z shall be determined and documented in the test report. If the lug pin is part of the scope of delivery, the pin diameter "P" shall be stated in the test report as well.

k. Test report

After the towing and recovery facility has been tested according to the procedures described in section j, a test report shall be issued by the manufacturer in conjunction with an accredited testing organisation/ testing institute. The report shall at least include the information shown below:

(1) Name and address of the manufacturer,
(2) Name and address of the accredited testing organisation/institute,
(3) Date (year and month) of manufacture,
(4) AEP-4478 standard short title (for example 4478-3),
(5) Part number and part name assigned by the manufacturer,
(6) NATO Stock Number (NSN), if available,

(7) Date (year, month and day) of the test,
(8) Test results (test procedure described in section j),
(9) Identification of the type of vehicle equipped with the facility under test, e.g. procurement lot number, contract number etc.,
(10) Signature by the manufacturer's authorized representative(s), date of report issued,

Test report annex:

In the test report annex, the testing organisation / institute involved by the vehicle manufacturer, shall confirm compliance with the test requirements / specifications (see section j) in a formless certificate.
In case of simulation based tests, the testing organisation/institute shall additionally confirm with a Certificate of Equivalence (CoE), that the practical tests are equivalent to the simulation based tests.

Note
(1) The test report shall be delivered together with the documentation of the first series-produced vehicle, or the first produced vehicle (demonstrator), to the customer.
(2) In case of technical need, a test report shall be delivered with modified in-service vehicles.

l. Declaration of Compliance (DoC)

The vehicle manufacturer shall declare the compliance of the towing and recovery facility with AEP-4478.
It shall contain the following minimum information:

(1) Name and address of the manufacturer,
(2) Date (yymm) of manufacture
(3) AEP-4478 standard short title (for example 4478-3)
(4) Declaration of Compliance
(5) Signature by an authorized person of the manufacturer,
(6) Date of issue
(7) Name, date and test report number of the first article inspection (see section „k“).

The DoC shall be presented to the Customer with each new vehicle or each modified in-service vehicle equipped with towing and recovery facilities according to AEP-4478, published in this edition.

ANNEX A: LUGS – GEOMETRIC DIMENSIONS

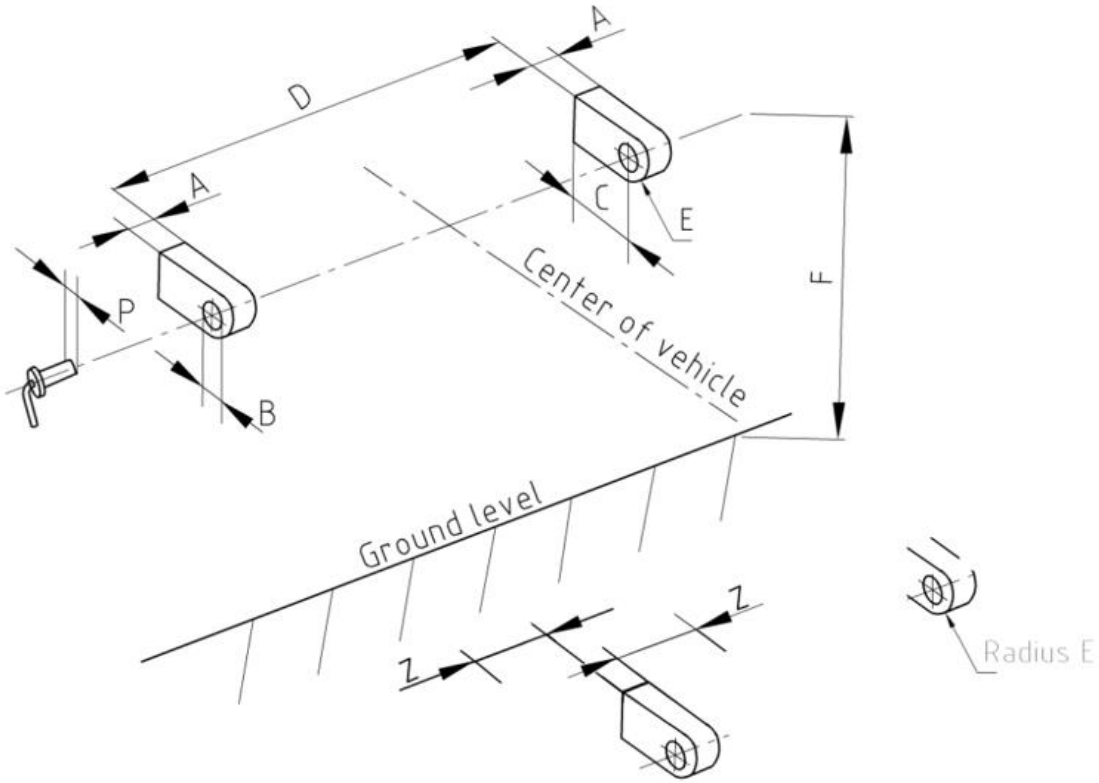

Figure 1, Lugs - geometric dimensions, spacing and connecting dimensions

The standardised dimensions, spacing and connecting dimensions of the towing and recovery facilities with their lugs are listed in Table 1.

ANNEX A TO
AEP-4478

Table 1: Lugs - Geometric dimensions, spacing and connecting dimensions

Standard 1[5]	Standard 2[6]	P (mm)	A (mm)	B (mm)	C (mm)	Z[7] (mm)	E (mm)	Gross vehicle weight rating (GVWR)
4478-1		19.05 ± 0.2	22.2 ± 0.8	20.5 ± 0.3	>25.4	>125	20.0 +0/-0.8	Up to and including 5000 kg
4478-2		25.4 ± 0.2	34.9 ± 0.8	26.5 +0.3/0	>31.7	≥200	32.15 + 0/-0.8	More than 5000 kg up to and including 10000 kg
4478-3		37.5 0/-0.4	44.0 ± 0.8	38.5 +0.5/0	>38.1	≥300	38.2 + 0/-0.8	More than 10000 kg up to and including 35000 kg
4478-4		57.2 ± 0.3	50.8 ± 0.8	60.0 +0,3/0	>63.5	≥300	62.3 + 0/-0.8	More than 35000 kg up to and including 70000 kg
	4478-5	39 -0.3/-0.5	35.0 ± 0.8	40.0 +0.5/0	>60.0	≥250	46.5 ± 0.8	More than 5000 kg up to and including 40000 kg
	4478-6	37.5 0/-0.4	44.0 ±0,8	38.5 +0.5/0	>57.0	≥330	40.0 ± 0.3	More than 5000 kg up to and including 40000 kg
	4478-7	50 0/-0.4	44.0 ±0,8	52 +0.5/0	>74.0	≥330	55.0 ± 0.8	More than 20000kg up to and including 70000kg
		No design standard has been set for this mass range						over 70000kg
	D: Spacing of the lugs to suit the chassis/frame is not fixed **F:** Dimension is not fixed							D and F shall documented in the user manual.

Lug selection

1. The Customer/Purchaser will decide whether Standard 1 lugs *or* Standard 2 lugs are realised on a military vehicle. The selection usually depends on the nationally fielded towing, recovery and transportation facilities available in theatre. Using adapters to achieve compatibility between Standard 1 and Standard 2 lugs may be beneficial.

2. In general, the gross weight of a vehicle is the decisive factor for allocating the lug size. The choice of lug strongly depends, however, on the expected loads placed on the lugs during towing, recovery and transportation. Consequently, the weight class allocations shown in the Table are just a guideline.

3. The lugs to be realised on the vehicles shall be marked in accordance with Table 1. *Example:* A lug realised in accordance with AEP-4478-3 shall be marked as *4478-3.*

[5] Standard 1 including lugs 4478-1 to 4478-4 is based on the preceding Edition of AEP-4478
[6] Standard 2 including lugs 4478-6 and 4478-7 is based on VG95710, a military standard published by DIN (German Institute for Standardisation). Lug 4478-5 is exclusively attached to military wheeled vehicles produced by EU manufacturers.
Lugs in accordance with Standard 2 are widely used on wheeled and tracked vehicles in Europe.
[7] Ideally, clearance Z should be realized on both sides of the lug

ANNEX B: LUGS - GEOMETRIC CLEARANCE

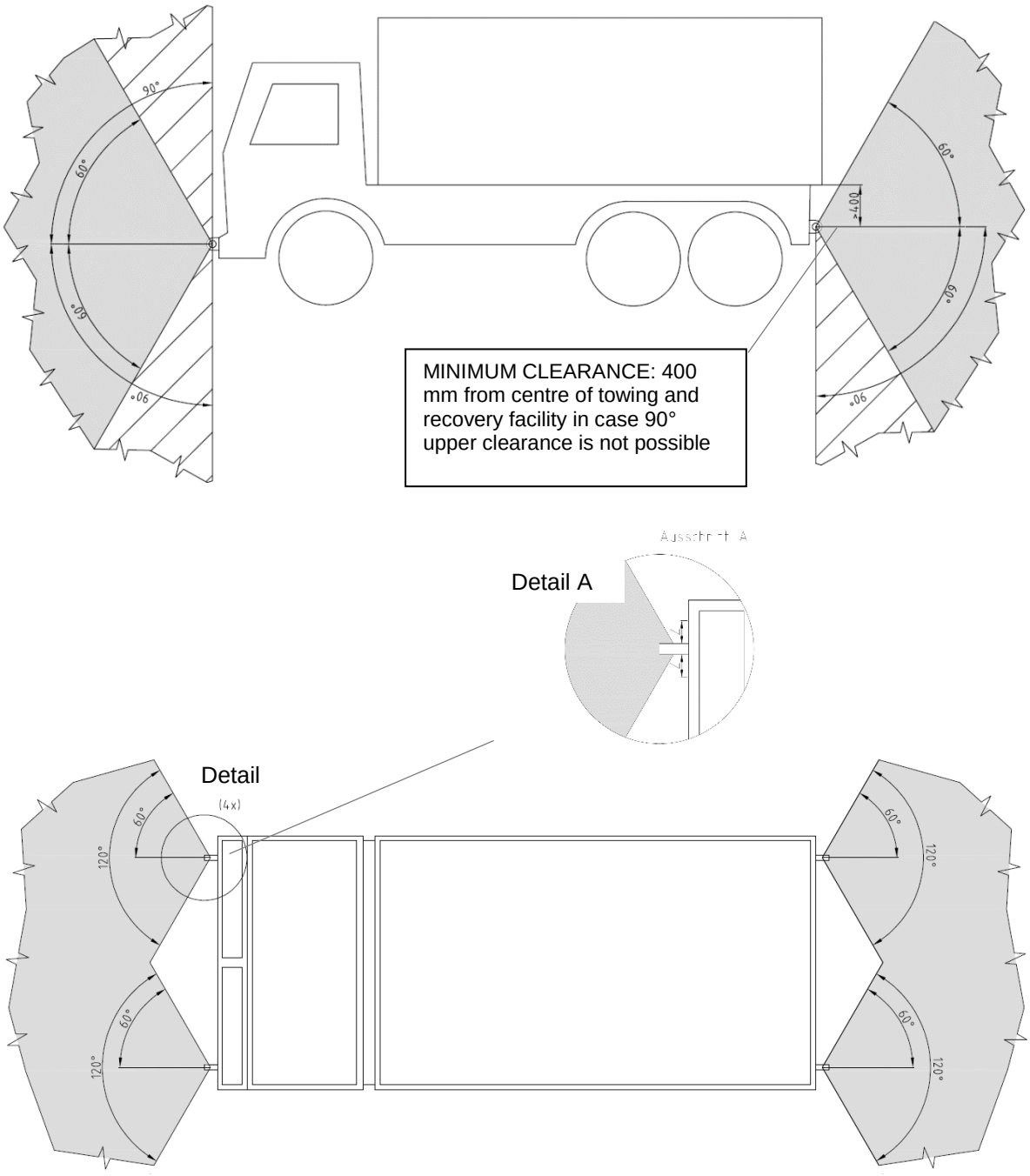

Figure 1: Wheeled Vehicles

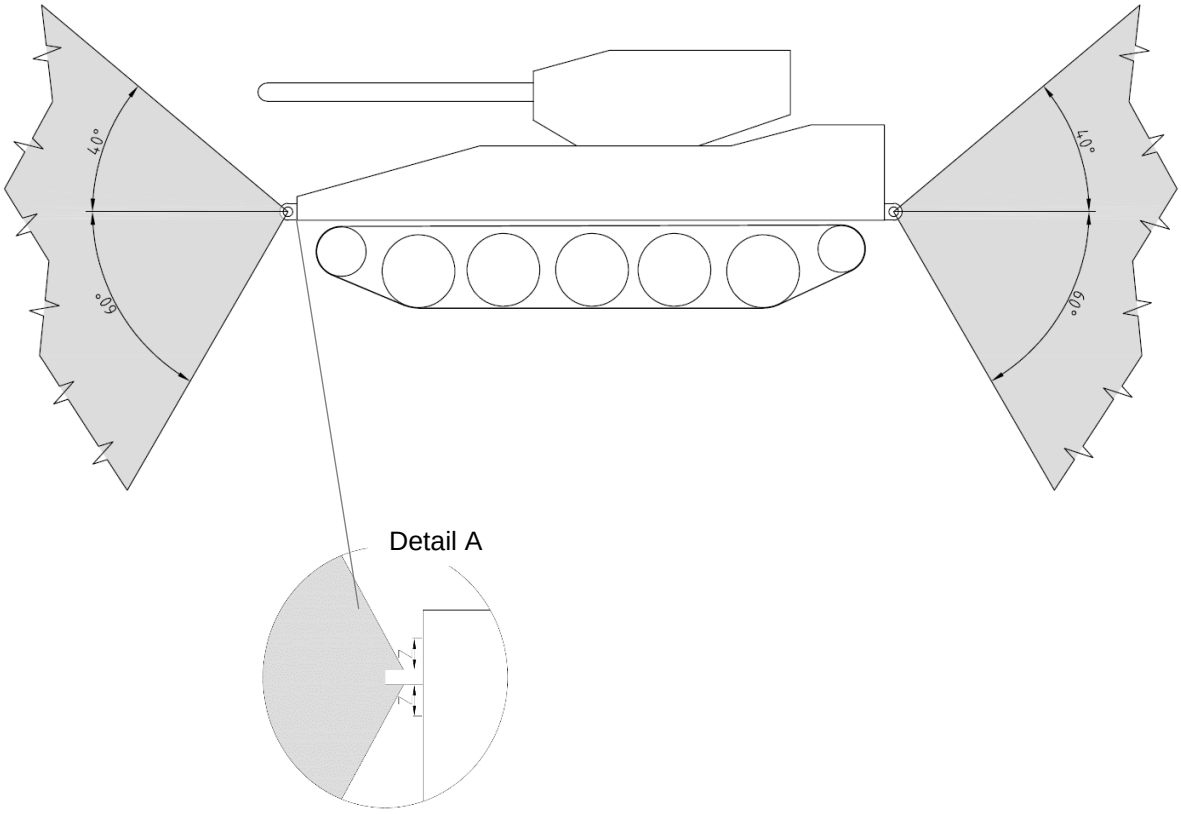

Figure 2: Tracked Vehicles

Lug Clearance Requirements

As a rule, the lugs shall have as much clearance as possible.

Figure 1

The 60° clearance angles shown in grey in Figure 1 constitute the minimum requirement. If a supported towing functionality is required, clearance angles of 90° vertically downwards shall be realized. If suspended towing is required, a clearance angle of 80° to 90° vertically upwards is required.

Figure 2

The clearance angles of 60° downwards and 40° upwards marked in grey in Figure 2 are the minimum requirement to be met.

ANNEX C: LUGS - FORCES AND DESIGN SPECIFICATIONS

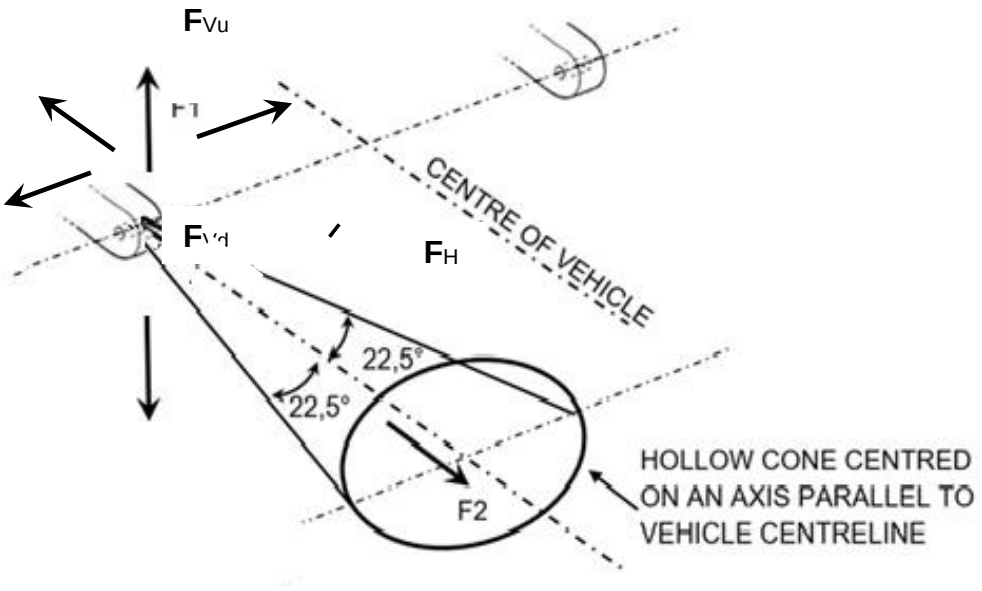

Figure 1 Vertical forces F_V and horizontal forces F_H and their directions

DESIGN SPECIFICATION PER LUG

F_{VU} (Newton) = f_d^4 x GVWR x 9.81 = F_{Hp} = 1.5 x GVWR x 9.81

F_{HL} (Newton) = f_d x GVWR x 9.81 = F_{Hp} = 1.5 x GVWR x 9.81 *(within the cone)*

Legend: forces in Figure 1

F_{Vu}	Force vertical, upward	90°
F_{Vd}	Force vertical, downward	90°
F_{HTo}	Force horizontal, transverse, outside	90°
F_{HTi}	Force horizontal, transverse, inside	90°
F_{HL}	Force horizontal, longitudinal (tensile)	22.5°-cone
F_{Hp}	Force horizontal, longitudinal (pressure)	22.5°-cone

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ANNEX D: LUGS - MAXIMUM ALLOWED LOAD

1. Maximum allowed load (MAL) on lug

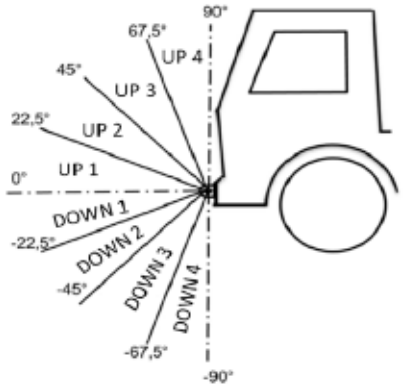

	Table 1A		Max allowed load [kN]	
	vertical	zone	front	rear
up	90°	UP 4		
	67,5°	UP 3		
	45°	UP 2		
	22,5°	UP 1		
down	-22,5°	DOWN 1		
	-45°	DOWN 2		
	-67,5°	DOWN 3		
	-90°	DOWN 4		

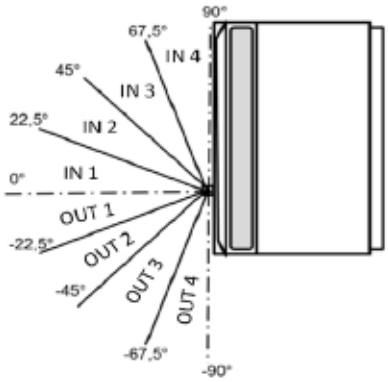

	Table 1B		Max allowed load [kN]	
	horizontal	zone	front	rear
in	90°	IN 4		
	67,5°	IN 3		
	45°	IN 2		
	22,5°	IN 1		
out	-22,5°	OUT 1		
	-45°	OUT 2		
	-67,5°	OUT 3		
	-90°	OUT 4		

Figure 1: Maximum allowed loads on the lugs, without connector *– sample form of presentation*

The vehicle manufacturer shall determine – in accordance with Tables 1 and 2 – the maximum loads allowed to act on the lugs at the rear and the front of the vehicle in the vertical and horizontal angle ranges and list them as maximum allowed loads in the tables.

The data sheet to be provided by the vehicle manufacturer shall include the information that the maximum allowed loads (MAL) stated in the table may be either pull loads or pressure loads acting on the towing and recovery facility. If the lug does *not* meet the pressure load-bearing capacity requirement, the manufacturer shall present a separate data sheet containing the information on the reduced pressure load-bearing capacity.

2. Maximum allowed load (MAL) on the connector

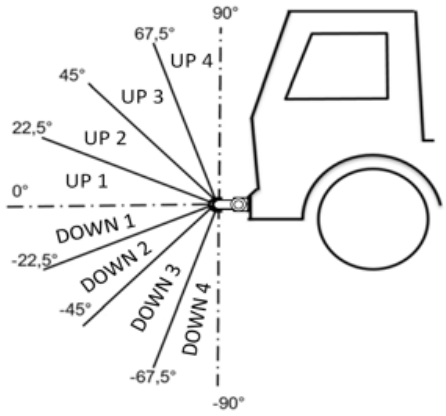

	Table 2A		Max allowed load [kN]	
	vertical	zone	front	rear
up	90°	UP 4		
	67,5°	UP 3		
	45°	UP 2		
	22,5°	UP 1		
down	-22,5°	DOWN 1		
	-45°	DOWN 2		
	-67,5°	DOWN 3		
	-90°	DOWN 4		

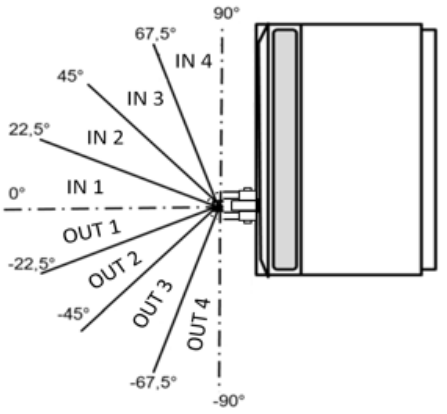

	Table 2B		Max allowed load [kN]	
	horizontal	zone	front	rear
in	90°	IN 4		
	67,5°	IN 3		
	45°	IN 2		
	22,5°	IN 1		
out	-22,5°	OUT 1		
	-45°	OUT 2		
	-67,5°	OUT 3		
	-90°	OUT 4		

The maximum allowed load on the Connector has been determind with the following connector attached to the lug	
Part number	
Part name	
Stock number, if available	
Manufacturer	
Length of lever arm (mm)	

Figure 2: Maximum allowed load on the connector – sample form of presentation

The vehicle manufacturer shall determine the maximum allowed load on the connector (shackle, T-hook etc.) attached to the relevant lug. The connector shall be specified in the tables by entering *part name, part number, stock number and manufacturer.* In addition, the *length of the lever arm* of the connector taken into account in the determination shall be specified in the table.

Connectors with a WLL marking may be adapted to the towing and recovery facilities and may be subjected to a load corresponding to twice the WLL load.

MAL = 2 x WLL x 9.81.

This is based on the prerequisite that the WLL connector is suitable for the intended use and that a safety factor against breakage of at least four is ensured.

**APPENDIX 1 TO
ANNEX D TO
AEP-4478**

APPENDIX 1 TO ANNED D:
Drawbar coupling and trailer coupling – Maximum allowed loads

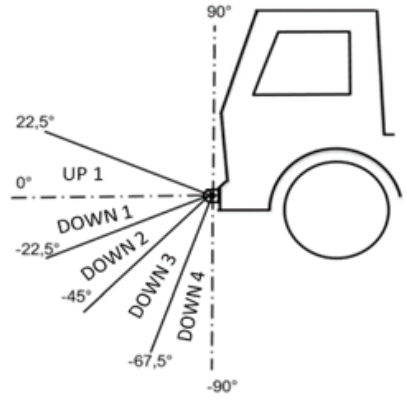

	Table TA		Max allowed load [kN]	
	vertical	zone	front	rear
up				
	22,5°	UP 1		
down	-22,5°	DOWN 1		
	-45°	DOWN 2		
	-67,5°	DOWN 3		
	-90°	DOWN 4		

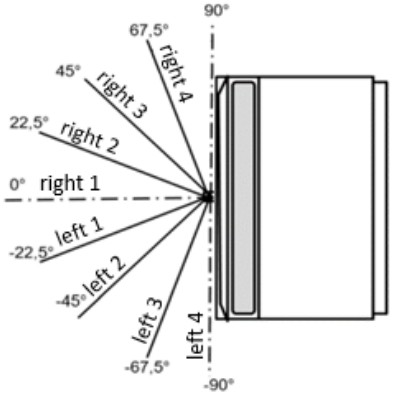

	Table TB		Max allowed load [kN]	
	horizontal	zone	front	rear
right	90°	right 4		
	67,5°	right 3		
	45°	right 2		
	22,5°	right 1		
left	-22,5°	left 1		
	-45°	left 2		
	-67,5°	left 3		
	-90°	left 4		

The maximum allowed loads are determind by the the manufacturer with following drawbar coupling	
Part number	
Part name	
Stock number, if available	
Manufacturer	
Towing capacity (t)	

Figure 3: Maximum allowed load on the coupling – sample form of presentation

On most vehicles, trailer couplings and/or towing couplings are installed in addition to the towing and recovery facilities in accordance with AEP-4478. Therefore, the vehicle manufacturer shall, in coordination with the coupling manufacturer, list the maximum allowed loads on the respective coupling in a data sheet as shown in Figure 3 above. That data sheet shall also be attached to the user manual.

Note: The tables shall provide the MAL that the coupling manufacturer has released in cooordination with the vehicle manufacturer. The determination of these performance data must not be based on the design factor laid down in the AEP [Chapter 2, section 2.2c].

AEP-4478(A)(1)