

Note: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

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DEPARTMENT OF DEFENSE INTERFACE STANDARD

TOWING FITTINGS AND PROVISIONS FOR MILITARY AIRCRAFT,
DESIGN REQUIREMENTS FOR



AMSC N/A

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DEPARTMENT OF DEFENSE
WASHINGTON, D.C. 20402

Towing Fittings and Provisions for Military Aircraft,
Design Requirements For

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 93), Lakehurst, N.J. 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Purpose. This standard covers general design requirements for towing fittings and provisions which are an integral part of military aircraft equipped with a wheel-type landing gear or skids.

1.2 Functions. The function of this standard shall be to standardize and maintain the configuration (s) of all aircraft towing fittings with a secondary goal of maintaining common ground support equipment interface of towbars and spotting dollies. This standardization effort shall apply to all land or carrier bases military aircraft of the Department of Defense or its allies.

1.3 Applicability. It is intended that this standard shall be applicable to all newly developed military aircraft. As a goal, it is desirable that commercial or modified commercial aircraft be equipped with towing fittings that are compatible with existing DOD inventory ground support equipment towbars.

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2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATION

MILITARY

- MIL-F-7179 - Finishes, Coatings, and Sealants for Protection of Aerospace Weapons System.
- MIL-S-7742 - Screw Threads, Standard Optimum Selected Series, General Specification for
- MIL-A-8863 - Airplane Strength and Rigidity Ground Loads for Navy Procured Airplanes.
- MIL-L-87139 - Landing Gear Systems

STANDARDS

MILITARY

- DOD-STD-100 - Engineering Drawing Practices.
- MIL-STD-889 - Dissimilar Metals.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this standard to the extent specified herein.

DRAWINGS

ARMY

- AA1730-1251 - Towbar, Aircraft, Universal.

AIR FORCE

- 55J22139 - Towbar, Aircraft, Type MD-1, Universal, Assembly of.

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NAVAL AIR SYSTEMS COMMAND

1479AS100-8 Albar (Adjustable Length Bar).
1479AS200-15 Albar.
1479AS300-20 Albar.
1479AS400-24 Albar.

PUBLICATIONS

NAVAL AIR SYSTEMS COMMAND

19-1-37 - Towbar, Aircraft, Model Albar and Model NT-4/NT-4A.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

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3. DEFINITIONS

3.1 Fittings. The fittings as stated herein are the structural provisions on the aircraft that provide mechanical attachment of the towbar, and transmit the towbar loads necessary for moving and maneuvering the aircraft when it is on the ground.

3.2 Drawbar. The drawbar shall be that part of the spotting dolly or tow vehicle which connects to the towbar and functions to transmit the towing force. The drawbar is a standard item of ground support which is part of the tow vehicle.

3.3 Lugs or rings. Lugs and rings are required to be provided on the aircraft main landing gear, for the purpose of emergency towing, when the aircraft has over run a hard surface runway or taxiway. Lugs or rings shall be positioned to permit towing of the aircraft in the forward or aft directions, with the use of tow cables, without damage to the aircraft or any component part.

3.4 Military aircraft. Military aircraft as used herein refers to those aircraft acquired by the Armed Forces using their formal documents, specifications and standards to acquire a new weapon system for specific mission use. Air Force examples of this type of aircraft are C-9 MED AIR EVAC (DC-9), C-43 NAV Trainer (Boeing 737), KC-10 Tanker (DC-10) and the E-4A Airborne Command Post (Boeing 747).

3.5 Nose gear bar. The nose gear bar shall be a cylindrical bar or pin designed to be in a horizontal position located in front of and attached to the nose gear assembly and to be provided with a sufficient clearance for tires and any other parts of the aircraft.

3.6 Towbar(s). Towbar(s) are a standardized item of ground support equipment that transmits the drawbar force to the aircraft. It is the interface between the aircraft and the SD-1 spotting dolly or tow vehicle. While the towbar transmits the drawbar force to the aircraft, by its length it provides sufficient clearance between the aircraft fuselage and the height of the SD-1 spotting dolly or tow vehicle. The towbar is used to move, turn or position the aircraft in either forward or reverse direction, it provides sufficient clearances for these operations in the hanger, hanger deck, flight line, flight deck or airfields, or for parking or spotting.

3.7 Towing force. When towing, the aircraft shall be in a three-point attitude such that the resultant of the vertical reactions at the ground are equal to the weight of the aircraft which pass through the center of gravity (CG). The towing force shall act parallel to the ground and shall be equal to the drawbar pull of the towing vehicle. The towing force shall consist of the inertia of the aircraft, the condition of the ground vs. wheels, skids, etc., and due to the landing gear configuration the direction of the tow load parallel to the ground but vectored through the CG.

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4. GENERAL REQUIREMENTS

4.1 Design. The towing fittings shall meet the requirements of MIL-A-8863 or MIL-L-87139 and shall be designed for use with universal towbars conforming to Table I. All towbar and fitting designs to be fully coordinated to be compatible with the strut design. The strength of the towing fittings shall be designed in accordance with the aircraft weights and given ground conditions, all probable load conditions on the fittings shall be considered. The design shall also include human engineering factors as well as personnel safety considerations.

TABLE I. Universal towbars by classification

Classification of Towbars	Aircraft Weight in Pounds (kg)	Towbar Drawing No.	Application	Towbar Weight in Pounds (kg)
1 Light Duty	0 to 17,000 (7711) 0 to 30,000 (13608) 0 to 40,000 (18144) 0 to 75,000 (34020) 0 to 90,000 (40824)	AA1730-1251 1479AS100 1479AS400 1479AS300 1479AS200	Army All Navy All Navy All Navy All Navy All	128 (58.1) 255 (115.7) 218 (98.9) 170 (77.1)
2 Medium Duty	10,000 to 350,000 (4,536) (158,760)	55J22139	Air Force F-15, F-16, A-10, C-130, C-141	550 (249.5)
3 Heavy Duty	350,000 to 850,000 (158,760) (385,560)			

4.2 Materials. Materials shall be of the aircraft quality, of the lightest practicable weight, suitable for the purpose intended, and shall be approved by the procuring activity. The towing fittings shall be fabricated of metal only. The metals used shall be treated to withstand corrosion caused by fuels, salt fog, or other atmospheric conditions when in storage or during normal service use. The protective finish shall be in accordance with MIL-F-7179.

4.3 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

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4.4 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other in respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of DOD-STD-100. The screw threads of the towing fittings shall be in accordance with MIL-S-7742. All threaded parts shall be either positively locked or safetied.

4.5 Drawings. Contractor's drawing of each new towing fittings design shall be submitted to the procuring activity for examinations and to determine compliance with the requirements of DOD-STD-100 to the level established by the procuring activity. These drawings shall contain no restrictions or limiting conditions.

4.6 Towing operations. Towing provisions shall permit the following operations:

- a. Towing or pushing the aircraft rapidly either forward or rearward and under positive control of the towing vehicle during all type of ground maneuvers.
- b. Maneuvering aircraft in limited areas, such as hangars, revetments, carrier decks, and rapid respotting on carrier decks.
- c. Maneuvering aircraft on prepared runways, taxiways, and unprepared strips.
- d. Maneuvering aircraft in mud, snow, and sand; unusual ground conditions.
- e. Maneuvering aircraft on inclined surfaces of 3 percent grade, including startups.
- f. Time-to-completion shall be determined for any spotting or maintenance requirements.
- g. All turn-around-times (TAT) shall be established using a towbar supplied as Government furnished property.
- h. For final development or preproduction tests the towbar used shall be Government loaned property.

4.7 Workmanship. Workmanship shall be of a high-grade or aircraft quality production specializing in highly-stressed interchangeable equipments and of a quality control able to provide all towing fittings free from any defects that could affect towing for any type of maneuvering during ground operations. These fittings shall be properly installed to accept the loads and configuration as applied through the towbar.

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5. DETAIL REQUIREMENTS

5.1 Nose-wheel, bicycle, tail-wheel, and skid type aircraft.

5.1.1 Nose and tail gear. A recess, with a depth and a diameter as indicated in Table II, shall be provided in each end of the nose-wheel or tail-wheel axle. The recess shall extend inboard from each outer face of the axle centerline, equivalent recesses shall be so positioned as to maintain horizontal alignment with the axle. On those aircraft where attachment of the towbar by means of the recess is considered to be impracticable, suitable attachment provisions shall be provided on the gear strut assembly in accordance with the spool dimensions contained in Table III. All towbar attachment provisions shall be such that gear steering can be accomplished with the towbar and shall be as near the centerline of the axle as practicable.

TABLE II. Hollow axle dimensions

Aircraft Weight In Pounds (kg)	Axle Inside Diameter In Inches (MM)	Minimum Depth of Hollow Axle in Inches (MM)
0 to 195,000 (88,450)	$3/4 -0 +1/64$ (19.05 -0 +0.40)	1 (25.40)
195,000 to 495,000 (88,450) (224,527)	$1-1/4 -0 +1/32$ (31.75 -0 +0.79)	1-1/2 (38.10)

TABLE III. Spool dimensions 1/

Aircraft Weight In Pounds (kg)	Spool Diameter in Inches (MM)	Flange Diameter in Inches (MM)	Width of Spool Between Flanges in Inches (MM)	Radius at Spool-Flange Intersection in Inches (MM)
0 to 195,000 (88,450)	7/8 (22.23) to 1 (25.40)	1-1/2 (38.10)	1 (25.40)	1/8 (3.175)
195,000 (88,450) to 495,000 (224,527)	1 (25.40) to 1-1/2 (38.10)	2 (50.80)	1 (25.40)	1/8 (3.175)
495,000 (224,527) to 650,000 (294,833)	2. (50.80) to 2.25 (57.15)	2.75 (69.85) to 3. (76.20)	7.25 (184.15)	1/4 (6.35)
650,000 (294,833) to 850,000 (385,551)	2.25 (57.15) to 2.75 (64.85)	3. (76.20) to 3.50 (88.90)	8.00 (203.20)	1/4 (6.35)

1/ A 1.500 inch spool may be used in the range 150,000 to 195,000 pounds if the design of the undercarriage necessitates the larger spool.

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NOTE: Design a clearance to be located both above and below the centerline of the nose gear bar. This clearance is to be $2 \frac{3}{4}$ times the diameter of the nose gear bar as measured above and below its centerline. The length of this clearance shall extend over the entire length of the nose gear bar.

5.1.2 Main gear. For emergency towing in deep snow, sand, and mud, all land-based aircraft shall be provided with lugs or rings in accordance with Table V to permit securing the attachment of a towline. The lugs or rings shall have a cross section free from sharp corners. The tow ring stock shall be essentially circular cross section. The tow rings or lugs shall be located as close to the center of the main gear-wheel axle as practicable, or at other suitable points to permit towing the aircraft forward and rearward. The rings or lugs shall be in a horizontal plane. For carrier aircraft, the tow ring shall be so designed that the towline may be looped about the struts or attached to other components, such as arresting gear hook or rearward tow fittings for emergency towing.

TABLE IV. Lug or ring dimensions

Maximum Takeoff Gross Weight in Pounds (kg)	Minimum Area of Clear Opening in Lug or Ring in Square Inches (MM ²)	Minimum Width of Clear Opening in Lug or Ring (Minor Axis of Opening) in Inches (MM)
0 to 30,000 (13,608)	2 (1290.32)	Circular hole
Over 30,000 (13,608)	3.14 (2025.80)	1.375 (34.9)

5.1.3 Aft fuselage. Suitable towbar attachment fittings shall be provided on the aft fuselage of carrier-type aircraft only. Fittings shall be located in a position that will minimize tipping of the fuselage during towing or stopping operations. Holes in the fittings shall have dimensions equivalent to that required for the nose-wheel axle. They shall have sufficient strength to withstand the asymmetrical loads imposed during turning while towing rearward or pushing forward by towbar. Fittings shall be spaced sufficiently to assure positive control during maneuvers specified under 4.6.

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5.2 Quadricycle gear aircraft. Provisions for attaching the towbar, including steering capability shall be made on the forward alighting gear. Provisions shall be in accordance with the dimensional requirements of 5.1.1.

5.3 Carrier borne aircraft. Carrier borne aircraft will be designed to be towed by both the SD-1 spotting dolly and by towbars. These items shall be equipped with provisions for engaging hollow axles, to the dimensions given in Table II, or by equivalent recesses positioned as to maintain horizontal alignment with the axle.

5.4 Skid type landing gear. For those aircraft, primarily helicopters, equipped with a skid type landing gear, the towing fittings shall be located of the centerline and forward of the center-of-gravity (CG). These shall allow for a reasonable misalignment during initial contact and shall be located to provide the tow bar with adequate clearance with the aircraft.

5.5 Attachment fittings and towbars. The attachment fittings shall be the interface with the towbar, the initial contact with the ground support equipment used for spotting or towing the aircraft. The height of the attachment fitting on each type of aircraft may vary but the towbar may be secured to the attachment at any reasonable height. The other end of the towbar, the lunette eye, shall be set over the pintle of the tow vehicle at an approximate height of either 12 or 18 inches from the ground.

5.6 Field roughness requirements. For towing on (a) unprepared sod, clay, or dirt fields, (b) semi-prepared matted sod, clay, or dirt fields, and (c) paved runways, the roughness or range of terrain contours and soil-bearing strength for design shall be as defined in Figure 1. The soil-bearing strength is given in terms of the California Bearing Ratio (CBR) and shall be constant up to a depth of at least one foot. For towing requirements specified herein, the ground roughness contours for design shall be 1-cosine shaped undulations of constant wave-length. Such undulations shall have all combinations of heights and lengths specified in Figure 1. The shape of the undulations in the lateral direction shall be held constant, the undulations shall be continuous, and the soil bearing strength shall be constant. Separately, the aircraft shall be required to traverse each specified contour shape during the towing at various speeds, such that angles up to 45 degrees will occur between the path of the aircraft and the lateral axis of the contour.

5.7 Towing. The aircraft shall be in the three-point attitude during any towing situation. The resultant of the vertical reactions at the ground shall be equal to the weight of the aircraft and shall pass through the center of gravity. The towing conditions shall be as specified in Table VI. The values of T used obtaining the loads specified in Table VI are those defined in Figures 2 and 3. These towing loads shall act parallel to the ground. The side component of the tow load at the main gear shall be reacted by a side force at the static ground line of the main gear to which the load is applied. In cases where the auxiliary gear is swiveling and the load directions specified cannot be obtained, the maximum attainable angle of the specified load which will not result in side load on the auxiliary wheel. Additional loads necessary for an equilibrium condition, shall be as follows, considering each separately:

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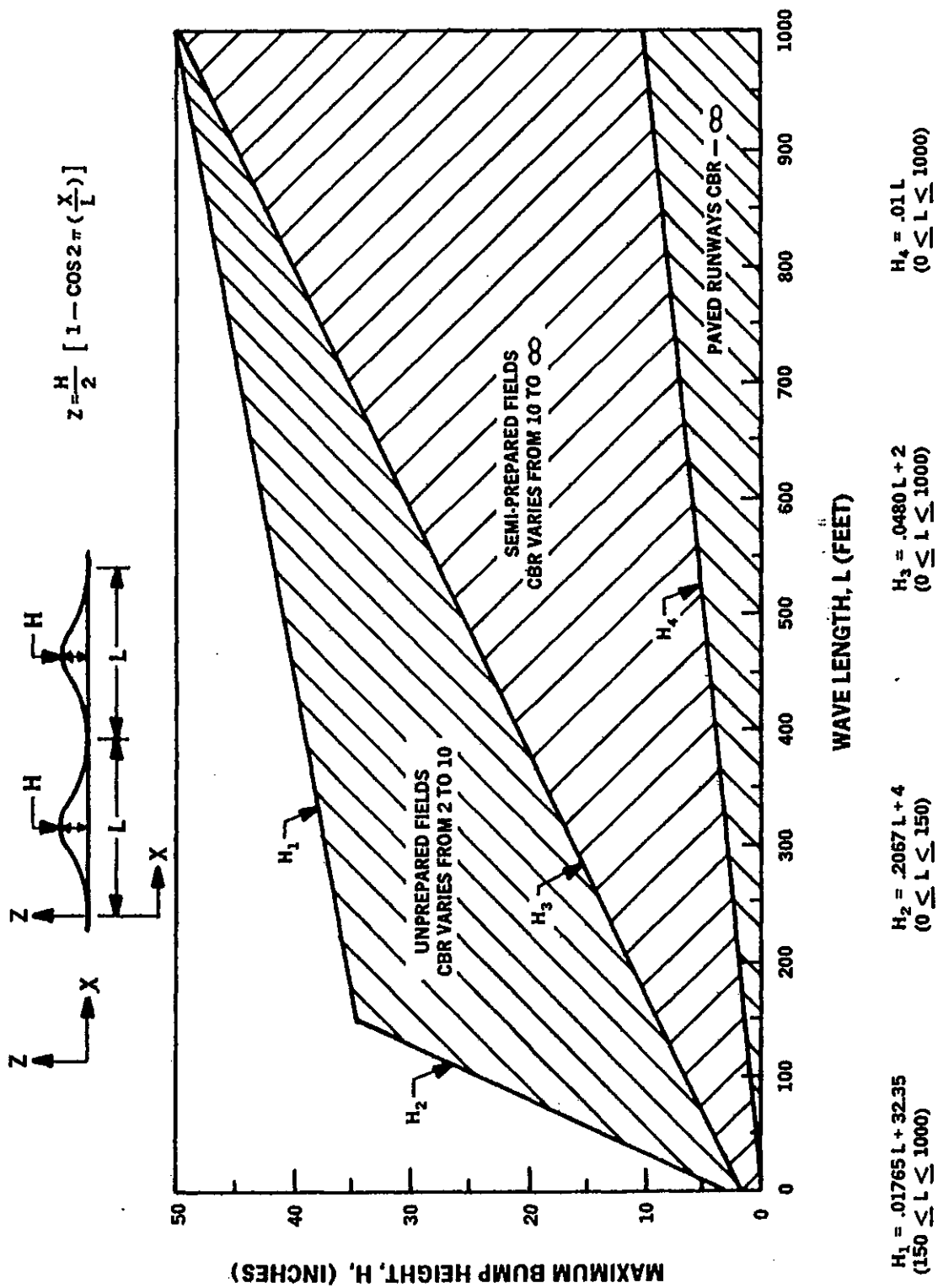
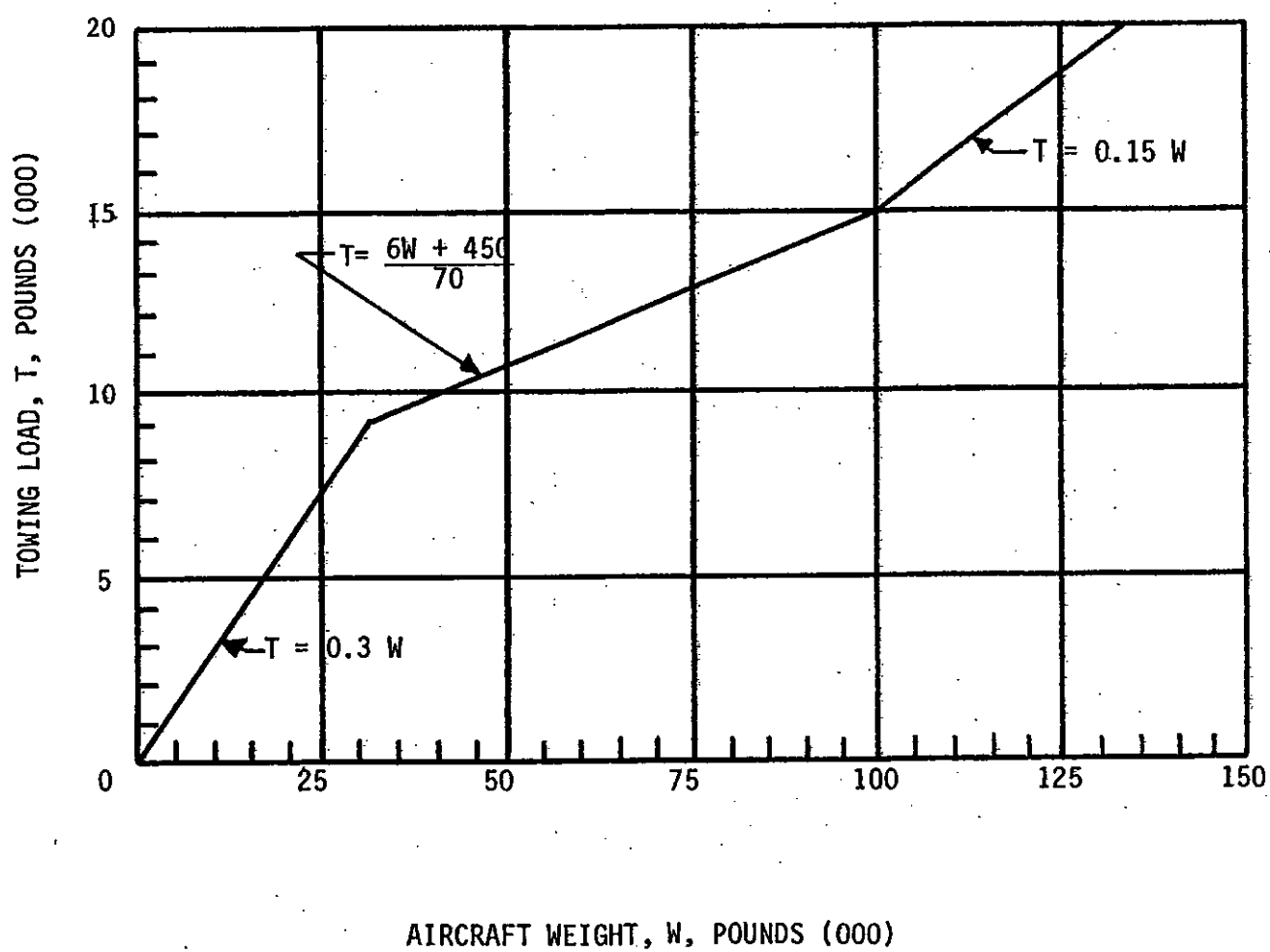
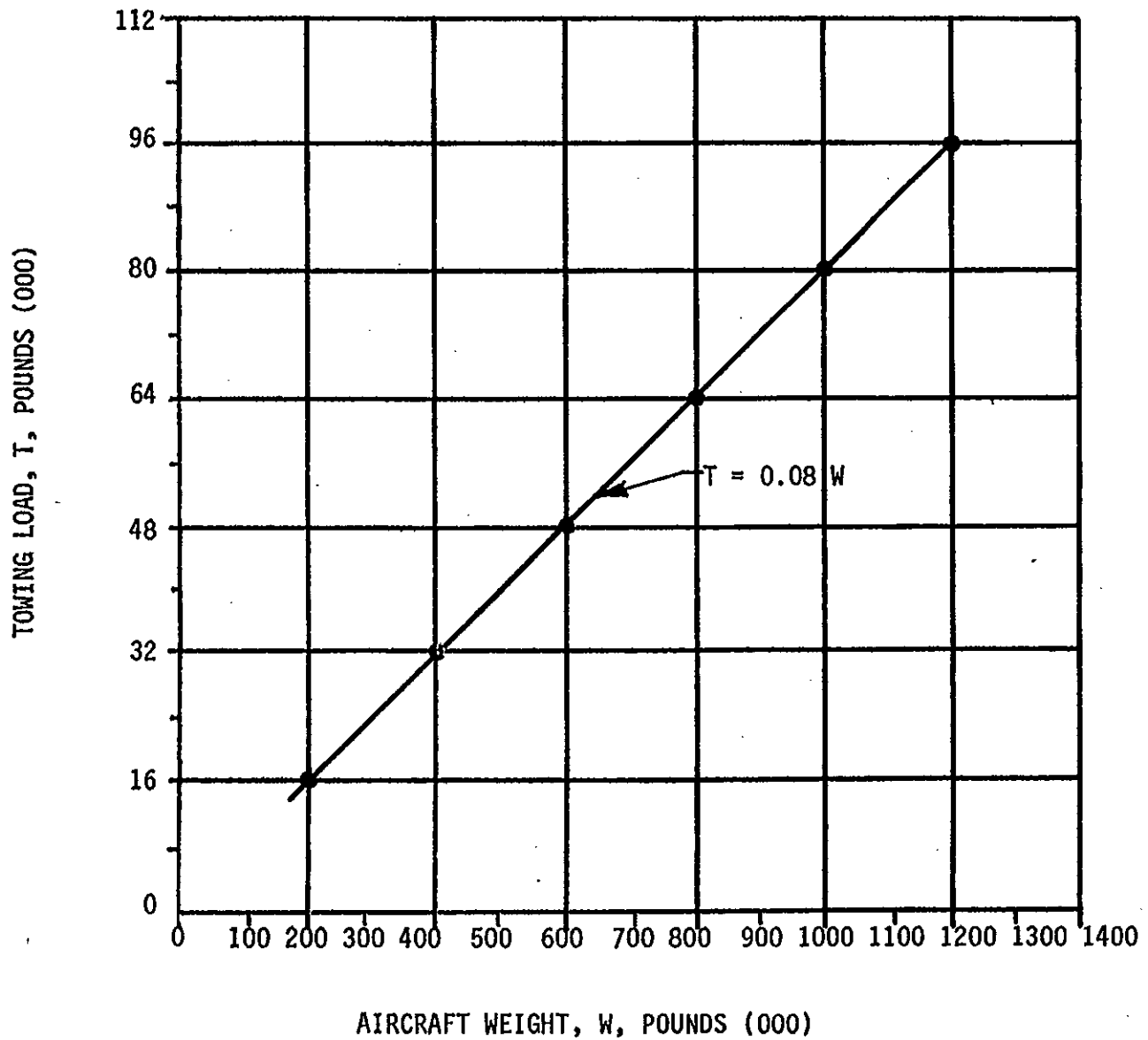


FIGURE 1. Ground roughness for landing, takeoff, and towing.

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FIGURE 2. Towing loads

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FIGURE 3. Towing loads, large aircraft.

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- a. Inertia of the aircraft.
- b. If a tow point is at or near a main-gear unit, a force acting at the axle of the wheel nearest the tow point in a direction opposite to the component of the tow load parallel to the plane of symmetry, equal in magnitude to this component or the vertical reaction at a main gear unit, whichever is lesser, combined with inertia load required for equilibrium. If a tow point is at the plane of symmetry, a force acting at the axle of the auxiliary wheel in a direction of the tow load, equal in magnitude to this tow load or the vertical reaction at the auxiliary gear unit, whichever is less, combined with inertial loads necessary for equilibrium.
- c. Ground roughness shall increase the force required to the tires, thereby increasing the total towing force required.

TABLE V. Towing test conditions

Test Condition	Towing Load		Rotation of Auxiliary Wheel Relative to Normal Position	Tow Point
	Direction from forward, degrees	Magnitude		
1	0	0.75T		At or near each main gear
2	+30			
3	180			
4	+150			
5	0	T	0	At auxiliary gear or near plane of symmetry
6	180			
7	0	T	180	
8	180			
9	+45	0.5T	+45	
10	+135			
11	+45	0.5T	+135	
12	+135			

Where T = Towing load in pounds

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5.8 Proof of design features and provisions. As directed by the procuring activity, a series of tests shall be conducted to verify that the various operations or maneuvers of 4.6 can be readily accomplished in a reasonable time. The time-to-complete, turn-around-time (TAT), simplicity of operation, and ease of maneuvering shall be verified. All tests and test data shall be fully evaluated in accordance with 5.6 and 5.7.

5.9 Government furnished property. Standard towbars from Government inventory may be furnished by the procuring activity for test purposes, manufacturing validation and use. These may be required during the length of the contract extending through production.

5.10 Government loaned property. The procuring activity may supply towbars for specific tests of 4.6 and 5.8 as required. These tests shall be scheduled and accomplished in accordance with the test and evaluation master plan (TEMP).

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6. NOTES

6.1 Intended use. The towing fittings and provisions are stated herein as the standard for all military aircraft depending on size. These towing fittings shall be the interface between the aircraft and the towbar of the ground support equipment.

6.2 Data requirements list and cross reference. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of the DoD FAR clause on data requirements (currently DoD FAR Supplement 52.227-7031) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard is cited in the following paragraphs:

Paragraph No.	Data Requirement Title	Applicable DID No.	Option
4.5	Drawings	DI-E-7431	---
5.9	GFE DD Form	DI-P-6161, 62, 63	---
5.10	610, 611, & 611-1	DI-P-6161, 62, 63	---

(Data item descriptions related to this standard, and identified in section 6 will be approved and listed as such in DoD 5000.19-L., Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publication and Forms Center or as directed by the contracting officer.)

6.3 Subject term (key word) listing.

Aircraft towing fittings and provisions
 Fittings and provisions for towing aircraft
 Provisions, fittings for aircraft towing
 Towing fittings and provisions, aircraft

6.4 International standardization agreements. Certain provisions of this standard are the subject of international standardization agreements ASCC Air Standards 25/7 and STANAG 3278 and 3279 as adopted for the North Atlantic Treaty Organization. When amendment, revision, or cancellation of this standard is proposed which affects or violates the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

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6.5 Changes from previous issue. Asterisks or vertical lines are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - AV
Air Force - 99
Navy - AS

Preparing activity:
Navy - AS

Project No. 1620-0129)

Review activities:

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Navy - MC

International Interest:

NATO