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SUPERSEDING
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2 APRIL 1956

MILITARY SPECIFICATION

PARACHUTE RECOVERY SYSTEMS, MISSILE AND DRONE, GENERAL REQUIREMENTS FOR DEVELOPMENT OF

This specification has been approved by the Department of Defense is mandatory for for use by the Department of the army, and Navy and air Force.

1. SCOPE

1.1 This specification covers the genera] requirements for the design, development, and testing of parachute recovery systems for missiles and target drones (see 6.).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part Of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

V-T-295 — Thread, Nylon.

MILITARY

MIL-W-4088 — Webbing, Textile, Woven Nylon. Specification for Construction of.

MIL-W-27265 — Webbing, Textile, Woven Nylon, Impregnated.

STANDARDS

FEDERAL

FED-STD-751 — Stitches, Seams and Stitchings.

MILITARY

MIL-STD-130 — Identification Marking of U.S. Military Property.

MIL-STD-143 — Specifications and Standards Order of Precedence for the Selection of.

3. REQUIREMENTS

3.1 Component parts. The recovery system (see 6.2.1) shall consist of the following subsystems: parachute, deployment (see 6.2.2), release and controls, and landing shock-absorbing or flotation, as applicable to the type of body to be recovered.

3.2 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.3 Materials.

3.3.1 *Fungus - proof materials.* Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where used find not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity; however, if they will be used in a hermetically sealed inclosure, fungicidal treatment will not be necessary.

3.3.2 *Water recovery.* All materials used in the recovery system shall not be harmed by immersion in salt water for a l-hour period, providing normal decontamination procedures are accomplished within 3 hours after immersion. The decontamination procedures, including equipment and facilities required, shall be subject to approval by the procuring activity.

3.4 Design and construction. The problem of providing a suitable recovery system for a particular missile or drone (see 6.2.3) shall be resolved in three steps: (a) overall design of the recovery system, (b) detailed design of the applicable subsystems, and (c) fabrication and testing of the resulting hardware. The development and testing of parachutes for applications other than human escape from aircraft has been largely sponsored by the military services. Theoretical considerations and design criteria in this field are at present. sufficiently fluid to permit the introduction of new ideas, designs, and procedures, provided they are proven by tests; therefore, all plans, designs, and test results shall be submitted to the procuring activity for evaluation and approval so that each recovery system may benefit from the latest information on parachutes, parachute accessories, and recovery systems (see 6.2.4) in general.

3.4.1 *Overall design of the recovery system.* The recovery system shall be designed to decelerate the recoverable body from the speed and altitude at which it is traveling prior to recovery to allow it to rest on the ground or water with a minimum of damage (see 6.2.5). The contractor shall study the recovery problem and submit a proposal of the complete recovery system. To enable the procuring activity to determine the suitability of the proposed system, the proposal shall include the number of stages. parachute types and sizes, parachute compartment locations and configurations, deployment system and procedure, release and control system, and subsystem and system test programs, and an analysis of the predicted performance of the system including recovery trajectories. The system shall be designed for a reliability of 98 percent and shall insure reusable parachutes for a minimum of five recoveries.

3.4.1.1 *Initiation.* Recovery shall normally be initiated by ground command; however, flight conditions such as engine failure, loss of control signal, gyro signal of flight instability, or loss of tracking signal can be used. In most cases. a combination of these reasons is desirable. The requirements of the missile or drone specification shall apply. In the event the specification requirements for the missile or drone do not specify the method or methods of initiation of recovery, a combination of the above methods shall be used.

3.4.1.2 *Recovery sequence.* Recovery shall normally consist of, but not be limited to, two or more stages involving parachutes or any other drag devices to accomplish the deceleration and subsequent descent to the ground. Figure 1 shows a plot of altitude versus flight path speed for a typical four-stage recovery system. The number of stages and the design of the parachute for each stage shall be determined from the following recovery conditions:

a. The speed and altitude to be used to deploy the firststage parachute shall determine its design requirements. The values selected shall be the most critical that can be reasonably expected to be encountered by the missile or drone during uncontrolled tests or operational flights.

b. The recovery weight shall be the weight of the missile, drone, or part thereof to be recovered. This value can vary because of changing conditions of the fuel load and shall be assumed to be the maximum weight under which recovery is to be made. Consideration shall be given to reducing this value by dumping fuel or jettisoning parts of the recoverable body.

c. Maximum deceleration is required in the determination of the number of stages, parachute sizes, and the timing of the recovery sequence. In the majority of cases, the deceleration forces developed at ground impact exceed the parachute-opening forces unless special provisions are made for reducing these landing forces. Not only shall the limit of the missile structure be considered in determining this value but also the power plant, instruments, control system, and other accessories, Figure 2 shows a typical parachute deceleration versus altitude curve for the four-stage recovery system shown on figure 1.

3..4.1.3 *Recovery trajectories.* The analysis of the predicted performance of the complete recovery system shall be summarized in a series of graphs presenting curves plotting altitude (feet), velocity (feet per second), dynamic pressure (pounds per square foot), and deceleration (g) versus a common time base. Each graph shall assume one set of conditions (altitude, velocity, dive angle. and recovery weigh t) at initiation of recovery.

3.4.1.4 *Packing procedures.* The step-by-step procedure for packing and installing the recovery system, including the equipment and facilities required, shall be subject to approval by the procuring activity.

3.4.2 *General design considerations of the recovery system.*

3.4.2.1 Parachute compartment. Reliable recovery operations depend on a minimum of interference with the parachute during the deployment procedure. Any projections, sharp edges, or exposed antenna wires in the deployment path are potential hazards to operation of the parachute. In general, the motion of the deploying parachute shall be straight aft in relation to the flignt path of the body.

3.4.2.1.1 *Compartment location.* The best location for the parachute compartment is in the extreme tail of the missile or drone; however, in many cases, this location encounters elevated temperatures because of its proximity to the engine. In such cases, the possibility of insulating or cooling the compartment, or both, shall be considered. If this is not practical, the compartment shall be located in an area where excessive heat is not encountered; however, the further aft it is in the body, the better. It shall be located so that the normal deployment path passes between such protrusions as the tail surfaces et cetera.

3.4.2.2 *Compartment design.* The compartment shall have a smooth interior surface with no protrusions or indentations. It shall be tapered slightly so that the opening is larger than any other part to enable the packed parachute to free itself from the sides as soon as it starts out of the compartment. If possible, the aft wall of the compartment shall have a considerable slope to aid in extracting the packed parachute. The outer edges of the compartment shall be rounded so that nothing can snag or tear the bag in which the parachute is packed. The design of the compartment and method of closure shall provide adequate sealing to keep the parachute completely dry.

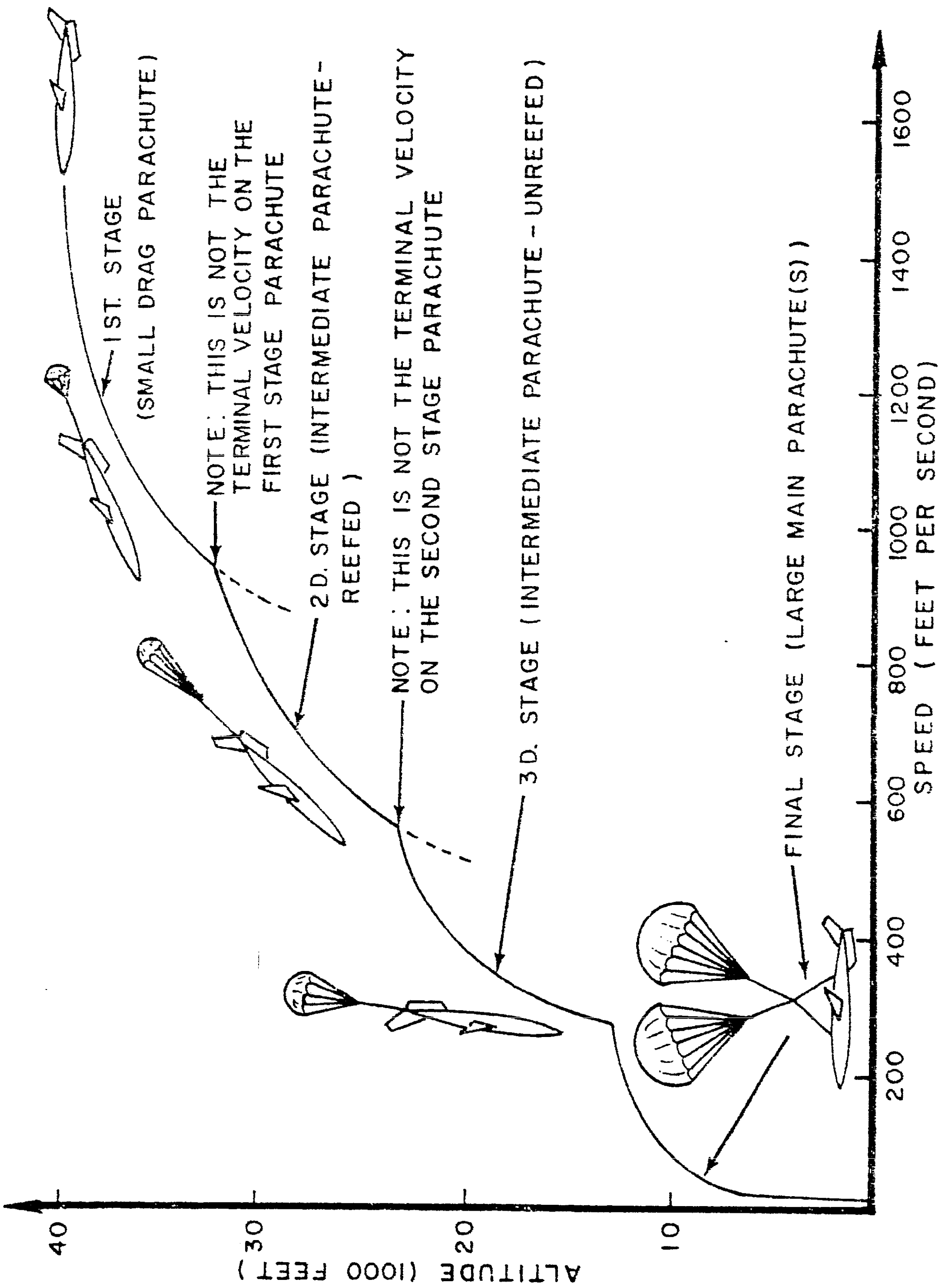


FIGURE 1. *Four-stage Recovery.*

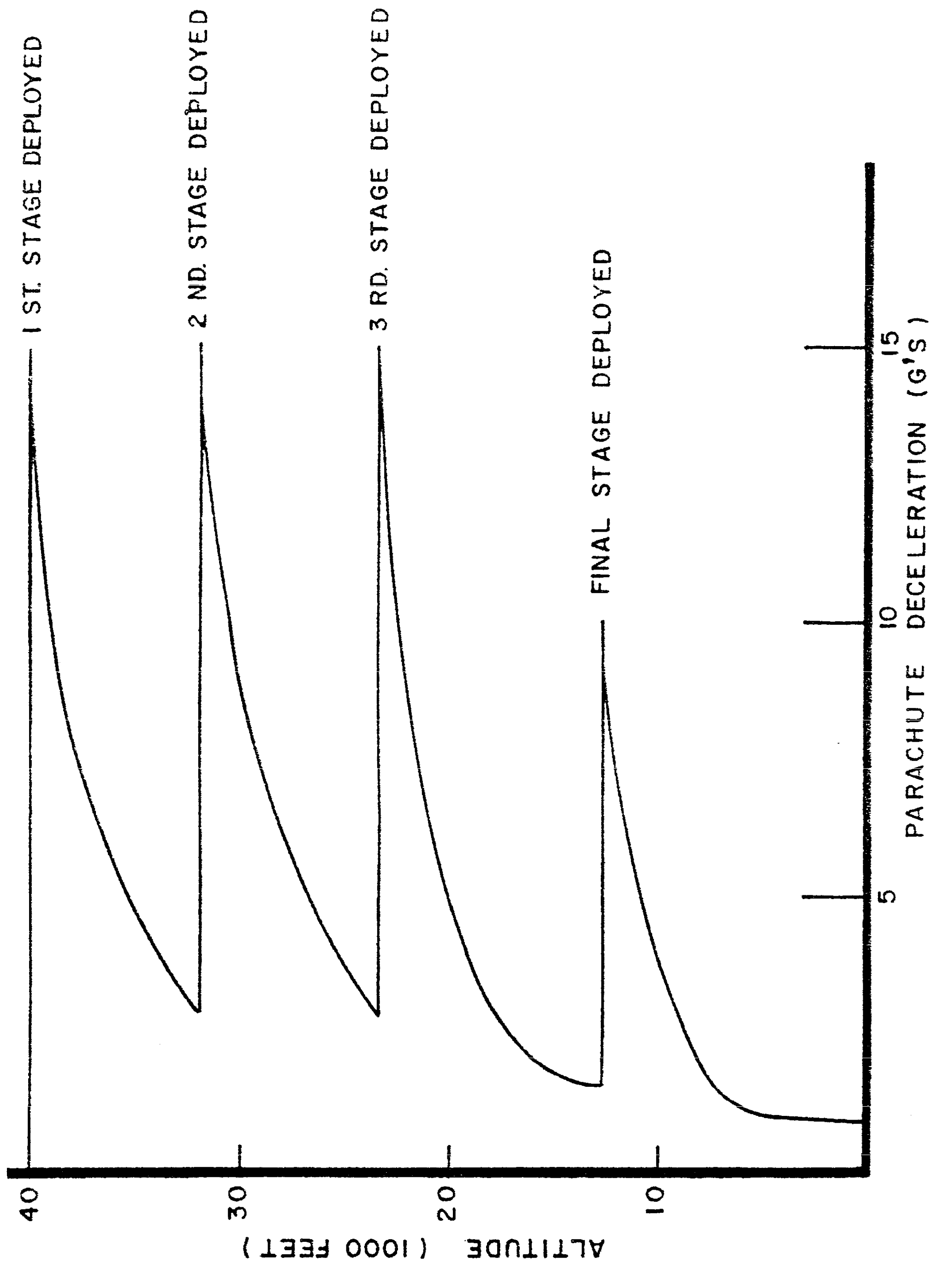


FIGURE 2. *Parachute Deceleration.*

3.4.2.2 *Stability of body prior to recovery.* Consideration shall be given to the stability of the missile, drone, or portion thereof just prior to the initiation of the recovery. The recovery problem is greatly simplified when control is exercised over the article until the first parachute is deployed. The recovery system shall be designed on the premise that this control is not possible; therefore, it is very important to know the approximate attitude of the recoverable body with respect to its flight path to provide reliable deployment.

3.4.2.3 Deployment. Deployment shall be orderly, and there shall be no slack, insofar as possible, in the connecting lines between the parachute canopy and the body being recovered, Consideration shall be given to the deployment of the first-stage parachute or pilot chute by some forceful means, such as a mortar or gun, to insure the reliability of parachute action during this critical period. Consideration shall be given to the possibility and effect of afterburning of the engine (rocket) on the deployed parachutes. Provisions shall be made to minimize or eliminate the detrimental effects of this condition.

3.4.3 *Safety factors.* The following factors shall apply to the design of the recovery system:

a. For parachutes the design factor shall be 1.5 based on the nominal strength of the materials used and the calculated maximum opening forces.

b. For risers the design factor shall be 2 based on the nominal strength of the materials used and the calculated maximum forces.

c. For attaching fittings the design factor shall be 1.5 based on the nominal strength of the materials used, the calculated maximum forces, and the possible angle of load application other than normal.

3.5 Performance. Each recovery system shall be capable of safely and adequately decelerating a body in flight and lowering it to land on the ground or water, as applicable, in a relatively undamaged condition.

3.6 Subsystems. The subsystems listed herein, but not limited thereto, shall operate satisfactorily under the most critical fright and environmental conditions to be encountered during test and operational flights of tile rnissile or drone on which it is to be used. The design and details of construction on the various subsystems and components shall be subject to approval by the procuring activity.

3.6.1 Parachute subsystem.

3.6.1.1 Deceleration-stage parachutes. All parachutes other than those used in the final recovery stage may be one of the following:

a. Ribbon parachute in accordance with MIL-P-6635.

b. Ribless guide surface parachute.

c. Ring slot parachute in accordance with MIL-C-9401.

3.6.1.2 *Final-stage parachutes.* The final-stage parachutes can be either one or a cluster of parachutes and may be one of the following:

a. Extended skirt parachute.

b. Ribbon parachute in accordance with MIL-P-6635.

c. Ring slot parachute in accordance with MIL-C-9401.

d. Solid flat circular parachute.

3.6.1.3 *Reefing* (see 6.2.6). Skirt reefing may be used to reduce the drag area when desired. Reefing rings can be in accordance with Drawing 48 A7995 and attached to each radial seam of the skirt in accordance with figure 3 but not limited thereto. A reefing line strong enough to withstand the opening forces shall be threaded through these rings to restrict the opening of the parachute canopy. Disreefing (see 6.2.7) shall be accomplished by severing the reefing line at the desired time. A disreefing device incorporating a suitable time delay shall be used to sever the reefing line. A minimum of two disreefing devices shall be used on each parachute.

3.6.1.4 *Risers and bridles* (see 6.2.8 and 6.2.9). Except for risers and bridles that are formed by the bundling of extra-long suspension lines attached to the canopy, webbings used for risers and bridles shall conform to MIL-W-4088 and MIL-W-27265. All stitching used in the fabrication of the risers and bridles shall conform to stitch type 301 of FED-STD-751 and shall be made with thread conforming to type I or II, class 1 of V-T-295 and of the size and the strength required. Features that permit interchange, removal, or replacement of risers and bridles without the use of special tools will be essential design considerations.

3.6.1.5 *Riser erector.* When specified by the procuring activity the recovery system shall have a riser erector opening or any other suitable means to facilitate target and missile retrieval on land or water. The opening shall be in a vertical plane relative to the vehicle, above the water and vehicle surface at least 18 inches, and adequate in size to insure easy insertion of a lifting hook from an airborne helicopter 30 feet above the surface. The opening shall be at the proper location on the vehicle to insure proper stability during airborne transportation by the helicopter and to insure minimum damage when the helicopter deposits the vehicle on land after the retrieval operation is completed.

3.6.2 *Deployment.*

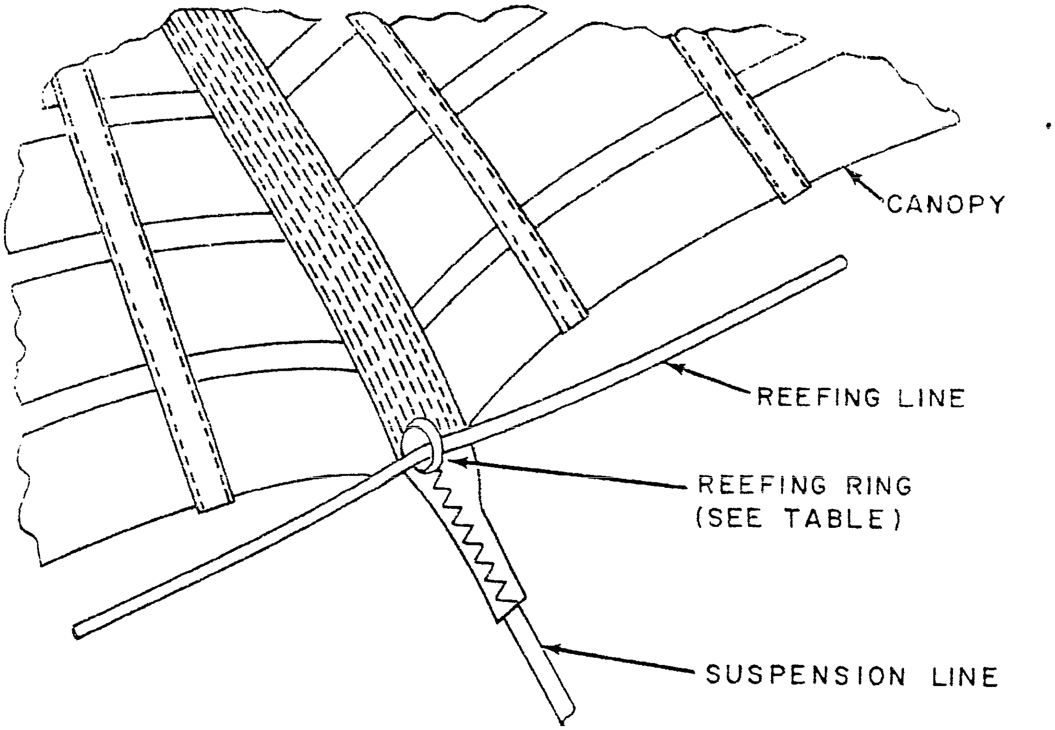
3.6.2.1 *Deployment bags.* Suitably designed deployment bags shall be used to pack the parachutes used for the various stages of recovery and may include the first-stage parachute when feasible. The bags shall cause orderly deployment and lower opening shock and shall protect the parachute during ground handling and extraction from the compartment during deployment. The bag shall be made of material of suficient strength to withstand force during deployment arid temperatures encountered in the parachute compartment of the specified aircraft. The bag shall be designed to include a set of internal flaps capable of retaining the canopy in the bag until the suspension lines are stretched. In operation, the bag shall be deployed by a pilot chute mortor or the previous stage parachute in such a manner that the riser. suspension lines, and canopy (in that sequence) are played out of the mouth of the bag as it moves aft in relation to the recoverable body. The internal flaps shall also be designed to aid in restraining the packed parachute in proper configuration.

3.6.2.2 *Pilot chute.* Upon release of the recovery-systern compartment cover, a pilot chute may be used to deploy the first-stage parachute. The design and placement of this pilot chute shall be such that it will quickly inflate in the airstream and shall not be blanketed by the parachute compartment cover or any other parts of the recoverable body. At no time shall a pilot chute be deployed while another parachute is functioning, because entanglement of the pilot chute in the lines of the inflated parachute will result in failure of the next stage parachute to be deployed.

3.6.3 *Release and controls subsystem.*

3.6.3.1 *Releases.* All releases shall be mechanical and powered by either springs or pyrotechnic devices. Wherever possible, they shall be designed so that the normal motion of the released article aids the action of the release system during the last half of its operating cycle. A suitable device shall be incorporated for releasing the final-stage parachute from the recoverable body after ground impact to prevent the final-stage parachute from dragging the body because of surface winds.

3.6.3.2 *Pyrotechnic devices.* The use of pyrotechnics for powering releases, explosive bolts, et cetera is acceptable provided



Reefing lines and ring attachments	Reefing Ring Drawing No.			
	48A7995	48A7995-1	48A7995-2	
Recommended reefing lines	550 pounds[1] 1000 pounds[2]	550 pounds[1] 1000 pounds[2] 1500 pounds[2]	1000 pounds or 1500 pounds[2]	2250 pounds[2]
Reefing ring attachment	6-cord[3]	6-cord[3]	550 pounds[1]	1000 pounds[2]
Stitching	6-double turns	8-double turns	1 row 1½ inches long[4]	2 rows 1½ inches long[4]

[1] Cord conforming to type III of MIL-C-5040.
[2] Webbing conforming to MIL-W-5625.
[3] Thread conforming to type I or II, class 1 of V-T-295.
[4] Stitch type 308 of FED-STD-751, using thread conforming to type I or II, class 1 of V-T-295.

FIGURE 3. *Reefing Ring and Skirt Attachment.*

that two independent powder charges are used, either one of which will accomplish the action. Individual powder charges shall be ignited by either an electrical igniter or a percussion cap. The design and evaluation of pyrotechnic devices shall be subject to the approval by the procuring activity.

3.6.3.3 *Controls.* The functioning of the recovery system shall be controlled by time, altitude, or pressure switches or a combination of these arranged to deploy the various parachutes as desired. These devices may perform their function by either direct mechanical linkage or electrical circuits. Where electrical circuits are utilized, two independent parallel-circuits complete with their timers or other controls and batteries shall be provided. They shall be arranged so that the failure of one circuit will not prevent the proper functioning of the recovery system as a whole.

3.6.3.4 *Sequencing.* Sequencing is normally accomplished by timers started with the initiation of recovery. Mechanical. electrical, or pyrotechnic (powder train) timers may be used if they are adaptable to the system and provided that they meet the environmental requirements of the recoverable body. Altitude or ram pressure switches, or both, may be used for sequencing the operation of the recovery system provided that a safety timer system is also incorporated. A suitable altitude control shall be placed in series with the release system on the final recovery stage so that this stage will not be actuated above 15,000 feet mean sea level. This shall prevent the large final-stage parachute from opening at altitudes where opening shock becomes excessive and also prevent excessive horizontal drift of the recoverable body while descending slowly on the parachute.

3.6.4 *Landing shock-absorbing subsystem.* To permit a higher rate of descent on the final-stage parachute and thus greatly reduce the weight and volume of the entire system, the use of landing deceleration devices shall be considered. These may be penetration spikes, air bags, retrorockets, or crushable portions of the recoverable body itself, such as ventral fins.

3.6.4.1 *Penetration spike.* The penetration spike is generally located on the nose of the missile. It shall be of sufficient strength to support the weight of the recoverable body without breaking. Consideration shall be given to the horizontal forces resulting from drift caused by ground winds at landing.

3.6.4.2 *Air bag.* The air bag is an inflatable bag which is stowed in the bottom of the missile in the collapsed condition. During descent on the parachute, it shall be released so that it extends below the bottom of the recoverable body. At ground impact it shall collapse, compressing the air trapped inside. The air shall be vented at a rate adequate to cushion the landing impact and prevent rebounding. One or more bags may be used as required.

3.6.4.3 *Retro-rocket system.* A retro-rocket system shall be actuated by electrical switches mounted at the lower extremity of vertical probes which extend beneath the recoverable body. The probes should be secured to the fuselage while in flight and released for downward deployment by mechanical force indicated by some step in the recovery sequence. Retro-rockets can be effectively installed at the point where the bridle from the recoverable body meets the parachute risers.

3.6.5 *Flotation subsystem.* A flotation system capable of floating the recoverable body for a 1-hour period shall be provided by either sealing compartments in the body or providing separate inflatable flotation equipment.

3.7 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130.

3.8 Workmanship. The recovery system, including all parts and accessories, shall be fabricated and finished in a workmanlike manner and shall be free from any defect which may affect serviceability of the product.

3.8.1 *Textile parts*. Particular attention shall be given to the backstitching of ends of stitchings and the protection of cut edges of all material. The ends of all stitching shall be backstitched unless otherwise specified in applicable parachute drawings or specifications. The cut edges of all materials shall be protected from fraying by either folding under or other treatment.

3.8.2 *Metal parts.* Particular attention shall be given to freedom from blemishes, burrs, sharp edges, and any other defects; thoroughness of soldering, welding, brazing, painting, wiring, and riveting; and alignment of parts and tightness of assembly screws and bolts.

3.8.3 *Cleaning*. The metal parts of the recovery system shall be thoroughly cleaned. Loose, spattered, or excess solder; metal chips: and any other foreign material shall be removed during and after final assembly.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 *Classification of tests.* All tests required herein for the testing of the recovery system are classified as acceptance tests. A report of all tests conducted in compliance with the requirements of this section shall be submitted to the procuring activity as evidence of suitability of the recovery system.

4.3 Acceptance tests.

4.3.1 *Subsystem tests.* Subsystem tests are tests performed on individual components of the recovery system to prove their suitability for the purpose intended.

4.3.2 *Dummy missile tests.* Dummy missile tests are tests performed on the entire recovery system to prove its acceptability for the recovery requirements of the missile or drone.

4.4 Test conditions.

4.4.1 *Instrumentation of tests*. All tests shall be instrumented in a manner approved by the procuring activity. Such instrumentation shall be used to measure and record opening shock, steady drag, velocity, altitude, temperature, and decelerations, as required by the particular test. Photographic coverage of the deployment of the parachutes shall be obtained.

4.5 Test methods.

4.5.1 *Examination of product.* Each recovery svstem shall be inspected to determine compliance with the requirements specified herein with respect to materials, workmanship, and marking.

4.5.2 *Subsystern tests.*

4.5.2.1 *Parachutes*. The individual parachutes used in the recovery system shall be visually inspected for compliance with the fabrication requirements specified herein, They shall be drop tested under conditions of attached load, altitude, and speed to be encountered on the actual missile. The parachute shall perform satisfactorily and de velop the decelerating force required without exceeding the maximum force allowable for the recoverable body on which it is to be used. Unless otherwise specified, damage to the parachutes caused by opening under the specified test conditions shall not be more than minor rips, tears, or burns. A minimum of three consecutive successful tests shall be made under conditions of maximum dynamic pressure with the appropriate weight and altitude.

4..5.2.2 *Parachute accesories.* All risers and bridles shall be tested in suitable testing machines to determine whether or not they develop the strength required for the particular application. Where these risers or bridles are attached to metal parts, such as clevises, bolts, or any other hardware items, they shall be tested using the actual parts involved.

4.5.2.3 *Release and controls subsystem.* All items of the parachute release and controls system shall be bench tested for proper functioning under the conditions of vibration, shock, altitude, pressure, temperature, and position likely to be encountered during the launching, flight, and recovery of the missile, drone. or recoverable body. Particular attention shall be given to the effect of radio or radar links, or both, between the ground and the missile to make certain that such transmissions will not damage, jam, or prematurely actuate such items prior to the initiation of recovery. The ground release mechanism shall be tested for operation under conditions of low ground contact shock and high surface winds.

4.5.3 *Dummy missile tests.* The dummy missile tests shall be made of the complete recovery system mounted in a stripped-down, ballasted version of the actual missile. Tests shall be made under the conditions specified in the requirements for the recovery system in the missile or drone specification, Unless otherwise specified, a minimum of three consecutive, completely successful tests shall be required before a particular recovery system is considered acceptable.

5. PREPARATION FOR DELIVERY

5.1 The preservation, packaging, packing, and marking for shipment of components, assemblies, or complete recovery systems shall be in accordance with the requirements of the specification of the missile, drone, or recoverable body on which it is to be used.

6. NOTES

6.1 Intended use. The recovery systems covered by this specification are intended for use in safely decelerating a body and lowering it to land on the ground or water, as applicable, in a relatively undamaged condition.

6.2 Definitions.

6.2.1 *Recovery system.* A recovery system is the assembly of components and parts required to return a missile or drone to the surface of the earth. This includes any shock-absorbing devices used to reduce the effect of landing impact, flotation equipment to keep the body afloat, and a device to prevent dragging of the body by surface wind after ground contact.

6.2.2 *Deployment.* Deployment is the portion of parachute operation beginning with extraction of the parachute from the compartment in which it is stowed and ending the instant the suspension lines are fully stretched but prior to the inflation of the canopy.

6.2.3 *Drone.* A drone is a radio-controlled aircraft used as a target.

6.2.4 *Recoveverable body.* A recoverable body is the missile, drone, or portions thereof being recovered.

6.2.5 *Minimum of damage.* Damage construed to be a minimum of damage will not include any failure or damage to the primary structure of the airframe of the missile or drone and should be confined to items or structure that may be replaced or repaired easily in the field.

6.2.6 *Reefing.* Reefing a temporary restriction of the drag area (parachute canopy) and thus a reduction of the deceleration forces. Reefing is accomplished by reefing rings and a reefing line.

6.2.7 Disreefing. Disreefing is the separation of the reefing line from the reefing rings (usually by cutting) to allow full inflation of the parachute canopy.

6.2.8 Risers. Risers are flexible load-carrying members that transmit the drag force of the parachute to the recoverable body. Risers may be formed by bundling a group of individual suspension lines or by using one or more plies of stronger material to which the suspension lines are attached. There may be one or more risers on any single parachute.

6.2.9 Bridle. A bridle is a multi-legged arrangement of flexible material that distributes the parachute forces equally to the several attachment points of a recoverable body.

Custodians:
Army—MI
Navy—Weps
Air Force—11

Other interests:
Reviewers:
Army—MI
Navy—Weps
Air Force—11, 67

Preparing activity:
Air Force—11

Project No. 1670-0101

SPECIFICATION ANALYSIS SHEET	Form Approved Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

ORGANIZATION	CITY AND STATE

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES" IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

DD FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE. AF-WP-O-MAY 64 505