

INCH-POUND

MIL-STD-814D
3 February 1997
SUPERSEDING
MIL-STD-814C
23 February 1993

DEPARTMENT OF DEFENSE
INTERFACE STANDARD

REQUIREMENTS FOR
TIEDOWN, SUSPENSION AND EXTRACTION PROVISIONS
ON MILITARY MATERIEL FOR AIRDROP



AMSC N/A

AREA 1670

MIL-STD-814D

FOREWARD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.
2. This revised standard provides the new tiedown, suspension, and extraction requirements for the Low Velocity Airdrop (LVAD) method of airdrop. The implementation of new airdrop systems and components have dictated the need to change the aforementioned requirements.
3. Provisions must also meet MIL-STD-209 so equipment can be transported by surface modes and internal air transports. Strength requirements of provisions specified in this issue of MIL-STD-814 exceed those specified in MIL-STD-209 for comparable size provisions.
4. MIL-HDBK-669 establishes a method of determining and evaluating the capability of the airdrop item to withstand the forces resulting from ground impact for both the low velocity and the low altitude parachute extraction loads.
5. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: U.S Army Natick Research, Development and Engineering Center, Natick, MA 01760-5017, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-STD-814D

CONTENTS

<u>PARAGRAPH</u>	<u>PAGE</u>
1. SCOPE	1
1.1 Scope	1
1.2 Application	1
2. APPLICABLE DOCUMENTS	1
3. DEFINITIONS	1
3.1 Airdrop	1
3.2 Airdrop weight	1
3.3 Container load	1
3.4 Design limit load	1
3.5 Extraction provision	1
3.6 Extraction system	1
3.7 Gross rigged weight	2
3.8 Item extraction	2
3.9 Low velocity platform airdrop	2
3.10 Materiel developer	2
3.11 Platform extraction	2
3.12 Platform load	2
3.13 Recovery parachute system	2
3.14 Suspended weight	2
3.15 Suspension provision	2
3.16 Tie-down provision	2
3.17 Ultimate strength	2
3.18 Working load	2
3.19 Yield load	3
4. GENERAL REQUIREMENTS	3
4.1 Location	3
4.2 Multipurpose functions	3
4.3 Methods of airdrop	3
5. DETAILED REQUIREMENTS	3
5.1 Tie-down provisions	3
5.1.1 Dimensional requirements	3
5.1.2 Working load, design limit load and minimum number	3
5.1.3 Ultimate strength	4
5.1.4 Location	4
5.1.5 Marking	5

MIL-STD-814D

CONTENTS

<u>PARAGRAPH</u>		<u>PAGE</u>
5.2	Suspension provision	5
5.2.1	Dimensional requirements	5
5.2.2	Working load and design limit load	5
5.2.3	Ultimate strength	5
5.2.4	Number and location	5
5.3	Extraction provisions	6
5.3.1	Use of existing components	6
5.3.2	Low velocity airdrop (LVAD)	6
5.3.2.1	Dimensional requirements	6
5.3.2.2	Working load and design limit load	6
5.3.2.3	Ultimate strength	7
5.3.2.4	Location	7
5.4	Special design military materiel provision requirements	7
5.5	Testing of provisions	7
5.5.1	Tie-down provisions	7
5.5.2	Suspension provisions	7
5.5.3	Low velocity extraction provision	7
6.	NOTES	
6.1	Integral documents	8
6.2	Associated documents	8
6.3	Container loads	8
6.4	Review and approval of new and developmental items for airdrop testing	8
6.5	Maximum width and height of airdrop items from C-130, C-141, C-5 and C-17 aircraft	8
6.6	International standardization agreements	10
6.7	Subject term (key word) listing	10
6.8	Changes from previous issue	10

MIL-STD-814D

FIGURES

<u>FIGURES</u>	<u>PAGE</u>
1. Tie-down provision design and dimensional requirements	11
2. Typical rigged load showing tie-downs	12
3. Tie-down provision limits of direction of loading	13
4. Dimensions requirements	
a. Suspension provision	14
5. Suspension provisions, direction of loading and locations	15
6A. Low velocity airdrop extraction provision dimensional requirements for items with an airdrop weight between 14,500 pounds and 34,236 pounds	16
6B. Low velocity extractional provisions dimensional requirements for existing towbars and pintles	17
7. Tip-off curve	18

TABLES

<u>TABLES</u>	<u>PAGE</u>
I. Number of tie-down provisions required per each longitudinal side	4
II. Low velocity airdrop extraction provision working load	6
III. Weight and dimensions of recovery parachutes for C-130 and C-141 aircraft	9
IV. Weight and dimensions of recovery parachutes for C-5 and C-17 aircraft	10
CONCLUDING MATERIAL	19

MIL-STD-814D

1. SCOPE

1.1 Scope. This standard establishes the design, number, and location requirements of airdrop tiedown, suspension, and extraction provisions on airdrop items delivered by LVAD.

1.2 Application. These requirements are applicable to provisions for:

- a. Tiedown of the item to an airdrop platform.
- b. Suspension of the item from the recovery parachute system during descent.
- c. Extraction of the item from an aircraft in flight.
- d. Internal restraint and testing of the provisions.

The requirements specified herein are for the design of new and developmental items of military materiel.

2. APPLICABLE DOCUMENTS

This section is not applicable to this standard.

3. DEFINITIONS

3.1 Airdrop. A movement by aircraft, wherein personnel, supplies and equipment are unloaded in flight.

3.2 Airdrop weight. The weight of the item, including external or internal loads such as fuel, ammunition, field gear, or rations.

3.3 Container load. Airdrop items are packed in an A-7A cargo sling, A-21, A-22, and A-23 fabric cargo bags with the energy dissipater, and may have a plywood skid on the bottom of the container. The completely rigged container load less the parachute must not weigh more than 2200 pounds.

3.4 Design limit load. The applied force, or maximum probable force, times a safety factor that a suspension, extraction, or tie-down provision, including its connecting structural members, can withstand when subjected to its most severe airdrop environment. This load must be less than the yield load.

3.5 Extraction provision. An integral fitting on the item, for attaching the extraction system.

3.6 Extraction system. A system used to withdraw airdrop items from aircraft in flight.

MIL-STD-814D

3.7 Gross rigged weight. The airdrop weight plus the weight of all airdrop rigging. For LVAD the gross weight = approximately 1600 pounds + 1.18 X airdrop weight.

3.8 Item extraction. The extraction system is attached to the airdrop item. The item must be equipped with extraction provisions.

3.9 Low velocity airdrop (LVAD). LVAD is a type of airdrop used for platform loads where the load is extracted from a C-130 aircraft at 140 knots, from C-141 and C-5 aircraft at 150 knots by extraction parachutes at an altitude of 700 feet or more. Recovery parachutes are attached to the load to slow the descent and to allow an impact velocity of approximately 28.5 ft/sec.

3.10 Materiel developer. Agency responsible for developing and fielding military equipment and materiel.

3.11 Platform extraction. The extraction system is attached to the platform. No extraction provisions are required on the airdrop item. Airdrop items weighing 14,500 pounds or less do not require extraction provisions for low velocity airdrop.

3.12 Platform load. Airdrop platform loads consist of supplies or equipment which have an airdrop weight of more than approximately 1800 pounds which are placed on top of energy absorbing material, and secured to a standard airdrop platform by fabric tie-down assemblies so that no damage will occur to the rigged load or aircraft during flight, extraction sequence, and ground impact.

3.13 Recovery parachute system. A system used to retard and stabilize the descent of an airdropped item.

3.14 Suspended weight. The gross rigged weight less the weight of the parachute system. Suspended weight = approximately 1700 pounds + 1.09 X airdrop weight.

3.15 Suspension provision. An integral fitting on the item for attaching the recovery parachute system.

3.16 Tie-down provision. An integral fitting or part of an item for restraining the item to an airdrop platform using tiedown assemblies.

3.17 Ultimate strength. The maximum force which a provision must withstand before breaking failure occurs.

MIL-STD-814D

3.18 Working load. The anticipated maximum resultant load imposed on a provision under actual service conditions.

3.19 Yield load. The force at which a provision including its connecting structural members exhibits a permanent deformation or set.

4. GENERAL REQUIREMENTS

4.1 Location. Tiedown, suspension, and extraction provisions shall be designed and located to permit immediate identification and proper effective use. Wherever possible, tiedown, suspension, and extraction provisions shall be located so as not to project beyond the envelope of the item of military materiel. All provisions shall be located so that slings and tiedowns do not come in contact with the equipment. If this is not possible, the structure shall be capable of withstanding the resulting forces and edges in contact with slings, and tiedowns shall be rounded to 0.25-inch radius minimum.

4.2 Multipurpose functions. Provisions shall be designed to perform as many functions as possible so as to reduce the weight and cost of the item. Airdrop provisions may be designed so they can be used for other kinds of transport. Tiedowns may be located so they may be used for lateral as well as longitudinal restraint.

4.3 Methods of airdrop. Airdrop items shall be capable of being delivered by the LVAD method of airdrop, unless otherwise indicated by the materiel developer.

5. DETAILED REQUIREMENTS

5.1 Tie-down provisions.

5.1.1 Dimensional requirements. Tie-down provisions shall be designed to the criteria given in Figure 1. The 10,000 and 20,000-pound provisions shall have a minimum 2 inch inside radius of the curved arc opening. A weldless ring such as the Crosby Laughlin-S 643 or equal, 0.875-inch minimum by 4-inch minimum ID may be used as a tie-down provision if it is attached, so that it can rotate freely from the horizontal plane to 90 degrees below and meet the strength requirements. Provisions shall be smooth, free of any sharp edge, sharp corner and burr to assure webbing attachments are not adversely effected.

5.1.2 Working load, design limit load, and minimum number. The working load of each tie-down provision and the minimum number of tie-down provisions required per longitudinal side of the airdrop items are listed in table I. The design limit load shall not be less than 1.25 times the working load. Low velocity airdrop values are based upon 3 G forward with a 10,000 pound minimum breaking strength of the tie-down strap, assuming a tie-down effectiveness due to a

MIL-STD-814D

strap angle of 30 degrees times 34.4 degrees. Airdrop items whose width between left and right tie-downs exceeds 60 inches must be provided with a minimum of one additional tie-down provision at each end of the airdrop item which is capable of restraining in both lateral direction, and have a working load equal to the side tie-down provision. Towing pintles, lunettes, shackles, etc., may be used as lateral tie-down provisions if they meet the strength and location requirements. Also, side tie-down provisions located at the corners opposite the extraction end may be used as lateral tie-down provisions.

* **TABLE I. Number of tie-down provisions required per each longitudinal side**

Type of delivery	Airdrop weight of item ^{1/} range (lbs.)	Number per side	Working load each (lbs.)	or	Number per side	Working load each (lbs.)
LVAD	up to 4766	2	5,000	-	-	-
	4767 - 7150	3	"	2	10,000	
	7151 - 9533	2	10,000	-	-	
	9534 - 14,300	3	"	-	-	
	14,301 - 19,066	4	"	2	20,000	
	19,067 - 23,833	5	"	3	"	
	23,834 - 28,603	3	20,000	-	-	
	28,604 - 38,136	4	"	-	-	
	38,137 - 47,670	5	"	-	-	
	47,671 - 52,270	6	"	-	-	

^{1/} Current aircraft capabilities limit the rigged weight to 42,000 pounds for LVAD from the C-130 aircraft, 38,500 pounds for LVAD from the C-141 aircraft, and 60,000 pounds for LVAD from the C-5 aircraft. The C-141 aircraft may airdrop up to 42,000 pounds during contingency situations following Air Force approval. Except as noted for the C-141 aircraft, rigged weight limits of aircraft shall not be exceeded.

5.1.3 Ultimate strength. The ultimate strength of each tie-down provision and supporting structure shall be at least 1.5 times the working load.

5.1.4 Location. Tie-down provisions shall be mounted along each side of the airdrop item in a horizontal position to 90 degrees below (preferred design), and shall be spaced as equally as possible and placed symmetrically in relation to the longitudinal axis of the item. The height of the tie-down provisions shall be, if possible, between 12 inches and 48 inches from the bottom of the airdrop item. Side tie-downs may be positioned at the corners so that they can be used for lateral restraint (see Figure 2). Each provision must be located so that a tie-down strap may be attached at any angle between 15 degrees and 45 degrees down from the horizontal, and between 0 degrees and 45

MIL-STD-814D

degrees from the longitudinal axis in both directions without interference with sharp edges of the airdrop item (see Figure 3). Smooth parts of the airdrop item in contact with the tie-down strap must be capable of withstanding the force applied by the strap without permanent deformation. See Figure 2 for a typical rigged load showing tiedowns.

5.1.5 Marking. Each tie-down provision shall be marked so as to identify the following:

The working load rating of the provision as a 5,000-pound, 10,000-pound, or 20,000-pound tiedown.

5.2 Suspension provisions.

5.2.1 Dimensional requirements. The suspension provisions provided for airdrop items shall have a minimum hole diameter of three inches.

Dimensional details for suspension provisions are as shown on Figure 4.

5.2.2 Working load and design limit load. Each forward or aft pair of suspension provisions shall withstand without permanent deformation the design limit load when applied within the angular ranges indicated in Figure 5. The working load for each pair of forward and aft suspension provisions is determined by multiplying the appropriate deceleration load factor (G) times the total suspended weight of the airdrop load. The design limit load shall not be less than 1.35 times the working load.

APPROXIMATE
AIRDROP

<u>WEIGHT (LBS)</u>	<u>G</u>	"G" X TOTAL SUSPENDED WEIGHT = WORKING LOAD
Up to 5000	3.50	
5001 - 21,200	3.00	
21,201 and above	2.50	

5.2.3 Ultimate strength. The ultimate strength of each suspension provision shall be a minimum of 1.5 times the working load.

5.2.4 Number and location. Four suspension provisions shall be provided for each airdrop item. Suspension provisions shall be attached in pairs so that each pair shall be spaced at equal distance from the lateral axis through the Center of Gravity (CG) of the airdrop item and above the horizontal plane passing through the CG of the airdrop item, at a height such that the interference between suspension slings and the item is minimized. Each suspension provision of a forward or an aft pair shall be located on the same horizontal plane, at equal distance from the longitudinal axis and on the same lateral axis (see Figure 5).

MIL-STD-814D

The spacing of the suspension provisions shall be within the following limits:

- (a) lateral spacing of at least one pair: minimum four feet.
- (b) longitudinal: minimum $\frac{1}{2}$ the length of the airdrop item; maximum 3 X (lateral spacing) or 20 feet, whichever is shorter.

Airdrop items smaller than the minimum spacing shall have the suspension provisions located at the outer edge of the item. It is desired that the provisions be located as far apart as possible within the above limits.

The plane of the suspension eye shall be in the longitudinal vertical plane of the load or in approximate alignment with the anticipated angle of the sling leg.

The use of a spreader bar is not authorized. Parts of the airdrop item in contact with the suspension slings shall be strong enough to withstand the resulting forces and shall not have any sharp edges.

NOTE: Some special items may be airdropped without suspension provisions by using platform suspension. For information contact: U.S. Army Natick Research, Development and Engineering Center, Kansas Street, Natick, MA 01760-5017.

5.3 Extraction provisions. These provisions are applicable if platforms are not available for extraction.

5.3.1 Use of existing components. Standard vehicle pintles, suspension provisions, tow bar attachments, etc., may be used as extraction provisions if they meet the detailed requirements. Non-welded attachment of the extraction provision to the item is preferred.

5.3.2 Low velocity airdrop (LVAD). A single airdrop extraction provision is required for airdrop items having an airdrop weight of more than 14,500 pounds.

MS 51118 can be used for extracting all loads with an airdrop weight of up to 34,236 pounds, provided attachments meet strength criteria.

5.3.2.1 Dimensional requirements. See Figures 6a and 6b.

5.3.2.2 Working load and design limit load. The extraction provisions shall have the following working load:

MIL-STD-814D

TABLE II LVAD provisions working load

Approximate airdrop weight <u>1/</u> (lbs.)	Working load (lbs.)
14,500 - 22,372	27,050
22,373 - 34,236	50,000
34,237 - 52,270	80,466 <u>2/</u>

1/ Current aircraft capabilities limit the LVAD gross rigged weight to 42,000 pounds for the C-130 aircraft, 38,500 pounds for the C-141 aircraft, and 60,000 pounds for the C-5 and C-17 aircraft.

LVAD loads weighing up to 42,000 pounds may be airdropped from the C-141 aircraft during contingency situations following Air Force approval. Except as noted for the C-141 aircraft, gross rigged weight limits of the aircraft shall not be exceeded.

2/ Based upon three 28-foot heavy duty extraction parachutes at 150 Knots Indicated Airspeed (KIAS).

NOTE: The design limit load shall not be less than 1.5 times the working load.

5.3.2.3 Ultimate strength. The ultimate strength of non-welded components shall be at least 1.65 times the working load. If welded components are used, the ultimate strength of the weld shall be at least 4.0 times the working load.

5.3.2.4 Location. The low velocity airdrop extraction provision shall be located in the vertical plane of the longitudinal centerline and on or below the level of the CG of the item.

5.4 Special design military materiel provision requirements. This standard does not include airdrop provision requirements for many special purpose items of military materiel being developed. The unique shape or other characteristics of the item may require special consideration. Assistance with the interpretation, airdrop design, assistance and/or deviations from this standard shall be referred to the U.S. Army Natick Research, Development and Engineering Center, Natick, MA 01760-5017.

5.5 Testing of provisions. Testing of provisions shall not result in visual permanent deformation or set in the provision or other equipment structural components.

5.5.1 Tie-down provisions. Each tie-down provision on one side of the airdrop item shall have test load (F) applied equal to or greater than the working load of the tiedown for not less than 6.0 seconds. This load shall be applied twice; one time at 45 degrees from the ground and in the longitudinal direction of the airdrop item; another at 45 degrees from the ground and 90 degrees from the longitudinal direction of the airdrop item. Tie-down provisions attached to the same structure member in the same orientation need not be tested.

MIL-STD-814D

5.5.2 Suspension provisions. Each individual suspension provision shall have a test load (F) applied equal to or greater than 1.25 times the working load designated for each pair of forward and aft provisions. The angle of pull for each provision in the longitudinal directions shall be applied at an angle of approximately 45 degrees up from the horizontal towards the CG of the item. The angle of pull in the lateral direction will be determined by the angle formed by the two adjacent side slings when joined at the apex. Nine-foot sling lengths will be used for items when the longitudinal distance between provisions is nine feet or less, and a length equal to the longitudinal distance between provisions above nine feet.

5.5.3 Low velocity extraction provisions. A low velocity extraction provision shall have a test load (F) equal to or greater than the design limit load applied in the longitudinal direction.

6. NOTES

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

6.1 Integral documents. The details of MIL-HDBK-669 and AR 70-47 are essential to the requirements of this document. The specific requirements of the above documents will be invoked as required by the procuring activity or the contracting officer.

6.2 Associated documents.

- | | |
|----------|--|
| Standard | - MIL-STD-1791, Designing for Internal Aerial Delivery in Fixed Wing Aircraft |
| Standard | - MIL-STD-209: Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment |
| Handbook | - AMCP 706-130: Design for Air Transport and Airdrop of Materiel |

6.3 Container loads. Items with an airdrop weight of less than 2100 pounds and dimensions less than 48 inches wide by 96 inches long by 48 inches high can be delivered by container airdrop. Items delivered by an airdrop container do not require tie-down provisions, suspension provisions, or extraction provisions.

6.4 Review and approval of new and developmental items for airdrop testing. Provisions must successfully withstand static loading tests. Design data and static test results shall be submitted to the U.S. Army Natick Research, Development and Engineering Center for review and coordination with the USAF prior to actual airdrop testing.

MIL-STD-814D

6.5 Maximum width and height of airdrop items from C-130, C-141, C-5 and C-17 aircraft.

The desired maximum width of an airdrop item is 103 inches; however, a maximum width of 108 inches is permitted if there is sufficient space available to securely tie down the item to the airdrop platform. The maximum overall height of a rigged load must not exceed 101 inches in height for the C-130 aircraft, and C-141 aircraft, 105 inches for the C-5 aircraft, and 120 inches for the C-17 aircraft. The rigged height is determined by adding the height of the energy dissipater stack configuration (10 inches for rubber-tired vehicles with suspension systems and 15.3 inches for all other items) to the airdrop item. The rigged item center of gravity is determined by using the CG of the suspended item and the CG of the recovery parachutes, (CG of the suspended item approximately equals the CG of the airdrop item). The weight and dimensions of the recovery parachutes are in table III for the C-130 and C-141 aircraft, and in table IV for the C-5 and C-17 aircraft. Parachutes are placed on top of the airdrop items and aligned flush with the end of the item if adequate space is available; otherwise the parachutes are placed and aligned across the aft end of the platform.

TABLE III. Weight and dimensions of recovery parachutes for C-130 and C-141 aircraft 1/

Suspended weight (lbs)	Weight of recovery parachutes (lbs.)	Dimensions of parachute cluster (inches)		
		Height	Lateral	Longitudinal
1,800 - 5,000	300	18	32	50
5,001 - 10,000	600	18	64	50
10,001 - 15,000	900	36	64	50
15,001 - 20,000	1200	36	64	50
20,001 - 25,000	1600	36	96	50
25,001 - 30,000	1900	36	96	50
30,001 - 35,000	2300	52	96	50
35,001 - 39,400	2600	52	96	50

1/ The height of the rigged load forward of the rigged CG is not to exceed the limits of the curve shown on Figure 7. Rearward of the rigged CG, the rigged height must be less than 100 inches. The absolute maximum height of rubber-tired vehicles is 90 inches in order to meet the requirement of MIL-HDBK-669 and allow for shimming in order to meet the C-141 roller loading limits. Items

MIL-STD-814D

must be rigged for airdrop and be measured to verify the height profile. The measured height profile must be sent to the Air Force for approval prior to actual airdrop testing. Weight limits of aircraft are not to be exceeded (see 1/ tables I and II).

TABLE IV. Weight and dimensions of recovery parachutes for C-5 and C-17 aircraft 1/

Suspended weight (lbs)	Weight of recovery parachutes (lbs)	Dimensions of parachute cluster (inches)		
		Height	Lateral	Longitudinal
1,800 - 5,000	300	18	32	50
5,001 - 10,000	600	18	64	50
10,001 - 15,000	900	36	64	50
15,001 - 20,000	1200	36	64	50
20,001 - 25,000	1600	36	96	50
25,001 - 30,000	1900	36	96	50
30,001 - 35,000	2300	52	96	50
35,001 - 40,000	2600	52	96	50
40,001 - 45,000	3400	70	96	50
45,001 - 50,000	3400	70	96	50
50,001 - 55,425	3700	70	96	50

1/ Weight limits of aircraft are not to be exceeded (see tables I and II)

6.6 International standardization agreements. Certain provisions in 5.1, 5.2 and 5.3 of this standard are subject to international standardization agreements ASCC Air Standard 44/21 and NATO-STD-3548. When notices, revisions, or cancellations of this standard are proposed which affect or violate the international agreements concerned, the preparing activity will take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required.

6.7 Subject term (key word) listing.

LVAD
Parachute
Platform
Rigging

MIL-STD-814D

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Custodians:

Army - GL
Air Force - 99

Preparing activity:

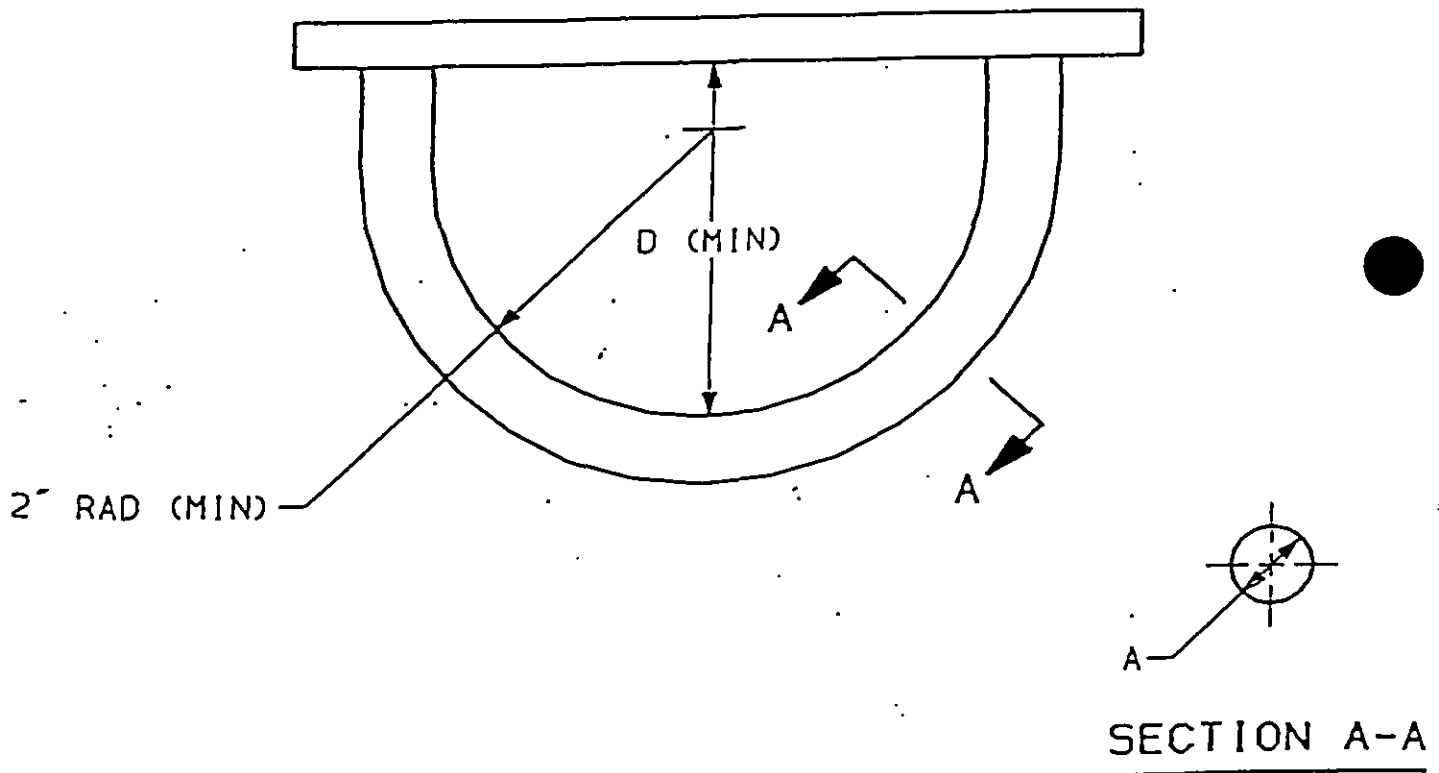
Army - GL
(Project 1670-0869)

Review activities:

Army - MT
Navy - MC
Air Force - 82

MIL-STD-814D

YIELD STRENGTH STRENGTH LB	MIN. CLEAR OPENING DIA. (\bar{D} IN.)	MIN. DIA. OF CROSS SECT. (\bar{A} IN.)	MAX. DIA. OF CROSS SECT. (\bar{A} IN.)
5000	2.0	0.4375	0.787
10000	2.5	0.750	0.787
20000	2.5	0.875	1.000



"MINIMUM CLEAR OPENING" DEFINES THE DIAMETER OF THE CROSS SECTION OF A ROUND BAR WHICH WILL PASS THROUGH THE FITTING.

FIGURE 1. Tiedown provision design and dimensional requirements

MIL-STD-814D

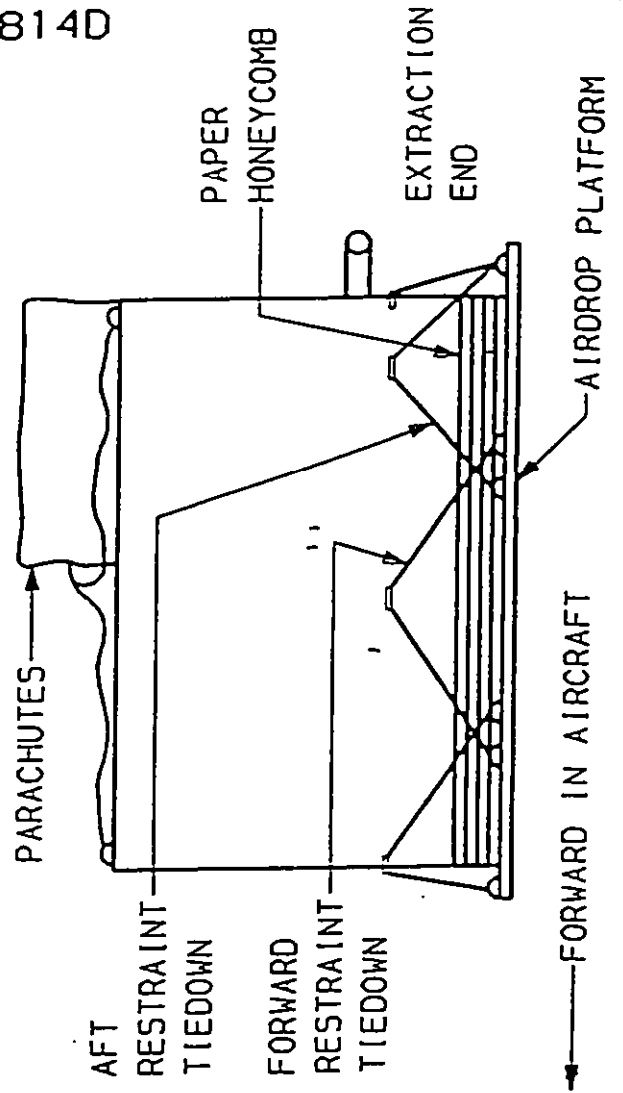
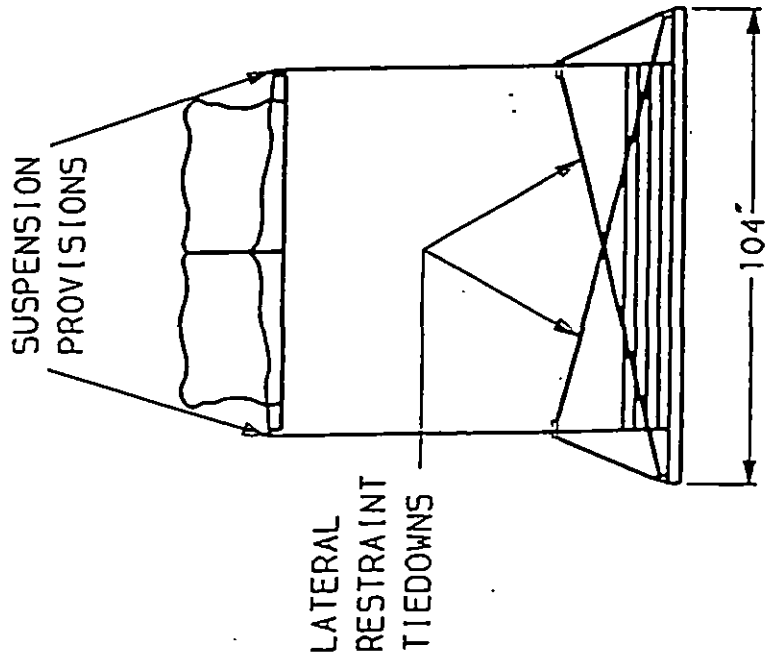
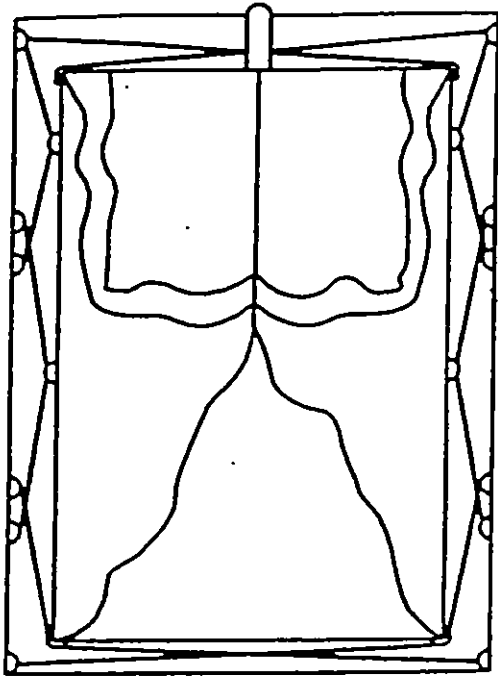
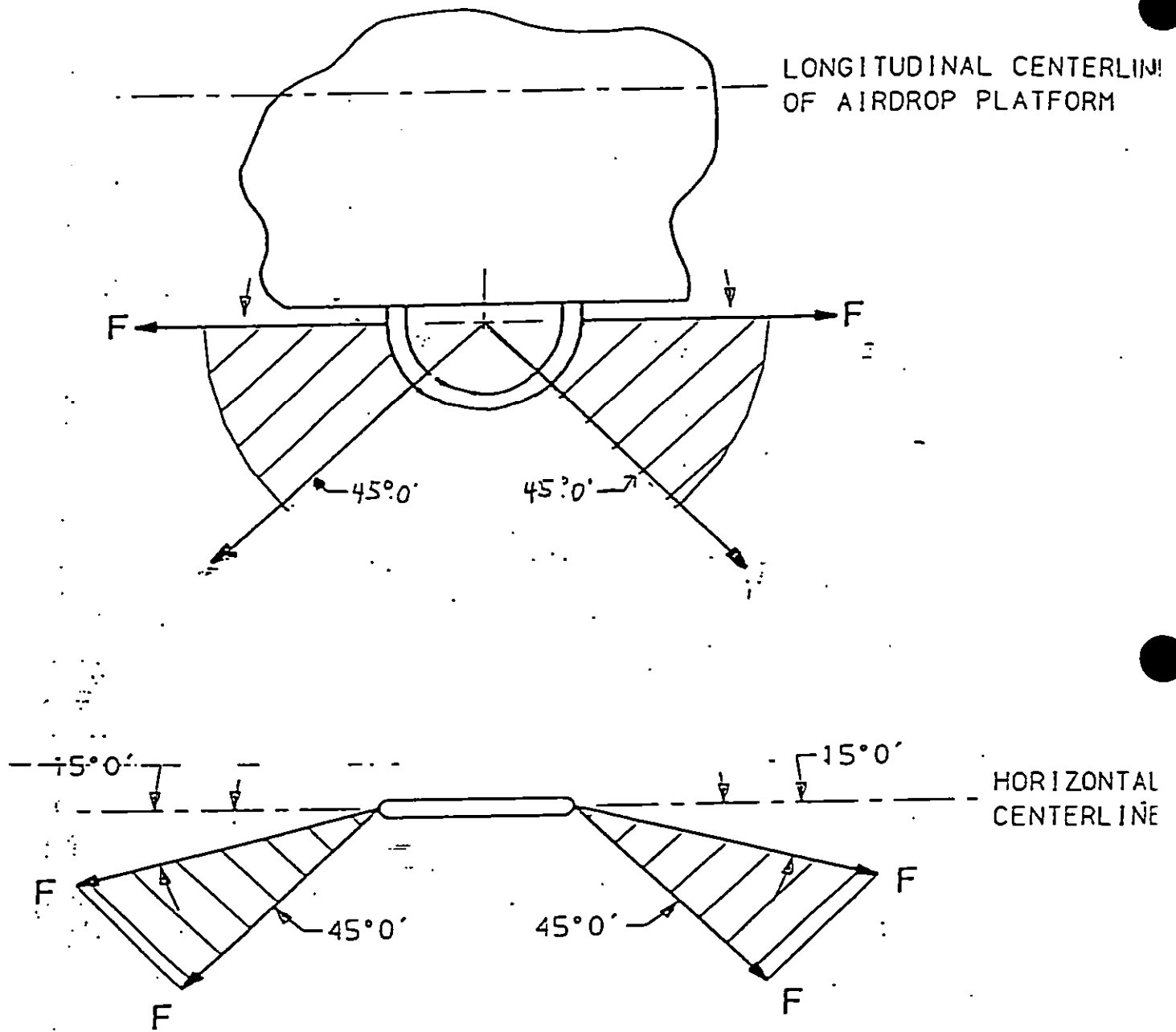


FIGURE 2. Typical rigged load showing tiedowns

MIL-STD-814D



1. DESIRED ANGLE OF TIEDOWN IS 30° DOWN FROM THE HORIZONTAL AND 30° FROM THE LONGITUDINAL CENTERLINE.

FIGURE 3

Tiedown provision limits of direction of loading.

MIL-STD-814D

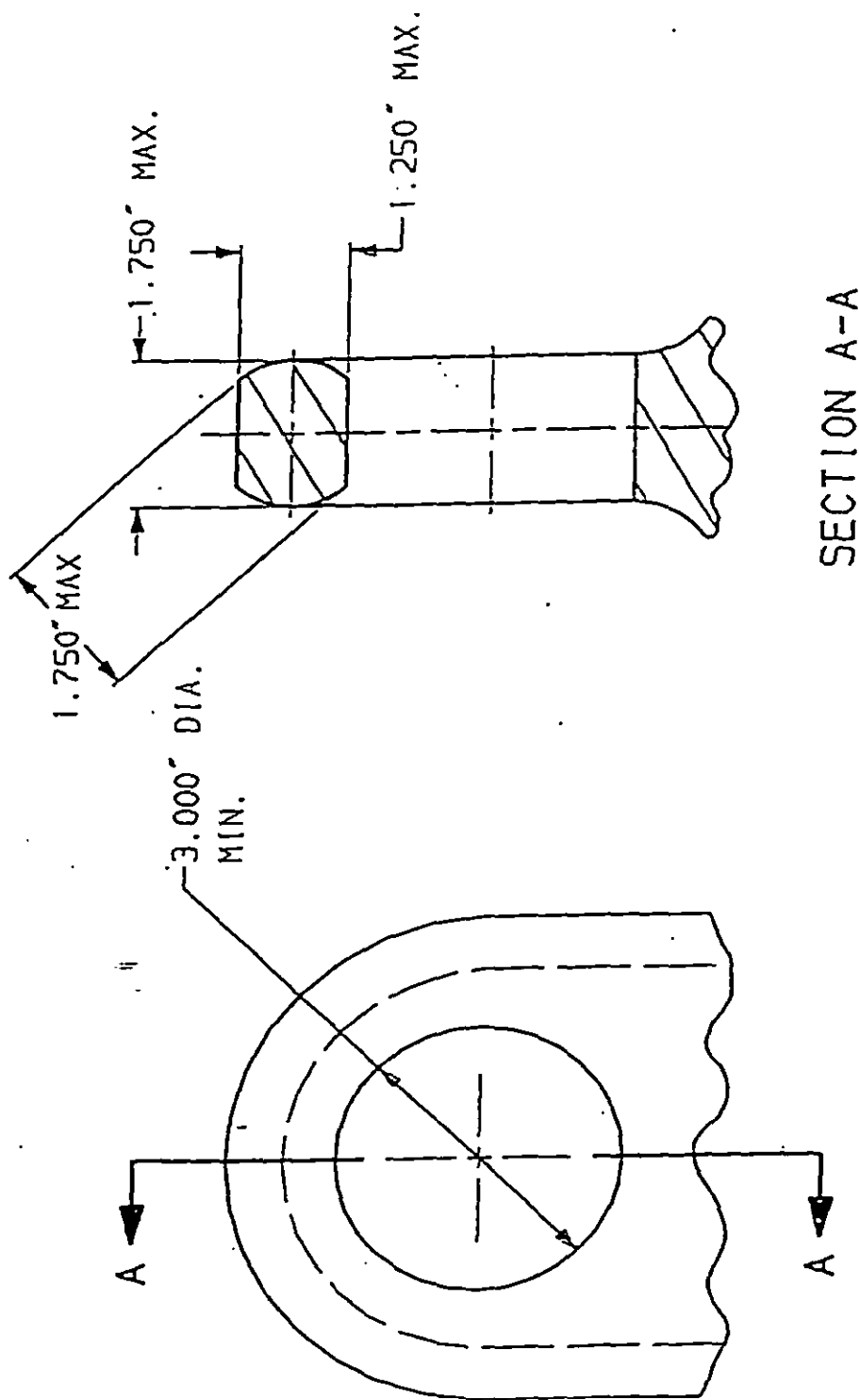
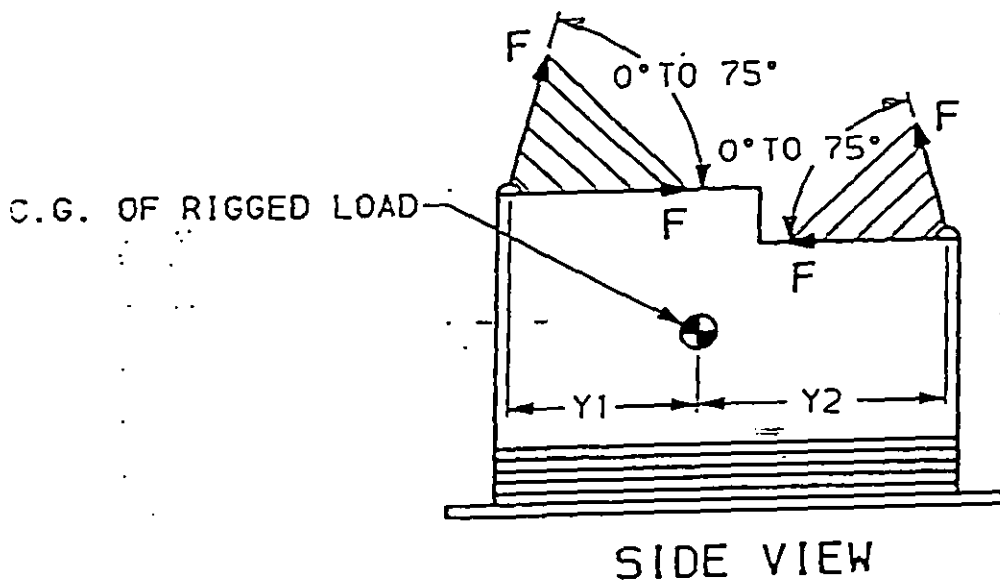
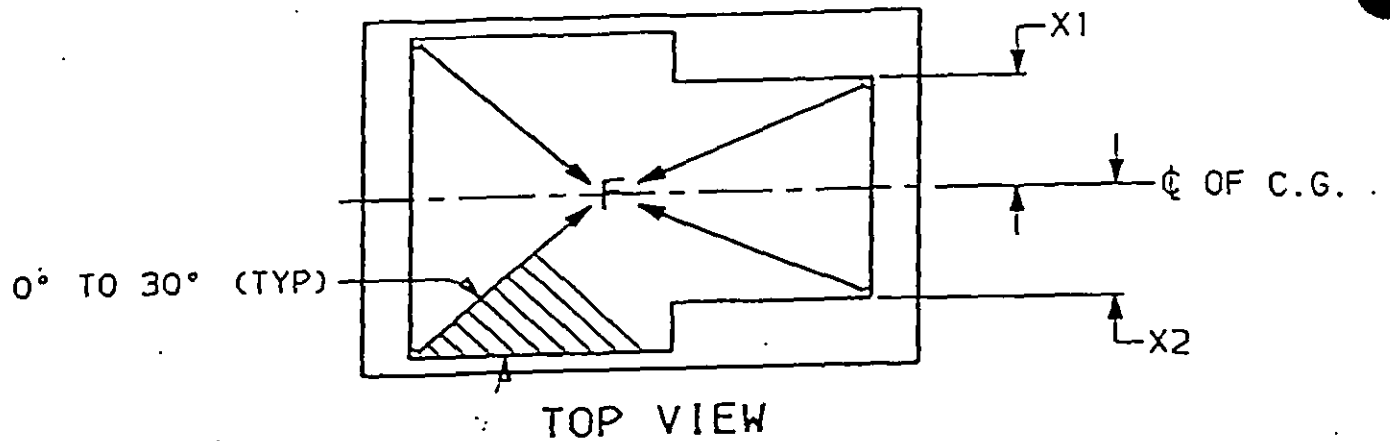


FIGURE 4. Dimensional requirements
a. Suspension provision

MIL-STD-814D



$X1 = X2$

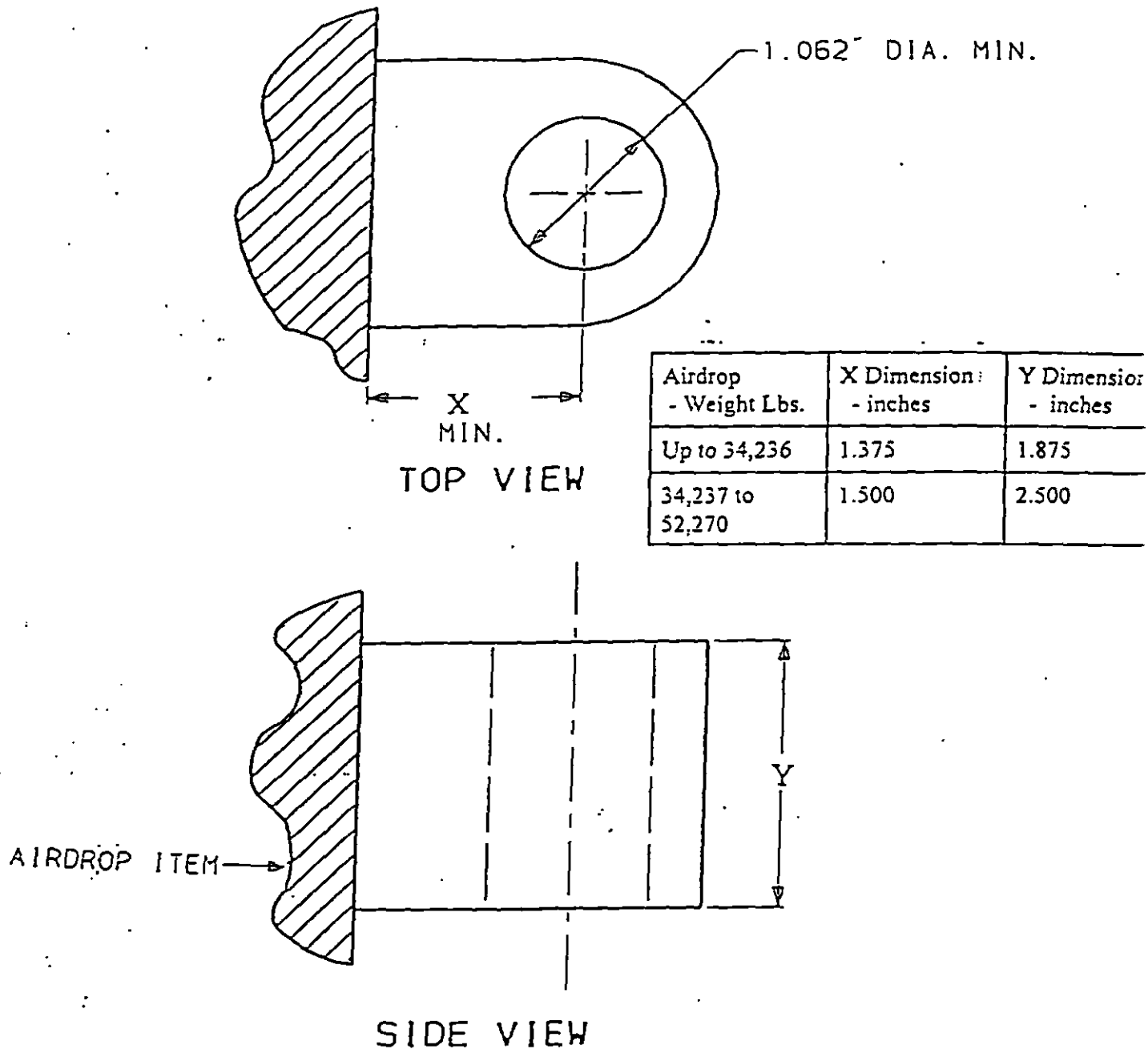
$Y1 = Y2$

$F = 0.50 \times (\text{DESIGN LIMIT LOAD})$

F=FORCE THAT EACH PROVISION
MUST WITHSTAND

FIGURE 5. Suspension provisions, Direction of loading and locations

MIL-STD-814D



EXISTING VEHICLE TOWBARS AND PINTLES MAY BE USED IF THEY MEET THE DIMENSIONAL REQUIREMENTS OF FIGURE 6B.

FIGURE 6A

Low velocity airdrop extraction provision dimensional requirements for items with an airdrop weight between 14,500 pounds and 52,270 pounds.

MIL-STD-814D

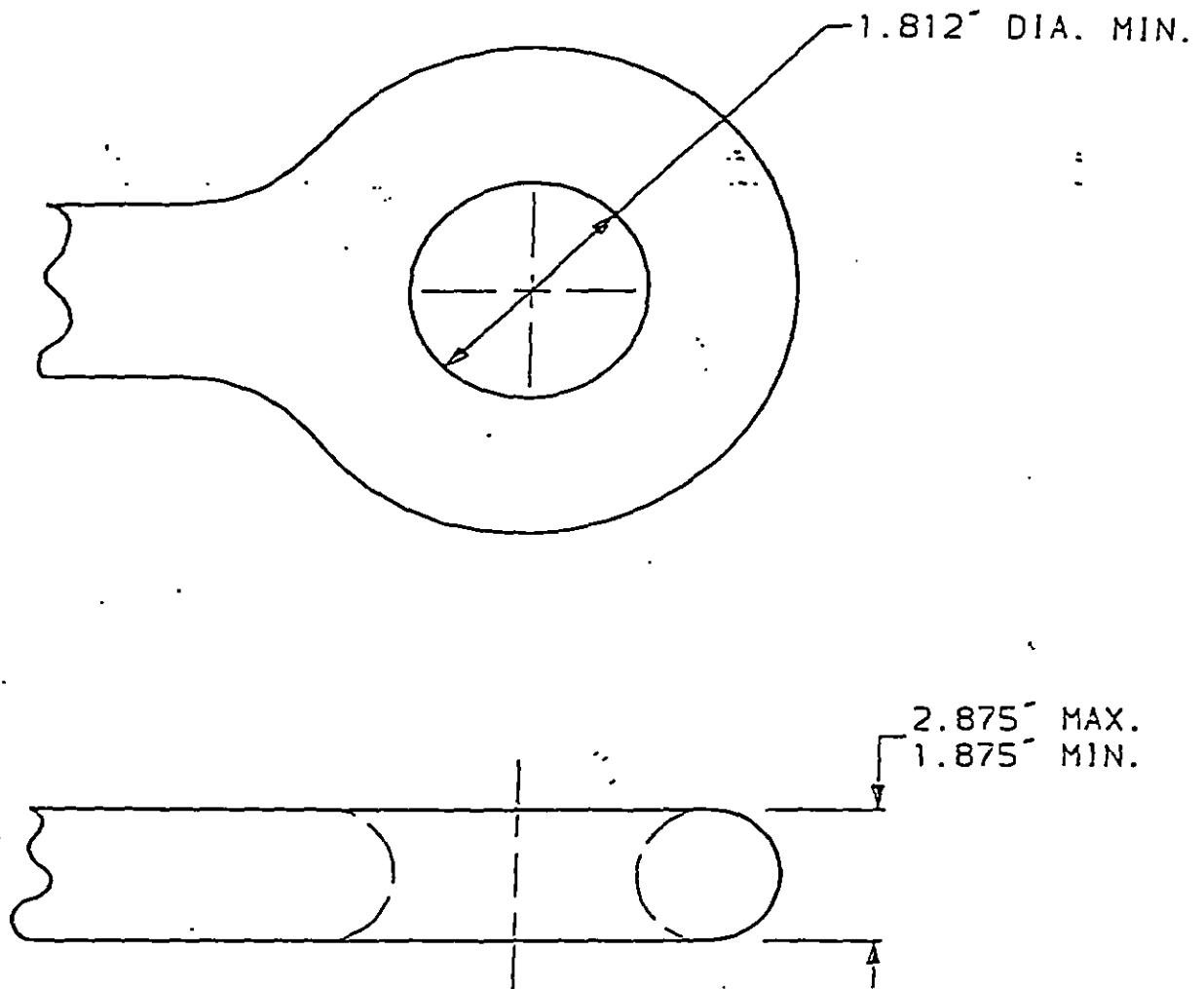


FIGURE 6B

Low velocity extraction provision dimensional requirements for existing towbars and pintles.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

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RECOMMEND A CHANGE	1. DOCUMENT NUMBER MIL-STD-814D	2. DOCUMENT DATE (YYMMDD) 97 02 03
3. DOCUMENT TITLE Requirements for Tiedown, Suspension and Extraction Provisions on Military Materiel for Airdrop		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	d. DATE SUBMITTED (YYMMDD)
a. NAME U.S. Army Natick RD&E Center	b. TELEPHONE (Include Area Code) (1) Commercial 508-233-5175 (2) AUTOVON 256-5175	
c. ADDRESS (Include Zip Code) Commander, U.S. Army Natick RD&E Center Attn: SSCNC-WEF Natick, MA 01760-5018	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	